6th UCAAT User Conference on Advanced Automated Testing

ETSI

Testing Network Softwarization

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Chair, TST WG, ETSI NFV ISG

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A Keysight Business

AGENDA

- Introduction and Background
- Testing Networking in Software
  - New features require new methodologies
- Industry Activities
  - ETSI NFV, Open Source

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INTRODUCTION AND BACKGROUND

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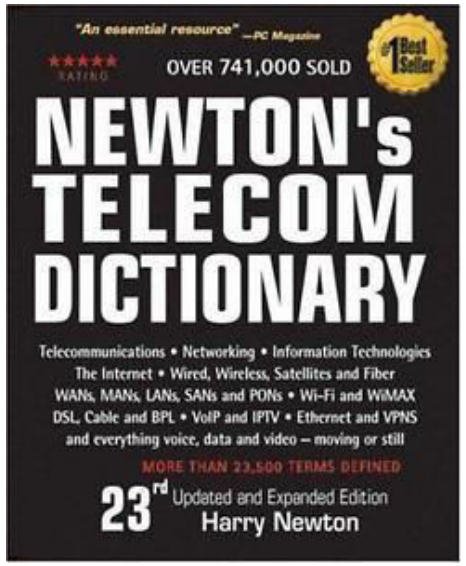
INTRODUCTION



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TESTING SOFTWARE NETWORKING

What's so hard about that?

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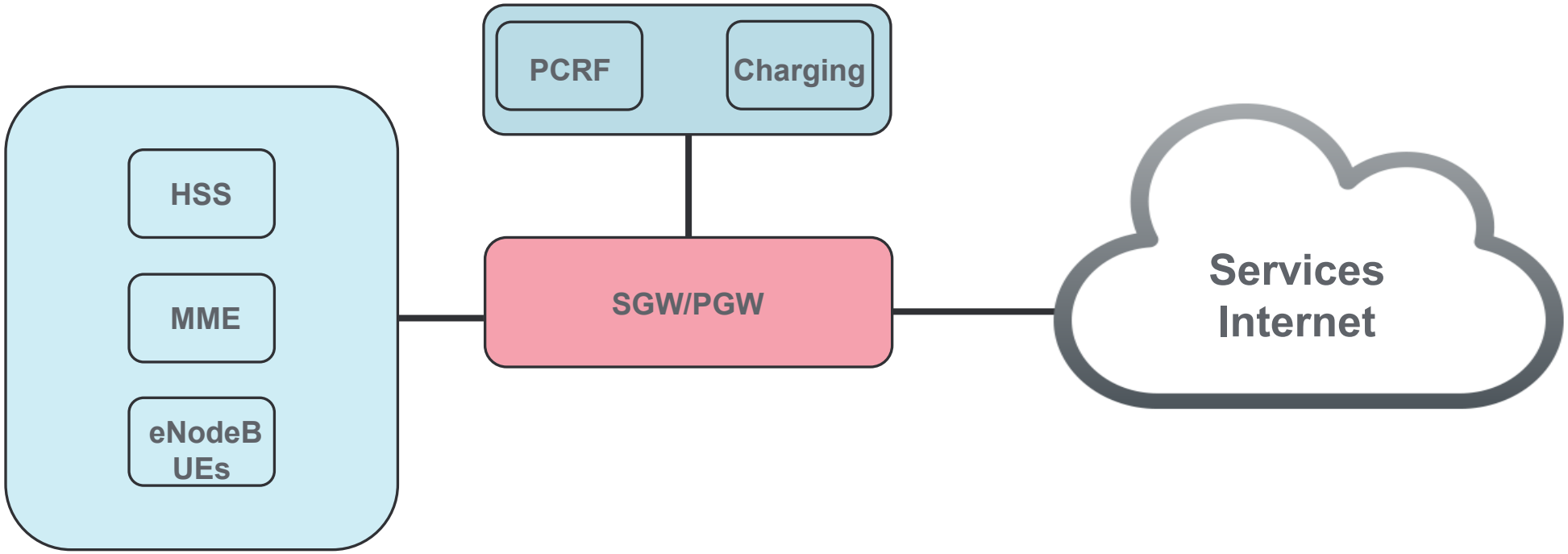
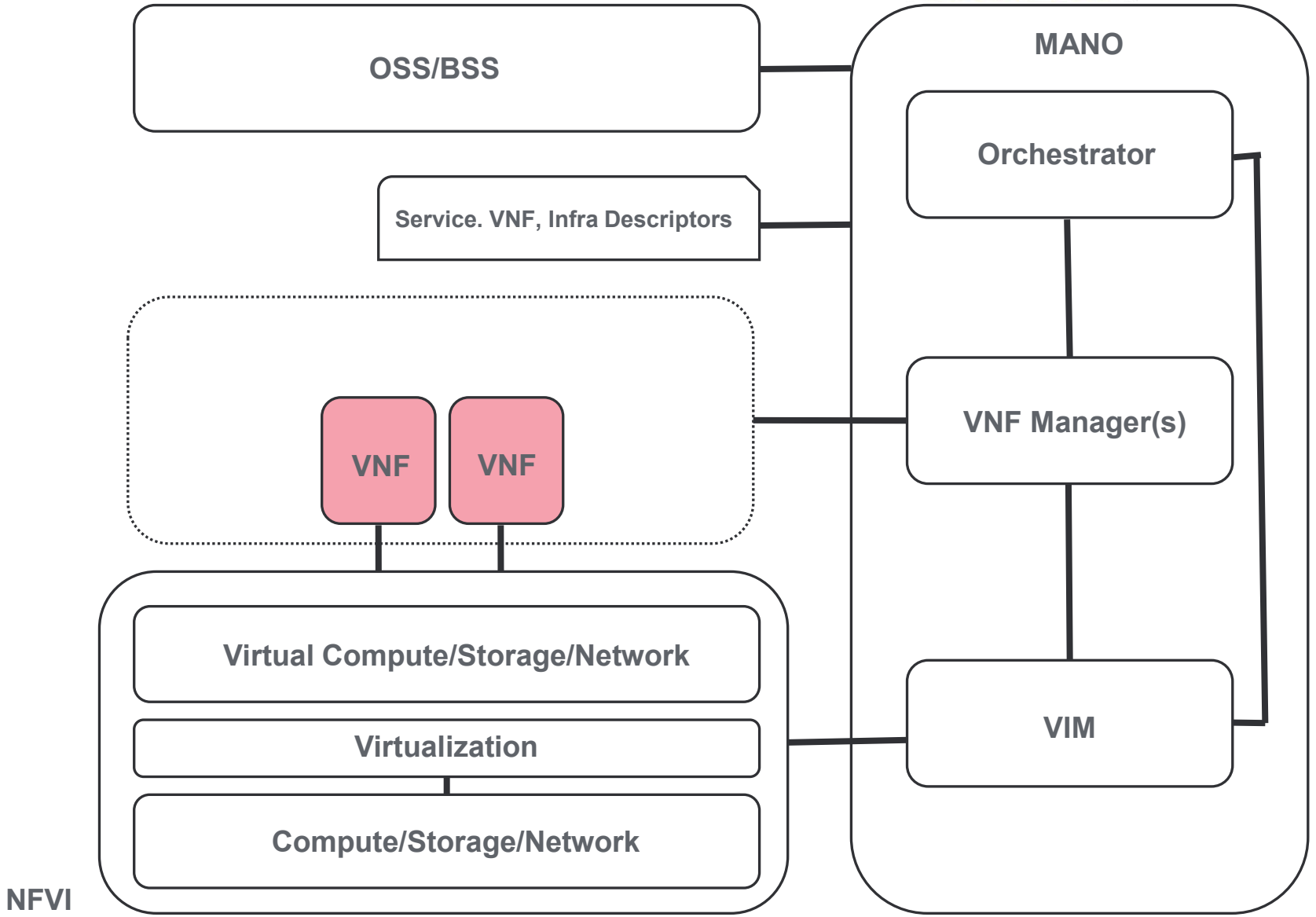
ISOLATING THE SYSTEM UNDER TEST (SUT)

Physical Elements



ISOLATING THE SUT

- Some VNF functionality has been moved out
- The SUT requires the complete environment in order to run



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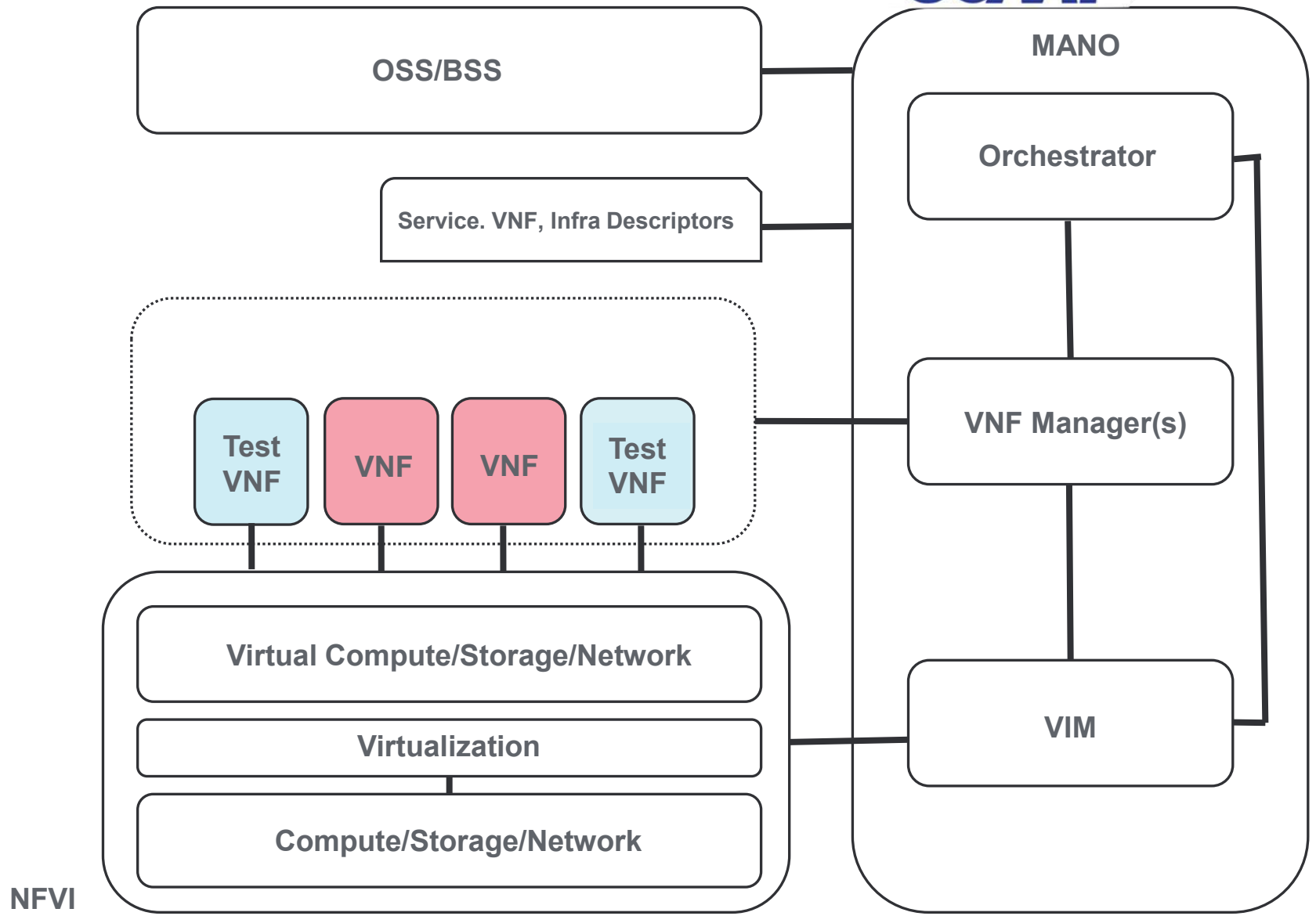
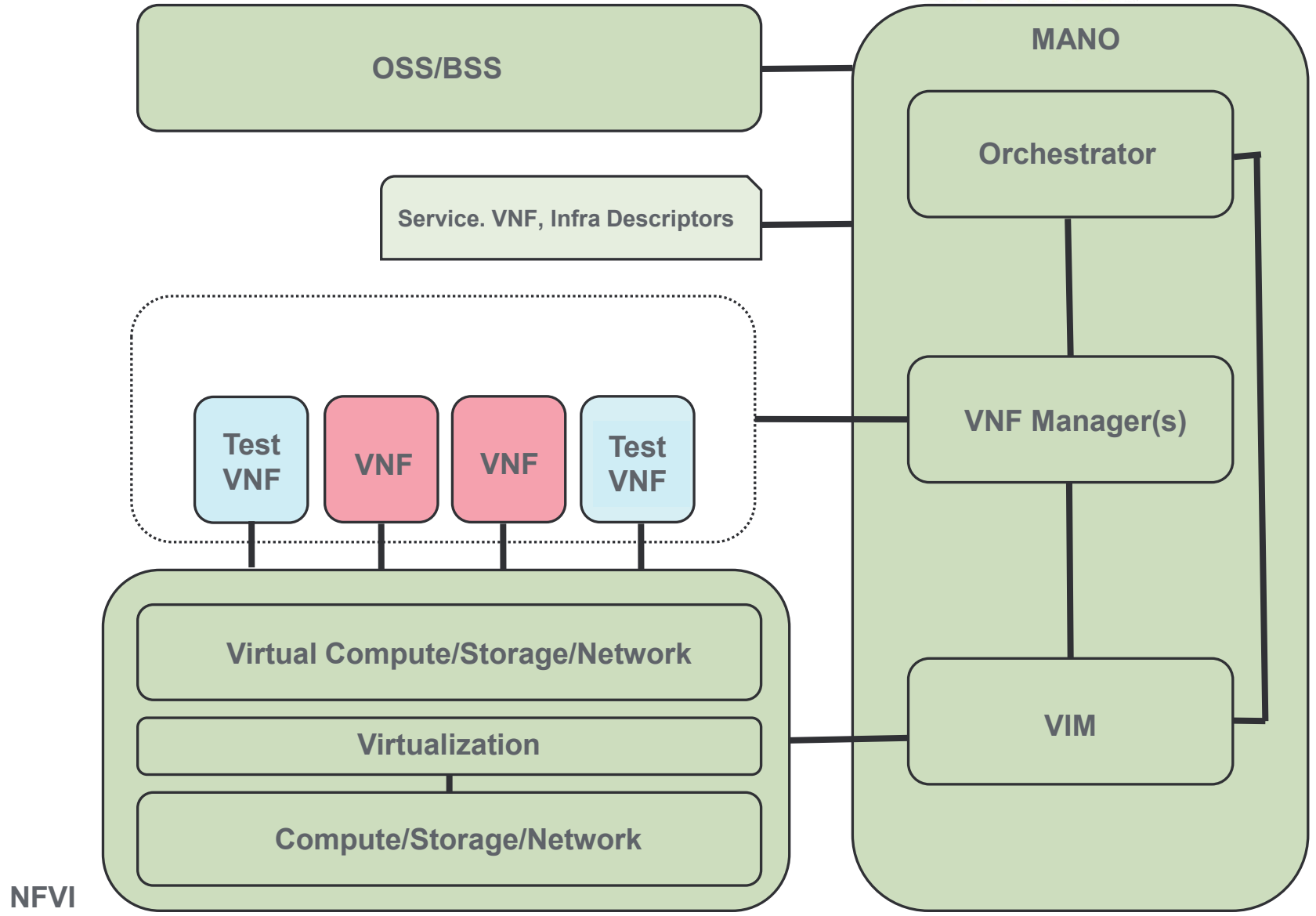
- Test VNFs can be placed to perform simulations



