DATA COMMUNICATIONS TECHNICAL REFERENCE
TR 54022
AT&T INTELLIGENT CALL PROCESSING (ICP) SERVICE
SIGNALING SYSTEM No. 7 NETWORK INTERFACE SPECIFICATION
ISSUE 5 FEBRUARY, 1997

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1. INTRODUCTION

1.1 General

This document provides the specific interface requirements for the interconnection of customer data bases to the AT&T Signaling System No. 7 (SS7) network for the Intelligent Call Processing (ICP) Service. It includes SS7 protocol messages and procedures, interface architectures, application interface description, and physical link requirements. Other applicable standards include ANSI MTP and SCCP 1996 and ITU-T TCAP 1993 (see also the standards listed in section 4.1.1). This document describes the extent that this interface differs from these standards.

AT&T reserves the right to revise this document to conform to changes or additions to industry standards, to add service capabilities, and to add network or procedural improvements.

1.2 Issue 5

Issue 5 supersedes Issue 4 dated June, 1996. In addition to editorial changes the following has been modified:

- Update from ANSI standard 1992 to 1996
- § 2.1 Feature Description (to include Mated Pair Option)
- § 3.1 Link Access Architecture (to include Mated Pair Option)
- § 3.2 Access Arrangements (to clarify)
- § 3.3.2 Internetwork Protocol Requirements (to clarify)
- § 4.1.3 Chapter T1.111.4 - Signaling Network Functions and Messages (to clarify)
- § 4.1.4 Chapter T1.111.7 - Testing and Maintenance (to clarify)
- § 4.2.1 Sub-System-Prohibited (SSP) Message (to include Mated Pair Option)
- § 5 ICP Technical Description (to include Mated Pair Option)
- § 6.4.1 SCCP Routing of CRP Query and Response Messages (to include Mated Pair Option)
- § 6.5.5.3 Digits (to clarify)
- § 7.2.1 Availability (to include Mated Pair Option)
- § 8 Related Documents and Ordering Information (to remove outdated references)

1.3 Organization of Document

This Technical Reference contains the following sections:

Section 1 - provides the purpose and organization of this document.

Section 2 - provides an overview description of the ICP service.

Section 3 - provides a description of the AT&T SS7 network interface architecture. This includes:

> The link access architecture that allows the interconnection of a customer signaling point (e.g., ICP customer data base) to the AT&T Signaling Network via customer dedicated 56kbps A-link pairs,

The access arrangement options for interconnecting to the AT&T SS7 signaling network, and

The protocol architecture for internetwork addressing of Signaling Points (SPs) as well as message screening for allowed message types and destinations.

Section 4 - describes the differences between the American National Standard Institute for Telecommunications (ANSI) specifications, T1.111 - 1996 for the Message Transfer Part (MTP) and T1.112 - 1996 for the Signaling Connection and Control Part (SCCP), and the corresponding AT&T specifications. In addition, the differences between the ITU-T (ITU Telecommunication Standardization Sector) Transactions Capabilities Application Part (TCAP) - 1993 Recommendations and the AT&T TCAP specifications are specified.

Section 5 - provides a technical description of the ICP service.

Section 6 - is a complete description of the ICP TCAP Application Service Element (ASE) and provides the definition of all of the TCAP query, response, and error messages, their content, and message flows.

Section 7 - describes the performance objectives for the SS7 network. The performance parameters include message transfer delay, SS7 network availability and signaling link error rate.

Section 8 - provides a listing of related Standards documents and information on obtaining them.

2. ICP SERVICE DESCRIPTION

The ICP service is an Advanced 800 service application platform that supports cooperative call processing features between the AT&T network and a customer premises (Private) database. This platform provides the basic capability to temporarily suspend an 800 call being processed in the AT&T Network Control Point (NCP) database and query a customer database to get routing information before resuming call processing. The customer database is referred to herein as the Customer Routing Point (CRP).

The CRP will contain the logic and data to determine the appropriate distribution of calls to any of several resources at multiple ICP subscriber locations. The CRP will use the information provided from the network, e.g., dialed 800 number, calling party's billing number (ANI), and Caller Entered Digits (CED) to make routing decisions that will direct ICP calls to the appropriate customer resource, e.g., geographically distributed agents, service complexes, or Automatic Response Units (ARUs).

2.1 Feature Description

The first feature to be offered on this platform is the Route Select feature. For the Route Select feature, the NCP will first collect the CED if required by the customer record contained in the NCP, prior to launching a query to the CRP. The CED could be a credit card number, Social Security Number, or some other information uniquely identifying the caller to the ICP subscriber. The NCP passes the Dialed 800 Number, the caller's ANI (if available) or originating Area Code (NPA), and the CED in the query to the CRP. The CRP returns an ICP Label back to the NCP for translation.

If the CRP does not respond to the NCP within a pre-determined time interval (which is per NCP site tunable and set during pre-service testing), or the response received from the CRP is in an incorrect format, the NCP will use Default logic to route the call. The Default routing logic is part of the Customer Record in the NCP, which can be updated via the Service Support System. In addition, calls that are received without ANI and calls originating from non-DTMF phones (from which CED cannot be collected) may also require Default routing. The Service Support System will provide the capability and flexibility for a customer to be able to construct customer specific Default logic.

If the ICP Label is valid, the NCP passes to the customer record the ICP Label and label type for ICP Label translation. The three label types of the ICP Label currently supported are:

1. Destination
2. Announcement
3. Post Feature

The customer record will first validate the label received from the CRP to ensure that it corresponds to one of the labels provisioned. If the ICP Label returned is not found, then the customer record at the NCP invokes the specified Other routing logic.

For the Announcement type label, the customer record will translate the label into an Announcement ID and instruct the Originating AT&T Switch to play a non-media related customized announcement or a "busy" tone and terminate the call.

For the Destination type label, the customer record will also perform the jurisdictional screening to ensure that the destination indicated by the label does not violate any state tariff. If the destination passes jurisdictional screening, then the call is routed to the terminating routing number indicated.

For the Post Feature type label, the customer record will translate the label into the appropriate call treatment determined by the call processing logic provisioned for the label.

For an invalid label, the NCP will discard the label and invoke the ICP subscriber specified Default logic to route the call. A label is declared invalid if it is **not**:

1. in the Binary Coded Decimal (BCD) format
2. of correct length as specified in the customer record.

The Mated Pair option, introduced in Issue 5, will allow (2) CRPs to be connected into the AT&T network and operate as a pair for the purposes of improved availability and disaster recovery. Each CRP will be connected to the AT&T Signaling Network via a pair of A-links (as in § 3.1 and § 3.2). This feature will allow backup of CRP applications and will allow load-sharing for the mated CRPs. The AT&T Signaling Network will route network queries to the appropriate CRP(s) and will automatically reroute in the case of a single CRP failure.

3. SS7 SIGNALING NETWORK INTERFACE ARCHITECTURE

3.1 Link Access Architecture

Figure 1 illustrates the SS7 interface between a customer signaling point (e.g., a data base machine capable of supporting SS7 signaling protocols) and the AT&T Signaling Network. Interconnections to the AT&T SS7 network from a customer signaling point should use, at a minimum, a pair of diverse 56 kbps digital A-links. These links should be engineered to carry no more than 40% of the total capability on each link. These links will occupy DS0 channels within DS1 facilities. Dedicated DS1s should be used for optimum performance. These facilities are available through AT&T tariffs, as described in section 3.2. The use of shared DS1s may impact signaling channel performance when troubleshooting shared services. The specific channel within the DS1 shall be specified by the customer. The customer will provision these links to an AT&T designated SS7 Network Interface (NI). A NI is a facility termination location, generally located at AT&T switch office locations. AT&T will provide service ports, maintaining diversity, to the appropriate Signal Transfer Point (STP) pair. The customer may use AT&T's SS7 large Network Identifier (NID) for signaling network interconnection (upon written request to AT&T) or may apply to Bellcore for its own small or large NID.

The ANSI Signaling System No. 7 MTP and SCCP protocols are supported at the interconnection interface. The AT&T STP will perform MTP and SCCP message screening (as described in Section 3.3.2.2) for allowed message types and origination and destination points. The SCCP Global Title Translation shall be performed to route TCAP messages to the appropriate destinations.

For the Mated Pair option (described in section 5), the links in the A-link access to each CRP should be engineered to carry no more than 40% of the total capability on each link. When engineering the links, the total traffic going to both CRPs during normal operations should be used (in the Mated Pair option, a single CRP may be required to handle the total traffic for both CRPs).

