

Open Networking Korea (ONK) 2020

“Soft Networking for Untact Age”

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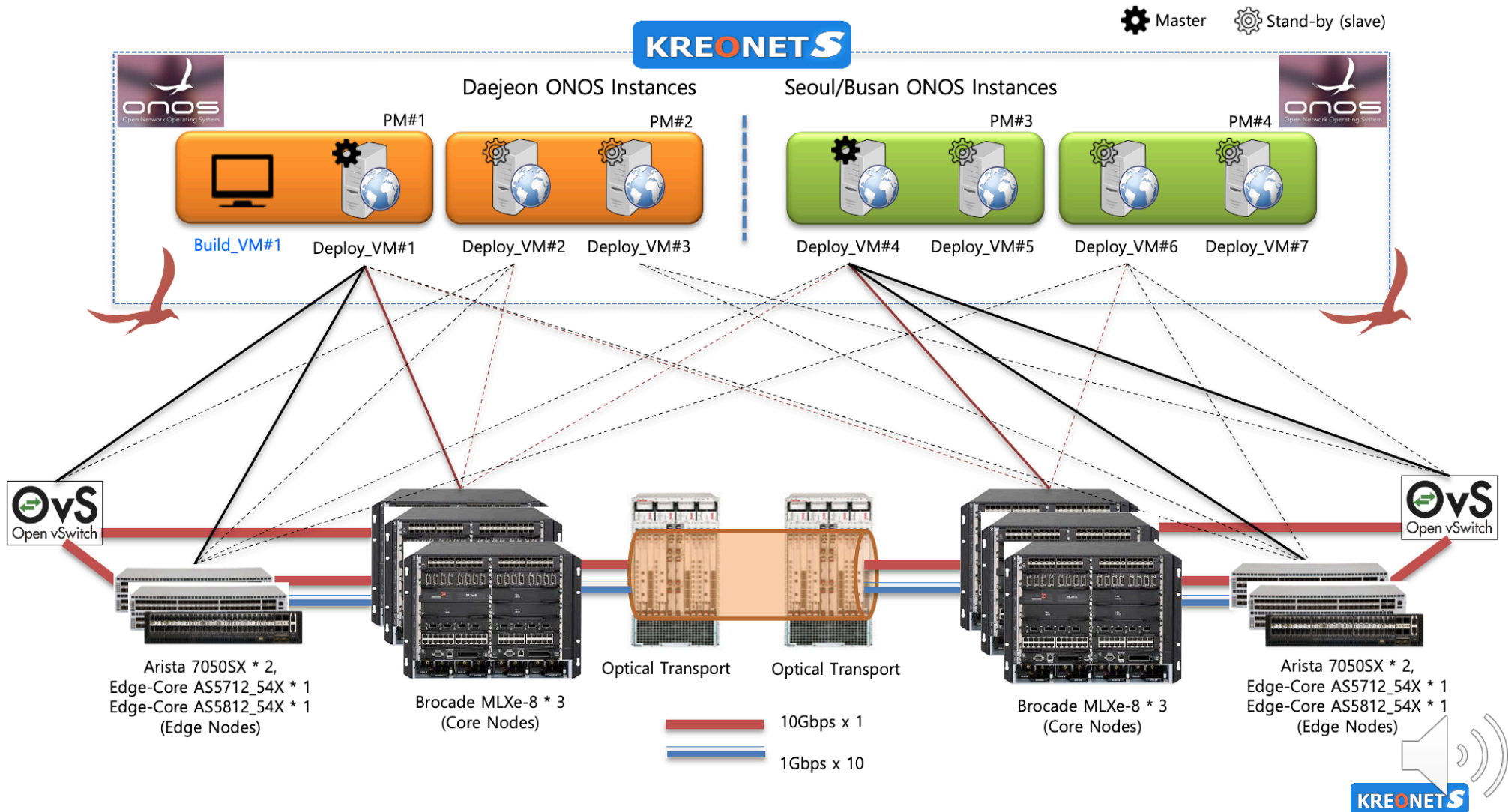


