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Recommendation

ITU-T H.705.3 (06/2024)

SERIES H: Audiovisual and multimedia systems

IPTV multimedia services and applications for IPTV – General aspects

Requirements and architecture for open IPTV multicast service

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Recommendation ITU-T H.705.3

Requirements and architecture for open IPTV multicast service

Summary

Recommendation ITU-T H.705.3 specifies the requirements and the referenced architecture of the open Internet protocol television (IPTV) multicast service. In this Recommendation, two solutions are introduced for different scenarios: a dedicated open IPTV multicast service system solution and an interface solution for exposing IPTV multicast network capability. The related functional components, requirements and the reference points are also defined accordingly.

With this Recommendation, IPTV service providers are able to expose their dedicated multicast network capability to the third parties so that over the top (OTT) live broadcast services deployed on the public Internet can improve the quality of experience (QoE) by taking advantage of the dedicated multicast network. Furthermore, new "live +" services may be developed based on the open multicast service defined in this Recommendation.

History*

Edition	Recommendation	Approval	Study Group	Unique ID
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Keywords

CDN, IPTV, multicast, multicast network capability exposure, open multicast service.

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

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Recommendation ITU-T H.705.3

Requirements and architecture for open IPTV multicast service

1 Scope

This Recommendation specifies the requirements and the architecture of the open Internet protocol television (IPTV) multicast service, which includes:

1) The requirements and architecture of the dedicated open IPTV multicast service system.
2) The requirements and scenarios for IPTV multicast network capability exposing.
3) The related reference points and procedure flows.

2 References

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

[ITU-T Y.1902] Recommendation ITU-T Y.1902 (2011), *Framework for multicast-based IPTV content delivery*.

[ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture*.

[ITU-T Y.2019] Recommendation ITU-T Y.2019 (2010), *Content delivery functional architecture in NGN*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 multicast network [b-ITU-T X.604]: Multicast network refers to any of the networks wherein legacy IP multicasting schemes are enabled with the help of multicast routing protocols, multicast forwarding capability of multicast routers in the networks, link-layer multicasting of the points of attachment in the network, and multicast membership signalling in the subnet such as IGMP/MLD. MMC services could be provisioned over the multicast network.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 external service provider: A service provider that can provide its own live streaming services but resides outside the Internet protocol television (IPTV) multicast network.

3.2.2 IPTV multicast network: An enclosed multicast network dedicated to bearing an Internet protocol television (IPTV) live steaming service.

3.2.3 trusted service provider: An external service provider that has already been authenticated or authorized by the IPTV multicast network provider and is permitted to directly access the underlay logical resources based on their agreement.

3.2.4 untrusted service provider: An external service provider who has not yet been authenticated or authorized by the Internet protocol television (IPTV) multicast network provider but can apply the IPTV multicast service by an open interface based on a specific business agreement.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CDN Content Delivery Network

DPI Deep Packet Inspection

FCC Fast Channel Change

FLUTE File Delivery over Unidirectional Transport

HLS HTTP Live Streaming

HTTP Hypertext Transfer Protocol

HTTPS Hypertext Transfer Protocol Secure

IGMP Internet Group Management Protocol

IPTV Internet Protocol Television

MA Multicast Agent

MAF Multicast Agent Functions

MC-fb Multicast Control Functional Block

MLD Multicast Listener Discovery

MMC Mobile Multicast Communications

MSF Multicast Server Functions

MSMF Multicast Service Management Functions

NORM NACK-Oriented Reliable Multicast

O&M-fb Operation and Maintenance Functional Block

OTT Over The Top

QoE Quality of Experience

RTP Real-time Transport Protocol

SP Service Provider

TD Terminal Device

VCDN Virtual Content Delivery Network

5 Conventions

The following conventions are used 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.

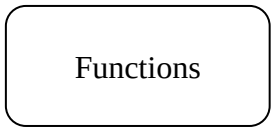
– The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

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

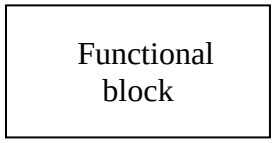
– The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation can still be claimed even if this requirement is present.

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

– The keyword "functions" is defined as a collection of functionalities. It is represented by the following symbol in the context of IPTV architecture:



– The keyword "functional block" is defined as a group of functionalities that have not been further subdivided at the level of detail described in this Recommendation. It is represented by the following symbol in the context of IPTV architecture:



6 Overview

Internet protocol television (IPTV) is a quality-guaranteed video/audio transmission service that functions by taking advantage of an enclosed managed network. Usually, IP-multicast technology can be adopted in the IPTV dedicated network, which is a managed network, to support a live broadcast service, such as linear TV or real-time communication services. A multicast dedicated network can efficiently reduce the broadband resource consumption and the number of back-to-source requests. However, most over the top (OTT) live broadcast services cannot adopt the IP-multicast solution directly due to problems such as multicast storm. A content delivery network (CDN) offers an alternative solution to distribute the live stream to end-users by unicast relaying. However, OTT CDN can only deploy its edge nodes on the public network edge and OTT end-users still need to connect to the CDN edge node by unicast. The traffic on the aggregation network and access network is proportional to the number of audiences.

Currently, as live broadcast services develop, many new features are increasingly involved in live broadcast services, such as virtual reality (VR), augmented reality (AR), interactive online promotions, influencer broadcasting, etc. These features bring a strict requirement of ultra-low latency for end-to-end content delivery. This Recommendation introduces a reference architecture for an open multicast service intended to expose the IPTV multicast network capability to third party live broadcast services.

Figure 6-1 shows an overview scenario of an open IPTV multicast service.

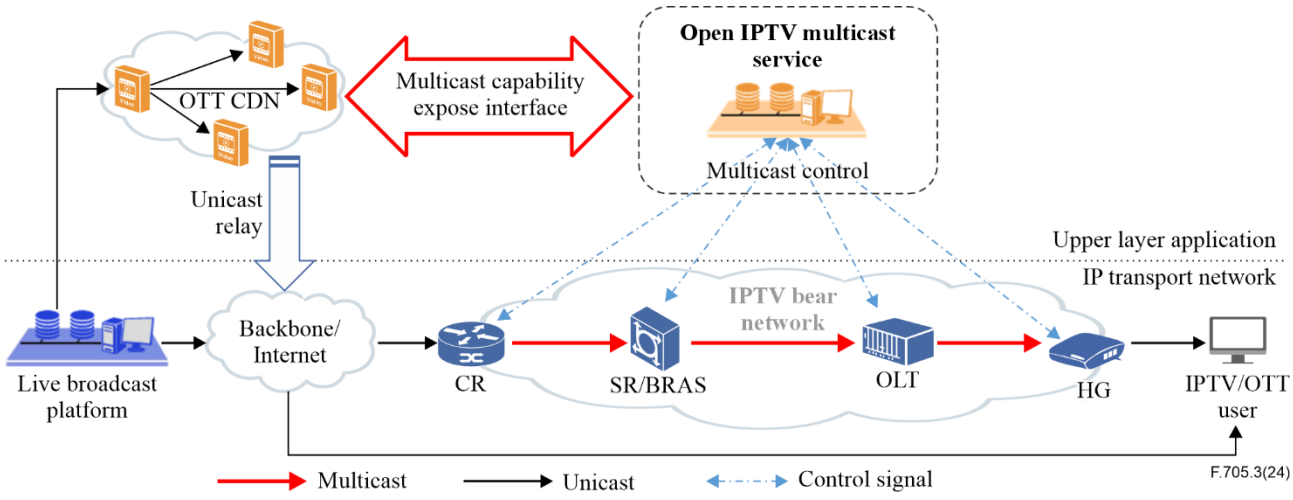


Figure 6-1 – Scenario of open IPTV multicast service

The open IPTV multicast service is responsible for allocating and reserving the multicast network resources for the OTT live broadcast service providers, according to their service features and requirements. It provides a content ingest interface for the live streaming service and then delivers the live content package to the end-user device by multicast mode.

