

RECOMMENDATION ITU-R BO.1724-1

Interactive satellite broadcasting systems (television, sound and data)

(Question ITU-R 26/6)

(2005-2007)

Scope

This Recommendation intends to specify the interactive satellite broadcasting systems (television, sound and data) under Question ITU-R 26/6 when a satellite return channel using geostationary-satellite systems is operated using the System A in Recommendation ITU-R BO.1516 in the broadcasting-satellite service (BSS).

Two systems are recommended for this subject. The first system is the European Telecommunication Standards Institute (ETSI) Standard ETSI EN 301 790V1.3.1, known as DVB-RCS. The second one is the Telecommunications Industry Association (TIA) Standard TIA 1008-A.

Normative texts for these specifications are given in URLs and descriptive summaries are provided in its Annexes.

The ITU Radiocommunication Assembly,

considering

- a) that substantial progress in digital broadcasting technologies has resulted in the implementation of operating digital systems in the broadcasting satellite service (BSS);
- b) that ITU-R has developed Recommendation ITU-R BO.1516 for digital multiprogramme television systems operating in the 11/12 GHz frequency range;
- c) that it is important to ensure the maximum commonality and compatibility with other return channel solutions for the different broadcasting media;
- d) that interactivity is recognized to be a desirable feature for broadcast services, the need for suitable systems being addressed by Question ITU-R 16/6, and that Question ITU-R 26/6 addresses the provision for anonymous reception for broadcasts;
- e) that the interaction channel systems for interactive services should ensure the access to all the terminals within the downlink service area;
- f) that the interaction channel solutions based on satellite should be compatible for individual and community reception systems;
- g) that the existence of a return channel may offer to the broadcasting entities the opportunity to provide interactive broadcasting services;
- h) that there is a need to identify interfaces for the interconnection of the satellite-broadcasting systems with other broadcasting media;
- j) that ITU-R has approved Recommendation ITU-R BT.1369 – Basic principles for a worldwide common family of systems for the provision of interactive television services;
- k) that ITU-R has approved Recommendation ITU-R BT.1434 – Network independent protocols for interactive systems;
- l) that ITU has developed Recommendations on interaction channel using public switched telephone network/integrated services digital network (PSTN/ISDN), mobile phone systems, cable systems, microwaves, etc.,

recommends

1 that, when a satellite return channel using geostationary-satellite systems is operated using the System A in Recommendation ITU-R BO.1516 in the BSS, the following two standards may be used:

European Telecommunications Standards Institute (ETSI) Standard ETSI EN 301 790¹ V1.3.1 (2003-03): <http://www.itu.int/ITU-R/study-groups/rsg6/etsi/index.html>, or Telecommunication Industry Agency (TIA) Standard TIA-1008-A: <http://www.itu.int/md/R03-WP6S-C-0191/en>;

2 that the descriptive summaries of the standards provided in Annexes 1 and 2, as well as the comparison Table 1, may be used to assist administrations in selecting an appropriate standard to meet their needs.

TABLE 1

Comparison Table for ETSI EN 301 790 V.1.3.1 and TIA-1008-A

Item	ETSI EN 301 790	TIA-1008-A
Broadcast channel	Recommendation ITU-R BO.1516	Recommendation ITU-R BO.1516
Return channel modulation	QPSK	CE-OQPSK
Return channel coding	Viterbi/Reed Solomon rates 1/2, 2/3, 3/4 or turbocode rates 1/3, 2/5, 1/2, 2/3, 3/4, 4/5, 6/7	Viterbi rate 1/2 or turbocode rate 1/2, 2/3, 4/5
Return channel data rate	No restriction	64, 128, 256, 512, 1 024, 2 048 ksymbol/s
Return channel spacing (minimum)	$1.35 \times \text{symbol rate}$	$1.25 \times \text{symbol rate}$
Return channel burst size	Variable length, defined as 1, 2 or 4 ATM cells, or $1, 2 \times N$: $N = 1$ to 12 MPEG2 cell(s)	Slotted Aloha – fixed length bursts (definable), dynamic stream – variable length bursts from specified minimum to full frame length
Return channel Media access control method	TDMA/FDMA bandwidth, transmission rate, coding rate, and duration of traffic slots are fixed or dynamic, slot by slot. Frequency hopping can be performed on a slot-by-slot basis	TDMA/FDMA (frequency assigned when inroute request made) – Can frequency-hop on a frame-by-frame basis
Return channel burst ARQ protocol?	Yes, as per IP on MPEG	Yes, with selective retransmit
Return channel bandwidth management	Continuous rate dynamic capacity, rate-based dynamic capacity, volume-based dynamic capacity, free capacity assignment	Slotted Aloha, dynamic stream with definable hangover period, inroute quality of service, constant bit rate

¹ The word “shall” in this ETSI standard should be considered as “should” in this ITU-R Recommendation.