- 발표 제목 : Wide-area 기반의 네트워크 자동화/지능화 구축개발현황

Contents

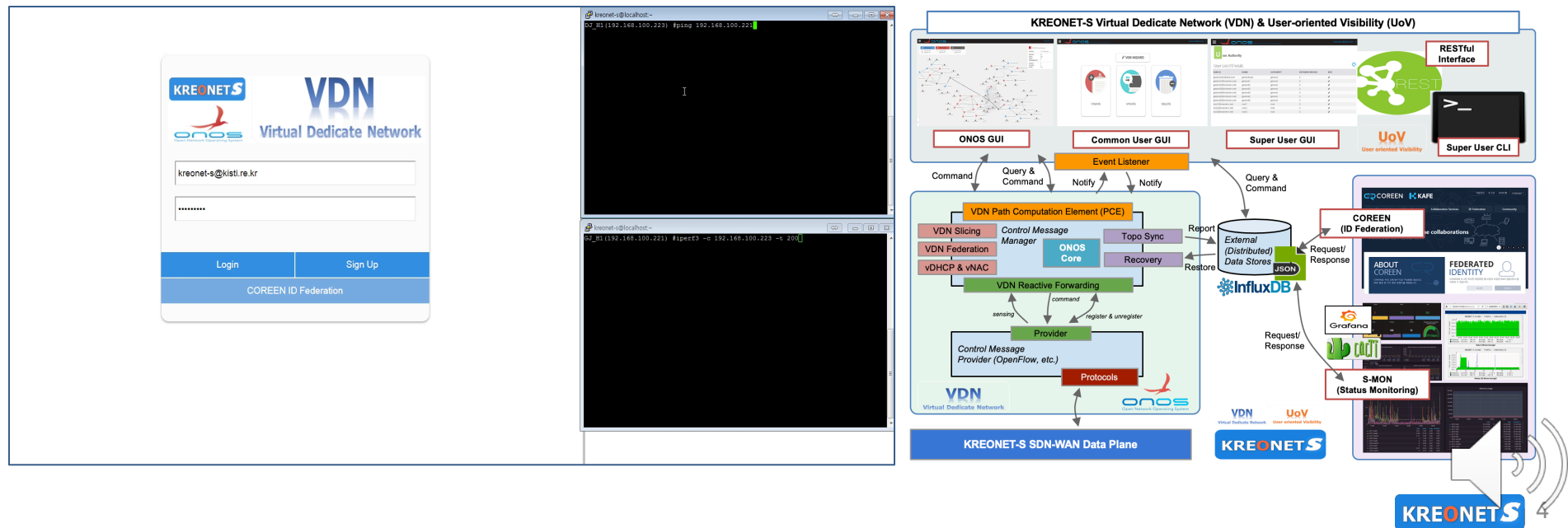
- KREONET-S as a Wide-area SDN
- Automation: Network Operations and VDN Provisioning
- Network Intelligence: Intelligent VDN
- Conclusion

