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Framework for multicast based IPTV content delivery

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Recommendation ITU-T Y.1902

Framework for multicast based IPTV content delivery

Summary

This Recommendation describes a framework for multicast based IPTV content delivery based upon different content delivery functional models and their associated requirements. The content delivery functional models are defined according to different methods of multicast-based IPTV content delivery in terms of IPTV functional architecture [ITU-T Y.1910]. Requirements for multicast capabilities specified in this Recommendation are based on the requirements provided in [ITU-T Y.1901].

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Recommendation ITU-T Y.1902

Framework for multicast based IPTV content delivery

1 Scope

This Recommendation provides a framework for multicast based IPTV content delivery based upon different content delivery functional models and their associated requirements for delivery of IPTV content to multiple end-users simultaneously.

The content delivery functional models are defined according to different methods of multicast-based IPTV content delivery in terms of the common functions of the IPTV functional architectural approaches (i.e., Non-NGN, NGN-non-IMS, and NGN-IMS) described in [ITU-T Y.1910].

For each content delivery functional model, different roles for the functions of the IPTV architecture are identified according to the multicast capabilities defined in [ITU-T Y.2236].

For each multicast capability, the corresponding requirements for multicast based IPTV content delivery are further identified based on the requirements to support IPTV services [ITU-T Y.1901].

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.1901] | ITU-T Recommendation Y.1901 (2009), <i>Requirements for the support of IPTV services</i> . |
| [ITU-T Y.1910] | ITU-T Recommendation Y.1910 (2008), <i>IPTV functional architecture</i> . |
| [ITU-T Y.2019] | ITU-T Recommendation Y.2019 (2010), <i>Content delivery functional architecture in NGN</i> . |
| [ITU-T Y.2236] | ITU-T Recommendation Y.2236 (2009), <i>Framework for NGN support of multicast-based services</i> . |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

- 3.1.1 channel changing** [ITU-T Y.1901]: The act of changing from one channel to another.

- 3.1.2 cluster** [ITU-T Y.2019]: Cluster is a grouping of content delivery processing entities with their related control entity. Such grouping allows the sharing of resources (e.g. storage capacity) based on provider's policy (e.g. taking into account parameters such as user location).
- 3.1.3 content provider** [ITU-T Y.1910]: The entity that owns or is licensed to sell content or content assets.
- 3.1.4 content segment** [ITU-T Y.1901]: A continuous portion of a piece of content, for example, a single topic in a news programme.
- 3.1.5 delivery** [ITU-T Y.1910]: In context of IPTV architecture, "delivery" is defined as sending contents to End-user.
- 3.1.6 distribution** [ITU-T Y.1910]: In context of IPTV architecture, "distribution" is defined as sending the content to appropriate intermediate locations to enable subsequent delivery.
- 3.1.7 end-user** [ITU-T Y.1910]: The actual user of the products or services.
NOTE – The end-user consumes the product or service. An end-user can optionally be a subscriber.
- 3.1.8 linear TV** [ITU-T Y.1910]: A television service in which a continuous stream flows in real time from the service provider to the terminal device and where the user cannot control the temporal order in which contents are viewed.
- 3.1.9 multicast** [b-ITU-T X.603]: A data delivery scheme where the same data unit is transmitted from a single source to multiple destinations in a single invocation of service.
- 3.1.10 multicast group** [b-ITU-T X.601]: A set of service users that abide by appropriate group-membership criteria, or a set of rules belonging to a group that enables multicast-based services and applications.
- 3.1.11 multicast connection** [ITU-T Y.2236]: A transmission path used for data transfer among members of a multicast group.
- 3.1.12 network provider** [ITU-T Y.1910]: The organization that maintains and operates the network components required for IPTV functionality.
NOTE 1 – A network provider can optionally also act as service provider.
NOTE 2 – Although considered as two separate entities, the service provider and the network provider can optionally be one organizational entity.
- 3.1.13 service provider** [b-ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider can optionally operate a network. A service provider can optionally be a customer of another service provider.
NOTE – Typically, the service provider acquires or licenses content from content providers and packages this into a service that is consumed by the end-user.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAA	Authentication, Authorization, Accounting
ALTO	Application-Layer Traffic Optimization
CD&SF	Content Delivery & Storage Functions
CDF	Content Delivery Functions
CDN	Content Delivery Network
CE	Customer Edge
CS	Content Source
DiffServ	Differentiated Services
DNS	Domain Name Services
DoS	Denial of Service
DSN	Distributed Service Network
EUF	End-User Functions
IGMP	Internet Group Management Protocol
MDT	Multicast Distribution Tree
MLD	Multicast Listener Discovery
MN	Management Node
MPLS	Multiprotocol Label Switching
MTF	Multicast Transport Functions
mVPN	Multicast Virtual Private Network
NF	Network Functions
NP	Network Provider
p2p	Peer-to-Peer
PE	Provider Edge
PIM	Protocol Independent Multicast
QoE	Quality of Experience
QoS	Quality of Service
SCF	Service Control Functions
SNMP	Simple Network Management Protocol
SP	Service Provider
TOCF	Traffic Optimization Control Function
VPN	Virtual Private Network
VRP	Virtual Routing and Forwarding

