

Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Connection Control Protocol (C2P) for DVB-RCS; Background Information

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

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1 Scope

The present BSM document provides background information for the specification of a Connection Control Protocol (C2P) for DVB-RCS networks [i.11], relying on specific DVB-RCS signalling.

C2P (and any other connection control protocol) is part of the control plane functionality and is generally used to establish connections with adequate resources in order to satisfy the service requirements of various multimedia applications. In this context, it can be seen as one component of the QoS end-to-end architecture, e.g. as defined in [i.3]. Recommendations for QoS specifications for DVB-RCS networks have been proposed by the SatLabs Group [i.4]; they will be considered in the definition of C2P. Moreover, SatLabs Group has also provided recommendations for the Harmonized Management and Control Plane Specifications in DVB-RCS networks [i.7]; some of the specified data structures (with enhancements) will be used in the definition of C2P specification [i.11].

To facilitate the definition of C2P, the present document provides an overview of the following aspects:

- Reference scenarios for DVB-RCS networks.
- C2P core elements and their inter-relationships, captured in various C2P models.
- Internetworking issues relevant to C2P, including the QoS models adopted for C2P and various terminal data structures (tables) for dynamic connectivity support.

The intention is to identify those elements common to all network reference scenarios, in order to define a basic framework for the specification of a connection protocol applicable to all scenarios.

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2.1 Normative references

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Not applicable.

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. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] ETSI EN 301 790 (V1.4.1): "Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems".
- [i.2] DVB-RCS 305 (06/03/01): Final Report of the AHG-RSAT Group.
- [i.3] ETSI TS 102 462 (V1.1.1): "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); QoS Functional Architecture".
- [i.4] SatLabs System Recommendations - Quality of Service Specifications, v1.

NOTE: Available at satlabs.org.

- [i.5] ETSI EN 300 421: "Digital Video Broadcasting (DVB): Framing structure, channel coding and modulation for 11/12 GHz satellite services".
- [i.6] ETSI EN 302 307 (V1.1.1): "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications".
- [i.7] SatLabs System Recommendations - Management & Control Planes Specifications, v1.

NOTE: Available at satlabs.org.

- [i.8] ETSI TS 102 429-1 (V1.1.1): "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Regenerative Satellite Mesh - B (RSM-B); DVB-S/DVB-RCS family for regenerative satellites; Part 1: System overview".
- [i.9] ETSI TS 102 293 (V1.1.1): "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; IP Interworking over satellite; Multicast group management; IGMP adaptation".
- [i.10] ETSI TS 102 294 (V1.1.1): "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; IP interworking via satellite; Multicast functional architecture".
- [i.11] ETSI TS 102 602 (V1.1.1): "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; Connection Control Protocol (C2P) for DVB-RCS; Specifications".
- [i.12] ETSI EN 301 192 (V1.4.2): "Digital Video Broadcasting (DVB); DVB specification for data broadcasting".
- [i.13] ETSI TS 102 606 (V1.1.1): "Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE) Protocol".
- [i.14] IETF RFC 2474: "Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers".
- [i.15] IETF RFC 2475: "An Architecture for Differentiated Service".
- [i.16] IETF RFC 1633: "Integrated Services in the Internet Architecture: an Overview".
- [i.17] IETF RFC 2212: "Specification of Guaranteed Quality of Service".
- [i.18] IETF RFC 2215: "General Characterization Parameters for Integrated Service Network Elements".
- [i.19] IETF RFC 2205: "Resource ReSerVation Protocol (RSVP) -- Version 1 Functional Specification".
- [i.20] IETF RFC 4609: "Protocol Independent Multicast - Sparse Mode (PIM-SM) Multicast Routing Security Issues and Enhancements".

