SatLabs Recommendations for Hub Verification Testing

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info@satlabs.org | http://www.satlabs.org

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Editor: Stephane Combes, ESA/ESTEC (stephane.combes@esa.int)

Inquiries related to the SatLabs Group should be directed to:

Xavier Lobao Pujolar - Chairman SatLabs Group

ESTEC P.O. Box 299
Noordwijk 2200 AG
Netherlands

Email: info@satlabs.org
Phone: +31 (0) 7156 53641
Fax: +31 (0) 7156 54093

Web site: www.satlabs.org

Table of Contents

1 References

[1] ETSI EN 301 790 v1.5.1, “Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems” (2009-05)

[2] ETSI TR 101 790 v1.4.1, “Digital Video Broadcasting (DVB); Interaction channel for Satellite Distribution Systems; Guidelines for the use of EN 301 790” (2009-07)

[3] SatLabs System Recommendations (Version 1.2) (2005-09)

[4] SatLabs System Recommendations (Version 1.3 and Version 2.1) (2010-01)

[5] SatLabs System Recommendations - QoS specifications, v1.1 (2010-01)

[6] SatLabs System Recommendations - M&C specifications, v1.1 (2010-01)

[7] IETF RFC 3246, An Expedited Forwarding PHB (Per-Hop Behavior) (2002-03)

[8] IETF RFC 2597, Assured Forwarding PHB Group (1999-06)

[9] SatLabs Interoperable PEP (I-PEP) v1 - Transport Extension and Session Framework for Satellite Communications: Air Interface Specification (2005-10)

[10] ETSI EN 300 468 v1.9.1, "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems" (2009-03)

[11] ETSI EN 302 307 v1.1.2: "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications" (2006-06)

[12] ETSI TR 102 376 v1.1.1: “Digital Video Broadcasting (DVB); User guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2)” (2005-02)

2 Acronyms

For the purposes of the present document, the following abbreviations apply:

8PSK	8-ary Phase Shift Keying
16APSK	16-ary Amplitude and Phase Shift Keying
32APSK	32-ary Amplitude and Phase Shift Keying
ACM	Adaptive Coding and Modulation
ACQ	Acquisition burst
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
AVBDC	Absolute Volume Based Dynamic Capacity
BSM	Broadband Satellite Multimedia
BUC	Block Upconverter
CCM	Constant Coding and Modulation
CMT	Correction Message Table
CRA	Continuous Rate Assignment
CRC	Cyclic Redundancy Check
CSC	Common Signalling Channel
CTB	Common Test Bed for DVB-RCS Terminals
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain name Server
DULM	Data Unit Labelling method
DVB	Digital Video Broadcast
DVB-S	Digital Video Broadcast via Satellite as specified in EN 300 421
DVB-S2	Digital Video Broadcast via Satellite, 2nd Generation, as specified in EN 302 307
EN	European Norm
FCT	Frame Composition Table
FEC	Forward Error Correction
FTP	File Transfer Protocol
GPS	Global Positioning System
GS	Generic Stream
HTTP	HyperText Transfer Protocol
ICMP	Internet Control Message Protocol
ID	Identity
IDU	Indoor Unit
IETF	Internet Engineering task Force
IF	Intermediate Frequency
IFL	Interfacility link
IGMP	Internet Group Management Protocol
INT	IP MAC Notification Table
IP	Internet Protocol
I-PEP	interoperable Performance Enhancement Proxy
LAN	Local Area Network
LNB	Low Noise Block
M&C	Management and Control
MAC	Medium Access Control
MF-TDMA	Multi Frequency Time Division Multiple Access
MIB	Management Information Base
MMT	Multicast PID Mapping Table
MPEG	Motion Pictures Expert Group
NAT	Network Address Translation
NCC	Network Control Centre
NCR	Network Clock Reference
NIT	Network Information Table
NLID	Network Layer Information Descriptor
ODU	Outdoor Unit
PAT	Program Association Table

