Course RF200 Section III

Introduction to Optimization Tools
Introduction To CDMA Field Tools: Topics

- Two Important Concepts
  - The Department Store Analogy - Tops-Down vs. Bottoms-Up
  - The Aeronautical Analogy - Accident Investigation Resources

- Survey of CDMA Field Tools
  - Mobile Tools
  - Handsets - Maintenance Displays
Department Store Analogy: Tops-Down, Bottoms-Up

Some things are easier to measure from the customer side!
To study the cause of an aeronautical accident, we try to recover the Flight Data Recorder and the Cockpit Voice Recorder.

To study the cause of a CDMA call processing accident, we review data from the Temporal Analyzer and the Layer 3 Message Files -- for the same reasons.
CDMA optimization data flows from three places:

- Switch
- CDMA peripherals (CBSC & BTS)
- Handset

Each stream of data has a family of software and hardware tools for collection and analysis.
CDMA Field Test Tools

Field Collection Tools using Handset Data
- Motorola
- Qualcomm
- Grayson
- Hewlett-Packard
- SAFCO
- Comarco
- LCC

PN Scanners
- Hewlett-Packard
- Berkeley Varitronics
- Grayson
- Qualcomm
- Safeco
- Willtech

- There are many commercial CDMA field test tools
- Characteristics of many test tools:
  - capture data from data ports on commercial handsets
  - log data onto PCs using proprietary software
  - can display call parameters, messaging, graphs, and maps
  - store data in formats readable for post-processing analysis
  - small and portable, easy to use in vehicles or even on foot
- A few considerations when selecting test tools:
  - does it allow integration of network and mobile data?
  - Cost, features, convenience, availability, and support
  - new tools are introduced every few months - investigate!
Qualcomm’s Mobile Diagnostic Monitor

- CDMA handset (customer provided)
- Proprietary connecting cable
- PC software for collection and field pre-analysis
  - Temporal analyzer display mode
  - Messaging
Grayson Electronics Mobile Collection Tools

- **Wireless Measurement Instrument**
  - one hardware platform, can contain up to 4 receivers, handsets, scanners, and other devices

- **Inspector32 PC collection software**
  - numerous output formats & exporting - ASCII messages, database, temporal data
  - simultaneous display of parameters, map location, messaging, PN scanner

- **Analyzer™ post-processing software**
  - call event statistics, parameters, performance indicators as map icons, graphs, and spreadsheet tables
  - message display window synched with maps and graphs
  - can search for events, messages
  - can study multiple drive files at once
LCC, SAFCO and Comarco Mobile Tools

**LCC:**
- RSAT2000 mobile collection
- Collect2000 PC collection software
- DeskCAT post-processing Software

**SAFCO (no photo available):**
- Mobile PC collection tool
- Portable pen-based PC tool
- OPAS post-analysis software

**COMARCO:**
- NES-series units / PC collection
- File formats for post-processing
- latest models include L3 messaging
PN Scanners

Why PN scanners? Because phones can’t scan remaining set fast enough, miss transient interfering signals

Berkeley Varitronics
- high-resolution, GPS-locked
  - full-PN scan speed 26-2/3 ms.
- 2048 parallel processors for very fast detection of transient interferors

Hewlett-Packard
- high resolution, GPS-locked
  - full-PN scan speed 1.2 sec.
- Integrated with spectrum analyzer and phone call-processing tool

Grayson Wireless
- lower-cost, low-end solution
  - full-PN scan speed 6.3 sec.
- integrated with phone & call-processing data collection tool
- high-end version also available using Berkeley Scanner
Drive-Test Tools: Grayson

Grayson’s Drive-Test Tools
Inspector Hardware Installation

Wireless Measurement Instrument

- Mounting location
  - The WMI should be secured against uncontrolled movement during sudden stops or turns
  - Air vents should not be obstructed
- DC power: 12 volts nominal
  - comfortably within current capability of vehicle cigar lighter outlets, or an inverter and dc adaptor may be used
  - if using cigar lighter socket secure cable against pullout
  - use only Grayson cables: inner pin ground (1), shell (+)
- Connect the phone(s) to the appropriately numbered DB-15 connectors on the right side of the WMI (depending on configuration, you may have from one to four installed)
- Connect a straight-thru serial cable from the COM port on the left side of the WMI to your computer’s serial port
GPS Basics

- GPS (Global Positioning System) was funded and implemented by the US military and serves both civilian and military users
  - approved military users use a high precision signal (“C/A”)
  - civilian users use “selective availability (S/A)” which includes various time-varying error factors with RMS error of about 30M
  - signals are spread-spectrum at approximately 1.6 GHz.

