Ethernet PON (EPON) and the PAR + 5 Criteria

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Agenda

Ethernet PON (EPON) and the

EFM PAR + 5 Criteria proposals

C1 Broad Market Potential
C2 Compatibility
C3 Distinct Identity
C4 Technical Feasibility
C5 Economic Feasibility

Criteria: Broad Market Potential

Multiple vendors, multiple users

Many ILECs supporting PON:

BT, SBC, NTT, Bell South, Deutsche Telecom, Korea Telecom, Singapore Telecom, US West, Swiss Telecom, Bell Canada, etc.

CLEC and ILECs trialing/deploying PON:

France Telecom, Shaw, T-Nova, Rural Telephone, Guthrie Telecom, Comcast, ATG, NTT, BellSouth, BT, Deutsch Telecom, BellSouth and others undisclosed

Market Research Supporting PON:

Potential demand in 10's of millions of ports

Yankee Group, CIBC, RHK market reports: $2.2B 4-yr cumulative (N. America)

EFM interest in EPON:

11 presentations from Service Providers and vendors discussing EPON in first 2 Study Group meetings

Favorable SG voting: 88-3 Jan survey, 59-3 Mar vote

Criteria: Broad Market Potential

Broad set of applications

EPON First Mile networks:

Fiber to the Home
Fiber to the Business
Fiber to the MDU, MTU
Fiber to the Curb

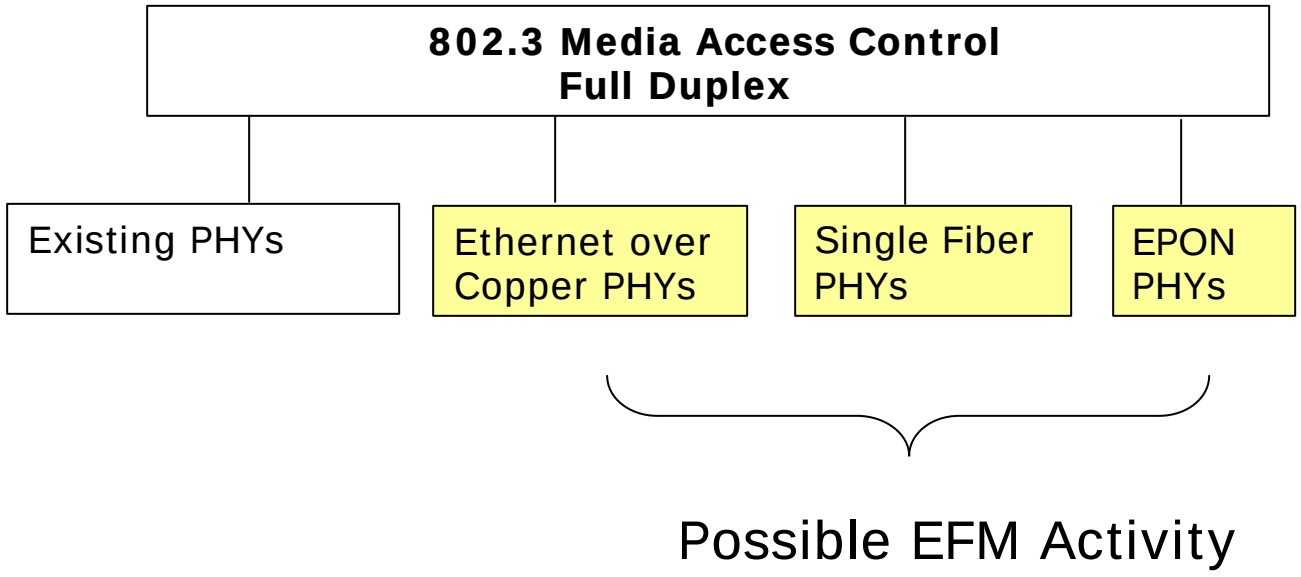
EPON First Mile services:

IP data, voice, video
10-1000 Mbps bandwidth per ONU

Criteria: Compatibility

Goals:

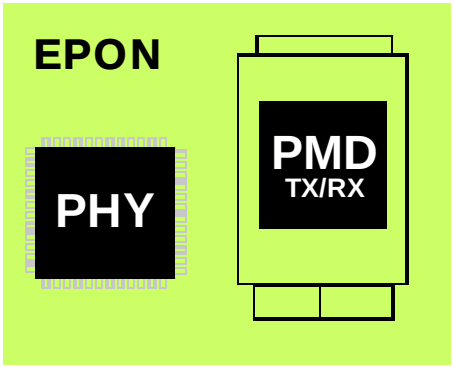
Preserve Ethernet frame format
Preserve Ethernet MAC
Preserve Ethernet MII



Criteria: Compatibility

Focused EPON Standard effort

Focus on PHYs
Minimize number of PMDs
Enable rapid development, interoperability and deployment



EPON standard:

focus, simplify

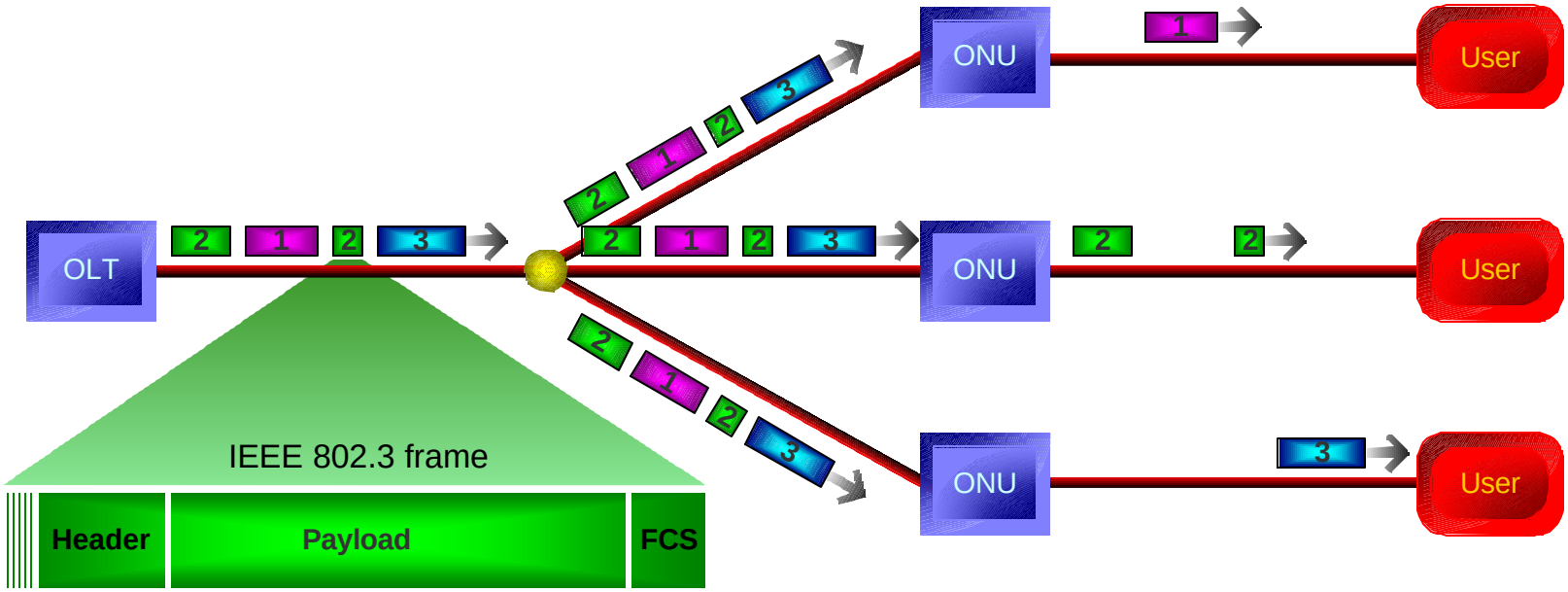
Criteria: Compatibility

	Point-to-point Ethernet	Point-to-multipoint Ethernet
Frame format	**IEEE Std. 802.3**	**IEEE Std. 802.3**
Prioritization	**IEEE Std. 802.1p**	**IEEE Std. 802.1p**
VLAN	**IEEE Std. 802.1Q**	**IEEE Std. 802.1Q**
Rate	**1000 Mbps**	**1000 Mbps**
Encoding	**8B/10B**	**8B/10B**
Physical media	**Singlemode fiber**	**Singlemode fiber**
Optical connectors	**SC**	**SC***
PHY	**1000BASE-LX**	**EPON PHY**

