IoT를 위한 SDN과 NFV 기술

(Open Standard + Open Source = Open Innovation)

신명기, ETRI

mkshin@etri.re.kr

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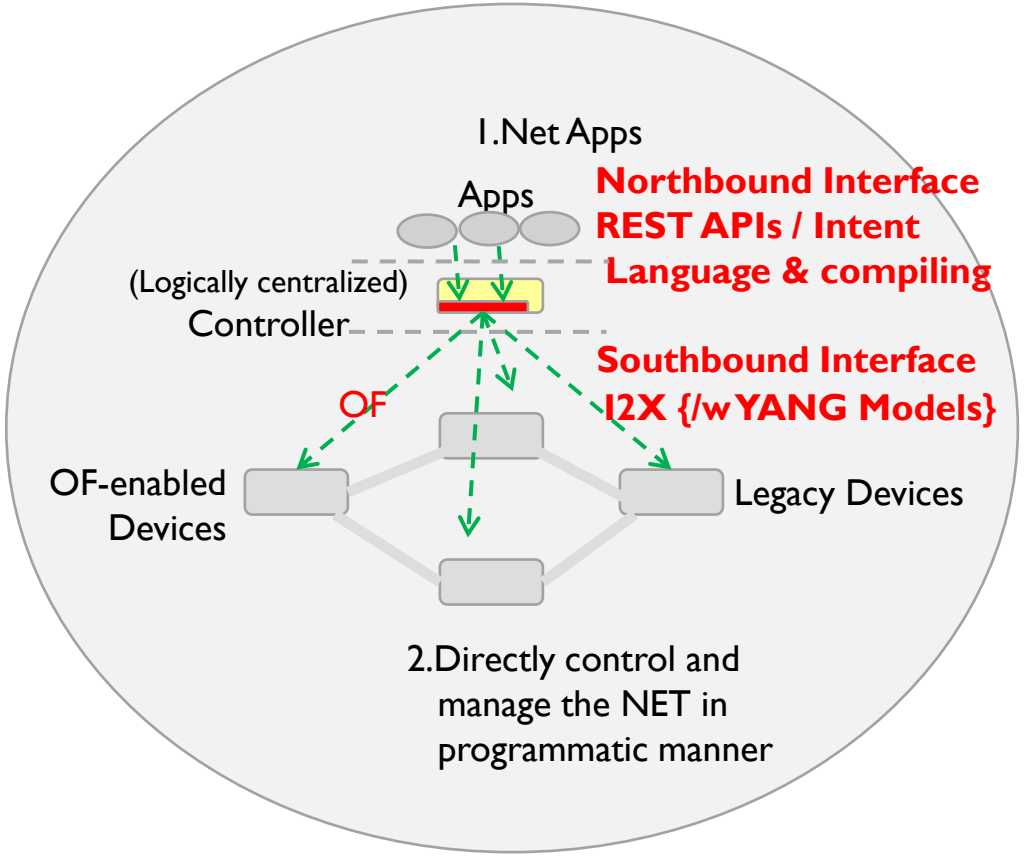
KRnet2015

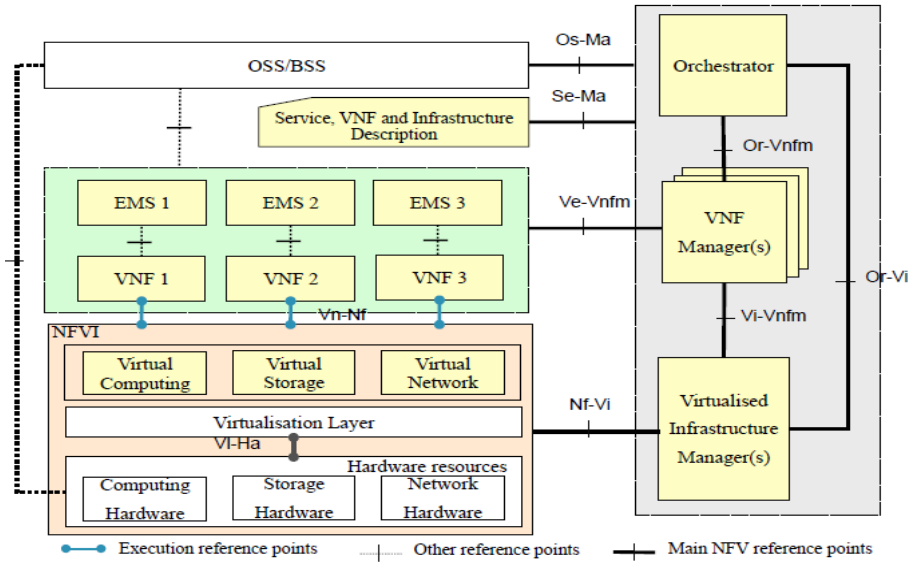
SDN - Open Standards

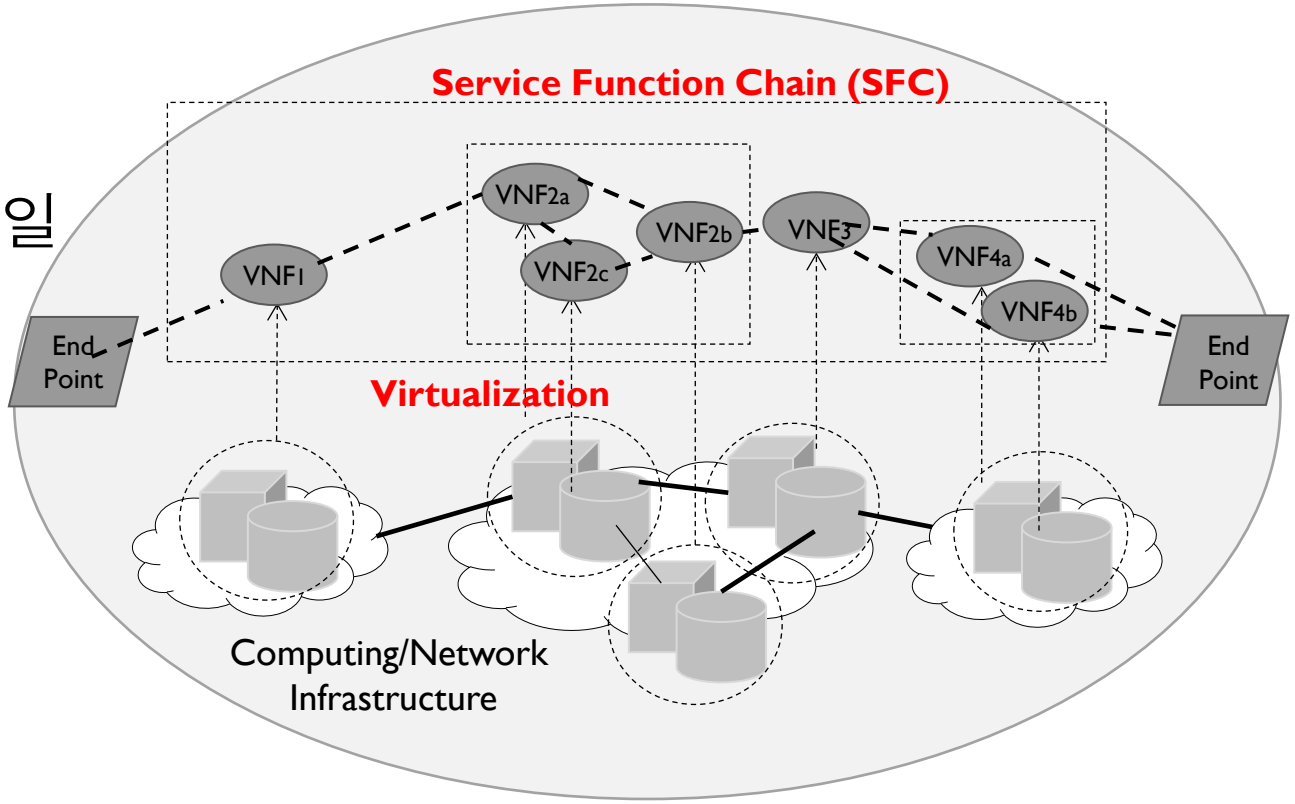
- Software-Defined Networking
- To decouple control planes from data plane through OPEN Network APIs
  - ➢ Directly control and manage the NET/INF in programmatic manner (넓은범위의 정의)
- TWO approaches **(Abstraction)**
  - New architecture – OpenFlow1.3.4/1.4 (Flow Tables' operations)
  - Existing architecture – Open APIs/Interface to the "X" (예, 라우터, 방화벽, 미들박스 /SFC, Optical devices, IoT devices, etc.)
    - IETF I2RS, SFC WG, I2NSF BoF (YANG data model-based)
    - Protocols – I2RS, NetConf, PCEP, XMPP …



NFV - Open Standards

- Network Functions Virtualization
- To relocate network functions from dedicated HW appliances to generic servers (e.g., 미들박스/방화벽, 모바일 GW, IoT GW등)
- ETSI NFV ISG – Phase-2



