Physical infrastructure management in NFV

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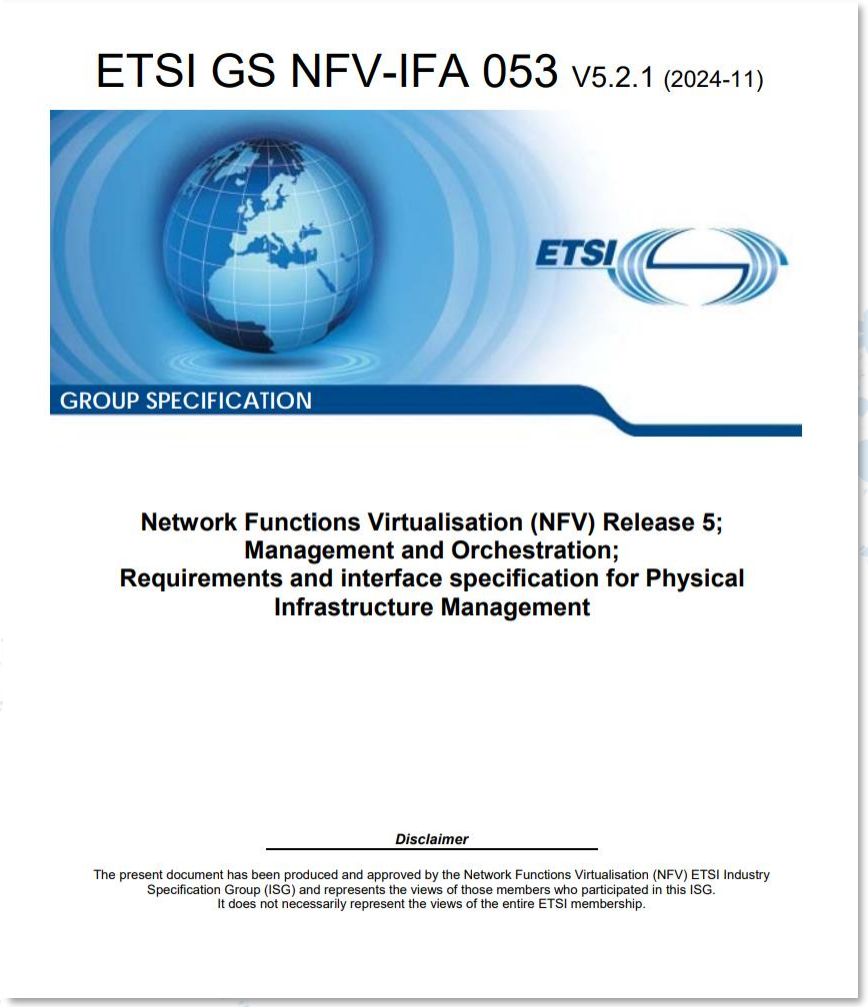
Physical Infrastructure Management feature in NFV

- ETSI ISG NFV started work on Physical Infrastructure Management (PIM) feature in 2023, with the aim to deliver it in release 5 of ETSI NFV specifications. The first set of specifications were delivered in August 2024.
- **Motivation and background**
  - Dive into details of the NFV (Telco Cloud) infrastructure in terms of its composition, its hardware resources and their fine-grained control and management
  - Manage physical resources in the NFV infrastructure to enable advanced NFV features and deployment scenarios, such as energy efficiency (Green NFV), vRAN use cases, bare-metal CIS Cluster deployments etc.
  - Enable network operators to control, manage, and monitor hardware resources that make up the NFV (Telco Cloud) infrastructure, providing a comprehensive *top-to-bottom* management of NFV-based cloud deployments
- **Key Features**
  - Introduction of PIM function, its services and interfaces in the logical NFV-MANO (Telco Cloud) architecture
  - Information modelling of physical resources managed by the PIM function
  - Interactions between PIM and other management functions inside NFV-MANO architectural framework
  - Performance measurements and alarms related to managed physical resources
  - Protocol and data model specification (RESTful APIs) of PIM service interfaces *[ongoing]*

Overview of ETSI GS NFV-IFA 053 [1]

- First set of comprehensive PIM specifications “Requirements and interface specification for Physical Infrastructure Management”, ETSI GS NFV-IFA 053 v5.1.1, in August 2024.
- **Overview**
  - Background and use cases for PIM in NFV
  - Requirements for physical infrastructure management
    - General requirements related to physical infrastructure management, e.g., resource provisioning and lifecycle management, inventory management, topology management etc.
  - Service interface specifications
    - Six distinct services fulfilling physical infrastructure management requirements via associated service interfaces
  - Information Modelling
  - Informative Annexes
    - Architectural analysis related to PIM placement and interface design
    - Analysis of existing solutions related to PIM, e.g., Ironic, Redfish etc.


