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

Cable modems

Component definition and interface specification for the next generation set-top box

Recommendation ITU-T J.293



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Recommendation ITU-T J.293

Component definition and interface specification for the next generation set-top box

Summary

Recommendation ITU-T J.293 defines three categories of STB to support the combination of various kinds of content distribution schemes including RF-based and IP-based networks. It also specifies STB components and interfaces based on the architecture defined in Recommendations ITU-T J.290, J.291 and J.292. This Recommendation further describes a configurable approach in order to support the region-specific content distribution systems. This Recommendation describes interfaces and behaviours of the components that constitute the STB in terms of physical issues, protocols, operating system, software platform, user interfaces, and so on.

Source

Recommendation ITU-T J.293 was approved on 13 June 2008 by ITU-T Study Group 9 (2005-2008) under Recommendation ITU-T A.8 procedure.

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Component definition and interface specification for the next generation set-top box

1 Scope

This Recommendation defines three categories of STB to support the combination of various kinds of content distribution schemes including RF-based and IP-based networks. It also specifies STB components and interfaces based on the architecture defined in [ITU-T J.290], [ITU-T J.291] and [ITU-T J.292]. This Recommendation further describes a configurable approach in order to support the region-specific content distribution systems. This Recommendation describes interfaces and behaviours of the components that constitute the STB in terms of physical issues, protocols, operating system, software platform, user interfaces, and so on.

In addition, this Recommendation is applicable not only to an external independent box implementation (i.e., STB) but also to other approaches such as TV panel-embedded implementation.

NOTE 1 – This Recommendation covers the existing content distribution systems including cable TV and IPTV at the time of publication, is subject to modification when a new content distribution system such as NGN-based IPTV is specified and available.

NOTE 2 – The structure and content of this Recommendation have been organized for ease of use by those familiar with the original source material; as such, the usual style of ITU-T recommendations has not been applied.

2 References

2.1 Normative 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 G.9954] Recommendation ITU-T G.9954 (2007), *Home networking transceivers – Enhanced physical, media access, and link layer specifications*.
- [ITU-T H.222.0] Recommendation ITU-T H.222.0 (2006) | ISO/IEC 13818-1:2007, *Information technology – Generic coding of moving pictures and associated audio information: Systems*.
- [ITU-T H.SUP1] H-series Recommendations – Supplement 1 (1999), *Application profile – Sign language and lip-reading real-time conversation using low bit rate video communication*.
- [ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution*.
- [ITU-T J.190] Recommendation ITU-T J.190 (2007), *Architecture of MediaHomeNet*.
- [ITU-T J.200] Recommendation ITU-T J.200 (2001), *Worldwide common core – Application environment for digital interactive television services*.

- [ITU-T J.201] Recommendation ITU-T J.201 (2004), *Harmonization of declarative content format for interactive television applications.*
- [ITU-T J.202] Recommendation ITU-T J.202 (2008), *Harmonization of procedural content formats for interactive TV applications.*
- [ITU-T J.215] Recommendation ITU-T J.215 (2007), *Client digital program insertion API.*
- [ITU-T J.290] Recommendation ITU-T J.290 (2006), *Next generation set-top-box core architecture.*
- [ITU-T J.291] Recommendation ITU-T J.291 (2006), *Next generation set-top-box cable architecture.*
- [ITU-T J.292] Recommendation ITU-T J.292 (2006), *Next generation set-top-box media independent architecture.*
- [ITU-T J.700] Recommendation ITU-T J.700 (2007), *IPTV service requirements and framework for secondary distribution.*
- [ITU-R BT.1306] Recommendation ITU-R BT.1306 (2006), *Error correction, data framing, modulation and emission methods for digital terrestrial television broadcasting.*
- [ITU-R BO.1408] Recommendation ITU-R BO.1408 (2002), *Transmission system for advanced multimedia services provided by integrated services digital broadcasting in a broadcasting-satellite channel.*
- [ITU-R BT.1700] Recommendation ITU-R BT.1700 (2005), *Characteristics of composite video signals for conventional analogue television systems.*
- [IEC 60958] IEC 60958 (2006), *Digital audio interface.*
- [IEC 62360] IEC 62360 (2008), *Baseline specifications of satellite and terrestrial receivers for ISDB (Integrated Service for Digital Broadcast).*
- [IEC 62481-1] IEC 62481-1 Ed. 1.0 (2007), *Digital living network alliance (DLNA) home networked device interoperability guidelines – Part 1: Architecture and protocol.*
- [IEC 62481-2] IEC 62481-2 Ed. 1.0 (2007), *Digital living network alliance (DLNA) home networked device interoperability guidelines – Part 2: DLNA media formats.*
- [RFC 2131] IETF RFC 2131 (1997), *Dynamic Host Configuration Protocol.*
- [RFC 2250] IETF RFC 2250 (1998), *RTP Payload Format for MPEG1/MPEG2 Video.*
- [RFC 3315] IETF RFC 3315 (2003), *Dynamic Host Configuration Protocol for IPv6 (DHCPv6).*
- [RFC 4862] IETF RFC 4862 (2007), *IPv6 Stateless Address Autoconfiguration.*
- [DVB-IP] ETSI TS 102 034 V1.3.1 (2007), *Digital Video Broadcasting (DVB); Transport of MPEG-2 TS Based DVB Services over IP Based Networks.*
- [TR-069] DSL Forum TR 069 (2007), *CPE WAN Management Protocol v1.1.*
- [TR-135] DSL Forum TR 135 (2007), *Data Model for TR-069 Enabled STB.*
- [ISO 13818-6] ISO | IEC 13818-6:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 6: Extensions for DSM-CC.*

