Note
Before using this information and the product it supports, read the information in "Notices" on page 365.

This edition applies to Version 2 Release 1 of z/OS (5650-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

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<table>
<thead>
<tr>
<th>Chapter 10. Ddpi_Thread APIs</th>
<th>65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_THID object</td>
<td>65</td>
</tr>
<tr>
<td>Ddpi_Thread_Type object</td>
<td>65</td>
</tr>
<tr>
<td>Ddpi_Thread object</td>
<td>65</td>
</tr>
<tr>
<td>ddplic_thread_create operation</td>
<td>65</td>
</tr>
<tr>
<td>ddplic_thread_term operation</td>
<td>66</td>
</tr>
<tr>
<td>ddplic_thread_get_owner operation</td>
<td>67</td>
</tr>
<tr>
<td>ddplic_thread_get_name operation</td>
<td>68</td>
</tr>
<tr>
<td>ddplic_thread_get_id operation</td>
<td>69</td>
</tr>
<tr>
<td>ddplic_thread_set_id operation</td>
<td>70</td>
</tr>
<tr>
<td>ddplic_thread_get_type operation</td>
<td>70</td>
</tr>
<tr>
<td>ddplic_thread_get_TCBaddr operation</td>
<td>71</td>
</tr>
<tr>
<td>ddplic_thread_get_user_area operation</td>
<td>71</td>
</tr>
<tr>
<td>ddplic_thread_list_mutex operation</td>
<td>72</td>
</tr>
<tr>
<td>ddplic_thread_list_cond operation</td>
<td>73</td>
</tr>
<tr>
<td>ddplic_thread_list_lock operation</td>
<td>74</td>
</tr>
<tr>
<td>ddplic_thread_list_class operation</td>
<td>75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 11. Ddpi_Lock APIs</th>
<th>77</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Lock object</td>
<td>77</td>
</tr>
<tr>
<td>Ddpi_LOID object</td>
<td>77</td>
</tr>
<tr>
<td>Ddpi_Lock_State object</td>
<td>77</td>
</tr>
<tr>
<td>ddplic_lock_create operation</td>
<td>78</td>
</tr>
<tr>
<td>ddplic_lock_term operation</td>
<td>79</td>
</tr>
<tr>
<td>ddplic_lock_get_owner operation</td>
<td>79</td>
</tr>
<tr>
<td>ddplic_lock_get_name operation</td>
<td>80</td>
</tr>
<tr>
<td>ddplic_lock_set_name operation</td>
<td>80</td>
</tr>
<tr>
<td>ddplic_lock_get_id operation</td>
<td>81</td>
</tr>
<tr>
<td>ddplic_lock_set_id operation</td>
<td>82</td>
</tr>
<tr>
<td>ddplic_lock_get_state operation</td>
<td>82</td>
</tr>
<tr>
<td>ddplic_lock_set_state operation</td>
<td>83</td>
</tr>
<tr>
<td>ddplic_lock_get_user_area operation</td>
<td>83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 12. Ddpi_Mutex APIs</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Mutex object</td>
<td>85</td>
</tr>
<tr>
<td>Ddpi_MUID object</td>
<td>85</td>
</tr>
<tr>
<td>Ddpi_Mutex_State object</td>
<td>85</td>
</tr>
<tr>
<td>ddplic_mutex_create operation</td>
<td>86</td>
</tr>
<tr>
<td>ddplic_mutex_term operation</td>
<td>86</td>
</tr>
<tr>
<td>ddplic_mutex_get_owner operation</td>
<td>87</td>
</tr>
<tr>
<td>ddplic_mutex_get_name operation</td>
<td>88</td>
</tr>
<tr>
<td>ddplic_mutex_set_name operation</td>
<td>88</td>
</tr>
<tr>
<td>ddplic_mutex_get_id operation</td>
<td>89</td>
</tr>
<tr>
<td>ddplic_mutex_set_id operation</td>
<td>90</td>
</tr>
<tr>
<td>ddplic_mutex_get_state operation</td>
<td>90</td>
</tr>
<tr>
<td>ddplic_mutex_set_state operation</td>
<td>91</td>
</tr>
<tr>
<td>ddplic_mutex_get_user_area operation</td>
<td>91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 13. Ddpi_Cond APIs</th>
<th>93</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Cond object</td>
<td>93</td>
</tr>
<tr>
<td>Ddpi_CVID object</td>
<td>93</td>
</tr>
<tr>
<td>Ddpi_Cond object</td>
<td>93</td>
</tr>
<tr>
<td>ddplic_cond_create operation</td>
<td>93</td>
</tr>
<tr>
<td>ddplic_cond_term operation</td>
<td>94</td>
</tr>
<tr>
<td>ddplic_cond_get_owner operation</td>
<td>95</td>
</tr>
<tr>
<td>ddplic_cond_get_name operation</td>
<td>95</td>
</tr>
<tr>
<td>ddplic_cond_set_name operation</td>
<td>96</td>
</tr>
<tr>
<td>ddplic_cond_get_id operation</td>
<td>97</td>
</tr>
<tr>
<td>ddplic_cond_set_id operation</td>
<td>97</td>
</tr>
<tr>
<td>ddplic_cond_get_state operation</td>
<td>98</td>
</tr>
<tr>
<td>ddplic_cond_set_state operation</td>
<td>98</td>
</tr>
<tr>
<td>ddplic_cond_get_user_area operation</td>
<td>99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 14. Ddpi_Module APIs</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Module object</td>
<td>101</td>
</tr>
<tr>
<td>Ddpi_Module_Format object</td>
<td>101</td>
</tr>
<tr>
<td>Ddpi_Module_Owner_Type data type</td>
<td>102</td>
</tr>
<tr>
<td>ddplic_module_create operation</td>
<td>103</td>
</tr>
<tr>
<td>ddplic_module_term operation</td>
<td>104</td>
</tr>
<tr>
<td>ddplic_module_get_access operation</td>
<td>105</td>
</tr>
<tr>
<td>ddplic_module_get_owner operation</td>
<td>105</td>
</tr>
<tr>
<td>ddplic_module_list_all_owners operation</td>
<td>106</td>
</tr>
<tr>
<td>ddplic_module_get_major_name operation</td>
<td>107</td>
</tr>
<tr>
<td>ddplic_module_get_minor_name operation</td>
<td>108</td>
</tr>
<tr>
<td>ddplic_module_get_format operation</td>
<td>109</td>
</tr>
<tr>
<td>ddplic_module_get_origin operation</td>
<td>109</td>
</tr>
<tr>
<td>ddplic_module_get_usage operation</td>
<td>110</td>
</tr>
<tr>
<td>ddplic_module_get_user_area operation</td>
<td>110</td>
</tr>
<tr>
<td>ddplic_module_list_encrypt operation</td>
<td>111</td>
</tr>
<tr>
<td>ddplic_module_list_class operation</td>
<td>112</td>
</tr>
<tr>
<td>ddplic_module_find_space operation</td>
<td>113</td>
</tr>
<tr>
<td>ddplic_module_extract_C_CPP_information operation</td>
<td>114</td>
</tr>
<tr>
<td>ddplic_module_extract_debug_info operation</td>
<td>115</td>
</tr>
<tr>
<td>ddplic_module_find_wsa operation</td>
<td>116</td>
</tr>
<tr>
<td>ddplic_module_get_dwarf_error operation</td>
<td>117</td>
</tr>
<tr>
<td>ddplic_module_list_function operation</td>
<td>117</td>
</tr>
<tr>
<td>ddplic_module_list_variable operation</td>
<td>119</td>
</tr>
<tr>
<td>ddplic_module_list_type operation</td>
<td>120</td>
</tr>
<tr>
<td>ddplic_module_list_sourcefile operation</td>
<td>121</td>
</tr>
<tr>
<td>ddplic_module_list_elf operation</td>
<td>122</td>
</tr>
<tr>
<td>ddplic_module_find_elf_given_address operation</td>
<td>122</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 15. Ddpi_Access APIs</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Access object</td>
<td>125</td>
</tr>
<tr>
<td>ddplic_access_create operation</td>
<td>125</td>
</tr>
<tr>
<td>ddplic_access_term operation</td>
<td>126</td>
</tr>
<tr>
<td>ddplic_access_get_owner operation</td>
<td>127</td>
</tr>
<tr>
<td>ddplic_access_get_debug operation</td>
<td>128</td>
</tr>
<tr>
<td>ddplic_access_set_debug operation</td>
<td>128</td>
</tr>
<tr>
<td>ddplic_access_list_elf operation</td>
<td>129</td>
</tr>
<tr>
<td>ddplic_access_get_user_area operation</td>
<td>130</td>
</tr>
<tr>
<td>ddplic_access_get_dwarf_error operation</td>
<td>131</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 16. Ddpi_Elf APIs</th>
<th>133</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ddpi_Elf object</td>
<td>133</td>
</tr>
<tr>
<td>Ddpi_Elf_Source object</td>
<td>133</td>
</tr>
<tr>
<td>Ddpi_Elf_Source_Type object</td>
<td>134</td>
</tr>
<tr>
<td>ddplic_elf_create operation</td>
<td>135</td>
</tr>
<tr>
<td>ddplic_elf_term operation</td>
<td>136</td>
</tr>
<tr>
<td>ddplic_elf_get_owner operation</td>
<td>137</td>
</tr>
<tr>
<td>ddplic_elf_get_source operation</td>
<td>137</td>
</tr>
<tr>
<td>ddplic_elf_set_source operation</td>
<td>138</td>
</tr>
<tr>
<td>ddplic_elf_get_elf operation</td>
<td>139</td>
</tr>
</tbody>
</table>
Chapter 25. Ddpi_PPA_Extract APIs 245
Ddpi_PPA1_data_struct_s object ........ 245
Ddpi_PPA2_data_struct_s object ....... 246
ddpi_ppa_extract_ppa1 operation ...... 246
ddpi_ppa_extract_ppa2 operation ....... 247
ddpi_ppa_extract_ppa1_entrypoint_name operation 248
ddpi_ppa_extract_CU_primary_source operation 249
Ddpi_PPA2_data_struct_s object ....... 249
Ddpi_PPA2_md5_sig operation ........ 250

Chapter 26. Ddpi_StackState APIs 253
Ddpi_StackState object ............ 253
Ddpi_Stack_Format object .......... 254
Ddpi_Stack_Type object .......... 254
Ddpi_Stack_Linkage object ....... 255
Ddpi_StackState_Identifier_Handler object ....... 256
Ddpi_StackState_Parent_Handler object ....... 256
ddpi_stackstate_create operation ....... 257
ddpi_stackstate_term operation ....... 257
ddpi_stackstate_init operation ....... 258
ddpi_stackstate_identify operation ....... 259
ddpi_stackstate_parent operation ....... 260
ddpi_stackstate_get_stack_format operation ....... 261
ddpi_stackstate_set_stack_format operation ....... 262
ddpi_stackstate_get_frame_type operation ....... 262
ddpi_stackstate_set_frame_type operation ....... 263
ddpi_stackstate_get_linkage operation ....... 263
ddpi_stackstate_set_linkage operation ....... 264
ddpi_stackstate_get_addr operation ....... 265
ddpi_stackstate_set_addr operation ....... 265
ddpi_stackstate_get_space operation ....... 266
ddpi_stackstate_set_space operation ....... 267
ddpi_stackstate_get_ep_locn operation ....... 267
ddpi_stackstate_set_ep_locn operation ....... 268
ddpi_stackstate_get_ppa1_locn operation ....... 268
ddpi_stackstate_set_ppa1_locn operation ....... 268
ddpi_stackstate_get_ppa2_locn operation ....... 269
ddpi_stackstate_set_ppa2_locn operation ....... 269

Chapter 27. Ddpi_StackState_Fn APIs 275
Ddpi_StackState_Fn object .......... 275
ddpi_stackstate_fn_create operation ....... 275
ddpi_stackstate_fn_term operation ....... 276
ddpi_stackstate_fn_add operation ....... 276
ddpi_stackstate_fn_get_count operation ....... 277
ddpi_stackstate_fn_get_identify operation ....... 278
ddpi_stackstate_fn_set_identify operation ....... 278
ddpi_stackstate_fn_get_parent operation ....... 279
ddpi_stackstate_fn_set_parent operation ....... 280

Chapter 28. Operations for Language Environment linkages ........ 281
ddpi_stackstate_identify operation ....... 281
ddpi_stackstate_parent operation ....... 281

Chapter 29. Ddpi_Storage APIs 283
Transparent access ............ 284
Opaque access ............ 284
Ddpi_SL_Policy_Trans object ....... 284
Ddpi_SSOperation object ....... 285
Ddpi_StorageLocn object ....... 285
Ddpi_SavedStorage object ....... 285
ddpi_storagelocn_create operation ....... 286
ddpi_storagelocn_term operation ....... 287
ddpi_storagelocn_get_space operation ....... 287
ddpi_storagelocn_set_space operation ....... 288
ddpi_storagelocn_get_addr operation ....... 288
ddpi_storagelocn_set_addr operation ....... 289
ddpi_storagelocn_get_storage operation ....... 290
ddpi_storagelocn_set_storage operation ....... 291
ddpi_storagelocn_get_policy operation ....... 292
ddpi_storagelocn_get_user_area operation ....... 293
ddpi_savedstorage_create operation ....... 294
ddpi_savedstorage_term operation ....... 295
ddpi_savedstorage_term_all operation ....... 295
ddpi_savedstorage_list_all_tokens operation ....... 296
ddpi_savedstorage_list_modified operation ....... 297
ddpi_savedstorage_get operation ....... 297
ddpi_savedstorage_list operate_all ....... 299
ddpi_savedstorage_find operation ....... 299
ddpi_savedstorage_next operation ....... 300
ddpi_savedstorage_get_modified operation ....... 301
ddpi_savedstorage_set_modified operation ....... 302
ddpi_savedstorage_reset_change operation ....... 303
ddpi_savedstorage_dump operation ....... 303
About this document

This information is the reference for the Common Debug Architecture (CDA) library libddpi. It provides a brief overview of CDA. The majority of the document is a detailed description of every CDA API. CDA is written in the C programming language and is based on ELF ABIs and the DWARF format.

This document uses the following terminology:

**ABI** *Application binary interface.* A standard interface by which an application gains access to system services, such as the operating-system kernel. The ABI defines the API plus the machine language for a central processing unit (CPU) family. The ABI ensures runtime compatibility between application programs and computer systems that comply with the standard.

**API** *Application programming interface.* An interface that allows an application program that is written in a high-level language to use specific data or functions of the operating system or another program. An extension to a standard DWARF API can include:
- Extensions to standard DWARF files, objects, or operations
- Additional objects or operations

**object** In object-oriented design or programming, a concrete realization (instance) of a class that consists of data and the operations associated with that data. An object contains the instance data that is defined by the class, but the class owns the operations that are associated with the data. Objects described in this document are generally a type definition or data structure, a container for a callback function prototype, or items that have been added to a DWARF file.

**operation** In object-oriented design or programming, a service that can be requested at the boundary of an object. Operations can modify an object or disclose information about an object.

Who should use this document

This document is intended for programmers who will be developing program analysis applications and debugging applications for the IBM® on the IBM z/OS® operating system. The libraries provided by CDA allow applications to create or look for DWARF debugging information from ELF object files on the z/OS V1R10 operating system.

This document is a reference rather than a tutorial. It assumes that you have a working knowledge of the following items:
- The z/OS operating system
- The libdwarf APIs
- The libelf APIs
- The ELF ABI
- Writing debugging programs in C, C++ or COBOL on z/OS
- POSIX on z/OS
The IBM Language Environment® on z/OS
UNIX System Services shell on z/OS

CDA and related publications

This section summarizes the content of the CDA publications and shows where to find related information in other publications.

Table 1. CDA, DWARF, ELF, and other related publications

<table>
<thead>
<tr>
<th>Document title and number</th>
<th>Key sections/chapters in the document</th>
</tr>
</thead>
</table>
| z/OS Common Debug Architecture User’s Guide, SC09-7653 | The user’s guide for the libddpi library. It includes:  
• Overview of the libddpi architecture.  
• Information on the order and purpose of calls to libddpi operations used to access DWARF information on behalf of model user applications.  
• Hints for using CDA with C/C++ source.  
| z/OS DWARF/ELF Extensions Library Reference, SC09-7655 | The reference for IBM extensions to the libdwarf and libelf libraries. It includes:  
• Extensions to libdwarf consumer APIs (Chapters 2 through 8)  
• Extensions to libdwarf producer APIs (Chapters 9 through 19)  
• Extensions to libelf APIs and utilities (Chapter 20)  
This document discusses only these extensions, and does not provide a detailed explanation of DWARF and ELF.  
| System V Application Binary Interface Standard | The Draft April 24, 2001 version of the ELF standard.  
For more information, go to: [http://www.ibm.com/software/awdtools/libraryext/library/](http://www.ibm.com/software/awdtools/libraryext/library/) |
| ELF Application Binary Interface Supplement | The Draft April 24, 2001 version of the ELF standard supplement.  
For more information, go to: [http://www.ibm.com/software/awdtools/libraryext/library/](http://www.ibm.com/software/awdtools/libraryext/library/) |
| DWARF Debugging Information Format, Version 3 | The Draft 8 (November 19, 2001) version of the DWARF standard. This document is available on the web. |
| Consumer Library Interface to DWARF | The revision 1.48, March 31, 2002, version of the libdwarf consumer library.  
| Producer Library Interface to DWARF | The revision 1.18, January 10, 2002, version of the libdwarf producer library.  
| MIPS Extensions to DWARF Version 2.0 | The revision 1.17, August 29, 2001, version of the MIPS extension to DWARF.  
Table 1. CDA, DWARF, ELF, and other related publications (continued)

<table>
<thead>
<tr>
<th>Document title and number</th>
<th>Key sections/chapters in the document</th>
</tr>
</thead>
</table>
| z/OS XL C/C++ User’s Guide, SC09-4767 | Guidance information for:  
  - z/OS C/C++ examples  
  - Compiler options  
  - Binder options and control statements  
  - Specifying z/OS Language Environment run-time options  
  - Compiling, IPA linking, binding, and running z/OS C/C++ programs  
  - Utilities (Object Library, CXXFILT, DSECT Conversion, Code Set and Locale, ar and make, BPXBATCH, c89, xlC, as, CDAHLASM)  
  - Diagnosing problems  
  - Cataloged procedures and REXX EXECs supplied by IBM  
| z/OS XL C/C++ Programming Guide, SC09-4767 | Guidance information for:  
  - Implementing programs that are written in C and C++  
  - Developing C and C++ programs to run under z/OS  
  - Using XPLINK assembler in C and C++ applications  
  - Debugging I/O processes  
  - Using advanced coding techniques, such as threads and exception handlers  
  - Optimizing code  
  - Internationalizing applications |
| z/OS Enterprise COBOL Programming Guide, SC14-7382 | Guidance information for:  
  - Implementing programs that are written in COBOL  
  - Developing COBOL programs to run under z/OS  
  - z/OS COBOL examples  
  - Compiler options  
  - Compiling, linking, binding, and running z/OS COBOL programs  
  - Diagnosing problems  
  - Optimization and performance of COBOL programs  
  - Compiler listings  

The following table lists the related publications for CDA, ELF, and DWARF. The table groups the publications according to the tasks they describe.

Table 2. Publications by task

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coding programs</td>
<td></td>
</tr>
</tbody>
</table>
  - DWARF/ELF Extensions Library Reference, SC09-7655  
  - z/OS Common Debug Architecture Library Reference, SC09-7654  
  - z/OS Common Debug Architecture User’s Guide, SC09-7653  
  - DWARF Debugging Information Format  
  - Consumer Library Interface to DWARF  
  - Producer Library Interface to DWARF  
  - MIPS Extensions to DWARF Version 2.0 |
Table 2. Publications by task (continued)

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<tr>
<th>Tasks</th>
<th>Documents</th>
</tr>
</thead>
<tbody>
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<td>• z/OS XL C/C++ Programming Guide, SC09-4765</td>
</tr>
<tr>
<td></td>
<td>• z/OS Enterprise COBOL Programming Guide, SC14-7382</td>
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<tr>
<td>General discussion of CDA</td>
<td>• z/OS Common Debug Architecture User’s Guide, SC09-7653</td>
</tr>
<tr>
<td></td>
<td>• z/OS Common Debug Architecture Library Reference, SC09-7654</td>
</tr>
<tr>
<td>Environment and application APIs (objects and operations)</td>
<td>• z/OS Common Debug Architecture Library Reference, SC09-7654</td>
</tr>
<tr>
<td>A guide to using the libraries</td>
<td>• z/OS Common Debug Architecture Library Reference, SC09-7654</td>
</tr>
<tr>
<td>Examples of producer and consumer programs</td>
<td>• z/OS Common Debug Architecture User’s Guide, SC09-7653</td>
</tr>
</tbody>
</table>

Softcopy documents

The following information describes where you can find softcopy documents.

The IBM z/OS Common Debug Architecture publications are supplied in PDF formats and IBM BookMaster® formats on the following CD: z/OS Collection, SK3T-4269. They are also available at the following Web site: www.ibm.com/software/awdtools/libraryext/library

To read a PDF file, use the Adobe Reader. If you do not have the Adobe Reader, you can download it (subject to Adobe license terms) from the Adobe web site at www.adobe.com

You can also browse the documents on the World Wide Web by visiting the z/OS library at www.ibm.com/servers/eserver/zseries/zos/bkserv/

Note: For further information on viewing and printing softcopy documents and using IBM BookManager®, see z/OS Information Roadmap.

Where to find more information

Please see z/OS Information Roadmap for an overview of the documentation associated with IBM z/OS.

Runtime Library Extensions on the World Wide Web


This page contains links to other useful information, including the Runtime Library Extensions information library, which includes the Common Debug Architecture documents.

Information updates on the web

For the latest information updates that have been provided in PTF cover letters and Documentation APARs for IBM z/OS, refer to the online list of APARs and PTFs. This document is updated weekly and lists documentation changes before they are incorporated into z/OS publications.
The online list of APARs and PTFs is found at: http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/BOOKS/ZIDOCMST/CCONTENTS

**Technical support**

Additional technical support is available from the z/OS XL C/C++ Support page. This page provides a portal with search capabilities to a large selection of technical support FAQs and other support documents.

You can find the z/OS XL C/C++ Support page on the Web at: www.ibm.com/software/awdtools/czos/support

Readme files that include changes to z/OS XL C/C++ publications are available from: www.ibm.com/support/docview.wss?uid=swg27007531

If you cannot find what you need, you can e-mail:

cominfo@ca.ibm.com

For the latest information about z/OS XL C/C++, visit the product information site at: www.ibm.com/software/awdtools/czos/

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Chapter 1. About Common Debug Architecture

Common Debug Architecture (CDA) was introduced in z/OS V1R5 to provide a consistent format for debug information on z/OS. As such, it provides an opportunity to work towards a common debug information format across the various languages and operating systems that are supported on the IBM zSeries eServer™ platform. The product is implemented in the z/OS CDA libraries component of the z/OS Run-Time Library Extensions element of z/OS (V1R5 and higher).

CDA components are based on:

- "The DWARF industry-standard debugging information format"
- "Executable and Linking Format (ELF) application binary interfaces (ABIs)"

CDA-compliant applications can store DWARF debugging information in an ELF object file. However, the DWARF debugging information can be stored in any container. For example, in the case of the C/C++ compiler, the debug information is stored in a separate ELF object file, rather than the object file. In the case of the COBOL compiler, the debug information is stored in a GOFF object file, as well as the program object. In either approach, memory usage is minimized by avoiding the loading of debug information when the executable module is loaded into memory.

The DWARF industry-standard debugging information format

The DWARF 4 debugging format is an industry-standard format developed by the UNIX International Programming Languages Special Interest Group (SIG). It is designed to meet the symbolic, source-level debugging needs of different languages in a unified fashion by supplying language-independent debugging information. The debugging information format is open-ended, allowing for the addition of debugging information that accommodates new languages or debugger capabilities.

DWARF was developed by the UNIX International Programming Languages Special Interest Group (SIG).

The use of DWARF has two distinct advantages:

- It provides a stable and maintainable debug information format for all languages.
- It facilitates porting program analysis and debug applications to z/OS from other DWARF-compliant platforms.

Executable and Linking Format (ELF) application binary interfaces (ABIs)

Using a separate ELF object file to store debugging information enables the program analysis application to load specific information only as it is needed. With the z/OSXL C/C++ compiler, use the DEBUG option to create the separate ELF object file, which has a *.dbg extension.
Note: In this information, those ELF object files may be referred to as an ELF object file, an ELF object, or an ELF file. Such a file stores only DWARF debugging information.

**GOFF program objects**

Using a GOFF program object file enables the program analysis application to load specific information only as it is needed. With the Enterprise COBOL compiler, use the TEST option to create DWARF debugging information in the GOFF object file. The debugging information is stored in a NOLOAD class, and will not be loaded into memory when the program object is loaded into memory.

**CDA libraries and utilities**

CDA comprises three libraries and two utilities.

The libraries are:
- **libelf**, header files are available in either:
  - /usr/lpp/cbclib/include/libelf (elf_repl.h, libelf.h, sys_elf.h)
  - CEE.SCEEH.H (ELF@REPL, LIBELF, SYS@ELF)
- **libdwarf**, header files are available in either:
  - /usr/lpp/cbclib/include/libdwarf (dwarf.h, libdwarf.h)
  - CEE.SCEEH.H (DWARF, LIBDWARF)
- **libddpi**, header files are available in either:
  - /usr/lpp/cbclib/include/libddpi (libddpi.h)
  - CEE.SCEEH.H (LIBDDPI)

The utilities are:
- isdcnvt
- dwarfdump

To ensure compatibility, the libdwarf and libelf libraries are packaged together in a single DLL. There are 3 versions:
- 31-bit NOXPLINK
- 31-bit XPLINK
- 64-bit

The libddpi library is available as a dynamic linking library. There are 3 versions available:
- 31-bit NOXPLINK DLL
- 31-bit XPLINK DLL
- 64-bit DLL

Regardless of whether a 64-bit or 31-bit version of a library is used, the created information is binary-equivalent. For example, a producer can use a 31-bit version of libdwarf and libelf to create the debug information and a consumer program can use a 64-bit version of libdwarf, libelf and libddpi to read the debug information.
**libelf**

The libelf APIs are used to create the ELF descriptor. The descriptor is then used by other APIs to read from, and write to, the ELF object file.

libelf is packaged as part of a dynamic link library (DLL). The XPLINK versions are packaged as part of CEE.SCEERUN2. The NOXPLINK version is packaged as part of CEE.SCEERUN.

- For 64-bit applications, libelf is shipped in the CDAEQED DLL as part of CEE.SCEERUN2.
- For 31-bit XPLINK applications, libelf is shipped in the CDAEED DLL as part of CEE.SCEERUN2.
- For 31-bit NOXPLINK applications, libelf is shipped in the CDAEDE DLL as part of CEE.SCEERUN.

When compiling an application that uses the libelf library, you must include libelf.h which is located in the /usr/lpp/cbclib/include/libelf directory.

Optionally, you can bind the module with an appropriate side deck:

- For 64-bit applications:
  - Bind with CEE.SCEELIB(CDAEQED) if you are using an IBM MVS™ file system
  - Bind with /usr/lpp/cbclib/lib/libelfdwarf64.x if you are using a hierarchical file system
- For 31-bit applications on an MVS file system:
  - Bind with CEE.SCEELIB(CDAEED) if you are using XPLINK version of DLL.
  - Bind with CEE.SCEELIB(CDAEDE) if you are using NOXPLINK version of DLL.
- For 31-bit applications on a z/OS UNIX file system:
  - Bind with /usr/lpp/cbclib/lib/libelfdwarf32.x if you are using XPLINK version of DLL.
  - Bind with /usr/lpp/cbclib/lib/libelfdwarf32e.x if you are using NOXPLINK version of DLL.

**Note:** IBM has extended the libelf library to support C/C++ on the z/OS operating system. These extensions enable the libelf library to be used in various environments without additional extensions. The generic interfaces provided by libelf are defined as part of the UNIX System V Release 4 ABI. For descriptions of the interfaces supported by libelf, refer to the following documents:

- *System V Application Binary Interface Standard*
- *DWARF/ELF Extensions Library Reference*

**libdwarf**

The libdwarf APIs:

- Create or read ELF objects that include DWARF debugging information
- Read GOFF program objects that include DWARF debugging information

libdwarf is packaged as a dynamic link library (DLL). The XPLINK versions are packaged as part of CEE.SCEERUN2. The NOXPLINK version is packaged as part of CEE.SCEERUN:

- For XPLINK applications, libdwarf is shipped in the CDAEED DLL.
• For NOXPLINK applications, libdwarf is shipped in the CDAEDEE DLL.

When compiling an application that uses the libdwarf library, you must include both libdwarf.h and dwarf.h (which are located in the /usr/lpp/cbclib/include/libdwarf directory). You can optionally bind the module with an appropriate side deck:

• For 64-bit applications:
  - Bind with CEE.SCEELIB(CDAEQED) if you are using an MVS file system.
  - Bind with /usr/lpp/cbclib/lib/libelfdwarf64.x if you are using a hierarchical file system.

• For 31-bit applications:
  - If you are using an MVS file system:
    - Bind with CEE.SCEELIB(CDAEED) if you are using XPLINK version of DLL.
    - Bind with CEE.SCEELIB(CDAEEDE) if you are using NOXPLINK version of DLL.
  - If you are using z/OS UNIX file systems:
    - Bind with /usr/lpp/cbclib/lib/libelfdwarf32.x if you are using XPLINK version of DLL.
    - Bind with /usr/lpp/cbclib/lib/libelfdwarf32e.x if you are using NOXPLINK version of DLL.

Note: IBM has extended the libdwarf library to support C/C++ and COBOL on the z/OS operating system. The IBM extensions to libdwarf provide:
• Improved speed and memory utilization
• Support for the IBM Enterprise COBOL languages

For information that is specific to these extensions, see DWARF/ELF Extensions Library Reference.

**libddpi**

The Debug Data Program Information library (libddpi) provides a repository for gathering information about a program module. A debugger or other program analysis application can use the repository to collect and query information from the program module.

**libddpi:**
• Supports conversion of non-DWARF C/C++ debugging information to the DWARF format. For example, the libddpi library is used to convert In Store Debug (ISD) information.
• Puts an environmental context around the DWARF information for both the producer APIs and the consumer APIs. For information on how to use libddpi, see Common Debug Architecture User’s Guide. This document provides the library reference information for libddpi.

The libddpi library is packaged as the static library libddpi.a in the /usr/lpp/cbclib/lib directory. This directory contains both the 31-bit and 64-bit versions of the library.

The libddpi library is also packaged as a dynamic link library (DLL). Both the 31-bit version and the 64-bit version are packaged as part of CEE.SCEERUN2:
• For 64-bit applications, libddpi is shipped in the CDAEQDPI DLL.
For 31-bit applications, `libddpi` is shipped in the CDAEDPI DLL.

When creating or compiling an application that uses `libddpi`, you must include `libddpi.h` in your source code. The `libddpi.h` file is located in the `/usr/lpp/cbclib/include/libddpi/` directory.

Optionally, you can bind the module with an appropriate side deck:

- For 64-bit applications:
  - Bind with CEE.SCEELIB(CDAEQDPI) if you are using an MVS file system
  - Bind with `/usr/lpp/cbclib/lib/libddpi64.x` if you are using a hierarchical file system.
- For 31-bit applications:
  - Bind with CEE.SCEELIB(CDAEDPI) if you are using an MVS file system.
  - Bind with `/usr/lpp/cbclib/lib/libddpi32.x` if you are using a hierarchical file system.

The main groups of APIs in `libddpi` are described in the following table:

<table>
<thead>
<tr>
<th>API groups</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDA application model APIs:</td>
<td>This group of consumer and producer APIs allows developers to model applications they are analyzing and to use those models to keep track of debugging information.</td>
</tr>
<tr>
<td>• Ddpi_Init and Ddpi_Finish APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Error APIs</td>
<td></td>
</tr>
<tr>
<td>• Processing storage deallocation APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Addr APIs</td>
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<td>• Ddpi_Elf loading API</td>
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<tr>
<td>• Ddpi_Info APIs</td>
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<td>• Ddpi_Space APIs</td>
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<td>• Ddpi_Process APIs</td>
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<td>• Ddpi_Thread APIs</td>
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<td>• Ddpi_Lock APIs</td>
<td></td>
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<tr>
<td>• Ddpi.Mutex APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Module APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Access APIs</td>
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<tr>
<td>• Ddpi_Elf APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Class APIs</td>
<td></td>
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<tr>
<td>• Ddpi_Section APIs</td>
<td></td>
</tr>
<tr>
<td>• Ddpi_EntryPt APIs</td>
<td></td>
</tr>
</tbody>
</table>
API groups | Description
---|---
CDA APIs that support use of the module map:
  - Ddpi_Function APIs
  - Ddpi_Variable APIs
  - Ddpi_Type APIs
  - Ddpi_Source APIs
  | The operations in this group:
  - Find and extract information about a specific function, including static functions. Each Ddpi_Function object is owned by a Ddpi_Elf object. A ddpi_function operation queries one or more Ddpi_Function objects and extracts information about the specific function.
  - Provide information about global variables. Each Ddpi_Variable object is owned by a Ddpi_Elf object.
  - Provide information about external types. Each Ddpi_Type object is owned by a Ddpi_Elf object.
  - Provide information about source files. Each Ddpi_Source object is owned by a Ddpi_Elf object.
System-dependent APIs | This group provides system-specific helper APIs.
System-independent APIs | This group provides generic common helper APIs.
DWARF-expression APIs | This group provides a DWARF expression evaluator which assists with the evaluation of some of the DWARF opcodes.
Utilities | This group:
  - Helps convert ISD debugging information into DWARF debugging information.
  - Supports the integrity of the program analysis application build.

**CDA application model APIs**

CDA application model APIs allow the CDA user to model the program that is being analyzed and track the debug information through the use of that model.

The following high-level diagram shows how some of the APIs in the CDA application mode relate to one another:
Note: This diagram does not show all the possible relationships within the hierarchy.

**isdcnvt**

Note: *isdcnvt* cannot be used to convert 64-bit objects. Debug information for 64-bit XL C/C++ applications is available only in DWARF format.

`isdcnvt` is a stand-alone utility that converts objects with In Store Debug (ISD) information into an ELF object file with DWARF debugging information. In other words, `isdcnvt` accepts objects with ISD C/C++ debugging information and generates an ELF object file containing debugging information in the DWARF format. It is shipped in the `/usr/lpp/cbclib/bin/isdcnvt` directory.

This converter supports debugging information generated by the TEST option for XL C/C++ compilers. For more information, see “CDA limitations” on page 9.

The following restrictions apply to the `isdcnvt` utility:
- Debugging information cannot be converted if the compilation unit (CU) has only line number information. This occurs if the GONUMBER and NOTEST compiler options are used.
• CUs cannot be converted if they have data only and do not contain any functions.

The required ISD information is generated by the IBM XL C/C++ compiler TEST option.

For more information on `isdcnvt`, see *Common Debug Architecture User’s Guide*. For more information on the code set conversion APIs, see Chapter 34, “Code set conversion APIs,” on page 347.

**dwarfdump**

The `dwarfdump` utility displays the debugging information of an ELF object file or GOFF program objects in user-readable form. It is shipped in the `/usr/lpp/cbclib/bin` directory.

`dwarfdump` works on DWARF objects nested within an ELF container or GOFF program objects. It can be used to validate the work of a developer who is accessing and manipulating DWARF debugging information.

The `dwarfdump` utility is available on both the IBM z/OS UNIX System Services and on IBM MVS.

On UNIX Systems Services,

```
dwarfdump [-options] inputfile
```

On MVS, use the following JCL to run the `dwarfdump` utility:

```
//DWFDUMP EXEC PGM=CDADUMP, REGION=0M
// PARM='<options>'
//SYSIN DD DISP=SHR,DSN=HLW.DBG(INPUTFN)
//STEPLIB DD DSN=CEE.SCEERUN2,DISP=SHR
//SYSOUT DD SYSOUT=*  
//SYSPRINT DD SYSOUT=*  
```

For a list of supported options or help information for `dwarfdump`, run `dwarfdump -h`.

---

**Changes for CDA**

The `Ddpi_Machinestate` APIs has been updated to support vector processing. For detailed information, see Chapter 24, “Ddpi_Machinestate APIs,” on page 205.

The `libdwarf` library has been changed to support DWARF in GOFF program objects such as those produced by Enterprise COBOL compiler. For more information on consuming DWARF in GOFF program object, refer to *Reading DWARF data from a GOFF program object file* in the CDA User’s Guide.

CDA libraries shipped with IBM z/OS now include a large number of new APIs. For a list of those APIs as well as some deprecated APIs, refer to the *Changes to DWARF/ELF library extensions* in the CDA DWARF/ELF Library Reference.

---

**CDA requirements and recommendations**

The CDA libraries are compiled with the z/OS XL C/C++ compiler.
To provide flexibility for developers who want to use the CDA application model, many libddpi objects have a variable-length user area. This allows the developers to store their own extra information in the libddpi model.

When you use CDA libraries, be aware of the following requirements and recommendations:

- To ensure the best possible application performance, run applications with the HEAPPOOLS(on) runtime option.
  - For 31-bit applications, you must specify the HEAPPOOLS(on) option in a pragma or CEEUOPT.
  - For 64-bit applications, the HEAPPOOLS(on) option is the default.
- Notice the code set in which strings are accepted and returned. By default, most character strings accepted and returned by the CDA libraries are encoded in the ISO8859-1 code set. You can use code set conversion operations to change the code set. For more information about the z/OS XL C/C++ compiler options, see z/OS XL C/C++ User’s Guide, SC09-4767.

CDA limitations

When you use CDA libraries, be aware of the following limitations:

- Conversion support for ISD debugging information is available only for 31-bit object files, modules or program objects built with:
  - IBM C/C++ for MVS/ESA V3R2
  - Any release of z/OS XL C/C++

This support is not intended to work with debugging information generated by the IBM C/370™ or IBM AD/Cycle C/370 compilers.

The CDA converter will be updated to match the TEST option support for the version of z/OS with which it is shipping. However, a lower-level CDA converter might not be able to properly convert the debugging data generated by the TEST option on a newer level of the z/OS C/C++ compiler.

If you bind your application with the CDA sidedeck on a newer level of z/OS, you will not be able to run the application on an older level of z/OS, because there might be some new APIs that are missing in the older level of z/OS. If you want your application to run on an older level of z/OS:
  - use dlopen(), dlget() to explicitly load the CDA DLL and API,
  - make sure you only use those CDA APIs that are available on the older level of z/OS.

- You must gather information and call the appropriate libddpi interface to generate objects (such as Ddpi_Space and Ddpi_Process) that can be used to model the behavior of an application under analysis. Although the libddpi library contains these objects, they are not created automatically when the application triggers an event.

  Note: These libddpi objects were created to:
    - Provide a structured information repository in a common format
    - Allow CDA to use expanded queries across a whole application, whether or not the application information is in an ELF object file, or has been modelled using libddpi elements such as Ddpi_Section
Chapter 2. Ddpi_Init and Ddpi_Finish APIs

The initialization and terminations APIs provide the data objects and functional operations required to initialize and terminate libddpi instances.

The Ddpi_Info_Mode object is a transparent data type that contains situation information (for example, the scope of the information and whether the data is acceptable to the ddpi_init) operation.

The Ddpi_Info object is:

- An opaque data type that stores the information that a program generates about itself as it runs (that is, internal session information for the current libddpi instance).
- The global structure (that is, the base object) for the application model.

Most ddpi operations take Ddpi_Info as a parameter either directly or indirectly.

You can use ddpi_init to initialize multiple libddpi instances. Each libddpi instance creates its own Ddpi_Info object.

Ddpi_Info_Mode object

Ddpi_Info_Mode determines the type of environment being analyzed by ddpi initialization and termination functions.

Ddpi_Info_Mode type definition

typedef enum Ddpi_Info_Mode_s {
  Ddpi_IM_Unknown = 0,
  Ddpi_IM_Machine = 1,
  Ddpi_IM_Mod_File = 2,
  Ddpi_IM_Cu_File = 3
} Ddpi_Info_Mode;

Ddpi_Info_Mode members

Ddpi_IM_Unknown
  If the value is 0, it will not be accepted by ddpi_init.

Ddpi_IM_Machine
  If the value is 1, this information processing session is on an active machine or in a post-mortem situation.

Ddpi_IM_Mod_File
  If the value is 2, this information-processing session is on a processing utility for one or more module files (for example, on a module-level debugger).

Ddpi_IM_Cu_File
  If the value is 3, this information is being processed at the compile unit (CU) or object file level. For example, the standalone conversion utility (isdcnvtx) is a sample CU processor. The utility converts debugging information from the in-store debugging (ISD) format to the DWARF format.
Ddpi_Info object

The Ddpi_Info object is an opaque data type that stores the information that a program generates about itself as it runs.

A program analysis application can gather this information and store it in a Ddpi_Info object. The program analysis application can then use the Ddpi_Info contents in its analysis of the program.

Examples of a program analysis application are:
- Debuggers and debug binders
- Profilers
- CU conversions

Type definition
typedef struct Ddpi_Info_s*

ddpi_init operation

The ddpi_init operation creates a Ddpi_Info object, which manages an libddpi processing session.

The Ddpi_Info object must be created before any other libddpi API is called.

The ddpi_init operation has two error-handling parameters:
- errhand defines the callback function that is called when an error occurs.
- errarg is a pointer that is passed to errhand when it is called.

The ddpi_init operation initializes any existing Ddpi_Error objects.

Note: If you do not terminate any previously used Ddpi_Error objects with ddpi_finish, the memory it uses cannot be reallocated.

Prototype
int ddpi_init(
    Ddpi_info_Mode mode,
    Ddpi_Handler errhand,
    Dwarf_Ptr errarg,
    int user_area_len,
    Ddpi_info* ret_info,
    Ddpi_Error* error);

Parameters

mode
This input parameter accepts the Ddpi_Info processing mode.

errhand
Input. This parameter accepts either the error-handling callback function or NULL.

errarg
Input. This parameter accepts either a pointer to additional information or NULL. It can be used to pass extra information to errhand. The pointer address, and not its target value, is copied into libddpi storage. The pointer
can be specified when either the ddpi_init or ddpi_error_set_errarg operation is called. errarg can be queried and changed using ddpi_error operations.

user_area_len
This input parameter accepts the user-area length.

ret_info
This output parameter returns the Ddpi_Info object.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful completion of the initialization.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
Returned if any of the following conditions are true:
• The mode parameter is invalid. For more information, see “Parameters” on page 12.
• ret_info is full.
• user_area_len is less than zero.
• An error occurs during allocation.

ddpi_finish operation

This operation terminates the current libddpi processing session and releases all resources associated with the Ddpi_Info descriptor.

Both the Ddpi_Info descriptor and the given Ddpi_Error object are freed and invalidated. The ddpi_finish operation then triggers the deallocation of any remaining entities that were children of the given Ddpi_Info descriptor.

Prototype

int ddpi_finish(
    Ddpi_Info info,
    Ddpi_Error* error);

Parameters

info
Input. This input parameter accepts the Ddpi_Info processing object.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful release of resources associated with the Ddpi_Info descriptor.

DW_DLV_ERROR
This value is returned if:
• info is NULL
- An unexpected error occurs while freeing storage

**Note:** The `ddpi_finish` operation never returns `DW_DLV_NO_ENTRY`. 
Chapter 3. Ddpi_Error APIs

Ddpi_Error APIs provide a consistent method of detecting and setting error conditions.

A Ddpi_Error object is created in response to an error condition generated by a producer or consumer application. Most ddpi operations take a Ddpi_Error object as a parameter. The exceptions are the utility operations and some flag-setting ddpi format operations.

When a call to a ddpi operation returns a value of DW_DLV_ERROR, an error has occurred. Error codes are set within the Ddpi_Error object to notify the program analysis application of the error condition. To extract error information from the error object, the program analysis application needs to contain error-handling callback functions.

If the Ddpi_Error object indicates that the error condition was triggered by a call to a libdwarf operation, the program analysis application can extract further information by querying the Dwarf_Error object that is stored in the Ddpi_Access object. For more information, see Chapter 15, “Ddpi_Access APIs,” on page 125.

If invalid arguments are specified when a ddpi operation is called, the return values are undefined. Because the return values specify the error-handling callback function to be called, the ddpi operation might terminate abnormally.

Examples of invalid arguments are:
• A NULL pointer to a ddpi operation (except where explicitly permitted).
• A pointer to an invalid address.
• A pointer to an uninitialized value.

The libddpi error parameter

The error parameter is a required parameter for all ddpi operations. It accepts and returns either the Ddpi_Error object or NULL.

Before a Ddpi_Error object can be used to capture error situations, it must be passed as an error parameter when the ddpi_init operation is called. In other words:
• For every libddpi instance, a unique Ddpi_Error object is initialized when the error parameter is passed to the ddpi_init operation.
• When an libddpi instance is terminated with the ddpi_finish operation, the program analysis application must pass the corresponding Ddpi_error object as a parameter. The ddpi_finish operation terminates both the Ddpi_Info object and its corresponding Ddpi-Error object.

When an error occurs, the error parameter value determines how the error condition is handled:
• If the error parameter is not NULL, error information is stored in the Ddpi_Error object.
• If the error parameter is NULL:
- The libddpi error process looks for the error-handling callback function specified by the ddpi_init operation.
- If no callback function was specified, the operation terminates abnormally.

Ddpi_Error object

The Ddpi_Error object contains the most recent libddpi error code.

There are no creation or termination operations for Ddpi_Error objects. The space for the object is allocated when ddpi_init is called. When a Ddpi_Error object is created, it is initialized to NULL. The space for the object is deallocated when ddpi_finish is called.

Note: If any Ddpi_Error object is generated, the Ddpi_Error type definition applies to the entire instance.

Type definition

typedef struct Ddpi_Error_s* Ddpi_Error;

Ddpi_Handler object

You must create your own error-handling procedure. The Ddpi_Handler object gives the type and interface information for this procedure. During initialization of the Ddpi_Info object, the callback function is given by the errhand parameter. After initialization, a Ddpi_Handler object is created whenever an error occurs, unless a Ddpi_Error object was passed to the function when it was called.

Type definition

typedef void (*Ddpi_Handler)(
    Ddpi_Error error,
    Dwarf_Ptr errarg);

Members

error
Input/Output. This accepts and returns the error parameter, which is a required parameter that handles error information generated by the ddpi producer or consumer operation. If error is not NULL, error information is stored in the given object. If error is NULL, the libddpi error process looks for an error-handling callback function specified by the ddpi_init operation. If no callback function was specified, the error process aborts.

errarg
Input. This accepts a pointer to additional information, as specified by the user for the program analysis application. The pointer can be specified when either the ddpi_init or the ddpi_error_set_errarg operation is called.

Error-handling callback functions

An error-handling callback function and a pointer to an error argument (errarg) can be specified by the program analysis application during initialization of libddpi. During initialization of the Ddpi_Info object, the callback function is given by the errhand parameter. If libddpi detects an error and no Ddpi_Error object is specified in the application, the error-handling callback function is called.
Note: You must create your own error-handling callback function. For more information, see "Writing DWARF data to the ELF object file" in z/OS Common Debug Architecture User’s Guide.

After initialization, the program analysis application can change the either the callback function or the errarg pointer received from the callback function. The callback function is changed by calling the ddpi_error_set_errhandler operation. The pointer is changed by calling the ddpi_error_set_errarg operation.

If an error-handling callback function has been specified in the application and if the value of the error parameter is NULL, the error parameter is passed to the specified callback function, and the operation that encountered the error condition returns a value of DW_DLV_ERROR.

Callback function arguments

The callback function passes two arguments:
- The first argument contains a pointer to a temporary Ddpi_Error object that documents the error.
- The second argument is the errarg pointer, which is provided as a convenience for the program analysis application. The pointer can be used to pass extra information to the callback function.

If invalid arguments are specified when an libddpi operation is called, the return values are undefined. The error-handling callback function might not be called, and the libddpi operation might abort execution. Examples of invalid arguments are:
- A NULL pointer to a libddpi operation (except where explicitly permitted)
- A pointer to an invalid address
- A pointer to an uninitialized value

ddpi_error_reset operation

The ddpi_error_reset operation resets the Ddpi_Error object value to the DDPI_DLE_NO_ERROR macro.

Unallocated Ddpi_Error objects are not used.

Prototype

```c
int ddpi_error_reset(Ddpi_Error* error);
```

Parameters

- `error`
  See “The libddpi error parameter” on page 15

Return values

The ddpi_error_reset operation always returns DW_DLV_OK.

ddpi_error_get_msg operation

The ddpi_error_get_msg operation retrieves the text message that describes the current error code.
These error messages are available only in English, and are provided only for your convenience when you are debugging an application. For a list of possible error messages, see Appendix A, “libddpi error macros and messages,” on page 351.

Prototype

char* ddpi_error_get_msg(
    Ddpi_Error error);

Parameters

error
    See “The libddpi error parameter” on page 15.

Return values

The ddpi_error_get_msg operation always returns an error message string. If the given error is NULL, this operation returns a message stating that the error is NULL. If the given error contains an unrecognized error code, the operation will return a message stating that the Ddpi_Error value is out of range.

ddpi_error_get_number operation

This operation retrieves the current error number as a Dwarf_Unsigned object.

The returned error number corresponds to one of the given DDPI_DLE macros given in libddpi.h. For more information about DDPI_DLE macros, see Appendix A, “libddpi error macros and messages,” on page 351.

Note: Validating the number is the responsibility of the caller.

Prototype

Dwarf_Unsigned ddpi_error_get_number(
    Ddpi_Error error);

Parameters

error
    See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
    This value is returned upon successful retrieval of the error number.

**DW_DLV_ERROR**
    If error is not NULL, the operation returns the error value without verifying that it is within the valid range. Validating the number is the responsibility of the caller.

**DW_DLV_NO_ENTRY**
    This value is returned if the value of the error parameter is NULL.

ddpi_error_get_errhandler operation

This operation designates the given error-handling callback function as the libddpi error handler.
Prototype

```c
int ddpi_error_get_errhandler(
    Ddpi_Info info,  
    Ddpi_Handler* ret_errhand, 
    Ddpi_Error * error);
```

Parameters

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.

- **ret_errhand**
  This input parameter accepts either the error-handling callback function or NULL. ret_errhand can be queried and changed using Ddpi_Error operations.

- **error**
  See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  This value is returned upon successful retrieval of the error handling callback function.

- **DW_DLV_NO_ENTRY**
  This value is returned if the ret_errhand is NULL.

- **DW_DLV_ERROR**
  This value is returned if:
  - info is NULL
  - ret_errhand is NULL
  - An error occurs while allocating memory

**ddpi_error_set_errhandler operation**

This operation designates the given error-handling callback function as the libddpi error handler.

Prototype

```c
int Ddpi_Handler ddpi_error_set_errhandler(
    Ddpi_Info info,  
    Ddpi_Handler errhand,  
    Ddpi_Error * error);
```

Parameters

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.

- **errhand**
  Input. This parameter accepts either the error-handling callback function or NULL.

- **error**
  See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  This value is returned upon successful release of resources associated with the Ddpi_Info descriptor.
**DW_DLV_NO_ENTRY**
This value is returned if the value of the error parameter is NULL.

**DW_DLV_ERROR**
If the value of the error parameter is not NULL, the operation returns the error value without verifying that it is within the valid range. This value is returned if:
- info is NULL
- An unexpected error occurs while freeing storage

---

## ddpi_error_get_errarg operation

This operation assigns the given error argument to the libddpi error argument.

### Prototype

```c
Ddpi_Handler ddpi_error_get_errarg(
    Ddpi_Info info,
    Dwarf_Ptr* ret_errarg,
    Ddpi_Error * error);
```

### Parameters

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.

- **ret_errarg**
  Output. This parameter returns the current error argument.

- **error**
  See [“The libddpi error parameter” on page 15](#).

### Return values

- **DW_DLV_OK**
  This value is returned upon successful assignment of the given error argument to the libddpi error argument.

- **DW_DLV_ERROR**
  This value is returned if info is NULL.

**Note:** The ddpi_error_get_errarg operation never returns DW_DLV_NO_ENTRY.

---

## ddpi_error_set_errarg operation

This operation assigns the given error argument to the libddpi error argument.

### Prototype

```c
int ddpi_error_set_errarg(
    Ddpi_Info info,
    Dwarf_Ptr errarg);
```

### Parameters

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.

- **errarg**
  Input. This parameter accepts either a pointer to additional information or NULL. It can be used to pass extra information to errhand. The pointer
address, and not its target value, is copied into libddpi storage. The pointer can be specified when either the ddpi_init or ddpi_error_set_errarg operation is called. errarg can be queried and changed using ddpi_error operations.

**Return values**

**DW_DLV_OK**
- This value is returned upon successful assignment of the given error argument to the libddpi error argument.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if info is NULL.

### ddpi_error_show_error operation

This operation enables or disables the verbose error display.

Error messages are controlled by the error handler provided by the user. By default, the verbose error display is disabled (false) and messages are not sent to STDERR. If the verbose error display is enabled (true), error messages are sent to STDERR whenever an error is detected. The message includes the message number, text, and traceback (if available).

**Prototype**

```c
int ddpi_error_show_error(
    Ddpi_Info info,
    Dwarf_Bool new_show,
    Dwarf_Bool* ret_prev_show,
    Ddpi_Error* error);
```

**Parameters**

**info**
- Input. This input parameter accepts the Ddpi_Info processing object.

**new_show**
- Enables (0) or disables (1) the verbose error display.

**ret_prev_show**
- This output parameter returns the previous setting for the error display.

**error**
- See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- This value is returned upon successful enablement or disablement of the verbose error display.

**DW_DLV_ERROR**
- This value is returned if:
  - info is NULL
  - ret_prev_show is NULL
Chapter 4. Processing storage deallocation APIs

The libddpi uses its own memory management processes when creating and terminating libddpi objects. In addition, some operations allocate memory on behalf of the program analysis (user) application. The ddpi_dealloc operation frees memory that was allocated on behalf of an application.

Examples of how to use ddpi_dealloc are given for each operation that requires it. For example, the ddpi_access_list_elf operation allocates memory in order to list the Ddpi_Elf objects associated with the given Ddpi_Access object. The code that deletes this list is:

```
ddpi_dealloc (info, *ret_elfs, DDPI_DLA_LIST)
```

where `ret_elfs` is the returned list.

Use the `ddpi_dealloc` operation only when it is recommended in the header file. The effect of using this operation on unknown pointers is undefined.

Ddpi_StorageLocn object

Ddpi_storagelocn is a pointer to data in memory, and not the actual data itself. It is an opaque data type that represents the address of a given location within an address space that is targeted by the user.

The Ddpi_storagelocn object contains:
- The address space, in the form of a "Ddpi_Space object" on page 35.
- The location address within the address space.
- The access policy, either opaque or transparent, to be used when accessing the storage.
- The user area, which is an optional object-extension area, and may be used by the Ddpi_StorageLocn object caller.

The creation, initialization, and destruction of a Ddpi_storagelocn object are handled as follows:
- The object is created by a successful call to the `ddpi_storagelocn_create` operation.
- The object is initialized by a successful call to the `ddpi_storagelocn_init` operation.
- Memory is deallocated by a successful call to the `ddpi_storagelocn_term` operation.

Type definition

```
typedef struct Ddpi_StorageLocn_s * Ddpi_StorageLocn;
```

Storage deallocation macros

Storage deallocation macros define the storage-deallocation types for use by program analysis applications. These values are specific to the type field of the `ddpi_dealloc` operation.
DDPI_DLA_LIST
This is used for an array of Dwarf_Ptr.

DDPI_DLA_ADDR
This is used for an array of Dwarf_Addr.

DDPI_DLA_ERROR
This is used for an array of Ddpi_Error objects.

DDPI_DLA_CHUNK
This is used for a chunk of bytes.

DDPI_DLA_STRING
This is used for an array of characters.

DDPI_DLA_SSTOR_TOKEN
This is used for an array of Ddpi_SSTor_Token objects.

---

ddpi_dealloc operation

This operation frees memory that has been allocated in support of the user. This operation is used to deallocate lists, entry points, DIEs and tokens.

Always deallocate libddpi entities by using their corresponding termination functions.

Notes:
1. Do not use the free function to deallocate the memory.
2. Do not use the ddpi_dealloc operation to deallocate libddpi entities such as the Ddpi_Info object.

Prototype

```c
int ddpi_dealloc(
    Ddpi_Info info,
    void* space,
    int type);
```

Parameters

info
Input. This input parameter accepts the Ddpi_Info processing object.

space
Input. This accepts the "Ddpi_StorageLocn object" on page 23.

type
Input. This accepts the storage allocation type. See "Storage deallocation macros" on page 23.

Return values

DW_DLV_OK
This value is returned upon successful deallocation of memory allocated to the user area.

DW_DLV_ERROR
This value is returned if info is NULL.

DW_DLV_NO_ENTRY
This value is returned if there is no storage to free, or if the given type is not known.
Chapter 5. Ddpi_Addr APIs

The Ddpi_Addr APIs are common routines that help you work with zSeries address types.

Ddpi_Addr_Mode object

The Ddpi_Addr_Mode object accepts valid constants that specify the environment's addressing mode.

Type definition

```c
typedef enum Ddpi_Addr_Mode_s {
    Ddpi_AM_Unknown = 0,
    Ddpi_AM_24    = 1,
    Ddpi_AM_31    = 2,
    Ddpi_AM_64    = 3
} Ddpi_Addr_Mode;
```

Ddpi_Addr_Mode members

- **Ddpi_AM_Unknown**
  - If the accepted value is 0, the addressing mode is not known and the Ddpi_Addr APIs will return DW_DLV_ERROR.

- **Ddpi_AM_24**
  - If the accepted value is 1, the ddpi_addr operations will use a 24-bit addressing mode.

- **Ddpi_AM_31**
  - If the accepted value is 2, the ddpi_addr operations will use a 31-bit addressing mode.

- **Ddpi_AM_64**
  - If the accepted value is 3, the ddpi_addr operations will use a 64-bit addressing mode.

ddpi_addr_normalize operation

This operation analyzes a Dwarf address to ensure that it is in the correct range for the given addressing mode. It also removes extraneous data.

Prototype

```c
int ddpi_addr_normalize(
    Ddpi_Info       info,
    Dwarf_Addr     in_addr,
    Ddpi_Addr_Mode amode,
    Dwarf_Addr*    ret_addr,
    Ddpi_Error*    error);
```

Parameters

- **info**
  - Input. This input parameter accepts the Ddpi_Info processing object.

- **in_addr**
  - Input. This accepts the address.
**ddpi_addr_offset_normalize operation**

This operation adds an offset to an address to correct its alignment for the given address mode.

**Prototype**

```c
int ddpi_addr_offset_normalize(
    Ddpi_Info info,
    Dwarf_Addr in_addr,
    Dwarf_Uint in_offset,
    Ddpi_Addr_Mode amode,
    Dwarf_Addr* ret_addr,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.

- **in_addr**
  Input. This accepts the address.

- **in_offset**
  Input. This accepts the address offset.

- **amode**
  Input. This accepts the address mode.

- **ret_addr**
  Output. This returns the normalized address.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  This value is returned upon successful alignment of Dwarf_Addr.

- **DW_DLV_ERROR**
  This value is returned if:
  - amode is unknown
  - out_addr is NULL
Chapter 6. Ddpi_Elf loading API

The Ddpi_Elf loading API loads and relocates the ELF object file.

When a compilation unit (CU) is loaded into memory, the relative (logical) addresses stored within the object file are mapped to physical addresses.

The program analysis application must explicitly load the corresponding ELF object file. At that time, the physical addresses within the ELF object file are relocated in memory to correspond to the physical addresses of the CU information. The Ddpi_Elf object holds the information required to relocate these addresses.

For more information about creation and use of Ddpi_Elf objects, see DWARF/ELF Extensions Library Reference, SC09-7655.

ddpi_elf_load_cu operation

The ddpi_elf_load_cu operation loads and relocates the ELF object file.

This operation verifies that the ELF object (inside the Ddpi_Elf object) has an MD5 signature that matches the CU that has been loaded into memory. If a match is found, the operation adjusts the relocatable physical addresses of the ELF object to correspond to the physical addresses of the CU that has been loaded into memory.

Prototype

```c
int ddpi_elf_load_cu(
    Ddpi_Info info,
    Ddpi_Elf pi_elf,
    Ddpi_Error* error);
```

Parameters

**info**
- Input. This input parameter accepts the Ddpi_Info processing object.

**pi_elf**
- Input. This accepts the Ddpi_Elf object containing the file-specific ELF object.

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- This value is returned upon verification that the ELF object (inside the Ddpi_Elf object) has an MD5 signature that matches the CU that has been loaded in memory.

**DW_DLV_ERROR**
- This value is returned if:
  - `pi_elf` is NULL
  - `pi_elf` does not have a valid ELF descriptor
  - The ELF descriptor contains invalid relocation types
  - There is insufficient memory
**DW_DLV_NO_ENTRY**
This value is returned if the MD5 signature does not match the CU that is loaded in memory.
Chapter 7. Ddpi_Info APIs

The Debug Data Program Information library (libddpi) provides a repository for gathering information about a program module. A debugger or other program analysis application can use the repository to collect and query information from the program module.

The Ddpi_Info object is the base object for the application model. Most libddpi operations take the Ddpi_Info object as a parameter, either directly or indirectly. If an object is based on the Ddpi_Info type definition, the information that a program generates about itself as it runs is accessible through that object. For more information about the Ddpi_Info data type, see “Ddpi_Info object” on page 12.

A program analysis application can use a single Ddpi_Info object for all its processing. Some applications may use more than one of these objects. For example, a Ddpi_Info object could be created for each currently active application user.

Each Ddpi_Info object is:
- Created when libddpi is initialized by a ddpi_init call.
- Terminated when libddpi is terminated by a ddpi_finish call.

The ddpi_info operations manage:
- Values that were set whenever the ddpi_init operation was called
- Values that have been added to the information as a result of creating Ddpi_Space objects

ddpi_info_get_mode operation

This operation is used to determine the processing mode of a Ddpi_Info object.

Prototype

```c
int ddpi_info_get_mode(
    Ddpi_Info info,
    Ddpi_Info_Mode* ret_mode,
    Ddpi_Error* error);
```

Parameters

- **info**
  - Input. This input parameter accepts the Ddpi_Info processing object.

- **ret_mode**
  - Output. This returns the Ddpi_Info mode.

- **error**
  - See “The libdddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  - This value is returned upon successful determination of the processing mode of a Ddpi_Info object.
**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:
- info is NULL
- ret_mode is NULL

---

**ddpi_info_get_user_area operation**

This operation returns the address of the user area that was allocated for the given Ddpi_Info object by the ddpi_init operation.

**Prototype**

```c
int ddpi_info_get_user_area(
    Ddpi_Info info,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  Input. This input parameter accepts the Ddpi_Info processing object.
- **ret_user_area**
  Output. This returns the user area of Ddpi_Info.
- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  This value is returned upon successful return of the address of the user area that was allocated for the given Ddpi_Info object by ddpi_init.
- **DW_DLV_ERROR**
  This value is returned if info is NULL.
- **DW_DLV_NO_ENTRY**
  This value is returned if the user area length is zero.