ETSI GS NFV-IFA 053 V5.2.1 (2024-11)

GROUP SPECIFICATION

Network Functions Virtualisation (NFV) Release 5;
Management and Orchestration;
Requirements and interface specification for Physical Infrastructure Management

Disclaimer

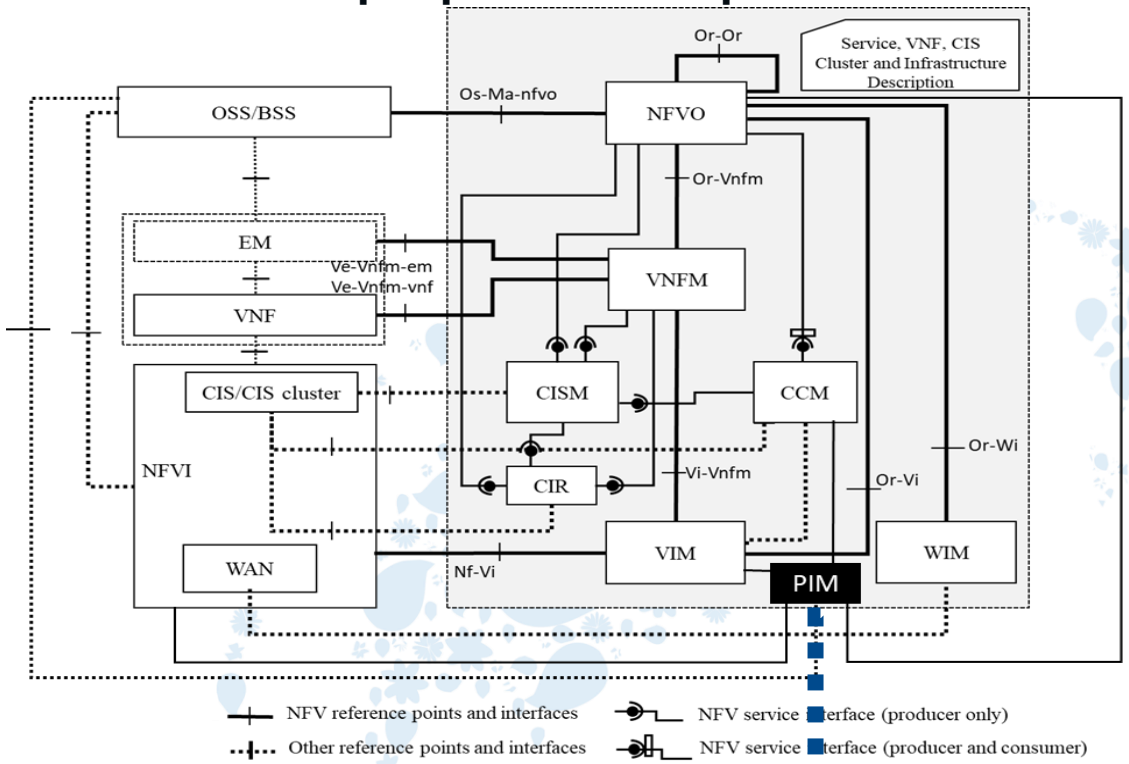
The present document has been produced and approved by the Network Functions Virtualisation (NFV) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG.
It does not necessarily represent the views of the entire ETSI membership.

The latest published version is publicly available here.
Version v5.3.1 will be published soon (can be accessed here).

