

Draft new Recommendation ITU-T Y.FMSC-UPE

Fixed, mobile and satellite convergence – User plane enhancement for IMT-2020 networks and beyond

Summary

Fixed, mobile and satellite convergence (FMSC) is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies being used. The user plane in IMT-2020 networks and beyond can be enhanced to facilitate a broader range of communication services, especially in FMSC scenarios after the introduction of satellites. This Recommendation specifies the overview, requirements, framework, network function enhancements, procedures and security considerations of user plane enhancement for FMSC, in the context of IMT-2020 networks and beyond. This Recommendation provides a solution for user plane enhancement in FMSC network for IMT-2020 and beyond. The radio aspects are out of the scope of this Recommendation.

Keywords

FMSC, IMT-2020, User plane enhancement

Table of Contents

| | Page |
|---|------|
| 1. Scope..... | 3 |
| 2. References..... | 3 |
| 3. Definitions..... | 4 |
| 3.1. Terms defined elsewhere | 4 |
| 3.2. Terms defined in this Recommendation | 4 |
| 4. Abbreviations and acronyms..... | 4 |
| 5. Conventions | 5 |
| 6. Overview on user plane enhancement in FMSC network..... | 5 |
| 7. Requirements of user plane enhancement in FMSC network..... | 8 |
| 7.1. General requirements..... | 8 |
| 7.2. Requirements on framework..... | 9 |
| 7.3. Requirements on network functions | 9 |
| 8. Framework of user plane enhancement in FMSC network..... | 9 |
| 8.1. FMSC framework enhancements | 9 |
| 8.2. Reference points | 10 |
| 9. Network function enhancements of user plane in FMSC network | 10 |
| 10. Procedures of user plane enhancement in FMSC network | 10 |
| 11. Security considerations | 10 |
| Appendix I..... | 11 |
| Use cases of user plane enhancement in FMSC network | 11 |
| Bibliography..... | 13 |
| Annex A A.1 justification for proposed draft new ITU-T Y.FMSC-UPE “Fixed, mobile and satellite convergence – User plane enhancement for IMT-2020 networks and beyond” | 14 |

Draft new Recommendation ITU-T Y.FMSC-UPE

Fixed, mobile and satellite convergence – User plane enhancement for IMT-2020 networks and beyond

1. Scope

This Recommendation specifies the user plane enhancement in FMSC for IMT-2020 networks and beyond. FMSC is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies being used [ITU-T Y.3200]. This Recommendation provides a solution for user plane enhancement in FMSC network for IMT-2020 and beyond focusing on the satellite-based user plane enhancement.

This Recommendation addresses the following aspects of user plane enhancement in FMSC for IMT-2020 networks and beyond:

- Overview;
- Requirements;
- Framework;
- Network function enhancements;
- Procedures;
- Security considerations.

Some relevant use cases are provided in Appendix I.

The radio aspects are out of the scope of this Recommendation.

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), <i>Requirements of the IMT-2020 network</i> . |
| [ITU-T Y.3102] | Recommendation ITU-T Y.3102 (2018), <i>Framework of the IMT-2020 network</i> . |
| [ITU-T Y.3104] | Recommendation ITU-T Y.3104 (2018), <i>Architecture of the IMT-2020 network</i> . |
| [ITU-T Y.3200] | Recommendation ITU-T Y.3200 (2022), <i>Fixed, mobile and satellite convergence – Requirements for IMT-2020 networks and beyond</i> . |
| [ITU-T Y.3201] | Recommendation ITU-T Y.3201 (2023), <i>Fixed, mobile and satellite convergence – Framework for IMT-2020 networks and beyond</i> . |

[ITU-T Y.3216] Recommendation ITU-T Y.3216 (2024), *Fixed, mobile and satellite convergence – Distributed core network for IMT-2020 networks and beyond*.

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 data plane [b-ITU-T Y.2011]: The set of functions used to transfer data in the stratum or layer under consideration.

3.1.3 fixed, mobile and satellite convergence (FMSC) [ITU-T Y.3200]: The capabilities that provide services and applications to end users regardless of the fixed, mobile or satellite access technologies being used independently of the users' location.

3.1.4 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.

3.1.5 multi-access user equipment (MUE) [b-ITU-T Y.3218]: User equipment which can support accessing two or more access networks simultaneously under the control of a network enhanced for multi-access capability.

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

3.1.7 third party (3rd party) [b-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.

3.1.8 user plane [b-ITU-T Y.2011]: A synonym for data plane.

3.2. Terms defined in this Recommendation

This Recommendation defines the following terms:

[Editor's Note] The term of user plane enhancement in FMSC network is for further study, in the context of IMT-2020 networks and beyond.

4. Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

| | |
|------|---|
| AF | Application Function |
| ASF | Authentication Server Function |
| CEF | Capability Exposure Function |
| E2E | End-to-End |
| FMSC | Fixed, Mobile and Satellite Convergence |

| | |
|------|--|
| MUE | Multi-access User Equipment |
| NACF | Network Access Control Function |
| NFR | Network Function Registry function |
| NSSF | Network Slice Selection Function |
| PCF | Policy Control Function |
| QoS | Quality of Service |
| 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 user plane enhancement in FMSC network

[Editor's Note] This clause presents the overview on user plane enhancement in FMSC network, in the context of IMT-2020 networks and beyond.

Fixed, mobile and satellite convergence (FMSC) network aims to address the diverse service requirements of multi-access user equipment (MUE). However, satellite networks, characterized by highly dynamic topologies, limited spectrum and power resources, as well as constraints imposed by orbital mechanics and the geographical location of ground communication stations, often face challenges in transmitting data to the ground in a timely manner. Such transmission bottlenecks not only impair the efficiency of data transmission and reception but also degrade task processing performance and user quality of service (QoS). With the advancement of satellite communication and inter-satellite link technologies, inter-satellite collaboration has emerged as a viable solution for wide area communication services.

To further enhance system performance in scenarios such as smart power grids, maritime communications, emergency communications and so on, it is significant to leverage the distributed computing resources within the network. This objective can be achieved by utilizing on-board computing technologies, including data correction and calibration, redundancy elimination, and data compression, to substantially decrease the volume of data requiring transmission, thereby alleviating the computational load of tasks. Furthermore, by promoting the user plane functionalities in the FMSC network, the on-board capabilities can be effectively utilized to achieve streamlined service

processing and help ensure end-to-end (E2E) QoS. Consequently, enhancing the user plane functionalities in satellite networks holds substantial significance.

FMSC is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies being used. The FMSC network consists of MUE, fixed/mobile/satellite access network, land-based/satellite-based core network, interworking function, land-based/satellite-based service platform, and land-based/satellite-based data network. The FMSC network is typically a large scale E2E network covering a large geographic area. The topology and organization of FMSC network is dynamic; the network entities, resources, capabilities, capacity, interfaces and procedures in FMSC network are heterogeneous. Figure 6-1 depicts the overall framework of FMSC for IMT-2020 networks and beyond [ITU-T Y.3201].

NOTE 1 – For considering specifications of FMSC in IMT systems, following documents are the foundations of IMT-2020 specifications:

- Framework/Objectives of IMT-2020 [b-ITU-R M.2083-0];
- Requirements of IMT-2020 [b-ITU-R M.2410-0] [b-ITU-R M.2411-0];
- Specifications of IMT-2020 [b-ITU-R M.2150-2].

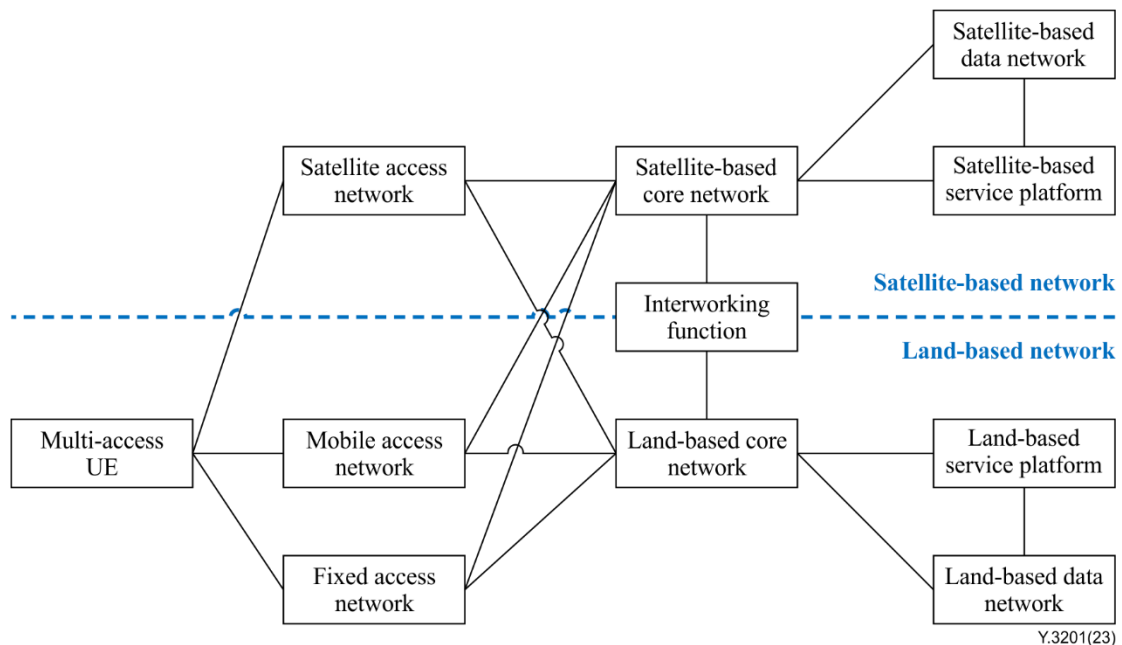


Figure 6-1 – Overall framework of FMSC for IMT-2020 networks and beyond [ITU-T Y.3201]

