40G Serial Module Technical Requirements

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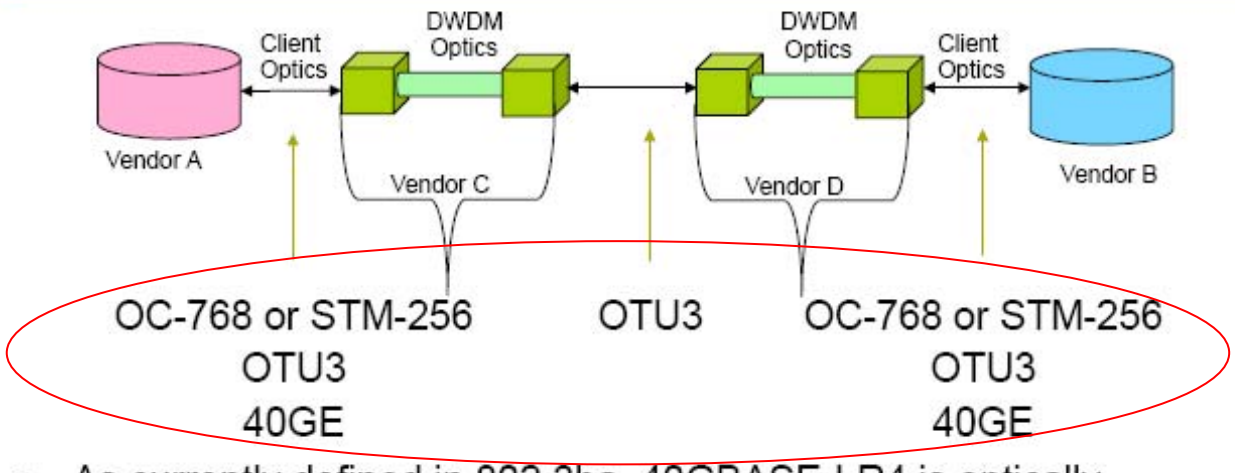
40Gb/s Ethernet Single-mode Fibre PMD Study Group

Content

- 40G tri-rate module
- Optical interface to 40G serial module
- Electrical interface to 40G serial module

40G serial module requirement

Carrier 40G Network Architecture



- As currently defined in 802.3ba, 40GBASE-LR4 is optically incompatible with installed base preventing development of a single multi-protocol 40G module (ex. CFP) that supports 40GE and the installed base of OC-768 or STM-256, and OTU3 services.
- This has significant cost implications for carrier networks.
- A single multi-protocol 40G module optimized for central office reach* benefits carriers immensely and enables efficient increase in the global Ethernet footprint and penetration.

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* Common reach for client interfaces in carrier networks is 2km

A single module may support Ethernet/POS/OTN interface, and be compatible with existing applications

40GE SMF PMD CFI Material

Common Optical Interface

- **The module supports three kinds of services (Ethernet/SDH/OTN)**
  - 40GE is defined in IEEE802.3ba, the bit rate is **41.25**Gbps
  - STM256 is defined in ITU-T G.707,the bit rate is approximately **39.81**Gbps
  - OTU3 is defined in ITU-T G.709,the bit rate is approximately **43.108**Gbps
  - OTU3e2 is defined in ITU-T Sup.43, the bit rate is approximately **44.58**Gbps
  - The tri-rate module is a multi-rate module, and supports 39~45Gbps
  - The O/E devices (laser diode, laser driver, modulator, PD) in 40G serial module must match these bit rates.