- GPS uses 21 active satellites and 3 parked spares, all in mid-level orbits at about 10,000 kM
  - typically 5 to 7 satellites are in view from any given location
  - constellation of visible satellites changes hour-by-hour
  - Reception from four satellites is sufficient to fix location with no prior assumptions
  - Three satellites are sufficient if user’s elevation already known
  - GPS reception suffers in cities, under bridges, any time the view of satellites is obstructed
  - Users in urban/obstructed areas supplement GPS with dead-reckoning systems that fill in gaps while GPS is obstructed
GPS and Inspector

There are many commercial GPS Receivers available and Inspector can use internal or external units

- Most common internal unit is a Trimble brand Placer model
  - plug GPS antenna into SMA connector on front of WMI
- External units, many with self-integrating dead reckoning capabilities, can be plugged into the DATA connector on the side of the WMI
  - GPS antenna and power connections go directly to the external main GPS receiver module
  - dead-reckoning connections also go to main module (configurations vary with make and model)

GPS antennas should be placed outside on the roof of the vehicle where their view of the sky is as unobstructed as possible

- not critical but recommended to keep GPS antenna at least a foot away from antenna used for cellular or PCS transmitting
Dead-Reckoning Systems

- Dead-reckoning systems normally use a combination of magnetic compass and wheel rotation sensors to augment GPS.
- The manufacturer’s instructions should be followed for installation. Major factors requiring attention are:
  - If used, Wheel sensors must be securely mounted to prevent accidental breakaway while driving (major injury hazard).
  - Magnetic compasses should be located as far as possible from magnetic field sources in or on the vehicle.
    - example: mag-mount antennas
    - (experimentation is often required)
  - Calibration by actual test is required to achieve workable accuracy for dead-reckoning systems.
PC Requirements for Inspector

- **Personal Computer Requirements**
  - Processor: 90 MHz. Pentium or better (133 recommended)
  - Display: at least VGA (640x480) color, passive
    - SVGA (800x600) color active is recommended
  - RAM: at least 16 MB. (32 MB recommended)
  - Hard Drive - at least 340 MB free (1 GB recommended)
  - Serial Ports - at least one, using fast 16550 UART
  - Speaker, integrated mouse (CD drive recommended)

- **Recommended Accessories:**
  - Mass storage - for archiving collected data:
    - Iomega Zip (100 MB), Jaz (1GB), Syquest 230 or 1.6 GB, CD-R or network server
  - Data Communications: Laplink for Windows 95

Inspector involves bursty streams of serial data and performance can be seriously impaired if the PC has power control or “sleep” features enabled. A continuous source of power must be available at all times logging is taking place and all power management features of the PC must be deactivated, i.e., put in “continuous” mode.
Safety Considerations

Safety Factors: All of the following items require consideration

- Divided attention while driving
- Security of hardware to prevent personal injury during sudden stops or overturning
- Reliability of connections to avoid interruptions and dangerous distractions during data collection
- Driving habits: stopping locations, drive-on and drive-off practices
Inspector Software Installation

- Installing and Configuring Inspector on a new PC
  - Inspector software is installed from diskettes. Refer to the user’s manual, section 1.3, for help with the procedure.
    - The setup process creates all needed configuration files.
  - The default location for the main program directory is:
    - c:\Program Files\Grayson Wireless\Inspector32
  - Drive test data collection files are customarily placed in a subdirectory called Logfiles
  - Digital map images for display during collection/playback are customarily placed in a subdirectory called Mapfiles
  - You can easily access Logfile and Mapfiles elsewhere

- Create an Inspector shortcut on your desktop or taskbar for convenient access

- Disable any laptop power management system

- Set your 16550 UART buffer to 1 byte
  - My Computer > Properties > Ports (COM & LPT) > Communications Port (usually COM 1) > Properties > Port Settings > Advanced > Receive Buffer Low (1) > OK
Getting Started and Solving Problems

At powerup, the screen at right will display briefly showing the status of each phone and decoder board presently configured. Disregard messages about unequipped hardware. In playback, you don’t need any hardware connected and may completely ignore this message.

Basic Troubleshooting Techniques

- Verify that all peripherals are powered up and initialized
- Verify the WMI has power and power-cycle it
- Reboot the collector PC last
  - complete boot from cold powerdown, not WIN95 restart
- if GPS consistently fails to lock, check GPS data rates and configuration; be sure GPS (if external) has clean power
The Grayson Strip Recorder: Settings

You can configure the strip recorder to display whatever parameters you want, at whatever scales you want.

The settings below are popular for troubleshooting.

