Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (RCS2) Part 1: Overview and System Level specification

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Intellectual Property Rights

Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI.

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardisation, interoperability and future proof specifications.

The present document is part 1 of a multi-part deliverable covering the DVB Interactive Satellite System specification as identified below :

TS 101 545-1: "Overview and System Level specification";

EN 101 545-2: "Lower Layers for Satellite Standard";

TS 101 545-3: "Higher Layers for Satellite Specifications";

Introduction

EN 301 790 [1] defines the first generation of DVB-RCS which is a system providing an interaction channel for satellite distribution systems. Together with its guidelines (TR 101 790 [i.1]) the specification describes how such system can be built on the physical and MAC layers to provide an efficient way of turning a satellite broadcast TV into a full VSAT solution capable of transporting IP traffic in a satellite-only system.

Since the original definition of DVB-RCS systems, several versions of the specification were issued, describing the requirements for the implementation of a system providing an interaction channel for satellite distribution systems.

The sum of these specifications allowed to adapt the DVB-RCS systems to different market segments from small to large networks and from fixed to mobile terminals but it appears that the evolutions of the physical layer techniques and the stabilisation of IP standards now deserves deeper changes which can only be implemented in a consistent way via the definition of a second generation system.

This document gives the system specifications for the 2nd Generation Interactive DVB Satellite System (DVB-ISS) and represents the first part of the multi-part specification of that system. It also provides an overview of the system whereas more specific aspects of the implementation are described in the guidelines for implementation and use document (part 4).

The requirements in this document have been introduced in order to provide the best possible interoperability between terminals and hubs, thus defining not only the lower layers of the system (up to layer 2) but also network functions as well as management and control capabilities.

As these specifications combined together may end up in a very complex terminal design, the specification also describes subsets of capabilities known as profiles that can be used together to address a given market segment.

1 Scope

System overview and specifications not only cover the air interface of the system but also other aspects of the such as monitoring and control, MAC and network layers features.

The detailed specifications for these different layers are presented in the other part if this multi-part specification which are introduced as normative references.

This document points to the adequate sections into the detailed specification documents and explains how the features must be combined to make a terminal compliant with different subsets of specifications mentionned as profiles.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references,only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] EN 301 790, “Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems”.

[2] EN 101 545-2, " Link and Physical Layers standard";

[3] TS 101 545-3: "Higher Layers Specifications";

[4] IETF RFC 3917 check BCP and STV numbers and the way of presenting for RFC’s, “Requirements for IP Flow Information Export (IPFIX)”.

[5] IETF RFC5474, “A Framework for Packet Selection and Reporting”

[6] IETF RFC1213, “Management Information Base for Network Management of TCP/IP-based internets: MIB-II”

[7] IETF RFC1901, “Introduction to Community-based SNMPv2”

[8] IETF RFC1908, “Coexistence between Version 1 and Version 2 of the Internet-standard Network Management Framework”

[9] “Digital Satellite Equipment Control (DiSEqC™) Bus specification”, European Telecommunication Satellite Organization

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 101 790: "Digital Video Broadcasting (DVB); Interaction channel for Satellite Distribution Systems; Guidelines for the use of EN 301 790".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Control plane : Communications that carry mainly signalling information.

Management plane : Communications that carry information to maintain the network and to perform operational functions.

Layer 1 Mesh Overlay System : a satellite interactive network that supplements the unidirectional satellite link from a TDM feeder to ISSTs and the unidirectional satellite link from ISSTs to an MF-TDMA gateway with two-way satellite links between the ISSTs. In such systems, the NCC is connected to the ISST via the feeder and gateway.

Layer 1 Regenerative and Re-multiplexing System : a satellite interactive network that relies on an on-board regenerative processor to demodulate upcoming MF-TDMA data from terminals and generate a TDM downlink signal with this data. Such system looks like an RCS second generation system from the layer 1 ISSTs perspective.

User plane : Communications that carry user information.

3.2 Symbols

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

α	Roll-off factor
Eb/N0	Ratio between the energy per information bit and single sided noise power spectral density
Es/N0	Ratio between the energy per transmitted symbol and single sided noise power spectral density
f0	Carrier frequency
fN	Nyquist frequency
NR,max	Number of replicas in a frame
Nrand	12-bit random number used as a random seed value during CRDSA frame decoding
Nslots	Number of the slots in the frame
Rs	Symbol rate corresponding to the bilateral Nyquist bandwidth of the modulated signal

3.3 Abbreviations

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

BCast	BroadCast
BPSK	Binary PSK
BTU	Bandwidth-Time Unit
CLI	Command Line Interface
CPM	Continuous Phase Modulation (or Modulator)
CRDSA	Contention Resolution DSA
CRSC	Circular Recursive Systematic Convolutional (code)
DFL	Data Field Length
DHCP	Dynamic Host Control Protocol
DNS	Domain Name Service5
DSA	Diversity Slotted Aloha
EAP	Extensible Authentication Protocol
FCT2	Frame Configuration Table 2
FL	Forward Link
FPDU	Frame PDU
GID	Group ID
GS	Generic Stream
GSPC	Generic Sub-block Polynomial Code
HLS	Higher Layer Specifications
HW	HardWare
ID	IDentifier
ISI	Input Stream Identifier
ISI	Input Stream Identifier
ISST	Interactive Satellite System Terminal
L2S	Lower Layer Signalling/Layer 2 Signalling
LID	Logon ID
LL	Link Layer
LM	Linear Modulation (or Modulator)
LT	Label Type
MATYPE	Mode Adaptation TYPE
MMT2	Multicast Mapping Table 2
MTU	Maximum Transmission Unit
NCC	Network Control Center
NMC	Network Management Center
PAM	Pulse Amplitude Modulation
PCCC	Parallel Concatenated Convolutional Codes
PDU	Protocol Data Unit
PEP	Performance Enhancing Proxy
PL	Physical Layer
PN	Pseudo Noise
PPDU	Payload-adapted PDU
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RA	Random Access
RL	Return Link
RLE	RL Encapsulation
RSGW	Regenerative Satellite GateWay
SA	Slotted Aloha
SCADA	Supervisory Control And Data Acquisition
SDU	Service Data Unit
SFS	Superframe Sequence
SHA	Secure Hash Algorithm
SNDU	SubNetwork Data Unit
SO	Satellite Operator
SOC	Satellite Operations Center
SNO	Satellite Network Operator

