

Table of Contents

1 Introduction

| | | |
|--------|--|------|
| 1.1 | General | 1-1 |
| 1.2 | Purpose and Limitations of This Document | 1-2 |
| 1.3 | Organization of the Document | 1-3 |
| 1.4 | Changes to GR-905-CORE | 1-5 |
| 1.4.1 | New Information in GR-905-CORE, Issue 12 | 1-5 |
| 1.4.2 | New Information in GR-905-CORE, Issue 11 | 1-5 |
| 1.4.3 | New Information in GR-905-CORE, Issue 10 | 1-6 |
| 1.4.4 | Changes to GR-905-CORE, Issue 9 | 1-6 |
| 1.4.5 | Changes to GR-905-CORE, Issue 8 | 1-7 |
| 1.4.6 | Changes to GR-905-CORE, Issue 7 | 1-7 |
| 1.4.7 | Changes to GR-905-CORE, Issue 6 | 1-7 |
| 1.4.8 | Changes to GR-905-CORE, Issue 5 | 1-7 |
| 1.4.9 | Changes to GR-905-CORE, Issue 4 | 1-8 |
| 1.4.10 | Changes to GR-905-CORE, Issue 3 | 1-8 |
| 1.4.11 | Changes to GR-905-CORE, Issue 2, Revision 1 | 1-9 |
| 1.4.12 | Changes to GR-905-CORE, Issue 2, Revision 2 | 1-9 |
| 1.5 | Requirements Terminology | 1-10 |
| 1.6 | Requirement Labeling Conventions | 1-11 |
| 1.6.1 | Numbering of Requirement and Related Objects | 1-11 |
| 1.6.2 | Requirement, Conditional Requirement, and Objective Identification | 1-11 |
| 1.6.3 | Requirements in This GR | 1-12 |
| 1.7 | Related Documents | 1-12 |

2 CCS Network Interconnection Architecture

| | | |
|-----------|---|------|
| 2.1 | Network Architecture | 2-2 |
| 2.1.1 | Overview | 2-2 |
| 2.1.2 | CCS Network Interconnection Architectures | 2-4 |
| 2.1.2.1 | Interconnection Using STPs and D-Link Quads | 2-5 |
| 2.1.2.2 | Interconnection Using A-Links | 2-5 |
| 2.1.2.3 | Other Interconnections | 2-5 |
| 2.1.3 | CCS Network Provider Network Topology | 2-10 |
| 2.1.4 | CCS Network Provider Network Access | 2-11 |
| 2.1.5 | CCS Network Availability | 2-11 |
| 2.1.6 | CCS Network Engineering | 2-11 |
| 2.1.6.1 | Fundamental Guidelines for Signaling Link Diversity and Capacity Planning | 2-12 |
| 2.1.6.1.1 | A-Link Set Diversity and Capacity Planning | 2-13 |
| 2.1.6.1.2 | D-Link Set Diversity and Capacity Planning | 2-14 |
| 2.1.6.1.3 | Link Augmentation | 2-15 |
| 2.2 | Protocol Architecture | 2-16 |
| 2.2.1 | Overview | 2-16 |
| 2.2.1.1 | Message Transfer Part (MTP) | 2-16 |
| 2.2.1.2 | Signaling Connection Control Part (SCCP) | 2-16 |
| 2.2.1.3 | Integrated Services Digital Network User Part (ISDNUP) | 2-16 |
| 2.2.1.4 | Transaction Capabilities Application Part (TCAP) | 2-17 |

| | | |
|-----------|--|------|
| 2.2.1.5 | Operations, Maintenance, and Administration Part (OMAP) | 2-17 |
| 2.2.2 | Addressing of Signaling Points | 2-18 |
| 2.2.2.1 | Assignment of Network Codes | 2-19 |
| 2.2.2.2 | Assignment of Cluster Codes | 2-21 |
| 2.2.2.3 | Assignment of Cluster Member Codes | 2-22 |
| 2.2.2.4 | Multiple Point Code Capability | 2-22 |
| 2.2.3 | Interconnecting STP Protocol Requirements | 2-22 |
| 2.2.3.1 | Protocol | 2-22 |
| 2.2.3.2 | Interconnecting STP Functions | 2-24 |
| 2.2.3.2.1 | Internetwork Routing | 2-24 |
| 2.2.3.2.2 | Message Screening | 2-26 |
| 2.3 | Interconnection to VOP Networks | 2-28 |
| 2.3.1 | VOP Network Architecture | 2-28 |
| 2.3.1.1 | Access Gateway (AG) | 2-29 |
| 2.3.1.2 | Trunk Gateway (TG) | 2-30 |
| 2.3.1.3 | Signaling Gateway (SG) | 2-30 |
| 2.3.1.4 | Call Connection Agent (CCA) | 2-30 |
| 2.3.1.5 | Service Agent (SA) | 2-30 |
| 2.3.1.6 | Routing and Translation Server (RTS) | 2-30 |
| 2.3.1.7 | Billing Agent (BA) | 2-31 |
| 2.3.1.8 | Feature Server (FS) | 2-31 |
| 2.3.1.9 | Core Network | 2-31 |
| 2.3.2 | VOP Network Interconnection | 2-31 |
| 2.3.3 | Interconnection to SIP Networks | 2-34 |
| 2.4 | Interconnection to BICC Networks and to Networks using ATM HSLs and IPVHSLs | 2-35 |
| 2.4.1 | BICC Networks | 2-35 |
| 2.4.2 | ATM HSLs and IPVHSLs | 2-36 |

3 Interface Protocols and Messages

| | | |
|-----------|---|------|
| 3.1 | Message Transfer Part | 3-1 |
| 3.1.1 | Signaling Link Functions | 3-1 |
| 3.1.1.1 | SS7 Signal Units | 3-2 |
| 3.1.1.2 | Functions and Codes of the Signal Unit Fields | 3-3 |
| 3.1.1.3 | Initial Alignment Procedure | 3-4 |
| 3.1.1.4 | Processor Outage | 3-5 |
| 3.1.1.5 | Level 2 Flow Control | 3-5 |
| 3.1.2 | Signaling Network Functions | 3-6 |
| 3.1.2.1 | MTP Message Handling | 3-6 |
| 3.1.2.1.1 | Message Labeling | 3-6 |
| 3.1.2.2 | Message Discrimination and Distribution | 3-7 |
| 3.1.2.3 | MTP Routing | 3-7 |
| 3.1.2.3.1 | Signaling Route Determination | 3-7 |
| 3.1.2.3.2 | Signaling Link Selection | 3-8 |
| 3.1.2.4 | Congestion Control and Message Priorities | 3-8 |
| 3.1.2.5 | MTP Network Management Functions | 3-9 |
| 3.1.3 | Signaling Traffic Management | 3-9 |
| 3.1.3.1 | Emergency Changeover | 3-10 |
| 3.1.3.2 | Signaling Link Changeback | 3-11 |
| 3.1.3.3 | Management Inhibiting | 3-12 |