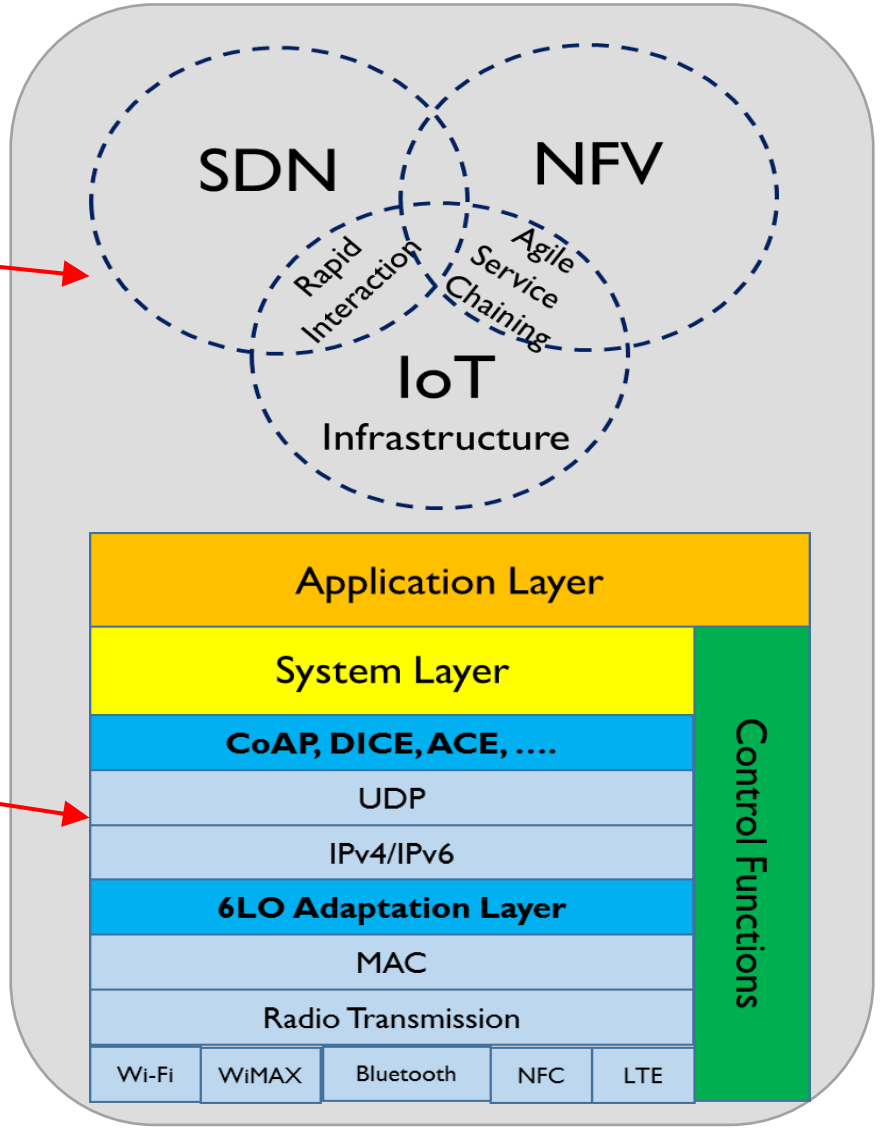


Why SDN+NFV in IoT ?

- To need rapid interaction between services and infrastructure
  - ➢ E.g., More agile communication (e.g., scale-in/out)
- Problems with end-to-end IP networking to resource-constrained IoT devices (e.g., RIOT, oneM2M, OIC, AllJoyn, etc.)
  - ➢ Control/manage a large number of devices with variety of IoT protocols

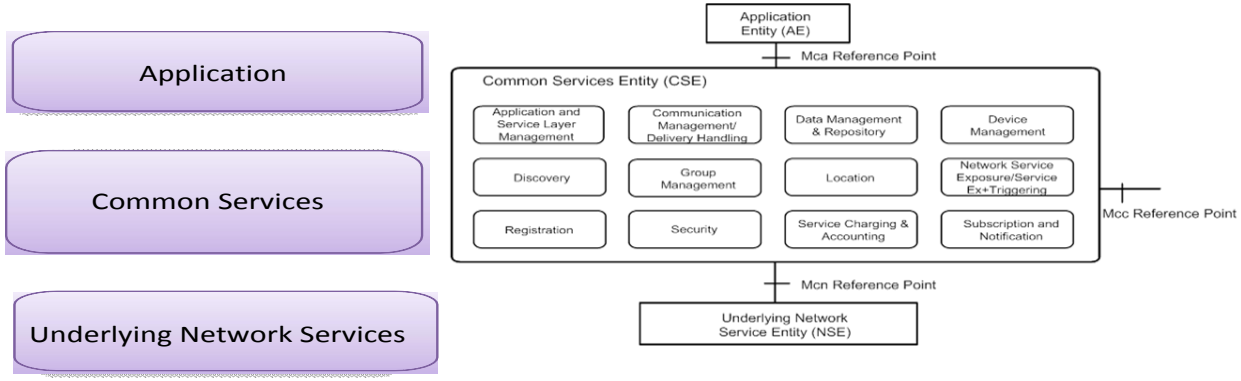
※ Capability mismatch between IoT devices

- ➢ MTU differences, simplified vs. full protocol stack (e.g., CoAP/UDP vs. HTTP/TCP), single stack vs. dual stack, processing and communications bandwidth, sleep schedule, security protocols, etc.
- ➢ Data/resource modeling and abstraction

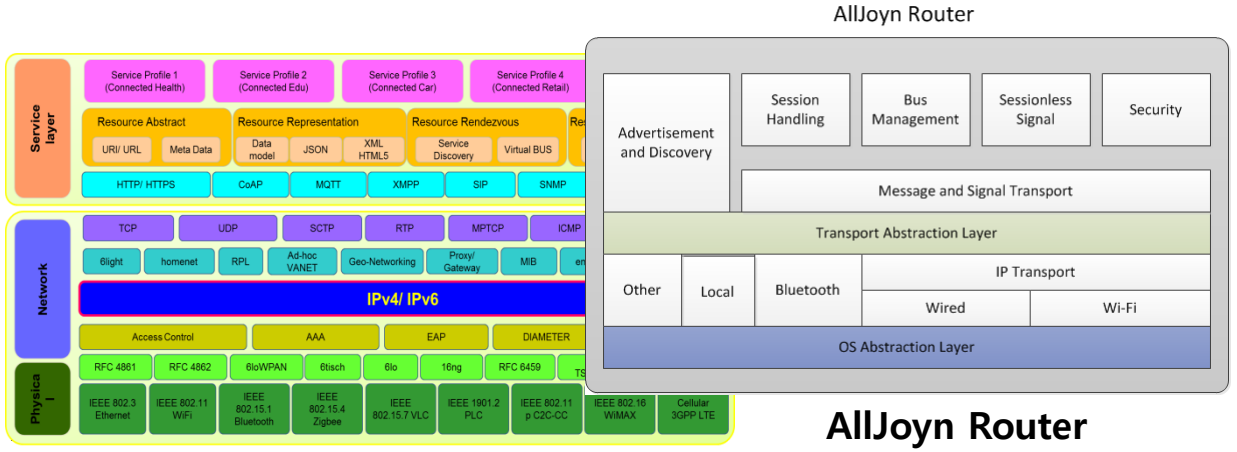


Internet of Things (IoT)

Source – 미래부, 사물인터넷 R&D 추진계획, 2014



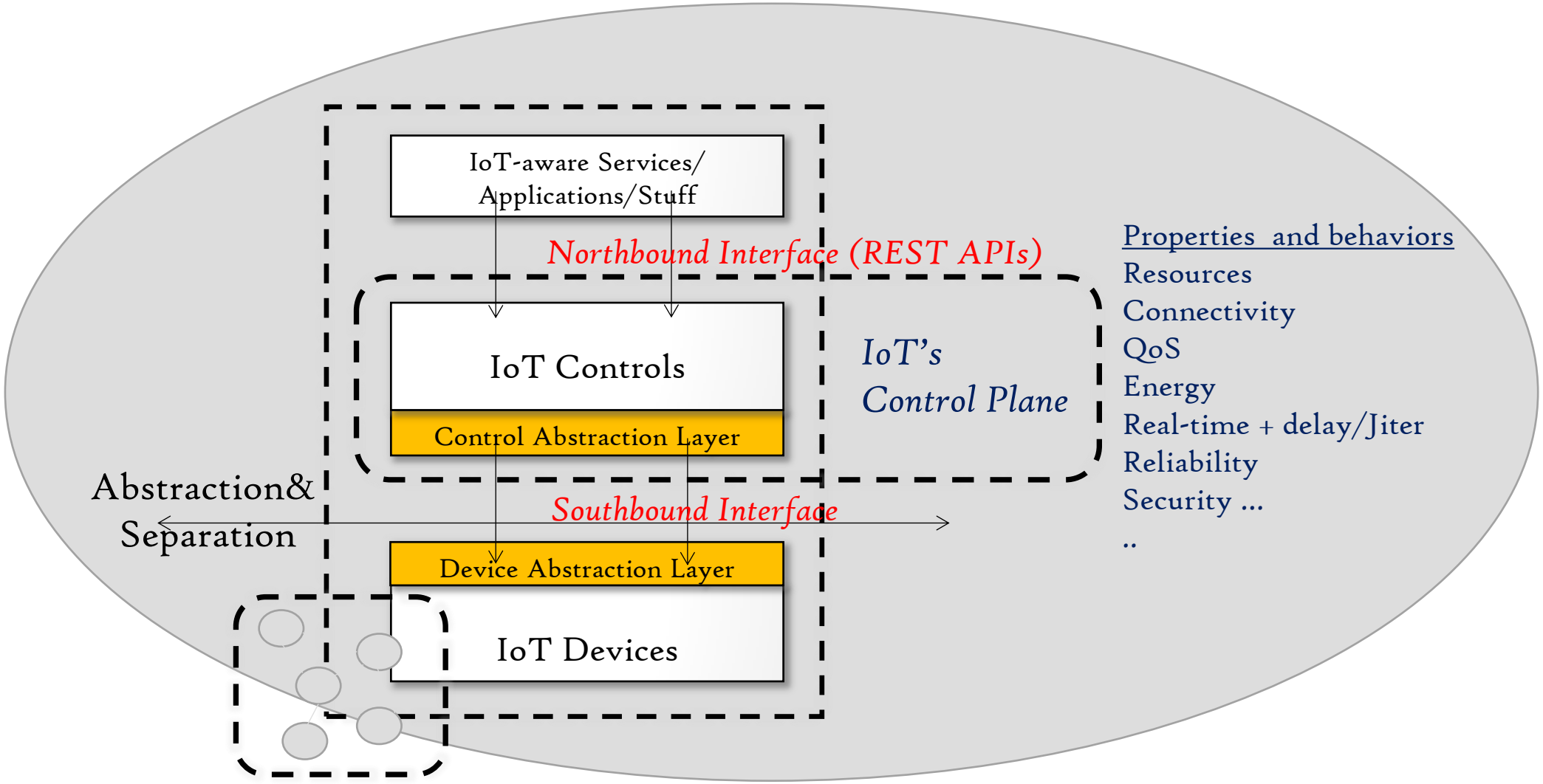
OneM2M Layered Model & Common Services Functions



