

# EPoC Architecture Choices

Ed Boyd, Broadcom

John Dickinson, Bright House

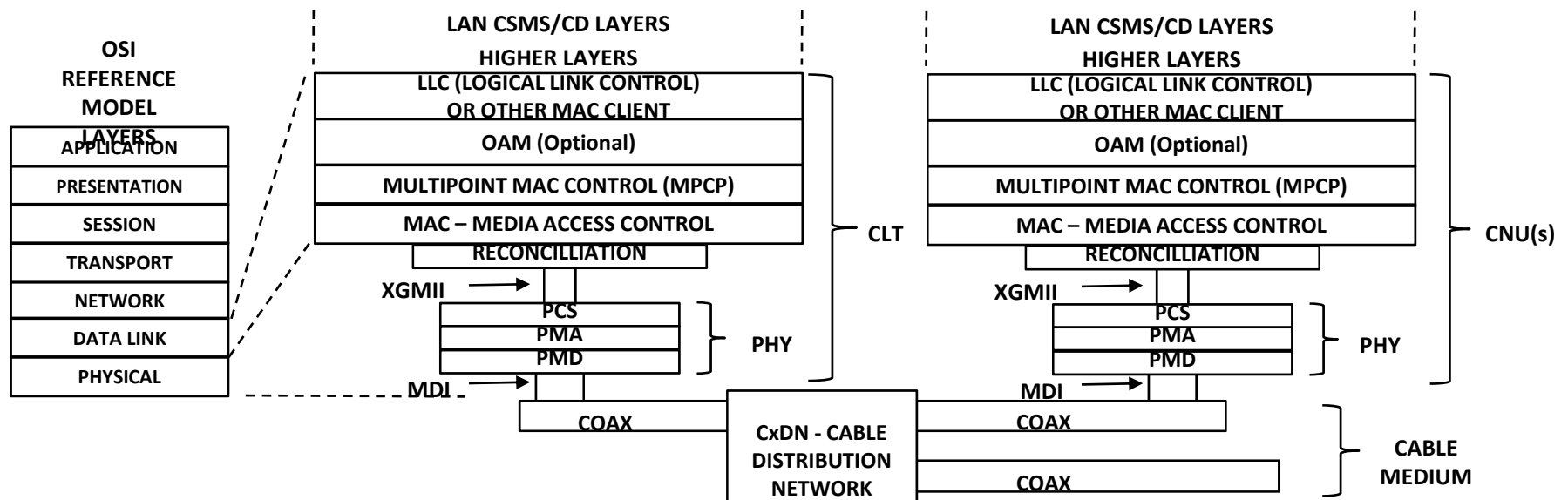
Eugene Dai, Cox

Marek Hajduczenia, ZTE

Mark Laubach, Broadcom

# Overview

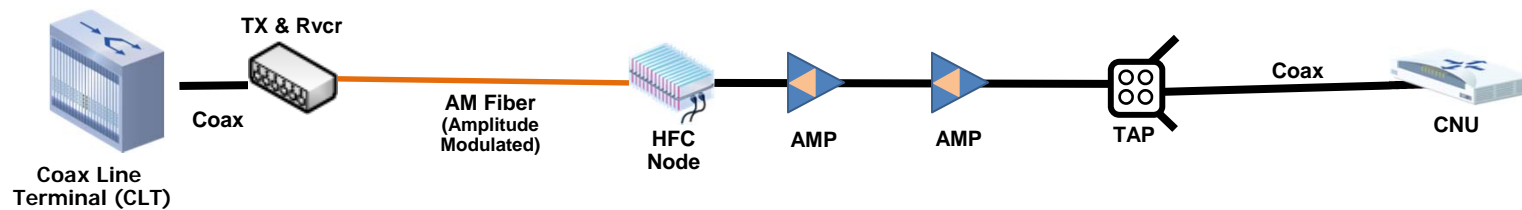
- EPoC is a new Coax PHY for the Ethernet MAC.
- What is the device in the middle of the EPoC network? Is it a Bridge or Repeater or some hybrid?
- This presentation examines the use of the a new EPoC PHY in a repeater or a bridge application.
- This presentation does NOT advocate the standardization of these devices in IEEE 802.3.



