



400GbE extended reach PMD

Yoshiaki Sone NTT
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Contributors and supporters



Contributors

Lu Huang

China Mobile

Supporters

Lu Huang

China Mobile

Ralf-Peter Braun

Deutsche Telekom

Xinyuan Wang

Huawei

Koichi Tamura

Oclaro

Yasuaki Kawatsu

Hitachi-metals

Jeffery Maki

Juniper

Kiyoto Takahata

NTT

Hideki Isono

Fujitsu Optical Components

Akio Tajima

NEC

Thomas McDermott

Fujitsu Network Communications

Michael Ressler

Hitachi Cable America

Winston Way

Neophotonics

Discussion scope of this session



Main Topic: 400GE extended reach PMD

Related topic: Extended reach PMD for 25G/50G/100G/200G



Main Scope



Related topics

media		Rate									
		10G	25G	40G	50G	100G			200G	400G	
				Gn1		Gn1	Gn2	Gn3		Gn1	Gn2
C2C/C2M interface		1x10G	1x25G	4x10G	1x50G*	10x10G	4x25G	2x50G* 1x100G*	4x50G*	16x25G 8x50G	
backplane		1x10G	1x25G	4x10G	1x50G*		4x25G		4x50G*		
CU Cable		1x10G	1x25G	4x10G	1x50G*	10x10G	4x25G		4x50G*		
MMF		1x10G	1x25G	4x10G	1x50G*	10x10G	4x25G	2x50G* 1x100G*	4x50G*	16x25G	
SMF	500m				1x50G*			2x50G* 1x100G*	4x50G* 2x100G*	4x100G PAM4	
	2km			1x40G	1x50G*			2x50G* 1x100G*	4x50G* 2x100G*	8x50G PAM4	
	10km	1x10G	1x25G*	4x10G WDM		4x25G WDM				8x50G PAM4	
	40km	1x10G	1x25G*	4x10G WDM		4x25G WDM					

* under discussion

Presentation overview



- Market information about extended reach optical interface
- Reach requirement and feasibility problem
- Activity proposal in NG-ECDC

■ Market growth

- 100G market is growing. 400G may follow growth trend of 100GE in near future.
- Early deployment of 400GE module may be in 2017.
- No reason for ER market will not emerge even early on.

■ Expected volume

More than half of inter-building link application.

→15% to 65% of inter-building links may not be covered by 10km interface

[reference]

- Application requirement for 400GE in 10km and above distance [[huang 3bs 01 0714](#)]
- Considerations on the Telecom Application for 400GbE [[song x 400 01a 1113](#)]

Application example

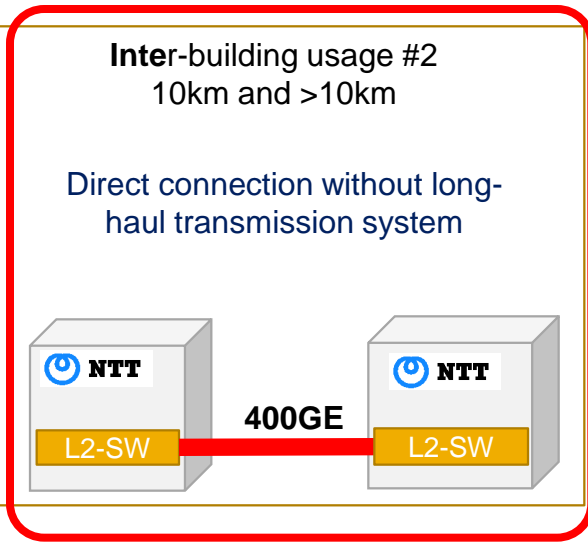
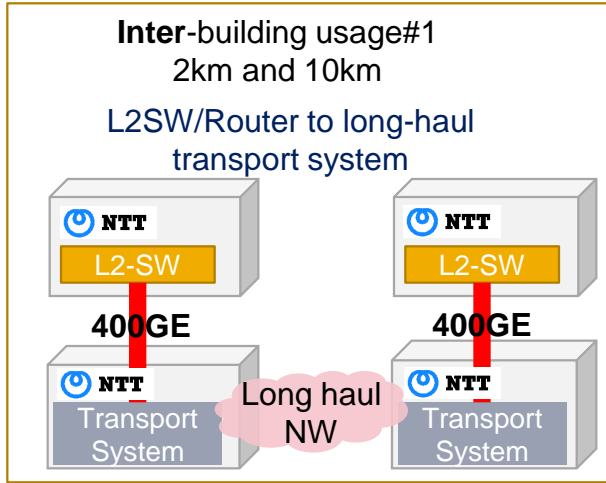
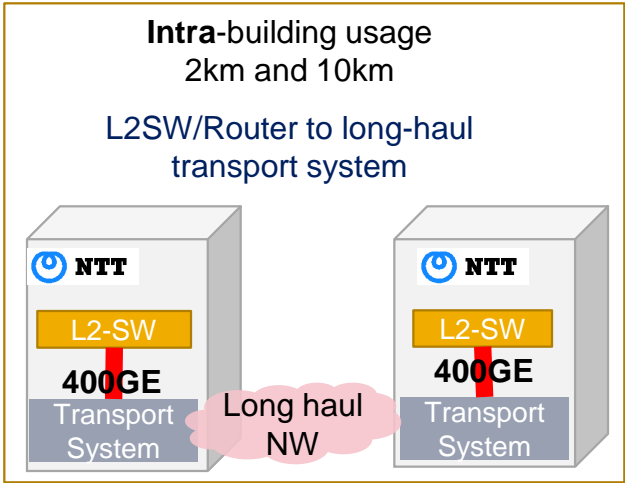


