ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

Recommendation

ITU-T J.484 (11/2023)

SERIES J: Cable networks and transmission of television, sound programme and other multimedia signals

Digital transmission of television signals – Part 4

Requirements of multicast adaptive bitrate (M-ABR) IP delivery

ITU-T J-SERIES RECOMMENDATIONS

Cable networks and transmission of television, sound programme and other multimedia signals

GENERAL RECOMMENDATIONS	J.1-J.9
GENERAL SPECIFICATIONS FOR ANALOGUE SOUND-PROGRAMME TRANSMISSION	J.10-J.19
PERFORMANCE CHARACTERISTICS OF ANALOGUE SOUND-PROGRAMME CIRCUITS	J.20-J.29
EQUIPMENT AND LINES USED FOR ANALOGUE SOUND-PROGRAMME CIRCUITS	J.30-J.39
DIGITAL ENCODERS FOR ANALOGUE SOUND-PROGRAMME SIGNALS - PART 1	J.40-J.49
DIGITAL TRANSMISSION OF SOUND-PROGRAMME SIGNALS	J.50-J.59
CIRCUITS FOR ANALOGUE TELEVISION TRANSMISSION	J.60-J.69
ANALOGUE TELEVISION TRANSMISSION OVER METALLIC LINES AND INTERCONNECTION WITH RADIO-RELAY LINKS	J.70-J.79
DIGITAL TRANSMISSION OF TELEVISION SIGNALS	J.80-J.89
ANCILLARY DIGITAL SERVICES FOR TELEVISION TRANSMISSION	J.90-J.99
OPERATIONAL REQUIREMENTS AND METHODS FOR TELEVISION TRANSMISSION	J.100-J.109
INTERACTIVE SYSTEMS FOR DIGITAL TELEVISION DISTRIBUTION (DOCSIS FIRST AND SECOND GENERATIONS)	J.110-J.129
TRANSPORT OF MPEG-2 SIGNALS ON PACKETIZED NETWORKS	J.130-J.139
MEASUREMENT OF THE QUALITY OF SERVICE - PART 1	J.140-J.149
DIGITAL TELEVISION DISTRIBUTION THROUGH LOCAL SUBSCRIBER NETWORKS	J.150-J.159
IPCABLECOM (MGCP-BASED) - PART 1	J.160-J.179
DIGITAL TRANSMISSION OF TELEVISION SIGNALS - PART 1	J.180-J.189
CABLE MODEMS AND HOME NETWORKING	J.190-J.199
APPLICATION FOR INTERACTIVE DIGITAL TELEVISION - PART 1	J.200-J.209
INTERACTIVE SYSTEMS FOR DIGITAL TELEVISION DISTRIBUTION (DOCSIS THIRD TO FIFTH GENERATIONS)	J.210-J.229
MULTI-DEVICE SYSTEMS FOR CABLE TELEVISION	J.230-J.239
MEASUREMENT OF THE QUALITY OF SERVICE - PART 2	J.240-J.249
DIGITAL TELEVISION DISTRIBUTION THROUGH LOCAL SUBSCRIBER NETWORKS	J.250-J.259
IPCABLECOM (MGCP-BASED) - PART 2	J.260-J.279
DIGITAL TRANSMISSION OF TELEVISION SIGNALS - PART 2	J.280-J.289
CABLE SET-TOP BOX	J.290-J.299
APPLICATION FOR INTERACTIVE DIGITAL TELEVISION - PART 2	J.300-J.309
MEASUREMENT OF THE QUALITY OF SERVICE - PART 3	J.340-J.349
IPCABLECOM2 (SIP-BASED) - PART 1	J.360-J.379
DIGITAL TRANSMISSION OF TELEVISION SIGNALS - PART 3	J.380-J.389
MEASUREMENT OF THE QUALITY OF SERVICE - PART 4	J.440-J.449
IPCABLECOM2 (SIP-BASED) - PART 2	J.460-J.479
DIGITAL TRANSMISSION OF TELEVISION SIGNALS - PART 4	**J.480-J.489**
TRANSPORT OF LARGE SCREEN DIGITAL IMAGERY	J.600-J.699
SECONDARY DISTRIBUTION OF IPTV SERVICES	J.700-J.799
MULTIMEDIA OVER IP IN CABLE	J.800-J.899
TRANSMISSION OF 3-D TV SERVICES	J.900-J.999
CONDITIONAL ACCESS AND PROTECTION	J.1000-J.1099
SWITCHED DIGITAL VIDEO OVER CABLE NETWORKS	J.1100-J.1119
SMART TV OPERATING SYSTEM	J.1200-J.1209
IP VIDEO BROADCAST	J.1210-J.1219
CLOUD-BASED CONVERGED MEDIA SERVICES FOR IP AND BROADCAST CABLE TELEVISION	J.1300-J.1309
TELEVISION TRANSPORT NETWORK AND SYSTEM DEPLOYMENT IN DEVELOPING COUNTRIES	J.1400-J.1409
ARTIFICIAL INTELLIGENCE (AI) ASSISTED CABLE NETWORKS	J.1600-J.1649

