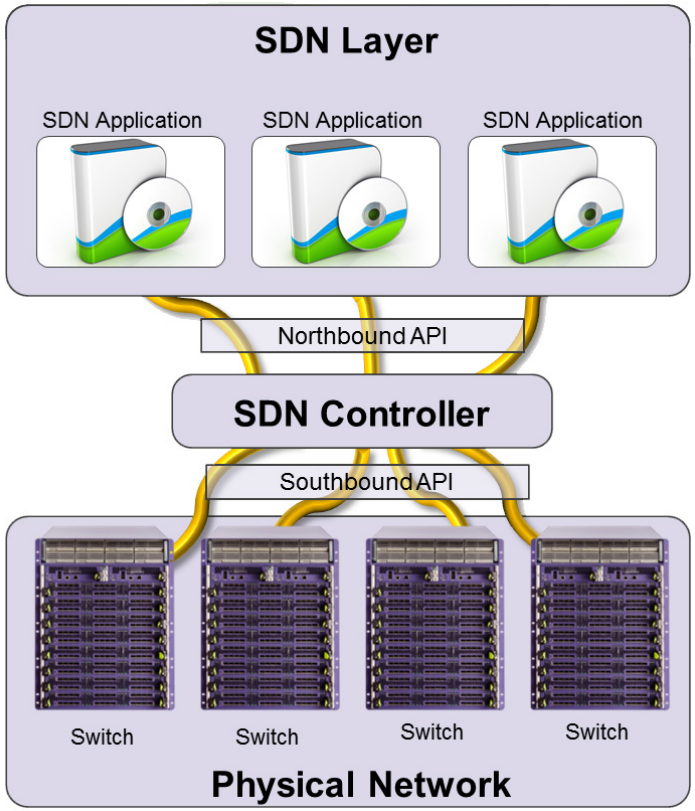
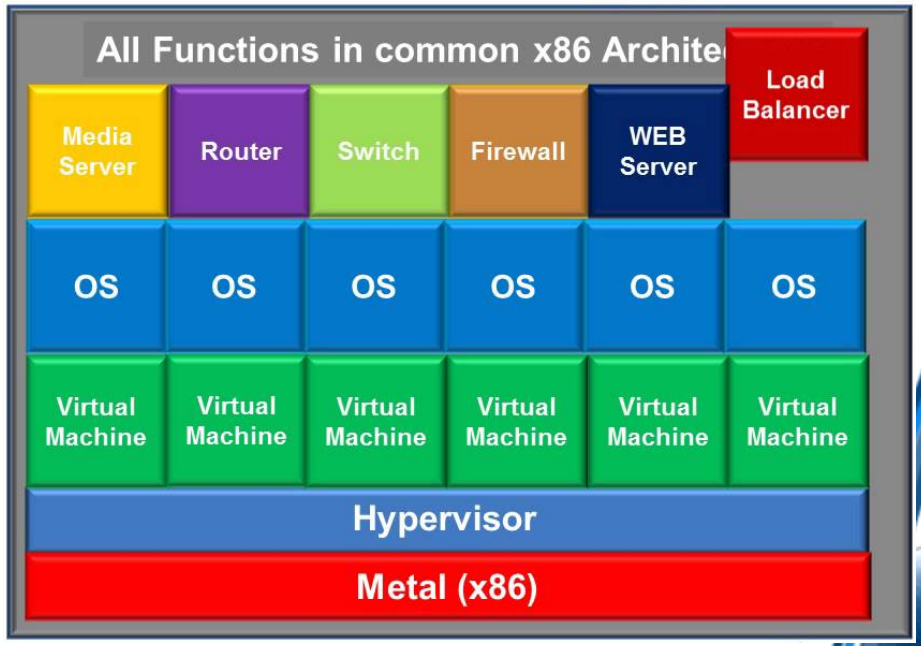
SDN/NFV Use case

AttoResearch

SDN and NFV





SDN(Software Defined Network)

- Control / Data Plane 분리
- 중앙집중 관제
- Software 컨트롤

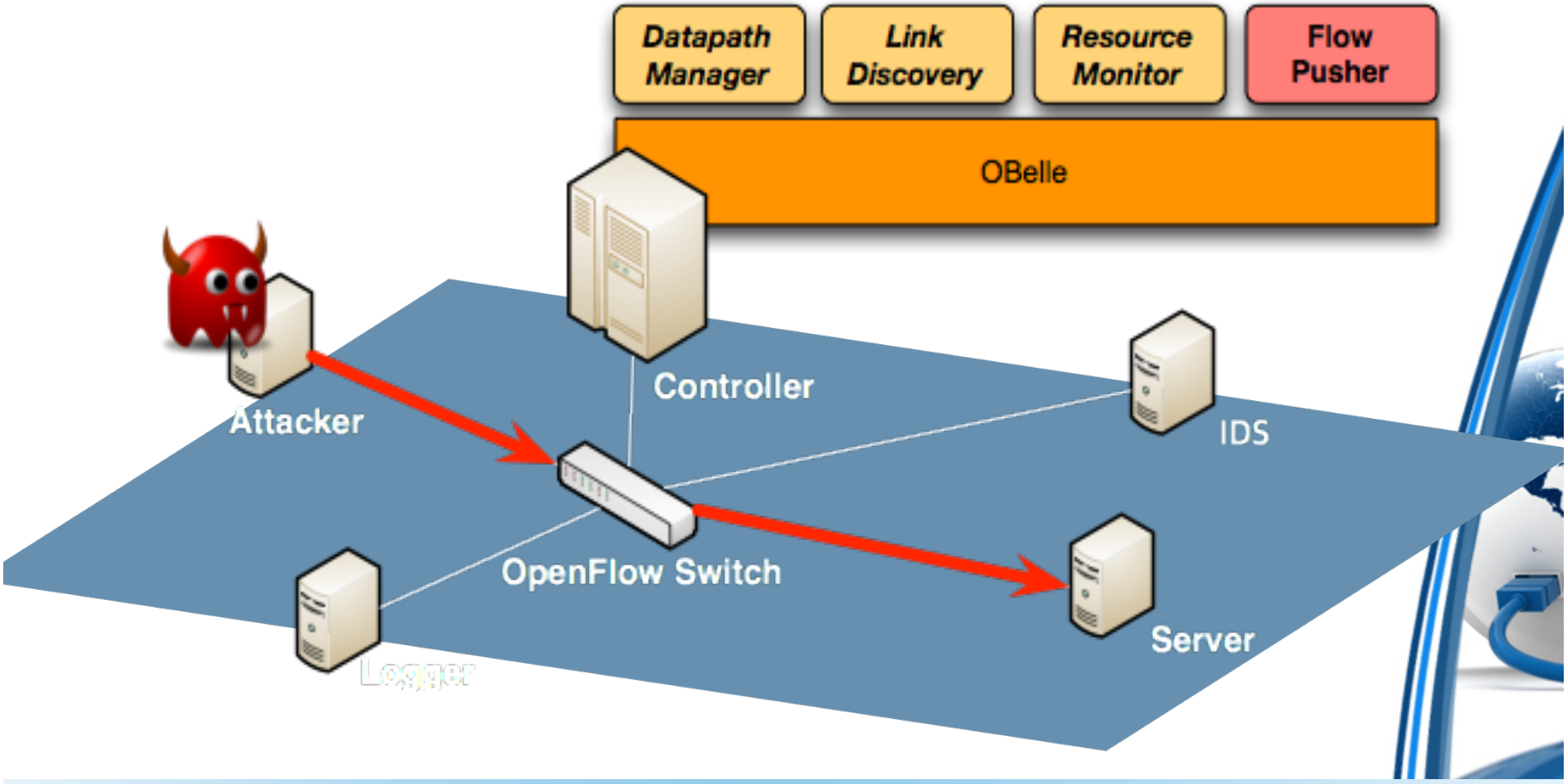
NFV(Network Function Virtualization)

- General Purpose 하드웨어
- 소프트웨어 네트워크 서비스
- 가상화

SDN Use case

Tapping

- 단순 스위칭/라우팅만이 아니라 트래픽 복제 가능
  - **IDS, IPS** 등 보안 장비와 연계 가능



Traffic Engineering

- **Google B4: IDC 간 Elephant traffic 관리 [SigComm13]**
  - 데이터센터 간 연결: **16** 곳, **46** 링크
  - **WAN** 회선은 비쌈
  - 사용률 **30% -> SDN**으로 **99%** 향상

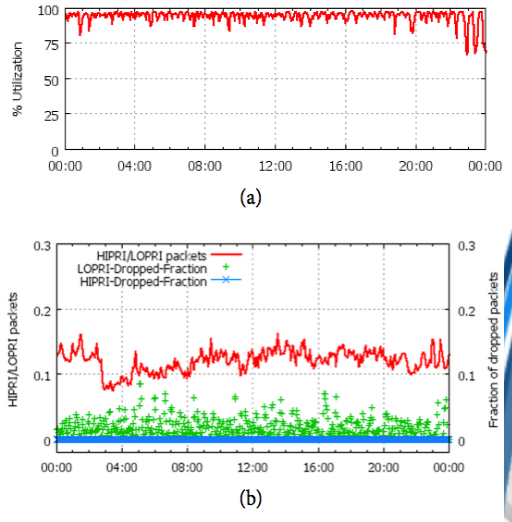


Figure 14: Utilization and drops for a site-to-site edge.

Streaming

- ◆ **IPTV Service Assurance using OpenFlow [Waina13]**
  - **IPTV** 품질 문제 발생시 즉각 복구
  - 대역폭 부족 시 **Multipath routing**

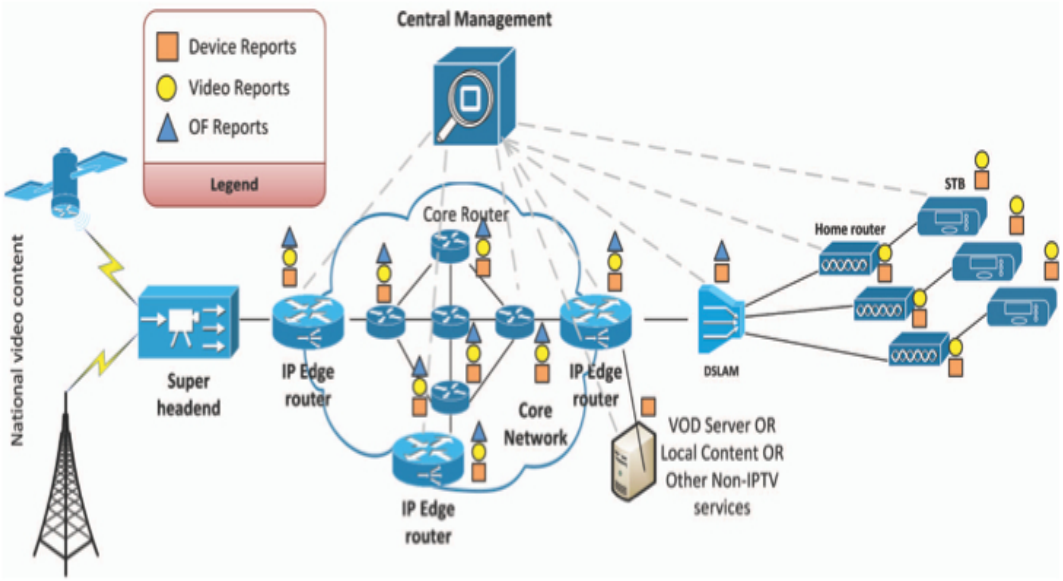
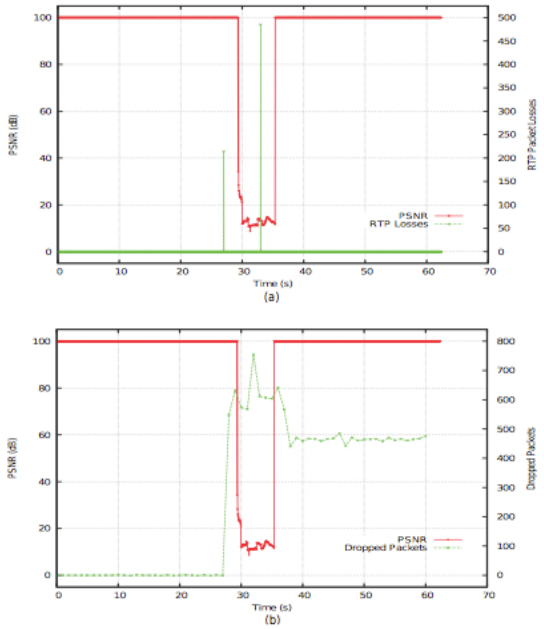
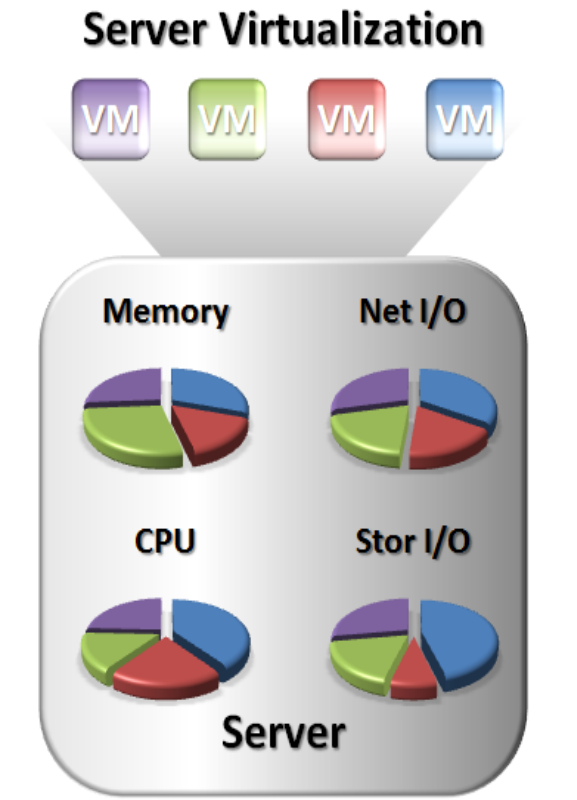


Figure 1: IPTV Deployment with OF Routing / Reporting: Report Types and Locations

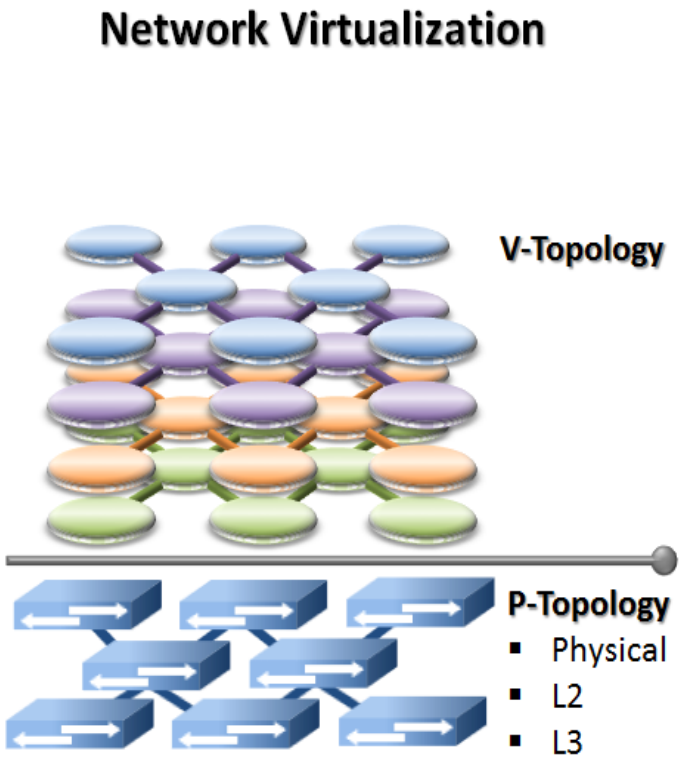


Cloud #1

- Network Slicing (~= virtualization)



