High-performance Network Accommodation and Intra-slice Switching Using a Type of Virtualization Node

Yasusi Kanada & Kei Shiraishi, Hitachi, Ltd.
Akihiro Nakao, University of Tokyo

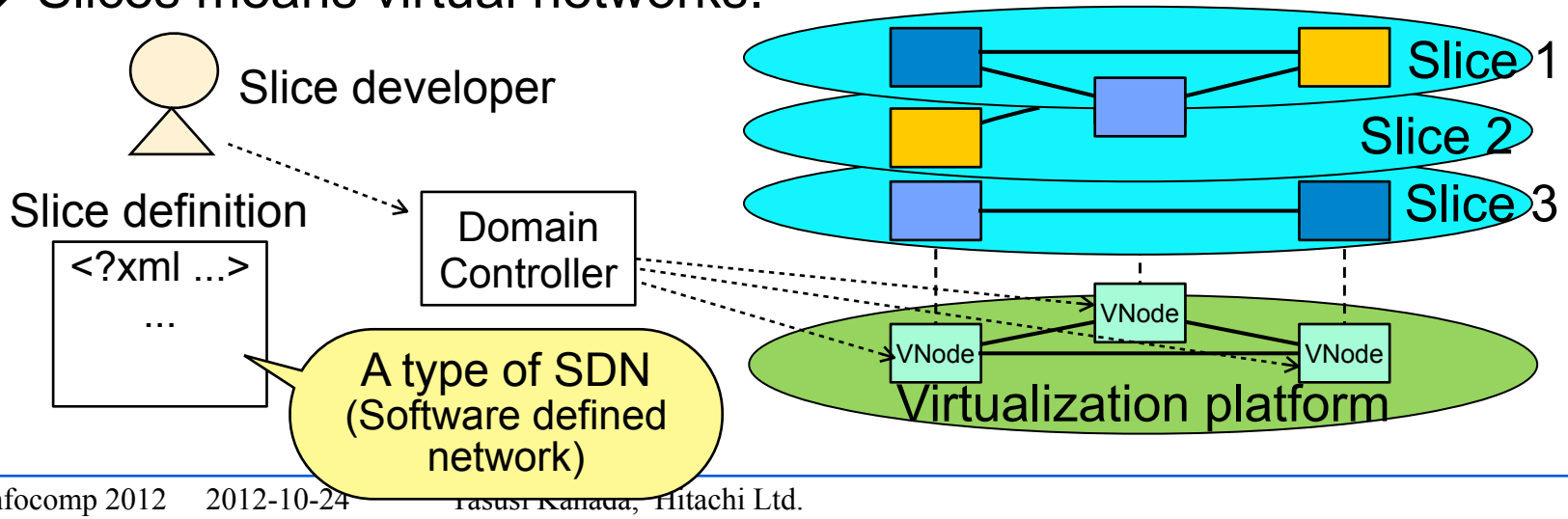
Introduction

- **We developed a network-virtualization architecture and platform in a collaboration project.**

