Upgrading Your System – a Telco User Perspective

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OPNFV SUMMIT

LINUX FOUNDATION COLLABORATIVE PROJECTS

Outline

- Introduction and Requirements
- Upgrade Scenarios
- OPNFV Escalator Project

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Upgrade and High Availability

- In Telco Networks “5 Nines“ (5 minutes per year) includes planned and unplanned outage.
  - Downtime during upgrade counts towards the 5-nines
  - Upgrade preparation and execution time may be longer
  - Traditional network functions can be upgraded with downtime < 1-2 minutes.

- BUT:
- What matters is the service downtime, not downtime of individual network function instances

Upgrade and Automation

- Typically Telco Networks consist of a high number of network functions; some of them with thousands of instances.
  - But the number of different types of network functions is smaller.

- Upgrades must be done for a larger number of network functions in the network, thus it is highly desired to have automation for upgrades

Upgrade in the Cloud

Cloud environments with NFV bring new opportunities and new challenges

- Virtualized Network Functions (VNFs) can easily be cloned before upgrades.
  - New mechanisms can be introduced on application (VNF) level
- Upgrade of VNF, Infrastructure and Cloud-Management can be decoupled
  - Reduce the risk during the upgrade process
  - Some building blocks can accept longer downtimes
- Failure during NFVI or VIM upgrade can affect many VNFs and thus cause network downtimes

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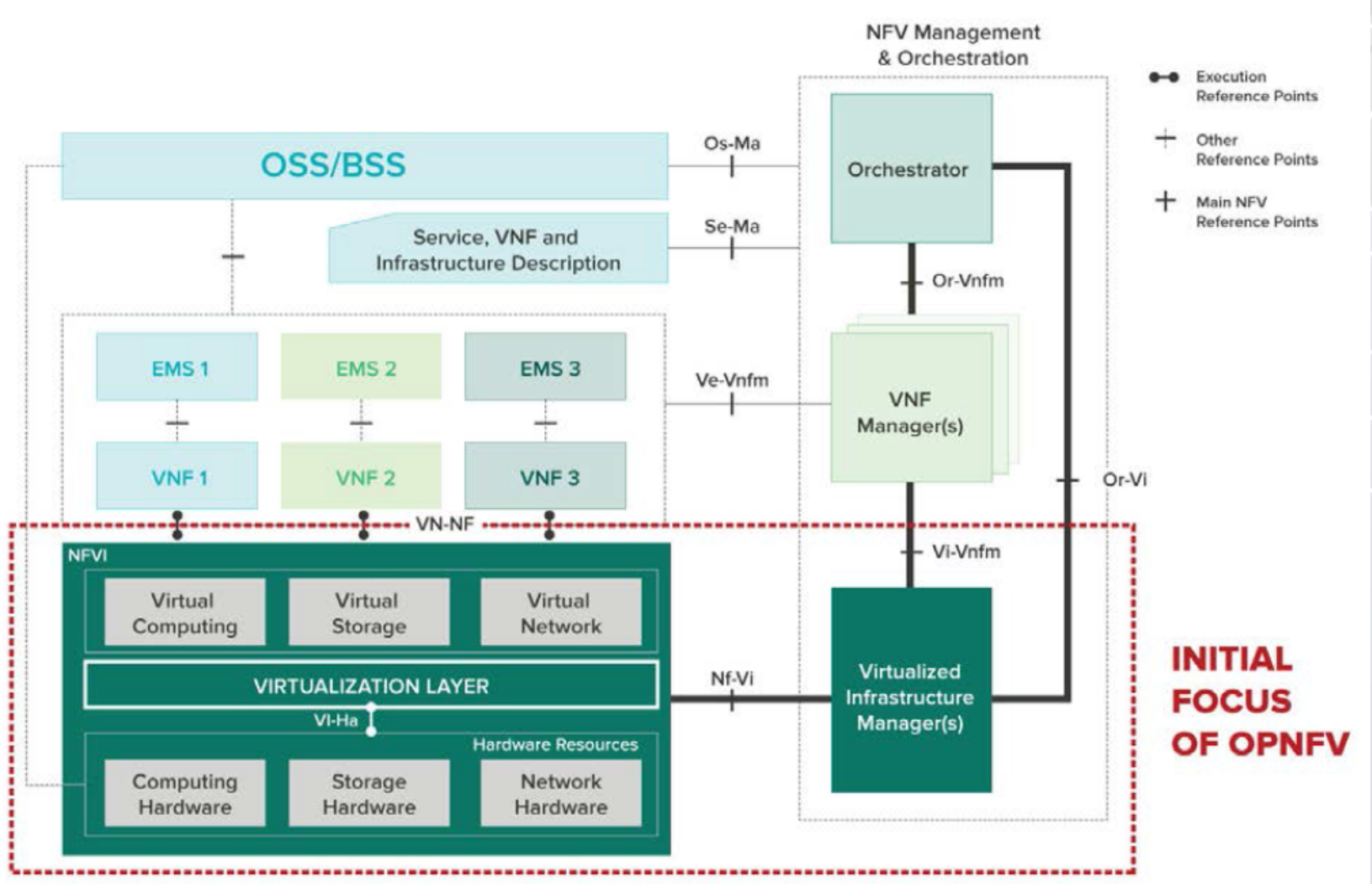
- Upgrade Scenarios
- OPNFV Escalator Project

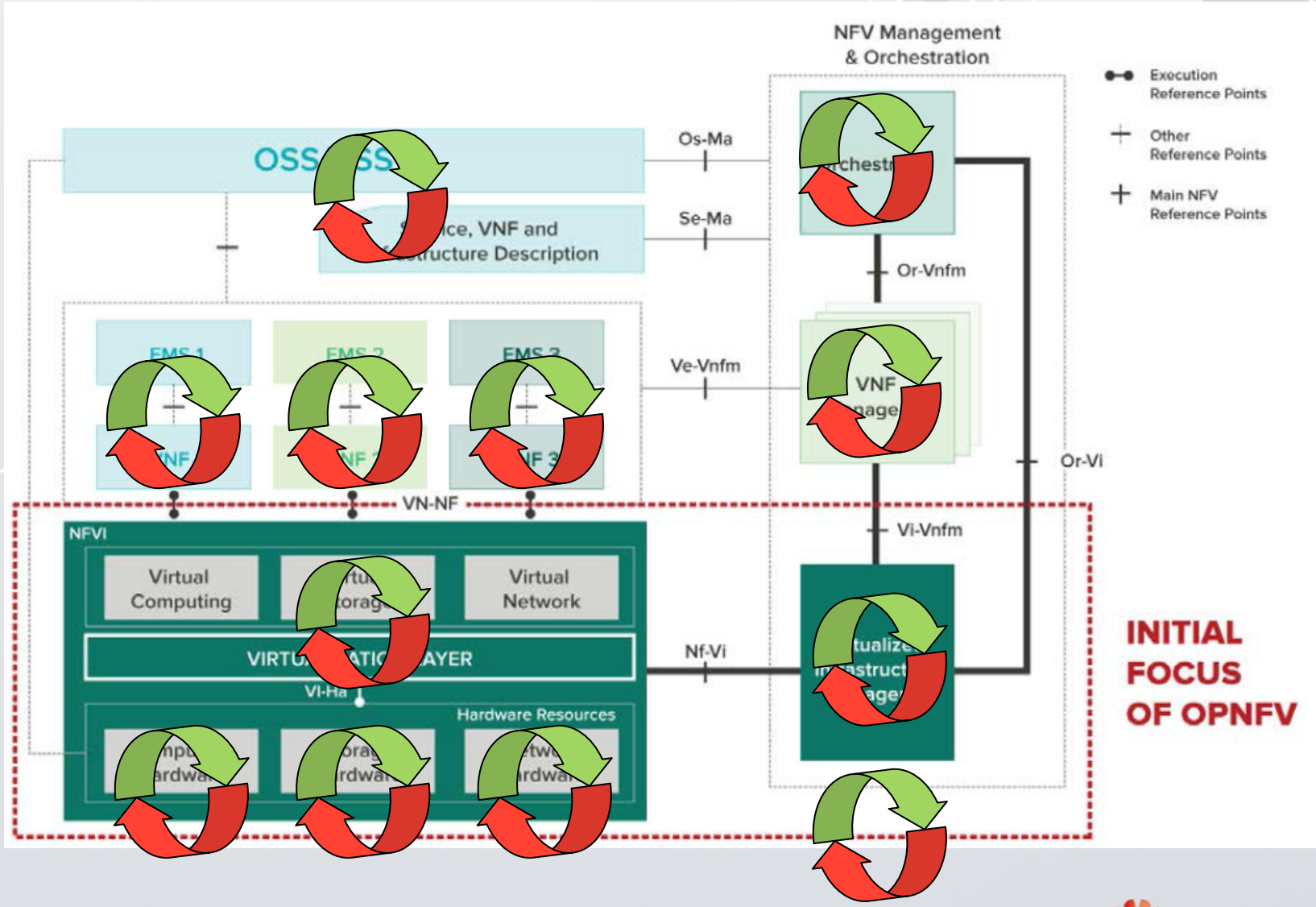
Building Blocks of an NFV based Network

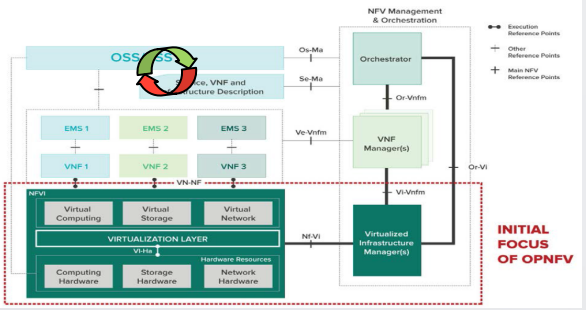


Building Blocks of an NFV based Network

Instead of vertically integrated systems, now there are many building blocks with standard interfaces

- Blocks can be upgraded separately.
- Each type of building block will have different requirements

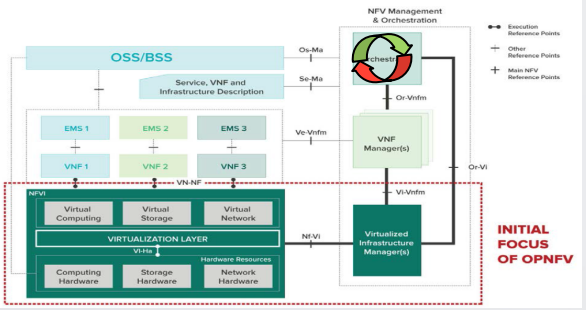




1. Upgrade of OSS/BSS systems

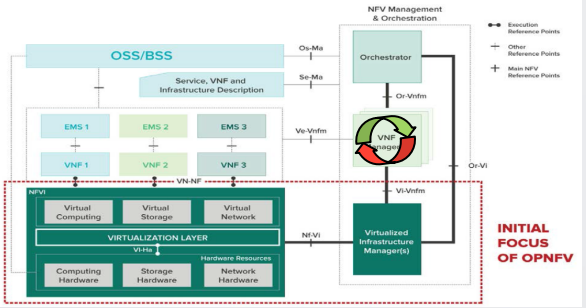
- OSS/BSS systems already today are operating independent from the network (considering software maintenance and HA). Therefore there are no new requirements as long as the role of OSS/BSS is not changed by the introduction of NFV

Please note that OSS/BSS could be deployed on OpenStack (which doesn‘t affect their upgrade significantly)



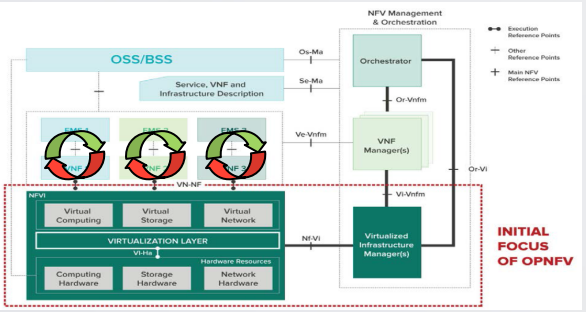
2. Upgrade of Orchestrator (NFVO)

- Acceptable downtime of NFVO during its upgrade can be longer than for network service.
  - NFVO downtime will not directly cause service downtime
  - No automatic scaling
  - No reaction on fault notifications
  - No Operational commands during part of the upgrade process
- Exact requirement must be determined .....
- Please note that NFVO could be deployed on OpenStack (which doesn‘t affect its upgrade significantly)



3. Upgrade of VNF Manager (VNFM)

- VNFM is responsible for lifecycle management of VNFs only.
  - VNFM downtime will not directly cause service downtime
  - No automatic scaling
  - No reaction on fault notifications
  - No Operational commands during part of the upgrade process
- NFV allows for generic or specific VNFM
- Generic VNFM is very independent from VNFs. Upgrade should be easy.
- Specific VNFM will have proprietary (thus possibly version-dependent) interfaces to VNF and might be upgraded together with the VNF.
  - Specific VNFM might be stateful and need its own upgrade process, synchronized with its VNF(s).



