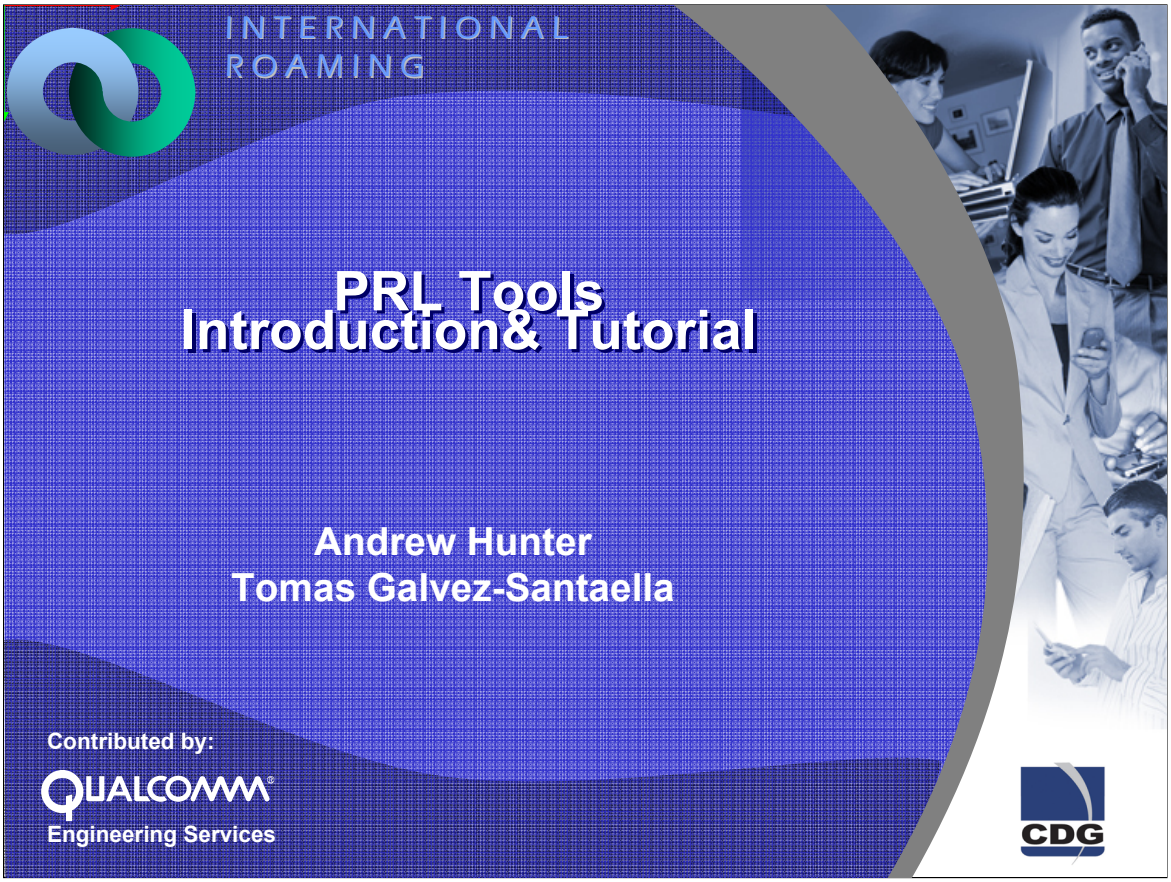
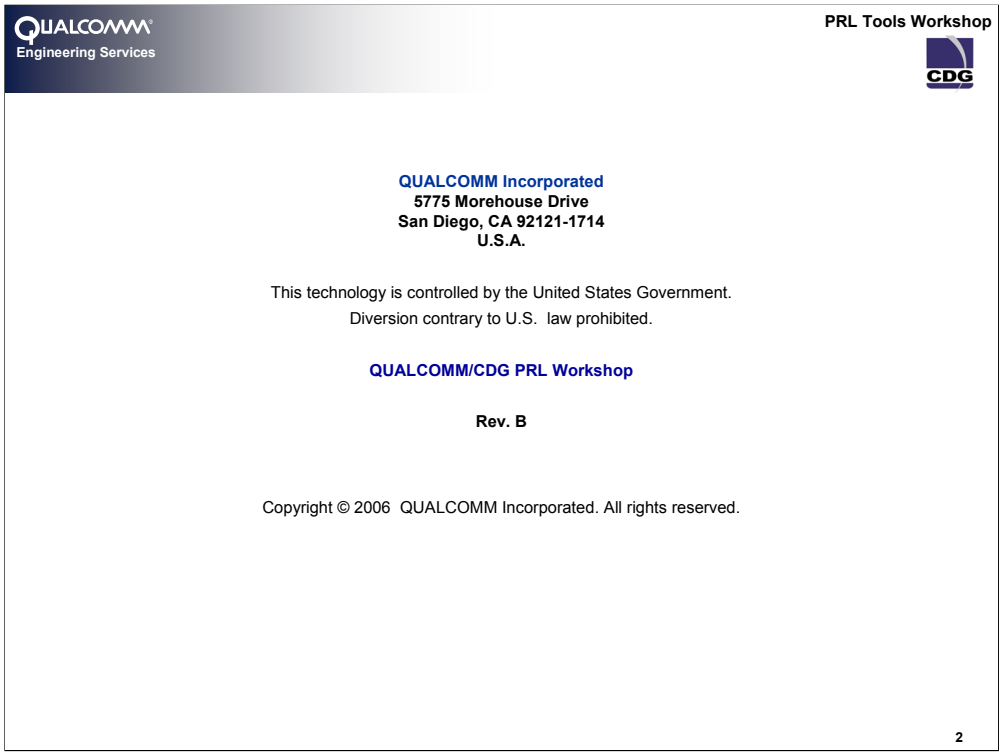
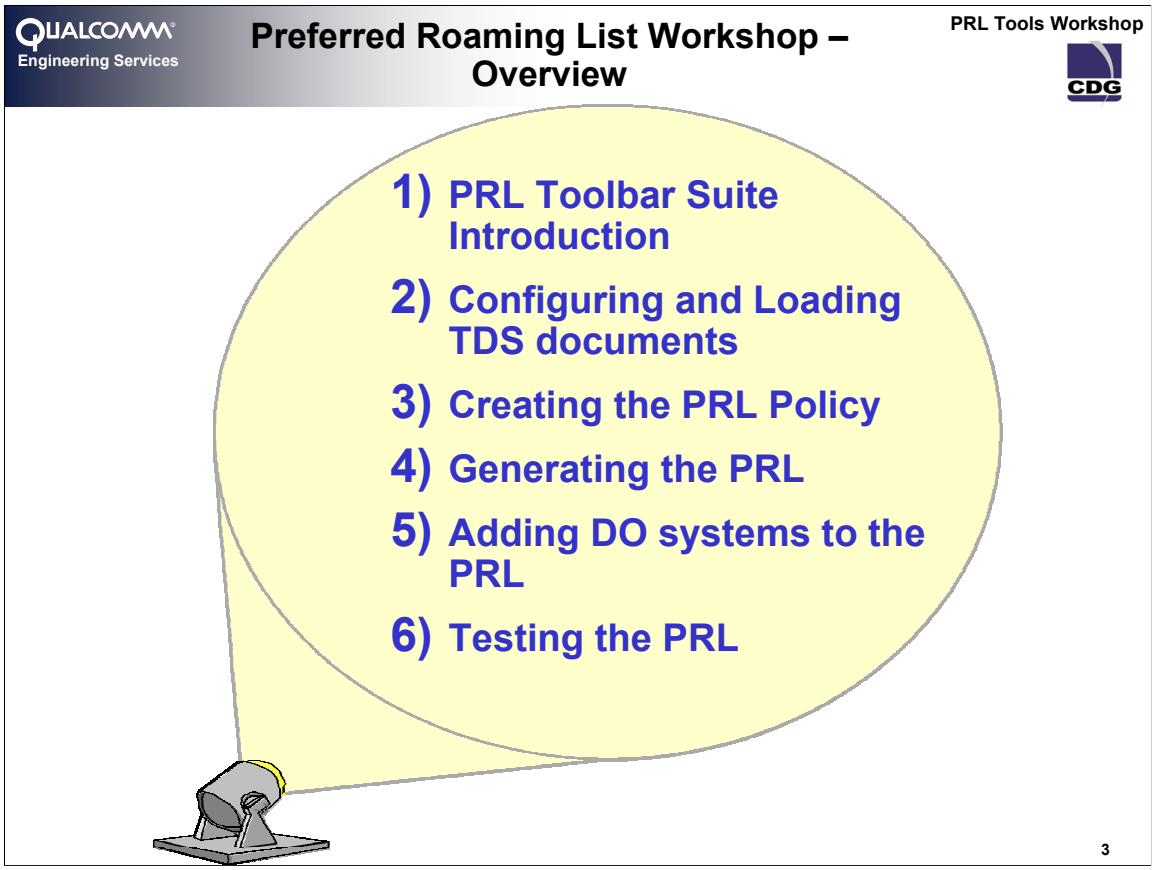


CDG

Student Guide

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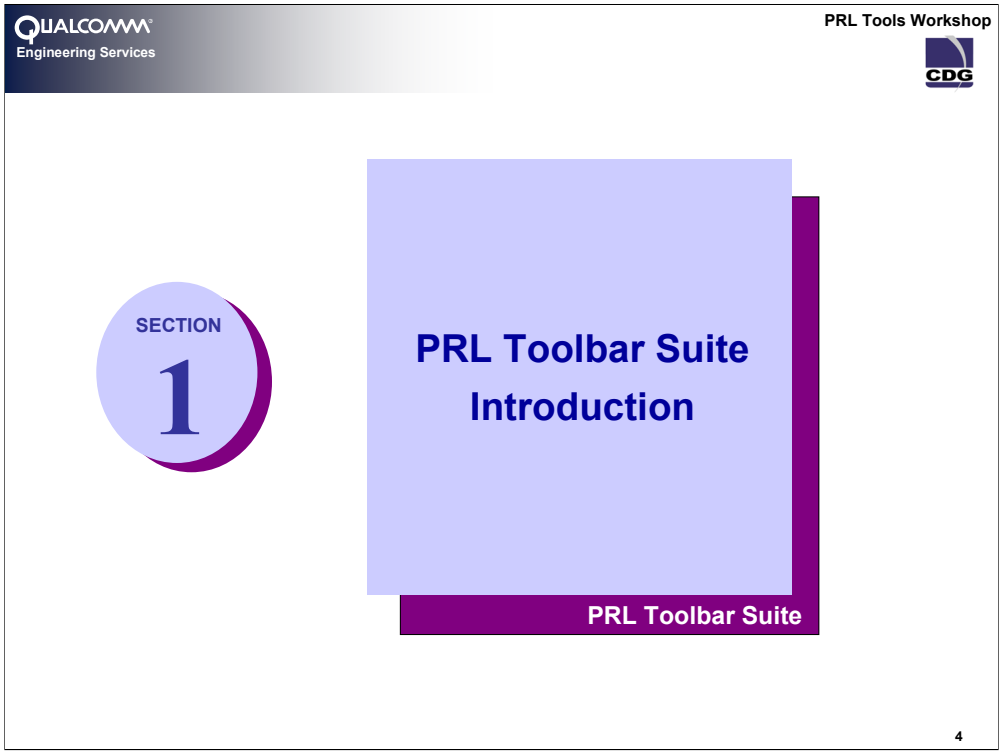
1) PRL Toolbar Suite Introduction
2) Configuring and Loading TDS documents
3) Creating the PRL Policy
4) Generating the PRL
5) Adding DO systems to the PRL
6) Testing the PRL
3

Notes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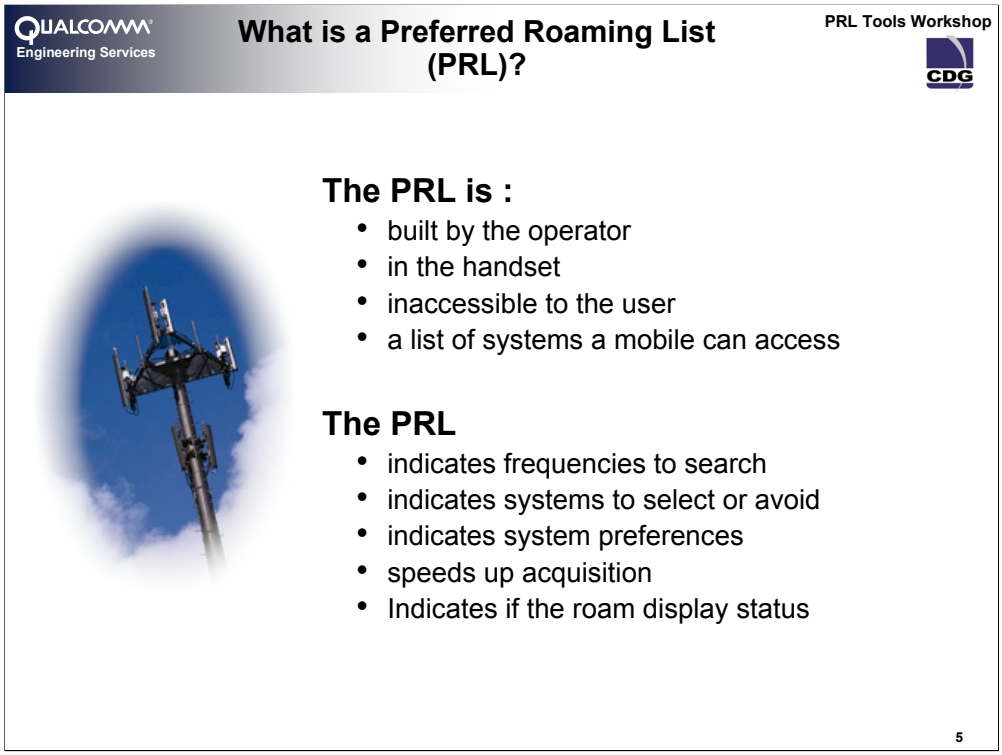


The PRL is often considered in two subtly different ways depending on an individual's particular context:

- Some see the PRL as a set of RF channels on which to search for service and the description of systems that can be found on those channels
- Others look at the PRL as being a list of mobile network systems that a mobile device is allowed to access and the frequencies on which they can be found.

Both are, of course, correct. The preferred roaming list is a device resident database. It does contain an indexed list of frequencies on which to search for particular systems. The PRL contains a list of systems that a device is permitted to access, and, those that it is explicitly forbidden to access. The list of systems is known as the System Table and the list of frequencies is known as the Acquisition Table

The PRL contains information to assist the mobile station in system selection and acquisition process. It indicates which systems the mobile station should use (preferred systems) and those which should not be used by the mobile station (negative systems). In addition to indicating which systems are preferred or negative, the PRL has information, which can help to optimize the acquisition time.

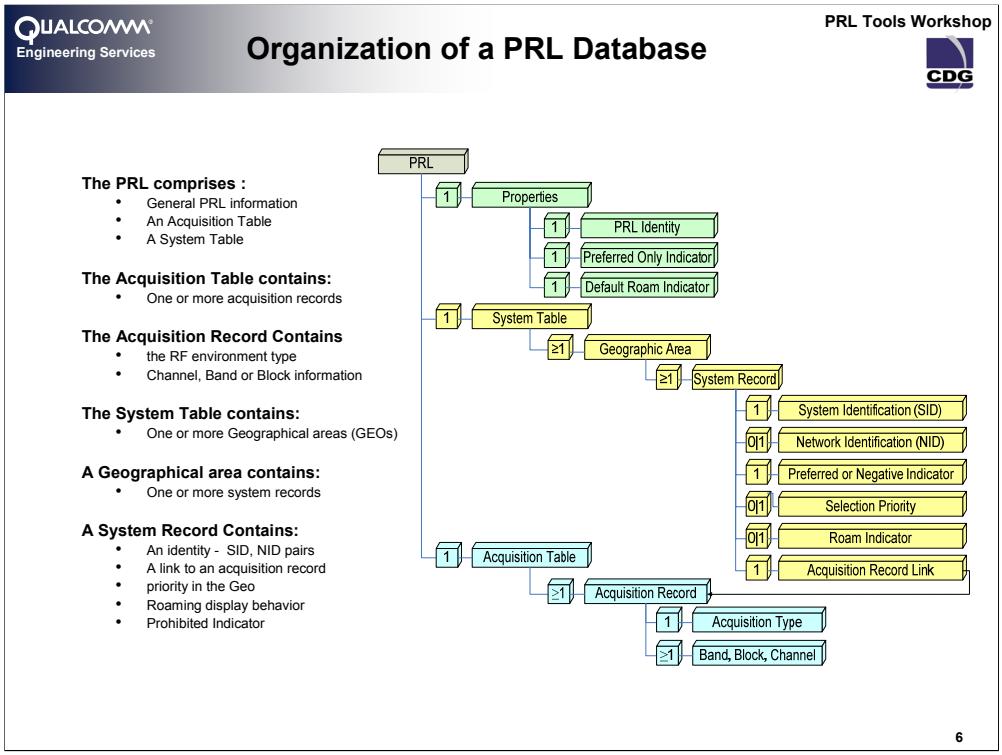
The PRL is built by an operator, loaded into the mobile device and is not accessible by the user. The full definition of the PRL is fully described in the standards – specifically the IS-683 family of standards, from revision A to revision E.

The Function of the Preferred Roaming List

The PRL assists the mobile in the acquisition and system selection process as governed by the system determination algorithms of the particular implementation. The PRL informs the device's system determination function as to which systems are permitted, preferred and prohibited. The use of a PRL speeds up acquisition and provides the operator with flexibility in specifying mobile search behavior in both the home and roaming markets.

The operator is able to specify whether a "Roam" condition is to be indicated on mobile's display and in the case where the Extended Roaming Indicators (ERI) are supported, a richer set of indicators can be selected for display.

The PRL standards (at various revisions) allow for the specification of a PRL covering CDMA One systems (IS-95), CDMA2000 (1xRTT) systems, IS-856 systems (CDMA2000 1x/IS-95 1xEV-DO) and UMTS/GSM systems



PRL Structure

The PRL comprises three major sections:

- A properties set (header information) that provides general information about the PRL,
- an acquisition table which lists all the frequencies that the device can search, and
- a system table which describes the systems

PRL Header Information (Properties)

The PRL Header information describes the *properties* of the whole PRL. These properties describe aspects such as its name (or identity), default behavior and the type of PRL.

Acquisition Table

The acquisition table contains acquisition records. An acquisition record provides the band and frequencies that the mobile station is to use when searching to acquire a system.

Acquisition records are listed in priority order (highest priority first) in the acquisition table. The channels in the "CHAN" field of the records are also listed in the priority order.

System Table

The system table contains records describing a system. The System Table is divided into one or more distinct segments; these are called Geographical Areas, or GEOs. A system record belongs to a Geographical Area. A geographical region would normally be used to group a set of systems found in the same physical region. Certain other aspects of a system record only have relevance within the context of a GEO, e.g. priority.

A system, in the context of the system table, is identified by its SID and NID. Each system table record has an indicator, which determines within which geographic area that a particular system belongs.

Other indicators declare whether the system is preferred (permitted) or negative (prohibited). Allowed systems can have relative priority with respect to each other within a geographic region, effectively making some systems more preferred than others. The priority that a system has is relative to the other systems in the same GEO. The most preferred system is the most desired system and what the mobile device will always try to obtain service. There is no limit to the number of priorities that can be present within a GEO. There can be multiple systems of equal priority.

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PRL Process

CDMA System selection function is a search engine

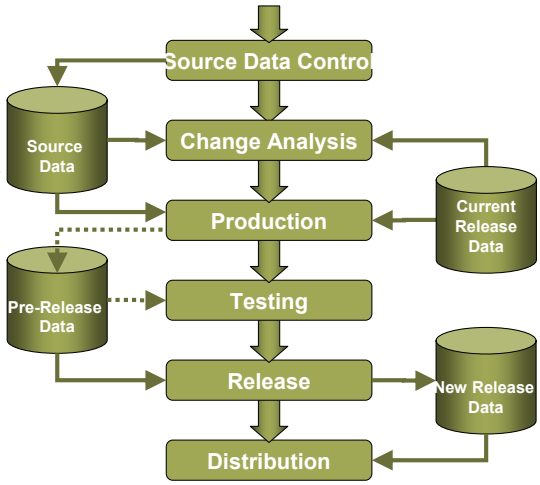
- that looks for CDMA networks
- PRL is can be considered to be the search data
- System selection search engine can be as good as the PRL database it searches against

A good PRL is the output of a solid process

- A PRL is as only as good as the source data used to build it
- Careful management and currency of input data is essential
- Achieving a good and manageable PRL requires management of
  - the input data from various sources
  - In-service PRLs
  - Dependency information between the two

Weakness in the PRL process can lead to the perception

- by the operator that the roaming process is over arduous
- by the end user that the service is either unavailable or unreliable.



