Signaling System 7 (SS7) Installation and Configuration Manual

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Revision History

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Table of Contents

Chapter 1

Introduction

1.1 Introduction

The *Signaling System 7 (SS7) Installation and Configuration Manual* describes the installation, configuration, and operation of the SS7 Message Transfer Part (MTP) and optional ISDN User Part (ISUP), Telephone User Part (TUP), Signaling Connection Control Part (SCCP), and Transaction Capabilities Application Part (TCAP) software for the TX Communication Processors under Windows NT/Windows 2000 and versions of UNIX.

1.2 Overview

The SS7 distribution software contains the TX Base/Device Driver and the SS7 software packages. This software contains a variety of components which facilitate the development of sophisticated SS7-based systems and applications.

The following components are installed with the TX Base/Device Driver:

- The TX device driver for the selected host operating system.
- The *`tdmcfg`* utility for configuring the characteristics of T1/E1 channels and assigning T1/E1 and/or MVIP/H.100/H.110 bus channels to SS7 ports.
- The *`cplot`* utility for downloading executable code and configuration data onto the board.
- The TX cpk/os operating system and related executables which are downloaded to the TX board at boot time.
- The *`txalarm`* utility which collects alarms from the TX board(s), displays them on a console screen, and optionally copies them to a disk file. This utility is also distributed in source form as a guide for developers integrating the TX board alarms into their own alarm monitoring systems.

Each of the SS7 software packages contains some or all of the following components.

- The SS7 protocol layer (MTP, SCCP, TCAP, ISUP, and/or TUP) executables which are downloaded to the TX board at boot time.
- Application program interfaces (APIs) - header files and libraries - for developing SS7-based applications. Separate APIs are typically provided for signaling applications (call processing applications and transaction processing applications) and management applications (configuration, control, monitoring, and statistics).
- Sample applications illustrating use of the APIs.
- A configuration utility for downloading configuration information from a text file on the host disk to the protocol layer task running on the TX board. Configuration utilities are also provided in source form as an example of management API usage for configuration.
- Sample configuration files for ANSI and/or ITU-T configurations.
- A management utility for controlling, monitoring, and collecting statistics on the that SS7 protocol layer. Like the configuration utilities, the management utilities are also provided in source form to illustrate use of the management APIs.

1.3 Usage

Use of the SS7 software requires the following steps:

1. Install the SS7 software.
2. If you use T1/E1 or MVIP/H.100/H.110 bus channels as the physical SS7 links, configure which streams/timeslots will carry the SS7 links.
3. Set up your SS7 MTP layer 3 configuration and, optionally, SCCP, TCAP, ISUP, and/or TUP configurations.
4. Download the TX board with the appropriate software and configurations.

Chapter 2

SS7 Software Installation

2.1 Before Starting Installation

Before you begin the software installation process you must have the following information available for *each* TX ISA communications processor in your system:

- The IRQ number assigned to the board with the on-board IRQ Select jumper
- The memory address assigned to the board via the on-board Memory Address Select DIP switches

2.2 General Installation Steps

The following installation steps are required, regardless of the target operating system:

1. Install the TX Base/Device Driver package.
2. Install the SS7 MTP package.
3. Install any optional SS7 software components (SCCP layer, TCAP layer, ISUP layer, and/or TUP layer).
4. Reboot the system to start the device driver.

2.2.1 Installing the Base/Device Driver Package

The Base/Device Driver package must be installed before any of the SS7 software packages. The exact procedure for installing and configuring the TX device driver varies for each supported operating system. See the software installation instructions for information on the installation of the Base/Device driver package for your operating system.

2.2.2 Installing the SS7 MTP and Optional Software Packages

The MTP layer should be the first SS7 package installed after the Base/Device Driver package has been installed. Again, the exact procedure for installing and configuring SS7 software packages varies for each supported operating system.

Once the MTP layer is installed, any of the other optional SS7 software packages may be installed at any time and in any order. It is not necessary to reboot your system after installing any of the SS7 software packages. The system only needs to be rebooted after installing the Base/Device Driver package or after modifying the device driver configuration.

Once started, the installation procedure for all the SS7 packages is self-explanatory. No SS7 configuration information is required at installation time. The installation process simply copies the necessary files for each package - board executables, API libraries, configuration and management utilities, sample configuration files, and sample applications - to the appropriate location on the target system.

WARNING:	If you are installing a new release over an existing installation and you have modified any of the sample configuration files or sample applications for any of the SS7 layers, please make sure they have been renamed, moved to another directory, or otherwise adequately backed up before starting the new installation. These files may be overwritten without warning by the new release installation.

Chapter 3

Getting Started

3.1 Introduction

The sample configuration files shipped with each of the SS7 software packages are set up to illustrate a simple SS7 configuration between two TX boards in a single PC chassis, connected by a single SS7 link, as illustrated in Figure 1:

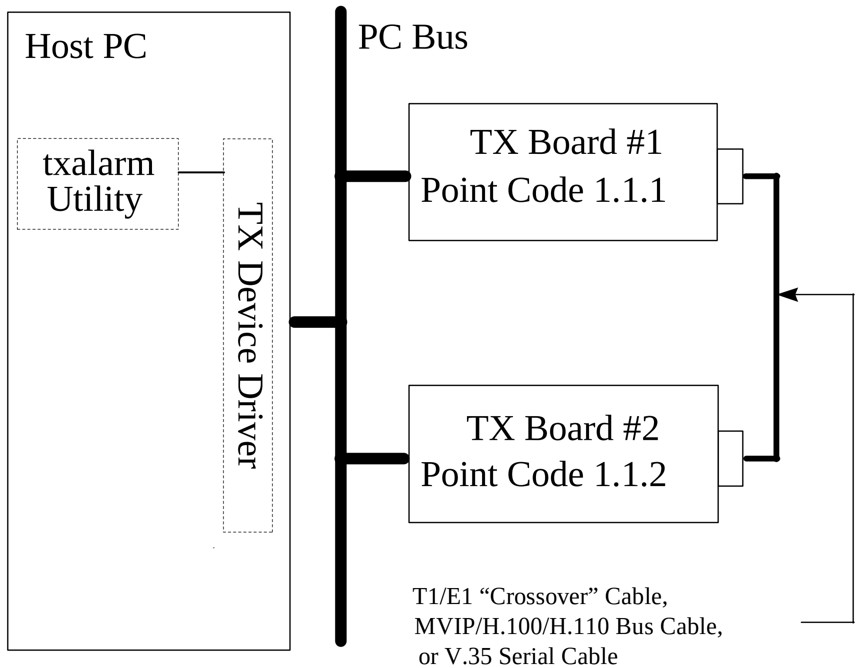

Figure 1. Sample SS7 Test Setup

Note: You cannot run the SS7 link test described in this section by looping back two ports on a single TX board. A minimum of two TX boards, or one board and a separate piece of SS7 test equipment capable of emulating an SS7 node up through MTP layer 3, are required.

Depending on the physical hardware configuration of your TX boards, the physical SS7 link interface between the boards may be one of the following interface types:

- A single timeslot on one of the T1/E1 ports (requires TX Dual-T1 or Dual-E1 daughterboard or rear I/O transition board)
- A single timeslot on the MVIP/H.100/H.110 bus
- A V.35 serial link (requires TX V.35 serial daughterboard or rear I/O transition board)

The sample configuration files shipped on the installation media assume a single SS7 link running in timeslot zero on T1 port A. If you use E1 rather than T1, or the MVIP/H.100/H.110 bus or V.35 serial links, you will have to make changes to the sample configuration files.

Once the appropriate physical connections are completed, the following steps are used to bring the link into service:

1. Make any necessary changes to the TDM and MTP3 configuration files.
2. Start the `txalarm` utility on your host PC to monitor the status of the links.
3. Download both boards using the `ss7load` download script.
4. Check the `txalarm` output to see that the link comes into service on both boards.
5. Troubleshoot any problems indicated in the `txalarm` output.

These steps are described in the following sections.

3.2 Modifying the Sample Configuration Files

If your hardware configuration does not match the configuration assumed by the sample configuration files, you'll have to modify the samples to get the SS7 link up and running.

All sample configuration files are found in the `\nms\tx\config\` directory for Windows NT/Windows 2000 and in the `/opt/nmstx/etc` directory on UNIX systems.

3.2.1 The TDM Configuration File

The sample TDM configuration files under Windows NT/Windows 2000 are named `tdmcp1.txt` and `tdmcp2.txt` (or `tdmcp1.cfg` and `tmdcp2.cfg` under UNIX). The sample TDM configuration file for board one is shown here:

```
CLOCK            NETA
SEC8K            NONE
# T1    Framing   Encoding   Buildout   Robbed Bit   Loop Master
# --    -------   --------   --------   ----------   -----------
  T1A     ESF       B8ZS         0        FALSE         FALSE
  T1B     ESF       B8ZS         0        FALSE         FALSE
#
#    Port          Stream          Channel      Count   Direction
# -----------   -----------    -------------    -----   ---------
    Port1           T1A            Channel0     Count1   Standard
```

The sample TDM configuration file presents a simple example of the most common type of TX board use. When a single TX board is present in a chassis, the `tdmcp1.txt` file can be used to configure a board with a Dual T1 daughterboard or rear I/O transition board. This configuration specifies `CLOCK NETA`, indicating the clock recovered from `T1A` should be presented onto the MVIP/H.100/H.110 bus. When two TX boards are present in a chassis, `tdmcp2.txt` can be used to configure board two. Board two is configured with the T1s set as Loop Master. This causes board two to use its internal oscillator as the clock source for both T1s. This board is also configured with `CLOCK BUS`, indicating the TDM clock should be taken from the MVIP/H.100/H.110 bus. These configuration files will require various changes to be made when the boards are being loaded for purposes other than initial testing.

The following list provides some common TDM configuration changes required for different hardware configurations. For more details on the content of the TDM configuration file, and how to compile it for use by the TX board kernel, see Chapter 4.

- If you use the V.35 serial interface rather than TDM ports, you do not need to modify the TDM configuration, as it won't be used. You do, however, need to change the SS7 link definition in the MTP 3 configuration file. See Section 3.2.2, *The MTP 3 Configuration File* for more information.

- The sample TDM configuration assumes T1 ports. If you are using the E1 interface instead, you must change the T1 parameters line to reflect proper E1 parameters and you must change the channel timeslot number assigned as `Port1` to a timeslot other than zero (timeslot zero is used solely for framing on E1 ports and cannot be used to transport data such as SS7).

- The sample configuration files contain commented out sections that define other types of TDM connections. Examples of connections over E1, MVIP, and H.100/H.110 are included.

- Clocking control may also need to be modified base on the specific environment. The example for CP #1 assumes to be receiving clock from T1A. This implies that T1A is connected to another T1 device that is acting as Loop Master. The example for CP #2 causes that CP to act as the Loop Master for both T1 interfaces. If this is not the desired clocking configuration then the `CLOCK` and/or `Loop Master` fields should be modified.

Once the TDM configuration file has been modified, it must be compiled into a binary image with the *`tdmcfg`* utility before downloading the board. See Section 4.3, *Configuration Binary File Generation* for details.

3.2.2 The MTP 3 Configuration File

The sample MTP 3 configuration files are named *mtp3cp1.cfg* (for board one) and *mtp3cp2.cfg* (for board two). The MTP 3 configuration file is a longer file, containing definitions of many of the attributes of the SS7 MTP layers: general attributes, link definitions, link set definitions, and route definitions. The MTP 3 configuration is described in detail in Section 5.2, *The MTP Configuration*.

The link one definition from the sample MTP3 configuration for board one is shown below:

```
#Link Parameters
#---------------
LINK              T1     # T<n> for T1/E1/MVIP, S<n> for serial (V.35)
LINK_SET          1
ADJACENT_DPC      1.1.2  # Board 2
LINK_SLC          0
MAX_CREDIT        127
MESSAGE_SIZE      272
#
# Level 2 parameters
#
LSSU_LEN          2
END
```

For this test, the only change that should be necessary to the MTP 3 configuration is if you use V.35 serial links rather TDM links. In this case you must change the link one definition from port `T1` to port `S1`. Also you must specify one side of the link (board one) as the DCE and the other side of the link (board two) as the DTE. Make sure that the link configured as the DCE also has its V.35 POD port strapped for DCE operation. Likewise, the link configured as the DTE must have its V.35 pod port strapped for DTE operation. See the appropriate hardware manual for details on configuring the V.35 pod.

3.3 Starting the txalarm Utility

The *`txalarm`* utility captures alarm messages from the boards, displays them on the screen, and optionally saves them to a disk file. It is the primary tool for monitoring what is happening on the link as you download the board and try to bring the link up.

The *`txalarm`* utility is best run from a separate window (“DOS window” in Windows NT/Windows 2000, or a “command window” when using a UNIX desktop-style user interface. It is run with the command:

`txalarm [-f` ***filename***`]`

where the *`-f`* option, if present, specifies the file to which alarms are copied (in addition to displaying them).

The output from *`txalarm`* looks similar to this:

<01/07/1998 16:17:04>	mtp	1	18180	MTP3 Link 1 Down
Timestamp	Task	Board Number	Alarm Number	Alarm Text

3.4 Downloading the Boards With ss7load

Once the configuration files are set and the *txalarm* utility is running, the TX boards can be downloaded with the software and configuration. The *ss7load* download script file is included to perform this action.

The *ss7load* script contains all the commands required to download the necessary software and configuration files to the TX boards. This script is resides in the following locations:

Operating System	Directory Location
Windows NT and Windows 2000	*\nms\tx\bin\ss7load.bat*
UNIX	*//opt/nmstx/bin/ss7load*

At installation time, the *ss7load* script contains commands to download and configure all the SS7 layers. Only the MTP layer is activated, however; the others are "commented out". To enable any optional SS7 layers you have installed you must edit *ss7load* and remove the comment symbols from the desired layers.

Note: Superuser permissions are required to edit the *ss7load* file on UNIX systems.

ss7load expects a single parameter on the command line: the board number. For the two-board test described here, the sequence would look something like this (user input is shown in **bold** type):

```
prompt> ss7load 1
CPMODEL V1.0: Copyright 1998, NMS Communicationss
Board #1 is a TX2000
Loading:  E.0 TX2000 Kernel (c)1996-1997 NMS Communicationss, Inc. 2/10/97
Loading: diag2000    Version C.1.0 12/10/97
Loading:
Loading: inf         Version C.4.0 12/10/97
Loading: mvip        Version A.1.0 12/10/97
Loading: t1e1mgr     Version A.1.0 12/10/97
Loading: mtp         Version B.3.0 01/14/98
mtp2cfg: sample MTP2 configuration application version B.1.0 Jan 14 1998
mtp3cfg: sample MTP3 configuration application version B.3.0 Jan 14 1998
prompt> ss7load 2
```

The following is output from `txalarm` when `ss7load` is executed for board one. An equivalent set of alarms is received from board two when it is downloaded.

```
<12/05/1997 15:51:58> mtp 1   1 Registering MTP Layer 2
<12/05/1997 15:51:58> mtp 1   1 Registering MTP Layer 3
<12/05/1997 15:51:58> mtp 1   1 Configuring MTP Layer 1
<12/05/1997 15:51:58> mtp 1   1 MTP1 Initializing.
<12/05/1997 15:51:58> mtp 1   1 MTP1 General Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP1 Configuring link 0: TDM, External
<12/05/1997 15:51:58> mtp 1   1 MTP1 Configuring link 1: TDM, External
<12/05/1997 15:51:58> mtp 1   1 MTP1 Configuring link 2: TDM, External
<12/05/1997 15:51:58> mtp 1   1 MTP1 Configuring link 3: TDM, External
<12/05/1997 15:51:58> mtp 1   1 MTP1 Configuration Done
<12/05/1997 15:51:58> mtp 1   1 Configuring MTP Layer 2
<12/05/1997 15:51:58> mtp 1   1 MTP2: General Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP2: Link 0 Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP2: Link 1 Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP2: Link 2 Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP2: Link 3 Configuration
<12/05/1997 15:51:58> mtp 1   1 MTP3: Ready…
```

3.5 Monitoring Link Status Through txalarm

Once the boards have been downloaded, they will repeatedly attempt to *align* the links (bring up through layer 2). Once link alignment has been achieved by MTP layer 2, MTP layer 3 will attempt to bring the links into service through an exchange of *signaling link test messages (SLTMs)* with its peer MTP 3 on the other board. Once this signaling link test is successfully completed, an alarm is generated from each board indicating that the link is up (in service). A typical alarm sequence for successful link startup looks like this:

```
<01/09/1998 09:54:21> mtp  1  1 Flushing Buffers (OPC=0)
<01/09/1998 09:54:21> mtp  1  1 Starting Alignment
<01/09/1998 09:54:21> mtp  1  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  1  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  1  1 Rx SIE (9)
<01/09/1998 09:54:22> mtp  1  1 ALIGN TIMER 4 EXPIRED (Link Aligned)
<01/09/1998 09:54:22> mtp  1  1 Setting link 0 ACTIVE in SigLinkAvail
<01/09/1998 09:54:22> mtp  1  1 DPC 0.1.2 is now ACCESSABLE (LinkSet 1)
<01/09/1998 09:54:22> mtp  1  1 Setting link 0 ACTIVE in TrafLinkAvail
<01/09/1998 09:54:22> mtp  1  1 Setting link 0 ACTIVE from SLTA
<01/09/1998 09:54:22> mtp  1  1 8179 MTP3 Link 0 Up
<01/09/1998 09:54:21> mtp  2  1 Flushing Buffers (OPC=0)
<01/09/1998 09:54:21> mtp  2  1 Starting Alignment
<01/09/1998 09:54:21> mtp  2  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  2  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  2  1 Rx SIE (9)
<01/09/1998 09:54:22> mtp  2  1 ALIGN TIMER 4 EXPIRED (Link Aligned)
<01/09/1998 09:54:22> mtp  2  1 Setting link 0 ACTIVE in SigLinkAvail
<01/09/1998 09:54:22> mtp  2  1 DPC 0.1.2 is now ACCESSABLE (LinkSet 1)
<01/09/1998 09:54:22> mtp  2  1 Setting link 0 ACTIVE in TrafLinkAvail
<01/09/1998 09:54:22> mtp  2  1 Setting link 0 ACTIVE from SLTA
<01/09/1998 09:54:22> mtp  2  1 8179 MTP3 Link 0 Up
```

3.6 Troubleshooting Link Problems Through txalarm

If the link does not come into service shortly after being downloaded, the cause of the problem may frequently be determined from the *`txalarm`* output. The primary cause of link initialization failures are physical connection problems. Physical connection problems are usually indicated by a repeated sequence of alarms indicating that `Align Timer 2 Expired` and `Alignment not possible` as shown in the following example:

```
<01/09/1998 09:49:58> mtp  2  1 Starting Alignment
<01/09/1998 09:49:58> mtp  2  1 Layer 1: AERM Threshold Reached
<01/09/1998 09:49:58> mtp  2  1 Alignment Aborting
<01/09/1998 09:50:10> mtp  2  1 ALIGN TIMER 2 EXPIRED, QLen=0 iacSt=8
<01/09/1998 09:50:10> mtp  2  1 LinkFailure : Alignment Not Possible
<01/09/1998 09:50:10> mtp  2  1 Flushing Buffers (OPC=0)
<01/09/1998 09:50:11> mtp  2  1 8180 MTP3 Link 0 Down
```

There are many possible causes of physical link connection problems. The following list illustrates a few of the possible causes.

- Missing or loose cable connections between the T1/E1 ports.
- Missing bus cable when one board is deriving clocking from the MVIP/H.100/H.110 bus.
- Incorrect clocking configuration between the two boards (both boards driving MVIP/H.100/H.110 bus clocks, neither driving MVIP/H.100/H.110 bus clocks, clocking not synchronized to T1/E1 port).
- Mismatched channel timeslot assignments between the two boards.
- Missing or loose cable connections between the boards and V.35 pods or between the two V.35 pods.
- Incorrect V.35 DCE/DTE configuration: both boards configured as DTE (the default), DCE side of link plugged into V.35 pod strapped for DTE operation or vice versa.

The link may also align successfully at layer 2 but fail the signaling link test at layer 3. This results in an alarm indicating that `Align Timer 4 Expired (Link Aligned)` followed by an MTP alarm indicating that the link is down, as shown in the following example:

```
<01/09/1998 09:54:21> mtp  1  1 Starting Alignment
<01/09/1998 09:54:21> mtp  1  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  1  1 IAC Rx SIO
<01/09/1998 09:54:21> mtp  1  1 Rx SIE (9)
<01/09/1998 09:54:22> mtp  1  1 ALIGN TIMER 4 EXPIRED (Link Aligned)
<01/09/1998 09:54:22> mtp  1  1 8180 MTP3 Link 0 Down
```

This failure is almost always caused by one of two configuration errors.

- The point codes assigned to each of the boards in the MTP 3 configuration file do not properly refer to each other.
- The link select code assigned to the link in the MTP 3 configuration file (LINK_SLC) of one board does not exactly match the link select code assigned to the same link in the MTP 3 configuration file of the second board.

Chapter 4

Configuring TDM Bus Physical Interfaces

4.1 Overview

If you use T1/E1 or MVIP/H.100/H.110 bus channels (also known as TDM channels) as the physical SS7 links, you must configure which streams/timeslots will carry the SS7 links. This requires the following steps:

1. Create a text file describing your T1/E1 and/or MVIP/H.100/H.110 bus configuration (a sample configuration file is provided with the distribution software).
2. Run the `tdmcfg` utility to create a binary TDM configuration file suitable for downloading to the TX board.
3. Add a command to the download script to download the TDM configuration to the TX board (see Chapter 5).

These steps are described in the following subsections. Each TX board in a system requires its own separate TDM configuration file.

4.2 TDM Configuration Creation

Dedicated data channels from the T1/E1/MVIP/H.100/H.110 interfaces are pre-configured by creating an off-line database and downloading it to the CPK kernel at download time. Off-line database creation consists of creating the configuration text file, generating the configuration binary file, and loading the configuration (binary) file.

Note: Each TX communications processor in a system must have its own separate dedicated data channel configuration database.