NICT 独立行政法人 情報通信研究機構　東京大学 THE UNIVERSITY OF TOKYO　NTT

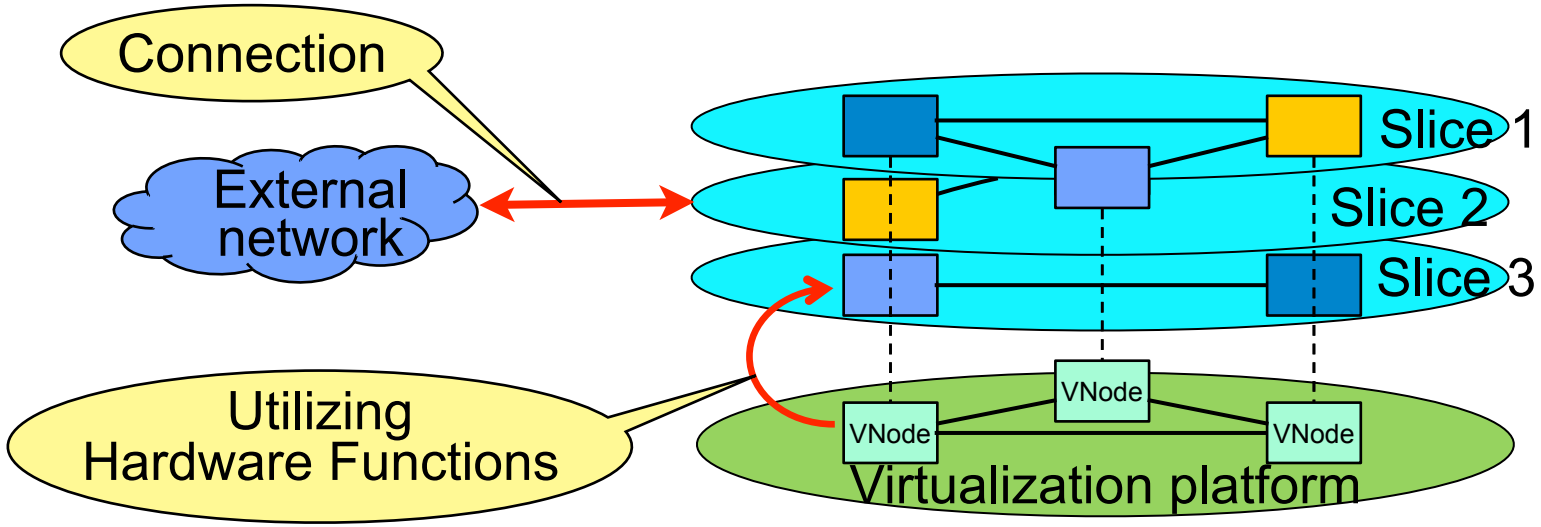
HITACHI Inspire the Next　NEC　FUJITSU

- **Multiple *slices* can be created on one physical network in this architecture and platform.**
  - Slices means virtual networks.



Introduction (cont'd)

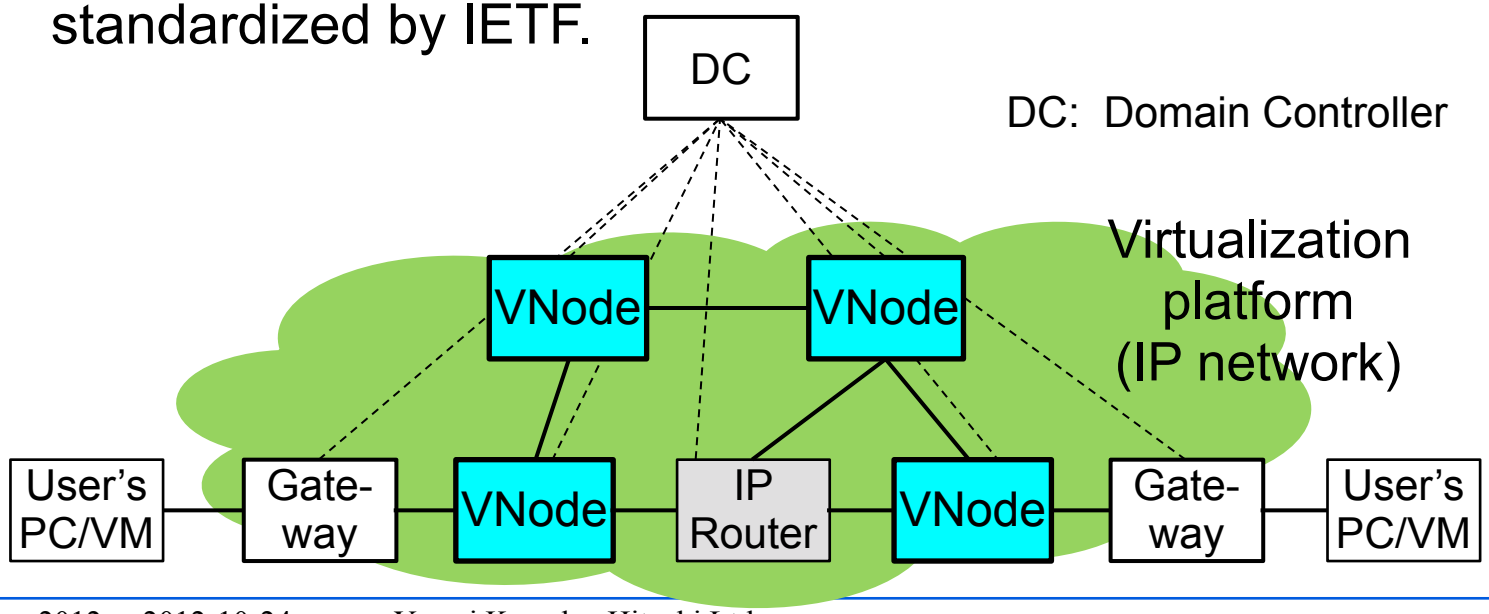
- **Two issues to be solved**
  - To connect a slice and an external network with high-performance.
    - A slice is something like a *closed* virtual world, but external connection is important for networking.
  - To utilize high-performance hardware function (such as Ethernet switching) of VNode on a slice.
    - A slice is isolated even from the platform.



- **These issues are solved by introducing a new type of node called NACE** (Network ACcommodation Equipment).

