More on Functional Assumptions and Requirements

Mark Laubach

Presentation Agenda

- Review operator technical comments from minutes

- ISO/OSI Layers and 802 Specifications

- EPON Service Expectations

- What is between Slide 18 and Slide 20?

- Comments on New Box T.B.D.

- Summary

Operator Input from Last Meeting Minutes

- In majority of North America, cable operators build their own networks inside of MxU
  - Impact: in NA, NODE + N issues will also cover MxU issues

- OLT should transparently manage ONU and CNU using the same EPON protocols

- EPoC must operate over the existing HFC network

- EPoC must support NODE + 3 requirements

- Low-split and Mid-split [preferred] spectrum allocations [for upstream]

- Business and residential services must co-exist on the same EPoC network

- EPoC must support Symmetric and Asymmetric services

Operator Input from Last Meeting Minutes

continued

- Start with desired rate of 1Gbps for upstream and downstream

- Spectrum allocation [must be] flexible enough that it will not hinder our future bandwidth plans

- Preference for "one device" in reference to CNU and supported frequency ranges

- Preference for "1GHz CPE" that can tune to frequency in that range and later develop 2GHz range with backwards compatibility/co-existence with 1GHz

- EPoC CPE should co-exist with existing DOCSIS devices

continued

- 1Gbps [EPON MAC user data rate] is enough initially for both residential and business [services], therefore we can stay at 1GHz, and if someone needs 10Gbps we can use fiber all the way

- Operators prefer to "stay beyond" [?] 1GHz with 1Gbps DS and 0.5Gbps US

- Use spectrum 1100MHz and below

- Cable operators are not going to change cable plants to support 10Gbps

- Jitter and delay to be same or close as possible to what we have in EPON

continued

- Coax needs to fill the gap where fiber is not available

- Spectral placement: design for uncertainty, be flexible with spectrum

- Speed/capacity should be greater than DOCSIS/QAM256 at the same spectral width

- OLT should schedule the transmissions of CNUs

- OLT should be in one place for management and control (required especially for DPoE)

- DOCSIS and EPoC live together

- Main driver for EPoC is using Ethernet, not just for higher speed

continued

- Cable operators are still formulating strategy

- Need to find most cost effective spectral placement to get to 1Gbps

- EPoC bit rates should be greater than 1024QAM. We should implement 12bit[s] per HZ to get effective MAC throughput of 10bits per HZ

- NODE + 6 in use, some operators may not go smaller than NODE + 3

Operator Input from Last Meeting Minutes

continued, a comment that didn't make the minutes:

- Need to support 1Gbps for business services at a minimum of 600 feet of coax [JD]

ISO/OSI Layers and 802 Specifications

- IEEE 802 follows telecomm industry use of the OSI/ISO network layer models

    - Partitions functions into layers and sub-layers
        - 802 is restricted to Data Link (LLC, MAC) layer and Physical Layer
        - Delineates responsibility, e.g. 802.3 vs 802.1, etc
    - Formal abstract interfaces for communicating up/down between layers
    - Please go read Tanenbaum, Wikipedia, IEEE 802.3 clauses, others
    - Three "planes"
        - User, Data, or Bearer – User data (e.g. MAC Data)
        - Control - signaling
        - Management – management, operations, administrative, network management
    - Rigorous and formal use in IEEE 802 specifications

continued

- Why mention this now?
  - May hear talk about who is responsible for what, e.g.
    - 802.3 versus 802.1
    - MAC layer vs PHY layer
  - May hear words like "layer violation"
    - This is usually a key phrase, usually signals we have a challenge to re-express desired functional behavior into "proper" layered approach
      - E.g. EPON Laser Control Function
  - The output of the Task Force will be a formal specification
    - Has to adhere to the way 802.3 standards are written
  - Specification (abstract) not implementation or product descriptions
    - Vendors have complete freedom to choose their independent implementations so long as interoperability is achieved

continued

- Ok, why again saying this now?

