

PGW Dialplan Guide

Configuration Overview



Dilip

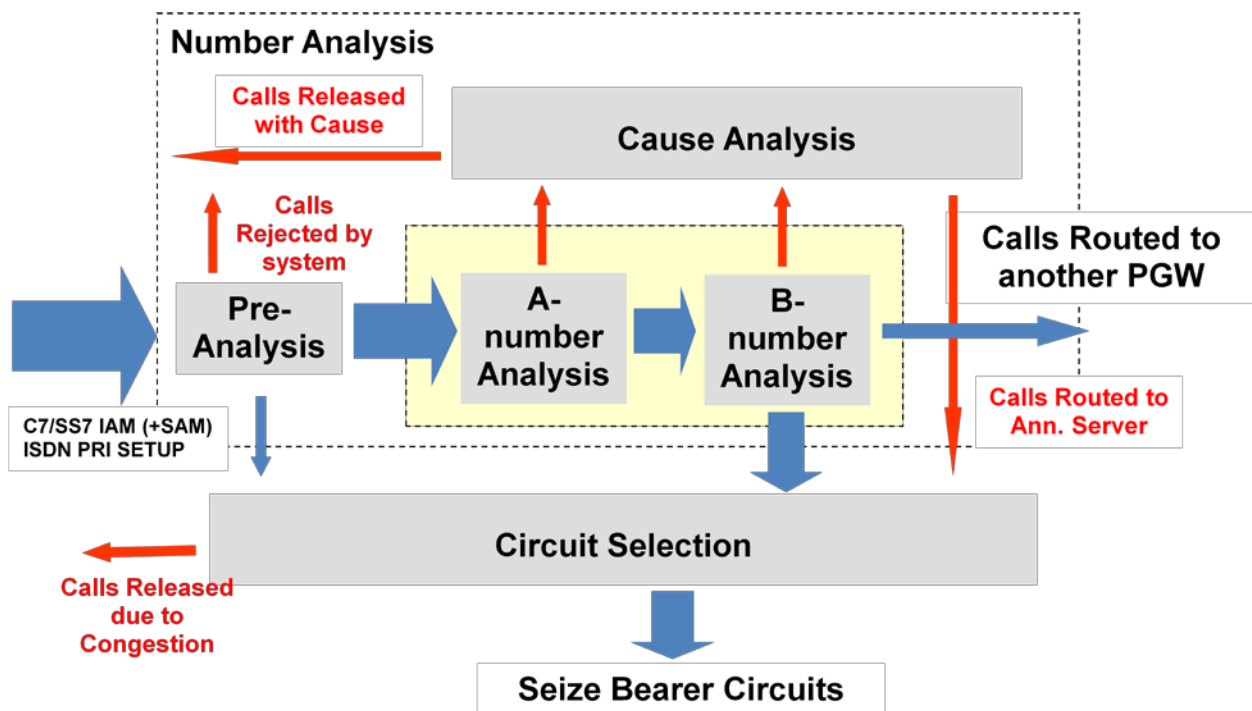
Routing and Analysis in the PGW 2200

All routing and analysis in the PGW is driven via a dial plan and accompanying routing data and no call can be completed without a routing and analysis definition being provided.

The dial plan provides the basic functionality needed to meet customer requirements for calling and called number analysis and analysis of other relevant parameters (e.g. NOA, NPI, CPC, TNS...). The routing plan types developed during provisioning of the Cisco PGW determine which trunks in a media gateway are assigned to a specific trunk group and which trunk groups are assigned to which routes. The routes are logical collections of trunk groups. Route lists are a collection of routes that define the possible outbound paths that can be selected in order to terminate the call to the required destination.

1.1 Analysis and Routing flow diagram

The processes by which the PGW analyses and routes calls are illustrated below:



1.2 Dial Plan Functions

A dial plan is a single file organized as a set of tables and is sub-divided into different sections. The dial plan can be changed dynamically (by the craftsperson) at any time and the change will be effective for all subsequent newly initiated calls.