A text file (hereafter referred to as the *tdmcfg.txt* file) is prepared, which contains a description of each dedicated data channel: the "port" that it is assigned to, the T1/E1 or MVIP/H.100/H.110 stream that it occupies, the first timeslot on that stream that it occupies, the number of timeslots used, and the direction (described below). The *tdmcfg.txt* file also configures the clocking associated with the MVIP/H.100/H.110 bus interface as well as the configuration of the T1/E1 interfaces. The following shows a sample *tdmcfg.txt* file.

```
#         T1 Example
#         Timing Configurations:
#
CLOCK     NETA
SEC8K     NONE
#
# TX Port    MVIP Stream   Start Channel   Count    Direction
# -------    -----------   -------------   -----    ---------
   Port1       Stream0        Channel0     Count1    Standard
   Port2       Stream1        Channel0     Count56   Standard
   Port3       Stream2        Channel0     Count1    Standard

   Port4         T1A          Channel0     Count1    Standard
#
# T1   Framing    Encoding   Buildout   Robbed Bit   Loop Master
# --   -------    --------   --------   ----------   -----------
  T1A     D4         B7ZS        0         TRUE          FALSE
  T1B     ESF        B8ZS        0         FALSE         FALSE


#         E1 Example
#         Timing Configurations:
#
CLOCK     NETA
SEC8K     NONE
#
# TX Port    MVIP Stream   Start Channel   Count    Direction
# -------    -----------   -------------   -----    ---------
   Port1       Stream0        Channel0     Count1    Standard
   Port2       Stream1        Channel0     Count56   Standard
   Port3       Stream2        Channel0     Count1    Standard

   Port4         E1B          Channel1     Count1    Standard
#
# E1   Framing    Encoding   Buildout   Robbed Bit   Loop Master
# --   -------    --------   --------   ----------   -----------
  E1A    CAS        HDB3         4         TRUE          FALSE
  E1B    CAS        HDB3         4         FALSE         FALSE
```

4.2.1 T1/E1 Configuration Options

The T1/E1 configuration line consists of an identifier indicating which circuit (A or B) is being configured followed by parameters specifying the Framing, Line Encoding, Line Buildout, Robbed Bit signaling, and Loop Master configuration for this circuit.

Framing Options - Determines the framing format to be used for this T1/E1 circuit.

None	Do not configure this T1/E1 circuit.
`D4`	[T1] D4 (193S) Framing.
`ESF`	[T1] Extended Superframe Format.
`CCS`	[E1] Frame alignment only (no multiframe alignment).
`CAS`	[E1] Standard frame alignment with *Channel Associated Signaling* (timeslot 16) multiframe alignment (no CRC4).
`CCSCRC4`	[E1] Standard frame alignment with CRC4 multiframe alignment (no CAS).
`CASCRC4`	[E1] Standard frame alignment with both *Channel Associated Signaling* (timeslot 16) and CRC4 multiframe alignment.

Encoding Options - Determines line encoding and zero suppression mechanism to be used for this circuit.

`NOZCS`	[T1 or E1] AMI encoding with no zero code suppression.
`B7ZS`	[T1] Bit Seven Zero Stuffing.
`B8ZS`	[T1] Bipolar Eight Zero Substitution.
`HDB3`	[E1] High Density Bipolar (order 3) encoding.

Buildout Options - Determines line buildout to be used for this T1/E1 circuit.

T1	E1
`0`: 0-133 Feet	
`1`: 133-266 Feet	
	`4`: 120 Ohm Normal With Protection Resistors [This value is the default for E1]
`2`: 266-399 Feet	
`3`: 399-533 Feet	
`4`: 533-655 Feet	

Robbed Bit Flag - Set to `TRUE` or `FALSE`, indicates whether Robbed Bit Signaling is used by the TX board on this T1/E1 circuit.

Loop Master Flag - Set to `TRUE` or `FALSE`, indicates whether this T1/E1 interface is the timing source for this circuit.

4.2.2 MVIP/H.100/H.110 Bus Timing Options

A TX communications processor may either provide an MVIP, H.100, or H.110 TDM bus interface. This interface is general referred to as MVIP in the following example. The bus timing entry describes the clocking configuration for the MVIP bus clock signals (/C4, /F0, C2) and Secondary 8K clock signals. The clocking configuration statement syntax is:

`CLOCK` ***clockmode***

`SEC8K` ***sec8kmode***

where ***clockmode*** is one of the following values:

Value	Description
`BUS`	MVIP adapter gets its timing signals **from** the MVIP bus (Default).
`MASTER`	MVIP adapter **drives** the MVIP bus clock signals from its internal clock.
`SEC8K`	The MVIP adapter drives the MVIP bus clock signals referenced from the MVIP Secondary 8K signal.
`NETA`	The MVIP adapter drives the MVIP bus clock signals and derives this timing from T1 interface A.
`NETB`	The MVIP adapter drives the MVIP bus clock signals and derives this timing from T1 interface B.

and ***sec8kmode*** is one of the following values:

Value	Description
`MASTER`	The MVIP adapter **drives** the SEC8K clock signals from its internal clock.
`NETA`	The MVIP adapter drives the SEC8K clock signals and derives this timing from T1 interface A.
`NETB`	The MVIP adapter drives the SEC8K clock signals and derives this timing from T1 interface B.
`NONE`	The SEC8K clock is not driven by the MVIP adapter (Default).

4.2.3 TDM Port Configuration

The channel definition entry describes the characteristics of each dedicated data channel. Channels are always defined as *full-duplex* connections. For the MVIP bus, stream ***n*** is always paired with stream ***n***+8. For the H.100/H.110 bus, stream ***n*** is always paired with stream ***n***+1.

By default, an MVIP stream numbering scheme is assumed. For H.100 and H.110 systems, add the following entry in the TDM configuration file to specify that the stream numbering is based on an H.100/H.110 numbering scheme:

```
BUS H100
```

The following table describes each field in the TDM configuration file:

Field	Description
`Port`***n***	Identifies the port assigned to this data channel, where ***n*** is an integer in the range 1 ≤ ***n*** ≤ ***maxPorts*** and ***maxPorts*** depends on the hardware configuration. This port number is used when configuring other TX communication software products to utilize this data channel.
`Stream`***n***	Identifies the MVIP stream that this channel occupies. • MVIP Stream numbers are 0-7 • H.100/H.110 Stream numbers are 0-30 (even numbers only) • T1/E1 Streams are identified by name (T1A, E1A, T1B, E1B) • T1/E1 B Stream number is 18
`Channel`***n***	Refers to the starting channel number. • MVIP uses channel numbers 0-31 • H.100/H.110 uses channel numbers 0-127 • T1 uses channel numbers 0-23 • E1 uses channel numbers 1-31 (0 is used for framing)
`Count`***n***	Identifies the number of timeslots that make up this channel. Valid range is 1-32. *Note:* A special case exists for a 56 Kb or a 48 Kb subrate on a single DSo. If count is set to 56 or 48, the indicated subrate is allocated.
`Direction`	Identifies the direction of bus signals for MVIP/H.100/H.110 channels.

Possible values are:

```
STANDARD:       MVIP                                H.100
                Stream 0    DSo0 = input            Stream 0
                            DSi0 = output            (Stream 1)
                Stream 1    DSo1 = input            Stream 2
                            DSi1 = output            (Stream 3)

REVERSE:        MVIP                                H.100
                Stream 0    DSo0 = output           Stream 0
                            DSi0 = input             (Stream 1)
                Stream 1    DSo0 = output           Stream 2
                            DSi1 = input             (Stream 3)
```

Note: `Reverse` is only applicable to MVIP/H.100/H.110 channels; T1/E1 channels should always be specified as `Standard`.

4.3 Configuration Binary File Generation

The configuration binary file is generated by running the configuration utility on the text file. This is done with the command:

`tdmcfg -i` ***filename***

The TDM Configuration utility will generate 2 files:

filename`.bin`	Binary configuration file
filename`.dbg`	Text representation of the above binary file

4.4 Configuration Download

The configuration is downloaded using the standard *`cplot`* utility with the `-g` option.

`cplot -g TDM -f` ***tdmcfg binary file name*** [`-c` ***board number***]

This must be downloaded before any tasks which might attempt to use the specified data channels.

Note: The TX board must have been previously loaded or reset (PCI boards) before performing this action.

Chapter 5

SS7 MTP Configuration

5.1 Introduction to the MTP Layer

The SS7 MTP layer 3 has two primary functions.

- Message routing and distribution
- Signaling network management

Message routing and distribution includes both the routing of outgoing messages to their specified destinations and the distribution of incoming messages to the appropriate user part or application. The SS7 MTP implementation uses a flexible configuration capability to support a wide variety of network routing and addressing requirements.

Signaling network management's job is to reconfigure the signaling network as needed to maintain signaling capability in the case of failures or congestion. This includes redirecting traffic away from failed links and/or signaling points (SPs), restoring traffic to restored links/SPs, and exchanging route status with adjacent SPs. The MTP 3 layer supports all required ANSI and ITU-T network management procedures without intervention from the user parts/applications.

The primary objects represented by MTP layer 3 are *signaling links, routes, linksets,* and *Network Service Access Points (NSAPs).*

Links define physical signaling links between the TX board and the adjacent signaling points. One link configuration must be performed for each physical signaling link. The attributes of a link include the point code of the adjacent signaling point, protocol variant employed on the link (ITU-T or ANSI), point code length, maximum packet length, various timer values, membership in a linkset, and others.

Linksets are groups of from one to 16 links that directly connect two signaling points. Although a linkset usually contains all parallel signaling links between 2 SPs, it is possible to define parallel link sets. Each signaling link defined is assigned membership in exactly one link set.

Routes specify the destination signaling points (or sub-networks (clusters) when route masks are employed) that are accessible from the target node. Each route is assigned a *direction* - up or down. One *up* route is required for the actual point code assigned to the signaling point being configured and for each point code that is to be emulated. Up routes are used to identify incoming messages that are to be routed up to the applications/user parts. One *down* route is required for each remote signaling point/network/cluster that is to be accessible from the SP being configured.

Down routes are used to route outgoing messages to the appropriate signaling links. Each down route is assigned to each linkset that can be used to reach that destination. Each link set within the route’s associated combined linkset may have an optional priority assigned, such that MTP routing will choose the highest priority available link set when routing an outgoing packet to a particular destination.

Note: Priorities range from 0 (highest) to 15 (lowest) for both links and linksets. Priorities must be assigned starting at zero and incremented by one for each lower priority (there can be no gaps in priority assignment).

Figure 2 illustrates the relationship between links, linksets, and routes.

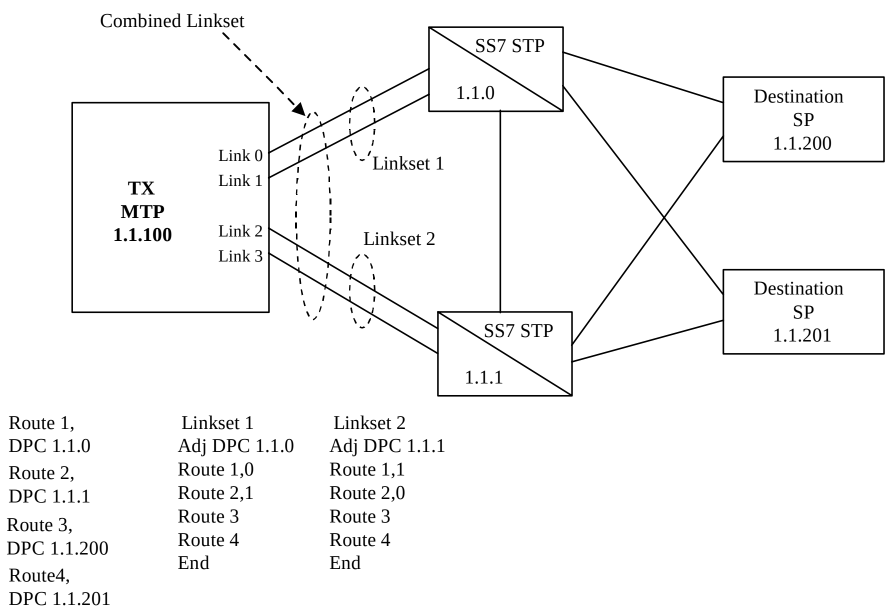

Figure 2. Links, Link Sets, and Routes

Network service access points (NSAPs) define the SS7 user parts, or applications, which are users of the MTP service. Each NSAP is associated with one user part or application (as identified by the *service indicator field* of a message) and one protocol variant (ITU-T or ANSI). Figure 3 illustrates the concept of NSAPs:

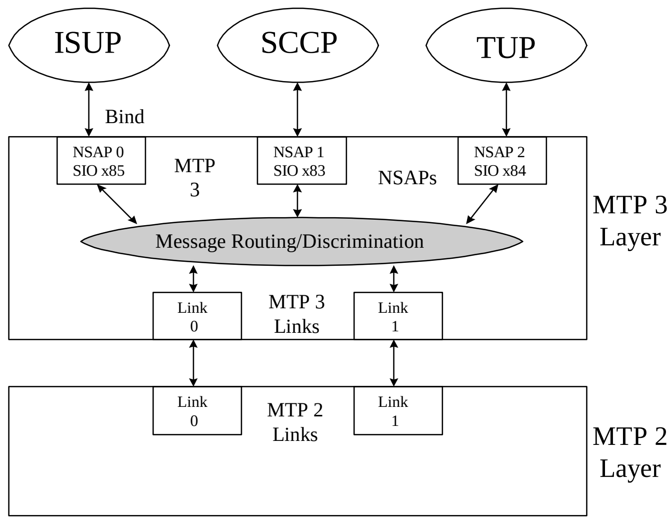

Figure 3. Network Service Access Points (NSAPs)

If multiple protocol variants are configured on the same MTP 3 instance (same board) then two NSAPs are required for each user part: one for ANSI, one for ITU-T. In this case, a single user part/application may associate itself with both NSAPs for that service, or separate user part/applications may be used for each protocol variant.

5.2 The MTP Configuration

The SS7 distribution software contains two MTP utility programs - *mtp3cfg* and *mtp2cfg* - which read a text configuration file and downloads the specified configuration to the MTP task on the TX board, typically as part of the download sequence.

The general format of the MTP configuration file is shown below:

```
<General Configuration Parameters>
END
<Link 0 definition>
<Layer 3 Parameters>
<Layer 2 Parameters>
END
<Link (n - 1) definition>
<Layer 3 Parameters>
<Layer 2 Parameters>
END
<NSAP 0 definition>
<NSAP Parameters>
END
<NSAP (n - 1) definition>
<NSAP Parameters>
END
<Route 0 definition>
<Route Parameters>
END
<Route (n - 1) definition>
<Route Parameters>
END
<Link Set 1 definition>
<Link Set Parameters>
END
<Link Set n definition>
<Link Set Parameters>
END
```

Use of the *mtp3cfg* utility is required for specifying the MTP layer 3 configuration. Use of the *mtp2cfg* utility is optional. It scans only the links definition section of the MTP configuration file and need only be run if it is necessary to override the default MTP layer 2 parameters assigned to each link (the default values for the MTP layer 2 parameters are specified in Section 5.5). The sample *ss7load* script, provided with the distribution software, executes both MTP configuration utilities.

5.2.1 General Configuration Section

The *general configuration parameters* define and control the general operation of the signaling point (SP) implemented by the TX SS7 software. General configuration parameters include the type of signaling point being constructed (SP or STP), the point code assigned to the signaling point, the MTP 3 timer resolution, the values for various SP-level timers, and the maximum number of other configurable elements (user parts (NSAPs), links, link sets, routes) to control memory allocation. The general parameters are configured once at board download time, before any other entities are configured. The board must be re-downloaded to change any of the general configuration parameters.

5.2.2 Links Configuration Section

The links configuration section defines the physical signaling links between the TX board and the adjacent signaling points. It contains a link configuration block for each SS7 link. The links section is scanned by both the MTP layer 3 and MTP layer 2 configuration utilities (this is the only section scanned by the MTP layer 2 configuration utility). Each link configuration block is comprised of both layer 3 parameters and layer 2 parameters, in any order.

The layer 3 configurable attributes of a link include the link number, the port and port type (serial or TDM) assigned to a link, the point code of the adjacent signaling point, protocol variant employed on the link (ITU-T or ANSI), point code length, maximum packet length, various timer values, membership in a linkset, and others.

The layer 2 configurable attributes include all layer 2 timers, the LSSU length to be used on the link, and the interface type - DCE or DTE - and baud rate for V.35 serial links.

5.2.3 Network Service Access Points (NSAPs) Section

Network service access points (NSAPs) define the SS7 user parts, or applications, which are users of the MTP service. The configurable attributes of NSAPs include the protocol variant (ITU-T or ANSI) and point code length supported by the user part/application associated with the NSAP, and the maximum number of user part/application messages to be queued (at each of the four possible message priority levels) when flow control between the MTP 3 and application is in effect.

5.2.4 Route Definition Section

Routes specify the destination signaling points (or sub-networks, for example, clusters when route masks are employed) that are accessible from the node being configured. Each route is assigned a *direction* - up or down. Up routes are used to identify incoming messages that are to be routed up to the applications/user parts. One *down* route is required for each remote signaling point/network/cluster that is to be accessible from the SP being configured. Down routes are used to route outgoing messages to the appropriate signaling links.

Other configurable attributes of routes include the destination point code, the protocol variant in use at the destination SP/cluster/network, and various timers associated with MTP route management.

5.2.5 Linkset Definition Section

The linkset configuration section contains a configuration block defining each linkset between the TX board and the adjacent signaling points. Linksets are numbered from 1 to MAX_LINKSETS (MAX_LINKSETS is a general configuration section parameter). The configurable attributes of a linkset include the point code of the adjacent signaling point, the list of routes that are accessible via that linkset, and the number of links to attempt to keep active.

5.3 Sample MTP Configuration File

The SS7 distribution software contains MTP sample configuration files for both ANSI and ITU-T configurations. The sample ANSI configuration for board one in the two-board sample test configuration appears as follows:

```
#-------------------------------------------------
# Overall MTP3 Parameters
#-------------------------------------------------
NODE_TYPE           STP        # choose STP [routing] or SP [non-routing]
PC_FORMAT           DFLT       # Point code format:  DFLT (8.8.8) / INTL
(3.8.3) / JNTT (7.4.5)
POINT_CODE          1.1.1
RESTART_REQUIRED    TRUE
VALIDATE_SSF        FALSE
MAX_LINKS           4
MAX_USERS           2          # sccp & isup
MAX_ROUTES          64
MAX_ROUTE_ENTRIES   32
MAX_LINK_SETS       2
MAX_ROUTE_MASKS     1
ROUTE_MASK          0xFFFFFFFF
END
#
#-------------------------------------------------
# Link Parameters
#-------------------------------------------------
LINK                0          #  Link number specified in MTPMGR commands
PORT               T1         #  T<n> for T1/E1/MVIP, S<n> for serial (V.35),
R for remote
LINK_SET            1
LINK_TYPE           ANSI       #  ANSI / ITU / JNTT
ADJACENT_DPC        1.1.2      #  Board 2
LINK_SLC            0
LSSU_LEN            2
SSF                 NATIONAL   # NATIONAL / INTERNATIONAL
END
#
# Sample Serial (V.35) configuration
#
#LINK               S1         #  T<n> for T1/E1/MVIP, S<n> for serial (V.35)
#LINK_SET            1
#LINK_TYPE           ANSI       #  ANSI / ITU / JNTT
#ADJACENT_DPC        1.1.2      #  Board 2
#LINK_SLC            0
#LSSU_LEN            2
#SSF                 NATIONAL   # NATIONAL / INTERNATIONAL
#INT_TYPE            DCE
#BAUD                56000
```

```
#END
#
#-------------------------------------------------
# User Parameters (NSAP definition)
#-------------------------------------------------
NSAP                 0          # isup must be NSAP 0 if its present
LINK_TYPE            ANSI       #  ANSI / ITU / JNTT
END
#
NSAP                1          # sccp can be 0 or 1, must be 1 if isup present
LINK_TYPE            ANSI       #  ANSI / ITU / JNTT
END
#
#-------------------------------------------------
# Routing Parameters
#-------------------------------------------------
#
# Route UP from network to applications on this node
#
ROUTE                0
DPC                  1.1.1      # this node
LINK_TYPE            ANSI       #  ANSI / ITU / JNTT
DIRECTION            UP         # default is DOWN
ADJACENT_ROUTE       FALSE
END
#
# Route to board 2
#
ROUTE                1
DPC                  1.1.2      # board 2's point code
LINK_TYPE            ANSI       #  ANSI / ITU / JNTT
END
#
#
#-------------------------------------------------
# Linkset Parameters
#-------------------------------------------------
LINK_SET_DESCRIPTOR       1
ADJACENT_DPC              1.1.2       # link set to board 2
MAX_ACTIVE_LINKS          4
ROUTE_NUMBER              1
END
#
```

5.4 MTP Configuration Considerations

The MTP 3 layer can be configured as either a signal transfer point (STP) or as a signaling end point, referred to simply as an SP. The primary difference between STP operation and SP operation is in the handling of messages received from signaling links by the MTP 3 layer but addressed to other destinations.

When configured as an STP, the MTP 3 layer will search for an outbound route to the message's destination and, if found, will route the message over an outbound link. When configured as an SP, the MTP 3 layer will discard such messages.

When configured as an STP, the MTP 3 layer will also perform the additional signaling route management procedures required of an STP. These primarily involve notifying adjacent SPs when they must no longer route messages to a particular destination through that STP due to failures or congestion (transfer prohibited/restricted), and notifying them again when normal communication with the concerned destination is restored (transfer allowed).

5.4.1 Configuring Routes to Non-Adjacent Nodes

The sample configuration shown above involves only a single adjacent signaling point directly connected to the TX board. You may also need to configure non-adjacent signaling points (for example, those that are not directly connected to the MTP 3 layer but are accessible through a signaling point that is directly connected), such as in the network configuration shown in Figure 4. The procedure for configuring a non-adjacent signaling point is as follows:

1. Configure all links, link sets, and routes to adjacent signaling points, such as the STPs in Figure 4, as described in the sample configuration files.
2. Add a route entry (direction down) for the non-adjacent SP, specifying its point code as the destination of the route.
3. Add the route number for the non-adjacent SP to the link set entry for each link set that may be used to reach the non-adjacent destination.