| | | |
|----------|--|------|
| 3.1.3.4 | Forced Rerouting | 3-13 |
| 3.1.3.5 | Controlled Rerouting | 3-13 |
| 3.1.3.6 | MTP Restart Procedure | 3-14 |
| 3.1.4 | Signaling Link Management | 3-16 |
| 3.1.4.1 | Signaling Link Activation/Deactivation | 3-16 |
| 3.1.4.2 | Procedures to Minimize Link Oscillation | 3-16 |
| 3.1.5 | Signaling Route Management | 3-17 |
| 3.1.5.1 | Transfer Prohibited/Transfer Cluster Prohibited Message | 3-17 |
| 3.1.5.2 | Transfer Allowed/Transfer Cluster Allowed Message | 3-19 |
| 3.1.5.3 | Transfer Restricted/Transfer Cluster Restricted Message | 3-19 |
| 3.1.5.4 | Transfer Controlled Message | 3-20 |
| 3.1.5.5 | Signaling Route Set Test Message | 3-20 |
| 3.1.5.6 | Signaling Route Set Congestion Test Message | 3-21 |
| 3.1.6 | CCS Network Provider STPs to ICN CCSO Interface Alternative | 3-22 |
| 3.2 | ISDNUP Non-Capability (Non-Call) Related Messages | 3-22 |
| 3.2.1 | Blocking Messages | 3-23 |
| 3.2.1.1 | CCS Network Provider Procedures at Sending Switch | 3-23 |
| 3.2.1.2 | CCS Network Provider Procedures at Receiving Switch | 3-23 |
| 3.2.1.3 | ICN Procedures at Receiving Switch | 3-24 |
| 3.2.2 | Circuit Group Blocking Messages | 3-24 |
| 3.2.2.1 | CCS Network Provider Procedures at Sending Switch | 3-25 |
| 3.2.2.2 | CCS Network Provider Procedures at Receiving Switch | 3-25 |
| 3.2.2.3 | ICN Procedures at Receiving Switch | 3-27 |
| 3.2.3 | Circuit Group Reset Messages | 3-27 |
| 3.2.3.1 | CCS Network Provider Procedures at Sending Switch | 3-28 |
| 3.2.3.2 | CCS Network Provider Procedures at Receiving Switch | 3-28 |
| 3.2.3.3 | ICN Procedures at Receiving Switch | 3-29 |
| 3.2.4 | Circuit Group Unblocking Messages | 3-29 |
| 3.2.4.1 | CCS Network Provider Procedures at Sending Switch | 3-29 |
| 3.2.4.2 | CCS Network Provider Procedures at Receiving Switch | 3-30 |
| 3.2.4.3 | ICN Procedures at Receiving Switch | 3-30 |
| 3.2.5 | Circuit Query Messages | 3-30 |
| 3.2.5.1 | CCS Network Provider Procedures at Sending Switch | 3-31 |
| 3.2.5.2 | Procedures at Receiving Switch | 3-34 |
| 3.2.6 | Circuit Validation Test Messages | 3-34 |
| 3.2.6.1 | CCS Network Provider Procedures at Sending Switch | 3-35 |
| 3.2.6.2 | Procedures at Receiving Switch | 3-35 |
| 3.2.7 | Continuity Check Request Message and Loop Back Acknowledgment Message | 3-36 |
| 3.2.7.1 | CCS Network Provider Procedures at Sending Switch | 3-36 |
| 3.2.7.2 | Procedures at Receiving Switch | 3-36 |
| 3.2.8 | Dual Seizure | 3-36 |
| 3.2.9 | Reset Circuit Message | 3-37 |
| 3.2.9.1 | CCS Network Provider Procedures at Sending Switch | 3-37 |
| 3.2.9.2 | CCS Network Provider Procedures at Receiving Switch | 3-37 |
| 3.2.9.3 | ICN Procedures at Receiving Switch | 3-38 |
| 3.2.10 | Test Calls | 3-38 |
| 3.2.11 | Unblocking Messages | 3-39 |
| 3.2.11.1 | CCS Network Provider Procedures at Sending Switch | 3-39 |
| 3.2.11.2 | CCS Network Provider Procedures at Receiving Switch | 3-40 |

- 3.2.11.3 ICN Procedures at Receiving Switch 3-40
- 3.2.12 Unequipped Circuit Identification Code Message 3-40
 - 3.2.12.1 CCS Network Provider Procedures at Sending Switch 3-40
 - 3.2.12.2 CCS Network Provider Procedures at Receiving Switch 3-41
 - 3.2.12.3 ICN Procedures at Receiving Switch 3-42
- 3.3 Testing and Maintenance Messages 3-42
 - 3.3.1 Signaling Link Test Message 3-42
 - 3.3.2 Messages in the MRVT and SRVT 3-43
 - 3.3.2.1 Messages in the MRVT 3-43
 - 3.3.2.1.1 CCS Network Provider Procedures at Sending Interconnecting STP 3-44
 - 3.3.2.1.2 CCS Network Provider Procedures at Receiving Interconnecting STP 3-44
 - 3.3.2.1.3 ICN Procedures at Receiving Node 3-44
 - 3.3.2.2 Messages in the SRVT 3-45
 - 3.3.2.2.1 CCS Network Provider Procedure at Sending Interconnecting STP 3-45
 - 3.3.2.2.2 CCS Network Provider Procedure at Receiving Interconnecting STP 3-46
 - 3.3.2.2.3 ICN Procedure at Receiving Node 3-46

4 Capabilities Supported

- 4.1 Internetwork Call Control (Non-ISDN) 4-1
 - 4.1.1 Internetwork Call Control Messages and Flows 4-2
 - 4.1.1.1 Call Flow Variations 4-5
 - 4.1.2 Originating InterLATA Call Control Access 4-8
 - 4.1.2.1 Dialing Plan 4-8
 - 4.1.2.1.1 Presubscription 4-8
 - 4.1.2.1.2 Called Party Address Parameter Based on Dialed Digits 4-9
 - 4.1.2.2 Originating Call Screening 4-12
 - 4.1.2.3 Originating Automatic Message Accounting (AMA) Recording 4-12
 - 4.1.2.4 Direct Access to ICN 4-13
 - 4.1.2.5 Access via Access Tandem 4-13
 - 4.1.2.5.1 All-SS7 Originating Access 4-14
 - 4.1.2.5.2 MF from EO to AT, SS7 from AT to ICN 4-14
 - 4.1.2.5.3 SS7 from EO to AT, MF from AT to ICN 4-14
 - 4.1.2.6 QoR Scenario 4-18
 - 4.1.2.7 Originating Access Mandatory Parameters 4-19
 - 4.1.2.8 Originating Access Additional Parameters 4-19
 - 4.1.2.8.1 Calling Party Number (CPN) 4-19
 - 4.1.2.8.2 Charge Number 4-19
 - 4.1.2.8.3 Originating Line Information Parameter 4-20
 - 4.1.2.8.4 Interaction of Charge Number, CPN, and OLIP 4-20
 - 4.1.2.8.5 Carrier Selection Indicator 4-20
 - 4.1.2.8.6 Transit Network Selection (TNS) Parameter 4-21
 - 4.1.2.8.7 Service Code Parameter 4-21
 - 4.1.2.8.8 Carrier Identification Parameter (CIP) 4-21
 - 4.1.2.8.9 Parameters Associated with Call Forwarding 4-22
 - 4.1.2.8.10 Generic Address Parameter (GAP) 4-23
 - 4.1.2.8.11 Jurisdiction Information Parameter (JIP) 4-23

| | |
|--|------|
| 4.1.2.8.12 Hop Counter Parameter | 4-23 |
| 4.1.2.8.13 Generic Name Parameter | 4-23 |
| 4.1.2.8.14 Parameters Associated with E9-1-1 Calls | 4-23 |
| 4.1.2.9 Call Utilizes LNP and Requires an Intermediate Carrier to Complete | 4-24 |
| 4.1.3 Terminating Call Control Access | 4-25 |
| 4.1.3.1 Parameters Received by the Terminating Entry Switch | 4-25 |
| 4.1.3.2 QoR Scenario | 4-29 |
| 4.1.3.3 Terminating Call Screening | 4-29 |
| 4.1.3.4 Terminating AMA Recording | 4-29 |
| 4.1.4 Tones and Announcements | 4-30 |
| 4.1.4.1 Busy Conditions | 4-30 |
| 4.1.4.2 Events Resulting in an Unsuccessful Call | 4-31 |
| 4.1.5 Other LATA Carrier Interconnection | 4-32 |
| 4.1.5.1 Calls Routed Based on Carrier Identification Code | 4-33 |
| 4.1.5.2 Calls Routed Based on Dialed Number | 4-35 |
| 4.1.6 Tandem Service Provider (TSP) Interconnection | 4-39 |
| 4.1.6.1 TSP Interconnection for Originating Traffic | 4-40 |
| 4.1.6.2 TSP Interconnection for Terminating Traffic | 4-40 |
| 4.1.7 Trunk Type Based on Routing Decisions | 4-42 |
| 4.1.8 Completion of Transmission Path | 4-45 |
| 4.1.9 Procedures for Handling Unrecognized Messages/Parameters | 4-46 |
| 4.1.9.1 Receipt of an Unrecognized Message Type | 4-46 |
| 4.1.9.2 Receipt of an Unrecognized Parameter | 4-46 |
| 4.1.9.3 Receipt of an Unrecognized Parameter Value | 4-46 |
| 4.1.10 ISDNUP Reaction to TFC/Isolation | 4-47 |
| 4.1.10.1 Congestion/Isolation at Call Origination | 4-47 |
| 4.1.10.2 Congestion/Isolation During Call Setup | 4-48 |
| 4.1.10.3 Congestion During Call Release | 4-48 |
| 4.1.10.4 Resetting Circuits | 4-49 |
| 4.1.10.5 Other Procedures | 4-49 |
| 4.1.10.6 ICN ISDNUP Reaction to TFC/Isolation | 4-50 |
| 4.1.11 Automatic Congestion Control | 4-50 |
| 4.1.11.1 Detection of Congestion and Transmission of Automatic Congestion Level Parameter | 4-51 |
| 4.1.11.2 Reception of and Response to ACL Parameter | 4-51 |
| 4.1.11.3 ACC Procedures for ICNs | 4-52 |
| 4.1.12 Hop Counter Procedures | 4-52 |
| 4.2 Additional SS7 Capabilities Supporting ISDN | 4-53 |
| 4.2.1 Internetwork Call Control Messages and Flows | 4-54 |
| 4.2.1.1 ISDN Calling Party to ISDN Called Party | 4-55 |
| 4.2.1.1.1 Call Flow Variations | 4-57 |
| 4.2.1.1.2 SS7-to-MF Interworking | 4-62 |
| 4.2.1.1.3 MF-to-SS7 Interworking | 4-63 |
| 4.2.1.2 ISDN Calling Party to Non-ISDN Called Party | 4-63 |
| 4.2.1.2.1 Call Flow Variations | 4-66 |
| 4.2.1.3 Non-ISDN Calling Party to ISDN Called Party | 4-67 |
| 4.2.1.3.1 Call Flow Variations | 4-67 |
| 4.2.2 Originating Call Control Access | 4-70 |
| 4.2.2.1 Dialing Plan | 4-71 |