PEP	Performance Enhancement Proxy
PCR	Program Clock Reference
PID	Packet Identifier
PMT	Program Map Table
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RBDC	Rate-Based Dynamic Capacity
RCS	Return Channel via Satellite
RCST	Return Channel via Satellite Terminal
RFC	Request For Comments
RMT	RCS Map Table
RSAT	Regenerative SATellite terminal
Rx	Reception
SAC	Satellite Access Control
SCT	Superframe Composition Table
SI	Service Information
SNMP	Simple Network Management Protocol
SPT	Satellite Position Table
SSR	SatLabs System Recommendations
SYNC	Synchronization
S/W	SoftWare
TBTP	Terminal Burst Time Plan
TCT	Time-slot Composition table
TDMA	Time Division Multiple Access
TFTP	Trivial File Transfer Protocol
TIM	Terminal Information Message
TMST	Transmission Mode Support Table
TRF	Traffic
TS	Transport Stream
Tx	Transmission
VBDC	Volume-Based Dynamic Capacity
VCM	Variable Coding and Modulation
VPN	Virtual Private Network

List of Tables

3 Introduction

This document defines the functionality which falls in the scope of DVB-RCS hub verification testing. It serves as the basis for test cases definition for the hub verification tests.

The basis for these Recommendations are the following documents:

- DVB-RCS Specifications [1]
- DVB-RCS Guidelines [2]
- SatLabs System Recommendations ([3], [4], [5] and [6])

Note that the mobility and mesh extensions defined in ETSI EN 301 790 V1.5.1 [1] are out of the scope of the present Recommendations.

The hub functionality is organized into “capability sets” which are meaningful groupings of functions in terms of interoperability with SatLabs compliant terminals. For each capability sets, basic and additional functionality is defined. Basic functionality encompasses features that are required for the hub to operate and interoperate with terminals. Additional functionality represents options or flexible implementations.

A hub may only support a subset of the functionality that is mandatory for the terminal. Only this subset of functionality will be applicable for the verification testing. The verification test is capable of verifying the functional elements that are mandatory for a terminal.
A hub may require that terminals support some specific SatLabs options.

General definitions:

For the purposes of the present document, the following terms and definitions apply:

Test System	The test set-up to be used for the SatLabs hub verification testing
May, Can	Used to define or describe optional requirements or flexible implementation
Should, Will	Used to define or describe guidelines or preferred implementation
Shall, Must	Used to define or describe mandatory requirements
Recommended	Description of functionality that is recommended to be implemented, but that is outside the scope of the SatLabs Hub verification testing.

Terminology:

A/VBDC designates the combination of VBDC and AVBDC request mechanisms.

4 Hub profiles definition

The Hub profiles determine the verification test cases that are applicable for the verification tests for that profile.

Traffic burst profiles:

- ATM profile
- MPEG profile

Either or both profiles can be supported by a Hub.

If the Hub only supports the MPEG profile, RCSTs need to support MPEG_TRF option.

Two Hub profiles are defined regarding Forward Link standard support:

- DVBS profile (DVB-S support)
- DVBS2 profile (DVB-S2 support)

Either or both profiles can be supported by a Hub.

A Hub supporting the DVBS2 profile supports one of the following DVB-S2 related profiles:

- CCM profile (CCM support)
- VCM profile (VCM support)
- ACM profile (ACM support)

Either one, two or all profiles can be supported by a Hub.

5 Hub capability sets definition

5.1 Basic functionality

The basic functionality capability set includes functions needed in order to manage network logon, synchronization, capacity requests handling and IP traffic transfer.

5.1.1 Core functionality

5.1.1.1 Network control

This section defines the control functions and mechanisms for providing basic network configuration and control functions in compliance with [1]. The mechanism categories are divided into:

- Forward link signalling to the terminal using RCS tables as defined in [1]
- Local control of terminal parameters and settings

5.1.1.1.1 Forward link signalling

The hub transmits the standard DVB-S/MPEG-2 and DVB-RCS signalling tables.