In the land-based converged network, the land-based core network provides all of the IMT-2020 core network functions, including network access control function (NACF), session management function (SMF), policy control function (PCF), capability exposure function (CEF), network function registry function (NFR), unified subscription management function (USM), network slice selection function (NSSF), authentication server function (ASF), application function (AF), and user plane function (UPF) for fixed access, mobile access and satellite access, each of which requires enhancements to support FMSC. In the satellite-based converged network, the satellite-based core network provides a simplified set of the IMT-2020 core network functions, in which NACF, SMF, USM and UPF are required; while PCF, CEF, NFR, NSSF, ASF and AF are optional. The UPF is customized to a lightweight version for deploying on the satellite, in the aspects of functionalities, interfaces, protocols and procedures. [ITU-T Y.3201].

Figure 6-2 depicts the architecture reference model of distributed core network for FMSC for IMT-2020 networks and beyond [ITU-T Y.3216]. In [ITU-T Y.3216], the enhanced FMSC framework consists of MUE, fixed/mobile/satellite access network, land-based/satellite-based core network,

interworking function, land-based/satellite-based service plane, land-based/satellite-based data network, and land-based/satellite-based management plane. Particularly, the user plane consists of traffic processing function, service processing function and policy enforcement function.

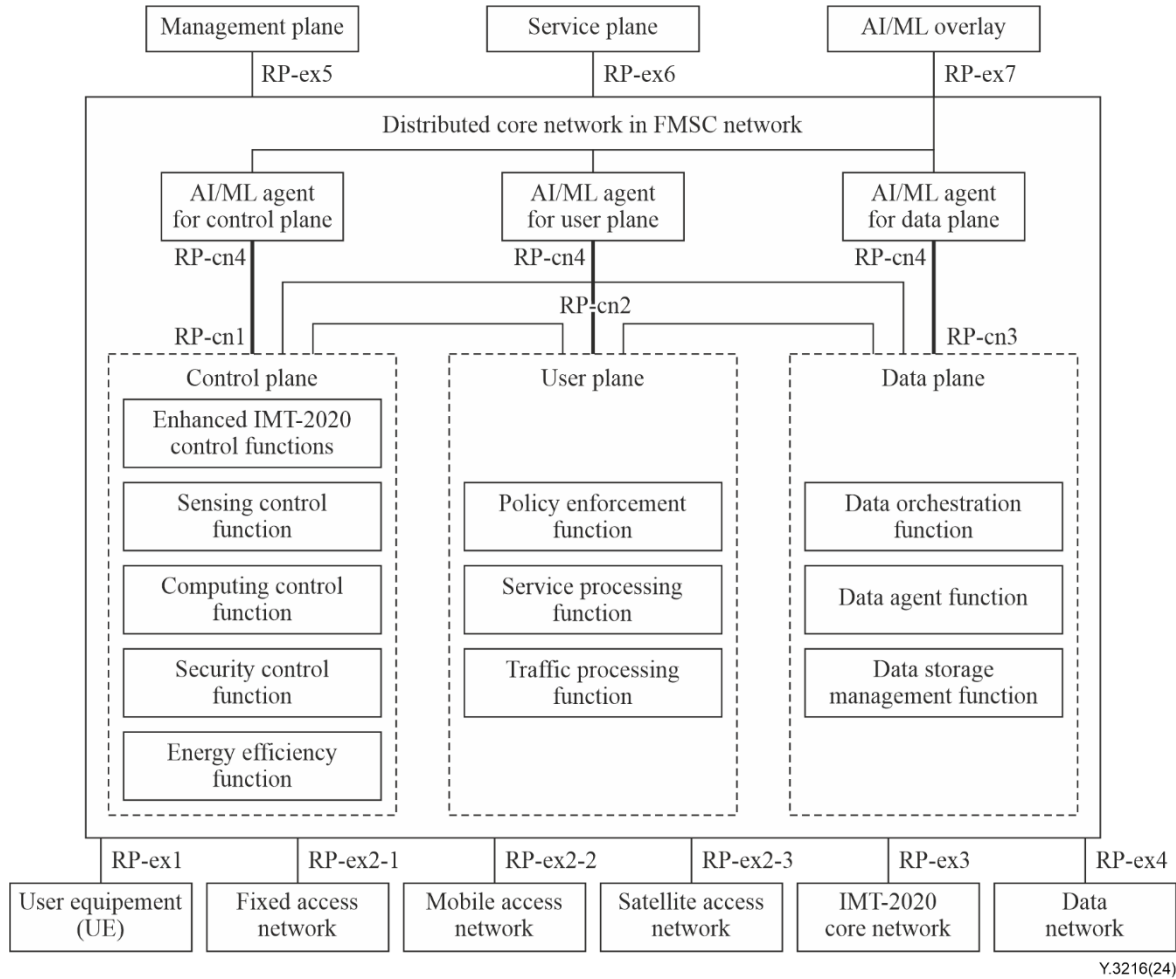


Figure 6-2 – Architecture reference model of distributed core network for FMSC for IMT-2020 networks and beyond [ITU-T Y.3216]