SVN	Satellite Virtual Network
SVNO	Satellite Virtual Network Operator
SW	SoftWare
SYNC	SYNChronisation (byte, burst)
SYNCD	SYNC Distance
TBTP2	Terminal Burst Time Plan 2
TDT	Time and Date Table
TMST2	Transmission Mode Support Table 2
TRANSEC	TRANSmission SECurity
UCast	UniCast
UPL	User Packet Length
UW	Unique Word
VLAN	Virtual Local Area
VNS	Virtual Network over Satellite

4 System definition

4.1 General

DVB-ISS is the standard conceived to provide a standardised broadband interactivity connection as an extension of the Digital Video Broadcasting Satellite systems. It defines the MAC and physical layer protocols of the air interface used between the satellite operator hub and the interactive user terminal as well as the network layer and the essential functions of the management and control planes of the terminal. It embraces the GSE and the DVB-S2 standards implemented in the commercial broadcasting environment, exploiting economics of scale.

In order to provide a real interoperability, the DVB-ISS specification describes Higher layers components adapted to satellite interactive systems. These component are parts of control and management planes and rely mainly on DVB and IETF standards or are derived from them.

A typical DVB-ISS Network will utilise a satellite with multi or single beam coverage. In most networks, the satellite carrying the forward link signal will also support the return link. The forward link carries signalling from the NCC and user traffic to ISSTs. The signalling from the Network Control Centre (NCC) to ISSTs that is required to operate the return link system is called "Forward Link Signalling". A Network Management Centre (NMC) provides overall management of the system elements and manages the Service Level Agreement (SLA) assigned to each ISST.

The following network topologies are addressed by this specification:

- Transparent star network system
- Transparent star network system with contention access

Future releases of the system are foreseen and they will cover:

- Layer 1 transparent mesh overlay system with dedicated or contention access
- regenerative mesh systems switching at different layers

These network topologies can be summarized in two main reference architectures, shown in Figure 1 and Figure 2 hereafter, transparent and regenerative. The actors of both interactive systems are the same and can be observed in Figure 3:

- Transparent system.
    - Transparent satellite(s). One or more transparent satellites provide the link between terminals and the Hub, or among terminals for the transparent mesh system. DTP (Digital Transparent Processor) payloads can also give multi-beam connectivity.

- Hub/NCC. Performs the control (NCC), management (NMC) functions and interfaces user plane (traffic gateway) functions.
- Star or mesh overlay terminals (ISSTs).The star transparent terminal complies with the specifications of the DVB-ISS standard, providing star connectivity, or mesh connectivity with a double satellite hop. The mesh overlay transparent terminal is more complex, it includes two or more demodulators (adapted to DVB-S2 or ISST-TX waveform) and provides both single-hop mesh and star connectivity.

