OF@TEIN+ Playground:
Visibility Support

OF@TEIN+ 1st
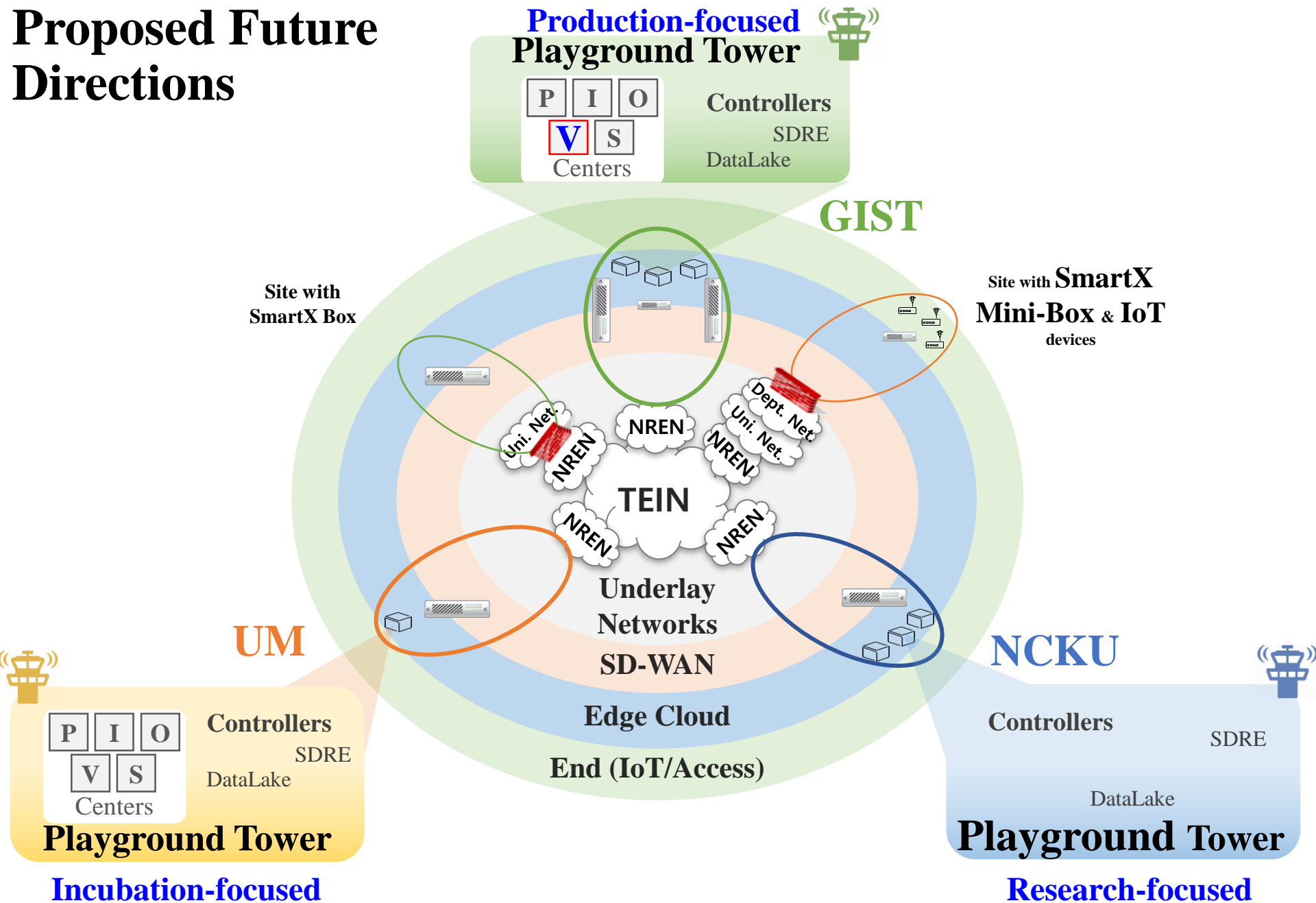
Annual Meeting 2018

Muhammad Usman

Networked Computing Systems Laboratory (NetCS Lab)
School of Electrical Engineering and Computer Science (EECS)
Gwangju Institute of Science and Technology (GIST)
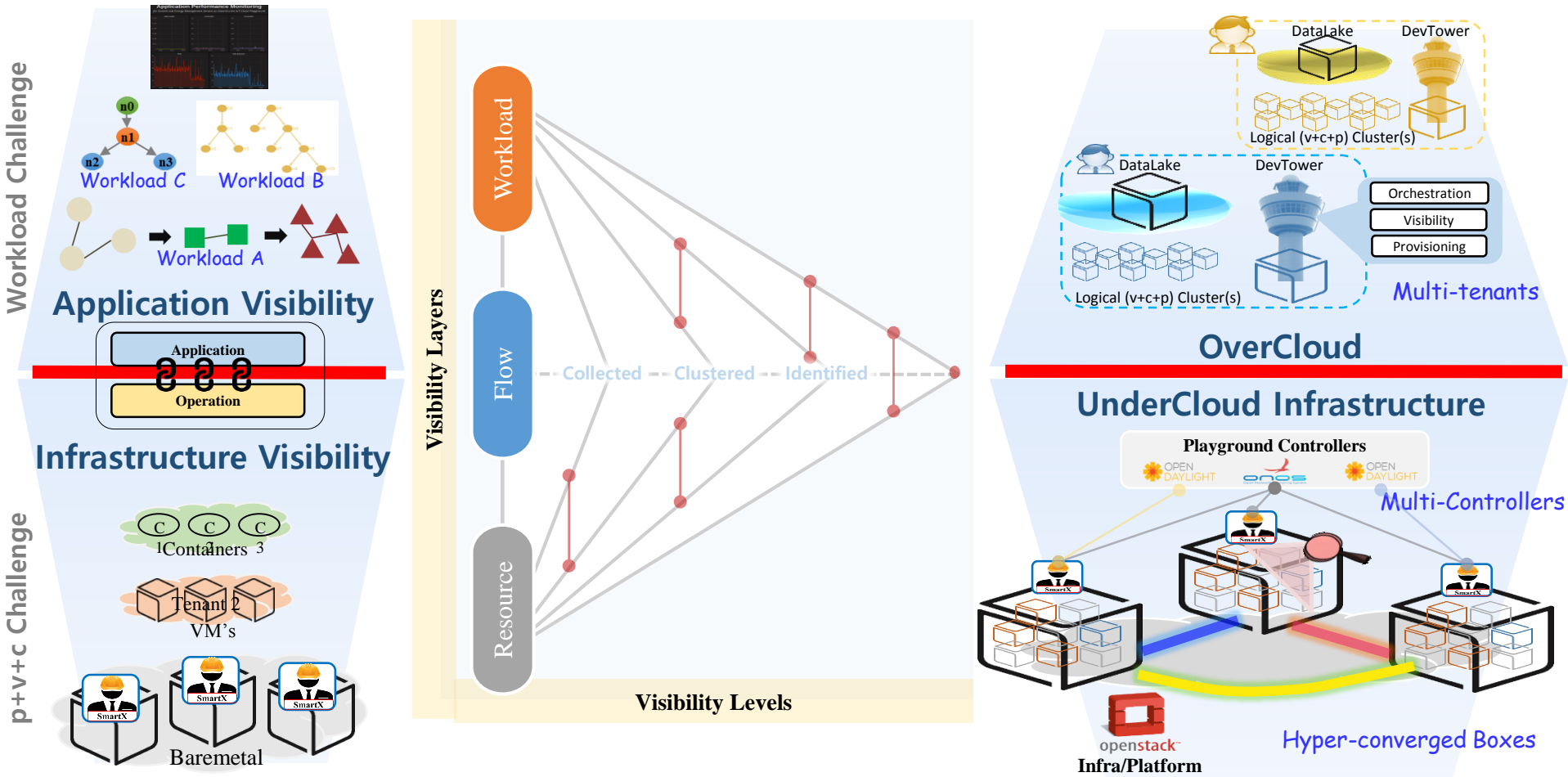**Gwangju, South Korea**

