



Technical Specification
for
Cable Modems (CM)
connected to the
Radio Frequency Interface
of the
**High-speed Data-Over-Cable Systems
(DOCSIS 1.1)**

IDA TS CM
Issue 1 Rev 1, May 2011

Info-Communications Development Authority of Singapore
Resource Management & Standards
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

© Copyright of IDA, 2011

This document may be downloaded from the IDA website at <http://www.ida.gov.sg> and shall not be distributed without written permission from IDA

Contents

		Page
Part A	Introduction	3
	1 Scope	3
	2 General Requirements	5
Part B	Data-Over-Cable Service Interface Specifications: Radio-Frequency Interface Specification	6
Table	1 Scope And Purpose	6
	2 Functional Assumptions	6
	3 Communication Protocols	7
	4 Physical Media Dependent Sublayer Specification	9
	5 Downstream Transmission Convergence Sublayer	9
	6 Media Access Control Specification	10
	7 Media Access Control Protocol Operation	12
	8 Quality Of Service & Fragmentation	13
	9 Cable Modem – CMTS Interaction	13
	10 Supporting Future New Cable Modem Capabilities	14
	11 Annexes to ITU-T Rec.J.112 Annex B	14
	Annex A: Well-known Addresses	
	Annex B: Parameters and Constants	
	Annex C: Common Radio Frequency Interface Encoding	
	Annex D: CM Configuration Interface Specification	
	Annex E:MAC Service Definition	
	Annex F: Example Preamble Sequence	
	Annex G: DOCSIS v1.0/v1.1 Interoperability	
	Annex H: Multiple Upstream Channel	
	Annex I: The Data-Over-Cable Spanning Tree Protocol	
	Annex J: Error Codes and Messages	
	Annex K: DOCSIS Transmission and Contention Resolution	
	Annex L: IGMP Example	
	Annex M: Unsolicited Grant Services	
	Annex N: European Specification Additions	
	12 Additional Requirements for Cable Modem Implementations	16
	Privacy for J.112 Annex B implementation	
	Operations Support System Interface (OSSI) & OSSI for Radio Frequency Interface	
Annex A	RFI Implementation Options & StarHub Specific Requirements	17
Annex B	References	19
Annex C	Corrigendum/Addendum	20

This Specification is subject to review and revision.

Part A Introduction

1 Scope

1.1 This Specification defines the Cable Modem to Radio Frequency Interface (RFI) requirements for bi-directional data transmission over hybrid fibre-coax cables based on the ITU-T Recommendation J.112 Annex B (03/2004). Two options for the physical layer technology are included, which have equal priority but are not required to inter-operate. One technology option is based on the downstream multi-programme television distribution which deploys 6 MHz channelling, and supports upstream transmission in the region of 5 MHz to 42 MHz. The other technology option is based on the multi-programme television distribution which deploys 8 MHz channelling, and supports upstream transmission in the region of 5 MHz to 65 MHz. The first¹ of these options is defined in clauses B.4, B.6 and B.7, whereas the second is defined by replacing the content of those clauses with the content of Annex B.N.

1.2 The intent is to permit deployment of data-over-cable systems in a multi-vendor interoperable environment. The simplified form of data-over-cable service is shown in Figure 1 where bi-directional Internet Protocol (IP) traffic is transferred transparently between the cable system head-end and the customer premises, over all-coaxial or hybrid fibre-coax (HFC) cable network.

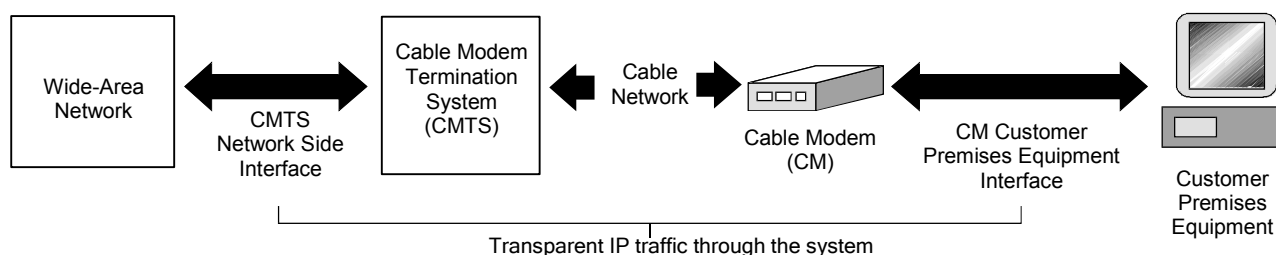


Figure 1 (Figure 1-1 of ITU-T Rec. J.112 Annex B):
Transparent IP traffic through the data-over-cable system

1.3 The reference architecture is shown in Figure 2.

1.4 The Specification has incorporated the current DOCSIS 1.1 RFI requirements, data privacy requirements described in the ITU-T Rec. J.125 (equivalent of DOCSIS SP-BPI+), and OSSI network management requirements (described in DOCSIS SP-OSS1v1.1).

1.5 Specific local network implementations are also included as Annex A to this Specification.

1.6 Cable modems shall have received the CableLabs certification, and be listed as CableLabs DOCSIS 1.1 certified products², and shall be able to inter-work properly with the local cable network.

