

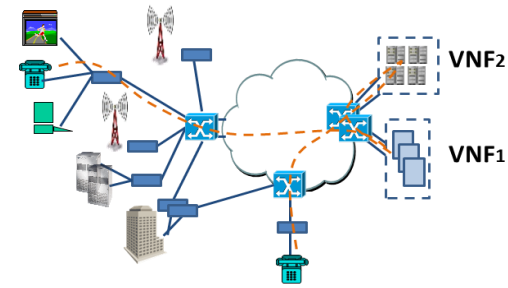
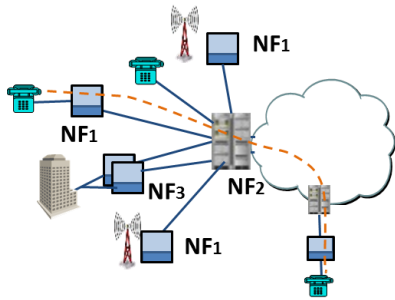
NFV / SDN RAM* Standards Contribution Overview

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** RAM = Reliability, Availability, Maintainability*

Drivers



Multiple services over packet network using VNFs



User-driven R/A metrics/targets based on service criticality, failure modes, costs

Multi-application services over packet network



Performance-based criteria for service failure / outage

De-coupling of NF from hardware with wide NW design flexibility



De-couple RAM metrics from equipment to VNF to support design flexibility

Increasing threat to services and network due to new causes



Broaden RAM metric causes to include DoS attacks, congestion, ...

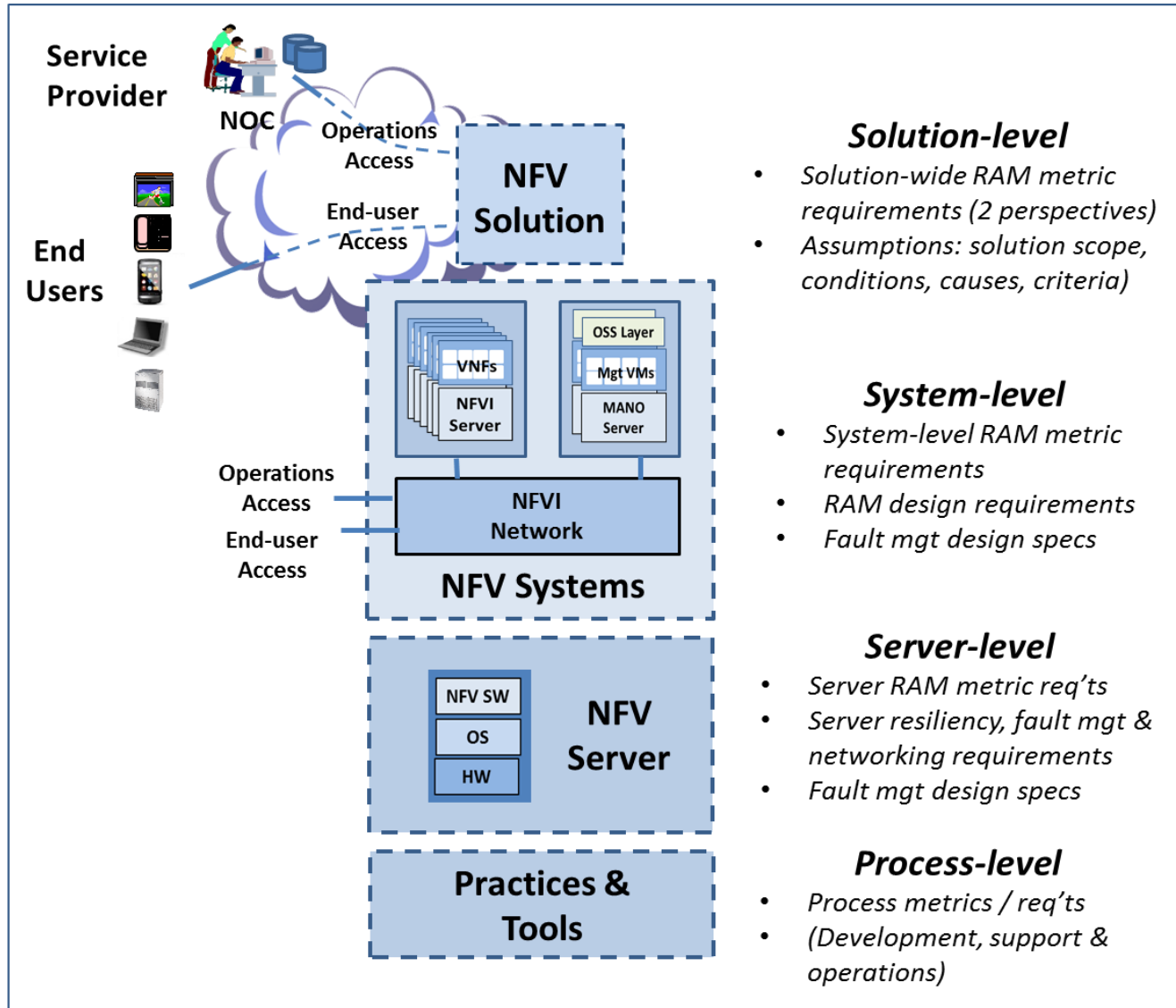
Equipment built from ecosystem of ISVs on standard HW platforms



