

Draft new Recommendation ITU-T Y.IMT2020-DDP

Future networks including IMT-2020: requirements and framework of distributed data plane

Summary

The distributed data plane refers to the pool of the network functionalities related with data collection, processing, storage and management in the core network for IMT-2020 and beyond for IMT-2020 and beyond. This Recommendation specifies the overview, requirements, functional architecture, procedures, security considerations, and use cases of distributed data plane, in the context of IMT-2020 and beyond.

Keywords

IMT-2020, distributed data plane, network functionalities, machine learning

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Draft new Recommendation ITU-T Y.IMT2020-DDP

Future networks including IMT-2020: requirements and framework of distributed data plane

1. Scope

This Recommendation specifies the distributed data plane in the context of IMT-2020 and beyond. The distributed data plane refers to the pool of the network functionalities related with data collection, processing, storage and management in the core network for IMT-2020 and beyond.

This Recommendation addresses the following aspects of distributed data plane:

- Requirements of distributed data plane, including general requirements, requirements on data services, requirements on network capabilities of data plane.
- Functional architecture of distributed data plane, including architecture reference model, capabilities of data plane and reference points.
- Procedures of distributed data plane.
- Security considerations of distributed data plane.

Some relevant use cases are provided in Appendix I.

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 Y.3101] Recommendation ITU-T Y.3101 (2018), *Requirements of the IMT-2020 network*.

[ITU-T Y.3102] Recommendation ITU-T Y.3102 (2018), *Framework of the IMT-2020 network*.

[ITU-T Y.3104] Recommendation ITU-T Y.3104 (2018), *Architecture of the IMT-2020 network*.

[ITU-T Y.3172] Recommendation ITU-T Y.3172 (2019), *Architectural framework for machine learning in future networks including IMT-2020*.

[ITU-T Y.IMT2020-DJLML] Recommendation ITU-T Y.IMT2020-DJLML, *Requirements and framework for distributed joint learning to enable machine learning in future networks including IMT-2020*

[ITU-T F.rfdssn] Recommendation ITU-T F.rfdssn, *Requirements and framework for Data Sharing Service Network*

ITU-T Y.IMT2020-DCN Recommendation ITU-T Y.IMT2020-DCN, *requirements and functional architecture of distributed core network*.

3. Definitions

3.1. Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 IMT-2020 [b-ITU-T Y.3100]: Systems, system components, and related technologies that provide far more enhanced capabilities than those described in [b-ITU-R M.1645].

NOTE – [b-ITU-R M.1645] defines the framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000 for the radio access network.

3.1.2 machine learning (ML) [ITU-T Y.3172]: Processes that enable computational systems to understand data and gain knowledge from it without necessarily being explicitly programmed.

3.1.3 machine learning overlay [ITU-T Y.3172]: A loosely coupled deployment model of machine learning functionalities whose integration and management with network functions are standardised.

NOTE – A machine learning overlay aims to minimise interdependencies between machine learning functionalities and network functions using standard interfaces, allowing for parallel evolution of functionalities of the two.

3.1.4 network function [b-ITU-T Y.3100]: In the context of IMT-2020, a processing function in a network.

3.1.5 distributed core network [ITU-T Y.IMT2020-DCN]:: A core network for future networks including IMT-2020, which builds on network functional units collaborating in a distributed manner to provide the network functions of control plane, user plane, and data plane, in which the network functional unit is a core network software unit consisting of atomic network functionalities on the basis of IMT-2020 core network functions.

3.2. Terms defined in this Recommendation

This Recommendation defines the following terms:

4. Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AF	Application Function
AI	Artificial Intelligence
ASF	Authentication Server Function
CEF	Capability Exposure Function
ML	Machine Learning
NACF	Network Access Control Function
NFR	Network Function Registry function
NSSF	Network Slice Selection Function
PCF	Policy Control Function
SMF	Session Management Function
UE	User Equipment

UPF	User Plane Function
USM	Unified Subscription Management function

5. Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6. Overview on distributed data plane

[Editor's Note] This clause presents the overview on distributed data plane in the context of IMT-2020 and beyond.

With the deployment of IMT-2020 networks, the distributed core network [ITU-T Y.IMT2020-DCN] has been proposed, which builds on network units (a network unit consisting of atomic network functionalities), networking and collaborating in distributed fashion to provide the network functions of control plane, user plane, and data plane. The control plane is a pool of control related network functionalities. The user plane is a pool of user related network functionalities. The data plane is a pool of data related network functionalities [ITU-T Y.IMT2020-DCN].