The PGW can handle multiple independent customer networks, each with its own dial plan (i.e. set of unique digit trees, black lists and white lists etc). To accomplish this, all dial plan tables are referenced with a CustGrpID field, which indicates the customer group for which a given database query applies (the term CustGrpID is synonymous with dial plan id). The CustGrpID is provisioned against an incoming trunk group and allows different interfaces to use different dial plans (or share a common one).

It is possible to switch dial plans during analysis. This can be provisioned to occur in Pre-Analysis or at any time during A number or B number analysis.

The incoming H.323 and SIP protocol interfaces each have a single trunk group appearance in the PGW and therefore have a single dial plan associated to them

1.2.1 Analysis and Routing Data Components

The following types of data components are used within analysis:

Digit Trees

A linked list of entries expanded in blocks of ten (or 16 if over-decadic numbering (A-F) is required) by the craftsperson for the analysis of A and B numbers. They provide the ability to analyse numbers digit by digit and allow actions (results) to be returned at any point during traversal through the linked list. This enables overlap and partial number analysis in addition to longest match methods.

Results

Specifies a particular action (along with accompanying data) to be performed such as for example digit modification. There are approximately 50 different types of action that can be provisioned by the user.

Result sets

A Result set is a grouping of one or more results. It can be attached to a branch in the digit analysis trees or referenced out of the pre-analysis and cause tables. There can be multiple references to the same Result set(s) within a dial plan.

2 Analysis Stages

The Analysis function is broken down into 4 discrete stages:

- Pre-Analysis
- A Number Analysis
- B Number Analysis
- Cause Analysis

2.1 Pre-Analysis

The purpose of Pre-Analysis is to analyse call set up input data (other than A and B party) in order to determine if there are overriding factors that require special treatment and may not to be subjected to the normal subsequent A number and B number analysis.

Pre-Analysis performs the follows actions (in order)

- Source IP address + CLI prefix analysis
(Used to set the initial dial plan)
- NOA/NPI A number analysis
- CPC analysis
- TMR analysis
- NOA/NPI B number analysis
- Carrier ID/TNS analysis
- NANP Number normalization

In each case a match leads to a result set where a number of different actions can be defined.

Typically these tables each provide the ability to normalize numbers into a common format suitable for subsequent A number and B number analysis. They also provide the ability to block calls with data settings that are not supported e.g. CPC or TMR values that are considered unacceptable to the administration. They provide the ability to switch to a specific dial plan in order to allow a particular call type to have different number analysis applied than would be the case for normal calls coming from the same source. Lastly, they allow the call to completely bypass number analysis and go directly to the route analysis function. This is required (for example) in the case of Carrier Id/TNS requirements.

The Pre-analysis stage can also be used to initiate backward requests for more (or missing) information such as CLI, CPC and service markings.

Results such as a New Dial Plan, Route and Cause are acted upon immediately and terminate the Pre-analysis stage. In the case of a dial plan switchover, pre-analysis will recommence in the new dial plan. In the case of a route result, route analysis will be initiated immediately. In the case of a cause result, cause analysis will be initiated using the cause value provided.

In contrast, Digit Modification results are cumulative during this stage of analysis i.e. modifications are applied immediately but the processing continues through the stages of pre-analysis and a subsequent modification can be applied to an already modified number.

2.2 A Number Analysis

Number Analysis of the calling number uses a dedicated Digit Tree. The tree is traversed digit by digit until all digits are analyzed or (and this is more normally the case) until the tree has no further blocks of digits provisioned (typically, this could be no further than the area code). Maintaining flexibility in building the depth of digit analysis allows the craftsperson to design the tree structure required to meet administration requirements and allows irregular numbering patterns to be catered for. This is important when considering the diverse numbering plans in effect around the world. At each node of the tree an index into the result set table can be provisioned and the results contained therein are collected for later analysis.

After tree traversal, the collected results are analyzed. Any Digit Modification requests found are performed (if there is more than one modification against the same number, only the last found is executed). If a cause result is found then call processing continues in cause analysis. If a dial plan switchover request is found then analysis is restarted in the new dial plan indicated. If a route result is found then analysis jumps straight into the route analysis function.

