

40GE PMD Target

Li Junjie

China Telecom

Zeng Li

Huawei Technologies

Gu Yuan

ZTE Corporation

40Gb/s Ethernet Single-mode Fibre PMD Task Force



ZTE中兴

Supporter

- **Song Shang**
 - **Frank Chang**
 - **Jon Anderson**
- Semtech**
- Vitesse**
- Opnext**

Content

- **40GE PMD distance requirement**
- **40GE PMD wavelength choice**

40GE PMD Objective

40GE SMF SG Objectives

Note: these objectives are currently approved by the study group and are pending approval from the 802.3 Working group in March 2010 plenary meeting.

- Preserve the IEEE 802.3 / Ethernet frame format utilizing the IEEE 802.3 MAC
- Preserve minimum and maximum FrameSize of current IEEE 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface
- Support a MAC data rate of 40 Gb/s
- Use the 40GBASE-R PCS and PMA
- Use only existing electrical and logical interfaces from IEEE Std 802.3 as modified by IEEE P802.3ba
- Provide Physical Layer specification which support 40 Gb/s operation over at least 2 km on SMF.
- Provide optical compatibility with existing carrier 40Gb/s client interfaces (OTU3/STM-256/OC-768/40G POS).

40GE SMF PMD objectives were approved the distance target of 40GE is at least 2km
802.3ba(100GE and 40GE) standard approved the distance target of 40GE is at least 10km

The new 40GE SMF PMD specification should support the majority of application. Not only 2km, but also 10km.

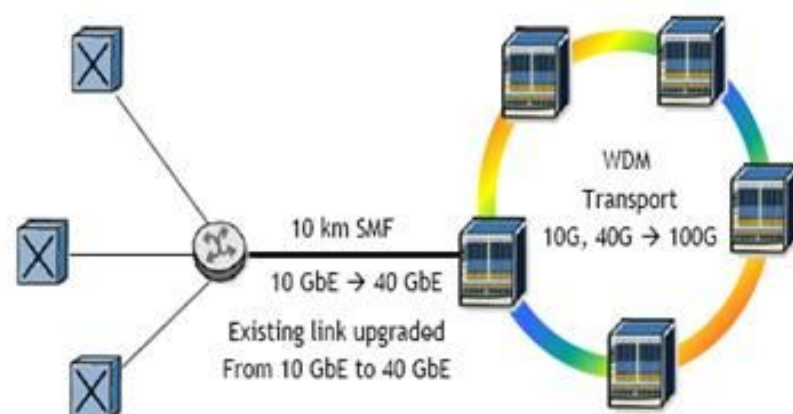
IEEE P802.3ba Objectives

- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum FrameSize of current 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface
- Provide appropriate support for OTN
- Support a MAC data rate of 40 Gb/s
- Provide Physical Layer specifications which support 40 Gb/s operation over:
 - at least 10km on SMF
 - at least 100m on OM3 MMF
 - at least 10m over a copper cable assembly
 - at least 1m over a backplane
- Support a MAC data rate of 100 Gb/s
- Provide Physical Layer specifications which support 100 Gb/s operation over:
 - at least 40km on SMF
 - at least 10km on SMF
 - at least 100m on OM3 MMF
 - at least 10m over a copper cable assembly

40GE PMD Distance Discussion

- Some discussion to 40GE PMD distance was presented in 802.3ba Task Force
 - http://www.ieee802.org/3/ba/public/AdHoc/40GSMF/carter_40_01_0208.pdf
 - http://www.ieee802.org/3/ba/public/AdHoc/40GSMF/simsarian_40_01_0308.pdf
- The conclusion (barbieri_01_0308 of 802.3ba contribution) shows that 10km of 40GE SMF is necessary

40 GbE and 100 GbE Applications



- There will be a market for 100 GbE SMF driven by high-end applications - e.g. IPTV video on demand
- Web surfing: bandwidth per user ~ 100 kb/s vs. HD TV: bandwidth per MPEG4 HD stream ~ 8 Mb/s
- Example metropolitan area network with 1 million households and 10% concurrency:
 - Video on demand generates ~800 Gb/s
 - Web surfing generates ~10 Gb/s
- Data applications can often be cost-effectively supported by 40 GbE switch interfaces
 - Connection from enterprise data center to 40 Gb/s WAN transport
- Need for 100GbE and 40 GbE on single-mode fiber comes from the diversity of applications
 - High-end, bandwidth intensive (e.g. entertainment networking) vs. data centric (e.g. server traffic aggregation)