---

**ddpi_info_list_space operation**

This operation returns a list of the Ddpi_Space objects associated with the given Ddpi_Info object. The ddpi_info_list_space operation sets the returned list to an array of Ddpi_Space descriptors, and sets the count of the items in that list to the number of entries in the array. The space list must be freed by the caller, but the individual Ddpi_Space objects should not be freed by the caller. These are not copies, but are the actual Ddpi_Space objects stored in the Ddpi_Info object.

The code to free the list is:

```c
ddpi_dealloc(info, *ret_space_list, DDPI_DLA_LIST)
```
Prototype

```c
int ddpi_info_list_space(
    Ddpi_Info info,
    Ddpi_Space** ret_space_list,
    Dwarf_Signed* ret_space_cnt,
    Ddpi_Error* error);
```

Parameters

- **info**: Input. This input parameter accepts the Ddpi_Info processing object.
- **ret_space_list**: Output. This returns a list of Ddpi_Space objects.
- **ret_space_cnt**: Output. This returns the count of entries in the list.
- **error**: See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**: This value is returned upon successful return of the list of the Ddpi_Space objects associated with the given Ddpi_Info object.
- **DW_DLV_NO_ENTRY**: This value is returned if the list is empty.
- **DW_DLV_ERROR**: This value is returned if:
  - info is NULL
  - ret_space_list or ret_space_cnt is NULL
  - An allocation error occurs

**ddpi_info_list_module operation**

This operation returns a list of the Ddpi_Module objects associated with the given minor name of an application-executable module. The ddpi_info_list_module operation sets the returned list to an array of Ddpi_Module descriptors, and sets the count of the items in that list to the number of entries in the array. The module list must be freed by the caller, but the individual Ddpi_Module objects should not be freed by the caller. These are not copies, but are the actual Ddpi_Module objects stored in the Ddpi_Info object.

The code to free the list is:

```c
    ddpi_dealloc(info, *ret_module_list, DDPI_DLA_LIST);
```

Prototype

```c
int ddpi_info_list_module(
    Ddpi_Info info,
    char* module_name,
    Ddpi_Module** ret_module_list,
    Dwarf_Signed* ret_module_cnt,
    Ddpi_Error* error);
```
Parameters

info
Input. This input parameter accepts the Ddpi_Info processing object.

module_name
Input. This accepts the Ddpi_Module file name. Only those modules with a
minor name that matches the given name are returned. It is not an error to
give module_name a value of NULL. In this case only, modules with no minor
name would be returned.

ret_module_list
Output. This returns the list of modules.

ret_module_cnt
Output. This returns the count of entries in the list.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
This value is returned upon successful return of the list of the Ddpi_Module
objects associated with the given minor name of an application-executable
module.

DW_DLV_ERROR
This value is returned if:
- info is NULL
- ret_module_list, ret_module_cnt or module_name is NULL
- An allocation error occurs

DW_DLV_NO_ENTRY
This value is returned if no module with the given name exists.

ddpi_info_set_dwarf_error_handler operation

The ddpi_info_set_dwarf_error_handler operation sets the DWARF error handler
and error argument that will be passed to the dwarf_elf_init() operation
whenever a Dwarf_Debug object is created by libddpi operations. If the debugger
calls any libdwarf operation and passes in a NULL Dwarf_Error object, this
operation will handle any libdwarf errors that occur.

Prototype

int ddpi_info_set_dwarf_error_handler(
    Ddpi_Info info,
    Dwarf_Handler errhand,
    Dwarf_Ptr errarg,
    Ddpi_Error* error);

Parameters

info
Input. This input parameter accepts the Ddpi_Info processing object.

errhand
Input. This parameter accepts either the error-handling callback function or
NULL.
**errarg**
Input. This parameter accepts either a pointer to additional information or NULL. It can be used to pass extra information to errhand. The pointer address, and not its target value, is copied into libddpi storage. The pointer can be specified when either the ddpi_init or ddpi_error_set_errarg operation is called. errarg can be queried and changed using ddpi_error operations.

**error**
See “The libddpi error parameter” on page 15

---

**Returned values**

**DW_DLV_OK**
This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
This value is never returned.

**DW_DLV_ERROR**
This value is returned if info is NULL or invalid.

---

**ddpi_info_set_dbg_dirs operation**

The ddpi_info_set_dbg_dirs operation sets or resets the list of directories that will be searched whenever a .dbg or .mdbg file needs to be opened. The list from any previous calls to this operation will be discarded and replaced. Only UNIX System Services directories can be specified, and either the absolute path or relative path can be used.

**Prototype**

```c
int ddpi_info_set_dbg_dirs(
    Ddpi_Info info,
    char** dirs,
    DwarfUnsigned num_dirs,
    Ddpi_Error* error);
```

**Parameters**

**info**
Input. This input parameter accepts the Ddpi_Info processing object.

**dirs**
Input. This accepts the list of directories to be searched for .dbg files.

**num_dirs**
Input. This accepts the number of directories in the list.

**error**
See “The libddpi error parameter” on page 15

---

**Returned values**

**DW_DLV_OK**
This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
This value is never returned.

**DW_DLV_ERROR**
This value is returned if:
- info is NULL or invalid.
• dirs is NULL.
Chapter 8. Ddpi_Space APIs

After a Ddpi_Info object has been created, a Ddpi_Space object is created for each address space that is used by the application. The dpi operations use it to address different types of storage without significant code changes. If libddpi is used for services other than application modelling, you might still need to create Ddpi_Space objects so that other libddpi operations can access storage.

To define the storage for read and write operations, use the following two objects:

- “Ddpi_GS_Handler callback function” on page 36
- “Ddpi_SS_Handler object” on page 37

These objects define all user storage. You must specify them when you access or assign a machine address space, a remote address space, or a post-mortem image address space.

For more information about accessing storage, see z/OS CDA User’s Guide.

Ddpi_Space object

The Ddpi_Space object is an opaque data type that contains information regarding application address spaces.

Type definition

```c
typedef struct Ddpi_Space_s* Ddpi_Space;
```

Ddpi_ASID object

An unsigned integer that identifies the address space.

Type definition

```c
typedef Dwarf_Unsigned Ddpi_ASID;
```

Ddpi_ALET object

The access-list entry type (ALET) object.

Type definition

```c
typedef Dwarf_Unsigned Ddpi_ALET;
```

Ddpi_Space_Type object

Identifies the type of the address space.

Type definition

```c
typedef enum Ddpi_Space_Type_s {
    Ddpi_ST_Unknown = 0,
    Ddpi_ST_Code = 1,
    Ddpi_ST_Data = 2
} Ddpi_Space_Type;
```
Members

Ddpi_ST_Unknown
   If this value is 0, the address space contents are invalid.

Ddpi_ST_Code
   If this value is 1, this address space contains code and data.

Ddpi_ST_Data
   If this value is 2, this address space contains only data.

Ddpi_Xfer_Status object

Contains the error codes for the ddpi_get_storage and ddpi_set_storage operations.

Type definition
typedef enum Ddpi_Xfer_Status_s {
   Ddpi_XFS_ok = 0,
   Ddpi_XFS_addr_space = 1,
   Ddpi_XFS_no_page = 2,
   Ddpi_XFS_no_page_access = 3,
   Ddpi_XFS_read_only = 4,
   Ddpi_XFS_addr_bad = 5,
   Ddpi_XFS_page_bad = 6,
   Ddpi_XFS_xfer_bad = 7
} Ddpi_Xfer_Status;

Members

Ddpi_XFS_ok
   If the returned value is 0, the transfer was successful.

Ddpi_XFS_addr_space
   If the returned value is 1, the address space was either invalid or inaccessible.

Ddpi_XFS_no_page
   If the returned value is 2, the page was mapped but unavailable.

Ddpi_XFS_no_page_access
   If the returned value is 3, the page was mapped but inaccessible.

Ddpi_XFS_read_only
   If the returned value is 4, storage contents could not be updated.

Ddpi_XFS_addr_bad
   If the returned value is 5, the address in the space was invalid.

Ddpi_XFS_page_bad
   If the returned value is 6, the page in the address space was invalid.

Ddpi_XFS_xfer_bad
   If the returned value is 7, there was a problem with the transfer mechanism.

Ddpi_GS_Handler callback function

This is the prototype for a function that a ddpi operation can call each time it needs to read from storage.
Type definition

typedef int (*Ddpi_GS_Handler) (
    Ddpi_StorageLocn locn,
    Dwarf_Ptr buffer,
    Dwarf_Unsigned read_len,
    Dwarf_Unsigned* ret_actual_len,
    Ddpi_Xfer_Status* ret_status);

Parameters

locn
    Input. This accepts the Ddpi_StorageLocn object that describes the location from which data will be read.

buffer
    Output. This returns the buffer to which data will be written.

read_len
    Input. This accepts the data length to read.

ret_actual_len
    Output. This returns the actual data length read.

ret_status
    Output. This returns the transfer status.

Ddpi_SS_Handler object

This defines the object that a ddpi operation uses whenever it needs to write to storage.

Type definition

typedef int (*Ddpi_SS_Handler) (
    Ddpi_StorageLocn locn,
    Dwarf_Ptr buffer,
    Dwarf_Unsigned wrt_len,
    Dwarf_Unsigned* ret_actual_len,
    Ddpi_Xfer_Status* ret_status);

Members

locn
    Input. This accepts the Ddpi_StorageLocn object that describes the location to which data will be written.

buffer
    Input. This accepts the buffer that contains the data to be written to the location.

wrt_len
    Input. This accepts the data length to read.

ret_actual_len
    Output. This returns the actual data length read.

ret_status
    Output. This returns the transfer status.
**ddpi_space_create operation**

The `ddpi_space_create` operation creates a `Ddpi_Space` object to represent a program address space and returns a descriptor that acts as a handle for accessing the space. The address space may be either an actual machine or post-mortem image. Alternative `Ddpi_Info` modes allow a single space to represent an application-executable module or a CU-level object file.

When you call the `ddpi_space_create` operation, and pass a character string as the parameter name, the operation copies the content of the name parameter and stores it to a copy. After the operation returns the copy, you can deallocate the original name to save storage.

**Prototype**

```c
int ddpi_space_create(
  Ddpi_Info info,
  Ddpi_Space_Type type,
  char* name,
  Ddpi_ASID asid,
  Ddpi_ALET alet,
  Dwarf.Addr limit,
  Ddpi_MS_Handler gs_handler,
  Ddpi_SS_Handler ss_handler,
  int user_area_len,
  Ddpi_Space* ret_space,
  Ddpi_Error* error);
```

**Parameters**

- `info`
  - Input. This accepts a `Ddpi_Info` object.

- `name`
  - Input. This accepts an optional space name string. The given value can be NULL.

- `type`
  - Input. This accepts a space type as described above.

- `asid`
  - Input. This accepts a space ASID ID.

- `alet`
  - Input. This accepts a space ALET ID.

- `limit`
  - Input. This accepts the maximum address within space.

- `gs_handler`
  - Input. This accepts the address of an operation that `libddpi` uses to read memory. If this operation is not provided, `libddpi` fails when it tries to read memory. The value can be NULL.

- `ss_handler`
  - Input. This accepts the address of an operation that `libddpi` uses to write to memory. If this operation is not provided, `libddpi` generates an error when it needs to write to memory. The value can be NULL.

- `user_area_len`
  - Input. This accepts the user-area length.

- `ret_space`
  - Output. This returns the space object.
error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful return of the descriptor that acts as a handle for accessing the space.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
Returned if:
• info is NULL
• ret_space is NULL
• user_area_len is less than zero
• An error occurs during memory allocation

ddpi_space_term operation

The ddpi_space_term operation releases all internal resources associated with the space descriptor, and invalidates space.

When you terminate space, you also terminate all its children (such as processes, modules, and threads) that have not already been terminated.

Prototype

int ddpi_space_term(
    Ddpi_Space   space,
    Ddpi_Error*  error);

Parameters

space
Input. This accepts the Ddpi_Space object.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful release of all internal resources associated with the space descriptor.

DW_DLV_NO_ENTRY
Returned if the space is not found in its parent space list.

DW_DLV_ERROR
Returned if:
• space is NULL
• Ddpi_Info that owns space is NULL
• An error occurs while deallocating memory
ddpi_space_get_owner operation

The ddpi_space_get_owner operation queries the owner of a given Ddpi_Space object and sets it to the returned Ddpi_Info object.

Prototype

```c
int ddpi_space_get_owner(
    Ddpi_Space space,
    Ddpi_Info* ret_owner,
    Ddpi_Error* error);
```

Parameters

- **space**
  Input. This accepts the Ddpi_Space object.

- **ret_owner**
  Output. This returns the Ddpi_Info object.

- **error**
  See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  Returned upon successful assignment of the owner of the returned Ddpi_Info object to the owner of the given Ddpi_Space object.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  Returned if:
  - space is NULL
  - Ddpi_Info associated with space is NULL
  - ret_owner is NULL

ddpi_space_get_name operation

The ddpi_space_get_name operation returns the name of a given Ddpi_Space object and sets the returned name to a pointer to a null-terminated string of characters.

`ddpi_space_get_name` returns the actual version of the name, and not a copy. Do not deallocate the returned pointer.

Prototype

```c
int ddpi_space_get_name(
    Ddpi_Space space,
    char** ret_name,
    Ddpi_Error* error);
```

Parameters

- **space**
  Input. This accepts the Ddpi_Space object.

- **ret_name**
  Output. This returns a pointer to the name string.
Return values

`DW_DLV_OK`
Returned upon successful retrieval of the returned name.

`DW_DLV_NO_ENTRY`
Returned if the name of the Ddpi_Space is NULL.

`DW_DLV_ERROR`
Returned if:
- space is NULL
- Ddpi_Info associated with space is NULL
- ret_name is NULL

**ddpi_space_set_name operation**

The `ddpi_space_set_name` operation assigns a new name to a given Ddpi_Space object.

`ddpi_space_set_name` can be used to set the name to NULL. `ddpi_space_set_name` copies the given name. The caller may deallocate `new_name` after the call to save memory.

**Prototype**

```c
int ddpi_space_set_name(
    Ddpi_Space space,
    char* new_name,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  Input. This accepts the Ddpi_Space object.

- **new_name**
  Input. This accepts the new name string.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful assignment of the returned name to the given space object.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  Returned if:
  - space is NULL
  - Ddpi_Info associated with space is NULL
  - An error occurs while allocating the memory for the copy of the name
**ddpi_space_get_type operation**

The `ddpi_space_get_type` operation returns the type of a given `Ddpi_Space` object.

**Prototype**

```c
int ddpi_space_get_type(
    Ddpi_Space    space,
    Ddpi_Space_Type* ret_type,
    Ddpi_Error*    error);
```

**Parameters**

- **space**
  - Input. This accepts the `Ddpi_Space` object.

- **ret_type**
  - Output. This returns the space type.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the type of the given space object.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - `space` is NULL
    - The `Ddpi_Info` object associated with `space` is NULL
    - `ret_type` is NULL

**ddpi_space_get_asid operation**

The `ddpi_space_get_asid` operation returns the address space identifier (ASID) for a given `Ddpi_Space` object.

**Prototype**

```c
int ddpi_space_get_asid(
    Ddpi_Space    space,
    Ddpi_ASID*    ret_asid,
    Ddpi_Error*    error);
```

**Parameters**

- **space**
  - Input. This accepts the `Ddpi_Space` object.

- **ret_asid**
  - Output. This returns the space ASID.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the ASID of the given space object.


**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
- space is NULL
- Ddpi_Info associated with space is NULL
- ret_asid is NULL

---

**ddpi_space_set_asid operation**

The `ddpi_space_set_asid` operation assigns a new address space identifier (ASID) to a given Ddpi_Space object.

**Prototype**

```c
int ddpi_space_set_asid(
    Ddpi_Space space,
    Ddpi_ASID new_asid,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  Input. This accepts the Ddpi_Space object.

- **new_asid**
  Input. This accepts the new space ASID.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful assignment of the returned ASID to the given space object.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  Returned if:
  - space is NULL
  - Ddpi_Info associated with space is NULL

---

**ddpi_space_get_alet operation**

The `ddpi_space_get_alet` operation returns the access list entry table (ALET) of a given Ddpi_Space object.

**Prototype**

```c
int ddpi_space_get_alet(
    Ddpi_Space space,
    Ddpi_ALET* ret_alet,
    Ddpi_Error* error);
```
Parameters

space
  Input. This accepts the Ddpi_Space object.

ret_alet
  Output. This returns the space ALET.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful retrieval of the ALET.

DW_DLV_NO_ENTRY
  Never returned.

DW_DLV_ERROR
  Returned if:
  • space is NULL
  • Ddpi_Info associated with space is NULL
  • ret_alet is NULL

ddpi_space_set_alet operation

The ddpi_space_set_alet operation assigns a new ALET to a given Ddpi_Space object.

Prototype

int ddpi_space_set_alet(
  Ddpi_Space space,
  Ddpi_ALET new_alet,
  Ddpi_Error* error);

Parameters

space
  Input. This accepts the Ddpi_Space object.

new_alet
  Input. This accepts the new space ALET specification.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful assignment of the returned ALET to the given space object.

DW_DLV_NO_ENTRY
  Never returned.

DW_DLV_ERROR
  Returned if:
  • space is NULL
  • Ddpi_Info associated with space is NULL

...
**ddpi_space_get_limit operation**

The `ddpi_space_get_limit` operation returns the maximum address size for a given Ddpi_Space object.

**Prototype**

```c
int ddpi_space_get_limit(
    Ddpi_Space space,
    Dwarf_Addr* ret_limit,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  Input. This accepts the Ddpi_Space object.

- `ret_limit`
  Output. This returns the maximum address.

- `error`
  See “The libddpi error parameter” on page 15.

**Return values**

- `DW_DLV_OK`
  Returned upon successful retrieval of the maximum address size of the queried space object.

- `DW_DLV_NO_ENTRY`
  Never returned.

- `DW_DLV_ERROR`
  Returned if:
  - `space` is NULL
  - Ddpi_Info associated with `space` is NULL
  - `ret_limit` is NULL

**ddpi_space_set_limit operation**

The `ddpi_space_set_limit` operation assigns a new maximum address to a given Ddpi_Space object.

**Prototype**

```c
int ddpi_space_set_limit(
    Ddpi_Space space,
    Dwarf_Addr new_limit,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  Input. This accepts the Ddpi_Space object.

- `new_limit`
  Input. This accepts the maximum address within space.

- `error`
  See “The libddpi error parameter” on page 15.
Return values

DW_DLV_OK
   Returned upon successful assignment of the returned maximum address size to
   the given space object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
   • space is NULL
   • Ddpi_Info associated with space is NULL

ddpi_space_get_user_area operation

The ddpi_space_get_user_area operation returns the address of the user area that
was allocated for the given Ddpi_Space object by ddpi_init.

Prototype

```c
int ddpi_space_get_user_area(
    Ddpi_Space space,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

Parameters

space
   Input. This accepts the Ddpi_Space object.

ret_user_area
   Output. This returns the user area of the space.

error
   See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
   Returned upon successful retrieval of the pointer to the work space allocated
   for the queried space object.

DW_DLV_NO_ENTRY
   Returned if the user area length is zero.

DW_DLV_ERROR
   Returned if:
   • space is NULL
   • Ddpi_Info associated with space is NULL
   • ret_user_area is NULL

ddpi_space_list_process operation

The ddpi_space_list_process operation returns a list of the Ddpi_Process objects
and the number of items in that list.

The ddpi_space_list_process operation sets the returned list to a pointer, which
points to an array of Ddpi_Process descriptors, and sets the ret_process_cnt to the
number of entries in the array.
The caller must free the process list but not the individual \texttt{Ddpi\_Process} objects.

These objects are not copies, but are the actual \texttt{Ddpi\_Process} objects stored in the \texttt{Ddpi\_Space}.

The code to free the list is:

\begin{verbatim}
rc = ddpi_dealloc(info, \*ret_process_list, DDPI\_DLA\_LIST);
\end{verbatim}

**Prototype**

\begin{verbatim}
int ddpi_space_list_process(
    Ddpi\_Space space,
    Ddpi\_Process** ret_process_list,
    Dwarf\_Signed* ret_process_cnt,
    Ddpi\_Error* error);
\end{verbatim}

**Parameters**

- \texttt{space}
  
  Input. This accepts the \texttt{Ddpi\_Space} object.

- \texttt{ret_process_list}
  
  Output. This returns the process list.

- \texttt{ret_process_cnt}
  
  Output. This returns the count of entries in the process list.

- \texttt{error}
  
  See \textit{"The libddpi error parameter" on page 15}.

**Return values**

- \texttt{DW\_DLV\_OK}
  
  Returned upon successful retrieval of the pointer to the process list.

- \texttt{DW\_DLV\_NO\_ENTRY}
  
  Returned if there are no processes in the list.

- \texttt{DW\_DLV\_ERROR}
  
  Returned if:
  \begin{itemize}
  
  \item space is NULL
  
  \item Ddpi\_Info associated with space is NULL
  
  \item ret\_process\_list or ret\_process\_cnt is NULL
  
  \end{itemize}

----

**ddpi\_space\_list\_hidden\_module operation**

The \texttt{ddpi\_space\_list\_hidden\_module} operation lists the hidden \texttt{Ddpi\_Module} objects associated with the given \texttt{Ddpi\_Space} object.

The \texttt{ddpi\_space\_list\_hidden\_module} operation sets the returned list to an array of \texttt{Ddpi\_Module} descriptors, and sets \texttt{ret\_hidden\_module\_cnt} to the number of entries in the array.

The caller must free the module list but not the individual \texttt{Ddpi\_Module} objects.

These are not copies, but are the actual \texttt{Ddpi\_Module} objects stored in the \texttt{Ddpi\_Space}.

The code to free the hidden-module list is:
rc = ddpi_dealloc(info, *ret_hidden_module_list, DDPI_DLA_LIST);

**Prototype**

```c
int ddpi_space_list_cond(
    Ddpi_Space   space,
    Ddpi_Module** ret_hidden_module_list,
    Dwarf_Signed* ret_hidden_module_cnt,
    Ddpi_Error*   error);
```

**Parameters**

- `space`
  Input. This accepts the Ddpi_Space object.

- `ret_hidden_module_list`
  Output. This returns the list of hidden modules.

- `ret_hidden_module_cnt`
  Output. This returns the count of entries in `ret_hidden_module_list`.

- `error`
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful retrieval of the pointer to the list of hidden modules.

- **DW_DLV_NO_ENTRY**
  Returned if the list of hidden modules is empty.

- **DW_DLV_ERROR**
  Returned if:
  - space is NULL
  - Ddpi_Info associated with space is NULL
  - `ret_hidden_module_list` or `ret_hidden_module_cnt` is NULL

**ddpi_space_unhide_module operation**

The `ddpi_space_unhide_module` operation activates the Ddpi_Module object in the given Ddpi_Process.

The `ddpi_space_unhide_module` operation also moves a module from the hidden-module list of a Ddpi_Space object and puts it into a module list of a Ddpi_Process object.

**Prototype**

```c
int ddpi_space_unhide_module(
    Ddpi_Space   space,
    Ddpi_Process process,
    Ddpi_Module  module,
    Ddpi_Error*  error);
```

**Parameters**

- `space`
  Input. This accepts the Ddpi_Space object.

- `process`
  Input. This accepts the Ddpi_Process object.
module
  Input. This accepts the Ddpi_Module object.

error
  See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
  Returned when the module is successfully moved from the list of hidden modules to the module list.

DW_DLV_NO_ENTRY
  Returned if the module is not found in the list of hidden modules.

DW_DLV_ERROR
  Returned if:
  • space is NULL
  • process is NULL
  • module is NULL

ddpi_space_is_hidden_module operation

The ddpispace_is_hidden_module operation queries if the given Ddpi_Module object is in the Ddpi_Space hidden-module list.

If ddpispace_list_class finds the Ddpi_Module object, it assigns a non-zero value to the object. If no Ddpi_Module object is found, the ddpispace_is_hidden_module operation assigns the value of the object to zero.

Prototype

int ddpispace_is_hidden_module(
  Ddpi_Space space,
  Ddpi_Module module,
  Dwarf_Bool* ret_bool,
  Ddpi_Error* error);

Parameters

space
  Input. This accepts the Ddpi_Space object.

module
  Input. This accepts the Ddpi_Module object.

ret_bool
  Output. This returns the Dwarf_Bool value of zero if module is not hidden, and a non-zero value if the module is hidden.

error
  See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
  Returned when a value has been successfully assigned to the given module.

DW_DLV_NO_ENTRY
  Never returned.
**DW_DLV_ERROR**

Returned if:
- space is NULL
- Ddpi_Info associated with space is NULL
- ret_bool is NULL

---

**ddpi_space_delete_module operation**

The ddpi_space_delete_module operation deletes the given Ddpi_Module object in the Ddpi_Process.

The ddpi_space_delete_module operation removes the Ddpi_Module object from the hidden_module_list, and it deletes the Ddpi_Space object from the owner_space_list of the Ddpi_Module. If the space is the only reference to the module, the module is terminated and all related storage is released.

**Prototype**

```c
int ddpi_space_delete_module(
    Ddpi_Space space,
    Ddpi_Module module,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  - Input. This accepts the Ddpi_Space object.

- **module**
  - Input. This accepts the Ddpi_Module object.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when:
    - The given module is successfully removed from the appropriate lists
    - The module is terminated (if appropriate)
    - The associated resources are released (if the module is terminated)

- **DW_DLV_NO_ENTRY**
  - Returned if the given module is not in the hidden-module list.

- **DW_DLV_ERROR**
  - Returned if:
    - space is NULL
    - Ddpi_Info associated with space is NULL
    - module is NULL

---

**ddpi_space_find_class operation**

The ddpi_space_find_class operation returns a Ddpi_Class object containing a given address.
Instead of searching through the entire Ddpi_Space until Ddpi_Class is found, the ddpi_space_find_class operation searches only the address-range table of the Ddpi_Space.

Prototype

```c
int ddpi_space_find_class(
    Ddpi_Space space,
    Dwarf_Addr addr,
    Ddpi_Class* ret_class,
    Ddpi_Error* error);
```

Parameters

space
Input. This accepts the Ddpi_Space object.

addr
Input. This accepts the required address.

ret_class
Output. This returns the Ddpi_Class object.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the Ddpi_Class object containing a given address is successfully returned.

DW_DLV_NO_ENTRY
Returned if:
- space does not have any class.
- The input address is not in the range of the space range table.

DW_DLV_ERROR
Returned if:
- space is NULL
- Ddpi_Info associated with space is NULL
- ret_class is NULL
Chapter 9. Ddpi_Process APIs

Like Ddpi_Space, Ddpi_Process is part of the libddpi application model.

Ddpi_Process is intended to be used by the program analysis application to keep track of information about various processes active in a given address space.

Ddpi_PRID object

Contains the DWARF process ID.

Type definition
typedef Dwarf_Unsigned Ddpi_PRID;

Ddpi_Process_Type object

Contains the process ID type.

Type definition
typedef struct Ddpi_Process_s* Ddpi_Process;

Ddpi_Process object

The Ddpi_Process object is an opaque data type that contains information about a process.

Type definition
typedef struct Ddpi_Process_s* Ddpi_Process;

ddpi_process_create operation

The ddpi_process_create operation creates a Ddpi_Process object to represent a process and returns a descriptor that represents a handle for accessing a process.

When you call the operation, and pass a character string as the parameter name, the operation copies the contents of name. After the operation returns, you can deallocate the original name to re-use the storage.

Prototype

int ddpi_process_create(
    Ddpi_Space space,
    char* name,
    Ddpi_Process_Type type,
    Ddpi_PRID id,
    int user_area_len,
    Ddpi_Process* ret_process,
    Ddpi_Error* error);

Parameters

space
    Input. This accepts the Ddpi_Space object that represents the address space of the owner of this process.
name
   Input. This accepts a process name.

type
   Input. This accepts a process type.
id
   Input. This accepts a process ID.
user_area_len
   Input. This accepts the user-area length.
ret_process
   Output. This returns the process object.

error
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful retrieval of the process descriptor.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
   • space is NULL
   • Ddpi_Info associated with space is NULL
   • ret_process is NULL
   • user_area_len is less than zero
   • An error occurs while allocating memory

ddpi_process_term operation

The ddpi_process_term operation releases all internal resources associated with the
process descriptor and invalidates process.

Termination of a process triggers the termination of any entities owned by this
process such as modules, threads or classes.

Prototype

int ddpi_process_term(
   Ddpi_Process process,
   Ddpi_Error* error);

Parameters

process
   Input. This accepts the Ddpi_Process object.

terror
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful termination of the process.

DW_DLV_NO_ENTRY
   Returned if the process is not found in its parent process list.
DW_DLV_ERROR
Returned if:
• process is NULL
• Ddpi_Info or the space associated with process is NULL
• An error occurs during termination of child descriptors
• An error occurs during memory deallocation.

ddpi_process_get_owner operation
The ddpi_process_get_owner operation queries the owning Ddpi_Space of a given Ddpi_Process object and assigns it to the given ret_owner parameter.

Prototype
int ddpi_process_get_owner(
    Ddpi_Process process,
    Ddpi_Space* ret_owner,
    Ddpi_Error* error);

Parameters
process
Input. This accepts the Ddpi_Process object.

ret_owner
Output. This returns the Ddpi_Space object that owns the given process.

error
See "The libddpi error parameter" on page 15

Return values
DW_DLV_OK
Returned upon successful release of resources associated with the Ddpi_Info descriptor.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
Returned if:
• process is NULL
• Ddpi_Info associated with process is NULL
• ret_owner is NULL

ddpi_process_get_id operation
The ddpi_process_get_id operation queries the process ID and assigns it to ret_id.

Prototype
int ddpi_process_get_id(
    Ddpi_Process process,
    Ddpi_PRID* ret_id,
    Ddpi_Error* error);

Parameters
process
Input. This accepts the Ddpi_Process object.
**ddpi_process_set_id operation**

The `ddpi_process_set_id` operation assigns a new ID to a given `Ddpi_Process` object.

**Prototype**

```c
int ddpi_process_set_id(  
    Ddpi_Process process,    
    Ddpi_PRID new_id,    
    Ddpi_Error* error);  
```

**Parameters**

- **process**
  
  Input. This accepts the `Ddpi_Process` object.

- **new_id**
  
  Input. This accepts the new process ID.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful assignment of the process ID.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  Returned if:
  - process is NULL
  - `Ddpi_Info` associated with process is NULL
  - `ret_id` is NULL

**ddpi_process_get_name operation**

The `ddpi_process_get_name` operation queries the name of a given `Ddpi_Process` object and sets the returned name to a pointer to a null-terminated string of characters.
Never deallocate the returned pointer because `ddpi_process_get_name` returns the actual version of the name, and not a copy.

**Prototype**

```c
int ddpi_process_get_name(
    Ddpi_Process process,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

- **process**
  - Input. This accepts the `Ddpi_Process` object.
- **ret_name**
  - Output. This returns the name string.
- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful assignment of the process name.
- **DW_DLV_NO_ENTRY**
  - Returned if name is NULL.
- **DW_DLV_ERROR**
  - Returned if:
    - process is NULL
    - `Ddpi_Info` associated with process is NULL
    - `ret_name` is NULL

---

**`ddpi_process_set_name` operation**

The `ddpi_process_set_name` operation assigns a new name to a given `Ddpi_Process` object, which can be used to set the name to NULL.

Because `ddpi_process_set_name` copies the given name, you can deallocate `new_name` after the call.

**Prototype**

```c
int ddpi_process_set_name(
    Ddpi_Process process,
    char* new_name,
    Ddpi_Error* error);
```

**Parameters**

- **process**
  - Input. This accepts the `Ddpi_Process` object.
- **new_name**
  - Input. This accepts the new process name string.
- **error**
  - See "The libddpi error parameter" on page 15.
**Return values**

**DW_DLV_OK**
- Returned upon successful assignment of the new process name.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- Returned if:
  - process is NULL
  - Ddpi_Info associated with process is NULL
  - An error occurs while allocating the memory for the copy of the name

---

**ddpi_process_get_TCBaddr operation**

The `ddpi_process_get_TCBaddr` operation returns the task control block (TCB) address for a given `Ddpi_Process` object.

**Prototype**

```c
int ddpi_process_get_TCBaddr(
    Ddpi_Process process,
    Dwarf_Addr* ret_tcbaddr,
    Ddpi_Error* error);
```

**Parameters**

`process`
- Input. This accepts the `Ddpi_Process` object.

`ret_tcbaddr`
- Output. This returns the TCB address of the process.

`error`
- See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the TCB address.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- Returned if:
  - process is NULL
  - Ddpi_Info associated with process is NULL
  - ret_context is NULL

---

**ddpi_process_set_TCBaddr operation**

The `ddpi_process_set_TCBaddr` operation assigns a new task control block (TCB) address to a given `Ddpi_Process` object.
Prototype

```c
int ddpi_process_set_TCBaddr(
    Ddpi_Process process,
    Dwarf_Addr tcbaddr,
    Ddpi_Error* error);
```

Parameters

- **process**
  - Input. This accepts the Ddpi_Process object.

- **tcbaddr**
  - Input. This accepts the new TCB address of the process.

- **error**
  - See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful assignment of the new TCB process name.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - process is NULL
    - Ddpi_Info associated with process is NULL

---

**ddpi_process_get_type operation**

The `ddpi_process_get_type` operation returns a type for a given Ddpi_Process object.

Prototype

```c
int ddpi_process_get_type(
    Ddpi_Process process,
    Ddpi_Process_Type* ret_type,
    Ddpi_Error* error);
```

Parameters

- **process**
  - Input. This accepts the Ddpi_Process object.

- **ret_type**
  - Output. This returns the process type.

- **error**
  - See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the process type.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
ddpi_process_get_user_area operation

The ddpi_process_get_user_area operation returns the user area for the given Ddpi_Process object.

Prototype

```c
int ddpi_process_get_user_area(
    Ddpi_Process process,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

Parameters

- **process**
  - Input. This accepts the Ddpi_Process object.

- **ret_user_area**
  - Output. This returns the user area of the process.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the user area of the process.

- **DW_DLV_NO_ENTRY**
  - Returned if the user area length is zero.

- **DW_DLV_ERROR**
  - Returned if:
    - process is NULL
    - Ddpi_Info associated with process is NULL
    - ret_user_area is NULL

ddpi_process_list_module operation

The ddpi_process_list_module operation returns a list of Ddpi_Module objects for a given Ddpi_Process and the number of items in that list.

The module list can be freed by the caller with the following code:

```c
rc = ddpi_dealloc(info, *ret_module_list, DDPI_DLA_LIST);
```

Do not free the individual Ddpi_Module objects because they are the actual Ddpi_Module objects stored in the Ddpi_Process.

Prototype

```c
int ddpi_process_list_module(
    Ddpi_Process process,
    Ddpi_Module** ret_module_list,
    Dwarf_Signed* ret_module_cnt,
    Ddpi_Error* error);
```
Parameters

process
Input. This accepts the Ddpi_Process object.

ret_module_list
Output. This returns a list of pointers to the Ddpi_Module.

ret_module_cnt
Output. This returns the count of entries in the module list.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
Returned upon successful retrieval of the process list.

DW_DLV_NO_ENTRY
Returned if the process list is empty.

DW_DLV_ERROR
Returned if:
• process is NULL
• Ddpi_Info associated with process is NULL
• ret_module_list or ret_module_cnt is NULL

ddpi_process_hide_module operation

The ddpi_process_hide_module operation hides a Ddpi_Module object that is to be reactivated later.

The ddpi_process_hide_module operation moves the Ddpi_Module object from the Ddpi_Process module list to the Ddpi_Space hidden module list.

Prototype

int ddpi_process_hide_module(
    Ddpi_Process process,
    Ddpi_Module module,
    Ddpi_Error* error);

Parameters

process
Input. This accepts the Ddpi_Process object.

module
Input. This accepts the Ddpi_Module object.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
Returned when the module has been successfully moved to the list of hidden modules.

DW_DLV_NO_ENTRY
Returned if the module is already hidden in the address space of the process.
DW_DLV_ERROR
  Returned if:
  • process is NULL
  • Ddpi_Info associated with process is NULL
  • module is NULL

ddpi_process_list_class operation

The ddpi_process_list_class operation returns a pointer to an array of the Ddpi_Class objects for a given Ddpi_Process and the number of entries in the array.

This class list can be freed by the caller with the following code:

```
rc = ddpi_dealloc(info, *ret_class_list, DDPI_DLA_LIST);
```

Do not free the individual Ddpi_Class objects because they are the actual objects stored in the Ddpi_Process.

Prototype

```
int ddpi_process_list_module(
    Ddpi_Process process,
    Ddpi_Class** ret_class_list,
    Dwarf_Signed* ret_class_cnt,
    Ddpi_Error* error);
```

Parameters

process
  Input. This accepts the Ddpi_Process object.

ret_class_list
  Output. This returns a list of pointers to the Ddpi_Class.

ret_class_cnt
  Output. This returns the count of entries in the class list.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful retrieval of the array pointer and the number of entries in the array.

DW_DLV_NO_ENTRY
  Returned if there are no classes.

DW_DLV_ERROR
  Returned if:
  • process is NULL
  • Ddpi_Info associated with process is NULL
  • ret_class_list or ret_class_cnt is NULL

ddpi_process_list_thread operation

The ddpi_process_list_thread operation lists the Ddpi_Thread objects associated with the given Ddpi_Process object.
The `ddpi_process_list_thread` operation also sets the returned list to a pointer, which points to an array of `Ddpi_Thread` descriptors and sets the `ret_thread_cnt` to the number of entries in the array.

The caller must free the thread list but not the individual `Ddpi_Thread` objects because these are not copies, but are the actual `Ddpi_Thread` objects stored in the `Ddpi_Process`.

The code to free the list is:

```c
rc = ddpi_dealloc(info, *ret_thread_list, DDPI_DLA_LIST);
```

**Prototype**

```c
int ddpi_process_list_thread(  
    Ddpi_Process process,  
    Ddpi_Thread** ret_thread_list,  
    Dwarf_Signed* ret_thread_cnt,  
    Ddpi_Error* error);
```

**Parameters**

- `process`  
  Input. This accepts the `Ddpi_Process` object.

- `ret_thread_list`  
  Output. This returns the list of threads.

- `ret_thread_cnt`  
  Output. This returns the count of entries in the list.

- `error`  
  See “The libddpi error parameter” on page 15.

**Return values**

- `DW_DLV_OK`  
  Returned upon successful return of the thread list and deallocation of storage.

- `DW_DLV_NO_ENTRY`  
  Returned if there are no threads associated with this process.

- `DW_DLV_ERROR`  
  Returned if:
  - `process` is NULL
  - `Ddpi_Info` associated with `process` is NULL
  - `ret_thread_list` or `ret_thread_cnt` is NULL
Chapter 10. Ddpi_Thread APIs

Ddpi_Thread APIs keep track of POSIX threads used in a given process.

Ddpi_THID object

The thread ID.

Type definition
typedef Dwarf_Unsigned Ddpi_THID;

Ddpi_Thread_Type object

The thread type.

Type definition
typedef enum Ddpi_Thread_Type_s {
  Ddpi_TT_Unknown = 0,
  Ddpi_TT_POSIX = 1
} Ddpi_Thread_Type;

Members

Ddpi_TT_Unknown
  If this value is 0, the thread type is unknown.

  Note: Not recommended.

Ddpi_TT_POSIX
  If this value is 1, the thread is a POSIX thread.

Ddpi_Thread object

The Ddpi_Thread object is an opaque data type that tracks threads for a given process.

Type definition
typedef struct Ddpi_Thread_s* Ddpi_Thread;

ddpi_thread_create operation

The ddpi_thread_create operation creates a Ddpi_Thread object to represent a POSIX thread and returns a descriptor that represents a handle for accessing the newly created thread.

When you call the ddpi_thread_create operation, and pass a character string as the parameter name, the operation copies the content of the parameter name into its own storage. After the operation returns a value, you can deallocate the original name and re-use the storage.

Note: If the thread type is unknown (set to 0), the effect of this operation is undefined.
Prototype

```c
int ddpi_thread_create(
    Ddpi_Process process,
    char* name,
    Ddpi_Thread_Type type,
    Ddpi_THID id,
    int user_area_len,
    Dwarf.Addr tcbaddr,
    Ddpi_Thread* ret_thread,
    Ddpi_Error* error);
```

Parameters

- **process**
  - Input. This accepts the Ddpi_Process object.

- **name**
  - Input. This accepts a thread name.

- **type**
  - Input. This accepts a thread type.

- **id**
  - Input. This accepts a thread ID.

- **user_area_len**
  - Input. This accepts the user-area length.

- **tcbaddr**
  - Input. This accepts task control block address.

- **ret_thread**
  - Output. This returns the thread object.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful return of the thread object descriptor.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - process is NULL
    - Ddpi_Info associated with process is NULL
    - ret_thread is NULL
    - user_area_len is less than zero
    - An error occurs while allocating memory

---

**ddpi_thread_term operation**

The ddpi_thread_term operation releases all internal resources associated with the thread descriptor, and invalidates thread.

Prototype

```c
int ddpi_thread_term(
    Ddpi_Thread thread,
    Ddpi_Error* error);
```
Parameters

thread
Input. This accepts the Ddpi_Thread object.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful release of all internal resources associated with the thread descriptor.

DW_DLV_NO_ENTRY
Returned if the given thread is not found in the thread list of the owning process.

DW_DLV_ERROR
Returned if:
• thread is NULL
• Ddpi_Info associated with thread is NULL
• An error occurs while terminating child descriptors
• An error occurs while deallocating memory

ddpi_thread_get_owner operation
The ddpi_thread_get_owner operation queries the owner of a given Ddpi_Thread object and sets the Ddpi_Thread object to the returned Ddpi_Process object.

Prototype

int ddpi_thread_get_owner(
    Ddpi_Thread thread,
    Ddpi_Process* ret_process,
    Ddpi_Error* error);

Parameters

thread
Input. This accepts the Ddpi_Thread object.

ret_process
Output. This returns the Ddpi_Process object that owns the given thread.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of the thread object.

DW_DLV_NO_ENTRY
Returned if the given thread is not found in the thread list of the owning process.

DW_DLV_ERROR
Returned if:
• thread is NULL
• Ddpi_Info associated with thread is NULL
• ret_process is NULL

**ddpi_thread_get_name operation**

The `ddpi_thread_get_name` operation queries the name of a given Ddpi_Thread object and sets the returned name to a pointer to a null-terminated string of characters.

Do not deallocate the returned pointer because the `ddpi_thread_get_name` operation returns the actual version of the name, and not a copy.

**Prototype**

```c
int ddpi_thread_get_name(
    Ddpi_Thread thread,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

- **thread**
  - Input. This accepts the Ddpi_Thread object.

- **ret_name**
  - Output. This returns the name string.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the pointer is successfully set to the retrieved thread name.

- **DW_DLV_NO_ENTRY**
  - Returned if the given thread is not found in the thread list of the owning process.

- **DW_DLV_ERROR**
  - Returned if:
    - thread is NULL
    - Ddpi_Info associated with thread is NULL
    - ret_name is NULL

**ddpi_thread_set_name operation**

The `ddpi_thread_set_name` operation assigns a new name to a given Ddpi_Thread object.

The `ddpi_thread_set_name` operation can be used to set the name to NULL. Because the `ddpi_thread_set_name` copies the given name, you can deallocate `new_name` after the call.

**Prototype**

```c
int ddpi_thread_set_name(
    Ddpi_Thread thread,
    char* new_name,
    Ddpi_Error* error);
```
Parameters

thread
   Input. This accepts the Ddpi_Thread object.

new_name
   Input. This accepts the new name string. This is the address of a
   NULL-terminated string containing the new name.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful assignment of the new name.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
   • thread is NULL
   • Ddpi_Info associated with thread is NULL
   • An error occurs during memory allocation for the copy of the name

ddpi_thread_get_id operation

The ddpi_thread_get_id operation returns the ID for the given Ddpi_Thread object.

Prototype

int ddpi_thread_get_id(
   Ddpi_Thread thread,
   Ddpi_THID* ret_id,
   Ddpi_Error* error);

Parameters

thread
   Input. This accepts the Ddpi_Thread object.

ret_id
   Output. This returns the thread ID.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful retrieval of the ID for the given Ddpi_Thread object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
   • thread is NULL
   • Ddpi_Info associated with thread is NULL
   • ret_id is NULL
ddpi_thread_set_id operation

The `ddpi_thread_set_id` operation assigns a new ID to a given Ddpi_Thread object.

Prototype

```c
int ddpi_thread_set_id(
    Ddpi_Thread thread,
    Ddpi_THID new_id,
    Ddpi_Error* error);
```

Parameters

- **thread**
  - Input. This accepts the Ddpi_Thread object.

- **new_id**
  - Input. This accepts the new thread ID.

- **error**
  - See "The libddpi error parameter" on page 15.

Return values

- `DW_DLV_OK`
  - Returned upon successful acceptance of the new thread ID.

- `DW_DLV_NO_ENTRY`
  - Never returned.

- `DW_DLV_ERROR`
  - Returned if:
    - thread is NULL
    - The Ddpi_Info object associated with thread is NULL.

ddpi_thread_get_type operation

The `ddpi_thread_get_type` operation returns the type of the given Ddpi_Thread object.

Prototype

```c
int ddpi_thread_get_type(
    Ddpi_Thread thread,
    Ddpi_Thread_Type* ret_type,
    Ddpi_Error* error);
```

Parameters

- **thread**
  - Input. This accepts the Ddpi_Thread object.

- **ret_type**
  - Output. This returns the thread type.

- **error**
  - See "The libddpi error parameter" on page 15.

Return values

- `DW_DLV_OK`
  - Returned upon successful retrieval of the thread object type.
**ddpi_thread_get_TCBaddr operation**

The `ddpi_thread_get_TCBaddr` operation returns the task control block (TCB) address for a given Ddpi_Thread object.

**Prototype**

```c
int ddpi_thread_get_TCBaddr(
    Ddpi_Thread thread,
    Dwarf_Addr* ret_tcbaddr,
    Ddpi_Error* error);
```

**Parameters**

- **thread**
  
  Input. This accepts the Ddpi_Thread object.

- **ret_tcbaddr**
  
  Output. This returns the TCB address of the thread.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful retrieval of the TCB address.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  Returned if:
  - thread is NULL
  - Ddpi_Info associated with thread is NULL
  - ret_tcbaddr is NULL

**ddpi_thread_get_user_area operation**

The `ddpi_thread_get_user_area` operation returns the address of the user area for the given Ddpi_Thread object.

**Prototype**

```c
int ddpi_thread_get_user_area(
    Ddpi_Thread thread,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```
Parameters

thread
Input. This accepts the Ddpi_Thread object.

ret_user_area
Output. This returns a pointer to the user area of the Ddpi_Thread.

error
See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
Returned upon successful retrieval of the user area address.

DW_DLV_NO_ENTRY
Returned if the user area length is zero.

DW_DLV_ERROR
Returned if:
• thread is NULL
• Ddpi_Info associated with thread is NULL
• ret_user_area is NULL

ddpi_thread_list_mutex operation

The ddpi_thread_list_mutex operation lists the Ddpi_Mutex objects associated with the given Ddpi_Thread object.

The ddpi_thread_list_mutex operation also sets the ret_mutex_list to an array of Ddpi_Mutex descriptors and sets the ret_mutex_cnt to the number of items in ret_mutex_list.

The caller must free the mutex list but not the individual Ddpi_Mutex objects because these are not copies, but are the actual Ddpi_Mutex objects stored in the Ddpi_Thread.

The code to free the mutex list is:

rc = ddpi_dealloc(info, *ret_mutex_list, DDPI_DLA_LIST);

Prototype

int ddpi_thread_list_mutex(
    Ddpi_Thread thread,
    Ddpi_Mutex** ret_mutex_list,
    Dwarf_Signed* ret_mutex_cnt,
    Ddpi_Error* error);

Parameters

thread
Input. This accepts the Ddpi_Thread object.

ret_mutex_list
Output. This is where the mutex list will be returned.

ret_mutex_cnt
Output. This returns the count of entries in the mutex list.
Return values

**DW_DLV_OK**

Returned upon successful retrieval of the mutex list.

**DW_DLV_NO_ENTRY**

Returned if the mutex list is empty.

**DW_DLV_ERROR**

Returned if:

- thread is NULL
- Ddpi_Info associated with thread is NULL
- ret_mutex_list or ret_mutex_cnt is NULL

### ddpi_thread_list_cond operation

The `ddpi_thread_list_cond` operation lists the `Ddpi_Cond` objects associated with the given `Ddpi_Thread` object.

The `ddpi_thread_list_cond` operation also sets the `ret_cond_list` to an array of `Ddpi_Cond` descriptors and sets `ret_cond_cnt` to the number of items in `ret_cond_list`.

The caller must free the condition-variable list but not the individual `Ddpi_Cond` objects because these are not copies, but are the actual `Ddpi_Cond` objects stored in the `Ddpi_Thread`.

The code to free the list is:

```c
rc = ddpi_dealloc(info, *ret_cond_list, DDPI_DLA_LIST);
```

### Prototype

```c
int ddpi_thread_list_cond(
    Ddpi_Thread thread,
    Ddpi_Cond** ret_cond_list,
    Dwarf_Signed* ret_cond_cnt,
    Ddpi_Error* error);
```

### Parameters

- **thread**
  
  Input. This accepts the `Ddpi_Thread` object.

- **ret_cond_list**
  
  Output. This returns the list of condition variables.

- **ret_cond_cnt**
  
  Output. This returns the count of entries in the list.

- **error**

  See “The libddpi error parameter” on page 15

### Return values

**DW_DLV_OK**

Returned upon successful retrieval of the condition-variable list.
**DW_DLV_NO_ENTRY**
Returned if there are no condition variables.

**DW_DLV_ERROR**
Returned if:
- thread is NULL
- Ddpi_Info associated with thread is NULL
- ret_cond_list or ret_cond_cnt is NULL

---

**ddpi_thread_list_lock operation**

The ddpi_thread_list_lock operation lists the Ddpi_Lock objects associated with the given Ddpi_Thread object.

The ddpi_thread_list_lock operation also sets ret_lock_list to an array of Ddpi_Lock descriptors and sets ret_lock_cnt to the number of items in ret_lock_list.

The caller must free the lock list but not the individual Ddpi_Lock objects because these are not copies, but are the actual Ddpi_Lock objects stored in the Ddpi_Thread.

The code to free the list is:

```c
rc = ddpi_dealloc(info, *ret_lock_list, DDPI_DLA_LIST);
```

**Prototype**

```c
int ddpi_thread_list_lock(
    Ddpi_Thread thread,
    Ddpi_Lock** ret_lock_list,
    Dwarf_Signed* ret_lock_cnt,
    Ddpi_Error* error);
```

**Parameters**

- **thread**
  - Input. This accepts the Ddpi_Thread object.

- **ret_lock_list**
  - Output. This returns the list of locks.

- **ret_lock_cnt**
  - Output. This returns the count of entries in the list.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the lock list.

- **DW_DLV_NO_ENTRY**
  - Returned if there are no locks.

- **DW_DLV_ERROR**
  - Returned if:
    - thread is NULL
    - The Ddpi_Info object associated with thread is NULL
    - ret_lock_list or ret_lock_cnt is NULL
ddpi_thread_list_class operation

The `ddpi_thread_list_class` operation lists the Ddpi_Class objects associated with the given Ddpi_Thread object.

The `ddpi_thread_list_class` operation also sets `ret_class_list` to an array of Ddpi_Class descriptors and sets `ret_class_cnt` to the number of items in `ret_class_list`.

The caller must free the class list but not the individual Ddpi_Class objects because these are not copies, but are the actual Ddpi_Class objects stored in the Ddpi_Thread.

The code to free the list is:

```c
rc = ddpi_dealloc(info, *ret_class_list, DDPI_DLA_LIST);
```

Prototype

```c
int ddpi_thread_list_class(
    Ddpi_Thread thread,
    Ddpi_Class** ret_class_list,
    Dwarf_Signed* ret_class_cnt,
    Ddpi_Error* error);
```

Parameters

thread
  Input. This accepts the Ddpi_Thread object.

ret_class_list
  Output. This returns the list of classes.

ret_class_cnt
  Output. This returns the count of entries in the list.

error
  See “The libddpi error parameter” on page 15

Return values

`DW_DLV_OK`
  Returned upon successful retrieval of the class list.

`DW_DLV_NO_ENTRY`
  Returned if there are no classes associated with the thread.

`DW_DLV_ERROR`
  Returned if:
  • `thread` is NULL
  • Ddpi_Info associated with `thread` is NULL
  • `ret_class_list` or `ret_class_cnt` is NULL
Chapter 11. Ddpi_Lock APIs

Read-write locks allow an application to make concurrent reads and exclusive writes to a protected shared resource. Before it can modify a resource, a thread must have an exclusive write lock. The write lock is granted only after all the read locks have been released. The Ddpi_Lock object, which describes a POSIX lock, is used to track internal information generated during these read-write locks. Each ddpi_lock operation creates and modifies the Ddpi_Lock object. A program analysis application can use the Ddpi_Lock object to determine which locks are in use for the application instance.

Ddpi_Lock object

The Ddpi_Lock object is an opaque data type that keeps track of the information within the read-write locks for a user application.

Type definition

typedef struct Ddpi_Lock_s* Ddpi_Lock;

Ddpi_LOID object

Contains the lock ID.

Type definition

typedef Dwarf_Unsigned Ddpi_LOID;

Ddpi_Lock_State object

 Defines the CDA lock states.

Type definition

typedef enum Ddpi_Lock_State_s {
    Ddpi_Lock_state_unknown = 0,
    Ddpi_Lock_for_read = 1,
    Ddpi_Lock_for_write = 2,
    Ddpi_Lock_wait_for_read = 3,
    Ddpi_Lock_wait_for_write = 4,
    Ddpi_Lock_unlock = 5,
    Ddpi_Lock_unwait = 6,
    Ddpi_Lock_relock = 7,
    Ddpi_Lock_unrelock = 8
} Ddpi_Lock_State;

Members

Ddpi_Lock_state_unknown
    0

Ddpi_Lock_for_read
    1

Ddpi_Lock_for_write
    2

Ddpi_Lock_wait_for_read
    3
ddpi_lock_create operation

The ddpi_lock_create operation creates a Ddpi_Lock object to describe a POSIX lock and returns a Ddpi_Lock descriptor.

Prototype

```c
int ddpi_lock_create(
    Ddpi_Thread thread,
    char* name,
    Ddpi_Lock_State state,
    Ddpi_LOID id,
    int user_area_len,
    Ddpi_Lock* ret_lock,
    Ddpi_Error* error);
```

Parameters

- **thread**
  - Input. This accepts the Ddpi_Thread object, which owns the lock.

- **name**
  - Input. This accepts a lock name.

- **state**
  - Input. This accepts a lock state.

- **id**
  - Input. This accepts a lock ID.

- **user_area_len**
  - Input. This accepts the user-area length.

- **ret_lock**
  - Output. This returns the Ddpi_Lock object.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the lock descriptor.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - thread is NULL
- Ddpi_Info associated with thread is NULL
- ret_lock is NULL
- user_area_len is less than zero
- An error occurs during memory allocation

**ddpi_lock_term operation**

The `ddpi_lock_term` operation releases all internal resources associated with the descriptor lock and invalidates lock.

**Prototype**

```c
int ddpi_lock_term(
    Ddpi_Lock lock,
    Ddpi_Error* error);
```

**Parameters**

- **lock**
  - Input. This accepts the Ddpi_Lock object.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful release of all internal resources associated with the descriptor lock.

- **DW_DLV_NO_ENTRY**
  - Returned if the lock is not found in the lock list of its parent threads.

- **DW_DLV_ERROR**
  - Returned if:
    - lock is NULL
    - thread or Ddpi_Info associated with lock is NULL
    - An error occurs while deallocating memory

**ddpi_lock_get_owner operation**

The `ddpi_lock_get_owner` operation queries the owner of a given Ddpi_Lock object and sets the returned Ddpi_Thread object.

**Prototype**

```c
int ddpi_lock_get_owner(
    Ddpi_Lock lock,
    Ddpi_Thread* ret_thread,
    Ddpi_Error* error);
```

**Parameters**

- **lock**
  - Input. This accepts the Ddpi_Lock object.

- **ret_thread**
  - Output. This returns the Ddpi_Thread object.

- **error**
  - See “The libddpi error parameter” on page 15
Return values

**DW_DLV_OK**  
Returned when the thread object has been successfully set.

**DW_DLV_NO_ENTRY**  
Never returned.

**DW_DLV_ERROR**  
Returned if:
- lock is NULL
- Ddpi_Info associated with lock is NULL
- ret_thread is NULL

---

**ddpi_lock_get_name operation**

The `ddpi_lock_get_name` operation finds the name of a given `Ddpi_Lock` object and sets the returned name to a pointer to a null-terminated string of characters.

Never deallocate the returned pointer because `ddpi_lock_get_name` returns the actual version of the name, and not a copy.

**Prototype**

```c
int ddpi_lock_get_name(
    Ddpi_Lock lock,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

**lock**  
Input. This accepts the `Ddpi_Lock` object.

**ret_name**  
Output. This returns the name string.

**error**  
See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**  
Returned when the pointer has been successfully set.

**DW_DLV_NO_ENTRY**  
Returned if name is NULL.

**DW_DLV_ERROR**  
Returned if:
- lock is NULL
- Ddpi_Info associated with lock is NULL
- ret_name is NULL

---

**ddpi_lock_set_name operation**

The `ddpi_lock_set_name` operation assigns a new name to a given `Ddpi_Lock` object.
The `ddpi_lock_set_name` operation can be used to set the name to NULL. `ddpi_lock_set_name` copies the given name. The caller may deallocate `new_name` after the call to save memory.

**Prototype**

```c
int ddpi_lock_set_name(
    Ddpi_Lock lock,
    char* new_name,
    Ddpi_Error* error);
```

**Parameters**

- **lock**
  - Input. This accepts the `Ddpi_Lock` object.

- **new_name**
  - Input. This accepts the new name string.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the lock object has been successfully renamed.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - `lock` is NULL
    - `Ddpi_Info` associated with `lock` is NULL
    - An error occurs during memory allocation for the copy of the name

**ddpi_lock_get_id operation**

The `ddpi_lock_get_id` operation returns the ID for a given `Ddpi_Lock` object.

**Prototype**

```c
int ddpi_lock_get_id(
    Ddpi_Lock lock,
    Ddpi_LOID* ret_id,
    Ddpi_Error* error);
```

**Parameters**

- **lock**
  - Input. This accepts the `Ddpi_Lock` object.

- **ret_id**
  - Output. This returns the lock ID.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the lock ID.
ddpi_lock_set_id operation

The ddpi_lock_set_id operation assigns a new ID to a given Ddpi_Lock object.

Prototype

```c
int ddpi_lock_set_id(
    Ddpi_Lock     lock,
    Ddpi_LOID     new_id,
    Ddpi_Error*   error);
```

Parameters

- `lock`  
  Input. This accepts the Ddpi_Lock object.

- `new_id`  
  Input. This accepts the new lock ID.

- `error`  
  See “The libddpi error parameter” on page 15.

Return values

- DW_DLV_OK  
  Returned upon successful assignment of the new ID to the lock object.

- DW_DLV_NO_ENTRY  
  Never returned.

- DW_DLV_ERROR  
  Returned if:
  - `lock` is NULL
  - Ddpi_Info associated with `lock` is NULL

ddpi_lock_get_state operation

The ddpi_lock_get_state operation returns the state for a given Ddpi_Lock object.

Prototype

```c
int ddpi_lock_get_state(
    Ddpi_Lock     lock,
    Ddpi_Lock_State* ret_state,
    Ddpi_Error*   error);
```

Parameters

- `lock`  
  Input. This accepts the Ddpi_Lock object.

- `ret_state`  
  Output. This returns the lock state.
error
  See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
  Returned upon successful retrieval of the lock object state.

**DW_DLV_NO_ENTRY**
  Never returned.

**DW_DLV_ERROR**
  Returned if:
  - `lock` is NULL
  - Ddpi_Info associated with `lock` is NULL
  - `ret_state` is NULL

---

**ddpi_lock_set_state operation**

The `ddpi_lock_set_state` operation assigns a new state to a given Ddpi_Lock object.

**Prototype**

```c
int ddpi_lock_set_state(
    Ddpi_Lock lock,
    Ddpi_Lock_State new_state,
    Ddpi_Error* error);
```

**Parameters**

`lock`
  Input. This accepts the Ddpi_Lock object.

`new_state`
  Input. This accepts the new lock state.

`error`
  See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
  Returned when the lock state has been successfully reset.

**DW_DLV_NO_ENTRY**
  Never returned.

**DW_DLV_ERROR**
  Returned if:
  - `lock` is NULL
  - Ddpi_Info associated with `lock` is NULL

---

**ddpi_lock_get_user_area operation**

The `ddpi_lock_get_user_area` operation finds the user area for a given Ddpi_Lock object and sets the start of the returned user area.
Prototype

```c
int ddpi_lock_get_user_area(
    Ddpi_Lock lock,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

Parameters

`lock`

Input. This accepts the Ddpi_Lock object.

