

Internet2 member meeting 2006

Session: Evolution of methods to enhance application performance over high-speed networks

Dec. 5th 2006

Jonathan Agre

Fujitsu Laboratories of America

Evolution of methods to enhance application performance over high-speed networks



- **Long-term, Long Distance Streaming Service Trial**
 - Jon Agre, Fujitsu Laboratories of America
- **Trusted Network Gateway**
 - Dan Dalton, Fujitsu Computer Products of America– (Jon Agre)
- **Comet PMC and Birth of the MAC Mini DV Appliance**
 - Bob Riddle, University of Michigan Medical Dept.
- **Using Comet DV at Internet2**
 - Laurence Kirchmeier – MERIT Network Inc.

Internet2 member meeting 2006

Long-term, Long-Distance Streaming Service Trial ~ over the Internet2 and APAN ~

Dec. 5th 2006

Fujitsu Laboratories of America

Jonathan Agre , Jun Kawai

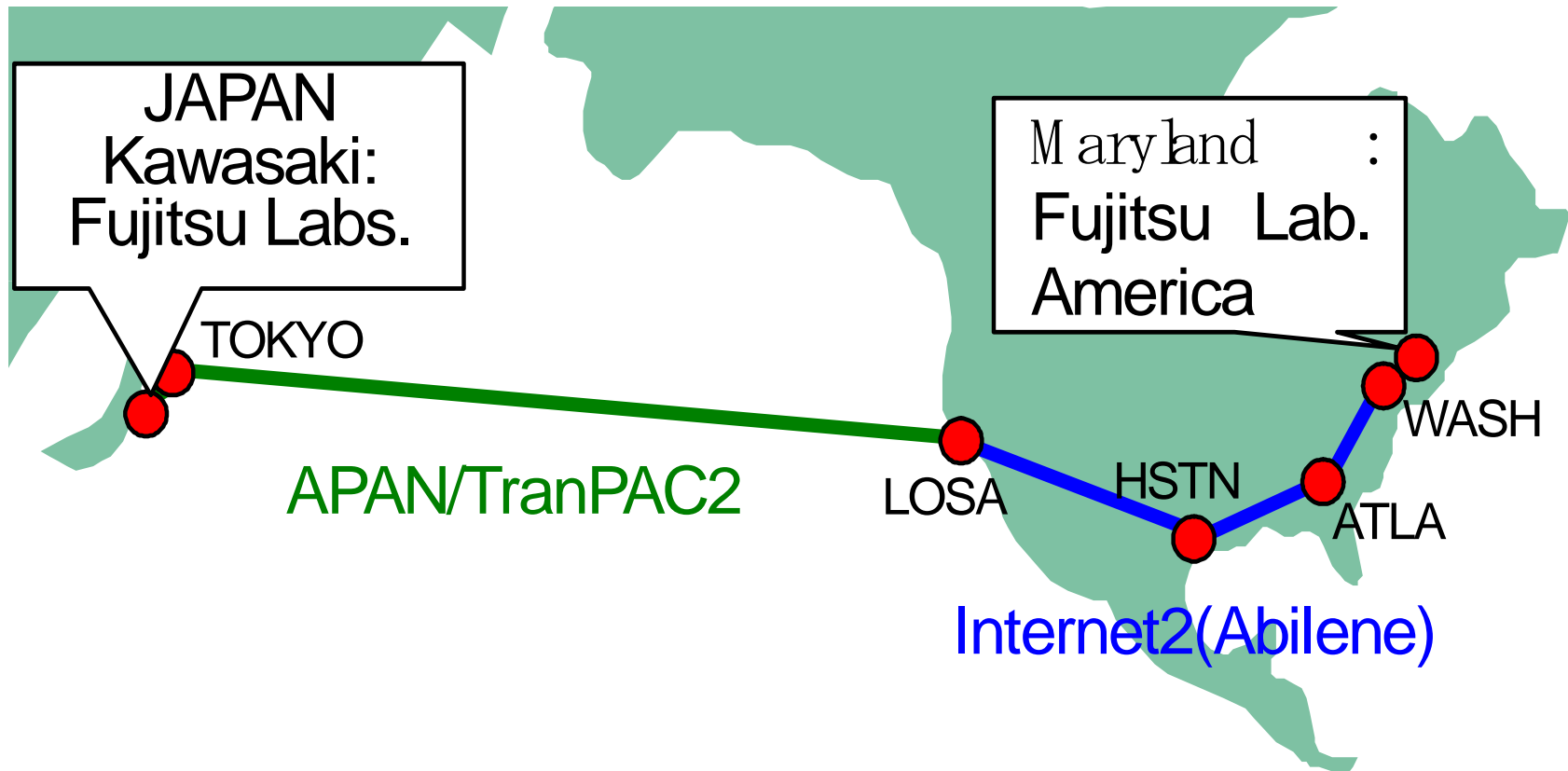
A. Jinzaki, M.Yamasawa

- Long term streaming service operation over the Internet2 and APAN to find out necessary requirements for stable and high performance.