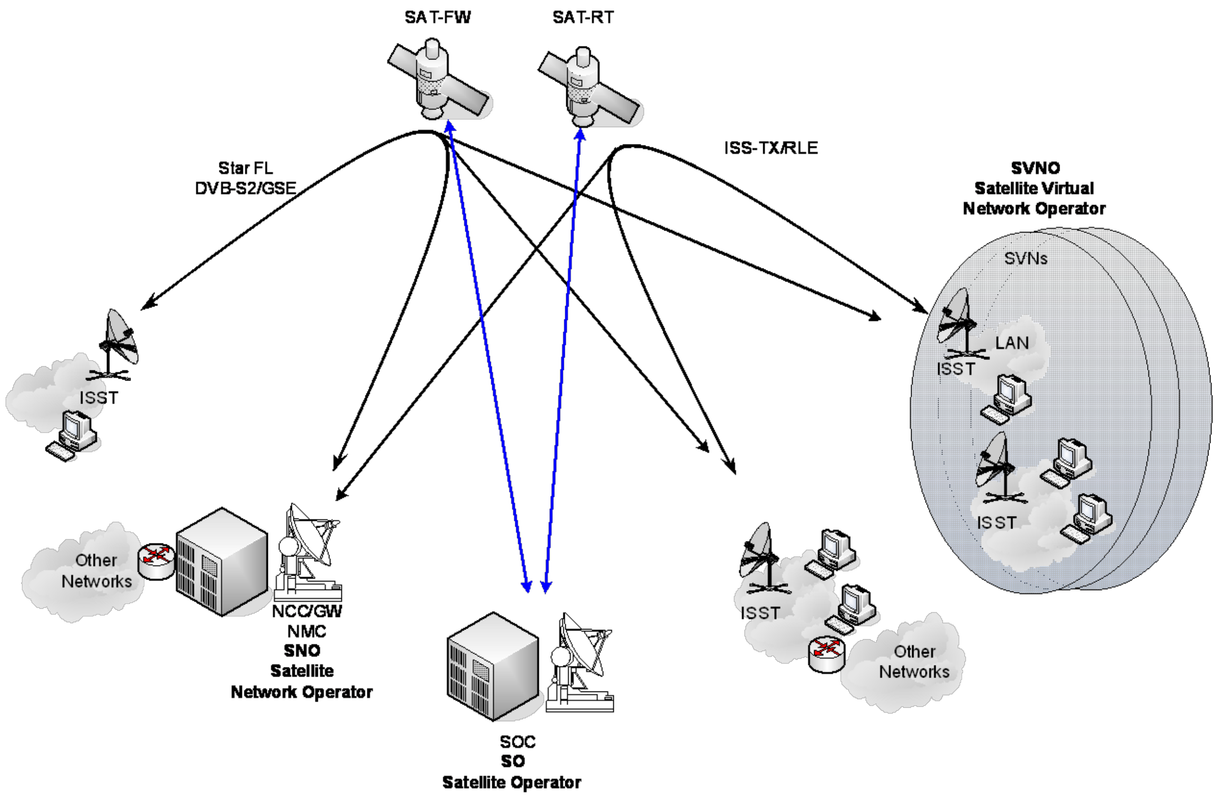

Figure 1: Main roles on transparent satellite interactive network

- Regenerative system (future release).
  - Regenerative satellite. Performs demodulation, demultiplexing, decoding (and possibly decapsulation) functions at the receiver side, on-board switching (at layer 2 or 3) for multi-beam systems, and the corresponding transmission functions after signal regeneration.
  - Management Station. It provides the management (NMC) and control (NCC) plane functions to the satellite network users.
  - Regenerative Satellite Gateway (RSGW). A RSGW provides regenerative ISST users with access to terrestrial networks. There may be one RSGW giving service to a small number of terminals, or to hundreds of terminals. Essentially, they comprise one ISST, plus an SLA Enforcer and an access router, but may also include voice, traffic acceleration servers, or a backhauling module.
  - Regenerative terminals. These ISSTs are identical in terms of hardware to the star transparent terminals. The software includes C2P functionality to support dynamic mesh connectivity.

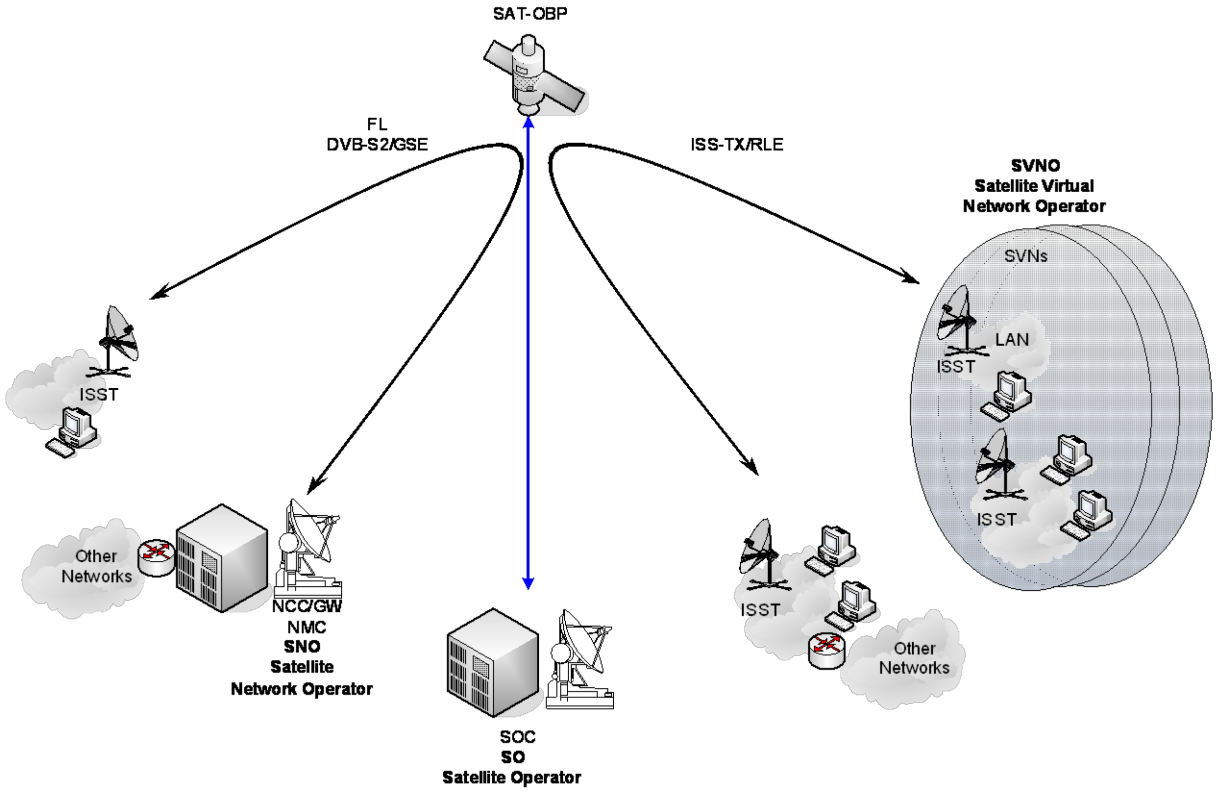

Figure 2: Example of main actors in a DVB-ISS system with regenerative satellite

Note : This figure only represents a potential architecture that should be further investigated in future releases of the DVB-ISS. The mesh contexts should have interoperability profiles defined in conjunction with the supplemental specification of the mesh control protocol that will operate on the concepts supported in the specific profile. It is expected that variants may exist. The complete control protocol for transparent star operation is specified in the normative documents [2] and [3], including profiles for transparent star.