¹ StarHub Cable Vision (SCV) has implemented the first option, which is based on the technology option deployed in North America.

² For connection to the SCV cable network, this is a mandatory requirement.

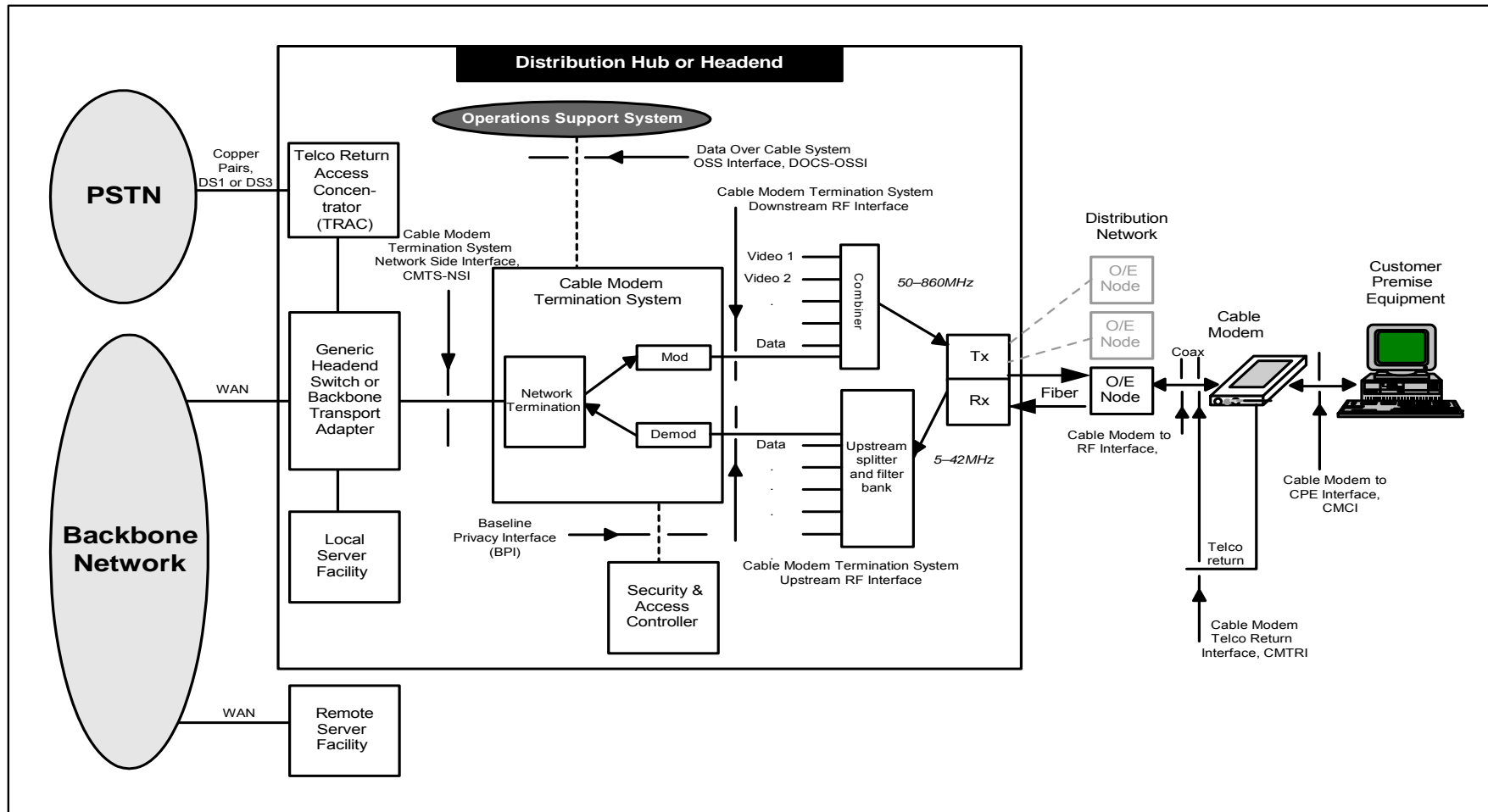


Figure 2 (Figure 1.2 of ITU-T Rec. J.112 Annex B):
Data-over-cable reference architecture

2 General Requirements

2.1 Power Supply

The equipment may be a.c. powered or d.c. powered. For an a.c. powered equipment, the Specification shall be complied with when operating from an a.c. mains supply of voltage, 230V \pm 10% and frequency, 50 Hz \pm 2%. Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the equipment to meet the Specification.

2.2 Identification of Equipment

The equipment shall be marked with the supplier or manufacturer's name or identification mark, and the supplier or manufacturer's model or type reference. The markings required shall be legible, indelible and readily visible.

2.3 Safety Requirements

The equipment shall be tested for compliance with the International Electrotechnical Commission IEC 60950-1 safety standard³. The requirements in IEC 60950-1 that are applicable to the equipment [e.g. class of equipment, type of telecommunication network voltage (TNV) circuit and types of components] shall be identified and complied with.

