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NVM Express® Technical Proposal (TP)

Technical Proposal ID	8016 – Subsystem Driven Zoning with Pull Registration
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References	TP 8010a – NVMe-oF Centralized Discovery Controller

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Technical Proposal Overview

Provide a standardized process for a Direct Discovery Controller (DDC) to provide Fabric Zoning information to a Centralized Discovery Controller (CDC) without the need to support Host functionality.

Revision History

Revision Date	Change Description
2022.04.26	Initial draft
2022.05.10	Second draft
2022.05.17	Third draft
2022.05.24	Fourth draft – technically complete
2022.06.21	Incorporated feedback from Matt Goepfert
2022.06.28	Updated for phase 2 exit
2022.07.12	Incorporated more feedback from Matt Goepfert
2022.07.26	Restricted the scope of the ‘Send Log Page’ command to ‘Send Discovery Log Page’
2022.07.28	Clean version for phase 2 exit
2022.08.18	Phase 3 exit
2022.09.27	Incorporated comments from Mike Allison
2022.09.29	Approved for integration
2022.11.26	Integrated
2022.11.28	Updated the navigation pane
2022.11.29	Incorporated feedback from Claudio DeSanti
2022.12.13	Updated drawings to Visio
2022.12.14	Editorial comments per Mike Allison

Description for Changes Document for TP 8016

New Features:

- Subsystem Driven Zoning for Pull Registration DDCs (optional feature)

Markup Conventions:

Black:	Unchanged (however, hot links are removed)
Red Strikethrough:	Deleted
Blue:	New
Blue Highlighted:	TBD values, anchors, and links to be inserted in new text.
<Green Bracketed>:	Notes to editor

Description of Specification Changes for NVMe Base Specification 2.0b

3.1.2.1.1 Command Support

Modify Figure 22 (I/O Controller – Admin Command Support) as shown below:

Figure 22: I/O Controller – Admin Command Support

Command	Command Support Requirements ¹	Reference
Delete I/O Submission Queue	M	5.7
Create I/O Submission Queue	M	5.5
Get Log Page	M	5.16
Send Discovery Log Page	P	5.NEWWNEW1
...		

3.1.2.1.2 Log Page Support

Modify Figure 24 (I/O Controller – Log Page Support) as shown below:

Figure 24: I/O Controller – Log Page Support

Log Page Name	Log Page Support Requirements ¹
...	...
Rotational Media Information	O
Pull Model DDC Request	P
Notes:	
1. O/M/P definition: O = Optional, M = Mandatory, P = Prohibited	

3.1.2.2.1 Command Support

Modify Figure 28 (Administrative Controller – Admin Command Support) as shown below:

Figure 28: Administrative Controller – Admin Command Support

Command	Command Support Requirements ¹	Reference
Delete I/O Submission Queue	P	5.7
Create I/O Submission Queue	P	5.5
Get Log Page	M	5.16
Send Discovery Log Page	P	5.NEWWNEW1
...		

3.1.2.2.2 Log Page Support

Modify Figure 29 (Administrative Controller – Log Page Support) as shown below:

Figure 29: Administrative Controller – Log Page Support

Log Page Name	Log Page Support Requirements ¹
...	...
I/O Command Set Specific Log Pages	P
Pull Model DDC Request	P
Notes:	
1. O/M/P definition: O = Optional, M = Mandatory, P = Prohibited	

3.1.2.3.3 Command Support

Modify Figure 32 (Discovery Controller – Admin Command Support) as shown below:

Figure 32: Discovery Controller – Admin Command Support

Command	Command Support Requirements ¹	Reference
Delete I/O Submission Queue	P	5.7
Create I/O Submission Queue	P	5.5
Get Log Page	M	5.16
Send Discovery Log Page	M ²	5.NEWWNEW1
...		

Notes:

- O = Optional, M = Mandatory, P = Prohibited
- Mandatory for CDCs and prohibited for Discovery controllers that are not a CDC.

3.1.2.3.3 Log Page Support

Modify Figure 33 (Discovery Controller – Log Page Support) as shown below:

Figure 33: Discovery Controller – Log Page Support

Log Page Name	Log Page Support Requirements ¹
...	...
Discovery	M
Pull Model DDC Request	P ²

Notes:

- O/M/P definition: O = Optional, M = Mandatory, P = Prohibited
- Mandatory for CDCs and prohibited for Discovery controllers that are not a CDC.

5 Admin Command Set

Modify Figure 138 (Opcodes for Admin Commands) as shown below:

Figure 138: Opcodes for Admin Commands

Opcode by Field			Combined Opcode ¹	Namespace Identifier Used ²	Command	Command Set Specific ³
(07)	(06:02)	(01:00)				
Generic Command	Function	Data Transfer ³				
0b	000 00b	00b	00h	No	Delete I/O Submission Queue	No
0b	000 00b	01b	01h	No	Create I/O Submission Queue	No
0b	000 00b	10b	02h	Yes	Get Log Page	No
0b	011 10b	01b	39h	No	Send Discovery Log Page	No
...						

5.2.1 Command Completion

Modify Figure 146 (Asynchronous Event Information – Notice) as shown below:

Figure 146: Asynchronous Event Information – Notice

Value	Description
...	...
F0h	Discovery Log Page Change: A change has occurred to one or more of the Discovery log pages. The host or Discovery controller should submit a Get Log Page command to receive updated Discovery log pages.
F1h	Host Discovery Log Page Change: A change has occurred to one or more of the Host Discovery log pages. The host or Discovery controller should submit a Get Log Page command to receive updated Host Discovery log pages.
F3h	Pull Model DDC Request: A pull model DDC is requesting a CDC to perform an operation.
F2 F4h to FFh	Reserved for future NVMe over Fabrics Asynchronous Event Notifications

5.16.1 Log Specific Information

Modify Figure 202 (Get Log Page – Log Page Identifiers) as shown below:

Figure 202: Get Log Page – Log Page Identifiers

Log Identifier	Scope	Log Page Name	Reference Section
...	...		
19h to 6Fh	Reserved		
70h		Discovery	5.16.1.23
71h		Host Discovery	5.16.1.NEW
73h		Pull Model DDC Request	5.16.1.NEW1
72 74h to 7Fh	Reserved		

5.27.1.8 Asynchronous Event Configuration (Feature Identifier 0Bh)

Modify Figure 326 (Asynchronous Event Configuration – Command Dword 11) as shown below:

Figure 326: Asynchronous Event Configuration – Command Dword 11

Bits	Description
31	Discovery Log Page Change Notification: This bit indicates that the Discovery controller reports Discovery Log Page Change Notifications. If set to '1', the Discovery controller shall send a notification if Discovery log page changes occur.
30	Host Discovery Log Page Change Notification: This bit indicates that the Discovery controller reports Host Discovery Log Page Change Notifications. If set to '1', the Discovery controller shall send a notification if Host Discovery log page changes occur.
28	Pull Model DDC Request Log Page Change Notification: This bit indicates that the Discovery controller reports Pull Model DDC Request log page Change Notifications. If set to '1', then the Discovery controller shall send a notification if Pull Model DDC Request log page changes occur.
29:28	Reserved
...	...