- [i.21] IETF RFC 826: "Ethernet Address Resolution Protocol: Or Converting Network Protocol Addressed to 48.bit Ethernet Address for Transmission on Ethernet Hardware".
- [i.22] IETF RFC 2237: "Japanese Character Encoding for Internet Messages".
- [i.23] IETF RFC 4080: "Next Steps in Signalling (NSIS): Framework".
- [i.24] IETF RFC 2362: "Protocol Independent Multicast-Sparse Mode (PIM-SM): Protocol Specification".
- [i.25] IETF RFC 2236: "Internet Group Management Protocol version 2 (IGMPv2)".
- [i.26] IETF RFC 3376: "Internet Group Management Protocol version 3 (IGMPv3)".
- [i.27] AmerHis System, Interactive Broadband DVB-RCS/S OBP Communication System.
- NOTE: Available at telecom.esa.int.
- [i.28] SkyplexNet System.
- NOTE: Available at telecom.esa.int.
- [i.29] SpaceMux.
- NOTE: Available at space.gc.ca or telesat.ca.
- [i.30] B. Le Stradic, M. Vaissiere, O. Bowles, Matra Marconi Space, United Kingdom "The WEST Project: exploiting the Ka-band spectrum to develop the Global Information Infrastructure" September 15 - 18, 1997 Sorrento, Italy, 3rd Ka-Band Utilization Conference.
- [i.31] IETF RFC 2774: "An HTTP Extension Framework".
- [i.32] IETF RFC 2211: "Specification of the Controlled-Load Network Element Service".
- [i.33] IETF RFC 2597: "Assured Forwarding PHB Group".
- [i.34] IETF RFC 3246: "An Expedited Forwarding PHB (Per-Hop Behavior)".
- [i.35] ETSI TR 101 790 (V1.3.1): "Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems; Guidelines for the use of EN 301 790".
- [i.36] IETF RFC 1518: "An Architecture for IP Address Allocation with CIDR".
- [i.37] IETF RFC 1519: "Classless Inter-Domain Routing (CIDR); an Address Assignment and Aggregation Strategy".
- [i.38] ITU-T Recommendation Q.2931: "Digital Subscriber Signalling System No. 2 - User-Network Interface (UNI) layer 3 specification for basic call/connection control; Modified by ITU-T Q.2971 (10/1995)".

3 Definitions and abbreviations

3.1 Definitions

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

Class of Service (CoS): specific behaviour regarding traffic handling/forwarding

NOTE: Can be used to categorize the traffic into different classes.

connection: layer 2 logical association between two or more network entities characterized by a C2P Class of Service (C2P CoS)

Connection Control Protocol (C2P): protocol that provides the interaction between RCSTs and NCC to support the set-up, modification and release of connections

control plane: the control plane in a layered protocol architecture; it performs, among others, connection control functions, including the signalling necessary to set up, supervise and release connections

Digital Video Broadcasting Return Channel by Satellite (DVB-RCS): protocol for an interaction (or return) channel in satellite links

Digital Video Broadcasting via Satellite (DVB-S): protocol for broadcasting TV signals and, by extension, data over satellite

gateway: general term to identify both the TSGW and the RSGW

interactive network: group of terminals serviced by an NCC

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

NOTE: An IP flow may be identified based on the following attributes: IP source and destination address, layer 4 protocol type, source and destination ports, class of service, router or switch interface.

management plane: in a layered protocol architecture, it provides two types of functions, namely layer management and plane management functions

Management Station (MS): network element that manages all the elements of the system of one satellite interactive network (IN); it also controls the sessions, resources and connections of the ground terminals; it is composed of the NMC and the NCC

mesh connection: direct connection established between two RCSTs

multicast: communication capability, which denotes unidirectional distribution from a single source access point to a number of specified destination access points

Network Control Centre (NCC): network element that provide real time control of the IN (e.g. session control, connection control, routing, terminals' access control to satellite resources, etc.)

Network Management Centre (NMC): network element in charge of the management of all the system elements in the IN

Network Operation Centre (NOC): is responsible for the centralized management and control functions in systems supporting multiple interactive networks, each controlled by its own NCC; NOC provides service and network (bandwidth) provisioning to the interactive network, co-ordination between NCCs, etc.

NOTE: In case of single interactive network the NOC and NCC functionality are merged.

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.)

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) that packets sent by the application experience when being transferred by the network

Return Channel Satellite Terminal (RCST): network element that provides the interface between the satellite system and external users

Regenerative Satellite Gateway (RSGW): network element in a regenerative satellite system that provides interconnection with terrestrial networks (Internet, ISDN/POTS and Intranet)

star connections: connections involving a gateway (TSGW in a transparent system or RSGW in a regenerative system).

NOTE: Star connections can involve one hop or double hop.

stream: logical flow of layer 2 data from one network reference point into the satellite network, resulting from the encapsulation of IP datagrams into MAC packets

Transparent Satellite Gateway (GW/TSGW): network element in a transparent satellite system that provides interfaces with terrestrial networks (Internet, ISDN/POTS and Intranet)

NOTE: The GW is typically integrated with the NCC in a single network element denoted as Hub.

user plane: user plane in a layered protocol architecture that provides the transfer of user data, along with associated controls (e.g. flow control, recovery from errors, etc.)

