

---

# SONET ATM Virtual Path Digital Cross-Connect Systems – Generic Criteria

## Contents

Preface .....	Preface-1
1. Introduction .....	1-1
1.1 Purpose and Scope .....	1-1
1.2 Target Audience .....	1-2
1.3 Structure and Use of This Document .....	1-2
1.4 Major Changes from Issue 2 .....	1-3
1.5 Major Related Documents .....	1-3
1.6 Requirements Terminology .....	1-4
1.7 Requirement Labeling Conventions .....	1-4
1.7.1 Numbering of Requirement and Related Objects .....	1-5
1.7.2 Requirement, Conditional Requirement, and Objective Object Identification .....	1-5
2. Background, Terminology, and Overview .....	2-1
2.1 SONET ATM Transport Networks .....	2-1
2.2 Terminology and Definitions .....	2-5
2.2.1 Summary .....	2-5
2.2.1.1 Comparison of SONET ATM VP Ring Types .....	2-10
2.2.2 Pre-SONET Digital Cross-Connect Systems .....	2-13
2.2.3 SONET Digital Cross-Connect Systems .....	2-14
2.2.4 Hybrid Cross-Connects .....	2-15
2.2.4.1 Benefits of Hybrid Cross-Connects .....	2-19
2.2.5 Pure ATM Cross-Connects .....	2-20
2.2.5.1 ATM Cross-Connects with STM Capabilities .....	2-22
2.2.5.2 Examples of ATM Cross-Connects with STM Capabilities .....	2-24
2.2.6 Further Cross-Connect Evolution .....	2-28
2.3 Cross-Connect Functions .....	2-29
2.4 Cross-Connect Applications .....	2-30
2.4.1 Gateway Applications .....	2-30
2.4.2 Hubbing Applications .....	2-31
2.4.3 Mesh Applications .....	2-31
2.4.4 Ring Applications .....	2-31
2.4.5 Centralization of Operations Activities .....	2-32
2.4.6 Bandwidth Management .....	2-32
2.4.7 Network Restoration .....	2-33
2.5 Services Supported .....	2-33

---

3.	Network Applications .....	3-1
3.1	Network Survivability .....	3-1
3.2	Ring Interconnection Node .....	3-2
3.3	Ring Transport Node .....	3-5
3.4	Hubbing via ATM VP Ring .....	3-6
3.5	Hubbing in a Mesh Network .....	3-7
3.6	Mesh Network .....	3-8
3.7	Ring-to-Mesh Interconnections .....	3-9
3.8	Network Evolution with ATM VPX .....	3-11
4.	Common ATM Transport Functionality and Criteria .....	4-1
4.1	High-Level Functional Models .....	4-1
4.1.1	Hybrid Cross-Connect .....	4-1
4.1.2	Pure ATM Cross-Connect .....	4-3
4.1.2.1	ATM Cross-Connects with STM Capabilities .....	4-5
4.2	General Cross-Connect and Upgrade Requirements .....	4-7
4.3	ATM Transport Requirements .....	4-7
4.3.1	Conventional SONET DCS with basic ATM Functionality .....	4-8
4.3.2	<b>SONET ATM VP Cross-Connects</b> .....	4-8
4.3.2.1	Functional Requirements .....	4-9
4.3.2.2	Transport Interface Requirements .....	4-11
4.3.3	SONET ATM VP Cross-Connects With Ring Functionality .....	4-11
4.4	STM Transport Requirements .....	4-12
4.5	Other Requirements .....	4-13
4.5.1	ATM Transport Performance .....	4-13
4.5.2	Reliability/Availability .....	4-14
4.5.3	ATM Layer Survivability .....	4-14
4.5.3.1	1+1/1:1 VPG/VP Protection .....	4-15
4.5.3.2	1:n VPG/VP Protection .....	4-15
4.5.3.3	Protection Performance .....	4-16
4.5.4	SONET and ATM Layer Protection Interaction .....	4-16
4.5.5	Ring Interconnection at the ATM Layer .....	4-17
4.5.6	Synchronization Interface .....	4-17
5.	Common ATM Operations Functionality and Criteria .....	5-1
5.1	TMN Operations Architecture .....	5-1
5.1.1	Operations Architecture Evolution .....	5-4
5.1.2	Hybrid Operations Architecture .....	5-5
5.2	Operations Functions .....	5-6
5.2.1	Configuration Management .....	5-7
5.2.1.1	Provisioning .....	5-7
5.2.1.2	External Update Support .....	5-8
5.2.1.3	Memory Update Support .....	5-8
5.2.1.4	Memory Query Support .....	5-10
5.2.1.5	Memory Backup and Restoration .....	5-10

---

---

5.2.1.6	Software Download Support.....	5-10
5.2.2	Fault Management.....	5-10
5.2.2.1	Alarm Surveillance .....	5-11
5.2.2.2	Fault Localization and Testing .....	5-12
5.2.3	Performance Management .....	5-13
5.2.3.1	Monitoring of Physical Transport Facilities .....	5-13
5.2.3.2	Protocol Monitoring/Analysis .....	5-13
5.2.3.3	ATM VP Performance Monitoring.....	5-14
5.2.4	Accounting Management .....	5-15
5.2.5	Security Management .....	5-15
5.3	Operations Interfaces .....	5-15
5.4	Operations Flows .....	5-17
5.5	Operations Communications.....	5-18
5.5.1	Upper Layer Requirements .....	5-19
5.5.2	Lower Layer Requirements.....	5-19
5.6	Other Requirements .....	5-21
5.6.1	Enabling/Disabling of SONET Functions.....	5-21
5.6.2	Operations and Maintenance of ATM Protection Switching.....	5-21
5.6.3	Interaction with ATM Switches .....	5-21
6.	Network Traffic Management.....	6-1
6.1	Functions and Procedures for Traffic Management.....	6-1
6.1.1	Introduction.....	6-1
6.1.2	Buffering .....	6-2
6.1.3	Policing .....	6-3
6.1.4	Selective Cell Discard.....	6-4
6.1.5	Traffic Congestion Indication .....	6-5
6.2	Traffic Contract.....	6-7
6.2.1	Traffic Parameters and Connection Traffic Descriptor.....	6-7
6.2.2	Traffic Contract.....	6-7
6.2.3	QoS and Performance .....	6-8
6.2.3.1	Performance Objectives by QoS Classes.....	6-8
6.2.3.2	Reference Loads and Measurement.....	6-9
6.3	Traffic Management Requirements.....	6-9
6.4	Network Data Collection.....	6-10
References	.....	References-1
Acronyms.....	.....	Acronyms-1
Requirement-Object List .....	.....	ROL-1
Requirement-Object Index .....	.....	ROI-1

