OF@TEIN+ Playground:
Software for SmartX Micro(μ)-Box

OF@TEIN+ 1st Annual Meeting 2018

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Outline

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- DRAFT Proposal for OF@TEIN+ Playground
- **SmartX Micro-Box: Concept & Requirements**
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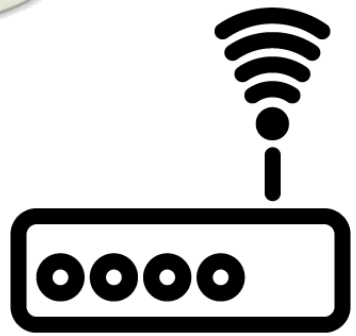
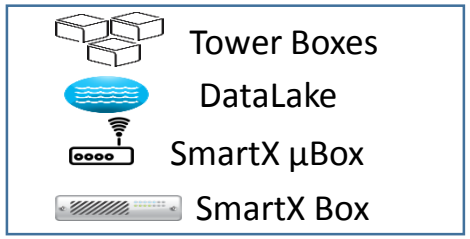
  - Motivation
  - Micro-Box Concept
  - SmartX Micro-Box Deployment Design
- **SmartX Micro-Box: Active Monitoring**
  - Design
  - Implementation
  - Results
- **SmartX Micro-Box: Passive Monitoring**
  - Design
  - Implementation
  - Results
- **SmartX Micro-Box: Accessibility**
  - Design
  - Future Directions



DRAFT Proposal for OF@TEIN+ Playground

2018.01.16



GIST

P V S O Centers

DataLake

SDX

Controllers

Playground Tower

Production-focused

Sites with **SmartX Box**

Sites with **SmartX µBox** for IoT Devices

NREN

Site Net.

NREN

Site Net.

NREN

NREN

TEIN

Underlay Networks

SD-WAN

Edge Cloud

End (IoT/Access)

UM

P O V S Centers

Controllers

SDX

DataLake

Playground Tower

Incubation-focused

NCKU

Controllers

SDX

SOC

P V S Centers

DataLake

Playground Tower

Research-focused

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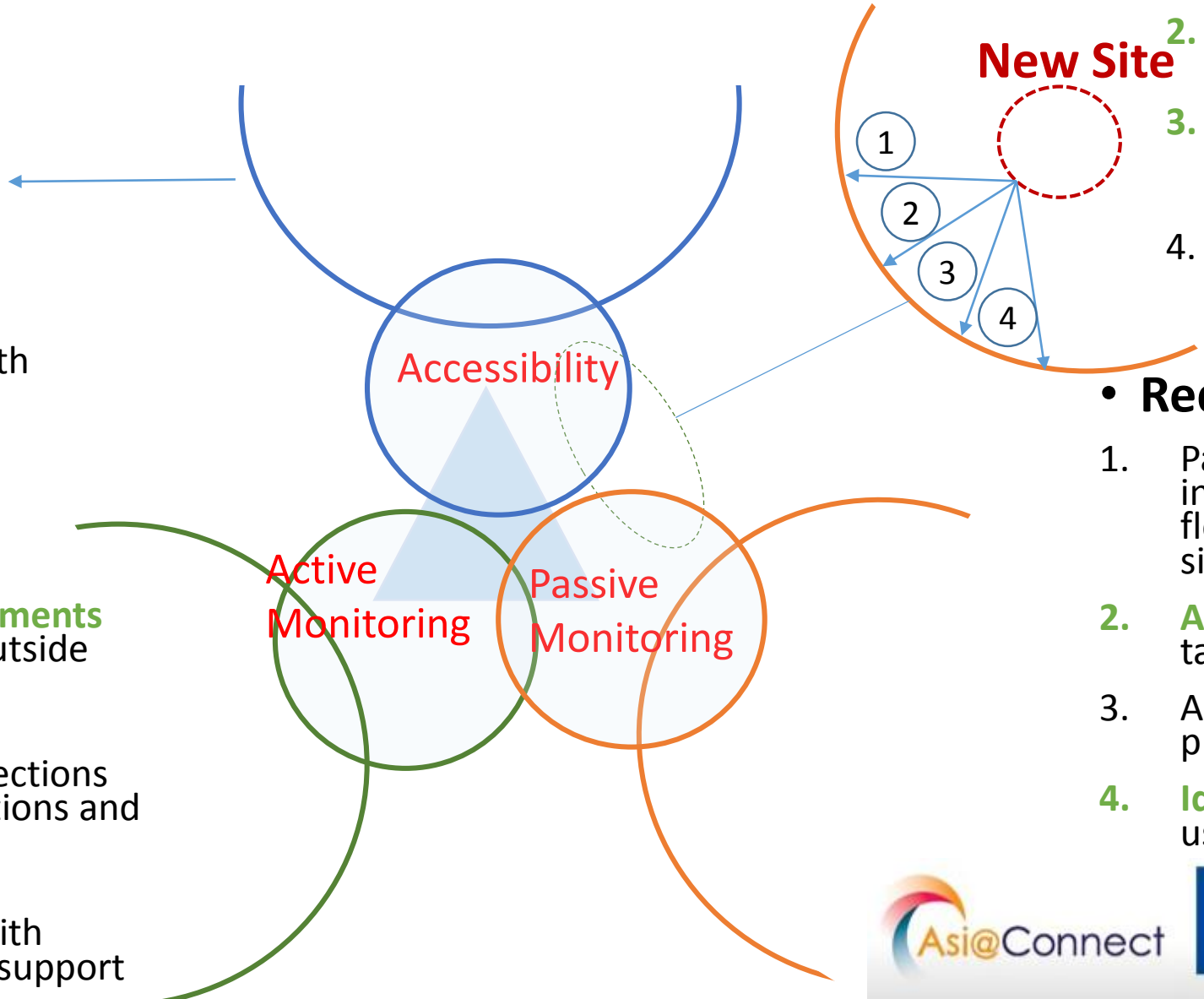
Requirement of Software for SmartX Micro-Box

- **Requirements**

1. Catering Firewall restrictions
2. Access for Site without SmartX Box
3. Access from internet with authentication.

- **Requirements**

1. Provide traffic **measurements** from both inside and outside network
2. Must verify site-to-site **reachability** in both directions (such as firewall restrictions and asymmetric routing)
3. A centralized **archive** of measurement results with dedicated visualization support



- **Requirements**

1. **Connection** accessibility with the network (i.e. Direct internet access)
2. **Resource/Service** accessibility
3. **Remote access** through Firewall with VLAN segmentation
4. Remote **authentication**

- **Requirements**

1. Packet precise **tracing** of all incoming and outgoing flows from any particular site
2. **Analyze** passing **traffic** to take action
3. Actively **stop** access to the playground infrastructure
4. **Identifying** each connected user.

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Motivation for Software for Micro-Box

- ***Portable resource efficient software***
- ***Assisting 'Visibility' and 'Access Center' in Production Focus Play Ground Tower***
- ***By providing monitoring and accessibility capabilities at the Site-level SmartX Box.***

OF@TEIN Playground Monitoring

- **Purpose**: To improve operations and reduce service interruptions of OF@TEIN Playground
  - **Active Monitoring:**
    - Injecting artificial traffic into network
    - Monitors and bases results on real-time data
    - Collect smaller amounts of data specific to the problem
    - Need to cater Network performance degradation
  - **Passive Monitoring**
    - Trace the packet traffic passing in/out of the Box.
    - Lightweight packet tracing replacing pcacp based method
    - Storing Data for predictive analysis
- **Goals:**
- Identify the Box status, 'Top talkers' and bandwidth abuser within the network environment (Services, Users, Machines)
- Setting baselines for traffic and bandwidth usage for analysis

Motivation for Software for Micro-Box

OF@TEIN Playground Accessibility

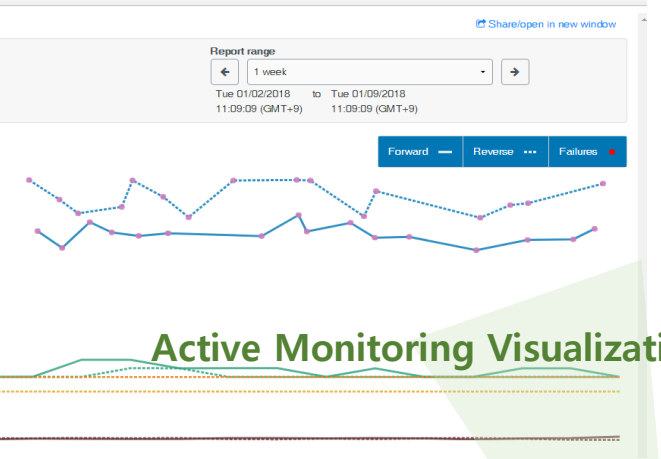
- **Purpose:**
- Solve the current access limitations to the resources (e.g. public IP address limitation, lack of graphical interface, bandwidth limitation).
- **Goals:**

i) Multiple points of entry for access center,

ii) Multiple access schemes with different solutions (script-/program-based and GUI-based accesses).