In this Recommendation, different solutions are introduced and the requirements, functional components, and the reference points are specified accordingly. However, direct access to the underlay physical multicast network is not recommended in this Recommendation.

NOTE – Usually underlay network elements, such as core routers, switches, etc., are the infrastructure equipment in the telecommunication network and by convention are strictly accessed through authorized operations only, according to the regulations. This Recommendation is mainly focused on the application layer solutions of providing an open IPTV multicast service but the study of preventing illegal access to the underlay network is out of the scope of this Recommendation.

7 Requirements of open IPTV multicast service

7.1 General requirements

GR-01: The open IPTV multicast service is required to provide an open multicast content delivery capability to the source content provider or CDN service provider.

GR-02: The open IPTV multicast service is required to adopt the security measures to prevent the underlying IPTV multicast network elements from unauthorized access.

GR-03: The open IPTV multicast service is recommended to provide multicast content delivery service to the terminal devices, even if the terminal device does not support multicast protocols.

GR-04: The open IPTV multicast service is recommended to be capable of ingesting content from content sources or CDN in an IPTV dedicated network or an OTT network, by unicast or multicast.

7.2 Requirements for dedicated open multicast system

7.2.1 Requirements for multicast management platform

MMP-01: The multicast management platform is required to manage the multicast agent(s), such as login, logout, heartbeat connection, etc.

MMP-02: The multicast management platform is recommended to maintain the multicast channel list and its related information, such as multicast time, channel information, etc.

MMP-03: The multicast management platform is recommended to dispatch the multicast channel list to multicast servers and multicast agents.

MMP-04: The multicast management platform is recommended to fully synchronise the updated information of multicast channels with multicast servers.

MMP-05: The multicast management platform is recommended to be capable of selecting one or more multicast protocols, such as real-time transport protocol (RTP) [b-IETF RFC 3550], NORM [b-IETF RFC 5740], etc., while it is configuring the multicast transmission methods.

7.2.2 Requirements for multicast server

MS-01: The multicast server is required to be capable of transmitting media streams to the multicast agents by multicast protocol, such as RTP [b-IETF RFC 3550], NORM [b-IETF RFC 5740], etc.

MS-02: The multicast server is recommended to obtain the unicast media stream from the content source and to be capable of converting the unicast stream to the multicast stream. The media description information is recommended to be created accordingly, e.g., multicast channel address, bitrate used in the channel, etc.

MS-03: The multicast server is recommended to obtain the multicast channel list and its related information from the multicast management platform.

MS-04: The multicast server is recommended to be capable of creating multicast channel(s).

MS-05: The multicast server can optionally process the unicast re-transmission request from client.

7.2.3 Requirements for multicast agent

MA-01: The multicast agent is required to be capable of receiving the multicast media stream from multicast server.

MA-02: The multicast agent is required to be capable of converting the multicast stream to the unicast stream. For example, the multicast agent can re-encapsulate the multicast data package into the unicast data package, which includes media file index and media file segments.

MA-03: The multicast agent is required to be capable of delivering the unicast media stream to terminal device.

MA-04: The multicast agent is recommended to be capable of joining a multicast group according to the related multicast channel identification.

MA-05: The multicast agent is recommended to retrieve the media description information from multicast server or CDN. Multicast group information related to the multicast channel can be extracted from the media description information.

MA-06: The multicast agent is recommended to be able to redirect or schedule the content request to the alternative content source if the multicast service is not available.

MA-07: The multicast agent can optionally send the unicast re-transmission request to the multicast server.

7.3 Requirements for multicast network capability expose function

MNEF-01: The multicast network capability expose function is recommended to provide a logical multicast network access interface to the content source which intends to use multicast delivery.

MNEF-02: The multicast network capability expose function is recommended to adopt the security mechanisms to prevent the underlying multicast network elements from the unauthorized access and control.

MNEF-03: The multicast network capability expose function can optionally be integrated with (IPTV) management functions [ITU-T Y.1910] or application functions [ITU-T Y.1910].

MNEF-04: The multicast network capability expose function is recommended to be capable of interacting with network management functions, including network orchestrator or network controller.

8 Dedicated open IPTV multicast system

8.1 System overview

Figure 8-1 shows an implementation example of a dedicated open IPTV multicast system:

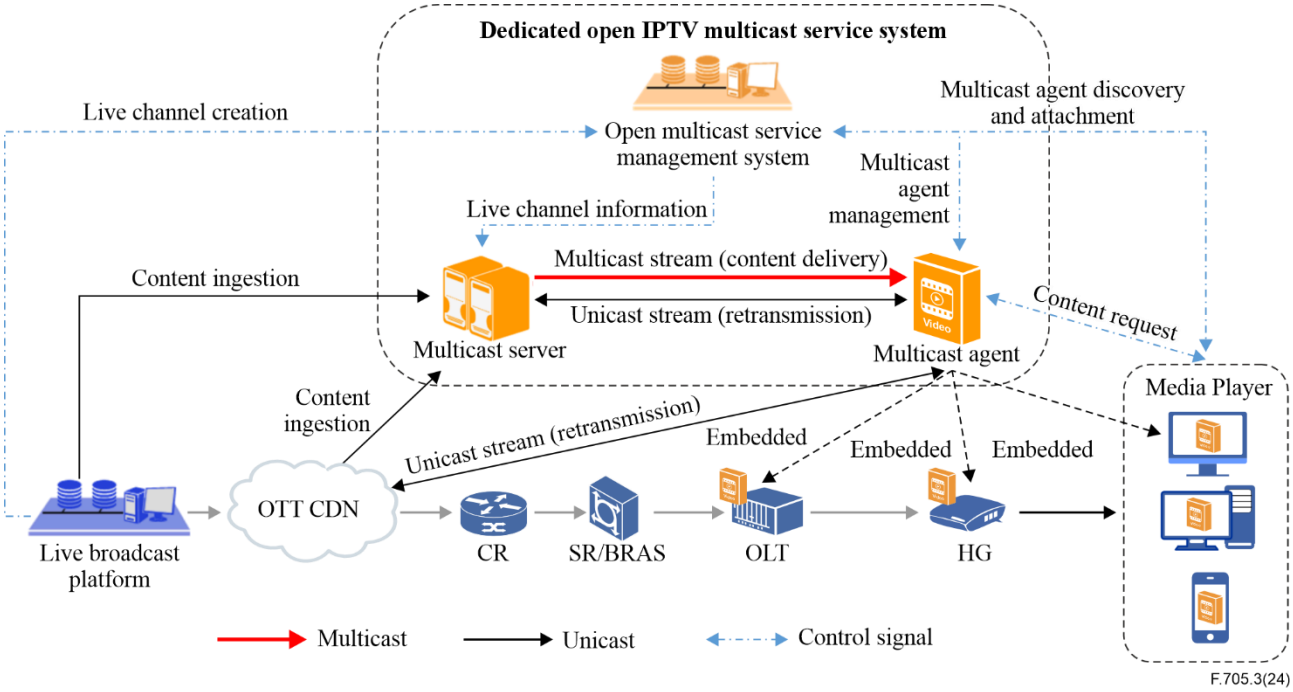


Figure 8-1 – An implementation example of dedicated open IPTV multicast system

The dedicated open IPTV multicast system represented in Figure 8-1 is mainly composed of three functional entities:

– **Open multicast service management system**

It is a central management platform which is responsible for providing the IPTV multicast service capabilities to the third-party service provider (SP)/content provider (CP), e.g., OTT live TV operator. The major role of the management platform is to manage the information of multicast channels, service scheduling, and the activities of multicast agents.

– **Multicast server**

It is responsible for ingesting the unicast content stream from the external content source and providing multicast stream transmission to the multicast agents. Meanwhile, it converts the unicast content into multicast content and manages the multicast channel information and the cached unicast content.