ISOLATING THE SUT

- Some VNF functionality has been moved out
- The SUT requires the complete environment in order to run
- Test VNFs can be placed to perform simulations
- Must maintain the environment constant



TEST UNIT SELECTION AND PLACEMENT

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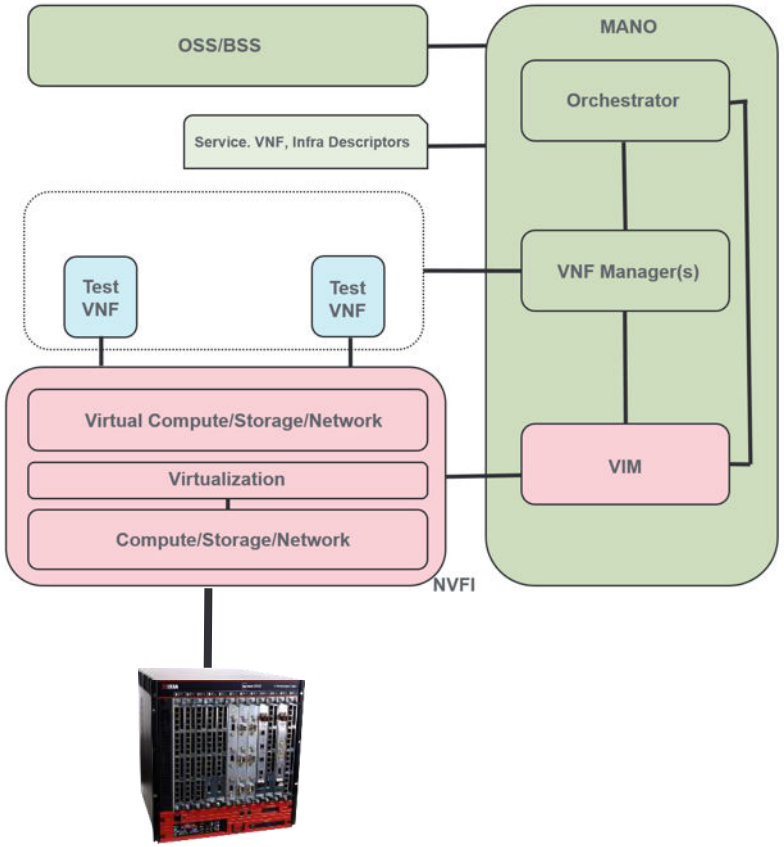
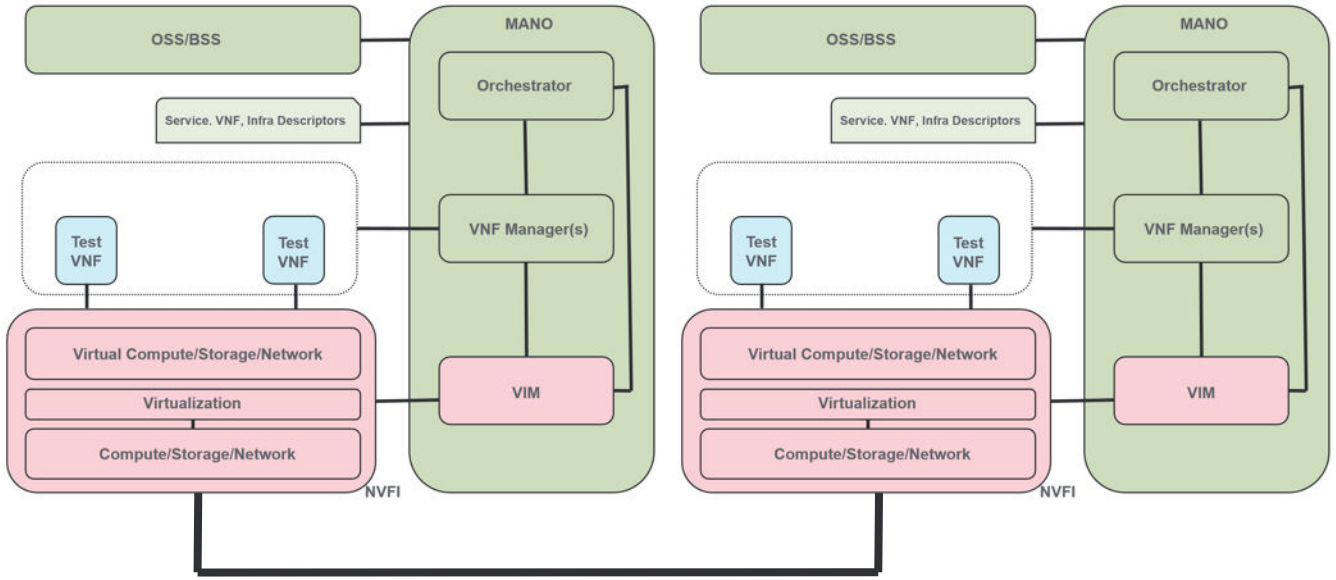
HW or SW-only

HW-Based



SW-Based



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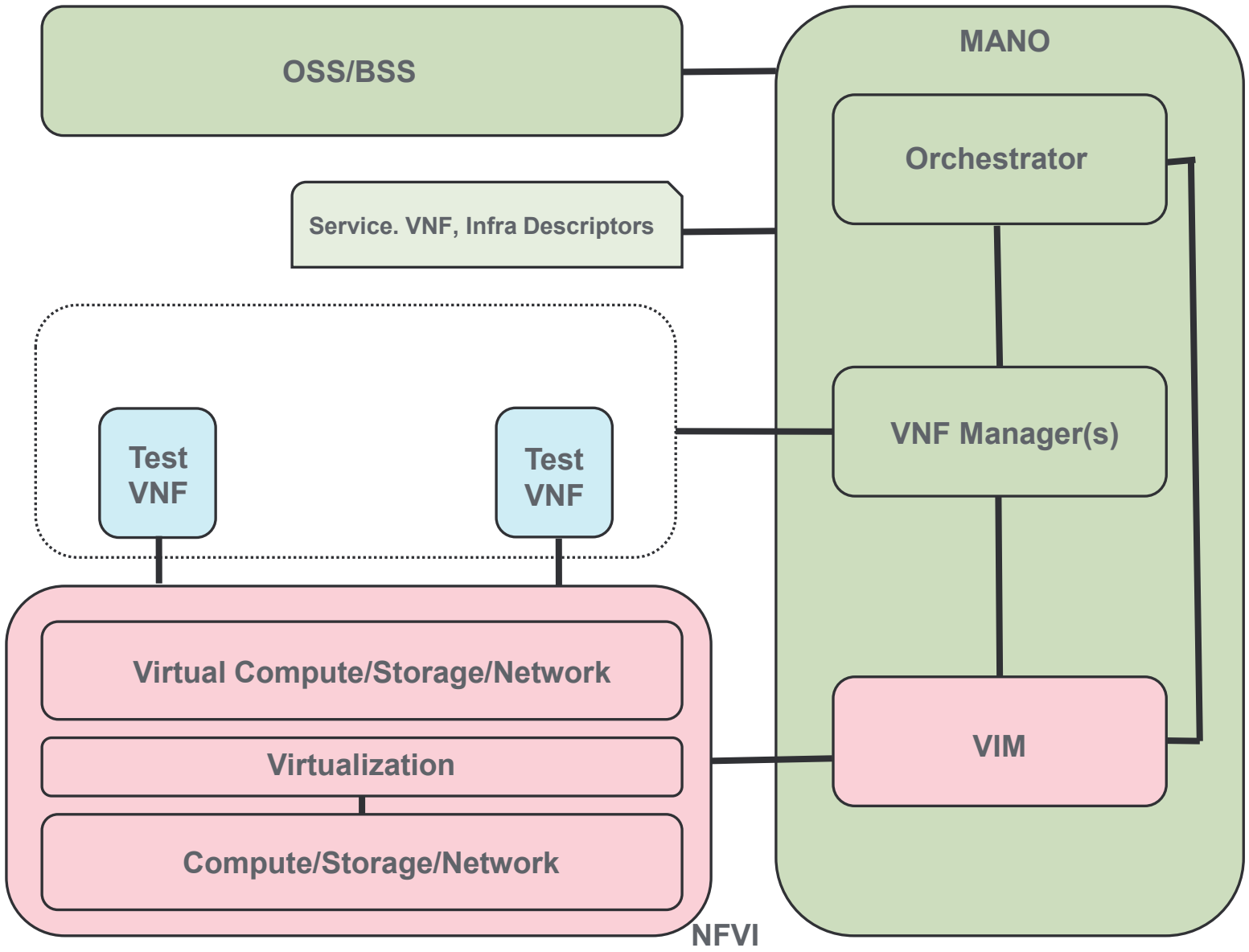
NFVI



