

OIF

CMIS – Versatile Control Set (CMIS-VCS)

OIF Webinar

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Agenda

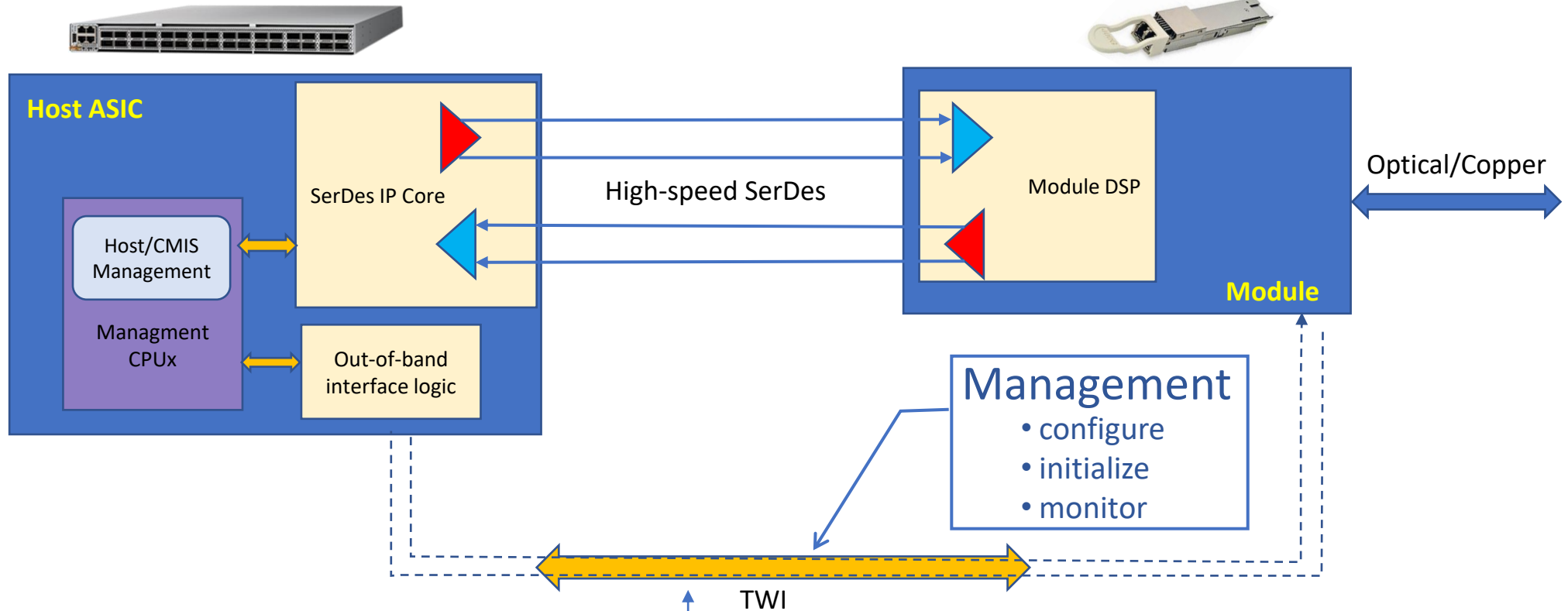
- CMIS Overview
- CMIS-VCS
- VCS Parameters
- Implementation Example
- Q&A

CMIS OVERVIEW

What is CMIS?

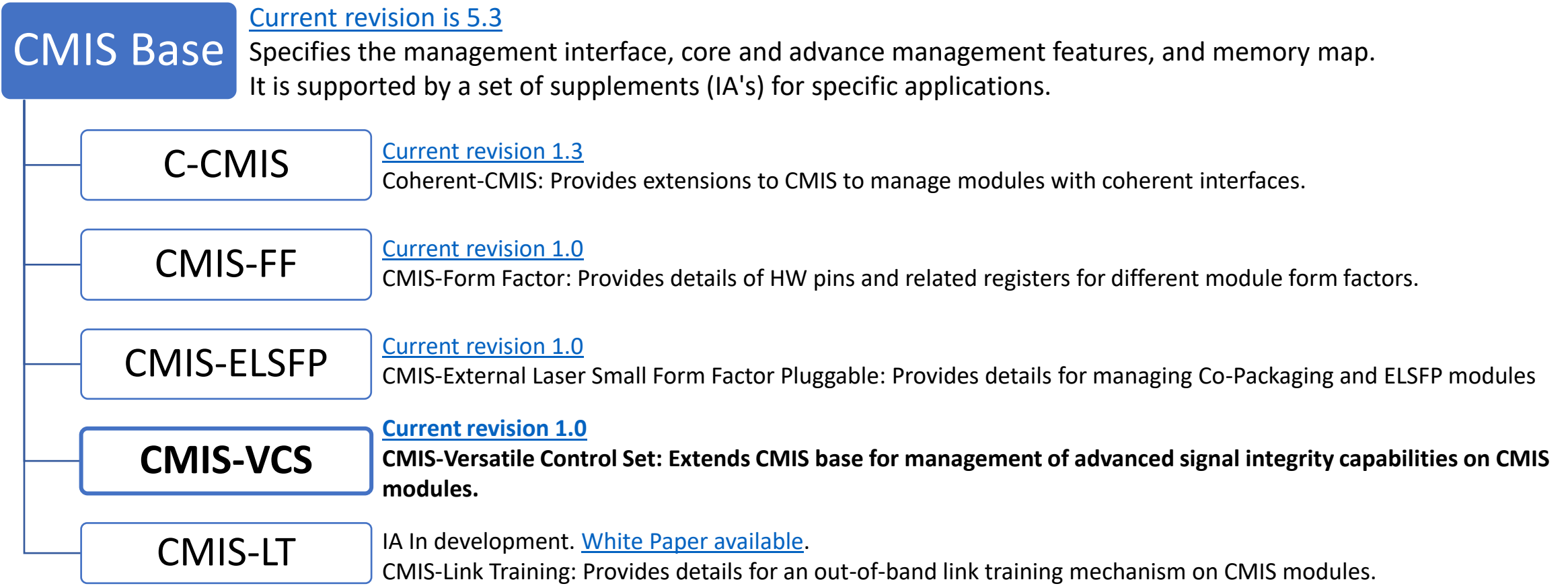
- Common Management Interface Specification (CMIS) is a management interface for optical modules and cable assemblies
- Provides a defined set of registers and functions for standard module management including:
 - Inventory data
 - Module and traffic configuration
 - Module monitoring (alarms/defects, performance monitoring)
 - Capability advertising
- Able to manage a wide range of optical modules including passive copper cables, 1300nm client plugs, 400ZR coherent modules, etc.
- It designed to operate over a two-wire interface (TWI) physical interface
- It works in conjunction with other industry standards like SFF-8024 and hardware MSAs