Extended reach(>10km) interface is essential for inter-building connections without long-haul transmission systems.

Media	Duplex single mode fiber		
Transmission distance	2km	10km	40km
Application			
802.3bs Objectives	✓	✓	-

Route-to-transport application

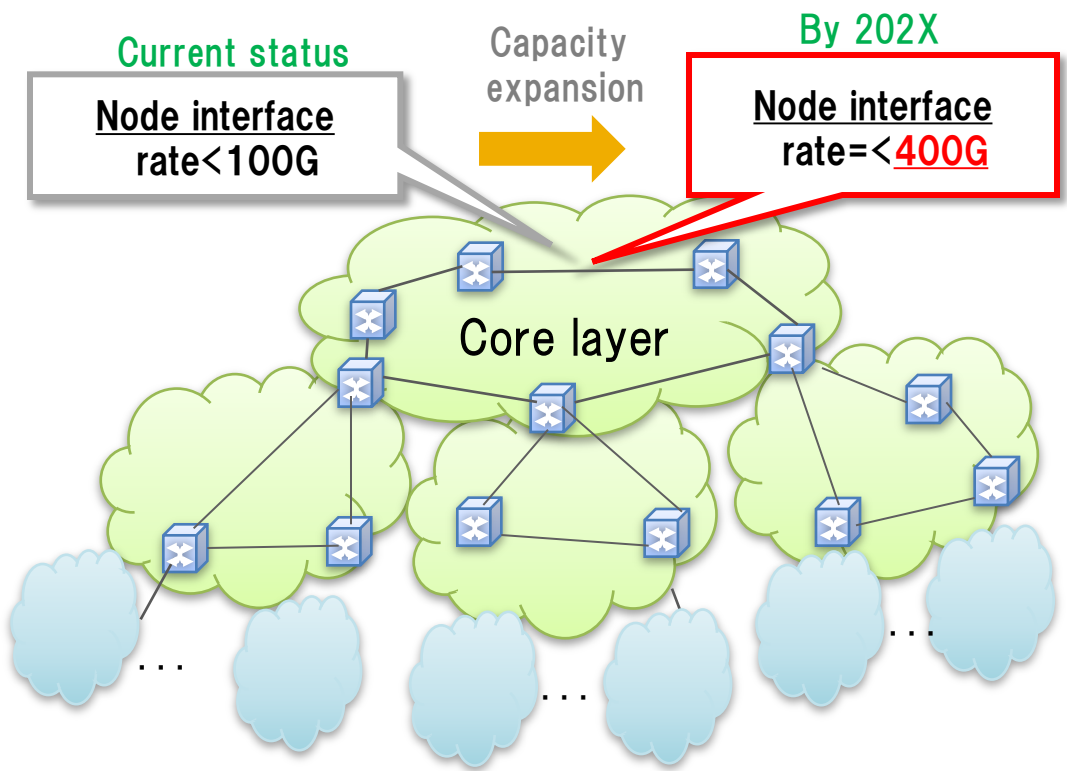
10km reach:
Covers 50% of inter-building links
40km reach(For example):
Covers almost 100% of inter-building links



Usage in core network layer



Currently, 10G/100G interfaces are used in core network layer. The application space will be replaced by 100G/400G interfaces to support traffic growth.