- Our primary mission is to produce a physical layer link specification
  - Adherence to specification regime might be viewed as limiting

- Our EPoC PHY will fit into a set of larger system specifications created outside of the IEEE
  - Many of the details have yet to be written, etc.
  - Other organizations will likely write these
    - E.g. CableLabs, SCTE, SARFT, others
    - Mark's word play: EPoCSIS "EPON over Cable Service Interface Specification"
  - Other organizations and specifications have much more freedom in specifying boxes and functionality
    - "Layers?", "We don't need no stink'n layers…."
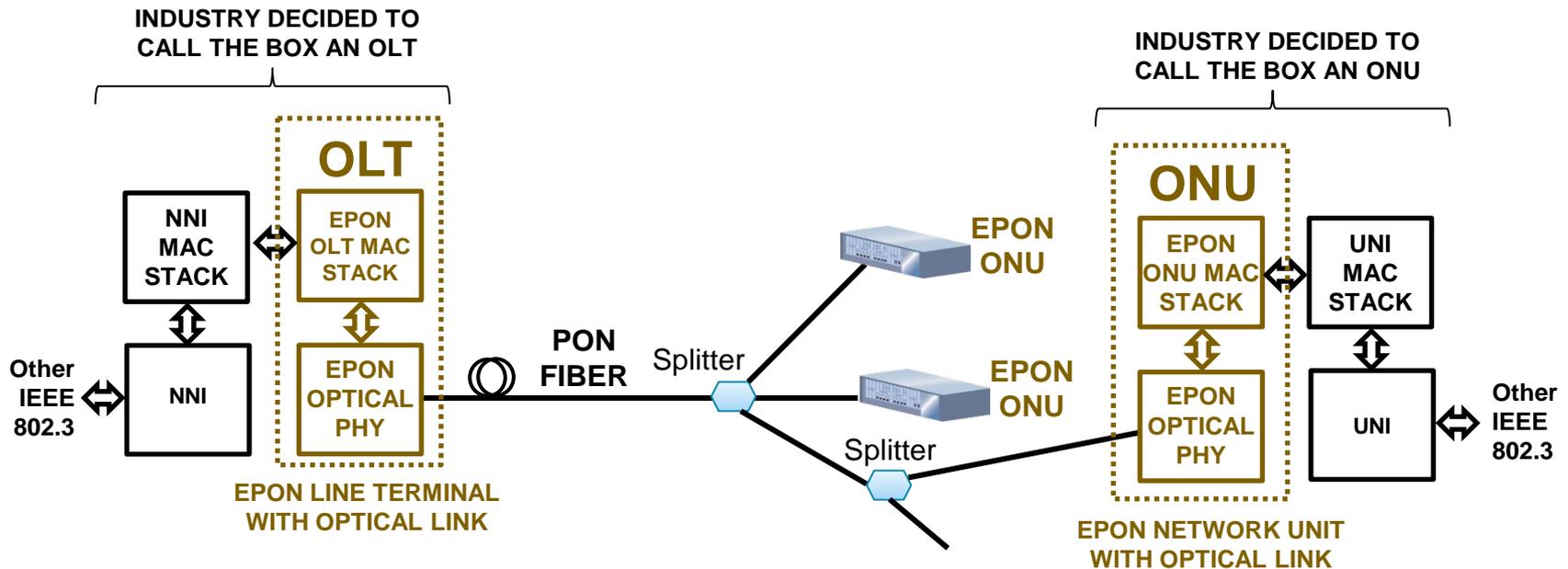
Specify What Makes Sense

- For consideration
  - What we want to do here should make sense in the context of IEEE 802.3
    - If it makes sense to do it here, then we do it
  - If it doesn't make sense, do it elsewhere

EPON Service Expectations

- What service providers expect from EPON
  - High speeds
  - Low and predictable (bounded) latency
  - MEF certifications and MEF-based SLA's with business customers
  - IEEE 1588 Precision Time Protocol for cell backhaul
  - Etc.

