APPROVED ON NOVEMBER 30th, 2015.

ISDB-T HARMONIZATION DOCUMENT

PART 2: INTERACTIVITY & MIDDLEWARE

November/2015)

The documentation herein described is currently presented for revision of the harmonization Working Group contact points of the ISDB-T International Forum.

FOREWORD

This draft document is the outcome of the joint efforts of the countries that have adopted the ISDB-T Standard under the standardization and technical cooperation activities of the ISDB-T International Forum. Participants agree on the relevance of enhancing the interoperability and conformity with ISDB-T systems and commit to maximize the commonality of technical specifications.

This document has no standardization value. Its purpose is to serve as a quick reference for characterizing the specificities of digital terrestrial television in the participant countries. It does not describe the industrial property rights mandatory to these standards, and no reference is made to the domestic policies of the countries.

This document is drafted in accordance with the rules established in the ISO/IEC Directives, Part 2.

List of participants

As of 2015, the countries participating in ISDB-T International Forum are listed below:

ARGENTINA
BOLIVIA
BOTSWANA
BRAZIL
COSTA RICA
CHILE
ECUADOR
GUATEMALA
HONDURAS
JAPAN
MALDIVES
NICARAGUA
PARAGUAY
PERU
PHILIPPINES
SRI LANKA
URUGUAY
VENEZUELA

ISDB-T Harmonization document for digital terrestrial television
Part 2: Interactivity & Middleware

1 Scope

This document summarizes the reference model specifications to enable data broadcasting to digital terrestrial television receivers among the countries that have adopted the ISDB-T Standard.

The interactivity environment would be either Ginga or BML support, and the systems would be focusing on integrated broadcast and broadband (IBB) digital television service compliance.

2 Normative References

The following referenced documents are essential for application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ABNT NBR 15604, *Digital terrestrial television – Receivers*

ABNT NBR 15606, Digital terrestrial television – Data coding and transmission specification for digital broadcasting

ABNT NBR 15607-1 Digital terrestrial television — Interactive channel Part1: Protocols, physical interfaces and software interfaces

ARIB STD-B21:2007, *Receiver for digital broadcasting*

ARIB STD-B24:2008, *Data coding and transmission specification for digital broadcasting*

ARIB TR-B14:2006, *Operational guidelines for digital terrestrial television broadcasting*

Harmonization Document between ABNT NBR 15604 and ARIB STD- B21:2009, *Digital terrestrial television broadcasting – Receivers*

Harmonization Document between ABNT NBR 15606 and ARIB STD- B23 and ARIB STD- B24 - Data Coding and transmission specification for digital broadcasting

ISDB-T Harmonization Document Part 1: Hardware. ISDB-T International Forum

ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

Recommendation ITU-R BT.1699-1 *Harmonization of declarative application formats for interactive TV*

Recommendation ITU-R BT.1722-2 *Harmonization of the instruction set for the execution engine for interactive TV applications*

Recommendation ITU-R BT.1889 *Common application environment for interactive digital broadcasting services*

Recommendation ITU-T J.200 *Worldwide common core-Application environment for digital interactive television services*

Recommendation ITU-T J.201 *Harmonization of declarative content formats for interactive television applications*

Recommendation ITU-T J.202 *Harmonization of procedural content formats for interactive television applications*

Recommendation ITU-T J.205 *Requirements for an application control framework using integrated broadcast and broadband digital television*

Recommendation ITU-T J.206 *Architecture for an application control framework using integrated broadcast and broadband digital television*

Recommendation ITU-R BT.2053-0 *Technical requirements for integrated broadcast-broadband systems*

3 Definitions

This clause is intentionally left blank.

4 Abbreviations and acronyms

This clause is intentionally left blank.

5 Overview of the Ginga architecture

Systems and receivers for terrestrial (over-the-air) transmission are depicted

Middleware for digital TV applications consists of execution engines of offered languages and function libraries which enable quick and easy development of such applications.

The universe of applications for digital television can be partitioned into two sets: the declarative application set and the imperative application set. A declarative application is one in which its "initial" entity is of the "declarative content" type. Similarly, a procedural application is one in which its "initial" entity is of the "procedural content" type.

