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Technical Specification

Digital Video Broadcasting (DVB);
Second Generation DVB Interactive Satellite System (DVB-RCS2);
Part 3: Higher Layers Satellite Specification

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Contents

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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 3 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 301 545-2: "Lower Layers for Satellite standard";

TS 101 545-3: "Higher Layers for Satellite Specification".

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 [i.1] the present document 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 RCST 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 present document provides the higher layers for satellite the 2^{nd} Generation Interactive DVB Satellite System (DVB-RCS2) and represents the third part of the multi-part specification of that system. The present document is the specification of the higher layers satellite architecture, signalling and functions required for the two way interactive satellite networks specified in [2].

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

The requirements in the present document have been introduced to provide the best possible interoperability between terminals and hubs, defining the network functions as well as management and control capabilities to complement the lower layers of the system (up to layer 2) given in part 2 [3].

1 Scope

The present document specifies the functional requirements for the higher protocol layers for the DVB-RCS2 satellite interactive system specified in [2]. The current document applies for the transparent star satellite network, as defined in [2], and it is concerned with RCSTs connecting LANs via satellite to other networks like e.g. the Internet, as an implementation of the lower layer protocol layers specified in [3].

The current specification is normative for the user plane and control plane, and informative for the management plane. For the latter, the specifications are provided as recommendations to guide in aligning implementations of M and C, aiming at a future enhancement to become a normative specification also for the management plane. For this purpose, the specification provides abstraction models, and recommends protocols and managed objects and structures that relate to these models. The recommendations aim at minimizing the gap between early M and C implementations and a future normative specification for the management plane.

The current non-normative recommendations for the management plane are intended to be extended by implementation dependent adaptation to create bilateral interoperability. The recommendations aim at making such adaptation a simple task.

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.

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[2] ETSI TS 101 545-1: "Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 1: Overview and System Level specification".

[3] ETSI EN 301 545-2: "Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 2: Lower Layers for Satellite standard".

[4] ETSI TS 102 606: "Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE) Protocol".

[5] ITU-T Recommendation X.693: "Information technology - ASN.1 encoding rules: XML Encoding Rules (XER)".

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2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.**

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3 Definitions, symbols and abbreviations

3.1 Definitions

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

assignment identifier: identifier used to indicate the association of a timeslot to the access method and possibly a specific RCST, as well as a specific channel for that RCST

NOTE: Each timeslot is associated with an Assignment ID in the control signalling from NCC to RCST.

Allocation Channel (AC): set of timeslots identified by one Assignment ID

NOTE: An allocation channel represents a portion of the retun link capacity that is assigned by the NCC to one or more streams of an RCST.

assigment ID: identifier composed of the Channel_ID and Logon_ID

NOTE: The Assignment_IDs are used in the TBTP2 for allocating MF-TDMA resources to data streams.

Behaviour Aggregate (BA): aggregate of packets that share the same network forwarding behaviour

NOTE: Within a connectivity aggregate (CA), the traffic of a TC constitutes a Behaviour Aggregate (BA).

control plane: communications that carry control signalling information

NOTE: A part of the layered RCS network architecture that, among other functions, is concerned with control functions.

Connectivity Channel (CC): transmission channel that support a shared transmission from one transmitter to one or several receivers

NOTE: The set of receivers may be limited to only one, like for transparent star (the RCSTs and the gateways).

Connection Control Protocol (C2P): layer1-2 connection control protocol supporting the regenerative and mesh overlay networking control signalling between the RCST and the NCC

Connectivity Aggregate (CA): comprises the traffic to be sent over a single satellite interface

NOTE: The CA is the output of a L3 routing or L2 forwarding decision.

Dedicated Access Service (DA service): control plane entity that is defined for each DA allocation channel and that regulates RCST behaviour while forwarding data traffic on the corresponding DA allocation channel (DA-AC)

NOTE: The DA service corresponds to the utilization of a DA-AC.

Differentiated Services Code Point (DSCP): IPv4 header Type Of Service octet or IPv6 Traffic Class octet when interpreted in conformance with the definition given in (RFC 2475 [i.27])

Digital Video Broadcasting Return Channel by Satellite (DVB-RCS): architecture for an interaction (or return) channel using satellite links and forming an Interactive Network (DVB-RCS2-S)

feeder:transmits the forward link signal, which is a standard satellite digital video broadcast (DVB-S or DVB-S2) uplink, onto which are multiplexed the user data and/or the control and timing signals needed for the operation of the Satellite Interactive Network (DVB-RCS2)

Forward Link (FL): satellite link from the NCC and Feeder to the RCSTs DVB-RCS2

Gateway (GW): receives the RCST return link signals, and provides the next-hop bi-directional network-layer interface for traffic sent using a star connection

NOTE: In the Star Topology, this includes the functionality of the Feeder that provides the forward link.

Generic Stream Encapsulation (GSE):encapsulation format defined in the Lower layers for use with continuous mode transmission. This is a particular subset of GSE

HID: hardware ID IEEE MAC-48 [i.56], a 6 Byte identifier that is permanently associated with a single RCST

Higher Layers: set of RCS network functions that are defined in the present document

NOTE: These layers perform functions relating to the operation of the network-layer and higher layers and define the interfaces presented to the attached LAN interface(s).

Higher Layer Service (HL service): per-hop treatment of Layer 3 PDUs characterised by a PHB

NOTE: A management construct that puts together policy and PHB. The HL service determines any traffic conditioning for the BA, and defines the queue management and scheduling parameters needed to realise the service.

HLS PDU Queue: queue in which Layer 3 protocol data units are held, pending transmission under the control of a specific Higher Layer Service

hub: combines a Feeder and Gateway, together with the NCC and NMC

hybrid transparent satellite network: network implemented partly as a transparent star satellite network and partly as a mesh overlay transparent satellite network

interactive network: set of RCSTs, Gateways, and NCC managed by a satellite network operator (SNO)

IP Flow: sequence of IP packets from an IP source to an IP destination

NOTE: An RCST routes a flow considering the network-layer attributes, including: IP source and destination address, protocol type, DSCP.

IP MicroFlow: single instance of an application-to-application flow of packets which is identified by source address, destination address, protocol_id, and source port, destination port (where applicable)

LAN Interface: interface presented by the RCST to an attached network, for example using the Ethernet standard

layer 1 mesh overlay system: satellite interactive network that supplements the unidirectional satellite link from a TDM feeder to RCSTs and the unidirectional satellite link from RCSTs to an MF-TDMA gateway with two-way satellite links between the RCSTs

NOTE: In such systems, the NCC is connected to the RCST via the feeder and gateway.

layer 1 regenerative and re-multiplexing system: 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

NOTE: Such system looks like an RCS second generation system from the layer 1 RCSTs perspective.

Link Stream (LS): sequence of lower layer Payload-adapted PDUs holding the sequence of HLPDUs of the associated SA

lower layers: set of RCS network functions that are defined in the lower layer specification [3]

Lower Layers Service (LL service): control plane entity that maps to any mix of RA services and DA services, serving one or several HL services

NOTE: The LL service may be any combination of DA services and RA services.

M and C: management and Control

management interface:interface of an RCST that is used for monitoring and management by the satellite service operator

NOTE: The interface is mapped to a layer 2 lable in the management SVN.

management plane: communications that carry information to maintain the network and to perform operational functions

NOTE: The management plane in RCS network architecture that provides the management of system elements, along with configuration of elements and monitoring of performance.

mesh link: link from an RCST to another RCST or a set of RCSTs that does not rely upon the signal being relayed by the Gateway

mesh connection: unidirectional or bidirectional connection over one mesh link or two oppositely directed mesh links connecting a pair of RCSTs, or a unidirectional connection over one mesh link connecting one RCST to a set of RCSTs

Multiprotocol Label Switching (MPLS):transmission mechanism defined in RFC 3031 [i.71]

NOTE: It operates between the link and network layers of the OSI model to unify the data transport service for circuit-based networks and packet based. It is also used to implement QoS and VPN features for packet switching over IP.

multicast: communication capability, which denotes unidirectional distribution from a single source access point to one or more destinations (a set of RCSTs and/or the Gateway)

Network Control Centre (NCC):provides control and monitoring functions

NOTE: It generates control and timing signals for the operation of the Satellite Interactive Network to be transmitted by one or several Feeder Stations (DVB-RCS2-S).

Network Management Centre (NMC): responsible for NCC, RCST, Gateways and OBP management functions

NOTE: Management messages from the NMC are forwarded to the NCC, which transmits them to the RCSTs if required (DVB-RCS2-S).

northbound interface: interface to the OSS that provides high-level network management and configuration functions

On-Board Processor (OBP): router or switch or multiplexer in the sky; it can decouple the uplink and downlink air interface formats (modulation, coding, framing, etc.)

Operator Virtual Network (OVN): network built using the Interactive Network to support a service managed by an SNO (Satellite Network Operator)

Per Hop Behaviour (PHB): HLS entity that defines the queuing, policing, and scheduling parameters needed to realise a specific QoS Class

NOTE: Set of policies that characterize the externally observable forwarding treatment applied at a differentiated services-compliant node to a behaviour aggregate defined by DiffServ architecture (RFC 2475 [i.27]). The PHB describes the processing for one specific hop (RFC 3086 [i.30]) and is associated with a HLS service. A PHB may be defined for any required purpose. Each PHB is identified by a PHB_ID.

PHB group: set of one or more PHBs that can only be meaningfully specified and implemented simultaneously, due to a common constraint applying to all PHBs in the set such as a queue servicing or queue management policy (RFC 3260 [i.32])

NOTE: A PHB group provides a service building block that allows a set of related forwarding behaviours to be specified together. A single PHB is a special case of a PHB group.

Quality of Service (QoS): network ability to provide service differentiation/guarantees and thus influence the perceived quality of communications with regard to a number of parameters (including delay, jitter, packet loss) experienced by packets in a Behaviour Aggregate when transferred by the interactive network

Random Access Service (RA service): control plane entity that is defined for each RA allocation channel and that regulates RCST behaviour while forwarding data traffic on the corresponding RA allocation channel

NOTE: The RA service provides the allowance to load a specific RA allocation Channel (RAAC). The RA service corresponds to the utilization of a RAAC.

Request Class (RC): layer 2 entity in the control plane that acts as a reference to the resource model for a particular link stream or set of link streams

NOTE: An RC identifies the resources allocation policy and connectivity associated with the flow that generated the request. If a different connectivity is required (e.g. in a mesh case), the RCST must specify a different RC. The RC identifies both a specific connectivity and a specific traffic aggregate. Each RC can support any mix of Capacity Categories [3], this mapping is provided by the LL service configuration. The behaviour of an RC is not defined by the set of capacity categories but by the relation to HL services that map to the LL services and RC.

Return Link (RL): Stream from the RCST to the NCC or Gateway

Return Link Encapsulation (RLE): encapsulation format defined in the Lower Layers Specification for use with burst-mode waveforms

NOTE: This has a similar higher-layer interface to GSE.

Return Channel via Satellite Terminal (**RCST):** terminal that combines the lower-layer specifications between [2] and the present document

Request Class (RC): reference that indicates the class association of each capacity request sent from an RCST to an NCC

NOTE: The class associates the request with a resource assignment policy and connectivity.

star connection: connection where traffic is sent to or from a Gateway

NOTE: The Gateway and an RCST are next hop neighbours at IP network level.

Satellite Virtual Network (SVN): logical subdivision of the network infrastructure. Traffic in one SVN is handled independently of traffic in other SVNs

NOTE: One SVN is reserved for management of all RCSTs in an Interactive Network. One of more SVNs may be combined to form a VRF Group.

Service Aggregate (SA): logical combination of one or more Behaviour Aggregates that use the same Lower Layer service

NOTE: Sequence of Higher Layer PDUs (HLPDUs) held by the associated Link Stream (LS). The SA sequence is a multiplex of HLPDUs of the different Bas that map to the same BA.

SVN-MAC: 3 byte label that uniquely identifies a layer 2 endpoint within the Interactive network

NOTE: Each RCST is dynamically allocated one SVN-MAC for management, and at least one SVN-MAC for user plane traffic.

Traffic Class (TC): description of flows that are assigned to the same BA

NOTE: A Traffic Class is defined by a traffic filter in terms of a Differentiated Services Code Point or other characteristics that may distinguish a subset of HL PDUs in a larger aggregate. Traffic classified to the same TC receives the same treatment within the satellite Interactive Network. A RC may be implemented as a set of one or more traffic filter records, a simple traffic filter could match only the DSCP.

traffic conditioning: control functions that can be applied to a Behavior Aggregate, application flow, or other operationally useful subset of traffic, e.g. routing updates (RFC 2475 [i.27])

NOTE: This may include metering, policing, shaping, and packet marking. Traffic conditioning is used to enforce agreements between domains and to condition traffic to receive a differentiated service within a domain by marking packets with the appropriate DCSP and by monitoring and altering the temporal characteristics of the aggregate where necessary.

traffic stream: administratively significant set of one or more microflows which traverse a path segment

NOTE: A traffic stream may consist of the set of active microflows which are selected by a particular classifier.

unicast: communication capability, which denotes unidirectional distribution from a single source access point to a single specified destination access point (RCST or Gateway)

user plane: communications that carry user information

NOTE: The user plane in the RSC network architecture that provides the transfer of user data, along with associated controls (e.g. flow control, recovery from errors, etc.).

Virtual LAN (VLAN): term specified by IEEE 802.1Q [i.58] that defines a method of differentiating and separating traffic on a LAN by tagging the Ethernet frames

Virtual Routing/Forwarding (VRF) Group: collection of one or more SVNs that share a common addressing space

NOTE: Addresses in the private range may be independently used in different VRFs. Each VRF Group has an independent set of forwarding and routing tables. A NAT gateway is required to communicate between VRF Groups that use overlapping network address spaces.

3.2 Symbols

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

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:

AAAA	Authentication Authorization Accounting Auditing
AAL	ATM Adaptation Layer
AC	Allocation Channel
ACM	Adaptive Coding and Modulation
ADSL	Asymmetric Digital Subscriber Line
AES	Advanced Encryption Standard
AF	Assured Forwarding PHB
AQM	Active Queue Management
AR	Address Resolution
ASCII	American Standard Code For Information Interchange
ASN	Abstract Syntax Notation
ATM	Asynchronous Transfer Mode
AVBDC	Absolute Volume-Based Dynamic Capacity
BA	Behavior Aggregate
BB	BaseBand
BE	Best Effort
BE	Best Effort service class
BER	Bit Error Ratio
BK	BacKground service class
BGP	Border Gateway Protocol
BoD	Bandwidth-on-Demand
BPSK	Binary Phase Shift Keying
BSM	Broadband Satellite Multimedia
BUC	Block Up Converter
BW	BandWidth
C2P	Connection Control Protocol
CA	Connectivity Aggregate

CAC	Connection Admission Control
CC	Capacity Class
CCM	Constant Coding and Modulation
CD	Critical Data
CL	Controlled Load service class
CIR	Carrier to Interference Ratio
CLI	Command Line Interface
CNR	Carrier Noise Ratio
CMF	Control and Monitoring Functions
CMI	Control and Management Interface
CR	Capacity Request
CRA	Continuous Rate Assignment
CRDSA	Contention Resolution Diversity Slotted Aloha
CSC	Common Signalling Channel
CW	Continuous Wave
DA	Dedicated Assignment
DA-AC	Dedicated Access Allocation Channel
DAMA	Demand Assignment Multiple Access
DC	Direct Current
DCCP	Datagram Congestion Control Protocol
DF	Don’t Fragment flag
DHCP	Dynamic Host Configuration Protocol
DiffServ	Differentiated Services
DNS	Domain Name Service
DR	Designated Router
DS	Differentiated Services
DSCP	Differentiated Services Code Point
DULM	Data Unit Labelling Method
DVB	Digital Video Broadcasting
EE	Excellent Effort service class
EF	Expedited Forwarding PHB
EIRP	Equivalent Isotropic Radiated Power
eTOM	enhanced Telecommunication Operations Map
FCA	Fault, Configuration, Accounting
FCAPS	Fault, Configuration, Accounting, Performance, Security management
FEC	Forwarding Equivalence Class
FIFO	First In First Out
FL	Forward Link
FLSS	Forward Link SubSystem
FPDU	Frame PDU
FTP	File Transfer Protocol
GS	Generic Stream
GSE	Generic Stream Encapsulation
GW	Gateway
HL	Higher Layer
HLS	Higher Layers (Satellite)
HLPDU	Higher Layer PDU
HTTP	HyperText Transfer Protocol
IANA	Internet Assigned Numbers Authority
ICMP	Internet Control Message Protocol
IDU	Indoor Unit
IETF	Internet Engineering task Force
IFL	Inter-Facility Link
IF-MIB	Interfaces MIB
IGMP	Internet Group Management Protocol
IN	Interactive Network
INID	Interactive Network ID
IP	Internet Protocol
IPDR	Internet Protocol Detail Record
IP/DVB	Internet Protocol / Digital Video Broadcasting
IP-MIB	IP MIB
IPSEC	IP Security

ISI	Input Stream Identifier
ISIS	Intermediate System to Intermediate System routing protocol
IS-IS	Intermediate System to Intermediate System
ISP	Internet Service Provider
JT	Jitter Tolerant
KB	Kilo Bytes
L1	Physical Layer
L2	Link Layer
L3	Network layer
LANS	Local Area Networks
LDP	Label Distribution Protocol
LER	Label Edge Router
LL	Lower Layer
LLQ	Low Latency Queuing
LLS	Lower Layer Service
LNB	Low Noise Block
LS	Link Stream
LSP	Label Switched Paths
LSR	Label Switched Router
LO	Local Oscillator
MAC	Medium Access Control
MBGP	Multi-protocol Border Gateway Protocol
MCRP	Multi-Channel Routing Protocol
MF-TDMA	Multi Frequency-Time Division Multiple Access
MIB	Management Information Base
MIB-II	Management Information Based version II
MLD	Multicast Listener Discovery
MMT	Multicast PID Mapping Table
MMT2	Multicast label Mapping Table
MPE	Multi-Protocol Encapsulation
MPEG	Moving Picture Experts Group
MPLS	Multi-Protocol Label Switching
MRIB	Multicast RIB
MSDP	Multicast Source Discovery Protocol (of ASM)
MTU	Maximum Transmission Unit
NA	Not-Accessible
NAPT	Network Address Port Translator
NAT	Network Address Translation
NBMA	Non-Broadcast Multiple Access
NC	Network Control service class
NCC	Network Control Centre
NCC/GW	Network Control Center / GateWay
NCC_ID	Network Control Center Identifier
NCR	Network Clock Reference
ND	Neighbour Discovery
NIT	Network Information Table
NLID	Network Layer Information Descriptor
NMC	Network Management Centre
OAM	Operations And Management
OBP	On Board Processor
ODU	Outdoor Unit
OID	Object IDentifier
ONID	Original Network ID
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First
OSS	Operations Support System
OUI	Organisationally Unique Identifier
OVN	Operator Virtual Network
PCP	Priority Code Point
PDP	Policy Decision Point (of DS)
PDR	Peak Data Rate
PDU	Protocol Data Unit

PEP	Protocol Enhancing Proxy (Agent)
PEP	Policy Enforcement Point (of DS)
PHB	Per Hop Behavior
PHY	Physical Link
PID	Program IDentifier
PIM	Protocol Independent Multicast
PIM-SM	Protocol Independent Multicast - Sparse Mode
PMT	Program Map Table
PMTUD	Path MTU Discovery
PPP	Point-to-Point Protocol
PPPoE	PPP over Ethernet
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RA	Random Access
RA-AC	Random Access Allocation Channel
RBDC	Rate-Based Dynamic Capacity
RC	Request Class
RCS	Return Channel via Satellite
RCS-MAC	RCS Medium Access Control address
RCST	Return Channel via Satellite Terminal
RED	Random Early Detection
RFC	Request For Comments (IETF)
RIB	Routing Information Base
RIP	Routing Information Protocol
RL	Return Link
RLE	Return Link Encapsulation
RL/UL	Return Link / UpLink
RLSS	Return Link SubSystem
RMT	RCS Map Table
RO	Read-Only
RRM	Radio Resource Management
RS-GW	Regenerative Gateway
RSPEC	Resource SPECification
RSVP	Resource ReSerVation Protocol
RT	Real Time
RTP	Real-time Transfer Protocol
RW	**Read-Write**
SA	Service Aggregate
SAMI	Subscriber Account Management Interface
SAP	Service Access Point
SCADA	Supervisory Control And Data Acquisition
SCPC	Single Carrier Per Channel
SCTP	Stream Control Transport Protocol
SD	Satellite Dependent
SDDP	Software and Data Distribution Protocol
SDR	Sustainable Data Rate
SF	SuperFrame
SI	Satellite Independent / Service Information
SIP	Session Initiation Protocol
SI-SAP	Satellite Independent SAP
SLA	Service Level Agreement
SLAmgmt	SLA management
SMI	Structure of Management Information
SNMP	Simple Network Management Protocol
SO	Satellite Operator
SNO	Satellite Network Operator
SP	Service Provider
SVN	Satellite Virtual Network
SVN-MAC	SVN Medium Access Control label
SVNMAC	Satellite Virtual Newtork MAC
SVNO	Satellite Virtual Network Operator
SW	Software

SWDL	SoftWare DownLoad
SYNC	Synchronization burst
TBD	To Be Defined
TBTP	Time Burst Time Plan
TC	Traffic Class
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TDM	Time Division Multiplex
TDMA	Time Division Multiple Access
TFTP	Trivial File Transfer Protocol
TIA	Telecommunication Industries Association
TID	Transfer IDentifiers
TIM-u	Terminal Information Message Unicast
TIM-b	Terminal Information Message Broadcast
TMN	Telecommunications Management Network
TRF	Traffic burst
TS	Transport Stream
TS-GW	Transparent Gateway
TSPEC	Traffic SPECification
TX	Transmission
TTL	Time To Live
UDP	User Datagram Protocol
UDP/IP	User Datagram Protocol / Internet Protocol
ULE	Unidirectional Lightweight Encapsulation
UMTS	Universal Mobile Telecommunication System
USM	User-based Security Model
VBDC	Volume-Based Dynamic Capacity
VCI	Virtual Circuit Identifier
VCM	Variable Code Modulation
VI	Video service class
VLAN	Virtual LAN
VoIP	Voice over IP
VO	Voice service class
VPI	Virtual Path Identifier
VPN	Virtual Private Network
VRF	Virtual Routing and Forwarding
WFQ	Weighted Fair Queueing
WRED	Weighted Random Early Detection
WRQ	Write Request
XML	Extensible Markup Language

4 Reference System Architecture

DVB-RCS2 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. It embraces the DVB-S and the DVB-S2 standards implemented in the commercial broadcasting environment, exploiting economics of scale.

To support interoperability, the DVB-RCS2 specification describes Higher layers components adapted to satellite interactive systems. These components are parts of control and management planes and rely mainly on DVB and IETF standards or are derived from them.

A typical DVB-RCS2 Interactive 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 RCSTs. The signalling from the Network Control Centre (NCC) to RCSTs 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 RCST.

The NCC is the central entity that supports control signalling via the Lower Layer Signalling (L2S) and the NMC is a central entity that support management signalling via IPv4.

4.1 System Roles

The system roles are defined by the DVB-RCS2 system specification [2]. This clause provides an informative description of roles and stakeholder/actors and their interaction/relationship in the context of the DVB-RCS2 high-level system architecture. This description is provided to help understanding of the framework of DVB-RCS2 management and control operations.

A role is defined by a logical grouping of responsibilities, with the intention of providing a generic framework for related functional entities with appropriate granularity, in order to allow role mapping to one or more real-life (physical) element(s) or entity(ies). A single role can be a real-life actor or multiple roles can be combined in one business actor. A role may have business responsibilities and/or technical responsibilities.

The system roles considered in a DVB-RCS2 system are defined in the system specification [2] and are illustrated by the model shown in the next figure 4.1. These definitions are included for convenience in the present document, as an introduction to HLS addressing concepts.

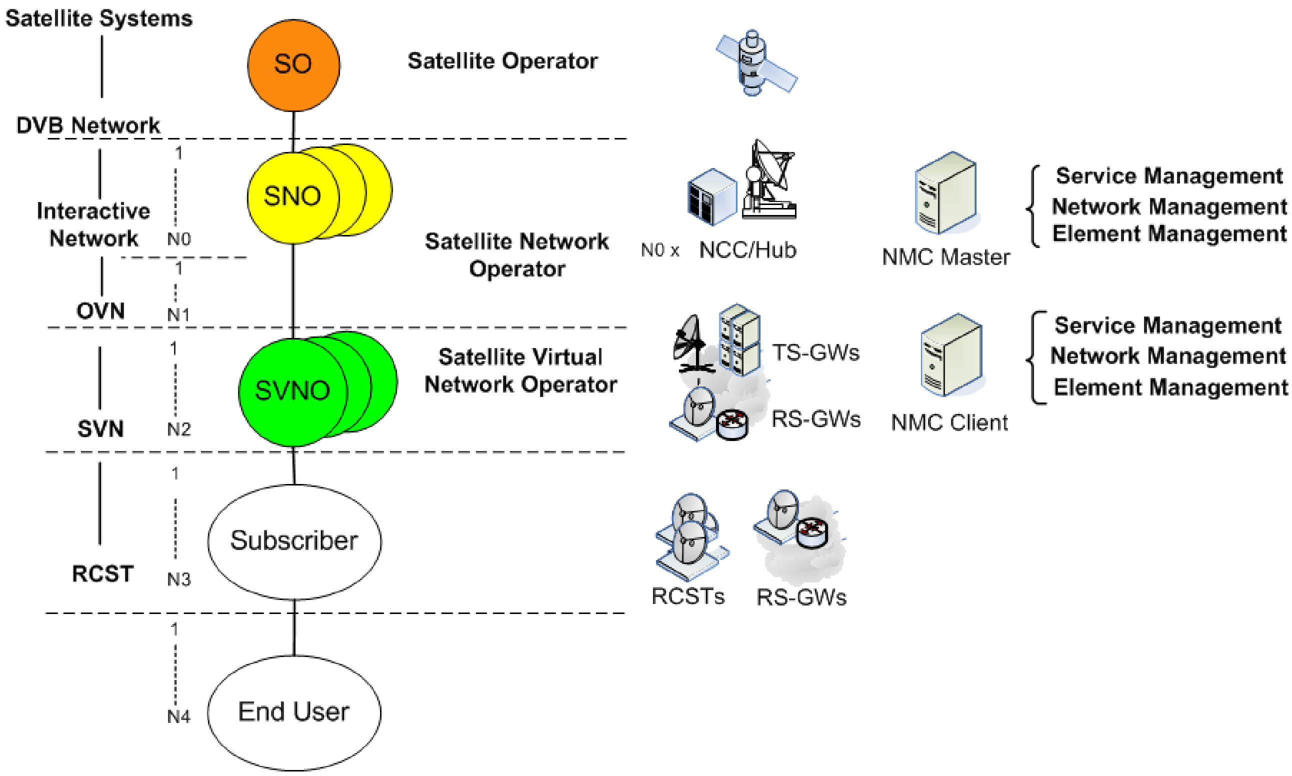


Figure 4.1: DVB-RCS2 actors and roles

- **The Satellite Operator** (SO) provides the satellite space segment and the satellite ground facility, consisting primarily of the Satellite Operating Centre. It owns and is responsible for maintaining, managing, deploying and operating the satellite and for all regulatory matters related to this operation. It sells capacity at transponder level to one or several SNOs.

NOTE 1: In a regenerative satellite system, the SO exchanges OBP configuration and status data with the SNO.

- **Satellite Network Operators (SNO)** are assigned one or more satellite transponders that they use to provide transmission and connectivity resources via the satellite system. The SNO operates in a DVB network, identified by an ONID. Each SNO controls its own capacity, owns at least one Hub/NCC and the NMC, and configures the time/frequency plan. Each IN is managed by the SNO (one DVB-RCS2 system). In the transparent architecture, the SNO controls the transparent gateway. The SNO may divide the interactive network into one or more **Operator Virtual Networks (OVN).** SNOs distribute their own physical and logical resources among OVNs. An OVN allows a defined subset of the RCSTs to form an RCS network that is independently controlled and managed by a Satellite Virtual Network Operator (SVNO). SVNOs are also called Service Providers, or SPs. Each SVNO will manage one or several OVNs. Some examples of SPs are an ISP, Telco or VPN SP. System physical resources are distributed among OVNs. The OVN is the base of the contract between the SNO and the SVNO.

NOTE 2: For the regenerative systems, there is a master SNO, controlling the Network Operation Centre (for OBP configuration), and secondary SNOs. The master SNO does not necessary use a single NCC/NMC.

- **Satellite Virtual Network Operators (SVNO)**, are assigned one or more Operator Virtual Networks (OVN)/ Each OVN is given some physical (e.g. peak and guaranteed kbps or frequency bandwidth, depending on the system definition) and logical (e.g. one Group_ID, a set of SVN numbers) resources. An active RCST can only be a member of one OVN. This is assigned at logon to the RCS 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. In a regenerative architecture, a SVNO may also manage one or several GWs.

- A subscriber is connected to the network via an RCST, with the service provided by one SVNO. Although an RCST may belong to only one OVN, it may participate in several SVNs, associated to the same SVNO.

- End-users are the physical person(s) or entity (e.g. application) that use(s) the subscribed satellite services. They use the RCSTs or hosts connected to the RCST LAN interface.

The RCST determines the ONID and INID from the Forward Link acquisition. They are indirectly determined by the start-up Forward Link and the population_Id, configured in advance in the RCST. The RCST understands the combination of {ONID, INID} as the SNO domain.

NOTE 3: A combination of {ONID, INID} identifies the network as an administrative entity to the RCST and thus implicitly, the SNO domain.

The NMC may exist as two principally types in a network, one used by the SNO and one used by the SVNO. The SVNO may have a back end connection to the SNO NMC.

One single terminal may be managed concurrently by one SNO and one SVNO. This applies to the consumer, corporate, SCADA, backhaul and Institutional.. This terminal belongs to the end user that assumes its cost. This subscriber will have one service package with the SNO or SVNO.

A multi-dwelling Satellite Terminal comprises multiple subscribers at a single location that share the terminal to access satellite broadband services. These subscribers belong to different domains or organizations differentiated by IP addressing. The RCST does not belong to one specific end user but to the SVNO. The service packages available to the residents of the multi-dwelling terminal are generally the same as those offered to typical consumers.

4.2 Higher Layer functional modules

Each RCST belongs to one RCS Interactive Network. The RCS Interactive Network complies the organization of the ISO/OSI protocol stack with protocol layers grouped into three layers:

- Physical layer (L1), specified by the DVB-RCS2 Lower Layer Specification
- Link layer (L2), partially specified by the DVB-RCS2 Lower Layer Specification
- Network layer and above (L3+), the main focus of this specification.

The RCS Interactive Network is further organized in three planes:

- User-plane (U-plane)
- Control-plane (C-plane)
- Management-plane (M-plane)

RCS functional modules can be logically placed in one or more of the three protocol layers (PHY, L2, L3+), and in one of the planes (U-, C, M-plane) as represented in figure 4.2.

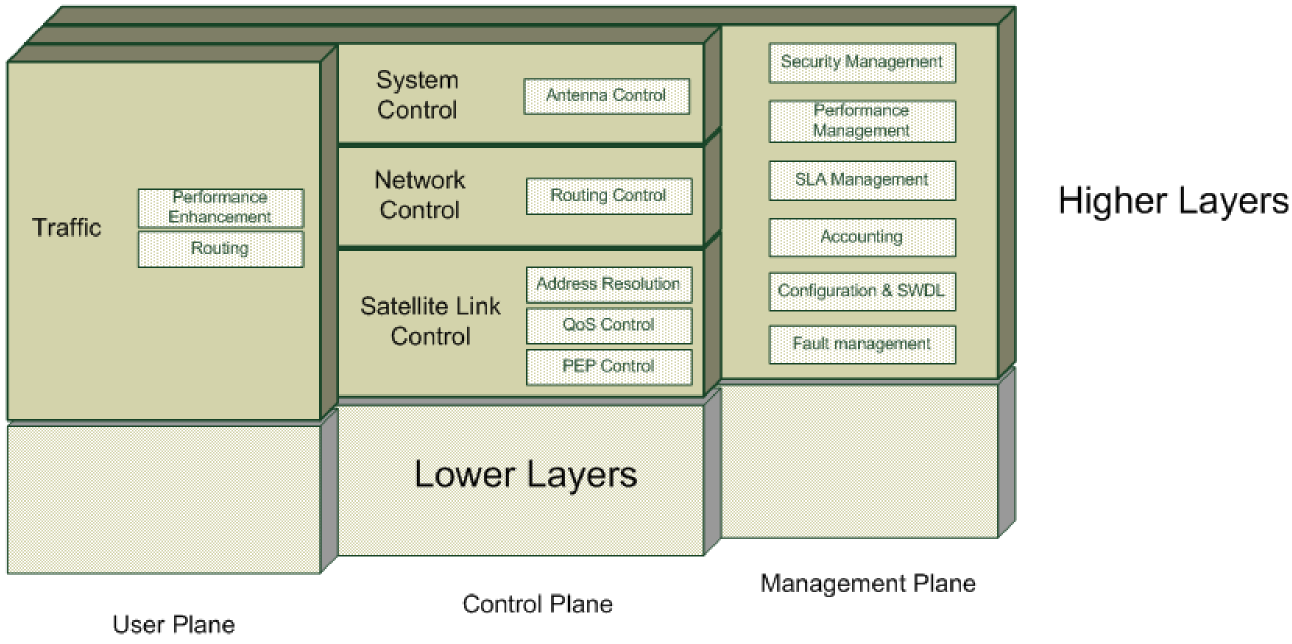


Figure 4.2: Higher layers functional modules

Figure 4.2 shows a simplified model that identifies the higher layer components and associates each with the corresponding plane. The present document defines link-layer functions relating to the operation of the network as a whole, other link layer functions are defined in [3] covering the full management plane. The main focus of the present document is the operation of protocols and networking functions at and above the network-layer.

All user plane functions of the interactive network for the present document, are performed in the DVB-RCS2 higher layers context.

4.3 Reference Architecture for Higher Layers

The RCST Higher Layers functional modules interface with:

- NCC Control and Monitoring Functions (CMF). This generates control and timing signals for the operation of the RCS Interactive Network. The signals are transmitted by one or several Feeders. The NCC is the central entity that supports signalling via the Lower Layer Signalling (L2S) as specified in [2].
- NMC management functions for Fault, Configuration, Accounting, Performance, Security (FCAPS) management. It transmits management signals using a Feeder.
- A set of one or more RCSTs that provide user traffic in star or mesh connectivity to end users.

The management functions performed in the NMC supports the interface with an OSS for business management functions.

The DVB-RCS2 higher layers context covers the management and control functions that to be performed by an RCST at the higher layers, excluding the physical interfaces or transmission mechanisms covered in [3].

The reference architecture for the Higher Layers is represented in figure 4.3. The reference architecture is divided into three different planes. Each higher layer function can be mapped to one of these planes and in different elements as shown in the figure 4.3.

The RCST has two physical interfaces:

- Satellite interface
- LAN interface

An RCST satellite interface (layer 1) support several Link Interfaces (layer 2), that again may have a User and control Interface (Layer 3) and an RCST Management and Control Interface (layer 3+).

The RCST is associated with their higher layer traffic interface types:

- Satellite User and Control Interface
- Satellite RCST Management and Control Interface
- LAN User and Control Interface
- LAN RCST Management and Control Interface

The Hub shares the satellite interface with the RCST, and has also another physical interface, Back-end interface, the latter with Higher Layer Traffic Interfaces:

- Back-end User and Control Interface
- Back-end Entity Management and Control Interface

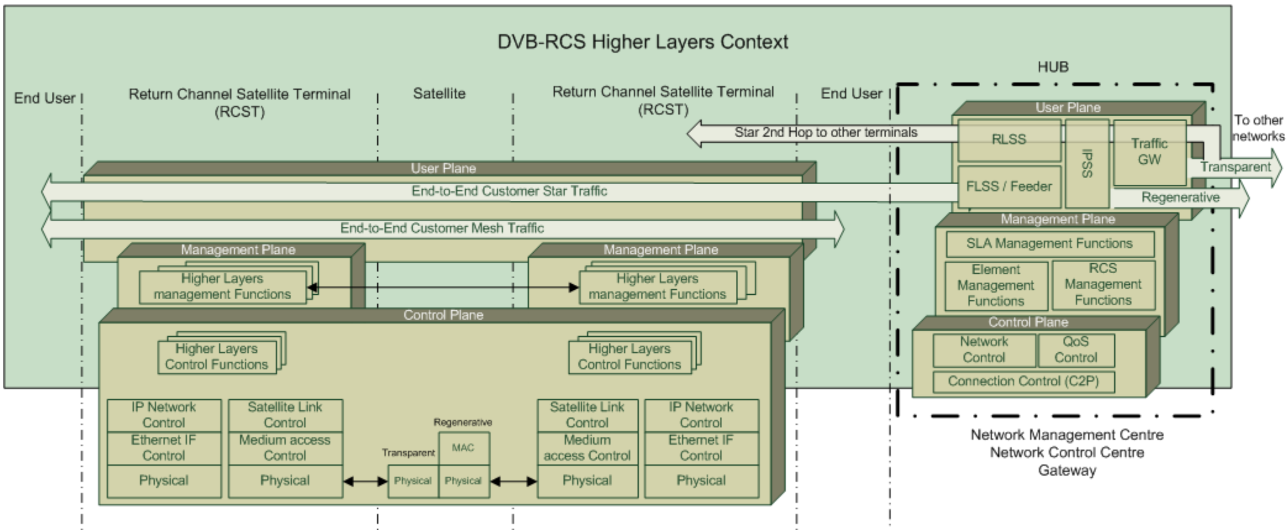


Figure 4.3: Elements functional architecture mapped in user, control and management planes

5 Operator Virtual Networks (OVN), SVNs and VRFs

This clause details administrative aspects of the RCST.

