

Terabit LAN Challenges

Osamu ISHIDA

NTT Network Innovation Labs

Yokosuka, Japan

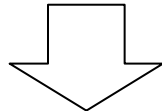
2007/3/25

Workshop on Future Optical Networks, OFC 2007, Anaheim

Outline

- Our Perspective

- Why “Terabit-LAN” ?
- What is “Terabit-LAN” ?
- How to explore “Terabit-LAN” ?



- Project “Lambda Access” (2006 - 2010)

- Participants
- Mission

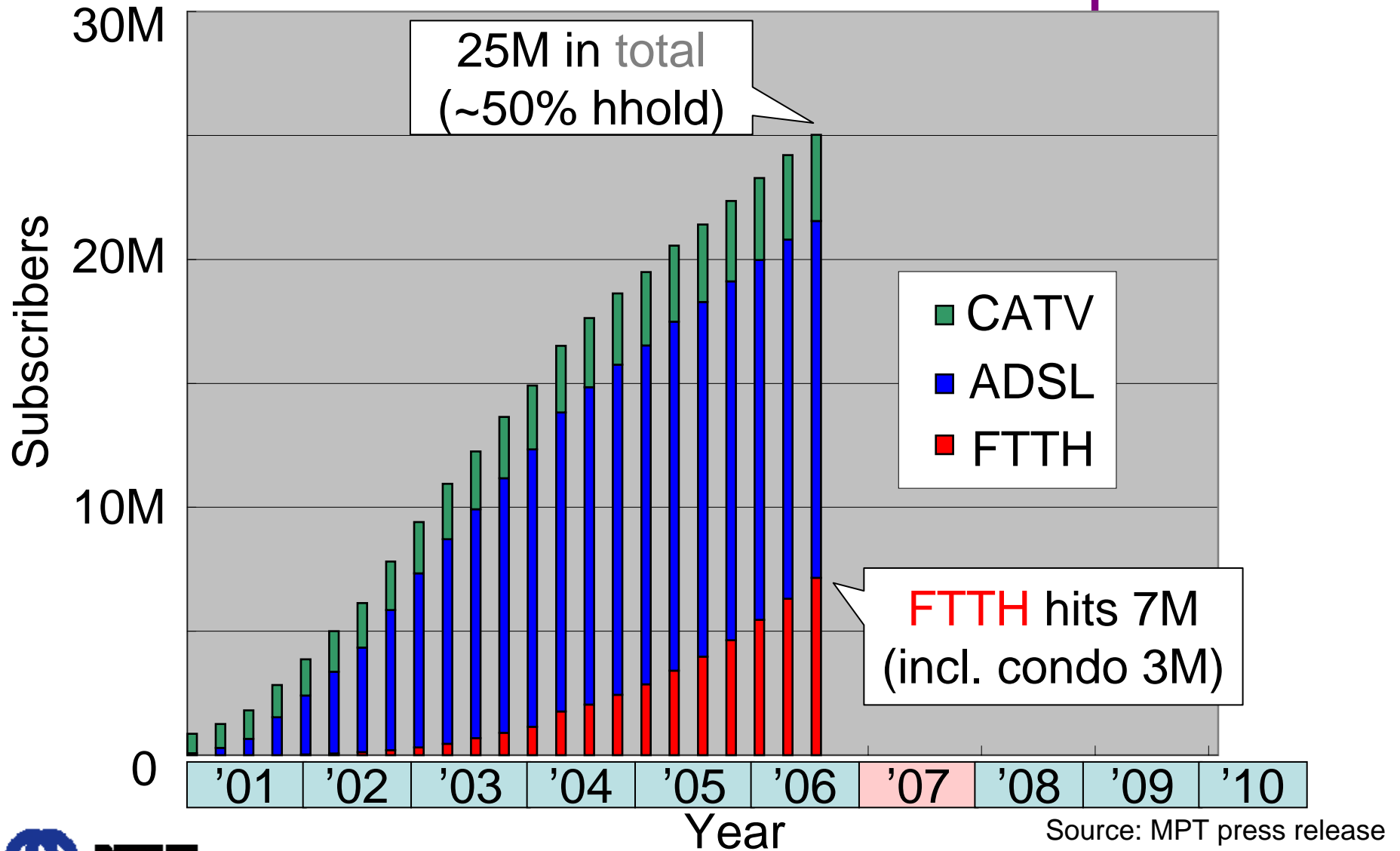


Our Perspective