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T J.484

Requirements of multicast adaptive bitrate (M-ABR) IP delivery

Summary

The increased use of audio-visual traffic on the Internet forces cable operators to invest in additional facilities each year. Most of the audio-visual traffic is unicast, which, unlike multicast, consumes much bandwidth, but is easy to use, and compatible with consumer devices such as smartphones and tablets.

Since some of unicast connections carry linear programming such as news and sports, the traffic on the delivery network can be significantly reduced if such linear programs are transmitted as a multicast.

Recommendation ITU-T J.484 defines the requirements of an Internet protocol (IP) delivery technology which makes use of multicast to reduce audio-visual traffic in the cable delivery network but uses hypertext transfer protocol (HTTP) based unicast inside the home network, thereby making it compatible with consumer devices such as smartphones.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T J.484	2023-11-15	9	11.1002/1000/15580

Keywords

Adaptive bit rate (ABR), cable television network, IP.

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

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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

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

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

NOTE

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

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

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T J.484

Requirements of multicast adaptive bitrate (M-ABR) IP delivery

1 Scope

This Recommendation defines the requirements of multicast adaptive bitrate (M-ABR) system for efficient delivery of real time and non-real time television programs over cable network.

The scope of this Recommendation includes:

– description of the architecture;

– requirements of M-ABR system over cable networks and its components;

– features of multicast network for M-ABR system and content selection.

For more information on the M-ABR system, there are some types of implementations, which can be found, for example, in [b-ETSI TS 103 769], [b-OC-TR-IP-MULTI-ARCH].

This Recommendation is targeted specifically to M-ABR system implementations in cable television network environment.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.701] Recommendation ITU-T H.701 (2009), *Content delivery error recovery for IPTV services.*

[ISO/IEC 14496-12] ISO/IEC 14496-12:2022, *Information Technology – Coding of audio-visual objects – Part 12: ISO base media file format.*

[ISO/IEC 23000-19] ISO/IEC 23000-19:2020, *Information Technology – Multimedia application format (MPEG-A) – Part 19: Common media application format (CMAF) for segmented media*.

[ISO/IEC 23009-1] ISO/IEC 23009-1:2022, *Information Technology – Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and segment formats*.

[ATSC A/331] Advanced Television Systems Committee, ATSC Standard A/331:2023-12, *Signaling, Delivery, Synchronization, and Error Protection* (13 December 2023).

[ETSI EN 301 192] ETSI EN 301 192 V1.7.1 (2021-08), *Digital Video Broadcasting (DVB); DVB specification for data broadcasting*.

[ETSI TS 102 606-1] ETSI TS 102 606-1 V1.2.1 (2014-07), *Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE); Part 1: Protocol*.

[IETF RFC 2710] IETF RFC 2710 (1999), *Multicast Listener Discovery (MLD) for IPv6*.

[IETF RFC 3376] IETF RFC 3376 (2002), *Internet Group Management Protocol, Version 3*.

[IETF RFC 3926] IETF RFC 3926 (2004), *FLUTE - File Delivery over Unidirectional Transport (obsolete*).

