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| **Abstract:** | This TD informs TSAG that SG16, at its last meeting in this study period (Rennes, 15-26 April 2024), has completed the proposals for its set of Questions as well as updates to its current title, mandate, lead roles and points of guidance (WTSA Res.2 elements), which will be included in its report to WTSA-24 as **required by WTSA‑20 Res.1**. The report of Study Group 16 to the WTSA-24 will be contained in the following WTSA-24 documents:  – Part I: **Document** [**17**](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-WTSA.24-C-0017) – General  – Part II: **Document** [**18**](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T22-WTSA.24-C-0018) – Questions proposed for study during the study period 2025-2028  **SG16 is recognisant** of TSAG's support for SG9 and SG16 consolidation as a single SG in the next study period and, in fact, these updated Res.2 elements were used to prepare the consolidated SG9 and SG16 (SGC) title, mandate, lead roles and points of guidance found in [TSAG-TD598](https://itu.int/md/T22-TSAG-240729-TD-GEN-0598/en), as well as for the text of consolidated Questions Q.Acc/C and Q.Coord/C. |

Attachments:

1. Updates to the current SG16 title, mandate, lead roles and points of guidance (WTSA Res.2)
2. Updates to the current SG16 Questions

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ATTACHMENT 1  
SG16 report to WTSA-24: Updates to the current SG16 title, mandate, lead roles and points of guidance (WTSA Res.2)

The following are the proposed changes to the Study Group 16 mandate and Lead Study Group roles agreed at the last Study Group 16 meeting in this study period, based on the relevant portions of [WTSA-20 Resolution 2](https://www.itu.int/dms_pub/itu-t/opb/res/T-RES-T.2-2022-PDF-E.pdf). Revision marks are relative to WTSA Res.2 (Geneva, 2022).

Annex A  
(to WTSA Resolution 2)

#### PART 1 ‑ GENERAL AREAS OF STUDY

**…**

Study Group 16

Multimedia technologies and e-services

ITU‑T Study Group 16 is responsible for studies relating to multimedia technologies, capabilities, systems, applications and services for existing and future networks.

This encompasses information and communication technologies (ICTs) for multimedia systems, applications, services, terminals and delivery platforms; accessibility for digital inclusion; ICTs for active assisted living; human interfaces; multimedia aspects of distributed ledger technologies; media and signal coding and systems; and digital multimedia services in various verticals (health, culture, mobility, etc.); multimedia aspects of metaverse related issues.

NOTE – When ITU-T Study Group 16 was created in 1996, one of its mandates was to continue ITU-T Study Group 1's studies on multimedia services. Accordingly, reference to "services" in the context of Study Group 16's mandate is to be understood as "multimedia services".

**…**

#### PART 2 ‑ Lead Study Groups in specific areas of study

**…**

SG 16 Lead study group on multimedia technologies, applications, systems and services

Lead study group on IP-based television services and digital signage

Lead study group on human factors and ICT accessibility for digital inclusion

Lead study group on multimedia aspects of automotive-related intelligent services

Lead study group on multimedia aspects of digital health

Lead study group on digital culture

Lead study group on multimedia aspects of distributed ledger technology (DLT) and its applications

Lead study group on multimedia aspects of metaverse technologies, applications, systems and services

**…**

Annex B  
(to WTSA Resolution 2)  
  
Points of guidance to study groups for the development  
of the post-2022 work programme

**…**

ITU‑T Study Group 16 will work on the following items:

– terminology for various multimedia services;

– operation of multimedia systems and applications, including interoperability, scalability and interworking over different networks;

– ubiquitous multimedia services and applications;

– multimedia aspects of digital services;

– multimedia system and service accessibility for digital inclusion;

– development of multimedia end-to-end architectures, including vehicle gateway for intelligent transport systems (ITS);

– high-layer protocols and middleware for multimedia systems and applications, including IP-based television services (managed and non-managed networks), Internet-based streaming media services and digital signage;

– media and signal coding;

– multimedia and multimode terminals;

– human-machine interaction;

– signal processing network equipment and terminals, gateway implementations, and characteristics;

– quality of service (QoS), quality of experience (QoE) and end-to-end performance in multimedia systems;

– security of multimedia systems and services;

– multimedia aspects of distributed ledger technology (DLT) and its applications;

– digital multimedia services and applications in various vertical industries;

– AI-enabled multimedia applications;

– multimedia aspects of metaverse technologies, applications, systems and services, including functional architecture, and platform interoperability.

In developing its studies, Study Group 16 will take into consideration societal and ethical aspects of intelligent applications.

ITU-T Study Group 16 will work collaboratively with all stakeholders working in the standardization areas within its mandate, in particular with other ITU study groups, other United Nations agencies, the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), industry forums and consortia, and regional and international standards development organizations.

**…**

Annex C  
(to WTSA Resolution 2)  
  
List of Recommendations under the responsibility of the respective   
study groups and TSAG in the 2025-2028 study period

*No changes are proposed to the list of Recs under SG16 responsibility in Res.2 Annex C.*

ATTACHMENT 2  
SG16 report to WTSA-24: Updated Questions for the 2025-2028 study period

## List of Questions proposed by Study Group 16

| Question number | Question title | Status |
| --- | --- | --- |
| A/16 | Multimedia and digital services coordination | Continuation of Q1/16 |
| B/16 | Artificial intelligence-enabled multimedia applications | Continuation of Q5/16 |
| C/16 | Visual, audio and signal coding | Continuation of Q6/16 |
| D/16 | Immersive live experience systems and services | Continuation of Q8/16 |
| E/16 | Multimedia systems, terminals, gateways and data conferencing | Continuation of Q11/16 |
| F/16 | Intelligent visual systems and services | Continuation of Q12/16 |
| G/16 | Multimedia streaming-related systems and services including content delivery, application platforms and end systems | Continuation of Q13/16 |
| H/16 | Multimedia framework, applications and services | Continuation of Q21/16 |
| I/16 | Multimedia aspects of distributed ledger technologies and related services | Continuation of Q22/16 |
| J/16 | Digital culture-related systems and services | Continuation of Q23/16 |
| K/16 | Human factors for intelligent user interfaces and services | Continuation of Q24/16 |
| L/16 | Accessibility to multimedia systems and services | Continuation of Q26/16 |
| M/16 | Vehicular multimedia communications, systems, networks, and applications | Continuation of Q27/16 |
| N/16 | Multimedia framework for digital health applications | Continuation of Q28/16 |

## Wording of Questions

### A DRAFT QUESTION A/16 Multimedia and digital services coordination

(Continuation of Question 1/16)

#### A.1 Motivation

ITU-T Study Group 16 has been assigned lead study group roles, and coordination is a major responsibility within the lead study group roles.

The objective of this Question is to coordinate and manage the development and progress of multimedia and digital services standardization, within Study Group 16 and externally. The technical studies themselves will be addressed in the relevant Questions of Study Group 16 as well as by other groups.

#### A.2 Study items

Study items to be considered include, but are not limited to:

– coordination across Questions within Study Group to ensure consistency, and avoid duplication of efforts;

– provide a focal point for responses to liaison statements and other external communications which cut across several Questions;

– coordination with other key players on multimedia and digital services standardization.

#### A.3 Tasks

Tasks include, but are not limited to:

– develop and update a multimedia services and applications standardization vision through an appropriate communication process amongst all interested parties, including the organization of workshops on dedicated standardization issues;

– document and agree the processes for coordination;

– using appropriate coordination mechanisms, negotiate with the relevant bodies to ensure that overlapping efforts are avoided, all required standards are being addressed, and the need for devices (e.g. gateways) to ensure end-to-end interoperability is minimized;

– cooperate with the Telecommunication Development Sector of ITU for activities aiming at bridging the standardization gap.

NOTE – This Question performs as a coordination focal point in the study group and as such it is not expected to produce any Recommendations.

#### A.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of SG16

Questions

– All Questions of Study Group 16

Study groups

– All ITU-T study groups and TSAG

– ITU-R SGs 5 and 6

– ITU-D SGs 1 and 2

Other bodies

– IEC TC 100, ISO/IEC JTC1 (SC 29, SC 35 and others), ISO (TC 22 / SC 31 and others), ETSI, IETF

– Relevant forums and consortia

### B DRAFT QUESTION B/16 Artificial intelligence-enabled multimedia applications

(Continuation of Question 5/16)

#### B.1 Motivation

The recent success of artificial intelligence (AI) in various applications has raised study and utilization of AI technology to a new height. AI has been the apex technology of the information age. One of the most exciting aspects of the AI inflection is that "real-world" use cases abound. At the same time, deep-learning-enabled advances in computer vision and technologies such as natural language processing are dramatically improving the quality of people's work and life.

At present, the ecological pattern of AI has been established gradually. Specialized intelligent applications will be the main potential area for the future development of AI. No matter whether it is a specialized or generalized application, the AI studies will focus on analysing data at three basic levels: computing layer (base), algorithm layer (technology) and application layer. Datasets are combined with powerful technology, value is being created and competitive advantage is being gained.

Multimedia has become the pioneer, and the concept of "AI-enabled multimedia" as well as "intelligent multimedia" has already come up. Scientists, engineers all over the world are delving into some of the most exciting areas such as computer vision and speech technologies. Computers are being taught to understand and generate multimedia contents, augmenting reality to guide field technicians when operations get complex, helping computers recognize people, detect sentiment and speak with emotion, and enrich video with metadata extracted from it.

AI-enabled multimedia applications are booming, emerging technologies brings not only new opportunities, but also new challenges as well as new demands. Taking multimedia data as an example, huge volume multimedia data does not indicate high quality labelling data that AI applications could benefit. If no guidelines or standards of multimedia format, labelling are developed, multimedia data collected and labelled by company A could not be used in company B. These results in huge resource waste and prevents the data flow, which can severely hinder the development of the AI industry.

This Question focuses on artificial intelligence-enabled multimedia applications, 1) to identify challenges facing the deployment of AI-enabled multimedia applications, 2) to analyse the impact of AI technologies in standards for multimedia applications, and 3) to identify evaluation and assessment specifications of applications, algorithms and data structures for standards in AI-enabled multimedia applications, in order to boost and innovate the development of multimedia as well as AI industry.

#### B.2 Study items

Study items to be considered include, but are not limited to:

– scope and definition of AI as it relates to multimedia applications;

– identify specific use cases where AI can be applied to multimedia applications;

– identify AI techniques facilitating intelligent and automated multimedia-based tasks;

– identify use cases, framework and requirements of multimedia applications using AI generated content (AIGC), including those utilizing large foundational models, techniques enabling AIGC are to be studied, works related to content itself, such as creation, inspection, regulation, etc., are out of the scope of this Question;

– data preparation for use with AI-enabled multimedia applications;

– specific system characteristics for AI-enabled multimedia applications;

– assessment and evaluation techniques for AI-enabled multimedia services;

– identification of how AI may impact existing multimedia applications;

– accessibility of AI enabled multimedia applications for all, to help persons with disabilities.