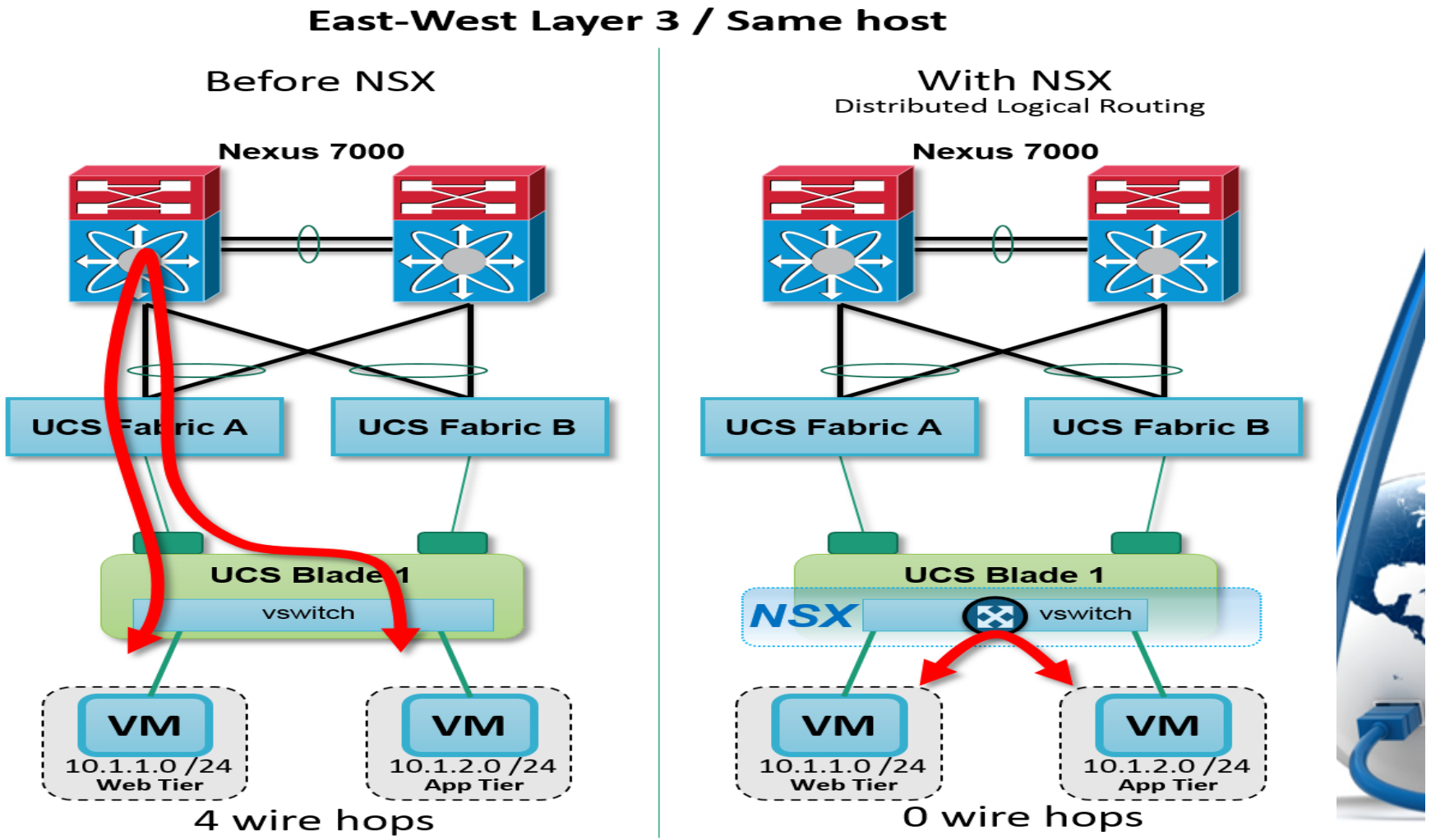
Virtualization of the hardware per VM tenant. Replication of hardware constructs as virtual hardware.



No virtualization of hardware. Encapsulation of traffic on existing infrastructure.

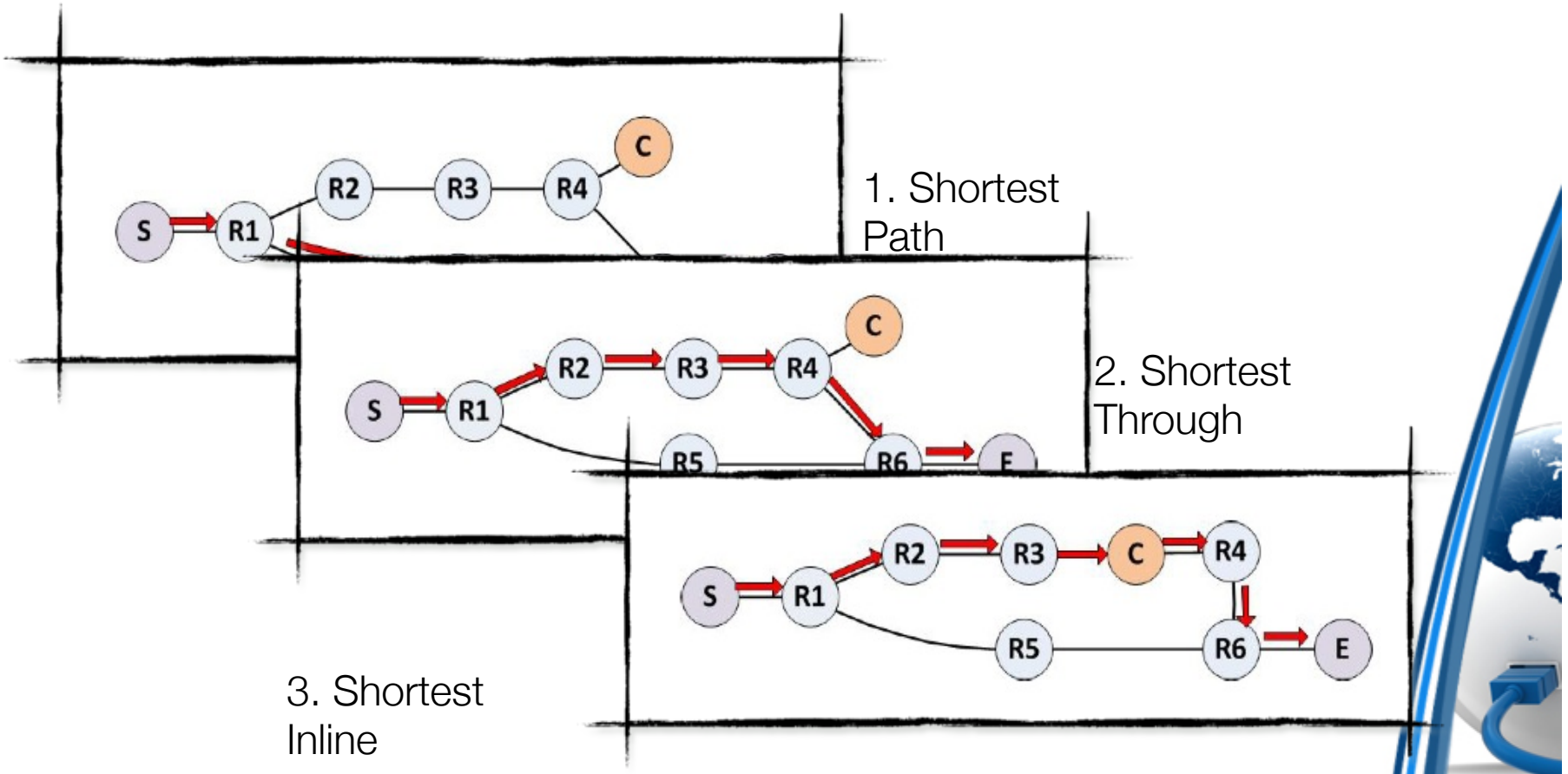
Cloud #2

- Efficient Traffic forwarding



Cloud #3

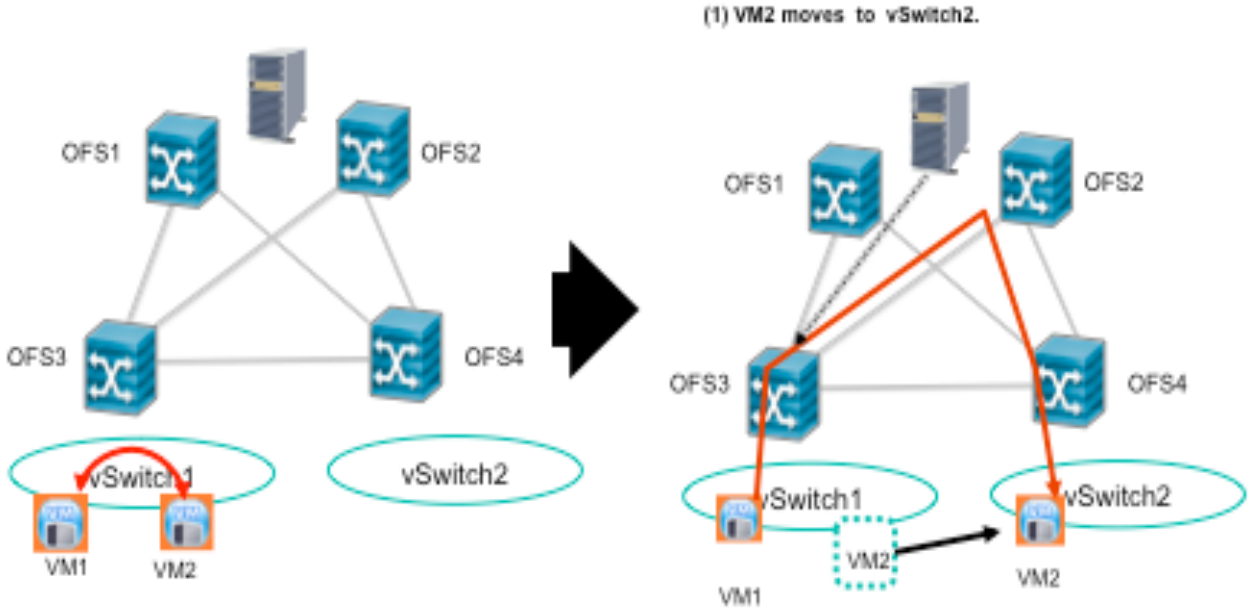
- **CloudWatcher (~= Secure Routing)**



Cloud #4

VM Migration

VM Live Migration: ProgrammableFlow Use Case from PlugFest



BigData

- Configuring the network for Hadoop [HotSDN12]
  - Aware of BigData traffic class
  - Bulk transfer
  - Data aggregation/partitioning
  - Control: default shortest path

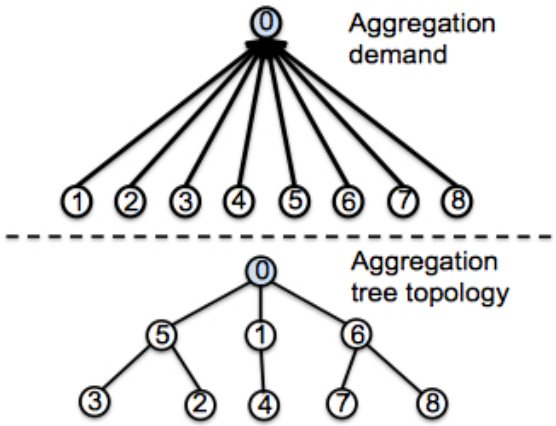


Figure 2: An Example of 8-to-1 Aggregation

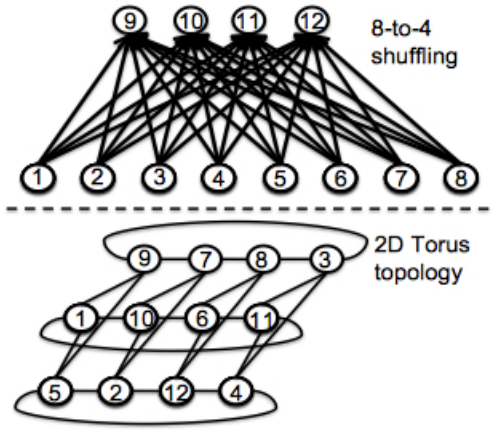


Figure 3: 8-to-4 Shuffling Using Torus Topology

SDN & Security

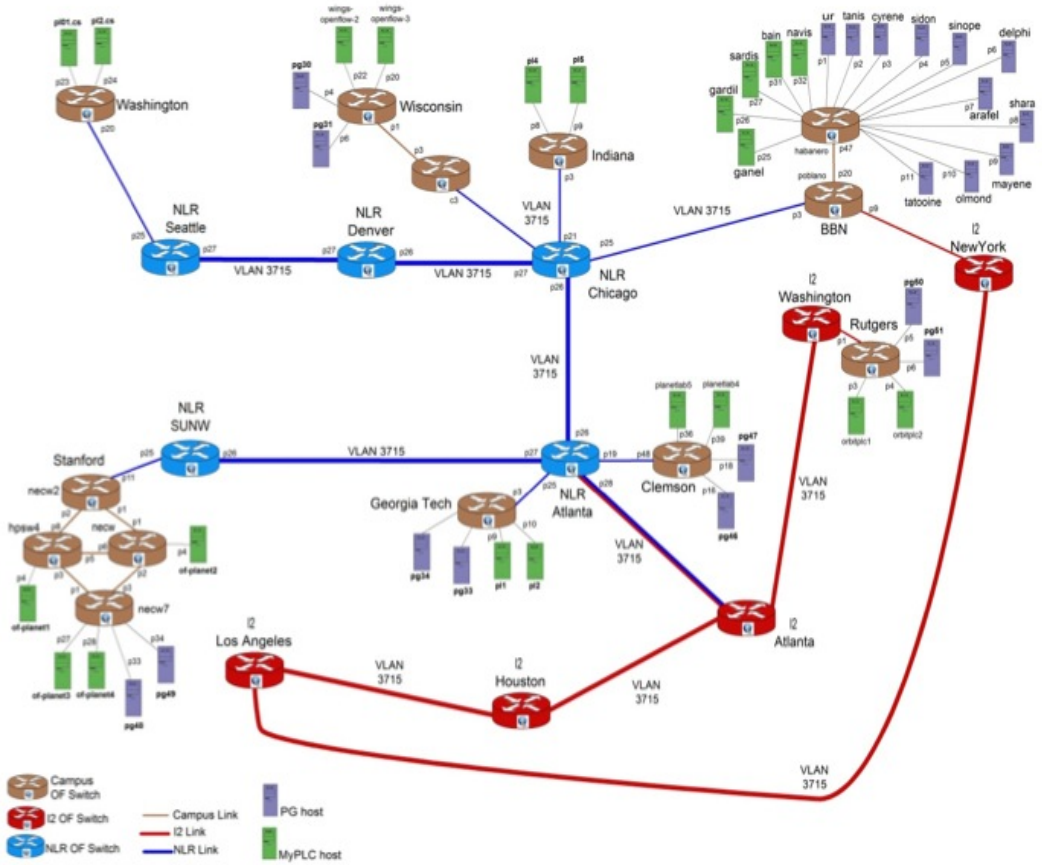
Security

- **Security in SDN**
  - **SDN**은 아직 초기 단계의 기술
  - 보안 측면은 고려 안된 부분이 많음
  - 알려진 대표적 이슈
    - **Packet Flooding attack**
    - **Rule Conflict & Dynamic Flow tunneling**
    - **Ref) http://sdnsecurity.org**