Add a new section 5.NEWW1 (Send Log Page command) as shown below:

5.NEWW1 Send Discovery Log Page (SDLP) command

The Send Discovery Log Page (SDLP) command is used by a CDC to send a discovery log page to a pull model DDC. This command uses the Data Pointer, Command Dword 10, Command Dword 11, Command Dword 12, and Command Dword 13, as shown in [Figure NEWNEW.1](#), [Figure NEWNEW.2](#), [Figure NEWNEW.3](#), [Figure NEWNEW.4](#), and [Figure NEWNEW.5](#).

Figure NEWNEW.1: Send Discovery Log Page (SDLP) – Data Pointer

Bits	Description
127:00	Data Pointer (DPTR): This field specifies the start of the data buffer. Refer to Figure 87 for the definition of this field.

Figure NEWNEW.2: Send Discovery Log Page (SDLP) – Command Dword 10

Bits	Description										
31:30	Requested Log Page Status (RLPS): This field specified the status of the requested log page. Defined values are: <table border="1" data-bbox="402 751 1360 951"> <thead> <tr> <th>Value</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>00b</td> <td>Valid Log Page: the requested log page is carried in the command.</td> </tr> <tr> <td>01b</td> <td>Invalid Log Page: The requested log page is invalid or not supported.</td> </tr> <tr> <td>10b</td> <td>Not Allowed Log Page: The requested log page is not allowed to be transferred by an SDLP command (refer to Figure NEWNEW.6).</td> </tr> <tr> <td>11b</td> <td>Not Successful: Retrieving the requested log page failed. Further details are provided in the SCT field and the SC field.</td> </tr> </tbody> </table>	Value	Definition	00b	Valid Log Page: the requested log page is carried in the command.	01b	Invalid Log Page: The requested log page is invalid or not supported.	10b	Not Allowed Log Page: The requested log page is not allowed to be transferred by an SDLP command (refer to Figure NEWNEW.6).	11b	Not Successful: Retrieving the requested log page failed. Further details are provided in the SCT field and the SC field.
Value	Definition										
00b	Valid Log Page: the requested log page is carried in the command.										
01b	Invalid Log Page: The requested log page is invalid or not supported.										
10b	Not Allowed Log Page: The requested log page is not allowed to be transferred by an SDLP command (refer to Figure NEWNEW.6).										
11b	Not Successful: Retrieving the requested log page failed. Further details are provided in the SCT field and the SC field.										
29:28	Reserved										
27:25	Status Code Type (SCT): Refer to figure 92 .										
24:17	Status Code (SC): Refer to figure 92 .										
16:15	Reserved										
14:08	Transferred Log Specific Parameter (TLSP): If not defined for the log page specified by the Log Page Identifier field, this field is reserved.										
07:00	Transferred Log Page Identifier (TLID): This field specifies the identifier of the sent log page.										

Figure NEWNEW.3: Send Discovery Log Page (SDLP) – Command Dword 11

Bits	Description
31:00	Number of Dwords: This field specifies the number of transferred dwords.

Figure NEWNEW.4: Send Discovery Log Page (SDLP) – Command Dword 12

Bits	Description
31:00	Transferred Log Page Offset Lower: This field specifies the least-significant 32 bits of the offset of the transferred log page.

Figure NEWNEW.5: Send Discovery Log Page (SDLP) – Command Dword 13

Bits	Description
31:00	Transferred Log Page Offset Upper: This field specifies the most-significant 32 bits of the offset of the transferred log page.

The transferred log page has the same format of the correspondent discovery log page retrieved by a Get Log Page command (refer to section [5.16](#)). The discovery log pages allowed to be transferred by a SDLP command are shown in [Figure NEWNEW.6](#).

Figure NEWNEW.6: Send Discovery Log Page (SDLP) – Allowed Log Page Identifiers

Log Identifier	Log Page Name
70h	Discovery
71h	Host Discovery
72h	AVE Discovery <defined in TP 8019>

If a not allowed log page is requested, the CDC shall set the RLPS field (refer to [Figure NEWNEW.2](#)) to 02h (i.e., Not Allowed Log Page) and transfer no log page.

The pull model DDC receiving a SDLP command may request the CDC to resend the requested log page when that log page is updated on the CDC. This is done through the LPUR bit of the SDLP Completion Queue Entry Dword 0, as shown in [Figure NEWNEW.7](#).

Figure NEWNEW.7: Send Discovery Log Page (SDLP) – Completion Queue Entry Dword 0

Bits	Description
31	Log Page Update Registration (LPUR): This bit specifies if the CDC shall resend the requested log page when that log page is updated on the CDC. If set to '1', then the CDC shall issue to the requesting pull model DDC a Send Discovery Log Page command including the requested log page when that log page is updated on the CDC; if cleared to '0', then the CDC is not required to issue a Send Discovery Log Page command when that log page is updated on the CDC. This registration is retained until the CDC issues the subsequent Send Discovery Log Page command to that requesting pull model DDC.
30:00	Reserved

Add a new section 5.16.1.NEW as shown below:

5.16.1.NEW1 Pull Model DDC Request Log Page (Log Identifier 73h)

The format of the Pull Model DDC Request log page is shown in [Figure NEWNEW.8](#).

Figure NEWNEW.8: Pull Model DDC Request Log Page

Bytes	Description														
Header															
00	Operation Request Identifier (ORI): This field indicates the operation that a pull model DDC is requesting a CDC to perform. Defined values are: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Value</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Reserved</td> </tr> <tr> <td>1</td> <td>Get Active ZoneGroup (GAZ) operation</td> </tr> <tr> <td>2</td> <td>Add/Replace Active ZoneGroup (AAZ) operation</td> </tr> <tr> <td>3</td> <td>Remove Active ZoneGroup (RAZ) operation</td> </tr> <tr> <td>4</td> <td>Discovery Log Page Request operation</td> </tr> <tr> <td>All others</td> <td>Reserved</td> </tr> </tbody> </table>	Value	Definition	0	Reserved	1	Get Active ZoneGroup (GAZ) operation	2	Add/Replace Active ZoneGroup (AAZ) operation	3	Remove Active ZoneGroup (RAZ) operation	4	Discovery Log Page Request operation	All others	Reserved
Value	Definition														
0	Reserved														
1	Get Active ZoneGroup (GAZ) operation														
2	Add/Replace Active ZoneGroup (AAZ) operation														
3	Remove Active ZoneGroup (RAZ) operation														
4	Discovery Log Page Request operation														
All others	Reserved														
03:01	Reserved														
07:04	Total Pull Model DDC Request Log Page Length (TPDRPL): This field indicates the length in bytes of the entire Pull Model DDC Request log page.														
TPDRPL-1:08	Operation specific parameters														

Modify section 5.NEW2 (Fabric Zoning Lookup command) as shown below:

5.NEW2 Fabric Zoning Lookup command

The Fabric Zoning Lookup (FZL) command is used to lookup a key associated with a Zoning data structure in the CDC. The FZL command uses the Data Pointer field, as shown in Figure NEW.15.

Figure NEW.15: Fabric Zoning Lookup (FZL) – Data Pointer

Bits	Description
127:00	Data Pointer (DPTR): This field specifies the start of the data buffer. Refer to Figure 87 for the definition of this field.