The functions of data plane include data storage management function, data agent function, and data orchestration function. The distributed data plane refers to these data related network functionalities deployed in a distributed manner in the core network for IMT-2020 and beyond. Although the functions of the data plane is provided at the high level in [ITU-T Y.IMT2020-DCN], how the data related network functionalities works and interacts is not discussed. Figure 6-1 depicts the design reference model of distributed data plane, in the context of IMT-2020 and beyond.

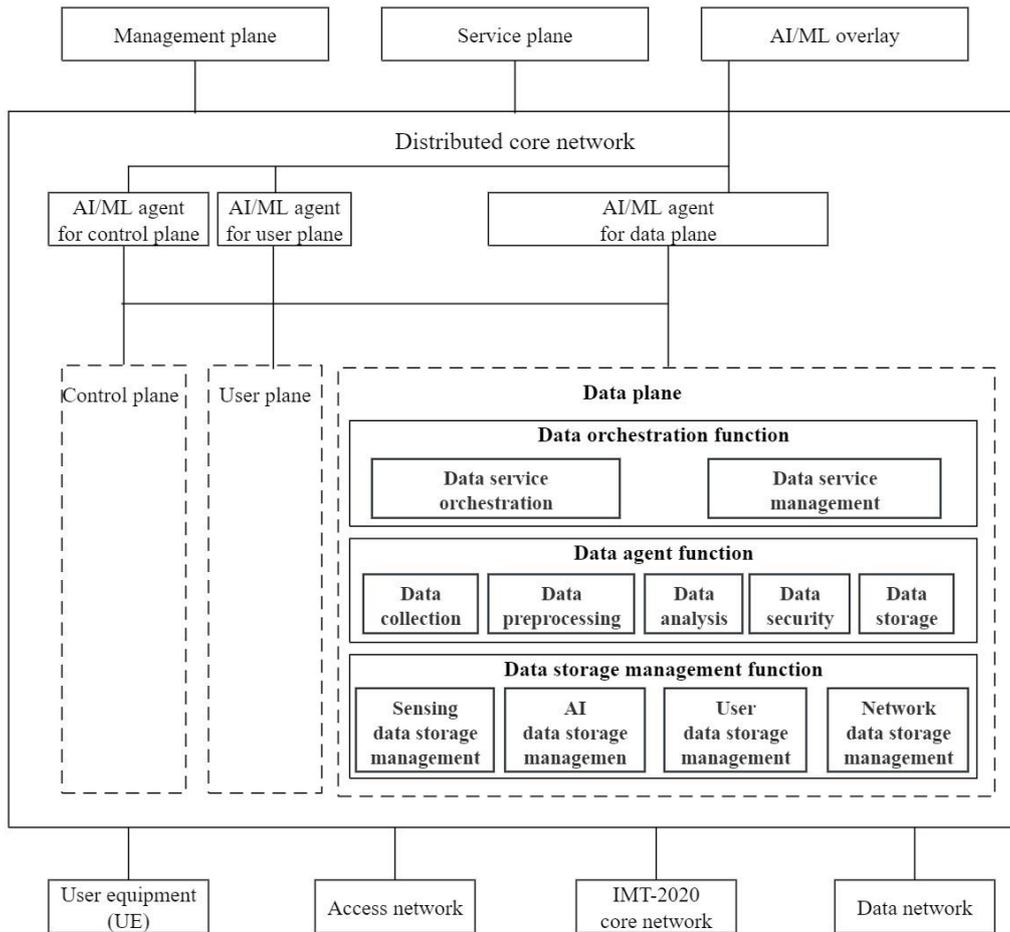


Figure 6-1 - Design reference model of distributed data plane

In the context of future networks including IMT-2020, there will be different types of data that need to be collected, processed and stored, e.g., AI-related data, sensing data. Table 6-1 shows the data in the distributed data plane.

Table 6-1 The data in the distributed data plane

Data	Types	Data source	Data characteristics
Sensing data	Sensing measurement data Sensing result data	UE RAN	Large amount of data Diverse data formats Multiple UEs or base stations may need to collaborate
AI data	Training/inference data set Model parameters ML models	UE RAN NF Model repository	Large amount of data ML models may be unstructured data Model parameters may be sparse
Network data	Network operation data	NF	Dynamic or semi-static data

User data	User Subscription data	USM	Static data Structured data
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Therefore, in order to support the distributed storage and collaborative processing and management of these diverse data, the distributed data plane introduces these functions that are derived from the IMT-2020 core network functions USM and ASF, enabling new capabilities.