<table>
<thead>
<tr>
<th>Suggested Graph Settings for Regular Use</th>
<th>Display Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 RX Power</td>
<td>Disable Legend Display</td>
</tr>
<tr>
<td>2 TX Gain Adjust</td>
<td>Disable Grid Display</td>
</tr>
<tr>
<td>3 Est. TX Power</td>
<td>Reverse Window</td>
</tr>
<tr>
<td>4 FER Instantaneous</td>
<td>Background Color</td>
</tr>
<tr>
<td>5 Number of Active</td>
<td>Disable Relative Scales</td>
</tr>
<tr>
<td>6 Composite Ec/lo</td>
<td></td>
</tr>
</tbody>
</table>

- RX Power: -110 to -20
- TX Gain Adjust: -30 to +30
- Est. TX Power: -63 to +30
- FER Instantaneous: 0 to 15%
- Number of Active: 0 to 6
- Composite Ec/lo: -31 to 0
Grayson Scanner Windows

Dual Mobile Pilot Sets Analyzer

Active Set PN Offsets

Candidate Set PN Offsets

Neighbor Set PN Offsets

Remaining Set PN Offsets

Ready

Scan: In cr(4)  Channel: 293  Threshold: -28.0  Window: 128  QCP800  CTM800

Start  MaxTime  Explo i ng... Paint Shop... Inspector32... PN Scanner

June, 1999  RF200 v2.0 (c) 1999 Scott Baxter
Grayson’s Scanner

[Graph showing a line chart with vertical bars and labeled axes]

June, 1999

RF200 v2.0 (c) 1999 Scott Baxter
Live Class Demonstration & Discussion

- Software Operating Features
  - Tour of the Main Menu and Available Windows

- Practical Precautions from current field experience
  - number of simultaneous open windows
  - phone serial data rate and throughput considerations

- Collecting an Actual Drive Survey (group project)
  - Choosing What to Log
  - Starting and Ending the Run
  - Replaying a Drive Test file

- Log File Converter Operation (to export for post-processing)

- Format Converter Operation (from earlier versions)

- Generating Maps with MapManager

- Orientation for Post-Processing Tools and Objectives

- Common Pitfalls and Problems
Grayson

Maps for Inspector and Analyzer
Map Backgrounds for Inspector32

- Inspector can display street maps in the background during data collection and data playback
  - Your position is shown by dots whose color can represent values of any parameter you choose (FER, RX level, etc.)
- The Pepperwhite CD contains street maps in vector form for the entire United States
- The MAPMAN program reads the Pepperwhite CD and creates bitmap (*.bmp) streetmap images of your system coverage area at any desired scale
  - you can choose the features you want to display, and their colors, formats, label sizes, background colors, etc.
  - you can create as many maps as necessary to cover your entire area of interest. The appropriate map will be selected automatically by Inspector for display
- After creating the maps you want, you won’t need MAPMAN or the Pepperwhite CD.
  - Store them in a safe place in case you ever want to generate maps for a different area or at a different scale.
- Maps created by others also can be easily copied to your PC, eliminating the need to do any of the following steps.
Installing MAPMAN on your PC

- MAPMAN version 1.3 comes on a series of floppy disks.
- Insert disk 1 and choose START RUN a:\setup.exe
- Follow instructions and answer all the prompts until installation is complete. We recommend you use the suggested default directory for the program.

This process is needed ONE TIME ONLY
Getting Around in MAPMAN: The Basics

- Make sure the Pepperwhite CD is installed in your CD drive
- Start the MAPMAN program.
  - START > PROGRAMS > MAPMAN > mapman
- Select MAP > CDMA SIZE. The map window will expand to fill the entire screen.
  - You should see a map of the United States including Alaska and Hawaii. If not, see “Troubleshooting and PWSTREET.INI” on a following page.
- Using the mouse and the left mouse button, “drag” to create a rectangle covering your system's approximate location
  - You should see county outlines and possibly some major city names. If not, see “Troubleshooting…..”.
  - The map will re-center itself anywhere you left-click the mouse.
  - You may “drag” another rectangle, or use the IN and OUT buttons, to position and scale the map as you wish
  - The 4mi button forces a display scale about 4 miles wide
  - You should see streets and detailed features. If not, see “Troubleshooting….”. 
Choosing the best Map Scale for your area

- You should choose an appropriate scale for the maps you create
  - The default is 4 miles, which is appropriate for dense areas like Manhattan, downtown Chicago, etc.
  - 8 miles is more appropriate for most metropolitan suburbs and medium-sized cities
  - 16 or even larger scales may be more appropriate for rural systems
  - If you choose a scale too small, the number of required maps will be large and many megabytes of disk space will be needed
  - If you choose a scale too large, map details will be too sparse

- Use the IN, OUT, and 4mi buttons to select the scale which looks best to you
Configuring Appearance of Map Features

- You can choose the types of features you want to display on the maps, along with their colors, line widths, label sizes, etc.
- With the cursor somewhere on the map, right-click the mouse. Select “Configure Map”.
  - the Customize Map Appearance window will appear
- Feature type descriptions will appear in the scrolling window
- Select a type of feature you wish to configure.
  - If the Draw/Outline button has black letters, you can click it to select when and how that type of feature will be displayed
  - If the Label button has black letters, you can click it to select when and how name labels for that feature will be displayed
  - If the Fill button has black letters, you can click it to select when that feature will be filled, and what fill color to use
- Continue to configure each feature as you wish, experimenting and looking at the map to evaluate the effects of your changes.
- When the map is just the way you like it, click OK.
- Save your configuration for future use:   FILE > SAVE CONFIG

This process is needed ONE TIME ONLY
Creating a Series of Bitmaps with MAPMAN

Now that you’ve got the map scale and appearance the way you want it, you’re ready to create and save a series of bitmaps.