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 document 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 “**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.

Requirements are identified using the convention for the requirements in [ITU-T Y.1901].

6 Overview

In the multicast based IPTV content delivery, IPTV content is delivered to one or more end-users simultaneously via the use of unicast and/or multicast mechanisms supported by network functions (NF) of the IPTV functional architecture.

To support the multicast based IPTV content delivery, the functions of the IPTV architecture provide their own capabilities as defined in [ITU-T Y.1910].

Figure 6-1 depicts the IPTV architectural overview (Figure 9-1/Y.1910 [ITU-T Y.1910]) and highlights the functional groups involved in multicast based IPTV content delivery which are in the scope of the framework provided in this Recommendation, i.e. service control functions (SCF), content delivery functions (CDF), end-user functions (EUF), and NF as defined in [ITU-T Y.1910].

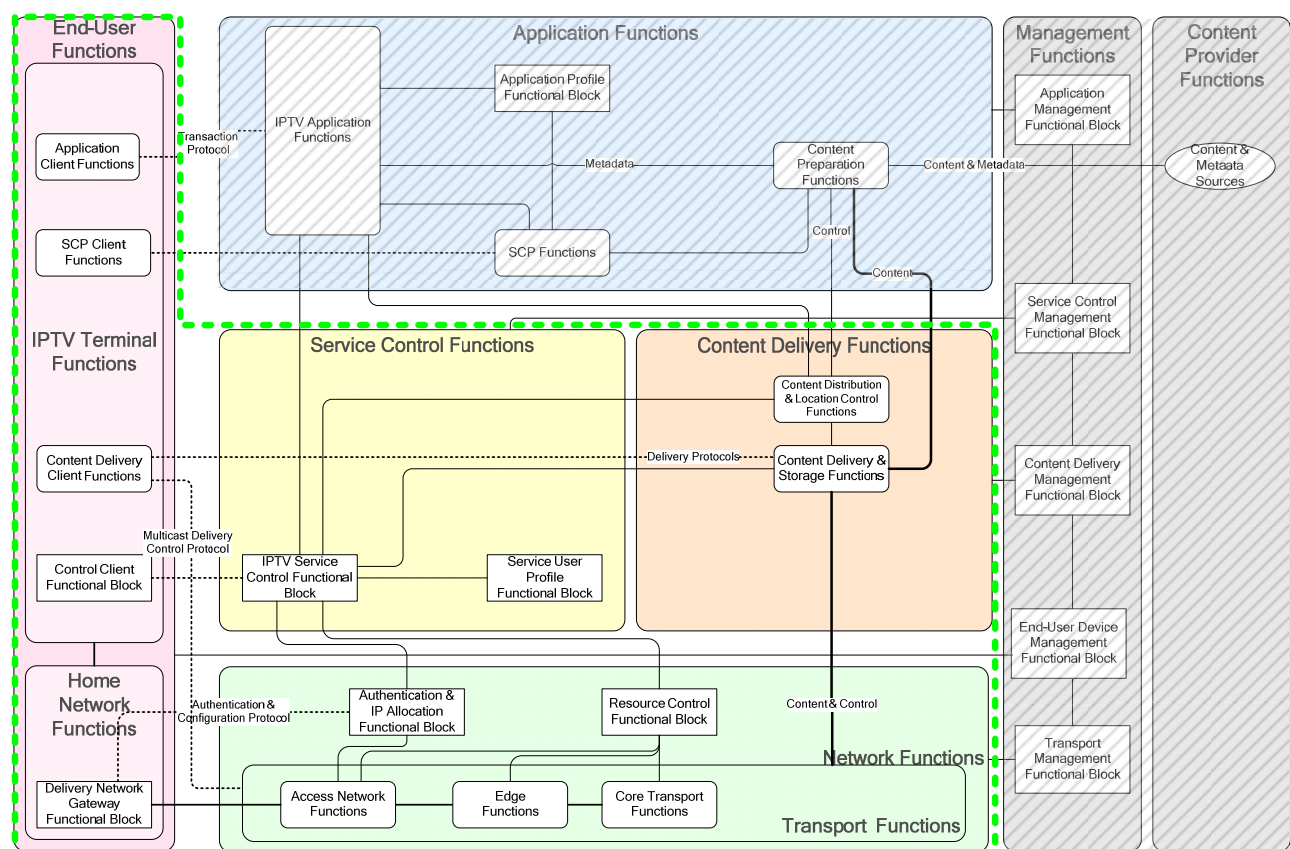


Figure 6-1 – IPTV functional architecture and the involved functions to multicast based IPTV content delivery

The roles and use of the functions of the IPTV functional architecture [ITU-T Y.1910] may vary depending upon the business models in place, thus leading to different content delivery functional models.

In the following clauses, this Recommendation describes such different functional models for multicast based IPTV content delivery. The involved functions of the IPTV functional architecture and their roles and use for each of the described models are shown. This Recommendation further describes the specific roles of the functions of IPTV functional architecture and the corresponding requirements for multicast based IPTV content delivery based on the multicast capabilities defined in [ITU-T Y.2236].

NOTE 1 – In this Recommendation, unless explicitly indicated otherwise, the term “multicast based IPTV content delivery” is used in general way to indicate a method of delivery of IPTV content to multiple end-users simultaneously. In [ITU-T Y.1910], the term “multicast content delivery” or “multicast delivery” is used more specifically to indicate one of the IPTV content delivery methods by which CDF delivers IPTV content to EUF via multicast transport functions (MTF).

NOTE 2 – This Recommendation does not address interconnection issues related to multicast based IPTV content delivery, e.g. interconnection between different service providers (SPs) supporting content delivery functions.

7 Functional models for multicast based IPTV content delivery

This clause describes the functional models for multicast based IPTV content delivery.

NOTE 1 – This Recommendation does not provide specific functional model for unicast content delivery. [ITU-T Y.1910] provides a description of the CDF that support unicast content delivery and which can be deployed in different ways depending of the delivery constraints. Starting from content delivery functions defined in [ITU-T Y.1910], [ITU-T Y. 2019] describes a further decomposed functional model called "hierarchical model" that can be used for unicast content delivery.

For each functional model, the description includes figures illustrating how relevant functions of the IPTV functional architecture are used for multicast based content delivery.

