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| **Source:** | Acting Rapporteur for Q4/9 | |
| **Title:** | Draft new Recommendation “Requirements for hybrid harmonized Application Control Framework supporting hybrid broadcast and broadband applications framework (J.acf-req)” for progressing | |

**Discussion**

Contribution COM9-C50 proposed a study on requirements that should be met by an Application Control Framework for digital TV devices, responsible for managing and controlling the interactive content and applications available though Digital TV Services, installed by the end user or embedded by the device manufacturers and providing an unified execution environment for them.

C50 is aimed at Recommendation J.acf-req ‘Requirements for hybrid broadcast and broadband application framework’ in order to initiate discussions on the matter.

At the SG 9 meeting held in March, 2011, Brazilian administration contributed further analysis on the requirements of the framework. The meeting discussed the document focusing role of the elements which are likely to be appeared in the control function of the framework. The text below is created as a result of discussion.

**<Recommendation ITU-T J.acf-req.>**

Draft new Recommendation “Requirements for hybrid broadcast and broadband application framework”

Summary

**Consumer electronics devices are more and more connected everyday. This tendency has also reached to the Digital TV Receivers, Blu-ray players, PVR devices and even Game Consoles.**

**Taking advantage of the increasing broadband availability Consumer Electronics manufacturers are embedding on their products applications able to retrieve content from proprietary services available through the Internet. Additionally, computational capabilities and increasing persistent storage availability in these devices would allow the end users to customize their devices by installing new applications, as it is already occurring with mobile phones, or games consoles.**

**In the same way, Digital TV Broadcasters are extending their systems in order to use broadband availability to improve their services by adding interactive non-linear and on-demand contents to their traditional offering. ETSI’s HbbTV and Project Canvas are examples of standardization efforts for this new opportunity.**

**Despite these up-to-date standardization efforts, most of the current solutions are closed/proprietary and focused on each industry specific problems.**

**This discussion proposes a study on requirements that should be met by an Application Control Framework for digital TV enabled devices, responsible for managing and controlling the interactive content and applications available though Digital TV Services, installed by the end user or embedded by the device manufacturers and providing an unified execution environment for them.**

**CONTENTS**

[1 Scope 3](#_Toc286139617)

[2 References 3](#_Toc286139618)

[3 Definitions 3](#_Toc286139619)

[3.1 Terms defined elsewhere: 3](#_Toc286139620)

[3.2 Terms defined in this Recommendation 3](#_Toc286139621)

[4 Abbreviations and acronyms 3](#_Toc286139622)

[5 Conventions 3](#_Toc286139623)

[6 Motivation 3](#_Toc286139624)

[7 HBB system analysis 3](#_Toc286139625)

[7.1 Digital TV Services and Hybrid Broadcast Broadband (HBB) TV Services 3](#_Toc286139626)

[7.2 Interactive Content (Applications) 3](#_Toc286139627)

[7.3 Delivery of Application Components 3](#_Toc286139628)

[7.4 Service Associated HBB Applications and Standalone HBB Applications 3](#_Toc286139629)

[7.5 Service Exclusive and Service Shared HBB Applications 3](#_Toc286139630)

[7.6 Application Control 3](#_Toc286139631)

[7.7 Application Permissions 3](#_Toc286139632)

[8 Functional Requirements for Hybrid Broadband Broadcast Application Control Framework (HBBACF) 3](#_Toc286139633)

[FR-HBBACF-01:Use ITU-T J.200 recommendations family as basis for new recommendation of a HBBACF 3](#_Toc286139634)

[FR-HBBACF-02:Coexistence and Backward Compatibility with current Digital TV Systems adherent to the ITU-T recommendations J.200, J.201 and J.202. 3](#_Toc286139635)

[FR-HBBACF-03:Support for delivering HBB Applications using any combination of delivery mechanism. 3](#_Toc286139636)

[FR-HBBACF-04: Application Catalogue User Interface 3](#_Toc286139637)

[FR-HBBACF-05: Application Catalogue User Interface Control by HBB Service Provider 3](#_Toc286139638)

[FR-HBBACF-06: Installable HBB Application Management 3](#_Toc286139639)

[FR-HBBACF-07: Standardized Internet Application Repository – Remote Application Catalogue 3](#_Toc286139640)

[FR-HBBACF-08: Application Installation Package 3](#_Toc286139641)

[FR-HBBACF-09: Resident Application Update 3](#_Toc286139642)

[FR-HBBACF-10: Application Life Cycle Model 3](#_Toc286139643)

[FR-HBBACF-11: HBB Application Control 3](#_Toc286139644)

[FR-HBBACF-12: Rules for choosing Service Associated HBB Application’s Source 3](#_Toc286139645)

[FR-HBBACF-13: Ensuring Digital TV Service Integrity and HBB Application Permissions Policy 3](#_Toc286139646)

[FR-HBBACF-14: Ensure User Privacy and User Data Protection 3](#_Toc286139647)

[FR-HBBACF-15: Service Content Protection 3](#_Toc286139648)

[FR-HBBACF-16: User Account Management 3](#_Toc286139649)

[FR-HBBACF-17: HBB Application’s User Settings Management 3](#_Toc286139650)

[FR-HBBACF-18: Location Awareness 3](#_Toc286139651)

[FR-HBBACF-19: Home Area Network Integration 3](#_Toc286139652)

[FR-HBBACF-20: HBB Receivers Capabilities 3](#_Toc286139653)

[FR-HBBACF-21: Digital TV Service Synchronization (Stream Events) 3](#_Toc286139654)

[FR-HBBACF-22: File Formats, Encodings and Protocols 3](#_Toc286139655)

[FR-HBBACF-23: Download Feature 3](#_Toc286139656)

[FR-HBBACF-24: PVR Feature 3](#_Toc286139657)

[FR-HBBACF-25: Streaming Capabilities 3](#_Toc286139658)

[FR-HBBACF-26: Content Purchase 3](#_Toc286139659)

[FR-HBBACF-27: Extended Service Information and Content Discovery 3](#_Toc286139660)

[FR-HBBACF-28: System updating and expandability 3](#_Toc286139661)

[FR-HBBACF-29: Pluggable Modules Support 3](#_Toc286139662)

Keywords

<Optional>

Introduction

<Optional - This clause should appear only if it contains information different from Scope and Summary>

# 1 Scope

This Recommendation defines high-level requirements for hybrid broadcast and broadband application framework to harmonize the behaviour and the interaction of a variety of types of applications including broadcast delivered, broadband delivered, pre-installed, via Application Repository, and home area network delivered. This Recommendation is intended to define a baseline for such a hybrid application framework.