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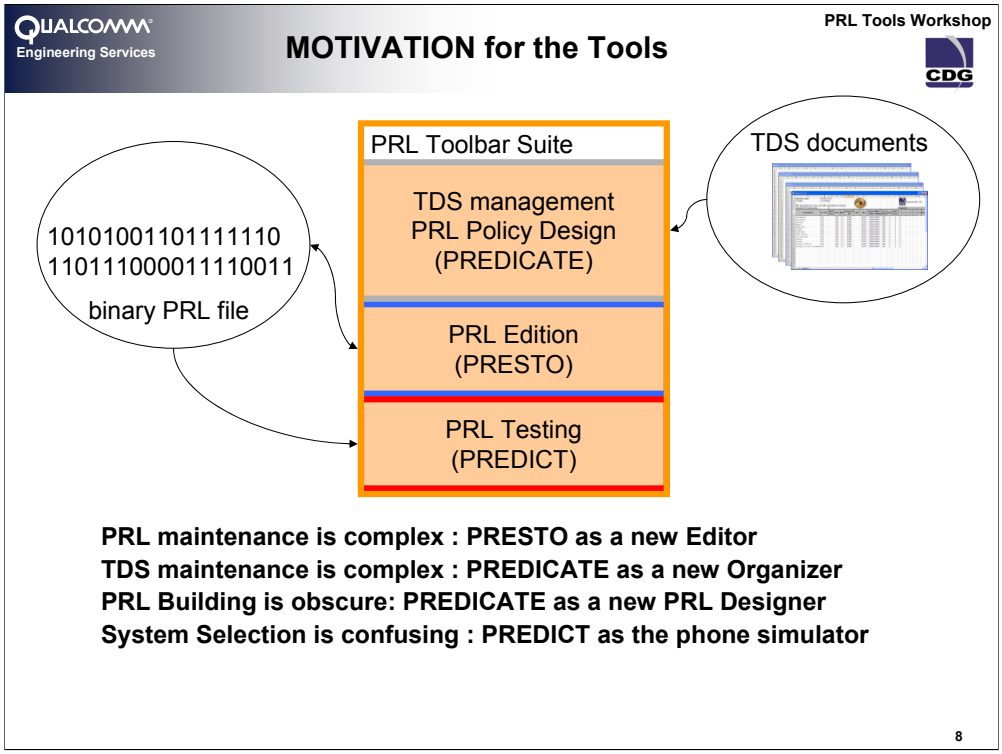
The PRL is a database that is used by system determination to determine where to search for systems and which systems are the best ones for service.

Any search result is directly related to the sources that are searched. The PRL can be considered to be the searchable data for the system selection process. The system selection search engine can only perform a job as good as the search data provided by the PRL database.

One of the most important aspects of a PRL is that it is the output of a process. The contents of the PRL can only ever be as good as the source data that is used to build it and, consequently, the system selection capability of the handset can only be as good the data in the PRL provided to it. The source data to build a PRL can come from many disparate sources. The key here is that the careful management and currency of input data is essential to producing a reliable, maintainable and traceable PRL design.

Achieving a good and manageable PRL requires a solid process that carefully manages the input data right through to the deposit of the PRL into the mobile device. Any weakness in this process can ultimately lead to the perception by the operator that the roaming process is over arduous.

Perhaps more harmful, , once unleashed into the customer domain, there is the risk that a poor PRL can cause the perception, by the end user, that the network and service have poor coverage, cannot or do not roam, are unavailable or just unreliable .



Motivation

PRL maintenance is complex:

Actions from the most abstract layer (contract agreements with other carriers) to a complex computer/headset technical field (binary file) are require.

TDS maintenance is complex:

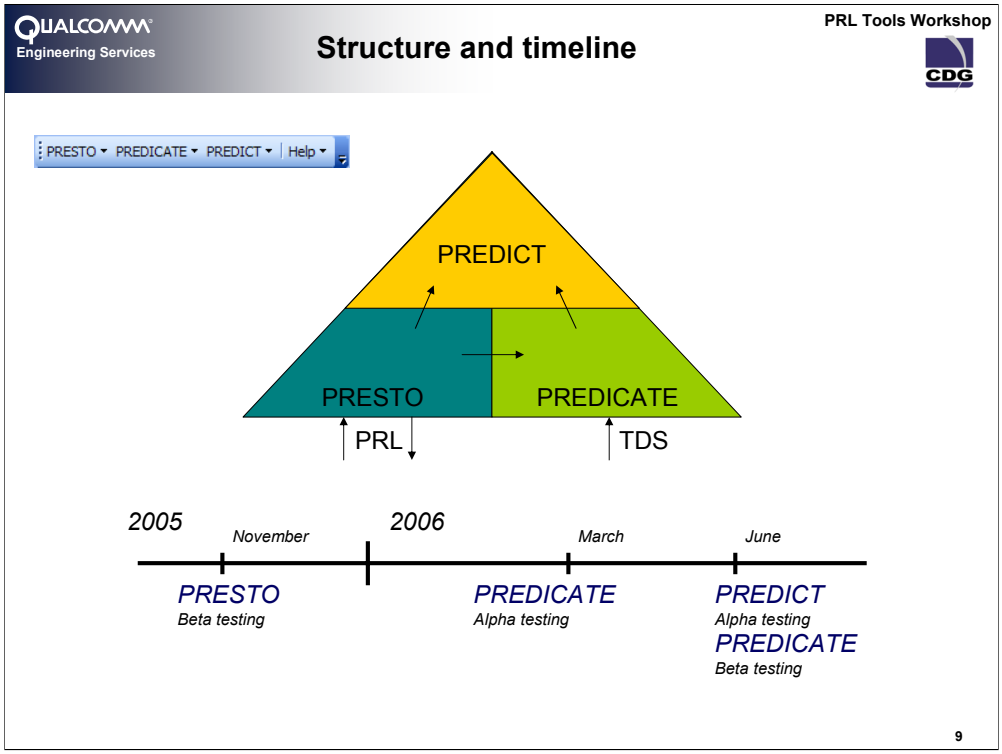
Current Datasheets are often incomplete and difficult to track, PREDICATE provides a geographical organization for TDS and updates !!

PRL Building is obscure:

Using the data coming directly from the TDS read by PREDICATE we have available a tool for PRL Policy Design, which which lead us to a PRL; easy and errorless.

System Selection is confusing:

PREDICT provides PRL developers a first testing environment for their PRL design before going to field test. The code inside PREDICT is the same code that is given to phone manufacturers.



Structure

PRESTO and PREDICATE are the interfaces with the file system. PRESTO is the PRL editor, thus it will act as the PRL reader any time that other part of the suite needs PRL information. PREDICATE is the TDS manager, It will classify the TDS documents by country and indicate which TDS records are not valid. Once the TDS data is loaded reporting is available. There will be also reporting against PRL data selected by the user.

PREDICT will take TDS data from PREDICATE and a PRL file read with PRESTO. Using the TDS data as an RF simulation it will execute the System Determination code over the PRL file, being able to PREDICT which state will the phone reach before the field testing and under ideal conditions.

Timeline

PRESTO: Interface with the binary form of a PRL

Currently under Beta testing (Bugs are being found !!); it will be released soon

PREDICATE: TDS and PRL Reporting → Policy checking

Beta testing starts today

PREDICT: PRL behavior testing using System Selection

Beta testing starts today

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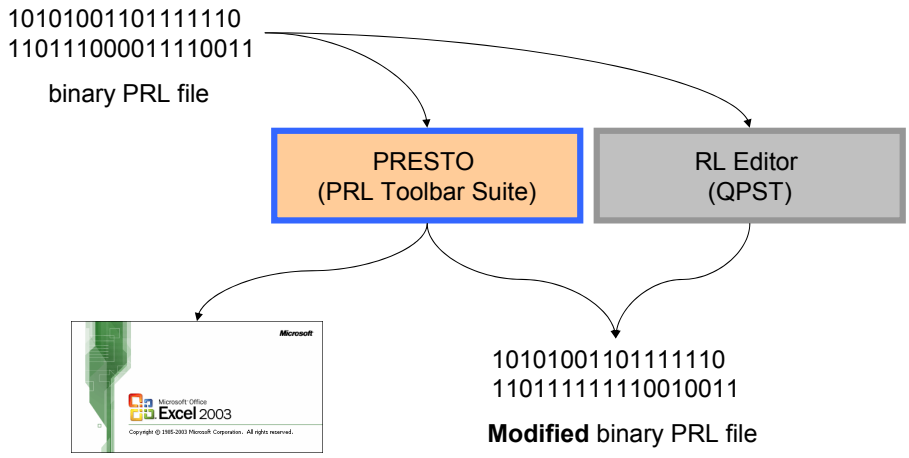
PRESTO



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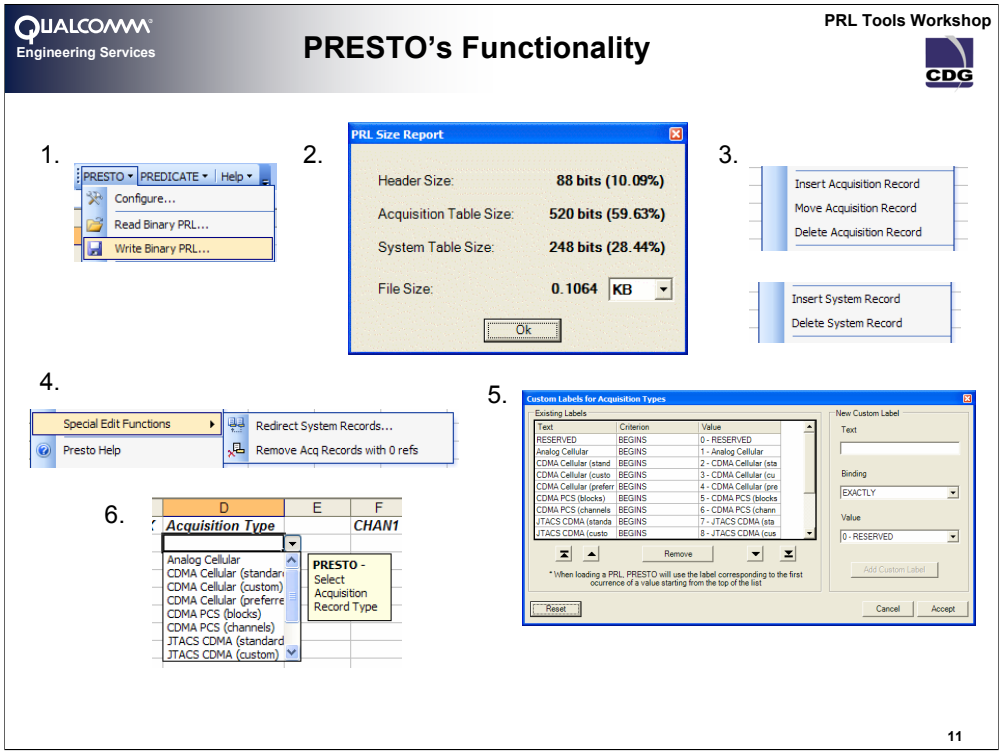

PRESTO's Functionality:

1. Read and Write PRL files to and from Excel
2. Give us the size of each Acquisition Record System Record and PRL file
3. Editing primitive functions:
    - Over Acquisition Records
        - Insert
        - Move
        - Delete
    - Over System Records
        - Insert
        - Delete
4. Special Edition Functions:
    - Remove non referenced Acquisition Records
    - Redirect System Records
5. Customizable Labels
6. Dynamic Validation

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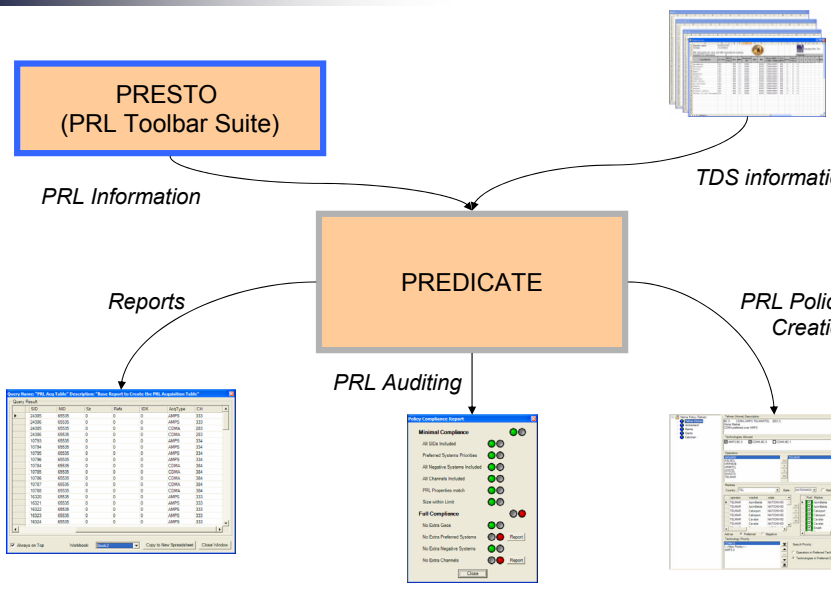
PREDICATE



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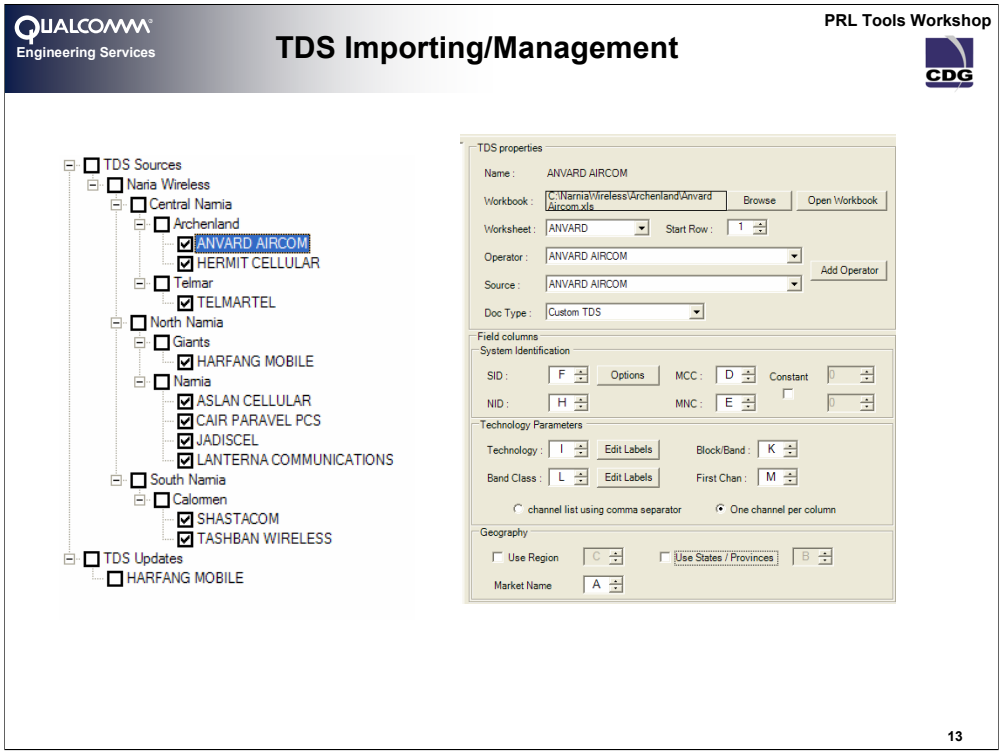
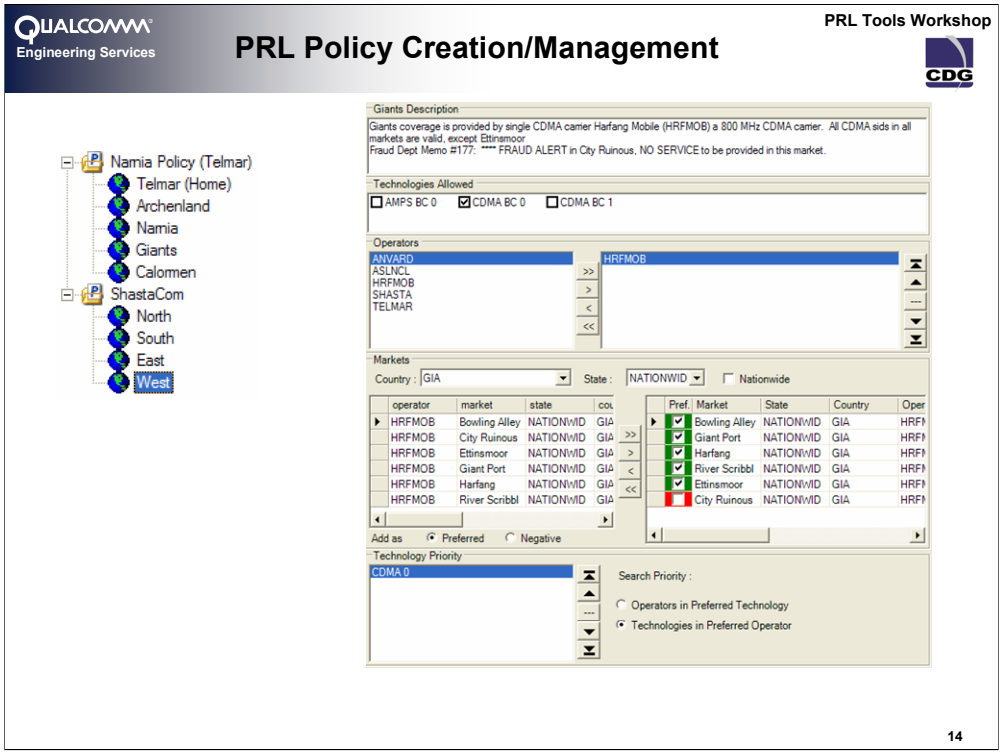


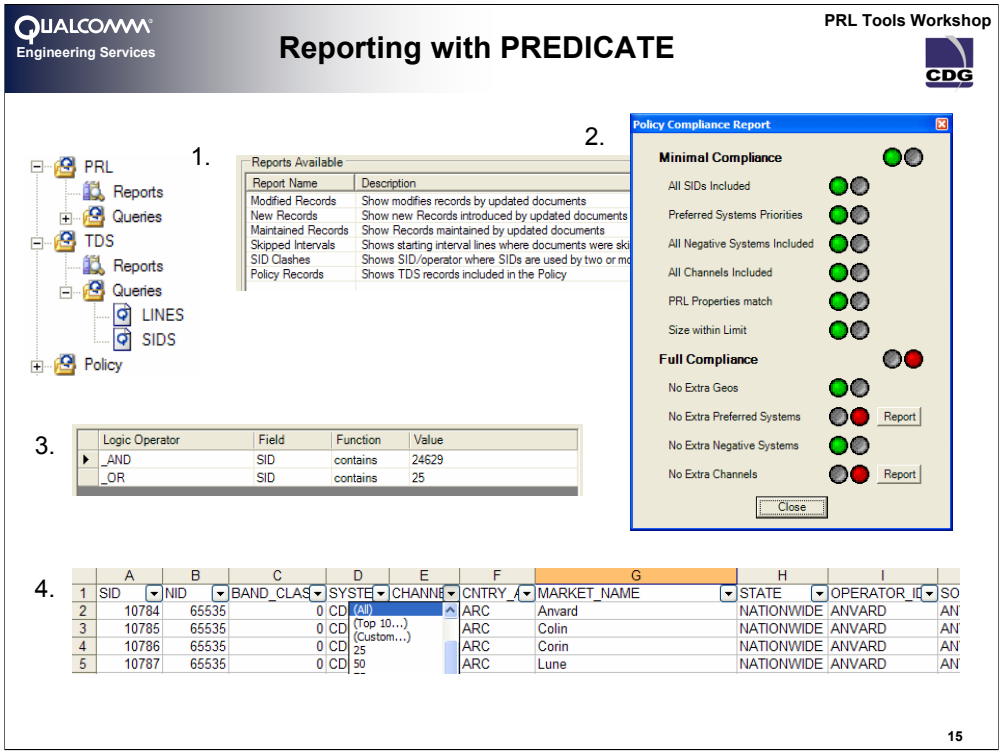
TDS Importing/Management

- Classify your TDS documents independently of where they are located in your hard drive
- Read the heterogeneus TDS information into a homogeneus database where it can be easily managed
- Manage TDS UPDATES automatically
- Report TDS reading problems such as:
  - Incoherent values
  - Missing information
  - Not valid entries



PRL Policy Creation/Management

- Define PRL Header properties
- Define each one of the Geos of your PRL
  - Add Operators and prioritize them
  - Add Markets
  - Restrict modes of operation and create priorities between them
- *All Information comes from the previously loaded TDS (No room for mistakes)*



Reporting with PREDICATE

1. Built-in reports:
   - Over TDS data ()
   - Over PRL data ()
   - Over a designed PRL Policy data ()
2. Crossed Reports
   - Complement PRL file with TDS information ()
   - Check if a PRL is compliant with a designed PRL Policy
3. Customized Queries
   - Boolean conditions (AND and OR)
4. All MS Office Excel report potential
   - Most impressive/useful: AutoFilter option

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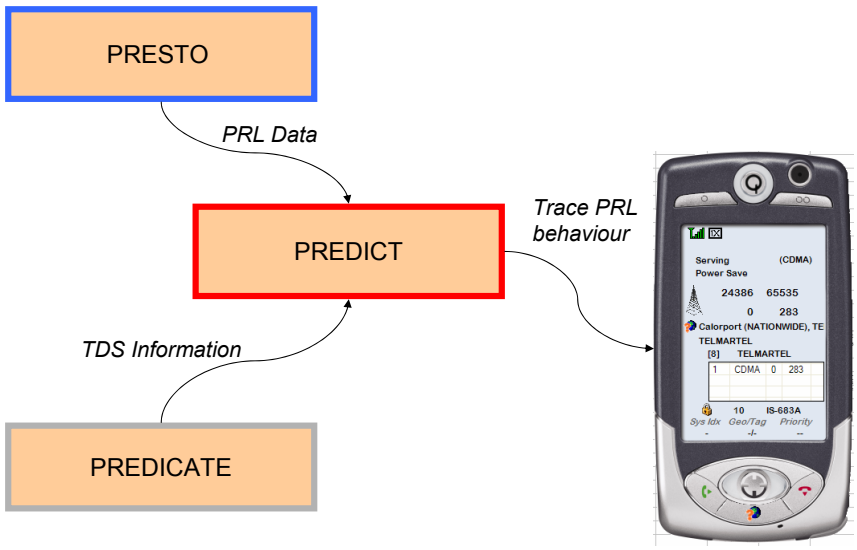
PREDICT



