REPORT/GATE FORMAT

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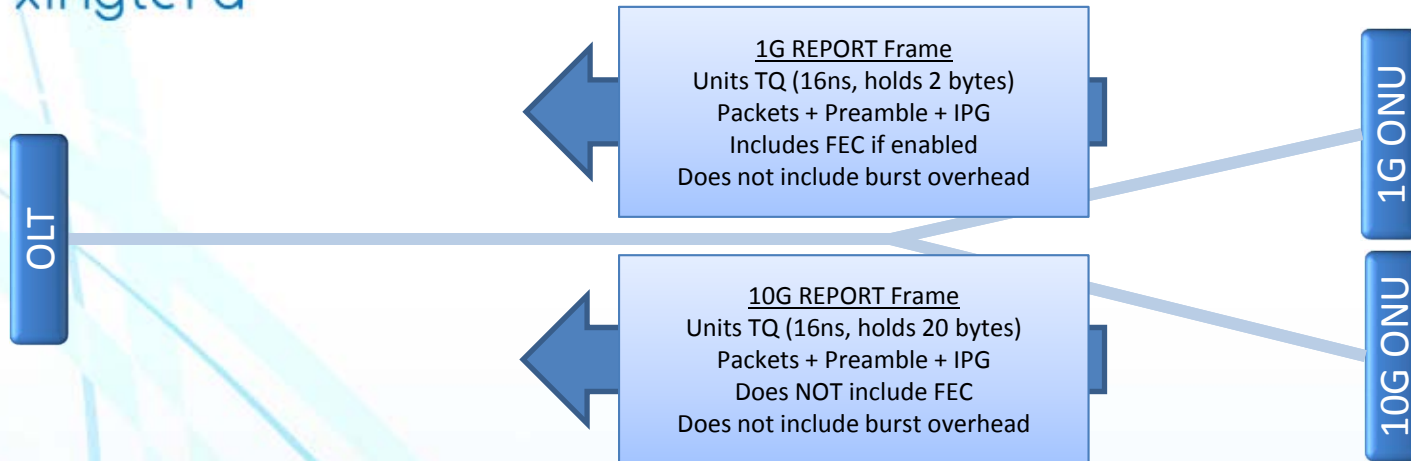
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Overview

- 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.
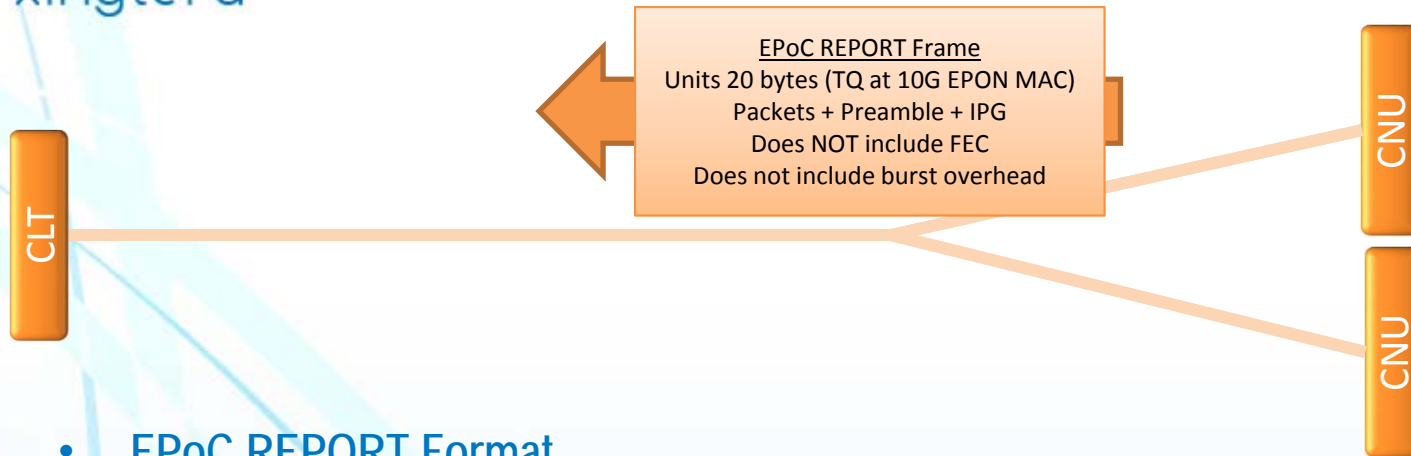
EPoC Rate Adaption

REPORT FRAME DEFINITION

EPON REPORT Format

1G REPORT Frame
Units TQ (16ns, holds 2 bytes)
Packets + Preamble + IPG
Includes FEC if enabled
Does not include burst overhead

10G REPORT Frame
Units TQ (16ns, holds 20 bytes)
Packets + Preamble + IPG
Does NOT include FEC
Does not include burst overhead

OLT

1G ONU

10G ONU

- 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 Frame
Units 20 bytes (TQ at 10G EPON MAC)
Packets + Preamble + IPG
Does NOT include FEC
Does not include burst overhead