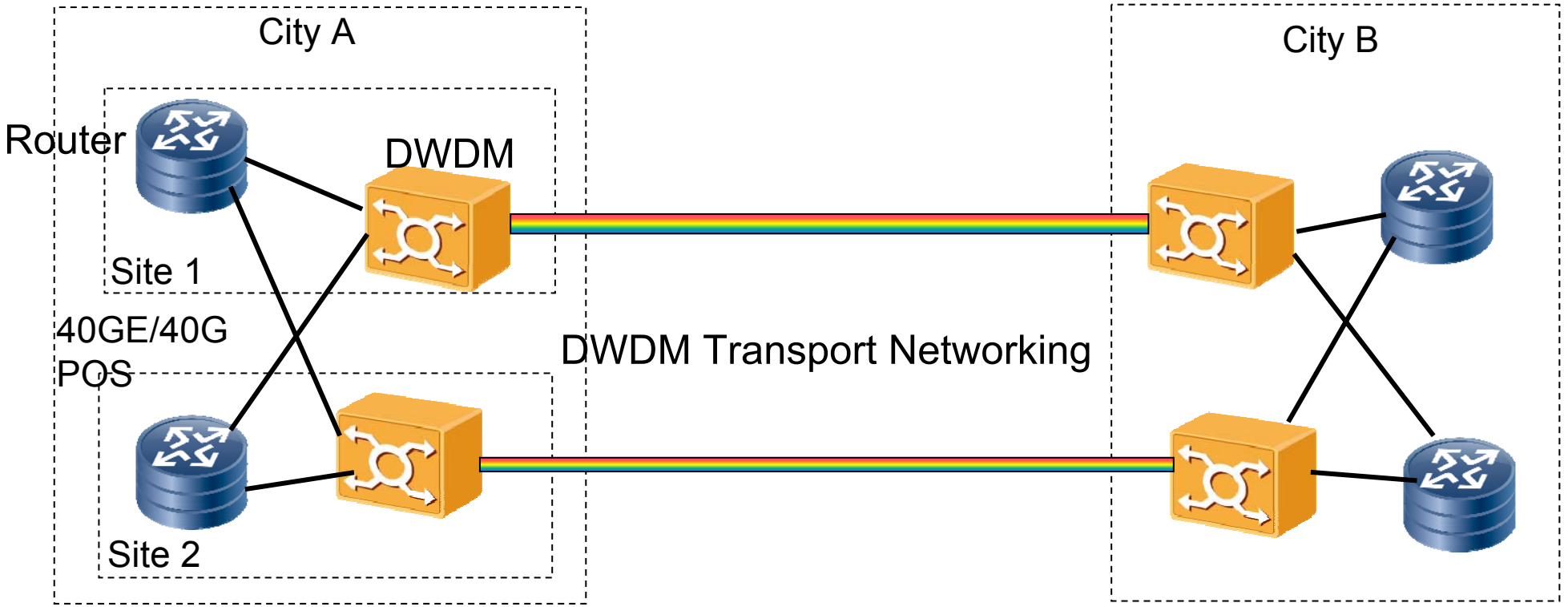
- **The operation parameters of 40G optical interface are shared by these three kinds of service**
  - In ITU-T G.959.1 and G.693, NRZ 40G is defined for intra-office applications
  - P1I1-3D1 is defined for 1310nm 10km application
  - VSR2000-3R1 is defined for 1310nm 2km application
  - VSR2000-3R2 is defined for 1550nm 2km application

The optical parameters in ITU-T standard

	VSR2000-3R2 (1550nm)	VSR2000-3R1 (1310nm)	P1I1-3D1 (1310nm)
Wavelength	1530-1565	1290 - 1330	1307 - 1317
Pout	+3 to 0	+3 to 0	+4 to 0
ER	8.2	8.2	8.2
Psens	-6	-5	-7
Distance	2km	2km	10km
Attenuation	4	4	6
Penalty	2	1	1
Document	G.693	G.693	G.959.1

VSR2000-3R2 is mainly deployed to 40G serial module in currently.
The distance target of P1I1-3D1 matches the 40GE objective of IEEE802.3ba

The objective of 40GE distance



Due to service protection, Routers connect to DWDM equipments with dual-homing configuration

- The distance of intra site connected is less than 2km
- The distance of between two sites connected will be more than 2km, and 10km is appropriate requirement

That is a requirement from China Telecom, If defined 40GE serial interface, 10km objective distance should be considered.