- Center the map as you want it: Left click with the cursor at the spot you’d like to be centered on your first map.
- Capture the map image: Click the Add Map button. The Save Map Image File window will appear and you can choose the file name to use, and the directory in which the map will be saved.
- Name the map and save it: The last three digits of the file name will be automatically incremented as you build additional maps. Edit the first letters of the map file name to whatever you wish to identify this series of maps, then click OK. The map will be saved and a red outline will appear around it to show it has been saved.
- Reposition, Capture, and Save the next map: Click the toolbar buttons for Up, Down, Left, or Right. Click the Add Map button, and accept the incremented default name.
- Repeat this process until you’ve built all the maps you need.
- Last, but not least, choose DIR > SAVE and give a name for the directory file which will become the index to this series of maps. Click OK to save.
Suggestions, Tips and Tricks for Creating Series of Bitmaps

- One easy way to create a series of bitmaps is to start near the middle of your coverage area and build maps in a spiral fashion working clockwise around the first map as shown in the figure at left.

- The size of the map files is influenced by the video display resolution and color depth of your PC. You can substantially reduce the sizes of the files you create by first setting your display to 16-color or 256-color mode. Choose: Start > Settings > Control Panel > Display > Settings > Color Palette.

As you move the cursor around the map display, notice that the names of the maps you’re touching are displayed live in the little embossed window on the toolbar.

You can manually edit or make notes on the bitmap files using any paint program.
Optional: Using MAPXFER to copy Regional data from the CD to your hard drive

- If desired, you can also use the MAPXFER program to transfer very compact regional files from the Pepperwhite CD to your hard drive, allowing you to generate other maps in the future using MAPMAN but without requiring the CD to be available.
- Insert the Pepperwhite CD in your PC’s CD drive.
- Choosing Start > Programs > Mapman > Mapxfer.
- Select the CD drive from the pulldown menu.
- In the Map File Extractor window, click on the tile you wish to copy to the hard drive. The Save As window will appear.
- Choose the directory location where you wish to save the file, and click OK. Wait while the file is copied.
- Continue with additional tiles if you wish.
- When you’ve copied all the tiles you wish, choose File > Exit.
- That’s it! Now you can run MAPMAN without the Pepperwhite CD whenever you want to build more bitmap files anywhere in the area you’ve just saved.
Troubleshooting and checking PWSTREET.INI

- If you cannot see map details, check the following points:
- To see street details in MAPMAN, the Pepperwhite CD must be in the CD drive chosen during program installation, or you must have already saved the tiles for your area to your hard drive using MAPXFER.
- Configuration data for the MAPMAN program is saved during installation in a file PWSTREET.INI in your WINDOWS directory
- To edit the file, double-click on it in the Windows Explorer
- Make any needed changes as shown in the window below
- Save the modified file. Choose FILE > SAVE. Restart MAPMAN.

```
TYPICAL CONTENTS OF THE PWSTREET.INI FILE
[pwstvbx]
CellsOnDisk=1  (0 for CD, 1 for your hard drive)
CellData=d:\  (location of the CD, or of files on disk)
BasePath=c:\Program\Grayson\MapMan13\
```
Map Index Files: *.dir and map_tile.txt

- Inspector32 uses the *.dir file automatically created by MAPMAN to automatically access the right map during collection or playback.
- Analyzer uses map_tile.txt files which can be created from the corresponding *.dir file in either of two ways:
  - Use Scott Baxter’s automatic utility, DIR2TILE.EXE
  - Edit manually using your favorite text editor (Word, Excel, etc.):

<table>
<thead>
<tr>
<th>Map File Name Series</th>
<th>Left Edge X</th>
<th>Bottom Edge Y</th>
<th>Right Edge X</th>
<th>Top Edge Y</th>
<th>Coord System</th>
<th>Description</th>
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<tbody>
<tr>
<td>MISS0001.BMP</td>
<td>-114.068448</td>
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<td>-113.952800</td>
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<td>MISSO001.BMP</td>
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<td>MISS0002.BMP</td>
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<td>-113.848736</td>
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<td>MISSO006.BMP</td>
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</table>

The *.dir file is automatically created by MAPMAN. Its fields are delimited by the pipe symbol, |.