The tables are described in Table 5-1:

Table	Descriptors	Comments
NIT	Linkage Satellite Delivery	Standard DVB-S table
PAT		Standard DVB-S table.
PMT		
RMT	Linkage (private data) Satellite Forward Link Satellite Return Link	
SCT/FCT/TCT		Should provide CSC slots with sufficient guard to compensate for uncertainties in the submitted NCR and the broadcasted satellite positions.
SPT		
NCR		May carry timing reference offset information in the optional payload (see [4]).

Table	Descriptors	Comments
CMT		Should be transmitted to serve as an unambiguous confirmation of the reception of each received SYNC burst.
TBTP		
TIM –U	Correction Message Forward Interaction Path Logon Initialize SYNC Assign Return Interaction Path	
TMST	As defined in [1].	Only applicable for the DVBS2 ACM profile.

Table 5-1: Forward Link signalling

5.1.1.1.2 Return Link TRF format

The hub must not set an RCST that does not explicitly indicate support for MPEG2-TS TRF, to operate with the traffic burst type MPEG2-TS TRF.

If the hub requires that an RCST supports the MPEG2-TS TRF, the RCSTs must support the MPEG_TRF option.

5.1.1.1.3 TIM RCST status bit

The unicast TIM RCST status bit fields are defined in [1]. For SatLabs Hub verification testing the comments listed in Table 5-2 apply:

Field name	Comments
ID_encrypt	Not tested
Logon_fail_(busy)	Not tested
Logon_denied	Tested. Conditions for testing should be specified by hub vendor.
Log_off	Tested. Should be received as a confirmation from the hub if the terminal sends a log-off request in the SAC field.
Rain_Fade_release	Not tested
Rain_Fade_detect	Not tested

Table 5-2: TIM RCST status bits

5.1.1.1.4 CSC burst content

A common understanding of the terminal capabilities signalled in the CSC burst as defined in [1] is critical for ensuring interoperability. For SatLabs Hub verification testing the following comments listed in Table 5-3 apply:

Field name	Comments
Security	Not tested
ATM connectivity	Not tested
MPEG2-TS TRF	For MPEG profile
RCST boards	One board assumed, other configurations not tested
Multi_IDU	Not tested, single IDU assumed in test setup
Freq Hopping Range	Only 20 MHz hopping range tested
RCST Class	Not tested
RCST MAC address	
CSC_Route_ID	Not tested
Dynamic connectivity	Not tested.
DVB-S capability	Depending on Hub profile
DVB-S2 capability	Depending on Hub profile
Burst type Identifier	

Table 5-3: CSC burst content

5.1.1.1.5 Capacity requests

The Hub must support either RBDC or A/VBDC (both VBDC and AVBDC) capacity request categories.

5.1.1.1.6 Superframe start time signalled in SCT

The superframe start time in the SCT must be kept within a range corresponding to no more than plus or minus 32767 superframe durations of the current NCR value.

5.1.1.2 Encapsulation and section packing

5.1.1.2.1 Encapsulation

In the forward link, the maximum MTU size to transport IP packets should not be less than 1500.

In the return link, the maximum MTU size to transport IP packets should not be less than 1500.

5.1.1.2.2 Section packing

In the forward link, section packing should be supported.

In the return link, when supporting MPEG, section packing must be supported.

5.1.1.3 Return Link Code Rates

For TRF bursts, the hub shall only assign turbo code rates selected from the following set: ½, 2/3, ¾, 4/5, 6/7.

For CSC and SYNC bursts, the hub may assign any of the turbo code rates specified by EN301790.

5.1.1.4 Superframe Duration Range

The hub must use a superframe duration between 25 and 750 ms.

5.1.1.5 DVB-S2

DVB-S2 is specified in [11] and [12]. DVB-RCS support for DVB-S2 forward link is defined in [1] and [2], complemented by [4].