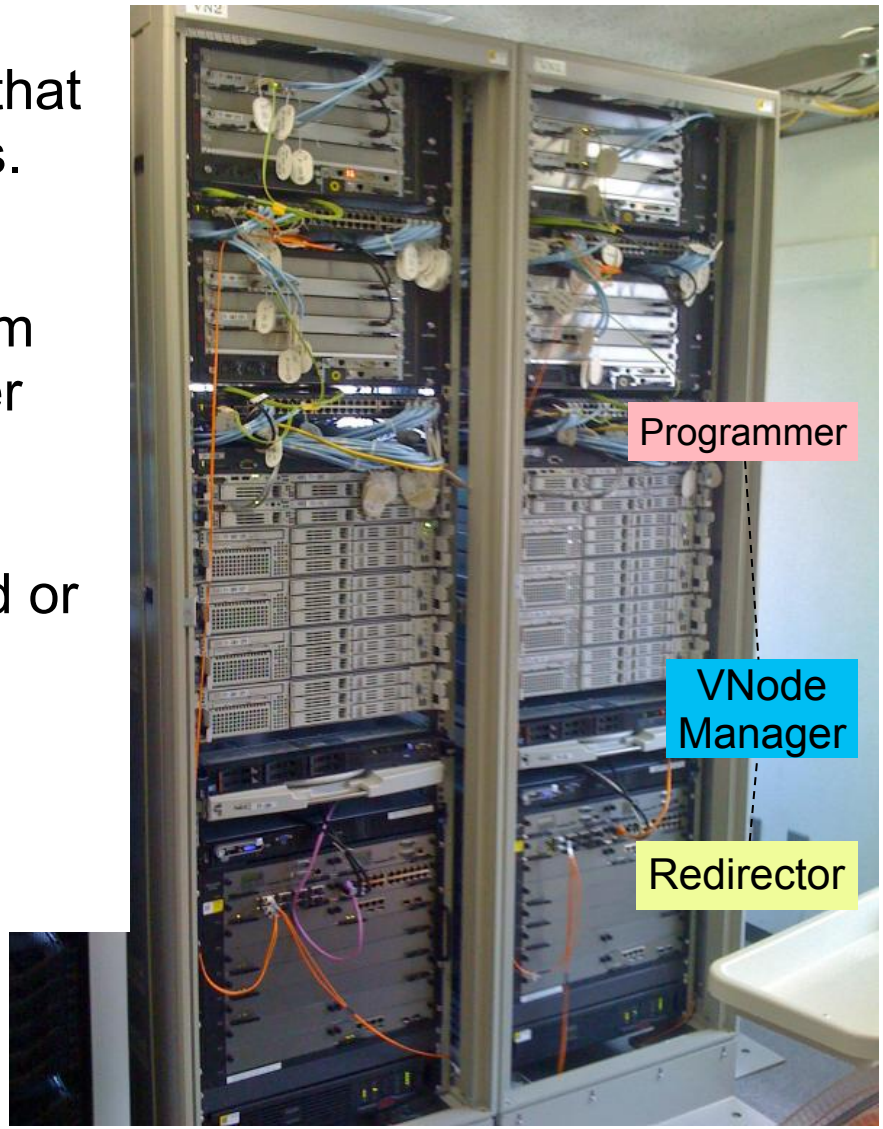
VNode

- **VNode (virtualization node) is a component of the network virtualization platform.**
  - VNode is a physical node.
  - VNode forwards packets on the platform as a router.
  - Slices are implemented as overlay networks on the virtualization platform.
  - VNodes are connected by tunnels using GRE/IP.
    - GRE (Generic Routing Encapsulation) is a protocol standardized by IETF.



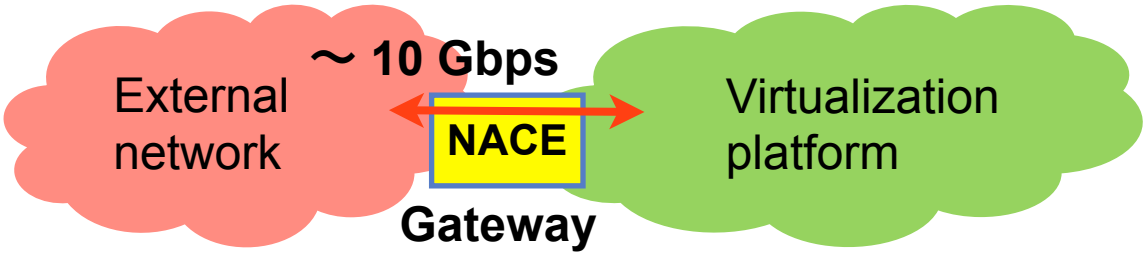
Components of VNode

- **Programmer**
  - is a programmable component that processes packets on the slices.
- **Redirector**
  - forwards (redirects) packets from another VNode to a programmer and forwards packets from a programmer to another VNode.
  - is a component that can forward or route packets on the platform.
- **VNode Manager**
  - is a software component that manages the VNode.

