

A YANG Data Model for Flex Ethernet(FlexE)

[draft-xiaobn-flexe-yang-mod-00](#)

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Overview of this Presentation

- This presentation mainly focuses on the FlexE Yang model, and tries to trigger some discussions on what can we do to FlexE technology with IETF control plane mechanisms. The solution for FlexE control discussed in this presentation and yang model draft is somewhat different from that in FlexE framework draft.
- The scope of this work is restricted to the cases described in [OIF FlexE IA 2.0].

Difference between Flexible Ethernet and Traditional Ethernet

- FlexE shim is just a built-in function in the Ethernet PCS. If a FlexE group is set up, a corresponding huge $n * 100\text{G}$ (or $n * 200\text{G}$, $n * 400\text{G}$) PCS module is created as well .
- One of the significant differences between the FlexE and the traditional 40G or 100G Ethernet is that the traditional Ethernet PCS has a 1:1 relationship with the client MAC flow, while FlexE has a more flexible structure, one PCS module can be associated with more than one client MAC flows.

General Control Requirements

- Two general requirements about FlexE may be derived based on the analysis in the previous slide, and these two requirements should be taken care first when using FlexE technology.
 - Configuration of FlexE group
 - Allocation of one FlexE group calendar slot resources to client signals.

Configuration of FlexE group (i.e., huge PCS module)

- One FlexE group must be configured first before any client signals are carried over it. Description about the operations needed can be found in section 7.6 of [OIF FlexE IA 2.0] when configuring FlexE group:
 - “When a new FlexE Group is brought into service, the **initial configuration must be provisioned from both ends, and the initial configuration must be the same.** The group is configured to consist of from 1 to n 100G FlexE Instances carried over from 1 to m PHYs of the same rate (100GBASE-R, 200GBASE-R, or 400GBASE-R).”
- It can be concluded from the above description that external configuration tools should be involved to bring one FlexE group into service. The initial configuration command can come from external management system, SDN controller...

Allocate resources for client signal

- Traffic flow of these FlexE client MAC signals are encapsulated into different FlexE calendar slots. **The question is how to allocate the slots to each FlexE clients? Does control plane need to be involved?**
- Clause 5.2.1.7 and 5.2.2.6 give answer:
 - “The **control function** manages which calendar slots each FlexE client is inserted into and inserts the FlexE overhead on each FlexE PHY in the transmit direction.”
 - “The **control function** manages which calendar slots each FlexE client is extracted from and extract the FlexE overhead from each FlexE PHY in the receive direction.”
- FlexE data plane already defined how to insert/extract the FlexE clients from calendar slots. So no need to use control plane means to deal with this. The conclusion is once a FlexE group is configured, how to use MAC layer resources is the same as that in traditional Ethernet.
- For this point, solution in this presentation is different from that in fwk draft.

What could control plane do?

- Using control mechanisms to configure FlexE group, which may include the configuration of group number, PHY number, FlexE instance number and correlation between logical PHY number and physical port number.
- Aware case may need some care, but never touch the slots.
- Control method should be provided to trigger the switch between A and B calendar configuration.
- Different kinds of alarm should be taken into consideration when modelling FlexE technology, which may include:
 - Parameters for creating FlexE group
 - Command for triggering the switch of calendar slots
 - Different kinds of alarm, which may include PHY failed, skew exceed threshold, inconsistent configuration between two ends...
 - Interworking between 5G slot granularity capable node and 25G slot granularity node.
 - More to be explored...

FlexE model: YANG Tree

```
module: ietf-flexe-yang
  +--rw flexe-configuration
    | +--rw flexe-groups
    | | +--rw flexe-group* [group-name]
    | |   +--rw group-name      string
    | |   +--rw group-attributes
    | |     +--rw group-number?   uint32
    | |     +--rw calendar-slot-granularity?  calendar-slot-granularity
    | |     +--rw flexe-phy-type?  flexe-phy-type
    | |     +--rw bonded-phys
    | |       | +--rw flexe-phys* [phy-number-in-group]
    | |       |   +--rw phy-number-in-group  uint8
    | |       |   +--rw local-phy-number?  uint16
    | |     +--rw flexe-instances
    | |       | +--rw flexe-instance* [flexe-instance-number]
    | |       |   +--rw flexe-instance-number  uint8
    | |       |   +--rw unequipped-flexe-instance* [flexe-instance-number]
    | |       |     +--rw flexe-instance-number  uint8
```

Description of FlexE Group

5G or 25G slot granularity
100G/200G/400GBASE-R

1/2/4 FlexE instances

FlexE model: YANG Tree

	+--rw rx-calendar?	calendar-A or B
	+--rw tx-calendar?	calendar-A or B
	+--rw tx-calendar-neg?	enumeration
	+--rw reply-ca-mode?	enumeration cccc