* investigate high density connectors like LC

Criteria: Compatibility

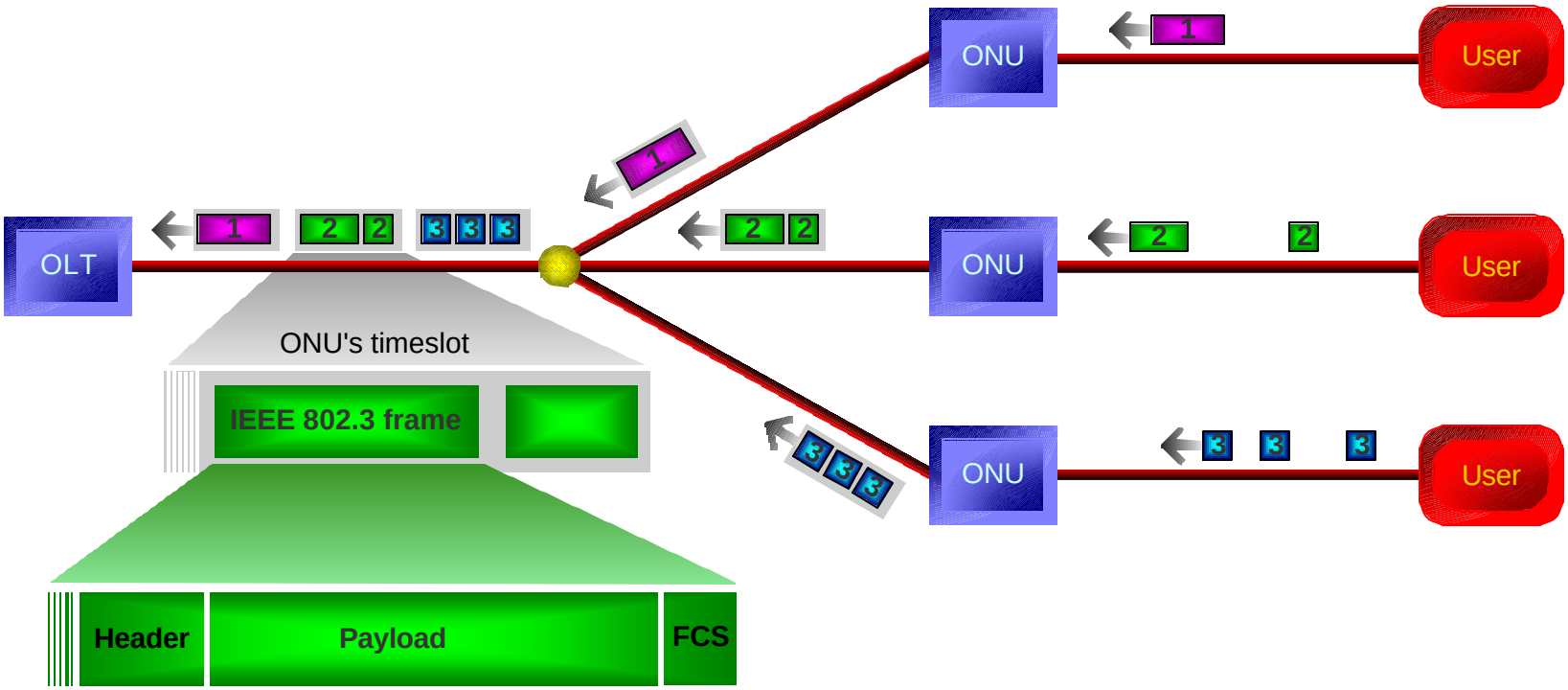
Downstream: broadcast, 802.3 frames



- IEEE 802.3 frame format
- Packets extracted by the MAC addresses at ONUs.

Criteria: Compatibility

Upstream: timeshare, 802.3 frames



- ONU sends Ethernet frames within assigned timeslot
- OLT sees a stream of 802.3 frames from multiple ONUs

Criteria: Compatibility

To preserve the 802.3 MAC, two methods have been proposed:

(1) PHY

standard 8B/10B encoding, SERDES, add multiple access manager, buffer

(2) MAC Control Message

utilize existing PAUSE control frame

Criteria: Distinct Identity

