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Cloud-based converged media services for IP and broadcast cable television

Specification of a cloud-based converged media service to support Internet protocol and broadcast cable television – System specification on collaboration between production media cloud and cable service cloud

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Summary

Recommendation ITU-T J.1303 is Part 3 of a multi-part deliverable covering the high-level system architecture for cloud-based converged media service to support IP and broadcast cable TV, as identified below:

Part 1: Requirements (ITU-T J.1301);

Part 2: System architecture (ITU-T J.1302);

Part 3: **System specification on collaboration between production media cloud and cable service cloud.**

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T J.1303	2022-01-13	9	11.1002/1000/14842

Keywords

Cable service cloud, CBCMS, cloud streaming service, edge cloud, production media cloud.

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Specification of cloud-based converged media service to support Internet protocol and broadcast cable television – System specification on collaboration between production media cloud and cable service cloud

1 Scope

This Recommendation specifies the architecture and the functions of collaboration between the production media cloud and the cable service cloud, the functions of collaboration between the central cloud and the edge cloud(s) under the control of the cable service cloud, and the functions of these two types of clouds. This specification is intended to enable rapid deployment of new services and flexible expansion of online services for cable television operators and provide diverse programmes originating from the Internet to users.

This system specification fulfils the requirements in [ITU-T J.1301] and complies with the system architecture in [ITU-T J.1302].

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 J.1301] Recommendation ITU-T J.1301 (2021), *Specification of cloud-based converged media service to support Internet protocol and broadcast cable television – Requirements.*

[ITU-T J.1302] Recommendation ITU-T J.1302 (2021), *Specification of a cloud-based converged media service to support Internet protocol and broadcast cable television – System architecture.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 cloud-based converged media service (CBCMS) [ITU-T J.1301]: The cloud-based converged media service is intended to be deployed by cable television operators and to support the requirements of rapid service innovation and deployment, which enables media service to be developed by separate vendors according to standard application programming interfaces (APIs), where appropriate.

3.1.2 multi-access edge computing (MEC) [b-ETSI GS MEC 001]: System which provides an IT service environment and cloud-computing capabilities at the edge of an access network that contains one or more types of access technology, and in close proximity to its users.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 cloud streaming service: The service using streaming technology to transmit media content from the cloud and allowing IP and broadcast cable TV users access Internet media without replacing set-top boxes or upgrading the firmware.

3.2.2 cable service cloud: The cloud which provides converged media service.

3.2.3 central cloud: The cloud that has the full set of services provided by the cloud service provider.

3.2.4 edge cloud: The cloud that is deployed close to users' locations and has a limited set of services compared to the central cloud.

3.2.5 production media cloud: The cloud in which the media is produced and customized according to group user or individual user requests and/or the analysis of customers preferences.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AI Artificial Intelligence

API Application Programming Interface

AR Augmented Reality

CBCMS Cloud-Based Converged Media Service

CCTV Closed-Circuit Television

CDN Content Distribution Network

ID Identification

IDC Internet Data Centre

MEC Multi-access Edge Computing

VR Virtual Reality

5 Conventions

In this Recommendation:

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

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The keywords **"can optionally"** indicate an optional requirement that 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 document 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 System architecture

The collaboration between the production media cloud and the cable service cloud is shown in Figure 1. The production media cloud provides the media content to the cable service cloud which further delivers the content to the users set-top boxes or mobile devices. The production media cloud is required to have the capabilities of media production, media operation and media resource management, and can optionally have the capability of user data analysis to recommend different programmes to different users according to the references deduced from the analysis result.

In the cable service cloud, there is one central cloud and multiple edge clouds which collaborate to process users' requests. The edge cloud is mainly responsible for local and real-time data processing tasks while the central cloud is mainly responsible for the processing of non-real-time and large amounts of data.

The central cloud is required to have the capabilities of operation, deployment, orchestration, and maintenance of edge clouds resources through a unified management and control module and can optionally have the capability of user data analysis.

Edge clouds are required to be deployed by cable TV operators to guarantee the latency. An edge cloud is composed of multiple nodes. In an edge node, it is recommended to use containers to deploy the services required by the service operation server, such as media caching and cloud streaming service, which is illustrated in Appendix I, etc. The service operation server processes the user's request. It can run on a standalone physical device in the edge cloud or be deployed in an edge node.

