REPORT/GATE FORMAT

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Overview

- EPON defines a physical layer for 1Gbps and 10Gbps.
- EPoC requires more granularity and flexibility to adapt to limited spectrum and low SNR.
- MPCP REPORT and MPCP GATE frames are designed for 1G and 10G data rates with a specified FEC overhead.
- With a flexible data rate, the definition of the REPORT and GATE frames must be altered to support EPoC.
- This presentation proposes a modified definition of the fields in the REPORT and GATE frames to support EPoC Rate Adaption.

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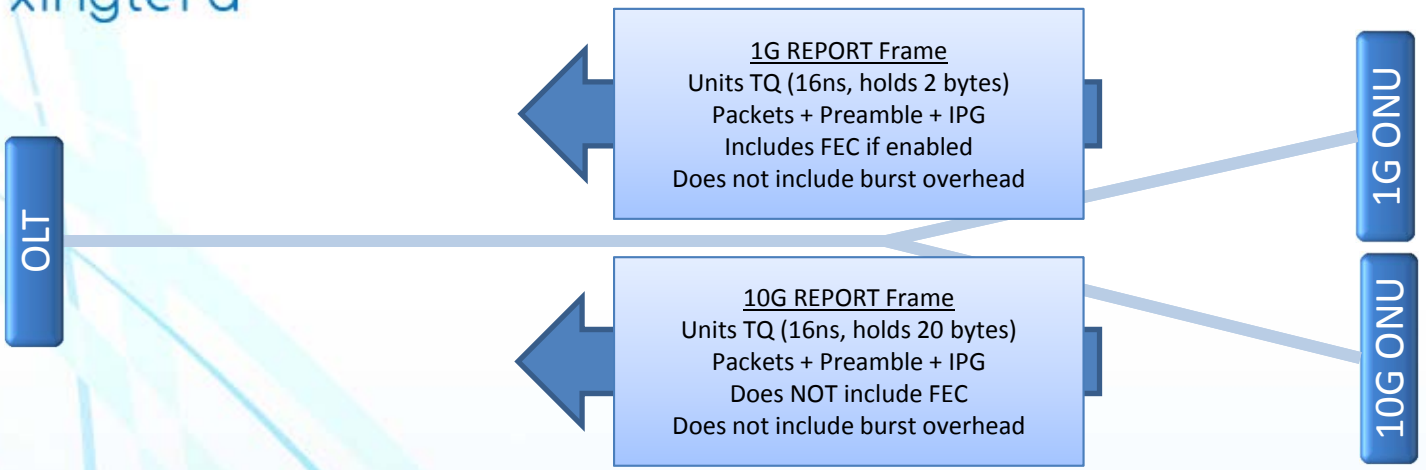
EPoC Rate Adaption