Each RCST shall be associated with a single OVN at logon. The OVN function operates in the management plane. It allows partitioning of the RCS network into independent and isolated sub-networks, where each sub-network comprises a set of network elements sharing a certain pool of resources.

An OVN is composed by one or more Satellite Virtual Networks (SVNs). An OVN consists of a managed routed IP address space. Multiple SVNs may be used to divide an IP network into multiple subnetworks, resembling the use of VLANs for controlling the scope of broadcast packets and logical separation of the user traffic. In addition, an OVN may use SVNs to control IP addressing through the Virtual Router Forwarding (VRF) function. An SNO or SVNO that wishes to independently assign a private address to an SVN must assign the SVN to a VRF group (i.e. this allows an SNO or SVNO to re-use the same private IP address range as used in other SVNs.

The RCST shall comply to the OVN addressing plan and routing information provided by the SNO or the SVNO.

A Virtual Routing Forwarding (VRF) Group has the following properties:

- When IP routing is used, the set of IP addresses must be coordinated within all SVNs that comprise a VRF group: each IP address shall uniquely identify a single IP interface. Address re-use (overlapping) is allowed for an address in the private IP address range (RFC 1918 [10]) or an IPv6 Unique Local Address, providing that the reuse is in a different VRF group.
- When MAC bridging is used, each VRF Group consists of a unique set of bridged layer 2 addresses.
- A VRF Group is normally assigned to one OVN. An OVN that supports multiple VRFs, allows an independent addressing plan in each VRF Group.

A multi-dwelling terminal shall support several SVNs, each one of them may correspond to a different Internet Service Provider. All these SVNs are controlled by the same SVNO and belong to the same OVN.

The complete addressing plan of each OVN includes:

- The set of SVN to be used and, assignment of each SVN to a VRF Group.
- The list of network addresses on the LAN Interface of each RCST assigned to an OVN.
- The default Gateway for each RCST (if any) and the list of Gateways that the RCST may access by following a certain criteria (e.g. traffic congestion, multicast capabilities, etc.)

The VRF of an RCST connects with the link interfaces (Layer 2) that supports user traffic.

6 Satellite Virtual Network (SVN) addressing

This clause provides an overview of the SVN addressing resolution required in the context of the HLS, in other words, the binding between the addresses used at layer 2 and the network layer interfaces, such as IP Multicast and Satellite Virtual Networks (SVNs).

6.1 SVN-MAC identifier

An RCST is uniquely identified within one SVN at layer 2 by a 3 byte SVN-MAC label. The SVN-MAC label equals the RCS-MAC of 24 bit length used in [2]. The value of the SVN mask indicates the number of bits in the SVN-MAC (from the most significant) that is interpreted as the SVN number, as shown in figure 6.1.

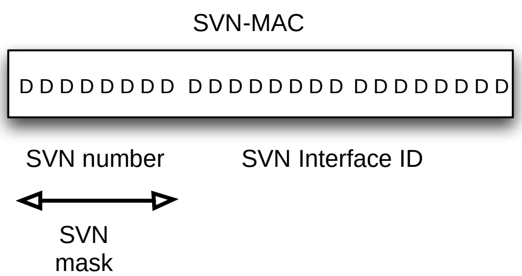


Figure 6.1: Relationship of SVN-MAC, SVN_mask, SVN number and SVN Interface ID

The SVN-MAC label is used for identification of the layer 2 destination in packets transmitted using the RCS Interactive Network.

6.2 IP unicast address resolution to SVN-MAC

A PDU sent using the return link in the star topology may carry an indication of the SVN, or suppress this and imply the SVN at the receiving Gateway. When the label is suppressed, the Gateway may utilise the TBTP2 to derive the RCST source address and knowledge that the traffic is directed to the gateway. The LLS can associate traffic with an SVN and provide transmission with neither a L2 source nor a destination address.

6.2.1 IPv4 address resolution for M and C SVN-MAC

The RCST shall be assigned one SVN-MAC label for management and control, as configured by the SNO during logon (see clause 8). SVN number zero is reserved for the SNO management and control in the OVN to which the RCST belongs. All RCSTs are therefore a member of the zero SVN.

PDUs received by an RCST with the assigned management SVN-MAC label shall be passed for host-processing by the RCST and passed to the control and management function within the higher layers.

A Gateway is able to identify M and C messages by the IPv4 address of the RCST, and therefore the SVN-MAC label needs not be sent on the return link, only the SVN number, since the LLS provides functions to identify the SVN.

The SNO-NMC connects via a management interface (SVN zero) that does not support a User and Control interface.

NOTE: Certain implementations may require the SVN-MAC label sent in the return link to easily identify the RCST for M and C.

6.2.2 Network address resolution to user traffic SVN-MAC

The RCST shall support at least one traffic interface, with a non-zero SVN. An SVNO may configure additional traffic interfaces by assigning additional SVN-MAC labels to an RCST that support this, also with a non-zero SVN. Each RCST traffic interface shall be identified by a SVN-MAC label, unique within the SNO forwarding link traffic multiplex. The SVN-MAC and SVN mask allows an RCST to identify the corresponding SVN number.

The SVNO-NMC connect via a management interface (SVN) that may support User and Control Interface.

NOTE 1: The SNO domain may use one or more multiplex streams. Each multiplex stream specification then indicates a forward link traffic multiplex for the RCS map service as specified in [3].

The RCST shall support SVNO management signalling using any assigned traffic SVN.

Within the OVN an RCST shall be assigned one or more IPv4 address corresponding to the configured SVN-MAC labels. The IPv4 address shall be unique within a VRF Group. In addition, the RCST shall allow the SVN-MAC interface to be assigned an IPv6 address and may support other network addresses.

NOTE 2: An RCST that is assigned multiple SVN-MAC labels corresponding to multiple traffic SVNs will normally also be assigned a separate IP address for each SVN-MAC (e.g. an IPv4 or IPv6 address). These addresses may be presented on separate physical LAN interfaces or separate VLAN sub-interfaces providing connectivity to multiple routed networks.

NOTE 3: The LLS includes mechanisms for SVN identification that allow it to suppress transmission of the SVN-MAC on a return link.

6.2.3 Multicast address resolution to a multicast SVN-MAC

The RCST shall support IP multicast addresses mapping to a SVN-MAC label using a mapping defined per SVN or via an explicit mapping indicated in the MMT2 signalling [2]. A multicast group shall be available to receivers in different SVNs using the shared address space as indicated in MMT2. The layer 2 mapping from an IP group destination address to a L2 SVN-MAC is specified in the LL [3]. This shall be performed using one of the two methods below:

- An implicit mapping based on a hash of the layer 3 network address to one of a range of SVN-MAC multicast labels.

This mapping is independent for each SVN. The SNO therefore defines the size of the mask for each SVN. It is important that multicast network addresses used in SVNs that belong to different VRF Groups may be identical but correspond to different multicast groups and need to be handled separately. This direct mapping is simple, but a restricted range of SVN-MAC addresses increases the risk of aliasing in which more than one independent layer 3 multicast group is mapped to the same layer 2 address. This mapping may be restricted to either IPv4 or IPv6. When both IPv4 and IPv6 are supported, the two sets of addresses may be mapped to the same block of SVN addresses. However this can also result in overlap between IPv4 and IPv6 multicast. This overlap between address ranges does not currently exist when utilising Ethernet and could have unwanted side-effects and the operator is therefore provided with flexibility to separate the two address spaces by utilising one bit in the SVN-MAC to indicate whether the mapping is for IPv4 and IPv6.

- An explicit mapping indicated in the MMT2 as defined in [2].

The MMT2 structure allows an RCST to differentiate aliasing for different network protocol address ranges e.g. so high rate streams e.g. this could allow a specific flow to be explicitly mapped to a layer 2 label. The simplest MMT contains one record per SVN that indicates the SVN-MAC range (i.e. mask size) that is to be used for mapping multicast traffic. This usage resembles the use with the direct mapping and would be functionally identical when the mask is configured to have the same length. The MMT2 may be used to support a network group that is accessible from more than one SVN and is mapped to a common SVN-MAC. In this particular case the SVN-MAC does not reside within the SVN for which the content will be received. The SNO is responsible for such system-wide co-ordination of the use of SVN-MACs. The MMT2 may also be used to support non-IP multicast services.

In addition, the RCST may use this third method:

- A mapping directly to a unicast SVN-MAC label assigned to an RCST.

In this case the RCST will unconditionally receive the multicast stream, and will perform any required filtering at the layer 3 interface, based on the contents of its IGMP/MLD group membership or PIM-SM forwarding state. This method shall be exclusive and must not be used when a multicast-mapped address is used. The group address must not be announced in the MMT2 for the SVN to which the SVN-MAC belongs. This rule is to prevent the packet being replicated and duplicate copies received by the same layer 3 interface.

These methods are specified for the IPv4, IPv6 and MAC address families, and may be used with any format. The choice of appropriate method depends on the goals of SVNO and SNO and shall be given at RCST logon following clause 9.

7 Network Layer Functions

The RCST network layer functions may comprise:

- **Methods to exchange L2 LAN information** - i.e. how LAN information is exchanged between an RCST and a Gateway to enable L2 packet forwarding.
- **Methods to exchange L3 routing information** - i.e. how dynamic routing information is exchanged between an RCST and a Gateway to enable IP packet forwarding.
- **Interface between the network layer to the satellite lower layer** - i.e. how to map network layer services to satellite lower layer services, such as QoS.

RCST support for bridging is an implementation dependent feature.

7.1 Network Interfaces and Forwarding

An RCST shall support the following forwarding modes:

- Layer 3 IPv4 user traffic packets forwarding
- Layer 3 IPv6 user traffic packets forwarding
- Dual stack IPv4/IPv6 forwarding

An RCST may support forwarding of the following types of PDUs:

- Layer 3 VLAN tag IP routing
- Layer 2 Ethernet Frames - when working in Bridge Mode: VLAN bridging or Ethernet bridging
- Layer 3 non-IP packets: MPLS bridging or X.25 bridging

The optional support is implementation dependent.

The RCST unicast IP packet forwarding function towards the LAN or satellite interface follows the procedure for typical packet processing outlined in figure 7.1.

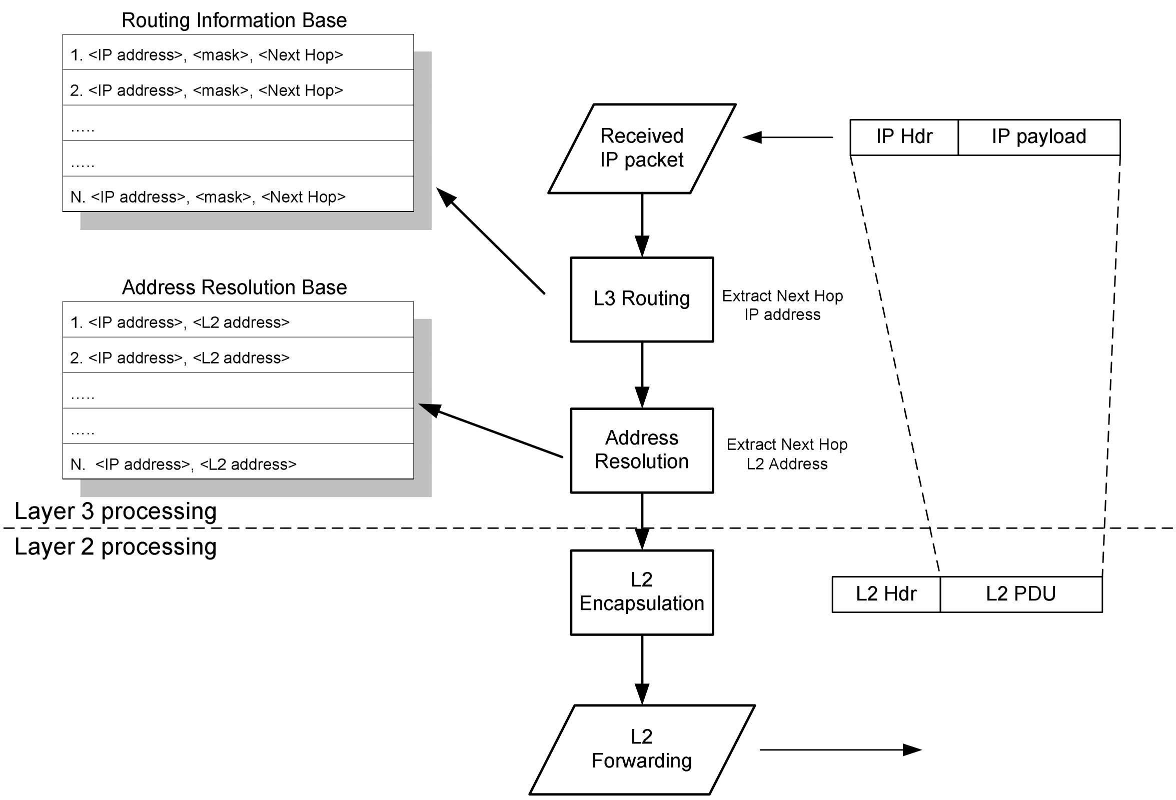


Figure 7.1: RCST Unicast IP packet forwarding

RCST IP packet forwarding comprises 5 main functions:

- **Routing Function (layer 3)**
  This function handles the generation and maintenance of a Routing Information Base, RIB. When the RIB is built, the information is used to select the appropriate next hop IP address corresponding to the IP destination address in the header of each processed packet, by performing a lookup of the destination address to find the best match entry. Support for dynamic routing is optional in an RCST, when supported, this function is responsible for detecting neighbouring routers and their reach ability to remote networks, and importing appropriate information to the RIB.

- **Address Resolution Function (layer 3)**
  This function receives the next hop IP address and looks this up in the address resolution (AR) database to determine the L2 next hop. It then queues the packet for the (sub) interface on which it will be sent.

- **QoS (layer 2/3)**
  This function manages the queue of packets awaiting transmission from L3 to a L2 next hop. It determines which packets are scheduled for transmission at L2. The function is described in (see clause 7.4).

- **Encapsulation Function (layer 2)**
  This function processes a queued IP packet, encapsulating this for transmission. In the encapsulation header this function sets the destination SVN-MAC (or a compressed form of this) to the destination address determined by the AR function. This method is specified in the Lower Layer Specification.

- **L2 Forwarding Function (layer 2)**
  This function is responsible for all L2 operations resulting in transmission of the encapsulated packet over the egress interface towards the L2 next hop.

  Forwarding for IPv4 on the satellite interface is required for core protocols, such as SNMP access by a SVNO to a SVN interface, PEP negotiation, Routing, etc. This support is required to support any network layer forwarding on the LAN Interface, even if IPv4 services are not supported on the LAN Interface

7.2 IPv4/IPv6 Interface to the link layer

The RCST IP processing function shall support:

- IPv4 only (RFC 1812 [8]).
- Dual stack IPv4 and IPv6 (hybrid IPv4/IPv6) (RFC 1812 [8]), (RFC 6204, [i.9]), (RFC 4241 [16]) and [i.6].
- IPv6 -only RFC 6204 [i.9], [i.6] except for SNO/SVNO management done over IPv4 (RFC 1812 [8]). In this case IPv4 is still required for the IP management interface.
- A Maximum Transmission Unit (MTU) of at least 1 500 bytes for each SVN interface, a larger value may be negotiated by the lower layers for each SVN [3].

7.2.1 IPv4 Interface to the Link Layer

The RCST IP processing function shall comply with the IPv4 interface to the lower layers. IPv4 (RFC 791[i.10]), (RFC 792 [i.11]) defines the IPv4 network-layer, this is the default network service provided by the present document. The requirements for hosts and routers using IPv4 are defined in (RFC 1122 [i.12]) and the router requirements are defined in RFC 1812 [8].

IPv4 packets received on the RCST LAN interface shall be forwarded according to the RCST IPv4 routing table (held in the RIB). Packets may also be redirected to an internal agent (e.g. PEP, intercepting proxy, etc.) for processing prior to transmission. Packets for transmission over the air interface are forwarded to the QoS module for transmission on the satellite interface. An RCST shall decrement the TTL field of packets that it forwards (RFC 1812 [8]) and shall not modify the DF field of an IPv4 packet that it forwards (RFC 791[i.10]).

IPv4 addresses are represented in the Domain Name System (DNS) using A records. The RCST shall support DNS as defined in RFC 1034 [i.60] and RFC 1035 [i.61]. The RCST shall also be able to perform DNS queries for these records.

The RCST IPv4 interface configuration shall be managed as given in clause 8.

7.2.2 IPv6 Interface to the Link Layer

The RCST IP processing function shall comply with the IPv6 interface to the lower layers. The base specification for IPv6 is defined in RFC 2460 [i.24]. The RCST shall support the node requirements defined in RFC 4294 [22] and superseded by ID.draft-ietf-6man-node-req-bis [i.6]. The RCST shall support ICMPv6 (RFC 4443[i.41]), DHCP (RFC 3315 [i.33]), Stateless Address Auto configuration (RFC 2462 [11]) and Neighbour Discovery (RFC 4861 [18]). If the RCST supports a MTU greater than 1 500 B on both the LAN and satellite interfaces, then Path MTU discovery shall be supported according to (RFC 1981 [20]).

IPv6 packets received on the LAN interface [i.25] of an RCST shall be forwarded according to the RCST IPv6 routing table (held in the RIB). Packets may also be redirected to an internal agent (e.g. PEP, intercepting proxy, etc) for processing prior to transmission. Packets for transmission over the air interface are forwarded to the QoS module for transmission over the satellite. An RCST shall decrement the IPv6 Hop Count Field of packets that it forwards.

The RCST shall manage IPv6 addresses (RFC 3513 [i.83]). IPv6 addresses are represented in the DNS using AAAA records. The use is defined in [9]. The RCST shall support DNS as defined in (RFC 3596 [i.85]) according to the best practice recommended in [15]. The RCST shall also be able to perform DNS queries for these records.

The RCST IPv6 interface configuration shall be managed as given in clause 8.

7.2.3 Network Address Translation (NAT / NAPT) (optional)

This clause defines optional support for NAT/NAPT for IPv4. It does not specify the use of an NAT/NAPT for IPv6 by an RCST.

An RCST that support the NAT/NAPT function, shall use the methods defined in (RFC 2663 [i.28]),(RFC 4787 [i.46]) for IPv4 for the following types: static, dynamic, port forwarding.

This RCST shall provide support for the NAT Behavioural Requirements for ICMP as defined by (RFC 5508 [i.52]). It shall provide Multicast support for NAT as defined in (RFC 5135[i.47]). It shall provide NAT/NAPT functions compatible with DNS Proxy functions as defined in (RFC 5625[i.54]).

If the RCST provides transport-specific NAT/NAPT functions, it shall provide these as defined for TCP (RFC 5382 [i.50]), UDP (RFC 4787 [i.46]), DCCP (RFC 5597 [i.53]) and SCTP (Draft-ietf-behave-sctpnat-05 [i.7]).

The RCST NAT/NAPT configuration shall be configured and managed as given in clause 8.

7.3 RCST Routing function

The RCST routing function shall enable the forwarding of both unicast and multicast traffic using the routing information stored in the routing table of the appropriate RCST Routing Information Base (RIB). The RCST shall allow the RIB to be populated with static routes via M and C functions and optionally using a dynamic routing protocol.

7.3.1 Overview of Routing

In a star topology, the default route will normally be the IP address of the Gateway within the IP network associated with an RCST. The RCST will be configured with the IP network addresses corresponding to active LAN interfaces, which will be added to the RIB. The RIB can additionally import routes to other networks reachable via its LAN interface(s).

The RCST RIB is consulted whenever an IP packet is received by the RCST on one of its ingress interfaces, to derive the next hop IP destination address corresponding to the IP destination address in forwarded IP packet. This in turn is used to identify the egress interface (L2 next hop). The RIB is used to construct an IP forwarding table to improve performance of the routing process.

In a star topology, the routing process at an RCST is simple, however, the Gateway (GW) needs to be configured with routes for the set of IP networks that are reachable via each RCST. For example, in figure 7.2 this requires the GW to not only forward packets to RCST addressed to network 1, but also packets addressed to the network connected via the router attached to network 1.

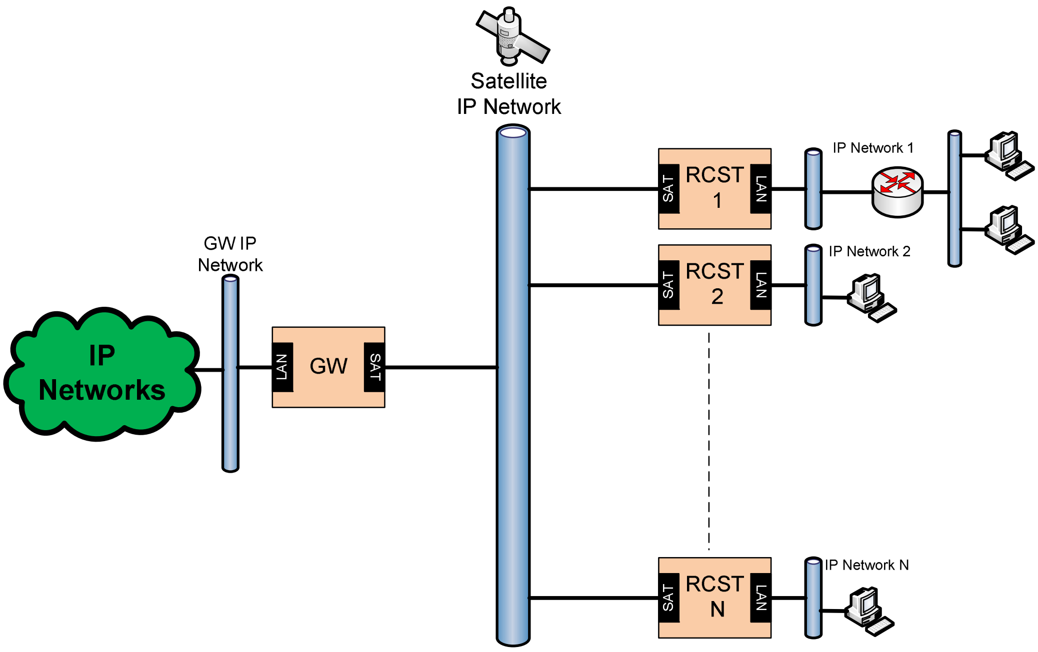


Figure 7.2: Example routing topology for a GW connecting N RCSTs

7.3.1.1 Overview of Dynamic Routing (optional)

An RCST can optionally support dynamic routing as specified in 7.3.1 and 7.3.1.1. This function is required for some system profiles.

Dynamic routing assists in managing the routing entries in the RIB for networks indirectly connected via an RCST. The dynamic routing protocol that may be used to import routing information to the RIB from a neighbouring router or to export routing information from the RIB to other neighbouring routers. This allows the path metrics to be recalculated when there is a change in the topology of the connected network, providing resilience to network link and/or router failure.

Figure 7.3 shows a set of routed networks connected to RCST 1. Dynamic routing allows changes in the topology of the attached networks to impact the forwarding of packets by an RCST and allows an RCST to propagate changes in the routing information to the Gateway Router, where it may change the routing within the satellite network (e.g. when a router attached to an RCST advertises reach ability to a network that was formally reached via a different RCST).

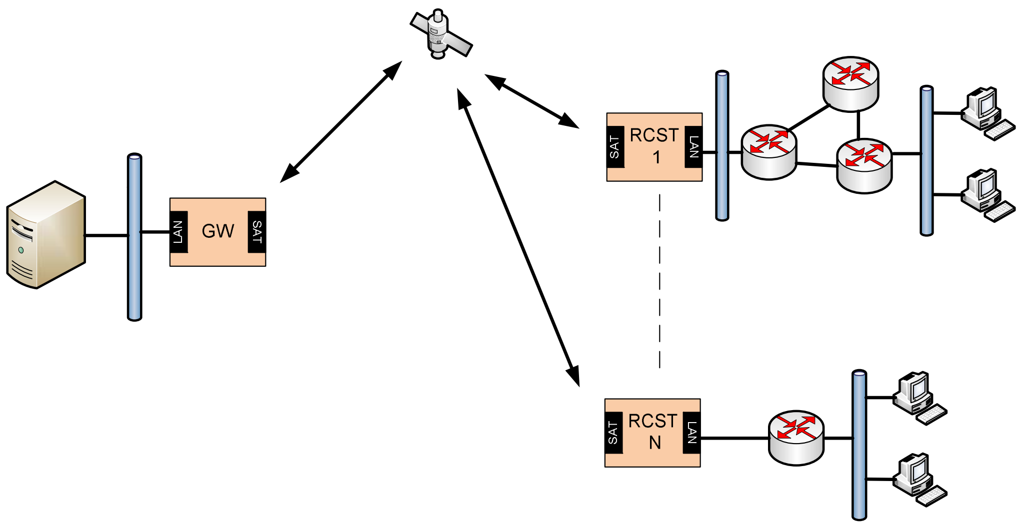


Figure 7.3: Multiple networks connected to an RCST

7.3.2 Routing

An RCST shall forward IP packets via the following IP traffic interfaces:

- **Satellite Interface -** One or more user traffic interfaces that connect the RCST to the satellite.
- **Management Interface -** A single IPv4 host interface used for RCST management and control.
- **LAN Interface -** One or more user traffic interfaces that connect the RCST to the LAN.

An RCST shall allow IPv4 and/or IPv6 to be configured for both the satellite and LAN user traffic interfaces.

The Gateway usually provides direct communication to all satellite IP networks. The RCST routing function shall be managed by the SNO and/or SVNO using the management interface, as defined in clause 8. The NMC is attached to the management network that provides connectivity to the management interface via the satellite.

7.3.3 VRF Groups

An RCST shall use a set of SVNs (i.e. related SVN-MAC addresses) that define one routable address domain for the higher layer processing. It shall maintain one routable address domain for each active address family (i.e. a RIB containing IPv4, IPv6, and the layer 2 forwarding table). To allow an RCST to support multiple routable address domains, an RCST may identify more than one Virtual Routing/Forwarding (VRF) group. Each VRF group shall define a routable address domain.

- An RCST that supports only one VRF group uses consistent IP addresses for all interfaces, including the management interface. The address reach ability information is stored in one single RIB. This is the default case.

- An RCST that supports more than one VRF group shall associate each VRF group with one RIB, a derived IP forwarding table (if used), and a set of interfaces that use the forwarding table. When dynamic routing is enabled for a VRF group, the RCST shall also provide one set of rules and one routing protocol instance for each VRF group (and possibly for each address family within a VRF group).

An RCST VRF group is identified as a combination of:

- A set of IP addresses with one routable address domain.
- One or more SVN-MAC (usually one).
- The OVN to which the VRF group belongs.

The RCST shall assign each SVN number to only one VRF group. All protocol data units exchanged within a VRF group must be unambiguously addressed by the higher layer address carried by the PDUs (e.g. IPv4 or IPv6 addresses). Within a VRF group, all IP addresses must be unique at Layer 3 and all bridged MAC addresses must be unique at Layer 2. This function resembles provider-provisioned Layer 3 Virtual Private Networks (RFC 4026 [i.38]). That is, within a VRF group, the set of SVNs may together use the full private addresses range, (plus any set of public IP addresses).

The RCST addressing plan information may include:

- The set of SVN to be used and assignment of each SVN to a VRF group (or the default VRF group).
- The list of network IPv4/IPv6 addresses per virtual LAN Interface.
- The IPv4 address of the RCST satellite interface for M and C signalling.
- The default route (e.g. gateway) for each RCST.

NOTE 1: An SVNO that wishes to independently assign a private IP address to an SVN must assign the SVN to a VRF group. For example, this allows an operator to re-use the same private IP address range in other parts of the Interactive Network).

NOTE 2: An RCST may support more than one IP network per SVN (e.g. in the case of dual stack IPv4 and IPv6 support).

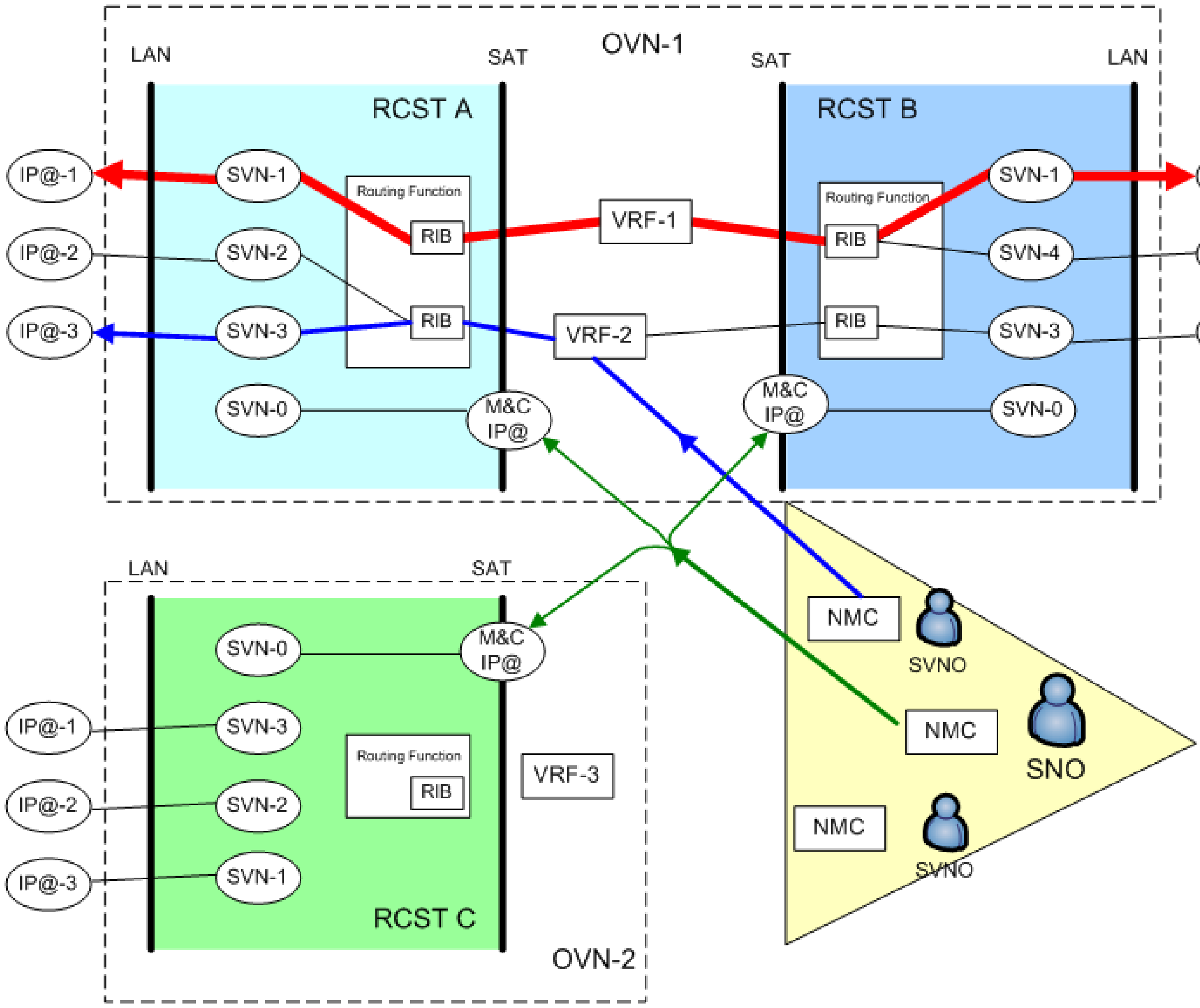


Figure 7.4: OVN, SVNs and VRFs domains

A bridged network can also utilise a VRF group, to ensure independent use of the MAC address space. This also supports situations where an operator wishes to allow the same MAC address to appear more than once within an interactive network.

The following examples illustrate the SVNO usage of VRF groups and multiple SVNs:

- An SVNO may use a single VRF group with one address space. Multiple SVNs may be used to segregate end user network traffic. This SVNO may allocate unique network addresses to each SVN-MAC that it supports. This addressing architecture could, for example, correspond to the assignment of globally routable IP addresses, or a single use of the private address space within the satellite interactive network.

- An SVNO may use multiple VRF groups. The SVNO is only required to allocate a network address that is unique within a VRF group. This addressing architecture allows the SVNO to assign customer networks to separate SVNs, each in a separate VRF group. In this case, the entire private address may be made available to each customer network. Routing between these address spaces would require NAT or NAPT to translate addresses between the VRF groups and also to/from the globally routed public Internet.

7.3.4 VLAN Support (optional)

The RCST may support Virtual LANS (VLANs) on the LAN interface to isolate the traffic belonging to one logical L2 network from a different logical L2 network.

When a LAN interface supports interpretation of an IEEE 802.1D [i.59] tag at the LAN ingress interface, the VLAN ID field in the tag shall denote the VLAN assigned to the frame. Untagged frames may be supported by an interface that also supports 802.1D format frames. These untagged frames shall be associated with a default VLAN ID. An RCST shall interpret a VLAN at the IP level as a subnetwork, with traffic from different VLANs being forwarded by an IP router via different subnet interfaces.

An RCST may be configured so that traffic received from the satellite interface may be transmitted on a LAN (sub) egress interface with a correspondingly configured VLAN tag.

In this mode IP routing is agnostic to the value of the VLAN tag (if any) associated with a LAN interface and the tag value is removed prior to transmission over the satellite interface. Therefore there is no implicit coordination of the VLAN-IDs used at the ingress and egress LAN interfaces.

7.3.4.1 VLAN tagged IP routing (optional)

An RCST may optionally support a mode that forwards an IP packet with an associated L2 IEEE 802.1D [i.59] tag, both from and to an RCST that operates as an IP router.

This mode permits a satellite network router to forward frames at the network layer (e.g. IPv4 or IPv6 routing) and simultaneously preserve the Ethernet Tag Control Identifier Field in 802.1D format across the satellite network, extracted from the MAC-layer header of each IP packet received on the ingress LAN interface. The Tag Control Identifier includes the L2 VLAN ID and Priority Code Point, PCP. This allows the received tag value to be re-inserted at the egress LAN interface when the packet leaves the satellite network.

When the routing function forwards an IP packet over the satellite interface in this mode, the Ethernet Tag Control Identifier Field shall be forwarded by including a tag extension header placed directly before the IP network header. The presence of this extension header is indicated by the Protocol Type value 0x8100. In this mode, the extension header is not preceded by the 6 byte MAC addresses on the satellite interface as it is on the LAN Interface. This encapsulation format can be used with GSE and with the Return Link encapsulation. The Return Link encapsulation may alternatively use a compressed type value (LLS) (0x0F or 0x31). The latter value indicates omission of the Protocol Type field from the 802.1D format, requiring the receiver to synthesize it before submission to the egress LAN (e.g. based on the version field carried in the first byte of the IP header).

An RCST in this mode shall also support forwarding of untagged IP packets by the IP router (i.e. an IP packet received at the LAN ingress without IEEE 802.1D [i.59] tag). These packets shall be forwarded without a tag extension header, using the routing method described in clause 7.3.5.

An RCST shall not forward IP packets with a L2 broadcast address using this mode. IP packets sent with a L2 broadcast address (e.g. DHCP Request messages) are processed by the local router, as are packets directed to the IP address of a router interface (e.g. ICMP, routing), as in clause 7.3.5.

This option does not forward the content of Ethernet frames that do not directly encapsulate IP packets, i.e. Frames with a Protocol Type value of 0x8100, but with other content than IP.

An RCST that is configured to assign values to a VLAN tag on transmission using the LAN interface shall perform this mapping for all traffic, including any packets forwarded with this tag extension header. When the IEEE 802.1D [i.59] tag assignment is configured, the RCST shall set the transmitted Ethernet Tag Control Identifier Field based on the router/interface configuration (e.g. by mapping the DSCP). This overrides then an Ethernet Tag Control Identifier Field transported over the satellite interface (this tag could have been dropped at the satellite network ingress).

NOTE: When an RCST uses this mode, VLAN IDs will be transported to the gateway from the ingress LAN. Correct operation will rely upon consistent handling of the VLAN IDs associated with packets from multiple RCSTs. This has implications on the configuration of network protocols at the gateway, such as OSPF, and this may require use of traffic separation techniques such as use of VRF groups, VLAN tags, or provider backbone bridges at the gateway.

