



# Technology adoption scenarios for 2km and 10km SMF PMDs

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# Supporters



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## ■ Background

Several proposals for 2km and 10km SMF PMD have been investigated. However, it seems to be difficult to satisfy all requirements of both PMDs by adopting a single technology.

There may be a good combination of different technologies for 2km and 10km PMDs. In this case, examining the overall advantage will be important as well as discussing individual PMDs.

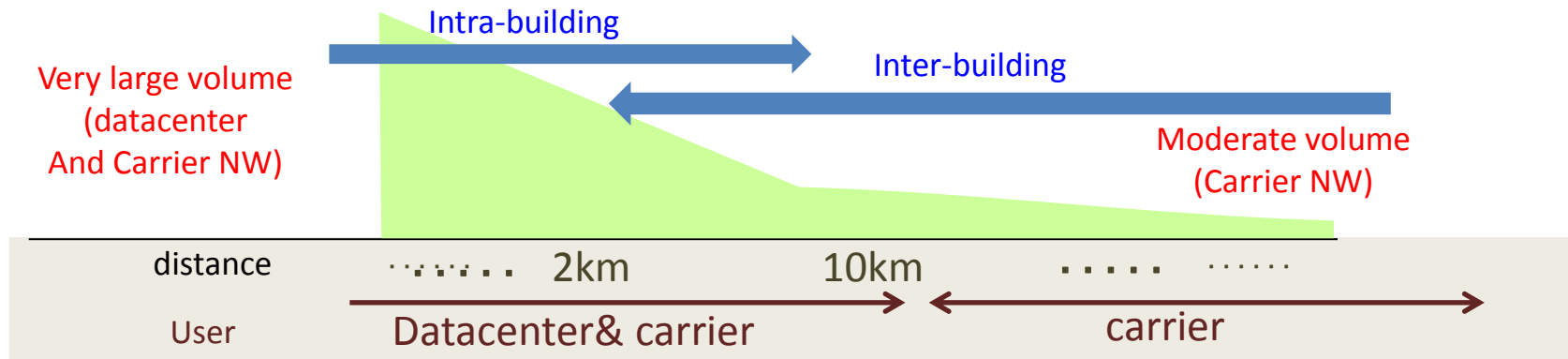
## ■ Overview of this presentation

Discuss the technology adoption scenario for SMF PMDs(2km and 10km) to achieve overall optimization.

# Expected market characteristics for duplex SMF PMDs



The market characteristic(volume and application) is different between 2km and 10km. Consideration of these differences is essential to making good technology adoption scenarios.



Reach	Application and market characteristic
2km	Intra-building and short inter-building links. Fairly large volume compared to 10km PMD will be deployed in datacenter.
10km	Mainly Inter-building links. Relatively smaller volume than 2km PMD but definitely market exists. Currently the longest reach in .3bs but does not cover the potential of the extended reach market.

# Strategy for technology adoption



Different view point is required for 2km and 10km for overall optimization.  
 Adoption of different numbers of lambdas and modulation schemes for each PMD is acceptable for unconstrained overall optimization.

	Position in market	Suggested policy for solution technology adoption
2km PMD	<ul style="list-style-type: none"> <li>•Volume zone of duplex SMF PMD.</li> <li>•Most users will deploy</li> <li>•Not “longest reach”</li> </ul>	<p>■ <b>Individual optimization for 2km has priority over technology harmonization with other PMDs</b></p> <p>Even <i>an improvement with a specific technology</i> [=individual optimization] just for 2km PMD will be a common merit for most users.</p> <p>⇒ <b>Should adopt the solution with potential for cost down/down sizing</b>                  2km PMD is important because it can be lower cost/smaller size compared to 10km SMF PMD.</p>
10km PMD	<ul style="list-style-type: none"> <li>•Not as large volume as 2km PMD.</li> <li>•Expected main user is carrier</li> <li>•“Longest reach” of .3bs</li> </ul>	<p>■ <b>Technology harmonization with other (potential) PMDs is high priority</b></p> <p>Few users deploy only 10km PMD. Market expansion of the adopted solution will be necessary for overall cost down.</p> <p>⇒ <b>Should adopt the solution with potential for reach extension.</b>                  Covering longer reach (as yet uncovered potential market) makes market expansion much easier.</p>

Strategy to gain overall cost-advantage for duplex-SMF PMDs.