KREONET-S as a Wide-area SDN



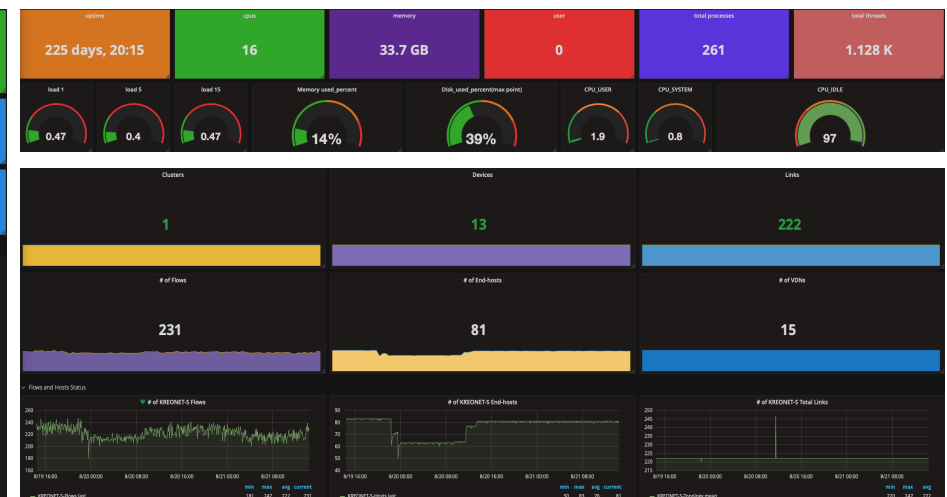
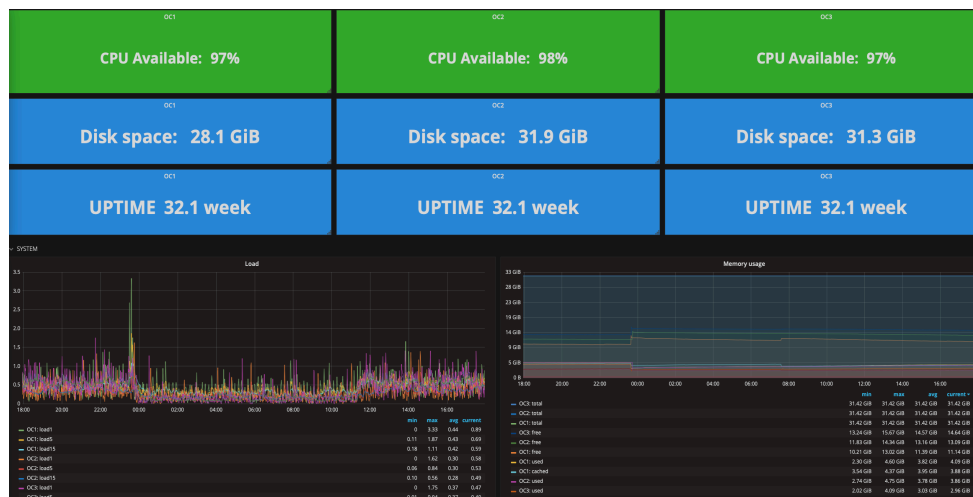
Wide-area E2E Virtual Networking

- 대역폭 요구(~100Gbps)에 따른 온디맨드 네트워크 슬라이스 생성(<10초)
 - 서비스/응용 별 배타적 데이터 전송을 통한 엄격한 망 격리 및 보안 환경
- 유무선 단말(end-host, UE) 자동화 인지 및 액세스 제어 가능
- SDN-IP 기반 네트워크 슬라이스 및 인터넷 게이트웨이 자동 연동/제어
- 네트워크 슬라이스에 특화된 가상망 DHCP 및 NAC 기능 제공
- 이용자 중심 네트워크 슬라이스 가시화 및 GUI, REST-API 인터페이스 제공



Automation for Reliable Operations

- **Critical Error Logs: INSTANT RECOVERY** demanded
 - “java.lang.OutOfMemoryError: GC overhead limit exceeded”
 - “org.onosproject.store.service.StorageException\$Timeout”
 - “org.onosproject.store.service.ConsistentMapException\$Timeout: onos-network-configs”
- **ONOS/VDN Operations Status and KREONET-S Topology**
 - ONOS Instances and Topology SCCs: Active or Inactive, 1 or more, etc.
 - KREONET-S Topology: # of devices, links, flows, end-hosts, VDNs, etc.
 - VDN-Telemetry: VDN operations dataset, OpenFlow/VDN PacketIn+, etc.
- **SNMP and sFlow based Devices and Specific End-hosts Monitoring**