The map_tile.txt file can be manually created. Its fields are tab-delimited.
Displaying Sites: the Cellrefs.txt file

- Cells are contained in a text datafile called Cellrefs.txt
- Inspector32 displays cell labels derived from Cellrefs.txt
- Analyzer currently supports automatic display of cell locations and other advanced cell cross-reference features.
- Cellrefs.txt may be built or edited in any of three ways:
  - manually in Excel or a word processor
  - using the convenient editor BTSedit.exe included on your demonstration disk
  - using an Analyzer add-in provided in version 2.02 and later

<table>
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<th>Technology</th>
<th>Site Name</th>
<th>Site ID</th>
<th>Lat</th>
<th>Long</th>
<th>Sector ID</th>
<th>Azimuth</th>
<th>Beamwidth</th>
<th>EIRP</th>
<th>PN</th>
<th>MCC</th>
<th>SID</th>
<th>NID</th>
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<td>36</td>
<td>2</td>
<td>29002</td>
<td>59802</td>
<td>0</td>
</tr>
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</table>

Cellrefs.txt file

Data fields are tab-delimited.
Building Cellrefs.txt files from DriveTest Data

- In many CDMA systems, base stations transmit their coordinates in the System Parameters message on the paging channel.
- The SITEPARS.EXE utility by Scott Baxter can automatically produce a Cellrefs.txt file directly from Grayson drive test files, using the following procedure:
  - Complete an idle mode drive-test looping through the coverage areas of each sector you wish to include in the database.
  - Use Inspector32 Tools>Log File Converter to export an ascii text file of the drive test (a file with the *.asc extension).
  - Load the file into MS Word or another text editor, and save it as “text with line breaks”.
  - Use SITEPARS.EXE to process the file with line breaks into a cellrefs.txt file.
Drive-Tests: HP PN Scanner

The HP Viper PN Scanner
Drive-Tests: Qualcomm Tools

Qualcomm Retriever PN Scanner
Qualcomm Retriever PN Scanner

■ FEATURES

• Scans all 512 pilots in less than 2.0 seconds
• View specific engineering parameters in either the idle mode or call-state mode
• User-configurable scanner parameters
• Windows size, Increment through PN space, Integration time, Scan pattern, User-defined pilot list, Detection thresholds, Pilot logging format
• Overriding OTA hand-off parameters
• Can add pilots to the "Search Neighbor Set" that are not in the "Neighbor List"
• Configure link speed from 38.4k to 115.2k
Drive-Tests: LCC Tools

The RSAT Drive-Test Tool
LCC’s Collection Tool
RSAT2000

Diagram of the RSAT-2000 CDMA System
RSAT 2000 Main Menu
RSAT 2000 Screens

<table>
<thead>
<tr>
<th>CALL-CDMA</th>
<th>Soft – 3 Way</th>
<th>ACTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN</td>
<td>16 20 28 12 48 F 16 20 28 12 48 S</td>
<td></td>
</tr>
<tr>
<td>SRCH</td>
<td>-7 -16 -9 -12 -10 -11 16</td>
<td></td>
</tr>
<tr>
<td>PSMM</td>
<td>-9 -6 -12 -10 -15 -22 28 8</td>
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<tr>
<td>CODE</td>
<td>22 35 15 42 37 18 28 10 -20</td>
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</tr>
<tr>
<td>SITE</td>
<td>FRA FRB CWC LMA LMB CTA Rx: -110</td>
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</tr>
<tr>
<td>CHAN</td>
<td>384 FER 1.23 TxA: +3 Tx: +39</td>
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</tr>
<tr>
<td>MK:01</td>
<td>REPLAY GRAPH ZOOM PRINT ESC</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>CALL-CDMA</th>
<th>Soft – 3 Way</th>
<th>CANDIDATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN</td>
<td>36 20 128 104 112 F 36 20 128 104 112 S</td>
<td></td>
</tr>
<tr>
<td>SRCH</td>
<td>-7 -16 -9 -12 -10 -16</td>
<td></td>
</tr>
<tr>
<td>PSMM</td>
<td>-9 -6 -12 -10 -15 -28 8</td>
<td></td>
</tr>
<tr>
<td>SITE</td>
<td>FRA FRB CWC LMA LMB Rx: -110</td>
<td></td>
</tr>
<tr>
<td>CHAN</td>
<td>384 FER 1.23 TxA: +3 Tx: +39</td>
<td></td>
</tr>
<tr>
<td>MK:01</td>
<td>REPLAY GRAPH ZOOM PRINT ESC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CALL-CDMA</th>
<th>Soft – 3 Way</th>
<th>NEIGHBOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN</td>
<td>PSMM</td>
<td>PN PSMM</td>
</tr>
<tr>
<td>16</td>
<td>-22</td>
<td>120 -24</td>
</tr>
<tr>
<td>64</td>
<td>-16</td>
<td>132 -32</td>
</tr>
<tr>
<td>*80</td>
<td>-8</td>
<td>144 -16</td>
</tr>
<tr>
<td>96</td>
<td>-18</td>
<td>*156 -8</td>
</tr>
<tr>
<td>108</td>
<td>-12</td>
<td>216 -32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>224 -16</td>
</tr>
<tr>
<td>MK:01</td>
<td>REPLAY ACTV CAND PRINT ESC</td>
<td></td>
</tr>
</tbody>
</table>
# RSAT 2000 Screens