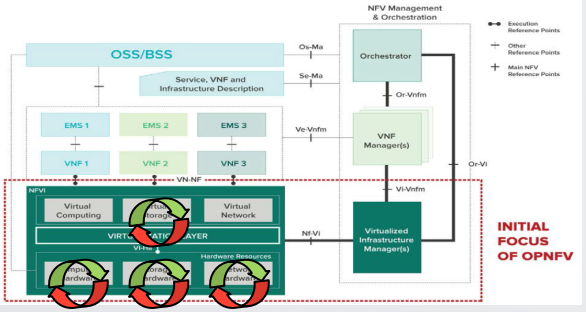
4. Upgrade of VNFs

- Upgrade process for VNFs and requirements will be different:

A. Large stateful VNFs with many VMs, internal redundancy, different roles of some VMs and internal dependencies
   - In many cases, they will come with a specific upgrade process, and will not need much interaction with cloud management or infrastructure
   - They might make use of VM cloning to improve their upgrade behavior.

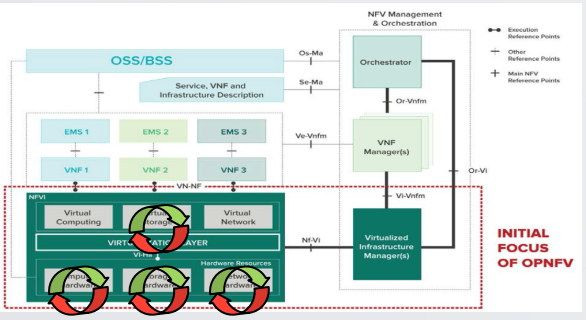
B. Small stateless VNFs operating in load sharing
   - They might not need an upgrade process at all: Just instantiate additional VNFs with new software and later kill old ones.

C. Any combination of these characteristics is possible



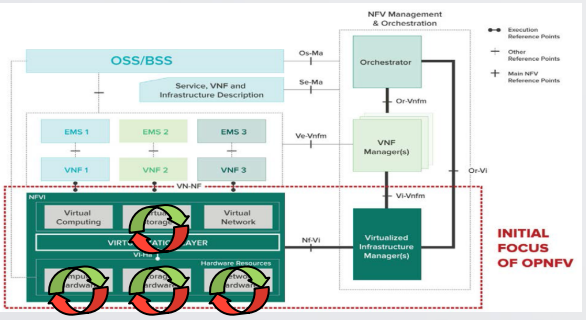
5. Upgrade of NFV Infrastructure

- NFVI typically consists of sets of identical components which host the virtual resources.
  - Upgrade can be done ”rolling“ component by component for every component type
    (this includes first adding new components and later removing old ones)
  - Assignment of virtual resources must be moved dynamically during the upgrade process
    - Mechanism might vary, depending on the user of the resource:
      - Sometimes we can rely on the redundancy mechanisms inside a VNF
      - Sometimes we can use live migration for moving the assignments
    - There needs to be cloud-level control of the upgrade process
      - Upgrade control might need to notify VNFs about resource upgrades
    - New and old components need to work in parallel providing resources to VNFs
    - We are talking about compute, and also storage and network resources
      - **Rolling upgrade to cover network resources is a new challenge**
    - We are talking about software, hardware and components with both.
- There are dependencies to be considered

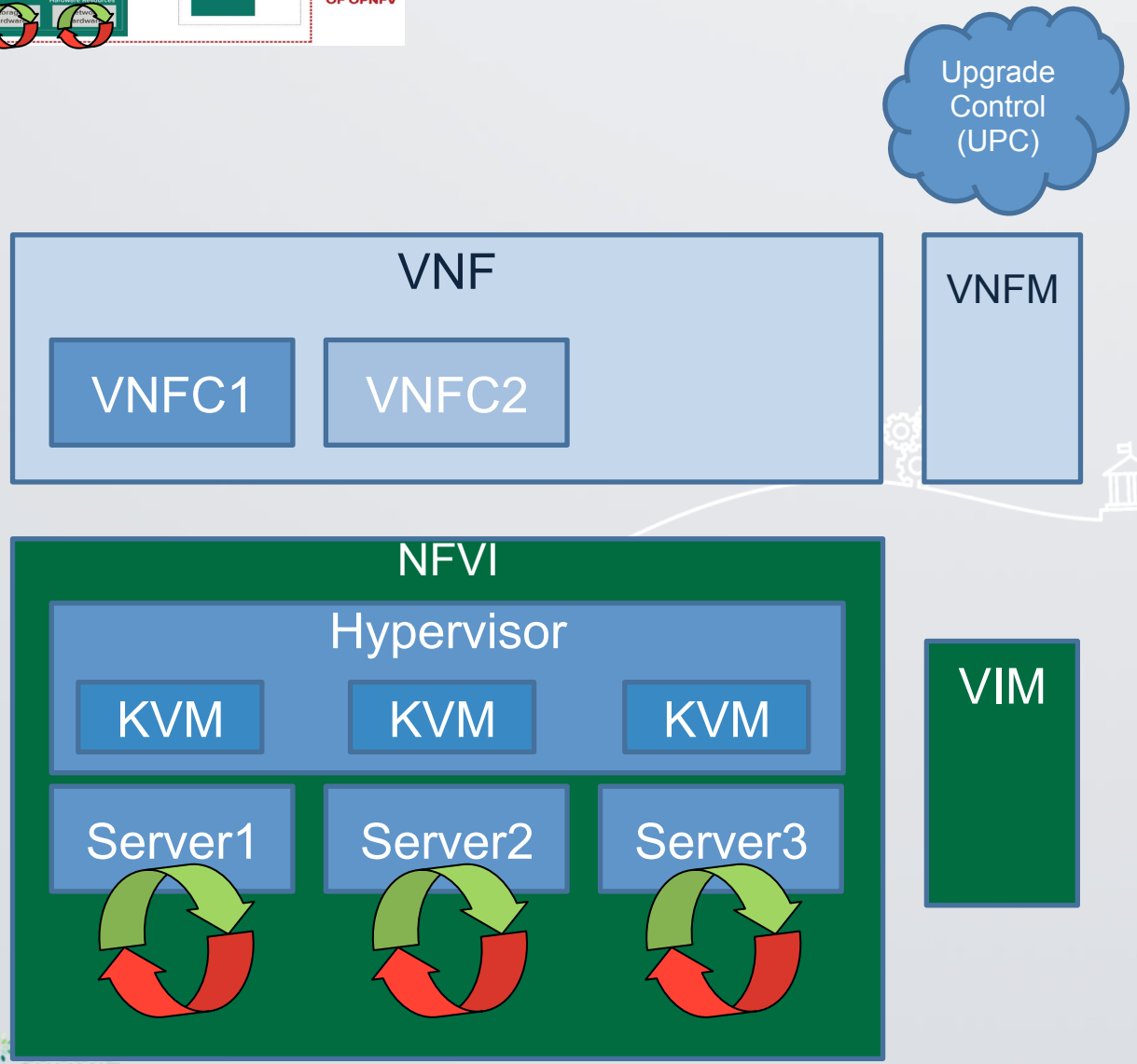


5. NFVI Upgrade and Dependencies

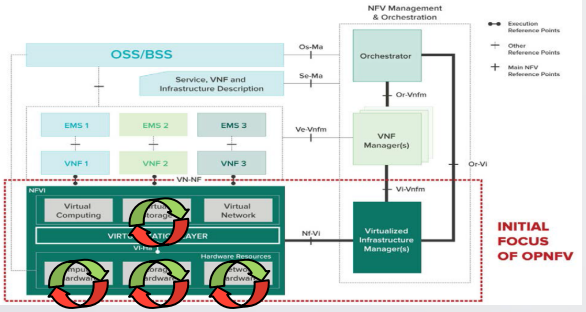
- Dependencies between NFVI components
  - Upgrade control must execute upgrades in a certain sequence
  - Upgrade of one component will result in downtime of another component
  - Should NFVI upgrade control be part of the VIM?
- VNFs will have dependency on multiple NFVI components



5. NFVI Upgrade Example



- Here we want to upgrade the servers in NFVI, hosting a VNF with two VNFCs (typically VMs) in active/standby configuration
- Assume there is an idle server
- Added some function “upgrade control“ without specifying where it would reside.
- Assume VNFC2 is now standby



