Progress of the Virtual Laboratory for Fusion Researches in Japan

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ICALEPCS 2009, Oct. 12-16, 2009, Kobe

Outline

- SNET
  - Virtual laboratory
  - SNET, for fusion activities in Japan

- Key issue … High-speed data transfer
  - Japan-France data transfer experiments
    - 1GE on July and 10GE on September

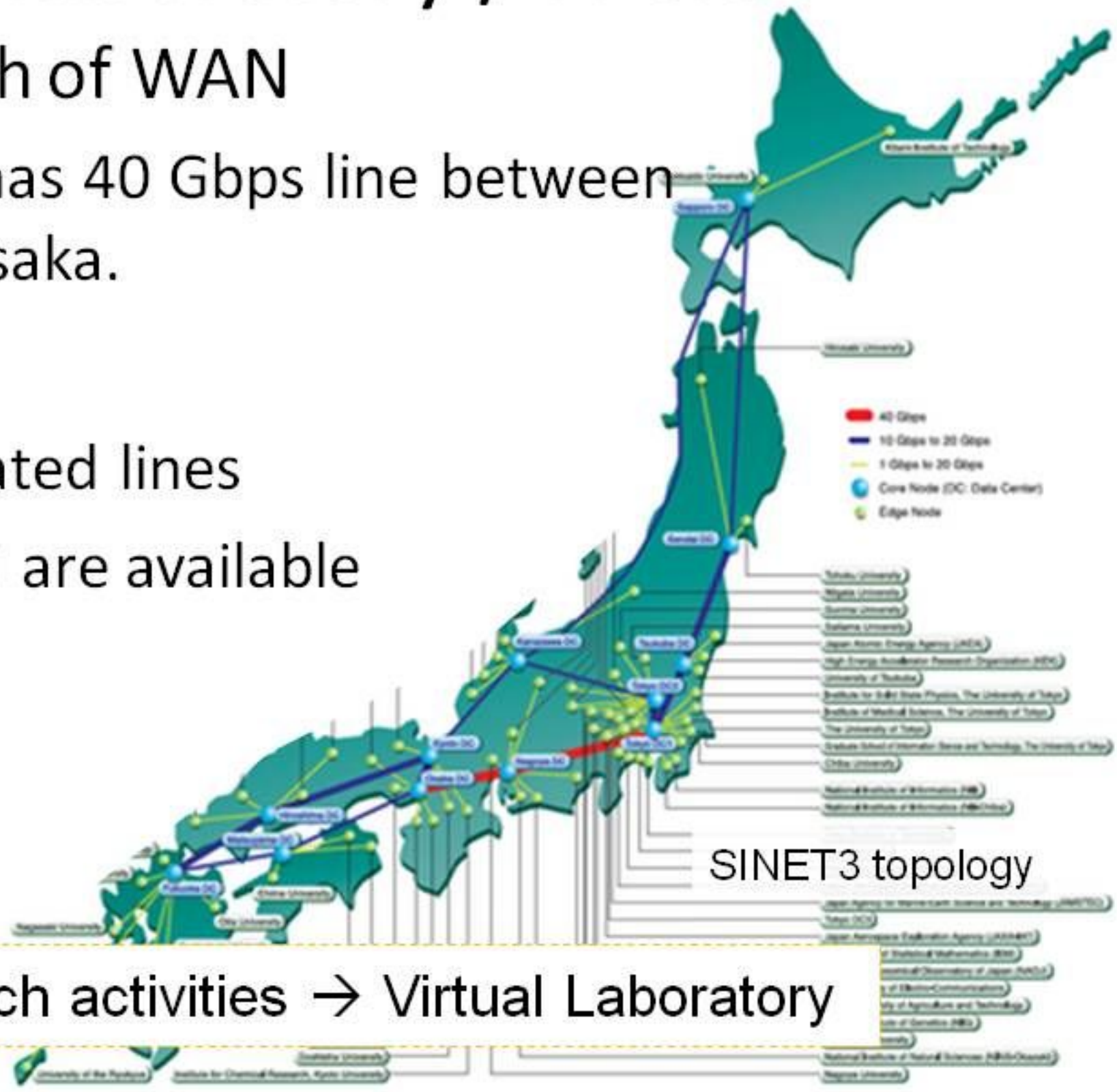
- Summary

Virtual laboratory / Research side

- The concentration of the experimental facility and the supercomputer.
- The increase of data.
  - High resolution, both space and time
- Larger project, more collaborators.
  - Around the nation, around the world

Virtual laboratory / IT side

- The bandwidth of WAN
  - SINET3 (NII) has 40 Gbps line between Tokyo and Osaka.
- VPN on WAN
  - Secure dedicated lines
  - L1/L2/L3 VPN are available on SINET3.



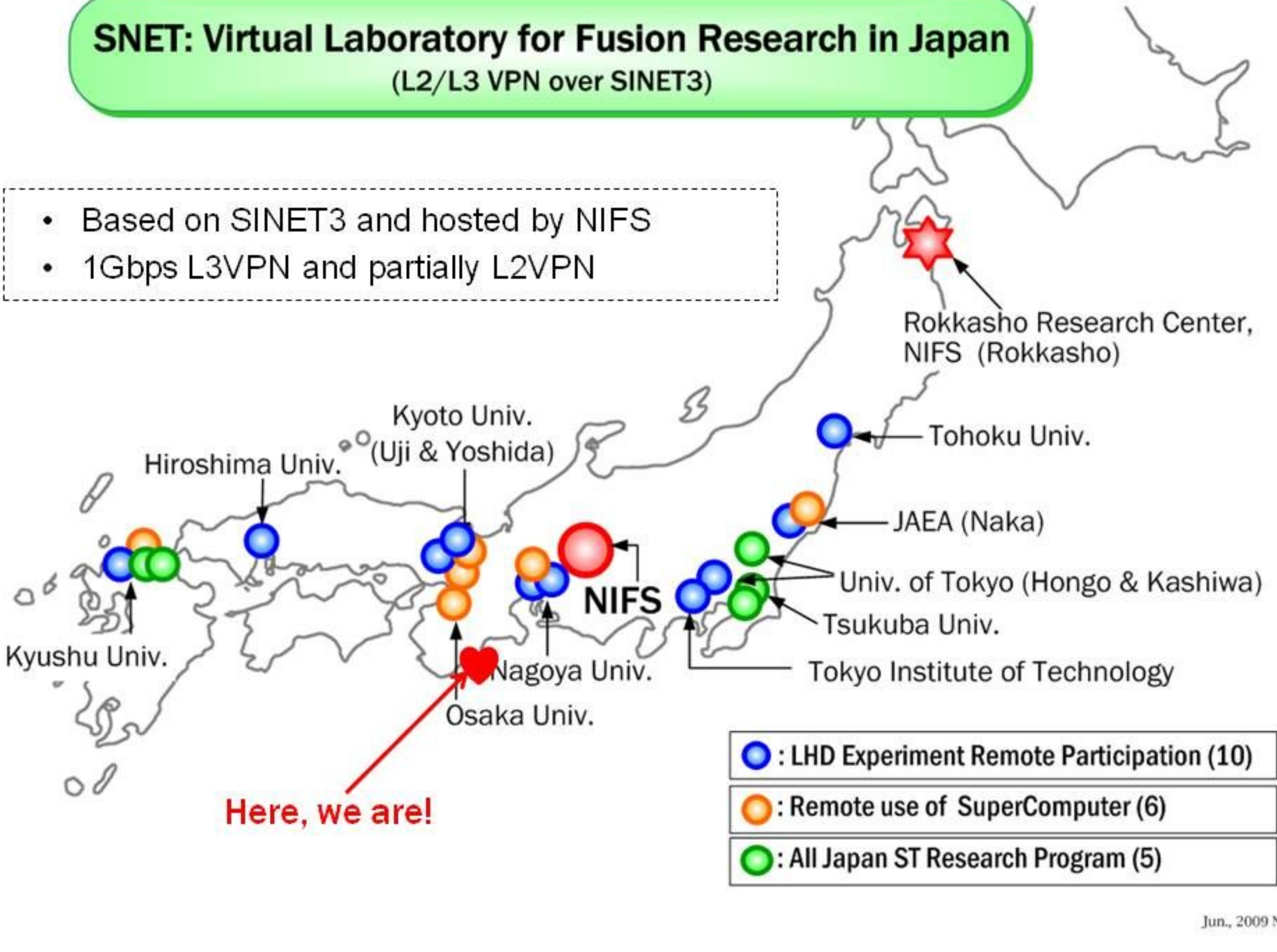
SINET3 topology

IT assists the research activities → Virtual Laboratory

SNET: Virtual Laboratory for Fusion Research in Japan

(L2/L3 VPN over SINET3)

- Based on SINET3 and hosted by NIFS
- 1Gbps L3VPN and partially L2VPN



Jun., 2009 NIFS

LHD experiment remote participation

FY2001

SNET has been hosted by NIFS since FY2001.

Kyoto Univ.

Data from LHD

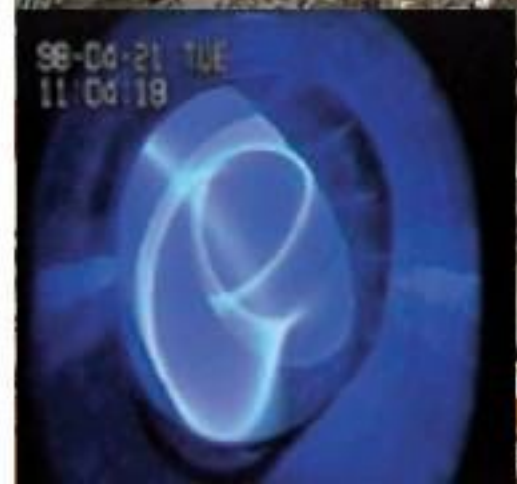
Univ. of Tokyo

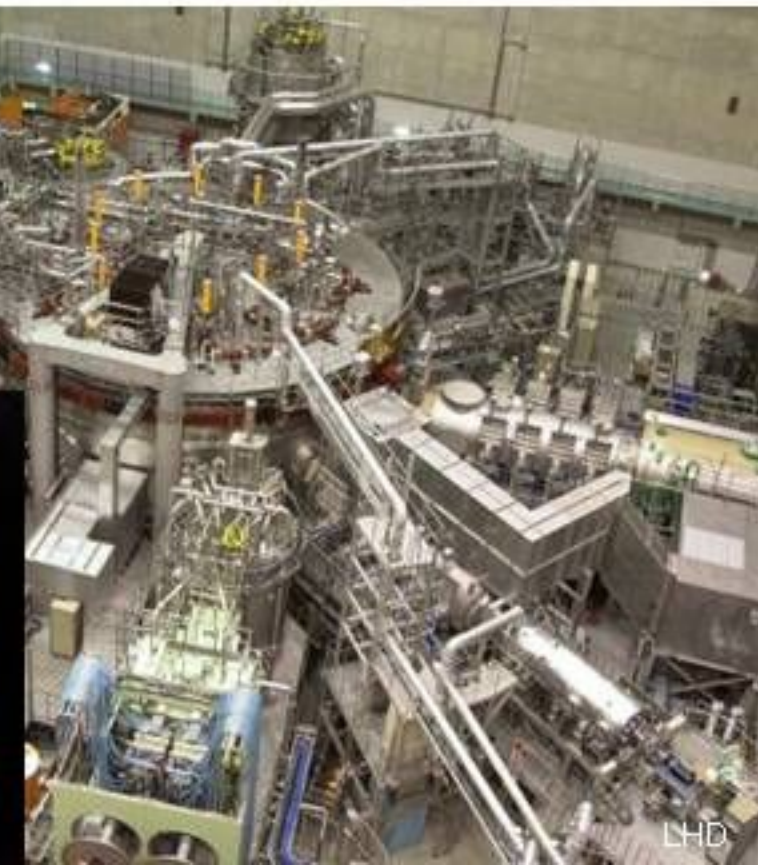
Kyushu Univ.

NIFS, LHD

View, analyze Diagnostics Data

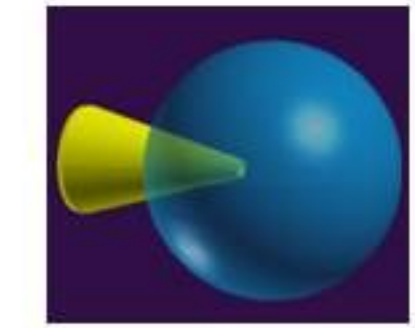
- Operate Diagnostics (LHD)
- Request operation mode

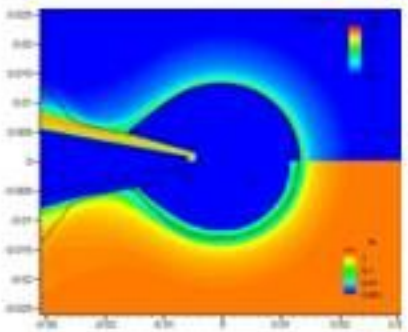




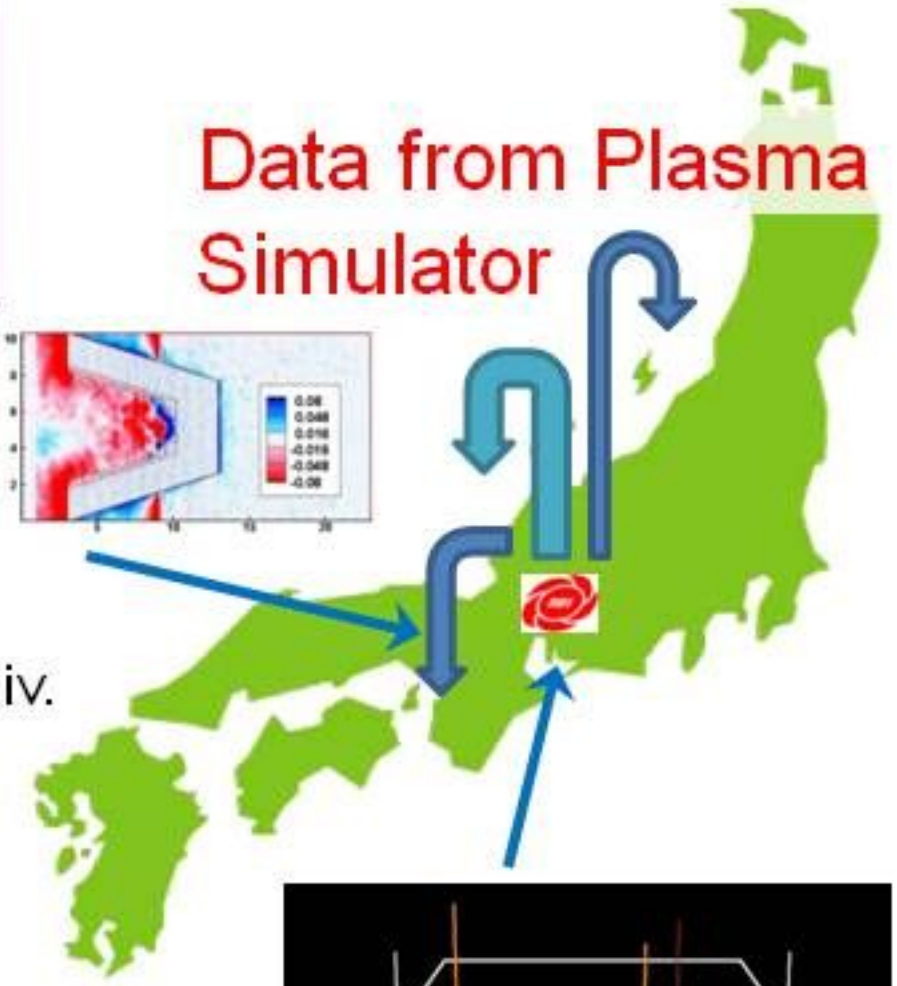
Remote Use of Supercomputer

FY2005

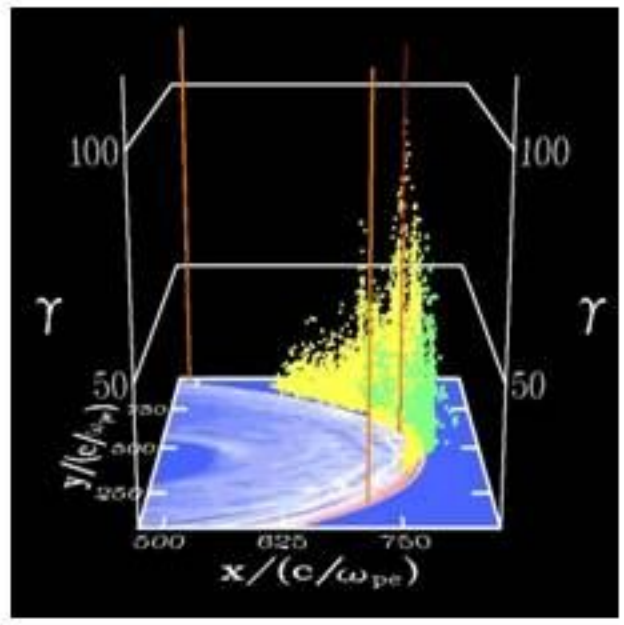




Data from Plasma Simulator



Osaka Univ.

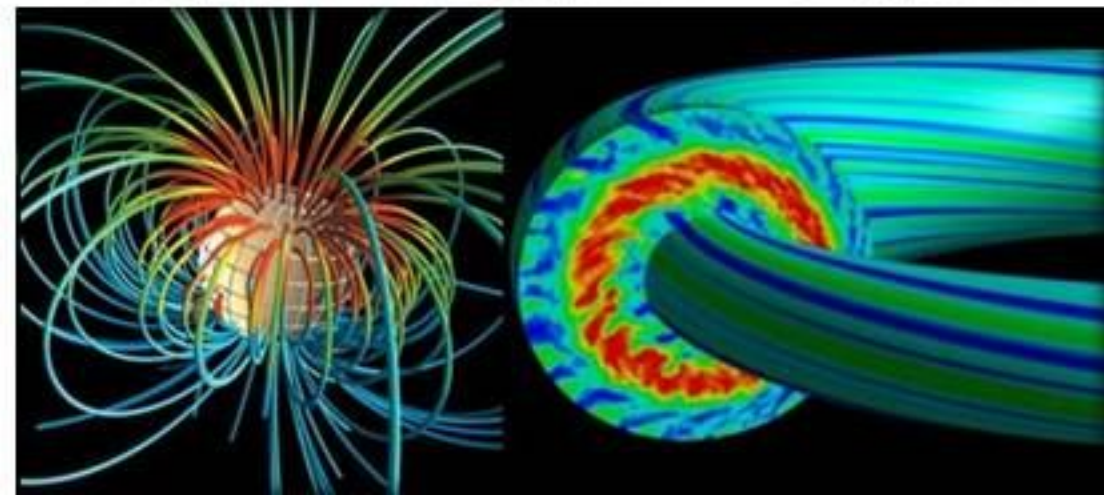


Nagoya Univ.

Plasma Simulator, NIFS

77 TFlops and 16 TB main memory

65th at TOP500 (June 2009)

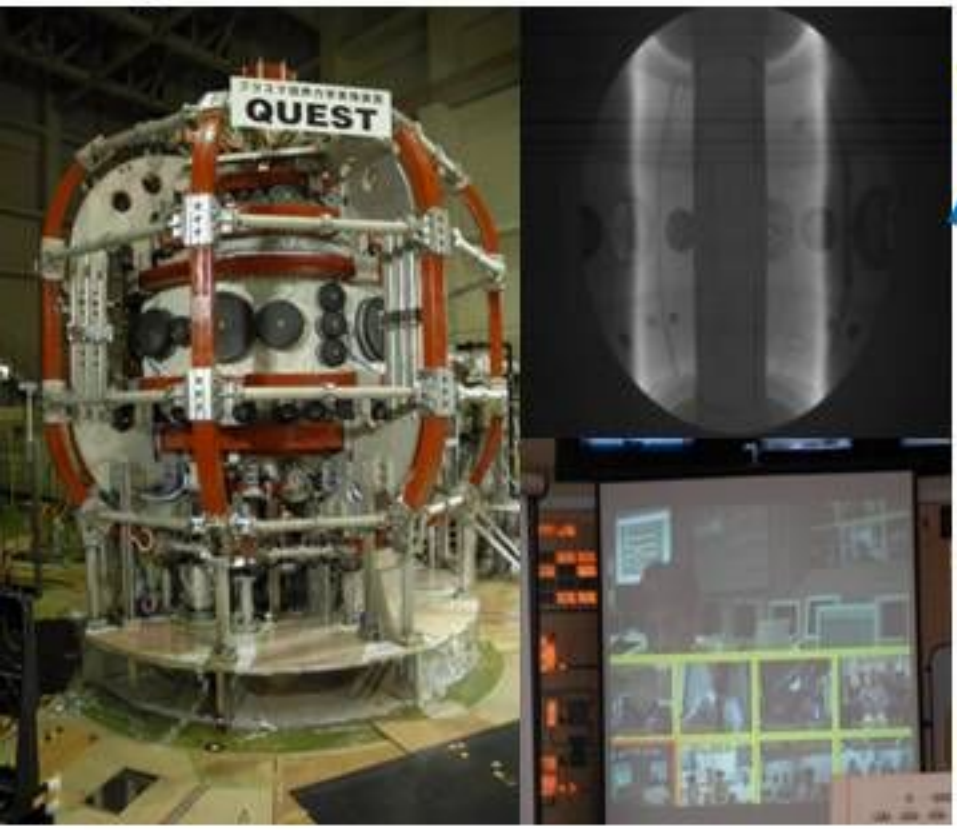


All Japan ST research program

FY2005

QUEST

Steady-state spherical tokamak (ST) Experiment Device, Kyushu Univ.



started on 26th June 2008

Data from QUEST / GAMMA-10

GAMMA-10

minimum-B anchored tandem mirror, Tsukuba Univ. (FY 2009)

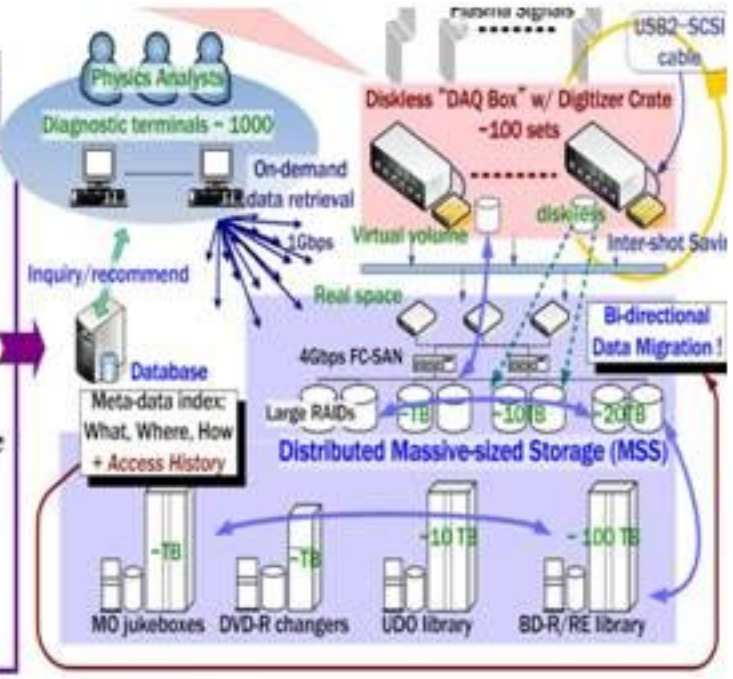
LABCOM, NIFS

data acquisition system

Facilitator DB

This mechanism can treat multiple data entries in
- DAQ Boxes or PCs
- RAID servers
- Mass storage servers.

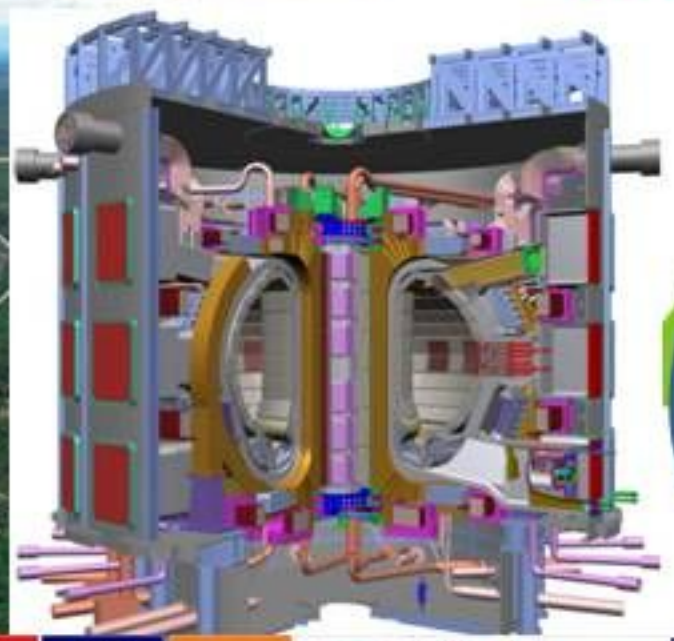
Entries are
1. registered in appearance
2. recommended on demand with priority.
3. keeping their own accessed histories to trigger recall.



ITER, international collaboration project

(FY2018)

To demonstrate the scientific and technical feasibility of fusion power.



All of the diagnostics data (0.2 ~ 3 PB/yr) (Proposed)

Data from ITER

IFEREC, the International Fusion Energy Research Centre, under ITER-BA Rokkasho

To universities and research institutes

ITER, Cadarache, France

Progress of SNET

Remote use of supercomputer system

FY2001

LHD experiment remote participation

FY2005

All Japan ST research program

(FY2018)

ITER, international collaboration project

Kyoto Univ.

LHD

Univ. of Tokyo

The Large Helical Device, LHD (NIFS)

GAMMA-10

ITER-BA IFEREC (Rokkasho, Japan)

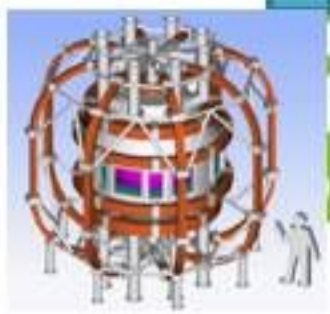
Data from ITER (proposed)

Kyushu Univ.

Data from QUEST

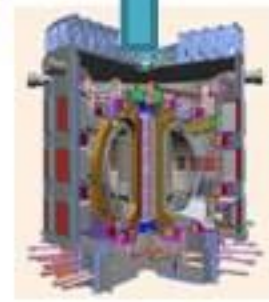
LABCOM data acquisition system (NIFS)

From NIFS to universities and reseaech institutes



Steady-state spherical tokamak Experiment Device, QUEST (Kyushu Univ., has been operated since FY2008)

To universities and reseaech institutes



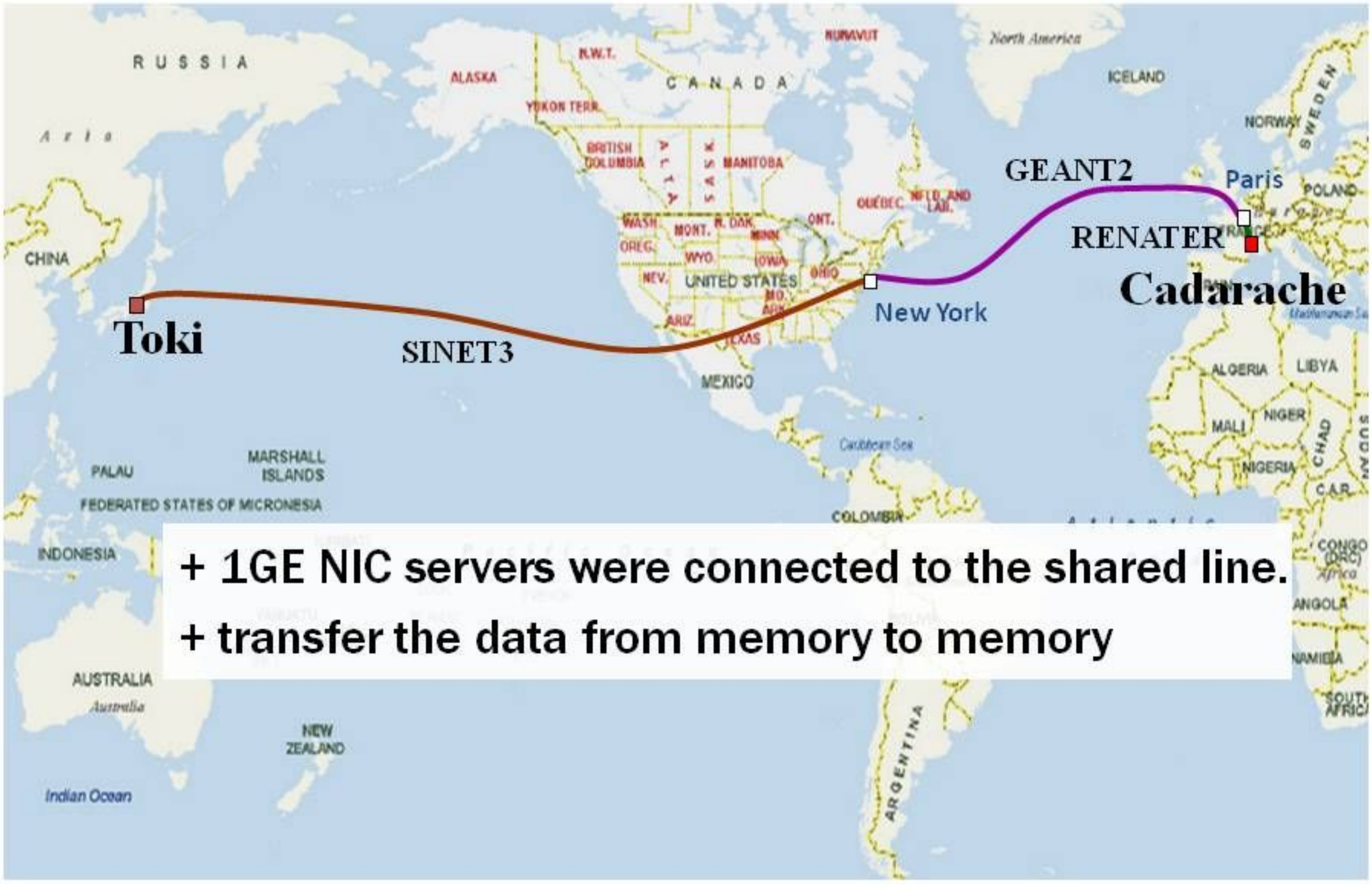
ITER (France)

High Speed Data Transfer

1st experiment on June 2009

Route map of 1st JP-FR data transfer experiment

15 – 22 June, 2009



+ 1GE NIC servers were connected to the shared line.

+ transfer the data from memory to memory

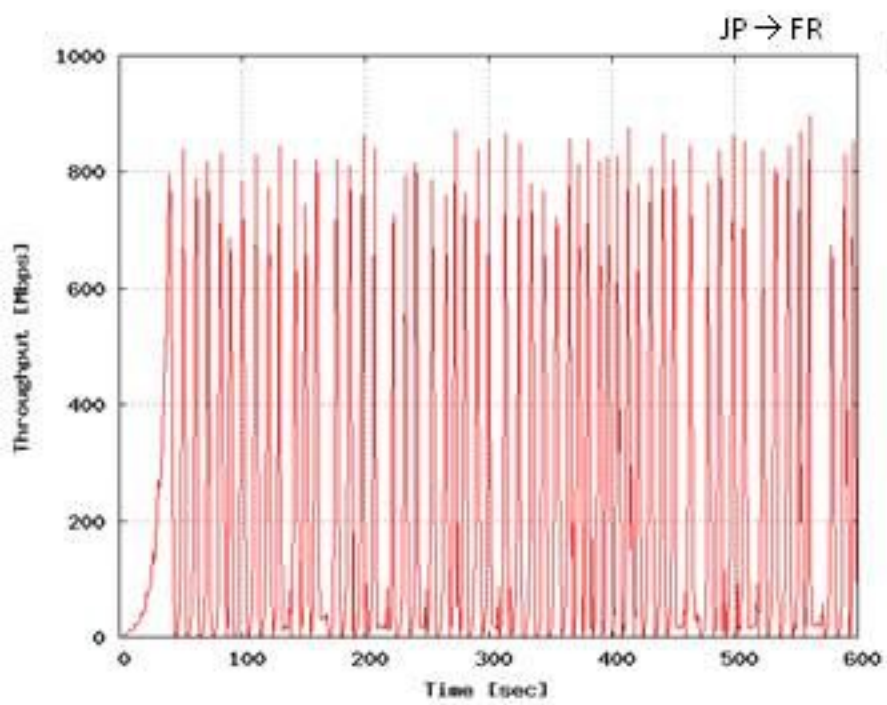
Results of 1st JP –FR data transfer experiment (1/2)

1.18 TB / 3 hours
Ave. 881 Mbps
Peak 899 Mbps

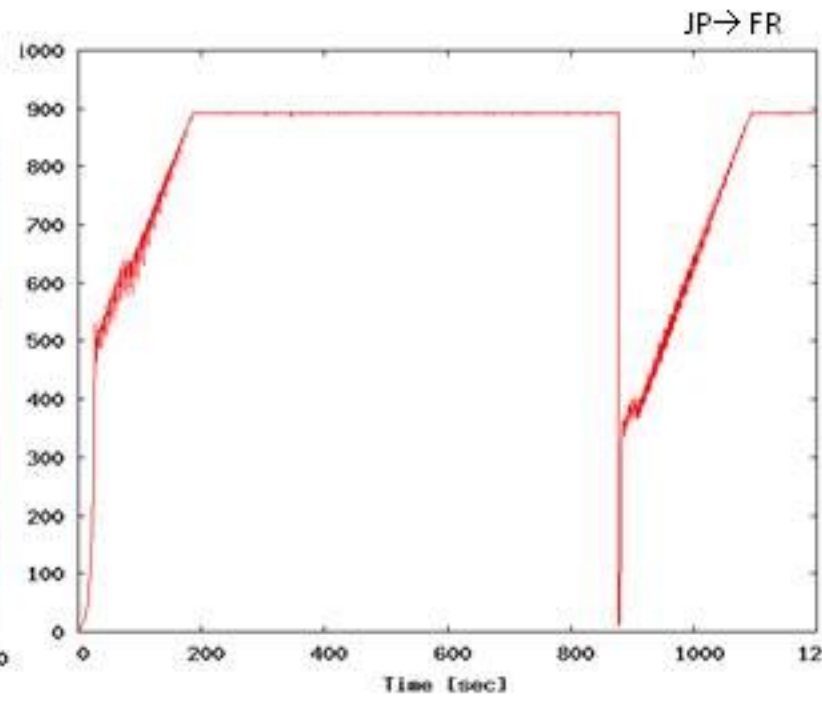
Toki site: Rack mounted server

Cadarache site: Note PC

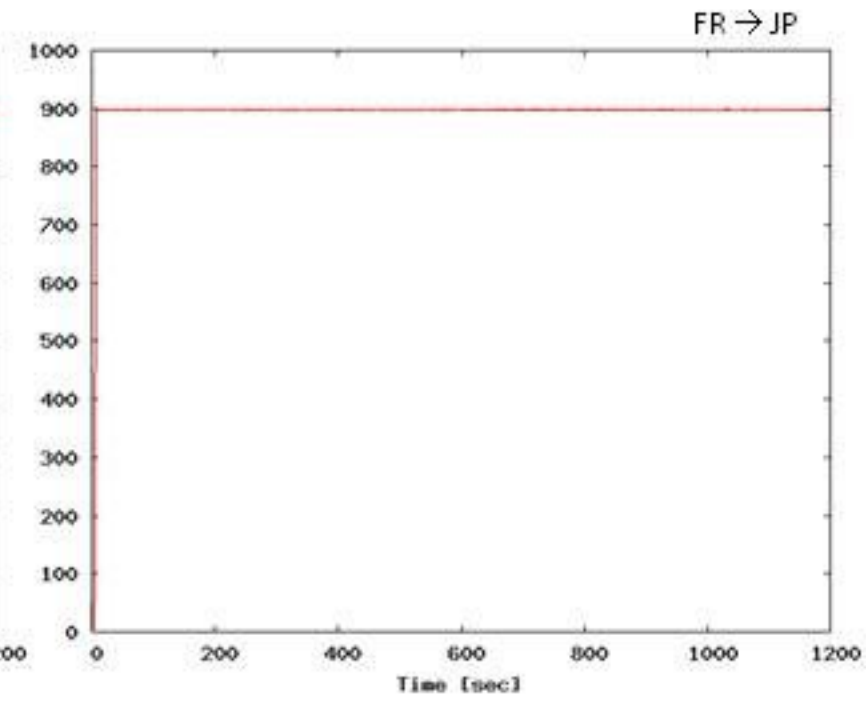
packet pacing: extend the interval of the packet.



W/o Packet pacing



PSPacer (PAUSE packet)

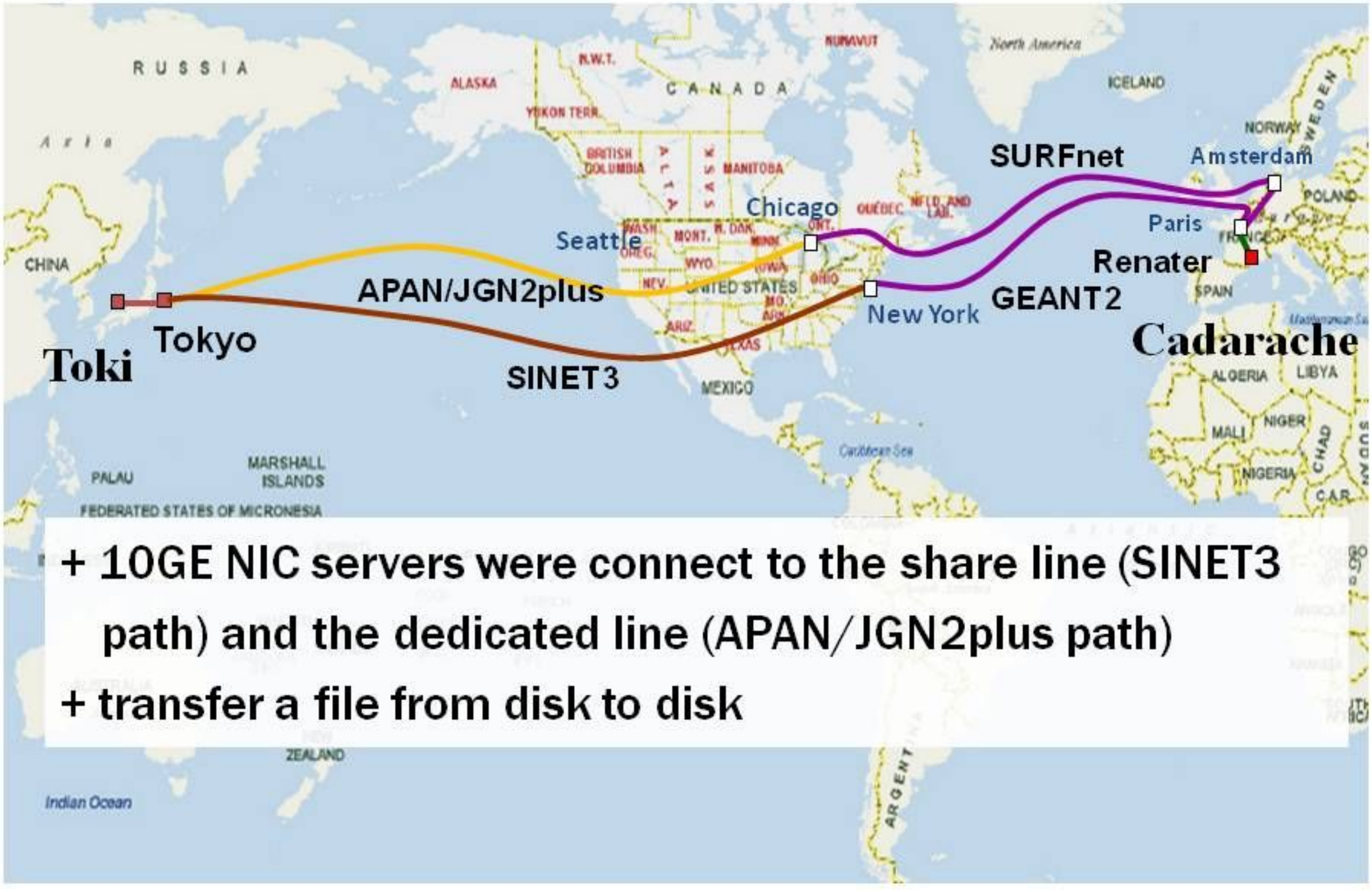


IPG tuning / NIC module

measured by iperf

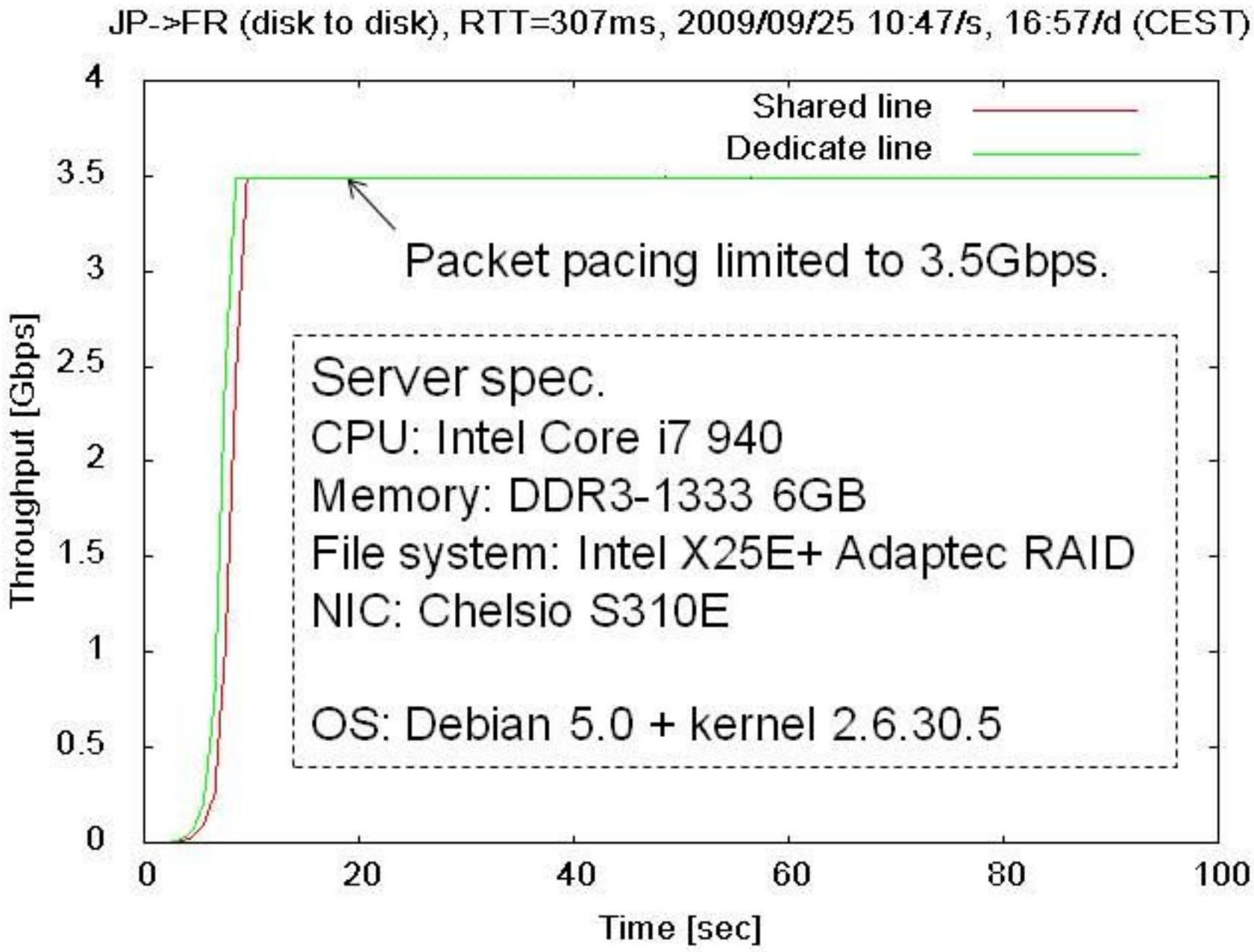
Route map of 2nd JP-FR data transfer experiment

21 – 25 September, 2009



+ 10GE NIC servers were connect to the share line (SINET3 path) and the dedicated line (APAN/JGN2plus path)
+ transfer a file from disk to disk

Results of 2nd JP –FR data transfer experiment



Toki site

Cadarache site

The available bandwidth was limited to 4Gbps on both path.

- The file of 86 GB has been transferred in 205 sec.
- The average throughput was 3.3 Gbps (> 80 % of limitation)

Summary

- SNET
  - is the network for the remote collaborations hosted by NIFS.
  - is successively supports many activities and many remote sites.
- High speed data transfer
  - Techniques for using 10GE have been established through JP-FR data transfer experiments.
    - Standard PC hardware and Linux is enough to do.
    - Packet pacing is very important to avoid the packet loss.
  - The results will be applied to SNET to enhance user's activities.

Acknowledgment

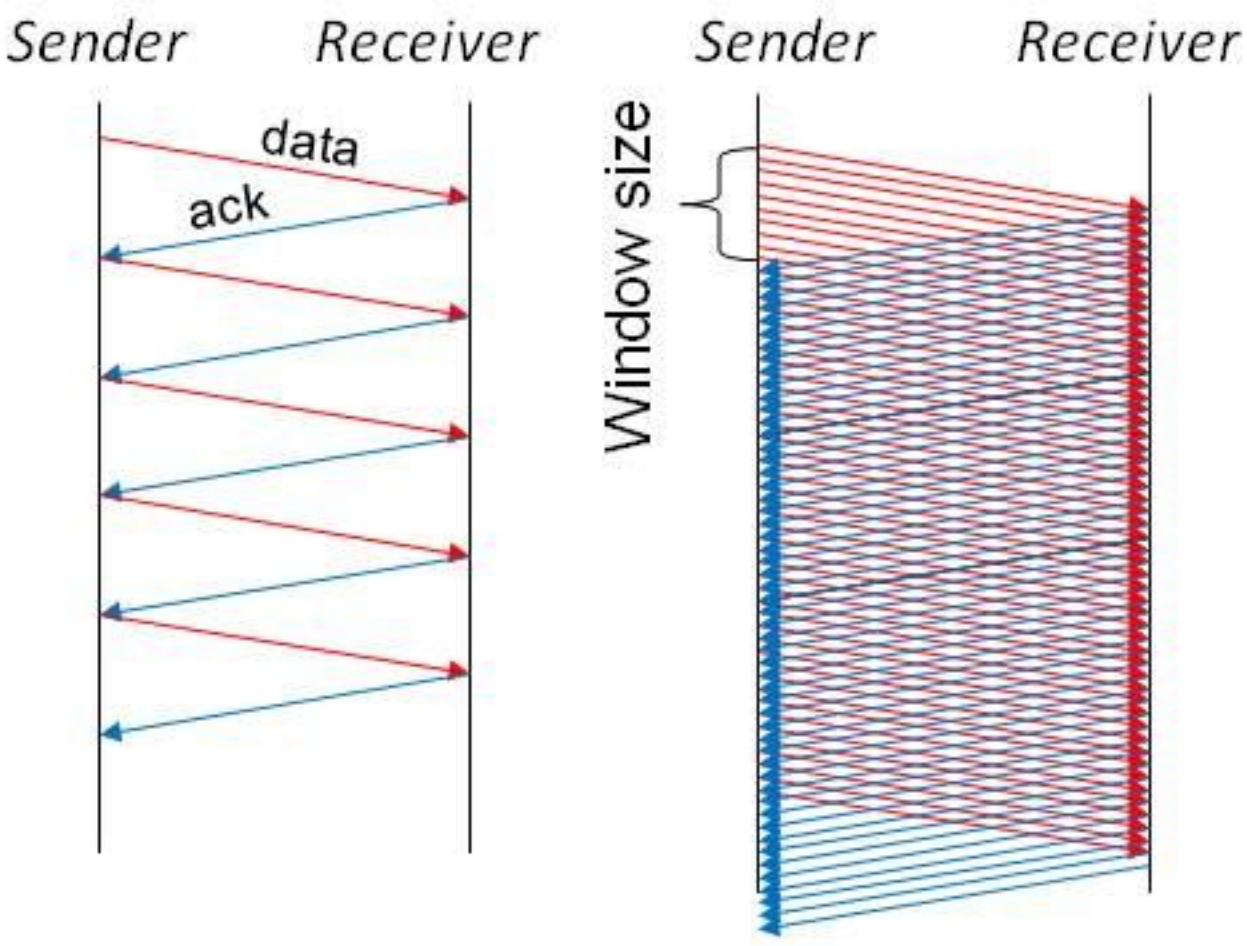
NIFS Univ. of Tokyo ITER Headquarters

- SINET3
- JGN2plus
- WIDE
- APAN-JP
- StarLight
- Internet2
- GEANT2
- Renater

CTC SP NVC Hitachi

LFN Problem (1/2)