`ret_user_area`

Output. This returns the lock user area.

`error`

See “The libddpi error parameter” on page 15.

Return values

`DW_DLV_OK`

Returned upon successful re-initialization of the lock object.

`DW_DLV_NO_ENTRY`

Returned if the user area length is zero.

`DW_DLV_ERROR`

Returned if:

- lock is NULL
- Ddpi_Info associated with lock is NULL
- ret_user_area is NULL
Chapter 12. Ddpi_Mutex APIs

Mutual exclusion (mutex) locks are used to synchronize thread execution so that only one thread can execute a critical section of code at any one time. The Ddpi_Mutex object keeps track of the information within the mutual exclusion locks that are used within the application.

Ddpi_Mutex object

The Ddpi_Mutex object is an opaque data type that tracks the information within the mutual exclusion locks that are used within the application.

Type definition

typedef struct Ddpi_Mutex_s* Ddpi_Mutex;

Ddpi_MUID object

Contains the Mutex ID.

Type definition

typedef Dwarf_Unsigned Ddpi_MUID;

Ddpi_Mutex_State object

Contains the mutex state.

Type definition

typedef enum Ddpi_Mutex_State_s {
  Ddpi_Mutex_State_unknown = 0,
  Ddpi_Mutex_lock = 1,
  Ddpi_Mutex_unlock = 2,
  Ddpi_Mutex_wait = 3,
  Ddpi_Mutex_unwait = 4,
  Ddpi_Mutex_relock = 5,
  Ddpi_Mutex_unrelock = 6
} Ddpi_Mutex_State;

Members

Ddpi_Mutex_state_unknown
  0

Ddpi_Mutex_lock
  1

Ddpi_Mutex_unlock
  2

Ddpi_Mutex_wait
  3

Ddpi_Mutex_unwait
  4

Ddpi_Mutex_relock
  5
ddpi_mutex_create operation

The ddpi_mutex_create operation creates a Ddpi_Mutex object to describe a POSIX mutex and assigns a Ddpi_Mutex descriptor.

Prototype

```c
int ddpi_mutex_create(
    Ddpi_Thread thread,
    char* name,
    Ddpi_Mutex_State state,
    Ddpi_MUID id,
    int user_area_len,
    Ddpi_Mutex* ret_mutex,
    Ddpi_Error* error);
```

Parameters

**thread**

Input. This accepts the Ddpi_Thread object, which owns the mutex.

**name**

Input. This accepts a mutex name.

**state**

Input. This accepts a mutex state.

**id**

Input. This accepts a mutex ID.

**user_area_len**

Input. This accepts the user-area length.

**ret_mutex**

Output. This returns the mutex object.

**error**

See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**

Returned upon successful assignment of the POSIX mutex descriptor.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

Returned if:

- thread is NULL
- Ddpi_Info associated with thread is NULL
- ret_mutex is NULL
- user_area_len is less than zero
- An error during memory allocation.

ddpi_mutex_term operation

The ddpi_mutex_term operation releases all internal resources associated with the mutex descriptor and invalidates mutex.
Prototype

```c
int ddpi_mutex_term(
    Ddpi_Mutex       mutex,
    Ddpi_Error*      error);
```

Parameters

**mutex**
Input. This accepts the Ddpi_Mutex object.

**error**
See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
Returned upon successful release of all internal resources associated with the mutex descriptor.

**DW_DLV_NO_ENTRY**
Returned if the mutex is not found in its parent threads mutex list.

**DW_DLV_ERROR**
Returned if:
- mutex is NULL
- Ddpi_Info or the thread associated with mutex is NULL
- An error occurs while deallocating memory

---

**ddpi_mutex_get_owner operation**

The `ddpi_mutex_get_owner` operation finds the owner of a given Ddpi_Mutex object and sets it to the returned Ddpi_Thread object.

Prototype

```c
int ddpi_mutex_get_owner(
    Ddpi_Mutex       mutex,
    Ddpi_Thread*     ret_thread,
    Ddpi_Error*      error);
```

Parameters

**mutex**
Input. This accepts the Ddpi_Mutex object.

**ret_thread**
Output. This returns the owner of the mutex.

**error**
See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
Returned when the returned mutex object value is successfully reset to the thread object value.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
**ddpi_mutex_get_name operation**

The `ddpi_mutex_get_name` operation finds the name of a given `Ddpi_Mutex` object and returns a pointer to the object.

Do not deallocate the pointer.

**Prototype**

```c
int ddpi_mutex_get_name(
    Ddpi_Mutex mutex,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

- `mutex`
  - Input. This accepts the `Ddpi_Mutex` object.

- `ret_name`
  - Output. This returns the name string.

- `error`
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the pointer has been set to the retrieved name.

- **DW_DLV_NO_ENTRY**
  - Returned if name is NULL.

- **DW_DLV_ERROR**
  - Returned if:
    - `mutex` is NULL
    - `Ddpi_Info` associated with `mutex` is NULL
    - `ret_name` is NULL

**ddpi_mutex_set_name operation**

The `ddpi_mutex_set_name` operation assigns a new name to a given `Ddpi_Mutex` object.

The `ddpi_mutex_set_name` operation can be used to set the name to NULL.

You can deallocate `new_name` after the call because `ddpi_mutex_set_name` copies the given name.

**Prototype**

```c
int ddpi_mutex_set_name(
    Ddpi_Mutex mutex,
    char* new_name,
    Ddpi_Error* error);
```
**Parameters**

**mutex**

Input. This accepts the Ddpi_Mutex object.

**new_name**

Input. This accepts the new name string.

**error**

See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**

Returned when the mutex object has been successfully renamed.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

Returned if:
- mutex is NULL
- Ddpi_Info associated with mutex is NULL
- An error occurs while allocating the memory for the copy of the name

---

**ddpi_mutex_get_id operation**

The `ddpi_mutex_get_id` operation returns the ID for a given Ddpi_Mutex object.

**Prototype**

```c
int ddpi_mutex_get_id(
    Ddpi_Mutex mutex,
    Ddpi_MUID* ret_id,
    Ddpi_Error* error);
```

**Parameters**

**mutex**

Input. This accepts the Ddpi_Mutex object.

**ret_id**

Output. This returns the mutex ID.

**error**

See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**

Returned upon successful retrieval of the mutex object ID.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

Returned if:
- mutex is NULL
- Ddpi_Info associated with mutex is NULL
- ret_id is NULL
**ddpi_mutex_set_id operation**

The `ddpi_mutex_set_id` operation assigns a new ID to a given Ddpi_Mutex object.

**Prototype**

```c
int ddpi_mutex_set_id(
    Ddpi_Mutex mutex,
    Ddpi_MUID new_id,
    Ddpi_Error* error);
```

**Parameters**

- **mutex**
  - Input. This accepts the Ddpi_Mutex object.

- **new_id**
  - Input. This accepts the new mutex ID.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when a new ID has been successfully assigned to `mutex`.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if:
    - `mutex` is NULL
    - `Ddpi_Info` associated with `mutex` is NULL

---

**ddpi_mutex_get_state operation**

The `ddpi_mutex_get_state` operation returns the state for a given Ddpi_Mutex object.

**Prototype**

```c
int ddpi_mutex_get_state(
    Ddpi_Mutex mutex,
    Ddpi_Mutex_State* ret_state,
    Ddpi_Error* error);
```

**Parameters**

- **mutex**
  - Input. This accepts the Ddpi_Mutex object.

- **ret_state**
  - Output. This returns the state of the Ddpi_Mutex object.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the Ddpi_Mutex object state.
**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
- mutex is NULL
- The Ddpi_Info object associated with mutex is NULL
- ret_state is NULL

---

**ddpi_mutex_set_state operation**

The ddpi_mutex_set_state operation assigns a new state to a given Ddpi_Mutex object.

**Prototype**

```c
int ddpi_mutex_set_state(
    Ddpi_Mutex mutex,
    Ddpi_Mutex_State new_state,
    Ddpi_Error* error);
```

**Parameters**

- **mutex**
  Input. This accepts the Ddpi_Mutex object.

- **new_state**
  Input. This accepts the new state of the mutex.

- **error**
  See the “libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  Returned when the Ddpi_Mutex object state has been successfully reset.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  Returned if:
  - mutex is NULL
  - Ddpi_Info associated with mutex is NULL

---

**ddpi_mutex_get_user_area operation**

The ddpi_mutex_get_user_area operation finds the user area for a given Ddpi_Mutex object and sets the start of the returned user area using the returned value.

**Prototype**

```c
int ddpi_mutex_get_user_area(
    Ddpi_Mutex mutex,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```
Parameters

mutex
   Input. This accepts the Ddpi_Mutex object.

ret_user_area
   Output. This returns the user area of the mutex.

error
   See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
   Returned upon successful re-initialization of the retrieved user area.

DW_DLV_NO_ENTRY
   Returned if the user area length is zero.

DW_DLV_ERROR
   Returned if:
   • mutex is NULL
   • The Ddpi_Info object associated with mutex is NULL
   • ret_user_area is NULL
Chapter 13. Ddpi_Cond APIs

Condition variables are used to block thread execution until a particular condition is satisfied. The condition is tested under the protection of a mutual exclusion (mutex) lock. The Ddpi_Cond object keeps track of the information within the condition variables that are used within the user application.

Ddpi_Cond object

This represents the state of the current condition variable.

Type definition

typedef enum Ddpi_Cond_State_s {
    Ddpi_Cond_state_unknown = 0,
    Ddpi_Cond_wait = 1,
    Ddpi_Cond_unwait = 2
} Ddpi_Cond_State;

Members

- Ddpi_Cond_state_unknown
  If this value is 0, the condition variable state is unknown. It is not recommended that you set the condition state as 0.

- Ddpi_Cond_wait
  If this value is 1, the condition variable is currently in the wait state.

- Ddpi_Cond_unwait
  If this value is 2, the condition variable is currently in the unwait state.

Ddpi_CVID object

The CVID data type.

Type definition

typedef Dwarf_Usigned Ddpi_CVID;

Ddpi_Cond object

The Ddpi_Cond opaque data type
- Tracks the information within the condition variables that are used within the user application.
- Contains information regarding application of a condition variable.

Type definition

typedef struct Ddpi_Cond_s* Ddpi_Cond;

ddpi_cond_create operation

The ddpi_cond_create operation creates a Ddpi_Cond object to describe a POSIX condition and assigns a Ddpi_Cond descriptor.
Prototype

```c
int ddpi_cond_create(
    Ddpi_Thread thread,
    char* name,
    Ddpi_Cond_State state,
    Ddpi_CVID id,
    int user_area_len,
    Ddpi_Cond* ret_cond,
    Ddpi_Error* error);
```

Parameters

**thread**
Input. This accepts the Ddpi_Thread object, which owns the condition variable.

**name**
Input. This accepts a condition-variable name.

**state**
Input. This accepts a condition-variable state.

**id**
Input. This accepts a condition-variable ID or 0.

**user_area_len**
Input. This accepts the user area length.

**ret_cond**
Output. This returns the condition-variable object.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful assignment of the POSIX condition descriptor.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
- thread or its associated Ddpi_Info is NULL.
- ret_cond is NULL.
- user_area_len is less than zero.
- An error occurs during memory allocation.

---

**ddpi_cond_term operation**

The ddpi_cond_term operation releases all internal resources associated with the condition-variable descriptor and invalidates cond.

Prototype

```c
int ddpi_cond_term(
    Ddpi_Cond cond,
    Ddpi_Error* error);
```

Parameters

**cond**
Input. This accepts the Ddpi_Cond object.
error
   See “The libddpi error parameter” on page 15.

Return values

**DW DLV_OK**
   Returned upon successful release of resources associated with the condition-variable descriptor.

**DW DLV_NO_ENTRY**
   Returned if the condition variable is not found in its parent thread's cond list.

**DW DLV_ERROR**
   Returned if:
   - cond or its associated thread or Ddpi_Info is NULL.
   - ret_thread is NULL.
   - An error occurs during memory deallocation.

---

**ddpi_cond_get_owner operation**

The `ddpi_cond_get_owner` operation queries the owner of a given Ddpi_Cond object and sets the returned Ddpi_Thread object.

**Prototype**

```c
int ddpi_cond_get_owner(
    Ddpi_Cond cond,
    Ddpi_Thread* ret_thread,
    Ddpi_Error* error);
```

**Parameters**

- **cond**
  
  Input. This accepts the Ddpi_Cond object.

- **ret_thread**
  
  Output. This returns the Ddpi_Thread object.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW DLV_OK**
  
  Returned when the condition object has been successfully reset.

- **DW DLV_NO_ENTRY**
  
  Never returned.

- **DW DLV_ERROR**
  
  Returned if:
  - cond or its associated Ddpi_Info object is NULL.
  - ret_thread is NULL.

---

**ddpi_cond_get_name operation**

The `ddpi_cond_get_name` operation queries the name of a given Ddpi_Cond object and sets the returned name to a pointer to a null-terminated string of characters.
Never deallocate the returned pointer because ddpi_cond_get_name returns the actual version of the name, and not a copy.

**Prototype**

```c
int ddpi_cond_get_name(
    Ddpi_Cond cond,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

- `cond`
  - Input. This accepts the Ddpi_Cond object.
- `ret_name`
  - Output. This returns the name string.
- `error`
  - See “The libddpi error parameter” on page 15.

**Return values**

- `DW_DLV_OK`
  - Returned when the pointer has been successfully set to the retrieved name.
- `DW_DLV_NO_ENTRY`
  - Returned if name is NULL.
- `DW_DLV_ERROR`
  - Returned if:
    - `cond` or its associated Ddpi_Info object is NULL.
    - `ret_name` is NULL.

**ddpi_cond_set_name operation**

The `ddpi_cond_set_name` operation assigns a new name to a given Ddpi_Cond object.

It can be used to set the name to NULL.

You can deallocate `new_name` after the call because `ddpi_cond_set_name` copies the given name.

**Prototype**

```c
int ddpi_cond_set_name(
    Ddpi_Cond cond,
    char* new_name,
    Ddpi_Error* error);
```

**Parameters**

- `cond`
  - Input. This accepts the Ddpi_Cond object.
- `new_name`
  - Input. This accepts the new name string.
- `error`
  - See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned when the Ddpi_Cond object has been successfully renamed.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- Returned if:
  - `cond` or its associated Ddpi_Info object is NULL.
  - An error occurs during memory allocation for the copy of the name

---

**ddpi_cond_get_id operation**

The `ddpi_cond_get_id` operation returns the ID for a given Ddpi_Cond object.

**Prototype**

```c
int ddpi_cond_get_id(
    Ddpi_Cond cond,
    Ddpi_CVID* ret_id,
    Ddpi_Error* error);
```

**Parameters**

- **cond**
  - Input. This accepts the Ddpi_Cond object.

- **ret_id**
  - Output. This returns the conditional variable ID.

- **error**
  - See "The libddpi error parameter" on page 15

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the conditional variable ID.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- Returned if:
  - `cond` or its associated Ddpi_Info object is NULL.
  - `ret_id` is NULL.

---

**ddpi_cond_set_id operation**

The `ddpi_cond_set_id` operation assigns a new ID to a given Ddpi_Cond object.

**Prototype**

```c
int ddpi_cond_set_id(
    Ddpi_Cond cond,
    Ddpi_CVID new_id,
    Ddpi_Error* error);
```
Parameters

cond
Input. This accepts the Ddpi_Cond object.

new_id
Input. This accepts the new conditional-variable ID.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful assignment of the new ID to the Ddpi_Cond object.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
Returned if cond or its associated Ddpi_Info object is NULL.

ddpi_cond_get_state operation

The ddpi_cond_get_state operation returns the state for a given Ddpi_Cond object.

Prototype

int ddpi_cond_get_state(
    Ddpi_Cond cond,
    Ddpi_Cond_State* ret_state,
    Ddpi_Error* error);

Parameters

cond
Input. This accepts the Ddpi_Cond object.

ret_state
Output. This returns the state of the conditional variable.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of the Ddpi_Cond object state.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
Returned if:
   • cond or its associated Ddpi_Info object is NULL.
   • ret_state is NULL.

ddpi_cond_set_state operation

The ddpi_cond_set_state operation assigns a new state to a given Ddpi_Cond object.
Prototype

```
int ddpi_cond_set_state(
    Ddpi_Cond        cond,
    Ddpi_Cond_State  new_state,
    Ddpi_Error*      error);
```

**Parameters**

- **cond**
  - Input. This accepts the Ddpi_Cond object.

- **new_state**
  - Input. This accepts the new state of the conditional variable.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful release of resources associated with the Ddpi_Info descriptor.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - Returned if cond or its associated Ddpi_Info object is NULL.

**ddpi_cond_get_user_area operation**

The `ddpi_cond_get_user_area` operation finds the user area for a given Ddpi_Cond object and sets the start of the returned user area using the returned value.

Prototype

```
int ddpi_cond_get_user_area(
    Ddpi_Cond        cond,
    Dwarf_Ptr*       ret_user_area,
    Ddpi_Error*      error);
```

**Parameters**

- **cond**
  - Input. This accepts the Ddpi_Cond object.

- **ret_user_area**
  - Output. This returns the user area of the conditional variable.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful re-initialization of the user area.

- **DW_DLV_NO_ENTRY**
  - Returned if the user area length is zero.

- **DW_DLV_ERROR**
  - Returned if:
    - cond or its associated Ddpi_Info is NULL
• `ret_user_area` is NULL.
Chapter 14. Ddpi_Module APIs

Ddpi_Module APIs provide information about the given module.

Use the ddpi_module operations to extract:
- The resources allocated to a given module
- The basic format and structure of the module

Ddpi_Module object

The Ddpi_Module object is an opaque data type that contains information about an application-executable module.

Type definition

typedef struct Ddpi_Module_s* Ddpi_Module;

Ddpi_Module_Format object

This object contains module object type.

Type definition

typedef enum Ddpi_Module_Format_s {
  Ddpi_MT_Unknown = 0,
  Ddpi_MT_MVS_PDS = 1,
  Ddpi_MT_MVS_PDSE = 2,
  Ddpi_MT_MVS_USS_HFS = 3,
  Ddpi_MT_CMS_24 = 4,
  Ddpi_MT_CMS_31 = 5,
  Ddpi_MT_VSE = 6,
  Ddpi_MT_OBJ_FILE = 7,
  Ddpi_MT_RAW = 8
} Ddpi_Module_Format;

Members

Ddpi_MT_Unknown
  If this value is 0, the module format is unknown.

Ddpi_MT_MVS_PDS
  If this value is 1, the module is a z/OS MVS PDS load module.

Ddpi_MT_MVS_PDSE
  If this value is 2, the module is a z/OS MVS PDSE program object.

Ddpi_MT_MVS_USS_HFS
  If this value is 3, the module is a z/OS UNIX System Session HFS program object.

Ddpi_MT_CMS_24
  If this value is 4, the module is a CMS 24-bit module.

Ddpi_MT_CMS_31
  If this value is 5, the module is a CMS 31-bit module.

Ddpi_MT_VSE
  If this value is 6, the module is a VSE executable file.
If this value is 7, the module is an object file.

If this value is 8, the module is a raw data storage extent.

**Ddpi_Module_Origin object**

This object contains the module origin type.

**Type definition**

```c
typedef enum Ddpi_Module_Origin_s {
    Ddpi_MO_Unknown = 0,
    Ddpi_MO_HFS = 1,
    Ddpi_MO_MVS_SD = 2,
    Ddpi_MO_MVS_PD = 3,
    Ddpi_MO_CMS_DISK = 4,
    Ddpi_MO_CMS_SFS = 5,
    Ddpi_MO_POSIX = 6,
    Ddpi_MO_VSE = 7
} Ddpi_Module_Origin;
```

**Members**

- **Ddpi_MO_Unknown**
  - If this value is 0, the module origin is unknown.

- **Ddpi_MO_HFS**
  - If this value is 1, the module origin is an HFS path name.

- **Ddpi_MO_MVS_SD**
  - If this value is 2, the module origin is an MVS sequential data set.

- **Ddpi_MO_MVS_PD**
  - If this value is 3, the module origin is an MVS partitioned data set.

- **Ddpi_MO_CMS_DISK**
  - If this value is the module origin is a CMS minidisk.

- **Ddpi_MO_CMS_SFS**
  - If this value is 4, the module origin is a CMS SFS.

- **Ddpi_MO_POSIX**
  - If this value is 5, the module origin is a CMS POSIX BFS path name.

- **Ddpi_MO_VSE**
  - If this value is 6, the module origin is a VSE file.

**Ddpi_Module_Owner_Type data type**

This is the type of module-owner data type.

**Type definition**

```c
typedef enum Ddpi_Module_Owner_Type_s {
    Ddpi_Module_OT_Unknown = 0,
    Ddpi_Module_OT_Space = 1,
    Ddpi_Module_OT_Process = 2
} Ddpi_Module_Owner_Type;
```

**Members**

- **Ddpi_Module_OT_Unknown**
  - If this value is 0, the module-owner data type is unknown.
**Ddpi_Module_OT_Space**
If this value is 1, the module is currently inactive and is stored in the hidden-module list of the Ddpi_Space object.

**Ddpi_Module_OT_Process**
If this value is 2, the module is module is currently active and owned by a Ddpi_Process object.

**ddpi_module_create operation**
The `ddpi_module_create` operation creates a Ddpi_Module object to represent an application-executable module and returns a descriptor that represents a handle for accessing the module.

When you call the `ddpi_module_create` operation, passing character strings as parameter names, the operation copies the content of names and records the address of copies. After this operation returns a value, you can deallocate the original names and save storage.

**Prototype**
```c
int ddpi_module_create(
    Ddpi_Info info,
    Ddpi_Module_Owner_Type owner_type,
    Ddpi_Module_Owner owner,
    char* major_name,
    char* minor_name,
    Ddpi_Module_Format format,
    Ddpi_Module_Origin origin,
    int user_area_len,
    Ddpi_Module* ret_module,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  Input. This accepts a Ddpi_Info object.

- **owner_type**
  Input. This accepts the module owner type. This type must be either Ddpi_Module_OT_Space or Ddpi_Module_OT_Process.

- **owner**
  Input. This accepts the module owner.

- **major_name**
  Input. This accepts the module location.

- **minor_name**
  Input. This accepts the module file name.

- **format**
  Input. This accepts the module format.

- **origin**
  Input. This accepts the module origin.

- **user_area_len**
  Input. This accepts the user-area length.

- **ret_module**
  Output. This returns the Ddpi_Module object.
error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful return of the descriptor that represents a handle for accessing the module.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
- `info` is NULL.
- `owner` is NULL.
- `owner_type` is neither the `Ddpi_Module_OT_Space` object nor the `Ddpi_Module_OT_Process` object.
- An error occurs during memory allocation.
- `major_name` or `minor_name` was not given.
- `user_area_len` is less than zero.

### ddpi_module_term operation

The `ddpi_module_term` operation releases all internal resources associated with the given `Ddpi_Module` object and invalidates `module`.

When you call the `ddpi_module_term` operation, passing character strings as parameter names, the operation copies the content of names and records the address of copies. After this operation returns a value, you can deallocate the original names and save storage.

**Prototype**

```c
int ddpi_module_term(
    Ddpi_Module module,
    Ddpi_Error* error);
```

**Parameters**

- `module`
  Input. This accepts the `Ddpi_Module` object.

- `error`
  See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
Returned upon successful release of all internal resources associated with the given `Ddpi_Module` object.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
Returned if:
- `module` is NULL.
- The `Ddpi_Info` object associated with `module` is NULL.
A problem occurs during deallocation of the child lists of the Ddpi_Entrypt, Ddpi_Access, or Ddpi_Class object.

An error occurs during memory deallocation.

**ddpi_module_get_access operation**

The `ddpi_module_get_access` operation associates the Ddpi_Access object with the given Ddpi_Module object. Because a Ddpi_Module object can contain a list of Ddpi_Access objects, this operation will return the Ddpi_Access object that was most recently used.

Never deallocate the returned object; `ddpi_module_get_access` returns the actual Ddpi_Access object, and not a copy.

**Prototype**

```c
int ddpi_module_get_access(
    Ddpi_Module module,
    Ddpi_Access* ret_access,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  Input. This accepts the Ddpi_Module object.

- **ret_access**
  Output. This accepts the Ddpi_Access object that was most recently used.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  Returned after the access module is successfully associated with the object module.

- **DW_DLV_NO_ENTRY**
  Returned if no Ddpi_Access object from the list was previously used.

- **DW_DLV_ERROR**
  This value is returned if:
  - module is NULL or invalid.
  - The Ddpi_Info object associated with the module is NULL or invalid
  - ret_access object is NULL.

**ddpi_module_get_owner operation**

The `ddpi_module_get_owner` operation returns the owner of the Ddpi_Module object, which gives instance-specific information.

If you want the list of all owners of all instances of this module, then use `ddpi_module_get_all_owners`.

Never deallocate the returned owner because `ddpi_module_get_owner` returns the actual owner, and not a copy.
Prototype

```c
int ddpi_module_get_owner(
    Ddpi_Module module,  
    Ddpi_Module_Owner* ret_owner,  
    Ddpi_Module_Owner_Type* ret_owner_type,  
    Ddpi_Error* error);
```

**Parameters**

**module**
- Input. This accepts the Ddpi_Module object.

**ret_owner**
- Output. This returns the owner of the Ddpi_Module.

**ret_owner_type**
- Output. This returns the owner type of the Ddpi_Module.

**error**
- See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful release of resources associated with the Ddpi_Info descriptor.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - module is NULL
  - Ddpi_Info associated with module is NULL
  - ret_owner is NULL

**ddpi_module_list_all_owners operation**

The `ddpi_module_list_all_owners` operation queries all owners of the Ddpi_Module object and returns a list of owners.

The `ddpi_module_list_all_owners` operation gives instance-specific information for all of the instances of the base-module type. For each item in the owner list, there is a corresponding entry in the owner type list.

Instances occur when `ddpi_module_create` creates two instances of the exact same module at the exact same address. The owner list and the owner type list must be freed by the caller.

Do not free the individual owners.

The code to free the `ret_owner_list` and the `ret_owner_type_list` is as follows:

```c
rc = ddpi_dealloc( info, &ret_owner_list, DDPI_DLA_LIST);
rc = ddpi_dealloc( info, &ret_owner_type_list, DDPI_DLA_LIST);
```

**Prototype**

```c
int ddpi_module_list_all_owners(
    Ddpi_Module module,
    Ddpi_Module_Owner** ret_owner_list,
```
Ddpi_Module_Owner_Type**
    ret_owner_type_list,
Dwarf_Signed*  ret_owner_count,
Ddpi_Error*     error);

Parameters

module
    Input. This accepts the Ddpi_Module object.
ret_owner_list
    Output. This returns the list of owners.
ret_owner_type_list
    Output. This returns the list of owner types corresponding to owner list.
ret_owner_count
    Output. This returns the number of items in the owner_list and in the
            owner_type_list.
error
    See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
    Returned upon successful retrieval of the owner list.
DW_DLV_NO_ENTRY
    Never returned.
DW_DLV_ERROR
    This value is returned if:
    • module is NULL
    • The Ddpi_Info object associated with module is NULL.
    • ret_owner_list, ret_owner_type_list, or ret_owner_count is NULL.
    • A problem occurs during memory allocation.

ddpi_module_get_major_name operation

The ddpi_module_get_major_name operation finds and returns the major name of
the Ddpi_Module object.

Never deallocate the returned pointer because this operation returns the actual
name, and not a copy.

Prototype

int ddpi_module_get_major_name(
    Ddpi_Module module,
    char** ret_major_name,
    Ddpi_Error* error);

Parameters

module
    Input. This accepts the Ddpi_Module object.
ret_major_name
    Output. This returns the major name of the module.
error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the major name of the module has been successfully assigned.

DW_DLV_NO_ENTRY
Returned if the retrieved name is NULL.

DW_DLV_ERROR
This value is returned if:
• module is NULL
• The Ddpi_Info object associated with module is NULL
• ret_major_name is NULL
• An internal error occurs

ddpi_module_get_minor_name operation
The ddpi_module_get_minor_name operation finds and returns the minor name of the Ddpi_Module object.

Never deallocate the returned pointer because this operation returns the actual name, and not a copy.

Prototype
int ddpi_module_get_minor_name(
    Ddpi_Module module,
    char** ret_minor_name,
    Ddpi_Error* error);

Parameters

module
Input. This accepts the Ddpi_Module object.

ret_minor_name
Output. This returns the minor name of the module.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the minor name of the object module has been successfully assigned.

DW_DLV_NO_ENTRY
Returned if the retrieved name is NULL.

DW_DLV_ERROR
This value is returned if:
• module is NULL
• The Ddpi_Info object associated with module is NULL
• ret_minor_name is NULL
• An internal error occurs
The ddpi_module_get_format operation returns the format of the Ddpi_Module object.

Prototype

```c
int ddpi_module_get_format(
    Ddpi_Module module,
    Ddpi_Module_Format* ret_format,
    Ddpi_Error* error);
```

Parameters

- **module**
  - Input. This accepts the Ddpi_Module object.

- **ret_format**
  - Output. This returns the format of module.

- **error**
  - See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the module format.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - module is NULL
    - The Ddpi_Info object associated with module is NULL
    - ret_format is NULL

The ddpi_module_get_origin operation returns the origin of the Ddpi_Module object.

Prototype

```c
int ddpi_module_get_origin(
    Ddpi_Module module,
    Ddpi_Module_Origin* ret_origin,
    Ddpi_Error* error);
```

Parameters

- **module**
  - Input. This accepts the Ddpi_Module object.

- **ret_origin**
  - Output. This returns the origin of module.

- **error**
  - See “The libddpi error parameter” on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the module origin.
**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- module is NULL
- The Ddpi_Info object associated with module is NULL
- ret_origin is NULL

---

**ddpi_module_get_usage operation**

The ddpi_module_get_usage operation returns the number of times that the Ddpi_Module object was created.

**Prototype**

```c
int ddpi_module_get_usage(
    Ddpi_Module module,
    Dwarf_Signed* ret_usage,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  Input. This accepts the Ddpi_Module object.

- **ret_usage**
  Output. This returns the number of times that the Ddpi_Module object was created.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful retrieval of the number of times that the Ddpi_Module object was created.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - module is NULL
  - The Ddpi_Info object associated with module is NULL
  - ret_usage is NULL

---

**ddpi_module_get_user_area operation**

The ddpi_module_get_user_area operation finds and returns the user area of the Ddpi_Module object.

**Prototype**

```c
int ddpi_module_get_user_area(
    Ddpi_Module module,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```
Parameters

module
   Input. This accepts the Ddpi_Module object.

ret_usage
   Output. This returns the user area of module.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful return of the user area.

DW_DLV_NO_ENTRY
   Returned if the length of the user area is zero.

DW_DLV_ERROR
   This value is returned if:
   • module is NULL
   • The Ddpi_Info object associated with module is NULL
   • ret_usage is NULL

ddpi_module_list_entrypt operation

The ddpi_module_list_entrypt operation lists the Ddpi_EntryPt objects associated with the given Ddpi_Module object.

The ddpi_module_list_entrypt operation also sets:
• ret_entrypt_list to an array of Ddpi_EntryPt descriptors
• ret_entrypt_cnt of the items in that list to the number of entries in the array

The caller must free the entry-point list but not the individual Ddpi_EntryPt objects because these are not copies, but are the actual Ddpi_EntryPt objects stored in the Ddpi_Module.

The code to free ret_entrypt_list is:

rc = ddpi_dealloc( info, *ret_entrypt_list, DDPI_DLA_LIST);

Prototype

int ddpi_module_list_entrypt(
   Ddpi_Module module,
   Ddpi_EntryPt** ret_entrypt_list,
   Dwarf_Signed* ret_entrypt_cnt,
   Ddpi_Error* error);

Parameters

module
   Input. This accepts the object.

ret_entrypt_list
   Output. This returns the list of the entry point.

ret_entrypt_cnt
   Output. This returns the count of the list.
error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned after the entry point list is successfully set to an array of Ddpi_EntryPt descriptors.

**DW_DLV_NO_ENTRY**
Returned if the length of the user area is zero.

**DW_DLV_ERROR**
This value is returned if:

- module is NULL
- The Ddpi_Info object associated with module is NULL
- ret_entrypt_list or ret_entrypt_cnt is NULL
- A problem during memory allocation.

### ddpi_module_list_class operation

The ddpi_module_list_class operation lists the Ddpi_Class objects in the address-range table of the Ddpi_Module object.

The ddpi_module_list_class operation also sets:

- ret_class_list to an array of Ddpi_Class descriptors
- ret_class_cnt of the items in that list to the number of entries in the array

The caller must free the entry-point list but not the individual Ddpi_Class objects because these are not copies, but are the actual Ddpi_Class objects stored in the Ddpi_Module.

The code to free ret_class_list is:

```c
rc = ddpi_dealloc(info, *ret_class_list, DDPI_DLA_LIST);
```

### Prototype

```c
int ddpi_module_list_class (  
  Ddpi_Module module,  
  Ddpi_Class** ret_class_list,  
  Dwarf_Signed* ret_class_cnt,  
  Ddpi_Error* error);
```

### Parameters

**module**
Input. This accepts the Ddpi_Module object.

**ret_class_list**
Output. This returns the list of the classes.

**ret_class_cnt**
Output. This returns the count of the list entries.

**error**
See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned after the entry point list is successfully associated with the array of descriptors.

**DW_DLV_NO_ENTRY**
- Returned if the list of entries is empty.

**DW_DLV_ERROR**
- This value is returned if:
  - module is NULL.
  - The Ddpi_Info object associated with module is NULL.
  - ret_class_list or ret_class_cnt is NULL.
  - A problem during memory allocation.

### ddpi_module_find_space operation

The `ddpi_module_find_space` operation returns the Ddpi_Space object that directly or indirectly owns the given Ddpi_Module object.

A Ddpi_Module object can be either active or hidden. If it is active, then the Ddpi_Module object is owned by a Ddpi_Process object. If it is hidden, the Ddpi_Module object is on the hidden-module list, and is owned directly by the Ddpi_Space object.

**Prototype**

```c
int ddpi_module_find_space(  
    Ddpi_Module module,  
    Ddpi_Space* ret_space,  
    Ddpi_Error* error);  
```

**Parameters**

**module**
- Input. This accepts the Ddpi_Module object.

**ret_space**
- Output. This returns the Ddpi_Space object for this instance.

**error**
- See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the module owner.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - module is NULL.
  - The Ddpi_Info object associated with module is NULL.
  - ret_space is NULL.
**ddpi_module_extract_C_CPP_information operation**

The ddpi_module_extract_C_CPP_information operation uses the given Ddpi_Module object to locate the module or program object, and extract all of the information needed to load a DWARF object for C/C++.

The ddpi_module_extract_C_CPP_information operation requires that a Ddpi_EntryPt with the symbol name of CEESTART has been created to properly point to the entry point of the module.

This is a specific helper operation for C/C++ debugging. It does not support other languages. It will not attempt to process a non-C/C++ compile unit (CU).

ddpi_module_extract_C_CPP_information creates and lists the Ddpi_Elf objects associated with the given Ddpi_Module object. It then sets the ret_elf_list to an array of Ddpi_Elf descriptors, and sets the ret_elf_cnt of the items in that list to the number of entries in the array.

The caller must free the Ddpi_Elf list but not the individual Ddpi_Elf objects because these are not copies, but are the actual Ddpi_Elf objects stored in the Ddpi_Module.

The code to free ret_elf_list is:

```
rc = ddpi_dealloc( info, *ret_elf_list, DDPI_DLA_LIST);
```

**Prototype**

```
int ddpi_module_extract_C_CPP_information (
    Ddpi_Module  module,
    Ddpi_Elf**  ret_elf_list,
    int*        ret_elf_cnt,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  - Input. This accepts the Ddpi_Module object.

- **ret_elf_list**
  - Output. This returns list of Ddpi_Elf objects.

- **ret_elf_cnt**
  - Output. This returns count of the list entries.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  - Returned after the ELF list is successfully associated with an array of ELF descriptors.

- **DW_DLV_NO_ENTRY**
  - Returned if no information could be extracted.

- **DW_DLV_ERROR**
  - This value is returned if:
    - module is NULL or invalid.
The Ddpi_Info object associated with the module is either NULL or invalid.

- ret_elf_list or ret_elf_cnt is NULL.
- There are no entry points on module.
- An entry point named CEESTART is not found.
- The given entry point does not have a storage extent attached (class).
- An error occurs finding the low address.

---

**ddpi_module_extract_debug_info operation**

The `ddpi_module_extract_debug_info` operation extracts, from the module map, all the information needed to create the DWARF debugging information. The extracted information is used to create ELF objects, as needed. The ELF objects are used to create the DIEs used by the debugger. A separate Ddpi_Access object will be created to own each Ddpi_Elf object. The list of Ddpi_Access objects created will be owned by the given Ddpi_Module object. Note that, if the program analysis application is using the module map, it needs to use this operation instead of the `ddpi_module_extract_C_CPP_information()` operation.

Successful implementation of the `ddpi_module_extract_debug_info` operation depends on the following conditions:

- The module has been set up with the correct address range.
- The program analysis application provides functions that retrieve information from the module map.

**Prototype**

```c
int ddpi_module_extract_debug_info(
    Ddpi_Module module,
    int elf_user_area_len,
    Dwarf_Bool* ret_mod_map,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  
  Input. This accepts the given Ddpi_Module object.

- **elf_user_area_len**
  
  Input. This accepts the user area length required for any Ddpi_Elf objects that might be created.

- **ret_mod_map**
  
  Output. This is returned whether or not a module map was found for the module.

- **error**
  
  See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  
  This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  
  No information could be extracted.

- **DW_DLV_ERROR**
  
  This value is returned if:
  
  - The module value is NULL or invalid.
The Ddpi_Info object associated with the module is NULL or invalid.
ret_mod_map is NULL.
An error occurs during the search for the low-order address.
An error occurs during creation of a Ddpi_Access or Ddpi_Elf object.
An error occurs during memory allocation.

**ddpi_module_find_wsa operation**

The ddpi_module_find_wsa operation finds the writable static area (WSA) for a given Ddpi_Module object.

ddpi_module_find_wsa can be called only after the module has been entered because it needs valid stack and registers for the given object.

This operation may be invoked by the expression evaluator if a WSA is needed in the given expression.

**Prototype**

```c
int ddpi_module_find_wsa(
    Ddpi_Info info,
    Ddpi_Module module,
    Ddpi_MachineState machinestate,
    Ddpi_StackState stackstate,
    Ddpi_Class* ret_wsa_class,
    Ddpi_Error* error);
```

**Parameters**

info
   Input. This accepts the libddpi consumer object.

module
   Input. This accepts the Ddpi_Module object associated with the WSA.

machinestate
   Input. This accepts the machine state of a live function in the module.

stackstate
   Input. This accepts the stack state of the same live function in the module for the machine state.

ret_wsa_class
   Output. This returns the WSA class.

error
   See “The libddpi error parameter” on page 15.

**Return values**

DW_DLV_OK
   Returned upon successful retrieval of the WSA class.

DW_DLV_NO_ENTRY
   Returned if no WSA was found.

DW_DLV_ERROR
   This value is returned if:
     • module is NULL or invalid.
     • The Ddpi_Info object associated with the module is either NULL or invalid.
• ret_wsa_class is NULL.
• machinestate or stackstate is NULL. If the WSA class is not already defined on module, then these parameters will be used to find and create a WSA class on module.
• The Language Environment (LE) is unable to find the WSA.

ddpi_module_get_dwarf_error operation

The ddpi_module_get_dwarf_error operation returns a pointer to the Dwarf_Error object for the given Ddpi_Module.

The Dwarf_Error object is found within the Ddpi_Access object, which is owned by the Ddpi_Module object.

Use the ddpi_module_get_dwarf_error operation if your application employs both a Ddpi_Error object and a Dwarf_Error object. It can extract the Dwarf_Error pointer and pass it to all libdwarf calls.

You must terminate the owning libdwarf instance to deallocate Dwarf_Error when ddpi_finish is called.

Prototype

int ddpi_module_get_dwarf_error(
    Ddpi_Module module,
    Dwarf_Error** ret_dwarf_error,
    Ddpi_Error* error);

Parameters

module
    Input. This accepts the Ddpi_Module object.

ret_dwarf_error
    Output. This returns the Dwarf_Error object.

error
    See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
    Returned upon successful retrieval of the pointer to the DWARF error module.

DW_DLV_NO_ENTRY
    Never returned.

DW_DLV_ERROR
    This value is returned if:
    • module is NULL.
    • ret_dwarf_error is NULL.
    • An error occurs during memory allocation.

ddpi_module_list_function operation

The ddpi_module_list_function operation retrieves a list of all the functions with the given name. This list will include all the functions whose fully qualified name (which is prefixed with a C++ class name, if applicable) or unqualified name matches the given name. The given name could also be a portion of the fully
qualified name. For example, the given name could be Classname::function, without the function parameters. If the given name is NULL, all of the functions in the module will be returned. The returned list will contain Ddpi_Function objects sorted by unqualified name.

The calling function should deallocate the returned list by using the following operation:

ddpi_dealloc(info, *ret_functions, DDPI_DLA_LIST);

Note: The actual Ddpi_Function objects must not be deleted. They will be deleted when the Ddpi_Module object is deleted.

Prototype

int ddpi_module_list_function(
    Ddpi_Module module,
    char* name,
    Ddpi_Function** ret_functions,
    Dwarf_Unsigned* ret_count,
    Ddpi_Error* error);

Parameters

module
Input. This accepts the Ddpi_Module object.

name
Input. This accepts the name of a function. If NULL is accepted, a list of all of the functions in the module will be returned.

ret_functions
Output. This returns a list of Ddpi_Function objects with the given name.

ret_count
Output. This returns the number of Ddpi_Function objects returned.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
The function was not found in the module, or a module map hasn’t been created for the module.

DW_DLV_ERROR
This value is returned if:
• module is NULL or invalid.
• The Ddpi_Info object associated with the module is either NULL or invalid.
• ret_functions is NULL.
• ret_count is NULL.
• An error occurs during memory allocation.
**ddpi_module_list_variable operation**

The `ddpi_module_list_variable` operation retrieves a list of all the global variables with the given name. This list will include all the variables whose fully qualified name (which is prefixed with a C++ class name, if applicable) or unqualified name matches the given name. If the given name is NULL, all of the global variables in the module will be returned. The returned list will contain `Ddpi_Variable` objects sorted by unqualified name.

The calling function should deallocate the returned list by using the following operation:

```c
ddpi_dealloc(info, *ret_variables, DDPI_DLA_LIST);
```

**Note:** The actual `Ddpi_Variable` objects must not be deleted. They will be deleted when the `Ddpi_Module` is deleted.

**Prototype**

```c
int ddpi_module_list_variable(
    Ddpi_Module module,
    char* name,
    Ddpi_Variable** ret_variables,
    Dwarf_Unsigned* ret_count,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  - Input. This accepts the `Ddpi_Module` object.

- **name**
  - Input. This accepts the name of an external type. If NULL is accepted, a list of all of the external types in the module will be returned.

- **ret_variables**
  - Output. This returns a list of `Ddpi_Variable` objects with the given name.

- **ret_count**
  - Output. This returns the number of `Ddpi_Variable` objects returned.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - Returned if the variable was not found in the module, or a module map hasn’t been created for the module.

- **DW_DLV_ERROR**
  - This value is returned if:
    - module is NULL or invalid.
    - The `Ddpi_Info` object associated with the module is either NULL or invalid.
    - `ret_variables` is NULL.
    - `ret_count` is NULL.
    - An error occurs during memory allocation.
**ddpi_module_list_type operation**

The `ddpi_module_list_type` operation retrieves a list of all the external types with the given name. This list will include all the types whose fully qualified name (which is prefixed with a C++ class name, if applicable) or unqualified name matches the given name. If the given name is NULL, all of the external types in the module will be returned. The returned list will contain `Ddpi_Type` objects sorted by unqualified name.

The calling function should deallocate the returned list by using the following operation:

```c
ddpi_dealloc(info, *ret_types, DDPI_DLA_LIST);
```

**Note:** The individual `Ddpi_Type` objects must not be deleted. They will be deleted when the module is deleted.

**Prototype**

```c
int ddpi_module_list_type(
    Ddpi_Module module,
    char* name,
    Ddpi_Type** ret_types,
    Dwarf_Unsigned* ret_count,
    Ddpi_Error* error);
```

**Parameters**

- **module**
  - Input. This accepts the `Ddpi_Module` object.

- **name**
  - Input. This accepts the external type name, or NULL to return all external types.

- **ret_types**
  - Output. This returns a list of `Ddpi_Type` objects with the given name.

- **ret_count**
  - Output. This returns the number of `Ddpi_Type` objects returned.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - This value is returned if the type was not found in the module, or a module map hasn’t been created for the module

- **DW_DLV_ERROR**
  - This value is returned if:
    - module is NULL or invalid.
    - The `Ddpi_Info` object associated with the module is either NULL or invalid.
    - `ret_types` is NULL.
    - `ret_count` is NULL.
    - An error occurs during memory allocation.
ddpi_module_list_sourcefile operation

The ddpi_module_list_sourcefile operation returns a list of Ddpi_Sourcefile objects whose names match the given name. All Ddpi_Sourcefile objects with that file name in any path will be returned. If the given name is NULL, all of the source files in the module will be returned. Note that if the same source file is used in more than one compilation unit, there will be a separate Ddpi_Sourcefile object for each compilation unit. The Ddpi_Sourcefile objects will be sorted by the file name without the full path.

The calling function should deallocate the returned list by using the following operation:

ddpi_dealloc(info, *ret_sourcefiles, DDPI_DLA_LIST);

Note: The individual Ddpi_Sourcefile objects in the list must not be deleted. They will be deleted when the module is deleted.

Prototype

int ddpi_module_list_sourcefile(
    Ddpi_Module module,
    char* name,
    Ddpi_Sourcefile** ret_sourcefiles,
    Dwarf_Unsigned* ret_count,
    Ddpi_Error* error);

Parameters

module
    Input. This accepts the Ddpi_Module object.

name
    Input. This accepts the source file name, or NULL to return all source files. The name can be a full path name, a file name without a path, a PDS name, or a sequential data-set name.

ret_sourcefiles
    Output. This returns the list of Ddpi_Sourcefile objects in the module with the given source file name.

ret_count
    Output. This returns the number of Ddpi_Sourcefile objects in the list.

error
    See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
    This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
    The given source file name is not represented by any of the Ddpi_Sourcefile objects in the module, or a module map hasn’t been created for the module.

DW_DLV_ERROR
    This value is returned if:
    • module is NULL or invalid.
    • The Ddpi_Info object associated with the module is either NULL or invalid.
    • ret_sourcefiles is NULL.
• ret_count is NULL.
• An error occurs while allocating memory.

**ddpi_module_list_elf operation**

Lists all of the Ddpi_Elf objects associated with the given Ddpi_Module object. It sets ret_elfs to an array of Ddpi_Elf objects and sets ret_elf_count to the number of entries in the array. The returned list will be sorted in ascending order by CU address.

The calling function should deallocate the returned list by using the following operation:
```
ddpi_dealloc(info, *ret_elfs, DDPI_DLA_LIST);
```

**Note:** The actual Ddpi_Elf objects must not be deallocated, as these are the actual Ddpi_Elf objects from the Ddpi_Access objects.

**Prototype**
```
int ddpi_module_list_elf(
    Ddpi_Module module,
    Ddpi_Elf** ret_elfs,
    Dwarf_Unsigned* ret_elf_count,
    Ddpi_Error* error);
```

**Parameters**

**module**
- Input. This accepts the Ddpi_Module object.

**ret_elfs**
- Output. This returns the list of Ddpi_Elf objects in the module.

**ret_elf_count**
- Output. This returns the number of Ddpi_Elf objects in the list.

**error**
- See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
- This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
- There are no Ddpi_Elf objects associated with the module.

**DW_DLV_ERROR**
- This value is returned if:
  - module is NULL or invalid.
  - ret_elfs is NULL.
  - ret_elf_count is NULL.

**ddpi_module_find_elf_given_address operation**

The ddpi_module_find_elf_given_address operation returns the Ddpi_Elf object that corresponds to the address range in the loaded module that contains the given address. The user must never deallocate the returned pointer.
Prototype

```c
int ddpi_module_find_elf_given_address(
    Ddpi_Module module,
    Dwarf_Addr address,
    Ddpi_Elf* ret_elf,
    Ddpi_Error* error);
```

Parameters

- **module**
  - Input. This accepts the Ddpi_Module object.

- **address**
  - Input. This accepts an address in the loaded module.

- **ret_elf**
  - Output. This returns the Ddpi_Elf object whose address range contains the given address.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - The given address is not within the address range for any of the Ddpi_Elf objects in the module.

- **DW_DLV_ERROR**
  - This value is returned if:
    - module is NULL or invalid.
    - ret_elf is NULL.
Chapter 15. Ddpi_Access APIs

The Ddpi_Access object contains and controls the items necessary to load and use ELF and DWARF objects.

When an error condition is triggered, and the resulting Ddpi_Error object indicates the error occurred during a call to a libdwarf operation, a program analysis application can extract further information by querying the Dwarf_Error object, which is stored in the Ddpi_Access object.

That Ddpi_Access object contains:
- The libdwarf consumer object (Dwarf_Debug). Each libddpi instance has a single Dwarf_Debug object, which can work with one or more Ddpi_Elf objects.
- A Dwarf_Error object, which is used for all calls to libdwarf operations. For example, if DDPI_DLE_DWARF_ERROR (error code 138) is returned, the Dwarf_Error object can be queried to determine the cause and type of the error.
- A list of Ddpi_Elf objects. It is recommended that a Ddpi_Elf object exist for each compilation unit (CU), debug-information file (debugging unit), or section of a unit. Each Ddpi_Elf object contains the handle to the ELF object file.

To access the Dwarf_Error object, you can use either of the following operations:
- "ddpi_access_get_dwarf_error operation" on page 131
- "ddpi_module_get_dwarf_error operation" on page 117

Both of these operations return the same Dwarf_Error object.

To create the Ddpi_Elf objects, you can use either of the following operations:
- "ddpi_module_extract_C_CPP_information operation" on page 114
- "ddpi_elf_create operation" on page 135

Ddpi_Access object

The Ddpi_Access object contains and controls the items needed to access or load ELF and DWARF objects. It has an opaque data type.

Type definition

typedef struct Ddpi_Access_s* Ddpi_Access;

ddpi_access_create operation

The ddpi_access_create operation creates a Ddpi_Access object and associates it with the Ddpi_Module.

The Ddpi_Access object manages access to the debugging data in an ELF file.

Note: Because no verification is done on input parameters, you can update the fields with the ddpi_access_set_* operations.
Prototype

```c
int ddpi_access_create(
    Ddpi_Module    module,
    Dwarf_Debug    debug,
    int            user_area_len,
    Ddpi_Access*   ret_access,
    Ddpi_Error*    error);
```

Parameters

- **module**  
  Input. This accepts the owning Ddpi_Module object.

- **debug**  
  Input. This accepts an instance of the debug access.

- **user_area_len**  
  Input. This accepts the length of the user area.

- **ret_access**  
  Output. This returns the Ddpi_Access object.

- **error**  
  See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**  
  Returned upon successful creation of the Ddpi_Access object.

- **DW_DLV_NO_ENTRY**  
  Never returned.

- **DW_DLV_ERROR**  
  This value is returned if:
  - module or ret_access variable is NULL.
  - user_area_len is less than zero.
  - An error during memory allocation.

**ddpi_access_term operation**

The ddpi_access_term operation terminates a given Ddpi_Access object and calls ddpi_elf_term to terminate Ddpi_Elf objects referred to in the Ddpi_Access object.

If ddpi_elf_term gives an unexpected return code, the return code and error will be returned to the caller of ddpi_access_term.

**Note:** If an error occurs in ddpi_elf_term, the remaining portions of the Ddpi_Elf list and the Ddpi_Access object are not deleted so that ddpi_access_term can be called again if the error is resolved. The ddpi_access_term operation does not call libdwarf to terminate the Dwarf_Debug object.

Prototype

```c
int ddpi_access_term(
    Ddpi_Access    access,
    Ddpi_Error*    error);
```
**Parameters**

access
   Input. This accepts the Ddpi_Access object.

error
   See "The libddpi error parameter" on page 15.

**Return values**

DW_DLV_OK
   Returned upon successful termination of the Ddpi_Access object.

DW_DLV_NO_ENTRY
   Returned if access does not match the access referred to in its parent.

DW_DLV_ERROR
   This value is returned if:
      • access or its associated information is NULL
      • An error occurs while terminating child descriptors
      • An error during memory allocation.

---

**ddpi_access_get_owner operation**

The ddpi_access_get_owner operation returns the owner of the Ddpi_Access object.

**Prototype**

```c
int ddpi_access_get_owner(
    Ddpi_Access access,
    Ddpi_Module* ret_owner,
    Ddpi_Error* error);
```

**Parameters**

access
   Input. This accepts the Ddpi_Access object.

ret_owner
   Output. This returns the Ddpi_Process object.

error
   See "The libddpi error parameter" on page 15.

**Return values**

DW_DLV_OK
   Returned upon successful retrieval of the Ddpi_Access object owner.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
      • access is NULL.
      • The Ddpi_Access or Ddpi_Info object associated with access is NULL.
      • ret_owner is NULL.
ddpi_access_get_debug operation

The ddpi_access_get_debug operation returns the Dwarf_Debug object that is stored in the given Ddpi_Access object. If the extraction function ddpi_module_extract_debug_info() was used, this operation will open the .dbg file and create a Dwarf_Debug object for the instance, if one does not already exist.

Use only libdwarf operations to modify the given Dwarf_Debug object because ddpi_access_get_debug does not return a copy, but the actual Dwarf_Debug object.

If the Dwarf_Debug object is deleted, use ddpi_access_set_debug to set the Dwarf_Debug pointer in the Ddpi_Access object to NULL.

Prototype

```
int ddpi_access_get_debug(
    Ddpi_Access access,
    Dwarf_Debug* ret_debug,
    Ddpi_Error* error);
```

Parameters

access
- Input. This accepts the Ddpi_Access object.

ret_debug
- Output. This returns the Dwarf_Debug object.

error
- See "The libddpi error parameter" on page 15.

Returned values

**DW_DLV_OK**
- This value is returned upon successful return of the Dwarf_Debug object.

**DW_DLV_NO_ENTRY**
- This value is returned if no valid .dbg files were located.

**DW_DLV_ERROR**
- This value is returned if:
  - access is NULL.
  - ret_debug is NULL.
  - A DWARF error occurs during creating the Dwarf_Debug object for the instance.
  - An error occurs during memory allocation.

ddpi_access_set_debug operation

The ddpi_access_set_debug operation sets the Dwarf_Debug object for the given Ddpi_Access object.

The given debug value is not verified in any way. If an older value is being replaced, the caller must properly handle it (for example, the caller must terminate the older value).
Prototype

```c
int ddpi_access_set_debug(
    Ddpi_Access access,
    Dwarf_Debug debug,
    Ddpi_Error* error);
```

Parameters

access
   Input. This accepts the Ddpi_Access object.

dep
   Input. This accepts the debug instance.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful assignment of the Dwarf_Debug object to the given
   Ddpi_Access object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   Returned if:
   • access is NULL.
   • The Ddpi_Info object associated with access is NULL.

`ddpi_access_list_elf` operation

The `ddpi_access_list_elf` operation lists the Ddpi_Elf objects associated with the
given Ddpi_Access object.

The `ddpi_access_list_elf` operation also sets the ret_elfs field to an array of
Ddpi_Elf descriptors and sets the ret_elf_count of the items in that list to the
number of entries in the array.

The caller must free the access list but not the individual Ddpi_Elf objects because
these are not copies, but are the actual Ddpi_Elf objects stored in the Ddpi_Access
object.

The Ddpi_Elf list is accurate only after another Ddpi_Elf object is added to, or
terminated from, the given Ddpi_Access object.

The code to free ret_elfs is:

```c
ddpi_dealloc(info, *ret_elfs, DDPI_DLA_LIST)
```

Prototype

```c
int ddpi_access_list_elf(
    Ddpi_Access access,
    Ddpi_Elf** ret_elfs,
    Dwarf_Unsigned* ret_elf_count,
    Ddpi_Error* error);
```
Parameters

access
  Input. This accepts the Ddpi_Access object.

ret_elfs
  Output. This returns the Ddpi_Elf list.

ret_elf_count
  Output. This returns the Ddpi_Elf count.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful release of resources associated with the Ddpi_Info descriptor.

DW_DLV_NO_ENTRY
  Returned if there are no entries on the access list.

DW_DLV_ERROR
  Returned if:
  • access or its associated Ddpi_Info is NULL.
  • ret_elfs or ret_elf_count is NULL.
  • An error occurs during allocation of the list to be returned.

ddpi_access_get_user_area operation

The ddpi_access_get_user_area operation returns the user area for the given Ddpi_Access object.

Prototype

int ddpi_access_get_user_area(
  Ddpi_Access access,
  Dwarf_Ptr* ret_user_area,
  Ddpi_Error* error);

Parameters

access
  Input. This accepts the Ddpi_Access object.

ret_user_area
  Output. This returns the user area.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful return of the user area.

DW_DLV_NO_ENTRY
  Returned if the user-area length is zero.

DW_DLV_ERROR
  Returned if:
  • access or its associated Ddpi_Info object is NULL.
ddpi_access_get_dwarf_error operation

The ddpi_access_get_dwarf_error operation returns the Dwarf_Debug object that is stored in the given Ddpi_Access object. If the extraction function ddpi_module_extract_debug_info() was used, this operation will open the .dbg file and create a Dwarf_Debug object for the instance, if one does not already exist.

**Note:** A Ddpi_Access object can have a Dwarf_Error object.

Use this operation when your application employs both a Ddpi_Error object and a Dwarf_Error object. It can extract a pointer to the Dwarf_Error object and pass it to all libdwarf calls.

The Dwarf_Error object is not removed from the Ddpi_Access object. You must terminate the owning libdwarf instance in order to terminate the Dwarf_Error object because the Dwarf_Error object is not deallocated when ddpi_finish is called.

**Prototype**

```c
int ddpi_access_get_dwarf_error(
    Ddpi_Access access,
    Dwarf_Error** ret_dwarf_error,
    Ddpi_Error* error);
```

**Parameters**

**access**

Input. This accepts the Ddpi_Access object.

**ret_dwarf_error**

Output. This returns the Dwarf_Error object.

**error**

See "The libddpi error parameter" on page 15.

**Returned values**

**DW_DLV_OK**

This value is returned upon successful return of the DWARF error object.

**DW_DLV_NO_ENTRY**

This value is returned if no valid .dbg files were located.

**DW_DLV_ERROR**

This value is returned if:

- access is NULL.
- ret_dwarf_error is NULL.
- A DWARF error occurs during creating the Dwarf_Debug object for the instance.
- An error occurs while allocating memory.
Chapter 16. Ddpi_Elf APIs

This information describes the operations that get and set information in the Ddpi_Elf object.

The Ddpi_Elf object stores the information needed to access, load, or relocate an ELF object file. For example, it contains a file handle and the address range of the compilation unit (CU) loaded in memory. A Ddpi_Elf object is created for each ELF object file. For information on loading and relocating the Ddpi_Elf object, see Chapter 6, “Ddpi_Elf loading API,” on page 27.