System Configurations	**Description**	**CCM profile**	**VCM profile**	**ACM profile**
QPSK with at least one of the following rates: 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 Or 8PSK with at least one of the following rates: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10		M	M	M
CCM		M		
VCM			M	
ACM				M
FECFRAME(normal)	64800 (bits)	M	O[1]	O[2]
FECFRAME(short)	16200 (bits) – no 9/10 support		O[2]	O[2]
Single Transport Stream		M	M	M
Single Generic Stream		N/A	N/A	N/A
Multiple Generic Stream		N/A	N/A	N/A
ISSY (input stream synchronizer)		N/A	N/A	N/A
RCS Specific				
ACM sub field support CNI & MODCOD_RQ	in SAC			M

Table 5-4: DVB-S2 support description

Note 1: A Hub with ACM profile must support either normal or short FECFRAME or both.
If such a Hub only supports normal FECFRAME, the RCST must support the normal FECFRAME option.

5.1.2 Additional functionality

5.1.2.1 Additional forward link signalling

The hub may exercise the coarse synchronisation procedure for RCSTs that support the COARSE_SYNC option and indicates at logon that coarse synchronisation is required (CSC flag).

The hub must not require an RCST that does not at logon indicate requirement for coarse synchronisation, to respond to the assignment of an acquisition slot.

If the hub requires that an RCST uses the coarse synchronization procedure when logging on, the RCSTs must support the COARSE_SYNC option.

The MMT may be used as a distribution mechanism for multicast configuration.

Table	Descriptors	Comments
TIM-U	ACQ Assign	
MMT	Multicast Mapping Table	Assigns FL PIDs to multicast groups

Table 5-5: Additional forward link signalling

5.1.2.2 NCR optional payload

The hub may implement the optional payload field in the PCR insertion TS packets.
If it does, the RCSTs have to be compliant to SSR Version 1.3 or 2.1 [4] or to be compliant to SSR Version 1.2 [3] and support the NCR_PAYLOAD option.

5.1.2.3 TIM RCST status bit

Field name	Comments
Wake_up	Detected if present, handled as if this status bit was 0 (normal logon confirmation).

Table 5-6: TIM RCST status bits for additional functionality

5.1.2.4 CSC burst content

Field name	Comments
RCST ACQ	Tested. A hub may require COARSE_SYNC option for the RCST in order to handle this capability.

MF-TDMA	Tested. A hub may require Dynamic_MF_TDMA option for the RCST in order to handle this capability.
Route_ID capable	Not tested A hub may require ROUTE_ID feature for the RCST in order to handle this capability.
Frequency Hopping	Tested A hub may require FAST_HOPP option for the RCST in order to handle this capability.

Table 5-7: CSC burst content for additional functionality

5.1.2.5 DVB-S2

System Configurations	Description	CCM profile	VCM profile	ACM profile
QPSK	1/4, 1/3, 2/5		O	O
16APSK	2/3, 3/4, 4/5, 5/6, 8/9, 9/10	O	O	O
32APSK	3/4, 4/5, 5/6, 8/9, 9/10		O	O
Multiple Transport Stream			O	O
Combined Single Generic & Single TS			O	O

Table 5-8: Additional DVB-S2 support description

A Hub may support QPSK with low code rates ($1/4$, $1/3$ or $2/5$). In order to use this functionality, RCSTs must support the QPSKLOW option.

A Hub may support 16APSK. In order to use this functionality, RCSTs must support the 16APSK option.

A Hub may support 32APSK. In order to use this functionality, RCSTs must support the 32APSK option.

A Hub may support Multiple Transport Stream. In order to use this functionality, RCSTs must support the MULTITS option.

A Hub may support Combined Single Generic and Single TS. In order to use this functionality, RCSTs must support the GSTS option.