– **Multicast agent**

It works as a client of the multicast server to provide the unicast stream to the end-user according to the content identification, e.g., content ID or channel ID. In contrast to the multicast server, the multicast agent converts the multicast stream into unicast stream before it delivers content to the end-user. In addition, the multicast agent may periodically report its service status to the multicast service management system.

Typically, the multicast agent is designed to be a software client that can be deployed on the different hosts, such as optical line terminal (OLT), home gateway (HG) or a user's terminal device. Depending on the deployment location and the number of potential customers, it may require different amounts of computing power. However, for the maximum efficiency of multicast transmission, it is recommended to embed the multicast agent into the user's terminal device and work together with media player.

8.2 Functional architecture

Figure 8-2 shows a reference functional architecture of the dedicated open IPTV multicast system.

NOTE – The functions of live content source and CDN are out of the scope of this Recommendation.

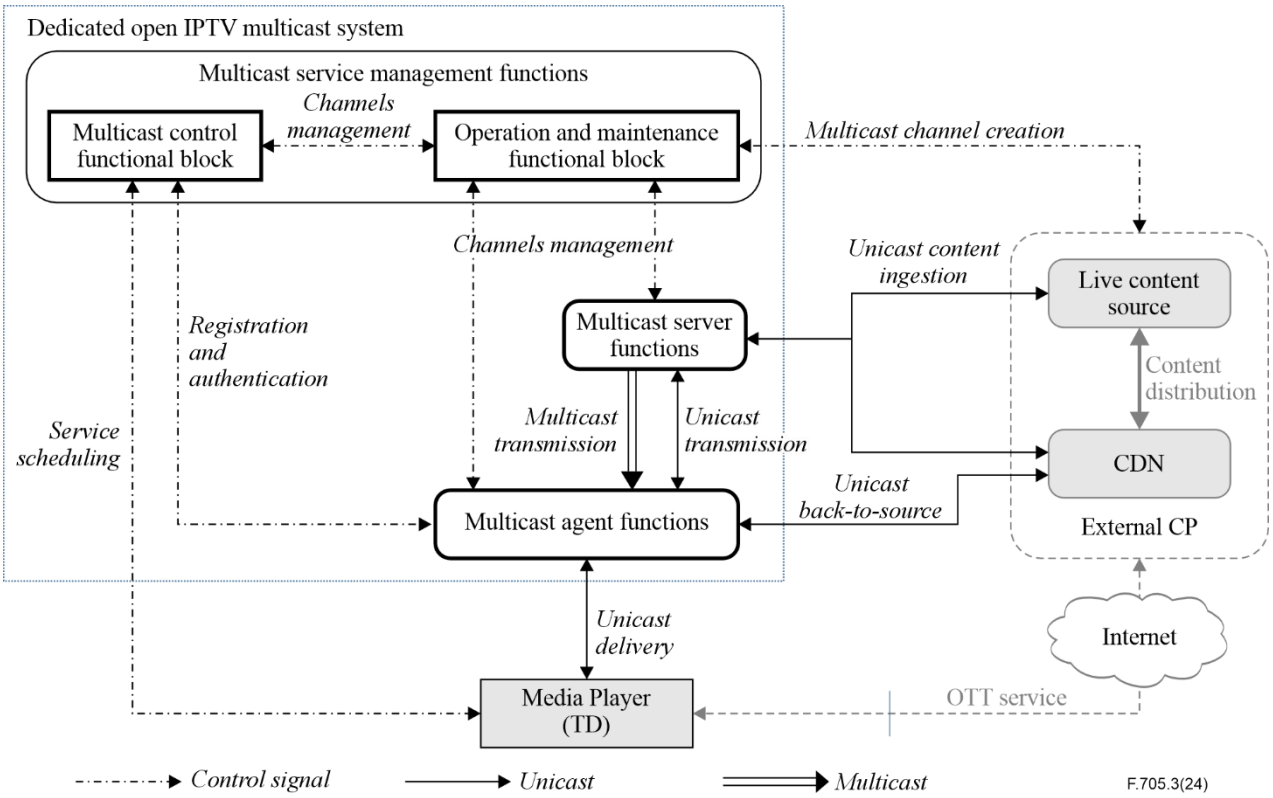


Figure 8-2 – Functional architecture of dedicated open IPTV multicast system

8.2.1 Multicast service management functions

Multicast service management functions (MSMF) are responsible for providing IPTV multicast capabilities to third party live service/content providers according to their requests. It is noted that MSMF is composed of two functional blocks:

– Operation and maintenance functional block

- Creates and maintains the list of channels and channel maps with the channel information.
- Dispatches the channel list and channel maps to multicast server functions and multicast agent functions.
- Configures the multicast protocols that are to be used for multicast server functions.
- Fully synchronizes multicast channels information with the multicast server.
- (Optional) multicast resource monitoring, such as multicast address, network bandwidth, etc.

– Multicast control functional block
  - Provides service scheduling for the terminal devices.
  - Manages and monitors the status of multicast agent functions, such as registration, authentication/authorization, heart-beat reporting, etc.

NOTE – MSMF may not need to be further decomposed as the above separated functional blocks if the realised scale of MSMF is limited but all the functions have been merged together.

8.2.2 Multicast server functions

Multicast server functions (MSF) are responsible for the following functions:

– Create the multicast channels according to the received channel list and channel maps.

– Obtain the unicast media stream from the content source and convert it to the multicast stream. The media description information is created accordingly, e.g., multicast channel address, bitrate used in the channel, etc.

– Transmit the media stream to the multicast agent function by using predefined multicast protocol, such as RTP [b-IETF RFC 3550], NORM [b-IETF RFC 5740], etc.

– Optionally process the unicast re-transmission request from client if the content is not available on the multicast server.

8.2.3 Multicast agent functions

Multicast agent functions (MAF) are responsible for the following functions:

– Retrieve the media description information from multicast server or CDN. Multicast group information related to the multicast channel can be extracted from the media description information.

– Join a multicast group according to the related multicast channel information.

– Receive the multicast media stream from the multicast server and convert the multicast stream to the unicast stream.

– Deliver the unicast media stream to the terminal device based on the request media description information.

– Provide "back-to-source" service to the end-user if the multicast channel is not available, as a proxy server.

– Optionally send the unicast re-transmission request to the multicast server or CDN if some of the media segments are missed.

– Optionally report its service status to the MSMF.

8.3 High-level workflow

Figure 8-3 shows the primary procedure for providing the multicast service to the external content providers by using dedicated open IPTV multicast service.

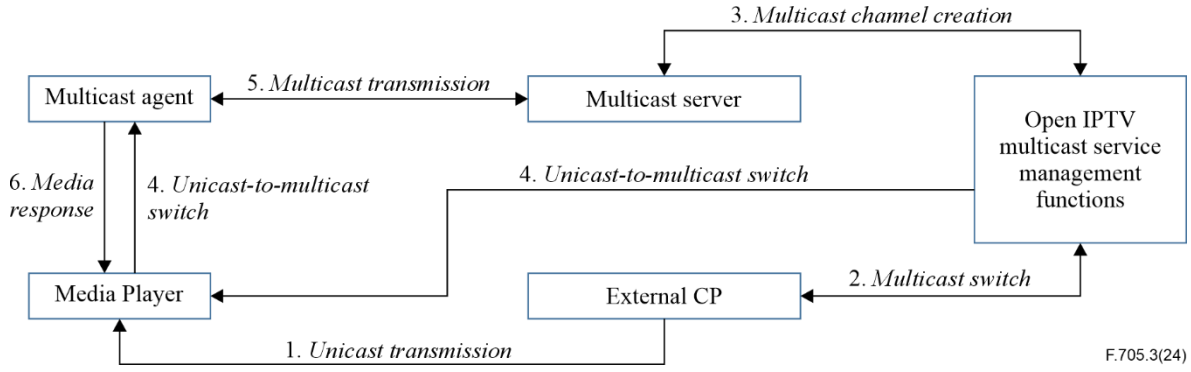


Figure 8-3 – High-level workflow

Typically, multicast service should be activated if the bandwidth or media server workload of the unicast service is approaching its limitation. Then the end-user will be transferred from the unicast media receiver to the multicast receiver by following the steps:

1) A media player (terminal device) gets the content from the CDN of an external CP by unicast transmission. The service request is initiated by media player and finally is responded to by one of the media servers in a CDN node.