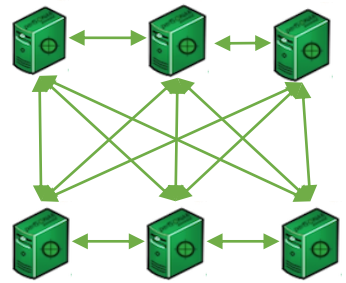
Updated: 2107-01-10

SmartX Micro-Box Deployment Design



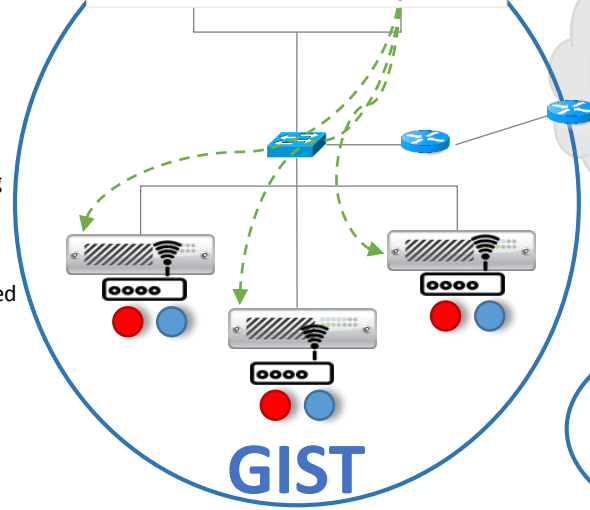
Active Monitoring Visualization

Active Monitoring



Playground Tower

OF@TEIN+ Playground



GIST

MYREN

ASTI

PREGINET

TEIN

NREN

NEWSITE

KOREN

VINAREN

THAIREN

CHULA

HUST

University/Department/Lab

Active Monitoring

Passive Monitoring

Access

One way Centralized access/monitoring only

SmartX µBox

SmartX Box

Firewall

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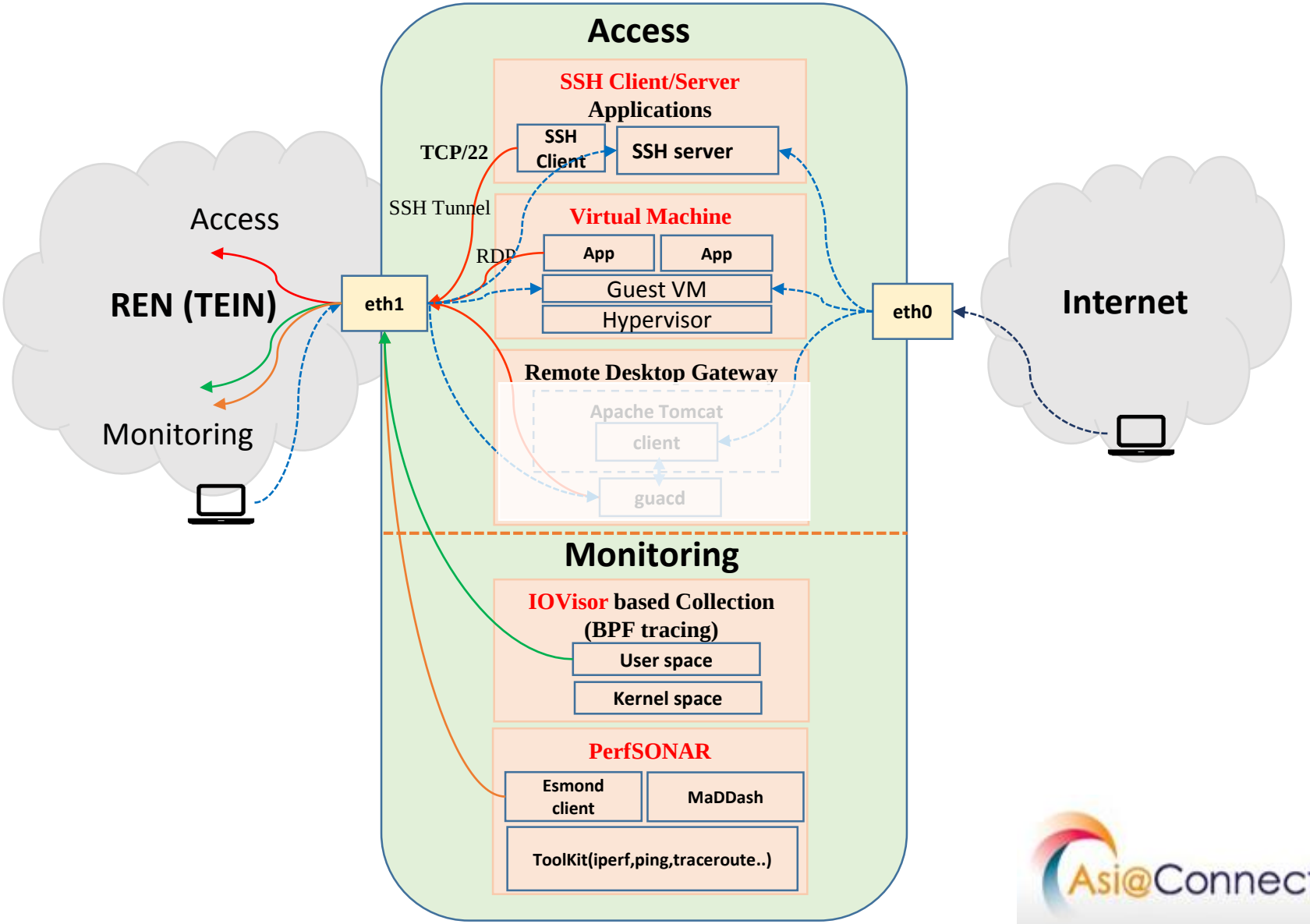
Software for Micro-Box : Concept



Connection with Box
Access
Passive Monitoring
Active Monitoring

??? Role of Micro-Box
What is Micro-Box
Why need for Micro-Box

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Software for SmartX Micro-Box (version $) Deployment Status

Site Name	Box IP	Software Component(s)			Deployment Status
		Active (perfSONAR)	Passive (IOVisor)	Access	
Visibility-Center	103.22.221.55	MaDDash (PerfSONAR Dashboard)			Running and configured for perfSONAR toolkit mesh
MY-UM	203.80.21.4	○	○	○	Running and Configured
TH-CHULA	161.200.25.99	○	○	○	Running and Configured
TW-NCKU	140.116.214.241	○	○	○	Running and Configured
PH-PREGINET	202.90.150.4	○	○	○	Running
GIST (KR-GIST1,KR-GIST2, KR-GIST3)	103.22.221.170				
	103.22.221.31				
	103.22.221.30				

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Installation Requirements of Software for SmartX Micro-Box

