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

**Possible EFM Activity**
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

<table>
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<tr>
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<th>Point-to-point Ethernet</th>
<th>Point-to-multipoint Ethernet</th>
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<td>Frame format</td>
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<td>Singlemode fiber</td>
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<td>Optical connectors</td>
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<td>SC*</td>
</tr>
<tr>
<td>PHY</td>
<td>1000BASE-LX</td>
<td>EPON PHY</td>
</tr>
</tbody>
</table>

* 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


- 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