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Radiocommunication Sector of ITU

Recommendation ITU-R BT.2075-3

(12/2020)

Integrated broadcast-broadband system

BT Series

Broadcasting service (television)

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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R BT.2075-3*

Integrated broadcast-broadband system

(Question ITU-R 131/6)

(2015-2017-2019-2020)

Scope

This Recommendation provides guidance in choosing an integrated broadcast-broadband (IBB) system. The guidance is described in terms of service capabilities and technical elements of the IBB systems.

Keywords

Integrated Broadcast-Broadband (IBB), HbbTV, HybridCast, TOPSmedia, Ginga

The ITU Radiocommunication Assembly,

considering

a) that Question ITU-R 131/6 has invited the ITU-R to study, *inter alia*, what data structure(s) is(are) most suited to conveying multimedia information to digital broadcast receivers and what application programming interfaces (APIs) should be specified for multimedia applications in broadcasting and webcasting platforms;

b) that Report ITU-R BT.2267 describes several integrated broadcast-broadband (IBB) systems;

c) that Recommendations ITU-R BT.2037 and ITU-R BT.2053 define requirements of IBB systems;

d) that devices with broadband Internet access are becoming widely available and offer multimedia applications;

e) that an ability to provide connected-TV enabled devices with already integrated off-the-shelf applications is of relevance to the end-user;

f) that an addition of content delivery over broadband network to the broadcast channel optimizes the bandwidth usage of the broadcast channel;

g) that common platforms are desirable for production and international exchange of IBB content and applications,

recommends

1 that administrations, broadcasters, and related industries wishing to implement an IBB system should consider the service capabilities and technical elements of the IBB systems described in this Recommendation;

2 that the IBB systems listed in the Annex should be considered for the choice of an IBB system and implementation of IBB services.

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* This Recommendation should be brought to the attention of ITU-T Study Groups 9 and 16.

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Annex

1 Introduction

This Recommendation provides guidance information for administrations, broadcasters, and related industries to consider implementing an IBB system. Section 3 describes the IBB systems while §§ 4 and 5 describe the service capabilities and technical elements of the IBB systems.

2 Abbreviations

AAC	Advanced audio coding
ABNT	*Associação Brasileira de Normas Técnicas* (Brazilian technical standards association)
ACAP	Advanced common application platform
AIT	Application information table
API	Application programming interface
ARIB	Association of radio industries and businesses
AVC	Advanced video coding
BML	Broadcast markup language
CC	Common core
CE	Consumer electronics
CEA	Consumer Electronics Association[1]
CENC	Common encryption
CORS	Cross-origin resource sharing
DAE	Declarative application environment
DASH	Dynamic adaptive streaming over HTTP
DNS	Domain name system
DNS-SD	DNS-based service discovery
DRM	Digital rights management
DSM-CC	Digital storage media command and control
DTV	Digital Television
DVB	Digital video broadcasting
EBU	European broadcasting union
EPG	Electronic program guide
ETSI	European telecommunications standards institute
HDR	High dynamic range
HE-AAC	High-efficiency advanced audio coding
HEVC	High-efficiency video coding

[1] In 2015, CEA was renamed CTA (Consumer Technology Association).

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HFR	High frame rate
HLS	HTTP live streaming
HTML	Hypertext markup language
HTTP	Hypertext transfer protocol
HTTPS	Hypertext transfer protocol secure
IBB	Integrated broadcast-broadband
IMSC	Internet media subtitles and captions
IP	Internet protocol
IPTV	Internet protocol television
IPTVFJ	IPTV forum Japan
ISDB	Integrated services digital broadcasting
JSON	JavaScript object notation
MMT	MPEG media transport
MPEG	Motion picture expert group
NCL	Nested context language
NGA	Next generation audio
OIPF	Open IPTV forum
PVR	Personal video recorder
REST	Representational state transfer
RTP	Real-time transport protocol
RTSP	Real time streaming protocol
SI	Service Information
SSDP	Simple service discovery protocol
SSL	Secure sockets layer
SVC	Scalable video coding
TCP	Transmission control protocol
TLS	Transport layer security
TS	Transport stream
TT	Timed text
TTA	Telecommunications technology association
TTML	Timed text markup language
UDP	User datagram protocol
UHDTV	Ultra-high-definition television
UI	User interface
UPnP	Universal plug and play
URI	Uniform resource identifier