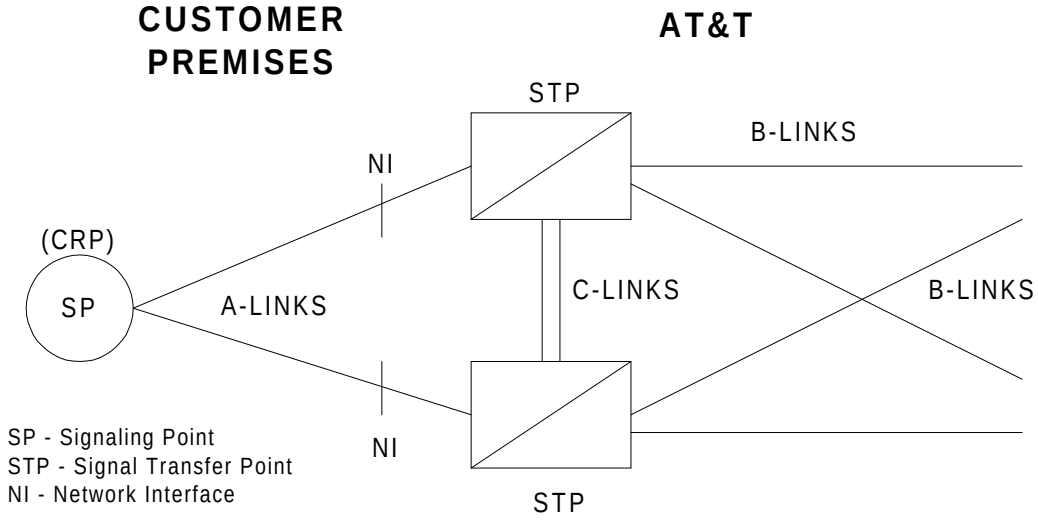


Figure 1. Link Access Architecture

3.2 Access Arrangements

Two 56 kbps links are required for the two A-links from a CRP to the STPs in the AT&T Signaling Network. They can be obtained via the following two options (or any combination thereof):

1 56 Kbps Dataphone® Digital Service (DDS)

2 ACCUNET® T1.5 Service

Physical diversity between the two links may be purchased, where available, for added reliability (see Section 7.2).

3.2.1 DDS

AT&T Dataphone® Digital Service (DDS) can provide 56 kbps service from the customer premises to an AT&T Point-of-Interface. The expected availability for DDS access is 99.975%, which is equivalent to a downtime of 2.2 hours per year. (DDS performance specifications may be found in AT&T Technical Reference 54075, dated November 1993, and DDS interface specifications may be found in AT&T Technical Reference 62310, dated August 1993.)

3.2.2 ACCUNET® T1.5 Service

AT&T ACCUNET® T1.5 Service provides a 24-channel service at 1.544 Kbps rate. One or both A-links could be derived over a single T1.5 service. A pair of physically diverse T1.5 facilities may be purchased for added reliability (see Section 7.2). The expected availability for the ACCUNET® T1.5 access is 99.975%, which is equivalent to a downtime of 2.2 hours per year. (ACCUNET® T1.5 performance specifications may be found in AT&T Technical Reference 62411, dated December 1990.)

3.3 Protocol Architecture

3.3.1 Overview

SS7 is a common channel signaling system whereby signaling links, separate from the voice path, are used to transfer messages between switches or other nodes to set up trunks or access data bases (e.g., AT&T NCPs, customer CRPs). The SS7 protocol consists of a layered structure with each layer routing specific functions. Levels 1, 2 and 3 make up the Message Transfer Part that provides the functions for the reliable transfer of signaling messages. Level 1, the physical level, includes the physical and electrical portion of the link and the means to access it. Level 2, the data link level, includes error detection and correction, sequence control, message delimitation using flags and link failure detection functions. Level 3, the network level, includes message handling and network management functions. All signaling points, including the customer CRP, must have the capability to properly respond to network management controls, such as transfer controlled, transfer prohibited, etc.

The major components of an SS7 network are Signaling Points (including switches, STPs, customer CRPs, and network databases), and Signaling Links. The STPs have a transfer functionality that incorporates the MTP and SCCP levels of the SS7 protocol to perform signaling message routing. The CRP functions solely as an end point.

Parts of the SS7 protocol that use the service of the MTP include SCCP, TCAP, and Integrated Services Digital Network - User Part (ISUP)[1]. The SCCP provides a connectionless service to

[1] Note that ISUP is not supported over the NCP-CRP interface.

transfer signaling messages between exchanges and specialized information centers such as databases. TCAP provides the messages and procedures for non-circuit related signaling, such as access to a database for a number translation.

3.3.2 Internetwork Protocol Requirements

3.3.2.1 Addressing and Routing

The label contained in a signaling message and used by the relevant User Part to identify the particular task to which the message refers (e.g., query a customer CRP) is used by the MTP to route the message towards its destination point. The part of the message that is used for routing is called the *routing label*, and it contains the information necessary to deliver the message to its destination point. See Figure 2.

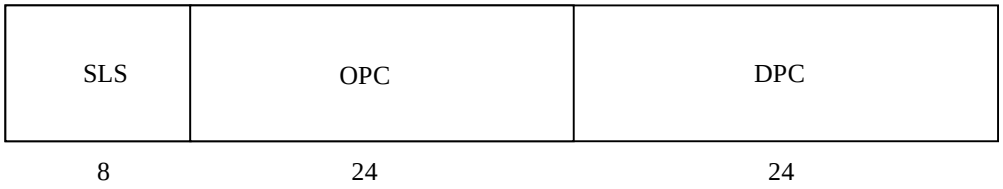


Figure 2. Routing Label Structure

The routing label has a length of 56 bits and is placed at the beginning of the signaling information field. The *Destination Point Code* (DPC) indicates the destination address of the message. The *Originating Point Code* (OPC) indicates the originating address of the message. The *Signaling Link Selection* (SLS) code determines the signaling link over which each outgoing CRP message is sent.

An unique numbering scheme for the coding of the fields is used for the signaling points of any network.

In the routing label both the OPC and the DPC are comprised of three fields as shown in Figure 3. These are dependent fields that make up an unique signaling network address for each signaling point.

In many cases the value in the network identifier field directly identifies the network to which a point code belongs; however, a number of values of that field have been reserved for small network code assignment so that more than 256 networks can be addressed. The network cluster field is used to identify the network to which the point code belongs. CRP must respond to any point code having a network identifier that is coded to 254, i.e., 11111110. NID 254 is not available for CRP Point Code assignment. In addition, AT&T has another SS7 Network large NID, code 231, which is available, upon request, for customers who wish to use it for point code assignment of CRP signaling points. The network cluster member field is coded binary in the AT&T network. The cluster member code 00000000 is reserved for addressing Signal Transfer Points.

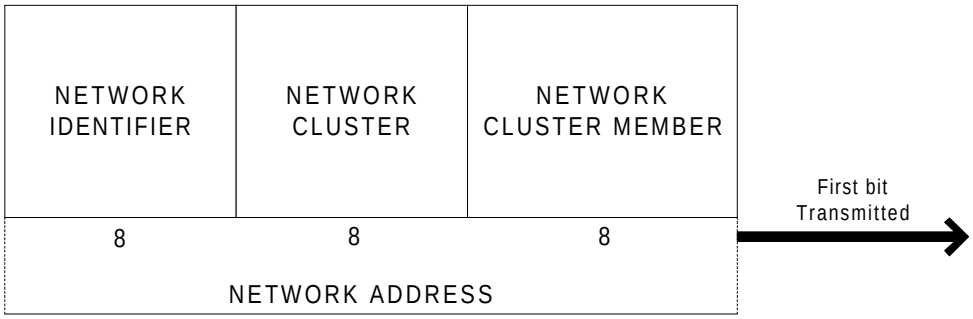


Figure 3. Signaling Point Code Structure

The SLS field is used, where appropriate, in performing load sharing. For messages which do not require special routing, a balanced mix of SLS codes should be used to ensure that traffic is distributed evenly across the network. Precise descriptions of special routing requirements can be found in ANSI T1.111.4 1996.

3.3.2.2 Message Screening

Message screening at the interconnecting AT&T STP is defined as an examination of designated fields of the incoming messages. The AT&T STP examines messages arriving on links that connect to other networks for valid values in certain fields of the message. The AT&T STP checks incoming messages for allowable values and allowable combinations of values in the MTP and/or SCCP addressing and formatting fields.

Message screening is provisionable for the specific link set and is to be determined based on customer and AT&T requirements. Thus, messages can be screened for certain attributes on one link set and for other attributes on a different link set. In general, the following messages can be discarded without notification to the CRP:

1. Messages which contain unauthorized/invalid Origination Point Code (OPC) and Subsystem Number (SSN) combination,
2. Messages which contain unauthorized/invalid Destination Point Code (DPC) and SSN - the CRP is expected to access only certain AT&T STPs and certain SSNs in the AT&T NCPs,
3. Messages which contain unauthorized/invalid Translation Type (TT), Global Title (GT), and Service Information Octet (SIO) - the CRP is expected to access the services currently supported by customer and AT&T agreements.

4. SS7 SIGNALING NETWORK INTERFACE PROTOCOLS

The SS7 protocol parts handled by the AT&T STP include the MTP and SCCP. The higher level protocols received at the interface, such as TCAP, are transported transparently by the STP. For the ICP application, compatibility with ANSI T1 MTP and SCCP as well as ITU-T TCAP is required.

4.1 Message Transfer Part

The Message Transfer Part provides the functions and procedures for, and relating to, the reliable transfer of messages in the proper sequence without loss or duplication. The AT&T implementation of the MTP is based on ANSI T1.111-1996 with the following exceptions or implementation options.