- **Security with SDN**
  - 기존 보안 응용/장비를 **SDN** 기술로 재구현 및 대체
  - **Firewall**
  - **DDoS detection**
  - **Scan detection**
  - …

Network debugging

- VeriFlow



http://groups.geni.net/geni/chrome/site/thumbnails/wiki/TangoGENI/OF-VLAN3715_1000.jpg

Complex interactions

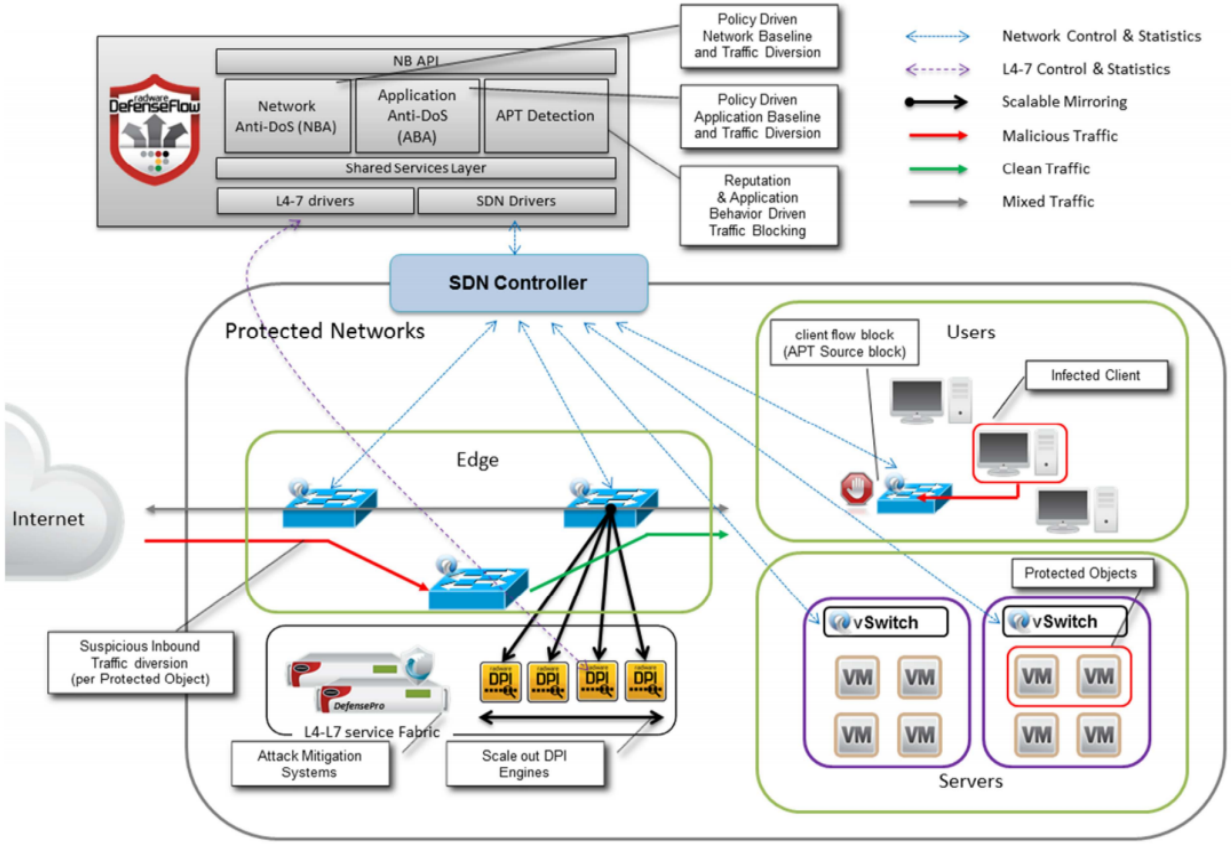
Misconfigurations

Unforeseen bugs

Difficult to test the entire network state space before deployment

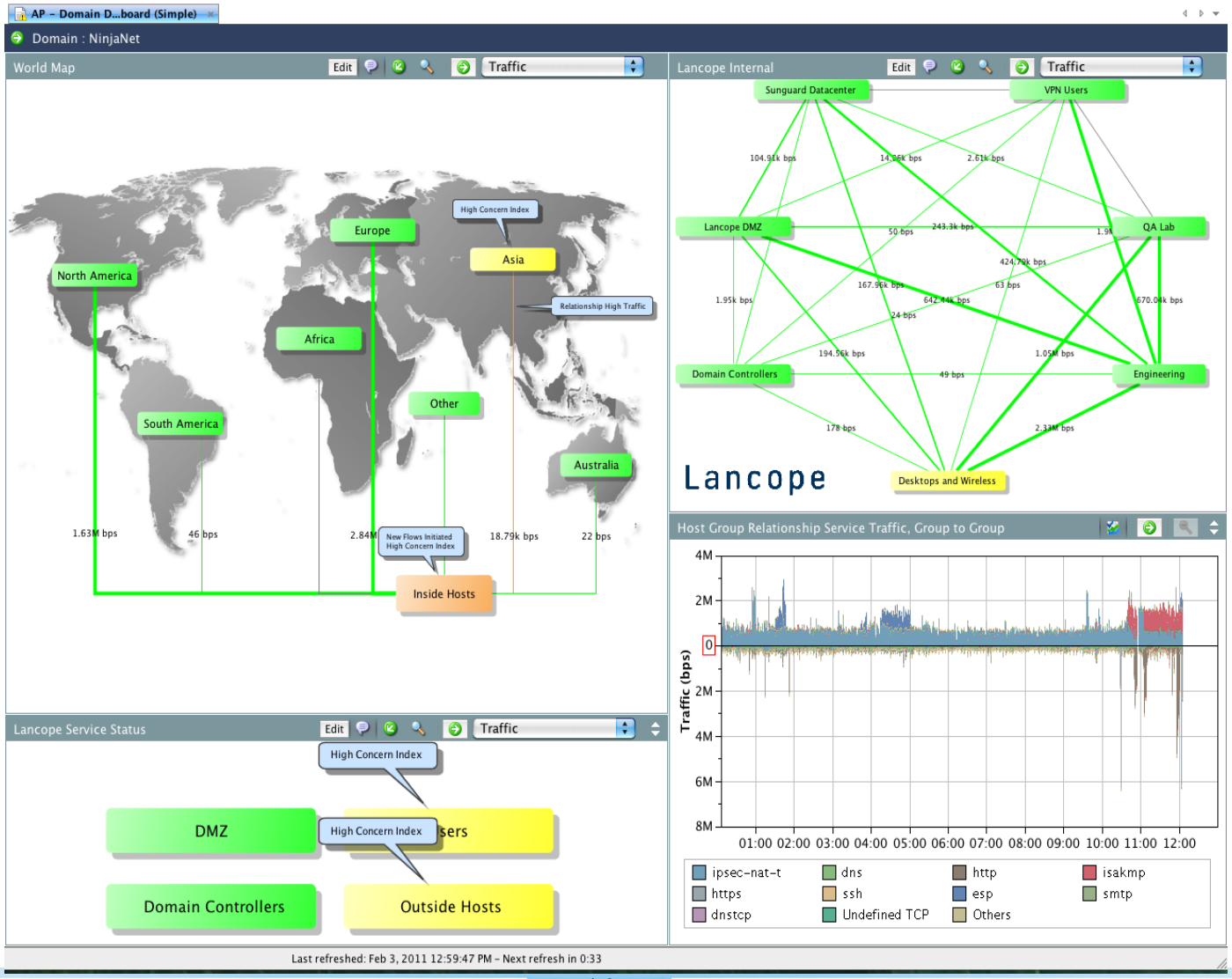
DDoS mitigation

- radware: DefenseFlow
  - SDN Based Network DDoS, Application DoS and APT Protection
  - One of 5 finalists for ONS Idol 2014



Flow monitoring

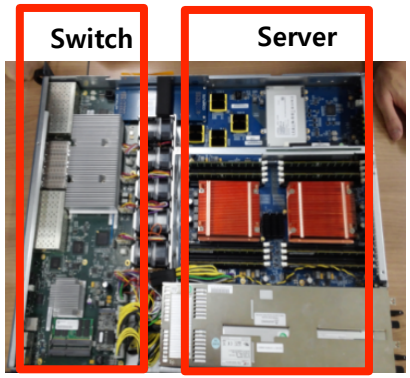
Lancope: StealthWatch System



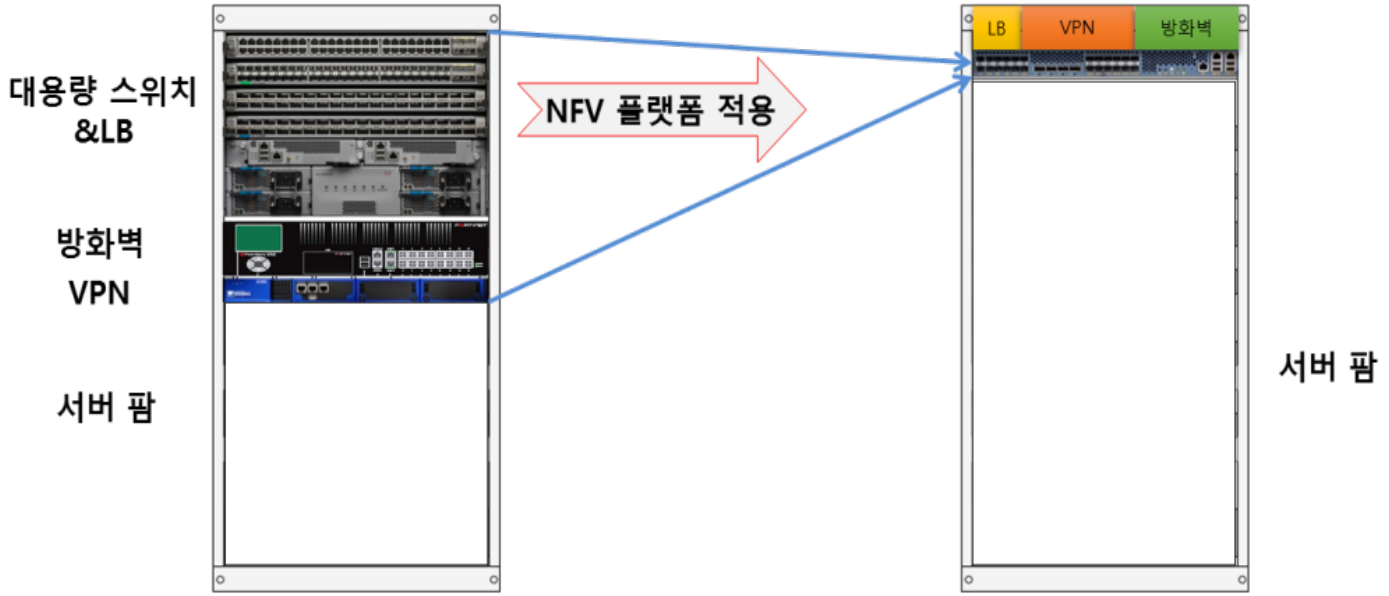
NFV Use case

Cloud ToR

- Service Interface for Collocation
  - On-demand VNF service, low OPEX
- Hybrid VNF Service for Public/Private Cloud
  - Distributed service with software VNF
  - Hardware accelerated service leveraging ASIC in switching chip
- Traffic Engineering, Monitoring and Auditing
  - Buffering and smart ECMP over racks
  - Per-tenant traffic monitoring and auditing by routing with VNID (VxLAN)

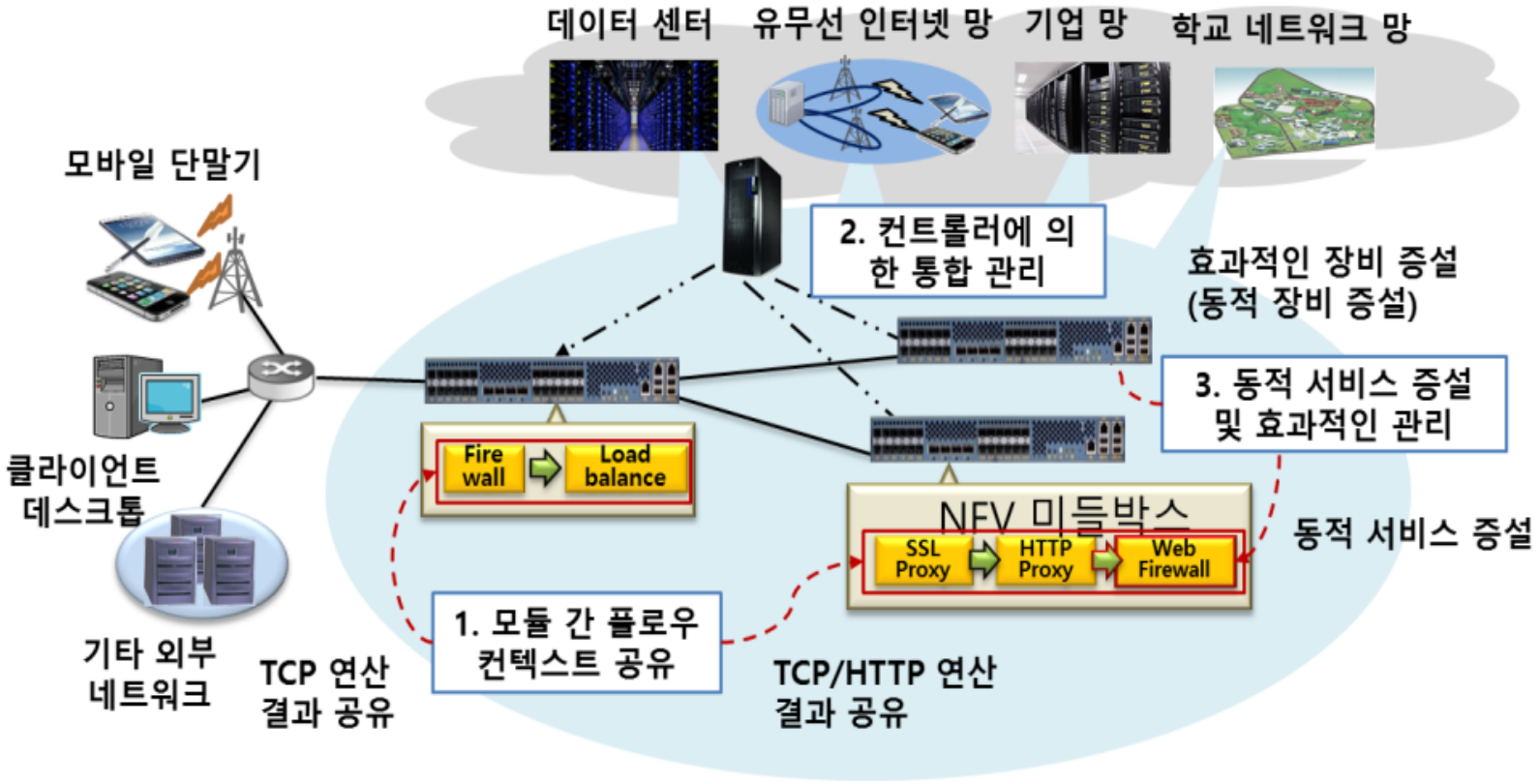


[Server-Switch HW]