---



---

## List of Figures

Figure 2-1.	Three Methods of Combining ATM and STM Traffic.....	2-1
Figure 2-2.	Conventional ATM Switching and SONET Transport Network .....	2-2
Figure 2-3.	Hybrid SONET/ATM NEs in an Example Network .....	2-2
Figure 2-4.	Pure ATM NEs in an Example Hybrid Network.....	2-3
Figure 2-5.	Pure ATM NEs in an Example Pure ATM Network.....	2-4
Figure 2-6.	Layer Structure of STM and ATM Transport Methods .....	2-5
Figure 2-7.	Hybrid SONET/ATM Transport Structure.....	2-15
Figure 2-8.	Current SONET DCS with SONET Interfaces.....	2-16
Figure 2-9.	SONET DCS with basic ATM Transport Capability .....	2-17
Figure 2-10.	Hybrid Cross-Connect - Segregated Interfaces .....	2-18
Figure 2-11.	Hybrid Cross-Connect - Mixed Interfaces.....	2-18
Figure 2-12.	Hybrid ADM - Mixed Ring Interfaces .....	2-19
Figure 2-13.	ATM Transport Structure .....	2-21
Figure 2-14.	ATM VPX with ATM Interfaces.....	2-22
Figure 2-15.	ATM VPX with SONET STM Capability .....	2-23
Figure 2-16.	ATM VPX with SONET STM Capability - STM/ATM Gateway.....	2-23
Figure 2-17.	ATM VPX with SONET STS-N Interfaces .....	2-24
Figure 2-18.	ATM VPX with W-DCS 3/1 Capability.....	2-25
Figure 2-19.	ATM VPX with W-DCS 3/1 Capability - More Detailed View .....	2-25
Figure 2-20.	ATM VPX with W-DCS 3/1 Capability - STM/ATM Gateway.....	2-25
Figure 2-21.	ATM VPX with B-DCS 3/3 Capability.....	2-26
Figure 2-22.	ATM VPX with B-DCS 3/3 Capability - More detailed View .....	2-26
Figure 2-23.	ATM VPX with B-DCS 3/3 Capability - STM/ATM Gateway .....	2-27
Figure 2-24.	Hybrid DCS/ATM VPX with SONET STM Capability .....	2-27
Figure 3-1.	Conventions for Figures in this Section .....	3-1
Figure 3-2.	STM Rings Interconnected Through Separate Hybrid Cross-Connect ....	3-3
Figure 3-3.	Hybrid Rings Interconnected through Separate Hybrid Cross-Connect ..	3-3
Figure 3-4.	Hybrid Cross-Connect in Single Node Ring Interconnection .....	3-4
Figure 3-5.	Hybrid Cross-Connects in Dual Node Ring Interconnection.....	3-4
Figure 3-6.	Multiple Ring Connection to BSS .....	3-5
Figure 3-7.	Ring Transport Node .....	3-5
Figure 3-8.	Hubbing Via Hybrid Ring .....	3-6
Figure 3-9.	Hubbing in a Mesh Network .....	3-7
Figure 3-10.	Hybrid Mesh Network .....	3-8
Figure 3-11.	Ring-to-Mesh Interconnection.....	3-9
Figure 3-12.	Ring-to-Mesh Interconnection, with Distinct Boundary .....	3-10
Figure 3-13.	Original SONET Network .....	3-11
Figure 3-14.	Adding Initial ATM Traffic.....	3-12
Figure 3-15.	Future Growth of ATM Traffic .....	3-13

---

Figure 3-16.	Ring/Mesh Architecture with Ring ATM VPX.....	3-14
Figure 4-1.	Hybrid Cross-Connect Functional Model.....	4-2
Figure 4-2.	Pure ATM Cross-Connect (ATM VPX).....	4-3
Figure 4-3.	ATM VPX with STM Capability .....	4-6
Figure 4-4.	ATM VPX with STM Capability - STM/ATM Gateway.....	4-6
Figure 5-1.	Multi-Tiered Operations Architecture, TMN Model.....	5-2
Figure 5-2.	TMN Layers and Management Functional Areas .....	5-3
Figure 5-3.	Operations Architecture Evolution .....	5-4
Figure 5-4.	TMN Architecture - Hybrid Operations .....	5-6
Figure 6-1.	An example showing the effect of buffer size on CLR .....	6-3
Figure 6-2.	An Example Policing Algorithm .....	6-4
Figure 6-3.	An Example Selective Cell Discard Algorithm.....	6-5
Figure 6-4.	Token Passing Events .....	6-6

## List of Tables

Table 2-1.	Summary of SONET ATM VP Ring Types .....	2-11
Table 2-2.	Summary of Ring Transport Multiplexing and Protection Switching Alternatives.....	2-12
Table 2-3.	ATM Functionality Levels in SONET Cross-Connects .....	2-16