5.NEW2.1 Command Completion

Upon completion of the Fabric Zoning Lookup (FZL) command, the controller posts a completion queue entry to the Admin Completion Queue indicating the status of the command. Command specific status values for the FZL command are defined in Figure NEW.16.

Figure NEW.16: Fabric Zoning Lookup (FZL) – Command Specific Status Values

Value	Description
30h	Zoning Data Structure Locked: The requested Zoning data structure is locked on the CDC.
31h	Zoning Data Structure Not Found: The requested Zoning data structure does not exist on the CDC.
33h	Requested Function Disabled: Fabric Zoning is not enabled on the CDC.
34h	ZoneGroup Originator Invalid: The DDC is not allowed to access the specified ZoneGroup.

The key associated with the Zoning data structure that matches the specified FZL data (refer to section 8.NEW.3.8) is returned in the Completion Queue Entry Dword 0, as shown in Figure NEW.17.

Figure NEW.17: Fabric Zoning Lookup (FZL) – Completion Queue Entry Dword 0

Bits	Description
31:00	Zoning Data Key (ZDK): The key associated with the Zoning data structure that matches the specified FZL data.

Modify section 5.NEW3 (Fabric Zoning Send command) as shown below:

5.NEW3 Fabric Zoning Send command

The Fabric Zoning Send (FZS) command is used to ~~transfer send~~ a Zoning data structure ~~to the CDC~~. The FZS command uses the Data Pointer, Command Dword 10, Command Dword 11, and Command Dword 12 fields, as shown in Figure NEW.18, Figure NEW.19, Figure NEW.20, and Figure NEW.21 respectively.

~~The CDC may check if the NQN contained in the ZoneGroup Originator field of the transferred ZoneGroup data structure matches the NQN contained in the HOSTNQN field of the Connect command sent from the DDC to that CDC. If the CDC performs this check and finds that the NQN contained in the ZoneGroup Originator field of the transferred ZoneGroup data structure does not match the NQN contained in the HOSTNQN field of the Connect command sent from the DDC to that CDC, then that CDC may abort the FZS command with a status code of ZoneGroup Originator Invalid.~~

Figure NEW.18: Fabric Zoning Send (FZS) – Data Pointer

Bits	Description
127:00	Data Pointer (DPTR): This field specifies the start of the data buffer. Refer to Figure 87 for the definition of this field.

Figure NEW.19: Fabric Zoning Send (FZS) – Command Dword 10

Bits	Description
31:00	Zoning Data Key (ZDK): If the FZS command is issued by a DDC, then this field specifies the key identifying a Zoning data structure in the Zoning database of the CDC. If the FZS command is issued by the CDC, then this field specifies the Transaction ID of the current Zoning operation.

Figure NEW.20: Fabric Zoning Send (FZS) – Command Dword 11

Bits	Description
31:00	Zoning Data Offset (ZDO): This field specifies the byte offset within a Zoning data structure to store the transferred data. The offset shall be dword aligned, indicated by bits 1:0 being cleared to 00b. The CDC-controller is not required to check that bits 1:0 are cleared to 00b. The CDC-controller may return a status code of Invalid Field in Command if bits 1:0 are not cleared to 00b. If the CDC-controller does not return a status code of Invalid Field in Command, then the CDC-controller shall operate as if bits 1:0 are cleared to 00b.

Figure NEW.21: Fabric Zoning Send (FZS) – Command Dword 12

Bits	Description
31	Last Fragment (LF): This bit specifies if the transferred data buffer contains the last fragment of this Zoning data structure. If set to '1', then the transferred data buffer contains the last fragment; if cleared to '0', then the transferred data buffer does not contain the last fragment.
30:2829	Reserved
28	ZDK Context (ZDKC): This bit specifies the content of the ZDK field. If set to '1', then the ZDK field contains a Transaction ID. If this bit is cleared to '0', then the ZDK field contains a Zoning data key. A CDC receiving a FZS command with this bit set to '1' shall abort the command with a status code of Invalid Field in Command. A DDC receiving a FZS command with this bit cleared to '0' shall abort the command with a status code of Invalid Field in Command.
27:00	Number of Dwords (NUMD): This field specifies the number of dwords to transfer. If this field is cleared to 0h, then the controller shall abort the command with a status code of Invalid Field in Command.

5.NEW3.1 Command Completion

Upon completion of the Fabric Zoning Send (FZS) command, the controller posts a completion queue entry to the Admin Completion Queue indicating the status of the command. Command specific status values for the FZS command are defined in Figure NEW.22.

Figure NEW.22: Fabric Zoning Send (FZS) – Command Specific Status Values

Value	Description
30h	Zoning Data Structure Locked: The requested Zoning data structure is locked on the CDC.
31h	Zoning Data Structure Not Found: The requested Zoning data structure does not exist on the CDC.
33h	Requested Function Disabled: Fabric Zoning is not enabled on the CDC.
34h	ZoneGroup Originator Invalid: The NQN contained in the ZoneGroup Originator field does not match the Host NQN used by the DDC to connect to the CDC The DDC is not allowed to access the specified ZoneGroup.

Modify section 5.NEW4 (Fabric Zoning Receive command) as shown below:

5.NEW4 Fabric Zoning Receive command

The Fabric Zoning Receive (FZR) command is used to ~~request receive~~ a Zoning data structure ~~from the CDC~~. The FZR command uses the Data Pointer, Command Dword 10, Command Dword 11, and Command Dword 12 fields, as shown in Figure NEW.23, Figure NEW.24, Figure NEW.25, and Figure NEW.26 respectively.

Figure NEW.23: Fabric Zoning Receive (FZR) – Data Pointer

Bits	Description
127:0	Data Pointer (DPTR): This field specifies the start of the data buffer. Refer to Figure 87 for the definition of this field.

Figure NEW.24: Fabric Zoning Receive (FZR) – Command Dword 10

Bits	Description
31:00	Zoning Data Key (ZDK): If the FZR command is issued by a DDC, then this field specifies the key identifying a Zoning data structure in the Zoning database of the CDC. If the FZR command is issued by the CDC, then this field specifies the Transaction ID of the current Zoning operation.

Figure NEW.25: Fabric Zoning Receive (FZR) – Command Dword 11

Bits	Description
31:00	Zoning Data Offset (ZDO): This field specifies the byte offset within a Zoning data structure to store the transferred data. The offset shall be dword aligned, indicated by bits 1:0 being cleared to 00b. The CDC-controller is not required to check that bits 1:0 are cleared to 00b. The CDC-controller may return a status code of Invalid Field in Command if bits 1:0 are not cleared to 00b. If the CDC-controller does not return a status code of Invalid Field in Command, then the controller shall operate as if bits 1:0 are cleared to 00b. If an offset greater than the size of the requested Zoning data structure is specified, then the CDC-controller shall abort the command with a status code of Invalid Field in Command.

Figure NEW.26: Fabric Zoning Receive (FZR) – Command Dword 12

Bits	Description
31:28	Reserved
28	ZDK Context (ZDKC): This bit specifies the content of the ZDK field. If set to '1', then the ZDK field contains a Transaction ID. If this bit is cleared to '0', then the ZDK field contains a Zoning data key. A CDC receiving a FZR command with this bit set to '1' shall abort the command with a status code of Invalid Field in Command. A DDC receiving a FZR command with this bit cleared to '0' shall abort the command with a status code of Invalid Field in Command.
27:00	Number of Dwords (NUMD): This field specifies the number of dwords to transfer. If this field is cleared to 0h, then the controller shall abort the command with a status code of Invalid Field in Command.