OIC Protocol Stack

AllJoyn Router Protocol Stack

IoT Abstraction by SDN



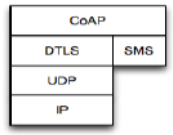
IoT GW Functions -> VNF

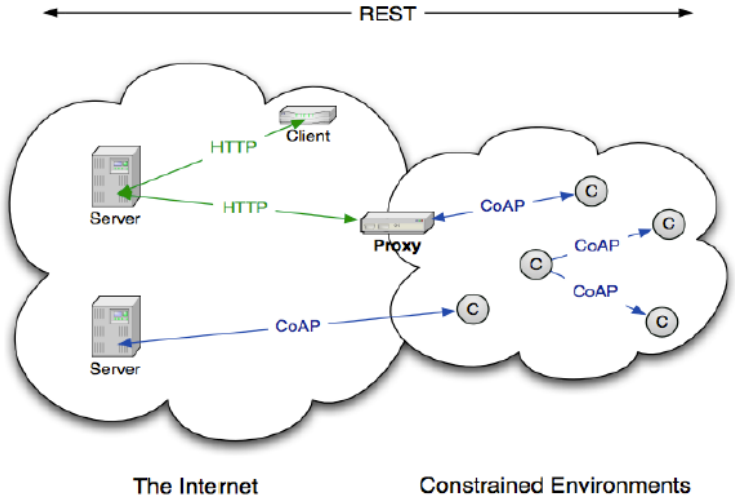
- To relocate various IoT GW functions from HW appliances to VMs and make them connected or chained together

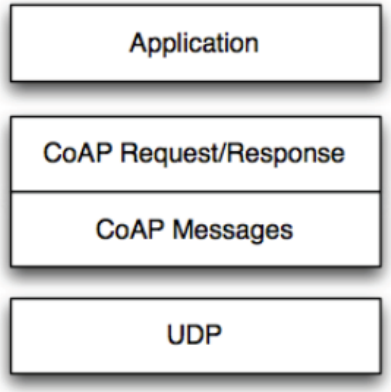
- IoT DPI functions
- L4~L7
  - CoAP (Proxy)- HTTP protocols mapping <draft-ietf-core-http-mapping>
  - DICE-TLS protocols mapping, Security services …
  - IoT device resource/data 변환 및 interworking (예, oneM2M <-> OIC, AllJoyn 등)
- L2~L3
  - IP mapping function for non-IP devices
  - 6LO functions (IPv6 Packets over WPAN, BLE, Low Power Wi-Fi, NFC, etc.)
    - RFC4944, RFC6282, RFC6775, and
    - Many other WG I-Ds (work-in-progresses)
    - IPv6 over NFC (ETRI)

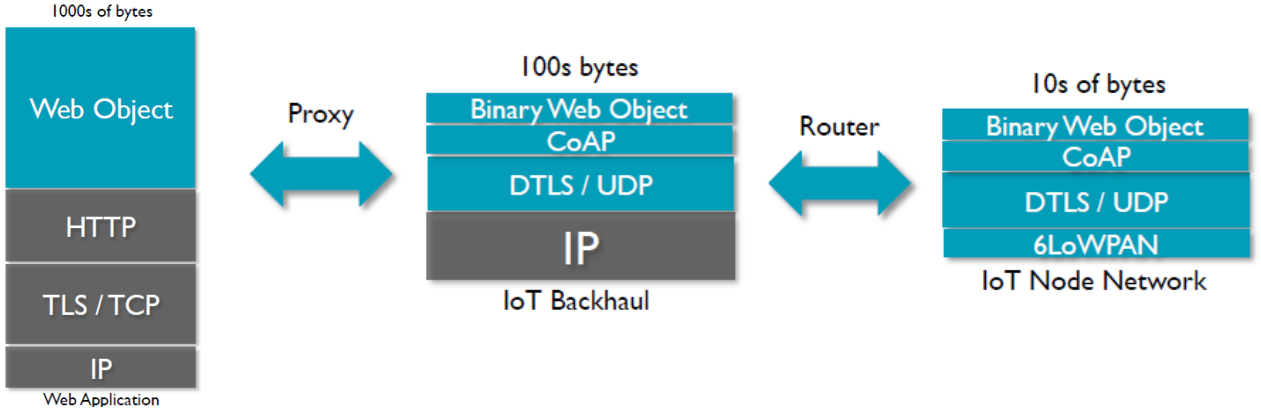
CoAP vs. HTTP <draft-ietf-core-http-mapping>

- Open IETF Standard
- Compact 4-byte Header
- UDP, SMS, (TCP) Support
- Strong DTLS Security
- Asynchronous Subscription
- Built-in Discovery

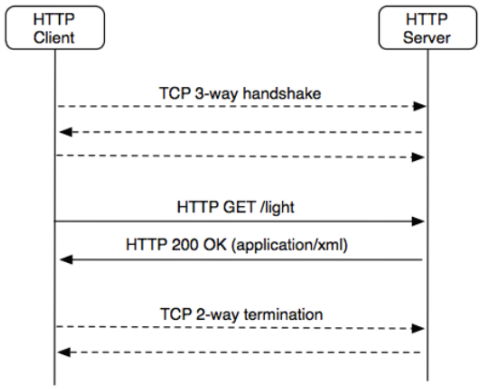




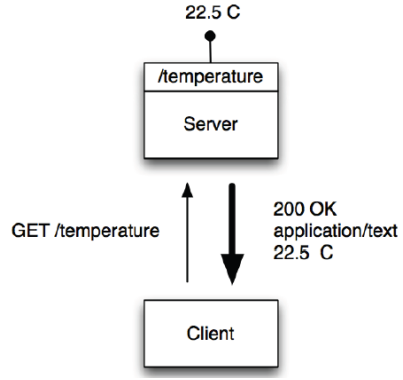




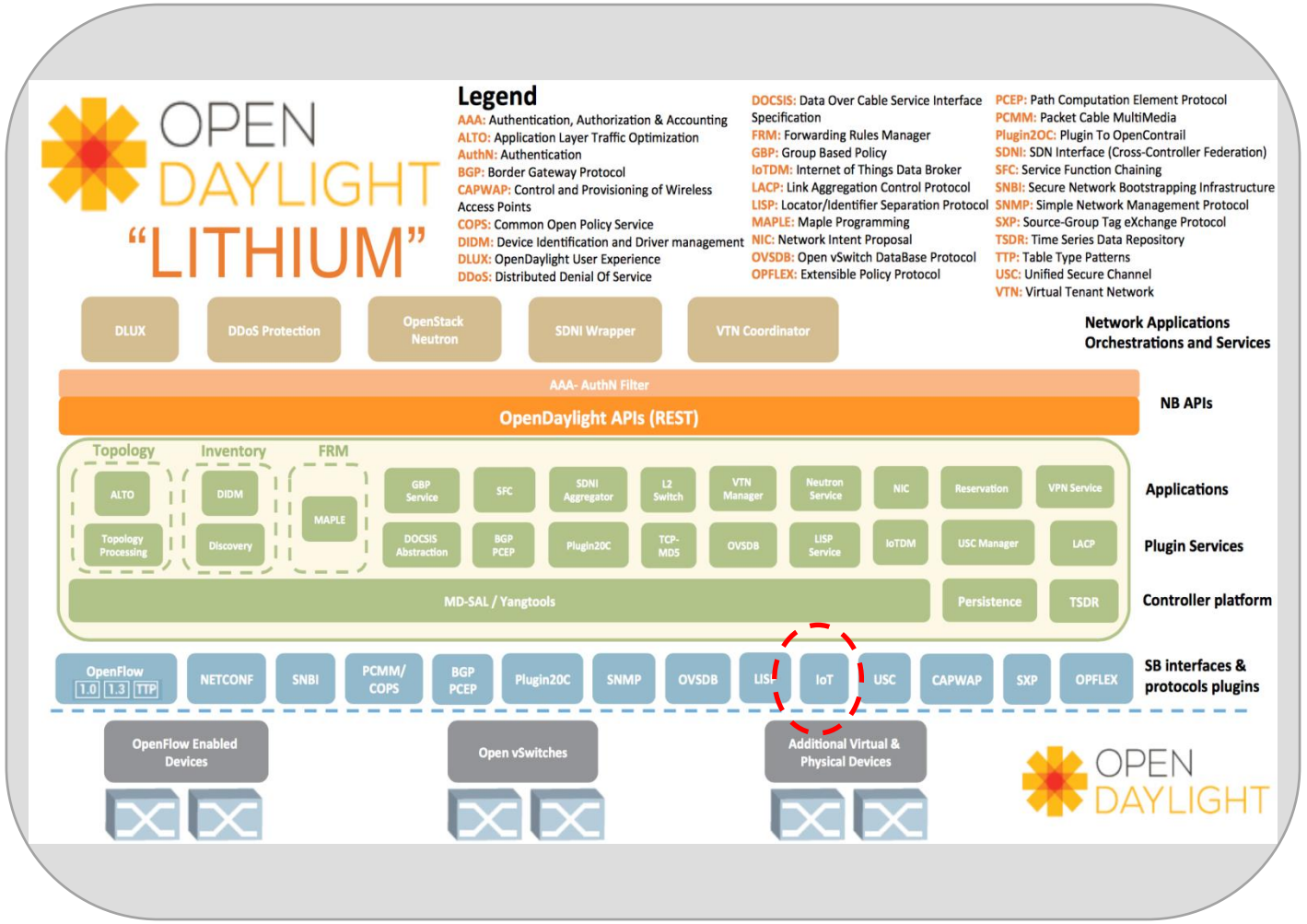
An HTTP Request



A REST Request



SDN - Open Sources (ODL)

