ETRI SmartNet
Open Source Activities

2016. 4. 8

Open Networking Korea 2016 Spring

최태상

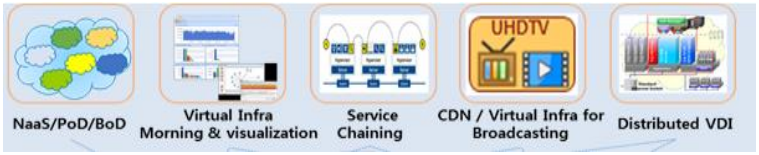
ETRI

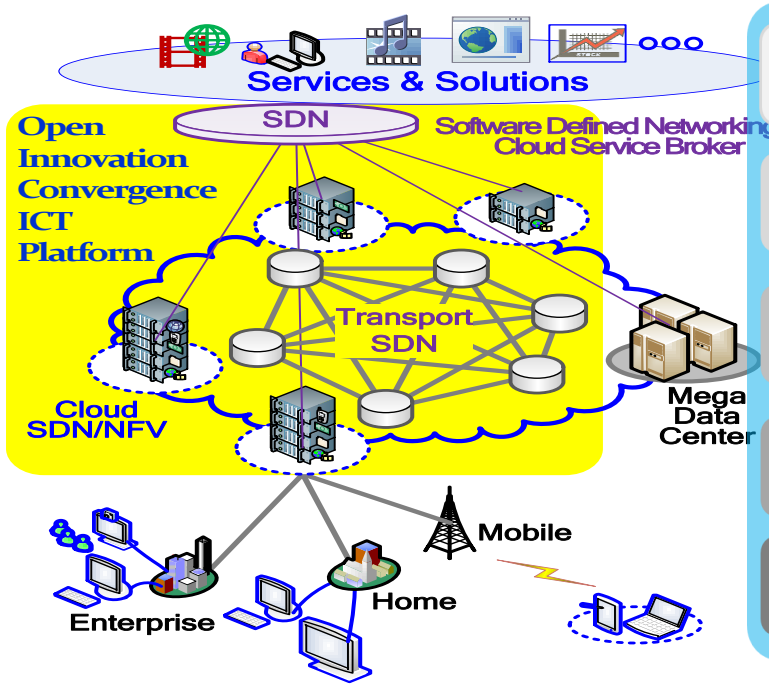
Topics

- ETRI SmartNet Introduction
- ODL Activity
- ACTN Activity
- ONOS Activity
- OPNFV Activity

연구개발 목표

컴퓨팅 및 네트워킹 자원이 밀 결합되고 통합적으로 제어되어
혁신적 응용과 서비스에 최적화 환경을 제공하는
Open Innovation 융합 ICT Platform 개발 및 기술확산 (TRL3 ~ TRL7)





- 지능형 엔지니어링 (자동화/자율화, Data Analytics)
- 네트워크 프로그래머빌러티 (service, function, path, policy: QoS, Security)
- 서비스 지향 E2E 네트워크 슬라이싱 (클라우드, Transport, 다중도메인/계층/Tech)
- (물리인프라)분산클라우드化 (MEC, Hybrid 클라우드, Fog 컴퓨팅)
- (시스템) 개방형 C/N 융합 플랫폼

① 조기 시장 창출·확산을 위한 SDN/NFV 표준 발굴

② 네트워크 가상화 제어관리 기술
- 캐리어급 트랜스포트 SDN 핵심기술
- 클라우드 네트워킹 제어 기술
- 다중 가상 네트워크 최적 제어

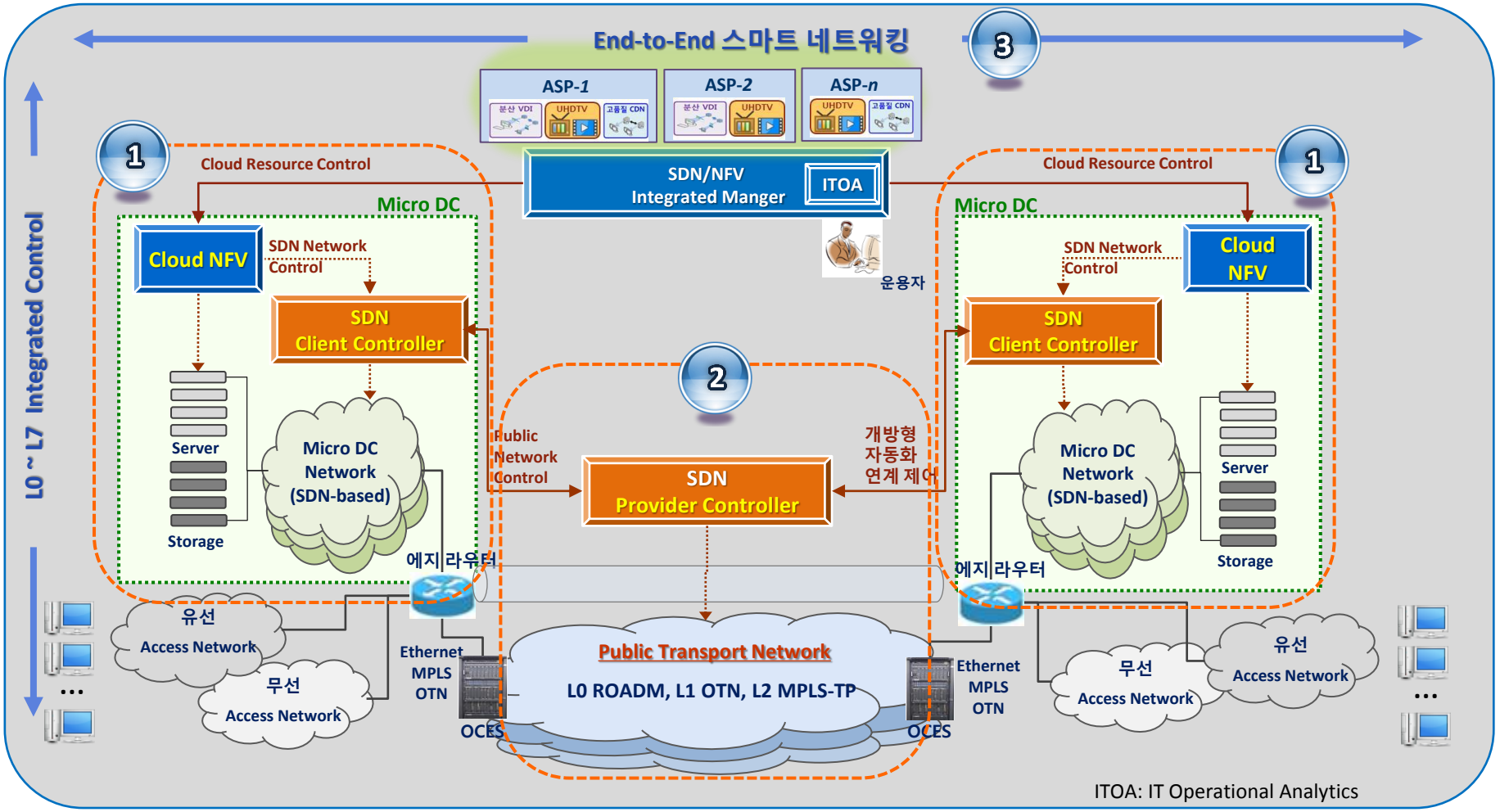
③ 분산 클라우드 및 NFV 플랫폼
- 서비스 오케스트레이션 기술
- VNF 및 VNFM 기술
- 클라우드 기반 VIM 기술
- NFV 플랫폼 DP 가속 기술

④ 지능형 운영분석기술
- 빅데이타 기반 운영분석
- SDN/NFV 검증 기술

⑤ NFV HW 공통플랫폼
- 스위치 및 서버

목표 연구 내용 및 범위

- 1차년도(2014년) : 스마트 클라우드 네트워킹 핵심 기술 개발
- 2차년도(2015년) : 스마트 트랜스포트 네트워킹 핵심 기술 개발
- 3차년도(2016년) : 종단간 스마트 네트워킹 핵심 기술 개발 및 상용화