Automation for VDN Provisioning

ONOS - Open Network Operating System

Create

Name: Is the proper name. Upload

Bandwidth: Gbps ☒ Auto Scale ☒ Proactive

SDN-IP Gateway: Allow Deny

DHCP Server:

User List: All Users Selected User(s)

Location **Network Devices** **Hosts/GW**

Gwangju
Seattle
Chicago
Seoul
Busan
Daejeon

Chicago-Edge**
KREONET-S-CHI-Core**

+ Add - Remove

Active VDN Information

Location	Network Devices	Hosts/GW
Daejeon	KREONET-S-DJ-Edge19	DJ-VM01
Seoul	Seoul-Edge*	SL-VM02
Busan	Busan-Edge**	BS-VM03
Gwangju	Gwangju-Edge***	GJ-VM01

VDN API

VDN Slicing App
ONOS Core REST API
VNAC API
VDN Federation API
DHCP Server App
VDN API
VDN orchestration REST API

api

DELETE /api/{id}
GET /api/{id}
PUT /api/{id}
GET /api

Response Messages

HTTP Status Code	Reason	Response Model	Headers
200	successful operation		
default	Unexpected error		

Try it out! Hide Response

curl

```
curl -X GET --header 'Accept: application/json' 'http://203.241.173.232:8181/vdn/v1/vdn/api'
```

Request URL

```
http://203.241.173.232:8181/vdn/v1/vdn/api
```

Response Body

```
{
  "892d0924-c734-4117-a773-6fa95016811a": {
    "id": "892d0924-c734-4117-a773-6fa95016811a",
    "type": "DEDICATED",
    "name": "VDN-KIST",
    "requireBandwidth": 40000,
    "bandwidth": 40000,
    "autoScale": false,
    "proactive": true,
    "realHostIds": [
      "F4:52:14:1C:86:09/None",
      "10:E8:78:7E:07:F7/None",
      "F4:52:14:1C:85:79/None",
      "E4:1D:2D:08:06:18/None",
      "50:6B:4B:7C:29:72/None"
    ],
    "bogusHostIds": []
  }
}
```

Response Code

```
200
```

Response Headers

```
{
  "transfer-encoding": "chunked",
  "server": "jetty(8.1.6.v20160208)",
  "content-type": "application/json"
}
```

POST /api

[BASE URL: /vdm/v1/vdn , API VERSION: 1.0]
Swagger UI (v2.2.10) adaptation

```
ONOS-Build-M01:/home/kreonet-s>onos
Password:
Welcome to Open Network Operating System (ONOS)!
```

Documentation: wiki.onosproject.org
Tutorials: tutorials.onosproject.org
Mailing lists: lists.onosproject.org