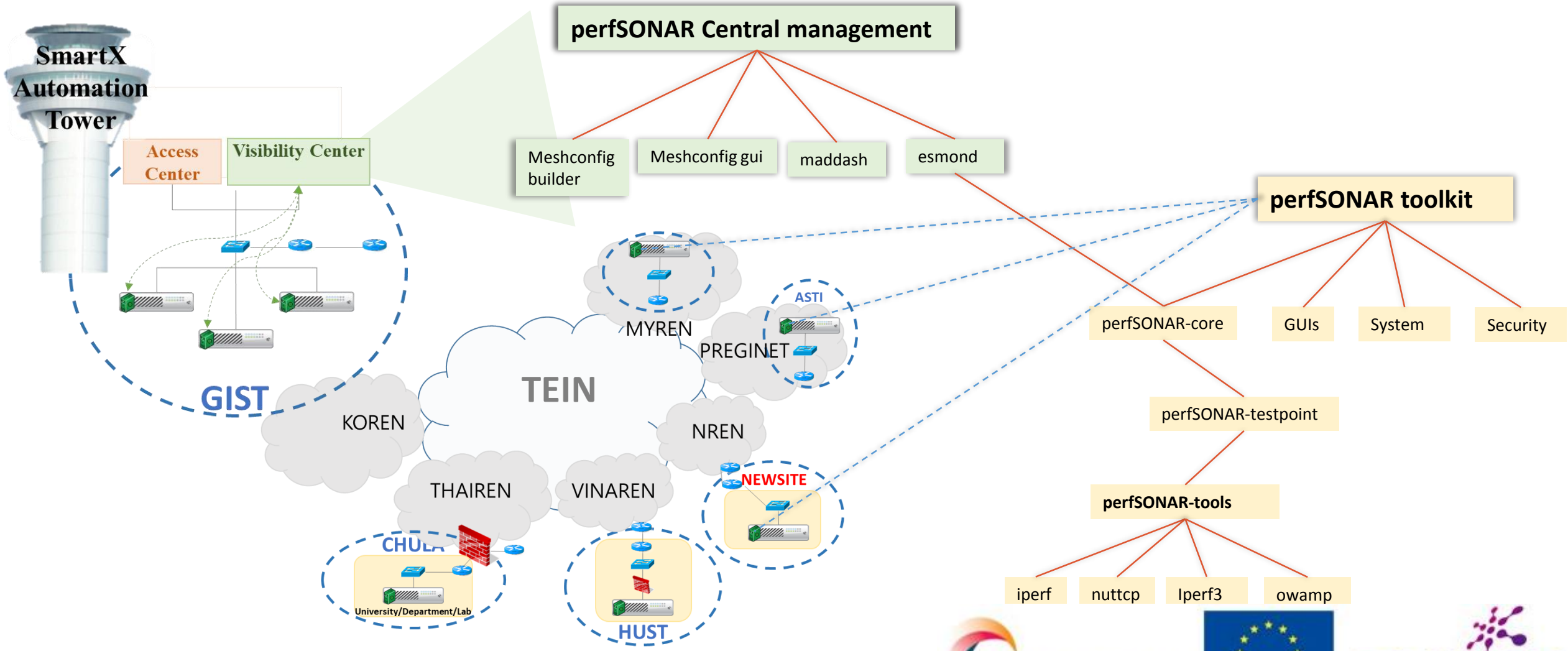
Software

- Ubuntu 14.04.4/16.04.*
- Linux kernel version 4.1 or newer

Hardware

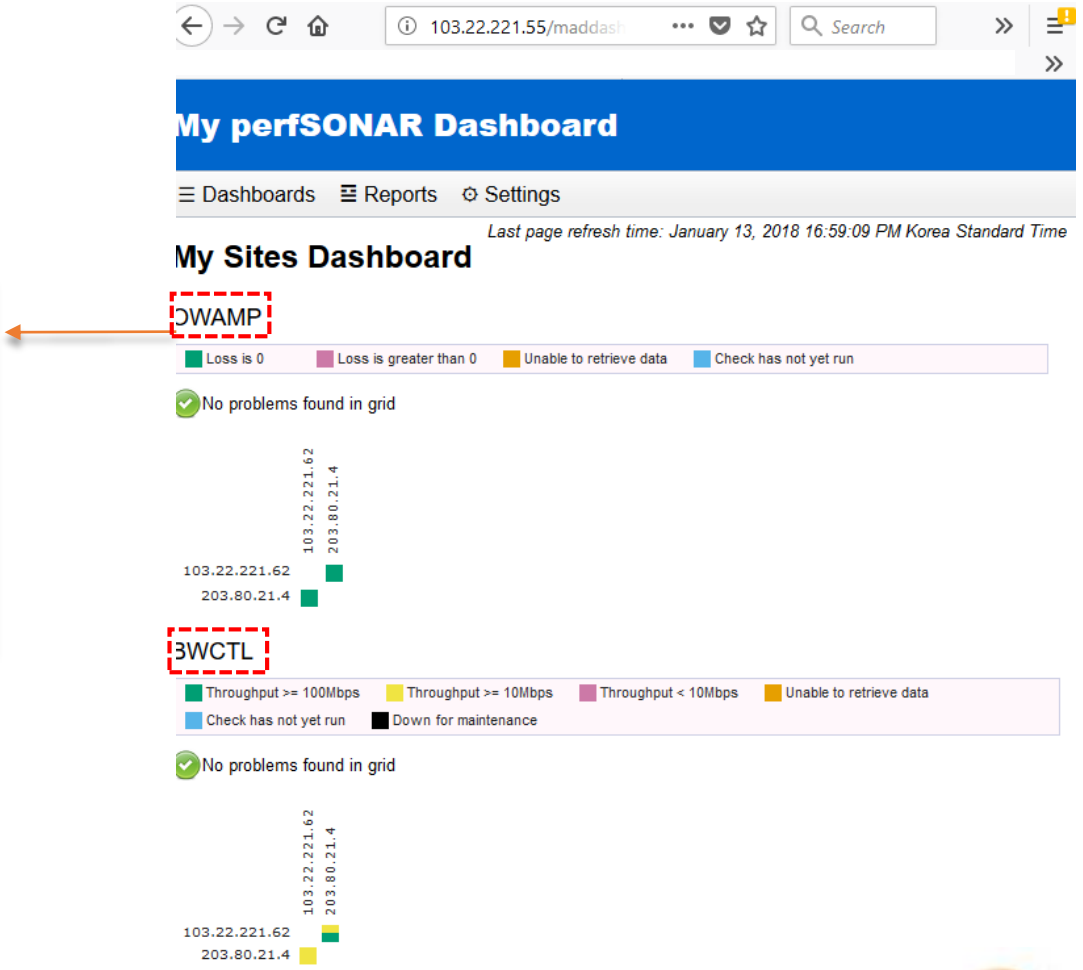
- 4GB RAM
- Minimum of 100GB of space for storage.
- Network interface card (1Gbps or greater) for Throughput testing
- 2.8GHz or higher Clock Speed
- Processor:x86 and x86_64 architectures
- Minimum of two Interfaces