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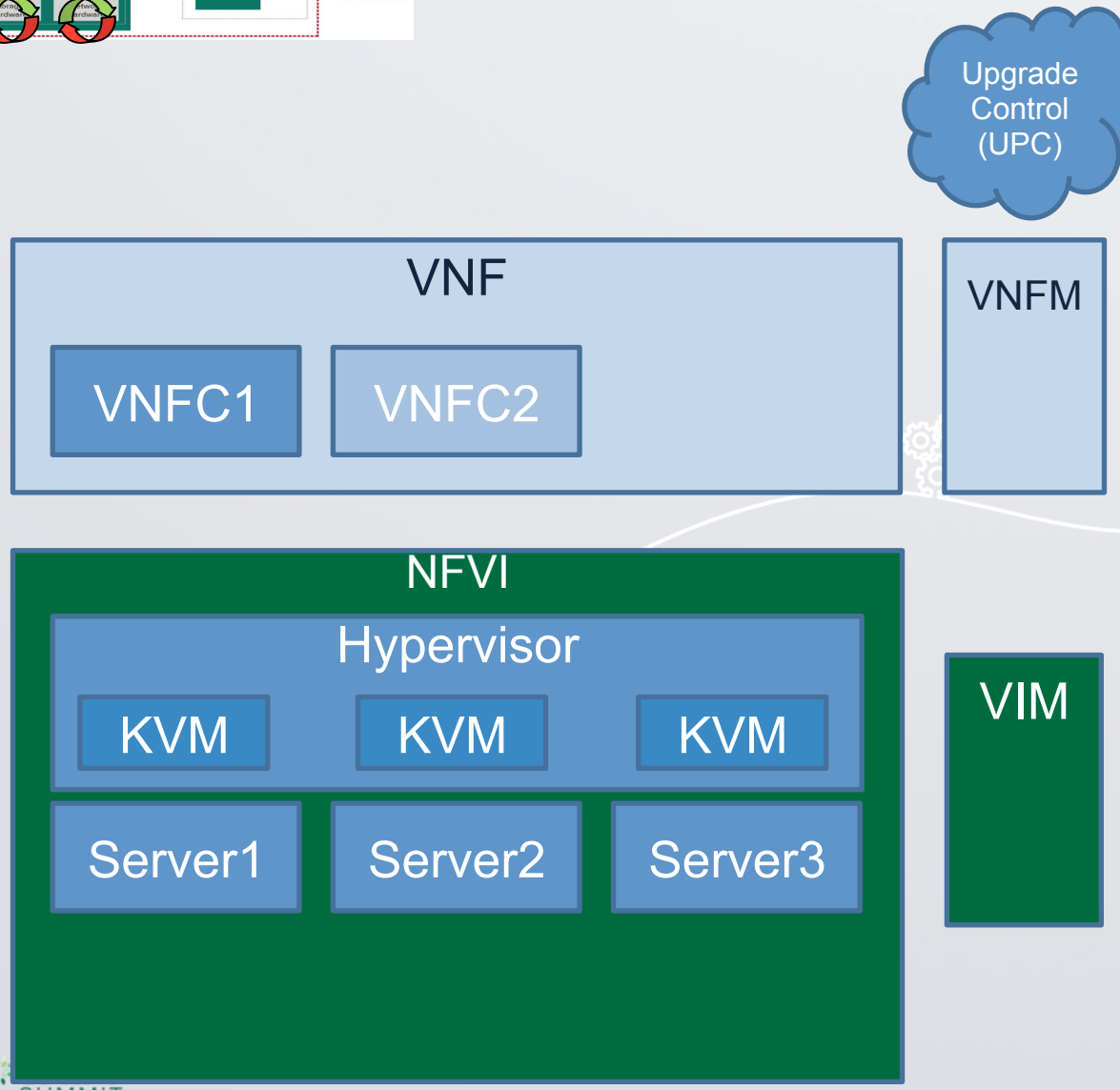
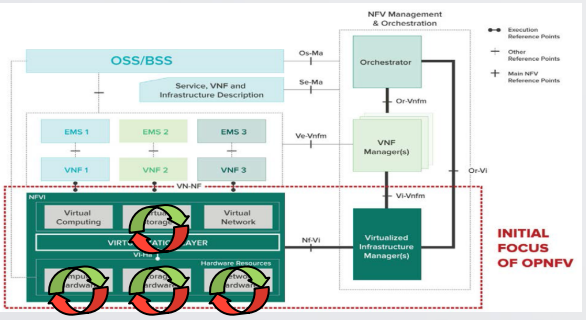


Step 1: Calculate upgrade sequence

(For optimized procedure, UPC needs to detect idle servers and servers running standby VNFC)



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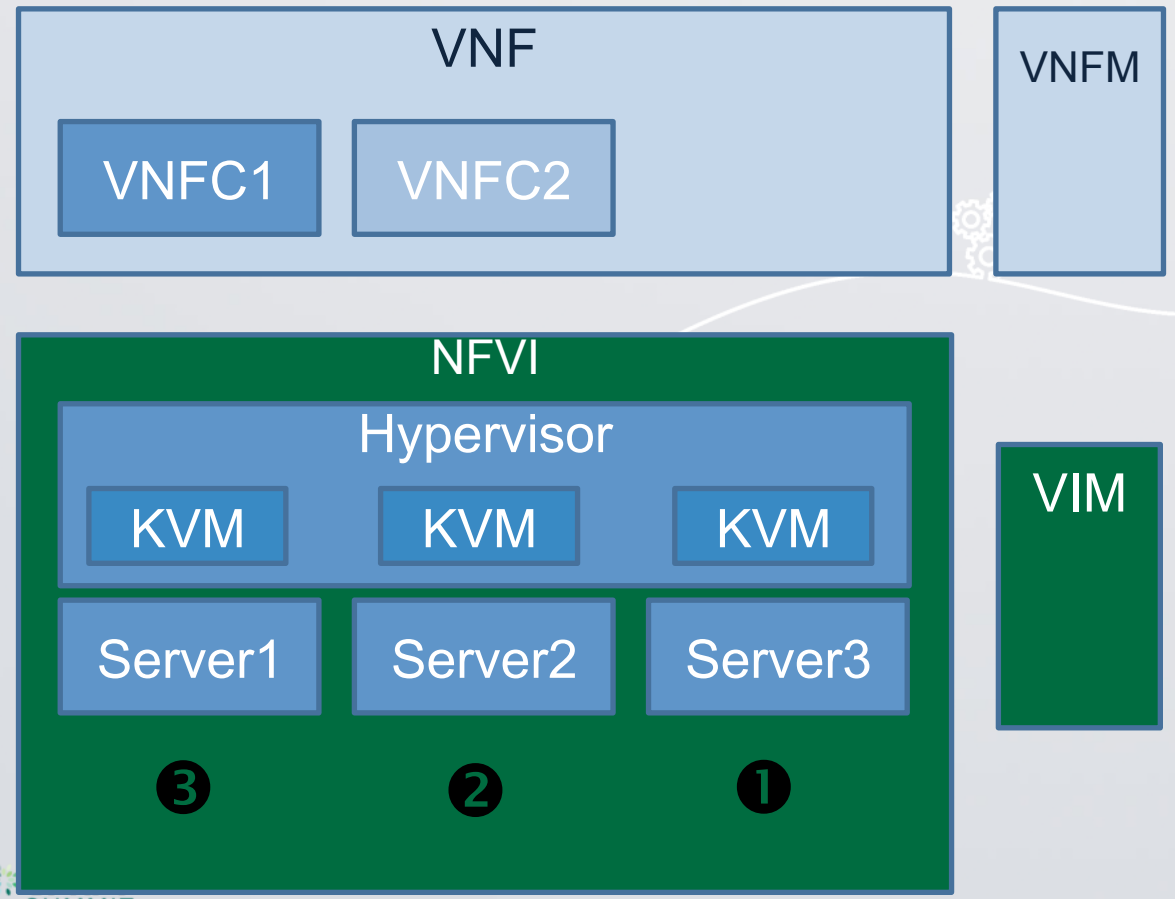

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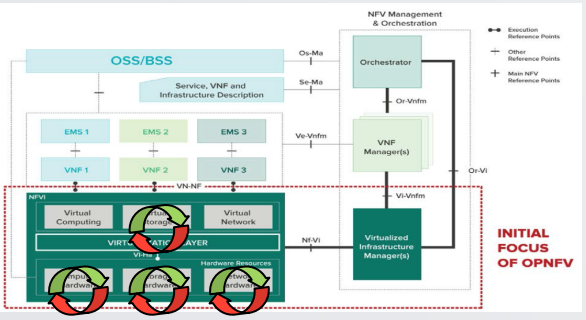

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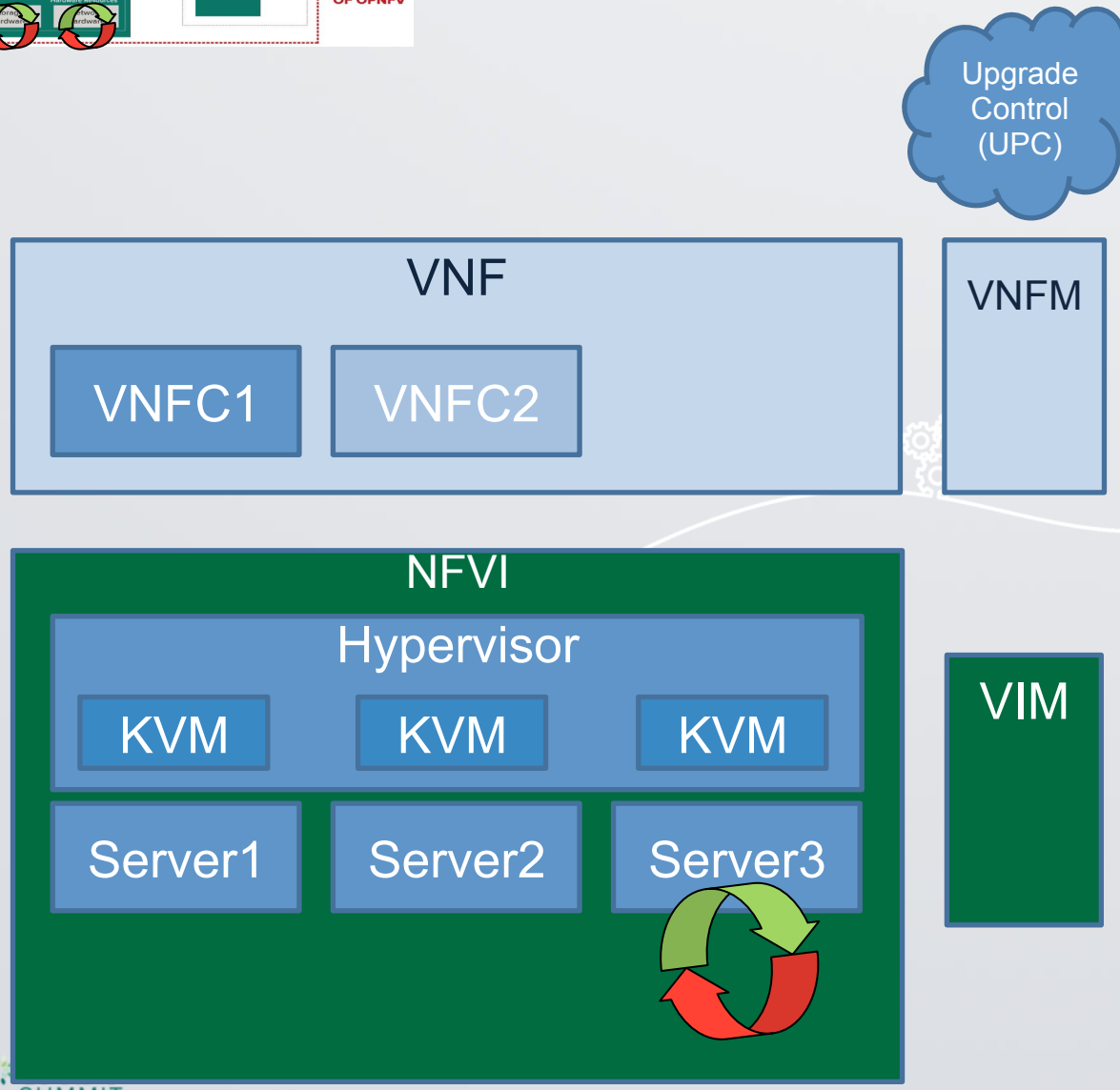
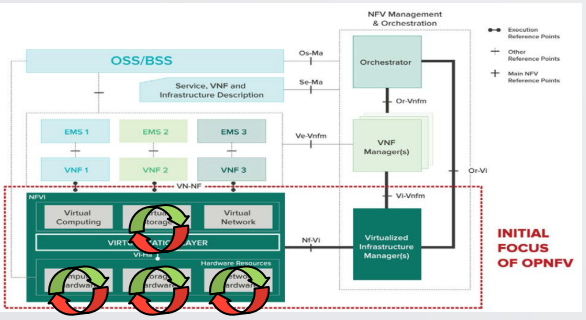


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

(In our case install new basic software:

KVM etc.)