- 4.2.2.1.1 Subscription Parameters per DN 4-71
- 4.2.2.1.2 Presubscription 4-72
- 4.2.2.2 Originating Access Modified and New Mandatory Parameters . . 4-72
 - 4.2.2.2.1 Forward Call Indicators Parameter 4-72
 - 4.2.2.2.2 User Service Information Parameter 4-72
 - 4.2.2.2.3 Cause Indicators Parameter 4-73
 - 4.2.2.2.4 Event Information Parameter 4-73
 - 4.2.2.2.5 Optional Backwards Call Indicators 4-73
 - 4.2.2.2.6 Called Party Number Parameter 4-73
- 4.2.2.3 Originating Access Modified and Additional Parameters 4-73
 - 4.2.2.3.1 Calling Party Number (CPN) Parameter 4-73
 - 4.2.2.3.2 Generic Address Parameter (GAP) 4-74
 - 4.2.2.3.3 Access Transport Parameter (ATP) 4-74
 - 4.2.2.3.4 Jurisdiction Information Parameter (JIP) 4-75
 - 4.2.2.3.5 Other Optional Parameters 4-75
 - 4.2.2.3.6 QoR Scenario 4-75
- 4.2.2.4 Originating Automatic Message Accounting (AMA) Recording . . 4-75
- 4.2.3 Terminating Call Control Access 4-76
 - 4.2.3.1 Parameters Received by the Terminating Entry Switch 4-76
 - 4.2.3.2 Terminating Access AMA Recording 4-77
 - 4.2.3.3 QoR Scenario 4-77
- 4.2.4 Completion of Transmission Path 4-77
 - 4.2.4.1 CCS Network Provider Originating or Tandem CCSSO 4-78
 - 4.2.4.2 CCS Network Provider Terminating CCSSO 4-78
 - 4.2.4.3 ICN Tandem CCSSO 4-79
- 4.2.5 ISDN Call Forwarding 4-79
 - 4.2.5.1 Terminating Traffic from an ICN - Calls to an ISDN Basic Rate Base DN
Which Are ISDN Call Forwarded 4-79
 - 4.2.5.2 Terminating Traffic to an ISDN Primary Rate Interface with Class II
Equipment 4-80
 - 4.2.5.3 Network Interface for Calls Which are ISDN Call Forwarded from an
ISDN Interface 4-80
 - 4.2.5.3.1 Original Called Number (OCN) Parameter 4-80
 - 4.2.5.3.2 Redirecting Number (RN) Parameter 4-80
 - 4.2.5.3.3 Redirection Information (RI) Parameter 4-80

5 Capability Related Protocol

- 5.1 ISDN Internetwork Call Control Protocol 5-1
 - 5.1.1 Address Complete Message 5-2
 - 5.1.1.1 Origination 5-2
 - 5.1.1.2 Subsequent Signaling 5-2
 - 5.1.2 Answer Message 5-3
 - 5.1.2.1 Origination 5-3
 - 5.1.2.2 Subsequent Signaling 5-4
 - 5.1.3 Circuit Reservation Message 5-4
 - 5.1.3.1 Mandatory Parameters 5-5
 - 5.1.4 Circuit Reservation Acknowledgment 5-5
 - 5.1.5 Continuity Check 5-5
 - 5.1.5.1 Continuity Check for CCSSOs with the Multiple Point Code Capability
5-9



| | | |
|-----------|--|------|
| 5.1.6 | Exit Message | 5-9 |
| 5.1.7 | Initial Address Message | 5-10 |
| 5.1.7.1 | Traffic Routed Based on Carrier Identification Code | 5-11 |
| 5.1.7.1.1 | Call Originates in CCS Network Provider Network | 5-12 |
| 5.1.7.1.2 | Call Originates in OLC's Network | 5-22 |
| 5.1.7.1.3 | Call Terminates in CCS Network Provider Network | 5-24 |
| 5.1.7.1.4 | Call Terminates in OLC's Network | 5-27 |
| 5.1.7.2 | Traffic Routed Based on Dialed Digits | 5-28 |
| 5.1.7.2.1 | Call Originates in CCS Network Provider Network | 5-29 |
| 5.1.7.2.2 | Call Originates in OLC's Network | 5-33 |
| 5.1.7.2.3 | CCS Network Provider Network Receives a Terminating Call | 5-34 |
| 5.1.7.2.4 | Call Terminates in OLC's Network | 5-36 |
| 5.1.8 | Release Message | 5-38 |
| 5.1.9 | Release Complete Message | 5-40 |
| 5.1.9.1 | Origination | 5-40 |
| 5.1.10 | Resume Message | 5-40 |
| 5.1.10.1 | Origination | 5-41 |
| 5.1.10.2 | Subsequent Signaling | 5-41 |
| 5.1.11 | Suspend Message | 5-41 |
| 5.1.11.1 | Origination | 5-41 |
| 5.1.11.2 | Subsequent Signaling | 5-41 |
| 5.1.12 | Call Progress Message | 5-41 |
| 5.1.13 | Confusion Message | 5-42 |
| 5.1.13.1 | Origination | 5-42 |
| 5.1.13.2 | Subsequent Signaling | 5-42 |
| 5.2 | ISDNUP Protocol to Support ISDN Access | 5-43 |
| 5.2.1 | Address Complete Message (ACM) for ISDN Access | 5-43 |
| 5.2.1.1 | Origination | 5-43 |
| 5.2.1.2 | Subsequent Signaling | 5-45 |
| 5.2.2 | Answer Message for ISDN Access | 5-46 |
| 5.2.2.1 | Origination | 5-46 |
| 5.2.2.2 | Subsequent Signaling | 5-46 |
| 5.2.3 | Call Progress Message for ISDN Access | 5-47 |
| 5.2.3.1 | Origination | 5-47 |
| 5.2.3.2 | Subsequent Signaling | 5-48 |
| 5.2.4 | Initial Address Message for ISDN Access | 5-48 |
| 5.2.4.1 | Origination | 5-48 |
| 5.2.4.2 | Subsequent Signaling | 5-51 |
| 5.2.5 | Release Message for ISDN Access | 5-51 |

6 Physical Level Specifications

| | | |
|-------|--|-----|
| 6.1 | Bearer Facility Transmission Rate | 6-1 |
| 6.2 | Diverse Physical Level Facility Routing for Combined Link Sets | 6-1 |
| 6.2.1 | Diversity Provisioning and Maintenance Guidelines | 6-2 |
| 6.3 | Facility Transmission Signal Structure | 6-2 |
| 6.3.1 | DS1 Signal Structure | 6-2 |
| 6.3.2 | DS0 Signal Structure | 6-2 |
| 6.4 | Physical Level Link Interface | 6-3 |
| 6.4.1 | V.35 Interface | 6-3 |
| 6.4.2 | DS0 Interface | 6-3 |

6.5 Synchronization 6-3

7 Performance

7.1 Signaling Network Transport Time 7-1
7.1.1 Network Components 7-1
7.1.2 Reference Connections 7-3
7.1.3 Time Intervals 7-4
7.1.4 Network Performance Guidelines 7-9
7.1.4.1 Internetwork Call Control 7-9
7.1.4.2 Database Queries and Responses 7-13
7.1.5 Network Timing Requirements 7-13
7.2 Signaling Network Availability 7-16
7.2.1 Diversity 7-16
7.2.1.1 Diversity Analysis for the Network Access Segment 7-19
7.2.1.1.1 Reference Model and Terminology 7-20
7.2.1.1.2 A-Link Diversity Analysis 7-21
7.2.1.2 Diversity Analysis for the Backbone Network Segment 7-24
7.2.1.2.1 Reference Model and Terminology 7-24
7.2.1.2.2 D-Link Diversity Analysis 7-24
7.3 Lost Message Probability 7-27
7.4 Undetected Error Probability 7-27
7.5 Message-Out-Of-Sequence Probability 7-27
7.6 Signaling Link Error Performance 7-27