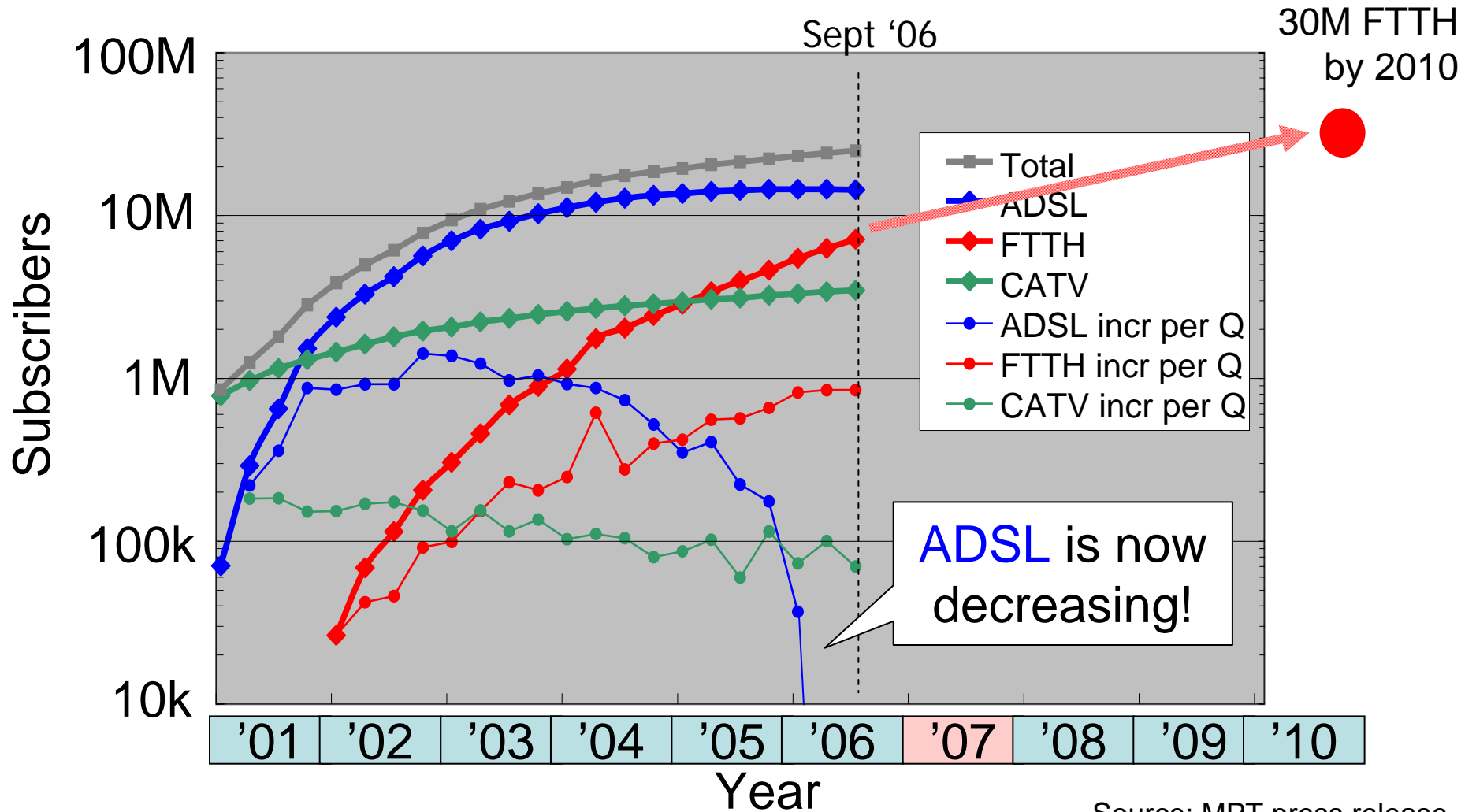
- Why “Terabit LAN”?
 - collaborate with high-end users
 - explore multiple-lambda Interfaces
- What is “Terabit LAN”?
 - scope, concept, and targets
- How to explore?
 - Share understandings of requirements and issues
 - Focus on user network access and its aggregation



Broadband Services in Japan



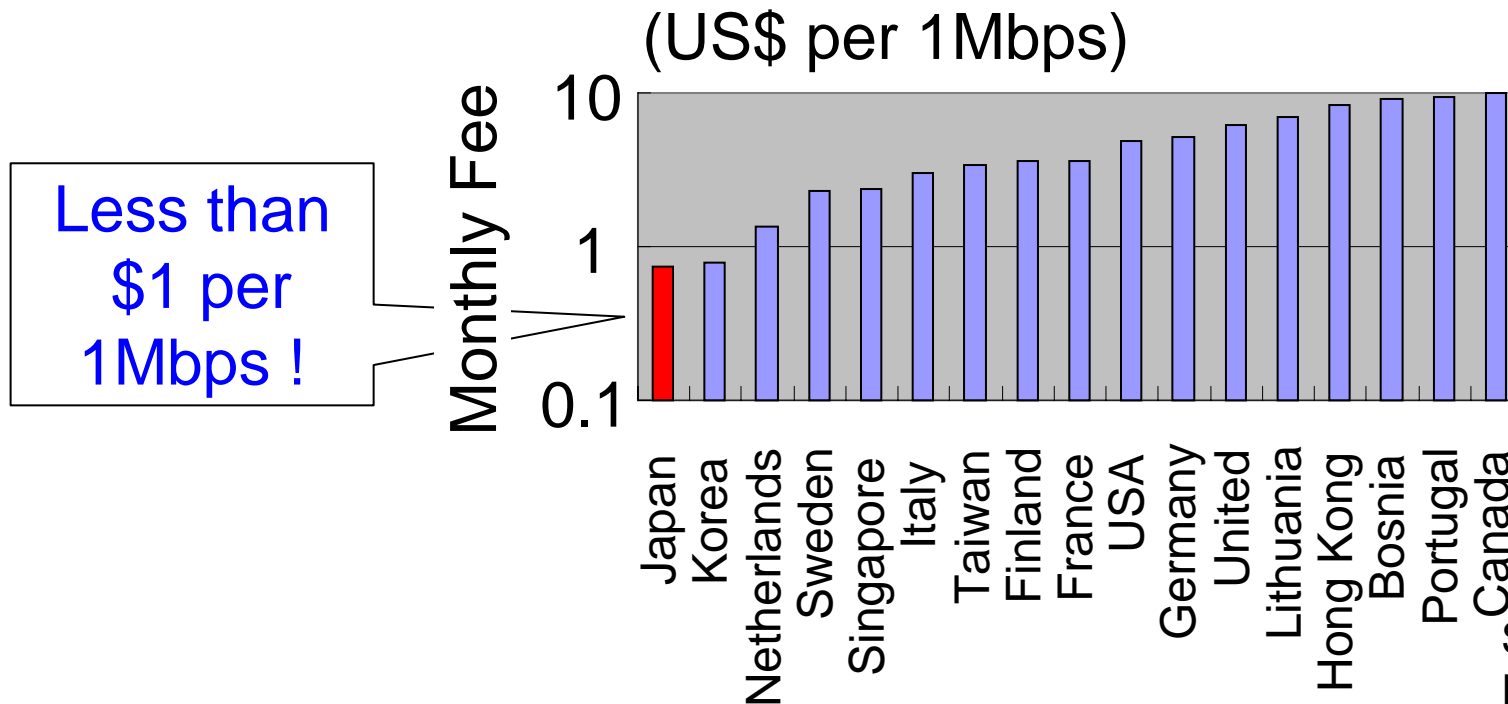
Broadband Services in Japan (log)