CLT

CNU

CNU

- ## 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.
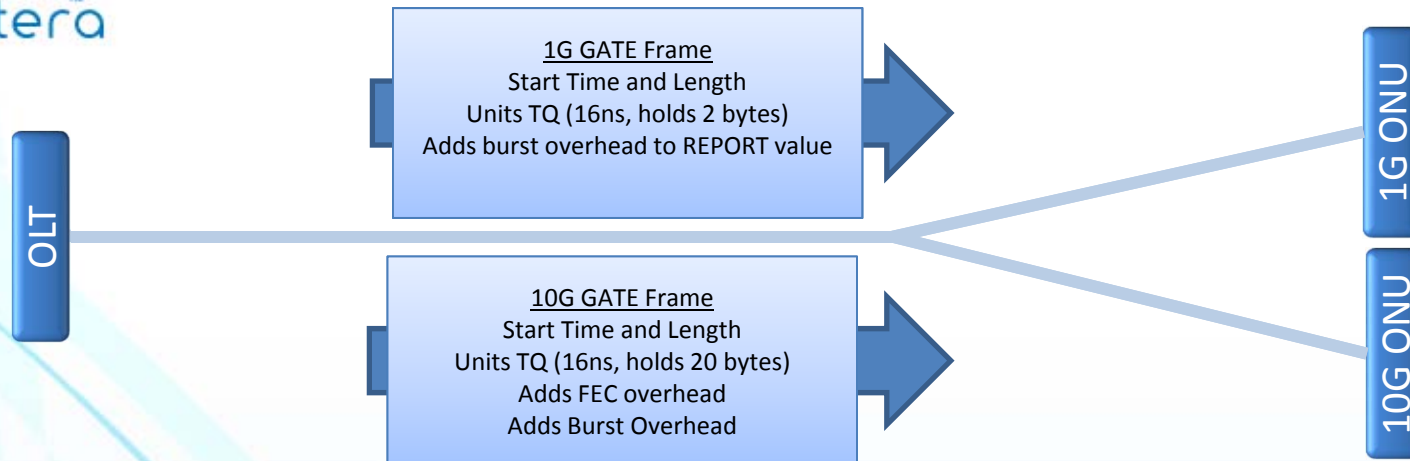
  EPoC REPORT frame should be unchanged from 10G EPON

EPoC Rate Adaption

GATE FRAME DEFINITION

EPON GATE Format

1G GATE Frame
Start Time and Length
Units TQ (16ns, holds 2 bytes)
Adds burst overhead to REPORT value

10G GATE Frame
Start Time and Length
Units TQ (16ns, holds 20 bytes)
Adds FEC overhead
Adds Burst Overhead
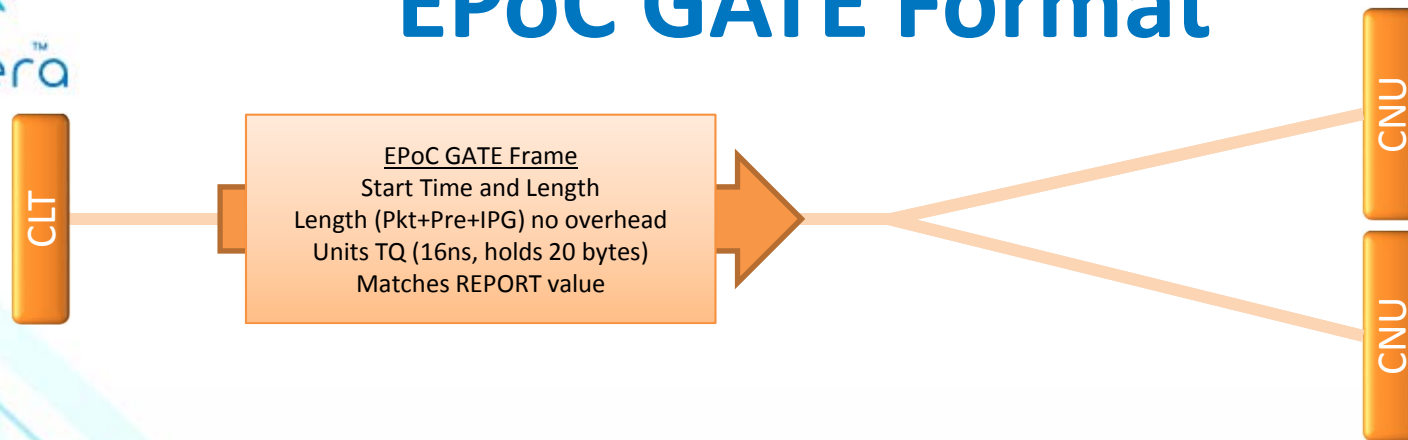
OLT