Annex 1

Descriptive summary of ETSI Standard EN 301 790 V1.3.1

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1 Introduction

This Annex provides a specification for the provision of an interaction channel for GSO satellite interactive networks with fixed return channel satellite terminals (RCSTs). This specification facilitates the use of RCST for individual or collective installation (e.g. SMATV) in a domestic environment. It also supports the connection of such terminals with in-house data networks. This specification may be applied to all frequency bands allocated to GSO satellite services.

2 Reference model of the satellite interaction network

2.1 Protocol stack model

For interactive services supporting broadcast to the end user with return channel, a simple communications model consists of the following layers:

Physical layer: where all the physical (electrical) transmission parameters are defined.

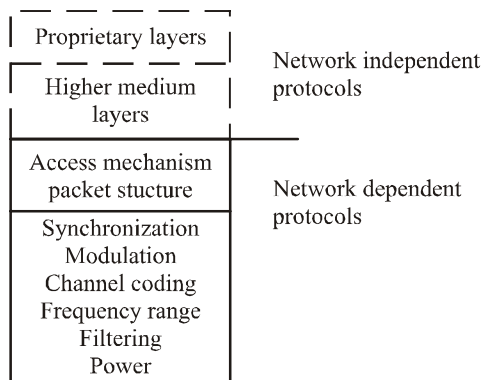
Transport layer: defines all the relevant data structures and communication protocols like data containers, etc.

Application layer: the interactive application software and runtime environment (e.g. home shopping application, script interpreter, etc.).

A simplified model of the OSI layers was adopted to facilitate the production of specifications for these layers. Figure 1 shows the lower layers of the simplified model and identifies some key parameters.

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FIGURE 1
Layer structure for generic system reference model



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The present text addresses the satellite interactive network dependent aspects only.

2.2 System model

Figure 2 shows the system model which is to be used within digital video broadcasting (DVB) for interactive services.

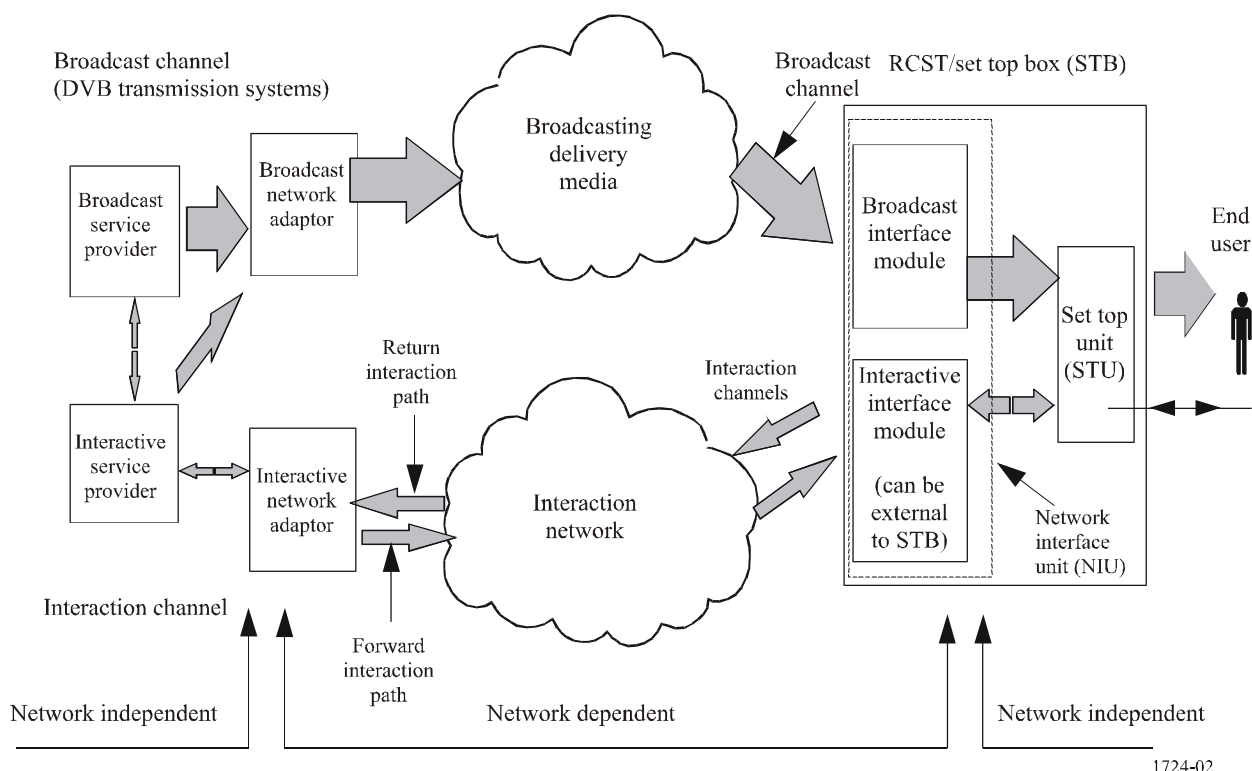
In the system model, two channels are established between the service provider and the user:

- *Broadcast channel:* A unidirectional broadband broadcast channel including video, audio and data is established from the service provider to the users. It may include the forward interaction path.