Source: MPT press release

Typical Service Prices in Japan

- 100Mb/s Optical Access
 - \$51 (JPY 6,200)
 - \$27 (JPY 3,200) for condo
- DSL Access
 - \$28 (JPY 3,300) for 47Mb/s
 - \$19 (JPY 2,300) for 1Mb/s



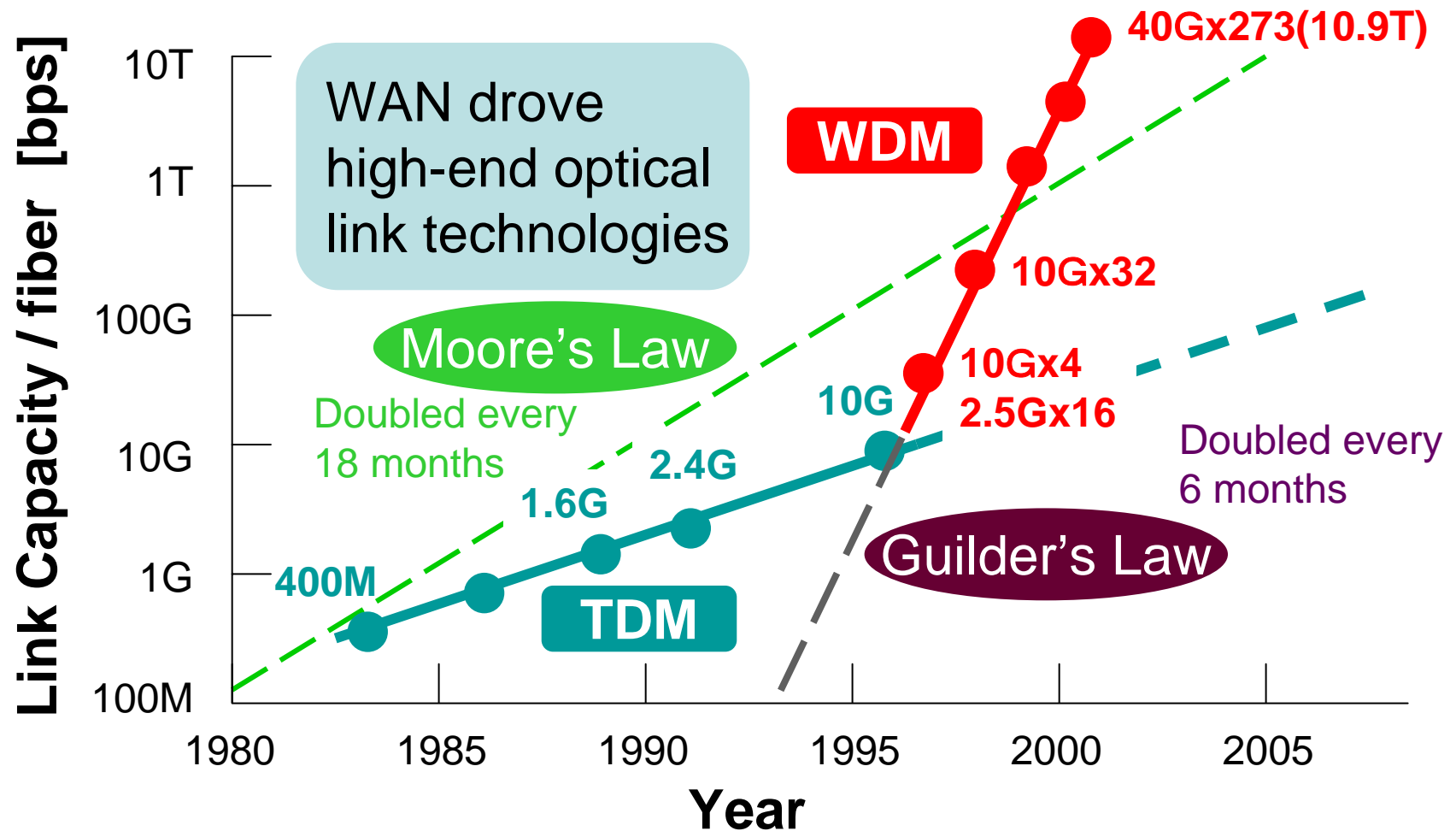
Source:
ITU Reports (2006)

Why T-LAN with “High-End Users”?