In FMSC network in the context of IMT-2020 networks and beyond, new types of features are introduced, such as multi-access edge computing, local data switching, service scheduling, and coordination of networking and computing. Besides, in scenarios such as smart power grids, maritime communications, and emergency communications, onboard user plane processing can decrease the volume of data requiring transmission to the ground and improve the task processing efficiency. Therefore, user plane enhancements are required to support new features in FMSC network in the context of IMT-2020 networks and beyond and this Recommendation focuses on the satellite-based user plane enhancement.

Figure 6-3 depicts the reference model of FMSC for IMT-2020 networks and beyond. In the reference model, MUE can access the fixed access network, mobile access network and satellite access network. It has the capability to capture and gather raw data. Given that a substantial volume of raw data, such as high-resolution images or videos, cannot be instantly transmitted through land-based access network, it can be transmitted to the satellite-based core network via the satellite access network instead. The UPF can be enhanced and designed to systematically process raw data into actionable information through pre-processing, redundancy removal, image enhancement, feature extraction, compression, etc. Following multiple procedures, the resultant data can be efficiently transmitted to the ground, thereby the volume reducing satellite-ground data transmission and enhancing the utilization efficiency of satellite computing resources.

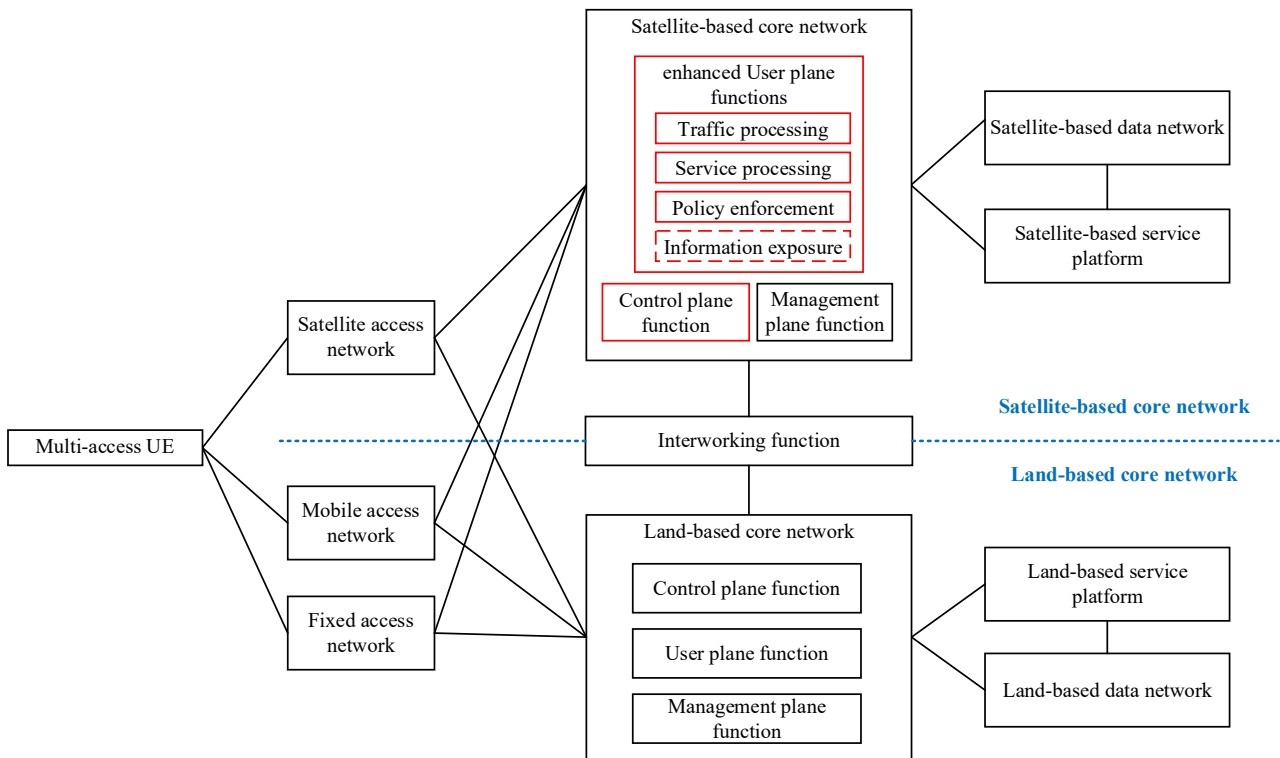


Figure 6-3 – Reference model of user plane enhancement in FMSC for IMT-2020 networks and beyond

[Editor's Note] The reference model of user plane enhancement in FMSC for IMT-2020 networks and beyond is for further consideration.