5 | 40GE SMF for Carrier Applications | March 2008

simsarian_40_01_0308

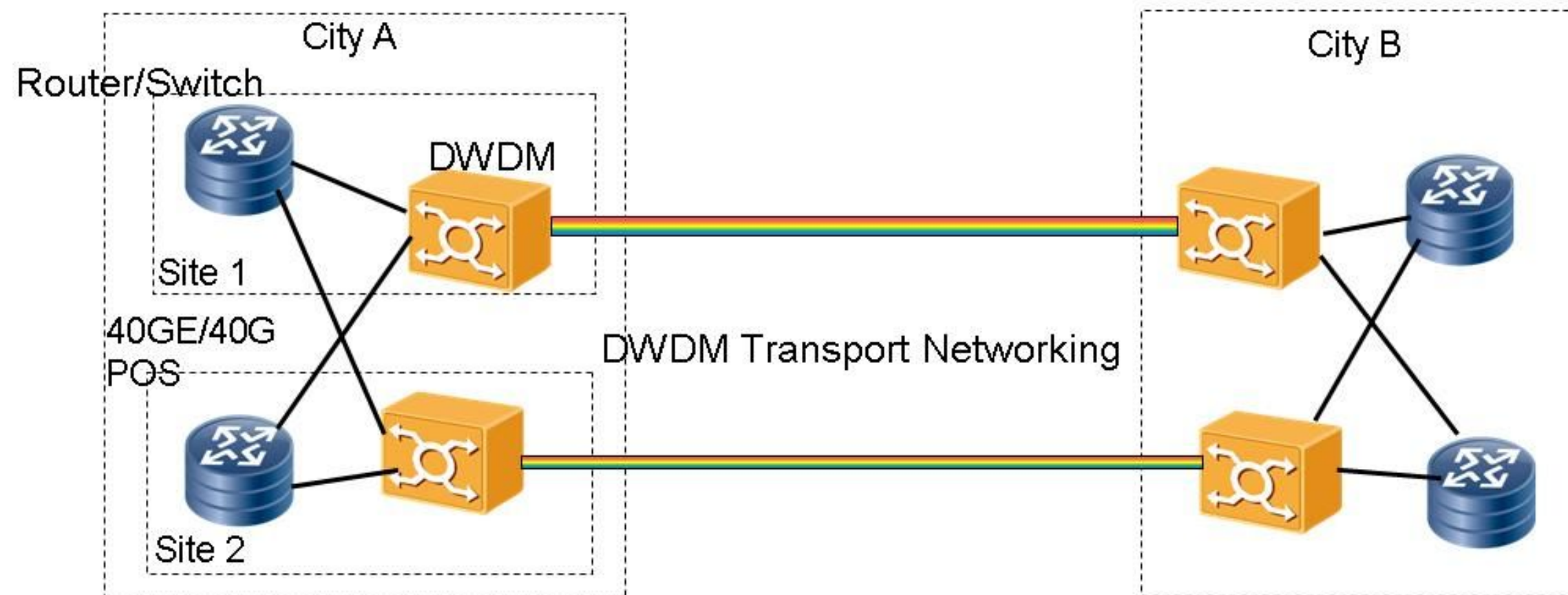
Alcatel-Lucent

Why 10km for 40GbE SMF

- During a teleconference representatives from the Carrier community indicated that SMF is required to connect Enterprise customers to Central Office locations because the Enterprise and Carrier equipment is increasingly not co-located for Ethernet-based WAN interconnection to OTN/WDM transport services.
- 10km ensures adequate coverage from a Carrier perspective to reach a broad population of their Enterprise customers for shared WAN transport.
- 10km would be consistent with de-facto or standard reaches for GbE, 10GbE, 100GbE.

barbieri_01_0308

One scenario of 40GE connection



Due to service protection, Routers connection to DWDM equipments with dual-homing configuration

