

Channel Control Protocol

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Channel Control Principles

- ❑ For backward compatibility, ONUs may need to operate with some of the channels turned off
 - 2nd gen ONU can operate as the 1st gen ONU
 - 3rd gen ONU can operate as either 1st gen or 2nd gen ONU

- ❑ Individual channels also may be turned off
 - To save power
 - To perform diagnostic/maintenance (i.e., rogue ONU detection)
 - For optical protection
 - Other reasons

- ❑ Turning channels on/off means turning OLT/ONU receivers and transmitters on and off

- ❑ **ONU should remember channel state across power cycle event.**
 - If a channel in an ONU has been disabled by NMS, that channel should not get enabled automatically after the ONU power cycle.

Key Features of 100G-EPON Architecture

No dependencies between the numbers of upstream and downstream channels enabled in each ONU



- Channels can be enabled and disabled independently based on traffic load or specific diagnostic/maintenance needs
- EPON's DC/UC bandwidth asymmetry can be changed dynamically

No fixed pairing between downstream and upstream channels



- A GATE arriving on any downstream channel may carry grants for any upstream channels.

No fixed mapping of LLIDs to channels



- Any LLID provisioned at a given ONU may be served by any of the channels enabled in that ONU

Channel Control Protocol Requirements

- ❑ To manage channels in 100G-EPON, the Channel Control Protocol needs to support two operations:
 1. **Querying ONU's channel state**
 2. **Configuring ONU channels**

Each ONU channel can be in one of these states:

- **Absent** (e.g., 50Gb/s ONU does not have channels 2 and 3)
- **Enabled** (channel is operational, i.e., it exists, not failed, and not disabled)
- **Remotely disabled** (i.e., disabled by the NMS)
- **Locally disabled** (i.e., disabled by ONU if PMD failure is imminent)
- **Failed** (i.e., PMD has failed)



To configure a channel, NMS issues one of these commands:

- **Enable Channel**
- **Disable Channel**

- ❑ Channel Control Protocol generally needs 4 messages:
 - **QUERY** – NMS queries ONU for the state of each channel.
 - **QUERY_RESPONSE** – ONU inform NMS of the state of each channel.
 - **CONFIG** – NMS configures one or more channels in the ONU.
 - **CONFIG_RESPONSE** – ONU informs NMS of the result of the last CONFIG command (and optionally, the new state of each channel).





- ❑ It is much more efficient to query/configure all eight channels (four downstream + four upstream) using one message than it is to use a separate message for each channel
 - One message exchange vs. eight message exchanges

- ❑ In eOAM, in situations like this, it is common to use a single read/write attribute with 4 OAMPDU types:

- QUERY  GetRequest
- QUERY_RESPONSE  GetResponse
- CONFIG  SetRequest
- CONFIG_RESPONSE  SetResponse

- ❑ Dozens of ONU capabilities are controlled this way. Control of ONU's channels is not unique or different.

- ❑ We don't necessarily need to use eOAM. If we define a new MAC Control protocol, we can get by with only two messages

- QUERY  **CC_REQUEST**
- QUERY_RESPONSE  **CC_REQUEST**
- CONFIG  **CC_RESPONSE**
- CONFIG_RESPONSE  **CC_RESPONSE**

Example Specification of Channel Control Protocol

(Using CC_REQUEST and CC_RESPONSE Messages)

CC_REQUEST Message NG → EPON

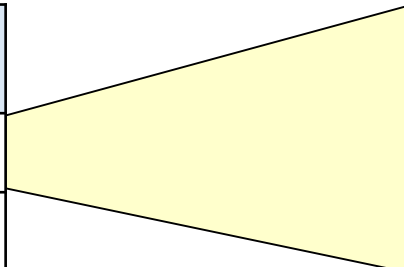
- Without any parameters – Query ONU for states of all channels (i.e., GetRequest)
- With a parameter **ChannelAction[8]** – enable/disable channels as requested (i.e., SetRequest)

ChannelAction Array

Array Index	Channel
0	DC0
1	UC0
2	DC1
3	UC1
4	DC2
5	UC2
6	DC3
7	UC3

ChannelAction Field

Bits	Description
0-7	Channel Action 0x00 – No Action 0x01 – Disable Channel 0x02 – Enable Channel 0x03-0xFF – values reserved



CC_RESPONSE Message

- CC_RESPONSE Message carries an array of 8 **ChannelInfo** fields, each representing one channel.