[IETF RFC 4326] IETF RFC 4326 (2005), *Unidirectional Lightweight Encapsulation (ULE) for Transmission of IP Datagrams over an MPEG-2 Transport Stream (TS)*.

[IETF RFC 5651] IETF RFC 5651 (2009), *Layered Coding Transport (LCT) Building Block*.

[IETF RFC 6726] IETF RFC 6726 (2012), *FLUTE - File Delivery over Unidirectional Transport*.

[IETF RFC 7233] IETF RFC 7233 (2014), *Hypertext Transfer Protocol (HTTP/1.1): Range Requests (obsolete)*.

[IETF RFC 8216] IETF RFC 8216 (2017), *HTTP Live Streaming*.

[IETF RFC 9110] IETF RFC 9110, STD 97 (2022), *HTTP Semantics*.

[IETF RFC 9113] IETF RFC 9113 (2022), *HTTP/2*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 CMAF [ISO/IEC 23000-19]: Common media format for MPEG-DASH and HLS, shortened segments (CMAF chunks) used for low latency delivery of content.

3.1.2 MPEG-DASH [ISO/IEC 23000-1]: An adaptive bitrate streaming technique that enables streaming of video and audio content over the Internet delivered from conventional HTTP web servers.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 content hosting function: Function that is used to store prepared content at the content provider or cable headend for delivery.

NOTE – Definition based on [b-ETSI TS 103 769].

3.2.2 content preparation function: Function of the content provider/cable headend to encode, encrypt and package content for delivery.

NOTE – Definition based on [b-ETSI TS 103 769].

3.2.3 layered coding transport (LCT): A coding technique that provides reliable multiple rate delivery of content to receivers.

3.2.4 multicast gateway function: Function usually placed in the customer premises equipment (CPE) that is used to receive multicast packets.

NOTE – Definition based on [b-ETSI TS 103 769].

3.2.5 multicast rendezvous: Function to inform users of availability of multicast sessions.

NOTE – Definition based on [b-ETSI TS 103 769].

3.2.6 unicast repair: Function that is used to repair multicast packets received in error using unicast (HTTP).

NOTE – Definition based on [b-ETSI TS 103 769].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ABR	Adaptive Bitrate
CDN	Content Delivery Network
CMAF	Common Media Application Format
CPE	Customer Premises Equipment
DASH	Dynamic Adaptive Streaming over HTTP
DOCSIS	Data over Cable Systems Interface Specifications
DRM	Digital Rights Management
FEC	Forward Error Correction
FLUTE	File Delivery over Unidirectional Transport
GSE	Generic Stream Encapsulation
HFC	Hybrid Fibre-Coaxial
HLS	HTTP Live Streaming
HTTP	Hypertext Transfer Protocol
IGMP	Internet Group Management Protocol (IPv4)
IP	Internet Protocol
ISOBMFF	ISO Base Media File Format
LCT	Layered Coding Transport
M-ABR	Multicast Adaptive Bitrate
MLD	Multicast Listener Discovery Protocol (IPv6)
MPE	Multiprotocol Encapsulation
PON	Passive Optical Network
QAM	Quadrature Amplitude Modulation
QoE	Quality of Experience
ROUTE	Real-time Object Delivery over Unidirectional Transport
STB	Set-Top Box
TSI	Transport Session Identifier
UDP	User Datagram Protocol
ULE	Unidirectional Lightweight Encapsulation
URL	Uniform Resource Locator
VOD	Video on Demand
XML	extended Markup Language

5 Conventions

In this Recommendation:

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

The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "**is prohibited from**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In the body of this Recommendation and its annexes, the words *shall*, *shall not*, *should*, and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required to*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 Overview

6.1 Background

Growth of audio-visual traffic is forcing cable operators to invest in additional facilities each year.

Most of the audio-visual traffic now is unicast. It is easy to use, and compatible with consumer devices such as smartphones and tablets. On the other hand, it consumes much bandwidth – the total bandwidth consumed is the bandwidth of a single connection multiplied by the number of users.