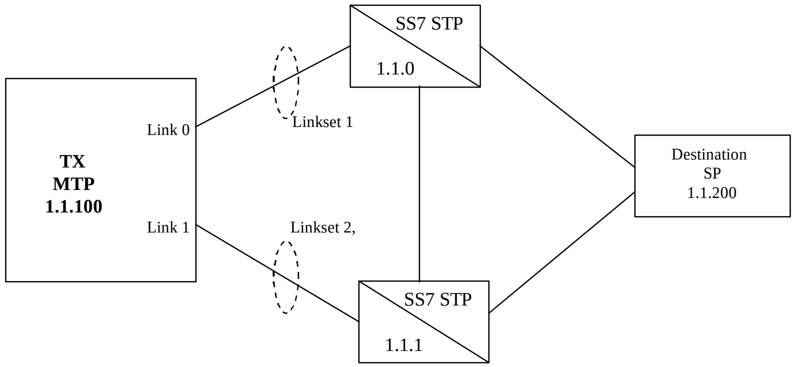

Figure 4. Non-Adjacent Signaling Point

Since the non-adjacent SP in Figure 4 (point code 1.1.200) is accessible from both STPs the route entry for 1.1.200 is added to the link set definitions for both linksets one and two. Note that since the STPs in Figure 4 are cross-connected, the route to each STP is also added to both linksets one and two since STP 1.1.1 may be reached directly through linkset two or indirectly through linkset one via STP 1.1.0. A sample MTP configuration file for this network configuration appears as follows:

```
<General Parameters>
#
#Link Parameters
#
LINK                      T1       # Link 0 to STP 1.1.0
LINK_SET                  1
ADJACENT_DPC              1.1.0
END
#
LINK                      T1       # Link 1 to STP 1.1.1
LINK_SET                  2
ADJACENT_DPC              1.1.1
END
#
#Routing Parameters
#
# Route UP from network to applications on this node
#
ROUTE                     0
DPC                       1.1.100  # this node
DIRECTION                 UP
END
#
ROUTE                     1
DPC                       1.1.0    # STP 1.1.0
END
#
ROUTE                     2
DPC                       1.1.1    # STP 1.1.1
END
#
ROUTE                     3
DPC                       1.1.200  # Route to non-adjacent 1.1.200
END
#
# Link set Parameters
#
LINK_SET_DESCRIPTOR       1
ADJACENT_DPC              1.1.0    # link set to STP 1.1.0
ROUTE_NUMBER              1
ROUTE_NUMBER              2
ROUTE_NUMBER              3
END
#
LINK_SET_DESCRIPTOR       2
ADJACENT_DPC              1.1.1    # link set to STP 1.1.1
ROUTE_NUMBER              1
ROUTE_NUMBER              2
ROUTE_NUMBER              3
END
```

5.4.2 Using Priorities

Priority levels range from 0 (highest) to 15 (lowest). If priorities are used, you must start with zero for the highest priority linkset for a given route and thereafter increment by one for lower priority linksets for that route. There cannot be any gaps in the priority assigned for a given route, although equal priorities are allowed.

Linkset priorities can be used to assure that the shortest path will be taken by a message, when available. Using Figure 2 as an example, we would want messages destined for STP 1.1.0 to use linkset one (when available) and not linkset two, which would require an extra hop through STP 1.1.1. Similarly, for messages to STP 1.1.1 we would always want to use linkset two, if available.

To assure that linkset one will always be chosen for messages to STP 1.1.0, if available, we can assign a higher priority to route one in linkset one. Likewise, we can do the same for STP 1.1.1, route two, and linkset two. Linkset priorities are defined in the configuration file by placing a comma and the priority after a route number in the linkset definition.

Note: Route number one (STP 1.1.0) is assigned priority zero in linkset one and priority one in linkset two, indicating linkset one is higher priority than linkset two for messages destined for STP 1.1.0. Route number two (STP 1.1.1) is assigned the reverse priorities. Routes three and four have no priorities assigned to them, indicating both linksets are of equal priority for reaching SP 1.1.200 and SP 1.1.201. When a priority is not specified, the default of zero (highest) is assigned. Therefore specifying 3,0 and 4,0 in both linksets would have the same results as not specifying a priority level at all. They are configured as equal priority because no matter which linkset is chosen, a message to either 1.1.200 or 1.1.201 will require two hops.

The following configuration excerpt shows how to specify linkset priorities for Figure 2:

```
#
# Routing Parameters
#
ROUTE            0
DPC              1.1.100      # this node
DIRECTION        UP
END
#
ROUTE            1
DPC              1.1.0        # STP 1.1.0
END
#
ROUTE            2
DPC              1.1.1        # STP 1.1.1
END
#
ROUTE            3
DPC              1.1.200      # SP 1.1.200
ADJACENT_ROUTE   FALSE        # Route to non-adjacent SP 1.1.200
END
#
ROUTE            4
DPC              1.1.201      # STP 1.1.201
ADJACENT_ROUTE   FALSE        # Route to non-adjacent SP 1.1.201
END
#
# Link Set Parameters
#
LINK_SET_DESCRIPTOR  1
ADJACENT_DPC         1.1.0
ROUTE_NUMBER         1,0
ROUTE_NUMBER         2,1
ROUTE_NUMBER         3
ROUTE_NUMBER         4
END

LINK_SET_DESCRIPTOR  2
ADJACENT_DPC         1.1.1
ROUTE_NUMBER         1,1
ROUTE_NUMBER         2,0
ROUTE_NUMBER         3
ROUTE_NUMBER         4
END
```

5.4.3 Using Routing Masks

The MTP 3 layer allows for the use of *routing masks* to help decrease the size of the routing tables that must be configured. Routing masks are bit masks that specify a subset of a destination point code to be matched against the routing table when searching for a route for either an inbound or outbound message.

Routing masks may be used to implement *network and cluster routing* in ANSI networks. For example, consider the following network diagram (Figure 5). Rather than specifying explicit routes to each of the seven remote SPs, routing masks and routes can be used (note that all point codes and routing masks, regardless of point code length, are stored internally as 32-bit unsigned integers). Routing masks are also useful when implementing server-type applications, such as Service Control Points (SCPs), where it is impractical to pre-configure the point codes of all possible requester signaling points.

Note: Routing masks are global to all links, link sets, and user parts, and are applied to both incoming and outgoing messages.

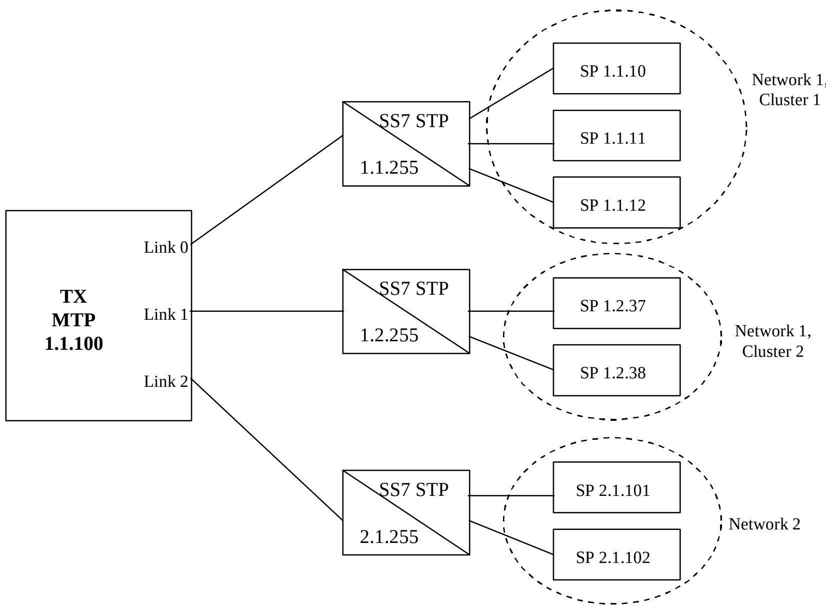

Figure 5. Using Routing Masks for Simpler Route Tables

Typical routing masks used in ANSI networks for routing based on Network and/or Cluster IDs are shown in the table below.

Note: Routing masks are applied to a message in the order that they appear in the MTP configuration file and the first matching mask/route is the one selected.

Routing Mask	**Comment**
0xFFFFFFFF	Always specify exact match as first mask
0xFFFFFF00	Match on network ID + cluster ID next
0xFFFF0000	Match on just network ID last

The following example shows a partial MTP configuration file for the network diagram provided earlier:

```
MAX_ROUTE_MASKS          3
ROUTE_MASK               0xFFFFFFFF     # always specify exact match 1st
ROUTE_MASK               0xFFFFFF00     # cluster mask next
ROUTE_MASK               0xFFFF0000     # network mask next
<Link Parameters>
#Routing Parameters
ROUTE                    0
DPC                      1.1.100        # Route up to this node
DIRECTION                UP
END
#
ROUTE                    1
DPC                      1.1.255        # Explicit route to STP 1.1.255
END
#
ROUTE                    2
DPC                      1.2.255       # Explicit route to STP 1.2.255
END
#
ROUTE                    3
DPC                      2.1.255       # Explicit route to STP 2.1.255
END
#
ROUTE                    4
DPC                      1.1.0         # Partial route to cluster 1.1.x
END
#
ROUTE                    5
DPC                      1.2.0         # Partial route to cluster 1.2.x
END
#
ROUTE                    6
DPC                      2.0.0         # Partial route to network 2.x.y
END
# Link set Parameters
LINK_SET_DESCRIPTOR      1
ADJACENT_DPC             1.1.255       # link set to STP 1.1.255
ROUTE_NUMBER             1             # explicit route to 1.1.255
ROUTE_NUMBER             4             # cluster route to 1.1.x
END
#
LINK_SET_DESCRIPTOR      2
ADJACENT_DPC             1.2.255       # link set to STP 1.2.255
ROUTE_NUMBER             2             # explicit route to 1.2.255
ROUTE_NUMBER             5             # cluster route to 1.2.x
END
#
```

```
LINK_SET_DESCRIPTOR      3
ADJACENT_DPC             2.1.255   # link set to STP 2.1.255
ROUTE_NUMBER             3         # explicit route to 2.1.255
ROUTE_NUMBER             6         # network route to 2.x.y
END
#
```

Although the previous example is specific to ANSI networks, routing masks can be applied equally to other networks (ITU-T based networks with 14- or 24-bit point codes) to reduce the size of routing tables.

When using routing masks and “partial-match” routes, the following guidelines should be adhered to.

- Always configure an UP route with the TX board’s point code first.
- Always configure an explicit route to each node directly connected to the TX board.
- Always configure an “exact match” routing mask - 0xffffffff - before any “partial match” routing masks.

5.4.4 Considerations for Configuring for Japan-NTT Protocol Variant

The following guidelines should be followed when configuring the MTP layer for Japan-NTT network operation.

1. The `LINK_TYPE` attribute for all links, NSAPs, and route entries should be set to `JNTT`.

2. The point code length for links and NSAPs will default to 16 once the `LINK_TYPE` is set to `JNTT`; there is no need to specify this explicitly. If desired for documentation purposes, however, the point code length can be explicitly set to 16 (the only supported value for JNTT link type) in the link and NSAP configurations.

3. 16-bit point codes may be specified in either hex or in "x.y.z" dotted notation. Hex point codes must be specified in the same order that they are transmitted on the link; that is, the U-code in the most significant seven bits, the S-code in the next four bits, and the M-code in the least significant five bits. In order to specify J-NTT 16-bit point codes in "x.y.z" notation, the `PC_FORMAT` parameter in the MTP 3 general configuration section must be set to the value `JNTT`.

   For example:

   ```
   PC_FORMAT     JNTT
   ...
   LINK          S1
   LINK_TYPE     JNTT
   ADJACENT_DPC  1.1.2
   ...
   ```

   Is equivalent to:

   ```
   ...
   LINK          S1
   LINK_TYPE     JNTT
   ADJACENT_DPC  0x421
   ...
   ```

5.4.5 Sample MTP Configuration File for Japan-NTT Protocol Variant

A sample MTP3 configuration file for two V.35 serial links with the JNTT protocol variant is shown below.

```
#------------------------------------------------------
# Sample MTP3 configuration for J-NTT protocol variant
#------------------------------------------------------
#Overall MTP3 Parameters
#------------------------
#
NODE_TYPE           SP            # choose STP [routing] or SP [non-routing]
PC_FORMAT           JNTT
POINT_CODE          1.1.1
RESTART_REQUIRED    FALSE
MAX_LINKS           4
MAX_USERS           2             # isup + 1 extra
MAX_ROUTES          64
MAX_ROUTE_ENTRIES   32
MAX_LINK_SETS       2
MAX_ROUTE_MASKS     1
ROUTE_MASK          0xFFFFFFFF
END
#
#Link Parameters
#---------------
#
# Link 0
#
LINK                S1            # Serial port 1
LINK_SET            1
LINK_TYPE           JNTT
ADJACENT_DPC        1.1.2
LINK_SLC            0
LSSU_LEN            1
INT_TYPE            DCE
BAUD                56000
END
#
# Link 1
#
LINK                S2            # Serial port 2 (V.35)
LINK_SET            1
LINK_TYPE           JNTT
ADJACENT_DPC        1.1.2
LINK_SLC            1
LSSU_LEN            1
INT_TYPE            DCE
BAUD                56000
```

```
END
#
#User Parameters (NSAP definition)
#---------------------------------
#
NSAP                0           # isup
LINK_TYPE           JNTT
END
#
NSAP                1           # spare
LINK_TYPE           JNTT
END
#
#
#Routing Parameters
#------------------
#
# Route UP from network to applications on this node
#
ROUTE               0
LINK_TYPE           JNTT
DPC                 1.1.1       # this node
DIRECTION           UP          # default is DOWN
ADJACENT_ROUTE      FALSE
END
#
# Route to Adjacent node
#
ROUTE               1
LINK_TYPE           JNTT
DPC                 1.1.2
END
#
#
# Linkset Parameters
#-------------------
LINK_SET_DESCRIPTOR 1
ADJACENT_DPC         1.1.2
MAX_ACTIVE_LINKS     4
ROUTE_NUMBER         1
END
#
```

5.5 MTP Configuration Parameters Reference

There are five major sections of the MTP configuration file - general parameters, link parameters, network SAP parameters, routing parameters, and link-set parameters.

5.5.1 General Parameters

The following table lists all configurable parameters in the MTP 3 general configuration section and their default values. The default values for all timers at the MTP 3 level are in tenths of a second. A configuration value of zero for a timer disables that timer. The MTP3_TIMER_RES parameter may be used to specify whether timer values being overridden in the MTP 3 configuration file are specified in seconds or tenths of a second.

Note: The PC_FORMAT attribute applies to all point codes throughout the entire MTP configuration file.

Parameter Name	Default	Range	Usage
PC_FORMAT	DEFAULT	DEFAULT [DFLT], INTER-NATIONAL [INTL], JNTT	Point Codes are interpreted/displayed as 24-bit 8.8.8 values. Point Codes are interpreted/displayed as 14-bit 3.8.3 values. Point codes are interpreted/displayed as 16-bit ***mcode*.*scode*.*ucode*** values with the U-code in the most significant 7 bits, the S-code in the next 4 bits, and the M-code in the least significant 5 bits.
POINT_CODE	none	N/A	The Point Code of this node, specified in dot notation (such as 2.45.76) or a hex number (such as 0x101). This is a required parameter.
NODE_TYPE	STP	STP | SP	Selects STP [routing] or SP [non-routing] mode of operation.

Parameter Name	Default	Range	Usage
POINT_CODE2		N/A	Alternate point code for this node when interfacing to both ANSI and ITU-T networks from same board (in that case, specify the ITU-T point code in POINT_CODE parameter and ANSI point code here).
MTP3_TIMER_RES	SECONDS	TENTHS, SECONDS	Specifies whether timer values in the configuration file are in seconds or tenths of a second.
RESTART_REQUIRED	TRUE	TRUE / YES FALSE / NO	Set to TRUE if full restart procedure required whenever node becomes accessible.
VALIDATE_SSF	TRUE	TRUE / YES FALSE / NO	When set to true, MTP 3 will validate incoming MTP 3 signaling network management (SNM) and test (SLTM/SLTA) messages; i.e., those whose SSF does not match the value configured for the link the message was received on will be rejected; otherwise the SSF will not be checked on incoming MTP 3 management or test messages - any SSF value will be accepted. MTP 3 will not validate the SSF in any incoming or outgoing user part messages.
DISABLE_UPU	FALSE	TRUE/YES FALSE/NO	If set to TRUE, MTP will never send a User Part Unavailable message.
MAX_LINKS	4	1 to 16	Maximum number of physical links (actual maximum depends on TX board model and hardware configuration).
MAX_USERS	2	1 to 64	Maximum number of MTP 3 users (user parts).
MAX_ROUTES	32	1 to 32767	Maximum number of routes.
MAX_ROUTE_ENTRIES	64	1 to 32767	Maximum number of route instances (logical max is MAX_LINKS * MAX_ROUTES, but can be decreased).

Parameter Name	Default	Range	Usage
MAX_LINK_SETS	1	1 to 16	Maximum number of link sets supported.
MAX_ROUTE_MASKS	0	0 to 8	Maximum number of routing masks. If zero, then all destination point code in outgoing messages must exactly match a point code in a route entry.
ROUTE_MASK	None	0x00 to 0xFFFFFFFF	A routing mask to be applied to destination point code before matching against route table entries. Can be used to reduce number of routes that must be configured or when remote destination point codes are not known at configuration time (that is, a database server). Multiple ROUTE_MASKs may be specified; they are applied in the order that they appear in the configuration file.
TIMER_T15	30	0 to 65535	Wait to start/repeat route set congestion test.
TIMER_T16	20	0 to 65535	Wait for route set congestion status update.
TIMER_T18_ITU	300	1 to 65535	ITU restart timer for an STP during which links are restarted and TFA, TFR, and TFP messages are received.
TIMER_T20_ITU	600	1 to 65535	ITU overall restart timer.
TIMER_T22_ANSI	300	1 to 65535	ANSI restart timer at restarting SP waiting for links to become available.
TIMER_T23_ANSI	300	1 to 65535	ANSI restart timer at restarting SP waiting for TRA messages.
TIMER_T26_ANSI	130	1 to 65535	ANSI restart timer at restarting SP waiting to repeat TRW message.
TIMER_T27_ANSI	30	1 to 65535	Minimum duration of unavailability for full restart.

Parameter Name	Default	Range	Usage
TIMER_TRTEINST	300	0 to 65535	Internal route instance timer (how long a route instance is valid) - NOT ANSI T30.
MTP3_TRACE_DATA	FALSE	TRUE, FALSE	TRUE starts tracing of all data between MTP 2 and MTP 3.
END	N/A	N/A	Marks the end of the general parameters section.

5.5.2 Link Parameters

The following tables specify the configuration parameters applicable to each link. The first table lists the layer 3 parameters and the second table lists the layer 2 parameters.

MTP 3 Link Parameters

MTP 3 Parameter	Default	Range	Usage
PORT	none	S1 to 4 (serial) T1 to 16 (TDM)	S***n*** for serial (V.35). T***n*** for T1, E1, MVIP, H.100 or H.110.
LINK	none	0 - 15	The zero based link number. This is the number you will use to refer to the link in MTPMGR commands.
LINK_TYPE	ANSI	ANSI ITU JNTT	MTP 3 protocol variant used on link.
ADJACENT_DPC	none	N/A	The point code of the node on the other end of the link. Use dot notation (such as 2.45.76) or a hex number (such as 0x101).
LINK_SET	1	1 to 16	The link set to which this link belongs.
SSF	NATIONAL (ANSI), INTER-NATIONAL (ITU-T)	NATIONAL, INTER-NATIONAL	The value used in the sub-service field (SSF) of the SIO.
SUB_SERVICE	2	0 to 3	Overrides SSF parameter. Use either SUB_SERVICE or the SSF parameter, but not both.
LINK_PRIORITY	0	0 to 3	Priority of this link within the link set. Priorities range from 0 [highest] to 3 [lowest].
MESSAGE_SIZE	272	64 to 1024	Maximum message length for this link.

MTP 3 Parameter	Default	Range	Usage
DISABLED	FALSE	TRUE / FALSE	If false, link will is initially enabled, i.e. it tries to align with the remote side immediately. If true, link is initially disabled, i.e. no attempt to align with remote side is made.
USE_PRIORITY	TRUE	TRUE | FALSE	If true, message priorities generated by user parts are inserted into the SIO octet (spare bits) of outgoing messages; otherwise, the SIO spare bits are set to zero. This is usually set to TRUE in ANSI networks and FALSE in ITU-T networks.
MGNT_MSG_PRIORITY	3	0 to 3	Priority to use for MTP3 management messages (3 = highest, 0 = lowest).
DPC_LENGTH	24 (ANSI) 14 (ITU) 16 (JNTT)	14 | 16 | 24	Number of bits in a point code, must be either 14, 16, or 24. *Note:* A DPC_LENGTH value of 16 is only valid on links whose LINK_TYPE is JNTT.
MAX_SLTM_RETRY	2	0 to 255	Maximum times to retry SLTM. A value of zero will result in infinite retries.
P0QUE_LENGTH	16	2 to 1024	Transmit queue length threshold at which the congestion priority is raised to level 0.
P1QUE_LENGTH	32	(p0Qlen + 2) to 1024	Transmit queue length threshold at which the congestion priority is raised to level 1.
P2QUE_LENGTH	64	(p1Qlen + 2) to 1024	Transmit queue length threshold at which the congestion priority is raised to level 2.
P3QUE_LENGTH	128	(p2Qlen + 2) to 1024	Transmit queue length threshold at which the congestion priority is raised to level 3.

MTP 3 Parameter	Default	Range	Usage
DISCARD_PRIORITY	0	0 to 3	The congestion priority at which messages with priority below the current threshold are discarded rather than being queued and risking further congestion escalation.
LINK_SLC	0	0 to 15	Link selection code for signaling link testing.
LINK_TEST_PATTERN	"TST"	1 to 15 ASCII Characters	Link test pattern for SLTM messages.
TIMER_T1	10	0 to 65535	Delay to avoid message mis-sequencing on changeover.
TIMER_T2	10	0 to 65535	Wait for changeover acknowledgment.
TIMER_T3	10	0 to 65535	Time controlled diversion - delay to avoid mis-sequencing on changeback.
TIMER_T4	10	0 to 65535	Wait for first changeback acknowledgment (first attempt).
TIMER_T5	10	0 to 65535	Wait for first changeback acknowledgment (second attempt).
TIMER_T6	10	0 to 65535	Delay for avoid mis-sequencing on controlled rerouting.
TIMER_T7	20	0 to 65535	Wait for data link connection acknowledgment.
TIMER_T11	600	0 to 65535	Transfer Restricted timer.
TIMER_T12	12	0 to 65535	Wait for uninhibit acknowledgment.
TIMER_T13	10	0 to 65535	Wait for forced uninhibit.
TIMER_T14	30	0 to 65535	Wait for inhibition acknowledgment.
TIMER_T17	10	0 to 65535	Delay to avoid oscillation of initial alignment failure and link restart.