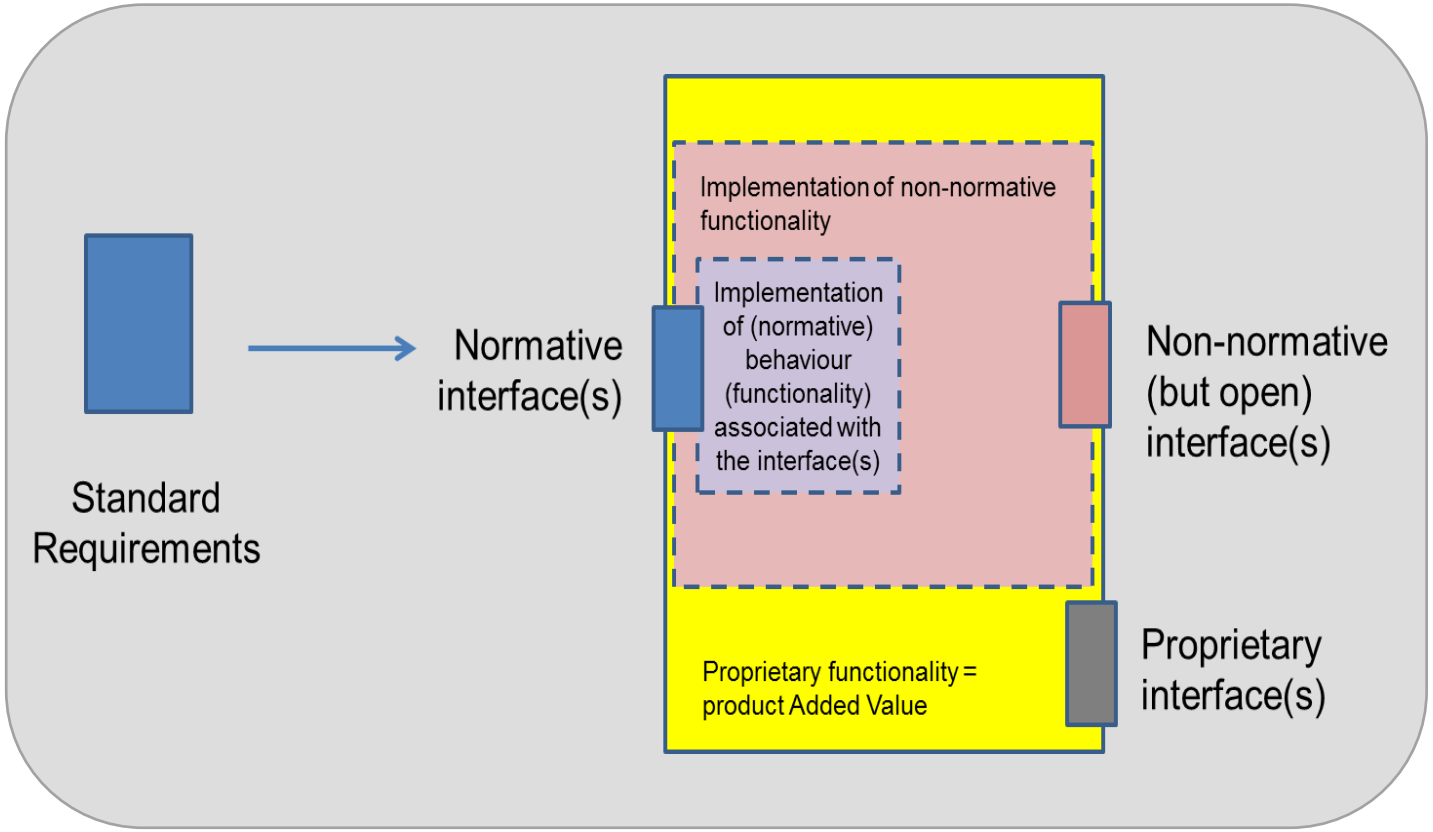


- Network Apps & Orchestration
- Controller Platform
  - Bidirectional REST for the NB API
  - A collection of dynamically pluggable modules to perform needed network tasks.
  - The SB interface is capable of supporting multiple protocols (as separate plugins).These modules are dynamically linked into a Service Abstraction Layer (SAL)
- NFV와의 연동

