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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Future networks

IMT-2020 network management and orchestration requirements

Recommendation ITU-T Y.3110

International Telecommunication Union

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Recommendation ITU-T Y.3110

IMT-2020 network management and orchestration requirements

Summary

Recommendation ITU-T Y.3110 describes requirements for network management and orchestration of IMT-2020. It describes high-level and functional requirements. The functional requirements consist of two levels: a) lifecycle management for all slices and b) instance management pertinent to each slice.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.3110	2017-09-13	13	11.1002/1000/13350

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FOREWORD

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IMT-2020 network management and orchestration requirements

1 Scope

This Recommendation specifies high-level and functional management and orchestration requirements for IMT-2020 in consideration of integrated management with existing networks. For the integrated management, only the requirements for a standard interface to the existing network management system are in scope.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T M.3010] Recommendation ITU-T M.3010 (2000), *Principles for a telecommunications management network*.

[ITU-T Y.3001] Recommendation ITU-T Y.3001 (2011), *Future networks: Objectives and design goals*.

[ITU-T Y.3100] Recommendation ITU-T Y.3100 (2017), *Terms and definitions for IMT-2020*.

[ITU-R M.2083-0] Recommendation ITU-R M.2083-0 (2015), *IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 management [ITU-T Y.3100]: In the context of IMT-2020, the processes aiming at fulfilment, assurance, and billing of services, network functions, and resources in both physical and virtual infrastructure including compute, storage, and network resources.

3.1.2 network slice [ITU-T Y.3100]: A logical network that provides specific network capabilities and network characteristics.

NOTE 1 – Network slices enable the creation of customized networks to provide flexible solutions for different market scenarios which have diverse requirements, with respect to functionalities, performance and resource allocation.

NOTE 2 – A network slice may have the ability to expose its capabilities.

NOTE 3 – The behaviour of a network slice is realized via network slice instance(s).

3.1.3 network slice instance [ITU-T Y.3100]: An instance of network slice, which is created based on network slice blueprint.

NOTE 1 – A network slice instance is composed of a set of managed run-time network functions, and physical/logical/virtual resources to run these network functions, forming a complete instantiated logical network to meet certain network characteristics required by the service instance(s).

NOTE 2 – A network slice instance may also be shared across multiple service instances provided by the network operator. A network slice instance may be composed of none, one or more sub-network slice instances which may be shared with another network slice instance.

3.1.4 orchestration [ITU-T Y.3100]: In the context of IMT-2020, the processes aiming at the automated arrangement, coordination, instantiation and use of network functions and resources for both physical and virtual infrastructure by optimization criteria.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 IMT-2020: (Based on [ITU-R M.2083-0]) Systems, system components, and related aspects that support to provide far more enhanced capabilities than those described in [b-ITU-R M.1645].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CAPEX Capital Expenditure

KPI Key Performance Indicator

LTE Long-term Evolution

NFV Network Function Virtualization

OPEX Operational Expenditure

SDN Software Defined Network

5 Conventions

None.

6 Introduction

IMT-2020 network management and orchestration should support a combination of IMT-2020 network systems and existing systems (e.g., LTE-Advanced, Wi-Fi and fixed network), coupled with new or revolutionary technologies designed to meet new customer demands such as low latency, massive connectivity, and large volume transmission. To meet these new requirements, the cost of deployment and operation will increase enormously. Network operators need to optimize capital expenditure/operational expenditure (CAPEX/OPEX) by strategically interacting with multiple technology ecosystems especially for different radio/fixed access and virtualized core network technologies. Therefore, management and orchestration for IMT-2020 network is required to support both existing networks as well as evolving networks in an integrated manner.

This Recommendation specifies such requirements in the following clauses.

7 High-level requirements for network management and orchestration of IMT-2020

The high-level management and orchestration requirements are as follows:

- IMT-2020 network is required to manage and orchestrate all resources that can be used to instantiate slices.
- IMT-2020 network is required to provide capabilities to instantiate a slice based on the available resources.
- IMT-2020 network is required to manage multiple slices (as slice instances) simultaneously and independently along with their lifecycle (including creation, instantiation, assurance, and termination of each slice).

- IMT-2020 network is required to provide capabilities to manage the total view of all active slice instances and remaining unused but available resources.
- IMT-2020 network is required to provide management capabilities that are dedicated to each slice instance. The instance management dedicated to a slice is required to work independently from the instance management dedicated to another slice.
- IMT-2020 network is required to support the fulfilment, assurance and billing of each slice instance.
- IMT-2020 network is required to provide interfaces to support management and orchestration for existing networks in an integrated manner.
- IMT-2020 network is required to support standard interfaces between capabilities for a) the slice lifecycle management and orchestration and b) the slice instance management.
- IMT-2020 network is required to support standard interfaces between a) the management and orchestration capabilities for IMT-2020 network and b) the management and orchestration capabilities for existing networks.