ETRI Electronics and Telecommunications Research Institute

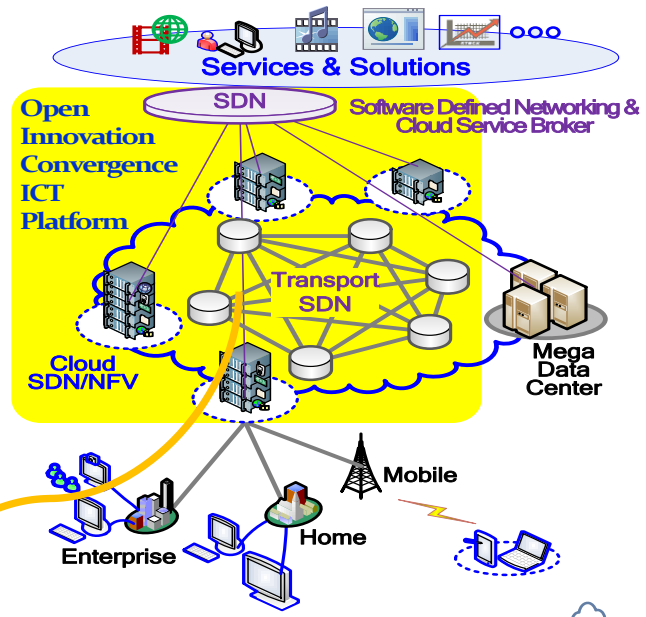
ODL Activity

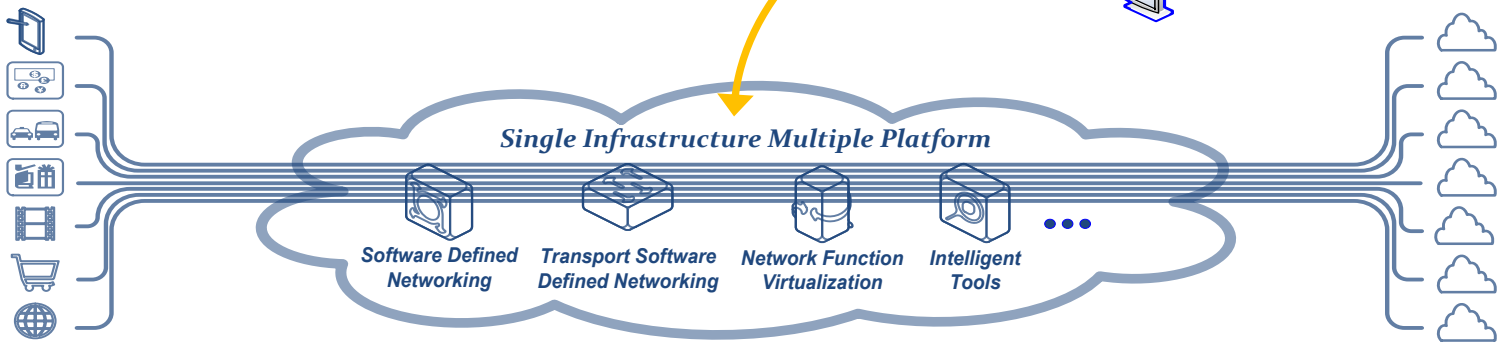
T-SDN Project Introduction

"Smart Networking Core Technology Development"

컴퓨팅 및 네트워킹 자원이 밀 결합되고 통합적으로 제어되어 혁신적 응용과 서비스에 최적화 환경을 제공하는 Open Innovation 융합 ICT Platform 개발 및 기술확산

- Key Challenge
  - End-to-End Provisioning and Orchestration over Multi-Vendor/Layer Transport Infra
  - Multi-Domain Network Orchestration with Distributed Cloud/NFV and Transport Infra
- Based on OpenDaylight Controller
  - Best-fit on the brown-field infra
  - Multiple southbound plugins architecture for PTN & OTN devices, and VTN(tenant networking) & OVSDB/OF(SFC)
  - Including ACTN Reference Architecture



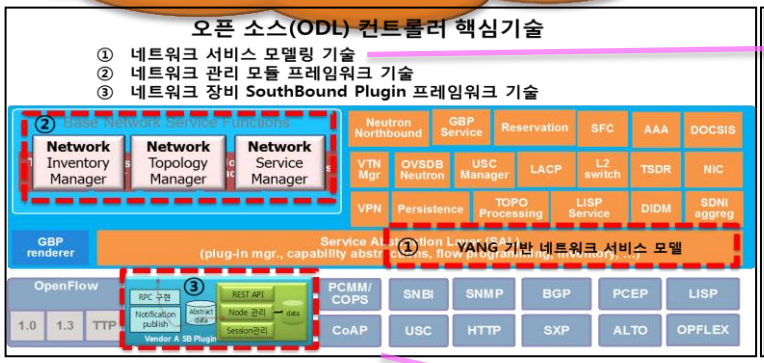


ETRI T-SDN Architecture & Eco-System

Open Source Eco-System
(OpenDaylight)
(Seoul&Daejun ODL meeup)

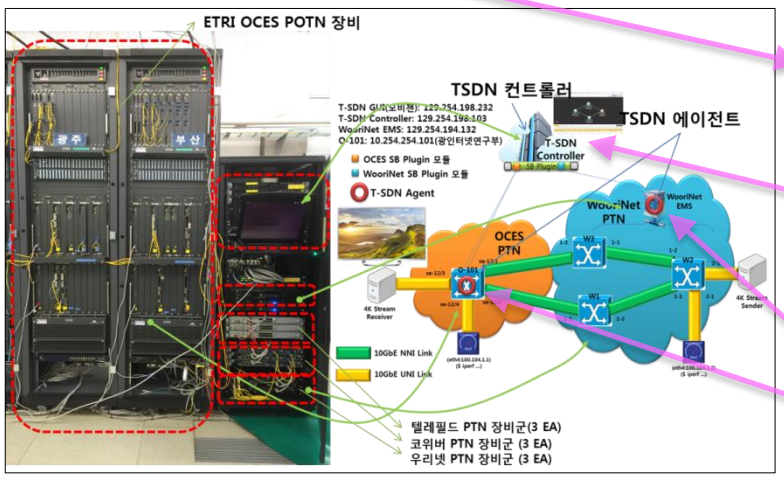
SDO
IETF(Bits N Bites),
ITU-T, ONF, TTA(PG201)

<표준화>

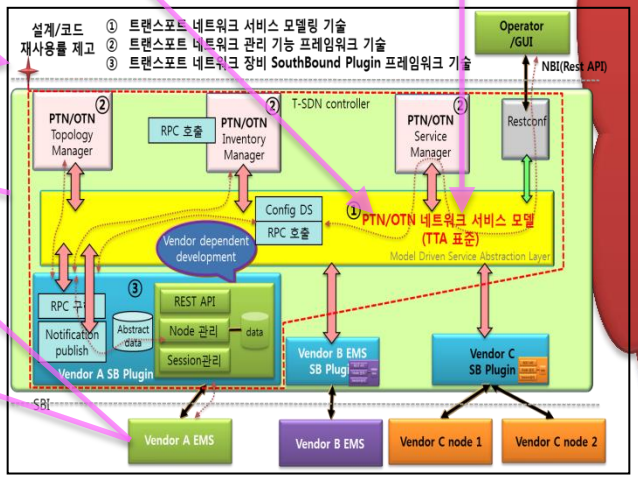


Domestic Transport SDN Eco-System

Carriers(KT, SKT, KINX)
Vendors(Woori-Net, Telefield, Coweaver)
Solutions(Mobigen)
Academy



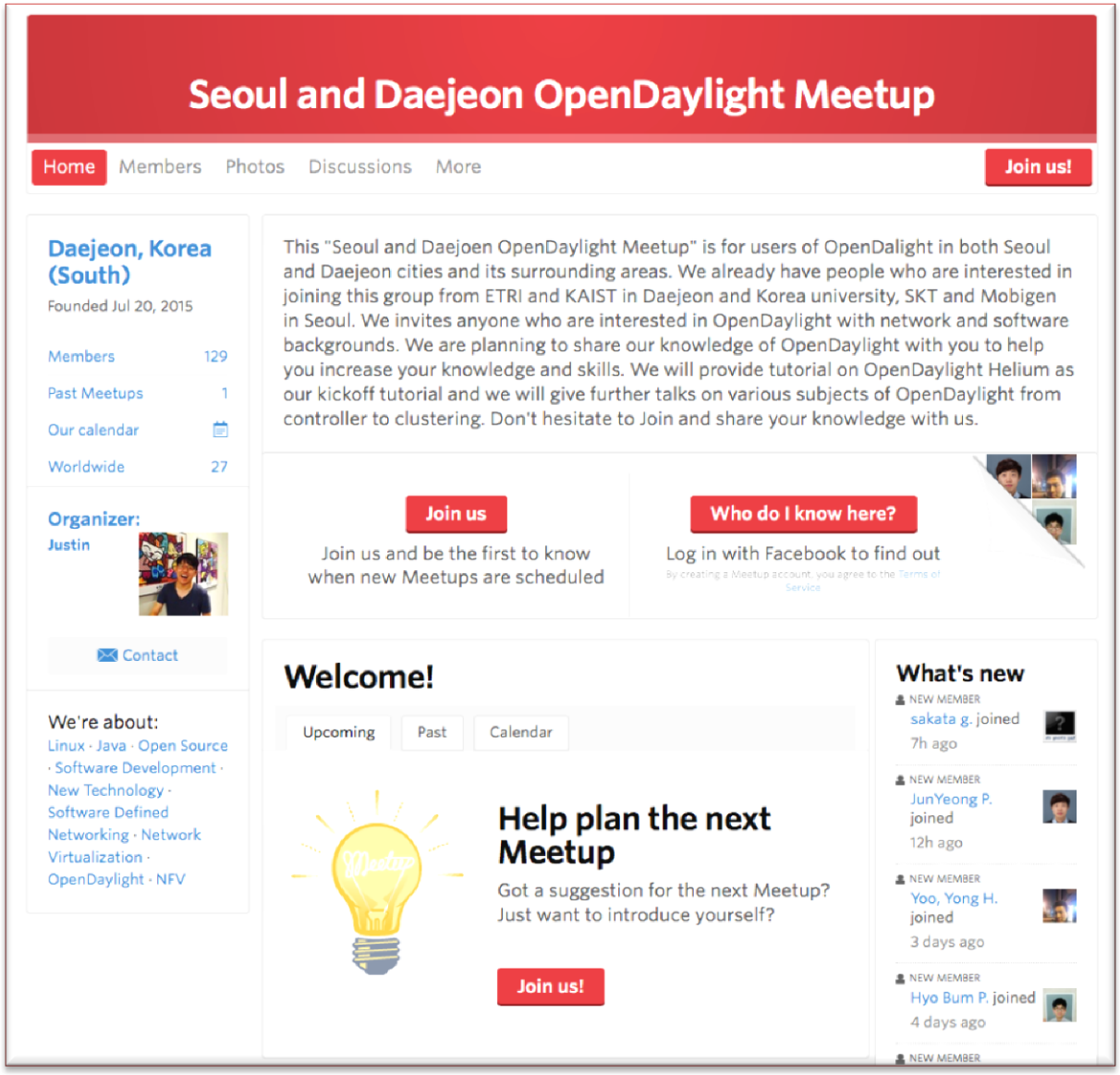
<표준기반 PTN BoD PoC>



<PTN/OTN SDN Controller>

https://wiki.opendaylight.org/view/Project_Proposals:MPLS-TP_Service

ODL User Groups



MPLS-TP Service Project on ODL

Project Proposals:MPLS-TP Service

Contents

[hide]