What is CMIS?



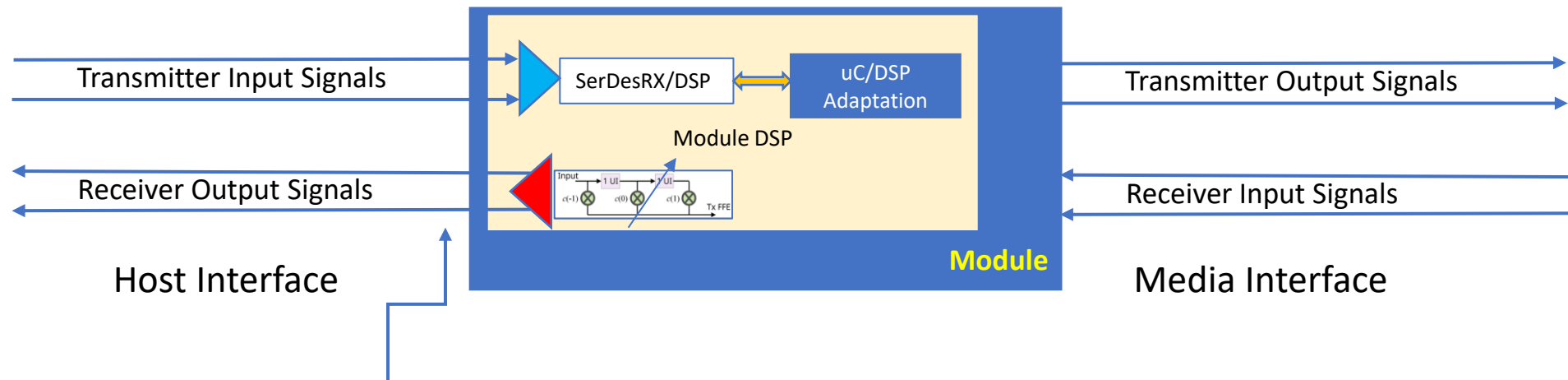
CMIS = Common Management Interface Specification

How is CMIS structured?



CMIS - Direction

- Transmitter (Tx) = Host to Media direction (i.e electrical to optical)
- Receiver (Rx) = Media to Host direction (i.e optical to electrical)



For example, [OutputEqPreCursorTargetRx<i>](#) refers to the precursor settings on the module to host electrical SerDes.

CMIS - Advertisement

- Modules use defined registers and CDB commands to advertise optional capabilities and module application information.
- Hosts read the advertised capabilities and manage the modules accordingly.
- Many of the features in CMIS are optional and within each feature there may be additional configuration options.

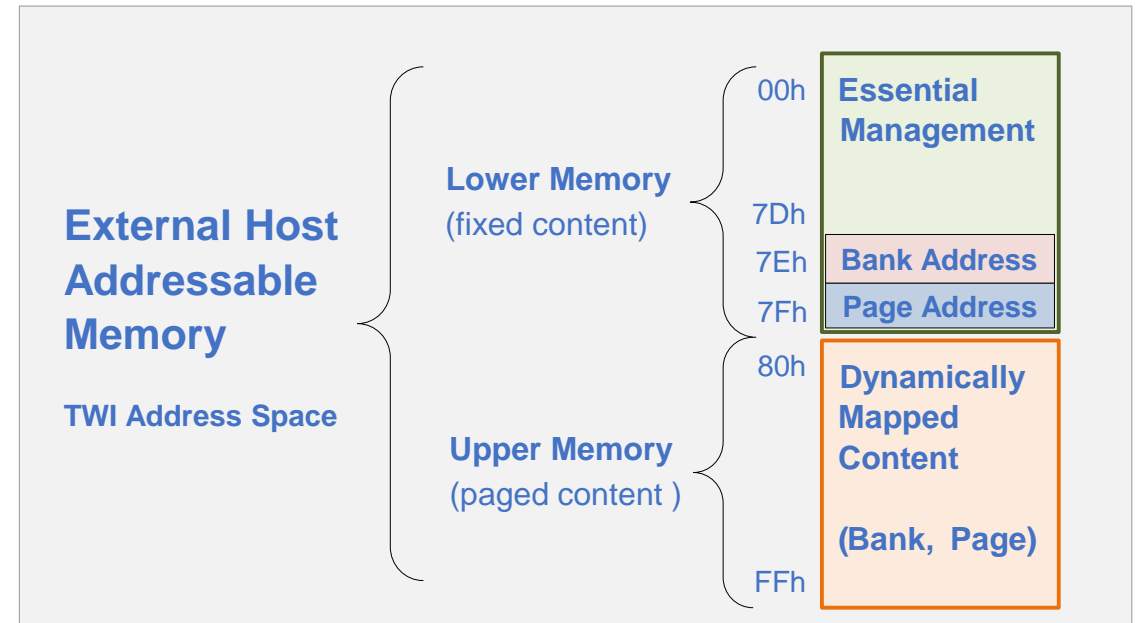
Examples:

- Supported grid spacing (e.g. 100GHz, 75GHz, 50GHz)
- CDB support and format.
- Supported temperature monitoring (AUX1, AUX2, ..)