".. Substantially different from other 802 standards"

✓ yes, there is no 802 standard for point-to-multipoint fiber for subscriber access networks

✓ ".. One unique solution to problem"

yes, one PHY, minimum PMDs

".. Follow the existing format and structure of 802.3 MIB definitions"

✓ yes, alignment per EFM OAM&P MIB direction

✓ ".. expand to include new media"

yes, point-to-multipoint optical

".. one solution for each media at a given operating speed range"

✓ yes, one media (SMF), and standard Ethernet rates

Criteria: Distinct Identity

Point-to-point Ethernet

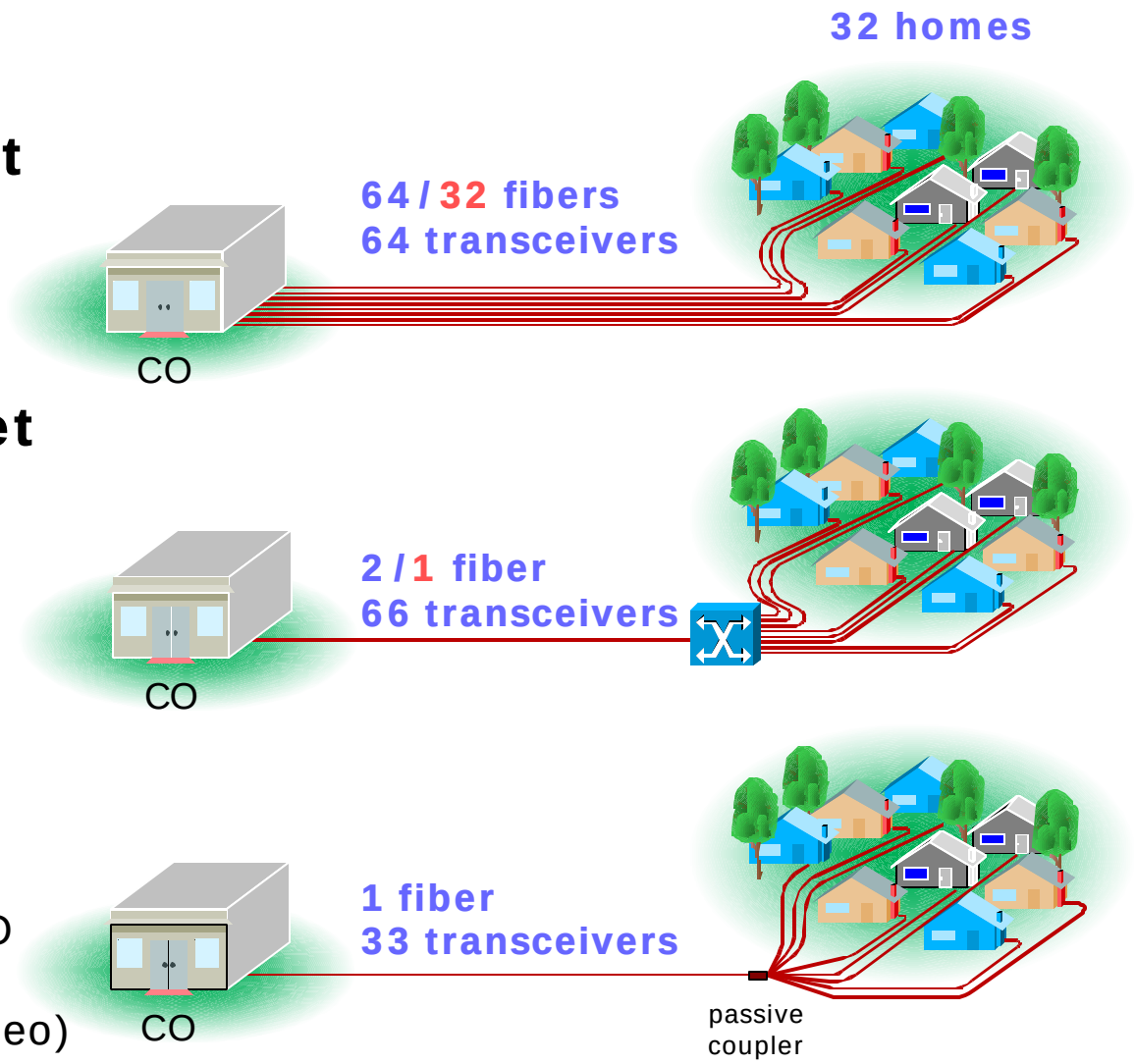
- → 2N fibers
- → 2N optical transceivers