2.2 Informative References

- [ACC-CHECKLIST] ITU-T Technical Paper (2006), *FSTP-TACL Telecommunications Accessibility Checklist*.
- [OC-SP-HOST2.1] OC-SP-HOST2.1-CFR-I01-070720, *OpenCable Host Device 2.1 Core Functional Requirements*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 BC-TD: A logical interface defined in 6.1.1 for content reception through a non-IP (RF-based) network.

3.2.2 NW-TD1: A logical interface defined in 6.1.2 for content reception through an IP network.

3.2.3 NW-TD2: A logical interface defined in 6.1.3 for interactive communications to outside of a home network through an IP network.

3.2.4 HN-TD1: A logical interface defined in 6.1.4 for content reception through an IP home network.

3.2.5 HN-TD2: A logical interface defined in 6.1.5 for interactive communications to entities within an IP home network.

3.2.6 TD-PD: A logical interface defined in 6.1.6 for connection between a peripheral device and the STB.

3.2.7 TD-OD: A logical interface defined in 6.1.7 between an output device and the STB.

3.2.8 home network coaxial modem: A modem for IP communications modulated over Coaxial cable for communications within the home, e.g., MOCA, HPNA over Coax.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AOD	Approved Output Domain
ASD	Authorized Service Domain
BED	Best Effort Domain
CA	Conditional Access
CAS	Conditional Access System
CM	Cable Modem
CMTS	Cable Modem Termination System
CPE	Customer Premises Equipment
CSP	Configurable Security Processor
DCAS	Downloadable Conditional Access System
DVR	Digital Video Recorder
eCM	Embedded Cable Modem

ECM	Entitlement Control Message
EMM	Entitlement Management Message
GPU	Graphics Processing Unit
GSD	Guaranteed Service Domain
HDD	Hard Disk Drive
HFC	Hybrid Fibre and Coaxial
HPNA	Home Phoneline Networking Alliance
IP	Internet Protocol
MPEG	Moving Picture Expert Group
OFDM	Orthogonal Frequency Division Multiplexing
PACM	Provisioning, Activation, Configuration, and Maintenance
PES	Packetized Elementary Stream
PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RG	Residential Gateway
RTP	Real-time Transport Protocol
SAC	Secure Authenticated Channel
SI	Service Information
STB	Set-Top Box
TCP	Transmission Control Protocol
TS	Transport Stream
UDP	User Datagram Protocol
WDM	Wavelength Division Multiplexing