2) The open multicast system keeps monitoring the service request by deep packet inspection (DPI) and analyses the request for obtaining the service information, based on the pre-defined filtering methods.

3) If the service information implied that the unicast-multicast switching condition is satisfied, the open multicast service platform sends the switch instruction to a multicast server. The multicast server creates multicast channels subsequently. The channels information will be returned to the open multicast service platform afterwards.

4) The open multicast service platform sends the multicast transmission switching instruction with the channels information to the media player.

5) The multicast agent collocated with the media player is enabled to receive the media stream by joining the multicast group according to the content information required by the media player.

6) The media agent returns the media files to the media player by converting the multicast stream into unicast stream.

9 Interface for IPTV multicast network capability exposure

The interface for exposing IPTV multicast network capability can provide an opportunity for a content provider to program the content delivery in a resource-controllable multicast network. Depending on the types of multicast network, this interface can be offered to a variety of live content providers, such as an OTT live TV provider or OTT live streaming influencer.

9.1 System overview

Figure 9-1 shows a scenario of the IPTV multicast network capability exposure solution. What distinguishes this scenario from previous dedicated open multicast systems is that it assists the live content providers to directly deliver their own content by utilizing the multicast network resource without handing the content over to another intermediate cache.

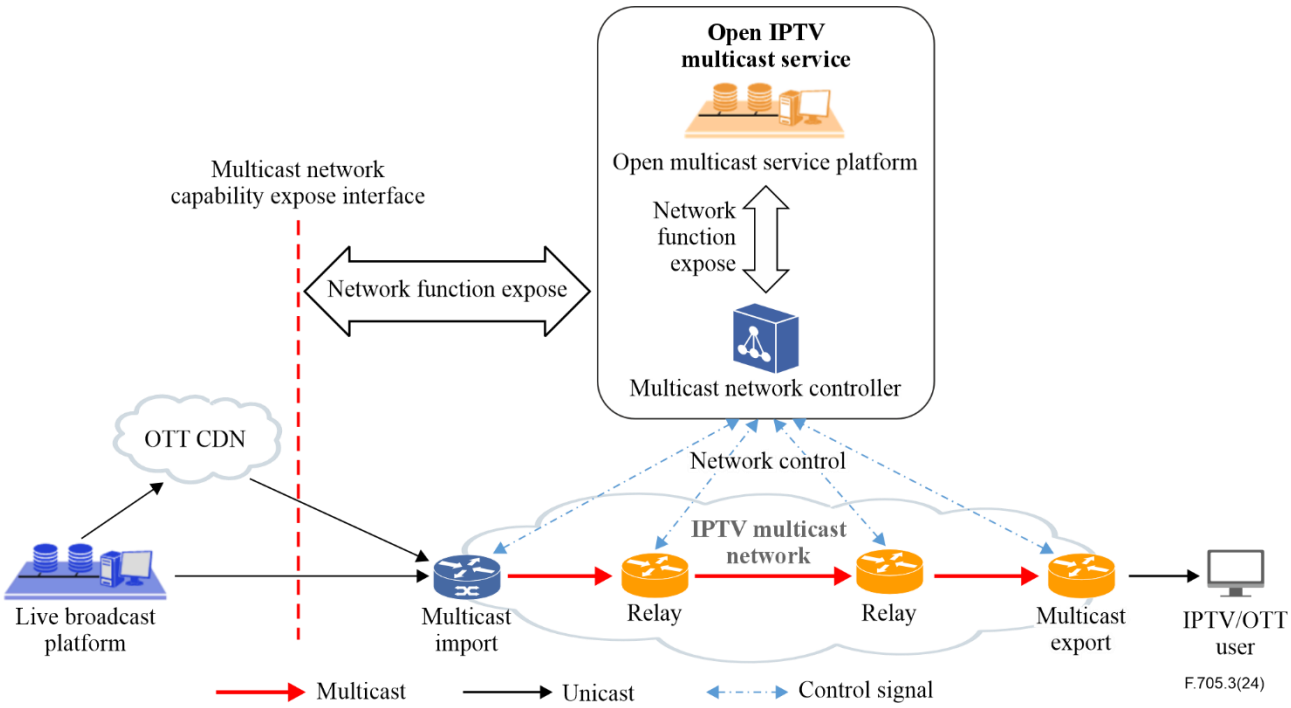


Figure 9-1 – A scenario of IPTV multicast network capability exposure

From a security perspective, it is important to restrict access to the network device in principle. A multicast network capability expose interface in this Recommendation is recommended to be designed to provide a logical multicast network resource for the content providers, which is able to restrict access to the network device from risky external operations. In addition, an authorization system may be applied before to grant the right to access multicast services in different levels.

NOTE – The issues of authentication or authorization are out of the scope of this Recommendation.

9.2 Working modes

The implementation of this expose interface is recommended to rely on the different working modes, according to the authority level of the external SPs.

9.2.1 Open network controller mode

In this mode, multicast network resources can be invoked by the network controller and can be offered to the external SPs as logical resources through the network capability expose interface. That means the external SP, e.g., a live TV service provider, is able to control the logical network resource directly and obtain the related information, such as choosing the stream import/export point, monitoring the user accessing information and traffic consumption, etc.

Figure 9-2 shows the conceptual framework of the open network controller mode.

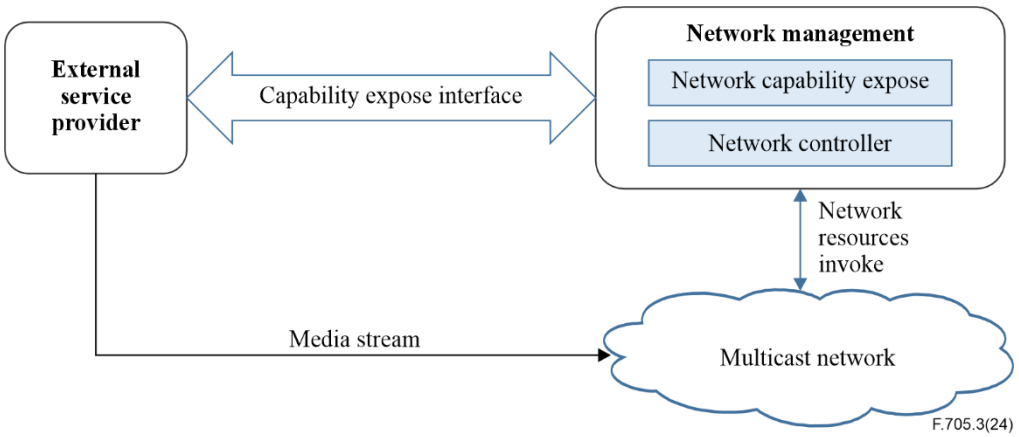


Figure 9-2 – Open network controller mode

The network controller can invoke and orchestrate the physical network resources from the underlying multicast network. With the assistance of network capability expose functions, the real network resources can be abstracted into the logical network resources which is able to be offered to the external SPs. A standard network capability expose interface defined in this Recommendation will be used to guide those SPs to establish the different multicast transmission paths with assistance of the multicast network controller.

This mode can improve the efficiency of content delivery and the precision of the traffic arrangement for the external SPs, but the complexity of service programming may be raised on the side of the external SP.