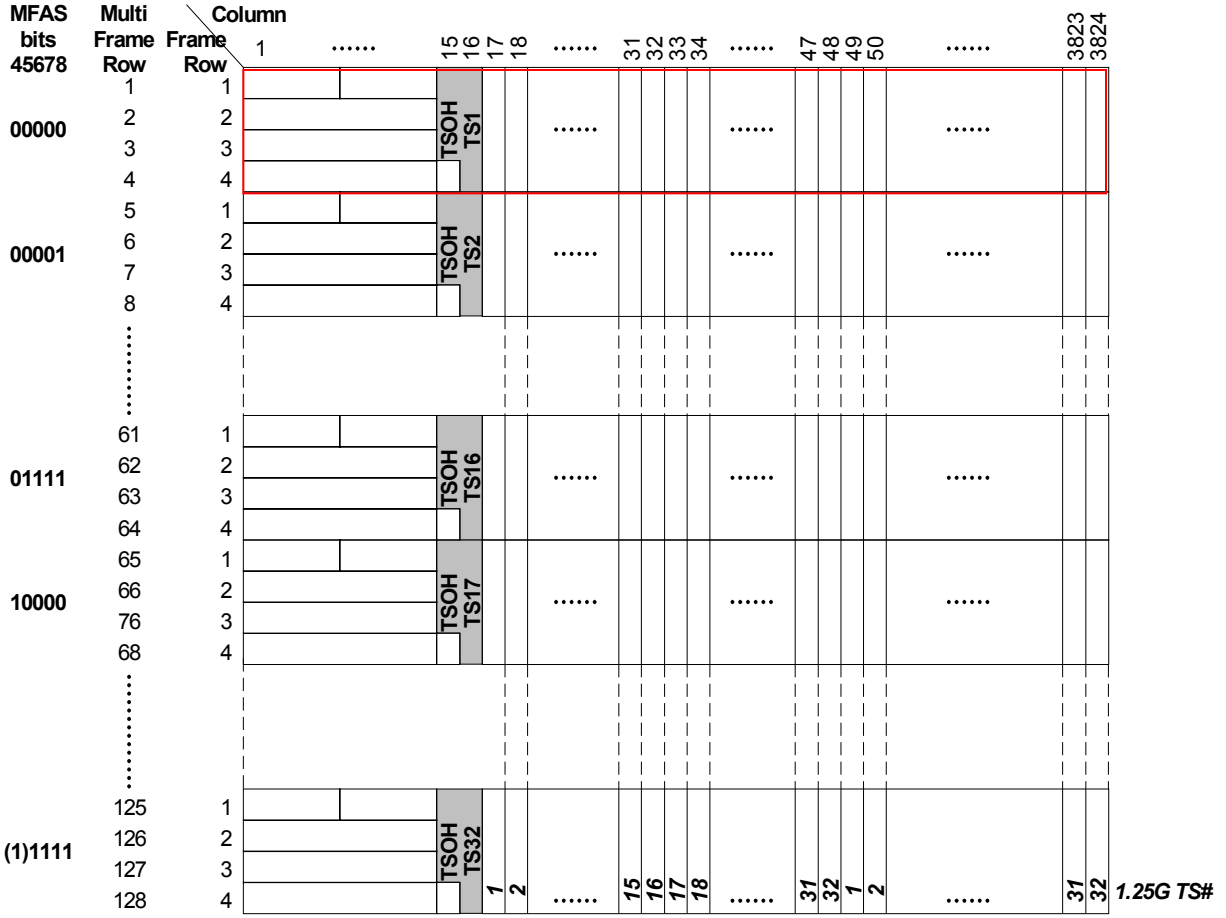
OTU3e2 Introduction

OTU3e2 Bit rate

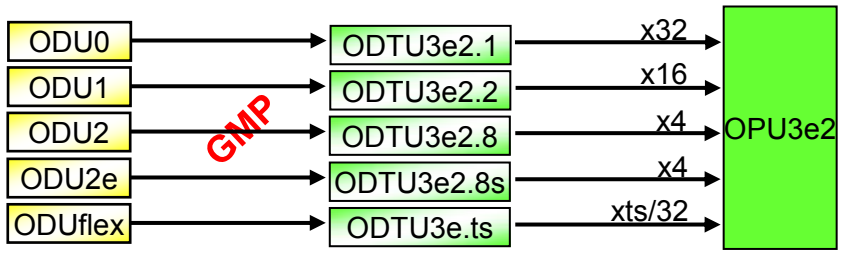
Signal type	nominal bit rate	tolerance
OTU3e2	243/217 x 16 x 2.488320Gbit/s	±20 ppm
ODU3e2	239/255 x 243/217 x 16 x 2.488320Gbit/s	±20 ppm
OPU3e2	238/255 x 243/217 x 16 x 2.488320Gbit/s	±20 ppm
ODTU3e2.ts	ts × 119/3824 × ODU3e2 bit rate	±20 ppm

- **OTU3e2 bit rate is approximately 44 583 355.576 kbit/s**
- **32 Tributary Slots (TS) of approximately 1.25 Gbit/s are interleaved within the OPU3e2**
- **The structure (TS) can support ODUj multiplexing into OPU3e2, and thus supporting many low speed services over optical transport system**