4.2 System Roles

The system roles considered in a DVB-ISS interactive system are presented in the model shown in Figure 3 :

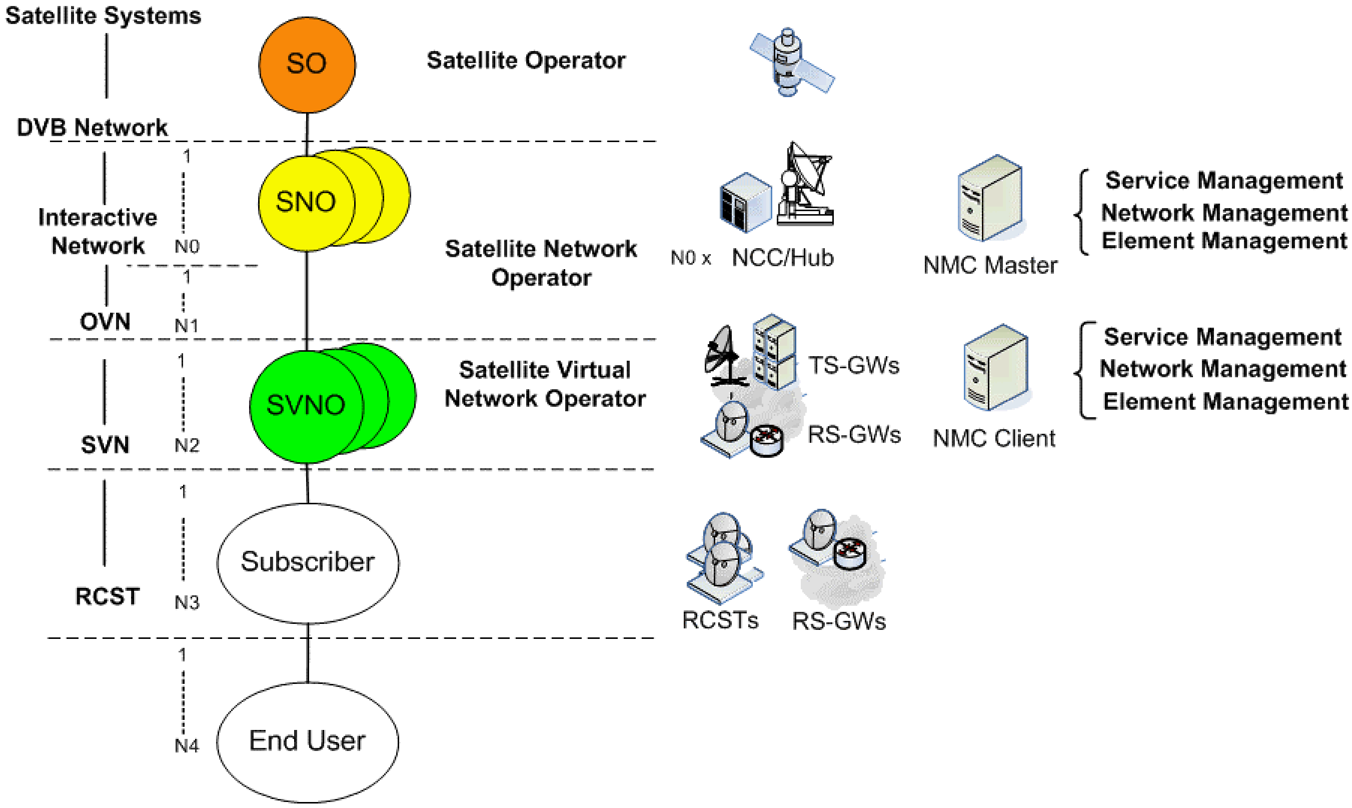

Figure 3 : DVB-ISS actors and roles

1. Satellite Operator (SO), who manages the whole satellite, and sells capacity at transponder level to one or several SNOs.
2. Satellite Network Operators (SNO), are assigned one or more satellite transponders. Each SNO owns one or more NCC/NMC, and configures the time/frequency plan. Each SNO is responsible for one IN, corresponding to one DVB network (identified by the Network_ID), controlling their own capacity. The SNO may divide the interactive network into one or more Operator Virtual Networks (OVN). Each OVN is an independently managed higher layer network, and is managed by a SVNO. SNOs distribute their own physical and logical resources among OVNs. In the transparent architecture the SNO owns the TS-GW.
3. Satellite Virtual Network Operators (SVNO), are assigned one or more Operator Virtual Networks (OVN), each being given some physical and logical resources. An active ISST can only be a member of one OVN, This is assigned at logon to the ISS Network. Each OVN is assigned a pool of SVN numbers from which it can allocate SVN-MAC addresses. The SVN concept is used to logically divide the addressing space controlled by the operator. SVNOs sell connectivity services to their subscribers and for the regenerative architecture may also manage one or several RSGWs.
4. Subscriber (ISST), are the user stations, which they contract to the SVNOs.
5. End-user are the final actors enjoying the satellite services, connected to the ISST LAN interface.

4.3 Physical layer

The physical layer of a DVB-ISS compliant terminal operating in a DVB-ISS system shall comply with the specifications defined in [2]. Not all specifications need to be implemented depending on the terminal profile (see Table 3) and also on supported options (see Table 2). The specification of the elements which are optional or normative as well as the profiles and their related options are described in section 4.11 Terminal capabilities and profiles.

4.4 Access layer

The access layer of a DVB-ISS compliant terminal operating in a DVB-ISS system shall comply with the specifications defined in [2]. Not all specifications need to be implemented depending on the terminal profile (see Table 3) and also on supported options (see Table 2). The specification of the elements which are optional or normative as well as the profiles and their related options are described in section 4.11 Terminal capabilities and profiles.

4.5 System architecture

The architecture of a DVB-ISS compliant terminal shall be compatible with the system architecture specified in [3].

4.6 Network layer

The network layer of a DVB-ISS compliant terminal shall follow the specifications indicated in [3]. Some of these specifications are optional and may be required to meet some of the defined terminals profiles, refer to section 4.11 Terminal capabilities and profiles of the present document for the details of these specifications.

4.7 Management functions

The management functions of a DVB-ISS compliant terminal shall follow the specifications indicated in [3] . Some of these specifications are optional and may be required to meet some of the defined terminals profiles, refer to section 4.11 Terminal capabilities and profiles of the present document for the details of these specifications.

4.8 Traffic interception

The traffic interception functions of a DVB-ISS compliant terminal shall follow the specifications indicated in [3]. These specifications are optional and are not required for any profile.

4.9 Terminal installation functions

The terminal installation functions of a DVB-ISS compliant terminal shall follow the specifications indicated in [3]. The potential waveforms to be used for the installation procedure are described in [2]. The motor control commands shall follow DiSEqC™ [9] specification. Implementation of these control commands are optional as indicated in Table 2 and are not required for any profile.