ChannelInfo Array

Array Index	Channel
0	DC0
1	UC0
2	DC1
3	UC1
4	DC2
5	UC2
6	DC3
7	UC3

ChannelInfo Field

Bits	Description
0-3	Channel Status 0x0 – Channel Absent 0x1 – Enabled 0x2 – Remotely disabled (i.e., disabled by the NMS) 0x3 – Locally disabled (i.e., disabled by ONU if PMD failure is imminent) 0x4 – Channel Failure (i.e., PMD has failed) 0x5-0xF – values reserved
4-7	Action Result Code 0x0 – No Action Requested 0x1 – Action Succeeded 0x2 – Action Failed 0x3 – No Change Required (i.e, the channel is already in the requested state) 0x4 – Invalid Command (i.e., an attempt to turn on a non-existent channel) 0x5-0xF – values reserved

Example a Response to a Query

□ Response to a Query of a 100G/50G ONU

Array Index	Channel	Channel Info Value	Description
0	DC0	0x01	Channel enabled; No action requested
1	UC0	0x01	Channel enabled; No action requested
2	DC1	0x01	Channel enabled; No action requested
3	UC1	0x04	Channel failure; No action requested
4	DC2	0x01	Channel enabled; No action requested
5	UC2	0x00	Channel absent; No action requested
6	DC3	0x02	Channel disabled remotely; No action requested
7	UC3	0x00	Channel absent; No action requested

Example Request and Response

- Request to and Response from a 100G/50G ONU.

Initial Channel State

Array Index	Ch	ChInfo Value	Description
0	DC0	0x01	Channel enabled
1	UC0	0x01	Channel enabled
2	DC1	0x01	Channel enabled
3	UC1	0x04	Channel failure
4	DC2	0x01	Channel enabled
5	UC2	0x00	Channel absent
6	DC3	0x02	Channel disabled remotely
7	UC3	0x00	Channel absent

CC_REQUEST Message

ChAction Value	Description
0x01	Enable channel
0x01	Enable channel
0x00	No action
0x02	Disable channel
0x02	Disable channel
0x01	Enable channel
0x02	Disable channel
0x02	Disable channel

CC_RESPONSE Message

ChInfo Value	Description
0x31	Channel enabled; No change required
0x31	Channel enabled; No change required
0x01	Channel enabled; No action requested
0x24	Channel failure; Action failed
0x12	Channel disabled remotely; Action succeeded
0x40	Channel absent; Invalid command
0x32	Channel disabled remotely; No change required
0x40	Channel absent; Invalid command

Channel State Transition Matrix

- Shows channel state change for any initial state and any received command

Received Command

		Received Command		
		0x00 No action	0x01 Disable channel	0x02 Enable channel
Initial Channel State	0x0 Channel absent	0x00 Channel absent; No action requested.	0x40 Channel absent; Invalid command.	0x40 Channel absent; Invalid command.
	0x1 Channel enabled	0x01 Channel enabled; No action requested.	0x12 Channel disabled remotely; Action succeeded.	0x31 Channel enabled; No change required.
	0x2 Remotely disabled	0x02 Channel disabled remotely; No action requested.	0x32 Channel disabled remotely; No change required.	0x11 Channel enabled; Action succeeded.
	0x3 Locally disabled	0x03 Channel disabled locally; No action requested.	0x12 Channel disabled remotely; Action succeeded.	0x11 Channel enabled; Action succeeded.
	0x4 Channel Failure	0x04 Channel failure; No action requested.	0x24 Channel failure; Action failed.	0x24 Channel failure; Action failed.

Thank You