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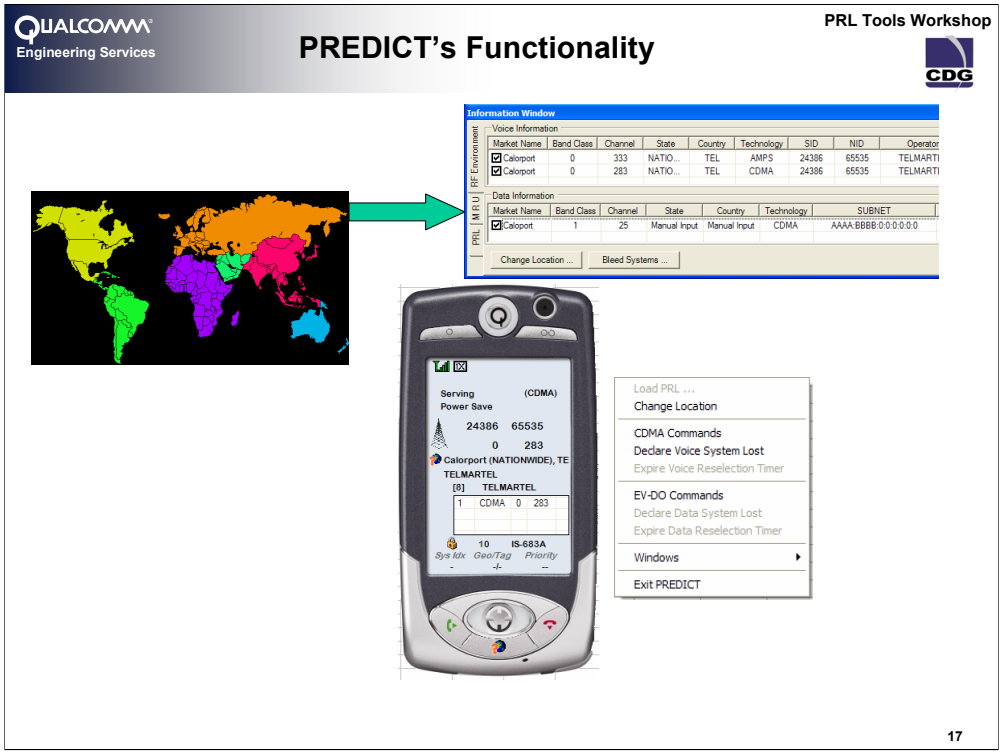
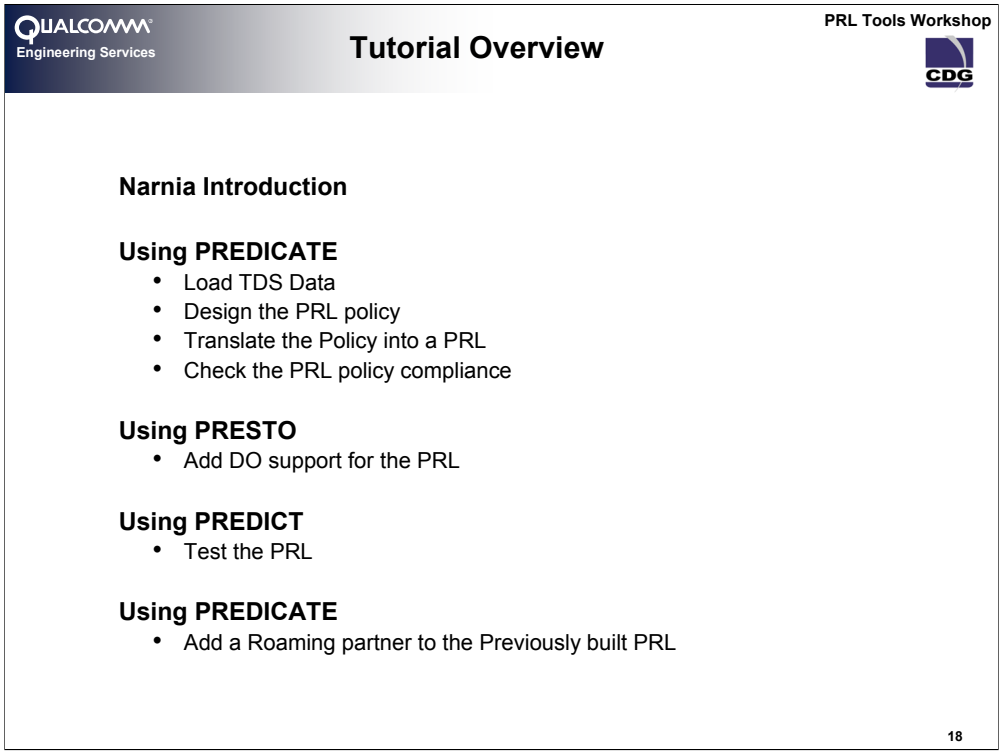


PREDICT's Functionality

PREDICT is a System Selection code simulator; it uses the same code that's given to manufacturers. The simulation is carried out using RF data coming from the TDS information previously loaded with PREDICATE. That data is narrowed down by clicking in a specific globe position on the map and slecting a market which TDS data is available for.

PRL information will be read with PRESTO, which guarantees that any PRL that PRESTO is able to read will be available for use in PREDICT. Some more information regarding the System Selection process (which usually is hidden) is available to the PRL Tester.



Tutorial Overview

During the tutorial data coming from a ficticious operator will be used. In order to demonstrate QUALCOMM PRL Toolbar Suite a set of operators have been created. These operators are located in a region called Narnia, whose Landscape and characteristic will need to be introduced in order to understand the turorial. Several operators provide wireless service in this region; TDS are provided for each one of the operators.

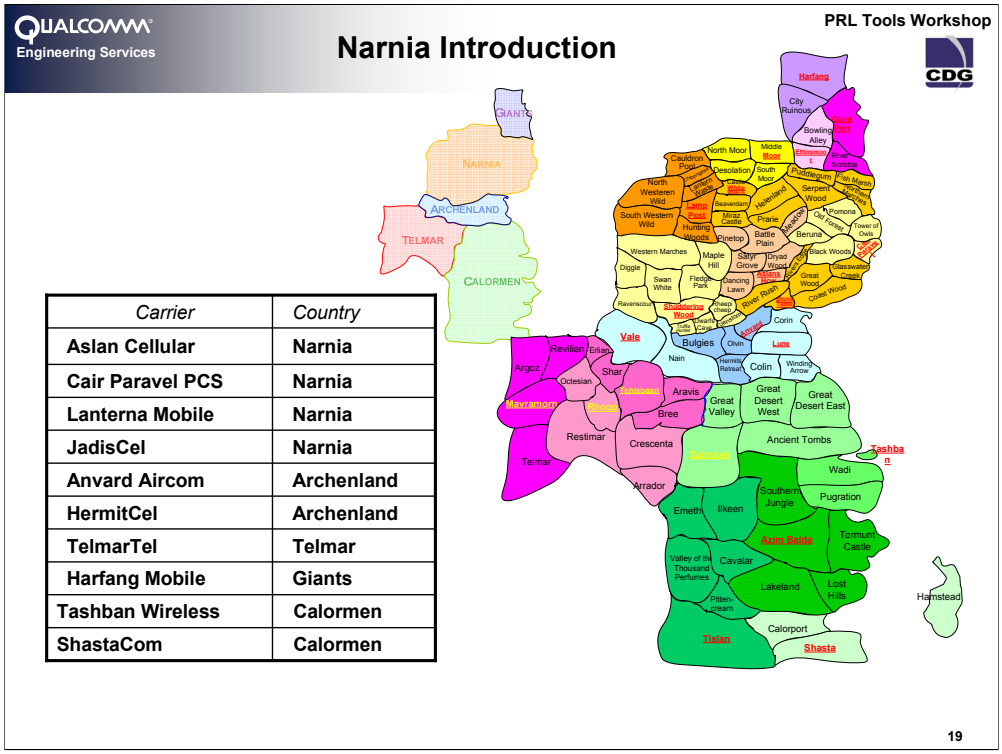
After the introduction of the Narnia data, we will pretend that we are one of the operators and that we want to build a PRL which complies with all the roaming agreements. We will start from scratch in the process of building a PRL. PREDICATE will be used for importing the TDS of each one of the operators (including ourselves).

When the TDS data is loaded into PREDICATE the PRL Policy design can start, creating the Geos and filling them with data and priorities. After the PRL Policy is completed, policy reports will help us to build the System and Acquisition Tables of the PRL. With the PRL built we can then demonstrate how to check its compliance with a given policy and how to interpret the PRL-Policy Compliance report.

After that and due to the lack of DO TDS data we will manually add DO support in the PRL for the home SIDs and for a foreign one.

With all in place (PRL built with DO information and the TDS loaded) we can proceed to start PREDICT and test the PRL behaviour.

After that we will show how to add a new roaming partner (probably one of the operators in the room) to the PRL.

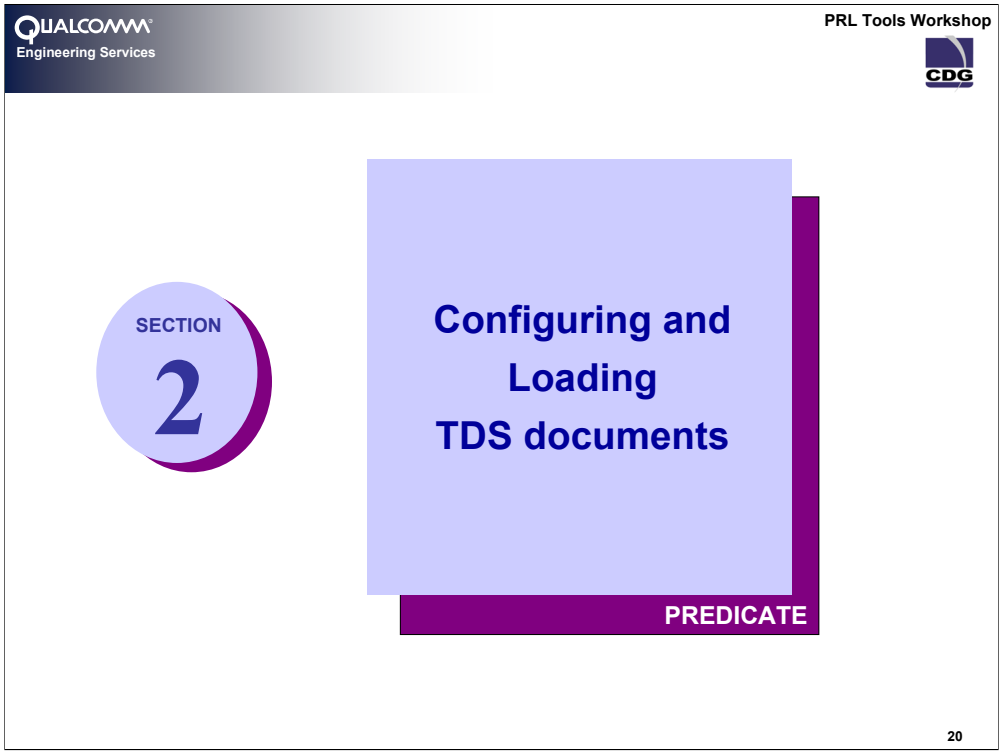


Carrier	Country
Aslan Cellular	**Narnia**
Cair Paravel PCS	**Narnia**
Lanterna Mobile	**Narnia**
JadisCel	**Narnia**
Anvard Aircom	**Archenland**
HermitCel	**Archenland**
TelmarTel	**Telmar**
Harfang Mobile	**Giants**
Tashban Wireless	**Calormen**
ShastaCom	**Calormen**

Narnia Introduction

In order to demonstrate the tools without compromising any real operator information, a ficticious wireless world has been created; Narnia. The countries and operators of this word are:

- Narnia
  - Aslan Cellular
  - Cair Paravel PCS
  - Lanterna Mobile
  - JadisCel
- Archenland
  - Anvard Aicom
  - HermitCel
- Telmar
  - TelmarTel
- Giants
  - Harfang Mobile
- Calormen
  - Tashban Wireless
  - ShastaCom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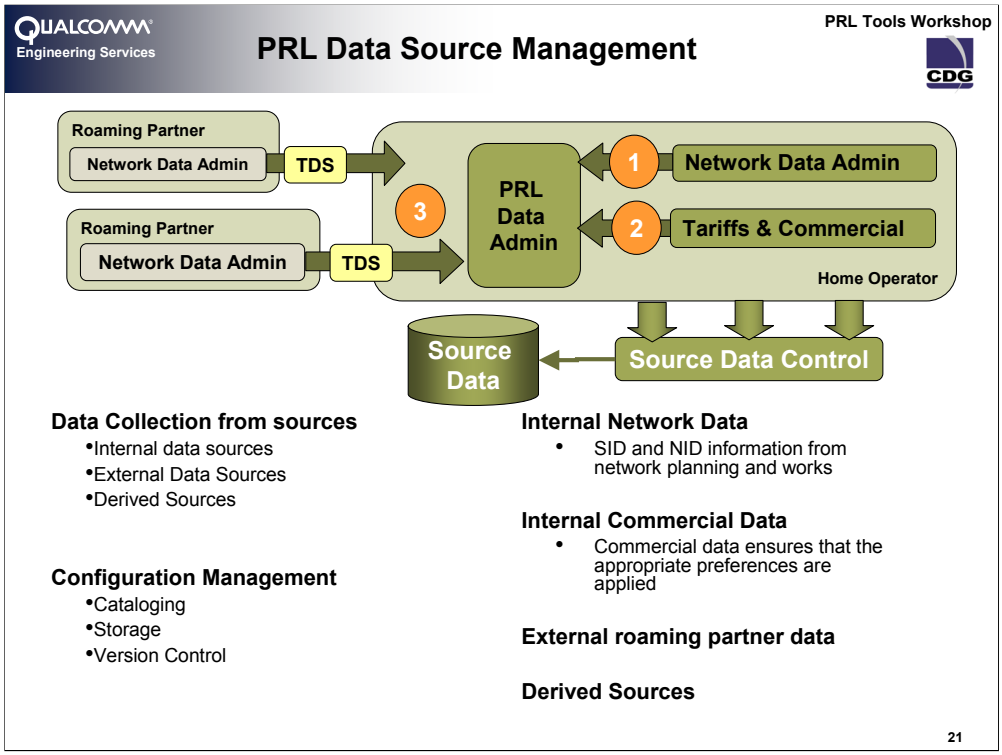


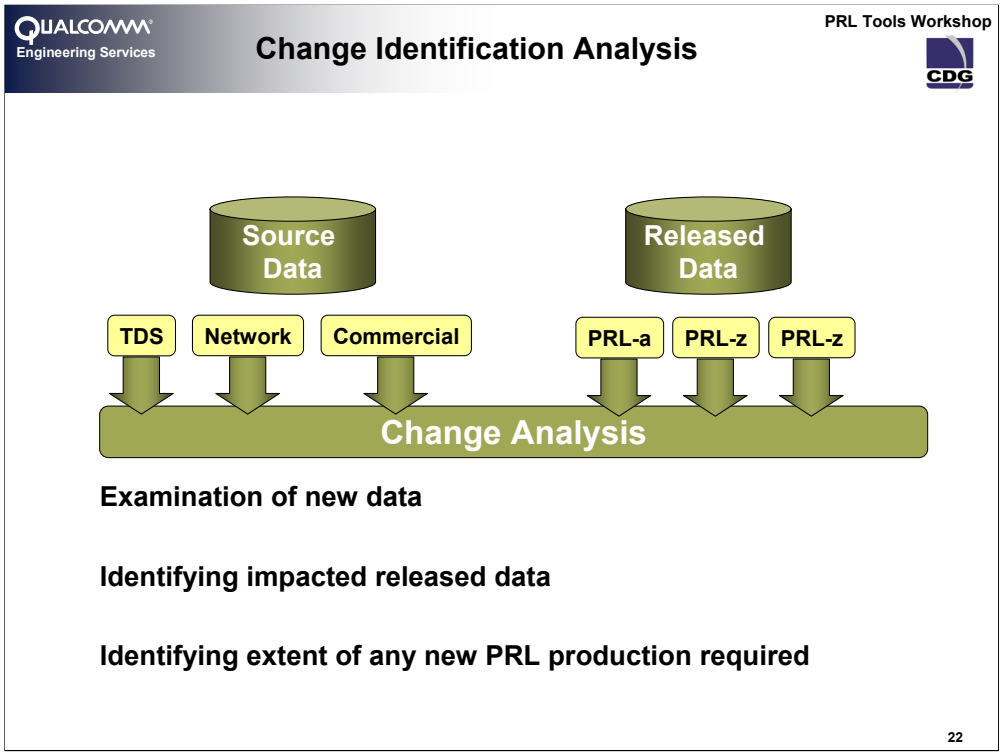
Source Data Management

The source data to build a PRL can come from a number of sources, both internal and external

- Internally from the Network Data department. SIDs and NIDs are a key part of the network configuration data that must be provided to various other interested departments, of which the department responsible for PRLs would be one. SID and NID information result from any number of other processes within the operator organization which can include initial network planning, ongoing network build-out, network modernization and upgrade or on-going network optimization and rationalization. Any of these processes can result SIDs and NIDs being assigned, reassigned or consolidated..
- Internally from the department responsible for negotiated wholesale roaming tariffs. In the case where more than one roaming partner is used in particular roaming markets, these tariffs would generally provide the basis for preferring one network over another. Preferences such as these are indicated to system selection by the PRL. Over time, tariffs may be renegotiated and preferences may change that would mean it is commercially important to ensure that the appropriate preference is applied to the appropriate roaming partner's network for system selection
- Externally from roaming partners. Data is exchanged between operators in a format commonly referred to as the Technical Data Sheet[1] (TDS). Of the information contained in the TDS are those sections describing the Broadcast SID/NID information and the associated BIDs of the commercial markets of the roaming partner's network.

Without management of source data, building and tracking PRLs can become an arduous task. This can be achieved with something as plain as rigorous manual logs or in some electronic form, such as, a database, spreadsheet or even a commercially available configuration management system. There is 100% certainty of change; business changes and new roaming partners cause changes to the network information. A version control process will ensure that future change (in either the production PRLs or personnel that produce them) is, at least, manageable.

[1] The general format for the Technical Data Sheet that is used between carriers is provided in the CDG Document #81. In many cases carriers' particular format may vary but the general content will be similar.



Change Identification Analysis

Knowing which information is the most current, and, where it is located is a critical first stage. However, once any one of these sources change, there immediately gives rise to some key questions:

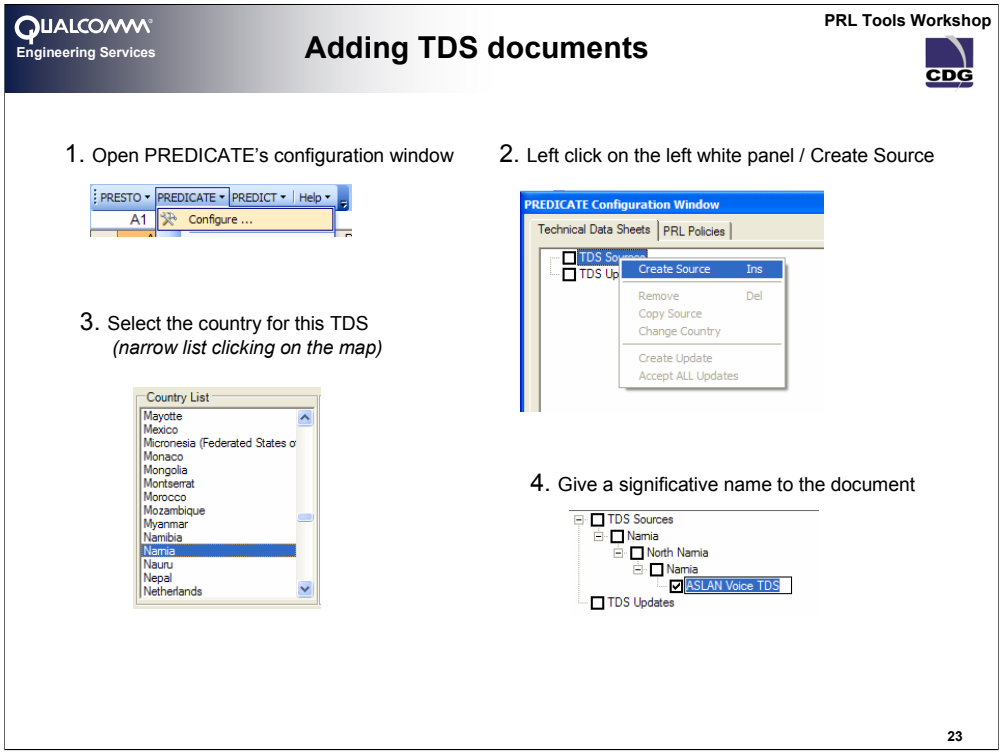
- Does this change affect any of the currently released or in-development PRLs?
- If so, which ones?
- If so, is this a change I need to, or can afford to, absorb at this time?
- If so, how and when should this change be propagated to the PRL work stream?

These questions, in essence, describe the functions of change analysis for the PRL process. Depending on how automated or linked configuration record keeping is, this may be a work function that can be an automated process or manual analysis. Either way, the goal has to be the examination of new data to identify any impacted released data.

Once the impacted PRLs are identified, the analysis should extend to figuring out the scope of the change, and, how it should be included. There can be many factors that affect the priority of an identified change, such as:

- Resources available to effect the change
- Revenue (or other) impacts of [not doing] the change
- Relative importance of the affected area to the customer base
- When in the PRL process new data arrives, i.e. cut-off or data-freeze dates.

All of the factors discussed above are considered and then the result is described in the change details and/or work orders for PRL production.