4.10 Terminal future configurations [informational]

Terminals capabilities defined in [2] and [3] cover essential use of the DVB-ISS systems. This informational section provides some insight of future usages of the system which are foreseen in the scope of mobile applications, mesh connectivity with or without regenerative satellites, improved return link efficiency and will be defined in new versions of the current set of specifications.

These usages are relying on the implementation of a set of capabilities already specified in DVB-RCS [1] which will probably be modified for DVB-ISS systems. As such, they are mentioned as reserved, which means they are not re-defined yet but will be part of future specifications in a new configuration.

Terminal feature	Comment
PHYSICAL LAYER	
Continuous carrier support on the return link	Mainly for mobile but potentially for backhauling
Mobile physical layer options (e.g. spreading, BSPK, …)	Mobile and small aperture terminals
OFDMA support on the return link	Improvement of the return link efficiency
MAC LAYER	
Transparent mesh overlay support	Transparent mesh systems
Regenerative satellite support	Regenerative mesh systems
Mobile MAC features	Features comprising Link-Layer FEC, pro-active retransmission, for mobile systems
Network LAYER	
GSM/ WiMax backhauling	Requires further investigation to assess which optimisations are required
IP Gateway implementation	To be further defined
Management LAYER	
Mobility management via lower layer	Applicable to mobile systems

Table 1 : Terminal future configurations options

4.11 Terminal capabilities and profiles

Systems implementing DVB-ISS standard are not mandated to implement all features defined in the lower layers and higher layer satellite specifications documents. In order to better match DVB-ISS systems with their potential uses, a set of terminal profiles and features is defined in this section.

Terminal optional features are defined as a set of capabilities that a terminal can implement or not depending on its design. Implementation of these features depends on the manufacturer decision and represents a competitive differentiation with respect to other designs. Normative features shall be implemented by all DVB-RCS-NG terminals.

The fact that these features are implemented or not does not prevent the terminal to be interoperable with hubs as the hub should be aware of the implementation of these features via signalling.

Terminal feature	Normative/ Optional	Comment
PHYSICAL LAYER		
QPSK/8PSK and CPM support on the return link	N	
Reference waveforms	N	
Custom waveforms	O	
Waveform bound permanently to timeslot	N	Definition via tables
Waveform allocated to timeslots at the time of assignment	N	Dynamic allocation via burst assignment
EIRP power control	N	For ISST not using MUC with CPM
Constant Power Density control	O	
Forward link DVB-S2 CCM, S2 ACM	N	
Forward Link Single Continuous Generic Stream	N	
Forward link Single TS Packet Stream	O	For migration support
Forward link Multiple Streams (TS or GS)	O	

GSE in BBframe CRC32	N	
MAC LAYER		
DAMA for traffic (supporting all capacity categories)	N	
Unsolicited DA for traffic	N	
Slotted Aloha logon	N	
Random Access combined with DAMA	O	
Random access with replicas	O	Constant of variable rate replication ratio
In-band signalling in traffic timeslots	N	
Signalling in DA signalling timeslots	N	
NETWORK LAYER		
DHCP on LAN interface	N	For IPV4 and IPV6 as specified in [3]
IPV4 and IPV6 support on traffic interface	N	
Dynamic multicast support	O	
DiffServ QoS support	N	
MPLS support	O	
CONTROL FUNCTIONS		
Motor control support	O	Via DiSeqC™ 2.x support [9]
MANAGEMENT PLANE		
IPV4 support on management interface	N	
IPV6 support on management interface	O	
Multicast software download	N	Specified in [3]
Support of RCS2 MIB	N	Specified in [3] (SatLabs MIB), will be further inserted in an updated version of RFC 5728
PEP negotiation protocol support	O/ N	Based on the signalling by the terminal of its hardware and software versions
XML file based configuration support	O	Find spec in HSL
SNMP V2c	N	Specified in [7] and [8] (RFC 1901 – RFC 1908)
SNMP MIB II	N	Specified in [6] (RFC 1213)
SNMP and CLI remote control via layer 2	O	Based on layer 2 tunneling. Refer to it in the LL spec.
Lower Layer Signalling ISST remote control	N	
Authenticated logon	O	
Lower Layer IPv4 M&C address assign	N	
IPDR support	O	
Syslog support	O	
HTTP management interface support	N	

Table 2 : Terminal features description

In addition to the terminals features, a set of profiles is defined. Capabilities used as keys for profiling allow system designers to identify a set of minimum specifications for a terminal that declares its compliance to a given profile. A terminal can comply to several profiles and implement features or have performances above those defined in Table 3 . The requirements in this section should be understood as minimum capabilities for a terminal to be declared as compliant to a usage profile.

	Consumer	Multi-dwelling	Corporate	SCADA	Backhaul	Institutionnal
PHYSICAL LAYER						
16 QAM return link modulation	O	O	N	O	N	N
32APSK Forward Link modulation	O	O	O	O	N	N
Essential waveform flexibility	O	O	N	O	N	N
Fast carrier switching	O	O	N	O	N	N
Lowest carrier switching class	1	1	2	1	2	2
MAC LAYER						
Minimum number of supported traffic SVN	1	4	4	1	4	4
Minimum number of layer 2 trafic classes (RC's and AC's)	3	3	7	3	3	7
Slotted Aloha traffic	O	O	O	N	O	O
TRANSEC hooks support	O	O	O	O	O	N
NETWORK LAYER						
Minimum number of simultaneous traffic multicast streams reception	16	64	64	16	16	64
OSPF support	O	N	N	O	N	N
Firewall capability	O	O	N	N	O	N
Multicast forwarding on the return link	O	O	O	O	O	N
MANAGEMENT LAYER						
SNMP v3 support (*)	O	N	N	O	N	N
Multi SVNO support	O	N	O	O	O	O

N : Normative capability required for this profile
O : Optional capability, not required for this profile
(*) SNMP V2c is required as a minimum for all terminals profiles while SNMP V3 should be normative unless specified optional

Table 3 : Terminal profiles description

4.12 System versioning

The scope of version 2 designated as the DVB-ISS standard is extended significantly compared to that of version 1 as defined in [1] and designated as DVB-RCS. In particular, DVB-ISS contains mandatory provisions for the management and control planes. Furthermore, in order to enhance efficiency, this version has introduced a significant number of non-backwards-compatible changes to certain mandatory provisions that are covered in both versions. This applies, inter alia, to the encapsulation, modulation and coding of the return link transmissions, as well as to the carriage of signalling in the forward link.