# 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 X.yyy] ITU-T RecommendationX.yyy (date),*Title*

[ITU-T J.200] Recommendation ITU-T J.200 (2010), Worldwide common core – Application environment for digital interactive television services.

# 3 Definitions

<Check in the ITU-T Terms and definitions database on the public website whether the term is already defined in another Recommendation. It may be more consistent to refer to such a definition rather than redefine it>

## 3.1 Terms defined elsewhere:

<Normally terms defined elsewhere will simply refer to the defining document. In certain cases, it may be desirable to quote the definition to allow for a stand-alone document>

This Recommendation uses the following terms defined elsewhere:

**3.1.1 <Term 1>** [Reference]: <optional quoted definition>

**3.1.2 <Term 2>** [Reference]: <optional quoted definition>

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

**3.2.1 Application:** any Digital TV Service Content of active nature, intended for the end user to interact with them.

**3.2.2** **Application Catalogue: Data** Structure listing available Applications (interactive content). This data structure is local to the HBB Receiver, describing the HBB Applications installed into the HBB Receiver.

**3.2.3 Application Catalogue User Interface:** User interface functionality over the HBB Digital TV Receiver, intended to allow the end user browse the available applications in the Application Catalogue or query Application Catalogues exposed by Application Repositories, and also list Applications available in the currently selected HBB Service or Broadcast DTV Service.

**3.2.4 Application Component:**Block of data that makes part of an Application. Application Component types are: Code, Resources, Meta-data, Control and User Settings.

**3.2.5 Application Install Package:**Application delivery mechanism in which several Application Components are bundled together in a single file.

**3.2.6 Application Repository: HTTP** Server, reachable through the Broadband Channel, that provides access to HBB Applications contained in it. These HBB Applications can be Downloaded and Installed into the HBB Receiver, manually, by the End User, or, in case of being signaled within a HBB Service, launched or installed automatically under HBB Service’s control using the HBB Application Control Mechanism.

**3.2.7 HBB Application Control Mechanism:** Mechanism used by HBB Service Providers to signal and control HBB Applications associated to their respective HBB Services. The mechanism contemplates the transmission of a HBB Service’s Interactive Content Control Data Structure within the HBB Service. Such data structure can support the signaling of HBB Applications retrievable from the Broadcast Channel or through the Broadband Channel from HTTP Servers and Application Repositories.

**3.2.8 Broadcast Digital TV Service:** Any Digital TV Service, delivered through a Broadcast Channel.

**3.2.9 Broadband Digital TV Service:** Any Digital TV Service, delivered through a Broadband Channel.

**3.2.10 Broadcast Channel:** A medium used to deliver Digital TV Service. Examples: Free to Air, Satellite and Cable.

**3.2.11 Broadband Channel:** A medium used to deliver Digital TV Service. Usually this medium is based on Internet or IP networks technologies, and allows the delivery of non-linear and on-demand Digital TV Service. A Broadband Channel also allows access to servers that may be located in the Broadband Network or the Internet.

**3.2.12 Broadband Network:** private IP network from a network provider. This is different from the open Internet, as hosts/servers in such network can only be accessed from HBB Receivers connected to it.

**3.2.13 Digital TV Service:** is the unit for delivering Audio-Visual contents to the end users. In a more extensive definition (the one adopted in this document), this unit also comprehends the delivery of Interactive content. It constitutes an editorially consistent whole and it is an aggregation of different kinds of Service Components.

**3.2.14 Digital TV Service Content:** audio/visual/interactive components delivered within a Digital TV Service as single editorially consistent whole.

**3.2.15 HBB Receiver:** A device capable of receiving and displaying Digital TV Services as well as HBB Services.

**3.2.16 HBB Digital TV Service (or HBB Service):** Digital TV Service that uses both Broadcast Channel and Broadband Channel to deliver its Service Components, taking advantage of both delivery mediums.

**3.2.17 HBB Service Provider:** entity (i.e. broadcasters), making available and delivering HBB Digital TVService.

**3.2.18 HBB Application:** this term is used to refer to applications that are delivered within an HBB Digital TV Service. However, in the context of this document, this term refers to both Service Associated HBB Applications and Standalone HBB Applications.

**3.2.19 HBB Installable Application:** HBB Application that can be downloaded and saved in into HBB Receiver persistent storage for later usage.

**3.2.20 HBB Resident Application:** HBB Application embedded into the HBB Receiver by the device manufacturer.

**3.2.21 Interactive Content (Application):** see definition for Application.

**3.2.22 Linear Digital TV Service:** Digital TV Service where exactly the same content is delivered to all the users at a given time, this is usually a limitation of the one way nature of the Broadcast Channel.

**3.2.23 On Demand Digital TV Service:** non-linear Digital TV Service where deliver of the contents happens upon user request.

**3.2.24 Non-Linear Digital TV Service:** Digital TV Service where it is possible to deliver different (and on demand) content to each user at any given time, this is usually an advantage of the two way nature of the Broadband Channel.

**3.2.25 Remote Application Catalogue:** Application Catalogue exported from an Application Repository. This differs from the normal Application Catalogue such that if the Remote Application Catalogue is very large there must a mechanism for querying it and retrieve it by small parts that can be handled in an efficient way in the HBB Receiver.

**3.2.26 Service Associated HBB Application:** Application that is part of the [HBB Digital TV] Service content.

**3.2.27 Standalone HBB Application:** Application that is not part of an [HBB Digital TV] Service content.

**3.2.28 Service Exclusive HBB Application:** Application that is listed as a component part of HBB Digital TV Service and its life cycle is strictly tied to the exhibition of such [HBB Digital TV] Service.

**3.2.29 Service Shared HBB Application:** Application that is listed as a component part of several different HBB Digital TV Services and its life cycle is extended as long as any of those HBB Digital TV Services is being exhibited.