2.4 Electromagnetic Compatibility (EMC) Requirements

The equipment shall comply with the EMC requirements defined in CISPR 22.

NOTE

The following notations are used in the Specification:

CR	Conformance requirement defines features and functions that must be supported at minimum.
M	Mandatory requirements
O	Optional requirements, which become mandatory when features and functions are supported.
NA	Not Applicable
GID	General Information and Definitions

³ The safety standard includes, among others, protection of telecommunications network service personnel and users of other equipment connected to the network from hazards in the equipment.

Part B Data-Over-Cable Service Interface Specifications: Radio-Frequency Interface Specification

(ITU-T Recommendation J.112 Annex B 03/2004)

Table 1: Scope and Purpose				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Scope & Purpose	B.1	1	GID	
Scope	B.1.1	1.1	GID	
Requirements	B.1.2	1.2	GID	
Background	B.1.3	1.3	M	This Specification defines an interface, commonly referred to as DOCSIS 1.1, which is an extension of the interface specified in DOCSIS 1.0. These extensions are entirely backward and forward compatible with the previous specification. DOCSIS 1.1 compliant CM must interoperate seamlessly with DOCSIS 1.0 CMTS. DOCSIS 1.1 compliant CMTS must seamlessly support DOCSIS 1.0 CM. Refer to ITU-T Rec. J.112 Annex B.G for further interoperability information.
References	B.2	Appendix O	GID	
Definitions and abbreviations	B.3	Appendix P	GID	

Table 2: Functional Assumptions				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Functional assumptions	B.4	2	GID	
Broadband access network	B.4.1	2.1	GID	
Equipment assumptions	B.4.2	2.2	–	Heading
Frequency plan	B.4.2.1	2.2.1	GID	
Compatibility with other services	B.4.2.2	2.2.2	M	
Fault isolation impact on other users	B.4.2.3	2.2.3	M	
Cable System Terminal Devices	B.4.2.4	2.2.4	M	The CM MUST meet and SHOULD exceed all applicable regulations for Cable System Terminal Devices and Cable ready Consumer Equipment as defined in FCC Part 15 and Part 76. None of these national specific requirements may be used to relax any of the specifications contained elsewhere within the present document.
RF channel assumptions	B.4.3	2.3	GID	
Transmission downstream	B.4.3.1	2.3.1	GID	
Transmission upstream	B.4.3.2	2.3.2	GID	
Availability	B.4.3.2.1	2.3.2.1	GID	
Transmission Levels	B.4.4	2.4	GID	The nominal power level of the upstream CM signal(s) will be as low as possible to achieve the required margin above noise and interference.
Frequency Inversion	B.4.5	2.5	GID	

Table 3: Communication Protocols				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Communication protocols	B.5	3	GID	
Protocol stack	B.5.1	3.1	GID	
CM and CMTS as hosts	B.5.1.1	3.1.1	M	The CM MUST function as IP hosts.
			M	The CM MUST support IP and ARP over DIX link-layer framing.
			O Note 1	The CM MAY transmit frames that are smaller than the DIX 64 byte minimum on an upstream channel.
			O Note 1	The CM MAY also support IP and ARP over SNAP framing.
			M	The CM MUST function as LLC hosts.
			M Note 2	The CM MUST respond appropriately to TEST and XID requests.
Data forwarding through the CM and CMTS	B.5.1.2	3.1.2	–	Heading
General	B.5.1.2.1	3.1.2.1	M	Forwarding of IP traffic MUST be supported. Other network layer protocols MAY be supported. The ability to restrict the network layer to a single protocol such as IP MUST be supported.
CMTS forwarding rules	B.5.1.2.2	3.1.2.2	GID	
CM forwarding rules	B.5.1.2.3	3.1.2.3	M	
The MAC Forwarder	B.5.2	3.2	GID	
Network Layer	B.5.3	3.3	GID	
Requirements for IGMP management	B.5.3.1	3.3.1	M Note 3	Active and Passive IGMF devices MUST support IGMPv2 [RFC-2236]
IGMP timer requirements	B.5.3.1.1	3.3.1.1	M	
CMTS rules	B.5.3.1.2	3.3.1.2	GID	
CM rules	B.5.3.1.3	3.3.1.3	M	CM MUST support IGMP following the cable specific rules given in § B.5.3.1.3 of J.112 Annex B.
			M Note 3	The CM must implement the passive IGMP mode.
			M Note 3	In active IGMP mode, the CM must have the capability to switch between modes.
<p>Note 1: Not supported by StarHub Cable Vision.</p> <p>Note 2: The CPE Controlled Cable Modem (CCCM) hard ware must not respond to [ISO8802-2] LLC host request (TEST and XID) addressed to either a Host CPE MAC address or the CM MAC address - this is the responsibility of the host CPE. The CM must pass TEST and XID frames transparently to the host CPE without responding to them on its own.</p> <p>Note 3: StarHub Cable Vision requires CM to implement the IGMP mode.</p>				