These changes have been introduced in a manner that facilitates a smooth migration from Version 1 to Version 2, with minimal operational impact. It is envisaged that such a migration may take place over an extended period of time. In particular, already-deployed ISST's operating according to Version 1 may not be software-upgradeable to Version 2, so a system operator may choose to operate according to Version 2 only on newly-deployed and replaced terminals. Accordingly, Version 1 may only be phased out as existing terminals reach the end of their operational life. It is therefore very important that the two versions can co-exist within a system and share the resources in an efficient manner.

Clause 4.12.1 describes the envisaged scenarios and associated normative provisions for forward links; Clause 4.12.2 presents the corresponding provisions for return and mesh links. Some considerations for Management and Control Planes, Synchronisation and Logon are presented in Clauses 4.12.3 and 4.12.4.

4.12.1 Forward Link

Migration scenarios for the forward link depend on the starting point. The forward link in DVB-RCS Version 2 is intended to use the Generic Stream Encapsulation protocol exclusively, including for transport of signalling. In DVB-RCS [1] specification, one or more Transport Streams are used to carry traffic and signalling.

The multi-input-stream capabilities of DVB-S2 can be exploited to allow sharing of a physical forward link carrier among ISST populations operating according to both versions. This greatly facilitates migration, in particular for systems employing a forward link that occupies a complete transponder. Avoiding multi-carrier operation eliminates the need to back off the transponder during the migration.

Carrier sharing is not possible if the original system uses DVB-S or include ISST's that support only the minimum functionality mandated for DVB-S2 (CCM with single input transport stream).

As a special provision to facilitate migration, Version 2 ISST's may be able to extract forward link traffic and signalling from a Transport Stream. This optional feature provides tools that facilitate the migration process. This feature ameliorates restrictions dictated by fundamental differences between forward link carriers, in particular between DVB-S and DVB-S2. By using this optional feature, it is possible to design hybrid migration scenarios for the overall system, in which the forward and return links are migrated separately. For example, a DVB-RCS forward link can be used to transport traffic and signalling to both DVB-RCS and DVB-ISS capable ISST's. The latter may in turn use a DVB-ISS return link.

Table 4 summarises the main issues associated with forward link migration from different starting points, in order of decreasing system impact. These are examples only; it is expected that details will be system-specific. It is further noted that there are no known DVB-RCS implementations that make use of Generic Streams for carrying traffic. Migration scenarios starting from Generic Streams have therefore not been considered. Some additional considerations are presented following the table.

Table 4: Forward link migration scenarios.

Migrating From	Main Considerations
DVB-S	The carrier can not be strictly Version-2 compliant, but can transport DVB-ISS information in a hybrid migration scenario.
DVB-S2 CCM with MPE (single-stream capable receivers)	The carrier can not be strictly DVB-ISS compliant, but can transport DVB-ISS information in a hybrid migration scenario.
DVB-S2 CCM with MPE (multi-stream capable receivers)	During the migration, at least one TS is retained to carry traffic for DVB-RCS terminals. This TS will also carry signalling. Although not strictly required, for best efficiency one or more GS's should carry the traffic for DVB-ISS terminals.
DVB-S2 ACM with MPE	During the migration, at least one TS is retained to carry traffic for DVB-RCS terminals. This TS will also carry signalling. NCR packets can be shared by all RCS and ISS terminals. Although not strictly required, for best efficiency one or more GS's should carry the traffic for DVB-ISS terminals.

When migrating from a DVB-S forward link, there is no possibility of operating it strictly according to DVB-ISS. However, if a hybrid migration arrangement is acceptable, the DVB-S carrier can be used to transport traffic and signalling DVB-ISS terminals, as described above. To support DVB-ISS terminals without the migration option, it is necessary to run the DVB-ISS component through a separate forward link. The relative carrier rates can be adjusted over time to match the traffic demands in the two components, as this evolves from DVB-RCS to DVB-ISS. If the original system operates in a quasi-linear, shared transponder, this will have little impact on the system efficiency — in fact, the higher efficiency of the DVB-S2-based DVB-ISS system will likely more than compensate for the added overhead incurred due to duplication of certain elements of signalling etc. If the original system uses a full transponder operated near saturation, it will be necessary either to provide additional capacity for the new carrier, or to back off the transponder to allow two-carrier operation. In the latter case, some capacity loss in the migration period is probably inevitable.

If the terminal in the original system allows it, this capacity loss can be further mitigated by carrying out the migration in two steps: by first switching to DVB-S2 operation in DVB-RCS, and subsequently introducing DVB-ISS operation on the shared carrier as described below.

A similar situation occurs if the original system uses DVB-S2 but includes DVB-RCS terminals that implement only the bare minimum required by the DVB-S2 standard (CCM with single transport stream). In this case, the multi-stream capabilities of DVB-S2 cannot be exploited, so it is again necessary either to use separate forward link carriers or to transport DVB-ISS traffic and signalling on the DVB-RCS carrier in a hybrid migration arrangement.