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URL	Uniform resource locator
VOD	Video on demand
W3C	World Wide Web Consortium
WebVTT	Web video text tracks
XML	Extensible markup language

3 The IBB Systems

3.1 System definition

The IBB Systems considered in this Recommendation are defined by the following specifications or standards.

HbbTV	For HbbTV1.5: ETSI TS 102 796 V1.2.1 (2012) http://webapp.etsi.org/ewp/copy_file.asp?wki_id=39272 For HbbTV 2.0.2: ETSI TS 102 796 V1.5.1 (2018) https://www.etsi.org/deliver/etsi_ts/102700_102799/102796/01.05.01_60/ts_102796v010501p.pdf [2]
Hybridcast	IPTVFJ STD-0010 V2.2, STD-0011 V2.5 and STD-0013 V2.8 http://www.iptvforum.jp/en/download/ ARIB STD-B62 V2.2 https://www.arib.or.jp/english/std_tr/broadcasting/sb_ej.html
TOPSmedia	HTML5 based Smart TV Platform, TTAK.KO-07.0111/R1 http://www.tta.or.kr/eng/new/standardization/eng_ttastddesc.jsp?stdno=TTAK.KO-07.0111/R1
Ginga	ABNT NBR 15606 (2018) series http://forumsbtvd.org.br/legislacao-e-normas-tecnicas/normas-tecnicas-da-tv-digital/english/ Recommendation ITU-T H.761 (2014), Nested Context Language (NCL) and Ginga-NCL http://www.itu.int/rec/T-REC-H.761

3.2 System summary

3.2.1 Hybrid Broadcast Broadband TV

Hybrid broadcast broadband TV (HbbTV) is an industry standard providing an open and business neutral technology platform that seamlessly combines TV services delivered via broadcast with services delivered via broadband and also enables access to internet only services for consumers using connected TVs and set-top boxes.

The HbbTV specification is based on existing standards and web technologies including OIPF (Open IPTV Forum), CEA, DVB and W3C. The standard provides the features and functionality

[2] NOTE –HbbTV 2.0.2 supersedes previous versions of HbbTV 2.0.

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required to deliver feature rich broadcast and internet services. Utilizing standard Internet technology, it enables rapid application development. It defines minimum requirements simplifying the implementation in devices and leaving room for differentiation, this limits the investment required by CE manufacturers to build compliant devices.

For a Connected TV set that is equipped with the HbbTV function, the consumer just has to push the red button on the TV's remote control to make the HbbTV launch page of the corresponding broadcaster visible. Subsequently, the end-user can select all services (incl. video-on-demand (VOD) and search functions) that are offered by or via this broadcast service specific portal. Example: A user would like to have more information on, say "Napoleon". The result of the search will be a list of all Napoleon-related video clips that are stored and offered by the collaborating broadcasters. Potentially, sound radio programmes and adapted Web-pages (incl. pictures and text files) could also be included in the result list. Viewing of the retrieved content is currently accomplished on the TV set but may in future also happen on a second screen, e.g. on a tablet computer.

HbbTV was developed in 2009 and first standardized by ETSI in 2010. Version 1.5 of the HbbTV specification has been published by the HbbTV Consortium in April 2012. Standardization of HbbTV 1.5 as ETSI TS 102796 v1.2.1 took place by ETSI in November 2012. Amongst other new features, adaptive streaming (in line with MPEG-DASH[3]) is supported. The latest version is HbbTV 2.0.1, published by ETSI as ETSI TS 102 796 V1.4.1 in August 2016. It includes an HTML browser profile and a number of additional features (many of them in the domain of companion screen integration and stream synchronization). In September 2018, the specification was updated to version 2.0.2 and published by ETSI as ETSI TS 102 796 V1.5.1 (2018-09). HbbTV 2.0.2 adds support for HDR (High Dynamic Range), HFR (Higher Framerates) and NGA (Next Generation Audio).

