What is Flexible Ethernet (FlexE)

• FlexE refers to a generic mechanism defined in OIF-FLEXE-01.0 implementation agreement for supporting a variety of Ethernet MAC rates e.g.:
  – 200G MAC through bonding of 100GBASE-R PHYs
  – sub-rate of 50G MAC over a 100GBASE-R PHY

• The FlexE group refers to a group of from 1 to 254 bonded 100G Ethernet PHYs

• FlexE utilizes the FlexE group framework to provide the aforementioned flexible MAC rates
FlexE Client MAC Rates

- **FlexE Client MAC Rate Support**
  - 10G, 40G, m x 25G

- **FlexE Client MAC Rates Configurations**
  - Super rate of bonded 100G Ethernet PHYs
  - Sub rate of bonded 100G Ethernet PHYs
  - Channelization within bonded 100G Ethernet PHYs
  - Sub rate of a single 100G Ethernet PHY
  - Channelization within a single 100G Ethernet PHY
FlexE Mux Functions

Standard Ethernet Stack
- Media Access Control (MAC)
- Physical Coding Sublayer (PCS)
- Physical Medium Attachment (PMA)
- Physical Medium Dependent (PMD)

FlexE Stack
- Media Access Control (MAC)
- FlexE Shim Layer
- Physical Coding Sublayer (PCS)
- Physical Medium Attachment (PMA)
- Physical Medium Dependent (PMD)

Client MAC Rate
- 10G or 40G or mx 25G

FlexE Mux
- Idle insertion for rate adaption
- LF
- FlexE Client Rate = 66/64 x FlexE Client MAC Rate
- Client 66B block distribution to master calendar and per PHY sub-calendar

Decoupling of MAC rates and PHY rates

Each FlexE client has its own separate MAC and Reconciliation Sublayer (RS)

PHY (100G)
FlexE Calendar Scheduler

Client MAC Rate to Master Calendar Slot Mapping

Logical Length of the Master Calendar for a FlexE Group Containing n 100G PHYs = 20 x n

Master Calendar Size = 20xn slots

PHY n ---- PHY 3 ---- PHY 2 ---- PHY 1
Slot 19 Slot 18

Round Robin Scheduling per PHY Sub-calender

FlexE Group Size = n

Per PHY Sub-calendar Size = 20 slots

Slot Granularity = 5G

Slot 19 (Last)

Transmission Order

Slot 0 (First)
The FlexE mux to the FlexE demux info exceeds the 24 bits available in a single ordered set block per PHY. Therefore, it is spread across 8 FlexE blocks on each PHY, each separated by $20 \times 1023$ FlexE data blocks.
Calendar Configuration Example Scenario 1

1. Program the new client slot assignment into the calendar currently not in use

Start a timer

2. Calendar switch Request (CR)

CA received prior to timer expiration

Calendar Switch Acknowledge (CA)

3. CA not received prior to timer expiration

4. Indicate change to new calendar

5. Raise an alarm or proceed with switch based on locally configured policy
Calendar Configuration Example Scenario 2

1. Program the new client slot assignment into the calendar currently not in use

   Start a timer

   CA received prior to timer expiration

   CA not received prior to timer expiration

2. Calendar switch Request (CR)

3. Calendar Switch Acknowledge (CA)

4. Indicate change to new calendar

5. Raise an alarm or proceed with switch based on locally configured policy
FlexE unaware transport
FlexE Requirements Summary

- Support usecases including FlexE unaware, FlexE aware, and FlexE Termination transport
- Support a flexible mechanism for configuring a FlexE group (e.g., signaling protocol or a SDN controller/management system)
- Support adding/removing a FlexE client to a FlexE group without affecting traffic on other clients
- Support resizing of FlexE client BW through coordination of calendar updates within a single FlexE group