[Editor's Note] Whether Information exposure functionalities in satellite-based user plane is mandatory or optional is for further study.

7. Requirements of user plane enhancement in FMSC network

[Editor's Note] This clause specifies the requirements of user plane enhancement in FMSC network, in the context of IMT-2020 networks and beyond, which include the general requirements, requirements on framework, and requirements on network functions.

7.1. General requirements

[Editor's Note] The general requirements of user plane enhancement in FMSC for IMT-2020 networks and beyond are for further consideration.

The general requirements of user plane enhancement in FMSC for IMT-2020 networks and beyond are as follows:

- It is required for user plane for FMSC to be compatible with diverse UEs, access networks and core networks of IMT-2020 networks and beyond.
- It is required for user plane in FMSC to support the service continuity and QoS of the data transmission.
- It is required for user plane in FMSC to support store, process, forward the data, i.e., images or videos.

7.2. Requirements on framework

The requirements on framework of user plane enhancement in FMSC for IMT-2020 networks and beyond are as follows:

7.3. Requirements on network functions

The requirements on user plane enhancement in FMSC for IMT-2020 networks and beyond are as follows:

- It is required for the user plane function in FMSC to support traffic processing of IMT-2020 networks and beyond.
- It is required for the user plane function in FMSC to support service processing of IMT-2020 networks and beyond.
- It is required for the user plane function in FMSC to support the policy enforcement of IMT-2020 networks and beyond.

8. Framework of user plane enhancement in FMSC network

[Editor's Note] This clause specifies the framework of user plane enhancement in FMSC network, in the context of IMT-2020 networks and beyond, which includes the FMSC framework enhancements and reference points.

8.1. FMSC framework enhancements

The FMSC framework enhancements for IMT-2020 networks and beyond is based on the reference model of user plane enhancement for FMSC for IMT-2020 networks and beyond, and specifies the FMSC network functions and reference points.

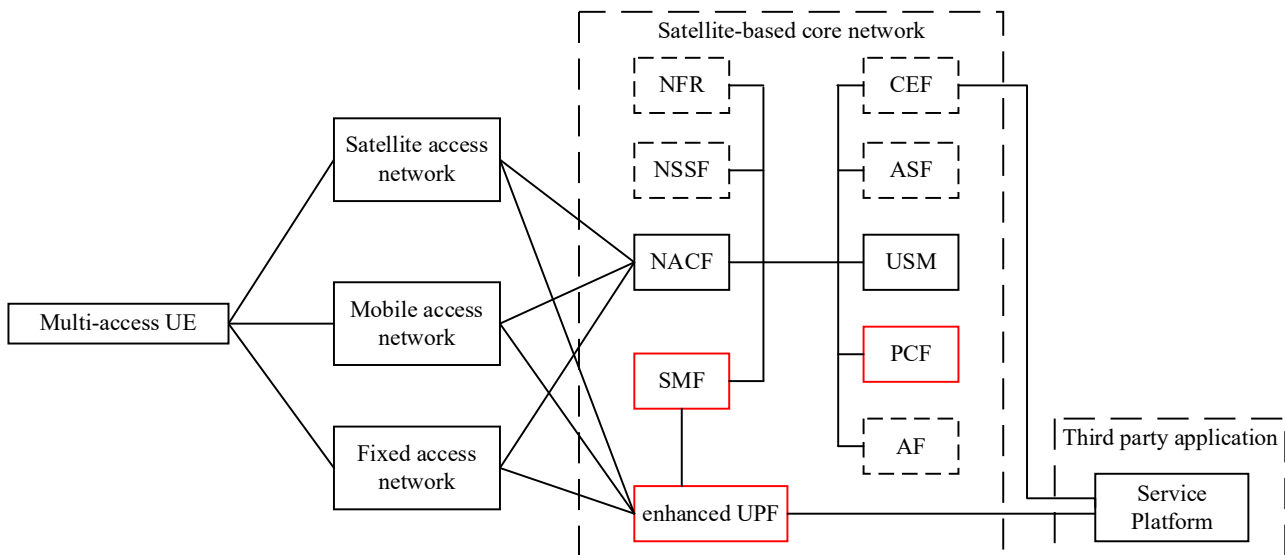


Figure 8-1 – Framework of user plane enhancement in FMSC for IMT-2020 networks and beyond

[Editor's Note] In the enhancement of user plane in the FMSC network, it is not feasible or optimal to deploy all network functions on-board satellites in the satellite core network. Future research will focus on the selective on-board deployment of specific network functions, such as the UPF, SMF, PCF and so on.