<table>
<thead>
<tr>
<th>CALL</th>
<th>Hard F to Soft 3</th>
<th>H/O HARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan</td>
<td>384 to 122 &gt; 1</td>
<td>changes</td>
</tr>
<tr>
<td>Offset</td>
<td>0 to 0 &gt; 1 *</td>
<td>changes</td>
</tr>
<tr>
<td>Disjoint Sets</td>
<td>&gt; 0</td>
<td>times</td>
</tr>
<tr>
<td>CDMA to AMPS</td>
<td>&gt; 0</td>
<td>times</td>
</tr>
<tr>
<td>CDMA to NAMPS</td>
<td>&gt; 0</td>
<td>times</td>
</tr>
</tbody>
</table>

MK:01 REPLAY SOFT ZOOM PRINT ESC

<table>
<thead>
<tr>
<th>IDLE–CDMA</th>
<th>Soft – 3 Way</th>
<th>ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIN: 320,320,320</td>
<td>Tadd: -16 dB</td>
<td>MxProbe: 3</td>
</tr>
<tr>
<td>Init/Nom: -6, 0</td>
<td>Tdrop: -20 dB</td>
<td>Acc Seq: 2</td>
</tr>
<tr>
<td>Pwr Incr: 2</td>
<td>Tcomp: 2.5 dB</td>
<td>Res Seq: 8</td>
</tr>
<tr>
<td>PAG/ACC: 3,2 Timer 27 sec</td>
<td>RxPwr: -85</td>
<td></td>
</tr>
<tr>
<td>Cr Probe:</td>
<td>Txpwr: 10</td>
<td></td>
</tr>
<tr>
<td>Cr Seq:</td>
<td>Txad: 33</td>
<td></td>
</tr>
</tbody>
</table>

MK:01 REPLAY ZOOM PRINT ESC

<table>
<thead>
<tr>
<th>CALL–CDMA</th>
<th>Soft – 3-Way</th>
<th>MARKOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>Markov, 8kbps</td>
<td></td>
</tr>
<tr>
<td>Full</td>
<td>0.00% TX Adj -12 RX Pwr -85</td>
<td></td>
</tr>
<tr>
<td>Half</td>
<td>0.00% TX Pwr 0</td>
<td></td>
</tr>
<tr>
<td>Quarter</td>
<td>0.00% Fngs 16 28 28</td>
<td></td>
</tr>
<tr>
<td>Eighth</td>
<td>0.00% Delay 8 10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.00% Sum 17</td>
<td></td>
</tr>
</tbody>
</table>

MK:01 REPLAY GRAPH ZOOM PRINT ESC
RSAT 2000 Screens

<table>
<thead>
<tr>
<th>CALL–CDMA</th>
<th>Soft 2 to Soft 3</th>
<th>H/O SOFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1WAY</td>
<td>79 to 79 MRa</td>
<td>132.0 mins</td>
</tr>
<tr>
<td>2WAY</td>
<td>33 to 33 MRb</td>
<td>12.0 mins</td>
</tr>
<tr>
<td>3WAY</td>
<td>** to 64 FRa</td>
<td>3.0 mins</td>
</tr>
<tr>
<td>4WAY</td>
<td>** to ** ***</td>
<td>0.0 mins</td>
</tr>
<tr>
<td>5WAY</td>
<td>** to ** ***</td>
<td>0.0 mins</td>
</tr>
<tr>
<td>6WAY</td>
<td>** to ** ***</td>
<td>0.0 mins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IDLE–CDMA</th>
<th>Soft – 3 Way</th>
<th>SERVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net: 65535</td>
<td>Base: 16</td>
<td></td>
</tr>
<tr>
<td>Sys: 8191</td>
<td>PN: 96</td>
<td></td>
</tr>
<tr>
<td>Loc: 4096</td>
<td>Code: 12</td>
<td>FREEMANA</td>
</tr>
<tr>
<td>Neighbors:</td>
<td>172 180 272 280 256 264</td>
<td></td>
</tr>
<tr>
<td>108 116 124 132 140 148 156 164</td>
<td></td>
<td></td>
</tr>
<tr>
<td>208 216 224 232 240 248</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MK:01 Replay HARD ZOOM PRINT ESC

MK:01 Replay PRINT ESC
Course RF200 Day 3

Maintenance Features of CDMA Handsets
Handsets as Tools: Simple but always Available!

Most CDMA handsets provide some form of maintenance display ("Debug Mode") as well as instrumentation access

- all CDMA drive-test tools use handsets as their “front-ends”

Using the handset as a manual tool without Commercial Test Tools:

- Enter the maintenance mode by special sequence of keystrokes

- Displayed Parameters
  - PN Offset, Handset Mode, Received RF Level, Transmit Gain Adjust

- Maintenance Display Applications
  - best serving cell/sector
  - simple call debugging (symptoms of weak RF, forward link interference, etc.)