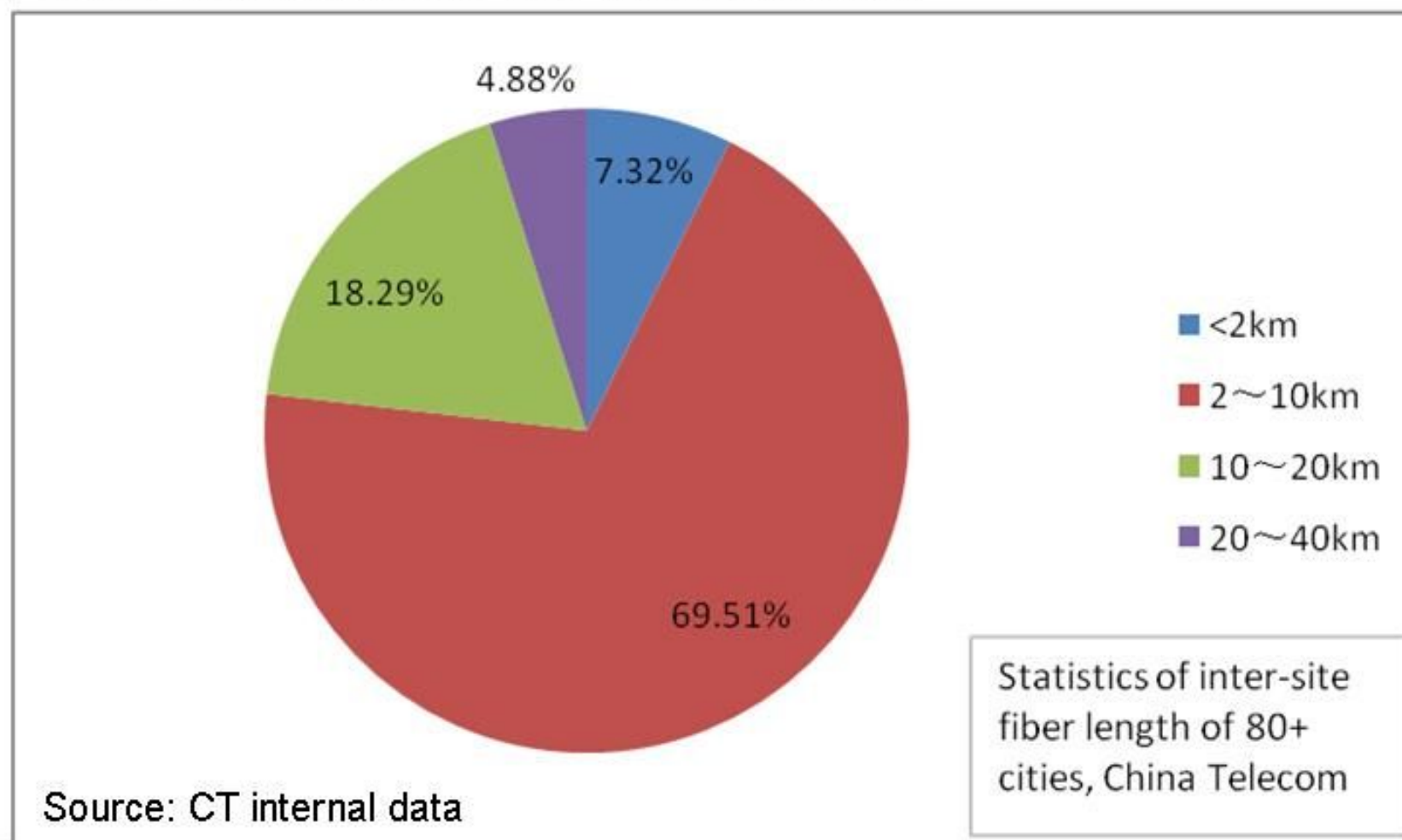
- The intra site connection is in the one building that is VSR
- The inter site connection is not in co-located building, the distance will be more than 2km.

The intra link and inter link must be the unified module and unified interface.

So if specified 40GE SMF PMD, the 10km distance requirement should be considered.

Investigation to inter site connection

- We investigate the inter site distance in more than 80 cities:
 - 2km only cover less than 8% of the connections;
 - 10km can cover about 75% of the connections;
 - 20km can cover more than 95% of the connections.