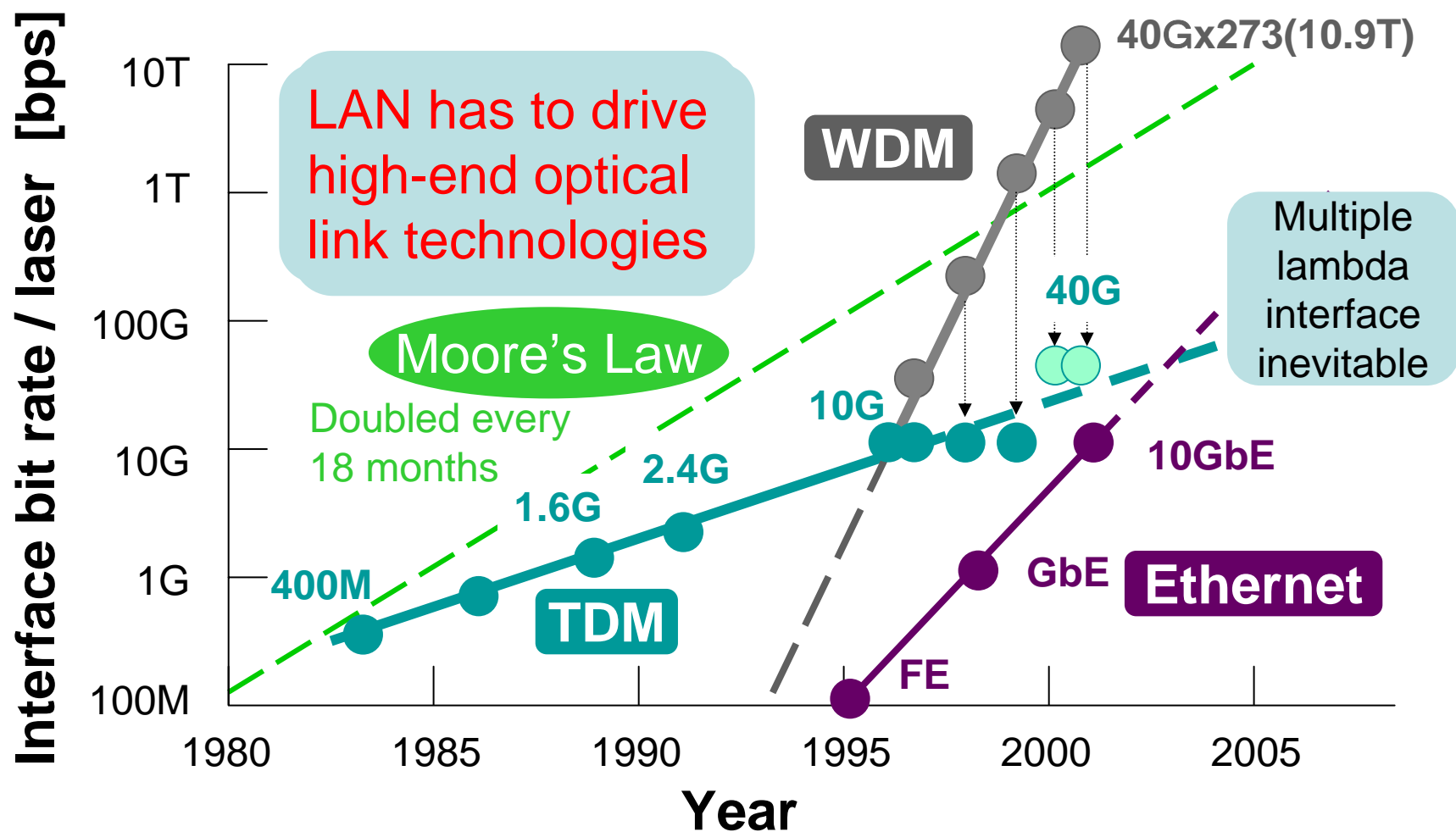
- Mass user will be satisfied with FTTH
- Full-IP networks will be built out to support such an extremely low-priced packet-based best effort services. But this may not be enough to share
 - e.g. 1Mb/s average x 30M subscriber = 30Tb/s
- Providers should find out yet another value added service **to share future lambda-rich infrastructure**
- Who needs? – **High-end users** will do
 - Performance is their first priority