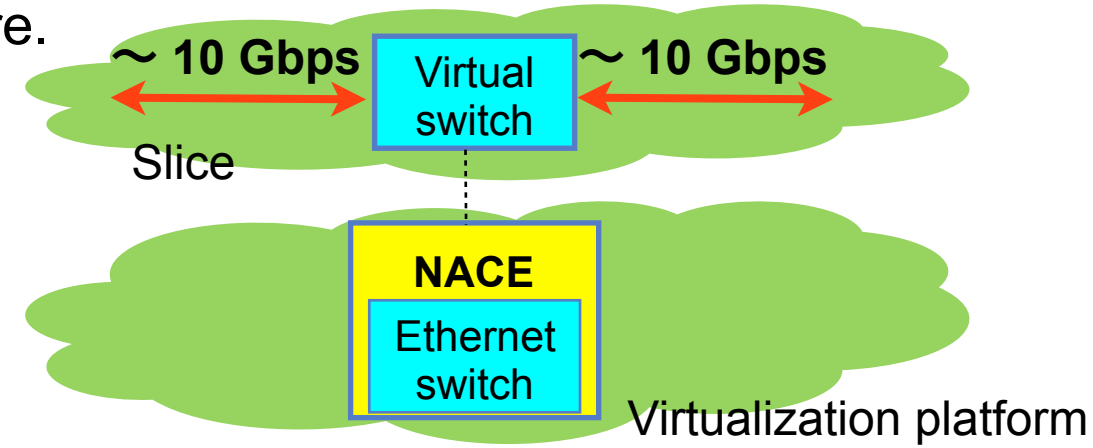


NACE and challenges

- **We developed NACE (Network ACcommodation Equipment) to solve the two issues.**
- **Two challenges**
  - *High-performance gateway function* between internal and external data representation.

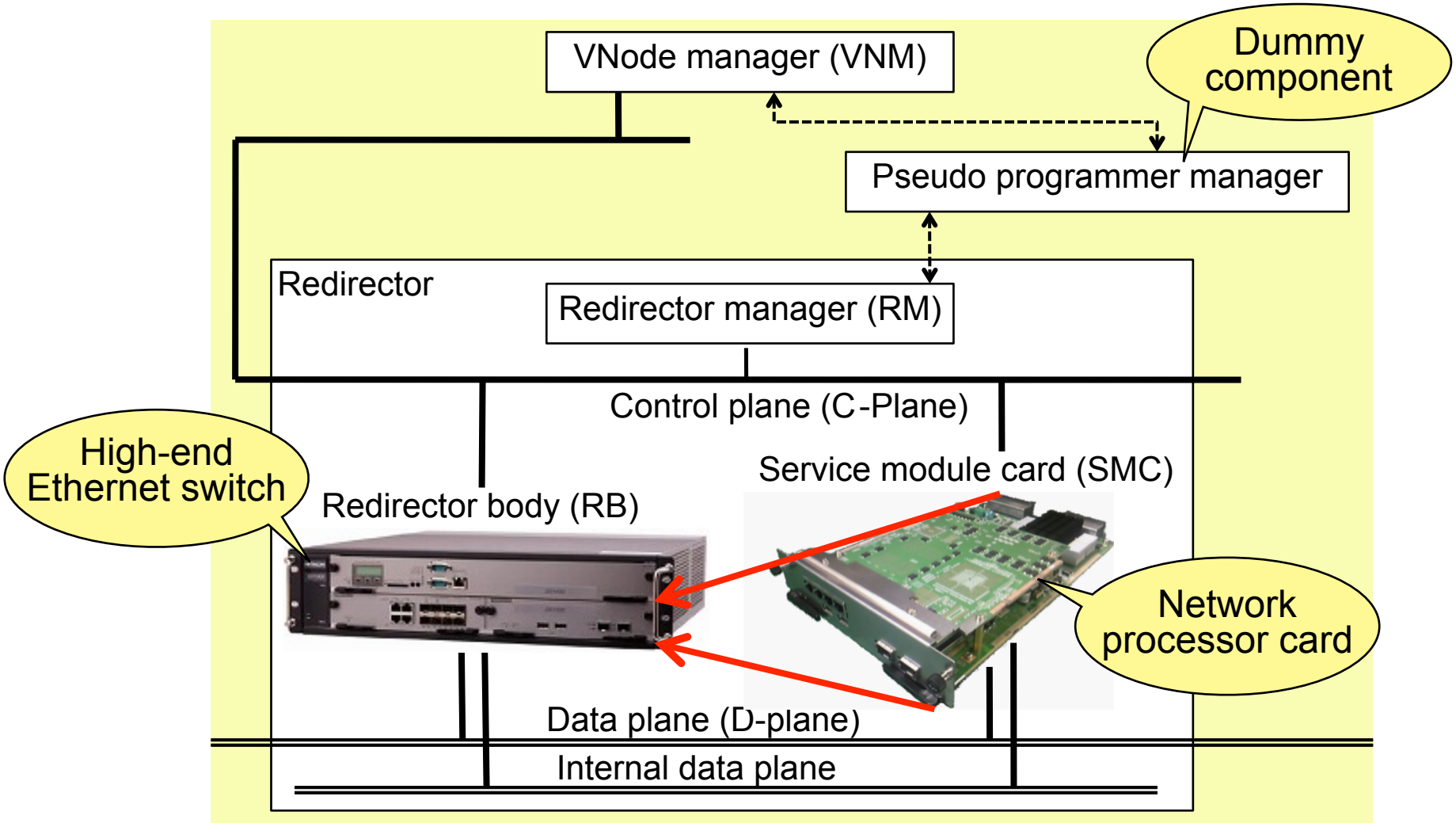


  - Utilizing *high-performance Ethernet switching* function of NACE hardware.



