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International Telecommunication Union
Standardization Sector

Supplement

ITU-T Y Suppl. 81 (03/2024)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Supplements to ITU-T Y-series Recommendations

ITU-T Y.3200 series – Use cases of satellite communications in developing countries

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Supplement 81 to ITU-T Y-series Recommendations

ITU-T Y.3200 series – Use cases of satellite communications in developing countries

Summary

Satellite communications is a type of communications using satellite-borne equipment as part of or all of the communication network. In developing countries, considering the limitations on the capabilities and capacity of land-based networks, the use of satellite communications is important. Supplement 81 to ITU-T Y-series Recommendations specifies some use cases and the corresponding requirements of satellite communication networks in developing countries, in the context of non-radio aspects of IMT-2020 networks and beyond.

History*

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T Y Suppl. 81	2024-03-15		11.1002/1000/15864

Keywords

Developing countries, requirements, satellite communications, use cases.

* To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

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Supplement 81 to ITU-T Y-series Recommendations

ITU-T Y.3200 series – Use cases of satellite communications in developing countries

1 Scope

This Supplement specifies some use cases and the corresponding requirements of satellite communication networks in developing countries, in the context of non-radio aspects of IMT-2020 networks and beyond. This Supplement addresses the following aspects of satellite communications in developing countries, focusing on the non-radio aspects:

- Use cases of satellite communications, which include use cases where there is no land-based network, the land-based network has a low data rate, the land-based network has a low capacity, there is no land-based network of a specific operator and as emergency communications (which could be consistent with some or all of the previous use cases).
- Requirements of satellite communications, which include the service requirements, network capability requirements and security requirements for the above use cases.

2 References

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

[ITU-T Y.3200] Recommendation ITU-T Y.3200 (2023), *Fixed, mobile and satellite convergence – Requirements for IMT-2020 network and beyond*.

[ITU-T Y.3201] Recommendation ITU-T Y.3201 (2023), *Fixed, mobile and satellite convergence – Framework for IMT-2020 networks and beyond*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement 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 [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].

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

3.1.6 management plane [b-ITU-T Y.2011]: The set of functions used to manage entities in the stratum or layer under consideration, plus the functions required to support this management.

3.1.7 network functions virtualization (NFV) [b-ETSI GS NFV 003]: Principle of separating network functions from the hardware they run on by using virtual hardware abstraction.

3.1.8 quality of service (QoS) [b-ITU-T Q.1743]: The collective effect of service performances, which determine the degree of satisfaction of a user of a service. It is characterized by the combined aspects of performance factors applicable to all services, such as:

– service operability performance;

– service accessibility performance;

– service retainability performance;

– service integrity performance; and

– other factors specific to each service.

3.1.9 service continuity [b-ITU-T Y.3204]: The ability for a moving object to maintain ongoing service, including maintaining current states such as the user network environment and session.

3.1.10 software-defined networking [b-ITU-T Y.3300]: A set of techniques that enables to directly program, orchestrate, control and manage network resources, which facilitates the design, delivery and operation of network services in a dynamic and scalable manner.

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

3.2 Terms defined in this Supplement

None.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AF Application Function

AI Artificial Intelligence

ASF Authentication Server Function

CEF Capability Exposure Function

DLT Distributed Ledger Technology

FMSC Fixed, Mobile and Satellite Convergence

GBR Guaranteed Bit Rate

GEO Geostationary Earth Orbit

gNB gNodeB

HEO Highly Elliptical Orbit

ING Intelligent Network Gateway

IoT Internet of Things

IUG Intelligent User Gateway

LEO Low Earth Orbit

MEC Multi-access Edge Computing

MEO Medium Earth Orbit

ML Machine Learning

NACF Network Access Control Function

NFR Network Function Registry function

NFV Network Functions Virtualization

NSSF Network Slice Selection Function

NTN Non-terrestrial Network

PCF Policy Control Function

QoS Quality of Service

RCS Rich Communication Suite

RTT Round-Trip Time

SDN Software-Defined Networking

SMF Session Management Function

UE User Equipment

UPF User Plane Function

USM Unified Subscription Management function

VCC Voice and video Call Continuity

WIMAX World Interoperability for Microwave Access

5 Conventions

In this Supplement:

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

6 Use cases of satellite communications in developing countries

6.1 Overview of use cases in developing countries

Satellite communications is a type of communications that uses a satellite-borne network and equipment as part of or all of a communication network. With the development of satellite communication technology, including the use of low earth orbit (LEO), medium earth orbit (MEO), geostationary earth orbit (GEO) and highly elliptical orbit (HEO) for the satellite architecture, satellite access evolution and other enhanced technical capabilities, the use cases and services of satellite communications are enriched. These developments, as well as standards evolution, make the collaboration with the land-based network technologically possible. The key elements for integration of satellite systems into next generation access technologies have been specified in [b-ITU-R M.2460-0].

NOTE 1 – Additionally, satellite-based network and its convergence with the land-based network have been studied in ITU-T, ITU-R, 3GPP, ETSI and IETF, being considered a major direction of network evolution and an essential part of the IMT-2020 network and beyond.

NOTE 2 – By the year 2024, in the practical use of satellite communications:

- The capacity (namely throughput) of a single satellite has reached 300 Gbit/s at maximum.
- The data rates of handset terminal, portable terminal and vehicular terminal have reached 1 Mbit/s, 30 Mbit/s and 100 Mbit/s on average, respectively.
- The round-trip time (RTT) of LEO satellite communications has reached 40 ms on average.
- The network functions virtualization (NFV) and software-defined networking (SDN) technologies have been supported by some types of satellites.

- The functionalities of access network and core network have been supported by some types of satellites.

In developing countries, considering the limitation on capabilities and capacity of land-based network, the satellite communications is of important needs. The use cases of satellite communications in developing countries include, but are not limited to, the following categories:

- No land-based network;
- Land-based network with low data rate;
- Land-based network with low capacity;
- No land-based network of a specific operator;
- Emergency communications.

In these categories, the category of no land-based network is supported with only satellite-based network; while the other categories are supported with hybrid network (including both satellite-based network and land-based network), in which fixed, mobile and satellite convergence (FMSC) can be introduced.

NOTE – FMSC is the capability that provides services and applications to end users regardless of the fixed, mobile or satellite access technologies being used independently of the users' location [ITU-T Y.3200]. The FMSC is achieved with the converged core network, including land-based core network and/or satellite-based core network (with an interworking function between them). The converged core network connects to the fixed access network, mobile access network, satellite access network, service platform and data network. The converged core network is enhanced (when land-based) or newly organized (when satellite-based) to support satellite access and FMSC on the basis of the IMT-2020 core network [ITU-T Y.3201].

6.2 Use cases of no land-based network

The use cases of no land-based network include ocean, sea, desert, deep mountain, deep forest, and the polar region, in which there is no land-based network. In these use cases, the communication services may include, but are not limited to, voice service, video service, message service, data service, broadcast service and multicast service, with the support of a satellite-based network. The type of user equipment (UE) may include a handset terminal, portable terminal, IoT terminal, vehicular terminal, maritime terminal and aviation terminal. The types of satellite networks include LEO satellite, MEO satellite, GEO satellite and HEO satellite.

NOTE – The message service may include short message service, multimedia message service and rich communication suite (RCS) service.

6.3 Use cases of land-based network with low data rate

The use cases of land-based network with low data rate include remote village, remote settlement, ecoregion and small island, in which there is a land-based network with a low data rate that could not meet the requirements of end users and communication services. In these use cases, the communication services may include, but are not limited to, voice service, video service, message service, data service, broadcast service and multicast service, with the support of a hybrid network. The type of UE may include a handset terminal, portable terminal, IoT terminal, vehicular terminal and fixed terminal. The types of satellite networks include LEO satellite, MEO satellite, GEO satellite and HEO satellite. The FMSC could be applied to facilitate the provision of services and enhance the service continuity and quality of service (QoS) in these use cases.