Name

MPLS-TP Service

Repo Name

mplstpservice

Description

In Korea, wired telecommunications carriers (KT, SKT, LGU+, and KINX) provide various network services with brownfield networks that consist of assorted transport technologies (SDH/MPLS-TP, OTN/OTH, ROADM/DWDM, IP/MPLS) with diverse network appliances (Firewall, IDS/IPS, Web Accelerator). In order to reduce CAPEX and to avoid vendor lock-in, these transport networks are often comprised of multi-vendor and multi-domain equipment, which leads to taking various forms of layered architectures such as (SDH/OTN+ROADM) or (PTN/OTN+ROADM). As a result, this byzantine complexity causes an increase in OPEX and becomes a significant hurdle in the era of software defined infrastructure (SDI) and agile networking infrastructure. Consequently, research organizations and local telecommunications carriers are investigating and analyzing requirements for transport SDN technology.

- Carrier's requirements

1. **Operational Simplicity** enables network service control/provision with simpler and more open APIs.
2. **Differentiated Service Delivery** means automatically allocating resources in accordance to the context of an application or a service.
3. **Scalability** means supporting multi-domain and multi-layer network service control/provision transactions in a scale of hours and minutes, not weeks and days.
4. **Security** provides enhanced security of provided network services or resource isolation
5. **Continuous Availability** means diverse and flexible network recovery in case of any disastrous or erroneous operations or failures.
6. **Legacy and multi-Domain Interworking** is about supporting network diversity.

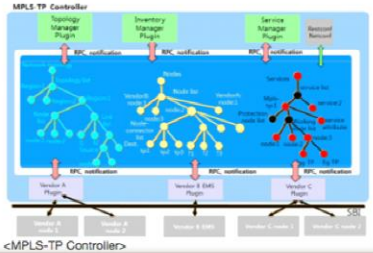
- Expectations

1. Solving instantaneous multi-vendor end-to-end service provisioning will lead to OPEX and CAPEX reduction.
2. Enabling sustainable multi-vendor-based transport networks for CAPEX reduction.
3. Operating efficiently through the global network view
4. Supporting the evolution into an open transport network infrastructure for various future services

Scope

This project aims to provide a transport SDN controller that enables flexible MPLS-TP service provision over various legacy devices and SDN devices in heterogeneous networks. The deliverables will include the YANG data models (inventory, topology and service) for MPLS-TP based packet transport network, MPLS-TP network managers and single/multiple SB plugins for MPLS-TP NEs (Network Elements).

- **Controller**



<MPLS-TP Controller>

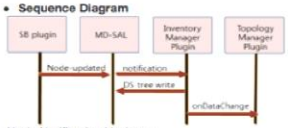
-**Inventory Manager** maintains the DB (Data Broker) based on the information gathered from SB Plugins or the MD-SAL. It can update the information or notify other managers as needed.
  -Implementing Notification
  -Manage information on nodes

-**Topology Manager** acquires information on nodes and network topologies through registering a listener on the Inventory Data Store Tree. It maintains its own Date Store for other plugins to use.
  -Implementing Notification
  -Manage information on nodes
  -Manage information on topologies and links

-**Service Manager** receives a user's service creation/modification/deletion request though the Restconf interfaces. It parses the input and invokes appropriate RPCs to create/modify/delete the requested service.
  -RPC call
  -Implementing Notification
  -Manage PTP Service

-**Southbound Plugin** connects to a EMS or MPLS nodes for control and management. It can notify the MPLS-TP controller or MD-SAL as needed.
  -RPC implementation
  -Manage node connections
  -Manage Node Information
  -Map node and MD-SAL information

- **Sequence Diagram**

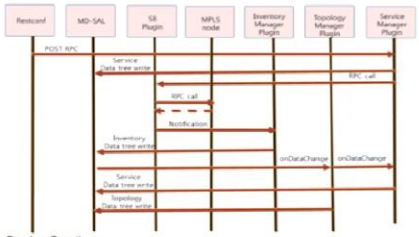


<Node Notification Update>

1. The SB Plugin detects that a new node has joined and sends a notification to the MD-SAL.
2. The MD-SAL routes the notification to bundles that registered the listener.
3. The Inventory Manager Plugin writes the node information on the Data Store.
4. The Topology Manager receives a notification through an "OnDataChanged" message.

<Link Notification Update>

1. The SB Plugin detects that a new link and send a notification to the MD-SAL.
2. The MD-SAL routes the notification to bundles that registered the listener.
3. The Topology Manager receives a notification and writes the link information on the Data Store.



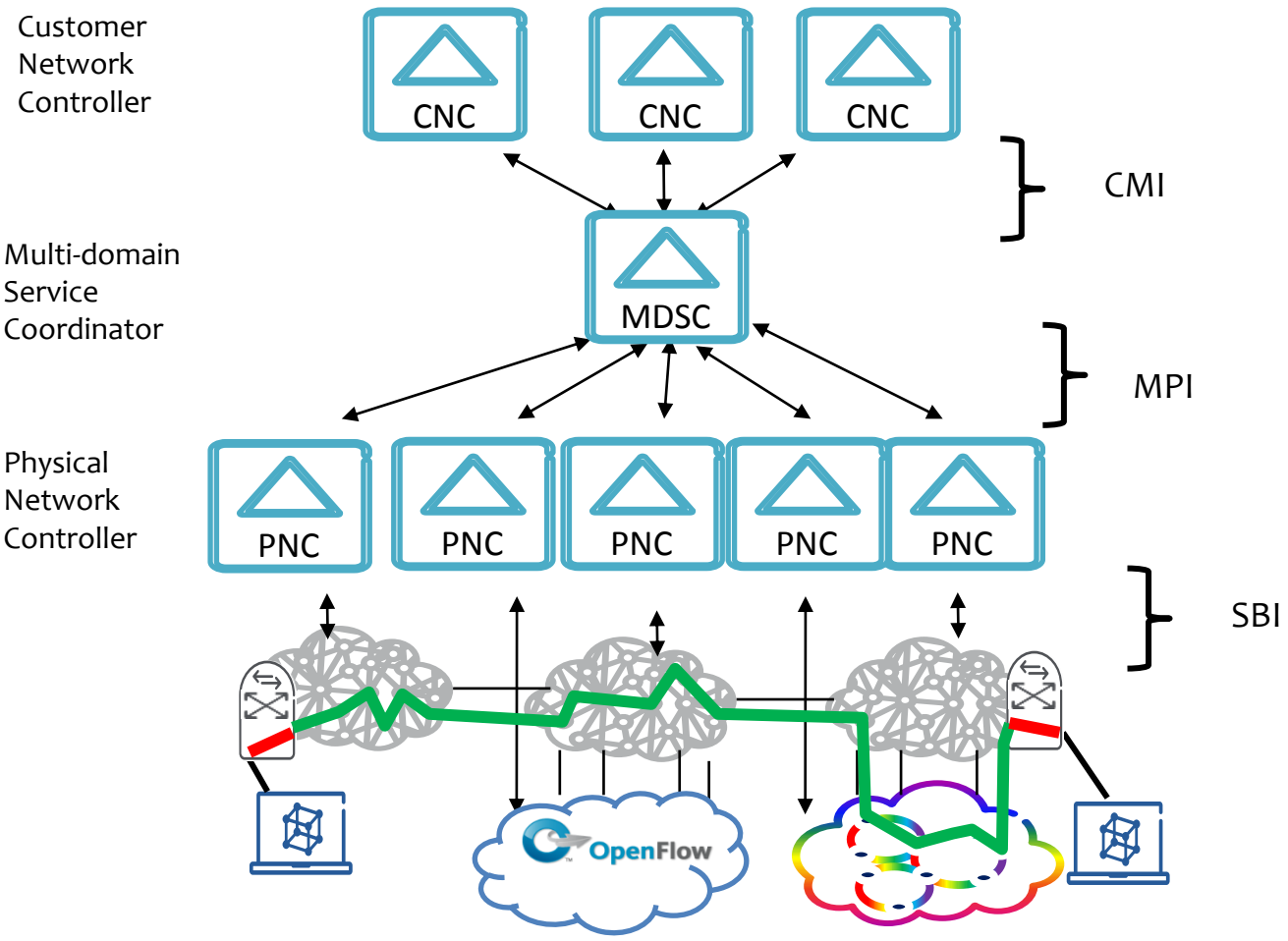
<Service Creation>

1. A user inputs a service creation command though a Restconf interface.
2. The Service Manager parses the input and checks its validity. Once it's verified, it writes to the MD-SAL and invokes RPCs in accordance with the input.
3. Upon receiving a RPC, the SB plugin translates the RPC into a target compatible command (an EMS or MPLS node) and sends it to the target entity.
4. The entity (the EMS or MPLS Node) executes the command and notifies the result to the SB Plugin.
5. The SB Plugin sends a notification message to the MD-SAL and the MD-SAL routes it to all registered bundles, in this case the Inventory Manager.
6. After certain verification procedures (format and contents), the Inventory Manager writes the information on the Date Store.
7. Upon receiving the "onDataChanged" message, the Topology and Service Managers reflect changes on their Date Store.

