International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Y.3130

(01/2018)

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

Future networks

Requirements of IMT-2020 fixed mobile convergence

Recommendation ITU-T Y.3130

International Telecommunication Union

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Recommendation ITU-T Y.3130

Requirements of IMT-2020 fixed mobile convergence

Summary

Recommendation ITU-T Y.3130 specifies service related requirements such as unified user identity, unified charging, service continuity and guaranteed quality of service support, and network capability requirements such as control plane convergence, user data management, capability exposure and cloud-based infrastructure, to support fixed mobile convergence in IMT-2020 networks.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.3130	2018-01-13	13	11.1002/1000/13467

Keywords

Fixed mobile convergence, IMT-2020, requirements.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Requirements of IMT-2020 fixed mobile convergence

1 Scope

This Recommendation specifies the requirements of fixed mobile convergence (FMC) in IMT-2020 networks; it covers aspects related to the overview and objectives of FMC, requirements from a service point of view, requirements from a network capability point of view and security considerations. Service scenarios supported by FMC in IMT-2020 are provided in the appendix.

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 Q.1762] Recommendation ITU-T Q.1762/Y.2802 (2007), *Fixed-mobile convergence general requirements*.

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

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 control plane [b-ITU-T Y.2011]: The set of functions that controls the operation of entities in the stratum or layer under consideration, plus the functions required to support this control.

3.1.2 fixed mobile convergence [ITU-T Y.3100]: In the context of IMT-2020, the capabilities that provide services and applications to end users regardless of the fixed or mobile access technologies being used and independently of the users' location.

3.1.3 IMT-2020 [b-ITU-R M.2083-0]: Systems, system components, and related aspects that support more enhanced capabilities than those described in Recommendation ITU-R M.1645.

NOTE – 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.

3.1.4 mobility [b-ITU-T Q.1706]: The ability for the user or other mobile entities to communicate and access services irrespective of changes of the location or technical environment.

3.1.5 mobility management [b-ITU-T Q.1706]: The set of functions used to provide mobility. These functions include authentication, authorization, location updating, paging, download of user information and more.

3.1.6 network virtualization [b-ITU-T Y.3011]: A technology that enables the creation of logically isolated network partitions over shared physical networks so that heterogeneous collection

of multiple virtual networks can simultaneously coexist over the shared networks. This includes the aggregation of multiple resources in a provider and appearing as a single resource.

3.1.7 service continuity [b-ITU-T Q.1743]: The uninterrupted user experience of a service that is using an active communication (e.g., an ongoing voice call) when a user equipment (UE) undergoes a radio access technology change or a CS/PS domain change without, as far as possible, the user noticing the change.

NOTE – In particular service continuity encompasses the possibility that after a radio access technologies (RAT)/domain change the user experience is maintained by a different telecommunication service (e.g., tele- or bearer service) than before the RAT/domain change.

3.1.8 third party (3rd party) [ITU-T Y.3100]: In the context of IMT-2020, with respect to a given network operator and network end users, an entity which consumes network capabilities and/or provides applications and/or services.

NOTE 1 – An example of 3rd party, a VNO (virtual network operator) may use capabilities exposed by a network operator, e.g., to manage specific network slices. Another example of 3rd party, a service and/or application provider (e.g., an OTT player) may provide applications and/or services to enhance the network capabilities.

NOTE 2 – Network end users are not regarded as 3rd parties.

3.1.9 user plane [b-ITU-T Y.1714]: Refers to the set of traffic forwarding components through which traffic flows.

NOTE 1 – "User plane" is also referred to as "transport plane" in other ITU-T Recommendations.

NOTE 2 – "User plane" is defined as a synonym for data plane in [ITU-T Y.2011].

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAA Authentication, Authorization, Accounting

AR Augmented Reality

BRAS Broadband Remote Access Server

CAPEX Capital Expenditure

CPE Customer Premises Equipment

FMC Fixed Mobile Convergence

HSS Home Subscriber Server

IMS IP Multimedia Subsystem

LAN Local Area Network

NFV Network Function Virtualization

OPEX Operating Expense

QoS Quality of Service

RAT Radio Access Technologies

RG Residential Gateway

SDN Software-Defined Networking

SGW Serving Gateway

UE User Equipment

VR Virtual Reality

WLAN Wireless Local Area Network

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 "IMT-2020 FMC network" indicates that the IMT-2020 network provides FMC capabilities.