6.4 Use cases of land-based network with low capacity

The use cases of land-based network with low capacity (namely volume) include remote Internet of Things (IoT), remote industrial network and remote vehicular network, in which there is a land-based network with low capacity, that could not meet the requirements of end users and communication services. In these use cases, the communication services may include, but are not

limited to, voice service, video service, message service, data service, broadcast service, multicast service, multi-access edge computing (MEC) service and vertical industry/government service, with the support of a hybrid network. The type of UE may include a handset terminal, portable terminal, IoT terminal, vehicular terminal and fixed terminal. The types of satellite networks include LEO satellite, MEO satellite, GEO satellite and HEO satellite. The FMSC could be applied to facilitate the provision of services and enhance the service continuity and QoS in these use cases.

6.5 Use cases of no land-based network of a specific operator

The use cases of no land-based network of a specific operator include domestic roaming between operators, international roaming between operators and global communication service provision, in which there is no land-based network of a specific operator. In these use cases, the communication services may include, but are not limited to, voice service, video service, message service, data service, broadcast service, multicast service, MEC service, vertical industry/government service, domestic roaming service, international roaming service and global communication service, with the support of hybrid network. The type of UE may include a handset terminal, portable terminal, IoT terminal, vehicular terminal and fixed terminal. The types of satellite networks include LEO satellite, MEO satellite, GEO satellite and HEO satellite. The FMSC could be applied to facilitate the provision of services and enhance the service continuity and QoS in these use cases.

6.6 Use cases of emergency communications

The use cases of emergency communications include large-scale emergency situations and local emergency situations in which the land-based network do not work properly or the capacity of land-based network declines significantly so it cannot meet the requirements of end users and communication services. In these use cases, the communication services may include, but are not limited to, voice service, video service, message service, data service, broadcast service, multicast service, MEC service, and vertical industry/government service, possibly with the support of a hybrid network. Depending on the destruction associated with the emergency, some infrastructures can be made unusable for a period of time, allowing for only satellite networks until these infrastructures are opened. The type of UE may include a handset terminal, portable terminal, IoT terminal, vehicular terminal and fixed terminal. The types of satellite networks include LEO satellite, MEO satellite, GEO satellite and HEO satellite. The FMSC could be applied to facilitate the provision of services, and enhance the service continuity and QoS in these use cases.

7 Requirements of satellite communications in developing countries

7.1 Service requirements in developing countries

The basic service requirements of satellite communications in developing countries are as follows:

- It is required for satellite-based networks and hybrid networks to support the use cases specified in this Supplement.
- It is required for satellite-based networks and hybrid networks to support voice service and video service.
- It is required for satellite-based networks and hybrid networks to support message service, including short message service, multimedia message service and RCS service.
- It is required for satellite-based networks and hybrid networks to support data service.
- It is required for satellite-based networks and hybrid networks to support broadcast service and multicast service.
- It is required for satellite-based networks and hybrid networks to support global communication service.

- It is required for satellite-based networks and hybrid networks to support service continuity during handover between different access networks, which includes voice and video call continuity (VCC), data service continuity and vertical industry service continuity.
- It is required for satellite-based networks and hybrid networks to support QoS for supported services and applications, including best-effort QoS and guaranteed bit rate (GBR) QoS.

The advanced service requirements of satellite communications in developing countries are as follows:

- It is recommended for satellite-based network and hybrid network to support MEC service and vertical industry/government service.
- It is recommended for satellite-based networks and hybrid networks to support domestic roaming service and international roaming service.
- It is recommended for satellite-based networks and hybrid networks to provide communication services based on the capabilities and capacity of the serving satellite.
- It is recommended for satellite-based networks and hybrid networks to support various type of UE, including handset terminal, portable terminal, IoT terminal, vehicular terminal and fixed terminal.
- It is recommended for satellite-based networks and hybrid networks to support multiple types of satellites, including those of LEO satellite, MEO satellite, GEO satellite and HEO satellite.

7.2 Network capability requirements in developing countries

The basic network capability requirements of satellite communications in developing countries are as follows:

- It is required for satellite-based networks and hybrid networks to support satellite link, including satellite access and satellite backhaul [ITU-T Y.3200].