During A number analysis, the following can be provisioned:

- *A Number Modification (including NOA, NPI, Presentation and Screening Indicators)*
- *B Number Modification (including NOA)*
- *Additional Calling Number modification (plus NOA, NPI, Presentation and Screening Indicators)*
- *A number length (used for truncation)*
- *Calling Number Copy (replace A number with network number and move existing calling number into additional calling number)*
- *Redirecting Number Modification (Including NOA)*
- *Call Screening (access to White list and Blacklist TimesTen databases)*
- *CPC Modification.*
- *Cause treatment*
- *Call cut off timer (i.e. maximum call duration)*
- *Dial Plan switchover (based on prefix analyzed or can also go to TimesTen database for full A number translation to obtain dial plan)*
- *Route Preferences (specifies the type of outbound network preferred/required e.g. VoIP/TDM)*
- *Codec usage (specify codecs that need to be matched against the destination capabilities note: this can also be set against incoming trunk group but is overridden if found provisioned against the A number)*
- *Charge Origin (used with charge destination and calendar plus clock to determine call tariff for advice of charge and CDRs etc)*
- *Call limit Label (indicates call limiting to be applied using referenced label)*
- *Override Call limiting (disable call limiting for current call)*

2.3 B Number Analysis

Number Analysis of the called number also uses a dedicated Digit Tree. The digit tree is traversed digit by digit until all digits are analyzed or until the tree has no further blocks of digits provisioned. If at this point, a Route or Cause has been found, then analysis is considered complete and any other results found during analysis (such as screening and/or digit modifications) will be executed. Call processing subsequently continues in either Route Analysis or Cause Analysis as appropriate. If no more digits are forthcoming then Cause analysis is invoked. A default route or cause treatment can be defined to handle unspecified or vacant numbers. The expected numbering length and type (open or closed) can be identified during B number analysis (overwriting the default provisioned on the ingress trunk group) and this enables Call processing to know how many more digits to await before setting up the terminating call leg. It also defines the closure point for digit reception. This permits overlap operation and variable length number handling. Backward requests can also be provisioned during this stage to ask for additional digits or service markings from the incoming network. As more digits are received, analysis is re-invoked and the entire number is represented again and used to walk down the digit tree. Results are collected and the same procedure as highlighted above is performed again.

In the case of forwarded or redirected calls, screening can be performed against either the original calling party or the redirecting party as required.

If a dial plan switchover request is found then analysis continues in the dial plan indicated and at the stage required (i.e. Pre-Analysis, A number or B number analysis).

All results accrued work on the longest match principle. This means that a duplicate result type will supersede an earlier result of the same type i.e. modifications are not cumulative and the last found Route/Cause/Charge/IN trigger etc. is the result that will be used.

B number analysis provides the following capabilities:

- *A Number Modification (including NOA, NPI, Presentation and Screening Indicators)*
- *B Number Modification (including NOA)*
- *Additional Calling Number modification (plus NOA, NPI, Presentation and Screening Indicators)*
- *Calling Number Copy (replace A number with network number and move existing calling number into additional calling number)*
- *Redirecting Number Modification (Including NOA)*
- *Announcement ('interim' or 'final' from gateway or external route server)*
- *Call Screening (access to White list and Blacklist Times ten databases)*
- *CPC Modification*
- *Route (3 options are available -> basic, conditional or percentage).*
- *Cause treatment*
- *Call cut off timer (i.e. maximum call duration)*
- *A Number Presentation indicator*
- *Dial Plan switchover (based on prefix analyzed or can also go to times ten database for full A number translation to obtain dialplan)*
- *Codec usage (specify codecs that need to be matched against the destination capabilities note: this overrides any requirements already identified in A number analysis or against the trunk group)*
- *Charge (used with charge origination and calendar plus clock to determine call tariff for advice of charge and CDRs etc)*
- *Incoming and Outgoing numbering lengths (min and max for open numbering schemes to assist overlap treatment)*
- *Service Markings Request (used for older TDM protocols that only provide this information on demand)*
- *Information Requests for More digits, CLI, CPC (used for some TDM protocol inter-working cases)*
- *IN trigger (with provisionable service key etc used to initiate TCAP dialog)*
- *Ported Number (Euro donor LNP: call to onboard local times ten ported number database)*
- *Rte Number (Euro Recipient LNP: removal of prefix and translation of full number to route)*
- *Data exchange (allows address data items to be switched about –primarily used in LRN replacement in North American LNP)*
- *MGCP dial package (used to terminate NAS dial access calls in PGW MGCP call control mode)*
- *Full B Number translation (go to Times ten database for full B number look up to obtain route)*
- *Test Call (for U.S market, indicates a test call sequence must be initiated)*
- *Call Limit Label (indicates call limiting to be applied using referenced label)*
- *Override Call limiting (disable call limiting for current call)*
- *MWI service (message waiting call inter-working)*