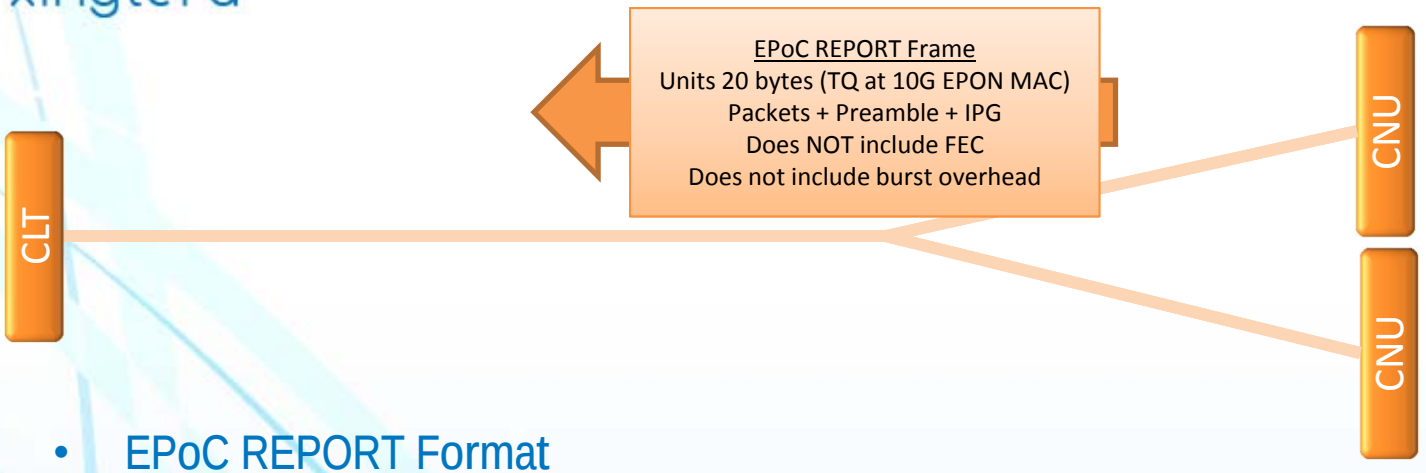
REPORT FRAME DEFINITION

EPON REPORT Format



- 1G EPON uses a per-packet FEC so it is included in the REPORT frame.
  - Without knowing the size of every packet in the upstream FIFO, it is impossible for the OLT to calculate the FEC overhead.
- 10G EPON uses a streaming FEC so it is not included in the REPORT frame.
  - OLT can determine FEC overhead since it is only based on burst size.
  - Queue sets can be combined into large grants if FEC is added at OLT. Fixed block FEC would be too pessimistic if added at ONU and REPORT values were combined. (Round up twice)
- EPoC uses the 10G EPON MAC and FEC is streaming
  - Can we use the 10G EPoC REPORT frame without any changes?

EPoC REPORT Format



- EPoC REPORT Format
  - REPORT frame is generated with the same format and units as 10G EPON.
  - REPORT Time units are referenced to the MAC interface assuming full 10Gbps operation.
    - TQ is NOT the time on the Coax after FEC and sub-rating.
      - NOTE: 10G EPON doesn't match the time on the Fiber since FEC overhead is not included.
    - TQ (20 Bytes) granularity should be adequate for EPoC. (Considering Min Burst Size of 84 Bytes, error is low)
    - REPORT values, range of values, and granularity of values do not change due to sub-rating.
      - Simple CNU and less testing
- Longer Delay EPoC
  - Since the REPORT format supports values up to 20 Bytes*2^16, a 5Gbps upstream could support up to 2ms of PHY delay.

EPoC REPORT frame should be unchanged from 10G EPON

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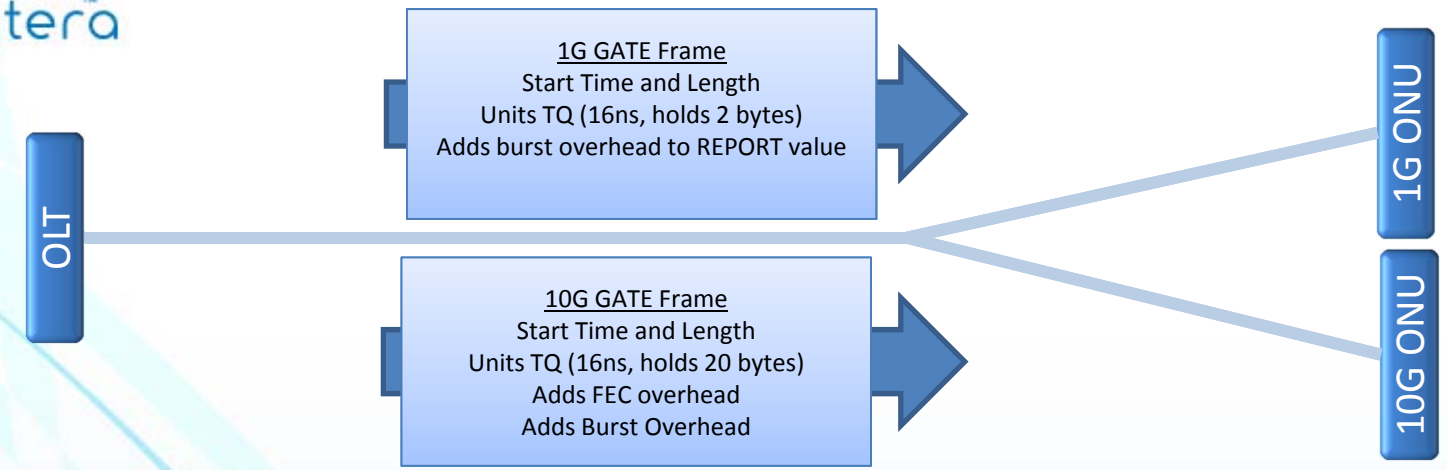
EPoC Rate Adaption

GATE FRAME DEFINITION

EPON GATE Format



- 1G EPON GATE frames
  - The length is generated by adding the optical or burst overhead (sync time and laser ON time) to the REPORT value.
  - The start time for the next GATE is computed by adding the length to the last start time and adding the laser off time. The ranging offset for the CNU is added.
  - The ONU uses the start time to start transmission and removes the burst overhead to determine the amount of MAC layer data to send.
- 10G EPON GATE frames
  - The length is generated by adding the FEC and the optical or burst overhead (sync time and laser ON time) to the REPORT value.
  - The start time for the next GATE is computed by adding the length to the last start time and adding the laser off time. The ranging offset for the CNU is added.
  - The ONU uses the start time to start transmission and removes the FEC/burst overhead to determine the amount of MAC layer data to send.