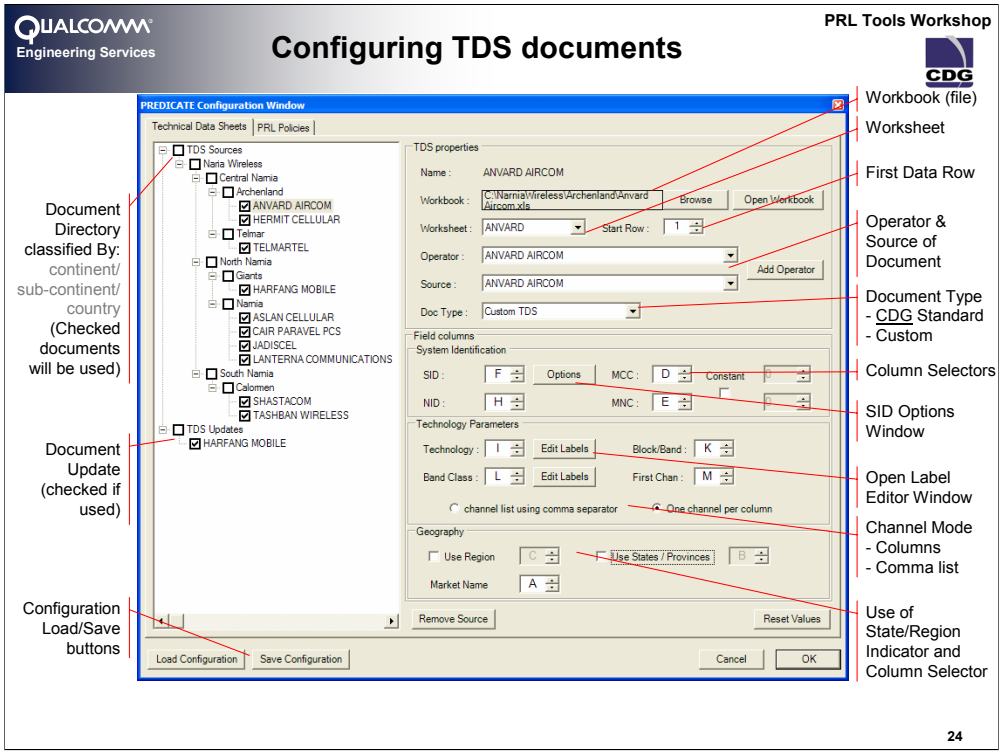
Adding TDS documents

In order to start PREDICATE's configuration we will need to open the configuration window by selecting the Configure … option under the PREDICATE's menu.

There are two main areas in the TDS tab of the PREDICATE's configuration window; the TDS organization tree (white panel towards the left edge of the window) and the TDS configuration area (rest of the window) which will load TDS configuration parameters as a different TDS document is selected on the TDS organization tree. To add a new TDS document, we will left click on the white panel on the left of the window and select the Create Source option.

A new window will pop up asking for a country where the new TDS document will belong to. The action for this window will be to select a country of the Country List, this list can be narrowed by clicking on a different colored region on the world map above the list.

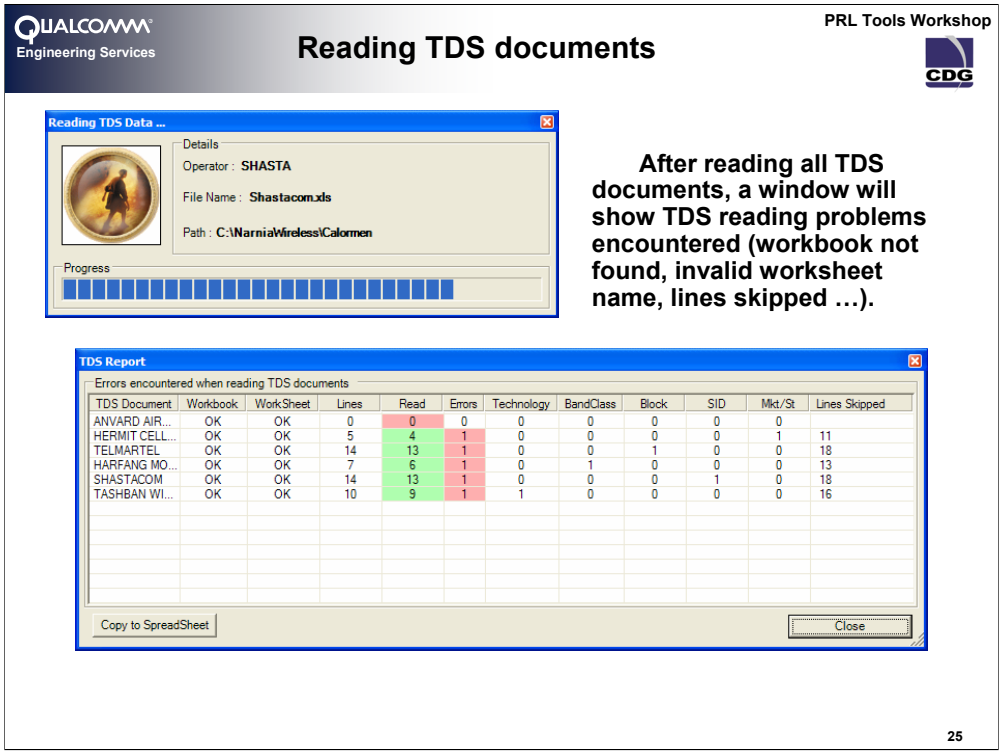
PREDICATE will then create a new source which will be classified by Continent/Subcontinent/Country based on the information previously provided. The first action will be to name this new source to a significative name which will help us identify it later.



Configuring TDS documents

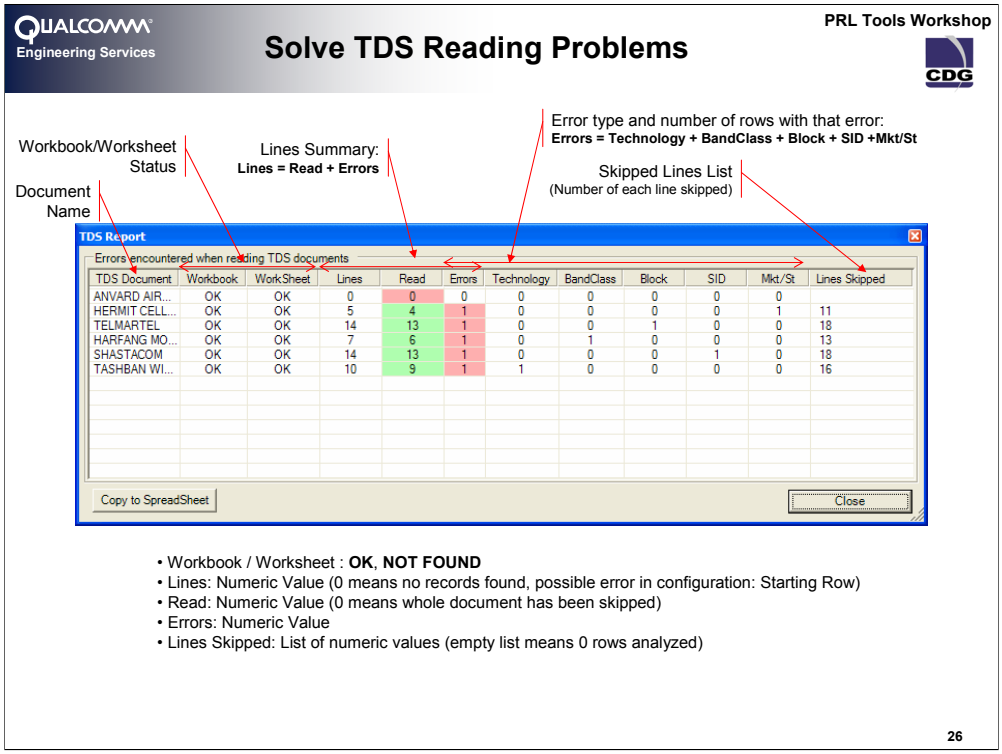
Although the fields can be configured in any order, some of the fields might not be available to donfigure depending on other field's value, following this order there will be no extra work configuring a TDS document:

1. Select the workbook where the TDS data resides by clicking on the Browse button.
2. Once the workbook is selected the worksheet drop-down box will be populated with the names of the worksheets, select the worksheet where the TDS data resides inside the workbook.
3. Indicate which one is the first row which contains data inside the spreadsheet.
4. Select the operator which this document belongs to and the operator which provided the document.
5. Select the document type:
   - When using a Standard CDG Document the column selectors won't be available because they are pre-established making easier the TDS importing process.
   - When using a custom TDS document the values for the SID, NID, MCC, MNC, Technology, Band-Class, Block, Channel, Region, State and Market should be specified as well as the mode the channels appear on the document (one channel per column or all the channels in a comma separated list).
6. Check whether this document contains Region information and/or State information



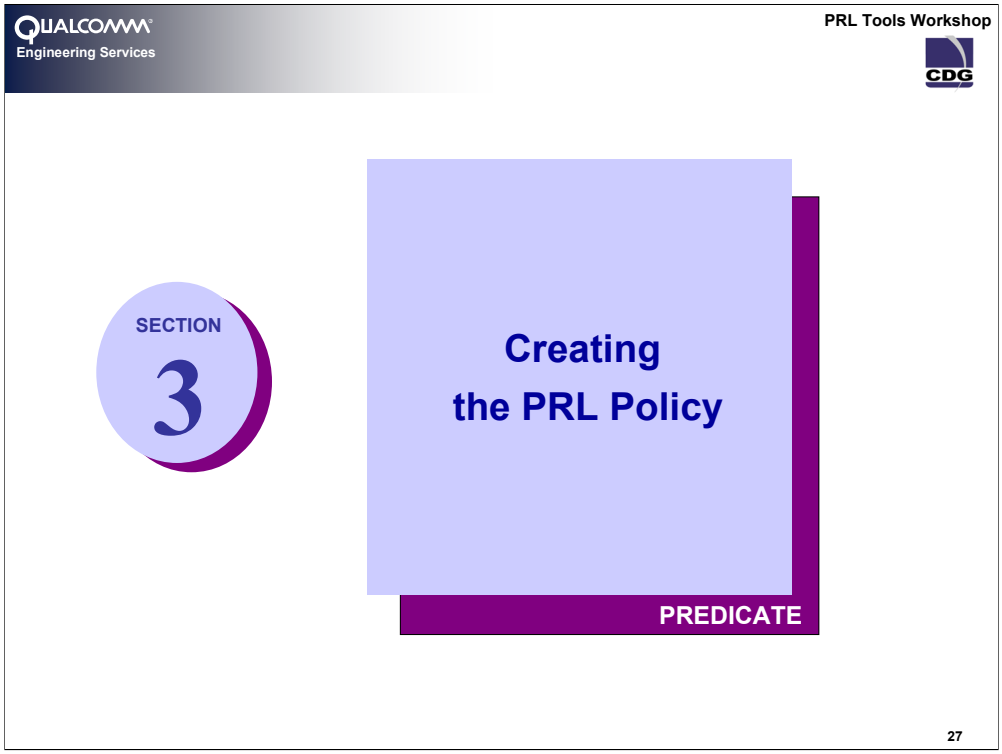
Reading TDS documents

When every TDS document is configured PREDICATE will attempt to read each one of them, a progress window will appear showing which document is being read each time. After all documents have been attempted PREDICATE will show a report window where only documents which contains errors will appear.



Solve TDS Reading Problems

- TDS Document: The document name which this document appear
- Workbook: Indicates whether the workbook has been found or not
- Worksheet: Indicates whether the worksheet has been found or not
- Lines: A number indicating the total number of TDS records processed (failed or successfully)
- Read: A number indicating the total number of TDS records succesfully read
- Errors: A number indicating the total number of TDS records which couldn't be read due to errors on those lines
- Technology: Number of TDS records which contain errors in the technology field
- BandClass: Number of records which contain errors in the Band-Class field
- Block: Number of TDS records which contained errors in the Block field
- SID: Number of TDS records which contain errors in the Market or State fields
- Mkt/St: Number of TDS records which contain errors in the Market or State fields
- Lines Skipped: A list of numbers corresponding to the Excel rows of the TDS document where the errors where found.



What is a PRL Policy?

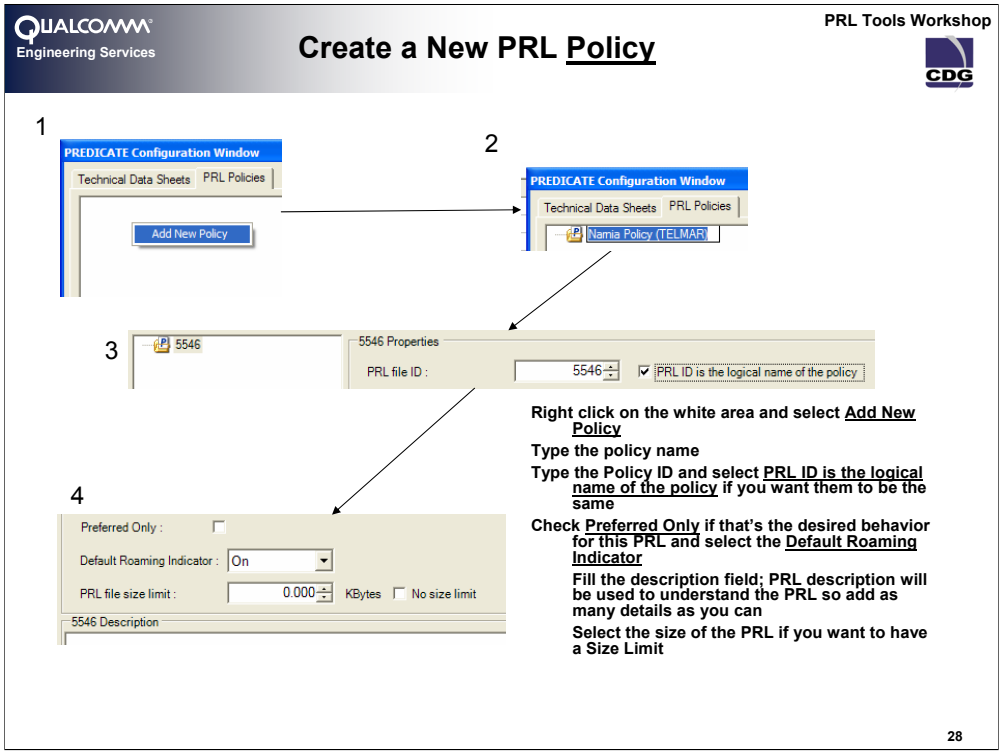
Why should I create a PRL Policy?

Where is the PRL Policy Editor?

The PRL Policy Editor is in the same window of the PREDICATE's configuration. Follow these instructions to get there:

•Click on PREDICATE/Configure…

•Click on the tab on the top part of the window labeled PRL Policies

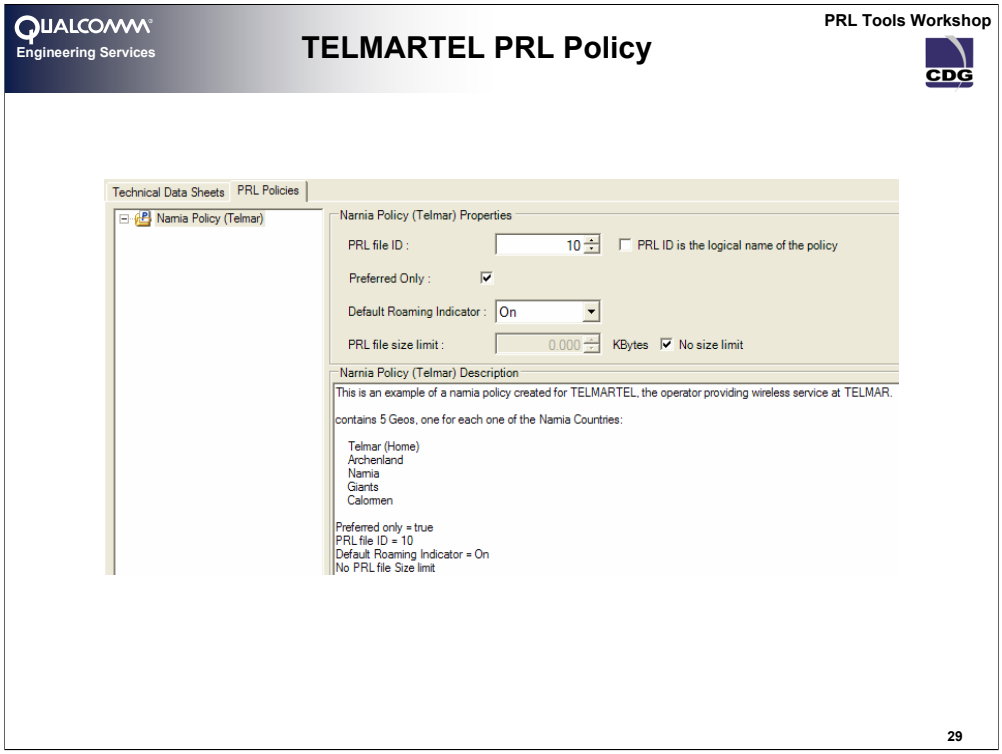


Create a New PRL Policy

The PRL Policy Editor has two main areas, one located next to the left edge of the window, which will reflect the policy names and structures and the rest of the window where there will be displayed the details of the policy selected on the lest part.

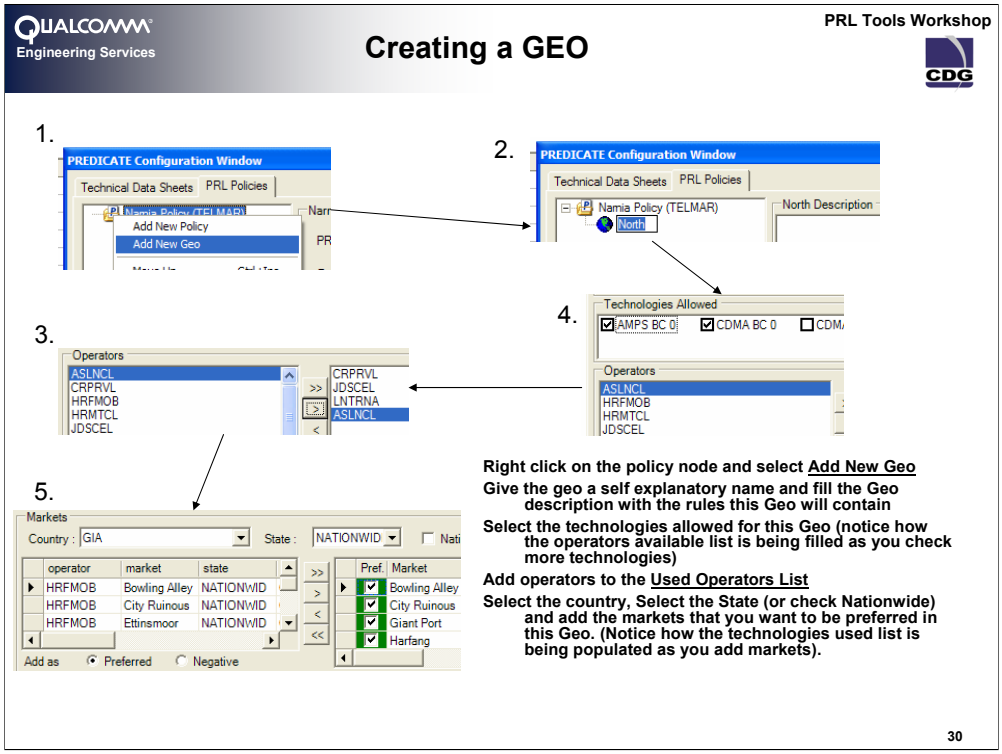
To start creating a policy follow these steps:

1. Right click on the white panel on the left; click on Add New Policy
2. A new Policy Icon will appear, edit its name to the name you want to give to the policy, in this example, **Narnia Policy (TELMAR)**. This name is a logical name which doesn't necessarily correspond to the PRL ID which goes in the header of the Binary PRL file. Once the Policy appears and is selected the Right part of the window will show the policy properties (note the similitude to the properties on the header of the PRL binary files).
3. Type the PRL ID which this policy represents (this is the ID which goes to the binary PRL file, in this case we will type **10**.
4. If you feel more comfortable using numbers to identify policies and want the logical name (the one appearing on the tree) of the policy to be the same as the PRL ID, then you should click the option right next to the PRL ID saying PRL ID is the logical name of the policy.



Create a New PRL Policy

5. Select if this PRL is closed by checking the Preferred Only check box or open, leaving it unchecked. For our example it will be checked.
6. Select the Default Roaming Indicator value; **On** in our example.
7. Select whether this PRL has a size limit or not; this option will be useful if you have a constrain on your handsets, Narnia handsets have plenty of room for their PRLs thus we'll check No Size Limit
8. Finally you can type the policy's description on the text box, this will help to understand why and how the policy was created and what is in this policy.

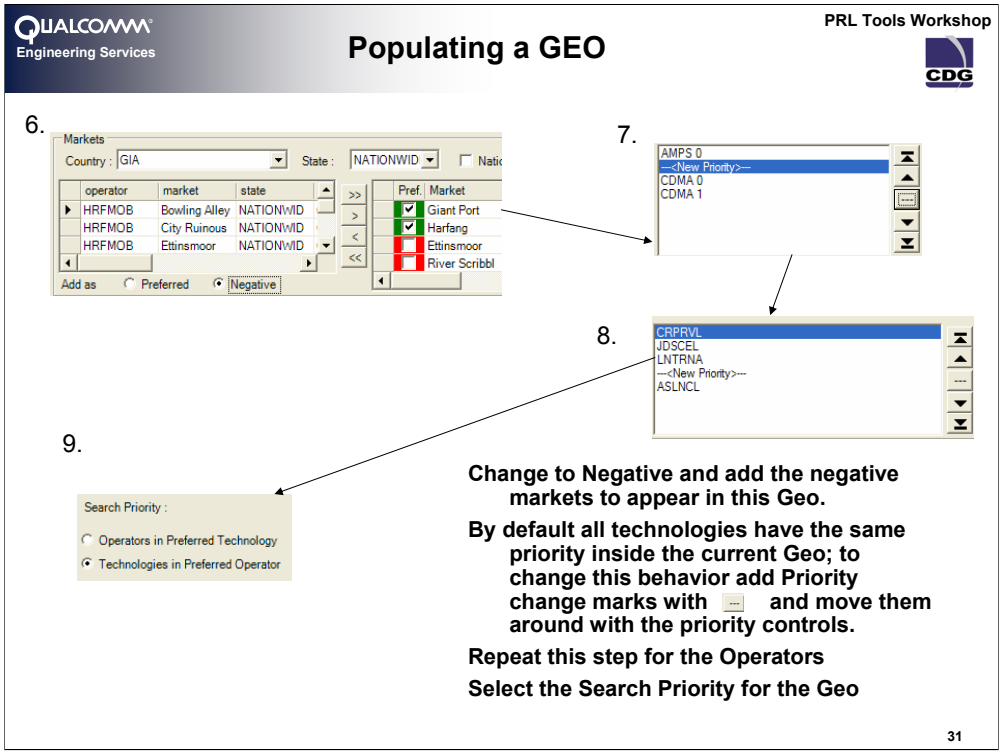


Creating a GEO

Besides the Policy Properties just defined a policy is also formed by GEOs. Each GEO will correspond to one GEO on your System table. Let's remember for those not familiar to the GEO numbers that a new GEO starts when the value New is found on the GEO field of a System record.