7.3.5 IPv4 Static Unicast Route Configuration

The RCST IP routing function shall be able to receive IPv4 static routing information from the SNO or the SVNO for each active SVN through the satellite interface. This information is used to populate the RIB.

The IPv4 static routing information comprises a set of route entries. Each route entry shall include the following fields specified in the IP forwarding table MIB as given in (RFC 4292 [i.39]). This information is a part of the RCST configuration for the VRF group associated with one or more SVNs and shall be managed as defined in clause 8.

7.3.6 IPv4 Dynamic Routing Configuration (Optional)

The RCST may optionally support a dynamic IPv4 routing protocol either by routing interactions though a satellite or LAN interface.

When dynamic routing is supported and enabled, the received routing information is used along with configuration information to populate the RCST RIB with IPv4 information. If this function is not enabled, the RCST shall discard all IP packets that carry routing protocol messages.

An RCST that provides the dynamic routing function for IPv4 on the LAN interface shall support OSPF (RFC 2328 [i.18]). It may also be configured to support other routing protocols such as RIPv2 (RFC 2453 [i.23]), IS-IS (RFC 1142 [i.13]).

The RCST OSPF function shall start as soon as there is IP connectivity via a user traffic interface across the SVN network. In star transparent scenarios, the RCST OSPF configuration shall indicate that the Gateway is the OSPF Designated Router (DR) for the satellite IP network.

NOTE: The DR must filter this routing information according to its assigned addressing plan (that is, it should only import routes that are consistent with the addressing using within the SVN/OVN assigned to the RCST within a single VRF group).

7.3.7 IPv4 Multicast

The RCST shall support the use of IPv4 multicast forwarding of traffic (RFC 1112 [19] from the satellite interface to the LAN interface(s). It shall also support IPv4 multicast forwarding of traffic from the LAN interface to the satellite interface(s), transported to the GW. This includes Administratively Scoped Multicast (RFC 2365 [i.22]) and Source-Specific Multicast (RFC 4607 [i.44], RFC 4608 [i.45]).

In IPv4, the Internet Group Management Protocol (IGMP) is used to discover multicast listeners (hosts that wish to receive multicast packets destined for specific multicast addresses) on directly attached links, include the RCST LAN interfaces.

The RCST IPv4 multicast functions:

- shall support satellite IPv4 multicast forwarding (multicast reception), being enabled / disabled by configuration (see clause 8);
- shall support static multicast configuration, as describes in clause 8;
- shall support IGMPv2 (RFC 2236 [i.17]) on each LAN interface;
- may also support IGMPv3 (RFC 3376 [i.34]) or IGMPv3 Lite RFC 5790 [i.98] on each LAN interface;
- shall support IPv4 multicast transmission enable / disable by configuration (see clause 8);
- may optionally support IPv4 multicast routing using PIM-SM (RFC 4601[i.43]) on a LAN interface configured by management (see clause 8);
- an RCST that supports dynamic multicast management may also support a dynamic multicast routing protocol on the LAN interface. In this case, the RCST shall support Protocol Independent Multicast (PIM) in the sparse mode (RFC 4601[i.43]) as the multicast routing protocol and shall provide methods to manage a Multicast RIB (MRIB).

7.3.8 IPv6 static unicast route configuration

The RCST IP routing function shall be able to receive IPv6 static routing information from the SNO or the SVNO for each active SVN through the satellite interface. This information is used to populate the RIB with IPv6 information.

The IPv4 static routing information comprises a set of route entries. Each route entry shall include the fields specified in the IP forwarding table MIB as given in (RFC 4292 [i.39]). This information is a part of the RCST configuration for the VRF group associated with one or more SVNs and shall be managed as defined in clause 8.

7.3.9 Dynamic IPv4 Multicast across satellite (Optional)

The RCST may optionally support dynamic IPv4 multicast membership across the satellite interface, this requires that RCST supports either an IGMP-Proxy Agent (RFC 4605 [17]) plus the adaptations required for the satellite environment as detailed in [7] or supports PIM-SM (RFC 4601[i.43]).

7.3.10 IPv6 Dynamic Routing Configuration (Optional)

The RCST may optionally support a dynamic IPv6 routing protocol either by routing interactions though a satellite or LAN interface.

When dynamic routing is supported and enabled, the received routing information is used along with configuration information to populate the RCST RIB with IPv6 information. If this function is not enabled, the RCST shall discard all IP packets that carry routing protocol messages.

An RCST that provides the dynamic routing function for IPv6 on the LAN interface shall support OSPF (RFC 5340 [i.49]).

Clause 7.3.6 provides information about the use of OSPF on the satellite interface.

7.3.11 IPv6 Multicast

The RCST shall support the use of IPv6 multicast forwarding of traffic from the satellite interface to the LAN interface(s). It shall also support IPv6 multicast forwarding of traffic from the LAN interface to the satellite interface(s), transported to the GW.

In IPv6 Multicast Listener Discovery (MLD, MLDv2 (RFC 3810 [i.37]), or MLDv2 lite (RFC 5790 [i.98]) protocol for IPv6 is used to discover multicast listeners (hosts that wish to receive multicast packets destined for specific multicast addresses) on directly attached links, include the RCST LAN interfaces.

The RCST IPv6 multicast functions:

- shall support satellite IPv6 multicast forwarding for the institutional RCST profile [2], and must support static multicast configuration for each active SVN. For the rest of RCST profiles, IPv6 multicast forwarding in the return channel is optional;
- shall support static multicast configuration, (see clause 8);
- shall support MLDv2 (RFC 3810 [i.37]) or MLDv2 Lite (RFC 5790 [i.98]) on each LAN interface;
- shall support IPv6 multicast transmission enable / disable by configuration, (see clause 8);
- may optionally support IPv6 multicast routing using PIM-SM (RFC 4601 [i.43]) on a LAN interface configured by management, (see clause 8);
- an RCST that supports dynamic multicast management may also support a dynamic multicast routing protocol on the LAN interface. In this case, the RCST shall support Protocol Independent Multicast (PIM) in the sparse mode (RFC 4601[i.43]) as the multicast routing protocol and shall provide methods to manage a Multicast RIB (MRIB);

The RCST IPv6 multicast routing configuration shall be configured and managed as given in clause 8.

7.3.12 Dynamic IPv6 Multicast across satellite (Optional)

The RCST may optionally support dynamic IPv6 multicast membership across the satellite interface, this requires that RCST supports either an MLD-Proxy Agent (RFC 4605 [17]) or supports PIM-SM (RFC 4601 [i.43]).

7.3.13 MPLS

Multi Protocol Label Switching (MPLS) is defined in (RFC 3031 [i.71]) and (RFC 4364 [i.96]). It operates at the boundary between L2 and L3, providing unidirectional connections known as Label Switched Paths (LSP). MPLS encapsulates IP and other traffic by adding an encapsulation header that includes an MPLS label. The use of the labels is controlled by one of the available techniques: LDP (RFC 5036 [i.97]), RSVP (RFC 2205 [i.16]), or BGP-4 (RFC 4271 [i.94]). The MPLS labels have only local significance at a specific interface. The set of IP packets that are forwarded over a given LSP belongs to the same Forwarding Equivalence Class (FEC), and should receive the same treatment by the network.

7.3.13.1 MPLS support in the RCST (Optional)

An RCST may optionally support IP-based transport of MPLS packets (RFC 4023 [i.91]) across the Operator Virtual Network. This transports MPLS signalling and data flows across the satellite interactive network. An RCST that supports this mode shall transparently forward IP packets with an IPv4 Protocol Number field or the IPv6 Next Header field set to 137. It shall assign MPLS packets with a specific FEC to a single HLS PHB group and HL service (RFC 3270 [i.72]). It may similarly forward IP packets that use the Generic Routing Encapsulation (RFC 2784 [i.70]) with a type of 0x8847 or 0x8848. In this mode, the RCST does not interact with the MPLS control plane.

An RCST connected to an MPLS network may also operate as a LSR (Label Switched Router) connected via the LAN interface to a standard LSR or LER. This requires MPLS signalling to be intercepted and processed by the RCST. It also requires an RCST to switch frames from/to the LAN Interface with a type of 0x8847 or 0x8848 (RFC 3031 [i.71]). These frames may be sent on the satellite interface using the standard type value or the compressed type of 0x13 or 0x14, corresponding respectively to 0x8847 and 0x8848. An RCST that supports this function may implement M and C functions that enhance measurement and control for the MPLS traffic (RFC 2702 [i.69]), allowing each LSP to be mapped to an appropriate HL service.

The RCST MPLS configuration shall be configured and managed as described in clause 8.

7.4 Quality of Service

The RCST shall support QoS mechanisms both at layer 2 and at layer 3. This clause describes the RCST QoS model in terms of QoS definitions and the RCST QoS cardinality model. The RCST QoS requirements will be composed by:

- QoS elements definitions
- RCST HL QoS model mapping to LL (cardinality diagram)
- RCST QoS classification functions

An RCST shall support traffic differentiation according to DiffServ (RFC 2474 [i.26], RFC 2475[i.27] RFC 3086 [i.30], RFC 3260 [i.32]) for differentiation of the traffic transmitted towards the satellite.

A host originating a flow may not provide explicit QoS signalling, but may use a session-layer protocol to co-ordinate the communication. A signalling proxy at the RCST may snoop these session layer control messages to infer a QoS requirement. The QoS is instead inferred from session characteristics such as the choice of codec (e.g. snooping SIP signalling for a VoIP call to determine the encoding rate chosen by an application or interception of a multimedia request using HTTP). Intercepting proxies are described in clause 9.

7.4.1 RCST Higher Layer QoS Model

The RCST QoS function applies to all the user traffic in the same connectivity aggregate that must be transmitted sharing a common transmission channel. The mapping of user traffic to a connectivity aggregate is responsibility of the forwarding and routing functions for the RCST.

Figure 7.5 illustrates relations between PDU aggregates and lower layer specific streams as these can be observed externally. The essential control entities are also shown.

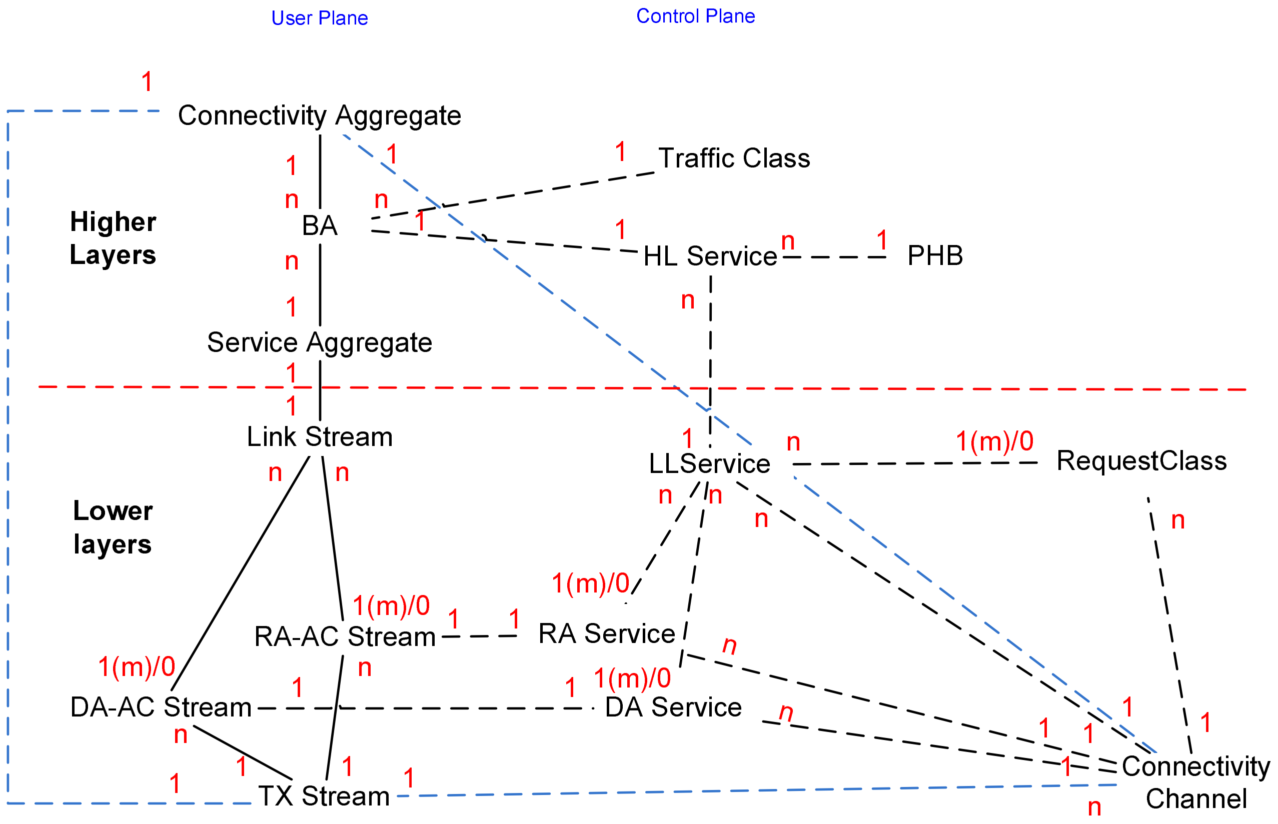


Figure 7.5: RCST QoS Control and Traffic model

Explanatory notes:

An RCST IP forwarding and routing function decide if a packet is destined for the satellite interface and therefore will seek to determine the next hop for this packet. This determines the Connectivity Aggregate (CA).

Each next hop may constitute a separate connectivity, or several next hops may share common L1 connectivity (e.g. through a shared carrier), depending on the configured topology.

A Traffic Class (TC) association is determined for each packet. The combination of the TC association and the CA association determines the Behaviour Aggregate (BA) to which a HLPDU belongs. This associates the TC with an HL Service.

NOTE 1: Aggregates are collection of packets.

The HL service maps a BA to a Lower Layer Service, and the traffic associated with a BA forms all or part of a single SA.

The HL Service determines any traffic conditioning specified for a BA, the characteristics of queuing at the HLS, and the corresponding Service Aggregate (SA) and LL Service to respectively be used for transmission and resource request. It also relates also the BA to a Per Hop Behaviour [i.30]. The PHB characteristics the BA and may be used by network operators to build consistent behaviours within a DS domain.

A Lower Layer Service (LL Service) is configured by the Lower Layer Signalling (L2S) system maps to the default Connectivity Channel (CC). All components of an LL Service set up by the L2S map to this connectivity by default.

All satellite resources map to the default Connectivity Channel unless the implementation is specifically designed and configured to differentiate the mapping of resources to connectivity.

A BA is provided with one LL Service, and may utilize any DA Service and RA Service that is permitted to be used by the LL service, but cannot use another LL Service.

The Service Aggregate (SA) is the sequence of Higher Layer PDUs (HLPDU) sent via a Link Stream (LS). The SA sequence is a multiplex of HLPDUs of the different BAs that map to the same SA.

The Link Stream (LS) is the sequence of Payload-adapted PDUs (PPDUs) hold the sequence of HLPDUs for the associated SA and may be associated to a logical flow of RLE/GSE traffic packets from the RCST or NCC/GW into the satellite network. All packets from one Link Stream have the same level of Precedence/Priority for layer 2 scheduling. The PPDUs in an LS may be multiplexed with PPDUs that belong to another LS. PPDUs are individually sized to fit within the available unoccupied Frame PDU (FPDU) payload.

The Link Stream (LS) may map to any combination of RA-AC Streams and DA-AC Streams as allowed by the associated LL service.

The SA sequence is a multiplex of HLPDUs of the different BAs that map to the same SA.

The aggregation to SA and LS for BAs that share an LL Service is implementation dependent. This freedom applies generally to BAs that share the set of DA Services and RA Services.

NOTE 2: Ordering is the key service that needs to be known when mapping PHBs (i.e. all flows within a PHB group should preserve packet order).

An LL Service allows use of either one or more DA Services or one or more RA services, or a combination of such service types.

An LL service may support two types of channels, depending on the capacity assignment:

- Dedicated Assignment (DA), the allocation channel is allocated via DAMA and dedicated capacity categories.
- Random Access (RA) assignment, the allocation channel is accessed via Random Access.

On the air interface, capacity is allocated to an Allocation Channel. The NCC may use one or more allocation channels to assign capacity to an RCST. An Allocation Channel represents a portion of the return link capacity that is assigned to one or more Streams.

NOTE 3: Signalling channels to the NCC are identified by the allowed content type of the channel.

Implementations may use Allocation Channels (AC) to indicate specific connectivity or for QoS differentiation:

- The mapping of an RC to an Allocation Channel is indirectly defined by the mapping between the nominal Dedicated Access Allocation Channel (DA-AC) and the nominal RC in the LL service.
- When allocation channels are used for differentiating connectivity, they may correspond to RL/UL physical partitions associated with different destination downlinks.

Each RA service is implemented on a dedicated RA allocation channel with an RCST specific and some generic load control. As seen from an RCST there is a 1 to 1 relation between an RA service and RA allocation channel.

A BA maps to an RA-AC if the allowed LL Service includes the corresponding RA service.

Each DA service is implemented on a dedicated DA-AC allocation channel given as part of the RCST QoS configuration. As seen from an RCST there is a 1 to 1 relation between an DA service and DA allocation channel.

A BA maps to an DA-AC if the allowed LL Service includes the corresponding DA service.

The Higher Layers interact with a Request Class via the concept of the LL Service.

When an RCST makes a capacity request it includes a reference to RC in the request sent to the NCC. The corresponding allocations made by the NCC in the TBTP2 are assigned to a specific DA-AC identified by an Assignment_ID.

An LL Service that allows use of a nominal DA Service is assumed to provide access to a nominal Request Class (RC). A nominal RC is not relevant if the DA service is solely FCA based.

An implementation must be capable of forwarding BA traffic by requesting with the nominal RC, and feed the BA traffic to the nominal DA-AC. It may be assumed that requesting with the nominal RC will make the NCC provision the nominal DA-AC with resources. Traffic for a DA Service appears as FPDUs in a DA-AC Stream.

The DA service is established by the resource provisioning of the associated DA-AC, as controlled by the NCC.

An implementation may issue resource requests associated to other RCs than the nominal RC if allowed to do so by the LL Service associated to the BA with the corresponding traffic.

An implementation may forward BA traffic by other DA Services than the nominal if allowed in the LL Service configuration. Traffic may also be forwarded by other RA Services than the nominal if allowed in the LL Service configuration.

The RA Service is defined by the resources provided to the associated Random Access Allocation Channel (RA-AC) as controlled by the NCC, the RA Load Control parameters associated with this RA-AC and the current loading of the RA-AC by the RCST. Traffic for an RA Service appears as FPDUs in an RA-AC Stream.

An RCST shall assume that a nominal DA Service will/may be provisioned by the NCC as specified for the nominal RC associated the DA Service by an LL Service. The DA Service specification can then be inferred from the configuration of this RC.

An RCST is assumed capable of utilizing resources assigned by the NCC to a DA-AC in excess of the expectations inferred from capacity requests and indicated constant rate assignment.

An RCST supporting RA is assumed capable of utilizing resources dynamically and statically allocated to an RA-AC.

The DA-AC Streams and RA-AC Streams aggregate to a TX Stream that holds the whole SA, including all CAs, BAs and SAs.

The L2S Stream is not shown in the diagram. It relates to the DA-AC Stream, the RA-AC Stream and directly to the TX Stream. All lower layer control plane entities except the CC relate to the L2S Stream, as the CC is implicit from the L2S perspective.

An RCST may support multiple connectivity channels, but in the star transparent scenario the set of receivers is limited to only one, (the RCST and the gateway).

NOTE 4: The connectivity channel concept may allow future versions of the present document , to support dynamic creation of multiple connectivity channels. Future versions of the present document may also allow the NCC to assign a mesh connection to a connectivity channel or to assign multiple mesh destinations to a single connectivity channel.

7.4.2 RCST QoS Classification Functions

The RCST QoS classification function shall identify a microflow or an aggregate of microflows (traffic stream).

RCST QoS configuration shall be supported by:

- assignment of traffic to an HL Service (and hence associated with a PHB): a set of traffic filters linked to one HL service class;
- management of each HLS PDU Queue by the associated HL Service;
- separation of resource demand into the LL service (and hence the corresponding Request Class);
- assignment of traffic from a HLS PDU Queue to the corresponding LL service to meet the goals set by the HL Service.

The combination of connectivity and TC defines the mapping of traffic to an HL Service. A TC may be used in more than one connectivity, it may be related to the satellite interface. Each TC shall be mapped to one HL Service.

A BA is a collection of HLS PDUs sharing transmission policies. A BA may hold multiple link destinations when the Connectivity Channel supports this. Multiple BAs may share the same LL Service.

Table 7.1 lists the RCST QoS configuration items that shall be required in the RCST to ensure to correct QoS behaviour in the control and user plane.

Table 7.1: RCST Classification Functions

QoS configuration Item	RCST QoS function
TC mapping to BA	Definition of Traffic Classes based on a set of parameters defining filter masks/criteria and mapping of a TC into a BA and HL service as defined in the IP classification table.
HL Service mapping table	Configuration of HLS Service policies such as queuing, shaping, dropping and mapping to a PHB

The QoS behaviour of the RCST shall be defined by QoS configuration tables in the control plane. These tables are defined as the RCST QoS configuration as specified in clause 8.

In addition, the RCST QoS data is completed with LL services information that is provided at logon and shall be saved in the MIB only for supervision, not for configuration, as specified in clause 8.

The RCST shall support HLS PDU queues monitoring related to BA and HL services.

7.4.2.1 IP Classification Table

The IP Classification Table defines the traffic classification used in RCST for transmission on a satellite interface. It is configured in each RCST by management or a local interface (e.g. CLI or web interface) as defined in clause 8. The exact format of IP Classification Table is as provided in clause 8.

The classification of packets can be based on filter criteria / masks, including primarily layer 3 (IPv4 or IPv6) parameters (RFC 4594 [i.42], but also be based on some layer 2 parameters. Each PDU is classified and associated to a traffic class (TC). If no filter mask is matched the packet shall be discarded.

A TC may be implemented as a set of one or more traffic filter records. Each record matches a set of header fields in the packet/PDU. A simple traffic filter could match only the DSCP, whereas a more complex multi-field classifier classifies packets based on the contents of a pre-selected set of header fields. The TC for IP MicroFlows shall include at least the DSCP, anyhow the recommended minimum TC may include a combination of the IP source addresses, the IP destination addresses, the DSCP, the protocol type and the source and destination port values.

IP MicroFlows are classified according to the first filter matched in the IP Classification Table. This assigns the traffic to a specific HLS service. The selected HLS service may also assign implementation-dependent methods including metering, connection control and admission control.

The description of the IPClassEntry parameters of the IP classification table is described in Table 7.2.

Table 7.2: IP Classification table parameters

Classification Parameter	Description
IPClassIndex	Index of the Traffic Classification Table. Used to identify a packet type or flow type
IPClassDscpLow	Specifies the low value of a range of DSCP values to which a packet is compared. A value of 0 is used to inactivate
IPClassDscpHigh	Specifies the high value of a range of DSCP values to which a packet is compared. A value of 63 is used to inactivate
IPClassDscpMarkValue	Specifies the DSCP value used to mark (remark) a packet. Possible DSCP mark values are (0,63). A value of 64 indicates no DSCP marking
IPClassIPProtocol	Specifies the IP protocol to which a packet is compared (e.g. TCP, UDP, etc.)
IPClassIPSrcAddressType	Specifies the type of Internet source address type (IPv4 or IPv6)
IPClassIPSrcAddress	Specifies the Internet source address to which a packet is compared
IPClassIPSrcAddressPrefixLength	Specifies the number of bits of the Internet source address prefix
IPClassIPDstAddressType	Specified the Internet destination address type (IPv4 or IPv6)
IPClassIPDstAddress	Specifies the Internet destination address to which a packet is compared.
IPClassIPDstAddressPrefixLength	Specifies the number of bits in the Internet destination address prefix
IPClassSrcPortLow	Specifies the low range of the source port number to which a packet is compared
IPClassSrcPortHigh	Specifies the high range of the source port number to which a packet is compared
IPClassDstPortLow	Specifies the low range of the destination port number to which a packet is compared
IPClassDstPortHigh	Specifies the high range of the destination port number to which a packet is compared
IPClassVlanPri	Specifies the VLAN User Priority to which a packet is compared
IPClassHLSAssociation	Associates the filter entry to a specific HL service (by reference to a HL service index)
IPClassAction	Specifies if the packets mapped to this entry (flow type) can be transmitted to the satellite interface or should be discarded ("0": Permit; "1": Deny). The parameter can be related to a firewall function, used to avoid undesired incoming traffic

The IP Classification table maps a set of traffic filters to the associated HLS service to be used by a traffic class.

The IP Classification table shall be kept in the RCST MIB as specified in clause 8.

7.4.2.2 HLS Service Mapping Table

The HLS Service Mapping table records the mapping of a HLS service to a Service Aggregate and LL Service. It also links the HL Service to the associated PHB.

The set of PHBs supported by an RCST are managed by the SVNO. Each PHB is identified by a PHB_ID.

The associated parameters per HL service are summarized in the Table 7.3

The HLS mapping table shall be kept in the RCST MIB as specified in clause 8.

Table 7.3: HL service mapping table parameters

HL Service Parameter	Description
HLServiceIndex	Index value of the HL service
LLServiceAssociation	Associates the HL service to a specific LL service (by reference to a LL service index)
diffPolicyPHBindex	Associates the HL service to a specific DiffServ Policy PHB high-level "network wide" policy definitions (by a reference to a DiffServ Policy PHB index)
diffPolicyPHBname	PHB name associated to the PHB index
Priority	Nominal priority of the PDUs in the HL service aggregate
MinRate	Minimum level of resources available to the HL service aggregate
MaxRate	Maximum level of resources available to the HL service aggregate
MaxIngressBurst	Maximum burst of traffic that the HL service will take
MinIngressBurst	Minimum burst of traffic that the HL service will take
MaxEgressBurst	Maximum burst of traffic that the HL service will issue in excess of maximum long term rate
MaxDelay	Nominal maximum transit delay for a PDU of the HL service aggregate
SchedulingType	Packet ordering policy and packet drop policy - FIFO - LLQ - WFQ - WRED - Other
L3IfNumber	Link to layer 3 interface
MaxLatency	Minimum time to hold on to a PDU in the HL service aggregate before it may be discarded
LinkRetransmissionAllowed	Packet re-transmission allowed / not allowed

7.4.3 Dynamic Connectivity (informative)

Dynamic connectivity is an optional mechanism defined as the capability to establish, modify, or release links between RCSTs and gateways based upon events occurring on traffic/control or management level.

Dynamic connectivity is implicitly associated to lower layer connectivity. A certain Connectivity Channel could be link from one origin RCST or origin gateway to one or several RCST destination or gateway destination.

Additional types of satellite interactive networks that exceed the reference model star transparent can be built implementing dynamic connectivity in the form of:

- dynamically controlled connectivity via direct mesh link between RCSTs, through satellite on board conversion from MF-TDMA to one or more TDM carriers
- dynamically controlled connectivity via direct mesh links between RCSTs equipped with an MF-TDMA receiver, through the MF-TDMA interaction channel over a transparent satellite

Dynamic lower layer connectivity is mandatory in mesh networks, while dynamic connectivity at higher layers may be applied for access control to any network scenario.

Dynamic connectivity may be handled by a Connection Control Protocol (C2P), as described in annex E.

7.5 Network Control Functions

This clause describes network-layer control functions. These control functions are processed within the network layer of an RCST.

7.5.1 Internet Control Message Protocol (ICMP)

The RCST shall support ICMP on each IPv4 interface as defined in (RFC 792 [i.11]) or on each IPv6 interface as defined in (RFC 4433 [i.41]).

The RCST shall respond to an ICMP-Echo request received via the satellite interface to any of its configured IP Interfaces when sent using the SVN-MAC label for the IP Interface.

An RCST shall respond to an ICMP-Echo request received via the satellite interface to the broadcast subnet address of IP network for which it is configured, when this is received using the SVN-MAC identifier corresponding to the IP Interface.

An RCST shall not respond to an ICMP-Echo request sent to the management IP address via a LAN Interface (unless this VRF Group is explicitly made available on a dedicated LAN interface).

An RCST should respond to an ICMP-Echo request sent to any assigned traffic IP address via any LAN Interface.

An RCST shall not respond to any ICMP-Echo request sent with an IP multicast destination address.

7.5.2 Neighbour Discovery (ND)

An RCST that supports IPv6 shall support ND as a configurable option on each active LAN interface. Use of ND on the satellite air interface is not specified in the present document.

7.5.3 Dynamic Host Configuration

The Dynamic Host Configuration Protocol (DHCP) is defined in (RFC 2131 [i.15]). The DHCP automates network-parameter assignment to network devices connected to a LAN interface from one or more DHCP servers. DHCP makes it easy to add new network devices to a network.

An RCST may support DHCP as a configurable option on each LAN interface. This may be a DHCP client interface.

An RCST may support a DHCP server that provides dynamic, automatic or static leases of addresses using an active LAN interface. An RCST that provides an IPv4 DHCP server may support DHCP-Relay as a configurable option on each active LAN interface.

The extensions of DHCP for IPv6 (DHCPv6) are specified in (RFC 3315 [i.33]). An RCST that supports IPv6 shall support DHCPv6 as a configurable option on each active LAN interface. This may be a client interface, or may be a server providing dynamic, automatic or static leases of addresses.

An RCST that supports an IPv6 DHCP server may support DHCP-Relay as a configurable option on an active LAN interface.

7.6 Extensions for Adapting the PDU

As introduced in the System specification [2], the RCST shall support a forward link using the Generic Stream Encapsulation (GSE) [4] protocol exclusively, including for transport of signalling, except for the migration scenarios already stated in the System specification [2]. The RCST shall also comply to GSE additional extensions defined in (RFC 4326 [i.40]) and (RFC 5163 [i.48]). The RCST Return Link shall support MF-TDMA link using the Return Link Encapsulation (RLE) [3].

An RCST may receive a GSE PDU that includes one or more extensions headers that are added by a remote HLS module to a PDU payload.

The PDU queued in the HLS PDU Queue may include one or more extensions headers that are added by an HLS module to a PDU payload. These extensions headers are identified at the HLS level by a 16 bit identifier encoded according to [4], and formatted as defined in section 5 of (RFC 4326 [i.40]). These extension headers are communicated along with the PDU payload to the remote HLS entity at the Gateway, NCC, or RCST. These headers shall be processed according to the reception rules for GSE.

Extension headers correspond to one of two types:

- An Optional Extension Header has a pre-defined length that is encoded in the extension field. An Optional Extension Header does not modify the format or encoding of the enclosed PDU (i.e. it can only add a tag or additional information to a PDU). If the header codepoint is not recognised at the receiver, the optional information is silently discarded, and the remainder of the PDU is processed (including any remaining extension headers). Sender modules that introduce optional headers may also include a probing mechanism to ensure that the remote endpoint is able to process the header they provide.
- Each Mandatory Extension Header has a length that is not necessarily communicated in the extension field. No limit is placed on the maximum length of a Mandatory Extension Header. A Mandatory Extension Header can modify the format or encoding of the enclosed PDU (e.g. to perform encryption and/or compression). The term "mandatory" refers to the receiver processing action, and not to the required support for the option. If the header codepoint is not recognised at the receiver, the PDU is silently discarded. Sender modules that introduce mandatory headers are advised to include a probing mechanism to ensure that the remote endpoint is able to process the header they provide.

Using this method, several PDU extension headers can be chained in series. The sender at the RCS lower layers may also add extension headers that enhance the physical layer (such as headers to support packet FEC). These extension headers are also removed after processing by the corresponding lower layer receiver, before an encapsulated PDU is passed to the higher layers. (RFC 5163 [i.48]) provides guidance on the ordering of extension headers when multiple extension headers are used.

Reception of an encapsulated PDU with an unknown protocol feature shall result in discard of the enclosed PDU.

7.6.1 Header Compression

Operation of header compression is not specified in the current version of the present document.

7.6.2 Bulk Compression

While bulk compression is intended to be transparent, that is the output data stream is meant to be identical to the input data stream, there are also loosely compression methods that rely on transcoding to modify the data. This approach generally requires knowledge and is described further in the section on transcoding.

Operation of bulk compression is not specified in the current version of the present document.

8 Management signalling

This clause and subclauses are in the present document provided as a recommendation for guiding in aligning implementations of M and C, aiming at a future evolution towards normative status.

The following recommendations are intended to be partly superseded and partly supplemented by an implementation dependent RCST MIB ASN.1 specification and an implementation dependent RCST configuration file specification. The combination of the present document and these specifications, assumed provided for an implementation, are intended to be the basis for bilateral interoperability in the management plane over the satellite interface.

8.1 Management reference architecture

This clause describes the network management functionality associated with DVB-RCS2 network. The purpose is to establish the basic framework for RCS network to be seen as part of the TMN model of telecom network management to help the operators to configure and manage the RCS network in an easy way. For this reason, the main management interfaces, management protocols, information and syntax needs to be identified.

Three elements are identified in the RCS network for provisioning of the management functionalities in DVB-RCS:

- The Operation Support Systems (OSS): it includes the management functions that enable a Provider to monitor, control, analyze and manage systems, resources and services. It provides high level support and control interface to lower level management data from network elements. The OSS should provide the development of a flexible service integration framework, which eases the introduction of new Technologies and reduces the cost base.
- The Network Management Centre (NMC) of the OVN.
- The Network Elements (RCST, Gateways, NCC, OBP).

The OSS is located in the in the Telco or Service Provider premises. In both cases, the OSS shall obtain the management information of the RCS network through the OSS-NMC interface.

The OVN management functionality shall assure the interoperability among OVN elements from different vendors, and the seamless integration with other networks, Service Providers and OSS (see figure 8.1).

The NMC performs all management functions, namely system configuration, fault management, system performances management and accounting data retrieval (FCAPS functions). The NMC and NCC could either be directly connected through a LAN interface, or via IP connection over terrestrial backhaul networks.

The NCC is in charge of control activities, i.e. session control (terminal log-on and RCST synchronization maintenance), resources control (RRM and SLA enforcement) based on DAMA rules, and DVB-S2/DVB-RCS2 tables control (i.e. NCC to RCST signalling and vice-versa).

The NCC is composed by a NCC core server, responsible of the Network Control Function and optimally by a Mediation Device, which is the front-end of the NCC from the management point of view. The NCC may be fully redundant based on a hot redundancy scheme: in case the nominal NCC fails, control is automatically switched over the second redundant NCC. Both NCCs should have a synchronized connection with the NMC with no loss of data in case of switchover.

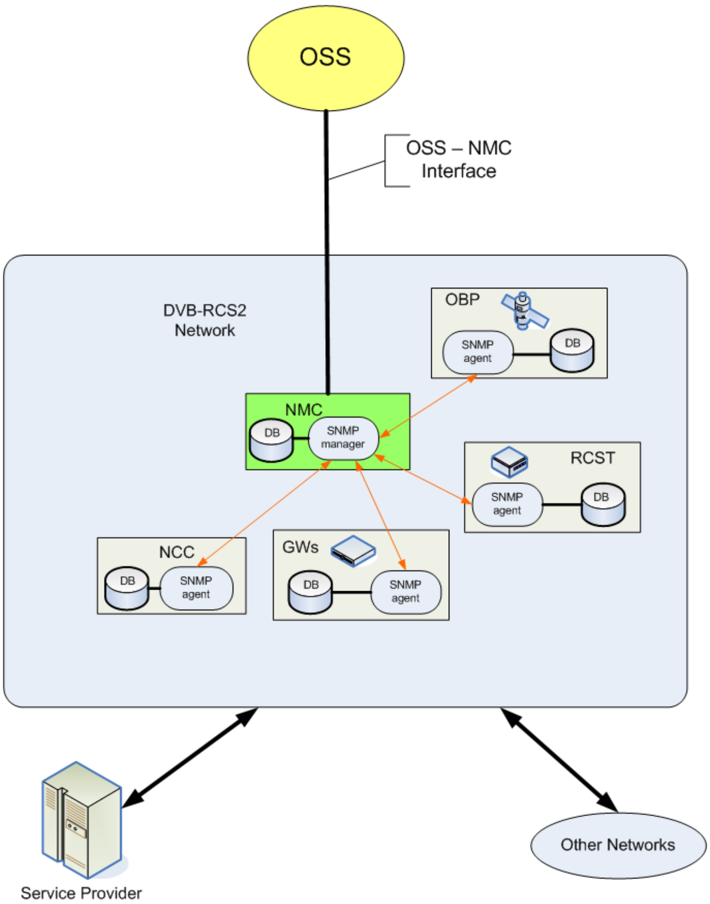


Figure 8.1: Management Reference Architecture

The management functionality of the OVN is divided in two environments:

- Internal management: covers the SNO and SVNO management functions towards the OVN and SVNs thanks to the NMC. The central manager is the NMC, which manages the following interactive satellite Network Elements (NEs):
  - RCSTs or satellite terminal.
  - Gateways that provide IP access to external networks.
  - NCC responsible of the control signalling and monitoring functions in real time over the Satellite Interactive Network to be transmitted by one or several Feeder Stations (DVB-RCS2-S).
  - NMC network devices.
  - OBP (On Board Processor) in mesh regenerative networks.
- OSS-NMC management (external): it compounds the NMC functionalities required to establish external management relationships with external management systems to the interactive satellite network. This relationship can be established by the SNO or SVNO.