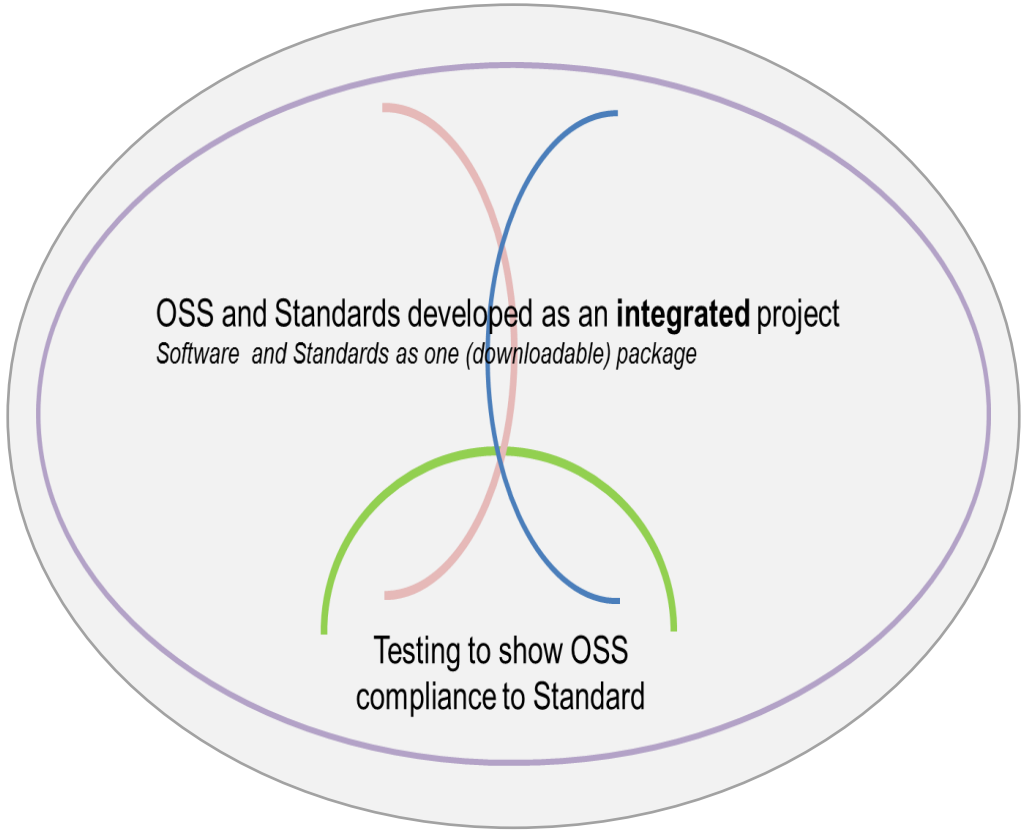
http://www.opendaylight.org/

SDN/NFV -Standard vs. OSS

SDOs and OSSs : Better Together



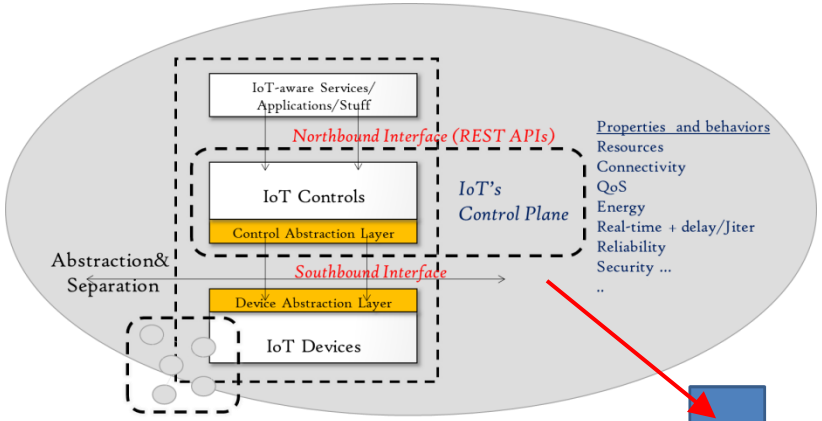
Standards to OSS

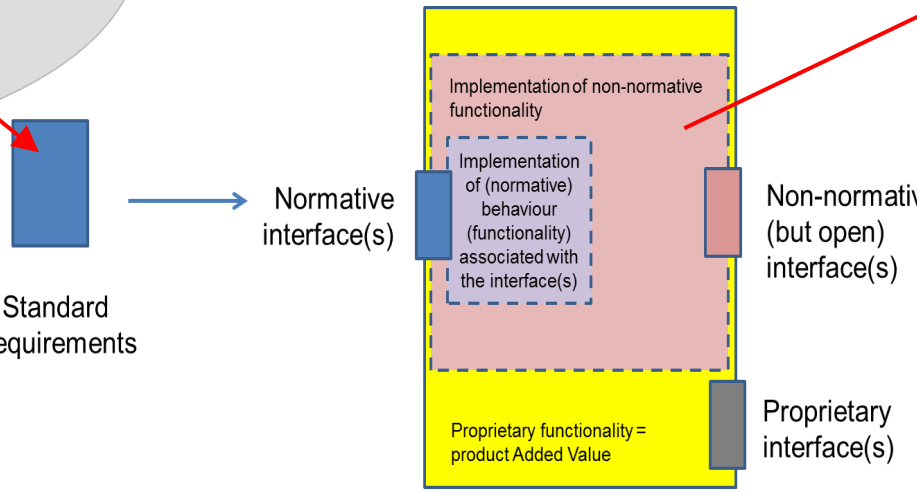


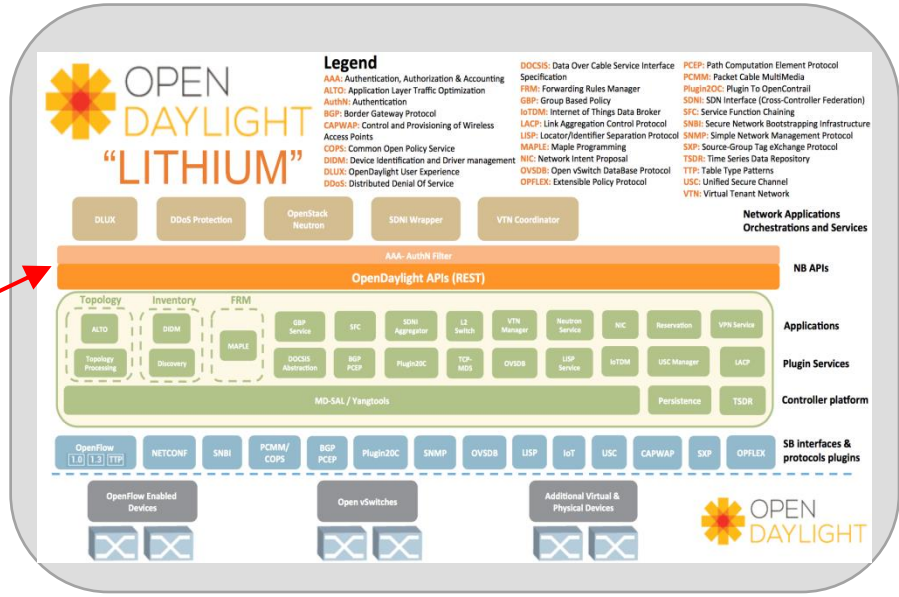
Tightly-coupled Standards+OSS

Source : ETSI NFV ISG SPECIAL SESSION on Open Source and standardization, 2014

IoT w/ SDN by Standard+OSS



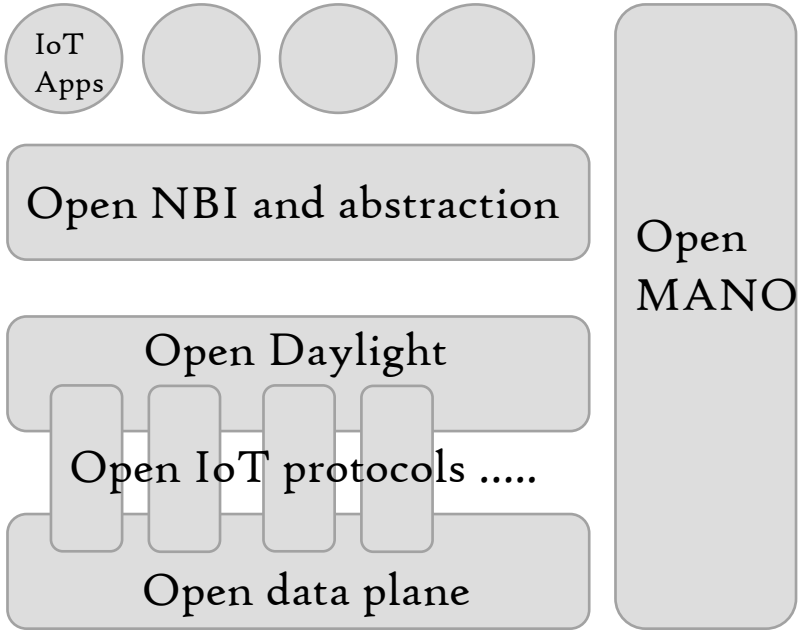




최소한의 표준(인터페이스+API의 제공)과 오픈소스 결합을 통한 시장친화적 SW의 빠른 개발 및 적용

Complete Set of Open SDN/NFV

- Open data plane – whitebox, baremetal machine, OCP ..
- Open controllers – ODL, ONOS ..
- Open protocols – ONF, IETF ...
- Open NBI and abstraction – REST APIs, Yang, Intent/policy
- Open management plane and operations – MANO (OPNFV, OpenStack) and OSS



Why ODL Chosen ?

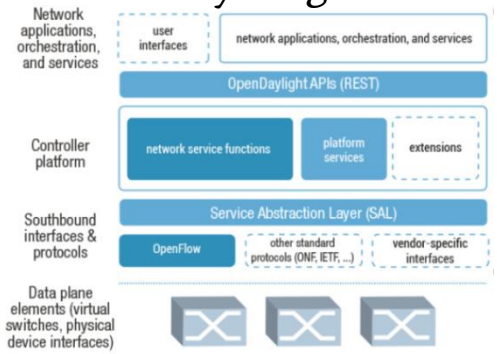
VS.

- Multi-protocol Support
- Model-Driven(MD) SAL

- Scale-out, HA, Performance
- Distributed Core

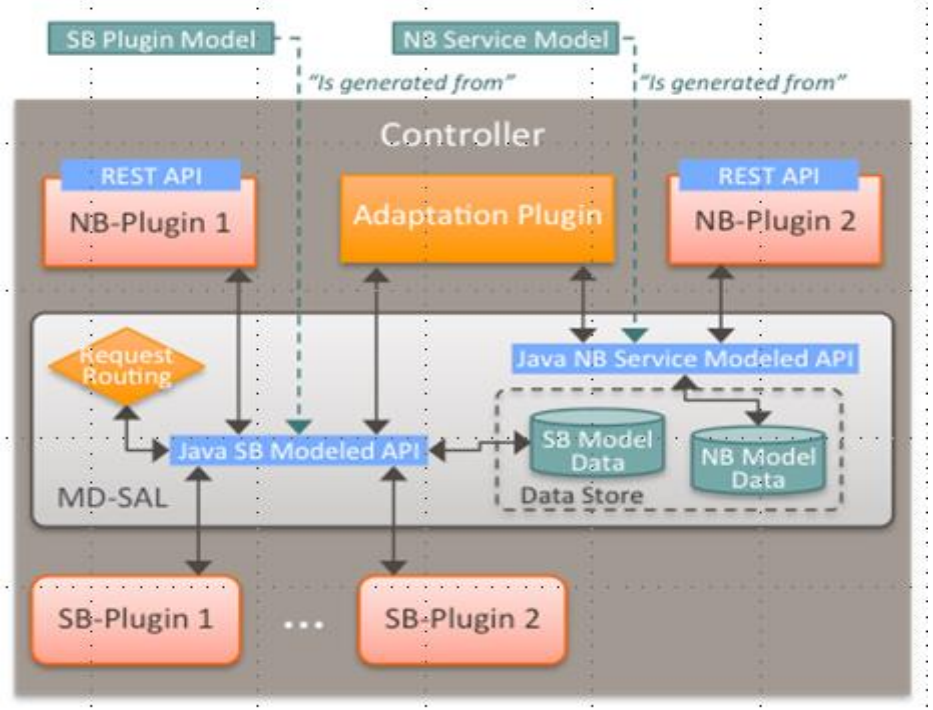
ODL Lithium, Revisit

Hydrogen



ODL SB Interfaces (for IoT)

- GBP(group-based policy) Renderers
- PCMM(Packet Cable MultiMedia)/COPS(Common Open Policy Service)
- SNBI(Secure Network Bootstrapping Infrastructure)
- plugin2OC(OpenContrail)
- LISP(Locator ID Separation Protocol)
- BGP(Border Gateway Protocol)
- PCEP(Path Computation Element Communication)
- SNMP(Simple Network Management Protocol)
- OpenFlow
- Netconf(Network Configuration Protocol)
- OVSDB
- IoTDM (IoT Data Management Broker) ➔ CoAP, MQTT, HTTP, etc.



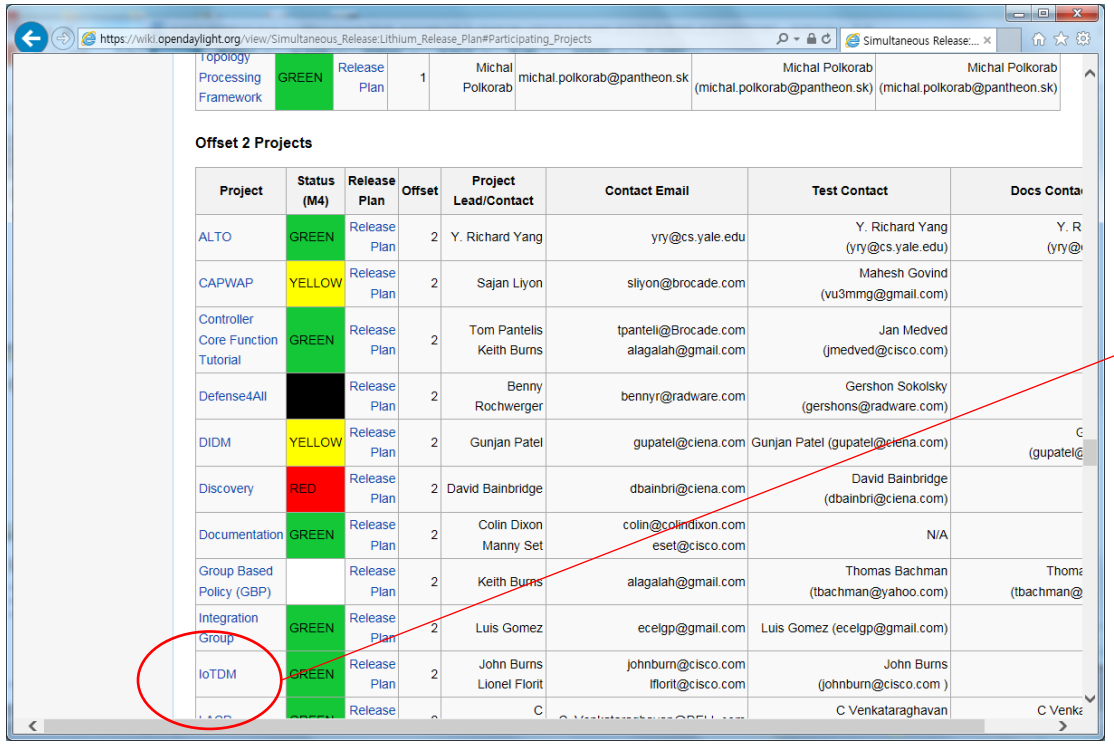
MD-SAL Model
(Model-driven Service Abstraction Layer)

ODL Members and Release

- Hydrogen - initial release
- Helium - current stable release
- Lithium - the next release (6/25/2015 → SR1 8/13 → SR2 9/24)

- https://wiki.opendaylight.org/view/Simultaneous_Release:Lithium_Release_Plan

ODL Lithium Project List



Topology Processing Framework | GREEN | Release Plan | 1 | Michal Polkorab | michal.polkorab@pantheon.sk | Michal Polkorab (michal.polkorab@pantheon.sk) | Michal Polkorab (michal.polkorab@pantheon.sk)

Offset 2 Projects

Project	Status (M4)	Release Plan	Offset	Project Lead/Contact	Contact Email	Test Contact	Docs Conta
ALTO	GREEN	Release Plan	2	Y. Richard Yang	yry@cs.yale.edu	Y. Richard Yang (yry@cs.yale.edu)	Y. R (yry@
CAPWAP	YELLOW	Release Plan	2	Sajan Liyon	sliyon@brocade.com	Mahesh Govind (vu3mmg@gmail.com)	
Controller Core Function Tutorial	GREEN	Release Plan	2	Tom Pantelis Keith Burns	tpanteli@Brocade.com alagalah@gmail.com	Jan Medved (jmedved@cisco.com)	
Defense4All		Release Plan	2	Benny Rochwerger	bennyr@radware.com	Gershon Sokolsky (gershons@radware.com)	
DIDM	YELLOW	Release Plan	2	Gunjan Patel	gupatel@ciena.com	Gunjan Patel (gupatel@ciena.com)	G (gupatel@
Discovery	RED	Release Plan	2	David Bainbridge	dbainbri@ciena.com	David Bainbridge (dbainbri@ciena.com)	
Documentation	GREEN	Release Plan	2	Colin Dixon Manny Set	colin@colindixon.com eset@cisco.com	N/A	
Group Based Policy (GBP)		Release Plan	2	Keith Burns	alagalah@gmail.com	Thomas Bachman (tbachman@yahoo.com)	Thoma (tbachman@
Integration Group	GREEN	Release Plan	2	Luis Gomez	ecelgp@gmail.com	Luis Gomez (ecelgp@gmail.com)	
IoTDM	GREEN	Release Plan	2	John Burns Lionel Florit	johnburn@cisco.com lflorit@cisco.com	John Burns (johnburn@cisco.com)	
		Release		C		C Venkataraghavan	C Venka