MTP 3 Parameter	Default	Range	Usage
TIMER_T22	1100	0 to 65535	Wait to repeat local inhibit test (ANSI T20 value).
TIMER_T23	1100	0 to 65535	Wait to repeat remote inhibit test (ANSI T21 value).
TIMER_T24	40	0 to 65535	Reserved for future use (NOT ANSI T24).
TIMER_T31	50	0 to 65535	Internal BSN Requested Timer (NOT ANSI T31).
TIMER_T32	100	0 to 65535	Wait for response to SLTM timer (ANSI T1.111.7 timer T1 - NOT ANSI T32).
TIMER_T33	200	0 to 65535	Signaling link connection timer (NOT ANSI T33).
TIMER_T34	600	0 to 65535	Periodic signaling link test timer (ANSI T1.111.7 timer T2 - NOT ANSI T34).
TIMER_T40	30	1 to 65535	Time to wait for a bind confirm from MTP 2 before sending another bind request.
TIMER_T41	30	1 to 65535	Time to wait for a disconnect confirm from MTP 2 before sending another disconnect request.
TIMER_T42	30	1 to 65535	Time to wait for a flow control confirm from MTP 2 before sending another flow control request.
TIMER_T43	30	1 to 65535	Time to wait for a status confirm from MTP 2 before sending another status request.
TIMER_T44	30	1 to 65535	Time to wait for an unbind confirm from MTP 2 before sending another unbind request.
LINK_TRACE_DATA	FALSE	TRUE, FALSE	TRUE starts tracing of all data between MTP 2 and MTP 3 on this link.
END	N/A	N/A	Marks end of this link definition.

MTP 2 Link Parameters

All layer 2 times are specified in tenths of seconds (e.g. 60 = 6 seconds).

MTP 2 Parameter	Default	Range	Description
ERR_TYPE	NORMAL	NORMAL, PCR	Error correction method: Normal or Preventive Cyclic Retransmission.
L2_T1	130 (ANSI) 400 (ITU-T)	1 to 65535	Timer aligned/ready.
L2_T2	115 (ANSI) 100 (ITU-T)	1 to 65535	Timer not aligned.
L2_T3	115 (ANSI) 15 (ITU-T)	1 to 65535	Timer aligned.
L2_T4_N	23 (ANSI) 82 (ITU-T)	1 to 65535	Normal proving period.
L2_T4_E	6 (ANSI) 5 (ITU-T)	1 to 65535	Emergency proving period.
L2_T5	1	1 to 65535	Timer sending SIB.
L2_T6	60	1 to 65535	Timer remote congestion.
L2_T7	20	1 to 65535	Timer excessive delay of acknowledgement.
L2_T10	30	1 to 65535	Amount of time MTP 2 can be isolated from a remote MTP 3 before sending processor outage (SIPO).
L2_T11	20	1 to 65535	Time to wait for a flow control acknowledgement from MTP 3 before sending another flow control indication.
L2_T12	20	1 to 65535	Time to wait for a status confirmation from MTP 3 before sending another status indication.
L2_T13	20	1 to 65535	Time to wait for a disconnect confirmation from MTP 3 before sending another disconnect indication.
LSSU_LEN	2	1 to 2	LSSU length.

MTP 2 Parameter	Default	Range	Description
MAX_FRAME	272	64 to 1024	Maximum frame length for MSU.
SUERM_THRESH	64	1 to 255	Signal unit error rate monitor threshold (bad frames).
SUERM_D_RATE	256	1 to 65535	Signal unit error rate monitor decrement rate (frames).
AERM_THRESH_E	1	1 to 255	Alignment error rate monitor error rate threshold (emergency alignment).
AERM_THRESH_N	4	1 to 255	Alignment error rate monitor error rate threshold (normal alignment).
MAX_RTB_MSGS	127	1 to 255	Maximum number of MSUs for retransmission (when using PCR error correction only).
MAX_RTB_OCTETS	34544	1 to 65535	Maximum number of MSUs octets for retransmission (when using PCR error correction only).
MAX_PROV_ABORT	5	1 to 255	Maximum # of proving failures.
BAUD	56000	4800, 9600, 19200, 28800, 38400, 48000, 56000, 64000	Baud rate for serial ports only (in bits per second).
INT_TYPE	DTE	DTE | DCE	Interface type for serial ports only.
DATA_ENC	NRZ	NRZ | NRZI	Data encoding (NRZ or NRZ inverted).
SHARE_FLAGS	TRUE	TRUE | FALSE	Allow single flag to be shared between frames.
USE_FLAGS	TRUE	TRUE | FALSE	Use flags (TRUE) or idles (FALSE) between frames.
MIN_FLAGS	0	0 to 15	Minimum number of additional flags between frames (in addition to shared flag).
ISO_THRESH	1000	1 to 65535	Number of messages queued to MTP 3 while isolated that will cause MTP 2 to begin processor outage (SIPOs).

MTP 2 Parameter	Default	Range	Description
L2_TXQ_THRESH1	50	1 to 65535	Transmission queue length at which the outbound flow control level is raised to one.
L2_TXQ_THRESH1_A	20	1 to 65535	Transmission queue length at which the outbound flow control level is lowered to zero.
L2_TXQ_THRESH2	200	1 to 65535	Transmission queue length at which the outbound flow control level is raised to two. The subsequent indication causes MTP 3 to cease all transmission to MTP 2 until the flow control level returns to one or zero.
L2_TXQ_THRESH2_A	100	1 to 65535	Transmission queue length at which the outbound flow control level is lowered to one.
L2_SAP_THRESH	500	1 to 65535	Number of messages queued to MTP 3 while inbound flow control is in effect that will cause MTP 2 to send busy indications (SIBs).
L2_SAP_THRESH_A	100	1 to 65535	Number of messages queued to MTP 3 while inbound flow control is in effect that will cause MTP 2 to stop sending busy indications (SIBs).
IDLE_FREQ	0	1 to 65535	Frequency at which FISUs are sent by the software (in ms). Zero indicates that hardware constantly retransmits duplicate FISUs as is the norm. Non-zero frequencies can be used by switches that process all FISUs (including duplicate FISUs) in the software.
RT_FREQ	0	1 to 65535	Frequency at which other retransmitted SUs (specifically LSSUs) are sent by the software (in ms). Zero indicates that hardware constantly retransmits duplicate LSSUs as is the norm. Non-zero frequencies can be used by switches which process all LSSU’s (including duplicate LSSUs) in the software.

5.5.3 Network Service Access Point (NSAP) Parameters

The following parameters are used for defining an NSAP (the service access point for MTP 3 by an upper layer task):

Parameter Name	Default	Range	Usage
NSAP	none	0 to (MAX_USERS-1)	The NSAP number. REQUIRED.
LINK_TYPE	ANSI	ANSI ITU JNTT	MTP 3 protocol variant used by this MTP 3 user part.
P0QUE_LENGTH	0	2 to 1024	Receive queue length threshold at which the congestion priority is raised to level 0.
P1QUE_LENGTH	512	(p0Qlen + 2) to 1024	Receive queue length threshold at which the congestion priority is raised to level 1.
P2QUE_LENGTH	768	(p1Qlen + 2) to 1024	Receive queue length threshold at which the congestion priority is raised to level 2.
P3QUE_LENGTH	896	(p2Qlen + 2) to 1024	Receive queue length threshold at which the congestion priority is raised to level 3.
DISCARD_PRIORITY	0	0 to 3	The congestion priority at which messages with priority below the current threshold are discarded rather than being queued and risking further congestion escalation.
DPC_LENGTH	24 (ANSI) 14 (ITU-T) 16 (JNTT)	14 | 16 | 24	Number of bits in a point code, must be either 14, 16, or 24. A DPC_LENGTH value of 16 is only valid on links whose LINK_TYPE is JNTT.
END			Marks end of this NSAP definition.

5.5.4 Routing Parameters

The following table lists all configurable parameters for a MTP 3 route entry.

Parameter Name	Default	Range	Usage
ROUTE	none	0 to MAX_ROUTES	Route identifier number, from 0 to MAX_ROUTES-1. REQUIRED.
DPC	none	N/A	The point code that's the target of the route entry. Use dot format (such as 2.45.76) or a hex number (such as 0x101).
SPTYPE	STP	SP | STP	Type of signaling point the destination is, SP or STP.
LINK_TYPE	ANSI	ANSI, ITU JNTT	MTP 3 protocol variant associated with this route.
SSF	NATIONAL (ANSI), INTER-NATIONAL (ITU-T)	NATIONAL, INTER-NATIONAL	Value for the sub-service field to be used in route management messages for this route.
SUB_SERVICE	2	0 to 3	Overrides SSF parameter. Use either SUB_SERVICE or the SSF parameter, but not both.
DIRECTION	DOWN	UP | DOWN	Route direction. UP routes result in messages being routed to user parts or applications on this node; DOWN routes are routes to remote signaling points.
ADJACENT_ROUTE	TRUE	TRUE | YES FALSE | NO	Indicates whether this is a route to an adjacent signaling point (a signaling point that is directly connected to this node) - used only if this node is configured for STP operation.

Parameter Name	Default	Range	Usage
ADJACENT_CLUSTER	FALSE	TRUE | YES FALSE | NO	Indicates whether this is a route to an adjacent cluster, allowing use of the cluster variant of route management messages (ANSI only).
TIMER_T8	10	0 to 65535	Transfer Prohibited inhibition timer.
TIMER_T10	450	0 to 65535	Wait to start/repeat periodic route set test.
TIMER_T19_ITU	680	1 to 65535	ITU restart timer to avoid ping-pong of TFP, TFR, or TRA messages.
TIMER_T21_ITU	640	1 to 65535	Overall ITU restart timer at adjacent SP.
TIMER_T25_ANSI	320	1 to 65535	ANSI restart timer at adjacent SP waiting for a TRA message.
TIMER_T28_ANSI	300	1 to 65535	ANSI restart timer at adjacent SP waiting for a TRW message.
TIMER_T29_ANSI	630	1 to 65535	ANSI restart timer started when a TRA is sent in response to an unexpected TRA or TRW.
TIMER_T30_ANSI	320	1 to 65535	ANSI restart timer to limit sending of TFPs and TFRs in response to unexpected TRA or TRW.
END			Marks end of this route definition.

5.5.5 Link Set Parameters

The following parameters are valid for defining a link set:

Parameter Name	Default	Range	Usage
LINK_SET_DESCRIPTOR	none	1 to MAX_LINKSETS	The Link Set identifier number; referenced in LINK_SET parameter of each individual link.
ADJACENT_DPC	none	N/A	The point of the adjacent SP that terminates this link set. Use "dotted" notation, 2.45.76 or hex number, 0x101.
MAX_ACTIVE_LINKS	16	1 to 16	*Target* number of links in this link set to keep active at any given time.
ROUTE_NUMBER	none (priority for a route defaults to zero)	0 to MAX_ROUTES	A route number and optional priority associated with a destination that can be reached through this link set; up to 16 route numbers may be specified per link set. The same route number may be assigned to multiple link sets. The optional priority associated with the route number is relative to other link sets which also contain this route number.
END			Marks end of this Link Set definition.

Chapter 6

SS7 ISUP Configuration

6.1 Introduction to the ISUP Layer

The SS7 ISDN User Part (ISUP) software provides the interface for applications to establish, maintain, and clear circuit switched connections via the SS7 network, in accordance with the CCITT Q.761-Q.764 and ANSI T1.113 (1988 and 1992) recommendations. The ISUP layer is also responsible for circuit [group] management, such as blocking, unblocking, and resetting of circuits and circuit groups.

The configurable objects represented by the ISUP layer are *Circuits*, *User Service Access Points (User SAPs)*, *Network Service Access Points (NSAPs)*, and *Routes*. In addition, the ISUP layer has a set of general configuration parameters which define the behavior of the ISUP layer as a whole.

Circuits are the physical bearer circuits controlled by the ISUP layer. Circuits are identified by both a **circuit index** and a **circuit identification code (CIC)**. The circuit index is a number unique across all circuits configured on a particular TX board. This number has only local significance - it is used between the ISUP layer and the local call processing application to identify a particular circuit.

The CIC (usually called the *kick*, or *kick code*) is used between signaling points (i.e., the ISUP layer and the far exchange that terminates the other end of the circuit) to uniquely identify a particular circuit. The CIC must be configured at both ends of the circuit to identify the exact same bearer facility, for example, the same T1 span and timeslot. CICs need not be unique across circuits that terminate on different far exchanges.

Circuits are specified in the ISUP configuration file in *groups*. A group is one or more circuits with contiguous circuit indexes and contiguous CICs that terminate on the same far exchange and have common characteristics. A single circuit group will frequently be used to represent all the timeslots on a single T1 or E1 span, for example. When defining a circuit group, only the circuit index and CIC of the first circuit in the group, along with the number of circuits in the group, are specified. The ISUP layer derives the circuit index and CIC for subsequent circuits since they are considered to be contiguous. The starting circuit index and starting CIC for a group need not be the same value.

User SAPs define the interface between the ISUP layer and the user applications.

Note: This release of the SS7 ISUP layer supports only a single user application; therefore only one user SAP should be configured.

The *NSAP* defines the interface between the ISUP layer and the MTP layer. It identifies the MTP network SAP to used by the ISUP layer, allowing multiple user parts (for example, ISUP and SCCP) to share access to the MTP layer services. Figure 6 illustrates the concept of user SAPs and NSAPs.

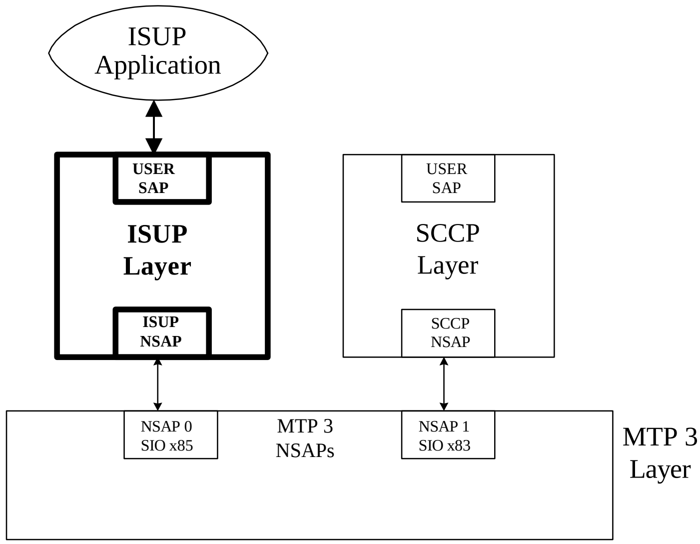

Figure 6. ISUP User SAPs and Network SAPs

Routes can be configured to allow the ISUP layer to select the circuit for an outgoing call based on the called party number. A route typically specifies a routing prefix such as the first three digits or first six digits of a directory number, to match against the called party number. Typically the application itself will perform circuit selection for outgoing calls, since it must perform any hardware setup and/or switching on the physical circuit. In this case, there is no need to configure any routes.

6.2 The ISUP Configuration

The SS7 ISUP software contains a utility program, *isupcfg*, which reads a text configuration file and downloads the specified configuration to the ISUP task on the TX board, typically as part of the download sequence.

The general format of the ISUP configuration file is as follows:

```
<General Configuration Parameters>
<User SAP definition>
<SAP Parameters>
END
<NSAP definition>
<NSAP Parameters>
END
<NSAP (n - 1) definition>
<NSAP Parameters>
END
<Route 0 definition>
<Route Parameters>
END
<Route (n - 1) definition>
<Route Parameters>
END
<Circuit Group 1 definition>
<Circuit Group Parameters>
END
<Circuit Group n definition>
<Circuit Group Parameters>
END
```

6.3 Sample ISUP Configuration File

The ISUP software contains sample configuration files for both ANSI and ITU-T configurations. These configurations may be used in conjunction with the MTP sample configuration files to test ISUP applications using two TX boards in a back-to-back arrangement (see Chapter 3). The following example shows the sample ANSI configuration file for one board.

```
# General configuration parameters
MAX_SAPS            2
MAX_NSAPS           2
MAX_CIRCUITS        96
MAX_GROUPS          5                !max number of circuit groups
MAX_CALLREFS        96               !max number of active circuits
MAX_ROUTES          10               !max number of routes
OPC                 1.1.1            !my point code
CLLINAME            NMSsfwB2.41
END
# Service Access Point (SAP)
USER_SAP            0
SWITCH_TYPE         ANSI92           !switch type (ITU, ANSI88, ANSI92,
                                      ANSI95, ITUWHITE, ITUBLUE, Q767)
MAX_LENGTH          20               !max length of a phone number
END
# Network Service Access Point (NSAP)
NSAP                0
SWITCH_TYPE         ANSI92           !switch type (ITU, ANSI88, ANSI92,
                                      ITUWHITE, ITUBLUE, Q767)
END
# Circuit Database
CIRCUIT             1                !circuit number
CIC                 1                !Circuit identification code
DPC                 1.1.2            !DPC of far exchange
SWITCH_TYPE         ANSI92           !switch type (ITU, ANSI88, ANSI92,
                                      ITUWHITE, ITUBLUE, Q767)
TRUNK               708
CIRCUIT_TYPE        BOTHWAY          !INCOMING, OUTGOING, or BOTHWAY
CONTROL_TYPE        ODD_EVEN         !ALL, NONE, or ODD_EVEN
NUM_CIRCUITS        24               !number of circuits in this group
END
#
CIRCUIT             25               !circuit number
CIC                 25               !Circuit identification code
DPC                 1.1.2            !DPC of far exchange
SWITCH_TYPE         ANSI92           !switch type (ITU, ANSI88, ANSI92,
                                      ITUWHITE, ITUBLUE, Q767)
TRUNK               847
CIRCUIT_TYPE        BOTHWAY          !INCOMING, OUTGOING, or BOTHWAY
```

```
CONTROL_TYPE          ODD_EVEN        !ALL, NONE, or ODD_EVEN
NUM_CIRCUITS          24              !number of circuits in this group
END
#
END
```

6.4 ISUP Configuration Parameters Reference

There are five major sections of the ISUP configuration file: general parameters, user SAP definition, network SAP definition, routes, and circuits.

6.4.1 General Parameters

The general parameters control the overall operation of the ISUP layer process.

Note: All ISUP timer values are in seconds.

Parameter Name	Default	Range	Usage
MAX_SAPS	1	1	Defines the maximum number of user applications.
MAX_NSAPS	1	1 to 255	Defines the maximum number of interfaces with the MTP 3 network layer.
MAX_CIRCUITS	96	0 to 65535	The maximum number of circuits to be managed by the ISUP layer.
MAX_GROUPS	32	0 to 65535	The maximum number of circuit groups managed by the ISUP layer.
MAX_CALLREFS	16	0 to 65535	This is the maximum number of call references, and hence connections, that ISUP can keep track of simultaneously.
MAX_ROUTES	16	0 to 65535	The maximum number of routes.
OPC	none	N/A	The Point Code of this node, specified as x.y.z (three bytes, decimal, separated by periods), as a hexadecimal value preceded by 0x (0x123), or as a decimal value.
PC_FORMAT	DEFAULT	DEFAULT [DFLT], INTER-NATIONAL [INTL], JNTT	Point Codes are interpreted/displayed as 24-bit 8.8.8 values. Point Codes are interpreted/displayed as 14-bit 3.8.3 values. Point codes are interpreted/displayed as 16-bit ***mcode***.***scode***.***ucode*** values with the U-code in the most significant 7 bits, the S-code in the next 4 bits, and the M-code in the least significant 5 bits.

Parameter Name	Default	Range	Usage
CLLINAME	none	N/A	The Common Language Location Identifier (CLLI) name assigned to this node (exactly 11 ASCII characters).
T18_TIMER	12	0 to 65535	Time to wait for a response to a group blocking message sent.
T19_TIMER	60	0 to 65535	Time to wait for a response to initial group blocking message sent.
T20_TIMER	12	0 to 65535	Time to wait for a response to a group unblocking message sent.
T21_TIMER	60	0 to 65535	Time to wait for a response to initial group unblocking message sent.
T22_TIMER	12	0 to 65535	Time to wait for a response to a circuit group reset message sent.
T23_TIMER	60	0 to 65535	Time to wait for a response to initial circuit group reset message sent.
T28_TIMER	10	0 to 65535	Time to wait for a CQR after sending a CQM.
TGRES_TIMER	5	0 to 65535	Group reset timer.
TFGR_TIMER	5	0 to 65535	ANSI first group received timer.
TRACE_EVENT	FALSE	TRUE | FALSE	Enables event logging when TRUE.
TRACE_DATA	FALSE	TRUE | FALSE	Enables data tracing when TRUE.
TRACE_WARNING	FALSE	TRUE | FALSE	Enables logging of unexpected information element value warnings when TRUE.
TRACE_ERROR	FALSE	TRUE | FALSE	Enables logging of message encoding errors when TRUE.
IG_PASS_ALNG	FALSE	TRUE FALSE	If set to TRUE, messages are sent in pass along format.
ITU_UCICS	FALSE	TRUE FALSE	Setting to TRUE allows an ITU configuration to send UCIC messages. Otherwise, UCIC's are not sent.
EXT_ELMTS	FALSE	TRUE FALSE	Setting to TRUE allows the sending and receiving of extended elements.

Parameter Name	Default	Range	Usage
RAW_MSGS	FALSE	TRUE FALSE	Setting to TRUE allows the sending and receiving of raw messages.
ONE_GRPMSG	FALSE	TRUE FALSE	When TRUE, the stack will react to the first CGB and GRS group message (ANSI only).
END	N/A	N/A	Marks the end of the general section.

6.4.2 Service Access Point (SAP) Definition

The SAP definition defines the characteristics of the ISUP service presented to the user application(s).

Note: This release of the ISUP layer software allows for configuration of only a single ISUP user SAP. Therefore, only one application may use the ISUP service at a time. Timer default values in parenthesis are ITU values.

Parameter Name	Default	Range	Usage
USER_SAP	none	0 to MAX_SAPS	SAP number
SWITCH_TYPE	ANSI92	ITU, ITUWHITE, ITUBLUE, ITU97, ETSIV2, ETSIV3, Q767, ANSI88, ANSI92, ANSI95, JNTT	The protocol variant employed for this application. Must match (one of) the switch type(s) defined in the NSAP definition section.
MASK	none	N/A	Routing mask for circuit selection by ISUP. Maximum of 20 ASCII characters where a 1 indicates the digit is significant for route matching and a 0 indicates the digit is ignored for route matching. For example, 1110000000 would cause ISUP to treat the first 3 digits of a called address as significant when route matching.
MAX_USER2USER	20	0 to 0xff	Sets the maximum length of User to User information in an IAM.
T1_TIMER	12 (15)	0 to 65535	Time to wait for a response to a release message sent.
T2_TIMER	0	0 to 65535	Time to wait for a resume message after a suspend message received.
T5_TIMER	60 (300)	0 to 65535	Time to wait for a response to initial release message sent.