3.2 Abbreviations

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

ActiveCnx Entry	Active Connection (Table) Entry
ActiveCnx Index	Active Connection (Table) Index
ADC	Analogue-to-Digital Conversion
ADR	Average Data Rate
AF	Assured Forwarding (DiffServ PHB)
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
AVBDC	Absolute Volume Based Dynamic Capacity
AVBDCRepTime	AVBDC Repetition Time
BE	Best Effort (DiffServ PHB)
BoD	Bandwidth on Demand
BSM	Broadband Satellite Multimedia
C2P CoS	C2P Class of Service
C2P PDR	C2P Peak Data Rate (used in C2P request messages)
C2P SDR	C2P Sustainable Data Rate (used in C2P request messages)
C2P	Connection Control Protocol
Channel_ID	Channel Identifier
Channel_ID_NCC	Channel Identifier at NCC
Channel_IDxy	Channel identifier for MAC CoS y in the connectivity channel x
CL	Controlled Load (IntServ Class of Service)
CMT	Correction Map Table
Cnx PDR'	(Admitted) Connection Peak Data Rate (used in C2P response messages)
Cnx SDR'	(Admitted) Connection Sustainable Data Rate (used in C2P response messages)
Cnx	Connection
CnxProfile Entry	Connection Profile (Mapping Table) Entry
CnxProfile Index	Connection Profile (Mapping Table) Index
CnxRef ID	Connection Reference Identifier (used in the Active Connection Table)
CoS	Class of Service
CPU	Computer Processing Unit
CR	Capacity Request
CRA	Constant Rate Assignment
CRC	Cyclic Redundancy Check
CSC	Common Signalling Channel
DAC	Digital-to-Analogue Conversion
DAMA	Demand Assignment Multiple Access
DiffServ	Differentiated Services
DL	Down Link
DR	Designated Router
DRM	Digital Rights Management (for security)
DSCP	Differentiated Service Code Point
DSM-CC	Digital Storage Medium - Command and Control
DULM	Data Unit Label Method
DVB	Digital Video Broadcasting
DVB-RCS	Digital Video Broadcasting Return Channel Satellite
DVB-S	Digital Video Broadcasting by Satellite
DVB-S2	Digital Video Broadcasting by Satellite Transmission 2 nd Generation
EF	Expedited Forwarding (DiffServ PHB)
ETSI	European Telecommunications Standards Institute
FCA	Free Capacity Assignment

FL	Forward Link
Group_ID	Group IDentifier
GS	Guaranteed Service (IntServ Class of Service)
GSE	Generic Stream Encapsulation
GW	GateWay
ID	IDentifier
IE	Information Element
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IMUX	Input MULTipleXer
IN	Interactive Network
INM	Inter-Network Management
IntServ	Integrated Services
IP CoS	IP class of service
IP PDR	IP Peak Data Rate (of an IP flow/flow aggregate)
IP SDR	IP Sustainable Data Rate (of an IP flow/flow aggregate)
IP	Internet Protocol
IP@	IP address
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU	International Telecommunications Union
Kbps	Kilo bits per second (thousands of bits per second)
LAN	Local Area Network
LNM	Local Network Management
Logon_ID	Logon IDentifier
M&C	Management and Control
MAC CoS	MAC Class of Service
MAC	Medium Access Control
MAC@	MAC address
MAC@dst	MAC address of the destination
MAC@src	MAC address of the source
Mbps	Mega bits per second (millions of bits per second)
MCD	Multi-Carrier Demodulator
MCU	Multi-Conference Unit
MDR	Minimum Data Rate
MF-TDMA	Multiple-Frequency Time-Division Multiple Access
MIB	Management Information Base
MPE	Multi-Protocol Encapsulation
MPEG	Moving Picture Experts Group
MS	Management Station
NCC	Network Control Centre
NMC	Network Management Centre
NOC	Network Operation Centre
NSIS	Next Step In Signalling (protocol)
OAM	Operation, Administration and Maintenance
OBP	On Board Processor
OMUX	Output Multiplexer
OSI	Open System Interconnection
PDR	Peak Data Rate
Phb Entry	PHB (Mapping Table) Entry
Phb Index	PHB (Mapping Table) Index
Phb PDR'	PHB Peak Data Rate (admitted rate; used for the configuration of IP mechanisms)
Phb SDR'	PHB Sustainable Data Rate (admitted rate; used for the configuration of IP mechanisms)
PHB	Per Hop Behaviour
PID	Program IDentifier
PIM-SIM	Protocol Independent Multicast-Sparse Mode (routing protocol)
PktClass Entry	Packet Classification (Table) Entry
PktClass Index	Packet Classification (Table) Index
PSTN	Public Switched Telephone Network
PTM	Point-To-Multipoint