# EPoC Deployment Options

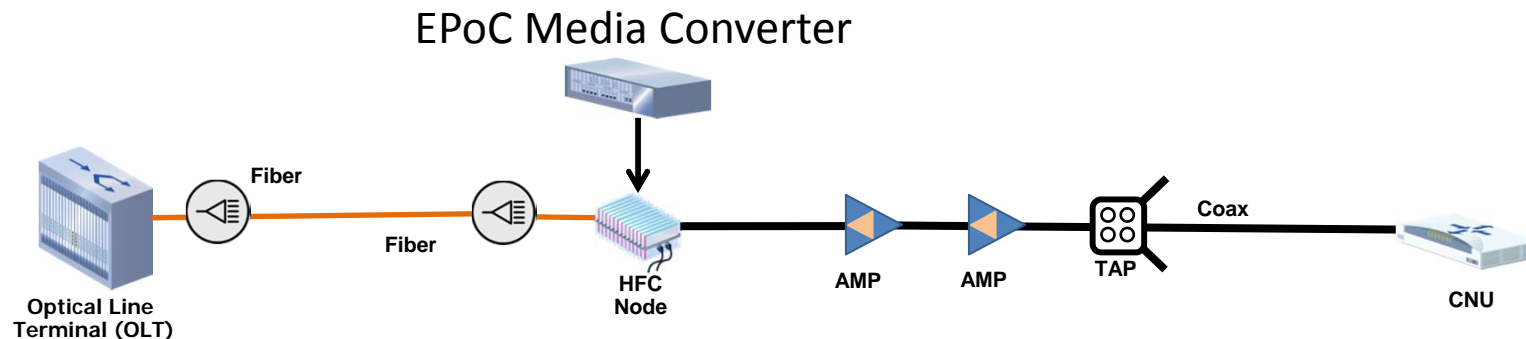
Option 1: Coax PHY on an OLT blade.

- EPoC PHY directly interfaces to Ethernet MAC.
- Easy to understand



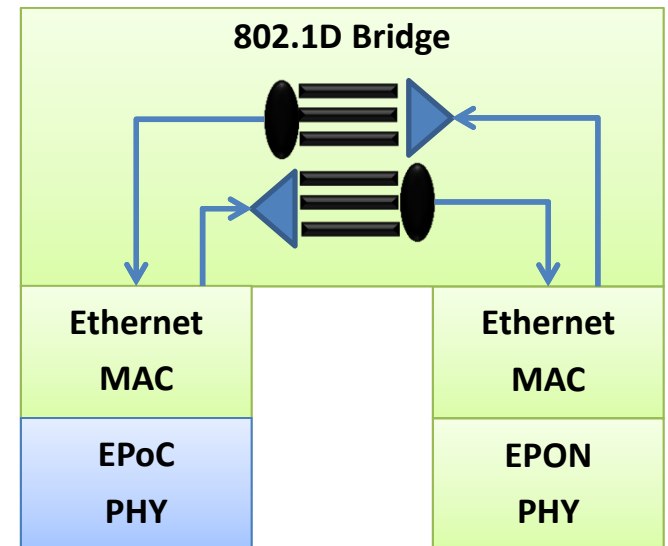
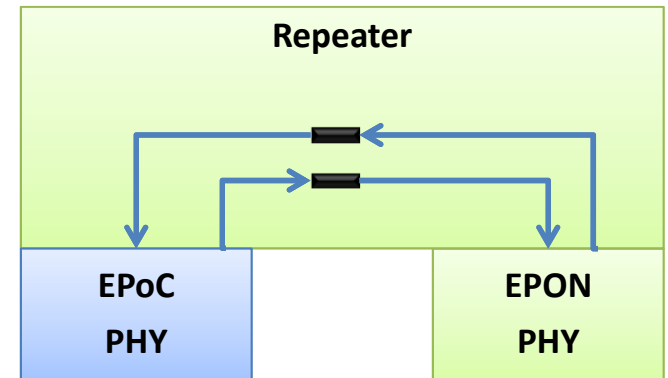
Option 2: EPoC Media Converter in outside plant NODE, Amplifier, or MDU Basement.

