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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Secondary distribution of IPTV services

Broadcast-centric IPTV terminal middleware

Recommendation ITU-T J.701

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Broadcast-centric IPTV terminal middleware

Summary

Recommendation ITU-T J.701 defines components of a broadcast-centric IPTV terminal middleware and provides a high-level description of functionality necessary to support IPTV services. These definitions and descriptions are intended to provide a migration path from existing terminal middleware for current digital broadcasting, with enhancements for IPTV support, to meet immediate market demand to deploy IPTV services.

This Recommendation also describes the terminal middleware architecture and its relationship with the service platform. Additionally, this Recommendation provides a table of application programming interface (API) classifications.

Source

Recommendation ITU-T J.701 was approved on 29 October 2008 by ITU-T Study Group 9 (2005-2008) under Recommendation ITU-T A.8 procedures.

FOREWORD

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1 Scope

This Recommendation defines components of a broadcast-centric IPTV terminal middleware and provides a high-level description of functionality necessary to support IPTV services. These definitions and descriptions are intended to assist in the establishment of a migration path from existing terminal middleware for current digital broadcasting, with enhancements for IPTV support, to meet immediate market demand to deploy IPTV services.

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.200] Recommendation ITU-T J.200 (2001), *Worldwide common core – Application environment for digital interactive television services*.

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation does not use any terms the following terms defined elsewhere.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 resource abstraction/middleware interface: An interface between the resource abstraction layer and the middleware service that encapsulates OS operations and the resources layer, and provides an abstract view of the resource layer.

3.2.2 resources: The native hardware and software entities that provide certain functionality to the middleware services component through the resource abstraction layer. The middleware service functions are provided to the application layer through the API of the middleware services.

3.2.3 service components: The components that offer functionalities to any upper layers, regardless of the type of software and hardware in the resource layer.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API Application Programming Interface

EPG Electronic Programme Guide

GUI Graphical User Interface

HTML Hypertext Markup Language

HTTP	Hypertext Transfer Protocol
HW	Hardware
OS	Operating System
PVR	Personal Video Recorder
RAL	Resource Abstraction Layer
RAM	Random Access Memory
RTSP	Real Time Streaming Protocol
SCP	Service and Content Protection
SIP	Session Initiation Protocol
SW	Software
VOD	Video on Demand

5 Broadcast-centric IPTV terminal middleware

The IPTV middleware supports the variety of functionalities (e.g., EPG, PVR, gaming, etc.) provided by the IPTV architecture to the IPTV terminal devices. Two types of middleware configuration can be considered: terminal middleware and distributed service enabler. This Recommendation focuses on the terminal middleware, whereas the definition of the distributed service enabler and its technical details are under study and may be the subject of a future ITU-T Recommendation. Figure 5-1 provides an overview of the IPTV middleware architecture, where the terminal middleware is illustrated on the left side.

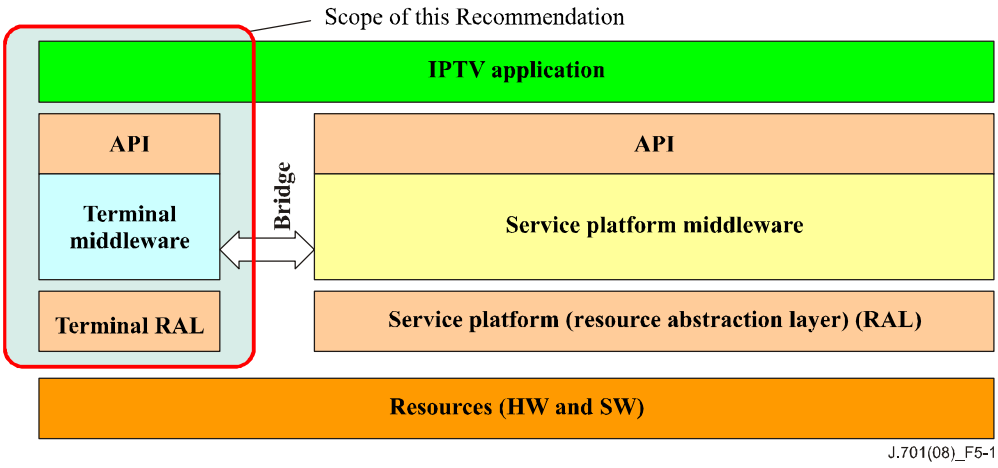

Figure 5-1 – IPTV middleware architecture

The following description of IPTV middleware architecture components includes more issues than those addressed within the scope of this Recommendation.

