

EPoC architectures and the “Transparency Wish”

Supporters

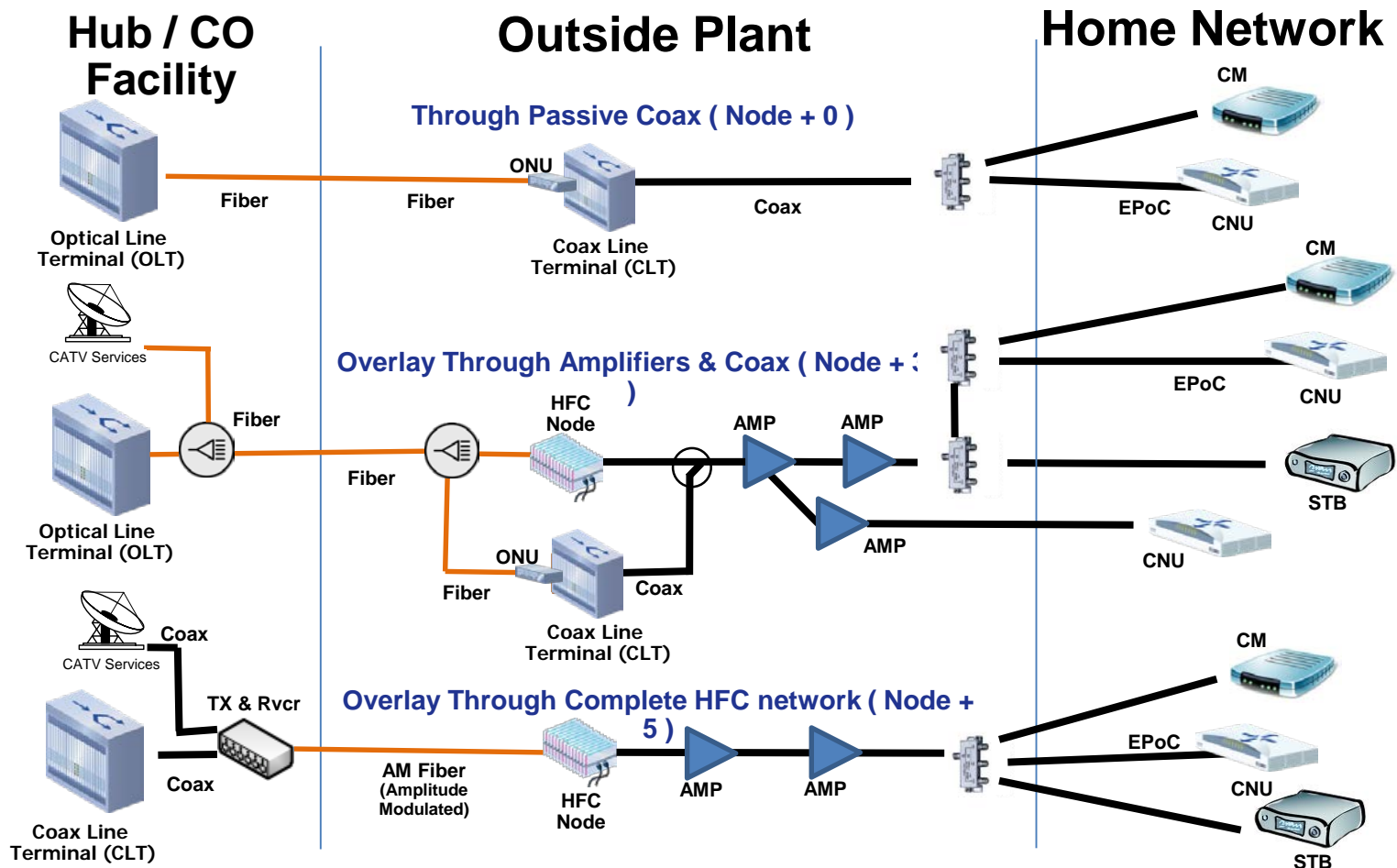
(alphabetic order, by first name)

