Routing Subsystem

The routing subsystem includes:
- Digit analysis
- Subscriber termination
- Carrier routing
- Trunk group termination
  - SS7 routing
  - SIP routing
  - CAS routing
  - ISDN routing (if connected to PBX)
  - H.323 routing

Note: The H323 feature flag is set to off in this release.

Routing selections include:
- Least-cost routing (LCR)
- Call routing based on dialed number or ANI
- Call routing based on TOD, DOW, DOY
- Call routing based on originator
- Call routing to carriers for calls that are casual dialed
- Call routing to intraLATA PIC, interLATA PIC, and international PIC
- Call screening based on destination, origination, service request, and type of call
Numbering Plans include:

- North American numbering plan (NANP)
- Support for service codes (N11)
- Vertical services access codes (*XX), including the following capabilities:
  - Service provider can activate or deactivate service codes
  - Service provider can reassign the routing for each service code
  - Support for 411 directory service
  - ANI delivery on 911 calls

The MGW and networks that connect to the Cisco BTS 10200 Softswitch are controlled by direct connections. The external interfaces connecting other switching systems or CAs are represented by trunk groups (TGs). A TG can be an IP interface (or a range of Real-time Transport Protocol [RTP] ports on an IP interface) or a group of DS0 channels connected to a Class 4 or 5 switch.

Signaling links (SLs) define the signaling interface properties between the Cisco BTS 10200 and other network elements. For example, a signaling link connecting the Cisco BTS 10200 and a Class 4 or 5 switch defines SS7 properties. Signaling connecting the Cisco BTS 10200 and another call agent defines CA to CA signaling properties (SIP-T), and the signaling link connecting the Cisco BTS 10200 and PBX or Class 5 defines ISDN PRI properties.

The TG in association with SLs provides call signaling and bearer paths. One or more TGS can share the same signaling links.

The following conditions are supported by the Cisco BTS 10200 routing subsystem (see Figure 12-1):

- A TG can span across multiple trunking gateways (TGWs).
- A TGW can be associated with more than one trunk group connecting to different nodes.

**Figure 12-1 Relationships of TGW, TG, and Trunks**

![Diagram of Relationships of TGW, TG, and Trunks](image)
Route Selection

As shown in Figure 12-2, when a request for routing is received by the routing subsystem, the subsystem first searches through the termination table to determine whether the called number is a subscriber. If the called number is a subscriber, the dial plan table processes the call through the dn2subscriber and subscriber tables. If the called number is not a subscriber, the call is routed to the appropriate trunk, carrier, or announcement.

Figure 12-2 Route Selection Flow
Policy-Based Routing

If policy-based routing is required, the dial plan entry for the corresponding called number (NPA/NXX) is associated with the route group ID. The Cisco BTS 10200 supports the following routing policies:

- Least-Cost Routing, page 12-4
- Prefix-Based Routing, page 12-4
- Line-Based Routing, page 12-4
- ANI-Based Routing, page 12-5
- Region-Based Routing, page 12-5
- Time of Day (TOD) Routing, page 12-5
- Percentage-Based Routing, page 12-6
- Route ID, page 12-6
- Trunk Group Selection Policies, page 12-6

Least-Cost Routing

With least-cost routing (LCR), the least expensive TG in a route is chosen. The TGs in a list may be provisioned in any order. The call processing function will find the relative cost of each TG in the route from the TG table and order them from least to most expensive. The least expensive idle trunk will be selected from this newly ordered TG list.