For our example there will be 5 GEOS, one for each country. We will start defining the GEO for TELMAR, which is our 'Home' country:

1. Select the just created policy, left click on it and Add New Geo
2. A new GEO Icon will appear under the policy, name it Telmar (Home), the right part of the window will change when a GEO node is selected, showing all the proerties of a GEO policy.
    - There is a GEO Description on the top of the GEO policy properties, this box will be filled as you change the GEO policy properties and/or you add Systems to the GEO.
3. Select the technologies you want to allow for this Geo (this will narrow the lists when you browse through them), for the Home Geo of Telmar we will allow only **AMPS BC 0** and **CDMA BC 0**. When there are technologies selected the available operators list will be populated with operators using that technology.
4. Among the list of operators select TELMAR and press the single > button to move it to the list of used operators.



Populating a GEO

5. Select the Country **TELMAR** and click **Nationwide**. The list of all available markets available for that operator in the country and state selected will appear.
6. In order to move all markets to the right list of markets used, click on the >> button. Notice that the Preferred option is selected, markets added will appear as preferred, if the Negative option was selected the markets added would appear as Negative. In this case all the home SIDs will be preferred.
7. The botton list will be populated as markets are added to the right list, after all the desired markets have been moved this last list will contain the technologies really used by this GEO (notice that it doesn't have to be the same as technologies allowed, you might think you want to use one technology but in reality that operator doesn't use it). You can insert priority changes in this list, meaning that inside this geo, the priority of one technology will be more than the other. In our example we have CDMA 0 and AMPS 0, as TELMAR we prefer to use CDMA over AMPS, so let's select the CDMA 0 on the list and click on the [--] button, a change on priority will be added between the two technologies used.
8. In a similar fashion the priorities between operators can be changed
9. Finally select which standard mode of sorting the records for this GEO, either Operators in Preferred Technology (i.e. first all the CDMA SIDs and after them all the AMPS SIDs and inside those two groups the operator sorted by priority) or Technologies in Preferred Operator (where all the records of the first operator will be listed by technology priority and the the second operator, etc …)

NOTE: as of today, the exceptions of priority are not contemplated in PREDICATE's.

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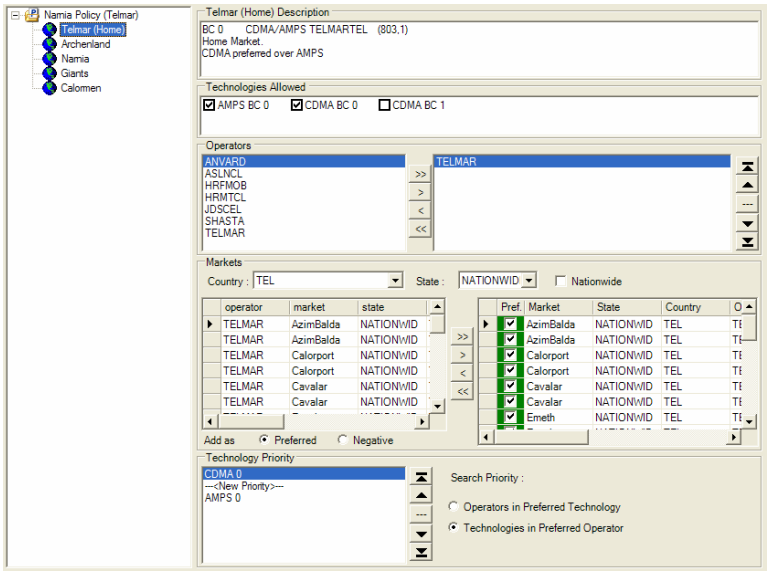
Telmar (Home) GEO



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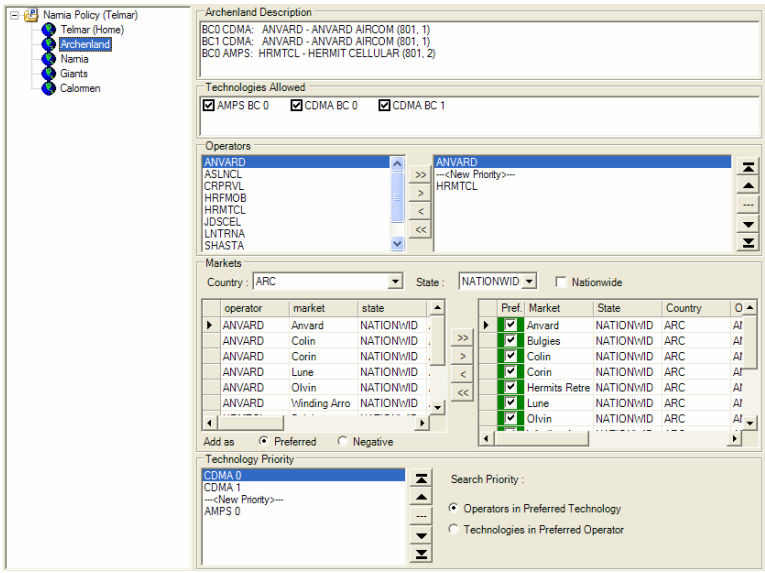
Archenland GEO



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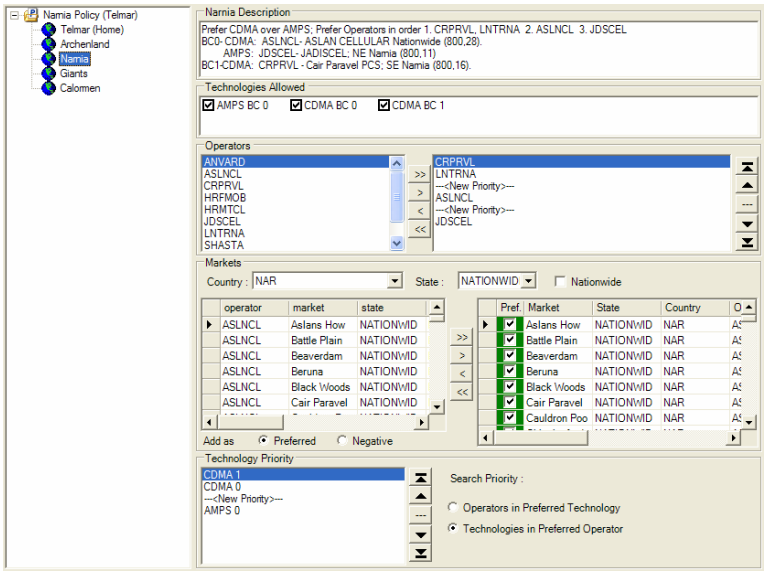
Narnia GEO



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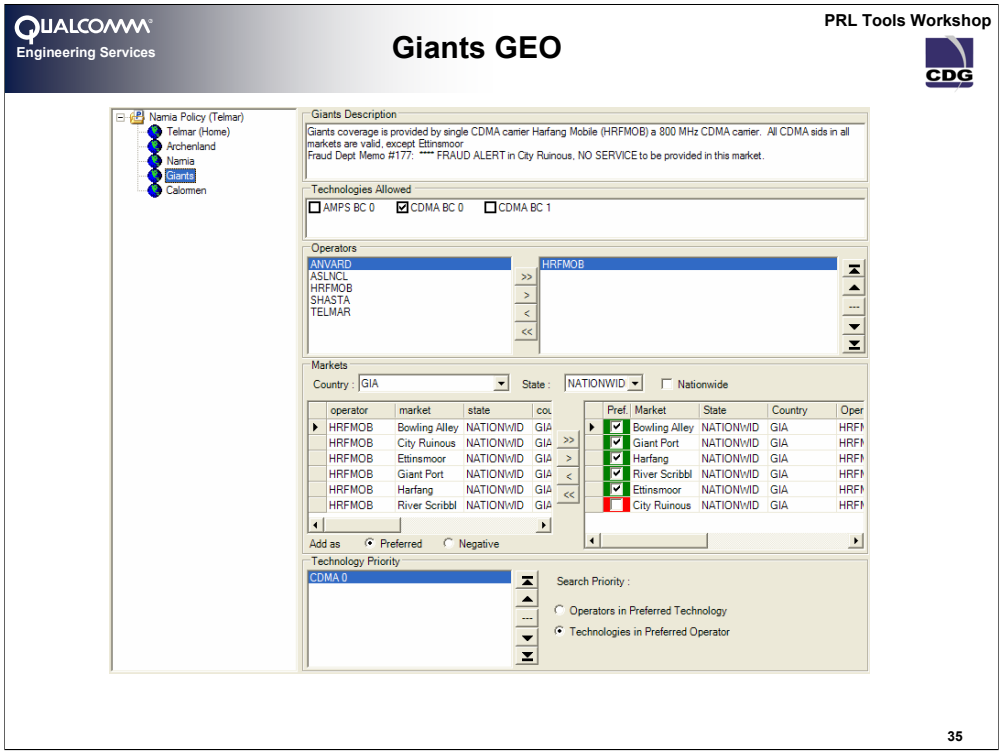

Giants GEO

Note the Negative System due to a fraud alert detected on that market **(City Ruinous)**

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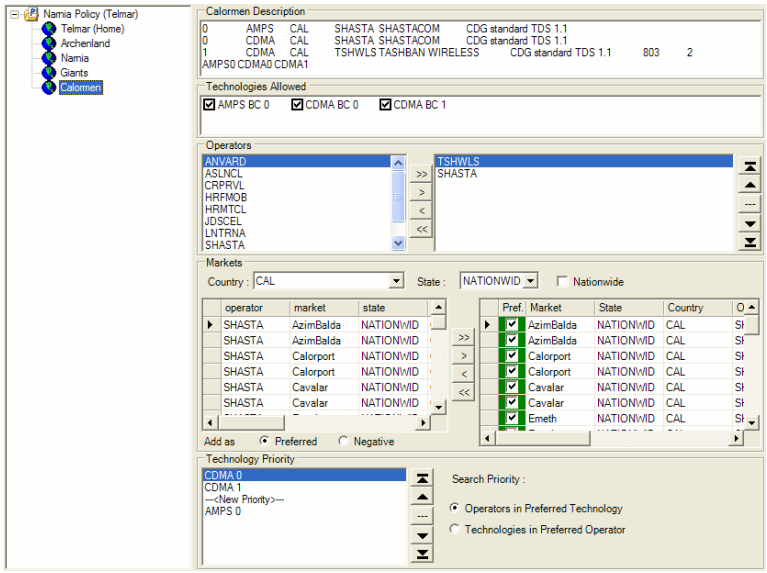
Calormen



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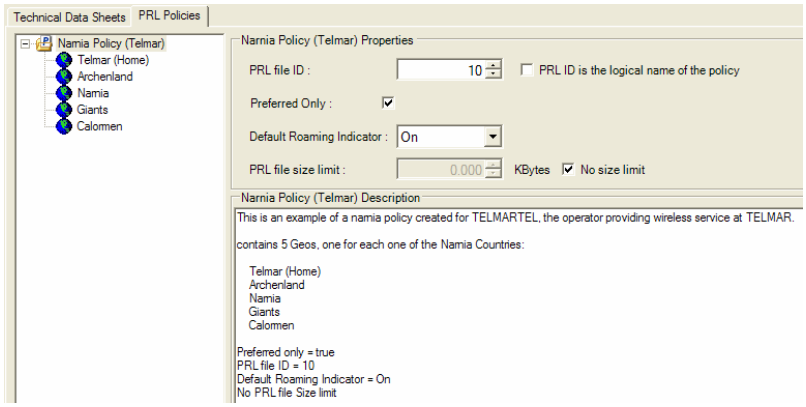
Final Result



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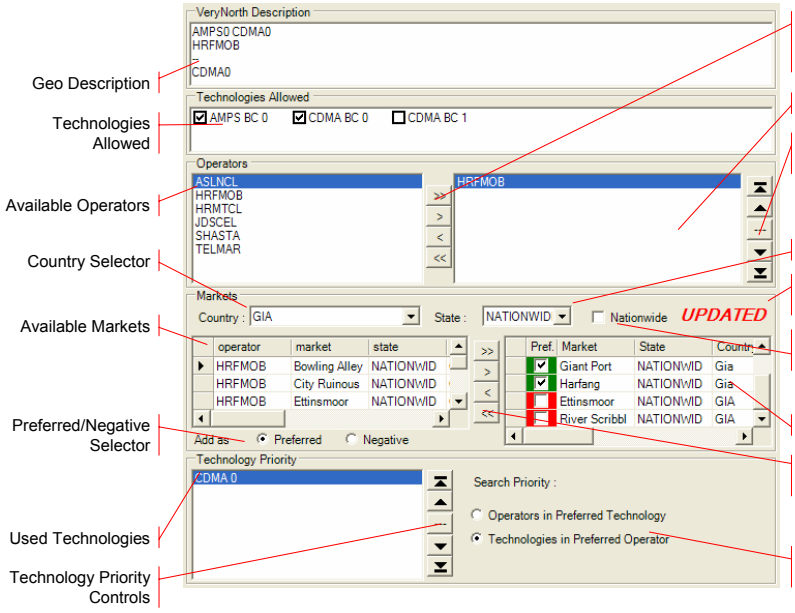
Geo Window Description



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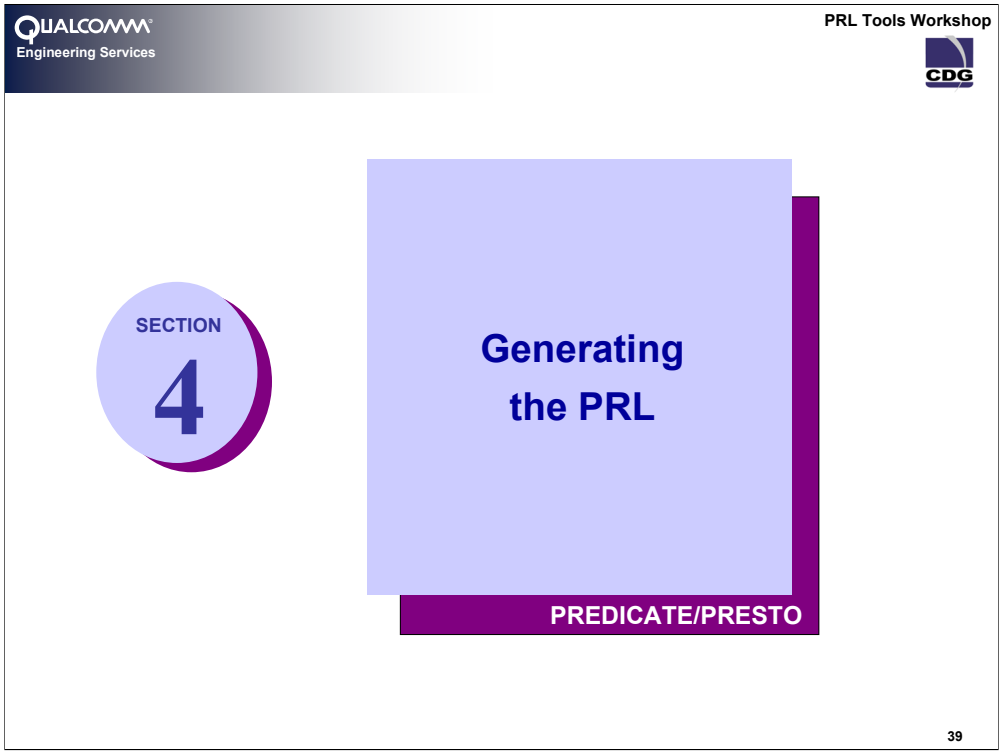
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SECTION
4
Generating
the PRL
PREDICATE/PRESTO
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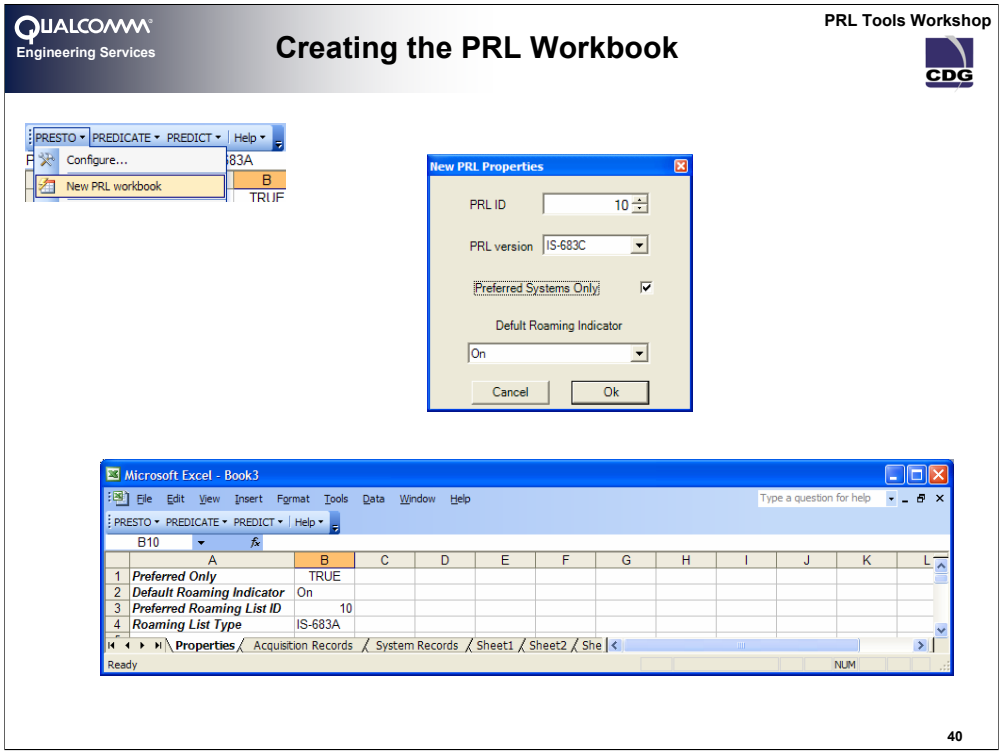
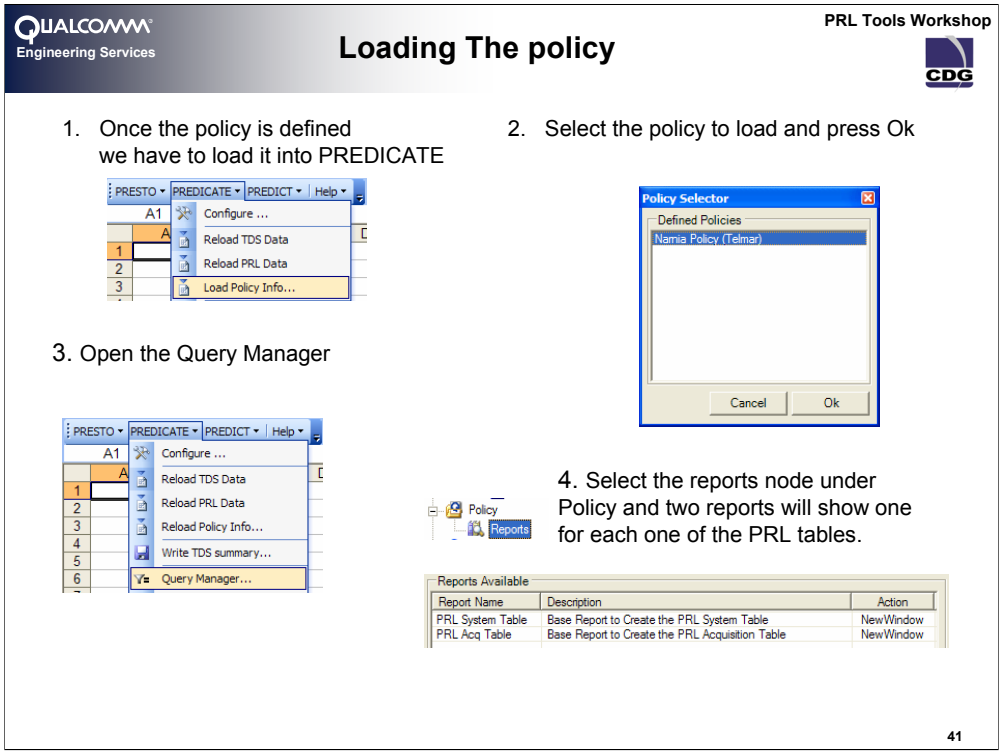


Creating the PRL Workbook

- Click PRESTO/New PRL workbook
- Select the PRL ID desired for this new PRL; **10** for the Narnia PRL
- Select the version of the new PRL; **IS-683C** for our example
- Select whether this PRL will be closed or not with the Preferred Systems Only of the new PRL checkbox
- Finally select the Default Roaming Indicator; **On** for our example.



Loading the Policy

PREDICATE's PRL Policy Editor can host multiple policies. In order to use one of the policies inside PREDICATE's report engine the user will have to select one of the policies following these steps:

•Select PREDICATE/Load Policy Info… (if there is a PRL policy already loaded this option will appear as Reload Policy Info…). A list with all the available policies will pop up.