- Ed Mallette, Bright House Networks
- John, Dickinson, Bright House Networks
- Jorge Salinger, Comcast
- Marek Hajduczenia, ZTE
- Matt Schmitt, CableLabs

Agenda

- Introduction
- Architecture Proposals
- Conclusion

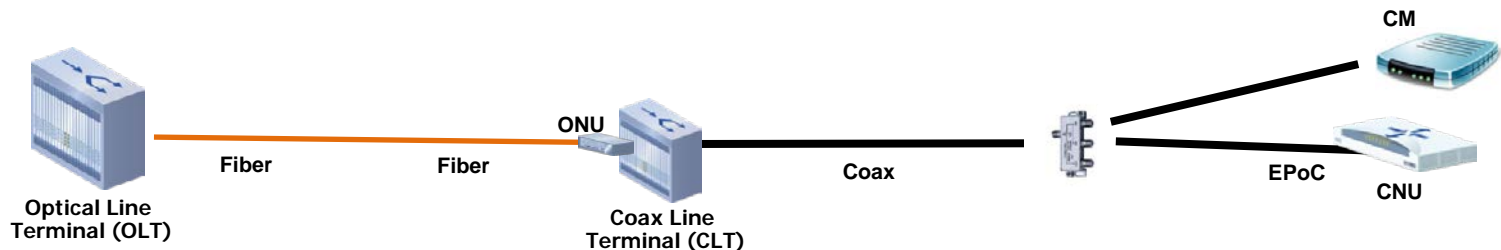
CFI and CLT



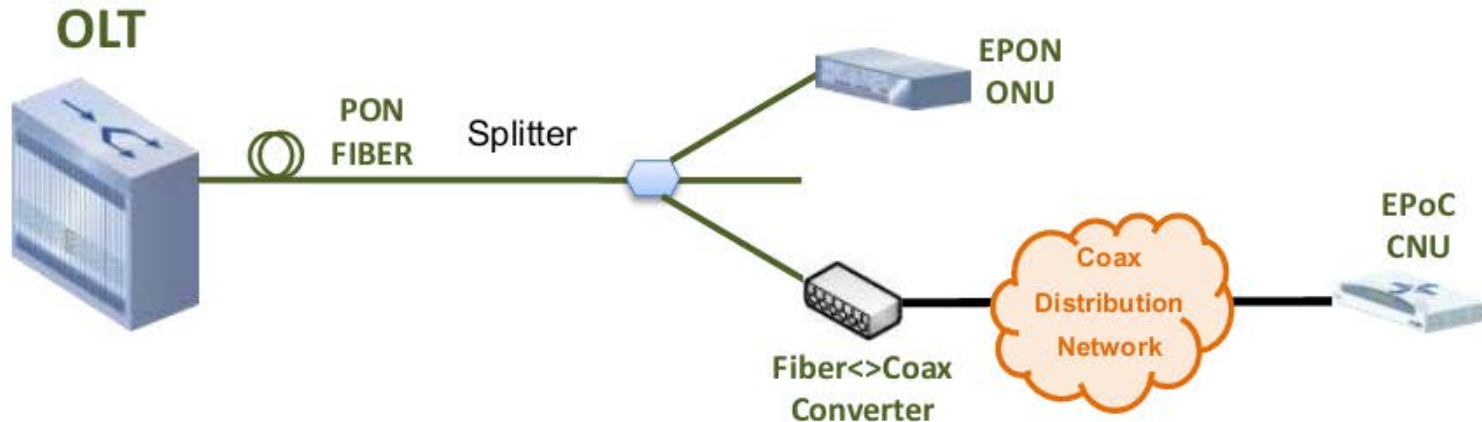
- CFI presentation refers to a device called a “CLT” or “Coax Line Terminal”, which appears in a variety of architectures

Implications of “CLT”