Prefix-Based Routing

Prefix-based routing is used to route calls to an interexchange carrier. A service provider can choose to route calls over different TGs based on the prefix dialed. The supported call types and their associated prefixes are

- National (1+)
- International (011+)
- Operator (0-, 00)
- National operator (0+)
- International operator (01+)
- Toll free (8xx)
- Cut-through calls (101xxxx#)
- Directory assistance (555-1212, NPA-555-1212)

Line-Based Routing

Routing of calls can be based on the originating subscriber line class (such as coin, coinless, hotel/motel or multiparty). If an incoming call is received over a feature group D SS7 TG, the originating line information parameter is used to determine the route.
ANI-Based Routing

Automatic number identification (ANI) routing is based on the subscriber ID of the calling party. The service provider can enable ANI-based routing by setting the ANI-BASED-ROUTING flag in the TRUNK-GRP table. When a call is received by the Cisco BTS 10200, the Cisco BTS 10200 performs a subscriber lookup based on the ANI (DN), and uses the subscriber properties to route the call.

Note
For a remote CENTREX or PBX application, each enterprise (or business group) is entered as a subscriber on the Cisco BTS 10200. Each ANI (DN) within the business group is linked to this subscriber ID.

The following are examples of ANI-based routing:

- For outgoing interLATA calls, the Cisco BTS 10200 needs to route the call to the nearest Access Tandem (AT) switch. The Cisco BTS 10200 first analyzes the calling party's DN and determines the subscriber ID. The Cisco BTS 10200 uses the subscriber information (dial plan ID or POP) to determine which AT switch is the nearest, and routes the call. The Cisco BTS 10200 provides data for transit network selection (TNS) in an SS7 outgoing setup message.
- For 911 calls, the Cisco BTS 10200 analyzes the calling party's DN, determines the subscriber ID, and routes the call to the PSAP designated for this subscriber.
- If Class of Service (COS) screening is required, the Cisco BTS 10200 analyzes the calling party’s DN, determines the subscriber ID, and allows or denies the outgoing call according to the parameters provisioned for this subscriber.

Region-Based Routing

If region-based routing is required, the Cisco BTS 10200 uses a look-up table to convert the calling party’s dialing number (DN) to a region. The Cisco BTS 10200 then routes the call according to the information provisioned for this region. If ANI is not available, the Cisco BTS 10200 routes the call according to the region assigned to the originating TG.

Time of Day (TOD) Routing

The TOD feature has the following subfeatures:

- Routing based on day of year (DOY)—Up to 10 DOY entries are supported. If a matching DOY entry is found, the call is routed on the basis of the DOY. Otherwise (if no matching DOY entry is found), the call is routed based on the DOW/TOD table.
- Routing based on day of week (DOW) and time of day (TOD)—Up to 10 DOW/TOD entries are supported. Ranges for both DOW and TOD can be provisioned. If an entry corresponding to the DOW/TOD is not found, a default entry should be provided in the database for routing.
Percentage-Based Routing

Percentage-based routing allows call distribution of a specified percentage of calls to different route groups. Up to 5 different percentage ranges (each directed to a specific route group) can be entered. The percentage ranges can be specified to a granularity of 1 percent, and the ranges should cover a total of 100 percent. A random number generator is used to sort calls into the specified percentage ranges, and the percentage range is used to route each call.

Route ID

The route table is used when the routing policy is specified as route ID. Up to 10 TGs can be provisioned per route ID. A TG is selected based on the trunk group selection policy specified in the route table.

Trunk Group Selection Policies

The TG selection policies are applied once a route has been selected. Route selection is based on the route selection policy, and each route can have up to 10 TGs. If all the TGs in a route are busy, the route can point to an alternate route. The following assumptions are made regarding TGs:

- TG is controlled by one CA
- TG can be split across multiple MGWs
- All Trunks in a TG have the same physical characteristics back to the IP network

TG selection policies are also applied based on the user requirements. The TG selection policies are not applied if the user has not requested any capabilities. The selection policy supported is selection of TG by cost.