- EPoC needs to meet same expectations
  - E.g. Where EPoC extends EPON onto Coax, same service expectations under all stated optimal conditions

- The only caveat to this:
  - When deployment conditions are not optimal on the coax, service providers will need to know where the "configuration boundaries" are that result in meeting or not meeting acceptable service performance
    - "Less than" speeds,
   - Increased latency interleaving for overcoming narrow band interferer noise, etc.

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REVIEW:

- IEEE 802.3 1GEPON and IEEE 802.3av 10GEPON
  - IEEE 802.3 specified the EPON "MAC Stack" and PHY
  - Industry created products and used the same OLT and ONU names

INDUSTRY DECIDED TO CALL THE BOX AN OLT

INDUSTRY DECIDED TO CALL THE BOX AN ONU

OLT

NNI MAC STACK

Other IEEE 802.3

NNI

EPON OLT MAC STACK

EPON OPTICAL PHY

EPON LINE TERMINAL WITH OPTICAL LINK

PON FIBER

Splitter

Splitter

EPON ONU

EPON ONU

ONU

EPON ONU MAC STACK

EPON OPTICAL PHY

EPON NETWORK UNIT WITH OPTICAL LINK

UNI MAC STACK

UNI

Other IEEE 802.3

What's between Slide 18 and Slide 20?

- Along came the IEEE 802.3 EPoC Study Group
  - New PHY under the same EPON "MAC Stacks"