For the security aspect, this mode is recommended to be offered strictly to the trusted SPs who have been fully authenticated in the previous stage.

9.2.2 Hybrid mode: converged platform of open multicast service with network controller

In this mode, an additional service platform, such as the dedicated open IPTV multicast service system mentioned in clause 8.1, is recommended to be involved, and some of its functions will be combined with the network management functions.

Figure 9-3 shows the conceptual framework of hybrid mode.

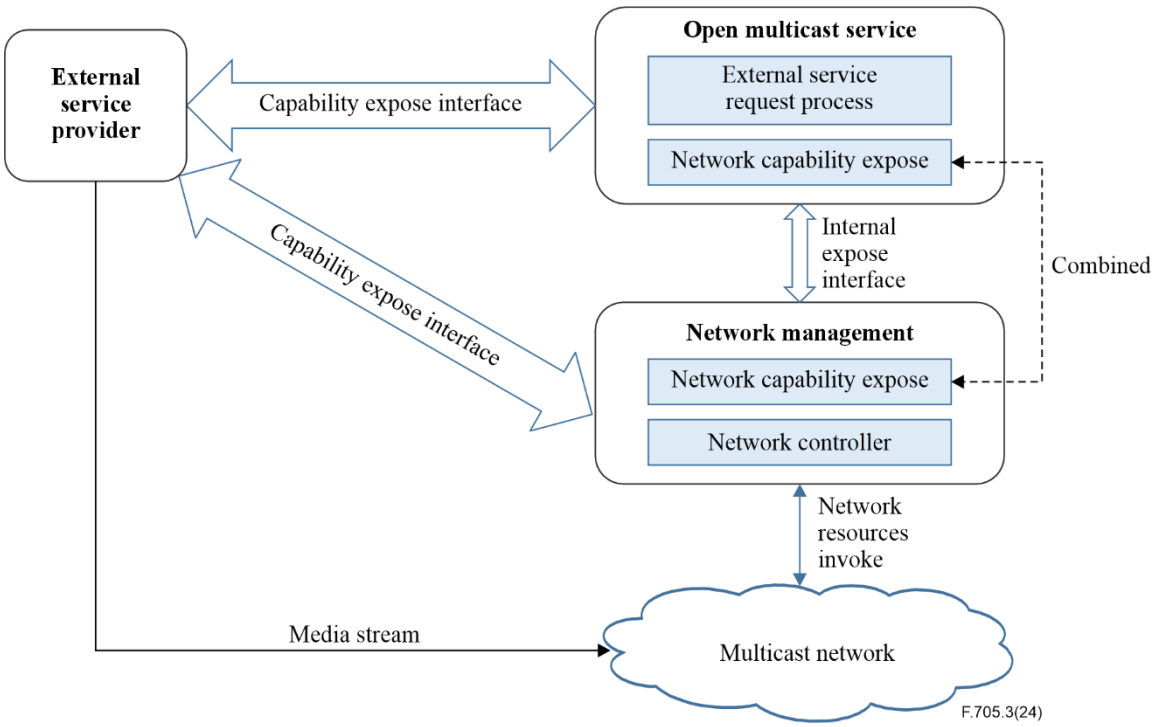


Figure 9-3 – Hybrid mode

This mode is recommended to be offered to both trusted and untrusted SPs according to their different authentication levels.

In principle, an external SP is not able to obtain the multicast network resources directly by communicating with the network controller in the initiate phase. Therefore, an open multicast service will be used to collect the requests from the external SPs and to return the logical network resources directly (similar to the intermediate mode described in clause 9.2.3). Furthermore, if the authentication of an external SP is confirmed, the capability expose interface redirected to the multicast network controller will be returned and will carry out the future communications.

Network capability expose functions can be realized in the network management system or multicast service platform or both, depending on the system implementation and the level of the customer's authorization.

This mode can protect the underlying multicast network element from the risky external operation. In addition, the SPs will have the opportunity to choose if they want to transfer their own content into an intermediate cache (may be provided by open multicast service provider) or not.

9.2.3 Intermediate mode

In this mode, an intermediate service platform is recommended to be provided with an open multicast service for the external SP to request multicast network resources. The intermediate service platform is capable of invoking logical network resources from network management functions via an internal expose interface between the intermediate platform and network management system.

Figure 9-4 shows the conceptual framework of intermediate mode.

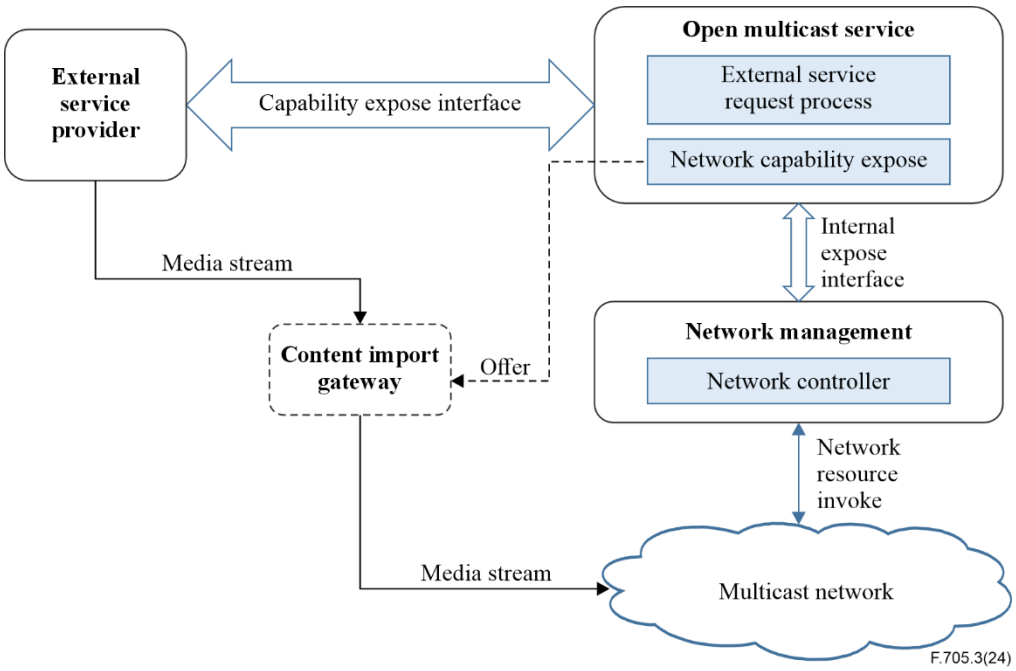


Figure 9-4 – Intermediate mode

This mode is highly recommended to be offered to untrusted SPs in order to completely shield sensitive underlying multicast network information from unauthorized access.

An open multicast service provided by the intermediate service platform offers a capability expose interface to the external SPs. The network capability expose functions are recommended to be implemented within the open multicast service and it can directly communicate with the network controller via a standard or private interface. The network resources request from an external SP will be optionally transformed to another format which can be recognized by the network controller. Only logical network resources information can be obtained and will be returned to the external SPs via the capability expose interface.

