



Transport networks for the next decade

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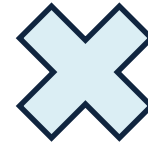
NTT network innovation laboratories

Presentation overview



**Network
requirement**

Carrier networks
toward the next
decade



Data-center-
inter connect

**Future
Ethernet**

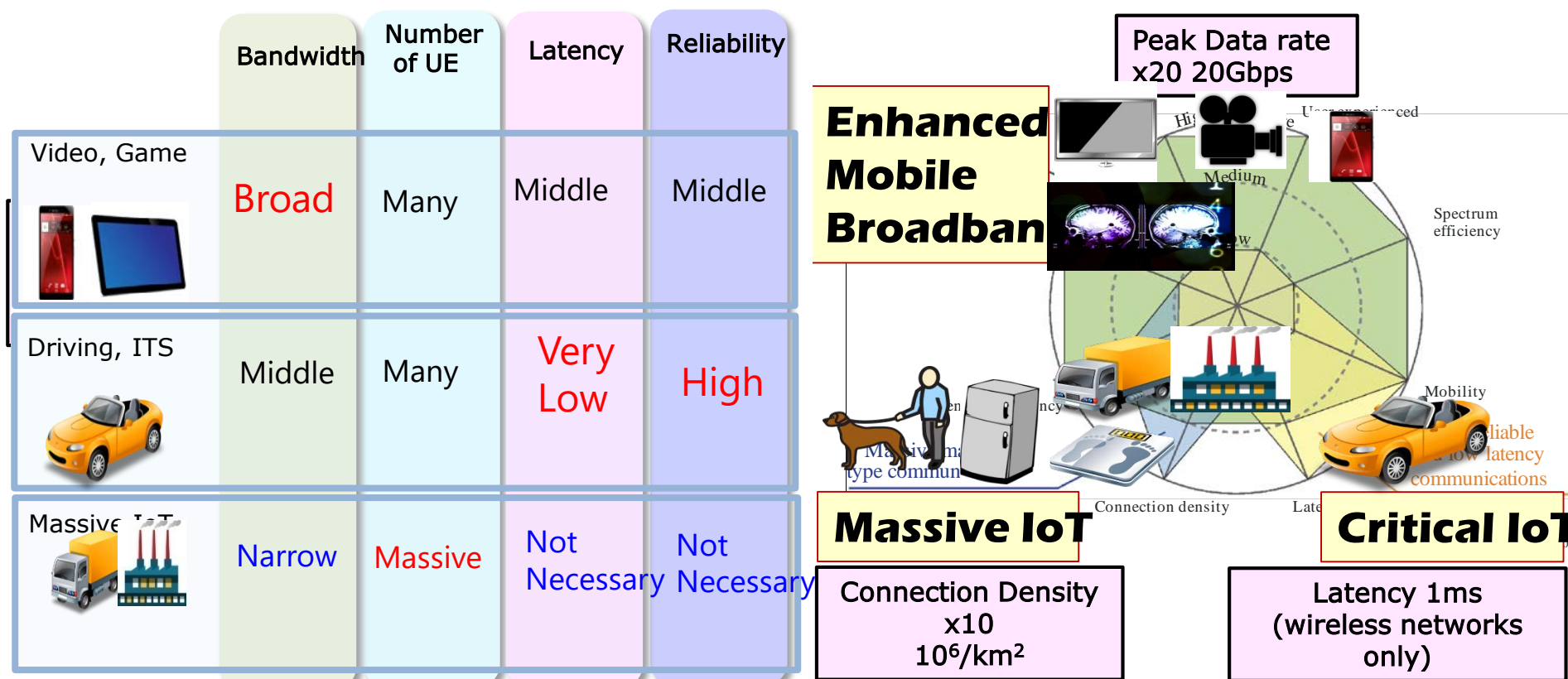
?