- *Interaction channel*: A bidirectional interaction channel is established between the service provider and the user for interaction purposes. It is formed by:
 - *Return interaction path (return channel)*: from the user to the service provider. It is used to make requests to the service provider, to answer questions or to transfer data.
 - *Forward interaction path*: from the service provider to the user. It is used to provide information from the service provider to the user and any other required communication for the interactive service provision. It may be embedded into the broadcast channel. It is possible that this channel is not required in some simple implementations which make use of the broadcast channel for the carriage of data to the user.

The RCST is formed by the network interface unit (consisting of the broadcast interface module and the interactive interface module) and the set top unit. The RCST provides interface for both broadcast and interaction channels. The interface between the RCST and the interaction network is via the interactive interface module.

FIGURE 2
A generic system reference model for interactive systems



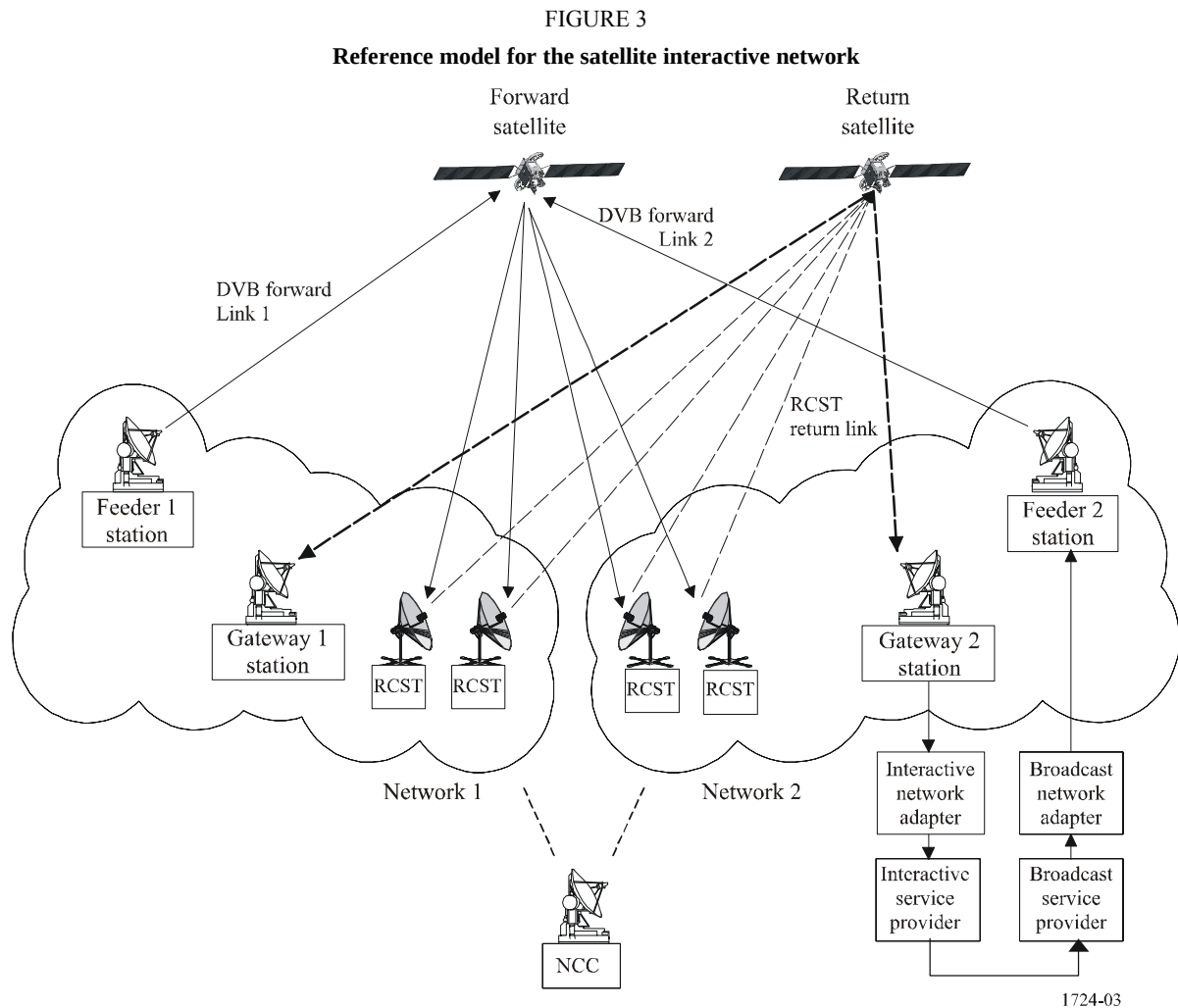
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2.3 Reference model of the satellite interactive network