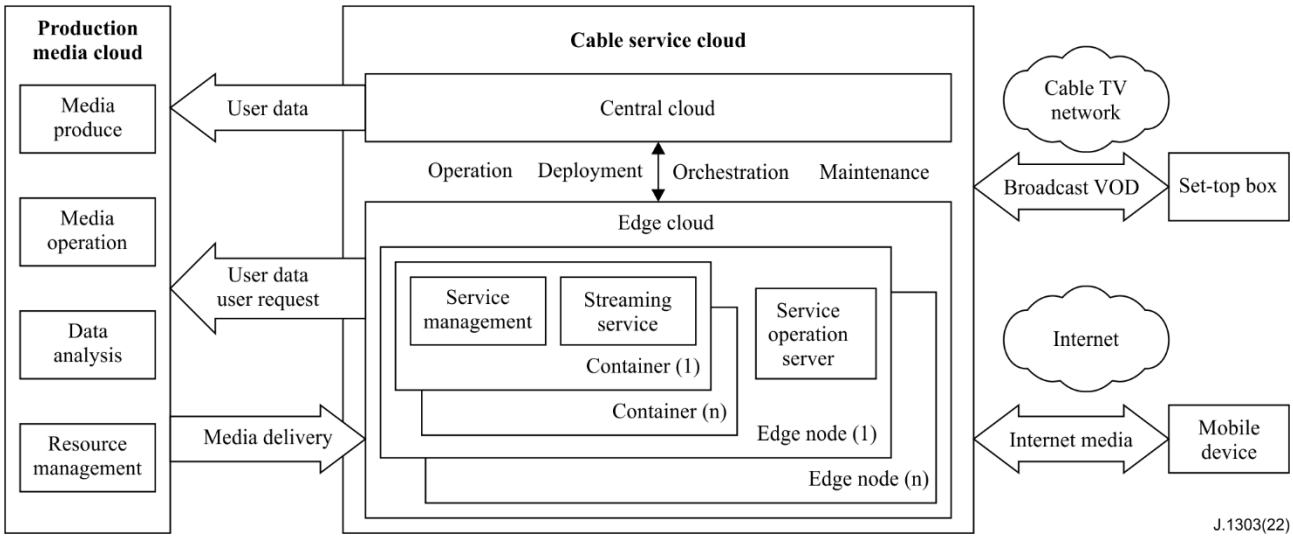

Figure 1 – Collaboration between production media cloud and a cable service cloud

The collaboration between the production media cloud and the cable service cloud is reflected in three ways.

– The cable service cloud forwards users' requests to the production media cloud.

– The production media cloud will find the proper media content in its storage or even produce new media programmes according to users' requests, then provide feedback to the cable service cloud which will then further make up the media programmes to fit the user devices.

– The cable service cloud will collect all kinds of user data such as the time of order, location of the user, model of the user's device, etc., and send the data to the production media cloud for statistics and analysis. The data can be sent from the edge cloud node directly to the production media cloud after de-identification. Alternatively, the data can be sent first to the central cloud. The central cloud will then perform analysis and only send the statistics data to the production media cloud.

7 Edge cloud

The edge cloud is composed of multiple edge nodes. The architecture of the edge cloud node is shown in Figure 2.

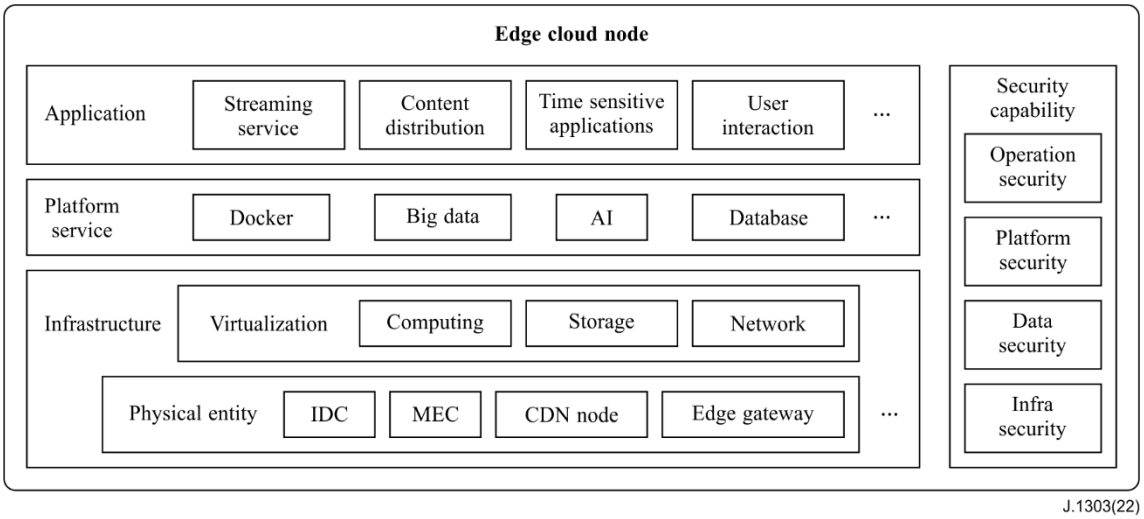

Figure 2 – The architecture of edge cloud

7.1 Infrastructure layer

Edge cloud can be deployed in the Internet data centre (IDC), multi-access edge computing (MEC), content distribution network (CDN) node, edge gateway, and other types of devices on which the resource can be virtualized.