10GBASE-ER/ZR have been very successful.



Similar market is expected for 400G extended reach module after the traffic growth

Extended reach market example (China Mobile)



- Now, China mobile has deployed more than half million PTN nodes, GE in access and 10GE in aggregation and core.
- According our survey, more than 0.5 million 10GE modules has been deployed in CMCC PTN field network, and the proportion of different types of 10GE modules are shown in following table:

Transmission Distance	<2km	10km	40km	80km
Ratio	0.28%	44.46%	44.05%	11.20%

- China Mobile has begin to deploy 100GE in PTN network, mainly in core and aggregation layers. Here is some data from Beijing and Shanghai:

Transmission Distance	<2km	10km	40km	80km
Beijing (>100 modules, only core layer)	0	0	40%	60%
Shanghai (>3000 modules, core and aggregation layers)	0	0	100%	

→ See slide 12 for Chia Mobile network architecture

Reach requirement and feasibility

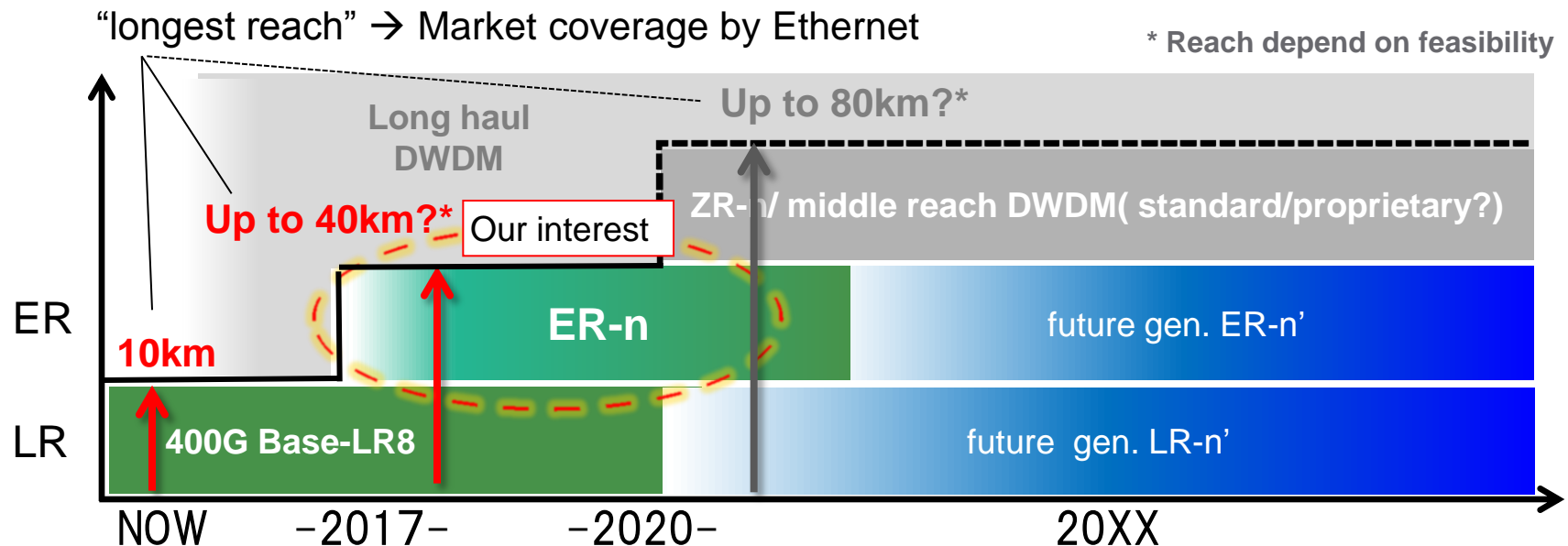


■ Reach requirement

- “The longer, the better” for the longest reach
 - >10km reach will bring more flexibilities in network architecture
- Market experience have proved there is a requirement up to 80km
- Likely 40km is a sweet spot in the current network architecture

■ Feasibility

- “The longer, the better” always faces technology limit.
- Technology limit depends on the timing we assume.