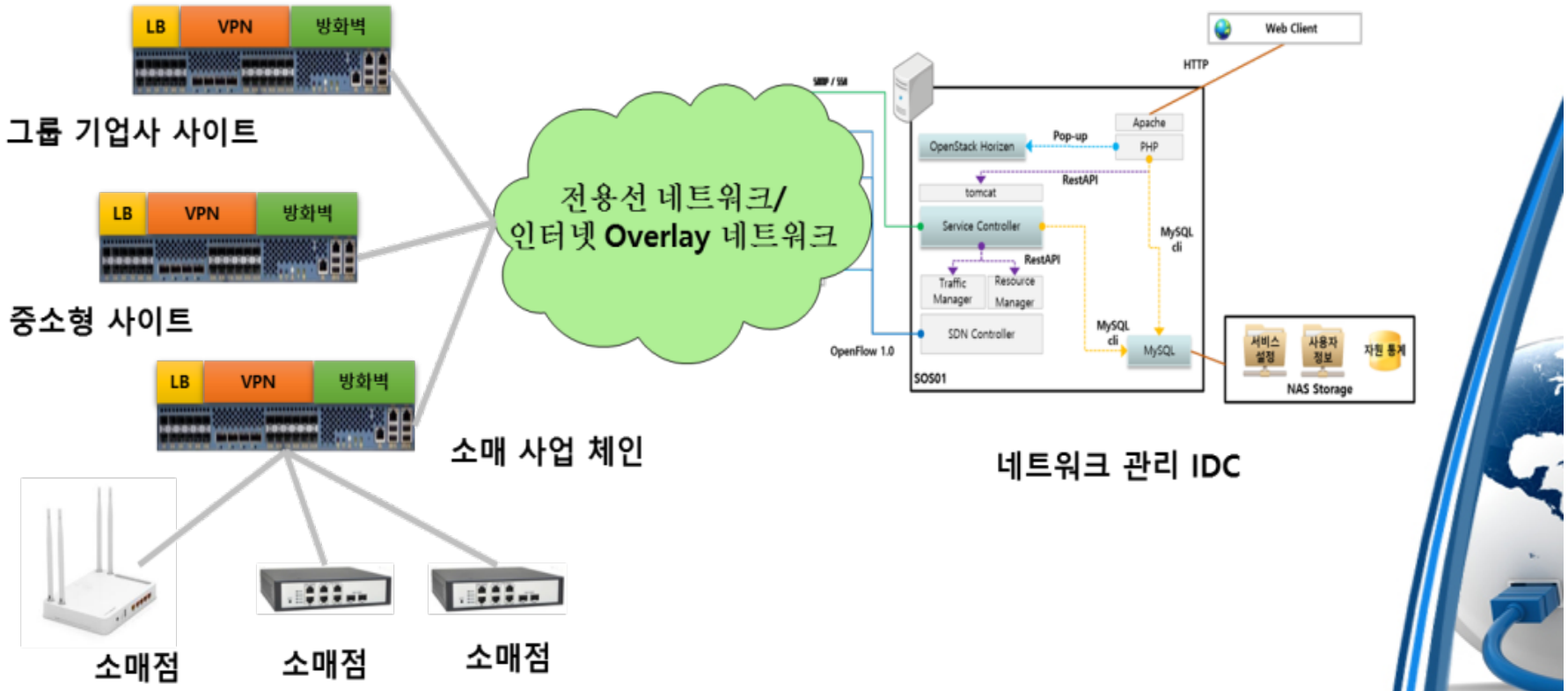
Network Appliance

- Service Consolidation Appliance for Various Networks
  - Data Centers, Mobile Network, Enterprise Network, Campus Network, …
  - Lower CAPEX by service consolidation



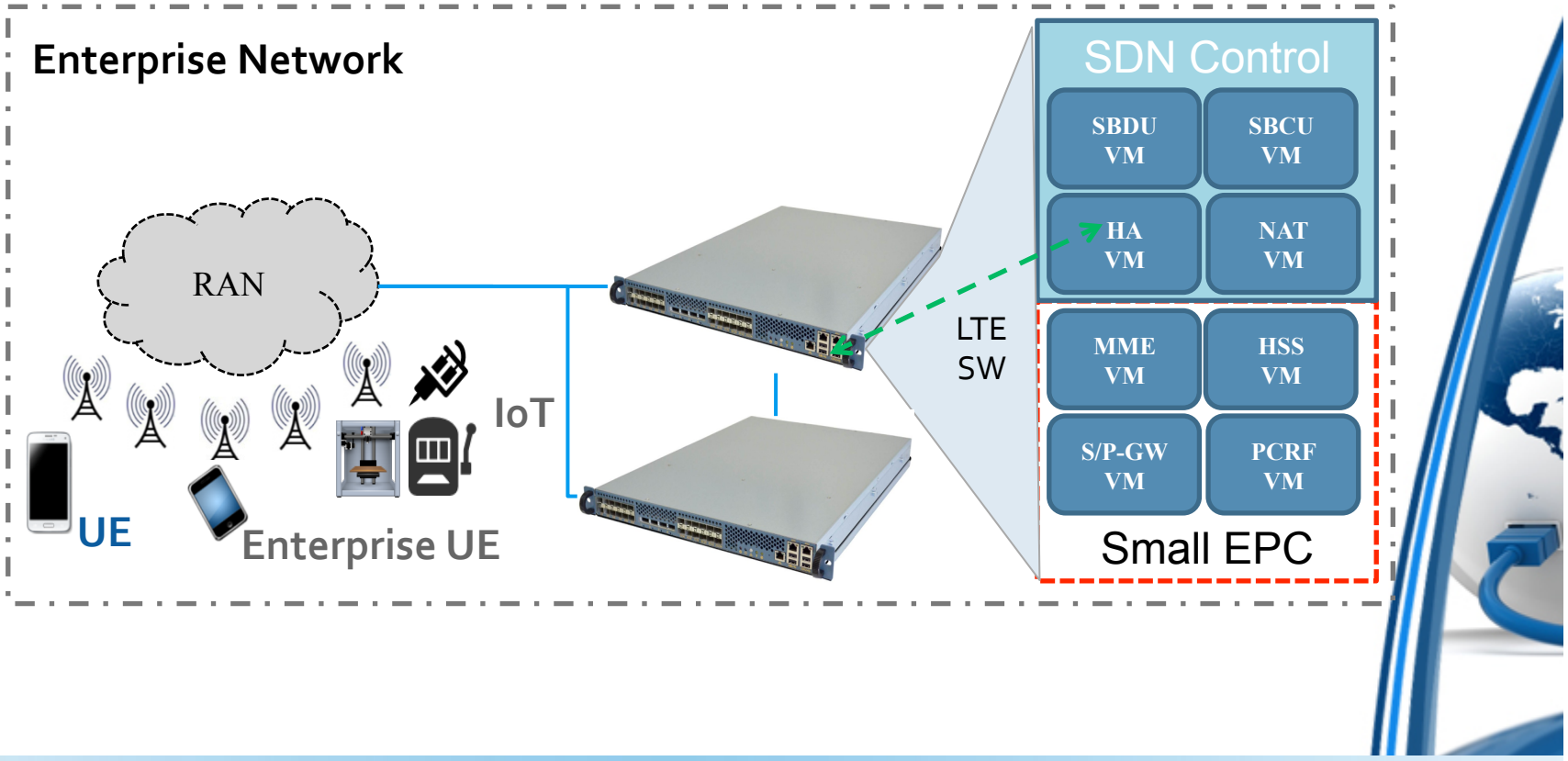
Managed Network

- Network Management as a Service for Retails and Enterprise Branches
  - Remote network management
  - Needs to scale up or down depending on target vCPE markets



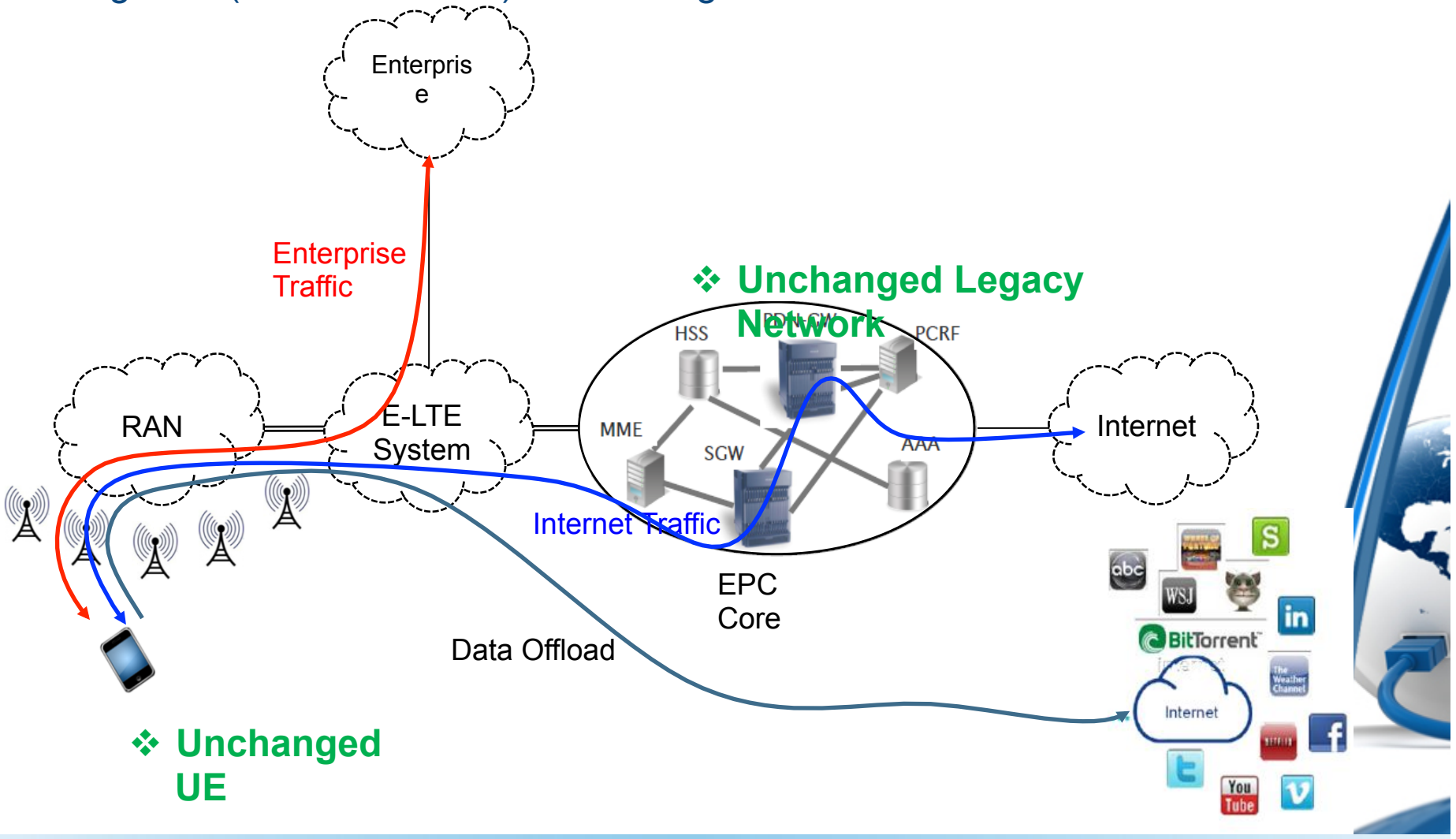
Small EPC

- Light Weight EPC for Enterprise EPC and Disaster Network
  - EPC + Port Density in a single box, can be carried by a person
  - Military Network, Disaster Network
  - Enterprise LTE Network



Mobile Edge Computing

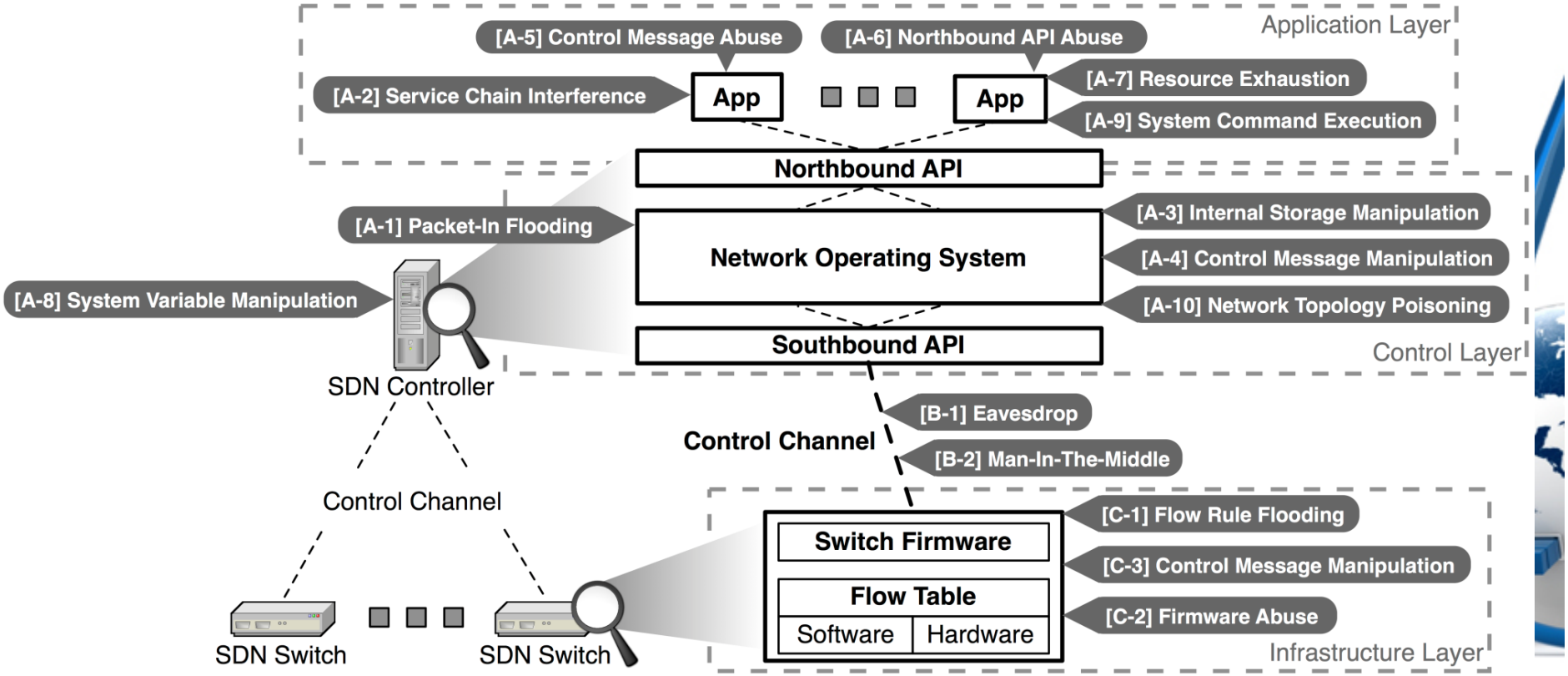
- Various VAS for 4G and beyond
  - E.g. LBO(Local BreakOut) with routing based on TEID in GTP