Outline

- **OF@TEIN+ Playground: Overview**
    - Future directions
    - Playground Visibility Challenges

- **SmartX MultiView Visibility Framework (MVF): Concept**
    - Key definitions
    - SmartX MVF early concept

- **SmartX MVF: Design**
    - Design challenges
    - SmartX MVF design

- **SmartX MVF: Implementation**
    - Interactive p+v Topological Visualization of OF@TEIN+ Playground
    - Flow-centric Visibility for OF@TEIN+ Playground

- **How to contribute**
    - GitHub-shared Software

- **Demonstration**
    - SmartX MultiView (software) video demonstration

OF@TEIN+ Playground: Proposed Future Directions

Production-focused
Playground Tower

| P | I | O |
| V | S |

Centers

Controllers
SDRE
DataLake

GIST

Site with **SmartX Box**

Site with **SmartX Mini-Box & IoT** devices

Uni. Net.
NREN
NREN
Dept. Net.
Uni. Net.
NREN
TEIN
NREN
NREN

Underlay Networks

SD-WAN

Edge Cloud

End (IoT/Access)

UM

NCKU

Controllers
SDRE
DataLake

Centers

Playground Tower

Incubation-focused

Controllers
SDRE
DataLake

Playground Tower

Research-focused

Playground Operation Monitoring Challenges

SmartX MVF: Concept

- SmartX MVF: Key definitions
- SmartX MVF: Early Concept

Definitions: Resource-layer, Flow-layer & Workload-layer Visibility

Resource-layer Visibility

Resource-layer visibility is responsible for monitoring and visualization of playground resources (e.g. physical, virtual, and container), infrastructure services (e.g. OpenStack Services, vSwitch service), and inter-connects (e.g. Management, Data) by dividing tasks in complexity/depth levels like collecting, Mapping and analyzing.

Flow-layer Visibility

Flow-layer visibility provides different level of flow information (i.e., collected, clustered, identified, and un-clustered flow) by utilizing a balanced flow collection, clustering, and tagging to support SDN-assisted flexible networking (i.e., steering/ mapping).

Workload-layer Visibility

Workload-layer visibility is responsible for monitoring and visualization of tenant-based applications which consists of inter-connected functions (e.g. Web, App, DB) and their placements based on available information from other visibility layers (e.g. Resource, Flow).

# Definitions: SmartX MultiView Visibility Framework (MVF) & SmartX MultiView

SmartX MultiView Visibility Framework – is an open-source framework that targets to streamline the visibility workflow for collection, validation, integration, storage, staging, and visualization.

SmartX MultiView – is an open-source collaboration project, designed to realize SmartX MultiView Visibility Framework for Multi-layer visibility and visualization under given Assumptions.
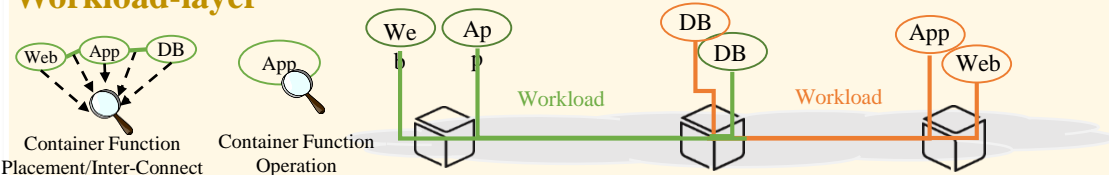
Assumptions

- Multi-site SDN-Cloud Playground
- p+v Resources are monitored
- IO Visor-based packet tracing for Flow monitoring (previously used Sampling & Mirroring approach)
- Tenant-based workload visualization (single tenant, single user, and specific application)
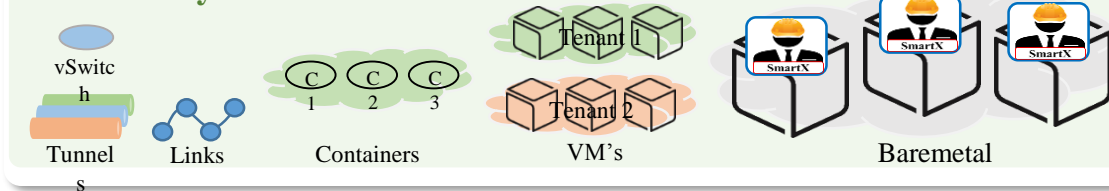
SmartX MultiView: Concept
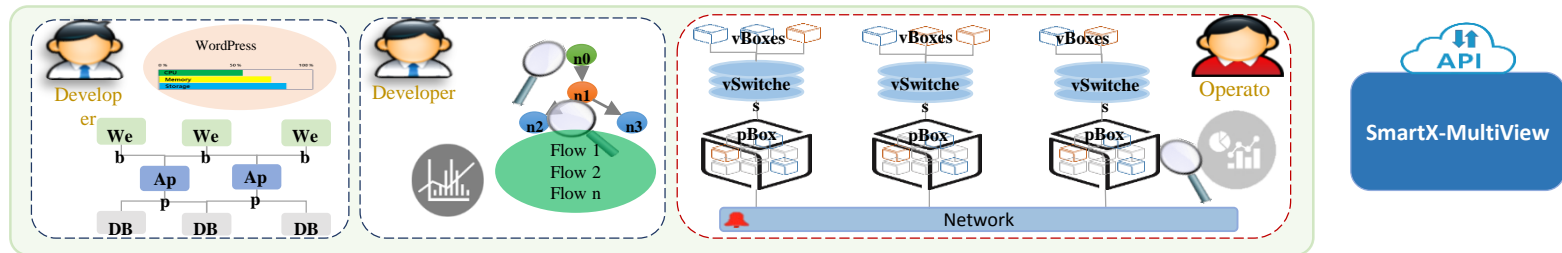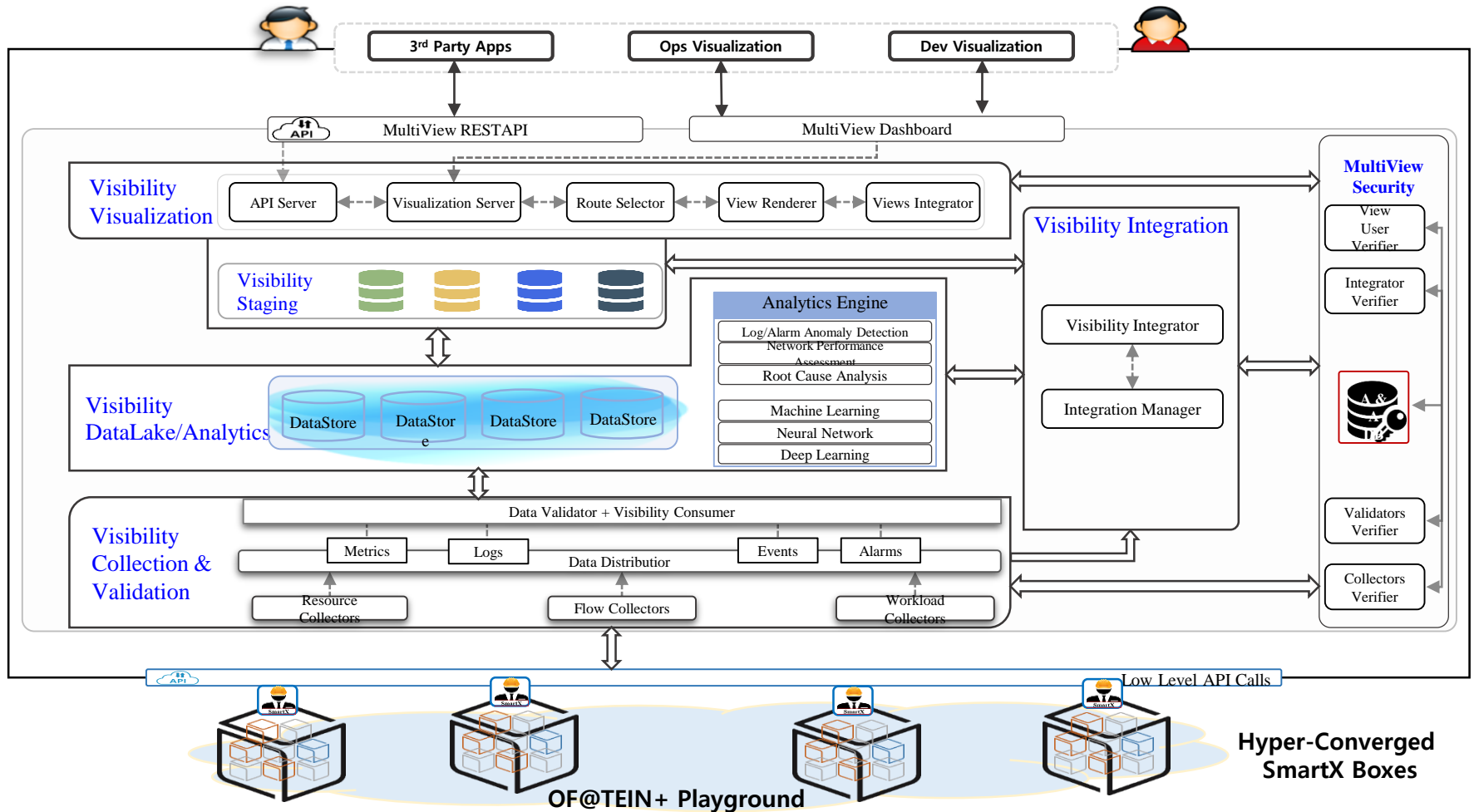
SmartX MVF: Design