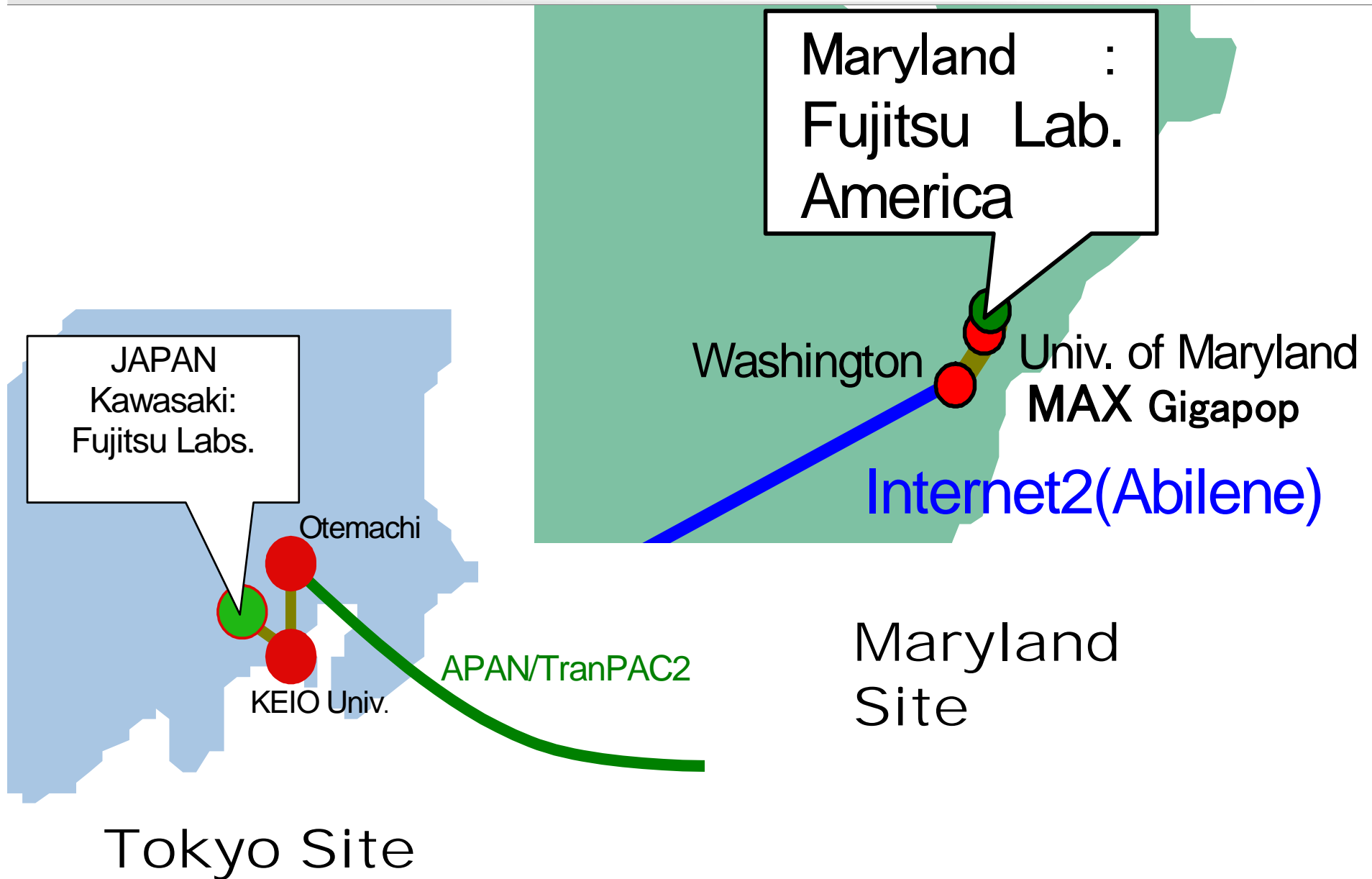
- Four year+ operation revealed:
 - TranPac2+Internet2 good stability level
 - Tunneling operation using Comet is extremely effective
(Since Oct. 2002)