**3.2.30 User Generated Content:** Content generated by other entities than Broadcasters, including content created by final users.

# 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

|  |  |
| --- | --- |
| AIT | Application Information Table |
| DSMCC DC | ISO/IEC13818-6 Digital Storage Media Command and Control – Data Carousel |
| DSMCC OC | ISO/IEC13818-6 Digital Storage Media Command and Control – Object Carousel |
| DAV | Distributed Authoring and Versioning |
| DLNA | Digital Living Network Alliance |
| EPG | Electronic Program Guide |
| HAN | Home Area Network |
| HBB | Hybrid Broadcast Broadband |
| HBBACF | Hybrid Broadcast Broadband Application Control Framework |
| HTTP | Hyper Text Transfer protocol |
| HTTPS | Secure Hyper Text Transfer protocol |
| NFS | Network File System |
| RTP | Real Time Protocol |
| RTSP | Real Time Streaming Protocol |
| URL | Universal Resource Locator |
|  |  |

# 5 Conventions

<Describe any particular notation, style, presentation, etc. used within the Recommendation, if any>

# Motivation

With the increasing availability of broadband internet access services, both Consumer Electronics Manufacturers and Digital TV Service Providers have started taking advantage of this trend providing connected devices and Internet services. The broadband technology also creates opportunities for players in other segments (such as Internet Based Multimedia Content Providers, Social Networks, Messaging, IP Telephony, etc) for delivering audio-visual-interactive content and connected applications to the living-room, traditionally restricted to TV Broadcasters, Cable TV and Satellite TV Service Providers.

As this ecosystem evolves and quickly incorporates new players, recommendations and standardization on how the systems should be designed and implemented will ease the path of this evolution.

At the same time, the standardization of such a framework would help all players to meet their interests:

* CE Manufacturers would be able to provide Connected TV enabled devices with already integrated off-the-shelf applications. These devices could be extended and customized by the end user by installing additional downloadable applications.
* Digital TV Broadcasters could improve their services by adding non-linear, on-demand, contents to their offers and at the same time taking full advantage of the broadband delivery channel for their HBB applications, thus optimizing bandwidth usage in their transport streams.
* Internet based Service Providers could use a new channel to offer their services.

In all cases, a single platform would be used simplifying and reducing the development effort for interactive content and applications.

# HBB system analysis

## Digital TV Services and Hybrid Broadcast Broadband (HBB) TV Services

A **Digital TV Service** is the unit for delivering Audio-Visual contents to the end users. In a more extensive definition (the one adopted in this document), this unit also comprehends the delivery of Interactive content. It constitutes an editorially consistent whole and it is an aggregation of different kinds of Service Components:

* Video
* Audio
* Closed Caption, Subtitles, Teletext
* Service Information (such as EPG info)
* Interactive Content (Applications)

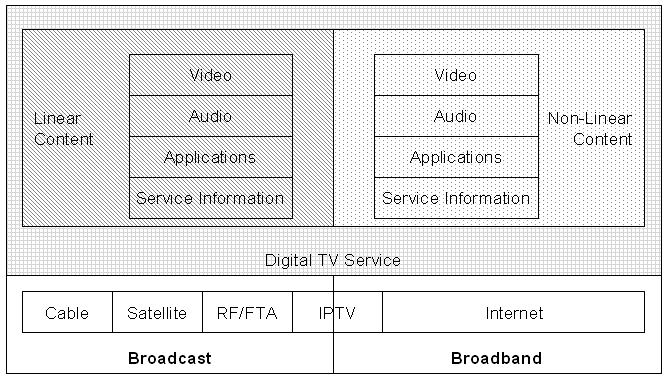
The most traditional case for delivering a Digital TV Service is through a Broadcast Channel (Free To Air, Satellite, Cable, etc). In this case all the Service Components are transmitted together, in the same channel. Digital TV Services transmitted entirely through a Broadcast Channel will be referred as **Broadcast Digital TV Services**.

Due to the one-way nature of the Broadcast Channel, the Broadcast Digital TV Services are **linear**: exactly the same content is delivered to all the users at a given time.

With the widespread adoption of high-speed broadband Internet Services a new delivery channel becomes available, the Broadband Channel. This new channel not only allows the delivery of linear Digital TV Services but also, thanks to its two-way nature, **non-linear (on-demand)** Digital TV Services.

Digital TV Services transmitted entirely through the Broadband Channel will be referred as **Broadband Digital TV Services** or **Standalone Internet Service** [b-EBU-req].

Both kinds of channels have their strong and weak points. By combining both of them, it is possible to deliver Digital TV Services that can take advantages of all the strong points from each one. In this case, some Service Components can be delivered through the Broadcast Channel and some other components can be delivered through the Broadband Channel. These kinds of services are considered to be **Hybrid Broadcast Broadband (HBB) Digital TV Services**.

****

**Fig. 7.1-1 Hybrid Broadcast Broadband (HBB) Digital TV Service**

## Interactive Content (Applications)

Most Digital TV Service’s components are of a passive nature (this is for video, audio, closed caption, service information). They do not allow user interaction.

In the other hand, the nature of **Interactive Contents or Applications** is active as they are intended for the user to interact with them. Each Interactive Content or Application usually consists of a set of the following Application Components:

* **Code:** compiled binary, bytecode, script (etc.) executables
* **Resources:** data files, fonts, images, or any other content consumed by the application during code execution
* **Meta-data:** additional information associated to application execution, that may include: application description (unique identification, version, name, icon, provider, language, settings, etc.), how it should be presented (dimension on the screen, position, states, etc.), security (signature, certificates, etc.), minimal requirements (minimal middleware version, minimal receiver capabilities, etc.), etc.
* **Control:** Signalling mechanism used by the Application Provider or the Content Provider in order 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.
* **User Settings:** Configuration parameters that may define Application Customization or store User Preferences for using this application. As an example, User Settings can be used to customize the application User Interface, the Application Behaviour and User Personal Data (name, age, gender, email, address, etc.)

HBB Application

Code

Resources

Meta-data

Control

User Settings

Fig. 7.2-1 HBB Application Components

Usually, the **Hybrid Broadcast Broadband (HBB) Application** term is used to refer to applications that are delivered within an HBB Digital TV Service. However, in the context of this document, this term refers to both Service Associated HBB Applications and Standalone HBB Applications (see section 7.4).