- NOTE: No boxes, no blades, industry still has to decide what products to specify/build and what to name
  - Thought best to avoid confusion with existing names in EPoC SG
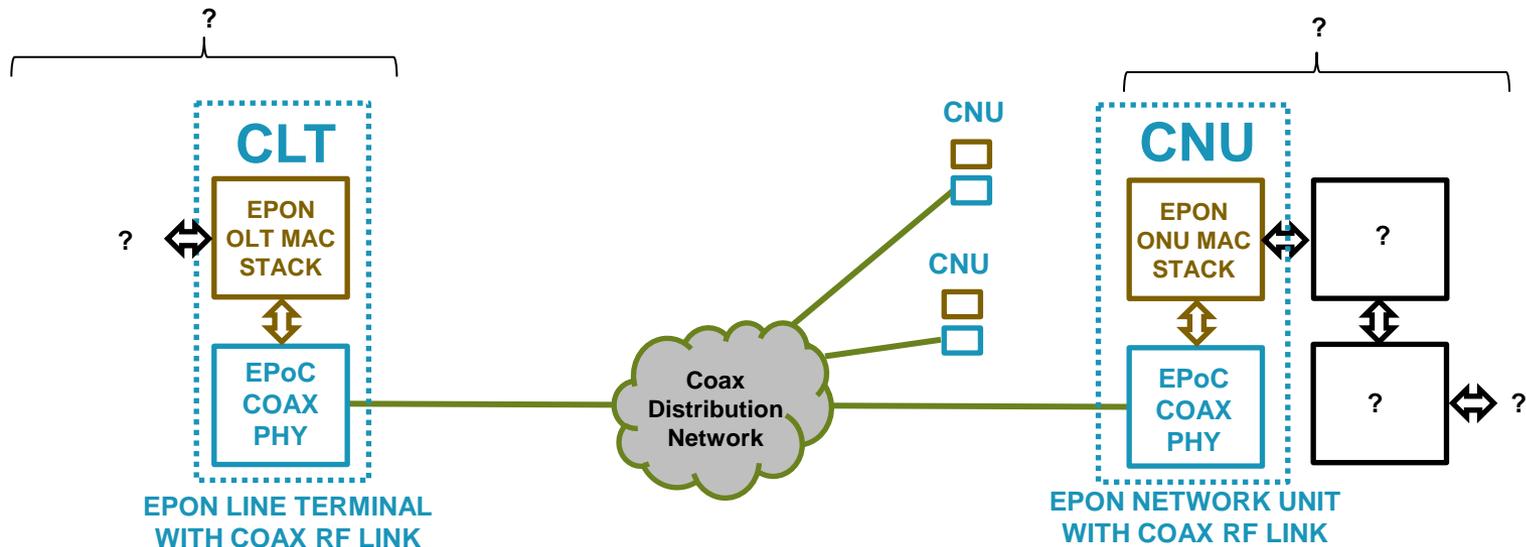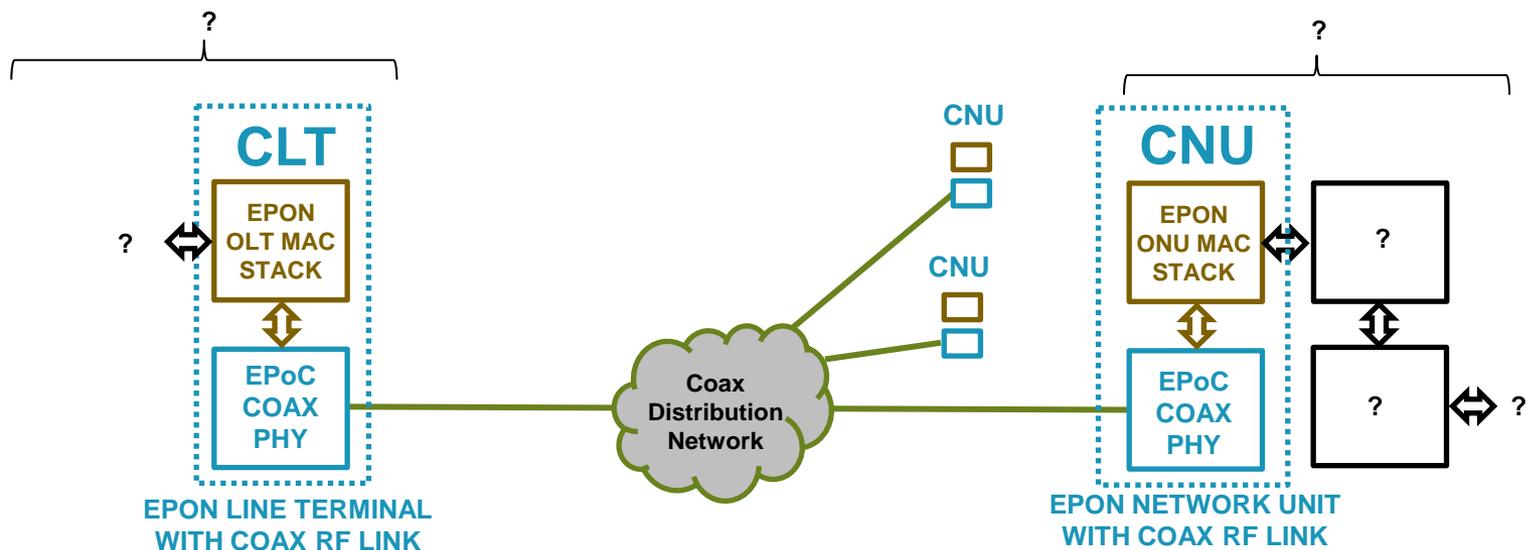
What's between Slide 18 and Slide 20?