- Multiple options exist for required functionality
- Need to evaluate.

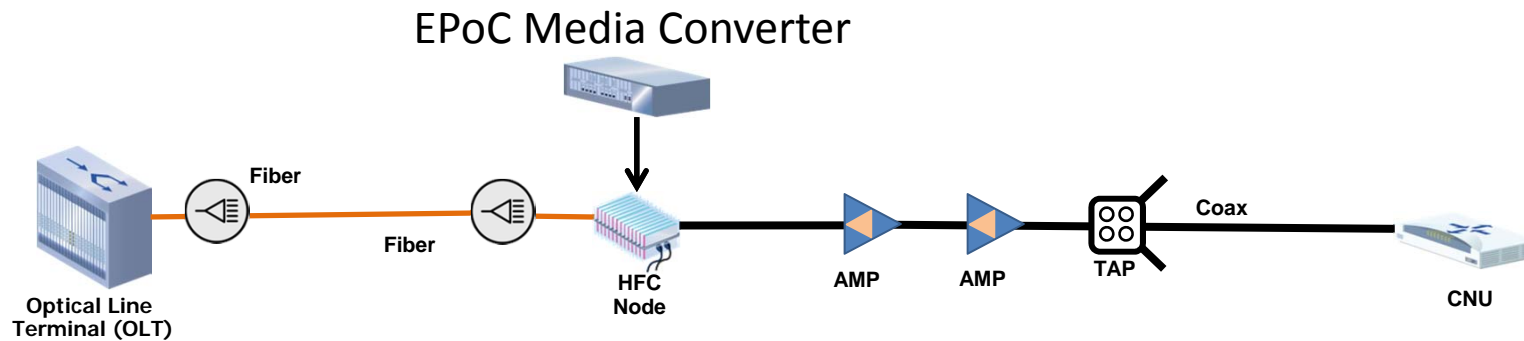


# Media Converter: Repeater or Bridge?

- Coax to Fiber Media Conversion could be designed as a repeater or a bridge.
- Repeater
  - Fixed delay from between Coax and Fiber.
  - Single small queue in upstream and downstream
  - Lower Cost & Power
  - No SLA provisioning
  - Single Layer of Scheduling
  - ONU MAC could be placed along side for managed repeater.
- Bridge
  - Double Scheduler (one for coax, one for fiber)
  - Queuing, Switching, and classification
  - Full utilization of Coax and Full Utilization of Fiber
  - Requires SLA Provisioning and Classification
- IEEE Standard should support either architecture



# Fiber Utilization Considerations



- Repeater

- The Upstream slot size on the Coax and Fiber must be equal.
- Coax slots could be less than 1Gbps due to sub-rating and not fully utilization the Fiber network.