8.2. Reference points

[Editor's Note] The reference points of user plane enhancement for FMSC for IMT-2020 networks and beyond are for further consideration.

The reference points of user plane enhancement in FMSC for IMT-2020 networks and beyond are as follows:

9. Network function enhancements of user plane in FMSC network

[Editor's Note] The network function enhancements of user plane are to be addressed.

10. Procedures of user plane enhancement in FMSC network

[Editor's Note] This clause specifies the procedures of user plane enhancement in FMSC network, in the context of IMT-2020 networks and beyond.

11. Security considerations

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

The security and privacy considerations of user plane enhancement for FMSC for IMT-2020 networks and beyond include the following aspects:

- Network security, including the security considerations on the access network, core network and service platform of FMSC network.
- Service security, including the security considerations on the communications services and third party services provided by FMSC network.
- User privacy, including the privacy considerations on the enhancement of user plane, which is responsible for collecting, storing, caching and processing the privacy sensitive data.

In addition, the security and privacy considerations of user plane enhancement in FMSC for IMT-2020 networks and beyond should be aligned with the requirements specified in [ITU-T Y.3200], [ITU-T Y.3101], and [b-ITU-T Y.2701].

Appendix I

Use cases of user plane enhancement in FMSC network

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

The use cases of user plane enhancement in FMSC network for IMT-2020 networks and beyond include, but are not limited to, the follows:

Use case 1: Remote sensing picture processing via land-based network in FMSC network

In FMSC network for IMT-2020 networks and beyond, the use case of remote sensing picture processing via land-based network is to be supported. As shown in Figure A-1, the satellite accesses the land-based access network. During satellite overpass, the captured data, e.g. a noisy cloud image [b-SD 2016], are transmitted to land-based access network and are processed, e.g. denoising, by land-based core network before being forwarded to the service platform.

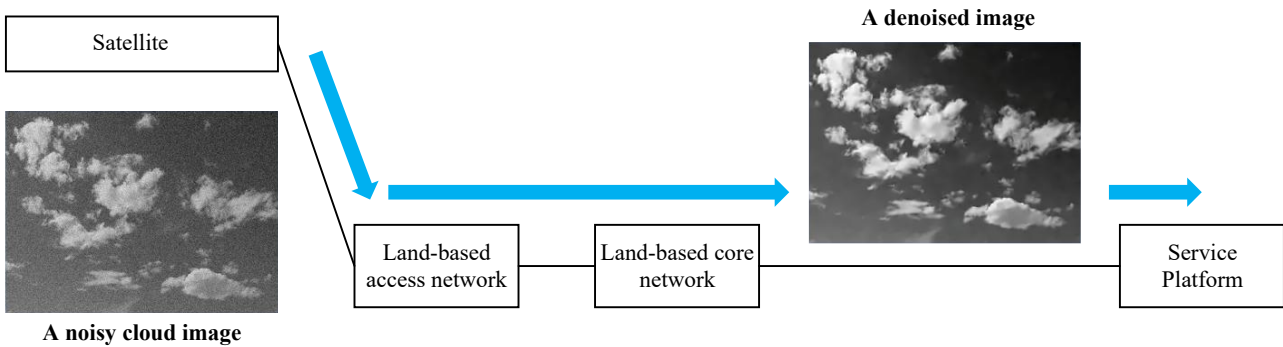


Figure A-1 – Remote sensing picture processing via land-based network in FMSC network

Use case 2: Remote sensing picture processing via satellite-based network in FMSC network

In FMSC network for IMT-2020 networks and beyond, the use case of remote sensing picture processing via satellite is to be supported. As shown in Figure A-2, a satellite accesses the satellite access network. The data can be transmitted to the satellite-based core network via inter-satellite links and processed onboard, and subsequently transmitted to the land-based core network and service platform.