2.4 Cause Analysis

Cause analysis is performed when either a call release message is received, a failure occurs during the call or when requested from other analysis table upon encountering a cause result type. The Cause code value and Cause location (if required) are used as an index to determine the behaviour of the PGW using result sets as described in Section 2.2.1.

Note: Protocol Cause values are mapped into system-wide internal cause values. It is these internal values that are used when populating the cause code tables.

Cause analysis provides the following capabilities:

- *B Number Modification (including NOA)*
 - *Redirecting Number Modification (including NOA)*
 - *Announcement ('interim' or 'final' from gateway or external route server)*
 - *Cause Code (used to modify Release codes sent to other nodes)*
 - *Dial Plan switchover (Re-analyse B number in a another dial plan)*
 - *Route (3 options are available -> basic, conditional or percentage).*
 - *Re-analyse B number (normally used in conjunction with B number modification)*
- Retry Action (Reattempt, Trunk group advance or Redirect – used to provision different retry treatment)*

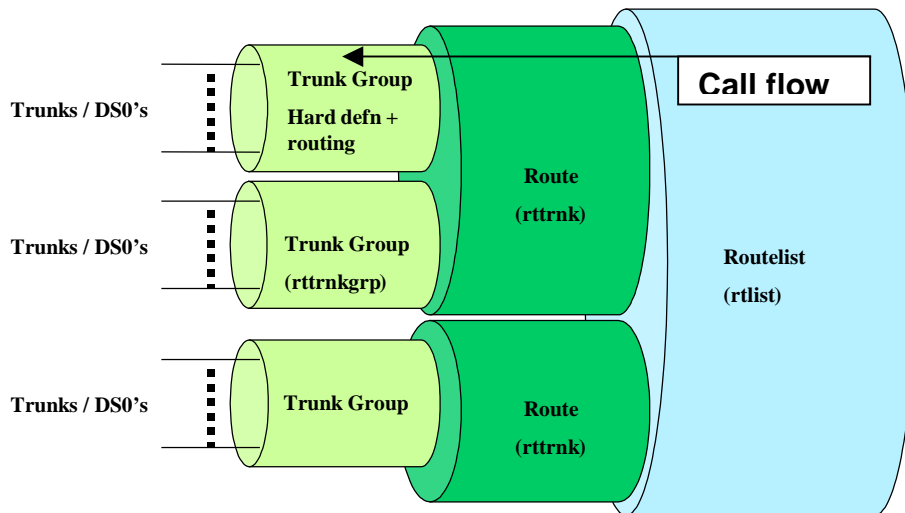
3 Routing Analysis

3.1 Selection Procedure

Routing analysis is initiated from Pre-analysis, B-number analysis, or Cause analysis. There are three types of route result: Basic Route, Conditional route, or Percentage route. A Basic Route result provides an index into a Route List that contains a sequential Route List that will be searched in turn for an available resource to use for the outbound call.