Come help out! Find out how at: contribute.onosproject.org

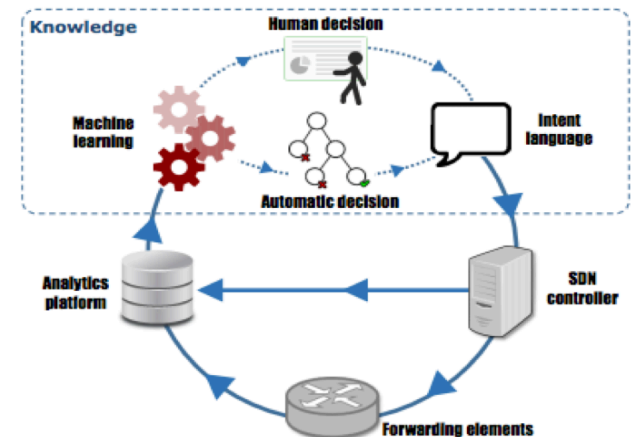
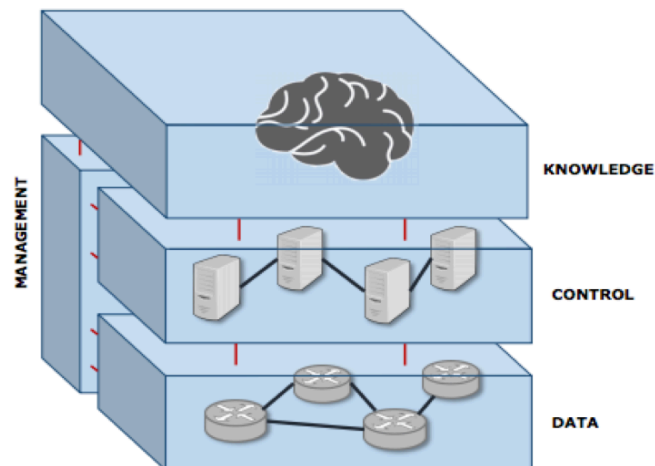
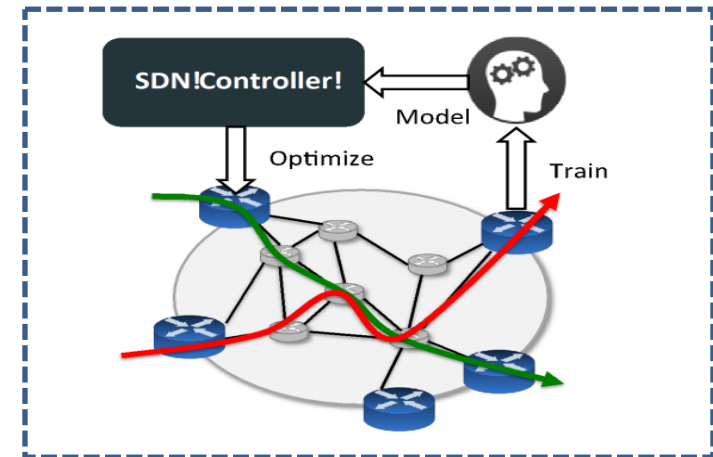
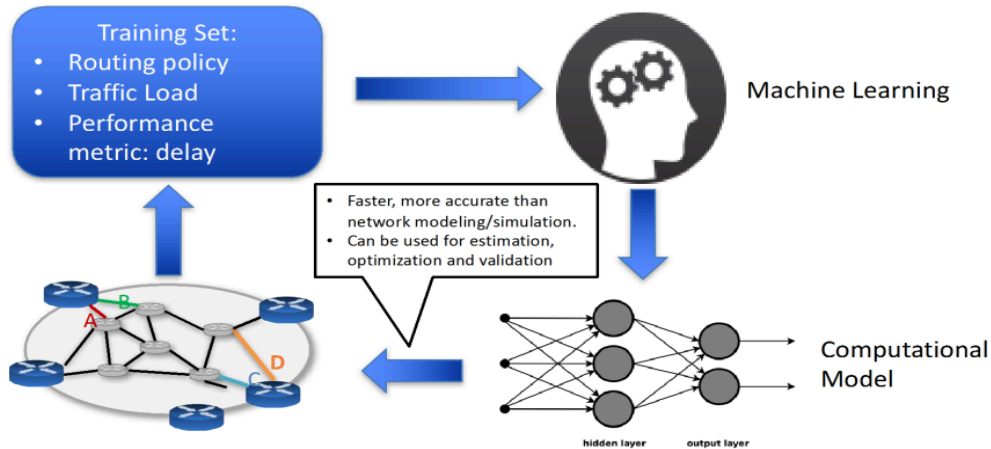
Hit '**<tab>**' for a list of available commands
and '**[cmd] --help**' for help on a specific command.
Hit '**<ctrl-d>**' or type '**system:shutdown**' or '**logout**' to shutdown ONOS.

```
onos> vdn
vdn
vdn-containhost
vdn-device-config
vdn-linkinfo
vdn-remove
vdn-user-create
vdn-user-list
vdn-user-remove
vdn-user-update
vdn:vdhcp-list
vdn:vdhcp-remove-vdn-mapping
vdn:vdhcp-show-config
vdn:vdhcp-show-mapped-ip
vdn:vdhcp-vdn-show-host-mapping
vdn:vnac-remove-vdn-mapping
vdn:vnac-set-vdn-mapping
vdn:vnac-show-rule
onos> vdn-create
```