- SmartX MVF: Design challenges
- SmartX MVF: Design
- Visibility Center: Design

SmartX MVF: Design Challenges
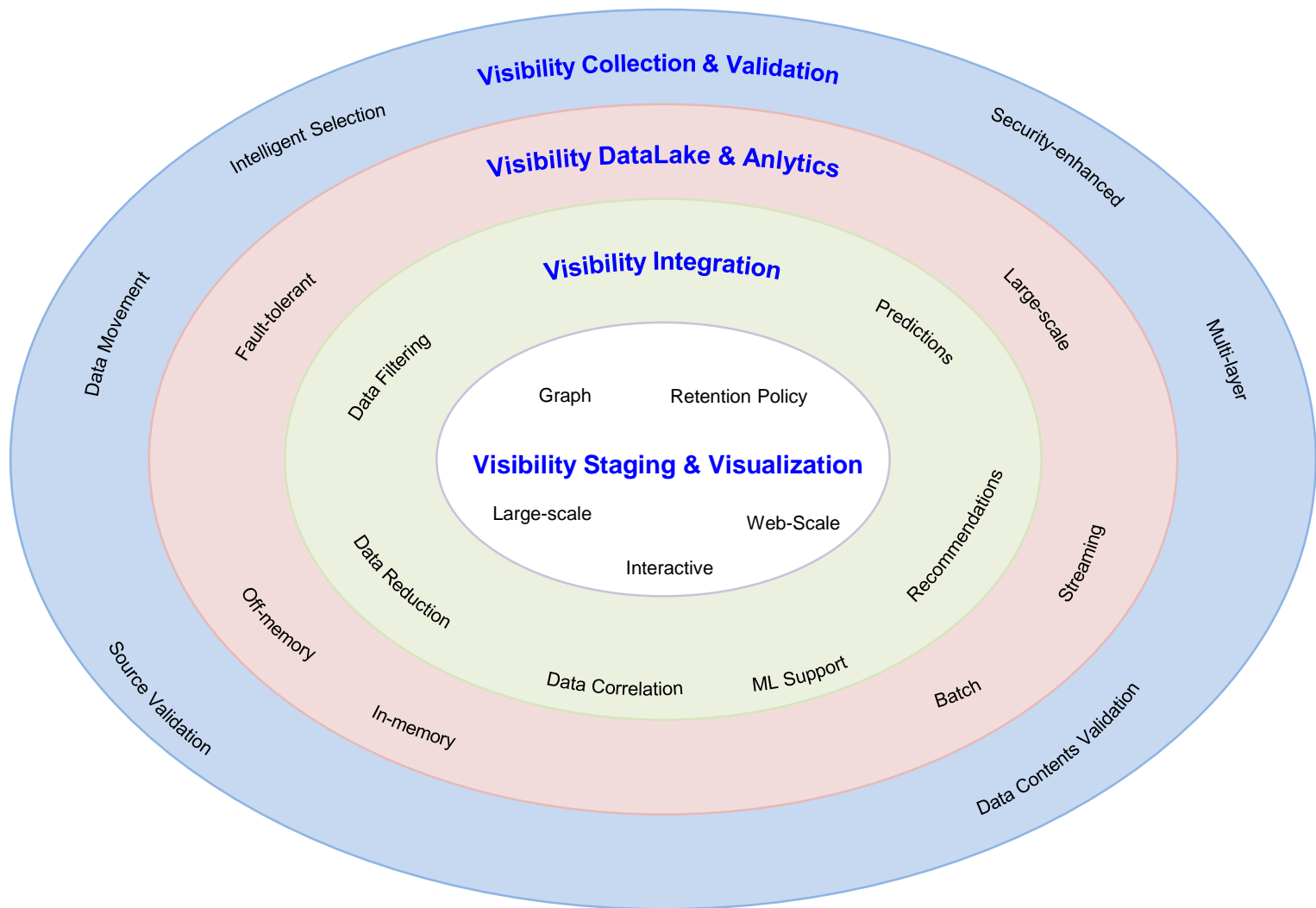
SmartX MultiView Visibility Framework: Design

SmartX MultiView: Implementation

- p+v Topological Visualization of OF@TEIN+ Playground
- Flow-centric Visibility Design for OF@TEIN+ Playground