SDN Solution

SDN 시대의 새로운 보안 위험

- SDN 환경에 대한 새로운 공격 패턴에 대한 대비 필수
- SDNSecurity.org

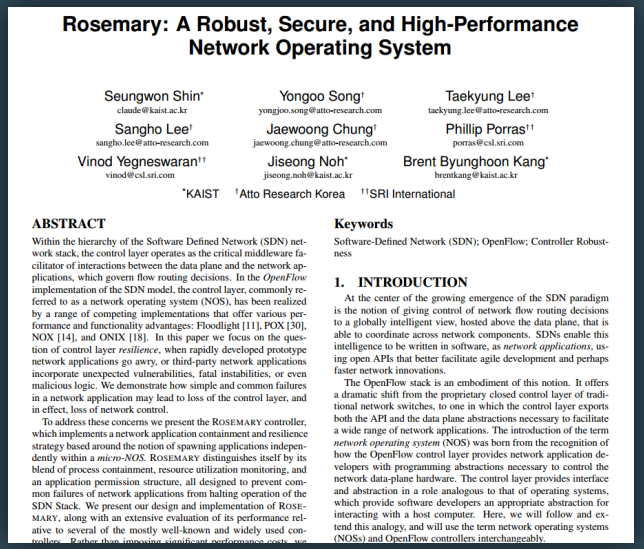


OBelle : 보안 강화 SDN 컨트롤러

OBelle (SDN 컨트롤러) v2.0

- 국내 최초 Openflow 1.3.3 지원
- SDN 컨트롤러의 안정성 강화를 위해 Rose mary kernel architecture 를 설계 및 구현
- SDN 애플리케이션 domain 을 controller k ernel 과 분리하여, 시스템 안정성 높임
- SDN 애플리케이션의 장애시, 장애 원인에 따라 자동 재시작

ACM CCS 2014,
"Rosemary: A Robust, Secure, and High-Performance Network Operating System"



Rosemary: A Robust, Secure, and High-Performance Network Operating System

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ABSTRACT

Within the hierarchy of the Software Defined Network (SDN) network stack, the control layer operates as the critical middleware facilitator of interactions between the data plane and the network applications, which govern flow routing decisions. In the *OpenFlow* implementation of the SDN model, the control layer, commonly referred to as a network operating system (NOS), has been realized by a range of competing implementations that offer various performance and functionality advantages: Floodlight [11], POX [30], NOX [14], and ONIX [18]. In this paper we focus on the question of control layer *resilience*, when rapidly developed prototype network applications go awry, or third-party network applications incorporate unexpected vulnerabilities, fatal instabilities, or even malicious logic. We demonstrate how simple and common failures in a network application may lead to loss of the control layer, and in effect, loss of network control.

To address these concerns we present the ROSEMARY controller, which implements a network application containment and resilience strategy based around the notion of spawning applications independently within a *micro-NOS*. ROSEMARY distinguishes itself by its blend of process containment, resource utilization monitoring, and an application permission structure, all designed to prevent common failures of network applications from halting operation of the SDN Stack. We present our design and implementation of ROSEMARY, along with an extensive evaluation of its performance relative to several of the mostly well-known and widely used con-

Keywords

Software-Defined Network (SDN); OpenFlow; Controller Robustness

1. INTRODUCTION

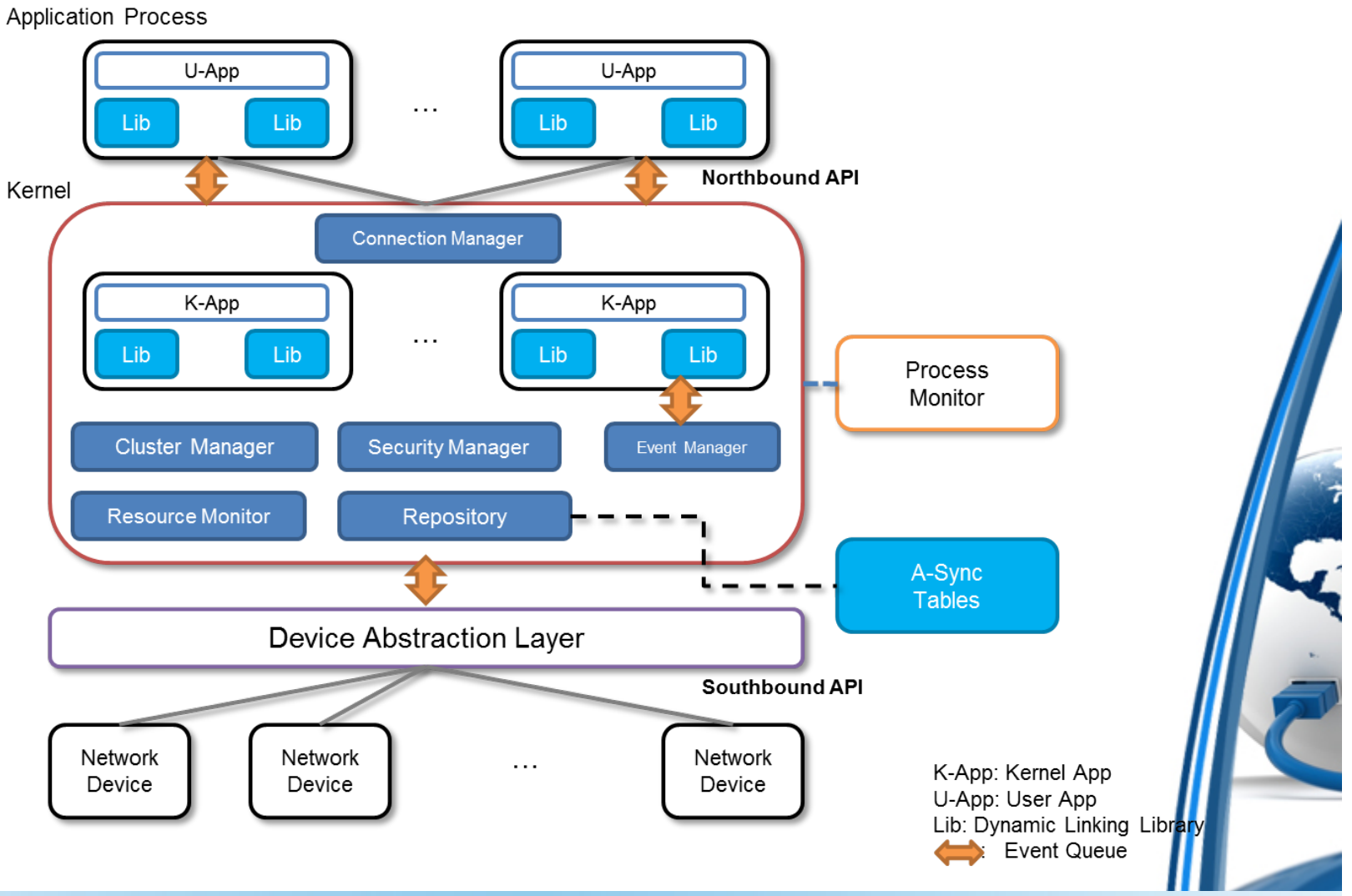
At the center of the growing emergence of the SDN paradigm is the notion of giving control of network flow routing decisions to a globally intelligent view, hosted above the data plane, that is able to coordinate across network components. SDNs enable this intelligence to be written in software, as *network applications*, using open APIs that better facilitate agile development and perhaps faster network innovations.

The OpenFlow stack is an embodiment of this notion. It offers a dramatic shift from the proprietary closed control layer of traditional network switches, to one in which the control layer exports both the API and the data plane abstractions necessary to facilitate a wide range of network applications. The introduction of the term *network operating system* (NOS) was born from the recognition of how the OpenFlow control layer provides network application developers with programming abstractions necessary to control the network data-plane hardware. The control layer provides interface and abstraction in a role analogous to that of operating systems, which provide software developers an appropriate abstraction for interacting with a host computer. Here, we will follow and extend this analogy, and will use the term network operating systems (NOSs) and OpenFlow controllers interchangeably.

(SRI, Kaist와 공동 논문출판)

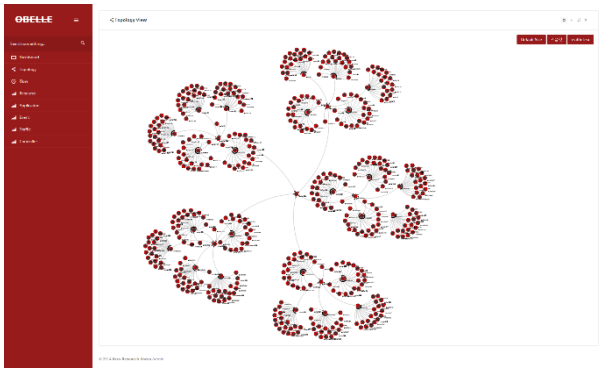
OBelle Architecture

- **Security 강화 Rosemary Kernel 기반**

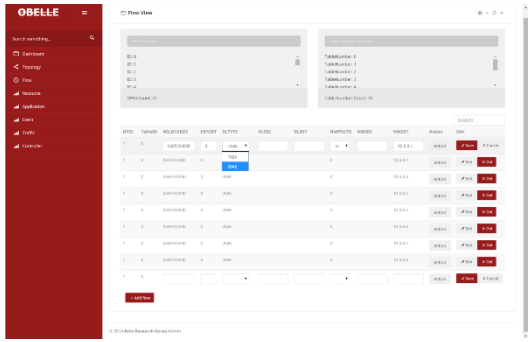


SDN 관제 시스템 – OBelle Archon

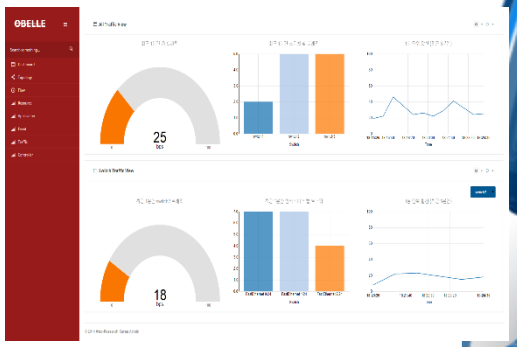
- 다양한 네트워크 Topology 의 효율적 표현 알고리즘 적용
- 양방향 link 표현, 트래픽 양에 따른 애니매이션 효과 및 색 변경
- Controller and application management UI
- Resource monitor, switch별 interface별 통계 그래프
- UI 상으로 관리되는 네트워크 히스토리 및 복구 기능



Topology map



Flow management

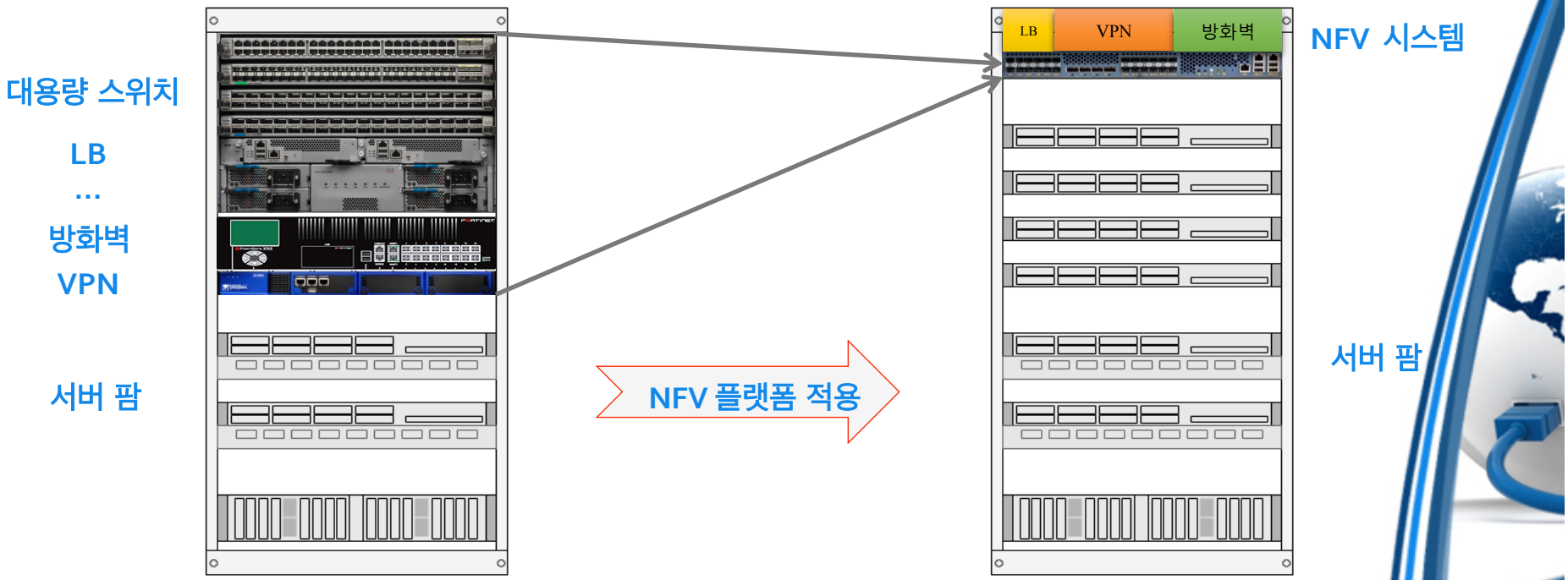


Resource monitor

NFV Solution

하드웨어 중심의 네트워크 서비스

- 고비용 하드웨어 장비 기반
  - 전용 하드웨어 사용 및 장비 중복에 의한 고비용 구조
- Static 서비스 시스템
  - 확장성 부족, 서비스 유연성 부족, 관리 어려움



Athene : 통합 네트워크 서비스 플랫폼

- OpenStack 기반의 NFV 플랫폼
- 다양한 VNF 제공

OpenStack + SDN + α

OpenStack :

VNF 를 위한 **기본** 인프라 **아키텍처**

- Nova: VNF를 위한 VM 관리
- Neutron: 모든 기능을 SDN으로 이관. 최소 FLAT 네트워크 관리
  - Mechanism Driver
  - Agent