EPoC GATE Format Options

- Use 10G EPON GATE frame Definition
  - Synctime, Laser ON, and Laser OFF
    - Configurable values so they could be adjusted for EPoC burst overheads.
    - Allowed range of values is likely too small for sub-rated EPoC overheads.
  - FEC Overhead
    - The 223/255 FEC overhead in 10G EPON does not match the proposed LDPC code rate.
    - The 255 byte un-shortened code word size at 10Gbps is not possible for EPoC.
  - Adding a Force REPORT
    - Adding 84 Bytes at 10Gbps will not allow for a REPORT frame to fit into the burst.
  - Sub-rating
    - The OLT would need to increase the GATE size by the sub-rating factor.
- Use EPoC PHY Overheads in GATE frame
  - Change FEC and Burst overhead calculation definition to match EPoC PHY values.
  - REPORT value will be extended for PHY overhead in GATE value.
    - Sub-rating for 10Gbps to 1Gbps will increase REPORT value by 10 times + FEC/Burst Overhead
    - 16 bit REPORT value will be limited since 16 bit GATE value will be out of range.
  - EPoC CNU MAC Control must perform complicated reverse calculation to figure out data needed.

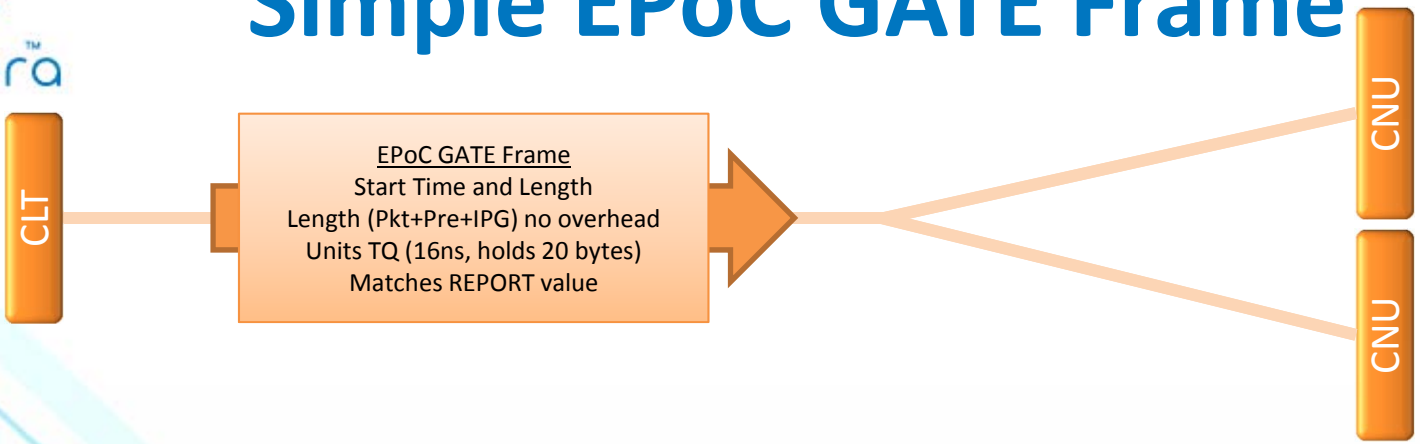
Both of these options are not ideal

Calculating the EPoC Burst Size(Length)

- The CLT must calculate the EPoC burst size to space the start times in the GATEs.
- Here is an early look at the calculation needed
  - Start with the REPORT value.
  - If piggyback REPORT frame needed, add 84 bytes.
  - Divide by maximum FEC block size, and use lookup table for the remainder. Add FEC parity and CRC-40 overhead for each FEC block.
  - Use the bits per symbol time ratio to convert the bytes into time.
  - Add burst overhead for Start/Stop Markers
  - Add fixed amount for time slot jitter and granularity rounding off.