4.1.1 Chapter T1.111.2 Data Link

Physical interlocation facility and intralocation equipment diversity of signaling links should be provided to meet the availability objectives specified in Section 7. Intralocation diversity includes all facility and terminal equipment, cables, power supplies, and cross connect frames. An A-link pair port connection should have diverse link facilities between the customer CRP and the AT&T NI. AT&T will provision diversity from the NI to the AT&T STPs.

Any compromises to the above requirements on A-links that the customer implements will impact service performance.

Synchronization of transmission facilities used for signaling links shall be in accordance with "The Digital Synchronization Network Plan" described in Technical Advisory TA-NPL-436, Issue 1, dated November 1986 and AT&T PUB 60110. Clock timing and synchronization is based on a Primary Reference Source described in ANSI standard T1.101-1994. The interface slip rate shall comply with ITU-T Recommendation G.822.

4.1.2 Chapter T1.111.3 Signaling Link

- **4.1 Acceptance of Alignment** - 4.1.3. The protocol states that the "octet counting" mode is entered when more than 'm' + 7 octets are received before a closing flag. The value of m, the maximum length of the signaling information field in octets, is 272. In AT&T's implementation, the octet counting mode is entered after the flag is received. Therefore, if the message exceeds 272 octets and the flag is corrupted, the octet counting mode begins after the next uncorrupted flag is received, not after the 272nd octet.

- **6. Preventive Cyclic Retransmission (PCR) Error Correction Method** - The PCR Error Correction Method is only applied to satellite links. AT&T is not connecting a CRP to satellite links. Therefore, this section is not applicable.

4.1.3 Chapter T1.111.4 - Signaling Network Functions and Messages

Please note that one new section (Sec. 9 - MTP Restart) was added to T1.111.4 - 1992.

- **9.0 MTP Restart** - The CRP shall be able to receive the TRW (Transfer Restart Waiting) and TRA (Transfer Restart Allowed) messages and perform the actions of a signaling point adjacent to a restarting signaling point.

- **11.2.7 MTP User Flow Control** - The AT&T STP will not be sending UPU (User Part Unavailable) or UPA (User Part Available) messages to the CRP.

- **12.2.2 Signaling Link Restoration** - While the link oscillation procedure is implemented at the AT&T STP, CRP does not need to implement this procedure.

- Sections **12.3, 12.4, 12.5, 12.6**, and **12.7** referring to the **Automatic Allocation of Signaling Terminals and Data Links** are not applicable to the AT&T network.

- **13.2 Transfer-Prohibited** - 13.2.2 AT&T employs the response method (versus the broadcast method) for sending transfer prohibited messages.

- **13.2 Transfer-Prohibited** - 13.2.2A The network option to send transfer-cluster-prohibited messages relating to the cluster is implemented.

- **13.3 Transfer-Allowed** - 13.3.2A The network option to send transfer-cluster-allowed messages relating to the cluster is implemented.

- **13.4 Transfer-Restricted** - 13.4.2A The network option to send transfer-cluster-restricted messages is implemented.

- **16.7 Abbreviations and Timers Used in Figures 23 to 46C**
  Timers associated with the MTP restart and the link oscillation procedures are implemented.

4.1.4 Chapter T1.111.7 - Testing and Maintenance

- **2.2 Signaling Link Test** - The signaling link test shall be used during link activation or restoration. The link becomes available only when the test is successful. If the signaling link test fails, the restoration procedure will automatically start/repeat until the signaling link is available. It is recommended that the testing of an in service signaling link be performed by the STP.

- **2.4 Circular Route Detection Test** (for ANSI 1996) - This procedure is implemented in the AT&T network.

4.2 Signaling Connection Control Part

The Signaling Connection Control Part for ICP provides connectionless services in addition to the Message Transfer Part. The SCCP is used to transfer non-circuit related signaling information via an SS7 network.

The SCCP connectionless services provide the SCCP user with the ability to transfer signaling messages via the signaling network without the setup of a signaling connection. In addition to the MTP routing capability, the Global Title Translation (GTT) function is provided within the SCCP that maps the Global Title of the SCCP called party address to a Signaling Point Code and SSN.

The AT&T SS7 Signaling Network interface at the SCCP level is in conformance with ANSI T1.112 Issue 2, with the following exceptions.

4.2.1 Sub-System-Prohibited (SSP) Message

Vendors shall implement the SSP procedure to handle unexpected sub-system failures as described in the applicable ANSI 1996 standard. The following implementation specifics shall be considered:

- The AT&T Network implementation of SSP will update the status of a prohibited SSN to sub-system allowed after 6 hours if a Sub-System-Allowed (SSA) message has not been received.

- If subsequent to the CRP sending a SSP to the network, the CRP receives queries while its sub-system is still prohibited, the CRP must respond with:
  - A UDTS message to the Calling Party Address in the query message, with return cause set to sub-system failure.
  - A SSP message to the OPC of the STP forwarding the query.
-

4.2.1.1 Single CRP Architecture

If a CRP using the Single CRP option initiates SSP messages to the network, queries for the affected sub-system will be blocked by the STP network (however, calls will be routed by the NCP using customer-provided default routing logic). In addition, the following circumstances will result:

- Network billing for CRP queries from the NCP that are subsequently blocked by the STP will continue.

- Post Dial Delay due to time-outs at the NCP caused by queries to the CRP being blocked at the STP will increase.

- Alarms in the network from query time-outs or from the subsystem prohibited condition will be generated, recommending maintenance intervention by AT&T network personnel.

For these reasons, AT&T does not recommend that CRPs using the Single CRP option initiate SSP messages to the network to disable transmission of queries to the CRP during the CRP routine maintenance activities. AT&T instead recommends that queries be turned off at the NCP using the normal ICP procedures for updating NCP routing logic.

4.2.1.2 Mated Pair Architecture

If a CRP using the Mated Pair option initiates SSP messages to the network, the following events will occur:

- The affected sub-system will be marked unavailable by the STP network, and sub-system test messages from the network to the CRP will be launched at regular intervals until the condition clears, or until six hours passes.

- If the CRP sending the SSP message is provisioned as the primary point code for the affected application, any queries for that application will be rerouted to the CRP provisioned as the backup.

- If the CRP sending the SSP message is provisioned as the backup point code for the affected

application, queries for that application will continue to be rerouted to the CRP provisioned as the primary. However, if the primary CRP should fail, queries for the affected application will be blocked at the STP network, with the same results as described for the Single CRP Architecture above.

- Alarms in the network from the subsystem prohibited condition will be generated, recommending maintenance intervention by AT&T network personnel.

Because of the network alarms generated, and that backup protection is effectively disabled when SSP messages are initiated to the network, AT&T still does not recommend using SSP messages to redirect queries during routine maintenance activities with a Mated Pair architecture, but instead recommends that queries be turned off at the NCP using the normal ICP procedures for updating NCP routing logic, as with the Single CRP architecture.

Note: After six hours the network will restore the affected prohibited SSN to sub-system allowed, whether or not an SSA was received concerning the prohibited sub-system, as stated in 4.2.1 above. If the CRP application affected was designated as the primary, traffic will be routed to the application again. If the CRP application was provisioned as the secondary, it would again receive traffic in the event of a failure of the primary.

4.3 Transaction Capabilities

For the ICP application, the messages and procedures at the interface for ANSI T1 MTP and SCCP are required for compatibility purposes. In addition, compatibility with ITU-T TCAP is required.

ITU-T TCAP protocol is specified in Recommendations Q.771 - Q.775 in the ITU-T 1993 White Book. Recommendation Q.771 contains a general description of the services provided by the Transaction Capabilities Application Part to the TC-User, and the services expected from the SCCP. Recommendation Q.772 defines the Transaction Capabilities (TC) Information Elements and their functions. Recommendation Q.773 defines the formats and encoding used for the Transaction Capabilities messages. Recommendation Q.774 is a detailed description of the Transaction Capabilities procedures as a protocol specification. Recommendation Q.775 is a TC User's Guide. It shows, through examples, how TCAP may be used by an application.

4.3.1 Transaction Capabilities Application Part

Transaction Capabilities (TC) provide functions and protocols to a large variety of applications distributed over switches and specialized centers (e.g., data bases) in telecommunications networks. The term "Transaction Capabilities" refers to Application layer services and protocols, called Transaction Capabilities Application Part (TCAP), plus any supporting Presentation, Session, and Transport layer services and protocols.

The overall objective of Transaction Capabilities is to provide the means for the transfer of information between nodes and to provide generic services to applications. These applications are referred to as TC-users. A *particular instance of a TC-user is an Application Service Element (ASE).* An individual ASE consists of Operations, Parameters, and Error Codes together with application procedures.

The AT&T implementation of the TCAP, referred to as CCS7 TCAP, is based on ITU-T TCAP with the following exceptions or implementation options.

4.3.1.1 Recommendation Q.773 TCAP Formats and Encodings

The paragraph numbers in the following lists refer to sections in Q.773-1993 White Book.

