A View on Scope, Assumptions, and Needs

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Introduction

- In November, the IEEE 802.3 Working Group accepted the EPOC Call for Interest (CFI) and created this Study Group
  - Created a "commitment to study" and to develop proposal and necessary documentation for the creation of a Task Force
  - Study effort bounded by "scope" and other elements of the CFI
- Moving forward, clarity and consensus on assumptions is fundamental
- Obtaining input and requirements from cable operators is key
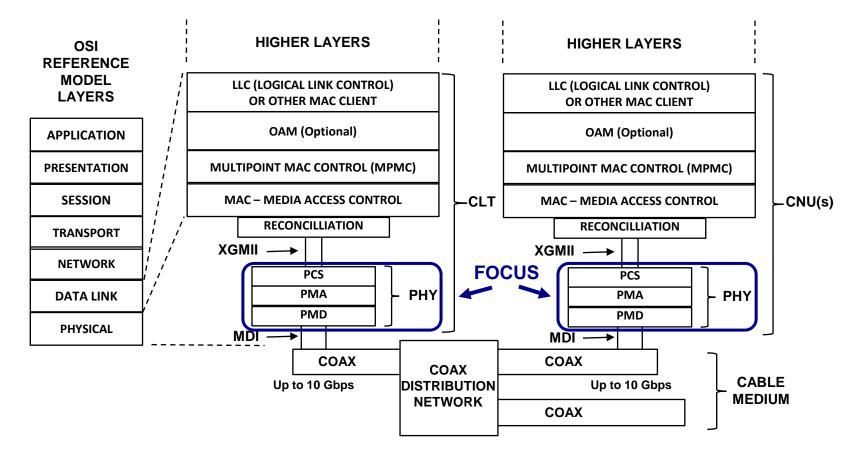
Call For Interest

BRIEF REVIEW

"Next Step: Extend EPON over Coax

- Proposed scope of study:

  A new PHY for operating the EPON protocol over Coaxial Distribution Networks ("EPoC")

  - Up to 10 Gbps downstream / Up to 10 Gbps upstream
    - Support symmetric and asymmetric full-duplex deployments

- Focused project

- No substantive changes to other EPON sublayers

  - Anticipate additional OAM messages for configuration, monitoring, etc."

"Project Focus – Layer Diagram

OSI REFERENCE MODEL LAYERS

APPLICATION	
PRESENTATION	
SESSION	
TRANSPORT	
NETWORK	
DATA LINK	
PHYSICAL	

HIGHER LAYERS

LLC (LOGICAL LINK CONTROL) OR OTHER MAC CLIENT

OAM (Optional)

MULTIPOINT MAC CONTROL (MPMC)

MAC – MEDIA ACCESS CONTROL

RECONCILLIATION

XGMII →

PCS
PMA
PMD
PHY

MDI →

CLT

FOCUS

HIGHER LAYERS

LLC (LOGICAL LINK CONTROL) OR OTHER MAC CLIENT

OAM (Optional)

MULTIPOINT MAC CONTROL (MPMC)

MAC – MEDIA ACCESS CONTROL

RECONCILLIATION

XGMII →

PCS
PMA
PMD
PHY

MDI →

CNU(s)

COAX

Up to 10 Gbps

COAX DISTRIBUTION NETWORK

COAX

Up to 10 Gbps

COAX

CABLE MEDIUM

CLT – COAX LINE TERMINAL
CNU – COAX NETWORK UNIT
MDI – MEDIUM DEPENDENT INTERFACE
OAM – OPERATIONS, ADMINISTRATION, & MAINTENANCE

PCS – PHYSICAL CODING SUBLAYER
PHY – PHYSICAL LAYER DEVICE
PMA – PHYSICAL MEDIUM ATTACHMENT
PMD – PHYSICAL MEDIUM DEPENDENT
XGMII – GIGABIT MEDIA INDEPENDENT INTERFACE "