The basic functionality of the NMC includes the manager of the elements of the network (RCST, GW, NCC). These functions shall support a SNMPv2c/SNMPv3 protocol and MIB data base (in the communication between NMC and network elements - Internal interface). The NMC is the SNMP manager and the RCST, NCC or Gateway are the SNMP agents. The NMC is extended to include Service and Network related management functions to provide an interface for an external OSS.

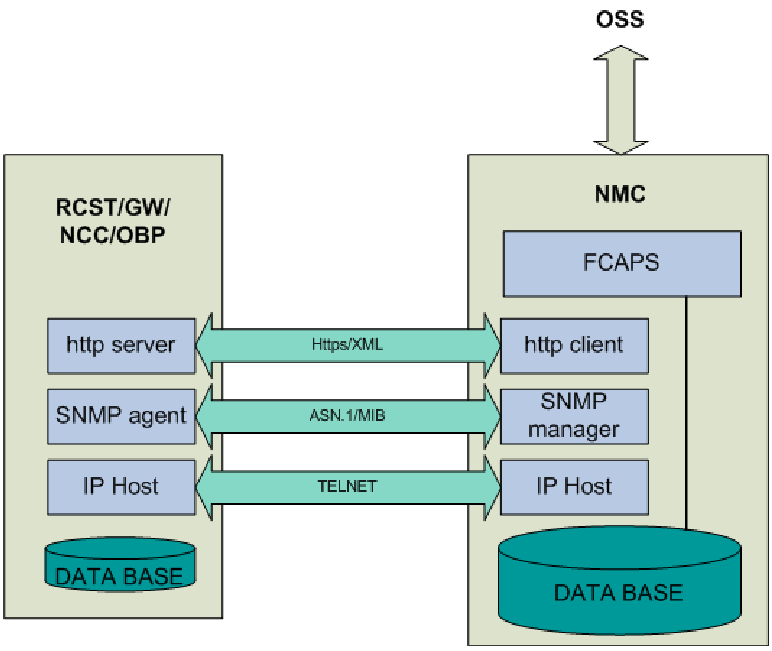


Figure 8.2: RCST - NMC management interactions

The NMC is the central entity that supports management signalling via IPv4.

In a multi SVNO environment, two types of NMC are considered:

- Primary NMC: this manages all the network elements of an interactive network. It is associated to the Satellite Network Operator (SNO).
- Secondary NMC: it is an instance of primary NMC associated to the Satellite Virtual Network Operator (SVNO). It can only manage the network elements associated to the SVNs of the SVNO using the IPv4 address allocated to the SVN interface.

The SVNO NMC or secondary NMC has a back-end connection to the SNO NMC or primary NMC. This connection could be provided via IP over terrestrial backhaul networks.

The NMC primary may support multiple SVNOs connections, allowing them to monitor their RCSTs and to down-load accounting data per SVN. A cold redundant equipment may be implemented in case of failure of the NMC primary. A common data base or synchronized data bases should be shared between the two NMCs in cold redundancy.

The NMC management functions specified follow the TMN framework of five-logical layers model:

- Business management.
- Service management:
- Network management.
- Element management.
- Network elements.

The NMC is specified in terms of the Service, Network and Element management layers. Business management is out of the scope for the present document. The Network element layer consists of the individual network elements, the RCSTs and gateways. The specification of the RCS network management aligns with the layers of the TMN models characterized by the FCAPS functions. They are characterized in the following subclauses.

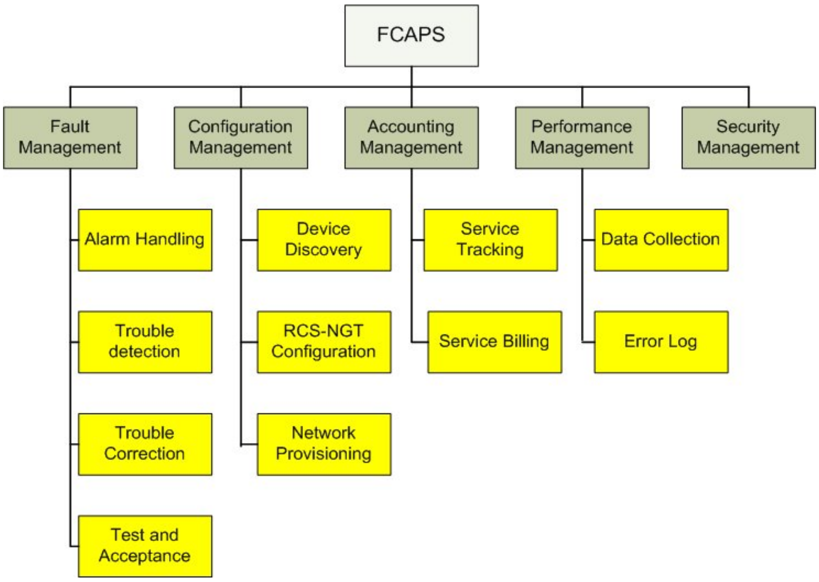


Figure 8.3: DVB-RCS2 FCAPS

One single terminal may be managed concurrently by one SNO and one SVNO. This applies to all RCST profiles.

In case of consumer, corporate, SCADA, backhaul and institutional the terminal belongs to the end user that assumes its cost. This subscriber will have one service package with the SNO or SVNO.

The multi-dwelling Satellite Terminal may comprise multiple subscribers at a single location that share the terminal to access satellite broadband services. None of these subscribers can afford the cost of the terminal. The terminal belongs to the SNO or SVNO. These subscribers have one different service package with the SNO or SVNO. The service packages available to the residents of the multi-dwelling terminal are generally similar to those offered to consumers. The SNO or SVNO should ensure each subscriber domain or organization differentiation based on VSNs.

A multi-dwelling terminal should support several SVNs, each one of them may correspond to a different subscriber. All these SVNs are controlled and managed by the same SVNO and belong to the same OVN. The SVNO and SNO should have the capability to assign each multi-dwelling RCST's SVN to a different subscriber and service package.

8.1.1 FCAPS

This clause defines the functional areas of network management in terms of FCAPS (Fault, Configuration, Accounting, Performance and Security) as applied to the management of an RCS2 network.

8.1.1.1 Fault management

Fault management seeks to identify, isolate, correct and record system faults. Fault identification relies on the ability to monitor and detect problems, such as error-detection events. RCS2 relies on SNMP notifications to deliver critical events that cause service interruption and need immediate response. Examples of these events are interface state up/down, and thresholds events when the total number of RCSTs in a fault condition exceeds a configured threshold.

8.1.1.2 Configuration management

Configuration management modifies the system configuration variables and collects configuration information for supervision. Configuration management is primarily concerned with network control via modifying operating parameters on network elements such as the RCST. Configuration parameters include both physical resources (e.g. interfaces) and logical objects (e.g. QoS parameters).

8.1.1.3 Accounting management

Accounting management includes collection of usage data and permits billing the customer based on the use of network resources. The NMC is the network element responsible for providing the usage statistics to support billing based on the RCST accounting data. Billing is out of the scope of the present document.

8.1.1.4 Performance management

Performance management includes collecting statistics of parameters such as frames lost at the MAC layer and number of codeword errors at the Physical layer.

SNMP polling is the mechanism used for collection mechanism for collection of RCST performance management statistics.

8.1.2 OSS – NMC interface

The OSS - NMC interface supports a comprehensive view of the network towards the SNO or external operators offering cost-effective management of the OVN.

The OSS - NMC interface provides the standard based management functions required in the NMC to interface with an OSS for efficient operation, administration, management and provisioning (OAMP and P) for day-to-day maintenance. The OSS - NMC interface allows the NMC FCAPS functionality integration with the OSS using an adaptation layer. These management functions should follow the interaction of processes defined by the eTOM.

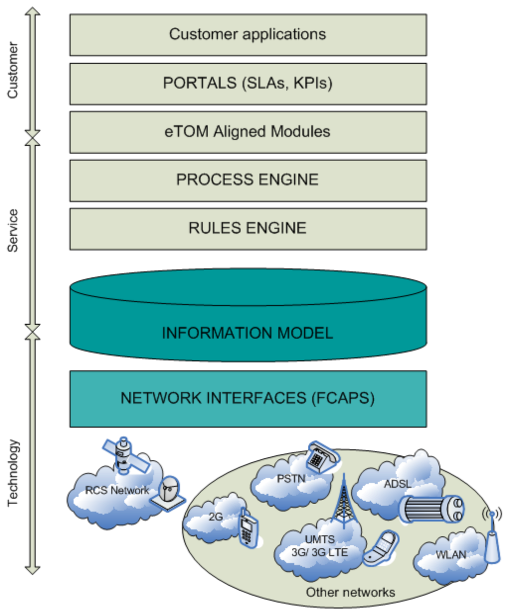


Figure 8.4: OSS-NMC management Interface

The NMC may use distributed SNMP-based management, offering a feature-rich management framework. The OSS-NMC interface may provide a database that stores the information with the status and service provisioning of the OVN. The information may be accessible via XML messaging of via MIB object model (RFC 1155 [i.62]) and SNMPv3 (RFC 2570 [i.67]),(RFC 2575 [i.68]) and (RFC 3416 [i.78]). Optionally, vendor specific solutions may be implemented.

The external OSS should access for the OVN management information related with service provisioning and SLA, fault, performance and accounting functions.

The OSS - NMC service provisioning application should keep:

- Network inventory management (full list of the network elements present)
- Service configuration and SLA data per OVN subscriber
- Status of the OVN elements based on the set of supported IETF MIB-II tables

The OSS - NMC fault management application should keep:

- Network events/faults detection from all the OVN elements
- Alarm data to a trouble ticket
- Alarm data to an SLA application

Faults are sent from the NMC to the OSS as SNMP notifications (traps).

The OSS - NMC accounting management should include collection of usage data based on a subscriber's use of network resources for billing.

The OSS - NMC performance management should include collection of parameters of performance monitoring data from the multiple vendors equipment across OVN. The data and statistics can be made available through collection of XML files via FTP or via NMC SNMP polling of the network elements and creation of a summary file per element per collection interval.

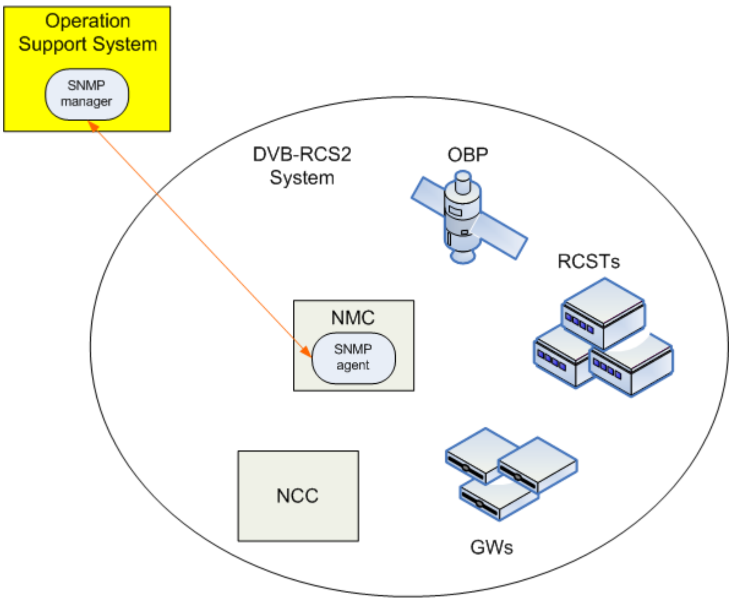


Figure 8.5: OSS-NMC management architecture

8.1.3 Subscriber accounting management interface

The specification of a Subscriber Account Management Interface (SAMI) enables prospective vendors to address the operational requirements of subscribers account management in a uniform and consistent manner. This enables operator and other interested parties to define, design, and develop Operations and Business Support Systems necessary for the commercial deployment of different class of services of DVB-RCS2, with accompanying usage-based billing of services for each individual subscriber.

Subscriber account management interface refers to the following business processes and terms:

- Class of Service Provisioning Processes, which are involved in the automatic and dynamic provisioning and enforcement of subscribed class of policy-based service level agreements (SLAs).
- Usage-Based Billing Processes, which are involved in the processing of bills based on services rendered to and consumed by paying subscribers. The present document focuses primarily on bandwidth-centric usage-based billing scenarios.

SAMIS uses the business model defined by IPDR streaming protocol (IPDR/SP Protocol Specification,Version 2.1 [i.8]) for the reliable and resource efficient transmission of accounting data. The IPDR Streaming Protocol enables efficient and reliable delivery of any data, mainly Data Records from Service Elements to any systems, such as mediation systems and BSS/OSS.

The IPDR approach is based on an object oriented modelling approach well known in the industry for capturing requirements and analyzing the data in a protocol independent representation. This approach defines requirements with use cases to describe the interactions between the operations support systems and the network element. The management information is represented in terms of objects along with their attributes and the interactions between these encapsulated objects (or also referred to as entities in some representations).

An RCS2 SAMIS IPDR record should be constructed from a number of attributes that describe the IPDR itself, the RCST that is serving the subscriber, and the QoS attributes and counters.

8.2 Management Protocol Stack

The basic management functionality consists of gathering of information about the state of electronic equipment from a remote location and the ability to control (read and write) this state remotely. It implies the use of a management protocol for the data exchange and use a unified set of tools with a common interface to help analysing and predicting problems so that remedial actions can be taken in a pro-active way.

The baseline Network Management protocol is SNMPv2c for consumer and SCADA profiles and SNMPv3 (RFC 2570 [i.67]),(RFC 2575 [i.68]) and (RFC 3416 [i.78]) for the other profiles.

The following means should be available for M and C of an RCST based on standard protocols:

- For RCST configuration, XML (XML11) format may be used (see clause 8.4).
- Optionally, other management protocols can complement SNMP. These protocols are:
  - SysLog (RFC 5424 [i.51]) (e.g. for trouble correction, performance monitoring, trouble detection)
  - Existing proprietary techniques including command-line-interface (CLI) or HTTP PUT/POST/GET messages

The following means are considered for M and C of an RCST based on standard protocols:

a) SNMP access via the NLID in L2S (custom tunnelling)

b) DHCP Option transmitted via L2S

c) SNMP access via UDP/IPv4

d) Configuration via XML file transferred by FTP/TCP/IPv4

e) M and C access via web browser and HTTP/TCP/IPv4

And the following may be available:

f) M and C access via web browser and HTTP/TCP/IPv6

g) ASCII instructions entered via the NLID in L2S (custom tunnelling)

The RCST Management protocol stack is illustrated by figures 8.6, 8.7 and 8.8:

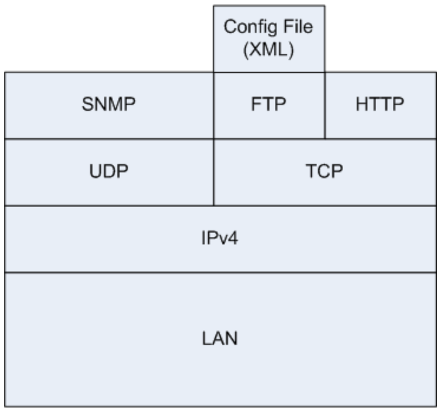


Figure 8.6: Protocol Stack for RCST management from the LAN interface

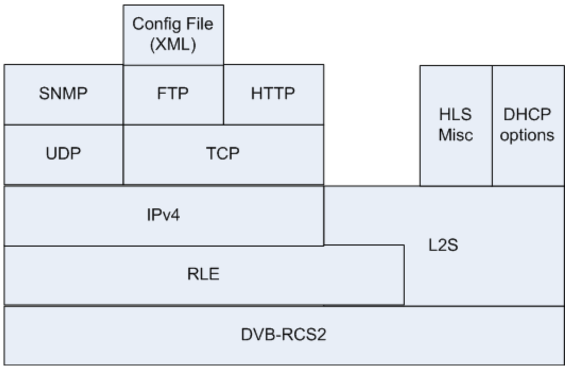
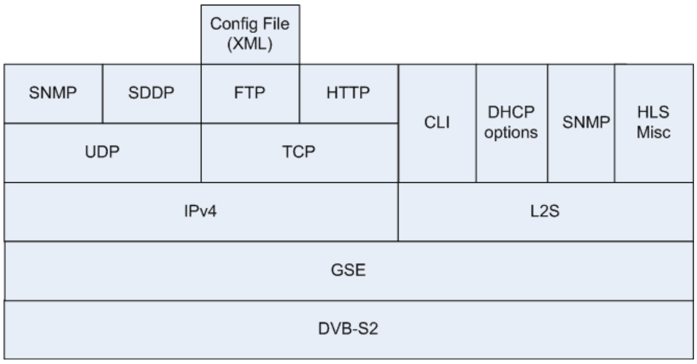


Figure 8.7: Protocol Stack for RCST satellite interface management (return link)



NOTE: HLS misc includes:
HL capabilities indication
Status flags for management
automated pointing alignment signals
SW version management

Figure 8.8: Protocol Stack for RCST remote management (forward link)

The IETF SNMP related RFCs are listed in table 8.1.

Table 8.1: SNMP IETF RFCs

RFC 3410 [i.73]	Introduction and applicability statements for Internet Standard Management Framework
RFC 3411 [i.35]	An architecture for describing Simple Network Management Protocol (SNMP)
RFC 3412 [i.74]	Simple Network Management Protocol (SNMP) Applications
RFC 3416 [i.78]	Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)
RFC 3414 [i.76]	User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
RFC 3417 [i.79]	Transport Mappings for the Simple Network Management Protocol (SNMP)
RFC 1157 [i.63]	A Simple Network Management Protocol
RFC 3418 [i.80]	Management Information Base for the Simple Network Management Protocol (SNMP)
RFC 3419 [i.81]	Textual Conventions for Transport Addresses
RFC 3584 [i.84]	Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework
RFC 3826 [i.88]	The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model
RFC 1901 [i.65]	Introduction to Community-based SNMPv2 (Informational)

For support of SIMv2, Table 8.1 lists the IETF SNMP-related RFCs which could be supported.

8.3 RCST Management Interfaces

Access to M and C functions may be discriminated according to interfaces, allowing to differentiate SNO, SVNO and user access to M and C.

The RCST M and C may be supported over the different interfaces as follows.

Table 8.2: Management protocols usage

	SNO/NCC	**SNO/NMC using RCST IPv4@ of SVN-0**	**SVNO/NMC using RCST IPv4@ of SVN-n (n>0)**	**LAN side manager using RCST IPv4@ from LAN interface**
Custom L2S as specified in LLS	According to LLS	Not required	Not required	Not required
NCC- flags/L2S	According to LLS	Not required	Not required	Not required
HL-Capability/L2S	Sent during logon with SVNO/NMC data	Sent to the RCST through the NCC during logon	Not required	Not required
HL-Initialize/L2S	Sent during logon with SNO/NMC data	Sent to the RCST through the NCC during logon	Not required	Not required
SNMP/NLID/L2S	Sent during logon with SNO/NMC data	Sent to the RCST through the NCC during logon	Sent to the RCST through the NCC	Not required
DHCP/L2S	Sent during logon with SVNO/NMC data	Not required	Sent to the RCST through the NCC with DHCP options per SVN-n	Not required
CLID/L2S	Implementation dependent	Implementation dependent	Not required	Not required
SNMP/UDP/IPv4	Not required	Allowed, mainly for supervision	Allowed, mainly for supervision	Only allowed for RCST installer
FTP/TCP/IPv4	Not required	Only for configuration/log file upload/download	Only for configuration/log file upload/download	Only allowed for RCST installer
HTTP/TCP/IPv4	Not required	Allowed	Allowed	Allowed with different access policies
SDDP/UDP/IPv4	Not required	Allowed for RCST SW download	Not required	Not required
SNMP/UDPIPv6	-	-	-	Only allowed for RCST installer

Support of M and C via SNMP/NLID/L2S may be required for bootstrap and other communication required supported when the IPv4 stack is not operational.

Only the SNO has access to this interface, via the NCC.

8.4 RCST configuration file management

The XML (XML11) format may be used for RCST configuration. It is recognised that an XML representation may be generated using ITU-T Recommendation X.693 [5].

NOTE: XML RCS configuration file requires the specification of object naming. As a first step ASCII representation will be used.

The following requirements apply for RCST configuration file management:

The RCST may, according to configuration, download over IPv4 using FTP a given configuration instruction file from a given location, as specified by the SNO/NMC via SNMP, and alternatively and optionally also as specified by other administrative means.
The RCST may be designed to accept a configuration instruction file that is not larger than 100 KB, and may accept a larger configuration instruction file.

The RCST may be able to store a minimum of one configuration instruction file for later to be taken into use, and may be able to store several.

The RCST assumes one of the stored configuration instruction files to hold the next configuration. Which configuration instruction file is considered next is implementation dependent.

The RCST takes the next configuration instruction file into use as instructed by the SNO/NMC. The RCST keeps its current configuration if there is no next configuration instruction file available.

The RCST may be able to process and effectuate configuration instructions provided by the NMC in a configuration file built from ASCII characters that are valid for configuration of the specific RCST.

The RCST may consider a configuration instruction file to be valid if all but the 4 last bytes hold ASCII characters of the valid range, and the last 4 bytes holds a valid CRC32 of the rest of the file content.

The RCST may accept a clear text CRC32 unless the RCST is administratively configured to only accept a de-scrambled CRC32.

The RCST may support implementation dependent de-scrambling of the configuration instruction file CRC32.

A claimed implementation of a standardized configurable object is expected to comply with the characteristics as specified for the standard object.

The RCST is expected to accept a file with a set of managed object configuration instructions that is consistent with the part of the current configuration of the RCST that is not being updated by the configuration instructions.

The RCST is expected to be capable of separating object configuration instructions that uses the delimitation rules that apply for the RCST implementation.

The RCST may silently discard a configuration instruction for a non-standard object.

The RCST may silently discard a configuration instruction exceeding the minimum configuration range for a standard object.

The RCST may silently discard a set of configuration instructions that is inconsistent with other configuration of the RCST that is not updated by the same configuration instruction file.

The RCST may accept configuration instruction for a standard managed object from a file also containing configuration instructions for non standard managed objects as long as all configuration instructions are delimited according to the rules that apply for the RCST.

The RCST may support at least Read-Only SNMP access to the current value of the standardised managed objects.

The RCST may provide a configuration file version number or a checksum if this is requested.

The version indicator of the configuration file is a Display String (RFC 1213 [i.64]). The file version will be contained in the file and its calculation is vendor specific. The following data objects may be used in the configuration update procedure:

- IP address of the TFTP/FTP server and path where the configuration file is located.
- Command to start the configuration download.
- Parameter to store the version of the downloaded configuration file.
- Command to activate the new configuration file.
- Parameter to store the version of the active configuration file.

The RCST configuration file parameters follow the same syntax as the parameters configured in the RCST MIB.

The configuration file remote download proceeds as follows:

1) Configuration update process may start anytime once the RCST has acquired the forward link and has performed a first log on.
2) The SNO will configure the FTP server IP address in the RCST.
3) The SNO will send a command for starting the download of the configuration file.
4) The RCST uses FTP and the above information to download the configuration file. Once downloaded, it validates the configuration file and checks the file version. Upon a successful validation and check, the RCST may update the parameter storing the last 'downloaded' configuration with the version of the file that was just downloaded.
5) The SNO will execute a command to activate the new configuration file at the desired time of activation (immediately following the download command or at a later time). In some RCST implementation, it may be required for the RCST to reboot in order to take into account the new configuration file (vendor specific). When the configuration file is activated, the RCST may update the object indicating the active configuration version of the activated configuration.

Full or delta configuration of common elements defined by the present document may be supported.

If there is a change done to the RCST configuration in advance of the activation of the file, this may superseded by the newly activated Configuration File.

8.5 RCST Software Delivery Download Management

When the RCST boots, it will first verify that the installed SW image is appropriate and will only then join the OVN (see the definition of the protocol for software upgrade in annex C).

The transition between software download and joining the OVN is vendor specific (a vendor may choose to perform a re-boot to achieve this).

8.5.1 RCST Software Delivery Download parameters

The basic parameters to perform the RCST software update are:

- Minimum SW version to operate in the System. This information is obtained from TIM-b through the Lowest Software Version descriptor. Lowest Software versions to operate in the interactive system are classified according to vendor OUI.
- Current software version executing at the terminal. The version is indicated to the NCC in the Logon burst (see [3]).
- Alternate software version (not the default for execution) stored in the RCST.

- Reboot command parameter. This variable may be used to force an RCST to reboot:
    1) idle
    2) normal = normal reboot (from current software load)
    3) alternate = reboot from alternate load (swap to alternate load before reboot)
- The IP information for downloading a software version that is being broadcasted/multicasted. This consists of the multicast IPv4 address and the UDP port that can be used to perform the Software download.
- A flag parameter to indicate to the RCST whether or not to ignore or not the SW version notified in TIM-b.

The RCST software update parameters may be kept in the RCST MIB and accessed by the SNO.

8.5.2 RCST Software Delivery Download procedure

The IP information to perform the SW download is taken from the Lowest Software Version descriptor that can be included in both TIM-b and TIM-u tables. Once RCST has acquired the forward channel, the RCST decodes this descriptor when included in the TIM-b, to execute a Software Upgrade procedure if the SW version of the RCST is lower that the indicated lowest software version broadcasted/multicasted, unless it has been configured to ignore broadcasted/multicasted Software updates.

The RCST does not need to download a new Software in case the lowest SW version indicated or a later version is already available.

At any moment, the SNO may force a Software change procedure on the RCST, using the Lowest Software Version descriptor included in the TIM-u. This applies for an upgrade or a downgrade, upon SNO discretion. In this case, the RCST may interrupt an ongoing software download operation.

The RCST may calculate an implementation dependent checksum of the downloaded Software image.

The software version field of the Logon burst is of size 8-bits, this cannot therefore be used to represent the exact software version. The value assigned in the CSC for a given software image is a vendor-specific. Vendors must publish a mapping table that relates the value reported in the CSC burst to the actual software version. The NCC should use the MAC address (in the CSC) to differentiate the reported software version for a specific vendor. In this way it may discriminate between two reported values from different vendors.

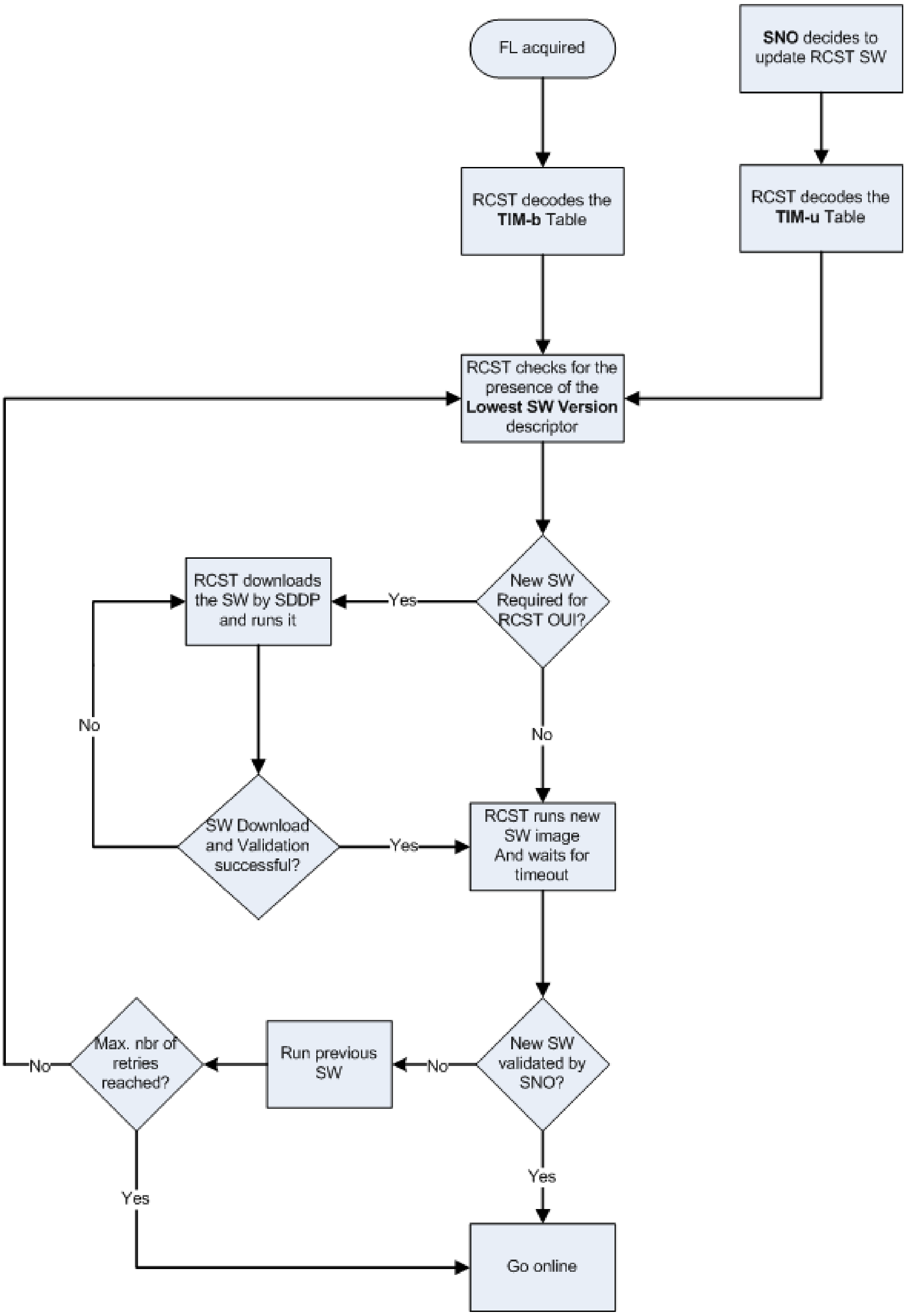


Figure 8.9: RCST SW check and download

8.6 RCST Managed Objects

The management information is a collection of managed objects residing in the different network elements and entities of DVB-RCS2 system.

Each RCST may support a MIB (Management Information Base) in line with the present document. The RCST MIB is the collection of managed objects residing in a virtual information store, and collections of related objects are defined in MIB modules.

The RCST MIB is written using ASN.1 and follows SMIv2 (RFC 1155 [i.62]).

Each managed object is expected to be specified with:

- the function applicable for the managed object
- impact of the managed object with respect to the applicable function
- parameter value type
- minimum value range for configuration
- default value
- persistence of configured value across reboot
- persistence of configured value across change of SNO domain
- persistence of configured value across an ordered reset to system faults (if this is applicable)
- mandatory or optional support over SNMP for interfacing a standard SNMP/IP based manager
- mandatory or optional support via ASCII based configuration instructions provided on file via FTP
- differences between SVNO and SNO management
- mandatory or optional support via HTTP for interfacing a standard web browser

The managed objects for support of RCST management are identified in the following clauses. Several sources are used to collect existing managed objects:

- MIB objects from RFC 5728 [i.55] located under the iso.org.dod.internet.mgnt.mib-2 branch. IANA has assigned transmission number 239
- MIB objects from MIB-II, sysObjectID from the system group of the mib-2 is used to provide an OID pointer to the vendor-specific RCS2 MIB
- Additional MIB modules which includes RCS2 vendor specific management information

The configuration of managed objects in the RCST may be supported either by SNMPv2c / SNMPv3 protocol and by configuration file. For most objects the latter is applicable.

The RCST may use the following tables to provide the desired SNMP Access:

- snmpCommunityTable (RFC 3584 [i.84]) for SNMP community configuration
- snmpTargetAddrTable (RFC 3413 [i.75])
- vacmAccessTable (RFC 3415 [i.77]): view access table configuration

The RCST may implement the MIB requirements in accordance to the present document regardless of the status of the object in the referenced source (e.g. deprecated or optional).

If not required by the present document, additional objects are optional.

The SNMP messages supported by the RCST are given in table 8.1.

Table 8.3: SNMP messages

Messages	Interface
get-request [MIB variable]	forward
get-next-request [MIB variable]	forward
get-response [MIB variable,value]	return
set-request[ack flag]	forward
trap[MIB variable value, value]	return

The RCST responds with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the non existent additional MIB object is made.

An RCST may as minimum implement MIB functional groups indicated Essential (E), and may also implement other (O) functional groups indicated:

Table 8.4: RCST MIB functional groups

Functional Group	MIB Module	Description	E/O	Source / Reference
System		MIB-2 System group is mandatory for any kind of device	E	RFC 1213 [i.64] RFC 3418 [i.80] note 1
Interfaces	IF-MIB	MIB-2 The network interfaces of the RCST	E	RFC 1213 [i.64] RFC 2863 [13]
IP	IP-MIB	Internet Protocol forwarding and routing information	E	RFC 1213 [i.64] RFC 4292 [i.39] RFC 4293 [i.95]
ICMP	ICMP-MIB	MIB-2 ICMP	E	RFC 1213 [i.64]
TCP	TCP-MIB	Transmission Control Protocol MIB Module	O	RFC 1213 [i.64] RFC 4022 [i.90]
UDP	UDP-MIB	User Datagram Protocol MIB Module	O	RFC 1213 [i.64] RFC 4113 [i.92]
SNMP	SNMPv2-MIB	SNMPv2 MIB Module	E	RFC 1213 [i.64] RFC 3418 [i.80]
IGMP	IGMP-STD-MIB	Internet Group Management Protocol MIB Module	O	RFC 2933 [14]
Ethernet	EtherLike-MIB	Ethernet Interface MIB module	O	RFC 3635 [i.87]
System configuration	RCS2-MIB	Sytem parameters, functional flags	E	RFC 5728 [i.55]
Network Configuration	RCS2-MIB	SVN MAC, multicast	E	RFC 5728 [i.55]
L3VRF configuration	RCS2-MIB	VRF configuration	E	RCS2 note 2
Installation	RCS2-MIB	RCS2 installation parameters, antenna alignment	E	RFC 5728 [i.55]
Control	RCS2-MIB	Device control	E	RFC 5728 [i.55]
State	RCS2-MIB	Device status	E	RFC 5728 [i.55]
Statistics	RCS2-MIB	For packets transmission, reception, BW allocated,	E	RCS2
QoSConfiguration	RCS2-MIB	for the satellite interface	E	RCS2
FlinkConfiguration	RCS2-MIB	part of satellite layer 1	E	RFC 5728 [i.55]
RlinkConfiguration	RCS2-MIB	part of satellite layer 1	E	RFC 5728 [i.55]
IPv4 DHCP	DHCP-MIB	IPv4 DHCP options	O	RFC 2132 [i.66]
IPv6 DHCP	DHCP-MIB	IPv6 DHCP options	O	RFC 3633 [i.86]
VLAN	RCS2-MIB	VLAN mode	O	RFC 4188 [i.93]
C2P Agent Configuration	RCS2-MIB	For mesh	O	RCS2
PEP Types	RCS2-MIB	For PEP types configuration	O	RCS2
NAT/NAPT	NAT, NAPT MIB	NAT and NAPT variants	O	RFC 4008 [i.89] RFC 3489 [i.82]
NOTE 1: The MIB-2 groups are the basic unit of conformance. The MIB-2 groups lists are applicable to RCS2 implementation, then it RCST is expected to implement all objects in a functional group. NOTE 2: RCS2 identifies the new MIB elements introduced for RCS2.				

The SNMP object type syntax is provided in table 8.5.