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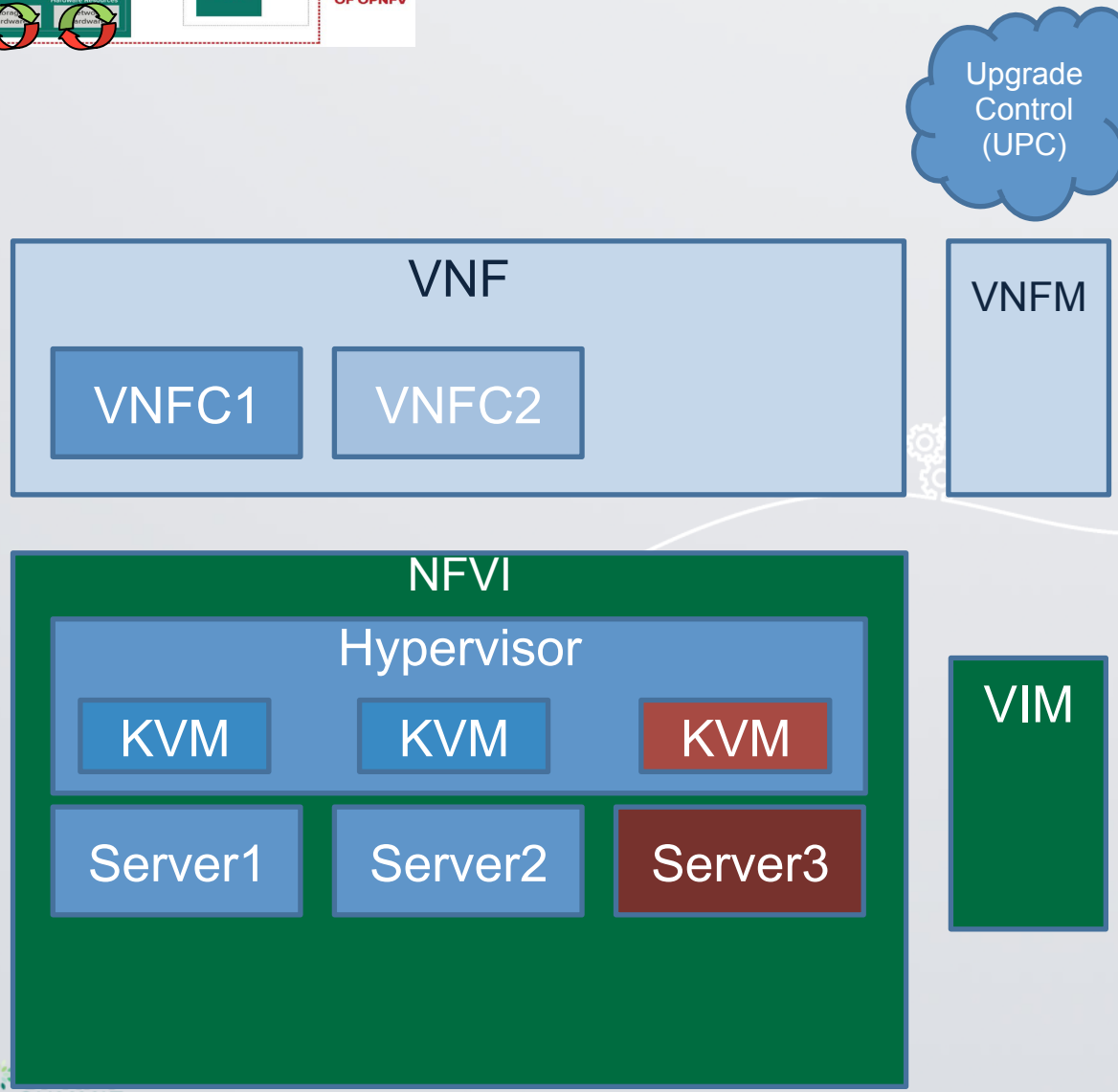
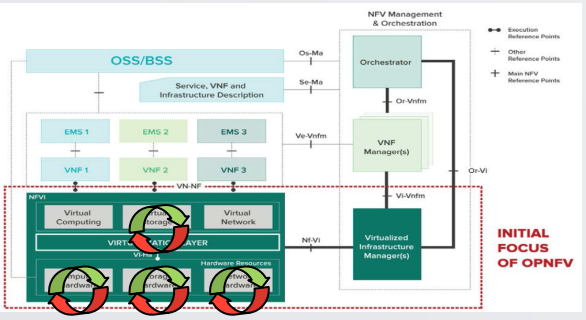


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Any communication between servers inside Hypervisor layer now is between new and old version



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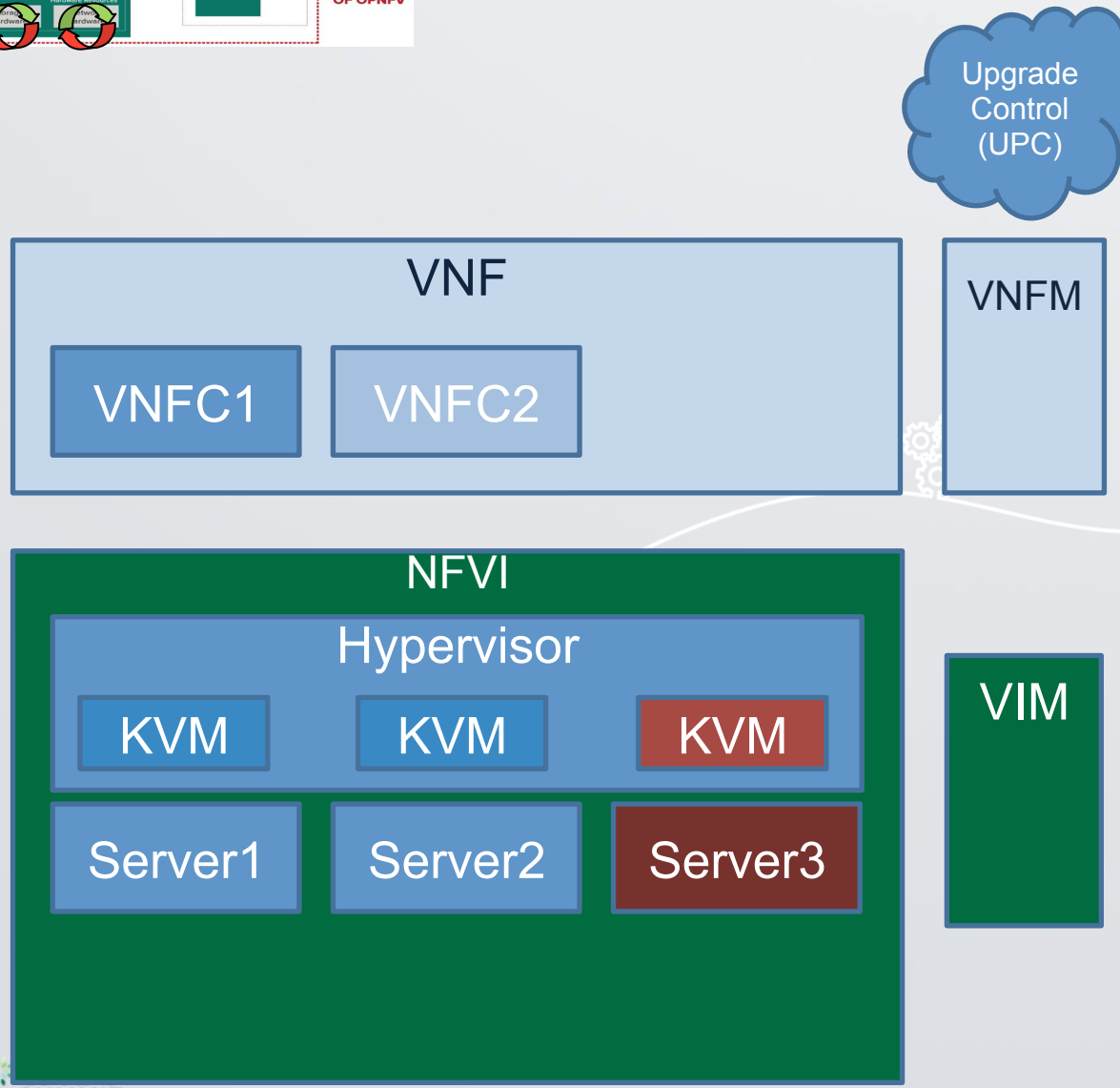


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

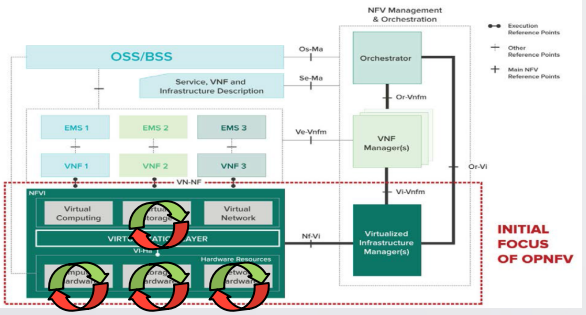
Step 3: Migrate VNF2 to Server 3

Here different methods are possible:

- Live migration
  (VNFM or UPC request from VIM)
- Smooth shutdown
  (VNFM initiates shutdown, allocates new resource, installs new VNFC2)
- Hard shutdown
  (VIM switches off Server 2 and allocates new resource for VNFC2 for VNFM)

Difficult to control for UPC. It needs to know details of resource allocation

Please note the necessary network reconfiguration.