IPTV application layer

The application layer is the layer where operators and third parties provide services and applications. These services and applications include EPG applications, VOD, linear TV streams, PVR, games, Internet applications as well as other value-added services.

API

An API is essentially a set of operations (or methods) that can be invoked on a component, each of which causes the component to exhibit behavioural functionality.

IPTV middleware

The IPTV middleware is divided into a service platform middleware and a terminal middleware linked through a bridge.

The IPTV middleware invokes the lower layer resources (e.g., network interfaces) to control them, and provides APIs for upper layers.

It is recommended that the IPTV middleware implement the relevant functional modules and end-user functions described in [ITU-T Y.1910].

The IPTV middleware also provides some specific functions:

- resource management function, a functional module to manage system resources in IPTV terminal devices;
- application management function, a functional module to manage the life cycle of the applications and interaction operations between them.

Resource abstraction layers

The resource abstraction layer (RAL) makes the middleware independent of lower software and hardware layers.

The resources abstracted in the RAL include:

- software resources, such as drivers and OS;
- hardware resources, such as computing devices, CPU, storage devices, codec, rendering devices (e.g., display, speaker), IO devices.

6 Broadcast-centric IPTV terminal middleware architecture

Figure 6-1 shows the IPTV terminal middleware architecture (note that this architecture is compatible with the architecture shown in Figure 1 of [ITU-T J.200]).

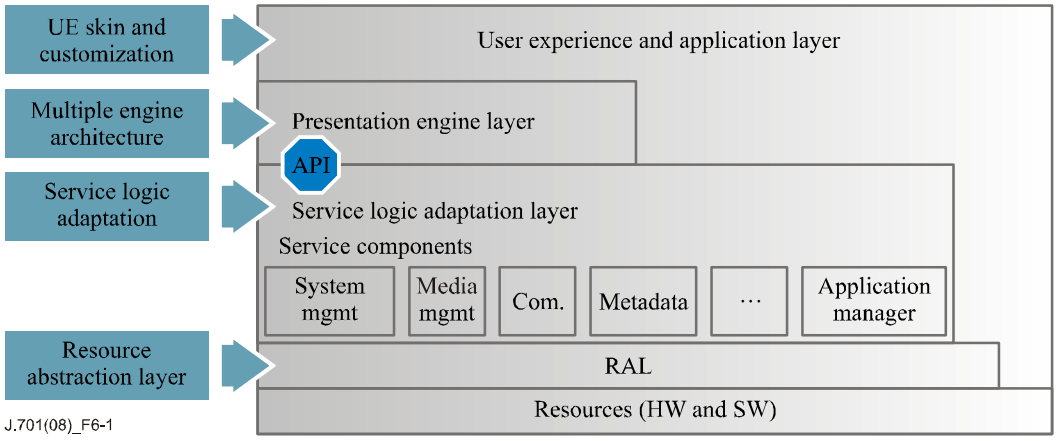

Figure 6-1 – IPTV terminal middleware architecture – Overview

Resource abstraction layer (RAL)

The IPTV terminal middleware is hardware-agnostic. A specific resource abstraction layer (RAL) exists for each specific hardware and operating system. This provides the necessary interface to the

lower layers (e.g., RAM, network access, hard drive, USB port, etc.). The RAL interface is designed so that device drivers can be written irrespective of the service logic adaptation layer.

Service logic adaptation layer

The service logic adaptation layer is made of service components. The service components are components that offer functionalities common to all middleware implementations (e.g., service selection and presentation, service information management, PVR, security systems). They are used and enriched by the application services in order to simplify the development of service components and applications above it.

The definition and the scope of services depend on the concrete functionalities deployed in the IPTV system.

Nevertheless, some service components can be defined that are generic in nature:

- system and resource management component;
- media management component;
- communication component;
- security component;
- metadata access component;
- user interaction component;
- audience measurement component.

All these components can optionally use the functions available on the network.

Presentation engine layer

The presentation engine layer may include various engines along with a set of high-level services. This layer is built on top of the service logic adaptation layer.