The calculation is too complicated for reverse calculation

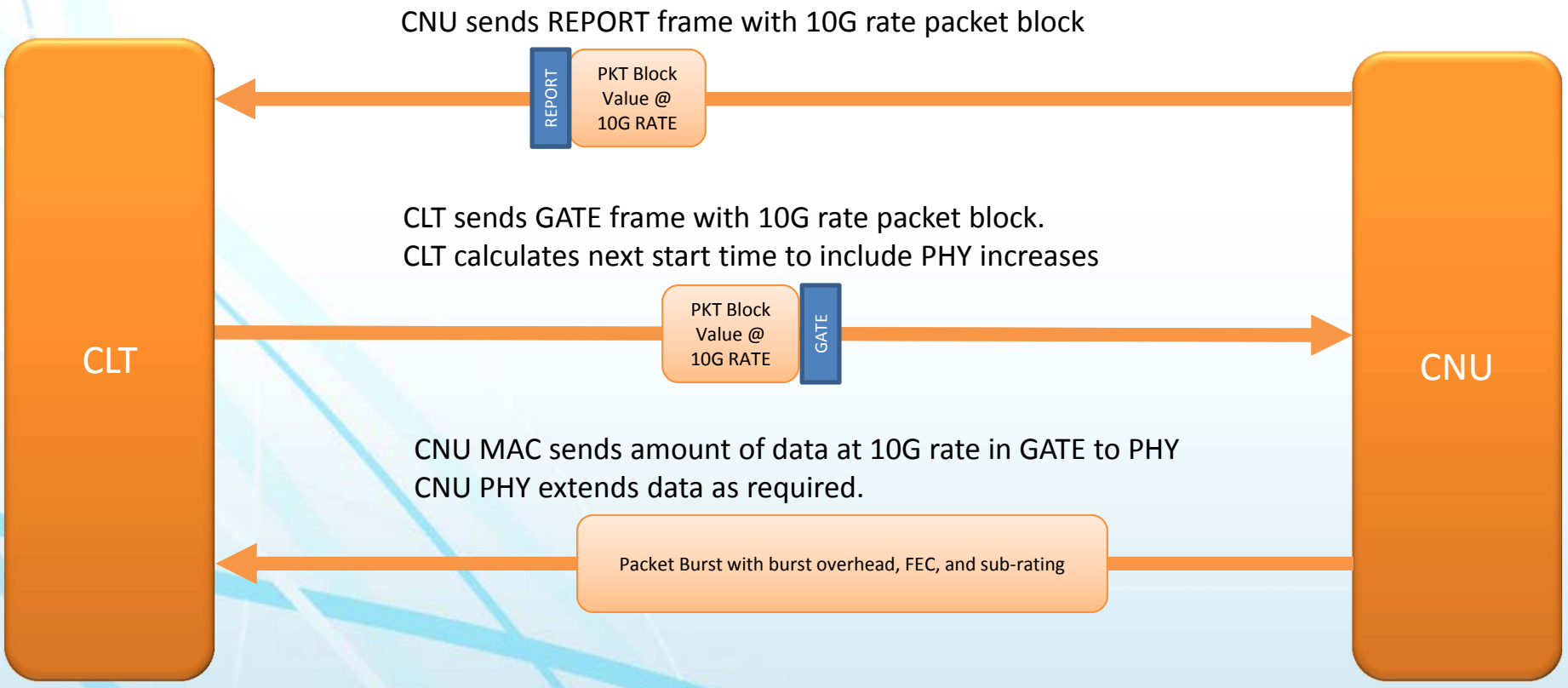
Simple EPoC GATE Frame



- EPoC can be simplified by NOT adding the PHY increases (FEC, burst overhead, and sub-rating) to the GATE frame length field.
- The CLT calculates next start time to include PHY increases (FEC, burst overhead, and sub-rating)
- The GATE frame is going to the Ethernet MAC so it should not include the PHY overhead.
- The CNU is simplified since it is no longer required to reverse calculate the payload from the burst size.
- REPORT and GATE frames will have the same definitions for their values.
- REPORT values won't be expanded beyond the 2^16 GATE frame limit.

EPoC GATE Frame Length should not include PHY overhead

EPoC REPORT to GATE to BURST



Conclusion

- Both REPORT and GATE values should be referenced to the 10Gbps MAC and not the rate of the PHY.
- 10G EPON REPORT Frames should be used without any changes.
- 10G EPON GATE Frame definition for length field should be modified to exclude overhead.
  - Don't use 10G EPON overhead
  - Don't redefine with EPoC overhead
- More work is needed to simplify and finalize the burst size equation.

No Augmentation is Needed for REPORT frame &
A Simplifying Augmentation for GATE frame

Straw Poll

- EPoC REPORT frame value should follow 10G-EPON definition:
  - Referenced to MAC time: 1 TQ is 20 Bytes at MAC Control
  - No PHY Layer overhead (i.e. FEC, sub-rating)

- YES:
- NO:
- ABSTAIN:

Straw Poll

- EPoC GATE Grant Length value should be 10G-EPON definition without PHY overhead:
  - Referenced to MAC time: 1 TQ is 20 Bytes at MAC Control
  - No PHY Layer overhead (i.e. synctime, laser ON/OFF, FEC, sub-rating)

- YES:
- NO:
- ABSTAIN: