Ultra high definition video transmission over dynamically configured SDN (Dynamic SDN)

Hiroyuki Kimiyama, Ph.D
Senior Research Engineer
NTT Network Innovation Laboratories

Table of contents

History

i-Visto XMS

i-Visto Gateway XG-1

- **i-Visto system** (Internet **Vi**deo **Stu**dio System) Store, Deliver and Transmit **Broadcasting-Quality** (*10bit 422 YUV*) High-Resolution Video
  - Uncompressed **HD**
  - Uncompressed **4K**
  - Uncompressed **8K …**

  and much higher resolution video over **IP Network** in real time with scalability [*1]

*1 H. Kimiyama, et. al, "Uncompressed 8K-Video System Using High-Speed Video Server System Over IP Network", Proc. of Asia Pacific Conference on Multimedia and Broadcasting (APMediaCast 2015), pp.99-105, 2015

You can get these as ***commercial products***!

Uncompressed 8K video system

- We developed "**strict**" *synchronization mechanism* for these equipment in order to handle 8K video (Please see ref. *1 in previous slide)
  - 8K video equipment for broadcasting only allow µsec jitter

NTT

Issue for using over shared IP networks

- How we can use these products on existing shared IP network?
  - ex. Internet2, JGN-X, and so on
- Before using, we need
  - Provisioning,
  - Negotiation,
  - Reservation, …
- But, sometimes congested in very short period even if bandwidth is enough (10GxN, 100G)
  - It causes jitter or packet loss
- In worst case, we cannot transfer very high quality video even if we prepared carefully because *it is the* **SHARED** *network*
- We need *new mechanism which enables to transmit very high quality constantly*

Motivation & proposal

- We newly research and develop ***Application*** **centric** transport mechanism
  - i.e. It enables *Application* to requests for re-routing packets to other ***less*** crowded path[s] ***immediately*** when congestion is observed
  - *Application* **ONLY** knows transmitted video quality

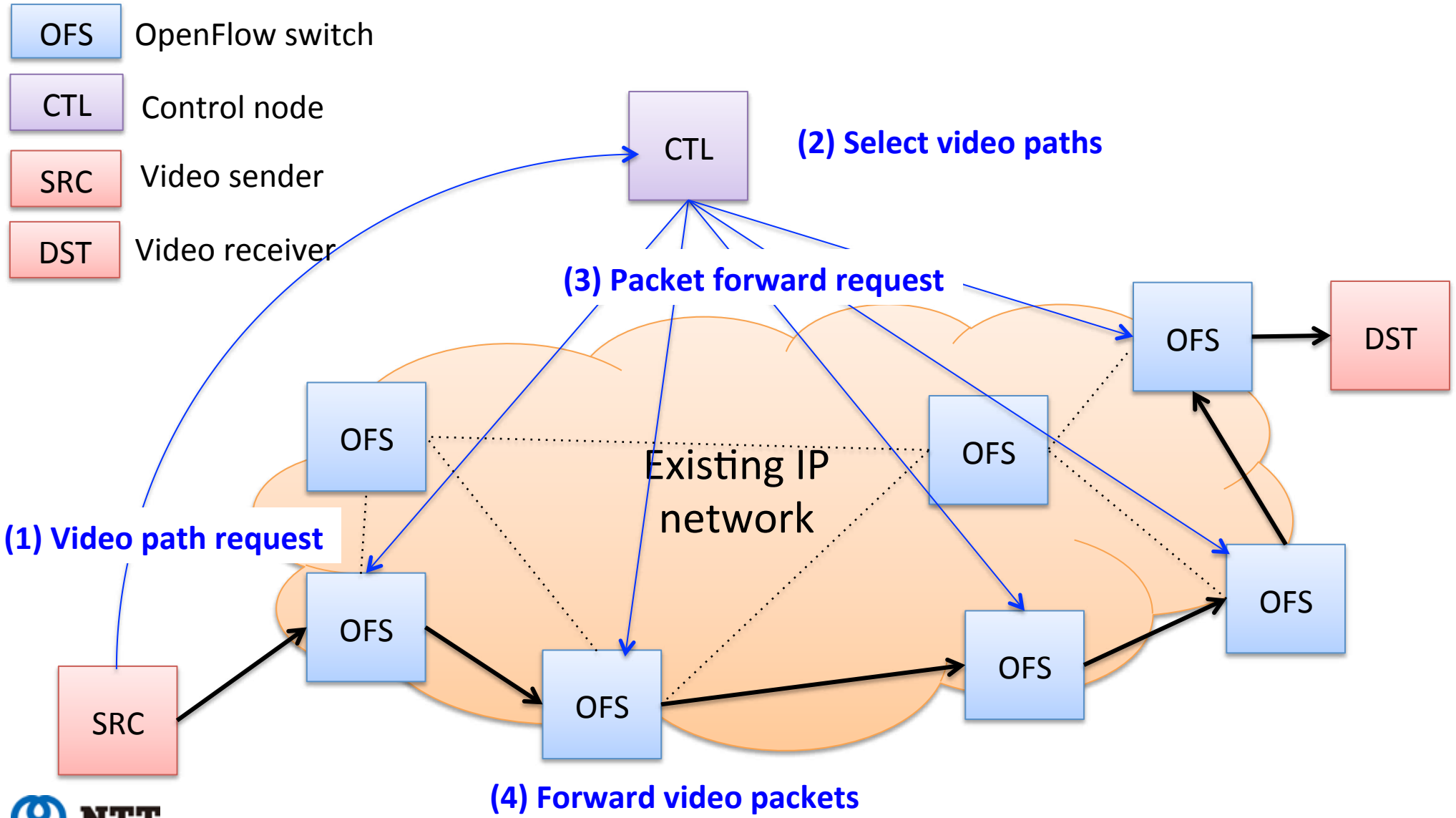
- Our proposal
  - Configure virtualized network instantly over existing shared IP network using OpenFlow switches: "***Dynamic SDN***" *2
    - Easy to re-route by reconfiguring OpenFlow switches with very short period
      - "Slice" based virtualization takes little more time for reconfiguration

*2 H. Kimiyama, et al, "High-resolution Video Transmission Network System Using Dynamic SDN", Proc. of 21st Asia-Pacific Conference on Communications Innovating Communications Networks toward Sustainable and Smart Society (APCC 2015), pp.338-342, 2015

NTT

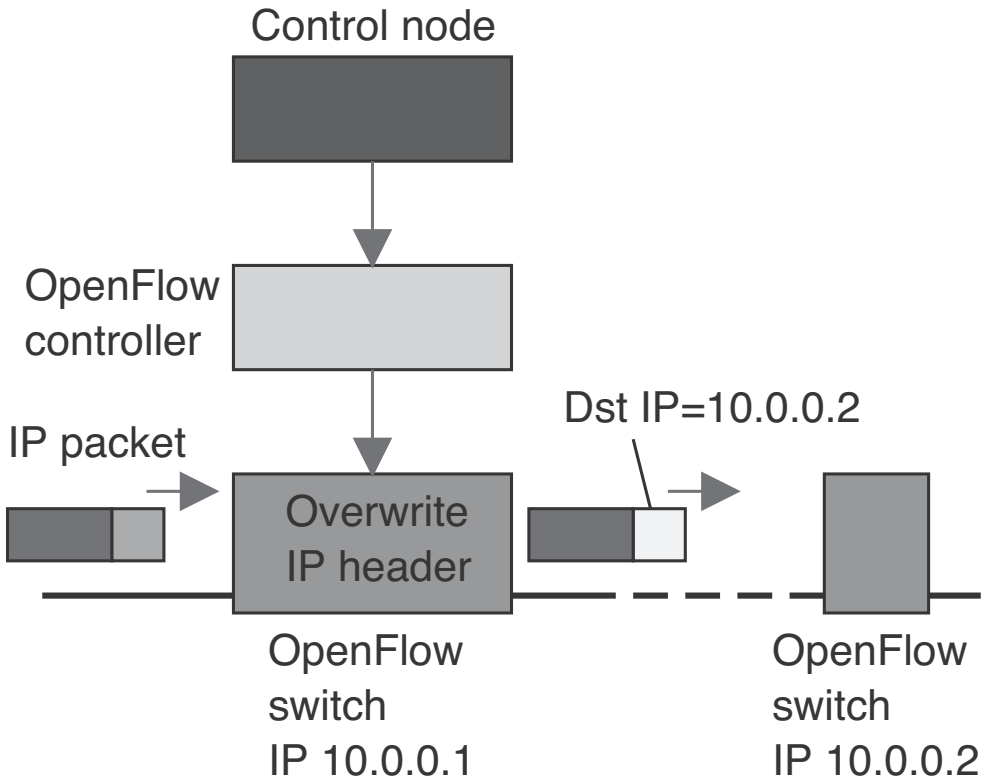
Basic Idea of Dynamic SDN

- Before sending video packets -



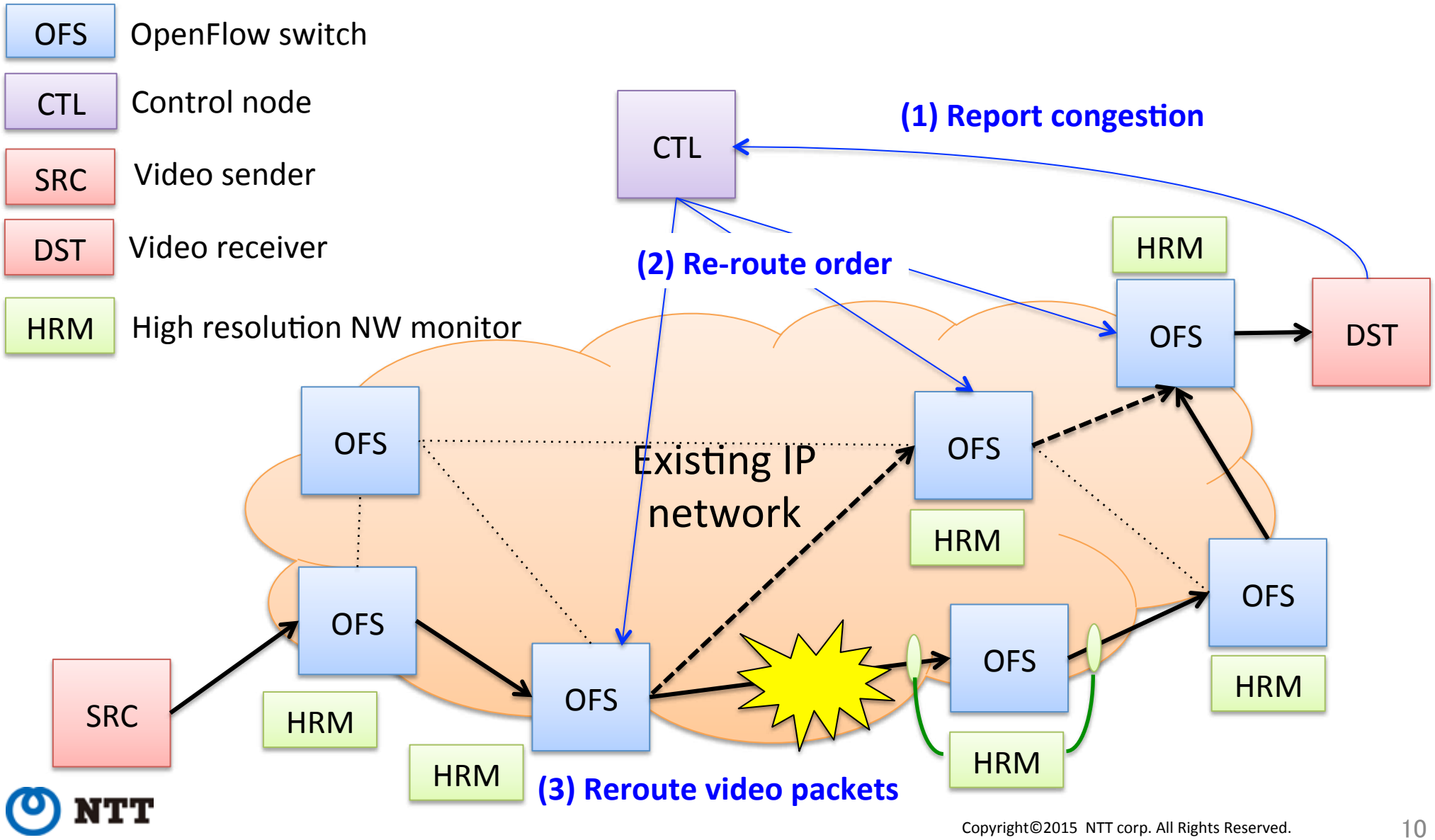
Mechanism of relaying IP packets

- OpenFlow switch relays IP packets with “NAT”
  - NAT: Network Address Transformation
  - Receive information about what IP packets relay to what IP address from the “Control node”
    - Each video stream is identified with source IP address, source port number and destination port number
  - Replace destination IP address with given IP address
  - Repeat this process in next OpenFlow switch



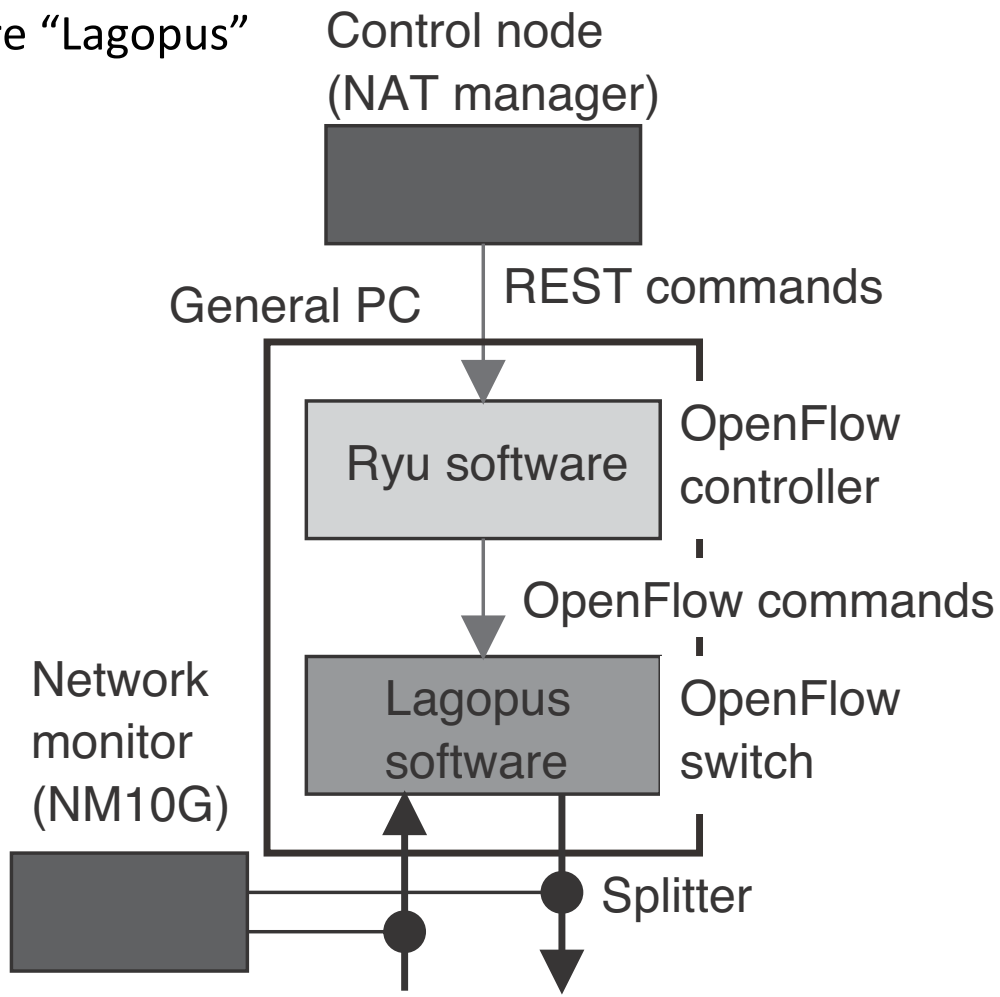
Basic Idea of Dynamic SDN

- re-routing process -

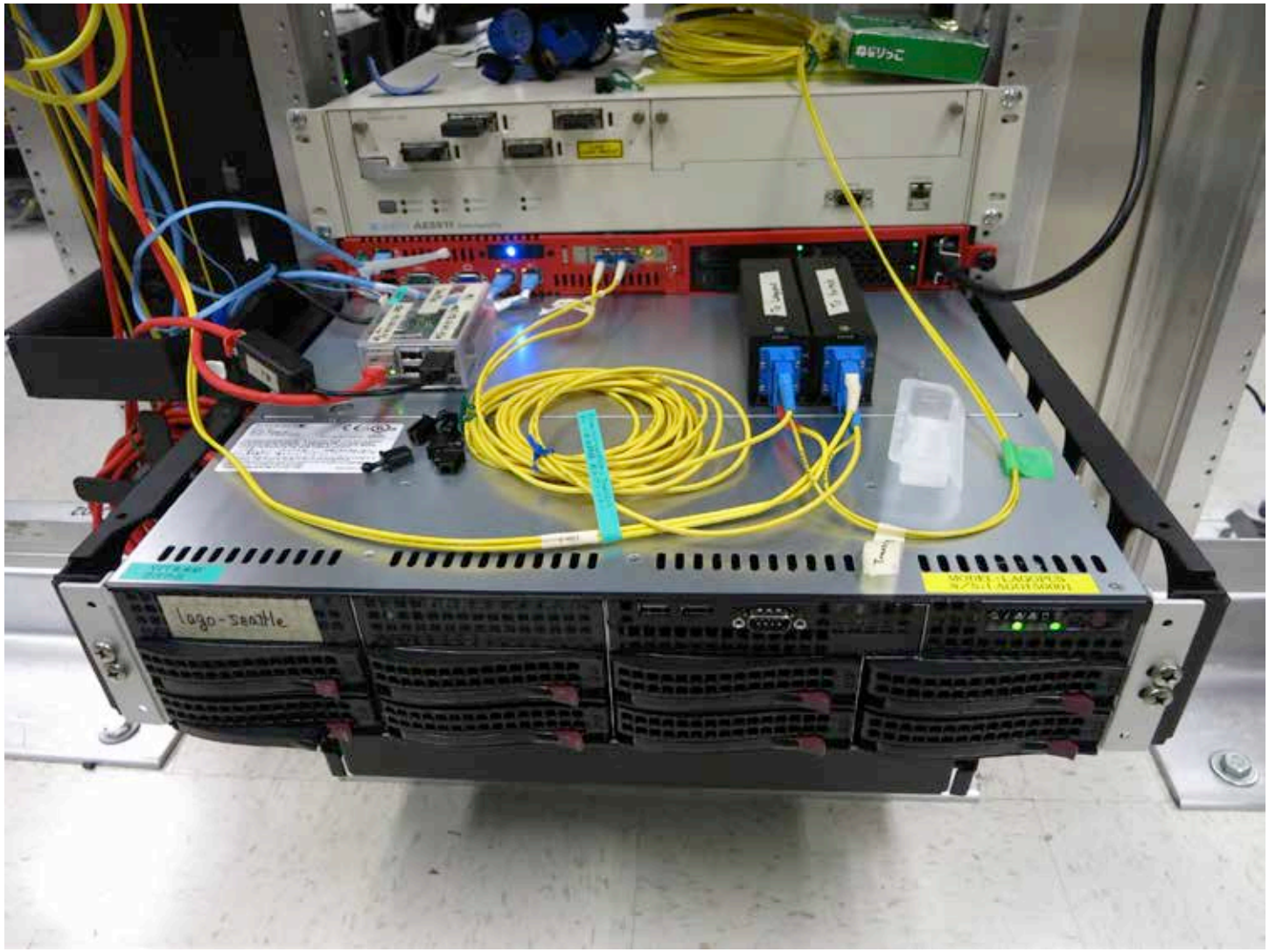


Implementation

- OpenFlow switch (OFS)
  - General PC and OpenFlow switch software “Lagopus”
    - https://lagopus.github.io/
- OpenFlow controller (OFC)
  - Major controller software “Ryu”
    - http://osrg.github.io/ryu/
  - Install into the same PC
- Network monitor
  - NM10G (aka. viaPlatz Stream monitor)
    - Commercial traffic monitor
    - http://www.viaplatz.com/4k/pdf/feature4k_en.pdf
- Control node
  - Originally implemented
  - Control OFS with REST message via OFC

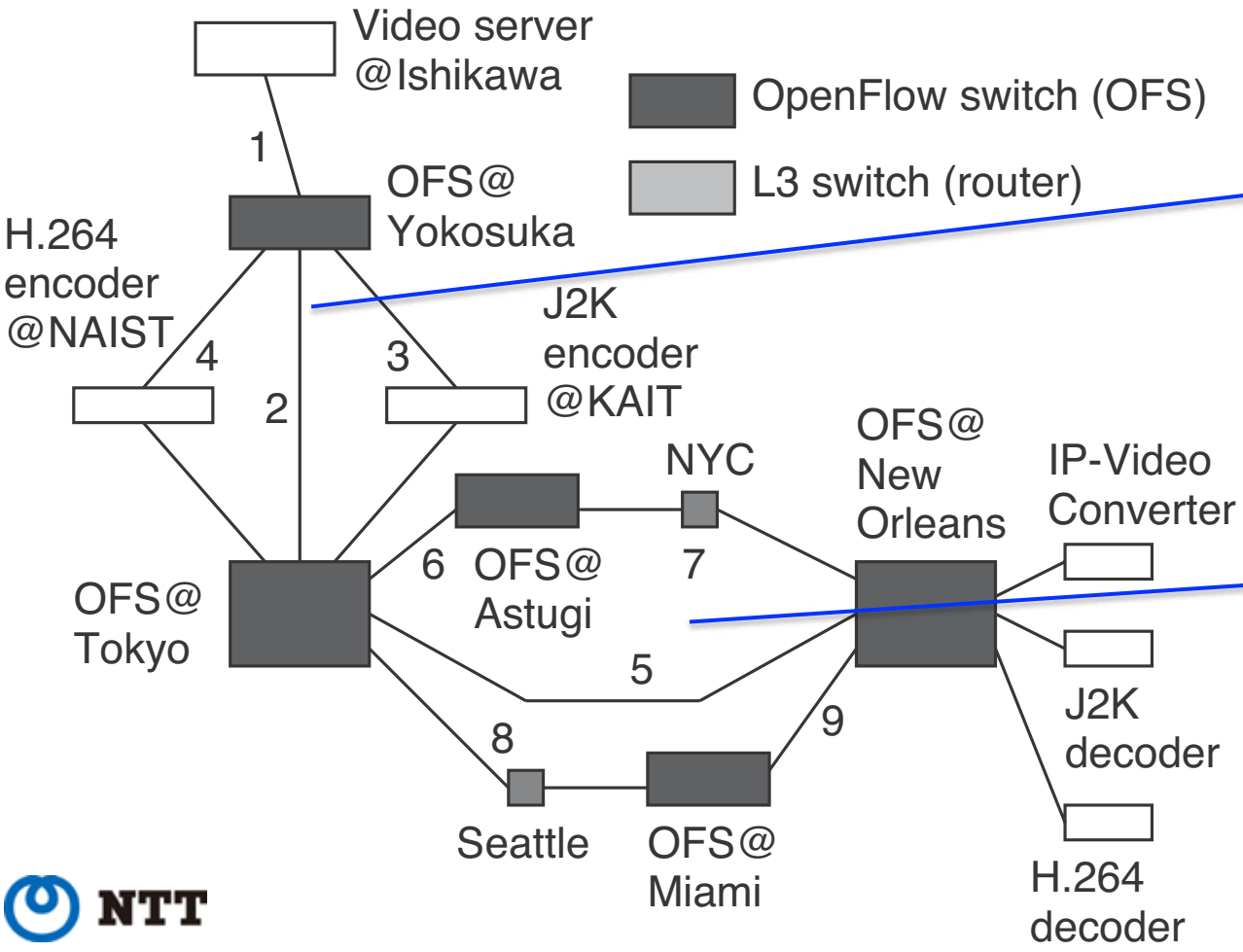


Implementation (Cont'd)



Experiment system configuration

- Outline of uncompressed HD transmission system over R&E network
  - Uncompressed HD server: Generate on-demand video stream
  - IP video converter: Convert received video packets to video signal

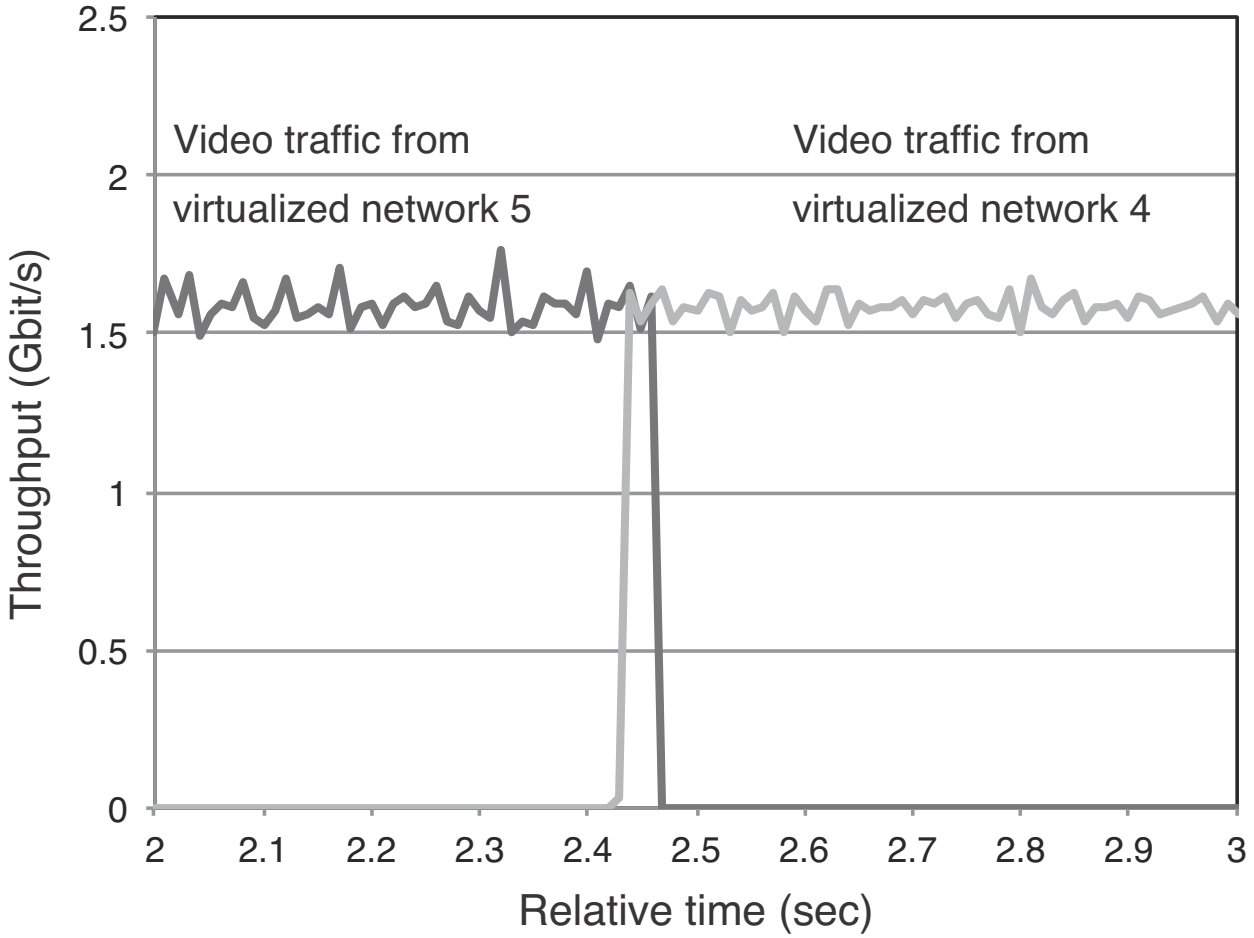


Configured **three virtualized networks** in Japan and used one of them

Configured **three virtualized networks** between Tokyo and New Orleans and selected one of them with

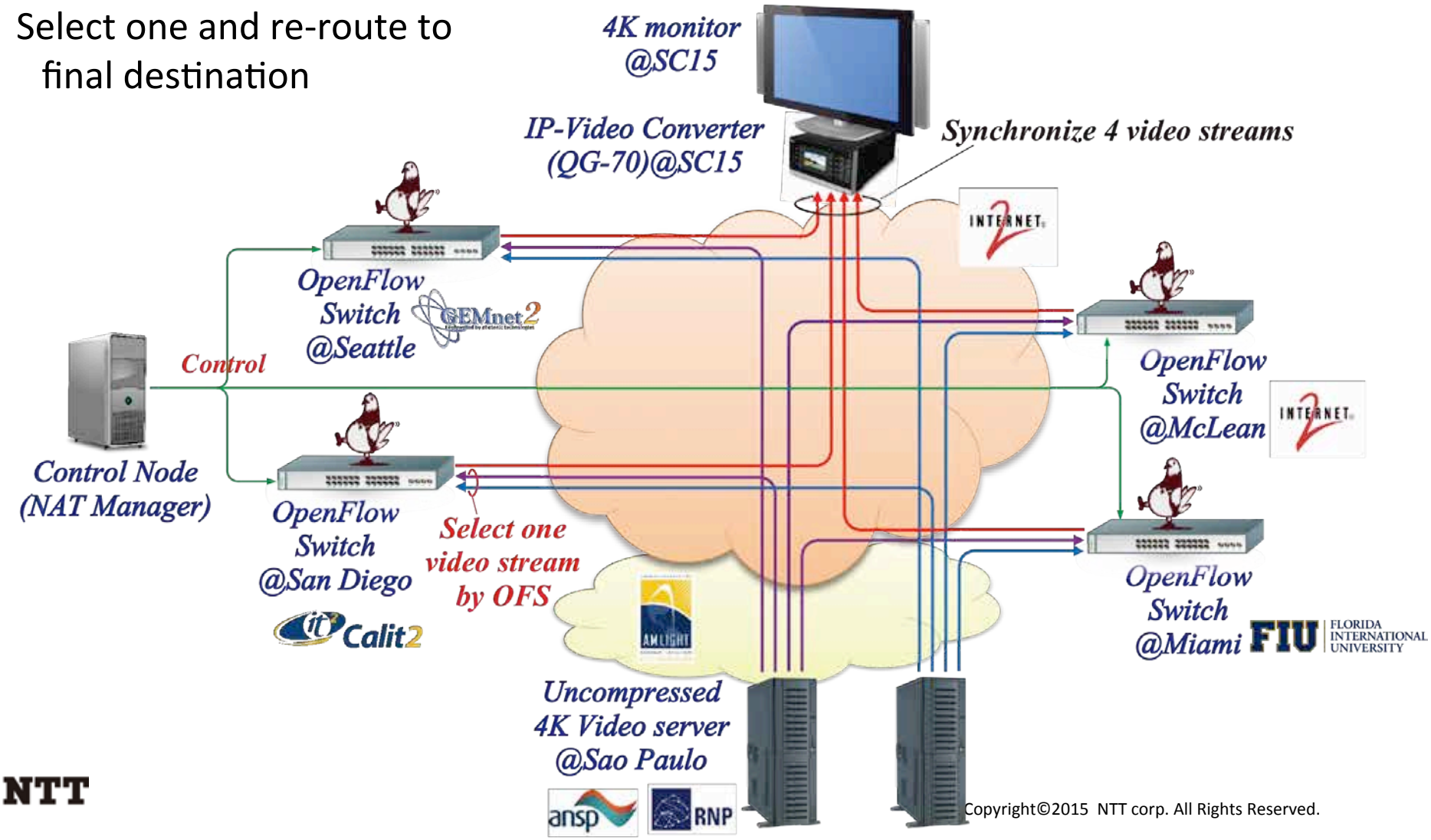
Experiment result

- Measured throughput with 10-msec resolution during re-routing
  - Overlapped video traffic is too small to absorb with IP-video converter's buffer