Apart from this case, the migration path from a DVB-S2 based DVB-RCS system depends on how the original system is operated; in particular on whether the original system is CCM or ACM. This distinction arises from the fact that DVB-RCS carries the NCR synchronisation information in different ways, depending on the mode. The method used in DVB-ISS is analogous to that used in DVB-RCS with ACM, while that used with CCM in DVB-RCS is substantially different. When migrating from a DVB-RCS CCM system, it may therefore be necessary to carry two separate sets of NCR packets: One transmitted according to the CCM method, one according to the ACM/DVB-ISS method. This depends on whether the backwards compatibility of the DVB-ISS terminals extends to supporting the CCM NCR method.

One or more Transport Streams must be retained during the migration to carry traffic to DVB-RCS terminals as well as to carry some or all signalling. For best efficiency, one or more GS's should be added to the carrier to handle traffic to DVB-ISS terminals.

In all DVB-S2 migration scenarios, input streams are separated by ISI value and no explicit re-configuration is required at the DVB-S2 level in order to apportion capacity among the two terminal populations.

4.12.2 Return link

While the basic MF-TDMA nature of the return link has been retained from DVB-RCS to DVB-ISS, incompatible changes have been introduced to the encapsulation (variable-payload RLE vs. fixed-payload ATM/MPEG), FEC coding (16-state vs. 8-state turbo code), burst formatting (distributed pilots vs. preamble-only), modulation (extension to 8PSK and 16QAM) and dynamic operation (rapid changes to the time slot parameters). It is envisaged that these changes will necessitate corresponding changes to the resource management functions. As a result of this, the recommended resource sharing method in the return link during migration from DVB-RCS to DVB-ISS is to exploit the multi-carrier nature of the transmission scheme, configuring separate sets of carriers with appropriate characteristics and capacity for the two terminals populations. This configuration will evolve over time, as the usage of DVB-RCS decreases and that of DVB-ISS increases. In all but the smallest systems, this will provide a relatively fine granularity for the capacity sharing. The partitioning will however be quasi-static, so some loss of capacity can be encountered. This loss is however at least partly compensated by the better power/bandwidth efficiency of Version 2, and can be further mitigated by the special logon provisions described below.

It is conceivable that individual carriers can be shared between DVB-RCS and DVB-ISS, by a judicious design of the frame formats that create non-overlapping resources for the two elements (e.g., letting the first half of each superframe be DVB-RCS and the second half DVB-ISS). This may be of interest particularly for very small systems. There are no special normative provisions to support this type of operation; implementation is left to individual vendors and system operators.

4.12.3 Management and Control Planes

Management and control plane functions above the MAC layer are outside the scope of DVB-RCS, with systems relying largely on vendor-specific provisions. By definition, there is therefore no interoperable migration path to DVB-ISS for these aspects.

4.12.4 ISST Synchronisation and Logon

Both versions of the standard have defined ways of locating the forward link carrier and the (TS or GS) stream carrying the signalling; based on the population_id and other fundamental parameters configured in each terminal. As a minimum, any terminal attempting to enter the system will therefore be able to locate the appropriate resources unambiguously and will therefore also be able to attempt logon in the appropriate partition of the return link resource.

Furthermore, as a migration aid, DVB-ISS includes an optional, backwards-compatible variant of the logon (CSC) burst from DVB-RCS. This variant allows the terminals to indicate its DVB-ISS capabilities as well as whether it can operate fully in accordance with DVB-RCS. This feature allows the NCC to make the decision about the version to be used for any session at logon time, rather than using a pre-determined configuration. This can be used for example for load balancing, hence minimising the impact of the resource partitioning between DVB-RCS and DVB-ISS.

4.13 Security aspects

This section addresses system security issues — concerned with protection of the network itself — as well as lawful interception of traffic.

System security comprises Confidentially, Integrity, Availability and Non-Repudiation. Each of these attributes can be associated with the U-Plane, C-Plane and M-Plane; the corresponding functional security needs are summarised in table 5.

Table 5: High-level security requirements.

	Confidentiality	Integrity	Availability	Non-repudiation
U-plane	Protection of unencrypted data and header information	***Use of standard techniques (e.g., CRC, sequence numbers)***		Provided by IPsec or HAIPE
C-plane	***Protection of User Traffic activity patterns and capacity requests.***	***Use of standard techniques (e.g., CRC, sequence numbers)***	Protection against Denial of Service attack	***User, Hub and ISST authentication.***
M-plane	***Protection of signalling; protection from Terminal Location Analysis***	***Use of standard techniques (e.g., CRC, sequence numbers)***	Protection against Denial of Service attack	***User, Hub and ISST authentication.***

The security aspects addressed in DVB-ISS are represented by *highlighting* in table 5. Correspondingly, for the purposes of the standard, security has been defined to include:

- Control, management and data confidentiality and integrity :
  - Risk of channel activity patterns tracking : disguise transmission energy in order to conceal channel activity fluctuations.
  - Risk of control channel information monitoring : disguise traffic volumes, secure traffic source and destination.
  - Risk of user data eavesdropping : disguise user information
- Network access and connection establishment :
  - Risk of hub and remote units faking : ensure that remote terminals connected to the network are authorized users.
  - Intrusion risk : mitigate the intrusion risk / protect against Denial-of-Services (DoS) and Replay attacks.

U-Plane security may be provided end-to-end using mechanisms outside the scope of the standard, e.g., IPsec (including HAIPE, High Assurance Internet Protocol Encryptor) or Transport Layer Security (TLS).

Protocols implemented within an ISST and operating at the network-layer or above (e.g., IP-level functions, configuration, management) can also present security vulnerabilities. As for the user plane, these can be secured using standards-based methods such as TCP secure, IPsec, and protocol-specific security extensions. Remedies for these issues are beyond the scope of standardisation.

There are known interactions with end-to-end security mechanisms and ISST protocol acceleration mechanisms such as intercepting proxies. These mechanisms can partially deny opportunities for split-TCP, application-specific protocol acceleration, compression, cross-layer QoS optimisation, etc., since these techniques require visibility of protocol headers (and in some cases the ability to modify them). This conflicts with the security goals. Remedies for these issues are system specific and beyond the scope of the standard.