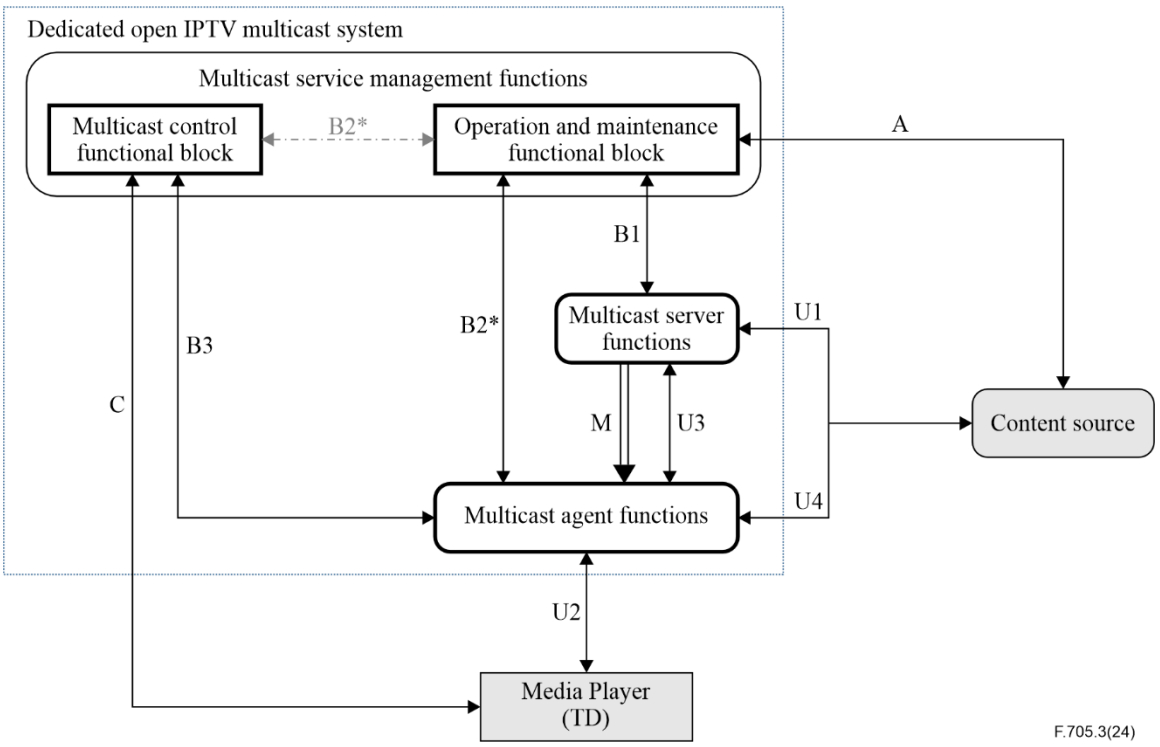
A content import gateway may be used if the open multicast service does not provide a content cache service. That gateway can act as the entry point of the physical multicast network.

The multicast network capability expose interface is particularly suitable for the networks where the network resources can be orchestrated, such as a BIER [b-IETF RFC 8279] network. A content delivery network (CDN) may be the other supplementary option for applying such a capability expose interface in the case that the CDN/VCDN solution is relied on a BIER network.

10 Reference points and procedure flow

10.1 Reference points of dedicated open IPTV multicast system

Figure 8-2 describes the interactions among the functions within the dedicated open IPTV multicast system. Figure 10-1 shows the respective recommended reference points between each of two functions or functional blocks; the detailed information of each reference point is defined in Table 1.



NOTE – The grey dashed line means the related interface can be optionally implemented. This situation can be found in explanation of RP-B2*.

Figure 10-1 – Referenced points

Table 1 – Reference points of dedicated open IPTV multicast system

Reference point		Definition	Protocol	Notes
A		Multicast service creation request; Reference point between content source and MSMF (Operation & Maintenance functional block)	HTTP/HTTPS	This RP is used for MSMF to receive the multicast service request from live content/service provider. Typically, the request includes the metadata of live content for creating and configuring multicast channels Map.
B	B1	Multicast channel management/configuration; Reference point between MSMF (Operation & Maintenance functional block) and MSF	HTTP (POST)	This RP is used to deliver the request of channel management, including channel creation, deletion and so on. Moreover, this RP can also be used to synchronise the configuration of channel map between MSMF and MSF.
	B2*	Multicast channel management/configuration; Reference point between MSMF (Operation & Maintenance functional block) and MAF	HTTP (POST)	Similar as B1, but between MSMF and MAF. NOTE* – This RP can optionally be reused to synchronise the configuration of channel map inside MSMF (between Operation and Maintenance functional block and Multicast Control functional block). For this implementation, B2 can optionally merged with B3.

Table 1 – Reference points of dedicated open IPTV multicast system

Reference point		Definition	Protocol	Notes
	B3	Multicast agent registration/login/heartbeat; reference point between MSMF (multicast control functional block) and MAF	HTTP (POST)	This RP is used for MAF to register/login onto MSMF. Once completed, this RP can be used for keeping live between MSMF and MAF.
C		Service scheduling/redirection; reference point between MSMF (multicast control functional lock) and terminal device (media player)	HTTP/HTTPS	This RP is used for Terminal Device (Media Player) to request the media service guide and receive the scheduling/redirection information.
M		Multicast stream transport; reference point between MSF and MAF	IGMP, FLUTE/NORM, RTP	This RP is used for MAF to join/quit multicast groups (channels) and to receive multicast streams.
U	U1	Unicast stream ingestion; reference point between MSF and content source	HTTP/FTP	This RP is used for ingesting media stream from content source, e.g., Live broadcast platform or CDN.
	U2	Media request; reference point between MAF and terminal device (media player)	HTTP/HTTPS (DASH/HLS)	This RP is used for Terminal device to request the media description information (e.g., M3U8 or MDP) and receive the media Index file or media segments, typically by DASH or HLS format NOTE – IF MAF is a client APP installed in a terminal device, this RP would be implemented as inner API.
	U3	Unicast stream request; reference point between MSF and MAF	HTTP/HTTPS (DASH/HLS)	This RP is used for MAF to request the media description information (e.g., M3U8 OR MDP) from MSF and receive the media Index file or media segments, typically by DASH or HLS format. This RP is also used for FCC and package repair.
	U4	Unicast stream request; reference point between MSF and MAF	HTTP/HTTPS (DASH/HLS)	If MSF is unavailable, or there is no channel provided, this RP is used for MAF to request unicast media from content source. In addition, this RP can also be used for fast channel change (FCC).

10.2 Procedure flows

The following clauses show the basic procedures by applying dedicated open IPTV multicast service.

10.2.1 Multicast channel creation and configuration

Figure 10-2 shows the basic procedure of multicast channel creation and configuration.

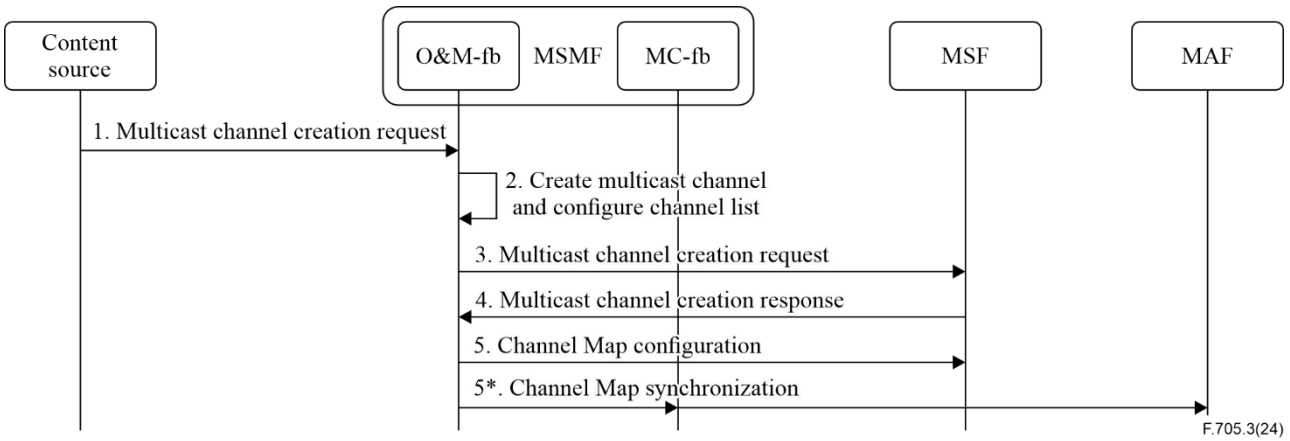


Figure 10-2 – Multicast channel creation and configuration procedure

The steps of the procedure:

1) A live content service provider requests enabling the multicast service and providing the content metadata from a content source, e.g., an original media server or CDN nodes.

