Enhancing Network Applications on VNode and GENI

VNode: Deeply Programmable Network Testbed

NTT, Fujitsu, Hitachi, NEC, Tokyo Univ., KDDI R&D Labs.

This research has been executed under the Commissioned Research of National Institute of Information and Communications Technology (NICT).
Network virtualization platform

- **Common SDN**
  - Software based manageable network with separating C-plane/D-plane
  - Cutting OPEX/CAPEX by automation by software and Constructing NW by common HW

- **Network virtualization platform**
  - Realizing “Deep programmability” by total virtualization of networking and computing adding separating C/D-plane
  - Realizing service chaining without limitation of physical network
Basic components of VNode system

- **VNode (NE)**
  - **VNode Manager (EMS)**
    - Integration of Programmer(s) and Redirector(s).
    - Negotiation of neighbor VNodes.
  - **Programmer (Router)**
    - Programmable processing units for routing/forwarding engine (VM, NPU, etc.).
  - **Redirector (Transmission)**
    - Tunnel creation for virtual link.

- **Access gateway (Gateway)**
  - Programmable gateway units for connecting user terminals and slices.

- **NW virt. mgmt. syst. (NMS)**
  - Integrated slice management in a domain.

- **Transport NW**
  - Provides the underlay connectivity or reachability between VNodes.

[Diagram of VNode system components]
Architecture and summary of our activities

- **New generation NW application A**
- **New generation NW application B**
- **New generation NW application C**

**Network Platform for Flexibly-Programmable Advanced Service Composition (Toyblock Networking)**

- **Univ. of Tokyo: Overall deeply programmable network architecture**
- **Fujitsu: Programmability on gateway**
- **NEC: Performance and programmability**
- **Hitachi: Precise resource isolation between slices**
- **NTT: Integrated mgmt. syst. with transport NW**

**NTT: High-precision network measurement system**

**Another NW virt. testbed (e.g. GENI)**

**Cloud Federation (slice exchange point)**

**Accommodation**

**Transport NW (e.g. optical)**

**Access gateway (AGW)**

**VNode**

**Transport NW Controller**
Prototype system (extended to U.S.)

- We are promoting constructing a testbed to install our technologies and services in future networks.
  - The testbed has been deployed on JGN-X of NICT. The latest version works from June 2014
  - It is publicly in service (7 VNodes, 2 Network Connectors, 6 Access Gateways)
- SDX (Software Defined eXchange) Project
  (A VNode in University of Utah connected to ProtoGENI)

Prototype system of programmable network virtualization technologies made in a project funded by NICT
Applications image using VNode system

Realizing video delivery service optimized for network and node resources by programmability of VNode system

- **Delivering ultra/super high definition video**
  → Realizing by installing cache function, multicast function, etc.

- **Live streaming from mobile terminals**
  → Realizing by dynamic path switching, adaptive installing functions, etc.

- **Delivering video optimized terminal performance and location**
  → Realizing by installing multicast function, transcoding function, etc.
**Enhanced Video Streaming Application**

**Demo Scenario**
- **Traffic Congestion**
  1. Detect congestion
  2. Put transcoder and decrease traffic volume
- **Join New User**
  3. Detect user request
  4. Put splitter and multicasting without additional core network traffic

**Merit**
- Realize low cost and high performance service by deploying software functions on programmable network
Control Result

- Automatic transcoding function deployment and un-deployment
  - traffic exceed upper limit → transcoder is deployed and traffic volume decrease
  - traffic fall under lower limit → transcoder is un-deployed and traffic volume get back
- Splitter function deployment → Link traffic DON’T increase

Additional Traffic (by iperf)

- Video traffic (original): about 5Mbps, video traffic (transcoded): about 500kbps, additional traffic: 5Mbps

- Upper limit: 9Mbps
- Lower limit: 800kbps
Application Utilizing AGW-VNode
Users’ location aware data deployment beforehand for better QoE

➢ Target of this technology
  – Avoiding performance degradation because of the large latency and instability of WAN.
  – Utilizing the programmability near users provided by AGW-VNode

➢ Details of this demonstration
  (A) With user-aware data deployment
    (a1) Users’ locations are detected
    (a2) Data is deployed near users in advance of users’ access
    (a3) Users get quick responses
  (B) Without user-aware data deployment
    (b1) Data is located far from users and users get only slow response
Non-IP and non-Ethernet protocols can be used in VNode infrastructure.
In this demo, instead of IP/Ethernet, IPON (IP/null) is used; IP addresses are used for both WAN routing and LAN switching.
This method solves “address redundancy problem” that causes complexity and inefficiency.

Communication in LAN and WAN using IPON

Network structure used for the demo

Loop is allowed!
Service Designing, Deployment and Re-organization

**Designing and Deployment**
- WEB based network service design tool
- Composition of Service system components
- Federated Slice over VNode/ProtoGENI

**Service System Re-organization**
- User devices
- New comers
- Initial component assignment
- Automatic generation of task flow for system change from initial design to final designs
- Contents server
- Caching component
- Re-organization
- Contents server

Initial component assignment

Automatic generation of task flow for system change from initial design to final designs