Table 3: Communication Protocols (Continued)				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFiv1.1	CR	Remarks
Above the Network Layer	B.5.4	3.4	M	In addition to the transport of user data, there are several network management and operation capabilities, which depend upon the Network Layer. These include: <ul style="list-style-type: none"> – SNMP (Simple Network Management Protocol [RFC-1157]) MUST be supported. – TFTP (Trivial File Transfer Protocol [RFC-1350]) MUST be supported. – DHCP (Dynamic Host Configuration Protocol [RFC-2131]) MUST be supported. – Time of Day Protocol [RFC-868], MUST be supported. – DHCP, TFTP and ToD client messages generated by the CM MUST only be sent via the RF Interface. – The CM's DHCP, TFTP and ToD client MUST ignore DHCP, TFTP and ToD server messages received on the CMCI port.
Data Link Layer	B.5.5	3.5	GID	
LLC sublayer	B.5.5.1	3.5.1	M	
Link-layer security sublayer	B.5.5.2	3.5.2	M	
MAC sublayer	B.5.5.3	3.5.3	GID	
Physical Layer	B.5.6	3.6	GID	
Downstream transmission convergence sublayer	B.5.6.1	3.6.1	GID	
PMD sublayer	B.5.6.2	3.6.2	GID	

Table 4: Physical Media Dependent Sublayer Specification				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Physical Media Dependent Sublayer Specification	B.6	4	-	Heading
Scope	B.6.1	4.1	GID	
Upstream	B.6.2	4.2	-	Heading
Overview	B.6.2.1	4.2.1	M	
Modulation formats	B.6.2.2	4.2.2	M	
FEC Encode	B.6.2.3	4.2.3	M	
Scrambler (Randomizer)	B.6.2.4	4.2.4	M	
Preamble Prepend	B.6.2.5	4.2.5	M	
Transmit pre-equalizer	B.6.2.6	4.2.6	M	
Burst Profiles	B.6.2.7	4.2.7	M	
Burst timing convention	B.6.2.8	4.2.8	GID	
Transmit Power Requirements	B.6.2.9	4.2.9	M	
Fidelity Requirements	B.6.2.10	4.2.10	M	
Frame Structure	B.6.2.11	4.2.11	M	
Signal Processing Requirements	B.6.2.12	4.2.12	M	
Upstream Demodulator Input Power Characteristics	B.6.2.13	4.2.13	M	
Upstream Electrical Output from the CM	B.6.2.14	4.2.14	M	
Downstream	B.6.3	4.3	-	Heading
Downstream Protocol	B.6.3.1	4.3.1	M	
Scalable Interleaving to Support Low Latency	B.6.3.2	4.3.2	M	
Downstream Frequency Plan	B.6.3.3	4.3.3	GID	
CMTS Output Electrical	B.6.3.4	4.3.4	GID	
Downstream Electrical Input to CM	B.6.3.5	4.3.5	M	
CM BER Performance	B.6.3.6	4.3.6	M	
CMTS Timestamp Jitter	B.6.3.7	4.3.7	GID	

Table 5 : Downstream Transmission Convergence Sublayer				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Downstream Transmission Convergence Sublayer	B.7	5	GID	
Introduction	B.7.1	5.1	GID	
MPEG Packet Format	B.7.2	5.2	M	
MPEG Header for DOCSIS Data-Over-Cable	B.7.3	5.3	M	
MPEG Payload for DOCSIS Data-Over-Cable	B.7.4	5.4	M	
Interaction with the MAC Sublayer	B.7.5	5.5	M	
Interaction with the Physical Layer	B.7.6	5.6	M	
MPEG Header Synchronization and Recovery	B.7.7	5.7	O Note 1	
Note 1: Not supported by StarHub Cable Vision.				

Table 6 : Media Access Control Specification				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFIv1.1	CR	Remarks
Media Access Control Specification	B.8	6	–	Heading
Introduction	B.8.1	6.1	–	Heading
Overview	B.8.1.1	6.1.1	GID	
Definitions	B.8.1.2	6.1.2	–	Heading
MAC-Sublayer Domain	B.8.1.2.1	6.1.2.1	GID	
MAC Service Access Point	B.8.1.2.2	6.1.2.2	GID	
Service Flows	B.8.1.2.3	6.1.2.3	M	For the network to function properly, the CM MUST support at least 1 upstream and 1 downstream Service Flow.
Upstream Intervals, Mini-Slots and 6.25-Microsecond Increments	B.8.1.2.4	6.1.2.4	GID	
Frame	B.8.1.2.5	6.1.2.5	GID	
Future Use	B.8.1.3	6.1.3	M	
MAC Frame Formats	B.8.2	6.2	–	Heading
Generic MAC Frame Format	B.8.2.1	6.2.1	GID	
PMD Overhead	B.8.2.1.1	6.2.1.1	GID	
MAC Frame Transport	B.8.2.1.2	6.2.1.2	GID	
Ordering of Bits and Octets	B.8.2.1.3	6.2.1.3	M	
MAC Header Format	B.8.2.1.4	6.2.1.4	M	
Data PDU	B.8.2.1.5	6.2.1.5	M	
Packet-Based MAC Frames	B.8.2.2	6.2.2	M	
ATM Cell MAC Frames	B.8.2.3	6.2.3	M	
Reserved PDU MAC Frames	B.8.2.4	6.2.4	M	
MAC-Specific Headers	B.8.2.5	6.2.5	M	
Extended MAC Headers	B.8.2.6	6.2.6	M	
Fragmented MAC Frames	B.8.2.7	6.2.7	M	
Error-Handling	B.8.2.8	6.2.8	M	
MAC Management Messages	B.8.3	6.3	–	Heading
MAC Management Message Header	B.8.3.1	6.3.1	M	
Time Synchronization (SYNC)	B.8.3.2	6.3.2	GID	Transmitted by CMTS
Upstream Channel Descriptor (UCD)	B.8.3.3	6.3.3	GID	Transmitted by CMTS
Upstream Bandwidth Allocation Map (MAP)	B.8.3.4	6.3.4	GID	Generated by CMTS
Ranging Request (RNG-REQ)	B.8.3.5	6.3.5	M	