5.2 Management & Control

5.2.1 Core functionality

5.2.1.1 Basic capabilities

5.2.1.1.1 SNMP

The Hub must support SNMPv2c.

5.2.1.1.2 File Transfer

The Hub must support either TFTP or FTP, and may support both.

If a Hub only supports FTP, the RCST needs to support the FTP option.

5.2.1.1.3 ICMP

The Hub must support ICMP.

5.2.1.2 RCST software update

The Hub must support the MSDP protocol as defined in [6].

5.2.1.3 CSC burst

Field name	Comments
SNMP	Tested
S/W version	Tested
RCST Mode	Installation and Operational Modes may be tested.

Table 5-9: CSC burst content for additional management functionality

5.2.2 Additional functionality

5.2.2.1 TIM RCST status bits

Field name	Comments
Transmit_Disable	Detected if transmitted by the hub. Would normally not occur under the hub verification testing unless the hub operator would like to test this function.

Table 5-10: TIM RCST status bits for additional management functionality

5.2.2.2 Management related RCST options

The hub may support installation log file for RCSTs. In order to use this functionality, RCSTs need to support the INSTALL_LOG option.

The Hub may rely on a Domain Name Server (DNS) for file transfers. The RCSTs then need to support the DNS option.

The Hub may support NLID in TIM-U in order to configure the RCST management IP address. In order to use this functionality, RCSTs must support the NLID option.

The Hub may support DHCP in order to configure the RCST management IP address. In order to use this functionality, RCSTs must support the DHCP option.

5.3 Basic resource control

5.3.1 Core functionality

The Hub is allowed to configure each RCST with the service level, the dynamically requested capacity categories allowed for each RC and the CRA level applicable for each RC. The Hub can assume that the RCST is capable of keeping this configuration as non-volatile data that is applied at the next logon. The Hub can assume that any RCST will support best effort operation by use of any capacity category.

In normal operating conditions, the Hub must not assign fewer resources to an RCST than indicated by the aggregate of the CRA level indicated for each RC.

If the Hub supports RBDC for a given RC and RCST, it must replace an existing RBDC request received from an RCST by a succeeding RBDC request from the same RCST aimed for the same RC as the existing RBDC request.

If the Hub supports RBDC for a given RC and RCST, it may apply *RBDCtimeOut* limitation in order to discard pending RBDC requests, separately for each RC of each RCST.

When the Hub supports RBDC for a given RC and RCST, it must not discard any existing RBDC request before *RBDCtimeOut* after reception of the request.

If the Hub supports A/VBDC for a given RC and RCST, it must serve AVBDC and VBDC requests by a common assignment process and must equally honor both request types when A/VBDC is authorized.

If the Hub supports A/VBDC, it must discard pending A/VBDC requests received earlier for an RC from an RCST when an AVBDC request is received from this RCST for the same RC.

If the Hub supports A/VBDC, it must increment a VBDC backlog by the VBDC request that arrives within *VBDCtimeOut* after the preceding A/VBDC for the same RC and from the same RCST.

If the Hub supports A/VBDC, it may apply *VBDCtimeOut* and *VBDCmaxBacklog* limitation in order to discard pending and excessive A/VBDC requests, separately for each RC of each RCST.

Pending A/VBDC must not be discarded before the hub has not received A/VBDC request for *VBDCtimeOut*, regarded separately for each RC of each RCST.

The Hub must consider that an RCST subtracts CRA from its estimated demand and issues the remainder as Capacity Requests.

The Hub should provide sufficient capacity request opportunities to each RCST in order to cope with the required performance of each behaviour aggregate.

5.3.2 Additional functionality

5.3.2.1 Resource control related RCST options

The hub may support setting of and may also require use of an AVBDC repetition period. In order to use this functionality, RCSTs must support the AVBDC_REP option.

The hub may support setting of and also require use of global RCST parameters for Capacity Categories. In order to use this functionality, RCSTs must support the RCST_PARA option.