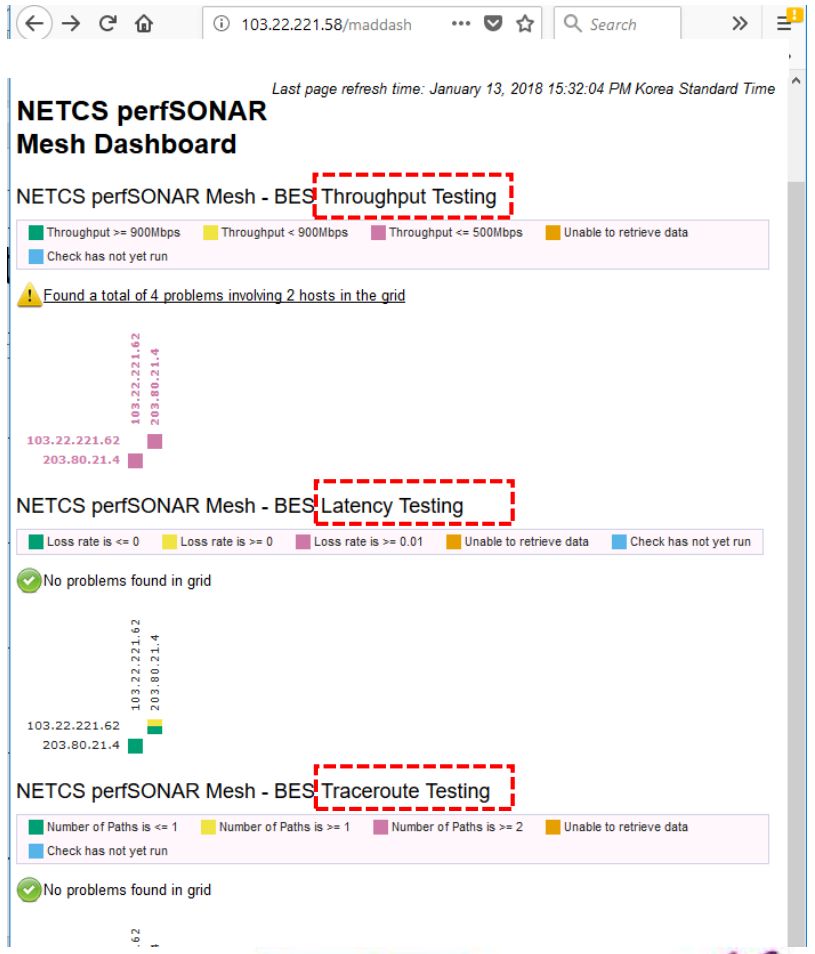
Active Monitoring (perfSONAR Installation) in SmartX Micro-Box



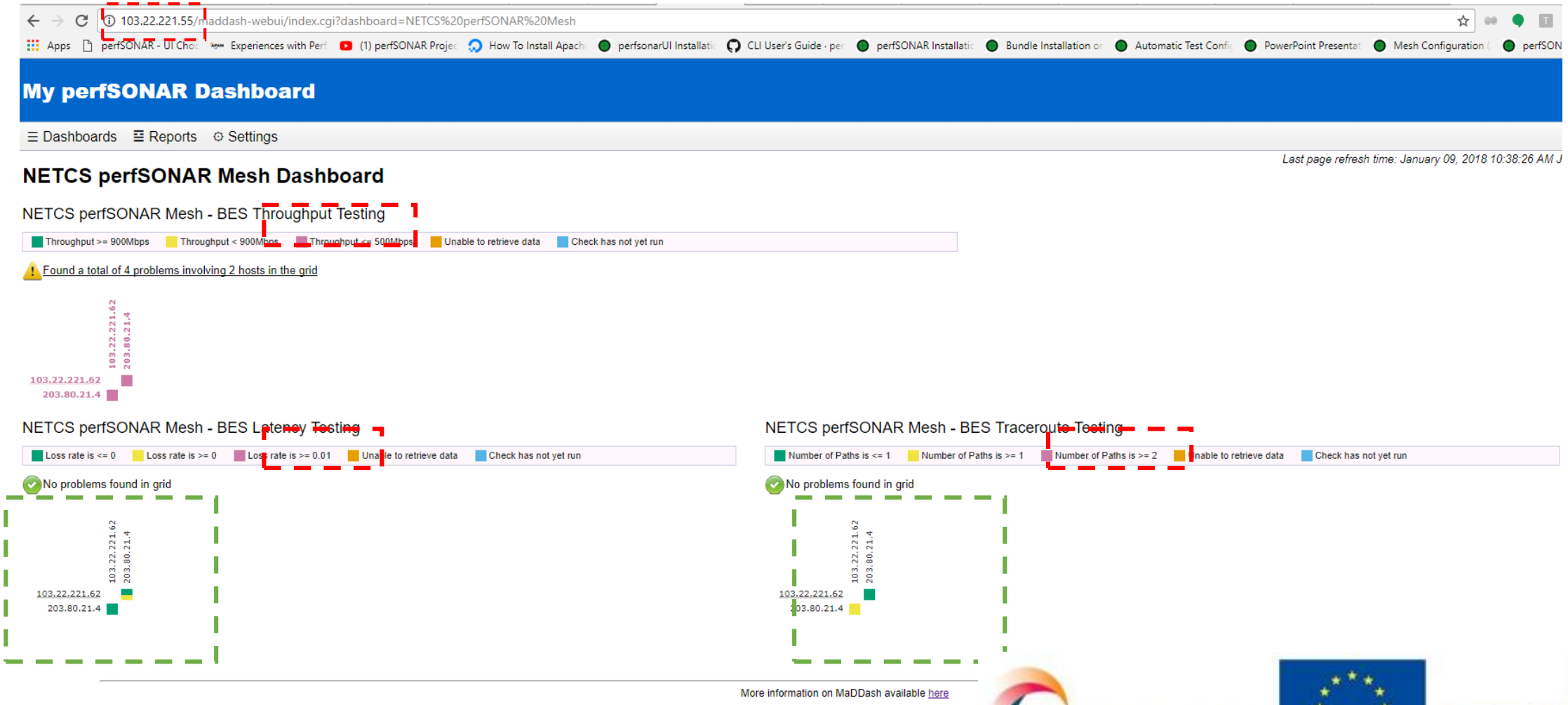
Active Monitoring : PerfSONAR Dashboard for Centralized status and Visualization

Configured Tests
- OWAMP
- BWCTL
- Throughput
- Latency testing
- traceroute





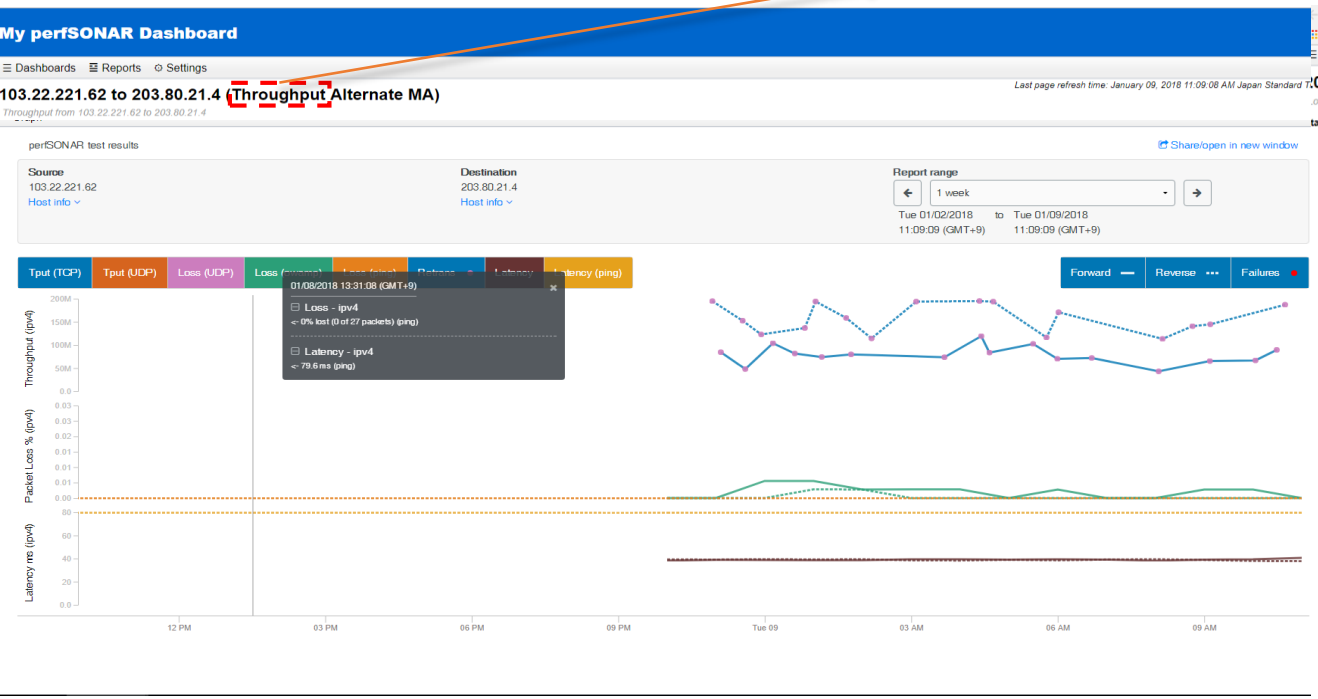
Active Monitoring : PerfSONAR Dashboard for Centralized status and Visualization