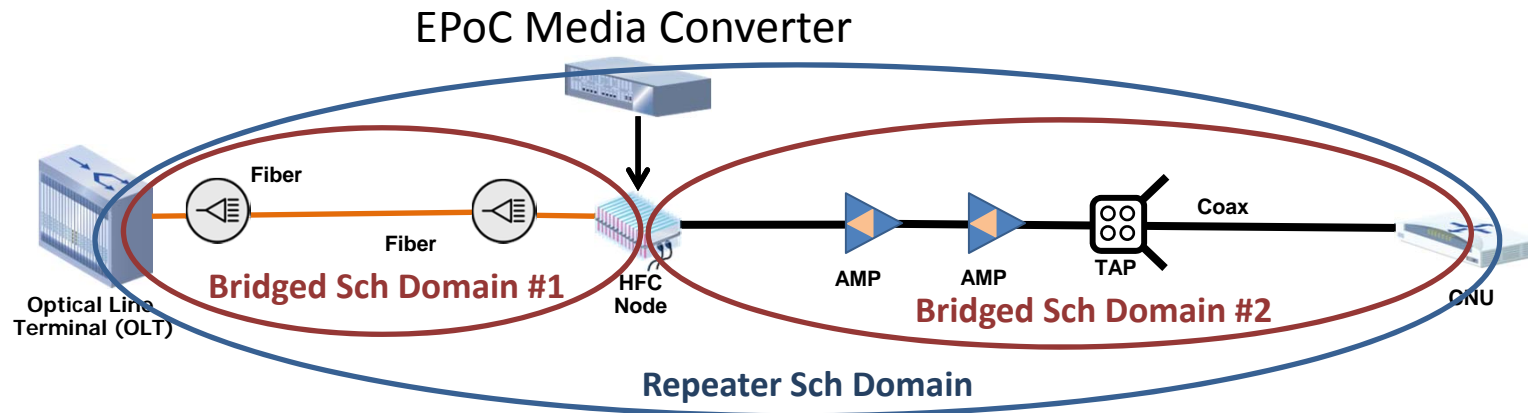


- Bridge

- Re-queued data can be fully utilize and over subscribe the Fiber network.
- The slot size for Fiber will be smaller than coax in a sub-rated system and allow for other media converters to send data.



# System Delay Considerations



- Upstream Delay for a Solicited EPoC Repeater can be defined by the following equation.

$$T_{\text{delay}} = \text{Polling\_Interval} + \text{Scheduler-Delay} + T_{\text{upstream}} + T_{\text{downstream}} * 2$$

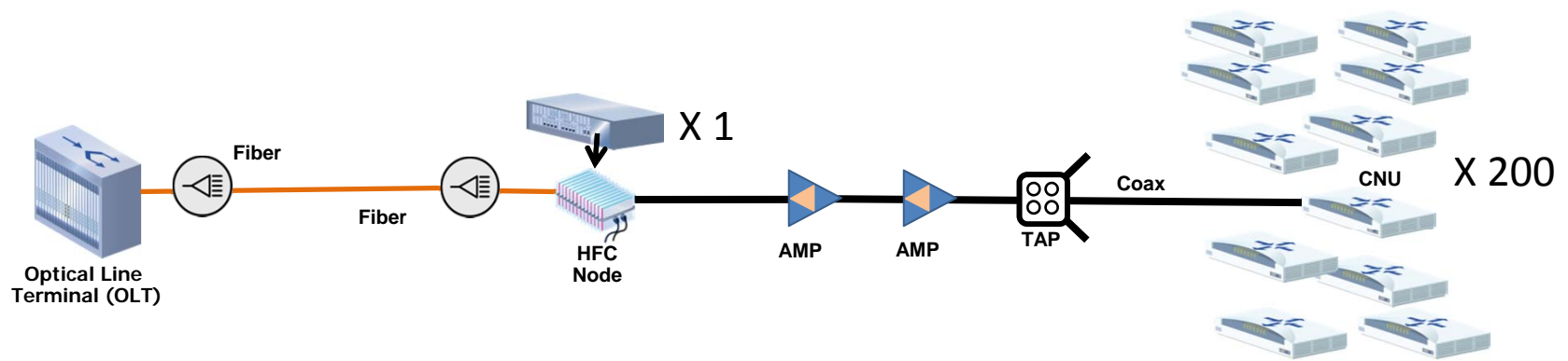
- Since the Bridged System has 2 Scheduling & Aggregation delays

$$T_{\text{delay}} = \text{Polling\_Interval} * 2 + \text{Scheduler-Delay} * 2 + T_{\text{upstream}} + T_{\text{downstream}} * 2$$

- While the propagation and PHY delays are the same for both systems, the doubling of the much larger delays for the scheduler and polling interval will almost double the system delay.