#### B.3 Tasks

Tasks include, but are not limited to:

– determine the scope and definitions of AI as it relates to multimedia applications;

– identify and collect specific use cases where AI can be applied to multimedia applications;

– identify data preparation requirements, including but not limited to data collection, data labelling, data control and data delivery;

– identify requirements, framework and architecture of AI systems/platforms enabling multimedia applications;

– identify multimedia related AI applications in vertical industries, such as manufacturing industry, energy industry, etc.;

– identify the requirements for evaluation and assessment methodologies for quantifying the performance of AI-enabled multimedia applications;

– identify and collect use cases on accessibility of AI enabled multimedia applications;

– maintain deliverables under the responsibility of the Question, including: ITU-T F.742.1, F.746.13，F.746.15, F.746.16, F.747.12, F.748.14, F.748.15, F.748.17, F.748.18, F.748.19, F.748.20, F.748.21.

An up-to-date status of work under this Question is contained in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=5/16>).

#### B.4 Relationships

Recommendations

– F.700-series

Questions

– All Questions of Study Group 16

Study groups

– ITU‑T SGs 12, 13, 15, 17 and 20

Other bodies

– ISO, IEC, ISO/IEC, ETSI, IEEE

– Artificial Intelligence Industry Alliance

– China Communications Standards Association

### C DRAFT QUESTION C/16 Visual, audio and signal coding

(Continuation of Question 6/16)

#### C.1 Motivation

The goal of this Question is to produce Recommendations for visual, speech, audio and signal coding methods appropriate for conversational (e.g. videoconferencing and video telephony) and non-conversational (e.g. multimedia streaming, broadcast TV, IPTV, file download, media storage/‌playback, remote screen display, digital cinema, or virtual & augmented reality) audiovisual services and other services. The Question is to focus primarily on the coding of visual signals, including the compression of:

– video sequences;

– still images;

– graphics;

– stereoscopic, multi-view, depth maps, and free-viewpoint visual information;

– light fields, point clouds, and volumetric imagery;

– computer displays;

– medical imaging;

– 360 degree/panoramic/spherical-view video sequences;

– video and images for virtual and augmented reality.

This Question will primarily focus on the maintenance and extension of existing video and still-image coding Recommendations and the development of new Recommendations using advanced techniques to significantly improve the trade-offs between bit rate, quality, delay, and algorithm complexity. The Question will also be responsible for maintenance and the development of new Recommendations for the coding of speech, audio, biomedical and other signals and network-based signal processing. Video, still-image, speech, audio, biomedical and other signal coding standards will be developed with sufficient flexibility to accommodate a diverse number of transport types (Internet, LAN, 5G and other mobile networks, ITU-T H.222.0, etc.).

#### C.2 Study items

Study items to be considered include, but are not limited to:

– new coding methods in order to achieve the following objectives:

• improvements in compression efficiency;

• robust operation in error/loss-prone environments (e.g. non-guaranteed-bandwidth packet networks or mobile wireless communication);

• reduction of real-time delay, complexity, and of channel acquisition time and random access latency;

– organization of the compressed data format to support packetization and streaming;

– development of supplemental enhancement information to accompany source data for enabling enhanced functionality in application environments;

– study and specification of data for annotation, indexing, and searching;

– techniques to permit networks or terminals to adjust bit rates efficiently;

– techniques for object coding and multi-view operation;

– techniques to permit terminals to rapidly adjust the region-of-interest and/or field of view of video stream playback;

– techniques for efficient coding of 360-degree/panoramic/spherical-view video sequences, including those formed by stitching video sequences from multiple cameras with projection/rendering warping;

– techniques for efficient coding of video, images, audio, point clouds, and other signals for virtual and augmented reality, navigation, medical, and other applications;

– techniques for efficient compressed-digital to compressed-digital processing (including transcoding);

– artificial intelligence technology for encoding and decoding of video, images, audio, biomedical and other signals and the processing and analysis of coded data;

– the impact of colorimetry, video and image quality assessment, and quality control requirements on video and image codec development;

– computer graphics compression;

– security aspects that directly affect video, speech, audio and signal coding (including watermarking techniques);

– coordination of video, still-image, speech, audio and signal coding matters not addressed in other coding Questions with other ITU study groups and other bodies;

– harmonization of video, still-image, speech, audio, biomedical and other signal coding activities with other standard development organizations (SDOs);

– enhancements to existing multimedia systems Recommendations including the addition of advanced audio and visual coding (e.g. ITU-T H.26x and G.72x extensions and beyond).

#### C.3 Tasks

Tasks include, but are not limited to:

– development of extensions, additional profiles, and maintenance updates for ITU-T H.266 (VVC);

– work towards development of a future video coding Recommendation with compression capability substantially beyond that of ITU-T H.266;

– address needs for signal type identification for use with video and image coding Recommendations, including extensions and maintenance for ITU-T H.273;

– conformance and reference software development and maintenance for ITU-T H.264 (AVC), ITU-T H.265 (HEVC), and H.266, including ITU-T H.264.1, H.264.2, H.265.1, H.265.2, and conformance testing and reference software for H.266 (H.266.1 and H.266.2);

– development of guidelines and informative reports for effective use of video and still-image compression coding technology;

– in liaison with other ITU-T standardization groups or SDOs, recommend what video and still-image coding standards should be used in services/applications, networks, devices and specified in related ITU-T Recommendations;

– development of supplemental enhancement information to accompany video, still-image, speech, audio, and signal data, including data for image/video annotation, indexing, and searching, including maintenance and extension of ITU-T H.271 and H.274 (VSEI);

– development of new image coding (T.8xx-sub-series) specifications;

– maintain the video, still-image, speech, and audio coding information in the ITU-T media coding database;

– maintenance of existing H-series video coding Recommendations and supplements, including ITU-T H.120, H.261, H.262 | ISO/IEC 13818-2, H.263, H.264 | ISO/IEC 14496-10, H.264.1, H.264.2, H.265 | ISO/IEC 23008-2, H.265.1, H.265.2, H.266 | ISO/IEC 23090-3, H.266.1, H.266.2, H.271, H.273, H.274 | ISO/IEC 23002-7, H-series Supplements 15, 18, and 19, and Technical Paper ITU-T HSTP-VID-WPOM;

– maintain and extend existing Recommendations and Supplements regarding still image coding, including ITU-T T.44, T.80, T.81, T.82, T.83, T.84, T.85, T.86, T.87, T.88, T.89, T.800, T.801, T.802, T.803, T.804, T.805, T.807, T.808, T.809, T.810, T.812, T.813, T.814, T.815, T.831, T.832, T.833, T.834, T.835, T.851, T.870, T.871, T.872, T.873 and T-series Supplement 2;

– maintenance of existing G-series regarding speech and audio coding and signal processing Recommendations including ITU-T G.711, G.711.0, G.711.1, G.718, G.719, G.720.1, G.722, G.722.1, G.722.2, G.723.1, G.726, G.727, G.728, G.729 and G.729.1;

– maintenance of related Recommendations to signal processing network equipment and functions: ITU T G.160, G.161, G.161.1, G.164, G.165, G.168, G.169, Q50-series, Q.115-series, G.799.1, G.799.2, G.799.3, G.776.1, G.776.4, G.763, G.764, G.765, G.766, G.767, G.768, G.769/Y.1242 and I.733;

– development of new coding Recommendations for speech, audio, biomedical and other signals.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=6/16>).

#### C.4 Relationships

Recommendations

– ITU-T H.300 sub-series systems Recommendations

– ITU-T H.241, H.245 and H.248-series

Questions

– Questions A/16, B/16, D/16, E/16, F/16, G/16, N/16

Study groups

– ITU-T SGs 9, 11, 12, 13

– ITU-R SG6

Other bodies

– ISO/IEC JTC 1/SC 29 WGs 1-8 (JPEG and MPEG) on video, image, speech, and audio coding

– IETF, DVB, ATSC, ARIB, 3GPP, DICOM, EBU, SCTE, SMPTE, MC-IF, MEF, VESA, W3C, CTA, IEC TC 100

### D DRAFT QUESTION D/16 Immersive live experience systems and services

(Continuation of Question 8/16)

#### D.1 Motivation

Recently, some of huge sport events and music concerts are not only broadcasted, but also delivered to remote sites for public viewing or live viewing in order to share emotion by audiences in remote sites as if they were in main event venues. In order to provide high-realistic sensations to audiences at remote sites, immersive live experience (ILE) needs to be implemented to reconstruct event sites virtually with presentation of real-sized objects and sound direction by transmitting environmental information together with audio and video streams.

Implementing ILE needs several technologies such as real-time object extraction technologies at event sites, spatial location sensing technologies for objects, sound direction identify technologies, media transport technologies for extracted objects including spatial location information, presentation technologies including 3D projection at remote sites, synchronous technologies with video, sound and lighting, and so on. Although some of them are already established, there are some conditions and/or limitations such as specific content and pre-arrangement of remote sites. Pre-arrangement of remote sites includes 3D projection mapping, and takes much time for adjustment of terminal devices. In addition, these technologies have not systemized, and most of them are not standardized yet.

In order to share enthusiasm at event venues with large audiences even if they are in remote sites far from event venue, implementing immersive live experience services based on standardized designs is desired. By standardizing ILE in ITU-T, it is expected that audiences anywhere in the world can cheer their favourite sport teams or artists at remote sites even if they are not in the event venue, and they can feel a sense of togetherness and get passionate as if they were in the event venue. Most of these technologies are related to the multimedia studies in Study Group 16, thus this Question will progress standardization activities of ILE.

Recently, metaverse and digital twin are foreseen to be used for any kinds of industries. Users need to use some special device such as head mounted display or AR glasses for their presentation function. Future presentation functions, which include immersive video and audio, haptic, scent, wind, temperature and humidity, of metaverse and/or digital twins could be similar to ILE, so some of ILE specifications could be used for those services, and some of ILE specifications might be needed to modifications to fit those services. This Question will progress standardization activities for presentation functions of metaverse and/or digital twins.

Globally interoperable standards will activate a market for the ILE systems and services. This Question will cover all relevant work items on multimedia aspects of immersive live experience systems and services. In addition, since metaverse and/or digital twin applications and services could utilize ILE-related Recommendations, this Question will also cover work items on presentation aspects of metaverse and/or digital twin applications and services.

