

# Extended EPON PMDs

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## Call for Interest

Marek Hajduczenia, ZTE Corp.

IEEE 802.3 Working Group, consensus building meeting

San Francisco, CA, USA

July 19, 2011

# Supporters

ordered by company name

- Ed Mallette, Bright House Networks
- Curtis Knittle, CableLabs
- Wang Bo, China Telecom
- Pei Zhang, China Unicom
- Phillip Chang, Comcast
- Charles Chen, Cortina
- Han-Hyub Lee, ETRI
- Duane Remein, FiberHome
- Hiroshi Hamano, Fujitsu Labs
- Victor Blake, Independent Contractor
- Hosung Yoon, Korea Telecom
- David Li, Ligent Photonics
- David Piehler, Neophotonics
- Liu Qian, RITT
- Frank Chang, Vitesse
- Marek Hajduczenia, ZTE Corporation

# Objectives for this meeting

- To measure the interest in starting a study group to develop a standards project proposal (a PAR and 5 Criteria) for Extended EPON PMDs.
  - Precise scope of what 'Extended EPON PMDs' will be discussed and decided by the Study Group when formed
  - For the sake of further discussion, consider it as PMDs supporting power budgets in excess of 802.3ah and 802.3av specifications
- At this time, we **don't need to**
  - Fully explore the problem
  - Debate strengths and weaknesses of solutions
  - Choose any one solution
  - Create PAR or five criteria
  - Create a standard or specification

# EPON – current status

- IEEE Std 802.3av was published in October 2009
- Commercial deployments of 10G-EPON are under way in various locations around the world (Asia, North America )
- IEEE 1904.1 (SIEPON) project was created after the release of IEEE Std 802.3av, driven by industry interest
- End EPON users (service providers) have raised a number of key questions:
  - **how to leverage EPON architecture in rural areas**
  - **how to further increase subscriber density in CO**
  - **how to decrease the cost of connection per subscriber**
  - **how to serve more people, at larger distance from CO using IEEE 802.3 EPON equipment and avoid proprietary solutions**
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# Why a New CFI Now?

- A new effort is needed to bring operators and suppliers together and discuss extended power budgets for EPON
  - Discussions between service providers and system suppliers are already underway in several locations (China, Japan, USA )
  - **We may see beginning of development of regional and non-interoperable PMD specifications and regionalization – not a good thing for EPON!**
- IEEE 802.3 WG is the right location for such efforts
  - EPON was developed within 802.3 WG (802.3ah & 802.3av projects)
  - Other interest groups and service providers are looking to 802.3 WG for guidance on the future of EPON technology
  - **A solution from 802.3 WG is needed to avoid proliferation of proprietary solutions and development of operator-specific solutions**

## “Extended EPON PMDs” Study Group Focus

- Examine the techno-economic feasibility of higher power budgets for EPON, including among the others extending existing 802.3ah and 802.3av specification by:
  - adding new power budget class(es) for 1G-EPON, 10/1G-EPON, and/or 10/10G-EPON, including extension to PMD specs and alternative mechanisms such reach extenders
  - extending existing management in Clause 45 as needed
- Discuss the number of new power budget classes, target power budget values etc.
- No new data rates, modulation formats etc. Changes to existing MAC and MAC Control definitions to be avoided.
- Reuse existing specifications and limit the number of new PMD types, changes on the ONU side and cost of the overall solution