The program analysis application uses the Ddpi_Elf object in order to specify a particular CU or section. Accordingly, the Ddpi_Elf object can be set either during creation or by individual routines. For more information on using a Ddpi_Elf object, see Common Debug Architecture User’s Guide, SC09-7653.

For C and C++ modules, you can use the ddpi_module_extract_C_CPP_information operation to automatically create Ddpi_Elf objects. For more information, see “ddpi_module_extract_C_CPP_information operation” on page 114.

Ddpi_Elf object

A Ddpi_Elf object is created for each ELF object file. This structure is used to coordinate access to an ELF object file that has been loaded and pointed to by an ELF descriptor. The data type is opaque.

The Ddpi_Elf object holds all information required to relocate the ELF object file:
- The name of the ELF object file
- The location of the PPA2 addresses
- A list of function addresses contained within the CU
- A list of PPA1 addresses contained within the CU
- The MD5 signature
- The Ddpi_Elf_Source object
- The high and low memory addresses for the CU that is in memory

To create the Ddpi_Elf object, two operations are provided:
- “ddpi_module_extract_C_CPP_information operation” on page 114
- “ddpi_elf_create operation” on page 135

Type definition

```c
typedef struct Ddpi_Elf_s* Ddpi_Elf;
```

Ddpi_Elf_Source object

An ELF object is loaded from an ELF source. The ELF source must remain open as long as the information from it is potentially in use. The Ddpi_Elf_Source object tracks this ELF source.

Ddpi_Elf_Source object has three members:
- A POSIX file (if given a POSIX file descriptor).
• An ANSI C file pointer.
• A memory pointer.

Type definition

typedef union Ddpi_Elf_source_s {
    int source_fd;
    FILE* source_fp;
    char* source_mp;
} Ddpi_Elf_Source;

Members

source_fd
This integer data type holds the descriptor of the POSIX file, from which the
ELF object was loaded.

source_fp
This field holds the pointer to the ANSI C file, from which the ELF object was
loaded.

source_mp
This character data type holds the pointer to the memory address from which
the ELF object was loaded.

Ddpi_Elf_Source_Type object

The Ddpi_Elf_Source_Type object determines which member of the
Ddpi_Elf_Source object is used to track the source of the ELF object.

If a Ddpi_Elf_Source value is not already set, set the Ddpi_Elf_Source_Type to
Ddpi_Elf_ST_Unknown.

Type definition

typedef enum Ddpi_Elf_Source_Type_s {
    Ddpi_Elf_ST_Unknown = 0,
    Ddpi_Elf_ST_fd = 1,
    Ddpi_Elf_ST_fp = 2,
    Ddpi_Elf_ST_mp = 3
} Ddpi_Elf_Source_Type;

Members

Ddpi_Elf_ST_Unknown
If this value is 0, the corresponding Ddpi_Elf_Source does not contain a valid
value.

Ddpi_Elf_ST_fd
If this value is 1, the corresponding Ddpi_Elf_Source contains a valid POSIX
file descriptor.

Ddpi_Elf_ST_fp
If this value is 2, the corresponding Ddpi_Elf_Source contains a valid ANSI C
file pointer.

Ddpi_Elf_ST_mp
If this value is 3, the corresponding Ddpi_Elf_Source contains a valid pointer
to a memory block.
ddpi_elf_create operation

The ddpi_elf_create operation creates a Ddpi_Elf object to enable access to debugging data in an ELF object file.

Note: The Ddpi_Elf objects can also be created by the ddpi_module_extract _C_CPP_information operation. This is the preferred operation if the loaded application-executable module was compiled with the z/OS XL C/C++ compiler. The operation creates and lists the Ddpi_Elf objects associated with the given Ddpi_Module object.

Prototype

```c
int ddpi_elf_create(
    Ddpi_Access access,
    Elf* elf,
    char* elf_filename,
    Ddpi_Elf_Source source,
    Ddpi_Elf_Source_Type source_type,
    Dwarf_Addr ppa2_addr,
    Dwarf_Addr* func_addr_list,
    Dwarf_Addr* ppa1_addr_list,
    int ppa1_elements,
    Dwarf_Addr csect_low_addr,
    Dwarf_Addr csect_high_addr,
    unsigned char md5_sig[16],
    int user_area_len,
    Ddpi_Elf* ret_elf,
    Ddpi_Error* error);
```

Parameters

access

Input. This provides access to libddpi.

e1f

Input. This provides the ELF object file descriptor.

e1f_filename

Input. This accepts the ELF object file name.

source

Input. This accepts the source pointer to be given to elf_begin.

source_type

Input. This accepts the source_type.

ppa2_addr

Input. This accepts the PPA2 address.

func_addr_list

Input. This accepts a list of function address in the same order as the ppa1_addr_list. The value is copied, and the user may free their version.

ppa1_addr_list

Input. This accepts a list of PPA1 addresses. The value is copied, and the user may free their version.

ppa1_elements

Input. This accepts the number of elements in PPA1 list.
csect_low_addr
Input. This accepts the lowest address in the CSECT (the first byte of the object). Specify \((\text{Dwarf\_Addr})-1\) for an unknown address. All other addresses will be taken as valid.

csect_high_addr
Input. This accepts the highest address in the CSECT (the last byte of the object). Specify \((\text{Dwarf\_Addr})-1\) for an unknown address. All other addresses will be taken as valid.

Note: csect_low_addr and csect_high_addr are not guaranteed to enclose all control blocks. They are guaranteed to enclose all executable code for the given compilation unit (CU) if they are set to a value that is not \(-1\).

md5_sig[16]
Input. This accepts and copies the MD5 signature.

user_area_len
Input. This accepts the user area length.

ret_elf
Output. This returns the \text{Ddpi\_Elf} object.

error
See “The libddpi error parameter” on page 15.

Return values

\text{DW\_DLV\_OK}
Returned upon successful retrieval of the ELF object.

\text{DW\_DLV\_NO\_ENTRY}
Returned if the user-area length is zero.

\text{DW\_DLV\_ERROR}
This value is returned if:
- user_area_len is less than zero
- An error occurs during memory allocation.

\text{ddpi\_elf\_term} operation
The \text{ddpi\_elf\_term} operation terminates a \text{Ddpi\_Elf} object and removes the given \text{Ddpi\_Elf} from the list in its parent access object.

Prototype
\begin{verbatim}
int ddpi_elf_term(
    \text{Ddpi\_Elf} elf,
    \text{Ddpi\_Error*} error);
\end{verbatim}

Parameters

elf
Input. This accepts a \text{Ddpi\_Elf} object.

error
See “The libddpi error parameter” on page 15.

Return values

\text{DW\_DLV\_OK}
Returned upon successful termination of the ELF object.
**DW_DLV_NO_ENTRY**
Retained if the ELF descriptor within the Ddpi_Elf object is not found in the list of the parent Ddpi_Access object.

**DW_DLV_ERROR**
This value is returned if:
- `elf` is NULL
- The ELF descriptor within the Ddpi_Elf object is NULL
- The Ddpi_Access or Ddpi_Info object associated with `elf` is NULL
- An error occurs during memory deallocation

---

### ddpi_elf_get_owner operation

The `ddpi_elf_get_owner` operation returns the owner of the Ddpi_Elf object.

**Prototype**

```c
int ddpi_elf_get_owner(  
    Ddpi_Elf  elf,    
    Ddpi_Access*  ret_owner,  
    Ddpi_Error*  error);  
```

**Parameters**

- `access`
  - Input. This accepts a Ddpi_Elf object.

- `ret_owner`
  - Output. This returns the Ddpi_Access object.

- `error`
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the ELF object owner.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `access` is NULL.
    - The ELF descriptor within the Ddpi_Elf object is NULL.
    - The Ddpi_Info object associated with `access` is NULL.
    - `ret_owner` is NULL
    - An error occurs during memory deallocation

---

### ddpi_elf_get_source operation

The `ddpi_elf_get_source` operation finds the source data of the Elf object.
Prototype

```c
int ddpi_elf_get_source(
    Ddpi_Elf d_elf,
    Ddpi_Elf_Source* ret_source,
    Ddpi_Elf_Source_Type* ret_source_type,
    Ddpi_Error* error);
```

Parameters

**d_elf**
- Input. This accepts a Ddpi_Elf object.

**ret_source**
- Output. This returns the source data. This cannot be a NULL value.

**ret_source_type**
- Output. This returns the type of the source data. This cannot be a NULL value.

**error**
- See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
- Returned upon successful return of source data.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - access is NULL.
  - The ELF descriptor within the Ddpi_Elf object is NULL.
  - The Ddpi_Info or Ddpi_Info object associated with d_elf is NULL.

ddpi_elf_set_source operation

The ddpi_elf_set_source operation stores the value returned by the elf_begin operation. The value can be a file descriptor, file pointer, or memory block.

Prototype

```c
int ddpi_elf_set_source(
    Ddpi_Elf d_elf,
    Ddpi_Elf_Source source,
    Ddpi_Elf_Source_Type source_type,
    Ddpi_Error* error);
```

Parameters

**d_elf**
- Input. This accepts a Ddpi_Elf object.

**source**
- Input. This accepts the source data.

**source_type**
- Input. This accepts the type of source data.

**error**
- See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful return of source data.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `d_elf` is NULL
  - The Ddpi_Info or Ddpi_Info object associated with `d_elf` is NULL.

---

**ddpi_elf_get_elf operation**

The `ddpi_elf_get_elf` operation finds the ELF object for the given Ddpi_Elf object.

**Prototype**

```c
int ddpi_elf_get_elf(
    Ddpi_Elf elf,
    Elf** ret_elf,
    Ddpi_Error* error);
```

**Parameters**

- **elf**
  - Input. This accepts a Ddpi_Elf object.

- **ret_elf**
  - Output. This returns the ELF object.

- **error**
  - See the *libddpi error parameter* on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful return of the ELF error object.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if an error occurs in the parameters.

---

**ddpi_elf_set_elf operation**

The `ddpi_elf_set_elf` operation assigns the ELF object to the given Ddpi_Elf object.

**Prototype**

```c
int ddpi_elf_set_elf(
    Ddpi_Elf d_elf,
    Elf* elf,
    Ddpi_Error* error);
```

**Parameters**

- **d_elf**
  - Input. This accepts a Ddpi_Elf object.
elf
   - Input. This accepts the ELF object that will be set in the Ddpi_Elf object.

error
   - See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
   - Returned upon successful assignment of the error object to the given ELF object.

**DW_DLV_NO_ENTRY**
   - Never returned.

**DW_DLV_ERROR**
   - This value is returned if an error occurs in the parameters.

---

**ddpi_elf_get_elf_file_name operation**

The `ddpi_elf_get_elf_file_name` operation returns the pointer to the ELF object filename, and not a copy.

Do not deallocate the pointer.

**Prototype**

```c
int ddpi_elf_get_elf_file_name(
   Ddpi_Elf elf,
   char** ret_elf_filename,
   Ddpi_Error* error);
```

**Parameters**

**elf**
   - Input. This accepts a Ddpi_Elf object.

**ret_elf_filename**
   - Output. This returns a debug instance. This value cannot be NULL.

**error**
   - See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
   - Returned upon successful return of the ELF name pointer.

**DW_DLV_NO_ENTRY**
   - Returned if there is no stored filename.

**DW_DLV_ERROR**
   - This value is returned if:
     - `elf` is NULL
     - The Ddpi_Access or Ddpi_Info object associated with `elf` is NULL.
     - `ret_elf_filename` is NULL.

---

**ddpi_elf_set_elf_file_name operation**

The `ddpi_elf_set_elf_file_name` operation assigns an ELF file name to the given Ddpi_Elf object and makes a copy of the given name.
Prototype

```c
int ddpi_elf_set_elf_file_name(
    Ddpi_Elf elf,
    char* elf_filename,
    Ddpi_Error* error);
```

Parameters

**elf**
Input. This accepts a Ddpi_Elf object.

**elf_filename**
Input. This accepts a new filename. No validation is done on this value. A NULL filename will cause any previous entry to be replaced with NULL.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful assignment of the object name.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- elf is NULL
- The Ddpi_Access or Ddpi_Info object associated with elf is NULL.
- ret_elf_filename is NULL.
- The function was unable to make a copy of the given filename.

**ddpi_elf_get_ppa_addrs operation**

The ddpi_elf_get_ppa_addrs operation queries the PPA addresses for a given Ddpi_Elf object.

Only C/C++ compilation units produce PPA control blocks. If the Ddpi_Elf object contains a C/C++ compilation unit, the operation will return one PPA2 address. If the compilation unit is compiled with ISD debug information (in other words, compiled with the TEST compiler option), then the operation will also return the PPA1 and the corresponding function addresses.

Prototype

```c
int ddpi_elf_get_ppa_addrs(
    Ddpi_Elf elf,
    Dwarf_Addr* ret_ppa2_addr,
    Dwarf_Addr** ret_ppa1_addrs,
    Dwarf_Addr** ret_func_addrs,
    int* ret_ppa1_count,
    Ddpi_Error* error);
```

Parameters

**elf**
Input. This accepts a Ddpi_Elf object.
**ret_ppa2_addr**
Output. This returns a PPA2 address of the compilation unit. 0 means that the PPA2 block does not exist.

**ret_ppa1_addrs**
Output. This returns a pointer to a PPA1 address list. This value cannot be NULL.

**ret_func_addrs**
Output. This returns a pointer to a function-address list. This value cannot be NULL.

**ret_ppa1_count**
Output. This returns the number of PPA1 addresses in the list, which is the same number as in the function-address list. This value cannot be NULL. If the returned value is 0, the PPA1 blocks do not exist or the compilation unit is not compiled with the TEST compiler option.

**error**
See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
Returned upon successful return of the PPA1 address list.

**Note:** This does not indicate the presence of PPA2/PPA1 blocks. You must check the individual return value to test for the presence of PPA control blocks.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
* elf is NULL or corrupted.
* The Ddpi_Access or Ddpi_Info object associated with elf is NULL.
* ret_elf_filename is NULL or corrupted.
* A returned pointer is NULL

---

**ddpi_elf_set_ppa_addrs operation**

The `ddpi_elf_set_ppa_addrs` operation assigns the PPA addresses to a given ELF object.

The `ddpi_elf_set_ppa_addrs` operation assigns all four fields each time and overwrites previous values. The values are copied into the Ddpi_Storage object. You can deallocate copies of the list.

**Prototype**

```c
int ddpi_elf_set_ppa_addrs(
    Ddpi_Elf elf,
    Dwarf_Addr ppa2_addr,
    Dwarf_Addr* ppa1_addrs,
    Dwarf_Addr* func_addrs,
    int ppa1_count,
    Ddpi_Error* error);
```
**Parameters**

**elf**
- Input. This accepts a Ddpi_Elf object.

**ppa2_addr**
- Input. This accepts a PPA2 address.

**ppa1_addrs**
- Input. This accepts a PPA1 address list. There must be ppa1_count members in this list.

**func_addrs**
- Input. This accepts a function address list. There must be ppa1_count members in this list.

**ppa1_count**
- Input. This accepts the number of PPA1 addresses.

**error**
See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- Returned upon successful assignment of the PPA addresses.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - elf is NULL or corrupted.
  - The Ddpi_Access or Ddpi_Info object associated with elf is NULL.

---

**ddpi_elf_get_md5_sig operation**

The ddpi_elf_get_md5_sig operation copies the MD5 signature into the given unsigned char[16] buffer.

**Prototype**

```c
int ddpi_elf_get_md5_sig(
    Ddpi_Elf elf,
    unsigned char ret_md5_sig[16],
    Ddpi_Error* error);
```

**Parameters**

**elf**
- Input. This accepts a Ddpi_Elf object.

**ret_md5_sig[16]**
- Output. This returns the MD5 signature.

**error**
See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- Returned upon successful return of the MD5 address.
DW_DLV_NO_ENTRY

Never returned.

DW_DLV_ERROR

This value is returned if:
- elf is NULL.
- The Ddpi_Access or Ddpi_Info object associated with elf is NULL.

**ddpi_elf_set_md5_sig operation**

The ddpi_elf_set_md5_sig operation assigns the MD5 signature to a given ELF object. It copies the given unsigned char[16] buffer into the MD5 signature.

**Prototype**

```c
int ddpi_elf_set_md5_sig(
    Ddpi_Elf elf,
    unsigned char md5_sig[16],
    Ddpi_Error* error);
```

**Parameters**

- **elf**
  
  Input. This accepts a Ddpi_Elf object.

- **md5_sig[16]**
  
  Input. This accepts a MD5 signature.

- **error**

  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**

  Returned upon successful assignment of the MD5 address.

- **DW_DLV_NO_ENTRY**

  Never returned.

- **DW_DLV_ERROR**

  This value is returned if:
  - elf is NULL.
  - The Ddpi_Access or Ddpi_Info object associated with elf is NULL.

**ddpi_elf_get_csect_addrs operation**

The ddpi_elf_get_csect_addrs operation queries the CSECT addresses for the ELF object and extracts the high and low addresses.

ddpi_elf_get_csect_addrs function helps to select and load a CU when there are multiple CUs from which to choose.

**Prototype**

```c
int ddpi_elf_get_csect_addrs(
    Ddpi_Elf d_elf,
    Dwarf_Addr* ret_low_addr,
    Dwarf_Addr* ret_high_addr,
    Ddpi_Error* error);
```
Parameters

d_elf
   Input. This accepts a Ddpi_Elf object.

ret_low_addr
   Output. This returns the lowest known address in CSECT (the first byte of the object). (Dwarf_Addr)-1 is not an acceptable value address.

ret_high_addr
   Output. This returns the highest known address in CSECT (the last byte of the object). (Dwarf_Addr)-1 is not an acceptable value address.

   Note: ret_low_addr and ret_high_addr are not guaranteed to enclose all control blocks. They are guaranteed to enclose all executable code for the given CU if they are set to a value that is not -1.

error
   See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
   Returned upon successful return of the high and low addresses.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • elf is NULL.
   • The Ddpi_Access or Ddpi_Info object associated with elf is NULL.

ddpi_elf_set_csect_addrs operation

The ddpi_elf_set_csect_addrs operation assigns the high and low addresses to the CSECT of the ELF object.

ddpi_elf_set_csect_addrs should be used for contiguous CUs only. These values help to determine the owning CU of a given address. That is, it is used to determine which CU to load, if there are multiple CUs.

An address of (Dwarf_Addr)-1 is considered a bad address. csect_low_addr points to the beginning of the object. csect_high_addr points to the last byte in the object. csect_low_addr and csect_high_addr are not guaranteed to enclose all control blocks. If they are set to a non -1 value, they are guaranteed to enclose all executable code for the given CU.

Prototype

int ddpi_elf_set_csect_addrs(
   Ddpi_Elf   d_elf,
   Dwarf_Addr low_addr,
   Dwarf_Addr high_addr,
   Ddpi_Error* error);

Parameters

d_elf
   Input. This accepts a Ddpi_Elf object.
low_addr
Input. This accepts the lowest known address in CSECT (the first byte of the object). (Dwarf.Addr)-1 is not an acceptable value address.

high_addr
Input. This accepts the highest known address in CSECT (the last byte of the object). (Dwarf.Addr)-1 is not an acceptable value address.

Note: low_addr and high_addr are not guaranteed to enclose all control blocks. They are guaranteed to enclose all executable code for the given CU if they are set to a value that is not -1.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful assignment of the high and low addresses.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• elf is NULL.
• The Ddpi_Access or Ddpi_Info object associated with elf is NULL.

ddpi_elf_get_user_area operation

The ddpi_elf_get_user_area operation returns a pointer to the user area for the Ddpi_Elf object.

Do not deallocate the pointer. It is not a copy.

Prototype

int ddpi_elf_get_user_area(
    Ddpi_Elf elf,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);

Parameters

elf
Input. This accepts a Ddpi_Elf object.

ret_user_area
Output. This returns the user area of the Ddpi_Elf object.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful return of the pointer to the user area.

DW_DLV_NO_ENTRY
Never returned.
**DW_DLV_ERROR**

This value is returned if:

- `elf` is NULL.
- The Ddpi_Access or Ddpi_Info object associated with `elf` is NULL.

**ddpi_elf_list_function operation**

The `ddpi_elf_list_function` operation lists all of the Ddpi_Function objects associated with the given Ddpi_Elf object. Although the calling module must deallocate the list, the individual Ddpi_Function objects in the list should never be deallocated, as these are the actual Ddpi_Function objects from the Ddpi_Elf object.

The calling function should deallocate the returned list by using the following operation:

```c
ddpi_dealloc(info, *ret_functions, DDPI_DLA_LIST);
```

**Prototype**

```c
int ddpi_elf_list_function(
    Ddpi_Elf elf,
    Ddpi_Function** ret_functions,
    DwarfUnsigned* ret_count,
    Ddpi_Error* error);
```

**Parameters**

- **elf**
  - Input. This accepts the Ddpi_Elf object.

- **ret_functions**
  - Output. This returns the list of Ddpi_Function objects in the Ddpi_Elf object as an array.

- **ret_count**
  - Output. This returns the number of Ddpi_Function objects in the array.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - There are no Ddpi_Function objects associated with the given Ddpi_Elf object.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `elf` is NULL or invalid.
    - The Ddpi_Info, Ddpi_Access, or Ddpi_Module object associated with the given Ddpi_Elf object is NULL or invalid
    - The `ret_functions` array is NULL.
    - The `ret_count` value is NULL.
    - An error occurs during memory allocation.
ddpi_elf_list_variable operation

The `ddpi_elf_list_variable` operation lists all of the Ddpi_Variable objects associated with the given Ddpi_Elf object. Although the calling module must deallocate the list, the individual Ddpi_Variable objects in the list should never be deallocated, as these are the actual Ddpi_Variable objects associated with the Ddpi_Elf object.

The calling function should deallocate the returned list by using the following operation:
```
ddpri_dealloc(info, *ret_variables, DDI_LA_LIST);
```

Prototype

```
int ddpi_elf_list_variable(
    Ddpi_Elf *elf,
    Ddpi_Variable** ret_variables,
    Dwarf_Untsigned* ret_count,
    Ddpi_Error* error);
```

Parameters

**elf**
- Input. This accepts the given Ddpi_Elf object.

**ret_variables**
- Output. This returns the list of Ddpi_Variable objects in the Ddpi_Elf object as an array.

**ret_count**
- Output. This returns the number of Ddpi_Variable objects in the array.

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
- There are no Ddpi_Function objects associated with the given Ddpi_Elf object.

**DW_DLV_ERROR**
- This value is returned if:
  - elf is NULL or invalid.
  - The Ddpi_Info, Ddpi_Access, or Ddpi_Module object associated with the given Ddpi_Elf object is NULL or invalid
  - The ret_variables array is NULL.
  - The ret_count value is NULL.
  - An error occurs during memory allocation.

ddpi_elf_list_type operation

The `ddpi_elf_list_type` operation creates an array that contains all of the Ddpi_Type objects associated with the given Ddpi_Elf object. Although the calling module must deallocate the list, the individual Ddpi_Variable objects in the list should never be deallocated; these are the actual Ddpi_Type objects associated with the Ddpi_Elf object.
The calling function should deallocate the returned array by using the following operation:
```
ddpi_dealloc(info, *ret_types, DDPI_DLA_LIST);
```

**Prototype**
```
int ddpi_elf_list_type(
    Ddpi_Elf *elf,
    Ddpi_Type** ret_types,
    DwarfUnsigned* ret_count,
    Ddpi_Error* error);
```

**Parameters**
- **elf**
  - Input. This accepts the given Ddpi_Elf object.
- **ret_types**
  - Output. This returns the list of Ddpi_Type objects in the Ddpi_Elf object as an array.
- **ret_count**
  - Output. This returns the number of Ddpi_Type objects in the array.
- **error**
  - See "The libddpi error parameter" on page 15

**Return values**
- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.
- **DW_DLV_NO_ENTRY**
  - There are no Ddpi_Type objects associated with the given Ddpi_Elf object.
- **DW_DLV_ERROR**
  - This value is returned if:
    - elf is NULL or invalid.
    - The Ddpi_Info, Ddpi_Access, or Ddpi_Module object associated with the given Ddpi_Elf object is NULL or invalid.
    - The ret_types array is NULL.
    - The ret_count value is NULL.
    - An error occurs during memory allocation.

---

**ddpi_elf_list_sourcefile operation**

The ddpi_elf_list_sourcefile operation creates an array that contains all of the Ddpi_Sourcefile objects associated with the given Ddpi_Elf object. Although the calling module must deallocate the list, the individual Ddpi_Sourcefile objects in the list should never be deallocated; these are the actual Ddpi_Sourcefile objects associated with the Ddpi_Elf object.

The calling function should deallocate the returned array by using the following operation:
```
ddpi_dealloc(info, *ret_sourcefiles, DDPI_DLA_LIST);
```
Prototype

```c
int ddpi_elf_list_sourcefile(
    Ddpi_Elf    elf,
    Ddpi_Sourcefile** ret_sourcefiles,
    Dwarf_Unsigned* ret_count,
    Ddpi_Error*   error);
```

Parameters

**elf**

Input. This accepts the given Ddpi_Elf object.

**ret_sourcefiles**

Output. This returns the list of Ddpi_Sourcefile objects in the Ddpi_Elf object as an array.

**ret_count**

Output. This returns the number of Ddpi_Sourcefile objects in the array.

**error**

See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**

This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**

This value is returned if there are no Ddpi_Sourcefile objects associated with the given Ddpi_Elf object.

**DW_DLV_ERROR**

This value is returned if:

- elf is NULL or invalid.
- The Ddpi_Info, Ddpi_Access, or Ddpi_Module object associated with the given Ddpi_Elf object is NULL or invalid.
- The ret_types array is NULL.
- The ret_count value is NULL.
- An error occurs during memory allocation.

**ddpi_elf_get_primary_sourcefile operation**

The ddpi_elf_get_primary_sourcefile operation returns the primary Ddpi_Sourcefile object associated with the given Ddpi_Elf object. The Ddpi_Sourcefile object should never be deallocated; this is the actual primary Ddpi_Sourcefile object associated with the Ddpi_Elf object.

Prototype

```c
int ddpi_elf_get_primary_sourcefile(
    Ddpi_Elf    elf,
    Ddpi_Sourcefile* ret_sourcefile,
    Ddpi_Error*   error);
```

Parameters

**elf**

Input. This accepts the given Ddpi_Elf object.
ret_sourcefile
   Output. This returns the primary Ddpi_Sourcefile object for the Ddpi_Elf object.

error
   See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
   This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
   The primary Ddpi_Sourcefile object is not available to the given Ddpi_Elf object.

DW_DLV_ERROR
   This value is returned if:
   • elf is NULL or invalid.
   • The Ddpi_Info, Ddpi_Access, or Ddpi_Module object associated with the given Ddpi_Elf object is NULL or invalid
   • The ret_sourcefile array is NULL.
   • An error occurs during memory allocation.
Chapter 17. Ddpi_Class APIs

A Ddpi_Class object is used to map certain portions of memory to certain uses. For example, it can be used to allocate space for program code, a Writable Static Area (WSA), a heap, or a stack. It can be mapped to a binder or goff class.

A class can be owned by one of the following three different entities: a module, a process, or a thread. Typically, these entities are owned at the module level (WSA, program_code, B_LIT), but some entities can be owned at the process level (heap), or the thread level (stack).

Ddpi_Class_Type object

The class type.

Type definition

typedef enum Ddpi_Class_Type_s {
    Ddpi_CT_Unknown = 0,
    Ddpi_CT_B_LIT = 1,
    Ddpi_CT_Program_code = 2,
    Ddpi_CT_WSA = 3,
    Ddpi_CT_Heap_Seg = 4,
    Ddpi_CT_Stack_Seg = 5,
    Ddpi_CT_Other = 6
} Ddpi_Class_Type;

Members

Ddpi_CT_Unknown
    If this value is 0, the mapped usage of the associated memory is unknown.

Ddpi_CT_B_LIT
    If this value is 1, the associated memory is mapped for literal values.

Ddpi_CT_Program_code
    If this value is 2, the associated memory is mapped for executable code.

Ddpi_CT_WSA
    If this value is 3, the associated memory is mapped for writable static area containing program variables.

Ddpi_CT_Heap_Seg
    If this value is 4, the associated memory is mapped for heap storage.

Ddpi_CT_Stack_Seg
    If this value is 5, the associated memory is mapped for stack storage.

Ddpi_CT_Other
    If this value is 6, the associated memory is mapped for storage of data that is not specified in the type definition.

ddpi_class_get_storage_attr operation

The dpdi_class_get_storage_attr operation returns the storage attribute of a given Ddpi_Class object.
Prototype

```c
int ddpi_class_get_storage_attr(
    Ddpi_Class       class_obj, /
    Ddpi_Class_Storage_Attr* ret_attr,
    Ddpi_Error*      error);
```

Parameters

class_obj
Input. This accepts the Ddpi_Class object.

ret_attr
Output. This returns the storage attribute.

error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful return of the class storage attribute.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- class_obj is NULL.
- The Ddpi_Info object associated with class_obj is NULL.
- ret_attr is NULL.

Ddpi_Class_Owner_Type object

This is used to describe which libddpi entity is the parent/owner of the associated Ddpi_Class_Owner object.

Type definition

```c
typedef enum Ddpi_Class_Owner_Type_s {
    Ddpi_Class_Owner_Unknown = 0,
    Ddpi_Class_Owner_Thread = 1,
    Ddpi_Class_Owner_Module = 2,
    Ddpi_Class_Owner_Process = 3
} Ddpi_Class_Owner_Type;
```

Members

Ddpi_Class_Owner_Unknown
0

Ddpi_Class_Owner_Thread
1

Ddpi_Class_Owner_Module
2

Ddpi_Class_Owner_Process
3
Ddpi_Class_Owner object

This object is used to hold the owner of the given Ddpi_Class object. The associated Ddpi_Class_Owner_Type object is used to determine which union member should be accessed.

Type definition

typedef union Ddpi_Class_Owner_s {
    Ddpi_Thread owner_thread;
    Ddpi_Module owner_module;
    Ddpi_Process owner_process;
} Ddpi_Class_Owner;

Members

owner_thread
    Ddpi_Thread

owner_module
    Ddpi_Module

owner_process
    Ddpi_Process

Ddpi_Class object

The Ddpi_Class object is an opaque data type that contains information regarding a single class of storage (using the binder and GOFF terminology) for a given application-executable module.

Type definition

typedef struct Ddpi_Class_s* Ddpi_Class;

ddpi_class_create operation

The ddpi_class_create operation creates a Ddpi_Class object to describe a typed set of storage ranges and returns a pointer to the object.

When the user calls this function, passing a character string as the parameter name, the operation copies the content of name and stores the copy. After this function returns, you can deallocate the original name and save storage.

Prototype

int ddpi_class_create(
    Ddpi_Class_Owner* owner,
    Ddpi_Class_Owner_Type owner_type,
    Ddpi_Class_Type type,
    char* name,
    Dwarf_Addr addr_low,
    Dwarf_Addr addr_high,
    Ddpi_Class_Storage_Attr attr,
    int user_area_len,
    Ddpi_Class* ret_class,
    Ddpi_Error* error);

Parameters

owner
    Input. This accepts the class owner.
owner_type
   Input. This accepts the class owner type.

type
   Input. This accepts the class type.

name
   Input. This accepts the class name string.

addr_low
   Input. This accepts the class start address (the first byte in the class).

addr_high
   Input. This accepts the class end address (the last byte in the class).

attr
   Input. This accepts the class storage attribute.

user_area_len
   Input. This accepts the user area length.

ret_class
   Output. This returns the Ddpi_Class pointer.

error
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful return of the class pointer.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • owner_type is not set to one of Ddpi_Class_Owner_Module,
     Ddpi_Class_Owner_Thread, or Ddpi_Class_Owner_Process objects.
   • owner is NULL.
   • The Ddpi_Space or Ddpi_Info object associated with owner is NULL.
   • ret_class is NULL.
   • An error occurs during memory allocation.
   • user_area_len is less than zero.
   • ret_class overlaps an existing class.

   Note: Only one class for a given address is allowed in a given address
   space. A class may overlap if it has exactly the same values for type, name,
   addr_low, addr_high, and attr.

ddpi_class_term operation

The ddpi_class_term operation releases all internal resources associated with the
descriptor class object, and invalidates the object.

The ddpi_class_term operation terminates the Ddpi_Section children of the given
class type.

Note: Termination of subcomponents is not done until all instances of the same
address range/class have been terminated.
Prototype

```c
int ddpi_class_term(
    Ddpi_Class class_obj,
    Ddpi_Error* error);
```

Parameters

class_obj
   Input. This accepts the Ddpi_Class object.

error
   See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
   Returned upon successful release of all internal resources associated with the
descriptor class object.

**DW_DLV_NO_ENTRY**
   Never returned.

**DW_DLV_ERROR**
   This value is returned if:
   • class_obj is NULL or not of a valid type
   • The Ddpi_Info object associated with class_obj is NULL
   • An error occurs during termination of child descriptors
   • An error occurs during memory allocation.
   • ret_class is NULL

**ddpi_class_get_owner operation**

The ddpi_class_get_owner operation returns the owner and owner type of a given
class object.

Prototype

```c
int ddpi_class_get_owner(
    Ddpi_Class_class_obj,
    Ddpi_Class_Owner* ret_owner,
    Ddpi_Class_Owner_Type* ret_owner_type,
    Ddpi_Error* error);
```

Parameters

class_obj
   Input. This accepts the Ddpi_Class object.

ret_owner
   Output. This returns the class owner.

ret_owner_type
   Output. This returns the class owner type.

error
   See "The libddpi error parameter" on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful return of the class owner and owner type.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `class_obj` is NULL.
  - The Ddpi_Info object associated with `class_obj` is NULL.

---

**ddpi_class_get_name operation**

The ddpi_class_get_name operation finds the name of a given Ddpi_Class object and sets the returned name to a pointer to a null-terminated string of characters.

`ddpi_class_get_name` returns the actual version of the name, not a copy. Never deallocate the returned pointer.

**Prototype**

```c
int ddpi_class_get_name(
    Ddpi_Class class_obj,
    char** ret_name,
    Ddpi_Error* error);
```

**Parameters**

- `class_obj`
  - Input. This accepts the Ddpi_Class object.

- `ret_name`
  - Output. This returns the name string.

- `error`
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful assignment of the name pointer.

- **DW_DLV_NO_ENTRY**
  - Returned if the name string is NULL.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `class_obj` is NULL.
    - The Ddpi_Info object associated with `class_obj` is NULL.

---

**ddpi_class_set_name operation**

The ddpi_class_set_name operation assigns a new name to a given Ddpi_Class object.

`ddpi_class_set_name` can be used to set the name to NULL. It copies the given name. The caller may deallocate `new_name` after the call to save memory.
Prototype

```c
int ddpi_class_set_name(
    Ddpi_Class class_obj,
    char* new_name,
    Ddpi_Error* error);
```

Parameters

class_obj
   Input. This accepts the Ddpi_Class object.

new_name
   Input. This accepts the new class name.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful assignment of the new class name.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   - class_obj is NULL
   - The Ddpi_Info object associated with class_obj is NULL.
   - An error occurs during memory allocation for the copy of the name string.

**ddpi_class_get_type operation**

The ddpi_class_get_type operation returns the type of the given Ddpi_Class object.

Prototype

```c
int ddpi_class_get_type(
    Ddpi_Class class_obj,
    Ddpi_Class_Type* ret_type,
    Ddpi_Error* error);
```

Parameters

class_obj
   Input. This accepts the Ddpi_Class object.

ret_type
   Output. This returns the class type.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned upon successful return of the class type.

DW_DLV_NO_ENTRY
   Never returned.
**DDPIERROR**

This value is returned if:

- `class_obj` is NULL.
- The Ddpi_Info object associated with `class_obj` is NULL.
- `ret_type` is NULL.

### ddpi_class_get_storage_attr operation

The ddpi_class_get_storage_attr operation returns the storage attribute of a given Ddpi_Class object.

**Prototype**

```c
int ddpi_class_get_storage_attr(
    Ddpi_Class class_obj, /
    Ddpi_Class_Storage_Attr* ret_attr,
    Ddpi_Error* error);
```

**Parameters**

- **class_obj**
  
  Input. This accepts the Ddpi_Class object.

- **ret_attr**
  
  Output. This returns the storage attribute.

- **error**
  
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful return of the class storage attribute.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  This value is returned if:

  - `class_obj` is NULL.
  - The Ddpi_Info object associated with `class_obj` is NULL.
  - `ret_attr` is NULL.

### ddpi_class_get_addr_low operation

The ddpi_class_get_addr_low operation returns the start address of a given class object.

**Prototype**

```c
int ddpi_class_get_addr_low(
    Ddpi_Class class_obj,
    Dwarf_Addr* ret_addr_low,
    Ddpi_Error* error);
```

**Parameters**

- **class_obj**
  
  Input. This accepts the Ddpi_Class object.
ret_addr_low
Output. This returns the starting address.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
Returned upon successful return of the class storage address.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• class_obj is NULL.
• The Ddpi_Info object associated with class_obj is NULL.
• ret_addr_low is NULL

ddpi_class_get_addr_high operation

The ddpi_class_get_addr_high operation returns the end address of a given class object.

Prototype

int ddpi_class_get_addr_high(
    Ddpi_Class class_obj,
    Dwarf_Addr* ret_addr_high,
    Ddpi_Error* error);

Parameters

class_obj
Input. This accepts the address.

ret_addr_high
Output. This returns the end address.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
Returned upon successful release of resources associated with the Ddpi_Info descriptor.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• class_obj is NULL.
• The Ddpi_Info object associated with class_obj is NULL.
• ret_addr_high is NULL
**ddpi_class_get_user_area operation**

The `ddpi_class_get_user_area` operation returns the user area of a given class object.

**Prototype**

```c
int ddpi_class_get_user_area(
    Ddpi_Class class_obj,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

**Parameters**

- `class_obj`  
  Input. This accepts the `Ddpi_Class` object.

- `ret_user_area`  
  Output. This returns the user area.

- `error`  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**  
  Returned upon successful release of resources associated with the `Ddpi_Info` descriptor.

- **DW_DLV_NO_ENTRY**  
  Returned if the user-area length is zero.

- **DW_DLV_ERROR**  
  This value is returned if:
  - `class_obj` is NULL.
  - The `Ddpi_Info` object associated with `class_obj` is NULL.

**ddpi_class_list_section operation**

The `ddpi_class_list_section` operation lists all `Ddpi_Section` objects associated with the given `Ddpi_Class` object.

It sets the list to point to `Ddpi_Section` descriptors and the number of `Ddpi_Section` objects.

When user processing is complete, you must call `ddpi_dealloc` with type `DDPI_DLA_LIST` to deallocate the list storage.

**Prototype**

```c
int ddpi_class_list_section(
    Ddpi_Class class_obj,
    Ddpi_Section** ret_section_list,
    Dwarf_Signed* ret_section_cnt,
    Ddpi_Error* error);
```

**Parameters**

- `class_obj`  
  Input. This accepts the `Ddpi_Class` object.
**Return values**

**DW_DLV_OK**

Returned upon successful retrieval of the class section list.

**DW_DLV_NO_ENTRY**

Returned if the retrieved section list is empty.

**DW_DLV_ERROR**

This value is returned if:

- `class_obj` is NULL.
- The Ddpi_Info object associated with `class_obj` is NULL.
- `ret_section_list` or `ret_section_cnt` is NULL.
- An error occurs during memory allocation for the list.
Chapter 18. Ddpi_Section APIs

You can use Ddpi_Section APIs to divide a class to smaller sections, such as for a pseudoregister (PR) or a control section (CSECT).

Ddpi_Section opaque object

The Ddpi_Section object is an opaque data type that contains information about application-executable modules.

Type definition

typedef struct Ddpi_Section_s* Ddpi_Section;

ddpi_section_create operation

The ddpi_section_create operation creates a Ddpi_Section object to describe a range of storage.

When the user calls the ddpi_section_create operation, passing a character string as the parameter name, the operation copies the content of name and sets section->ds_name to the copy. You can deallocate the copy.

If the parent class has the same attributes as another class (such as name, type, and location), this section is applied to both instances of the class.

Prototype

int ddpi_section_create(
    Ddpi_Class class_obj,
    char* name,
    Dwarf_Addr addr_low,
    Dwarf_Addr addr_high,
    int user_area_len,
    Ddpi_Section* ret_section,
    Ddpi_Error* error);

Parameters

class_obj
    Input. This accepts the Ddpi_Class object.

name
    Input. This accepts the section name.

addr_low
    Input. This accepts the section start address

addr_high
    Input. This accepts the section end address.

user_area_len
    Input. This accepts the user area length.

ret_section
    Output. This returns the Ddpi_Section object.

error
    See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful creation of the section copy.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - class_obj is NULL
  - The Ddpi_Info object associated with class_obj is NULL.
  - ret_section is NULL.
  - An error occurs during allocation of memory for the new section.
  - An error occurs during allocation of memory for the copy of the name.
  - An error occurs during allocation of memory for the section list of the parent class.
  - user_area_len is less than zero.

---

**ddpi_section_term operation**

The ddpi_section_term operation releases all internal resources associated with the descriptor section, and invalidates section.

**Prototype**

```c
int ddpi_section_term(
    Ddpi_Section section,
    Ddpi_Error* error);
```

**Parameters**

**section**
- Input. This accepts the Ddpi_Section object.

**error**
- See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful release of resources associated with the section descriptor.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - section is NULL
  - The Ddpi_Info object associated with section is NULL.
  - An error occurs during allocation of memory.

The ddpi_section_term operation returns **DW_DLV_OK** The ddpi_section_term operation returns **DW_DLV_ERROR** if:
ddpi_section_get_owner operation

The ddpi_section_get_owner operation queries the owner of a given Ddpi_Section object.

Prototype

```c
int ddpi_section_get_owner(
    Ddpi_Section section,
    Ddpi_Class* ret_owner,
    Ddpi_Error* error);
```

Parameters

- **section**: Input. This accepts the Ddpi_Section object.
- **ret_owner**: Output. This returns the section owner.
- **error**: See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**: Returned upon successful release of resources associated with the Ddpi_Info descriptor.
- **DW_DLV_NO_ENTRY**: Never returned.
- **DW_DLV_ERROR**: This value is returned if:
  - `section` or its corresponding Ddpi_Info object is NULL.
  - `ret_owner` is NULL.

ddpi_section_get_name operation

The ddpi_section_get_name operation finds the name of a given Ddpi_Section object and sets the returned name to a pointer to a null-terminated string of characters.

The name string is part of the Ddpi_Section object, and must not be deallocated by the caller.

Prototype

```c
int ddpi_section_get_name(
    Ddpi_Section section,
    char** ret_name,
    Ddpi_Error* error);
```

Parameters

- **section**: Input. This accepts the Ddpi_Section object.
- **ret_name**: Output. This returns the section name.
error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful retrieval of the section name pointer.

**DW_DLV_NO_ENTRY**
Returned if the retrieved name is NULL.

**DW_DLV_ERROR**
This value is returned if:
- section or its corresponding Ddpi_Info object is NULL.
- ret_name is NULL.

**ddpi_section_set_name operation**

The **ddpi_section_set_name** operation assigns a new name to a given Ddpi_Section object.

**Prototype**

```c
int ddpi_section_set_name(  
    Ddpi_Section section,  
    char* new_name,  
    Ddpi_Error* error);  
```

**Parameters**

- **section**
  Input. This accepts the Ddpi_Section object.

- **new_name**
  Input. This accepts the new section name.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful release of resources associated with the Ddpi_Info descriptor.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - section or its corresponding Ddpi_Info object is NULL.
  - An error occurs while allocating storage.

**ddpi_section_get_addr_low operation**

The **ddpi_section_get_addr_low** operation returns the start address of a given Ddpi_Section object.
Prototype

```c
int ddpi_section_get_addr_low(
    Ddpi_Section section,
    Dwarf_Addr* ret_addr_low,
    Ddpi_Error* error);
```

Parameters

- **section**
  - Input. This accepts the Ddpi_Section object.

- **ret_addr_low**
  - Output. This returns the start address.

- **error**
  - See "The libddpi error parameter" on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful return of the section ID start address.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - section or its corresponding Ddpi_Info object is NULL.
    - ret_addr_low is NULL.

**ddpi_section_get_addr_high operation**

The `ddpi_section_get_addr_high` operation queries the end address of a given Ddpi_Section object, where addr_high is the address of the last byte in the section.

Prototype

```c
int ddpi_section_get_addr_high(
    Ddpi_Section section,
    Dwarf_Addr* ret_addr_high,
    Ddpi_Error* error);
```

Parameters

- **section**
  - Input. This accepts the Ddpi_Section object.

- **ret_addr_high**
  - Output. This returns the start address.

- **error**
  - See "The libddpi error parameter" on page 15

Return values

- **DW_DLV_OK**
  - Returned upon successful retrieval of the section ID end address.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
ddpi_section_set_addr operation

The `ddpi_section_set_addr` operation assigns the start and end addresses of a given `Ddpi_Section` object.

Prototype

```c
int ddpi_section_set_addr(
    Ddpi_Section section,
    Dwarf_Addr addr_low,
    Dwarf_Addr addr_high,
    Ddpi_Error* error);
```

Parameters

- **section**
  Input. This accepts the `Ddpi_Section` object.

- **addr_low**
  Input. This accepts the new start address.

- **addr_high**
  Input. This accepts the new end address.

- **error**
  See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  Returned upon successful assignment of the section address.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - section or its corresponding `Ddpi_Info` object is NULL.
  - `addr_low` or `addr_high` extends outside the address range of the owning class.

ddpi_section_get_user_area operation

The `ddpi_section_get_user_area` operation returns a pointer to the user area allocated for the given `Ddpi_Section` object.

Prototype

```c
int ddpi_section_get_user_area(
    Ddpi_Section section,
    Dwarf_Ptr* ret_user_area,
    Ddpi_Error* error);
```

Parameters

- **section**
  Input. This accepts the `Ddpi_Section` object.
**ret_user_area**

Output. This returns the section user area.

**error**

See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**

Returned upon successful return of the pointer to the user area.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:

- `section` or its corresponding `Ddpi_Info` object is NULL.
- The address extends outside the address range of the owning class.
Chapter 19. Ddpi_Function APIs

Ddpi_Function APIs find and extract information about a specific function, including static functions. Each Ddpi_Function object is owned by a Ddpi_Elf object. A ddpi_function operation queries one or more Ddpi_Function objects and extracts information about the specific function.

Ddpi_Function object

Each Ddpi_Function object is an opaque data type that contains information about a specific function, including static functions. If the function is defined in more than one compilation unit, there will be a separate Ddpi_Function object for each compilation unit.

A Ddpi_Function object can be queried to get:

- The fully qualified name of the function.
- The unqualified name of the function.
- The Ddpi_Access object that identifies the .dbg file for the function.

If the function is not a member of a C++ class, the fully qualified name will be the same as the unqualified name.

Type definition

typedef struct Ddpi_Function_s* Ddpi_Function;

ddpi_function_get_full_name operation

The ddpi_function_get_full_name operation returns the fully qualified name (which is prefixed with the C++ class name, if applicable) of the function. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

int ddpi_function_get_full_name(
    Ddpi_Function function,
    char** ret_full_name,
    Ddpi_Error* error);

Parameters

function
    Input. This accepts the Ddpi_Function object for the function.

ret_full_name
    Output. This returns the fully qualified name of the function.

error
    See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
    This value is returned upon successful completion of the operation.
dw_dlv_no_entry
This value is never returned.

dw_dlv_error
This value is returned if:
• function is NULL or invalid.
• The Ddpi_Elf, Ddpi_Access or Ddpi_Info object associated with the function is either NULL or invalid.
• ret_full_name is NULL.

ddpi_function_get_short_name operation

The ddpi_function_get_short_name operation returns the unqualified name which is not prefixed with a C++ class name) of the function. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

```
int ddpi_function_get_short_name(
    Ddpi_Function function,
    char** ret_short_name,
    Ddpi_Error* error);
```

Members

function
Input. This accepts the Ddpi_Function object for the function.

ret_short_name
Output. This returns the unqualified name of the function.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• function is NULL or invalid.
• The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the function is either NULL or invalid.
• ret_short_name is NULL.

ddpi_function_get_access operation

The ddpi_function_get_access operation returns the Ddpi_Access object whose Dwarf_Debug object contains the function instance. The actual Ddpi_Access object is returned, not a copy. The user must never deallocate the returned pointer.
Prototype

```c
int ddpi_function_get_access(
    Ddpi_Function function,
    Ddpi_Access* ret_access,
    Ddpi_Error* error);
```

Parameters

- **function**: Input. This accepts the Ddpi_Function object for the function.
- **ret_access**: Output. This returns the Ddpi_Access object whose Dwarf_Debug object contains the function instance.
- **error**: See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**: This value is returned upon successful completion of the operation.
- **DW_DLV_NO_ENTRY**: This value is never returned.
- **DW_DLV_ERROR**: This value is returned if:
  - function is NULL or invalid.
  - The Ddpi_Elf, Ddpi_Access or Ddpi_Info object associated with the function is either NULL or invalid.
  - ret_full_name is NULL.

**ddpi_function_get_elf operation**

The ddpi_function_get_elf operation returns the Ddpi_Elf object that owns the function instance. The actual Ddpi_Elf object is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

```c
int ddpi_function_get_elf(
    Ddpi_Function function,
    Ddpi_Elf* ret_elf,
    Ddpi_Error* error);
```

Members

- **function**: Input. This accepts the Ddpi_Function object for the function.
- **ret_elf**: Output. This returns the Ddpi_Elf object that owns the function.
- **error**: See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**: This value is returned upon successful completion of the operation.
**ddpi_function_get_die_offset operation**

The `ddpi_function_get_die_offset` operation returns the DIE offset of the function.

**Prototype**

```c
int ddpi_function_get_die_offset(
    Ddpi_Function function,
    Dwarf_Off* ret_offset,
    Ddpi_Error* error);
```

**Parameters**

- **function**
  
  Input. This accepts the Ddpi_Function object for the function.

- **ret_offset**
  
  Output. This returns the DIE offset for the function.

- **error**
  
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  
  This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  
  This value is never returned.

- **DW_DLV_ERROR**
  
  This value is returned if:
  - function is NULL or invalid.
  - ret_offset is NULL.

**ddpi_function_get_func_encrypt operation**

The `ddpi_function_get_func_encrypt` operation returns the entry point of a function.

**Prototype**

```c
int ddpi_function_get_func_encrypt(
    Ddpi_Function function,
    Dwarf_Addr* ret_func_encrypt,
    Ddpi_Error* error);
```

**Parameters**

- **function**
  
  Input. This accepts the Ddpi_Function object for the function.
ret_func_encrypt
Output. This returns the address of the function entry point.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is returned if the Ddpi_Function object does not contain the address of the function entry point. This can happen if you are using a previous version of the dbgld utility to generate the .mdbg file. Try to regenerate the .mdbg file with the latest dbgld utility.

DW_DLV_ERROR
This value is returned if:
• function is NULL or invalid.
• ret_func_encrypt is NULL.

ddpi_function_get_first_stmt_addr operation
The ddpi_function_get_first_stmt_addr operation returns the address of the first executable statement of a function.

Prototype
int ddpi_function_get_first_stmt_addr(
    Ddpi_Function function,
    Dwarf_Addr* ret_first_stmt_addr,
    Ddpi_Error* error);

Parameters
function
Input. This accepts the Ddpi_Function object for the function.

ret_first_stmt_addr
Output. This returns the address of the first executable statement of the function.

error
See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is returned if the Ddpi_Function object does not contain the address of the first executable statement within the function. This can happen if you are using a previous version of the dbgld utility to generate the .mdbg file. Try to regenerate the .mdbg file with the latest dbgld utility.

DW_DLV_ERROR
This value is returned if:
• function is NULL or invalid.
• ret_first_stmt_addr is NULL.
Chapter 20. Ddpi_Variable APIs

Ddpi_Variable APIs provide information about global variables in the .debug_info section.

Ddpi_Variable object

A Ddpi_Variable object contains information about a global variable, including global static variables and static members. If this variable is in more than one compilation unit, there will be a separate Ddpi_Variable object for each unit.

A Ddpi_Variable object can be queried to get the following items:
- The fully qualified name (which is prefixed with the C++ class name if applicable).
- The unqualified name.
- The Ddpi_Access object whose .dbg file contains the variable.

If the variable is not nested within a C++ class, the fully qualified name will be the same as the unqualified name.

Type definition

typedef struct Ddpi_Variable_s* Ddpi_Variable;

ddpi_variable_get_full_name operation

The ddpi_variable_get_full_name operation returns the fully qualified name (which is prefixed with the C++ class name, if applicable) of the variable. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

int ddpi_variable_get_full_name(
   Ddpi_Variable variable,
   char** ret_full_name,
   Ddpi_Error* error);

Parameters

variable
Input. This accepts the Ddpi_Variable object for the variable.

ret_full_name
Output. This returns the fully qualified name of the variable.

error
See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.
**DW_DLV_ERROR**

This value is returned if:
- variable is NULL or invalid.
- The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the variable is either NULL or invalid.
- ret_full_name is NULL.

---

**ddpi_variable_get_short_name operation**

The `ddpi_variable_get_short_name` operation returns the unqualified name (which is not prefixed with a C++ class name) of the variable. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

**Prototype**

```c
int ddpi_variable_get_short_name(
    Ddpi_Variable variable,
    char** ret_short_name,
    Ddpi_Error* error);
```

**Parameters**

- **variable**
  - Input. This accepts the Ddpi_Variable object for the variable.
- **ret_short_name**
  - Output. This returns the unqualified name of the variable.
- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.
- **DW_DLV_NO_ENTRY**
  - This value is never returned.
- **DW_DLV_ERROR**
  - This value is returned if:
    - variable is NULL or invalid.
    - The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the variable is either NULL or invalid.
    - ret_short_name is NULL.

---

**ddpi_variable_get_access operation**

The `ddpi_variable_get_access` operation returns the Ddpi_Access object whose Dwarf_Debug object contains the variable instance. The actual Ddpi_Access object is returned, not a copy. The user must never deallocate the returned pointer.

**Prototype**

```c
int ddpi_variable_get_access(
    Ddpi_Variable variable,
    Ddpi_Access* ret_access,
    Ddpi_Error* error);
```
Parameters

variable
Input. This accepts the Ddpi_Variable object for the variable.

ret_access
Output. This returns the Ddpi_Access object whose Dwarf_Debug object contains
the variable instance.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• variable is NULL or invalid.
• The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the variable
  is either NULL or invalid.
• ret_access is NULL.

ddpi_variable_get_die_offset operation
The ddpi_variable_get_die_offset operation returns the DIE offset of the variable
in the .debug_info section.

Prototype

int ddpi_variable_get_die_offset(
    Ddpi_Variable variable,
    Dwarf_Off* ret_offset,
    Ddpi_Error* error);

Members

variable
Input. This accepts the Ddpi_Variable object for the variable.

ret_offset
Output. This returns the DIE offset for the variable.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• variable is NULL or invalid.
• ret_offset is NULL.
Chapter 21. Ddpi_Type APIs

Ddpi_Type APIs provide information about external types in the .debug_info section.

Ddpi_Type object

A Ddpi_Type object contains information about an external type. If this type is in more than one compilation unit, there will be a separate Ddpi_Type object for each unit.

This object can be queried for the following information:
- The fully qualified name (which is prefixed with the C++ class name if applicable).
- The unqualified name.
- The Ddpi_Access object whose .dbg file contains the external type.

If the type is not nested within a C++ class, the fully qualified name will be the same as the unqualified name.

Type definition

typedef struct Ddpi_Type_s* Ddpi_Type;

ddpi_type_get_access operation

The ddpi_type_get_access operation returns the Ddpi_Access object whose Dwarf_Debug object contains the type instance. The actual Ddpi_Access object is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

int ddpi_type_get_access(
    Ddpi_Type type,
    Ddpi_Access* ret_access,
    Ddpi_Error* error);

Parameters

type
    Input. This accepts the Ddpi_Type object for the type.

ret_access
    Output. This returns the Ddpi_Access object whose Dwarf_Debug object contains the type instance.

error
    See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
    This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
    This value is never returned.
DW_DLV_ERROR
This value is returned if:

- type is NULL or invalid.
- The Ddpi_Elf, Ddpi_Access or Ddpi_Info object associated with the type is either NULL or invalid.
- ret_full_name is NULL.

ddpi_type_get_elf operation
The ddpi_type_get_elf operation returns the Ddpi_Elf object that owns the Ddpi_Type object for the type instance. The actual Ddpi_Elf object is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

```c
int ddpi_type_get_elf(
    Ddpi_Type type,
    Ddpi_Elf* ret_elf,
    Ddpi_Error* error);
```

Parameters

- **type**
  Input. This accepts the Ddpi_Type object for the instance.

- **ret_elf**
  Output. This returns the Ddpi_Elf object that owns the Ddpi_Type object for the type instance.

- **error**
  See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  This value is never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - type is NULL or invalid.
  - ret_elf is NULL.

ddpi_type_get_die_offset operation
The ddpi_type_get_die_offset operation returns the DIE offset of the type in the .debug_info section.

Prototype

```c
int ddpi_type_get_die_offset(
    Ddpi_Type type,
    Dwarf_Off* ret_offset,
    Ddpi_Error* error);
```

Members

- **type**
  Input. This accepts the Ddpi_Type object for the instance.
ret_offset
Output. This returns the DIE offset for the type.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• type is NULL or invalid.
• ret_offset is NULL.
Chapter 22. Ddpi_Sourcefile APIs

Ddpi_Sourcefile APIs provide information about source files in the .debug_srcfiles section.

Ddpi_Sourcefile object

A Ddpi_Sourcefile object contains information about a source file. If this source file is in more than one compilation unit, there will be a separate Ddpi_Sourcefile object for each unit.

This object can be queried to get the following information:

- The full path name.
- The file name without the full path.
- The Ddpi_Access object whose .dbg file contains information from the source file.

Type definition

typedef struct Ddpi_Sourcefile_s* Ddpi_Sourcefile;

ddpi_sourcefile_get_full_name operation

The ddpi_sourcefile_get_full_name operation returns the full path name of the source file for the compilation unit. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

Prototype

int ddpi_sourcefile_get_full_name(
  Ddpi_Sourcefile sourcefile,
  char** ret_full_name,
  Ddpi_Error* error);

Parameters

sourcefile
  Input. This accepts the Ddpi_Sourcefile object for the source file.

ret_full_name
  Output. This returns the full path name of the source file.

error
  See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
  This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
  This value is never returned.

DW_DLV_ERROR
  This value is returned if:
    - sourcefile is NULL or invalid.
- The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the source file is either NULL or invalid.
- ret_full_name is NULL.

### ddpi_sourcefile_get_short_name operation

The `ddpi_sourcefile_get_short_name` operation returns the name of the source file for the compilation unit, without the full path. The actual version of the name is returned, not a copy. The user must never deallocate the returned pointer.

**Prototype**

```c
int ddpi_sourcefile_get_short_name(
    Ddpi_Sourcefile sourcefile,
    char** ret_short_name,
    Ddpi_Error* error);
```

**Parameters**

- **sourcefile**
  Input. This accepts the Ddpi_Sourcefile object for the source file.

- **ret_short_name**
  Output. This returns the path name of the source file, without the path.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  This value is never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - sourcefile is NULL or invalid.
  - The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the source file is either NULL or invalid.
  - ret_short_name is NULL.

### ddpi_sourcefile_get_access operation

The `ddpi_sourcefile_get_access` operation returns the Ddpi_Access object whose Dwarf_Debug instance contains information from the source file for the compilation unit. The actual Ddpi_Access version is returned, not a copy. The user must never deallocate the returned pointer.

**Prototype**

```c
int ddpi_sourcefile_get_access(
    Ddpi_Sourcefile sourcefile,
    Ddpi_Access* ret_access,
    Ddpi_Error* error);
```

**Parameters**

- **sourcefile**
  Input. This accepts the Ddpi_Sourcefile object for instance.
ret_access
Output. This returns the Ddpi_Access object whose Dwarf_Debug object contains the instance information.

error
See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• sourcefile is NULL or invalid.
• The Ddpi_Elf, Ddpi_Access, or Ddpi_Info object associated with the source file is either NULL or invalid.
• ret_access is NULL.

ddpi_sourcefile_get_die_offset operation
The ddpi_sourcefile_get_die_offset operation returns the DIE offset of the source file.

Prototype
int dmpi_sourcefile_get_die_offset(
    Ddpi_Sourcefile sourcefile,
    Dwarf_Off* ret_offset,
    Ddpi_Error* error);

Members

sourcefile
Input. This accepts the Ddpi_Sourcefile object for the source file.

ret_offset
Output. This returns the DIE offset.

error
See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
This value is returned upon successful completion of the operation.

DW_DLV_NO_ENTRY
This value is never returned.

DW_DLV_ERROR
This value is returned if:
• sourcefile is NULL or invalid.
• ret_offset is NULL.
**ddpi_sourcefile_get_source_lines operation**

The `ddpi_sourcefile_get_source_lines` operation returns the contents of the source file at the given line numbers. The returned string will be NULL terminated. To return all remaining lines, pass 0 for `num_lines`. If `num_lines` exceeds the remaining number of lines, all remaining lines will be returned.

**Prototype**