Table 8.5: RCST MIB SNMP objects syntax

SNMP Object Type	Description
Integer32	Represents integer-valued information -2^31 and 2^31 inclusive in big Indian order from SNMPv2-SMI.
INTEGER	Used to represent integer-valued information as named-number enumeration. In this case, only those named-numbers so enumerated may be present as a value.
OCTET STRING	A string of 0 or more 8-bit bytes. Each byte has a value between 0 and 255. In the BER encoding used for this data type, a count of the number of bytes in the string precedes the string. These strings are not null-terminated strings.
DisplayString	A textual description of the entity. Printable ASCII characters.
PhysAddress	OCTET STRING specifying a media or physical address.
MacAddress	represents an 802 MAC address represented in the 'canonical' order defined by IEEE 802-2001 [i.57], OCTET STRING (SIZE(6)).
Counter32	A non-negative integer whose value increases monotonically from 0 to 2^32 – 1, and then wraps back to 0 from SNMPv2-SMI.
Counter64	A non-negative integer whose value increases monotonically from 0 to 2^64 – 1, and then wraps back to 0.
Gauge32	A non-negative integer between 0 and 2^32 –1, whose value can increase or decrease, but latches at its maximum value. That is, if the value increments to 2^32 –1, it stays there until reset from SNMPv2-SMI.
Gauge64	A non-negative integer between 0 and 2^64 –1, whose value can increase or decrease, but latches at its maximum value. That is, if the value increments to 2^64 –1, it stays there until reset.
Unsigned32	Unsigned32 specifies a value whose range includes only non-negative integers (0 to 4294967295), as given in SNMPv2-SMI.
RowStatus	Type textual convention, mainly used to declare dynamic tables, to manage the creation and deletion of conceptual rows, used as the value of the SYNTAX clause for the status column of a conceptual row (RFC 2579 [99]). The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1). A row can be created either by createAndGo and automatically change to active state or createAndWait to add more parameters before becoming active.
TimeTicks	Non-negative integer which represents the time, modulo 2^32 (4 294 967 296 decimal), in hundredths of a second between two epochs, from SNMPv2-SMI.
TimeStamp	Textual convention based on the TimeTicks type. With a TimeStamp, the first reference epoch is defined as the time when sysUpTime (MIB-II system SNMP object) was zero, and the second reference epoch is defined as the current value of sysUpTime from SNMPv2-TC.
SEQUENCE	Similar to a programming structure with entries.
Sequence Of	An array with elements with one type.
InetAddress	Denotes a generic Internet address, either IPv4 or IPv6 address as an OCTET STRING (SIZE (0..255)) as defined in (RFC 2465 [12]).
InetAddressType	Type of Internet address, unknown(0), IPv4(1), IPv6(2), dns(16) as defined in (RFC 2465 [12]).
InetAddressPrefixLength	This data type is used to model InetAddress prefixes. This is a binary string of up to 16 octets in network byte-order (RFC 2465 [12]).
InetPortNumber	Port number as defined in (RFC 2465 [12]).
Textual conventions	Textual conventions for RCST indications of DVBRCS2 capabilities, including profiles, options and optional features from SNMPv2-TC. The mapping to the profiles is to be understood as described here: (0) refers to the most significant bit. A value of 1 indicates that the respective option is supported.
DSCP	Differentiated Service Code Point from DIFFSERV-DSCP-TC.

The access rights to a particular SNMP object are defined cross-checking both the maximum level of access of that SNMP object and the access rights granted to the entity according to its community name.

Table 8.6: RCST MIB Objects MAX-ACCESS values

MAX-ACCESS Value	SNMPv2 Protocol Operation	
	READ-ONLY	READ-WRITE
Read-only (RO)	Available for get and trap operations	
Read-write (RW)	For get and trap operations	Available for get, set, and trap operations
Read-create (RC)	Available for get and trap operations	Available for get, set, create, and trap operations
Accessible-for-notify	Available for trap operations	
Not-accessible (NA)	Unavailable	

The following subclauses provide details for the managed objects. An RCST may implement the managed objects as specified in these clauses.

The RCST may support a minimum of 10 available SNMP table rows, unless otherwise specified to the RFC. The RCST minimum number of available SNMP table rows mean rows (per table) that are available to support device configuration.

8.6.1 System group

The system group follows the definition provided in (RFC 1213 [i.64]), (RFC 3418 [i.80]).

The RCST may implement the System Group (RFC 3418 [i.80]) possibly with exceptions, as specified in the System MIB module listed in this clause.

Table 8.7: RCST System Group

Functional Group	System						
Element	Parameter	Type	Unit	Range	Default	Description	Source
sysDescr	DisplayString	RO	-	-	-	Textual description of the entity in ASCII characters.	RFC 1213 [i.64]
sysObjectID	Object ID	RO	-	-	-	Vendor's authoritative identification	RFC 1213 [i.64]
sysUpTime	TimeTicks	RO	Hundreds of seconds	-	-	Time since the network management was re-initialized (time since logon)	RFC 1213 [i.64]
sysContact	DisplayString	RW	-	-	-	Contact person for this managed RCST	RFC 1213 [i.64]
sysLocation	DisplayString	RW	-	-	-	GPS position of the RCST ODU expressed as longitude, latitude and altitude. The string has 31 characters in the following format <xx.xxx>, <a>, <yyy.yyy>, <b>, <zzzz.z>, M, where x,y and z represent digits, a=N or S, b= E or W.	RFC 1213 [i.64]
sysServices	INTEGER	RO	-	(0..127)	-	Value that indicates the set of services that this entity primarily offers.	RFC 1213 [i.64]

8.6.2 Interfaces group

The interfaces group follows the definition provided in (RFC 2863 [13]). This clause documents only the differences or particularities from the requirements specified in the interfaces MIB module.

The ifType label values for DVB-RCS2 may be assigned by IANA. The ifTypes associated with an RCST interface in RCS2 are:

- dvbRcs2downstream: corresponds to the forward link on an RCS2 system. It is based on DVB-S2 standard [6]. Only transparent systems are considered by the present MIB module.

- dvbRcs2MAClayer: represents the complete air interface of an RCST. This interface support star and mesh networks and is bi-directional. Only star networks are considered by the present MIB module.
- dvbRcs2upstream: represents the physical link for the return of an RCS2 transparent system of the uplink of an RCS2 regenerative system. It is based on the specification provided in [3].

One or several Ethernet interfaces are used on the LAN side of the RCST.

An instance of ifEntry is expected for each dvbRcs2downstream (normally one) and dvbRcs2MAClayer interface (normally one).

The ifStackTable (RFC 2863 [13]) identifies the relationships among sub-interfaces. The dvbRcs2MAClayer interface is layered on top of the downstream and upstream interfaces.

The RCST may discard any traffic over an interface whose ifAdminStatus is "down" (traffic includes data and management traffic where applicable).

Table 8.8: RCST Interfaces Group

Functional Group	**interfaces**						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
ifNumber	INTEGER	RO	-	0..32	3	Number of network interfaces present in the RCST, minimum 3	RFC 1213 [i.64]
ifTable	SEQUENCE ifEntry	-	-	-	-	Interfaces table contains information on the entity's interfaces.	RFC 1213 [i.64]
ifEntry	ifEntry SEQUENCE OF{ ifIndex, ifDescr ifType ifMtu ifSpeed ifPhysAddress ifAdminStatus ifOperStatus ifLastChange ifInOctets ifInUcastPkts ifInNUcastPkts ifInDiscards ifInErrors ifInUnknownProtos ifOutOctets ifOutUcastPkts ifOutNUcastPkts ifOutDiscards ifOutErrors ifOutQLen ifSpecific }	-	-	-	-	Each downstream or upstream interface is one ifEntry Each dvbRcs2MACLayer interface may be attached to a different VRF	RFC 1213 [i.64]
ifIndex	INTEGER	RO	-	1..32	-	ifTable index	RFC 1213 [i.64]
ifType	INTEGER	RO				IANA value of dvbRcs2 interface	RFC 1213 [i.64]
ifSpeed	GAUGE	RO	Bits/s			Speed in bits/s of this interface. This is the symbol rate multiplied with the number of bits per symbol	RFC 1213 [i.64]
ifHighSpeed	INTEGER	RO	Bits/s				RFC 1213 [i.64]
ifPhysAddress	OCTET STRING	RO	-	-	-	The SVN MAC label of 3 bytes that identifies this interface.	RFC 1213 [i.64]
ifAdminStatus	INTEGER	RO	-	-	-	Administrative status of the interface	RFC 1213 [i.64]

Functional Group	interfaces						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
ifOperStatus	INTEGER	RO	-	-	-	Current operational status of the interface 'down' = notReady; 'dormant' = configFileComplete 'up' = operational	RFC 1213 [i.64]
ifMTU	INTEGER	RO	bytes		1500	Size of the largest frame that can be sent on this interface, specified in octets. The value includes the length of the MAC header.	RFC 1213 [i.64]
ifInOctets	Counter	RO	Octets		0	The total number of octets received on this interface including the L2 header.	RFC 1213 [i.64]
ifInUcastPkts	Counter	RO	Packets		0	Number of unicast packets received on this interface. Including IP data packets and L2S packets.	RFC 1213 [i.64]
ifInNUcastPkts	Counter	RO	Packets		0	Number of multicast or broadcast packets received on this interface. Including IP data packets and L2S packets.	RFC 1213 [i.64]
ifInDiscards	Counter	RO	Packets		0	Total number of received packets that have been discarded on this interface. Including IP data packets and L2S packets.	RFC 1213 [i.64]
ifInErrors	Counter	RO	Packets		0	Number of inbound packets that contained error preventing them from being deliverables to higher layers. Possible reasons L2 errors.	RFC 1213 [i.64]
ifInUnknownProtos	Counter	RO	Packets		0	Number of frames with unknown packet type.	RFC 1213 [i.64]
ifOutOctets	Counter	RO	Octets		0	Returns the number of octets transmitted on this interface, including the length of L2 header	RFC 1213 [i.64]
ifOutUcastPkts	Counter	RO	Packets		0	Returns the number of packets transmitted on this interface. Including IP data packets and L2S packets.	RFC 1213 [i.64]
ifOutNUcastPkts	Counter	RO	Packets		0	Returns the number of multicast / broadcast of octets transmitted on this interface including IP data packets and L2 packets.	RFC 1213 [i.64]
ifOutDiscards	Counter	RO	Packets		0	Total number of outbound packets which were discarded, possible reasons are buffer shortage, or not enough transmission resources.	RFC 1213 [i.64]
ifOutErrors	Counter	RO	Packets		0	Number of packets that could not be transmitted due to errors.	RFC 1213 [i.64]

8.6.3 ip group

The RCST requirements for (RFC 4293 [i.95]) are defined in this clause.

The RCST may implement the ipv4GeneralGroup.

The RCST may implement ipv6GeneralGroup.

The RCST may implement the ipv4InterfaceTable.

The RCST may populate the ipv4InterfaceTable with each Ethernet interface with an assigned IPv4 address. The RCST may record other interfaces in the ipv4InterfaceTable which have assigned IPv4 addresses.

The RCST may populate the ipv6InterfaceTable with each Ethernet interface with an assigned IPv6 address. The RCST may record other interfaces in the ipv6InterfaceTable which have assigned IPv6 addresses.

The RCST may implement the ipSystemStatsTable.

The RCST may implement the ipIfStatsTable.

The RCST may implement the ipAddressPrefixTable.

The RCST may implement the ipAddressTable.

The RCST may implement the ipNetToPhysicalTable.

The RCST may implement the ipDefaultRouterTable.

If the RCST has been configured for a default route, the RCST is assumed to populate the default router in the ipDefaultRouterTable.

The RCST may populate the ipDefaultRouterTable with an IPv4 and/or IPv6 statically configured default router or a default router learned through a dynamic update mechanism such as a routing protocol update or IPv6 router advertisement message.

The RCST IP forwarding table follows the format given by (RFC 4293 [i.95]) that describes the managed objects related to the forwarding of Internet protocol (IP) packets in an IP version independent manner. This clause documents only the differences or particularities from the requirements specified in the interfaces MIB module.

The RCST ip forwarding information is composed by the inetCidrRoute branch that hangs from the ipForward MIB group from the ip(24) of mib-2.

Each VRF group will count with its own inetCidrRouteTable set of entries identified by the ifIndex, the interface identifier. The RCST network MIB group is assumed to contain the list of VRFs that apply to a particular RCST (see clause 8.6.13) and the association with the SVN number.

Each entry in the inetCidrRouteTable will have as index the following MIB objects:

- inetCidrRouteDestType
- inetCidrRouteDest
- inetCidrRoutePfxLeng
- inetCidrRoutePolicy
- inetCidrRouteNextHoType
- inetCidrRouteNextHop

These objects may be provided for the creation of a new route entry in the table and are considered "not accessible". Any modification will require a route deletion and a new route creation.

This is dynamic SNMP table, independently if the IP routes are created thanks to statically (i.e. during initial installation) or dynamically (i.e. thanks to OSPF dynamic routing protocol).

The information of the default Gateway for the RCST (if any) and the list of Gateways that the RCST may access by following a certain criteria (e.g. traffic congestion, multicast capabilities) may be included in the ipInetCidrRouteTable, the metric objects could be used for this purpose.

Table 8.9: RCST IP Forwarding Group

Functional Group	Ip forwarding						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
inetCirdRouteNumber	Gauge32	RO	-	-	-	The number of current netCidrRouteTable entries that are not invalid.	RFC 4292 [i.39]
inetCidrRouteDiscards	Gauge32	RO	-	-	-	Number of valid route entries discarded from the inetCisdrRouteTable. Entries that do not appear in the table.	RFC 4292 [i.39]
inetCidrRouteTable	SEQUENCE	NA	-	-	-	The RCST's IP Routing Table.	RFC 4292 [i.39]
inetCidrRouteEntry	SEQUENCE OF	NA	-	-	-	A particular route to a particular destination, under certain policy.	RFC 4292 [i.39]
inetCidrRouteDestType	InetAdressType	NA	-	-	-	The type of inetCidrRouteDest address, as defined in RFC 4001 [100].	RFC 4292 [i.39]
inetCidrRouteDest	InetAddress	NA	-	-	-	Destination IP address of this route following RFC 4292 [i.39]	RFC 4292 [i.39]
inetCidrRoutePfxLen	InetAddressPrefixLength	NA	-	-	-	Number of leading one bits that form the mask following RFC 4292 [i.39]	RFC 4292 [i.39]
inetCidrRoutePolicy	OBJECT IDENTIFIER	NA	-	-	00	Additional index that may delineate between different entries. Not used by default for RCS2 RCST.	RFC 4292 [i.39]
inetCidrRouteNextHopType	InetAddressType	NA	-	-	-	Address type of the next hop	RFC 4292 [i.39]
inetCirdRouteNextHop	InetAddress	NA	-	-	-	Next hop IP address	RFC 4292 [i.39]
inetCidrRouteIfIndex	InterfaceIndexOrZero	RC	-	-	-	The ifIndex value that identifies the local interface through which the next hop of this route should be reached. Value 0 represents no interface specified.	RFC 4292 [i.39]
inetCidrRoutetype	INTEGER	RC	-	-	-	Type of route following RFC 4292 [i.39]	RFC 4292 [i.39]
inetCidrRouteProto	IANAipRouteProtocol	RO	-	-	-	The routing mechanism via which this route was learned, only applies for dynamic routing and OSPF protocol (13) Open Short Path First	RFC 4292 [i.39]
inetCidrRouteAge	Gauge32	RO	Seconds	-	-	Number of seconds since the route was last updated.	RFC 4292 [i.39]
inetCidrRouteNextHopAS	InetAutonomousSystemNumber	RC	-	-	0	Autonomous System number of the next hop. Default value zero, unknown or not relevant.	RFC 4292 [i.39]

Functional Group	Ip forwarding						
Element	Parameter	Type	Unit	Range	Default	Description	Source
inetCidrRouteMetric1	Integer32	RC	-	-	-1	Primary metric for this route. The semantics of the metric are determined by OSPF. When not used, default value is -1	RFC 4292 [i.39]
inetCidrRouteMetric2	Integer32	RC	-	-	-1	Alternative routing metric. Default not used, -1	RFC 4292 [i.39]
inetCidrRouteMetric3	Integer32	RC	-	-	-1	Alternative routing metric. Default not used, -1	RFC 4292 [i.39]
inetCidrRouteMetric4	Integer32	RC	-	-	-1	Alternative routing metric. Default not used, -1	RFC 4292 [i.39]
inetCidrRouteMetric5	Integer32	RC	-	-	-1	Alternative routing metric. Default not used, -1	RFC 4292 [i.39]
inetCidrRouteStatus	RowStatus	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1)	RFC 4292 [i.39]

8.6.4 Ethernet Interface MIB group

The RCST may implement (RFC 3635 [i.87]) for each of its Ethernet interfaces.

8.6.5 icmp MIB group

The RCST may implement icmpStatsTable from (RFC 4293 [i.95]).

The RCST may implement icmpMsgStatsTable from (RFC 4293 [i.95]).

8.6.6 udp MIB group

The RCST may implement UDP-MIB (RFC 4113 [i.92]).

8.6.7 tcp MIB group

The RCST may implement TCP-MIB group (RFC 4022 [i.90]).

8.6.8 snmp MIB group

The RCST may implement the SNMP group from (RFC 3418 [i.80]). This group provides SNMP protocol statistics and protocol error counters.

The snmpCommunityTable is defined in the "SNMP Community MIB Module" section of (RFC 3584 [i.84]).

The snmpTargetAddrTable is defined in the "Definitions" section of (RFC 3413 [i.75]).

The RCST may create one row in snmpTargetAddrTable for each SNMPv2c Transport Address Access.

SNMP access is controlled and specified by the MIB objects in (RFC 3315 [i.35]) through (RFC 3415 [i.77]), and (RFC 3584 [i.84]). The RCST may have several interfaces. If SNMP access filters are applied to RCST IfIndex 1, the RCST may apply the same filters to the "Additional LAN interfaces".

8.6.9 dhcp MIB group

The RCST DHCP options configuration for IPv4 may follow (RFC 2132 [i.66]).

The RCST DHCP options configuration for IPv6 may follow (RFC 3633 [i.86]).

The RCST DHCP LAN interface server for IPv4 may be disabled in the RCST by default. When enabled, it may be possible to configure the IPv4 address of the RCST LAN interface, IPv4 mask, and a range of IPv4 addresses allocable for the DHCP service.

The RCST DHCP LAN interface server for IPv6 may be disabled by default.

8.6.10 igmp MIB group

The RCST may implement (RFC 2933 [14]) when supporting IGMPv2 for dynamic multicast group management.

8.6.11 System configuration group

System configuration group gathers some basic information that would allow anyone to trace the history "the life" of the RCST, as well as to get a complete description of its constitution on the component point of view, including the options/features support statement. Many of the parameters will be defined at installation.

The RCST system configuration MIB group includes the following modules:

- dvbRcs2SystemProfileMap represents the RCS2 profiles supported.
- dvbRcs2SystemOptionalMap represents the RCS2 options supported. They represent important functionality, with impact on interoperability, and their support is advertised with the RCST logon.
- dvbRcs2SystemFeatureMap represents the RCS2 optional features. These represent minimum features, not necessary for interoperability.

Table 8.10: RCST System RCS2 Group

Functional Group	DvbRcs2SystemConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2SystemProfileMap	Textual convention	RW		Cosumer(0), SOHO(1), Multi-dwelling (2), Corporate (3), SCADA (4), Backhaul (5), Institutional (6)		Indicates RCST profile definition	RCS2
dvbRcs2SystemOptionMap	Textual convention	RW		16QAMrtn (0), 32APSKfwd (1), waveformFlex (2), fastCarrierSwitch (3), lowestCarrierSwitch (4), slottedAlohaTraffic (5), transecHooksSupport (6), ospfSupport (7), firewall (8), multicastFwd (9), snmpv3 (10), multiSVNO (11) contentionSync(12), nomarclFec(13), multiTs(14), qsTs(15), VLAN(16), enhMulticast(17)		Enumerates the RCST options for RCS2	RCS2

Functional Group	DvbRcs2SystemConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2SystemFeaturesMap	Textual convention	RO		qpsk_8psk_cpmRtn (0), refWaveforrms (1), customWaveforms (2), waveformBound (3), waveformToTimeslot (4), eirpPowerCtrol (5), contantPowerCtrl (6), fwdLinkDvbs2 (7), fwdLinkSingleGS (8), fwdLinkTSPacketStream (9), fwdLinkMultipleStreams (10), gseBBFrameCRC32 (11), damaTraffic (12), unsolicitedDATraffic (13), slottedAlohaLogon (14), recombinedDAMA (15), raReplicas (16), inbandSignalling (17), signallingDAtimeslots (18), dhcpLAN (19), ipv4ipv6Support (20). DynamicMulticast (21), diffservQoS (22), mplsSupport (23), motorControl (24), sddp (25), pepNegotiationProtocol (26), authenticatedLogon (27), dynamicRouting (28), mesh (29), SCPC (30), space3 (31)		Optional compatibility features and minor options mapping. The terminal informs the Hub which are the supported features. The Hub in return will set up the option flags required for a particular session.	RCS2
dvbRcs2LowerLayerCapabvilities	Textual convention	RO		multipleGS1(0), multipleGS2(1), reserved1(2), fullRangeFLMODCOD (3), fullRangeRLMODCOD(4), fastCarrierSwitching (5), carrierSwitchingClass1(6), carrierSwitchingClass2(7), EsN0powerCtrl(8), constantPowerSpectrumDensity(9), slottedAlohaTraffic(10), crdsaTrafficSupport (11), reserved2(12), reserved3(13), reserved4(14), customCCCPMwaveform(15), service1(16), service2(17), service3(18), service4(19), nbrofL2ifs(20), nbrofL2ifs(21), nbrofL2ifs(22), nbrofL2ifs(23), SWversion1(24), SWversion1(25), SWversion1(26), SWversion1(27), SWversion1(28), SWversion1(29),		Lower layer capabilities following Table 8.5 from [3]	RCS2

Functional Group	DvbRcs2SystemConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
				SWversion1(30), SWversion1(31)			
dvbRcs2SystemCapabilities	Textual convention	RO		freqhoppingRange1(0), freqhoppingRange2(1), mfTdma(2), rcstClass1(3), rcstClass2(4), dynamicConnectivity(5), mobile(6), transec(7)		RCST capabilities to be informed to the NCC during logon	RCS2
dvbRcs2HigherLayerCapabilities	Textual convention	RO		ipv4ipv6Support (0), dynamicMulticast (1), diffservQoS (2), mplsSupport (3), snmpv2c(4), dynamicConnectivity(5), reserved(6), reserved(7)		Higher layer capabilities	RCS2
dvbRcs2PointingAlignmentSupport	Unsigned32	RO		0 – Reserved 1 – Nominal CW EIRP in the pointing direction 2-127 Reserved 128-255 User defined		8 bit field that indicates the support of pointing alignment probing	RCS2
dvbRcs2SystemNetworkTopologySupport	Textual convention	RO		starTransparent (0), meshRegenerative (1), meshTrasnparent (2), hybrid (3)		Network topology as described in [2]	RCS2
dvbRcs2SystemNetworkEncapsulationModeTx	INTEGER	RO		ATM(1), MPEG(2), RLE(3), GSE(4)		Encapsulation mode for transmission	RCS2
dvbRcs2SystemNetworkEncapsulationModeRx	INTEGER	RO		ATM(1), MPEG(2), RLE(3), GSE(4)		Encapsulation mode for reception	RCS2
dvbRcs2SystemOduAntennaSize	INTEGER32	RW	cm	-		Diameter of the antenna	RFC 5728 [i.55]
dvbRcs2SystemOduSspa	INTEGER32	RW	0.1W	-		Power level of the Solid State Power Amplifier	RFC 5728 [i.55]
dvbRcs2SystemOduGain	INTEGER32	RW	0.1dBi	-		Antenna peak gain of the ODU	RFC 5728 [i.55]
dvbRcs2SystemOduTxType	SnmpAdminString	RW		-		Type of transmitter installed in the ODU	RFC 5728 [i.55]
dvbRcs2SystemOduRxType	SnmpAdminString	RW		-		Type of LNB installed in the ODU, with information such as vendor type, output type …	RFC 5728 [i.55]
dvbRcs2SystemOduRxBand	INTEGER	RW		High-band (0), Low Band (1)		LNB high band / Low band selector. High band corresponds to the emission of an 18-26 khz tone with 0.4-0.8 Vpp in the Rx IFL cable.	RFC 5728 [i.55]

Functional Group	DvbRcs2SystemConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2SystemOduRxLO	INTEGER32	RW		-		LNB High Band / Low Band selector. High Band corresponds to the emission of an 18-26 kHz tone with 0.4-0.8 Vpp in the Rx IFL cable: (0) - High Band (1) - Low Band"	RFC 5728 [i.55]
dvbRcs2SystemOduTxLO	INTEGER32	RW		-	-	Frequency of Block Up-Converter Local Oscillator (in 100 Hz)	RFC 5728 [i.55]
dvbRcs2SystemPopulationID	INTEGER	RW		-	-	Population ID, required during installation.	RFC 5728 [i.55]
carrierFrequencyChange	INTEGER	RO		(1) Class1, (2) Class2, (3) Class 3, (4) Class 4	-	RCST carrier frequency hopping class	RCS2

8.6.12 Network Config group

This group contains all the MIB objects related to addressing and network parameters for the RCS2 RCST.

The minimum set of network config group parameters is intended to cover the RCST addressing plan the RCST VRF groups configuration.

The RCST addressing plan is composed of:

- The set of SVN to be used and, assignment of each SVN to a VRF Group included in the vrfGroupTable.
- The list of network IPv4/IPv6 addresses per virtual LAN Interface: information provided using the ifTable for interfaces definition and the ipInetCidrRouteTable.
- The IPv4 address of the RCST satellite interface for M and C signalling included in this group.

Table 8.11: RCST Network RCS2 Group

Functional Group	dvbRcs2NetworkConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2OamInetAddress Type	InetAddressType	RW	-	-	-	Type of internet address of dvbRcs2NetworkOaminetAddress. As specified, the type should be IPv4(1)	RCS2
dvbRcs2NetworkOamInet Address	InetAddress	RW	-	-	-	Terminal IP address for management	RFC 5728 [i.55]
dvbRcs2NetworkOamInet AddressPrefixLength	InetAddressPrefixLength	RW	-	-	-	Prefix length of the terminal management IP address. If the prefix is unknown or does not apply, the value is zero.	RFC 5728 [i.55]
dvbRcs2NetworkOamInet AddressAssign	INTEGER (0) oamInetAddressStatic, (1) oamInetAddressDynamic	RW	-	-	-	Identifies wether the OAM IP address is statically or dynamically assigned.	RFC 5728 [i.55]
svnMacMgmt	OCTET STRING	RW	-	-	-	RCST SVN MAC label used for M and C, given at logon. Saved in the MIB object for supervision.	RCS2
svnMacMgmtMask	OCTET STRING	RW	-	-	-	SVN mask used for M and C given at logon. Saved in the MIB for supervision.	RCS2
NetworkConfigTable	SEQUENCE OF NetworkConfig ENTRY	NA				RCST LAN interface addresses configuration. NOTE: One different LAN interface could be identified per subscriber for a Multi-dwelling terminal	RCS2
NetworkConfigEntry	SEQUENCE OF { NetworkConfigIndex, NetworkConfigLANInetAddressIfIndex, NetworkConfigLANInetAddressType, NetworkConfifLANInetAddressPrefixLength, NetworkConfigAirInterfaceDefaultGateway InetAddresstype, NetworkConfigAirInterfaceDefaultGateway InetAddress, NetworkAirInterface DefaultGatewayInetAddressPrefixLength, NetworkPrimaryDns ServerInetAddressType, NetworkPrimaryDns ServerInetAddress, NetworkPrimaryDns ServerInetAddressPrefixLength,	NA					

Functional Group	dvbRcs2NetworkConfig						
Element	Parameter	Type	Unit	Range	Default	Description	Source
	NetworkSecondaryDnsServerInetAddressType, NetworkSecondaryDnsServerInetAddress, NetworkSecondaryDnsServerInetAddressPrefixLength}						
NetworkConfigIndex	INTEGER	NA				Table index	
NetworkConfigLANInetAddressIfIndex	INTEGER	RC				ifIndex from the interfaces group	
NetworkConfigLANInetAddressType	InetAddressType	RC	-	-	-	Type of Internet address on the LAN interface. If there is no address, the value is unknown (0)	RCS2
NetworkConfigLANInetAddress	InetAddress	RC	-	-	-	Internet address of the LAN interface associated to the IfIndex	RCS2
NetworkConfigLANInetAddressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length of the LAN IP address associated to the IfIndex	RCS2
NetworkConfigAirInterfaceDefaultGatewayInetAddresstype	InetAddressType	RC	-	-	-	Default gateway IP address type	RCS2
NetworkConfigAirinterfaceDefaultGatewayInetAddress	InetAddress	RC	-	-	-	IP address of the default gateway associated to the IfIndex	RCS2
NetworkConfigAirInterfaceDefaultGatewayInetAddressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length of the default gateway IP address	RCS2
NetworkConfigPrimaryDnsServerInetAddressType	InetAddressType	RC	-	-	-	Type of IP address for dns server	RCS2
NetworkConfigPrimaryDnsServerInetAddress	InetAddress	RC	-	-	-	DNS server IP address in the NCC	RCS2
NetworkConfigPrimaryDnsServerInetAdrressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length for the DNS server in the NCC	v
NetworkConfigSecondaryDnsServerInetAddressType	InetAddressType	RC	-	-	-	Type of IP address for the secondary DNS server in the NCC	v
NetworkConfigSecondaryDnsServerInetAddress	InetAddress	RC	-	-	-	IP address of the secondary DNS server in the NCC	v
NetworkConfigSecondaryDnsServerInetAddressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length of the secondary DNS server in the NCC	RCS2
NetworkConfigRowStatus	Row Status	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1). A row can be created either by createAndGo and automatically change to active state or createAndWait to add more parameters before becoming	RCS2

Functional Group	dvbRcs2NetworkConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
						active.	
dvbRcs2NetworkNmcMgt InetAddress	InetAddressType	RW	-	-	-	Type of address of the management server in the NMC	RFC 5728 [i.55]
dvbRcs2NetworkNmcMgt InetAddress	InetAddress	RW	-	-	-	NMC IP address	RFC 5728 [i.55]
dvbRcs2NetworkNmcMgt inetAddressPrefixLength	InetAddressPrefixLength	RW	-	-	-	NMC IP address prefix length	RFC 5728 [i.55]
dvbRcs2NetworkConfigFileDownloadUrl	Uri (SIZE(0..65535))	RW	-	-	-	Fullpath name for the configuration file download.	RFC 5728 [i.55]
dvbRcs2NetworkInstallLogFileDownlaodUrl	Uri (SIZE(0..65535))	RW	-	-	-	Full path name of the installation log file to download	RFC 5728 [i.55]
dvbRcs2NetworkConfigFileUploadUrl	Uri (SIZE(0..65535))	RW	-	-	-	Fullpath name for the configuration file upload.	RFC 5728 [i.55]
dvbRcs2NetworklogFileUploadUrl	Uri (SIZE(0..65535))	RW	-	-	-	Full path name for the event log file	RFC 5728 [i.55]
dvbRcs2NetworkInstallLogFileUploadUrl	Uri (SIZE(0..65535))	RW	-	-	-	Full path name for the installation log file	RFC 5728 [i.55]

8.6.13 L3VirtualRoutingForwardingConfig group

These set of parameters determine L3 virtual routing forwarding configuration of the RCST.

Table 8.12: RCST VRF RCS2 Group

Functional Group	dvbRcs2 L3VirtualRoutingForwardingConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
vrfGroupTable	SEQUENCE OF vrfGroupEntry	NA	-		-	VRF group table that contains the IP routing forwarding information of the RCST per interface	RCS2
vrfGroupEntry	SEQUENCE { vrfGroupIndex, vrfGroupSVNnumber , vrfSVNMAClabel, vrfGroupIfInterface, vrfGroupSVNMask, vrfSVNmtu, vrfGroupIfInterface, vrfOSPFrouting, vrfMulticastMapping Method vrfMulticastFwd vrfMulticastRtn vrfIgmpVersion vrfIgmpQuerierLAN vrfIgmpProxy vrfIgmpQuerierSAT vrfIgmpForward vrfPimSM vrfMldQuerierLAN vrfMldProxy vrfMldQuerierSAT vrfMldForward vrfGroupStatusRow}	NA	-		-	VRF group table entry, each entry will identify a particular SVN association to one VRF group, and the corresponding interface ifIndex.	RCS2
vrfGroupIndex	INTEGER	NA	-		-	VRF group table index or VRF group identified	RCS2

Functional Group	dvbRcs2 L3VirtualRoutingForwardingConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
vrfGroupSVNnumber	INTEGER	RC	-		-	SVN number associated to this VRF group	RCS2
vrfGroupSVNMAClabel	OCTET STRING	RC	-		-	SVNMAC label identifier attached to this VRF group	RCS2
vrfGroupSVNMask	OCTET STRING	RC	-		-	The corresponding SVN mask attached to this VRF group	RCS2
vrfSVNmtu	Unsigned32	RC				The MTU that applies to all traffic SVNs	RCS2
vrfGroupIfInterface	INTEGER	RC	-		-	ifIndex from the interfaces group linked to this VRF group. Each Each entry in the ipInetCidrRouteTable is linked to a different interface.	RCS2
vrfOSPFRouting	INTEGER	RC		Static (1), Dynamic (2)		Routing option: static or dynamic	RCS2
vrfOSPFrouterAddressType	InetAddressType	RC	-	-	-	In case of dynamic routing, this is the type of address of the OSPF module in the NCC/Gateway Router.	RCS2
vrfOSPFrouterAddress	InetAddress	RC	-	-	-	In case of dynamic routing, this is the address of the OSPF module in the NCC/Gateway Router.	RCS2
vrfOSPFrouterPrefix	InetAddressPrefix	RC	-	-	-	In case of dynamic routing, this is the prefix of address of the OSPF module in the NCC/Gateway Router.	RCS2
vrfMulticastMappingMethod	INTEGER	RC		Mode1 (1), mode2(2), mode3(3)	Mode1(1)	Configuration of the multicast mapping method in the terminal as described in clause 6.2.3 NOTE	RCS2
vrfMulticastFwd	boolean	RC		Disable(0), enable(1)	Enable (1)	Enable/disable multicast reception	RFC 5728 [i.55]
vrfMulticastRtn	boolean	RC		Disable(0), enable(1)	Enable (1)	Enable/disable multicast transmission When enabled, the RCST can forward multicast traffic towards the satellite interface	RFC 5728 [i.55]
vrfIgmpVersion	INTEGER	RC		(2) version 2, (3) version 3	(2) version 2	IGMP v2 is mandatory if dynamic multicast is implemented	RCS2
vrfIgmpQuerierLAN	boolean	RC		Disable(0), enable(1)	Disable (0)	Enable/disable igmp querier towards RCST LAN Static or dynamic multicast towards the LAN	RCS2

Functional Group	dvbRcs2 L3VirtualRoutingForwardingConfig						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
vrfIgmpProxy	boolean	RC		Disable(0), enable(1)	Disable (0)	Enable/disable igmp proxy towards the satellite interface For sending IGMP queries to the satellite interface	RCS2
vrfIgmpQuerierSAT	boolean	RC		Disable(0), enable(1)	Disable (0)	Enable/disable igmp querier towards the satellite interface Flag activated, the RCST can dynamically manage multicast groups with listeners behind other RCSTs belonging to the same SVN	RCS2
vrfIgmpForward	boolean	RC		Disable(0), enable(1)	Disable (0)	Enable/disable IGMP forwarding (no treatment to IGMP messages) When enable assumes IGMP querier and proxy are disabled. This is used when customer needs to use a separate multicast router.	RCS2
vrfPimSM	boolean	RC		Disable(0), enable(1)	Disable (0)	When enabled, the RCST will intercept multicast PIM messages over the satellite interface	RCS2
vrfMldQuerierLAN	boolean	RC		Disable(0), enable(1)	Disable (0)	Implies multicast reception enabled fro IPv6	RCS2
vrfMldProxy	boolean	RC		Disable(0), enable(1)	Disable (0)	Required for dynamic multicast using MLD for IPv6	RCS2
vrfMldQuerierSAT	boolean	RC		Disable(0), enable(1)	Disable (0)	For sending general and group queries to the satellite interface.	RCS2
vrfMldForward	boolean	RC		Disable(0), enable(1)	Disable (0)	Transparent forwarding of MLD messages to/from the satellite interface.	RCS2
vrfGroupStatusRow	Row Status	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1). A row can be created either by createAndGo and automatically change to active state or createAndWait to add more parameters before becoming active.	RCS2
NOTE: The 3 modes for multicast mapping are: Mode1) Implicit mapping hash layer 3 network address to one of a range of SVN-MAC multicast labels Mode2) Explicit mapping given by MMT2 Mode3) Mapping directly to a unicast SVN-MAC label assigned to an RCST							

8.6.14 Installation group

These set of parameters determine the installation parameters for the RCST initial antenna alignment.