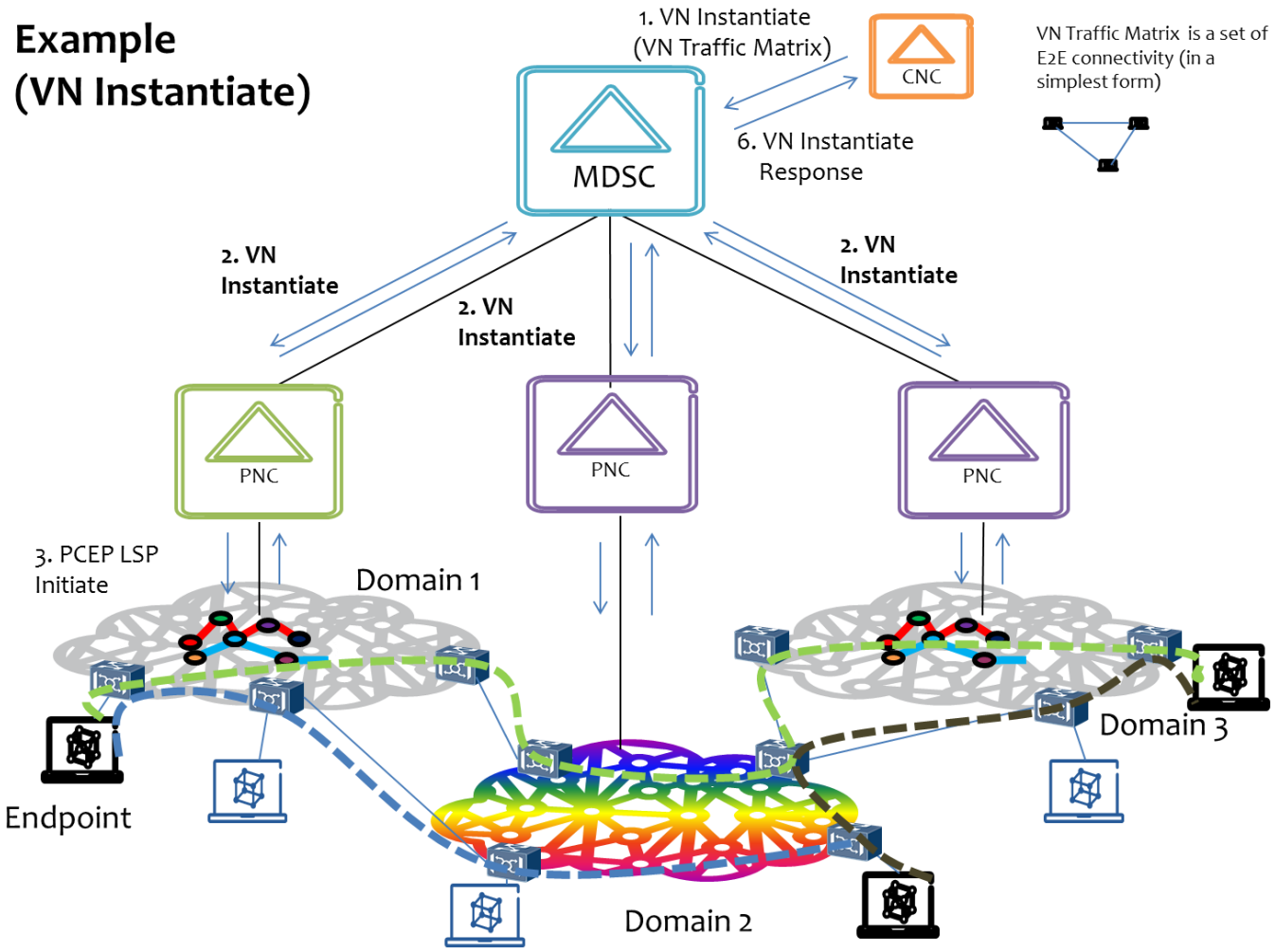
ACTN Activity

ACTN Reference Architecture

- Enabling OpenFlow-based transport domains, while supporting legacy heterogeneous transport network control/ management technologies (e.g., GMPLS/ASON, PCE, NMS/EMS)
- Multi-domain service coordination based on abstraction/virtualization
- Distributed data centers dispersed over different domains including wireless backhaul transport, metro and core packet/optical networks



How ACTN works



Status Update

- ACTN has progressed in TEAS (Traffic Engineering Architecture and Signaling) WG in IETF Routing Area
  - ACTN Requirements Draft has been adopted as WG document: http://datatracker.ietf.org/doc/draft-actn-requirement/
  - ACTN Info Model and Framework are also in progress.
  - Solutions are also being discussed.

- Open Source ACTN
  - Project has been launched.
  - Ericsson and Huawei are the two leading vendors.
  - Details will be presented later.
  - Making ACTN implementation easier as the APP is independent of OS platform (ONOS, ODL, Pipe OS, etc.).

Open ACTN 데모

- IETF 97(Nov.2016, Seoul) Bits-N-Bites for interoperability test between SDN controllers from multi-vendors
  - 해외 기관: Huawei, Ericsson
  - 국내 기관: TTA 산하의 T-SDN 표준 실무반에서 ACTN 표준화 및 Open ACTN 데모 추진 방안 협의 중
    - 참여 기관: 통신사업자(KT, SKT, LGU+), 벤더(우리넷, 텔레필드), ETRI

ONOS Activity

Open-TAM Subproject Overview

- OPEN-TAM Subproject Setup
  - Feb. 2015: Kick-off Conference Call with ONOS TSR
  - Mar. 2015: Proposal of a Subproject: OPEN-TAM
  - Mar. 2015: Creation of OPEN-TAM Future Project Wiki Page
    - Two work items: Adaptive Flow Monitoring (AFM) & Selective DPI (S-DPI)
- Development and Release Plans
  - Started with Blackbird 1.1.0 release
  - Phase 1 result (AFM) was incorporated in EMU release (Nov. 2015)
  - Phase 2 (S-DPI) will be in GoldenEye release (May. 2016)

Adaptive Flow Monitoring Motivation

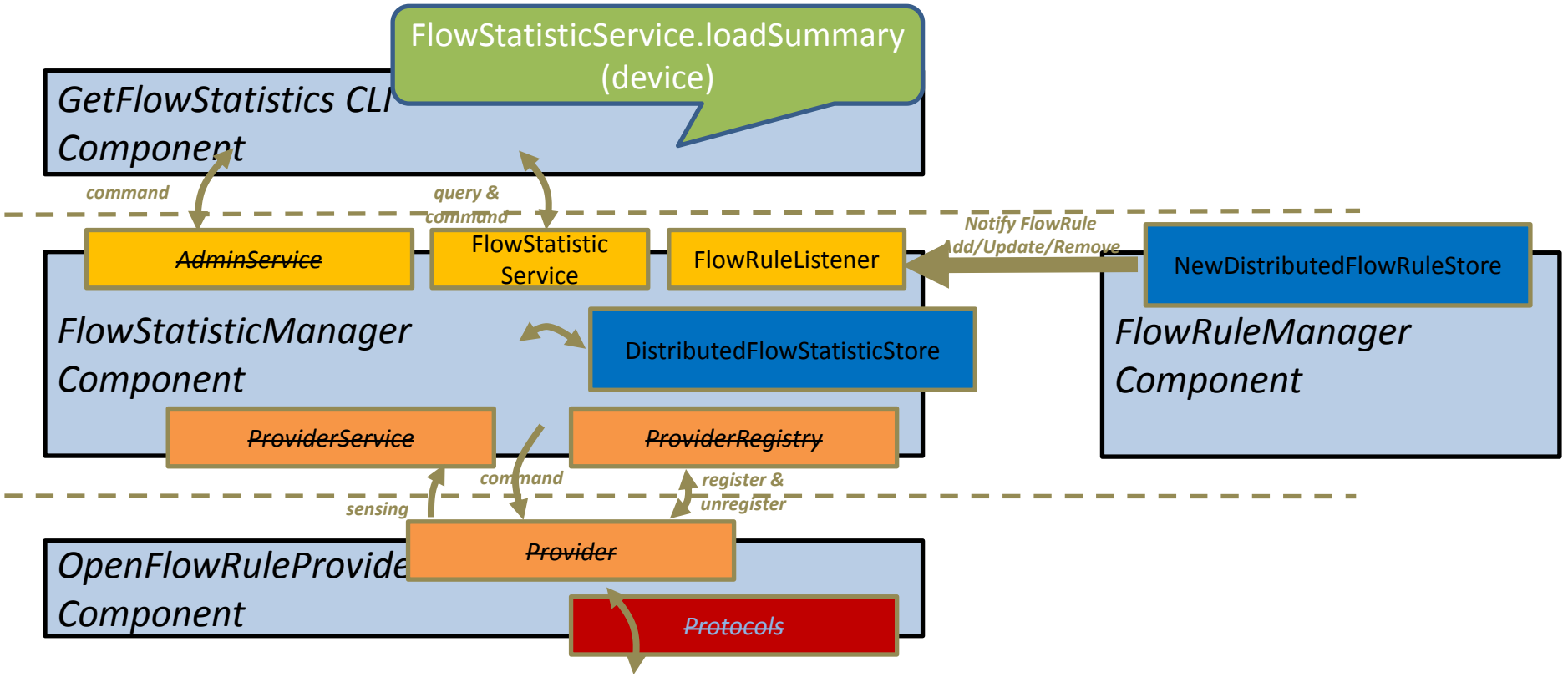
- Default ONOS Flow Monitoring Issues
  - Default FlowRule service collects all flow information from all devices at every time interval (default 10 seconds)
  - This mechanism may cause **performance degradation issue** at each collection time in a large-scale real carrier network due to the number of switches and its associated flows (for example; WAN: ~500 Routers, ~10K ports, ~1-10M flows per port)
  - To overcome performance problem in a simple way, we can maintain collection time interval value with a large number. It then causes another critical issue: **lack of accuracy**

