

## Contents

1.	Introduction . . . . .	1-1
1.1	Background . . . . .	1-1
1.2	Purpose of Document . . . . .	1-2
1.3	Scope of Document . . . . .	1-2
1.4	Target Audience . . . . .	1-4
1.5	Structure and Use of This Document . . . . .	1-4
1.6	Requirements Terminology . . . . .	1-4
1.7	Requirement Labeling Conventions . . . . .	1-5
1.7.1	Numbering of Requirement and Related Objects . . . . .	1-5
1.7.2	Requirement, Conditional Requirement, and Objective Object Identification . . . . .	1-6
2.	ATM Network Architectures . . . . .	2-1
2.1	ATM Technology . . . . .	2-1
2.1.1	ATM Cells . . . . .	2-1
2.1.2	Adaptation . . . . .	2-1
2.1.3	Virtual Paths and Virtual Channels . . . . .	2-2
2.1.4	ATM Layer Operations Flows . . . . .	2-3
2.2	Terminology Issues . . . . .	2-5
2.3	ATM Network Elements . . . . .	2-7
2.4	Service Access Scenarios . . . . .	2-7
2.4.1	Basic Access Scenarios . . . . .	2-8
2.4.2	Integrated Local Management Interface (ILMI) . . . . .	2-9
2.4.3	Access Signaling . . . . .	2-10
2.4.4	Proxy Signaling . . . . .	2-11
2.4.5	Virtual UNIs . . . . .	2-13
2.4.6	IMA Access Links . . . . .	2-14
2.5	Interoffice Signaling . . . . .	2-15
2.6	PNNI Signaling and Routing . . . . .	2-17
2.7	Service Offerings . . . . .	2-20
2.7.1	Permanent Virtual Circuits (PVCs) . . . . .	2-22
2.7.2	Switched Virtual Circuits (SVCs) and Switched Virtual Paths (SVPs) . . . . .	2-23
2.7.3	Soft PVCs . . . . .	2-24
2.7.4	Voice and Telephony Over ATM . . . . .	2-24
2.8	ATM Network Architectures . . . . .	2-30
2.9	Connection Protection for ATM Traffic . . . . .	2-30
2.9.1	Physical Layer Protection . . . . .	2-31
2.9.2	ATM Layer Connection Protection . . . . .	2-31
2.9.2.1	Dedicated Point-to-Point VP/VPG Protection . . . . .	2-31
2.9.2.2	ATM Protection Domains . . . . .	2-32
3.	Management Architectures . . . . .	3-1
3.1	TMN Logical Architecture . . . . .	3-1
3.1.1	Management Functional Areas . . . . .	3-1

3.1.2	Logical Layers and Management Systems . . . . .	3-2
3.2	Network Level Management Framework . . . . .	3-5
3.2.1	Motivation for the Network View . . . . .	3-5
3.2.2	Network Level Concepts . . . . .	3-6
3.2.2.1	Layer Networks . . . . .	3-7
3.2.2.2	Client-Server Relationships Among Layer Networks . . . . .	3-8
3.2.2.3	Subnetworks, Partitioning, and Links . . . . .	3-8
3.2.2.4	Subnetwork Connection . . . . .	3-10
3.2.2.5	Modeling Interlayer Relationships . . . . .	3-11
3.3	Scheduling . . . . .	3-12
3.4	NMS Architecture . . . . .	3-13
3.5	ATM NMS GR Functional Scope . . . . .	3-15
3.5.1	Network Elements . . . . .	3-16
3.5.2	Services . . . . .	3-16
3.5.3	Protection . . . . .	3-17
3.5.4	MAFs . . . . .	3-17
4.	Operations Functional Requirements . . . . .	4-1
4.1	Configuration Management . . . . .	4-1
4.1.1	Network Planning and Engineering . . . . .	4-4
4.1.1.1	Network Infrastructure Design . . . . .	4-4
4.1.1.2	Access Infrastructure Design . . . . .	4-6
4.1.1.3	Facility Infrastructure Design . . . . .	4-7
4.1.1.4	Routing Design . . . . .	4-8
4.1.2	Installation . . . . .	4-9
4.1.2.1	Network Installation Administration . . . . .	4-10
4.1.2.2	Material Management . . . . .	4-12
4.1.2.3	Scheduling and Dispatch Administration for Installation Force . . . . .	4-13
4.1.3	Service Planning and Negotiation . . . . .	4-14
4.1.4	Provisioning . . . . .	4-14
4.1.4.1	Network Configuration . . . . .	4-15
4.1.4.2	Network Resource Selection and Assignment . . . . .	4-26
4.1.4.3	Interexchange Circuit Design . . . . .	4-28
4.1.4.4	Access Circuit Design . . . . .	4-29
4.1.4.5	Leased Circuit Design . . . . .	4-31
4.1.4.6	Facility Design . . . . .	4-33
4.1.4.7	Manage Pending Network Changes . . . . .	4-33
4.1.4.8	Network Connection Management . . . . .	4-35
4.1.4.9	Circuit Inventory Notification . . . . .	4-44
4.1.4.10	Circuit Inventory Query . . . . .	4-45
4.1.4.11	Resource Provisioning Selection and Assignment (RPSA) Reporting . . . . .	4-45
4.1.4.12	Inventory Notification and Query (INQ) Reporting . . . . .	4-46
4.1.5	Status and Control . . . . .	4-46
4.1.5.1	Message Handling Systems Network Status . . . . .	4-47