8 Interface Provisioning, Operations, and Maintenance

8.1 Introduction 8-1
8.1.1 Operational Guidelines 8-1
8.1.2 Assumptions 8-1
8.2 Link Provisioning and Maintenance 8-1
8.2.1 General Link Provisioning 8-2
8.2.2 Timer Values 8-2
8.2.3 Procedural Information 8-2
8.2.4 Other Protocol Information 8-3
8.2.5 Link Measurement Data 8-4
8.2.6 Link Control Office Designation 8-4
8.2.6.1 General Responsibilities 8-5
8.2.6.2 General Link Responsibilities 8-5
8.2.6.3 Link Provisioning and Maintenance Coordination Responsibilities 8-7
8.2.6.4 Signaling Link Control Designation Responsibilities 8-7
8.2.7 Exchange Point of Contact Information 8-7
8.2.8 Route Diversity Management 8-7
8.3 SS7 Trunk Provisioning and Maintenance 8-7
8.3.1 Conversion from MF to SS7 Signaling 8-8
8.3.2 Management of Dual Seizures 8-8
8.3.2.1 Alarm Reporting Procedures 8-8
8.3.3 Continuity Check Procedure 8-8
8.3.3.1 Frequency of Continuity Tests 8-9
8.3.4 Assignment Criteria 8-9
8.3.4.1 Separation of Traffic by Trunk Groups 8-10

| | |
|---|-------|
| 8.3.5 Exchange of Trunk Provisioning Information and Translations Questionnaire | 8-10 |
| 8.3.6 Tones and Announcements | 8-11 |
| 8.4 Link Testing (Level One) | 8-11 |
| 8.5 Compatibility Testing | 8-12 |
| 8.5.1 Background | 8-12 |
| 8.5.2 Terminology | 8-12 |
| 8.5.3 Objective | 8-13 |
| 8.6 Internetwork Compatibility Tests for Levels 2 and 3 | 8-13 |
| 8.6.1 Intrusive Compatibility Tests | 8-16 |
| 8.6.1.1 Level 2 Tests | 8-16 |
| 8.6.1.2 Level 3 Tests | 8-35 |
| 8.6.2 Non-Intrusive Compatibility Tests | 8-36 |
| 8.6.2.1 Level 2 Tests | 8-36 |
| 8.6.2.2 Level 3 Tests | 8-38 |
| 8.7 Signaling Route Management Tests | 8-45 |
| 8.8 ISDNUP Call Setup Tests | 8-50 |
| 8.8.1 Trunk Maintenance Tests | 8-51 |
| 8.8.2 Call Setup Tests | 8-68 |
| 8.9 Non-ISDN Call Setup Call-Through Tests | 8-77 |
| 8.9.1 Test Configurations | 8-77 |
| 8.9.1.1 SS7 Trunk Interface Compatibility Testing Arrangement | 8-77 |
| 8.9.1.2 SS7 Trunk Interface End-to-End Testing Arrangement | 8-80 |
| 8.9.1.3 Test Equipment | 8-84 |
| 8.9.1.4 Messages Sequences and Protocol Simulator | 8-84 |
| 8.9.1.5 Trunk Test Set | 8-85 |
| 8.9.1.6 Test Procedures | 8-85 |
| 8.9.1.7 Protocol Analysis | 8-85 |
| 8.10 Intrusive Tests | 8-88 |
| 8.11 Introduction to Compatibility Tests for ISDN Access | 8-104 |
| 8.11.1 Operational Guidelines | 8-104 |
| 8.11.2 Prerequisites | 8-104 |
| 8.11.3 Purpose | 8-104 |
| 8.11.4 ISDN Impacts on ISDNUP Messages | 8-105 |
| 8.11.5 Description of Tests | 8-105 |
| 8.12 Call-Through Tests | 8-105 |
| 8.12.1 Recommended Minimum Subset of Call-Through Tests | 8-105 |
| 8.13 Test-Set Generated Tests | 8-109 |
| 8.13.1 Basic Calls | 8-109 |
| 8.13.2 IAM Followed By ANM | 8-110 |
| 8.13.3 REL With Cause, Temporary Failure | 8-111 |
| 8.13.4 Terminating REL With Cause, Bearer Capability Not Implemented, User | 8-111 |
| 8.13.5 Terminating REL With Cause, Bearer Capability Not Implemented, Remote Local Network | 8-112 |
| 8.13.6 Terminating REL With Cause, Normal Release (Data) | 8-112 |
| 8.13.7 Originating REL After ACM (Data) | 8-113 |
| 8.13.8 Originating REL With Cause, Normal Release (Data) | 8-113 |
| 8.13.9 Terminating REL With Cause, User Busy | 8-114 |
| 8.13.10 Terminating REL With Cause, Call Rejected, Location User | 8-114 |

- 8.13.11 Upgrade Routing (Optional Test, Network Architecture Dependent) 8-115
- 8.13.12 Terminating REL With Cause, User Alerting, No Answer 8-115
- 8.13.13 Terminating REL With Cause, No User Responding (Data) 8-116
- 8.13.14 ACM With “Call Delay at the Terminating Interface” 8-116
- 8.13.15 ACM With “Call Delay at the Terminating Interface (Excessive Delay),”
Followed by ANM 8-117
- 8.13.16 Intercept RELs 8-117
- 8.13.17 Intercept ACM, Provide Tone or Announcement 8-118
- 8.13.18 REL on Announcement Time-Out 8-119
- 8.13.19 Intercept ACM, Route to Tone or Announcement 8-119
- 8.13.20 CPG After ACM 8-120
- 8.13.21 T_t Expiration 8-121
- 8.13.22 CPG With ALERTing 8-121
- 8.13.23 CPG With ALERTing, ANM 8-122
- 8.13.24 ASC Route Does Not Support Requested Bearer 8-122
- 8.13.25 GAP Without CPN 8-123
- 8.13.26 GAP With CPN 8-123

Appendix A: Message and Parameter Formats and Codes

- A.1 MTP Message Formats A-1
 - A.1.1 General A-1
 - A.1.2 Routing Label A-2
 - A.1.3 Heading Code (H0) A-2
 - A.1.4 Changeover Message A-3
 - A.1.4.1 Format A-3
 - A.1.4.2 Fields A-3
 - A.1.4.3 Signal Codes A-3
 - A.1.5 Changeback Message A-4
 - A.1.5.1 Format A-4
 - A.1.5.2 Fields A-4
 - A.1.5.3 Signal Codes A-4
 - A.1.5.4 Changeback Code A-4
 - A.1.6 Emergency Changeover Message A-5
 - A.1.6.1 Format A-5
 - A.1.6.2 Fields A-5
 - A.1.6.3 Signal Codes A-5
 - A.1.7 Transfer-Prohibited Message A-6
 - A.1.7.1 Format A-6
 - A.1.7.2 Fields A-6
 - A.1.7.3 Signal Codes A-6
 - A.1.7.4 Signaling Point Identity A-6
 - A.1.8 Transfer-Allowed Message A-7
 - A.1.8.1 Format A-7
 - A.1.8.2 Fields A-7
 - A.1.8.3 Signal Codes A-7
 - A.1.8.4 Signaling Point Identity A-7
 - A.1.9 Transfer-Restricted Message A-8
 - A.1.9.1 Format A-8
 - A.1.9.2 Fields A-8
 - A.1.9.3 Signal Codes A-8