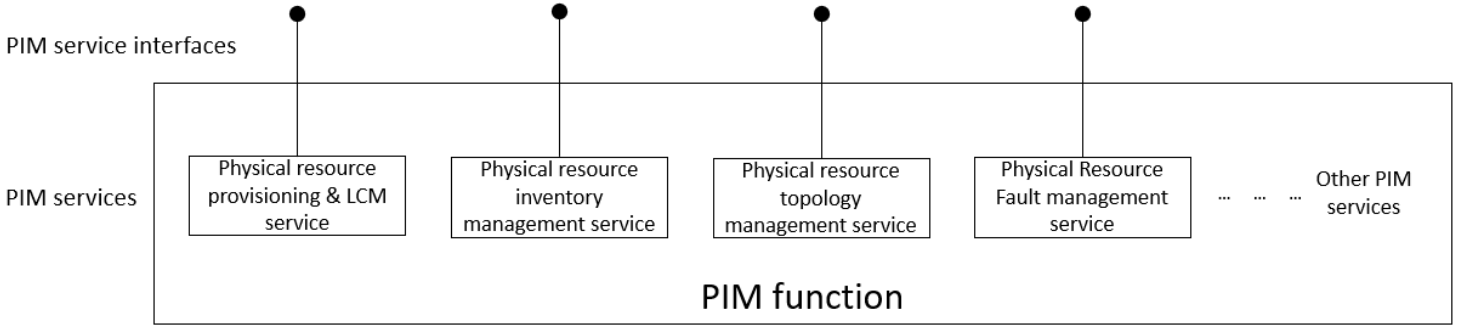
Logical representation of PIM function and its services

NFV-MANO Architectural Framework (Release 5)

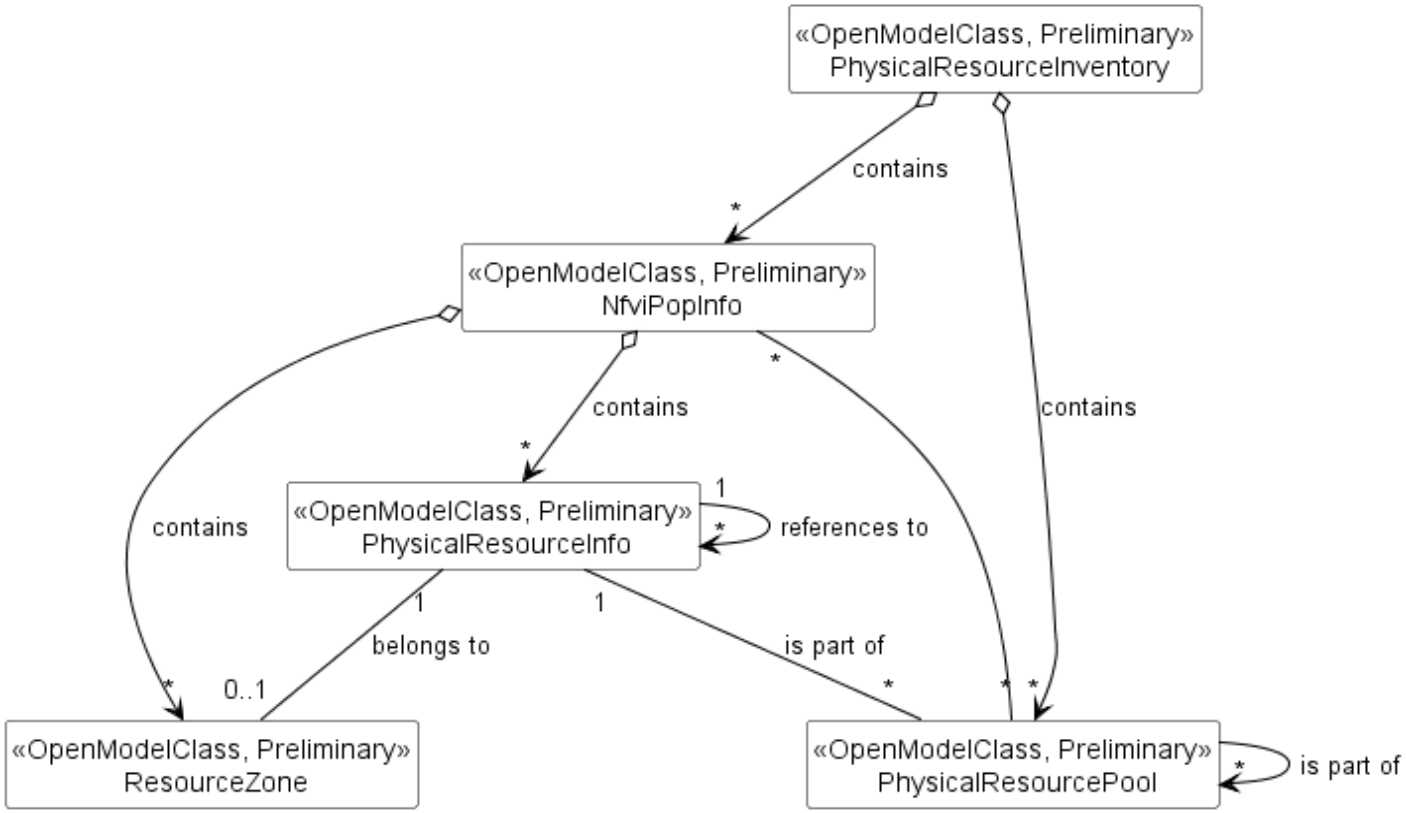
The PIM function inside NFV-MANO as an example placement option