6 Introduction

6.1 Overview of FMC in IMT-2020 network

According to [ITU-T Y.3101], the IMT-2020 network is envisioned to have an access network-agnostic architecture whose core network will be a common unified core network for new radio access technologies for IMT-2020, as well as existing fixed and wireless networks (e.g., wireless local area network (WLAN)). The access technology-agnostic unified core network is expected to be accompanied by common control mechanisms which are decoupled from access technologies.

Emerging information and communications technologies (e.g., virtualization, cloud, software-defined networking (SDN), network function virtualization (NFV)) are transforming telecommunication operators' networks including fixed and mobile networks to achieve high resource utilization and network flexibility, which can contribute to network functions' convergence in an IMT-2020 network:

- A common infrastructure is intended to separate network functions from the dedicated hardware; it will be transformed into cloud-based or NFV/SDN-based common infrastructure, including multilayer data centres with general hardware, intelligent management and orchestration. This would allow a flexible deployment of fixed and mobile network functions.
- Fixed and mobile network functions are realized by software with a separation of the control plane and user plane. Softwarized control and user plane functions are easier to be upgraded and designed in a converged way, to enable flexible services, overall network design and evolution.

6.2 Objectives of FMC in IMT-2020 network

6.2.1 Service objective

Through FMC provided by an IMT-2020 network, the end user can enjoy a seamless service experience and ubiquitous service availability, and service providers can provide seamless service realization for fixed and mobile access networks.

6.2.2 Network evolution objective

FMC provides possibilities of mutual evolution and coordination of different access networks in an IMT-2020 network, to achieve overall network evolution with the following characteristics:

- Enable flexible network operation by the coordination of fixed access and mobile access network connections, e.g., traffic offload from mobile access network into fixed access network;

- enable converged network functionalities or capabilities of fixed and mobile networks, e.g., unified charging to support flexible market promotion policy;
- share infrastructure resources between fixed network functions and mobile network functions;
- share common value added services between fixed and mobile networks;
- reduce the capital expenditure (CAPEX) and operating expense (OPEX), e.g., implementing shared common user profile data, common functions like charging, etc.

7 Requirements of FMC in IMT-2020 network from service point of view

The requirements of FMC in an IMT-2020 network from the service point of view are based on the general requirements described in [ITU-T Y.3101].

7.1 Unified user identity

In the IMT-2020 FMC network, the end user is facilitated to use fixed and mobile access technologies. It is a significant improvement to the user experience if a unified user identity is applied when the end user is using fixed and mobile access technologies. One use case related to unified user identity is provided in the appendix. (See use case 1 in Scenario A)

Requirements of unified user identity are as follows:

- Unified user identity is required to support an end user's single identification for both fixed and mobile access technologies.
- Unified user identity is required to support an end user's single authentication and authorization for fixed and mobile access technologies.
- Unified user identity is required to enable unified charging for fixed and mobile access technologies.

7.2 Unified charging

In the IMT-2020 FMC network, charging information of one single end user for both fixed service and mobile service is integrated, which brings benefit to the network operator by reducing operation costs (e.g., one unified repository of charging information is needed instead of distributed ones for different access networks) and by supporting a flexible accounting strategy. One use case related to unified charging is provided in the appendix. (See use case 1 in Scenario A)

Requirement of unified charging is as follows:

- Unified charging is required to support a unified user's account which includes charging information for fixed and mobile services.