Ethernet toward the next decade

Mobile network service in 5G era

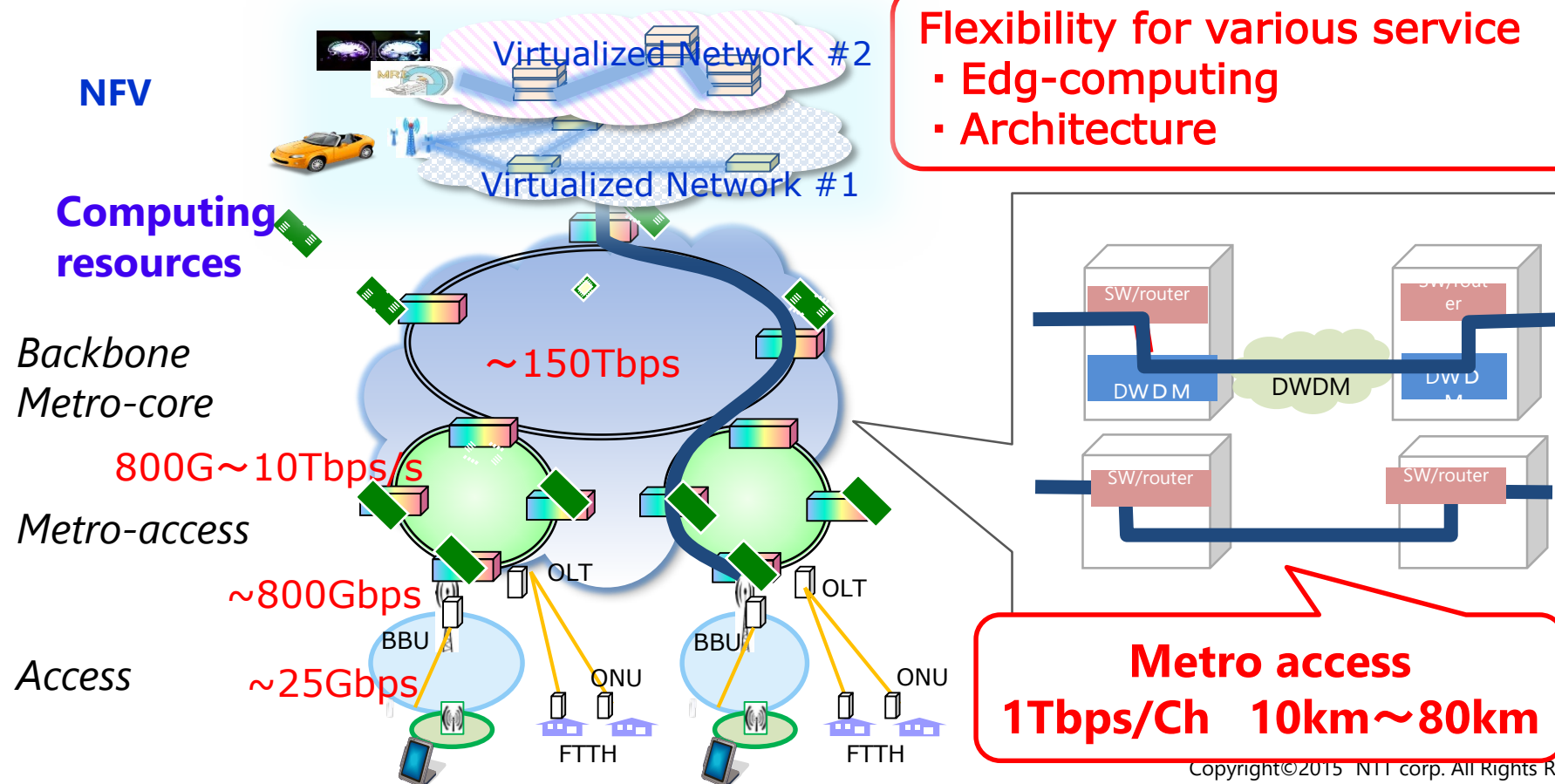
- 5G mobile technologies are planned to enhance key capabilities.
- Required key capabilities differ according to the usage scenarios.
- There are lots of POCs/fields-trials among many carriers.