Logical representation of the PIM function exposing various management services via respective management service interfaces.



PIM Information Model



- Abstract information model covering high-level objects managed by PIM
- The generic *PhysicalResourceInfo* object can represent various kinds of hardware resources that make up the physical infrastructure
  - Standalone hardware components, e.g., CPU, GPU, memory, disks, switches etc.
  - Composed systems, e.g., servers computer systems, compute nodes etc.
  - Chassis, Racks, Cooling Fans etc.
- Inventory and topology management related objects
  - Inventory, NFVI PoPs
  - Resource Pools, Resource Zones

Analysis of existing solutions related to PIM functionality

- ETSI NFV has also analysed some existing solutions related to PIM functionality in ETSI GS NFV-IFA 053 [1]
  - OpenStack's Bare Metal Service (Ironic)
  - Kubernetes' Bare Metal management solution (Metal3)
  - DMTF Redfish Protocol and Data Model

OpenStack Ironic [2]	Metal3 [3]	DMTF Redfish [4,5]
• Provisioning and management of Bare Metal nodes for OpenStack cloud deployments ○ Nodes management ○ Network and storage management ○ Allocations and Scheduling ○ Hardware inspection ○ Logging ○ Fault Management	• Provisioning and management of Bare Metal nodes for Kubernetes clusters ○ Cluster API provider ○ Bare metal operator ○ Ironic Backend	• The Redfish RESTful interface for provisioning and LCM of hardware resources • The Redfish Data Model specification for representing different resources and objects • Redfish services like composition service, telemetry service, log service etc. and their relationship with PIM services

Ongoing and future activities for PIM

- RESTful protocol and data model specification for PIM service interfaces (APIs), ongoing work in SOL WG of ETSI ISG NFV (ETSI GS NFV-SOL 026 [6])
  - NFV's stage 3 solution (protocol and data model specifications) will likely reuse Redfish protocol and data model specifications [4, 5] for relevant PIM service interfaces and managed objects
- Declarative management for physical infrastructure in the new Telco Cloud architecture as described in ETSI GR NFV-IFA 054 [7]
- Integration of PIM functionality and services in the new Telco Cloud architecture for TC infrastructure management
- Cover new kinds of hardware resources (being studied in ETSI GR NFV-EVE 023 [8]) for emerging use cases, like in-network computing, acceleration management, etc.

References

[1] ETSI GS NFV-IFA 053 v5.2.1 (https://www.etsi.org/deliver/etsi_gs/NFV-IFA/001_099/053/05.02.01_60/gs_NFV-IFA053v050201p.pdf)

[2] OpenStack® Ironic supported documentation (23.2 series) (https://docs.openstack.org/ironic/2023.2/)

[3] Metal3 Documentation (https://book.metal3.io/)

[4] DMTF® Redfish Specification: DSP0266 (https://www.dmtf.org/dsp/DSP0266)

[5] DMTF® Redfish Data Model Specification DSP0268 (https://www.dmtf.org/dsp/DSP0268)

[6] ETSI GS NFV-SOL 026 (draft) (https://docbox.etsi.org/ISG/NFV/Open/Drafts/SOL026)

[7] ETSI GR NFV-IFA 054 (https://www.etsi.org/deliver/etsi_gr/NFV-IFA/001_099/054/06.01.01_60/gr_NFV-IFA054v060101p.pdf)

[8] ETSI GR NFV-EVE 023 (draft) (https://docbox.etsi.org/ISG/NFV/Open/Drafts/EVE023)

Thank you for your attention

Any further questions?

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