7.3 Service continuity and guaranteed quality of service support

Emerging applications (e.g., augmented reality (AR), virtual reality (VR)) pose high network performance requirements (e.g., bandwidth, latency). Considering the status of active fixed or mobile network connections (e.g., when a single fixed or mobile network connection cannot provide the required network performance), mobile or fixed network connections can be initiated and reused to provide complementary network performance. In this case, service continuity (for support of both scenarios of handover between access networks with different technologies and migration from a single access network to multiple access networks with different technologies) and guaranteed quality of service (QoS) need to be supported by FMC in an IMT-2020 network. Two use cases related to service continuity and guaranteed QoS support are provided in the appendix. (See use case 2 in Scenario A and use case 1 in Scenario B)

Service continuity and guaranteed QoS support are aligned with the requirements of diversity of service continuity control identified in [ITU-T Y.3101], in particular with the following additional requirements:

- Service continuity is required to support a seamless service experience when there is a handover between fixed and mobile access technologies, no matter if the handover is initialized by the network side or user side.
- Service continuity is required to support a seamless service experience when there is a migration from a single access network to multiple access networks with different technologies.
- Guaranteed QoS is required to be supported for both single and multiple access network connections.

8 IMT-2020 FMC network capability requirements

The requirements of IMT-2020 FMC network capabilities are based on the requirements of fixed mobile convergence described in [ITU-T Y.3101].

8.1 Control plane convergence

Separation of user plane and control plane is a key design principle of an IMT-2020 network's architecture, which separates functions (e.g., serving gateway (SGW), broadband remote access server (BRAS), etc.) into control plane functions and user plane functions. The control plane executes most of the control logics, and the user plane mainly provides packet switching under the instruction of the control plane.

This clause demonstrates requirements of control plane convergence.

NOTE – User plane convergence requirements are for further study.

8.1.1 Authentication and authorization

Authentication and authorization for FMC are aligned with the requirements of authentication identified in [ITU-T Y.3101], in particular with the following additional requirements:

- An IMT-2020 FMC network is required to provide a unified storage capability for authentication and authorization data for fixed and mobile access technologies.
- An IMT-2020 FMC network is required to support a unified authentication and authorization framework for a unified identity of the end user for fixed and mobile access technologies.

8.1.2 QoS control

QoS control for FMC is aligned with the requirements of QoS control identified in [ITU-T Y.3101], in particular with the following additional requirements:

- An IMT-2020 FMC network is required to support unified measurement of network performance (e.g., bandwidth, latency) for fixed and mobile access technologies.
- An IMT-2020 FMC network is required to support unified QoS policy management for fixed and mobile access technologies.
- An IMT-2020 FMC network is required to support a unified QoS decision-making point in the control plane and distributed QoS enforcement points in the user plane.

8.1.3 Charging

Charging for FMC is aligned with the requirements of charging identified in [ITU-T Y.3101], in particular with the following additional requirements:

- An IMT-2020 FMC network is required to support aggregation of charging information, simultaneously and independently of the access network fixed or mobile technology, for a single user, to determine total charging information for the user.
- An IMT-2020 FMC network is required to support charging models for fixed-only and mobile-only services, as well as for integrated fixed and mobile services.

8.1.4 Session management

Requirements of session management for FMC include:

- An IMT-2020 FMC network is required to support traffic switching, splitting and steering between fixed access networks and mobile access networks on the network side.
- An IMT-2020 FMC network is required to support traffic switching, splitting and steering on the user equipment side.

NOTE 1 – Traffic steering aims to select the access network(s) to transport traffic.

NOTE 2 – Traffic splitting aims to divide traffic into multiple pieces which are transported through different access networks.

NOTE 3 – Traffic switching allows the movement of traffic from one access network to another one.

8.1.5 Mobility management

Mobility management for FMC is aligned with the requirements of enhanced mobility management identified in [ITU-T Y.3101], in particular with the following additional requirements:

- An IMT-2020 FMC network is required to support a unified mobility state management capability for mobile and fixed access networks.
- An IMT-2020 FMC network is required to support session continuity when the end user moves between fixed and mobile access networks.

NOTE – The mobility scenarios supported in the IMT-2020 FMC network include the following:

- Intra-access mobility: when an end user equipment moves within an access network (such as new radio network) and changes its access point.
- Inter-access mobility: when an end user equipment switches between different access networks (such as new radio network and fixed network) and changes its access point.