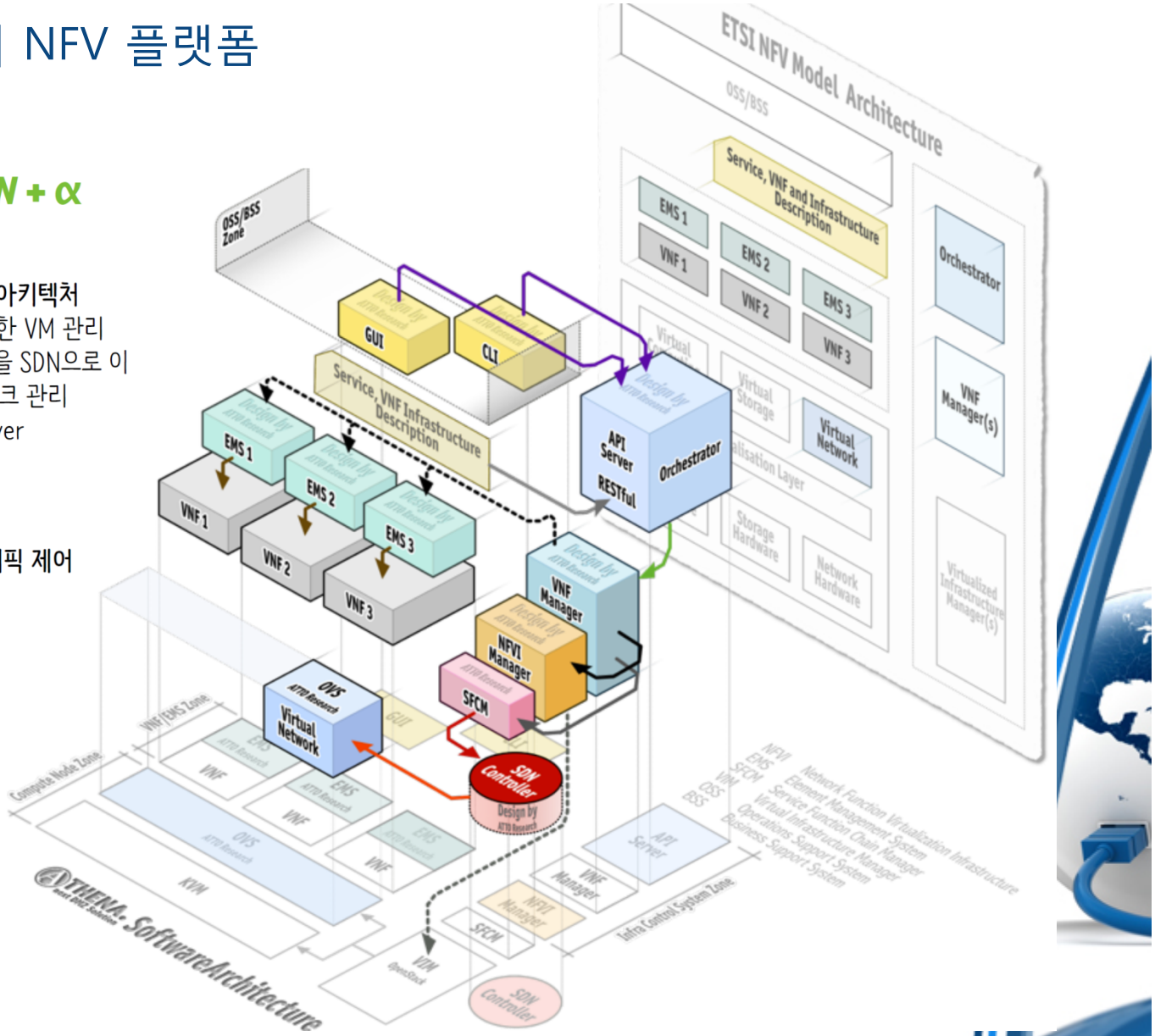
SDN :

VNF들 사이 네트워크 **트래픽 제어**

- Service Chaining
- HA
- Auto Scaling

SDN Controller :

당사 제작 OBelle로 최적화



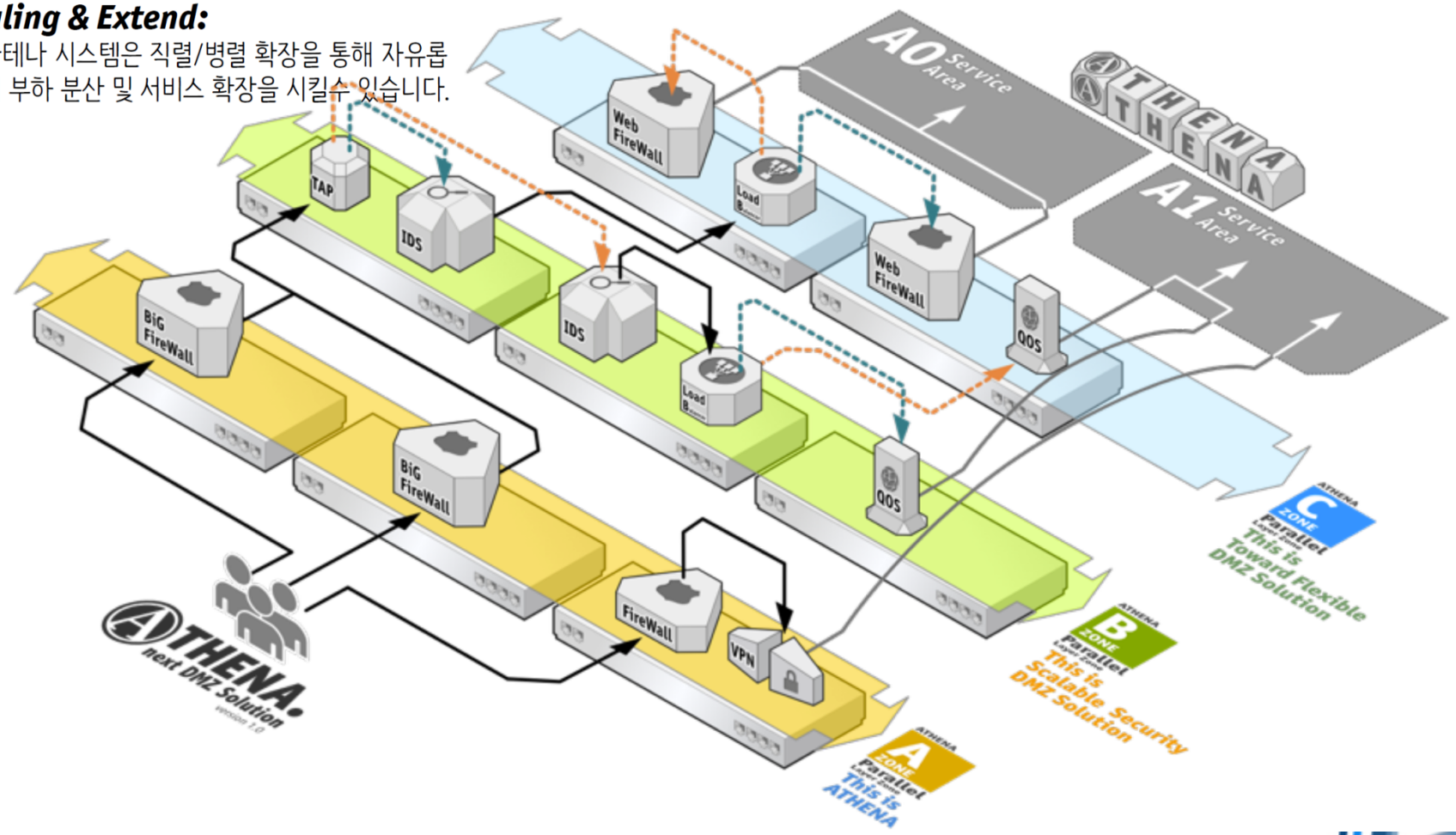
Athene Clustering Architecture

Dynamic Service Chaining:

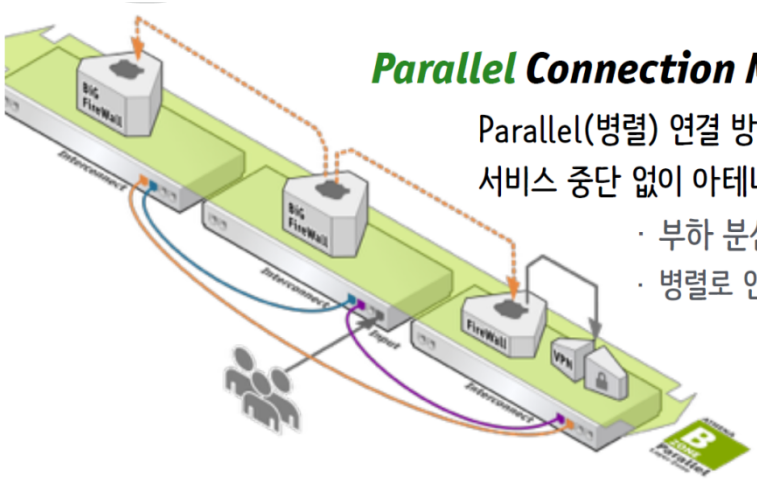
아테나 시스템은 관리자가 원하는 트래픽을 원하는 서비스들만 원하는 순서로 자유롭게 지정할 수 있습니다.

Scaling & Extend:

아테나 시스템은 직렬/병렬 확장을 통해 자유롭게 부하 분산 및 서비스 확장을 시킬수 있습니다.



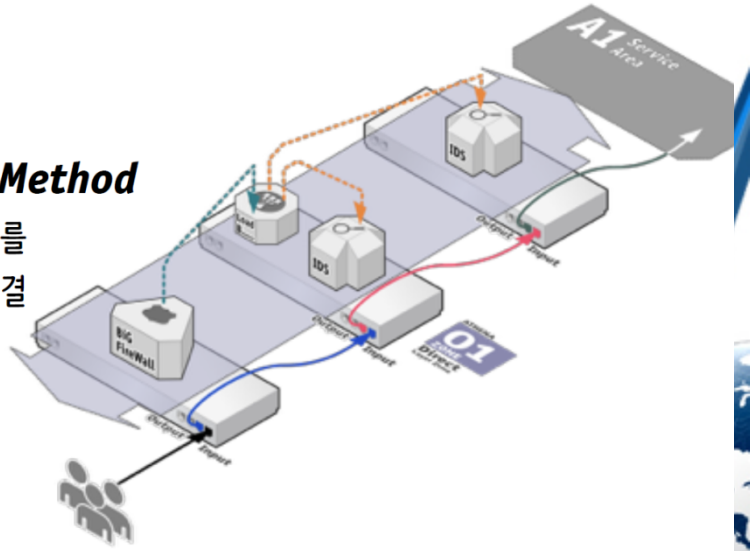
Physical & Logical Scaling



Parallel Connection Method

Parallel(병렬) 연결 방법은 아테나 장비들을 Interconnect Port를 이용해 연결
서비스 중단 없이 아테나 장비 확장 가능

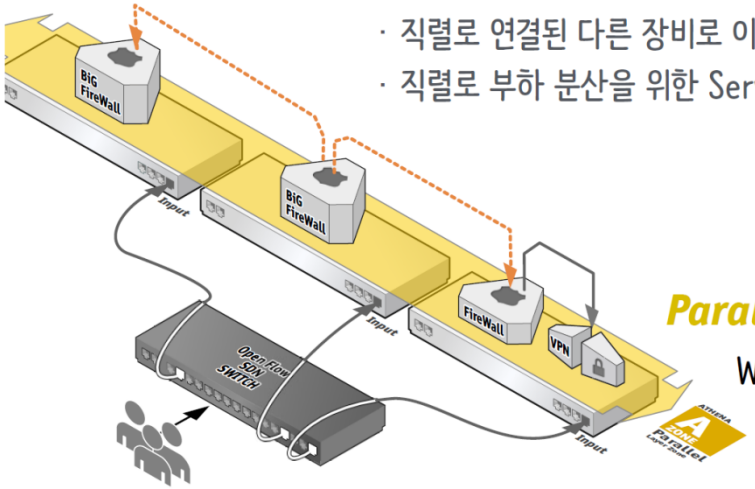
- 부하 분산을 위해 VNF를 여러장비로 확장하는 Service Scaling
- 병렬로 연결된 다른 장비로 이어지는 Service Chaining 구성 가능



Direct Connection Method

Direct(직렬) 연결 방법은 Input, Output Port를
네트워크 케이블로 연속적으로 이어서 연결

- 직렬로 연결된 다른 장비로 이어지는 Service Chaining 구성
- 직렬로 부하 분산을 위한 Service Scaling 가능



Parallel Connection with *SDN Switch* Method

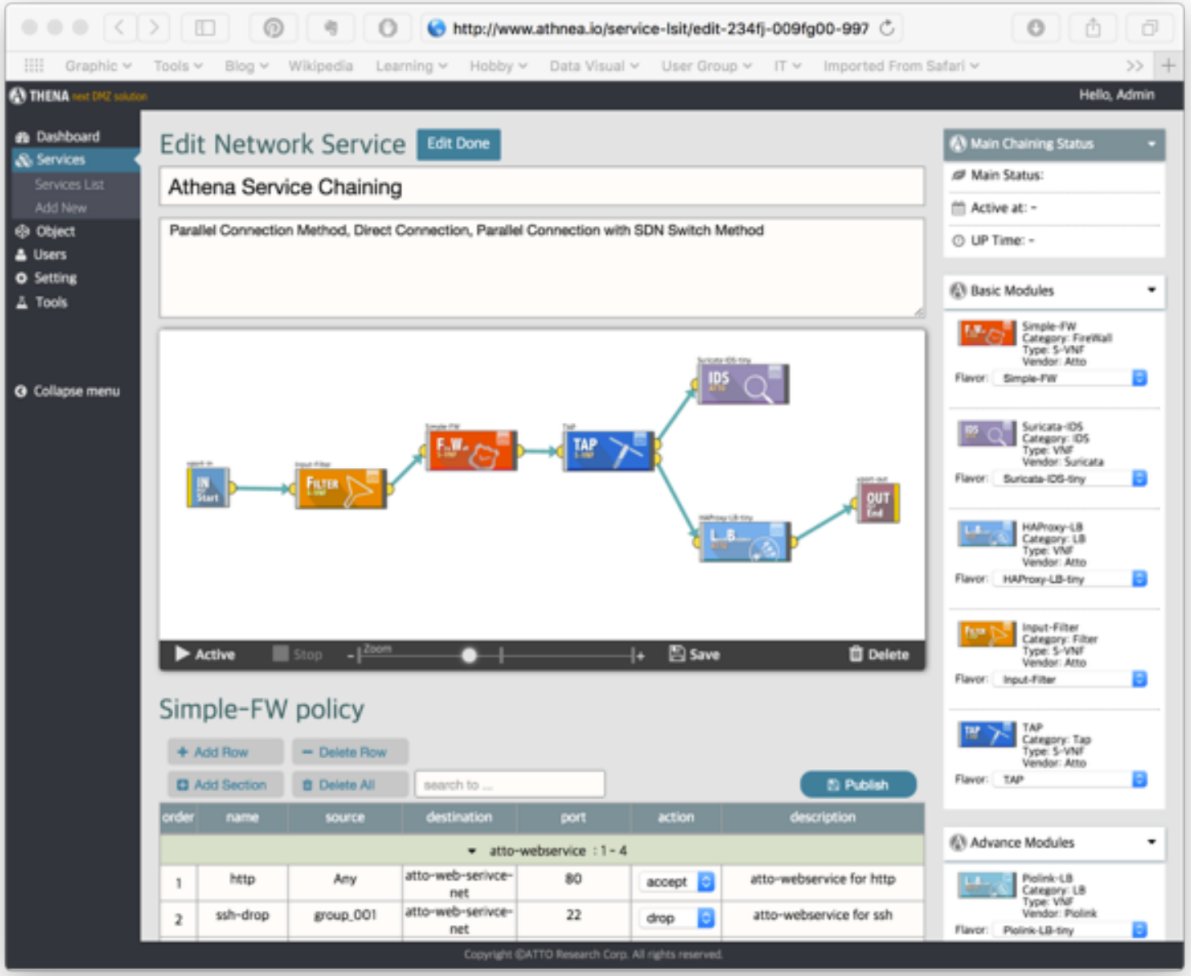
WAN 데이타 도입 네트워크 부분에 OpenFlow SDN 스위치를 둔, Parallel 연결 방식의 확장 버전으로 부하 분산을 극대화한 대규모 시스템에 적합한 방식

Athene UI

Web-based Service Chaining Design Tool

Easy Drag & Drop :

아테나는 관리자가 원하는 서비스 체인을 쉽게 작성할 수 있도록 웹 기반 관리 툴을 제공합니다. Drag & Drop 기반의 직관적인 서비스 관리 툴은 작업창에서 서비스 모듈을 끌어다 배치하고 연결하여 누구나 쉽게 복잡한 서비스 연결을 만들수 있게 해줍니다.