Establish metrics/reqt's hierarchy: service – network – VNF - subsystems

Vestiges of legacy PSTN-derived RAM metrics/targets/criteria still being applied to emerging network in the name of “carrier-grade”

NFV RAM Framework



Solution-level

- Solution-wide RAM metric requirements (2 perspectives)
- Assumptions: solution scope, conditions, causes, criteria)

System-level

- System-level RAM metric requirements
- RAM design requirements
- Fault mgt design specs

Server-level

- Server RAM metric req'ts
- Server resiliency, fault mgt & networking requirements
- Fault mgt design specs

Process-level

- Process metrics / req'ts
- (Development, support & operations)

NFV RAM Metrics

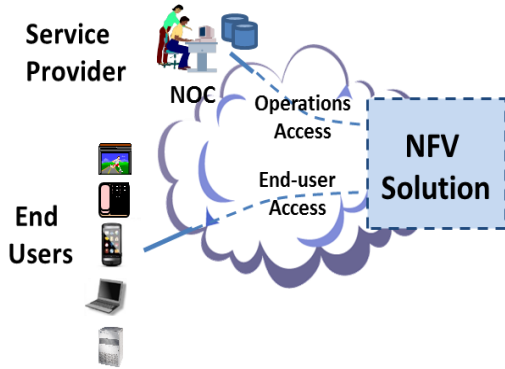


Table 2A: NFV Solution RAM Requirements (Attended)

VNF Downtime Metrics	Essential	Critical	Non-critical
Catastrophic VNF Downtime	0.5	1.0	3.0
Major VNF Downtime	1.0	2.0	5.0
Minor VNF Downtime	1.0	5.0	10.0
Individual Access VNF Service Downtime	2.5	8.0	15.0
Loss of NFV MANO	1.0	2.0	2.0
Unplanned Maintenance Action Ratio	1.5	1.25	1.1

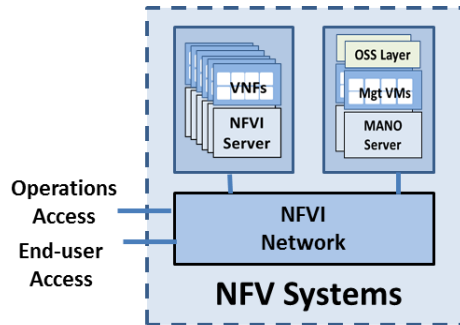
Note: Downtime units are in 'minutes per year'

The NFV Solution shall meet these targets under the following conditions:

- Failure modes caused by hardware, firmware and software failures, and normal operational tasks assuming annual software upgrades
- Unattended office average travel time is 3.5 hours including logistics
- Attended office average logistic time is 30 minutes
- NFV operation is 24/7 with no planned downtime for maintenance
- All software failures requiring craft person intervention to repair the system can be completed remotely.

Example Table of a Subset of RAM Metrics and Targets

NFV RAM Design Requirements



NFV-6: The NFV systems shall be capable of supporting a wide range of redundancy types like n:m and n+m where n is the number in-service systems and m is the number of redundancy systems or amount of reserved capacity.