In figures 7-1 to 7-4, the boxes in dotted lines indicate the IPTV domains which are defined in [ITU-T Y.1910] and solid lines indicate the content distribution paths. The solid lines with arrows indicate the forwarding of replicated data performed by the multicast capability. The small rounded boxes indicate the instances of relevant IPTV architecture functions for multicast based IPTV content delivery in the considered model. The IPTV domains and functions which provide multicast capabilities in the considered model are highlighted.

NOTE 2 – In the figures 7-1 to 7-4, the control paths for multicast based IPTV content delivery are omitted given that the functional models for content delivery are differentiated depending upon which functions perform the multicast based delivery of IPTV content.

NOTE 3 – The figures in this clause depict some examples of content distribution paths. However in the multicast based IPTV content delivery, the way on how to construct a content distribution path (e.g., mesh-based, tree-based) and to distribute the content among the instances of functions in IPTV architecture (e.g., pull-based or push-based, multiple source-based or single source-based) may vary depending on implementation choices.

NOTE 4 – In the IPTV functional architecture [ITU-T Y.1910], there are other functional groups (such as content preparation functions, home network functions) which are related to multicast based IPTV content delivery. Given that the roles of these functions do not vary in the different considered content delivery functional models, these functions are not mentioned for simplicity reasons.

The following sub-clauses describe four different functional models for multicast based delivery of IPTV content.

These functional models are mainly differing due to the roles and use of the functions which are supporting the multicast capabilities for delivering IPTV content. In this Recommendation, the considered multicast capabilities described in [ITU-T Y.2236] consist of multicast group management, multicast service control, quality of service (QoS) control, security, mobility, accounting & charging, and multicast data delivery. Depending on the functional model, these capabilities are supported by different functions in the IPTV functional architecture.

More details about these functional models are provided in Appendix I.

7.1 Network multicast model

In this model, the multicast capabilities are supported by MTF which is provided in the network provider (NP) domain (i.e. by the telecommunication equipments operated and controlled by the network provider). Each instance of EUF registers itself to a specific multicast group by exchanging messages for joining (e.g. Internet Group Management Protocol (IGMP) [b-IETF RFC 3376] messages) with an MTF instance. MTF instances construct multicast distribution paths and IPTV content is delivered from content sources (CSs) via the CDF to each EUF along the paths.

Figure 7-1 depicts how the IPTV content is delivered by the relevant functions in the network multicast model.

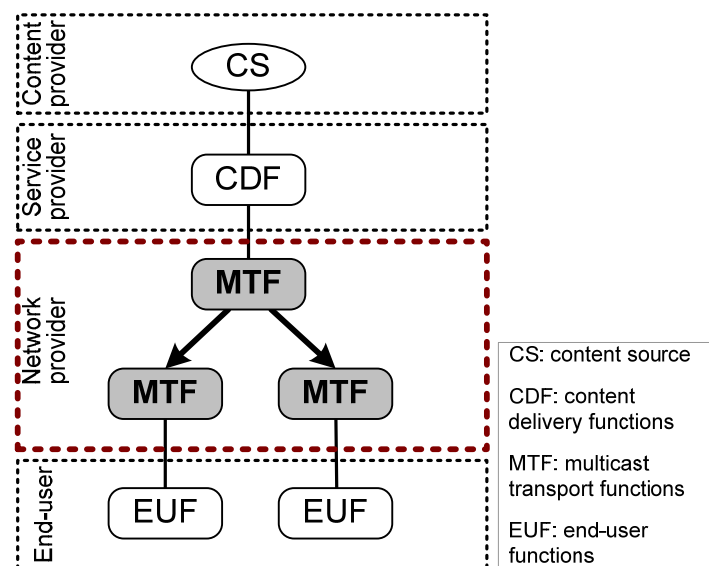


Figure 7-1 – Network multicast-based content delivery

In this model, a network provider provides and manages the multicast capabilities for multicast based IPTV content delivery. Performance of a network multicast-based IPTV content delivery is tightly related to the condition of NP's network.