#### D.2 Study items

Study items to be considered include, but are not limited to:

– domain of immersive live experience services;

– use cases and requirements for immersive live experience systems and services;

– architectural aspects of immersive live experience systems to support requirements and various use cases;

– presentation equipment profiles for supporting various kinds of immersive live experience applications;

– presentation functions or profiles which may combine immersive video and audio, haptic, scent, wind, temperature and humidity, for various kinds of metaverse and/or digital twin services and applications by utilising immersive live experience specifications;

– provision of content including spatial information from content source to presentation equipment for immersive live experience;

– multimedia application frameworks for immersive live experience, including five sensory (vibration, smell, humid, temperature and so on) information transmission;

– usage of cloud computing technologies for efficient deployment and operation, and for effective service offering;

– presentation aspects of immersive live experience services such as combination of multiple displays, multiple speakers and lighting equipment;

– specifications on metadata and media format for immersive live experience content for fitting with the use cases;

– management and operational aspects of immersive live experience systems;

– definition and evaluation/measurement methods of quality of ILE (immersiveness, live experiences, and others);

– consideration on providing emergency information including warning messages in the disaster environment;

– consideration on providing accessibility for disabled people, elder people, and foreign visitors;

– review and analysis of existing Recommendations and relevant specifications to find any reusable materials for immersive live experience systems and services;

– considerations on how to help measure and mitigate climate change.

#### D.3 Tasks

Tasks include, but are not limited to:

– identification of the use cases and requirements;

– definition of functional architectures and its components to support use cases and requirements for immersive live experience systems and services;

– definition of immersive live experience presentation equipment profiles based on capabilities;

– definition of metaverse and/or digital twin presentation functions or profiles which may combine immersive video and audio, haptic, scent, wind, temperature and humidity by utilising immersive live experience capabilities;

– definition of a mechanisms and protocols to provide content delivery function;

– definition of interface specifications amongst functional components of immersive live experience systems;

– definition of procedures and methods to interact between immersive live experience systems and audiences' devices such as smart phone and tablet PC;

– definition of multimedia application frameworks, metadata and media formats for providing immersive live experience services;

– definition of control functions for synchronous/asynchronous presentation of multiple displays and other presentation equipment;

– definition of quality of ILE (immersiveness, live experiences, and others);

– modification and/or extension of existing Recommendations under the ITU-T Study Group 16 responsibility to provide immersive live experience services;

– maintain deliverables under the responsibility of the Question, including: ITU-T H.430.x series;

– collaboration and harmonization with other standardization bodies, forums and consortia to develop Recommendations to support immersive live experience service.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=8/16>).

#### D.4 Relationships

Recommendations

– ITU-T Study Group 16 Recommendations, in particular telepresence system Recommendations ITU-T F.734, ITU-T H.420

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SGs 9, 11, 12, 13, 17 and 20

– ITU-R SGs 5 and 6

– ITU-D SGs 1 and 2

Other bodies

– ISO, IEC, ISO/IEC JTC1

– ETSI SIG MEC (Mobile Edge Computing)

– W3C, IETF (e.g. CLUE), IEEE

– 3GPP SA4

### E DRAFT QUESTION E/16 Multimedia systems, terminals, gateways and data conferencing

(Continuation of Question 11/16)

#### E.1 Motivation

In line with its lead study group roles, Study Group 16 strives to make advances in multimedia communication systems that take advantage of emerging technologies, as well as advances in and deeper understanding of existing technologies, in an effort to enable new and better forms of communication capabilities.

To that end, Study Group 16 developed several sets of videoconferencing Recommendations: ITU‑T H.320 for audiovisual communication systems for N-ISDN environments; ITU-T H.323, one of the most widely used packet-switched communication systems supporting audio, video, and data collaboration; ITU-T H.324 for audiovisual communications over fixed and mobile (wireless) telephone networks; and ITU-T H.310-series for point-to-point and multipoint communications on B-ISDN networks. For data conferencing in point-to-point and multipoint environments, the T.120-series of ITU-T Recommendations was developed, enabling capabilities like file transfer, electronic whiteboarding, and screen sharing. To enable an H.323 gateway to be realized as two components from different vendors distributed across different physical platforms, the ITU-T H.248-series, which decomposes the H.323 gateway function defined in ITU-T H.246 into functional subcomponents called media gateway controllers and media gateways, was developed to specify the protocols these components use to communicate. While originally addressing H.323 gateways, the H.248 protocol is applicable to many different types of gateways.

Several enhancements, with particular attention to the support of advanced coding technologies, security features, interworking with other terminals accommodated in different networks and enhancements to cover other services, may need to be developed in the form of new Recommendations or revision to existing ones to assure existing systems remain competitive in the marketplace. In line with its objective to improve the lives of users through improved multimedia communications capabilities, Study Group 16 continues its study of newer multimedia communications systems and functions that include applications like telepresence, which offers a user-rich immersive experience.

In addition to the core multimedia system specifications, various supporting protocols and functions are essential to successful deployment of terminals, gateways, gatekeepers, multipoint control units, and other elements that comprise a system. This Question explores advanced multimedia functions that will enable videoconferencing, data conferencing, telepresence, distance learning, e-health, interactive multimedia information distribution, real-time multimedia collaboration in future networks environment and existing packet-based networks. Aspects include multimedia directory services, quality of service (QoS), quality of experience (QoE), multimedia security, and multimedia mobility.

This Question considers multimedia gateway architecture and the development of multimedia gateway control protocols for gateways interworking existing networks and new networks.

This Question also deals with extension and maintenance of this large body of multimedia conferencing standards.

#### E.2 Study items

Study items to be considered include, but are not limited to:

– enhancements to existing Recommendations by the addition of advanced audio and visual coding (e.g. ITU-T H.265 extensions and beyond);

– enhancements to interoperability of H.300-series terminals by using new and emerging protocols and architectures, such as WebRTC, private media, etc., through additions to ITU-T H.246 and other Recommendations as necessary;

– continued enhancements relating to error resilience in error-prone environments, such as mobile networks;

– specifications of multimedia system characteristics to support non-conversational services, such as retrieval, messaging, or distribution services;

– enhancements to existing H-series Recommendations with respect to accessibility;

– next generation multimedia system and its related functions and capabilities, including system architecture, signalling protocols, downloadable codecs, service discovery, transcoding functions, distributed applications, integrated QoS, gateways, security, mobility, and accessibility;

– architecture and protocols to integrate and enhance advanced service features, such as directory services, QoS/QoE, security, and mobility, with the Study Group 16 defined multimedia system platforms;

– performance monitoring and measurement functions for multimedia applications;

– requirements for metadata in descriptions of user profile, terminal capability, access network characteristics and service profile that relate to service mobility;

– standardizing the means for full interworking between telepresence systems, including means facilitating the coherent presentation of multiple audio and video streams, allowing remote participants to be rendered at their true size for their apparent distance, maintaining correct eye contact, gesticular cues, and simultaneously providing spatial audio that is consistent with the video presentation, as well as taking into account the meeting environment to provide a more immersive experience;

– new functionality to the H.248.x sub-series to enable existing and new network nodes to work as a split media gateway controller and media gateway. Items of study may also include further work on IP-IP connection models such as QoS control, network address translation (NAT) and firewalling, enhanced conferencing, media streaming control, network access control, secure media transport, privacy enhanced transport and new real time communication architectures;

– consideration will also be given to the evolution of media gateways and media gateway controllers with respect to architectures based on cloud, software defined networks (SDN) and network function virtualisation (NFV);

– considerations on how to help measure and mitigate climate change.

#### E.3 Tasks

Tasks include, but are not limited to:

– development of new Recommendations pertaining to the study items above as needed;

– produce enhanced QoS/QoE, gateway, security, and mobility mechanisms for multimedia systems;

– enhancement and maintenance of ITU-T F.734, H.100, H.110, H.130, H.140, H.221, H.222.0, H.222.1, H.223, H.224, H.225.0, H.226, H.230, H.231, H.233, H.234, H.235-series, H.239, H.241, H.242, H.243, H.244, H.245, H.246, H.247, H.248-series, H.249, H.281, H.310, H.320, H.321, H.322, H.323, H.324, H.331, H.332, H.341, H.350 series, H.360, H.361, H.362, H.420, H.450-series, H.460-series, H.501, H.510, H.530, T.120-series, T.134, T.135, T.137, T.140 and H-series Supplements 1, 2, 4 to 9, 11 to 14.

An up-to-date status of work under this Question is found in the Study Group 16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=11/16>).

#### E.4 Relationships

Recommendations

– ITU-T F.700-series, G.700-series audio codecs, G.1000, G.1010, G.1080, H.260-series video codecs, Q.115.0, Q.931, Q.1707, Q.1950, T.38, V.151, V.152, V.153, X.509, X.680, X.690, X.800-series, X.1303, Y.1540, Y.1541, Y.2111

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SG2 for service aspects

– ITU-T SG5 for ICT environmental aspects

– ITU-T SG11 for signalling

– ITU-T SG12 for quality aspects and performance

– ITU-T SG13 for future networks aspects

– ITU-T SG15 for transport aspects

– ITU-T SG17 for security, web services, languages, directories and ASN.1

– ITU-T SG20 for IoT and smart cities

– ITU-R SG5 for IMT

– ITU-R SG6 on broadcasting

– ITU-D SG2 on information and communication infrastructure and technology development, emergency telecommunications and climate change adaptation

Other bodies

– 3GPP for multimedia security, mobility and gateways incorporating a H.248-based interface

– ETSI NFV on virtualization

– ECMA on QSIG interworking and tunnelling

– IEEE for 802.x WLAN and Link Layer security

– ISO/IEC JTC1/SC27 for digital signature, key management, non-repudiation, etc.

– ISO/IEC JTC1/SC29 for MPEG aspects, content and copy protection, watermarking, IPMP, secure JPEG 2000, etc.

– IETF for HTTP, TLS, media transmission, media packetization, Internet supported services, QoS, security, IP mobility, WebRTC extensions

– IETF AVTCORE, MMUSIC for media gateways and controllers

– IANA for package registration matters

– NIST for AES and other cryptographic algorithms, FIPS security documents, security guidelines, etc.

– W3C for HTML, XML, WebRTC

### F DRAFT QUESTION F/16 Intelligent visual systems and services

(Continuation of Question 12/16)

#### F.1 Motivation

An intelligent visual system is a type of telecommunication system that enables a computing device to inspect, evaluate and identify still or moving images. A typical intelligent visual application is video surveillance. A video surveillance system is a telecommunication system which is used to remotely capture and present multimedia to the end user via networks with ensured quality, security and reliability, and to perform intelligent analysis tasks.

In the past decade, there has been significant development in security industry worldwide, and intelligent visual applications are becoming increasingly popular in both developed and developing countries. According to a [research report](https://web.archive.org/web/20240514144128/https:/www.marketsandmarkets.com/Market-Reports/video-surveillance-market-645.html), the typical application of intelligent visual services, visual surveillance, is expected to grow from 36.89 billion US dollars to 68.34 billion US dollars from 2018 to 2023, with a compound annual growth rate of 13.1%. The potential market is huge.