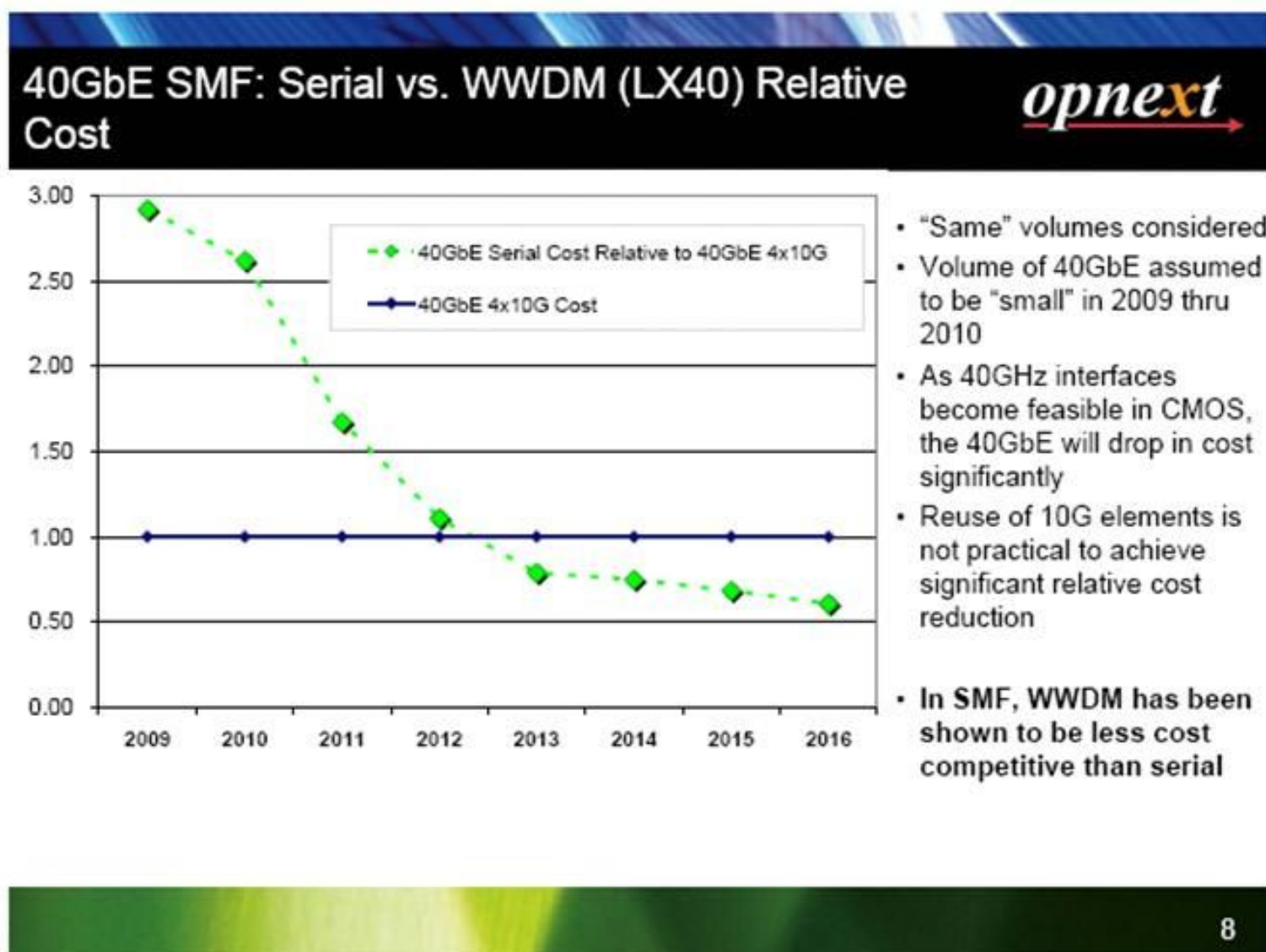
Technical Feasibility

	VSR2000-3R2 (1550nm)	VSR2000-3R1 (1310nm)	P1I1-3D1 (1310nm)	P1S1-3D1 (1310nm)
Wavelength(nm)	1530-1565	1290 - 1330	1307 - 1317	1310 – 1314
Pout(dBm)	+3 to 0	+3 to 0	+4 to 0	+7 to +4
ER(dB)	8.2	8.2	8.2	8.2
Psens(dBm)	-6	-5	-7	-7.5
Distance	2km	2km	10km	20km
Attenuation(dB)	0 – 4	0 – 4	0 – 6	3 – 10.5
CDmax(ps/nm)	+40	+6.6	+16	+27
Penalty(dB)	2	1	1	1
Document	G.693	G.693	G.959.1	G.959.1