CMIS Memory Map

- CMIS uses pages to turn the 256-byte TWI message into a memory map consisting of thousands of registers
- Registers are grouped in pages of 128 bytes
- Each page provides specific functionality
- Banking allows module to instantiate multiple copies of a page.

For example, 4x100GE: 4 banks of 100GE alarms/PMs pages.



For memory map details, [See CMIS base, Section 8.](#)

CMIS Command Data Block (CDB)

- An optional feature for command-reply message exchange between host and module
 - It support bulk data transfer (upgrades, performance monitoring, diagnostics and debug, etc).
 - CDB implementation is mandatory for VCS support.
- Each CDB command has a unique ID.
- CDB commands are executed on Page 9Fh. Pages A0h-Afh are used as the Extended Payload (EPL).

CMIS-VCS



CMIS – Versatile Control Set (VCS) Overview

- CMIS base provides fixed definitions for SI controls.
- As SerDes get faster and more complex, new controls are needed and some existing controls are not longer needed.
- Fixed definitions consume increasing amounts of memory space some of which is unused/wasted.
- CMIS-VCS provides a mechanism for the module to advertise its supported SI controls and the layout of those controls in the memory space.
- This versatile control set definition enables expansion of SI controls without changing CMIS base definitions or impacting existing installations.
- CMIS-VCS is a supplement IA to CMIS base.

CMIS-VCS Features

- It provides an extended list of SI parameters while reusing the same banked pages defined in CMIS base (Pages 10h/18h, 11h/19h).
- The host reads the module's advertised SI controls via CDB and configures the settings accordingly.
- It allows for configurable module/host ownership per parameter, per application, rather than just per application (CMIS base).
- It maintains the same CMIS 5.x memory space for compatibility with non-VCS aware hosts.

CMIS Staged and Active Control Sets

- CMIS base defines two Staged Control Sets containing per lane configuration settings. The second Stage Control Set is optional.
- The Active Control Set contains the current per lane configuration settings. These are Read-only registers.
- The memory space for Staged and Active control sets are identical.

| Function | Page | Bytes | Overflow Page | Overflow Page Bytes |
|----------------------|------|---------|---------------|---------------------|
| Staged Control Set 0 | 10h | 153-175 | 18h | 144-199 |
| Staged Control Set 1 | 10h | 188-210 | 18h | 200-255 |
| Active Control Set | 11h | 214-234 | 19h | 152-207 |