The computing, storage and network resources are required to be virtualized at the deployment of the node.

7.2 Platform layer

At the platform layer the edge cloud is required to provide docker service and can optionally provide services such as big data processing, artificial intelligence (AI) and cloud database, etc.

7.3 Application layer

At the platform layer the edge cloud is required to provide media content distribution service and can optionally provide time sensitive applications such as augmented reality (AR) / virtual reality (VR), user interaction and streaming service, etc.

7.4 Security requirements

The edge cloud is required to provide fundamental security measures from these aspects:

– Infrastructure security: deploying access control system and closed-circuit television (CCTV) at the physical location;

– Data security: encrypting the data stored at the edge node and the data transmitted to the central cloud or the production media cloud, etc.;

– Platform security: providing secure isolation among instances, secure storage of cyphering keys, authentication and authorization of access request, etc.;

– Operation security: providing intrusion detection, discovery of abnormal service requests, etc.

8 Central cloud

The central cloud can work collaboratively with multiple edge clouds through a unified management and control module, including:

– Unified scheduling: The edge cloud can run and deploy on edge infrastructure such as IDC, MEC nodes, CDN nodes, or edge gateways and perform resources management. The central cloud can schedule storage, computing, network and other infrastructure resources of the edge cloud according to users' service requirements and select the most appropriate resources in the edge cloud. The edge cloud can apply to the central cloud for resource requests according to the business needs;

– Unified orchestration management: The central cloud can achieve unified resource orchestration and business orchestration, and can manage the life cycle of each edge cloud application in a unified way, including service start and stop, network status monitoring, etc., and can release an edge cloud node in the case of failure or other needs of migration of application instances;

– Unified deployment: The central cloud and edge cloud coordinate the service deployment and conduct unified management to provide remote deployment of various edge cloud services;

– Unified operation and maintenance: The edge cloud can carry out remote operation and maintenance work. The related operations can be carried out in the central cloud;

– Security capabilities: The central cloud can provide security capabilities to the edge cloud to achieve capabilities including infrastructure security, cloud platform security, operation security and data security.

9 Service operation server

9.1 Required functions

The service operation server is required to have the functions of event management, session management, authentication and authorization, media format adaption, media protocol adaption, streaming push and on-self management.

9.1.1 Event management

Event management includes the following capabilities:

– Preconfigure remote control key-value mapping. Mapping the keys of the remote controllers associated with the set-top boxes models to the values of the Internet media services in the launched menu.

9.1.2 Session management

Session management includes the following capabilities:

– Connect with the Internet media service deployed in the central cloud and request for edge cloud resource allocation;

– Maintain the media service request information which is necessary for launching the correct streaming application in the docker instance in the edge cloud.

9.1.3 Authentication and authorization

The authentication and authorization request is sent to the authentication server which is already deployed by the cable TV operator.

9.1.4 Media format adaption

If the resolution of the set-top box is lower than the media streaming generated in the edge cloud, the service operation server is required to perform format adaption.

9.1.5 Media protocol adaption

The service operation server is required to choose the proper communication protocol to transmit the media stream according to the model of the set-top box.

9.1.6 Streaming push

The service operation server is required to push the media stream to the correct set-top box.

9.1.7 On-self management

On-self management includes the following capabilities:

– Manage different Internet media resources which can be launched in the service menu.

9.2 Optional functions

The service operation server can optionally provide the capabilities of audit, data analysis, and other media processing capabilities listed in Part 2: System architecture clause 8.1. These capabilities are shown in the programme menu pushed from the service operation server to the set-top box.

9.2.1 Audit

Audit includes the following capabilities:

– Secure storage of the service log file;

– Transmitting the information necessary for billing, to the cable TV operator's billing server.

9.2.2 Data analysis

Data analysis includes the following capabilities:

– Statistics of the media programmes ordered by users.

Appendix I

The examples of cloud streaming service procedures

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

I.1 Introduction

There is huge amount of non-intelligent set-top boxes in the stock market which cannot access Internet media services. The cost of replacing these boxes is unacceptable by the broadcast cable TV operators. It is also not applicable to remotely upgrade the firmware of the boxes as the manufacturers and the models are numerous.