- **4.1.3 Transmission Order** - Note (a) to Figure 8/Q.773: The user should be aware of total message length limitations when using TCAP in the SS No. 7 connectionless environment. *In the AT&T network, the total message length of a TCAP message is restricted to 254 octets.*

- **4.2.1.3 Transaction ID Tags** - The length of a Transaction ID is 1 to 4 octets. *In the AT&T network, Transaction IDs are always 4 octets in length*.

5. ICP TECHNICAL DESCRIPTION

5.1 Single CRP Architecture

The architecture for the ICP service using the Single CRP option is shown in Figure 4. The ICP subscriber's database (CRP) accesses the AT&T STP via a pair of A-links.

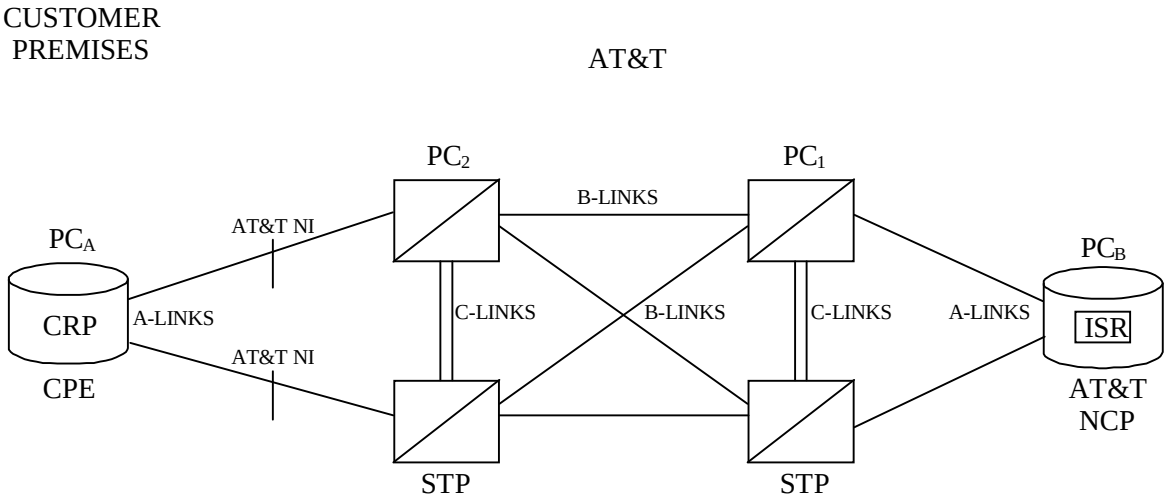


Figure 4. ICP Service Architecture with Single CRP Option

5.1.1 Architecture/Call Flow

The call flow for this feature is as follows:

1. The AT&T NCP (PC_B) recognizes the ICP call from the dialed 800 number and the instructions in the ICP Subscriber Record (ISR) in the NCP.

2. The NCP collects Caller Entered Digits (CED) from the caller, if instructed by the ISR.

3. The NCP formulates an ICP CCS7 TCAP query with a Global Title address for the CRP and the appropriate Translation Type and sends the query to the AT&T STP (PC_1). The query contains the dialed 800 Number and other parameters.

4. The AT&T STP (PC_1) performs a Global Title Translation (GTT) on the query and routes it to the appropriate CRP (PC_A) through the AT&T network by MTP routing.

5. The CRP (PC_A) processes the query, formulates a response containing the ICP Label, and sends it back to the NCP (PC_B) through the AT&T network by MTP routing.

6. The AT&T STP (PC_2) performs message screening on the response message. If the message fails screening it is discarded. If the message passes screening, it is routed to the NCP through the AT&T network by MTP routing.

7. The NCP routes the call using the ICP Label received from the CRP.

8. If for any reason, the NCP does not receive a valid response from the CRP in the allowed time, the NCP will use the default routing provisioned in the ISR.

5.2 Mated Pair Architecture

The architecture for the ICP service with the Mated Pair option is shown in Figure 5. Each ICP subscriber's database (CRP) accesses the AT&T STP via a pair of A-links.

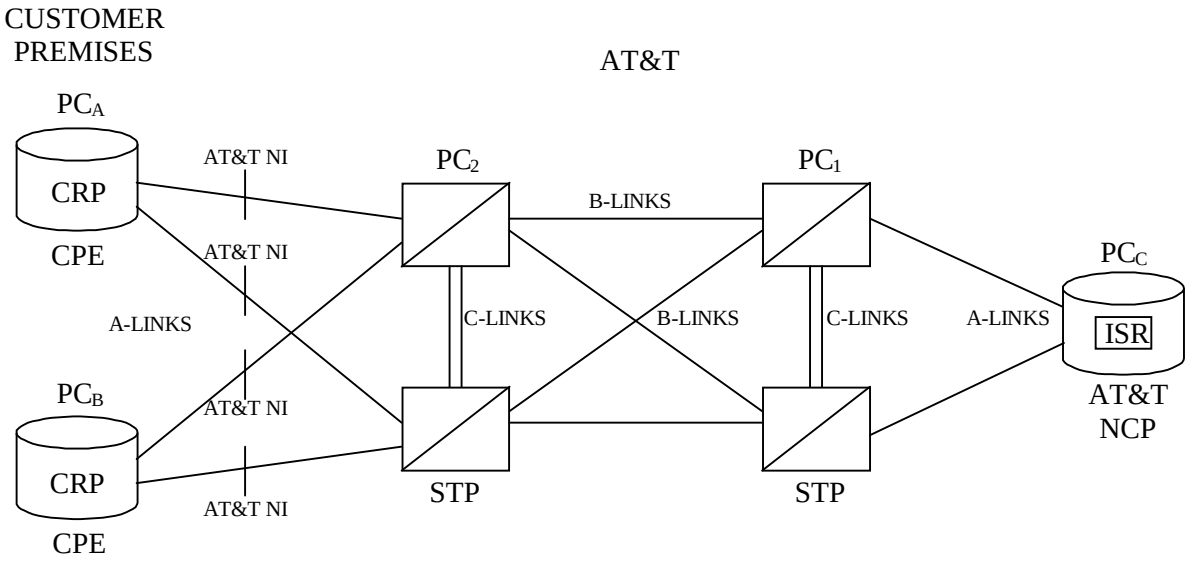


Figure 5: ICP Service Architecture with Mated Pair Option

5.2.1 Mated Pair Operating Modes

Each CRP Subsystem Number (SSN) on a mated pair of CRPs can be operated in one of two modes:

- **"active/standby"**
  In this case, all queries for that SSN will be routed to a single CRP PC at any one point in time. When ordering service, the customer will need to indicate which CRP PC should be designated as the primary and which CRP PC should be designated as the secondary for that SSN. The customer may choose either of the CRP PCs as primary for each SSN.

- **"load sharing"**
  In this case, some queries for that SSN will be routed to one of the CRP PCs and some queries for the same SSN will be routed to the other CRP PC. This is accomplished by providing the customer with two CRP Identifiers to use in the ICP Subscriber Record (ISR) in the NCP. The customer has flexibility in how they wish to divide queries between the CRP Identifiers. The use of this mode requires that the mated CRPs be able to accommodate simultaneous queries to both CRPs for the same SSN.

  Another attribute of this mode is the ability to change the primary/secondary relationship by simply updating the routing logic in the ISR (this could be useful during routine CRP maintenance activities as recommended in § 4.2.1.2).

In either case, following a failure of a single CRP, all queries will be routed to the remaining CRP. The customer will need to choose which mode they desire for each SSN on a mated pair of CRPs when ordering service.

5.2.2 Architecture/Call Flow

The call flow for this feature is as follows:

1. The AT&T NCP (PC_C) recognizes the ICP call from the dialed 800 number and the instructions in the ICP Subscriber Record (ISR) in the NCP.

2. The NCP collects Caller Entered Digits (CED) from the caller, if instructed by the ISR.

3. The NCP formulates an ICP CCS7 TCAP query with a Global Title address for the CRP and the appropriate Translation Type and sends the query to the AT&T STP (PC_1). The query contains the dialed 800 Number and other parameters.

4. The AT&T STP (PC_1) performs a Global Title Translation (GTT) on the query and routes it to the appropriate CRP through the AT&T network by MTP routing. If the primary CRP PC and SSN is available, the query will get routed to the primary (PC_A). If the primary CRP PC and SSN is unavailable but the secondary CRP PC and SSN is available, the query will get routed to the secondary (PC_B).

5. The CRP (PC_A or PC_B) processes the query, formulates a response containing the ICP Label, and sends it back to the NCP (PC_C) through the AT&T network by MTP routing.

6. The AT&T STP (PC_2) performs message screening on the response message. If the message fails screening it is discarded. If the message passes screening, it is routed to the NCP through the AT&T network by MTP routing.

7. The NCP routes the call using the ICP Label received from the CRP.

8. If for any reason, the NCP does not receive a valid response from the CRP in the allowed time, the NCP will use the default routing provisioned in the ISR.