| | |
|---|------|
| A.1.9.4 Signaling Point Identity | A-8 |
| A.1.10 Signaling-Route-Set-Test Message | A-9 |
| A.1.10.1 Format | A-9 |
| A.1.10.2 Fields | A-9 |
| A.1.10.3 Signal Codes | A-9 |
| A.1.11 Management Inhibit Message | A-10 |
| A.1.11.1 Format | A-10 |
| A.1.11.2 Fields | A-10 |
| A.1.11.3 Signal Codes | A-10 |
| A.1.12 Transfer-Controlled Message | A-11 |
| A.1.12.1 Format | A-11 |
| A.1.12.2 Fields | A-11 |
| A.1.12.3 Signal Codes | A-11 |
| A.1.12.4 Signaling Point Identity | A-11 |
| A.1.12.5 Status Field | A-11 |
| A.1.13 Signaling-Route-Set-Congestion-Test Message | A-12 |
| A.1.13.1 Format | A-12 |
| A.1.13.2 Fields | A-12 |
| A.1.13.3 Signal Codes | A-12 |
| A.1.14 Traffic Restart Message | A-12 |
| A.1.14.1 Format | A-12 |
| A.1.14.2 Fields | A-13 |
| A.1.14.3 Signal Codes | A-13 |
| A.1.15 Abbreviations Used for MTP Message H1 Codes | A-13 |
| A.2 ISDNUP Formats | A-15 |
| A.2.1 ISDNUP Message Formats | A-15 |
| A.2.2 ISDNUP Parameter Formats | A-25 |
| A.2.2.1 Backward Call Indicators Parameter | A-25 |
| A.2.2.2 User Service Information Parameter | A-27 |
| A.2.2.3 Called Party Number Parameter | A-28 |
| A.2.2.4 Calling Party Number Parameter | A-30 |
| A.2.2.5 Calling Party's Category | A-31 |
| A.2.2.6 Carrier Selection | A-32 |
| A.2.2.7 Cause Indicators Parameter | A-33 |
| A.2.2.8 Charge Number Parameter | A-36 |
| A.2.2.9 Circuit Group Characteristics Indicator | A-38 |
| A.2.2.10 Circuit Group Supervision Message Type Indicator | A-39 |
| A.2.2.11 Circuit Identification Name Parameter | A-40 |
| A.2.2.12 Circuit State Indicator Parameter | A-41 |
| A.2.2.13 Circuit Validation Response Indicator Parameter | A-42 |
| A.2.2.14 CLLI™ Code Parameter | A-42 |
| A.2.2.15 Continuity Indicators Parameter | A-43 |
| A.2.2.16 Forward Call Indicators | A-43 |
| A.2.2.17 Message Type Parameter | A-45 |
| A.2.2.18 Nature of Connection Indicators | A-46 |
| A.2.2.19 Originating Line Information Parameter | A-47 |
| A.2.2.20 Outgoing Trunk Group Number | A-48 |
| A.2.2.21 Range and Status Parameter | A-48 |
| A.2.2.22 Service Code Parameter | A-49 |
| A.2.2.23 Suspend/Resume Indicators | A-50 |

| | | |
|----------|---|------|
| A.2.2.24 | Transit Network Selection Parameter | A-50 |
| A.2.2.25 | Carrier Identification Parameter | A-52 |
| A.2.2.26 | Event Information Indicators | A-54 |
| A.2.2.27 | Optional Backward Call Indicators | A-55 |
| A.2.2.28 | Original Called Number Parameter | A-56 |
| A.2.2.29 | Redirecting Number Parameter | A-58 |
| A.2.2.30 | Redirection Information Parameter | A-58 |
| A.2.2.31 | Automatic Congestion Level Parameter | A-59 |
| A.2.2.32 | Hop Counter Parameter | A-59 |
| A.2.2.33 | Jurisdiction Information Parameter | A-60 |
| A.2.2.34 | Generic Address Parameter | A-61 |
| A.2.2.35 | Redirect Capability Parameter | A-63 |
| A.2.2.36 | Redirect Counter Parameter | A-64 |
| A.2.2.37 | Redirection Number Parameter | A-64 |
| A.2.2.38 | Generic Digits Parameter | A-66 |
| A.2.2.39 | Calling Geodetic Location | A-67 |
| A.2.3 | Modified ISDNUP Messages to Support ISDN Access | A-77 |
| A.2.4 | Modified ISDNUP Parameters to Support ISDN Access | A-79 |
| A.2.4.1 | User Service Information - Modified for ISDN Access | A-79 |
| A.2.4.2 | Calling Party Number Parameter - Modified for ISDN Access | A-81 |
| A.2.4.3 | Cause Indicators Parameter - Modified for ISDN Access | A-83 |
| A.2.4.4 | Original Called Number Parameter - Modified for ISDN Access | A-87 |
| A.2.4.5 | Redirecting Number Parameter - Modified for ISDN Access | A-89 |
| A.2.4.6 | Redirection Information Parameter | A-90 |
| A.2.5 | Additional ISDNUP Parameters to Support ISDN Access | A-91 |
| A.2.5.1 | Access Transport Parameter | A-91 |
| A.2.5.2 | Notification Indicator Parameter | A-92 |
| A.3 | Testing and Maintenance Message Formats | A-93 |
| A.3.1 | General | A-93 |
| A.3.2 | Routing Label | A-93 |
| A.3.3 | Signaling Link Test Messages | A-93 |
| A.3.3.1 | Format | A-93 |
| A.3.3.2 | Fields | A-94 |
| A.3.3.3 | Signal Codes | A-94 |
| A.3.4 | Message Formats | A-95 |

Appendix B: Timer Values

Appendix C: Facility and Translation Requirements

| | | |
|-----|--|-----|
| C.1 | Call-Through Test Requirements | C-1 |
| C.2 | Test-Set Generated Test Requirements | C-2 |

Appendix D: Basic Network Test Configurations

Appendix E: Variables for Additional ISDN Call-Through Tests

Appendix F: Statement of Principles

| | | |
|-----|------------------------|-----|
| F.1 | Introduction | F-1 |
| F.2 | Protection | F-1 |
| F.3 | Detection | F-2 |

| | |
|---------------------------|-----|
| F.4 Containment | F-2 |
| F.5 Correction | F-3 |

Appendix G: Bearer Independent Call Control

| | |
|--|------|
| G.1 Introduction | G-1 |
| G.2 Motivation for BICC | G-1 |
| G.3 BICC Architecture | G-2 |
| G.3.1 BICC Network Architecture | G-2 |
| G.3.2 BICC Protocol | G-3 |
| G.3.3 BICC Messages and Parameters | G-3 |
| G.3.3.1 BICC Messages and Parameters Different from ISUP Counterparts | G-4 |
| G.3.3.1.1 Initial Address Message (IAM) | G-4 |
| G.3.3.1.2 Continuity Message (COT) | G-5 |
| G.3.3.1.3 Exit Message (EXM) | G-6 |
| G.3.3.2 ISUP Messages Not Used in BICC Protocol | G-6 |
| G.3.3.3 ISUP Parameters Not Used in BICC Protocol | G-7 |
| G.4 BICC/ISUP Interconnection Issues | G-7 |
| G.4.1 Parameters Modified for BICC from ISUP, and Defined for BICC but not for | |
| ISUP | G-8 |
| G.4.1.1 CIC Parameter | G-8 |
| G.4.1.2 APP | G-9 |
| G.4.1.3 Global Call Reference Parameter | G-9 |
| G.4.1.4 Inter-Nodal Traffic Group Identifier | G-10 |
| G.4.2 Continuity Procedures | G-10 |
| G.4.2.1 BICC Network Signaling to ISUP Network | G-10 |
| G.4.2.2 ISUP Network Signaling to BICC Network | G-11 |
| G.4.3 Parameters and Messages Defined for ISUP but not for BICC | G-12 |
| G.4.4 Message Priority | G-12 |
| G.4.5 Sample Call Flow | G-13 |

Appendix H: High Speed Links (HSLs)

| | |
|--|------|
| H.1 Introduction | H-1 |
| H.2 Asynchronous Transfer Mode High-Speed Links (ATM HSLs) | H-1 |
| H.2.1 Motivation for ATM HSLs | H-1 |
| H.2.2 ATM HSL Architecture | H-2 |
| H.2.2.1 ATM HSL Network Architecture | H-2 |
| H.2.2.1.1 Using ATM HSLs for Network Interconnection | H-4 |
| H.2.2.1.2 ATM HSL Protocol | H-5 |
| H.2.2.1.3 Physical Layer | H-5 |
| H.2.2.1.4 ATM Layer | H-6 |
| H.2.2.1.5 Signaling ATM Adaptation Layer (SAAL) | H-6 |
| H.2.2.1.6 MTP Level 3 | H-6 |
| H.2.2.1.7 Differences between SS7/MTP2 and SS7/ATM | H-7 |
| H.2.3 ATM HSL/MTP Interconnection Issues | H-9 |
| H.2.3.1 ATM HSL Network Interconnection Architectures | H-10 |
| H.2.3.2 Protocol Differences | H-11 |
| H.2.3.2.1 STPs | H-11 |
| H.2.3.2.2 Signaling Message Length | H-11 |
| H.2.3.2.3 Signaling Link Selection (SLS) | H-12 |
| H.2.3.2.4 Changeover Order Message Format | H-12 |