Optical Link Performance, per fiber



Optical Link Performance, per Laser



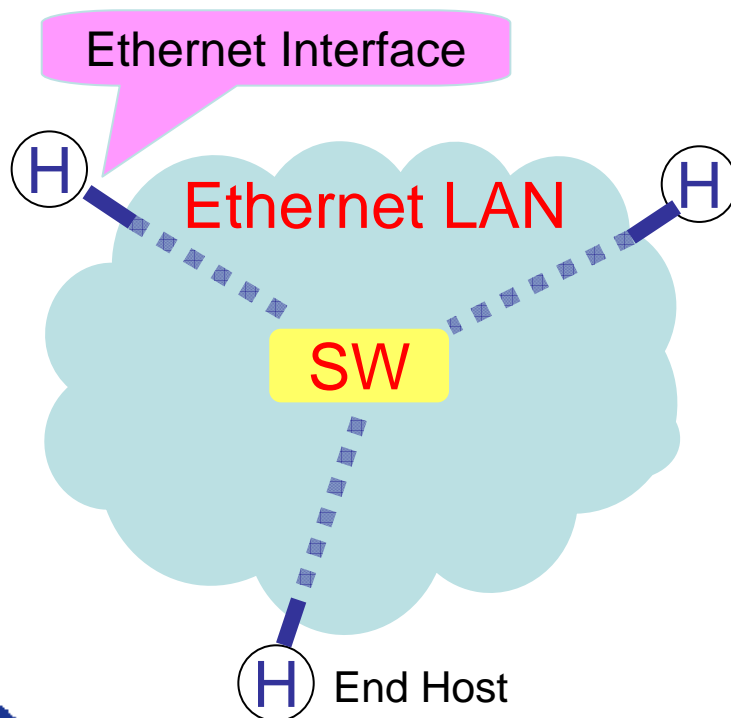
Our Perspective

- Why “Terabit LAN”?
 - collaborate with high end users – **share infrastructure**
 - explore multiple lambda Interfaces – **as a new paradigm**
- What is “Terabit LAN”?
 - scope, concept, and targets
- How to explore?
 - Share understandings of requirements and issues
 - Focus on user network access and its aggregation

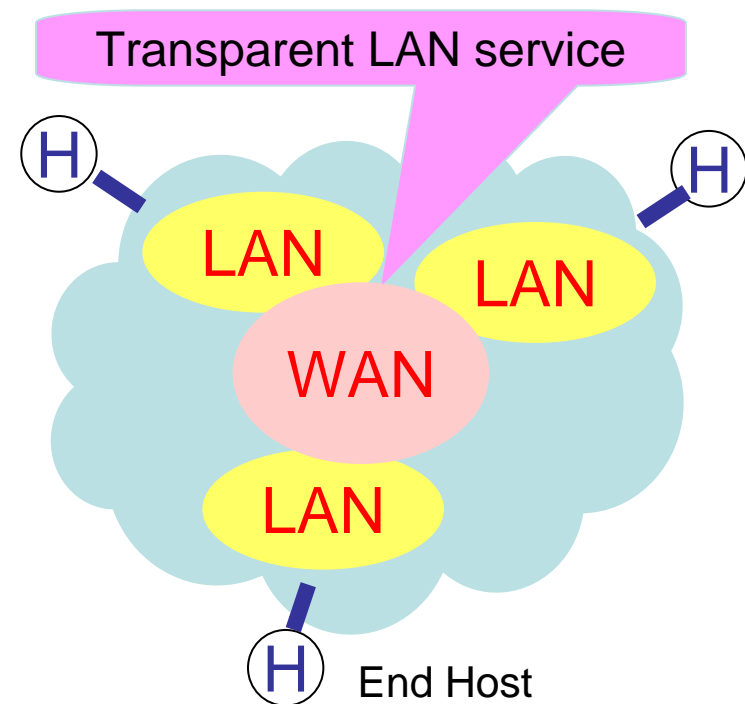


Today's LAN (= Ethernet)

- Interface scales from 10M to 10Gbps per Host
 - any to any, L3 transparent, and Plug & Play
- Diameter scales seamlessly from Local Area to Wide Area
 - Host does not see any differences except for larger latency and jitter