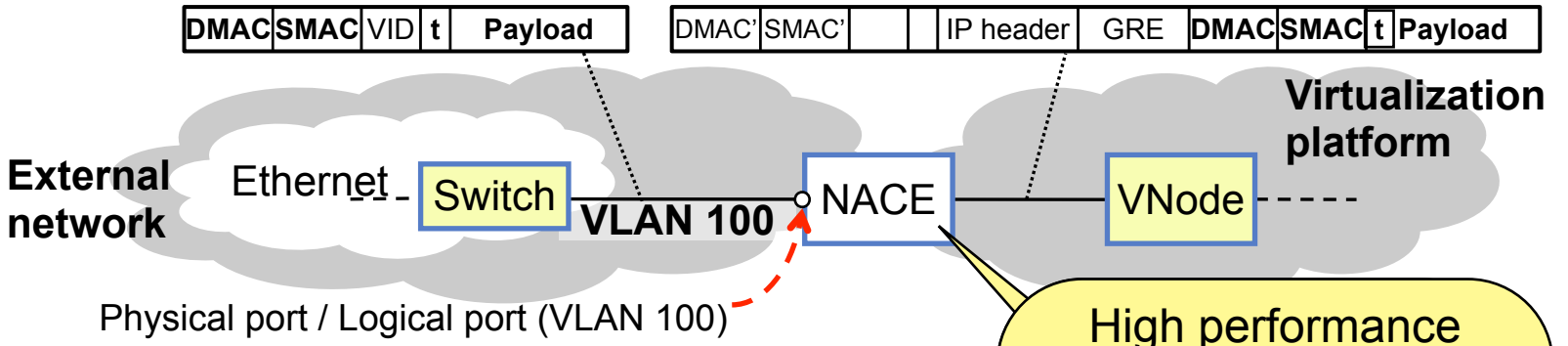
Structure of NACE

- **NACE is a remodeled version of VNode.**
  - consists of VNM, Redirector, and Pseudo programmer manager.

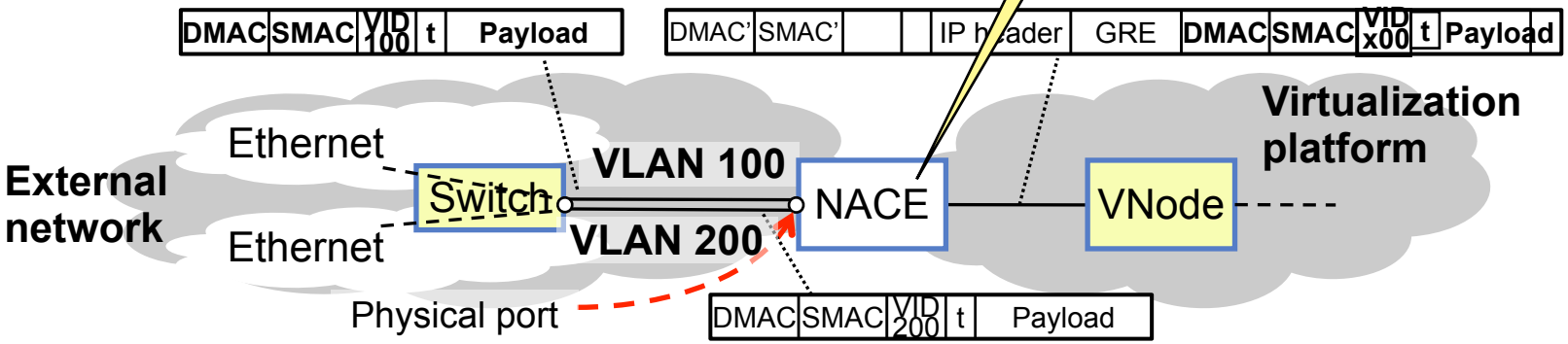


NACE as Gateway -- 1st challenge

- **External networks are connected to NACE as VLANs.**
- **Types of network accommodation**
  - One-to-one accommodation
    - accommodates one VLAN to a slice.