5.NEW4.1 Command Completion

Upon completion of the Fabric Zoning Receive (FZR) command, the controller posts a completion queue entry to the Admin Completion Queue indicating the status of the command. Command specific status values for the FZR command are defined in Figure NEW.27.

Figure NEW.27: Fabric Zoning Receive (FZR) – Command Specific Status Values

Value	Description
30h	Zoning Data Structure Locked: The requested Zoning data structure is locked on the CDC.
31h	Zoning Data Structure Not Found: The requested Zoning data structure does not exist on the CDC.
33h	Requested Function Disabled: Fabric Zoning is not enabled on the CDC.
34h	ZoneGroup Originator Invalid: The DDC is not allowed to access the specified ZoneGroup.

The last fragment indication is returned in Dword 0 of the completion queue entry, as defined in Figure NEW.28.

Figure NEW.28: Fabric Zoning Receive (FZR) – Completion Queue Entry Dword 0

Bits	Description
31	Last Fragment (LF): This bit specifies if the transferred data buffer contains the last fragment of this Zoning data structure. If set to '1', then the transferred data buffer contains the last fragment; if cleared to '0', then the transferred data buffer does not contain the last fragment.
30:00	Reserved

Modify section 8.NEW.3.8 (Zoning Operations) as shown below:

8.NEW.3.8 Zoning Operations

8.NEW.3.8.1 Overview

ZoneGroups are data structures maintained and managed (i.e., created, read, modified, or deleted) in the Zoning database of the CDC. During a ~~'write'~~ access ~~on-to~~ a ZoneGroup (e.g., the ZoneGroup is created or modified) through an administrative interface ~~outside the scope of this specification~~ (e.g., an administrative interface on the CDC ~~outside the scope of this specification~~ or the protocol defined in this specification), the ZoneGroup ~~may~~ becomes locked to ~~any~~ access from any other ~~administrative~~ interface ~~outside the scope of this specification~~.

Management of ZoneGroups generally happens through an administrative interface ~~outside the scope of this specification~~ on the CDC. Push model Direct Discovery controllers (DDCs) may be able to manage their own ZoneGroups (i.e., ZoneGroups having the DDC NQN as ZoneGroup Originator) ~~through the Get Active ZoneGroup (GAZ) operation (refer to section 2.2), the Add/Replace Active ZoneGroup (AAZ) operation (refer to section 2.3), and the Remove Active ZoneGroup (RAZ) operation (refer to section 2.4)~~ as specified in section 8.NEW.3.8.2. Pull model DDCs may be able to manage their own ZoneGroups (i.e., ZoneGroups having the DDC NQN as ZoneGroup Originator) as specified in section 8.NEW.3.8.3.

By default, a ZoneGroup should be accessible only to an administrative interface outside the scope of this specification on the CDC and to the ZoneGroup originator DDC ~~through the protocol defined in this specification~~.

If Fabric Zoning is not enabled on the CDC, then that CDC:

- shall abort all Fabric Zoning commands (i.e., any Fabric Zoning command that is issued as part of a Zoning operation) ~~issued by a push model DDC~~ with a status code of Requested Function Disabled; ~~and-~~
- shall not react to Pull Model DDC Request asynchronous event notifications issued by a pull model DDC.

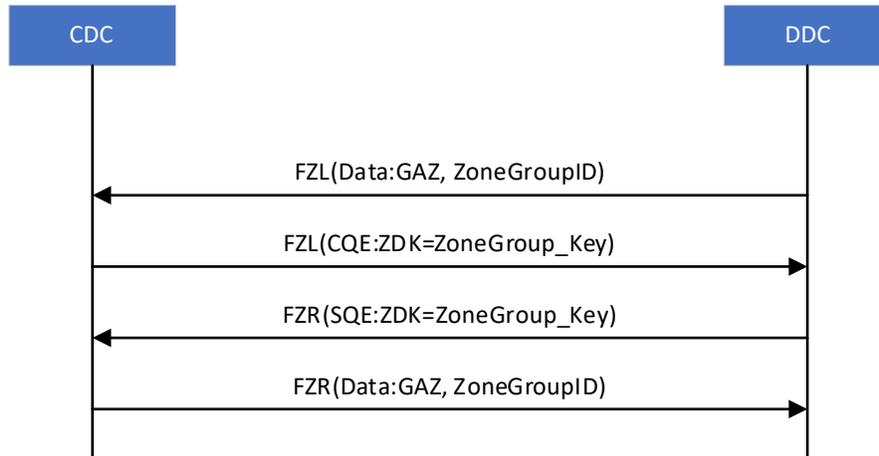
8.NEW.3.8.2 Push Model DDC Operations

8.NEW.3.8.2.1 Get Active ZoneGroup (GAZ)

<This was section 8.NEW.3.8.2 in TP8010a>

The Get Active ZoneGroup (GAZ) operation allows a DDC to retrieve from the CDC an active ZoneGroup associated with the DDC ~~issuing~~ ~~initiating~~ the GAZ ~~request~~ operation. For a push model DDC, ~~T~~the GAZ operation is mapped to an FZL command to lookup the key of the ZoneGroup to retrieve in ~~the Zoning database of the CDC~~ ZoneDBActive in that CDC, followed by one or more FZR commands to retrieve that ZoneGroup from the CDC, as shown in ~~Figure NEW~~ 9.

Figure NEWNEW.9: GAZ for Push Model DDC



The identifier of the ZoneGroup to get is provided in the FZL buffer, as shown in Figure NEW.49.

Figure NEW.49: FZL Data for GAZ

Bytes	Description
00	Operation type: 1h (i.e., Lookup for Get Active ZoneGroup)
03:01	Reserved
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

The FZL command returns the key of the ZoneGroup to retrieve as a Zoning Data key value in the Completion Queue. For the FZL command of a GAZ operation:

- if the requested ZoneGroup does not exist on the CDC, then the CDC shall abort the command with a status code of Zoning Data Structure Not Found; or
- if the requested ZoneGroup is locked on the CDC (i.e., another administrative interface ~~outside the scope of this specification~~ is modifying that ZoneGroup), then the CDC shall abort the command with a status code of Zoning Data Structure Locked.

The Zoning Data key value returned by the FZL command is used in the Command Dword 10 of the FZR commands (refer to Figure NEW.24) to retrieve that ZoneGroup or a fragment of that ZoneGroup. The ZoneGroup definition is retrieved through one or more subsequent FZR commands and is returned in the FZR buffer, as shown in Figure NEW.50. The FZR completion queue entry sending ~~the buffer containing~~ the last fragment shall have the Last Fragment (LF) bit set to '1' in Completion Queue Entry Dword 0 (refer to Figure NEW.28).