SmartX MultiView: Implementation Tools
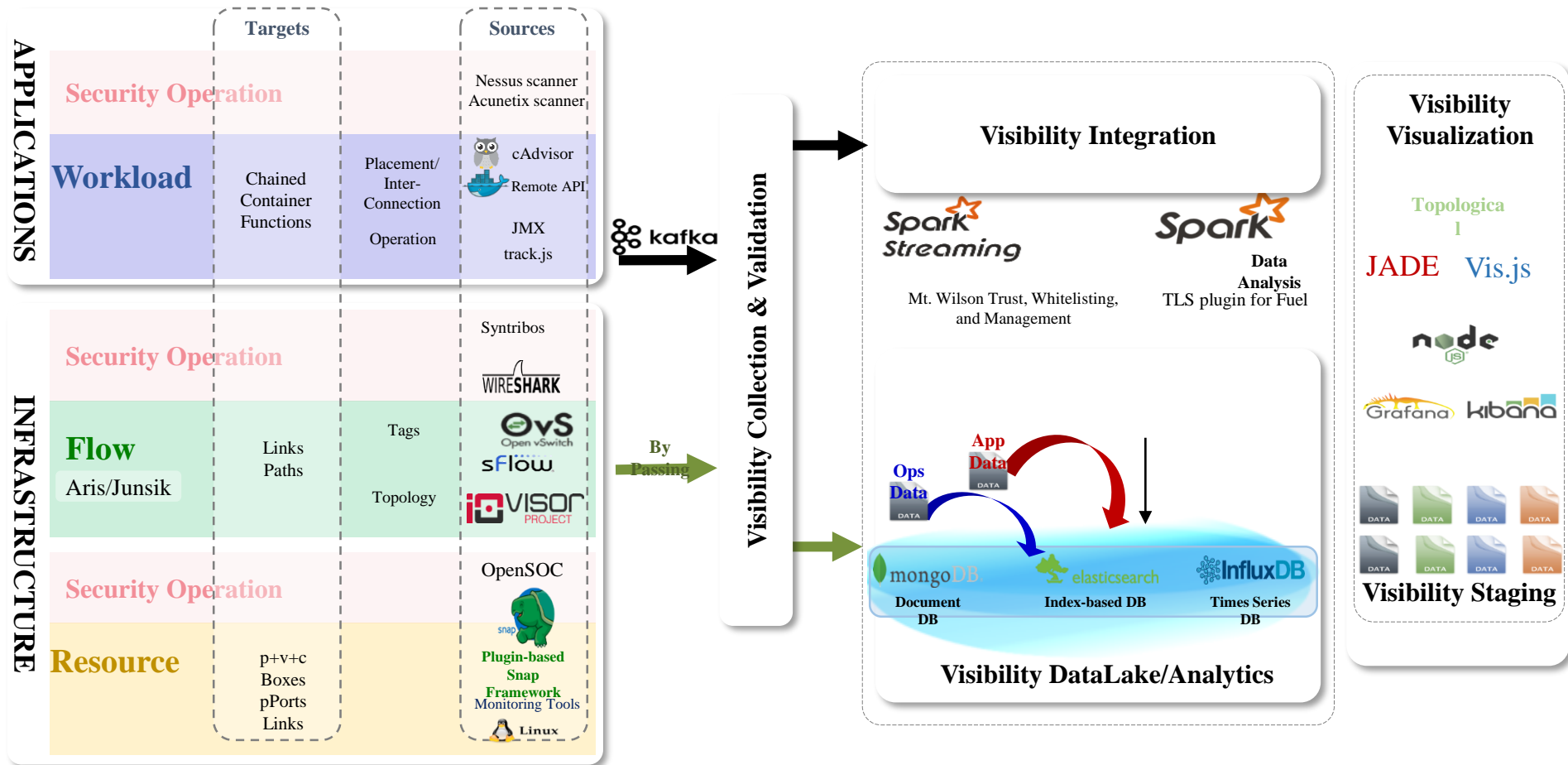
SmartX MultiView Interactive Visualization: p+v Topological Visualization Concept
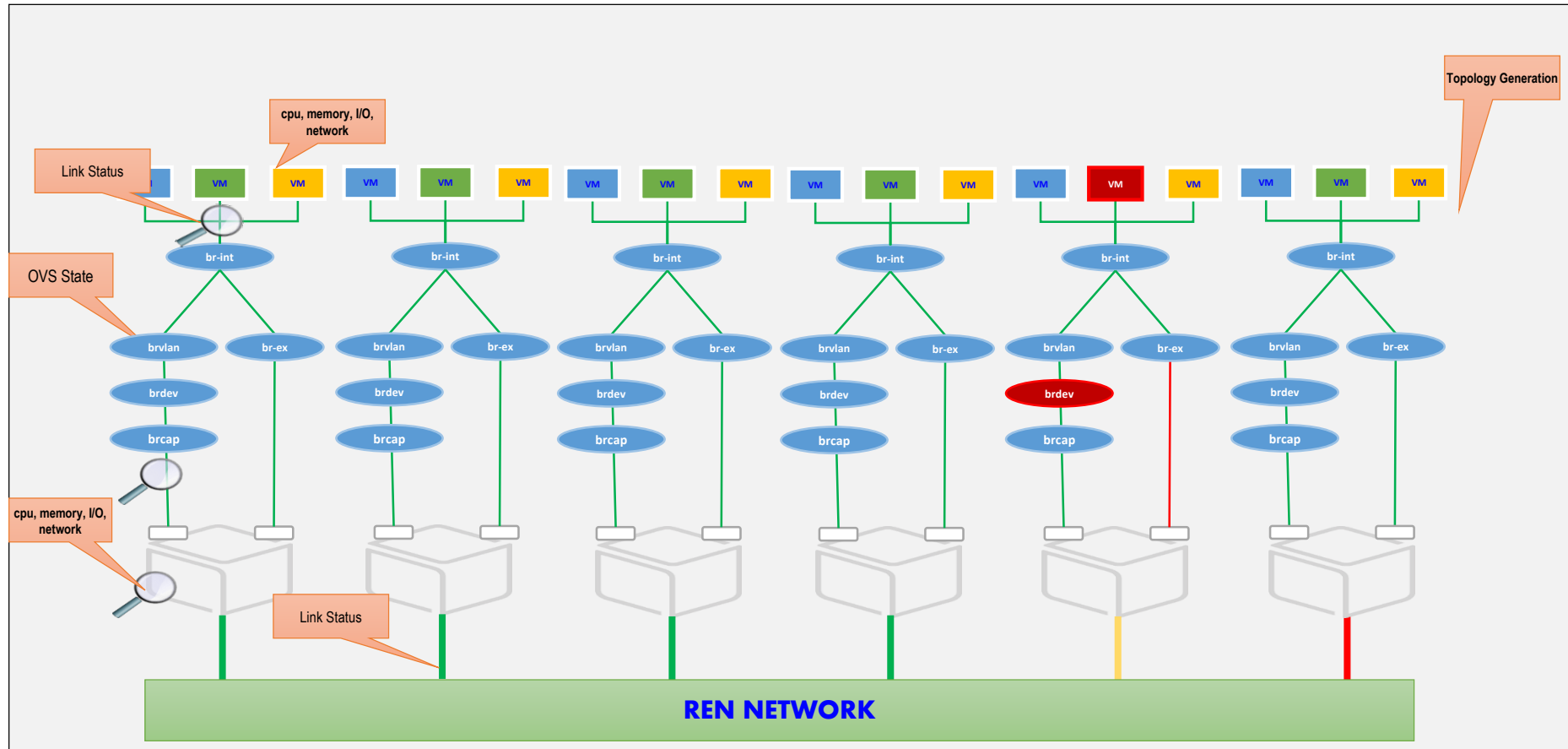
SmartX MultiView Interactive Visualization: p+v Topological Design

Resource-layer Analysis Model
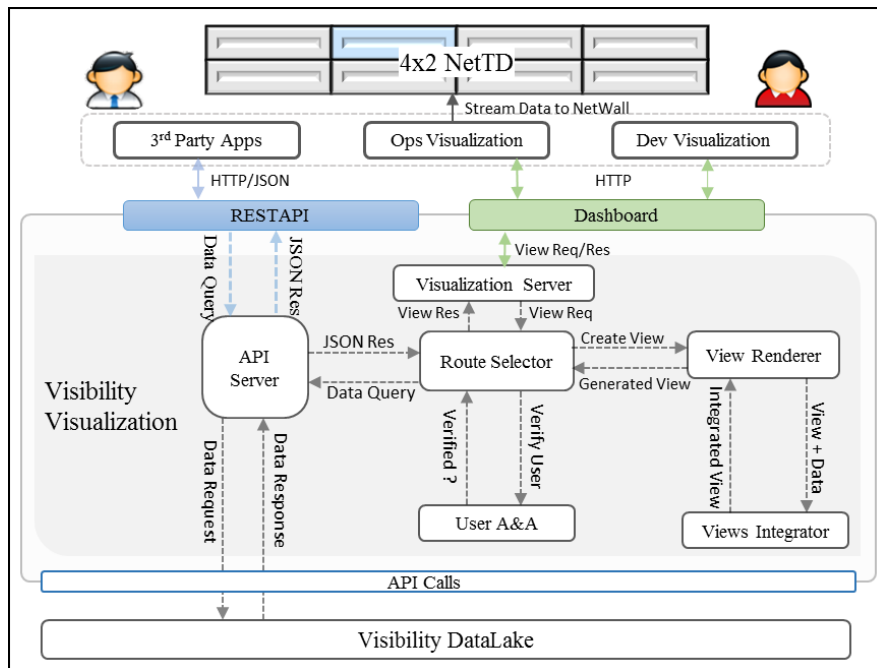
Interactive Visualization Design