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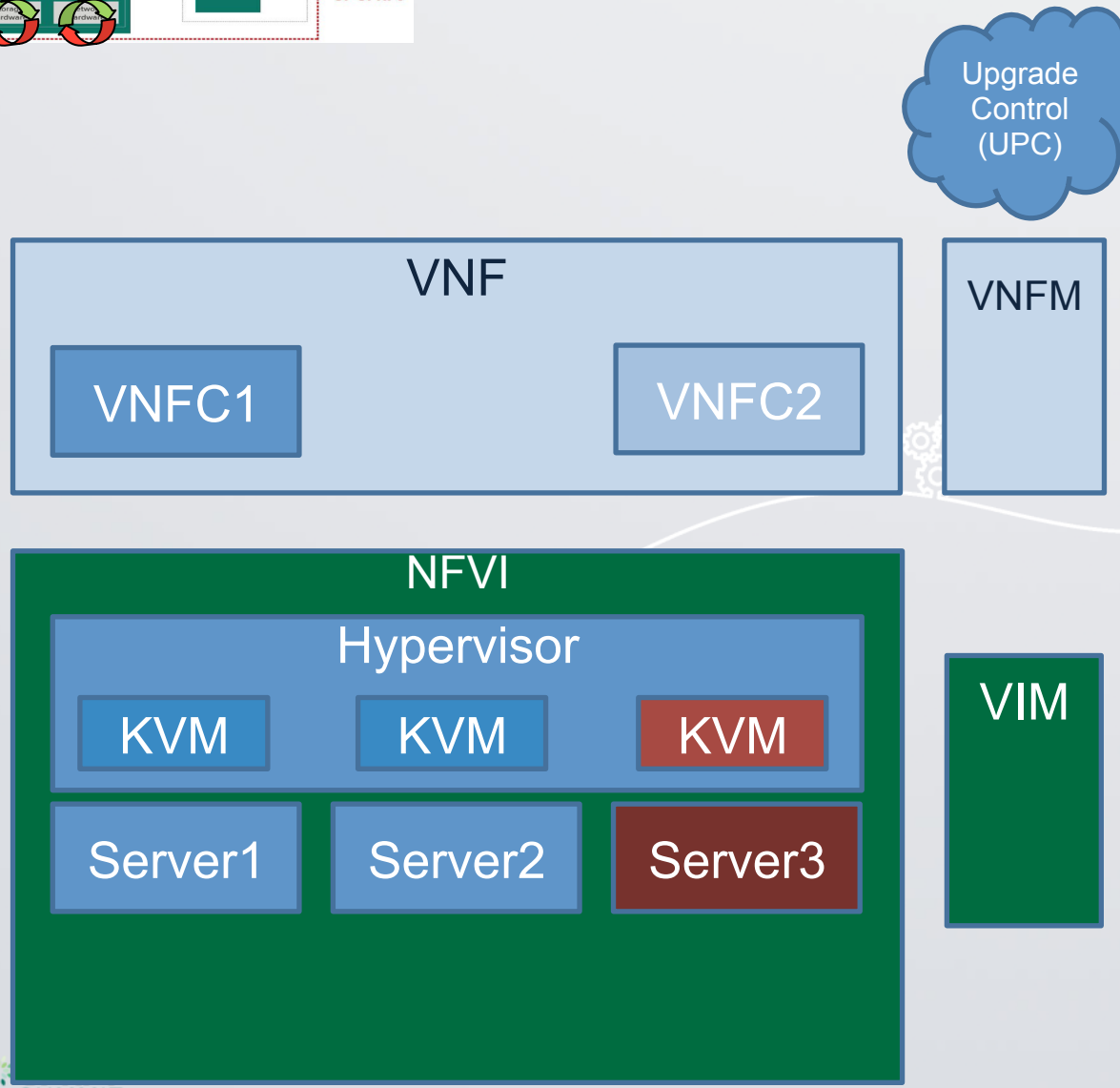


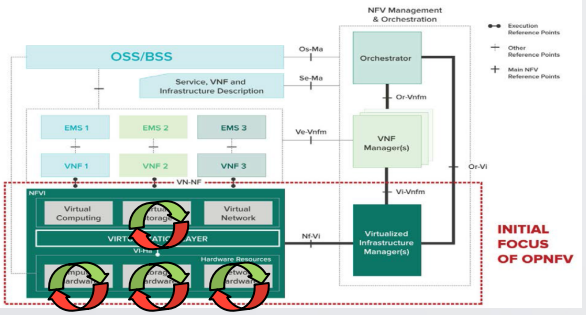
Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

(UPC needs to trigger VNFM)



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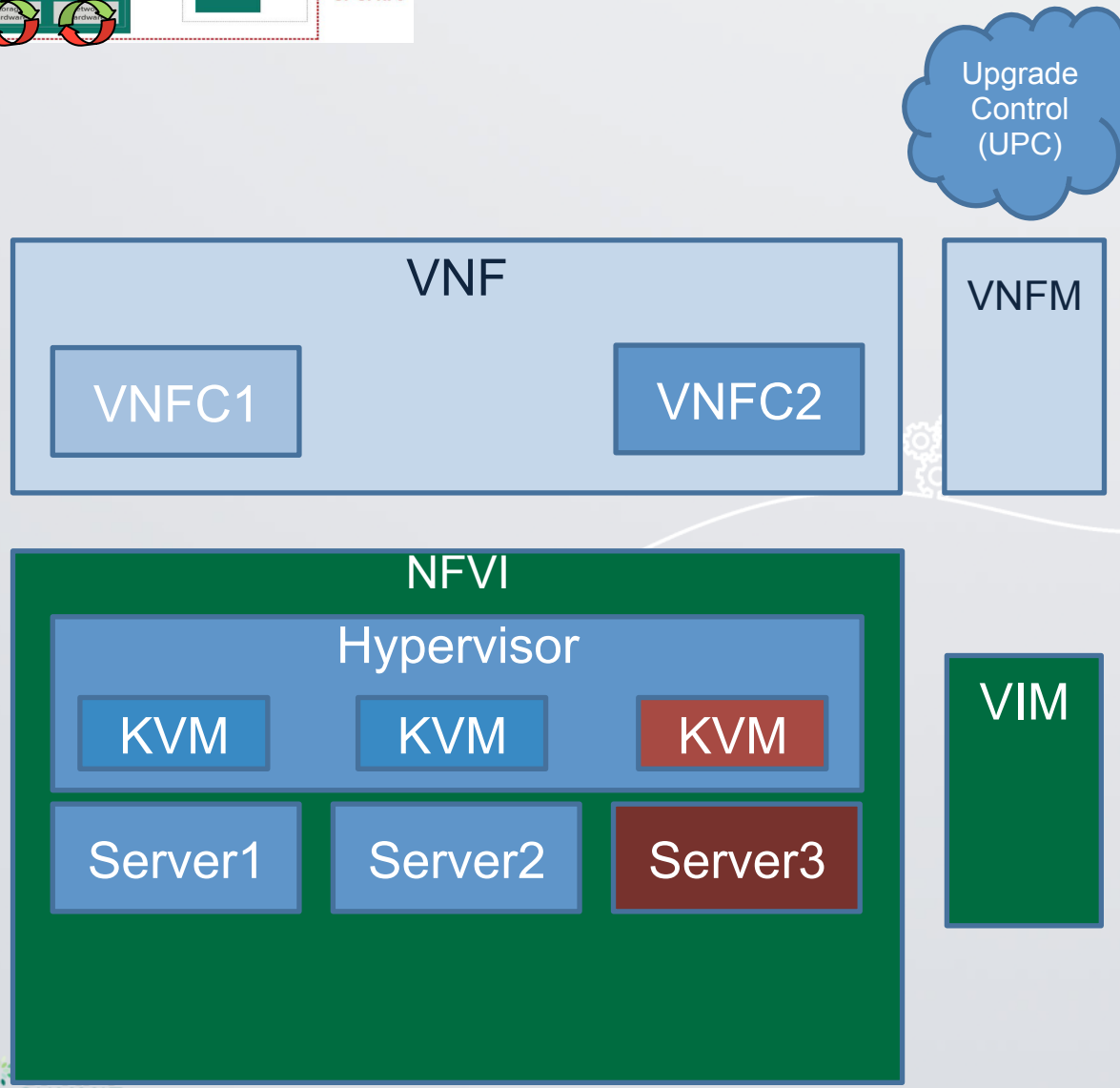


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

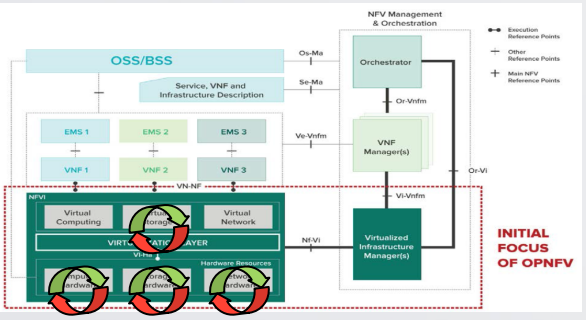
Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run

on new hypervisor

(please note, it might not be easy to achieve that the VNF can execute properly on two hypervisor versions when optimizations are in place)



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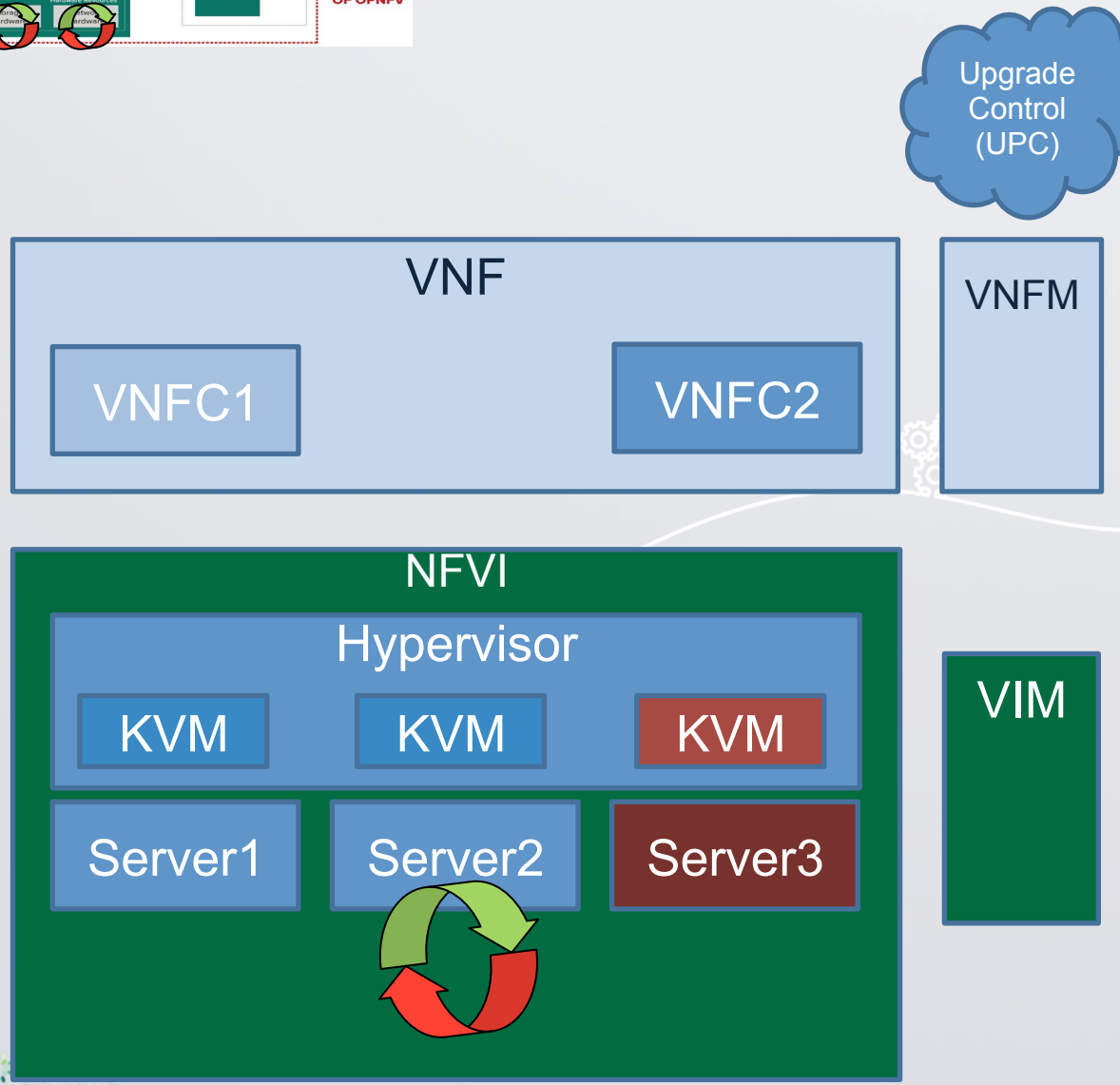