VNF Type

↓

Workload Operations

↓

Metrics Categories

↓

Metrics

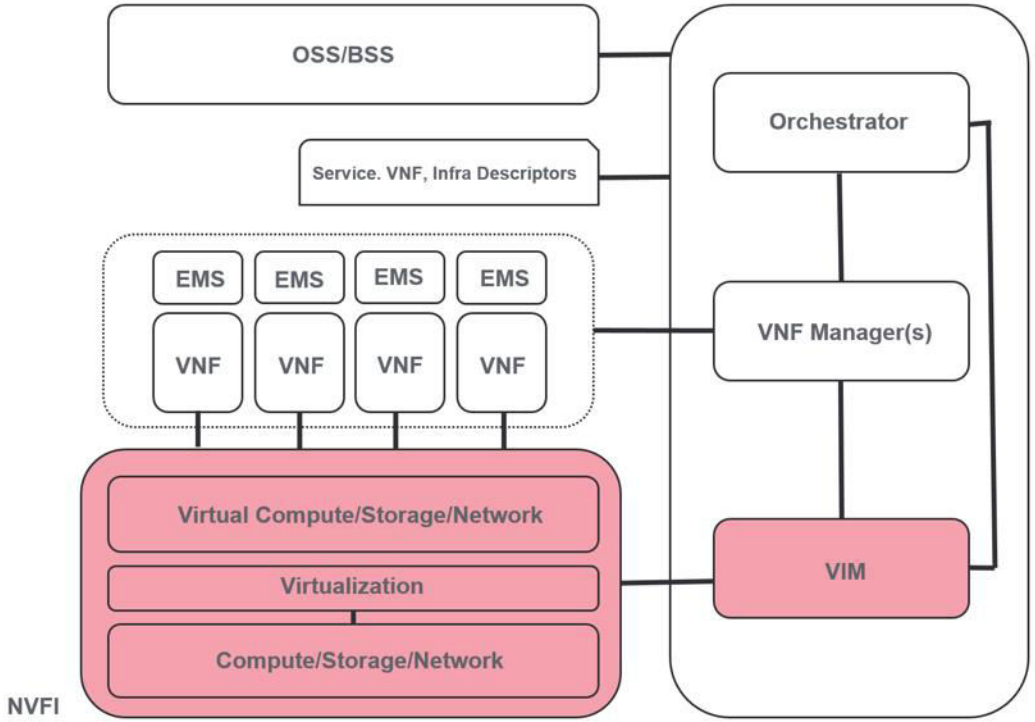
↓

Test Cases

NFVI

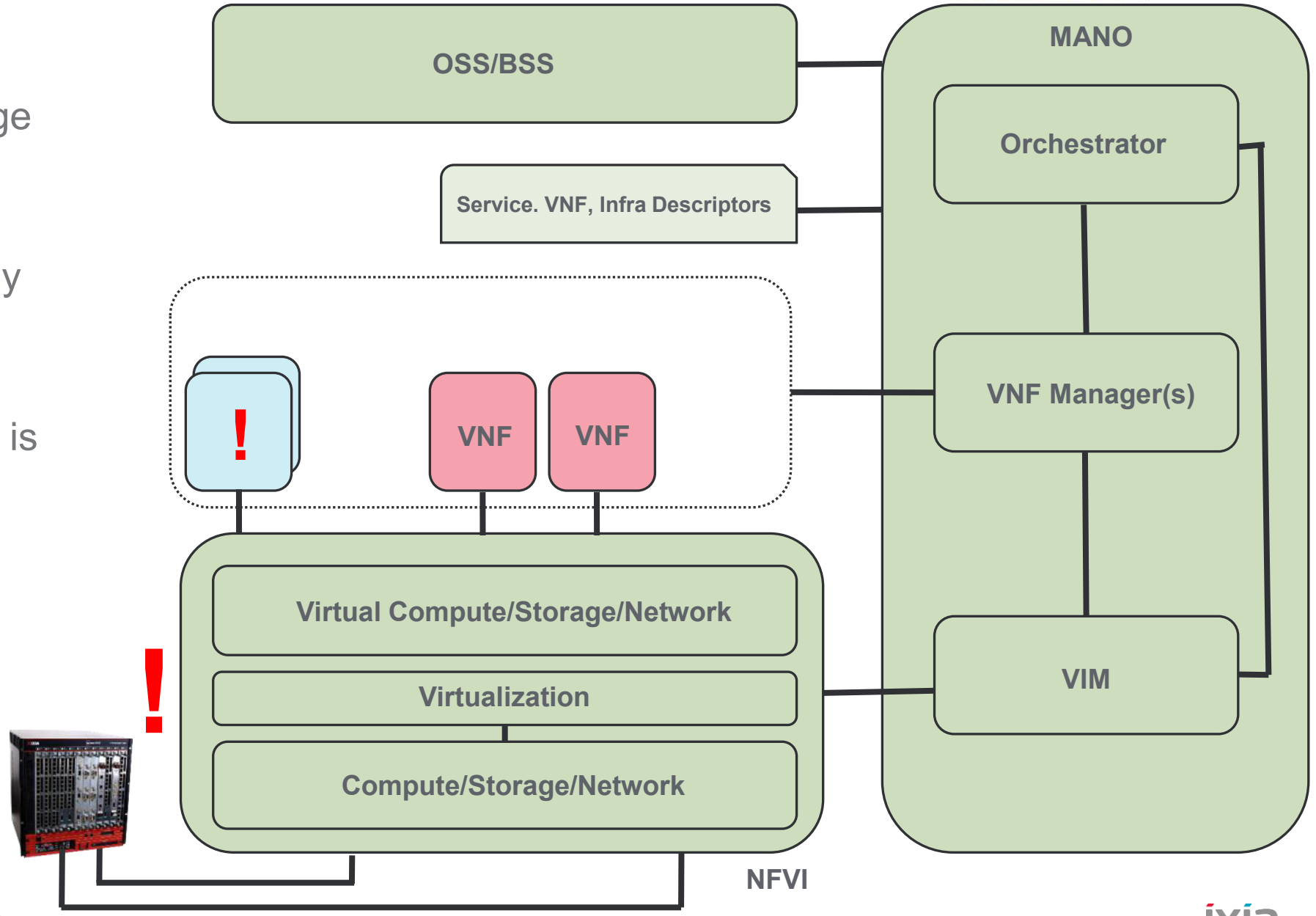
Performance Testing

- Performance Verification
  - Validating the advertised performance of a SUT
- Benchmarking
  - Determining the maximum performance of a platform
- Dimensioning
  - Determining the amount of platform resources required to achieve a performance target



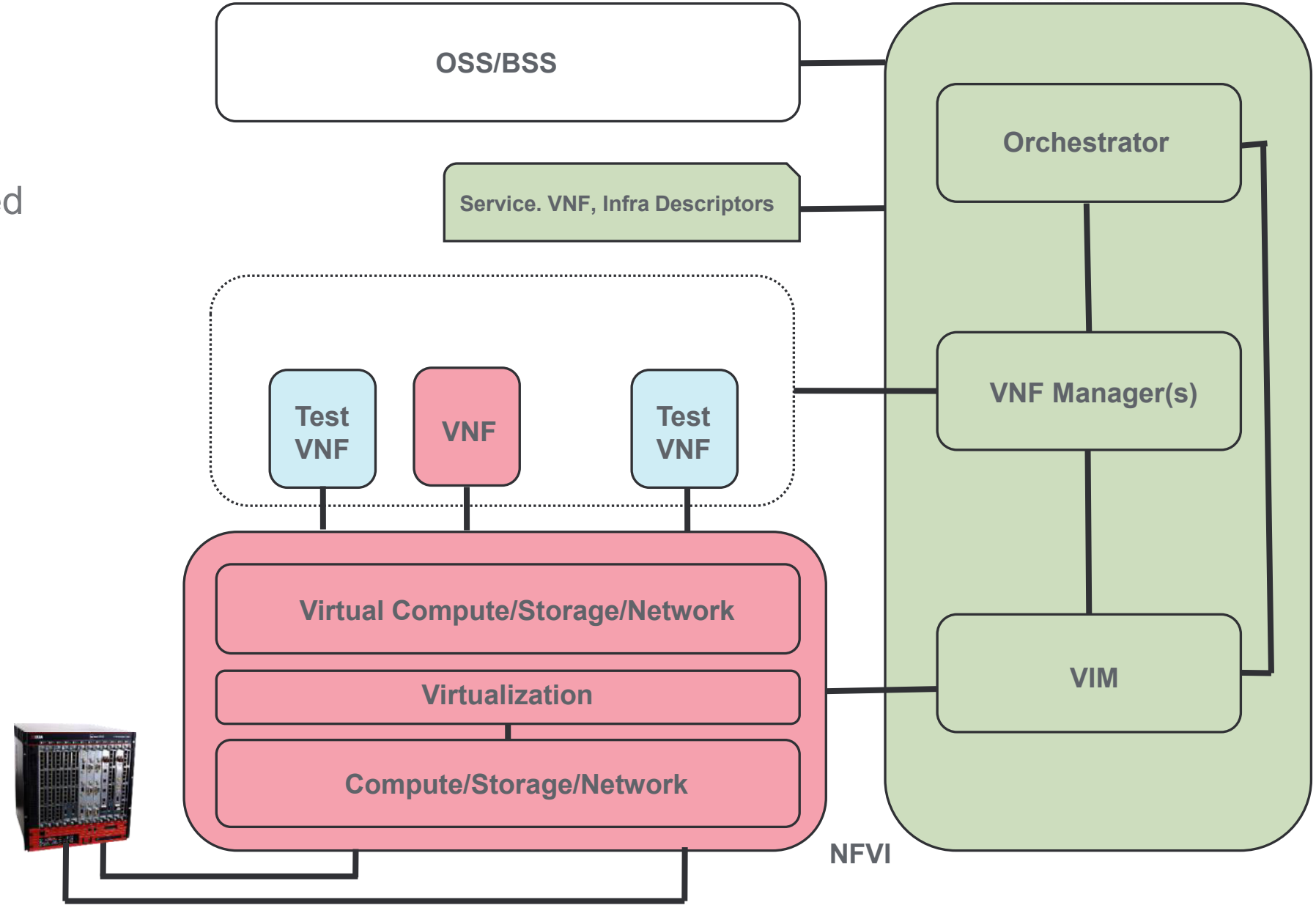
MULTI-TENANCY

- Shared resources change the behavior and predictability
- VNFs can become “noisy neighbors”
- Achieving predictable behavior for other VNFs is the goal
- Platform can become “noisy” too



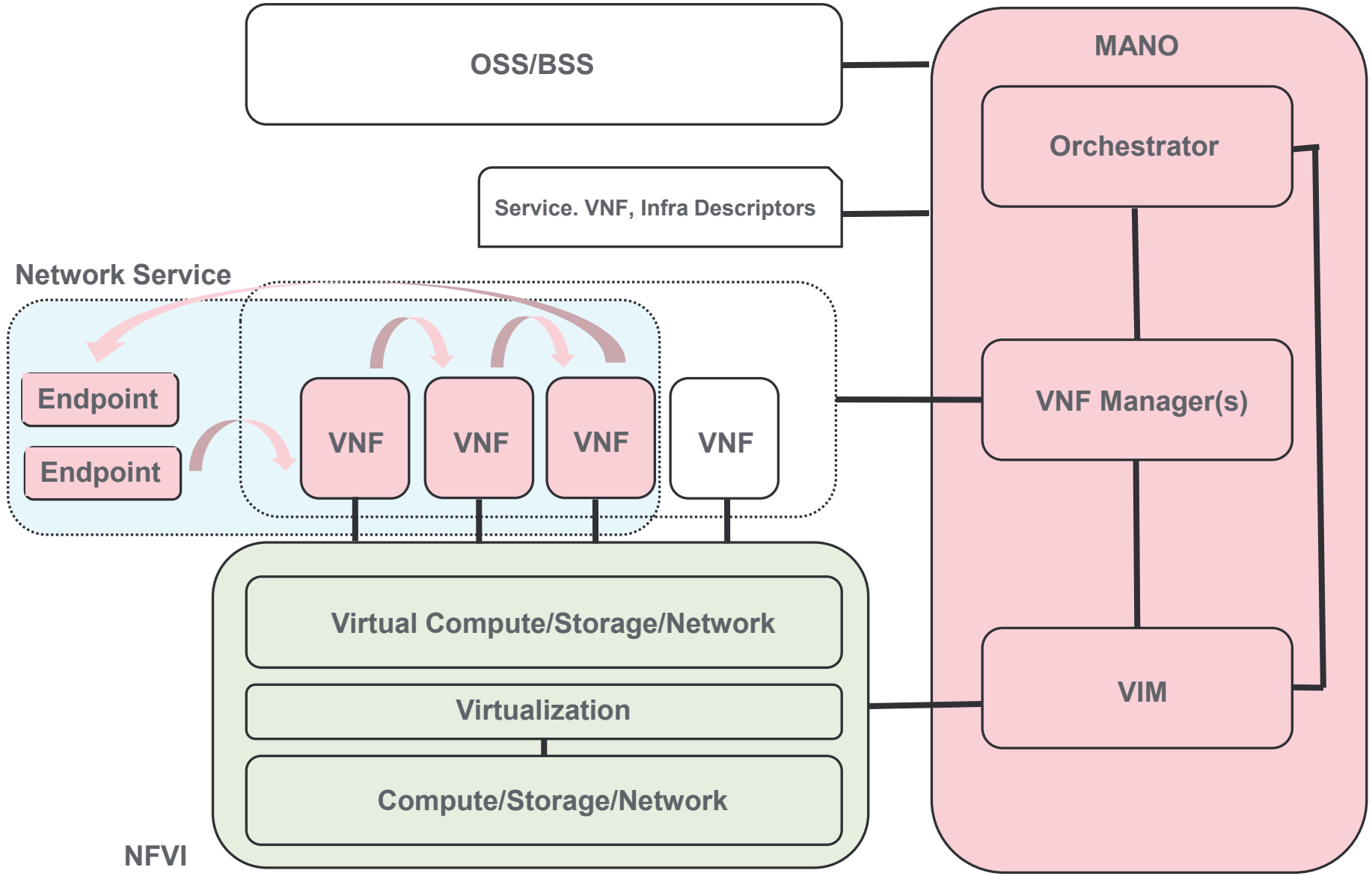
ACCELERATION

- Various acceleration techniques have appeared
  - DPDK
  - SR-IOV
  - Fast Data - FD.io
- Have various impacts on performance and latency



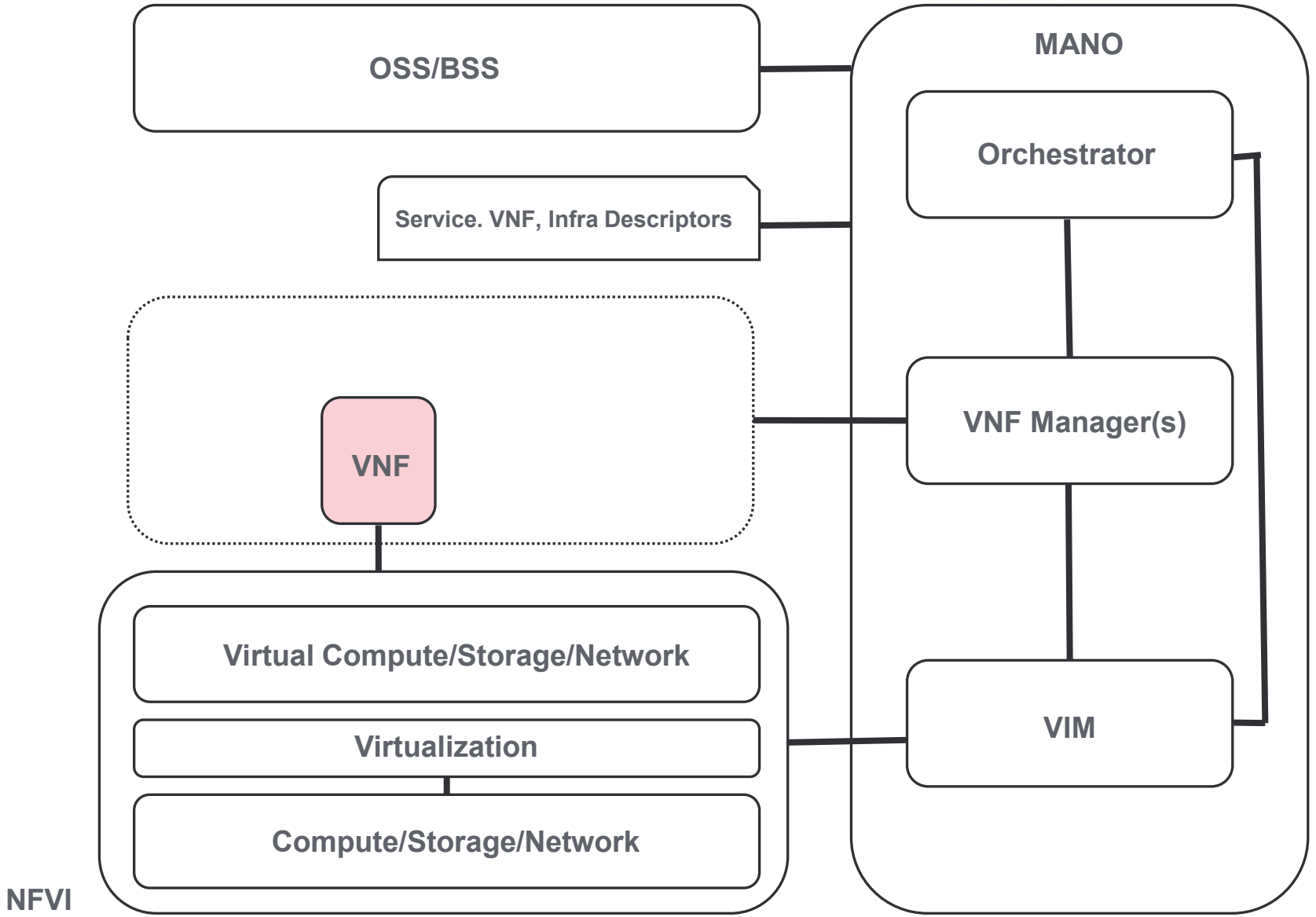
VNFFG AND NETWORK FORWARDING PATH

- Definition of a network service using VNF Forwarding Graphs
- Establishment of the forwarding path has many options: vSwitch, SDN, etc
- Performance will vary based on networking technologies used
- Slicing!