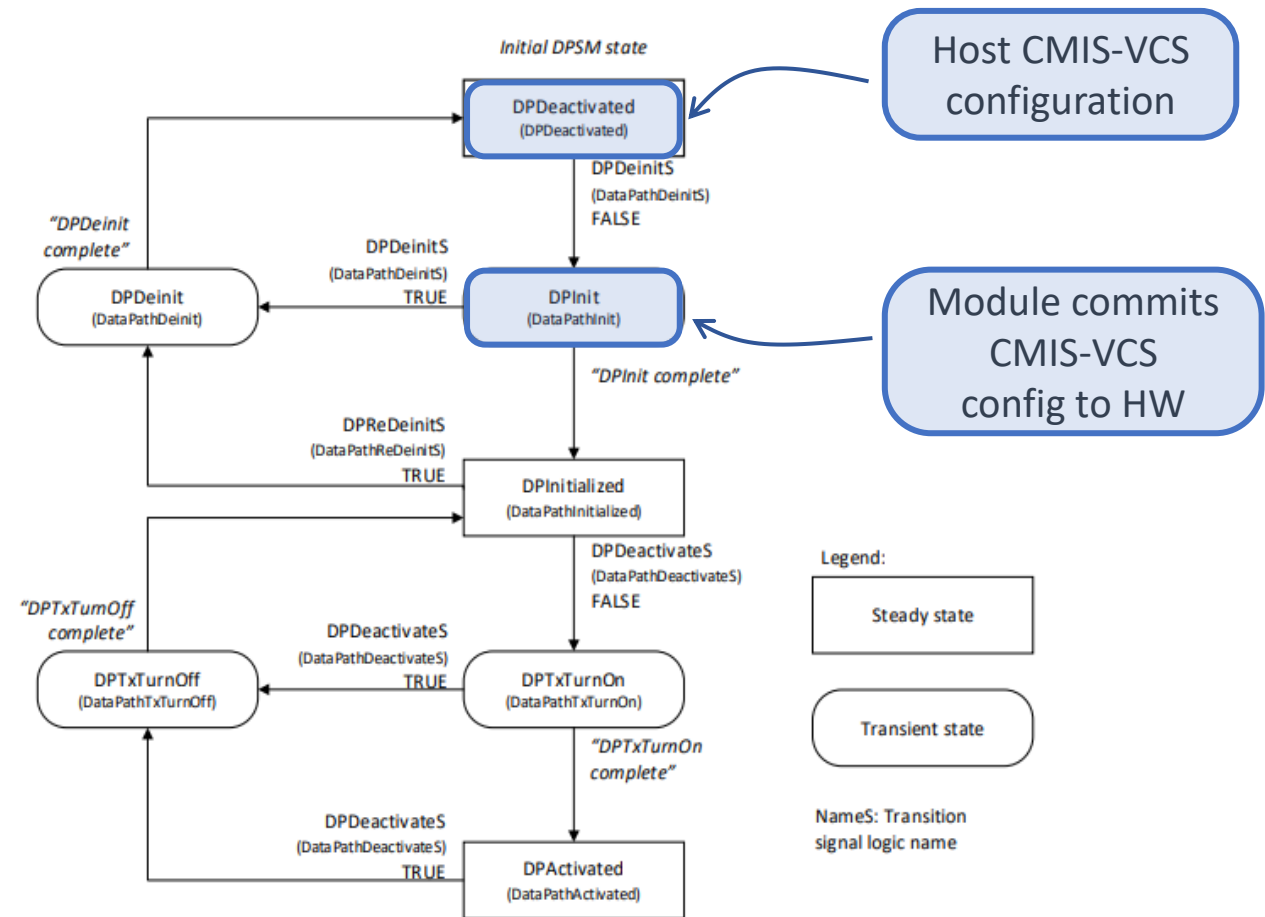


CMIS-VCS Descriptors

- The module advertises the VCS parameters it supports via CDB commands.
- The module provides **VCS Parameter Descriptors** which contain the characteristic information of each parameter the module supports.
- The **VCS Descriptor** is the sequence of VCS Parameter Descriptors.
- The order of VCS Parameter Descriptors in the VCS Descriptor defines the layout of the memory space (control sets).
- VCS supports two VCS Descriptors, one read-write and one read-only.

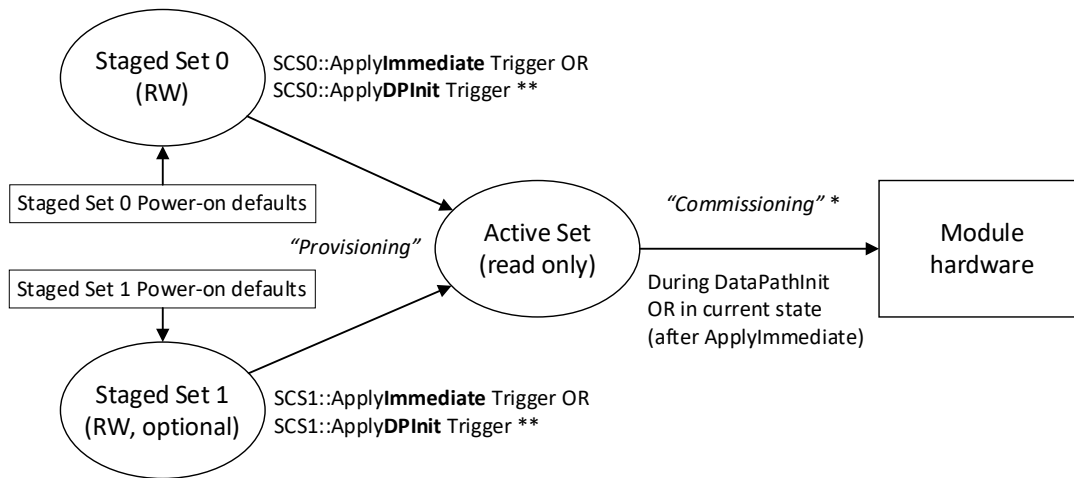
CMIS Data Path State Machine (DPSM)

- CMIS-VCS uses the same DPSM as defined in CMIS base.
- State machine to initialize a Data Path in the module. One module can support several data paths (applications). Each application is given a unique identified (AppSel).
- DPSM takes the module from DP_Deactivated (laser off) to DP_Activated (laser on)