- New architecture / standard must preserve expected EPON services as measured at the MAC/PHY interface;
  - E.g. MAC data rate

- NOTE: based on available spectrum, noise and impairment conditions, etc. available link speeds will vary significantly (imagine VDSL)
  - E.g. "less than" maximum specification rate
  - Set by operator, then discovered and tuned during CNU auto-negotiation with CLT
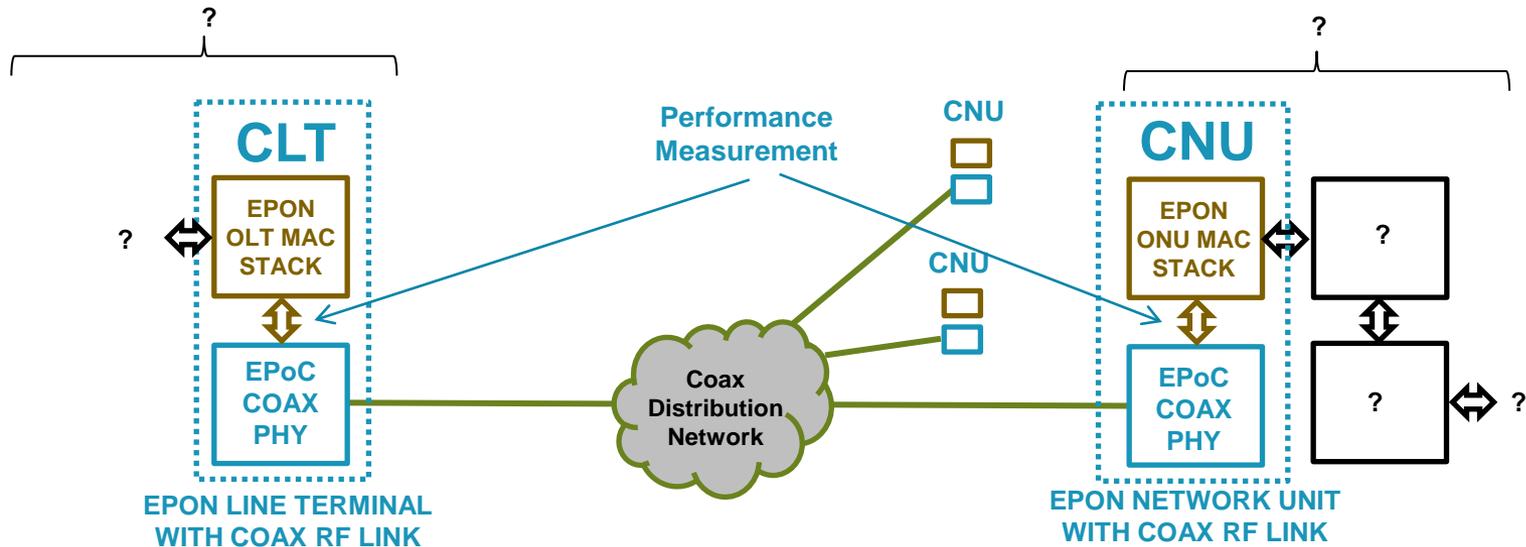
What's between Slide 18 and Slide 20?