5.3 Network Element Capabilities

5.3.1 ICP Service Capabilities

The CRP must provide the following capabilities:

1. Any CRP that is in service (as Single CRP or primary or secondary in Mated Pair) must keep both A-links aligned and must be ready to accept queries during normal operations.
2. The CRP must recognize an ICP CCS7 TCAP query (as specified in Section 6.4).
3. The CRP must be able to formulate an ICP CCS7 TCAP response (as specified in Section 6.4).
4. The CRP must not originate any ICP CCS7 TCAP queries (Begin Messages) into the AT&T Signaling Network.
5. To minimize the Post Dialed Delay (PDD), AT&T recommends that the CRP formulate and send a response to an ICP CCS7 TCAP query within 0.5 second of receipt of the query.

In addition, for the Mated Pair architecture, the CRP must provide the following capabilities:

1. The CRP is responsible for notifying the network (using SSP as specified in § 4.2.1) for any application-related failures that are relevant.

2. A mated pair of CRPs must be able to accept and respond to queries for all applications that are on either CRP.

It is also strongly recommended, for the Mated Pair architecture that:

1. Each CRP should be engineered to handle 100% of the total load sent to the pair of CRPs so that either one can accommodate all of the traffic. If this is not done properly, an overload condition at the surviving CRP may result following a CRP or A-link pair failure.
2. Any data relevant to the CRP application and to returning routing labels should be consistent on both CRPs so that calls are routed consistently during normal operations and during a failure.
3. If choosing the "load sharing" mode, the CRP vendor and/or customer is responsible for ensuring that the CRP application will accommodate simultaneous queries to both CRPs for a single SSN.
4. Customer should have an alarming system that will detect CRP failure and initiate restoration procedures for failed components.

6. ICP APPLICATION SERVICE ELEMENT

The ICP is an application built on the top of TCAP, that will utilize the services of TCAP, SCCP, and MTP layers provided by the Signaling System No. 7. The Application Service Element (ASE) for ICP is based on a subset of AT&T CCS7 TCAP. The ICP-specific TCAP Messages, Operations, Parameters, and Error Codes together with procedures are referred to in this document as the ICP CCS7 TCAP protocol.

The ICP CCS7 TCAP protocol is described in the following subsections.

6.1 General Rules

6.1.1 Asymmetric ASE

The ICP ASE defined here is asymmetric, i.e., only AT&T's network data base (NCP) can initiate a query to a CRP. The CRP will not initiate queries, it will only respond to a query.

6.1.2 Rules for ICP CCS7 TCAP Operations

1. Only Class 1 Operations shall be supported for ICP. Class 1 Operations always require a response, whether the result of the operation was success or failure.

2. The successful outcome of an Operation should be reported in the Return_Result (Last) component. Return_Result (Not Last) Component is not used.

3. The unsuccessful outcome of an Operation should be reported in the Return_Error component.

4. The TCAP protocol violations should be reported in the Reject component or via P_Abort.

5. The U-Abort procedure is not supported over the NCP-CRP interface.

6.1.3 Message Set

A three-message set shall be used in the ICP CCS7 TCAP:

1. BEGIN
2. END
3. ABORT

Each NCP-CRP transaction consists of one Begin message sent from the NCP to the CRP and one End message returned by the CRP to the NCP. Each message will contain only one component.

6.2 Miscellaneous Rules

6.2.1 Use of Sequence Parameter

The Sequence Tag parameter is optional when there is only one parameter present in a Component. When there is more than one parameter in a Component (applicable to all Component types), the parameters must be preceded by the Sequence Tag.

6.3 ICP's ASE - General Description

The ICP ASE provides an application-to-application procedure for obtaining routing instructions from the customer's database (CRP). A client-server model is followed in this communication, where the NCP is the client node and the CRP is the server node. The NCP sends a query to the remote CRP node asking it to perform the "Find_ICP_Route" operation. The CRP performs the

Find_ICP_Route operation and sends the results of the operation back to the NCP in the form of a response. The CRP shall not initiate queries.

The query from the NCP must contain the following parameters:

- Dialed_Number (e.g. 800-NXX-XXXX)
- ANI (when available, otherwise originating NPA)

In addition, the query can include an optional parameter, namely, the Caller Entered Digits (CED), if required by the ICP subscriber. The CED could contain up to 30 digits. The CED shall be collected by the AT&T network, prior to launching the query to the CRP, by playing a non-media related customized announcement to the caller. The caller will need a DTMF phone ("Touch-tone" phone) to enter the CED. If the caller does not have the touch-tone phone, CED cannot be collected, in which case CED will not be sent to the CRP.

A successful response from the CRP must contain a ICP Label recognizable by the NCP. The NCP will translate the ICP Label into a terminating Routing Number or an announcement. In addition to the ICP Label, the response may also contain an optional Customer Database Provided Digits (CDPD) parameter to be forwarded by the NCP to the final destination of the call.

6.4 ICP CCS7 TCAP Message Flow

This section describes the ICP CCS7 TCAP message flow for the NCP-CRP interaction procedure described in the previous section. A three message procedure is employed. A single TCAP message (BEGIN) flows as a query from NCP to CRP, and a single message (END or ABORT) flows back to the NCP as a response. For basic TCAP protocol violation, e.g., when a CRP receives a message other than the Begin message or the Begin message is badly formatted, the CRP shall use the standard TCAP Abort procedure.

The message structure for Begin, End, and Abort messages is specified in ITU-T Q.773 Tables 4, 5, and 7 respectively.

Whenever the NCP queries the CRP, it activates a CRP Response Timer and times the response from the CRP. The timer value shall be site tunable. The actual timer value for a particular CRP shall be selected during the pre-service testing. In order to keep the added Post Dialed Delay (PDD) due to the CRP dip to a minimum, the default timer value is set to 2 seconds (range from 2 to 5 seconds). If the timer expires before the response is received, the NCP invokes ICP subscriber's Default routing logic contained in the NCP to route the call.

The message flows for various scenarios are shown in Figures 6 through 10.

6.4.1 SCCP Routing of CRP Query and Response Messages

Every CRP that interfaces with the AT&T SS7 signaling network must be assigned an unique Point Code (PC), in accordance with Section 3.3.2.1 of this document. In addition, the corresponding ICP application in the CRP must be assigned a Sub-System Number (SSN). The CRP query is routed through the AT&T SS7 signaling network using the CRP Point Code and SSN.

ICP applications that use the Mated Pair option will be assigned the same Sub-System Number on both CRPs in the mated pair (however, each CRP in the mated pair will have a unique Point Code).

The NCP Point Code and the Sub-System Number (SSN) corresponding to the ICP application are also included in the query message **in the SCCP calling party** address. The CRP shall use this address as the destination address for the response message.

6.4.2 Successful Response Scenario

If the CRP is able to select a termination treatment for the call, it sends an ICP CCS7 TCAP End message with a Return_Result (Last) component to NCP. The Return_Result (Last) component structure is specified in ITU-T Q.773 Table 16.

The required parameter in the response message is:

- ICP Label

The ICP label and label type are used by the customer record at the NCP for translation for determination of final call treatment. The customer record first determines if the ICP Label returned is one of labels provisioned at the NCP. If the label returned is not found then the Other routing logic which is part of the customer record is invoked.[2] If the returned ICP Label is of the announcement type, the NCP will translate it into an Announcement ID and provide a customer specified announcement treatment to the call.

If the returned ICP Label is of the destination type, the customer record first applies jurisdictional screening to the termination indicated.[3] If the termination passes jurisdictional screening the customer record then routes the call to the Termination Routing Number.

If the termination does not pass jurisdictional screening, the customer specified Default routing logic is invoked to route the call.

If the returned ICP Label is of Post Feature type, the customer record translates the label to the appropriate call treatment determined by the call processing logic provisioned for the label.

In addition to the ICP Label, the CRP may also return an optional Customer Database Provided Digits (CDPD) parameter.

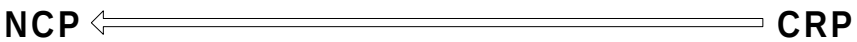
The TCAP message flow between the NCP and the CRP for the successful response scenario is illustrated in Figure 6.

[2] The service support system will provide the capability and flexibility for the customer to construct Other specific routing logic. The Other routing logic may or may not be the same as the Default routing logic.

[3] Jurisdictional Screening ensures that the call from the originating NPA to the destination (as indicated by the ICP Label) does not violate any state tariff.

- ❑ Message Type = Begin
- COMPONENT TYPE = Invoke
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (Parameters must be sent in a parameter sequence in the order indicated.)
  1. Digits (Dialed No, Telephony, BCD)
  2. Digits (ANI, Telephony, BCD)
  PARAMETERS (Optional)
  3. Digits (CED, N/A, BCD)

The NCP activates the CRP Response Timer.



- ❑ Message Type = End
- COMPONENT TYPE = Return_Result (Last)
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (If optional parameter is sent, parameters must be sent in a parameter sequence in the order indicated.)
  1. ICP_Label
  PARAMETERS (Optional)
  2. Digits (CDPD*, N/A, BCD)

Notes:
* Customer Database provided Digits

Figure 6. NCP/CRP Interaction - Return_Result (Last)

6.4.3 Unsuccessful Response - Error Conditions

6.4.3.1 Error Handling Approach

In order to distinguish provisioning errors that might require work center intervention, from errors caused by users (e.g. caller enter digits), two error handling approaches have been adopted.