It is possible to choose the 1310nm to support the 10km reach. It can cover from 2km to 10km

Economic Feasibility

http://www.ieee802.org/3/ba/public/mar08/traverso_04_0308.pdf

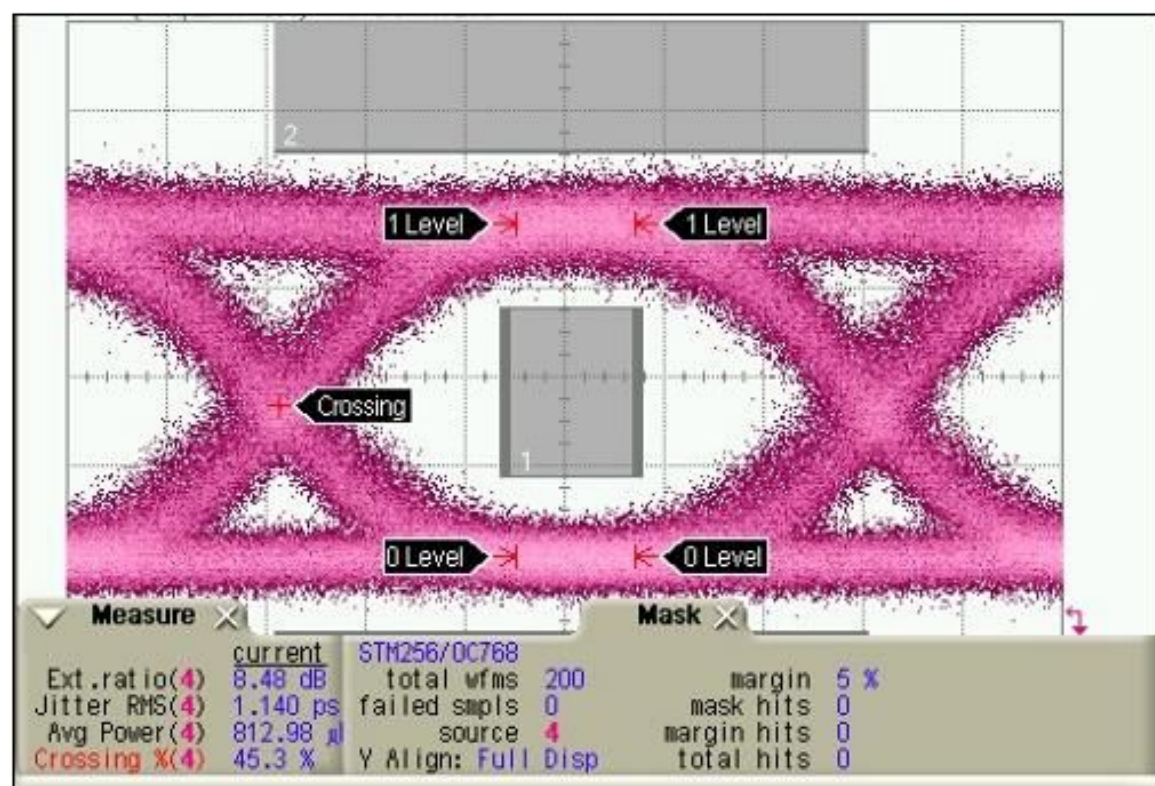


40GE economic discussion was presented in 802.3ba TF. It is showed the 40GE serial module would be reduced cost in trend