Importance of key capabilities in different usage scenarios

Metro-access/core transport NW toward the next decade

- In 2026 we will need **more than x25 larger bandwidth** (ref. slide#13) **+1Tbps Ethernet port will be required.**
- Flexibility is achieved using **NFV and edge-computing architecture**



Key to achieve the cost-efficiency



■ Requirement

- Higher performance (bandwidth),
- Higher functionality (flexibility)
- ~~Higher cost?~~ ➡ Lower cost

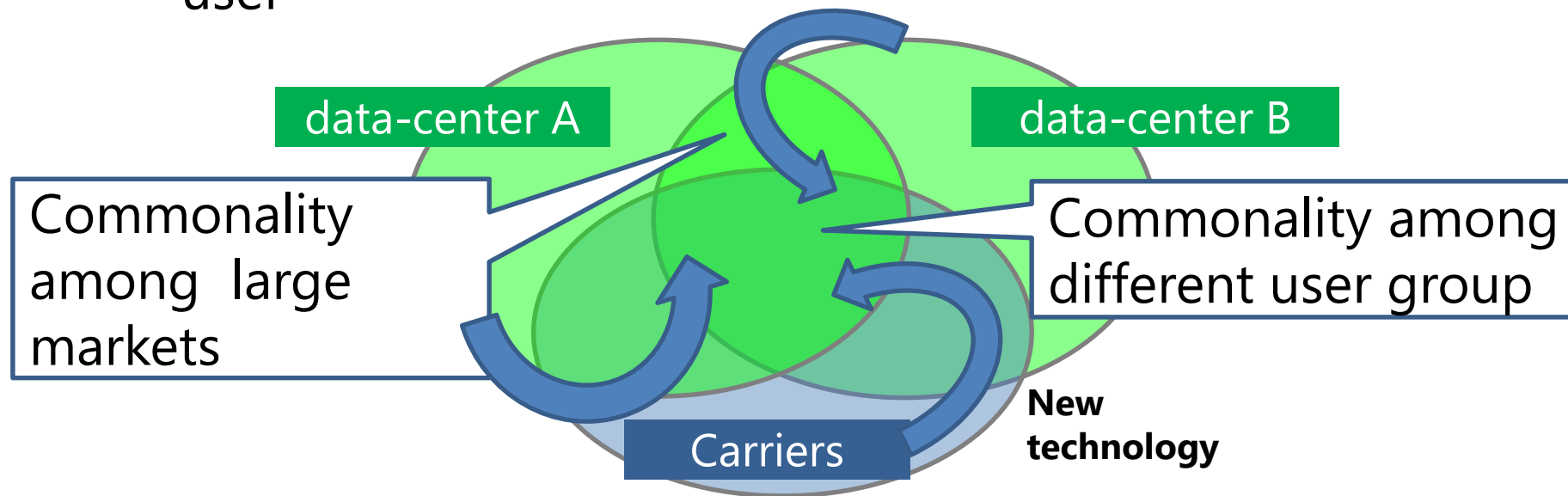
➔ CAPEX & OPEX reductions are necessary

■ Key : Commonality in various solutions

- Hardware/software component commonality
Avoid fragmentation of technology development
- Operation and management commonality
Operation with the same box, same operation-system,
and same operator's skill

Collaborations for successful commonalization

- Commonality among large markets
 - Significantly reduce equipment cost
- Commonality among different user group
 - Accelerate to share new technologies developed by each user



Open innovation is a key for efficient commonalization.

e.g Open Compute Project, Telecom Infra Project

Metro data-center interconnect(DCI) is an emerging area where data-center and carrier can collaborate

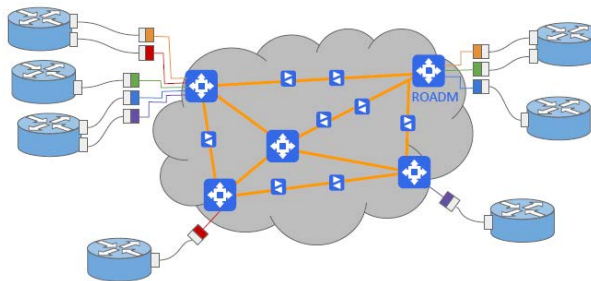
Emerging requirements : metro data-center interconnect

- ~100km reach for P2P metro inter-building connection
- DMDM over SMF

➡ We can have some commonality between carrier and datacenter?