Table 6 : Media Access Control Specification (Continued)				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Ranging Response (RNG-RSP)	B.8.3.6	6.3.6	GID	Transmitted by CMTS
			M	A CM MUST be prepared to receive a Ranging Response at any time, not just following a Ranging Request.
			M	On the first Ranging Response received by the CM during the initial ranging, this channel ID may be different from the channel ID the CM used to transmit the ranging request (see ITU-T Rec. J.112 Annex B.H). Thus, the CM MUST use this channel ID for the rest of its transactions, not the channel ID it initiated the range request from.
Registration Request (REG-REQ)	B.8.3.7	6.3.7	M	A Registration Request MUST be transmitted by a CM at initialisation after receipt of a CM parameter file
Registration Response (REG-RSP)	B.8.3.8	6.3.8	GID	Transmitted by CMTS
Registration Acknowledge (REG-ACK)	B.8.3.9	6.3.9	M	
Upstream Channel Change Request (UCC-REQ)	B.8.3.10	6.3.10	GID	May be transmitted by CMTS
Upstream Channel Change Response (UCC-RSP)	B.8.3.11	6.3.11	M	
Dynamic Service Addition - Request (DSA-REQ)	B.8.3.12	6.3.12	M	
Dynamic Service Addition - Response (DSA-RSP)	B.8.3.13	6.3.13	M	
Dynamic Service Addition - Acknowledge (DSA-ACK)	B.8.3.14	6.3.14	M	
Dynamic Service Change - Request (DSC-REQ)	B.8.3.15	6.3.15	M	
Dynamic Service Change - Response (DSC-RSP)	B.8.3.16	6.3.16	M	
Dynamic Service Change - Acknowledge (DSC-ACK)	B.8.3.17	6.3.17	M	
Dynamic Service Deletion - Request (DSD-REQ)	B.8.3.18	6.3.18	M	
Dynamic Service Deletion - Request (DSD-RSP)	B.8.3.19	6.3.19	M	
Dynamic Channel Change - Request (DCC-REQ)	B.8.3.20	6.3.20	M	
Dynamic Channel Change - Response (DCC-RSP)	B.8.3.21	6.3.21	M	
Dynamic Channel Change - Acknowledge (DCC-ACK)	B.8.3.22	6.3.22	GID	
Device Class Identification Request (DCI-REQ)	B.8.3.23	6.3.23	O Note 1	
Device Class Identification Response (DCI-RSP)	B.8.3.24	6.3.24	GID	
Upstream Transmitter Disable (UP-DIS) MAC Management Message	B.8.3.25	6.3.25	O Note 1	
Note 1: Requirements are mandatory if clauses are applicable.				

Table 7 : Media Access Control Protocol Operation				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFiv1.1	CR	Remarks
Upstream Bandwidth Allocation	B.9.1	7.1	M	The CM MUST time its transmission so that the CMTS receives it in the time reference specified.
			O	CMs MAY issue requests to the CMTS for upstream bandwidth.
The Allocation Map MAC Management Message	B.9.1.1	7.1.1	GID	
Information Elements	B.9.1.2	7.1.2	M	
Requests	B.9.1.3	7.1.3	M	
Information Element Feature Usage Summary	B.9.1.4	7.1.4	M	
Map Transmission and Timing	B.9.1.5	7.1.5	M	
Protocol Example	B.9.1.6	7.1.6	M	
Support for Multiple Channels	B.9.2	7.2	O Note 1	
Timing and Synchronisation	B.9.3	7.3	M	
Global Timing Reference	B.9.3.1	7.3.1	M	
CM Channel Acquisition	B.9.3.2	7.3.2	M	
Ranging	B.9.3.3	7.3.3	M	
Timing Units and Relationships	B.9.3.4	7.3.4	GID	
Upstream Transmission and Contention Resolution	B.9.4	7.4	GID	
Contention Resolution Overview	B.9.4.1	7.4.1	M	
Transmit Opportunities	B.9.4.2	7.4.2	M	
CM Bandwidth Utilization	B.9.4.3	7.4.3	M	
Data Link Encryption Support	B.9.5	7.5	GID	
MAC Messages	B.9.5.1	7.5.1	M	
Framing	B.9.5.2	7.5.2	M	
Note 1: Not supported by StarHub Cable Vision.				

