

Superseded

Data-Over-Cable Interface Specifications

Radio Frequency Interface Specification

SP-RFII01-970326

**INTERIM
SPECIFICATION**

Notice

This document was prepared by Arthur D. Little, Inc., under contract to MCNS Holdings, L.P. Neither Arthur D. Little, Inc. nor MCNS Holdings, L.P. is responsible for any liability of any nature whatsoever resulting from or arising out of use or reliance upon this specification by any party. This document is furnished on an "AS IS" basis and neither Arthur D. Little, Inc. nor MCNS Holdings, L.P., provides any representation or warranty, express or implied, regarding its accuracy, completeness, or fitness for a particular purpose. Distribution of this document is restricted pursuant to the terms of separate agreements negotiated with each of the parties to whom this document has been furnished.

© Copyright 1997 MCNS Holdings, L.P.
All rights reserved.

Document Status Sheet

Document Control Number: SP-RFII01-970321

Reference: Radio Frequency Interface Specification

Revision History: D01 2/24/97 Released for MCNS/author comments
D01 3/10/97 Revisions for approval
D01 3/21/97 Released for publication
D01 3/26/97 Re-released for publication

Date: March 26, 1997

Status Code: ~~Work in~~ Draft **Interim** Released

	Process		
Distribution Restrictions:	Arthur D. Little only	ADL/MCN S/ Authors	ADL/MCNS/ Vendor
			Public

Key to Document Status Codes

Work in Process An incomplete document, designed to guide discussion and generate feedback, that may include several alternative requirements for consideration.

Draft A document in specification format considered largely complete, but lacking review by MCNS and vendors. Drafts are susceptible to substantial change during the review process.

Interim A document which has undergone rigorous MCNS and vendor review, suitable for use by vendors to design in conformance with, and suitable for field testing.

Released A stable document, reviewed, tested and validated, suitable to enable cross-vendor interoperability.

Contents

EXECUTIVE SUMMARY xi

1. SCOPE AND PURPOSE.....1

1.1 SCOPE1

1.2 REQUIREMENTS.....1

1.3 BACKGROUND.....1

 1.3.1 Service Goals1

 1.3.2 Reference Architecture2

 1.3.3 Server Location.....5

2. FUNCTIONAL ASSUMPTIONS.....7

2.1 BROADBAND ACCESS NETWORK7

2.2 EQUIPMENT ASSUMPTIONS7

 2.2.1 Frequency Plan.....7

 2.2.2 Compatibility with Other Services.....7

 2.2.3 Fault Isolation Impact on Other Users.....8

2.3 RF CHANNEL ASSUMPTIONS.....8

 2.3.1 Transmission Downstream8

 2.3.2 Transmission Upstream9

2.4 TRANSMISSION LEVELS.....10

2.5 FREQUENCY INVERSION10

3. COMMUNICATION PROTOCOLS.....11

3.1	PROTOCOL STACK	11
3.1.1	CM and CMTS as Hosts.....	11
3.1.2	Data Forwarding Through the CM and CMTS	12
3.2	THE MAC FORWARDER.....	15
3.2.1	Example Rules for Data-Link-Layer Forwarding	16
3.3	NETWORK LAYER	16
3.4	ABOVE THE NETWORK LAYER	16
3.5	DATA LINK LAYER	17
3.5.1	LLC Sublayer	17
3.5.2	Link-Layer Security Sublayer	17
3.5.3	MAC Sublayer.....	17
3.6	PHYSICAL LAYER.....	18
3.6.1	Downstream Transmission Convergence Sublayer	18
3.6.2	PMD Sublayer.....	18
4.	PHYSICAL MEDIA DEPENDENT SUBLAYER SPECIFICATION	21
4.1	SCOPE	21
4.2	UPSTREAM.....	21
4.2.1	Overview	21
4.2.2	Modulation Formats	22
4.2.3	FEC Encode.....	25
4.2.4	Scrambler (Randomizer).....	25
4.2.5	Preamble Prepend	26
4.2.6	Burst Profiles	26
4.2.7	Burst Timing Convention	29
4.2.8	Transmit Power Requirements.....	30
4.2.9	Fidelity Requirements	31
4.2.10	Frame Structure.....	32
4.2.11	Signal Processing Requirements	34
4.2.12	Upstream Demodulator Input Power Characteristics.....	35
4.2.13	Upstream Electrical Output from the CM	36
4.3	DOWNSTREAM	36
4.3.1	Downstream Protocol.....	36
4.3.2	Scalable Interleaving to Support Low Latency.....	36
4.3.3	Downstream Frequency Plan	37
4.3.4	CMTS Output Electrical	37
4.3.5	Downstream Electrical Input to CM.....	38
4.3.6	CM BER Performance	38
5.	DOWNSTREAM TRANSMISSION CONVERGENCE SUBLAYER	41
5.1	INTRODUCTION	41
5.2	MPEG PACKET FORMAT	41
5.3	MPEG HEADER FOR MCNS DATA-OVER-CABLE.....	42
5.4	MPEG PAYLOAD FOR MCNS DATA-OVER-CABLE.....	42
5.5	INTERACTION WITH THE MAC SUBLAYER.....	43
5.6	INTERACTION WITH THE PHYSICAL LAYER	44