# Extended EPON PMDs Market

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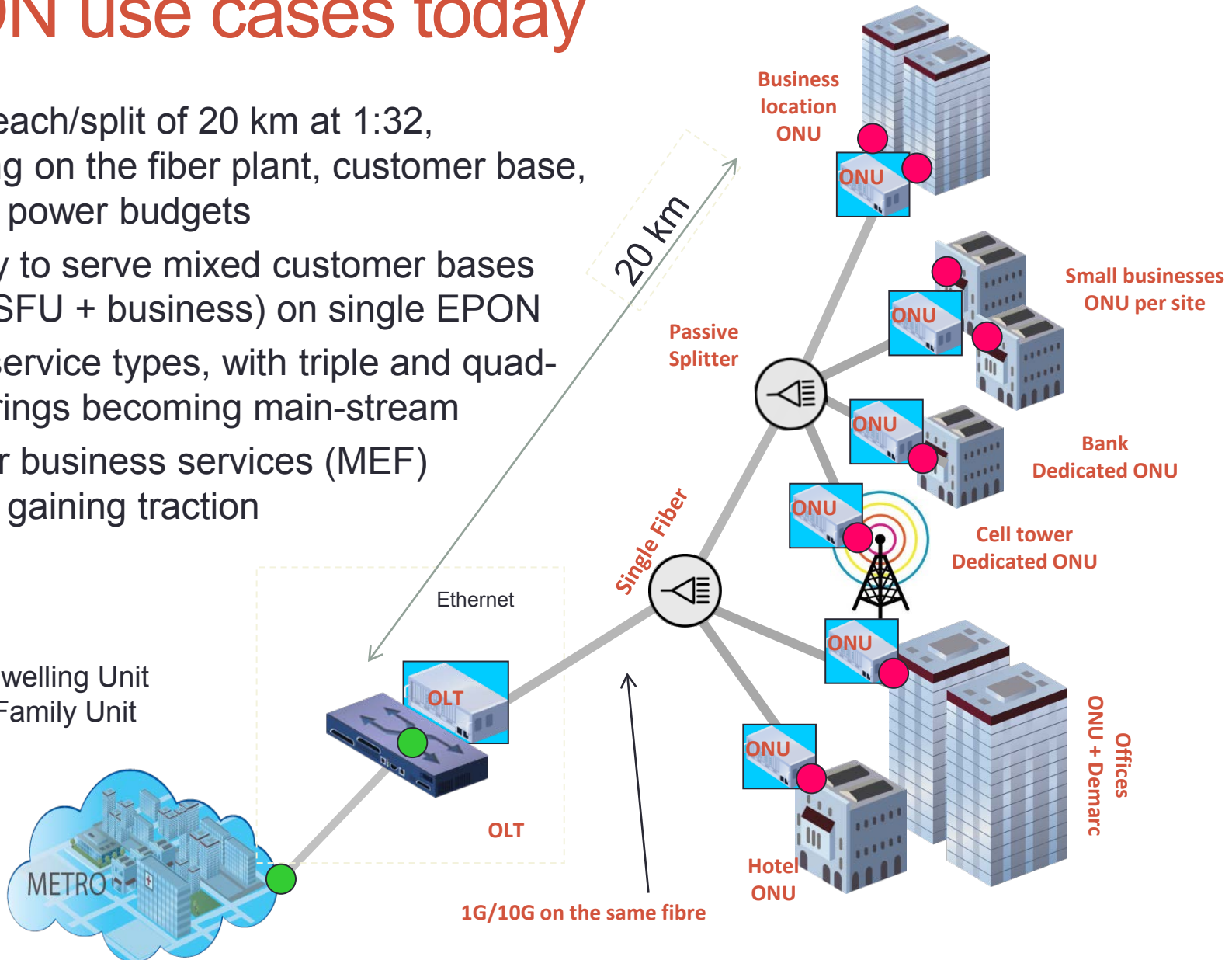
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# EPON use cases today

- Typical reach/split of 20 km at 1:32, depending on the fiber plant, customer base, available power budgets
- Tendency to serve mixed customer bases (MDU + SFU + business) on single EPON
- Various service types, with triple and quad-play offerings becoming main-stream
- EPON for business services (MEF) is rapidly gaining traction

MDU = Multi Dwelling Unit  
SFU = Single Family Unit

Metro Core





# EPON needs to go further

- Neighborhoods close to COs and covered with fiber network are subject to fierce competition among service providers. Being able to serve customers further away from the CO becomes a market differentiator.
- Sometimes, fiber drops in already existing ODN need to be extended to support customers located further away from CO, increasing the distance between ONUs and OLT.
- **CONCLUSIONS**: existing limitations for differential loss may need to be revisited to accommodate larger distance between ONUs connected to the same OLT port. Also, maximum OLT – ONU distance needs to be extended.

# EPON needs to go wider

- Proliferation of micro and pico cells increases the number of ONUs connected per OLT port.
- Being able to connect more customers to a single OLT port (assuming bandwidth demand is not a problem) leads to lower cost deployments (more connected subscribers share a port)
- **CONCLUSIONS** : need to support larger split ratios, leading to higher power budget requirements. 1:128+ split ratio at ~5 km is what operators are looking for today, with tendency to increase to 1:256/512 at 2-3 km distance for dense metro scenarios (~31-33 dB power budget).

# EPON proliferation

- EPON is used in various applications around the world: SFU, business and commercial customers, mobile backhauling (with / without physical link protection), MDU with coax / LAN on UNI side, video distribution systems and industrial applications.
- Cost-effectiveness of EPON, its technical maturity and large industrial eco-system make it an attractive alternative to exiting xDSL / coaxial links.
- EPON is also used in emerging applications, developed because of EPON's techno-economic success. As an example, CableLabs developed a set of DPoE™ (DOCSIS Provisioning of EPON) specifications, using EPON as a replacement of DOCSIS for business and commercial services.