The first approach handles errors caused by the user entering unexpected input values. In this case the CRP should return a Return_Result (Last) component in the End message with a valid label. This will prevent exception messages from being generated at the NCP as a result of unexpected user input values.

The second approach is for handling error conditions caused by provisioning errors between the NCP and CRP. In this scenario the CRP will return a Return_Error component in the End message. This will invoke customer specified Default routing logic to route the call. Once the call progresses to the stage that a CRP query is launched, it is not considered prudent to block it even when the query process does not result in a successful outcome.

The various error scenarios and their treatment in the NCP is discussed in the following sections.

6.4.3.2 Return_Result (Last) Response

(User Input Errors) If the CRP receives an invalid parameter in the TCAP Begin message, attributed to user input error (e.g. unexpected CED value), the CRP shall send a ICP CCS7 TCAP End message with a Return_Result (Last) component containing an ICP Label.

The NCP-CRP TCAP message exchange for this scenario is illustrated in Figure 6.

After receiving the ICP CCS7 TCAP End message, the NCP will terminate that TCAP transaction with the CRP.

6.4.3.3 Return_Error Response (Provisioning Errors)

If the CRP receives an invalid parameter in the TCAP Begin message, attributed to a provisioning error between the NCP and CRP, it shall send a ICP CCS7 TCAP End message with a Return_Error component. The error code is "Input Error" and the required parameter is "Input Error Cause" with a value corresponding to one of the causes specified in Table 1. The CRP will also return, in the END message, the parameter (optional) that caused the error in the CRP.

The Return_Error component structure is specified in ITU-T Q.773 Table 17. The NCP-CRP TCAP message exchange for this scenario is illustrated in Figure 7.

The NCP invokes Default routing logic to route the call.

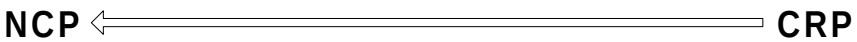
Error Cause Descriptions	
Input Error	Invalid Dialed Number Unexpected Input Data Format Missing Parameter Unexpected Parameter

Table 1. Error Causes in the Return_Error Component

- ❑ Message Type = Begin
- COMPONENT TYPE = Invoke
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (Parameters must be sent in a parameter sequence in the order indicated.)
  1. Digits (Dialed No, Telephony, BCD)
  2. Digits (ANI, Telephony, BCD)

  PARAMETERS (Optional)
  3. Digits (CED, N/A, BCD)

The NCP activates the CRP Response Timer.



- ❑ Message Type = End
- COMPONENT TYPE = Return_Error
  ERROR CODE = Input Error
  PARAMETERS (Mandatory)
  (If optional parameter is sent, parameters must be sent in a parameter sequence in the order indicated.)
  1. Input_Error_Cause

  PARAMETERS (Optional)
  2. Digits (Dialed No. or ANI or CED)

Figure 7. NCP/CRP Interaction - RETURN_ERROR

6.4.3.4 REJECT Response

If a component (e.g., Invoke) received from the NCP by the CRP is badly structured or out of context, the CRP shall return a ICP CCS7 TCAP End message with a Reject component to the NCP. The Reject component structure is specified in the ITU-T Recommendation Q.773 Table 18. The Reject component will include a mandatory Problem Code element, as defined in the ITU-T Recommendation Q.773 Tables 25-29.

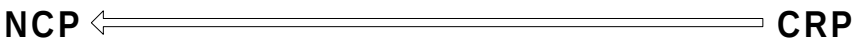
The NCP will invoke Default routing logic to route the call.

The TCAP flow for this call scenario is illustrated in Figure 8.

- ❑ Message Type = Begin
- COMPONENT TYPE = Invoke
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (Parameters must be sent in a parameter sequence in the order indicated.)
  1. Digits (Dialed No, Telephony, BCD)
  2. Digits (ANI, Telephony, BCD)

  PARAMETERS (Optional)
  3. Digits (CED, N/A, BCD)

The NCP activates the CRP Response Timer.



- ❑ Message Type = End
- COMPONENT TYPE = Reject
  PROBLEM CODE (Mandatory)
  PARAMETERS (Mandatory)
  - None

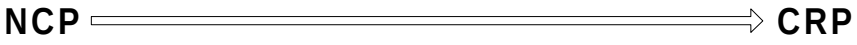
Figure 8. NCP/CRP Interaction - REJECT

6.4.3.5 ABORT Response

If the Transaction ID or the message (e.g., Begin) received by the CRP from the NCP causes errors because it violates the TCAP protocol, the CRP must return an Abort message with a P_Abort_Cause for a Transaction sublayer violation. The P_Abort_Cause tag and values are defined in ITU-T Recommendation Q.773 Tables 11 and 12 respectively.

The NCP will invoke Default routing logic to route the call.

The TCAP message exchange between the NCP and the CRP for this call scenario is illustrated in Figure 9.



- ❑ Message Type = Begin
- COMPONENT TYPE = Invoke
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (Parameters must be sent in a parameter sequence in the order indicated.)
  1. Digits (Dialed No, Telephony, BCD)
  2. Digits (ANI, Telephony, BCD)

  PARAMETERS (Optional)
  3. Digits (CED, N/A, BCD)

The NCP activates the CRP Response Timer.

- ❑ Message Type = Abort
- P_Abort_Cause

Figure 9. NCP/CRP Interaction - ABORT

6.4.3.6 Transaction Error

If the response received from the CRP contains a badly formatted message or a Message Type that violates the TCAP protocol (i.e., it is not an End or Abort message), the NCP will discard the message and terminate that TCAP transaction with the CRP. The NCP will not send an Abort message back to the CRP.

The NCP will invoke Default routing logic to route the call.

6.4.3.7 Component Error

If the ICP CCS7 TCAP End message received from the CRP contains a badly structured component, or an out of context component (e.g., an Invoke instead of Return_Result) that violates

the TCAP protocol, the NCP will discard the message and terminate that TCAP transaction with the CRP. The NCP will not send a Reject component back to the CRP.

The NCP will invoke Default routing logic to route the call.

6.4.3.8 Missing ICP_Label

If the required parameter (i.e., ICP_Label) in the ICP CCS7 TCAP End message, Return_Result (Last) component returned to the NCP from the CRP is missing, and/or unexpected parameters are included, the NCP will discard the message and terminate that TCAP transaction with the CRP. The NCP will not send a Return_Error component back to the CRP.

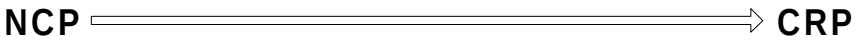
The NCP will invoke Default routing logic to route the call.

6.4.3.9 Timer Expires Condition

If the CRP Response Timer expires before the response from CRP is received by the NCP, the NCP will discard any further messages from the CRP for that TCAP transaction, without notifying the CRP.

The NCP will invoke Default routing logic to route the call.

The TCAP message exchange between the NCP and the CRP for this call scenario is illustrated in Figure 10.



- Message Type = Begin
- COMPONENT TYPE = Invoke
  OPERATION = Find_ICP_Route
  PARAMETERS (Mandatory)
  (Parameters must be sent in a parameter sequence in the order indicated.)
  1. Digits (Dialed No, Telephony, BCD)
  2. Digits (ANI, Telephony, BCD)

  PARAMETERS (Optional)
  3. Digits (CED, N/A, BCD)

The NCP activates the CRP Response Timer.

The CRP Timer expires and the NCP invokes Default logic to route the call.

Figure 10. NCP/CRP Interaction - TIMER EXPIRES

6.5 ICP's Specific Operation/Parameter/Error Encodings

This section specifies encodings pertaining to ICP ASE. These encodings are based on ITU-T Recommendation Q.773 structure. All codings must be in short form (i.e., no long or indefinite forms are supported).

6.5.1 Sequence Tag

The Sequence Tag is coded as specified in the ITU-T Recommendation Q.773 Table 23.

	H	G	F	E	D	C	B	A
Sequence Tag	0	0	1	1	0	0	0	0

6.5.2 ICP's Specific Operations

The Operation Code for the ICP CCS7 TCAP protocol follows an Operation Code Tag and Operation Code length. The Operation Code length is one octet.

The Operation Code tag for ICP Operation Codes corresponds to the Local Operation tag, specified in the ITU-T Recommendation Q.773 Table 22:

	H	G	F	E	D	C	B	A
ICP Operation Code tag	0	0	0	0	0	0	1	0

The following two Operation Codes are defined for ICP. Only one Operation, namely, the Find_ICP_Route, shall be used in the initial ICP release. The second Operation, namely, the Find_ICP_Caller_Class, is reserved for future use.

ICP Operations	H	G	F	E	D	C	B	A
Find_ICP_Route	0	0	0	0	0	0	0	1
Find_ICP_Caller_Class	0	0	0	0	0	0	1	0

6.5.3 ICP's Specific Parameters Tags

The following parameters shall be used in the ICP messages. The Customer ID parameter is not included in the CRP query in the initial ICP release. This parameter is reserved for future use.