Table 8 : Quality Of Service & Fragmentation				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Quality of Service & Fragmentation	B.10	8	GID	
Theory of Operation	B.10.1	8.1	GID	
Concepts	B.10.1.1	8.1.1	M	
Object Model	B.10.1.2	8.1.2	GID	
Service Classes	B.10.1.3	8.1.3	GID	
Authorization	B.10.1.4	8.1.4	M	
Types of Service Flows	B.10.1.5	8.1.5	M	
Service Flows and Classifiers	B.10.1.6	8.1.6	M	
General Operation	B.10.1.7	8.1.7	–	Heading
Static Operation	B.10.1.7.1	8.1.7.1	M	
Dynamic Service Flow Creation - CM initiated	B.10.1.7.2	8.1.7.2	O	
Dynamic Service Flow Creation - CMTS initiated	B.10.1.7.3	8.1.7.3	GID	
Dynamic Service Flow Modification and Deletion	B.10.1.7.4	8.1.7.4	GID	
Upstream Service Flow Scheduling Services	B.10.2	8.2	M	
Fragmentation	B.10.3	8.3	M	
CM Fragmentation Support	B.10.3.1	8.3.1	M	
CMTS Fragmentation Support	B.10.3.2	8.3.2	GID	
Fragmentation Example	B.10.3.3	8.3.3	GID	
Payload Header Suppression	B.10.4	8.4	GID	

Table 9 : Cable Modem - CMTS Interaction				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFlv1.1	CR	Remarks
Cable Modem - CMTS Interaction	B.11	9	GID	
CMTS Initialization	B.11.1	9.1	GID	
Cable Modem Initialization	B.11.2	9.2	M	
Standard Operation	B.11.3	9.3	M	
Dynamic Service	B.11.4	9.4	M	
Dynamic Service Flow State Transitions	B.11.4.1	9.4.1	GID	
Dynamic Service Addition	B.11.4.2	9.4.2	–	Heading
CM Initiated Dynamic Service Addition	B.11.4.2.1	9.4.2.1	M	
CMTS Initiated Dynamic Service Addition	B.11.4.2.2	9.4.2.2	GID	
Dynamic Service Addition State Transition Diagrams	B.11.4.2.3	9.4.2.3	GID	
Dynamic Service Change	B.11.4.3	9.4.3	M	
Dynamic Service Deletion	B.11.4.4	9.4.4	M	
CM Initiated Dynamic Service Deletion	B.11.4.4.1	9.4.4.1	GID	
CMTS Initiated Dynamic Service Deletion	B.11.4.4.2	9.4.4.2	GID	
Dynamic Service Deletion State Transition Diagrams	B.11.4.4.3	9.4.4.3	GID	
Dynamically Changing Downstream and/or Upstream Channels	B.11.4.5	9.4.5	GID	
Fault Detection and Recovery	B.11.5	9.5	M	
Prevention of Unauthorised Transmissions	B.11.5.1	9.5.1	M	

Table 10 : Supporting Future New Cable Modem Capabilities				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFIv1.1	CR	Remarks
Supporting Future New Cable Modem Capabilities	B.12	10	–	Heading
Downloading Cable Modem Operating Software	B.12.1	10.1	M	

Table 11 : Annexes to ITU-T Rec.J.112 Annex B				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFIv1.1	CR	Remarks
Well-known Addresses	Annex B.A	Appendix A	M	
Parameters and Constants	Annex B.B	Appendix B	M	
Common Radio Frequency Interface Encoding	Annex B.C	Appendix C	GID	
Encoding for Configuration and MAC-Layer Messaging	B.C.1	C.1	M	
Configuration File and Registration Settings	B.C.1.1	C.1.1	M	
Configuration-File-Specific Settings	B.C.1.2	C.1.2	M	
Registration-Request/Response-Specific Encoding	B.C.1.3	C.1.3	M	
Dynamic-Service-Message-Specific Encoding	B.C.1.4	C.1.4	M	
Quality-of-Service-Related Encodings	B.C.2	C.2	–	Heading
Packet Classification Encodings	B.C.2.1	C.2.1	M	
Service Flow Encodings	B.C.2.2	C.2.2	M	
Encoding for Other Interfaces	B.C.3	C.3	–	Heading
Telephone Settings Option	B.C.3.1	C.3.1	O	
Baseline Privacy Configuration Settings Option	B.C.3.2	C.3.2	O	
Confirmation Codes	B.C.4	C.4	M	
Confirmation Codes for Dynamic Channel Change	B.C.4.1	C.4.1	GID	
Confirmation Codes for Major Errors	B.C.4.2	C.4.2	GID	
CM Configuration Interface Specification	Annex B.D	Appendix D	–	Heading
CM IP Addressing	B.D.1	D.1	–	Heading
DHCP Fields used by the CM	B.D.1.1	D.1.1	M Note 1	
CM Configuration	B.D.2	D.2	–	Heading
CM Binary Configuration File Format	B.D.2.1	D.2.1	M	
Note 1: The CM MUST be capable of filtering all broadcast traffic from the local LAN or host CPE, with the exception of DHCP (as identified by the destination port number in the UDP header) and ARP packets				