Figure NEW.50: FZR Data for GAZ-Response

Bytes	Description
00	Operation type: 2h (i.e., Get Active ZoneGroup for a push model DDC)
03:01	Reserved
07:04	ZoneGroup generation number
11:08	ZoneGroup fragment length (ZGFL)
15:12	Reserved
ZGFL+15:16	ZoneGroup fragment

For the FZR command of a GAZ response operation:

- if the ZoneGroup identified by the specified ZoneGroup key does not exist on the CDC, then the CDC shall abort the command with a status code of Zoning Data Structure Not Found; or

- if the ZoneGroup identified by the specified ZoneGroup key is locked on the CDC (i.e., another administrative interface ~~outside the scope of this specification~~ is modifying that ZoneGroup), then the CDC shall abort the command with a status code of Zoning Data Structure Locked.

When a ZoneGroup is transferred in multiple fragments, the receiver shall verify that the ZoneGroup generation number stays constant across all FZR commands. If the ZoneGroup generation number changes, then the GAZ operation shall be aborted. The DDC shall not process received ZoneGroup information until the full ZoneGroup (i.e., all of the fragments of the ZoneGroup) is received.

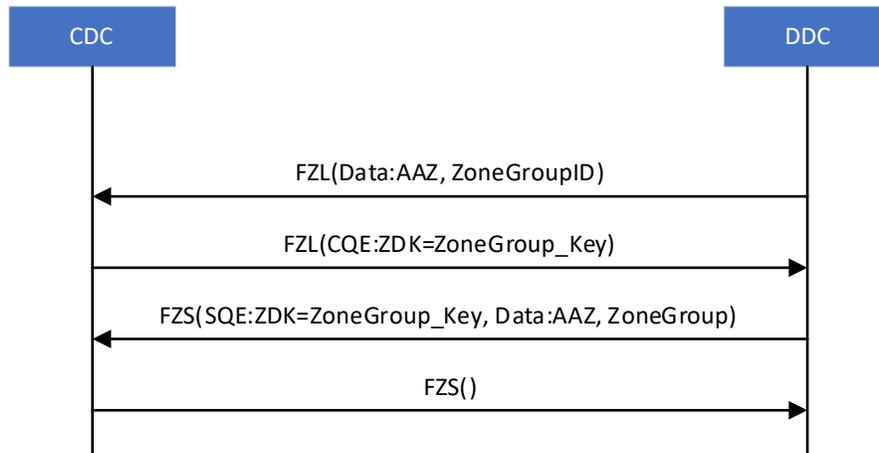
The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC issuing the FZL command or FZR command is authorized to read the ZoneGroup specified in the FZL data (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the HOSTNQN field of the Connect command sent from the DDC to that CDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall abort the FZL command and the FZR command with a status code of ZoneGroup Originator Invalid.

8.NEW.3.8.2.2 Add/Replace Active ZoneGroup (AAZ)

<This was section 8.NEW.3.8.3 in TP8010a>

The Add/Replace Active ZoneGroup (AAZ) operation allows a DDC to add or replace in the CDC an active ZoneGroup associated with the DDC ~~issuing~~ ~~initiating~~ the ~~GAZ-AAZ request~~ operation. For a push model DDC, ~~the~~ AAZ operation is mapped to an FZL command to lookup the key of the ZoneGroup to add or replace in ~~the Zoning database of the CDC~~ ZoneDBActive in that CDC, followed by one or more FZS commands to provide the CDC with the ZoneGroup to add or replace, as shown in **Figure NEWNEW.10**.

Figure NEWNEW.10: AAZ for Push Model DDC



The identifier of the ZoneGroup to add or replace is provided in the FZL buffer, as shown in Figure NEW.51.

Figure NEW.51: FZL Data for AAZ

Bytes	Description
00	Operation type: 3h (i.e., Lookup for Add/Replace Active ZoneGroup)
03:01	Reserved
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

The FZL command returns the key of the ZoneGroup to add or replace as a Zoning Data key value in the Completion Queue. For the FZL command of an AAZ operation:

- if the ZoneGroup that matches the specified FZL data exists ~~on the Zoning database of the CDC~~ in ZoneDBActive in that CDC and is locked by another administrative interface ~~outside the scope of~~

~~this specification~~, then the CDC shall abort the command with a status code of Zoning Data Structure Locked;

- if the ZoneGroup that matches the specified FZL data exists ~~on the Zoning database of the CDC~~ in ZoneDBActive in that CDC and is not locked by another administrative interface ~~outside the scope of this specification~~, then that ZoneGroup should be locked by the submitting DDC and its key shall be returned as the Zoning Data key in the Completion Queue; or
- if the ZoneGroup that matches the specified FZL data does not exist ~~on the Zoning database of the CDC~~ in ZoneDBActive in that CDC, then an empty ZoneGroup having the provided identifier shall be created ~~on the Zoning database of the CDC~~ in ZoneDBActive in that CDC, that ZoneGroup should be locked by the submitting DDC, and its key shall be returned as the Zoning Data key in the Completion Queue.

Successful completion of the FZL command for the AAZ operation results in the identified ZoneGroup on the CDC being locked by the DDC performing the operation.

The ZoneGroup to add or replace is provided in the FZS buffer of subsequent FZS commands with the appropriate Zoning Data key in Command Dword 10 (refer to Figure NEW.19) and is transferred in one or more fragments, as needed, as shown in Figure NEW.52. The FZS command sending ~~the buffer containing~~ the last fragment shall have the Last Fragment (LF) bit set to '1' in Command Dword 12 (refer to Figure NEW.21).

Figure NEW.52: FZS Data for AAZ

Bytes	Description
00	Operation type: 4h (i.e., Add/Replace Active ZoneGroup for a push model DDC)
03:01	Reserved
NUMD*4+03:04	ZoneGroup fragment

For the FZS command of an AAZ request operation:

- if the ZoneGroup identified by the specified ZoneGroup key does not exist on the CDC, then the CDC shall abort the command with a status code of Zoning Data Structure Not Found; or
- if the ZoneGroup identified by the specified ZoneGroup key is locked by another entity on the CDC (i.e., another administrative interface ~~outside the scope of this specification~~ is modifying that ZoneGroup), then the CDC shall abort the command with a status code of Zoning Data Structure Locked.

The CDC shall update a ZoneGroup ~~in its Zoning database~~ and increment its generation number only upon successful reception of the full ZoneGroup (i.e., all of the fragments of the ZoneGroup). Successful receipt of the full ZoneGroup for the AAZ operation shall unlock the identified ZoneGroup on the CDC. If the full ZoneGroup is not received within 30 seconds from the establishment of the lock (during processing of the related FZL command), then all the received data shall be discarded and the lock shall be released (i.e., ~~the Zoning database~~ ZoneDBActive in that CDC is not changed).

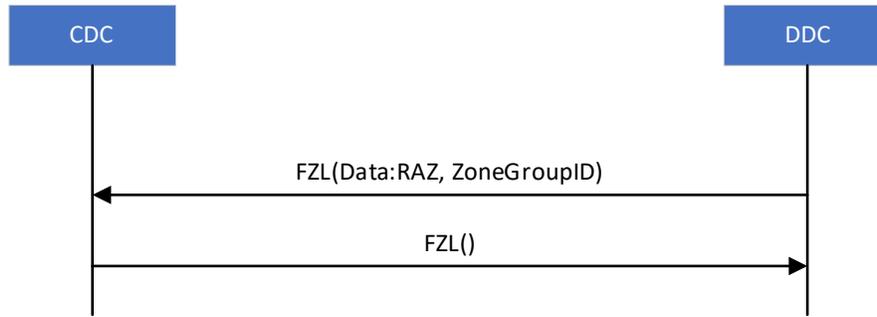
The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC issuing the FZL command or FZS command is authorized to write the ZoneGroup specified in the FZL data (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the HOSTNQN field of the Connect command sent from the DDC to that CDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall abort the FZL command and the FZS command with a status code of ZoneGroup Originator Invalid.