There is a growing need of interworking between intelligent visual systems for communications. Underlying technologies, such as cloud computing, cloud storage, edge computing, edge storage, artificial intelligence (AI), big data, and intelligent analysis are needed in addition to video acquisition, coding, transmission, distribution and storage. Intelligent visual systems have become a whole ecosystem, highly connected to smart city and safe city construction. Standards should be used to support the development of the industry, and meet the need of rapid development. In addition, new information technologies continue to emerge, and the intelligent visual platform should be open to and capable of continuous evolution. The scope of the intelligent visual standards should be expanded to align with the market and to promote their development.

A range of standardization-related and industry initiatives have commenced across the globe examining different aspects of intelligent visual system. There are various activities, including international exhibitions, and exploratory workshops. Open Network Video Interface Forum (ONVIF) was established in May 2008, aiming at providing and promoting standardized interfaces for effective interoperability of IP-based physical security products. By 2020, ONVIF has released two versions of core specifications, two data format specifications, six profiles and 22 service specifications. IEC TC 79 WG12 focuses on video surveillance system (VSS) to produce IEC standards for VSS and applications taking into account the system, component and equipment requirements, testing and integration. Other SDOs (such as ISO/IEC JTC1, 3GPP and ETSI) are also developing intelligent visual standards according to their scope.

ITU-T SG16 developed various Recommendations on intelligent visual systems, including ITU-T F.743 series, H.626 series and H.627 series. This Question was established to meet the strong standardization need from the industry and to accommodate the existing work within ITU-T, including the enhancement and maintenance of the Recommendations and development of the many ongoing work items. This Question is intended to produce the deliverables related to intelligent visual systems and machine vision systems.

#### F.2 Study items

Study items to be considered include, but not limited to:

– scope and definition of intelligent visual systems and services;

– use cases and requirements for intelligent visual systems and services;

– state-of-the-art technologies for intelligent visual systems and services;

– architecture of intelligent visual systems and services;

– management and maintenance of intelligent visual systems and services;

– devices and terminals in intelligent visual systems;

– resource management in intelligent visual systems;

– data management for intelligent visual systems and services;

– video and image data acquisition, storing, sharing and applying in intelligent visual systems;

– big data and intelligent services for intelligent visual systems;

– machine vision and computer vision applications and services;

– intelligent visual systems and services for metaverse and digital twin applications;

– interworking with other systems;

– conformance and interoperability testing for intelligent visual systems;

– video content analysis performance testing, grading and ranking;

– security and privacy aspects of intelligent visual systems;

– new trend and emerging services based on intelligent visual technologies;

– strategy and roadmap for intelligent visual standardization.

#### F.3 Tasks

Tasks include, but are not limited to:

– develop Recommendations on the definitions of terminologies, use cases, requirements, reference architecture, signalling, protocol, testing and evaluation for intelligent visual systems and services;

– develop Recommendations on intelligent visual architectures, e.g. mobile video perception system, intelligent visual system, point-to-point intelligent visual system, video cloud as a service intelligent visual system, and immersive intelligent visual systems;

– develop Recommendations on intelligent visual system management and maintenance;

– develop Recommendations on device and terminal in intelligent visual systems;

– develop Recommendations on resource management in intelligent visual systems;

– develop Recommendations on data management for intelligent visual systems;

– develop Recommendations on acquisition, storing, sharing and applying of video and image data in intelligent visual systems;

– develop Recommendations on big data and intelligent services for intelligent visual systems;

– develop Recommendations on machine vision and computer vision applications and services;

– develop Recommendations on intelligent visual systems and services for metaverse and digital twin applications;

– develop Recommendations on interworking with other systems;

– develop Recommendations or whitepapers on the application of video content analysis technology in different industries;

– develop Recommendations on performance testing, grading and ranking of video content analysis;

– develop Recommendations on conformance and interoperability tests for intelligent visual systems;

– consider security and privacy aspects for intelligent visual systems;

– identify new trend and emerging services based on intelligent visual technologies;

– cooperate with other relevant SDOs;

– maintain and update the roadmap of intelligent visual systems and services;

– enhance and maintain ITU-T F.743 series, H.626 series, H.627 series, and Recommendations ITU-T F.748.16, F.747.11 and F.747.13.

Other topics can also be studied as appropriate, based on contributions.

An up-to-date status of work under this Question is contained in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=12/16>).

#### F.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of SG16

Questions

– Questions B/16, C/16, E/16, G/16, H/16, K/16

Study Groups

– ITU-T SG13 on cloud computing in intelligent visual system

– ITU-T SG12 and ITU-R SG6 on video quality assessment

– ITU-T SG17 on security of intelligent visual systems ([Q6/17])

– ITU-T SG20 on interface with IoT systems and smart cities

Other bodies

– IEC TC79 on video surveillance system integration

– ISO/IEC JTC1 SC29 on content description

– ISO TC42 on machine vision aspects

– ONVIF on device interoperability

– 3GPP SA1 on 5G intelligent visual application

– ETSI ENI and SAI on intelligent analysis application

### G DRAFT QUESTION G/16 Multimedia streaming-related systems and services including content delivery, application platforms and end systems

(Continuation of Question 13/16)

#### G.1 Motivation

As the lead study group on multimedia technologies, applications, systems and services, Study Group 16 meets the demands of a fast-evolving market by producing standards for multimedia communication systems that take advantage of both emerging and existing technologies.

In this regard, Study Group 16 has been successful in producing numerous Recommendations that address topical areas such as multimedia terminal design, home networking, multimedia architecture, audiovisual communications, multimedia conferencing, media coding, multimedia content representation and delivery, Internet Protocol Television (IPTV) systems, digital signage (DS) systems, multimedia security, metadata, multimedia directories and multimedia service description.

Since broadband services over various access technologies are constantly evolving and gaining increased popularity, in conjunction with the advances on user interfaces and terminal devices, there is a growing need for new integrated multimedia services where users can seamlessly switch amongst the different multimedia consumption experiences available from multiple sources. IPTV and DS are regarded as the typical multimedia consumption services.

IPTV is a multimedia service including television, video, audio, text, graphics and data delivered over IP based networks that are managed to provide the required level of QoS and QoE, security, interactivity and reliability.

DS systems and services may provide optimal contents containing personalized advertisements that target individual audiences through interactions between the audiences and a digital signage system.

With SG16's success on creating a series of Recommendations covering the diverse aspects of multimedia services, systems and platforms, IPTV and DS services have become mature enough to be one of the most popular services world-widely.

The market now demands standardized interoperable solutions that encompass all forms of IP-based media streaming services including IP-based television service, DS and other media services that would be affected by emerging technologies such as AI. SG16 has noticed that the common services capability of IP-based television and DS including content integration, handling and delivery is able to be utilized by more types of multimedia services, based on the technologies that developed by the other SGs or SDOs.

Service providers and network providers are starting to aggregate and support multiple services beyond IP-based television and DS applications themselves from their managed network with QoS and resource provisioning based on their expertise to provide the needed approaches and harmonized solutions for IP-based media integration, handling and streaming (MIHS) services.

This Question is intended to produce deliverables related to study not only the IP-based television services and DS services, but also IP-based media integration, handling and streaming (MIHS) services.

Regarding IP-based television service and DS, the Question concerns their support for interactivity, middleware, multimedia applications, enhanced user interfaces, metadata, content formats and their uses, such as virtual reality (VR), augmented reality (AR) and metaverse.

This Question will also study the mechanisms for media handling and streaming service, including multi-source media content integration, reassembling, handling, content delivery systems and cloud-edge computing needed to facilitate effective and interoperable use beyond IP-based television and DS service.

#### G.2 Study items

Study items to be considered include, but are not limited to:

– identify and investigate the use cases, requirements, functional architecture, application platforms and end systems for IP-based television, DS and MIHS services;

– review and analyse existing standards and Recommendations to find gaps seen against the requirements of IP-based television, DS and MIHS services related platforms and end systems, and to identify those requirements where new standards or changes to existing standards are recommended;

– help coordinate, harmonize and encourage interoperability amongst existing systems and standards for IP-based television, DS and MIHS services related platforms and end systems;

– investigate functional architectures for terminals of IP-based television service and DS service;

– identify services and applications relevant to IP-based television, DS and MIHS services related platforms and end systems;

– based on the analysis of requirements and existing standards related to IP-based television service and DS service, investigate the relevant areas, including but not limited to:

• metadata, i.e. the descriptive data about content and environment;

• service navigation, channel and menu processing;

• service discovery;

• content presentation;

• integrated service application platforms for IP-based television service and digital signage based on the conventional IPTV functional architecture;

• IP-based television service and digital signage deployed/enhanced by support of (mobile/multi-access) edge computing;

• support of extended reality (XR) including augmented reality (AR) , virtual reality (VR) , mixed reality (MR), and other immersive content services;

• terminal devices for IP-based television service and DS that support multiple sources of content and delivery, such as hybrid terminals;

• applications using IP-based television service and DS, such as e-services (e.g. e-health and e-learning);

• audience measurement;

• IP-based television service middleware and application frameworks;

• required aspects of security on the related applications;

• IP-based television service end systems, and interworking between them (such as companion screen, multi-screen, head-mounted displays, AR glasses);

• conformance and interoperability of IP-based television service systems and services;

• consider how IP-based television content delivery services (e.g. over-the-top services, IPTV) would integrate with each other and/or take advantage of each of their best features;

• how to enrich user experience and engagement (e.g. IP-based social TV, recommendation systems, supporting targeted content, including targeted advertisement, enhancing audience measurement, use of big data and of video sensors);

– based on the analysis of requirements and existing standards related to IP-based MIHS, investigate the relevant areas, including but not limited to:

• IP-based multimedia content distribution, delivery system and networking, including low latency and ultra-high bandwidth;

• open service application platforms and open API for ingesting content and services from other content/service providers;

• content handling services from the multiple sources;

• multimedia content delivery from multiple sources and their integration;

• enhanced user interaction in content delivery services and interactive services;

– consideration on the new technologies and new services which could impact the service development of IP-based television, DS and MIHS, but not limited to:

• consideration of new emerging technologies such as artificial intelligence, natural language translation, motion recognition, immersive experiences, UHD including 4K and 8K, XR (such as AR,VR and MR), and IMT-2020/5G for providing enhanced DS, IP-based television, and IP-based MHIS service;

• facilitate DS, IP-based television and IP-based MIHS service converging with cross-industry new technologies, help the coordination of the related standards and evolution of the related specifications;

• considerations on how the evolution of cloud computing, big data, network functions virtualization (NFV), software defined networks (SDN), and other trending ICTs may help deploying IP-based television, DS and IP-based MIHS services as well as enhance them and implement new applications;

• considerations on how the evolution of mobile networks (IMT-2020/5G and beyond) and the mobility capability may impact IP-based television, DS and IP-based MIHS services;