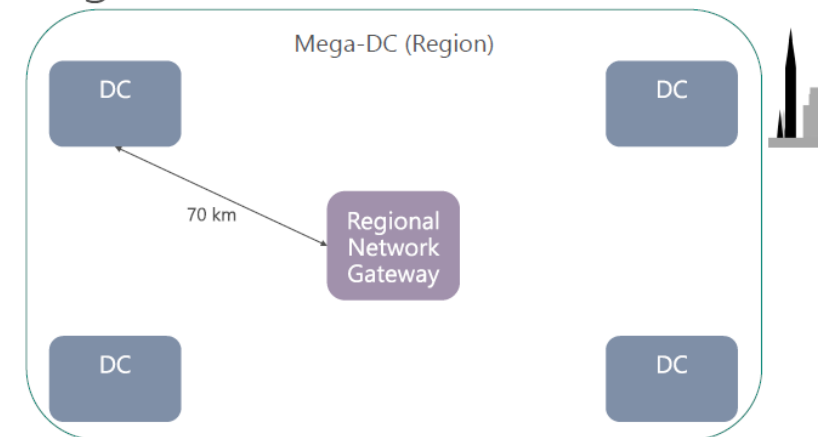
Backbone Network Elements

- Fiber & line system: limited resource, long time to acquire additional fiber and/or light fiber pair
- DWDM terminal/transponder: cost dominated by line-side optics
- Router: cost can be lower than other elements



Google

Mega Data Center Architecture v2.0



Ethernet toward the next decade



Current Ethernet success

- The most widely used standardized interface
- Increasing variety by adopting $[N] \times [25\text{Gbaud/lane}]$ PMDs



Ethernet in the next decade

- Will be continuously the most used standardized interface
- Further variety of PMDs with the low of $[N] \times [X \text{ Gbaud/lane}]$?

■ **Commonality in various PMDs is important** to avoid technology fragmentation, while various types are needed

■ **metro access/DCI networks can be a new area** we can exploit the commonality

Summary



In the next decade

- Service : Various requirements
- Technology : NFV, edge-computing
- Traffic volume : Continuous increase (1Tbps/Ch)



Network requirement

- More bandwidth with flexibility and further cost-efficiency for various services



Key to the success

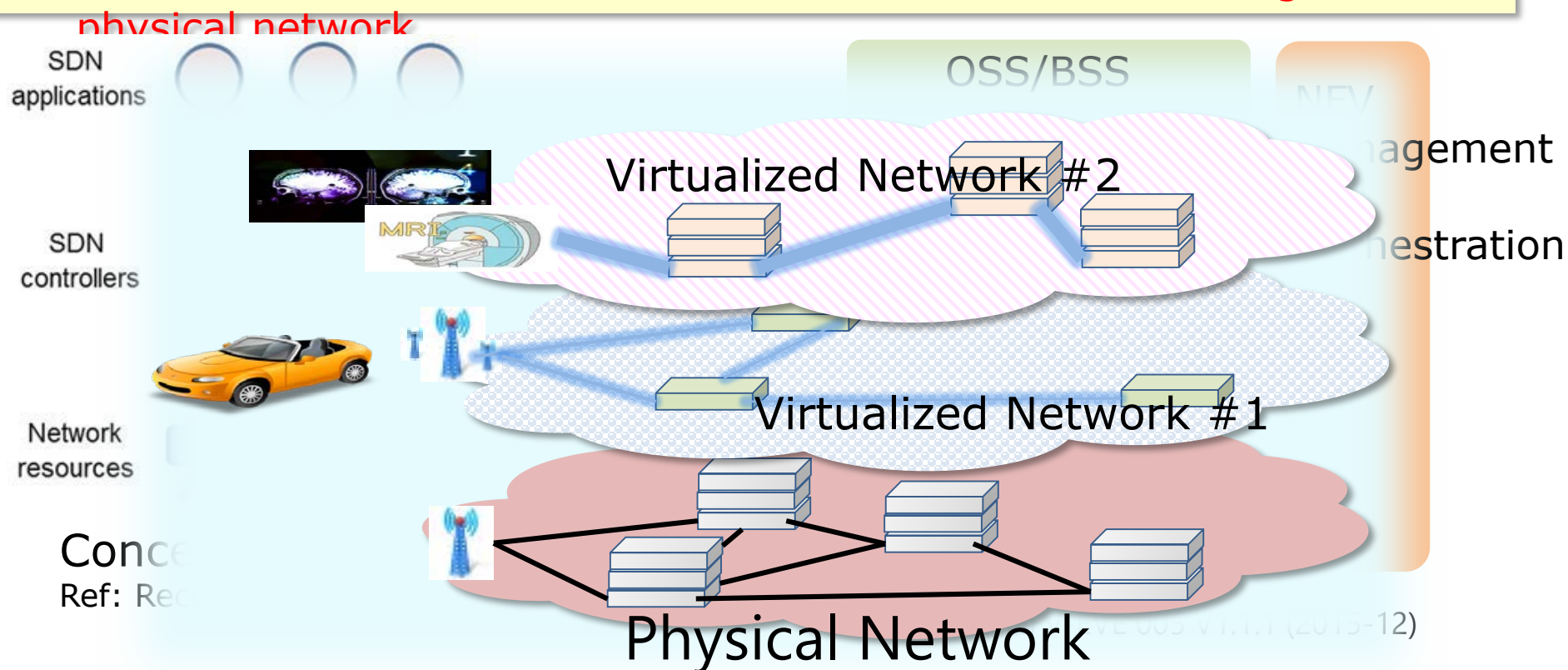
Commonality in various solutions and users collaboration