## Delivery of Application Components

In the same way as the HBB Digital TV Service’s components can be delivered through different channels (Broadcast and Broadband), Application Components from the same Application can also be delivered through different channels.

Delivery of an HBB Application can be classified on the following cases:

a. All the HBB Application’s components are delivered by the broadcast channel.

a.1 In this case, they can be transmitted using the mechanisms already provided by Middleware Specifications in conformance with recommendation [ITU-T J.200] such as [b-MHP], [b-ARIB B.24], [b-ARIB B.23] or [b-GINGA]:

* Code and Resources: delivered using DSMCC DC/OC
* Meta-data: Partially delivered using DSMCC DC/OC (i.e.: signature and permission information). Partially delivered on the AIT table (i.e.: application name, application arguments, application type, middleware version required, etc.) or DSMCC Stream Events.
* Control: Using mechanism such as the AIT control code and additional flags or DSMCC stream events.

a.2 As an alternative, in order to clearly differentiate HBB Applications from conventional applications and preclude compatibility problems in already deployed devices, a mechanism which only HBB receivers accept can be used (see requirement FR-HBBACF-02).

b. All the HBB Application’s components delivered entirely by the broadband channel can be retrieved as a file package (i.e.: zip, tar, jar, etc.) containing the code, resources and meta-data. Control may still be get from the broadcast signal, or a network server through the broadband channel. [b-GINGA-J] and [b-JAVADTV] specification already defines the use of package files (.jar) for transmitting applications through the interactivity (broadband) channel.

c. Hybrid delivery of an HBB Application occurs when some parts of its components are retrieved from the broadcast channel and other parts from the broadband channel in any combination of the two previous examples. MHP and Ginga already include mechanisms for supporting many types of combinations for delivering HBB Applications.

In [b-MHP] or in [b-GINGA], broadcast signalling of broadband applications may use the transport\_protocol\_descriptor’s protocol\_id number 3 (HTTP) in the AIT table to indicate the set of URLs from where the application’s components must be downloaded.

d. HBB Receivers may have a persistent storage space for installing Installable HBB Applications. Once installed, these applications are available to the user at anytime. Installable HBB Applications can be downloaded into the receiver in the following ways:

d.1. Automatically, when signalled in a selected service (broadcast or broadband), a special signalling mechanism can be used in order to indicate that the application is to be installed in the receiver. Such a mechanism is provided by the AIT’s UNBOUND control code in [b-GINGA]. In this case, application components delivery can happen in any of the modalities described in a, b or c.

d.2. Manually by the user (user installed application), through an Application Management User Interface provided by the receiver. In this case, Installable HBB Applications source can be very diversified (i.e.: a server reached through the broadband channel – in the broadband network or Intenert - , an Application Repository, another device in the HAN, pluggable storage device, etc).

In case of Installable HBB Applications, they are not required to be available to receivers or continuously transmitted in the broadcast signal during all the time they are signalled as available by the HBB Service Provider (broadband or broadcast).

e. **Resident HBB Applications** are applications embedded in the HBB Receiver by its manufacturer. Usually they would be stored in the receiver’s ROM, or bundled within the receiver’s firmware. These applications may not be uninstalled by the end user. Installation, updating and removal of these applications should be actions exclusively allowed to the HBB Receiver’s Manufacturer.

f. Applications can also be downloaded from a selectable Application Repository.

In case of the User Settings, a default set of values can be transmitted with the application using any of the methods described above. For actual values (customized by the user), the following alternatives are possible:

* stored in the receiver persistent storage (most usual case)
* shared among several devices present in the HAN
* retrieved from a HTTP Server using some user identification method such a user account through the broadband channel

## Service Associated HBB Applications and Standalone HBB Applications

**Service Associated HBB Applications** are those applications delivered or listed as a component part of the Digital TV Service (e.g. applications listed in the Digital TV Service’s AIT).

On the other hand, **Standalone HBB Applications** are those that are not delivered within the Digital TV Service. Usually, they would be manually launched by the end user from the Application Catalogue User Interface. Applications delivered by any channel except the Broadcast Channel, such as User Installed HBB Applications or Resident HBB Applications are usually (but not always) Standalone HBB Applications.

In some cases, the Digital TV Service can include signalling for Installed HBB Applications or even Resident HBB Applications or Application Repository’s HBB applications.

## Service Exclusive and Service Shared HBB Applications

These concepts only apply to Service Associated HBB Applications.

**Service Exclusive HBB Applications** are those applications that are delivered within an HBB Digital TV Service and their life cycle is strictly tied to the exhibition of such HBB Digital TV Service.

On the contrary, **Service Shared HBB Applications** can be defined as those applications that are delivered within several HBB Digital TV Services and their life cycle is extended as long as any of those HBB Digital TV Services is being exhibited.

As commonly defined by most of the middleware specifications conformant with the [b-ITU-T J.200] ([b-MHP], [b-GEM], [b-GINGA], [b-ACAP], [b-OCAP], [b-ARIB B.23]), Applications can be signalled as being bounded to the service or not. Defined rules are:

- Execution of Service Exclusive (service bounded) application must be terminated when the Service exhibition is stopped.

- In case of Service Shared (service unbounded) applications, execution should continue in case of the same application being also signalled in the service that is selected next.

Both Service Exclusive and Service Shared HBB Applications should be considered Service Associated HBB Applications and should be terminated in case of not longer being signalled within the HBB Digital TV Service.

## Application Control

In [ITU-T J.200] compliant middleware implementations, Broadcasters (also known as Service Providers) can control the execution, availability and visibility of the Applications, using mechanisms such as those available through the AIT ([b-GEM], [b-MHP], [b-ACAP], [b-OCAP], [b-GINGA], [b-ARIB B.23]).

Usually, the Service Providers cannot control HBB Applications not signalled in their service and manually started by the user.

## Application Permissions

Security definitions are included in [ITU-T J.200] adherent implementations such as [b-MHP] and [b-GINGA], considering:

* Application Authentication mechanisms;
* Application permission granting mechanism;
* Policies to restrict the usage of APIs and functionalities only to ‘trusted’ applications.