Flow-layer Analysis Model
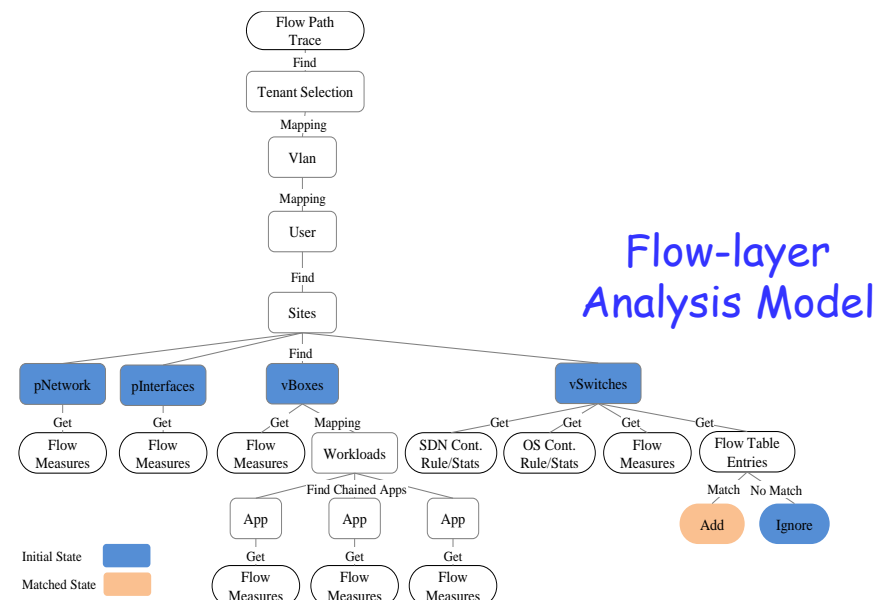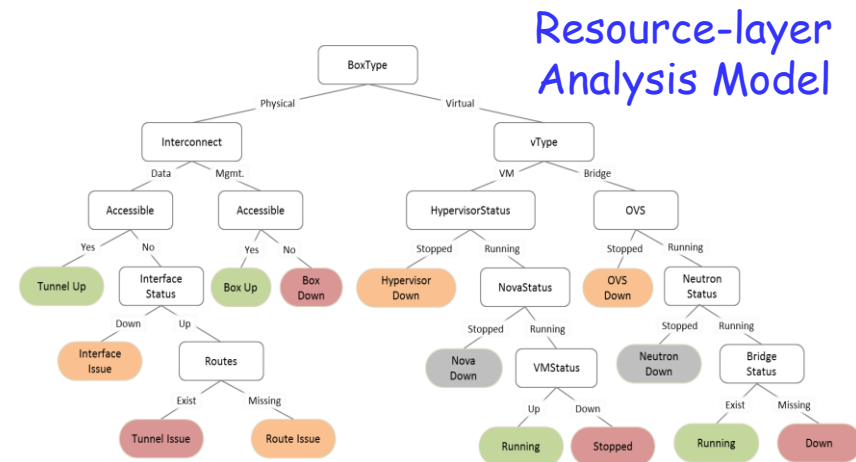
Visibility Data Translation into Visual Components
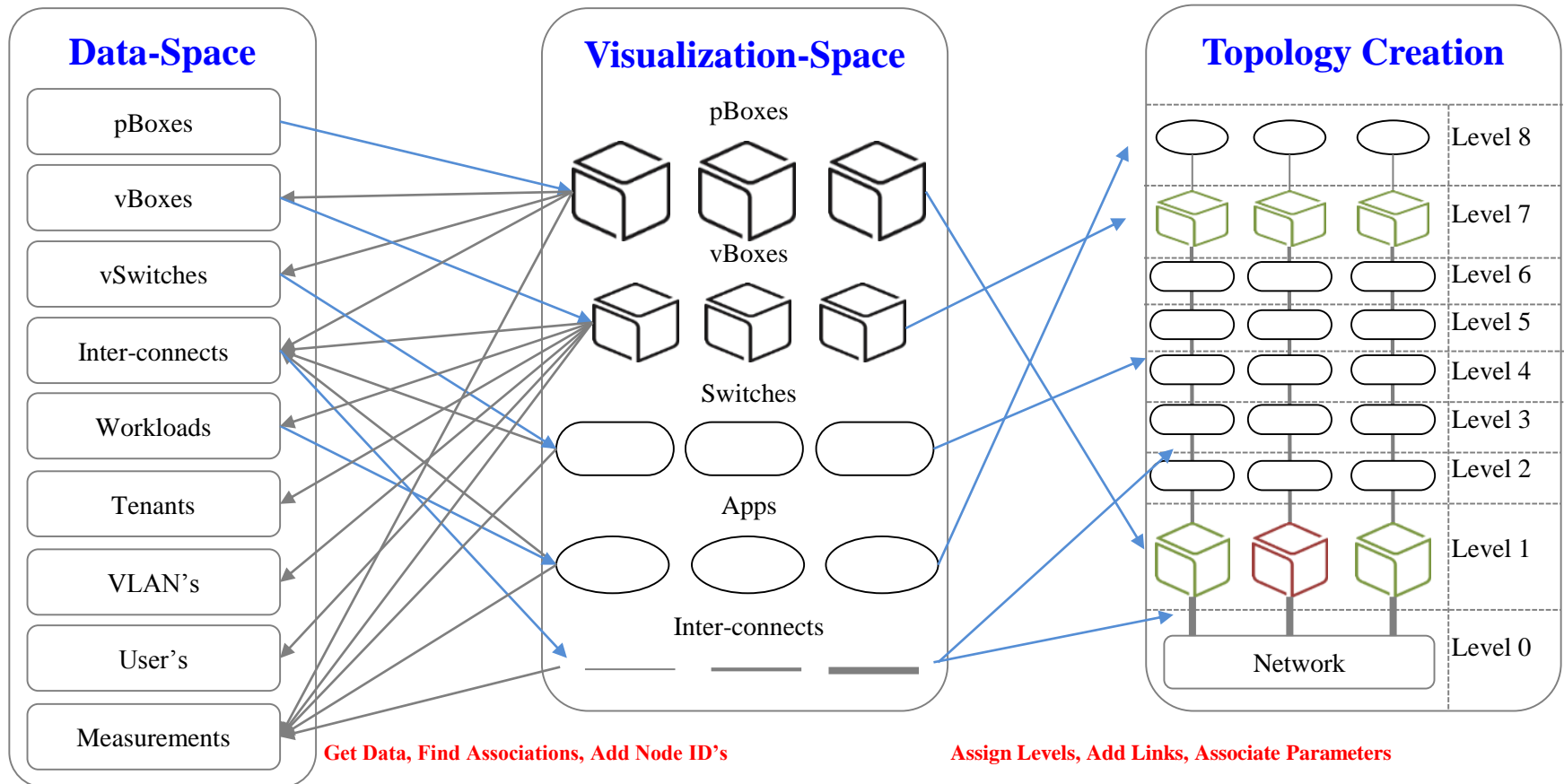
SmartX MultiView Interactive Visualization: Results
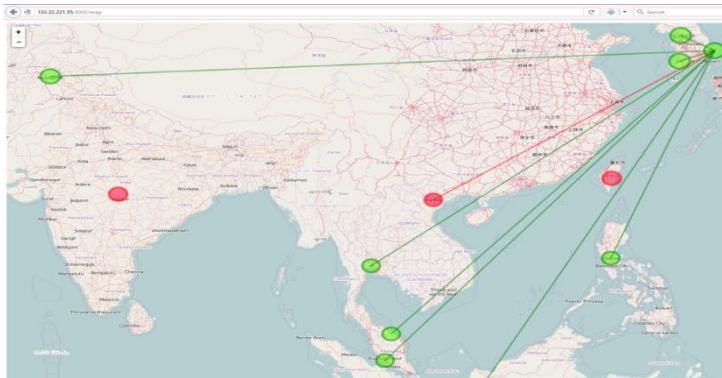
Geographical View