Thank you

Backup slides

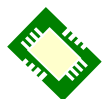
Key innovation#1 :SDN/NFV architecture

- SDN makes network resources that can be abstracted and programmable.
 - NFV framework enables virtualized network functions on physical resources.
- Virtualized networks accommodate various services on a single



Key innovation#2 :edge computing architecture

Edge computing will be a key technology to support various services in 5G era.



Computing resources

Horizontally distributed
(e.g., OTT datacenter)

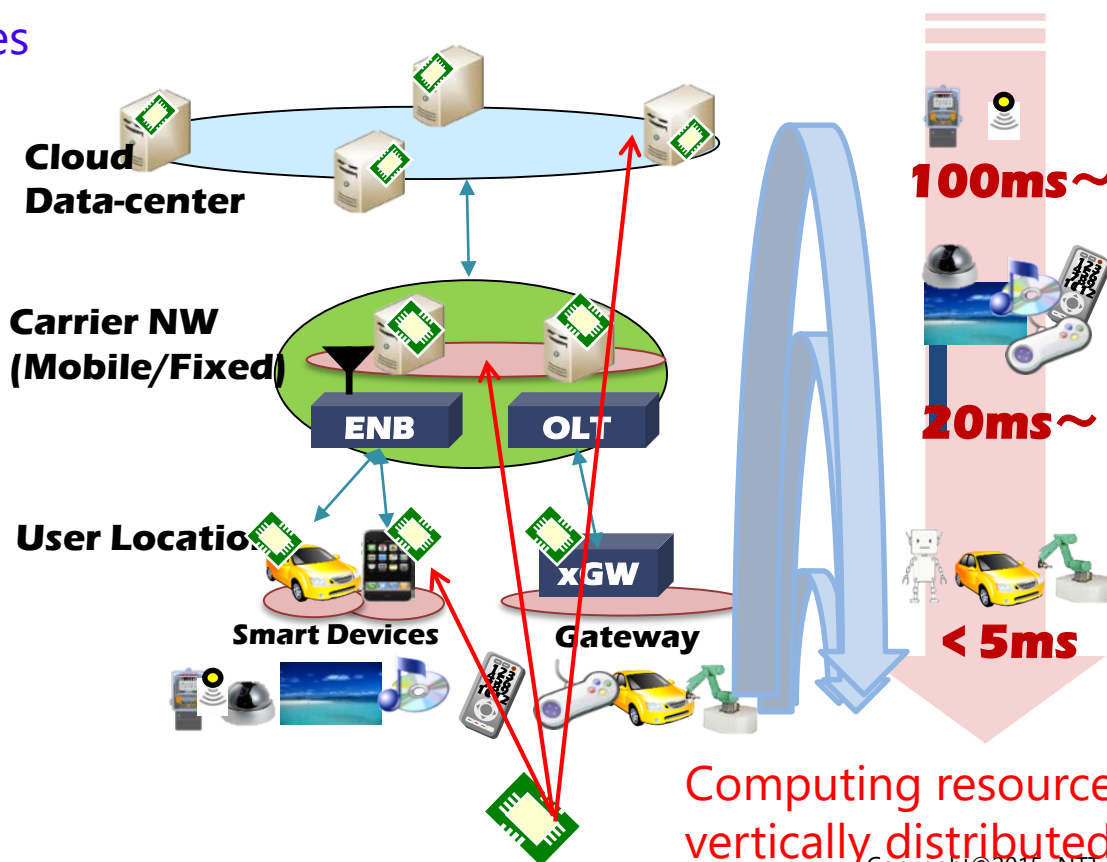
Horizontally distributed
(e.g., carriers)

