Maintenance Channel message format for "Remote CMIS" capability

Jose Galan, Sridhar Ramesh - MaxLinear

Vasu Parthasarathy, Rajesh Satapathy, JW Lee - Broadcom

Adee Ran - Cisco

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Introduction

- Supporting an in-band maintenance channel (MC) in 400GPL can be a new good tool for link monitoring and maintenance for Ethernet links
- The Common Management Interface Specification (CMIS) defines a generic management communication interface together with a generic management interaction protocol between hosts and managed modules
- CMIS itself is not an in-band protocol. CMIS defines the management model and register/semantics, but the standard transport is a local host-to-module interface (typically I^2C)
- This presentation shows how to transport of CMIS messages via in-band MC and how to read/write CMIS registers remotely

Maintenance channel using AMs

- **The idea that link between two PMAs can use the AM bandwidth for an in-band maintenance channel (MC) was discussed in previous meetings**
  - See presentation by Adee in last IEEE 802.3 September meeting (next slide): https://www.ieee802.org/3/400GPL/public/2609/ran_400GPL_01_2609.pdf

Maintenance channel using AMs

- The number of AMs per physical lane varies as shown in the table.

PHY type	400GBASE-R		800GBASE-R		1.6TBASE-R	
Number of AMs	16		32		16	
Time between AM groups [1]	~105 µs		~105 µs		~105 µs	
SerDes rate [2]	400G	200G	400G	200G	400G	200G
# of PMA lanes	1	2	2	4	4	8
AM group size per PMA lane	16	8	16	8	4	2
Message bytes per PMA lane	144	72	144	72	36	18

[1] See gustlin_3dj_01b_230206, page 10

[2] 200G/lane PMAs are likely out of scope for 802.3dv

The minimum message size is 36 bytes per lane for 400GPL PMAs. Depending on PHY type, longer messages can be used.

9 bytes available per AM per PMAL

Remot/In-band access to CMIS

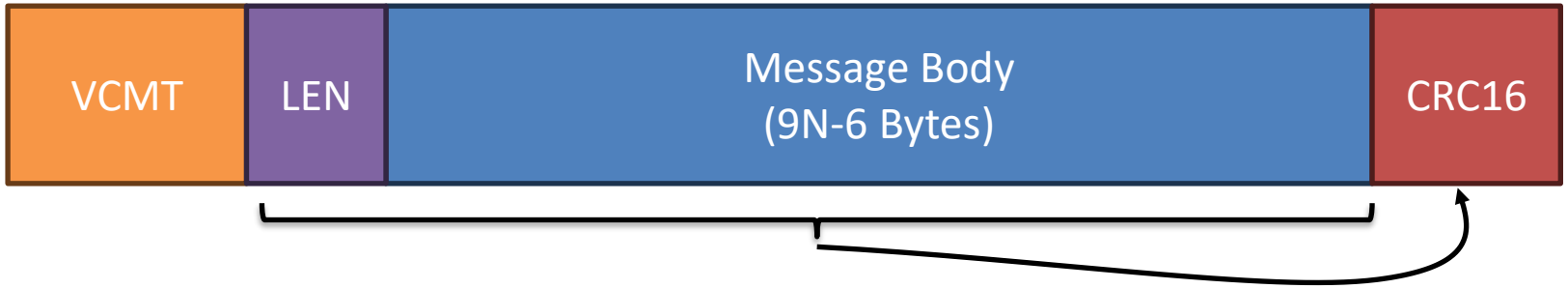
- **CMIS commands are exchanged directly between host and module locally**
- **But, if an in-band maintenance channel (MC) is implemented, then:**
- **The management application in one node can create a CMIS request message such as:**
  - Example: READ_CMIS_Register(module=2, #params)
- **The maintenance channel transports the CMIS request as payload in the MC**
- **The remote node reads this message, and sends the results back also in the payload of the MC**
  - Minimum message size is 36 bytes for 400GPL PMAs
  - Longer messages can be used, depending on PHY type

Proposed MC message format (See *ran_3dv_01_2611*)