8.NEW.3.8.2.3 Remove Active ZoneGroup (RAZ)

<This was section 8.NEW.3.8.4 in TP8010a>

The Remove Active ZoneGroup (RAZ) operation allows a DDC to remove from the CDC an active ZoneGroup associated with the DDC ~~issuing/initiating~~ the RAZ ~~request~~ operation. ~~For a push model DDC,~~ the RAZ operation is mapped to an FZL command to provide to the CDC with the identifier of the ZoneGroup to remove, ~~as shown in Figure NEWNEW.11~~.

Figure NEWNEW.11: RAZ for Push Model DDC



The identifier of the ZoneGroup to remove is provided in the FZL buffer, as shown in Figure NEW.53.

Figure NEW.53: FZL Data for RAZ

Bytes	Description
00	Operation type: 5h (i.e., Lookup for Remove Active ZoneGroup)
03:01	Reserved
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

For the FZS command of an RAZ request operation:

- if the requested ZoneGroup does not exist on the CDC, then the CDC shall abort the command with a status code of Zoning Data Structure Not Found; or
- if the requested ZoneGroup is locked on the CDC (i.e., another administrative interface ~~outside the scope of this specification~~ is modifying that ZoneGroup), then the CDC shall abort the command with a status code of Zoning Data Structure Locked.

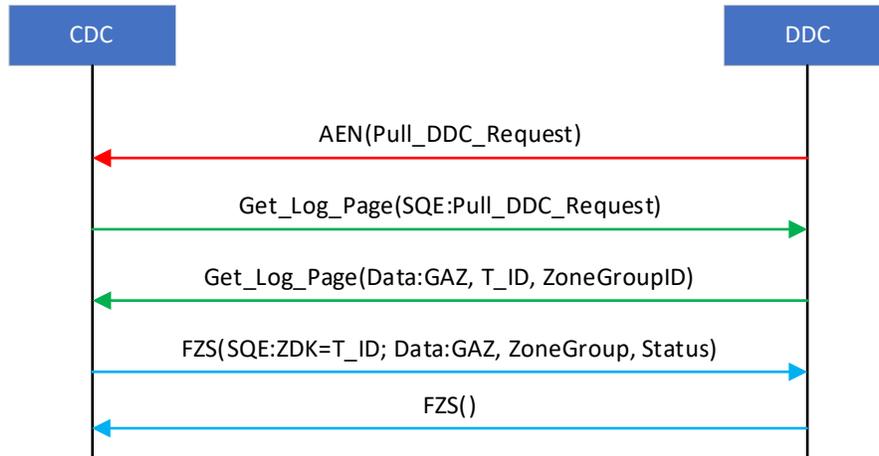
The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC issuing the FZL command is authorized to remove the ZoneGroup specified in the FZL data (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the HOSTNQN field of the Connect command sent from the DDC to that CDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall abort the FZL command with a status code of ZoneGroup Originator Invalid.

8.NEW.3.8.3 Pull Model DDC Operations

8.NEW.3.8.3.1 Get Active ZoneGroup (GAZ)

The Get Active ZoneGroup (GAZ) operation allows a DDC to retrieve from the CDC an active ZoneGroup associated with that DDC. For a pull model DDC the GAZ operation is mapped to a Pull Model DDC Request asynchronous event notification (refer to [Figure 146](#)). The CDC responds to that asynchronous event notification with a Get Log Page command requesting the Pull Model DDC Request log page (refer to section [5.16.1.NEW1](#)), to which the DDC responds with a log page requesting a GAZ operation for a specified ZoneGroup. The GAZ operation is then completed by the CDC by issuing one or more FZS commands to send that ZoneGroup and the operation status to the DDC, as shown in [Figure NEWNEW.12](#).

Figure NEWNEW.12: GAZ for Pull Model DDC



The format of the operation specific parameters of a Pull Model DDC Request log page requesting a GAZ operation is shown in [Figure NEWNEW.13](#).

Figure NEWNEW.13: GAZ Operation Specific Parameters for Pull Model DDC Request Log Page

Bytes	Description
03:00	Transaction ID (T_ID)
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

The Transaction ID field is used to relate the Pull Model DDC Request log page for a pull model GAZ to the subsequent FZS command(s). The Zoning Data Key in Command Dword 10 (refer to [Figure NEW.19](#)) in the FZS command(s) shall be set to the received Transaction ID value. The ZoneGroup definition is sent through one or more subsequent FZS commands and is provided in the FZS buffer, as shown in [Figure NEWNEW.14](#). The FZS command sending the last fragment shall have the Last Fragment (LF) bit set to '1' in Command Dword 12 (refer to [Figure NEW.21](#)).

Figure NEWNEW.14: FZS Data for Pull Model GAZ

Bytes	Description
00	Operation type: 7h (i.e., Get Active ZoneGroup for a pull model DDC)
03:01	Reserved
07:04	GAZ operation status
11:08	ZoneGroup fragment length (ZGFL)
15:12	Reserved
ZGFL+15:16	ZoneGroup fragment

The GAZ operation status field is used to encode status information for the pull model GAZ operation, as shown in [Figure NEWNEW.22](#).

When a ZoneGroup is transferred in multiple fragments, if the CDC detects the ZoneGroup definition has changed while sending the fragments, then the CDC shall issue an FZS command with a zero length ZoneGroup fragment and GAZ operation status set to 5h (i.e., ZoneGroup Changed), and the GAZ operation shall be aborted.

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model GAZ operation does not exist on the CDC, then the CDC shall issue an FZS command with a zero length ZoneGroup fragment

and GAZ operation status set to 2h (i.e., Zoning Data Structure Not Found), and the GAZ operation shall be aborted.

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model GAZ operation is locked on the CDC (i.e., another administrative interface outside the scope of this specification is modifying that ZoneGroup), then the CDC shall issue an FZS command with a zero length ZoneGroup fragment and GAZ operation status set to 3h (i.e., Zoning Data Structure Locked), and the GAZ operation shall be aborted.

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model GAZ operation is not locked on the CDC, then the CDC shall continue the GAZ operation by issuing one or more subsequent FZS commands containing the fragments of the requested ZoneGroup. The last fragment shall specify GAZ operation status cleared to 0h (i.e., Operation Successful), and the other fragments shall specify GAZ operation status set to 1h (i.e., Operation in Progress).