ODTU3e.ts

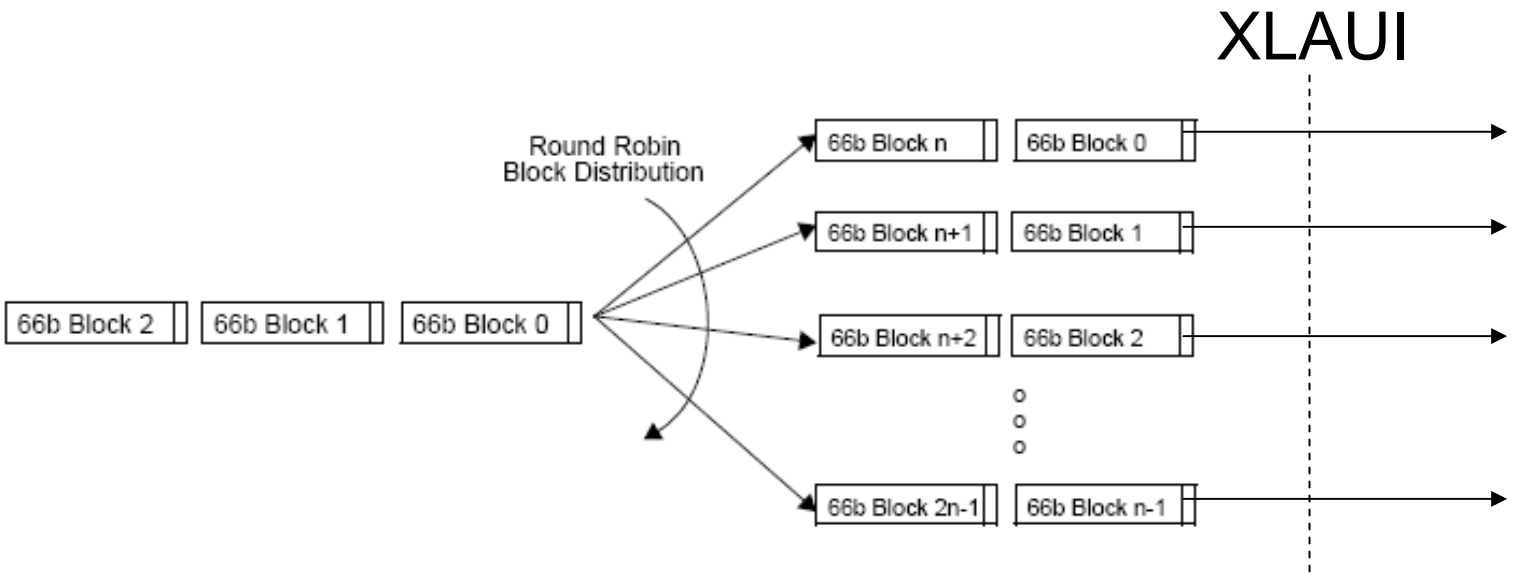


Mapping/ Multiplexing



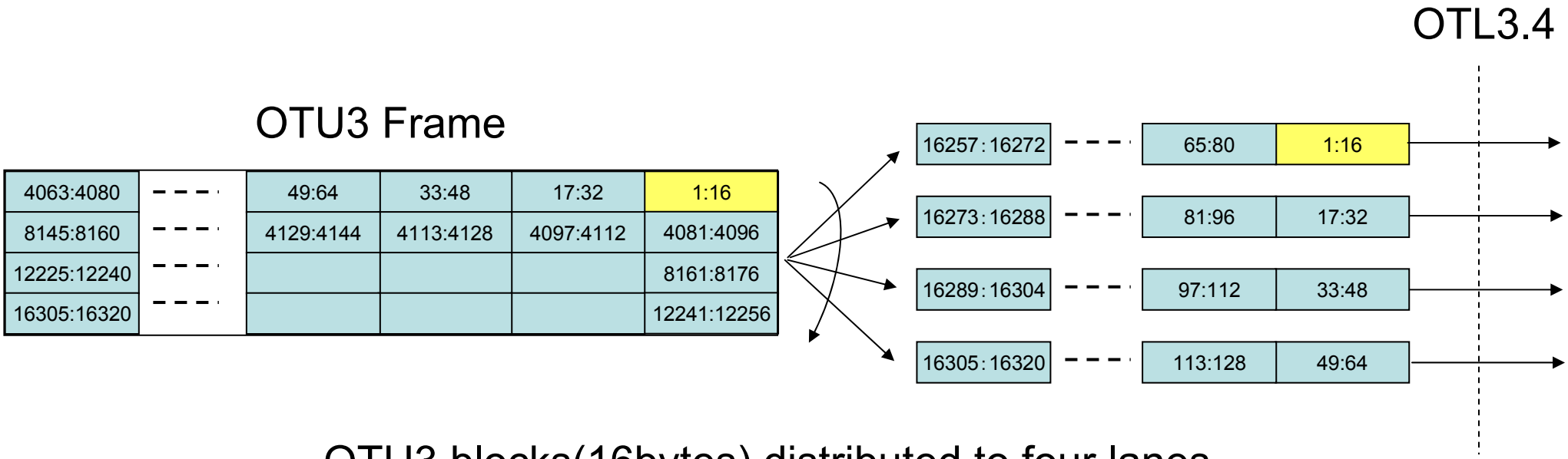
Common Electrical Interface

- **MLD mechanism has been defined in these three kinds of services**
  - 40GE is defined as XLAUI in IEEE802.3,
  - STM-256 is STL256.4, and OTU3 is defined as OTL3.4 in G.709
  - The electrical interface is 4*10Gbps