ICP Parameter Tags	H	G	F	E	D	C	B	A
Customer ID	1	0	0	0	0	0	0	1
ICP Label	1	0	0	0	0	0	1	0
Input Error Cause	1	0	0	0	0	0	1	1
Digits	1	0	0	0	0	1	0	0

6.5.4 ICP's Specific Error Codes

The following Error Code values shall be used in the CRP Return Error component.

- Input Error: For invalid, unexpected or missing parameter errors.

The Input_Error code will require an Input_Error_Cause parameter that carries the error cause value.

ICP Error Code	H	G	F	E	D	C	B	A
Input Error	0	0	0	0	0	0	1	1

6.5.5 ICP's Specific Parameter Contents

6.5.5.1 Input_Error_Cause

The following Cause values are used for the Input_Error error code in the Return_Error component:

The Input_Error_Cause parameter is coded context specific primitive.

Input_Error_Cause = 10000011
Length = 00000001
Value

The allowed Values (Error Causes) are coded as follows:

Input_Error_Cause Value	
Unknown	00000000
Invalid Dialed Number	00000001
Unexpected Input Data Format	00000010
Missing Parameter	00000011
Unexpected Parameter	00000100

6.5.5.2 ICP Label

The ICP_Label is a variable length parameter, indicating a termination treatment. Each digit within this parameter is coded as Binary Coded Decimal (BCD). The parameter is coded as context specific primitive:

ICP_Label = 10000010	
Length = XXXXXXXX	
Type_of_Label	
No. of Digits	
2nd Digit	1st Digit
--	--
--	--
nth Digit or Filler	n-1st Digit

The Number of Digits in the ICP_Label range from 1 to 10.

The three types of ICP_Label currently defined for ICP service are Destination, Announcement and Post Feature. Additional Types could be defined in future. The Type field for these ICP Labels is coded as follows:

Type_of_Label	H	G	F	E	D	C	B	A
Destination	0	0	0	0	0	0	0	1
Announcement	0	0	0	0	0	0	1	0
Post Feature	0	0	0	0	0	0	1	1

6.5.5.3 Digits

The Digits parameter provides information on the number of digits that follow, Type (e.g., ANI), Nature (e.g., international), Numbering Plan (e.g., telephony), and Encoding method (e.g., BCD). The Digits parameter can be repeated in a message to carry multiple numbers, e.g., Dialed Number and ANI. The Digits parameter is encoded as context-specific (i.e., in the context of the Sequence parameter) primitive, with a tag value of 4:

	H	G	F	E	D	C	B	A
Digits	1	0	0	0	0	1	0	0
Length	X	X	X	X	X	X	X	X

The Digits length is variable. The contents are coded as follows:

Type_of_Digits	
Nature_of_Number	
Numbering_Plan	Encoding
Number_of_Digits	
2nd Digit	1st Digit
--	--
--	--
nth Digit	n-1st Digit

The 1st digit represents the most significant digit of a number and the nth digit represents the least significant digit of the number.

6.5.5.3.1 Type of Digits

a. **Dialed Number (Called):** the dialed 800 number for ICP.

b. **ANI (Calling Number):** the ANI information of the caller.

c. **CED:** Caller Entered Digits collected by the NCP.

d. **CDPD:** Customer Database Provided Digits returned by the CRP.

The Type_of_Digits field is coded as follows:

Type_of_Digits	H	G	F	E	D	C	B	A
Dialed_Number (Called)	0	0	0	0	0	0	0	1
ANI (Calling_Number)	0	0	0	0	0	0	1	0
CED	0	0	0	0	0	0	1	1
CDPD	0	0	0	1	0	0	0	0

Note 1: The CED and the CDPD can each contain up to 30 digits. The Nature of Number and the Numbering Plan fields for both the parameters shall be coded as “National” and "Not Applicable” respectively.

Note 2: The Numbering Plan field for the Called Number shall be Telephony. The Called Number will contain up to 11 digits.

Note 3: The ANI shall be represented by a Digits parameter with Type of Digits field equal to Calling Number. The Calling Number shall contain up to 15 digits. The Numbering Plan field shall be Telephony. If only the originating NPA or the originating country code (for international numbers) is known, the remaining digits shall be zeros. In some cases (e.g. calls originated in the Caribbean), the NPANXX may be provided with the remaining digits set to zeros.

6.5.5.3.2 Nature of Number

This provides additional information on the "Type of Digits". The Nature of Number field is coded as a bit map. Bit A indicates whether the number is National or International. Bit B indicates the Number Presentation Restricted/Not Restricted. For ICP, the only value supported of Bit B shall be "Number Presentation Not Restricted" (bit B=0).

Nature of Number	H	G	F	E	D	C	B	A
National	0	0	0	0	0	0	0	0
International	0	0	0	0	0	0	0	1

Note: The international numbers, of the format CC-NN, is expanded to have a maximum length of 15 digits. A Country Code (CC) is assigned to be either 1, 2 or 3 digits in length. The country code that is sent will always be 3 digits in length (prefixed with zeros as needed).

6.5.5.4 Encoding

This indicates the digits encoding scheme.

a. Binary_Coded_Decimal (BCD)

The Encoding field is coded as follows:

Encoding	D	C	B	A
BCD	0	0	0	1

6.5.5.4.1 Numbering Plan

This indicates the numbering plan associated with the digits. The Numbering_Plan field is coded as follows:

Numbering_Plan	H	G	F	E
Unknown or Not_Applicable	0	0	0	0
Telephony_Numbering_Plan	0	0	1	0

6.5.5.4.2 Number of Digits

This field indicates, in binary, the number of digits that follow. This field is one octet long, allowing 255 total digits.

6.5.5.4.3 Digit Representation

If the Encoding is set to BCD, the individual digits are coded in semi-octets as follows:

Digit	H/D	G/C	F/B	E/A
Digit 0 or filler	0	0	0	0
Digit 1	0	0	0	1
Digit 2	0	0	1	0
Digit 3	0	0	1	1
Digit 4	0	1	0	0
Digit 5	0	1	0	1
Digit 6	0	1	1	0
Digit 7	0	1	1	1
Digit 8	1	0	0	0
Digit 9	1	0	0	1
Undefined	1	0	1	0
*	1	0	1	1
#	1	1	0	0
Undefined	1	1	0	1
Undefined	1	1	1	0
Undefined	1	1	1	1

7. PERFORMANCE AND RELIABILITY

7.1 ICP Message Transfer Delay

This section provides estimates of the message transfer delay for the AT&T SS7 Signaling Network. The estimates are based on component delay objectives and are applied in section 7.1.3 to message flows for the ICP application.

The delay estimates are provided for the network when there are no failures. Delay will be greater when there are STP or signaling link failures.

These values are the same irrespective of using the Single CRP or Mated CRP architecture.

7.1.1 Component Delays

The message transfer delay is composed of several component delays which are defined below:

Signaling Link Queuing Delay, T_Q , is the period which starts when the last bit of the message enters the transmit buffer of the outgoing link and ends when the first bit of the message is placed onto the signaling link.

Emission Time, T_E , is the period which starts when the first bit of the message is placed onto the signaling link and ends when the last bit is placed onto the signaling link. It is a function of link speed and message length. The average message length is assumed to be 100 octets for database query/response messages.

Propagation Delay, T_P , is the period which starts when the first (last) bit of the message is placed onto the signaling link and ends when the first (last) bit is placed in the receive buffer of the receiving link node. For terrestrial links, it is a function of link length (1 ms /100 miles). T_{PA} and T_{PB} refer to propagation delays for A- and B-links respectively. The average length of B- and A-links, are 2300 and 400 miles respectively.

STP Processor Handling Delays, is the period which starts when the last bit of the message is placed in the receive buffer of the incoming link to the STP and ends when the last bit of the message is placed in the transmit buffer of the outgoing link.

- T_{SS} is the STP processor handling delay for messages requiring Global Title Translation (GTT) and Full Gateway Screening(FGS).

- T_{SG} is the STP processor handling delay for messages requiring GTT or FGS, but not both.

- T_{SM} is the STP processor handling delay for messages requiring MTP routing only (no FGS or GTT).

Network Control Point (NCP) Database Processor Handling Delays, T_{NM} , is the period which starts when the last bit of the message is placed in the receive buffer of the incoming link to the NCP and ends when the last bit of the message is placed in the transmit buffer of the outgoing link.

7.1.2 Assumptions and Calculations of the Delays

The following are assumptions behind the message flow and the calculations:

- Full gateway screening is performed on incoming queries and responses at the AT&T gateway (interconnecting) STP.

- Global title translation is performed on database queries.

- No global title translation is performed on the response messages.

The component delay objectives are presented in Tables 2 and 3.