5.4 Enhanced QoS

5.4.1 Core functionality

5.4.1.1 IP layer QoS on the return link

The Hub is allowed to configure IP layer QoS parameters in the RCST as defined in [6]. The following 3 PHB groups may be supported:

- Expedited Forwarding PHB [7]
- One Assured Forwarding PHB Class (AF3) with at least two drop precedences [8]
- Best Effort PHB

5.4.1.2 Link layer QoS on the return link

The hub can assume that an RCST will support use of at least one of the authorized dynamically requested capacity categories per aggregate, simultaneously for the best effort traffic aggregate, the AF traffic aggregate and the EF traffic aggregate. The hub can assume that an RCST will support CRA for the allowed traffic with the highest precedence (EF>AF>BE).

The Hub is allowed to configure the mappings between DSCP, PHB, RC, dynamic capacity request types, Channel_ID and VPI/VCI or PID at RCST log-on. The Hub can assume that the RCST is capable of keeping this configuration as non-volatile data that is applied at the next logon.

The Hub should use the RC indication given in the Capacity Requests, through the Channel_ID field, in order to apply the capacity assignment policy specifically applicable to this RC.

5.4.2 Additional functionality

5.4.2.1 IP layer QoS on the forward link

The Hub may support IP DiffServ. In this case, the following PHBs may be supported:

- Expedited Forwarding PHB [7]
- One Assured Forwarding PHB Class (AF3) with at least two drop precedences [8]
- Best Effort PHB

5.4.2.2 QOS related RCST options

The hub may be able to configure EF and AF PHBs in RCSTs. In order to support this functionality RCSTs need to support the ENHQOS option.

5.5 I-PEP

5.5.1 Core functionality

The hub may support the I-PEP protocol defined in [9].

5.5.2 Additional functionality

The hub may support some of the I-PEP protocol options defined in [9].

6 Hub profile recommendations

6.1 DVB-RCS options

The DVB-RCS options that the hub MUST support are given in Table 6-1.

Acronym (ID)	Description
TURBO	Turbo decoding with default permutation parameters
SECTION_PACKING	Hub supports DSM-CC section packing in the return direction for a hub supporting the MPEG profile
FINE_SYNC	Fine Synchronization

Table 6-1: DVB-RCS options that MUST be supported by the hub

6.2 SatLabs verification testing

Hubs can be tested against any of the requirements defined in section 5. In order to validate a given level of interoperability for the hub, SatLabs recommends to test full capability sets (i.e. all the core functionality of a capability set).

SatLabs defined capability sets are:

- Basic functionality
- Management and control
- Basic Resource Control
- Enhanced QoS
- Interoperable PEP

A hub which is successfully tested against all the core requirements of a given capability set is said to be compliant with this capability set and it is expected that SatLabs compliant terminals will interoperate with the hub up to the level of functionality covered by the capability set.

In order to provide a reasonable level of confidence that a hub will interwork with any SatLabs Version 2 terminal, it is recommended that the hub complies with the requirements of the capability sets “Basic Functionality”, “Management and Control” and “Basic Resource Control”.

6.3 Applicable parameter ranges

Under the hub verification tests the hub operational configuration and signalling must be compatible with SatLabs System Recommendations v.1.3 or v.2.1 [4].

7 Hub verification testing

The Hub verification test set-up is installed at the SatLabs Laboratory. The setup has the following key features:

- 1.2 meter Ku.band antenna
- Universal LNB (10.95- 12.75 GHz)
- 2 Watt Ku band BUC with output band 13.75 GHz – 14.25 GHz. The band 14.25 – 14.50 GHz can also be supported by replacing the BUC.
- 3-axis motorised antenna control
- Support for SatLabs version 1.3 and 2.1 functionality except that 4 ATM cells with SAC prefix is not supported
- Return link symbol rate 128 ksps – 2 Msps
- DVB-S or DVB-S2 CCM forward links
- Industry standard IP application test applications such as web browser, ftp, iperf.exe