  - Our proposal to this problem is an effective flow monitoring scheme called, **Adaptive Flow Monitoring Service** that can minimize collection computing overhead and provide more accurate flow statistics

Adaptive Flow Monitoring Algorithm

1. Initialize Variables and Setup Tasks() {
    - CAL_AND_SHORT_POLL_INTERVAL= 5, MID_POLL_INTERVAL=10, LONG_POLL_INTERVAL= 15, ENTIRE_POLL_INTERVAL=30
    - Set each tasks being executed at every corresponding time interval }
2. CAL_AND_SHORT_FLOWS_TASK() {
    - IF at first time call or ENTIRE_POLL_INTERVAL, send FlowStatsRequest message getting all flow entries.
    - Else at every call, calculates FlowLiveType and save it appropriate tables
    - Sends FlowStatsRequest message only for SHORT_FLOWs entries
3. MID_FLOWS_TASK() {
    - If at every time call and not ENTIRE_POLL_INTERVAL, sends FlowStatsRequest message only for MID_FLOWs entries }
4. LONG_FLOWS_TASK() {
    - If at every time call and not ENTIRE_POLL_INTERVAL, sends FlowStatsRequest message only for LONG_FLOWs entries }

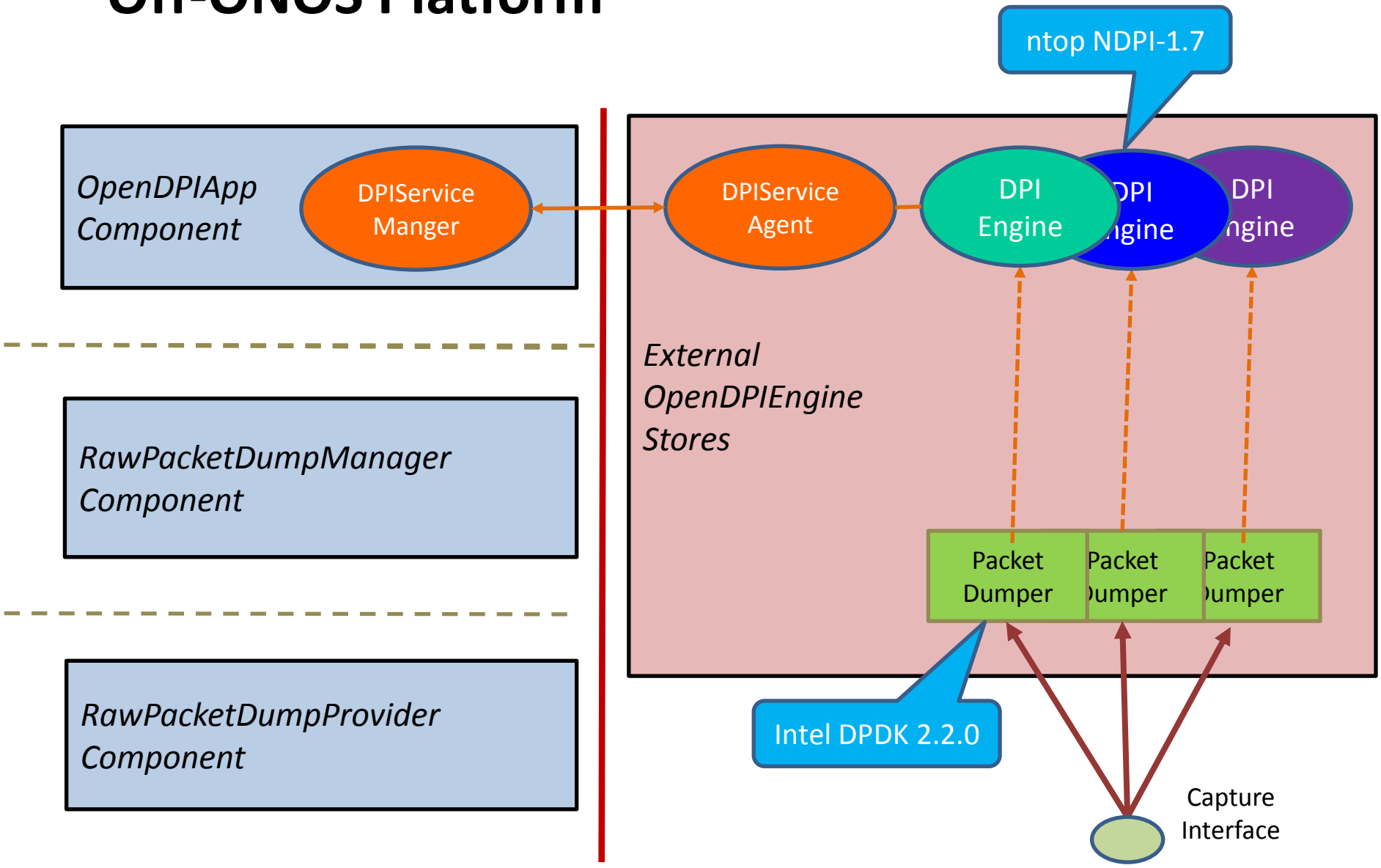
Open-TAM: Adaptive Flow Monitoring



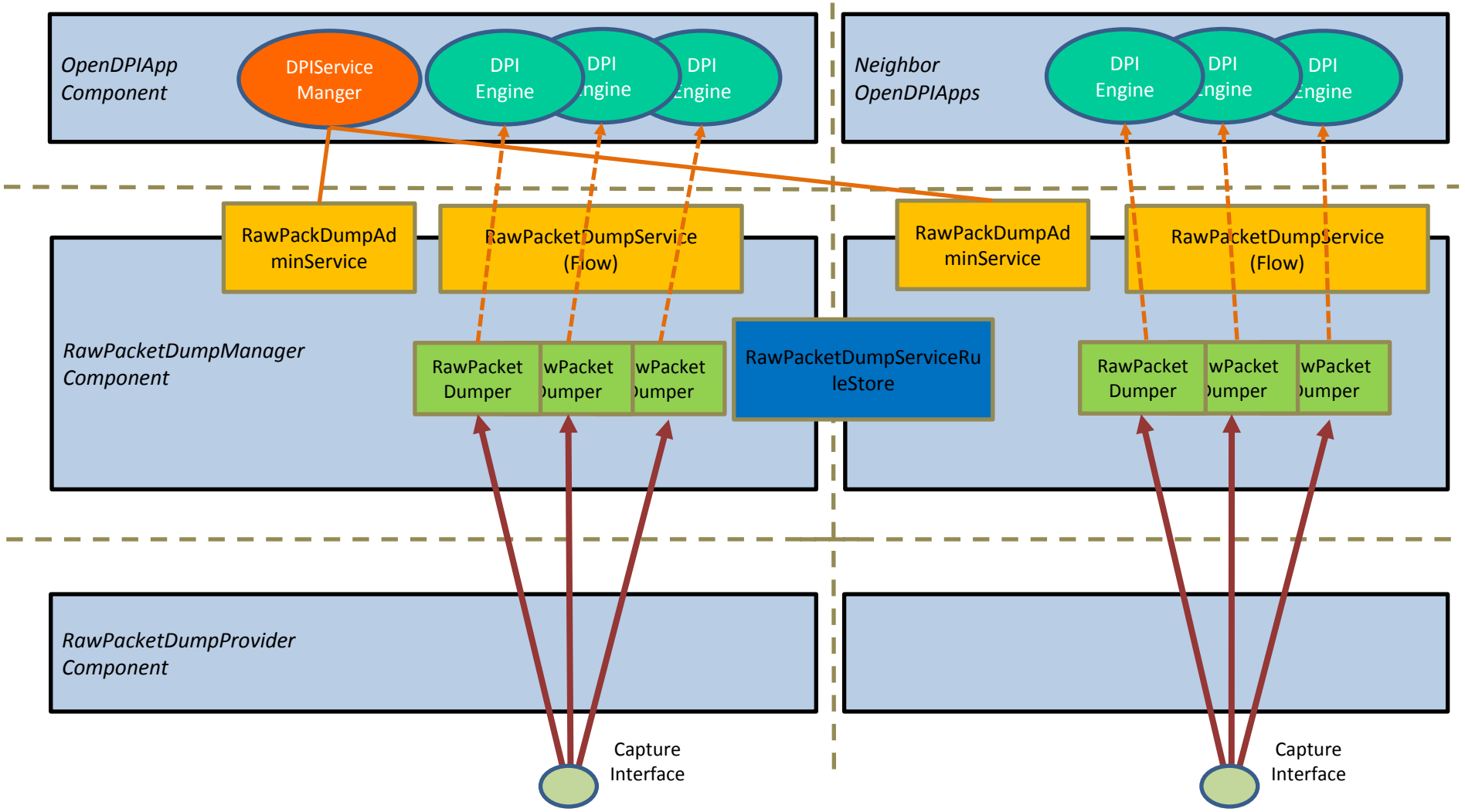
Selective-DPI Motivation

- Default ONOS Application Monitoring Issues
  - Current ONOS flow can be classified and selected by lower-level FlowSelection criteria based on FlowRule entry (eg., ports, ether_type, vlan_id, 5-tuple, etc.)