40GE Block distribution to four lanes

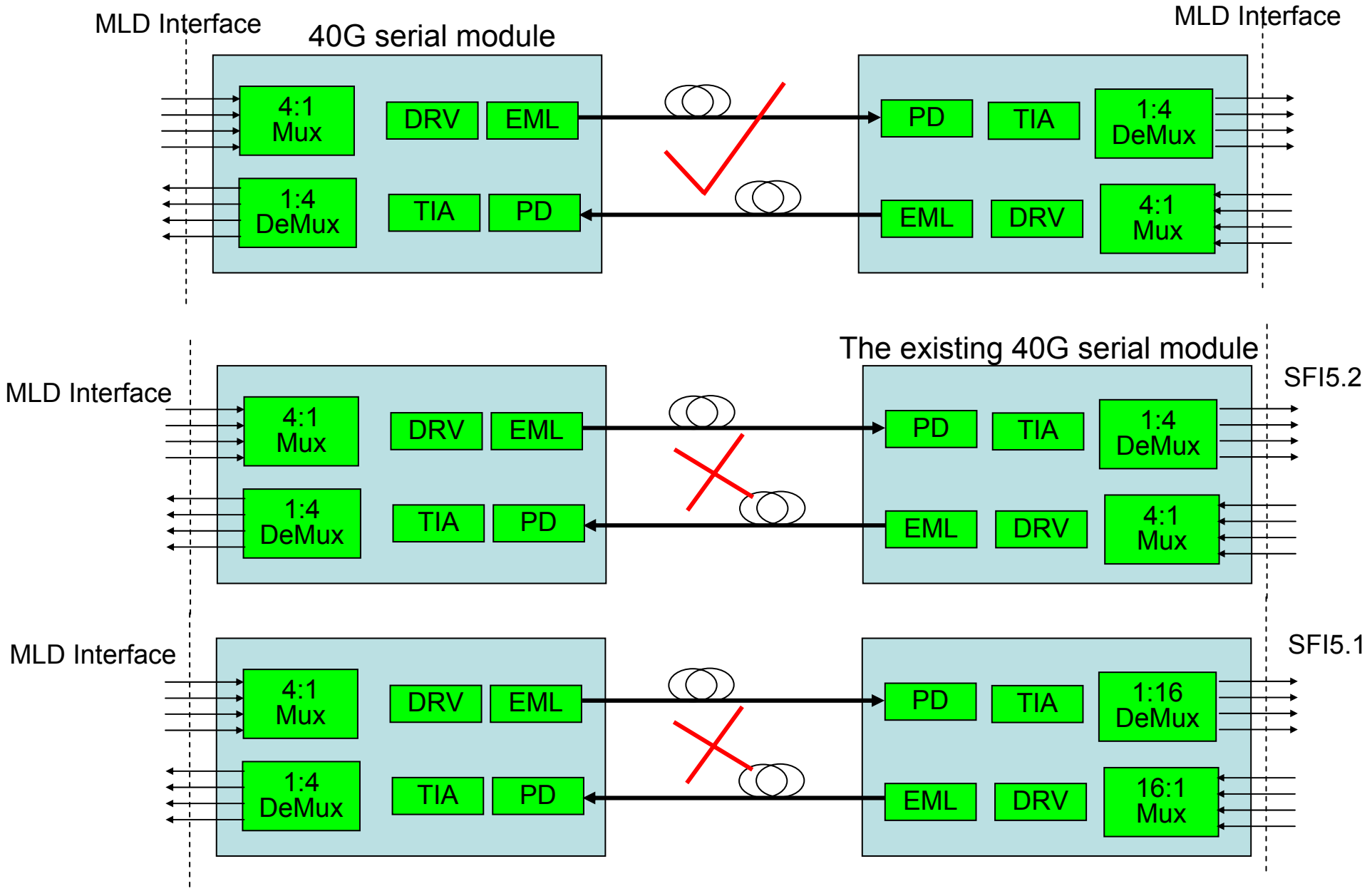
OTL3.4 Interface



OTU3 blocks(16bytes) distributed to four lanes

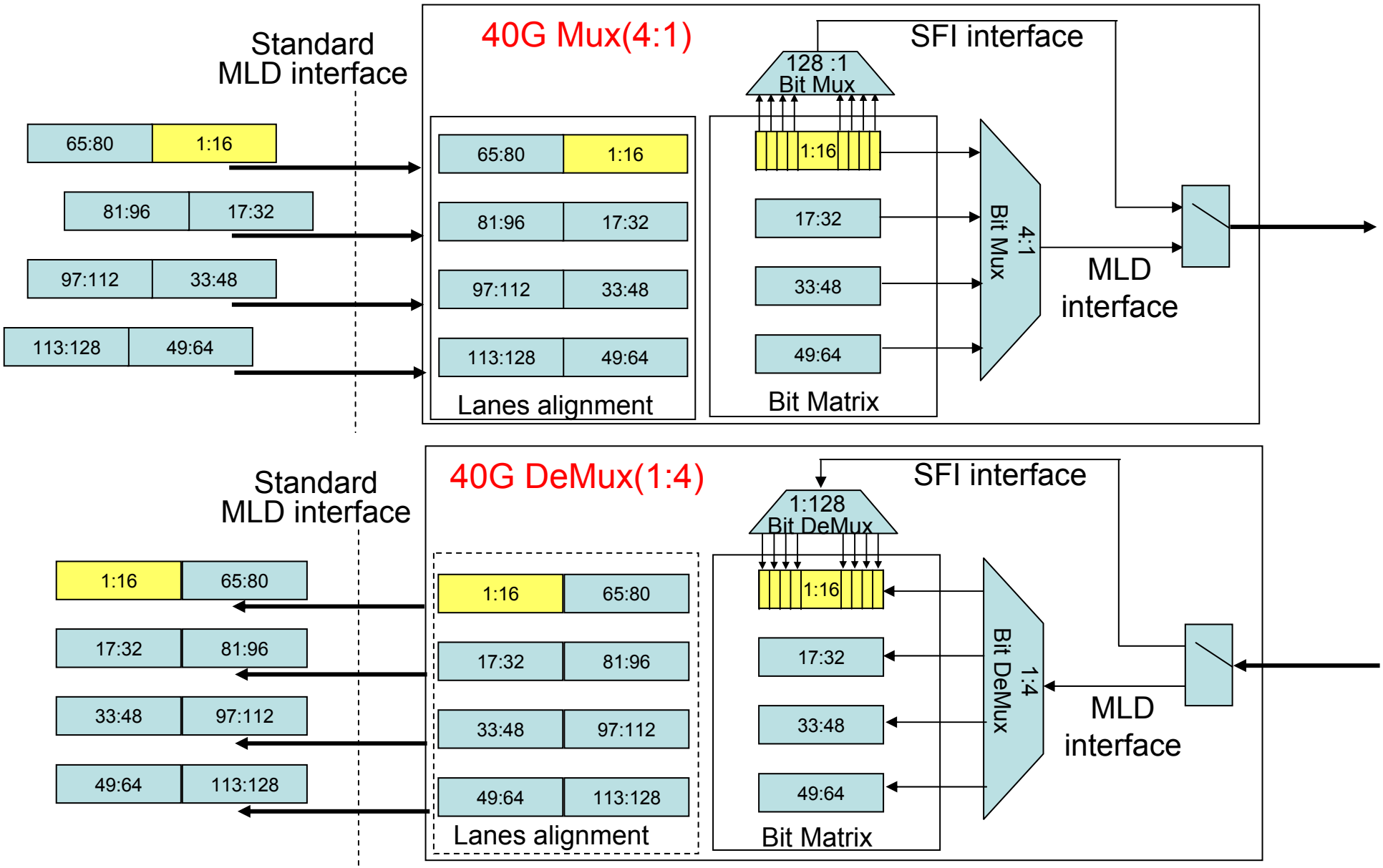
- OTU3 frame is 4080x4 bytes
- OTU3 frame is distributed in 16-byte incremental step sequence, round robin, to each of the four physical lanes.
- The first 16-byte block allows to identify a particular lane
- At the OTU3 frame boundary, the lane assignments are rotated, which will place the first 16 bytes of the OTU3 frame on each lane once per framer
- OTU3 striped across four physical lanes of the interface is OTL3.4, each lane bit rate is about 10Gbps

Compatibility with existing applications



Block muxing interface does not inter-operate with bit muxing interface !!

40G Mux/DeMux to Support Interface Conversion



Bit Matrix (4*128bit), two operation modes: 1) To MLD interface, bits read from row; 2) To SFI interface, bits read from column

Suggestion

- Common optical interface to 40G multi-rate module
  - **To match bit rate from 39Gbps to 45Gbps**
  - **Common operation parameters of optical interface for multi-rate module**

- Common electrical interface to 40G multi-rate module
  - **Select MLD standard interface (4*10G) for 40G serial module**
  - **Mux/DeMux providing block-mux to bit-mux conversion**

- 40Gb/s Ethernet Single-mode Fibre PMD Study Group
  - **An IEEE 802.3 Ethernet 40Gb/s serial PHY provides optical compatibility with existing carrier 40Gb/s client interfaces and potential 40Gb/s client interfaces (e.g., OTU3/OTU3e2/STM-256/OC-768/40G POS).**

Thanks

- **Below people provided valuable suggestions and comments**
  - Li JunJie (China Telecom)
  - Song QuanShang (Semtech)
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  - Wenbin Jiang
  - ……

Thank You