PTP	Point-To-Point
PVC	Permanent Virtual Circuit
QID	Queue IDentifier
QoS	Quality of Service
R1	First Rate (of a token bucket)
R2	Second rate (of a token bucket)
RBDC	Rate Based Dynamic Capacity
RBDCMax	RBDC Maximum (parameter)
RBDCTimeout	RBDC Timeout (parameter)
RC Entry	Request Class (Table) Entry
RC Index	Request Class (Table) Index
RC	Request Class
RCST	Return Channel Satellite Terminal
RF	Radio Frequency
RFC	(IETF) Request For Comments
RL	Return Link
Route_ID	Route IDentifier
RSAT	Regenerative SATellite
RSGW	Regenerative Satellite GateWay
RSM-B	Regenerative Satellite Multimedia system Family B
RSPEC	Request SPECification
RSVP	Resource reSerVation Protocol
Rx	Receive
SatLabs	Satellite Laboratories
SCD	Single Carrier Demodulator
SCPC	Single Channel Per Carrier
SDP	Session Description Protocol
SDR	Sustainable Data Rate
SIAF	Satellite Independent Access Function
S-IGMP	Satellite Internet Group Management Protocol
SIP	Session Initiation Protocol
SI-SAP	Satellite Independent Service Access Point
SLA	Service Level Agreements
SNMP	Simple Network Management Protocol
SP	Service Provider
SSR	SatLabs Systems Recommendations
ST	Satellite Terminal (e.g. in BSM)
Stream_ID	Stream IDentifier
SYNC	SYNChronization (burst type)
TBTP	Terminal Burst Time Plan
TCA	Traffic Conditioning Agreement
TCP	Transmission Control Protocol
TDM	Time Division Multiplex
TIM	Terminal Information Message
TIMb	TIM broadcast
TIMu	TIM unicast
TOS	Type Of Service
TRF	TRaFic (burst)
TS	Transport Stream
TSGW	Transparent Satellite GateWay
TSPEC	Traffic SPECification
Tx	Transmit
UDP	User Datagram Protocol
uimsbf	unsigned integer most significant bit first
UL	UpLink
VBDC	Volume Based Dynamic Capacity
VBDCMax	VBDC Maximum (parameter)
VBDCMaxBacklog	VBDC Maximum Backlog (parameter)
VBDCTimeout	VBDC Timeout (parameter)
VCC	Virtual Channel Connection
VCI	Virtual Connection Identifier
VLAN	Virtual LAN

VoIP	Voice over IP
VPI	Virtual Path Identifier
VSN	Virtual Satellite Network

4 DVB-RCS Network Reference Scenarios

Network reference scenarios are defined on the basis of a well-defined set of driver factors concerning satellite network architecture, satellite network topology and satellite payload features. In particular, the reference scenarios considered in the present document are classified with regard to the following criteria:

- Number of spot beams (network architecture):
 - single-beam;
 - multi-beam.
- Network topology:
 - star;
 - mesh.
- Satellite payload architecture:
 - transparent (or transponded);
 - regenerative.

Based on the above criteria, the following network reference scenarios are identified:

- single-beam/multi-beam, star transparent;
- single-beam/multi-beam, mesh transparent;
- single-beam/multi-beam, star/mesh regenerative.

In the above list the term "transparent" refers both to a pure transparent satellite transponder (bent-pipe) and also to a satellite transponder which does not perform any demodulation, but is able to perform some form of physical layer switching, e.g.:

- by switching uplink carriers in a beam to different downlink beams, by means of an Input Multiplexer (IMUX) and an Output Multiplexer (OMUX); or
- by performing Analogue-to-Digital Conversion (ADC) on the uplink carriers, followed by digital switching and Digital-to-Analogue Conversion (DAC).

The network reference scenarios described in this clause apply primarily to the DVB-RCS networks - a particular implementation of the Broadband Multimedia Satellite (BSM) networks. Many architectural/topological aspects of the reference scenarios also apply to the BSM networks in general; however, the description of scenarios in the present document is in terms of DVB-RCS specifics (especially with regard to the satellite air interface/waveforms).

4.1 Transparent Satellite Network

Two different transparent scenarios can be considered based on the network topology: star or mesh. They will be reviewed in the next sub-clauses. The main features of each topology will be described for both single-beam and multi-beam network architectures and the differences between them will be identified.