Playground Tower
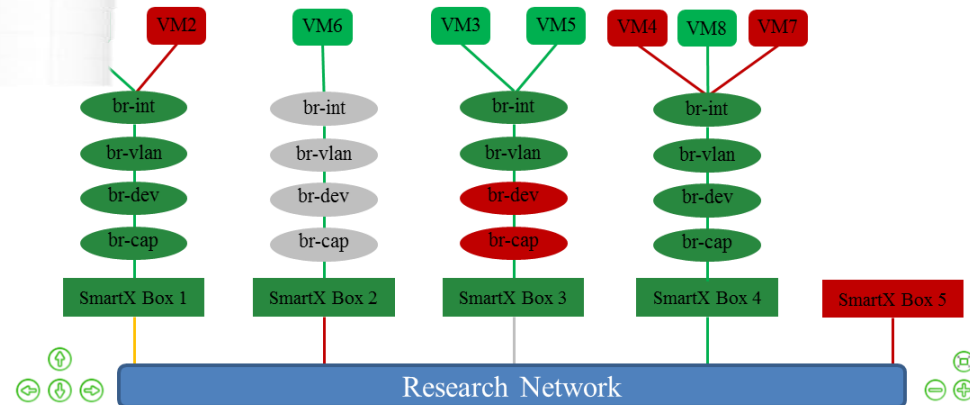
p+v topological view
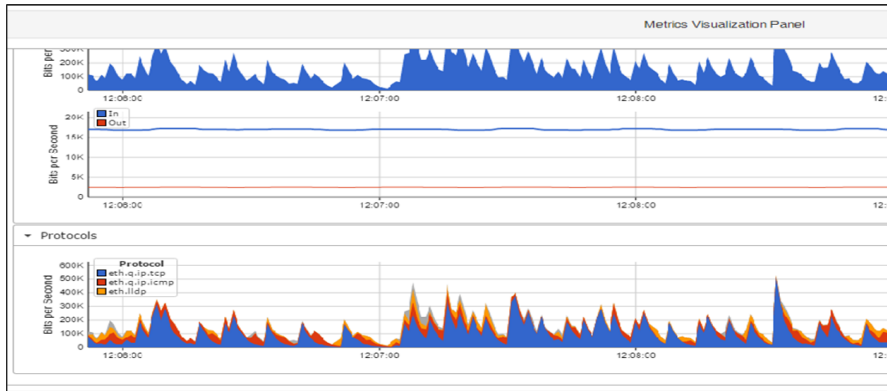
Flow-layer Visibility View

Inter-Connect Flow Path View
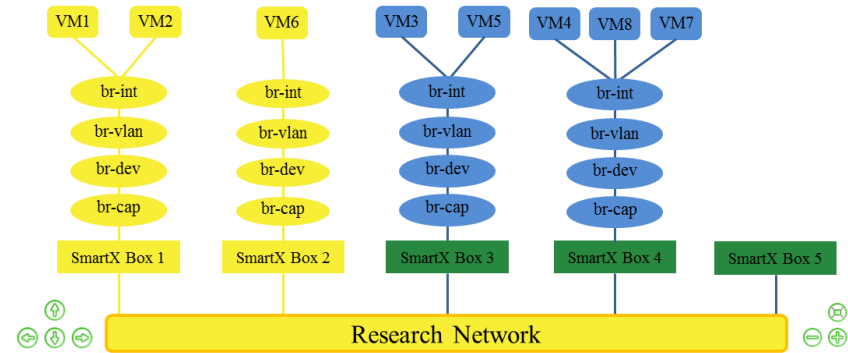
Tenant-ID	Tenant-Name	VLAN	USER-ID	USER-Name
ec8174bf08414e3	demo	102	c163bcf77ef84b12	demo
48943d51ede547	test	101	k455l32k4e89727	test