Route analysis and selection is based solely on the trunk group data provisioned in the routing plan (i.e. only Trunk Groups contained within the routing trunk group tables will be used for Outgoing calls). Trunk groups not defined in the Route Analysis tables can still be used for inbound calls.

The Route List/Route/Trunk group hierarchy is shown below



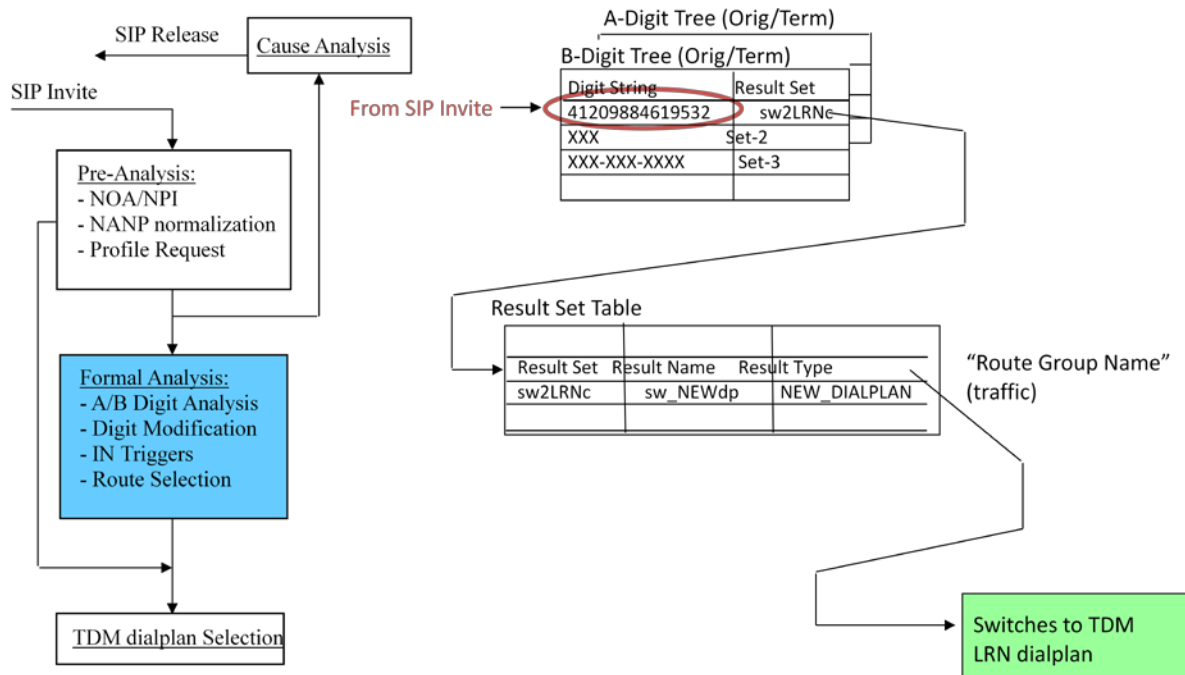
Routes are selected in a predefined order within the route list and Trunk Groups within a route are also selected in order unless load sharing is enabled or preferential selection is active. Load sharing enables calls to be evenly distributed across all Trunk Groups in a route.