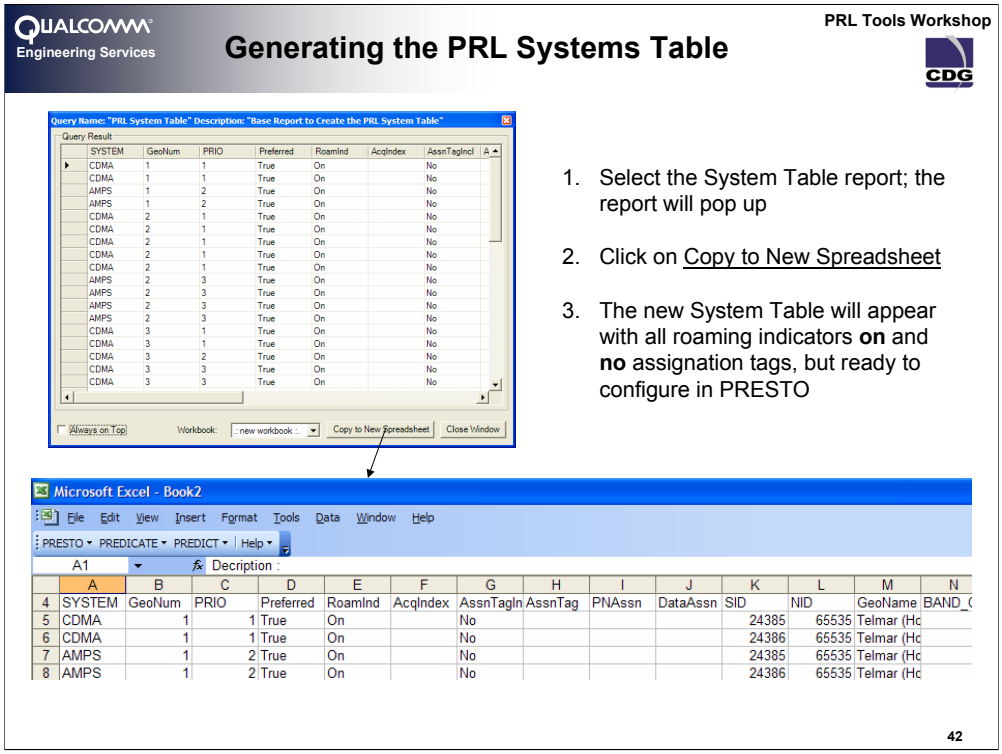
•Select the policy to load; **Narnia Policy (Telmar) for this tutorial**.

•A progress bar will indicate the state of the operation.

Once a PLR Policy is loaded another node called Policy on the Query Manager; to open this window:

•Select the Query Manager … option on the PREDICATE's menu

•Select the Reports node under Policy. A list of available reports will be shown on the right side of the window.



Generating the Systems Table

•Select the report called PRL System Table

•Press the Run button

•A window with the report results will appear. Examine the content of this report; the rows are sorted by Geo and then Priority, it's been created applying the priorities indicated on the PRL Policy Editor to the markets selected.

•Select the PRL workbook previously created.

•Press the Copy to New Spreadsheet button; the results will be copied to the PRL workbook as another spreadsheet.

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Generating the Acquisition Table

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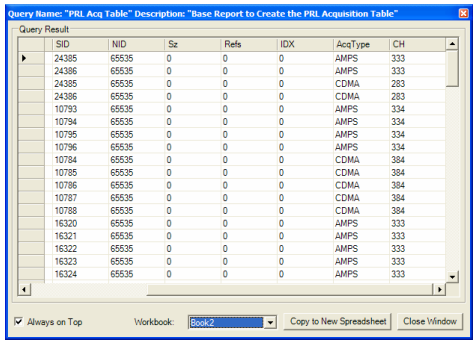
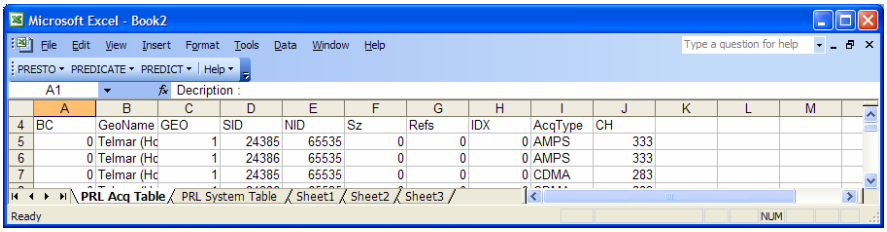


1. Select the Acquistion Table report; the report will pop up
2. Select the workbook previously created with the Systems Table.
3. Click on Copy to New Spreadsheet
4. The new Acquisition Table will be printed to a spreadsheet
5. Further processing needed



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Generating the Systems Table

- Select the report called PRL Acquisition Table
- Press the Run button
- A window with the report results will appear. Examine the content of this report; this result is very similar to the Systems Table report, it only has one more column, the channel column, extra system table columns (Pref/Neg, Assn Tag, Acquisition Index …) are suppressed for this report..
- Select the PRL workbook previously created.
- Press the Copy to New Spreadsheet button; the results will be copied to the PRL workbook as another spreadsheet.

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Generating the PRL

Form Acquisition Table

- For each SID, NID, BC combination
  - Reduce multiple records into one with a list of channels
- Add acquisition index to the Acquisition Table
- Determine Acq type for each record from the Tech and Band-class

Form System Table

- Add the system Table Index to the System Table
- Link System Table records to Acquisition Table Records
  - Identify the SID, NID and Band-class in both tables
  - Add the Acq index to the System Table

Optimize Acquisition Table Phase 1

- For each equivalent set of Acquisition Records
  - Redirect each duplicate record to the first occurrence
  - Delete all 0 referenced Acquisition records

Optimize Acquisition Table Phase 2

- Replace any CDMA CSTM lists with valid CDMA STD mnemonics
- Replace and complete PCS block channel lists with PCS CH record types.

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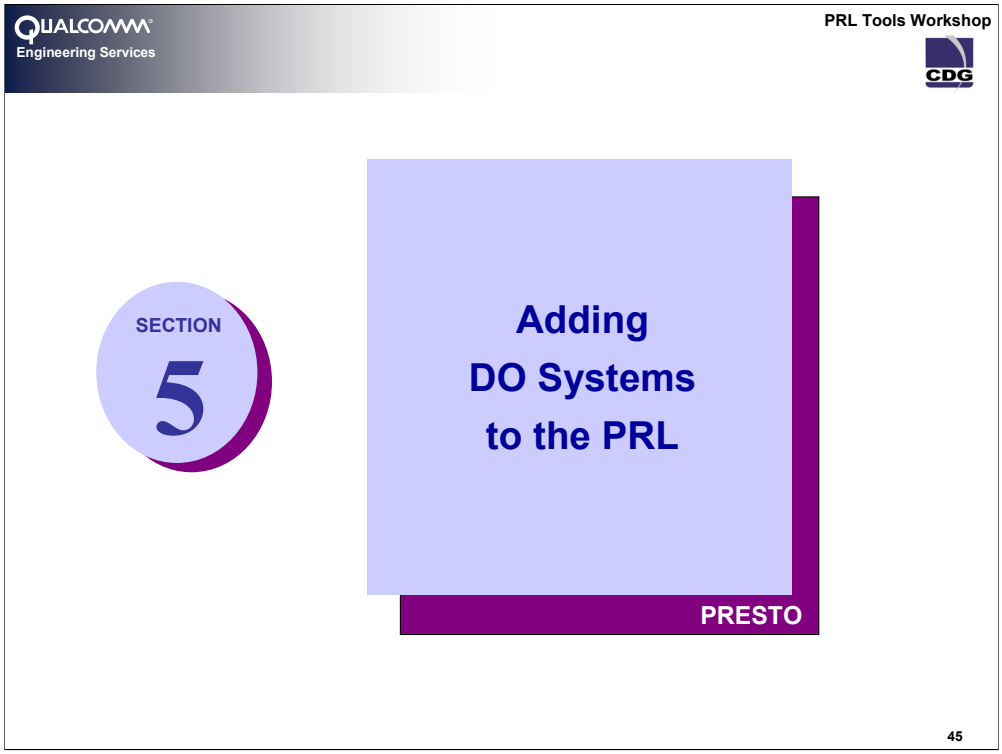
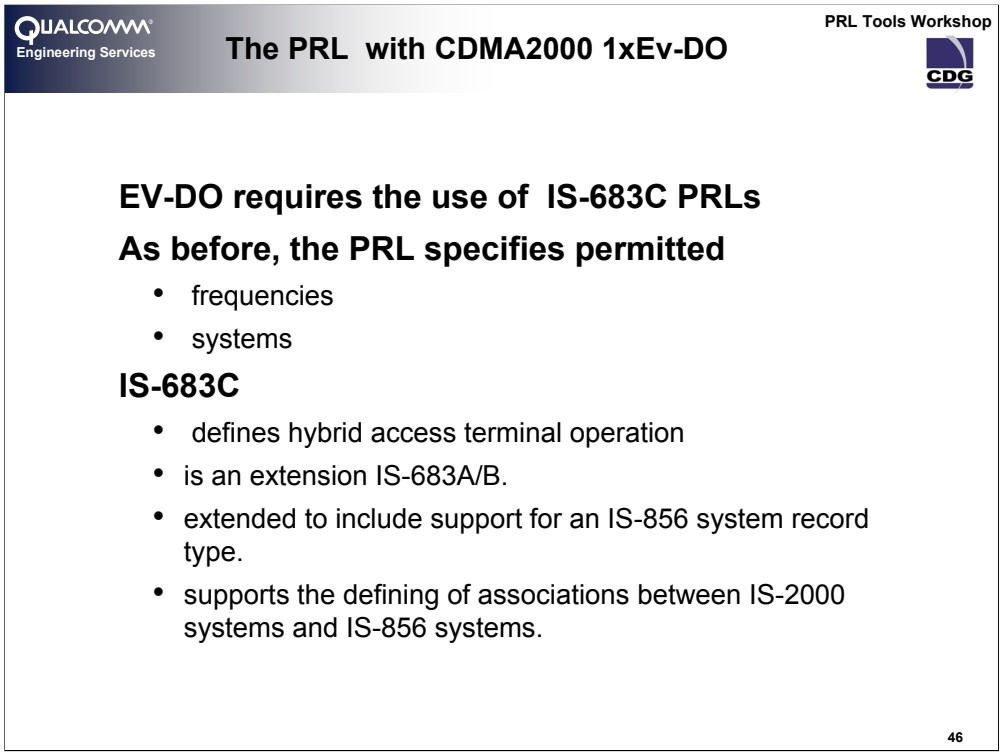


Adding DO Systems to the PRL

In order to start with this section, read the PRL just created and activate the Dynamic Validation in PRESTO/Dynamic Validation.



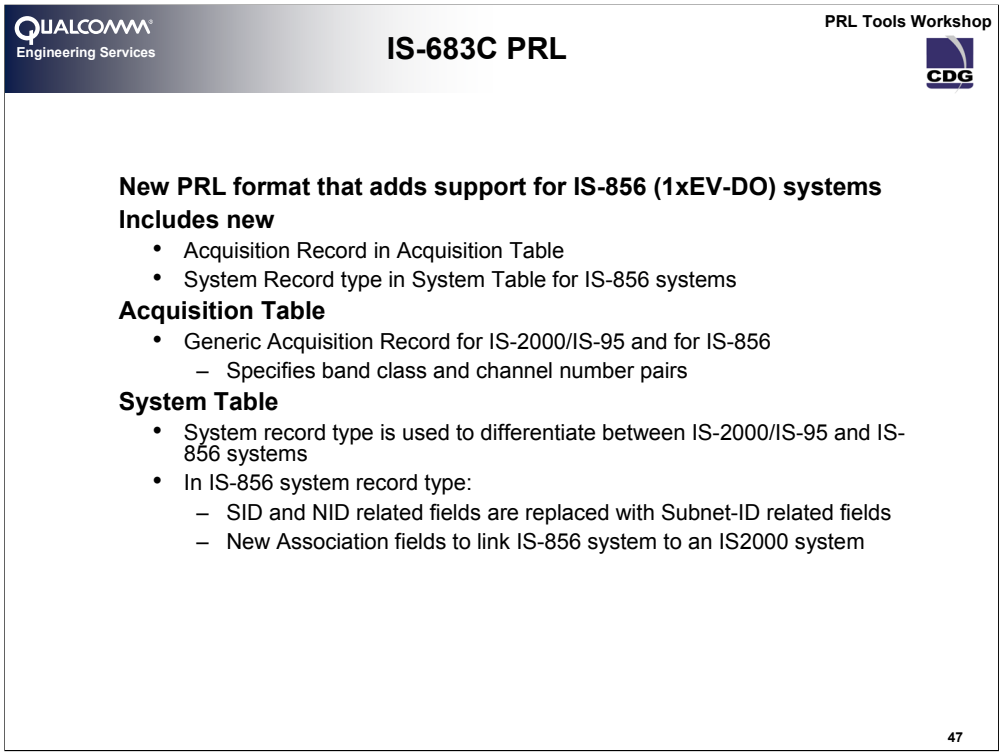
The PRL for 1xEV-DO Systems

What is 1xEV-DO?

CDMA2000 1xEV-DO is an evolution of CDMA2000 and an approved 3G standard for fixed, portable and mobile applications. CDMA2000 1xEV-DO is "data optimized," providing a peak forward data rate of 2.4 Mbps for revision 0 and 3.1Mbps for revision A, and peak reverse rates of 153kbps and 1.8 Mbps for revision) and A respectively. IS-856 describes the operation of CDMA2000 1xEV-DO systems.

Understanding some of the basics of an 1xEV-DO network and the mode of operation of the 1xEV-DO device (often called the Access Terminal or AT) is necessary to understand how to properly construct a PRL and how that PRL is used by the device. Elements that are necessary are

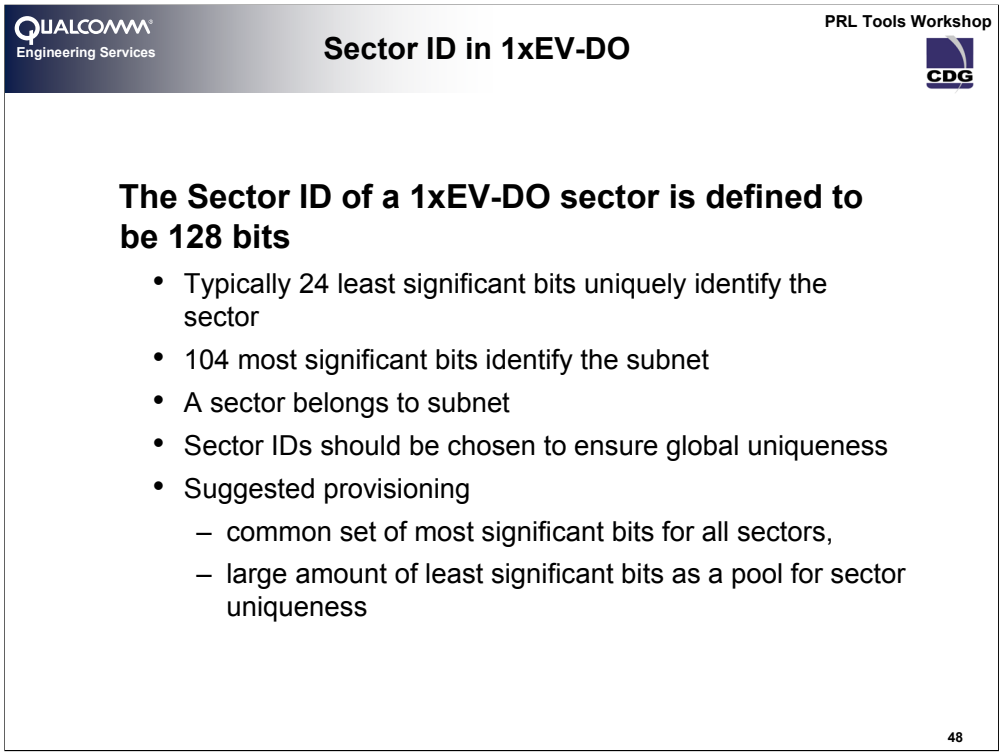
- The Sector-ID and its use in 1xEV-DO systems
- The subnet ID and its use in the PRL and how it relates to Sector ID
- Hybrid Mode 1xEV-DO Operation



IS-683-C PRL Structure

The PRL in revision C of the standard adds some new structure and meaning. It still contains the three major sections as before (i.e. properties, Acquisition Table and System Table) but additional elements now allow for:

- A new table called the common sub-net table
- A new extended system record that can describe analog, 1x/IS-95 and 1xEV-DO systems.
- New grouping and linkage mechanisms that introduce a new level of sub-grouping of 1x/IS-95 and 1xEV-DO systems fully contained within the existing GEO grouping mechanism.
- New generic CDMA and 1xEV-DO acquisition records



The Sector ID in 1xEV-DO

The Sector ID of a 1xEV-DO sector is name that it broadcasts to identify itself. It is defined to be 128 bits and comprises two major elements

- Sector identity part. Typically the 24 least significant bits uniquely identify the sector
- Subnet identity part. Typically the 104 most significant bits identify the subnet

A sector belongs to subnet. One analogy that may help here is that the subnet identity part is similar to the SID in 1x/IS-95 systems and the sector identity part is similar to a NID. However, unlike a NID, the sector identity parts should be chosen to ensure global uniqueness as opposed to the NID being unique only within the SID namespace.

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Subnet ID in the 1xEV-DO PRL

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Access Terminal uses the SubnetID field in an the PRL to determine if it should continue to stay on an acquired 1xEV-DO network

The SubnetID field is defined by a value and a length.

A length of zero

- defined as a wildcard mask
- Select any 1xEV-DO system

When the length is non-zero

- Forms a mask on the length most significant bits of the SectorID
- Sector ID received in the Sector Parameters Message
- If the mask matches the length most significant bits can select this 1xEV-DO system.
- If the mask does not match, the Access terminal continues to search

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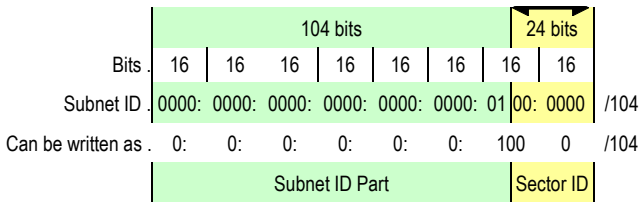
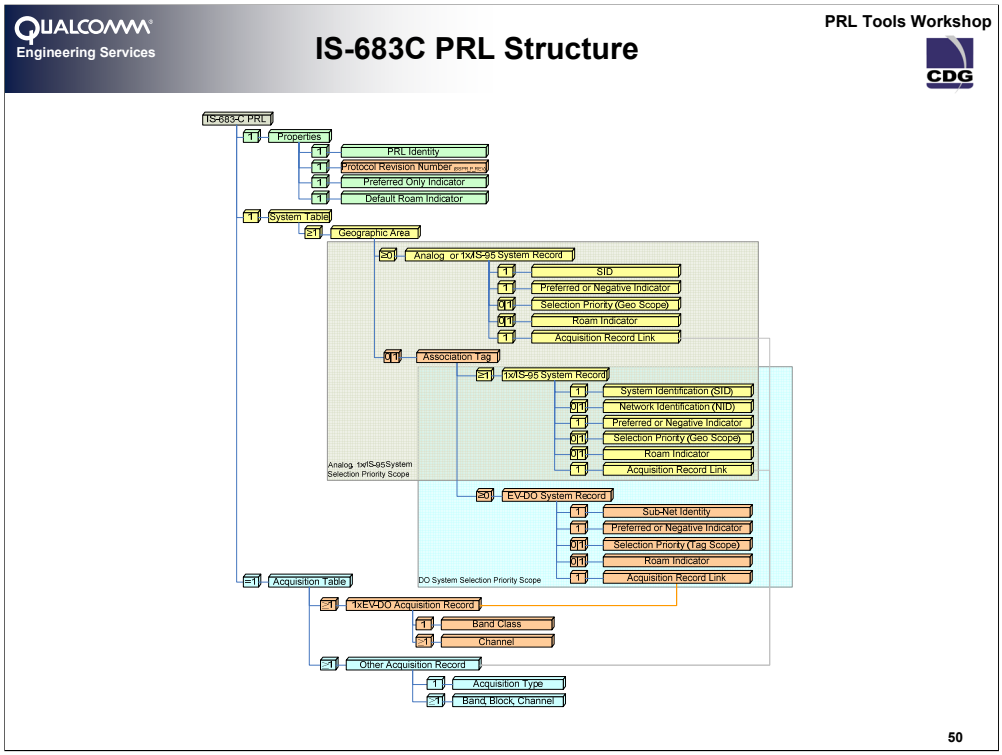
Subnet Id in 1xEV-DO

A subnet ID in the PRL is a 128-bit address value formatted according to the IPV6 protocol (not an IPV6 address). IPV6 format comprises eight 16-bit values separated by colons followed by a slash and a length value within the range 0 to 127. It is not necessary to write the leading zeros in an individual field, but there must be at least one numeral in every field. e.g.



Just as a SID of zero value meant any SID in 1x, a subnet ID of /0 indicates a wildcard subnet ID and indicates any 1xEV-DO system is selectable (subject to network authorization and authentication.)

The Length value indicates how much of the subnet-ID is significant. Generally 1xEV-DO systems are only specified in the PRL at the subnet-ID part (equivalent to SID only usage in 1x) and thus the length generally will be 104 bits or less.



Grouping of Systems Within the Scope of a GEO

1xEV-DO systems are deployed either as adjunct or overlay networks to 1x/IS-95 networks. Detecting a 1x/IS-95 network would not necessarily reveal any information about the presence of a 1xEV-DO network. While both 1x/IS-95 and 1xEV-DO systems can be accessed independently, operational scenarios exist where a mobile device would access both.