Step 1: Calculate upgrade sequence

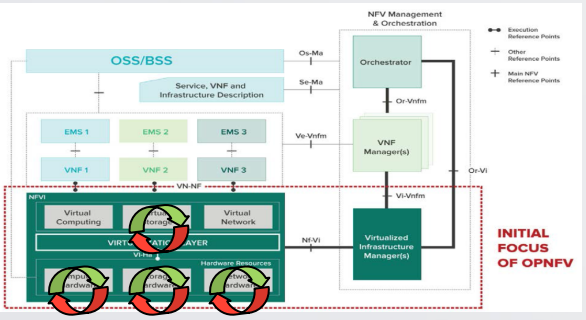
Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

Step 6: Upgrade Server 2



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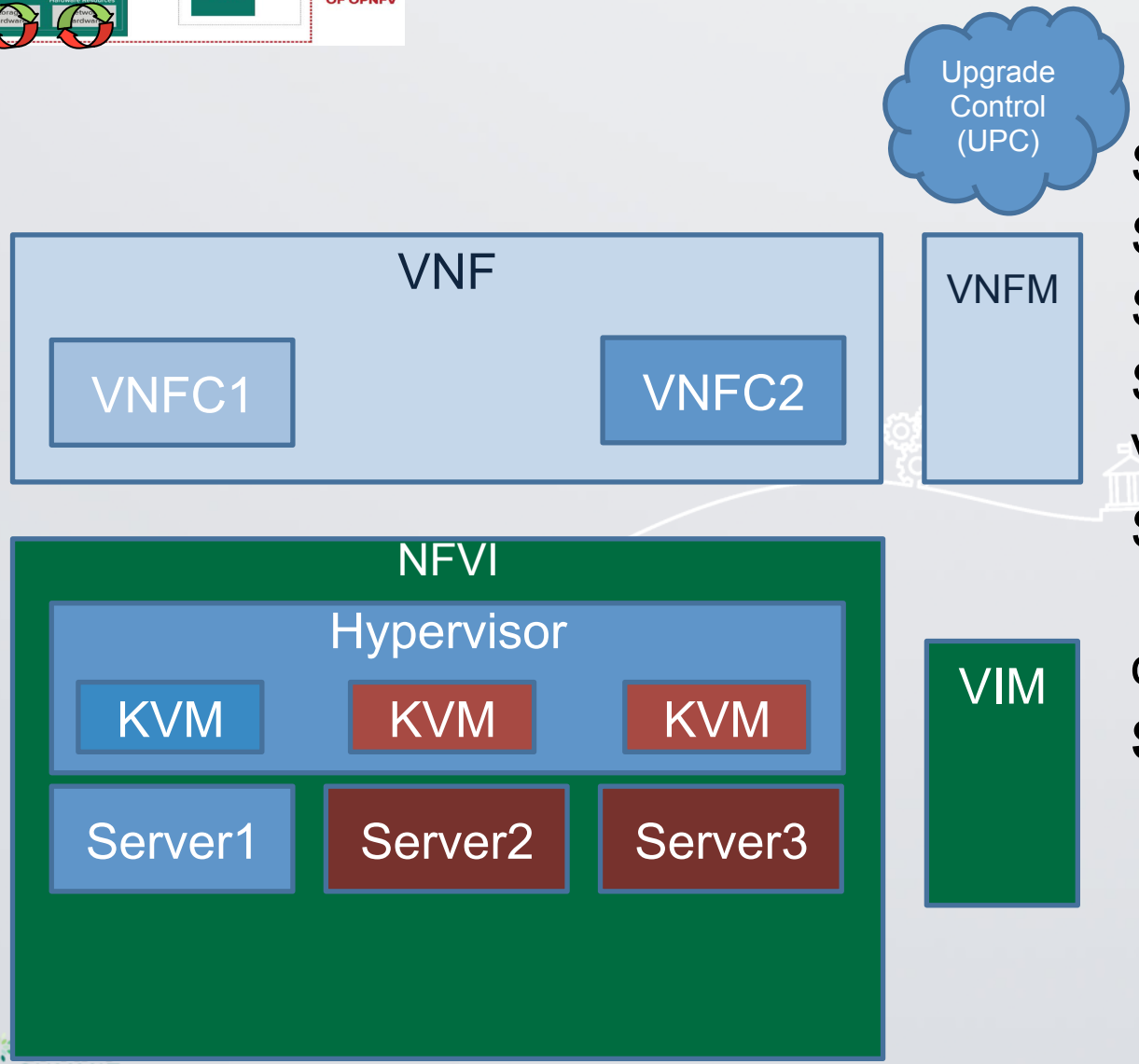

Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

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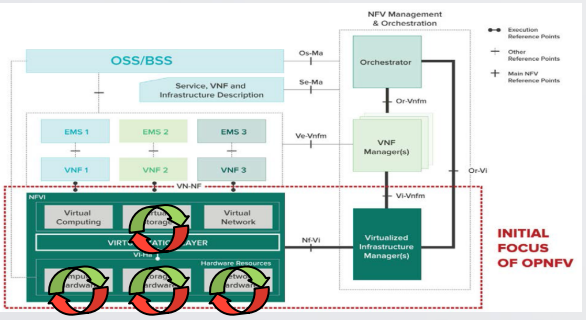

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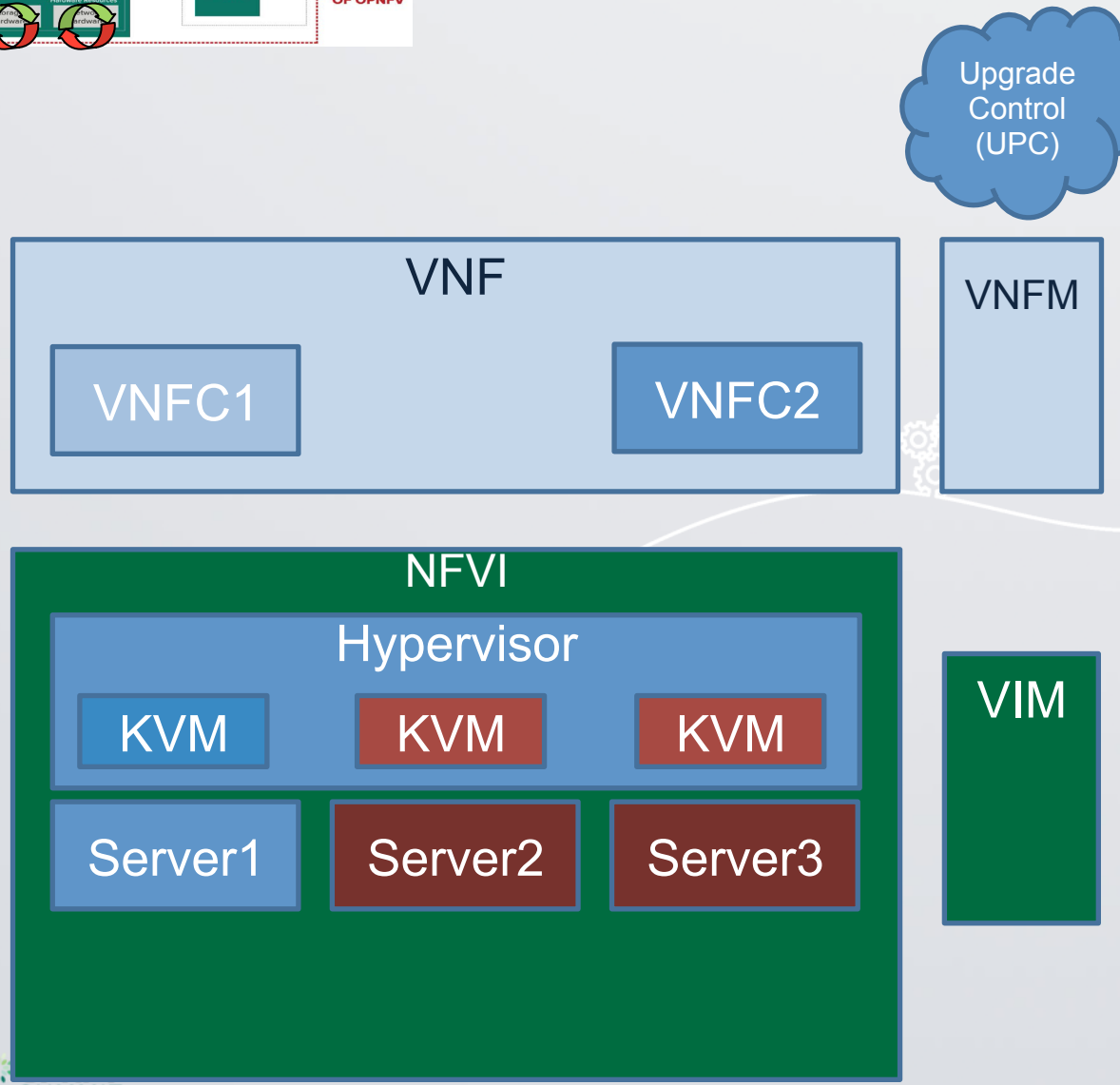


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

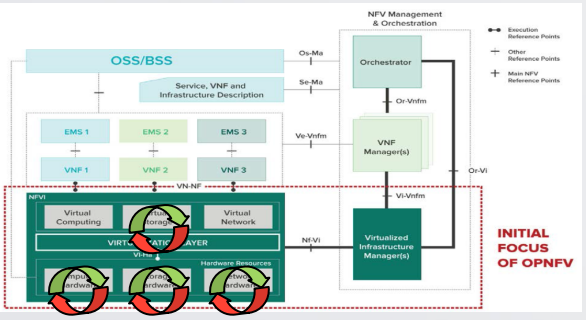
Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

Step 6: Upgrade Server 2

Step 7: Migrate VNFC1 (as above)