NFV-7: The NFV Solution shall be capable of policy-based recovery prioritization to dynamically recover VNF protection groups based on the specified policy to the backup system(s).

NFV-8: NFVI failure modes shall not have a VNF impact scope greater than the number of VNFs that the NFVI system serves.

NFV-9: NFV-MANO failure modes shall not impact the functioning of the NFVI and VNF systems.

NFV-10: The NFV System shall support geo-redundancy of VNF protection groups for distance of up to 500 km.

NFV-11: NFVI server and network hardware failures shall be automatically detected and alarmed with the following impact on VNF services during detection, recovery, recovered state and returned-to-service as follows:

Essential Service: No impact

Critical Service: Loss of VNF services within its scope of less than 30 seconds

Non-Critical Service: Loss of VNF services within its scope for the MTTR duration

NFV-12: NFVI software failures shall be automatically detected and alarmed in less than 10 seconds. The system shall detect unsuccessful recovery and automatically initiate a system re-start that shall take less than 5 minutes.

NFV-13: Resources reserved for redundancy shall be adequately provisioned and tested to ensure readiness at levels to achieve VNF Downtime and Maintenance Requirements (Table 1).

NFV-14: The NFVI system shall be capable of in-service upgrades, patching and VM Migration with the following impact on VNF services:

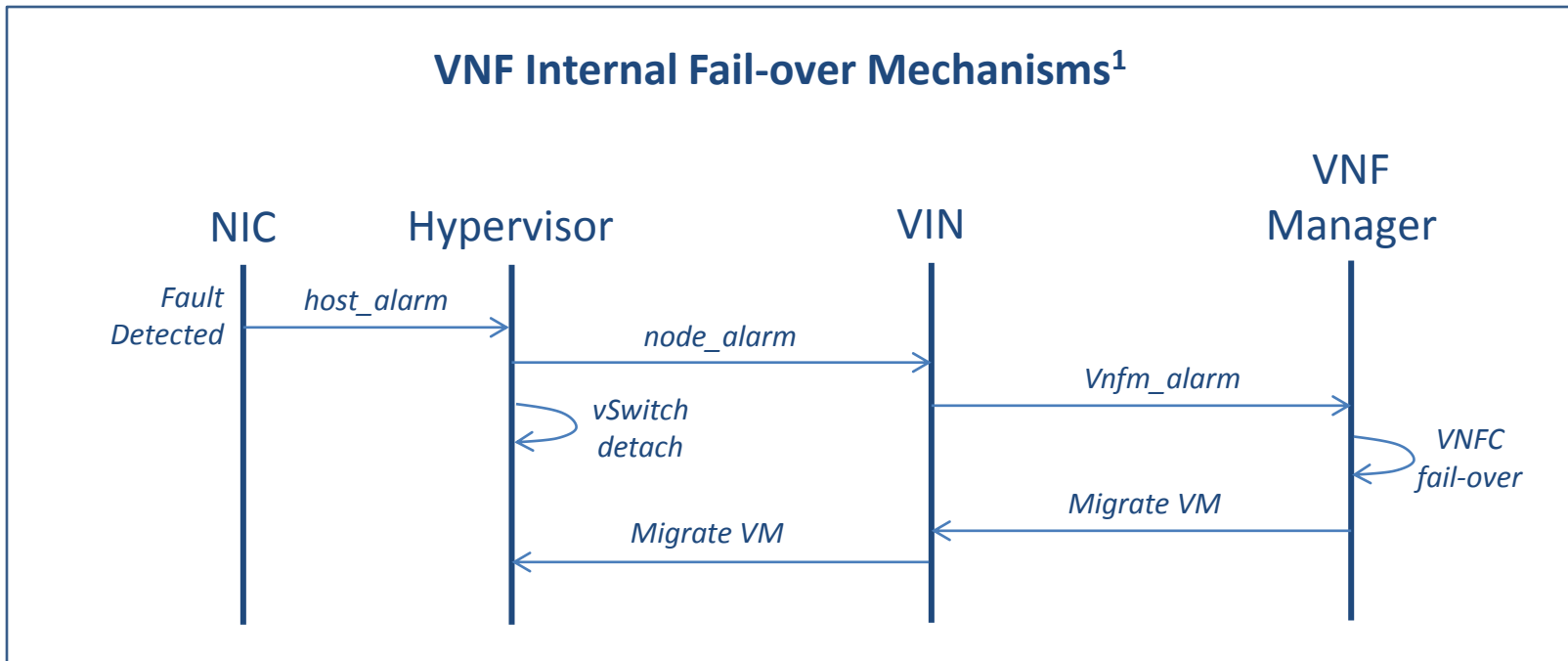
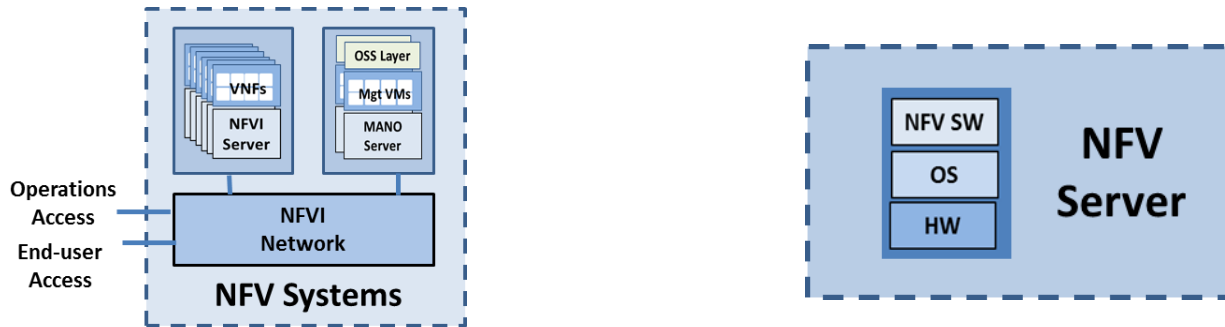
Essential Service: no impact on established communications sessions for