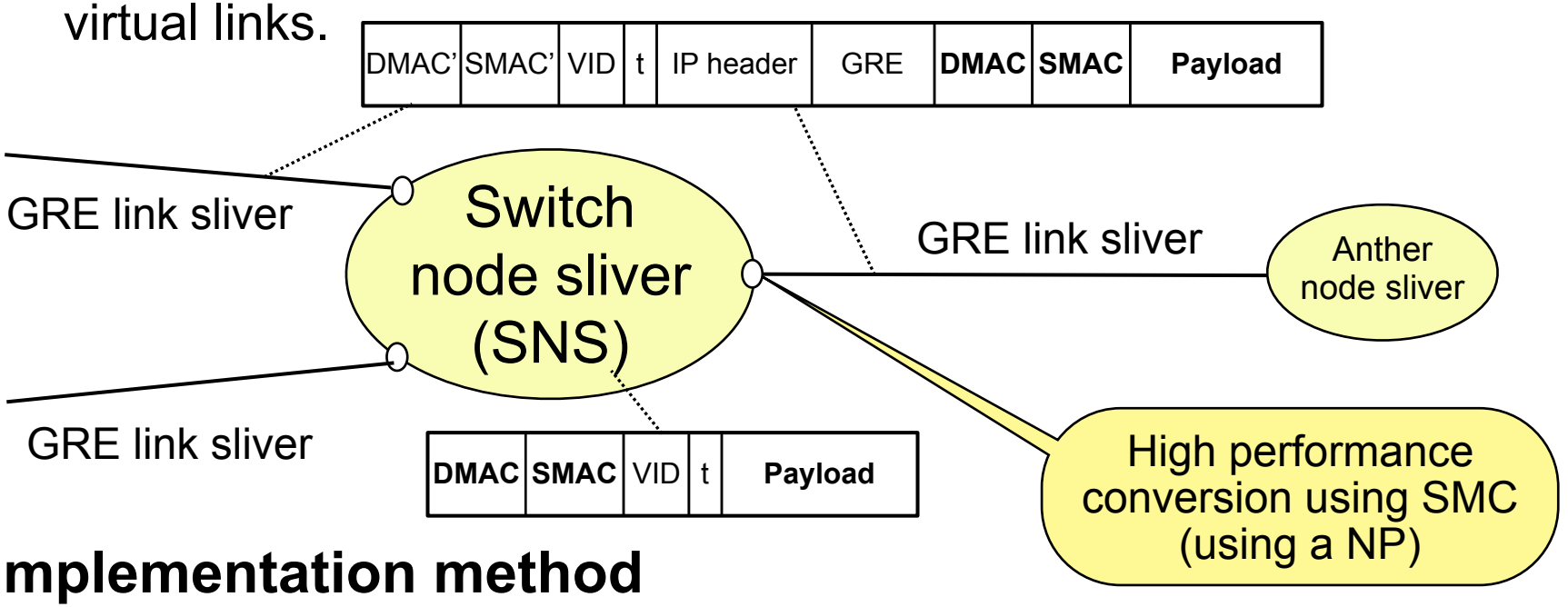
  - Many-to-one accommodation
    - accommodates two or more VLANs to a slice.



NACE as Intra-slice Switch -- 2nd challenge

▶ Specification method (slice design)

- ◆A slice developer can create a “switch node sliver (SNS)” in a NACE. -- SNS is a type of virtual node.
- ◆SNS works as a virtual Ethernet switch.
- ◆An SNS can connect to other node slivers using (GRE-based) virtual links.