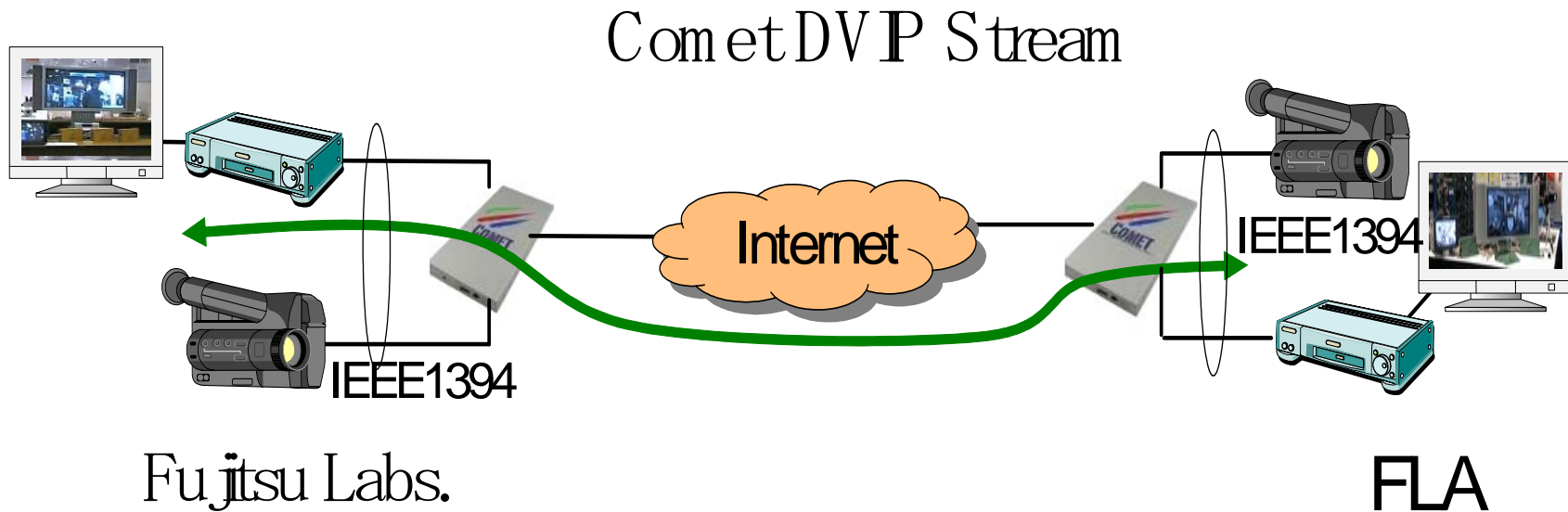
- Network configuration
 - Internet backbone
 - Local network, Tokyo site / Maryland site
- Equipment and system used
 - DVIP
 - HDVIP
- Encapsulation process in Comet
 - DVIP
 - HDVIP
- Performance data
- Historical Events
- Conclusions

Network Configuration

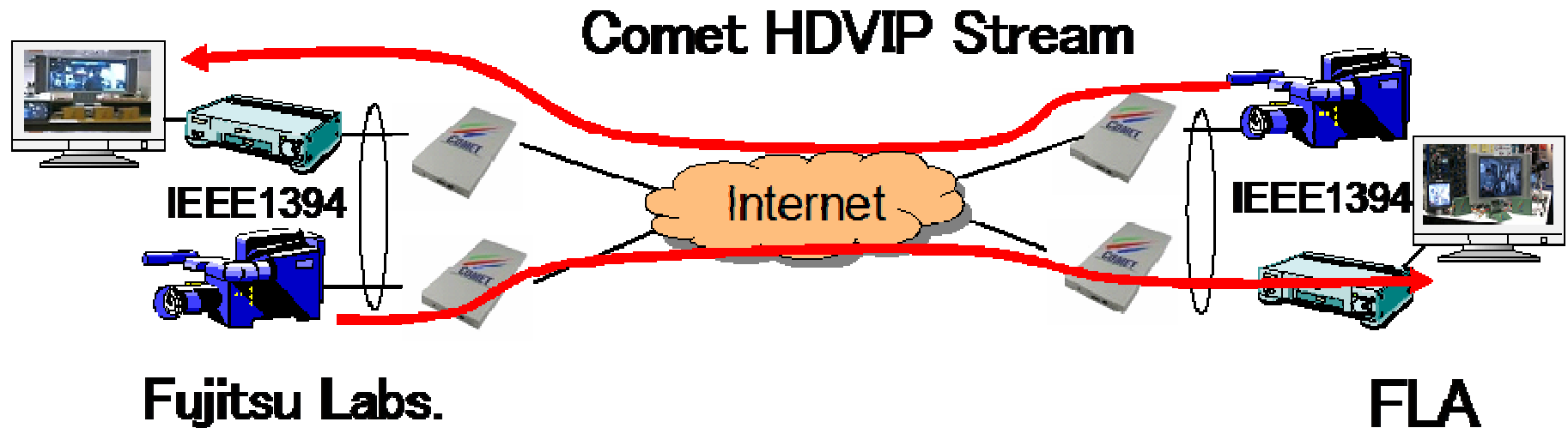


Local Site Network





- Digital Video standard equipment:
 - Commercially available DV cameras
 - DV encoded data is packed by DVIP scheme then launched for transmission
 - One comet box processes bi-directional line



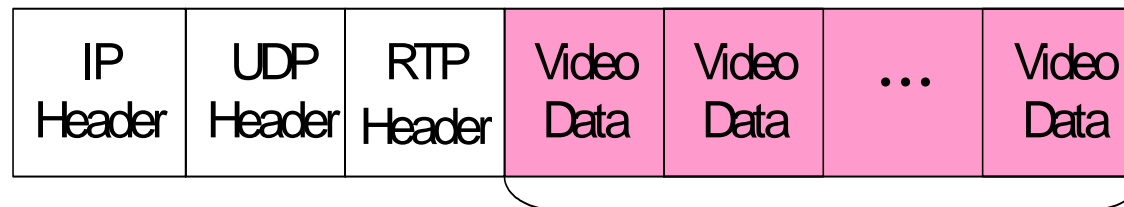
- High Def. Digital Video equipment:
 - Commercially available HDV cameras
 - HDV data is directly packed into IP packets, then encapsulated for transmission
 - One comet box processes uni-directional line

■ DVIP

Original Digital Video packet



Encapsulation



DVIP packet

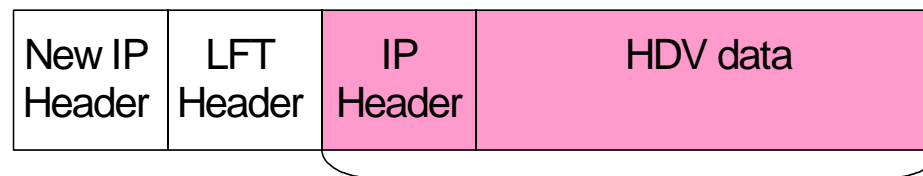
Digital video data

■ HDVIP

Original packet



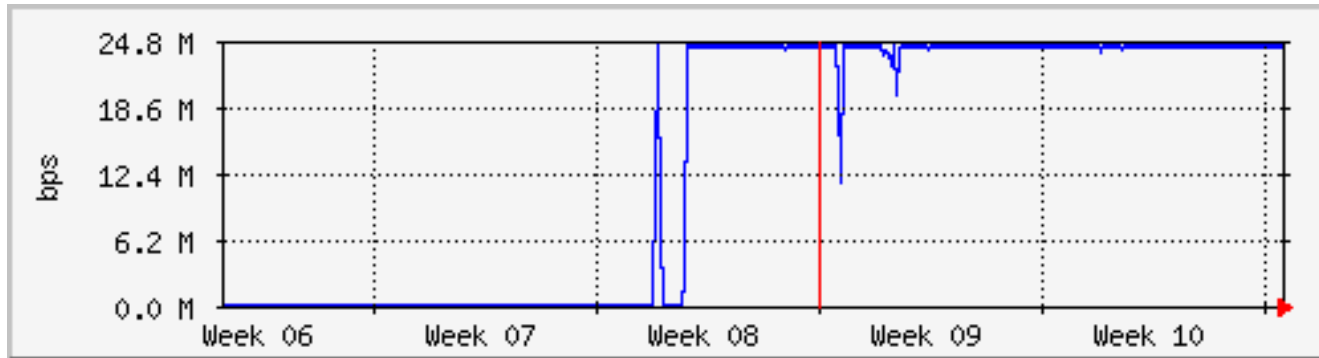
Encapsulation



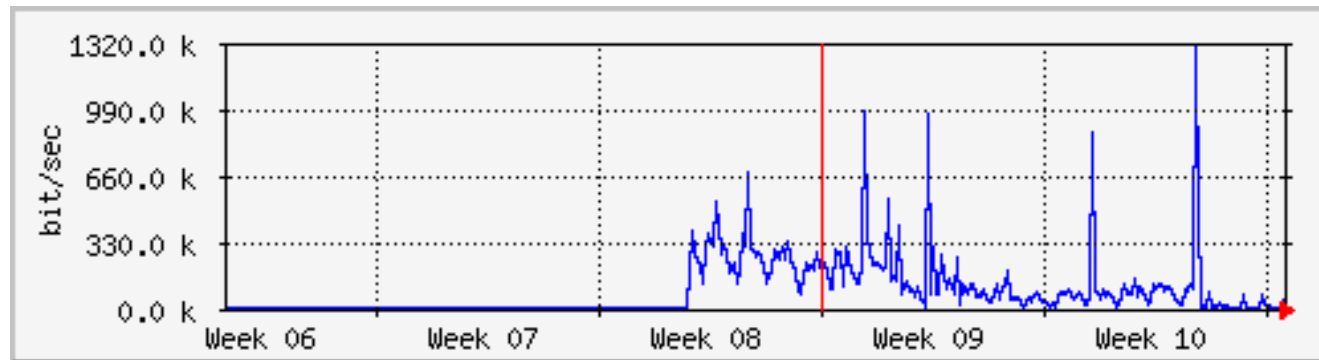
HDVIP packet

HDV data packet

Network Traffic



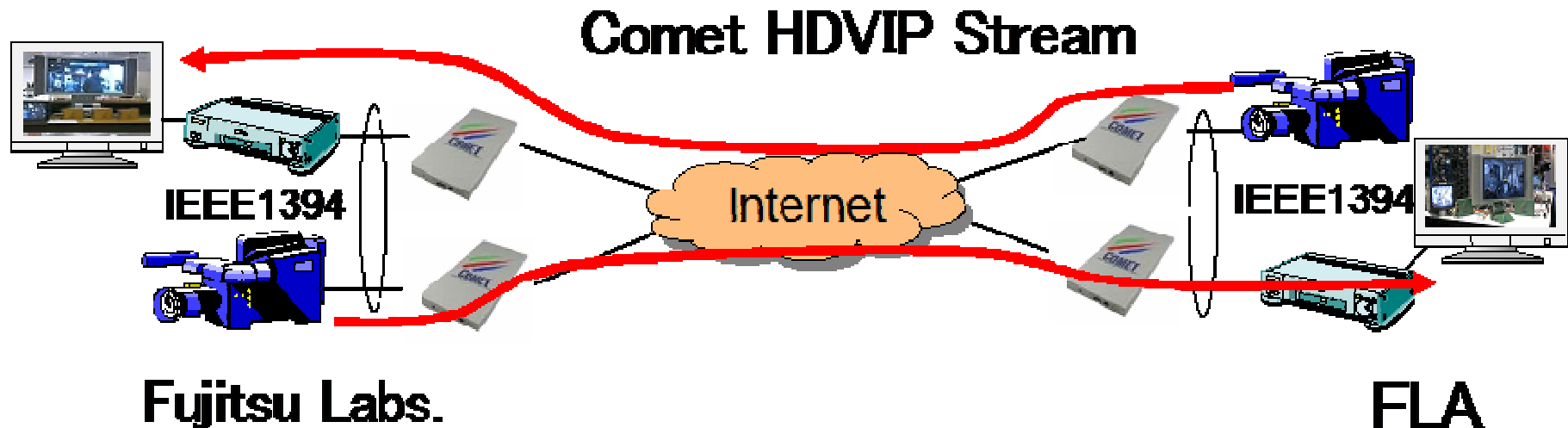
Comet HDVIP Streams



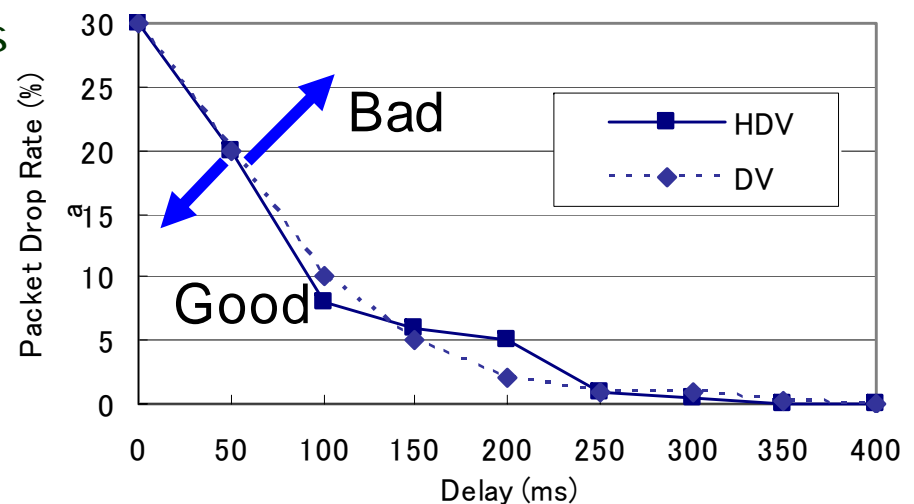