Parameter Name	Default	Range	Usage
T6_TIMER	30	0 to 65535	Time to wait for a resume message after a suspend (network) message received.
T7_TIMER	25	0 to 65535	Time to wait for a response (for example, ACM, ANS, or CON) to the latest address message sent.
T8_TIMER	12	0 to 65535	Time to wait for a continuity message after receiving IAM requiring continuity check.
T9_TIMER	180	0 to 65535	Time to wait for answer of outgoing call after ACM message received.
T16_TIMER	12	0 to 65535	Time to wait for a response to a reset message sent.
T17_TIMER	12 (300)	0 to 65535	Time to wait for a response to initial reset message sent.
T27_TIMER	240	0 to 65535	Time to wait for a continuity check request after ensuing continuity check failure indication is received. See the TCCR_TIMER field below.
T31_TIMER	0 (disabled)	0 to 65535	Time to wait before reusing call reference after a connection is cleared.
T33_TIMER	15	0 to 65535	Time to wait for a response to information request message sent.
TEX_TIMER	0 (disabled)	0 to 65535	Time to wait before sending ANSI exit message
TCRM_TIMER	4	0 to 65535	Time to wait for a response to a circuit reservation message sent.
TCRA_TIMER	10	0 to 65535	Time to wait for an IAM message after circuit reservation acknowledgment message sent.
TCCR_TIMER	20 (240)	0 to 65535	Time to wait for CCR after the first COT indicating failure. See the T27_TIMER field above.
END	N/A	N/A	Marks the end of the SAP section.

6.4.3 Network Service Access Point (NSAP) Definition

The NSAP definition defines the characteristics of the ISUP interface to the MTP 3 layer.

Parameter Name	Default	Range	Usage
NSAP	none.	1 - 32	Name of the NSAP section for the rest of the parameters.
SWITCH_TYPE	ANSI92	ITU, ITUWHITE, ITUBLUE, ITU97, ETSIV2, ETSIV3, Q767, ANSI88, ANSI92, ANSI95, JNTT	The protocol variant employed for this MTP interface. Must match (one of) the switch type(s) defined in the MTP 3 NSAP definition section.
SSF	NATIONAL	NATIONAL, INTER-NATIONAL, 0-3, RESERVED, SPARE	The value used in the sub-service field (SSF) of the service information octet in outgoing ISUP messages on this MTP interface.
MTP_SAP	0	0 to 255	MTP Service Access Point to which to bind ISUP. This must match one of the NSAP numbers defined in the MTP configuration file; also must be unique among all user parts that use the MTP service (that is., SCCP, TUP).
END	N/A?	N/A	Marks the end of the NSAP section.

6.4.4 Circuit Group Definitions

The circuit group definitions specify the characteristics of each of the circuit groups to be managed by the ISUP layer. This includes the circuit identification codes (CICs), destination point code (DPC) at the other end of the circuits, and circuit type (incoming, outgoing, or both). One entry is made for each circuit group.

Note: Timer default values in parenthesis are ITU values.

Parameter Name	Default	Range	Usage
CIRCUIT	none	1 to MAX_CIRCUITS	The number of the first circuit in this group. Circuits in this group are numbered from this value to (value+ NUM_CIRCUITS - 1). This range must be unique for all circuits defined. This value is used by the application and the ISUP layer to identify circuits, but has no meaning to the far exchange.
CIC	1	0 to 4095	The circuit identification code (CIC) of the first circuit in this group. Circuits in this group are assigned CICs from this value to (value + NUM_CIRCUITS-1). The number range must agree with the CICs assigned to this circuit group at the far exchange.
DPC	none	N/A	The destination point code to which this circuit group connects.
CIRCUIT_TYPE	INCOMING	INCOMING, OUTGOING, BOTHWAY	Direction of calls allowed on this circuit group.
CONTROL_TYPE	NONE	NONE, ALL, ODD_EVEN	Dual seizure control.
GROUP_CHARS	0	0 to 0xff	This value, if non-zero, is placed in the Group Characteristics of the CVR message.

Parameter Name	Default	Range	Usage
SWITCH_TYPE	ANSI92	ITU, ITUWHITE, ITUBLUE, ITU97, ETSIV2, ETSIV3, Q767, ANSI88, ANSI92, ANSI95, JNTT	The protocol variant employed for this application. Must match (one of) the switch type(s) defined in the NSAP definition section.
SSF	0xff (NSAP)	NATIONAL, INTER-NATIONAL, 0-3, RESERVED, SPARE, 0x0ff	The NSAP value is the default, however, putting a value in this field overrides the default.
NUM_CIRCUITS	1	1 to 4095	The number of circuits in this circuit group.
T4_TIMER	0	0 to 65535	Time to wait for call modification complete message.
T12_TIMER	12 (15)	0 to 65535	Time to wait for response to blocking message.
T13_TIMER	60 (300)	0 to 65535	Time to wait for a response to the initial blocking message sent.
T14_TIMER	12 (15)	0 to 65535	Time to wait for a response to an unblocking message sent.
T15_TIMER	60 (300)	0 to 65535	Time to wait for a response to the initial unblocking message sent.
TVAL_TIMER	30	0 to 65535	ANSI circuit validation timer.
TPAUSE_TIMER	2	0 to 65535	Time to wait after MTP Pause before resetting circuits.
END	N/A	N/A	Marks the end of this circuit group definition.

Chapter 7

SS7 SCCP Configuration

7.1 Introduction to the SCCP Layer

The SS7 SCCP layer builds on the services of the MTP layer to provide SS7 applications with a higher level transport subsystem. In particular the SCCP layer adds the following services to those provided by the MTP layers:

- The ability to address individual applications or databases, known as *subsystems*, at a signaling point through a SCCP-level address consisting of a point code and a *subsystem number.*
- An OSI-like connectionless transport service.
- An OSI-like connection-oriented transport service.
- An address translation mechanism, called *global title translation*, which can translate a string of digits (such as a telephone number or mobile identification number) into a point code and/or subsystem number, isolating applications from changes in the physical SS7 network structure.
- A subsystem management layer which tracks the status of targeted subsystems at particular signaling points, known as *concerned signaling points*, and can optionally associate a *backup signaling point* with a subsystem for high availability applications.

Applications access these services either directly from the SCCP layer or indirectly through the TCAP layer.

The SS7 SCCP layer implements these services through the configuration of several entities: User Service Access Points, Network Service Access Points, Routes, and Address Translations, in addition to general configuration parameters which control the operation of the SCCP layer as a whole.

User Service Access Points (User SAPs) define the interface between the user applications and the SCCP layer. One user SAP is defined for each application using the SCCP layer services. A user SAP is associated with a single subsystem number and protocol variant (ANSI or ITU-T). The user SAP defines whether the application is replicated on another node for reliability purposes, and lists any *concerned point codes* (nodes which must be notified of any change in the status of the application). Figure 7 illustrates the concept of user SAPs. Note that when the application interfaces to the TCAP layer, the TCAP SAPs map one-for-one with a SCCP user SAP.

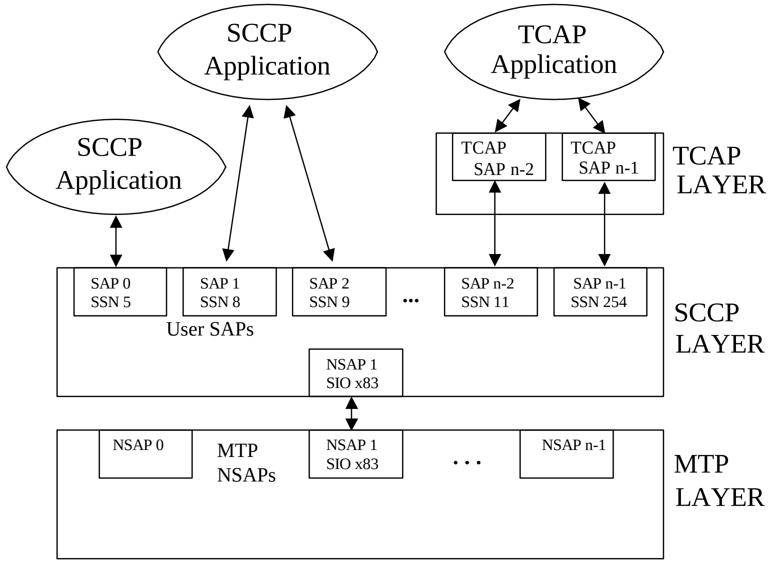

Figure 7. SCCP User Service Access Points

Network SAPs define the interface between the SCCP layer and the MTP layer 3. One network SAP is defined for each MTP 3 layer interface that the SCCP layer uses. Typically the SCCP layer has only a single network SAP, although if the same system supports multiple *protocol variants* (ANSI and ITU-T), the SCCP layer would have a separate network SAP for each switch type.

One *route* is defined for each destination signaling point that the SCCP layer may be used to access. The route defines the destination point code of that signaling point and each subsystem of interest at that signaling point as well as any backup point codes which replicate those subsystems. If the SCCP *default routing* feature is employed, all routing is deferred to the MTP layers and no SCCP routes need not be defined. This is described in detail in Section 7.4.

Address Translation entries define how the SCCP layer is to translate and/or route between global titles, point codes, and subsystem numbers. Global title translation is described in more detail in Section 7.5.

Figure 8 illustrates the relationship between the various configurable entities.

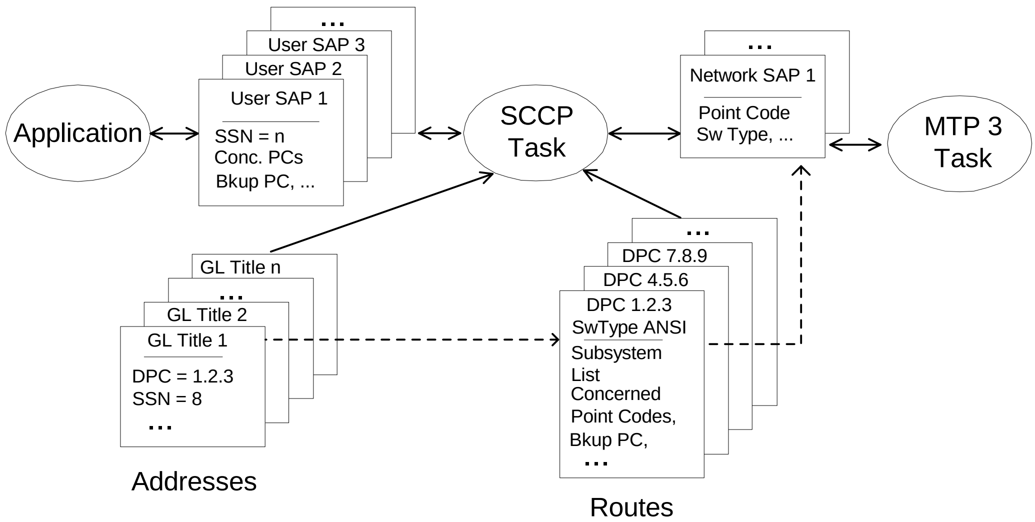

Figure 8. SCCP Configurable Entities

7.2 The SCCP Configuration

The SS7 SCCP software contains a utility program, *sccpcfg*, which reads a text configuration file and downloads the specified configuration to the SCCP task on the TX board, typically as part of the download sequence.

The general format of the SCCP configuration file is provided here:

```
<General Configuration Parameters>
<User SAP 0 definition>
<SAP Parameters>
END
<User SAP n-1 definition>
<SAP Parameters>
END
<NSAP definition>
<NSAP Parameters>
END
<Address Translation definition>
<Address Translation Parameters>
END
<Address Translation definition>
<Address Translation Parameters>
END
<Route 0 definition>
<Route Parameters>
END
<Route m-1 definition>
<Route Parameters>
END
```

7.3 Sample SCCP Configuration File

The SCCP distribution software contains sample configuration files for both ANSI and ITU-T configurations. These configurations may be used in conjunction with the MTP sample configuration files to test SCCP applications using two TX boards in a back-to-back arrangement (see Chapter 3). The following example shows the sample ANSI configuration file for one board.

Note: All SCCP timer values are in seconds; a timer value of zero disables that timer.

```
#
# Sample SCCP configuration file for the following configuration
#
#       General:
#       4 user APPs max
#       1 MTP3 network SAP
#       all others general defaults
#       User SAPs:
#       ANSI-92, 1.1.2 is concerned PC
#       Network Saps:
#       ANSI, point code = 1.1.1
#       Routes:
#       1 to 1.1.2, SSNs 3 & 4, 1.1.2 is concerned PC
#       Address translations:
#       8477069701 = far point code, SSN 3, 8477069700
#       847xxxxxxx = far point code, SSN 4
#
# General Configuration Section
MAX_USERS         4         # Max SCCP user applications
MAX_NSAPS         2         # Number of MTP3 interface (max 1
                            # per switch type)
MAX_SCLI          1         # Max simultaneous sequenced
                            # connectionless data xfers (Class 1 only)
MAX_ADDRS         2         # Max Address translation entries
MAX_ROUTES        10        # Max far point codes SCCP knows
DEF_ROUNTING      FALSE     # Set Default Routing (FALSE=OFF, TRUE=ON)
SAVE_CONNS        FALSE     # Drop connections on lost link
                            # (FALSE) or don’t drop (TRUE).
ALARM_LEVEL       1         # Set alarm level reporting (0=off,
                            # 1=default, 2=debug, 3=detail)
TRACE_DATA        FALSE     # Set data tracing (FALSE=OFF, TRUE=ON)
MAX_ADJDPC        2         # Max far point codes directly adjacent to us
MAX_MSGDRN        5         # Max msgs to send in a batch when MTP comes
                            # up. (prevents flooding when link(s)come up)
MAX_XUDT          1         # Number of control blocks to allocate for
                            # reassembling segmented extended
                            # UnitDaTa (ITU-92 only)
```

```
MAX_XUDTXREF      2         # Max number of local references
                            # used to segment eXtended UnitDaTa
MAX_CONN          512       # Max number of simultaneous connections
CONN_THRESH       1         # Minimum number of SCCP buffers
                            # that must be available for new
                            # connection to be accepted
QUEUE_THRESH      8         # Max number of buffers that can
                            # be queued for connection waiting
                            # for conn window to open
SOG_THRESH        3         # Minimum number of SCCP buffers
                            # that must be available for SOR
                            # request from replicated (backup)
                            # subsystem to be accepted

# Note all timer values are in seconds (0 disables timer)
XREFFRZ_TIMER     2         # wait before reusing local reference
#ASMB_TIMER       0         # wait for all segments of
                            # segmented XUDT (ITU-92 only)
FREEZE_TIMER      2         # wait before reusing connection reference
CONN_TIMER        180       # wait for response to connection request
TXINACT_TIMER     600       # wait with no outgoing packets on
                            # a connection before issuing
                            # Inactivity test (IT) message
RXINACT_TIMER     900       # wait with no incoming packets on
                            # a connection before releasing
                            # connection (should be > TXINACT_TIMER)
REL_TIMER         10        # wait for response to release request
#REPREL_TIMER     0         # wait for response to 2nd release
                            # request (ITU only)
#INTERVAL_TIMER   0         # wait before reporting abnormal
                            # release (ITU only)
GUARD_TIMER       2         # wait after MTP3 traffic restart
                            # before application traffic
RESET_TIMER       30        # wait for response to Reset Request
#SCLI_TIMER       0         # max time sequenced
                            # connectionless transmission can
                            # take(class 1)
SST_TIMER         30        # time between subsystem status tests
SRT_TIMER         30        # time between subsystem routing tests

NSAP_TIMER        1         # time between bursts of messages
                            # to MTP3 when draining built-up
                            # queue (prevents congestion when
                            # link comes back up
IGNORE_TIMER      30        # delay after receiving SOG before
                            # actually going out of service
COORD_TIMER       30        # wait for grant to go out of
                            # service (SOG) after issuing SOR request
END
#
```

```
# User SAP configuration for 1st application
#
USER_SAP          0          # Sap number start at 0
SWITCH_TYPE       ANSI92     # one of ITU92, ITU88, ANSI92, ANSI88
#BACKUP_PC        1.2.3      # this application not replicated for now

#Concerned point codes (Nodes to be notified of App's availability) up to 8
CONC_PC           1.1.2
ADDR_MASK         FFF0000000 # requires match on only 1st 3
                             # digits of global title
MAX_HOPS          10         # maximum network hops
END                          # User application 0
#
# User SAP configuration for 2nd application
#
USER_SAP          1          # Application 1
SWITCH_TYPE       ANSI92     # one of ITU92, ITU88, ANSI92, ANSI88
#BACKUP_PC        1.2.3      # this application not replicated for now

#Concerned point codes (Nodes to be notified of App's availability) up to 8
CONC_PC           1.1.2
ADDR_MASK         FFF0000000 # requires match on only 1st 3
                             # digits of global title
MAX_HOPS          10         # maximum network hops
END                          # User application 1
#
# User SAP configuration for 3rd application
#
USER_SAP          2          # Application 2
SWITCH_TYPE       ANSI92     # one of ITU92, ITU88, ANSI92, ANSI88
#BACKUP_PC        1.2.3      # this application not replicated for now

# Concerned point codes (Nodes to be notified of Apps availability) up to 8
CONC_PC           1.1.2
ADDR_MASK         FFF0000000 # requires match on only 1st 3
                             # digits of global title
MAX_HOPS          10         # maximum network hops
END                          # User application 1
#
# User SAP configuration for 4th application
#
USER_SAP          3          # Application 3
SWITCH_TYPE       ANSI92     # one of ITU92, ITU88, ANSI92, ANSI88
#BACKUP_PC        1.2.3      # this application not replicated for now
# Concerned point codes (Nodes to be notified of App's availability) up to 8
CONC_PC           1.1.2
ADDR_MASK         FFF0000000 # requires match on only 1st 3
                             # digits of global title
MAX_HOPS          0          # maximum network hops
END                          # User application 1
```

```
#
# Network (MTP3) Saps - one per switch type
#
NSAP                 1          # SCCP must be NSAP 1 if isup present too
SWITCH_TYPE          ANSI       # one of ITU, ANSI
DPC                  1.1.1      # REQUIRED - this node's point code
DPC_LEN              4          # normally wouldn't specify this -
                                # let it default based on switch type
MSG_LEN              256        # MTU length on this network
TXQ_THRESH           20         # max packets queued to this MTP3
ADDR_MASK            FFFFFFFFFF # match 10 digits for global title
                                # translation of incoming packets
MAX_HOPS             10         # maximum network hops
END                             # of ANSI MTP3 NSAP
#
# Address Translations: 8477069701
#
ADDRESS              8477069701 # global title - incoming
REPLACE_GLT          TRUE       # remove translated global title
                                # from message
SWITCH_TYPE          ANSI       # one of ITU, ANSI
NI_IND               NATIONAL   # one of NATIONAL [NAT],INTERNATIONAL [INTL]
ROUTING_IND          C_SSN      # set outgoing routing flag(PC_SSN or GLT)
DPC                  1.1.2      # translated destination point code
SSN                  3          # translated subsystem number
GT_FORMAT            1          # outgoing global title includes
                                # translation type, numbering
                                # plan, and encoding scheme
TRANS_TYPE           2          # translation type
NUM_PLAN             1          # ISDN numbering plan
GL_TITLE             8477069700 # outgoing global title
END                             # of address translation for 8477069701
#
# Address Translations: 847xxxxxxx
#
ADDRESS              847        # global title - incoming
REPLACE_GLT          FALSE      # include translated global title
                                # in message
SWITCH_TYPE          ANSI       # one of ITU, ANSI
NI_IND               NATIONAL   # one of NATIONAL [NAT].INTERNATIONAL [INTL]
ROUTING_IND          GLT        # set outgoing routing flag(PC_SSN or GLT)
DPC                  1.1.2      # translated destination point code
SSN                  4          # translated subsystem number
END                             # of address translation for 847xxxxxxx

#
# Routes: 1 for each node known to the SCCP layer
#
ROUTE               1.1.2       # destination point code
SWITCH_TYPE         ANSI        # one of ITU, ANSI
```

```
ADJACENT        TRUE         # this dest directly adjacent
TRANSLATOR      FALSE        # not a translator node
#BACKUP_PC      x.y.z        # this node not currently replicated

       #define all subsystems of interest at 1.1.1 (up to 8)
SSN             3            # first subsystem at 1.1.2
SSN_SNR         TRUE         # normal routed
SSN_ACC         TRUE         # initially accessable
#SSN_BPC        x.y.z        # this subsystem not currently replicated
       # concerned point codes - other nodes to be notified when
       # status of this SSN at this node changes - must have a
       # route for any point code listed here
#CONC_PC        q.r.s        # 1st concerned point code
#CONC_PC        q.r.t        # 2nd concerned point code
END                          # of route 1.1.2, SSN 3

SSN             4            # another subsystem at 1.1.2
SSN_SNR         TRUE         # normal routed
SSN_ACC         TRUE         # initially accessable
#SSN_BPC        x.y.z        # this subsystem not currently replicated
       #concerned point codes - other nodes to be notified when
       # status of this SSN at this node changes - must have a
       # route for any point code listed here
#CONC_PC        q.r.s        # 1st concerned point code
#CONC_PC        q.r.t        # 2nd concerned point code
END                          # of route 1.1.2, SSN 4

END                          # of route 1.1.2
```

7.4 Using Default Routing

The *SCCP Default Routing* feature allows routing of SCCP packets generated by local applications (either directly via the SCCP API or through the SS7 TCAP layer) to signaling points whose point codes and subsystem numbers are not pre-configured.

This feature is primarily intended for applications that will act as databases, or servers, in an SS7 network and cannot be pre-configured with the point codes of all clients that will access the server. This feature may also be suitable for other SCCP and/or TCAP based applications that do not require the signaling point and subsystem management features of the SCCP management functions, such as *replicated subsystems*.

7.4.1 Introduction

When default routing is enabled, the SCCP layer attempts to deliver messages for which it has no explicit route entry by relying solely on the MTP layer routing. This applies to all classes of SCCP messages: connectionless, connection-oriented, and management. This effectively disables all SCCP management functionality for those remote signaling points/subsystems without explicit routes. This has several ramifications, which are described in Section 7.4.5, *SCCP Limitations When Default Routing is Enabled*.

When default routing is enabled, it may still be desirable to pre-configure routes to certain known destinations, such as adjacent STPs/translators, or other remote subsystems which are replicated and require the SCCP management procedures for routing to backup signaling points in case of outages or congestion.