4.13.1 Transmission Security (TRANSEC)

The countermeasure techniques commonly used for mitigating security risks in the management and control planes are known as TRANSEC. The techniques foreseen in the standard include link layer encryption including its associated key management, authentication and traffic activity concealment / obfuscation. The normative document provides features for transport of the information associated with these countermeasures, including for example encryption key exchange messages, initialisation vectors and authentication handshaking. Given that specific requirements and preferred techniques vary substantially between users, details of the techniques and associated signalling are outside the scope of the normative provisions. A number of implementations are described in the guidelines document.

TRANSEC encryption can be applied in the link layer to both Forward Link (FL) and Return Link (RL) of a DVB-ISS network, to all data packets (payloads and headers) and to all signalling, with a small number of exceptions dictated by physical transport considerations. Link layer encryption is foreseen to be based on approved algorithms, used in approved modes of operations. For military and governmental applications the encryption algorithms and the operation modes will normally be military approved.

On the forward link, the traffic activity can be concealed / obfuscated by transmitting dummy or “chaff” packets in broadcast mode. On the return link, the traffic activity can be concealed / obfuscated by transmitting dummy bursts. The policies for slot allocation for dummy bursts are system specific.

In order to ensure that transport of TRANSEC-specific information can take place in an interoperable manner, the following mandatory protocol types are defined for GSE in the forward link and RLE in return/mesh links :

- TRANSEC_Chaff : This mandatory protocol type indicates that the packet contains meaningless “chaff” or “dummy” data. The contents of such packets shall be discarded by the receiver.
- TRANSEC_Certificate : This mandatory protocol type indicates that the packet contains certificate exchange information for control of a TRANSEC function. The packet contents are implementation-specific. Such packets can be discarded by receivers not implementing TRANSEC.

The corresponding protocol type values are assigned by the IETF.

4.13.2 Lawful Interception

A DVB-ISS Network may need to consider the requirements for lawful interception of user traffic. These requirements vary depending on location and local legislation.

For star networks, lawful interception functionality may be provided at the hub.

In mesh networks, the opportunities for lawful interception are system dependent. OBP-based mesh networks typically assemble all transmissions into a single TDM per beam, so interception can be achieved by the same means as for star networks, by employing a single receiving station in each beam. This function will normally be available at the NCC in any case.

Some transparent mesh networks also have a reception function at the hub, where all traffic can be monitored. Although usually intended for extraction of signalling, this function can also be used for lawful interception.

In those transparent mesh networks where no central traffic monitoring is available as part of the normal system operation, it may be necessary to install dedicated monitoring facilities in each beam.

A number of existing techniques may be used for interception of traffic in IP networks, including DVB-ISS networks. These include for example IPFIX (Internet Protocol Flow Information Export) [4] and PSAMP (Packet Sampling) [5]. The former is an IETF standard for common export of Internet Protocol flow information from routers, probes, and other devices. It is used by mediation systems, accounting/billing systems, and network management systems to facilitate services such as measurement, accounting, and billing. The PSAMP protocol allows packets to be selected from a stream according to a set of standardised selectors, to form a stream of reports on the selected packets, and to export the reports to a collector using the IPFIX framework. The details of these techniques, and the manner in which they are applied, are outside the scope of the standard.

4.14 Evaluation and certification

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Annex <A> (normative): Title of normative annex

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Annex <B> (informative): Title of informative annex

*Each annex **shall** start on a new page.*

Use the Heading 8 style for the title and the Normal style for the text.

B.1 First clause of the annex

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B.1.1 First subdivided clause of the annex

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The following text is to be used when appropriate:

Abstract Test Suite (ATS) text block

This text should be used for ATSs using TTCN-2 or TTCN-3. The subdivision is recommended.

Use one of the three following choices: Either:

For test suite specified in TTCN version 2 (TTCN-2): Provide both Graphical Rendition (GR) and Machine Processable (MP) files.

The following text should be used for ATSs using TTCN-2. The subdivision is recommended.

This ATS has been produced using the Tree and Tabular Combined Notation (TTCN) according to ISO/IEC 9646-3 [<x>].

The ATS was developed on a separate TTCN software tool and, therefore, the TTCN tables are not completely referenced in the table of contents. The ATS itself contains a test suite overview part which provides additional information and references.

For test suite specified in TTCN version 3 (TTCN-3) Tabular Format: Provide both Graphical Rendition (GR) and Machine Processable (MP) files.

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For test suites specified in TTCN version 3 (TTNC-3) Core Language: Provide only the machine processable (MP) file.

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This ATS has been produced using the Testing and Test Control Notation (TTCN) according to ES 201 873-2 [<x>].

<x1> The TTCN Graphical form (TTCN.GR)

The TTCN.GR representation of this ATS is contained in an Adobe Portable Document Format™ file (<any_name>.PDF contained in archive <Shortfilename>.ZIP) which accompanies the present document.

<x2> The TTCN Machine Processable form (TTCN.MP)

The TTCN.MP representation corresponding to this ATS is contained in an ASCII file (<any_name>.MP contained in archive <Shortfilename>.ZIP) which accompanies the present document.

Where an ETSI Abstract Test Suite (in TTCN) is published in both .GR and .MP format these two forms shall be considered equivalent. In the event that there appears to be syntactical or semantic differences between the two then the problem shall be resolved and the erroneous format (whichever it is) shall be corrected.

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Annex <y> (informative): Bibliography

The annex entitled "Bibliography" is optional.

It shall contain a list of standards, books, articles, or other sources on a particular subject which are not mentioned in the document itself (see clause 12.2 of the EDRs http://portal.etsi.org/edithelp/Files/other/EDRs_navigator.chm).

It shall not include the following:

- *normative references (such references shall be listed in clause 2.1);*
- *informative references (such references shall be listed in clause 2.2).*

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History

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History box entries

Document history		
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A few examples:

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