For procedural applications, the IPTV terminal middleware is recommended to be equipped with elements defined in Figure 2 of [ITU-T J.200], in the service logic adaptation layer and the presentation engine layer. For declarative applications, the IPTV terminal middleware is recommended to be equipped with elements defined in Figure 3 of [ITU-T J.200], in the service logic adaptation layer and the presentation engine layer. The definitions of "procedural application" and "declarative application" can also be found in [ITU-T J.200].

User experience and application layer

The applications are either downloaded or resident. In particular, an application is powered by a presentation engine (e.g., HTML browser). An application can either have full or restricted access to the presentation engine layer features. Moreover, some applications may directly access the service logic adaptation layer without using a presentation engine or may also directly access the resource abstraction layer.

6.1 IPTV terminal middleware components and APIs

This clause describes the functionalities of the IPTV terminal middleware components and identifies their APIs.

6.1.1 System and resource management component

The system and resource management component is used to manage IPTV terminal device resources, and provide the software initialization API, the upgrade and download API, the system resources management API, and the terminal management API to the upper application layer.

Software initialization and diagnosis API: An IPTV terminal middleware API that is responsible for initializing the IPTV terminal device, preparing the running environment and providing diagnostic capabilities to the IPTV terminal device.

This API is used to execute the following functions:

- configuration of the IPTV terminal device;
- initialization of tasks, such as application management, service and content protection (SCP) task, subscriber authentication process, etc.;
- network connection initialization, such as to get network parameter, configure access mode, etc.;
- initialization of resources, such as memory, timer, I/O equipment, A/V decoder and other system resources;
- coordination with other IPTV terminal device APIs, such as to work with the security and authentication API (see clause6.1.4) to start the user authentication procedure, to work together with the upgrade and download API to check software version and perform the software upgrade procedure;
- diagnosis of the IPTV terminal device.

Device software upgrade API: An IPTV terminal middleware API that is responsible for the dynamic downloading and upgrading of the IPTV terminal device. This API covers terminal middleware and lower layer.

This API is used to execute the following functions:

- device software download and upgrade for middleware layer;
- device software download and upgrade for resource abstraction layer;
- validity check of device software and data.

Terminal management API: An IPTV terminal middleware API that is responsible for the IPTV terminal management and configuration function.

This API is used to execute the following functions:

- remote management;
- log management;
- software version management;
- server parameter configuration, such as server address configuration;
- access mode and parameter configuration;
- media device parameter configuration, such as the decoder;
- subscriber configuration, such as access account and service account.

System resource management API: An IPTV terminal middleware API that is responsible for scheduling resources used by applications and managing their status.

This API is used to execute the following functions:

- status registration of resource usage by application;
- allocation and scheduling of resource to application;
- resource release management.

Removable storage API: An IPTV terminal middleware API that is responsible for accessing the information available in a removable storage device (e.g., USB connected external memory device).

This API is used to execute the following functions:

- access user information, such as user authentication, user ID, network access authority;

- access service information, such as service profile authorized by service providers;
- access billing information, such as prepaid account, fees consumed;
- access user preferences such as accessibility features and display settings.

6.1.2 Media management component

Media management component is responsible for managing media streaming, media presentation and media storing, and providing media service API to the upper layer.

Media service API: An IPTV terminal middleware API that is responsible for managing media streaming and media presentation.

This API is used to execute the following functions:

- media streaming management, such as media streaming session set-up and control for VoD, multicast linear TV, unicast linear TV and time shift;
- media decoder control;
- media rendering and playback control management, such as play, stop, pause and resume;
- closed caption presentation and control (e.g., selection, showing and hiding);
- triggering of the SCP process;
- media buffer management (e.g., acquisition of buffer status).

PVR and storage management API: An IPTV terminal middleware API that is responsible for managing PVR functions, and storage device and stored contents.

This API is used to execute the following functions:

- media recording and playback;
- programmed recording;
- storage device management (e.g., status acquisition of the storage device);
- stored media management.

6.1.3 Communication component

The communication component is responsible for IPTV terminal device communications. It includes two APIs: the basic communication API and the supplemental communication API.

Application download API: an IPTV terminal middleware API that is responsible for downloading applications from the service platform. Terminal devices can download applications from the service platform through this API.