8 Functional requirements for network management and orchestration of IMT-2020

8.1 Functional requirements of network slice life cycle management and orchestration

- The IMT-2020 slice lifecycle management is required to support slice capacity management and optimization to ensure optimal resource usage while maintaining quality.
- The IMT-2020 slice lifecycle management is required to support provisioning and instantiation of requested slices by the customers. Provisioning may involve interactions with external provisioning functional entities such as software defined network/network function virtualization (SDN/NFV) orchestrator and/or controllers.
- The IMT-2020 slice lifecycle management is required to support inter-slice orchestration (e.g., orchestrated provisioning of multiple slices and resolving issues on quality, fault, anomaly, and charging among multiple slices).
- The IMT-2020 slice lifecycle management is required to support a standard interface for the customers and applications to request slice lifecycle management operations and associated information.
- The IMT-2020 slice lifecycle management is required to support the assurance of the instantiated slices according to the given key performance indicator (KPI).
- The IMT-2020 slice lifecycle management is required to support the accounting management of the instantiated slices based on resource usage.
- The IMT-2020 slice lifecycle management is required to store a) the slice-related information from customer's request and b) the management information from the slice instance.
- The IMT-2020 slice lifecycle management is required to support the collection and analysis of the status and events of the instantiated slice resources for the purpose of fault, performance, and security management.
- The IMT-2020 slice lifecycle management is required to manage the lifecycle of the management information in a repository.
- The IMT-2020 slice lifecycle management is required to support standard interfaces to customers and IMT-2020 slice instance management plane.

8.2 Functional requirements of network slice instance management

8.2.1 Functional requirements for configuration management

- The IMT-2020 network slice instance management is required to support discovering and bootstrapping of physical and virtual data plane functions and resources.
- The IMT-2020 network slice instance management is required to support the discovery of data control and service plane functions and resources.
- The IMT-2020 network slice instance management is required to support the abstraction of technology specific virtual resources into technology independent common information.
- The IMT-2020 network slice instance management is required to support the correlation between virtual and physical resources.
- The IMT-2020 network slice instance management is required to support repository of the managed resources discovered by a resource discovery function and the lifecycle management of stored management information.
- The IMT-2020 network slice instance management is required to support the storage of configuration management information in a resource repository in each IMT-2020 plane.
- The IMT-2020 network slice instance management is required to support interfaces to other management functional entities that require configuration management information.

8.2.2 Functional requirements for fault management

- The IMT-2020 network slice instance management is required to support the collection of fault information from the functions of physical and virtual data plane, control plane, and service plane and from their resources.
- The IMT-2020 network slice instance management is required to support analysis to identify root causes from fault information from the functions of physical and virtual data plane, control plane, and service plane and their resources in each IMT-2020 plane as well as in a multi-plane environment.
- The IMT-2020 network slice instance management is required to support fault isolation and associated control actions to eliminate fault.
- The IMT-2020 network slice instance management is required to support the storage and retrieval of fault management information in a resource repository in each IMT-2020 plane.
- The IMT-2020 network slice instance management is required to support interfaces to other management functional entities that require fault management information.

8.2.3 Functional requirements for performance management

- The IMT-2020 network slice instance management is required to support the collection of performance information from the functions of physical and virtual data plane, control plane, and service plane and from their resources.
- The IMT-2020 network slice instance management is required to support the analysis of performance information from the functions of physical and virtual data plane, control plane, and service plane and the resources in each IMT-2020 plane as well as in a multi-plane environment based on given KPIs including energy-awareness.
- The IMT-2020 network slice instance management is required to support the coordination of multi-plane resource management.
- The IMT-2020 network slice instance management is required to support the storage and retrieval of performance management information in a resource repository in each IMT-2020 plane.
- The IMT-2020 network slice instance management is required to support interfaces to other management functional entities that require performance management information.

8.2.4 Functional requirements for accounting management

- The IMT-2020 network slice instance management is required to support the metering of physical and virtual data plane, control plane, and service plane resources for the purpose of billing.
- The IMT-2020 network slice instance management is required to support charging and billing capabilities based on the metered data.
- The IMT-2020 network slice instance management is required to support the storage and retrieval of accounting information.

8.2.5 Functional requirements for security management

- The IMT-2020 network slice instance management is required to support the collection of anomaly information from the functions of physical and virtual data plane, control plane, and service plane and from their resources.
- The IMT-2020 network slice instance management is required to support analysis to identify root causes of anomaly based on anomaly, fault, and performance information from the functions of physical and virtual data plane, control plane, and service plane and their resources in each IMT-2020 plane as well as in a multi-plane environment.
- The IMT-2020 network slice instance management is required to support anomaly isolation and associated control actions to eliminate it.
- The IMT-2020 network slice instance management is required to support storage and retrieval of anomaly management information in a resource repository in each IMT-2020 plane.
- The IMT-2020 network slice instance management is required to support interfaces to other management functional entities that require anomaly management information.

8.2.6 Functional requirements for interworking with external management entities

- The IMT-2020 network slice instance management is required to support standard interfaces to:

  a) a slice lifecycle management and orchestration plane;

  b) external management systems,

  with the purpose of requesting and receiving management operations and associated information.
- The IMT-2020 network slice instance management can optionally support standard interfaces to a peer IMT-2020 slice instance management plane in other IMT-2020 domain to request and receive management operations and associated information.
- The IMT-2020 network slice instance management is required to support abstraction of IMT-2020 management information for the exchange with external management entities for inter-domain management information hiding purpose.
- The IMT-2020 network slice instance management is required to support policy exchanges with external management entities for end-to-end network service data analytics, anomaly detection/isolation, and charging.

9 Security consideration

Security requirements of IMT-2020 network management and orchestration are defined in this Recommendation as a part of the high-level and functional requirements.

Bibliography

[b-ITU-R M.1645] Recommendation ITU-R M.1645 (2003), *Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000*.

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