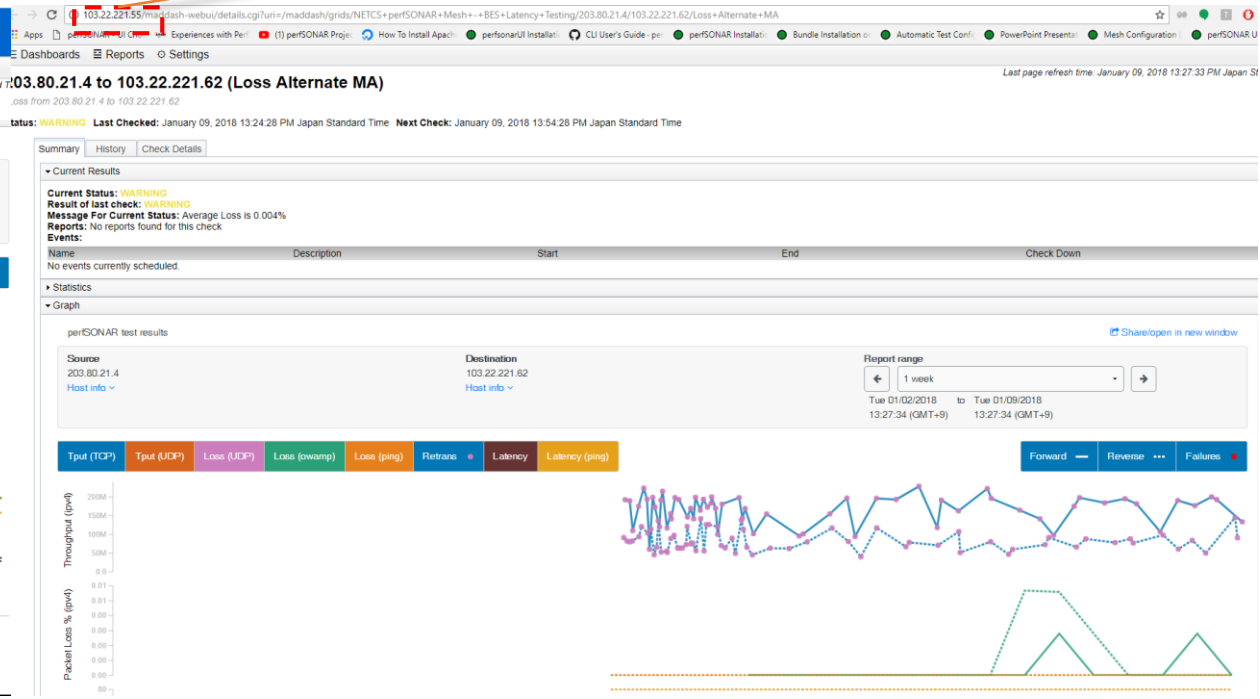


Active Monitoring : PerfSONAR Dashboard for Centralized status and Visualization

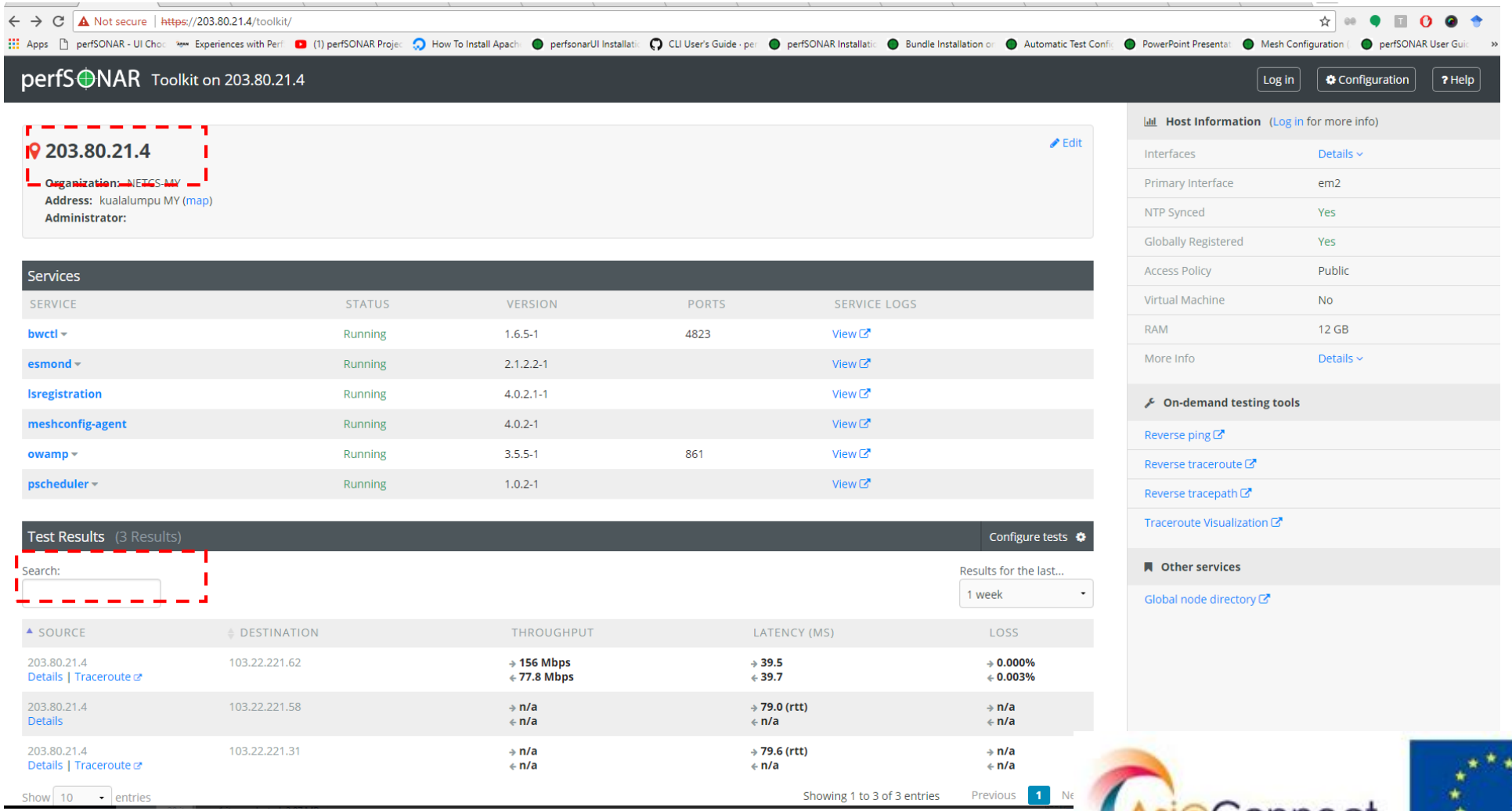
Throughput graph

IP with MaDDash Configured

