



400GE SMF considerations

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Outline



High-bitrate application background in China

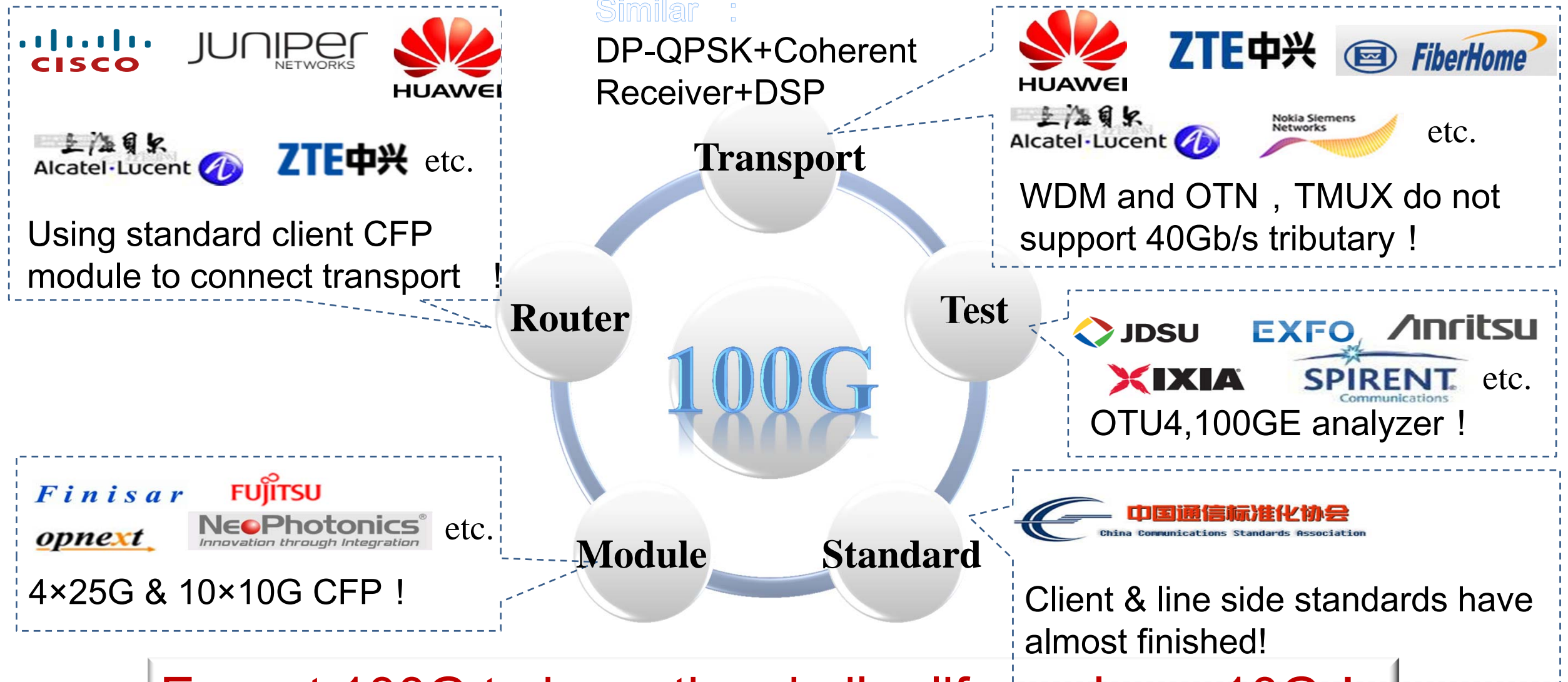


400GE SMF technical scheme discussion



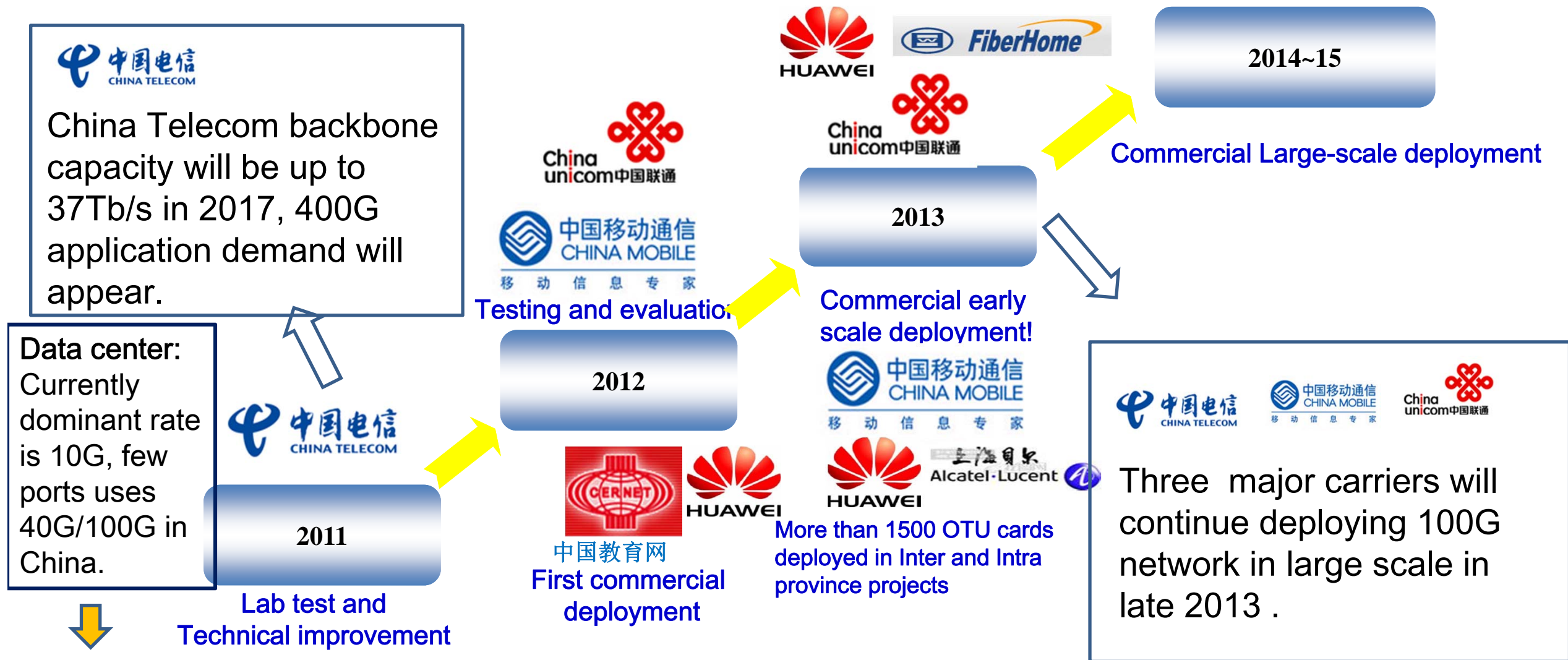
Summary

100G industry status in China



Expect 100G to have the similar life cycle as 10G !

100G application in China



400G application may firstly appear in long-haul application in China !

400GE SMF target distance discussion(1)

IEEE 802.3 GE~100GE existing SMF target distance

Bit-rate	Application Code	Target Distance	NOTE
GE	1000BASE-LX	5km	SMF,1310nm
10GE	10GBASE-SW/ 10GBASE-SR	10km	SMF,1310nm
	10GBASE-EW/ 10GBASE-ER	30km/40km	SMF,1550nm
	10GBASE-LX4	10km	SMF,1310nm,WDM
40GE	40GBASE-LR4	10km	SMF,1310nm,CWDM
	40GBASE-ER4 (TBD)	30km/40km	SMF,1310nm,CWDM
	40GBASE-FR	2km	SMF,1550nm
100GE	100GBASE-LR4	10km	SMF,1310nm,WDM
	100GBASE-ER4	30km/40km	SMF,1310nm,WDM
	TBD(802.3bm)	500m	SMF,1310nm,TBD

Target distance may be the balance among application demand, cost, size and power etc. !



400GE SMF target distance discussion(2)

400GE SMF major application field and target distance

1. Large scale data-center intra-connections

500m may be enough in data-center application and at the same time it may reuse 100GE target distance. *(300m will meet most of all data center intra-connections demand in near future in China.)*

2. Metro inter-connections between IP routers

For metro IP application, IP router may use 400GE interface as the PHY to connect directly, and reuse existing 10km & 30~40km target distance may be preferred.

3. IP routers and WDM/OTN transport inter-connections

Typical distance between IP routers and WDM/OTN transport equipment is 2km. A few will be between 2km and 10km as equipment room rearrangement. Thus 2km may be another option for 400GE SMF target distance.

400GE SMF target distances are proposed as follows:

(1)500m (2)2km;(3)10km;(4) 40km; and 2km is the competitors with 10km in some ways.

400GE SMF possible solutions

Potential Scheme