| | | |
|-----------|--|------|
| H.2.3.3 | Differences in Engineering MTP Level 2 Links and ATM HSLs . . . | H-12 |
| H.2.3.4 | Performance | H-13 |
| H.2.3.4.1 | Signaling Network Transport Time | H-13 |
| H.2.3.4.2 | Signaling Network Availability | H-13 |
| H.2.3.4.3 | Diversity | H-14 |
| H.2.3.4.4 | Messages | H-14 |
| H.2.3.5 | Interface Provisioning, Operations, and Maintenance | H-14 |
| H.3 | Internet Protocol Virtual High-Speed Links (IPVHSLs) | H-15 |
| H.3.1 | Motivation for IPVHSLs | H-15 |
| H.3.2 | IPVHSL Architecture | H-16 |
| H.3.2.1 | IPVHSL Network Architecture | H-16 |
| H.3.2.2 | IPVHSL Protocol | H-17 |
| H.3.3 | IPVHSL/MTP Interconnection Issues | H-19 |
| H.3.3.1 | Protocol Differences | H-21 |
| H.3.3.1.1 | Message Length | H-21 |
| H.3.3.1.2 | Signaling Link Selection | H-21 |
| H.3.3.1.3 | Differences in Engineering MTP Level 2 Links and IPVHSLs | H-22 |
| H.3.3.2 | Performance | H-23 |
| H.3.3.2.1 | Signaling Network Transport Time | H-23 |
| H.3.3.2.2 | Signaling Network Availability | H-24 |
| H.3.3.2.3 | Diversity | H-24 |
| H.3.3.2.4 | Messages | H-25 |
| H.3.3.3 | Interface Provisioning, Operations, and Maintenance | H-25 |

Appendix I: Session Initiation Protocol (SIP)

| | | |
|-----------|---|------|
| I.1 | Introduction | I-1 |
| I.2 | Motivation | I-1 |
| I.3 | SIP Architecture | I-2 |
| I.3.1 | SIP Network Architecture | I-2 |
| I.3.1.1 | Clients | I-3 |
| I.3.1.2 | Servers | I-4 |
| I.3.1.2.1 | Proxy Servers | I-4 |
| I.3.1.2.2 | Redirect Servers | I-4 |
| I.3.1.2.3 | Location Servers | I-5 |
| I.3.1.2.4 | Registrar Server | I-5 |
| I.3.2 | SIP Protocol | I-5 |
| I.3.3 | SIP Messages and Parameters | I-6 |
| I.3.3.1 | SIP Request Messages | I-6 |
| I.3.3.2 | SIP Response Messages | I-7 |
| I.3.3.3 | SIP Message Headers | I-8 |
| I.3.4 | SIP Call Flows | I-9 |
| I.3.4.1 | ISUP to SIP Interworking | I-10 |
| I.3.4.2 | SIP to ISUP Interworking | I-11 |
| I.3.4.3 | ISUP to SIP to ISUP Interworking (SIP Bridging) | I-14 |
| I.4 | Summary | I-16 |

Appendix J: Probability Models for System Failures

| | | |
|-----|-----------------------------------|-----|
| J.1 | Case 1: Series System | J-1 |
| J.2 | Case 2: Parallel System | J-2 |

Appendix K: IP Multimedia Subsystem (IMS) Overview

| | |
|---|------|
| K.1 Introduction | K-1 |
| K.2 3GPP IMS Architecture | K-1 |
| K.3 3GPP IMS Session Flows | K-5 |
| K.3.1 General End-to-End IMS Session Flow | K-5 |
| K.3.2 Interworking with the PSTN | K-8 |
| K.3.2.1 PSTN Origination | K-9 |
| K.3.2.2 PSTN Termination | K-12 |
| K.4 ATIS NGN Architecture | K-15 |
| K.4.1 ATIS NGN Functional Architecture and Interfaces | K-15 |
| K.5 Relationship Between 3GPP IMS and ATIS NGN Functional Architectures | K-18 |
| K.6 ATIS Emergency Services Next Generation Network (ES-NGN) | K-21 |

Appendix L: Network Interconnection to Support the Delivery of Legacy Emergency Call Originations to IP-Enabled PSAPs

| | |
|---|------|
| L.1 Introduction | L-1 |
| L.2 Overview of the NENA i3 Solution | L-1 |
| L.2.1 Functional Elements of the i3 Solution | L-2 |
| L.2.2 i3 Interfaces | L-5 |
| L.2.3 Network Interconnection Architecture Overview | L-6 |
| L.2.3.1 Interconnection of Legacy Wireline End Offices and Legacy Network Gateways | L-7 |
| L.2.3.2 Interconnection of Legacy Wireless Mobile Switching Center and Legacy Network Gateway | L-8 |
| L.2.3.3 Call Flow - Legacy Originating Network Directly Connected to Legacy Network Gateway | L-10 |
| L.2.3.4 Legacy Originating Network to i3 ESInet Interconnection Involving an SR | L-12 |
| L.2.4 Signaling Protocol Interworking | L-14 |

Appendix M: Session Border Control (SBC) Overview

| | |
|---|-----|
| M.1 Introduction | M-1 |
| M.2 Overview of SBC Functionality | M-1 |
| M.2.1 Call Control Signaling Path (CCSP) Functionality | M-2 |
| M.2.1.1 Access Control and Authentication, Authorization and Accounting (AAA) | M-2 |
| M.2.1.2 Signaling Protocol Translation and Interworking | M-3 |
| M.2.1.3 Call/Session-Based Routing | M-3 |
| M.2.1.4 Data Services Platform (DSP) Service Control | M-3 |
| M.2.1.5 Topology and End User Hiding | M-4 |
| M.2.1.6 Security | M-4 |
| M.2.2 Media Path (MP) Functionality | M-4 |
| M.2.2.1 Access Control | M-4 |
| M.2.2.2 Call/Session Managed Media Control | M-5 |
| M.2.2.3 Topology Hiding | M-5 |
| M.2.2.4 Security | M-5 |
| M.2.3 Operations, Administration, Maintenance and Provisioning (OAMP) Functionality | M-5 |
| M.3 Relationship with ATIS NGN Architecture | M-6 |

M.4 Relationship with ATIS Emergency Services Next Generation Network (ES-NGN) Architecture M-7

Appendix N: References

N.1 **Telcordia Documents** N-1
N.2 **American National Standards Institute (ANSI) Documents** N-3
N.3 **International Telecommunications Union - Telecommunications Standardization Sector Documents** N-4
N.4 **Network Interconnection/Interoperability Forum (NIIF) (formerly the Network Operations Forum [NOF]) Documents** N-5
N.5 **Internet Engineering Task Force (IETF) Documents** N-5
N.6 **United States Telephone Association (USTA) Documents** N-6
N.7 **NENA Documents** N-6
N.8 **European Telecommunication Standards Institute (ETSI) Documents** N-6
N.9 **Third Generation Partnership Project (3GPP) Documents** N-6

Appendix O: Glossary



List of Figures

| | | |
|-------------|--|------|
| Figure 1-1 | GR-905-CORE and Other Document Relationships | 1-1 |
| Figure 2-1 | Relationships Among Terms Defined in Text | 2-4 |
| Figure 2-2 | STPs to ICN STPs Signaling Network Interconnection Architecture | 2-7 |
| Figure 2-3 | STPs to ICN SEP Signaling Network Interconnection Architecture . | 2-8 |
| Figure 2-4 | STPs to ICN STP/Combined Node Signaling Network Interconnection Architecture | 2-9 |
| Figure 2-5 | STPs to OLC A-Link Concentrator Signaling Network Interconnection Architecture | 2-10 |
| Figure 2-6 | An Example of a CCS Network Architecture | 2-12 |
| Figure 2-7 | A-Link Set Capacity Planning with 2-Way Diversity | 2-13 |
| Figure 2-8 | D-Link Set Capacity Planning with 3-Way Diversity | 2-15 |
| Figure 2-9 | SS7 Protocol Architecture | 2-17 |
| Figure 2-10 | Routing Label Structure for North American Networks | 2-18 |
| Figure 2-11 | Signaling Point Code (SPC) Structure | 2-18 |
| Figure 2-12 | Conceptual View of Gateway Screening and Routing Functions . . | 2-24 |
| Figure 2-13 | Key Elements in a VOP Network | 2-29 |
| Figure 2-14 | Interconnection to PSTN | 2-32 |
| Figure 3-1 | Format for MSU | 3-3 |
| Figure 3-2 | Format for LSSU | 3-3 |
| Figure 3-3 | Format for FISU | 3-3 |
| Figure 4-1 | Typical Call Setup and Release (Assumes Calling Party Disconnect) | 4-4 |
| Figure 4-2 | Call Flow Variations | 4-7 |
| Figure 4-3 | Originating Call Control Access: Direct | 4-10 |
| Figure 4-4 | Originating Call Control Access: Via Access Tandem - All SS7 . . . | 4-11 |
| Figure 4-5 | Originating Access: Interworking Inband Exchange Access Signaling to SS7 | 4-15 |
| Figure 4-6 | Originating Access: Interworking Inband International Exchange Access Signaling to SS7 | 4-16 |
| Figure 4-7 | Originating Access: Interworking of SS7 to Inband Exchange Access Signaling | 4-17 |
| Figure 4-8 | Originating Access: Interworking of SS7 to Inband International Exchange Access Signaling | 4-18 |
| Figure 4-9 | Terminating Call Control Access: Direct | 4-27 |
| Figure 4-10 | Terminating Call Control Access: Via Access Tandem | 4-28 |
| Figure 4-11 | IntraLATA OLC Interconnection: Direct | 4-36 |
| Figure 4-12 | IntraLATA OLC Interconnection: Via Tandem — All SS7 | 4-37 |
| Figure 4-13 | IntraLATA OLC Interconnection: Via Access Tandem — Interworking MF to SS7 | 4-38 |
| Figure 4-14 | IntraLATA OLC Interconnection: Via Access Tandem — Interworking SS7 to MF | 4-39 |
| Figure 4-15 | Originating Call Control Access: CCS Network Provider EO with TSP Tandem CCSSO | 4-41 |
| Figure 4-16 | Terminating Call Control Access: Via TSP Tandem | 4-42 |
| Figure 4-17 | Illustration of Internetwork Trunk Groups | 4-45 |
| Figure 4-18 | Typical Call Setup Between Two ISDN End Users | 4-56 |
| Figure 4-19 | Call Setup Attempt from ISDN Calling Party to ISDN Called Party, with a Confusion Message | 4-59 |