  - There is **no application classification service** for ONOS data plane user-data
  - We proposed to add a **Selective DPI service** that can filter data plane user-data from controller traffic and classify them with application level granularity by using a open source DPI s/w

Selective DPI: OpenDPIManager Architecture: Off-ONOS Platform

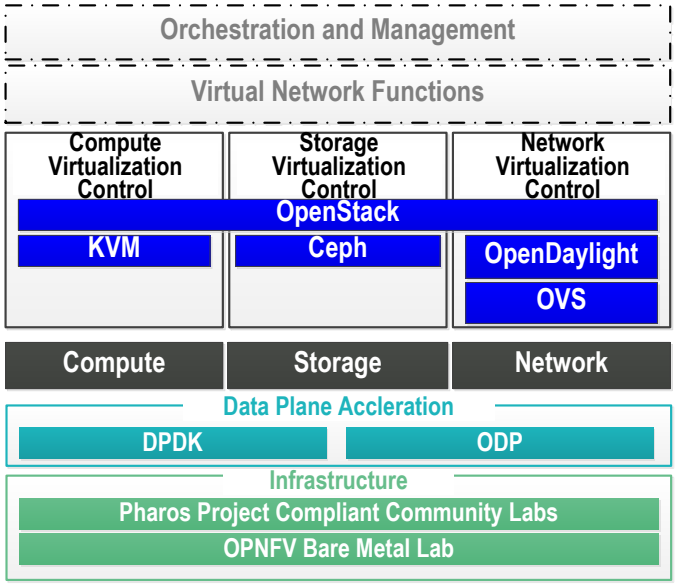


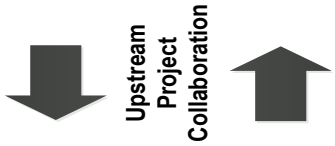
Selective DPI: OpenDPIManager Architecture: On-ONOS Platform

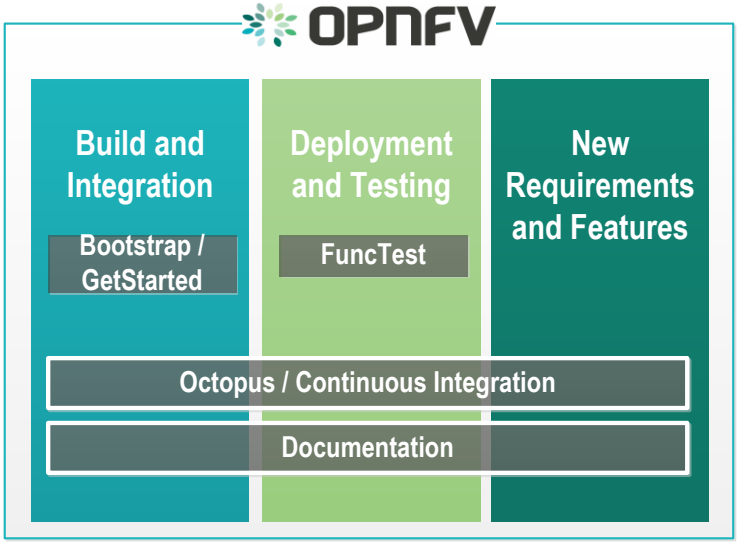


OPNFV Activity

OPNFV(Open Platform for NFV) 개요

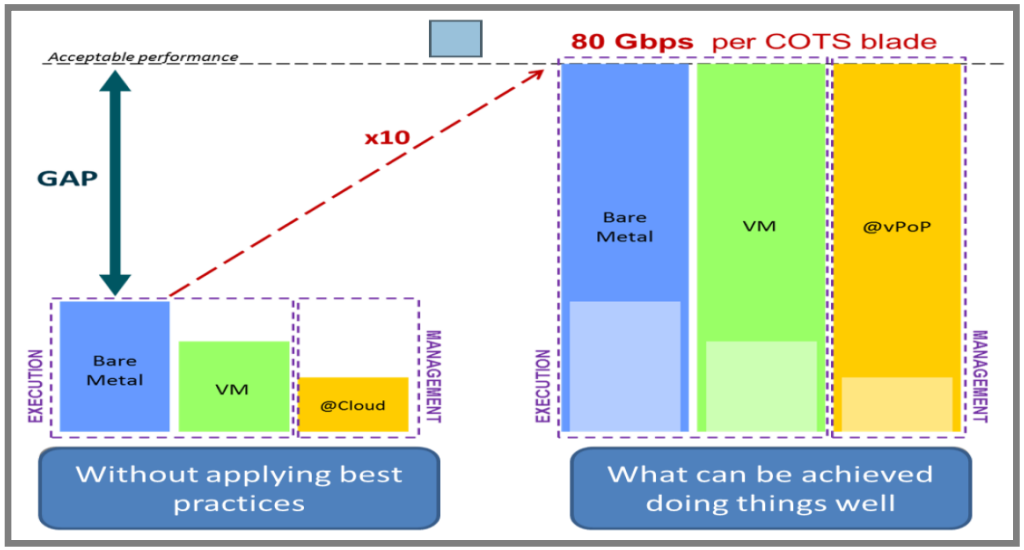




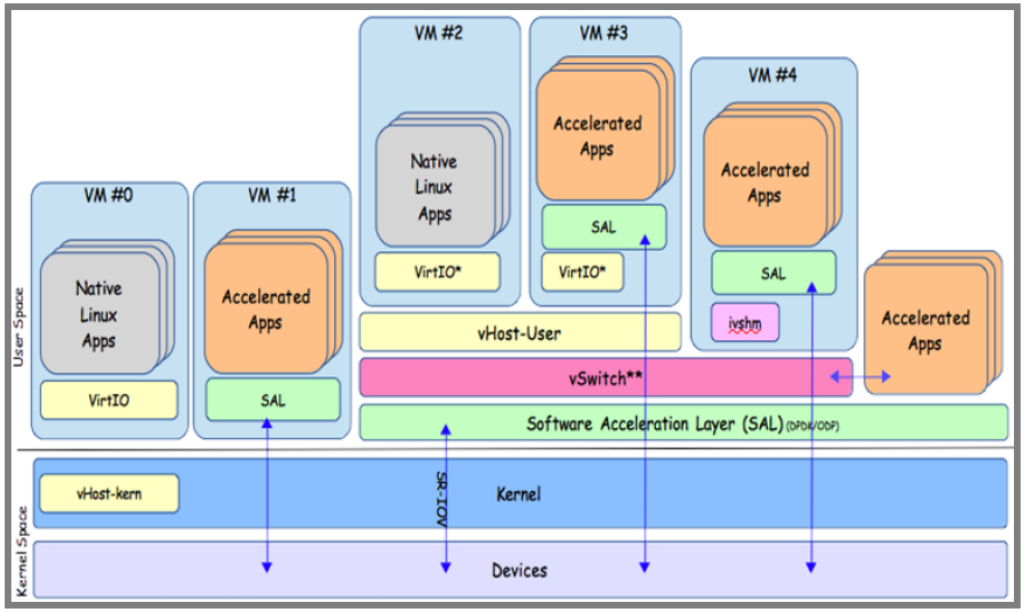


- 개요
  - 통신사업자 주도로 2014년 10월 출범
  - 상호 운용성 보장 NFV 솔루션 개발 촉진
  - NFV 솔루션 개발을 위한 오픈소스 커뮤니티 활성화
  - Arno 배포(2015/6), Bramaputra(2016/2 예정)
- OPNFV 특징
  - OPNFV는 모듈 기반의 구조를 채택 : 이종 NFV 솔루션이 상호 운용될 수 있는 오픈소스 기반의 NFV 참조 플랫폼의 확장성 보장
  - OPNFV 관련 주요 상위 프로젝트
    - ✓ 가상 인프라 관리 : OpenStack
    - ✓ 네트워크 제어 : ODL
    - ✓ 가상 스위치: Open vSwitch, Linux Bridge
    - ✓ 데이터플레인 가속 : DPDK, ODP
    - ✓ 운용체제 : Linux
- OPNFV 주요 프로젝트
  - Bootstrap/GetStarted : 상위 프로젝트와 연계하여 VNF 실행 인프라 구성
  - Pharos(Test Infrastructure) : 회원사에 분산된 시험 환경 연합 구축
  - FuncTest : OPNFV 플랫폼 시험, 검증 및 절차 제공