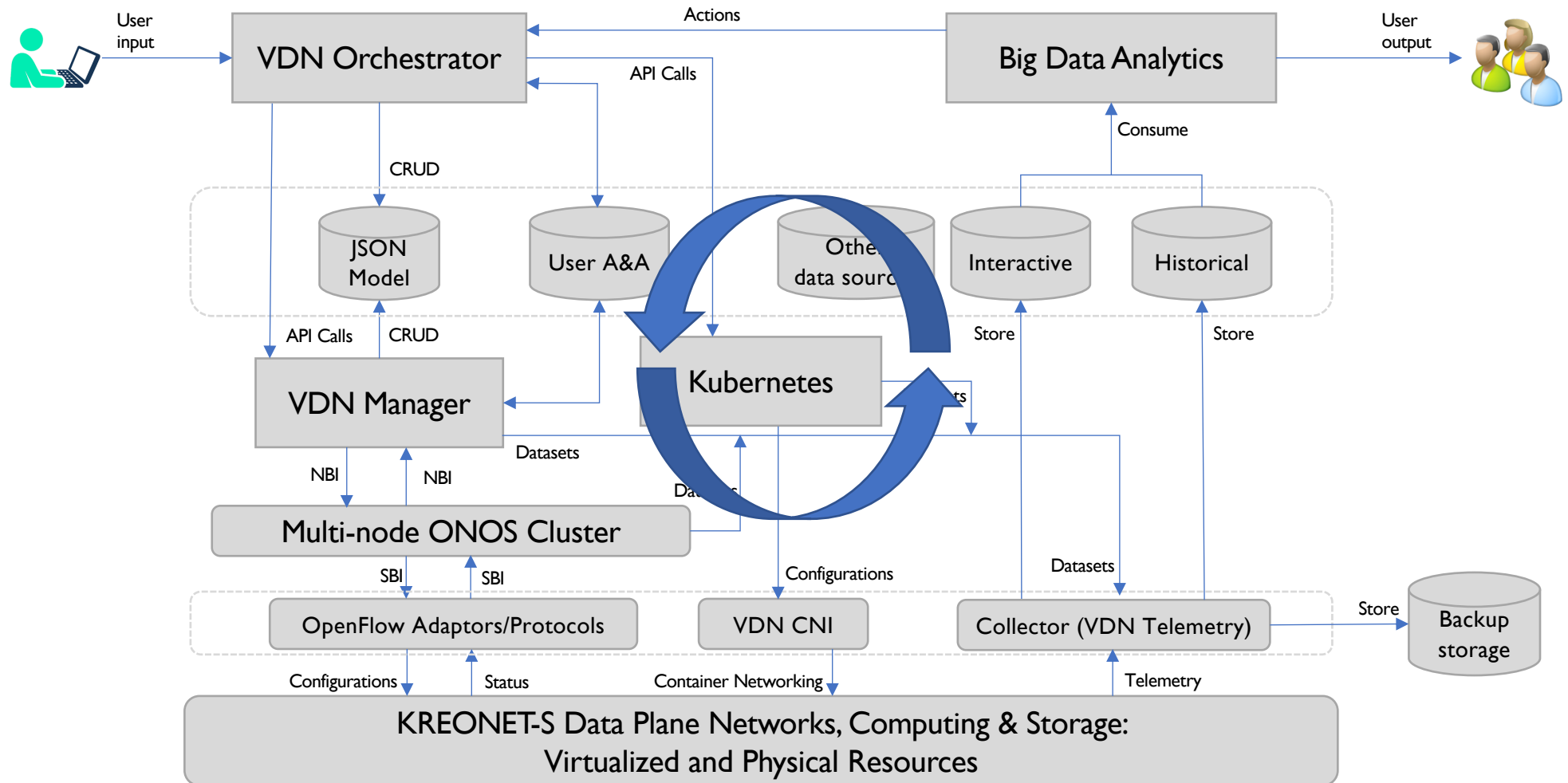

General SDN Impact on NI

- **AI/ML is hard to be applied** to traditional networks
 - **Heterogeneous network infrastructure**: complexity of network system
 - **Inherently distributed nature of Internet**: each network node can only view or act over a small portion of network system
- **SDN decouples the control plane and data plane**
 - SDN resource management by **a logically centralized controller**
 - **Global network topology view** and **dynamic programming/flow control**
 - **Real-time network state & configuration data as well as flow-granularity info.**
- **AI/ML** gains great advantage from the **centralized SDN Controller**
 - **Bringing intelligence** to the SDN controller
 - Data analysis, network optimization, and **automated provisioning of services**
 - **AI/ML to be executed on the network in real-time** via dynamic programmability