Cloud streaming service is a type of cloud-based converged media service which uses streaming technology to transmit Internet originated media content from cloud and allowing the IP and the broadcast cable TV users access Internet media without replacing their set-top box or upgrading the firmware. Cloud streaming service is deployed in the service cloud of the broadcast cable TV operators, and enables flexible expansion of online services, smart adaption of service origins or paths to meet the distribution needs for different terminal types and network status. With cloud streaming service broadcast cable TV operators can greatly reduce terminal investment, improve user experience and accelerate the deployment of new services.

Figure I.1 shows the system architecture of a cloud streaming service.

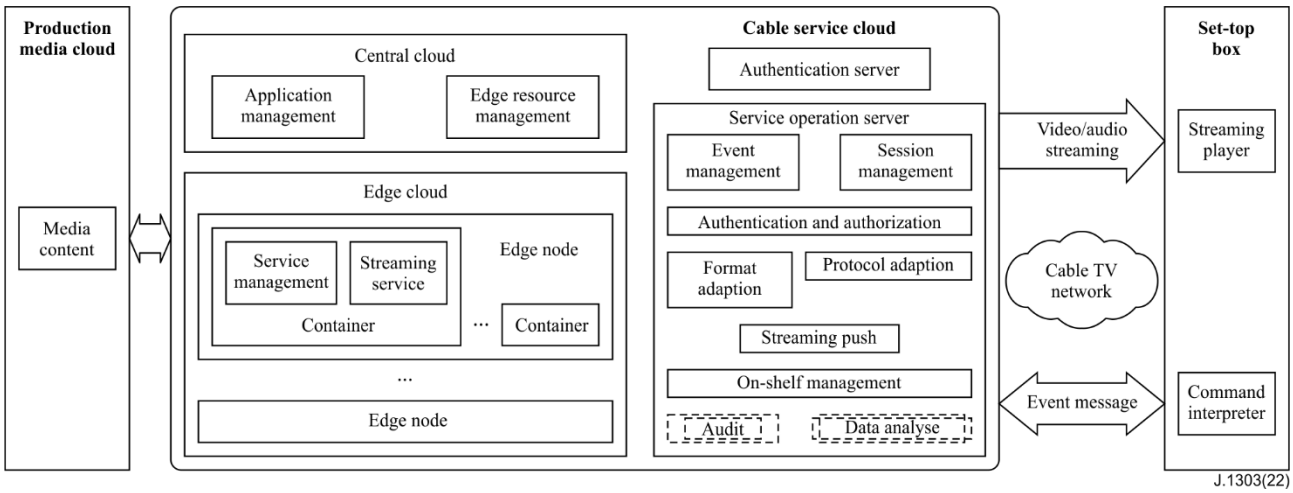

Figure I.1 – System architecture

The edge node is required to provide management streaming service and streaming service in the containers.

Service management includes the following capabilities:

– Verify the session set-up request of the set-top box;

– Manage the session with the set-top box;

– Map the media request to correct the Internet media programme;

– Send the media request to the correct the Internet media resource.

Streaming service includes the following capabilities:

– Decode the original media received from the Internet media resource;

– Reformate the media to a stream;

– Send the stream to the service operation server.

The central cloud is required to provide application management which allocates the instance identification (ID) to each service request. The edge resource management in this scenario includes the following capabilities:

– Monitor the quota of the available resource in each edge cloud node;

– Schedule the edge cloud node closest to the set-top box to create a docker instance for the streaming service;

– Migrate a streaming service to a new docker or another edge cloud node in case the status of the current docker or edge cloud node is abnormal.

I.2 Process

The process of a cloud streaming service is as indicated in Figure I.2.

1) When the set-top box is bootstrapping, an Internet media service menu is pushed to the set-top box from the service operation server;

2) The user can choose a media programme from the menu using a remote controller and the service request will be sent to the service operation server as a command;

3) The service operation server requests the authentication server to authenticate the user and verify if the user has registered for the Internet media service;

4) The service operation server sends the service request to the central cloud;

5) The central cloud schedules the edge cloud node resource for the service request;

6) The central cloud sends the instance ID to the service operation server;

7) The service operation server forwards the instance ID to the set-top box;

8) The command is transferred to the edge cloud;

9) The edge cloud creates a docker instance which is installed in the codec application of the media programme ordered by the user;

10) The set-top box sets up a session with the docker instance in the edge cloud node using the instance ID and other parameters;

11) The edge cloud sends the service request to the media server in which the original media resource is hosted;

12) The media server sends the media back to the docker instance;

13) The docker instance decodes the media programme and turns it into a media stream in a format which will be displayed by the set-top box directly;

14) The media stream is sent to the service operation server;

15) The service operation server does the format adaption and protocol adaption according to the model of the set-top box if needed;

16) The service operation server sends the media stream to the set-top box;

17) The set-top box displays the media stream.