Concept of Flow-centric Visibility Leveraging SmartX MultiView Framework
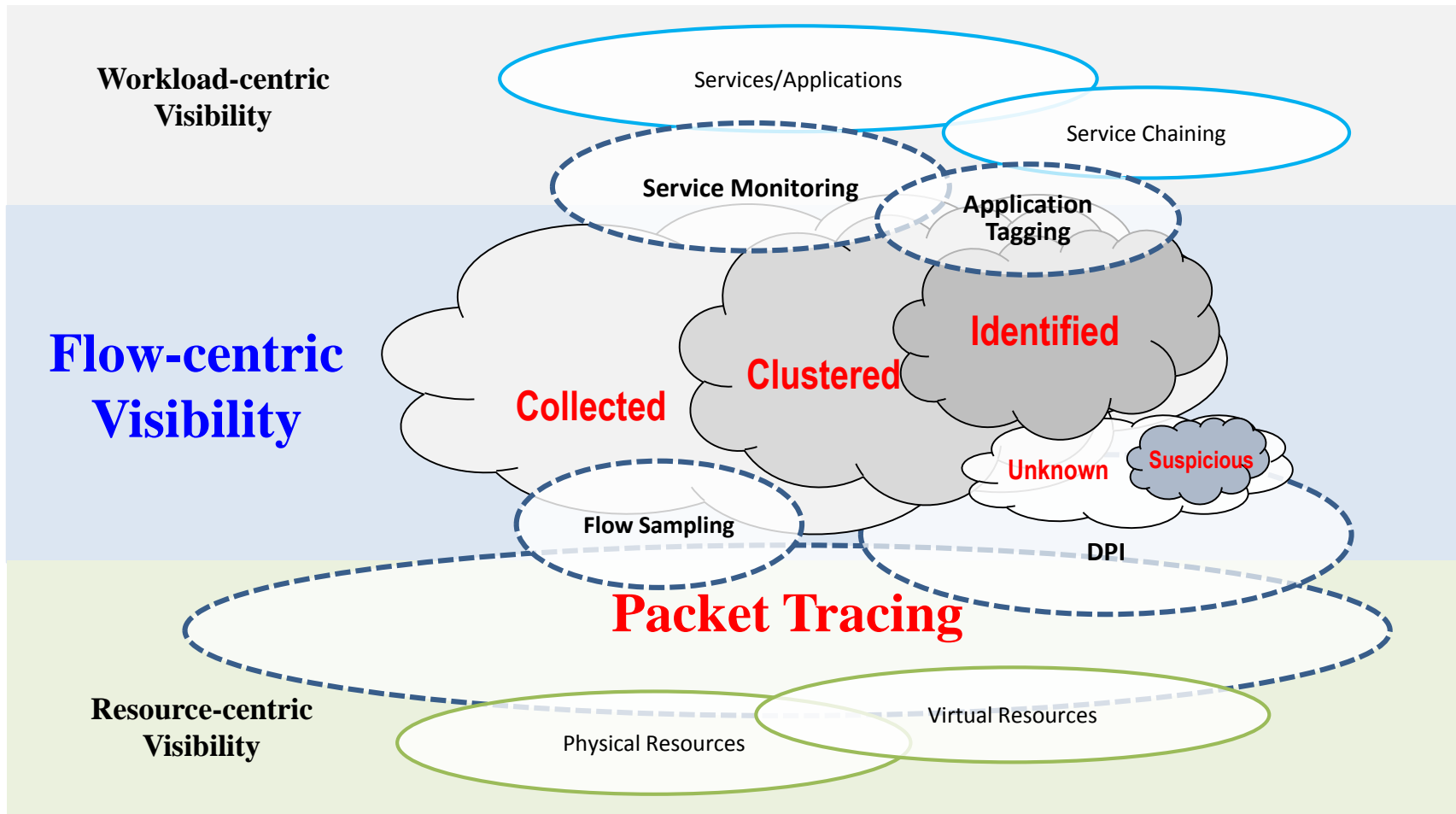
Flow-centric Visibility Design: Augmentation, Clustering & Identification Assisted by SmartX Tagging
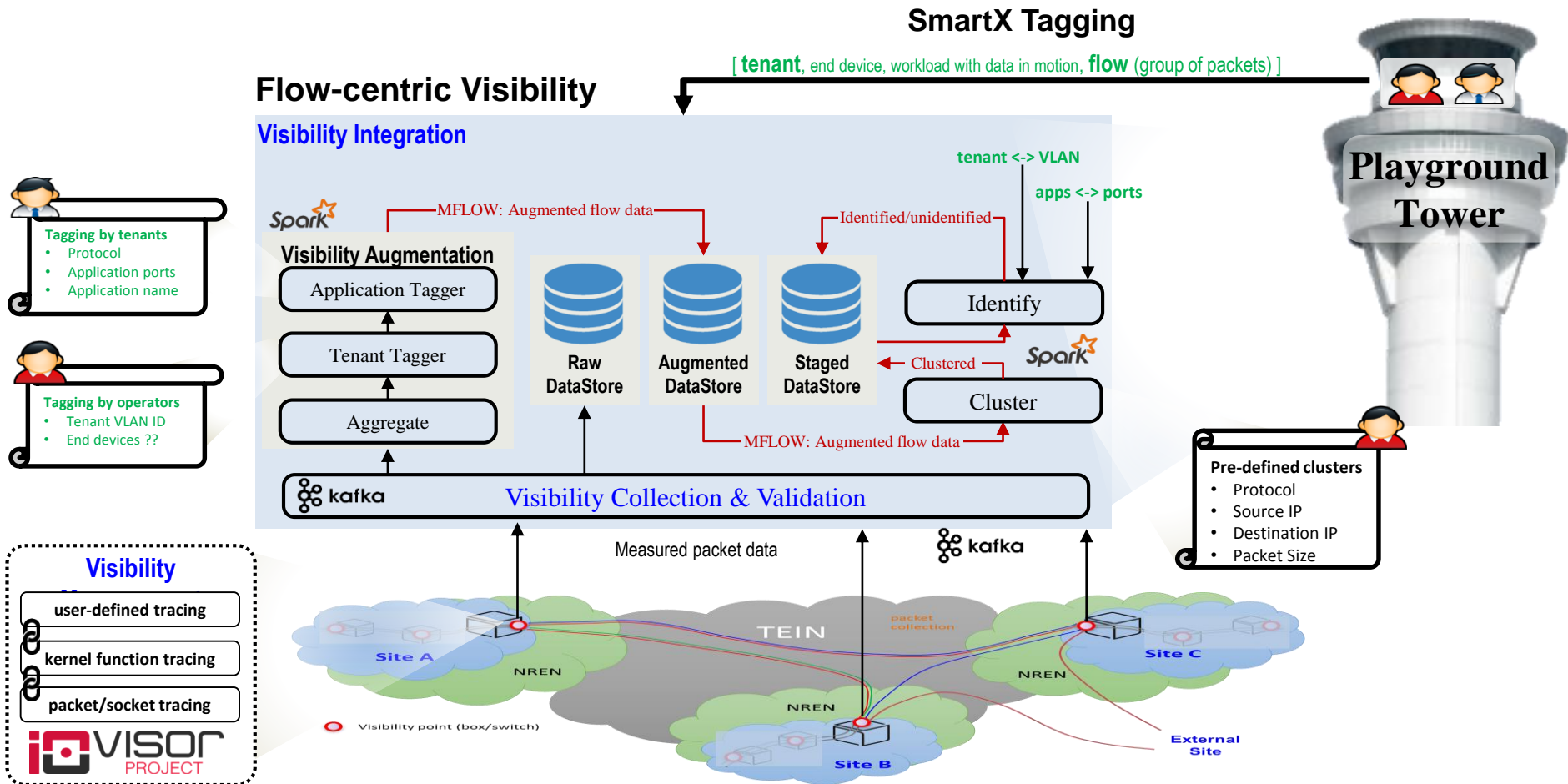
Flow-centric Visibility Implementation: Policy-based Networking Control

Elasticsearch   http://103.22.221.56:9200/   [Connect]   **elasticsearch**   cluster health: yellow (26 of 52)

Overview | Indices | Browser | Structured Query [+] | Any Request [+]

Browser

All Indices ▼

Searched 5 of 5 shards. 126 hits. 0.001 seconds

INDICES
- .kibana
- flow-centric-data
- flow-centric-data1
- flow-control-policy
- flow-iovisor-data-koren
- flow-sflow-data

TYPES
- config
- dashboard
- flowPolicy
- flowdetail
- index-pattern
- mirror
- search
- server
- timelion-sheet
- url
- visualization

FIELDS
- ▶ @timestamp   ?
- ▶ @version
- ▶ AgentID
- ▶ AgentList
- ▶ Application
- ▶ Bytes
- ▶ Cluster
- ▶ FlowKey
- ▶ FlowTag
- ▶ FrameSize
- ▶ Metric.Bytes
- ▶ Metric.Frames
- ▶ TransportProtocol
- ▶ accessCount
- ▶ accessDate   ?