Table 8.13: RCST Installation RCS2 Group

Functional Group	**dvbRcs2Installation**						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2InstallAntennaAlignmentState	INTEGER (1) antennaAlignmentStart, (2) antennaAlignmentdeny, (3) antennaAlignmentContinue, (4) antennaAlignmentStop, (5) antennaAlignmentSuccess, (6) antennaAlignmentFail	RW				Indicates state of the antenna alignment	RFC 5728 [i.55]
CwFrequency	Unsigned32	RW	x100 Hz			Frequency of the transmitted continous wave	RFC 5728 [i.55]
CwMaxDuration	Unsigned32	RW	seconds			Time after which the CW carrier must be put down	RFC 5728 [i.55]
CwPower	Integer32	RW	x0.1dBm			IDU tx power level when the IDU is configured to send CW.	RFC 5728 [i.55]
CoPolReading	Unsigned32	RW	x0.1dB			Co-polarization measured value during installation	RFC 5728 [i.55]
XPolReading	Unsigned32	RW	x0.1dB			Cross-polarization measured value during installation	RFC 5728 [i.55]
CoPolTarget	Unsigned32	RW	x0.1dB			Co-polarization target value during installation	RFC 5728 [i.55]
XPolTarget	Unsigned32	RW	x0.1dB			Cross-polarization target value during installation	RFC 5728 [i.55]
StandByDuration	Unsigned32	RW	x0.1dB			Time to wait in stand-by mode	RFC 5728 [i.55]
TargetEsN0	Unsigned32(0..315)	RW	x0.1dB			This value describes the wanted Es/N0 value that enables operation of the return link with the required link with the required error performance.	RFC 5728 [i.55]
MaxFwdAlignThrExeDuration	Unsigned32	RW	seconds			The duration of the time interval during which fwd alignment accuracy must be achieved	RCS2

Functional Group	dvbRcs2Installation						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
MaxFail	Counter	RO	nbr			Max nbr of alignment failures.	RCS2
posDelayCorrection	Unsigned32	RW	NCR ticks			Additional initial delay correction for the RCST, in NCR ticks. The system will delay transmission of the CSC burst by this number of ticks.	RCS2
posSearchN	Unsigned32	RW				Maximum attempts of timing position search for the start time of logon burst during logon. If N is this value then (2N+1) attempts will be done along with T(Burst_start_offset), which ranges as -NT.....0T.....+NT	RCS2

8.6.15 Control group

This MIB group contains objects a network manager can use to invoke actions and tests supported by the RCST agent and to retrieve the action/test results.

Table 8.14: RCST Installation RCS2 Group

Functional Group	dvbRcs2Control						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2CtrlReboot	INTEGER	RW		Idle(1), normal(2), alternate(3)		Variable that forces RCST to reboot: (1) idle, (2)normal reboot (from current SW load), (3) reboot from alternate load	RFC 5728 [i.55]
dvbRcs2CtrlRCSTTxDisable	INTEGER	RW		Idle(1), disable(2)		This variable forces the RCST to stop transmission	RFC 5728 [i.55]
dvbRcs2CtrlUserTrafficDisable	INTEGER	RW		Idle(1), disable(2)		Variable to disable user traffic (only RCST management signalling traffic can be transmitted)	RFC 5728 [i.55]
dvbRcs2CtrlCwEnable	INTEGER	RW		Off(1), on(2)		Variable to force RCST start transmission of CW	RFC 5728 [i.55]

Functional Group	dvbRcs2Control						
Element	Parameter	Type	Unit	Range	Default	Description	Source
dvbRcs2CtrlOduTxReferenceEnable	INTEGER	RW		Off(1), on(2)		Enables activation and deactivation of the 10Mhz reference clock in the Tx IFL cable	RFC 5728 [i.55]
dvbRcs2CtrlOduTxDCEnable	INTEGER	RW		Off(1), on(2)		Enables activation and deactivation of DC in the Tx IFL	RFC 5728 [i.55]
dvbRcs2CtrlOduRxDCEnable	INTEGER	RW		Off(1), on(2)		Enables activation and deactivation of DC in the Rx IFL	RFC 5728 [i.55]
dvbRcs2CtrlDownloadFileCommand	INTEGER	RW		Idle(1), config(2), installation Log(3)		Variable that initiates an RCST configuration file download process	RFC 5728 [i.55]
dvbRcs2CtrlUploadFileCommand	INTEGER	RW		Idle(1), config(2), eventAlarm(3), installation Log(4)		Variable that initiates an RCST configuration file upload process	RFC 5728 [i.55]
dvbRcs2CtrlActivateConfigFileCommand	INTEGER	RW		Idle(1), activate(2)		Variable that triggers the RCST to use the configuration file and updates its parameters accordingly.	RFC 5728 [i.55]
dvbRcs2CtrlRcstLogonCommand	INTEGER	RW		Idle(1), logon(2)		Variable that initiates RCST logon	RFC 5728 [i.55]
dvbRcs2CtrlLogoffCommand	INTEGER	RW		Idle(1), logoff(2)		Variable that initiates RCST logoff	RFC 5728 [i.55]

8.6.16 State group

This MIB group describes the fault state, software versions, configuration file versions and rest of status parameters of the RCST.

Table 8.15: RCST State RCS2 Group

Functional Group	dvbRcs2State						
Element	Parameter	Type	Unit	Range	Default	Description	Source
dvbRcs2RCSTMode	INTEGER	RW		(0) Installation (1) Operational		Identifies the current status mode of the RCST and allows the RCST to return to the installation mode when needed	RFC 5728 [i.55]
dvbRcs2RCSTFaultStatus	INTEGER	RO		(0) No Fault, (1) fault		Provides the fault status of the terminal	RFC 5728 [i.55]
dvbRcs2FwdLinkStatus	INTEGER	RO		(0) notAcquired, (1) acquired		Provides the status of the RCST forward link.	RFC 5728 [i.55]
dvbRcs2RtnLinkStatus	INTEGER	RO		(0) loggedOff, (1) loggedOn		Provides the status of the RCST return link.	RFC 5728 [i.55]

Functional Group	dvbRcs2State						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2DvbState	INTEGER	RO		configComplete (1), nitWait (2), pat1Wait (3), pmt1Wait (4), rmtWait (5), pat2Wait (6), pmt2Wait (7), dvbRcsWait (8), loggingOn (9), coarseSync (10), fineSync (11), active (12), hold (13), loggedOff (14)		The current state of the IDU	RCS2
dvbRcs2logUpdated	INTEGER	RO		(0) noUpdate, (1) logFileUpdated		Indicates the existence of an updated event log file: no update (0), event log file updated (1). The RCST should remove the "Event file updated " indication as the log file is fetched by the NCC.	RFC 5728 [i.55]
dvbRcs2RCSTCurrent SoftwareVersion,	snmpAdminString	RO				Current RCST Sw version	RFC 5728 [i.55]
dvbRcs2RCSTAlternat eSoftwareVersion,	snmpAdminString	RO				Alternate (backup/new) RCST software version	RFC 5728 [i.55]
dvbRcs2RCSTActivate dConfigFileVersion,	snmpAdminString	RO				Version of the most recently activated configuration file	RFC 5728 [i.55]
dvbRcs2RCSTDownloa dedConfigFileVersion	snmpAdminString	RO				Version of the most recently downloaded configuration	RFC 5728 [i.55]
dvbRcs2FwdStatusTab le	SEQUENCE OF dvbRcs2FwdStat usEntry	NA				Table that describes the current status of the Forward Link interfaces	RFC 5728 [i.55]

Functional Group	dvbRcs2State						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2FwdStatusEntry	SEQUENCE {dvbRcs2FwdStatusIndex, dvbRcs2FwdStatusIfReference, dvbRcs2FwdStatusONetId , dvbRcs2FwdStatusNetId, dvbRcs2FwdStatusNetName, dvbRcs2FwdStatusFormat , dvbRcs2FwdStatusFrequency, dvbRcs2FwdStatusPolar , dvbRcs2FwdStatusInnerFec, dvbRcs2FwdStatusSymbolRate, dvbRcs2FwdStatusRolloff , dvbRcs2FwdStatusModulation , dvbRcs2FwdStatusFecFrame, dvbRcs2FwdStatusPilot , dvbRcs2FwdStatusBer, dvbRcs2FwdStatusCnr, dvbRcs2FwdStatusRxPower}	NA				An entry in the forward lnk status table. Each entry is associated with a physical interface.	RFC 5728 [i.55]
dvbRcs2FwdStatusIndex	Unsigned32 (1..8)	NA				Index of the forward link table	RFC 5728 [i.55]
dvbRcs2FwdStatusIfReference	Unsigned32 (1..8)	RO				Cross reference to the interface table	RFC 5728 [i.55]
dvbRcs2FwdStatusONetId	Unsigned32	RO				Reflects the last ONID given during logon RCS2 (from the RCS tables)	RFC 5728 [i.55]
dvbRcsFwdStatusNetId	Unsigned32	RO				Interactive network ID of the forward link (from the RCS table)	RFC 5728 [i.55]
dvbRcsFwdStatusNetName	SnmpAdminString	RO				The name of the interactive network of the forward link (from the RCS Map Table)	RFC 5728 [i.55]
dvbRcsFwdStatusFormat	INTEGER	RO		dvbs (0), dvbs2ccm (1), dvbs2acm (2), reservedFormat (3)		Specifies the transmission format applied on the forward link. Supported values are (from RCS Map Table): 0: DVB-S 1: DVB-S2 using CCM 2: DVB-S2 using VCM or ACM 3: reserved"	RFC 5728 [i.55]

Functional Group	dvbRcs2State						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcsFwdStatusFrequency	Unsigned32	RO	100Hz			An estimate of the frequency of the forward link. Its value is given in multiples of 100 kHz	RFC 5728 [i.55]
dvbRcsFwdStatusPolar	INTEGER			(0) linear-horizontal (1) linear-vertical (2) circular-left (3) circular-right		2-bit field giving the polarization of the forward link Supported values are (from RCS Map Table): 00: linear and horizontal 01: linear and vertical 10: circular left 11: circular right	RFC 5728 [i.55]
dvbRcsFwdStatusInnerFec	INTEGER			unknown (-1), fecRate12 (0), fecRate23 (1), fecRate34 (2), fecRate56 (3), fecRate78 (4), fecRate89 (5), fecRate35 (6), fecRate45 (7), fecRate910 (8), fecRate25 (9), fecRate13 (10), fecRate14 (11), noInnerCode(12)		Specifies the inner Forward Error Correction used on the forward link for transmission to the RCST. The RCST will report a value that has been used for transmission to the RCST within the most recent 60 seconds. If this is not relevant, the RCST will report 'unknown'."	
dvbRcsFwdStatusSymbolRate	Unsigned32	RO	100 sybols/s			An estimate of the symbol rate of the forward link. Its value is given in multiples of 100 symbols/s.	RFC 5728 [i.55]
dvbRcsFwdStatusRolloff	INTEGER	RO		(0) not defined, (1) 10%, (2) 20%, (3) 25%, (4) 35%		An estimate of the roll-off applied on the forward link. Supported values are: 0: undefined 1: 0.10 2: 0.20 3: 0.25 4: 0.35"	RCS2
dvbRcsFwdStatusModulation	INTEGER	RO		unknown (0), mBPSK (1), mQPSK (2), m8PSK (3), m16APSK (4), m32APSK (5)		Indicates the modulation on the forward link used for transmission to the RCST. Supported values are: 0: unknown 1: BPSK 2: QPSK 3: 8PSK 4: 16APSK 5: 32APSK	RFC 5728 [i.55]

Functional Group	dvbRcs2State						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
						The RCST will report a value that has been used for transmission to the RCST within the most recent 60 seconds. If this is not relevant, the RCST will report 'unknown'."	
dvbRcsFwdStatusFecFrame	INTEGER	RO		unknown (0), shortframe (1), longframe (2)		Indicates the frame length used on the forward link for transmission to the RCST. Supported values are: 0: Unknown 1: Short frame 2: Normal frame The RCST will report a value that has been used for transmission to the RCST within the most recent 60 seconds. If this is not relevant, the RCST will report 'unknown'."	RFC 5728 [i.55]
dvbRcsFwdStatusPilot	INTEGER	RO		unknown (0), pilotNotused (1), pilotUsed (2)		Indicates whether pilots are used on the forward link for transmission to the RCST. Supported values are: 0: Unknown 1: Pilots are not used 2: Pilots are used The RCST will report a value that has been used for transmission to the RCST within the most recent 60 seconds. If this is not relevant, the RCST will report 'unknown'."	
dvbRcsFwdStatusBer	Integer32	RO	Exponent of 10			Provides the RCST BER on the Forward Link in log10units	RFC 5728 [i.55]
dvbRcsFwdStatusCnr	Integer32	RO	0.1dB			Provides the RCST CNR on the Forward Link in 0.1 dB units	RFC 5728 [i.55]
dvbRcsFwdStatusRxPower	Integer32	RO	0.1dBm			Provides the RCST power level of the Forward Link as received by the IDU, in 0.1 dBm units	RFC 5728 [i.55]

Functional Group	dvbRcs2State						
Element	Parameter	Type	Unit	Range	Default	Description	Source
dvbRcs2RtnStatusEbN0	Integer32	RO	0.1dB			The EbN0 value reported for the return link, referenced to the regular SYNC burst transmission, in 0.1 dB	RFC 5728 [i.55]
dvbRcs2RtnStatusSFDuration	Unsigned32	RO	0.1ms			The duration of the currently applied return link superframe structure, in tenths of milliseconds	RFC 5728 [i.55]
dvbRcs2RtnStatusTxPower	Unsigned32	RO	0.1dB			Transmission IDU Tx power during last logon	RFC 5728 [i.55]
dvbRcs2AlignmentStatus	INTEGER (0) not confirmed aligned, (1) confirmed aligned	RO				RCST flag that reflects the alignment status given by the NCC during logon	RCS2
dvbRcs2SubscriptionStatus	INTEGER (0) NotConfirmedSubscription (1) ConfirmedSubscription					Flag to reflect the RCST subscription status given by the NCC at logon	RCS2
dvbRcs2ComissionedStatus	INTEGER (0) Not confirmed commissioned (1) confirmed user associated to the RCST (2) higher layer M and C address is assigned (3) NCC indicates the commissioning is completed	RO				RCST commissioned status. The flag can be raise by loading a new configuration file. At a change of NIT or RMT, the RCST changes this flag to "Not confirmed commissioned"	RCS2
typeOfLogon	INTEGER	RO		Basic (0), LargeTiming (1)		Two variants of logon procedure exist, the basic procedure and a procedure extension called Logon at Large Timing	RCS2
NetworkingStatus	Unsigned32	RO					RCS2
RCSTidentifier	Unsigned32	RO				RCST identifier given at logon Reset every logon session	RCS2
lowerLayerCapabilities	Textual convention	RO		MultipleGSsupport(0), MultipleGSsupport(1), reserved(2), fullRangeFLmodcod(3), fullrangeRLmodcod(4), carrierSwitchClass(5), EsN0powerCtrl(6), ctepowerSpectr		RCST lower layer capabilities	RCS2

Functional Group	dvbRcs2State						
Element	Parameter	Type	Unit	Range	Default	Description	Source
				umDensity(7), slottedAlohaTraffic(8), crdsaTraffic(9), stream(10), reserved(11), reserved(12), reserved(13), reserved(14), reserved(15), reserved(16)			
statusSatelliteID	Unsigned32	RO				Reflects the last valid value of SatelliteID at logon	RCS2
statusPopulationID	Unsigned32	RO				Reflects the last valid value for PopulationID at logon.	RCS2
StatusNCC_ID	Unsigned32	RO				Reflects the last valid value for NCC_ID at logon	RCS2
transmissionContextIndication	INTEGER (0) TDMA_DA (1) TDMA_slottedAloha (2) TDMA_CRDSA (3) TDMA_RAtype3 (4) TDMA_RAtype4 (5) TDM (6) Other	RO				RCST transmission context identification	RCS2

8.6.17 Statistics group

Statistics are provided in the interfaces group per SVN interface or per IPv4/IPv6 interface.

Other statistics could be provided per HLS queue, in terms of packets sent/received, and per multicast session.

RCST statistics may include:

- number of logons
- last time of a logon session
- number of SYNC without response
- number of CMT2 losses
- number of TBTP2 losses
- number of schedule failures

The counters are assumed reset after an RCST reboot but kept after logoff/logon sessions.

Table 8.16: RCST Statistics RCS2 Group

Functional Group	dvbRcs2RcstStatistics						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
nbrLogons	Counter32	RO			0	Counter of logon sessions since last reboot	RCS2
lastTimeLogonSession	Seconds	RO			0	Time elapsed since last successful logon	RCS2
nbrSYNCnotanswered	Counter32	RO			0	Counter of SYNC sent with no answer from NCC	RCS2
nbrCMT2losses	Counter32	RO			0	Counter of CMT2 losses, after waiting maxresponse time for a CMT2	RCS2
nbrSchedulerFailures	Counter32	RO			0	Counter of Scheduler failures since last reboot	RCS2
nbrRtnLinkFailures	Counter32	RO			0	Counter of rtn link failures since last reboot	RCS2
nbrNCCReceiveFailures	Counter32	RO			0	Counter of NCC reception errors since last reboot	RCS2
nbrLinkFailureRecovery	Counter32	RO			0	Counter of Link Failure recoveries since last reboot	RCS2

8.6.18 QoS configuration group

This group contains objects to configure the Quality of Service (QoS) of the RCST.

The QoS configuration may include the following tables:

- IP Classification table
- HLS mapping table
- LLS configuration table (for supervision only, saves the information given at logon)

Table 8.17 is a sketched list of managed objects that would be required for managing RCST QoS configuration. Well-known queuing terms are here used to indicate the packet ordering policy and the packet drop policy applied for the flow.

The actual implementation of an attempted QoS configuration could be possible to read back via SNMP/IP, and could depend on the actual support in the specific device.

The RCST keeps its MAC service configuration in the MIB after reboot or logon, as long it connects to the same NCC/NMC. Change in any of the parameters in the NIT given by the Network_ID or in RMT given by the NCC_ID.

Table 8.17: RCST QoS RCS2 Group

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
IPClassTable	SEQUENCE OF IPClassEntry	NA	-	-	-	Traffic Classification table for IP traffic	RCS2
IPClassEntry	SEQUENCE { IPClassIndex, IpClassDscpLow, Ip IPClassDscpHigh, IPClassDscpMarkValue, IPClassIPProtocol, IPClassSrcInetAddressType, IPClassIPSrcInetAddress, IPClassSrcInetAddr, essPrefixLength, IPClassDstInetAddressType, IPClassIPDstInetAddress, IPClassIPDstInetAddressPrefixLength, IPClassSrcPortLow, IPClassSrcPortHigh, IPClassDstPortLow, IPClassDstPortHigh, IPClassVlanUserPri, IPClassVLANID, IPClassHLSAssociation, IPClassAction, IPClassOutOctets, IPClassOutPkts, IPClassRowStatus}	NA	-	-	-	IP traffic classification entry	RCS2
IPClassIndex	Unsigned32	NA	-	-	-	Index automatically incremented one by one	RCS2
IPClassDscpLow	Dscp	RC	-	-	-	Low value of a range of DiffServ code points	RCS2
IPClassDscpHigh	Dscp	RC	-	-	-	High value of a range of DiffServ code points	RCS2
IPClassDscpMarkValue	DscpOrAny	RC	-	-	-	DiffServ code point value used to mask the packet; -1 indicates no DSCP marking	RCS2
IPClassIPProtocol	Unsigned32	RC	-	-	-	IP protocol to which a packet is compared. A value of 255 means match all.	RCS2
IPClassSrcInetAddressType	InetAddressType	RC	-	-	-	Type of Internet address of IpClassIpSrcInetAddress	RCS2
IPClassIPSrcInetAddress	InetAddress	RC	-	-	-	IP source address to which a packet is compared	RCS2
IPClassSrcInetAddressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length of the IP source that will be matched for this traffic class	RCS2
IPClassDstInetAddressType	InetAddressType	RC	-	-	-	Type of Internet address of IpClassIpDstInetAddress	RCS2
IPClassIPDstInetAddress	InetAddress	RC	-	-	-	IP destination address to which a packet is compared	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	Parameter	Type	Unit	Range	Default	Description	Source
IPClassIPDstInetAddressPrefixLength	InetAddressPrefixLength	RC	-	-	-	Prefix length of the IP destination that will be matched for this traffic class	RCS2
IPClassSrcPortLow	InetPortNumber	RC	-	-	-	Low range of source port to which a packet is compared	RCS2
IPClassSrcPortHigh	InetPortNumber	RC	-	-	-	High range of source port to which a packet is compared	RCS2
IPClassDstPortLow	InetPortNumber	RC	-	-	-	Low range of destination port to which a packet is compared	RCS2
IPClassDstPortHigh	InetPortNumber	RC	-	-	-	High range of destination port to which a packet is compared	RCS2
IPClassVlanUserPri	Integer32(-1..7)	RC	-	-	-	VLAN user priority to which a packet is compared. A value of -1 indicates that the selectivity is inactive. 16-bit Tag that contains a 3-bit Priority field and a 12-bit VLAN number	RCS2
IPClassVLANID	Integer32	RC	-	-	-	VLAN identifier (12bits) from the 802.1D/Q tag header	RCS2
IPClassHLSAssociation	Unsigned32	RC	-	-	-	Associate the filter entry to a specific HL service.	RCS2
IPClassAction	INTEGER	RC	-	-	-	Forward the packet (1), or act a firewall when set to (-1).	RCS2
IPClassOutOctets	Counter32	RO	-	-	-	Statistics of packets octets that matched this IP traffic class since last logon	RCS2
IPClassOutPkts	Counter32	RO	-	-	-	Statistics of packets that matched this IP traffic class since last logon	RCS2
IPClassRowStatus	RowStatus	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2
HLServiceTable	SEQUENCE OF HLServiceEntry	NA	-	-	-	HLServices table	RCS2
HLServiceEntry	SEQUENCE{ HLServiceIndex HLserviceLLServiceAssociation HLservicediffPolicyPHBindex HLservicePHBname HLservicePriority HLserviceMinRate HLserviceMaxRate HLserviceMaxIngressBurst HlserviceMinIngressBurst HLserviceMaxEgressBurst HLserviceMaxDelay HLserviceQueueTyp	NA	-	-	-	Table entry for HL service table	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
	e HLserviceL3IfNumbe r MaxLatency LinkRetransmissionA llowed HLServiceRowStatus }						
HLServiceIndex	Unsigned32	NA	-	-	-	Table index	RCS2
HLserviceLLServiceA ssociation	Unsigned32	RC	-	-	-	This object is an association of the HLservice to a LL service	RCS2
HLservicediffPolicyP HBindex	Unsigned32	RC	-	-	-	Identification of the PerHopBehaviour (PHB). If follows the unsigned 16-bit binary encoding as specified in RFC 3140 [21]. The value 0 designates the Default PHB.	RCS2
HLservicePHBname	SNMPAdminString	RC	-	-	-	The name of the PHB	
HLservicePriority	Unsigned32	RC				HL service priority level	RCS2
HLserviceMinRate	Unsigned32	RC	kbps			HL service minimum rate, minimum level of resources available to the HL services aggregate, in kilo bits per second	RCS2
HLserviceMaxRate	Unsigned32	RC	kbps			HL service maximum rate, maximum level of resources available to the HL services aggregate in kilo bits per second	RCS2
HLserviceMaxIngress Burst	Unsigned32	RC	Bytes			HL service Max Ingress burst, maximum burst of traffic that the HL services will take	RCS2
HLlserviceMinIngress Burst	Unsigned32	RC	Bytes			HL service Min Ingress burst, minimum burst of traffic that the HL services will take	RCS2
HLserviceMaxEgress Burst	Unsigned32	RC	Bytes			HL service Max Egress Burst, maximum burst of traffic that the HL services will issue in excess of maximum long term rate	RCS2
HLserviceMaxDelay	Unsigned32	RC	Seco nds			Maximum Delay for this HL service, nominal maximum transit delay for a PDU of the HL service aggregate	RCS2
HLserviceQueueType	INTEGER	RC		FIFO (0), LLQ (1), WFQ(2) WRED (3), Other (4)		Queue scheduling typedrop strategy associated to the HLService: FIFO is Tail Drop LLQ is Head Drop WFQ is based on the CIR per HL service as the minimum weight parameter Other is a vendor specific strategy	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
HLserviceL3IfNumber	Unsigned32	RC				Interface ID associated to the HL service (interface identifier from the interfaces group)	RCS2
MaxLatency	Unsigned32	RC	-	-	-	Minimum time to hold on to a PDU in the HL services aggregate before it may be discarded	RCS2
LinkRetransmissionAllowed	Unsigned32	RC	-	-	-	Packet re-transmission allowed / not allowed	RCS2
HLServiceRowStatus	RowStatus	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2
LLserviceTable	SEQUENCE OF LLserviceEntry	NA	-	-	-	LowerLayer services table that saves the information provided by the LL service descriptor for supervision only.	RCS2
LLserviceEntry	SEQUENCE { LLserviceIndex LLserviceRCIndex LLserviceDAACIndex LLserviceCS_RAACmap LLserviceRCIndex LLserviceRAACIndex LLserviceCD_RCmap LLserviceCS_DAACmap LLserviceRowStatus RCTable RCEntry RCindex RCcontantAssignment RCvolume_allowed RCrbdc_allowed RCmax_service_rate RCmin_service_rate RCconstant_service_rate RCmax_backlog RCrowStatus RAACTable RAACEntry RAACIndex RAACmaxUniquePayloadBlock RAACmaxConsecutiveBlock RAACminIdleBlock RAACdefaults_field_size RAAC_raLoad_control RAACrowStatus}	NA	-	-	-	Entry of LL service Table	RCS2
LLserviceIndex	Unsigned32	NA	-	-	-	Index of LL service Table	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
LLserviceRCIndex	Unsigned32	RC	-	-	-	A 4 bit field indicating the nominal request class for the associated Link Service.	RCS2
LLserviceDAACIndex	Unsigned32	RC	-	-	-	A 4 bit field indicating the nominal dedicated access allocation channel associated with the Link Stream. The Assignment ID associated to the request class has an offset to the Assignment ID Base equal to the nominal_da_ac_index;	RCS2
LLserviceCS_RAAC map	Unsigned32	RC	-	-	-	16 bit field indicating the allowance to conditionally map resource demand for the associated Link Stream into capacity requests for other RCs, with bit 0 referring to rc_index=0, bit 1 referring to rc_index=1 and so on;	RCS2
LLserviceRCIndex	Unsigned32	RC	-	-	-	A 16 bit field indicating the allowance to conditionally map traffic from the Link Stream into the different dedicated assignment allocation channels, indicated by a flag for each DA-AC, with bit 0 referring to da_ac_index=0, bit 1 referring to da_ac_index=1 and so on.	RCS2
LLserviceRAACIndex	Unsigned32	RC	-	-	-	A 4 bit field indicating the nominal random access allocation channel associated with the Link Lower layer Service. The corresponding Assignment ID equals the highest Assignment ID value in the system minus ra_ac_index	RCS2
LLserviceCD_RCmap	Unsigned32	RC	-	-	-	An 8 bit field indicating the allowance to conditionally map Link Stream traffic into the different random access allocation channels, indicated by a flag for each RA-AC, with bit 0 referring to ra_ac_index=0, bit 1 referring to ra_ac_index=1 and so on.	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
LLserviceCS_DAAC map	Unsigned32	RC	-	-	-	A 16 bit field indicating the allowance to conditionally map traffic from the Link Stream into the different dedicated assignment allocation channels, indicated by a flag for each DA-AC, with bit 0 referring to da_ac_index=0, bit 1 referring to da_ac_index=1 and so on.	RCS2
LLserviceRowStatus	Unsigned32	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2
RCTable	SEQUENCE	NA	-	-	-	RC Table configuration table	RCS2
RCEntry	SEQUENCE OF	NA	-	-	-	RC Entry	RCS2
RCindex	Unsigned32	NA	-	-	-	The RCST by default maps its default request class to rc_index 0.	RCS2
RCcontantAssignment	INTEGER	RC		Non-solicited(0), Solicited(1)		Flag to indicate if constant non-solicited assignment is provided for the RC	RCS2
RCvolume_allowed	INTEGER	RC		NotAllowed(0), Allowed(1)		Flag to indicate if A/VBDC requests are allowed for the rc_index	RCS2
RCrbdc_allowed	INTEGER	RC	kbps	NotAllowed(0), Allowed(1)		Flag to indicate if RBDC requests are allowed for the rc_index in kilo bits per second	RCS2
RCmax_service_rate	Unsigned32	RC	kbps			Field that indicates the maximum service rate for the rc_index. The maximum allowed RBDC equals this level substracted by the CRA in kilo bits per second	RCS2
RCmin_service_rate	Unsigned32	RC	kbps			Field that indicates the minimum rate that can be expected assigned when actively requesting any dynamic capacity for the rc_index	RCS2
RCconstant_service_rate	Unsigned32	RC	kbps			16-bit field indicating the admitted CRA level associated with the request class in kilo bits per second	RCS2
RCmax_backlog	Unsigned32	RC	kbps			8-bit field indicating the max volume request backlog that the NCC will accept to hold for the rc_index in kilo bits per second	RCS2

Functional Group	dvbRcs2QoSConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
RCrowStatus	RowStatus	RC				The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2
RAACTable	Unsigned32	RC				Table that contains the Random Access allocation channels configuration	RCS2
RAACEntry	Unsigned32	RC				Entry for Random Access Table	RCS2
RAACIndex	Unsigned32	RC				Index for Random Access Table	RCS2
RAACmaxUniquePayloadBlock	Unsigned32	RC				8-bit field that indicates the max number of unique payloads that the RCST is permitted to send in an RA block	RCS2
RAACmaxConsecutiveBlock	Unsigned32	RC				8-bit field that indicates the max number of consecutive RA blocks that the RCST is permitted to access for sending unique payloads	RCS2
RAACminIdleBlock	Unsigned32	RC				8-bit field that indicates the min nbr of RA bloacks that the RCST ignores for a given ra_ac index after having accessed a max allowed nbr of consecutive RA blocks	RCS2
RAACdefaults_field_size	Unsigned32	RC				8-bit field indicating the method dependent size of the defaults_for_ra_load_control field that contains the default values for the dynamic load control parameers	RCS2
RAAC_raLoad_control	Unsigned32	RC				A defauts_field_size byte field that contains the default values for the load control method for the random access allocation channel.	RCS2
RAACrowStatus	RowStatus	RC				The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2

8.6.19 Flink configuration group

Table 8.18 contains the list of the fowardlink attachment points (e.g. different for installation and operation).

Table 8.18: RCST Flink configuration RCS2 Group

Functional Group	dvbRcs2FwdConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
dvbRcs2FwdStart Table	Sequence of FwdStartEntry	NA				The Table described the forward link parameters used for the start up with the NCC.	RFC 5728 [i.55]
dvbRcs2FwdStart Entry	SEQUENCE { dvbRcs2FwdStart Index, dvbRcs2FwdStart PopID, dvbRcs2FwdStart Frequency, dvbRcs2FwdStart Polar , dvbRcs2FwdStart Format, dvbRcs2FwdStart Rolloff, dvbRcs2FwdStart SymbolRate , dvbRcs2FwdStart InnerFec, dvbRcs2FwdStart RowStatus	NA					RFC 5728 [i.55]
dvbRcs2FwdStartI ndex	Unsigned32(1..8)	NA				Index of the Forward Link StartConfig table.	RFC 5728 [i.55]
dvbRcs2FwdStart PopId	Integer32	RC				Population identifier associated with the start-up Forwardlink: -1: any (auto) 0-65535: specific StartPopId If 'any' is set, the RCST will assume membership of any announced population ID and will commence with logon in accordance with this assumption	RFC 5728 [i.55]
dvbRcs2FwdStart Frequency	Unsigned32	RC	x100 kHz			Frequency of the start transponder carrying a Network Information Table to which any RCST triggers to acquire forward link. Its value is given in multiples of 100 kHz	RFC 5728 [i.55]
dvbRcs2FwdStart Polar	INTEGER	RC		linearHori zontal (0), linearVerti cal (1), circularLef t (2), circularRig ht (3)		2-bit field giving the polarization of the start transponder carrying a network Information Table to which any RCST shall trigger to acquire forward link: 00: linear and horizontal 01: linear and vertical 10: circular left 11: circular right"	RFC 5728 [i.55]
dvbRcs2FwdStart Format	INTEGER	RC		auto (-1), dvbs (0), dvbs2ccm (1), dvbs2acm (2)		Specifies the transmission format standard applied for the startup stream. The start transport stream carries a Network Information Table that the RCST uses for acquiring the forward link signaling. Supported values are: -1: unspecified (automatic format acquisition is assumed) 0: DVB-S (support of this value is mandatory if DVB-S support	RFC 5728 [i.55]

Functional Group	dvbRcs2FwdConfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
						is claimed) 1: DVB-S2 with CCM (support of this value is mandatory if DVB-S2 CCM support is claimed) 2: DVB-S2 with VCM or ACM (support of this value is mandatory if DVB-S2 ACM support is claimed) This allows the RCST to discriminate between CCM and VCM/ACM when selecting the forward link. The support of automatic format selection is optional. One or several of the other format selections must be supported, according to the claimed SatLabs profile support."	
dvbRcs2FwdStart RollOff	INTEGER	RC		autoRollof f (0), rolloff010,(1) rolloff020 (2), rolloff025 (3), rolloff035 (4)		Specifies the receive filter roll-off applied on the start transponder. The start transponder carries a Network Information Table that the RCST uses for acquiring the forward link signalling.Supported values are: 0: any (auto) 1: 0.10 2: 0.20 3: 0.25 4: 0.35"	RFC 5728 [i.55]
dvbRcs2FwdStart SymbolRate	Unsigned32	RC	x100 sym bols/ s			Specifies the symbol rate on the start transponder carrying a Network Information Table to which any RCST triggers to acquire forward link. Its value shall be given in multiples of 100 symbols/s	RFC 5728 [i.55]
dvbRcs2FwdStartI nnerFec	INTEGER	RC		autoFec (-1), fecRate12 (0), fecRate23 (1), fecRate34 (2), fecRate56 (3), fecRate78 (4), fecRate89 (5), fecRate35 (6), fecRate45 (7), fecRate91 0 (8), fecRate25 (9), fecRate13 (10),		Specifies the inner Forward Error Correction used on the start transponder carrying a Network Information Table to which any RCST triggers to acquire forward link. Supported values are: autoFec (-1), fecRate1/2 (0), fecRate2/3 (1), fecRate3/4 (2), fecRate5/6 (3), fecRate7/8 (4), fecRate8/9 (5), fecRate3/5 (6), fecRate4/5 (7), fecRate9/10 (8), fecRate2/5 (9), fecRate1/3 (10), fecRate1/4 (11), noInnerCode (12) The support of autoFec is optional	RFC 5728 [i.55]

Functional Group	dvbRcs2FwdConfiguration						
Element	Parameter	Type	Unit	Range	Default	Description	Source
				fecRate14 (11), noInnerCode (12)			
dvbRcs2FwdStartRowStatus	RowStatus	RC				The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RFC 5728 [i.55]

8.6.20 Rlink configuration group

Table 8.19 contains the list of the return link attachment points (e.g. different for installation and operation).

Table 8.19: RCST Rlink configuration RCS2 Group

Functional Group	dvbRcs2RtnConfiguration						
Element	Parameter	Type	Unit	Range	Default	Description	Source
RtnConfigMaxEirp	Integer32	RW	x0.1 dBm			Max Equivalent Isotropic Radiated Power (EIRP) of the RCST, given in resolution of 0.1 dBm and applied when the IDU can, itself, set the necessary IDU TX output level, e.g. when using a BUC that has a power level detector and that provides sufficient feedback to the IDU."	
RtnConfigDefIfLevel	Integer32	RW	x0.1 dBm			IDU TX output level applied in case the dvbRcsRtnConfigMaxEirp cannot be used. The resolution is 0.1 dBm and the accuracy is +/- 1 dBm.	

8.6.21 VLAN configuration group

VLAN MIB is configurable on a per-interface basis and depends in several parts on the IF-MIB (RFC 2863 [13]).

The RCST may support the following MIB table entries to control the use of the VLAN-Tagged IP Routing mode:

- A management parameter that describes whether an RCST is capable of supporting this mode as part of the System configuration MIB dvbRcs2SystemOptionMap.
- A management parameter that allows the NCC to control the use of this mode by an RCST for a specific LAN interface.

The following MIB table entries define the set of tag values that are assumed to be used by an RCST that enables this option. These management and control functions define the set of VLAN-IDs and the Priority Code Point (PCP) values that may be used by an RCST for frames received on a specified LAN interface.

- A set of allowed VLAN-IDs may be set. This table permits wild-card values that may match several VLAN-IDs. A frame with a VLAN ID that is not in this table is forwarded in an untagged format.
- A maximum PCP value is specified. This determines the highest PCP value that will be forwarded from an RCST to the satellite interface (higher values will be reduced to this value).

8.6.22 NAT/NAPT configuration group

NAT MIB is configurable on a per-interface basis and depends in several parts on the IF-MIB (RFC 2863 [13]).

NAT MIB is defined in (RFC 4008 [i.89]) and NAPT variants in (RFC 3489 [i.82])

The RCST may implement the natInterfaceTable MIB module from (RFC 4008 [i.89]) to configure interface specific realm type and the NAT services enabled for the interface. natInterfaceTable is indexed by ifIndex and also includes interface specific NAT statistics.

The RCST may implement natAddrMapTable MIB module from (RFC 4008 [i.89]) to configure address maps on a per-interface basis.

The RCST may implement two Bind tables, natAddrBindTable and natAddrPortBindTable from (RFC 4008 [i.89]), defined to hold the bind entries. Entries are derived from the address map table and are not configurable.

The RCST may implement the natSessionTable defined to hold NAT session entries.

The RCST NAT/NAPT function may be configurable per enabled interface, including the following parameters:

- NAT enable/disable flag. By default NAT may be disabled.
- Global and Local addresses.
- Static NAPT UDP/TCP port translation range.
- Dynamic NAPT UDP/TCP port translation range.