■ Solution continuity

- » There has been successful Ethernet standards for ER interface. (10G, 40G, 100G)
- » Existing Ethernet user expects the same distance coverage for 400G Ethernet to keep the same network architecture

■ Reduction of operation and maintenance cost

- » Proprietary solution may force on operators additional testing (e.g. interoperability evaluation), and continued maintenance/debug of specifications.
 - In contrast, standards made by continuous SDO like IEEE802.3 can reduce such long term operation costs.

■ Utilization of logical/electrical Ethernet technologies

- » Recent interface technologies can not be successful without coordinating various technology areas (e.g. DSP).

Activity proposal in ECDC



■ Background

There is a need for >10km standardized interface for ~2020 market.
The “longest reach” interface should be >10km if feasible.

■ Question

What is the suitable reach for “*longest reach*” 400GbE PMD in ~2020 market?

■ Proposal

Create a technology roadmap to address above question in NG-ECDC.
(possible output=white paper)



Innovative R&D by NTT

Thanks

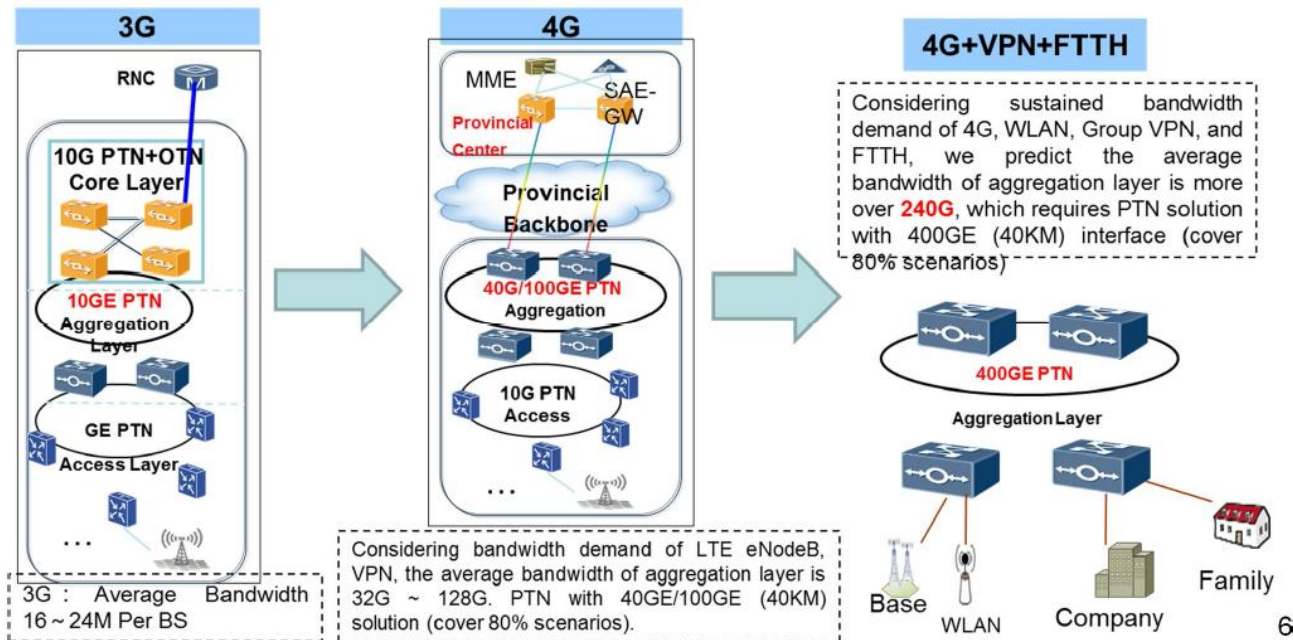
Backhaul network in China Mobile



Application requirement for 400GE in 10km and above distance
 [[huang_3bs_01_0714](#)]

Link Scenario in Backhaul Network

- Based on Ethernet technology, we choose PTN to build the mobile backhaul networks of China Mobile
- Because backhaul network is in metro area, where is usually lack of OTN, most of link between PTN nodes are direct fiber connection
- With the large scale deployment of TD-LTE, PTN is evolving from 10GE to 40GE/100GE, and we believe 400GE will be necessary in the near future



Technical approaches for reach extension



- For 2km and 10km PMD(s)
 - » 8x50G PAM4 (TF adopted as 400GBase-FR8 and LR8)
- Possible approaches for reach extension

Possible approaches of reach extension	
APD receiver	Improve receiver sensitivity
Strong FEC	More coding gain
Equalizer	Relaxation of component bandwidth requirement.

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