Trunk Selection Policies in the TG

Trunk selection policies are applied to each TG, and allow the service provider to control the assignment of trunks. The CA supports the following trunk selection policies, provisionable in the TG table:

- Ascending (default)—Select trunks in ascending order
- Odd—Select only odd numbered trunks
- Descending—Select trunks in descending order
- Least recently used—Select least recently used trunk
- Even—Select only even numbered trunks

Glare Resolution Parameter in the TG

The glare parameter in the TG table is provisioned for bothway trunks only (those that carry both incoming and outgoing calls). Glare is a condition in which the stations at both ends of the trunks seize the trunk simultaneously. The glare parameter defines which station will be given priority to seize the trunk:

- Odd—This trunk group is master of odd numbered trunks.
• Even—This trunk group is master of even numbered trunks.
• All—This trunk group is master of all trunks.
• Slave—This trunk group yields any trunk in glare condition.

| Note | When provisioning ISDN trunk groups, glare must be set to All. Setting glare to Slave can cause CIC/trunk instability |

## Trunk Group Types

The following TG types are supported in the TRUNK-GRP table in the Cisco BTS 10200 database:

- ANNC
- SOFTSW
- CAS
- ISDN
- SS7
- H323

| Note | The H323 feature flag is set to off in this release. |

The required fields (tokens) for each of these TGs in the TRUNK-GRP table are listed in the following sections. In addition to the tokens listed here, there are several optional tokens that can be provisioned by the user as desired. See the *Cisco BTS 10200 Softswitch CLI Reference Guide* for a complete list of all token values.

### Announcement Trunk Group

The announcement TG (ANNC TG) is used to define announcement trunks. The announcements are played on an MGCP-controlled MGW. In an ATM environment, an ATM MGW is connected to an announcement server via TDM trunks. The ANNC TG is also used to define the TDM trunk group. The fields for the ANNC TG are listed in Table 12-1.

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (ANNC)</td>
<td>Identifies the TG type as Announcement/MGCP</td>
</tr>
</tbody>
</table>
Trunk Group Types

Chapter 12      Routing Subsystem

Softswitch Trunk Group

The fields in the softswitch TG are listed in Table 12-2.

Table 12-2  Softswitch TG Required Fields and Descriptions

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (SOFTSW)</td>
<td>Identifies the TG type as Softswitch (CA to CA trunks)</td>
</tr>
<tr>
<td>SOFTSW-TSAP-ADDR</td>
<td>TSAP address of the Cisco BTS 10200</td>
</tr>
<tr>
<td>TG-PROFILE-ID</td>
<td>TG profile ID to be used</td>
</tr>
<tr>
<td>DIAL-PLAN-ID</td>
<td>Dial plan ID to be used</td>
</tr>
</tbody>
</table>

CAS Trunk Group

The fields in the CAS TG are listed in Table 12-3.

Table 12-3  CAS TG Required Fields and Descriptions

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (CAS)</td>
<td>Identifies the TG type as CAS</td>
</tr>
<tr>
<td>TG-PROFILE-ID</td>
<td>TG profile ID to be used</td>
</tr>
<tr>
<td>DIAL-PLAN-ID</td>
<td>Dial plan ID to be used</td>
</tr>
</tbody>
</table>

ISDN Trunk Group

The fields in the ISDN TG are listed in Table 12-4.

Table 12-4  ISDN TG Required Fields and Descriptions

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (ISDN)</td>
<td>Identifies the TG type as ISDN</td>
</tr>
<tr>
<td>MAIN-SUB-ID</td>
<td>ID of main subscriber number on PBX</td>
</tr>
<tr>
<td>TG-PROFILE-ID</td>
<td>TG profile ID to be used</td>
</tr>
<tr>
<td>DIAL-PLAN-ID</td>
<td>Dial plan ID to be used</td>
</tr>
<tr>
<td>MGW-ID</td>
<td>MGW ID to be used</td>
</tr>
</tbody>
</table>
SS7 Trunk Group

The fields in the SS7 TG are listed in Table 12-5.

Table 12-5  SS7 TG Required Fields and Descriptions

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (SS7)</td>
<td>Identifies the TG type as SS7</td>
</tr>
<tr>
<td>DPC</td>
<td>Destination Point Code</td>
</tr>
<tr>
<td>TGPROFILE-ID</td>
<td>TG profile ID to be used</td>
</tr>
<tr>
<td>DIAL-PLAN-ID</td>
<td>Dial plan ID to be used</td>
</tr>
</tbody>
</table>

H.323 Trunk Group

Note  The H323 feature flag is set to off in this release.