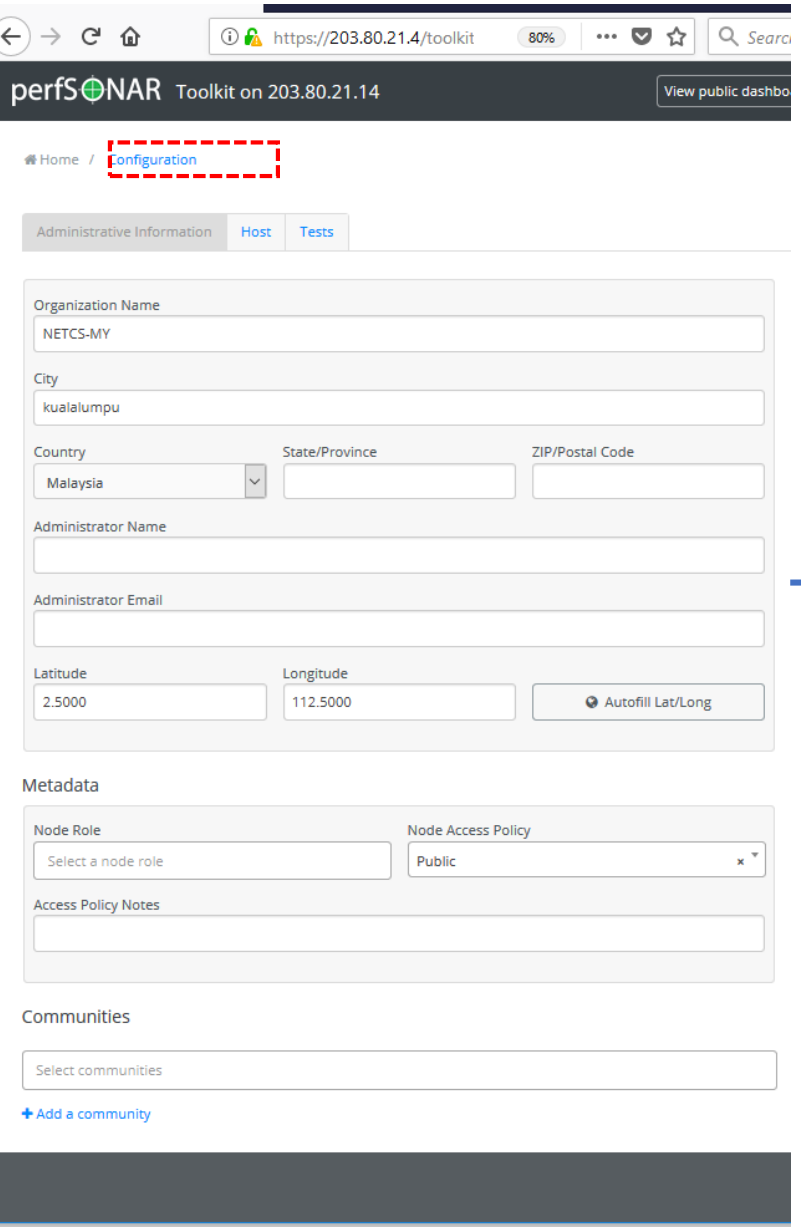


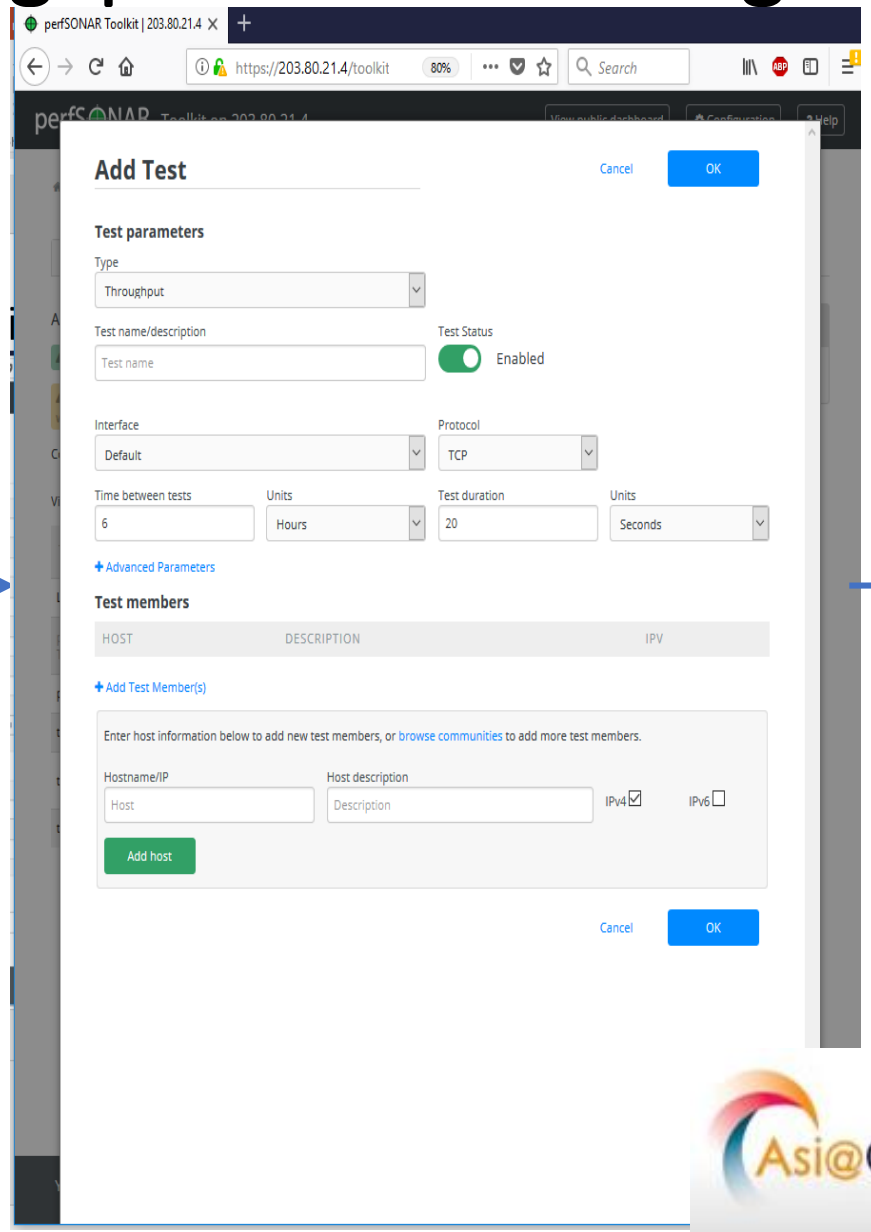


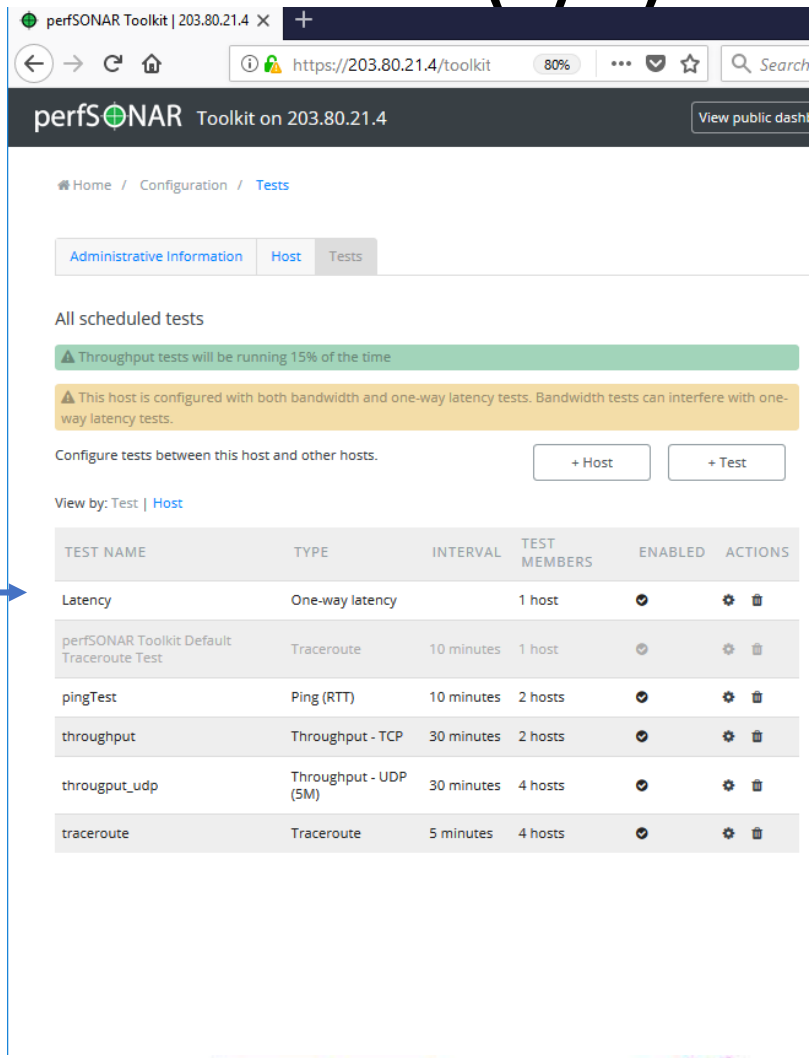
Active Monitoring: perfSONAR Running on SmartX Micro-Box with Test Results