Re-transmission

High Definition Digital Video Streaming

- 30Mbps HDV/DV streaming without data loss

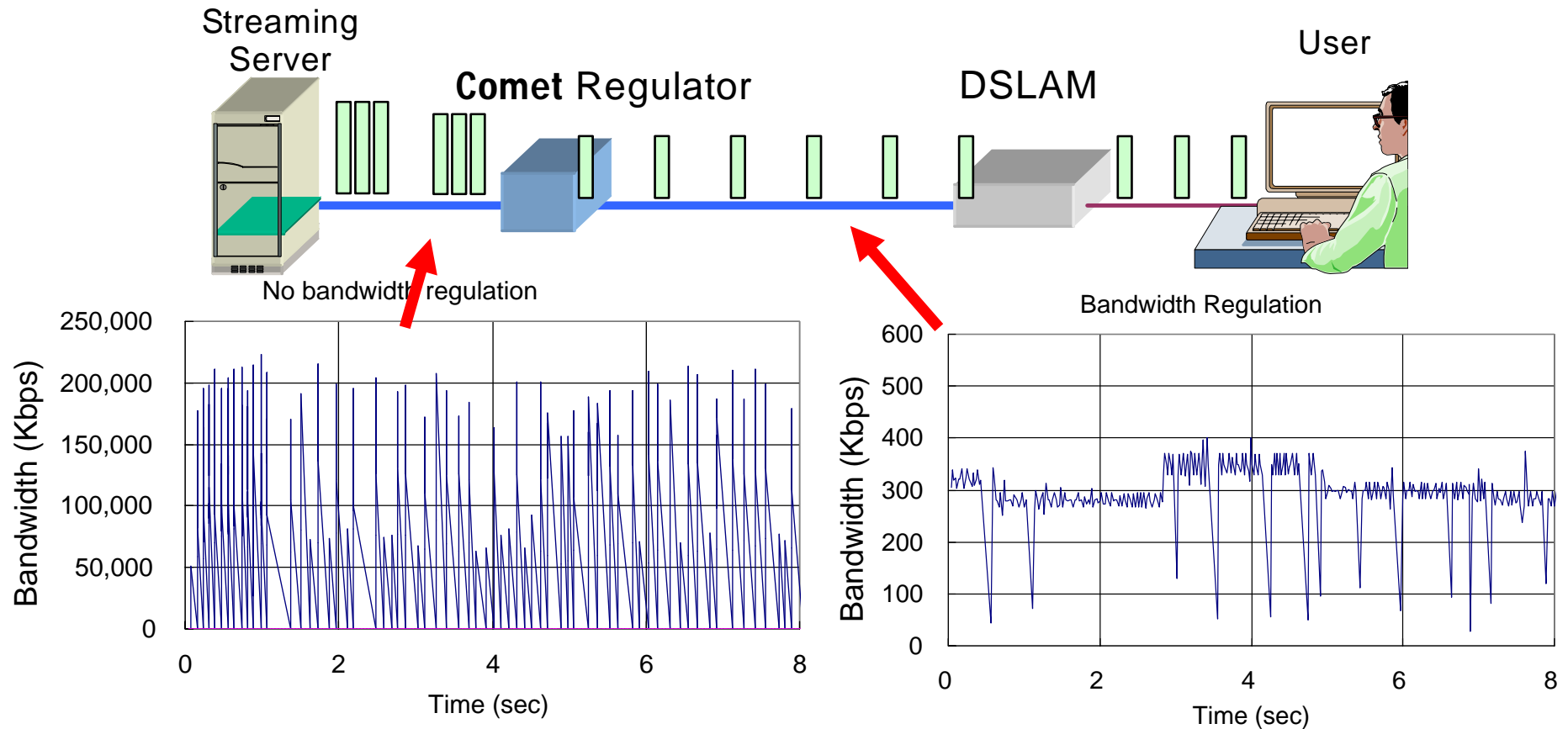


- Small PMC box "Comet" performs high quality HDV/DV streaming
- Recovers 10% Packet Loss in 100ms Delay
- 100 micro-sec delay in the "Comet"
- Japan-US trial since Nov. 2003