HbbTV is used for information, education and entertainment (e.g. catch-up TV). It is also used for commercial applications (music download, online shopping, (targeted) advertisement, etc.). HbbTV is very suited to provide access services for people with disabilities: signer video, audio description, spoken subtitles, multi-lingual text subtitles, multi-language sound tracks or additional sound tracks with clear(er) audio dialogues, etc. It was also demonstrated that HbbTV represents a prime means to alert the general public in case of a crisis (automatic popup of alert messages).

3.2.2 Hybridcast

Hybridcast, the IBB system that uses HTML5, was standardized in Japan for versions 1.0 and 2.0 in March, 2013 and June, 2014 respectively. The system facilitates the offering of services through a combination of broadcast and broadband telecommunication resources and features. The latest specifications considered most of the requirements in Recommendations ITU-R BT.2053 and ITU-T J.205 including broadcast centric scenario. To achieve the required functionalities, the specifications define system model, application model, application control signals, receiver behaviour, additional APIs etc. The specifications also define mechanisms and functionalities for companion device collaboration, non-broadcast-oriented managed application, application programming interfaces (APIs) for accurately synchronized presentation of video or graphics with broadcast video, application invocation for playing back of VOD or recordings, and support for MPEG-DASH.

In addition, to support interactive ultra-high definition television (UHDTV), ARIB STD-B62, 'the second generation multimedia coding scheme for digital broadcasting', was standardized in July 2014. ARIB STD-B62 defines Hybridcast application environment for UHDTV with MPEG2-TS and MPEG media transport (MMT). When using MPEG2-TS, existing digital

[3] The acronym DASH stands for "Dynamic Adaptive Streaming over HTTP", an MPEG standard for adaptive bit-rate media streaming (ISO/IEC 23009).

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broadcasting standards can be used for interactive UHDTV services. When using MMT, ARIB STD-B62 states how Hybridcast application environment works with MMT.

One of the system specifications, IPTVFJ STD-0010, defines system model, application model, application control signals, transport protocols, behaviour for using VOD, monomedia coding, and receiver functions. IPTVFJ STD-0011 defines HTML application structure, behaviour and syntax of elements, and additional objects and APIs. IPTVFJ STD-0013 defines additional details and supplemental information including device discovery protocols, communication protocols between a TV and a companion device, a receiver tune function of the companion device, an application launch function on a TV from the companion device, and MPEG-DASH profiles for on-demand content playback.

In Hybridcast standards, two types of applications are defined to allow flexible and varied IBB services. One of the types, broadcast-oriented managed application, is an application which is strictly associated to broadcast channels. This type of applications is controlled by an application control signal delivered over broadcast signals to launch and terminate such applications. The other type, non-broadcast-oriented managed application, is an application authorized by broadcasters and allowed access to broadcast resources. Non broadcast-oriented managed applications are allowed to be presented with broadcast programmes simultaneously, and end-users can control the launch and termination of the applications at any time regardless of the selection of broadcast channel.

All Hybridcast applications are under control of application control information. To provide service associated IBB services which is tightly combined with broadcasting services and can be provided through broadcast-oriented managed applications, broadcaster's authorization is required. This can be achieved by an Application Information Table (AIT) to be included in the broadcast signal or the service associated IBB services to be authorized by an integrity check server. For stand-alone IBB services independent from broadcast channels and provided by non-broadcast-oriented managed applications, it is assumed that a receiver obtains application control information from repository servers. Application control information for this type notifies broadcast and receiver resources the application accesses. Broadcasters provide application control information that contains information on execution condition and access restriction to broadcast resources. A receiver evaluates application control information from both application repository and broadcasters, and determines how to manage the application. Formats of application control information are defined in ARIB STD-B24, IPTVFJ STD-0011 and ARIB STD-B60 each of which is used for relevant delivery channels and services.