SCALING

- Dynamic allocation of resources based on trigger criteria
- Criteria can be network, compute or storage based



SCALING

- Dynamic allocation of resources based on trigger criteria
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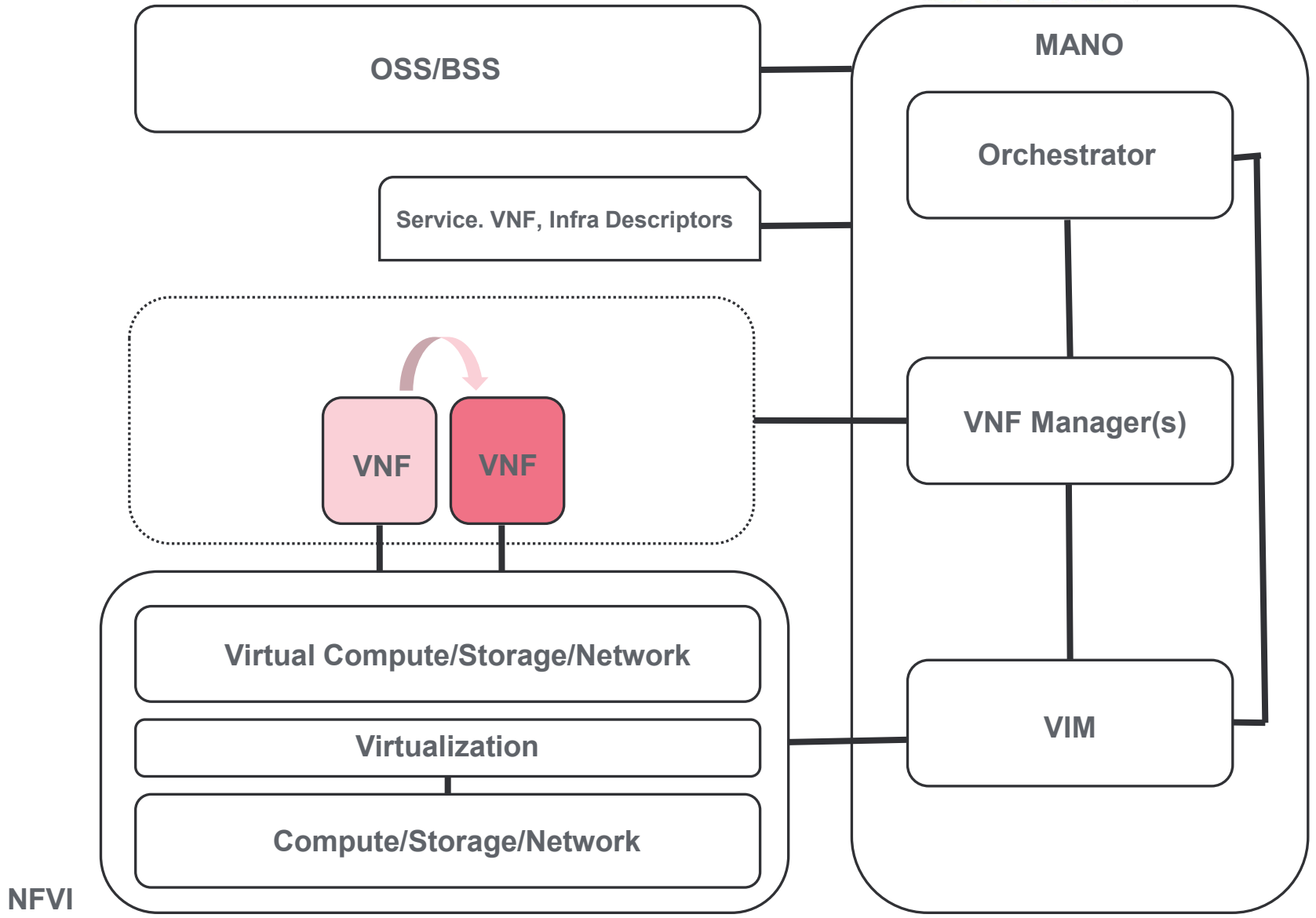
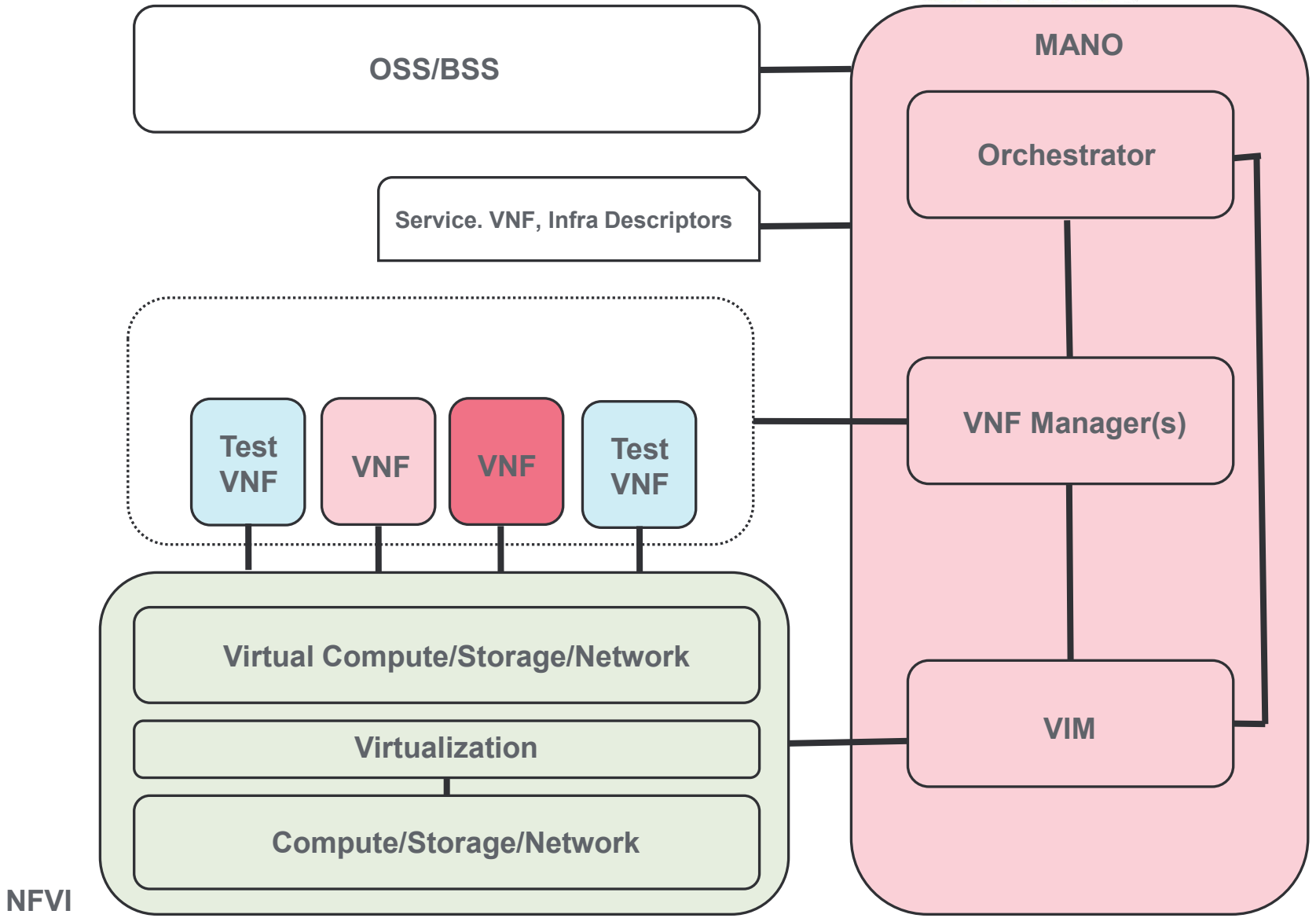
- Once trigger is reached, resources allocated to instantiate a new VNF-C

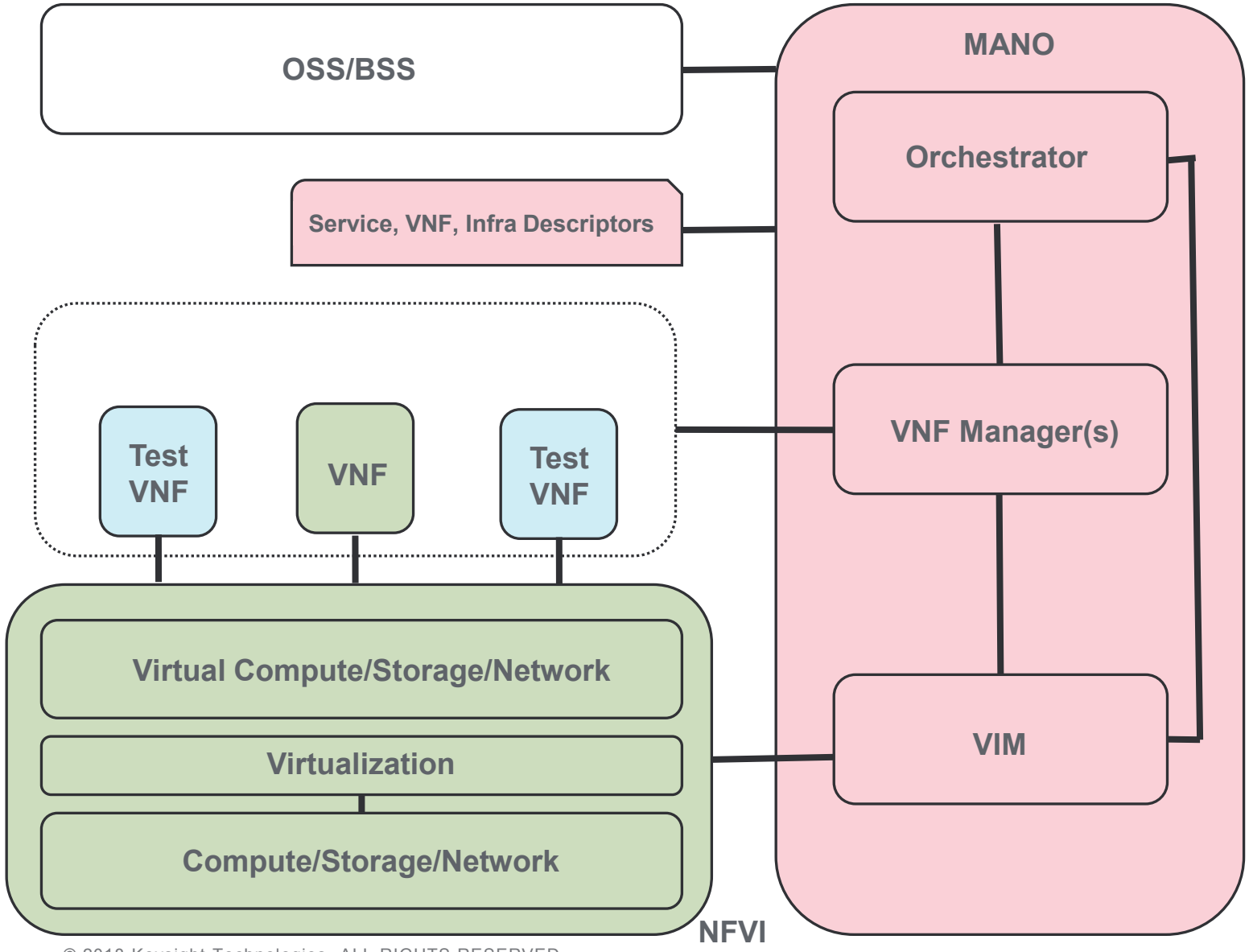


SCALING

- Dynamic allocation of resources based on trigger criteria
- Criteria can be network, compute or storage based
- Once trigger is reached, resources allocated to instantiate a new VNF-C
- Test VNFs placed to simulate the required trigger traffic
  - SW or HW configurations