OPNFV DPACC 프로젝트(1/2)



Source: Network Functions Virtualisation – White Paper #3 (2014)

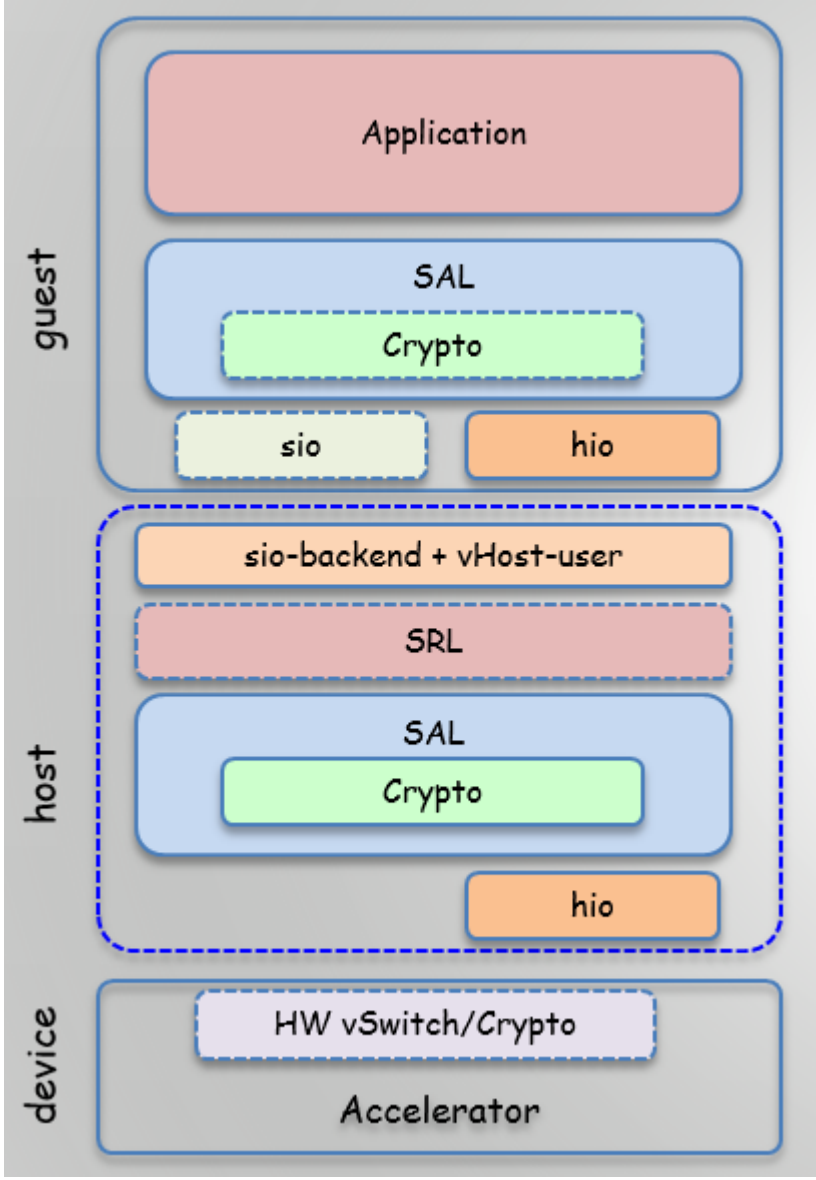


Source: China DPDK Summit 2015

- DPACC 프로젝트: NFV를 위한 DPA 기술에 요구사항 정의
- 프레임워크 정의 및 일부 usecase 시험
- 프레임워크 및 시험 도구에 대한 오픈 소스 제공
- 테스트 결과 배포, 통합 및 조정
- 인터페이스 규격화

- 11 Committers:
  China Mobile, ARM, Cavium Network, Huawei, 6wind, DELL, AT&T, Freescale, Altera, Intel, ZTE
- 22 Contributors: ARM, BT, Xilinx, Ezchip, ZTE, Intel, 6wind, NSN, Huawei, Altera, Astri, Juniper, Freescale, ETRI
- DPACC Upstream 프로젝트: OpenDataPlane, DPDK, OpenCL, LibVirt , VirtIO, OpenStack

OPNFV DPACC 프로젝트(2/2)

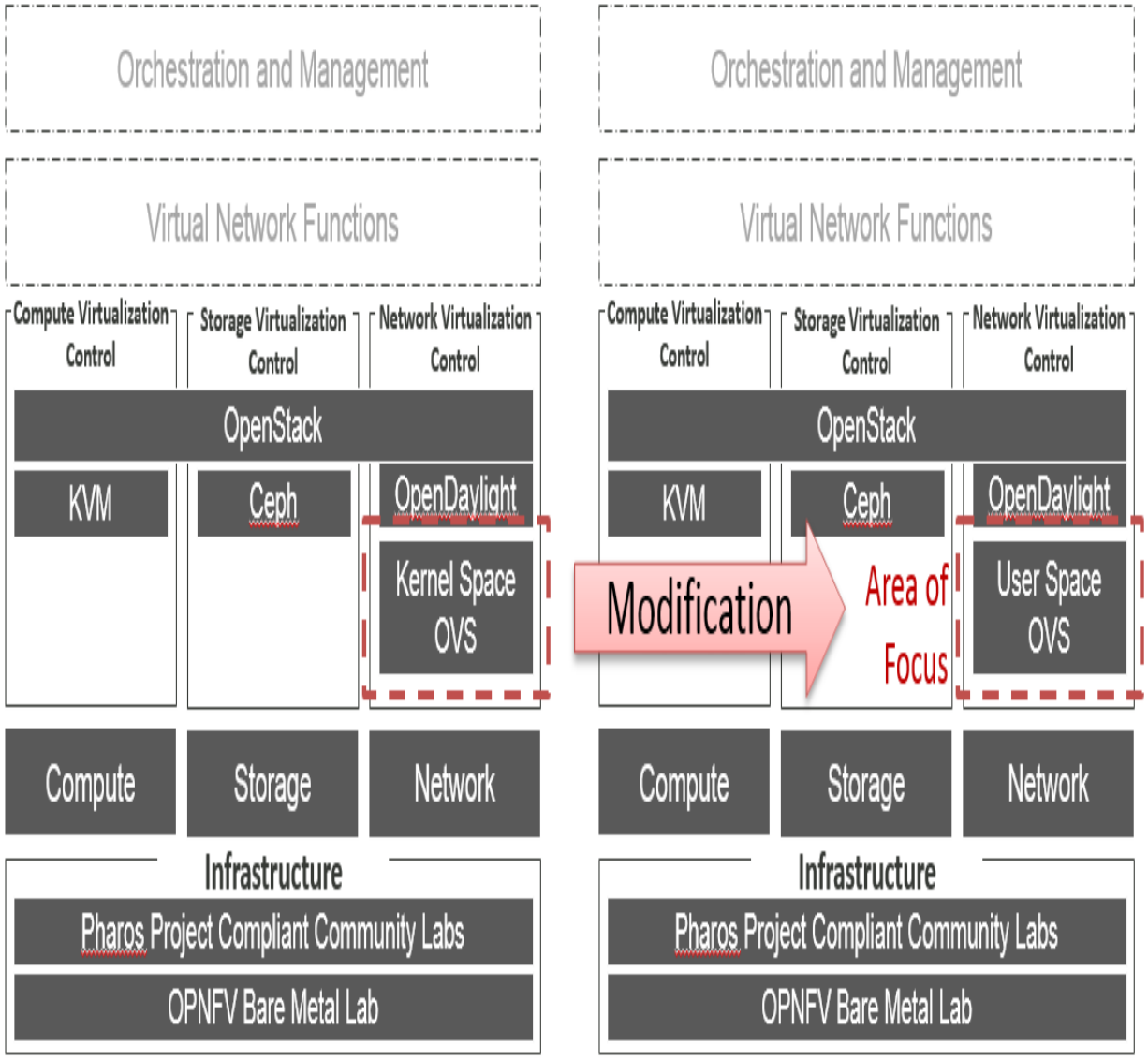


DPACC Architecture: NFV High Level View

- Current Working Items
  - DPACC architecture
  - DPACC usecases
  - DPACC requirements
  - Gap Analysis of OpenStack for DPACC
  - API Guidelines
- Asia and Europe Weekly Meetings
  - When: Every Friday 9:30-10:30 UTC (12:30PM Seoul, Friday)
  - IRC channel: freenode.net (http://webchat.freenode.net/?channels=opnfv-dpacc)
  - https://global.gotomeeting.com/join/623117821
- Asia and America Weekly Meetings
  - When: Every Friday 3:00-4:00 UTC (6:30PM Seoul, Friday)
  - IRC channel: freenode.net (http://webchat.freenode.net/?channels=opnfv-dpacc)
  - https://global.gotomeeting.com/join/230251565