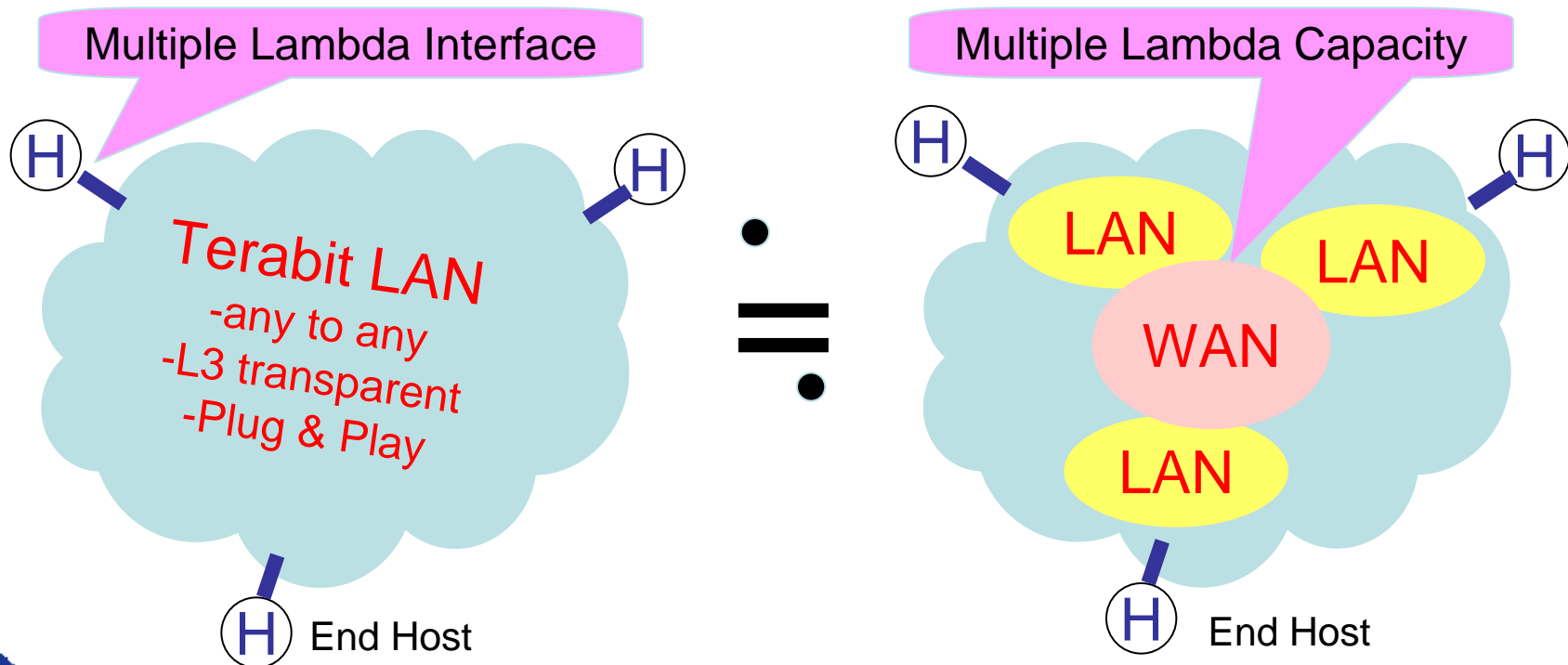


•
=
•



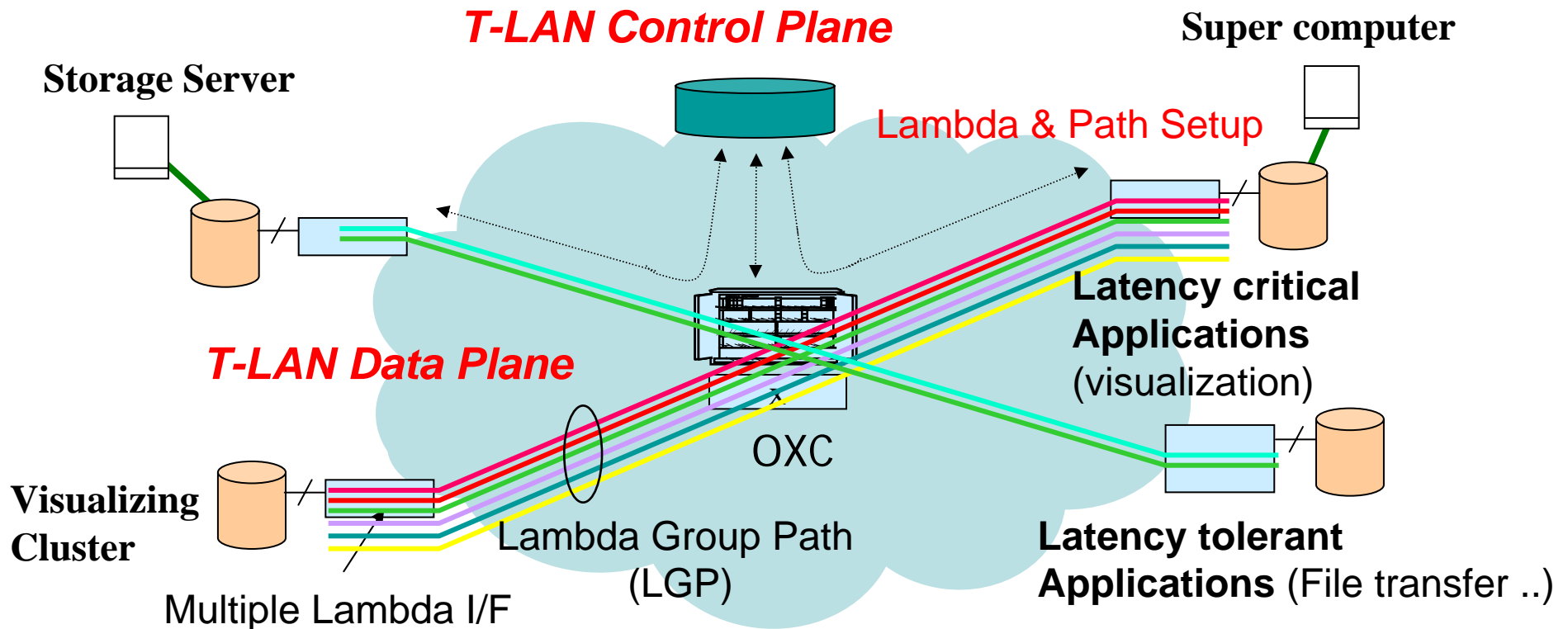
Scope of “T-LAN” (Terabit Ether***?)