Streaming Regulation

- “Comet” reduces packet loss in ADSL streaming



- Field Trial in “Live Eclipse Antarctica” in Nov. 2003

- 350 clients, 300Kbps each, were fully regulated by one “Comet” box

<http://www.live-eclipse.org>

Studio View of FJL and FLA

FLA College Park Studio



FJL Kawasaki Studio



HD Display

Comet Processors at FLA



DV Display at FLA

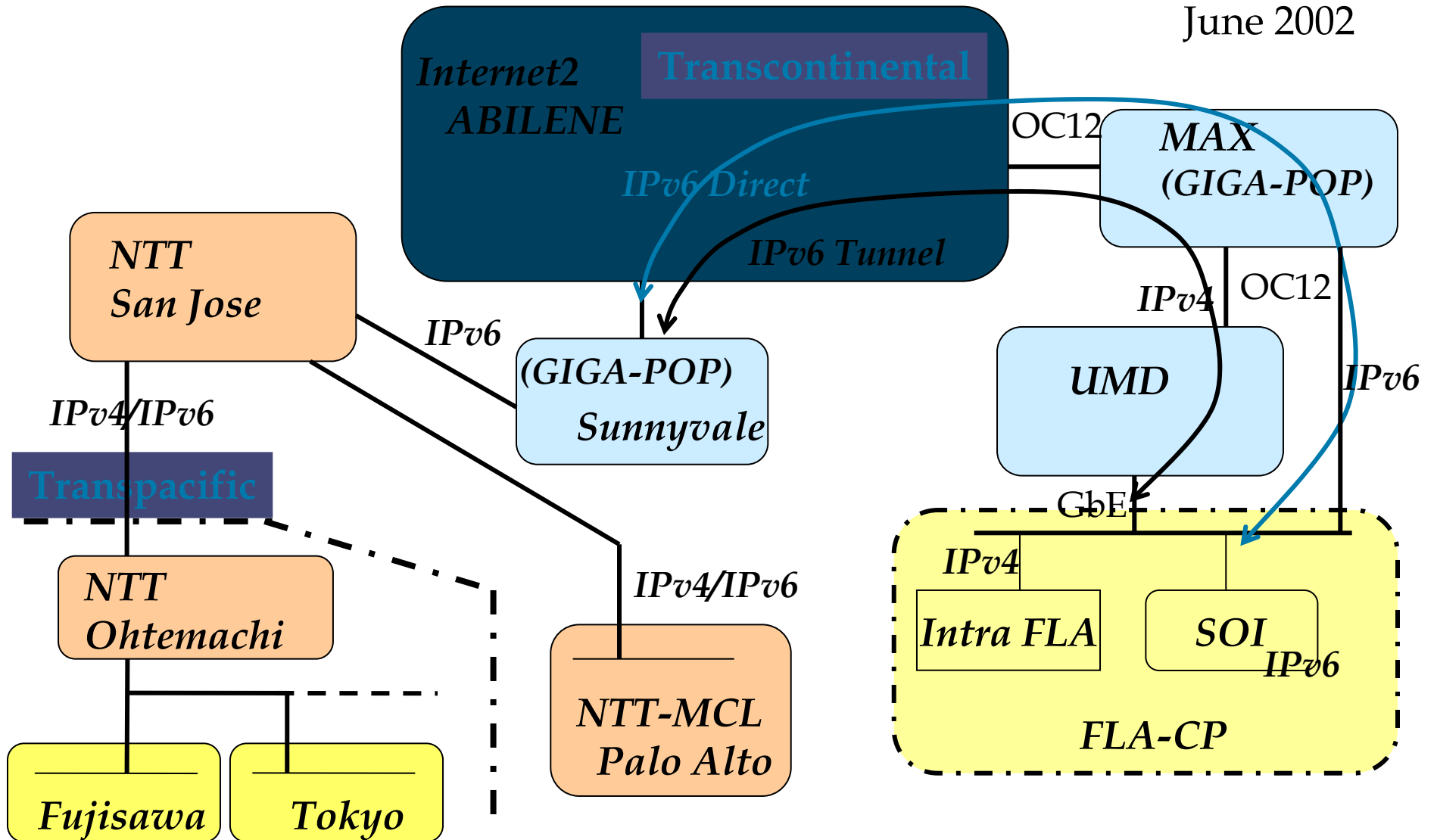


WIDE

School of Internet

- School Of Internet Project
 - Started at Oct. 1997
- One of the Activities of the WIDE Project
 - WIDE Project: directed by Prof. Murai, Keio Univ.
- Previous Experiences with US-Japan
 - Wisconsin Univ.(99), UCSD(00), NTT-MCL(00)
- Japanese Universities involved
 - Keio Univ., Univ. of Tokyo, NAIST, etc
- Partly funded by Japanese Government
 - Networking Cost of Trans-Pacific
- FLA Studio set up in 11/2001
 - DV Cameras, DVTS, Internet2

June 2002



School of Internet

- **Lecture series held on 11/09, 12/07 in 2001, 1/11, 1/18 in 2002, 02:20 - 05:30 EST**
 - From FLA-CP to Keio SFC Campus
 - KEIO Class, "Design Language Workshop E" lectured by Ms. Yoshida
 - Students' homework was placed on the Web.
 - Lecturer evaluated their homework by interviewing each student.
 - The interactive discussion is the key part of the lecture



Nikkei Conference

School of Internet

- **Video Conference on 12/7/2001
19:20-22:20 EST**
 - From FLA-CP to Keio SFC Campus
 - Nikkei Conf. on "Internet Governance" by Prof. Kokuryo, Prof. Murai, Mr. Katoh, Mr. Maxell etc.
 - Panel Discussion joined by two panelists in US.



School of Internet

- **Press Conference on 3/21/2002 20:30-22:00 EST**
 - From FLA-CP to Keio SFC, Univ. Tokyo, NAIST, etc
 - Press Conf. on SOI Multicast Remote Lecture Exp.
 - Lecturer: Prof. Murai Keio Univ.
Commentators: Prof. Riley UMD
and Dr. Matsuo FLA
 - Lectured and commented from US Studio and made discussions jointly between US and Japan



Press Conf. I

School of Internet



Seminar by Nobel Laureate

School of Internet

- **“IT Economy” Seminar on 9/27/2002
20:30-22:00 EST**
 - From FLA-CP to Japan, Thailand, Singapore, Myanmar, etc
 - Lecturer: Prof. L. Klein, UPenn., Prof. Adams, Northeastern Univ.
 - Asian countries were connected by satellite from Keio University



Other Activities I

School of Internet

- **IPv6 Demo on Internet 2 Fall Meeting 2002 in Oct., 2002**
 - Digital Video Conf. Demo between Los Angeles and College Park
 - Comet boards developed by Fujitsu Laboratories are used



Other Activities II

School of Internet

- **Multi-Media Okayama on 11/15/ 2002**
 - From FLA-CP to Okayama and other places
 - Prof. Murai presented Keynote Speech from College Park
- **Remote Lecture by Matsuo in Dec. 2002**
 - Lectures of University of Tokyo