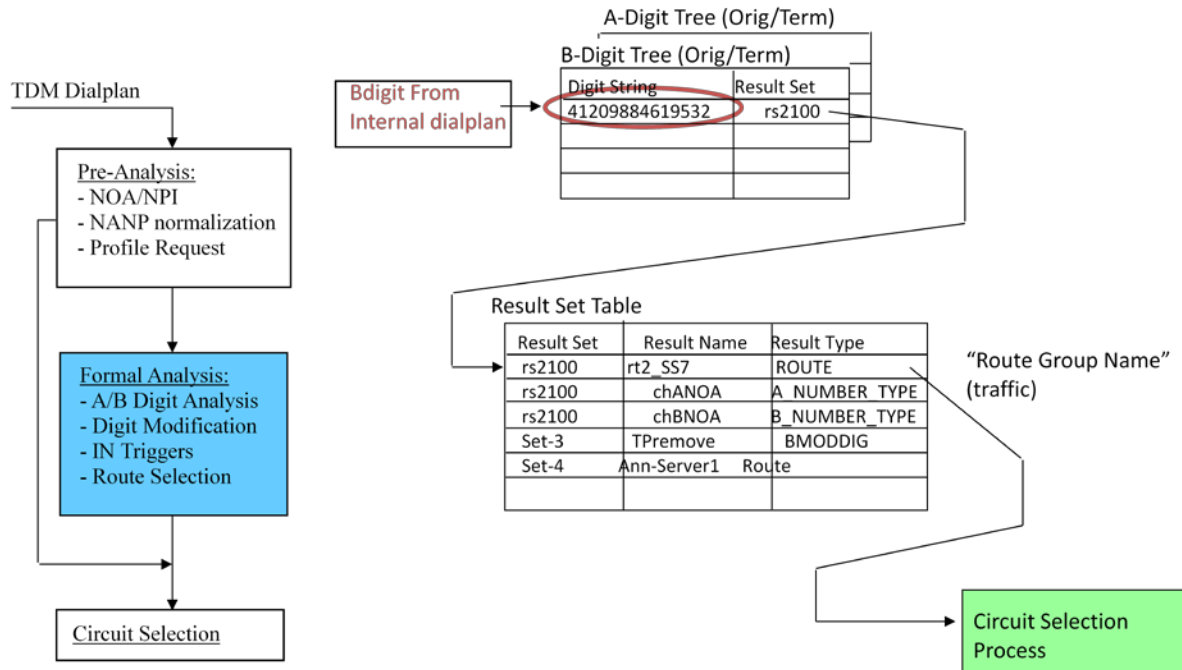
Each Trunk Group has global attributes which are constant regardless of the route they are declared in. These attributes include a CIC selection method (ascending, descending, random, least idle and most idle).

3.2 Formal Analysis

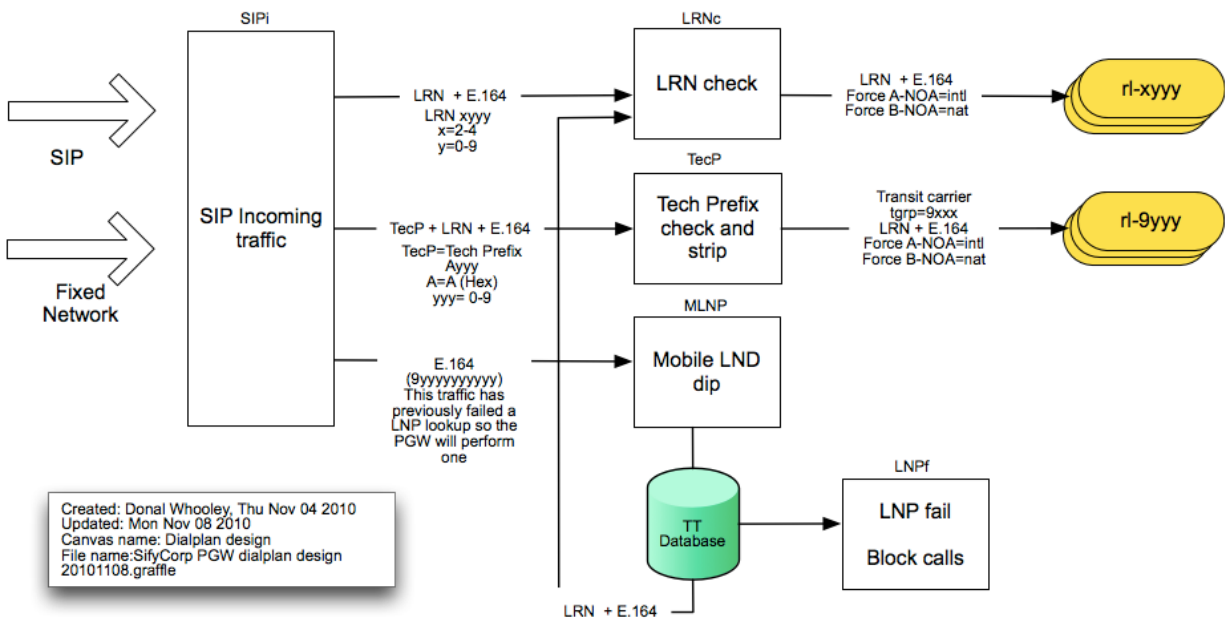
The below call analysis flow shows how the SIP call is processed and terminated to PSTN.