This API is used to execute the following functions:

- Download and install applications and related information from the service platform to terminals. Examples of assumed use cases of this application download API are as follows.
  - download the menu application when the terminal is booted;
  - download new applications (such as game application, etc.) from the service platform;
  - download updated versions of the pre-installed application. Note that the pre-installed application does not include the device software addressed in clause 6.1.1.
- Coordination with the security and authentication API to check validity of the application.

Supplemental communication API: An IPTV terminal middleware API that is responsible for supplemental service communication. Supplemental services includes Internet browsing, e-mail and user-to-user communication services such as text messaging, voice/video chat, caller ID and presence.

This API is used to execute the following functions:

- Internet client management, such as web browser, e-mail and news client;
- signalling protocol for user-to-user communications (SIP);
- protocol support for presence (SIMPLE);
- media encoding and decoding capability exchange for user-to-user communication;
- media transport capability for user-to-user communication.

Mainly, the application which equips user-to-user communication capability is expected to be a pre-installed application or a certified application that is granted proper network access rights.

6.1.4 Security component

Security component is responsible for the security mechanism of the whole system, including subscriber authentication, media authorization, network security, software upgrade security, and service application security. This middleware service component provides the security and authentication API and the SCP API to the upper layer.

Security and authentication API: An IPTV terminal middleware API that is responsible for the security mechanism of whole system, including subscriber authentication, network security, software upgrade, service application security, etc.

This API is used to execute the following functions:

- subscriber authentication and identification information management;
- authorization of services and/or applications;
- software upgrade and download authentication;
- network security policy management;
- key, token and registration information management;
- parental control-related information management;
- content purchasing information management.

SCP API: An IPTV terminal middleware API that is responsible for processing rights control messages, processing rights management messages, and enabling the upper layer to access the rights SCP system.

This API is used to execute the following functions:

- license management;
- right management;
- key management;
- decryption control of media stream and data stream.

6.1.5 Metadata access component

The metadata access component is responsible for metadata system access, the metadata presentation and service selection management, and provides the metadata access API to the upper layer.

Metadata API: An IPTV terminal middleware API that is responsible for metadata system access.

This API is used to execute the following functions:

- metadata acquisition;
- metadata acquisition management;
- metadata compression and decompression.

6.1.6 User interaction component

The user interaction component is responsible for interacting with end-users, and for dispatching events originated by the end user to the application layer user interaction API in the application layer.

End-user interaction API: An IPTV terminal middleware API that is responsible for the interaction with end users, and for dispatching events originated by the end user to the application layer.

This API is used to execute the following functions:

- interaction with end user's operation, via keyboard, mouse or remote controller;
- receiving and dispatching events from the end user to the application layer;
- display of text information to request an end user's response, e.g., service provider's terms and conditions notification to the end user;
- display of service provider logo.

Graphical user interface API: An IPTV terminal middleware API that is responsible for providing the GUI engine to upper applications to implement the graphic design, display and control function.

This API is used to execute the following functions:

- graphic design and display function;
- user interface control interface design and display function;
- text rendering;
- set image and video attribute, and draw.

6.1.7 Metric gathering component

Audience measurement API: An IPTV terminal middleware API that is responsible for audience measurement. It is applicable for viewership data tracking. As this API deals with user privacy aspects, it needs to comply with privacy protection laws in each region and/or with standards such as [b-OECD], [b-ISO/IEC 27001] and [b-ISO/IEC 27002]. It means that end-user permission has to be considered when collecting and transferring private data into a viewership data tracking server.

This API is used to execute the following functions:

- measurement and transmission timing management;
- context information management;
- end-user permission management.

6.2 Classification of IPTV terminal middleware components APIs

Table 6-1 provides the list of recommended and optional APIs.

Table 6-1 – IPTV terminal middleware components – API classification

API	Recommended	Optional
Software initialization and diagnosis	X	
Device software upgrade	X	
Terminal management		X
System resource management		X
Removable storage		X
Media service	X	
PVR and storage management		X
Application download	X	
Supplemental communication		X
Security and authentication	X	
SCP	X	
Metadata	X	
End-user interaction	X	
Graphical user interface		X
Audience measurement		X

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[b-OECD] OECD (1980), *OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data*.

[b-ISO/IEC 27001] ISO/IEC 27001:2005, *Information technology – Security techniques – Information security management systems – Requirements*.

[b-ISO/IEC 27002] ISO/IEC 27002:2005, *Information technology – Security techniques – Code of practice for information security management*.

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