The fields in the H.323 TG are listed in Table 12-6.

Table 12-6  H.323 TG Required Fields and Descriptions

<table>
<thead>
<tr>
<th>Field (Token)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Unique identifier for this TG</td>
</tr>
<tr>
<td>CALL-AGENT-ID</td>
<td>ID of CA for this TG</td>
</tr>
<tr>
<td>TG-TYPE (H323)</td>
<td>Identifies the TG type as H.323</td>
</tr>
<tr>
<td>H323-GW-ID</td>
<td>Specifies the gateway ID for this trunk group</td>
</tr>
<tr>
<td>TGPROFILE-ID</td>
<td>TG profile ID to be used</td>
</tr>
</tbody>
</table>
Carrier-Based Routing and Service Provider-Based Routing

This section describes the carrier-based and service provider (SP) based routing features. In a wholesale network environment, the wholesale network operator (NO) owns and operates the facility. The NO provides transport facilities to carry voice calls on behalf of smaller SPs and for SPs that are not facility based. Some SPs may own facilities terminating directly on NO equipment. The Cisco BTS 10200 supports two types of routing options for the NO:

- Route calls over the SP facilities if a route exists on the SP facilities
- Route calls over NO facilities if SP based facilities do not exist

Note: When Cisco BTS 10200 database tables are named in this section, refer to the Cisco BTS 10200 Softswitch CLI Reference Guide for detailed provisioning options.

Carrier Selection for Outgoing Calls

For outgoing interLATA calls, the Cisco BTS 10200 selects the carrier based on one of the following:

- The subscriber’s presubscribed interexchange carrier (PIC)
- The dialed carrier ID if the call was a casual call

Note: The CARRIER table can be provisioned to route calls for the carrier according to information provided by the SP. If a specific SP ID is entered, the routing options in the SP table are used, rather than routing options in the CARRIER table. This is referred to as SP-based routing.

For outgoing toll-free calls, the Cisco BTS 10200 receives the carrier ID based on a toll-free query to a service control point (SCP).

For outgoing 500 (PCS rate) and 900 (premium rate) calls, the DESTINATION table can be provisioned with unique carrier IDs for each of these call types. The Cisco BTS 10200 routes the calls via these assigned carriers.
Carrier Selection for TG-Originated Calls

In a Class 4 environment, the Cisco BTS 10200 is connected to several PSTN switches. For trunk groups (TGs) between the Cisco BTS 10200 and a Tandem switch, the TG table can be provisioned to route the call based on either the carrier ID or the SP ID.

The TGs can be provisioned as either of the following:

- A shared TG that carries traffic for multiple carriers—The Cisco BTS 10200 uses carrier identification parameter (CIP) or transit network selection (TNS) parameter to determine the carrier ID.
- A dedicated TG that carries traffic only for one particular carrier—The Cisco BTS 10200 uses CIP, TNS, or the carrier ID assigned to the TG.

If a SP ID is assigned to the TG, the SP ID is used for routing. The Cisco BTS 10200 identifies the carrier for the TG-originated call, and uses one of the following (provisionable) methods to route the call:

- The dial plan provisioned for a SP specified in the TG table
- The dial plan provisioned for a SP specified in the CARRIER table

**Note**  To enable SP ID selection in the TG table (for SP-based routing), the TRAFFIC TYPE token in the TG table must be provisioned as TANDEM.

Technical Prefix Group Routing for H.323 Applications

**Note**  The H323 feature flag is set to off in this release.

The Cisco BTS 10200 can perform SP-based routing on H.323-controlled calls using technical prefix digits. The Cisco BTS 10200 maps technical prefix to SP ID according to provisioning in the TECHNICAL PREFIX GROUP table.