1. $16 \times 25\text{G}$ WDM –duplex SMF / parallel SMF (short term)

In duplex SMF scheme, existing 100GBASE-LR4/ER4 technical proposal can be reused except for new wavelengths and mux/demux redefining.

In parallel SMF scheme, existing 100GBASE-LR4/ER4 technical proposal can be reused except for fiber connector type changing to MPO, and 100GBASE-LR4/ER4 basic modules can be reused.

2. $8 \times 50\text{G}$ PAM-4 – duplex SMF/parallel SMF (short term)

This will introduce new modulation format and need to evaluate system performance & cost.

3. $8 \times 50\text{G}$ NRZ– duplex SMF/parallel SMF (long-term)

50G NRZ devices are more expensive, and normal 50G NRZ transmission performance is poor[~2km],it will need system performance & cost evaluation.

4. $4 \times 100\text{G}$ higher order modulation –duplex SMF /parallel SMF (long-term)

This will introduce new modulation format and need system performance & cost evaluation. For example, PAM-4 and PAM-8 modulation format, etc..

400GE SMF possible solutions are proposed as follows:

Those solution closely related with application transmission distance, $16 \times 25\text{G}$ WDM and $8 \times 50\text{G}$ PAM-4 may be the major proposal candidates in short term,

Summary

1. 100G has begun its scale deployment in carriers and research networks in China. It is expected that 100G have the similar life cycle as 10G.
2. China telecom backbone capacity will be up to 37Tb/s in 2017. Currently data-center dominant bit-rate is 10G and 400G demand may appear firstly in long-haul application in China.
3. Target distance may be the balance among application demand, cost, size, power etc., and (1)500m (2)2km;(3)10km;(4) 40km are proposed as the target distance for 400GE SMF.
4. 400GE SMF have several possible optical transmission solutions, and they are closely related with transmission distance, 16 × 25G WDM and 8 × 50G PAM-4 may be the major proposal candidates in short term. System performance & cost evaluation of these competitors can be investigated in detail in the next step.



THANK YOU
FOR YOUR ATTENTION!