Horizontally distributed

If we can virtualize functions...,

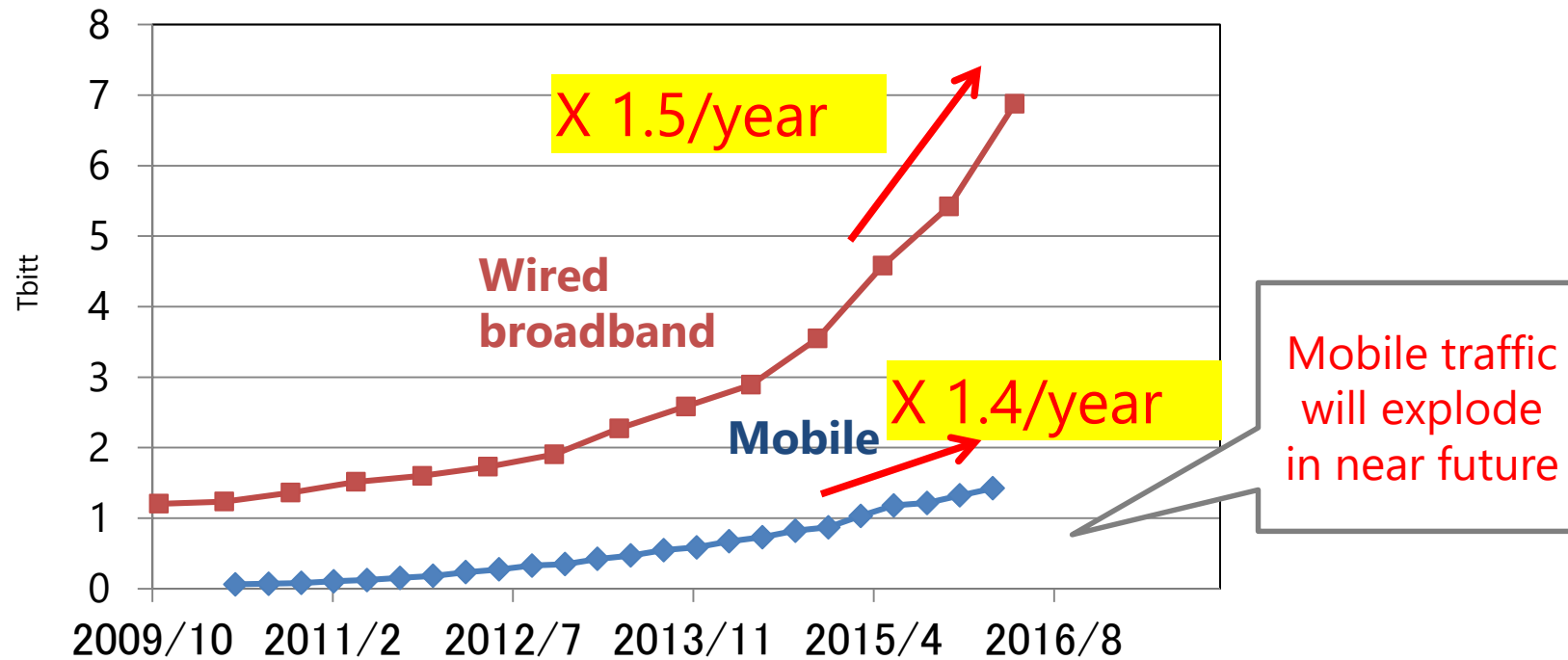
Physical Network

Latency requirements



Data traffic increase

- Internet traffic is increasing 50%/year
- mobile traffic is increasing 40%/year



- Major three mobile carriers in Japan have decided to release further cheaper subscription plans this month
about \$67 for 8Gbyte/month → about \$60 for 20Gbyte/month

Solutions for over 10km systems

System capacity /Fiber