8.6.23 PEP negotiation configuration

The PEP negotiation group compiles all the necessary information to perform PEP negotiation between the RCST and the NCC.

Table 8.20: RCST PEP negotiation RCS2 Group

Functional Group	dvbRcs2RCSTPepNegotiation						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
hlsAgentmulticastInetAddresstype	InetAdressType	RW	-	-	-	Multicast IPv4 address type to be used by the HLS negotiation agent	RCS2
hlsAgentMulticastInetAddress	InetAddress	RW	-	-	-	Multicast IPv4 address to be used by the HLS negotiation agent	RCS2
hlsAgentMulticastInetAddressPrefixLength	InetAddressPrefixLength	RW	-	-	-	Multicast IPv4 address prefix length to be used by the HLS negotiation agent	RCS2
hlsnegotiationAgentudpPort	InetPortNumber	RW	-	-	-	UDP port to be used by the HLS negotiation agent	RCS2
pepTypePerIfTable	SEQUENCE	NA	-	-	-	RCST PEP configuration per Interface	RCS2
pepTypeIfEntry	SEQUENCE OF	NA	-	-	-	PEP table entry	RCS2
pepTypeIfIndex	Unsigned32	NA	-	-	-	Index for PEP configuration per interface	RCS2
pepTypefInterfaceID	Interface	RC	-	-	-	Interface ID from the interfaces group	RCS2
pepTypenonStandardPEPmechanism	BOOLEAN	RC	-	-	-	Flag to disable non standard PEP mechanisms for SVN-MAC	RCS2
pepTypeIfVendorID	OCTET STRING	RC	-	-	-	PEP Vendor ID	RCS2
pepTypeIfProductID	OCTET STRING	RC	-	-	-	PEP Product ID	RCS2
pepTypeIfTCP	INTEGER	RC		Disabled (0), Enabled(1)		TCP PEP status enabled / disabled	RCS2
pepTypeIfHTTP	INTEGER	RC		Disabled (0), Enabled(1)		HTTP PEP status enabled / disabled	RCS2
pepTypeRowStatus	RowStatus	RC	-	-	-	The row status, used according to row creation and removal conventions. A row entry cannot be modified when the status is marked as active(1).	RCS2

8.6.24 SDDP configuration

The SDDP configuration group comprises information related to download of software to the RCST by SDDP.

Table 8.21: RCST SDDP RCS2 Group

Functional Group	dvbRcs2SDDPconfiguration						
Element	**Parameter**	**Type**	**Unit**	**Range**	**Default**	**Description**	**Source**
Blksize	Unsigned32	RO	Bytes			Set the DATA block size to another value than the default of 512 byte	RCS2
Tsize	Unsigned32	RO	Bytes			Indicates the total transfer size	RCS2
manufID	Unsigned32	RO	24 bit as decimal value			Indicates the OUI	RCS2
SwVersion	Unsigned32	RW				Current SW version in the SW distribution carousel, respective to the manufID and vendor specific parameters	RCS2
MinSwVersion	Unsigned32	RW				Indicates the minimum SW version required for log-on, with respect to manufID and vendor specific parameters	RCS2
Method	Unsigned32	RW				Indicates if the SW update method is different from the default "immediate". It can also be "pending", i.e. awaiting the next RCST restart.	RCS2
Timeout	Unsigned32	RW	seconds			Indicates the timeout when waiting for the next DATA packet, default value is given in the initial configuration (sec).	RCS2
MgroupType	InetAddress Type	RW					RCS2
MgroupAddress	InetAddress	RW				Set a redirection multicast group address respective to the manufID and vendor specific parameters	RCS2
MgroupPrefixLength	InetAddress PrefixLengt h	RW					RCS2
Port	InetPort	RW				Sets a redirection UDP port respective to the manufID and vendor specific parameters	RCS2
Layer2	Unsigned32	RW	Bytes			Indicate the redirection layer 2 address for a specific download	RCS2

8.7 RCST Commissioning and initialization

This clause provides a description of the initial RCST commissioning and configuration for a successful logon in the OVN.

The RCST commissioning and configuration is done during installation by RCST configuration file and is completed during logon thanks to the information provided in the TIM unicast message. Earlier local/remote configuration of the terminal is superseded by the information contained in the Logon Response Descriptor, Lower Layer Service Descriptor, Higher Layer Descriptor or the MIB objects in the Network Layer Information Descriptor (NLID).

The format of the Higher Layer descriptor is provided in [3].

The complete set of RCST parameters seeks to be sufficient to ensure correctly operation in the RCS2 interactive satellite system.

The RCST commissioning and configuration covers the following steps:

1) Verify RCST commissioned flag. If not OK initiate the RCST initial settings.

2) RCST initial settings made by the installer or through a configuration file.

3) RCST Software check and update. The correct version is identified through Forward Link signalling.

4) RCST MAC-level logon (as defined in [3]). The RCST acquires the corresponding set of descriptors.

5) RCST configuration update. A final adjustment of the RCST configuration can be made in this phase thanks to the latest RCST logon information. The System configuration MIB may reflect the options and final system configuration of the RCST after logon.

After these steps, the RCST will reach the operational state and will be ready to transmit traffic. Figure 8.10 shows a sequence diagram with the different states and performed actions. Subsequent updates of software and configuration are assumed possible once the RCST is in operational state using the management IP interface.

If the commissioned-ok flag is not set, the RCST may block network forwarding of user traffic to/from the LAN interface. This allows further IP configuration. The RCST completes the configuration by enabling traffic forwarding when the commissioned-ok flag is set (e.g. by loading a new configuration or direct action to raise the flag).

The RCST logon procedure logon may be conditioned by the commissioning state of the RCST. The commissioning state of the RCST is assumed notified to the NMC and to the NMC through the logon flags as specified in [3].

The RCST MIB-II system, interfaces, ip, RCS2 system, RCS2 network, RCS2 QoS, RCS2 VRF parameters are assumed to be configured before the RCST can start working at the MAC level.

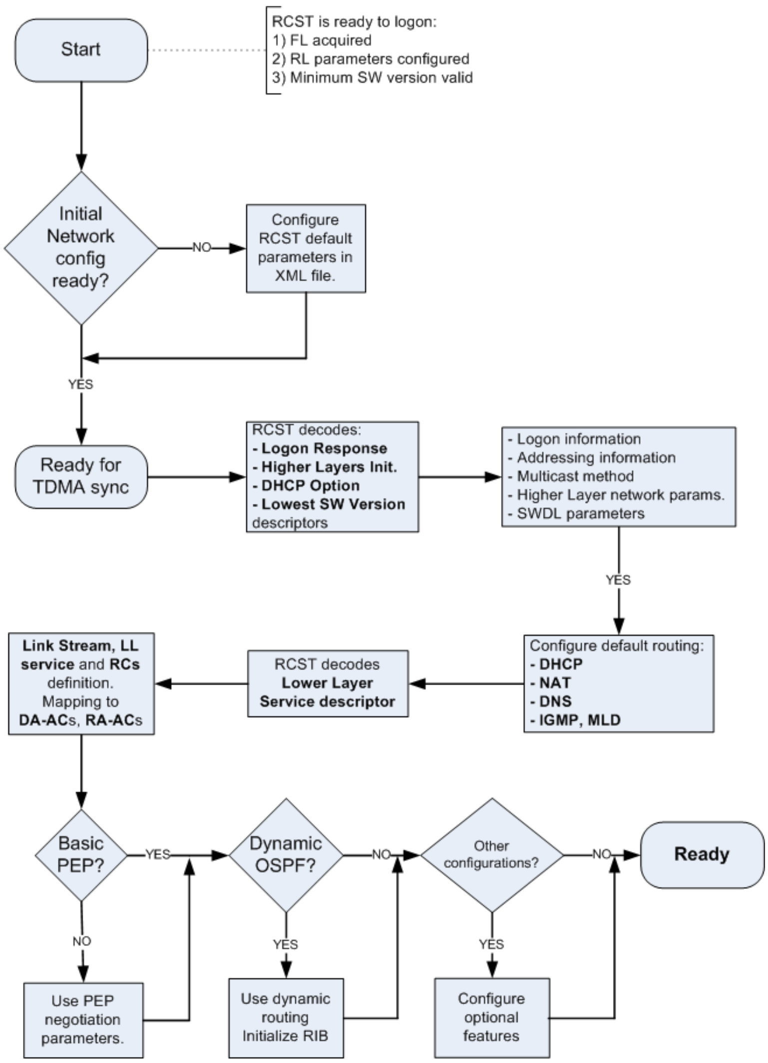


Figure 8.10: RCST commissioning and logon procedure

The following clause enumerates a list of parameters necessary for RCST initial commissioning.

8.7.1 RCST Management Signalling Configuration parameters

The RCST management signalling information may include:

- RCST IPv4 address for M and C
- RCST SVN-MAC of the management interface
- SVN mask bits of the assigned management SVN-MAC
- IPv4 address and subnet of the Management interface of the NMC
- SNMP read/write community strings (char string) for the SNO and SVNO

The RCST needs to indicate it has a valid M and C IP address associated or its management entity or not at logon.

The RCST needs to keep its M and C address across reboots and re-logons as long as it connects to the same NCC/NMC.

The management SVN is indicated by the NCC in the MAC Logon response.

After successful logon, the RCST is assumed able to receive remote configuration commands using the SNMP protocol, or any tunnelling protocol specified in [3].

SNMP configuration is given also by MIB parameters in SNMP group (see clause 8.8).

8.7.2 RCST HLS Configuration parameters

The RCST HLS parameters are configurable both locally by the RCST installer and remotely by management via configuration file.

The RCST systems parameters may be configured providing the following parameters:

- RCST System group (see clause 8.6.1)
- RCST System configuration group (see clause 8.6.10)

The RCST completes its SVN interfaces configuration according to the parameter values provided during logon. The logon information provided in Logon Response and the Higher Layer Initialization and the DHCP Option descriptors, whose format is specified in [3] supersede the configuration provided by local or remote configuration file.

The RCST addressing and networking information may be configured by providing the following parameters:

- RCST interfaces group (see clause 8.6.2)
- RCST IP group (see clause 8.6.3)
- RCST RCS2 network group (see clause 8.6.12), including the DNS proxy enabled for IPv4/IPv6 using IPv4IPv6 transport per interface
- RCST RCS2 VRF configuration (see clause 8.6.13)
- RCST VLAN configuration (see clause 8.6.21)
- RCST NAT/NAPT configuration (see clause 8.6.22)

The set of networking and routing options in the RCST may be initialize during logon thanks to the DHCP Option descriptor in TIM-u message, specifically per each of the LAN interfaces corresponding to the traffic SVNs supported by the RCST.

Once the RCST has decoded the Lower Layer Service descriptor, it is needed to perform the mapping between the HLS and LL parameters related to QoS (LL services). For that purpose, a minimum configuration with the default setting for the following parameters may be provided through an RCST configuration file. This information may be superseded using a TIMu NLID descriptor during logon.

The RCST QoS configuration may include:

- Default entry in the IP classification table. The RCST may include one entry in this table, matching all the IP traffic. This entry is linked to the default HLService.
- HLS mapping table. At least one entry with the default policy is provided in the default RCST configuration.
- LL service parameters provided during logon.

The MIB objects needed to configure these parameters are listed in clause 8.6.

The use of non-standard PEP by a SVN is enabled in the lower layer signalling. PEP negotiation is also configured by the lower layers per SVN using the Higher Layer Initialization descriptor, notified in the logon TIM-u following the PEP negotiation protocol parameters in clause 8.6.23.

The configuration may be controlled following login using the HLS agent negotiation messages (see clause 9.2.1) transport over UDP/IP.

PEP negotiation protocol configuration is supported via the RCST MIB as described in clause 8.6.23. PEP may be enabled/disabled per RCST interface.

8.8 RCST MIB access management Roles

M and C could be supported by the different roles interfaces as follows, indicated as Essential (E) or Other (O):

Table 8.22: RCST MIB access management roles

		SNO						SVNO				User	
		SNMP/NLID		SNMP/IP		ASCII File/FTP		SNMP/IP		ASCII File/FTP		HTTP/IP	
Functional Group	**Description**	**O/E**	**Access**	**O/E**	**Access**	**O/E**	**Access**	**O/E**	**Access**	**O/E**	**Access**	**O/E**	**Access**
SystemConfig	RCS2 System config	E	WO	E	RW	E	WO	E	RO	E	RW	O	RO
NetworkConfig	RCS2 Network config	E	WO	E	RW	E	WO	E	RO	E	RW	O	RO
Installation	RCS2 installation	-	-	E	RW	E	WO	E	RW	E	RW	O	RO
Control	RCS2 control commands	E	WO	E	RW	E	WO	E	RW	E	RW	O	RO
State	RCS2 state	-	-	E	RO	-	-	E	RO	-	-	O	RO
Statistics	RCS2 statistics	-	-	E	RO	-	-	E	RO	-	-	O	RO
QoSConfiguration	for the satellite interface	-	-	E	RO	E	WO	E	RO	E	WO	O	RO
FlinkConfiguration	part of satellite LL	-	-	E	RO	E	WO	E	RO	E	WO	O	RO
RlinkConfiguration	part of satellite LL	-	-	E	RO	E	WO	E	RO	E	WO	O	RO
VRFConfig	VRF	-	-	O	RO	O	WO	E	RO	E	WO	O	RO
VLAN	VLAN	-	-	O	RO	O	WO	E	RO	E	WO	O	RO
C2P Agent Configuration	For mesh	-	-	O	RO	O	WO	E	RO	E	WO	O	RO
PEP Negotiation	PEP	-	-	O	RO	E	WO	E	RO	-	-	O	RO
System	System MIB-II	-	-	E	RW	E	WO	E	RO	E	WO	O	RO
Interfaces	Interfaces MIB-II	-	-	E	RW	E	WO	E	RO	E	WO	O	RO
IP	IP MIB-II	-	-	E	RW	E	WO	E	RO	E	RW	O	RO
ICMP	ICMP MIB-II	-	-	E	RW	E	WO	E	RO	E	RW	O	RO
TCP	TCP parameters	-	-	O	RO	O	WO	O	RO	E	RW	O	RO
UDP	UDP parameters	-	-	O	RO	O	WO	O	RO	E	RW	O	RO
SNMP	SNMP parameters	O	WO	E	RW	E	WO	E	RO	E	RW	O	RO
IGMP	IGMP MIB-II	O	WO	E	RW	E	WO	O	RO	E	RW	O	RO
Ethernet	Ethernet MIB-II	-	-	O	RO	O	WO	O	RO	O	WO	O	RO
NAT/NAPT	NAT/NAPT MIB-II	-	-	E	RW	E	WO	E	RO	E	RW	O	RO
IPv4 DHCP	DHCP options	-	-	E	RW	E	WO	E	RO	E	RW	O	RO
IPv6 DHCP	DHCP options	-	-	E	RW	E	WO	E	RO	E	RW	O	RO

9 Intercepting traffic

This clause describes a set of agents that provide deep packet inspection to allow cross-layer optimisation of higher layer functions.

Interception of packets is associated with a specific SVN-MAC over which the traffic will be sent/received.

9.1 Agent Architecture

In the present document, an agent is defined as an entity that intercepts specific control traffic flows, redirecting these to an HLS module.

Figure 9.1 illustrates this ingress/egress processing by the higher-layer system, focussing on network-layer processing following reception of a packet by the LAN interface. The diagram is intended to be informative and does not mandate any particular internal structure of an RCST. Solid lines represent the flow of PDUs and other data through the system, whereas dashed lines are used to denote control relationships. Simple functions or objects are represented by boxes, selector mechanisms by hexagons, and complex objects by pentagons.

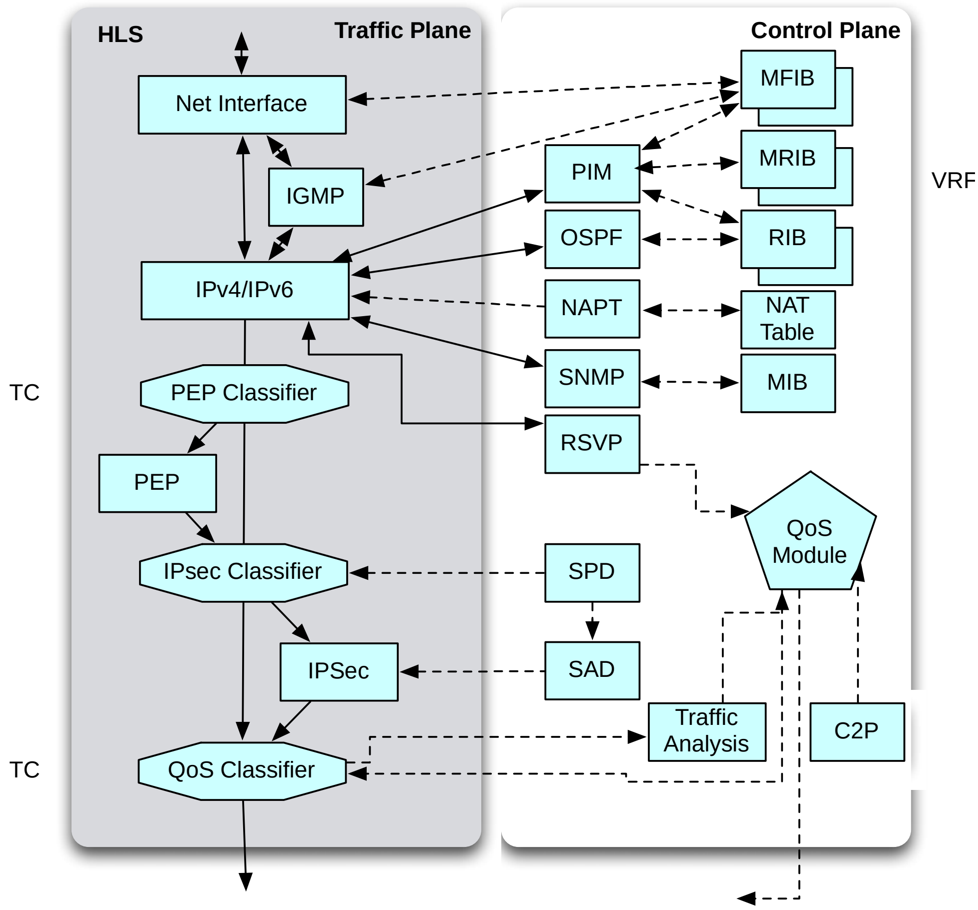


Figure 9.1: RCST network layer functions illustrating an example of placement of PEP and IPsec

9.2 HLS Agent Control Protocol

This clause describes a protocol to configure and control the agents in an RCST.

The RCST shall support the HLS agent control protocol. This protocol is used over the IPv4 address provisioned for a satellite interface and bound to a SVN-MAC label for management signalling. Functions of the protocol include selecting operational parameters and enabling/disabling specific agents.

Each RCST Agent control message shall contain a one byte field in the first byte of each message. This indicates the type of message. A message with a type value of zero shall be used to indicate an error message. A message with an unknown type shall be silently discarded. Receivers shall not generate an error message for an unknown message type (these values are reserved for future versions of the specification).

Messages exchanged using an SVN shall be used by the NCC to configure the operation of the RCST Agent modules for the corresponding Traffic SVN. Messages shall be exchanged using the management SVN.

The following message types are supported in the present version of the specification.

Table 9.1: Agent Control message formats

Message	Message ID	Vendor OUI and Product ID	Product Capability List	Configuration Block
Error	0			
PEP Advertise	1	N ≥ 1	N	
PEP Offer	2	M ≥ 1		
PEP Use	3	1		0 or 1
Reserved	>3			

A receiver shall silently ignore all reserved values.

The RCST shall support the current set of messages for TCP-PEP negotiation. Each offer contains N descriptors for the offered TCP-PEPs. Each response contains M descriptors for the supported TCP-PEPs, where M=<N. The NCC finally selects one TCP-PEP.

The RCST Agent negotiation messages shall be transported in the following way:

- The IPv4 multicast group destination address and UDP port number are received via a descriptor in the TIM-U.
- A PEP Advertise message is received on the forward link. This shall be directed to either the advertised IPv4 multicast address or unicast to the assigned RCST IPv4 address. The message is sent using the advertised UDP port.
- A PEP Offer message is sent with an IPv4 destination address that matches the IP source address of the PEP Advertise message and using the UDP destination port that was used in the PEP Offer message. The IP packet is sent with the IP source of the RCST and using the same SVN on which the PEP Offer was received.
- A PEP Use or PEP Error message is sent in response to a PEP Offer message. This has an IP source address that is identical to the IP destination address of the PEP Offer and a IPv4 destination address identical to the IP source address used for the PEP Offer. The UDP source port is identical to the UDP destination port of the PEP Offer message.

The above exchange is used to configure the PEP used for a specific SVN. An RCST that supports multiple SVNs shall repeat this negotiation for each SVN that is active.

Other uses of this protocol are currently reserved.

9.2.1 PEP Negotiation Protocol

An RCST or/and NCC can provide a TCP-PEP and protocol acceleration support. The Satlabs systems recommendations (SatLabs System Recommendations [i.2]) define a TCP-PEP for use for with an RCS network. Advice on the use of TCP-PEPs is provided in (RFC 3135 [i.31]) and (RFC 3449 [i.36]). (RFC 3135 [i.31]) advises that operators and users should be able to control whether a TCP-PEP is used for a specific session.

The RCST shall support a mechanism by which an RCST selects the TCP-PEP Agent that it will use. When multiple versions of a specific TCP-PEP are available, this mechanism shall also be used to select the version that is used. When no TCP-PEP is available, this mechanism shall be used to indicate no TCP-PEP support to the NCC.

Each uniquely identifiable set of parameters is called a "PEP configuration". A vendor has the flexibility to create multiple "PEP configuration" entries for the same TCP-PEP module, if this introduces potential modes that can be recognised as a basis for negotiation.

An RCST shall allow none (null TCP-PEP), one or multiple versions of a TCP-PEP to simultaneously process traffic. The use of the null TCP-PEP does not modify the traffic.

When multiple TCP-PEP are supported by the RCST, one and only one PEP shall be configured per SVN-MAC. A Traffic Class may be used to segregate traffic between different active TCP-PEP modules.

The RCST shall comply with the PEP negotiation that comprises three stages:

1) In the first stage, the PEP negotiation starts with a message advertising a set of PEP configurations. This may be broadcast periodically (in the case of a NCC), or triggered by another event (e.g. Logon or setup a mesh connection).

2) In the second stage, the RCST selects the TCP-PEP it prefers to use from the offered set (if any). It then generates an offer message. The choice is based on local policy at the receiver and knowledge of the available PEP configurations. An RCST may (optionally) utilize the capability field to choose between equivalent offers. This identifies one or more candidate PEP configurations. This could be one of the following:

    - A single offered TCP-PEP configuration, which the RCST believes matches the initiator's offered set of PEP configurations.

    - An offer indicating multiple TCP-PEP configuration offerings, from which the initiator should choose one to use.

    - An error response that indicates that client wishes to abort the present negotiation.

3) The final stage is the selection of the PEP to be used for the SVN-MAC on which the offer was received. The initiator selects an identical or compatible PEP configuration. This selection must be made from the offered set, and the initiator then informs the RCST which TCP-PEP to use. An error message may be sent when the negotiation cannot be completed.

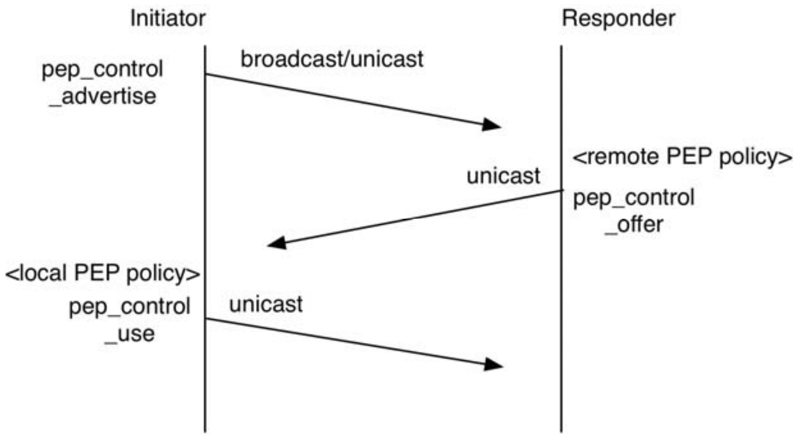


Figure 9.2: PEP Negotiation Exchange

Once activated, the relevant configuration of parameters can be successfully performed by a two-sided PEP, an optional configuration string may be used to assist in this initial configuration.

9.2.1.1 PEP Control Advertise Message

A PEP Control Advertise Message is used to indicate the set of TCP-PEP configurations available at the initiating entity. Each PEP configuration is identified by the combination of a pep_vendor_id (encoded as a 24-bit OUI value), and a pep_standards_id. The pep_product_id is selected by the vendor to identify a particular implementation (software version and/or model number). The pep_standards_id field references a particular feature set (uniquely identifiable version of a PEP).

The RCST shall accept the PEP Control Advertise message sent in broadcast mode by the NCC. The broadcast message announces a system-wide capability applicable to all SVNs.

The RCST shall accept the PEP Control Advertise message sent in unicast to a peer RCST using a mesh connection.

The PEP-Capability field is used to carry an indication of the class of TCP-PEP mechanisms that are supported. This is intentionally not a detailed specification of specific mechanisms or specific values, and should only be used to help identify the most suitable client TCP-PEP configuration.

Table 9.2: PEP Control Advertise Message

Syntax	No. of bits (default value)	Mnemonic
pep_control_advertisement () {		
pep_control_type	8 (0x01)	uimsbf
number_of_records	8	uimsbf
for (i=0; i < number_of_records i++) {		
pep_vendor_id	24	uimsbf
pep_product_id	16	uimsbf
pep_standards_Id	16	uimsbf
pep_capability	32	uimsbf
}		
}		

The default PEP profile shall be zero. A non-zero value is used to indicate a fully-specified PEP configuration.

Table 9.3: PEP Control capability field

Syntax	No. of bits	Mnemonic
pep_capability () {		
pep transparent_ipv4_supported	1	bslbf
pep_transparent_ipv6_supported	1	bslbf
pep_transparent_other_supported	1	bslbf
pep_ipv4_supported	1	bslbf
pep_ipv6_supported	1	bslbf
pep_other_supported	1	bslbf
reserved	1	bslbf
pep_ipv4_header_compression	1	bslbf
pep_ipv4_content_compression	8	bslbf
pep_ipv6_header_compression	1	bslbf
pep_ipv6_content_compression	1	bslbf
pep_udp_header_compression	1	bslbf
pep_udp_content_compression	1	bslbf
pep_tcp_header_compression	1	bslbf
pep_tcp_content_compression	1	bslbf
pep_tcp_transparent_interception	1	bslbf
pep_tcp_transform	1	bslbf
pep_http_header_compression	1	bslbf
pep_http_transparent_interception	5	bslbf
pep_http_transform	1	bslbf
pep_http_content_transcode	1	bslbf
pep_https_transform		

A PEP client that can operate without a peer at the hub side (i.e. it does not require a peer at the initiator to convert PEP format packets back to the original protocol). The table above defines a set of capability attributes. These values are defined below:

pep_transparent_ipv4_supported: The PEP will intercept and process IPv4 packets (including possibly also interpreting transport and higher packets carried within IPv4 packets, as indicated by other flags).

pep_transparent_ipv6_supported: The PEP will intercept and process IPv6 packets (including possibly also interpreting transport and higher packets carried within IPv4 packets, as indicated by other flags).

pep_transparent_other_supported: The PEP will intercept and process other (e.g. user-defined) packets (including possibly also interpreting transport and higher packets carried within these user-defined packets, as indicated by other flags).

pep_ipv4_content_compression: The PEP will perform lossless compression of IPv4 content.

pep_ipv6_content_compression: The PEP will perform lossless compression of IPv6 content.

pep_udp_content_compression: The PEP will perform lossless compression of UDP content.

pep_tcp_content_compression: The PEP will perform lossless compression of TCP content.

pep_other_compression: The PEP will perform lossless compression of custom content.

pep_tcp_transparent_interception: The PEP will intercept TCP connections (e.g. split TCP) by preserving TCP compatibility.

pep_http_transparent_interception: The PEP will intercept HTTP by preserving HTTP compatibility (e.g. pre-fetching).

pep_rtp_transparent_interception: The PEP will intercept RTP by preserving RTP compatibility.

pep_http_transcode: The PEP will perform HTTP content transcoding (e.g. image/voice codec transcoding).

pep_rtp_transcode: The PEP will perform RTP content transcoding.

pep_other_transcode: The PEP will perform transcoding of custom content.

One-sided operation use only a PEP at the advertising end, and no enhancement at the remote end. Remote sides may therefore reasonably expect that one-sided enhancements will be able to provide some form of acceleration.

The following capability attributes resemble those defined for one-way operation, but require a corresponding PEP entity at the remote end. The specifics of the PEP method depend on the specific implementation as defined by the combination of (pep_vendor_id, pep_product_id, pep_standards) fields.

pep_ipv4_supported: The PEP will intercept and process IPv4 packets (including possibly also interpreting transport and higher packets carried within IPv4 packets, as indicated by other flags). If this field is ‘0’, the PEP will not perform any of the functions listed below for IPv4 traffic.

pep_ipv6_supported: The PEP will intercept and process IPv6 packets (including possibly also interpreting transport and higher packets carried within IPv6 packets, as indicated by other flags). If this field is ‘0’, the PEP will not perform any of the functions listed below for IPv6 traffic.

pep_other_supported: The PEP will intercept and process other (e.g. user-defined) packets (including possibly also interpreting transport and higher packets carried within these user-defined packets, as indicated by other flags). If this field is ‘0’, the PEP will not perform any of the functions listed below for these user-defined packets.

pep_ipv4_header_compression: The PEP will perform IPv4 header compression.

pep_ipv6_header_compression: The PEP will perform IPv6 header compression.

pep_udp_header_compression: The PEP will perform compression of UDP/IP headers.

pep_tcp_header_compression: The PEP will perform compression of TCP/IP headers.

pep_http_header_compression: The PEP will perform compression of HTTP headers.

pep_rtp_header_compression: The PEP will perform compression of RTP/UDP/IP headers.

pep_tcp_transform: The PEP will intercept TCP/IP connections (e.g. split TCP) through provisioning the remote peer to do the appropriate inverse transform.

pep_http_transform: The PEP will intercept HTTP/TCP/IP through provisioning the remote peer to do the appropriate inverse transform, according to the default method for the implementation.

pep_https_transform: The PEP will intercept HTTPS/TCP/IP through provisioning the remote peer to do the appropriate inverse transform.

pep_rtp_transform: The PEP will intercept RTP through provisioning the remote peer to do the appropriate inverse transform.

pep_other_transform: The PEP will intercept other (e.g. user-defined) packet types through provisioning the remote peer to do the appropriate inverse transform.

pep_other_custom: The PEP will perform other (e.g. user-defined) two-sided enhancements.

A sender shall assign all reserved values to zero, and shall ignore any reserved values on reception.

9.2.1.2 PEP Control Offer Message

An RCST shall respond to the advertisement with an offer that indicates the set of TCP-PEPs that it wishes to support. The RCST shall make this selection by matching the combination of Vendor OUI (24 bits) and the product ID against the corresponding values for the TCP-PEPs that it supports. The capability information is not present (the initiator should understand the capabilities/compatibility of each TCP-PEP).

The PEP Control Offer Message is a unicast message that is used to indicate the set of TCP-PEP configurations that are available at the remote entity. Each TCP-PEP is identified by the pep_vendor_id (encoded as a 24-bit OUI value), and a pep_product_id, selected by the vendor to identify a particular feature set (software version and/or uniquely identifiable version of a TCP-PEP). The message includes the standards_id and pep_capability fields of the advertisement message. The responder should only include TCP-PEP configurations in the list that are expected to be compatible with those that were offered. If there are no available TCP-PEPs, it shall return an error message to abort the use of a TCP-PEP.

An RCST may issue a PEP Control Offer Message at any time for any active SVN-MAC. The offer shall force renegotiation of the PEP to be used for the SVN-MAC.

Table 9.4: PEP Control Offer Message

Syntax	No. of bits (default value)	Mnemonic
pep_control_offer_response () {		
pep_control_type	8 (0x02)	uimsbf
number_of_records	8	uimsbf
for (i=0; i < number_of_records i++) {		
pep_vendor_id	24	uimsbf
pep_product_id	16	uimsbf
pep_standards_Id	16	uimsbf
pep_capability	32	uimsbf
}		

The pep_capability value has the same format as specified for an offer message. A sender shall assign all reserved values to zero, and must ignore unknown values on reception.

9.2.1.3 PEP Control Use Message

Transmission of a PEP control use message instructs the remote entity to use one of the offered PEPs for the SVN-MAC on which it is received. The message shall identify one of the offered set of TCP-PEPs and may optionally include a block of up to 256 bytes configuration data to be sent to the remote TCP-PEP. The contents of the configuration block shall be transported to the remote TCP-PEP without modification. Use of this data is vendor-specific.

A PEP Control Use Message may be sent at any time for any active SVN-MAC. The message shall assign the PEP to be used for the specified SVN-MAC.

Table 9.5: PEP Control Use Message

Syntax	No. of bits (default value)	Mnemonic
pep_control_use () {		
pep_control_type	8 (0x03)	uimsbf
pep_vendor_id	24	uimsbf
pep_product_id	16	uimsbf
pep_config_size	8	uimsbf
for (i=0; i < pep_config_size i++) {		
pep_configuration_block	8	uimsbf
}		
hls_tc	16	uimsbf
}		

Reception of a PEP Control Use message shall cause the receiving entity to use the instructed PEP for the SVN-MAC on which it is received. The PEP shall be bound to a traffic classifier ID when the hls_tc value is non-zero. Classifier IDs are configured at a remote RCST using the QoS module (e.g. this could be used to bind all traffic from a particular set of IP addresses to a PEP, or to use multiple classifiers to enable a sender to select which traffic is not processed by a specific PEP).

No response is required unless the entity cannot activate the required PEP configuration. In this latter case, the entity shall return an error code to report the problem. Reception of a request to use a PEP that was not in the set of offered PEPs shall result in returning an error message with an error code of "3".

The reply is sent as a UDP datagram sent to the source of the advertisement with the same port.

9.2.1.4 Agent Control Error Message

The Agent Control Error Message is a unicast message that indicates that requested action in a control message was not performed by a client. The message includes a one byte field indicating the requested_action that generated the error and a one byte error_code that uses one of the values specified in table 9.6.

Table 9.6: Agent Control Error Message

Syntax	No. of bits (default value)	Mnemonic
agent_control_error () {		
agent_control_type	8 (0x00)	uimsbf
requested_action	8 (0x00)	uimsbf
error_code	8	uimsbf
}		

The set of currently specified error codes is specified below.

Table 9.7: Agent Control Error Message

Error Codes	Value	Note
protocol_error	0	The Control message has an unknown syntax
no_compatible_pep	1	There are no available PEP Entities that match those listed in an offer or use message
temporary_error	2	The PEP Control message cannot be processed at this time, or has been disabled (this value indicates a soft error, and implementation should not cache this response and should try again later).
invalid_use	3	The PEP requested in a "use" message was not one of the offered set of PEPs.
unspecified_error	4-255	

NOTE: An error message shall not be issued for an unknown control value, to allow for the possible introduction of other control messages in future releases of the present document.

9.3 Signalling and Control Agents

This clause identifies a set of functions that may exist in the HLS to intercept signalling and provide control functions to the HLS. The current specification only specifies a limited subset of this set of agents.

9.3.1 RSVP Proxy

RSVP is specified in (RFC 2205 [i.16]). RFC 2750 [i.29] defines extensions for supporting generic policy based admRcs2ion control in RSVP. Operation of an RSVP proxy is not specified in the current version of the present document.

9.3.2 IGMP/MLD Proxy

Operation of an IGMP/MLD proxy is not specified in the current version of the present document.

9.3.3 RSVP-TE Proxy

Operation of a RSVP-TE proxy is not specified in the current version of the present document.

9.3.4 DNS Proxy

Relaying (proxy) of DNS is defined in (RFC 5625 [i.54]) and may be used to support NAT usage. Operation of a DNS proxy is not specified in the current version of the present document.

10 CONTROL OF MOTORIZED MOUNT (Optional)

This clause specifies what is needed to control a motorized mount for steering an antenna.

In order to control the motorized mount, the modem must support the elements of the DiSEqC standard as defined in the Eutelsat Reference Document "Bus Functional Description", version 4.2 available free of charge through the Eutelsat website (http://www.eutelsat.com/satellites/4_5_5.html). In particular, the modem must be able to support the elements described in the clause titled "Bus Hardware Specification", "Method of Data-Bit Signalling" and "Message Data Format".

Concerning the "Bus Hardware Specification", the modem must support the recommended DC Supply current drain level of up to 500 mA.

Regarding the "Message Data Format", the following must be supported:

- For the Framing Byte, the byte with Hex value E0 must be supported ("Command from Master, No reply required, First transmission").
- For the Address Byte, the bytes with Hex values 31 and 32 (Azimuth Positioner and Elevation Positioner, respectively) must be supported. If a third motorized axis is used for polarisation control, the byte with Hex value 21 must be supported.
- For the Command Byte, the bytes with Hex values 60, 6B, 6C, 6E must be supported.