Component	Mean Delay (ms)
T_Q Signaling Link Queuing Delay	4
T_E Emission Time(100 octets; 67 octets)	14; 9.6
T_{PA} A-link Propagation Delay	4
T_{PB} B-link Propagation Delay	23
T_{SS} 2STP Processor Handling Delay, GTT AND FGS	50
T_{SG} 2STP Processor Handling Delay GTT or FGS	40
T_{SM} 2STP Processor Handling Delay, no GTT	20
T_{NM} NCP Processor Handling Delay	250

Table 2. Signaling Network Component Delay Objectives (ms)

	Database (query/response)
Component	Mean Delay (ms)
T_{CSS} ,Cross 2STP Delay, with GTT AND FGS = $T_{SS} + T_Q + T_E$	68
T_{CSG} , Cross 2STP Delay, with GTT or FGS = $T_{SG} + T_Q + T_E$	58
T_{CSM} , Cross 2STP Delay, no GTT = $T_{SM} + T_Q + T_E$	38

Table 3. Cross STP Delay Definitions and Objectives (ms)

7.1.3 CRP Access Message Transfer Delay Estimate

The incremental message transfer delay is estimated as shown in Figure 11. The incremental delay includes that due to both the CRP query and the response and is estimated at 504 ms. This incremental delay does not include the CRP processing delay. (The expected CRP processing delay is specified in Section 5.3.1 item 5.)

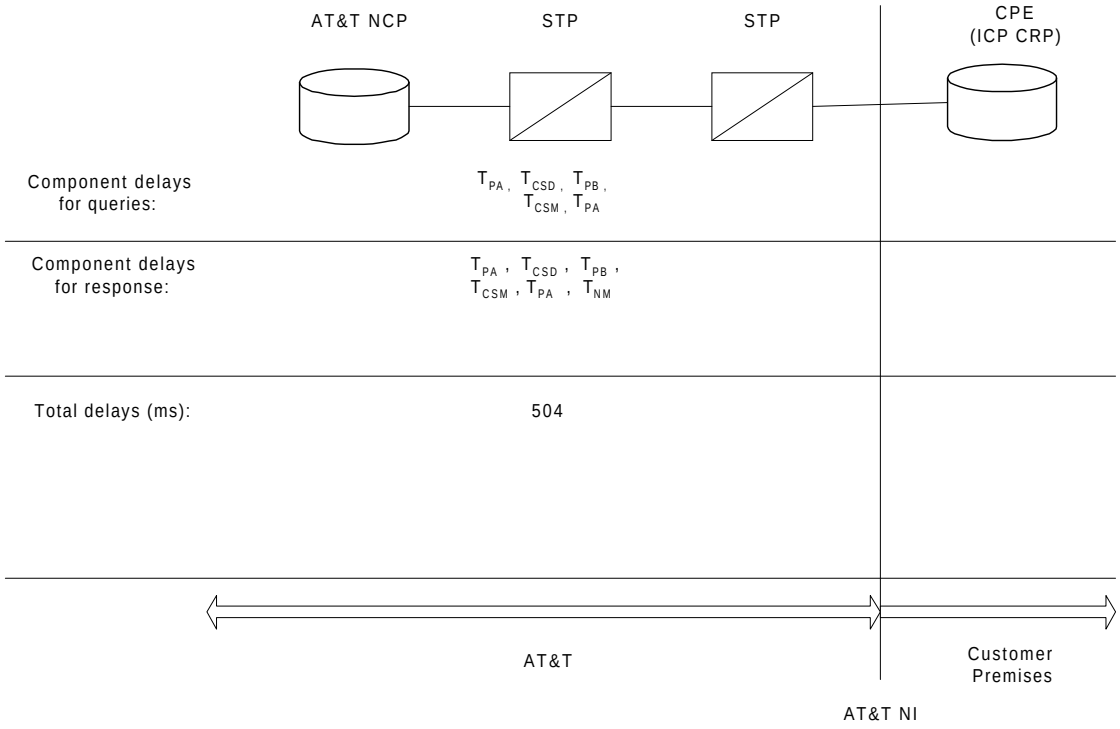


Figure 11. Incremental Delay Estimate for CRP Access

7.2 Access Performance

7.2.1 Availability

The AT&T SS7 signaling network availability objective is a maximum downtime of 10 minutes per year per pair of users/signal points. The downtime objective apportioned to the access links is 2 minutes per year. This access objective can be met by provisioning access links via a diverse pair of 56 kbps A-links. For instance, AT&T DDS or ACCUNET® T1.5 service could be used to interconnect CRP to the AT&T SS7 NI. The expected downtime for either type of access, without diversity, is 2.2 hours per year. The expected downtime, with diversity, is less than 2 minutes per year.

During the time when both A-links are down, the AT&T interconnecting STPs will declare them out-of-service, thereby, isolating the CRP from the AT&T network. If the isolated CRP has been preprovisioned with the Mated Pair Option, the AT&T signaling network will automatically reroute queries to the mated CRP. If both mated CRPs are isolated from the AT&T network at the same time, or if the Mated Pair Option was not preprovisioned, the ICP calls will continue to be routed using customer's Default routing plan built in the NCP. In that case, the added call distribution control provided by the CRP will be lost during that time. The interconnecting STPs will continue to monitor the failed A-links. When the A-links are restored, they will be declared "in-service" by the interconnecting STPs and routing of ICP traffic to the appropriate CRP will resume.

Customers should conduct their own risk analysis to decide whether they need the added reliability provided by access diversity.

7.3 AT&T SS7 Network Availability

The network availability objective is on the basis that for any pair of users/signal points (SPs) the expected downtime between them should not exceed 10 minutes per year; this objective is consistent with ANSI SS7 Protocol Specifications. The AT&T SS7 signaling network has an expected downtime of 4 minutes per year with 2 minutes allocated to the access portion at each end and 0 minutes allocated to the backbone network. This objective assumes that all SPs are dual homed to a pair of STPs via a pair of diverse A-links. The additional 6 minutes, making up the 10 minute downtime, is allocated to the originating and terminating SPs, 3 minutes each.

7.4 Lost Message Probability

Information contained in the Message Transfer Part (MTP) of the SS7 protocol is used to route signaling messages in the correct order onto assigned outgoing links of an STP. To achieve reliable transfer with internetwork signaling arrangements, it is an objective that on average, no more than one in 10^7 signaling messages be lost because of MTP failure (error or mishandling).

7.5 Undetected Error Probability

The Message Transfer Part of the SS7 protocol is designed to protect signaling messages against errors. To achieve adequate performance, it is an objective that on the average, no more than one signaling message out of 10^9 transferred across the Network Interface (NI) contains an error not detected by the CRP (at the MTP level).

7.6 Messages-out-of Sequence Probability

The objective for messages delivered out of sequence, or duplicated messages, is that, on average, no more than one in 10^{10} occur.

7.7 Signaling Link Bit Error Rate

The signaling links should have a long-term Bit Error Rate of 10^{-6} or less.

8. Related Documents and Ordering Information

This document, in addition to ANSI SS7 specifications and ITU-T recommendations referred to herein, provides the necessary compatibility information to interconnect with the AT&T Signaling Network.

The applicable Standards documents are:

1. ANSI T1.111 - 1996, Message Transfer Part.
2. ANSI T1.112 - 1996, Signaling Connection Control Part.
3. ITU-T Recommendations Q.771 - Q.775, Transaction Capabilities Application Part (Fascicle VI.9 - section 1, 1993 White book).
4. AT&T Technical Reference 54075
5. AT&T Technical Reference 62310
6. AT&T Technical Reference 62411
7. AT&T Technical Reference 54016
8. AT&T Technical Advisory TA-NPL-436, Issue 1, November, 1986
9. AT&T Pub 60110
10. ANSI T1.101 - 1994
11. ITU-T Recommendation G.822

Ordering information for the procurement of the ANSI SS7 specifications is as follows:

American National Standards Institute, Inc.
11 West 42nd Street
New York, N. Y. 10036
Telephone: (212) 398-0023
Fax: (212) 302-1286

Ordering information for the procurement of the ITU-T specifications is as follows:

International Telecommunication Union
Place des Nations
CH-1211 Geneva 20, Switzerland
Telephone: 011+41 22 730 5111
Fax: 011+41 22 733 7256

Ordering information for the procurement of AT&T documents is as follows:

Call: AT&T Customer Information Center
USA: (800) 432-6600
EUROPE: 010-1-317-322-6416
FAR EAST: 010-1-317-322-6389
AMERICAS/MID EAST/AFRICA: 010-1-317-322-6646

Write: AT&T Customer Information Center

2855 North Franklin Road
P.O. Box 19901
Indianapolis, IN 46219

GLOSSARY

ANI	Automatic Number Identifier
ANSI	American National Standard Institute
ARU	Automatic Response Units
ASE	Application Service Element
BCD	Binary Coded Decimal
CDPD	Customer Database Provided Digits
CED	Caller Entered Digits
CRP	Customer Routing Point
DDS	Dataphone® Digital Service
DPC	Destination Point Codes
DTMF	Dual Tone Multifrequency
GTT	Global Title Translation
ICP	Intelligent Call Processing
ISR	ICP Subscriber Record
ISUP	Integrated Services Digital Network - User Part
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
MTP	Message Transfer Part
NCP	Network Control Point
NI	Network Interface
NID	Network Identifier
NPA	Numbering Plan Area
OPC	Originating Point Code
PC	Point Code
PDD	Post Dialed Delay
SCCP	Signaling Connection Control Part
SS7	Signaling System 7
SSA	Subsystem Allowed
SSN	Subsystem Number
SSP	Subsystem Prohibited
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part
UDTS	Unitdata Service