ETSI ES 203 682 V1.1.1 (2020-02)

Environmental Engineering (EE);
Green Abstraction Layer (GAL);
Power management capabilities of the future energy telecommunication fixed network nodes;
Enhanced Interface for power management in Network Function Virtualisation (NFV) environments

Reference
DES/EE-EEPS22

Keywords
energy management, NFV

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Environmental Engineering (EE).

Modal verbs terminology

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Introduction

Green Abstraction Layer (GAL) ETSI ES 203 237 [1] provides means of exchanging information about capabilities and parameter settings between energy-aware networking devices and their network management primitives. It allows hiding the specificities of devices and their internal operations by means of an abstract interface, through which only a description of energy-related parameters can be conveyed, read and configured.

The scenario introduced by the advent of Network Function Virtualisation possibly accompanied by the further increase in flexibility and programmability brought forth by Software Defined Networking, is changing the network paradigms and the associated GAL design. With NFV, network functionalities become virtualised network functions which can be automatically deployed, migrated, re-configured. The same physical machines of a provider's infrastructure may well serve the needs of different VNFs. In this NFV context, establishing a mapping between the Energy-Aware States of logical entities (e.g. virtualised network functions) and the energy consumption of the hardware hosting the Virtual Machines that execute these logical entities is a challenging task. There is therefore the need to adapt the GAL specification ETSI ES 203 237 [1] to the NFV environment (GALv2), and to address the use of GALv2 in the ETSI NFV architectural framework ETSI GS NFV 002 [i.1].

The present document was developed jointly by ETSI TC EE and ITU-T Study Group 5. It is published respectively by ITU and ETSI as ETSI ES 203 682 (the present document) and Recommendation ITU-T L.1362 [i.6], which are technically-equivalent.

1 Scope

The present document proposes an evolved version of the Green Abstraction Layer formulation capable of operating within ETSI NFV environments.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

[1] ETSI ES 203 237: "Environmental Engineering (EE); Green Abstraction Layer (GAL); Power management capabilities of the future energy telecommunication fixed network nodes".

[2] ETSI GS NFV-IFA 005: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".

[3] ETSI GS NFV-IFA 006: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification".

[4] ETSI GS NFV-IFA 007: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Or-Vnfm reference point - Interface and Information Model Specification".

[5] ETSI GS NFV-IFA 008: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Ve-Vnfm reference point - Interface and Information Model Specification".

[6] ETSI GS NFV-IFA 011: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; VNF Descriptor and Packaging Specification".

[7] ETSI GS NFV-IFA 013: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Os-Ma-Nfvo reference point - Interface and Information Model Specification".

[8] ETSI GS NFV-IFA 014: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Network Service Templates Specification".

2.2 Informative references

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI GS NFV 002: "Network Functions Virtualisation (NFV); Architectural Framework".

[i.2] ETSI GS NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

[i.3] ETSI GS NFV-EVE 001: "Network Functions Virtualisation (NFV); Virtualisation Technologies; Hypervisor Domain Requirements specification; Release 3".

[i.4] Recommendation ITU-T E.800: "Terms and definitions related to quality of service and network performance including dependability".

[i.5] ETSI GS NFV-INF 004: "Network Functions Virtualisation (NFV); Infrastructure; Hypervisor Domain".

[i.6] Recommendation ITU-T L.1362: "Interface for power management in NFV environments "Green Abstraction Layer 2".

[i.7] ETSI GS NFV-IFA 027: "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Performance Measurements Specification".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

adaptive rate: technique to dynamically modulate the capacity of a network device or a sub-component in order to meet the traffic requirements

NOTE: Available in ETSI ES 203 237 [1].

advanced configuration and power interface: provides an open industrial standard for device configuration and power management by the operating system

NOTE: Available in ETSI ES 203 237 [1].

convergence layer interface: GAL interface designed to map the GAL commands and data into low-level configuration registers/APIs

NOTE: Available in ETSI ES 203 237 [1].

Energy-Aware Entity (EAE): network entity that can adapt its energy consumption such as network performance levels are satisfied

NOTE: Examples include central processing unit (CPU), virtual CPU, virtual machine, virtualised network function.

Energy-Aware State (EAS): data structure containing power, network performance, available functionalities, and responsiveness information characterizing an Energy-Aware Entity

NOTE: It can be configured by control plane processes through the Green Standard Interface.

entity: device or a sub-part of it, of which the GAL constitutes the energy-aware interface

NOTE 1: At the lowest hierarchical levels, an entity can correspond to a chip, a network processor, a link interface. At medium hierarchical levels, it can correspond to line-cards, chassis, etc. At the highest level the entire device corresponds to an entity. Higher level entities can include one or more entities at lower levels. This hierarchical architecture is optional and the relative depth should depend on the specific internal architecture of the network device.