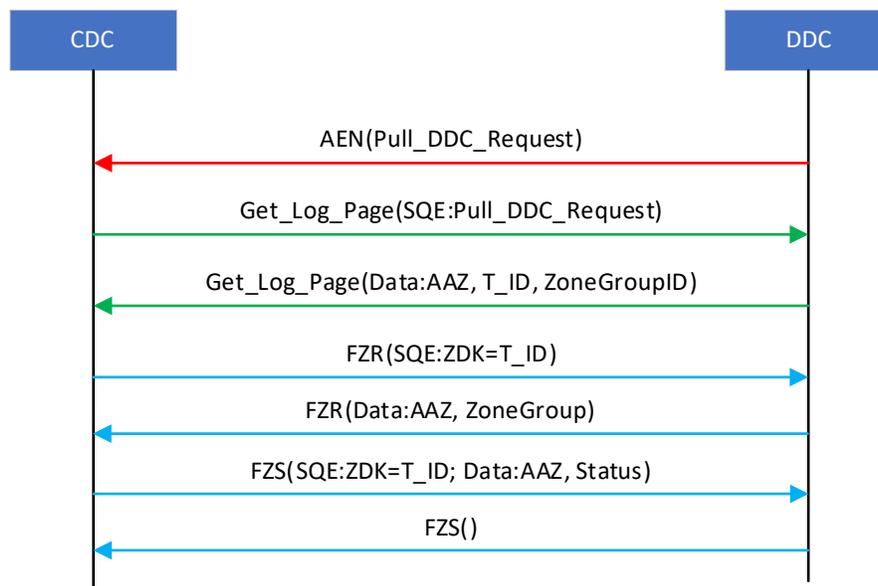
The DDC shall not process received ZoneGroup information until the entire ZoneGroup (i.e., all of the fragments of the ZoneGroup) is received.

The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC requesting the GAZ operation is authorized to read the ZoneGroup indicated in Pull Model DDC Request log page for Pull Model GAZ operation (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the SUBNQN field of the Connect command sent from the CDC to that DDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall issue an FZS command with a zero length ZoneGroup fragment and GAZ operation status set to 4h (i.e., ZoneGroup Originator Invalid), and the GAZ operation shall be aborted.

8.NEW.3.8.3.2 Add/Replace Active ZoneGroup (AAZ)

The Add/Replace Active ZoneGroup (AAZ) operation allows a DDC to add or replace in the CDC an active ZoneGroup associated with that DDC. For a pull model DDC the AAZ operation is mapped to a Pull Model DDC Request asynchronous event notification (refer to [Figure 146](#)). The CDC responds to that asynchronous event notification with a Get Log Page command requesting the Pull Model DDC Request log page (refer to section [5.16.1.NEW1](#)), to which the DDC responds with a log page requesting an AAZ operation for a specified ZoneGroup. The AAZ operation is then completed by the CDC by issuing one or more FZR commands to retrieve that ZoneGroup from the DDC, and one FZS command to provide an operation status to the DDC, as shown in [Figure NEWNEW.15](#).

Figure NEWNEW.15: AAZ for Pull Model DDC



The format of the operation specific parameters of a Pull Model DDC Request log page requesting an AAZ is shown in [Figure NEWNEW.16](#).

Figure NEWNEW.16: AAZ Operation Specific Parameters for Pull Model DDC Request Log Page

Bytes	Description
03:00	Transaction ID (T_ID)
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

The Transaction ID field is used to relate the Pull Model DDC Request log page for a pull model AAZ operation to the subsequent FZR and FZS command(s). The Zoning Data Key in Command Dword 10 (refer to [Figure NEW.24](#)) of the FZR command(s) shall be set to the received Transaction ID value. The Zoning Data Key in Command Dword 10 (refer to [Figure NEW.19](#)) of the FZS command shall be set to the received Transaction ID value.

If the specified ZoneGroup is locked on the CDC, then the AAZ operation shall be aborted by the CDC by issuing one FZS command with AAZ operation status set to 3h (i.e., Zoning Data Structure Locked) to the DDC. The Transaction ID value returned by the DDC in the Pull Model DDC Request log page for a pull model AAZ operation shall be the same in the FZS command for this AAZ operation.

If the specified ZoneGroup:

- does not exist in ZoneDBActive in that CDC; or
- exists in ZoneDBActive in that CDC and is not locked by another administrative interface,

then the CDC shall lock the specified ZoneGroup in ZoneDBActive and complete the AAZ operation by issuing one or more FZR commands to request from the DDC the ZoneGroup definition to add/replace, followed by an FZS command to report status information to the DDC. The ZoneGroup definition is sent through one or more FZR commands and is provided in the FZR buffer, as shown in [Figure NEWNEW.17](#). The FZR completion queue entry sending the last fragment shall have the Last Fragment (LF) bit set to '1' in Completion Queue Entry Dword 0 (refer to [Figure NEW.28](#)).

Figure NEWNEW.17: FZR Data for Pull Model AAZ

Bytes	Description
00	Operation type: 9h (i.e., Add/Replace Active ZoneGroup for a pull model DDC)
07:01	Reserved
11:08	ZoneGroup fragment length (ZGFL)
15:12	Reserved
ZGFL+15:16	ZoneGroup fragment

The CDC shall not process received ZoneGroup information until the entire ZoneGroup (i.e., all of the fragments of the ZoneGroup) is received. Upon receiving the ZoneGroup information, the CDC shall update that ZoneGroup in ZoneDBActive in that CDC, increment the ZoneGroup generation number, and issue an FZS command with AAZ operation status cleared to 0h (i.e., Operation Successful) to the DDC.

The AAZ operation status is sent through the FZS command and is provided in the FZS buffer, as shown in [Figure NEWNEW.18](#).

Figure NEWNEW.18: FZS Data for Pull Model AAZ

Bytes	Description
00	Operation type: Ah (i.e., AAZ status for a pull model DDC)
03:01	Reserved
07:04	AAZ operation status

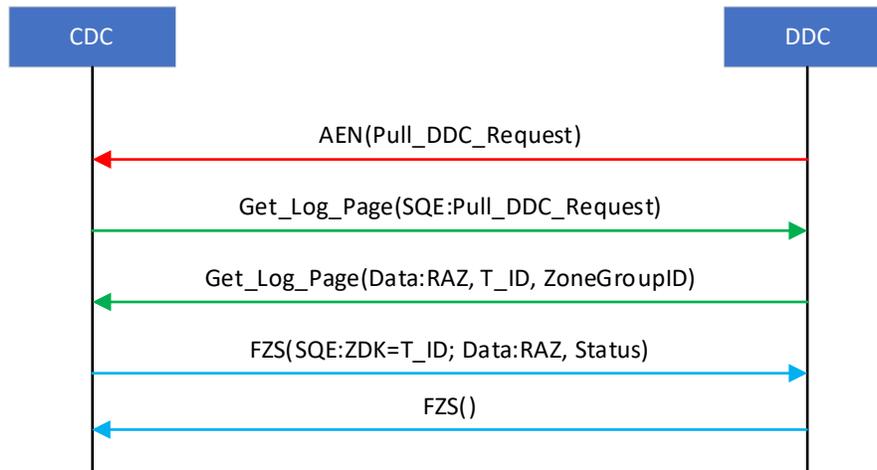
The AAZ operation status field is used to encode status information for the pull model AAZ operation, as shown in [Figure NEWNEW.22](#).

The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC requesting the AAZ operation is authorized to write the ZoneGroup indicated in Pull Model DDC Request log page for Pull Model AAZ operation (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the SUBNQN field of the Connect command sent from the CDC to that DDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall issue an FZS command with AAZ operation status set to 4h (i.e., ZoneGroup Originator Invalid), and the AAZ operation shall be aborted.