- Couple other items
  - The PMD is RF Electrical at the CLT and CNU
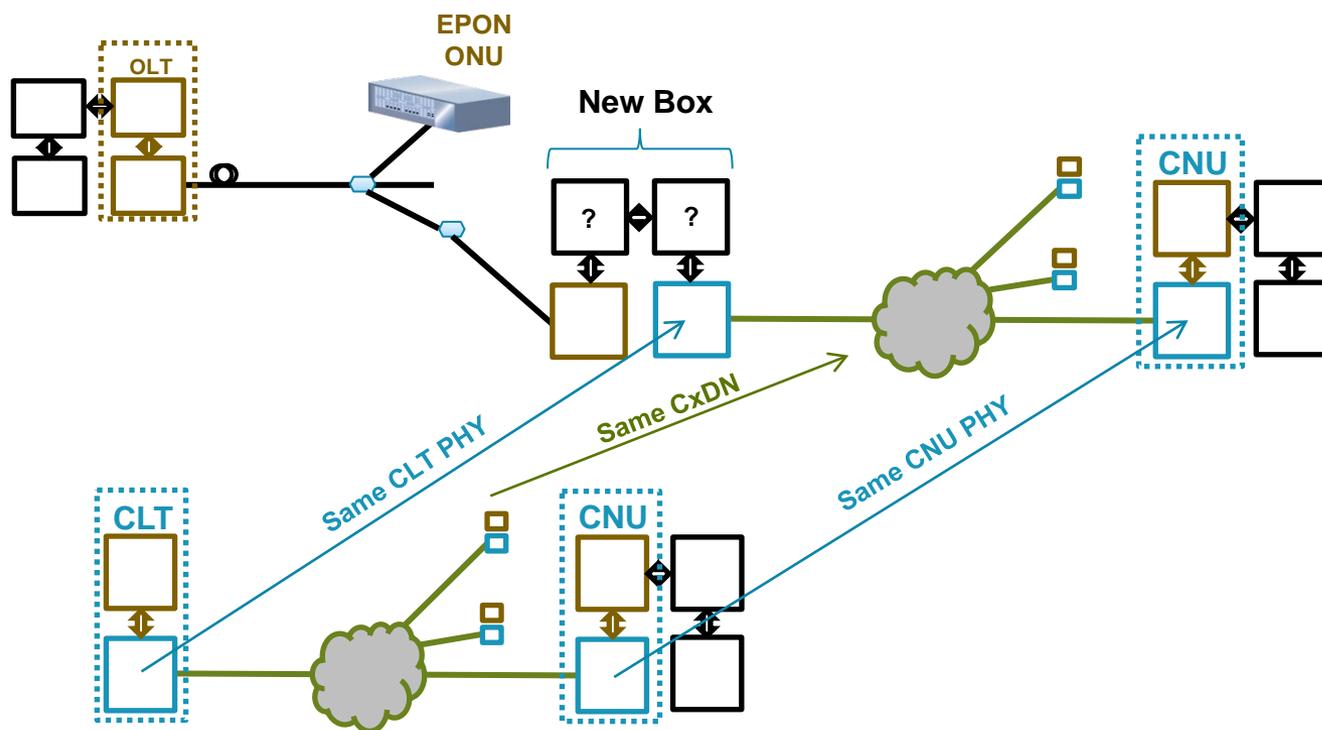 - The MDI is the international standard F connector

What's between Slide 18 and Slide 20?

- Combining
  - EPON picture, with
  - EPoC CLT and CNU picture

  Yields…..

What's between Slide 18 and Slide 20?

- A changed "Slide 19"

- The cable industry wants this architecture enabled

- What is inside the new box is T.B.D.
  - One question is who determines…

What's between Slide 18 and Slide 20?

- Performance requirements are unchanged however performance measurement points for system have changed
  - Adding the new box and CNU to existing EPON shouldn't change system MEF and 1588 performance

- This is a larger more complex system

Thoughts on the Bigger System

- It would be helpful if the cable industry tackles the bigger system issues
  - System performance
  - System management
  - Deployment use cases
  - Etc.

- System specification + IEEE EPoC PHY would specify system box / product / implementation requirements

- In terms of the "New Box", the freedom of the cable industry's ability to specify implementation might be more time and effort effective then pursuing in IEEE EPoC
  - However, what does make sense to do here, we'll do

Summary

- Reviewed technical guidance points from operator's raised in the last SG meeting
  - Useful in reviewing any PAR, Criteria, and Objective proposals

- IEEE 802 has a formal specification process
  - Other organizations can be much more flexible with defining boxes and implementations

- Overall system performance is of critical issue for maintaining EPON service expectations for EPoC system
  - CLT <> CNU architecture we can measure within the SG
  - "New Box" architecture requires working with the bigger system picture. Do we do this ourselves or get help?

- We'll do what we need to do in IEEE 802.3 EPoC
  - Don't "bite"off too much time
  - Work with industry EPoC groups and activities for productivity

Thank You

Mark Laubach