4.1.5.2	Connectivity Status . . . . .	4-48
4.1.5.3	Transport Network Status . . . . .	4-48
4.1.6	Data Management . . . . .	4-48
4.2	Performance Management . . . . .	4-50
4.2.1	Performance Monitoring . . . . .	4-50
4.2.1.1	Network Performance Monitoring Event Correlation and Filtering . . . . .	4-51
4.2.1.2	Data Aggregation and Trending . . . . .	4-51
4.2.1.3	Circuit-Specific Data Collection . . . . .	4-51
4.2.2	Performance Management Control . . . . .	4-54
4.2.3	Performance Analysis . . . . .	4-55
4.2.3.1	Traffic Exception Analysis . . . . .	4-55
4.2.3.2	Traffic Capacity Analysis . . . . .	4-56
4.2.3.3	Network Performance Characterization . . . . .	4-57
4.2.3.4	Performance Reporting . . . . .	4-58
4.3	Fault Management . . . . .	4-59
4.3.1	Reliability, Availability, and Survivability (RAS) Quality Assurance . . . . .	4-59
4.3.2	Alarm Surveillance . . . . .	4-60
4.3.2.1	Alarm Reporting . . . . .	4-61
4.3.2.2	Network Fault Event Analysis, Including Correlation and Filtering . . . . .	4-61
4.3.2.3	Root Cause Alarm Analysis (RCAA) Reporting . . . . .	4-63
4.3.2.4	Alarm Status Modification . . . . .	4-63
4.3.3	Fault Localization . . . . .	4-63
4.3.4	Fault Correction . . . . .	4-67
4.3.4.1	Scheduling and Dispatch Administration of Repair Force . . . . .	4-67
4.3.4.2	Repair Strategy . . . . .	4-69
4.3.5	Testing . . . . .	4-70
4.3.5.1	Circuit Selection, Test Correlation and Fault Location . . . . .	4-70
4.3.5.2	Selection of Test Suite . . . . .	4-75
4.3.5.3	Test Access Network Control and Recovery . . . . .	4-75
4.3.6	Trouble Administration . . . . .	4-76
4.4	Accounting Management . . . . .	4-78
4.4.1	Usage Measurement . . . . .	4-78
4.4.1.1	Usage Data Generation, Collection, and Distribution . . . . .	4-78
4.4.1.2	Administration of Usage Data Collection . . . . .	4-79
4.4.2	Tariffing/Pricing . . . . .	4-79
4.4.3	Collections and Finance . . . . .	4-80
4.4.4	Enterprise Control . . . . .	4-80
4.5	Security Management . . . . .	4-80
4.5.1	Prevention . . . . .	4-80
4.5.1.1	Identification . . . . .	4-81
4.5.1.2	Authentication . . . . .	4-81

4.5.1.3	System Access Control . . . . .	4-82
4.5.1.4	Resource Access Control . . . . .	4-82
4.5.1.5	Data and System Integrity . . . . .	4-83
4.5.2	Detection . . . . .	4-83
4.5.2.1	Internal Traffic and Activity Pattern Analysis . . . . .	4-83
4.5.2.2	Network Security Alarm . . . . .	4-83
4.5.2.3	Software Intrusion Audit . . . . .	4-85
4.5.3	Containment and Recovery . . . . .	4-85
4.5.3.1	Network Intrusion Recovery . . . . .	4-85
4.5.3.2	Administration of Network Revocation Lists . . . . .	4-85
4.5.3.3	Protected Storage of Network Configuration Data . . . . .	4-86
4.5.3.4	Severing Internal Connections . . . . .	4-86
4.5.4	Security Administration . . . . .	4-86
4.5.4.1	Testing of Audit Trail Mechanism . . . . .	4-87
4.5.4.2	Administration of Internal Authentication . . . . .	4-87
4.5.4.3	Administration of Internal Access Control . . . . .	4-87
4.5.4.4	Administration of Internal Certification . . . . .	4-87
4.5.4.5	Administration of Internal Encryption and Keys . . . . .	4-87
4.5.4.6	Network Audit Trail Management . . . . .	4-87
4.5.4.7	Network Security Alarm Management . . . . .	4-88
4.5.4.8	Security Reporting . . . . .	4-89
5.	Requirements for NMS Distribution . . . . .	5-1
5.1	Requirements for Functionally Distributed NMSs . . . . .	5-1
5.2	Requirements for Geographically Distributed NMSs . . . . .	5-2
5.3	Requirements Concerning NMS Load Sharing . . . . .	5-3
5.4	Requirements Concerning Replicated NMSs . . . . .	5-3
6.	Common System Requirements . . . . .	6-1
6.1	Common Operations Management . . . . .	6-1
6.1.1	Data Communications . . . . .	6-1
6.1.2	User Support . . . . .	6-2
6.1.3	Data Management . . . . .	6-7
6.1.3.1	User Identification . . . . .	6-8
6.1.3.2	System Log-On Record . . . . .	6-8
6.1.3.3	Data Export . . . . .	6-9
6.1.4	Operations Control Management . . . . .	6-9
6.2	System Administration . . . . .	6-10
6.3	System Reliability and Availability . . . . .	6-11
6.4	System Capacity and Performance . . . . .	6-12
6.4.1	System-to-System Interface . . . . .	6-12
6.4.2	Real Time Performance . . . . .	6-13
6.4.3	Performance Measurements/Alarms . . . . .	6-14
6.5	Equipment Environment . . . . .	6-15
6.6	Product Support . . . . .	6-16
7.	Operations Interfaces . . . . .	7-1
7.1	Existing/Developing Network View Standards . . . . .	7-1