Declarative content shall be based on a declarative language, that is, a language that emphasizes the declarative description of the problem instead of its breakdown into an algorithmic implementation. Imperative content shall be based on a non-declarative language. Non-declarative languages can follow different paradigms. Thus, we have module-based languages, object-oriented languages, etc. Literature on digital television, however, uses the term "procedural" or “imperative” to represent all languages that are non-declarative. In imperative programming, the computer shall be informed about each step to be executed.

One can assert that in procedural languages, the developer has great power over the code and is able to establish the entire flow of control and execution of the program, and because of this language expressiveness, the degree of complexity is greater. Java is the most common language found in imperative environments of digital television systems.

The architecture and features of the Ginga specification designed for application in transmission systems and receivers for terrestrial (over-the-air) transmission are depicted in in Figure 1.[1]

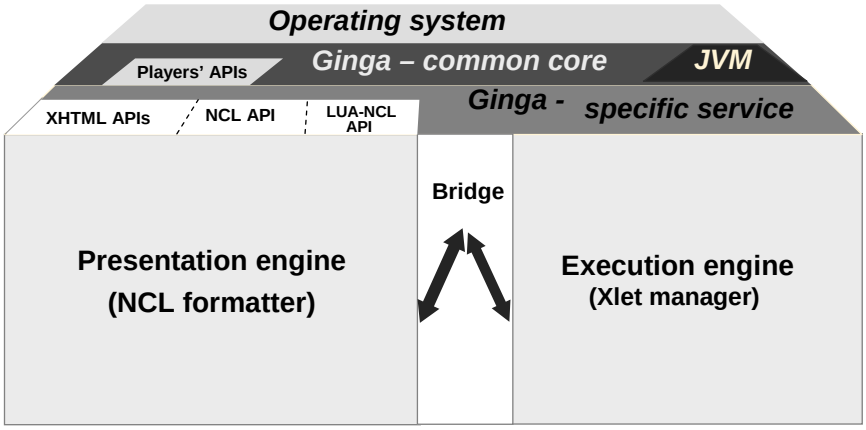

Figure 1 – High-level architecture of Ginga middleware

[1] Figure 1 corresponds to the basic architecture stated in Recommendation ITU-T J-200 [04/2010] part. 6.1, page 6, figure 1. Application environment system architecture.

Ginga-NCL (or Presentation engine) is a logical subsystem of the Ginga system that processes NCL application[2]. A key component of Ginga-NCL is the declarative-content decoding player (NCL formatter). Other important modules are the XHTML-based user's agent, which includes a stylesheet language (CSS) and may include ECMAScript interpreter, and the LUA engine, which is responsible for interpreting LUA Scripts. LUA is an imperative language that runs a scripting language of NCL.

Ginga-J (or Execution engine) is a logical subsystem of the Ginga System that processes imperative applications (Java Xlets). A key component of the imperative application environment is the imperative content execution mechanism, which is based on a Java Virtual Machine. Ginga-J is based on JavaTV 1.1.2; thus, it is compatible with other middleware systems based on Java such as those based on Globally Executable MHP (GEM). Interoperability and harmonization of Ginga-J and other procedural environments is described in ITU-T Recommendation J.202.

The ISDB-T system has chosen LUA as its script language and Java as the system's language. It should be stressed that LUA and JAVA have the same expressiveness. What can be done by using one language can be done by using the other, however with different degrees of complexity and efficiency.

Common content decoders shall serve the needs of both imperative and declarative application decoding. Ginga-common Core (CC) comprises common content decoders and procedures to obtain data transported in MPEG-2 transport streams (TS) and through return channels.

A bridge between both environments gives support to hybrid applications with specified entities in NCL, Lua, and Java.

Both Ginga-J and Ginga_NCL provide support to multiusers, multiple input and output devices, and multi-network interactions.

In general, Ginga is unaware of native applications such as: closed captioning, conditional access (CA) system messages, receiver menus, and native electronic program guides (Electronic Program Guide – EGP).

[2] NCL is a trade mark and its specification is PUC-Rio's intellectual property (INPI Technological Transference Department – N° 0007 162-5; 20/12/2005)

6 Broadcast Markup Language (BML) Architecture Overview

BML (Broadcast **M**arkup **L**anguage**)** is a multimedia application language developed by ARIB through its Satellite Digital Television System Development study group.