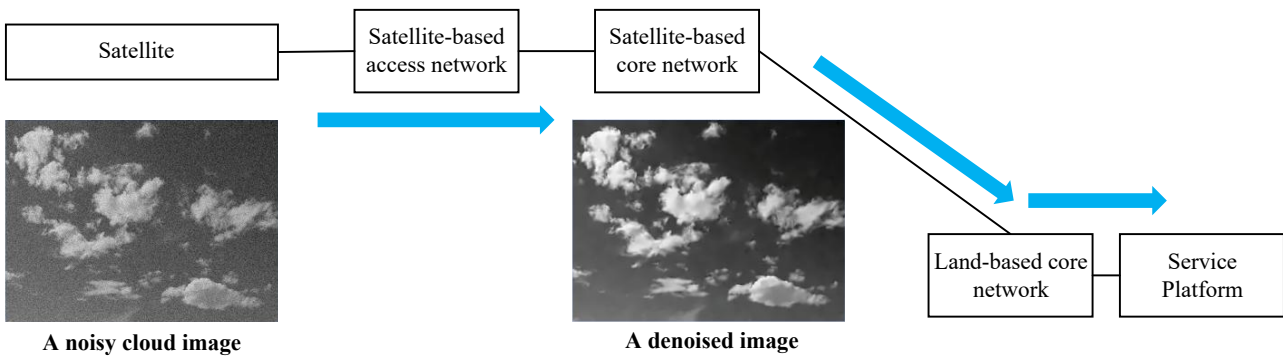


Figure A-2 – Remote sensing picture processing via satellite-based network in FMSC network

Use case 3: Video processing in FMSC network

In FMSC network for IMT-2020 networks and beyond, the use case of satellite-based video processing has emerged as a key research area [b-LS 2023]. As shown in Figure A-3, a MUE accesses the FMSC network. Leveraging the proposed user plane enhancement architecture in the FMSC network, the data, i.e., videos, can be transmitted to the core network via inter-satellite links or satellite ground link and processed, and subsequently transmitted to the service platform.

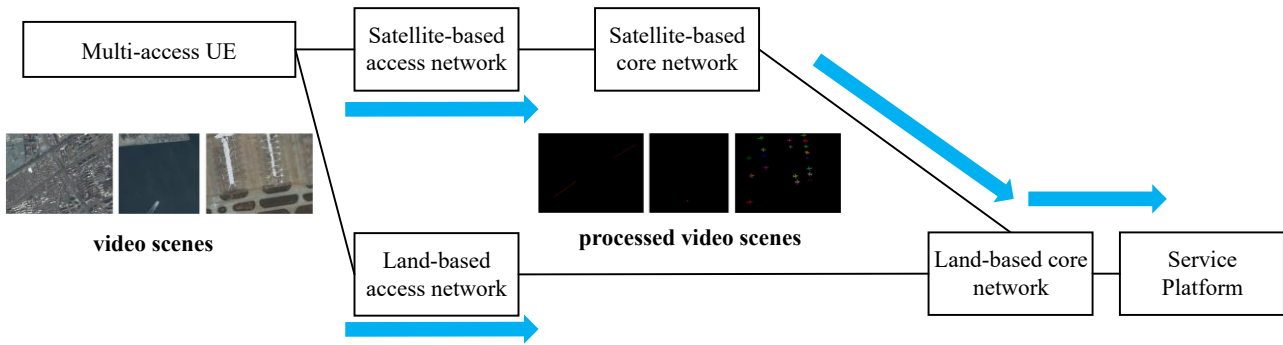


Figure A-3 – Video processing in FMSC network

Use case 4: Power data processing in FMSC network for smart grid scenario

In FMSC network for IMT-2020 networks and beyond, the massive data processing in smart grids has emerged as a significant use case [b-MS 2022]. As shown in Figure A-4, this architecture enables flexible data transmission for smart grid UE through either terrestrial networks or satellite links, ensuring the data transmission requirements of power services are met while maximizing the long-term energy efficiency of the system.