MANO FUNCTIONS



- VNF Package Mgmt
  - Onboarding
- VNF Lifecycle Management
- VNF Performance Management
- VNF Fault Management
- NS Lifecycle Management
- NS Performance Management
- NS Fault Management

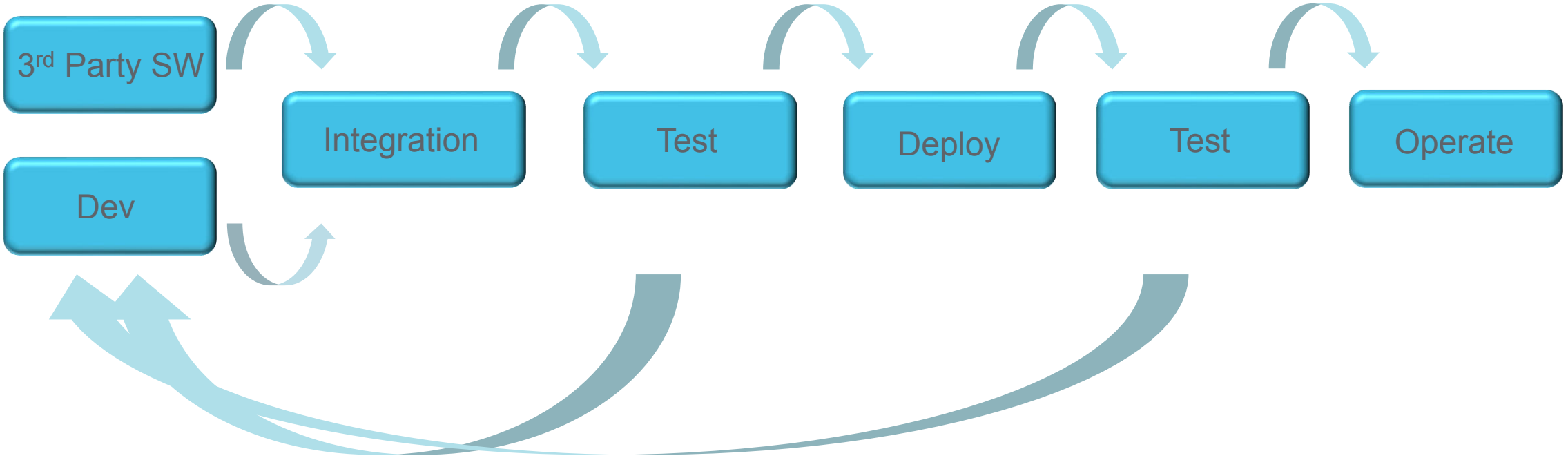
DEVOPS AND CI/CD

Opportunity!

- DevOps
  - Combination of different operational areas into one cohesive service delivery team:
    - Dev, QA, Operations, Security, Others as needed
  - Typically associated with an Agile delivery process
    - Small changes - easier to pinpoint failures
- CI/CD: Continuous Integration and Continuous Delivery/Deployment
  - All new system updates and additions are immediately integrated and tested
  - Purpose is to find failures immediately (fail fast, fail forward)
- Automation!
  - Continuous testing, monitoring and feedback

DEVOPS AND CI/CD

The Pipeline



- SW deployment enables the deployment of test units along with the system
- Sanity tests (and more) can be triggered automatically upon deployment

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INDUSTRY ACTIVITIES

Who's doing what

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ETSI NFV TST

Testing, Experimentation and Open Source

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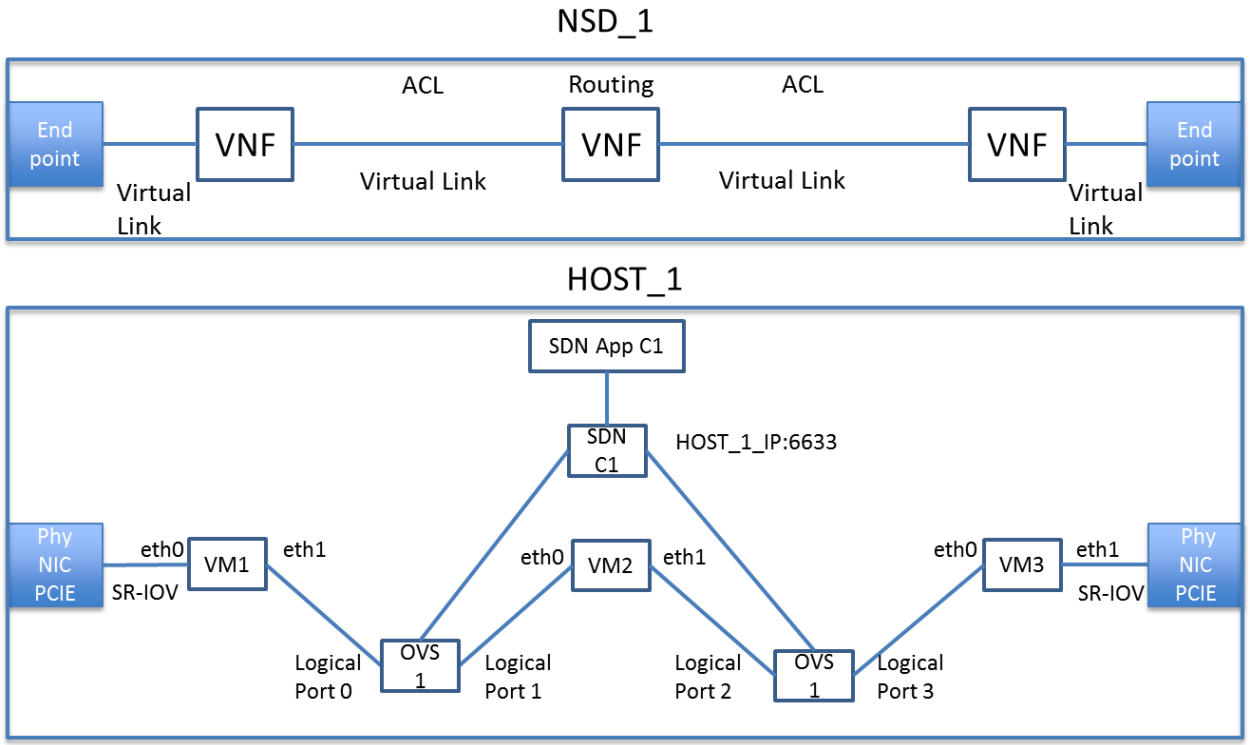
TST001 – PRE-DEPLOYMENT TESTING

- Target audience:
  - All companies wanting to validate new SW, SW updates
  - CI/CD pipeline
- Content summary
  - Definition of SUTs
  - Test methods for pre-deployment validation of SUTs
  - Pre-deployment validation of NFV Infrastructure
  - Pre-deployment validation of VNFs
  - Pre-deployment validation of Network Services

TST004 – PATH IMPLEMENTATION TESTING

- Guidelines for test plan on path implementation through NFVI
- SUT options
  - Fct placement
  - SDN application type
  - SDN controller type
- Metrics
  - VNFC instantiation time
  - Path instantiation
  - 1st packet latency
  - Subsequent packet latency
  - Std pkt transfer measurements
- Procedures
- Examples



TST007 – GUIDELINES FOR INTEROP TESTING

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- Test Descriptions (Test Cases)
- Interoperability Features Statement
  - List of all features that need to be supported
  - Referenced by the individual Test Descriptions
  - VIM, NFVO, VNFM, EM/VNF
- Features taken from IFA documents
  - VNF Package Mgmt, LCM, Fault Mgmt, Performance Mgmt
  - NS LCM, Update, Healing, Termination
- Interoperability Testing Guidelines for NFVI-VIM, MANO and VNF
- Detailed collection of test descriptions for most functionality

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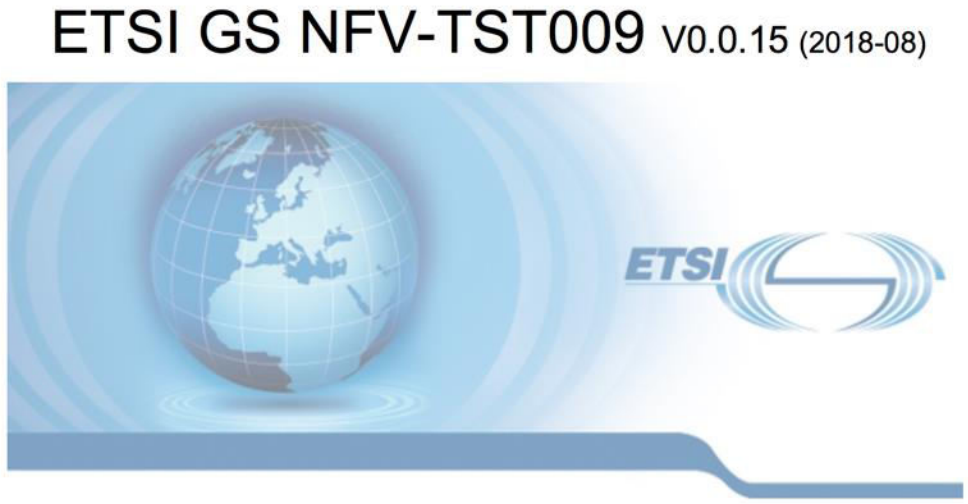
TST009 – NFVI NETWORK BENCHMARKS AND MEASUREMENT METHODS

- Expands the Requirements and Methods of RFC2544
  - New reality of NFVI platforms are different than dedicated “boxes” of the past
- Benchmark definition
- Test setups
- Test tool requirements
- Methods of Measurement



Rapporteur: Al Morton (AT&T Labs)

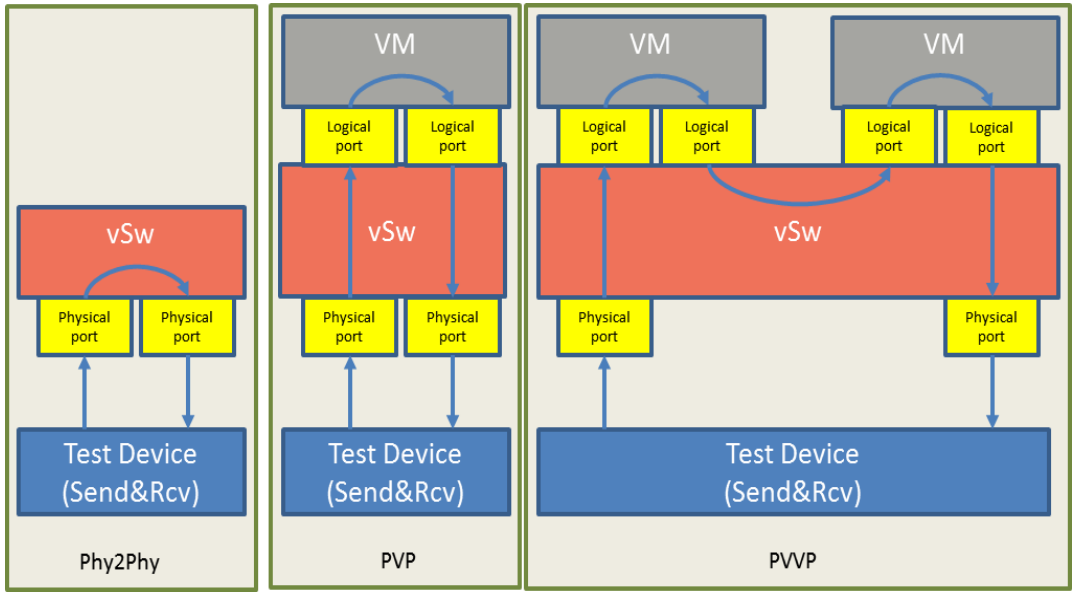
BENCHMARKS

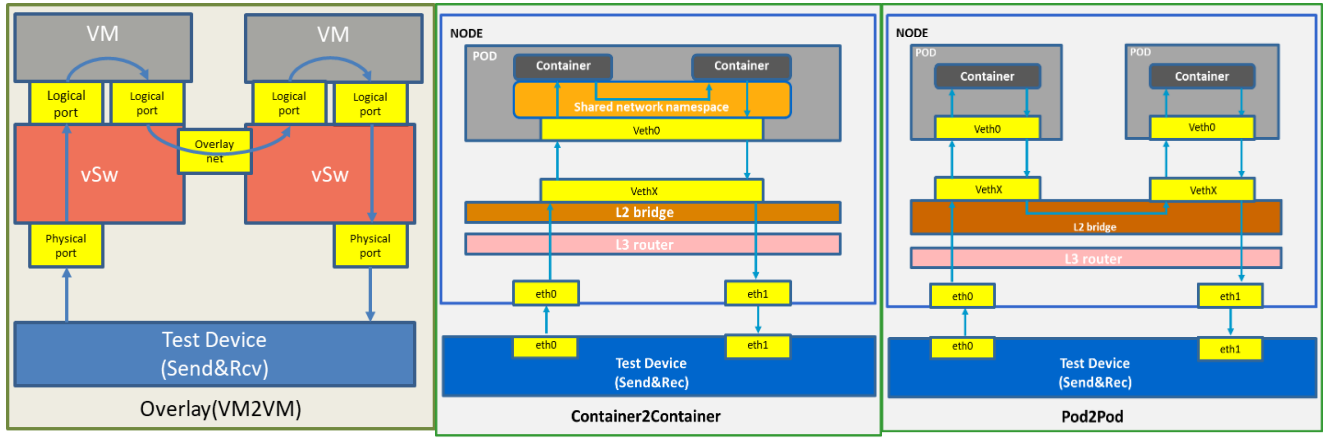
- Throughput
  - Offered Load Frame Size
  - Offered Load Step Size
  - Min Trial Repetition Interval
  - Trial Duration
  - Max X% Loss Ratio
  - Max # of Trials
- Latency
- Delay Variation
- Loss