# Extended EPON PMDs Technology

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# Technical status for EPON PMD

- 10G-EPON PMDs are available from several manufacturers. Such devices were considered state of the art when 802.3av-2009 was released.
- Development of EPON transceivers has not stopped with 802.3av-2009 publication. The focus of new developments is on improved launch power and better sensitivity 1G and 10G PMD components.

# Higher power budget      many choices!

- There are multiple ways of reaching higher power budget:
  - Increase transmitter launch power (improved lasers, external / internal amplifiers)
  - Increase receiver sensitivity (improved receiver sensitivity, preamplifier)
  - Include in-line amplification (reach extender) providing optical or OEO amplification for passing data streams
  - Decrease the ODN loss (lower loss fiber, improved splitter design etc.)
- Line cost and power consumption per subscriber are primary considerations when designing higher power budget solution for EPON.
- The resulting trade-offs will have to be examined under this project to achieve optimum mixture of advanced technology and low end cost

# Extended EPON PMDs

## Summary & Straw Polls

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## A few words to wrap up

- New applications for EPON are emerging, requiring support for higher power budget(s) for various techno-economic reasons.
- IEEE 802.3 WG is the best forum to address these new requirements in an interoperable manner, preventing likely market segmentation and regionalization
- Support for higher power budgets can be realized today for 10G-EPON and 1G-EPON links in a cost-efficient manner, reusing 802.3 EPON ONU specifications and/or using alternative mechanisms as reach extenders.
- A Study Group within IEEE 802.3 WG is needed to examine this topic in more detail and provide guidance for the industry on EPON evolution in the higher power budget domain.



# Call for Interest

- Should a Study Group be formed for “Extended EPON PMDs”?

(all people in the room)

- Yes:
- No:
- Abstain:

(802.3 WG voters only)

- Yes:
- No:
- Abstain:

# Participation

- I will participate in the “Extended EPON PMDs” Study Group in IEEE 802.3 WG.
  - \_\_\_ Tally
  
- My company would support participation in the “Extended EPON PMDs” Study Group in IEEE 802.3 WG
  - \_\_\_ Tally

# Backup Slides

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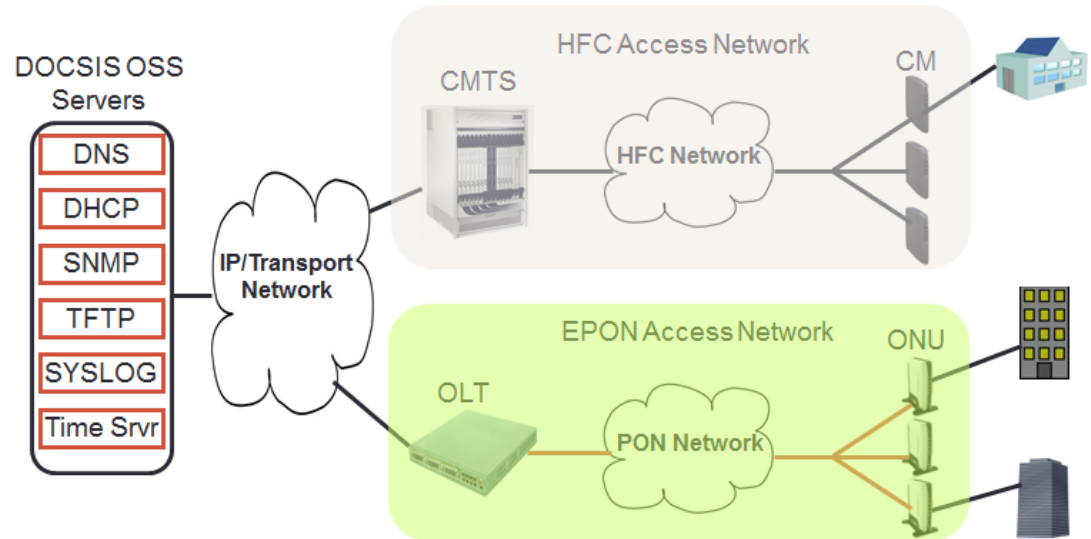
# General Guidelines for When Things Get Done

- CFI stage (where we are right now)
  - Measure interest in forming a Study Group to examine the topic of interest (Extended EPON PMDs) and request 802.3 WG during the closing plenary to form such a Study Group
- Study Group (next step, if approved by 802.3 WG)
  - Identify the scope of the future project and identify its goals, without selecting solution for the problem - see example for 10G-EPON: [http://www.ieee802.org/3/av/tf\\_docs/10gepon\\_objectives\\_0706.pdf](http://www.ieee802.org/3/av/tf_docs/10gepon_objectives_0706.pdf)
  - Based on the identified scope and goals, fill in PAR and 5 Criteria documents (examples for 10G-EPON available at [http://www.ieee802.org/3/av/tf\\_docs/10gepon\\_5criteria\\_0506.pdf](http://www.ieee802.org/3/av/tf_docs/10gepon_5criteria_0506.pdf), <http://standards.ieee.org/about/sasb/nescom/projects/802-3av.pdf>)
- Task Force (future step, if PAR approved by 802 EC and NesCom)
  - Start the technical discussions / decision process on the solutions for the problem identified by the Study Group within the limits established by project PAR and objectives
  - This is when we make technical proposals, select the most fitting one and do draft development + commenting. Not before.