7.4.2 Enabling Default Routing

Default routing is disabled by default. To enable default routing, the following statement is added to the general configuration parameters section of the SCCP configuration file.

```
DEF_ROUTING  TRUE   # Default Routing (FALSE = OFF, TRUE = ON)
```

7.4.3 Impact of Default Routing on SCCP Message Routing

Routing of outbound messages by the SCCP layer is now performed as follows.

1. Global title translation, if necessary, is performed on the outbound message.
2. The SCCP layer checks for an explicit route to the destination point code. If an explicit route exists, the status of the destination signaling point and subsystem, if known, are checked. If the destination signaling point is active and the destination subsystem available (or unknown - such as routing by global title), the message is passed to the MTP 3 layer for delivery. If the signaling point is not accessible or the subsystem is unavailable, standard routing failure treatment is applied.
3. If no explicit route exists for the destination point code and *default routing* is disabled, standard routing failure treatment is applied.
4. If no explicit route exists for the destination point code and *default routing* is enabled, the message is passed to MTP 3 for delivery. If the MTP 3 layer is unable to deliver the message for any reason, the message is discarded and no notification is given to the application that originated the message.

7.4.4 Impact of Default Routing on SCCP Management

The SCCP layer does not attempt to track the status of signaling points and subsystems which are not explicitly defined with route entries. Subsystem prohibited (SSP) and subsystem allowed (SSA) messages received for signaling points with no explicit route entry are ignored. Likewise, *pause*, *resume*, and *remote user unavailable* indications from the MTP 3 layer regarding signaling points with no explicit route entry are ignored. In effect, signaling points/subsystems with no explicit route entry are always considered available at the SCCP layer.

Subsystem testing is applied only to explicitly configured signaling points and subsystems (that is, SST messages are never sent to destinations with no explicit route entry defined).

If a subsystem test (SST) message is received from a signaling point which is not explicitly configured with a route entry, the appropriate response (SSA if the local subsystem is available, no response if the local subsystem is prohibited or unequipped) is returned, provided that the MTP 3 layer is able to route the response to that signaling point.

If the SCCP layer receives a message from an unknown (not explicitly configured) remote signaling point for a local subsystem which is either prohibited or unequipped, a subsystem prohibited (SSP) message is returned to the originating signaling point, provided that the MTP 3 layer is able to route to that signaling point. The appropriate message return (connectionless) or connection refusal (connection request) procedures are also performed.

7.4.5 SCCP Limitations When Default Routing is Enabled

As described above, use of *default routing* effectively disables the SCCP layer management functions for those signaling points not explicitly configured with route entries. This section summarizes many of the limitations which result from the use of default routing.

- If a **local** subsystem is to be replicated and take advantage of the SCCP layer’s ability to route incoming messages to the backup signaling point when the local application is unavailable, an explicit route to the backup signaling point must be configured.
- If a **remote** subsystem is to be replicated and take advantage of the SCCP layer’s ability to route outgoing messages to the backup signaling point when the primary signaling point or subsystem is unavailable, explicit routes to both the primary and backup signaling points must be configured.
- If a local application (SCCP or TCAP API user) wishes to receive status indications for a remote signaling point/subsystem when it becomes available, unavailable, or congested then an explicit route entry must be configured for each such remote signaling point and it must be listed as a concerned point code in the application’s user SAP configuration.
- If a remote subsystem is to receive automatic SSP and SSA messages when a local application (SCCP or TCAP API user) declares itself unavailable/available then an explicit route entry must be configured for each such remote signaling point and it must be listed as a concerned point code in the application’s user SAP configuration.
- Subsystem prohibited (SSP) and subsystem allowed (SSA) messages received for signaling points with no explicit route entry are ignored. In effect, signaling points/subsystems with no explicit route entry are always considered available at the SCCP layer.

7.5 Configuring Global Title Translations

The SS7 SCCP layer supports global title translation, a feature which allows applications to address messages with a string of digits, such as a telephone number or a mobile identification number, and rely on the network configuration to route the message to the correct destination signaling point and subsystem. This can help isolate applications from changes in the network structure, such as when a particular network database is moved from one signaling point code to another. This feature is available for both applications accessing the SCCP layer directly and for applications using the SCCP layer indirectly through the TCAP layer.

The SCCP layer can translate a global title into its final destination address (point code and subsystem number) or, more likely, into the address of a *gateway STP.* A gateway STP is typically an STP containing a global title translation capability which acts as the entry point to a network for all requests originating from outside the network. In either case, the global title digits may be carried through in the translated address for subsequent translation by the gateway STP or analysis by the destination application.

Consider the example network diagram shown in Figure 9. The SCCP application uses both the 800 number translation and 900 number translation services provided by the databases shown.

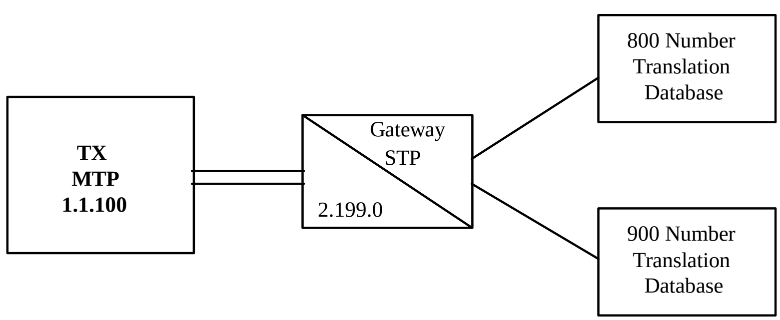

Figure 9. Example Global Title Translation Network Diagram

In this case, the network addresses (point codes) of these databases are not known to the node; only the address of the gateway is configured in the SS7 configuration files.

When the application sends a request for either an 800 number or 900 number translation, it generates a SCCP request (or TCAP request) with the 10-digit 800 or 900 number to be translated as the global title digits and the routing indicator field set to *route by global title*. The application does not include a point code or subsystem number in the destination address.

The following SCCP sample configuration illustrates the configuration of the address translation.

- The ADDRESS_MASK parameter for the user SAP that corresponds to this application is set to `FFF0000000`. This causes the SCCP layer to choose the first address translation entry whose first 3 digits match the first three global title digits in the message whose address is being translated.
- The configured address translation for both 800 and 900 numbers specifies the point code of the gateway STP, which will perform subsequent global title translation on the message's destination address to insert the actual point code of the appropriate database. A subsystem number is also included here, although it could also be inserted by the gateway STP.
- The configured address translation for both 800 and 900 numbers specifies a routing indicator of *route by global title* to indicate to the gateway STP to perform global title translation; it also indicates that the original global digits are *not* to be replaced in the outgoing message so that the gateway STP may perform the subsequent translation.

The following example illustrates ANSI address formats:

```
#
# Sample configuration of Global Title Translation
< … General Parameters >
# User SAP configuration for example application
USER_SAP          0           # Application 1
SWITCH_TYPE       ANSI92      # protocol variant
CONC_PC           2.199.0     # Gateway STP
ADDR_MASK         FFF0000000  # match 1st 3 global title digits
END                           # User application 0

# Address Translations: 800XXXXXXX numbers
ADDRESS           800         # global title - incoming
REPLACE_GLT       FALSE       # retain global title in message
SWITCH_TYPE       ANSI        # Address format - one of ITU, ANSI
NI_IND            NATIONAL    # national address format
DPC               2.199.0     # translated destination point code
SSN               254         # translated subsystem number
ROUTING_IND       GLT         # set outgoing routing flag to GLT
END                           # of address translation for 800xxxxxxx
# Address Translations: 900XXXXXXX numbers
ADDRESS           900         # global title - incoming
REPLACE_GLT       FALSE       # retain global title in message
SWITCH_TYPE       ANSI        # Address format - one of ITU, ANSI
NI_IND            NATIONAL    # national address format
DPC               2.199.0     # translated destination point code
SSN               254         # translated subsystem number
ROUTING_IND       GLT         # set outgoing routing flag to GLT
END                           # of address translation for 900xxxxxxx
< Route entry for gateway STP >
```

The Address Masks have the following properties:

- Incoming messages use the Address Mask(s) defined in the Network SAP section of the SCCP configuration file.
- Outgoing messages use the Address Mask(s) defined in the User SAP section of the SCCP configuration file.
- Up to four Address Masks can be defined in each Network SAP or User SAP section.
- Address Masks are applied in the order they are defined in the configuration file. Therefore, list the most specific mask first, and the most general mask last.

7.6 SCCP Configuration Reference

There are five major sections of the SCCP configuration file - general parameters, user SAP definition, network SAP definition, routes, and circuits.

7.6.1 General Parameters

The general parameters configuration section defines the operational characteristics of the SCCP layer, such as upper bounds for internal data structures (these determine the amount of memory used by the SCCP layer), queue thresholds, and various protocol timer values. It is the first section of the configuration file.

Field Name	Default	Range	Description
MAX_USERS	2	1 to 255	Maximum number of user SAPs.
MAX_NSAPS	1	1 to 255	Maximum number of network SAPs.
MAX_SCLI	20	0 to 65535	Maximum number of simultaneous sequenced connectionless data transfers.
MAX_ADDRS	7	0 to 65535	Maximum number of address translation entries.
MAX_ROUTES	4	0 to 65535	Maximum number of route entries.
MAX_ADJDPC	4	0 to 65535	Maximum number of point codes that can be specified as adjacent (that is, are notified directly by this node of status changes).
MAX_MSGDRN	5	0 to 65535	Maximum number msgs queued to MTP3 to send in one time interval when exiting flow control (5 is the suggested default).
MAX_XUDT	0	0 to 65535	Maximum number of control blocks to allocate for reassembling segmented extended unit data (used only for ITU-92, should be zero for ANSI operation).
MAX_XUDTXREF	0	0 to 65535	Maximum number of local references used to segment extended unit data (used only for ITU-92, should be zero for ANSI operation).

Field Name	Default	Range	Description
MAX_CONN	512	0 to 65535	Maximum number of simultaneous connections.
DEF_ROUTING	FALSE	TRUE | FALSE	Disable (FALSE) or enable (TRUE) default routing feature (see Section 7.4).
PC_FORMAT	DEFAULT	DEFAULT [DFLT], INTER-NATIONAL [INTL], JNTT	Point Codes are interpreted/displayed as 24-bit 8.8.8 values. Point Codes are interpreted/displayed as 14-bit 3.8.3 values. Point codes are interpreted/displayed as 16-bit ***mcode.scode.ucode*** values with the U-code in the most significant 7 bits, the S-code in the next 4 bits, and the M-code in the least significant 5 bits.
SAVE_CONNS	FALSE	TRUE | FALSE	Drop (FALSE) or retain (TRUE) connections when destination inaccessible.
ALARM_LEVEL	1	0 to 3	Alarm level reporting: 0=disable, 1=default, 2=debug, 3=detail.
TRACE_DATA	FALSE	TRUE | FALSE	Disable (FALSE) or enable (TRUE) data tracing.
CONN_THRESH	3	0 to 9	Minimum percentage of board memory that must be available before accepting a new connection in either direction; expressed in units of 10% (for example, 3=30%).
QUEUE_THRESH	3	0 to 32766	Maximum number of data messages that may be queued for a connection waiting for the connection window to open.
SOG_THRESH	1	0 to 9	Minimum percentage of board memory that must be available before granting a Subsystem Out-of-Service (SOR) request from a backup signaling point, expressed in units of 10% (for example, 3=30%).
SCLI_TIMER	2 Secs	0 to 65535	Maximum time that a sequenced connectionless transmission may take before control block is deallocated.
SST_TIMER	30 Secs	0 to 65535	Wait between subsystem status tests.

Field Name	Default	Range	Description
NSAP_TIMER	1 Sec	0 to 65535	Time to wait between draining blocks of queued messages to the MTP 3 layer after exiting flow control (thus used to prevent flooding MTP 3 after network congestion abates - see also MAX_MSGDRN.
SRT_TIMER	30 Secs	0 to 65535	Wait between subsystem routing tests (ANSI only).
IGNORE_TIMER	30 Secs	0 to 65535	Time period after local subsystem goes out of service to ignore subsystem test messages.
COORD_TIMER	30 Secs	0 to 65535	Time to wait for response to coordinated state change request.
XREFFRZ_TIMER	1 Sec	0 to 65535	Time to freeze a XUDT local reference before reusing it (ITU-92 only).
ASMB_TIMER	20 Secs	0 to 65535	Maximum time for reassembling all segments of a XUDT message (ITU-92 only).
FREEZE_TIMER	1 Sec	0 to 65535	Time to freeze a connection local reference before reusing it.
CONN_TIMER	180 Secs	0 to 65535	Wait for response to connection request.
TXINACT_TIMER	600 Secs	0 to 65535	Wait with no outgoing packets on a connection before sending an Inactivity Test message.
RXINACT_TIMER	900 Secs	0 to 65535	Wait with no incoming packets on a connection before clearing connection (should be > TXINACT_TIMER).
REL_TIMER	4 Secs	0 to 65535	Wait for response to release request.
REPREL_TIMER	4 Secs	0 to 65535	Time to wait for response to 2nd release request (ITU-T 92 only).
INTERVAL_TIMER	8 Secs	0 to 65535	Wait to report abnormal release timer.
GUARD_TIMER	1 Sec	0 to 65535	Time to wait after MTP 3 restart before allowing application traffic.
RESET_TIMER	6 Secs	0 to 65535	Time to wait for response to reset request.

Field Name	Default	Range	Description
AIC_TIMER	480 Secs	0 to 65535	Time with no application activity for an active connection before SCCP generates a Connection Inactivity Indication event. Used only if the application inactivity control is enabled for that user SAP.
AIC_RESP_TIMER	10 Secs	0 to 65535	Time application gets to respond to a Connection Inactivity Indication event. Used only if the application inactivity control is enabled for that user SAP.
ACR_TIMER	10 Secs	0 to 65535	Time application gets to respond to an incoming connection indication with either a connection response or release request before SCCP layer refuses connection. If value is zero, then no timing for application response is performed.
SCCP_ALARM_ LEVEL	1	1 to 3	Desired level of alarms generated by SCCP layer. Must be one of: • 1 (Normal) - Normal service impacting alarms. • 2 (Debug) - All Normal alarms plus all messages in or out. • 3 (Detail) - All Debug alarms plus detailed events.
MEM_THRESH_1	10	0 to 99	Percentage of board memory available at which memory congestion level 1 starts.
MEM_THRESH_2	8	0 to 99	Percentage of board memory available at which memory congestion level 2 starts.
MEM_THRESH_3	5	0 to 99	Percentage of board memory available at which memory congestion level 3 starts.
END	N/A	N/A	This is a required parameter that denotes end of the section.

7.6.2 User Service Access Point (USAP) Definitions

One user SAP is defined for each application using the SCCP layer services. A user SAP is associated with a single subsystem number and switch type (ANSI88, ANSI92, ANSI96, ITU88, or ITU92). The user SAP defines whether the application is replicated on another node for reliability purposes, and lists any *concerned point codes* (nodes which must be notified of any change in the availability of the application).

Field Name	Default	Range	Description
USER_SAP	None	0 to (MAX_USERS-1)	Marks start of a User SAP definition. User SAP numbers start at 0 and are numbered sequentially up to MAX_USERS-1.
SWITCH_TYPE	ANSI92	ITU88, ITU92, ITU96 ANSI88, ANSI 92, ANSI96	Protocol variant employed on this user SAP.
BACKUP_PC	None	Use "dotted" notation, 2.45.76, or hex number, 0x101.	Point code where this subsystem is backed up.
CONC_PC	None	Use "dotted" notation, 2.45.76, or hex number, 0x101.	Concerned point code to be notified of changes in the availability of this application; up to eight CONC_PC entries (on separate lines) are allowed per User SAP.
ADDR_MASK	FFF...F	N/A	ASCII string describing which digits of global title to match on when performing global title translation (see *note*). Up to four ADDR_MASK entries are allowed per User SAP.
MAX_HOPS	10	1 to 15	Hop count value to be used on outgoing SCCP messages from this SAP.

Field Name	Default	Range	Description
INACT_CONTROL	False	True /False 0/1 Yes/No	When true, enables SCCP inactivity timing on connections associated with this SAP, allowing SCCP to detect and clear connections that the application has lost track of. Application must handle Connection Inactivity Indication event and respond with Connection Inactivity Response if this feature is enabled.
CONG_THRESH_1	600	1 to 2000	Number of messages outstanding to a higher level task (such as TCAP) or a user application at which inbound congestion level 1 starts.
CONG_THRESH_2	900	1 to 2000	Number of messages outstanding to a higher level task (such as TCAP) or a user application at which inbound congestion level 2 starts.
CONG_THRESH_3	1200	1 to 2000	Number of messages outstanding to a higher level task (such as TCAP) or a user application at which inbound congestion level 3 starts.
END			This is a required parameter that denotes end of the section.

Note: Address masks are ASCII strings containing a `0` (zero) or `f` in each character position to determine whether the corresponding global title digit is used in the match. For example, the string `000fffffff` will result in ignoring the 1st three digits and comparing only last 7 digits when searching the global title table for a match. Similarly, the string `fff` will compare only the first 3 digits to determine a match.

7.6.3 Network Service Access Point (NSAP) Definitions

The Network SAP defines the point at which the SCCP layer accesses the network (MTP 3) layer. One network SAP is defined for each switch type (ANSI or ITU-T) supported. The NSAP number assigned in this section (NSAP ***number*** statement) must match a valid NSAP number defined in the NSAPs section (NSAP ***number*** statement) of the MTP 3 configuration file.

Note: If both the SCCP and ISUP layers are used on the same board, the SCCP layer cannot be assigned to MTP3 NSAP 0 (zero); ISUP always uses this NSAP.

Field Name	Default	Range	Description
NSAP	None	0 to (MAX_NSAPS-1)	Marks start of a Network SAP definition; NSAP numbers start at 0 and are numbered sequentially up to MAX_NSAPS-1 (this must match a NSAP number defined in the MTP 3 configuration).
SWITCH_TYPE	ANSI	ITU, ANSI	Protocol variant employed on this NSAP.
SSF	NATL (ANSI), INTL (ITU)	INTERNATIONAL | ITL, SPARE, NATIONAL | NATL, RESERVED | RES	The value to be used in the sub-service field for this network.
DPC	None	Use "dotted" notation, e.g., 2.45.76 or hex number, e.g., 0x101	Point code of this node on this network interface. This parameter is required.
DPC_LEN	24 (ANSI | ITU) 14 (ITU)	14 or| 24	Point code length employed on this network.
MSG_LEN	256	32 to 1500	Maximum length of a message passed to MTP 3 on this SAP.
TXQ_THRESH	20	0 to 32766	Maximum number of messages to queue to MTP 3 (that is, when flow control is on) before discarding.

Field Name	Default	Range	Description
ADDR_MASK	FFF...F	N/A	Ascii string describing which digits of global title to match on when performing global title translation (refer to the note below and also note from User SAP section). Up to four ADDR_MASK entries are allowed per Network SAP.
MAX_HOPS	10	1 to 15	Hop count value to be used when returning undeliverable incoming messages back to the source of the message.
SCCP_NI_IND	0 (ITU) 1 (ANSI)	0 or 1	Used by SCCP for national/international indicator in called/calling party address parameter of outgoing SCCP management messages.
END			This is a required parameter that denotes end of the section.

Note: The Network SAP address mask is used only when providing global translation for *incoming* messages (those received from the network). For messages originated by an application on this node, the User SAP address mask is used.

7.6.4 Address Translation Definitions

Address entries define how the SCCP layer is to translate and/or route between global titles, point codes, and subsystem numbers. A global title may translate into one of the following:

- A point code and subsystem number (use GT_FORMAT 0)
- Another global title only (in this case the message to be routed must include a destination point code in addition to the incoming global title)
- Another global title + point code
- Another global title + subsystem number (in this case the message to be routed must include a destination point code in addition to the incoming global title)
- Another global title + point code + subsystem number

Multiple address translations may be configured, up to the MAX_ADDRS value specified in the general parameters section.

Field Name	Default	Range	Description
ADDRESS	None	N/A	Incoming global title string, ascii (ASCII digits (for example 0-9).
REPLACE_GLT	FALSE	TRUE | FALSE	If TRUE, replace translated global title in outgoing message If FALSE, incoming global title and translated point code & subsystem are copied to outgoing message.
SWITCH_TYPE	ANSI	ITU | ANSI	Format of this address.
NI_IND	NAT	NATIONAL | NAT, INTERNATIONAL | INTL	National/International indicator.
ROUTING_IND	PC_SSN	PC_SSN, GLT	Routing indicator for translated address, either `route by PC & SSN` or `route by global title`.
SSN	None	0 to 255	Translated subsystem number (required for GT_FORMAT 0).

Field Name	Default	Range	Description
DPC	None	Use dot notation, (such as 2.45.76) or a hex number (such as 0x101).	Translated destination point code (required for GT_FORMAT 0).
GT_FORMAT	0	0 to 4	Defines structure of outgoing global title. Used only when REPLACE_GLT parameter is TRUE.
		0	No global title translation.
		1	ANSI: Outgoing global title includes translation type, numbering plan, and encoding scheme. ITU: Outgoing global title includes nature of address indicator.
		2	ANSI and ITU: Outgoing global title includes translation type only.
		3	ITU only: Outgoing global title includes translation type, numbering plan, and encoding scheme.
		4	ITU only: Outgoing global title includes translation type, numbering plan, encoding scheme, and nature of address indicator.
GL_TITLE	None	N/A	Outgoing global title string (ASCII digits; such as 0-9). Used only when REPLACE_GLT parameter is TRUE.
TRANS_TYPE	0	0 to 255	Outgoing global title translation type, used only when REPLACE_GLT parameter is TRUE.
NAT_ADDR	3	0 to 4	Outgoing global title nature of address indicator (ITU only). Used only when REPLACE_GLT parameter is TRUE.
NUM_PLAN	1	0 to 15	Outgoing global title numbering plan (ISDN Numbering Plan). Used only when REPLACE_GLT parameter is TRUE.
END	N/A	N/A	A required parameter that denotes the end of the section.

7.6.5 Route Definitions

A route configuration entry defines a point code (and its subsystems) known to this node. A route entry must be defined for each point code and switch type to which this node may send SCCP messages.

Note: Each route definition contains one or more subsystem definitions, each of which spans multiple lines and is terminated with an END statement. Each route definition as a whole is also terminated with an END statement. Mismatched END statements are a common cause of configuration errors and can cause unpredictable results.