• considerations on the innovation of requirements, use cases, application platform, multimedia content delivery system and end system for providing DS and IP-based television services in the metaverse environment;

– based on the service features provided by IP-based television and DS services, investigate the relevant areas, including but not limited to:

• considerations on how media accessibility may rely on multiple aspects of IP-based television services and DS, together with Questions focused on accessibility and human factor aspects;

• consideration on how digital divide may be mitigated by applying already existing mature and stable technologies rather than only on future advanced technologies;

• consideration on providing emergency information services including early warning by DS systems and IP-based television services in the disaster environment;

• consideration on providing accessibility for persons with disabilities and specific needs (including foreign visitors) by DS and IP-based television services;

• considerations on how to help measure power consumption and mitigate disaster and climate change;

#### G.3 Tasks

Tasks include, but are not limited to, the development of deliverables on the IP-based television, DS and MIHS services in following areas:

– use cases, requirements, functional architectures, framework and protocols for IP-based television, DS and MIHS services;

– required aspects of the related application platform and end systems, such as Connected TV, Smart TV, OTT TV and IPTV;

– required aspects of middleware and application platforms;

– required aspects of IP-based video content handling, reassembling, adaptation, distribution and delivery;

– required aspects of open/integrated application platform;

– configuration of IP-based television, DS and MIHS services ;

– deployment scenarios of IP-based television, DS and MIHS services;

– interface between content providers and service providers;

– IP-based television service audience measurement, including the use of video sensors;

– IP-based television service widgets and widget service;

– multiple IP-based television and DS terminal devices, their interworking and multi-device services;

– IP-based television terminal device models, including mobile model and virtualized model;

– multimedia application frameworks for IP-based television, DS and MIHS services;

– enhanced user interface for IP-based television service and DS;

– XR (such as AR, VR and MR) and multi-viewing support in IP-based television and DS service;

– IP-based television service metadata, including scene-based metadata;

– conformance and interoperability testing on IP-based television, DS and MIHS services;

– framework and protocols to provide services having public characteristics, including emergency warning and notification, and accessibility for persons with disabilities and specific needs over IP-based television service and DS systems;

– implementation, migration and integration of IP-based television service and DS service within metaverse environment;

– enhancement and maintenance of ITU-T H.700-series (including ITU-T H.780, H.781, H.782, H.783, H.784, H.785.0, H.785.1), H.644-series (including ITU-T H.644.1, H.644.2, H.644.3, H.644.4, H.644.5), T.170-series, T.180, H-series Supplement 3 and relevant Technical Papers on IPTV and DS systems and services.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=13/16>).

#### G.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of SG16

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SGs 2, 5, 9, 11, 12, 13, 15, 17 and 20

– ITU-R SG5 and SG6

Other bodies

– ATIS, CTA (ex CEA), DLNA, Broadband Forum, DVB, ARIB, ABNT, ATSC, APT, HGI, OASIS, WHO, Personal Connected Health Alliance (Continua), DTG

– ISO, IEC, ISO/IEC, ETSI, IETF, W3C

### H DRAFT QUESTION H/16 Multimedia framework, applications and services

(Continuation of Question 21/16)

#### H.1 Motivation

The standardization work in Study Group 16 has resulted in the definition of several multimedia systems. ITU-T H.610 defines a multiservice system architecture and customer premises equipment architecture for the delivery of video, data and voice services across a VDSL access network to an in-home environment, and the H.700-series defines a family of IPTV protocols. As broadband services over various access technologies have evolved and given that the desire for the delivery of multimedia services to the home and other service platforms has gained attention from service providers, networking architectural issues and their impact on broader communication systems and services must also be considered.

This Question is intended to produce the deliverables related to multimedia standardization work including multimedia related networks, enabler platform and services, core audio and video technologies, multimedia data analysis, various multimedia services and applications, including information-centric networks (ICNs), unified status monitoring, media processing, interactive and distribution service, multimedia data asset management, virtual and augmented reality (VR/AR), distance learning services, digital human and digital twin, etc. The Question will also focus on emerging multimedia related content including multimedia aspects of metaverse.

#### H.2 Study items

Study items to be considered include, but are not limited to:

– identify multimedia services and applications that are studied by ITU and other bodies and produce a map of their interrelationship;

– study of multimedia system, service and application based on cutting-edge technologies including multimedia aspects of metaverse by collecting use cases, identifying requirements, defining architectures and developing underlying protocols;

– identify the services and applications to be explored by Study Group 16 and define their respective scopes, requirements and contribute to the development of technical specifications;

– study network-related multimedia framework, applications, and services, which built for various multimedia systems, e.g. cloud computing systems, edge computing systems, etc., and underlying; networks, network context awareness and adaption, information-centric networks, error-prone networks, mobile edge networks, etc;

– study media streams transport: generic formats and encapsulation methods of various media streams for the purpose of transport over heterogeneous networks (in coordination with relevant IETF WGs such as AVTCORE);

– study multimedia enabler platforms and services, such as media processing, distribution and interaction, etc;

– study multimedia data analysis related technology, solutions, services and regulations;

– study of cloud and edge computing-based multimedia services and applications by identifying requirements, defining architectures and developing underlying protocols;

– study mobile edge computing (MEC)-related multimedia services, such as MEC based VR/AR applications, traffic information monitoring and management, etc.;

– study smart device-based multimedia application and services (such as smart speaker based audio/video communication, set-top box based multimedia communications) as well as their advanced presentation forms on ultra-high definition, VR and holographic communication;

– study internet-based streaming media services, such as online education, video based online shopping, video based social services, live event broadcast, video based marketing, online corporate training, online medical diagnosis, call service, etc.

#### H.3 Tasks

Tasks include, but are not limited to:

– documentation of architectural assumptions made by previous work on multimedia standardization (H- and T-series Recommendations) and production of the scope, use cases, and requirements capture for the services and applications under Study Group 16 responsibility;

– study use cases, requirements, framework, functional architectures on multimedia aspects of metaverse technologies, applications, systems and services;

– study the use cases, requirements, framework, functional architecture and protocols for and, if needed, create F- and H-series Recommendations to cover new multimedia technology, systems, applications and services, e.g.:

• retrieval services, including interactive audiovisual and multimedia services;

• real-time collaboration services;

• intelligent multimedia services and applications;

• cloud and edge computing-based multimedia services and applications;

• MEC-based multimedia services and applications;

• multimedia data analysis architecture and related application and services;

• Internet-based streaming media services;

• network-related multimedia framework, applications, and services;

• enhanced multimedia call service;

– identify requirements for service-agnostic multimedia service functions;

– develop service-agnostic architecture specifications, such as the inspection technology, inspection policy, delivery function, robustness, etc.;

– coordinate with ITU-T Study Groups 2, 9, 11, 12, 13, 15, 17, 20 and other groups to advance multimedia services and applications related work;

– enhancement and maintenance of Recommendations ITU-T F.700, F.701, F.702, F.703, F.720, F.721, F.723, F.724, F.731, F.732, 733, F.740, F.740.1, F.741, F.742, F.743.4 to F.743.10, F.743.13, F.743.14, F.743.15, F.743.20, F.743.21, F.745, F.746, F.746.1, F.746.2, F.746.3, F.746.4, F.746.5, F.746.6, F.746.7, F.746.8, F.746.9, F.746.10, F.746.11, F.746.12, F.746.14, F.746.17, F.747.9, F.748.16, F.750, F.761, H.610, H.611, H.622.2, [H.625](http://www.itu.int/rec/T-REC-H/recommendation.asp?lang=en&parent=T-REC-H.625), H.629.1, H.643.1.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=21/16>).

#### H.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of SG16

– ITU-T J.160- and J.170-series

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SGs 2, 9, 11, 12, 13, 15, 17 and 20 for multimedia studies related to cloud computing, future networks and IoT

– ITU-T SG5 for ICT and climate change issues

– ITU-R SG6 for multimedia-related studies and broadcast services and applications

Other bodies

– 3GPP for mobile multimedia services and applications

– Architectural groups within regional telecommunications standardization bodies

– IETF for Internet services (particularly the Applications and Real-Time Area, Transport Area, and Internet Area)

– W3C for Internet multimedia services and applications

– DMTF for cloud computing related multimedia services and applications

– IMTC/MEF for interoperability

– Broadband Forum for home network issues and other E2E IP/MPLS network issues

– ISO, IEC, OASIS and UN/ECE for the MoU on electronic business

– ISO/IEC JTC1/SCs 25 (home networking), 29 (JPEG/MPEG), 35 (user interfaces)

– APT ASTAP EGMA for speech-to-speech translation

### I DRAFT QUESTION I/16 Multimedia aspects of distributed ledger technologies and related services

(Continuation of Question 22/16)

#### I.1 Motivation

A distributed ledger is a type of ledger that is shared, replicated, and synchronized in a distributed and decentralized manner. Distributed ledger technologies (DLT) are secure by design and exemplify a distributed computing system with high Byzantine fault tolerance. Decentralized consensus has therefore been achieved with a DLT system. This makes DLT potentially suitable for processing and storing the management of transactions, events and records immutably in a decentralized fashion. DLT has a great potential to enhance the trustworthiness of digital services and applications in a broad area of digitalization of society, including but not limited to digital identity management, financial transaction processing, government issued document provenance, international telecommunication settlements, copyright management of multimedia content, food traceability, and voting.

Currently, a range of standardization-related and industry initiatives have commenced across the globe examining different aspects of DLT. Various activities, including exploratory workshops and cross-industry collaboration initiatives, have served as forums for discussion of potential technical challenges around the widespread adoption of DLT.

This Question is the dedicated group under SG16 to conduct DLT standards related study and to develop Recommendations on DLT and DLT based digital services.

#### I.2 Study items

Study items to be considered include, but are not limited to:

– concepts, coverage, vision and use cases of digital services based on DLT;

– characteristics and requirements for digital services based on DLT;

– architectural framework and communication technologies for digital services based on DLT;

– analysis and evaluation of the current status of DLT and its maturity to support digital services;

– investigate the relations between DLT, digital fiat currencies, crypto tokens, and digital assets, including management, exchange and transactions, etc

– define general requirements and framework for DLT;

– research security and privacy aspects related to digital services based on DLT;

– investigate the relations between DLT, artificial intelligence, metaverse, web3.0 and other emerging technologies, examine means for extending digital trust in the context of digital services using DLT;

– identify stakeholders with whom ITU-T could collaborate further on and potential collective actions and specific next steps.

NOTE – This Question will take into consideration identified policy and regulatory implications of application of DLT in digital services.