- Handset Limitations during manual observation
  - no memory: real-time observations only; no access to messages or call details; serving PN offset not updated during voice calls
Qualcomm & Sony Maintenance Displays

Press This:

Menu

See This:

MAIN MENU
1: Volume
2: Call Info
3: Security

continue:

See This:

DEBUG
1: Screen
2: Test Calls
3: CDMA Only

4: Errors
5: Clr Errors
6: 13K Voice

See following legend for maintenance display values

(* or correct code, if different)
Qualcomm & Sony Phones with Jog Dials

- Enter 111111
- Press dial in for OPTIONS
- Dial to FIELD DEBUG, press
- enter Field Debug Security Code
- press Screen
Interpreting the QCP Maintenance Display

PN Offset

Receive State

Rx CAR

Receive Power

Transmit Adjust

Unsupported
A = active pilots
X = exit reason

0 - Pilot Channel Acquisition Substate
1 - Sync Channel Acquisition Substate
2 - MS Idle State
3 - System Access State
4 - Traffic Channel State

Receive Power Conversion:
RX_{dbm} = XX_{DEC} / 3 - 63.25 (800 MHz)
RX_{dbm} = XX_{DEC} / 3 - 66.25 (1900 MHz)
(if XX>7F, use XX = XX_{DEC}-256)

Transmit Gain Adjust Conversion:
TX_{adj} = XX_{DEC} / 2

Transmit Power Output Conversion:
TX_{dbm} = -73 - RX_{dbm} - TX_{adj} (800 MHz)
TX_{dbm} = -76 - RX_{dbm} - TX_{adj} (1900 MHz)
**Entering the Samsung Maintenance Display**

**Press This:**
- **Main Menu**
  - 1: Call Logs
  - 2: Phone Book

**See This:**
- Main Menu
  - 1: Call Logs
  - 2: Phone Book

**continue:**
- **Setup**
  - 1: Auto Retry
  - 2: Anykey Ans

**See This:**
- Setup
  - 1: Auto Retry
  - 2: Anykey Ans

**Service Code**
- ????

**See This:**
- Service Code
  - ????

**Debug Menu**
- 1: Screen
  - 2: Test Calls

**Debug Menu**
- 3: Errors
  - 4: Erase Error

**See This:**
- Debug Menu
  - 1: Screen
  - 2: Test Calls
  - 3: Errors
  - 4: Erase Error

See following legend for maintenance display values

(* or correct code, if different)
Interpreting Samsung Maintenance Display: Acquisition, Idle, and Access States

Display toggles between:
- System Identifier (SID)
- Network Identifier (NID)

Slot Cycle Index

0 - Pilot Channel Acquisition Substate
1 - Sync Channel Acquisition Substate
2 - MS Idle State
3 - System Access State
4 - Traffic Channel State
5,6,7 - various call service options

Processing State

Receive Power, dbm

Ec/Io, db (primary PN only)

Frequency (channel #)

Transmit Power Output Calculation:

\[
TX_{dbm} = RX_{dbm} - TXADJ_{db} \quad (800 \text{ MHz})
\]

\[
TX_{dbm} = -76 - RX_{dbm} - TXADJ_{db} \quad (1900 \text{ MHz})
\]
Interpreting Samsung Maintenance Display: Traffic Channel State

Transmit Vocoder Rate
1 = 1/8
2 = 1/4
4 = 1/2
8 = Full

Receive Vocoder Rate

Walsh code assigned

Receive Power, dbm

Ec/lo, db (primary PN only)

Frequency (channel #)

Transmit Gain Adjust, db

PN Offset

SVC

TV1 RV8 08 7
T-63 D105-06
P016 CH0600

Transmit Power Output Calculation:
\[
TX_{\text{dbm}} = -73 - RX_{\text{DBM}} - TXADJ_{\text{db}} \text{ (800 MHz)}
\]
\[
TX_{\text{dbm}} = -76 - RX_{\text{DBM}} - TXADJ_{\text{db}} \text{ (1900 MHz)}
\]

0 - Pilot Channel Acquisition Substate
1 - Sync Channel Acquisition Substate
2 - MS Idle State
3 - System Access State
4 - Traffic Channel State
5,6,7 - various call service options

Processing State
Entering Denso Debug Mode

- Enter ##DEBUG (##33284)
- Scroll down to SAVE
- Press OK
- Highlight SERVICE SCREEN
- Press OK

- If you want to make a test call, dial the digits and press OK while in idle mode
### Denso Maintenance Display