1G ONU

10G ONU

- **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

EPoC GATE Frame
Start Time and Length
Length (Pkt+Pre+IPG) no overhead
Units TQ (16ns, holds 20 bytes)
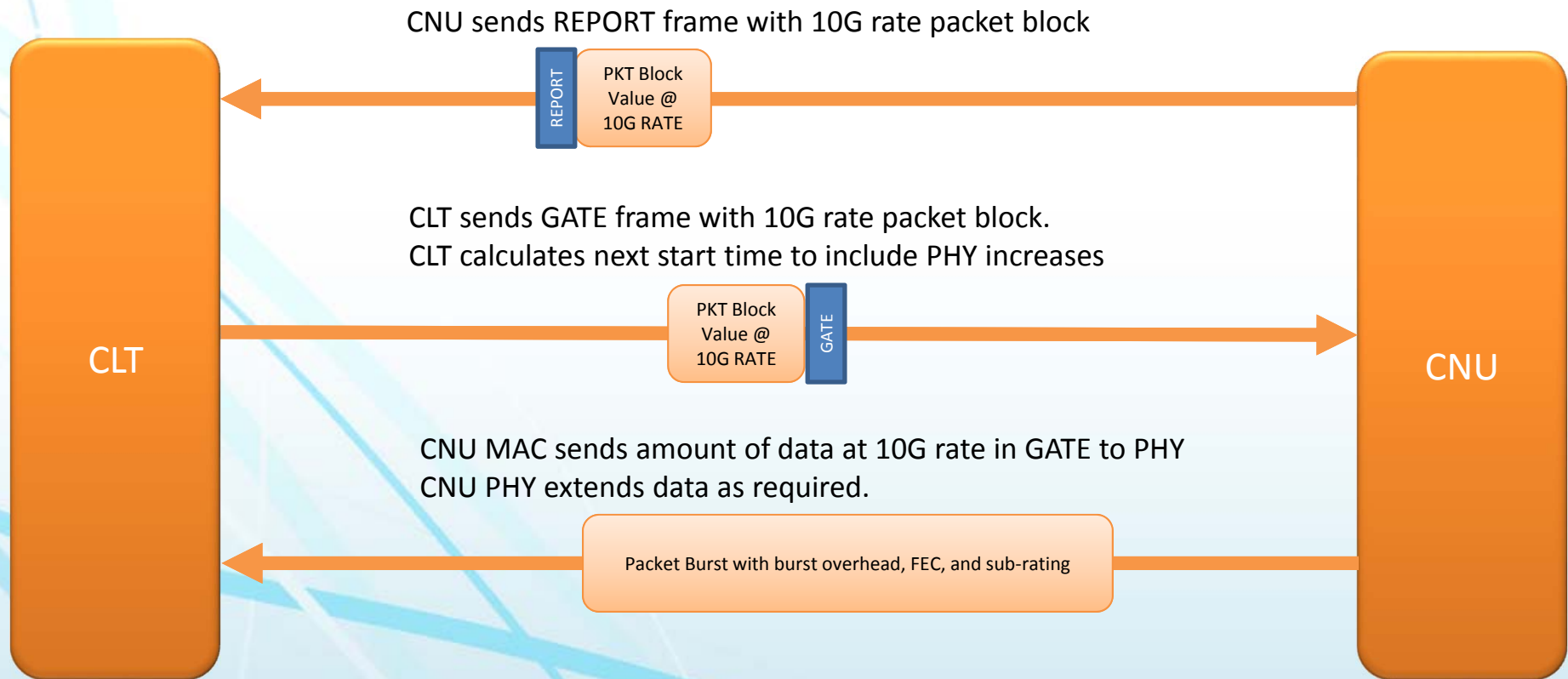Matches REPORT value

- **EPoC GATE Frame**
  - CLT calculation for Start Time and Length must be changed to support EPoC FEC, burst overheads, and sub-rating.
  - CNU calculation for determining the amount of MAC data in the GATE must be modified to support EPoC FEC, burst overheads, and sub-rating.

- **EPoC Simplification**
  - EPoC can be simplified by NOT adding the FEC, burst overhead, and sub-rating to the GATE frame length field.
  - The Start Time must be increased by adding the FEC, burst overhead, and sub-rating. (CLT calculation only)
  - 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 can't be expanded beyond the 2^16 GATE frame limit.

EPoC GATE Frame Length should not include PHY overhead

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EPoC REPORT to GATE to BURST

CNU sends REPORT frame with 10G rate packet block

CLT

REPORT | PKT Block Value @ 10G RATE

CLT sends GATE frame with 10G rate packet block.
CLT calculates next start time to include PHY increases

PKT Block Value @ 10G RATE | GATE

CNU

CNU MAC sends amount of data at 10G rate in GATE to PHY
CNU PHY extends data as required.

Packet Burst with burst overhead, FEC, and sub-rating

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Calculating the EPoC Slot Size

- The CLT must calculate the EPoC Slot 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

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.

- More work is needed to simplify and finalize the slot size equation.

Minimal Augmentation is Needed for EPoC REPORT & GATE frames