BML was standardized for satellite broadcasting services in Japan starting in December 2000. BML has been widely adopted in Japanese broadcasting services such as terrestrial digital TV and mobile terrestrial multimedia broadcasting services.

BML is defined in ARIB STD-B24 and Recommendation ITU-R BT.1699 and is designed to provide bidirectional communication capability by using a return channel.

BML is based on XHTML1.0, CSS1, and part of CSS2, DOM1, and part of DOM2 defined by W3C. BML employs ECMAScript as a script language and also has functional extensions that are required for broadcasting services.

The following are some of the key features enabling various data broadcasting services.

- Timeline control
  - ✓ Module update

    Module update is conducted at certain timings as a method to replace specific modules and provide updated content. With this method, data broadcast content can be synchronized with the progress of a TV program in a simple manner.

  - ✓ Event message

    Event messages are 244 byte short electronic messages that work as trigger signals. Because event messages can reach running data broadcast content faster than module updates, they are used for more accurate synchronization with TV programs. For example, this feature enables viewer participation in TV programs in which synchronization is important, such as a quiz show. .

- Viewer profile control

  In general, all the information in running BML content is erased when its execution is terminated or transitioned to another document. However, some of the information can be read by different BML content through special memory called Ureg and Non-Volatile Memory (NVRAM). NVRAMs are divided into a common area and private area. The common area can be used to input specific types of information, for example, a name, to BML content. The private area can be used for content or specific channel information such as that used in the next episode of the TV program.

7 Integrated broadcast-broadband (IBB) systems

IBB services should be able to extend the traditional broadcasting using any telecommunication mechanism available in order to bring new, high-quality, interactive and complementary content to the end-user. Such systems should be open, customizable and easy to use, while maintaining the traditional TV user experience, copyright and the broadcaster audiovisual integrity. The major point of difference between IBB systems and the web-based services is the capability to combine multi-functional IBB applications with traditional broadcast programs or services[3].

[3] Report ITU-R BT.2267-4 (02/2015) “Integrated broadcast-broadband systems”, page 1, 2015

Logical High Level Architecture (Informative)

A view of the logical high level architecture of the system is shown in Figure 2.

The Ginga middleware as specified in all the volumes of the ABNT NBR 15606 standard fulfills the requirements for ITU-T Recommendations J.200, J.201 and J.202. As illustrated in Figure 2, the specifications of these Recommendations can be used as execution environment of IBB applications. Hence, the Ginga middleware can be one of the application environment in IBB systems.

Hybridcast is an IBB system that uses HTML5 standardized in Japan. The system offers a variety of services through a combination of broadcast and broadband telecommunication resources and features. Although Hybridcast is not a source standard of ITU-T J.200 series Recommendations, the latest version, version 2.0, considers most of the requirements defined in Recommendations ITU-T J.205 and ITU-R BT.2053. Its functional architecture conforms to the mandatory architecture in Figure 2.