NOTE 2: Available in ETSI ES 203 237 [1].

Green Abstraction Layer (GAL): interface between data and control planes for exchanging data regarding the power of a device

NOTE: Available in ETSI ES 203 237 [1].

Green Standard Interface (GSI): GAL interface designed to exchange power management data in a simplified way among data-plane elements and processes realizing control plane strategies

NOTE: Available in ETSI ES 203 237 [1].

hypervisor: piece of software which partitions the underlying physical resources, creates Virtual Machines, and isolates them from each other

NOTE 1: ETSI GS NFV-INF 004 [i.5]: In essence, the hypervisor can emulate every piece of the hardware platform even in some cases, completely emulating a CPU instruction set such that the Virtual Machine believes it is running on a completely different CPU architecture from the actual CPU on which it is running. Such emulation, however, has a significant performance cost. The number of actual CPU cycles needed to emulate virtual CPU cycle can be large.

NOTE 2: Available in ETSI GS NFV-EVE 001 [i.3].

Hypervisor Domain (HD): general area for focus which includes hypervisors

NOTE: Available in ETSI GS NFV-EVE 001 [i.3].

low power idle: technique to force a device (or a sub-component) to enter low power states when it does not forward/process packets

NOTE: Available in ETSI ES 203 237 [1].

network performance: ability of a network or network portion to provide the functions related to communications between users

NOTE 1: Network performance applies to the network provider's planning, development, operations and maintenance and is the detailed technical part of Quality of Service offered.

NOTE 2: Network performance parameters are meaningful to network providers and are quantifiable at the part of the network which they apply.

NOTE 3: Available in Recommendation ITU-T E.800 [i.4].

operating mode: operating state of a given entity. The possible values are active or standby

NOTE 1: It is required to distinguish two different types of Energy-Aware Entity (EAE). When the operating states are selected by the EAE itself (internal operating mode) and when the operating states are controlled and selected by external processes (external operating mode). Examples of such processes are Local Control Policies or Network Control Policies.

NOTE 2: Available in ETSI ES 203 237 [1].

standby mode: operating mode characterized by low power and reduced functionality

NOTE 1: The reduction can be done by cutting power to unused entity components. In standby mode, the entity provides a sub-set of functionality depending on the specific power profile.

NOTE 2: Available in ETSI ES 203 237 [1].

Virtualisation Container (VC): partition of a compute node that provides an isolated virtualised computation environment

NOTE: Available in ETSI GS NFV 003 [i.2].

Virtual Deployment Unit (VDU): construct that can be used in an information model, supporting the description of the deployment and operational behaviour of a Virtualised Network Function Component

NOTE: Available in ETSI GS NFV 003 [i.2].

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

API	Application Program Interface
BSS	Business Support System
CD	Compute Domain
CP	Connection Point
CPU	Central Processing Unit
DF	Deployment Flavour
EAE	Energy-Aware Entity
EAS	Energy-Aware State
EM	Element Manager
GAL	Green Abstraction Layer
GSI	Green Standard Interface
HD	Hypervisor Domain
LCM	Lifecycle Management
MANO	NFV Management and Orchestration
ND	Network Domain
NFV	Network Functions Virtualisation
NFVI	Network Functions Virtualisation Infrastructure
NFVO	Network Functions Virtualisation Orchestrator
NIC	Network Interface Controller
NS	Network Service
NS DF	Network Service Deployment Flavour
NSD	Network Service Descriptor
OSS	Operations Support System
PM	Performance Management
PNF	Physical Network Function
QoS	Quality of Service
VC	Virtualisation Container
VDU	Virtual Deployment Unit
VIM	Virtual Infrastructure Manager
VL	Virtual Link
VM	Virtual Machine
VNF	Virtualised Network Function
VNF DF	Virtualised Network Function Deployment Flavour
VNFC	Virtualised Network Function Component
VNFD	Virtualised Network Function Descriptor
VNFM	Virtualised Network Function Manager

4 Foreground

4.1 Green Abstraction Layer

Green Abstraction Layer (GAL), see ETSI ES 203 237 [1] provides means of exchanging information about capabilities and parameter settings between energy-aware networking devices and their network management primitives. It allows hiding the specificities of devices and their internal operations by means of an abstract interface, through which only a description of energy-related parameters can be conveyed, read and configured. At the same time, a hierarchical structure is defined in order to propagate a similar abstract representation throughout the component parts of devices (chassis, subsystems, electronic boards, etc.) at the proper level of detail and granularity.