8.NEW.3.8.3.3 Remove Active ZoneGroup (RAZ)

The Remove Active ZoneGroup (RAZ) operation allows a DDC to remove from the CDC an active ZoneGroup associated with that DDC. For a pull model DDC the RAZ operation is mapped to a Pull Model DDC Request asynchronous event notification (refer to [Figure 146](#)). The CDC responds to that asynchronous event notification with a Get Log Page command requesting the Pull Model DDC Request log page (refer to section [5.16.1.NEW1](#)), to which the DDC responds with a log page requesting an RAZ operation for a specified ZoneGroup. The RAZ operation is then completed by the CDC by issuing one FZS command to provide an operation status to the DDC, as shown in [Figure NEWNEW.19](#).

Figure NEWNEW.19: RAZ for Pull Model DDC



The format of the operation specific parameters of a Pull Model DDC Request log page requesting an RAZ operation is shown in [Figure NEWNEW.20](#).

Figure NEWNEW.20: RAZ Operation Specific Parameters for Pull Model DDC Request Log Page

Bytes	Description
03:00	Transaction ID (T_ID)
227:04	ZoneGroup Originator
257:228	ZoneGroup Name

The RAZ operation is then completed by the CDC by issuing one FZS command to report status information to the DDC. The Transaction ID field is used to relate the Pull Model DDC Request log page for a pull model RAZ operation to the subsequent FZS command. The Zoning Data Key in Command Dword 10 (refer to [Figure NEW.19](#)) of the FZS command shall be set to the received Transaction ID value.

The RAZ operation status is sent through the FZS command and is provided in the FZS buffer, as shown in [Figure NEWNEW.21](#).

Figure NEWNEW.21: FZS Data for Pull Model RAZ

Bytes	Description
00	Operation type: Ch (i.e., RAZ status for a pull model DDC)

Bytes	Description
03:01	Reserved
07:04	RAZ operation status

The RAZ operation status field is used to encode status information for the pull model RAZ operation, as shown in [Figure NEWNEW.22](#).

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model RAZ operation does not exist on the CDC, then the CDC shall issue an FZS command with RAZ operation status set to 2h (i.e., Zoning Data Structure Not Found), and the RAZ operation shall be aborted.

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model RAZ operation is locked on the CDC (i.e., another administrative interface is modifying that ZoneGroup), then the CDC shall issue an FZS command with RAZ operation status set to 3h (i.e., Zoning Data Structure Locked), and the RAZ operation shall be aborted.

If the ZoneGroup indicated in the Pull Model DDC Request log page for a pull model RAZ operation is not locked on the CDC, then the CDC shall continue the GAZ operation by removing the requested ZoneGroup from ZoneDBActive in that CDC and by issuing one subsequent FZS command with RAZ operation status cleared to 0h (i.e., Operation Successful).

The CDC may enforce access restrictions to the Zoning data structures. In this case, the CDC shall check if the DDC requesting the RAZ operation is authorized to remove the ZoneGroup indicated in the Pull Model DDC Request log page for Pull Model RAZ operation (e.g., if the CDC allows access to a ZoneGroup only to the DDC that created that ZoneGroup, verify that the ZoneGroup Originator field matches the NQN contained in the SUBNQN field of the Connect command sent from the CDC to that DDC). If that DDC is not authorized to access the specified ZoneGroup, then the CDC shall issue an FZS command with RAZ operation status set to 4h (i.e., ZoneGroup Originator Invalid), and the RAZ operation shall be aborted.

8.NEW.3.8.3.4 Pull Model DDC Zoning Operations Status Values

The Pull Model DDC Zoning operations status values are listed in [Figure NEWNEW.22](#).

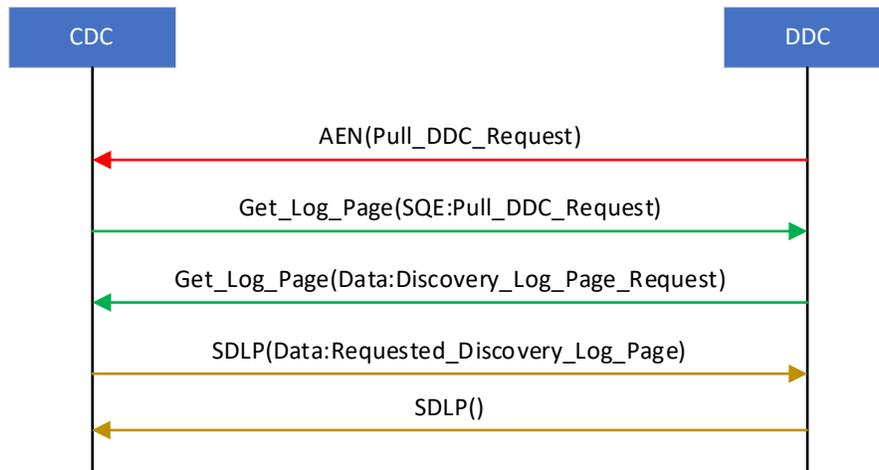
Figure NEWNEW.22: Pull Model DDC Zoning Operations Status Values

Value	Description
0h	Operation Successful
1h	Operation in Progress
2h	Zoning Data Structure Not Found
3h	Zoning Data Structure Locked
4h	ZoneGroup Originator Invalid
5h	ZoneGroup Changed
All others	Reserved

8.NEW.3.8.3.5 Pull Model DDC Discovery Log Page Request

A Pull Model DDC retrieves a discovery log page from the CDC through a Pull Model DDC Request asynchronous event notification (refer to [Figure 146](#)). The CDC responds to that asynchronous event notification with a Get Log Page command requesting the Pull Model DDC Request log page (refer to section [5.16.1.NEW1](#)), to which the DDC responds with a log page requesting a Discovery Log Page Request operation. The Discovery Log Page Request operation is then completed by the CDC by issuing a SDLP command (refer to section [5.NEWNEW1](#)) to provide the requested discovery log page to the DDC, as shown in [Figure NEWNEW.23](#).

Figure NEWNEW.23: Log Page Request Operation



The format of the operation specific parameters of a Pull Model DDC Request log page requesting a Log Page Request operation is shown in [Figure NEWNEW.24](#).

Figure NEWNEW.24: Log Page Request Operation Specific Parameters for Pull Model DDC Request Log Page

Bytes	Description
00	Log Page Request Log Page Identifier (LPRLID)
01	Log Page Request Log Specific Parameter (LPRLSP)
03:02	Reserved

The LPRLID field and the LPRLSP field have respectively the same format and semantics of the LID field and the LSP field in Command Dword 10 of a Get Log Page command. For example, to retrieve the Host Discovery log page, the LPRLID field is set to 71h.

Description of Specification Changes for NVM Express Management Interface Specification 1.2b

6.3 Get Log Page

Modify Figure 122 (Management Endpoint - Log Page Support) as shown below:

Figure 122: Management Endpoint - Log Page Support

Log Page Name ³	Log Identifier	Requirements ¹	
		NVMe Storage Device	NVMe Enclosure
...			
Discovery	70h	○	○
Host Discovery	71h	○	○
Pull Model DDC Request	73h	○	○
...			