```c
int ddpi_sourcefile_get_source_lines(
    Ddpi_Sourcefile sourcefile,
    Dwarf_Unsigned first_line,
    Dwarf_Unsigned num_lines,
    char** ret_source,
    Ddpi_Error* error);
```

**Parameters**

- **sourcefile**
  - Input. This accepts the `Ddpi_Sourcefile` object for the source file.

- **first_line**
  - Input. This accepts the first line number to retrieve.

- **num_lines**
  - Input. This accepts the number of lines to retrieve, or 0 to retrieve all remaining lines.

- **ret_source**
  - Output. This returns the contents of the source file at the given lines.

- **error**
  - Input or output. This accepts and returns the `Ddpi_Error` object. This is a required parameter that handles error information generated by the producer or consumer application. If `error` is not NULL, the error information will be stored in the given object. If `error` is NULL, the API will search the error handler that is specified by the `ddpi_init` function. If no handler is specified, the application will abort.

**Return values**

- **DW_DLV_OK**
  - This value is returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - The given line numbers are out of range for the source file, or there is no captured source available for this file.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `sourcefile` is NULL or invalid.
    - The `Ddpi_Elf`, `Ddpi_Access`, `Ddpi_Module`, or `Ddpi_Info` object associated with `sourcefile` is either NULL or invalid.
    - `ret_source` is NULL.

**ddpi_sourcefile_query_capsrc operation**

The `ddpi_sourcefile_query_capsrc` operation returns whether the debug information contains a copy of the source file text.
Prototype

```c
int ddpi_sourcefile_query_capsrc(
    Ddpi_Sourcefile sourcefile,
    Dwarf_Bool* ret_capsrc,
    Ddpi_Error* error);
```

Parameters

**sourcefile**
- Input. This accepts the `Ddpi_Sourcefile` object that represents a source file.

**ret_capsrc**
- Output. This returns true if source text is embedded within debug information; otherwise, it returns false.

**error**
- See “The libddpi error parameter” on page 15

Return values

**DW_DLV_OK**
- This value is returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
- This value is never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `sourcefile` is NULL.
  - `ret_capsrc` is NULL.
Chapter 23. Ddpi_EntryPt APIs

Ddpi_EntryPt contains the following information:

- The location of the entry point
- The PDS/PDSE member name with which the application-executable module was entered or could be entered
- The symbol or control-section (CSECT) name of the entry point
- The addressing mode (AMODE) of the entry point
- The location of the program code in memory that contains the entry point
- The offset from the low address to the actual entry point of the module

**Ddpi_EntryPt object**

The Ddpi_EntryPt object is an opaque data type that contains information regarding a single entry point for a given application-executable module.

**Type definition**

```c
typedef struct Ddpi_EntryPt_s* Ddpi_EntryPt;
```

**Ddpi_EntryPt_Type object**

Contains the entry-point type constants.

**Type definition**

```c
typedef enum Ddpi_EntryPt_Type_s {
    Ddpi_EPT_Unknown = 0,
    Ddpi_EPT_MVS_PDS_Member = 1,
    Ddpi_EPT_MVS_PDS_Alias = 2,
    Ddpi_EPT_Unnamed = 3
} Ddpi_EntryPt_Type;
```

**Members**

- **Ddpi_EPT_Unknown**
  
  If this value is 0, the entry-point type is unknown or unacceptable.

- **Ddpi_EPT_MVS_PDS_Member**
  
  If this value is 1, the entry-point type is MVS or PDS.

- **Ddpi_EPT_MVS_PDS_Alias**
  
  If this value is 1, the entry-point type is an MVS or PDS alias.

- **Ddpi_EPT_Unnamed**
  
  If this value is 2, the entry-point type is unnamed.

**ddpi_entrypt_create operation**

The `ddpi_entrypt_create` operation creates an entry-point object to describe the entry point of a `Ddpi_Module` object and returns a descriptor.

When you call `ddpi_entrypt_create`, and pass a character string as the parameter name, the operation copies the content of name into its own storage. Once the operation returns the descriptor, you can deallocate the original name and save storage.
Prototype

```c
int ddpi_entrypt_create(
    Ddpi_Module module,
    char* entry_name,
    char* symbol_name,
    Ddpi_EntryPt_Type type,
    Ddpi_Addr_Mode mode,
    Ddpi_Class storage,
    Dwarf_Off storage_off,
    int user_area_len,
    Ddpi_EntryPt* ret_entrypt,
    Ddpi_Error* error);
```

Parameters

module
   Input. This accepts the Ddpi_Module object.

entry_name
   Input. This accepts the name or alias of the entry point. The value must be provided in ASCII.

symbol_name
   Input. This accepts the entry point symbol name. For example, the value could be `CEESTART` for C/C++.

type
   Input. This accepts the entry-point type.

mode
   Input. This accepts the entry-point address mode.

storage
   Input. This accepts the extent of the entry point storage.

storage_off
   Input. This accepts the offset of the entry-point storage.

user_area_len
   Input. This accepts the user-area length.

ret_entrypt
   Output. This returns a descriptor, which points to the entry-point object just created.

error
   See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
   Returned upon successful return of the entry-point object descriptor.

**DW_DLV_NO_ENTRY**
   Never returned.

**DW_DLV_ERROR**
   This value is returned if:
   • mode is NULL.
   • The Ddpi_Info object associated with module is NULL.
   • symbol_name is NULL.
   • ret_entrypt is NULL.
   • storage the (Ddpi_Class) is NULL.
An error occurs during memory allocation.
- user_area_len is less than zero.

### ddpi_entrypt_term operation

The `ddpi_entrypt_term` operation terminates an entry-point object.

The `ddpi_entrypt_term` operation releases all internal resources associated with the entry-point descriptor and invalidates the entry point.

**Prototype**

```
int ddpi_entrypt_term(
    Ddpi_EntryPt entrypt,
    Ddpi_Error* error);
```

**Parameters**

- **entrypt**
  - Input. This accepts the entry-point object.

- **error**
  - See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the entry-point object descriptor.

- **DW_DLV_NO_ENTRY**
  - Returned if the entry point was not found in its parent’s list of modules.

- **DW_DLV_ERROR**
  - This value is returned if:
    - **entrypt** is NULL.
    - The `Ddpi_Module` or `Ddpi_Info` object associated with `entrypt` is NULL.
    - An error occurs while terminating child descriptors.
    - An error occurs during memory allocation.

### ddpi_entrypt_get_owner operation

The `ddpi_entrypt_get_owner` operation returns the owner of an entry-point object, and returns a pointer to the owner.

**Prototype**

```
int ddpi_entrypt_get_owner(
    Ddpi_EntryPt entrypt,
    Ddpi_Module* ret_owner,
    Ddpi_Error* error);
```

**Parameters**

- **entrypt**
  - Input. This accepts the entry-point object.

- **ret_owner**
  - Output. This returns the `Ddpi_Module` object.

- **error**
  - See "The libddpi error parameter" on page 15
**Return values**

**DW_DLV_OK**
- Returned upon successful return of the entry-point object pointer.

**DW_DLV_NO_ENTRY**
- Returned if the entry point was not found in its parent's list of modules.

**DW_DLV_ERROR**
- This value is returned if:
  - `entrypt` is NULL.
  - The `Ddpi_Info` object associated with `entrypt` is NULL.
  - `ret_owner` is NULL.

---

**ddpi_entrypt_get_entry_name operation**

The `ddpi_entrypt_get_entry_name` operation returns the entry (or alias) name of an entry-point object, and returns a pointer to the name.

The name string is part of the `Ddpi_EntryPt` object, and must not be deallocated.

**Prototype**

```c
int ddpi_entrypt_get_entry_name(
    Ddpi_EntryPt entrypt,
    char** ret_entry_name,
    Ddpi_Error* error);
```

**Parameters**

- **entrypt**
  - Input. This accepts the entry-point object.
- **ret_entry_name**
  - Output. This returns a pointer to the entry name.
- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful return of the entry-point alias name.

**DW_DLV_NO_ENTRY**
- Returned if the entry name is not available.

**DW_DLV_ERROR**
- This value is returned if:
  - `entrypt` is NULL.
  - The `Ddpi_Info` object associated with `entrypt` is NULL.
  - `ret_entry_name` is NULL.

---

**ddpi_entrypt_set_entry_name operation**

The `ddpi_entrypt_set_entry_name` operation assigns a new entry (or alias) name of an entry-point object.
When the user calls the `ddpi_entrypt_set_entry_name`, passing a character string as the parameter name, the operation copies the content of name into its own storage. After the operation returns a value, you can deallocate the original name and save storage.

### Prototype

```c
int ddpi_entrypt_set_entry_name(
    Ddpi_EntryPt entrypt,
    char* new_entry_name,
    Ddpi_Error* error);
```

### Parameters

- **entrypt**
  - Input. This accepts the entry-point object.

- **new_entry_name**
  - Input. This accepts a new entry name.

- **error**
  - See [“The libddpi error parameter” on page 15](#).

### Return values

- **DW_DLV_OK**
  - Returned upon successful assignment of the entry-point alias name.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - entrypt is NULL.
    - The Ddpi_Info object associated with entrypt is NULL.

---

### ddpi_entrypt_get_symbol_name operation

The `ddpi_entrypt_get_symbol_name` operation returns the symbol name of an entry-point object.

The name string is part of the Ddpi_EntryPt object, and must not be deallocated.

### Prototype

```c
int ddpi_entrypt_get_symbol_name(
    Ddpi_EntryPt entrypt,
    char** ret_symbol_name,
    Ddpi_Error* error);
```

### Parameters

- **entrypt**
  - Input. This accepts the entry-point object.

- **ret_symbol_name**
  - Output. This returns the symbol name of the entry point.

- **error**
  - See [“The libddpi error parameter” on page 15](#).
Return values

DW_DLV_OK
   Returned upon successful assignment of the entry-point alias name.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • entrypt is NULL.
   • The Ddpi_Info object associated with entrypt is NULL.
   • ret_symbol_name is NULL.

ddpi_entrypt_set_symbol_name operation

The ddpi_entrypt_set_symbol_name operation assigns a new symbol name of an entry-point object.

When the user calls ddpi_entrypt_set_symbol_name, passing a character string as the parameter name, the operation copies the content of name into its own storage. After the operation returns a value, you can deallocate the original name and save storage.

Prototype

int ddpi_entrypt_set_symbol_name(
    Ddpi_EntryPt entrypt,
    char* new_symbol_name,
    Ddpi_Error* error);

Parameters

entrypt
   Input. This accepts the entry-point object.

new_symbol_name
   Input. This accepts the new symbol name of the entry point.

error
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful assignment of the new symbol name.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • entrypt is NULL.
   • The Ddpi_Info object associated with entrypt is NULL.
   • new_symbol_name is NULL or 0 bytes long.

ddpi_entrypt_get_type operation

The ddpi_entrypt_get_type operation returns the type of an entry-point object.
Prototype

```c
int dpi_entrypt_get_type(
    Ddpi_EntryPt entrypt,
    Ddpi_EntryPt_Type* ret_type,
    Ddpi_Error* error);
```

Parameters

- **entrypt**
  Input. This accepts the entry-point object.

- **ret_type**
  Output. This returns the type of the entry point.

- **error**
  See "The libddpi error parameter" on page 15

Return values

- **DW_DLV_OK**
  Returned upon successful retrieval of the entry-point object type.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - entrypt is NULL.
  - The Ddpi_Info object associated with entrypt is NULL.
  - ret_type is NULL

**ddpi_entrypt_set_type operation**

The ddpi_entrypt_set_type operation assigns a new type of an entry-point object.

Prototype

```c
int dpi_entrypt_set_type(
    Ddpi_EntryPt entrypt,
    Ddpi_EntryPt_Type new_type,
    Ddpi_Error* error);
```

Parameters

- **entrypt**
  Input. This accepts the entry-point object.

- **new_type**
  Input. This accepts the new type of the entry point.

- **error**
  See "The libddpi error parameter" on page 15

Return values

- **DW_DLV_OK**
  Returned upon successful assignment of the entry-point object type.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
ddpi_entrypt_get_addr_mode operation

The ddpi_entrypt_get_addr_mode operation returns the address mode (AMODE) of an entry-point object.

Prototype

```c
int ddpi_entrypt_get_addr_mode(
    Ddpi_EntryPt entrypt,
    Ddpi_Addr_Mode* ret_amode,
    Ddpi_Error* error);
```

Parameters

entrypt
Input. This accepts the entry-point object.

ret_amode
Output. This returns the addressing mode of the entry point.

error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful return of the entry-point address mode.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- entrypt is NULL.
- The Ddpi_Info object associated with entrypt is NULL.
- ret_amode is NULL.

ddpi_entrypt_set_addr_mode operation

The ddpi_entrypt_set_addr_mode operation assigns a new AMODE of an entry-point object.

Prototype

```c
int ddpi_entrypt_set_addr_mode(
    Ddpi_EntryPt entrypt,
    Ddpi_Addr_Mode new_amode,
    Ddpi_Error* error);
```

Parameters

entrypt
Input. This accepts the entry-point object (Ddpi_EntryPt).

new_amode
Input. This accepts the object that contains the new entry-point AMODE (Ddpi_Addr_Mode).

ret_type is NULL.
The Ddpi_Info object associated with entrypt is NULL.
ret_type is NULL.
error
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful assignment of the entry-point address mode.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `entrypt` is NULL.
- The `Ddpi_Info` object associated with `entrypt` is NULL.

### ddpi_entrypt_get_storage_extent operation

The `ddpi_entrypt_get_storage_extent` operation returns a pointer to the storage-extent class of an entry-point object.

Do not terminate or delete this pointer. It will be terminated when `libddpi` is terminated.

#### Prototype

```c
int ddpi_entrypt_get_storage_extent(
    Ddpi_EntryPt entrypt,
    Ddpi_Class* ret_storage_extent,
    Ddpi_Error* error);
```

#### Parameters

- **entrypt**
  Input. This accepts the entry-point object.

- **ret_storage_extent**
  Output. This returns the `Ddpi_Class` object of the entry point.

- **error**
  See “The libddpi error parameter” on page 15.

#### Return values

- **DW_DLV_OK**
  Returned upon successful return of the pointer to the storage-extent class of the entry-point object.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - `entrypt` is NULL.
  - The `Ddpi_Info` object associated with `entrypt` is NULL.
  - `ret_storage_extent` is NULL.
ddpi_entrypt_set_storage_extent operation

The ddpi_entrypt_set_storage_extent operation assigns the storage extent of an entry-point object to a Ddpi_Class object.

Do not terminate or delete this pointer. It will be terminated when libddpi is terminated.

Prototype

```c
int ddpi_entrypt_set_storage_extent(
    Ddpi_EntryPt enetrypt,
    Ddpi_Class new_storage_extent,
    Ddpi_Error* error);
```

Parameters

- **entrypt**
  - Input. This accepts the entry-point object.

- **new_storage_extent**
  - Input. This accepts the new Ddpi_Class object of the entry point.

- **error**
  - See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful assignment of a pointer to the storage-extent class of the entry-point object.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - entrypt is NULL.
    - The Ddpi_Info object associated with entrypt is NULL.
    - new_storage_extent is NULL.

ddpi_entrypt_get_storage_offset operation

The ddpi_entrypt_get_storage_offset operation returns the storage offset of an entry-point object.

The offset is relative to the start address of the storage-extent Ddpi_Class object.

Prototype

```c
int ddpi_entrypt_get_storage_offset(
    Ddpi_EntryPt entrypt,
    Dwarf_Off* ret_storage_off,
    Ddpi_Error* error);
```

Parameters

- **entrypt**
  - Input. This accepts the entry-point object.

- **ret_storage_off**
  - Output. This returns the storage offset of the entry point.
ddpi_entrypt_set_storage_offset operation

The ddpi_entrypt_set_storage_offset operation assigns the storage offset of an entry-point object.

The offset is relative to the start address of the storage-extent Ddpi_Class object.

Prototype

```c
int ddpi_entrypt_set_storage_offset(
    Ddpi_EntryPt entrypt,
    Dwarf_Off new_storage_off,
    Ddpi_Error* error);
```

Parameters

- `entrypt`
  Input. This accepts the entry-point object.

- `new_storage_off`
  Input. This accepts the storage offset of the entry point.

- `error`
  See “The libddpi error parameter” on page 15

Return values

- `DW_DLV_OK`
  Returned upon successful assignment of the entry-point storage offset.

- `DW_DLV_NO_ENTRY`
  Never returned.

- `DW_DLV_ERROR`
  This value is returned if:
  - `entrypt` is NULL.
  - The Ddpi_Info object associated with `entrypt` is NULL.
  - `ret_storage_extent` is NULL.

ddpi_entrypt_get_user_area operation

The ddpi_entrypt_get_user_area operation queries the user area of an entry-point object. It then returns a pointer to the start of the user area.
Prototype

```c
int ddpi_entrypt_get_user_area(
    Ddpi_EntryPt  entrypt,
    Dwarf_Ptr*    ret_user_area,
    Ddpi_Error*   error);
```

Parameters

**entrypt**

Input. This accepts the entry-point object.

**ret_user_area**

Output. This returns a pointer to the user area of the entry point.

**error**

See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**

Returned upon successful return of the user area start address.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:
- entrypt is NULL.
- ret_user_area is NULL.
Chapter 24. Ddpi_Machinestate APIs

This object contains members that represent the different registers and other machine-related information, such as the program status word (PSW). A Ddpi_Machinestate object can represent either the actual (current) machine state or the model (original) machine state.

Use the Ddpi_Machinestate object to show the current state of the system and its registers.

In order to create a model, the registers themselves, not the objects, are changed to represent the modeled state. An application uses the Ddpi_Machinestate object to keep track of the original state of the machine. After it stops actively debugging an executable module, the debugger can return the machine to its original state.

Note: Ddpi_Machinestate is also used by the formatting operations. For more information, see Chapter 30, “Ddpi_Format APIs,” on page 305.

Ddpi_Machinestate objects must be created by the ddpi_machinestate_create operation and initialized by the ddpi_machinestate_init operation.

Use set and get operations to assign and verify values.

Use query operations to determine if the value has been modified since the last time all of the modified bits were reset by the ddpi_machinestate_reset_change operation.

Use context APIs to relate a machine state with a currently-operating task.

The PSW contains both the instruction pointer (IP) address and the addressing mode (AMODE). The Ddpi_Machinestate object allows the IP address and AMODE to be updated separately from the PSW. Any change in IP or AMODE can affect the validity of the PSW, and a change in PSW affects the value and validity of the IP and AMODE.

Ddpi_MachineState object

The Ddpi_MachineState object is an opaque data structure that associates all information regarding the given machine state for a given context.

Type definition

typedef struct Ddpi_MachineState_s* Ddpi_MachineState;

Ddpi_AR object

The Ddpi_AR object contains valid address register (AR) types.

Type definition

typedef enum Ddpi_AR_s {
    Ddpi_AR00 = 0,
    Ddpi_AR01 = 1,
    Ddpi_AR02 = 2,
    Ddpi_AR03 = 3,
} Ddpi_AR;
Ddpi_AR04  =  4,
Ddpi_AR05  =  5,
Ddpi_AR06  =  6,
Ddpi_AR07  =  7,
Ddpi_AR08  =  8,
Ddpi_AR09  =  9,
Ddpi_AR10  = 10,
Ddpi_AR11  = 11,
Ddpi_AR12  = 12,
Ddpi_AR13  = 13,
Ddpi_AR14  = 14,
Ddpi_AR15  = 15
} Ddpi_AR;

Members
Ddpi_AR00
  0
Ddpi_AR01
  1
Ddpi_AR02
  2
Ddpi_AR03
  3
Ddpi_AR04
  4
Ddpi_AR05
  5
Ddpi_AR06
  6
Ddpi_AR07
  7
Ddpi_AR08
  8
Ddpi_AR09
  9
Ddpi_AR10
 10
Ddpi_AR11
 11
Ddpi_AR12
 12
Ddpi_AR13
 13
Ddpi_AR14
 14
Ddpi_AR15
 15
Ddpi_CR object

Contains the control register (CR).

**Type definition**

```c
typedef enum Ddpi_CR_s {
  Ddpi_CR00 = 0,
  Ddpi_CR01 = 1,
  Ddpi_CR02 = 2,
  Ddpi_CR03 = 3,
  Ddpi_CR04 = 4,
  Ddpi_CR05 = 5,
  Ddpi_CR06 = 6,
  Ddpi_CR07 = 7,
  Ddpi_CR08 = 8,
  Ddpi_CR09 = 9,
  Ddpi_CR10 = 10,
  Ddpi_CR11 = 11,
  Ddpi_CR12 = 12,
  Ddpi_CR13 = 13,
  Ddpi_CR14 = 14,
  Ddpi_CR15 = 15
} Ddpi_CR;
```

**Members**

- **Ddpi_CR00**
  - 0
- **Ddpi_CR01**
  - 1
- **Ddpi_CR02**
  - 2
- **Ddpi_CR03**
  - 3
- **Ddpi_CR04**
  - 4
- **Ddpi_CR05**
  - 5
- **Ddpi_CR06**
  - 6
- **Ddpi_CR07**
  - 7
- **Ddpi_CR08**
  - 8
- **Ddpi_CR09**
  - 9
- **Ddpi_CR10**
  - 10
- **Ddpi_CR11**
  - 11
- **Ddpi_CR12**
  - 12
- **Ddpi_CR13**
  - 13
- **Ddpi_CR14**
  - 14
- **Ddpi_CR15**
  - 15
Ddpi_FPR object

Contains the floating-point register (FPR).

Type definition
typedef enum Ddpi_FPR_s {
    Ddpi_FPR00 = 0,
    Ddpi_FPR01 = 1,
    Ddpi_FPR02 = 2,
    Ddpi_FPR03 = 3,
    Ddpi_FPR04 = 4,
    Ddpi_FPR05 = 5,
    Ddpi_FPR06 = 6,
    Ddpi_FPR07 = 7,
    Ddpi_FPR08 = 8,
    Ddpi_FPR09 = 9,
    Ddpi_FPR10 = 10,
    Ddpi_FPR11 = 11,
    Ddpi_FPR12 = 12,
    Ddpi_FPR13 = 13,
    Ddpi_FPR14 = 14,
    Ddpi_FPR15 = 15
} Ddpi_FPR;

Members
Ddpi_FPR00
  0
Ddpi_FPR01
  1
Ddpi_FPR02
  2
Ddpi_FPR03
  3
Ddpi_FPR04
  4
Ddpi_FPR05
  5
Ddpi_FPR06
  6
Ddpi_FPR07
  7
Ddpi_FPR08
  8
Ddpi_FPR09
  9
Ddpi_GPR object

Contains the general-purpose register (GPR).

Type definition
typedef enum Ddpi_GPR_s {
    Ddpi_GPR00 = 0,
    Ddpi_GPR01 = 1,
    Ddpi_GPR02 = 2,
    Ddpi_GPR03 = 3,
    Ddpi_GPR04 = 4,
    Ddpi_GPR05 = 5,
    Ddpi_GPR06 = 6,
    Ddpi_GPR07 = 7,
    Ddpi_GPR08 = 8,
    Ddpi_GPR09 = 9,
    Ddpi_GPR10 = 10,
    Ddpi_GPR11 = 11,
    Ddpi_GPR12 = 12,
    Ddpi_GPR13 = 13,
    Ddpi_GPR14 = 14,
    Ddpi_GPR15 = 15
} Ddpi_GPR;

Members
Ddpi_GPR00
    0
Ddpi_GPR01
    1
Ddpi_GPR02
    2
Ddpi_GPR03
    3
Ddpi_GPR04
    4
Ddpi_GPR05
    5
Ddpi_GPR06
    6
Ddpi_PSW object

The program status word (PSW).

Type definition
typedef struct Ddpi_PSW_s {
  int zero_field0:1;
  int per_mask:1;
  int zero_field1:2;
  int bit4:1;
  int dat_mode:1;
  int io_mask:1;
  int external_mask:1;
  int psw_key:4;
  int bit12:1;
  int machine_check_mask:1;
  int wait_state:1;
  int problem_state:1;
  int as_control:2;
  int condition_code:2;
  int program_mask:4;
  int zero_field2:7;
  int extended_am:1;
  int basic_am:1;
  int zero_field3:31;
  Dwarf.Addr IP;
} Ddpi_PSW;

Members

zero_field0:1
  Integer type. Reserved. The field must be zero.

per_mask:1
  Integer type. Program-event recording mask.

zero_field1:2
  Integer type. Reserved. The field must be zero.
bit4:1
    Integer type. Bit 4.

dat_mode:1
    Integer type. Controls the Dynamic Address Translation (DAT) of storage addresses during storage access.

io_mask:1
    Integer type. I/O interrupt mask.

external_mask:1
    Integer type. External interrupt mask.

psw_key:4
    Integer type. Storage-access key.

bit12:1
    Integer type. Bit 12 must be 0 for the MVS-architecture PSW.

machine_check_mask:1

wait_state:1
    Integer type. 1. No instructions processed by the CPU, but interruptions may take place. 0. Normal instruction fetch and execution.

problem_state:1
    Integer type. 1. CPU in problem state. 0. CPU in supervisor state.

as_control:2
    Integer type. Address-translation mode control.

condition_code:2
    Integer type. Condition code.

program_mask:4
    Integer type. Program mask bits, one per exception type

zero_field2:7
    Integer type. Reserved. The field must be zero.

extended_am:1
    Integer type. Controls size of effective addresses, in conjunction with the basic_am.

basic_am:1
    Integer type. Basic-address mode control.

zero_field3:31
    Integer type. Reserved. The field must be zero.

IP Dwarf.Addr type. Instruction-address pointer.

Ddpi_PSW_Type object
The PSW type.

Type definition
typedef enum Ddpi_PSW_Type_s {
    Ddpi_PSW_T_current  = 0,
    Ddpi_PSW_T_machchk  = 1,
    Ddpi_PSW_T_io      = 2
} Ddpi_PSW_Type;
Members

Ddpi_PSW_T_current
If this value is 0, the PSW gives the execution status.

Ddpi_PSW_T_machchk
If this value is 1, the PSW gives the machine state.

Ddpi_PSW_T_io
If this value is 2, the PSW gives the I/O state.

Ddpi_Context object

The Ddpi_Context object contains valid context data types.

Type definition
typedef union Ddpi_Context_s {
  Ddpi_Thread       cx_thread;
  Ddpi_Process      cx_process;
} Ddpi_Context;

Members

cx_thread
Ddpi_Thread type with pthread context information.

cx_process
Ddpi_Process type with MVS TCB context information.

Ddpi_Context_Type object

The Ddpi_Context_Type object contains the data type of the context in which the compilation unit is running.

Type definition
typedef enum Ddpi_Context_Type_s {
  Ddpi_CX_unknown     = 0,
  Ddpi_CX_pthread     = 1,
  Ddpi_CX_TCB         = 2
} Ddpi_Context_Type;

Members

Ddpi_CX_unknown
If this value is 0, the context data type is unknown.

Ddpi_CX_pthread
If this value is 1, the program is running under a POSIX thread.

Ddpi_CX_TCB
If this value is 2, the program is running under MVS TCB.

Ddpi_VR object

The Ddpi_VR object contains valid vector register (VR) types.

Type definition
typedef enum Ddpi_VR_s {
  Ddpi_VR00    = 0,
  Ddpi_VR01    = 1,
  Ddpi_VR02    = 2,
  Ddpi_VR03    = 3
} Ddpi_VR;
Ddpi_VR03 = 3,
Ddpi_VR04 = 4,
Ddpi_VR05 = 5,
Ddpi_VR06 = 6,
Ddpi_VR07 = 7,
Ddpi_VR08 = 8,
Ddpi_VR09 = 9,
Ddpi_VR10 = 10,
Ddpi_VR11 = 11,
Ddpi_VR12 = 12,
Ddpi_VR13 = 13,
Ddpi_VR14 = 14,
Ddpi_VR15 = 15,
Ddpi_VR16 = 16,
Ddpi_VR17 = 17,
Ddpi_VR18 = 18,
Ddpi_VR19 = 19,
Ddpi_VR20 = 20,
Ddpi_VR21 = 21,
Ddpi_VR22 = 22,
Ddpi_VR23 = 23,
Ddpi_VR24 = 24,
Ddpi_VR25 = 25,
Ddpi_VR26 = 26,
Ddpi_VR27 = 27,
Ddpi_VR28 = 28,
Ddpi_VR29 = 29,
Ddpi_VR30 = 30,
Ddpi_VR31 = 31
Chapter 24. Ddpi_Machinestate APIs

Members

Ddpi_VR00 = 0
Ddpi_VR01 = 1
Ddpi_VR02 = 2
Ddpi_VR03 = 3
Ddpi_VR04 = 4
Ddpi_VR05 = 5
Ddpi_VR06 = 6
Ddpi_VR07 = 7
Ddpi_VR08 = 8
Ddpi_VR09 = 9
Ddpi_VR10 = 10
ddpi_machinestate_create operation

The ddpi_machinestate_create operation creates a Ddpi_MachineState object to describe the processor state and returns a descriptor that represents the system state at the time the descriptor was created.

Prototype

```c
int ddpi_machinestate_create(
    Ddpi_Space space,
    Ddpi_Context_Type context_type,
    Ddpi_Context context,
    Ddpi_MachineState* ret_machinestate,
    Ddpi_Error* error);
```

Parameters

- **space**
  - Input. This accepts the Ddpi_Space object.
- **context_type**
  - Input. This accepts the execution context type.
- **context**
  - Input. This accepts the Ddpi_Context object.
- **ret_machinestate**
  - Output. This returns the Ddpi_MachineState object.
- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful return of the machine state object descriptor.
- **DW_DLV_NO_ENTRY**
  - Never returned.
- **DW_DLV_ERROR**
  - This value is returned if:
    - space is NULL.
    - The Ddpi_Info object associated with space is NULL.
    - ret_machinestate is NULL.
    - An error occurs during memory allocation.

ddpi_machinestate_term operation

The ddpi_machinestate_term operation terminates the given Ddpi_MachineState object.

ddpi_machinestate_term releases all internal resources associated with the machine state object, and invalidates the given machine state.

Prototype

```c
int ddpi_machinestate_term(
    Ddpi_MachineState machinestate,
    Ddpi_Error* error);
```
Parameters
machinestate
   Input. This accepts the Ddpi_MachineState object.

error
   See “The libddpi error parameter” on page 15.

Return values
DW_DLV_OK
   Returned upon successful invalidation of the given machine state object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • space is NULL.
   • The Ddpi_Space or Ddpi_Info object associated with space is NULL.
   • ret_machinestate is NULL.
   • A problem occurs during termination of the stack state.
   • An error occurs during memory allocation.

ddpi_machinestate_init operation
The dpip_machinestate_init operation resets the given Ddpi_MachineState object and its associated Ddpi_StorageLocn object.

dpi_machinestate_init never attempts to reset the Ddpi_Space object and the Ddpi_Context object.

The nested Ddpi_StorageLocn is set back to SL_Policy_Opaque and the address is set back to 0.

Prototype
int dpip_machinestate_init(
    Ddpi_MachineState machinestate,
    Ddpi_Error* error);

Parameters
machinestate
   Input. This accepts the Ddpi_MachineState object.

error
   See “The libddpi error parameter” on page 15.

Return values
DW_DLV_OK
   Returned upon successful invalidation of the given machine state object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • machinestate is NULL
The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.

- ddpi_storagelocn_set_policy returns DW_DLV_ERROR.
- ddpi_storagelocn_set_addr returns DW_DLV_ERROR.

### ddpi_machinestate_clone operation

The `ddpi_machinestate_clone` operation clones the internal state of a `Ddpi_MachineState` object to a new `Ddpi_MachineState` object.

The `ddpi_machinestate_clone` operation creates the new `Ddpi_MachineState` object by:

2. Copying the states from the given `Ddpi_MachineState` object into the new `Ddpi_MachineState` object.
3. Creating a new `Ddpi_StorageLocn` object with the same settings as the `Ddpi_StorageLocn` object from the original `Ddpi_MachineState` object.

#### Prototype

```c
int ddpi_machinestate_clone(
    Ddpi_MachineState original,
    Ddpi_MachineState* clone_ptr,
    Ddpi_Error* error);
```

#### Parameters

- **original**
  - Input. This accepts the original `Ddpi_MachineState` object.

- **clone_ptr**
  - Output. This returns a pointer to the `Ddpi_MachineState` object that will receive the clone information.

- **error**
  - See “The libddpi error parameter” on page 15.

#### Return values

- **DW_DLV_OK**
  - Returned upon successful creation of the given machine state object clone.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `original` is NULL
    - The Ddpi_Space or Ddpi_Info object associated with `original` is NULL.
    - An error occurs during creation of the nested `Ddpi_StorageLocn` object.

### ddpi_machinestate_copy operation

The `ddpi_machinestate_copy` operation copies the internal state of a `Ddpi_MachineState` object to another existing `Ddpi_MachineState` object.

The `ddpi_machinestate_copy` operation creates a new `Ddpi_StorageLocn` with the same `Ddpi_StorageLocn` settings as the original `Ddpi_MachineState`. 
Prototype

```c
int ddpi_machinestate_copy(
    Ddpi_MachineState  original,
    Ddpi_MachineState  copy,
    Ddpi_Error*        error);
```

Parameters

**original**
- Input. This accepts the original `Ddpi_MachineState` object.

**copy**
- Input. This accepts the `Ddpi_MachineState` object to be updated with the copy.

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- Returned upon successful creation of the storage location copy.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `original` is NULL.
  - The `Ddpi_Space` or `Ddpi_Info` object associated with `original` is NULL.
  - `copy` is NULL.
  - An error occurs during update or access of the nested `Ddpi_StorageLocn` object.

**ddpi_machinestate_get_gpr operation**

The `ddpi_machinestate_get_gpr` operation returns specific GPR elements of the `Ddpi_MachineState` object.

`ddpi_machinestate_copy` returns:
- The GPR value
- The GPR high and low flags for the given GPR, depending on settings given at the time of the flags are assigned
- The GPR value modified flag, to indicate whether the GPR value has been modified since the last reset
- The stored location of the GPR, which may be used when shadowing GPR values or walking a stack

Prototype

```c
int ddpi_machinestate_get_gpr(
    Ddpi_GPR      gpr_nbr,
    Ddpi_MachineState  machinestate,
    Dwarf_Signed*  ret_gpr_value,
    Dwarf_Bool*    ret_gpr_high_valid,
    Dwarf_Bool*    ret_gpr_low_valid,
    Dwarf_Bool*    ret_gpr_modified,
    Dwarf_Unsigned* ret_gpr_locn,
    Ddpi_Error*    error);
```
Parameters

gpr_nbr
Input. This accepts the GPR number.

machinestate
Input. This accepts the original Ddpi_MachineState object.

ret_gpr_value
Output. This returns the GPR value.

ret_gpr_high_valid
Output. This returns the high GPR valid flag.

ret_gpr_low_valid
Output. This returns the low GPR valid flag.

ret_gpr_modified
Output. This returns the GPR modified flag.

ret_gpr_locn
Output. This returns the GPR location.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of the GPR settings.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• machinestate is NULL
• The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
• gpr_nbr is out of range
• ret_gpr_value, ret_gpr_high_valid, ret_gpr_low_valid, ret_gpr_modified, or ret_gpr_locn are NULL
• An error occurs during creation of the nested Ddpi_StorageLocn object.
• An error occurs when a DWARF function is called.

DDPI_MACHINESTATE_SET_GPR_OPERATION

The ddpi_machinestate_set_gpr operation updates the GPR value, flags, and location of a given Ddpi_MachineState object.

Prototype

int ddpi_machinestate_set_gpr(
   Ddpi_GPR gpr_nbr,
   Ddpi_MachineState machinestate,
   Dwarf_Signed gpr_value,
   Dwarf_Bool gpr_high_valid,
   Dwarf_Bool gpr_low_valid,
   Dwarf_ Unsigned gpr_locn,
   Ddpi_Error* error);
Parameters

gpr_nbr
   Input. This accepts the GPR number.

machinestate
   Input. This accepts the Ddpi_MachineState object.

gpr_value
   Input. This accepts the new GPR value.

gpr_high_valid
   Input. This accepts the new high GPR valid flag.

gpr_low_valid
   Input. This accepts the new low GPR valid flag.

gpr_locn
   Input. This accepts the new GPR location.

error
   See “The libdmpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful assignment of the saved GPR settings to the new
   machine state object.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
      • machinestate is NULL
      • The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
      • gpr_nbr is out of range.
      • An unknown value is given for the valid flags.
      • An error occurs when a DWARF function is called.

ddpi_machinestate_query_gpr_change operation

The ddpi_machinestate_query_gpr_change operation checks the state of a given
GPR for any change, and returns true if a bit setting has been modified.

Prototype

int ddpi_machinestate_query_gpr_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);

Parameters

machinestate
   Input. This accepts the Ddpi_MachineState object.

ret_flag
   Output. This returns true if the state of the GPR has changed.

error
   See “The libdmpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful return of the flag that indicates whether a change in GPR has occurred.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `machinestate` is NULL
  - The Ddpi_Space or Ddpi_Info object associated with `machinestate` is NULL.
  - An error occurs when a DWARF function is called.

**ddpi_machinestate_get_fpr operation**

The `ddpi_machinestate_get_fpr` operation returns specific FPR values of the given Ddpi_MachineState object.

The `ddpi_machinestate_get_fpr` operation returns:
- The value of the requested FPR number.
- The valid flag for the given FPR. This is dependent on the last value given by the user.
- The modified flag for the given FPR. This indicates whether the FPR value has been modified since the last reset.
- The stored location of this FPR. This may be used when shadowing FPR values.

**Prototype**

```c
int ddpi_machinestate_get_fpr(
    Ddpi_FPR fpr_nbr,
    Ddpi_MachineState machinestate,
    Dwarf_Signed* ret_fpr_value,
    Dwarf_Bool* ret_fpr_valid,
    Dwarf_Bool* ret_fpr_modified,
    Dwarf_Unsigned* ret_fpr_locn,
    Ddpi_Error* error);
```

**Parameters**

- **fpr_nbr**
  - Input. This accepts the FPR number.

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **ret_fpr_value**
  - Output. This returns the FPR value.

- **ret_fpr_valid**
  - Output. This returns the FPR valid flag.

- **ret_fpr_modified**
  - Output. This returns the FPR modified flag.

- **error**
  - See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful retrieval of the FPR settings.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - machinestate is NULL
  - The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
  - ret_fpr_value, ret_fpr_valid, ret_fpr_modified, or ret_fpr_locn is NULL.
  - fpr_nbr is out of range.
  - An error occurs when a DWARF function is called.

---

**ddpi_machinestate_set_fpr operation**

The ddpi_machinestate_set_fpr operation updates the given FPR of a given Ddpi_MachineState object.

The ddpi_machinestate_set_fpr operation updates the FPR value, flag, and location.

**Prototype**

```c
int ddpi_machinestate_set_fpr(
    Ddpi_FPR fpr_nbr,
    Ddpi_MachineState machinestate,
    Dwarf_Signed fpr_value,
    Dwarf_Bool fpr_valid,
    Dwarf_Unsigned fpr_locn,
    Ddpi_Error* error);
```

**Parameters**

- **fpr_nbr**
  - Input. This accepts the FPR number.

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **fpr_value**
  - Input. This accepts the FPR value.

- **fpr_valid**
  - Input. This accepts the FPR valid flag.

- **fpr_locn**
  - Input. This accepts the new FPR location, or 0.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- Returned upon successful update of the FPR settings.

**DW_DLV_NO_ENTRY**
- Never returned.
**DW_DLV_ERROR**

This value is returned if:

- `machinestate` is NULL.
- The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
- `ret_fpr_value`, `ret_fpr_valid`, `ret_fpr_modified`, or `ret_fpr_locn` is NULL.
- `fpr_nbr` is out of range.
- An error occurs when a DWARF function is called.

---

**ddpi_machinestate_query_fpr_change operation**

The `ddpi_machinestate_query_fpr_change` operation returns true if a bit setting on any FPR is modified.

**Prototype**

```c
int ddpi_machinestate_query_fpr_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`  
  Input. This accepts the `Ddpi_MachineState` object.

- `ret_flag`  
  Output. This returns true if the state of the FPR has changed.

- `error`  
  See ["The libddpi error parameter" on page 15](#)

**Return values**

- **DW_DLV_OK**  
  Returned upon successful retrieval of the flag that indicates whether a change in FPR has occurred.

- **DW_DLV_NO_ENTRY**  
  Never returned.

- **DW_DLV_ERROR**  
  This value is returned if:
  - `machinestate` is NULL
  - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
  - An error occurs when a DWARF function is called.

---

**ddpi_machinestate_get_fpcr operation**

The `ddpi_machinestate_get_fpcr` operation returns specific floating-point control register (FPCR) elements of the given `Ddpi_MachineState` object.

`ddpi_machinestate_get_fpcr` returns the following elements:

- The FPCR value of the given `Ddpi_MachineState` object
- The valid flag for this FPCR, based on the last value given when setting the FPCR
- The modified flag for this FPCR, which indicates whether the FPCR value has been modified since the last reset
• The stored location of this FPCR, which may be used when shadowing FPCR values

Prototype

```c
int ddpi_machinestate_get_fpcr(
    Ddpi_MachineState machinestate,
    Dwarf_Signed* ret_fpcr_value,
    Dwarf_Bool* ret_fpcr_valid,
    Dwarf_Bool* ret_fpcr_modified,
    Dwarf_Unsigned* ret_fpcr_locn,
    Ddpi_Error* error);
```

Parameters

- `machinestate`  
  Input. This accepts the Ddpi_MachineState object.

- `ret_fpcr_value`  
  Output. This returns the FCPR value.

- `ret_fpcr_valid`  
  Output. This returns the FCPR valid flag.

- `ret_fpcr_modified`  
  Output. This returns the FCPR modified flag.

- `ret_fpcr_locn`  
  Output. This returns the FCPR location.

- `error`  
  See “The libddpi error parameter” on page 15.

Return values

- `DW_DLV_OK`  
  Returned upon successful return of the FPCR settings.

- `DW_DLV_NO_ENTRY`  
  Never returned.

- `DW_DLV_ERROR`  
  This value is returned if:
  • `machinestate` is NULL
  • The Ddpi_Space or Ddpi_Info object associated with `machinestate` is NULL.
  • `ret_fpcr_value`, `ret_fpcr_valid`, `ret_fpcr_modified`, or `ret_fpcr_locn` is NULL.
  • An error occurs when a DWARF function is called.

**ddpi_machinestate_set_fpcr operation**

The `ddpi_machinestate_set_fpcr` operation updates specific FPCR elements of the given Ddpi_MachineState object.

`ddpi_machinestate_set_fpcr` updates the following elements:

• The FPCR value of the given Ddpi_MachineState object
• The valid flag for this FPCR, based on the last value given when setting the FPCR
• The stored location of this FPCR, which may be used when shadowing FPCR values
Prototype

```c
int dpi_machinestate_set_fpcr(
    Ddpi_MachineState machinestate,
    Dwarf_Signed fpcr_value,
    Dwarf_Bool fpcr_valid,
    DwarfUnsigned fpcr_locn,
    Ddpi_Error* error);
```

Parameters

machinestate
   Input. This accepts the Ddpi_MachineState object.

fpcr_value
   Input. This accepts the FPCR value.

fpcr_valid
   Input. This accepts the FPCR valid flag.

fpcr_locn
   Input. This accepts the new FPCR location, or 0.

error
   See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
   Returned upon successful assignment of the FPCR settings.

**DW_DLV_NO_ENTRY**
   Never returned.

**DW_DLV_ERROR**
   This value is returned if:
   - machinestate is NULL
   - The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
   - An unknown value is given for the valid flag
   - An error occurs when a DWARF function is called.

 advertisers_query_fpcr_change operation

The `dpi_machinestate_query_fpcr_change` operation queries a given
Ddpi_MachineState object, and returns true if a bit setting has been modified on
any FPCR element.

Prototype

```c
int dpi_machinestate_query_fpcr_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

Parameters

machinestate
   Input. This accepts the Ddpi_MachineState object.

ret_flag
   Output. This returns true if the state of the FPCR has changed.
Return values

**DW_DLV_OK**
- Returned upon successful retrieval of the flag that indicates whether a change in FPCR has occurred.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - machinestate is NULL
  - The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
  - An error occurs when a DWARF function is called.

### ddpi_machinestate_get_ar operation

The `ddpi_machinestate_get_ar` operation returns specific AR elements of the given Ddpi_MachineState object.

### Prototype

```c
int ddpi_machinestate_get_ar(
  Ddpi_AR ar_nbr,
  Ddpi_MachineState machinestate,
  Dwarf_Signed* ret_ar_value,
  Dwarf_Bool* ret_ar_valid,
  Dwarf_Bool* ret_ar_modified,
  Dwarf_Unsigned* ret_ar_locn,
  Ddpi_Error* error);
```

### Parameters

- **ar_nbr**
  - Input. This accepts the AR number.

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **ret_ar_value**
  - Output. This returns the AR value.

- **ret_ar_valid**
  - Output. This returns the AR valid flag.

- **ret_ar_modified**
  - Output. This returns the AR modified flag.
ret_ar_locn
Output. This returns the AR location.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful return of the AR settings.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
- machinestate is NULL
- The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
- ret_ar_value, ret_ar_valid, ret_ar_modified, or ret_ar_locn is NULL.
- ar_number is out of range.
- An error occurs when a DWARF function is called.

ddpi_machinestate_set_ar operation

The ddpi_machinestate_set_ar operation updates the given AR of the given Ddpi_MachineState object.

ddpi_machinestate_set_ar updates the AR value, flag, and location.

Prototype

```c
int ddpi_machinestate_set_ar(
    Ddpi_AR ar_nbr,
    Ddpi_MachineState machinestate,
    Dwarf_Signed ar_value,
    Dwarf_Bool ar_valid,
    DwarfUnsigned ar_locn,
    Ddpi_Error* error);
```

Parameters

ar_nbr
Input. This accepts the AR number.

machinestate
Input. This accepts the Ddpi_MachineState object.

ar_value
Input. This accepts the new AR value list.

ar_valid
Input. This accepts the new AR valid flag.

ar_locn
Input. This accepts the new AR location, or 0.

error
See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
Returned upon successful assignment of the AR settings to the given machine state object.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `machinestate` is NULL
- The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
- `ar_nbr` is out of range
- An unknown value is given for the valid flag
- An error occurs when a DWARF function is called.

---

### `ddpi_machinestate_query_ar_change` operation

The `ddpi_machinestate_query_ar_change` operation queries the given `Ddpi_MachineState` object and returns true if any bit setting has been modified any AR.

**Prototype**

```
int ddpi_machinestate_query_ar_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`
  - Input. This accepts the `Ddpi_MachineState` object.

- `ret_flag`
  - Output. This returns true if the state of the AR has changed.

- `error`
  - See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
Returned upon successful return of the flag that indicates whether a change in AR has occurred.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `machinestate` is NULL
- The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
- An error occurs when a DWARF function is called.
ddpi_machinestate_get_cr operation

The `ddpi_machinestate_get_cr` operation returns specific CR elements of the given `Ddpi_MachineState` object.

`ddpi_machinestate_get_cr` returns the following elements:
- The value of the requested CR number
- The valid flag for the given CR, based on the last value given when setting the CR
- The modified flag for the given CR, which indicates whether the CR value has been modified since the last reset
- The stored location of this given CR, which may be used when shadowing CR values

Prototype

```c
int ddpi_machinestate_get_cr(
    Ddpi_CR cr_nbr,
    Ddpi_MachineState machinestate,
    Dwarf_Signed* ret_cr_value,
    Dwarf_Bool* ret_cr_valid,
    Dwarf_Bool* ret_cr_modified,
    Dwarf_Unsigned* ret_cr_locn,
    Ddpi_Error* error);
```

Parameters

- **cr_nbr**
  - Input. This accepts the CR number.

- **machinestate**
  - Input. This accepts the `Ddpi_MachineState` object.

- **ret_cr_value**
  - Output. This returns the CR value.

- **ret_cr_valid**
  - Output. This returns the CR valid flag.

- **ret_cr_modified**
  - Output. This returns the CR modified flag.

- **ret_cr_locn**
  - Output. This returns the CR location.

- **error**
  - See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful return of the CR settings.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `machinestate` is NULL
    - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
    - `ret_cr_value`, `ret_cr_valid`, `ret_cr_modified`, or `ret_cr_locn` is NULL.
• cr_number is out of range.
• An error occurs when a DWARF function is called.

**ddpi_machinestate_set_cr operation**

The `ddpi_machinestate_set_cr` operation updates the given CR of a given `Ddpi_MachineState` object.

`ddpi_machinestate_set_cr` updates the CR value, flag, and location.

**Prototype**

```c
int ddpi_machinestate_set_cr(
    Ddpi_CR cr_nbr,
    Ddpi_MachineState machinestate,
    Dwarf_Signed cr_value,
    Dwarf_Bool cr_valid,
    Dwarf_Unsigned cr_locn,
    Ddpi_Error* error);
```

**Parameters**

- **cr_nbr**
  - Input. This accepts the CR number.

- **machinestate**
  - Input. This accepts the `Ddpi_MachineState` object.

- **cr_value**
  - Input. This accepts the new CR value list.

- **cr_valid**
  - Input. This accepts the new CR valid flag.

- **cr_locn**
  - Input. This accepts the new CR location, or 0.

- **error**
  - Input. See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful update of the CR settings.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - machinestate is NULL
    - The `Ddpi_Space` or `Ddpi_Info` object associated with machinestate is NULL.
    - `cr_nbr` is out of range.
    - An unknown value is given for the valid flag.
    - An error occurs when a DWARF function is called.

**ddpi_machinestate_query_cr_change operation**

The `ddpi_machinestate_query_cr_change` operation queries the given `Ddpi_MachineState` object and returns true if any bit setting has been modified on any CR.
Prototype

```c
int ddpi_machinestate_query_cr_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

Parameters

**machinestate**
Type: Ddpi_MachineState
Input. This accepts the Ddpi_MachineState object.

**ret_flag**
Type: Dwarf_Bool
Output. This returns true if the state of the CR has changed.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful return of the flag that indicates whether a change in
CR has occurred.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- machinestate is NULL
- The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
- An error occurs when a DWARF function is called.

---

**ddpi_machinestate_get_psw operation**

The ddpi_machinestate_get_psw operation returns specific PSW elements of the
given Ddpi_MachineState object.

ddpi_machinestate_get_psw returns the following elements:
- The value of the requested PSW type.
- The valid flag for the given PSW.

**Note:** The PSW as a whole can be invalidated if a invalid AMODE or IP is set.
- The modified flag for the given PSW, which indicates whether the PSW value
  has been modified since the last reset, or if the AMODE or IP have been
  modified.
- The stored location of this given PSW, which may be used when shadowing
  PSW values.

Prototype

```c
int ddpi_machinestate_get_psw(
    Ddpi_PSW_Type psw_type,
    Ddpi_MachineState machinestate,
    Ddpi_PSW* ret_psw_value,
...
Dwarf_Bool* ret_psw_valid,
Dwarf_Bool* ret_psw_modified,
Dwarf_Unsigned* ret_psw_locn,
Ddpi_Error* error);

Parameters

psw_type
Input. This accepts the PSW type.

machinestate
Input. This accepts the Ddpi_MachineState object.

ret_psw_value
Output. This returns the PSW value.

ret_psw_valid
Output. This returns the PSW valid flag.

ret_psw_modified
Output. This returns the PSW modified flag.

ret_psw_locn
Output. This returns the PSW location.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful return of the PSW values.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• machinestate is NULL
• The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
• ret_psw_value, ret_psw_valid, ret_psw_modified, or ret_psw_locn is NULL
• psw_number is out of range
• An error occurs when a DWARF function is called.

ddpi_machinestate_set_psw operation

The ddpi_machinestate_set_psw operation updates the given PSW of the given
Ddpi_MachineState object.

ddpi_machinestate_set_psw updates the PSW value, flag, and location.

Prototype

int ddpi_machinestate_set_psw(
    Ddpi_PSW_Type psw_type,
    Ddpi_MachineState machinestate,
    Ddpi_PSW psw_value,
    Dwarf_Bool psw_valid,
    Dwarf_Unsigned psw_locn,
    Ddpi_Error* error);
Parameters

`psw_type`  
Input. This accepts the PSW type.

`machinestate`  
Input. This accepts the Ddpi_MachineState object.

`psw_value`  
Input. This accepts the new PSW value.

`psw_valid`  
Input. This accepts the new PSW valid flag.

`psw_locn`  
Input. This accepts the new PSW location, or 0.

`error`  
See “The libddpi error parameter” on page 15.

Return values

`DW_DLV_OK`  
Returned upon successful assignment of the PSW values.

`DW_DLV_NO_ENTRY`  
Never returned.

`DW_DLV_ERROR`  
This value is returned if:
- `machinestate` is NULL
- The Ddpi_Space or Ddpi_Info object associated with `machinestate` is NULL.
- An unknown value is given for the valid flag
- An error occurs when a DWARF function is called.

**ddpi_machinestate_query_psw_change operation**

The `ddpi_machinestate_query_psw_change` operation queries the given Ddpi_MachineState object and returns true if a bit setting has been modified on any PSW.

A bit setting is modified whenever the PSW, AMODE or IP was set.

**Prototype**

```c
int ddpi_machinestate_query_psw_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

**Parameters**

`machinestate`  
Input. This accepts the Ddpi_MachineState object.

`ret_flag`  
Output. This returns true if the state of the PSW has changed.

`error`  
See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful return of the flag that indicates whether a change in PSW has occurred.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `machinestate` is `NULL`
  - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is `NULL`.
  - An error occurs when a DWARF function is called.

---

**ddpi_machinestate_get_ip operation**

The `ddpi_machinestate_get_ip` operation returns specific IP elements of the given `Ddpi_MachineState` object.

`ddpi_machinestate_get_ip` returns the following elements:
- The value of the current IP in the `Ddpi_MachineState`
- The valid flag for the given IP. True is returned if the value of the current IP is known to be valid. The IP can be invalidated by calling `ddpi_machinestate_set_ip` or `ddpi_machinestate_set_psw` with an invalid value
- The modified flag for the given IP, which indicates whether the IP value has been modified since creation or the last reset. The value can also be modified by calls to `ddpi_machinestate_set_psw` for the current IP

**Prototype**

```c
int ddpi_machinestate_get_ip(
    Ddpi_MachineState machinestate,  
    Dwarf_Addr* ret_ip,              
    Dwarf_Bool* ret_ip_valid,       
    Dwarf_Bool* ret_ip_modified,    
    Ddpi_Error* error);
```

**Parameters**

- **machinestate**
  - Input. This accepts the `Ddpi_MachineState` object.

- **ret_ip**
  - Output. This returns the IP value.

- **ret_ip_valid**
  - Output. This returns the IP valid flag.

- **ret_ip_modified**
  - Output. This returns the IP modified flag.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful return of the IP values.
**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:
- `machinestate` is NULL
- The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
- `ret_ip_value`, `ret_ip_valid`, or `ret_ip_modified` is NULL.
- An error occurs when a DWARF function is called.

### ddpi_machinestate_set_ip operation

The `ddpi_machinestate_set_ip` operation updates the IP of the given `Ddpi_MachineState` object.

**Note:** An invalid IP will invalidate the whole PSW.

**Prototype**

```c
int ddpi_machinestate_set_ip(
    Ddpi_MachineState machinestate,
    Dwarf.Addr new_ip,
    Dwarf.Bool new_ip_valid,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`
  - Input. This accepts the `Ddpi_MachineState` object.

- `new_ip`
  - Input. This accepts the new IP.

- `new_ip_valid`
  - Input. This accepts the new IP valid flag.

- `error`
  - See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful update of the IP values.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `machinestate` is NULL
    - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
    - An unknown value is given for the valid flag
    - An error occurs when a DWARF function is called.
**ddpi_machinestate_get_amode operation**

The `ddpi_machinestate_get_amode` operation returns specific AMODE elements of the given `Ddpi_MachineState` object.

The `ddpi_machinestate_get_amode` operation returns the following elements:

- The value of the current AMODE.
- The validation flag for the AMODE. For example, if the value of the current AMODE is known to be valid, the operation returns true.

**Note:** The AMODE can be invalidated by calling `ddpi_machinestate_set_amode` or `ddpi_machinestate_set_psw` with an invalid value.

- The modification flag for the AMODE, which indicates whether the AMODE value has been modified since its creation or most recent reset.

**Note:** The value can also be modified by calls to `ddpi_machinestate_set_psw` for the current AMODE.

**Prototype**

```c
int ddpi_machinestate_get_amode(
    Ddpi_MachineState  machinestate,
    Ddpi_Addr_Mode*     ret_amode,
    Dwarf_Bool*          ret_amode_valid,
    Dwarf_Bool*          ret_amode_modified,
    Ddpi_Error*         error);
```

**Parameters**

- `machinestate`  
  Input. This accepts the `Ddpi_MachineState` object.

- `ret_amode`  
  Output. This returns the AMODE value.

- `ret_amode_valid`  
  Output. This returns the AMODE valid flag.

- `ret_amode_modified`  
  Output. This returns the AMODE modified flag.

- `error`  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**  
  Returned upon successful retrieval of the AMODE values.

- **DW_DLV_NO_ENTRY**  
  Never returned.

- **DW_DLV_ERROR**  
  This value is returned if:
  - `machinestate` is NULL
  - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
  - `ret_amode`, `ret_amode_valid`, or `ret_amode_modified` is NULL
  - An error occurs when a DWARF function is called.
**ddpi_machinestate_set_amode operation**

The `ddpi_machinestate_set_amode` operation updates the AMODE of the given `Ddpi_MachineState` object.

An invalid AMODE will invalidate the whole PSW.

**Prototype**

```c
int ddpi_machinestate_set_amode(
    Ddpi_MachineState machinestate,
    Ddpi_Addr_Mode new_amode,
    Dwarf_Bool new_amode_valid,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`
  - Input. This accepts the `Ddpi_MachineState` object.
- `new_amode`
  - Input. This accepts the new AMODE.
- `new_amode_valid`
  - Input. This accepts the new AMODE valid flag.
- `error`
  - See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful update of the AMODE values.
- **DW_DLV_NO_ENTRY**
  - Never returned.
- **DW_DLV_ERROR**
  - This value is returned if:
    - `machinestate` is NULL
    - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
    - An unknown value is given for the valid flag
    - An error occurs when a DWARF function is called.

**ddpi_machinestate_get_space operation**

The `ddpi_machinestate_get_space` operation returns the current `Ddpi_Space` object in the given `Ddpi_MachineState` object.

**Prototype**

```c
int ddpi_machinestate_get_space(
    Ddpi_MachineState machinestate,
    Ddpi_Space* ret_space,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`
  - Input. This accepts the `Ddpi_MachineState` object.
**ddpi_machinestate_set_space operation**

The `ddpi_machinestate_set_space` operation associates the given `Ddpi_Space` object with the given `Ddpi_MachineState` object.

`ddpi_machinestate_set_space` will also update the `Ddpi_Space` value associated with the `Ddpi_StorageLocn` that is nested inside the given `Ddpi_MachineState`.

**Prototype**

```c
int ddpi_machinestate_set_space(
    Ddpi_MachineState machinestate,
    Ddpi_Space space,
    Ddpi_Error* error);
```

**Parameters**

- **machinestate**
  
  Input. This accepts the `Ddpi_MachineState` object.

- **space**
  
  Input. This accepts the `Ddpi_Space` object.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful update of the SPACE values.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  This value is returned if:
  - machinestate is NULL
  - The `Ddpi_Space` or `Ddpi_Info` object associated with machinestate is NULL.
  - ret_space is NULL.
  - An error occurs when updating space in the `Ddpi_StorageLocn` object.
An error occurs when a DWARF function is called.

**ddpi_machinestate_get_storagelocn operation**

The `ddpi_machinestate_get_storagelocn` operation returns the Ddpi_StorageLocn object nested within the Ddpi_MachineState object.

Do not call `ddpi_storagelocn_term` to delete Ddpi_StorageLocn. This Ddpi_StorageLocn is terminated when the owning Ddpi_MachineState is terminated.

**Prototype**

```c
int ddpi_machinestate_get_storagelocn(
    Ddpi_MachineState machinestate,
    Ddpi_StorageLocn* ret_locn,
    Ddpi_Error* error);
```

**Parameters**

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **ret_locn**
  - Output. This returns the Ddpi_StorageLocn object.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the STORAGELOCN values.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - machinestate is NULL
    - The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
    - ret_locn is NULL
    - An error occurs when a DWARF function is called.

**ddpi_machinestate_get_context operation**

The `ddpi_machinestate_get_context` operation returns the current context address and type associated with a Ddpi_MachineState object.

**Prototype**

```c
int ddpi_machinestate_get_context(
    Ddpi_MachineState machinestate,
    Ddpi_Context_Type* ret_type,
    Ddpi_Context* ret_context,
    Ddpi_Error* error);
```

**Parameters**

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.
**ddpi_machinestate_set_context operation**

The `ddpi_machinestate_set_context` operation assigns the given context and context type to the `Ddpi_StorageLocn` object associated with the `Ddpi_MachineState` object.

**Prototype**

```c
int ddpi_machinestate_set_context(
    Ddpi_MachineState machinestate,
    Ddpi_Context_Type type,
    Ddpi_Context context,
    Ddpi_Error* error);
```

**Parameters**

- **machinestate**
  - Input. This accepts the `Ddpi_MachineState` object.