- Interface scales seamlessly from 10G to 1Tb/s per Host
- Diameter scales seamlessly from Local Area to Wide Area
 - fiber propagation **delay is inevitable**, while it can be deterministic



T-LAN Concept

- Control plane on shared packet-based network
- Data plane on dynamically-assigned lambda-path network
 - Number of lambda is determined by latency requirement



This figure is based on Tomizawa, Hagimoto (NTT) et al., "T-LAN with optical virtual concatenation", OFC2005

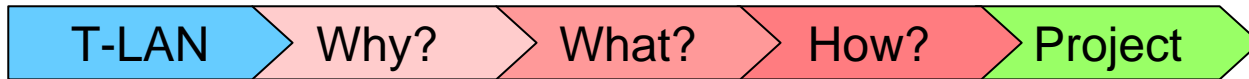
T-LAN Targets

- Explore new or classic paradigms
 - Multiple-lambda optical interfaces **to end hosts**
 - Network facility shared by a lambda
 - Dynamic lambda setup and release
- Provide extreme performance
 - Multiple 10 Gbps capacity on demand
 - Absolute low latency and fluctuation-less, just distance delay
- Scale seamlessly from T-LAN to T-WAN



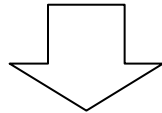
Our Perspective

- Why “Terabit LAN”?
 - collaborate with high end users – **share infrastructure**
 - explore multiple lambda Interfaces – **as a new paradigm**
- What is “Terabit LAN”?
 - scope, concept, and targets – **Multiple Lambdas to Users**
- **How to explore?**
 - Share understandings of requirements and issues
 - Focus on user network access and its aggregation



Outline

- Our Perspective
 - Why “Terabit-LAN” ?
 - What is “Terabit-LAN” ?
 - How to explore “Terabit-LAN” ?

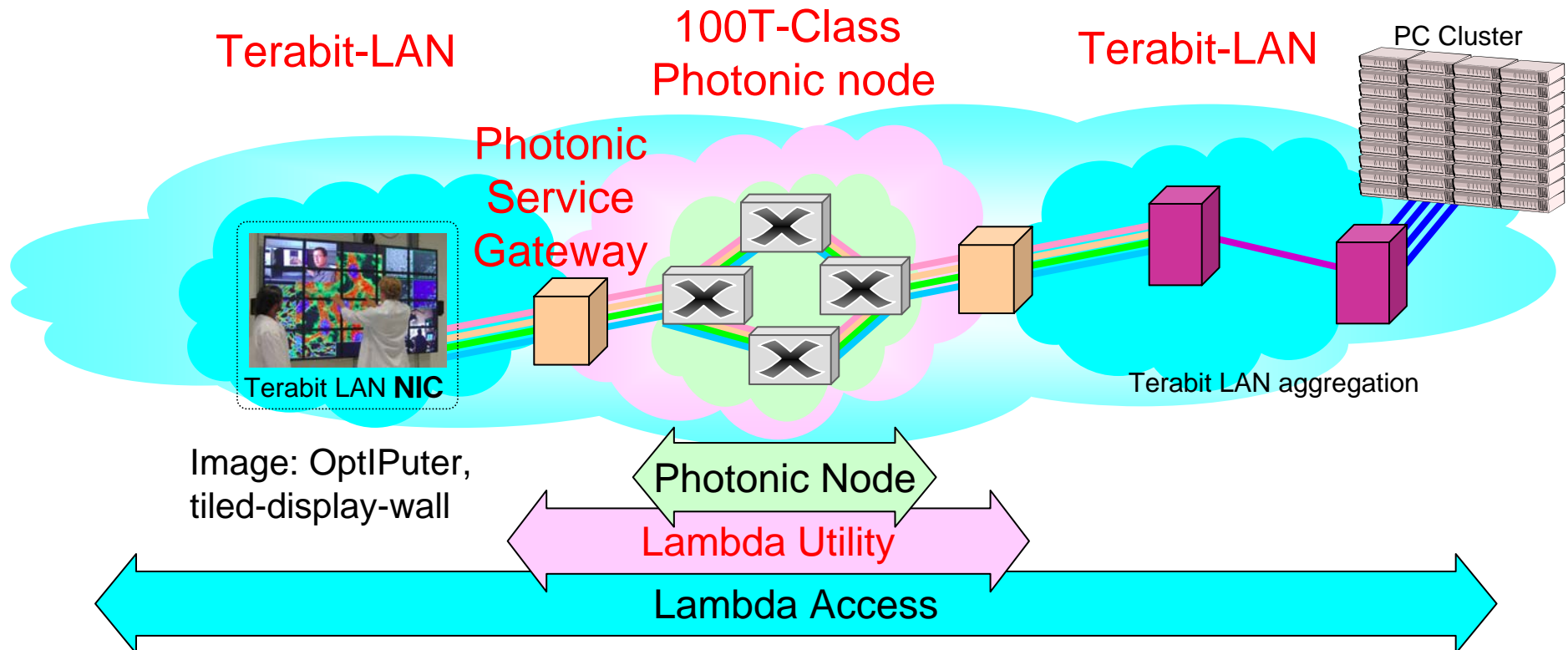


- Project “Lambda Access” (2006 - 2010)
 - Participants
 - Mission



Photonic Network R&D Projects

- 5-year projects funded by NICT (an agency of Japan. Gov)
- Prepare user-controllable >100G data transfer via backbone



Goals of “Lambda Access”

Project Goal: Providing Terabit-LAN (T-LAN) Environment

Establishing lambda-access technologies that provide on-the-fly over-10Gbps data transport via backbone optical infrastructure with

- Network Interface at 100Gbps,
- L1 VPN with 10 x 10G Lambda paths, and
- Networking of 10 hosts.