Usually, only trusted applications are allowed to change the service exhibition state (controlling service audio and video), using the interactive channel or controlling other applications.

# 8 Functional Requirements for Hybrid Broadband Broadcast Application Control Framework (HBBACF)

This chapter provides a list of requirements that should be met by the HBB Application Control Framework (HBBACF).

### FR-HBBACF-01: Use ITU-T J.200 recommendations family as basis for new recommendation of a HBBACF

The ITU-T J.200 recommendations family already provides a major number of definitions for functional requirements, architecture and API that can also be used in the context of HBB Applications and HBB Digital TV Services.

The architecture recommended in [ITU-T J.200] could be used as a basis and extended by a new recommendation in order to fulfil additional requirements listed in this document.

The new recommendation should propose extensions to the Presentation and Execution Engines proposed by [ITU-T J.200] and described in [b-ITU-T J.201] and [b-ITU-T J.202].

### FR-HBBACF-02: Coexistence and Backward Compatibility with current Digital TV Systems adherent to the ITU-T recommendations J.200, J.201, H.761 and J.202.

The HBBACF should be designed in a way to allow the coexistence of HBB Applications with conventional Broadcast Applications, as already supported in the [ITU-T J.200], [b-ITU-T J.201], [b-ITU-T H.761] and [b-ITU-T J.202], and applications in the HBB model seamlessly. Gradual evolution of current Digital TV Services to HBB Digital TV Services should be possible in such a way that:

1. HBB Content could be ignored or not detected by already deployed receivers intended for conventional Digital TV Services and with no support for HBB Content. This also applies to HBB Receivers that are not connected to a broadband connection.
2. HBB Content enabled receivers should be capable of exhibiting content (in special for interactive content) from conventional Digital TV Services.

The end user experience when navigating through Digital TV Services and HBB Digital TV Services should be as much transparent as possible.[b-EBU-req]

### FR-HBBACF-03:Support for delivering HBB Applications using any combination of delivery mechanism.

The HBBACF should provide support for handling HBB Applications delivered in any of the possible combinations described in 7.3, (Broadcast, Broadband, Hybrid, Stored, Application Repository and HAN)

1. In the case described by 7.3, item a.1, “All HBB Application’s Components transmitted by the broadcast channel”, the same transmission and signalling mechanism as used for conventional Digital TV Services can be used.
2. Any combination of Application Component delivery mechanisms should be allowed:

Table 1 – Application Components and applicable delivery transports

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Application Component** | **Delivery Channel** | | | | |
| **Broadcast Ch.** | **Broadband Ch.** | **Previously Installed in the receiver’s persistent storage** | **Via Application Repository** | **Home Area Network (HAN)** |
| Code | Yes – (mechanisms such as DSMCC DC/ OC) | Yes – (using http protocol; code can be delivered in packages such as zip, jar files or an Application Installation Package) | Yes | Yes – (using http protocol; code can be delivered in packages such as zip, jar files or an Application Installation Package) | Yes, using an Application Installation Package |
| Resources | Yes – (mechanisms such as DSMCC DC/ OC) | Yes – (using http, https, rtp/rtsp protocols; resources can be delivered as series of files, streams or in packages such as zip, jar files or an Application Installation Package as well) | Yes | Yes – (using http, https, rtp/rtsp protocols; resources can be delivered as single files or in packages such as zip, jar files or an Application Installation Package as well) | Yes, using an Application Installation Package.  Media resources(such as pictures, music, video files, video streams or audio streams) could be shared by other devices in the HAN and used as application resources.  (using protocols such as http, https, rtp/rtsp , nfs, DAV, DLNA, etc; resources can be retrieved as single files or streams) |
| Meta-data  (such as application id, name, version, locations for retrieving other application components, etc.) | Yes – (using mechanism such as AIT table, DSMCC Stream Events or DSMCC DC/OC) | Yes – (using http protocol; this meta-data can be delivered as an application description file both as a single file or within packages such as zip, jar files or an Application Installation Package) | Yes – (this meta-data can be stored as an application descriptor file both as a single file or within packages such as zip, jar files or an Application Installation Package) | Yes – (this meta-data can be stored as an application descriptor file both as a single file or within packages such as zip, jar files or an Application Installation Package) | Yes, using an Application Installation Package |
| Meta-data (such as application signatures, certificate files, permission files, etc.) | Yes – (mechanisms such as DSMCC DC/OC) | Yes – (using http protocol; this meta-data can be delivered both as single files or within packages such as zip, jar files or an Application Installation Package) | Yes – (this meta-data can be stored as an both as a single files or within packages such as zip, jar files or an Application Installation Package) | Yes – (this meta-data can be stored as an both as a single files or within packages such as zip, jar files or an Application Installation Package) | Yes, using an Application Installation Package. |
| Control | Service Associated HBB Applications. (can be controlled by the Service Provider)  (using mechanism such as AIT table or DSMCC Stream Events) | Service Associated HBB Applications.  (control mechanism TBD) | Standalone HBB Applications  Launched by the user from the Application Catalogue User Interface. | Standalone HBB Applications  Launched by the user from the Application Catalogue User Interface. | Standalone HBB Applications  Launched by the user from the Application Catalogue User Interface. |
| User Settings | - | Yes – when the user can login using a previously registered account with the Broadband Digital Service Provider | Yes – stored as properties or custom files in the receiver’s persistent storage. | Yes - when the user can login using a previously registered account in an Application Repository | Yes – (using protocols such as http, https, rtp/rtsp , nfs, WebDAV, DLNA, etc; to share properties among devices in HAN) |

In case of Code, Resources, and Meta-data the use of more than one delivery mechanism at the same time should be allowed.

From the End User point of view, the HBB Application delivery mechanism should be as much transparent as possible ([b-EBU-req]).

When using an Application Installation Package, Code, Resources and Meta-data would usually be bundled together in the same package.