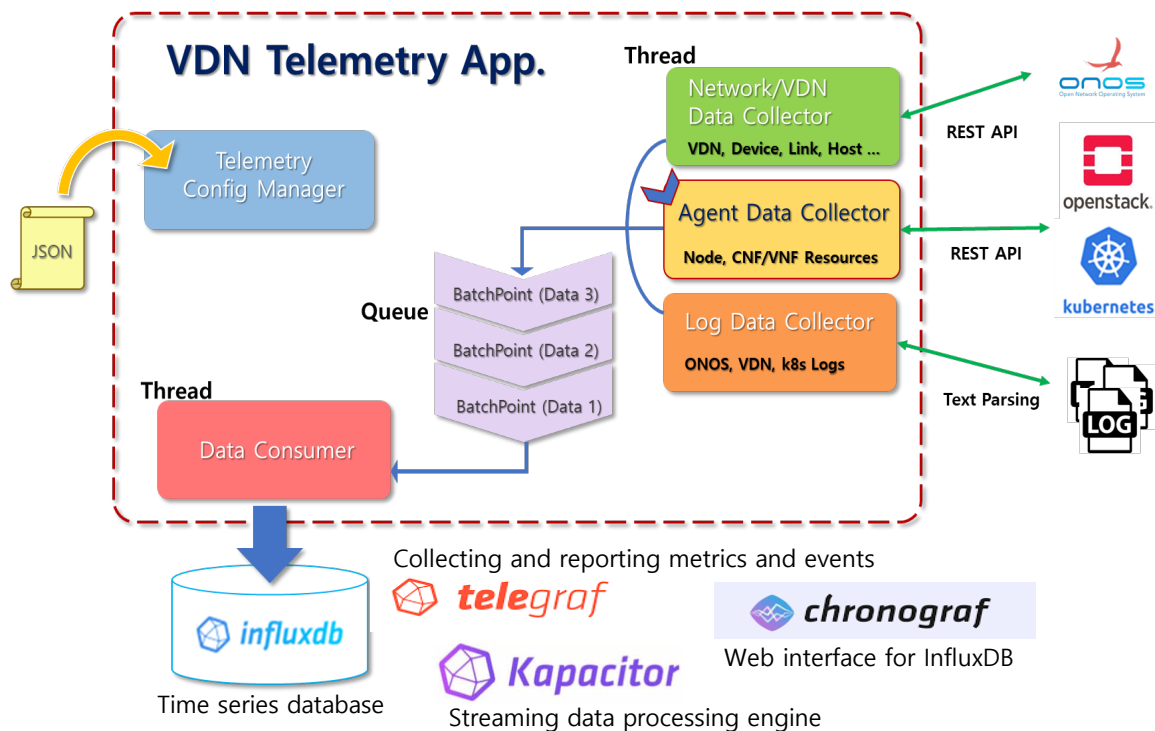
KDN Operation Loop w/ SDN



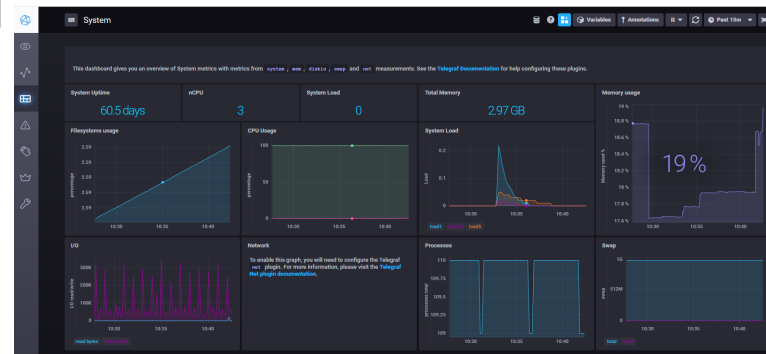
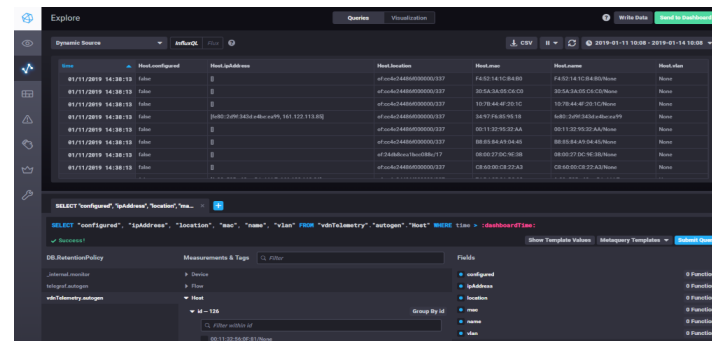
NI Control Loop on KREONET-S



ONOS/VDN Telemetry



- **ONOS/VDN status:** device, link, host, flow, port, etc.
- **ONOS/VDN logs:** "INFO", "ERROR"
- **OpenFlow/VDN PacketIn+:** etherType, vlanID, srcMac, dstMac, device, srcPort, dstPort, protocol, srcAddress, dstAddress, srcPort, dstPort, flags, etc.
- **VDN operations:** time, operationType, vdnId, name, bandwidth, vdnHosts, vdnDevices, vdnLinks, vdnOwner, vdnUsers, autoScale, proactive, createTime, updateTime
- **k8s Dataset:** Node, CNF/VNF Resources (CPU, Memory, Storage)



- Collecting Dataset from SDN/NFV Environment
- CNF/VNF Dataset Acquisition and Stabilization w/ VDNO-k8s interface Improvement
- Monitoring and Visualization : Telegraf, Chronograf, Kapacitor, Grafana, etc.

Conclusion

- KREONET-S is Moving Forward to Network Intelligence
 - Software-Defined InterConnections and Automated E2E Network Slicing
 - Underlying KREONET-S Infrastructure + Software-defined Wireless Networks
 - Advancing Network Automation/Intelligence for Autonomic Environment
 - VDN Telemetry + Big Data Analytics + VDN/VDNO Resource Provisioning
 - Intelligent Network Slicing: Prediction of VDN allocation, deletion and isolation
 - Autonomic UE Management for (Fixed/Mobile) Wireless Network
 - VNF Anomaly Detection, Resource Prediction, Auto-Scaling + Intrusion Detection, Autonomic Control and Optimization
- Further Development Direction
 - KREONET-S Expansion and New Releases of VDN v2.0 and VDNO v1.2
 - Wi-Fi 6 and 5G Testbed Expansion, Interconnecting to KREONET-S for Intelligent Network Slicing and Beamforming Prediction Experiments
 - Launching a KISTI Startup Company: 5G/6G/Wi-Fi Network Slicing Platform

Thank You!

Questions and/or Comments to

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For more Information:

<http://www.kreonet-s.net>