An overall satellite interactive network, within which a large number of RCSTs will operate, will comprise the following functional blocks, as shown in Fig. 3:

- *Network control centre (NCC)*: An NCC provides monitoring and control functions. It generates control and timing signals for the operation of the satellite interactive network to be transmitted by one or several feeder stations.

- **Traffic gateway (TG):** A TG receives the RCST return signals, provides accounting functions, interactive services and/or connections to external public, proprietary and private service providers (e.g. databases, pay-per-view TV or video sources, software download, teleshopping, telebanking, financial services, stock market access, interactive games, etc.) and networks (e.g. internet, ISDN, PSTN, etc.).
- **Feeder:** A feeder transmits the forward link signal, which is a standard satellite digital video broadcast (DVB-S) uplink, onto which are multiplexed the user data and/or the control and timing signals needed for the operation of the satellite interactive network.



The forward link carries signalling from the NCC and user traffic to RCST. The signalling from the NCC to RCST that is necessary to operate the return link system is called “forward link signalling” in the following. Both the user traffic and forward link signalling can be carried over different forward link signals. Several RCST configurations are possible depending on the number of forward link receivers present on the RCST.

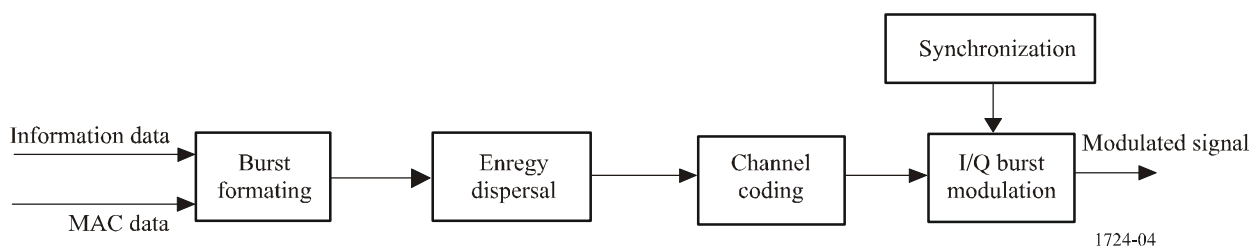
3 Forward link

The RCST should be able to receive digital signals conforming to ETSI Standards EN 300 421, TR 101 202, ETS 300 802, EN 300 468, EN 301 192 and ETR 154.

4 Return link baseband physical layer specification and multiple access definition

Specifications for the baseband physical layer are given in this section. Figure 4 represents the generic digital signal processing to be performed at the RCST transmitter side, from the burst formatting of the serial information bit-stream, to the modulation representing the digital to analogue conversion. The signal processing to be performed by each subset is described in the following sections.

FIGURE 4
Block diagram of the RCST return link baseband signal processing



4.1 RCST synchronization

4.1.1 Timing control

The synchronization of the RCST is an important feature of the satellite interactive network. Constraints are imposed on the RCST to obtain an efficient TDMA system with minimum interference between users and maximum throughput, although they can be minimized if the NCC performs tasks such as satellite frequency translation error and common-mode Doppler compensation for RCST carrier frequency. For this reason, the synchronization scheme is based on information contained within the forward link signalling as follows:

- network clock reference (NCR);
- signalling in DVB/MPEG-2 transport stream (TS) private sections.

The NCR is distributed with a specific PID within the MPEG-2 TS that carries the forward link signalling. The NCR distribution follows the PCR distribution mechanism as defined in ISO/IEC 13818-1, which is usually derived from an MPEG video encoder, whereas here the NCR is derived from the NCC reference clock. The NCC reference clock will have an accuracy of 5 ppm or better.

4.1.2 Carrier synchronization

The MPEG-2TS that carries the forward link signalling contains an NCR information which provides a 27 MHz reference of the NCC reference clock to the RCST. The RCST reconstructs the reference clock from the received NCR information as implemented in MPEG decoders for MPEG-2 transport streams (MPEG-2 TS). The RCST then performs a comparison to determine the offset between the local reference clock which controls the RCST up-converter local oscillator and the reference clock recovered from the received NCR. It then compensates the carrier frequency according to this offset. This local carrier synchronization provides a way of adjusting the transmit frequency of all RCST on the network to almost the same frequency.

Normalized carrier frequency accuracy should be better than 10^{-8} (root mean square).