Critical Service: < 30 seconds where new communication sessions cannot be established but established sessions cannot be dropped.

Non-critical Service: < 5 minutes where new sessions cannot be established but established sessions cannot be dropped.

***Example Table of a Subset of RAM Design Requirements
(From KerrNet Contribution)***

NFV Fault Management Design Specifications



Note 1: Example from ETSI Resiliency Document rel001v100

NFV RAM Requirements Opportunities

- **NFV RAM Metrics:** defines the NFV RAM metrics, metric criteria, and compliance conditions. This document ensures consistency across the industry when setting and reporting targets. It would update TL9000 metrics for NFV solutions.
- **Setting NNF RAM Metric Targets:** provides a guide on how to set RAM metric targets. The document would also provide a set of default targets.
- **NFV RAM Design Requirements:** defines design requirements for NFV resiliency and fault management used to design and verify NFV solutions and systems. These are implementation-independent requirements.
- **NFV RAM Specifications:** specifies solution-wide fault management design specifications to support fault handling interoperability for NFV solutions built by multiple vendors.
- **NFV RAM Modeling Guide:** specifies the methodologies used to model NFV designs to compute NNF RAM metrics. The purpose is to promote consistency across the industry so that results from different vendors can be compared with confidence.
- **NFV RAM Measurement:** specifies the requirements for auto-measurement of packet performance in NFV solutions and how to use the data to automatically compute RAM metrics.

NFV Requirements/Standards Status

Table 1: NFV RAM Requirements Scope

NFV Requirement Area	IEEE NFV RAM	Other Initiatives
RAM Metric Definitions	Proposed	Unknown (TL9000?)
RAM Metric Targets	Proposed	Typically market driven
RAM Guidelines (see above)	Proposed	Unknown
RAM Design Requirements	Proposed	ETSI NFV
Fault Mgt Design Spec	Open	ETSI NFV
Server Fault Mgt Specs	Open	ETSI NFV (OSDL?)
Process Engineering	Open	Unknown (TL9000 / CMMI?)

CMMI: Capability Maturity Model Integration

OSDL: Open Source Development Labs

- ***Current view using RAM Framework***
- ***No evidence of plans for standards as yet***