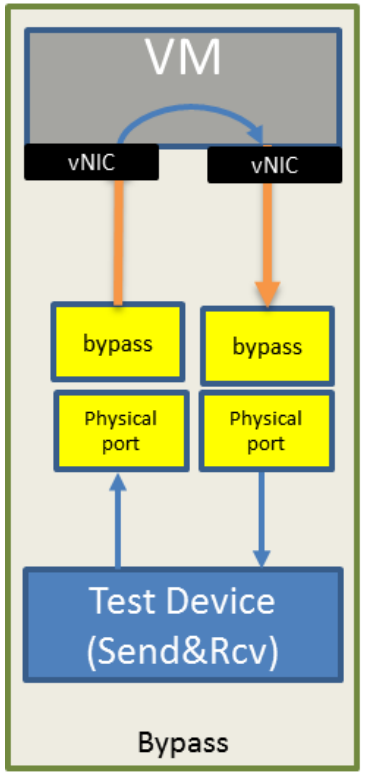
For each Benchmark:

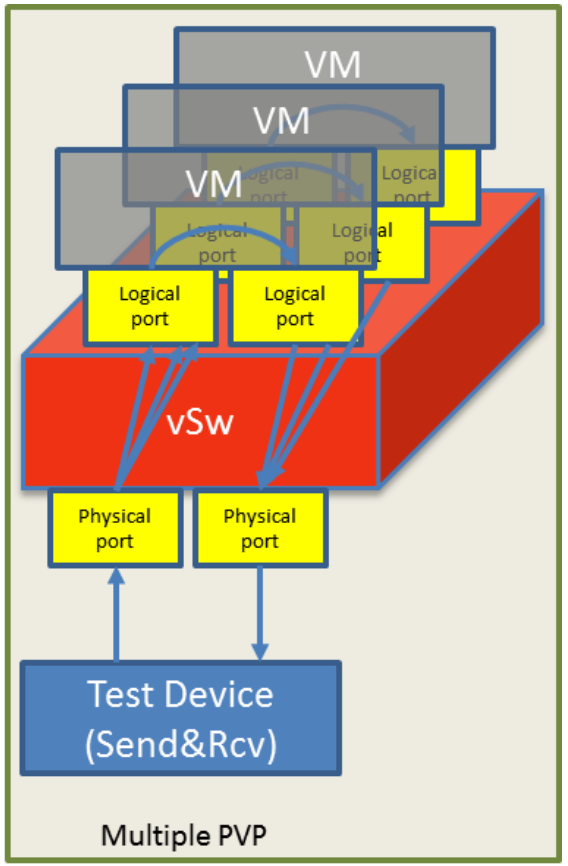
- Background
- Name
- Parameters
- Scope
- Units of Measure
- Definition
- Units of Measure
- Sources of Error
- Discussion
- Reporting Format

TEST SETUP EXAMPLES

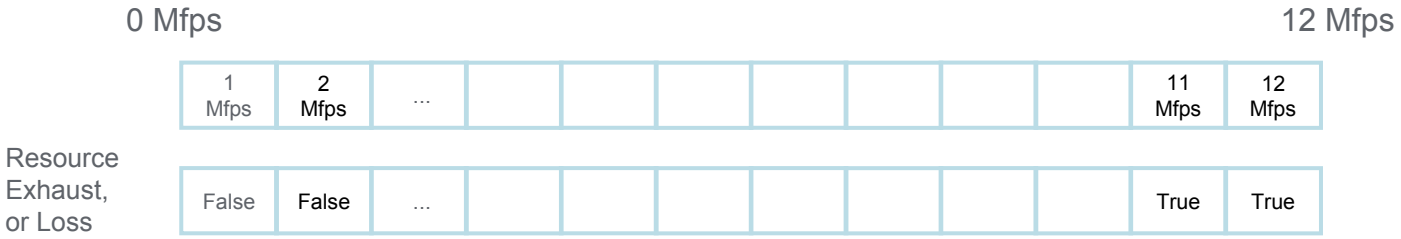


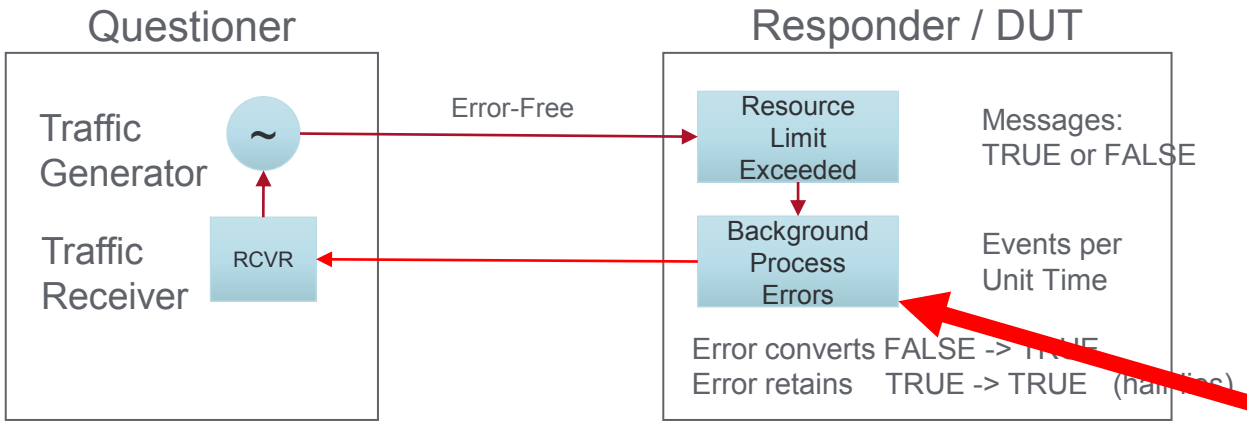






MITIGATING BACKGROUND PROCESSES THAT CAUSE ERRORS (LOSS)





Because of the nature of NFVI platform

Andrzej Pelc, "Searching games with errors— fifty years of coping with liars ", Theoretical Computer Science 270 (2002) 71–109. Available from https://www.gwern.net/docs/statistics/comparison/2002-pelc.pdf

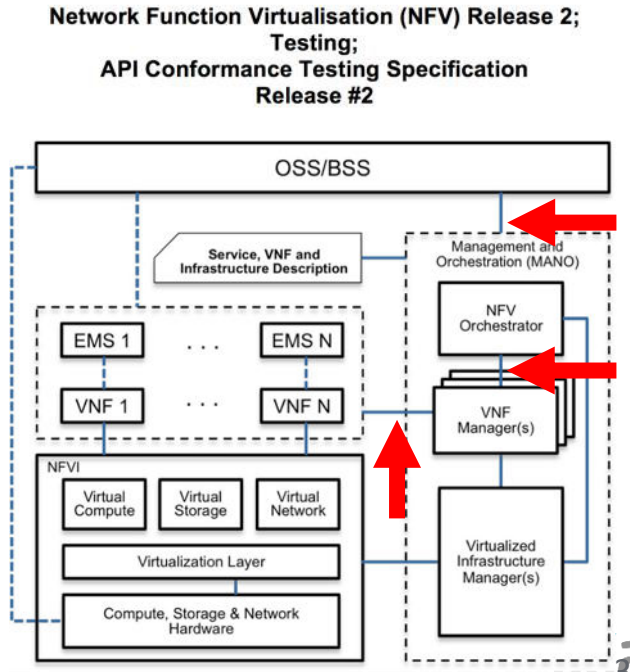
BINARY SEARCH WITH LOSS VERIFICATION

- Goal
  - Separate resource exhaustion and loss due to transient processes
  - They are dealt with in separate ways
- Solution
  - If a trial fails because of loss (< z), run the trial again with the same stimulus (Max (r) = 2)
  - Keep trials short to avoid transients
  - Isolate loss due to transients
    - Run long duration tests to characterize effects and frequency

Prototyped with OPNFV
Showed marked
success in repeatability

TST010 – MANO API CONFORMANCE TEST SUITE

- For 3 Reference Points:
  - Os-Ma-Nfvo - ETSI GS NFV-SOL 005
  - Or-Vnfm - ETSI GS NFV-SOL 003
  - Ve-Vnfm - ETSI GS NFV-SOL 002
- Document + Automatable Test Descriptions
  - OpenAPIs developed by the SOL WG
  - Using the open source Robot Framework



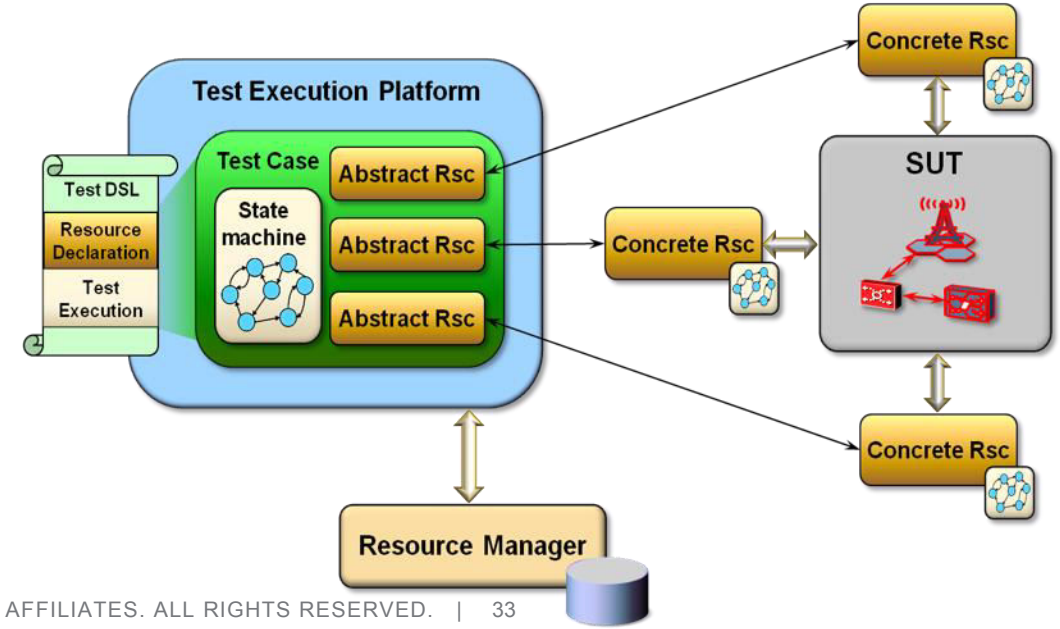
Collaboration with OPNFV:

- Functest Integration
- Potential Instrumented Platform

Rapporteur: Pierre Lynch (Keysight)

TST011 – TEST DOMAIN AND DESCRIPTION LANGUAGE RECOMMENDATIONS

- NFV Test Domain with automation ecosystem
- Recommendations for a DSL (Domain Specific Language)

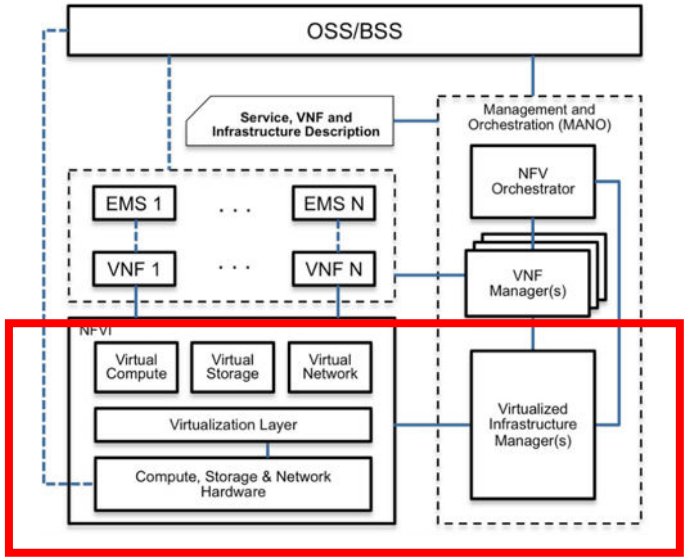


Network Functions Virtualisation (NFV);
Testing;
Test Domain and Description Language Recommendations
Release #

Rapporteur: Frank Massoudian (Huawei)