### FR-HBBACF-04: Application Catalogue User Interface

An Application Catalogue User Interface is a functionintended for listing the applications available that can be launched by the user. This concept is already present in Digital TV middleware standards such as [b-GINGA] or [b-MHP]. As an extension to the concepts in current Digital TV middleware specifications, the Application Catalogue User Interface in the HBBACF should include the following functionalities:

* Listing Applications available to the user including:
  + Conventional Digital TV Services Interactive Content that can be launched by the user. Ex: signalled with AIT control codes AUTOSTART([b-MHP], [b-GINGA-Data Transmission]), PRESENT([b-MHP], [b-GINGA-Data Transmission]), STORED( [b-GINGA-Data Transmission]), REMOTE([b-GINGA-Data Transmission]), UNBOUND([b-GINGA-Data Transmission]), etc. and visibility flag enabled ([b-GINGA-Data Transmission],[b-MHP]).
  + Service Associated HBB Application meeting the same signalled requirements as for Conventional Digital TV Services Interactive Content.
  + Standalone HBB Applications (both Installed HBB Applications and Resident HBB Applications).
* Retrieving Application Catalogues from an Application Repository
* Allow to the end user to launch any listed application
* Allow to the end user to bring to focus any listed application already in execution
* Allow to the end user to terminate any listed application already in execution
* Provide access to the available user oriented application Meta-Data (such application name, provider, version, etc)

### FR-HBBACF-05: Application Catalogue User Interface Control by HBB Service Provider

There should be a mechanism to allow the HBB Service Provider to control the order in which the Applications in the Application Catalogue User Interface are listed when the receiver is tuned in to its HBB Service. Purpose of this is to highlight those Applications that are related to the active HBB Service.

### FR-HBBACF-06: Installable HBB Application Management

A mechanism and policies for Installing HBB Applications and managing the persistent storage in the HBB Receiver should be considered by the recommendation. As described in , item d, installation could occur when indicated by the HBB Service Provider or by a specific action from the user. These cases should be also handled by the HBBACF.

HBB Applications can be installed in the HBB Receiver’s persistent storage:

* Automatically installed: when signalled in a selected service (broadcast or broadband), a special signalling can be used in order to indicate that the application is to be installed in the receiver. Such a mechanism can be provided by the AIT’s UNBOUND control code in [b-GINGA-Data Transmission].

Automatically installed applications may require authorization from the end user.

* User installed application. In this case, the Installable HBB Applications source can be very diversified. Ex:
  + a server reached through the broadband channel (ie: a server in the Internet or broadband network);
  + Application Repository;
  + another device in the HAN;
  + pluggable storage device (such a USB stick or external Hard Disk); etc.

In case of Application Repository, the Installable Application Manager should retrieve a Remote Application Catalogue from the Application Repository.

In case of another device in the HAN or pluggable storage device (such a USB stick or external Hard Disk), the device should be inspected looking for Application Install Packages and a list should be presented to the end user in order to choose which HBB Applications to Install.

In all cases, for a User Installed Application, the HBB Application should be installed from Application Install Packages.

In case of usage of Installable HBB Applications, rules for Application Storage management that must be considered by the HBB Service Provider and the HBB Receiver should be defined. Forexample:

- For automatically installed applications, a least recently used algorithm may be used for uninstalling HBB Applications under low storage space available conditions.

- In case of user installed applications, HBB Receivers should provide some mechanism for the user being able to request the HBB Application uninstalling.

- In both cases, when installing a newer version of an HBB Application, the older version must be removed.

The Installable HBB Application Management should also be considered an application update mechanism. For example, periodically checking the installation source (in example: the Application Repository from where the HBB Application has been downloaded) looking for recent versions of the already installed applications.

Additionally, a mechanism and policies for controlling the version of the Installable HBB Applications should be included in the HBBACF recommendation.

The Installable HBB Application Management sub-system should also provide a mechanism for the End User to manage the available persistent space and for removing Installed Applications.

The Installable HBB Application Management sub-system should allow the end user to arrange the Installed HBB Applications in a customizable hierarchical directory structure.

### FR-HBBACF-07: Standardized Application Repository – Remote Application Catalogue

Application Repositories are services (not to be confused with DTV Service or HBB DTV Service) intended to distribute applications for on-demand installation. The following use cases should be considered by the recommendation:

* End user should be able to browse and search through the applications made available on each repository. Browsing the catalogue and the search results should support pagination.
* End User should be able to retrieve Application Information Details such as name a brief description, icon, screen shots, price, version, required storage space, vendor, etc;
* End User should be able to choose an Applications to install in the HBB Receiver;
* End User should be able to login to the Application Repository with a previously registered User Account;
* Some content may not be free, in this case, End User should be able to purchase the Application with credits previously charged to his User Account. Once the payment can be confirmed, the Application should become available for installing.
* Application Search should be available by using the following filters:
  + Predefined Keywords (using a list of predefined keywords that could be retrieved from the Application Repositories)
  + Application Name
  + Custom Keywords (user entered)
  + Other

**Note:** All End User Interactions with the Remote Application Catalogue described above, are meant to be executed through the Application Catalogue User Interface.

### FR-HBBACF-08: Application Installation Package

The recommendation should include the definitions on format and contents for the package file used to distribute the Installable HBB Applications.

### FR-HBBACF-09: Resident Application Update

Since the HBBACF is also intended to manage Resident Applications, which are embedded in the HBB Receiver and controlled by the manufacturer, an update mechanism should be provided in order to meet this need from devices’ manufacturers.

### FR-HBBACF-10: Application Life Cycle Model

The HBB Application Life Cycle Model should be equivalent to each one defined by the middleware implementations adherent to the [ITU-T J.200]. In example Xlet Life Cycle model defined by [b-CDC] and adopted in [b-MHP], [b-ARIB B.23], [b-GINGA-J] and [b-HbbTV] or also Application Life Cycle model used in [b-ARIB B.24], [b.ITU-T H.761] and [b-GINGA-NCL].

### FR-HBBACF-11: HBB Application Control

In an analogous way as described in section 7.6, it should be possible for the HBB Service Provider to control the execution, availability and visibility only of the Service Associated HBB Applications ([b-HbbTV]).

The HBBACF should provide an HBB Application Control Mechanism (to be used by the HBB Service Provider) suitable for the Broadband and Application Repository scenarios in addition to those used in Broadcast scenarios. The **HBB Service’s Interactive Content Control Data Structure** refers to the Data Structures transmitted within the HBB Service to implement such HBB Application Control Mechanism.