[Editor's Note] The design reference model of distributed data plane is for further consideration.

7. Requirements of distributed data plane

[Editor's Note] This clause specifies the requirements of distributed data plane , in the context of IMT-2020 and beyond, which include general requirements, requirements on data services, requirements on network capabilities of data plane.

7.1. General requirements

TBD

7.2. Requirements on data services

TBD

7.3. Requirements on network capabilities of data plane

TBD

8. Functional architecture of distributed data plane

[Editor's Note] This clause specifies the functional architecture of distributed data plane , in the context of IMT-2020 and beyond, which includes architecture reference model, capabilities of data plane and reference points.

8.1. Architecture reference model

For further study.

8.2. Capabilities of data plane

[Editor's Note] This clause specifies the capabilities of data plane. There are three types of data plane functions, including the data storage management function, the data agent function, and the data orchestration function. A data storage management function is required to manage the diverse data storage capabilities. Data agents are introduced to provide the capabilities of data collection, processing, storage, forwarding, analysis and so on. Data orchestration is responsible for

managing and controlling the data agents. It is used to select appropriate data agents for collaboration, and to establish data transmission pipeline. This enables automatic data management.

TBD

8.3. Reference points

TBD

9. Procedures of distributed data plane

[Editor's Note] This clause specifies the procedures of distributed data plane, in the context of IMT-2020 and beyond.

TBD

10. Security considerations

[Editor's Note] This clause presents the security considerations of distributed data plane , in the context of IMT-2020 and beyond, which include network functionality security and user privacy.

TBD

Appendix I

Use cases of distributed data plane

(This appendix does not form an integral part of this Recommendation.)

The use cases of distributed data plane for IMT-2020 and beyond are as follows.

Use case 1: The distributed data plane for sensing data processing and transmission

The sensing data is a new type of data in the context of IMT-2020 and beyond. The sensing measurement data is usually collected from multiple UEs or base stations and aggregated to a node for processing to obtain sensing results. Therefore, the distributed data plane is designed to support the fusion processing and transmission of sensing data, providing the sensing service.

Use case 2: The distributed data plane for AI data processing and transmission

The AI data, including the ML models, the parameters, and the training data, are required to be processed and transmitted in the distributed core network. In particular, the data is needed to be processed, including data filtering, data deduplication, etc., to provide high quality data for AI training and inference. The QoS for AI data transmission may be different compared to traditional user session transmission. Therefore, the distributed data plane is designed to support data processing for AI training and inference in a collaborative way and guarantee the QoS for AI-related data transmission, further enabling the intelligent network.

Use case 3: The distributed data plane for user data storage

Due to the private implementations of USMs, the data storage formats for user subscription data stored in USMs from different manufacturers may be different. For example, the formats of identifiers (such as IMSI and IMS identifiers) and the ways of authentication may be different. Considering that the logical networking may change due to the upgrading of network, the user subscription data in different regions need to be migrated and merged. In this case, the formats of user subscription data between different USMs may be inconsistent. The distributed data plane is proposed to address the challenges.

Appendix II

Standardization landscape on distributed data plane

(This appendix does not form an integral part of this Recommendation.)

The core networks for IMT-2020 and beyond have been studied in ITU-T SG13.

The requirements, framework, and architecture of IMT-2020 network have been specified in “Requirements of the IMT-2020 network” [ITU-T Y.3101], “Framework of the IMT-2020 network” [ITU-T Y.3102], and “Architecture of the IMT-2020 network” [ITU-T Y.3104].

The following table briefly shows the gap analysis for the proposed new work item.