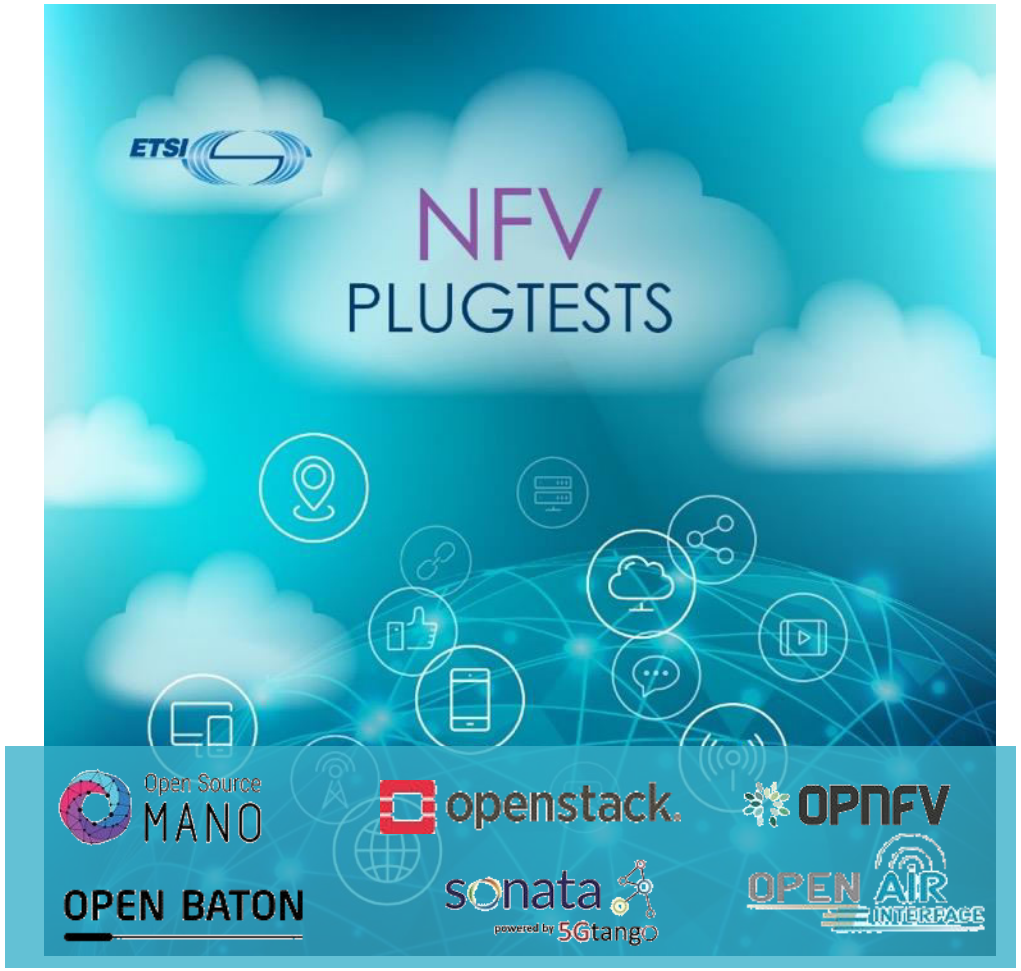
TST012 - VIM & NFVI CONTROL AND MANAGEMENT PERFORMANCE EVALUATION

- Focus on the control plane performance of VIM + NFVI
- Based on functional requirements in ETSI GS NFV-IFA010
- Potential Metrics:
  - Virtualization container instantiation
  - Scaling
  - Migration
- Delicate!
  - VNFs can impact these metrics
  - Care will be taken to define the metrics and methods to be independent of VNF (maybe use standard samples)



Rapporteur: Huang Cheng (Huawei)

3RD NFV PLUGTESTS & OPNFV PLUGFEST



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#NFVplugtests

#OPNFVplugfest

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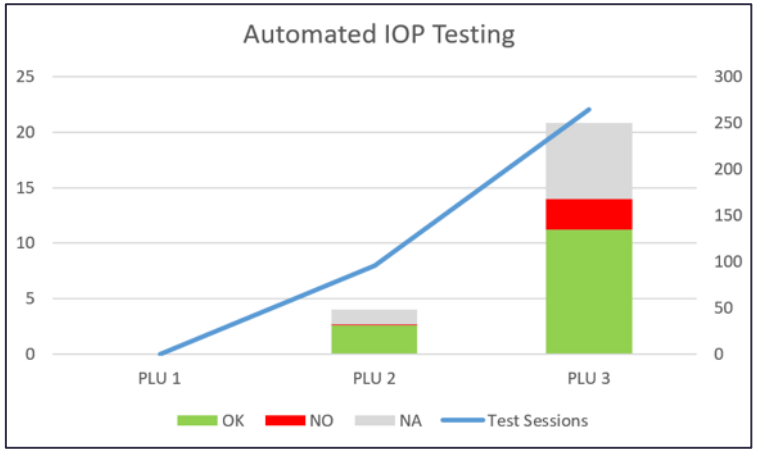
CROSS-COMMUNITY SYNERGY & JOINT ACTIVITIES

- Several cross-community activities:
- TST009 - Testing specification of networking benchmarks and measurement methods for NFVI
- TST010 - API conformance testing specification

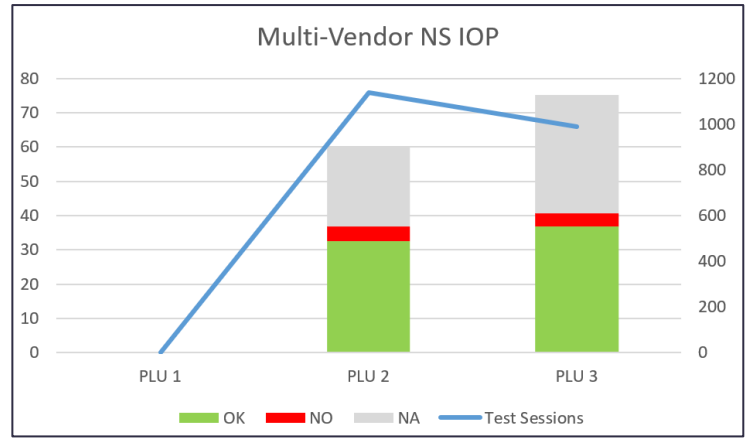
- NFVI validation track (Dovetail)
- OSM integration in OPNFV XCI
- NSH based SFC Testing

RESULTS HIGHLIGHTS

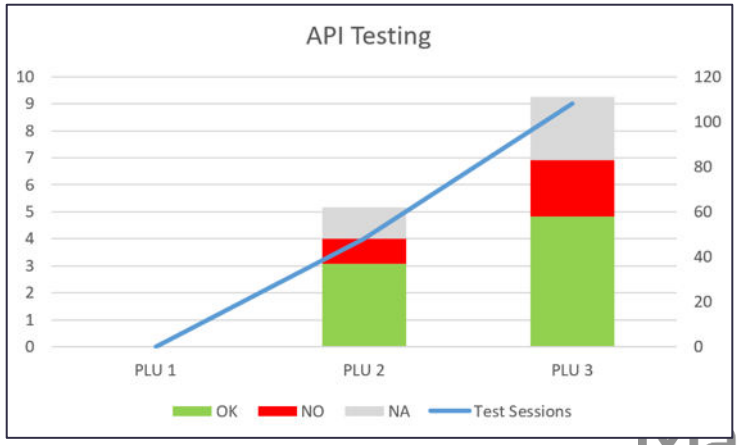
- Most of the interop testing focused on multi-vendor NS
  - More Test Cases run in fewer (but longer) Test Sessions
  - Interop rates similar to January (slightly higher)



- +175% of automated interop testing



- Learnings to guide TST010 NFV Conformance Testing



OVERALL RESULTS

Overall Results	Number of Test Sessions	Interoperability (TCs Run)		TCs Not Run	TCs Totals	
		OK	NO	NA	Run	Total
	97	736	95	636	831	1.467

Table 27a: IOP Overall Results

Overall Results	Number of Test Sessions	API Validation (TCs Run)		TCs Not Run	TCs Totals	
		OK	NO	NA	Run	Total
	9	58	25	28	83	111

Table 27b: API Track Overall Results

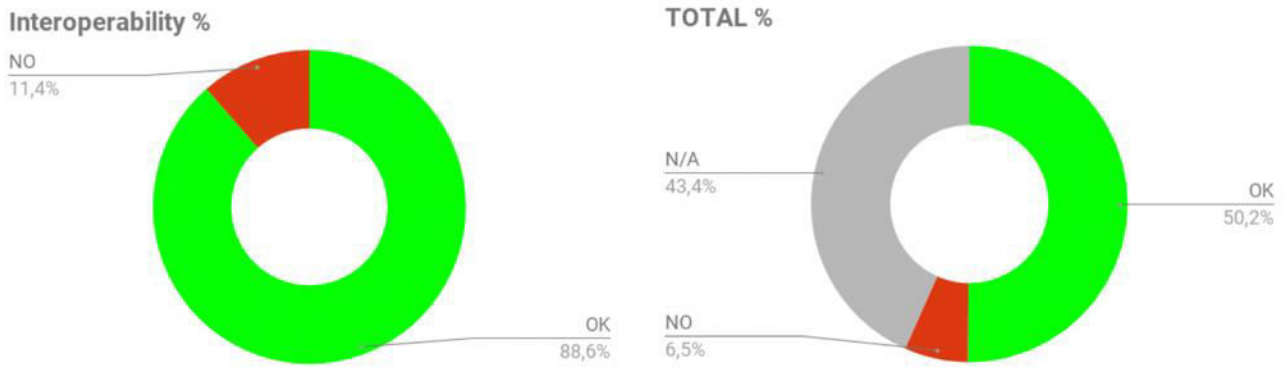


Figure 23. IOP Overall results 3rd NFV Plugtests (%)

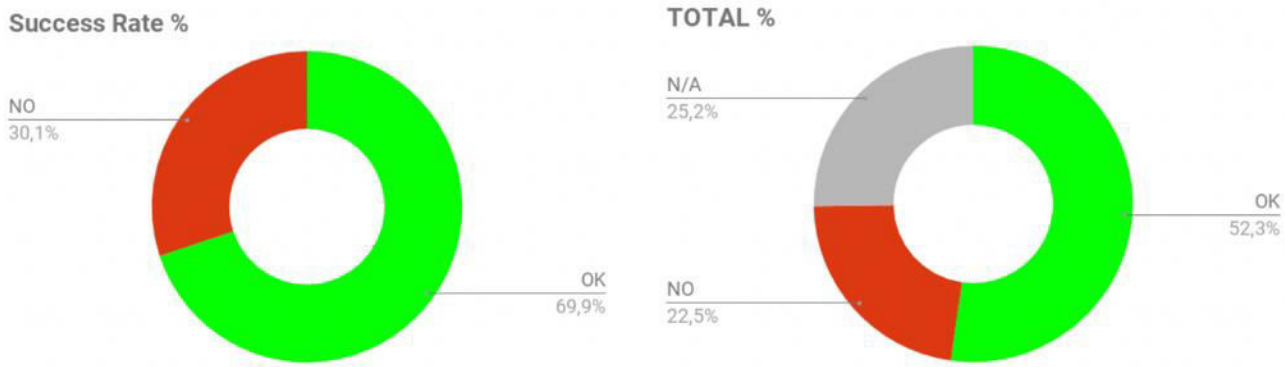


Figure 24. API Track Overall results 3rd NFV Plugtests (%)

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OPEN SOURCE

Young Guns

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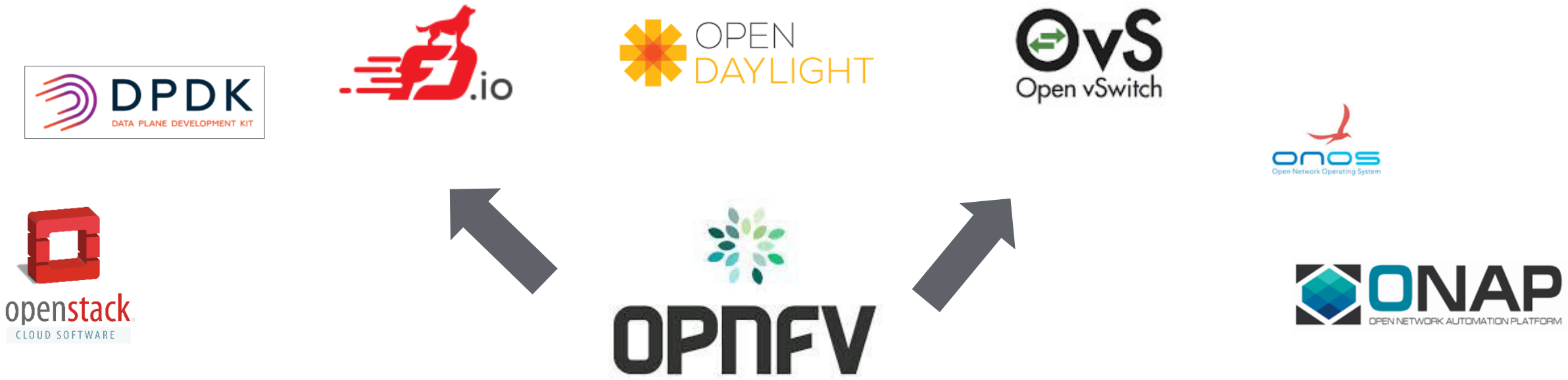
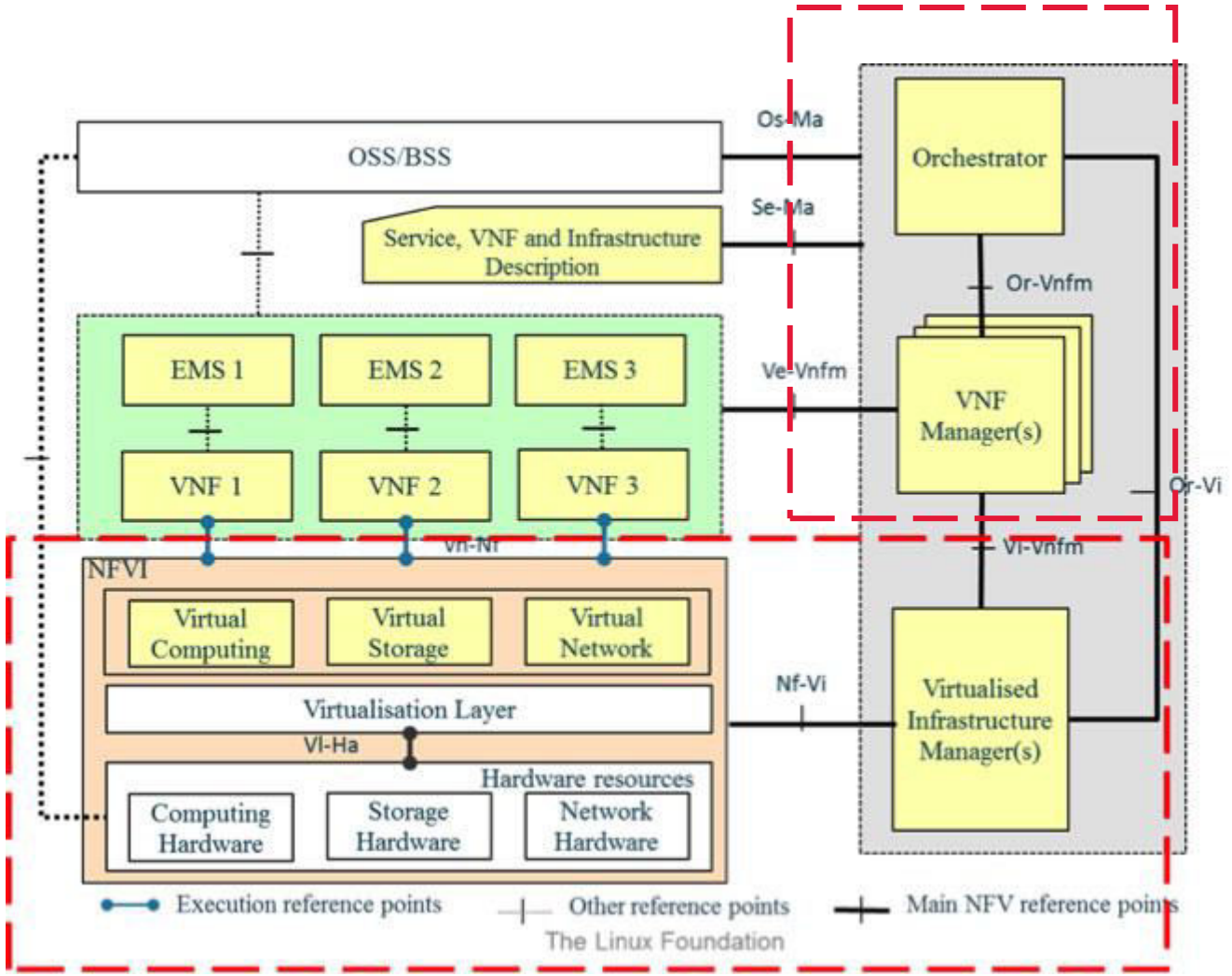
OPNFV: UPSTREAM FIRST