On the core network, this abundance of unicast connections can be mitigated by the use of cache servers on the content delivery network (CDN), but for cable television access network, cache servers are of no use. Instead, use of multicast can reduce traffic carrying linear programming such as news and sports, but multicast is not always supported by all consumer devices.

6.2 Use of multicast adaptive bitrate

To mitigate the congestion of cable IP network due to overcrowding use of unicast, use of multicast adaptive bitrate (M-ABR) is considered effective.

M-ABR sends audio-visual content streams from cable headend to subscriber gateways using multicast, and the consumer device requests contents from the gateway using a HTTP based unicast connection.

Use cases of M-ABR include real time IP delivery of television programmes, sports events in particular, which would consume much bandwidth if multicast were not used.

7 General description of the system

General description of M-ABR includes, among others, the following:

– The system delivers linear audio-visual streams from cable headend to subscriber gateway using either unicast or multicast, and consumer devices connected to the subscriber gateway get the content using HTTP, just like watching video on demand (VOD).

– Unicast is used when a small number of subscribers watch the same audio-visual stream, but when more subscribers watch the same audio-visual streams, multicast is used.

– To use either unicast or multicast is also decided by other factors including the available bandwidth and expected audience ratings, and may be dynamically switched as needed.

– The multicast streams support multiple bit rates or layered coding transport (LCT) [IETF RFC 5651] in response to different access network bandwidths and different consumer device display sizes and capabilities.

– To protect the multicast audio-visual stream from errors that could occur during transmission, the system uses either forward error correction (FEC), or error repair on an individual receive device basis [ITU-T H.701].

M-ABR system comprises functions for content preparation, content hosting, multicast server, multicast gateway, content playback, unicast repair and others, as shown in Figure 1. The figure highlights the following interfaces in red font:

– **O_{in}**: Interface between content hosting function and multicast server to pull content for delivery.

– **P_{in}**: Interface between content preparation function and multicast server to push content for delivery.

– **M**: Interface between multicast server and multicast gateway for delivery of content by multicast.

– **A**: Interface between content hosting function and unicast repair function to retrieve errored packets.

– **L**: Interface between multicast gateway and content playback to get content by HTTP.