#### I.3 Tasks

Tasks include, but are not limited to:

– utilize the deliverables related to DLT that were produced by relevant ITU-T focus groups and study gaps amongst those groups and what need to be achieved;

– develop documents which reflect how technologies enable applications and services by the underlying nature of the ecosystem, taking into account existing applicable best practices of risk assessment methodologies and business models for DLT applications;

– develop Recommendations on the definitions of terminologies, taxonomy, reference architecture, testing and evaluation for DLT systems, and DLT-based digital services including but not limited to finance, government, industry, energy, telecommunication, and healthcare;

– study and analyse the implications of mandating interoperability and interconnection of services based on DLT. This will include the development of a standardization roadmap for interoperable services based on DLT taking into consideration the interoperability challenges and best practices;

– study and analyse technology competitiveness issues that may hinder the deployment of digital services based on DLT;

– develop technical reports describing and addressing the standardization gaps and identifying future DLT-based digital services standardization work for ITU-T study groups;

– maintain deliverables under the responsibility of the Question, including: Recommendations ITU-T F.751.0, F.751.1, F.751.2, F.751.3, F.751.4, F.751.5, F.751.6, F.751.7; Technical Papers ITU-T HSTP.DLT-RF, HSTP.DLT-UC, HSTP.DLT-Risk.

An up-to-date status of work under this Question is contained in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=22/16>).

#### I.4 Relationships

Recommendations

– N/A

Questions

– Questions F/16, K/16, N/16

Study groups

– ITU-T SG17 on DLT security ([Q14/17])

– ITU-T SG3, SG5, SG11, SG13 and SG20

Other bodies

– ISO/TC 307 and ISO/TC 307/JWG 4 (Joint ISO/TC 307 - ISO/IEC JTC 1/SC 27 WG on blockchain and distributed ledger technologies and IT Security techniques)

– ISO/IEC JTC1/SC 29

– ETSI ISG PDL

– IEEE, IETF

– CEN/CENELEC

– UN/CEFACT

– United for Smart Sustainable Cities (U4SSC) initiative

– World Bank

– Linux Foundation Hyperledger

– Enterprise Ethereum Alliance

### J DRAFT QUESTION J/16 Digital culture-related systems and services

(Continuation of Question 23/16)

#### J.1 Motivation

The application of ICT technology in the field of culture can effectively maintain the cultural diversity and support the exchange and sharing of cultures around countries in the world. Catastrophic events in the cultural field have made the need for such applications more urgent.

Digital culture is the general term for products and services that aim at maintaining cultural diversity and improving the effectiveness of cultural communication. Digital culture-related systems and services refer to a set of capabilities intended to support culture related applications with the advanced digital multimedia technologies.

Digital culture mainly includes cultural resource digitization and cultural content expression.

Culture resource digitalization uses digital technologies to support collection, classification and storage of culture resources which include tangible and intangible cultural heritage, culture relics, artworks, museum collections and other culture related resources. Although a series of standards related to cultural resources have been developed by relevant organizations, important gaps exist and the applicability level of these standards in digital culture-related systems and services still needs to be improved.

Culture content expression uses multimedia technologies to support the creation, dissemination and representation of digital culture products such as animation, game, reading, music, etc. Digital galleries, digital museums and community digital cultural spaces are typical applications that represent digital culture content on general terminals or on dedicated terminals with advanced multimedia capabilities.

With the rapid development of technology, the next generation mobile communications, cloud computing, artificial intelligence, big data, Internet of things (IoT) and virtual reality have also been introduced into digital culture-related systems and services. These technologies bring various types of culture experience and multimodal interaction applications, but at the same time they also increase the system complexity and interoperability difficulty, so normative definition, requirements, and architecture are needed for digital culture-related systems and services.

Study Group 16, as the lead study group for multimedia technologies, applications, systems and services, will coordinate the technical standardization of multimedia systems and services for digital culture-related applications in ITU-T. This Question will develop corresponding Recommendations and other deliverables, drawing on the best possible expertise, which may reside in other Questions, ITU-T Study Groups and other standards committees.

#### J.2 Study items

Study items to be considered include, but not limited to:

– scope and definitions of digital culture-related systems and services;

– roadmap of digital culture-related standards;

– use cases and requirements of digital culture-related systems and services;

– architecture of digital culture-related systems and services;

– application of relevant existing standards for culture resource digitalization that support collection, classification and storage of culture resources;

– application of relevant existing standards for culture content expression which support the creation, dissemination and representation of digital culture products;

– multimodal interaction experience of digital culture-related systems and services;

– security and privacy of digital culture-related systems and services;

– application of intelligent technologies (e.g. artificial intelligence generated content and metaverse) in support of digital culture-related systems and services;

– new directions or emerging services and applications based on digital culture technologies, including gap analyses;

– standards evolution strategy for digital culture.

#### J.3 Tasks

Tasks include, but are not limited to:

– develop Recommendations on the definitions of terminologies, requirement, reference architecture, testing and evaluation for digital culture-related systems and services;

– develop the roadmap of digital culture-related systems and services;

– develop Recommendations on big data and intelligent application for digital culture-related system, service and application;

– develop Recommendations on application of culture resource;

– develop Recommendations on application of culture content expression;

– develop Recommendations on multimodal interaction experience of digital culture-related systems and services;

– develop Recommendations on the security and privacy of digital culture-related systems and services;

– promote close liaison with relevant organizations, such as UNESCO and ISO/IEC JTC1 groups;

– identify new trend, emerging services and applications of digital culture-related systems and services;

– maintain deliverables under the responsibility of the Question, including Recommendations ITU-T F.740.2, F.740.3, F.740.4, F.740.5, F.740.6, F.740.7, F.743.17, T.621.

Other topics can also be studied as appropriate, based on contributions.

An up-to-date status of work under this Question is contained in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=23/16>).

#### J.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of SG16

Questions

– All Questions of Study Group 16

Study Groups

– ITU-T SGs 12, 13, 17 and 20

Other bodies

– UNESCO and other institutions working on the digital culture field

– IEEE, ISO, ISO/IEC JTC1 SCs 2, 7, 24, 29, 27, 36, 41 and 42

### K DRAFT QUESTION K/16 Human factors for intelligent user interfaces and services

(Continuation of Question 24/16)

#### K.1 Motivation

The studies in this Question relate to intelligent user interfaces and services with human factors for the better understanding of human factors that will accommodate persons with specific needs (including but not limited to older persons, children, indigenous people, persons with illiteracy, non-native speakers) to have greater usability of telecommunication/ICT products and services.

Intelligent user interfaces include areas such as speech user interfaces, emotion-enabled user interfaces and usable information delivery interfaces that facilitate intelligent man-machine interaction. The direct interface between human and machine is expected to increase in various areas. Recent development of technology has reached the level of directly interface with machine for human organ replacement or to supplement human function. Emerging technologies, such as cameras connected to the optic nerve to recover lost vision due to retina damage, or robotic limb implants for individuals without arms or legs, are advancing.

The acquisition and application of the required knowledge and relevant tools should enable all persons to benefit from developments in telecommunication/ICT and ensure that no new barriers to usability are created. Such studies are also needed to reduce the cultural and linguistic barriers associated with the increasing amount of travel and cross-border movement.

The Question is also responsible for the maintenance and enhancements of those Recommendations and Supplements in the E and F series that are related to human factors listed under *Tasks*, below.

#### K.2 Study items

Study items to be considered include, but are not limited to:

– requirements for man-machine interaction, such as multimodal interaction services and brain computer interfaces (BCI);

– methods for human dialogue interfaces between the user and the system;

– characteristics and requirements for intelligent user interfaces and services with human factors;

– characteristics and requirements for language-specific issues such as natural language understanding and generation;

– architectural framework for intelligent user interfaces and services with human factors;

– approaches to facilitate entering information with technologies such as voice, gesture, emotion, or eye-tracking interface, etc;

– development on new symbols, pictograms and emoticons including symbols for facilities and services;

– development of intelligent user interface to eliminate, or at least minimize barriers for public services and terminals;

– societal concerns and ethical issues related with human factors for intelligent solutions and applications;

– analysis of human factors for the new technologies, such as human-assisting devices, artificial intelligence-enabled devices/services, IoT services and metaverse;

– characteristics and requirements for human-care services and wellness services.

#### K.3 Tasks

Tasks include, but are not limited to:

– develop Recommendations on requirements for man-machine interaction, such as multimodal interaction services and brain computer interfaces (BCI);

– develop Recommendations on methods for human dialogue interfaces between the user and the system;

– develop Recommendations on framework and requirements for intelligent user interfaces and services with human factors;

– develop Recommendations on characteristics and requirements for language-specific issues such as natural language understanding and generation;

– develop Recommendations on approaches to facilitate entering information with technologies such as voice, gesture, emotion, or eye-tracking interfaces;

– develop Recommendations on new symbols, pictograms and emoticons including symbols for facilities and services;

– develop Recommendations on intelligent user interface to minimize or eliminate barriers for public services and terminals;

– develop Recommendations on societal concerns and ethical issues related with human factors for intelligent solutions and applications;

– develop Recommendations on characteristics and requirements for human-care services and wellness services;

– identify new trend, emerging services and applications of human factor related systems and services;

– maintenance and enhancement of the following Recommendations: E.120 to E.128, E.130 to E.139, E.161, E.180-series (E.181, E.182, E.183, E.184), E.330-series (E.330, E.331, E.333), F.747.10, F.900-series (F.901, F.902, F.910), H.862-series (H.862.0, H.862.1, H.862.2, H.862.3, H.862.4, H.862.5);

– maintenance and enhancement of E-series Supplements 3, 5 and 6.

NOTE – S-series Supplement 1 (under ITU-T SG2) also contains human factor elements.

An up-to-date status of work under this Question is contained in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=24/16>).

#### K.4 Relationships

Recommendations

– System and service Recommendations with human factor aspects, in particular in the E-, F-, H- and T-series

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SG2 (Q3/2)

– ITU-T SG17

– ITU-T SG20

– ITU-D Q7/1, Q2/2

Other bodies

– ITU-T JCA-AHF

– ITU IRG-AVA

– CEN TC 224 WG 6 on man-machine interfaces

– ETSI TC HF on human factors

– IEC TC 100

– ISO/TC 159/SC 4 on ergonomics of human system interaction

– ISO/IEC JTC1/SC 35 on user interfaces

– MPAI

– IEEE SA

### L DRAFT QUESTION L/16 Accessibility to multimedia systems and services

(Continuation of Question 26/16)

#### L.1 Motivation

The capability to handle different information media and control actions varies within wide boundaries amongst users of telecommunication and multimedia services. The variation may come from age-related functional limitations, disabilities, or other natural causes. With the ageing populations in large parts of the world, many users will have sensory and motor limitations. It is important to address this wide variety in capabilities in the original design of telecommunication services and systems, so that an increasing number of users can make use of the mainstream telecommunication services. Legislation in many countries is also beginning to follow the trend of requiring universal design, as defined by the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), in all forms of communication services and devices, as well as Sustainable Development Goals (SDGs).