Figure 4-20 Call Setup Attempt — Timer T₃₀₃ Expires for the First Time . . . 4-60

Figure 4-21 Call Setup Attempt for Speech or 3.1-kHz Audio Call, RELEase COMplete Message after Second SETUP Message at Called ISDN End User . 4-61

Figure 4-22 Call Setup Attempt for Unrestricted Digital Information, RELEase COMplete Message after Second SETUP Message at Called ISDN End User 4-62

Figure 4-23 Call Setup from ISDN Caller to Non-ISDN Called Party with SS7-to-MF Interworking 4-64

Figure 4-24 Call Setup Between Two ISDN End Users with MF-to-SS7 Interworking 4-65

Figure 4-25 Call Setup Attempt from ISDN Calling Party to Non-ISDN Called Party 4-66

Figure 4-26 Call Setup Attempt from ISDN Calling Party to Non-ISDN Called Party, Called Party Disconnect 4-68

Figure 4-27 Call Setup Attempt from Non-ISDN Calling Party to ISDN Called Party, Second SETUP Message and Call Proceeding at Called ISDN End User 4-69

Figure 4-28 Call Setup Attempt from Non-ISDN Calling Party to ISDN Called Party, RELEase COMplete Message with “Call Rejected” after First SETUP Message 4-70

Figure 4-29 ISDN Call Forwarding — Base DN Has I-CFV or I-CFIB, and Call Is Forwarded 4-81

Figure 4-30 ISDN Call Forwarding — Base DN Has I-CFDA, and Call Is Forwarded Before ACM Is Sent to Originating CCSSO 4-82

Figure 4-31 ISDN Call Forwarding — Base DN Has I-CFDA, and Call Is Forwarded After ACM Is Sent to Originating CCSSO 4-83

Figure 5-1 CCS Network Provider Network Interfaces for Originating Traffic (Routed Based on Carrier Identification Code) 5-12

Figure 5-2 CCS Network Provider Network Interfaces for Terminating Traffic . . 5-25

Figure 5-3 CCS Network Provider Network Interfaces for Traffic Routed on Dialed Digits 5-29

Figure 6-1 DS1 Interface (V.35 Port on the Interconnecting SP) 6-4

Figure 6-2 DS1 Interface (DS0A Port on the Interconnecting SP) 6-5

Figure 6-3 DS0 Clock and Signal Formats 6-6

Figure 7-1 Signaling Message Transport - Examples 7-5

Figure 7-2 CCS Network Provider Signaling Message Transport - Examples . . 7-6

Figure 7-3 IXC Signaling Message Transport - Examples 7-7

Figure 7-4 IXC Signaling Message Transport - Examples 7-8

Figure 7-5 Example of IAM Transport 7-10

Figure 7-6 Example of REL Message Transport 7-14

Figure 7-7 CCS MTP Network Downtime Objective 7-17

Figure 7-8 STP-to-STP Interface Downtime Objective 7-18

Figure 7-9 STP-to-CCSSO Interface Downtime Objective 7-19

Figure 7-10 Generic Network Access Segment Model 7-20

Figure 7-11 Network Access Segment (CCSSO to Mated STPs) 7-23

Figure 7-12 D-Link(s) - No Diversity 7-24

Figure 7-13 2-Way D-Link Diversity 7-25

Figure 7-14 3-Way D-Link Diversity 7-26

Figure 8-1 Level 2 Tests 8-14



| | | |
|-------------|--|------|
| Figure 8-2 | Level 3 Intrusive Tests | 8-15 |
| Figure 8-3 | Level 3 Non-Intrusive Tests | 8-16 |
| Figure 8-4 | Signaling Route Management Example | 8-47 |
| Figure 8-5 | Hubbing Test Example | 8-49 |
| Figure 8-6 | SS7 Trunk Interface Compatibility Testing Arrangement | 8-78 |
| Figure 8-7 | SS7 Trunk Interface End-to-End Testing Arrangement (Two LEC Networks and One IXC Network) | 8-82 |
| Figure A-1 | Routing Label | A-2 |
| Figure A-2 | Changeover Message | A-3 |
| Figure A-3 | Changeback Message | A-4 |
| Figure A-4 | Emergency Changeover Message | A-5 |
| Figure A-5 | Transfer-Prohibited Message | A-6 |
| Figure A-6 | Transfer-Allowed Message | A-7 |
| Figure A-7 | Transfer-Restricted Message | A-8 |
| Figure A-8 | Signaling-Route-Set-Test Message | A-9 |
| Figure A-9 | Management Inhibit Message | A-10 |
| Figure A-10 | Transfer-Controlled Message | A-11 |
| Figure A-11 | Signaling-Route-Set-Congestion-Test Message | A-12 |
| Figure A-12 | Traffic Restart Message | A-12 |
| Figure A-13 | Backward Call Indicators Parameter | A-25 |
| Figure A-14 | User Service Information Parameter | A-27 |
| Figure A-15 | Called Party Number Parameter | A-28 |
| Figure A-16 | Calling Party Number Parameter | A-30 |
| Figure A-17 | Calling Party's Category Parameter | A-31 |
| Figure A-18 | Carrier Selection Parameter | A-32 |
| Figure A-19 | Cause Indicators Parameter | A-33 |
| Figure A-20 | Charge Number Parameter | A-36 |
| Figure A-21 | Circuit Group Characteristics Indicator Parameter | A-38 |
| Figure A-22 | Circuit Group Supervision Message Type Indicator Parameter | A-39 |
| Figure A-23 | Circuit Identification Name Parameter | A-40 |
| Figure A-24 | Circuit State Indicator Parameter | A-41 |
| Figure A-25 | Circuit Validation Response Indicator Parameter | A-42 |
| Figure A-26 | CLLI™ Code Parameter | A-42 |
| Figure A-27 | Continuity Indicators Parameter | A-43 |
| Figure A-28 | Forward Call Indicators Parameter | A-43 |
| Figure A-29 | Message Type Parameter | A-45 |
| Figure A-30 | Nature of Connection Indicators Parameter | A-46 |
| Figure A-31 | Originating Line Information Parameter | A-47 |
| Figure A-32 | Outgoing Trunk Group Number Parameter | A-48 |
| Figure A-33 | Range and Status Parameter | A-48 |
| Figure A-34 | Service Code | A-49 |
| Figure A-35 | Suspend/Resume Indicators Parameter | A-50 |
| Figure A-36 | Transit Network Selection Parameter Field with 4-Digit Carrier Identification Code | A-50 |
| Figure A-37 | Codes for Circuit Code Subfield | A-52 |
| Figure A-38 | Carrier Identification Parameter with 4-Digit Carrier Identification Parameter Field | A-52 |
| Figure A-39 | Event Information Indicators Parameter Field | A-54 |
| Figure A-40 | Optional Backward Call Indicators Parameter Field | A-55 |
| Figure A-41 | Original Called Number Parameter | A-56 |