5 System Overview

5.1 Content distribution context

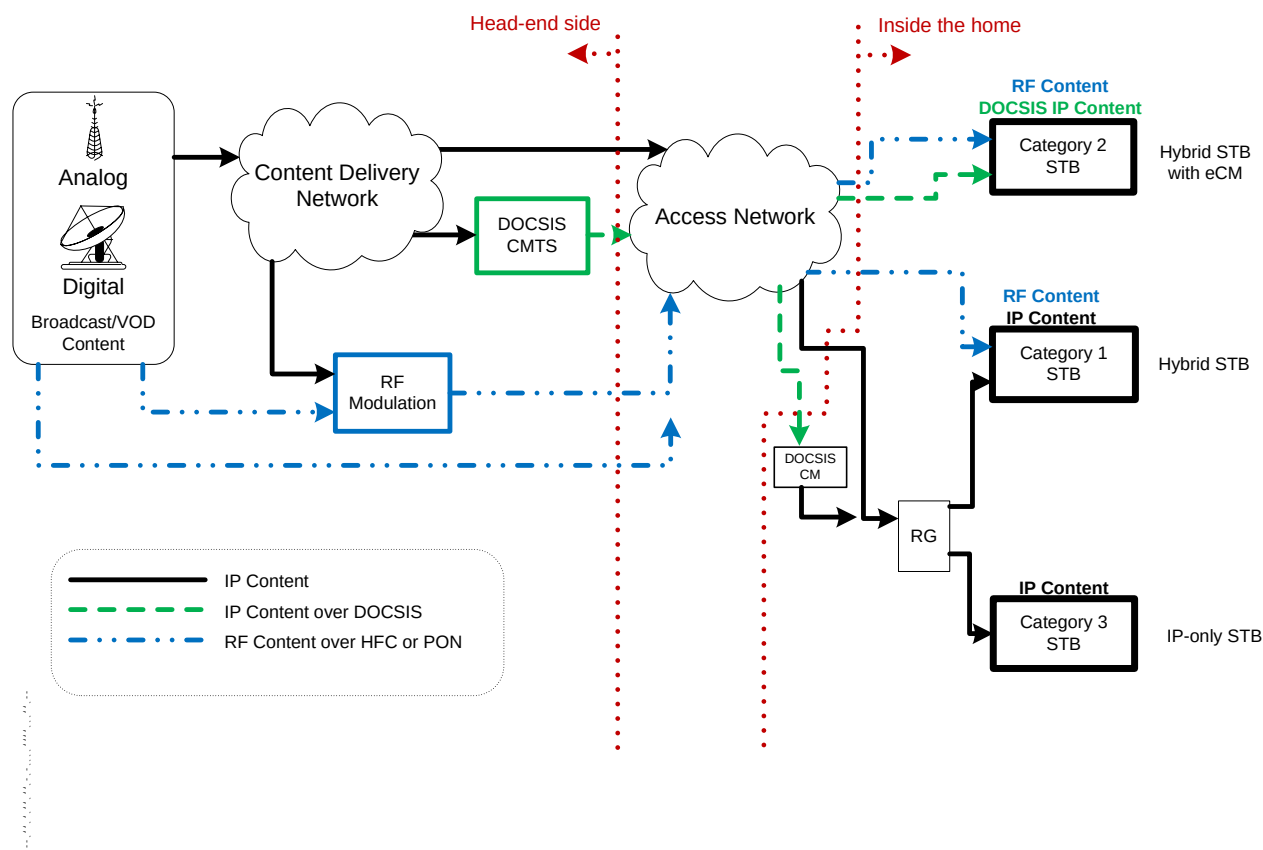


Figure 1 – Client devices in an assumed content distribution network: content flow aspect

Figure 1 shows an assumed distribution network drawn in a content flow aspect. In this Recommendation, the STB receives content signals from the head-end and makes an interactive communication as an in-home equipment (CPE). In Figure 1, there are two cases for content signal distribution, i.e., RF modulated signals such as QAM, OFDM and IP packets such as RTP/UDP/IP. Only IP technology is used for control and interactive communication signal flow in this context. The most applicable access networks are HFC, DSL, or Optical Fibre, but other networks are envisioned. The RF signal can be carried by an HFC or Optical Fibre network. The IP signal may be carried by HFC with DOCSIS, Optical Fibre, DSL or other access networks that support IP transmission, e.g., WiMax. This Recommendation defines three categories of STB as shown in Figure 1.

Category 1 STB (Hybrid STB): This type of STB is required to receive RF-based content signals as well as IP-based ones. The Hybrid STB is applicable to both Optical Fibre where RF signals are multiplexed with IP packets by WDM and HFC where RF modulated content signals and IP packets modulated by DOCSIS are carried. For any cases, a Residential Gateway (RG) is usually used and in-home devices connected to the RG constitute the IP home network. Logically, two kinds of wirings are necessary, i.e., the IP home network and the RF signal wiring. If IP over coaxial cable technology is used, these two wirings can be physically integrated into one coaxial cable.

Category 2 STB (Hybrid STB with embedded CM): This type of STB is required to be a hybrid STB with an embedded DOCSIS cable modem inside the STB. An HFC access network is directly connected to the STB. IP packets received through DOCSIS are terminated by an embedded cable modem.