Multimedia systems and services have great potential to provide valuable and accessible information in a way that the individual user can control, if care is taken from the beginning in universal design of these services and systems, making them accessible to as many users as possible. The following deliverables were created under the accessibility activities in Study Group 16 and its predecessors:

– ITU-T V.18 for real time text telephony;

– ITU-T T.140 as the general presentation protocol for real time text conversation;

– ITU-T T.134 for real time text conversation in T.120 data conferencing environments;

– Annex G to ITU-T H.323 for real time text conversation in H.323 packet multimedia environment;

– Annex L to ITU-T H.324 for real time text conversation in low bit-rate multimedia applications;

– ITU-T F.703 – Multimedia conversation service description. Includes definitions of the accessible conversational services, i.e., total conversation;

– H-series Supplement 1 – Application profile – Sign language and lip-reading real-time conversation using low bit-rate video communication;

– ITU-T F.790 – Telecommunications accessibility guidelines for older persons and persons with disabilities;

– ITU-T F.791 – Accessibility terms and definitions;

– ITU-T H.702 – Accessibility profiles for IPTV systems;

– ITU-T F.930 – Multimedia relay services;

– ITU-T F.921 – Audio-based indoor and outdoor network navigation system for persons with vision impairment;

– ITU-T F.922 – Requirements of information service system for visually impaired persons;

– ITU-T Technical Paper FSTP-AM – Guidelines for accessible meetings;

– ITU-T Technical Paper FSTP-ACC-RemPart – Guidelines for supporting remote participation in meetings for all;

– ITU-T Technical Paper FSTP-TACL – Telecommunications accessibility checklist;

– ITU-T Technical Paper FSTP-WebVRI – Guidelines on Web-based remote sign language interpretation (VRI).

These deliverables are complemented by a number of additions to other Recommendations, the total conversation concept was founded for conversation in video, text and voice as an accessible superset of video telephony, text telephony and voice telephony.

The task of this Question is to engage in standardization activities leading to services and systems that apply the universal design concept.

Consideration should be given to services in new generation networks with fixed as well as mobile features.

The group also has a task to promote and enhance accessibility as a normal part of ITU work.

#### L.2 Study items

Study items to be considered include, but are not limited to:

– clauses on accessibility issues in relevant Recommendations, declaring how inclusive design is achieved, as requested by ITU Plenipotentiary Conference Resolution 175 (rev. Bucharest 2022) and by the UNCRPD and SDGs;

– support for wide performance limits in production, perception and control of each medium in communication services to allow for maximum usability in accordance with the principles of universal design. Specifically, study profiling of the latest video coding standards to fulfil sign language and lip-reading needs at very low bit rates and in error prone environments;

– study potential accessibility benefits offered by emerging technologies, such as immersive environments, virtual worlds, metaverse, artificial intelligence, independent living, home automation, communication between smart things (IoT), cloud-based service and smart homes;

– specification of interfaces on communication equipment to allow various forms of user interface equipment to be attached in order to enable session and device control and media handling by persons with varying capabilities and preferences;  
NOTE – Examples of what the interfaces should support include: talking menus, keyboards, pointing devices, listening and viewing devices, Braille and voice call control, text conversation input and output;

– multimedia services including mechanisms for transformation between different media forms of the same content in order to adapt to the capabilities and preferences of end users. Such mechanisms may be automatic, for example text-to-speech, or performed by people, for example sign language interpretation;

– mechanisms for user selectable media, including its production, storage, transport, presentation and logical linking;

– specification of accessible services using wireless telecommunication technologies, and using wireless short-range technologies for provision of convenient accessible features on communications equipment;

– mechanisms for interworking with mono-media services in an accessible way (e.g. text telephony and voice telephony);

– maintenance of the total conversation concept, and its inclusion in any new multimedia conversation protocol;

– study the requirements on multimedia metadata from an accessibility point of view to encourage universal design in this field;

– study access to emergency services and early warning services by persons with disabilities and specific needs with a wide range of communication channels, e.g. text, sign language, and lip-reading supported speech, audio description, and braille;

– mechanisms for disability-inclusive disaster risk reduction.

#### L.3 Tasks

Tasks include, but are not limited to:

– coordination with other ITU-R, ITU-T and ITU-D study groups for fulfilment of accessibility requirements in their Recommendations;

– coordination with other SDOs for fulfilment of accessibility requirements in their specifications;

– continue to support the collaboration with ISO/IEC JTC1/SC 35 on standards for ICT accessibility;

– promotion of total conversation defined in ITU-T F.703 as a mainstream service;

– promotion of the concept of universal design, as defined in the UNCRPD;

– promotion of the SDGs;

– develop guidance for implementers of interfaces between communication devices and user interface devices;

– contribute to the continued harmonization and maintenance of the real time text telephone service, for example when new technologies are specified for PSTN or IP transmission;

– create guidelines for the design of IP terminal devices and IP communication systems for the inclusion of accessibility features including text conversation, video and alerting, and maintain interoperability with legacy text telephones;

– develop Recommendations and guidelines to improve accessibility to audiovisual media, such as IPTV systems and streaming media;

– develop Recommendations and guidelines to improve accessibility of services using new emerging technologies such as artificial intelligence and metaverse;

– assist in the development of guidelines to improve accessibility and usability for emerging new devices such as head-mounted displays (HMD) supporting extended reality (e.g., augmented, virtual and mixed reality), immersive environments, virtual worlds and metaverse;

– assist in the development of guidelines for procurement of accessible systems, services and devices;

– develop specification in support of total conversation for disabilities beyond the needs of the deaf;

– develop guidance for implementers of relay systems for deaf, hard of hearing and speech-impaired users;

– maintain the list of suitable accessibility terms and definitions;

– maintain the documents under the responsibility of the Question (including ITU-T F.790-series, V.18; FSTP-TACL, FSTP-AM, FSTP-ACC-RemPart);

– modification and/or extension of existing deliverables under ITU-T Study Group 16 responsibility to enable accessible systems (including ITU-T F.703 and H.702).

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=26/16>).

#### L.4 Relationships

Recommendations

– ITU-T F.700, G.722, G.722.2, G.729, G.769/Y.1242, G.799.1/Y.1451.1, H.300-series, H.248, H.264, H.265, H.17, H.700-series, V.150-series, T.140, Y.1901

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SG9 on IP Cablecom

– ITU-T SG12 on media quality

– ITU-T SG13 on future networks

– ITU-T SG15 on access networks, for inclusive design in communication services

– ITU-T SG17 on privacy, security and child online protection

– ITU-T SG20 on IoT and smart cities & communities

– ITU-R WP5A, SG6

– ITU-D SG1 on access to telecommunication services for persons with disabilities

– ITU-D SG2 on development and management of telecommunication services and networks and ICT applications

Other ITU bodies

– ITU-T JCA-AHF, IRG-AVA

– ITU-D special initiatives

Other bodies

– IETF in general, and specifically the MMUSIC, WebRTC and AVT groups

– 3GPP and 3GPP2 for mobile accessibility inclusion and co-ordination of text telephony and total conversation related issues

– ETSI, particularly TC HF (Human Factors)

– ISO/IEC JTC1/SC 35 on accessibility and user interfaces

– ISO/TC 159/SC 4 on accessibility (TBC)

– IEC TC100 on assisted living

– W3C on Web accessibility

– G3ict (Global Initiative for Inclusive ICTs)

– Internet Governance Forum

– WHO, WIPO and other United Nations specialized agencies

Regional organizations such as the Asia Pacific Telecommunity, European Accessibility Resource Centre, AccessibleEU, Zero Project

– Disability organizations including the World Federation of the Deaf (WFD), World Blind Union (WBU), International Federation of Hard of Hearing People (IFHOH) and Disabled People's International (DPI)

### M DRAFT QUESTION M/16 Vehicular multimedia communications, systems, networks, and applications

(Continuation of Question 27/16)

#### M.1 Motivation

Vehicle data collected by in-vehicle sensors and other electronic devices through in-vehicle networks are critical to intelligent transportation system (ITS) services and applications. They will also enable emergency telecommunications and new business models from associated industries (e.g., insurance, car-sharing).

Vehicle gateways are intended to provide and support telecommunication. In this context, vehicle gateways have a significant role in supporting ubiquitous connectivity in heterogeneous environments. Therefore, global standards for vehicle gateways should also be developed to support global seamless ITS services and applications, and to allow plug-and-play operation in any vehicle for any consumer device.

With the rapid development of intelligent and connected vehicles and automated driving systems (ADS), the future of information and entertainment (infotainment) in the vehicle will drastically change with respect to the traditional infotainment (radio-based), which characterized the vehicles of our generation. While research is progressing towards a vision that supports a vehicle becoming a third living space (after home and office), and its embedded screen becoming the fourth way to accessing infotainment (after TV, PC monitor and mobile phone devices), the need to study vehicular multimedia systems and technologies rises. Study Group 16 established a Focus Group on Vehicular Multimedia (FG-VM) (2018-2022) and it pioneered research in the area of vehicular multimedia. This Question continues international standardization in this field.

In addition, given the importance and urgency to preserve our environment from climate change and enhance road safety, ITU-T SG16 recognizes the role of ITS services and applications, which have the potential to improve traffic management, reduce congestion and related carbon emissions, as well as reduce vehicle accidents improving road safety. To this end, ITU-T SG16 established the Focus Group on Artificial Intelligence for Autonomous and Assisted Driving (FG-AI4AD) (2019-2022). This Question continues to study the deliverables of FG-AI4AD for international standardization. With the recent introduction of automated and assisted driving, the Question will study communications, system, networks, and applications for automated and assisted driving.

As new forms of transportation develop, the Question will study communications, systems, networks, and applications on vehicles in any form, including civilian unmanned aerial vehicles (CUAV).

The Question will defer the study of relevant QoS and QoE aspects of vehicular multimedia systems to ITU-T SG12. The Question will consult ITU-T SG17 when discussing security aspects of vehicular multimedia systems and ITU-T SG20 when discussing smart city aspects of vehicular multimedia systems.

#### M.2 Study items

Study items to be considered include, but are not limited to:

– use cases and requirements of vehicle gateways as a bridge for "vehicular-to-everything" (V2X) communications;

– architectures and mechanisms of vehicle gateway systems;

– use cases and requirements of future vehicular multimedia systems based on communication networks;

– architecture of vehicular multimedia systems;

– terms and definitions of vehicular multimedia communications, systems, networks, and applications;

– implementation aspects of vehicular multimedia systems, APIs and communication protocols;

– enhancements to support, directly or indirectly, emergency and early warning services (e.g. for traffic accidents);

– enhancements required to support security and privacy of vehicular multimedia systems;

– considerations on road safety with respect to ITS and connected automated vehicles (CAV);

– considerations on vehicle gateway and system using vehicle-to-grid (V2G);

– considerations on vehicle gateway system for non-terrestrial vehicles (CUAV, ship, spacecraft, etc.).