Calendar configuration A or B

Calendar Ack mode

FlexE model: YANG Tree

```
| +--rw flexe-clients
|   +--rw flexe-client* [client-name]
|     +--rw client-name      string
|     +--rw client-attribute
|       | +--rw client-number? uint32
|       | +--rw bandwidth
|       |   +--rw signal-type? flexe-client-signal-rate
|       |   +--rw mac-rate?   rt-types:bandwidth-ieee-float32
|     +--rw used-flexe-resources
|       +--rw used-rsc* [calendar flexe-group]
|         +--rw calendar      calendar-AorB
|         +--rw flexe-group    string
|         +--rw flexe-instance? uint8
+--ro flexe-group-state
  +--ro port-group
    +--ro port-group* [port-group-id]
      +--ro port-group-id  uint32
      +--ro intf-state?   intf-state c
```

Description of FlexE client

Bandwidth

--Confined to 10G, 40G or m*25G

A or B calendar slot being in use

State of port in FlexE Group

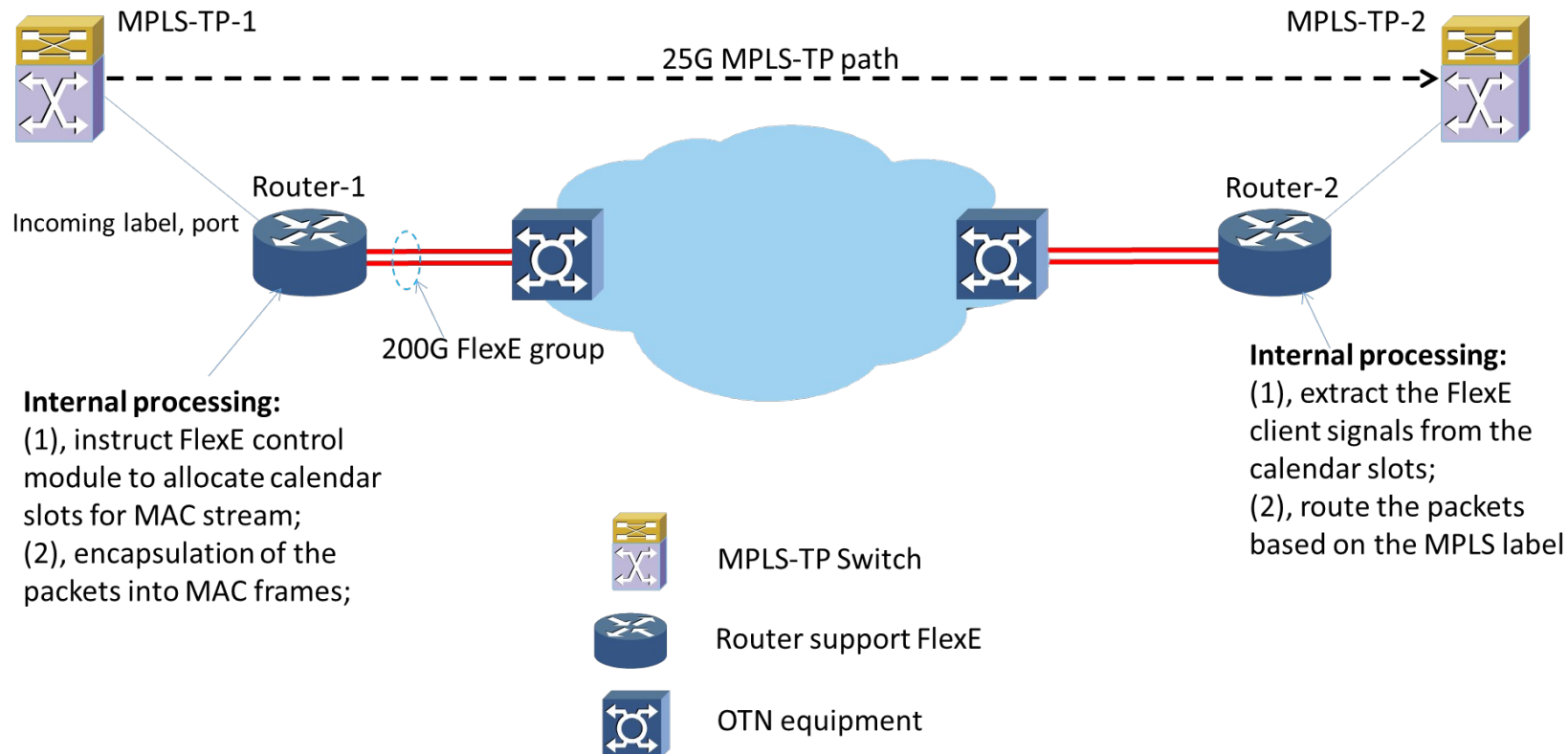
Next steps

- Solicit more feedback from WG
- Continue to update the draft based on the feedback, as the solution proposed in current draft is different from that in the fwk draft. Allocation of slot resources to FlexE client does not to be modelled by external control tools. Data plane can deal with that.