Formal Analysis - Routing





Sifycorp PGW Dialplan Design



4 Routing and Trunk Group creation

4.1 Routing based on LRN

```
prov-add:rtrnkgrp:name="2100",type=1,reattempts=3,queuing=0,cutthrough=0,resincperc=0
```

```
prov-add:rtrnk:weightedTG="OFF",name="rt2100",trnkgrpnum=2100
```

```
prov-add:rtlist:name="rl2100",rtname="rt2100",distrib="OFF"
```

Incoming SIP Dialplan

```
numan-add:dialplan:custgrpid="SIPi", OVERDEC="YES"
```

```
numan-add:dpsel:custgrpid="SIPi",newdp="LRNc"
```

```
numan-
```

```
add:resulttable:custgrpid="SIPi",name="sw_NEWdp",resulttype="NEW_DIALPLAN",dw1="LRNc",dw2="1",setname="sw2LRNc"
```

```
//// All LRN prefixes start with 2 - 4 ////
```

```
numan-add:bdigtree:custgrpid="SIPi",callside="originating",digitstring="2",setname="sw2LRNc"
```

```
numan-add:bdigtree:custgrpid="SIPi",callside="originating",digitstring="3",setname="sw2LRNc"
```

```
numan-add:bdigtree:custgrpid="SIPi",callside="originating",digitstring="4",setname="sw2LRNc"
```

Termination SS7 Dialplan

```
numan-add:dialplan:custgrpid="LRNc", OVERDEC="YES"
```

```
numan-add:resultset:custgrpid="LRNc",name="rs2100"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="rt2_SS7",resulttype="ROUTE",dw1="rl2100",setname="rs2100"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="chANOA",resulttype="A_NUMBER_TYPE",dw1="5",setname="rs2100"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="chBNOA",resulttype="B_NUMBER_TYPE",dw1="4",setname="rs2100"
```

```
numan-add:bdigtree:custgrpid="LRNc",callside="originating",digitstring="2100",setname="rs2100"
```

4.2 Routing based on Prefix

Termination SS7 dialplan

```
numan-add:dialplan:custgrpid="LRNc", OVERDEC="YES"
```

```
numan-add:resultset:custgrpid="LRNc",name="rs80025"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="rt2_SS7",resulttype="ROUTE",dw1="rI9000",setname="rs80025"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="TPremove",resulttype="BMODDIG",dw1="1",dw2="4",setname="rs80025"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="chANOA",resulttype="A_NUMBER_TYPE",dw1="5",setname="rs80025"
```

```
numan-
```

```
add:resulttable:custgrpid="LRNc",name="chBNOA",resulttype="B_NUMBER_TYPE",dw1="4",setname="rs80025"
```

```
numan-add:bdigtrees:custgrpid="LRNc",callside="originating",digitstring="80025",setname="rs80025"
```

4.3 Load Share of calls between 2 different TG

prov-add:rttrnkgrp:name="3020",type=1,reattempts=1,queuing=0,cutthrough=3,resincperc=0

prov-add:rttrnkgrp:name=" 9417",type=1,reattempts=1,queuing=0,cutthrough=3,resincperc=0

prov-add:rttrnk:weightedTG="ON",name="rt3020",trnkgrpnum=3020

prov-add:rttrnk:weightedTG="OFF",name="rt9417",trnkgrpnum=9417

prov-ed:rttrnk:name="rt3020",trnkgrpnum=9417

prov-add:rtlist:name="rl3020",rtname="rt3020",distrib="ON"