Category 3 STB (IP-only STB): This type of STB is required to have an IP network interface only. All signals including content reception, controls and interactive communication are carried over IP.

Table 1 summarizes content distribution services, transmission schemes, and access media supported by each type of the above-described STBs. In this Recommendation, STB is required to support both services of content broadcasting and VOD streaming.

Table 1 – Supposed access network, transmission schemes, and supported services for each STB category

	Supposed access network examples	Transmission schemes	Supported services
Category 1 STB	Optical Fibre or HFC with external DOCSIS modem	RF and IP	RF content broadcasting IP content broadcasting RF VOD with IP session control IP VOD with IP session control
Category 2 STB	HFC with embedded DOCSIS modem	RF and IP	RF content broadcasting IP content broadcasting RF VOD with IP session control IP VOD with IP session control
Category 3 STB	Optical Fibre, DSL HFC with external DOCSIS modem	IP	IP content broadcasting IP VOD with IP session control

NOTE – This Recommendation considers a downloading service as one of the services supported by an application platform defined in clause 7.9.

5.2 Reference STB Architecture

The reference architecture of STB defined by this Recommendation is based on [ITU-T J.290]. Figure 2 illustrates a functional block diagram of STB that consists of:

- Provisioning, Activation, Configuration, and Maintenance (PACM)
- Signal reception
- Transport stream handling
- Configurable security processing for CAS
- Media (video, audio, text, etc.) decoding
- Rendering (video, audio, graphics processor)
- Signal outputs including copy protection
- Digital Video Recorder (DVR) control including local digital program insertion
- Interactive communication interface
- Application platform (Middleware)
- Microcontroller
- Digital rights management for home network
- Home network connection
- User interfaces including remote control and its receiver
- STB remote management (as a part of PACM)
- Diagnostics (as a part of PACM)
- Mechanical

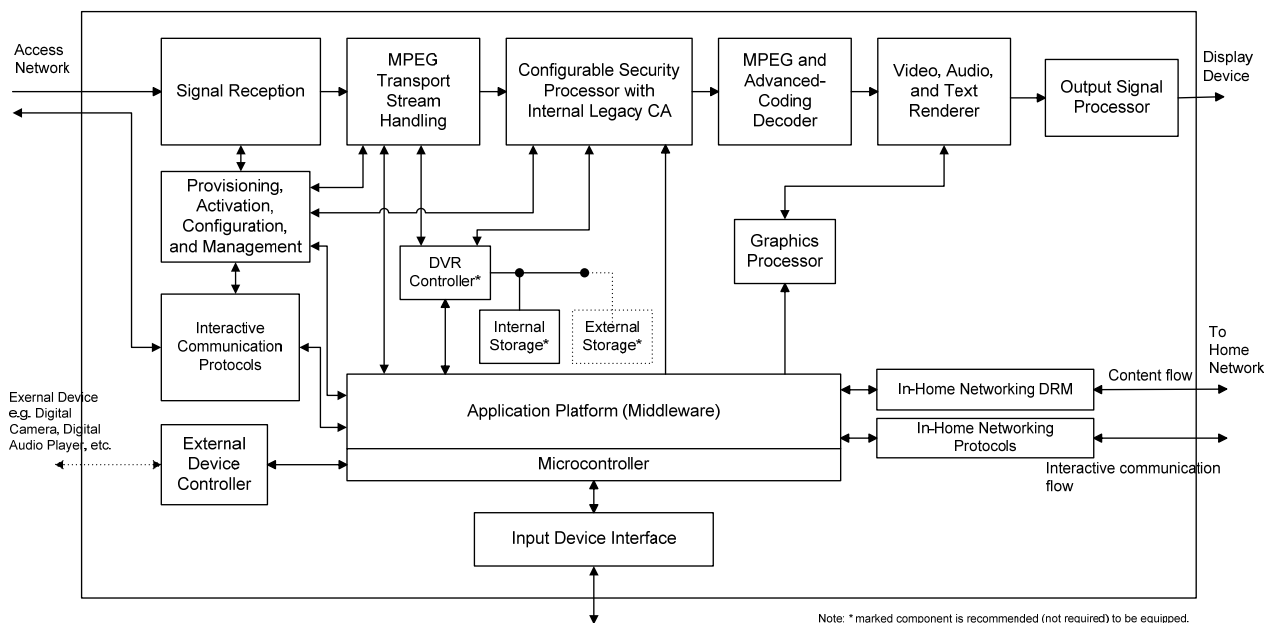


Figure 2 – Functional Block Diagram based on [ITU-T J.290]

Figure 2 shows fundamental components of STB, each of which is defined in this Recommendation. This figure shows a generic diagram in terms of network connections for content signal reception, interactive communication, and home network connection. As described in clause 5.1, there are a variety of STB implementations. Examples are shown in Appendix I according to the three categories defined in clause 5.1.