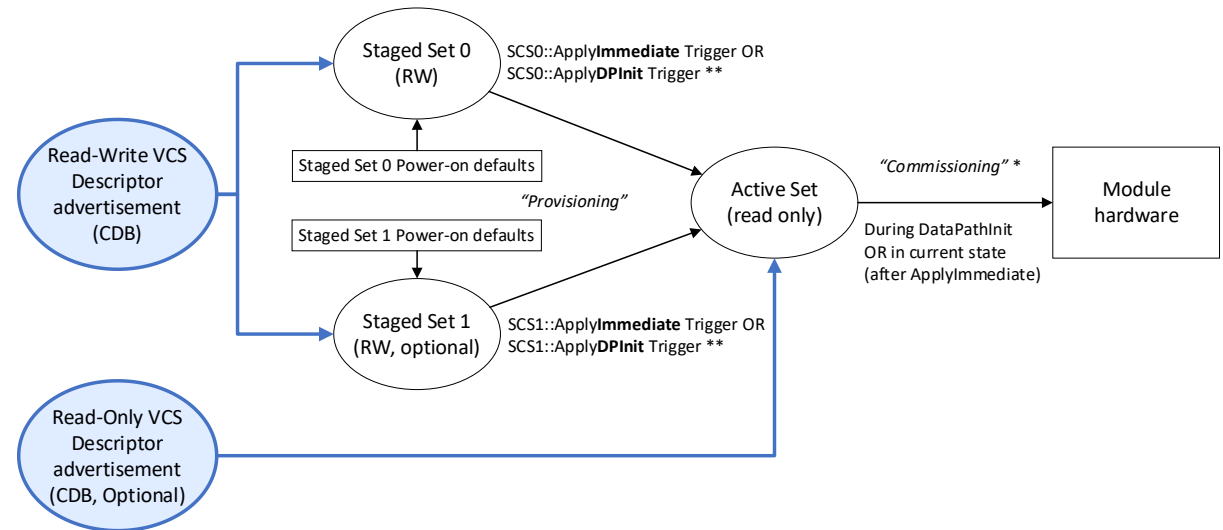


CMIS-VCS Configuration Flow diagram

CMIS base Control Set flow diagram



CMIS-VCS Control Set flow diagram



VCS Parameters

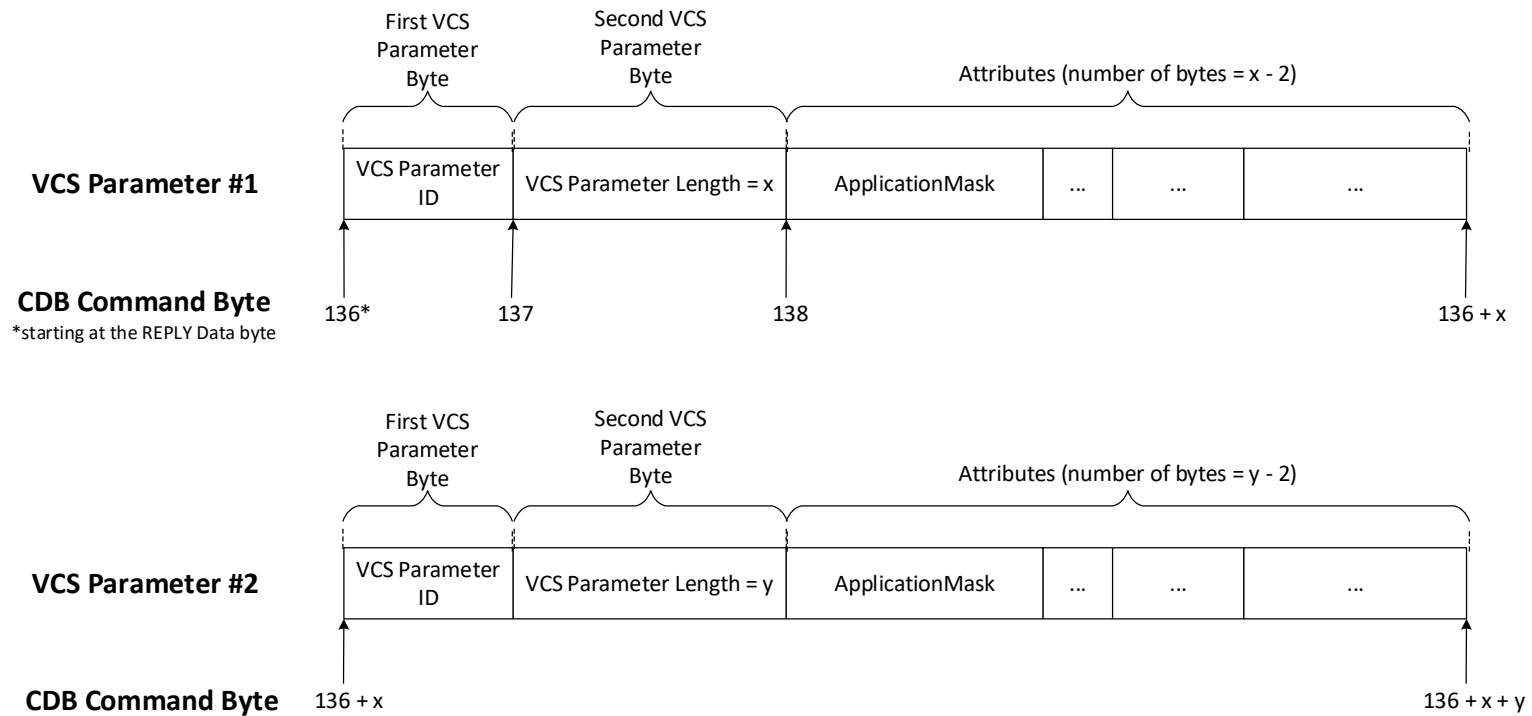


CMIS-VCS Parameters

- A VCS Parameter is a SI parameter that is defined by CMIS-VCS.
- The module implementation of the VCS Parameters is advertised via VCS Parameter Descriptors.
- Each VCS Parameter contains a set of attributes that describe its characteristics (e.g. min, max, resolution, etc).
- The number of attributes varies depending on the parameter.
- All VCS Parameters contain 4 standard attributes in addition to the characteristic attributes:
 - A unique Parameter ID attribute.
 - Parameter Length attribute, which value includes the ID and length fields.
 - ApplicationMask attribute, which is used to indicate if the parameter is applicable to a particular AppSel.
 - MemoryLength attribute, indicates the number of bytes the parameter will occupy in the Control Set.