Field Name	Default	Range	Description
ROUTE	None	Use dot notation (such as 2.45.76) or a hex number (such as 0x101).	Destination point code. This parameter is required.
SWITCH_TYPE	ANSI	ITU | ANSI	Protocol variant for this point code.
TRANSLATOR	TRUE	TRUE | FALSE	If TRUE, this signaling point is a translator node.
ADJACENT	TRUE	TRUE | FALSE	If TRUE, this signaling point is adjacent for SCCP point code & subsystem management procedures.
BACKUP_PC	None	Use dot notation, (such as 2.45.76) or a hex number (such, 0x101).	Backup point code. If not present, signaling point is not replicated.
SSN	None	0 to 255	Subsystem number, also denotes beginning of Subsystem definition subsection which itself is terminated by END statement; up to 8 subsystem definition subsections may be included in each route definition.
SSN_SNR	TRUE	TRUE | FALSE	Subsystem is normal routed (TRUE) or backup routed (FALSE)

Field Name	Default	Range	Description
SSN_ACC	TRUE	TRUE | FALSE	Subsystem is initially accessible (TRUE) or not (FALSE).
SSN_BPC	None	Use dot notation (such as 2.45.76) or a hex number (such as 0x101)	Subsystem backup point code (if not present, subsystem is not replicated).
SSN_UP_ON_RESUME	1	0 | 1	A value of 1 specifies that the subsystem is immediately put back in service when a Point Code Resume message is received from MTP. The Subsystem Test procedure is not started. A value of 0 disables this functionality.
CONC_PC	None	Use dot notation (such as 2.45.76) or a hex number (such as 0x101)	Concerned point code to be notified of changes in the availability of this subsystem; up to eight CONC_PC entries (on separate lines) are allowed per subsystem per route.
END	N/A	N/A	This is a required parameter thatthe denotes end of `current subsystem` definition subsection (repeated for each separate SSN section within this route entry).
END	N/A	N/A	This is a required parameter that denotes the end of the `current route` definition section.

Chapter 8

SS7 TUP Configuration

8.1 Introduction to the TUP Layer

Like the ISUP layer, SS7 Telephone User Part (TUP) software provides an interface for applications to establish, maintain, and clear circuit switched connections via the SS7 network. The TUP layer is also responsible for circuit [group] management, such as blocking, unblocking, and resetting of circuits and circuit groups.

The SS7 TUP layer operates in accordance with the CCITT (ITU-T) recommendations Q.721-Q.724 and China GF001 - 9001 *(Technical Specifications of SS7 for the National Telephone Network of China).* TUP is not used in ANSI networks, so there is no applicable ANSI standard for TUP.

The configurable objects represented by the TUP layer are *Circuits, User Service Access Points (User SAPs),* and *Network Service Access Points (NSAPs).* In addition, the TUP layer has a set of general configuration parameters which define the behavior of the TUP layer as a whole.

Circuits are the physical bearer circuits controlled by the TUP layer. Like the ISUP layer, circuits are identified by both a *circuit index* and a *circuit identification code (CIC)*. The circuit index is a number unique across all circuits configured on a particular TX board. This number has only local significance - it is used between the TUP layer and the local call processing application to identify a particular circuit.

The CIC (usually called the *kick*, or *kick code*) is used between signaling points (the SS7 TUP layer and the far exchange that terminates the other end of the circuit) to uniquely identify a particular circuit. The CIC must be configured at both ends of the circuit to identify the exact same bearer facility, for example, the same T1 span and timeslot. CICs need not be unique across circuits that terminate on different far exchanges.

Circuits are specified in the TUP configuration file in *groups*. A group is one or more circuits with contiguous circuit indexes and contiguous CICs that terminate on the same far exchange and have common characteristics. A single circuit group will frequently be used to represent all the timeslots on a single T1 or E1 span, for example. When defining a circuit group, only the circuit index and CIC of the first circuit in the group, along with the number of circuits in the group, are specified. The TUP layer derives the circuit index and CIC for subsequent circuits since they are considered to be contiguous. The starting circuit index and starting CIC for a group need not be the same value.

User SAPs define the interface between the TUP layer and the user applications.

Note: This release of the TUP layer supports only a single user application. Only one user SAP should be configured.

The *NSAP* defines the interface between the TUP layer and the MTP layer. It identifies the MTP network SAP to used by the TUP layer, allowing multiple user parts (TUP, ISUP, and SCCP) to share access to the MTP layer services. Figure 10 illustrates the concept of user SAPs and NSAPs:

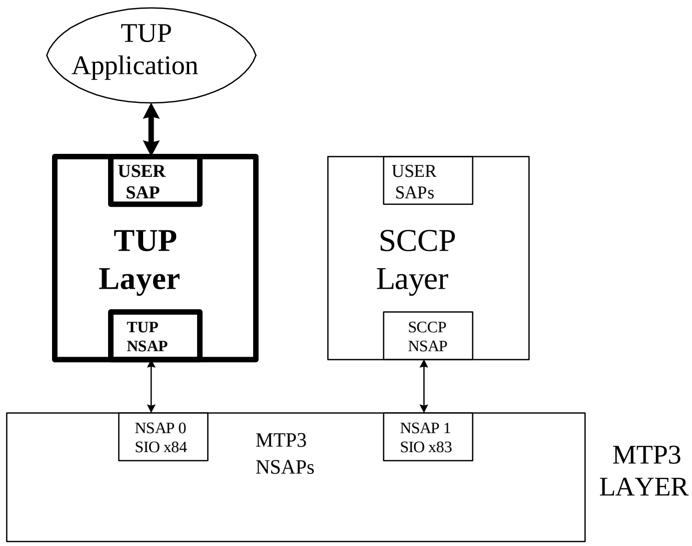

Figure 10. TUP User SAPs and Network SAPs

8.2 The TUP Configuration

The SS7 distribution software contains a utility program, *tupcfg*, which reads a text configuration file and downloads the specified configuration to the TUP task on the TX board, typically as part of the download sequence.

The general format of the TUP configuration file is provided here:

```
<General Configuration Parameters>
<User SAP definition>
<SAP Parameters>
END
<NSAP definition>
<NSAP Parameters>
END
<Circuit Group 1 definition>
<Circuit Group Parameters>
END
<Circuit Group n definition>
<Circuit Group Parameters>
END
```

8.3 Sample TUP Configuration File

The TUP distribution software contains sample configuration files for both ITU-T and China configurations. These configurations may be used in conjunction with the MTP sample configuration files to test TUP applications using two TX boards in a back-to-back arrangement (see Chapter 3). The following example shows the sample ITU-T configuration file for one board:

```
#  TUP Configuration File
# General configuration parameters
MAX_SAPS            1
MAX_NSAPS           2
MAX_CIRCUITS        2048
MAX_GROUPS          16      !max number of circuit groups
MAX_DPCS            16      !max number of dest. point codes
MAX_ROUTES          10      !max number of routes
ALARM_LEVEL         2       !alarm level
TRACE_EVENT         NO      !turning on=YES/off=NO event tracing
TRACE_DATA          NO      !turning on=YES/off=NO data tracing
TIMER_TRACE         NO      !turning on=YES/off=NO timer tracing
CHECKPOINT_TYPE     YES     !enable checkpointing from primary to backup
                            !this parameter is not required in
                            !standalone mode
MTPPAUSE_TIMER      2       !MTP3 Pause timer started when pause is
                            !received from MTP3. On expiration, all of
                            !the configured circuits are cleaned up.
                            !If it is set to zero, then this timer is
                            !disabled.
END
# Service Access Point (SAP)
USER_SAP            0
SWITCH_TYPE         ITU-T   !switch type (ITU-T, CHINA)
QCONGONSET1         64      !user queue congestion onset level 1
QCONGABATE1         32      !user queue congestion abatement level 1
QCONGONSET2         96      !user queue congestion onset level 2
QCONGONSET2         64      !user queue congestion abatement level 2
QCONGONSET3         128     !user queue congestion onset level 3
QCONGONSET3         96      !user queue congestion abatement level 3
END
# Network Service Access Point (NSAP)
NSAP                0       !Network layer SAP Id
MTPSAP              0       !MTP layer SAP Id
SWITCH_TYPE         ITU-T   !switch type (ITU-T, CHINA)
OPC                 0x01    !my point code
SSF                 SSF_NAT !sub-service field value to use
END
#
# Circuit Database
```

```
CIRCUIT                1          !circuit number
CIC                    0          !circuit identification code
DPC                    0x02       !DPC of serving far exchange
NUM_CIRCUITS           200        !number of circuits in this group
GROUP_ID               1
SWITCH_TYPE            ITU-T      !switch type (ITU-T, CHINA)
END
#
# Circuit Group 2
CIRCUIT                201        !circuit number
CIC                    200        !circuit identification code
DPC                    0x02       !DPC of serving stp
NUM_CIRCUITS           200        !number of circuits in this group
GROUP_ID               2
SWITCH_TYPE            ITU-T      !switch type (ITU-T, CHINA)
END
#
# Circuit Group 3
CIRCUIT                513        !circuit number
CIC                    513        !circuit identification code
DPC                    2          !DPC of serving stp
NUM_CIRCUITS           255        !number of circuits in this group
GROUP_ID               3
END
#
END                                # End TUP configuration
```

8.4 TUP Configuration Parameters Reference

There are five major sections of the TUP configuration file: general parameters, user SAP definition, network SAP definition, routes, and circuits.

8.4.1 General Parameters

The general parameters control the overall operation of the TUP layer process.

Parameter Name	Default	Range	Usage
MAX_SAPS	1	1	Defines the maximum number of user applications.
MAX_NSAPS	1	1	Defines the maximum number of interfaces with the MTP 3 network layer.
MAX_CIRCUITS	96	0 to 65535	The maximum number of circuits to be managed by the TUP layer.
MAX_GROUPS	32	0 to 65535	The maximum number of circuit groups managed by the TUP layer.
MAX_DPCS	16	1 to 256	Defines the maximum number of destination point codes configured.
ALARM_LEVEL	1	1 to 4	In order to limit the number of alarms to the more critical ones, set this number closer to 1.
TRACE_EVENT	NO	YES | NO	YES enables event tracing. NO disables event tracing.
TRACE_DATA	NO	YES | NO	YES enables data tracing. NO disables data tracing.
TIMER_TRACE	NO	YES | NO	YES enables timer tracing. NO disables timer tracing.
CHECKPOINT_TYPE	YES	YES | NO	Enables (YES) or disables (NO) checkpointing from primary to backup in redundancy mode. *Note:* This parameter is not required in standalone mode.

Parameter Name	Default	Range	Usage
MTPPAUSE_TIMER	2	0 to 65535	Specifies the maximum duration of an MTP3 pausetimer before clearing circuits associated with a DPC. The MTP3 pause timer starts when a pause is received from MTP3. When the pause timer expires, all the configured circuits associated with the DPC for which the pause is received are cleaned up. Setting the timer value to 0 disables this functionality.
PC_FORMAT	DEFAULT	DEFAULT [DFLT], INTER-NATIONAL [INTL], JNTT	Point Codes are interpreted/displayed as 24-bit 8.8.8 values. Point Codes are interpreted/displayed as 14-bit 3.8.3 values. Point codes are interpreted/displayed as 16-bit ***mcode*.*scode*.*ucode*** values with the U-code in the most significant 7 bits, the S-code in the next 4 bits, and the M-code in the least significant 5 bits.
T20 _TIMER	5	0 to 65535	Time to wait to send the second confirming group reset signal.
T21_TIMER	15	0 to 65535	Time to wait for a response to circuit group reset signal (should be 4-15 seconds).
T22_ TIMER	60	0 to 65535	Time to wait to send another group reset signal.
T23_TIMER	5	0 to 65535	Time to wait to send the second confirming maintenance group block signal.
T24_TIMER	5	0 to 65535	Time to wait to send the second confirming maintenance group unblock signal.
T25_ TIMER	300	0 to 65535	Time to wait to alert maintenance group unblock signal.
T26_TIMER	15	0 to 65535	Time to wait for a response to maintenance group block signal (should be 4-15 seconds).
T27_TIMER	60	0 to 65535	Time to wait to send another maintenance group block signal.
T28_TIMER	15	0 to 65535	Time to wait for a response to maintenance group unblock signal (should be 4-15 seconds).

Parameter Name	Default	Range	Usage
T29_TIMER	60	0 to 65535	Time to wait to send another maintenance group unblock signal.
T30_TIMER	5	0 to 65535	Time to wait to send the second confirming hardware failure group block signal.
T31_TIMER	5	0 to 65535	Time to wait to send the second confirming hardware failure group unblock signal.
T32_TIMER	15	0 to 65535	Time to wait for a response to hardware failure group block signal (should be 4-15 seconds).
T33_TIMER	60	0 to 65535	Time to wait to send another hardware failure group block signal.
T34_TIMER	15	0 to 65535	Time to wait for a response to hardware failure group unblock signal (should be 4-15 seconds).
T35_TIMER	60	0 to 65535	Time to wait to send another hardware failure group unblock signal.
T36_TIMER	5	0 to 65535	Time to wait to send the second confirming software group block signal.
T37_TIMER	5	0 to 65535	Time to wait to send the second confirming software group unblock signal.
T38_TIMER	15	0 to 65535	Time to wait for a response to software group block signal (should be 4-15 seconds).
T39_TIMER	60	0 to 65535	Time to wait to send another software group block signal.
T40_TIMER	15	0 to 65535	Time to wait for a response to software group unblock signal (should be 4-15 seconds).
T41_TIMER	60	0 to 65535	Time to wait to send another software group unblock signal.
END	N/A	N/A	Marks the end of the general section.

8.4.2 Service Access Point (SAP) Definition

The SAP definition defines the characteristics of the TUP service presented to the user application(s).

Note: This release of the TUP layer software allows for configuration of only a single TUP user SAP. Only one application may use the TUP service at a time.

Parameter Name	Default	Range	Usage
USER_SAP	none	0 to MAX_SAPS	SAP number.
SWITCH_TYPE	ITU-T	ITU-T, CHINA	The switch type (version of the TUP protocol employed for this application). Must match (one of) the switch type(s) defined in the NSAP definition section.
QCONGONSET1	32		User queue congestion onset level 1.
QCONGABATE1	16		User queue congestion abatement level 1.
QCONGONSET2	64		User queue congestion onset level 2.
QCONGABATE2	48		User queue congestion abatement level 2.
QCONGONSET3	96		User queue congestion onset level 3.
QCONGABATE3	80		User queue congestion abatement level 3.
END			Marks the end of the SAP section.

8.4.3 Network Service Access Point (NSAP) Definition

The NSAP definition defines the characteristics of the TUP interface to the MTP 3 layer.

Note: This release of the TUP layer software allows for configuration of only a single NSAP. Only one switch type may be handled at a time.

Parameter Name	Default	Range	Usage
NSAP	none		NSAP ID.
SWITCH_TYPE	ITU-T	ITU-T, CHINA	The switch type (that is, the version of the SS7 protocol employed for this MTP 3 interface). Must be either ITU-T or CHINA.
OPC	none	N/A	The Point Code of this node, specified as x.y.z (three bytes, decimal, separated by periods) or as a hexadecimal number (for example, 0***xnnnnn***).
SSF	SSF_NAT	SSF_INTL, SSF_SPARE, SSF_NAT, SSF_RES	The Sub-service field of the SIO in outgoing TUP packets.
MTPSAP	0	0 to MAX_NSAPS	The MTP SAP with which to bind.
END	N/A	N/A	Marks the end of the NSAP section.

8.4.4 Circuit/Group Definitions

The circuit set definitions specify the characteristics of each of the circuit sets to be managed by the TUP layer. This includes the circuit identification codes (CICs) and destination point code (DPC) at the other end of the circuits. One entry is made for each circuit set. Any set can be designated as a predefined group by adding a group number to this definition. A predefined group can more easily be reset, blocked and unblocked with the API or by the network.

Parameter Name	Default	Range	Usage
CIRCUIT	none	1 to 65535	The number of the first circuit in this set. Circuits in this set are numbered from this number to (this number + NUM_CIRCUITS-1). This range must be unique for all circuits defined. This number is used by the application and the TUP layer to identify circuits, but has no meaning to the far exchange.
CIC	0	0 to 4095	The circuit identification code (CIC) of the first circuit in this set. Circuits in this set are assigned CICs from this number to (this number + NUM_CIRCUITS-1). This number range must agree with the CICs assigned to this circuit set at the far exchange.
DPC	none	N/A	The destination point code that this circuit set connect to. Use dot notation (such as 2.45.76) or a hex number (such as 0x101).
GROUP_ID	0	0 to 65535	This is the group ID number to assign to this group of circuits. 0 designates these circuits as not being a group.
NSAP_ID	0	0 to MAX_NSAPS	Which NSAP to use for these circuits, this value should match an NSAP ID in the NSAP definition area.
SWITCH_TYPE	ITU-T	ITU-T, CHINA	The protocol variant employed for this MTP 3 interface.
NUM_CIRCUITS	1	1 to 255	The number of circuits in this circuit set.
T1_TIMER	15	0 to 65535	Time to wait for continuity or continuity failure signal (10-15 seconds).

Parameter Name	Default	Range	Usage
T2_TIMER	30	0 to 65535	Time to wait for address complete signal (20-30 seconds).
T3_TIMER	15	0 to 65535	Time to wait for clear forward signal after sending unsuccessful signal (4-15 seconds).
T4_TIMER	15	0 to 65535	Time to wait for clear forward signal after sending call-failure signal (4-15 seconds).
T5_TIMER	60	0 to 65535	Time to stop sending call-failure signals.
T6_TIMER	15	0 to 65535	Time to wait for release guard signal (4-15 seconds).
T7_TIMER	60	0 to 65535	Time to stop sending clear forward signals.
T8_TIMER	2	0 to 65535	Time to wait for a backward check-tone (should not exceed 2 seconds).
T9_TIMER	5	0 to 65535	Time to delay start first-time continuity recheck (1-10 seconds).
T10_TIMER	180	0 to 65535	Time to delay for multiple re-tests of continuity (60-180 seconds).
T11_TIMER	60	0 to 65535	Time to wait to alert maintenance following initiation of blocking signal.
T12_TIMER	15	0 to 65535	Time to wait for response to blocking signal (4-15 seconds).
T13_TIMER	60	0 to 65535	Time to wait to alert maintenance that a response to the initial blocking signal is not received.
T14_TIMER	60	0 to 65535	Time to wait to repeat blocking signal.
T15_TIMER	15	0 to 65535	Time to wait for a response to an unblocking signal (4-15 seconds).
T16_TIMER	60	0 to 65535	Time to wait to alert maintenance that a response to the initial unblocking signal is not received.
T17_TIMER	60	0 to 65535	Time to wait to repeat unblocking response.

Parameter Name	Default	Range	Usage
T18_TIMER	15	0 to 65535	Time to wait for a response to a reset-circuit signal (should be 4-15 seconds).
T19_TIMER	60	0 to 65535	Time to wait to send another reset-circuit signal.
END	N/A	N/A	Marks the end of this circuit group definition.

Chapter 9

SS7 TCAP Configuration

9.1 Introduction to the TCAP Layer

The SS7 TCAP layer adds transaction services onto the connectionless data transfer service provided by the SCCP layer. Transactions in the SS7 network are typically database queries/responses or requests to activate services in remote switching points.

The SS7 TCAP layer can be configured for either ANSI (see ANSI T1.114) or ITU-T (see Q.771 - Q.775) operation, on a per-application basis. Use of ITU-T TCAP on top of an ANSI MTP/SCCP stack is fully supported. Use of the TCAP layer requires use (and proper configuration of) the SCCP and MTP layers.

The TCAP layer configuration consists of *general configuration parameters* and TCAP *User Service Access Points (SAPs)*. The general configuration parameters define the resource allocation for the TCAP layer: maximum number of user SAPs, maximum number of simultaneous dialogs, and maximum number of outstanding invokes.

User SAPs define the interface between a TCAP user application and the TCAP layer. One user SAP is defined for each application using the TCAP layer services. A user SAP is associated with a single subsystem number and protocol variant (ANSI-88, ANSI-92, ANSI-96, ITU-88, ITU-92, or ITU-97). Each TCAP user SAP maps directly to a SCCP user SAP in the SCCP configuration file (see Chapter 7), although not all SCCP SAPs must be assigned to TCAP applications; some applications may access the SCCP layer directly.

The relationship between TCAP user SAPs and SCCP user SAPs is illustrated in Figure 11.

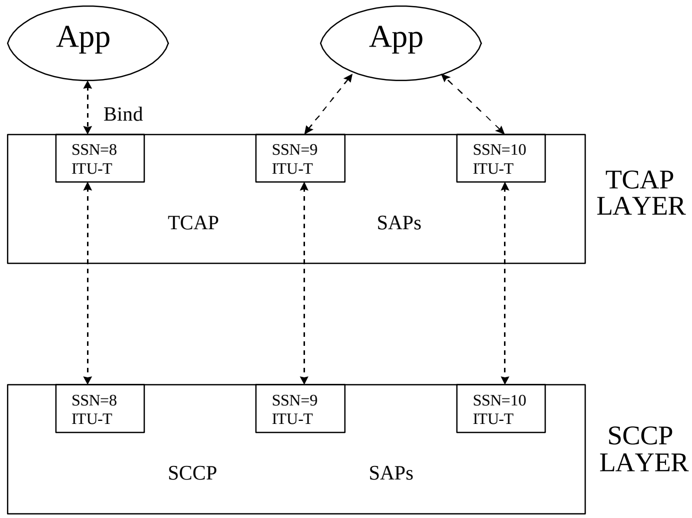

Figure 11. TCAP Service Access Points

9.2 The TCAP Configuration File

The TCAP distribution software contains an application (`tcapcfg`) which reads a text configuration file and downloads it to the TCAP layer on the TX board, typically as part of the boot sequence. A sample configuration file, `tcapcpn.cfg` is included with the distribution software and is shown below.

Note: Not all configurable parameters need be specified in the configuration file. Most will default to reasonable values if not specified.

```
#
# Sample TCAP configuration file for the following configuration
#
#       General:
#           4 user APPs max
#           200 max simultaneous dialogs
#           200 max simultaneous invokes
#           all others general defaults
# General Configuration Section
TCAP_ALARM_LEVEL      1       # standard alarms
MAX_TCAP_USERS        4       # Max TCAP user applications
MAX_TCAP_DIALOGS      200     # Max TCAP simultaneous dialogs
MAX_TCAP_INVOKES      200     # Max TCAP simultaneous invokes
END
#
# User SAP configuration for 1st application
#
USER_SAP              0       # Sap number start at 0
SWITCH_TYPE           ANSI92  # one of ITU92, ITU88, ANSI92, ANSI88
END                           # User application 0
#
# User SAP configuration for 2nd application
#
USER_SAP              1       # Sap number start at 0
SWITCH_TYPE           ANSI92  # one of ITU92, ITU88, ANSI92, ANSI88
END                           # User application 0
#
# User SAP configuration for 3rd application
#
USER_SAP              2       # Sap number start at 0
SWITCH_TYPE           ANSI92  # one of ITU92, ITU88, ANSI92, ANSI88
END                           # User application 0
#
# User SAP configuration for 4th application
#
USER_SAP              3       # Sap number start at 0
SWITCH_TYPE           ANSI92  # one of ITU92, ITU88, ANSI92, ANSI88
END                           # User application 0
```

9.3 TCAP Configuration Reference

The following sections detail the configurable parameters for each configuration section.

