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

Internet of things and smart cities and communities – Frameworks, architectures and protocols

Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks

Recommendation ITU-T Y.4421

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Summary

Widely-used civilian unmanned aerial vehicles (UAVs) generate increasing requirements for communication and network capabilities, including seamless coverage, low latency, Gbps-level rate and high-accuracy positioning. Existing commercial products of civilian UAVs utilize a direct radio link, which is limited by service distance and quality. Therefore IMT-2020 can be employed for UAV communication. UAVs require simultaneous services with different characters, for which a brand new type of user terminal to IMT-2020 is required. Likewise, IMT-2020 is a novel communication network for UAVs since it was originally designed for ground coverage. With the purpose of implementing the support of civilian UAV operations in IMT-2020 networks and improving the quality of UAV application services, a set of functionalities is needed to bridge the gap for interoperation between unmanned aerial system (UAS) and IMT-2020 networks. Recommendation ITU-T Y.4421 provides a functional architecture for UAVs and UAV controllers using IMT-2020 networks and functionalities defined in the application layer, service and application support layer, and security capabilities. The motivation of this Recommendation is to solve the issues of civilian UAVs accessing and communicating in IMT-2020 networks using its transmission capabilities.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Functional architecture, IMT-2020, unmanned aerial vehicles.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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Recommendation ITU-T Y.4421

Functional architecture for unmanned aerial vehicles and unmanned aerial vehicle controllers using IMT-2020 networks

1 Scope

The scope of this Recommendation includes:

– **Functional architecture**: a reference architecture of functionalities for civilian unmanned aerial vehicles (UAVs) and UAV controllers using IMT-2020 networks as user terminals.

– **Functionalities**: functionalities defined in the functional architecture, including application layer, service and application support layer and security capabilities.

Additionally, relevant requirements, procedures, security considerations and deployment use cases for using the functional architecture are defined in this Recommendation.

NOTE 1 – The existing IMT-2020 generic functionalities and capabilities, as well as the powering and monitoring modules already integrated in the UAVs for flight are out of the scope of this work item.

NOTE 2 – The regulations and supervision of civilian unmanned aerial vehicle flights, such as for example category specification and functionality defined for registration, identification, traffic management addressed by the International Civil Aviation Organization (ICAO), are out of the scope of this work item. Any implementation based on this Recommendation should be limited by being aligned with regional and national regulations.

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.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.

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

[ITU-T Y.3501] Recommendation ITU-T Y.3501 (2016), *Cloud computing – Framework and high-level requirements*.

[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*.

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.2091]: A structured set of capabilities, which provide value-added functionality supported by one or more services, which may be supported by an API interface.

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3.1.2 capability [b-ITU-R M.1224-1]: The ability of an item to meet a service demand of given quantitative characteristics under given internal conditions.

3.1.3 civilian unmanned aerial vehicle [b-ITU-T F.749.10]: An unmanned flying device controlled by a ground control station or telecontroller via various wireless communication means. It usually consists of an aeroplane body, a power device, aviation electrical and electronic equipment and mission payload equipment, etc. and is used in non-military application areas such as industrial and consumer areas to complete the specific operation and transportation of data including audio, video and image.

3.1.4 device [b-ITU-T Y.4000]: With regard to the Internet of things, this is a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing.

3.1.5 Internet of things (IoT) [b-ITU-T Y.4000]: A global infrastructure for the information society enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving, interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – In a broad perspective, the IoT can be perceived as a vision with technological and societal implications.

3.1.6 reference point [ITU-T Y.2012]: A conceptual point at the conjunction of two non-overlapping functional entities that can be used to identify the type of information passing between these functional entities.

3.1.7 service [b-ITU-T Y.2091]: A set of functions and facilities offered to a user by a provider.

3.1.8 thing [b-ITU-T Y.4000]: With regard to the Internet of things, this is an object of the physical world (physical things) or of the information world (virtual things), which is capable of being identified and integrated into communication networks.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

4G	Fourth Generation
eMBB	Enhanced Mobile Broadband Services
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identification
IoT	Internet of Things
MTC	Machine Type Communication
mMTC	Massive Machine Type Communication
NFV	Network Functions Virtualization
QoS	Quality of Service
SDN	Software-Defined Networking
SIM	Subscriber Identity Module

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