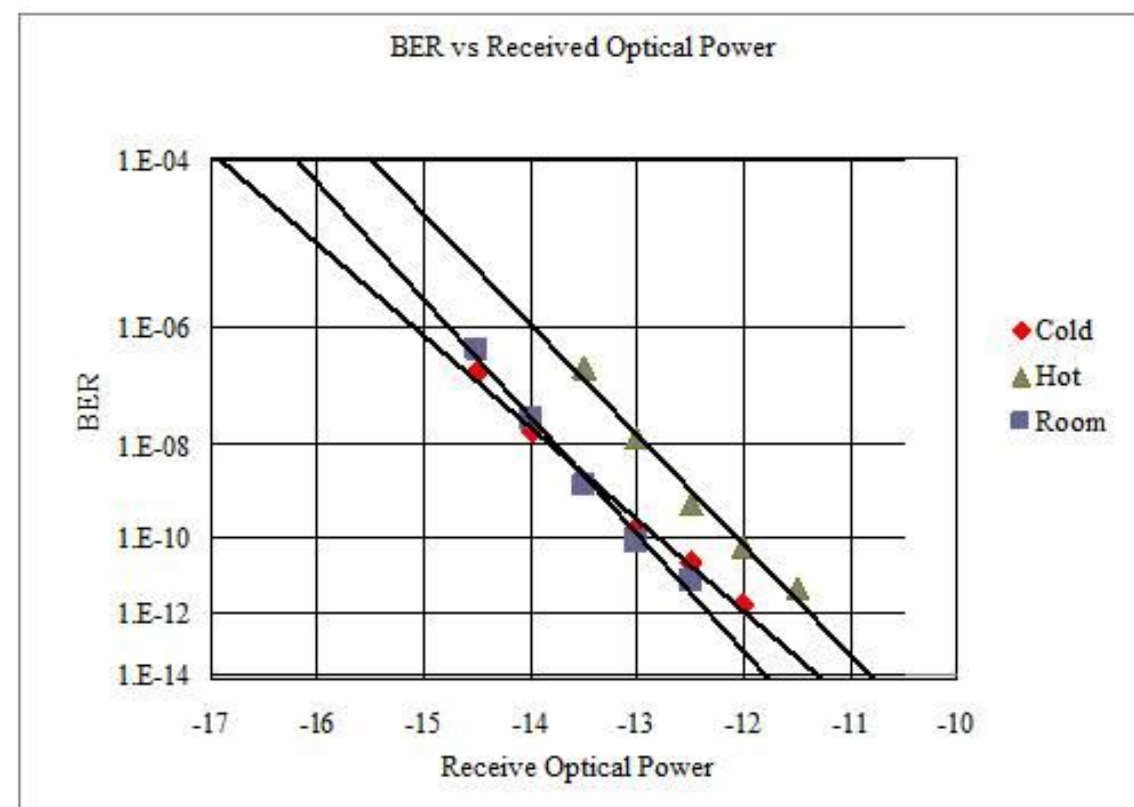
Compatibility

- Receiver Compatibility Requirement in ITU-T G.693 Table4(Note d&e):
 - A receiver in compliance with this application(VSR2000-3R1) is required to operate in any of the application codes VSR2000-3R1, VSR2000-3R3 or VSR2000-3R5. It shall, as a minimum, operate over the wavelength range of 1290-1330 nm as well as the range 1530-1565 nm.
 - A receiver in compliance with application VSR2000-3R2 will operate in either of the application codes VSR2000-3R3 or VSR2000-3R5. It will also operate in the application code VSR2000-3R1 if its operating wavelength range includes 1290-1330 nm.
- Test Results
 - We test the interoperation between a VSR2000-3R2 compatible module (1550nm) and a P1I1-3D1 compatible module (1310nm)
 - 1310nm TX and 1550nm RX: >12km G.652 fiber, penalty <1dB
 - 1550nm TX and 1310nm RX: >2km G.652 fiber, penalty <2dB
- We believe that 1310nm module can be interoperated with existing 1550nm module

40G 1310nm testing



ER:8.48dB



Sensitivity: -12.4dBm (25°C)

Thanks Gu Yuan(ZTE) providing the testing data of 40G 1310nm
It is available of 40G 1310nm 10km module

Summary

- **The 10km connection requirement should be considered to 40GE SMF PMD**
 - It is also compatible to the objective in 802.3bg (at least)
 - It will meet the majority requirement of inter-site connection in carrier networks
 - The same interface and the same module are used in the one network
- **40G 1310nm serial module is a better choice to match the most requirement**
 - It can cover the connection distance from 2km to 10km
 - 10km NRZ 40G module(P1I1-3D1) has been standardized by ITU-T G.959.1 and will be commercially available
 - Possibility of more extended distance target, if choose 1310nm wavelength
 - P1S1-3D1: distance target 20km in G.652 (ITU-T G.959.1)
 - P1L1-3C1: distance target 40km in G.652 (ITU-T G.959.1)
- **It is proposed the 1310nm P1I1-3D1 application specification be adopted for P802.3bg**

Thank You