Source: OPNFV DPACC Architecture Documentation

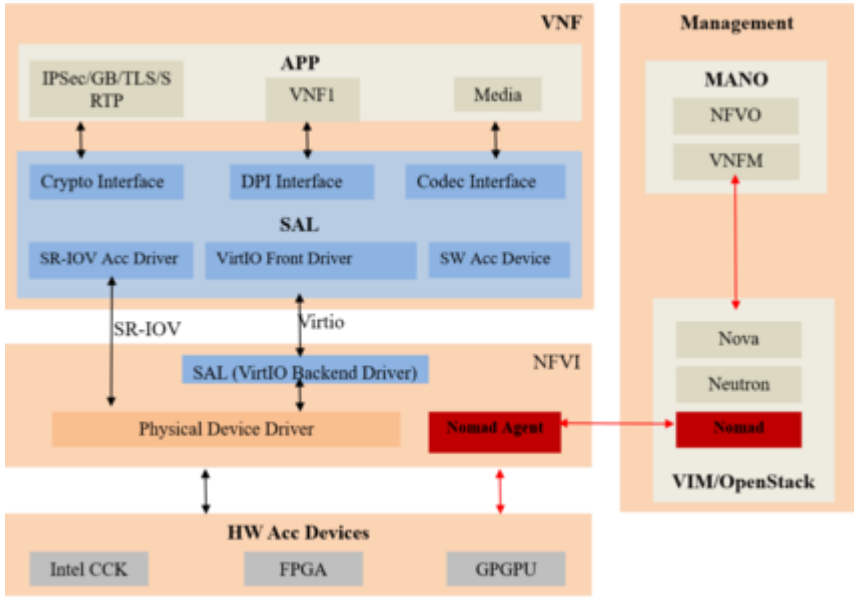
OPNFV OVSNFV 프로젝트

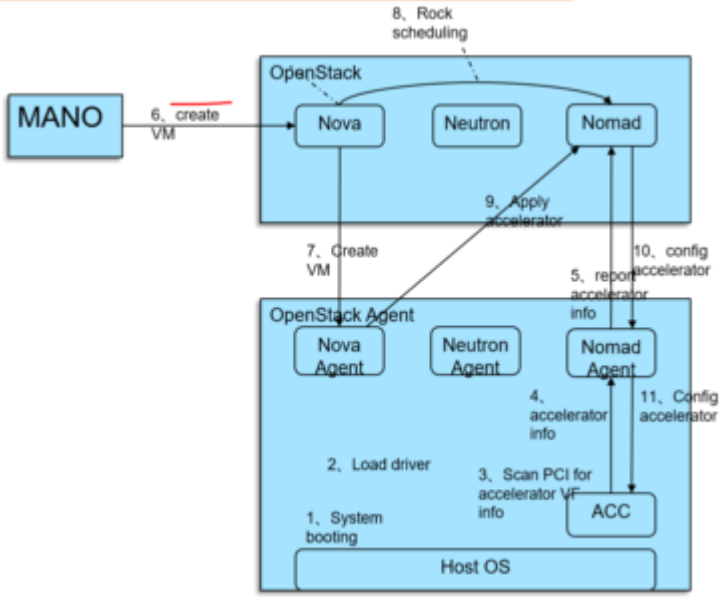


Source Open vSwitch for NFV - Original Project Proposal (https://wiki.opnfv.org/open_vswitch_for_nfv)

- OVSNFV 프로젝트: 사용자 공간의 DPDK 기반 OVS를 OPNFV에서 설치할 수 있도록 선택옵션을 제공하는 프로젝트
  - OPNFV Bramaputra에 포함 예정
  - 6 Committers: Intel, Redhat, Huawei, Ericsson
  - 7 Contributors: Intel, Nokia, ETRI, KDDILabs
- Weekly conference call on Monday at 13:00 (Dublin/London) (10PM, Seoul, Monday)
  - https://global.gotomeeting.com/join/810210245
  - Minutes (Meetbot): http://ircbot.wl.linuxfoundation.org/meetings/opnfv-ovsnfv/

OpenStack Nomad 프로젝트



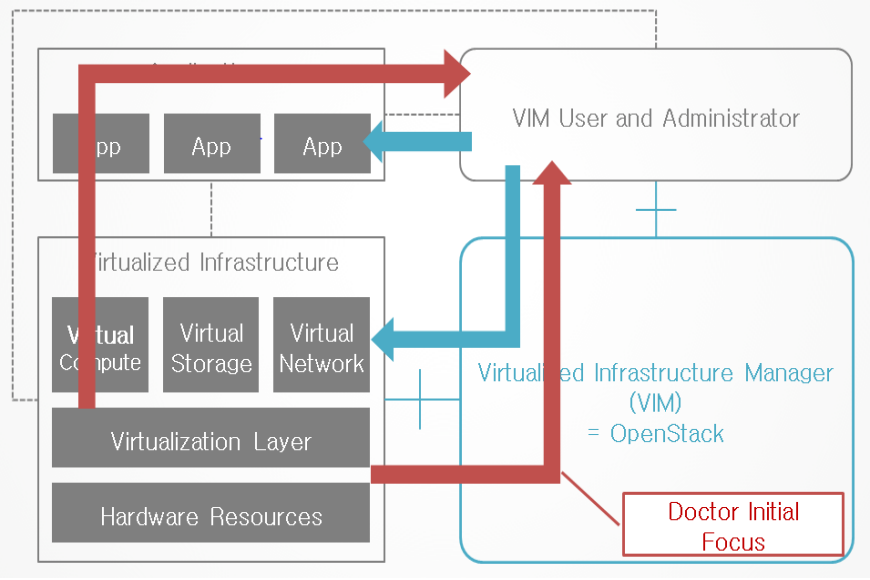


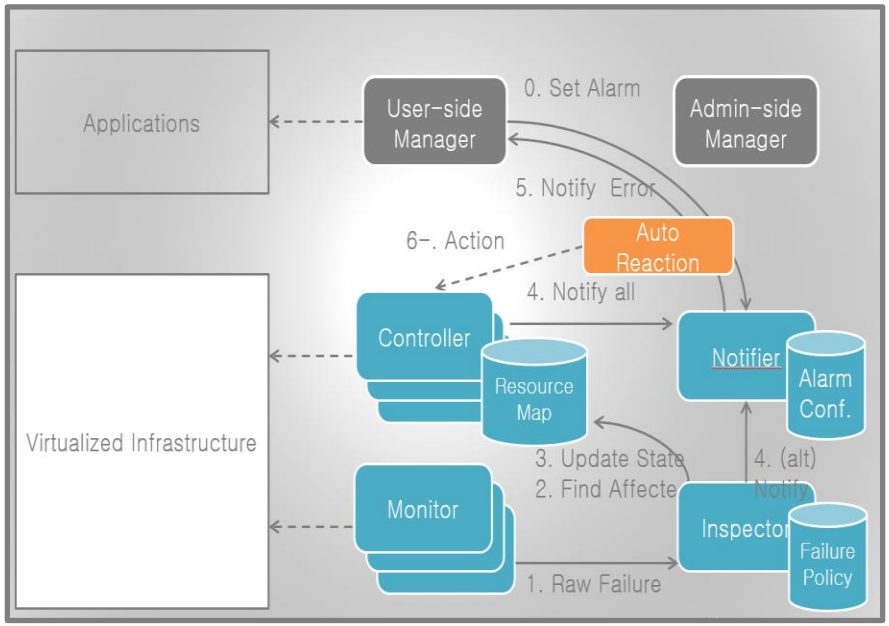
OpenStack Nomad Project Design

- OpenStack Nomad Overview
  - Nomad is an OpenStack project that aims to provide a general purpose management framework for distributed acceleration resources (i.e. various types of accelerators such as IP-SEC , NVMe, NVMe Over Fabric, DPDK and so on)
- Members of "OpenStack Nomad Team"
  - Lingli Deng
  - Michele Paolino
  - Nikolay Nikolaev
  - Paul Kangil Choi(ETRI)
  - Vincent JARDIN
  - yuanpeng
  - Zhipeng
  - China Mobile, Huawei, Virtual Open Systems, 6wind, ETRI
- OpenStack Summit 2016 Presentation
  - Make Workloads Nomadic When Accelerated - Introduction of the Nomad Project

Source: OpenStack Nomad Project Documentation

OPNFV PINPOINT/DOCTOR 프로젝트





- OPNFV DOCTOR 프로젝트
  - OPNFV 요구사항 정의 프로젝트
  - 장애 관리와 유지 보수를 제공하기 위한 프로젝트
  - NFVI 와 VIM 계층에서 동작하는 네트워크 서비스의 고 가용성 보장을 위한 프레임워크 요구 사항 정의
  - VIM 으로 부터 가상화된 자원에 대한 비가용 정보를 신속히 수신하고 이를 복구하여 서비스의 연속성을 확보
- 19 Contributors: NEC, CISCO, NOKIA, Huawei, Intel, ZEC, Spirent, NTT DOCOMO, AT&T, ZTE, KDDI, ETRI 등
- 진행 상태
  - 초기 요구 사항 정의, 아키텍춰 설계는 완료됨
  - Blueprints 를 기반으로 개발 중
  - ETSI NFV 와 표준화 협력 중
  - 매주 화요일 화상 회의 진행 중

Source: PINPOINT(https://wiki.opnfv.org/projects/pinpoint)

Thank You
for Your Attention

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