The antenna alignment procedure follows the steps shown in Figure 10.1. In a first phase of the procedure, the RCST shall use the alignment thresholds to perform the alignment of the forward channel. The alignment threshold parameters to be used are: *MaxFwdAlignThrExcDuration*, *MaxFail*, described in Table 10.1.

Once the requested accuracy of the forward channel alignment has been reached, the RCST shall start decoding the Forward Link signalling.

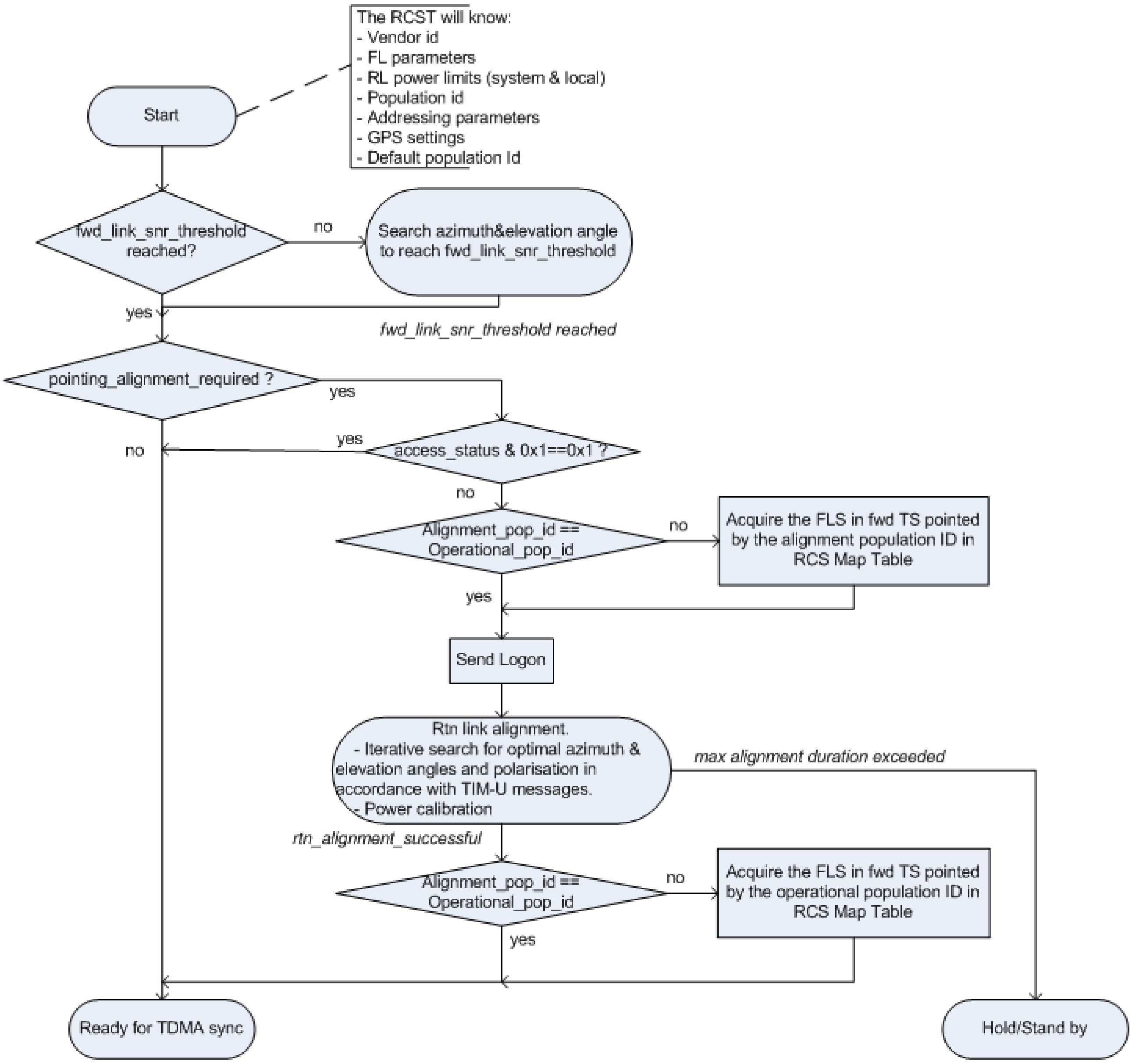


Figure 10.1: RCST antenna alignment and logon

Table 10.1: Alignment parameters in the initial configuration

Parameter	Description
MaxFwdAlignThrExcDuration	The duration of the time interval during which fwd alignment accuracy must be achieved.
MaxFail	Maximum number of alignment failures. The corresponding counter is incremented every time the state machine re-visits the FwdAligment state.

Annex A (informative): RCST MIB

Clause intentionally left blank.

This informative annex will include the new RCST MIB following the MIB objects requirements in clause 8, in a revised version of the present document.

The RCST MIB recommended syntax is ASN.1.

Annex B (informative): RCST Configuration file

Clause intentionally left blank.

This informative annex will include the configuration file in XML format following the MIB definition, in a revised version of the present document.

Annex C (informative): Specification of the Software Download Delivery Protocol (SDDP)

C.1 Introduction

The present annex defines a unidirectional multicast protocol, from hub to terminals allowing to update the Software run by Terminals. This is denoted SDDP (Software and Data Download Protocol) and allows sending Software files in a data carousel fashion (the same file transmission being sent successively in loops) In particular:

- This annex defines how to locate the forward link stream containing SDDP in a network.
- This annex defines the signalling information used to locate SDDP.
- This annex defines the transmission of SDDP as a standardized IP multicast.
- SDDP is based on the OUI (Organization Unique Identifier) identifying a terminal manufacturer.
- This annex defines components that can be used to enhance the SDDP functionality in an upward-compatible way. This provides a standard mechanism for carrying additional information, e.g. update scheduling information, extensive selection and targeting information, action notification, filtering descriptors.

C.2 Scope

DVB-RCS2 terminal software is complex. To guarantee the functionality of a terminal, as well as increasing its functionality once deployed in the field, a software update service is required. The present annex specifies a mechanism for signalling a software update service and the means to carry the data for this software update service.

The SDDP protocol takes advantage of the IP capabilities present in a DVB-RCS2 terminal to keep the lower layer implementation simple and unchanged from the DVB-RCS2 specification (DVB-RCS2). It also takes advantage of the multicast capabilities of DVB-S and DVB-S2.

C.3 Overview of the Basic Protocol

A file transfer begins with a request send from the Hub to write a file (WRQ message) or an information (INFO message) indicating where the file is located. The transmission of the file content on the forward link then proceeds. The file is sent in fixed length blocks, specified by the block size parameter (see clause C.7), typically 512 bytes. Each data packet contains one block of data (DATA message). A data packet of less than the block size terminates the transfer.

Most errors cause termination of the transfer. Errors are caused by three types of events: not being able to satisfy the request (e.g. access violation), receiving a packet that cannot be explained by a delay in time or by duplication in the network (e.g. an incorrectly formed packet), and loss of access to a necessary resource (e.g. memory resources exhausted or access denied during a transfer).

SDDP recognizes only one error condition that does not cause termination, the source port of a received packet being incorrect.

This protocol is very restrictive, in order to simplify implementation. For example, the fixed length blocks makes allocation straightforward.

C.4 Relation to other Protocols

SDDP is based on the TFTP Protocol (Revision 2) elements specified in (RFC 1350 [i.14]) modified to apply for the one-way file transfer associated with multicast. TFTP options as specified by (RFC 2347 [i.19]), TFTP Blocksize Option (RFC 2348 [i.20]) and TFTP Timeout Interval and Transfer Size Options (RFC 2349 [i.21]) are also supported. In addition, application specific options are defined. The TFTP elements are amended with an optional information carousel that supports scaling and increased speed of commissioning.

The SDDP is implemented on top of the User Datagram protocol (UDP). Since this Datagram service is implemented on IP, packets will have an IP header, a UDP header, and a SDDP header. Additionally, the packets will be encapsulated and sent using a DVB-RCS2 FL stream.

Figure C.1 shows the order of the contents of a packet encapsulated using an MPE/GSE header, IP header, UDP header, SDDP header and the payload of the SDDP packet. (This may or may not be data depending on the type of packet as specified in the SDDP header.) SDDP does not specify any values in the IP header. On the other hand, the source and destination port fields of the UDP header (its format is given in the appendix) are used by SDDP and the length field reflects the size of the SDDP packet. The Transfer IDentifiers (TID's) used by SDDP are passed to the UDP layer to be used as ports; therefore they must be between 0 and 65,535. The initialization of TID's is discussed in the section on initial connection protocol.

The SDDP header consists of a 2B opcode field that indicates the type of packet (e.g. DATA, etc.) These opcodes and the formats of the various types of packets are discussed further in the section on SDDP packets.

```
---------------------------------------------------------
| GSE | IP | UDP | SDDP |
---------------------------------------------------------
```

Figure C.1: Order of Headers when using a GSE Stream

C.5 Basic SDDP Packet Formats

SDDP supports three types of packets, all of which have been mentioned above:

Opcode	Operation
2	Write request (WRQ)
3	Data (DATA)
255	Information (INFO)

The SDDP header of a packet contains the opcode associated with that packet.

```
 2 bytes    string      1 byte    string   1 byte
 ------------------------------------------------
| Opcode |  Filename  |   0  |    Mode    |   0  |
 ------------------------------------------------
```

Figure C.2: WRQ packet

WRQ packets (opcode 2) have the format shown in Figure C.2. The file name is a sequence of bytes in netascii terminated by a zero byte. The mode field contains the string "octet" (or any combination of upper and lower case, such as "OCTET", "Octet", etc.) in netascii. Octet mode is used to transfer a file that is in the 8-bit format of the indicated target type.

```
 2 bytes    2 bytes     n bytes
 ----------------------------------
| Opcode |   Block #  |   Data     |
 ----------------------------------
```

Figure C.3: DATA packet

Data is transferred in DATA packets depicted in Figure C.3. DATA packets (opcode = 3) have a block number and a data field. The block numbers assigned to data packets begin with one and increase by one for each new block of data. This restriction allows the sender to use a single number to discriminate between new packets and duplicates. The data field is from zero to N bytes long. If it is exactly N bytes long, the block is not the last block of data. If it is from zero to (N-1) bytes long, it signals the end of the transfer. If the file ends with a final data segment of N bytes the transfer will be terminated by a block with a zero length data field. The default value of N is 512. Another block size can be indicated by the parameter "blksize".

```
  2 bytes
-----------
| Opcode |
-----------
```

Figure C.4: INFO packet

Control information may be transferred regularly in INFO packets depicted in Figure C.4. INFO packets (with opcode = 255) typically carry additional parameters (see C.7). INFO packets may occur anywhere in the SDDP stream.

C.6 Parameter Transfer

The parameter transfer mechanism specified in the present document allows file transfer parameters to be conveyed prior to the transfer using a mechanism that is consistent with SDDP's Request Packet format.

SDDP parameters are appended to the Write Request and Information packets.

Parameters are appended to an SDDP Write Request packet as follows:

```
+-------+---~~---+---+---~~---+---+----~~----+---+---~~---+---+-->
|  opc   |filename| 0  |  mode   | 0   |  parm1    | 0  | value1  | 0   |  <
+-------+---~~---+---+---~~---+---+----~~----+---+---~~---+---+-->
                    >---~~----+---+---~~---+---+
                    <  parmN   | 0  | valueN | 0   |
                    >---~~----+---+---~~---+---+
```

Opc The opcode field contains a 2, for Write Requests (RFC 1350 [i.14]).
Filename The name of the file to be read or written (RFC 1350 [i.14]). This is a NULL-terminated field.
Mode The mode of the file transfer: "netascii", "octet", or "mail", as defined in (RFC 1350 [i.14]). This is a NULL-terminated field.
parm1 The name of the first parameter in case-insensitive ASCII (e.g. blksize). This is a NULL-terminated field.
value1 The value associated with the first parameter, in case-insensitive ASCII. This is a NULL-terminated field.
parmN, valueN The final parameter/value pair. Each NULL-terminated field is specified in case-insensitive ASCII.

Figure C.5: SDDP parameters in WRQ packet

INFO messages have exactly the same layout as WRQ ones. The only difference is that they are assigned an opcode of 255 instead of 2. INFO messages are repeated at a higher rate than a WRQ. The WRQ is sent only once per loop of the data carousel, on the same redirected IP address and UDP port as the data, just before the file is sent. INFO messages may be sent at a higher rate and are sent on the default multicast group and port. The maximum length of INFO messages or WRQ is 512 bytes.

The parameter names and values are all NULL-terminated, in keeping with the original request format. If multiple parameters are to be specified, they are appended to each other. The order in which parameters are specified is not significant. The maximum size of a request packet is 512 octets.

C.7 Parameters

Table C.1: SDDP parameters

Parameter	*Required functionality (O/M)*	*Presence of the parameter in message (O/M)*	Occurrence	Function	Value
blksize	***M***	***O***	WRQ, INFO	Set the DATA block size to another value than the default of 512 byte	Decimal number of bytes
Tsize	***M***	***M***	WRQ, INFO	Indicates the total transfer size	Decimal number of bytes
manufID	***M***	***M***	WRQ, INFO	Indicates the OUI	24 bit OUI as decimal value
Vendor specific parameters	***O***	***O***	WRQ, INFO	Maximum of 10 vendor specific parameters. A server shall support that many parameters. An RCST implementation shall not consider the server is able to handle more.	Manufacturer specific
ver	***M***	***O***	WRQ, INFO	Current SW version in the SW distribution carousel, respective to the manufID and vendor specific parameters	Manufacturer specific
minver	***O***	***O***	WRQ, INFO	Indicates the minimum SW version required for log-on, with respect to manufID and vendor specific parameters	Manufacturer specific
method	***O***	***O***	WRQ, INFO	Indicates if the SW update method is different from the default "immediate". It can also be "pending", i.e. awaiting the next RCST restart.	"immediate" "pending"
timeout	***O***	***O***	WRQ, INFO	Indicates the timeout when waiting for the next DATA packet, default value is given in the initial configuration (sec).	Decimal seconds
mgroup	***O***	***O***	INFO	Set a redirection multicast group address respective to the manufID and vendor specific parameters	Dot separated decimal
port	***O***	***O***	INFO	Sets a redirection UDP port respective to the manufID and vendor specific parameters	Decimal
layer2	***O***	***O***	INFO	Indicate the redirection layer 2 address for a specific download	Decimal number of bytes

An M indicates parameters and functionality that must be supported. An O indicates parameters and functionality that may or should be supported. It some cases the lack of support of the latter type of functionality must be compensated through the capability of manual configuration at the RCST to allow the RCST to be entered into a system that utilizes all capabilities of the SDDP.

If a parameter occurs in an INFO message and the occurrence column states "WRQ, INFO" it should also be present in the WRQ message.

The SDDP server has to provide the mandatory parameters and may supply the other parameters as required for functionality and consistency.

C.8 Initial Connection Protocol

A transfer may be established by sending an INFO message on the default multicast group and UDP port. In this case the terminal will redirect to a new IP address and port and will start reading the file on this multicast address and UDP port. A WRQ should be sent on the redirected IP address and UDP port to signal the beginning of the file. The terminal implementation may either wait for this WRQ and obtain the data blocks of the file in order (starting from block number 1) or it may just pickup anywhere in the data carousel (not waiting for the WRQ) and it may download the file until all block numbers of that file have been received. There should be only one file per redirected IP address and port.

In the case that a new software is introduced for a certain terminal the server needs to first start the data carousel for this software and after that can start sending INFO messages. When the old software is withdrawn, the server must first stop sending the INFO messages and after that stop the data carousel.

A transfer may also be established by sending WRQ messages on the default multicast group and port, that the RCST keeps listening even after redirection. In this case the terminal will use the default multicast IP address and UDP port for obtaining the data stream.

If an INFO messages does not contain any redirection a write request is to be expected on the default multicast group and UDP port.

The default multicast group and UDP port are 239.192.0.1 and 49152 unless specified otherwise in the RCST configuration. The default port value is used as the default Transfer Identifier (TID) of TFTP.

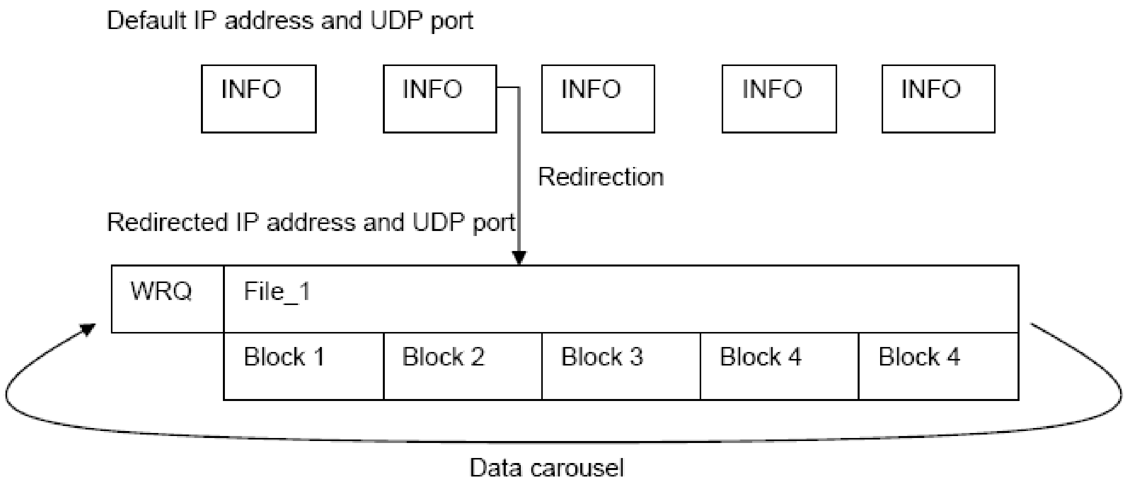


Figure C.6: SDDP redirection and carousel

C.9 Service Location

Once the IP/DVB service is identified, the RCST can map the multicast SVN-MAC label value used to identify the SDDP flow within a FL stream.

The SW update information channel can run alone on the default address (locally scoped, all systems) or can be multiplexed with a SW stream/carousel. SW streams can be separated into different multicast addresses that map to different IPv4 and hence different layer 2 address labels.

C.10 Signal Sequence and Timing

The RCST must be capable of receiving DATA packets at a pace of up to 50 kbps. This allows the RCST time to access the data storage. An RCST may have capability to support even higher rates. This is subject to manufacturer specification.

If the RCST has not received the next DATA packet within a given timeout (see timeout parameter in clause C.7) it shall terminate the file reception and it shall retune to the default multicast group and UDP port.

In the case that the RCST implementation waits for the WRQ before storing any data packets, the RCST shall retune to the default multicast group and UDP port if such a request could not be received within 30 minutes.

An RCST that is not engaged in receiving DATA packets shall be capable of decoding INFO packets and WRQ on its default multicast group and UDP port.

C.11 Flow Diagram for SDDP

The following procedure occurs every time the RCST initiates a logon procedure:

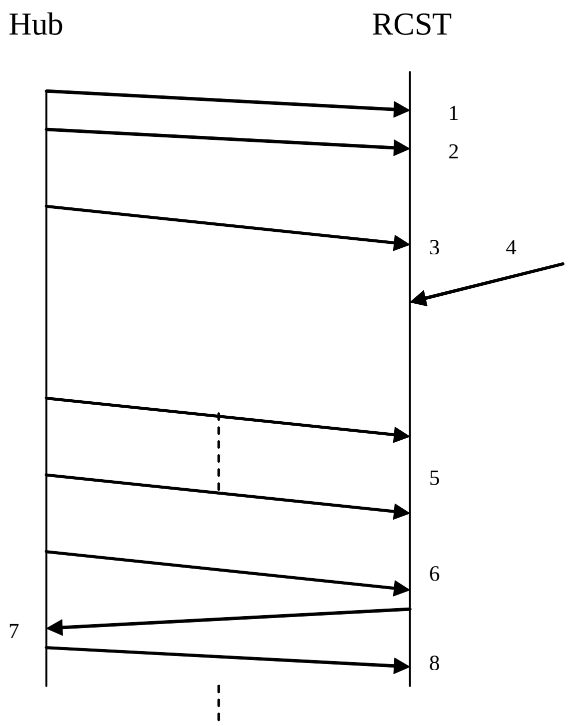


Figure C.7: SDDP flow diagram

1) An RCST in initialization mode tunes onto the FL.

2) It locates the appropriate L2 multicast SVN-MAC for SWDL.

3) It starts reception using the configured IPv4 multicast address and port (normally the default values) and decodes the stream. The stream may include manufacturer specific receiver redirection to another multicast address and port. It may also include additional vendor specific information.

4) The operator may directly set the multicast address and port to be used as entry point (can compensate for lack of redirection information).

5) The RCST sets the link-layer filter that allows it to receive IPv4 Multicast packets from a particular layer 2 SVN-MAC label., and the port where it expects to find SW update, and receives a file.

As SW update download is completed, the RCST replaces the alternate SW load with the new downloaded SW and updates the *dvbRcs2RCSTAlternateSoftwareVersion* MIB parameter (RFC 5728 [i.55]).

6) In parallel the RCST will acquire the TBTP/TBTP2.

7) The RCST can send logon request in CSC slot.

8) The hub will respond with TIM-U.

Vendor specific configuration can prevent an RCST from logon until a given SW version has been downloaded. SW version can indeed be checked in the RCST capability field of the CSC burst (see DVB-RCS2). Otherwise the RCST logon will proceed in parallel with the SW download.

As an RCST continuously listens to the Forward Link Signalling, the SW download can be triggered at any time when multicast address and port are found.

C.12 Definition of multicast IP address

The SW information channel should be located on the default multicast address. Vendor specific redirection information should be located in this channel. Alternatively the target multicast address and port can be configured manually at the RCST.

The default multicast address should be under control by the network operator and should not be used for user traffic. It is within the local network control block address range. Note that if IGMP is in use on the FL general IGMP queries can also occur addressed to this address. These will not interfere with SDDP that uses UDP.

The hub should block user traffic on the multicast addresses assigned to SW update to avoid any possibility of conflict. It is e.g. possible to select custom SW update multicast addresses from the Organization Local Scope multicast addresses. Another possibility is to use non-conflicting addresses from the Local Network Control Block, but note that packets with these addresses will not be forwarded by IP routers.

Administratively Scoped IP Multicast (RFC 2365 [i.22]) specifies:

239.192.0.0/14 is defined to be the IPv4 Organization Local Scope, and is the space from which an organization should allocate sub-ranges when defining scopes for private use.

C.13 Transfer Error Handling

The RCST should discard duplicate packets and should also detect missing packets through the consecutive block numbering. The SW acceptance process of the RCST should include vendor specific consistency control of the received data.

C.14 Vendor-Specific Methods

Additional vendor specific parameters may be included as required as in TFTP.

An RCST must ignore any unknown parameters.

C.15 Location of the Assigned Layer 2 Address

This clause specifies actions when operating in a transition mode, An RCST using a FL in the MPEG-TS mode will detect the PID on which it will listen for the SW update information stream in the following manner:

Before logon:

- directly on a layer with an address identified by MMT lookup

After logon:

- through a direct address mapping to a multicast SVN-MAC label
- through the Forward Interaction Path descriptor [3] received as logon response

Annex D (informative): Example use of RCST QoS system model

Figure D.1 illustrates the relationship between modules the higher layer QoS functions and the lower layers QoS functions. The diagram is intended to be informative and does not mandate any particular internal structure of an RCST. Solid lines represent the flow of PDUs and other data through the system, whereas dashed lines are used to denote control relationships. Simple functions or objects are represented by boxes, selector mechanisms by hexagons, and complex objects by pentagons.

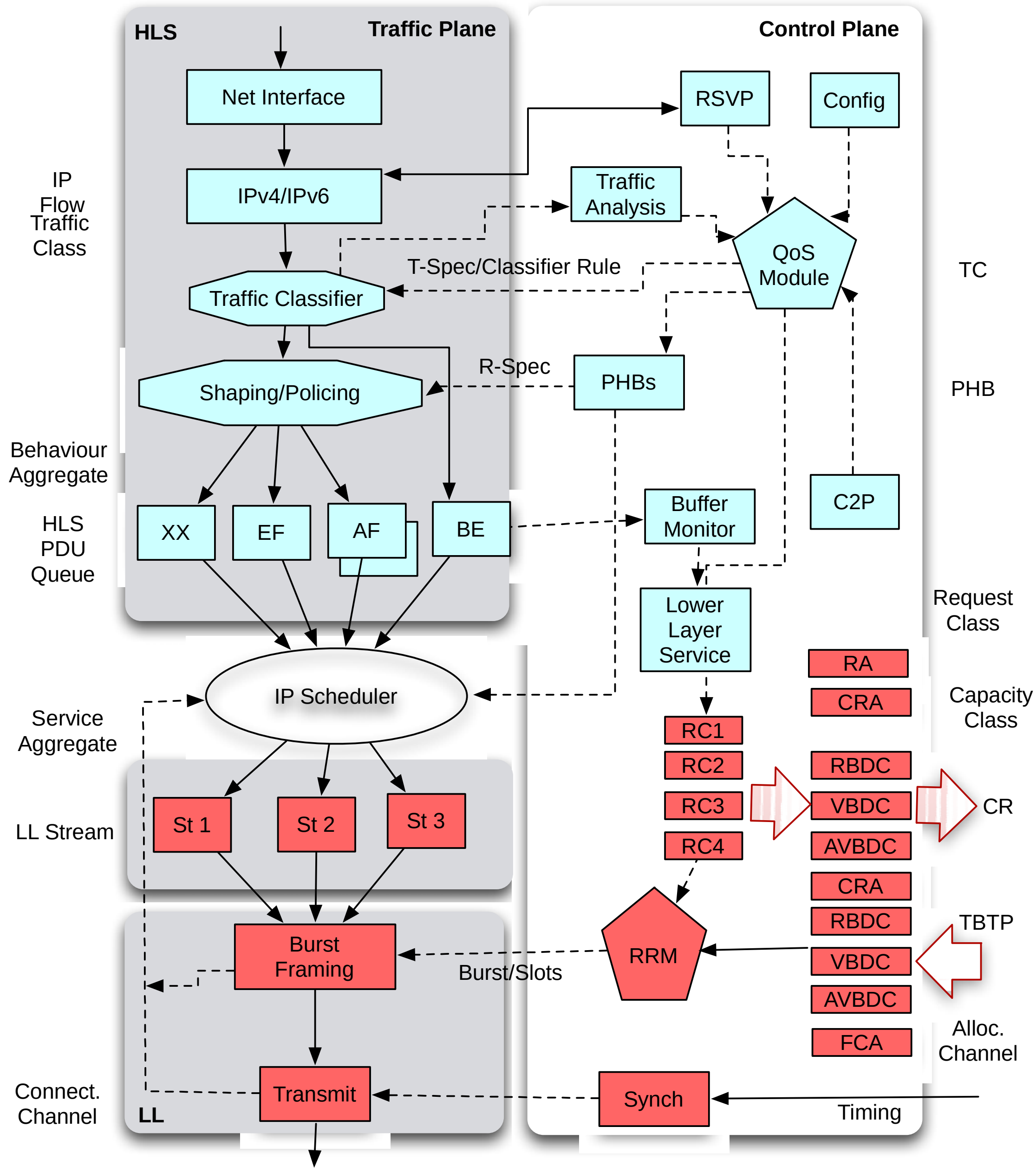


Figure D.1: Logical HLS QoS Processing

In the diagram, the data paths are represented by dashed lines and control paths by dashed lines. Traffic arriving at the LAN network interface of an RCST has been divided into several Traffic Classes (TCs). These classes are mapped to 5 per-hop behaviours (PHBs). These traffic classes may for instance reflect a best effort Diffserv Code Point (TC1), and unknown service category (TC2) – in this case mapped to the Best Effort (BE) PHB, an Assured Forwarding codepoint mapped to one of the two AF PHBs, and an Expedited Forwarding class mapped to the EF PHB. The final traffic class maps to be a special-purpose class, the XX PHB. Each HLS PDU queue (behaviour aggregate) is in turn mapped to a Link Stream (service aggregate) for transmission (ST1-ST3). The Radio Resource Management (RRM) object is responsible for requesting capacity from the NCC.

The outputs of the HLS PDU Queues hold the data to be sent over the lower layer service. This implies the action of an IP scheduler (represented by a white oval). This may be understood to be activated each transmission opportunity (notified by the TBTP) to select the PDUs that are segmented into the stream. The selection is based on the PHBs (which indicate the lower service), and link-layer information. This ensures that PDUs or segmented PDUs are sent using the corresponding allocation channel. When required, PDUs pass through a segmentation function, so that any unsent data is postponed to a later scheduling opportunity. Each segment is then encapsulated into one of the configured streams (ST1-ST3 in the diagram) and is then placed in the burst for transmission. The scheduler could use a strict priority scheduler or a weighted priority scheduler, but is not specified in the present document. Since in this example there are three Link Streams, ST1 can preempt ST2 or ST3.

Annex E (informative): The Connection Control Protocol (C2P)

Dynamic connectivity may be supported thanks to the Connection Control Protocol (C2P). C2P is a control signalling protocol between the NCC and the RCST. C2P allows the mapping of IP parameters and policies to L2 parameters, and to dynamically set connectivity channels to an RCST according to set of values configured by management.

E.1 C2P Functions

The current C2P [i.3] [i.4] is seen as a complement to the functionality of the interfaces already defined in the DVB-RCS2 and DVB-S/S2 standards. The functions added by the C2P protocol to the control plane of DVB-RCS2 can be summarized as:

- Establishment/modification/release of connectivity channels between sets of communicating parties (network elements) in a DVB-RCS2 system (RCSTs, Gateway, NCC).
- QoS-driven dynamic allocation of bandwidth resources connectivity channels, following the execution of a Connection Admission Control (CAC) function.
- Dynamic control of the communicating parties in the DVB-RCS2 system, via configuration parameters and policies.
- Dynamic allocation/assignment of logical resources to allocation channels.
- Address resolution for the purpose of RLE/GSE encapsulation.
- Definition of isolated and independent satellite sub-networks within the global interactive network (i.e. each subnetwork is characterized by its own terminal population, bandwidth resources, addressing space/plan).

C2P functions implementation may also perform address resolution functions and IP routing functions.

E.2 C2P Procedures

The C2P protocol performs unicast/multicast address resolution routing function, specifically for meshed systems. If the next hop IP address of an outgoing packet is not found in the AR database, a C2P connection establishment request is triggered by the RCST to find the L2 address of the next hop. In case that the system does not support the dynamic routing function (e.g. OSPF), the C2P protocol can assist the RCST with IP routing information.

The NCC allows establishment of C2P connections only between RCSTs belonging to the same OVN and located in a common VRF domain, otherwise rejecting the connection requests.

The complete C2P specification is to be completed together with the full specification of the mesh scenario profile for RCS2.

Annex F (normative): Antenna Alignment message data formats

Table F.1 shows all required Message Data Formats to control the motorized mount. The table includes the meaning, format and possible Data values for the Command Bytes.

Table F.1: Motorized Mount Command Bytes

Byte 1 Framing Byte	Byte 2 Address Byte	Byte 3 Command Byte	Byte 4 Data Byte	Byte 5 Data Byte
E0	31	60 Stop azimuth Positioned movement	00 Example; E0 31 60 00 Stops the azimuth Positioner.	Not used
"	"	6B Drive motor to Reference Position (Reset position)	00 Example; E0 31 6B 00 Moves the azimuth Positioner to Reference Position (Reset position).	Not used
"	"	6C Goto x.x°, drive motor to x.x°. Store current motor position.	**WX,** where **W** = **D**; for **Anticlockwise** Rotation **W** = **E**; for **Clockwise** Rotation **XY** = hexadecimal value of **integer** part of the azimuth angle. **Z** = hexadecimal value of **decimal** part of the azimuth angle (see table in clause 7.3.X.1). Special command; E0 31 6C A0 00 - Stores the azimuth Positioner actual position. Example; E0 31 6C E0 03 Rotates the azimuth Positioner 0.2° clockwise from the current position.	**YZ,** See left
"	"	6E Goto x.x°. Drive motor to x.x° from Reference Position	**WX,** where **W** = **D**; for **Anticlockwise** Rotation **W** = **E**; for **Clockwise** Rotation **XY** = hexadecimal value of **integer** part of the azimuth angle. **Z** = hexadecimal value of **decimal** part of the azimuth angle (see table in clause 7.3.X.1). Example; E0 31 6E E0 95 Rotates azimuth Positioner 9.3° clockwise from Reference Position.	**YZ,** See left
"	32	60 Stop elevation Positioner movement.	00 Example; E0 32 60 00 Stops the elevation Positioner.	Not used
"	"	6B Drive motor to Reference Position (Reset position)	00 Example; E0 32 6B 00 Moves the elevation Positioner to Reference Position (Reset position).	Not used

Byte 1 Framing Byte	Byte 2 Address Byte	Byte 3 Command Byte	Byte 4 Data Byte	Byte 5 Data Byte
"	"	6C Goto x.x°, drive motor to x.x°. Store current motor position.	**WX,** where **W** = **D**; for **Down** Rotation **W** = **E**; for **Up** Rotation **XY** = hexadecimal value of **integer** part of the elevation angle. **Z** = hexadecimal value of **decimal** part of the elevation angle (see table in clause 7.3.X.1). Special command; E0 32 6C A0 00 - stores the elevation Positioner actual position. Example; E0 32 6C E0 03 Moves up elevation Positioner 0.2° from the current position.	**YZ,** See left
"	"	6E Goto x.x° Drive motor to x.x° from Reference Position	**WX,** where **W** = **D**; for **Down** Rotation **W** = **E**; for **Up** Rotation **XY** = hexadecimal value of **integer** part of the elevation angle. **Z** = hexadecimal value of **decimal** part of the elevation angle (see table in clause 7.3.X.1). Example; E0 32 6E E0 95 Moves elevation Positioner up 9.3° from the Reference Position.	**YZ,** See left
"	21 TBC	60	00 Stop skew Positioner movement	Not used
"	"	6B Drive motor to Reference Position (Reset position)	00 Example; E0 21 6B 00 Drive motor to Reference skew position (Reset position)	Not used
"	"	6C Goto x.x°, drive motor to x.x°. Store current motor position.	**WX,** where **W** = **D**; for **Anticlockwise** Rotation (looking from behind dish towards satellite TBC) **W** = **E**; for **Clockwise** Rotation **XY** = hexadecimal value of **integer** part of the elevation angle. **Z** = hexadecimal value of **decimal** part of the elevation angle (see table in clause 7.3.X.1). Special command; E0 21 6C A0 00 - stores the skew Positioner actual position. Example; E0 21 6C E0 03 Moves skew Positioner 0.2° clockwise from the current position.	**YZ,** See left

Byte 1 Framing Byte	Byte 2 Address Byte	Byte 3 Command Byte	Byte 4 Data Byte	Byte 5 Data Byte
"	"	6E Goto x.x° Drive Motor to x.x° from Reference Position	**WX,** where **W** = **D**; for **Anticlockwise** Rotation (looking from behind dish towards satellite TBC) **W** = **E**; for **Clockwise** Rotation **XY** = hexadecimal value of **integer** part of the azimuth angle. **Z** = hexadecimal value of **decimal** part of the azimuth angle (see table in clause 7.3.X.1). Example; E0 21 6E E0 95 Rotates skew Positioner 9.3° clockwise from Reference Position.	**YZ,** See left

F.1 Hexadecimal value for the decimal part

Table F.2: Hexadecimal value

Decimal	Hex	Decimal	Hex
0.0°	0	0.5°	8
0.1°	2	0.6°	A
0.2°	3	0.7°	B
0.3°	5	0.8°	D
0.4°	6	0.9°	E

The hexadecimal value for the decimal part of the azimuth, elevation or skew angle (=Z) is in accordance with the following table.

F.2 Stored position

The command to store the position of the azimuth Positioner is E0316CA000, for elevation Positioner it is E0326CA000 and for skew Positioner it is E0216CA000 (TBC). At the moment of sending these commands the motorized mount stores internally the actual positions.

To move the Positioners into these stored positions the commands are E0316CD000 for azimuth Positioner, E0326CD000 for elevation Positioner and E0216CD000 for skew Positioner.

F.3 Reference position (reset position)

The motorized mount Reference Positions (Reset Positions) are fixed, factory set positions for the elevation, azimuth and skew Positioners.

The Azimuth Reference Position is the midpoint of the movement range of the azimuth axis. For a terminal pointed correctly it would correspond to pointing directly South/North (depending on installation being on Northern/Southern hemisphere).

The Elevation Reference Position is defined as the tangent line on the Earth surface of the place of installation. For a motorised mount perfectly on a vertical pole it would correspond to pointing directly towards the horizon.

The Skew Reference Position is the position when the skew is aligned with the vertical polarisation being exactly normal to the horizon (TBC).

Annex G (informative): Bibliography

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History

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