- The term “CLT” has some specific implications
 - In particular, this indicates a “termination” of the MAC layer
 - Or put another way, that the EPoC network is completely separate from an EPON network
- For example, in the segment from the previous slide below, there are two completely separate networks for coax and fiber
 - One from the OLT to the ONU
 - One from the CLT to the CNU



A Transparency Wish aka, the Infamous “slide 19”



- At the interim meeting in January, Mark Laubach proposed the above architecture
 - Utilizes a single OLT to support both ONUs and CNU
 - A “Fiber-Coax Converter” is used to link the coax CNU to the fiber OLT “transparently”
- He suggested that we should avoid doing anything that would prevent that approach from being realized
 - Indicated MSO interest as a reason

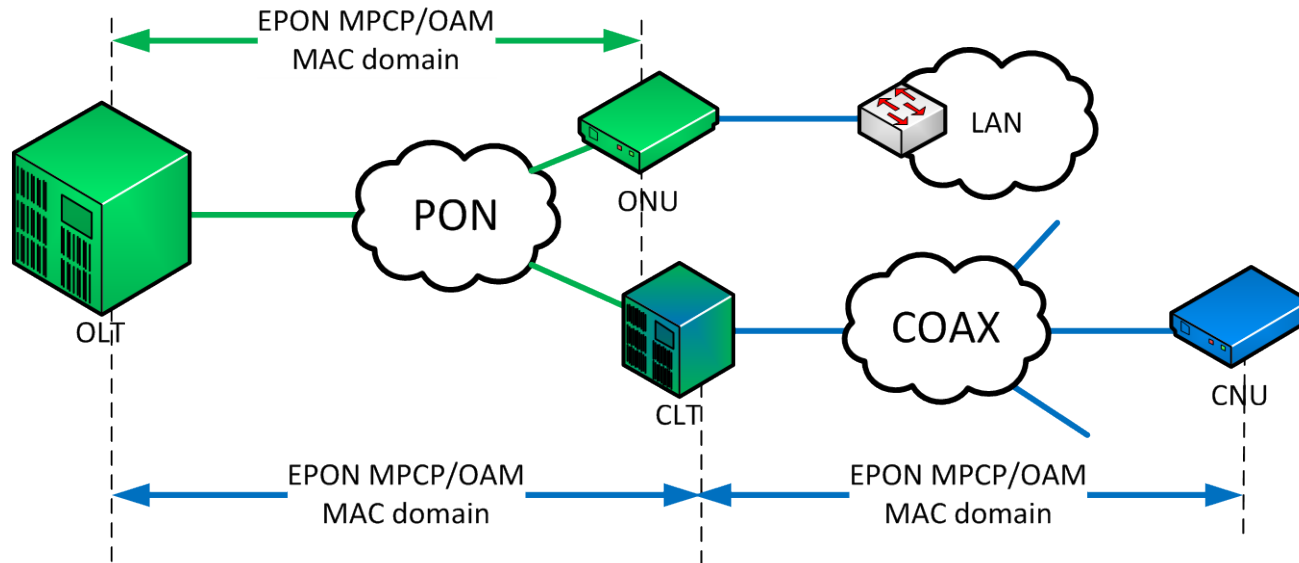
The need for “Transparency” in EPoC

- Many MSOs are or will be deploying EPON services
 - Would like to use EPoC to extend EPON services to customers attached to the HFC network
- Would be desirable to use same OLTs to extend EPON to coax
 - Also provides a good upgrade path over time from coax to additional fiber
- To accomplish the above, need to define – or at least account for – a device that links the fiber and coax portions of the network
 - Transparent to the EPON MAC and MAC Control,
 - Converts optical EPON signals into RF signals and vice versa,
 - Performs any other functions required to support the scheduling and operation of coax based devices
- For purposes of this deck, will refer to this device as an “OCU” or Optical-Coax Unit (other names are possible)