NOTE 1 – The satellite link includes those of the non-terrestrial network (NTN) [b-3GPP TR 38.821].

- It is required for satellite-based networks and hybrid networks to support the use of satellite access technologies and satellite access interfaces.

NOTE 2 – The satellite access technologies and satellite access interfaces include those of NTN [b-3GPP TR 38.821].

- It is required for satellite-based networks and hybrid networks to support the satellite classes specified in [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the connections between end users and the hybrid network, and the connections between the hybrid network and the data network (including the Internet).
- It is required for satellite-based networks and hybrid networks to support the mobility management functions [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the session management functions [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the connection management functions [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the subscription management functions [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the authentication and authorization functions [ITU-T Y.3200].
- It is required for satellite-based networks and hybrid networks to support the user plane functions [ITU-T Y.3200].

- It is required for satellite-based networks and hybrid networks to support multi-connectivity and FMSC technologies [ITU-T Y.3201].
- It is required for satellite-based networks and hybrid networks to support low-cost deployment.

The advanced network capability requirements of satellite communications in developing countries are as follows:

- It is recommended for satellite-based networks and hybrid networks to support ubiquitous connectivity.
- It is recommended for satellite-based networks and hybrid networks to be scalable and customizable.
- It is recommended for satellite-based networks and hybrid networks to support the policy control functions [ITU-T Y.3200].
- It is recommended for satellite-based networks and hybrid networks to support the capability exposure functions [ITU-T Y.3200].
- It is recommended for satellite-based networks and hybrid networks to support the service plane functions [ITU-T Y.3200].
- It is recommended for satellite-based networks and hybrid networks to support the management plane functions [ITU-T Y.3200].
- It is recommended for satellite-based networks and hybrid networks to support the enabling technologies including network slicing, MEC, artificial intelligence (AI) / machine learning (ML), distributed ledger technology (DLT) and network sharing [ITU-T Y.3201].

7.3 Security requirements in developing countries

The security and privacy requirements of satellite communications in developing countries are as follows:

- It is required for satellite-based networks and hybrid networks to support the security mechanisms for the control plane, including the 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), and application function (AF).
- It is required for satellite-based networks and hybrid networks to support the security mechanisms for the user plane, including the user plane function (UPF).
- It is required for satellite-based networks and hybrid networks to support the security mechanisms for the service plane, including the communication services specified in this Supplement.
- It is required for satellite-based networks and hybrid networks to support the security mechanisms for the management plane, including the functionalities according to the management functional areas listed in [b-ITU-T M.3010], i.e., performance management, fault management, configuration management, accounting management and security management.
- It is required for satellite-based networks and hybrid networks to support the privacy protection mechanisms for the network entities of access network, core network and service platform, which could store, cache and process user data related to privacy.

In addition, the security and privacy considerations of satellite communications in developing countries should be aligned with the requirements specified in [ITU-T Y.3101] and [b-ITU-T Y.2701].

Appendix I

Questionnaire on use of satellite communications by developing countries – Summary

Supplement 81 to ITU-T Y.3200 series was developed based on a questionnaire on the use of satellite communications by developing countries. In total, 51 countries from all five Administrative Regions (Region A – The Americas; Region B – Western Europe; Region C – Eastern Europe and Northern Asia; Region D – Africa; and Region E – Asia and Australasia) answered the questionnaire.

Appendix II

A hybrid satellite/IMT-2020 network scheme

This appendix proposes a hybrid satellite/IMT-2020 network scheme, which can facilitate developing countries to serve remote areas with a negotiable cost. Figure II.1 depicts the hybrid satellite/IMT-2020 network scheme. The scheme is based on core network satellite backhaul converged land-based MEC associated with World Interoperability for Microwave Access (WIMAX).