Active Monitoring: perfSONAR Configuration On-Site (1/2)







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Active Monitoring: perfSONAR Configuration for Central Management (2/2)

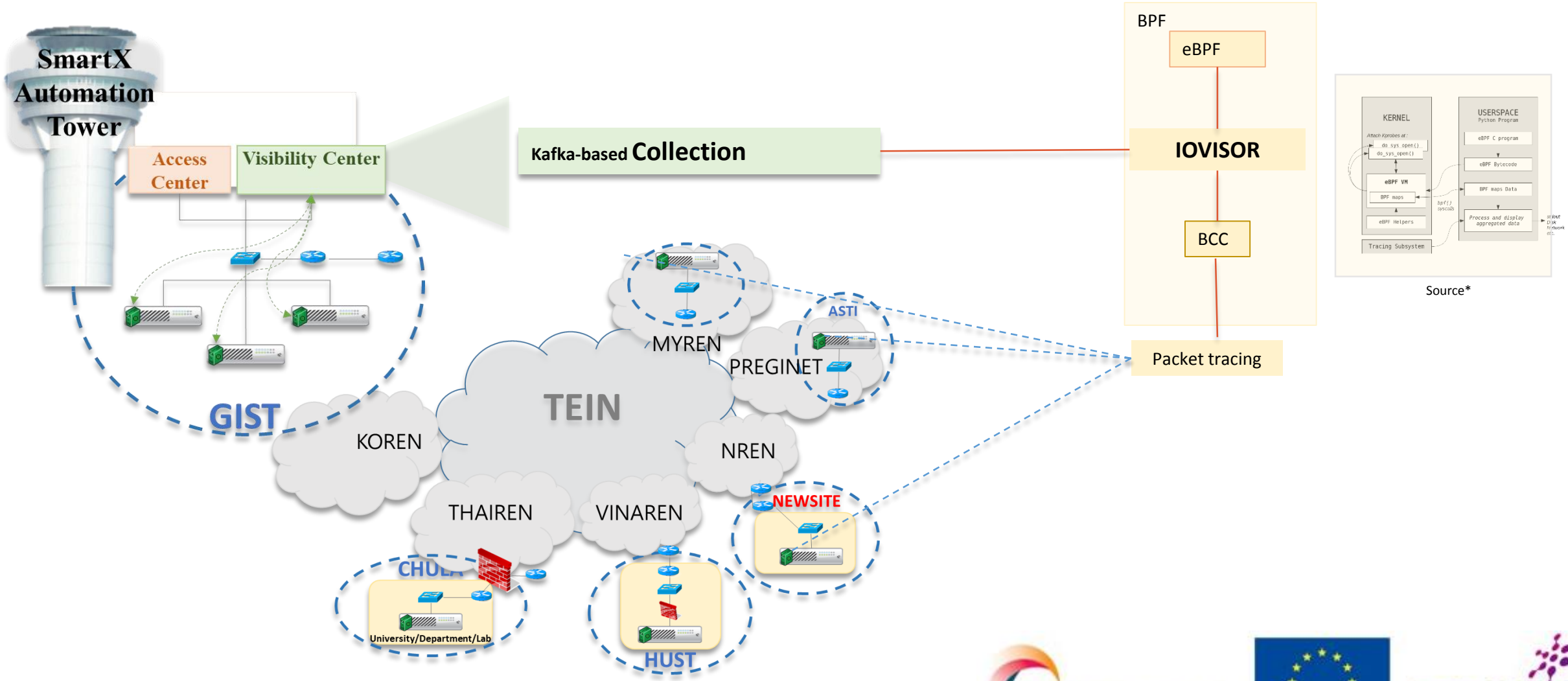
Mesh File Publish as json

```
{
   "tests" : [
      {
         "description" : "BES Throughput
Testing",
         "members" : {
            "members" : [
               "203.80.21.4",
               "103.22.221.62"
            ],
            "type" : "mesh"
         },
         "parameters" : {
            "duration" : "20",
            "tool" : "bwctl/iperf3",
            "omit_interval" : "5",
            "interval" : "28800",
            "type" :
"perfsonarbuoy/bwctl",
            "force_bidirectional" : "1",
            "random_start_percentage" :
"25",
            "protocol" : "tcp"
         }
      },
      {
         "members" : {
            "members" : [
               "203.80.21.4",
               "103.22.221.62"
            ],
            "type" : "mesh"
         },
```

Configuration File for the maddash-server Component

```
NETCS_perfSONAR_Mesh_-_BES_Throughput_Testing_-
_Throughput_Alternate_MA:
    checkInterval: 14400
    critical_description: Throughput <= 500Mbps
    description: Throughput from %row to %col
    id: NETCS_perfSONAR_Mesh_-_BES_Throughput_Testing_-
_Throughput_Alternate_MA
    name: Throughput Alternate MA
    ok_description: Throughput >= 900Mbps
    params:
      command:
'/usr/lib/nagios/plugins/check_throughput.pl -u %maUrl -w
0.9: -c 0.5: -r 86400 -s %row -d %col -a %col -p tcp'
      graphUrl:
        103.22.221.62:
          default: /perfsonar-
graphs/?url=%maUrl&source=%row&dest=%col&agent=%col
        203.80.21.4:
          default: /perfsonar-
graphs/?url=%maUrl&source=%row&dest=%col&agent=%col
      maUrl:
        103.22.221.62:
          default:
http://203.80.21.4/esmond/perfsonar/archive
        203.80.21.4:
          default:
http://103.22
    retryAtte
    retryInte
    timeout:
    type: net
    warning d
```

Passive Monitoring using IOVisor in SmartX Micro-Box



*Source: https://thenewstack.io/comparing-dtrace-iovisor-new-systems-performance-platform-advance-linux-networking-virtualization/

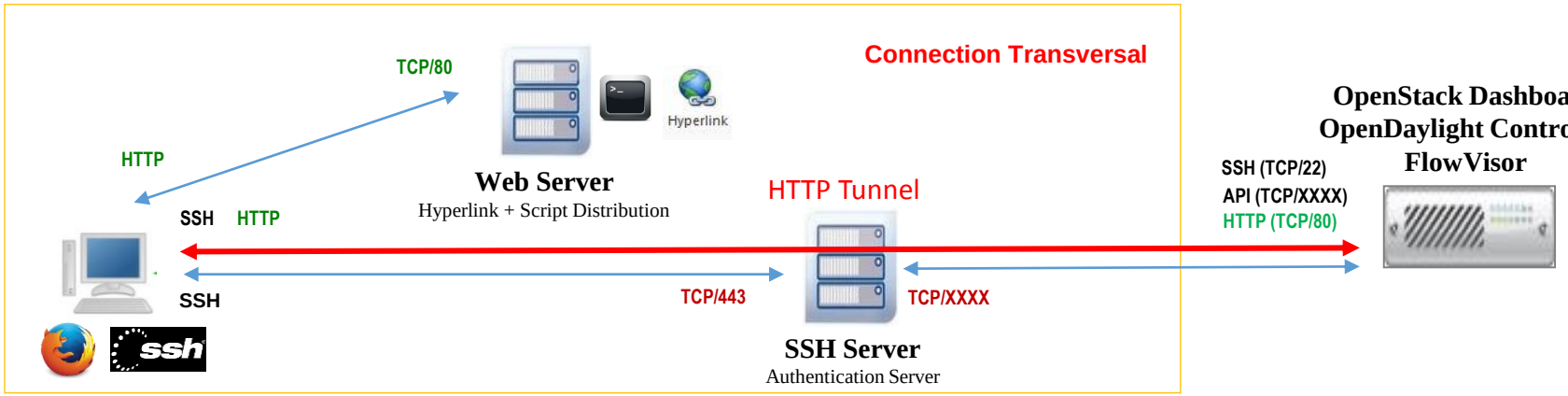
Passive Monitoring: Collection at SmartX Micro-Box