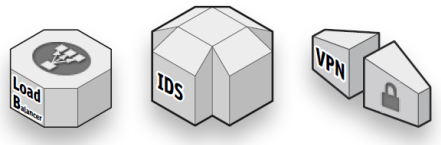
다양한 네트워크 서비스 제공

VNF: Virtual Network Function

L7 Load Balancer (HTTP/HTTPS/SSL)
- 자체개발 VNF
- 3rd Party: 파이오링크 ADC

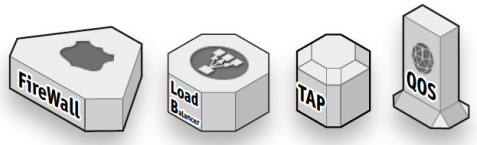
IDS/IPS
- 자체개발 VNF

VPN
- 자체개발 VNF(L3,IPSEC)
- 3rd Party: SECUI L2VPN



S-VNF: Software Defined Network + Virtual Network Function

NAT 자체개발
Basic Firewall 자체개발
L4 load Balancer 자체개발
Tap 자체개발
Traffic Shaper (QoS) 자체개발
Class of Service (CoS) 자체개발



Athene on Commodity 하드웨어

x86 based Commodity Server

Basic SPEC.

Case Type: 1U Rack
CPU: Intel Xeon E5-2580v3(2.50Ghz 12Cores) * 2EA
Memory: DDR4 16G ECC * 8EA (128Gb)
HDD: MLC SSD 2TB * 2EA * 4(TB)

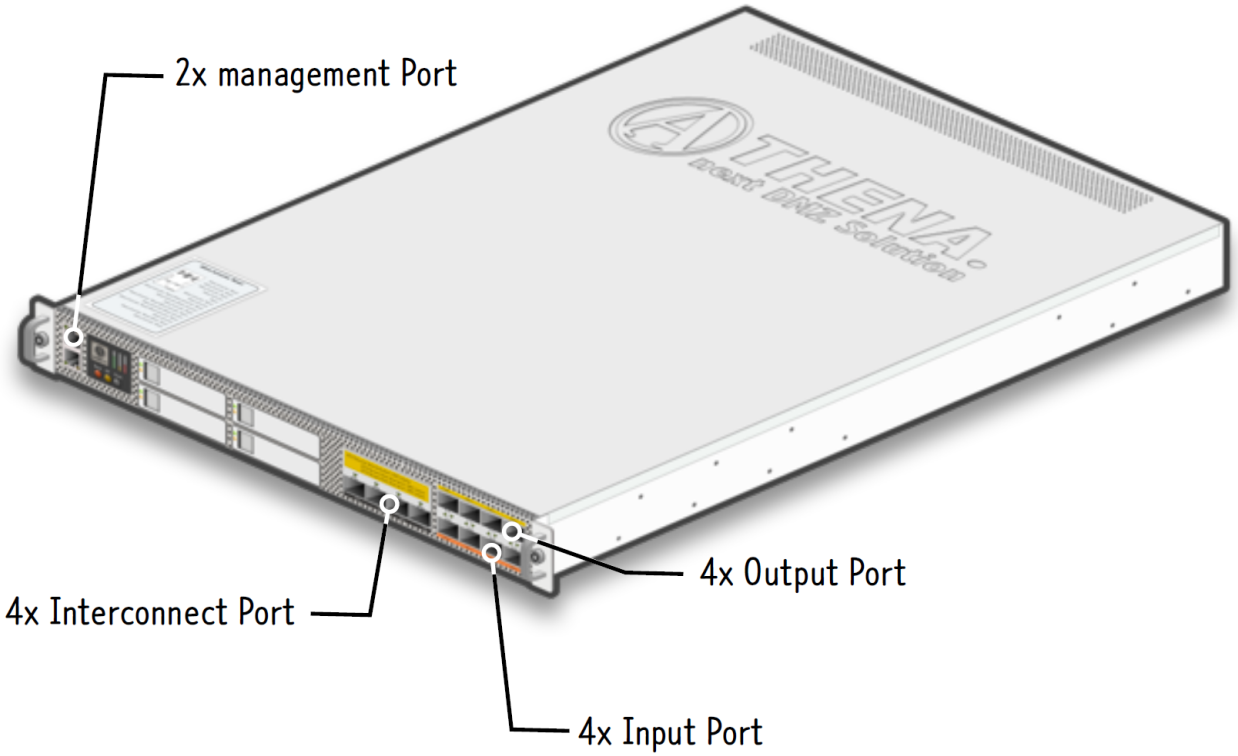
Network SPEC.

SFP+ 10GbE
- 총 12 Port
- 4x Input
- 4x Output
- 4x Interconnect

UTP 1G Port
- 2x Management Port

Network Capacity

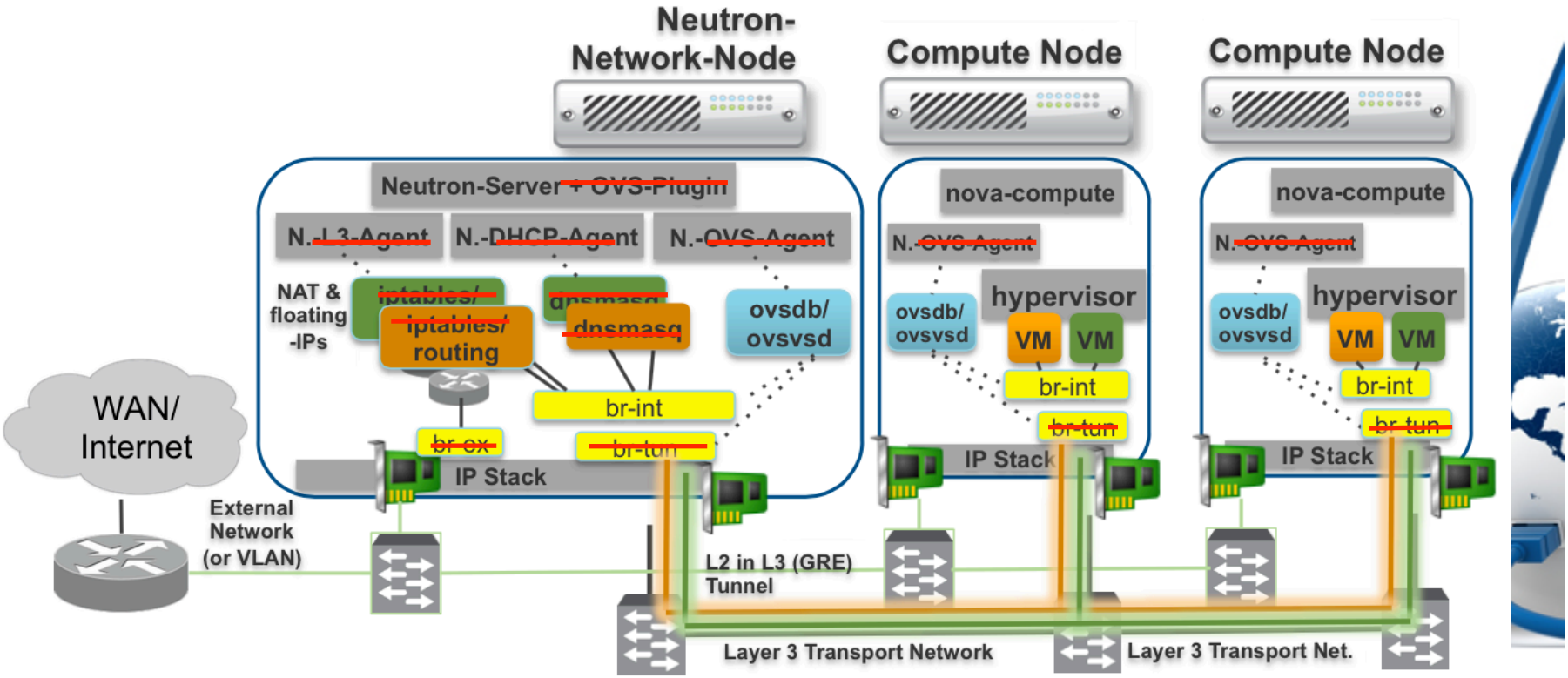
Switching > 10Gbps
IDS > 8Gbps



Cloud Network Solution

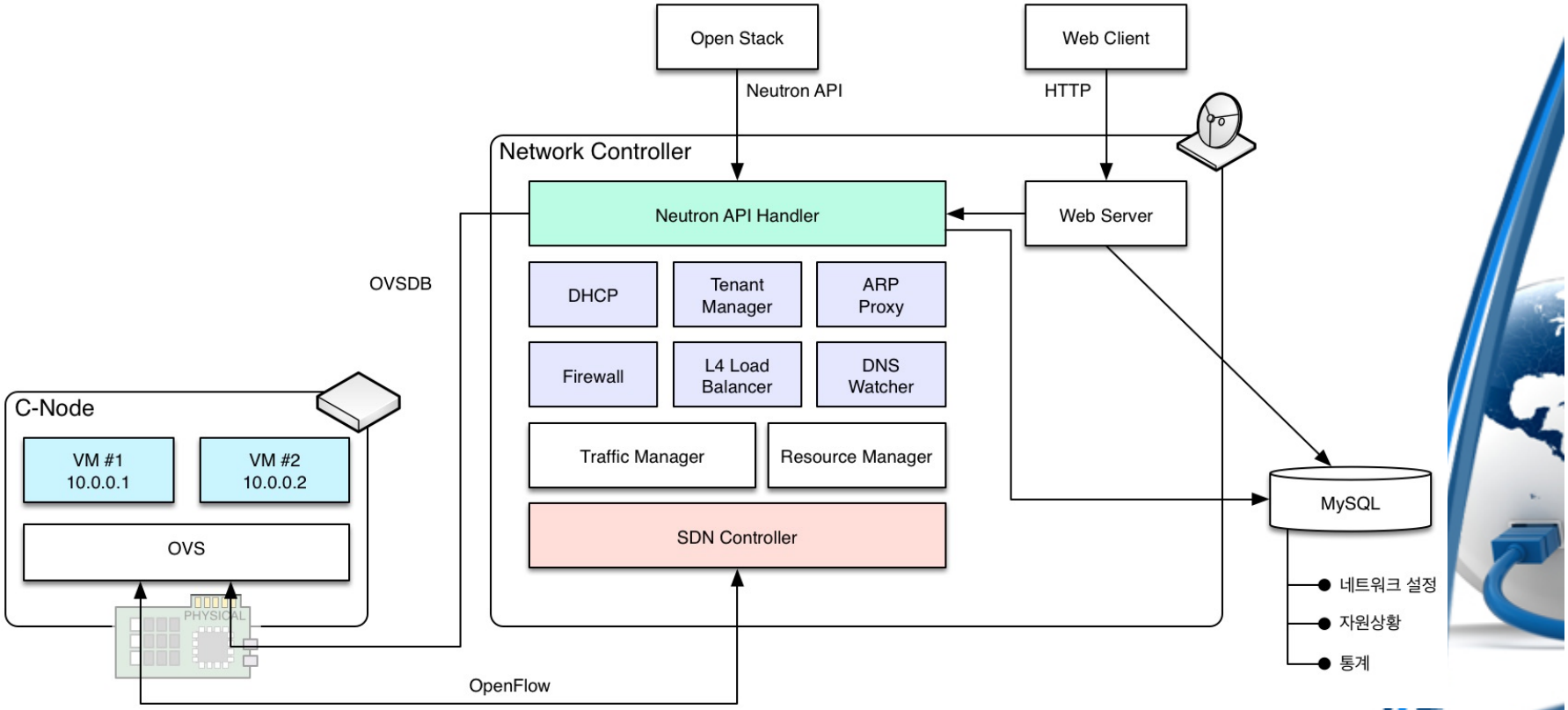
OpenStack Neutron 의 문제점들

- Legacy 네트워킹의 문제점을 그대로 가짐
  - 다수의 분산된 에이전트들에 대한 운영 및 관리 어려움
  - 복잡한 소프트웨어 브릿지 구조의 의한 성능 저하



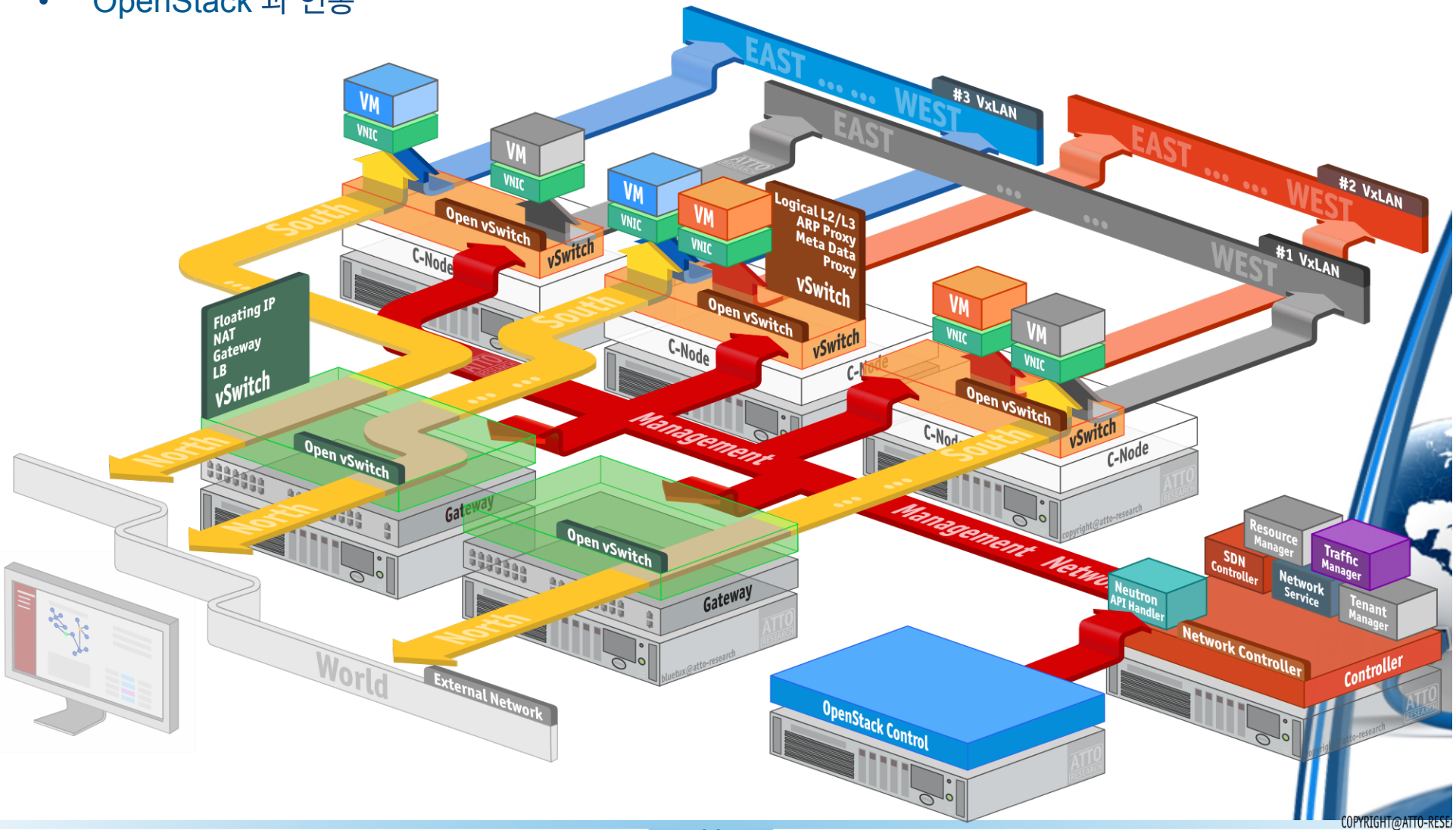
SONA : SDN 기반 Cloud Networking

- SDN Controller를 확장한 Overlay 가상 네트워크 용 Controller
  - Neutron API Handler로 OpenStack에서 전달되는 Neutron v2.0 API 처리
  - SDN APP으로 C-Node, Gateway의 OVS를 제어해서 Overlay 가상네트워크 최적화
  - 운영 시스템에서 필요한 관리, 모니터링 기능 제공