## ■ 2km SMF

Individual optimization focusing on 2km reach is priority issue.  
The solution with potential for cost-down/downsize is desired.

## ■ 10km SMF

Technology sharing with other PMDs is priority issue.  
The solution with reach extension capability is desired.

Adoption of different numbers of lambdas and modulation schemes should be an option for unconstrained overall optimization

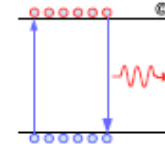


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# Backup slides

From ghiasi\_3bs\_01b\_0514

## Summary



- ❑ **During 802.3bm study phase an SMF reach of 500 m was more than adequate to address nearly all data center but no longer is the case**
  - Minimum reach needs to be 1 km with target of 2 km
  - A 2 km reach will also address building to building application
- ❑ **In 2011 Google was the 1<sup>st</sup> to build a data center with area of ~ 1M sq-ft several time larger than other operating data centers**
  - SuperNAP in Las Vegas with area of 2.2M sq-ft takes the crown
  - In 2014 there are numerous data center approaching or even larger than 1 M sq-ft
    - Building ~1 M sq-ft data center is now the norm
    - Bigger is better
- ❑ **With data centers power dissipation growing exponentially power dissipation has to be a key metric in .bs.**



From nicholl\_3bs\_01\_0514

## 40GbE Deployment Observations

### SMF Reach: 2km versus 10km ?

- Q4/2013 shipments<sup>1</sup>: 88% 2km (LR4-Lite)  
1% 2km (FR)  
11% 10km (LR4)
- Clearly 2km (and low cost) is what the industry wants. Is there enough volume of 10km to warrant a unique PMD ?

### Fiber Type: MMF versus SMF ?

- Q4/2013 shipments<sup>1</sup>: 65% MMF (SR4)  
35% SMF (LR4, FR, LR4-lite)
- Strong demand for MMF, indicating a more DC centric application space ? MMF numbers may be skewed (on the high side) by the 4x10G breakout application.
- No data yet on MMF BiDi, to give some insight into preference for MMF ribbon versus MMF duplex

# 10km and 40km reach need



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From huang\_3bs\_01\_071

## Proposal

Set China mobile as example:

- Now, China mobile has deployed more than half million PTN nodes, GE in access and 10GE in aggregation and core.
- According our survey last year, **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%

- We intend to use 40GE and 100GE interface in metro core and aggregation layer to replace 10GE.
- 40GE and 100GE long distance (40km and 80km) modules are expected to be used with the same percentage as for 10GE, because the application scenarios are totally the same.
- We trust that IEEE802.3 will develop a 40km PMD for 400GE over duplex SMF in a future project.

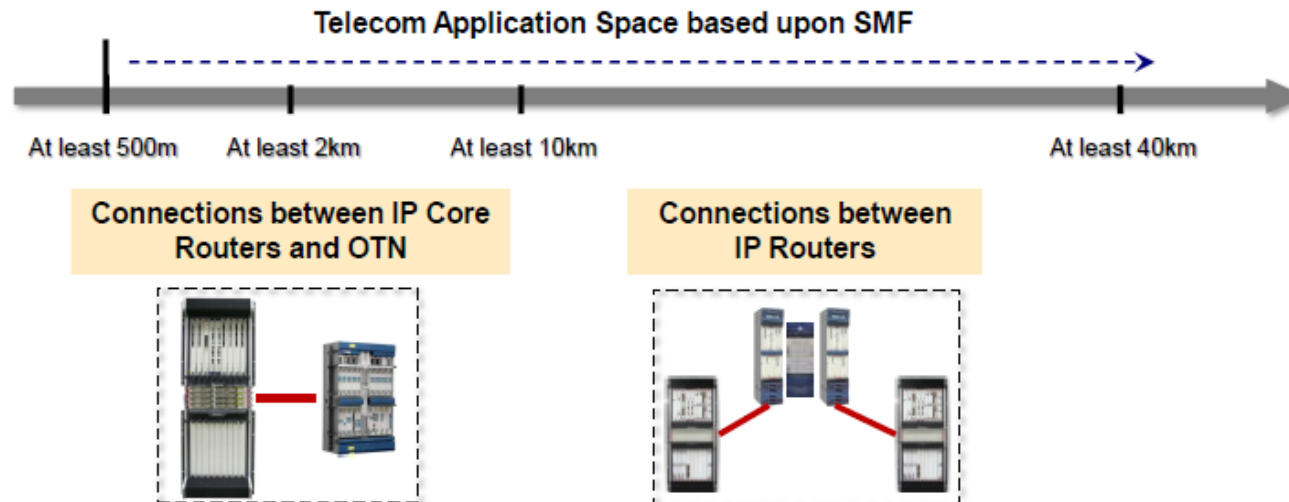
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# 2km, 10km and 40km reach need