CMIS-VCS Parameters

- The VCS Parameters Descriptors are advertised via CDB commands in TLV format



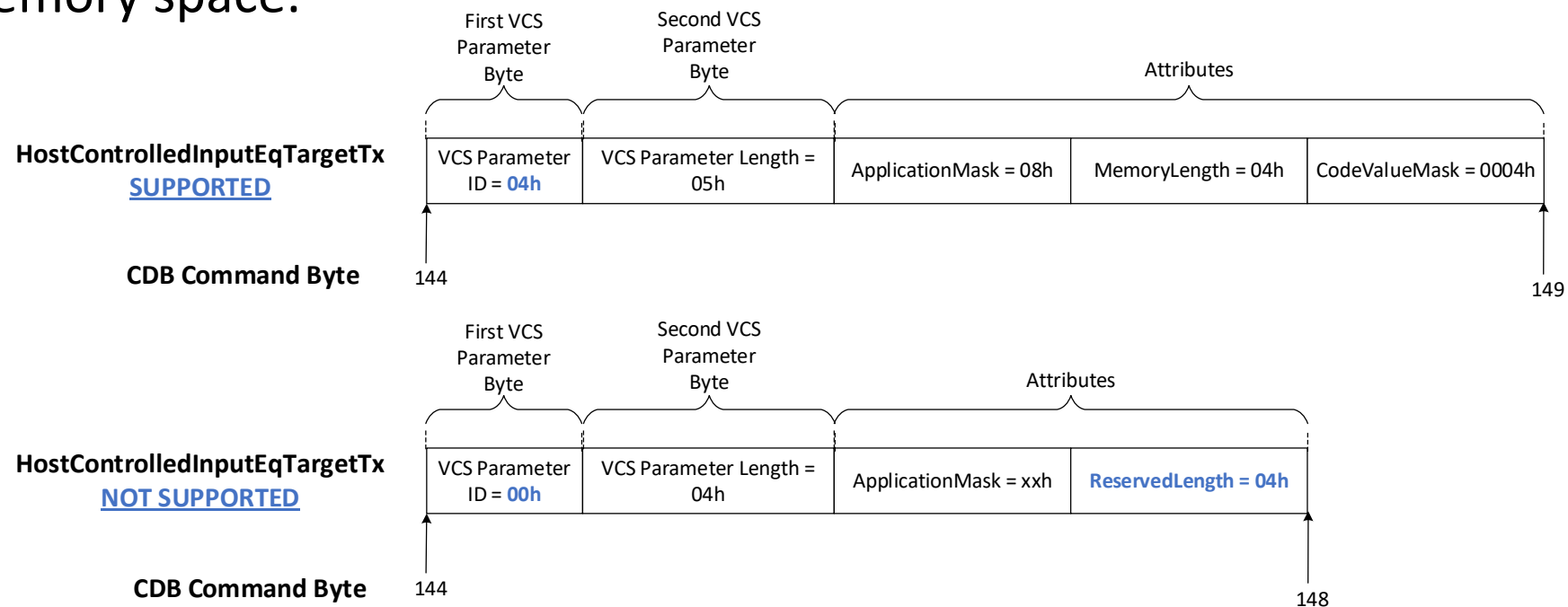
Supported VCS CDB Commands

| ID | Command Title | Description | Type |
|-------------|-----------------------------------|--|------|
| 4000h | VCS Descriptor overview | Returns details of the VCS Descriptor (VCS version supported, ApplicationMask Length, Overflow Page Support, Read-only Parameter support). | Rqd. |
| 4001h | Read-Write VCS Descriptor Command | VCS Descriptor consisting of a sequence of Read-Write VCS Parameter Descriptors (TLV encoded) – These parameters populate the Stage and Active Control Set memory space. | Adv. |
| 4002h | Read-Only VCS Descriptor Command | VCS Descriptor consisting of a sequence of VCS Parameter Descriptors (TLV encoded) - These parameters will populate the Active Control Set memory space only and appear after the Read-write parameters in the memory space. | Adv. |
| 4003h | Custom VCS Descriptor | Reserved for custom vendor-specific VCS Descriptors | Adv. |
| 4004h-40FFh | - | Reserved | |



Special CMIS-VCS Parameters

- **ReservedSpaceIndicator:** It is used to reserve memory space for unused parameters for the purpose of maintaining compatibility with CMIS base Control Set memory space.



Special CMIS-VCS Parameters

- **ExplicitControlPerParam**: It is used to indicate ownership of each parameter between host and module.
- CMIS base provides a single ownership control to the host or module for all parameters within an application.
- VCS provides ownership control per parameter, which allows the host to only set the parameters it cares about.
- The module advertises the size of the ExplicitControlPerParam mask, where each bit corresponds to a parameter in the order of advertisement.