Table 11 : Annexes to ITU-T Rec.J.112 Annex B (Continued)				
Title	ITU-T Rec. J.112 Annex B	DOCSIS SP RFIv1.1	CR	Remarks
Configuration File Settings	B.D.2.2	D.2.2	M	The following configuration settings MUST be supported by all CMs: <ul style="list-style-type: none"> – Downstream Frequency Configuration Setting – Upstream Channel ID Configuration Setting – Network Access Configuration Setting – End Configuration Setting – Maximum Number of CPEs
			O	The rest of the configuration settings are optional. Except for the “Telephone Settings Option” and “Vendor-Specific Configuration Settings”, a configuration setting must be supported if it is present in the configuration file.
Configuration File Creation	B.D.2.3	D.2.3	M	
Configuration Verification	B.D.3	D.3	M	
MAC Service Definition	Annex B.E	Appendix E	GID	
Example Preamble Sequence	Annex B.F	Appendix F	GID	
DOCSIS v1.0/v1.1 Interoperability	Annex B.G	Appendix G	–	Heading
Introduction	B.G.1	G.1	Note 2	
General Interoperability Issues	B.G.2	G.2	GID	
Provisioning	B.G.2.1	G.2.1	M	
Registration	B.G.2.2	G.2.2	GID	
Dynamic Service Establishment	B.G.2.3	G.2.3	GID	
Fragmentation	B.G.2.4	G.2.4	GID	
Multicast Support	B.G.2.5	G.2.5	M	
Upstream Channel Change	B.G.2.6	G.2.6	GID	
Hybrid Devices	B.G.3	G.3	GID	
Interoperability & Performance	B.G.4	G.4	GID	
Multiple Upstream Channel	Annex B.H	Appendix H	GID	
The Data-Over-Cable Spanning Tree Protocol	Annex B.I	Appendix I	M	
Error Codes and Messages	Annex B.J	Appendix J	M	
DOCSIS Transmission and Contention Resolution	Annex B.K	Appendix K	GID	
IGMP Example	Annex B.L	Appendix L	M	
Unsolicited Grant Services	Annex B.M	Appendix M	-	Heading
Unsolicited Grant Services (UGS)	B.M.1	M.1	M	
Unsolicited Grant Services with Activity Detection (UGS-AD)	B.M.2	M.2	O	
European Specification Additions	Annex B.N	Appendix N	Note 3	
<p>Note 2: It is necessary for a DOCSIS 1.1 CM to function like a DOCSIS 1.0 CM when inter-operating with a DOCSIS 1.0 CMTS.</p> <p>Note 3: This Annex applies to the second technology option, and describes the physical layer specifications required for the EuroDOCSIS cable modems. Requirements are “M” if the technology option is selected.</p>				

Table 12 : Additional Requirements for Cable Modem Implementations				
Title	ITU-T	DOCSIS	CR	Remarks
Link Privacy for Cable Modem Implementations	Rec. J.125	SP BPI+	M	The CM must support MAC layer privacy services for CMTS-CM communications, providing cable modem users with data privacy across the cable network and preventing unauthorised users from gaining access to network's RF MAC services.
Operations Support System Interface (OSSI)	–	SP-OSSlv1.1	M	The CM must support network management requirements as defined in the DOCSIS SP-OSSlv1.1
OSSI for Radio Frequency Interface	–	SP-RFv.1.1 and SP-OSSlv1.1	M	Access to CM functions must only be allowed via interfaces specifically prescribed by the DOCSIS SP-RFv.1.1 and SP-OSSlv1.1

Annex A

RFI Implementation Options & StarHub Specific Requirements

Optional RFI Requirement	ITU-T Rec. J.112 Annex B (03/2004)	StarHub Cable Vision's Selected Option
CM and CMTS as hosts - The CM MAY transmit frames that are smaller than the DIX 64 byte minimum on an upstream channel.	B.5.1.1	Not supported
CM and CMTS as hosts - The CM MAY also support IP and ARP over SNAP framing.	B.5.1.1	Not supported
MPEG Header Synchronization and Recovery	B.7.7	Not supported
Support for Multiple Channels	B.9.2	Not supported
European Specification Additions	Annex B.N	Not supported