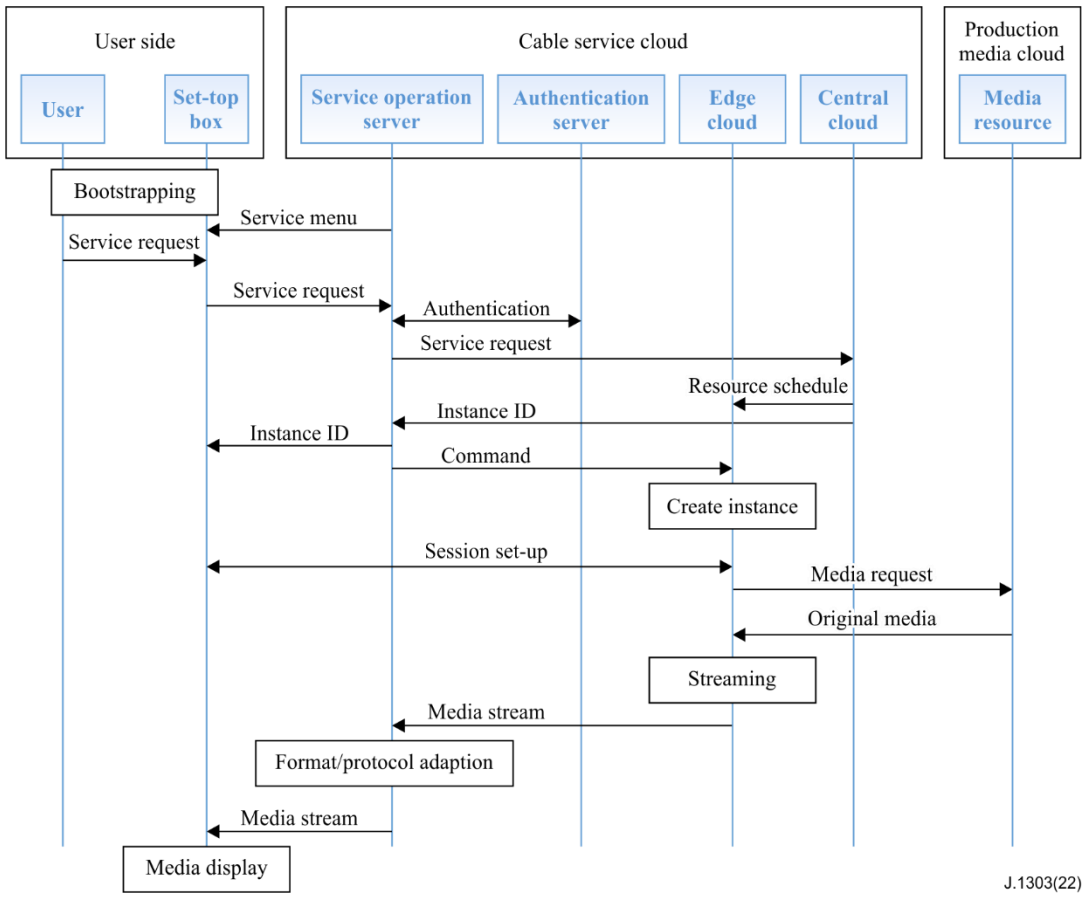

Figure I.2 – Cloud streaming service procedure

Bibliography

[b-ETSI EN 301 192] ETSI EN 301 192 V1.6.1 (2015), *Digital Video Broadcasting (DVB); DVB specification for data broadcasting*.
https://www.etsi.org/deliver/etsi_en/301100_301199/301192/01.06.01_60/en_301192v010601p.pdf

[b-ETSI GS MEC 001] ETSI GS MEC 001 (2019), Multi-access Edge Computing (MEC); Terminology.
https://www.etsi.org/deliver/etsi_gs/mec/001_099/001/02.01.01_60/gs_mec001v020101p.pdf

[b-ETSI TS 102 809] ETSI TS 102 809 V1.3.1 (2017*), Digital Video Broadcasting (DVB); Signalling and carriage of interactive applications and services in Hybrid broadcast/broadband environments*.
https://www.etsi.org/deliver/etsi_ts/102800_102899/102809/01.03.01_60/ts_102809v010301p.pdf

[b-ISO/IEC 14496-12] ISO/IEC 14496-12:2015, *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format*.
https://www.iso.org/standard/68960.html

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