Octet index	Content	Details	Initial application
2:0	Virtual clock + Message type (VCMT) [1]	1 octet repeated 3 times Bit 7: outgoing message toggle Bit 6: incoming message toggle Bit 5: incoming message acknowledge Bits 4:0: outgoing message type	Type=0: MC internal messages Type=1: Transmitter adjustment Type=2: Remote CMIS request/response Type=3: Time synchronization Type=4-31: reserved (ignore on receipt)
3	Length	1 octet	For Type 0, 1,3 (single-block message) : 0 Can be used to enable multi-block messages (e.g. Type 2)
(9N-3):4	Message Body	9N-6 [2] message octets, interpreted per message type	For type 1: based on Annex 178B E1 format • Coefficient select • Coefficient request • Coefficient select echo • Coefficient status For other types: see other contributions
(9N-1):(9N-2)	CRC16[1]		

[1] See details in presentation '*ran_3dv_01_2611*' of IEEE 802.3 Plenary meeting Bangkok November 2026
[2] N is the number of PCSLs in the PMA lane: 16 for 400G/800G, 4 for 1.6T

Proposed message-block format (cont'd)



- **For 1.6T, N=4, minimum message body is 30 bytes**
- **CRC16 is calculated on the preceding 9N-5 (31 or 139) octets (LEN+Message body), then appended**
  - Does not change between repetitions of the same message block
  - Serves as message integrity check, ensuring reliability of MC messages
- **Uses the CRC-16-CCITT generator polynomial $x^{16} + x^{12} + x^5 + 1$ (0x1021)**
- **Receiver can use CRC16 to skip comparing multiple repetitions**
  - If CRC matches, no need to wait
  - CRC failure indicates errors in reception (receiver should wait for the next repetition)

In-band MC with a min payload of 30 bytes

- CMIS register reads/writes are very small
- CMIS CDB commands are variable sized
- VDM/DDM telemetry values are typically a few bytes
- Firmware downloads require fragmentation

Carry Raw CMIS register operations

- **A 30-byte message is more than sufficient**
- **#param Example:**
  - LineMask 1 byte
  - Opcode 1 byte
  - Page 1 byte
  - Bank 1 byte
  - Offset 2 bytes
  - Length 2 bytes
  - Data 0..22 bytes
- **LineMask bit-map field to identify the lane of interest**
  - Bit0=Lane1, …, Bit7=Lane8
- **With this, the following (and more) CMIS messages can be transported:**
  - Temperature, Voltage, RX power, TX power, Bias current, Alarm bits, Module state, Application select, Laser controls, …

Carry CDB requests

- **A basic CDB header is only 8 bytes:**
  - Command ID 2,
  - EPL Length 2,
  - LPL Length 1,
  - Check Code 1,
  - Reserved 2
- **Remaining is 14 bytes for carrying CDB without fragmentation**
- **This is enough for many commands:**
  - Query Status (0x0000)
  - Module Features (0x0040)
  - Firmware Features (0x0041)
  - Many diagnostic control commands
- **But not large replies, large replies require fragmentation**

Carry DDM responses

- **DDM responses are 16 bytes**
  - Metric ID 2 bytes
  - Timestamp 4 bytes
  - Temperature 2 bytes
  - Voltage 2 bytes
  - Rx Power 2 bytes
  - Tx Power 2 bytes
  - Tx Bias 2 bytes
- **A single 22-byte maintenance message could easily transport a complete DDM snapshot**

Carry VDM metrics

- **A metric is usually 7 bytes**
  - Metric ID 2 bytes,
  - Units 1 byte,
  - Value 4 bytes
- **Examples: OSNR, Pre-FEC BER, Post-FEC BER, CD …**
- **Transport 3 VDM metrics in one 22-byte message**

CMIS requests messages (TBD)

- **Example:**
  - Opcode 0x01 Read Register
  - Opcode 0x02 Write Register
  - Opcode 0x03 Execute CDB
  - Opcode 0x04 Read CDB Reply
  - Opcode 0x05 Read DDM Snapshot
  - Opcode 0x06 Read VDM Metrics

Currently undefined

- **Firmware download blocks, can be larger than 22 bytes**

Summary

- **Simple and extensible format for transport of CMIS messages is presented**
- **Potential to enable Remote-CMIS (R-CMIS)**