7.1.1	ITU-T Q.18/4 Generic Network Level Model . . . . .	7-1
7.1.2	ATM Forum Network Level Model . . . . .	7-2
7.1.3	TeleManagement Forum Network Level Model for ATM . . . . .	7-2
7.1.4	Internet Engineering Task Force (IETF) RFC 2515 . . . . .	7-3
7.2	SMS/NMS Interface . . . . .	7-3
7.3	NMS/EMS Interface . . . . .	7-15
7.4	Trouble Ticket System Interface . . . . .	7-24
7.5	Scheduling and Dispatch System Interface . . . . .	7-25
References . . . . .		References-1
Glossary . . . . .		Glossary-1
Acronyms . . . . .		Acronyms-1
Requirement-Object Index . . . . .		ROI-1



## List of Figures

Figure 2-1.	Virtual Channel Connections . . . . .	2-2
Figure 2-2.	Virtual Path Connections . . . . .	2-3
Figure 2-3.	Illustration of VP/VC Connections and Segments . . . . .	2-4
Figure 2-4.	ATM Network Access Scenarios . . . . .	2-8
Figure 2-5.	ILMI Example . . . . .	2-10
Figure 2-6.	Access Signaling on a UNI . . . . .	2-11
Figure 2-7.	Proxy Signaling . . . . .	2-13
Figure 2-8.	Example Configuration of Two Virtual UNIs . . . . .	2-14
Figure 2-9.	Inverse Multiplexing for ATM . . . . .	2-15
Figure 2-10.	An Example Signaling Configuration . . . . .	2-17
Figure 2-11.	PNNI Hierarchy Example . . . . .	2-19
Figure 2-12.	PVC Establishment . . . . .	2-23
Figure 2-13.	Tandem Replacement Architecture . . . . .	2-26
Figure 2-14.	Voice Tandem Gateway Functions . . . . .	2-27
Figure 2-15.	Media Gateway Controller Functions . . . . .	2-29
Figure 2-16.	Example of ATM Network Architecture . . . . .	2-30
Figure 2-17.	Examples of PDs for a Single ATM Connection . . . . .	2-33
Figure 3-1.	TMN Functional Structure . . . . .	3-4
Figure 3-2.	Examples of System Implementation of TMN Logical Layer Functions . . . . .	3-5
Figure 3-3.	ATM VC LND and Trail . . . . .	3-7
Figure 3-4.	Client-Server Relationships Among Layer Network Domains . . . . .	3-8
Figure 3-5.	Basic Subnetwork Topology Relationships . . . . .	3-10
Figure 3-6.	Example of Partitioning . . . . .	3-10
Figure 3-7.	Subnetwork Connection in Unpartitioned and Partitioned Views . . . . .	3-11
Figure 3-8.	Inter-Layer Configuration . . . . .	3-12
Figure 3-9.	Depiction of a Periodic Schedule . . . . .	3-13
Figure 3-10.	NMS Architecture Example . . . . .	3-15
Figure 4-1.	General Flow for Configuration Management . . . . .	4-2
Figure 4-2.	Loopback Locations with ATM VP Protection . . . . .	4-71





## List of Tables

Table 2-1.	Mapping of Terminology . . . . .	2-6
Table 3-1.	General Types of ATM Network Layers . . . . .	3-9
Table 4-1.	Impact of 1+1 VP Protection Switching on OAM Cell Loopback Test . . . . .	4-72
Table 4-2.	Impact of 1:1 VP Protection Switching on OAM Cell Loopback Test . . . . .	4-73
Table 6-1.	User Identification Data . . . . .	6-8
Table 7-1.	ATM Client/NMS Operations Interface Requirements . . . . .	7-3
Table 7-2.	ATM NMS/EMS Operations Interface Requirements . . . . .	7-15
Table 7-3.	TT System/NMS Operations Interface Requirements . . . . .	7-24
Table 7-4.	Sched. & Disp./NMS Operations Interface Requirements . . . . .	7-26