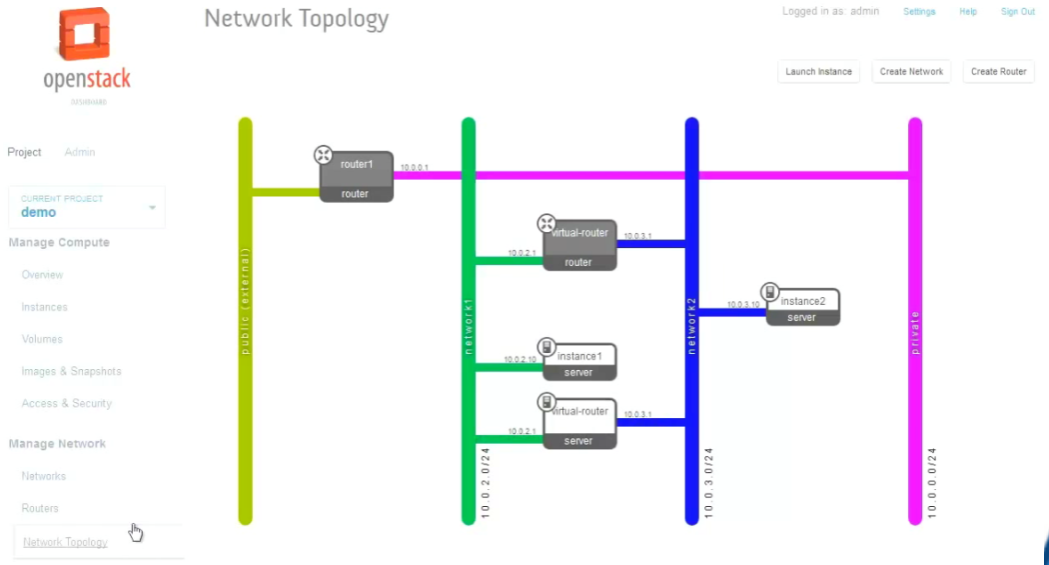
SONA Architecture

- SDN Controller 기반 Overlay 가상 네트워크 시스템
- OpenStack 과 연동

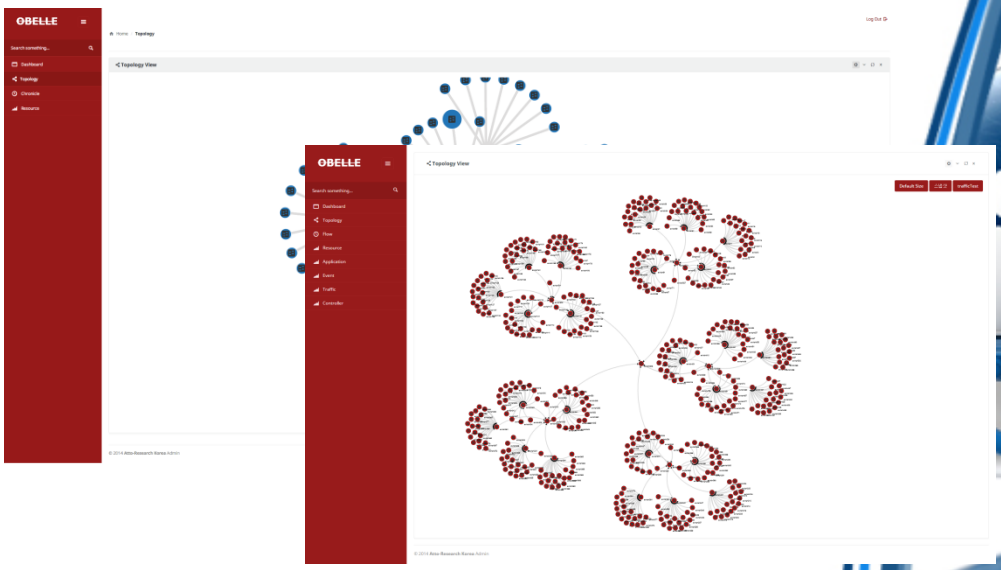


SONA management

- 테넌트 별 가상 네트워크 관리
  - OpenStack Horzion 기반
  - Neutron API v2.0을 통해 연동
  - 네트워크, 서브넷, 포트 관리



- Web-based management system
  - 웹기반 네트워크 관제 솔루션
  - OBelle Archon 기반
  - 네트워크 장치/구성 자동 인식
  - 트래픽 정보 조회
  - 시스템 이벤트 모니터링
  - 시스템 설정 동적 변경



SONA 주요 기능

목표 시스템	기능 리스트
네트워크 컨트롤러	▪ Neutron API Proxy ▪ L2 switching ▪ L3 routing ▪ DHCP ▪ ARP Proxy ▪ DNS (외부 서비스 이용) ▪ HA (Active-Active or Active-Standby) ▪ SDN Controller 통합
고성능 vSwitch	▪ Line-rate 급 OpenFlow 1.3 / 1.4 지원 소프트웨어 스위치 ▪ Host -Guest 뿐만 아니라 Guest-Guest 통신 가속 지원
네트워크 가상화	▪ VXLAN/NVGRE를 이용한 동일 Tenant VM 간 터널링 ▪ BUM 트래픽 최적화 ▪ Logical Switching/Routing
External Gateway	▪ Floating IP ▪ NAT ▪ L3 Gateway ▪ Firewall
운영시스템	▪ 웹 기반 운영시스템 ▪ 가상 네트워크 생성/변경/삭제

OnLab 과의 co-development

https://wiki.onosproject.org/display/ONOS/DC+Network+Virtualization

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- Use Cases
  - CORD: Central Office Reimagined as a Datacenter (vCPE, vOLT, NFaaS)
  - CORD: Leaf-Spine Fabric with Segment Routing
  - CORD: Leveraging Container Based Deployment and Microservices
  - **DC Network Virtualization**
  - Deployment in elastic environments
  - E-CORD: Enterprise CORD
  - Converged Packet Optical
  - IP RAN
  - M-CORD: Mobile Cord
  - Multicast Use Case
  - NFV (NFaaS)
  - Packet Optical
  - Peering Router - ONF's Project Atrium
  - SDN-IP
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ONOS / Wiki Home / Use Cases

Tools

DC Network Virtualization

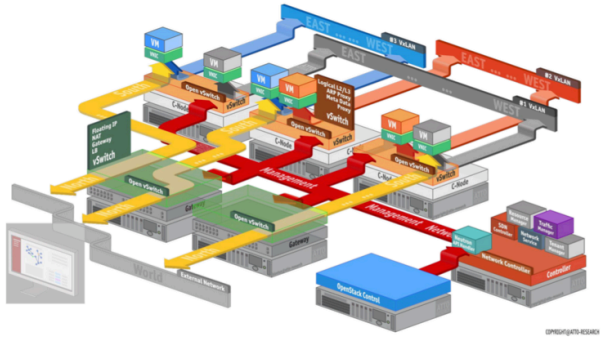
Created by Hyunsun Moon, last modified by Sangho Lee on Mar 23, 2016

Overview

OpenStack Neutron Plugin for ONOS

Project name: SONA(Simplified Overlay Networking Architecture)

SONA is the optimized multi-tenant network virtualization service for Cloud-based data center. Basically, it implements OpenStack Neutron's ML2 mechanism driver and L3 service plugin for ONOS, that is, it can be used to create virtual private networks and routing them through OpenStack Neutron. It leverages VXLAN based overlay networks to provision a virtual network but in an optimized way. It also provides gateway scalability, which acts as a connection point between virtual networks and outside of the world. Gateway device can be OVS or dedicated hardware.



Features

- Optimized logical switching
  - Multicast free VXLAN implementation
  - Logical switching for East-West traffics : No need to go through gateway device for East-West traffics
- Broadcast free : use built in ONOS applications for DHCP and ARP
- Agentless : no Neutron agents or network nodes are required
- Scalable gateway

OVS Acceleration

Project Members

Name	Organization	Role	Email
Daniel Park	SK Telecom	Project Lead	dan.park@sk.com
Sangho Shin	SK Telecom	Technical Lead	sangho.shin@sk.com
Hyunsun Moon	SK Telecom	Technical Team	hyunsun.moon@sk.com
Kyuhwi Choi	ATTO Research	Technical Lead	kyuhwi.choi@atto-research.com
Heeseong Lee	ATTO Research	Technical Team	heeseong.lee@atto-research.com
Sangho Lee	ATTO Research	Technical Team	sangho.lee@atto-research.com

Operation Intelligence Solution

봐야 할 것이 너무 많다

- 클라우드가 싫습니다.
  - 물리 계층, 가상 계층, 서비스 체이닝 등 챙길게 너무 많다.
- 지금의 관제 툴들은 더 많은 정보를 보여주려고 한다.

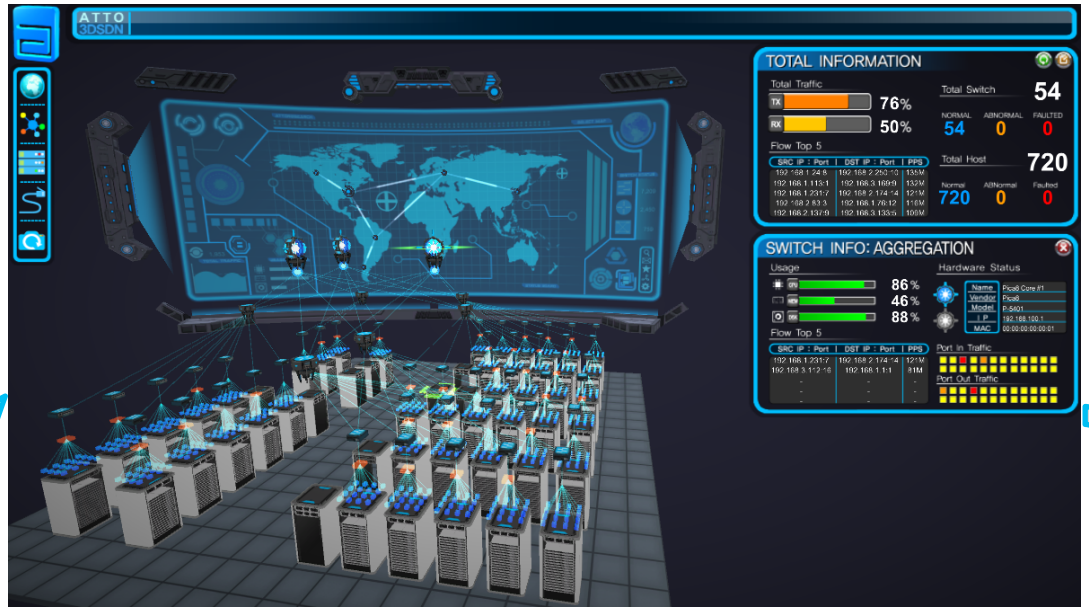
Hermes : 다음 1초에 당신이 봐야할 것

- Innovative Network Monitor/Control Loop

  Data Agent => Real-time Big Data => 3D Rendering => SDN

- 시스템 구성도

Control

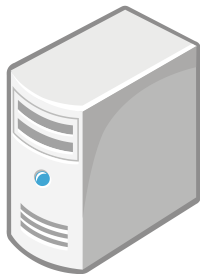


Big data analysis

Data collector

Switch

Server



SDN Controller

3D Visualization

- 3D 물리 환경과 직접 매칭
  - 문제 지점을 직관적으로 표현
- 2D card deck 시스템
  - 관련 핵심 정보만 표현
  - Customized card 추가 가능

Company Overview

연혁

2012. 01 Atto Research 설립
2013. 12 상용 SDN Controller OBelle 출시
2015. 11 NFV 플랫폼 Athena 출시
2015. 12 산업은행 투자유치
2016. 02 3D NMS 솔루션 Hermes 출시

대표 이사

정재웅 대표이사

- PhD. Electrical Engineering(Stanford)
- Senior Research Scientist(Intel)

비전

- 글로벌 최고 수준의 초고속 네트워크 데이터 처리기술 개발
- 금융/통신 및 네트워크 산업의 고성능 IT솔루션 개발

사업 분야

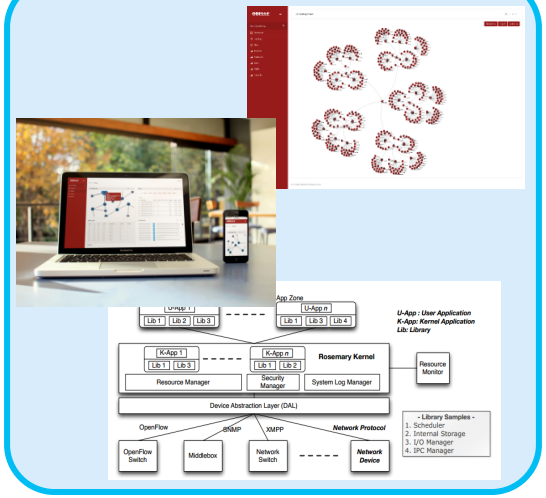
- OpenFlow 기반 SDN/NFV 솔루션
- 초고속 금융거래 솔루션

고객

- 통신사업자 (SDN/NFV)
- 증권사 (초고속 거래 솔루션, 트레이딩 플랫폼)
- 민간 기업 및 정부 기관

주요 사업 분야

SDN & NFV Technology



Product
- SDN Controller *OBelle*
- SDN 기반 관제 솔루션 *OBelle Archon*
- NFV 플랫폼 *Athene*
- Virtual Router *OBelle OSR*

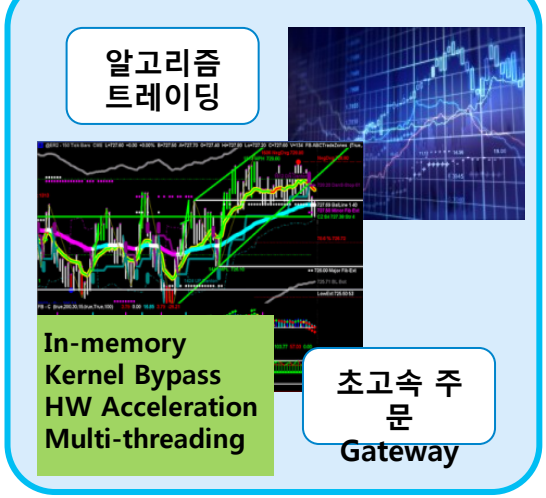
Service
- SDN 도입 관련 컨설팅 서비스
- SDN 지원 네트워크 하드웨어 Reseller 서비스

3D Network Management System

Product
- 3D 기반 지능형 네트워크 모니터링&관리 솔루션 *Hermes*

Service
- 네트워크 모니터링 관련 컨설팅 서비스

Ultra Low Latency Trading Platform



Solution
- Low Latency Trading Platform *Attick*
- Low Latency Exchange GW *AttoFEP*
- DMA Risk Mgmt. System *AttNexus*

Service
- DMA (Direct Market Access) Infra 컨설팅
- Low Latency Infra 구축 컨설팅

감사합니다

info@atto-research.com