5.3 Use case scenarios

There are several variations for implementation of interactive communication interface. The interface provides a communication channel with other devices including head-end based on IP-based protocols. There are mainly two types of configurations depending on whether DOCSIS modem is embedded in the STB or not. In addition, there can be several implementation variations in each case.

5.3.1 For category 1 and 3 STB

If the STB is used with IP-based access networks such as Optical Fibre, DSL or with an external DOCSIS modem, the communication signal between outside the home and the STB can be multiplexed with other IP packets communicating with in-home devices. The simplest implementation example is shown in Figure I.5.

If television signal is provided by RF-modulated signal and the communication channel uses IP-based access network or an external DOCSIS modem, the same configuration applies to this case. Examples are shown in Figures I.1 and I.2. The difference between them is that the latter case uses a coaxial modem that multiplexes IP packets on RF television signals in a coaxial cable.

For any implementation configurations, an external residential gateway is required to achieve appropriate routing of IP packets, some of which should communicate with the head-end side, and others should communicate with in-home devices.

5.3.2 For category 2 STB

If the STB equips embedded DOCSIS modem, the communication signal between outside the home and the STB shall be separately handled from other IP packets communicating with in-home

devices as shown in Figure I.3. In this case, a cable interface is used to communicate with the head-end side, whereas 100 Base-T interface is used for in-home communication.

Figure I.4 illustrates other implementation example where a home network coaxial modem is used to multiplex IP packets on RF television signals in a coaxial cable. This means that RF television signals, DOCSIS IP signal, and modulated IP-packets for in-home communications coexist in a coaxial cable.

5.4 Home networking configurations

To clarify signal flows incoming to the STB or outgoing from the STB, several home networking configurations are illustrated in Appendix II.

5.5 Design Concept

STB defined in this Recommendation is designed with a configurable approach in order to support various kinds of content distribution systems such as cable television or IPTV that might be region-specific. Implementations of the following functionalities shall be modularized to be selectable from the corresponding specifications defined in clause 7.

- Signal reception
 - each content distribution system will have to choose one and more alternatives
- Transport stream handling
 - each content distribution system will implement a common part and one or more alternatives
- Security processing
 - each content distribution system will implement a common part and one or more alternatives
- Rendering
 - each content distribution system will implement a common part and one or more alternatives
- Signal output and copy protection
 - each content distribution system will have to choose one or more alternatives
- Application platform
 - each content distribution system will implement one or more of the following:
 - a) J.201-based
 - b) J.202-based
 - c) each content distribution system may implement native application support (outside the scope of this Recommendation)

Figure 3 shows a graphical explanation of the above-described concept. A gray-shaded box denotes a component that depends on each content distribution system listed in clause 7.2 and one or more alternatives should be chosen in accordance with the system that the STB would support. A hatched box denotes a component that also depends on content distribution system selection, but it would be realized with a common basic implementation plus one or more specific portions corresponding to the content distribution system supported by the STB. White box represents a component that can be commonly used for any content distribution system.