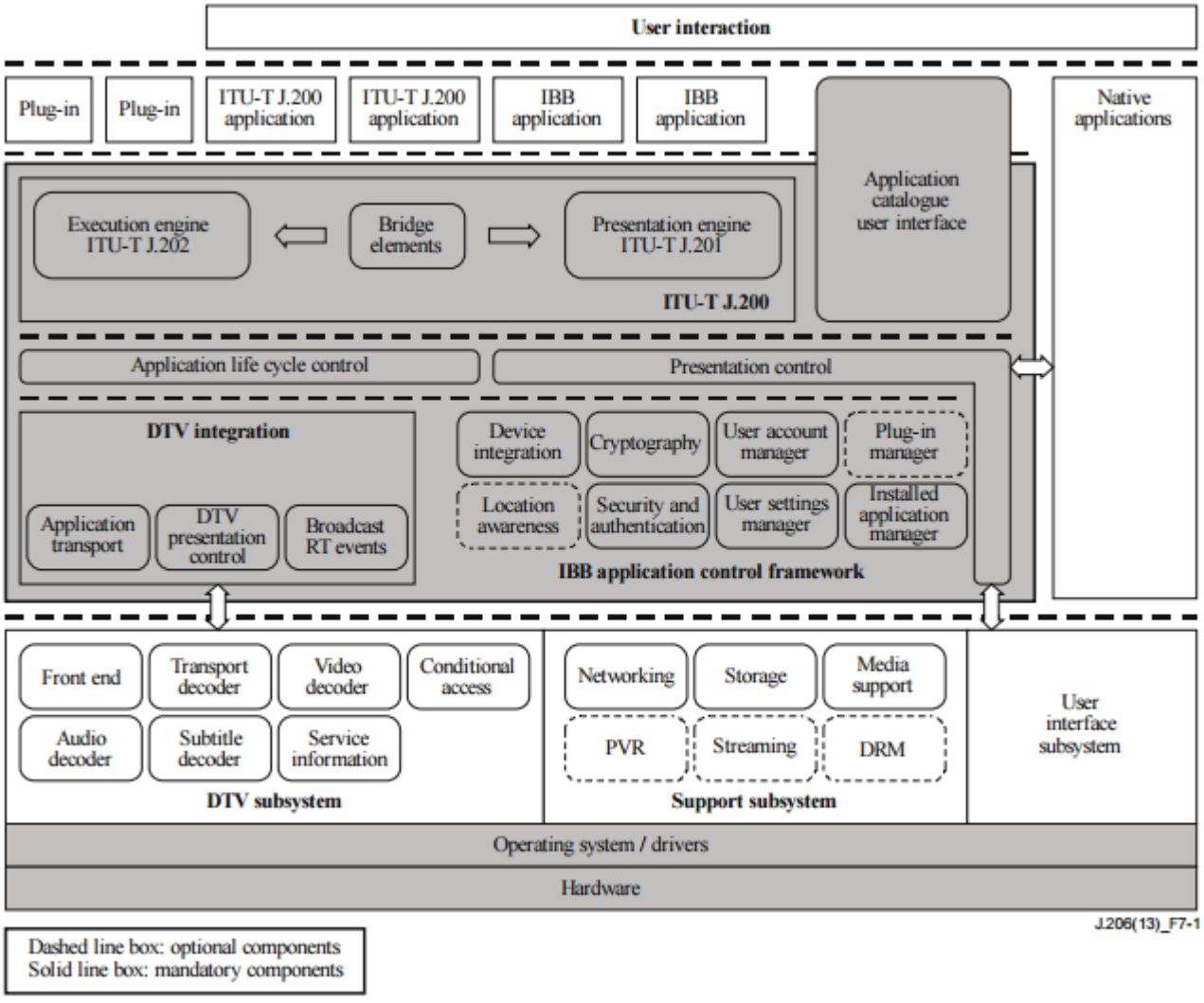

Figure 2 – Proposed high level architecture for IBB DTV receiver (source: Figure 7-1 in Rec. ITU-T J.206)

For further details on the mandatory requirements and the logical high level architecture of IBB systems, refer to Recommendations ITU-T J.205 and J.206, and Recommendation ITU-R BT.2053.

8 Remote control

To ensure a stable and common reference for application developers and consumers, it is necessary to specify the minimum functions related to remote control.

The concept of remote control has evolved. Remote control is commonly used for many purposes, for example, TV/receiver control, channel selection, access to information on programs and services, and interactivity, and it provides a variety of user interfaces (use of movement sensors, cameras, touch screens, multifunction mobiles, etc.). However, the following functions shall be present regardless of its physical implementation:

Numeric functions:
Numeric information group corresponds to 0,1,2,3,4,5,6,7,8,9.
Numeric functions are used for: channel selection and alphanumeric input functions for both interactive and receiver built-in applications and/or functions.[4]

Interactive functions:
Interactive functions are used for navigating in any interactive and built-in receiver applications and/or functions.

At least, the following subgroups of interactive "keys[5]" shall exist:

- color function subgroup (red, green, yellow, and blue)
- directional function subgroup (left arrow, right arrow, up arrow, and down arrow)
- selection function subgroup (Ok, and Back, and Exit) (Exit is not applicable for BML)

Override of determined functions in the subgroups above is not permitted.

[4] In some cases, keys for numbers 10, 11 and 12 may exist additionally.

[5] "Keys" is understood in a wide sense, e.g.: physical keys, touch icons, or movement sensors.