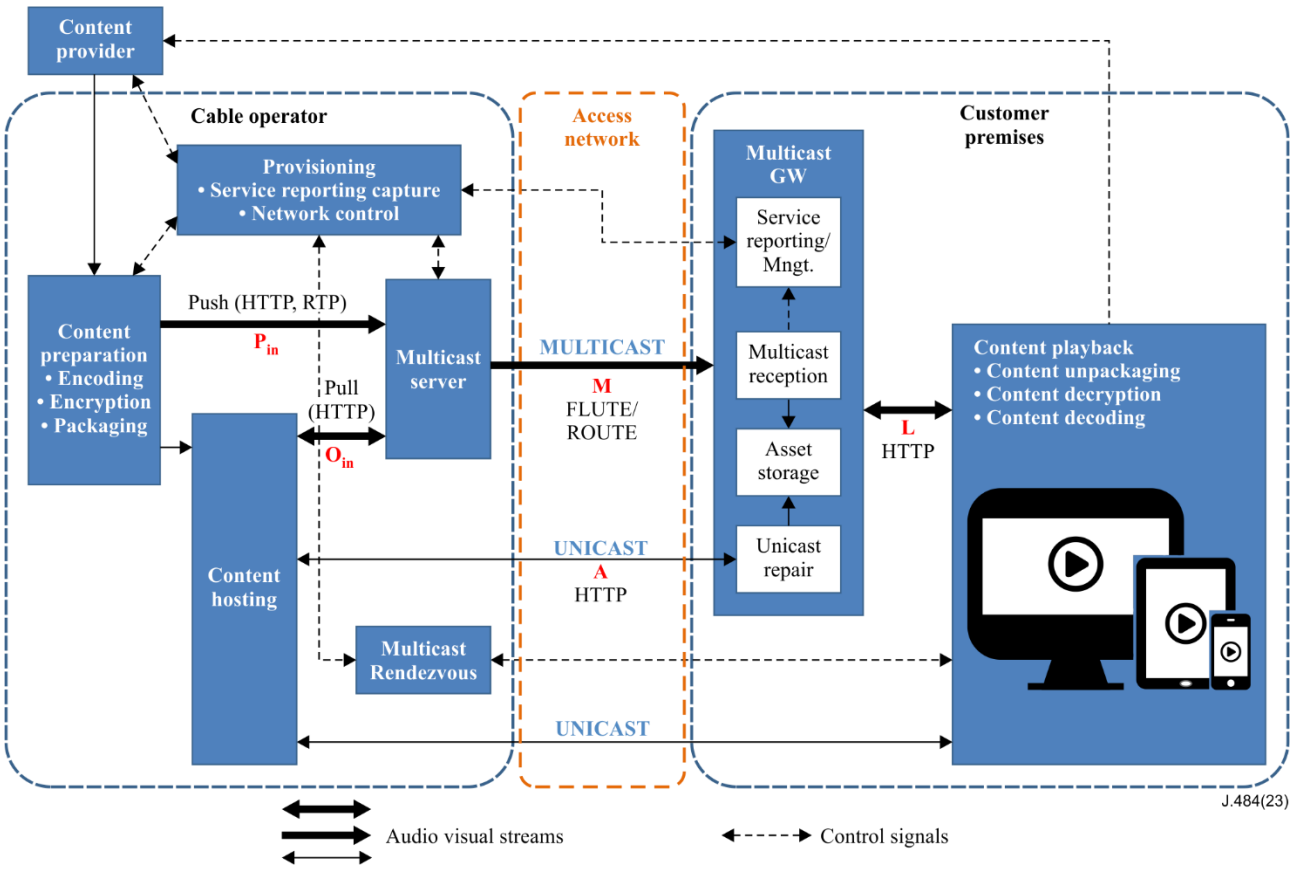

Figure 1 – M-ABR system architecture

8 Requirements

Clauses 8.1 to 8.9 describe requirements of each function necessary to apply M-ABR to cable television networks.

8.1 Content preparation requirements

The content preparation function comprises content encoding, encryption and packaging subfunctions.

– [M-ABR-ContReq-01] The content preparation function is required to encode source video and audio streams to reduce the bit rate. A single source media may be encoded into a number of different bitrate streams to match delivery conditions and players' display sizes.

– [M-ABR-ContReq-02] The content preparation function is required, when digital rights management (DRM) is in use, to encrypt content streams using DRM keys.

– [M-ABR-ContReq-03] The content preparation function is required to output a sequence of packaged media segments. Examples of packaging formats are ISO base media file format (ISOBMFF or MP4) [ISO/IEC 14496-12] for MPEG-DASH [ISO/IEC 23009-1], fragmented MPEG2-TS for HTTP live streaming (HLS) [IETF RFC 8216], and common media application format (CMAF), as defined by [ISO/IEC 23000-19] for both MPEG-DASH and HLS.

8.2 Content hosting requirements

– [M-ABR-ContReq-04] The content hosting function is required to store prepared content segments for delivery to the multicast server, as well as for delivery by unicast, or to repair content using unicast.

8.3 Multicast server requirements

The multicast server function comprises content ingest and multicast transmission subfunctions, usually co-located with the cable headend.

– [M-ABR-MSverReq-01] The content ingest subfunction in a multicast server is required to ingest content segments from either the content preparation or the hosting function using a pull or a push method.

– [M-ABR-MSverReq-02] For real time content, the content ingest subfunction in a multicast server is required to ingest content segments from the content preparation function immediately as they are created, using a push interface (P_{in}). HTTP or RTP is used for this purpose.

– [M-ABR-MSverReq-03] For non-real time content, the content ingest subfunction in a multicast server is required to ingest content packages from the content hosting function using a pull interface (O_{in}). O_{in} is also required to work with real-time content as well. O_{in} uses HTTP.