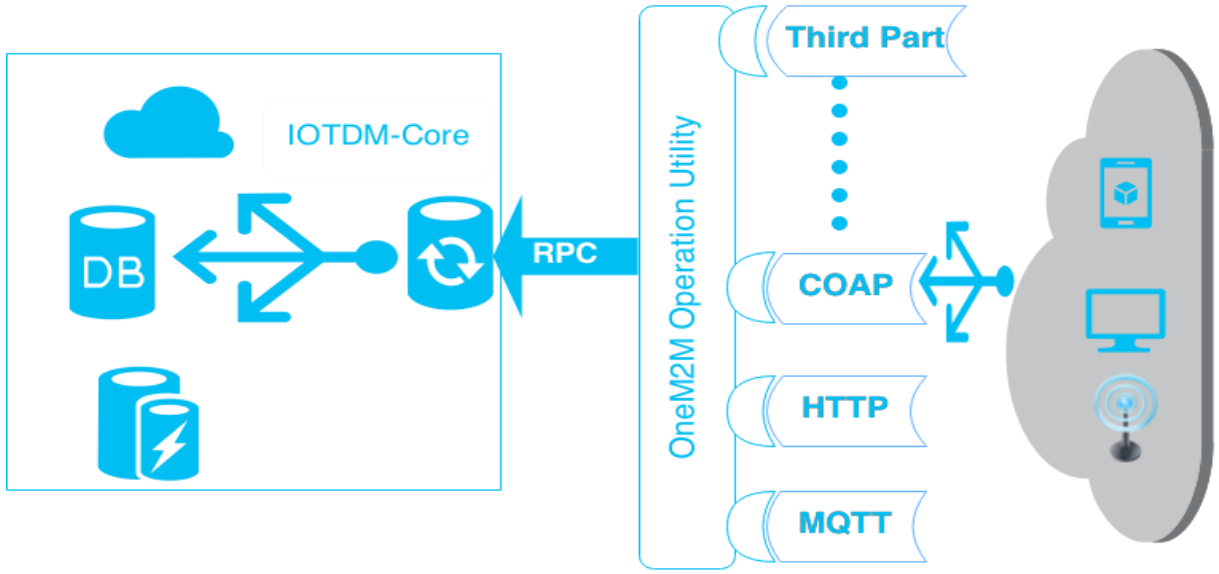
- https://wiki.opendaylight.org/view/Simultaneous_Release:Lithium_Release_Plan#Participating_Projects
- IoT Data Management (IoTDM)
- https://wiki.opendaylight.org/view/IoTDM:Main

IoTDM (IoT를 위한 SDN)

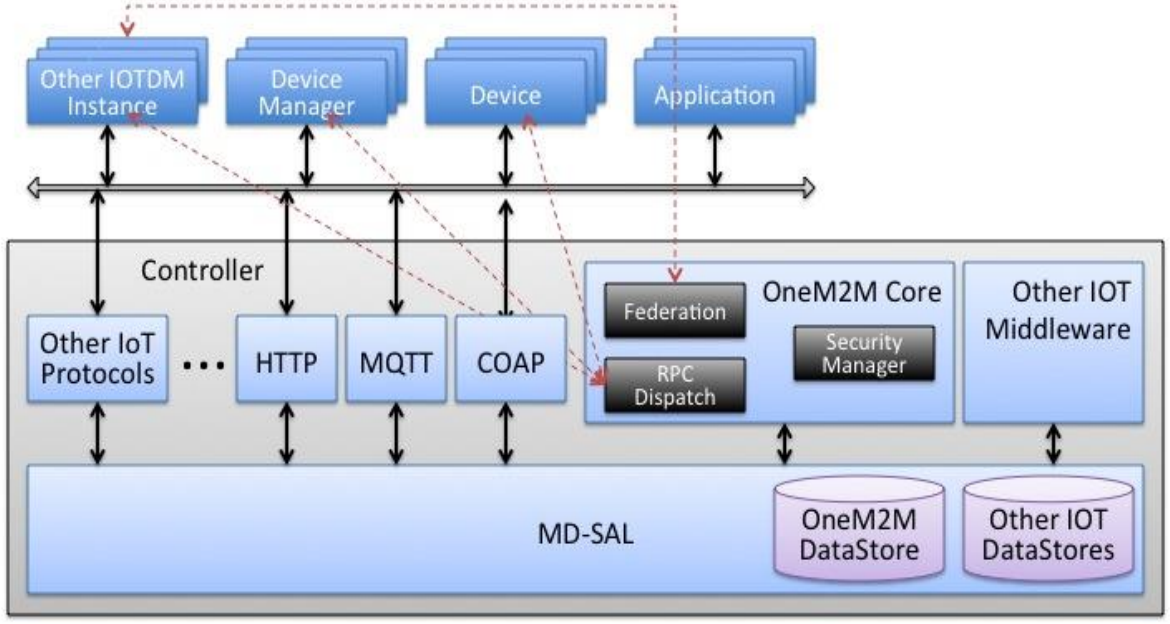
- Project Creation Date: December 9th, 2014
- Project Lead: John Burns (Cisco)
- Committers: (Cisco & ETRI)
  - lflorit@cisco.com Lionel Florit, ODL userID lflorit
  - johnburn@cisco.com John Burns, ODL userID jburns
  - repenno@gmail.com Reinaldo Penno
  - cyc79@etri.re.kr, Yunchul Choi , ETRI
  - kblomseth@echelon.com, Kevin Blomseth, Echelon, ODL userID kblomseth
  - jmedved@cisco.com Jan Medved
- Mailing List: iotdm-dev@lists.opendaylight.org

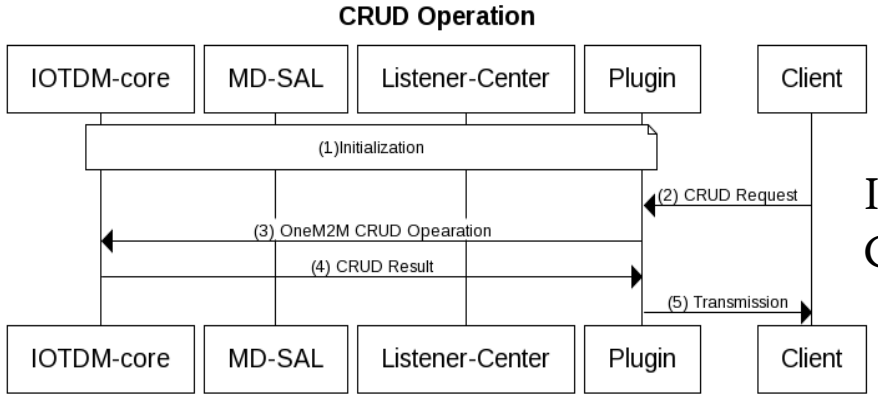
IoTDM - Mission

- The IoTDM project is about developing a data-centric middleware that will act as a oneM2M compliant IoT Data Broker (IOTDM) and enable authorized applications to retrieve IoT data uploaded by any device.



IoTDM - Architecture

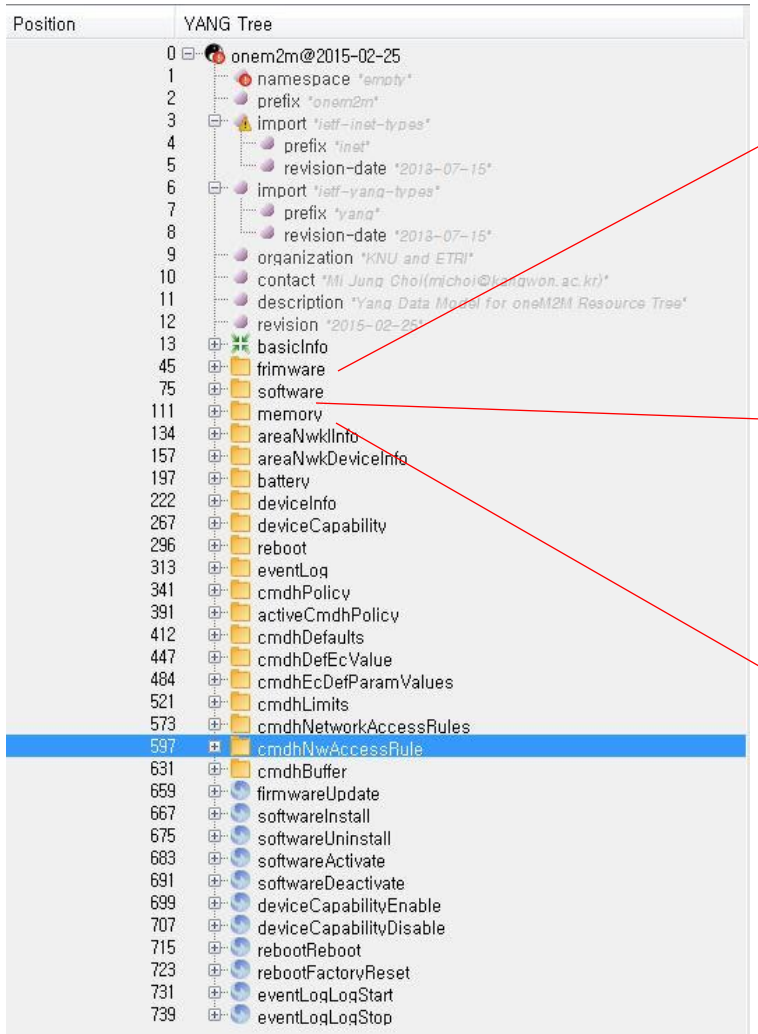


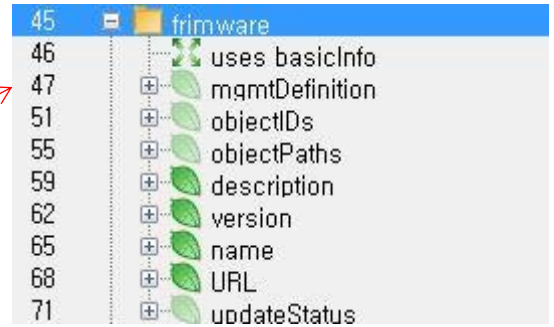


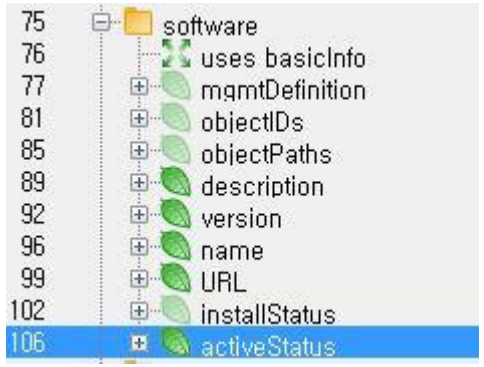
IoTDM-
CRUD operations

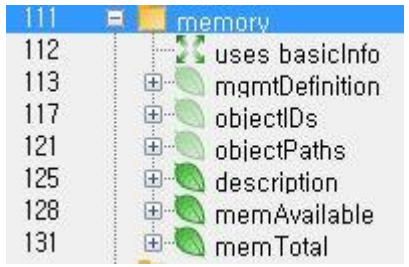
- IoTDM-Core
  - RESTful architecture
  - Integration of existing common IoT southbound protocols: CoAP, MQTT, HTTP
  - Definition of a YANG model representing the oneM2M resource tree
  - Security Manager – User Authentication and Policy Enforcement