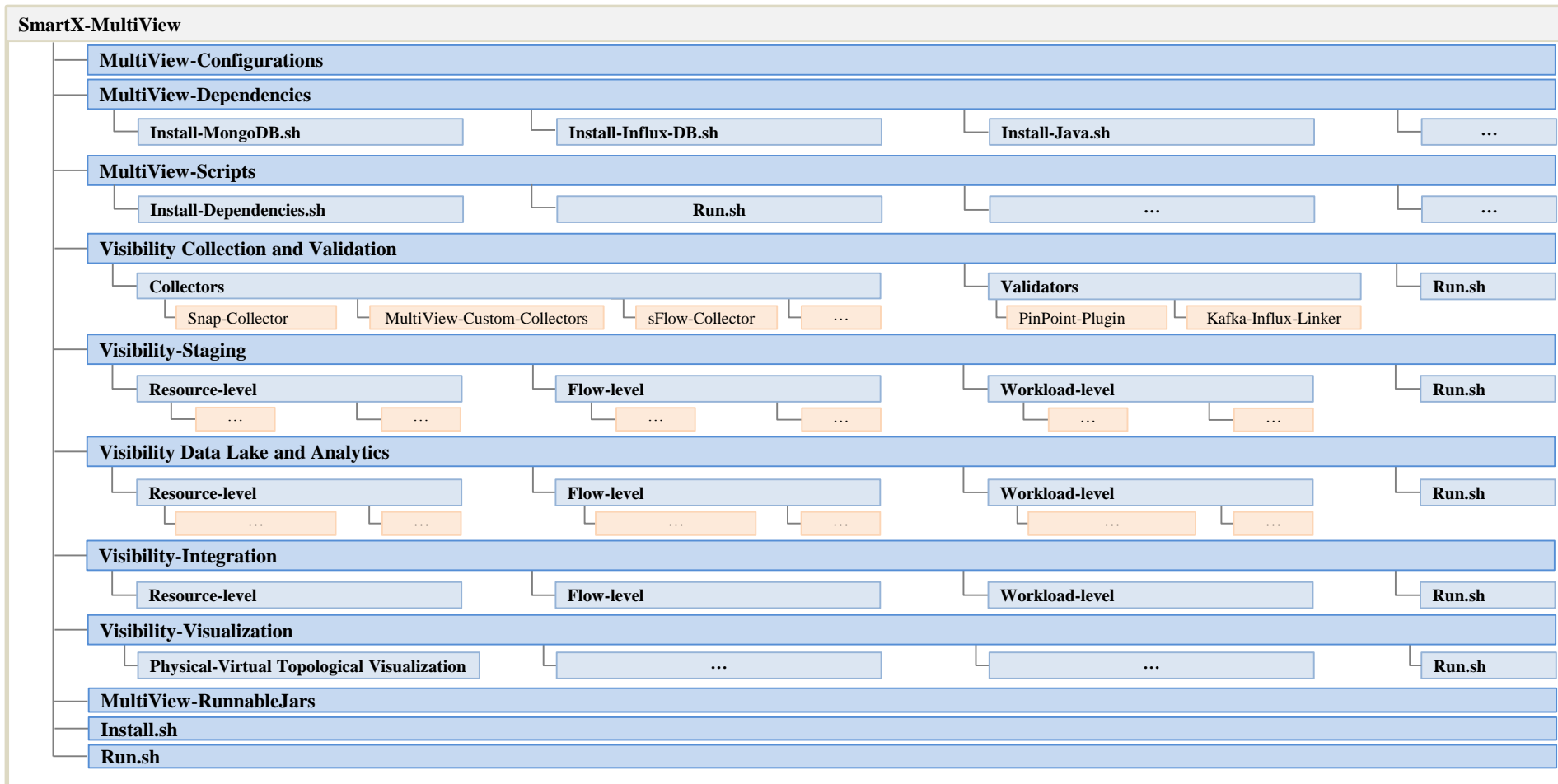| _index	_type	_id	_score ▲	processing_time	srchost	desthost	subnet	subnetcluster	packets	application	flowPolicy
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Mj	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	132	rt Service Multiplexer	FORWARD
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Mm	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	197	Character Generator	FORWARD
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Mo	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	197	IMP Logical Address Maintenance	FORWARD
flow-control-policy	flowPolicy	AWC2MUpGnsamiWVE76Mu	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	192	Daytime (RFC 867)	FORWARD
flow-control-policy	flowPolicy	AWC2MUpGnsamiWVE76Mv	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	127	NSW User System FE	FORWARD
flow-control-policy	flowPolicy	AWC2MUpHnsamiWVE76Mx	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	182	NI MAIL	FORWARD
flow-control-policy	flowPolicy	AWC2MUpHnsamiWVE76Mz	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	209	Login Host Protocol (TACACS)	FORWARD
flow-control-policy	flowPolicy	AWC2MUpHnsamiWVE76M0	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	202	Remote Mail Checking Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUtdnsamiWVE76NX	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	352	Resource Location Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUtfnsamiWVE76Na	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	425	Digital Audit Daemon	FORWARD
flow-control-policy	flowPolicy	AWC2MUo7nsamiWVE76MQ	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	95	IMP Logical Address Maintenance	FORWARD
flow-control-policy	flowPolicy	AWC2MUo7nsamiWVE76MS	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	95	WhoIs	FORWARD
flow-control-policy	flowPolicy	AWC2MUo4nsamiWVE76MN	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	206	NI FTP	FORWARD
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Mg	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	186	Gopher	FORWARD
flow-control-policy	flowPolicy	AWC2MURLnsamiWVE76NJ	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	230	Message Processing Module [recv]	FORWARD
flow-control-policy	flowPolicy	AWC2MUo1nsamiWVE76ME	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	161	Time / W32.Sober.I virus	FORWARD
flow-control-policy	flowPolicy	AWC2MUpAnsamiWVE76Mc	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	200	TACACS-Database Service	FORWARD
flow-control-policy	flowPolicy	AWC2MUtcnsamiWVE76NS	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	279	TACACS-Database Service	FORWARD
flow-control-policy	flowPolicy	AWC2MUs0nsamiWVE76NR	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	268	MSG Authentication	FORWARD
flow-control-policy	flowPolicy	AWC2MUo4nsamiWVE76ML	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	78	Daytime	FORWARD
flow-control-policy	flowPolicy	AWC2MUtnnsamiWVE76Nr	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	6780	SSH Remote Login Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUtnnsamiWVE76Nq	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	297	XNS Time Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUtpnsamiWVE76Nx	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	7091	SSH Remote Login Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUtpnsamiWVE76Nv	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	345	XNS Clearinghouse	FORWARD
flow-control-policy	flowPolicy	AWC2MUtwnsamiWVE76N6	1	1514885033916	192.168.1.17	192.168.1.46	192.168.1.0/24	KNOWN	67148		DROP
flow-control-policy	flowPolicy	AWC2MUtjnsamiWVE76Nl	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	373	Domain Name Server	FORWARD
flow-control-policy	flowPolicy	AWC2MUu6nsamiWVE76N9	1	1514885033916	192.168.1.46	192.168.1.17	192.168.1.0/24	KNOWN	77529		DROP
flow-control-policy	flowPolicy	AWC2MUtinsamiWVE76Ni	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	322	Message Processing Module [recv]	FORWARD
flow-control-policy	flowPolicy	AWC2MUtlnsamiWVE76No	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	2644	Unassigned	FORWARD
flow-control-policy	flowPolicy	AWC2MUtonsamiWVE76Nt	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	368	Trivial File Transfer	FORWARD
flow-control-policy	flowPolicy	AWC2MUtsnsamiWVE76N1	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	271	Gopher	FORWARD
flow-control-policy	flowPolicy	AWC2MUtvnsamiWVE76N3	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	377	Graphics	FORWARD
flow-control-policy	flowPolicy	AWC2MURQnsamiWVE76NL	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	255	Graphics	FORWARD
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Me	1	1514885033916	192.168.1.67	192.168.1.7	192.168.1.0/24	IDENTIFIED	153	Message Send Protocol	FORWARD
flow-control-policy	flowPolicy	AWC2MUpBnsamiWVE76Mk	1	1514885033916	192.168.1.7	192.168.1.67	192.168.1.0/24	IDENTIFIED	199	Discard	FORWARD

Initial results for Flow-centric visibility integration

How to Contribute into SmartX MultiView Software

SmartX-MultiView

MultiView-Configurations

MultiView-Dependencies

| Install-MongoDB.sh | Install-Influx-DB.sh | Install-Java.sh | … |

MultiView-Scripts

| Install-Dependencies.sh | Run.sh | … | … |

Visibility Collection and Validation

| Collectors | Validators | **Run.sh** |

| Snap-Collector | MultiView-Custom-Collectors | sFlow-Collector | … | PinPoint-Plugin | Kafka-Influx-Linker |

Visibility-Staging

| Resource-level | Flow-level | Workload-level | **Run.sh** |

| … | … | … | … | … | … |

Visibility Data Lake and Analytics

| Resource-level | Flow-level | Workload-level | **Run.sh** |

| … | … | … | … | … | … |

Visibility-Integration

| Resource-level | Flow-level | Workload-level | **Run.sh** |

Visibility-Visualization

| Physical-Virtual Topological Visualization | … | … | **Run.sh** |

MultiView-RunnableJars

Install.sh

Run.sh

GitHub-shared Software

https://github.com/OFTEIN-NET/Visibility-SmartX-MultiView

SmartX MultiView:
Demonstration

Thank You

ops@oftein.net