9.3.1 General Parameters Definition

The general parameters configuration section defines the operational characteristics of the TCAP layer, mostly upper bounds for internal data structures (these determine the amount of memory used by the TCAP layer). It is the first section of the configuration file.

Field Name	Range	Description
MAX_TCAP_USERS	1 to 512	Maximum number of user SAPs. Default value is 4.
MAX_TCAP_DIALOGS	1 to 32767	Maximum number of TCAP transactions that may be pending at any one time. Default value is 256.
MAX_TCAP_INVOKES	1 to 32767	Maximum number of TCAP invoke operations that may be pending at any one time. Default value is 256.
MIN_TID_LEN	1 to 4	Forces use of transaction IDs of at least the specified number of bytes when using ITU-T TCAP; Primarily for interoperability with certain networks which require use of 4-byte transaction IDs. Default value is 1.
PC_FORMAT	DEFAULT [DFLT], INTER-NATIONAL [INTL], JNTT	Point Codes are interpreted/displayed as 24-bit 8.8.8 values. Point Codes are interpreted/displayed as 14-bit 3.8.3 values. Point codes are interpreted/displayed as 16-bit values in the following format: ***mcode.scode.ucode*** where the U-code occupies the most significant 7 bits, the S-code occupies the next 4 bits, and the M-code occupies the least significant 5 bits. Default value is DEFAULT.
TCAP_ALARM_LEVEL	0 to 3	The level of alarms to be generated by the TCAP layer: 0 = none (not recommended) 1 = service impacting events 2 = individual transaction impacting events (encode/decode errors) 3 = debugging level Default value is 1.

Field Name	Range	Description
TCMEM_THRESH_1	1 to 99	Percentage of memory available in default message buffer pool below which congestion level 1 is triggered. Default value is 20.
TCMEM_THRESH_2	1 to 99	Percentage of memory available in default message buffer pool below which congestion level 2 is triggered. Must be less than TCMEM_THRESH_1. Default value is 15.
TCMEM_THRESH_3	1 to 99	Percentage of memory available in default message buffer pool below which congestion level 1 is triggered. Must be less than TCMEM_THRESH_2. Default value is 10.

9.3.2 User Service Access Point (SAP) Definitions

One user SAP is defined for each application/subsystem using the TCAP layer services. A user SAP is associated with a single subsystem number and switch type (`ANSI88`, `ANSI92`, ANSI96, `ITU88`, or `ITU92`, `ITU97`).

Note: Field names indicated in **bold** are only available with SS7 3.5 and later releases.

Field Name	Range	Description
USER_SAP	0 to (MAX_USERS-1)	Marks start of a User SAP definition. User SAP numbers start at zero and are numbered sequentially up to MAX_USERS-1. There is no default value.
SWITCH_TYPE	ITU88, ITU92, ITU97 ANSI88, ANSI92, ANSI96	Protocol variant used on this SAP. Default value is ANSI92.
TCAP_T1	1 to 32767	Default invocation timer, in seconds (time to wait for response to invoke). Default value is 60.
TCAP_T2	1 to 32767	Time to wait for reject of a non-invoke component, in seconds, before considering operational successful (where applicable). Default value is 60.
TCAP_SEQ_TIMER	1 to 255	Duration to request SCCP to maintain SLS for when sequential delivery required. Default value is 60.
SCCP_SAP	0 to 32766	SCCP SAP ID (from SCCP config.) to map this TCAP SAP onto. By default, set to the same value as the TCAP SAP ID.
ALLOW_INVOKE_END	0 or 1	When set to 1, allows an Invoke component in an ITU-T End message. Default value is 0.

Field Name	Range	Description
SCCP_ADDR_OVERRIDE	0 or 1	SCCP called and calling addresses specified by a user application are ignored for the following messages: • ITU-T: Continue, End, and User Abort • ANSI: Conversation, Response, and User Abort If set to 1, SCCP called and calling addresses specified by the user application are used for all affected messages. Default value is 0.
INACTIVITY_TIMER	0 to 64535	Default inactivity timer. Number of seconds before an inactivity indication is sent for a transaction with no traffic. If set to zero, the inactivity timer is disabled. Default value is 0.
DEFAULT_CHECKPOINT	CHKPT_NONE, CHKPT_SEND, CHKPT_ALL	Default checkpoint value. If set to CHKPT_ALL, all transactions are checkpointed to the backup TCAP task. If set to CHKPT_SEND, only transactions initiated by the TX board are checkpointed. If set to CHKPT_NONE, no transactions are checkpointed. Default value is CHKPT_NONE.
TCQ_THRESH_1	1 to 65535	Number of inbound messages queued to the application before entering level 1 congestion. Default value is 600.
TCQ_THRESH_2	1 to 65535	Number of inbound messages queued to the application before entering level 2 congestion. Must be greater than TCQ_THRESH_1. Default value is 900.
TCQ_THRESH_3	1 to 65535	Number of inbound messages queued to the application before entering level 2 congestion. Must be greater than TCQ_THRESH_2. Default value is 1200.

Chapter 10

SS7 Software Download

10.1 Introduction

The SS7 distribution CD-ROM contains a sample script, *ss7load*, for downloading the SS7 software and configuration files to the TX board(s) for each operating system. The *ss7load* utility may be found in the following locations:

Windows NT/Windows 2000:	*\nms\tx\bin\ss7load.bat*
UnixWare and Solaris:	*/opt/nmstx/bin/ss7load*

The sample script takes a single parameter, the board number, which is required On some operating systems this may default to board 1 if omitted). The following example shows the output of *ss7load* when run on Windows NT or Windows 2000:

```
prompt> ss7load 1
CPMODEL V1.0: Copyright 1998, NMS Communications
Board #1 is a TX2000
Loading: E.0 TX2000 Kernel (c)1996-1997 NMS Communications, Inc. 2/10/97
Loading: diag2000 Version C.1.0 12/10/97
Loading:
Loading: inf Version C.4.0 12/10/97
Loading: mvip Version A.1.0 12/10/97
Loading: t1e1mgr Version A.1.0 12/10/97
Loading: mtp Version B.3.0 01/14/98
mtp2cfg: sample MTP2 configuration application version B.1.0 Jan 14 1998
mtp3cfg: sample MTP3 configuration application version B.3.0 Jan 14 1998
```

The exact contents of the *ss7load* script varies by operating system, but the basic functions executed by *ss7load* are as follows (the order is significant):

1. A utility program is executed to determine the model number of the board so that the correct operating system kernel may be downloaded. For PCI and Compact PCI boards, the kernel exists on flash.

   The *txflash* utility is used to reset PCI and Compact PCI boards. If the version of the operating system on the TX board's flash memory does not match the version installed on the host system, the *txflash* utility automatically updates the board's flash image before resetting the board.

2. The operating system kernel and related utility software modules are downloaded using the *cplot* loader utility.

3. The *mvip* and *t1e1mgr* tasks are downloaded to the board. These tasks enable use of the MVIP switching and T1/E1 configuration/control APIs. If

your system does not use these APIs, these commands may be removed from *ss7load*.

4. The SS7 MTP layer task (*mtp.lot*) is downloaded to the board. This task must be downloaded before any of the other SS7 software layers. This is the only required SS7 module.

5. Any optional SS7 layers which have been manually enabled are downloaded to the board.

6. The *mtp2cfg* (optional) and *mtp3cfg* (required) utilities are executed to download the MTP configuration to the MTP task. Again, the MTP layers must be configured before any of the other SS7 layers.

7. Any optional SS7 configuration utilities which have been enabled are executed to download their respective configurations to the appropriate SS7 layer task. Again, the order shown in the *ss7load* file should be maintained.

By default, the sample *ss7load* script installed with the SS7 MTP package downloads only the MTP software and configuration to the board. The commands to load and configure the other SS7 software layers (ISUP, TUP, SCCP, and TCAP) are present, but commented out.

Note: If you use any of these optional software layers, you must edit the *ss7load* script to enable the download and configuration of the applicable layers.

You may also want to modify the script to change the file and/or path names of the SS7 configuration files as you modify the sample configuration files to meet your system needs.

The following examples show the *ss7load* scripts for Windows NT/Windows 2000 and UNIX systems, respectively.

10.2 Sample ss7load Script for Windows NT/Windows 2000

```
@echo off
REM
REM  Choose redundant or standalone path/file names for configuration files
REM
set TXMODE=standalone
REM set TXMODE=redundant
REM
set TXUTIL=\nms\tx\bin
set TXCP=\nms\tx\cp
set TXCONFIG=\nms\tx\config\%TXMODE%\ansi
set BRD=1
if not "%1"=="" set BRD=%1
REM
REM                TX Series COMMUNICATIONS PROCESSOR BOOT FILE
REM
REM
REM Execute this file to boot/configure a TX Series Communications Processor
REM
REM
REM Get the model number
%TXUTIL%\cpmodel -b %BRD%
if errorlevel 3220 goto boot3220
if errorlevel 3210 goto boot3210
if errorlevel 3000 goto boot3000
if errorlevel 2000 goto boot2000
echo ERROR! Check board number
goto end

:boot3220
%TXUTIL%\txflash -s %TXCP%\cpk3220.bin -b %BRD%
if errorlevel 1 goto failedload
set TXTYPE=3220
goto loadsw

:boot3210
%TXUTIL%\txflash -s %TXCP%\cpk3210.bin -b %BRD%
if errorlevel 1 goto failedload
set TXTYPE=3210
goto loadsw

:boot3000
%TXUTIL%\cplot -c %BRD% -f %TXCP%\cpk3000.lo -k -a -u ss7
if errorlevel 1 goto failedload
set TXTYPE=3000
goto loadsw

:boot2000
```

```
%TXUTIL%\cplot -c %BRD% -f %TXCP%\cpk2000.lo -k -a -u ss7
if errorlevel 1 goto failedload
set TXTYPE=2000
goto loadsw

:failedload
echo ERROR! Kernel failed to load.  Check IRQ and I/O address settings.
goto end

:loadsw
REM
%TXUTIL%\cplot -c %BRD% -f %TXCP%\diag%TXTYPE%.lot   -n diag    -p 2  -a
%TXUTIL%\cplot -c %BRD% -f %TXCONFIG%\TDMcp%BRD%.bin -g tdm
%TXUTIL%\cplot -c %BRD% -f %TXCP%\debug.lot          -n debug   -p 3  -a
%TXUTIL%\cplot -c %BRD% -f %TXCP%\arp.lot            -n arp     -p 17 -a
%TXUTIL%\cplot -c %BRD% -f %TXCP%\inf.lot            -n inf     -p 16 -a
REM
REM download the MVIP and T1/E1 manager tasks to enable use
REM of the MVIP and T1/E1 host APIs; NOTE: if you do not
REM use either of these APIs, remove the following 2 lines.
REM
%TXUTIL%\cplot -c %BRD% -f %TXCP%\mvip.lot           -n mvip    -p 4  -a
%TXUTIL%\cplot -c %BRD% -f %TXCP%\t1e1mgr.lot        -n t1e1mgr -p 15 -a
REM
REM To enable packet tracing in the ISUP or TUP layer, make the following
REM command active to download the ETP trace collector on the board.
REM
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\etp.lot        -n etp     -p 14 -a
REM
REM Load TXMON
REM
REM ****** IMPORTANT NOTE: *******
REM For convenience we are loading TXMON only in redundant mode.  This is
REM convenient because MTP will detect the lack of TXMON and will auto-
REM matically enter standalone mode and attempt to bring up links, without
REM application intervention.  NOTE HOWEVER, TXMON can be used as a health
REM monitor for a single board application in standalone mode.  In this case
REM the MTP will remain in a Starting state until an application (eg. RMG),
REM using the HMI API, specifically sets the mode to Standalone. In other
REM words links will not automatically try to align if TXMON is loaded.
REM
if "%TXMODE%"== "standalone" goto notxmon
%TXUTIL%\cplot -c %BRD% -f %TXCP%\txmon.lot          -n txmon   -p 9 -a
:notxmon
REM
REM Load MTP3 task
REM
%TXUTIL%\cplot -c %BRD% -f %TXCP%\mtp.lot        -n mtp    -p 10 -a -s 12000
REM
REM Enable the following downloads for SS7 layers you do use
```

```
REM
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\sccp.lot       -n sccp    -p 11  -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\isup.lot       -n isup    -p 12  -s
40960 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\tup.lot        -n tup     -p 12  -s
40960 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\tcap.lot       -n tcap    -p 13  -a
REM
REM
REM ISUP only: Enable the download of the ISUP database required for your
configuration.
REM
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\itublue.lot       -n itublue  -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\ituwhite.lot      -n ituwhite -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\q767.lot          -n q767     -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\ansi88.lot        -n ansi88   -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\ansi92.lot        -n ansi92   -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\ansi95.lot        -n ansi95   -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\itu97.lot         -n itu97    -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\etsiv2.lot        -n etsiv2   -p 5 -a
rem %TXUTIL%\cplot -c %BRD% -f %TXCP%\etsiv3.lot        -n etsiv3   -p 5 -a
REM
REM Configure SS7 MTP2, MTP3, ISUP, TUP & SCCP - enable these commands
REM for any SS7 layers you do use
REM
REM NOTE: Level 2 configurability is now available.  However,
REM       level 2 configuration is not strictly necessary.  The defaults
REM       will work for most installations.
REM
%TXUTIL%\mtp2cfg -b %BRD% -f %TXCONFIG%\MTP3cp%BRD%.cfg
%TXUTIL%\mtp3cfg -b %BRD% -f %TXCONFIG%\MTP3cp%BRD%.cfg
if "%TXMODE%"== "standalone" goto stdalncfg
rem
rem  Load redundant configuration files - note that both boards in redundant
rem  pair use the same configuration file
rem
rem %TXUTIL%\sccpcfg -b %BRD% -f %TXCONFIG%\SCCP.cfg
rem %TXUTIL%\isupcfg -b %BRD% -f %TXCONFIG%\ISUP.cfg
rem %TXUTIL%\tupcfg  -b %BRD% -f %TXCONFIG%\TUP.cfg
rem %TXUTIL%\tcapcfg -b %BRD% -f %TXCONFIG%\TCAP.cfg
goto end
:stdalncfg
rem
rem  Load standalone configuration files - note that each board in a
standalone
rem  configuration gets a configuration file unique to that board
rem
```

```
rem %TXUTIL%\sccpcfg -b %BRD% -f %TXCONFIG%\SCCPcp%BRD%.cfg
rem %TXUTIL%\isupcfg -b %BRD% -f %TXCONFIG%\ISUPcp%BRD%.cfg
rem %TXUTIL%\tupcfg  -b %BRD% -f %TXCONFIG%\TUPcp%BRD%.cfg
rem %TXUTIL%\tcapcfg -b %BRD% -f %TXCONFIG%\TCAPcp%BRD%.cfg
:end
set TXMODE=
set TXUTIL=
set TXCP=
set TXCONFIG=
```

10.3 Sample ss7load Script for UNIX Systems

```
#!/bin/ksh
#**************************************************************************
***
# File:ss7load
# Objective:Reset board, clear driver stats, load CPK/OS and
#   related tasks, and configure SS7
# Project:SS7 Redundancy. Version 3.5
#
#**************************************************************************
***

#**************************************************************************
***
# Check args - Get the board number
case $# in
0)
    BRD=1
    ;;
1)
    BRD=$1
    ;;
*)
        echo "Usage: ss7load <board#>"
        exit 1
esac

#
if [ -z "$TXUTIL" ]
then
TXUTIL=/opt/nmstx/bin
fi
if [ -z "$TXBASE" ]
then
TXBASE=/opt/nmstx/cp
fi
if [ -z "$TXMODE" ]
then
TXMODE=standalone
fi
if [ -z "$TXCONFIG" ]
then
TXCONFIG=/opt/nmstx/etc/$TXMODE/ansi
fi

# Clear driver statistics
$TXUTIL/cputil -b$BRD -C
```

```
#***************************************************************************
# get board type
#
# NOTE: On UNIX the board type is determined
#       so that you do not need to edit this portion of
#       the script as the documentation might indicate
#

BOARDTYPE=‘$TXUTIL/cpmodel -b$BRD | tail -1 | cut -d’ ’ -f5‘

case $BOARDTYPE in
TX3220)
    CPK=""
    DIAG="diag3220.lot"
                FLASH="cpk3220.bin"
    ;;
TX3210)
    CPK=""
    DIAG="diag3210.lot"
                FLASH="cpk3210.bin"
    ;;
TX3000)
    CPK="cpk3000.lo"
    DIAG="diag3000.lot"
    ;;
TX2000)
    CPK="cpk2000.lo"
    DIAG="diag2000.lot"
    ;;
*)
    echo "Board $BRD not available"
    exit 1
    ;;
esac

#***************************************************************************
# load CPK/OS and related tasks
#
if [ ! -z "$CPK" ]
then
$TXUTIL/cplot -c $BRD -f $TXBASE/$CPK -k -u ss7 -a
```

```
# Make sure kernel load was successful
        if [ $? -ne 0 ]
        then
            echo "Kernel load failed, exiting $0 script"
            exit 1
        fi
else
        $TXUTIL/txflash -s $TXBASE/$FLASH -b$BRD
fi

#
# Load related tasks
#
$TXUTIL/cplot -c $BRD -f $TXBASE/$DIAG -n diag -p 2 -a
$TXUTIL/cplot -c $BRD -f $TXBASE/inf.lot -n inf -p 16  -a

#
# load TDM configuration - note: remove this line if you use
# serial (V.35) ports rather than T1/E1/MVIP
#
$TXUTIL/cplot -c $BRD -f $TXCONFIG/TDMcp${BRD}.bin -g tdm


#
# load the MVIP and T1/E1 manager tasks to enable use
# of the MVIP and T1/E1 host APIs. Note: if you do not
# use either of these APIs, remove the following two lines
#

$TXUTIL/cplot -c $BRD -f $TXBASE/mvip.lot -n mvip -p 4 -a
$TXUTIL/cplot -c $BRD -f $TXBASE/t1e1mgr.lot -n t1e1mgr -p 15 -a

#
# To use txdbg, you should uncomment the following line to
# load the debug task
#
#$TXUTIL/cplot -c $BRD -f $TXBASE/debug.lot -n debug -p 3 -a

#
# To enable packet tracing in the ISUP layer, make the following
# command active to load the ETP trace collector on the board
#
#$TXUTIL/cplot -c $BRD -f $TXBASE/etp.lot -n etp -p 14 -a

#
# Load the ARP and TX Monitor tasks
#
$TXUTIL/cplot -c $BRD -f $TXBASE/arp.lot -n arp -p 20 -a

#
```

```
# ***** IMPORTANT NOTE *****
# For convenience we are loading TXMON only in redundant mode. This is
# convenient because MTP will detect the lack of TXMON and will
automatically
# enter standalone mode and attempt to bring up the links, without
# application intervention. NOTE HOWEVER, TXMON can be used as a health
# monitor for a single board application in standalone mode. In this case
# the MTP will remain in a Starting state until an application (ie. RMG),
# using the HMI API, specifically sets the mode to Standalone. In other
# words links will not automatically try to align if TXMON is loaded.
#
if [ $TXMODE = "redundant" ]
then
   $TXUTIL/cplot -c $BRD -f $TXBASE/txmon.lot -n txmon -p 12 -a
fi

#
# MTP and ISUP layers
#
$TXUTIL/cplot -c $BRD -f $TXBASE/mtp.lot -n mtp -p 10 -a -s 12000
#$TXUTIL/cplot -c $BRD -f $TXBASE/sccp.lot -n sccp -p 11 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/tcap.lot -n tcap -p 13 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/tup.lot  -n tup  -p 12 -a -s 40960
#$TXUTIL/cplot -c $BRD -f $TXBASE/isup.lot -n isup -p 12 -a -s 40960

#
# ISUP database - Exactly one of these must be enabled to use ISUP
#
#$TXUTIL/cplot -c $BRD -f $TXBASE/itublue.lot -n itublue -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/ituwhite.lot -n ituwhite -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/q767.lot -n q767 -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/ansi88.lot -n ansi88 -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/ansi92.lot -n ansi92 -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/ansi95.lot -n ansi95 -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/itu97.lot  -n itu97  -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/etsiv2.lot -n etsiv2 -p 5 -a
#$TXUTIL/cplot -c $BRD -f $TXBASE/etsiv3.lot -n etsiv3 -p 5 -a
```

```
#***************************************************************************
# Configure MTP2, MTP3, ISUP
#
if [ $TXMODE = "redundant" ]
then
$TXUTIL/mtp2cfg -b $BRD -f $TXCONFIG/MTP3cp${BRD}.cfg
$TXUTIL/mtp3cfg -b $BRD -f $TXCONFIG/MTP3cp${BRD}.cfg
#$TXUTIL/sccpcfg -b $BRD -f $TXCONFIG/SCCP.cfg
#$TXUTIL/tcapcfg -b $BRD -f $TXCONFIG/TCAP.cfg
#$TXUTIL/isupcfg -b $BRD -f $TXCONFIG/ISUP.cfg
#$TXUTIL/tupcfg  -b $BRD -f $TXCONFIG/TUP.cfg
else
$TXUTIL/mtp2cfg -b $BRD -f $TXCONFIG/MTP3cp${BRD}.cfg
$TXUTIL/mtp3cfg -b $BRD -f $TXCONFIG/MTP3cp${BRD}.cfg
#$TXUTIL/sccpcfg -b $BRD -f $TXCONFIG/SCCPcp${BRD}.cfg
#$TXUTIL/tcapcfg -b $BRD -f $TXCONFIG/TCAPcp${BRD}.cfg
#$TXUTIL/isupcfg -b $BRD -f $TXCONFIG/ISUPcp${BRD}.cfg
#$TXUTIL/tupcfg  -b $BRD -f $TXCONFIG/TUPcp${BRD}.cfg
fi

#
exit 0
```

Index

N

S

T

U