Sustainable Network Resource Management System for Virtual Private Clouds

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CloudCom2010
Cloud computing environment

Infrastructure as a Service (IaaS)

On-demand provisioning of servers (Virtual Machines) and storages

Enterprise user A

Enterprise user B

Virtual Private Cloud

...How about network?
Problem of general virtual private clouds

- Virtual private cloud #1
- Virtual private cloud #2

Security isolation

Physical network

Wide area network

Data center network

Traffic congestion (e.g. TCP incast)

Affect to the other networks
Approach

**Objective:**
Performance isolation among virtual private clouds

- Assign different queues at network equipment
- Handle various network equipment
- Orchestrate with VM provisioning
Network resource management system (NRM)

- Manages bandwidth and topology of physical network
- Allocates guaranteed bandwidth to each virtual network

![Diagram showing network resource management system (NRM) with physical network, Virtual routers, VLANs, and Virtual networks #1, #2, and n.](image-url)
NRM (1) G-lambda project

- A joint project of NICT, AIST, NTT and KDDI R&D labs
- To define and standardize the web service interface between network and applications

![Diagram showing the interaction between NRM and Resource Coordinator with provisioning arrows]
NRM (2) Dynamic Circuit Network

- A project of Internet2
- Multiple domains can negotiate by using the Inter-Domain Controller (IDC) protocol.

IDC: Inter-Domain Controller
DC: Domain Controller
Problem to handle various network equipment

This model needs time and costs to develop new NRMs.
Problem to handle multipoint network

- NRM can support only point-to-point provisioning
  - Full-meshed path provisioning
  - Bandwidth arrangement among paths

...too complicated to users
Proposed mechanisms

**Objective:**
Performance isolation among virtual private clouds

- Assign different queue at network equipment
- Handle various network equipment
- Control network easily
- Changing mechanism of software modules
- Virtual network point
Problem of NRMs

Conventional NRM

Control drivers are embedded.

Sustainable NRM

Control drivers are developed independently.
CHAMELEON software architecture

- CHAning MEchanism of software moduLE based on the cONtext (CHAMELEON)
  - Install control drivers
    - without any modification of NRMss
    - under the operation of the NRM
  - Keep the control drivers as cache

![Diagram of CHAMELEON architecture]

1. send device information
2. install

Repository server

Universal socket

Sustainable NRM
Processing time to install and control

- install the control driver
- control network equipment

- download
- cache
- embedded

- RPR
- MPLS
- core switch
- aggregation switch
- ToR switch
- virtual switch
Proposed mechanisms

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- Changing mechanism of software modules
Virtual network point

User view

Virtual network point

Mapping to physical links by NRM
Tested network configuration

Wide area network

Data center network

RPR: Resident Protection Ring
MPLS: Multiple Protocol Label Switching
ToR: Top of Rack
Mapping from virtual network point to physical links

Step1: Split logical links based on network domains
Mapping from virtual network point to physical links

Step 1: Split logical links based on network domains
Step 2: Aggregate logical links
Mapping from virtual network point to physical links

Step 1: Split logical links based on network domains
Step 2: Aggregate logical links
Conclusion

- Ideal virtual private clouds
  - Security isolation
  - Performance isolation

- Sustainable network resource management system
  - Handling various network equipment

  Changing mechanism of software modules

  Virtual network point

- Future works
  - Demonstration of performance isolation
  - Scalability evaluation of the proposed mechanisms