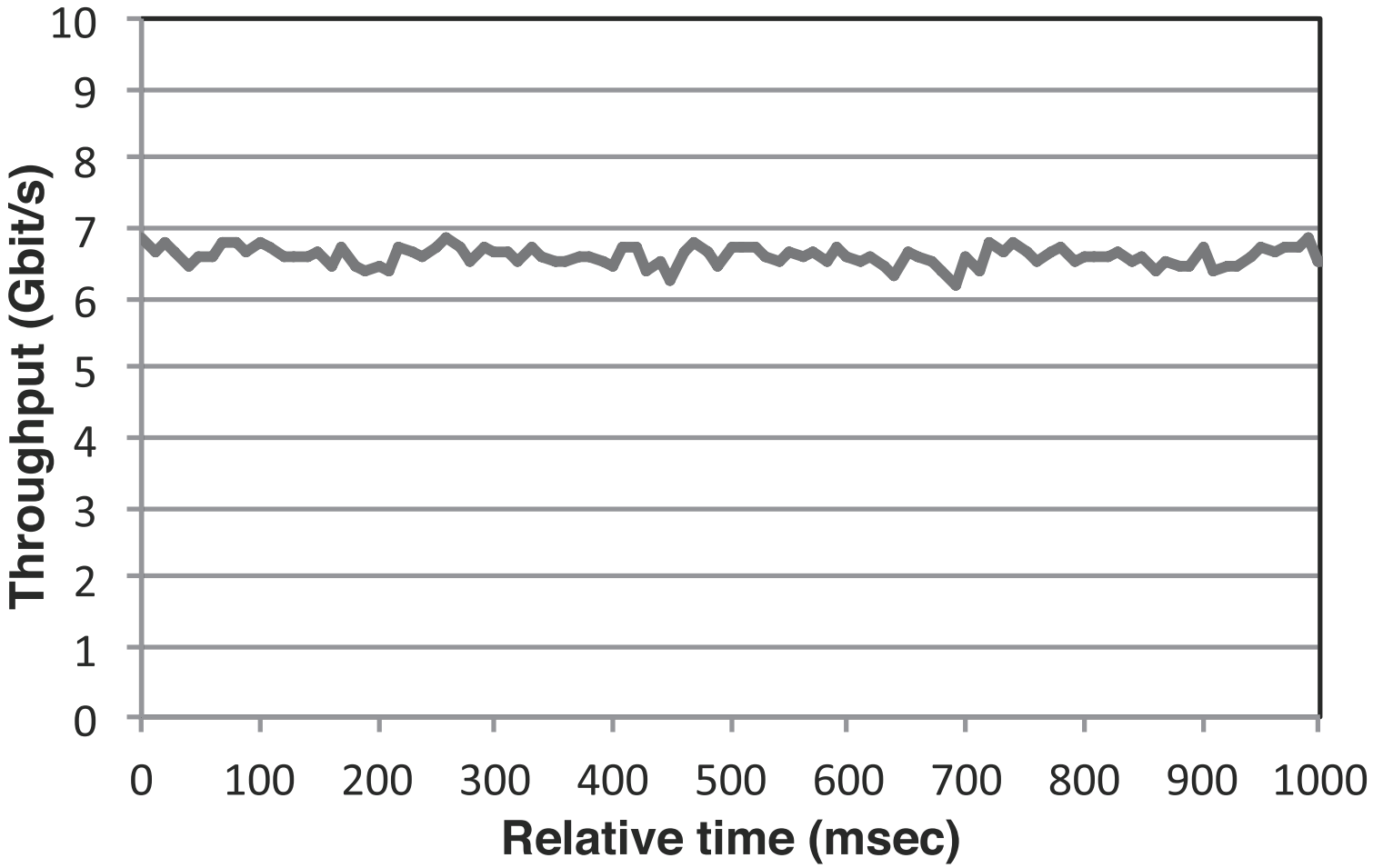


Multiple paths transport and video switching

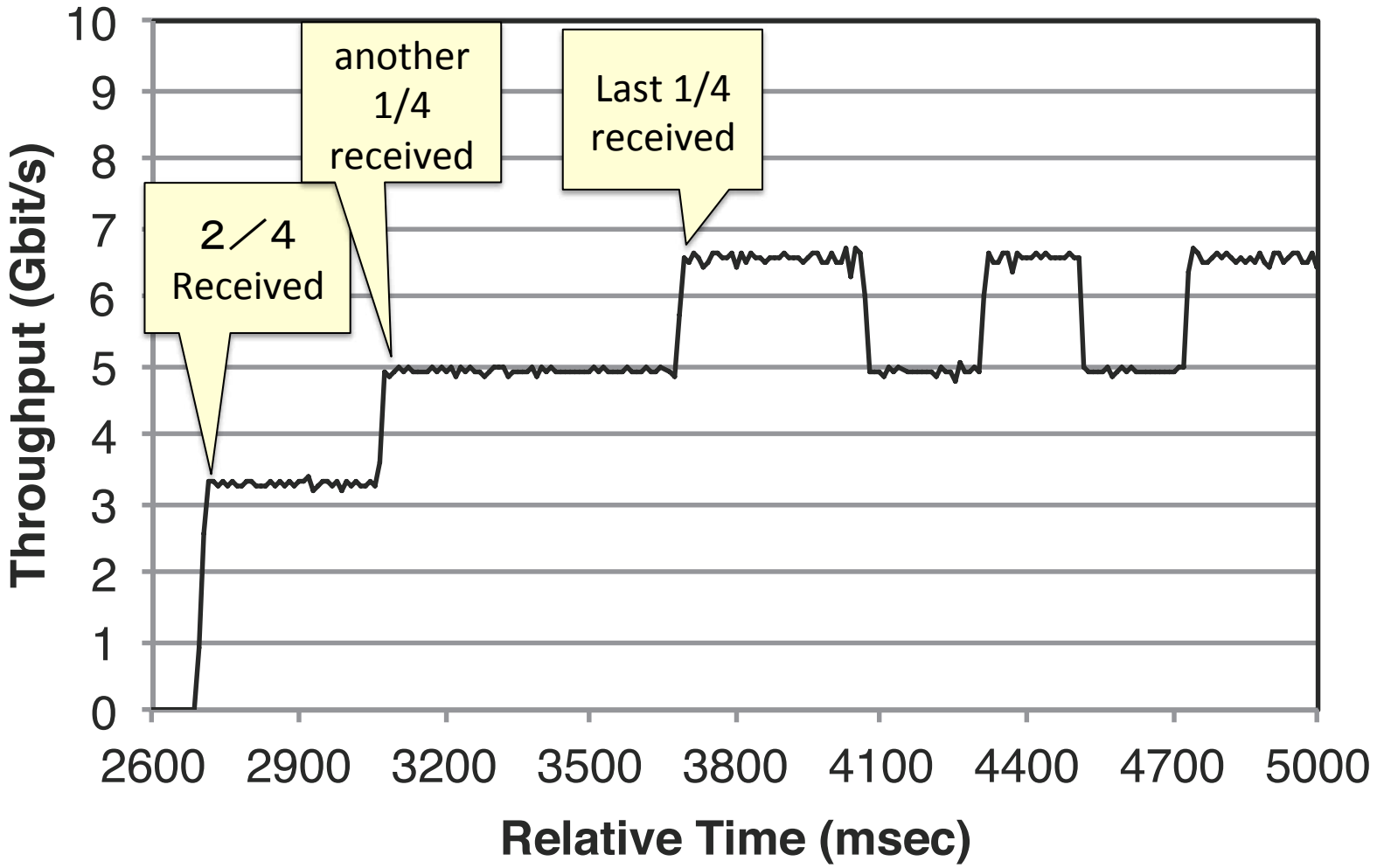
- Demos in Internet2 Technology Exchange 2015 (Cleveland) and SC15 (Austin)
- Send two uncompressed 4K video via 4 individual paths
- Select one and re-route to final destination



Video traffic data with 10msec resolution



Video traffic data with 10msec resolution



Conclusion

- We propose configuration method of application controllable virtualized network (VN): “Dynamic SDN”
- We show implementation method and experimental results
  - The method enables to
    - Reconfigure virtualized network without interruption of video transmission
    - Adapt to multiple path video transmission
- Future plan
  - Develop automatically reconfiguration mechanism
  - Improve start up synchronization during multipath transmission
  - And so on

We really thanks!!

Innovative R&D by NTT

INTERNET2

RNP

AMLIGHT

PACIFIC WAVE

ansp

FIU FLORIDA INTERNATIONAL UNIVERSITY

Obrigado!

GEMnet2 Empowered by photonic technologies

it2

NTTIT

JGN-X

StarBED

SINET4

NTT