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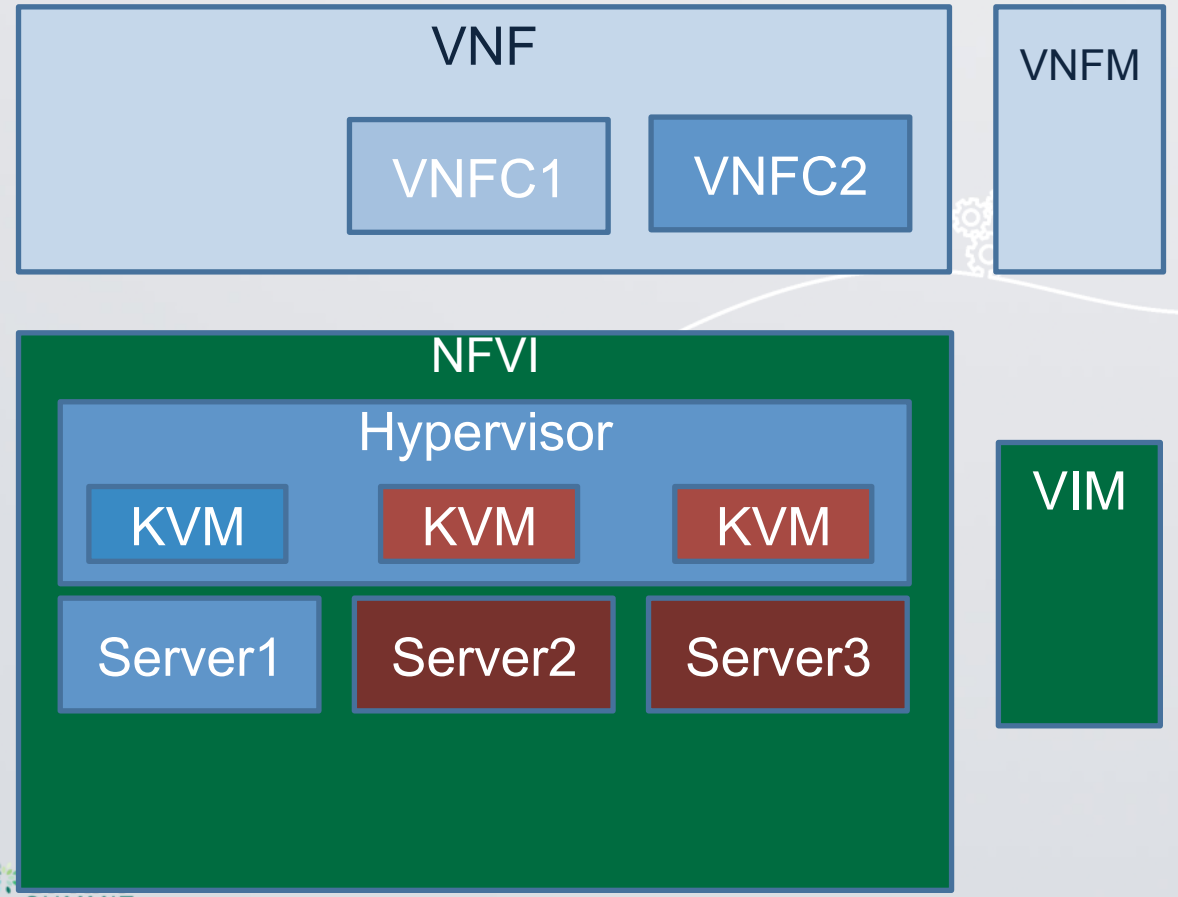

Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

Step 6: Upgrade Server 2

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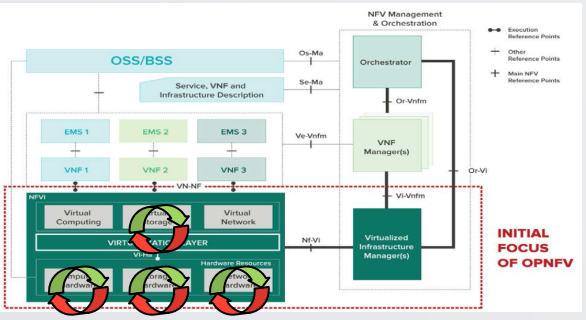

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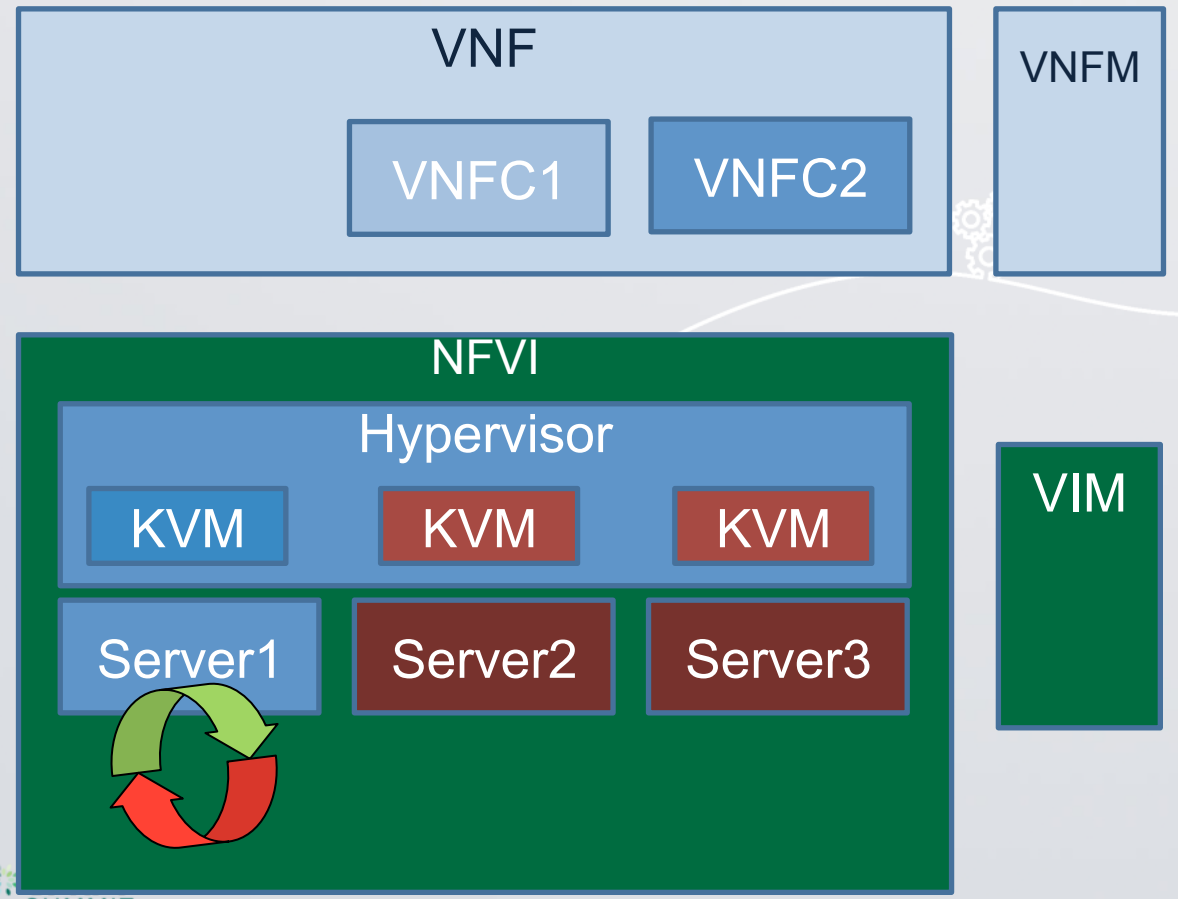


Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

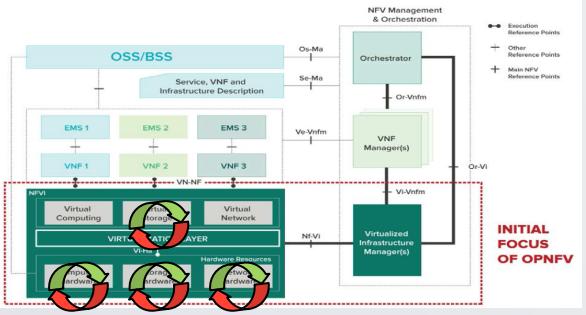
Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

Step 6: Upgrade Server 2

Step 7: Migrate VNFC1

Step 8: Upgrade Server 1



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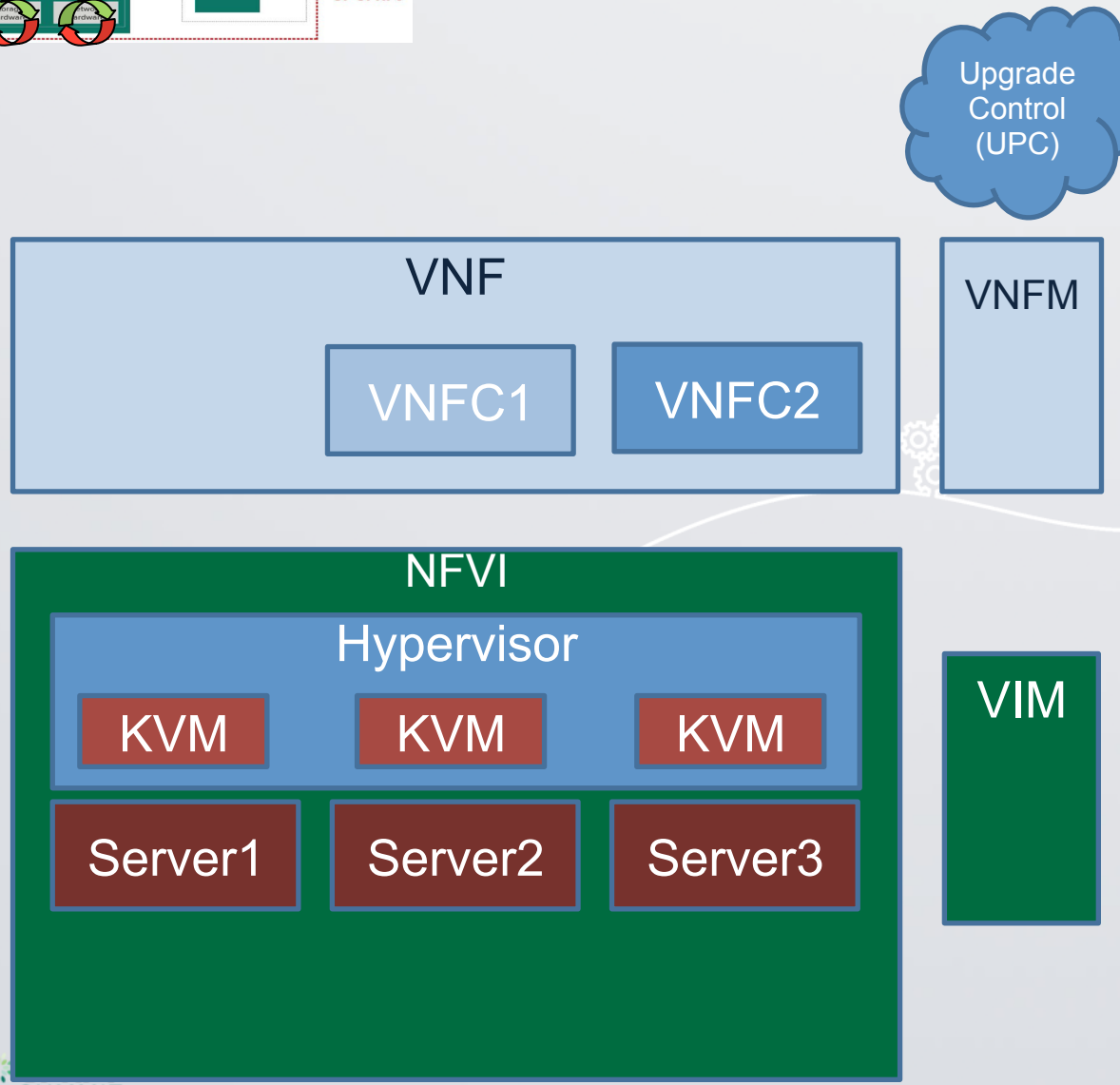

Step 1: Calculate upgrade sequence

Step 2: Upgrade Server 3

Step 3: Migrate VNF2 to Server 3

Step 4: Switch-over active role from VNFC1 to VNFC2

Step 5: Now active VNFC needs to run on new hypervisor

Step 6: Upgrade Server 2

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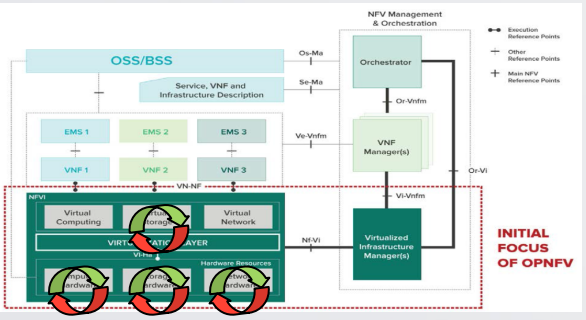