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"Path Forward

- IEEE 802.3 EPON is in mass deployment

- To meet the growing needs of carriers and cable operators, the EPON protocol must transparently operate over coaxial distribution networks
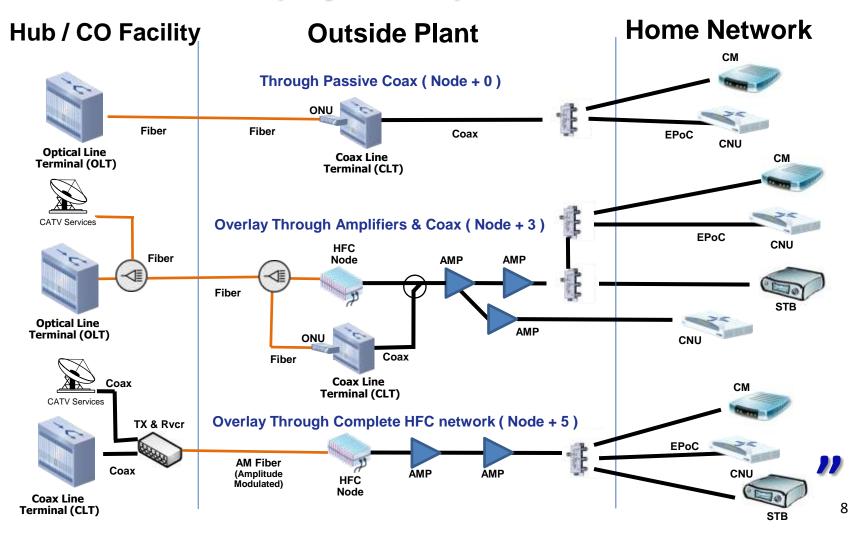
  We recommend that IEEE 802.3 charter a Study Group for a new PHY for operating the EPON protocol over Coaxial Distribution Networks ("EPoC") "

Study Four Coaxial Network Topologies

- Study / consider four network topologies
  1. Cable operator: Passive, "NODE + 0"
  2. Cable operator: "NODE + N", where N > 1 (typically 3)
  3. Cable operator: traditional HFC
  4. MxU (multiple dwelling/tenant): passive and with amplifiers
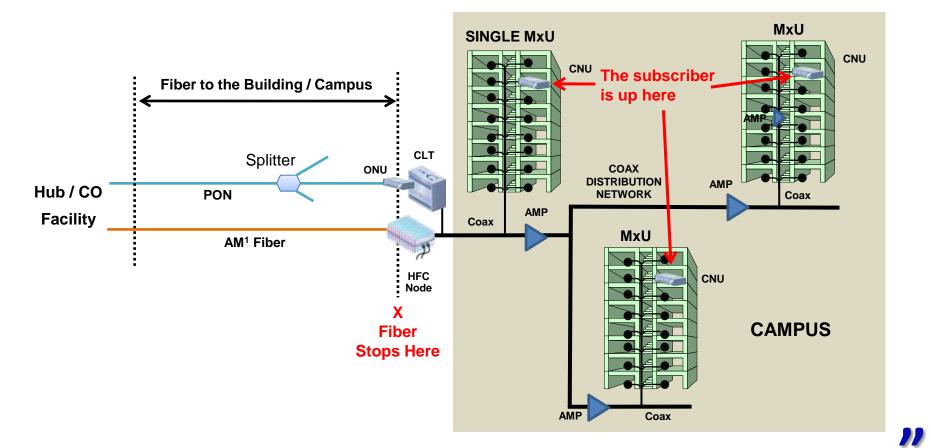   - Cable operator might not own, only share

"1. Considering common coaxial cable topologies and architectures

MSO Deployment Options over Coax

"The MxU Fiber – Coax Gap

- Fiber stops outside the building / campus, remainder of run is coaxial cable

¹Amplitude Modulated

Provisioning and Flexibility

- Cable operator controls use of spectrum
  - Flexibility in use of spectrum
  - Adaptability to U.S. and international configurations
- No interference to (and from) existing services
- Compatible with evolving cable standards and local provisioning
  - "re-provisioning" as needed
  - Adjustability in use of more spectrum

Mark's View and Suggestions on Study Group Work and Developing

FUNCTIONAL ASSUMPTIONS

Study Group versus Task Force

- Study Group
  - Studies high-level issues and requirements
    - Creates PAR, 5 criteria, and objectives to pass to Task Force
  - Examines operational level details consistent with scope and operator requirements that are general to Task Force work
  - Determines "plausibility"
    - Anticipates implementation issues, first pass relative costs, etc.
    - "Within our Study Group 'sandbox', we expect to be able to do this…."

- Task Force
  - Writes the draft standard
  - Selects the mathematics of implementation
    - Modulation, forward error correction, cable impairment protection, etc.
    - Detail cable models and studies
  - Determines PHY initialization, maintenance and management

Industry has Significant Experience

- The good news is that we can look at the experience that has already been developed over the past 15+ years of DOCSIS ®
  - Performance considerations with respect to impairments, etc.
  - Electrical input / output considerations, etc.
  - Etc.
- EPON and 'carrier class Ethernet' expectations are well known
  - IEEE P1904.1 SIEPON
  - Cable Industry and DOCSIS DPoE ™
  - Metro Ethernet Forum (MEF)
- No need to (re) invent everything,
  - Observe, listen, and re-use as needed