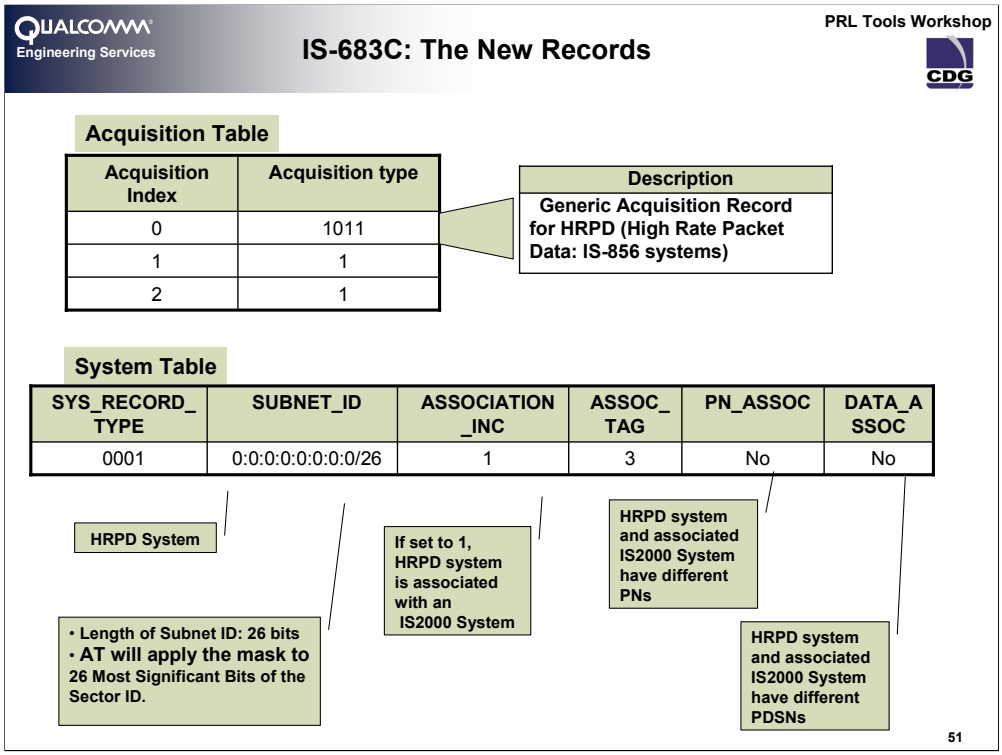
1xEV-DO by itself brought about the need for new system record and acquisition record types, however, the need to access both types of network at the same time introduced the need to capture co-location information in the PRL.This collocation scheme can only be applied (i.e. only has meaning) within the context of a geographical area.

Common Sub-net Table

A 1xEV-DO system is recognized by a [up to] 128 bit subnet identity as opposed to the 15 bit SID for analog and 1x/IS-95 systems. The common subnet identity table provides a mechanism for Subnet-ID compression by repeating any common Subnet-ID prefix only once in this table .

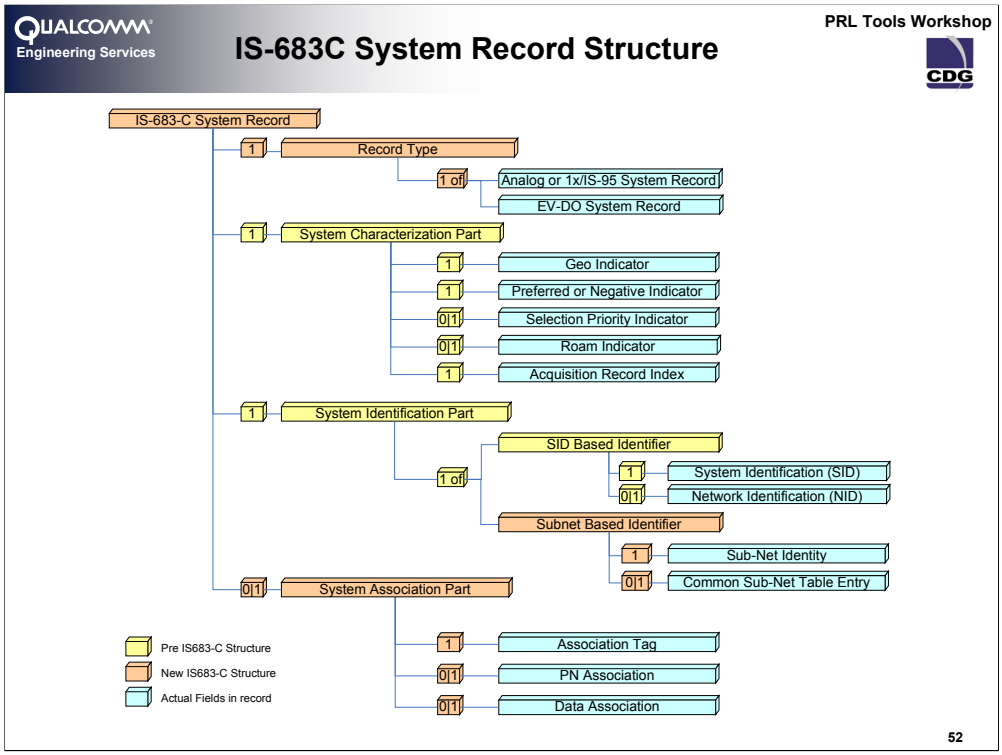
This is, in effect, a table of Subnet-ID prefixes. A 1xEV-DO system record, with a common Subnet-ID prefix, would then contain only the unique least significant bits of the Subnet-ID and refer to an entry in the common subnet table for the most significant bits. The full Subnet-ID would be obtained by concatenating the prefix from the common subnet table and the least significant bits from the 1xEV-DO system record.

Although this mechanism is described in the standards and likely present in most implementations of system determination; most of the PRL writing tools, that produce IS683C PRLs, do not currently perform this optimization.



The PRL with 1xEV-DO

As before, the PRL still specifies the frequencies and systems that the access terminal is allowed to acquire. The standard has been extended to include support for an IS-856 system record type. The preferred roaming list format has also been extended to include support for defining associations between IS-2000 systems and IS-856 systems. These extensions to the preferred roaming list format are defined in the IS-683C standard.

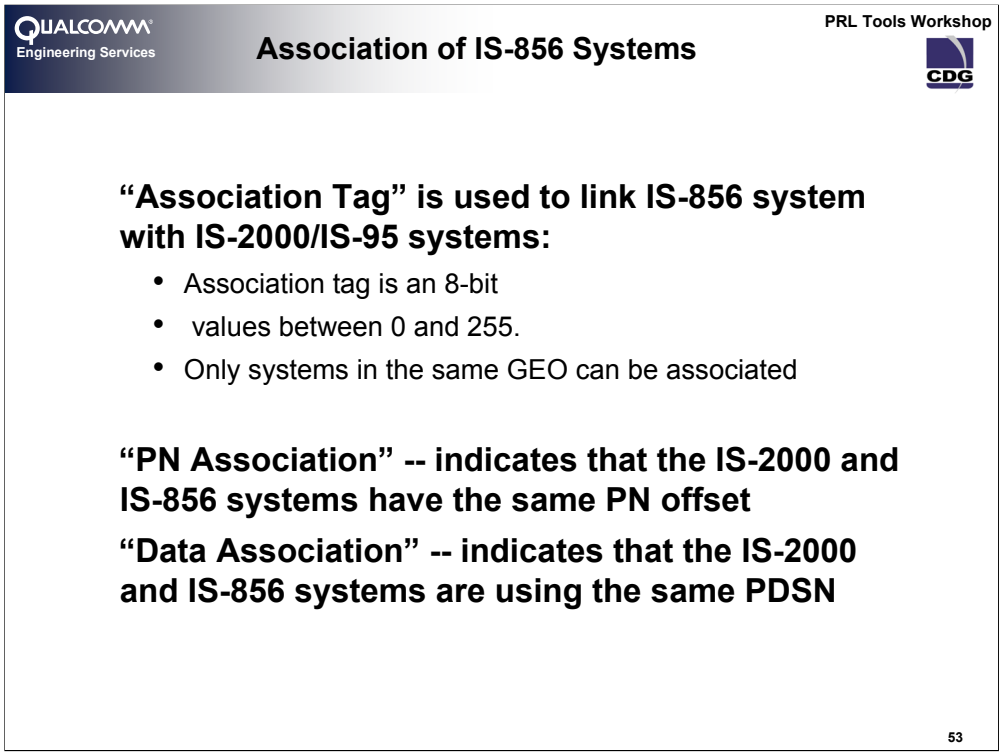


The IS-683-C System Record Structure

The new system record introduced by IS-683-C (the extended system table record) can be conceptually visualized as comprising four parts, namely

- The record type indicates if the record is a type 0 system record (analog, 1x/IS-95) or a type 1 1xEV-DO system record.
- The System Characterization Part identifies the GEO, preference type, selection priority, roam indicator and the acquisition record that describes the band-class and channels for the system.
- The System Identification part describes the broadcast identity of the system that is to be recognized. An analog system has only a SID, a 1x/IS-95 system has a SID and optionally a NID and a 1xEV-DO system has a subnet-id.
- The Association part identifies systems that are co-located (i.e. grouped together inside the GEO scope) for the purposes of hybrid operation.

This representation is shown, only the right most nodes of this representation actually represent fields in the system table record.



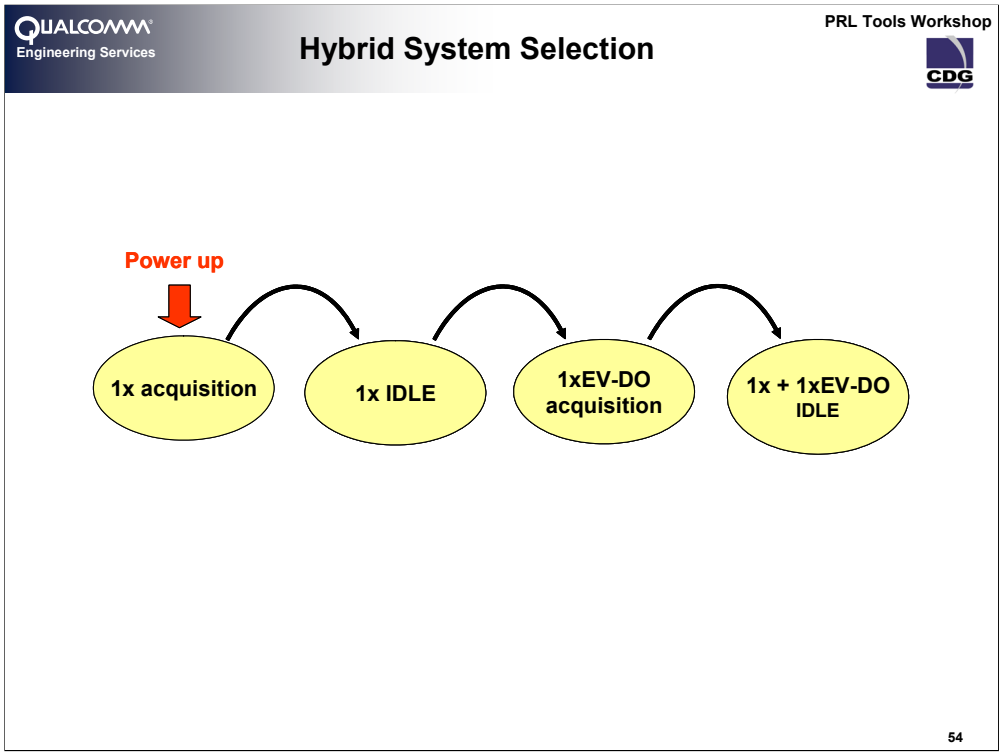
Association Part

The presence of an association is indicated by the field ASSOCIATION_INC. having a value of 1 There are three associations which comprise the association part of the system record.

The first, and most significant in use today, is the ASSOCIATION_TAG. This is an 8-bit number that names the 'association set' to which this system record belongs. The set name only has meaning witihin the scope of a GEO. System records in the same GEO that have the same Association Tag are members of the same set. System records in different GEOs that have the same Association Tag are ***not*** members of the same set.

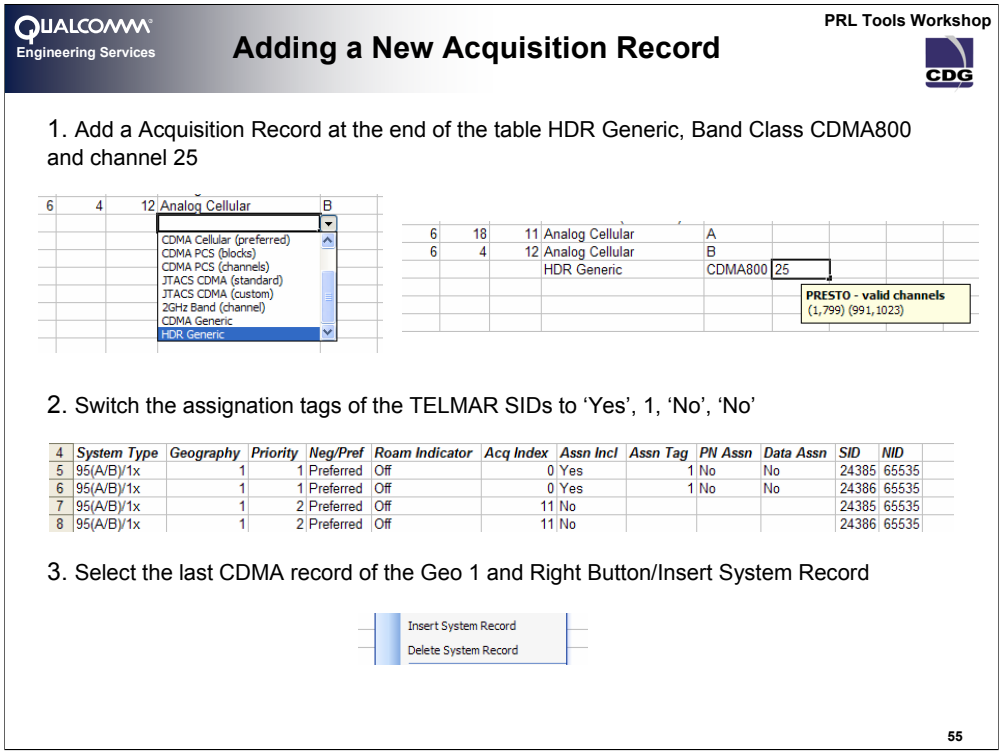
The other two associations, while present in the PRL, are not currently used by system selection but their description is included here for completeness. The associations are

- PN association flag identifies systems that have the same PN offset assignment (i.e., collocated).
- Data association flag identifies systems that can reach the same set of PDSNs (i.e., associated).



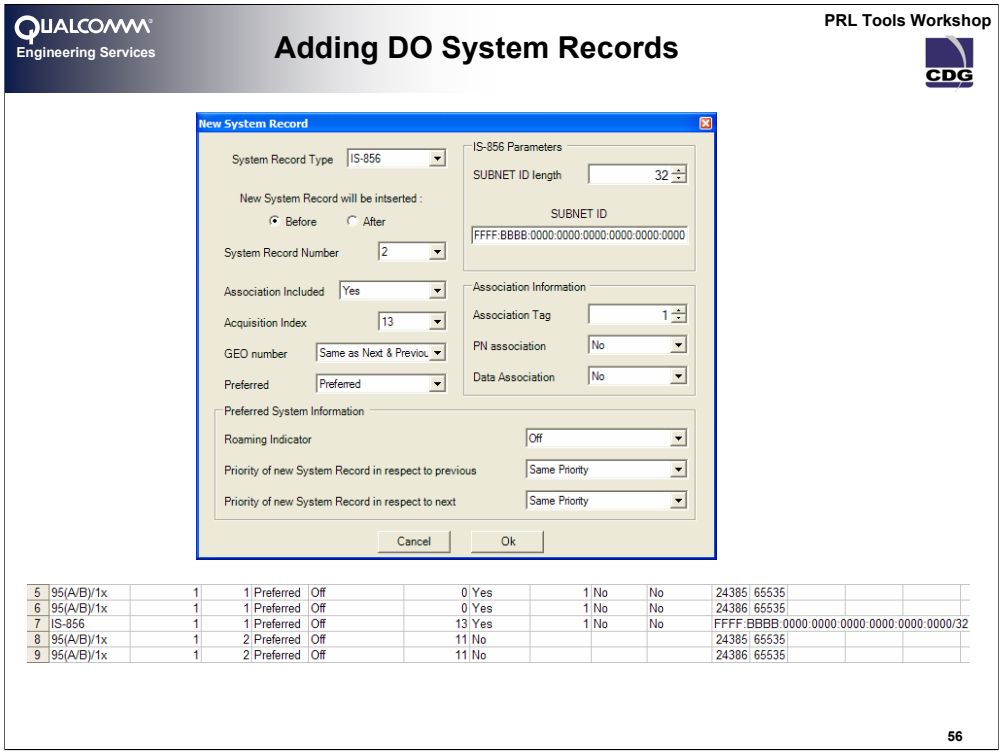
Hybrid System Selection

hybrid device attempts to performs 1x/IS-95 system determination first. Once the best available 1x/IS-95 system has been selected an attempt is made to acquire the best available 1xEV-DO system. as is depicted above. Generally, the hybrid device will only attempt to acquire an 1xEV-DO system only once a 1x/IS-95 system has been acquired and then, only one that is in the same association set scope as the serving 1x/IS-95 system in the PRL



Adding a New HDR Acquisition Record

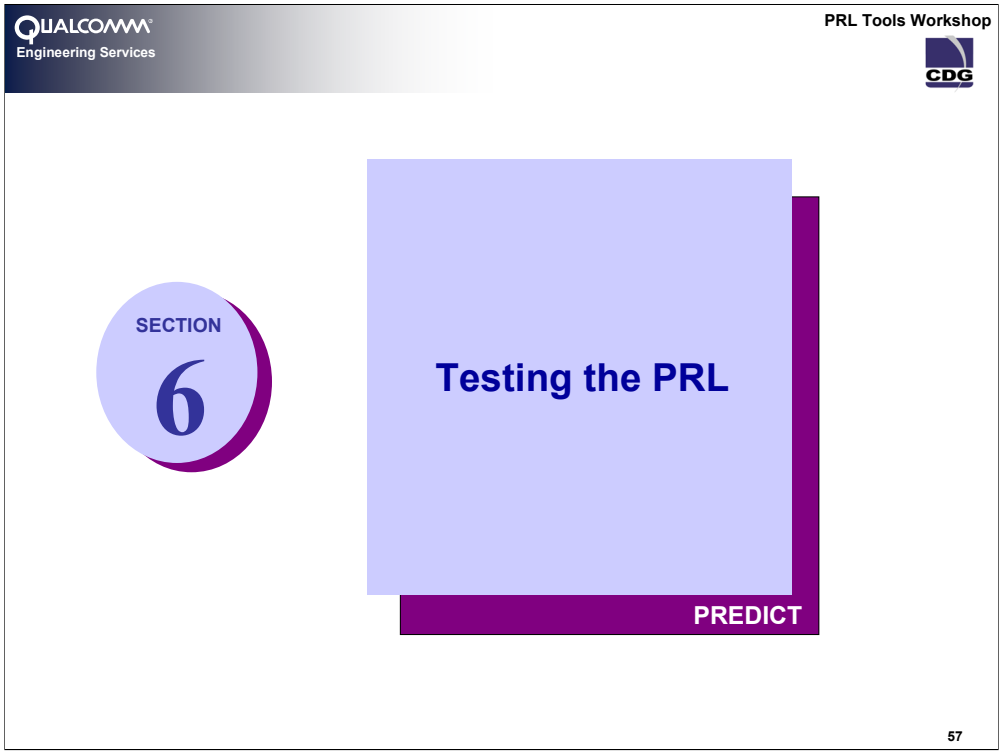
- Select HDR Generic for the new acquisition type from the drop-down box after the last Acquisition Record
- In the first channel column select the Band-Class of the first channel, **CDMA800** for our example.
- In the next cell type the channel, **25** will work
- Change the Assignation Included field of the first two acquisition records to **Yes**; these are the two records corresponding to CDMA for TELMAR.
- Type **1** in the Assignation Tag field
- **No** in PN and Data assignation fields



Adding DO System Records

Select the third system record, right click with the mouse / Insert System Record. A window will pop up letting you select all the information of the new system record. Change the fields as shown in the slide and press Ok. A new DO system record has been added, with the same tag of the two 1x system records preceding it.