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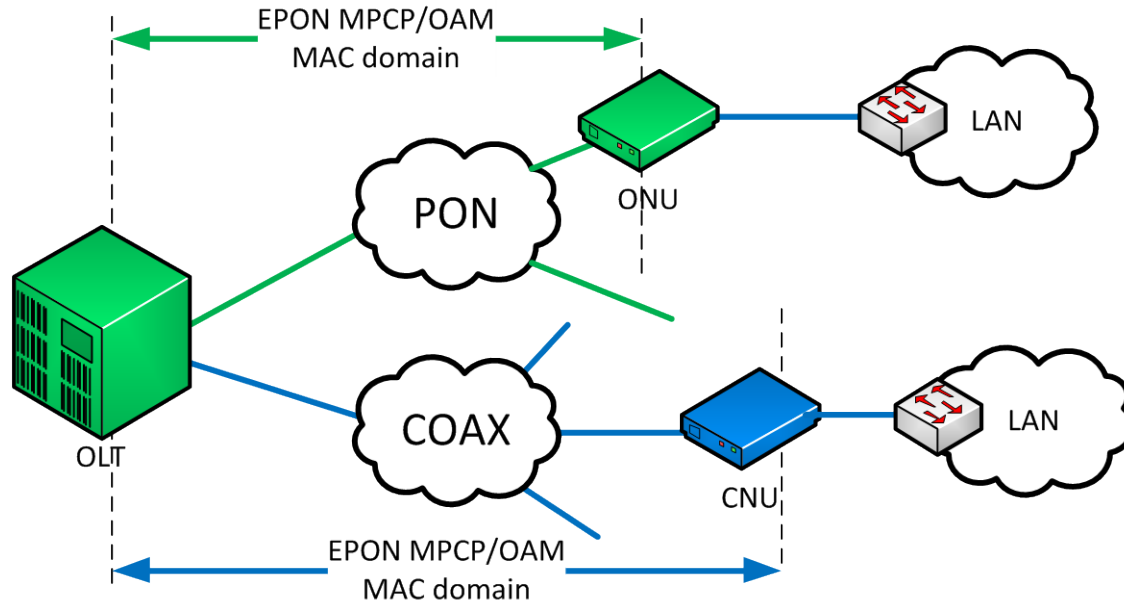
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Separate MAC domains (AP1)



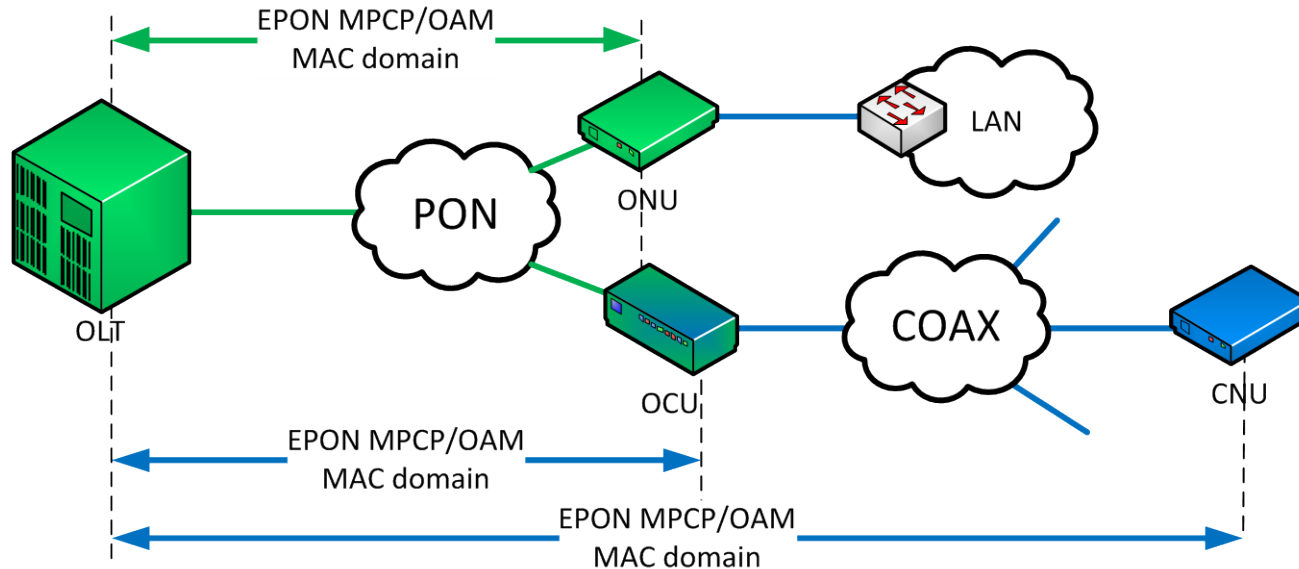
- Architecture originally defined in CFI
- CLT can exist in various locations in the network (see Slide 4); backhaul link can use any form of Ethernet (including EPON)
- CLT directly manages CNU, granting bandwidth and controlling other management aspects of the device
 - Interaction between the CNU and CLT is very similar to interaction between ONU and OLT, just running over coax plant.
- EPON OLT does not have direct access to CNU. All aspects of coax plant are hidden away from EPON OLT