Supported CMIS-VCS Parameters

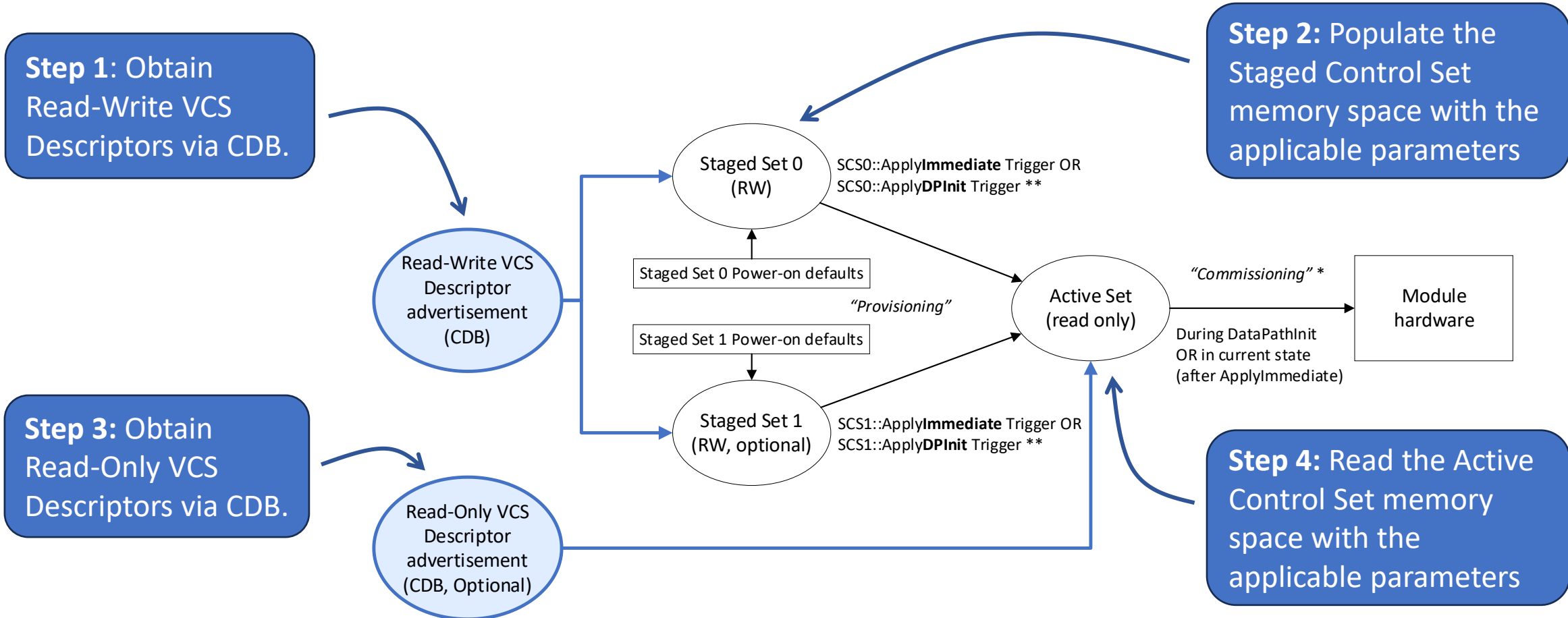
| VCS Parameter ID | Parameter Name | Description | Type | Notes |
|------------------|--------------------------------------|---|------|--|
| 00h | ReservedSpaceIndicator | Used to reserve memory space for unused parameters. | RW | VCS special Parameter |
| 01h | ExplicitControlPerParam | Bit mask of VCS Parameter to explicitly control | RW | VCS special Parameter |
| 02h | AdaptiveInputEqEnableTx | Enable Tx adaptive input equalizer | RW | CMIS base Parameter |
| 03h | AdaptiveInputEqRecallTx | Recall stored Tx equalizer adaptation settings | RW | CMIS base Parameter |
| 04h | HostControlledInputEqTargetTx | Host Controlled Tx input equalizer | RW | CMIS base Parameter – Encoded values |
| 05h | CDREnableTx | Tx CDR enable/bypass | RW | CMIS base Parameter |
| 06h | CDREnableRx | Rx CDR enable/bypass | RW | CMIS base Parameter |
| 07h | OutputEqPrePostCursorTargetRx | Rx output equalization pre/post-cursor target | RW | CMIS base Parameter – Encoded values |
| 08h | OutputAmplitudeTargetRx | Rx output amplitude target | RW | CMIS base Parameter – Encoded values |
| 09h | HostControlledInputEqTargetNumericTx | Host-controlled Tx Input equalization – Numeric. | RW | VCS Parameter – Expands 04h (Numeric values) |
| 0Ah | OutputEqTargetNumericRx | Rx Output Equalization Target – Numeric. | RW | VCS Parameter – Expands 07h (Numeric values) |
| 0Bh | OutputPrecodingEnableRx | Enable/disable precoding on Rx output | RW | VCS Parameter |
| 0Ch | InputPrecodingEnableTx | Enable/disable precoding decoder on Tx input | RW | VCS Parameter |
| 0Dh | OutputEqPrePostCursorCoeffRx | Rx output equalizer Pre/Post-cursor coefficient | RW | VCS Parameter – Expands 07h (Per tap control) |
| 0Eh | OutputFineAmplitudeSettingRx | Rx output fine amplitude setting | RW | VCS Parameter – Expands 08h (Finer encoded values) |
| 0Fh | HostChannelLossRx | Host Rx channel loss in dB | RW | VCS Parameter |
| 10h | HostChannelLossTx | Host Tx channel loss in dB | RW | VCS Parameter |
| 11h | NonLinearCompensationTx | Module Non-Linear Compensation | RO | VCS RO Parameter |
| 12h | InputEqPrePostCursorCoeffTx | Tx Input Pre-Equalizer Pre/Post-Cursor Target | RO | VCS RO Parameter |