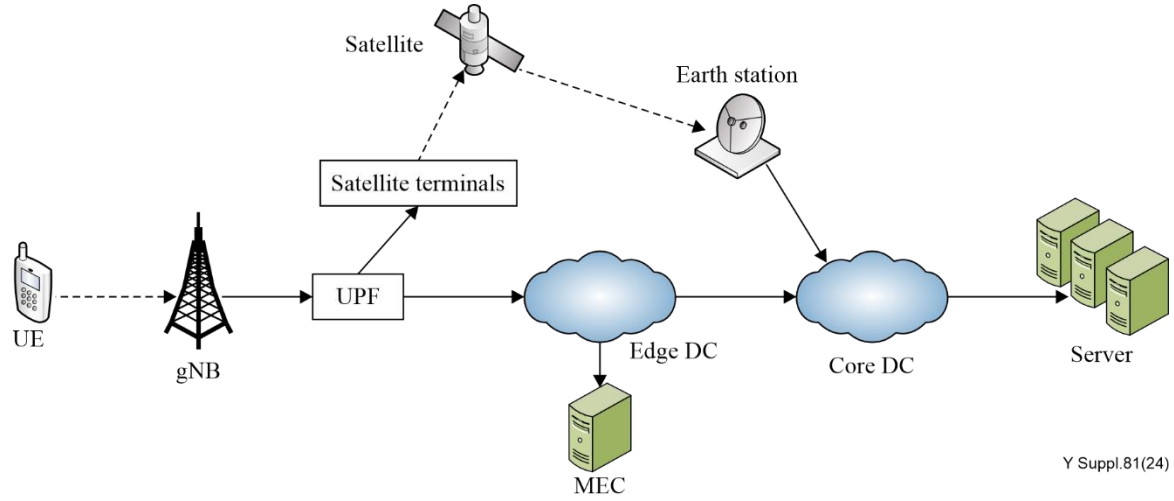

Figure II.1 – A hybrid satellite/IMT-2020 network scheme

For the satellite backhaul scenario, the use cases include, for example, the backhaul between a gNodeB (gNB) in a remote area and a UPF, as well as the backhaul between a gNB deployed at a very remote site and an IMT-2020/MEC Dublin Core associated with WIMAX.

The hybrid network (satellite/IMT-2020) is associated by two intelligent proxy servers, including an intelligent user gateway (IUG) and intelligent network gateway (ING). The IUG connects the users and the hybrid network while the ING connects the hybrid network and the Internet. They are both operated by the hybrid access provider.

The hybrid part of the network is thus entirely managed by the hybrid access provider via its two proxy servers; it is transparent from the point of view of the rest of the network. It is therefore the hybrid operator who is responsible for the hybridization policy and its proper functioning.

The MEC infrastructure reduces network latency by bringing resources closer to the user, accesses cloud resources in a remote data centre via mobile access, and processes data at the network edge.

The IMT-2020/MEC architecture drives distributed data and computing at the edge of the IMT-2020 network.

The Dublin Core is a digital cataloguing system improved to make search engines much more accurate and efficient; it contains many terms to describe resources such as web pages and media such as videos and images.

The UPF is the hub that manages functionalities related to user data (packet routing, QoS and user traffic reporting).

The main task is to study the impacts of supporting satellite access and backhaul on the IMT-2020 system associated with WIMAX, in order to allow a user still dependent on IMT-2020 earth station to communicate and not to be linked directly to the satellite in remote areas.

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*.

[b-ITU-R M.2460-0] Recommendation ITU-R M.2460-0 (2019), *Key elements for integration of satellite systems into Next Generation Access Technologies*.

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

[b-ITU-T Q.1743] Recommendation ITU-T Q.1743 (2016), *IMT-Advanced references to Release 11 of LTE-Advanced evolved packet core network.*

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

[b-ITU-T Y.3204] Recommendation ITU-T Y.3204 (2023), *Fixed, mobile and satellite convergence – Service continuity for IMT-2020 networks and beyond*.

[b-ITU-T Y.3300] Recommendation ITU-T Y.3300 (2014), *Framework of software-defined networking*.

[b-3GPP TR 38.821] 3GPP TR 38.821 (2021), *Solutions for NR to support non-terrestrial networks (NTN) (Release 16)*.

[b-ETSI GS NFV 003] ETSI GS NFV 003 V1.2.1 (2014), *Network functions virtualisation (NFV); Terminology for main concepts in NFV*.

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Published in Switzerland
Geneva, 2024