- **type**
  - Input. This accepts the new `Ddpi_Context_Type` object.

- **context**
  - Input. This accepts the new `Ddpi_Context` value.

- **error**
  - Input. This accepts the `Ddpi_Error` object.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful update of the CONTEXT address and type.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `machinestate` is NULL.
    - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is NULL.
    - `ret_context` or `ret_type` is NULL.
    - An error occurs when a DWARF function is called.
• machinestate is NULL
• The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
• ret_context or ret_type is NULL.
• An error occurs when a DWARF function is called.

**ddpi_machinestate_reset_change operation**

The ddpi_machinestate_reset_change operation resets all modified flags in the Ddpi_MachineState object.

**Prototype**

```c
int ddpi_machinestate_reset_change(
    Ddpi_MachineState machinestate,
    Ddpi_Error* error);
```

**Parameters**

machinestate

Input. This accepts the Ddpi_MachineState object.

error

See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**

Returned upon successful update of the modified flag values in the machine state object.

**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:

• machinestate is NULL
• The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
• An error occurs when a DWARF function is called.

**ddpi_machinestate_any_change operation**

The ddpi_machinestate_any_change operation queries if there have been any changes to the machine state since the last call to ddpi_machinestate_reset.

ddpi_machinestate_term releases all internal resources associated with the machine state object, and invalidates the given machine state.

**Prototype**

```c
int ddpi_machinestate_any_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_bool,
    Ddpi_Error* error);
```

**Parameters**

machinestate

Input. This accepts the Ddpi_MachineState object.
ret_bool
   Output. This returns true if the state of the Ddpi_MachineState has changed.

error
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon successful return of the information indicating whether the
   flags in the machine state object have changed.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • machinestate is NULL
   • The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
   • An error occurs when a DWARF function is called.

ddpi_machinestate_get_vr operation

The ddpi_machinestate_get_vr operation returns specific VR elements of the
Ddpi_MachineState object.

Prototype

int ddpi_machinestate_get_vr(
   Ddpi_VR vr_nbr,
   Ddpi_MachineState machinestate,
   char* vr_value[16],
   Dwarf_Bool* return_vr_valid,
   Dwarf_Bool* return_vr_modified,
   Dwarf_Unsigned* return_vr_locn,
   Ddpi_Error * error);

Parameters

vr_nbr
   Input. This accepts the VR number.

machinestate
   Input. This accepts the original Ddpi_MachineState object.

vr_value
   Output. This returns the VR value. Caller is in charge of 16 bytes of memory.

ret_vr_valid
   Output. This returns the VR valid flag.

ret_vr_modified
   Output. This returns the VR modified flag.

ret_vr_locn
   Output. This returns the VR location.

error
   See “The libddpi error parameter” on page 15.
Return values

DW_DLV_OK
   Returned upon successful retrieve of the VR settings.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • machinestate is NULL
   • The Ddpi_Space or Ddpi_Info object associated with machinestate is NULL.
   • vr_number is out of range.
   • vr_value, ret_vr_valid, ret_vr_modified, or ret_vr_locn is NULL.
   • An error occurs during creation of the nested Ddpi_StorageLocn object.
   • An error occurs when a DWARF function is called.

ddpi_machinestate_set_vr operation

The ddpi_machinestate_set_vr operation updates the VR value, flags, and location of a given Ddpi_MachineState object.

Prototype

int ddpi_machinestate_set_vr(
   Ddpi_VR vr_nbr,
   Ddpi_MachineState machinestate,
   char vr_value[16],
   Dwarf_Bool vr_valid,
   Dwarf_Unsigned vr_locn,
   Ddpi_Error * error);

Parameters

vr_nbr
   Input. This accepts the VR number.

machinestate
   Input. This accepts the Ddpi_MachineState object.

vr_value
   Input. This accepts the new VR value.

vr_valid
   Input. This accepts the new VR valid flag.

vr_locn
   Input. This accepts the new VR location.

error
   See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
   Returned upon successful assignment of the saved VR settings to the new machine state object.

DW_DLV_NO_ENTRY
   Never returned.
**DW_DLV_ERROR**

This value is returned if:
- `machinestate` is `NULL`.
- The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is `NULL`.
- `vr_nbr` is out of range.
- An unknown value is given for the valid flags.
- An error occurs when a DWARF function is called.

---

**ddpi_machinestate_query_vr_change operation**

The `ddpi_machinestate_query_vr_change` operation checks the state of a given VR for any change, and returns true if a bit setting has been modified.

**Prototype**

```c
int ddpi_machinestate_query_vr_change(
    Ddpi_MachineState machinestate,
    Dwarf_Bool* ret_flag,
    Ddpi_Error* error);
```

**Parameters**

- `machinestate`
  - Input. This accepts the `Ddpi_MachineState` object.

- `ret_flag`
  - Output. This returns true if the state of the VR has changed.

- `error`
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the flag that indicates whether a change in VR has occurred.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `machinestate` is `NULL`.
    - The `Ddpi_Space` or `Ddpi_Info` object associated with `machinestate` is `NULL`.
    - An error occurs when a DWARF function is called.
Chapter 25. Ddpi_PPA_Extract APIs

Ddpi_PPA_Extract APIs to help you manage the different PPA formats and conditions. They extract the same data regardless of the version of PPA that is being used. Use them only with IBM C/C++ compilation units (CUs).

Ddpi_PPA1_data_struct_s object

Contains the PPA1 data structure definition.

Type definition

```c
#define PPA1_DATA_STRUCT_VERSION 0x01
typedef struct Ddpi_PPA1_data_struct_s {
  Dwarf_Small       ppa1_data_struct_version;
  Dwarf_Small       ppa1_version;
  Dwarf_Bool        ppa1_has_off_to_len_of_name;
  Dwarf_Small       ppa1_offset_to_length_of_name;
  Dwarf_Bool        ppa1_external_proc;
  Dwarf_Bool        ppa1_primary_ep;
  Dwarf_Bool        ppa1_LE_dsa;
  Dwarf_Bool        ppa1_library;
  Dwarf_Bool        ppa1_sampling;
  Dwarf_Bool        ppa1_dsa_exit;
  Dwarf_Bool        ppa1_is_64_bit;
  Dwarf_Bool        ppa1_exceptx;
  Dwarf_Bool        ppa1_PPA3_full;
  Dwarf_Small       ppa1_flag2;
  Dwarf_Bool        ppa1_argparse;
  Dwarf_Bool        ppa1_redir;
  Dwarf_Bool        ppa1_execops;
  Dwarf_Small       ppa1_linkage;
  Dwarf_Off         ppa1_offset_to_PPA2;
  Dwarf_Bool        ppa1_has_addr_to_PPA3;
  Dwarf_Off         ppa1_addr_to_PPA3;
  Dwarf_Half        ppa1_GPR_save_mask;
  Dwarf_Bool        ppa1_state_table;
  Dwarf_Bool        ppa1_dll;
  Dwarf_Bool        ppa1_SF_layout;
  Dwarf_Small       ppa1_calling;
  Dwarf_Bool        ppa1_sleaf;
  Dwarf_Bool        ppa1_old_code;
  Dwarf_Ushort      ppa1_max_space;
  Dwarf_Small       ppa1_save;
  Dwarf_Bool        ppa1_async_cond;
  Dwarf_Bool        ppa1_word0_SF_init;
  Dwarf_Bool        ppa1_glue_code;
  Dwarf_Bool        ppa1calling;
  Dwarf_Bool        ppa1_argument;
  Dwarf_Bool        ppa1_register12;
  Dwarf_Bool        ppa1_vararg;
  Dwarf_Bool        ppa1_async_interrrupts;
  Dwarf_Off         ppa1_offset_code_descriptor;
  Dwarf_Ushort      ppa1_parm_length;
  Dwarf_Ushort      ppa1_prolog_length;
  Dwarf_Small       ppa1alloca_reg;
  Dwarf_Off         ppa1off_stack_pointer_update;
  Dwarf_Ushort      ppa1length_of_code;
  Dwarf_Bool        ppa1_has_offset_state_variable;
  Dwarf_Off         ppa1offset_state_variable;
  Dwarf_Bool        ppa1has_arg_area_length;
  Dwarf_Off         ppa1arg_area_length;
} Ddpi_PPA1_data_struct_s;
```
Dwarf_Bool ppa1_has_saved_FPR_mask;
Dwarf_Half ppa1_saved_FPR_mask;
Dwarf_Bool ppa1_has_saved_AR_mask;
Dwarf_Half ppa1_saved_AR_mask;
Dwarf_Bool ppa1_has_saved_locator;
Dwarf_Unsigned ppa1_FPR_saved_locator;
Dwarf_Bool ppa1_has_AR_saved_locator;
Dwarf_Unsigned ppa1_AR_saved_locator;
Dwarf_Bool ppa1_has_member_word;
Dwarf_Unsigned ppa1_member_word;
Dwarf_Bool ppa1_has_intf_mapping_flags;
Dwarf_Unsigned ppa1_intf_mapping_flags;
Dwarf_Bool ppa1_has_java_method_locator;
Dwarf_UAddr ppa1_java_method_locator;
Dwarf_Unsigned ppa1_PPA3_offset;
Dwarf.Addr ppa1_address;
} Ddpi_PPA1_Data_Struct;

Ddpi_PPA2_data_struct_s object

Contains the PPA2 data structure definition.

Type definition

#define PPA2_DATA_STRUCT_VERSION 0x01
typedef struct Ddpi_PPA2_data_struct_s {
    Dwarf_Small ppa2_data_struct_version;
    Dwarf_Small ppa2_version;
    Dwarf_Small ppa2_member_id;
    Dwarf_Small ppa2_sub_member_id;
    Dwarf_Small ppa2_member_defined;
    Dwarf_Off ppa2_offset_to_CEESTART;
    Dwarf_Off ppa2_offset_to_PPA4;
    Dwarf_Off ppa2_offset_to_timestamp;
    Dwarf_Off ppa2_offset_to_primary_epa;
    Dwarf_Bool ppa2_binary_float;
    Dwarf_Bool ppa2_library_code;
    Dwarf_Bool ppa2_service_info;
    Dwarf_Bool ppa2_md5_sig_in_timestamp_area;
    Dwarf.Addr ppa2_address;
} Ddpi_PPA2_Data_Struct;

ddpi_ppa_extract_ppa1 operation

The ddpi_ppa_extract_ppa1 operation extracts the PPA1 into a preallocated structure with the version token set.

If the version token is not set or is not recognized, the current version of the function will be used.

Prototype

int ddpi_ppa_extract_ppa1 (Ddpi_Space space, Dwarf.Addr ppa1_addr, Dwarf_Small data_struct_version, Ddpi_PPA1_Data_Struct* ppa1_data_struct, Ddpi_Error* error);

Parameters

space
Input. This accepts the address Ddpi_Space object.
**ppa1_addr**

Input. This accepts the PPA1 address.

**data_struct_version**

Input. This accepts the PPA1_DATA_STRUCT_VERSION.

**ppa1_data struct**

Input/Output. This accepts and returns the allocated PPA1 data structure.

**error**

See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**

Returned upon successful retrieval of the PPA1 address.

**DW_DLV_NO_ENTRY**

Returned when the PPA1 does not have the language environment signature.

**DW_DLV_ERROR**

This value is returned if:

- space is NULL.
- The Ddpi_Info object associated with space is NULL.
- ppa1_addr is Dwarf_NULL.
- ppa1_data_struct is NULL.
- data_struct_version is unrecognized.
- An error occurs during memory access.

---

**ddpi_ppa_extract_ppa2 operation**

The ddpi_ppa_extract_ppa2 operation extracts the PPA2 into a preallocated structure with the version token set.

If the version token is not set or not recognized, the current version of the function will be used.

**Prototype**

```c
int ddpi_ppa_extract_ppa2 (  
  Ddpi_Space space,  
  Dwarf_Addr ppa2_addr,  
  Dwarf_Small data_struct_version,  
  Ddpi_PPA2_Data_Struct* ppa2_data_struct,  
  Ddpi_Error* error);
```

**Parameters**

**space**

Input. This accepts the address Ddpi_Space object.

**ppa2_addr**

Input. This accepts the PPA2 address.

**data_struct_version**

Input. This accepts the PPA2_DATA_STRUCT_VERSION.

**ppa2_data struct**

Input/Output. This accepts and returns the allocated PPA2 data structure.

**error**

See “The libddpi error parameter” on page 15.
Return values

The `ddpi_ppa_extract_ppa2` operation returns DW_DLV_OK upon successful return of the PPA2 address. The `ddpi_ppa_extract_ppa2` operation returns DW_DLV_ERROR if:

- space is NULL
- Ddpi_Info associated with space is NULL
- ppa2_addr is Dwarf_NULL
- ppa2_data_struct is NULL
- data_struct_version is unrecognized
- An error occurs while accessing memory

**Note:** `ddpi_ppa_extract_ppa2` never returns DW_DLV_NO_ENTRY.

---

`ddpi_ppa_extract_ppa1_entrypoint_name` operation

The `ddpi_ppa_extract_ppa1_entrypoint_name` operation extracts and returns the PPA1 entry-point name.

`ddpi_ppa_extract_ppa1_entrypoint_name` takes a `ppa1_data_struct` and returns a buffer containing the function name from the PPA1 as a NULL-terminated string. It is the responsibility of the user to delete the name buffer. See the following example of the deletion code:

```c
rc = ddpi_dealloc(info, *ret_entrypt_name, DDPI_DLA_STRING)
```

**Prototype**

```c
int ddpi_ppa_extract_ppa1_entrypoint_name(
    Ddpi_Space space,
    Ddpi_PPA1_Data_Struct* ppa1_data_struct,
    char** ret_entrypt_name,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  - Input. This accepts the address `Ddpi_Space` object.

- `ppa1_data_struct`
  - Input. This accepts the PPA1 data structure containing the required extract and PPA1-address data.

- `ret_entrypt_name`
  - Output. This returns the PPA1 entry-point name.

- `error`
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the PPA2 entry-point name.

- **DW_DLV_NO_ENTRY**
  - Returned if there is no entry-point name.

- **DW_DLV_ERROR**
  - This value is returned if:
    - space is NULL.
• The Ddpi_Info object associated with space is NULL.
• ppa1_data_struct or ret_entrypt_name is NULL.
• ppa1_data_struct is NULL.
• data_struct_version is unrecognized.
• An error occurs during memory access.
• An error occurs during memory allocation.

**ddpi_ppa_extract_CU_primary_source operation**

The `ddpi_ppa_extract_CU_primary_source` operation extracts the first entry-point name from the PPA4, if the name is present.

`ddpi_ppa_extract_CU_primary_source` takes a `ppa2_data_struct` and returns a buffer containing the primary-source file name as a NULL-terminated string.

You must delete the name buffer after the value is returned finished.

See the following code example to delete a name buffer:

```c
rc = ddpi_dealloc(info, *ret_source_name, DDPI_DLA_STRING)
```

**Prototype**

```c
ddpi_ppa_extract_CU_primary_source(
    Ddpi_Space space,
    Ddpi_PPA2_Data_Struct* ppa2_data,
    char** ret_source_name,
    Ddpi_Error* error);
```

**Parameters**

`space`
- Input. This accepts the address `Ddpi_Space` object.

`ppa2_data`
- Input. This accepts a PPA2 data structure containing the required extract data.

`ret_source_name`
- Output. This returns the entry-point name.

`error`
- See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the PPA4 source data.

**DW_DLV_NO_ENTRY**
- Returned if:
  • The CU source name is unavailable
  • The given CU was compiled with the DEBUG(FORMAT(CDA)) compiler option

**DW_DLV_ERROR**
- This value is returned if:
  • space is NULL.
  • The Ddpi_Info object associated with space is NULL.
• ppa2_data_struct or ret_source_name is NULL.
• ppa1_data_struct is NULL.
• data_struct_version is unrecognized.
• An error occurs during memory access.
• An error occurs during memory allocation.

**ddpi_ppa2_md5_sig operation**

The `ddpi_ppa2_md5_sig` operation either extracts the MD5 signature (if the CU was compiled to create CDA debugging information) or creates an MD5 signature to be used with the converter.

`ddpi_ppa2_md5_sig` uses a given PPA2 address and PPA1 address list to:

• Extract the compiler-generated source from the given module image, for CDA debugging information
• Create an MD5 signature to match the converted source, for ISD debug information

The given `ppa1_list` is returned in descending address order.

**Prototype**

```c
int ddpi_ppa2_md5_sig(
    Ddpi_Space    space,
    Dwarf_Addr *  ppa1_list,
    int           ppa1_elements,
    Dwarf_Addr    ppa2_addr,
    unsigned char digest[16],
    Ddpi_Error*   error);
```

**Parameters**

`space`
Input. This accepts the address `Ddpi_Space` object.

`ppa1_list`
Input. This accepts the list of PPA1 addresses for the CU.

`ppa1_elements`
Input. This accepts the number of PPA1 elements for the CU.

`ppa2_addr`
Input. This accepts the PPA2 addresses for the CU.

`digest[16]`
Output. This returns the PPA2 MD5 signature.

`error`
See "The libddpi error parameter" on page 15.

**Return values**

`DW_DLV_OK`
Returned upon successful retrieval or creation of the MD5 signature.

`DW_DLV_NO_ENTRY`
Returned if:

• PPA1 does not have a pointer to name.
• PPA1 does not have the language environment signature.
**DW_DL_V_ERROR**

This value is returned if:

- space is NULL.
- The Ddpi_Info object associated with space is NULL.
- ppa2_addr is NULL.
- ppa1_list is NULL and ppa1_elements are greater than 1.
- An error occurs during access of the given PPA1s or PPA2s.
- An error occurs when an allocation of temporary space failed.
Chapter 26. Ddpi_StackState APIs

Every function of an application is allocated space in the stack. This space is referred to as a stack frame, or dynamic storage area (DSA). ddpi_stackstate operations create, format, and terminate objects in order to read and write stack-frame information. Ddpi_StackState objects store different elements of the stack frame.

The CDA library provides three types of APIs to manage stack frame information:

Ddpi_StackState APIs
The ddpi_stackstate operations:

- Create Ddpi_StackState objects to contain different elements of the stack frame.
- Use the Ddpi_Stackstate Fn object when they call a program analysis application (user-supplied) stack-state handler function to load the stack-state information.
- Use the program analysis application stack-state handler functions to load the information. Stack-state handler functions identify the stack type and extract stack-state information.

Ddpi_Stackstate Fn APIs
The ddpi_stackstate_fn operations:

- Create the Ddpi_Stackstate Fn object.
- Register the stack-state handler functions that are available in the program analysis application by adding them to the Ddpi_Stackstate Fn object.

Standard stack state-handler APIs for Language Environment
Stack-state handlers collect stack-frame information as they walk the stack, and load it into the Ddpi_StackState objects. The CDA library provides two operations that read the stack frames that conform to Language Environment. You can use these operations as prototypes to create other stack-state handling functions.

Note: For more information about z/OS stack frames, see z/OS Language Environment Vendor Interfaces, SA22-7568.

Ddpi_StackState object
A Ddpi_StackState object is an opaque data type that contains information about a single stack frame.

Each Ddpi_StackState object tracks the following information:

- The stack frame format
- The type of stack frame convention
- The types of stack linkage
- Location of the DSA
- DSA length
- Allocate base
- Location of the parent
- Location of the alloca area
Location of the PPA1 block
Location of the PPA2 block

An instance of the Ddpi_StackState type is created as a result of a successful call
to the ddpi_stackstate_create operation. The initial state of a Ddpi_StackState
object can be any of the following options:
• The stack format, type, and linkage are unknown
• The DSA location is 0, the DSA length is 0
• The parent stack, initial alloca base, PPA1 block, and PPA2 block location are all
  0

The storage pointed to by this descriptor will be freed during the execution of the
ddpi_stackstate_term operation. An instance of the Ddpi_StackState object can be
reset to the initial state by the ddpi_stackstate_init operation.

**Type definition**
typedef struct Ddpi_StackState_s* Ddpi_StackState;

**Ddpi_Stack_Format object**
This contains the stack frame format, which indicates the direction in which the
stack will grow.

**Type definition**
typedef enum Ddpi_Stack_Format_s {
  Ddpi_STSF_Unknown = 0,
  Ddpi_STSF_UP = 1,
  Ddpi_STSF_DOWN = 2,
  Ddpi_STSF_NONE = 3
} Ddpi_Stack_Format;

**Members**

**Ddpi_STSF_Unknown**
If this value is 0, it will not be accepted by the ddpi_stackstate_create
operation.

**Ddpi_STSF_UP**
If this value is 1, the DSA format suits a NOXPLINK-compiled program that
uses an upward growing stack.

**Ddpi_STSF_DOWN**
If this value is 2, the DSA format suits an XPLINK-compiled program that uses
an downward growing stack.

**Ddpi_STSF_NONE**
If this value is 3, the DSA format does not suit the program.

**Ddpi_Stack_Type object**
This contains the type of stack-frame convention.

**Type definition**
typedef enum Ddpi_Stack_Type_s {
  Ddpi_STST_Unknown = 0,
  Ddpi_STST_31_NOXPLINK = 1,
  Ddpi_STST_31_XPLINK = 2,
} Ddpi_Stack_Type;
Ddpi_STST_64_XPLINK = 3,
Ddpi_STST_31_TYPE1 = 4,
Ddpi_STST_64_TYPE1 = 5
} Ddpi_Stack_Type;

Members

Ddpi_STST_Unknown
If this value is 0, it will not be accepted by ddpi_stackstate_create.

Ddpi_STST_31_NOXPLINK
If this value is 1, the stack type is 31-bit NOXPLINK.

Ddpi_STST_31_XPLINK
If this value is 2, the stack type is 31-bit XPLINK.

Ddpi_STST_64_XPLINK
If this value is 3, the stack type is 64-bit XPLINK.

Ddpi_STST_31_TYPE1
If this value is 4, the stack type is 31-bit Type-1.

Ddpi_STST_64_TYPE1
If this value is 5, the stack type is 64-bit Type-1.

Ddpi_Stack_Linkage object

This contains the types of stack linkage.

Type definition
typedef enum Ddpi_Stack_Linkage_s {
   Ddpi_STSL_Unknown = 0,
   Ddpi_STSL_PRIVATE = 1,
   Ddpi_STSL_FSTLNK = 2,
   Ddpi_STSL_XPLINK = 3,
   Ddpi_STSL_OS = 4,
   Ddpi_STSL_PLI = 5,
   Ddpi_STSL_TYPE1 = 6
} Ddpi_Stack_Linkage;

Members

Ddpi_STSL_Unknown
This value will not be accepted by the ddpi_stackstate_create operation.

Ddpi_STSL_PRIVATE
If this value is 1, the stack linkage is C (NOXPLINK, 31-bit).

Ddpi_STSL_FSTLNK
If this value is 2, the stack linkage is C++ (NOXPLINK, 31-bit).

Ddpi_STSL_XPLINK
If this value is 3, the stack linkage is XPLINK (31-bit, 64-bit).

Ddpi_STSL_OS
If this value is 4, the stack linkage is OS.

Ddpi_STSL_PLI
If this value is 5, the stack linkage is PL/I.

Ddpi_STSL_TYPE1
If this value is 6, the stack linkage is Type-1 (31-bit, 64-bit).
Ddpi_StackState_Identify_Handler object

The Ddpi_StackState_Identify_Handler object defines the prototype for a stack-state handler function that gathers information from the initial stack frame.

The program analysis application should provide different versions of stack-state handler functions. As a convenience, CDA supplies the ddpi_stackstate_identify_le operation to identify the stack state for Language Environment applications.

Type definition

typedef int (*Ddpi_StackState_Identify_Handler) (  
  Ddpi_MachineState machinestate,  
  Ddpi_StackState stackstate,  
  Dwarf_Ptr workarea,  
  unsigned int workarea_len,  
  Ddpi_Error* error);

Members

machinestate
  Input. This accepts the Ddpi_MachineState object.

stackstate
  Input. This accepts the Ddpi_StackState object.

workarea
  Input. This accepts a pointer to the work area buffer.

workarea_len
  Input. This accepts the work area length.

error
  See “The libddpi error parameter” on page 15.

Ddpi_StackState_Parent_Handler object

The Ddpi_StackState_Parent_Handler object defines the prototype for a stack-state handler function that gathers information from the parent stack frame. Several versions of the function should be based on this prototype.

As a convenience, CDA provides the ddpi_stackstate_identify_le operation to gather information from the parent stack frame when Language Environment linkages are in effect.

Type definition

typedef int (*Ddpi_StackState_Parent_Handler) (  
  Ddpi_MachineState machinestate,  
  Ddpi_StackState stackstate,  
  Ddpi_MachineState parent_machinestate,  
  Ddpi_StackState parent_stackstate,  
  Dwarf_Ptr workarea,  
  unsigned int workarea_len,  
  Ddpi_Error* error);

Members

machinestate
  Input. This accepts the child Ddpi_MachineState object.
Input. This accepts the child Ddpi_StackState object.

Output. This returns the parent Ddpi_MachineState object.

Output. This returns the parent Ddpi_StackState object.

Input. This accepts a pointer to the work-area buffer.

Input. This accepts the work-area length.

See "The libddpi error parameter" on page 15.

**ddpi_stackstate_create operation**

The ddpi_stackstate_create operation allocates sufficient contiguous memory for a Ddpi_StackState object, and initializes that object.

**Prototype**

```c
int ddpi_stackstate_create(
    Ddpi_Info info,
    Ddpi_StackState* ret_stackstate,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  - Input. This accepts the Ddpi_Info object.

- **ret_stackstate**
  - Output. This returns the Ddpi_StackState.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the stack-state object has been successfully initialized.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - info is NULL
    - ret_stackstate is NULL
    - An error occurs during memory allocation.

**ddpi_stackstate_term operation**

The ddpi_stackstate_term operation releases all the memory associated by the Ddpi_StackState object.
Prototype

```c
int ddpi_stackstate_term(
    Ddpi_StackState  stackstate,
    Ddpi_Error*      error);
```

Parameters

- **stackstate**
  Input. This accepts the Ddpi_StackState object.

- **error**
  See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  Returned when the resources associated with the stack state object have been successfully released.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - info is NULL.
  - ret_stackstate is NULL.
  - An error occurs during memory deallocation.

---

**ddpi_stackstate_init operation**

The ddpi_stackstate_init operation initializes the state of the a Ddpi_StackState object.

Prototype

```c
int ddpi_stackstate_init(
    Ddpi_StackState  stackstate,
    Ddpi_Error*      error);
```

Parameters

- **stackstate**
  Input. This accepts the Ddpi_StackState object.

- **error**
  See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  Returned when the given state-stack object has been successfully initialized.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL
  - An error occurs during memory deallocation.
**ddpi_stackstate_identify operation**

The ddpi_stackstate_identify operation attempts to identify and dissect the initial stack frame.

The initial stack frame is associated with the target machine state contained in the given Ddpi_MachineState object. ddpi_stackstate_identify uses the operations associated with the Ddpi_MachineState object to examine the register and storage contents.

The outer ddpi_stackstate_identify operation will iterate through the Ddpi_StackState_Fn object, which is provided by the application. When a stack frame is successfully identified, the Ddpi_StackState object is initialized, and set up with all relevant stack frame information.

**Prototype**

```c
int ddpi_stackstate_identify(
    Ddpi_StackState_Fn stackstate_fn,
    Ddpi_MachineState machinestate,
    Ddpi_StackState stackstate,
    Dwarf_Ptr workarea,
    unsigned int workarea_len,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate_fn**
  - Input. This accepts the Ddpi_StackState_Fn object.

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **stackstate**
  - Input. This accepts the Ddpi_StackState object.

- **workarea**
  - Input. This accepts the pointer to the work area buffer.

- **workarea_len**
  - Input. This accepts the work area length.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the given state-stack object has been successfully identified and analyzed.

- **DW_DLV_NO_ENTRY**
  - Returned if the stack frame is not in a format that is recognized by this exit.

- **DW_DLV_ERROR**
  - This value is returned if:
    - stackstate is NULL.
    - The Ddpi_Info object associated with stackstate is NULL.
    - stackstate_fn is NULL.
    - machinestate is NULL.
**ddpi_stackstate_parent operation**

The ddpi_stackstate_parent operation attempts to identify and dissect the parent stack frame associated with the target machine state.

This process requires the target machine state and the current stack frame. The target machine state is specified by the given Ddpi_MachineState object. The current stack frame is specified by the given Ddpi_StackState object.

ddpi_stackstate_parent uses the APIs associated with the Ddpi_MachineState object to examine the register and storage contents.

The outer ddpi_stackstate_parent operation will iterate through the Ddpi_StackState_Fn object, which is provided by the application. When a stack frame is successfully identified, the parent Ddpi_MachineState object is initialized and all relevant machine state values are set. If any value is unknown or questionable, the valid flag for that value must be FALSE.

**Note:** The parent Ddpi_MachineState object may also be cloned from the current Ddpi_MachineState object, as appropriate.

The parent Ddpi_StackState object is then initialized, and set up with all relevant parent stack frame information.

**Prototype**

```c
int ddpi_stackstate_parent(
    Ddpi_StackState_Fn stackstate_fn,
    Ddpi_MachineState machinestate,
    Ddpi_StackState stackstate,
    Ddpi_MachineState parent_machinestate,
    Ddpi_StackState parent_stackstate,
    Dwarf_Ptr workarea,
    unsigned int workarea_len,
    Ddpi_Error* error);
```

**Parameters**

**Ddpi_StackState_Fn**

Input. This accepts the Ddpi_StackState_Fn object.

**machinestate**

Input. This accepts the Ddpi_MachineState object.

**stackstate**

Input. This accepts the Ddpi_StackState object.

**parent_machinestate**

Output. This returns the parent Ddpi_MachineState object.

**parent_stackstate**

Output. This returns the parent Ddpi_StackState object.

**workarea**

Input. This accepts a pointer to the work area buffer.

**workarea_len**

Input. This accepts the work area length.

**error**

See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned when a pointer to the parent of the given state-stack object has been successfully retrieved.

**DW_DLV_NO_ENTRY**
- Returned if the parent stack frame is not in a format that is recognized by this exit.

**DW_DLV_ERROR**
- This value is returned if:
  - `stackstate` is NULL.
  - `parent_stackstate` is NULL.
  - The Ddpi_Info object associated with `stackstate` is NULL.
  - `stackstate_fn` is NULL.
  - `machinestate` is NULL.
  - `parent_machinestate` is NULL.

---

**ddpi_stackstate_get_stack_format**

The `ddpi_stackstate_get_stack_format` operation returns the Ddpi_StackState object format.

**Prototype**

```c
int ddpi_stackstate_get_stack_format(  
    Ddpi_StackState stackstate,  
    Ddpi_Stack_Format* ret_format,  
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  - Input. This accepts the Ddpi_StackState object.

- **ret_format**
  - Output. This returns the stack format.

- **error**
  - See “The libddpi error parameter” on page 15

**Return values**

**DW_DLV_OK**
- Returned when a pointer to the format of the given state-stack object has been successfully retrieved.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - `stackstate` is NULL.
  - The Ddpi_Info object associated with `stackstate` is NULL.
  - `ret_format` is NULL.
ddpi_stackstate_set_stack_format operation

The ddpi_stackstate_set_stack_format operation assigns the given format to the Ddpi_StackState format.

Prototype

```c
int ddpi_stackstate_set_stack_format(
    Ddpi_StackState stackstate,
    Ddpi_Stack_Format new_format,
    Ddpi_Error* error);
```

Parameters

stackstate
    Input. This accepts the Ddpi_StackState object.

new_format
    Input. This accepts the new stack format.

error
    See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
    Returned when a pointer to the format of the given state-stack object has been successfully assigned.

DW_DLV_NO_ENTRY
    Never returned.

DW_DLV_ERROR
    This value is returned if:
    • stackstate is NULL.
    • The Ddpi_Info object associated with stackstate is NULL.
    • ret_format is NULL.

ddpi_stackstate_get_frame_type operation

The ddpi_stackstate_get_frame_type operation returns the Ddpi_StackState type.

Prototype

```c
int ddpi_stackstate_get_frame_type(
    Ddpi_StackState stackstate,
    Ddpi_Stack_Type* ret_type,
    Ddpi_Error* error);
```

Parameters

stackstate
    Input. This accepts the Ddpi_StackState object.

ret_type
    Output. This returns the stack frame type.

error
    See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
Returned when a pointer to the frame of the given state-stack object has been successfully retrieved.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `stackstate` is NULL.
- The `Ddpi_Info` object associated with `stackstate` is NULL.
- `ret_type` is NULL.

---

**ddpi_stackstate_set_frame_type operation**

The `ddpi_stackstate_set_frame_type` operation assigns the given type to the `Ddpi_StackState` object type.

**Prototype**

```c
int ddpi_stackstate_set_frame_type(
    Ddpi_StackState stackstate,
    Ddpi_Stack_Type new_type,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  Input. This accepts the `Ddpi_StackState` object.

- **new_type**
  Input. This accepts the new stack frame type.

- **error**
  See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
Returned when a pointer to the frame of the given state-stack object has been successfully assigned.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `stackstate` is NULL.
- The `Ddpi_Info` object associated with `stackstate` is NULL.

---

**ddpi_stackstate_get_linkage operation**

The `ddpi_stackstate_get_linkage` operation returns the `Ddpi_StackState` object linkage.
Prototype
int ddpi_stackstate_get_linkage(
    Ddpi_StackState stackstate,
    Ddpi_Stack_Linkage* ret_linkage,
    Ddpi_Error* error);

Parameters
stackstate
    Input. This accepts the Ddpi_StackState object.

ret_linkage
    Output. This returns the subprogram linkage.

error
    See “The libddpi error parameter” on page 15.

Return values
DW_DLV_OK
    Returned when the object linkage of the given state-stack object has been successfully retrieved.

DW_DLV_NO_ENTRY
    Never returned.

DW_DLV_ERROR
    This value is returned if:
    • stackstate is NULL.
    • The Ddpi_Info object associated with stackstate is NULL.
    • ret_linkage is NULL.

ddpi_stackstate_set_linkage operation
The ddpi_stackstate_set_linkage operation assigns the given subprogram linkage to the Ddpi_StackState linkage.

Prototype
int ddpi_stackstate_set_linkage(
    Ddpi_StackState stackstate,
    Ddpi_Stack_Linkage new_linkage,
    Ddpi_Error* error);

Parameters
stackstate
    Input. This accepts the Ddpi_StackState object.

new_linkage
    Input. This accepts the new subprogram linkage.

error
    See “The libddpi error parameter” on page 15.

Return values
DW_DLV_OK
    Returned when the object linkage of the given state-stack object has been successfully assigned.
DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
• stackstate is NULL.
• The Ddpi_Info object associated with stackstate is NULL.

**ddpi_stackstate_get_dsa_locn operation**

The `ddpi_stackstate_get_dsa_locn` operation returns the Ddpi StackState DSA location.

**Prototype**

```c
int ddpi_stackstate_get_dsa_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr* ret_dsa_locn,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  Input. This accepts the Ddpi StackState object.

- **ret_dsa_locn**
  Output. This returns the DSA location.

- **error**
  See [“The libddpi error parameter” on page 15](#).

**Return values**

- **DW_DLV_OK**
  Returned when a pointer to the DSA location of the given state-stack object has been successfully retrieved.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  • stackstate is NULL.
  • The Ddpi_Info object associated with stackstate is NULL.
  • ret_dsa_locn is NULL.

**ddpi_stackstate_set_dsa_locn operation**

The `ddpi_stackstate_set_dsa_locn` operation assigns the given location to the Ddpi StackState DSA location.

**Prototype**

```c
int ddpi_stackstate_set_dsa_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr new_dsa_locn,
    Ddpi_Error* error);
```
**Parameters**

`stackstate`  
Input. This accepts the Ddpi_StackState object.

`new_dsa_locn`  
Input. This accepts the new DSA location.

`error`  
See "The libddpi error parameter" on page 15.

**Return values**

`DW_DLV_OK`  
Returned when a pointer to the DSA location of the given state-stack object has been successfully assigned.

`DW_DLV_NO_ENTRY`  
Never returned.

`DW_DLV_ERROR`  
This value is returned if:
- `stackstate` is NULL.
- The Ddpi_Info object associated with `stackstate` is NULL.

---

**ddpi_stackstate_get_dsa_len operation**

The `ddpi_stackstate_get_dsa_len` operation returns the Ddpi_StackState DSA length.

**Prototype**

```c
int ddpi_stackstate_get_dsa_len(
    Ddpi_StackState stackstate,
    Dwarf_Unsigned* ret_dsa_len,
    Ddpi_Error* error);
```

**Parameters**

`stackstate`  
Input. This accepts the Ddpi_StackState object.

`ret_dsa_len`  
Output. This returns the DSA length.

`error`  
See "The libddpi error parameter" on page 15.

**Return values**

`DW_DLV_OK`  
Returned when the length of the DSA location of the given state-stack object has been successfully retrieved.

`DW_DLV_NO_ENTRY`  
Never returned.

`DW_DLV_ERROR`  
This value is returned if:
- `stackstate` is NULL.
- The Ddpi_Info object associated with `stackstate` is NULL.
- `ret_dsa_len` is NULL.
**ddpi_stackstate_set_dsa_len operation**

The `ddpi_stackstate_set_dsa_len` operation assigns the given length to the Ddpi_StackState DSA length.

**Prototype**

```c
int ddpi_stackstate_set_dsa_len(
    Ddpi_StackState stackstate,
    Dwarf_Unsigned new_dsa_len,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  - Input. This accepts the `Ddpi_StackState` object.

- **new_dsa_len**
  - Input. This accepts the new DSA length.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the length of the DSA location of the given state-stack object has been successfully assigned.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - stackstate is NULL.
    - The `Ddpi_Info` object associated with stackstate is NULL.

**ddpi_stackstate_get_laa_locn operation**

The `ddpi_stackstate_get_laa_locn` operation queries the Library Anchor Area (LAA) address for the current stack frame.

**Prototype**

```c
int ddpi_stackstate_get_laa_locn(
    Ddpi_StackState stackstate,
    Dwarf_Unsigned* ret_laa_locn,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  - Input. This accepts the `Ddpi_StackState` object.

- **ret_laa_locn**
  - Output. This returns the LAA address.

- **error**
  - See "The libddpi error parameter" on page 15.
Return values

**DW_DLV_OK**
- Returned when the Library Anchor Area (LAA) address for the current stack frame has been successfully retrieved.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL.

---

**ddpi_stackstate_set_laa_locn operation**

The `ddpi_stackstate_set_laa_locn` operation assigns the given value as the Library Anchor Area (LAA) address for the current stack frame.

**Prototype**

```c
int ddpi_stackstate_set_laa_locn (  
  Ddpi_StackState stackstate,  
  Dwarf_Addr new_laa_locn,  
  Ddpi_Error* error);  
```

**Parameters**

- **stackstate**
  - Input. This accepts the `Ddpi_StackState` object.

- **new_laa_locn**
  - Input. This accepts the new DSA LAA address.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned when the Library Anchor Area (LAA) address for the current stack frame has been successfully assigned.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL.

---

**ddpi_stackstate_get_parent_locn operation**

The `ddpi_stackstate_get_parent_locn` operation returns the `Ddpi_StackState` parent stack location.

**Prototype**

```c
int ddpi_stackstate_get_parent_locn(  
  Ddpi_StackState stackstate,  
  Dwarf_Addr* ret_parent_locn,  
  Ddpi_Error* error);  
```
Parameters

stackstate
- Input. This accepts the Ddpi_StackState object.

ret_parent_locn
- Output. This returns the parent stack location.

error
- See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
- Returned when the parent stack address for the current stack frame has been successfully retrieved.

DW_DLV_NO_ENTRY
- Never returned.

DW_DLV_ERROR
- This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL.
  - ret_parent_locn is NULL.

ddpi_stackstate_set_parent_locn operation

The ddpi_stackstate_set_parent_locn operation assigns the given parent stack frame location to the Ddpi_StackState parent stack location.

Prototype

int ddpi_stackstate_set_parent_locn(
    Ddpi_StackState stackstate,
    Dwarf.Addr new_parent_locn,
    Ddpi_Error* error);

Parameters

stackstate
- Input. This accepts the Ddpi_StackState object.

new_parent_locn
- Input. This accepts the new parent stack frame location.

error
- See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
- Returned when the parent stack address for the current stack frame has been successfully assigned.

DW_DLV_NO_ENTRY
- Never returned.

DW_DLV_ERROR
- This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL.
ddpi_stackstate_get_alloca_base operation

The ddpi_stackstate_get_alloca_base operation returns the Ddpi_StackState object initial alloca_base.

Prototype

```c
int ddpi_stackstate_get_alloca_base(
    Ddpi_StackState stackstate,
    Dwarf_Addr* ret_alloca_base,
    Ddpi_Error* error);
```

Parameters

stackstate
- Input. This accepts the Ddpi_StackState object.

ret_alloca_base
- Output. This returns the alloca_base.

error
- See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
- Returned when the initial alloca_base for the current stack frame has been successfully retrieved.

DW_DLV_NO_ENTRY
- Never returned.

DW_DLV_ERROR
- This value is returned if:
  - stackstate is NULL.
  - The Ddpi_Info object associated with stackstate is NULL.
  - ret_alloca_base is NULL.

ddpi_stackstate_set_alloca_base operation

The ddpi_stackstate_set_alloca_base operation assigns the given alloca_base to the Ddpi_StackState initial alloca_base.

Prototype

```c
int ddpi_stackstate_set_alloca_base(
    Ddpi_StackState stackstate,
    Dwarf_Addr new_alloca_base,
    Ddpi_Error* error);
```

Parameters

stackstate
- Input. This accepts the Ddpi_StackState object.

new_alloca_base
- Input. This accepts the new alloca_base.

error
- See "The libddpi error parameter" on page 15.
Return values

**DW_DLV_OK**
 - Returned when the initial `alloca_base` for the current stack frame has been successfully assigned.

**DW_DLV_NO_ENTRY**
 - Never returned.

**DW_DLV_ERROR**
 - This value is returned if:
   - `stackstate` is NULL.
   - The `Ddpi_Info` object associated with `stackstate` is NULL.

---

**ddpi_stackstate_get_ep_locn operation**

The `ddpi_stackstate_get_ep_locn` operation returns the address of the entry point of the subprogram whose invocation resulted in the creation of the current stack frame.

**Prototype**

```c
int ddpi_stackstate_get_ep_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr* ret_ep_locn,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  - Input. This accepts the `Ddpi_StackState` object.

- **ret_ep_locn**
  - Input. This accepts the address object.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
 - Returned when the address of the entry point of the subprogram whose invocation resulted in the creation of the current stack frame has been successfully retrieved.

**DW_DLV_NO_ENTRY**
 - Never returned.

**DW_DLV_ERROR**
 - This value is returned if:
   - `stackstate` is NULL.
   - The `Ddpi_Info` object associated with `stackstate` is NULL.
   - `ret_ep_locn` is NULL.

---

**ddpi_stackstate_set_ep_locn operation**

The `ddpi_stackstate_set_ep_locn` operation assigns the given PPA1 location to the entry-point address for subprogram invoked for the current stack frame.
Prototype
int ddpi_stackstate_set_ep_locn (
    Ddpi_StackState stackstate,
    Dwarf_Addr new_ep_locn,
    Ddpi_Error* error);

Parameters
stackstate
    Input. This accepts the Ddpi_StackState object.

new_ep_locn
    Input. This accepts the new PPA1 location.

error
    See "The libddpi error parameter" on page 15

Return values
DW_DLV_OK
    Returned when the address of the entry point of the subprogram whose
    invocation resulted in the creation of the current stack frame has been
    successfully assigned.

DW_DLV_NO_ENTRY
    Never returned.

DW_DLV_ERROR
    This value is returned if:
    • stackstate is NULL.
    • The Ddpi_Info object associated with stackstate is NULL.

ddpi_stackstate_get_ppa1_locn operation

The ddpi_stackstate_get_ppa1_locn operation returns the Ddpi_StackState PPA1
location.

Prototype
int ddpi_stackstate_get_ppa1_locn (
    Ddpi_StackState stackstate,
    Dwarf_Addr* ret_ppa1_locn,
    Ddpi_Error* error);

Parameters
stackstate
    Input. This accepts the Ddpi_StackState object.

ret_ppa1_locn
    Output. This returns the PPA1 location.

error
    See "The libddpi error parameter" on page 15

Return values
DW_DLV_OK
    Returned when the address of the PPA1 location has been successfully
    retrieved.

DW_DLV_NO_ENTRY
    Never returned.
**DW_DLV_ERROR**

This value is returned if:

- stackstate is NULL.
- The Ddpi_Info object associated with stackstate is NULL.
- ret_ppal_locn is NULL.

---

**ddpi_stackstate_set_ppa1_locn operation**

The `ddpi_stackstate_set_ppa1_locn` operation assigns the given PPA1 location to the Ddpi_StackState PPA1 location.

**Prototype**

```c
int ddpi_stackstate_set_ppa1_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr new_ppa1_locn,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  
  Input. This accepts the Ddpi_StackState object.

- **new_ppa1_locn**
  
  Input. This accepts the new PPA1 location.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned when the address of the PPA1 location has been successfully assigned.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  This value is returned if:
  
  - stackstate is NULL.
  
  - The Ddpi_Info object associated with stackstate is NULL.

---

**ddpi_stackstate_get_ppa2_locn operation**

The `ddpi_stackstate_get_ppa2_locn` operation returns the Ddpi_StackState PPA2 location.

**Prototype**

```c
int ddpi_stackstate_get_ppa2_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr* ret_ppa2_locn,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate**
  
  Input. This accepts the Ddpi_StackState object.
ret_ppa2_locn
Output. This returns the PPA2 location.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the address of the PPA2 location has been successfully retrieved.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
- stackstate is NULL.
- The Ddpi_Info object associated with stackstate is NULL.
- ret_ppa2_locn is NULL.

ddpi_stackstate_set_ppa2_locn operation

The ddpi_stackstate_set_ppa2_locn operation assigns the given PPA2 location to the Ddpi_StackState PPA2 location.

Prototype

int ddpi_stackstate_set_ppa2_locn(
    Ddpi_StackState stackstate,
    Dwarf_Addr new_ppa2_locn,
    Ddpi_Error* error);

Parameters

stackstate
Input. This accepts the Ddpi_StackState object.

new_ppa2_locn
Input. This accepts the new PPA2 location.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the address of the PPA2 location has been successfully assigned.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
- stackstate is NULL.
- The Ddpi_Info object associated with stackstate is NULL.
- ret_ppa2_locn is NULL.
Chapter 27. Ddpi_StackState_Fn APIs

Ddpi_StackState_Fn operations create objects in which to register the available stack-state handler functions that are provided by the program analysis application. These stack-state handler functions are used to identify the stack type and to collect stack-state information. Ddpi_StackState objects store this information. These objects are used whenever a ddpi_stackstate operation calls a user-supplied stack-state handler function.

For a description of all APIs that handle stack-frame information, see Chapter 26, “Ddpi_StackState APIs,” on page 253.

Ddpi_StackState_Fn object

This object is an opaque data type that associates all the identify or parent functions for different types.

Type definition

typedef struct Ddpi_StackState_Fn_s* Ddpi_StackState_Fn;

ddpi_stackstate_fn_create operation

The ddpi_stackstate_fn_create operation allocates a piece of memory big enough to hold a Ddpi_StackState_Fn object.

Prototype

int ddpi_stackstate_fn_create(
    Ddpi_Info info,
    Ddpi_StackState_Fn* ret_stackstate_fn,
    Ddpi_Error* error);

Parameters

info
    Input. This accepts the Ddpi_Info object.

ret_stackstate_fn
    Output. This returns the Ddpi_StackState_Fn object.

error
    See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
    Returned when the Ddpi_StackState_Fn object has been successfully retrieved.

DW_DLV_NO_ENTRY
    Never returned.

DW_DLV_ERROR
    This value is returned if:
        • info is NULL.
        • ret_stackstate_fn is NULL.
        • An error occurs during memory allocation.

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ddpi_stackstate_fn_term operation

The ddpi_stackstate_fn_term operation releases all the resources associated with the Ddpi_StackState_Fn object.

Prototype

```c
int ddpi_stackstate_fn_term(
    Ddpi_StackState_Fn stackstate_fn,
    Ddpi_Error* error);
```

Parameters

stackstate_fn
- Input. This accepts the Ddpi_StackState_Fn object.

error
- See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
- Returned when the resources associated with the Ddpi_StackState_Fn object have been successfully released.

DW_DLV_NO_ENTRY
- Never returned.

DW_DLV_ERROR
- This value is returned if:
  - stackstate_fn is NULL.
  - The Ddpi_Info object associated with stackstate_fn is NULL.
  - An error occurs during termination of child descriptors.
  - An error occurs during memory allocation.

ddpi_stackstate_fn_add operation

The ddpi_stackstate_fn_add operation adds a pair of identify and parent handlers to support stack frame queries.

Prototype

```c
int ddpi_stackstate_fn_add(
    Ddpi_StackState_Fn stackstate_fn,
    Ddpi_StackState_Identify_Handler identify_handler,
    Ddpi_StackState_Parent_Handler parent_handler,
    Ddpi_Error* error);
```

Parameters

stackstate_fn
- Input. This accepts the Ddpi_StackState_Fn object.

identify_handler
- Input. This accepts the stack-state handler function that will gather the information for the initial stack-frame. For example, if the stack frame conforms to the LE, then you can use ddpi_stackstate_identify_le.

parent_handler
- Input. This accepts the stack-state handler function that will gather the
information for the parent stack-frame. For example, if the stack frame conforms to the LE, then you can use \texttt{ddpi\_stackstate\_parent\_le}.

\textbf{error}  
See "The libddpi error parameter" on page 15.

\textbf{Return values}  
The \texttt{ddpi\_stackstate\_fn\_add} operation returns \texttt{DW\_DLV\_OK} when the handlers to support stackframe queries have been successfully added. The \texttt{ddpi\_stackstate\_fn\_add} operation returns \texttt{DW\_DLV\_ERROR} if:

- \texttt{stackstate\_fn} is NULL
- \texttt{Ddpi\_Info} associated with \texttt{stackstate\_fn} is NULL
- \texttt{identify\_handler} is NULL
- \texttt{parent\_handler} is NULL
- An error occurs while deallocating memory

\textbf{Note:} \texttt{ddpi\_stackstate\_fn\_add} never returns \texttt{DW\_DLV\_NO\_ENTRY}.

\textbf{ddpi\_stackstate\_fn\_get\_count operation}  
The \texttt{ddpi\_stackstate\_fn\_get\_count} operation returns the number of elements in the handler list associated with the \texttt{Ddpi\_StackState\_Fn} object.

\textbf{Prototype}
\begin{verbatim}
int ddpi_stackstate_fn_get_count(Ddpi_StackState_Fn stackstate_fn, int* ret_count, Ddpi_Error* error);
\end{verbatim}

\textbf{Parameters}
- \texttt{stackstate\_fn}  
  Input. This accepts the \texttt{Ddpi\_StackState\_Fn} object.
- \texttt{ret\_count}  
  Output. This returns the number of handlers.
- \texttt{error}  
  See "The libddpi error parameter" on page 15.

\textbf{Return values}
- \texttt{DW\_DLV\_OK}  
  Returned when the number of elements in the handler list associated with the \texttt{Ddpi\_StackState\_Fn} object has been successfully returned.
- \texttt{DW\_DLV\_NO\_ENTRY}  
  Never returned.
- \texttt{DW\_DLV\_ERROR}  
  This value is returned if:
  - \texttt{stackstate\_fn} is NULL
  - The \texttt{Ddpi\_Info} object associated with \texttt{stackstate\_fn} is NULL.
  - \texttt{ret\_count} is NULL.
ddpi_stackstate_fn_get_identify operation

The ddpi_stackstate_fn_get_identify operation returns the address of the specified ddpi_stackstate_identify operation.

Prototype

```c
int ddpi_stackstate_fn_get_identify(
    Ddpi_StackState_Fn stackstate_fn,
    int index,
    Ddpi_StackState_Identify_Handler* /* -
    ret_identify_handler,
    Ddpi_Error* error);
```

Parameters

- **stackstate_fn**
  - Input. This accepts the Ddpi_StackState_Fn object.

- **index**
  - Input. This accepts the index of the identify function.

- **ret_identify_handler**
  - Output. This returns the handler of the identify function.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - stackstate_fn is NULL.
    - The Ddpi_Info object associated with stackstate_fn is NULL.
    - ret_identify_handler is NULL.

ddpi_stackstate_fn_set_identify operation

The ddpi_stackstate_fn_set_identify operation assigns the address of the specified ddpi_stackstate_identify operation to the given index.

Prototype

```c
int ddpi_stackstate_fn_set_identify(
    Ddpi_StackState_Fn stackstate_fn,
    int index,
    Ddpi_StackState_Identify_Handler identify_handler,
    Ddpi_Error* error);
```

Parameters

- **stackstate_fn**
  - Input. This accepts the Ddpi_StackState_Fn object.

- **index**
  - Input. This accepts the index of the identify function.
**identify_handler**
Input. This accepts the new handler of the identify function.

**error**
See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
Returned when the address of the specified ddpi_stackstate_identify operation to the given index has been successfully retrieved.

**DW_DLV_NO_ENTRY**
Returned if the index is out of range.

**DW_DLV_ERROR**
This value is returned if:
- stackstate_fn is NULL.
- The Ddpi_Info object associated with stackstate_fn is NULL.

---

**ddpi_stackstate_fn_get_parent operation**

The ddpi_stackstate_fn_get_parent operation returns the address of the specified ddpi_stackstate_parent operation.

**Prototype**

```c
int ddpi_stackstate_fn_get_parent(
    Ddpi_StackState_Fn stackstate_fn,
    int index,
    Ddpi_StackState_Parent_Handler* ret_parent_handler,
    Ddpi_Error* error);
```

**Parameters**

**stackstate_fn**
Input. This accepts the Ddpi_StackState_Fn object.

**index**
Input. This accepts the index of the parent function.

**ret_parent_handler**
Output. This returns the parent handler.

**error**
See “The libddpi error parameter” on page 15.

**Return values**

**DW_DLV_OK**
Returned when the address of the specified ddpi_stackstate_parent operation has been successfully retrieved.

**DW_DLV_NO_ENTRY**
Returned if the index is out of range.

**DW_DLV_ERROR**
This value is returned if:
- stackstate_fn is NULL.
- The Ddpi_Info object associated with stackstate_fn is NULL.
- ret_parent_handler is NULL.
**ddpi_stackstate_fn_set_parent operation**

The `ddpi_stackstate_fn_set_parent` operation assigns the address of the specified `ddpi_stackstate_parent` operation to the given index.

**Prototype**

```c
int ddpi_stackstate_fn_set_parent(
    Ddpi_StackState_Fn stackstate_fn,
    int index,
    Ddpi_StackState_Parent_Handler parent_handler,
    Ddpi_Error* error);
```

**Parameters**

- **stackstate_fn**
  - Input. This accepts the `Ddpi_StackState_Fn` object.

- **index**
  - Input. This accepts the index of the parent function.

- **parent_handler**
  - Input. This accepts the new parent handler.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned when the address of the specified `ddpi_stackstate_parent` operation has been successfully retrieved.

- **DW_DLV_NO_ENTRY**
  - Returned if the index is out of range.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `stackstate_fn` is NULL
    - The `Ddpi_Info` object associated with `stackstate_fn` is NULL.
Chapter 28. Operations for Language Environment linkages

Stack-state handler functions walk the stack, gathering the required stack-frame information, and add it into the Ddpi_StackState objects. As a convenience, stack-state handler operations are provided for Language Environment linkages. They can also be used as prototypes on which to base alternative versions, depending upon your needs.

For a description of all APIs that handle stack-frame information, see Chapter 26, "Ddpi_StackState APIs," on page 253.

ddpi_stackstate_identify_le operation

The ddpi_stackstate_identify_le operation is a standard handler to identify the initial Language Environment stack frame.

Prototype

```
int ddpi_stackstate_identify_le(
    Ddpi_MachineState machinestate,
    Ddpi_StackState stackstate,
    Dwarf_Ptr workarea,
    unsigned int workarea_len,
    Ddpi_Error* error);
```

Parameters

- **machinestate**
  - Input. This accepts the Ddpi_MachineState object.

- **stackstate**
  - Input. This accepts the Ddpi_StackState object.

- **workarea**
  - Input. This accepts a pointer to the work area buffer.

- **workarea_len**
  - Input. This accepts the work area length.

- **error**
  - See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful completion of the operation.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if there is an error.

ddpi_stackstate_parent_le operation

The ddpi_stackstate_parent_le operation is a standard handler to identify the parent language environment stack frame.
Prototype

```c
int ddpi_stackstate_parent_le(
    Ddpi_MachineState machinestate,
    Ddpi_StackState stackstate,
    Ddpi_MachineState parent_machinestate,
    Ddpi_StackState parent_stackstate,
    Dwarf_Ptr workarea,
    unsigned int workarea_len,
    Ddpi_Error* error);
```

Parameters

**machinestate**
- Input. This accepts the child Ddpi_MachineState object.

**stackstate**
- Input. This accepts the child Ddpi_StackState object.

**parent_machinestate**
- Output. This returns the parent Ddpi_MachineState object.

**parent_stackstate**
- Output. This returns the parent Ddpi_StackState object.

**workarea**
- Input. This accepts a pointer to the work area buffer.

**workarea_len**
- Input. This accepts the work area length.

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- Returned upon successful completion of the operation.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if there is an error.
Chapter 29. Ddpi_Storage APIs

The Ddpi_Storage APIs provide the only way for the program analysis application to access user memory.

This interface provides the following benefits:
• Consistent access to local, remote, and recorded storage locations without requiring significant modifications to the program analysis application.
• Protection when an operation involving the storage is not successful.
• The ability to filter storage access.

There are two types of Ddpi_Storage objects.
• Ddpi_StorageLocn points to data in memory.
• Ddpi_SavedStorage represents a block of address space.

Both objects use the address space, but there is no other relationship between them. That is, Ddpi_SavedStorage objects are not owned by Ddpi_StorageLocn objects, but by the Ddpi_Space object. A program analysis application can create multiple Ddpi_StorageLocn objects and Ddpi_SavedStorage objects.

Access to storage within a user address space is achieved through calls to the ddpi_storagelocn_get_storage and ddpi_storagelocn_set_storage operations. These operations use a Ddpi_StorageLocn object to identify the actual address space and location. Calls to these operations can invoke the Ddpi_Space_GS_Handler (get-storage handler) and Ddpi_Space_SS_Handler (save-storage handler) callback functions. These callback functions are the application-specific memory-access functions that were registered for the address space in the Ddpi_Space object.

Process flow: Accessing or modifying user storage

Access through the Ddpi_StorageLocn object can be either transparent (which allows specific elements within the space to be addressed individually) or opaque (which limits addressability to the space as a single element).

1. The program analysis application stores the user data in the application address space where the debugging objects, including Ddpi_Info and Ddpi_Space, were created.
2. The program analysis application calls the ddpi_savedstorage_create operation to create the appropriate Ddpi_SavedStorage objects. These objects describe each area of the user storage contained in the user storage space. They are created under the Ddpi_Space object that corresponds to the user address space. As each object is created, an identifier token is returned to the program analysis application.
3. The program analysis application can now use a Ddpi_StorageLocn object set in transparent mode to update the actual storage and insert the overlay hooks.
4. The program analysis application now interacts with the user or a command file and performs the required actions. Any user activity that requires access or modification of user storage will call ddpi_storagelocn_get_storage or ddpi_storagelocn_set_storage. This activity will use a Ddpi_StorageLocn object in opaque mode. The access operations check if any Ddpi_SavedStorage objects describe user storage for each request, and ensure that, for each address...
space, the appropriate application-specific access or update operation will be
invoked. Storage locations that are not identified by Ddpi_SavedStorage objects
can be accessed by calling the get-storage and set-storage callback functions
registered under the Ddpi_Space object.

5. When the user storage is restored, the ddpi_savedstorage_get_modified
operation can be used to determine if the real storage should be updated.

6. When the user storage is terminated, the program analysis application must
terminate the Ddpi_SavedStorage objects. The program analysis application
calls the ddpi_savedstorage_term operation, passing the appropriate identifier
token as an argument.

**Transparent access**

If the access policy in the Ddpi_StorageLocn object is set to transparent, calls to the
ddpi_storagelocn_get_storage operation invoke the callback function contained in
the Ddpi_Space_GS_Handler object and return the contents to the Ddpi_StorageLocn
object. Similarly, calls to the ddpi_storagelocn_set_storage operation invoke the
callback function contained in the Ddpi_Space_SS_Handler object and update the
memory address in the Ddpi_StorageLocn object.

**Opaque access**

If the Ddpi_StorageLocn object specifies the opaque access policy, the program
analysis (user) application can insert a saved storage block between the actual
storage and the application. This allows the application to hide modifications to
the real storage, such as illegal instructions that allow control to be caught.

The Ddpi_SavedStorage object represents the saved storage block. It is created by
the ddpi_savedstorage_create operation. If this block does not exist for all or part
of a storage read request, then the Ddpi_Space_GS_Handler callback function
(provided when the d dpi_s pace_create operation is called) is used to access the
Ddpi_StorageLocn object. Similarly, for a write request, if a saved storage block
exists for a given address range, it is updated with the new data. Otherwise, the
Ddpi_Space_SS_Handler callback function is called for data in addresses that do not
correspond to any existing saved storage block.

A common use of opaque storage would be to create overlay hooks, where the first
two bytes of the user-program instruction are saved and replaced by a service call.
If the program analysis application dumps or disassembles storage containing
those bytes, it calls the ddpi_storagelocn_set_storage operation in opaque mode,
and the original opcode is revealed. The program analysis application can use a
Ddpi_StorageLocn object with a transparent access policy to set up and remove the
overlay hook.

**Ddpi_SL_Policy_Trans object**

This is an enumeration that is used to specify the storage access policy for a given
Ddpi_StorageLocn object.

**Type definition**