oneM2M Resources: Yang Modeling



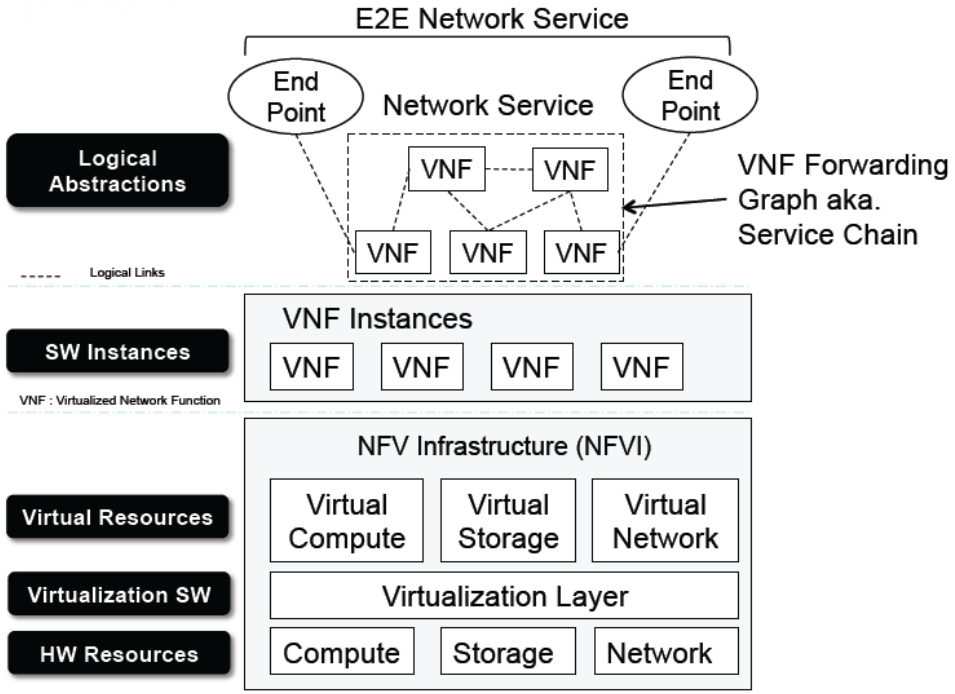


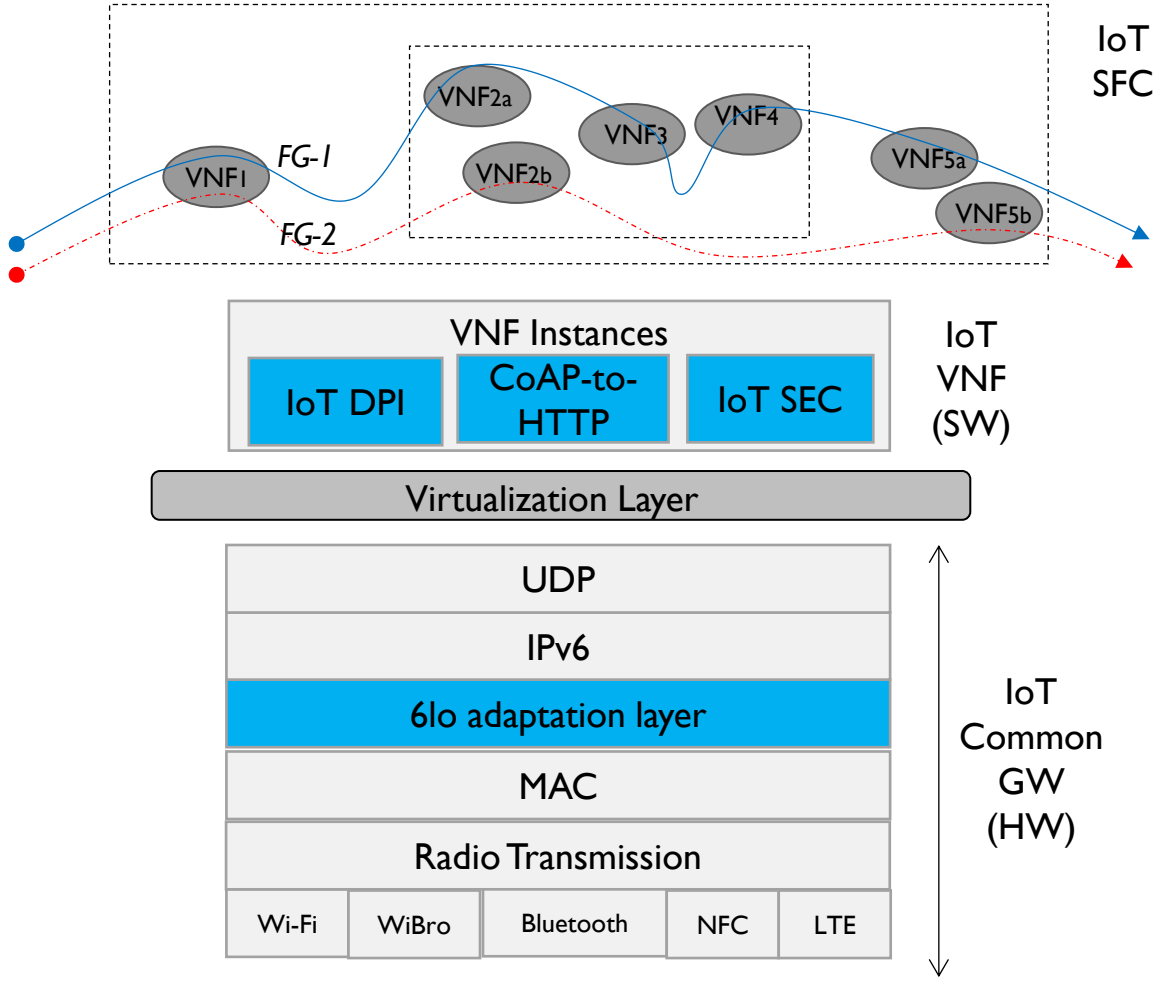





```
container frimware {
  uses basicInfo;
  leaf mgmtDefinition {
    type string;
    config false;
    description
      "Specifies the type of <mgmtObj> resource
  }
  leaf objectIDs {
    yang:object-identifier;
    config false;
    description
      "Contains the list URNs that uniquely ide
      If the <mgmtObj> resource is mapped to mu
  }
  leaf objectPaths {
    type string;
    config false;
    description
      "Contains the list of local paths of the
      This attribute shall be provided during t
      The format of this attribute shall be a l
      The combination of the objectPath and the
  }
  leaf description {
    type string;
    description
      "Text format description of <mgmtObj>.";
  }
  leaf version {
    type string;
    description
      "The version of the firmware.";
  }
  leaf name {
    type string;
```