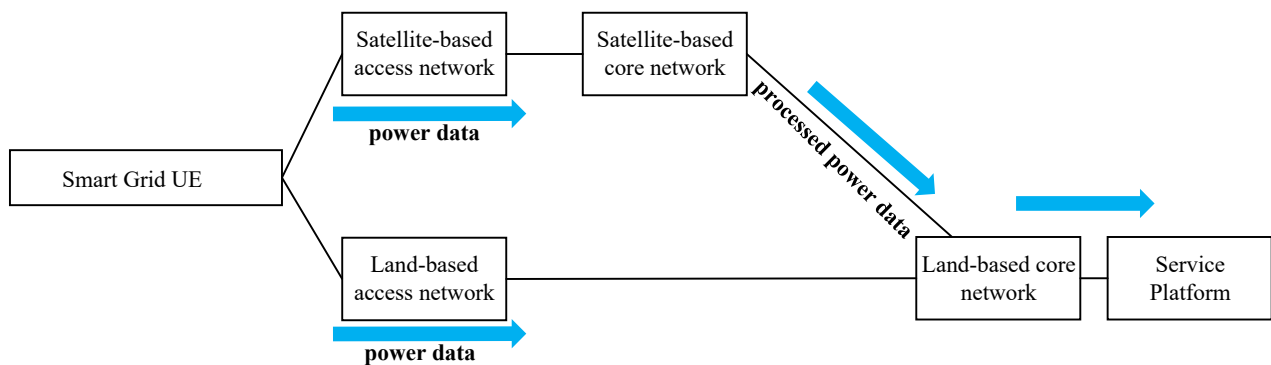


Figure A-4 – Power data processing in FMSC network for smart grid scenario

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.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.
- [b-ITU-T Y.3100] Recommendation ITU-T Y.3100 (2017), *Terms and definitions for IMT-2020 network*.
- [b-ITU-T Y.3218] Recommendation ITU-T Y.3218 (2025), *Fixed, mobile and satellite convergence – Service scheduling for IMT-2020 networks and beyond*.
- [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*.
- [b-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*.
- [b-ITU-R M.2150-2] Recommendation ITU-R M.2150-2 (2023), *Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2020 (IMT-2020)*.
- [b-ITU-R M.2410-0] Report ITU-R M.2410-0 (2017), *Minimum requirements related to technical performance for IMT-2020 radio interface(s)*.
- [b-ITU-R M.2411-0] Report ITU-R M.2411-0 (2017), *Requirements, evaluation criteria and submission templates for the development of IMT-2020*.
- [b-ITU-R M.2460-0] Report ITU-R M.2460-0 (2019), *Key elements for integration of satellite systems into Next Generation Access Technologies*.
- [b-SD 2016] S. Dev, B. Wen, Y. H. Lee and S. Winkler (2016), *Ground-based image analysis: a tutorial on machine-learning techniques and applications*. *IEEE Geoscience & Remote Sensing Magazine*, 4(2), pp. 79-93, doi: 10.1109/MGRS.2015.2510448.
- [b-LS 2023] Li, S., Sun, X., Gu, Y., Lv, Y., Zhao, M., Zhou, Z., ... & Yang, J. (2023), *Recent advances in intelligent processing of satellite video: Challenges, methods, and applications*. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 16, 6776-6798.
- [b-MS 2022] Meng, S., Zhu, S., Wang, Z., Zhang, R., Han, J., Liu, J., ... & Zhao, X. (2022), *Jdapcoo: Resource scheduling and energy efficiency optimization in 5G and satellite converged networks for power transmission and distribution scenarios*. *Sensors*, 22(18), 7085.
-

Annex A

A.1 justification for proposed draft new ITU-T Y.FMSC-UPE “Fixed, mobile and satellite convergence – User plane enhancement for IMT-2020 networks and beyond”

| | | | |
|---|--|--|--------------------------|
| Question: | Q23/13 | Proposed new ITU-T Recommendation | Geneva, 27 February 2026 |
| Reference and title: | ITU-T Y.FMSC-UPE “Fixed, mobile and satellite convergence – User plane enhancement for IMT-2020 networks and beyond” | | |
| Base text: | SG13-TD398/WP1 | Timing: | 2028-03 |
| Editor(s): | Heng Wang, China Telecom, e-mail: wangh26@chinatelecom.cn Wei Li, CAICT, liwei3@caict.ac.cn Pengyu Li, China Telecom, e-mail: lipengyu@chinatelecom.cn Zhenghao Li, SGCC, e-mail: lizhenghao@sd.sgcc.com.cn Nanxiang Shi, China Mobile, e-mail: shinanxiang@chinamobile.com Bo Hu, BUPT, e-mail: hubo@bupt.edu.cn | Approval process: | AAP |
| <p>Scope (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability):</p> <p>This Recommendation specifies the user plane enhancement in FMSC network for IMT-2020 networks and beyond. This Recommendation provides a solution for user plane enhancement in FMSC network for IMT-2020 and beyond, focusing on the satellite-based user plane enhancement.</p> <p>This Recommendation addresses the following aspects of user plane enhancement in FMSC for IMT-2020 networks and beyond:</p> <ul style="list-style-type: none"> • Overview; • Requirements; • Framework; • Network function enhancements; • Procedures; • Security considerations. | | | |
| <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>Fixed, mobile and satellite convergence (FMSC) is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies being used. The user plane in IMT-2020 networks and beyond can be enhanced to facilitate a broader range of communication services, especially in FMSC scenarios after the introduction of satellites. This Recommendation specifies the overview, requirements, framework, network function enhancements, procedures and security considerations of user plane enhancement for FMSC, in the context of IMT-2020 networks and beyond. The radio aspects are out of the scope of this Recommendation.</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.3200, ITU-T Y.3201, ITU-T Y.3216</p> | | | |
| <p>Liaisons with other study groups or with other standards bodies:</p> <p>ITU-T SG11, ITU-T SG17, ITU-R WP4B, ITU-R WP5D, 3GPP SA1</p> | | | |
| <p>Supporting members that are committing to contributing actively to the work item:</p> <p>China Telecom, CAICT, SGCC, China Mobile, BUPT</p> | | | |