Figure A-42 Redirection Information Parameter A-58
Figure A-43 Automatic Congestion Level Parameter A-59
Figure A-44 Hop Counter Parameter A-59
Figure A-45 Jurisdiction Information Parameter A-60
Figure A-46 Generic Address Parameter A-61
Figure A-47 Redirect Capability Parameter A-63
Figure A-48 Redirect Counter Parameter A-64
Figure A-49 Redirection Number Parameter A-64
Figure A-50 Generic Digits Parameter Field A-66
Figure A-51 Calling Geodetic Location Parameter Field A-67
Figure A-52 Ellipsoid Point Shape Description A-68
Figure A-53 Shape Description of an Ellipsoid Point with Uncertainty A-70
Figure A-54 Shape Description of a Point with Altitude and Uncertainty A-71
Figure A-55 Shape Description of an Ellipse on the Ellipsoid A-73
Figure A-56 Shape Description of an Ellipsoid Circle Sector A-74
Figure A-57 Shape Description of Polygon A-76
Figure A-58 User Service Information Parameter - Modified for ISDN Access A-79
Figure A-59 Calling Party Number Parameter - Modified for ISDN Access A-81
Figure A-60 Cause Indicators Parameter - Modified for ISDN Access A-83
Figure A-61 Original Called Number Parameter - Modified for ISDN Access A-87
Figure A-62 Redirection Information Parameter - Modified for ISDN Access A-90
Figure A-63 Access Transport Parameter - Added for ISDN Access A-91
Figure A-64 Notification Indicator Parameter - Added for ISDN Access A-92
Figure D-1 Configuration A (Call-Through Tests) D-1
Figure D-2 Configuration B (Test-Set Generated Tests) D-2
Figure G-1 Initial BICC Architecture G-3
Figure G-2 Backward Bearer Connection Setup with COT G-14
Figure H-1 Example of CCS Network Architecture with A-, C-link ATM HSLs H-3
Figure H-2 Example of CCS Network Architecture with B-, C-, D-link ATM HSLs H-4
Figure H-3 SS7 56-Kbps Links and ATM HSL Protocol Model H-8
Figure H-4 Network Architecture for IPVHSLs H-17
Figure H-5 IPVHSL Protocol Stack H-19
Figure I-1 Generic SIP-based Network Architecture I-3
Figure I-2 SIP Stack I-6
Figure I-3 ISUP to SIP Interworking I-10
Figure I-4 SIP and ISUP Interworking I-12
Figure I-5 ISUP-SIP-ISUP Interworking I-14
Figure J-1 Series System J-1
Figure J-2 Parallel System J-2
Figure K-1 3GPP Reference Architecture for the IP Multimedia Core Network Subsystem K-2
Figure K-2 Simplified IMS Functional Architecture K-3
Figure K-3 Procedures for the Establishment of Sessions (without Preconditions) K-6
Figure K-4 PSTN Origination with IMS Termination Example K-10
Figure K-5 IMS Origination with PSTN Termination Example K-13
Figure K-6 ATIS NGN Functional Architecture as Described in ATIS-1000018 K-16
Figure K-7 Proposed Update to ATIS NGN Functional Architecture K-20
Figure K-8 Adaptation of VoIP Interconnection Reference Model for ES-NGN K-22

| | | |
|------------|--|------|
| Figure L-1 | NENA LTD WG View of i3 Functional Architecture | L-2 |
| Figure L-2 | Legacy Wireline Originating Network to i3 ESInet Interconnection . | L-8 |
| Figure L-3 | Legacy Wireless Originating Network to i3 ESInet Interconnection | L-10 |
| Figure L-4 | Legacy Originating Network to i3 ESInet Interconnection Using Direct Connection to Legacy Network Gateway | L-11 |
| Figure L-5 | Transitional Interconnection Architecture Involving a Selective Router L-13 | |
| Figure L-6 | Emergency Call Setup: Origination in a Legacy Network and Termination to i3 PSAP | L-15 |
| Figure M-1 | ATIS-1000026.2008 Locations of SBC Functions | M-2 |
| Figure O-1 | Relationships Among Some Frequently Used Terms | O-3 |

List of Tables

| | | |
|------------|---|-------|
| Table 2-1 | Assignment of Network Cluster Codes to States, Provinces, and Territories (as shown in Chapter T1.111.8 of ATIS-1000111.2005) | 2-19 |
| Table 3-1 | Circuit Query Actions - Transient and Unequipped States | 3-32 |
| Table 3-2 | Circuit Query Actions - Blocking States | 3-33 |
| Table 3-3 | Circuit Query Actions - Busy/Idle States | 3-34 |
| Table 4-1 | Originating Access Type by TGN on AMA Record | 4-13 |
| Table 4-2 | Terminating Access Type by TGN on AMA Record | 4-30 |
| Table 4-3 | Handling of Events Resulting in an Unsuccessful Call | 4-32 |
| Table 4-4 | Example ACC Control Response Percentages | 4-52 |
| Table 4-5 | Completion of Transmission Path at Originating or Tandem CCSSO | 4-78 |
| Table 5-1 | Coding Rules for the Called Party Number Parameter | 5-14 |
| Table 5-2 | Correspondence Between MF Sequence and Coding of Called Party Number | 5-16 |
| Table 5-3 | Correspondence Between MF INC Sequence and Coding of Called Party Number | 5-16 |
| Table 7-1 | Average One-Way Message Transport Times (ms) — IAM | 7-11 |
| Table 7-2 | Average One-Way Message Transport Times (ms) — ACM, ANM, REL, RLC Messages | 7-15 |
| Table 7-3 | Network Access Segment Component Downtime Allocations | 7-21 |
| Table 8-1 | Signaling Route Management Routing List | 8-47 |
| Table 8-2 | Recommended Minimal Subset of Call-Through Tests | 8-107 |
| Table A-1 | Message Priorities | A-16 |
| Table A-2 | Address Complete Message | A-17 |
| Table A-3 | Answer Message | A-17 |
| Table A-4 | Blocking and Blocking Acknowledgment Messages | A-17 |
| Table A-5 | Circuit Group Blocking and Unblocking Messages | A-17 |
| Table A-6 | Circuit Group Reset and Circuit Group Reset Acknowledgment Messages | A-18 |
| Table A-7 | Circuit Query Message | A-18 |
| Table A-8 | Circuit Query Response Message | A-18 |
| Table A-9 | Circuit Reservation Message | A-19 |
| Table A-10 | Circuit Reservation Acknowledgment Message | A-19 |
| Table A-11 | Circuit Validation Test Message | A-19 |
| Table A-12 | Circuit Validation Response Message | A-19 |
| Table A-13 | Continuity Message | A-20 |
| Table A-14 | Continuity Check Request Message | A-20 |
| Table A-15 | Exit Message | A-20 |
| Table A-16 | Initial Address Message | A-21 |
| Table A-17 | Loop Back Acknowledgment Message | A-21 |
| Table A-18 | Release Message | A-22 |
| Table A-19 | Release Complete Message | A-22 |
| Table A-20 | Reset Circuit Message | A-22 |
| Table A-21 | Resume Message | A-22 |
| Table A-22 | Suspend Message | A-23 |
| Table A-23 | Unblocking Message | A-23 |
| Table A-24 | Unblocking Acknowledgment Message | A-23 |

| | | |
|------------|--|-------|
| Table A-25 | Unequipped Circuit Identification Code Message | A-23 |
| Table A-26 | Call Progress Message | A-24 |
| Table A-27 | Confusion Message | A-24 |
| Table A-28 | Address Complete Message - Modified for ISDN Access | A-77 |
| Table A-29 | Answer Message - Modified for ISDN Access | A-77 |
| Table A-30 | Initial Address Message - Modified for ISDN Access | A-78 |
| Table A-31 | Call Progress Message - Modified for ISDN Access | A-78 |
| Table A-32 | Signaling Link Test Message | A-94 |
| Table A-33 | MRVT Message | A-95 |
| Table A-34 | MRVA (Success) Message | A-97 |
| Table A-35 | MRVA (Failure) Message | A-98 |
| Table A-36 | SRVT Message | A-99 |
| Table A-37 | SRVA (Success) Message | A-101 |
| Table A-38 | SRVA (Failure) Message | A-102 |
| Table B-1 | MTP Level 2 Timer Values | B-1 |
| Table B-2 | MTP Level 3 Timer Values | B-2 |
| Table B-3 | ISDNUP Timer Values | B-4 |
| Table B-4 | Testing and Maintenance Timer Values | B-6 |
| Table B-5 | Timer Values in the MRVT and SRVT | B-6 |
| Table E-1 | Values | E-2 |
| Table K-1 | Correspondence Between 3GPP Functional Entities and ATIS NGN Architecture Functional Entities | K-19 |
| Table K-2 | Updated Correspondence Between 3GPP Functional Entities and ATIS NGN Architecture Functional Entities | K-20 |