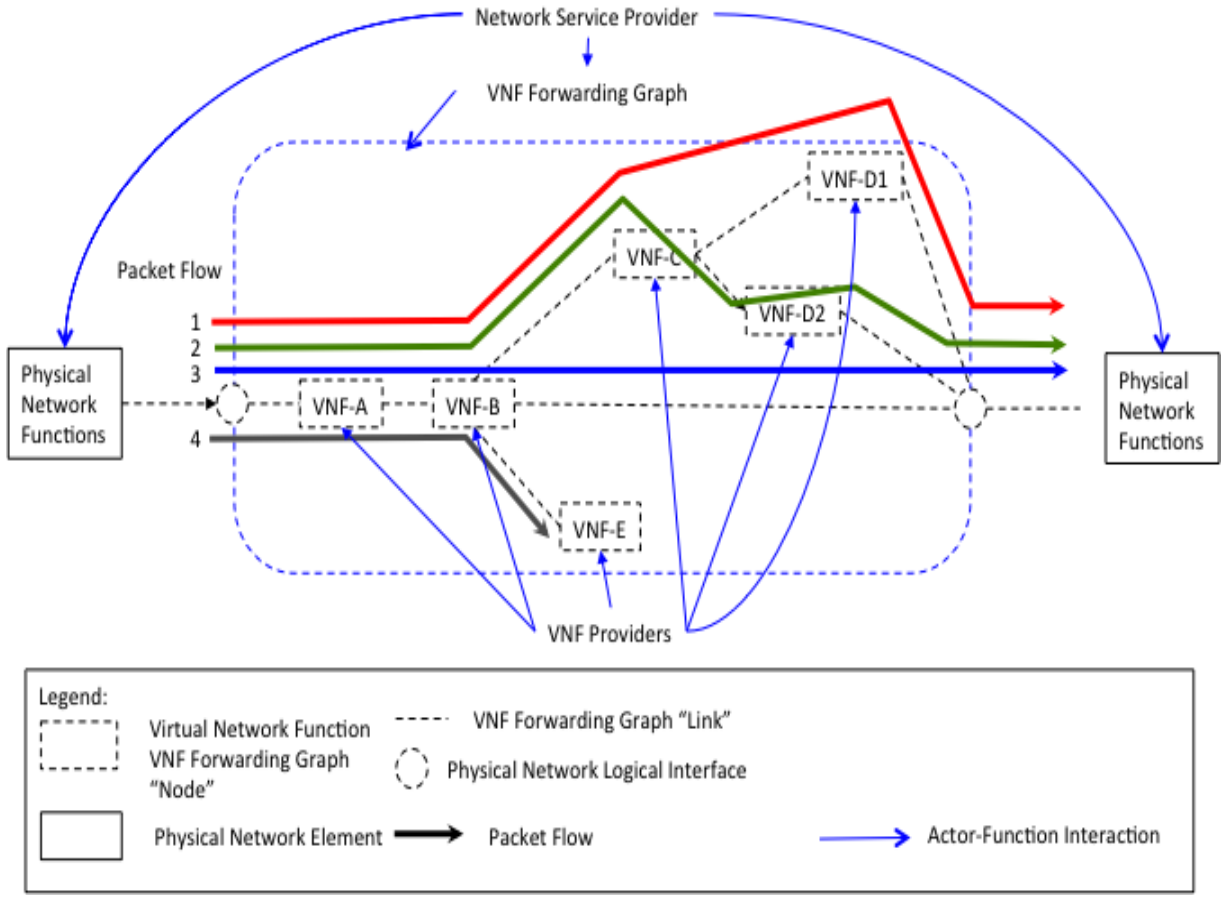
NFV - Virtualized IoT GW Functions

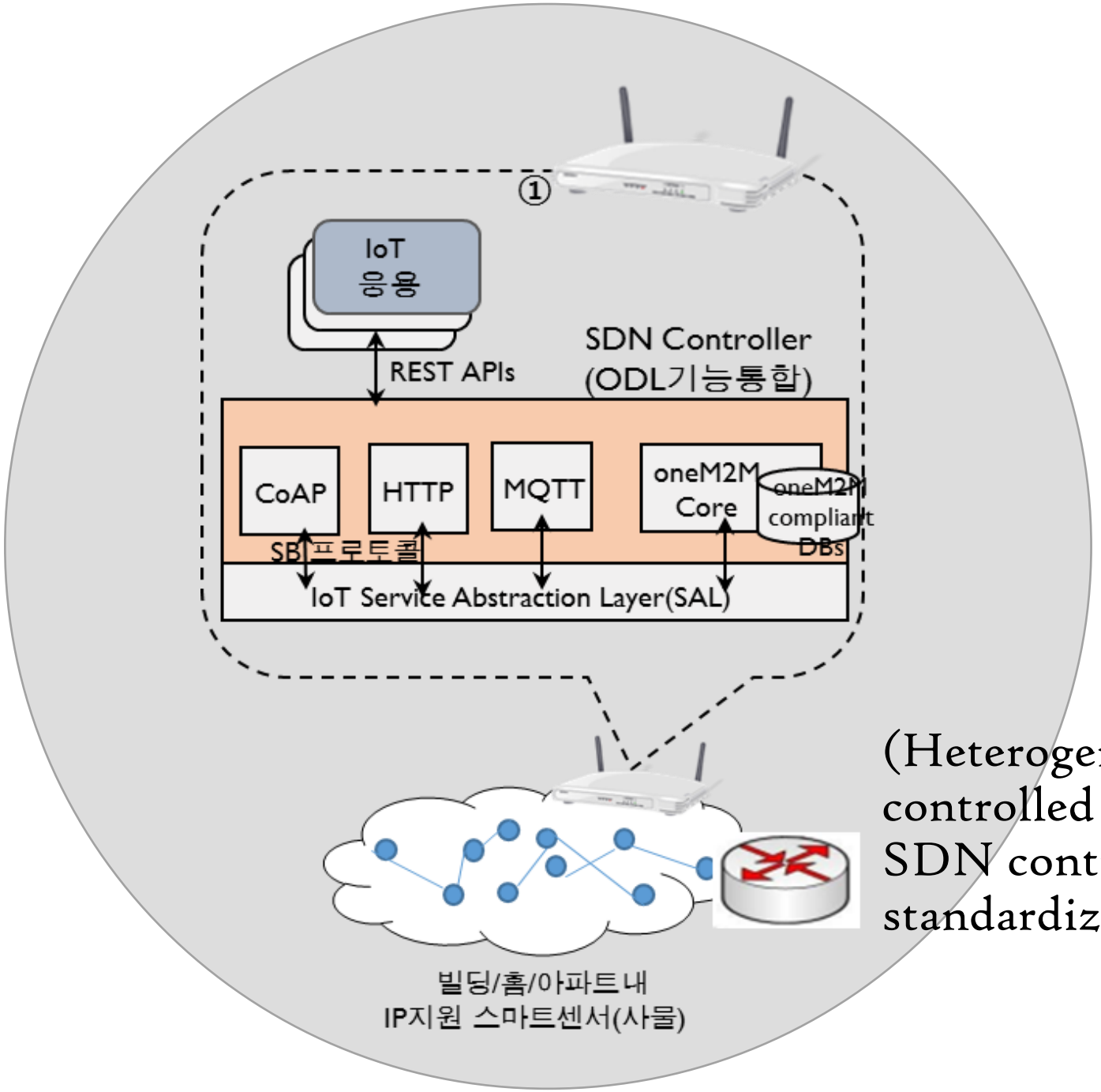




SFC Resource Management

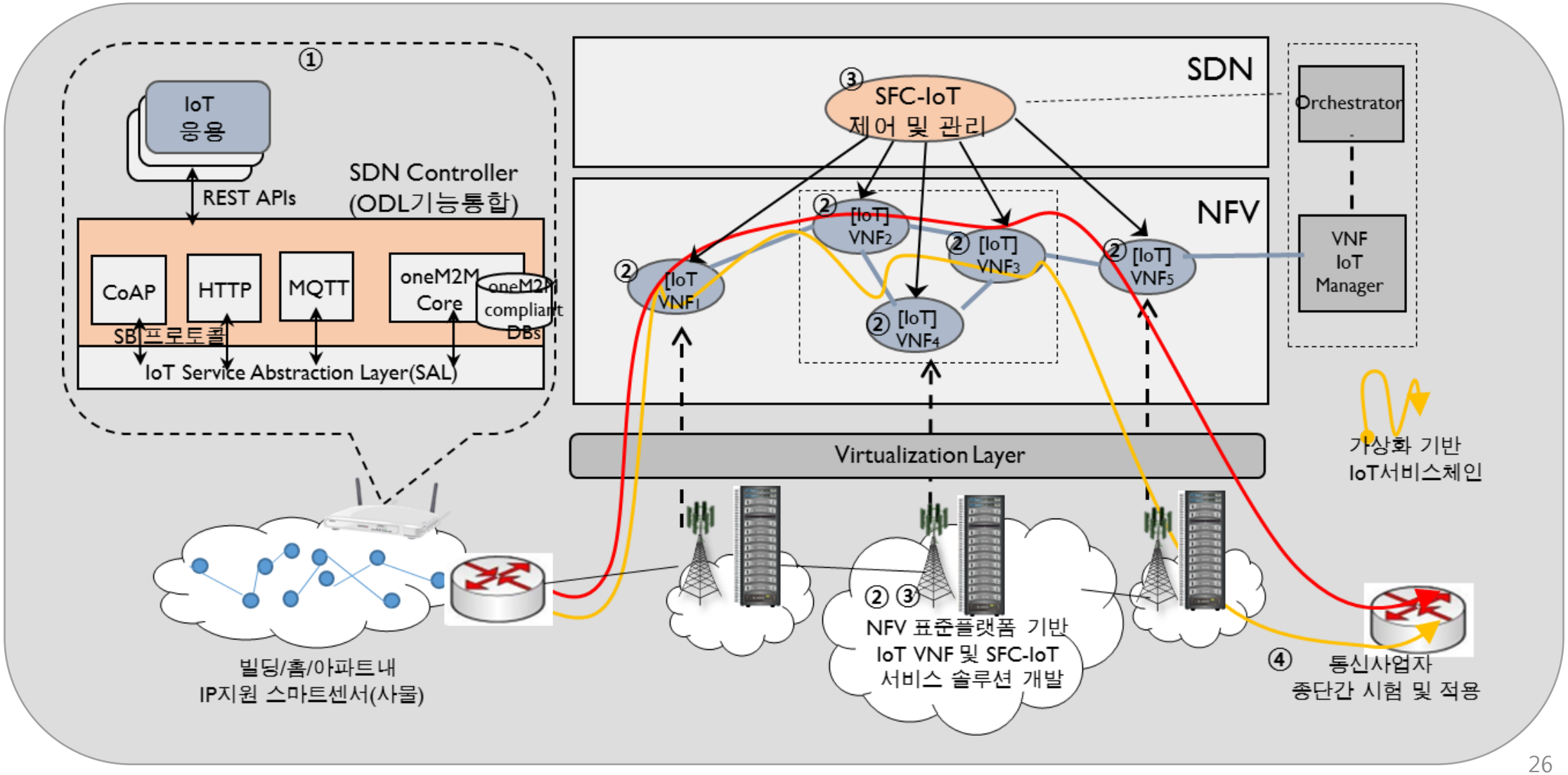
- IoT Network Forwarding Path depends on the resource states
  - Fail-over
  - Load balancing
  - Energy efficiency
  - Path optimization
  - Traffic optimization
  - End-to-end latency optimization
  - End-point mobility
- draft-irtf-nfvrg-resource-management-service-chain
- IoT control planes for SFC





(Heterogeneous) IoT devices controlled and managed by SDN controllers by means of standardized manners

SDN/NFV 기반 E2E IoT 서비스



Wrap-up & Summary

- SDN은 서비스와 디바이스를 새롭게 Abstraction (모델링)!
  - Data plane과 Control plane을 분리하는 실마리에서 출발
- NFV는 네트워크 function (L4-L7)를 Virtualization
  - 미들박스/GW 하드웨어로 부터 서비스 소프트웨어를 분리
- SDN은 새로운 인프라 (IoT, 5G등)를 추상화/가상화/모델링하는 기술로 진화중
- SDN/NFV+ IoT 결합은 유연한 IoT 서비스 인프라 구축가능
  - 최소한의 표준(인터페이스+API의 제공)과 오픈소스 결합을 통한 시장친화적 SW의 빠른 개발 및 적용
  - 오픈소스 프로젝트와 연계되어 강력한 추진동력 탑재
- Open Daylight의 IoTDM은 IoT를 위한 SDN의 첫번째 오픈소스 프로젝트 (ODL 은 IoT의 다양한 프로토콜들을 plug-in인 하기에 적합)
  - SBI로 CoAP 등 새로운 IoT 프로토콜의 플러그인 제공
  - 새로운 산업 생태계 구성 및 Killer service를 기대 (Open Northbound APIs for IoT Apps)