#### M.3 Tasks

Tasks include but are not limited to:

– studies on the use cases, requirements and functions of vehicular gateway systems related to V2X;

– studies on the use cases, requirements and functions of vehicular multimedia and their reference model(s);

– studies on the interface among vehicular multimedia system and networks;

– studies on the interface between vehicle gateway and ICT devices;

– studies on the relevant necessary protocols to support vehicle-oriented services and applications;

– studies on implementation aspects of vehicular multimedia systems, APIs and communication protocols;

– studies on road safety, automated and assisted driving and the performance evaluation of the artificial intelligence system responsible for the driving tasks;

– study the deliverables from ITU-T FG-AI4AD towards their endorsement as ITU-T Recommendations;

– studies vehicle gateway system for CUAV systems;

– maintain deliverables under the responsibility of the Question: Recommendation ITU-T F.749 series, H.550 series, H.560; H-Series Supplement 20; Technical Papers FSTP.SS-OTA, HSTP-CITS-Reqs.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=27/16>).

#### M.4 Relationships

Recommendations

– E, F, G, H, I, Q, T, V, X, Y-series Recommendations under the responsibility of Study Group 16

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SGs 2, 11, 12, 13, 17, 20

– ITU-R SGs 1, 4, 5, 6

– ITU-D SG2

Other bodies

– AUTOSAR WPII-1.1 Software Architecture

– Collaboration on ITS communications (CITS)

– CCSA

– IEC TC 69, TC 100

– IEEE 802, 802.11, 802.15.1

– IrDA (Infrared Data Association)

– ISO TC 22 (Road vehicles) SC 31 (Data communication)

– ISO TC 204 (Intelligent transport systems) WG14 (Vehicle/roadway warning and control systems), WG16 (Communications) and WG17 (Nomadic Devices in ITS systems)

– JSR298 Telematics API

– OSGi Alliance Vehicle Expert Group (VEG)

– SAE International ORAD Committee

– UNECE WP1, WP29 GRSG, WP29 GRVA, and WP29 TF-VC

– 3GPP SA WG2/WG6

– International Civil Aviation Organization (ICAO), European Union Aviation Safety Agency (EASA)

### N DRAFT QUESTION N/16 Multimedia framework for digital health applications

(Continuation of Question 28/16)

#### N.1 Motivation

WHO defines that "… digital health is understood to mean 'the field of knowledge and practice associated with any aspect of adopting digital technologies to improve health, from inception to operation'. This definition is in line with WHO EB142/20 of 20173 and encompasses eHealth"[[1]](#footnote-1).

In the same document, it is said that "Moving from eHealth to Digital Health puts more emphasis on digital consumers, with a wider range of smart-devices and connected equipment being used, together with other innovative and evolving concepts as that of Internet of things (IoTs) and the more widespread use of artificial intelligence, big data and analytics. Digital Health is changing the way health systems are run and health care is delivered".

The evolution of advanced digital telecommunication techniques has enabled the development of multimedia systems to support digital health applications, including telemedicine.

Moreover, within the context of the "new normal" forced upon the world by the COVID-19 pandemic, digital health is certainly one of the key elements in the pandemic policy and response, as well as one of the most effective tools to tackle this global issue.

With such a background, this Question is concerned with standardization of multimedia systems and services to support digital health applications.

Here is some additional information on the motivation of the Question.

Digital health uses information and communication technology (ICT) to support health needs, while telemedicine is considered as that part of digital health where telecommunication systems which allow interconnecting remote locations and to access distant resources. Examples of telemedicine applications are teleconsulting, teleradiology, telesurgery, etc. The applicability of the work in this Question includes also diverse patients, carers, and healthcare providers.

"…[T]o assess their use of digital technologies for health, including in health information systems at the national and subnational levels, in order to identify areas of improvement, and to prioritize, as appropriate, the development, evaluation, implementation, scale-up and greater utilization of digital technologies, as a means of promoting equitable, affordable and universal access to health for all, including the special needs of groups that are vulnerable in the context of digital health"1.

"Digital health, or the use of digital technologies for health, has become a salient field of practice for employing routine and innovative forms of information and communications technology (ICT) to address health needs. The term digital health is rooted in eHealth, which is defined as "the use of information and communications technology in support of health and health-related fields". Mobile health (mHealth) is a subset of eHealth and is defined as "the use of mobile wireless technologies for health". More recently, the term digital health was introduced as "a broad umbrella term encompassing eHealth (which includes mHealth), as well as emerging areas, such as the use of advanced computing sciences in 'big data', genomics and artificial intelligence".[[2]](#footnote-2)

The field of digital health is dynamic and progressing rapidly. e-health, medical informatics, health informatics, telemedicine, telehealth and mHealth are some of the terms that have been used over the last five decades, depending on the available technologies and accessibility of the baseline infrastructure. These terms have been used to describe the application of information and communication technologies (ICTs) to areas of health, health care and wellbeing. More recently, the term digital health has been selected to embody integration of concepts yet be flexible enough to foster diversity of purposes, technologies and other specificities.1

NOTE 1 – According to the World Health Organization (WHO), telemedicine is "the use of information and communication technology to deliver medical services and information from one location to another".

This Question focuses on standardization of multimedia systems and services to support digital health applications.

In order to allow a wide deployment of digital health applications, in particular in developing countries, it is important to achieve interoperability amongst systems and to reduce the cost of devices through economies of scale. Consequently, the development of global international standards with the involvement of the major players (governments, inter-governmental organizations, non-governmental organizations, medical institutions, doctors, manufacturers, etc.) is a key factor to achieve these objectives.

Considering the fact that many organizations are already active in this field (with which ITU has existing cooperation agreements) and that, in addition to technical issues, there are a number of other aspects to be considered (e.g. legal, ethical, cultural, economic, regional), it is considered that the various ITU-T study groups can provide the right environment to harmonize and coordinate the development of a set of open global standards for digital health applications.

In the framework of this Question, Study Group 16, consistent with its lead study roles, will coordinate the technical standardization of multimedia systems and capabilities for digital health applications in ITU-T, and will develop corresponding Recommendations and other deliverables.

NOTE 2 – Improvements and additions to the specific characteristics of multimedia systems and terminals under the responsibility of other Study Group 16 Questions will be addressed within those Questions. The Question will consult ITU-T SG20 when discussing IoT and smart city aspects of digital health.

#### N.2 Study items

Study items to be considered include, but are not limited to:

– identification of user requirements (both those providing and receiving healthcare);

– multimedia framework (including overall concept) for digital health applications (e.g., personal connected health, diagnostics, telemonitoring for communicable disease control, telehealth, mobile health and telemedicine) that leverage various types of information (e.g., brain and other neurological information, physiological information and ambient information);

– impact of new areas of study such as artificial intelligence, bioinformatics (genomics in particular), health software, pharmacovigilance, videogaming, esports, virtual reality, metaverse and digital twin in standards for digital health;

– consideration of usability of digital health systems and devices, including accessibility for persons with disabilities and specific needs;

– roadmap for digital health standards;

– generic architecture for digital health applications;

– specific system characteristics for digital health applications (e.g. video and still picture coding, audio coding, security, directory architecture, safe listening, etc.);

– glossary of digital health (e.g., telehealth and telemedicine);

– consideration of structure and format of data (including metadata) for digital health, and methods for inputting, transmitting, storing, querying, finding, identifying, categorizing and processing them;

– personal connected health devices, and personal health devices, systems and services;

– management and exchange of digital health records, including person generated health records and electronic health records;

– leverage multimedia and digital health technologies to meet requirements from, e.g., WHO and other stakeholders (e.g., NCDs, and/or epidemic outbreaks) and considerations on how to use multimedia for e-education related to health;

– development of conformance testing specifications and capability maturity models for standards in the above-mentioned study items.

#### N.3 Tasks

Tasks include, but are not limited to:

– support the efforts against medical emergencies such as COVID-19 with standardization;

– continue to support the collaboration with WHO, especially on its "make listening safe" initiative and accessible telehealth;

– continue to support the collaboration with IEEE on "Continua";

– multimedia framework for digital health applications such as UHD, IPTV and mobile;

– considerations on how accessibility to digital health applications may be enhanced;

– maintain a high-visibility web page documenting the progress of the Question;

– roadmap for digital health/telemedicine standards, compiling and analysing standardization requirements from digital health stakeholders and identifying standardization items with priorities;

– update the inventory of existing digital health/telemedicine standards;

– support of ITU-D digital health activities, including capacity building;

– provide inputs for extension and improvement of existing Recommendations on multimedia systems (ITU-T H.323, H.420, H.700-series; H.264, H.265, H.266; V.18, etc.);

– consideration on the application of already existing mature and stable technologies rather than only on future advanced technologies;

– maintain and expand deliverables under the responsibility of the Question: ITU-T F.780.x-sub-series, H.810-H.850 series, H.860, H.861.x sub-series, H.870-series, FSTP-CONF-F780.1, FSTP-RTM, FSTP-SLD-UC, HSTP.CONF-H870, HSTP-H810, HSTP-H810-XCHF, HSTP-H812-FHIR.

An up-to-date status of work under this Question is found in the SG16 work programme (<https://www.itu.int/ITU-T/workprog/wp_search.aspx?sp=17&q=28/16>).

#### N.4 Relationships

Recommendations

– ITU-T H.800-series, H.300-series, H.260-series, H.420-series, H.700-series, T.80-series, T.800-series, V.18

Questions

– All Questions of Study Group 16

Study groups

– ITU-T SGs 5, 9, 12, 13, 17 and 20

– ITU-R SG5

– ITU-D SG2

Other bodies

– WHO, ICAO and other relevant international agencies

– FDA, CDC/NIOSH, NIH and other relevant regulatory bodies

– JIC (Joint Initiative Council for Global Health Informatics Standardization), HL7, IHE (Personal Connected Health Alliance/Continua), Association for Advancement of Medical Instrumentation (AAMI), Global Alliance for Genomics and Health (GA4GH), DICOM, GSMA, DAISY Consortium, and other relevant forums and consortia

– ISO (TC215 and its SC1 in particular), IEC (TC100 and TC108 in particular), CEN, CENELEC (TC108X WG03 in particular), ETSI, IETF, IEEE (11073 WGs in particular) and other relevant standardization bodies

– Video Games Europe, Global Video Game Coalition, Global Esports Federation (for safe-listening in esports and gaming) and other relevant industry groups

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1. Draft "Global strategy for digital health 2020-2024", WHO, <https://www.who.int/health-topics/digital-health>. [↑](#footnote-ref-1)
2. WHO Guidelines: "Recommendations on digital interventions for health system strengthening", 2019, <https://www.who.int/reproductivehealth/publications/digital-interventions-health-system-strengthening/en>. [↑](#footnote-ref-2)