Table 1 – Standardization activities related to the proposed new work item

GAP between current work and the new work item		
ITU-T Recommendations	Current work item	New work item
ITU-T Y.3174 <i>Framework for data handling to enable machine learning in future networks including IMT-2020</i>	ITU-T Y.3174 describes a framework for data handling to enable machine learning in future networks including International Mobile Telecommunications (IMT)-2020. It provides a data handling framework based on ML overlay.	This recommendation provides the requirements and framework for distributed data plane in the core network in the context of IMT-2020 and beyond. This recommendation focuses on how the network functionalities collect and process the data, which is not based ML overlay.
ITU-T Y.IMT2020-DJLML <i>Requirements and framework for distributed joint learning to enable machine learning in future networks including IMT-2020</i>	ITU-T Y.IMT2020-DJLML specifies requirements and framework for distributed joint learning to enable machine learning in future networks including IMT-2020. In this framework, the Data services function provides authorized consumers with the capabilities of collecting, processing, retrieving and sharing data, which is based ML overlay.	This recommendation provides the requirements and framework for distributed data plane in the core network in the context of IMT-2020 and beyond. This recommendation focuses on how the network functionalities collect and process the data, which is not based ML overlay.
ITU-T F.rfdssn <i>Requirements and framework for Data Sharing Service Network</i>	ITU-T F.rfdssn provides requirements for data sharing service network (DSSN). DSSN connects data providers and data demanders. Data demanders cover many industries that need data sharing, such as financial, Internet, medial, telecommunication. Data providers can be enterprises, institutes and so on.	This recommendation provides the requirements and framework for distributed data plane in the core network. The data come from the network, instead of the data outside the network. This recommendation focuses on how the network functionalities collect and process the data within the network, enabling ML.
ITU-T Y.IMT2020-DCN	ITU-T Y.IMT2020-DCN specifies the distributed core network, which builds on network functional units collaborating in a distributed manner to provide the network	This recommendation provides the requirements, frameworks, and technologies of data plane in detail. ITU-T Y.IMT2020-DCN mentioned that the data plane is a pool of data related

	functions of control plane , user plane, and data plane. The functions of the data plane will be provided at the high level.	network functionalities. This recommendation provides the data types, the definition and requirements of data plane, how these network functionalities works and interacts, including how the data plane interacts with control plane to provide the data service .
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This work item specifies the distributed data plane for IMT-2020 and beyond, in the aspects of overview, requirements, functional architecture, procedures, security considerations, and use cases.

Bibliography

- [b-ITU-T Y.2011] Recommendation ITU-T Y.2011 (2004), *General principles and general reference model for Next Generation Networks*.
- [b-ITU-T Y.3100] Recommendation ITU-T Y.3100 (2017), *Terms and definitions for IMT-2020 network*.
- [b-ITU-T Y.3324] Recommendation ITU-T Y.3324 (2018), *Requirements and architectural framework for autonomic management and control of IMT 2020 networks*.
- [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*.

Annex A

A.1 justification for proposed draft new ITU-T Y.IMT2020-DDP “Future networks including IMT-2020: requirements and framework of distributed data plane”

Question:	Q20/13	Proposed new ITU-T Recommendation	Geneva, 4-15 March 2024
Reference and title:	ITU-T Y.IMT2020-DDP “Future networks including IMT-2020: requirements and framework of distributed data plane”		
Base text:	SG13-TD766/WP1	Timing:	2026-03
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<p>Scope (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability):</p> <p>For the purpose of enhancing the support of distributed data storage, collaborative processing and management for IMT-2020 and beyond, this Recommendation addresses the distributed data plane for IMT-2020 and beyond. It addresses in particular the following aspects of distributed data plane, in the context of IMT-2020 and beyond:</p> <ul style="list-style-type: none"> • Requirements of distributed data plane, including general requirements, requirements on data services, requirements on network capabilities of data plane. • Functional architecture of distributed data plane, including architecture reference model, capabilities of data plane and reference points. • Procedures of distributed data plane. • Security considerations of distributed data plane. 			
<p>Summary (provides a brief overview of the purpose and contents of the Recommendation, thus permitting readers to judge its usefulness for their work):</p> <p>The distributed data plane refers to pool of network functionalities related with data collection, processing, storage and management, which are deployed in a distributed manner in the core network for IMT-2020 and beyond. It is of important needs to specify a framework for distributed data plane, which is market valuable for network operators and end users with enhanced support of distributed data storage, collaborative processing and management.</p> <p>This Recommendation specifies the distributed data plane for IMT-2020 and beyond, in the aspects of requirements, functional architecture, procedures, security considerations</p>			
<p>Relations to ITU-T Recommendations or to other standards (approved or under development):</p> <p>ITU-T Y.3101, ITU-T Y.3102, ITU-T Y.3104, ITU-T Y.3172, Y.IMT2020-DCN</p>			
<p>Liaisons with other study groups or with other standards bodies:</p> <p>ITU-T SG11, ITU-T SG17, ITU-R, 3GPP SA2, ETSI F5G, IRTF NMRG, IETF NVO3</p>			
<p>Supporting members that are committing to contributing actively to the work item:</p> <p>China Mobile, Zhejiang Lab, Huazhong University of Science and Technology</p>			