– [M-ABR-MSverReq-04] The multicast transmission subfunction in a multicast server is required to format received ingest objects into multicast transport objects as multicast packets for transmission over a cable delivery network. It is required to use the multicast media transport protocols, i.e., either FLUTE or ROUTE, as defined in clause 9.

8.4 Multicast gateway requirements

The multicast gateway (GW) function comprises multicast reception, asset storage, unicast repair and service reporting/management subfunctions. This function usually resides in customer premises equipment (CPE) such as home GW or IP-STB.

– [M-ABR-MgwReq-01] The multicast reception subfunction in a multicast GW is required to acquire multicast transport objects received via a cable access network, and convert them into playback delivery objects.
– [M-ABR-MgwReq-02] The multicast reception subfunction in a multicast GW is required to expose the converted objects in order to service request from the content playback function.
– [M-ABR-MgwReq-03] To support playback objects in MPEG-DASH format, the multicast GW is required to implement support for HTTP byte range request as specified in [IETF RFC 7233] and [IETF RFC 9110], and HTTP/1.1 [IETF RFC 7233] chunked transfer coding for low latency operation.
– [M-ABR-MgwReq-4] The service reporting subfunction in a multicast GW is required to compute service-related metrics, and send them to service reporting capture in the provisioning function.

The requirements of the unicast repair subfunction are defined in clause 8.6.

8.5 Content playback requirements

The content playback function comprises subfunctions for content request and retrieve, content unpackaging, content decryption, decoding and presentation (rendering).

– [M-ABR-PlaybackReq-01] The content playback function is required to request and retrieve transport objects from multicast GW using HTTP.
– [M-ABR-PlaybackReq-02] The content playback function is required to unpackage the content package contained in the retrieved transport objects and extract elementary stream data for use by the content decryption, decoding and presentation subfunctions.
– [M-ABR-PlaybackReq-03] When DRM is in use, the content playback function is required to obtain the DRM decryption key and decrypt encrypted elementary streams.
– [M-ABR-PlaybackReq-04] The content playback function is required to decode the elementary media streams to be rendered for playback on a screen or loudspeaker.
– [M-ABR-PlaybackReq-05] The content playback function is required to report information about the behaviour and quality of experience (QoE) of content playback to the content provider (or provisioning).

8.6 Unicast repair requirements

If multicast packets received in error cannot be recovered by using FEC, unicast repair should be used to repair those errors.

– [M-ABR-UnirepairReq-01] The multicast GW should attempt to obtain the lost packets from the content hosting function using HTTP/1.1 or optionally HTTP/2 [IETF RFC 9113]. This interface is indicated as interface A in Figure 1.
– [M-ABR-UnirepairReq-02] To minimize the amount of retransmitted traffic, the multicast GW and the content hosting function shall support the use of byte range requests.

8.7 Provisioning requirements

The provisioning function comprises service reporting capture and network control subfunctions.

– [M-ABR ProvReq-1] The service reporting capture subfunction is required to collect service reporting information describing the performance of the service from the multicast GW and the content provider.
– [M-ABR ProvReq-2] The network control subfunction is required to control and configure network resources. This includes the switching between unicast and multicast based on the

service reporting information and the multicast content selection policy as described in clause 11.

8.8 Multicast rendezvous requirements

The multicast rendezvous service is used to inform users of the availability of multicast sessions.

– [M-ABR MrReq-1] The multicast rendezvous service is required to maintain records of multicast gateway instances received from the network control function, inform the content playback function of the availability of multicast sessions, and redirect it to a multicast GW if one is available.

8.9 Lowlatency operation requirements

– [M-ABR LowLatencyReq-1] To deliver real time content with minimum delay, it is recommended that the multicast transmission subfunction in the multicast server use CMAF chunks which are shorter subsets of dynamic adaptive streaming over HTTP (DASH) or HLS media segments.

9 Multicast transport session

– [M-ABR MuchicastTransportReq-1] The Multicast server is required to transmit a multicast transport session which is a stream of video and audio packets for reception by a multicast GW via reference point M. Its parameters are defined by an Extended Markup Language (XML) instance document and include multicast media transport protocol in use, endpoint address, bitrate, and forward error correction (FEC) information.