2) MSMF creates multicast channels based on the information of the request and generates a multicast channel map, including channel list, multicast group information, etc.

3) MSMF sends the request to MSF for creating a multicast channel.

4) MSF creates a multicast channel based on the request and reports the creation result to MSMF.

5) MSMF, actually the operation and maintenance functional block, sends the multicast channel map to the MSF for configuration. MSF then transforms the unicast stream into a multicast stream and updates the multicast address information within the multicast channel map.

NOTE – (5*) as to the alternative implementations, the operation and maintenance functional block may also send the multicast channel MAP to MAF for synchronization directly, or relayed by multicast control functional block, if the internal reference point is implemented.

10.2.2 Live content ingestion and process

Figure 10-3 shows the procedure of ingesting live content from the content source into MSMF and processing.

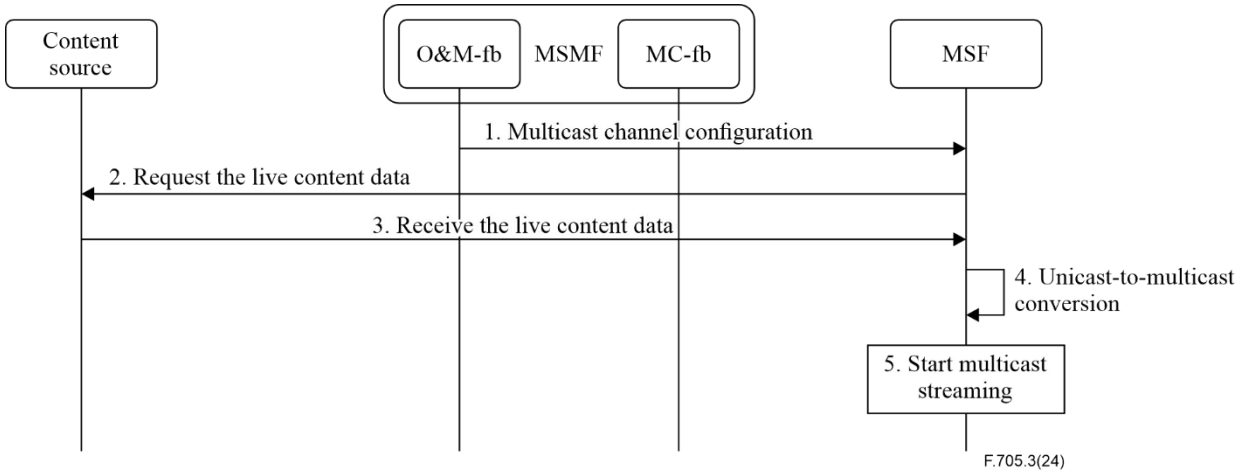


Figure 10-3 – Live content ingestion and process

The steps of the procedure:

1) MSMF (processed by O&M-fb) sends the multicast channel configuration information to MSF.

2) MSF obtains the content URL from that information and requests live content date from content source by unicast.

3) The content data is returned to MSF, which includes index media file, metadata and media stream file, etc.

4) The original media file stored in MSF, which was encapsulated as unicast format, is transformed into the multicast format before transmitting.

5) MSF starts multicast steaming.

10.2.3 Content request rescheduling

Figure 10-4 shows the procedure of rescheduling a content request from the media player (TD) to a MAF.

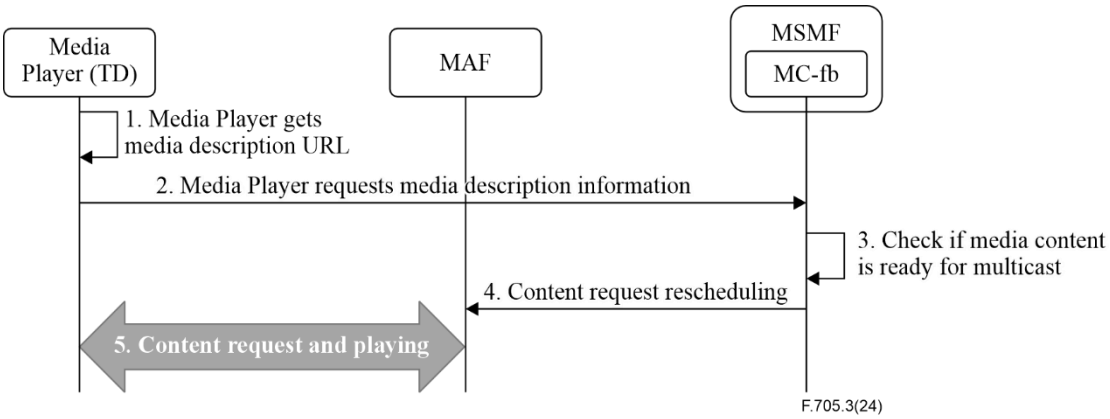


Figure 10-4 – Content request rescheduling procedure

The steps of the procedure:

1) The media player (TD) obtains the URL of the media description information corresponding to the media content. Previously, the content accessing information in the content source has been updated as the entry address of MSMF.

2) The media player therefore sends the requests to the MC-fb (in MSMF) for media description information.

3) The MC-fb determines whether the requested media content exists on a multicast channel (support multicast transmission). If the multicast channel exists, the request is redirected to the MAF which the terminal device is being attached. If there is no multicast channel or the multicast channel is unavailable, the terminal device request is redirected to the content source as the normal unicast process.

4) The MC-fb returns the media description information request redirection response message, which includes the IP address information of the MAF.

5) The media player executes subsequent request and playback processes.

10.2.4 Media content request and conversion

Figure 10-5 shows the procedures of a media stream request from a media player (TD) and the entire process between MSF and MAF.