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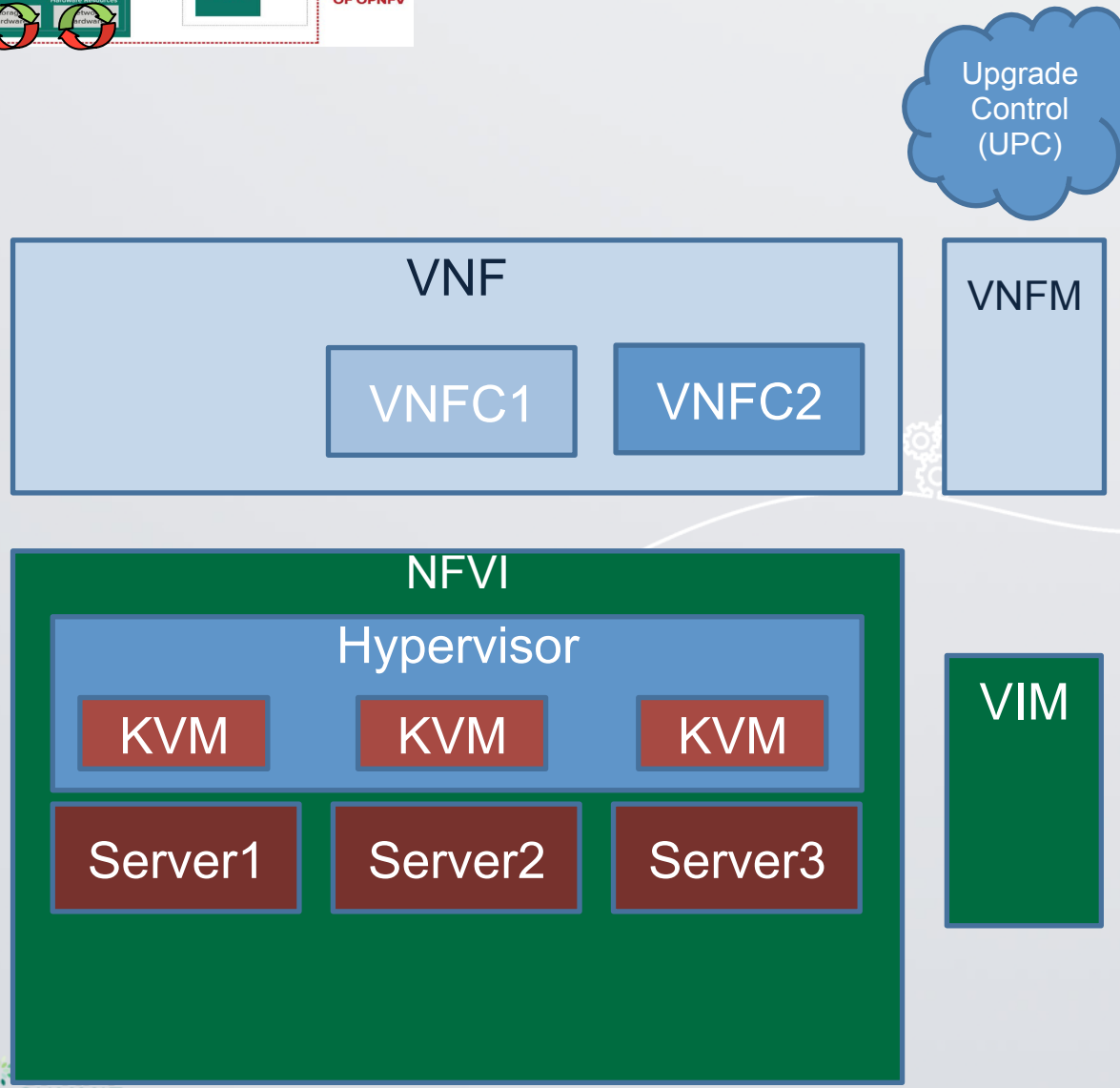
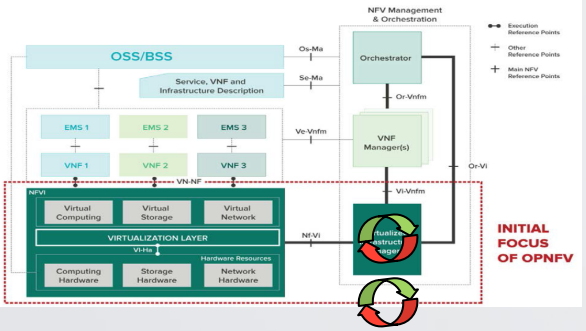


Please note:

Similar process is needed in case of upgrade for network equipment.

Typically it is much more complex to calculate the dependency and the sequence for VNFC migration during the upgrade.

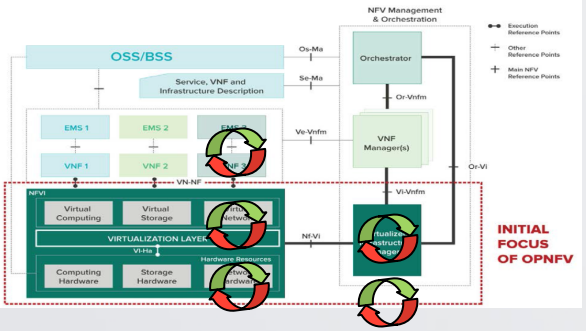
Redundant network paths will help.



6. Upgrade of Virtualization Infrastructure Manager (VIM) – OpenStack part

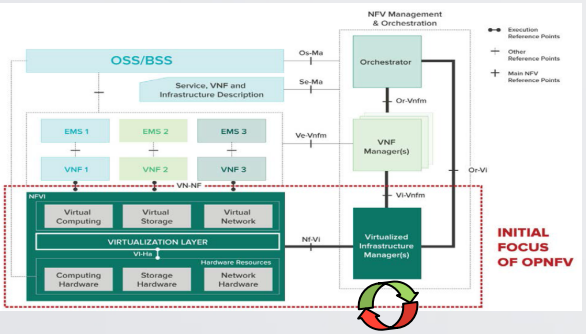
- OpenStack modules come with upgrade processes
- VIM will contain more than OpenStack
- Dependencies between OpenStack modules can be solved in different ways.
- Stable overall process is needed and also control is needed.
- There is ongoing work in cross-project group on upgrade
  This work concentrates on supporting operators.
  See oops session during Tokyo summit

- Downtime of the VIM (OpenStack):
  - OpenStack Downtime will not be service downtime, so it can be longer than 5 minutes.
  - BUT:
    This is the case only if new version can take over complete old configuration without interruption of the VNFs



7. Upgrade of Virtualization Infrastructure Manager (VIM) – SDN controller parts

- Tasks of SDN controller in NFV Reference Architecture sometimes are partly in VIM, sometimes NFVI Network Domain, sometimes even VNF – depending on the SDN applications that are used
  - Most tasks of the SDN controller are in the area of network orchestration and configuration. Here requirements like in VIM apply:
    New version must take over all configuration from old version without outage
  - Some actions (e.g. Fault managment or dynamic routing) however will be part of the user plane, so controller downtime will lead to some kind of service degradation.
- Upgrading the SDN controller will be a critical part of upgrade in NFV based networks
  - Upgrade mechanisms must be provided by controller provider, but need to be synchronized with main upgrade control

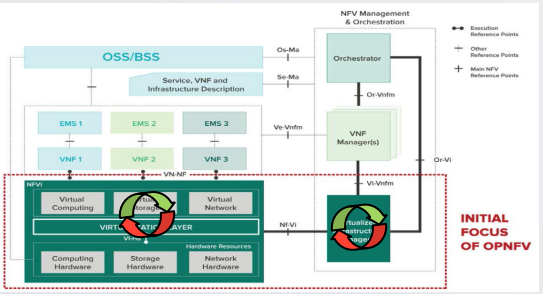


8. Consideration about the Hardware OpenStack is Running on

- In many cases, OpenStack is running on separate servers that are not used for VNF work loads. All modules will use redundant (HA) configuration. Also these servers need to be upgraded evetually.
- Since all modules are using redundant configuration, this should easily be possible.

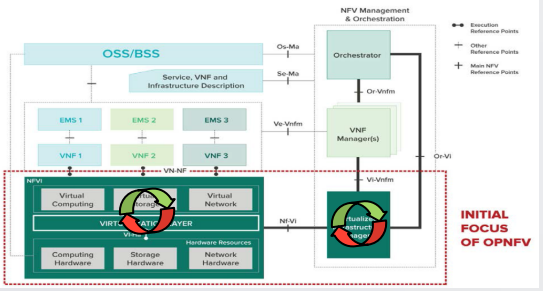
Outline

- Introduction and Requirements
- Upgrade Scenarios
- OPNFV Escalator Project



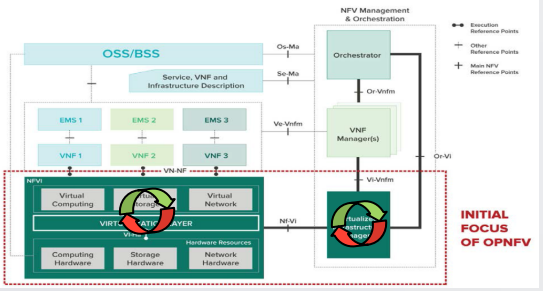
OPNFV Escalator Project

- Scope: Software Upgrade for NFVI+VIM
  - First step: VIM upgrade
- Define more detailed user requirements
  - E.g. Duration times, Granularity,
  - Upgrade preparation, Mechanisms, Interfaces
  - Information Flows
- Committers and Contributors from:
  - China Mobile, Docomo, Ericsson, Huawei, ZTE (PTL)
- Deliverable for Brahmaputra release:
  - Requirement Specification: How to prepare components in their „old version“ to support upgrade within the „new version“



OPNFV Escalator Project: Functional Requirements (draft)

- Description of Upgrade Preparation
- Validation of the Upgrade Plan
- Backup/Snapshot (protection in case of upgrade failures)
- Execution
- Testing
- Restore/Rollback
- Monitoring and Logging the upgrade progress
- Administrative Control
- Requirements on Object being upgraded

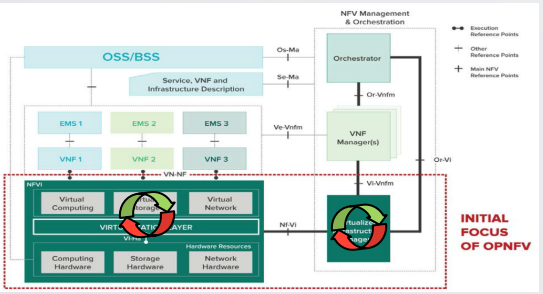


OPNFV Escalator Project: Use Cases and Scenarios

- Minimal Configurations
- HA Configurations
- Multisite Configurations

We do this starting with a questionnaire to other OPNFV projects:

https://wiki.opnfv.org/_media/wiki/opnfv_escalator_questionnaire_20150723.pptx
https://docs.google.com/forms/d/11o1mt15zcq0WBtXYK0n6lKF8XuIzQTwvv8ePTjmcoF0/viewform?usp=send_form



OPNFV Escalator Project

- Please join us!

- http://wiki.opnfv.org/escalator

THANK YOU

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