Write the PRL to its binary for to make sure that all the fields are correct.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Testing the PRL
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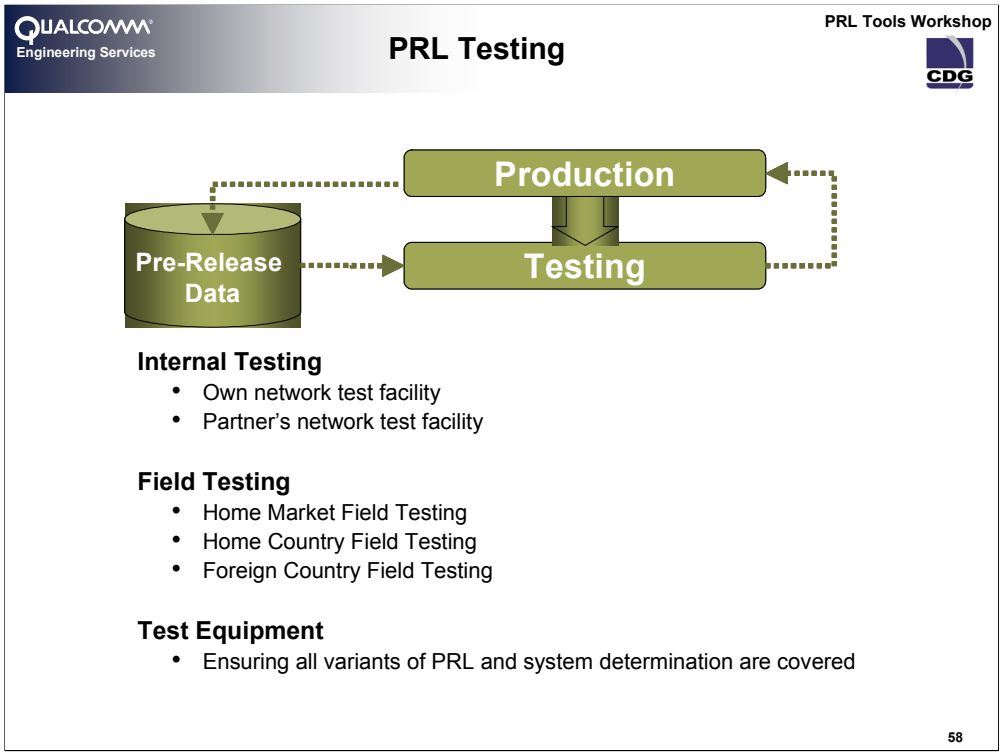


PRL Testing

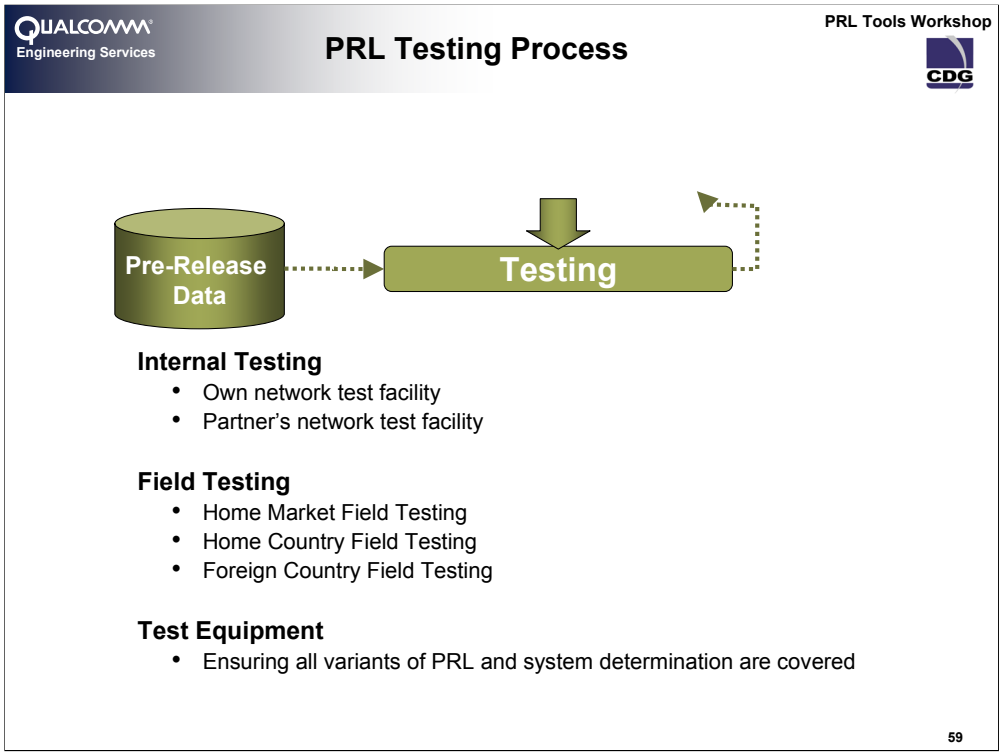
As with most things in life, the earlier an error is discovered, the quicker and easier it is to address. PRLs are no exception to this principle. However, because a PRL is describing so many different radio environments and serving systems (both local and remote), the number of test traces tends to be high and the configuration of a test harness is not as straightforward as some other test scenarios.

The rigor of the testing generally depends on the time and resources available. There are various forms of testing that can be applied, both with a PRL in a standalone environment without a handset (off-target testing) and with a PRL loaded into a handset which is them placed in a real RF environment (on-target testing).

On target testing can vary in its forms. In the situation where an operator has access to a network test facility, radio environments can be simulated, a device loaded with the pre-release PRL. Where no such facility exists often in-market testing is performed. Since this is the most expensive form of testing and is fraught with coordination difficulties, it tends to be only a selective subset of the PRL that is tested. These in market tests can include:

- Home Market Field Testing
- Home Country Field Testing
- Foreign Country Field Testing

PRL testing is addressed later and dealing with the various types of testing and introduces some sample tests that can be performed.



PRL Testing

The testing of a PRL is an important part of its life, since a PRL is literally deployed into every handset detection of errors post-distribution can be expensive. Testing of a PRL falls into three major categories

Static Linkage testing

An audit that the PRL as built reflects the technical data upon which it is predicated – off target i.e. not on a handset.

Trace behavior testing

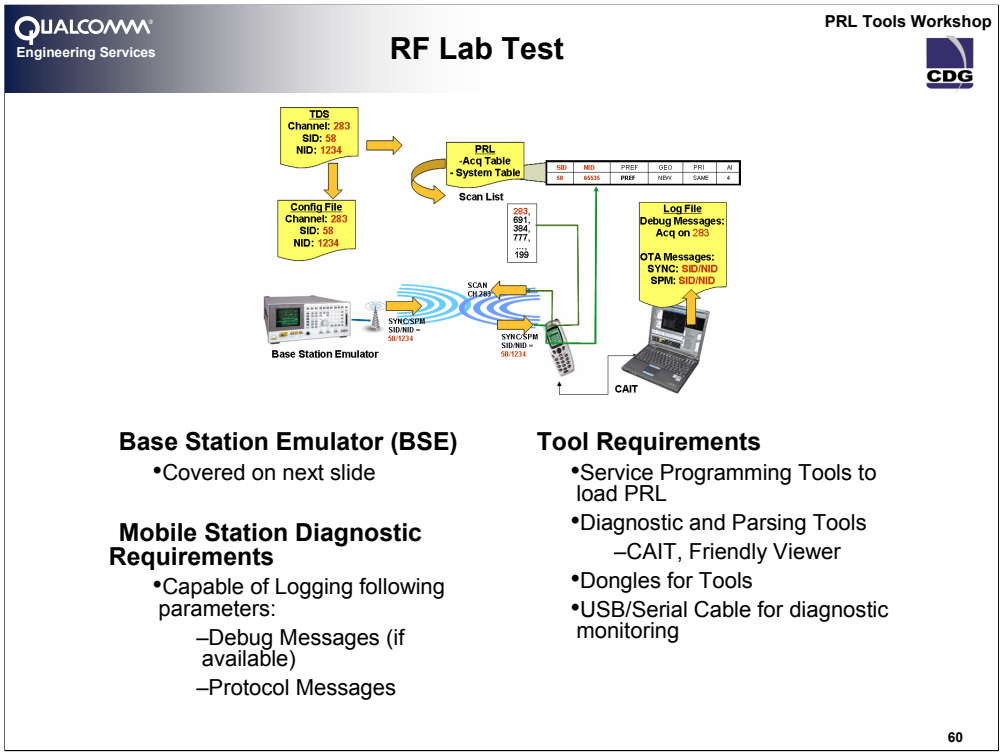
A trace through the expected system selection behavior to verify blocked systems and priorities– off target i.e. not on a handset.

Controlled RF (lab) testing

Use of base station emulation equipment to broadcast actual RF signals and verify PRL behavior in a handset.

Field Testing

Field testing in target markets to verify a handset exhibits system selection behavior.



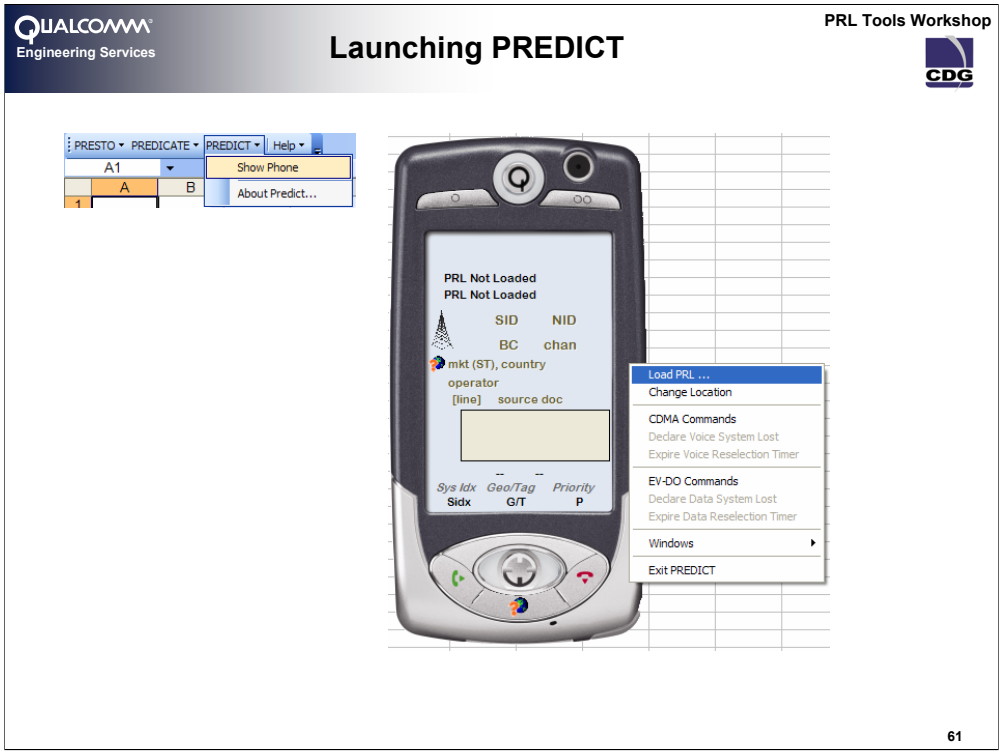
RF (Lab) Testing Set-up

This is on-target testing (i.e. it is performed with the PRL loaded in one or more handsets). Handsets are tested in a simulated RF environment. The RF environment is created by use of one or more Base Station Emulators (BSE) configured to a particular technology, band-class, channel and SID-NID combination using the technical data from which the PRL was constructed.

A typical set up and flow of a lab test of a PRL is shown. The BSE is configured according to the technology, band-class and channel to be simulated (from information in the TDS). The handset is loaded with the PRL under test; the handset is also connected to a logging tool (such as QUALCOMM CDMA Air Interface Tester – CAIT). The logging tool will show the over the air messages indicating the selected. If CAIT is used and the device is a QUALCOMM MSM based device that has not had debugging information disabled by the manufacturer, debug messages can be examined to show the system acquisition progress.

The RF Lab set up should include

- Base Station Emulator (BSE)
- Mobile Station (MS)
- Attenuators (ATN)
- Laptop
- Diagnostic Tools
- Service programming Tools
- USB/Serial cable for Diagnostic monitoring and Programming
- PRL Under Test



Trace Behavior Testing

PREDICT™, a tool from QUALCOMM Engineering Services, performs system selection on a PRL by using the information from the Technical Data Sheet(s) upon which the PRL is based. Given a specific location, PREDICT™, will perform system selection in line with the behavior of the default QUALCOMM MSM System Determination shipped by QCT. It will show the channels scanned, the system selected SID, technology and channel information and provide cross referencing to the technical data.

Launching PREDICT

Select the Show Phone option in the PREDICT menu; the PREDICT phone will appear in your screen. The main areas in the PREDICT phone are:

•Display: will show the User Icons and also more detailed information about voice and data serving systems. It also has an area where the last scanned channels will be listed.

•Lower Buttons area: Contains the Power button and the current location button. The power button will only be active when a PRL has already been loaded.

•Upper Buttons area: these two buttons will switch the display to show the data or voice parameters.

•Contextual menu (left click): options for load a PRL, change the Location, show other information windows, controls for losing the system for both voice and data and Exit PREDICT.

Loading a PRL file into PREDICT

On the contextual menu select Load PRL… browse to the file you want to load. The PRL properties will appear on the lower part of the display if the loading was successful.

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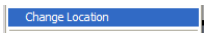
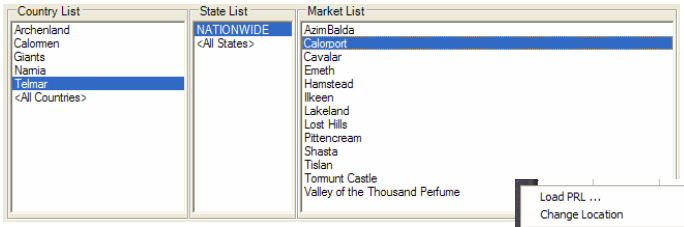
Changing the Location and Bleeding

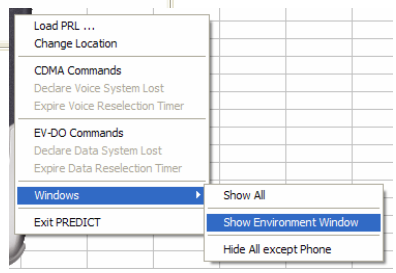
1. Select the Change Location option in the Contextual Menu



2. In the country list select Telmar and Calorport on the Market List



3. Open the Environment window by Windows/Show Environment window in the contextual menu



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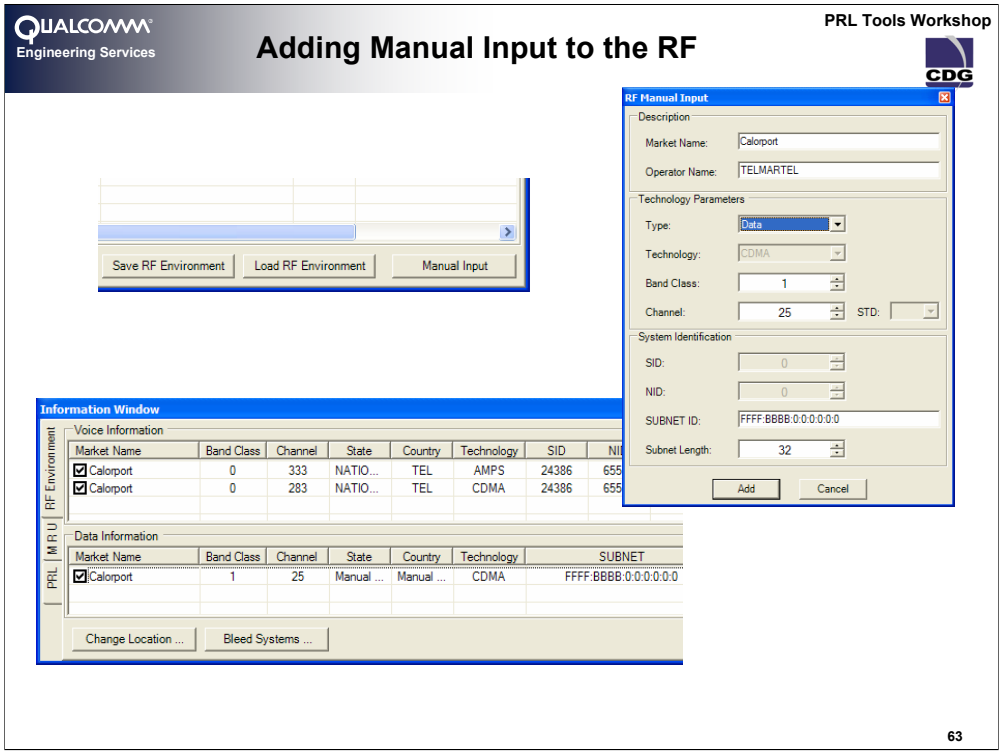
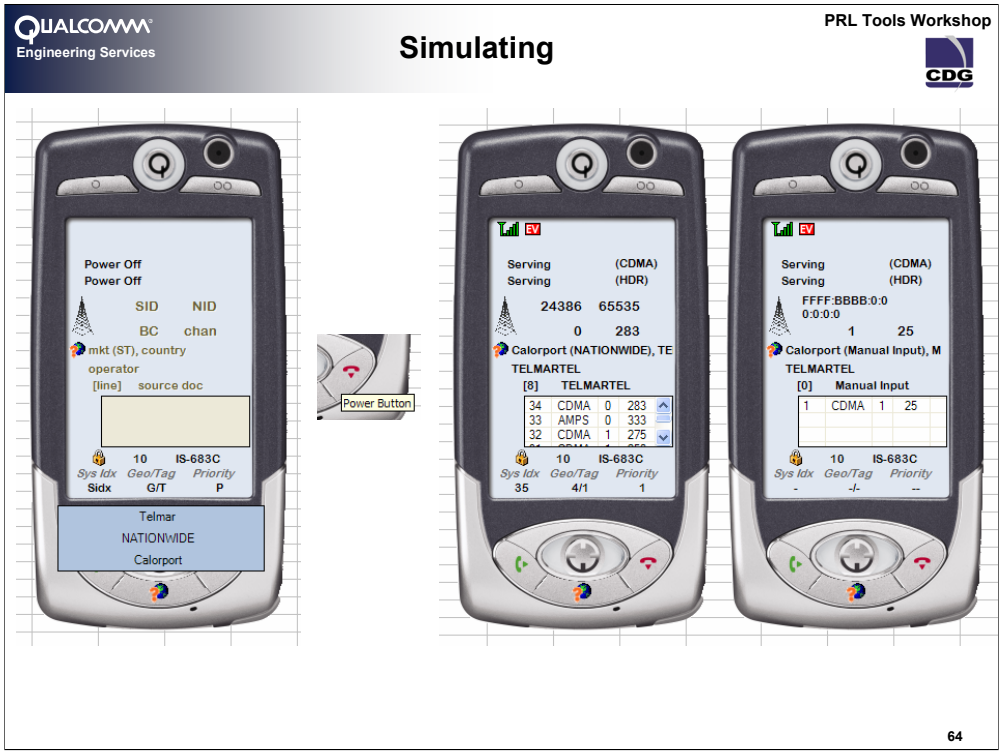


Adding Manual Input to the RF

After changing the location to Calorport we are going to add data information for DO to the RF environment. Press the Add Manual Input button and fill the window as shown on the slide. Click Add; a new record will appear on the Data information.



Simulating

When the PRL is loaded and the RF information is in place, PREDICT is ready to simulate; press the Power button as if you were turning on your phone. When PREDICT stabilizes you will be able to see the display data of the acquired voice and data systems. In the upper part of the display you will see the icons as they would be shown to the user.

It is also interesting to be able to see the channels that have been attempted to acquire, both voice and data have an independent list, which can be copied to a spreadsheet.

After the phone is settle you can Add, enable and disable new RF information and declare a system lost from the contextual menu to proceed with the simulation in different scenarios.

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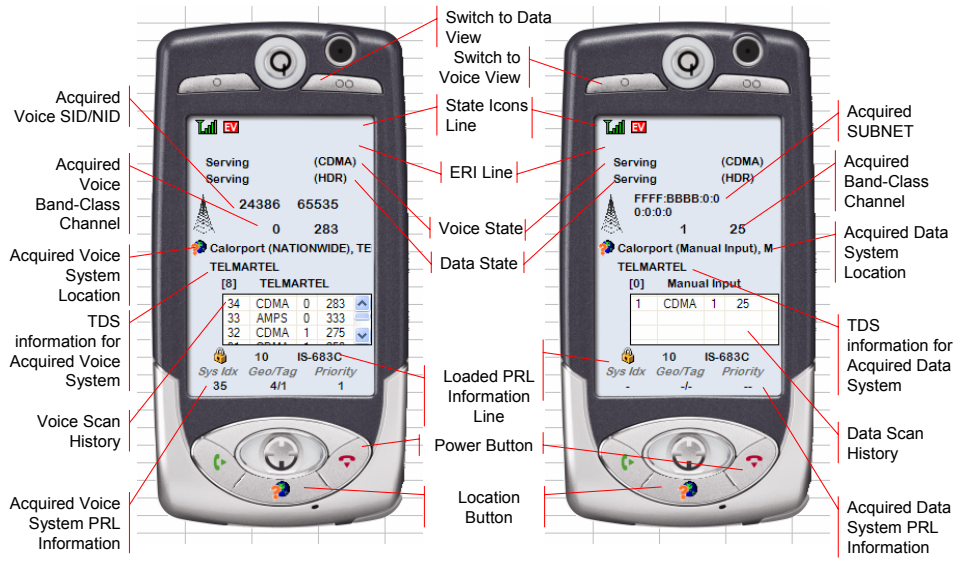
PREDICT legend



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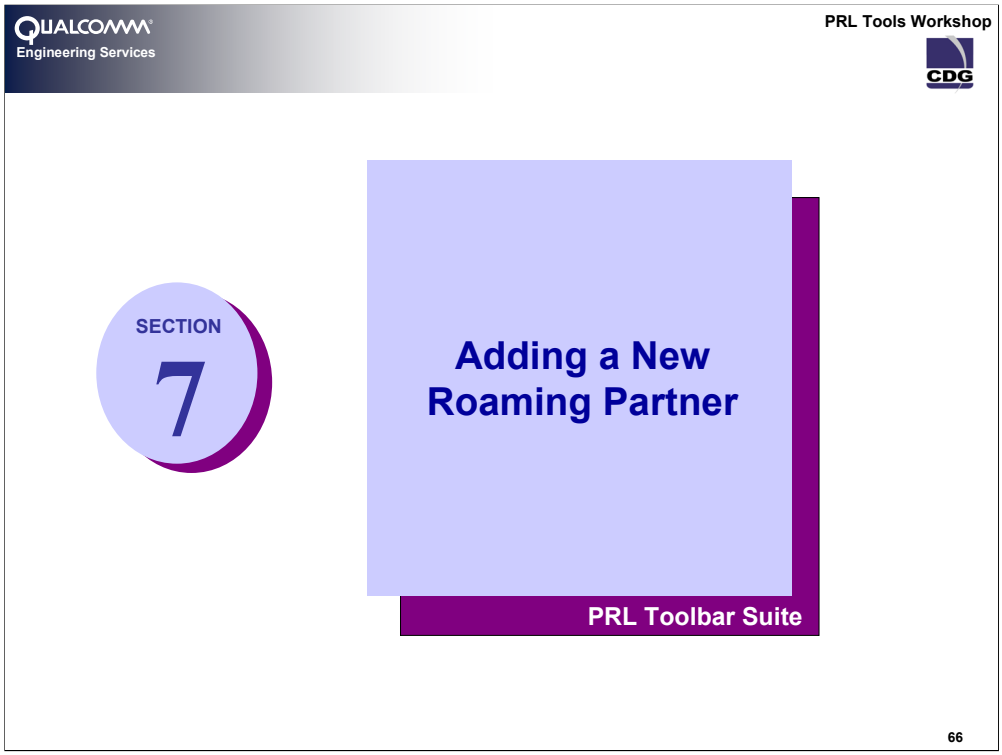
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Adding a New Roaming Partner
PRL Toolbar Suite
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Steps

Configure the new TDS roaming partner document

Create a New Geo in the PRL Policy (or add SIDs to the GEO they belong to)

Reproduce the PRL Creation steps.

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Course Summary

- PRL Toolbar Suite Introduction
- Configuring and Loading TDS documents
- Creating the PRL Policy
- Generating the PRL
- Adding DO systems to the PRL
- Testing the PRL

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Notes

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Contact Information

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