8.2 User data management

The location and structure of user data storage vary in different access networks. For example, user data is stored by the authentication, authorization, accounting (AAA) server in fixed networks, while it is stored and managed by the home subscriber server (HSS) in 4G networks. This kind of data separation results in several drawbacks such as data redundancy and service development difficulties. So a unified database can reduce maintenance costs and provide conditions for service development and (big) data analysis.

Requirements of user data management for FMC are as follows:

- An IMT-2020 FMC network is required to support a single centralized user data storage for an end user's access to the IMT-2020 network using fixed and mobile access technologies;
- An IMT-2020 FMC network is required to support unified access mechanisms in user data storage.

8.3 Network capability exposure

Within the capability limits set by the network operators, in order to allow third parties to access information regarding services provided by the IMT-2020 network, and to dynamically customize the network capabilities for diverse use cases, the IMT-2020 FMC network is required to support network capability exposure.

Network capability exposure for FMC is aligned with the requirements identified in [ITU-T Y.3101], in particular with the following additional requirement:

- An IMT-2020 FMC network is required to support the exposure of the end user's access type, including single (fixed or mobile) access type, and simultaneous (fixed and mobile) access type, accessible by third parties.

8.4 Cloud-based infrastructure

Cloud-based network infrastructure is a set of interconnected multilayer data centres (e.g., edge data centre, core data centre) with general purpose standardized hardware, centralized management and orchestration enabled by NFV and SDN technologies. The IMT-2020 FMC network is expected to be deployed on a cloud-based network infrastructure in order to support flexible and automatic network deployment, extension and scalability.

Requirements of cloud-based infrastructure for FMC are as follows:

- An IMT-2020 FMC network is required to support network functions to be designed in a cloud native way.
- An IMT-2020 FMC network is required to support network functions to be deployed on cloud-based network infrastructure.
- An IMT-2020 FMC network is required to support network management and orchestration capabilities.

9 Security considerations

An IMT-2020 FMC network is required to be aligned with the security requirements contained in [ITU-T Q.1762] and the requirements of security and personal data protection contained in [ITU-T Y.3101], with the following additional ones:

- An IMT-2020 FMC network is required to provide mechanisms to support data confidentiality and integrity for fixed and mobile access networks.
- An IMT-2020 FMC network is required to provide secure storage, handling and enforcement of policies.
- An IMT-2020 FMC network is required to provide a security coordination function for coordinating security policies of each and all involved access networks.

Appendix I

Service scenarios supported by FMC in IMT-2020

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

This section lists two service scenarios, and related use cases supported by FMC in IMT-2020 network, for readers to understand related requirements of FMC in IMT-2020.

Service scenarios supported by FMC in IMT-2020 are not limited to the ones depicted in Figure I.1 and Figure I.2.

Scenario A: Fixed broadband service via fixed and (or) mobile access networks

Figure I.1 illustrates the scenario of a fixed broadband service via fixed and (or) mobile access networks. A terminal (e.g., customer premises equipment (CPE), residential gateway (RG)) of a fixed broadband service can be globally controlled by an IMT-2020 FMC network, and get access to data sources (e.g., websites on the Internet) via both fixed and mobile access networks simultaneously (which 'and' in the figure stands for) or via one of the access technologies at one time (which 'or' in the figure stands for).

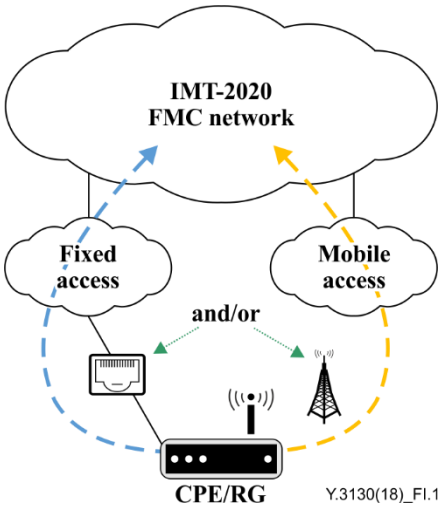

Figure I.1 – Fixed broadband service via fixed and (or) mobile access networks

There are some points to highlight for this scenario. An IMT-2020 FMC network:

- serves both fixed and mobile access networks;
- supports the use of fixed or mobile access network, or simultaneous use of both, seamlessly, to provide a high performance user experience;
- transports traffic on one or the other access networks, or transports on both simultaneously, and traffic can be split, combined, steered according to service requirements and network conditions for user experience optimization;
- supports the continuous and consistent provision of charging, traffic policies, etc.;
- supports unified management of subscriber's mobility and session stack;
- supports unified management of subscriber's identity and credentials.