- IOVisor:
  - Constantly collect data from the network over a certain period of time
  - Bases results on the long-term measurements data.
  - Traces traffic as they enter or leave the specific site.
  - Advantage: Far less resource-consumption as compared to active monitoring

```
root@netcs-desktop:/home/netcs# ./packet_tracing_with_kafka_temp.py
In file included from /virtual/main.c:2:
In file included from include/net/sock.h:51:
In file included from include/linux/netdevice.h:38:
In file included from include/linux/dmaengine.h:20:
In file included from include/linux/device.h:24:
In file included from include/linux/pinctrl/devinfo.h:21:
In file included from include/linux/pinctrl/consumer.h:17:
In file included from include/linux/seq_file.h:10:
include/linux/fs.h:2659:9: warning: comparison of unsigned enum expression < 0 is always false [-Wtautological-compare]
        if (id < 0 || id >= READING_MAX_ID)
            ~~ ^ ~
1 warning generated.
MachineIP    ipver      Src IP Addr      src Port      Dst IP Addr     Dst Port  Packet Length    protocol  Local_Src_Addr  Local_des_Addr  VNI VLANID
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '228', '6', '218.14.190.16', '250.110.255.100', '104', '49')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '62.31.182.229', '77.159.226.20', '104', '301')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '204.102.61.143', '204.184.217.113', '104', '89')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '182.128.137.203', '45.92.150.104', '104', '231')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '129.66.215.182', '84.53.2.42', '104', '326')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '123.74.143.86', '201.220.28.190', '104', '248')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '127.170.255.107', '67.200.198.96', '104', '402')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '77.239.234.217', '140.14.224.248', '104', '230')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '145.72.69.159', '93.207.189.137', '104', '312')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '102.78.127.91', '140.3.180.195', '104', '31')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '138.73.95.121', '66.247.90.83', '104', '186')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '85.1.163.130', '14.73.50.81', '104', '87')
('', '4', '103.22.221.62', '22', '203.237.53.66', '2182', '196', '6', '175.229.117.134', '232.240.238.252', '104',
```

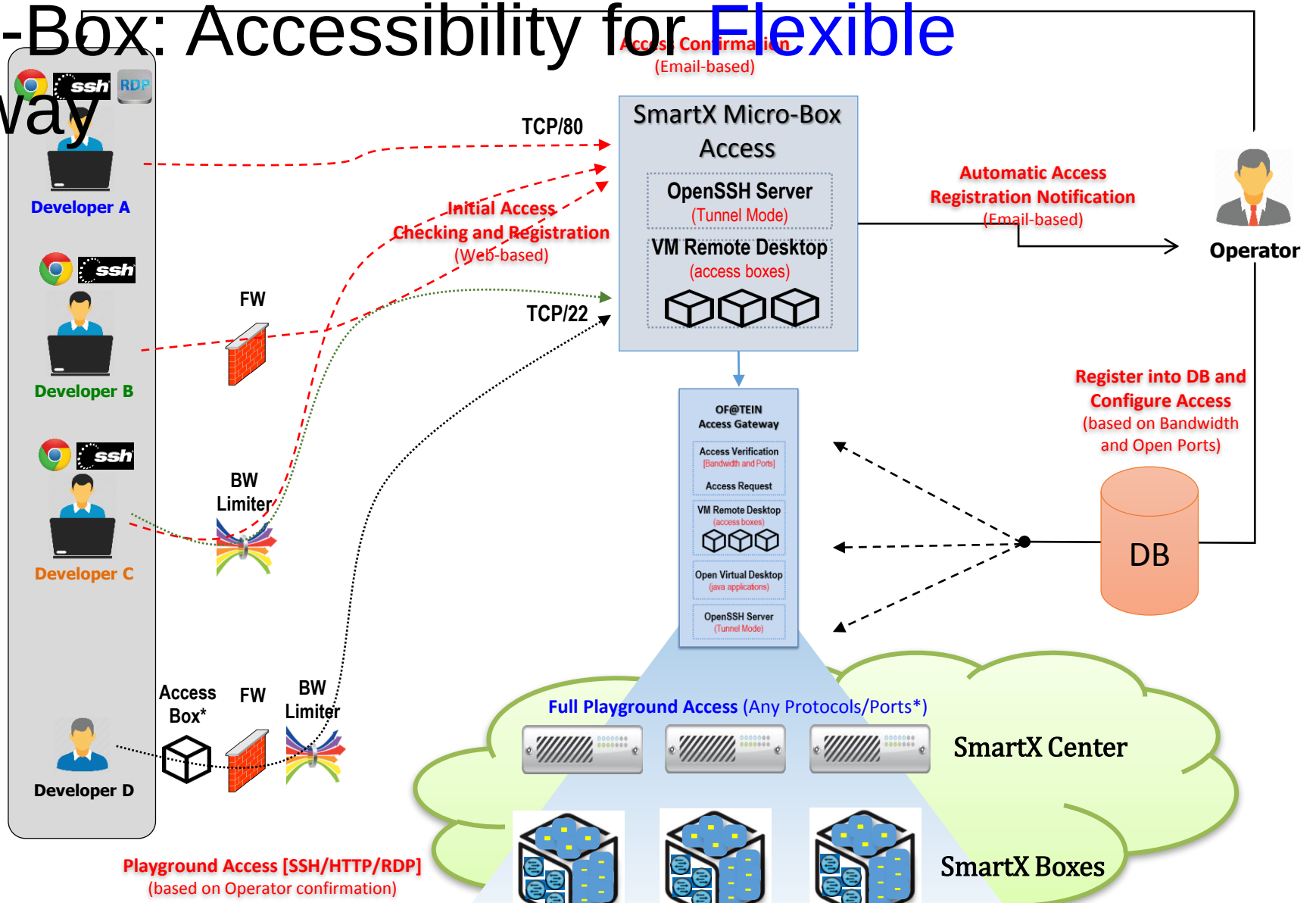
SmartX Micro-Box: Accessibility

1. Heterogeneous physical network setup and Multi-domain network administrative over OF@TEIN
2. Distributed Resources controlled by centralized tools (SmartX Operation and Automation Center)
3. Customized tools and applications sharing is challenging
4. Centralized Access for easy incoming and outgoing access control
5. Shared environment or common virtual desktop for easy shared customized tools and applications



"Providing common/similar access to every operators and developers to OF@TEIN resources in every sites (region) from some external network (possibly internet*) for experimentation. "

SmartX Micro-Box: Accessibility for Flexible Access Gateway



Smartx Micro-Box – Installation/Configuration scripts

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Future Directions for SmartX Micro-Box

- Containerized solution for SmartX Micro-Box
- Secure Update
- Add appropriate logging into "Daily Visibility Report“
- Identify optimal measurement settings for active monitoring

GitHub

https://github.com/SmartX-Team/Provisioning-SmartX-MicroBox

docker

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Options for SmartX Mini-Box Hardware Details(Type $) for software

Box Type	SmartX Box (Type O)	SmartX Box	Atom Based
Model/ CPU	SuperMicro E300-8D	SuperServer E300-9A	Super Micro E200-9A
Memory Types	4x DDR4 DIMM	4x DDR4 DIMM Sockets Supports up to 64GB DDR4 ECC/non-ECC UDIMM	4x DDR4 DIMM Supports up to 256GB DDR4 ECC RDIMM
Processor	Intel® Xeon® processor D-1518, Single socket FCBGA 1667; 4-Core, 8 Threads, 35W	Intel® Atom® processor C3858 FCBGA 1310 CPU TDP support 25W	Intel® Atom® processor C3558, Single socket FCBGA 1310
	Mini-1U	Mini-1U - CSE-E300	Mini-1U - CSE-101F
# of USB Ports	2x USB 3.0 ports 4x USB 2.0 ports	2 USB 3.0 ports (rear)	2 USB 2.0 ports
DIMM Size	32GB, 16GB, 8GB, 4GB	32GB	32GB, 16GB, 8GB, 4GB