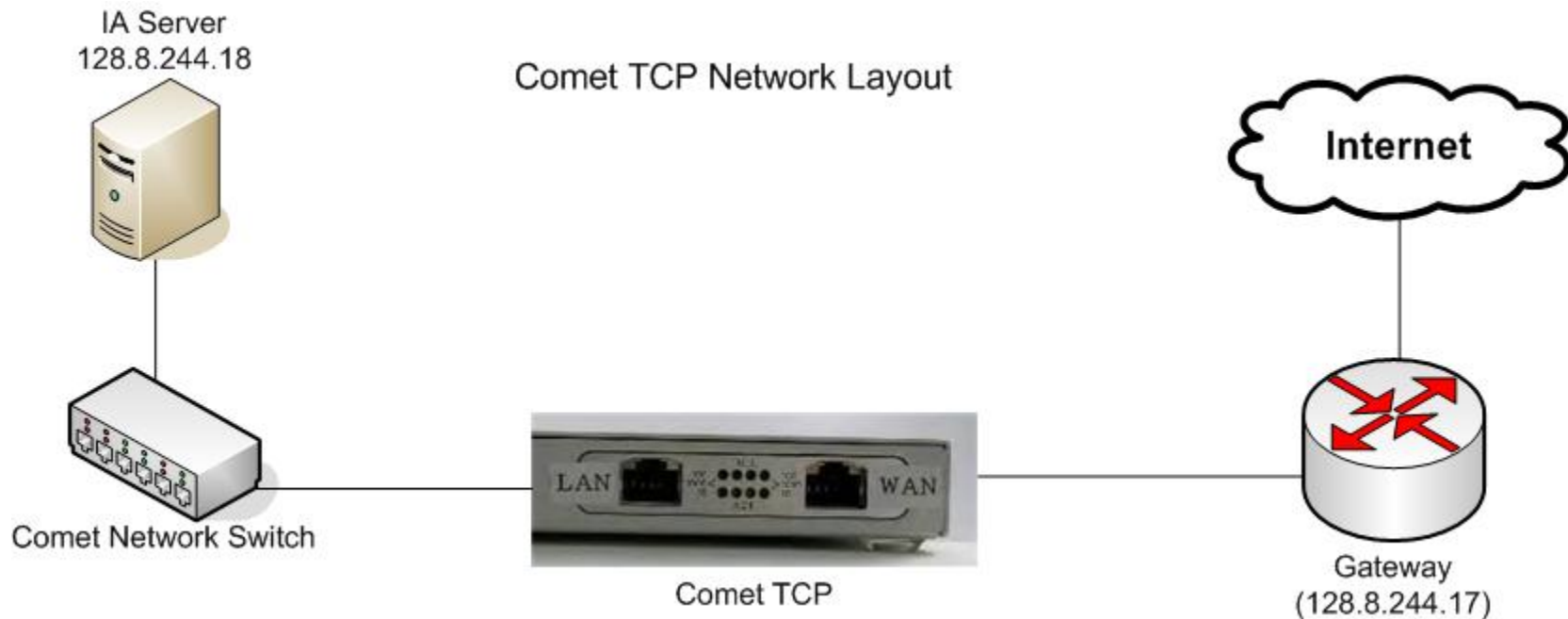


■ Data Reservoir

- High speed disc synchronization system
- Internet Standard iSCSI
- High speed, long distance competitions
- Prof. Kei Hiraki, U of Tokyo



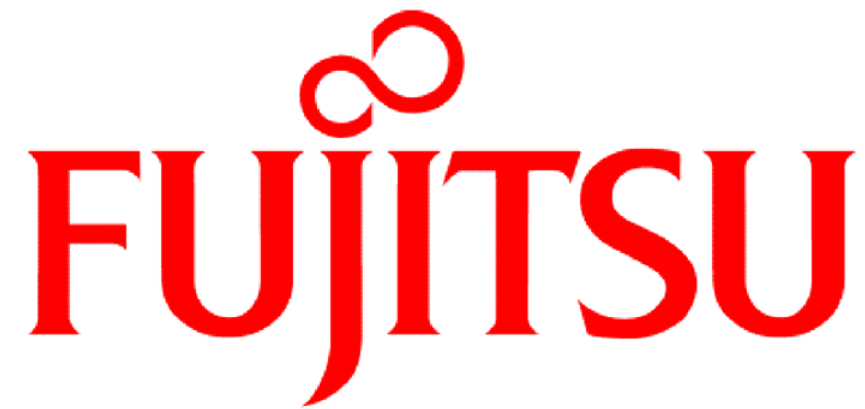
Streaming Video/Data Experiments



- Four year operation revealed:
 - TranPac2+Internet2 good stability level
 - Tunneling operation using Comet was extremely effective
- Necessary requirements
 - Encapsulation of DV packet with UDP to ensure bandwidth and elimination of missing packet
 - Packet alignment to achieve constant average bandwidth
- Now upgrading to Comet Trusted Network Gateway
 - Secure video transmissions



Thank you for your attention



FUJITSU

THE POSSIBILITIES ARE INFINITE