WDM Seamless Access: Breakthrough to T-LAN NIC

- Multi-Lane scalable interface for over-10G data streams
- Mega-byte-class jumbo frames for T-LAN transport processing

Frame-multiplexed Ultra High Speed Access: Breakthrough to T-LAN Aggregator

- Stochastic frame aggregation up to 100G with QoS control
- 100G single-lambda transport



Overview: Lambda Access Project (2006 – 2010)

WDM Seamless Access Technology

- Single user network access via multiple lambdas
- Inverse-multiplexing of single user Mega-Byte frame
- Seamless access protocols to the lambda utility

Frame-Multiplexed Ultra High Speed Access Technology

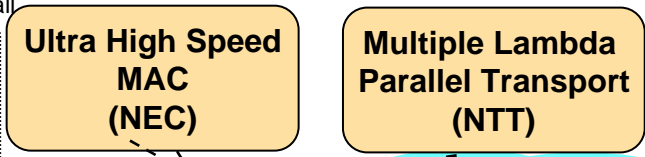
- Multiple user network access via single lambda
- Statistic aggregation of multiple user frames
- End-end frame-base seamless OAM protocols

Ultra High-Speed Network Interface Card (Terabit-LAN NIC)

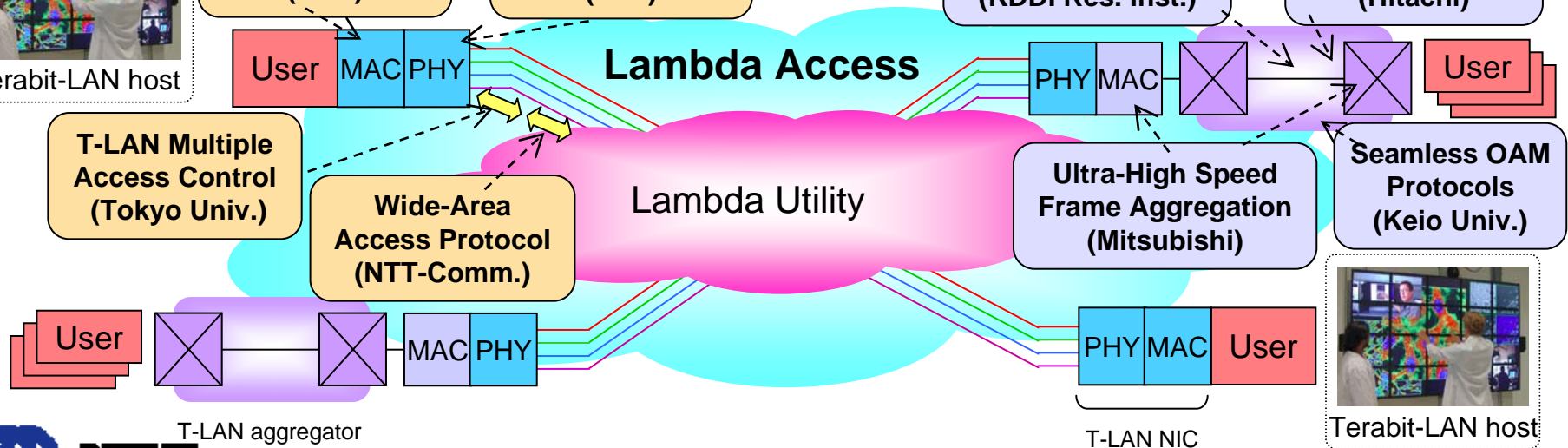
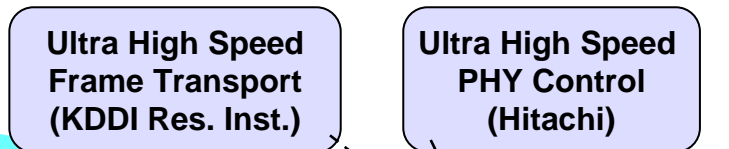
Image from Prof. L. Smarr,
OptIPuter's tiled-display-wall



Terabit-LAN host



Ultra High-Speed Frame Aggregator (Terabit-LAN Aggregator)



March 25, 2007

O. Ishida, "T-LAN Challenges," OFC2007 Workshop on FONs

Summary

- Terabit LAN – Multiple lambdas to end host
 - Our motivation, definition, and approaches
- Project “Lambda Access”
 - 5-year ('06-'10) project funded by NICT
 - NICT is an agency of Japanese government, National Institute of Information and Communications Technology
 - Support on-the-fly >100Gbps E2E data transfer