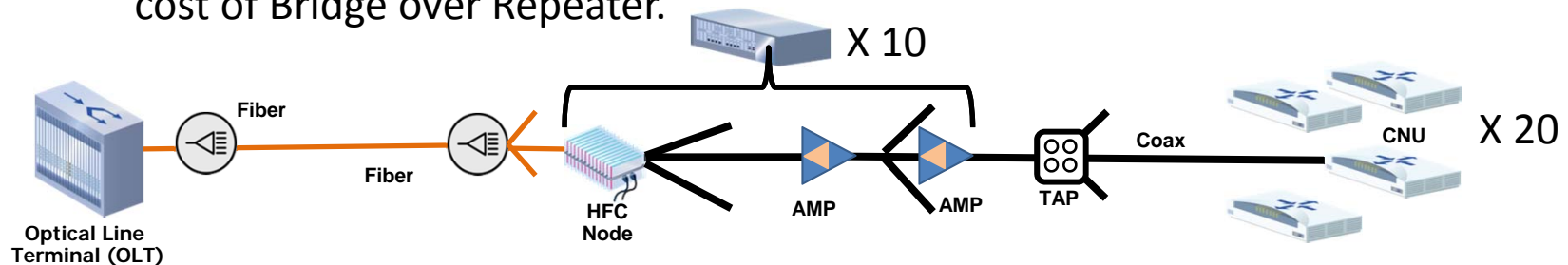
# Scenario Choices (Large Coax Networks)

- Single OLT port serves a large network. (CNU count approaches OLT port limit)
- OLT could use point-to-point optics (CWDM or DWDM)
- Single media converter for many CNU's.
- Repeater is the clear choice.
  - Lower Cost and Power with no provisioning in the outside plant.
  - Higher performance due to lower delay from single scheduling stage.
  - No utilization improvement by Bridging



# Scenario Choices (Small Coax Networks)

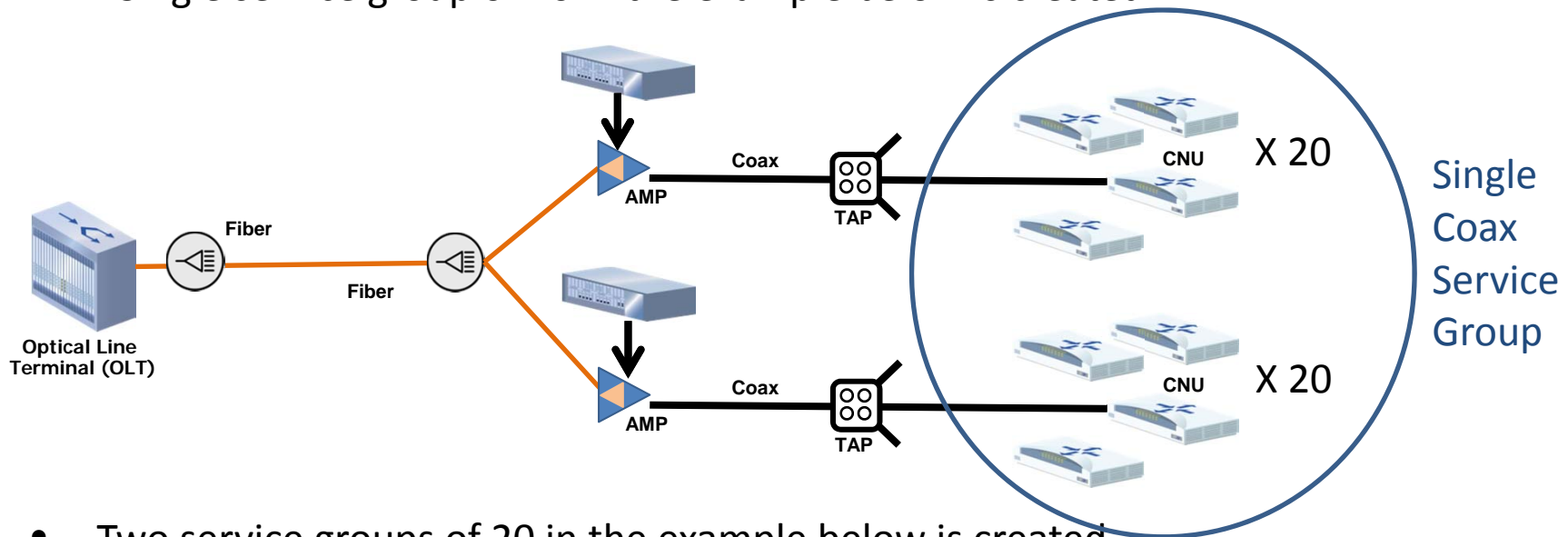
- Multiple media converters for fewer CNU's in a coax service group (Deep Fiber)
- Single OLT port with Multiple Repeaters
  - OLT port sees a single large Coax Network (same as Large Coax Network)
  - The fiber combines multiple Coax networks into a single logical network.
  - Lowest Cost Solution, Low Delays, Lower Utilization
- Single OLT port with Multiple Bridges
  - Allows for independent utilization of each Coax segments
  - PON Fiber can be fully utilized and over subscribed.
  - Conserves trunk fiber.
- Multiple OLT ports with Repeaters
  - Allows for simple outside plant devices, lower delays , and high utilization but more fiber or wavelengths required.
  - It is not clear if cost of additional OLT ports is more or less than the additional cost of Bridge over Repeater.