Hybridcast services were launched in September, 2013. Hybridcast is used to offer a variety of information including news, weather, stock market information, Electronic Program Guide (EPG), and VOD as well as program related services for quiz shows. HTML5 allow the provision of rich and useful services by involving existing web servers and thus the number of services that use Hybridcast is increasing rapidly.

3.2.3 TOPSmedia

TOPSmedia (TV Open Platform for Smart media) is an open smart TV platform standard that specifies the web runtime environments for smart TV application based on state-of-the-art HTML5 technologies. (The official title of the standard is "HTML5 based Smart TV Platform, TTAK.KO-07.0111/R1") An application in compliance with this specification can be developed and deployed taking advantage of HTML5 features and interfaces, and will provide the same user experience on smart TV receivers from various broadcasting systems like terrestrial, cable, satellite and IPTV.

This specification suggests four criteria to define smart TV application's types considering smart TV's specific features different from PC or smart phone. They consist of execution method, application packaging, broadcasting resource relation and channel bound.

According to four criteria, application can be divided into signal application, store application and broadband application, or divided into package application and non-package application, or divided

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into broadcast activated application and broadcast inactivated application, or finally divided into channel bound application and channel unbound application. These kinds of applications types define the specific smart TV receiver's behavior according to these types of requirements.

Furthermore, it defines smart TV extended APIs that is the set of interfaces to support smart TV specific features such as smart TV application, broadcasting resources, smart TV devices and other advanced functionalities.

Through the extended APIs, smart TV application can use interfaces to manage current running application like create, destroy and key/permission control, to control broadcasting video, channel and program, to get information about manufacturer, model and version. Besides, the extended APIs also supports multiscreen interfaces to communicate and work together with companion devices like smart phone or tablet and digital rights management (DRM)[4] interfaces to present protected contents.

Finally, to support the application's lifecycle control according to application signal provided by broadcaster, this specification defines an application signal profile based on AIT of ETSI TS 102 809. It defines application package profile for configuration and compression format to support download and install from application repository. Furthermore, it has other features like protocol and contents formats, receiver minimum requirements and own profile definitions. This specification has been developed in continuous relationship with the standardization committee of TTA (Telecommunications Technology Association). The next version will include new features like content synchronization, remote application control, advanced user input like gesture and voice control, T-commerce and so on. This future version is expected to be completed during the year 2015.

Currently, a few of the cable and IPTV broadcaster in Korea have been developed and tested smart TV receivers compliant with this specification, and it is expected that they will start an official launch of the TOPSmedia during the year 2015.

3.2.4 Ginga

Since its first version, Ginga middleware targets the integration of DTV and broadband services. Ginga was developed in 2006 and firstly standardized by ABNT (Associação Brasileira de Normas Técnicas) in November, 2007. The Ginga specifications have continuously evolved ever since through the introduction of new receiver profiles. The first profile introduced is known as profile A (FSA_09 for full-seg or OSA_09 for one-seg) and the latest profile is known as profile D (FSD_09 for full-seg or OSD_09 for one-seg). IBB support in Ginga is provided by functional components and APIs defined throughout its subsystems, which include the Ginga Common-Core, Ginga-NCL (mandatory in all interactive receiver profiles – A to D), Ginga-J (optional in receiver profiles A to C, not applicable in receiver profile D) and Ginga-HTML5 (mandatory in receiver profile D). Their current specifications, standardized under the ABNT NBR 15606 (2018) series, fully address IBB requirements as specified in Recommendation ITU-R BT.2053.

In Ginga, application signalling and life-cycle control is delivered by using application information table (AIT), in accordance with ABNT NBR 15606-3. The AIT can signal applications bounded to the DTV Service or Service Associated Applications (delivered via broadcast or broadband). The signalling and life-cycle control are managed by selected broadcaster.