```c
typedef enum Ddpi_SL_Policy_s {
  Ddpi_SL_Policy_Unknown = 0,
  Ddpi_SL_Policy_Opaque = 1,
  Ddpi_SL_Policy_Trans = 2
} Ddpi_SL_Policy;
```
Members

_Ddpi_SL_Policy_Unknown_
   If this value is 0, the policy is unknown. Not a recommended setting.

_Ddpi_SL_Policy_Opaque_
   If this value is 1, the _Ddpi_StorageLocn access is opaque.

_Ddpi_SL_Policy_Tran_
   If this value is 2, the _Ddpi_StorageLocn is transparent.

_Ddpi_SSStor_Token object_
   The token of the saved storage block, defined as an opaque data type.

Type definition
   typedef unsigned int _Ddpi_SSStor_Token;  

_Ddpi_StorageLocn object_
   _Ddpi_storagelocn_ is a pointer to data in memory, and not the actual data itself. It is an opaque data type that represents the address of a given location within an address space that is targeted by the user.

   The _Ddpi_storagelocn_ object contains:
   - The address space, in the form of a "Ddpi_Space object" on page 35.
   - The location address within the address space.
   - The access policy, either opaque or transparent, to be used when accessing the storage.
   - The user area, which is an optional object-extension area, and may be used by the _Ddpi_StorageLocn object caller.

   The creation, initialization, and destruction of a _Ddpi_storagelocn_ object are handled as follows:
   - The object is created by a successful call to the _ddpi_storagelocn_create_ operation.
   - The object is initialized by a successful call to the _ddpi_storagelocn_init_ operation.
   - Memory is deallocated by a successful call to the _ddpi_storagelocn_term_ operation.

Type definition
   typedef struct _Ddpi_StorageLocn_s * _Ddpi_StorageLocn;

_Ddpi_SavedStorage object_
   The _Ddpi_SavedStorage_ object, defined as an opaque data type, represents a block in the local-address space of an application.

   This object contains a buffer that is to be used instead of the real memory at a given address. _Ddpi_SavedStorage_ object contains:
   - The starting address (low address) within the user address space to be replaced by the given buffer.
   - The length of the user storage.
The buffer of the user-address space.
The modification flag, which if set, indicates that this storage has been modified since its creation.

A Ddpi_SavedStorage object is created by a successful call to ddpi_savedstorage_create. A Ddpi_SavedStorage object is freed by a call to the ddpi_savedstorage_term operation.

Type definition
typedef struct Ddpi_SavedStorage_s * Ddpi_SavedStorage;

ddpi_storagelocn_create operation

The ddpi_storagelocn_create operation creates a Ddpi_StorageLocn object. This object is a pointer to describe a location within a given address space (Ddpi_Space) and the access policy.

Prototype
int ddpi_storagelocn_create(
  Ddpi_Space space,
  Dwarf.Addr addr,
  Ddpi_SL_Policy policy,
  int user_area_len,
  Ddpi_StorageLocn* ret_locn,
  Ddpi_Error* error);

Parameters
space
  Input. This accepts the Ddpi_Space object, which represents the address space that is pointed to by the Ddpi_StorageLocn.

addr
  Input. This accepts the address in the address space pointed to by the Ddpi_StorageLocn. The address can be changed at any time prior to termination of the Ddpi_StorageLocn by using ddpi_storagelocn_set_addr.

policy
  Input. This accepts the initial storage policy for this Ddpi_StorageLocn. The policy can be changed using ddpi_storagelocn_set_policy.

user_area_len
  Input. This accepts the length of the user area.

ret_locn
  Output. This returns the Ddpi_StorageLocn object created by this call.

error
  See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
  Returned upon successful retrieval of the Ddpi_StorageLocn object.

DW_DLV_NO_ENTRY
  Never returned.

DW_DLV_ERROR
  This value is returned if:
  * space is NULL
• ret_locn is NULL
• policy is an invalid policy
• There is insufficient memory

**ddpi_storagelocn_term operation**

The **ddpi_storagelocn_term** operation releases all the resources associated with the Ddpi_StorageLocn object.

**Prototype**

```c
int ddpi_storagelocn_term(
    Ddpi_StorageLocn locn,
    Ddpi_Error * error);
```

**Parameters**

- **locn**
  
  Input. This accepts the Ddpi_StorageLocn object to be freed.

- **error**
  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful release of all resources associated with the Ddpi_StorageLocn object.

- **DW_DLV_NO_ENTRY**
  
  Never returned.

- **DW_DLV_ERROR**
  
  This value is returned if:
  
  - locn is NULL
  - An error occurs during memory deallocation.

**ddpi_storagelocn_get_space operation**

The **ddpi_storagelocn_get_space** operation returns the Ddpi_Space object referred to by the given Ddpi_StorageLocn object.

**Prototype**

```c
int ddpi_storagelocn_get_space(
    Ddpi_StorageLocn locn,
    Ddpi_Space * space,
    Ddpi_Error* error);
```

**Parameters**

- **locn**
  
  Input. This accepts the Ddpi_StorageLocn object, which contains the required Ddpi_Space.

- **space**
  
  Output. This returns the Ddpi_Space object referred to by the given Ddpi_StorageLocn object.

- **error**
  
  See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful retrieval of the Ddpi_Space object referred to by the given Ddpi_StorageLocn object.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if an error occurs.

**ddpi_storagelocn_set_space operation**

The **ddpi_storagelocn_set_space** operation assigns the given address space as the Ddpi_StorageLocn object's new target address space.

**Prototype**

```c
int ddpi_storagelocn_set_space(
    Ddpi_StorageLocn locn,
    Ddpi_Space space,
    Ddpi_Error* error);
```

**Parameters**

- **locn**
  - Input. This accepts the Ddpi_StorageLocn object that is to be updated.

- **space**
  - Input. This accepts the Ddpi_Space object to be assigned to the given Ddpi_StorageLocn. This value will override the previous space value.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the Ddpi_Space object referred to by the given Ddpi_StorageLocn object.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - locn is NULL
  - space is NULL
  - locn does not have the correct version or is corrupted

**ddpi_storagelocn_get_addr operation**

The **ddpi_storagelocn_get_addr** operation examines the current Ddpi_StorageLocn object and returns the current address.

**Prototype**

```c
int ddpi_storagelocn_get_addr(
    Ddpi_StorageLocn locn,
    Dwarf_Addr * addr,
    Ddpi_Error* error);
```
Parameters

**locn**
Input. This accepts the Ddpi_StorageLocn object that has the current address value.

**addr**
Output. This is where the address value from the Ddpi_StorageLocn object is returned.

**error**
See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
Returned upon successful retrieval of the current address of the given Ddpi_StorageLocn object

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if there is an error.

**ddpi_storagelocn_set_addr operation**

The ddpi_storagelocn_set_addr operation changes the address in the given Ddpi_StorageLocn object to the given address.

The CDA user can then use this updated Ddpi_StorageLocn to access memory at the new address.

Prototype

```c
int ddpi_storagelocn_set_addr(
    Ddpi_StorageLocn locn,
    Dwarf_Addr addr,
    Ddpi_Error* error);
```

Parameters

**locn**
Input. This accepts the Ddpi_StorageLocn object, which will be updated with the given address.

**addr**
Input. This accepts the new address for the given Ddpi_StorageLocn object.

**error**
See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
Returned upon successful update of the address of the given Ddpi_StorageLocn object.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- locn is NULL.
- The Ddpi_Space object is NULL.
- addr is outside of the range of the Ddpi_Space object.
- locn does not have the correct version or is corrupted.

**ddpi_storagelocn_get_storage operation**

The `ddpi_storagelocn_get_storage` operation requests that `bufferLn` bytes of data be read from the address and address space of a `Ddpi_StorageLocn` object, then written to the data buffer in the caller's address space.

When writing, the `ddpi_storagelocn_get_storage` operation conforms to the `Ddpi_StorageLocn` access policy and any relevant `Ddpi_SavedStorage` objects.

In the absence of read access problems (such as page, access or segment exceptions), `ddpi_storagelocn_get_storage` reads `bufferLn` bytes storage associated with the `Ddpi_StorageLocn` object, returns it through `buffer` and sets `dataLn` to `bufferLn`. Otherwise, it sets `dataLn` to the actual data length read, and returns the read storage through `buffer`. This operation will use the `get_storage_handler` that was provided when creating the `ddpi_space` (unless a `storagelocn_policy` is opaque and the requested storage is in a saved storage block).

**Prototype**

```c
int ddpi_storagelocn_get_storage(
    Ddpi_StorageLocn  locn,
    char*        buffer,
    Dwarf_Unsigned bufferLn,
    Dwarf_Unsigned* ret_dataLn,
    Ddpi_Error*  error);
```

**Parameters**

**locn**
- Input. This accepts the `Ddpi_StorageLocn` object that points to the location of the data that is to be read. This object supplies the address space, the address of the data, and the access policy.

**buffer**
- Input/Output. This accepts and returns the buffer to which the requested storage will be written. Only the first `ret_dataLn` bytes of data will contain valid values on the return.

**bufferLn**
- Input. This accepts the data length to read.

**ret_dataLn**
- Output. This returns the actual data length read. It will return zero if no values were read. It will return a non-zero value if a portion was successfully read. In either case, the return code does not affect this value.

**error**
- See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
- Returned upon successful retrieval of the pointer to the `bufferLn` bytes storage.
**DDPI/DDI Storage APIs**

**DW_DLV_NO_ENTRY**
Returned if bufferLn is zero.

**DW_DLV_ERROR**
This value is returned if an error occurs.

**ddpi_storagelocn_set_storage operation**

The `ddpi_storagelocn_set_storage` operation requests that bufferLn bytes of data be written via the Ddpi_StorageLocn object from the data buffer in the caller's address space, respecting the Ddpi_StorageLocn access policy and any relevant Ddpi_SavedStorage objects.

In the absence of write access problems (such as page, access or segment exceptions), `ddpi_storagelocn_set_storage` writes bufferLn bytes of storage associated with the Ddpi_StorageLocn object from buffer and sets dataLn to bufferLn. Otherwise, it sets dataLn to the actual data length written. This operation will use the set_storage_handler that was provided when creating the ddpi_space (unless a storagelocn_policy is opaque and the requested storage is already mapped in a saved storage block).

**Prototype**

```c
int ddpi_storagelocn_set_storage(
    Ddpi_StorageLocn locn,
    char * buffer,
    Dwarf_Unsigned bufferLn,
    Dwarf_Unsigned* ret_dataLn,
    Ddpi_Error* error);
```

**Parameters**

- **locn**
  Input. This accepts the Ddpi_StorageLocn object that points to the location where the data is to be written. This object supplies the address space, the address of the data, and the access policy.

- **buffer**
  Input. This accepts the buffer that contains the data to be written to the storage location.

- **bufferLn**
  Input. This accepts the number of bytes from the buffer that should be written to storage.

- **ret_dataLn**
  Output. This returns the number of bytes that were written to storage. This value should be zero if no bytes were written. This value should be non-zero if an error occurred when writing part of the data (even though the return code from this operation could still be DW_DLV_ERROR). It will return zero if no bytes were written. It will return a non-zero value if an error occurred while writing part of the data, even if the return code from this operation is DW_DLV_ERROR.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful assignment of the pointer to the bufferLn bytes of storage.
**DW_DLV_NO_ENTRY**
Retained if bufferLn is zero.

**DW_DLV_ERROR**
This value is returned if:
- locn is NULL.
- The Ddpi_Space object is NULL.
- The data to be written into the Ddpi_StorageLocn object exceeds the boundary of the Ddpi_Space object.
- locn does not have the correct version or is corrupted.

---

**ddpi_storagelocn_get_policy operation**

The ddpi_storagelocn_get_policy operation returns the policy of the given Ddpi_StorageLocn object.

**Prototype**

```c
int ddpi_storagelocn_get_policy(
    Ddpi_StorageLocn locn,
    Ddpi_SL_Policy* return_policy,
    Ddpi_Error* error);
```

**Parameters**

- **locn**
  Input. This accepts the Ddpi_StorageLocn object to be queried for its current policy setting.

- **return_policy**
  Output. This is the location where the operation returns the access policy (opaque or transparent) of the given Ddpi_StorageLocn object.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful retrieval of the pointer to the policy of the given Ddpi_StorageLocn object.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - locn is NULL.
  - The Ddpi_Space object is NULL.
  - return_policy is NULL.
  - locn does not have the correct version or is corrupted.

---

**ddpi_storagelocn_set_policy operation**

The ddpi_storagelocn_set_policy operation updates the given Ddpi_StorageLocn object with the given policy.
Prototype

```c
int dpi_storagelocn_set_policy(
    Ddpi_StorageLocn locn,
    Ddpi_SL_Policy policy,
    Ddpi_Error* error);
```

**Parameters**

- `locn`
  - Input. This accepts the Ddpi_StorageLocn object to be updated.

- `policy`
  - Input. This accepts the access policy value that will replace the current policy of the Ddpi_StorageLocn object.

- `error`
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful update of the policy of the given Ddpi_StorageLocn object.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `locn` is NULL.
    - The Ddpi_Space object is NULL.
    - `policy` is invalid.
    - `locn` does not have the correct version or is corrupted.

---

**ddpi_storagelocn_get_user_area operation**

The `ddpi_storagelocn_get_user_area` operation returns the address of the user area for the given Ddpi_StorageLocn object.

**Prototype**

```c
int dpi_storagelocn_get_user_area(
    Ddpi_StorageLocn locn,
    char ** return_user_area,
    Ddpi_Error * error);
```

**Parameters**

- `locn`
  - Input. This accepts the Ddpi_StorageLocn object.

- `return_user_area`
  - Output. This returns the address of the user area for the given Ddpi_StorageLocn object.

- `error`
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the pointer to the user area.
**DW_DLV_NO_ENTRY**
  Returned if the user area length is zero.

**DW_DLV_ERROR**
  This value is returned if:
  - `locn` is NULL.
  - The Ddpi_Space object is NULL.
  - `locn` does not have the correct version or is corrupted.

**ddpi_savedstorage_create operation**

The `ddpi_savedstorage_create` operation creates a Ddpi_SavedStorage object to identify substituted user storage.

The contents of the given buffer are copied into libddpi storage, and then stored so that they can quickly be accessed by the address. This operation returns a token, which identifies a specific saved storage area through the `ret_token` parameter.

**Prototype**

```c
int ddpi_savedstorage_create(
    Ddpi_Space space,
    Dwarf_Addr locn,
    unsigned int len,
    Dwarf_Ptr buffer
    Ddpi_SStor_Token ret_token,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  Input. This accepts the Ddpi_Space object.

- **locn**
  Input. This accepts the starting address of the given address space.

- **len**
  Input. This accepts the length of the given address space.

- **buffer**
  Input. This accepts the content of the given address space.

- **ret_token**
  Output. This returns the token used to identify the Ddpi_SavedStorage object.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful retrieval of the token that identifies the saved storage area.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - `space` is NULL.
  - `buffer` is zero in length.
- ret_token is NULL.
- space exceeds the limit of the Ddpi_Space object.
- ret_token does not have the correct version or is corrupted.
- There is insufficient memory to create a Ddpi_SavedStorage object.

**ddpi_savedstorage_term operation**

The `ddpi_savedstorage_term` operation releases all the resources associated with the given Ddpi_SavedStorage object.

**Prototype**

```c
int ddpi_savedstorage_term(
    Ddpi_Space space,
    Ddpi_SStor_Token token,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  
  Input/Output. This accepts and returns the Ddpi_Space object that contains the given Ddpi_SavedStorage token.

- `token`
  
  Input. This accepts the Ddpi_SavedStorage object.

- `error`
  
  See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  
  Returned upon successful retrieval of the token that identifies the saved storage area.

- **DW_DLV_NO_ENTRY**
  
  Returned if the token is invalid.

- **DW_DLV_ERROR**
  
  This value is returned if:
  - space is NULL.
  - The Ddpi_SavedStorage object does not have the correct version or is corrupted.
  - An error occurs during deallocation of memory.

**ddpi_savedstorage_term_all operation**

The `ddpi_savedstorage_term_all` operation releases all the resources associated with all of the Ddpi_SavedStorage objects attached to a given space.

**Prototype**

```c
int ddpi_savedstorage_term_all(
    Ddpi_Space space,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  
  Input. This accepts the Ddpi_Space object.
Return values

**DW_DLV_OK**
- Returned upon successful release of the resources associated with all the saved storage objects attached to the given storage space.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - space is NULL
  - At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.
  - An error occurs during deallocation of memory.

---

### ddpi_savedstorage_list_all_tokens operation

The `ddpi_savedstorage_list_all_tokens` operation returns a list of all the saved storage tokens in a given Ddpi_Space object.

This list must be freed by the caller with the following code:

```c
ddpi_dealloc(info, *ret_tokens, DDPI_DLA_SSTOR_TOKEN)
```

**Prototype**

```c
int ddpi_savedstorage_list_all_tokens(
    Ddpi_Space space,
    Ddpi_SStor_Token** ret_tokens,
    Dwarf_Unsigned* num_tokens,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  - Input. This accepts the Ddpi_Space object.

- **ret_tokens**
  - Output. This returns the list of the tokens in the Ddpi_Space object.

- **num_tokens**
  - Output. This returns the number of tokens in the list.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the list of saved storage tokens.

- **DW_DLV_NO_ENTRY**
  - Returned if there are no saved storage tokens in space.

- **DW_DLV_ERROR**
  - This value is returned if:
    - space is NULL.
At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.

An error occurs during deallocation of memory.

### `ddpi_savedstorage_list_modified` operation

The `ddpi_savedstorage_list_modified` operation returns a list of all the saved storage tokens in a given Ddpi_Space that have the modified bits set.

This list must be freed by the caller with the following code:

```c
ddpi_dealloc(info, *ret_tokens, DDPI_DLA_SSTOR_TOKEN)
```

**Prototype**

```c
int ddpi_savedstorage_list_modified(
    Ddpi_Space space,
    Ddpi_SStor_Token** ret_tokens,
    Dwarf_Unsigned* num_tokens,
    Ddpi_Error* error);
```

**Parameters**

- `space`
  - Input. This accepts the Ddpi_Space object.

- `ret_tokens`
  - Output. This returns the list of the modified tokens in the Ddpi_Space object.

- `num_tokens`
  - Output. This returns the number of tokens in the list.

- `error`
  - See "The libddpi error parameter" on page 15

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the list of all the saved storage tokens, in the given Ddpi_Space object, that have the modified bits set.

- **DW_DLV_NO_ENTRY**
  - Returned if, in `space`, there is no saved storage token with a modified bit set.

- **DW_DLV_ERROR**
  - This value is returned if:
    - `space` is NULL.
    - At least one of the Ddpi_SavedStorage objects associated with `space` does not have the correct version or is corrupted.
    - An error occurs during deallocation of memory.

### `ddpi_savedstorage_get` operation

The `ddpi_savedstorage_get` operation queries the Ddpi_SavedStorage object that corresponds to the given token.

The `ddpi_savedstorage_get` operation returns:

- The start address of the saved storage block (`ret_locn`)
- The size of the saved storage block (`ret_len`)
• The contents of the saved storage block (ret_buffer)

The consumer must not delete or modify the storage pointed to by ret_buffer.

**Prototype**

```c
int ddpi_savedstorage_get(
    Ddpi_Space space,
    Ddpi_SStor_Token token,
    Dwarf.Addr* ret_locn,
    unsigned int* ret_len,
    Dwarf_Ptr* ret_buffer,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  - Input. This accepts the Ddpi_Space object. This is the address space that contains the saved storage block to be queried.

- **token**
  - Input. This accepts the Ddpi_SavedStorage token to be queried.

- **ret_locn**
  - Output. This is a pointer to an address. The address gives the location of the saved storage buffer in its parent address space. This field cannot be NULL.

- **ret_len**
  - Output. This is a pointer to the location where the length of the saved storage block will be returned. This field cannot be NULL.

- **ret_buffer**
  - Output. This is a pointer to the buffer where the contents of the saved storage block will be returned. This is the libddpi internal storage block and should not be modified or deallocated by the user. This field cannot be NULL.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of:
    • The start address of the saved storage block (ret_locn).
    • The size of the saved storage block (ret_len).
    • The contents of the saved storage block (ret_buffer).

- **DW_DLV_NO_ENTRY**
  - Returned if there is not a saved storage block corresponding to the given token.

- **DW_DLV_ERROR**
  - This value is returned if:
    • space is NULL
    • ret_buffer is NULL
    • At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.
**ddpi_savedstorage_list_all operation**

The `ddpi_savedstorage_list_all` operation returns a list of all the saved-storage tokens in a given space.

**Prototype**

```c
int ddpi_savedstorage_list_all(
    Ddpi_Space space,
    Ddpi_SStor_Token** ret_tokens,
    Dwarf_Unsigned* num_tokens,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  - Input. This accepts the `Ddpi_Space` object.

- **ret_tokens**
  - Output. This returns the list of tokens.

- **num_tokens**
  - Output. This returns the number of tokens in the list.

- **error**
  - See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful retrieval of the list of all the saved-storage tokens in the given space.

- **DW_DLV_NO_ENTRY**
  - Returned if there are no saved-storage tokens in the space.

- **DW_DLV_ERROR**
  - This value is returned if:
    - space and its associated `Ddpi_Info` object is NULL.
    - `ret_tokens` is NULL.
    - `num_tokens` is NULL.

**ddpi_savedstorage_find operation**

The `ddpi_savedstorage_find` operation finds the first `Ddpi_SavedStorage` token that identifies an address range in a given space.

The first token maps all or part of the given location and length within the given address space.

Notice that a given range can have multiple `Ddpi_SavedStorage` objects.

This operation returns only the first token. To find the next token, use `ddpi_savedstorage_next`.

To find the address range and contents that correspond to the returned token, use `ddpi_savedstorage_get`. 
Prototype

```c
int ddpi_savedstorage_find(
    Ddpi_Space    space,
    Dwarf_Addr   locn,
    unsigned int len,
    Ddpi_SStor_Token* ret_token,
    Ddpi_Error*   error);
```

Parameters

**space**
Input/Output. This accepts and returns the Ddpi_Space object. This represents the address space that might have a saved storage block at the given location.

**locn**
Input. This accepts the address location. This is the start of the address range, in which the operation will look for a saved storage block.

**len**
Input. This defines the length of the area of memory that starts at locn and runs until locn + len - 1. The zone of memory defined by this range is where this operation will search to see if there is a saved storage block.

**ret_token**
Output. This returns the token that corresponds to the first saved storage block in the given address range.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful retrieval of the first token that identifies an address range in a given space.

**DW_DLV_NO_ENTRY**
Returned if there is no Ddpi_SavedStorage object at the location with the address space.

**DW_DLV_ERROR**
This value is returned if:
- space is NULL
- ret_token is NULL
- len is zero in length
- At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.

**ddpi_savedstorage_next operation**

The ddpi_savedstorage_next operation finds the Ddpi_SavedStorage token following the given token.

This is defined as the storage block that follows the given token with the closest possible address.
Prototype

```c
int ddpi_savedstorage_next(
    Ddpi_Space   space,
    Ddpi_SStor_Token token,
    Ddpi_SStor_Token* ret_next_token,
    Ddpi_Error*    error);
```

Parameters

**space**
Input. This is the address space that holds the given saved storage token (token).

**token**
Input. A token for a saved storage block that exists in the given space.

**ret_next_token**
Output. This parameter returns the address of the next token.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned upon successful retrieval of the Ddpi_SavedStorage token following the given token.

**DW_DLV_NO_ENTRY**
Returned if there is no Ddpi_SavedStorage object at the location with the address space.

**DW_DLV_ERROR**
This value is returned if:
- space is NULL.
- token does not refer to an existing saved-storage block.
- ret_next_token is NULL.
- At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.

**ddpi_savedstorage_get_modified operation**

The ddpi_savedstorage_get_modified operation queries the Ddpi_SavedStorage buffer, and indicates if it has been modified, either by a ddpi_storagelocn_set_storage to the saved storage block, or forced by a call to ddpi_savedstorage_set_modified.

Prototype

```c
int ddpi_savedstorage_get_modified(
    Ddpi_Space   space,
    Ddpi_SStor_Token token,
    Dwarf_Bool*   ret_bool,
    Ddpi_Error*   error);
```

Parameters

**space**
Input. This accepts the Ddpi_Space object to which the saved storage block belongs.
token
Input. This accepts the Ddpi_SavedStorage token that corresponds to the relevant saved storage area.

ret_bool
Output. A pointer to a boolean value. This will be true if the call to ddpi_storagelocn_set_storage has occurred to the saved storage block, or if the CDA user has explicitly set the modified bit by calling ddpi_saved_storage_set_modified.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of the boolean value that indicates whether the storage buffer has been modified.

DW_DLV_NO_ENTRY
Returned if there is no saved storage block that corresponds to the given token.

DW_DLV_ERROR
This value is returned if:
• space is NULL.
• ret_bool is NULL
• At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.

ddpi_savedstorage_set_modified operation

The ddpi_savedstorage_set_modified operation sets the modification bit for the given saved storage token for the given Ddpi_Space object.

Prototype

int ddpi_savedstorage_set_modified(
    Ddpi_Space space,
    Ddpi_SStor_Token token,
    Ddpi_Error* error);

Parameters

space
Input. This accepts the address space that contains the saved storage block that will be marked as modified.

token
Input. This accepts the token that corresponds to the saved storage block that is to be marked as modified.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the modification bit for the given saved storage token for the given Ddpi_Space object has been successfully reset.
**DW_DLV_NO_ENTRY**
Returned if there is no saved storage block that corresponds to the given token.

**DW_DLV_ERROR**
This value is returned if:
- space is NULL.
- token is NULL.
- At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.

### ddpi_savedstorage_reset_change operation

The ddpi_savedstorage_reset_change operation sets the modified bit of the saved storage block identified by the given token in the given Ddpi_Space.

**Prototype**

```c
int ddpi_savedstorage_reset_change(
    Ddpi_Space space,
    Ddpi_SStor_Token token,
    Ddpi_Error* error);
```

**Parameters**

- **space**
  Input. This accepts the address space that contains the saved storage block to be marked as not modified.

- **token**
  Input. This accepts the token that identifies the saved storage block to be marked as not modified. This token must refer to an active saved storage block.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned when the modified bit in the given Ddpi_Space object has been successfully reset.

- **DW_DLV_NO_ENTRY**
  Returned if there is no saved storage block that corresponds to the given token.

- **DW_DLV_ERROR**
  This value is returned if an error occurs.

### ddpi_savedstorage_dump operation

The ddpi_savedstorage_dump operation dumps out the saved storage blocks (token, address, length and contents) to the given FILE.

ddpi_savedstorage_dump is provided to aid the consumer in debugging their application.
Prototype

```c
int ddpi_savedstorage_dump(
    Ddpi_Space     space,
    FILE*          fp,
    Dwarf_Bool    Ascii,
    Ddpi_Error*    error)
```

Parameters

**space**
- Input. This accepts the Ddpi_Space object to which the saved storage block corresponds.

**fp**
- Input. This accepts the destination for the dumped information.

**Ascii**
- Input. This accepts the type of character set for the information: ASCII (1), or EBCDIC (0).

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- Returned when the contents of the saved storage blocks (token, address, length and contents) has been successfully dumped to a file.

**DW_DLV_NO_ENTRY**
- Returned if there is no saved storage block.

**DW_DLV_ERROR**
- This value is returned if:
  - space is NULL.
  - fp is NULL.
  - At least one of the Ddpi_SavedStorage objects associated with space does not have the correct version or is corrupted.
  - There is insufficient memory.
Chapter 30. Ddpi_Format APIs

The Ddpi_Format APIs control the content and format of the DWARF debugging information that is sent to output. The APIs use a combination of standard printf specifiers and Ddpi_Format specifiers. The ddpi_format operations generate DWARF debugging information; some of the operations override the default behavior of the Ddpi_Format specifiers.

The Ddpi_Format APIs support all data types, including complex types that contain different values or variables. Complex types include structures, unions, classes, enumerated types, arrays, and functions, also referred to as composite types.

Note: If the module map is used, the access field in the Ddpi_Xeval_Context object must be set before is passed into any of the ddpi_format operations.

For your convenience, some operations replace the use of Ddpi_Format specifiers.

Ddpi_Format specifiers

The libddpi design recognizes that output data will include the names and values of variables, types and functions. The Ddpi_Format specifiers handle this type of information.

For example:
- The %<NT> specifier indicates that a variable name should be sent to output.
- The %<I> specifier indicates that an indentation should be added, based on the nested position of the given data.

Composite-type data can be extracted for an entire structure or for a single member. For example, if the ddpi_formatter operation specifies %<Nd>, the function will return both the tag name and the variable name of the given composite variable.

Specifiers that identify output data

%<NT> causes the function to return the type of the variable.
%<NV> causes the function to return the name of the variable.
%<Nd> causes the function to return both the type and name of the variable.
%<ND> behaves the same as %<Nd>, except that the composite types are expanded. For example, if a structure is used, then the function will also return the type and name of the members.
%<V> causes the function to return the value of the variable.
Specifiers that format output data

%<Ix>
Causes the function to create an indentation, where x is the depth in the current nested level of a composite type. For example, %<I3> will cause an indentation of three spaces per level. For a member of a structure inside a structure, the indentation would be six spaces.

%<S>
Causes the function to print a string that is enclosed in double quotes, and replace non-printable characters with dots.

%<C>
Causes the function to print a character enclosed in single quotes. It replaces control characters, based on the input character set (EBCDIC or ASCII), as shown in Table 3. It replaces other non-printing characters with dots.

Table 3. Control character replacements for ASCII and EBCDIC

<table>
<thead>
<tr>
<th>EBCDIC input character</th>
<th>ASCII input character</th>
<th>Replacement string</th>
</tr>
</thead>
<tbody>
<tr>
<td>\x15</td>
<td>\xa</td>
<td>\n</td>
</tr>
<tr>
<td>\x5</td>
<td>\x9</td>
<td>\t</td>
</tr>
<tr>
<td>\xb</td>
<td>\xb</td>
<td>\v</td>
</tr>
<tr>
<td>\x16</td>
<td>\x8</td>
<td>\b</td>
</tr>
<tr>
<td>\xd</td>
<td>\xd</td>
<td>\r</td>
</tr>
<tr>
<td>\xc</td>
<td>\xc</td>
<td>\f</td>
</tr>
<tr>
<td>\x2f</td>
<td>\x7</td>
<td>\a</td>
</tr>
</tbody>
</table>

user defined
The format specifier also accepts the general syntax %<fmt_name>, where fmt_name is a symbolic name representing a format string. fmt_name must be defined by a previous call to the ddpi_format_set_type_format operation. Substitution is done recursively until all items with the %<...> syntax are replaced.

Example: If you want to replace all occurrences of %<UINT> in the given format string with %12.12u, use the following statement:

ddpi_format_set_type_format(info, "UINT", "%12.12u");

ddpi_formatter operation
The ddpi_formatter operation formats the data for a given DIE according to the specifiers in a format string.

For example, the following code is called:

ddpi_formatter(info, context, die, "The %<NT> variable %<NV> has value %<V>", &b, &err);

The DIE represents the variable with the declaration int i = 2; This will return the string:

The int variable i has value 2.

The formatted string is returned in return_buff. The caller should free the storage using dwarf_dealloc with type DW_DLA_STRING.
Prototype

```c
int ddpi_formatter(
    Ddpi_Info info,
    Ddpi_Xeval_Context* context,
    Dwarf_Die die,
    char* fmt,
    char** return_buff,
    Ddpi_Error* error);
```

Parameters

**info**
- Input. This accepts the Ddpi_Info object.

**context**
- Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The access field in the Ddpi_Xeval_Context object must be set before is passed into any of the ddpi_format operations.

**die**
- Input. This accepts the DIE to be formatted.

**fmt**
- Input. This accepts the format string.

**return_buff**
- Output. This returns the formatted string.

**error**
- See "The libddpi error parameter" on page 15.

Return values

**DW_DLV_OK**
- Returned upon successful format of the data for a given DIE.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - info, context, die or return_buff is NULL.
  - Any other internal error occurs. (Check the Ddpi_Error object for the cause.)

**ddpi_format_address operation**

The `ddpi_format_address` operation formats the data at the address in the given token according to the type DIE. It returns the formatted string in return_buff.

The formatting is done as `%<V>`. (See "Ddpi_Format specifiers" on page 305). Array subranges can also be formatted.

The caller should free the memory allocated for the return string using `ddpi_dealloc` with type `DDPI_DLA_STRING`.

Prototype

```c
int ddpi_format_address(
    Ddpi_Info info,
    Ddpi_Xeval_Context* context,
    Ddpi_Xeval_Token token,
    Dwarf_Die type_die,
```
Dwarf_Unsigned low_index,
Dwarf_Unsigned count,
char** return_buff,
Ddpi_Error* error);

Parameters

info
Input. This accepts the Ddpi_Info object.

context
Input. This accepts the Ddpi_Xeval_Context array. The access field in the
Ddpi_Xeval_Context object must be set before is passed into any of the
ddpi_format operations.

token
Input. If a module map is used, this accepts the XEVAL token.

type_die
Input. This accepts the type DIE.

low_index
Input. This accepts the low index in the subrange if the data is an array.
Otherwise this parameter is ignored.

count
Input. This accepts the number of elements to format if the data is an array. If
the value is 0, then the whole array will be formatted.

return_buff
Output. This returns the formatted string.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful call of the address data for a given DIE.

DW_DLV_NO_ENTRY
Returned if the token is not an address.

DW_DLV_ERROR
This value is returned if:
• info, context, type_die, or return_buff is NULL.
• Any other internal error occurs. (Check the Ddpi_Error object for the cause.)

ddpi_format_bitfield_address operation

The ddpi_format_bitfield_address operation formats the bit field from the
member token and returns the formatted string in return_buff.

The formatting is done as %<V>. (See “Ddpi_Format specifiers” on page 305). Array
subranges can also be formatted.

The caller should free the memory allocated for the return string using
ddpi_dealloc with type DDPI_DLA_STRING.
Prototype

```c
int ddpi_format_bitfield_address(
    Ddpi_Info info,
    Ddpi_Xeval_Context* context,
    Dwarf_Die member_die,
    Ddpi_Xeval_Token member_token,
    char** return_buff,
    Ddpi_Error* error);
```

Parameters

- **info**
  - Input. This accepts the Ddpi_Info object.

- **context**
  - Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The access field in the Ddpi_Xeval_Context object must be set before it is passed into any of the ddpi_format operations.

- **member_die**
  - Input. This accepts the bitfield member DIE.

- **member_token**
  - Input. This accepts the member token from XEVAL.

- **return_buff**
  - Output. This returns the formatted string.

- **error**
  - See “The libddpi error parameter” on page 15.

Return values

- **DW_DLV_OK**
  - Returned upon successful format of the bit field address.

- **DW_DLV_NO_ENTRY**
  - Returned if the DIE is not for a bit field.

- **DW_DLV_ERROR**
  - This value is returned if:
    - info is NULL
    - context, member_die, or return_buff is NULL
    - An error occurs

---

**ddpi_format_set_input_charset operation**

The ddpi_format_set_input_charset operation assigns the character set for characters that are passed to the formatter.

Prototype

```c
int ddpi_format_set_input_charset(
    Dwarf_IBM_charset_type cs);
```

Parameters

- **cs**
  - Input. This accepts the character-set type.

Return values

The ddpi_format_set_input_charset operation always returns DW_DLV_OK.
ddpi_format_set_type_format operation

The ddpi_format_set_type_format operation assigns the type format specifier for the given type name.

Prototype

```c
int ddpi_format_set_type_format(
    Ddpi_Info info,
    char* typeName,
    char* fmt,
    Ddpi_Error* error);
```

Parameters

- **info**
  - Input. This accepts the Ddpi_Info object.
- **typeName**
  - Input. This accepts the name of the type.
- **fmt**
  - Input. This accepts the format specifier for the type.
- **error**
  - Input. This accepts the libddpi error parameter.

Return values

- **DW_DLV_OK**
  - Returned upon successful assignment of the type format specifier for the given type name.
- **DW_DLV_NO_ENTRY**
  - Never returned.
- **DW_DLV_ERROR**
  - This value is returned if:
    - info is NULL.
    - typeName is NULL.
    - fmt is NULL.
    - An error occurs while allocating memory.

ddpi_format_get_type_format operation

The ddpi_format_get_type_format operation returns the type format specifier for the given type name.

Prototype

```c
int ddpi_format_get_type_format(
    Ddpi_Info info,
    char* name,
    char** ret_format,
    Ddpi_Error* error);
```

Parameters

- **info**
  - Input. This accepts the Ddpi_Info object.
**typeName**
Input. This accepts the name of the type.

**fmt**
Output. This returns the format specifier for the type.

**error**
See “The libddpi error parameter” on page 15.

### Return values

**DW_DLV_OK**
Returned upon successful retrieval of the type format specifier for the given type name.

**DW_DLV_NO_ENTRY**
Returned if the type name is not found.

**DW_DLV_ERROR**
This value is returned if ret_fmt is NULL.

### ddpi_format_set_composite_format operation

The `ddpi_format_set_composite_format` operation assigns the composite format specifiers for the given composite type name.

### Prototype

```c
int ddpi_format_set_composite_format(  
    Ddpi_Info info,  
    char* typeName,  
    char* head,  
    char* body,  
    char* aux,  
    char* tail,  
    Ddpi_Error* error);
```

### Parameters

**info**
Input. This accepts the Ddpi_Info object.

**typeName**
Input. This accepts the name of the type.

**head**
Input. This accepts the returned format specifier for the head.

**body**
Input. This accepts the returned format specifier for the body.

**aux**
Input. This accepts the returned format specifier for the auxiliary separator.

**tail**
Input. This accepts the returned format specifier for the tail.

**error**
See “The libddpi error parameter” on page 15.
**Return values**

**DW_DLV_OK**
Returned upon successful assignment of the composite format specifiers for the given composite type name.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `info` is NULL
- `typeName` is NULL
- `head`, `body`, `aux`, or `tail` is NULL
- An error occurs during memory allocation.

---

**ddpi_format_get_composite_format operation**

The `ddpi_format_get_composite_format` operation returns the composite format specifiers for the given composite type name.

**Prototype**

```c
int ddpi_format_get_composite_format(
    Ddpi_Info info,
    char* name,
    char** ret_head,
    char** ret_body,
    char** ret_aux,
    char** ret_tail,
    Ddpi_Error* error);
```

**Parameters**

- `info`
  Input. This accepts the `Ddpi_Info` object.

- `name`
  Input. This accepts the name of the type.

- `ret_head`
  Output. This returns the format specifier for the head.

- `ret_body`
  Output. This returns the format specifier for the body.

- `ret_aux`
  Output. This returns the format specifier for the auxiliary separator.

- `ret_tail`
  Output. This returns the format specifier for the tail.

- `error`
  See "The libddpi error parameter" on page 15.

**Return values**

**DW_DLV_OK**
Returned upon successful retrieval of the composite format specifiers for the given composite type.

**DW_DLV_NO_ENTRY**
Returned if the type name is not found.
**DW_DLV_ERROR**

This value is returned if:

- ret_head
- ret_body
- ret_aux
- ret_tail

---

**ddpi_format_expand_type_format operation**

The `ddpi_format_expand_type_format` operation returns the expanded format specifier string.

**Prototype**

```c
int ddpi_format_expand_type_format(  
    Ddpi_Info info,  
    char* fmt,  
    char** ret_buff,  
    Ddpi_Error* error);
```

**Parameters**

- **info**  
  Input. This accepts the `Ddpi_Info` object.
- **fmt**  
  Input. This accepts the input specifier string.
- **ret_buff**  
  Output. This returns the expanded specifier string.
- **error**  
  See “The libddpi error parameter” on page 15.

**Return values**

- **DW_DLV_OK**  
  Returned upon successful retrieval of the expanded format specifier.
- **DW_DLV_NO_ENTRY**  
  Returned if the type name is not found.
- **DW_DLV_ERROR**  
  This value is returned if:
  - There is an error during memory allocation.
  - `info` is NULL.
  - `fmt` or `ret_buff` is NULL.

---

**ddpi_format_i_to_hex operation**

The `ddpi_format_i_to_hex` operation formats the value in hexadecimal format, given the size of the value.

**Prototype**

```c
int ddpi_format_i_to_hex (  
    Ddpi_Info info,  
    Dwarf_Signed val,  
    Dwarf_Signed bytes,  
    char** ret_buff,  
    Ddpi_Error* error);
```
Parameters

**info**
Input. This accepts the Ddpi_Info object.

**val**
Input. This accepts the value to be formatted.

**bytes**
Input. This accepts the size of the val in bytes.

**ret_buff**
Output. This returns the formatted output.

**error**
See “The libddpi error parameter” on page 15.

Return values

**DW_DLV_OK**
Returned when the value is successfully formatted in hexadecimal format.

**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
• There is an error during memory allocation.
• info is NULL.
• ret_buff is NULL.

The ddpi_format_i_to_hex operation returns DW_DLV_OK. The ddpi_format_i_to_hex operation returns DW_DLV_ERROR if:
• An error occurs while allocating memory

Note: ddpi_format_i_to_hex never returns DW_DLV_NO_ENTRY.

**ddpi_format_hexdump operation**

The ddpi_format_hexdump operation formats an area of storage in hexadecimal format according to the parameters given.

ddpi_format_hexdump places the content into columns, with each column displaying the given number of bytes in hexadecimal format.

Prototype

```c
int ddpi_format_hexdump(  
    Ddpi_Info info,  
    Dwarf_Ptr area,  
    DwarfUnsigned arealen,  
    DwarfUnsigned col,  
    DwarfUnsigned col_bytes,  
    char* delimiter,  
    char** ret_buff,  
    Ddpi_Error* error);  
```

Parameters

**info**
Input. This accepts the Ddpi_Info object.
area
Input. This accepts the pointer to the storage area that will be dumped.

arealen
Input. This accepts the length of the storage area that will be dumped.

col
Input. This accepts the number of columns per row.

col_bytes
Input. This accepts the number of bytes per column.

delimiter
Input. This accepts the column delimiter. This is NULL if the parameter is not used.

ret_buff
Output. This returns the formatted output.

error
See "The libddpi error parameter" on page 15

Return values

DW_DLV_OK
Returned when the given area of storage is successfully formatted in hexadecimal format.

DW_DLV_NO_ENTRY
Returned if arealen is 0 or area is NULL.

DW_DLV_ERROR
This value is returned if:
  • There is an error during memory allocation.
  • info is NULL
  • ret_buff is NULL
  • col or col_bytes is 0

ddpi_format_chardump operation
The ddpi_format_chardump operation formats an area of storage in character format according to the parameters given.

ddpi_format_chardump places the content into columns, with each column displaying the given number of bytes in character format.

Prototype

```c
int ddpi_format_chardump(
    Ddpi_Info info,
    Dwarf_Ptr area,
    DwarfUnsigned arealen,
    DwarfUnsigned col,
    DwarfUnsigned col_bytes,
    char* delimiter,
    char* subchar,  // not used in this example
    char** ret_buff,
    Ddpi_ERROR* error);
```
Parameters

info
Input. This accepts the Ddpi_Info object.

area
Input. This accepts the pointer to the storage area that will be dumped.

arealen
Input. This accepts the length of the storage area that will be dumped.

col
Input. This accepts the number of columns per row.

col_bytes
Input. This accepts the number of bytes per column.

delimiter
Input. This accepts the column delimiter. This is NULL if the parameter is not used.

sub_char
Input. This accepts the substitution character for non-printing characters. This is NULL if the parameter is not used.

ret_buff
Output. This returns the formatted output.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the given area of storage is successfully formatted in character format.

DW_DLV_NO_ENTRY
Returned if arealen is 0 or area is NULL.

DW_DLV_ERROR
This value is returned if:
• There is an error during memory allocation.
• info is NULL.
• ret_buff is NULL.
• col or col_bytes is 0.

ddpi_format_dbx_hexdump operation

The ddpi_format_dbx_hexdump operation formats an area of storage in dbx style.

Prototype

int ddpi_format_dbx_hexdump(
    Ddpi_Info info,
    Dwarf_Ptr area,
    Dwarf_Signed arealen,
    Dwarf_Bool showsame,
    char** ret_buff,
    Ddpi_Error* error);
 Parameters

info
Input. This accepts the Ddpi_Info object.

area
Input. This accepts the pointer to the storage area that will be dumped.

arealen
Input. This accepts the length of the storage area that will be dumped.

showsame
Input. This accepts the option to display rows that are identical to the previous row.

ret_buff
Output. This returns the formatted output.

error
See “The libddpi error parameter” on page 15

 Return values

DW_DLV_OK
Returned when the given area of storage is successfully formatted in dbx style.

DW_DLV_NO_ENTRY
Returned if arealen is 0 or area is NULL.

DW_DLV_ERROR
This value is returned if:
  • There is an error during memory allocation.
  • info is NULL.
  • ret_buff is NULL.
  • col or col_bytes is 0.

ddpi_format_get_DIE_xeval_token operation

The ddpi_format_get_DIE_xeval_token operation returns the XEVAL token associated with the location expression of a given DIE with a DW_AT_location attribute.

The token entity must be freed by the caller as follows:

ddpi_dealloc(info, ret_token->xt_token, DDPI_DLA_CHUNK)

 Prototype

int ddpi_format_get_DIE_xeval_token (  
  Ddpi_Info info,  
  Ddpi_Xeval_Context* context,  
  Dwarf_Die die,  
  Ddpi_Xeval_Token* ret_token,  
  Ddpi_Error* error);

 Parameters

info
Input. This accepts the Ddpi_Info object.
context
Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The access field in the Ddpi_Xeval_Context object must be set before is passed into any of the ddpf_format operations.

die
Input. This accepts the DIE with the location expression.

ret_token
Output. This returns the token.

error
See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned when the XEVAL token associated with the location expression of a given DIE with a DW_AT_location attribute has been successfully returned.

DW_DLV_NO_ENTRY
Returned if the location expression does not exist.

DW_DLV_ERROR
This value is returned if:
• info, context, die, or ret_token is NULL.
• the module or machine state associated with context is NULL.
• Any other internal error occurs (check Ddpi_Error for the cause).

ddpi_format_get_DIE_member operation

The ddpf_format_get_DIE_member operation returns the member DIE (DW_TAG_member) and XEVAL token for a given member name within a given DW_TAG_structure_type, DW_TAG_union_type, or DW_TAG_class_type DIE.

Optionally, the location expression token can be retrieved if the returned XEVAL token is not NULL.

The returned DIE and XEVAL token must be freed by the caller as follows:

dwarf_dealloc (dbg, *ret_die, DW_DLA_DIE)
ddpi_dealloc(info, ret_token->xt_token, DDPI_DLA_CHUNK)

Prototype

int ddpf_format_get_DIE_member (  
    Ddpi_Info info,  
    Ddpi_Xeval_Context* context,  
    Dwarf_Die csu_type_die,  
    Ddpi_Xeval_Token die_token,  
    char* memname,  
    Dwarf_Die* ret_die,  
    Ddpi_Xeval_Token* ret_token,  
    Ddpi_Error* error);

Parameters

info
Input. This accepts the Ddpi_Info object.
Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The access field in the Ddpi_Xeval_Context object must be set before is passed into any of the ddpi_format operations.

csu_type_die
Input. This accepts the DW_TAG_class_type, the DW_TAG_structure_type, or the DW_TAG_union_type DIE.

die_token
Input. This accepts the XEVAL token referencing the class, structure, or union object.

memname
Input. This accepts the member name to find.

ret_die
Output. This returns the DW_TAG_member DIE.

ret_token
Output. This returns the XEVAL token, or NULL if it is not used.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of both of the following items:
• The member DIE (DW_TAG_member)
• The XEVAL token for a given member name within a given DW_TAG_structure_type, DW_TAG_union_type, or DW_TAG_class_type DIE

DW_DLV_NO_ENTRY
Returned if the member name cannot be found or if the location expression does not exist.

DW_DLV_ERROR
This value is returned if:
• info, context, csu_type_die, or ret_die is NULL.
• The module or machine state associated with context is NULL.
• Any other internal error occurs (check Ddpi_Error for the cause).

**ddpi_format_get_array_DIE_xeval_token operation**

The ddpi_format_get_array_DIE_xeval_token operation returns the location expression token for an array index and the type of DIE of the array.

The calling function should free the returned DIE and XEVAL token as follows:
```c
dwarf_dealloc (dbg, *ret_die, DW_DLA_DIE)
ddpi_dealloc(info, ret_token->xt_token, DDPI_DLA_CHUNK)
```

**Prototype**

```c
int ddpi_format_get_array_DIE_xeval_token (  
    Ddpi_Info info,  
    Ddpi_Xeval_Context* context,  
    Dwarf_Die array_die,  
    Ddpi_Xeval_Token die_token,  
    Dwarf_Unsigned index,
```

Chapter 30. Ddpi_Format APIs  319
Dwarf_Bool  check_bound,
Ddpi_Xeval_Token*  ret_token,
Dwarf_Die*  ret_typedie,
Ddpi_Error*  error);

Parameters

info
Input. This accepts the Ddpi_Info object.

custom
Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The
access field in the Ddpi_Xeval_Context object must be set before is passed into
any of the ddpi_format operations.

array_die
Input. This accepts the array DIE. Note that this must be a DW_TAG_array_type
DIE.

die_token
Input. This accepts the XEVAL token referencing the array object.

index
Input. This accepts the index into the array.

check_bound
Input. This accepts the setting for the boundary flag of the array.

ret_token
Output. This returns the XEVAL token for the array element at the given index.

ret_typedie
Output. This returns the type DIE of the array at the given index. This must be
must be a DW_TAG_array_type DIE.

error
See “The libdmpi error parameter” on page 15.

Return values

DW_DLV_OK
Returned upon successful retrieval of both of the following items:
• The location expression token for an array index
• The type of DIE of the array

DW_DLV_NO_ENTRY
Returned if both of the following conditions are true:
• check_bound is true
• index is out of range

DW_DLV_ERROR
This value is returned if:
• info, context, ret_token, or ret_type_die is NULL.
• array_die is NULL or not a DW_TAG_array_type.
• The module or machine state associated with context is NULL.
• A memory allocation error occurs.
• Any other internal error occurs (check Ddpi_Error for the cause).
ddpi_format_get_ptr_to_mem_xeval_token operation

The ddpi_format_get_ptr_to_mem_xeval_token operation returns an XEVAL token for a pointer to member.

To return an XEVAL token for a pointer to member, the ddpi_format_get_ptr_to_mem_xeval_token operation performs the following steps:
- Push the address of the pointer to member onto the location expression stack.
- Push the base address of the object onto the location expression stack.
- Evaluate the DW_AT_use_location expression for the pointer to the member type.

The returned token must be freed by the calling function as follows:

ddpi_dealloc(info, ret_this_token->xt_token, DDPI_DLA_CHUNK)
ddpi_dealloc(info, ret_mbr_token->xt_token, DDPI_DLA_CHUNK)

Prototype

```c
int ddpi_format_get_ptr_to_mem_xeval_token (  
    Ddpi_Info info,  
    Ddpi_Xeval_Context* context,  
    Ddpi_Xeval_Token obj_token,  
    Dwarf_Die obj_type_die,  
    Ddpi_Xeval_Token mptr_token,  
    Dwarf_Die mptr_type_die,  
    Ddpi_Xeval_Token* ret_this_token,  
    Ddpi_Xeval_Token* ret_mbr_token,  
    Ddpi_Error* error);
```

Parameters

info
   Input. This accepts the Ddpi_Info object.

custom
   Input. If a module map is used, this accepts the Ddpi_Xeval_Context array. The access field in the Ddpi_Xeval_Context object must be set before is passed into any of the ddpi_format operations.

obj_token
   Input. This accepts the token with the address of the object.

obj_type_die
   Input. This accepts the DW_TAG_structure_type, DW_TAG_union_type, or DW_TAG_class_type DIE.

mptr_token
   Input. This accepts the token with the address of the pointer to member.

mptr_type_die
   Input. This accepts the DW_TAG_ptr_to_member_type DIE.

ret_this_token
   Output. This returns the XEVAL token for the adjusted this pointer.

ret_mbr_token
   Output. This returns the XEVAL token for the member.

error
   See “The libddpi error parameter” on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful retrieval of the XEVAL token for the specified pointer to member.

**DW_DLV_NO_ENTRY**
- Returned if the containing class of `mptr_type_die` is not `obj_type_die` or any of its base classes.

**DW_DLV_ERROR**
- This value is returned if:
  - `info` is `NULL`.
  - `context`, `obj_type_die`, `mptr_type_die`, `ret_this_token`, or `ret_mbr_token` is `NULL`.
  - `mptr_type_die` is not a pointer to a member type.
  - `DW_AT_use_location` does not exist for the type of `mptr_type_die`.
  - `DW_AT_containing_type` does not exist for the type of `mptr_type_die`.
  - An error occurs.

### ddpi_format_set_showbases operation

The `ddpi_format_set_showbases` operation sets whether or not the values of base classes are printed.

**Prototype**

```c
int ddpi_format_set_showbases(
    Dwarf_Bool show_bases);
```

**Parameters**

- `show_bases`  
  Input. This accepts a value for the flag that indicates if base classes printed.

### ddpi_format_set_maxstring operation

The `ddpi_format_set_maxstring` operation sets the maximum length of strings printed with the `%<S>` format specifier.

If the value is 0, then there is no maximum.

**Prototype**

```c
int ddpi_format_set_maxstring(
    Dwarf_Unsigned max_string);
```

**Parameters**

- `max_string`  
  Input. This accepts the maximum length of strings.

### ddpi_format_set_expand_classes operation

The `ddpi_format_set_expand_classes` operation sets the `%<Nd>` format specifier to expand or not expand classes.
Prototype

int ddpi_format_set_expand_classes(
    Dwarf_Bool expand_classes);

Parameters

expand_classes
    Input. This accepts a value for the flag that indicates if classes are expanded.

Return values

ddpi_format_set_expand_classes always returns DW_DLV_OK.

ddpi_format_set_expand_structs operation

The ddpi_format_set_expand_structs operation sets the %<Nd> format specifiers to expand or not expand structures.

Prototype

int ddpi_format_set_expand_structs(
    Dwarf_Bool expand structs);

Parameters

expand structs
    Input. This accepts a value for the flag that indicates if structures are expanded.

Return values

ddpi_format_set_expand_structs always returns DW_DLV_OK.

ddpi_format_set_expand_unions operation

The ddpi_format_set_expand_unions operation sets the %<Nd> format specifier to expand unions or not to expand unions.

Prototype

int ddpi_format_set_expand_unions(
    Dwarf_Bool expand unions);

Parameters

expand unions
    Input. This accepts a value for the flag that indicates if unions are expanded.

Return values

ddpi_format_set_expand_unions always returns DW_DLV_OK.

ddpi_format_set_expand Enums operation

The ddpi_format_set_expand Enums operation sets the %<Nd> format specifier to expand or not expand enumerated types.
Prototype

```c
int ddpi_format_set_expand Enums(
    Dwarf_Bool   expandEnums);
```

Parameters

expandEnums
  Input. This accepts a value for the flag that indicates if enumerated types are expanded.

Return values

ddpi_format_set_expand Enums always returns DW_DLV_OK.

ddpi_format_set_expand_funcpar operation

The ddpi_format_set_expand_funcpar operation sets the %<Nd> format specifier to expand or not expand function parameters.

Prototype

```c
int ddpi_format_set_expand_funcpar(
    Dwarf_Bool   expand_funcpar);
```

Parameters

expand_funcpar
  Input. This accepts a value for the flag that indicates if function parameters are expanded.

Return values

ddpi_format_set_expand_funcpar always returns DW_DLV_OK.

ddpi_format_set_expand_memfunc operation

The ddpi_format_set_expand_memfunc operation sets the %<Nd> format specifier to expand or not expand the member functions.

Prototype

```c
int ddpi_format_set_expand_memfunc(
    Dwarf_Bool   expand_memfunc);
```

Parameters

expand_memfunc
  Input. This accepts a value for the flag that indicates if member functions are expanded.

Return values

ddpi_format_set_expand_memfunc always returns DW_DLV_OK.

ddpi_format_set_expand_memdata operation

The ddpi_format_set_expand_memdata operation sets the %<Nd> format specifier to expand or not expand the names of data members.
Prototype

int ddpi_format_set_expand_memdata(
   Dwarf_Bool expand_memdata);

Parameters

expand_memdata
   Input. This accepts a value for the flag that indicates if data member names are expanded.

Return values

ddpi_format_set_expand_memdata always returns DW_DLV_OK.

ddpi_format_clear_user_format operation

The ddpi_clear_user_format operation clears a user-format specifier for the given type name.

Prototype

int ddpi_format_clear_user_format(
   Ddpi_Info info,
   char* typeName,
   Ddpi_Error* error);

Parameters

info
   Input. This accepts the Ddpi_Info object.

typeName
   Input. This accepts the type name.

error
   See “The libddpi error parameter” on page 15

Return values

DW_DLV_OK
   Returned when the given user-format specifier for the given type name is successfully cleared.

DW_DLV_NO_ENTRY
   Returned if a user-format specifier is not found for the type name.

DW_DLV_ERROR
   This value is returned when info is NULL.
Chapter 31. Ddpi_Xeval APIs

The Ddpi_Xeval APIs are a set of low-level operations. They assist with the evaluation of the DWARF opcodes such as conversions, addition, multiplication, bitwise operations, and string length. Although these APIs are partly an implementation of the DWARF Expression Evaluator, they cannot reside in libdwarf because the operations require system-level information when evaluating the expressions. In order to have access to this information, the expression evaluator must be a part of libddpi.

The Ddpi_Xeval objects contain information about the operations, operands, and results. This information is necessary for the evaluation of the DWARF opcodes. There is also a context object (Ddpi_Xeval_Context) that contains the module, stack state, and machine state information. The Ddpi_Xeval_Context object allows an expression to be evaluated at a particular program, scope, and place in the stack, so that the behavior of a variable, at the time it was called, can be determined.

Note: The operands and results are referred to as tokens in this information.

The callback functions allow a consumer process to use its own implementation to override the default implementation. The callbacks can also extend the default implementation with the opcodes or types of the consumer process. These are used when processing other DWARF expressions. For example, when converting, the consumer might want to use their own conversion rules instead of the standard-C semantics.

The following types are currently not supported by the Ddpi_Xeval APIs:

- DW_ATE_complex_float
- DW_ATE_IBM_complex_float_hex
- DW_ATE_IBM_imaginary_float_hex
- DW_ATE_IBM_packed_decimal
- DW_ATE_IBM_zoned_decimal
- DW_ATE_IBM_register

Ddpi_Xeval_Xtended_Op object

The Ddpi_Xeval_Xtended_Op object contains the DWARF opcode.

Type definition
typedef struct Ddpi_Xeval_Xtended_Op {
  Dwarf_Small xx_op;
  Dwarf_Small xx_sub_op;
  Dwarf_Half xx_pad;
} Ddpi_Xeval_Xtended_Op;

Members

xx_op
  The mandatory DW_OP_DWARF opcode, defined as type Dwarf_Small.

xx_sub_op
  If the opcode is DW_OP_IBM_builtin or DW_OP_IBM_user, this is the sub-opcode. Otherwise, this is 0x00. It is defined as type Dwarf_Small.
Currently, this is a reserved member, and must be 0. It is defined as type Dwarf_Half.

Ddpi_Xeval_Token_Kind object

The Ddpi_Xeval_Token_Kind object is a structure that contains information about the type of the token.

**Type definition**

typedef struct Ddpi_Xeval_Token_Kind {
    Dwarf_Small xk_base_encoded_type;
    Dwarf_Half xk_size;
    Dwarf_Small xk_len2;
    Dwarf_Small xk_len3;
} Ddpi_Xeval_Token_Kind;

**Members**

- **xk_base_encoded_type**
  The DW_AT_E-encoded base type, defined as type Dwarf_Small.

- **xk_size**
  The physical size of the token in bytes or 0xFFFF to indicate LEB128. Defined as Dwarf_Half.

- **xk_len2**
  The member size for complex types, or the number of digits for decimal types. For all other types, it should be 0. Defined as Dwarf_Small.

- **xk_len3**
  The number of decimal places for decimal types. For all other types, it should be 0. Defined as Dwarf_Small.

Ddpi_Xeval_Token object

The Ddpi_Xeval_Token object contains information about the token.

**Type definition**

typedef struct Ddpi_Xeval_Token {
    Ddpi_Xeval_Token_Kind xt_kind;
    void * xt_token;
} Ddpi_Xeval_Token;

**Members**

- **xt_kind**
  The type of the token.

- **xt_token**
  The token entity.

Ddpi_Xeval_Context object

The Ddpi_Xeval_Context object contains information about a variable at the time and place it was requested from a CDA expression. The variable may be requested from a different program, a different scope, or a different place in the stack. The Ddpi_Xeval_Context object can be saved and used later to retrieve the behavior of the variable at the time it was called.
Type definition

typedef struct Ddpi_Xeval_Context_s {
    Dwarf_Small xeval_context_data_struct_version;
    Ddpi_Module module;
    Ddpi_StackState ss;
    Ddpi_MachineState ms;
    /*-- End of version 0x01 structure -------------------------------*/
} Ddpi_Xeval_Context;

Members

xeval_context_data_struct_version
    The version of the variable.

module
    The Ddpi_Module object.

    Note: The module field will be used only if both of the following conditions are true:
    • The access field is NULL.
    • The xeval_context_data_struct_version field is 0x02.

ss
    The Ddpi_StackState object.

ms
    The Ddpi_MachineState object.

access
    The Ddpi_Access object.

Ddpi_Xeval_Unary_Func object

The Ddpi_Xeval_Unary_Func object contains the prototype of the function used to override the processing of a single unary DWARF op.

It overrides the processing of the op if:
• It has been registered as a unary function for a user type
• It has been registered as an override unary function
• It has been registered as an override conversion function

Type definition

typedef int (*Ddpi_Xeval_Unary_Func)(
    Ddpi_Xeval_Token_Kind kind,
    Ddpi_Xeval_Xtended_Op op,
    Ddpi_Xeval_Token parm,
    Ddpi_Xeval_Token* result,
    DwarfUnsigned* err_val);

Members

kind
    Input. This accepts the type of the value that the operation is supposed to return. It is expressed in token terms.

op
    Input. This accepts the opcode.

parm
    Input. This accepts the token, on which the operation will be performed.
Output. This returns the result token, which must be non-NULL. Also, the Ddpi_Xeval_Token data type must be non-NULL, with enough storage allocated to contain the entity.

Output. This returns the DDPI_DLE error code.

Ddpi_Xeval_Binary(Func object

The Ddpi_Xeval_Binary(Func object contains the prototype for a callback function used to override the processing of a single binary DWARF op.

It overrides the processing of the op if:

- It has been registered as a binary function for a user type
- It has been registered as an override binary function

Type definition

typedef int (*Ddpi_Xeval_Binary(Func)(
   Ddpi_Xeval_Token_Kind kind,
   Ddpi_Xeval_Xtended_Op op,
   Ddpi_Xeval_Token parm1,
   Ddpi_Xeval_Token parm2,
   Ddpi_Xeval_Token* result,
   Dwarf_Unsigned* err_val);

Members

kind
Input. This accepts the type of the value that the operation is supposed to return. It is expressed in token terms.

op
Input. This accepts the opcode.

parm1
Input. This accepts the first token, on which the operation will be performed.

parm2
Input. This accepts the second token, on which the operation will be performed.

result
Output. This returns the result token, which must be non-NULL. Also, the xt_token field must be non-NULL with enough storage allocated to contain the entity.

err_val
Output. This returns the DDPI_DLE error code.

ddpi_xeval_eval_unary_op operation

The ddpi_xeval_eval_unary_op operation runs the given operation, then compares the given kind parameter with the type of the result.

If the types do not match, then the result of the operation will be converted to the given kind after the operation. The conversion follows standard C conversion rules. The parm parameter must have a type that is valid for the operation. If necessary, the consumer can convert the token to the required type with the DW_OP_IBM_conv macro before calling this operation.
Prototype

```c
int ddpi_xeval_eval_unary_op(
    Ddpi_Info info,
    Ddpi_Xeval_Token_Kind kind,
    Ddpi_Xeval_Xtended_Op op,
    Ddpi_Xeval_Token parm,
    Ddpi_Xeval_Token* result,
    Ddpi_Error* error);
```

Parameters

- `info` - Input. This accepts the `Ddpi_Info` object.
- `kind` - Input. This accepts the type of the operation, which also determines the type of the result.
- `op` - Input. This accepts the op code.
- `parm` - Input. This accepts the token, on which the operation will be performed.
- `result` - Output. This returns the result token, which must be non-NULL. Also, the `xt_token` field must be non-NULL with enough storage allocated to contain the entity.
- `error` - See "The `libddpi` error parameter" on page 15.

Return values

- **DW_DLV_OK** - Returned upon successful completion.
- **DW_DLV_NO_ENTRY** - Never returned.
- **DW_DLV_ERROR** - This value is returned if:
  - `info`, `result`, or the associated `xt_token` is NULL
  - `kind` is not valid
  - The operation isn't supported or it failed

Invalid data types

For the `DW_OP_abs` and `DW_OP_not` operations, the invalid data types are:
- `DW_ATE_address`
- `DW_ATE_boolean`
- `DW_ATE_float`
- `DW_ATE_IBM_float_hex`

For the `DW_OP_neg` and `DW_OP_IBM_logical_not` operations, the invalid data types are:
- `DW_ATE_address`
- `DW_ATE_boolean`
**ddpi_xeval_eval_binary_op operation**

The `ddpi_xeval_eval_binary_op` operation compares the types of the `parms`, converts them following Standard C conversion rules, and then performs the operation.

The `ddpi_xeval_eval_binary_op` operation then compares the type of the result to the value of the given `kind` parameter. If the types do not match, the result of the operation is converted to the given type. The `parm` parameters must have a type that is valid for the operation. If necessary, the consumer can convert the tokens to the required type with the `DW_OP_IBM_conv` macro before calling this operation.

**Prototype**

```c
int ddpi_xeval_eval_binary_op(
    Ddpi_Info info,
    Ddpi_Xeval_Token_Kind kind,
    Ddpi_Xeval_Xtended_Op op,
    Ddpi_Xeval_Token parm1,
    Ddpi_Xeval_Token parm2,
    Ddpi_Xeval_Token* result,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  Input. This accepts the `Ddpi_Info` object.