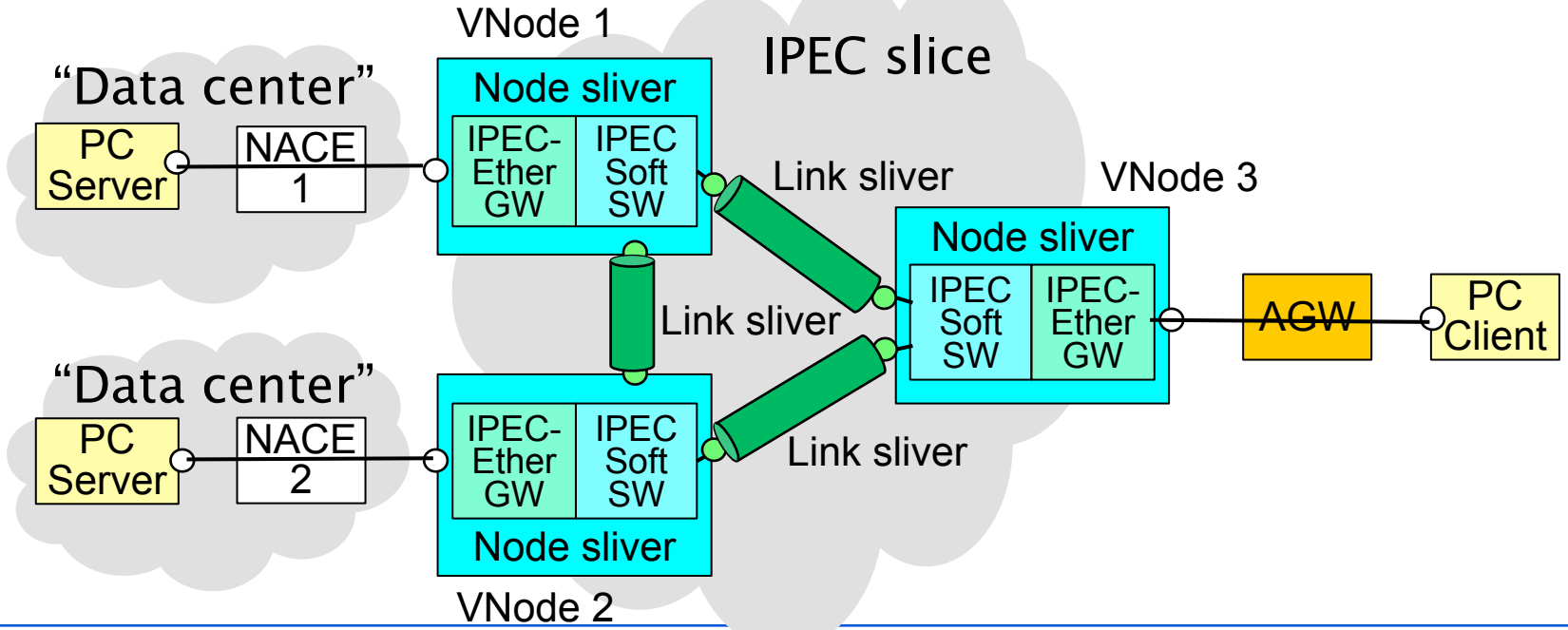


▶ Implementation method

- ◆An SNS is implemented by the Ethernet switch (redirector body).
- ◆Virtual links are implemented by using an SMC (using a NP).

Applications and Evaluations of NACE, 1/2

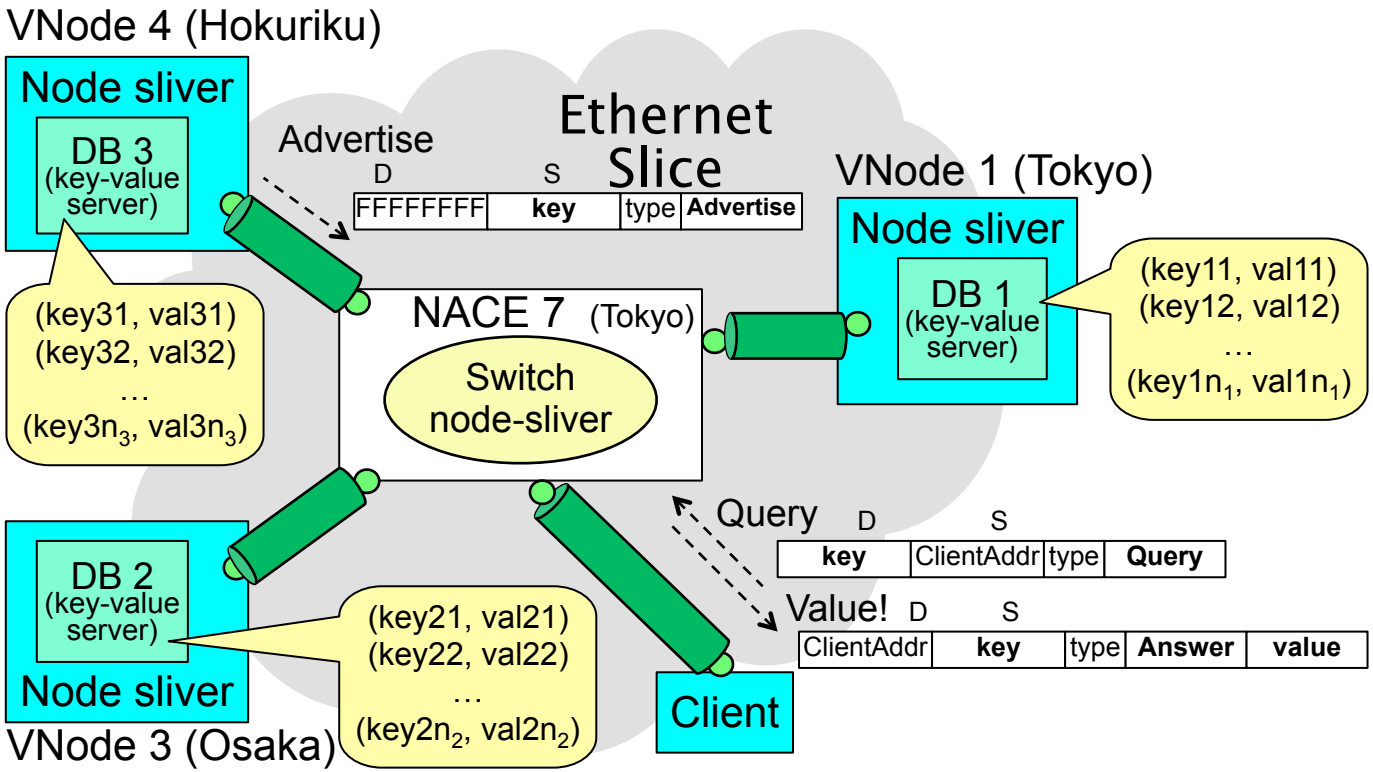
- **Gateway for data centers -- a method for testing a new protocol**
  - Two simulated data centers with PC servers are connected to a slice using two NACEs, and a PC client is connected to the slice.
  - A new (non-IP) protocol called IPEC (IP Ether Chimera) is used on the slice.
  - IP/Ethernet is used in the data centers and in the PC client.
  - The protocol is converted on the border (IP/IPEC <-> IP/Ethernet).