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IEEE 802.3

- The IEEE 802.3 Working Group is the authority on Ethernet standards development and maintenance
  - It all happens right here, "we own it"
    - We don't dependently "co-develop" with other standards or specification organizations
    - We do coordinate via liaison as much as possible, subject to our consensus process
  - Study Group / Task Force has to meet 802.3 expectations
- Expect the (draft) standard may be used and depended on by other organizations
  - E.g. IEEE 802.1 may depend in the future as part of a bridging standard
  - E.g. CableLabs, SCTE, SARFT, etc. may choose to use our PHY standard as a component in their future system specifications
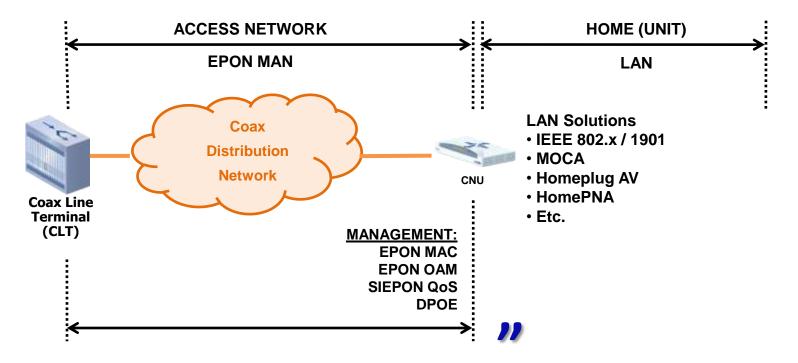
Fundamental Assumptions

- The primary user of this standard is the cable operator
  - To deliver high speed Ethernet services to their subscribers
  - EPoC must permit migration to all services over IP/Ethernet in the future
- The cable operator
  - Owns, maintains the cable network and all services on the cable for all cable operator topologies (non MxU)
    - Including provisioning of spectrum for every service, including EPoC
  - EPoC must not interfere with other services and must be tolerant of "well known" interference from other services
  - EPoC should provide a stated level of service in all cable operator topologies
    - EPoC must be provided sufficient allocations of spectrum and operational conditions for intended operation
    - Details are "to be studied" to determine plausible configurations

Fundamental Assumptions, cont.

- For MxU topologies, the cable operator may not fully own the cable network
  - The cable operator still has to make sufficient spectrum available for their intended operation of EPoC
  - This future IEEE standard may not run in all MxU configurations
    - MxU configurations must conform to IEEE EPoC operational requirements
      - Available spectrum
      - Physical and environmental conditions
    - Details are "to be studied" to determine plausible configurations

"Access Network vs. LAN

- EPON/EPoC MAN is the Access Network
  - Management directly to the Subscriber CNU
  - Does not go into the LAN domain, stops at demarc

ACCESS NETWORK	HOME (UNIT)
EPON MAN	LAN

Coax Distribution Network

Coax Line Terminal (CLT)

CNU

LAN Solutions
- IEEE 802.x / 1901
- MOCA
- Homeplug AV
- HomePNA
- Etc.

MANAGEMENT:
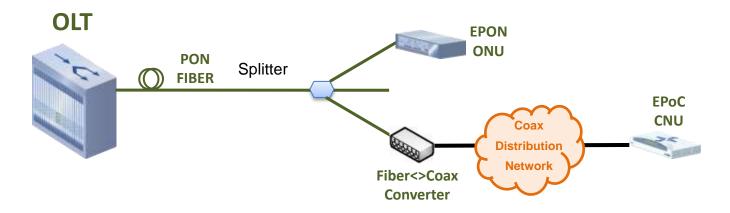EPON MAC
EPON OAM
SIEPON QoS
DPOE

"

Fundamental Assumptions, cont.

- EPoC maintains EPON operational transparency
  - No substantive changes to EPON MAC, MPMC
    - Probably includes vendor's DBA's
    - "substantive" here means architectural or process changes
    - Separate from adjusting known time/timer values (cable network maximum distance, inter packet gap on upstream), for example
  - Carrier Class Ethernet
    - Delay and Jitter expectations?
    - Impact on MEF certifications?
    - What are cable operator requirements / expectations?

A Transparency Wish

- Our work here is limited to a new PHY for EPON
  - CLT and CNU PHY specifications

- Others will take this new PHY standard and incorporate into other configurations that are beyond our scope
  - i.e. IEEE 802.1 bridges, fiber<>coaxial converters, etc.

- It would be nice if we don't break this configuration from being realized:
  - i.e. All EPON ONUs and all EPoC CNUs "on" the same PON are in the same MAC domain
  - Cable operators might be interested in this future configuration

SUMMARY

Summary

- Cable operator input and requirements are needed

- Fundamental assumptions need to be developed to help guide and focus the working group

- Some we are already given:
  - IEEE 802.3 Ethernet and EPON
  - Our CFI scope

- The suggestions here are meant to stimulate future contribution and subsequent consensus building