Use case 1

A user can have a portable RG. When at home, he can access the fixed broadband service. When he goes out, he can take this RG with him, and benefit of its capability to connect via a mobile access network. The user can use the same identity and credentials to surf the Internet with terminals that connect to the Wi-Fi hotspot created by the RG, which gets access to a cellular network provided by the same operator. All the charging records are attributed to a unified bill for this user.

Use case 2

An RG, connected to the fixed broadband line, is simultaneously providing both wired LAN and Wi-Fi connections at home. A user is watching TV, which connects to the RG by a wired LAN interface. At the same time, he is making a voice call based on an IP multimedia subsystem (IMS) [b-ITU-T Y.2021] with his cell phone via Wi-Fi. The IMT-2020 FMC network detects that the bandwidth provided by the fixed access network for this RG is not enough to support both a TV service and voice call service, so under the control of the IMT-2020 FMC network, the RG simultaneously opens a connection via a mobile access network (without releasing exited fixed connection) to broaden the bandwidth so as to fulfil the requirements of all the services it carries.

Scenario B: Mobile broadband service via fixed and (or) mobile access networks

Figure I.2 illustrates the scenario of a mobile broadband service via fixed and (or) mobile accesses. A terminal (e.g., cell phone) of a mobile broadband service can be globally controlled by an IMT-2020 FMC network, and get access to data sources (e.g., websites on the Internet) via both fixed and mobile access networks simultaneously (which 'and' in the figure stands for) or via one of the access technologies at one time (which 'or' in the figure stands for).

NOTE – In this scenario, the fixed access network for the mobile broadband service indicates that a mobile terminal (e.g., cell phone) can connect to a fixed access network via wireless hotspots (e.g., Wi-Fi) provided by traditional fixed gateways (e.g., CPE, RG).

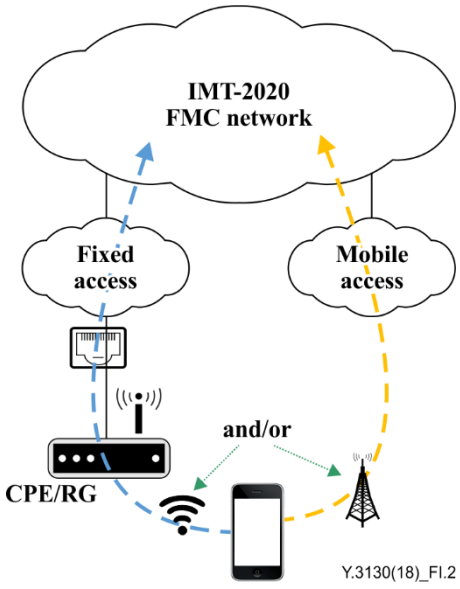

Figure I.2 – Mobile broadband service via fixed and (or) mobile access networks

The points to highlight for this scenario are aligned with those described in Scenario A.

Use case 1

A user of a mobile broadband service is making a voice call based on an IP multimedia subsystem (IMS) via a cellular network. When the user steps into his house, the cellular coverage is too weak to provide enough bandwidth for this phone call. An IMT-2020 FMC network detects this situation and

switches the mobile seamlessly to the Wi-Fi hotspot provided by the RG at home. The voice call continues and all data packets of this dialogue are not dropped or missed.

Use case 2

A user can get access to multiple kinds of service (e.g., data service, voice service) over mobile broadband. When the user initiates a voice call, mobile access connection will be selected and used for a voice service. At the same time or after that, a fixed access connection will be selected and used for the data download traffic when the user initiates a movie file download.

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Printed in Switzerland
Geneva, 2018