9.1 Multicast media transport protocol

(1) FLUTE

FLUTE (File Delivery over Unidirectional Transport) has two versions: [IETF RFC 6726] and [IETF RFC 3926]. The version in use is required to be indicated in the multicast transport session parameters.

(2) ROUTE

ROUTE (Real-time Object Delivery over Unidirectional Transport) is defined in [ATSC A/331], and is considered as an advanced version of FLUTE.

9.2 Endpoint address

Endpoint address parameters comprise a source IP address (S), a destination multicast group IP address (G) and a destination User Datagram Protocol (UDP) port number (P), collectively referred to as the <S, G, P> triplet, along with a media transport session identifier (TSI) specified by multicast media transport protocol, see clause 9.1.

9.3 Example of IP multicast sessions

Video and audio service components can be delivered by a multicast server in a single or multiple transport sessions, using FLUTE/ROUTE sessions as follows:

1) To deliver video and audio service components over a single multicast transport session, the same FLUTE/ROUTE sessions with endpoint address <S1, G1, P1> can be used for both video and audio. Segment uniform resource locators (URLs) are used to separate different service components.

2) To deliver video and audio service components in separate multicast transport sessions, different FLUTE/ROUTE sessions with different destination UDP port numbers (P1 and P2), or different IP multicast groups (G1 and G2) can be used.

3) To deliver multiple video components of different bit rates, different FLUTE/ROUTE sessions with different IP multicast groups (G1 and G2) can be used.

Using different IP multicast groups can reduce the amount of traffic reaching a multicast GW, but increases the number of simultaneous multicast groups in the system.

10 IP multicast network

For the transmission of multicast packets over interface M in Figure 1, either cable IP multicast network running Internet Group Management Protocol (IGMP) [IETF RFC 3376] or Multicast Listener Discovery Protocol (MLD) [IETF RFC 2710] over data over cable systems interface specifications (DOCSIS) or passive optical network (PON), or quadrature amplitude modulation (QAM) based cable broadcast bearer over hybrid fibre-coaxial (HFC) or optical fibre is used as access network.

– [M-ABR-ipmulticastReq-01] For the transmission of IP multicast packets over a cable access network (interface M in Figure 1), the multicast server and the multicast GW are required to support IGMP (Internet Group Management Protocol) when IPv4 is in use, or MLD (Multicast Lister Discovery) when IPv6 is in use.

– [M-ABR-ipmulticastReq-02] When broadcast bearer is used to transmit IP multicast packets, the multicast server is required to encapsulate those IP packets using either unidirectional lightweight encapsulation (ULE) [IETF RFC 4326], generic stream encapsulation (GSE) [ETSI TS 102 606-1], or multiprotocol encapsulation (MPE) for the transmission of IP datagrams over MPEG-2 TS. MPE is defined by digital video broadcasting (DVB) and appears in [ETSI EN 301 192].

11 Multicast content selection

The content to be delivered by multicast should be selected using either of the following two methods. Use of other methods is not precluded.

– Viewership-driven multicast

  In this approach, the system monitors the number of simultaneous requests for a programme, and when that number exceeds a certain threshold, that content is delivered by multicast. When the number is set to two, any content that has more than one viewer is delivered by multicast.

– Policy-driven multicast

  In this approach, the operator determines a priori, based on the viewership history or audience rating, a specific set of channels that are made available for multicast delivery at any given time.

Bibliography

[b-ETSI TS 103 769] Technical Specification ETSI TS 103 769 (2020), *Digital Video Broadcasting (DVB); Adaptive media streaming over IP multicast.*

[b-OC-TR-IP-MULTI-ARCH] Cable Television Laboratories (2014), *Inc: IP Multicast Adaptive Bit Rate Architecture Technical Report*. <https://www.cablelabs.com/specifications/ip-multicast-adaptive-bit-rate-architecture-technical-report>

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	**Cable networks and transmission of television, sound programme and other multimedia signals**
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems

Published in Switzerland
Geneva, 2024