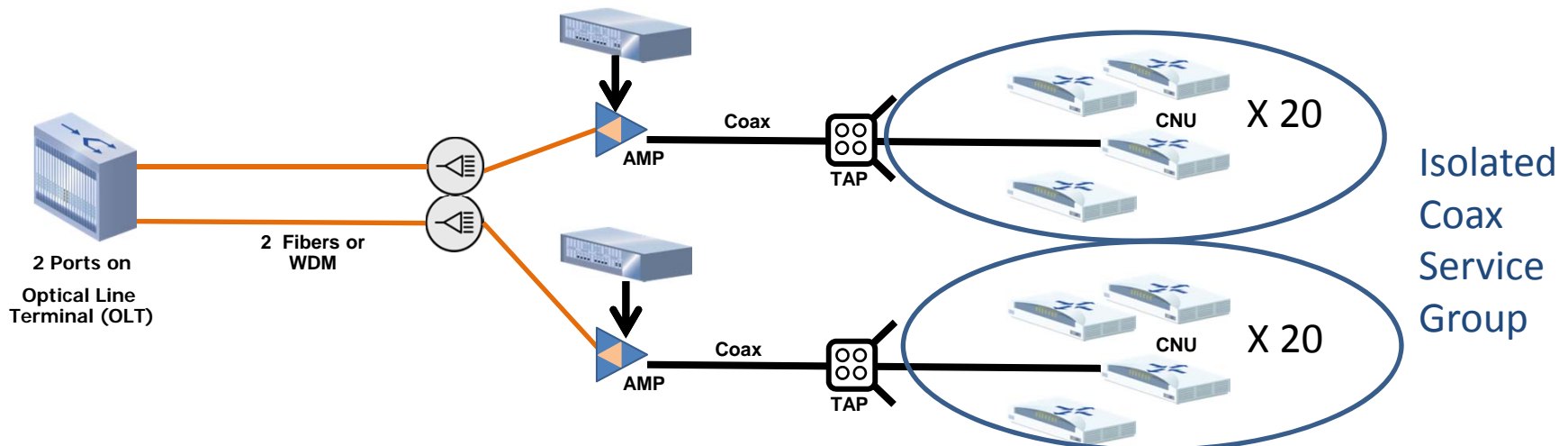


# Multiple OLT Ports with Repeaters

- A Single service group of 40 in the example below is created



- Two service groups of 20 in the example below is created



# Conclusions

- Media Converter Repeaters
  - Low Cost and Simple devices are great for the outside plant.
  - Repeaters can support a large Coax network
  - Repeaters allow for lower delays
- Media Converter Bridges
  - Allow for oversubscription of the coax and fiber segments
  - Good solution if fiber is limited.
- All we need is a PHY
  - An EPoC PHY will allow the specification of CLT's, Media Converter Bridges, and Media Converter Repeaters by Operators in RFPs or other system level standards groups.
  - Don't try to specify hybrid bridge/repeaters or their functions in IEEE 802.3. They don't belong here.