An example of such **HBB Service’s Interactive Content Control Data Structure** is the AIT used in [b-HbbTV]. The use of other mechanisms to support the HBB Service’s Interactive Content Control Data Structure must also be considered. In HBB DTV Systems derived from existing DTV Systems, it would be desired to evolve the HBB Application Control Mechanism from the mechanism currently used in these systems.

In case of signalling and controlling an HBB Application, from an Application Repository, as an HBB Service Content, a link to the HBB Application in the Remote Application Catalogue (belonging to the proper Application Repository) must be included within the HBB Service’s Interactive Content Control Data Structure. Depending on the Control Code in such data structure, the application could be installed or executed directly from the Application Repository.

The HBBACF should be capable of handling Service Associated and Standalone HBB Applications as described in the section 7.4 (also considered in [b-HbbTV]).

In case of Service Associated HBB Applications, it should be possible for the HBBACF to handle both Service Exclusive and Service Shared HBB Applications, accordingly to what is described in section 7.5.This is already considered in [b-MHP] and [b-GINGA-J].

The HBBACF should allow that, in the case of HBB Model, HBB Applications could be launched in the following ways:

* 1. signalled to be auto-started in the current selected HBB Service;
  2. started by an already existing application using some middleware provided API;
  3. user started from the Application Catalogue User Interface.

HBB Application termination should occur:

* 1. signalled to be KILLed or DESTROYed in the current selected HBB Service;
  2. if it was started as a Service Associated Application and it has been removed from the Service’s Application Information Table
  3. stopped by other Service Associated Application (with proper permissions) using some middleware provided API;
  4. user stopped from the Application Catalogue User Interface;
  5. a Service change occurs and application is Service Exclusive HBB Application;
  6. a Service change occurs and application is Service Shared HBB Application, but conditions to keep the application alive are not met (application is not signalled in the new selected service);
  7. the HBB Application terminates itself by calling an specific middleware provided API;
  8. an exception is raised and it is not handled by the HBB Application; or
  9. HBB Receiver runs out of enough resources to execute the HBB Application.

Most of these mechanisms (from a to l) are already defined in [b-MHP], [b-GINGA], [b-ARIB B.23] and [b-HbbTV]. In such cases, the recommendation should use already existent definitions.

The HBBACF framework should support two or more HBB Applications to be executed simultaneously. As defined in FR-HBBACF-04, the Application Catalogue User Interface should allow the user to bring the different applications to focus. Additionally, the HBB Application Control Framework should grant the isolation between the running applications within its scope, but the HBB Receiver should provide isolation from other platform applications. This is important for standalone HBB applications that may not be aware of other applications executed in the system.

### FR-HBBACF-12: Rules for choosing Service Associated HBB Application’s Source

It should be possible that the same HBB Application could be made available through different channels (or delivery mechanisms) at the same time. A criteria also considering Installable HBB Application or application versioning should be defined. As in example, a decision table such as below could be defined:

**Table 2 – Proposed Application Source Decision Table**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ACTION** | **Already INSTALLED or RESIDENT** | **Version of the installed HBB Application is same or newer** | **Is it an Installable HBB Application?** | **Is the HBB Application transmitted in the current selected service?** |
| Download from the available source, avoiding interruption of the service exhibition. | No | - | No | No |
| Download from the current selected service. | No | - | No | Yes |
| Download from the available source, avoiding interruption of the service exhibition, and install. | No | - | Yes | No |
| Download from the current selected service and install. | No | - | Yes | Yes |
|  | Yes | No and App is not Resident | Yes | Yes |
| Use the installed application. | Yes | Yes | Yes | - |
|  | Yes | No or App is Resident | Yes | No and Service exhibition needs to be interrupted to download the latest version or application is not currently available for downloading. |
| Download and install. | Yes | No and App is not Resident | Yes | No. Service exhibition can continue for downloading the latest version. |

### FR-HBBACF-13: Ensuring Digital TV Service Integrity and HBB Application Permissions Policy

As previously defined, a Digital TV Service is a unit for delivering Audio-Visual-Interactive contents to the end users, and constitutes an editorially consistent whole.

It is a requirement for the HBBACF to ensure that the Digital TV Service is always consistent to the Service Provider editorial ([b-EBU-req]).

Service Associated HBB Applications can be allowed to be displayed combined and interact with the other Service Contents (audio, video, closed caption and other interactive content) belonging to the same Digital TV Service (rationale behind this is that Service Associated HBB Applications are part of the same editorial unit). In this case, Application Authentication and Permission Rules such as those defined by [b-MHP], Chapter 12 or by Ginga[b-GINGA-Security] should be applicable (see section in this document).

HBB Service Providers may desire to explicitly grant permissions to specific Standalone HBB Applications (such as Installed HBB Applications, Internet TV applications) or applications associated to different services in order behave as if they were part of the service. A mechanism should be also defined for this, in order to allow Standalone HBB Applications to:

1. overlay over other service’s contents such as the service’s video or other service’s applications;
2. manage or change service exhibition such as video control (video freeze, stop, scaling, etc.), audio control (audio stop, volume level change, etc.) and starting or stopping any other service component (subtitles, closed captions, alternate audio, alternate video, etc);
3. interact, communicate or control(start/pause/destroy) other HBB Applications from the service.

The Recommendation for HBBACF should consider that, when executing Standalone HBB Applications or HBB Applications from other Service Providers with no explicit permissions granted from the currently selected HBB Service Provider, the service exhibition must be stopped (video hidden, audio muted and any other service content hidden) as defined in [b-HbbTV] and [b-EBU-req]. An alternate option to be studied in this case is to divide the screen in such a way that the service content exhibition and the HBB Application are displayed in different and not overlapping regions. In these cases, separation from HBB Application and Digital TV Service content must be very clear to the end user.

### FR-HBBACF-14: Ensure User Privacy and User Data Protection

Authentication mechanism and permissions policies should be considered for HBB Applications in order to protect User Privacy and Data. Refer to section , for additional references on this requirement.

### FR-HBBACF-15: Service Content Protection

A mechanism for protection of Copyrighted Content delivered within the Digital TV Service must be considered ([b-EBU-req], [b-HbbTV]).