Thanks

Example - FlexE Client Configuration Procedures

- Example below is to set up a 25G MPLS-TP P2P path (from MPLS-TP-1 to MPLS-TP-2) over one FlexE link. This is to help understand why control of FlexE client is not needed. FlexE group is assumed configured.
- Detailed description can be found in the next two slides.

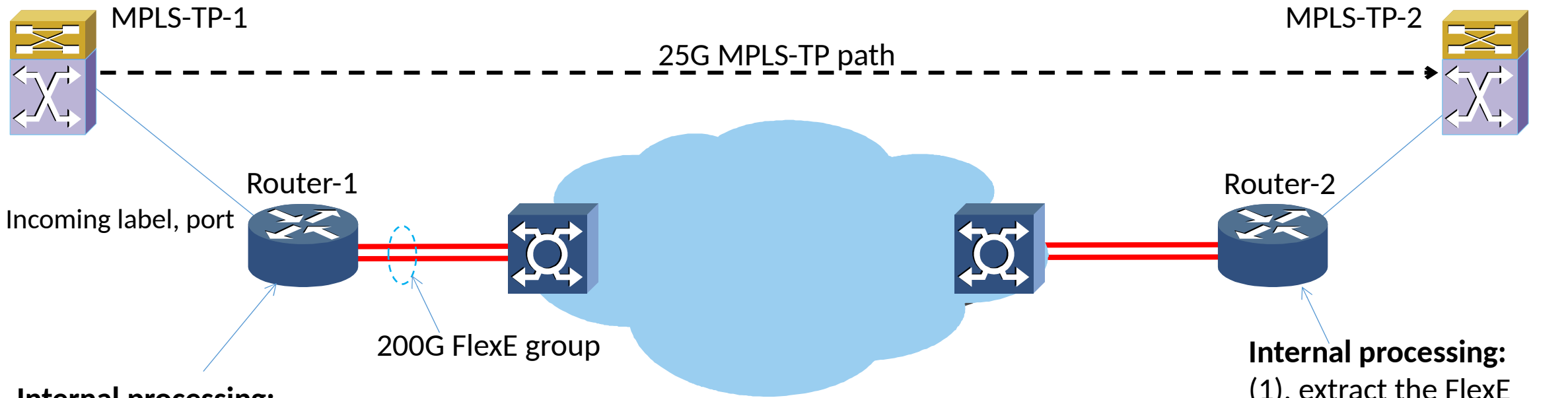


Example - FlexE client Configuration Procedures

- Configuration needed for each node when setting up MPLS-TP path:
 - Outgoing MPLS label and output port, 25G □ MPLS-TP-1;
 - Incoming MPLS label and input port, 25G □ Router-1;
 - MPLS traffic over FlexE link, from Router-1 to Router-2;
 - Outgoing MPLS label and outgoing port, 25G □ Routing-2;
 - Incoming label and input port, 25G □ MPLS-TP-2;

Example - FlexE Client Configuration Procedures

- What else would be done by Router-1 and Router-2 if we want to put MPLS packets over FlexE link?
 - Router-1, perform the commonly used data link (i.e., MAC) encapsulation procedures to transmit the packet to next hop Router-2, which includes:
 - (1), encapsulation of the packets into MAC frames. The source and destination MAC address can be derived by searching Router-1's internal mapping table, i.e., (outgoing label, outgoing port, MAC address) table.
 - (2), in addition, Router-1 would instruct the required bandwidth information from Router-1 to Router-2 to FlexE control module, the FlexE control module then allocates 5*5G calendar slots to the MPLS-TP client signal, and insert FlexE overhead onto each PHY.
 - (3), Router-1's configuration is finished.
 - Router-2's configuration would be different, as its function is to extract the FlexE client signal from the calendar slots according to the information carried in the FlexE overhead and route the packets based on the MPLS label. As there is no switching of calendar slots in FlexE, the calendar slots allocated to certain client signal would not change.
 - **Conclusion: no external configuration tools is needed when put MPLS traffic on FlexE link.**






Internal processing:

- (1), instruct FlexE control module to allocate calendar slots for MAC stream;
- (2), encapsulation of the packets into MAC frames;

Internal processing:

- (1), extract the FlexE client signals from the calendar slots;
- (2), route the packets based on the MPLS label

-  MPLS-TP Switch
-  Router support FlexE
-  OTN equipment