- OPNFV is an integration project, incorporating other open source components to create a platform for NFV
- Most of the development in OPNFV is actually on upstream projects

OPNFV SCOPE



TESTING PROJECTS

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Name	Purpose	Notes
Pharos	Infrastructure - Federated labs for CI and feature testing	12+ labs available
Functest	Feature testing (production deployment)	Umbrella test project with database/API and dashboard
Yardstick	Framework with generic test cases for NFVI (compute, storage and networking)	Framework and methodology for other test projects to plugin
VSPERF	Virtual switch benchmarking	Methodology and tools
CPERF	Controller performance benchmarking	
Qtip	Platform component benchmarking	Compute, storage, NW tests
Storeperf	Tool to measure block and object storage performance of an NFVI	
Bottlenecks	Framework to look for system constraints	
NFVBench	L2/L3 forwarding performance	Black Box approach using open source tools (T-Rex)

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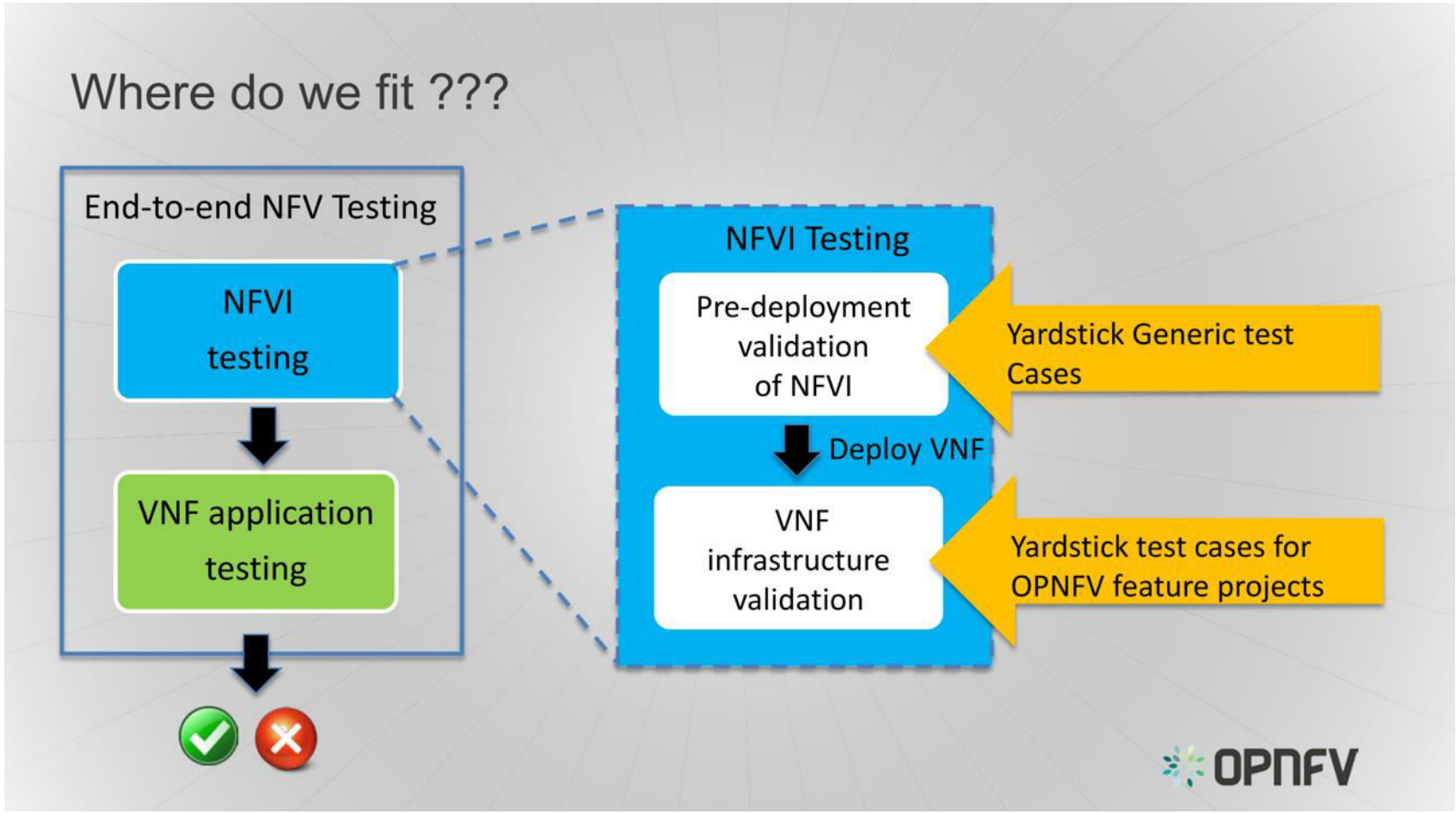
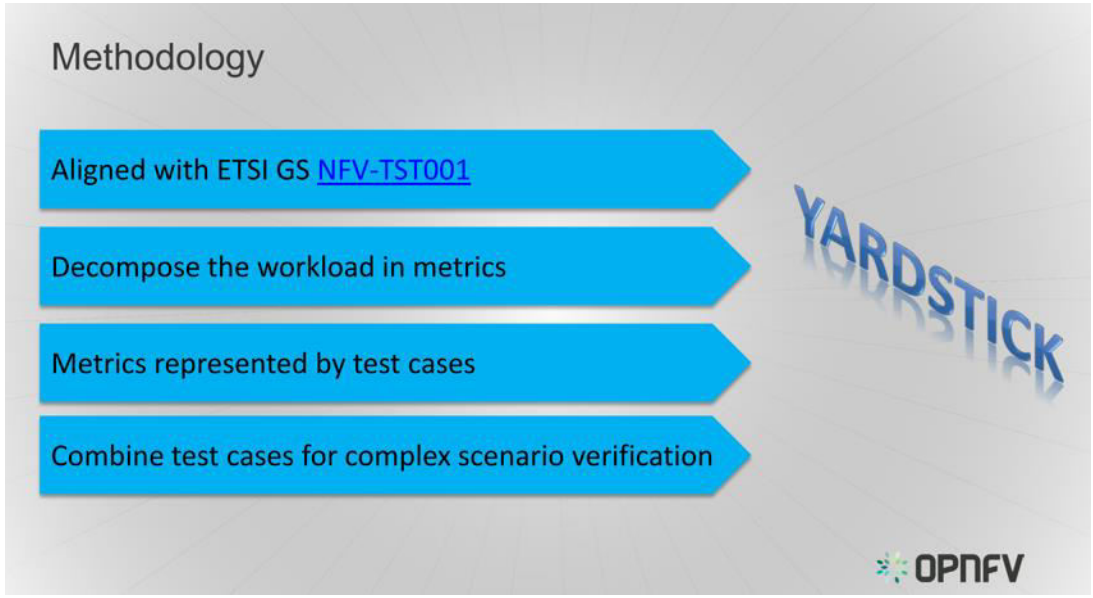
OPNFV YARDSTICK

- Framework and methodology for NFVI testing

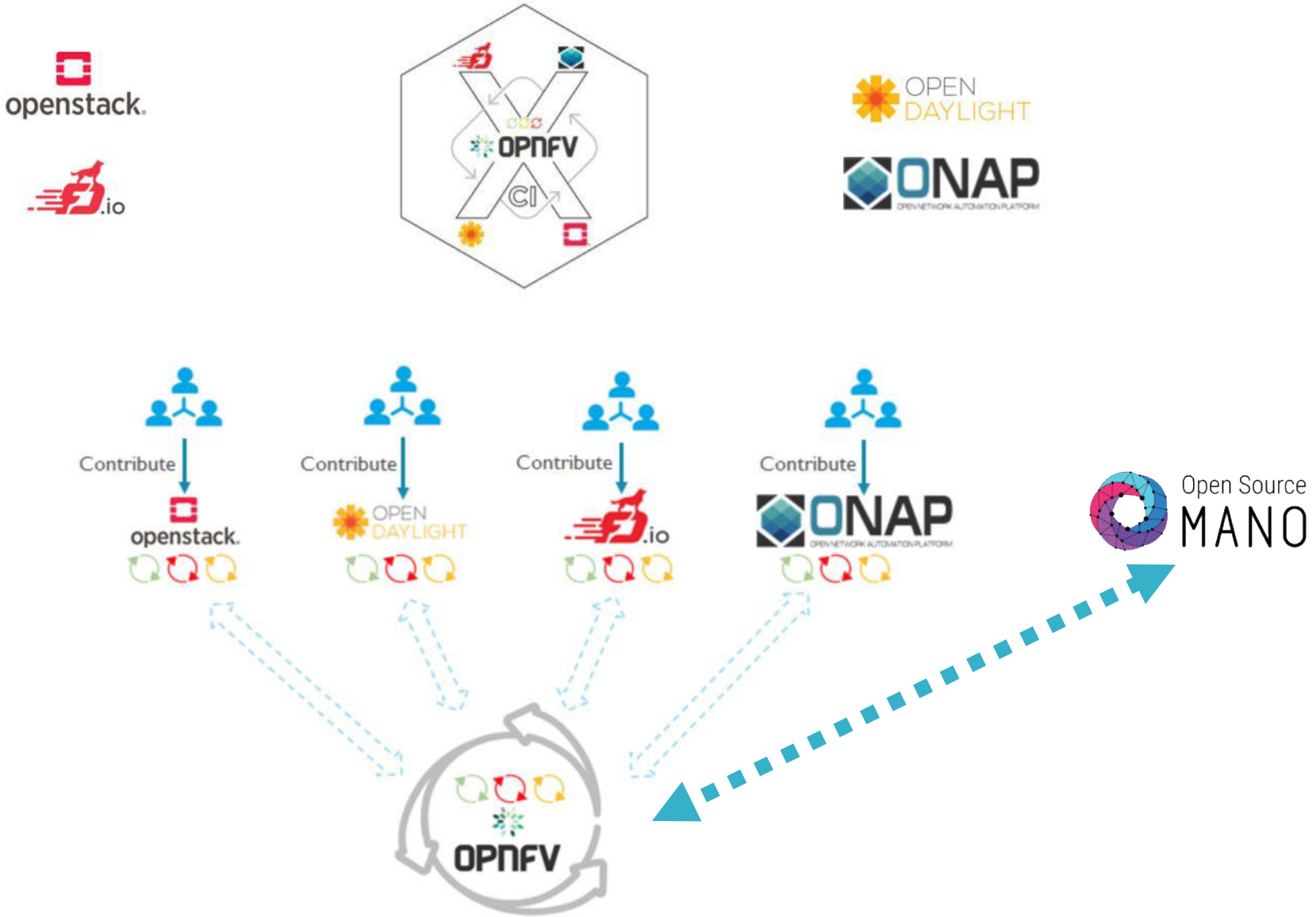


OPNFV YARDSTICK (CONT)

- Part of CI pipeline – daily execution
- Test cases
  - Generic Test Cases for NFVI verification (compute, storage, network)
  - Test cases for OPNFV Projects: HA, SFC, SDNVPN, IPVSIX, VNFFG, KVM
  - Execute Yardstick Generic Test cases for OVS4NFV, ARMBAND



CROSS-COMMUNITY CI (XCI)



SUMMARY

- New considerations for testing methodologies
  - SUT Isolation
  - Test Unit Selection and Placement
- New functionality
  - Multi-Tenancy
  - Acceleration
  - VNFFG & Network Forwarding Path, Slicing
  - Scaling
  - MANO
- New possibilities
  - DevOps and CI/CD
- SDOs and Open Source very active!