StarHub Cable Vision's Specific Requirement		CR	Remarks
CM Adjacent Channel Power	BIE-TP-01	–	Heading
Adjacent Channel Power Test	BIE-TP-01	M	CM adjacent channel power MUST be at least -44dBc, for an upper/lower adjacent channel bandwidth of 1.6MHz. CM adjacent channel power MUST be at least -41dBc, for an upper/lower adjacent channel bandwidth of 3.2MHz.
Harmonics	BIE-TP-01	M	The 2 nd and 3 rd harmonics of the upstream centre frequency, measured in 160kHz bandwidth, MUST be at least -47dBc.
CM Throughput Performance Specifications	BIE-TP-02	M	In the downstream direction at a rate of 2930 packet/sec and packet size of 64bytes, packet losses MUST be less than 0.1%. In the downstream direction at a rate of 124 packet/sec and packet size of 1518 bytes, packet losses MUST be less than 0.1%.
CM Registration Test	BIE-TP-03	M	The CM MUST register with the CMTS within 60 seconds under un-congested traffic.
		M	The CM MUST register within 60 seconds even under 98 percent upstream channel utilization on the CMTS.
CM Frequency Agility Test - Frequency Hopping Test	BIE-TP-04	M	The CM MUST be capable of hopping to a specified upstream channel when commanded by the CMTS.
CM Applications Test	BIE-TP-09	–	Heading
VPN	BIE-TP-09	M	The CM MUST permit the customer initiated VPN client to successfully create a VPN tunnel through the CM The CM MUST permit data to be transmitted successfully between the client and the VPN connected network.
OS support	BIE-TP-09	M	The CM (Ethernet connection) MUST support win95/98SE/NT/ME/2000/XP, MacOS 8.x/9.x/10.x(X). The CM (USB) MUST support win98SE/ME/2000/XP. WHQL certified USB driver MUST be provided.

StarHub Cable Vision's Specific Requirement		CR	Remarks
CM Applications Test (Continued)	BIE-TP-09	–	Heading
HTTP server	BIE-TP-09	O	HTTP server should have the following levels of access control: a) No CPE access after registration (Ethernet & USB ports) b) Restricted access after registration (i.e. no access to DS/US info, Headend info) c) Unrestricted access after registration
		O	CM internal web pages should provide information on: a) Initialization status b) Software version c) CM up-time & DHCP lease information d) HFC & CPE interface MAC addresses e) Transmit & receive power level f) CPE MAC & IP addresses learnt by CM g) Filter list h) Event list of at least 100 entries
		M	The CM MUST have the capability of disabling access to the CM's http server/management interface via the CM's configuration file parameters.
Filters	BIE-TP-09	O	CM should support the following filters: a) MAC address filtering b) Forced reboot via SNMP set command c) ARP storm filtering d) ARP filtering e) Permit/deny multicast access f) Enable/Disable CPE traffic (Ethernet or USB) g) 1 IP source address filter per CPE h) Rate-limiting on each SNMP trap
QOS Classifier Specifications Test	BIE-TP-015	–	Heading
MAC SA	BIE-TP-015	M	The CM MUST be capable of classifying via a packet's MAC source address
IP ToS	BIE-TP-015	M	The CM MUST be capable of classifying via a packet's ToS.
IP protocol	BIE-TP-015	M	The CM MUST be capable of classifying via a packet's IP protocol
IP source address	BIE-TP-015	M	The CM MUST be capable of classifying via a packet's IP source address
TCP/UDP source port start/end	BIE-TP-015	M	The CM MUST be capable of classifying via TCP/UDP source start/end port
Service flows	BIE-TP-015	M	The CM MUST support a minimum of four (4) downstream and four (4) upstream service flows.
QOS Service-Flow Encoding Test	BIE-TP-016	–	Heading
QoS timeout	BIE-TP-016	M	The CM MUST be capable defaulting to the primary service flow when the QoS timeout occurs. The CM MUST observe traffic priority settings. The higher priority MUST be given lower delay and higher buffering preference.
Interoperability Test	BIE-TP-020	M	The CM has obtained the CableLabs certification, and is listed as a CableLabs DOCSIS 1.1 certified product. The CM shall be tested successfully for interoperability with StarHub's cable network

Annex B

References

For the technical requirements captured in this Specification, reference has been made to the following documents:

ITU-T Rec. J.110 Annex B (03/2004)	Data-over-cable service interface specifications: Radio-frequency interface specification Annex B
ITU-T Rec. J.125 (04/2004)	Link Privacy for Cable Modem Implementations
SP-RFIV1.1-I110-030730	Data-Over-Cable Service Interface Specification - Radio Frequency Interface Specification
SP-BPI+-I11-040407	Baseline Privacy Plus Interface Specification
SP-OSSIV1.1-I07-030730	Operations Support System Interface Specification
SP-CMCI-I09-030730	Cable Modem to Customer Premise Equipment Interface Specification
IEC 60950-1: 2001	Information Technology Equipment - Safety
IEC CISPR 22: 2003-04	Information Technology Equipment - Radio disturbance characteristics - Limits and methods of measurement

Annex C

Corrigendum/Addendum

Changes to IDA TS CM Issue 1, Jul 05			
Page	TS Ref.	Items Changed	Effective Date
–	–	Change of IDA's address at cover page to Mapletree Business City.	1 May 11

Changes to IDA TS CM 2			
Page	TS Ref.	Items Changed	Effective Date
–	–	The IDA TS CM Issue 1 (Jul 05) has superseded the IDA TS CM 2 Issue 1 (2 Jan 03). It has also incorporated the EMC requirements, previously published under the IDA TS EMC Issue 1 Rev 1.	21 Jul 05
–	–	Title of Specification has been renamed as "Technical Specification for Cable Modems connected to the Radio Frequency Interface of the High-speed Data-Over-Cable Systems (DOCSIS 1.1)" [IDA TS CM Issue 1]. Changes are mainly editorial in nature. There are no changes to the technical requirements.	21 Jul 05