Applications and Evaluations of NACE, 2/2

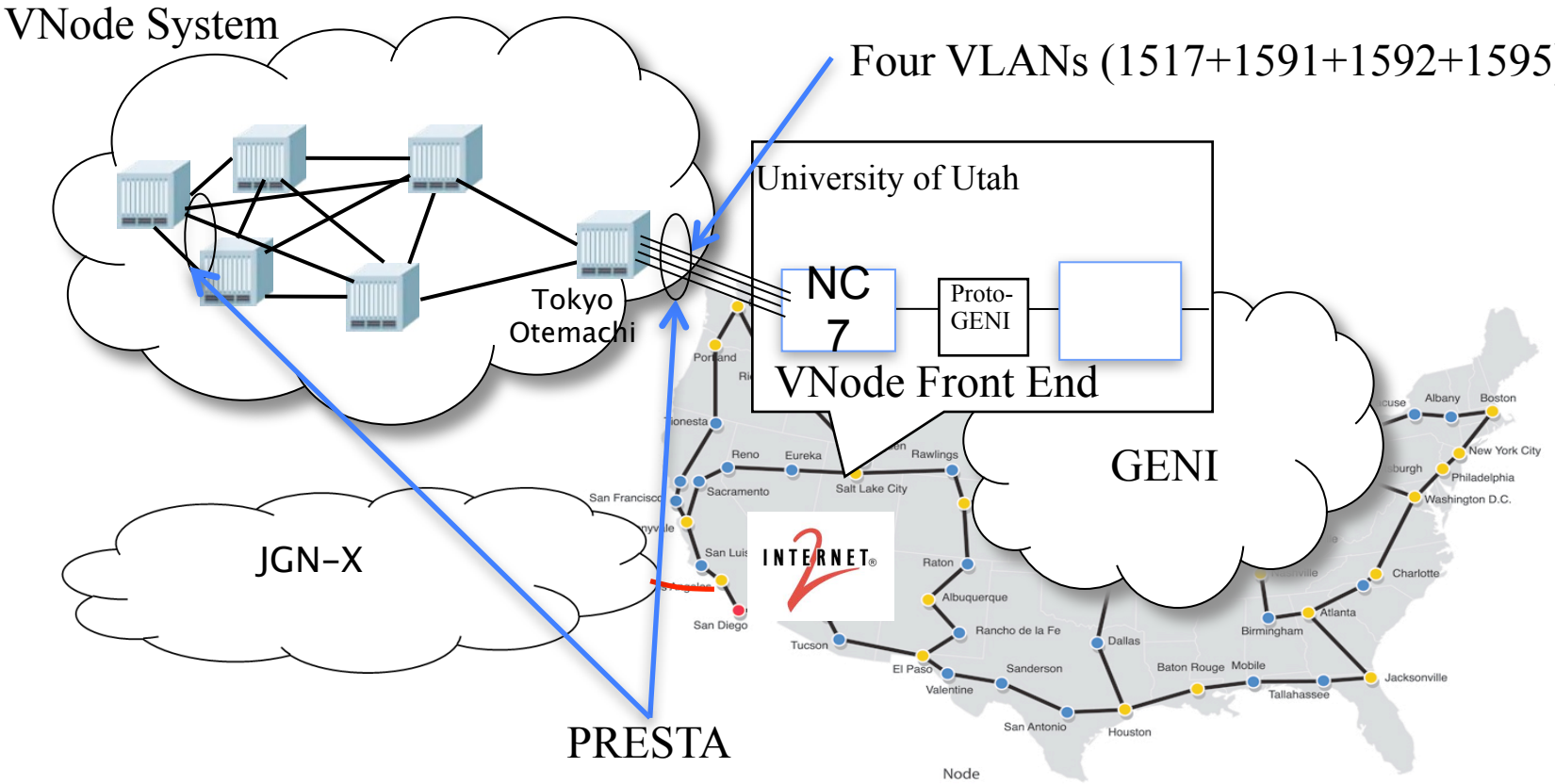
▶ Distributed key-value store using an intra-slice switch

- ◆In this slice, MAC addresses are used for keys instead of hardware addresses.
- ◆The virtual switch selects a key-value store (server) using the key (destination MAC) in a query packet.



Slice-to-slice Connection and Demos in GEC 15

- **In GEC 15 in October 23, our platform was connected to GENI** (GEC 15 = 15th GENI Engineering Conference @ Houston, TX)
  - They are connected by a NACE placed at the University of Utah.
  - Slices of ProtoGENI are connected to our slices on JGN-X (a testbed in Japan).



Summary

- **NACE, a type of physical node, is introduced to a network virtualization architecture.**
- **NACE has two roles.**
  - A network-slice gateway.
  - An intra-slice virtual switch.
- **The performance of NACE is upto 10 Gbps in both gateway and virtual switch.**
- **We tested several applications and evaluated NACE, and obtained expected results and good performance.**
  - Gateway for data centers -- a method for testing a new protocol
  - Distributed key-value store using an intra-slice switch
  - GEC 15 demo