Terabit LAN Challenges

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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

25M in total (~50% hhold)

FTTH hits 7M (incl. condo 3M)

Source: MPT press release

March 25, 2007 O. Ishida, "T-LAN Challenges," OFC2007 Workshop on FONs
Why?

Broadband Services in Japan (log)

- ADSL
- FTTH
- CATV

Total

ADSL incr per Q
FTTH incr per Q
CATV incr per Q

30M FTTH by 2010

Source: MPT press release

ADSL is now decreasing!
Less than $1 per 1Mbps!
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

- WAN drove high-end optical link technologies
- Moore’s Law: Doubled every 18 months
- Guilder’s Law: Doubled every 6 months

Why?

- T-LAN

Link Capacity / fiber [bps]

Year


10T 1T 100G 10G 1G 100M

- 40Gx273(10.9T)
- 10Gx32
- 10Gx4
- 2.5Gx16

Why?

- T-LAN

NTT March 25, 2007 O. Ishida, "T-LAN Challenges," OFC2007 Workshop on FONs
LAN has to drive high-end optical link technologies
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?  
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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

**Multiple Lambda Interface**

Terabit LAN
- any to any
- L3 transparent
- Plug & Play

**Multiple Lambda Capacity**

=

End Host

End Host
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

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March 25, 2007  O. Ishida, "T-LAN Challenges," OFC2007 Workshop on FONs
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
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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

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

Lambda Access

Ultra High-Speed Network Interface Card (Terabit-LAN NIC)
- Ultra High Speed MAC (NEC)
- Multiple Lambda Parallel Transport (NTT)

Lambda Utility
- Ultra High-Speed Frame Aggregator (Terabit-LAN Aggregator)
- Ultra High Speed Frame Transport (KDDI Res. Inst.)
- Ultra High Speed PHY Control (Hitachi)
- Ultra-High Speed Frame Aggregation (Mitsubishi)
- Seamless OAM Protocols (Keio Univ.)

Users
- Terabit-LAN host
- T-LAN Multiple Access Control (Tokyo Univ.)
- Wide-Area Access Protocol (NTT-Comm.)
- T-LANNIC
- T-LAN aggregator

Images from Prof. L. Smarr, OptIPuter’s tiled-display-wall

March 25, 2007
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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