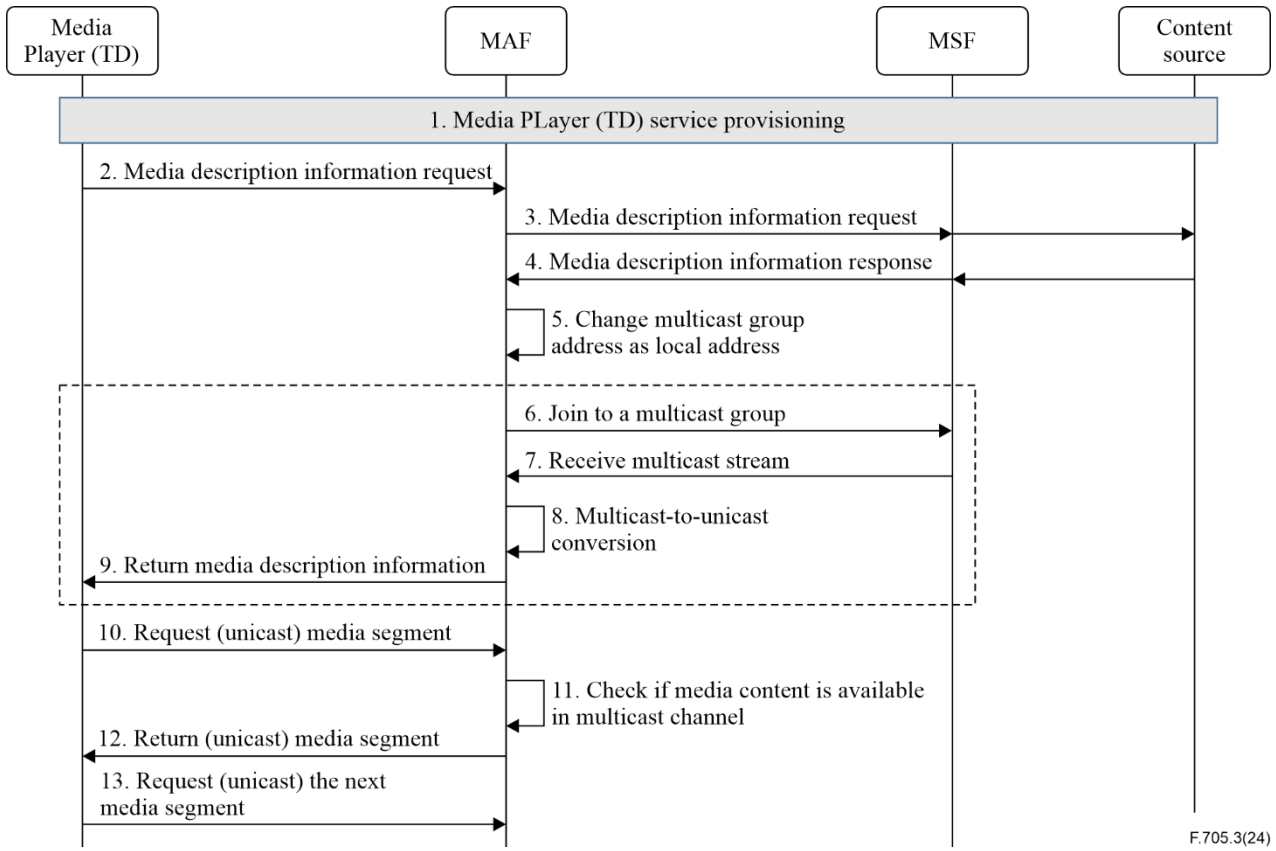


Figure 10-5 – Media content request and conversion procedures

The steps of the procedure:

1) The media player obtains the URL of the media description information corresponding to the request content and initiates a service attachment process with MSMF. The process of service attachment can follow the rescheduling process in clause 10.2.3.

2) The media player requests media description information from MAF.

3) The MAF sends a request for media description information to MSF. If the MSF is unavailable, a request can be sent to the content source.

4) The MAF receives media description information returned from the MSF (or from the content source).

5) The MAF obtains the multicast group information and converts the index file address and/or media segments addresses included therein into the local addresses of the MAF.

6) The MAF joins a specified multicast group based on the multicast group information.

7) The MAF receives the multicast stream sent by the MSF, which encapsulates index files and/or media segments corresponding to the media description information.

8) The MAF directs index files and media segments in multicast data packets to local index files and local media segments respectively based on its address (change multicast format to unicast format).

9) The MAF returns the media description information to the media player.

NOTE 1 – Due to potential concurrent processing in practical implementation, the steps 6-9 may not always be executed in sequence, for example, steps 6-8 may be processed after step 9.

10) The media player requests a media segment from the MAF based on the media description information.

11) The MAF determines whether the requested playback content exists on a multicast channel (supports multicast transmission). If a multicast channel exists, proceed to the next step; otherwise, initiate a unicast (proxy) mechanism to request media content slices from the live platform/CDN.

NOTE 2 – During playback, if the MAF finds that the requested media segments by the media player cannot be normally received through multicast data packets sent by the MSF (e.g., multicast server is crashed or multicast stream is interrupted in step 7), it needs to request media index files and local media content files corresponding to multicast data packets from the previous media server (e.g., content source) that was requested for the media description information before.

12) The MAF returns the media segment to the media player through unicast transmission.

13) The media player requests the subsequent media segments.

10.2.5 Multicast agent registration/login

Figure 10-6 shows the procedures of MAF registration and authentication during login.

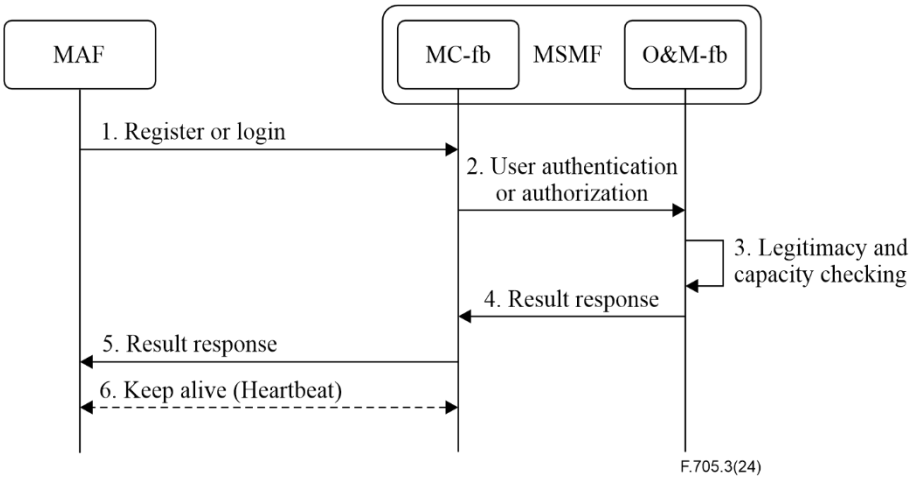


Figure 10-6 – MAF registration and login procedures

The steps of the procedure:

1) When The MAF is activated, it initiates a registration/login request to the MSMF (actually processed by MC-fb).

2) The MC-fb requests user authentication/authorization from the O&M-fb.

3) The O&M-fb verifies the legitimacy of MAF and users as well as the system capacity.

4) The O&M-fb returns the authentication result to the MC-fb, and the MC-fb caches that authentication result.

5) The MC-fb returns the registration result to the MAF.

6) The MAF regularly initiates a heartbeat mechanism process to the MC-fb and provides the performance of the MAF as reference data. The MC-fb updates the MAF status, returns a heartbeat response to the MAF, and sends the latest multicast channel MAP (if any).

NOTE – If the MAF fails to pass the login or authentication, the original unicast/multicast function of the media player remains unchanged. If the MAF passes the verification, its multicast function will be enabled.

Appendix I

Scenarios of service providers utilizing open multicast service

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

In various scenarios, the open multicast business model enables different levels of service and resource allocation based on the trust level and needs of the service provider. Trusted providers enjoy more direct access and capabilities, suitable for established businesses needing robust and reliable service, while untrusted providers, typically newer or smaller entities, start with more limited access, providing a pathway to build trust and potentially expand their services over time.

I.1 Trusted service provider

A well-established, national broadcasting company TS, known for its high-quality live TV and event broadcasting services, wishes to enhance its live streaming capabilities. TS has a longstanding relationship with a leading IPTV multicast network provider, MP. With signed business agreements, TS has been authenticated and authorized, and granted the status of a trusted service provider.

Given its trusted status, TS directly accesses MP's IPTV multicast network, bypassing traditional CDNs. TS leverages this access for broadcasting major live events (e.g., sports events, concerts) with enhanced quality and lower latency, offering an improved viewer experience. MP calculates and allocates dedicated multicast resources to TS, ensuring stable and high-quality delivery of high-demand content. TS pays MP for this premium access on a usage basis, correlating with the viewer traffic and bandwidth utilized. Furthermore, TS can offer its viewers packages with exclusive content, leveraging its enhanced delivery capability, thereby increasing its subscriber base and revenue.

I.2 Untrusted service provider

A startup firm, US, focusing on independent film and documentary streaming, seeks to expand its audience reach with live streaming options. US is relatively new and does not have a prior relationship with any IPTV multicast network provider. They approach an IPTV multicast network provider, MP, to utilize their multicast services but are categorized as an untrusted service provider due to the lack of an established trust relationship.

US accesses MP's multicast services via an open interface, adhering to the terms and conditions set for untrusted providers. MP provides a limited amount of multicast resources to US, with stricter monitoring and control to safeguard the network. US is charged based on the actual usage of multicast resources, with options to scale up as their audience grows. US uses this opportunity to offer live Q&A sessions with filmmakers and exclusive live-streamed events for its niche audience. Over time, as US establishes a track record of responsible usage and compliance, they aspire to gain trusted status, allowing for more direct network access and resource allocation.

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