Implementation Example



Example: Module with 4 AppSels

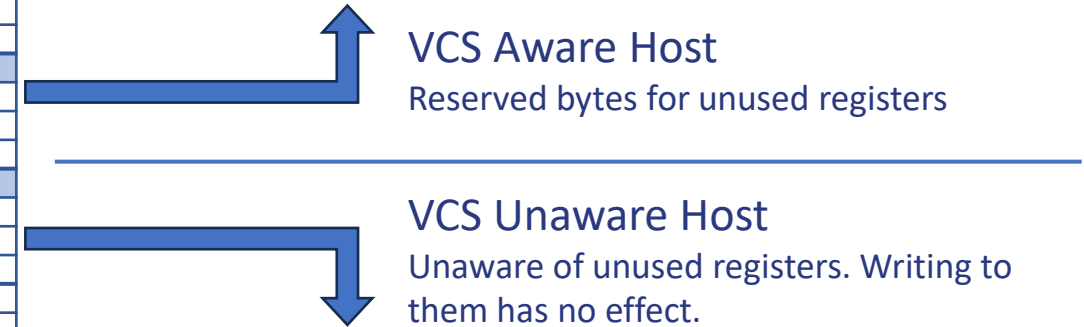


STEP 1 – Read-Write CDB Command Reply

| Read-Write VCS Descriptor CDB Command | Attribute | Value | Comment |
|---------------------------------------|--------------------|-------|--|
| VCS Parameter #1 | ID | 02h | AdaptiveInputEqEnableTx VCS Parameter |
| | Length | 04h | |
| | ApplicationMask | 0Fh | Applies to all AppSels |
| | MemoryLength | 01h | One byte in the Control Set memory Space |
| VCS Parameter #2 | ID | 00h | AdaptiveInputEqRecallTx field, not supported. |
| | Length | 04h | |
| | ApplicationMask | xxh | This attribute is ignored. Value is don't care. |
| | ReservedLength | 02h | AdaptiveInputEqRecallTx would have consumed 2 bytes |
| VCS Parameter #3 | ID | 04h | HostControlledInputEqTargetTx VCS Parameter |
| | Length | 06h | |
| | ApplicationMask | 08h | Applies to CAUI-4 AppSel only |
| | MemoryLength | 04h | Four bytes in the Control Set memory Space |
| VCS Parameter #4 | CodeValueMask | 0004h | 3 rd bit of the mask indicates Code Value = 3 (3dB) |
| | ID | 00h | CDREnableTx field, not supported. |
| | Length | 04h | |
| | ApplicationMask | xxh | This attribute is ignored. Value is don't care. |
| VCS Parameter #5 | ReservedLength | 01h | CDREnableTx would have consumed 1 byte |
| | ID | 00h | CDREnableRx field, not supported. |
| | Length | 04h | |
| | ApplicationMask | xxh | This attribute is ignored. Value is don't care. |
| VCS Parameter #6 | ReservedLength | 01h | CDREnableRx would have consumed 1 byte |
| | ID | 07h | OutputEqPrePostCursorTargetRx VCS Parameter |
| | Length | 07h | |
| | ApplicationMask | 0Fh | Applies to all AppSels |
| VCS Parameter #7 | MemoryLength | 04h | Four bytes in the Control Set memory Space |
| | PrePostCursorIndex | FFh | Pre-cursor C-1 |
| | CodeValueMask | 0002h | 2 nd bit of the mask indicates Code Value = 2 (2dB) |
| | ID | 07h | OutputEqPrePostCursorTargetRx VCS Parameter |
| VCS Parameter #8 | Length | 07h | |
| | ApplicationMask | 0Fh | Applies to all AppSels |
| | MemoryLength | 04h | Four bytes in the Control Set memory Space |
| | CodeValueMask | 0004h | 3 rd bit of the mask indicates Code Value = 3 (3dB) |
| VCS Parameter #8 | ID | 08h | OutputAmplitudeTargetRx VCS Parameter |
| | Length | 06h | |
| | ApplicationMask | 0Fh | Applies to all AppSels |
| | MemoryLength | 04h | Four bytes in the Control Set memory Space |
| VCS Parameter #8 | CodeValueMask | 0007h | Supports Code Values 0, 1, and 2 but not 3 |

STEP 2 – Staged Control Set memory space

| (Page 10h) Byte | Register Description |
|------------------|----------------------------------|
| 153 | AdaptiveInputEqEnableTx<i> |
| 154 - 155 | Reserved |
| 156 - 159 | HostControlledInputEqTargetTx<i> |
| 160 | Reserved |
| 161 | Reserved |
| 162 - 165 | OutputEqPreCursorTargetRx<i> |
| 166 - 169 | OutputEqPostCursorTargetRx<i> |
| 170 - 173 | OutputAmplitudeTargetRx<i> |



| (Page 10h) Byte | Register Description |
|------------------|---|
| 153 | AdaptiveInputEqEnableTx<i> |
| 154 - 155 | AdaptiveInputEqRecallTx<i> |
| 156 - 159 | HostControlledInputEqTargetTx<i> |
| 160 | CDREnableTx<i> |
| 161 | CDREnableRx<i> |
| 162 - 165 | OutputEqPreCursorTargetRx<i> |
| 166 - 169 | OutputEqPostCursorTargetRx<i> |
| 170 - 173 | OutputAmplitudeTargetRx<i> |

STEP 3 – Read-Only CDB Command Reply

VCS Aware Host
Active Control Set populated with RO Parameters



| Read-Only VCS Descriptor CDB Command | Attribute | Value | Comment |
|--------------------------------------|--------------------|-------|---|
| VCS Parameter #1 | ID | 11h | NonLinearCompensationTx VCS Parameter |
| | Length | 04h | |
| | ApplicationMask | 01h | Applies to the first AppSel |
| | MemoryLength | 10h | Sixteen bytes in the Control Set memory Space |
| VCS Parameter #2 | ID | 12h | InputEqPrePostCursorCoeffTx VCS Parameter. |
| | Length | 06h | |
| | ApplicationMask | 01h | Applies to the first AppSel |
| | MemoryLength | 08h | Eight bytes in the Control Set memory Space |
| | PrePostCursorIndex | FFh | Pre-Cursor C-1 |
| | StepSize | 00h | StepSize = 0.01dB |



VCS Unaware Host
No RO Parameters. Active Control Set is the same as the Staged Control Set

STEP 4 – Active Control Set memory space

| (Page 11h) Byte | Register Description |
|-----------------|----------------------------------|
| 214 | AdaptiveInputEqEnableTx<i> |
| 215-216 | Reserved |
| 217-220 | HostControlledInputEqTargetTx<i> |
| 221 | Reserved |
| 222 | Reserved |
| 223-226 | OutputEqPreCursorTargetRx<i> |
| 227-230 | OutputEqPostCursorTargetRx<i> |
| 231-234 | OutputAmplitudeTargetRx<i> |

Need an overflow page (19h) to accommodate RO Parameters

| (Page 19h) Byte | Register Description |
|-----------------|---|
| 152-159 | FixedNLClowTargetTx<i> |
| 160-167 | InputEqPrePostCursorCoeffTx<i> |

| (Page 11h) Byte | Register Description |
|-----------------|---|
| 214 | AdaptiveInputEqEnableTx<i> |
| 215-216 | AdaptiveInputEqRecallTx<i> |
| 217-220 | HostControlledInputEqTargetTx<i> |
| 221 | CDREnableTx<i> |
| 222 | CDREnableRx<i> |
| 223-226 | OutputEqPreCursorTargetRx<i> |
| 227-230 | OutputEqPostCursorTargetRx<i> |
| 231-234 | OutputAmplitudeTargetRx<i> |

Q&A