- **kind**
  Input. This accepts the type of the operation, which also determines the type of the result.

- **op**
  Input. This accepts the `op` code.

- **parm1**
  Input. This accepts the first token, on which the operation will be performed.

- **parm2**
  Input. This accepts the second token, on which the operation will be performed.

- **result**
  Output. This returns the result token, which must be non-NULL. Also, the `xt_token` field must be non-NULL with enough storage allocated to contain the entity.

- **error**
  See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  Returned upon successful completion.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - `info`, `result`, or the associated `xt_token` is NULL
  - `kind` is not valid
  - The operation isn't supported or it failed
Invalid data types

For the DW_OP_and, DW_OP_or, DW_OP_shl, DW_OP_shr, DW_OP_shra, and DW_OP_xor operations, the invalid data types are:

- DW_ATE_address
- DW_ATE_boolean
- DW_ATE_float
- DW_ATE_IBM_float_hex

For the DW_OP_IBM_builtin, DW_OP_IBM_logical_and, DW_OP_IBM_logical_or, and DW_OP_mod operations, the invalid data types are:

- DW_ATE_address
- DW_ATE_boolean

For the DW_OP_div, DW_OP_mul, DW_OP_minus, DW_OP_plus, DW_OP_le, DW_OP_ge, DW_OP_eq, DW_OP_lt, DW_OP_gt, and DW_OP_ne operations, the invalid data type is DW_ATE_boolean.

ddpi_xeval_override_conv_func operation

The ddpi_xeval_override_conv_func operation overrides the default expression-evaluator behavior for given type conversions.

ddpi_xeval_override_conv_func is registered in the Ddpi_Info object. If the provided override function is NULL, then the type conversion will revert to the default.

Prototype

```c
int ddpi_xeval_override_conv_func(
    Ddpi_Info info,
    Ddpi_Xeval_Token_Kind from_kind,
    Ddpi_Xeval_Token_Kind to_kind,
    Ddpi_Xeval_Unary_Func func,
    Ddpi_Error* error);
```

Parameters

- **info**
  - Input. This accepts the Ddpi_Info object.

- **from_kind**
  - Input. This accepts the type, from which the given function will translate.

- **to_kind**
  - Input. This accepts the type to which the given function will translate.

- **func**
  - Input. This accepts the override function that converts the entity from the first given type to the second type.

- **error**
  - See "The libddpi error parameter" on page 15

Return values

- **DW_DLV_OK**
  - Returned upon a successful call.
**DW_DLV_NO_ENTRY**
Never returned.

**DW_DLV_ERROR**
This value is returned if:
- `info` is NULL
- `from_kind` or `to_kind` are not valid
- An allocation error occurs

### ddpi_xeval_override_unary_func operation

The `ddpi_xeval_override_unary_func` operation overrides the default expression-evaluator behavior for a given unary operation.

`ddpi_xeval_override_unary_func` is registered in the `Ddpi_Info` object. If the provided override function is NULL, then the unary operator processing will revert to the default.

**Note:** It is not possible to override the behavior for a single kind of token without overriding the behavior for all types supported by the `op`. For example, if you are using the `DW_OP_ADD` `op`, then you cannot override a float without overriding all types supported by `DW_OP_ADD`.

#### Prototype

```c
int ddpi_xeval_override_unary_func(
    Ddpi_Info info,
    Ddpi_Xeval_Xtended_Op op,
    Ddpi_Xeval_Unary_Func func,
    Ddpi_Error* error);
```

#### Parameters

- **info**
  Input. This accepts the `Ddpi_Info` object.

- **op**
  Input. This accepts the `op` code for which this function will be used to override all the default processing.

- **func**
  Input. This accepts the override function for the given operation. It must be capable of doing all the required processing for all of the types of tokens that are used.

- **error**
  See "The libddpi error parameter" on page 15.

#### Return values

- **DW_DLV_OK**
  Returned upon a successful call.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - `info` is NULL.
  - An allocation error occurs.
  - The operation is not unary.
ddpi_xeval_override_binary_func operation

The ddpi_xeval_override_binary_func operation overrides the default expression-evaluator behavior for a given binary operation.

ddpi_xeval_override_binary_func is registered in the Ddpi_Info object. If the provided override function is NULL, then the binary operator processing will revert to the default.

Note: It is not possible to override the behavior for a single kind of token without overriding the behavior for all types supported by the op. For example, if you are using the DW_OP_ADD op, then you cannot override a float without overriding all types supported by DW_OP_ADD.

Prototype

int ddpi_xeval_override_binary_func(
    Ddpi_Info info,
    Ddpi_Xeval_Xtended_Op op,
    Ddpi_Xeval_Binary_Func func,
    Ddpi_Error* error);

Parameters

info
   Input. This accepts the Ddpi_Info object.

op
   Input. This accepts the op code for which this function will be used to override all the default processing.

func
   Input. This accepts the override function for the given operation. It must be capable of doing all the required processing for all of the types of tokens that are used.

error
   See “The libddpi error parameter” on page 15.

Return values

DW_DLV_OK
   Returned upon a successful call.

DW_DLV_NO_ENTRY
   Never returned.

DW_DLV_ERROR
   This value is returned if:
   • info is NULL
   • An allocation error occurs
   • The operation is not binary

ddpi_xeval_provide_unary_func_user_type_support operation

The ddpi_xeval_provide_unary_func_user_type_support operation registers a processing function to a given user type.

The consumer instance then uses this function to provide the specific support required for a given unary operator based on this user type. For example, if the
user type is identified as DW_ATE_IBM_user_type, then a function may be required in order to perform a DW_OP_neg operation.

Prototype

```c
int ddpi_xeval_provide_unary_func_user_type_support (Ddpi_Info info,
             Ddpi_Xeval_Xtended_Op op,
             Ddpi_Xeval_Unary_Func func,
             Ddpi_Error* error);
```

Parameters

- **info**
  Input. This accepts the Ddpi_Info object.

- **op**
  Input. This accepts the op code, which defines the user type this function supports.

- **func**
  Input. This accepts the function for the given operation, which will associate it with the user type. It must be capable of doing all of the required processing for the given type of token.

- **error**
  See "The libddpi error parameter" on page 15.

Return values

- **DW_DLV_OK**
  Returned upon a successful call.

- **DW_DLV_NO_ENTRY**
  Never returned.

- **DW_DLV_ERROR**
  This value is returned if:
  - info is NULL
  - An allocation error occurs
  - The operation is not unary

**ddpi_xeval_provide_binary_func_user_type_support operation**

The ddpi_xeval_provide_binary_func_user_type_support operation registers a processing function to a given user type.

The consumer instance uses this function to provide the specific support required for a given unary operator based on this user type. For example, if the user type is identified as DW_ATE_IBM_user_type, then a function may be required in order to perform a DW_OP_plus operation.

Prototype

```c
int ddpi_xeval_provide_binary_func_user_type_support (Ddpi_Info info,
             Ddpi_Xeval_Xtended_Op op,
             Ddpi_Xeval_Binary_Func func,
             Ddpi_Error* error);
```
Parameters

info
Input. This accepts the Ddpi_Info object.

op
Input. This accepts the op code, which defines the user type this function supports.

func
Input. This accepts the function for the given operation, which will associate it with the user type. It must be capable of doing all of the required processing for the given type of token.

error
See "The libddpi error parameter" on page 15.

Return values

DW_DLV_OK
Returned upon a successful call.

DW_DLV_NO_ENTRY
Never returned.

DW_DLV_ERROR
This value is returned if:
- info is NULL
- An allocation error occurs
- The operation is not binary

ddpi_xeval_engine operation

The ddpi_xeval_engine operation performs the operations in the given location-expression list, and then returns the token on top of the stack after the operations are done.

The token entity must be freed by the caller per the following code:

ddpi_dealloc(info, ret_val->xt_token, DDPI_DLA_CHUNK)

Prototype

int ddpi_xeval_engine(
    Ddpi_Info info,
    Dwarf_Locdesc * llbuf,
    Dwarf_Half context_version,
    Ddpi_Xeval_Context * context,
    Ddpi_Xeval_Token * initial_token,
    Ddpi_Xeval_Token * ret_val,
    Ddpi_Error * error);

Parameters

info
Input. This accepts the Ddpi_Info object.

llbuf
Input. This accepts the location-expression list.

context_version
Input. This accepts the version of the context array. The constant DDPI_XEVAL_CONTEXT_VERSION contains the current version.
context
Input. This accepts the context array.

func
Input. This accepts the function for the given operation, which will associate it with the user type. It must be capable of doing all of the required processing for the given type of token.

initial_token
Input. This accepts a token to initially push onto the stack. It should be NULL if it is not required.

ret_val
Output. This returns the token, which cannot be NULL.

error
See "The libddpi error parameter" on page 15.

Return values
DW_DLV_OK
Returned upon a successful call.

DW_DLV_NO_ENTRY
Returned if the location-expression list is empty.

DW_DLV_ERROR
This value is returned if:
• info is NULL
• lbuf is NULL
• context is NULL
• ret_val is NULL
Chapter 32. Code set specification APIs

The code set specification operations take ISD information generated by the z/OS XL C/C++ compiler, and create an ELF object file that contains DWARF debugging information. These operations are used by the isdcnvt utility. They can also be accessed during run time.

For more information about the utility, see z/OS Common Debug Architecture User’s Guide, SC09-7653.

Note: For a list of code sets supported by the iconv utility, see z/OS XL C/C++ Programming Guide, SC09-4765.

The following information describes the operations that allow users to specify the code set that the application uses.

**ddpi_info_set_codeset operation**

The ddpi_info_set_codeset operation specifies the code set for all of the strings (character arrays) that will be passed into libddpi operations.

**Prototype**

```c
int ddpi_info_set_codeset(
    Ddpi_Info info,
    const __ccsid_t codeset_id,
    __ccsid_t* prev_cs_id,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  Input. This accepts the Ddpi_Info object.

- **codeset_id**
  Input. This accepts the code set for all the strings that will be passed into libddpi operations. The user can obtain this ID by calling __toCcsid().
  
  For more information on the __toCcsid() function, see the library functions in z/OS XL C/C++ Run-Time Library Reference. For a list of code sets that are supported, see z/OS XL C/C++ Programming Guide.

- **prev_cs_id**
  Output. This returns the code set that was specified in the last call to this operation.
  
  If the operation is called for the first time, this returns ISO8859-1, which is the default code set. If you specify NULL, then the previously specified code set will not be returned.

- **error**
  See “The libddpi error parameter” on page 15

**Return values**

- **DW_DLV_OK**
  Returned upon successful assignment of the code set information for all of the strings (character arrays) that will be passed into the libddpi operations.
**DW_DLV_NO_ENTRY**

Never returned.

**DW_DLV_ERROR**

This value is returned if:
- info is NULL.
- codeset_id is invalid.
- ddpi_info_set_codeset is unable to convert the specified code set into an internal code set.

---

**ddpi_format_set_codeset operation**

The `ddpi_format_set_codeset` operation specifies the code set for all characters that are stored within the Ddpi_Space object.

The formatter requires this information when it formats the characters within the object.

`ddpi_format_set_codeset` performs the same function as `ddpi_format_set_input_charset`.

**Note**: Although `ddpi_format_set_input_charset` will continue to be supported, it will not be developed further. For this reason, it is recommended that you replace `ddpi_format_set_input_charset` with `ddpi_format_set_codeset`.

**Prototype**

```c
int ddpi_format_set_codeset(
    Ddpi_Info info,
    const __ccsid_t codeset_id,
    __ccsid_t* prev_cs_id,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  
  Input. This accepts the Ddpi_Info object.

- **codeset_id**

  Input. This accepts the code set for all the strings that will be passed into the formatter operations. You can obtain this ID by calling `_toCcsid()`.

  For more information on the `_toCcsid()` function, see the library functions in z/OS XL C/C++ Run-Time Library Reference. For a list of code sets that are supported, see z/OS XL C/C++ Programming Guide.

- **prev_cs_id**

  Output. This returns the codeset that was specified in the last call to this operation.

  If the operation is called for the first time, this returns IBM-1047, which is the default code set. If you specify NULL, then the previously specified code set will not be returned.

- **error**

  See "The libddpi error parameter" on page 15.
Return values

**DW_DLV_OK**
- Returned upon successful assignment of the code set format for all of the strings (character arrays) that will be passed into libddpi operations.

**DW_DLV_NO_ENTRY**
- Never returned.

**DW_DLV_ERROR**
- This value is returned if:
  - An unprintable character is found in the input buffer.
  - info is NULL.
  - codeset_id is invalid.
  - ddpi_format_set_codeset is unable to convert the specified code set into an internal code set.
Chapter 33. Character translation APIs

The ddpi, dwarf, and elf libraries store character data in ASCII format. Values extracted from PPAs or objects may be in EBCDIC. The character translation operations allow the user to quickly translate printable characters between IBM-1047 (EBCDIC) and ISO-8859-1 (ASCII).

ddpi_translate_ibm1047_to_iso8859_1 operation

The ddpi_translate_ibm1047_to_iso8859_1 operation translates character data from IBM-1047 (EBCDIC) to ISO-8859-1 (ASCII).

This operation only translates printable characters. from_buffer is the address of the input string. to_buffer is the address of a section of storage where you should put the output string. A Ddpi_Storagelocn is not used to access either buffer, so the buffers must be in the local address space.

Prototype

```c
int ddpi_translate_ibm1047_to_iso8859_1(
    Ddpi_Info info,
    char* to_buffer,
    char* from_buffer,
    DwarfUnsigned data_len,
    DwarfUnsigned* ret_actual_len,
    Ddpi_Error* error);
```

Parameters

info
- Input. This accepts the Ddpi_Info object.

to_buffer
- Output. This returns the output buffer.

from_buffer
- Input. This accepts the input buffer.

data_len
- Input. This accepts the number of characters for translation.

ret_actual_len
- Output. This returns the number of characters that were translated successfully.

error
See **The libddpi error parameter” on page 15**

Return values

DW_DLV_OK
- Returned upon successful return of the pointer to the output string storage.

DW_DLV_NO_ENTRY
- Never returned.

DW_DLV_ERROR
- This value is returned if:
  - An unprintable character is found in the input buffer.
  - info is NULL.
to_buffer, from_buffer, or ret_actual_len pointer is NULL.
- data_len is 0.

**ddpi_translate_iso8859_1_to_ibm1047 operation**

The `ddpi_translate_iso8859_1_to_ibm1047` operation translates character data from ISO-8859-1 (ASCII) to IBM-1047 (EBCDIC).

This operation only translates printable characters:
- from_buffer is the address of the input string.
- to_buffer is the address of a section of storage where you can put the output string.

**Note:** A Ddpi_Storagelocn object is not used to access either buffer, so the buffers must be in the local address space.

**Prototype**

```c
int ddpi_translate_iso8859_1_to_ibm1047(
    Ddpi_Info info,
    char* to_buffer,
    char* from_buffer,
    Dwarf_Unsigned data_len,
    Dwarf_Unsigned* ret_actual_len,
    Ddpi_Error* error);
```

**Parameters**

- **info**
  - Input. This accepts the Ddpi_Info object.

- **to_buffer**
  - Output. This returns the output buffer.

- **from_buffer**
  - Input. This accepts the input buffer that contains the characters to be translated.

- **data_len**
  - Input. This contains the number of characters in the input buffer.

- **ret_actual_len**
  - Output. This returns the number of characters that were translated successfully.

- **error**
  - See "The libddpi error parameter" on page 15.

**Return values**

- **DW_DLV_OK**
  - Returned upon successful return of the pointer to the input string storage.

- **DW_DLV_NO_ENTRY**
  - Never returned.

- **DW_DLV_ERROR**
  - This value is returned if:
    - An unprintable character is found in the input buffer.
    - info is NULL.
    - to_buffer, from_buffer, or ret_actual_len pointer is NULL.
• data_len is 0.
Chapter 34. Code set conversion APIs

ELF objects contain string literals that are encoded in the ISO8859-1 code set. Most CDA operations accept and return string literals encoded in this code set. Applications on the z/OS platform use code sets that are supported by the ICONV function. In fact, the majority of applications on the z/OS platform use string literals encoded in IBM-1047 code set. Before an application encoded in the IBM-1047 code set can use an ELF object, it has to convert the input strings to the ISO8859-1 code set.

For more information about the `iconv` utility, see z/OS Common Debug Architecture User’s Guide, SC09-7653. For a list of code sets supported by the `iconv` utility, see z/OS XL C/C++ Programming Guide, SC09-4765.

The following information describes the operations that allow users to convert input strings to and from ISO8859-1 and IBM-1047 encoding.

**ddpi_convert_c_cpp_isdobj operation**

The `ddpi_convert_c_cpp_isdobj` operation converts a single GOFF/XOBJ object into the DWARF format.

The object must contain debugging information in the ISD format. The CDA user is responsible for creating an ELF descriptor that will be used to write the converted DWARF debugging information into the ELF object file. `ddpi_convert_c_cpp_isdobj` terminates the descriptor on completion.

**Prototype**

```c
int ddpi_convert_c_cpp_isdobj (
    Ddpi_Space space,
    Dwarf.Addr low_addr,
    Dwarf.Addr high_addr,
    Elf* elf,
    int* errcode);
```

**Parameters**

* space
  Input. This accepts the `Ddpi_Space` object.

* low_addr
  Input. This accepts the start address in the `Ddpi_Space` object.

* high_addr
  Input. This accepts the end address in the `Ddpi_Space` object.

* elf
  Input. This accepts the ELF container for the DWARF debugging information.

* errcode
  Output. This returns `libddpi` error code.

**ddpi_fp_convert_c_cpp_isdobj operation**

The `ddpi_fp_convert_c_cpp_isdobj` operation converts a single C/C++ object, that contains ISD debugging information, into the DWARF format.
ddpi_fp_convert_c_cpp_isdobj will use fopen to open a temporary file for holding the ELF object. When the operation exits, a file pointer will be opened for reading. The operation will also create an ELF object associated with the file pointer.

**Prototype**

```c
int ddpi_fp_convert_c_cpp_isdobj (  
    Ddpi_Space space,  
    Dwarf_Addr start_addr,  
    Dwarf_Addr end_addr,  
    FILE** ret_fp,  
    Elf** ret_elf,  
    int* errcode);
```

**Parameters**

- **space**
  - Input. This accepts the Ddpi_Space object.

- **start_addr**
  - Input. This accepts the start address in the Ddpi_Space object.

- **end_addr**
  - Input. This accepts the end address in the Ddpi_Space object.

- **ret_fp**
  - Output. This returns a temporary file pointer for the ELF object file.

- **ret_elf**
  - Output. This returns an ELF descriptor that is used to read from the ELF object file.

- **errcode**
  - Output. This returns a pointer to the libddpi error code.
Chapter 35. Build information APIs

Build information operations return information about the libddpi build.

ddpi_build_version operation

The ddpi_build_version operation displays the build ID of the ddpi library. Every release/PTF of the ddpi library will have an unique build ID. This information is useful for providing service information to IBM customer support. Calling this function will emit the build ID string (encoded in ISO8859-1) to stdout.

Prototype

```c
char* ddpi_build_version(void);
```

Return values

Returns the libddpi build ID. The returned string is encoded in ISO8859-1.

Example

```c
/* Compile this code with ASCII option */
printf("Library(ddpi) Level(%s)\n", ddpi_build_version());
```

ddpi_dll_version operation

The ddpi_dll_version operation validates the version of the DLL, and should be used when dynamically linking to the ddpi library. To find the current library version, call the function with `-1` as an argument.

Prototype

```c
unsigned int ddpi_dll_version(unsigned int ver);
```

Return values

0   DLL version is compatible. The user code is compiled with a libddpi DLL that is the same as the current one, or perhaps earlier.

Any non-zero value. The returned value is the version of libddpi DLL used for building the user code, which means that the user code is compiled with an libddpi DLL that is more recent than the current library and the DLL version is incompatible.

Example

```c
#include "libddpi.h"

dllhandle *cdadll;
unsigned int (*version_chk)(unsigned int);
unsigned int dll_version;

#ifdef _LP64
#define __CDA_DDPI "CDAEQDPI"
#else
#endif
```
#define __CDA_DDPI "CDAEDPI"
#endif

#if LIBDDPI_IS_DLL
  cdadll = dlload(__CDA_DDPI);
  if (cdadll == NULL) {
    /* libddpi DLL not found */
  }

  version_chk = (unsigned int (*)(unsigned int))
    dllqueryfn(cdadll, "ddpi_dll_version");
  if (version_chk == NULL) {
    /* Version API not found, should NEVER happen */
  }

  dll_version = version_chk (LIBDDPI_DLL_VERSION);
  if (dll_version != 0) {
    /* Incompatible DLL version */
  }
#endif
Appendix A. libddpi error macros and messages

The following information describes the error macro DDPI_DLE_LAST and the message macros that define the error messages.

**DDPI_DLE_LAST error macro**

DDPI_DLE_LAST is used to indicate the number of messages that libddpi can generate.

**Error messages**

The table lists the error messages that can be generated by the libddpi library.

*Note:* The message macros that have names that contain “XFS” apply to user-defined storage callback functions. XFS stands for data transfer.

Table 4. libddpi error messages

<table>
<thead>
<tr>
<th>Message macro</th>
<th>Message number</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDPI_DLE_NO_ERROR</td>
<td>0</td>
<td>No error.</td>
</tr>
<tr>
<td>DDPI_DLE_INFO_NULL</td>
<td>1</td>
<td>Ddpi_Info object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_SPACE_NULL</td>
<td>2</td>
<td>Ddpi_Space object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_PROCESS_NULL</td>
<td>3</td>
<td>Ddpi_Process object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_NULL</td>
<td>4</td>
<td>Ddpi_Thread object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_MUTEX_NULL</td>
<td>5</td>
<td>Ddpi_Mutex object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_COND_NULL</td>
<td>6</td>
<td>Ddpi_Cond object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_LOCK_NULL</td>
<td>7</td>
<td>Ddpi_Lock object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_POLICY_UNKNOWN</td>
<td>8</td>
<td>The given storagelocn policy is not opaque or transparent.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_NULL</td>
<td>9</td>
<td>Ddpi_Module object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_NULL</td>
<td>10</td>
<td>Ddpi_Class object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_SECTION_NULL</td>
<td>11</td>
<td>Ddpi_Section object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_ENTRYPT_NULL</td>
<td>12</td>
<td>Ddpi_Entrypt object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_ARANGE_NULL</td>
<td>13</td>
<td>Ddpi_Arange object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_STORAGELOCN_NULL</td>
<td>14</td>
<td>Ddpi_StorageLocn object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_STACKSTATE_NULL</td>
<td>15</td>
<td>Ddpi_StackState object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINENSTATE_NULL</td>
<td>16</td>
<td>Ddpi_Machinestate object does not exist.</td>
</tr>
</tbody>
</table>
Table 4. libddpi error messages (continued)

<table>
<thead>
<tr>
<th>Message macro</th>
<th>Message number</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDPI_DLE_STACKSTATE_FN_NULL</td>
<td>17</td>
<td>Ddpi_StackState_Fn object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_DATA_CORRUPTION</td>
<td>18</td>
<td>Ddpi detected data corruption of its internal structures.</td>
</tr>
<tr>
<td>DDPI_DLE_ACCESS_NULL</td>
<td>19</td>
<td>Ddpi_Access object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_FILE_NULL</td>
<td>20</td>
<td>Ddpi_File object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERT_NULL</td>
<td>21</td>
<td>Ddpi_Convert object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_IDENTIFY_HANDLER_NULL</td>
<td>22</td>
<td>Ddpi_StackState_Identify handler does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_PARENT_HANDLER_NULL</td>
<td>23</td>
<td>Ddpi_StackState_Parent handler does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_GET_STORAGE_HANDLER_NULL</td>
<td>24</td>
<td>Ddpi_Space handler for ddpi_get_storage() invoked, but does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_SET_STORAGE_HANDLER_NULL</td>
<td>25</td>
<td>Ddpi_Space handler for ddpi_set_storage() invoked, but does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_DEMAND_MODULE_HANDLER_NULL</td>
<td>26</td>
<td>Ddpi_Space handler for ddpi_demand_module() invoked, but does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_DEMAND_ELF_HANDLER_NULL</td>
<td>27</td>
<td>Ddpi_Space handler for ddpi_demand_elf() invoked, but does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_OTHER_HANDLER_NULL</td>
<td>28</td>
<td>Ddpi_Space handler invoked, but does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_NAME_NULL</td>
<td>29</td>
<td>Name is null.</td>
</tr>
<tr>
<td>DDPI_DLE_NAME_EMPTY</td>
<td>30</td>
<td>Name is an empty string.</td>
</tr>
<tr>
<td>DDPI_DLE_RETURN_PTR_NULL</td>
<td>31</td>
<td>Parameter used to return value is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_ZERO_LENGTH</td>
<td>32</td>
<td>Length must be non-zero.</td>
</tr>
<tr>
<td>DDPI_DLE_BUFFER_NULL</td>
<td>33</td>
<td>Data buffer address is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_LIST_DETAIL_NULL</td>
<td>34</td>
<td>List detail element NULL during addition to list.</td>
</tr>
<tr>
<td>DDPI_DLE_LIST_EMPTY</td>
<td>35</td>
<td>List should contain elements, but is empty.</td>
</tr>
<tr>
<td>DDPI_DLE_ENTRY_NOT_IN_LIST</td>
<td>36</td>
<td>Expected entry not found in list.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_INFO_FAIL</td>
<td>37</td>
<td>Allocate Ddpi_Info failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SPACE_FAIL</td>
<td>38</td>
<td>Allocate Ddpi_Space failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_PROCESS_FAIL</td>
<td>39</td>
<td>Allocate Ddpi_Process failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_THREAD_FAIL</td>
<td>40</td>
<td>Allocate Ddpi_Thread failed.</td>
</tr>
<tr>
<td>DDPI_DLE_INVALID_DDPI_ENTITY</td>
<td>41</td>
<td>One of the given Ddpi* entities is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_MODULE_FAIL</td>
<td>42</td>
<td>Allocate Ddpi_Module failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_CLASS_FAIL</td>
<td>43</td>
<td>Allocate Ddpi_Class failed.</td>
</tr>
</tbody>
</table>
Table 4. libddpi error messages (continued)

<table>
<thead>
<tr>
<th>Message macro</th>
<th>Message number</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDPI_DLE_ALLOC_ENTRYPT_FAIL</td>
<td>44</td>
<td>Allocate Ddpi_Entrypt failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SECTION_FAIL</td>
<td>45</td>
<td>Allocate Ddpi_Section failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_LOCK_FAIL</td>
<td>46</td>
<td>Allocate Ddpi_Lock failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_MUTEX_FAIL</td>
<td>47</td>
<td>Allocate Ddpi_Mutex failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_COND_FAIL</td>
<td>48</td>
<td>Allocate Ddpi_Cond failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_STORAGELOCN_FAIL</td>
<td>49</td>
<td>Allocate Ddpi_Storagelocn failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_MACHINESTATE_FAIL</td>
<td>50</td>
<td>Allocate Ddpi_Machinestate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_STACKSTATE_FAIL</td>
<td>51</td>
<td>Allocate Ddpi_StackState failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_STACKSTATE_FN_FAIL</td>
<td>52</td>
<td>Allocate Ddpi_StackState_Fn failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SAVEDSTORAGE_FAIL</td>
<td>53</td>
<td>Allocate Ddpi_Savedstorage failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SS_DIRECTORY_FAIL</td>
<td>54</td>
<td>Allocate Ddpi_SS_Directory failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SSTOR_TOKEN_FAIL</td>
<td>55</td>
<td>Allocate Ddpi_SS_Token failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SS_REPOSITORY_FAIL</td>
<td>56</td>
<td>Allocate Ddpi_SS_Repository failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_SS_BLOCK_FAIL</td>
<td>57</td>
<td>Allocate Ddpi_SS_Block failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_STRING_FAIL</td>
<td>58</td>
<td>Allocate string failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_LIST_FAIL</td>
<td>59</td>
<td>Allocate Ddpi_List failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_ADDR_FAIL</td>
<td>60</td>
<td>Allocate Ddpi.Addr failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_CHAIN_FAIL</td>
<td>61</td>
<td>Allocate Ddpi_Chain failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_LINK_FAIL</td>
<td>62</td>
<td>Allocate Ddpi_Link failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_OTHERS_FAIL</td>
<td>63</td>
<td>Allocate other storage failed.</td>
</tr>
<tr>
<td>DDPI_DLE_INFO_TERM_FAIL</td>
<td>64</td>
<td>Ddpi_Init terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_SPACE_TERM_FAIL</td>
<td>65</td>
<td>Ddpi_Space terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_PROCESS_TERM_FAIL</td>
<td>66</td>
<td>Ddpi_Process terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_TERM_FAIL</td>
<td>67</td>
<td>Ddpi_Thread terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_FLAG_BIT_IDX_BAD</td>
<td>68</td>
<td>The given index was not between 0 and 31 (inclusive).</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_TERM_FAIL</td>
<td>69</td>
<td>Ddpi_Module terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_TERM_FAIL</td>
<td>70</td>
<td>Ddpi_Class terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ENCRYPT_TERM_FAIL</td>
<td>71</td>
<td>Ddpi_Encrypt terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_SECTION_TERM_FAIL</td>
<td>72</td>
<td>Ddpi_Section terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_LOCK_TERM_FAIL</td>
<td>73</td>
<td>Ddpi_Lock terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_MUTEX_TERM_FAIL</td>
<td>74</td>
<td>Ddpi_Mutex terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_COND_TERM_FAIL</td>
<td>75</td>
<td>Ddpi_Cond terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERT_TERM_FAIL</td>
<td>76</td>
<td>Ddpi_Convert terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_STORAGELOCN_TERM_FAIL</td>
<td>77</td>
<td>Ddpi_Storagelocn terminate failed.</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINESTATE_TERM_FAIL</td>
<td>78</td>
<td>Ddpi_Machinestate terminate failed.</td>
</tr>
<tr>
<td>DDPI_DLE_INFO_MODE_UNKNOWN</td>
<td>79</td>
<td>Unknown Ddpi_Info_Mode value.</td>
</tr>
<tr>
<td>DDPI_DLE_SPACE_NO_MATCH_MODULE</td>
<td>80</td>
<td>Ddpi_Space does not have a matched Ddpi_Module object.</td>
</tr>
<tr>
<td>DDPI_DLE_SPACE_NO_MATCH</td>
<td>81</td>
<td>Ddpi_Space object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_PROCESS_NO_MATCH_THREAD</td>
<td>82</td>
<td>Ddpi_Process does not have a matched Ddpi_Thread object.</td>
</tr>
<tr>
<td>DDPI_DLE_PROCESS_NO_MATCH</td>
<td>83</td>
<td>Ddpi_Process object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_NO_OWNER</td>
<td>84</td>
<td>Ddpi_Module object has no owner.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_USAGE_NOT_ZERO</td>
<td>85</td>
<td>Ddpi_Module object's usage is not zero.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_NO_MATCH_ENTRYPT</td>
<td>86</td>
<td>Ddpi_Module has no matched Ddpi_Entrypt object.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_NO_MATCH_SPACE</td>
<td>87</td>
<td>Ddpi_Module has no matched Ddpi_Space object.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_NO_MATCH_SECTION</td>
<td>88</td>
<td>Ddpi_Class has no matched Ddpi_Section object.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_NO_OWNER</td>
<td>89</td>
<td>Ddpi_Class object has no owner.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_NO_MATCH</td>
<td>90</td>
<td>Ddpi_Class object is not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_NOT_IN_ARANGE_TBL</td>
<td>91</td>
<td>Ddpi_Class object is not in the address range table.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_OWNER_TYPE_UNKNOWN</td>
<td>92</td>
<td>Ddpi_Class object has an unknown owner.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_NO_MATCH_COND</td>
<td>93</td>
<td>DDpi_Thread has no matched Ddpi_Cond object.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_NO_MATCH_MUTEX</td>
<td>94</td>
<td>Ddpi_Thread has no matched Ddpi_Mutex object.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_NO_MATCH_LOCK</td>
<td>95</td>
<td>Ddpi_Thread has no matched Ddpi_Lock object.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_NO_MATCH</td>
<td>96</td>
<td>Ddpi_Thread object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_MUTEX_NO_MATCH</td>
<td>97</td>
<td>Ddpi_Mutex object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_LOCK_NO_MATCH</td>
<td>98</td>
<td>Ddpi_Lock object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_COND_NO_MATCH</td>
<td>99</td>
<td>Ddpi_Cond object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_SECTION_NO_MATCH</td>
<td>100</td>
<td>Ddpi_Section object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_ENTRYPT_NO_MATCH</td>
<td>101</td>
<td>Ddpi_Entrypt object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_FILE_NO_MATCH</td>
<td>102</td>
<td>Ddpi_File object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERT_NO_MATCH</td>
<td>103</td>
<td>Ddpi_Convert object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_ACCESS_NO_MATCH</td>
<td>104</td>
<td>Ddpi_Access object not matched.</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINESTATE_GPR_COUNT</td>
<td>105</td>
<td>Ddpi_Machinestate GPR count error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINESTATE_FPR_COUNT</td>
<td>106</td>
<td>Ddpi_Machinestate FPR count error</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_AR_COUNT</td>
<td>107</td>
<td>Ddpi_Machinestate AR count error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_CR_COUNT</td>
<td>108</td>
<td>Ddpi_Machinestate CR count error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_PSW_COUNT</td>
<td>109</td>
<td>Ddpi_Machinestate PSW count error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_GPR_VALID_FLAG</td>
<td>110</td>
<td>Ddpi_Machinestate GPR valid flag error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_FPR_VALID_FLAG</td>
<td>111</td>
<td>Ddpi_Machinestate FPR valid flag error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_CR_VALID_FLAG</td>
<td>112</td>
<td>Ddpi_Machinestate CR valid flag error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_AR_VALID_FLAG</td>
<td>113</td>
<td>Ddpi_Machinestate AR valid flag error</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINEMACHINESTATE_PSW_VALID_FLAG</td>
<td>114</td>
<td>Ddpi_Machinestate PSW valid flag error</td>
</tr>
<tr>
<td>DDPI_DLE_STORAGE_USERSTORAGE_EXCEED</td>
<td>115</td>
<td>Ddpi_Storage user storage exceeded.</td>
</tr>
<tr>
<td>DDPI_DLE_SAVEDSTORAGE_TOKEN_WRONG</td>
<td>116</td>
<td>Ddpi_Savedstorage token error</td>
</tr>
<tr>
<td>DDPI_DLE_AMODE_UNKNOWN</td>
<td>117</td>
<td>Addressing mode (AMode) is unknown.</td>
</tr>
<tr>
<td>DDPI_DLE_RMODE_UNKNOWN</td>
<td>118</td>
<td>Residency mode (RMode) is unknown.</td>
</tr>
<tr>
<td>DDPI_DLE_GS_FAILURE</td>
<td>119</td>
<td>GetStorage routine failure occurred.</td>
</tr>
<tr>
<td>DDPI_DLE_SS_FAILURE</td>
<td>120</td>
<td>SetStorage routine failure occurred.</td>
</tr>
<tr>
<td>DDPI_DLE_INSERT_SS_TREE_FAIL</td>
<td>121</td>
<td>Unable to insert entry in Ddpi_SavedStorage tree.</td>
</tr>
<tr>
<td>DDPI_DLE_INTERNAL_ERROR</td>
<td>122</td>
<td>libddpi internal error</td>
</tr>
<tr>
<td>DDPI_DLE_SAVEDSTORAGE_ALREADY_MAPPED</td>
<td>123</td>
<td>Address range already mapped by another Ddpi_SavedStorage object.</td>
</tr>
<tr>
<td>DDPI_DLE_ADDR_EXCEEDS_SPACE_LIMIT</td>
<td>124</td>
<td>New address exceeds maximum address defined by Ddpi_Space object.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_OP_NOT_SUPPORTED</td>
<td>125</td>
<td>Opcode not supported for this evaluation/override function.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_OP_ERROR</td>
<td>126</td>
<td>Evaluation error</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_UNKNOWN_TYPE</td>
<td>127</td>
<td>DW_ADE_ type is unknown.</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_ADDR_SPACE</td>
<td>128</td>
<td>XFS_addr_space: address space unavailable</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_NO_PAGE</td>
<td>129</td>
<td>XFS_no_page: page unavailable</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_NO_PAGE_ACCESS</td>
<td>130</td>
<td>XFS_no_page_access: unavailable to access page</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_READ_ONLY</td>
<td>131</td>
<td>XFS_no_read_only: memory is read only</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_ADDR_BAD</td>
<td>132</td>
<td>XFS_addr_bad: invalid address given</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_PAGE_BAD</td>
<td>133</td>
<td>XFS_page_bad: invalid page given</td>
</tr>
<tr>
<td>DDPI_DLE_XFS_XFER_BAD</td>
<td>134</td>
<td>XFS_xfer_bad: error occurred during data transfer</td>
</tr>
<tr>
<td>DDPI_DLE_ADDR_RANGE_EXCEEDS_SPACE_LIMIT</td>
<td>135</td>
<td>Address range exceeds maximum address defined by Ddpi_Space object.</td>
</tr>
<tr>
<td>DDPI_DLE_IP_NOT_FOUND</td>
<td>136</td>
<td>A valid Instruction Pointer was not found.</td>
</tr>
<tr>
<td>DDPI_DLE_ADDRESS_ALREADY_MAPPED</td>
<td>137</td>
<td>The address is already assigned to a non-matching class.</td>
</tr>
<tr>
<td>DDPI_DLE_DWARF_ERROR</td>
<td>138</td>
<td>A Dwarf_Error occurred.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_ELF_FAIL</td>
<td>139</td>
<td>An error occurred while allocating a Ddpi_Elf.</td>
</tr>
<tr>
<td>DDPI_DLE_ADDR_NOT_IN_MODULE</td>
<td>140</td>
<td>Given address is not in a known module in this address space.</td>
</tr>
<tr>
<td>DDPI_DLE_DDPI_ELF_NULL</td>
<td>141</td>
<td>The Ddpi_Elf is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_EP_NOT_CEESTART</td>
<td>142</td>
<td>The given entry point is not a CEESTART.</td>
</tr>
<tr>
<td>DDPI_DLE_IP_NOT_IN_MAPPED_MEMORY</td>
<td>143</td>
<td>The class that contains the Instruction Pointer address has not been defined.</td>
</tr>
<tr>
<td>DDPI_DLE_CONTEXT_NULL</td>
<td>144</td>
<td>A null dwarf context version was given to the expression engine.</td>
</tr>
<tr>
<td>DDPI_DLE_CONTEXT_VERSION_BAD</td>
<td>145</td>
<td>An invalid dwarf context version was given to the expression engine.</td>
</tr>
<tr>
<td>DDPI_DLE_DWARF_LOCDESC_NULL</td>
<td>146</td>
<td>The given dwarf location description was null.</td>
</tr>
<tr>
<td>DDPI_DLE_DWARF_LOC_NULL</td>
<td>147</td>
<td>The given dwarf location was null.</td>
</tr>
<tr>
<td>DDPI_DLEALLOC_ACCESS_FAIL</td>
<td>148</td>
<td>The allocation of a Ddpi_Access failed.</td>
</tr>
<tr>
<td>DDPI_DLEALLOC_CONVERT_FAIL</td>
<td>149</td>
<td>The allocation of a Ddpi_Convert failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_NULL</td>
<td>150</td>
<td>Elf object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA1_ADDR_NULL</td>
<td>151</td>
<td>Given PPA1 address is null.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA2_ADDR_NULL</td>
<td>152</td>
<td>Given PPA2 address is null.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA3_ADDR_NULL</td>
<td>153</td>
<td>Given PPA3 address is null.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA4_ADDR(NULL</td>
<td>154</td>
<td>Given PPA4 address is null.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA_DATA_STRUCT_NULL</td>
<td>155</td>
<td>Given ppa data struct does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_PPA_DATA_UNSUPORTED_VERSION</td>
<td>156</td>
<td>Given ppa data struct version is not supported.</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_UNRECOGNIZED_PROLOG</td>
<td>157</td>
<td>The given prolog is not a recognized type.</td>
</tr>
<tr>
<td>DDPI_DLE_INVALID_CHAR</td>
<td>158</td>
<td>The given character is not a printable character.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_BEGIN_ERROR</td>
<td>159</td>
<td>A call to elf_begin() failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_GETIDENT_ERROR</td>
<td>160</td>
<td>A call to elf_getident() failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_GETEHDR_ERROR</td>
<td>161</td>
<td>A call to elf32_getehdr() or elf64_getehdr() failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_GETSHDR_ERROR</td>
<td>162</td>
<td>A call to elf32_getshdr() or elf64_getshdr() failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_STRPTR_ERROR</td>
<td>163</td>
<td>A call to elf_strptr() failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_FILE_INVALID</td>
<td>164</td>
<td>ELF file format is invalid.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_FILE_ERROR</td>
<td>165</td>
<td>Error occurred during scan of ELF file.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_SYMBOL_ERROR</td>
<td>166</td>
<td>Error occurred during load of ELF .symtab.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_REL_SYMBOL_ERROR</td>
<td>167</td>
<td>Invalid symbol index encountered in ELF relocation section.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_REL_TYPE_ERROR</td>
<td>168</td>
<td>Invalid relocation type encountered in ELF relocation section.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_REL_SECTION_ERROR</td>
<td>169</td>
<td>Invalid relocation section index encountered in ELF relocation section.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_FILE_TEXT_HAS_BITS</td>
<td>170</td>
<td>ELF .text section sh_type is not SHT_NOBITS.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_PPA2_SYMBOL_MISSING</td>
<td>171</td>
<td>.ppa2 MD5 signature symbol not found in ELF .symtab section.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_ELFDETAILS_FAIL</td>
<td>172</td>
<td>Allocate Ddpi_ElfDetails failed.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_ELF_SYMBOL_FAIL</td>
<td>173</td>
<td>Allocate Ddpi_ElfSymbol failed.</td>
</tr>
<tr>
<td>DDPI_DLE_CNVT_METHOD_NULL</td>
<td>174</td>
<td>The convert method was null.</td>
</tr>
<tr>
<td>DDPI_DLE_ELFDETAILS_NULL</td>
<td>175</td>
<td>The Ddpi_Elfdetails was null.</td>
</tr>
<tr>
<td>DDPI_DLE_TOKEN_SIZE_TOO_SMALL</td>
<td>176</td>
<td>The token size is too small.</td>
</tr>
<tr>
<td>DDPI_DLE_RETURN_LOCATION_TYPE_INVALID</td>
<td>177</td>
<td>The return location type is invalid.</td>
</tr>
<tr>
<td>DDPI_DLE_NO_SUBRANGE_TAG</td>
<td>178</td>
<td>The array_type tag does not have a subrange_type tag.</td>
</tr>
<tr>
<td>DDPI_DLE_SUBRANGE_INVALID</td>
<td>179</td>
<td>The subrange is not contained in the array.</td>
</tr>
<tr>
<td>DDPI_DLE_TOKEN_INVALID</td>
<td>180</td>
<td>The xeval token is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_TYPE_UNKNOWN</td>
<td>181</td>
<td>The given storage allocation type is not recognized.</td>
</tr>
<tr>
<td>DDPI_DLE_ACCESS_ALREADY_DEFINED</td>
<td>182</td>
<td>The given module already has an access and only one access is allowed per module.</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_EL_F_HAS_NO_DEBUG_DATA</td>
<td>183</td>
<td>The ELF file does not contain any debug information.</td>
</tr>
<tr>
<td>DDPI_DLE_DIE_NULL</td>
<td>184</td>
<td>The given DIE is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_BAD_COLUMN</td>
<td>185</td>
<td>The given number of columns is invalid.</td>
</tr>
<tr>
<td>DDPI_DLE_PTM_DIE_INVALID</td>
<td>186</td>
<td>The DIE is either not a pointer-to-member DIE, or doesn’t have the DW_AT_use_location and DW_AT_containing_type attributes.</td>
</tr>
<tr>
<td>DDPI_DLE_CODESET_INVALID</td>
<td>187</td>
<td>Invalid codeset specified.</td>
</tr>
<tr>
<td>DDPI_DLE_CODESET_CONVERSION_ERROR</td>
<td>188</td>
<td>Error converting between codesets.</td>
</tr>
<tr>
<td>DDPI_DLE_STRING_NULL</td>
<td>189</td>
<td>Ddpi_String object is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_INFO_INVALID</td>
<td>190</td>
<td>Ddpi_Info object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_MUTEX_INVALID</td>
<td>191</td>
<td>Ddpi_Mutex object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_STORAGELOCN_INVALID</td>
<td>192</td>
<td>Ddpi_StorageLocn object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_MACHINESTATE_INVALID</td>
<td>193</td>
<td>Ddpi_MachineState object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_ENTRYPT_INVALID</td>
<td>194</td>
<td>Ddpi_Entrypt object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_COND_INVALID</td>
<td>195</td>
<td>Ddpi_Cond object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_SAVEDSTORAGE_INVALID</td>
<td>196</td>
<td>Ddpi_SavedStorage object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_SECTION_INVALID</td>
<td>197</td>
<td>Ddpi_Section object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_SPACE_INVALID</td>
<td>198</td>
<td>Ddpi_Space object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_STACKSTATE_INVALID</td>
<td>199</td>
<td>Ddpi_StackState object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_INVALID</td>
<td>200</td>
<td>Ddpi_Module object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_LOCK_INVALID</td>
<td>201</td>
<td>Ddpi_Lock object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_EL_F_INVALID</td>
<td>202</td>
<td>Ddpi_Elf object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_ACCESS_INVALID</td>
<td>203</td>
<td>Ddpi_Access object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_CLASS_INVALID</td>
<td>204</td>
<td>Ddpi_Class object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_PROCESS_INVALID</td>
<td>205</td>
<td>Ddpi_Process object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_THREAD_INVALID</td>
<td>206</td>
<td>Ddpi_Thread object is not valid.</td>
</tr>
<tr>
<td>DDPI_DLE_CONCAT_COMPLETE</td>
<td>207</td>
<td>The get_storage handler did not get the required number of bytes.</td>
</tr>
<tr>
<td>DDPI_DLE_SS_INCOMPLETE</td>
<td>208</td>
<td>The set_storage handler did not set the required number of bytes.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERT_FN_NULL</td>
<td>209</td>
<td>Ddpi_Convert_Fn object does not exist.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERT_HANDLER_NULL</td>
<td>210</td>
<td>Ddpi_Convert_Handler object does not exist.</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_DEBUG_FORMAT_UNSUPPORTED</td>
<td>211</td>
<td>The format of the debugging information is unsupported.</td>
</tr>
<tr>
<td>DDPI_DLE_ELF_CSECT_OVERLAP</td>
<td>212</td>
<td>The address ranges of the CSECTS in 2 Ddpi_Elf objects partially overlap.</td>
</tr>
<tr>
<td>DDPI_DLE_ALLOC_CONVERT_FN_FAIL</td>
<td>213</td>
<td>Allocate Ddpi_Convert_Fn failed.</td>
</tr>
<tr>
<td>DDPI_DLE_CONVERTER_INFO_VERSION_BAD</td>
<td>214</td>
<td>Invalid version in the Ddpi_Converter_Info structure.</td>
</tr>
<tr>
<td>DDPI_DLE_SYSADATA_FILE_ERROR</td>
<td>215</td>
<td>Error reading the SYSADATA file.</td>
</tr>
<tr>
<td>DDPI_DLE_MODULE_READ_ERROR</td>
<td>216</td>
<td>Error reading the module.</td>
</tr>
<tr>
<td>DDPI_DLE_CSECT_EXTRACT_ERROR</td>
<td>217</td>
<td>Error extracting the CSECTS from the module.</td>
</tr>
<tr>
<td>DDPI_DLE_USER_AREA_INVALID</td>
<td>218</td>
<td>The user area does not contain valid information.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_INTDIV</td>
<td>219</td>
<td>Evaluation is terminated by an integer divide by zero exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_INTOVF</td>
<td>220</td>
<td>Evaluation is terminated by an integer overflow exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTDIV</td>
<td>221</td>
<td>Evaluation is terminated by a floating point divide by zero exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTOVF</td>
<td>222</td>
<td>Evaluation is terminated by a floating point overflow exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTUND</td>
<td>223</td>
<td>Evaluation is terminated by a floating point underflow exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTRES</td>
<td>224</td>
<td>Evaluation is terminated by a floating point inexact result exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTINV</td>
<td>225</td>
<td>Evaluation is terminated by an invalid floating point operation exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTSUB</td>
<td>226</td>
<td>Evaluation is terminated by a subscript is out of range exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_FLTSIG</td>
<td>227</td>
<td>Evaluation is terminated by a significance exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_DECDATA</td>
<td>228</td>
<td>Evaluation is terminated by a decimal data exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_DECDIV</td>
<td>229</td>
<td>Evaluation is terminated by a decimal divide exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_DECOVF</td>
<td>230</td>
<td>Evaluation is terminated by a decimal overflow exception.</td>
</tr>
<tr>
<td>DDPI_DLE_XEVAL_UNKNOWN</td>
<td>231</td>
<td>Evaluation is terminated by an unknown floating point exception.</td>
</tr>
<tr>
<td>DDPI_DLE_FUNCTION_NULL</td>
<td>232</td>
<td>The Ddpi_Function is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_VARIABLE_NULL</td>
<td>233</td>
<td>The Ddpi_Variable is NULL.</td>
</tr>
<tr>
<td>Message macro</td>
<td>Message number</td>
<td>Message</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>DDPI_DLE_TYPE_NULL</td>
<td>234</td>
<td>The Ddpi_Type is NULL.</td>
</tr>
<tr>
<td>DDPI_DLE_SOURCEFILE_NULL</td>
<td>235</td>
<td>The Ddpi_Sourcefile is NULL.</td>
</tr>
</tbody>
</table>
Appendix B. Accessibility

Accessible publications for this product are offered through .

If you experience difficulty with the accessibility of any z/OS information, send a detailed message to the or use the following mailing address.

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
United States

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features in z/OS can help users do the following tasks:

- Run assistive technology such as screen readers and screen magnifier software.
- Operate specific or equivalent features by using the keyboard.
- Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products such as screen readers function with the user interfaces found in z/OS. Consult the product information for the specific assistive technology product that is used to access z/OS interfaces.

Keyboard navigation of the user interface

You can access z/OS user interfaces with TSO/E or ISPF. The following information describes how to use TSO/E and ISPF, including the use of keyboard shortcuts and function keys (PF keys). Each guide includes the default settings for the PF keys.

- z/OS TSO/E Primer
- z/OS TSO/E User’s Guide
- z/OS ISPF User’s Guide Vol I

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users who access IBM Knowledge Center with a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line because they are considered a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that the screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually
exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The * symbol is placed next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is given the format 3 \* FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3\* FILE indicates that syntax element \* FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol to provide information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, it indicates a reference that is defined elsewhere. The string that follows the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you must refer to separate syntax fragment OP1.

The following symbols are used next to the dotted decimal numbers.

? indicates an optional syntax element
The question mark (?) symbol indicates an optional syntax element. A dotted decimal number followed by the question mark symbol (?) indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that the syntax elements NOTIFY and UPDATE are optional. That is, you can choose one or none of them. The ? symbol is equivalent to a bypass line in a railroad diagram.

! indicates a default syntax element
The exclamation mark (!) symbol indicates a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the dotted decimal number can specify the ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In the example, if you include the FILE keyword, but do not specify an option, the default option KEEP is applied. A
default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, the default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP applies only to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

* indicates an optional syntax element that is repeatable
The asterisk or glyph (*) symbol indicates a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3* , 3 HOST, 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:
1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write HOST STATE, but you cannot write HOST HOST.
3. The * symbol is equivalent to a loopback line in a railroad syntax diagram.

+ indicates a syntax element that must be included
The plus (+) symbol indicates a syntax element that must be included at least once. A dotted decimal number followed by the + symbol indicates that the syntax element must be included one or more times. That is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the * symbol, the + symbol can repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loopback line in a railroad syntax diagram.
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**Standards**

The libddpi library supports the DWARF Version 3 and Version 4 format and ELF application binary interface (ABI).

DWARF was developed by the UNIX International Programming Languages Special Interest Group (SIG). CDA’s implementation of DWARF is based on the DWARF 4 standard.

ELF was developed as part of the System V ABI. It is copyrighted 1997, 2001, The Santa Cruz Operation, Inc. All rights reserved.
Index

A
access policies
opaque 284
specifying 284
transparent 284
access policy
determining 292
setting 293
accessibility 361
contact IBM 361
features 361
addresses
validating 25
API types, libddpi
CDA-application model 4
conversion 4
DWARF-expression 4
support 4
system-dependent 4
system-independent 4
APIs
customer 2
producer 2
ASCII
codeset 8
compiler option 8
assistive technologies 361

C
CDA
definition 1
libraries 2
changes 8
CDA 8
codeset
ASCII(ISO8859-1) 8
Common Debug Architecture 1
compiler options
ASCII 8
GONUMBER 7
NOTEST 7
TEST 7
XPLINK 8
compiler version requirements 8
consumer
API 2
contact
z/OS 361
conversion
utility 7

D
data types
Ddpi_Info_Mode 11
initialization and termination 11
libddpi
initialization and termination 11
Ddpi_finish 13
Ddpi_SavedStorage object
and opaque access 284
Ddpi_Space_GS_Handler object
and opaque access 284
and transparent access 284
Ddpi_Space_SS_Handler object
and opaque access 284
and transparent access 284
Ddpi_StorageLocn object
and access policy 284, 292, 293
and access to storage 284
and opaque access 284
DWARF
converting from ISD format 11
definition 1
format 3
objects 1
DWARF Expression Evaluator 327
Dwarf_Debug 1
Dwarf_P_Debug 1
dwarfdump 8

E
ELF 3
definition 1
object file, definition 1
environment
determining 11
error conditions
notification of 15
error handling
ddpi_init parameters 12
error situations
capturing 15
Executable and Linking Format 3

G
GONUMBER compiler option 7

H
HEAPPOOLS(on) run-time option 8

I
In Store Debug 7
in-store debugging (ISD)
converting to DWARF format 11
ISD 7
isdcnvt 7

K
keyboard
navigation 361
PF keys 361
shortcut keys 361

L
Language Environment linkages 281
libddpi
data types
initialization and termination 11
libddpi library 4
libdwarf library 3
libdwarf objects definition 1
libel library 3
libraries
CDA 2
libdppi 4
libdwarf 3
libel 3

M
memory
reallocation 12

N
navigation
keyboard 361
NOTEST compiler option 7
Notices 365

O
object
consumer 1
DWARF 1
ELF object file 1
libdwarf 1
producers 1
opaque access
description 284
operations 13
options
compiler 7, 8
run-time 8

P
POSIX threads 65
producer
API 2
program analysis applications
examples 12

R
requirements
CDA 8
compiler 8
run-time option
HEAPPOOLS(on) 8
S
sample applications
dwarfdump 8
shortcut keys  361
standard stack state-handlers
  for Language Environment
    linkages  281
standards
  DWARF 3
  ELF 3
storage access policy
  specification  284

T
technical support, finding  xiii
TEST compiler option  7
threads
  conditional execution  93
  POSIX  65
variables
  application usage information  93
transparent access
  description  284

U
user area  8
user interface
  ISPF  361
  TSO/E  361
utilities
  dwarfdump  8
  isdcnvtr  7

V
variable-length user area  8

X
XPLINK compiler option  8