Curb Switched Ethernet

- → Electrical power in the field
- → 2N+2 optical transceivers
- → Drop rate < Trunk rate

Ethernet PON (EPON)

- → 1/2N Fibers
- → N+1 optical transceivers
- → No electrical power in field
- → Minimum fibers/space in CO
- → Drop bursts to trunk rate
- → Downstream broadcast (video)



Criteria: Technical Feasibility

- Initial PON technology, deployment, studies demonstrated by FSAN 1994-2001. Systems currently operating at OC-3, OC-12.
- Ethernet PONs have been demonstrated; no major technology hurdles
- EPONs can use off-the-shelf Ethernet switch cores
- EPONs use standard Ethernet test equipment
- EPONs use currently available optics (lasers, detectors, connectors)
- EPON technical papers presented (ref. EFM meetings)

Criteria: Technical Feasibility

General Agreement

- 802.3/Standard format frames, encoding
- Ethernet standard line rates
- Singlemode fiber
- Single fiber
- Distance: 10 km (min)
- Rate 1000 Mbps
- PMD investigate 1310/1310, 15xx/1310, and ITU 983.3
- PMD 1310 nm at ONU
- Number of ONUs 1 to 16 (min)
- Connector: SC, investigate high density connectors like LC

Criteria: Economic Feasibility

Minimum CO Equipment and Space

→ Minimizes number of CO fibers to manage
→ Minimizes number of CO transceivers
→ Reduces rack space in CO by 1/N

Low Cost Fiber Infrastructure

→ Reduces trunk fiber count
→ Significant economic benefit

Reduced maintenance costs

→ No power in field, passive optics
→ Eliminates curb-side batteries, electronic enclosures

One Network for all services

→ Eliminates need for service-specific infrastructure
→ 10-1000 Mbps services as market requires

Summary

- EPON meets PAR + 5 Criteria
- Optical point-to-point and point-to-multipoint are both important for Ethernet access networks
- Suggest Objective change

  replace: PHY for long distance over PON
  with: PHY for PON, 10 km*, 1000 Mbps, SMF, 1:16*

  *minimum floor