Control Access mechanism for non-universally-free content and Content Usability rules (like parental control and content rating/classification) should be also considered.

### FR-HBBACF-16: User Account Management

The user account could be associated to:

* HBB Application’s Custom User Settings stored in an HBB Receiver device, other devices in the HAN or servers reached through the broadband channel
* Grant access to a set of applications and services
* Account of credits or payment information for accessing non-free content
* Other accounts used in Internet Services (such as email, social networks, instant messaging, voice and video calls, etc)

Many devices are usually shared among several users (ex: a TV Set shared by the members of a family). In the other hand, some devices are mostly used by a single person (PDA, mobile phone, etc). The HBBACF should be aware of this and support the ability to handle several user accounts.

From the HBB Application point of view, it should only be possible to access resources and settings associated only to the currently logged in account.

### FR-HBBACF-17: HBB Application’s User Settings Management

The HBBACF should include a standardized application settings configuration feature in order to be able to integrate seamlessly to the System Settings Configuration UI.

It should be possible that the user settings could be stored and retrieved in different ways such as:

* stored in the receiver persistent storage (most usual case)
* shared among several devices present in the HAN
* retrieved from a server using some user identification method such as a user account through the broadband channel

### FR-HBBACF-18: Location Awareness

The HBBACF should provide mechanisms for HBB Application retrieve location information.

Additionally, HBB Receivers should be capable of retrieving HBB Application content selectively based on their location. ([b-EBU-req])

### FR-HBBACF-19: Home Area Network Integration

The HBBACF should provide mechanisms for discovering and interacting with other devices in the Home Area Network.

It is suggested to refer to ITU-T Draft Recommendation [b-J.hadi] for HAN Service definitions and mechanisms for discovering and interacting with other devices in the HAN.

### FR-HBBACF-20: HBB Receivers Capabilities

It should be considered for the HBBACF Recommendation current trends on devices with Digital TV receiving capabilities. Other than TV Sets and Set Top Boxes, HBB Digital TV Services may be delivered to Computers, Game Consoles, PVR devices, Blu-ray players, Hand Held Devices and Mobile Phones.

This requirement is intended to consider the following aspects:

* Screen Resolution
* Device Computational Capabilities
* User Input Method (Remote Control, Pointer Device, Multi Touch Screen, Alphanumeric Keyboard, etc.)

### FR-HBBACF-21: Digital TV Service Synchronization (Stream Events)

HBBACF should follow recommendations and mechanisms from [b-HbbTV], [b-MHP], [b-GINGA-NCL], [b-ITU-T H.761] and [b-GINGA-J].

### FR-HBBACF-22: File Formats, Encodings and Protocols

For file formats and protocols, those already used in [b-HbbTV], [b-MHP], [b-ARIB B.23], [b-ARIB B.24], [b-GINGA-NCL] [b.ITU-T H.761] and [b-GINGA-J] should be used.

Special care must be taken for including definitions on:

* Protocols and encoding formats for streaming multimedia content, such as audio and video.
* File and encoding formats for on demand multimedia content and minimal capabilities required for the HBB Receiver

HBB receivers may have stream capture capabilities (FR-HBBACF-24). It should be considered that multimedia encodings and protocols would be used for the captured media.

### FR-HBBACF-23: Download Feature

It should be considered the inclusion of an API for allowing applications to download and store contents in the HBB Receiver’s persistent storage, mechanism already available in [b-MHP] and [b-GINGA-J].

### FR-HBBACF-24: PVR Feature

An API should be provided to HBB Applications in order to allow them to:

* Query the recording schedule
* Query the recorder events
* Schedule or cancelling recording events
* Start, Pause or Stop and the speed of the playback of recorded content
* Identify if the HBB Application is being executed within the context of a recorded event. In such a case, it should be possible to the HBB Application to show when it was recorded.

This API should be integrated with the APIs used to query the schedule information such as used by an EPG.

### FR-HBBACF-25: Streaming Capabilities

Streaming capabilities exposed as an API extension to [b-ITU-TJ.202] would allow implementing applications such VOIP and Video Calls.

Stream playback capabilities should be also exposed to the interactive content and applications as API extensions to [b-ITU-TJ.202], allowing the implementation of client applications and players for Internet Services such as Internet multimedia content providers and content aggregators.

### FR-HBBACF-26: Content Purchase

A mechanism for allowing the user to make payments should be included in the HBBACF. An API for cryptography and certificate management should be considered. As a reference, cryptographic capabilities defined in [b-MHP] or [b-GINGA-J] could be used. These also include an API for accessing functionalities available in devices such as smart cards or cryptographic USB token.

The list of use cases to be covered includes purchase of:

* multimedia content to be streamed to the HBB Receiver
* multimedia content to be stored into the HBB Receiver
* access to non-free HBB Service (Paid TV Service)
* HBB Applications (usually installable standalone HBB Applications)

Additionally, the list of use cases should include the purchase of any other goods or General Services not to be directly used by the HBB Receiver (T-Commerce).

Payment methods to be included would depend on the region (credit cards, bank account transfers, debts on the cable or telephone bill, or credits previously acquired from some Internet Service provider).

### FR-HBBACF-27: Extended Service Information and Content Discovery

In addition to querying the Service Information Database, HBBACF should provide to HBB Applications a mechanism to find TV shows, including single episodes and series, and any other Digital TV Service content, taking into account broadcast and broadband content [b-EBU-req].

With this intention, it should be studied the possibility of providing to the HBB Application access to mechanisms more oriented to information search and retrieval like Internet Search engines.

### FR-HBBACF-28: System updating and expandability

HBBACF should consider a mechanism to support expandability and upgradability, in order to be future-proof and evolve by embracing new features ([b-EBU-req]).

### FR-HBBACF-29: Pluggable Modules Support

HBBACF should consider an extension mechanism based on pluggable software components, that, once installed in the HBB Receiver, would extend the HBBACF by exposing new APIs to the Applications.

The mechanism should consider an API for the pluggable module publishing its services and another API for Applications discovering and making use of them.

Annex A  
  
<Annex Title>

(This annex forms an integral part of this Recommendation)

<Body of annex A>

Appendix I  
  
<Appendix Title>

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

<Body of appendix I>

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