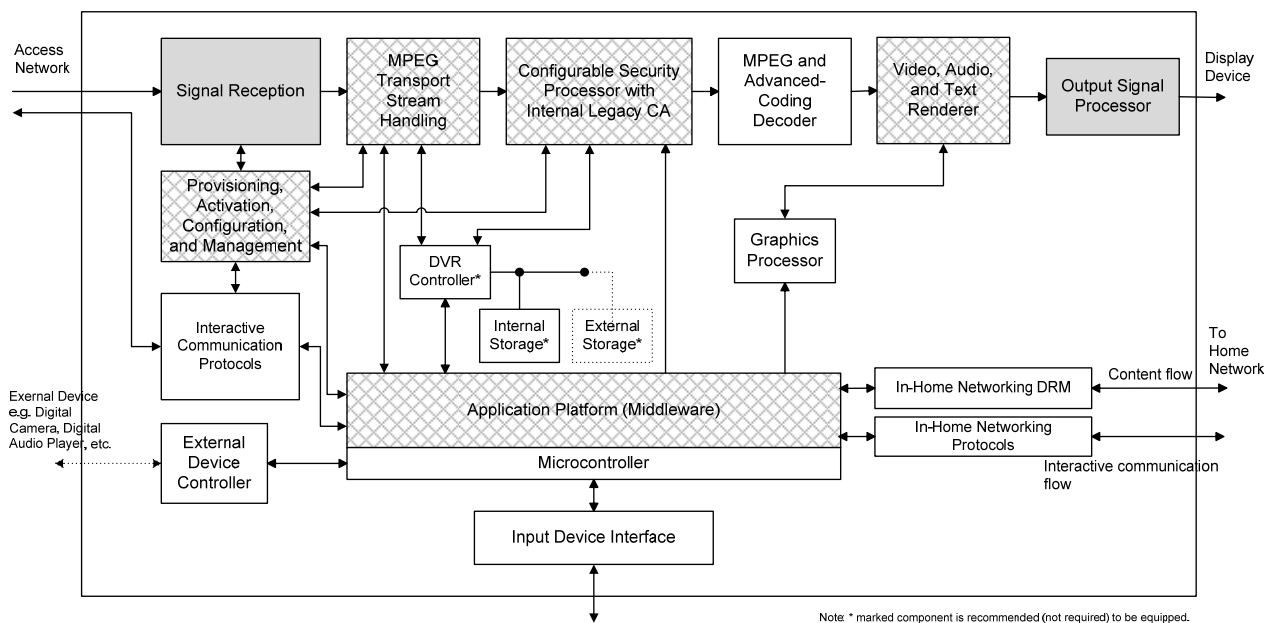


Figure 3 – Graphical Explanation of the Design Concept of a STB defined by this Recommendation

6 STB interfaces

6.1 Logical interfaces

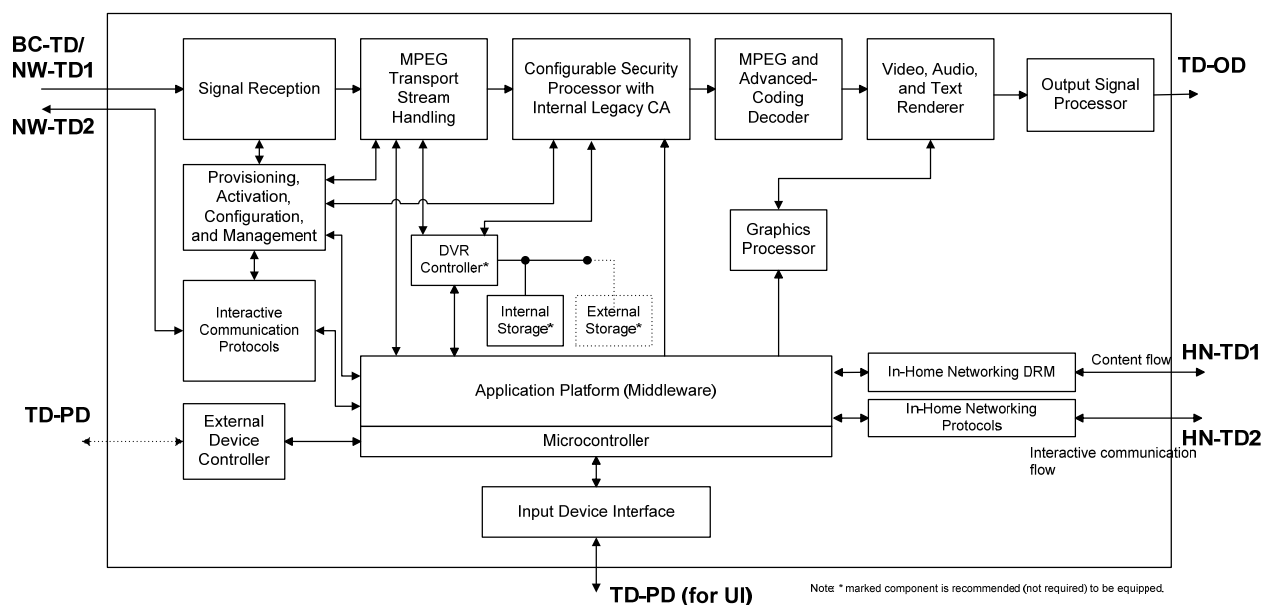


Figure 4 – Logical interface definitions

Figure 4 depicts logical interfaces of the STB.