Additionally, applications can be launched by Stream Event editing commands, user selection among the available applications (installed or signalled) via Application Catalogue UI, via Ginga CC WebServices app control API or via Ginga CC WebServices deep link API.

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[4] The term "digital rights management" (DRM) refers to the management of user access to protected content and protected services.

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DSMCC Object Carousel is used as transport protocol for applications delivered within the DTV Signal. Alternatively, applications can be retrieved through a broadband channel by using the HTTP protocol. The transport protocol mechanism is signalled in the AIT by using the transport protocol descriptor in accordance to ABNT NBR 15606-3.

Once the application is being executed in the receiver, it can use protocols such as HTTP, HTTPS, or more basic IP-based protocols such as TCP sockets and UDP, to communicate with servers or retrieve additional resources (code, images, video, audio, etc.) through a broadband channel.

Ginga-CC delivers applications with their associated media content that can come from broadcast channels or broadband IP services to Ginga-NCL (nested context language), Ginga-J or Ginga-HTML5, depending on the type of application. Ginga-CC includes a remote API that allows for the access and certain degree of control over the broadcast services, based on the REST architectural style. Ginga-CC WebServices (ABNT NBR 15606-11) provides this remote API to broadcaster-authorized Ginga and non-Ginga applications. In this way, any application running on devices in the home network (TV, SmartTV, SmartPhone etc) may be authorized to be part of the IBB experience.

Ginga-NCL is tasked with running NCL applications. NCL applications are collected inside a data structure known as private base. Ginga associates at least one private base with each TV channel (set of services) in which service associated applications are stored. Stand-alone applications are managed in specific private bases: one for resident applications and another for installed applications. Applications in a private base may be edited, started, paused, resumed, aborted, stopped, saved and may refer to each other.

A private base manager component is tasked with supporting signalling mechanism (NCL editing commands and control delivered using AIT table control code field) used to control when and how the application must be active/inactive, installed/removed, available/unavailable, visible/hidden, etc., or even if control must be left completely to the end-user. The AppCatUI is an extension of the Ginga middleware that must be provided by the IBB receiver, intended for listing the available applications in the private base data structure that can be launched by the end user, adding, moving and removing applications, in agreement with Recommendation ITU-T J.205.

NCL is the declarative language of Ginga. Its characteristics make it a sound declarative solution for IBB services: the language flexibility; its reuse facility; multi-device support (companion device collaboration); presentation and application content adaptability; API for building and modifying applications on-the-fly; and, mainly, its intrinsic high-level ability for easily defining spatiotemporal synchronisation among media assets (including viewer interactions). For particular procedural needs, e.g. when more complex dynamic content generation is required, NCL provides support to the Lua scripting language. NCL applications have a stricter separation between its content and its structure. NCL does not define itself any media content. Instead, it defines the glue that holds media objects together in multimedia presentations. An NCL document (NCL application code) only defines how media objects are structured and related, in time and space. Each media object of NCL specifies the URI Scheme used to retrieve its content. Depending on the specified scheme, Ginga-NCL knows if it has to get the content from the broadcast signal, from the IP network or from local storage. Ginga-NCL is mandatory in all interactive receiver profiles as defined in ABNT NBR 15606-1.

Ginga-J is an optional procedural environment, based on the Java language. Its stack includes the core API from Recommendation ITU-T J.202 and Recommendation ITU-R BT.1722 (specifically, CDC 1.1, FP 1.1, PBP 1.1.2 and JavaTV 1.1), the JavaDTV set of API as defined in ABNT NBR 15606-6, and a set of system-specific API defined in the ABNT NBR 15606-4.

Ginga-HTML5 (ABNT NBR 15606-10) has been incorporated as another presentation engine into Ginga, starting with receiver profile D. It supports an HTML5 language profile that is a subset of W3C specifications with no extensions for IBB-specific functionalities. The HTML5 profile seeks equivalency with the W3C-specific definitions found in HbbTV 2.0.1. For IBB features, Ginga-

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