Common headend device (AP2)



- Extension of CLT concept, but supporting both optical and coax outputs with separate ports
- Could operate with separate or combined MAC domains between fiber and coax
 - If separate, “OLT” manages ONUs and CNUs separately and directly
 - If combined, a single MAC interleaves transmissions into PON and COAX networks and schedules upstream transmissions in a non-overlapping manner
- This configuration might require substantial changes to the way EPON MAC is connected to underlying PCS and PMD for optical and coaxial PHYs

Single MAC domain (AP3) “transparent management”

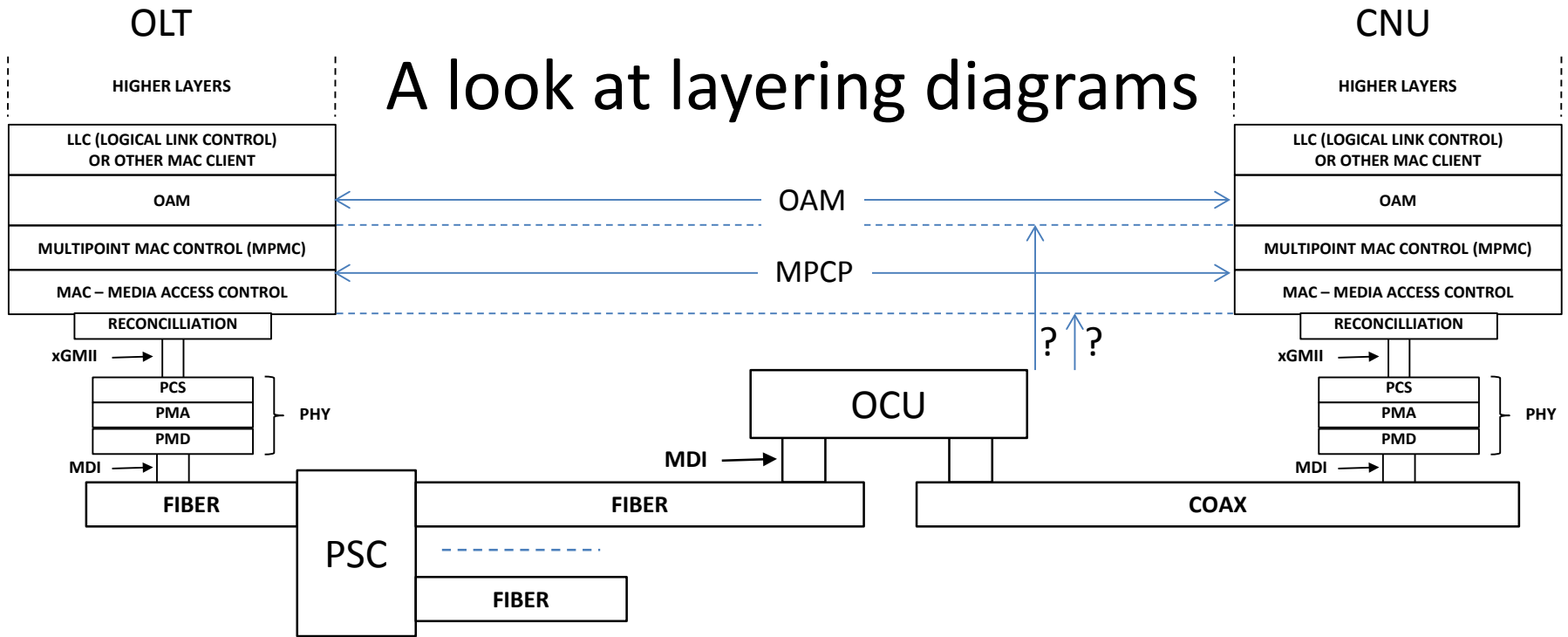


- OCU converts from optical to electrical in the downstream, and electrical to optical in the upstream
- EPON OLT directly manages CNU: MAC Control and OAM messages are passed transparently through OCU when directed to CNU (single MAC domain between OLT and CNU, OLT and OCU, OLT and ONU)
- OCU does not communicate with CNU using MPCP (i.e. OCU does not play the role of OLT for CNU)
- Only this scenario addresses the “Transparency Wish” established before

Additional notes on OCU functions

- Detailed list of functions for OCU beyond optical-electric conversion would need to be determined, but could include one or more of the following:
 - Control the PHY layer parameters and characteristics of the coax network
 - Discover information about the coax portion of the network and the capabilities of the CNUs
 - May need to pass some of this information to the OLT to assist with scheduling
 - Performs additional management functions specific to the coax network
 - Filtering of LLIDs not destined for certain CNUs
- An open question is how aware of the coax portion of the network the OLT will need to be
 - In part, will depend on what functions can be handled in the OCU
- Function of the in-field OCU may be also incorporated into the EPON OLT to drive the HFC plant directly, without extra media conversion

A look at layering diagrams



- Questions that may need to be answered at TF (see below). Some aspects may need to be discussed at SG as well:
 - What is within OCU functional block i.e. at what layer it should terminate at: MAC, RS, xGMII, PCS?
 - in AP1 case, are we defining a new type of device or a combination of existing devices?
 - What other functional requirements do we put on OCU e.g. rate adaptation, per LLID filtering?
 - How should OCU inform EPON OLT about parameters of the coaxial plant and what parameters should be provided to EPON OLT (maximum data rate, quality, etc.) ? How to combine this information with CNU devices?
 - How can MPCP mechanisms be modified to a smallest extent possible to support CNU control as well ? The same comment / question applies to the MPCP discovery and registration process as well.

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What MSOs need in EPoC...

- Ability to reuse existing EPON/DPoE gear (already fielded by operators) to manage EPoC devices
- To support this:
 - EPON OLT MUST be able to:
 - control CNU (via OAM / eOAM / MPCP)
 - schedule CNU without modification of existing MPCP scheduling scheme and with minimum changes to MPCP in general (if any)
 - EPoC OCU SHOULD be able to:
 - receive OAM / eOAM / MPCP management from OLT
 - Report parameters of coaxial plant to OLT to the extent needed, for example to set data rate information for the given CNU
 - EPoC CNU MUST be able to:
 - receive OAM / eOAM / MPCP management from OLT
 - follow the same operational logic as EPON ONU controlled by MPCP
- Other architectures are also possible and should not be precluded, but the above set of requirements needs to be supported

Proposal

- Acknowledge AP3 as a desired architecture for EPoC
 - Could have implications on the choice of proposals to adopt for EPoC
 - Could impact the messaging that ultimately needs to be defined for EPoC
- Work to ensure we don't preclude this architecture with any choices made by the Study Group
 - May want to consider Objective(s) to safeguard the option
- Preserve AP1 (CLT approach) as an architecture option as well (make sure we don't preclude it)
- Investigate whether or not significant changes would be needed to additionally support AP2

Thank you