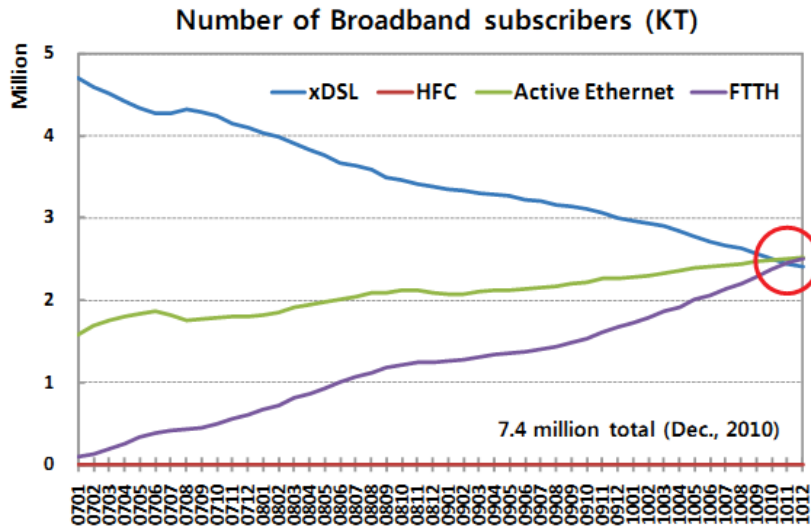
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# DOCSIS Provisioning of EPON

- What is added in DPoE specifications: management, provisioning, accounting, troubleshooting and service configuration.
- Additional requirements for PHY layer e.g. transceiver monitoring support.
- Defines specifications for EPON devices to support DOCSIS network provisioning and service concepts, reusing existing 802.1 and 802.3 standards, where available
- Builds on the flexibility of EPON technology and its similarity (at logical level) to DOCSIS.
- Introduces cost-effective, fiber-based alternative to coax access infrastructure, allowing MSOs lower CAPEX and OPEX for access networks.

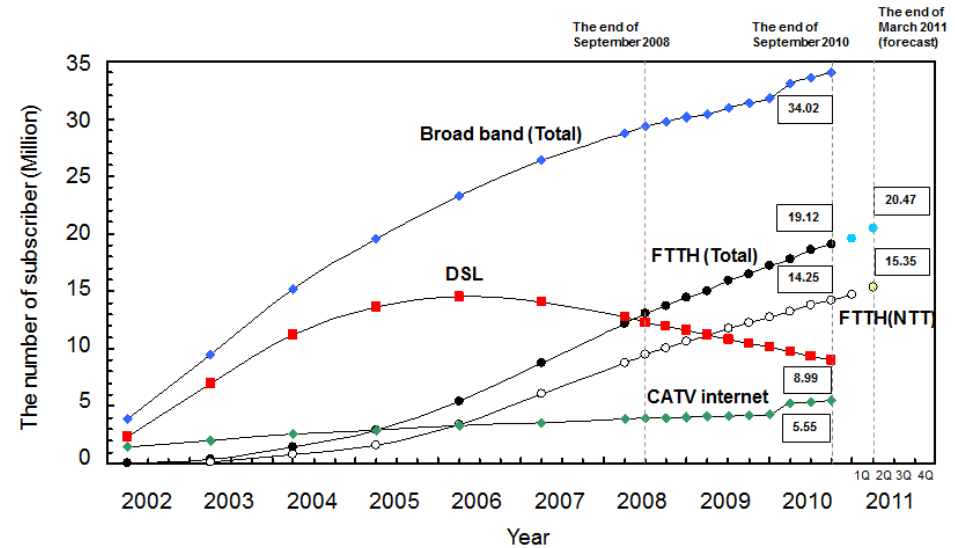


# Largest EPON deployments



Source: Korea Communications Commission

KT (S. Korea), 2.6 million lines, Dec 2010



Source: OFC 2012, NMB Workshop, "FTTx in Japan"

Japan, 19.1 million lines, Dec 2010

- In 2011Q1, 21 million subscribers in China were connected to EPON based access (~6 million new subs for xDSL in the same period)
- In total, ~210 million subscribers served via EPON around the world (MDU, SFU, SBU scenarios) as of 2011Q1 (source: internal ZTE study)