From song\_x\_400\_01\_0913

## Motivation and Application Space of 400GbE SMF



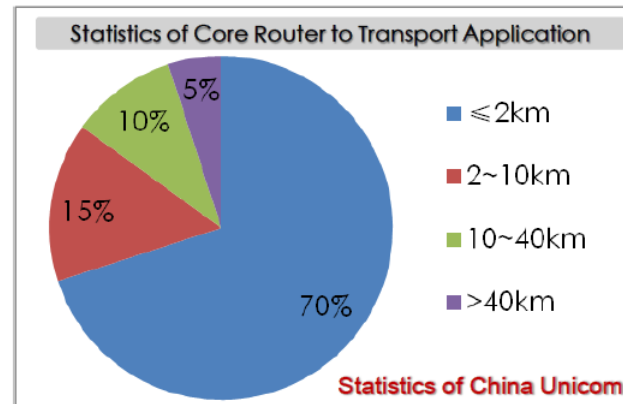
- Telecom application is an important domain for the first adoption of 400GbE.
  - ✓ Connections between IP Routers suggest an SMF distance objective of 10km, and additionally 40km for some of the Metro applications. Duplex fiber solutions are regarded necessary for both applications.
  - ✓ Connections between IP Core Routers and OTN equipments, suggest SMF distance objective of 2km. Also in this case Duplex fiber solutions are regarded necessary.
- So we definitely need an SMF distance objective of 10km.
- If we can generate a specification for at least 2km which enables a significantly lower cost solution than for 10km then a 2km SMF objective should be added.

From song\_x\_400\_01a\_1113

## Application Space of 400GbE (Core router to transport application)

- As the infrastructure, the carrier sites are not expected to change with the upgrade of capacity. The modes of 10G / 40G interconnection (especially considering CHINA169 Network) and other carrier sites' information are of great value for reference.
- China Unicom investigated the distance of ~70 sites for the interconnect between CHINA169 backbone transport room and core router room.
  - 2km can cover about 70% of the connections;
  - 10km can cover about 85% of the connections;
  - 40km can cover at least 95% of the connections.

- Notes: Even the router rooms and the transport rooms are in the same location, 500m can cover only <50% applications in the core router to transport scenario, it is not enough for the most of telecom applications, because of considerations on the “between floors” and “between buildings” scenarios.



# <10km and 40km reach need



From some 400 01 0114

	Requirement	Coverage by the current scope
<b>Intra-building</b> <ul style="list-style-type: none"><li>•Service node to service node</li><li>•Service node to transmission system</li></ul>	~about 10 km over SMF	<b>Already included in current objectives</b> <ul style="list-style-type: none"><li>•at least 2km over SMF</li><li>•at least 10km over SMF</li></ul>
<b>Inter-building</b> <ul style="list-style-type: none"><li>•Between service nodes in different buildings</li></ul>	~about 40km over SMF	<b>Not included in current objectives</b>

10km reach can cover only about 50% of inter-building links

40km reach can cover almost all cases (excluding some exceptions) of inter-building links.

For close inter-building links, Ethernet transceivers are used if it is more cost-effective than long-haul DWDM system.

# Proposals for SMF PMDs



[review of proposals]

reach	proposals
2km SMF	56x8λ PAM4 116Gx4λ DMT 112Gx4λ PAM4 56Gx8λ NRZ
10km SMF	56x8λ PAM4 116Gx4λ DMT 56Gx8λ NRZ