5.7	MPEG HEADER SYNCHRONIZATION AND RECOVERY	44
6.	MEDIA ACCESS CONTROL SPECIFICATION	44
6.1	INTRODUCTION	44
6.1.1	Overview	44
6.1.2	Definitions.....	45
6.1.3	Future Use	46
6.2	MAC FRAME FORMATS	46
6.2.1	Generic MAC Frame Format.....	46
6.2.2	Packet-Based MAC Frames.....	50
6.2.3	ATM Cell MAC Frames	51
6.2.4	Reserved PDU MAC Frames	51
6.2.5	MAC-Specific Headers	52
6.2.6	Extended MAC Headers.....	56
6.2.7	Error-Handling	58
6.3	MAC MANAGEMENT MESSAGES	58
6.3.1	Message Format	58
6.3.2	MAC Management Messages.....	60
6.4	UPSTREAM BANDWIDTH ALLOCATION	76
6.4.1	The Allocation Map MAC Management Message	77
6.4.2	Map Transmission and Timing	80
6.4.3	Protocol Example	81
6.4.4	Contention Resolution.....	82
6.4.5	CM Behavior.....	83
6.4.6	Support for Multiple Channels	83
6.4.7	Classes of Service	84
6.5	TIMING AND SYNCHRONIZATION	85
6.5.1	Global Timing Reference	85
6.5.2	CM Channel Acquisition.....	86
6.5.3	Ranging.....	86
6.5.4	Timing Units and Relationships.....	87
6.6	DATA LINK ENCRYPTION SUPPORT	88
6.6.1	MAC Messages	88
6.6.2	Framing.....	88
7.	CABLE MODEM - CMTS INTERACTION	91
7.1	CMTS INITIALIZATION	91
7.2	CABLE MODEM INITIALIZATION	91
7.2.1	Scanning and Synchronization to Downstream.....	93
7.2.2	Obtain Upstream Parameters.....	93
7.2.3	Message Flows During Scanning and Upstream Parameter Acquisition	95
7.2.4	Ranging and Automatic Adjustments.....	96
7.2.5	Establish IP Connectivity.....	101
7.2.6	Establish Time of Day.....	101
7.2.7	Establish Security Association.....	102

7.2.8	<i>Transfer Operational Parameters</i>	102
7.2.9	<i>Registration</i>	102
7.2.10	<i>Service IDs During CM Initialization</i>	103
7.2.11	<i>Multiple-Channel Support</i>	104
7.2.12	<i>Remote RF Signal Level Adjustment</i>	104
7.2.13	<i>Changing Upstream Burst Parameters</i>	106
7.2.14	<i>Changing Upstream Channels</i>	106
7.2.15	<i>Fault Detection and Recovery</i>	108
7.2.16	<i>Prevention of Unauthorized Transmissions</i>	109
8.	SUPPORTING FUTURE NEW CABLE MODEM CAPABILITIES	111
8.1	SETTING UP COMMUNICATIONS ON AN ENHANCED BASIS	111
8.1.1	<i>Upstream Enhanced / Downstream Standard</i>	111
8.1.2	<i>Downstream Enhanced / Upstream Enhanced or Standard</i>	111
8.2	DOWNLOADING CABLE MODEM OPERATING SOFTWARE	111
9.	PROVISION FOR OTHER FUTURE CAPABILITIES	113
9.1	ANTICIPATED PHYSICAL-LAYER CHANGES	113
9.1.1	<i>Adding Upstream Channel and Burst Configuration Settings</i>	113
9.1.2	<i>Downstream Channel Improvements</i>	114
9.2	NEW NETWORK SERVICE REQUIREMENTS	114
9.2.1	<i>Multicast Service IDs</i>	114
9.2.2	<i>RSVP Support for Upstream Traffic</i>	115
9.3	PID FILTERING CAPABILITY	116
	APPENDIX A - WELL-KNOWN ADDRESSES	117
A.1	MAC ADDRESSES	117
A.2	MAC SERVICE IDs	117
A.3	MPEG PID AND TABLE_ID	117
	APPENDIX B - PARAMETERS AND CONSTANTS	119
	APPENDIX C - CM CONFIGURATION INTERFACE SPECIFICATION	121
C.1	DHCP FIELDS USED BY THE CM	121
C.2	CM BINARY CONFIGURATION FILE FORMAT	121
C.3	CONFIGURATION FILE SETTINGS	122
C.4	CONFIGURATION FILE CREATION	123
C.5	CM MIC CALCULATION	124
C.6	CMTS MIC CALCULATION	125
	<i>C.6.1 Digest Calculation</i>	125
C.7	REGISTRATION CONFIGURATION SETTINGS	125
C.8	ENCODINGS	126
	<i>C.8.1 End-of-Data Marker</i>	126
	<i>C.8.2 Pad Configuration Setting</i>	126
	<i>C.8.3 Downstream Frequency Configuration Setting</i>	126
	<i>C.8.4 Upstream Channel ID Configuration Setting</i>	127
	<i>C.8.5 Network Access Control Object</i>	127

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.