The effective throughput is much less than the bandwidth of the link at Long Fat Network. (ex. 1Gbps, RTT=20ms → ftp 60Mbps)



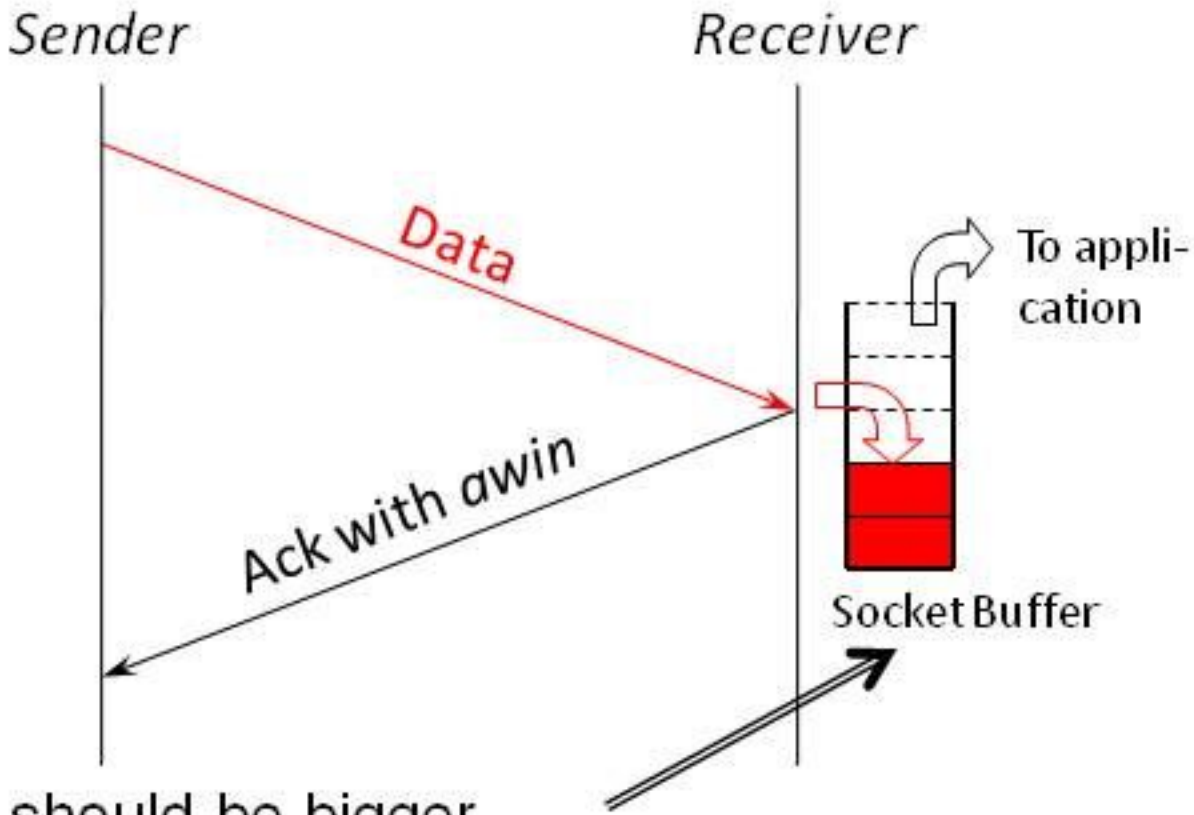
(a) TCP protocol (b) LAN (c) WAN

Data is red and acknowledgement is blue

LFN Problem (2/2)

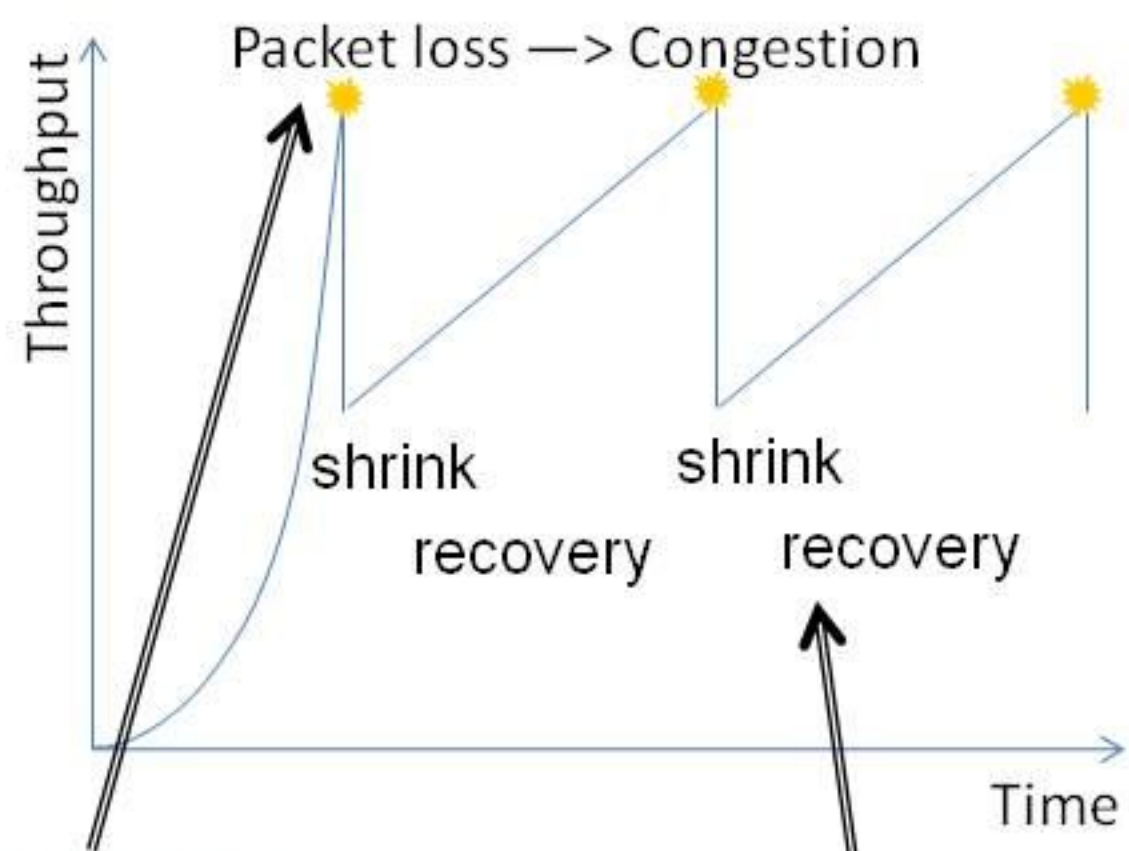
Window size = $\min$(awin, cwin)

awin : advertised window size



should be bigger
than bandwidth-delay product.
(ex. 1Gbps, RTT=20ms:
BDP=1000/8*0.02=2.5MB)

cwin : congestion windows size



- Use packet pacing,
  extend the interval of the packet.
- Polish optical connectors.

Choose congestion avoidance algorithm: Reno, BIC, ...