Middleware environment

Table 2 lists the middleware environment adopted by each country (when version is not specified, it must be considered the latest version of the standard).

Country	Middleware Environment		Remarks
	Declarative	Imperative	
ARGENTINA	ABNT NBR 15606-1, ABNT NBR 15606-2, ABNT NBR 15606-3, ABNT NBR 15606-5, ABNT NBR 15606-7, ABNT NBR 15606-9		1) Support for application resolutions 720x576(4:3) and 720x576 (16:9) is mandatory 2) Requires support for playback of multimedia files (MPEG-4 container, H.264 video and AAC LC audio) 3) Requires compliance with LIFIA's Test Suite v3.0
BOLIVIA			
BOTSWANA	ARIB TR-B14 ARIB STD-B24		
BRAZIL	ABNT NBR 15606-2, ABNT NBR 15606-5 and ABNT NBR 15606-7	ABNT NBR 15606-4, ABNT NBR 15606-6 and ABNT NBR 15606-8	1) Requires compliance with SBTVD Forum's Test Suite
	ABNT NBR 15606-1, ABNT NBR 15606-3, ABNT NBR 15606-9		
COSTA RICA			
CHILE			
ECUADOR			
GUATEMALA			
HONDURAS			
JAPAN	ARIB TR-B14 ARIB STD-B24		
MALDIVES	ARIB TR-B14 ARIB STD-B24		
NICARAGUA			
PARAGUAY			
PHILIPPINES	ARIB TR-B14 ARIB STD-B24		
PERU			
SRI LANKA			
URUGUAY			
VENEZUELA	ABNT NBR 15606-1, ABNT NBR 15606-2, ABNT NBR 15606-3, ABNT NBR 15606-5, ABNT NBR 15606-7, ABNT NBR 15606-9		1) Mandatory native font is Nimbus Sans L instead of Tiresias. 2) Uses UTF8 for text encoding

Table 2 – Middleware environment by country

9 Tests Suite (Informative)

Interactive receivers should implement one or more interactive systems or codings in this document. For Ginga middleware, interoperability and functionalities compatible with Ginga implementations, tests suite listed in Remarks column in table 2 are available in order to maximize interoperability.

Variations in different processing capacity and volatile memory (RAM) set up, as well as the search of optimization and performance improvement, imply that tests suites shall be updated from time to time, selecting them, if possible, according to priorities.

Bibliography:

Luis Fernando Gomes Soares, Guido Lemos de Souza Filho Interactive Television in Brazil: System software and the Digital Divide

Luis Fernando Gomes Soares, Interactive TV is made with Ginga, SBTVD Forum, SET Magazine, Nº 07 pages 67-70

Dr. Guido Lemos De Souza Filho (LAVID-UFPB),Bycon Project, ICT- 2008, Lyon, France, 24/11/2008

Fábio Ellwanger, Gustavo, Balbinot, UNISINOS, A Lingugem de Programação Lua

Laboratório TeleMidia (PUC-Rio), Ambiente para Desenvolvimento de Aplicações Declarativas para a TV Digital Brasileira

Marcus Aurélio Ribeiro Manhães, Pei Jen shieh, Amilton da Costa Lamas e Pedro Eduardo de Oliveira Macedo.- Canal de Interatividades em TV Digital, CPqD Tecnología, Campinas, V1, n1, p. 29-36, jan/dez. 2005

Deisy Fernanda Feitosa, Kellyanne Carvalho Alves, Pedro Nunes Neto (UFPB), Conceitos de interatividade e suas funcionalidades na TV digital, WWW.bocc.ubi.pt

Francisco Sant'Anna, Renato Cerqueira, Luiz Fernando Gomes Soares (PUC-Rio) NCLua – Objetos Imperativos Lua na Linguagem Declarativa NCL

Luis Fernando Gomes Soares, Simone Diniz Junqueira Barbosa, Programando em NCL 3.0, 2da Edición, (TeleMidia- PUC Rio), 2012, http://www.telemidia.puc-rio.br/sites/telemidia.puc-rio.br/files/Programando_em_NCL_30.pdf

TOTVS, Brasil 4D DTV ISDB-T STB Requirements, May, 2014