<table>
<thead>
<tr>
<th>CBV:</th>
<th>3957</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABV:</td>
<td>3954</td>
</tr>
<tr>
<td>ABT:</td>
<td>031</td>
</tr>
<tr>
<td>ARF:</td>
<td>0000</td>
</tr>
<tr>
<td>CCL:</td>
<td>01</td>
</tr>
<tr>
<td>SID:</td>
<td>04157</td>
</tr>
<tr>
<td>NID:</td>
<td>00001</td>
</tr>
<tr>
<td>CH:</td>
<td>0100</td>
</tr>
<tr>
<td>RSSI:</td>
<td>093</td>
</tr>
<tr>
<td>DPN:</td>
<td>084</td>
</tr>
<tr>
<td>TX:</td>
<td>-46</td>
</tr>
<tr>
<td>BFRM:</td>
<td>0000</td>
</tr>
<tr>
<td>TFRM:</td>
<td>0001</td>
</tr>
<tr>
<td>FER:</td>
<td>0.71</td>
</tr>
<tr>
<td>LT:</td>
<td>036:06:36</td>
</tr>
<tr>
<td>LG:</td>
<td>-086:45:36</td>
</tr>
<tr>
<td>EC:</td>
<td>-63</td>
</tr>
<tr>
<td>PN:</td>
<td>084</td>
</tr>
<tr>
<td>FNGLK:</td>
<td>Y Y N</td>
</tr>
<tr>
<td>WLSH:</td>
<td>01 01 01</td>
</tr>
<tr>
<td>ACT:</td>
<td>084 484 096 -01 -01 200</td>
</tr>
<tr>
<td>CND:</td>
<td>220 332 200</td>
</tr>
<tr>
<td>NGH:</td>
<td>076</td>
</tr>
</tbody>
</table>

**Charging Battery Voltage**

**Average Battery Voltage**

**System ID**

**Network ID**

**RF Channel Frequency**

**Digital PN Offset**

**Number of Bad Frames**

**Number of Good Frames**

**Base Station coordinates**

**Current status of Rake Fingers**

**Active Pilot Set**

**Candidate Pilot Set**

**Neighbor Pilot Set**
The Sanyo Dual-Band Phone

Press This:

- press menu 7, 0
- enter in DEBUGM (332846)
- screens are similar to QCP phones
Entering Maintenance Mode: Motorola

■ To Enter Maintenance Mode:
  • Press FCN 00**83786633 STO; Phone will display US ’
  • Enter 55#
  • Press * to step to number 9
  • Enter 01000000, Press STO
  • Power cycle phone -- Test mode is now enabled!

■ To access the screens:
  • Press FCN FCN (Phone should now say "Old Markov Call")
  • Use volume keys or * or # keys, scroll to "Call Status Mode Off"
  • Press Smart Button (between volume keys) to enable screen
  • Press END

■ You should now be in Call Status Mode!
■ Nice display includes active PNs, Ec/Io, etc.
### Motorola Maintenance Display

<table>
<thead>
<tr>
<th>Last Call Indicator</th>
<th>NI</th>
<th>No Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR</td>
<td>Mobile Release</td>
<td></td>
</tr>
<tr>
<td>BR</td>
<td>Base Release</td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>Traffic Channel Lost</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>Layer 2 Ack Fail</td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>No Channel Asn Msg</td>
<td></td>
</tr>
<tr>
<td>N5</td>
<td>N5M failure</td>
<td></td>
</tr>
<tr>
<td>BS</td>
<td>BS Ack Failure</td>
<td></td>
</tr>
<tr>
<td>WO</td>
<td>L3 WFO State Timeout</td>
<td></td>
</tr>
<tr>
<td>MP</td>
<td>Max Probe Failure</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>Paging Channel Loss</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Reorder or Rel on PCH</td>
<td></td>
</tr>
<tr>
<td>??</td>
<td>Unknown Condition</td>
<td></td>
</tr>
</tbody>
</table>

### Call Counter

- **Dropped Call Counter**
- **Call Counter**

### Current Service Option

- **8V** 8K voice
- **8L** 8K Loopback
- **8EV** EVRC
- **8S** 8K SMS
- **13L** 13K Loopback
- **13S** 13K SMS
- **8MO** 8K Markov Old
- **DAT** Data
- **8M** 8K Markov
- **13M** 13K Markov
- **13v** 13K Voice
- **N/A** Null

### Current SID

### Current NID

### Current RSSI

### Current TX dbm

### Current FER

### Strongest Active

- PN
- Ec/lo
- # Cand.
- # Neighbors
- Current RF Channel

<table>
<thead>
<tr>
<th># Active</th>
<th>PN</th>
<th>Ec/lo</th>
<th># Cand.</th>
<th># Neighbors</th>
<th>Current RF Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 7 2</td>
<td>0 6 5</td>
<td>1</td>
<td>0 0</td>
<td>3 8 4</td>
<td></td>
</tr>
</tbody>
</table>

### Strongest Neighbor

<table>
<thead>
<tr>
<th>1 6 8</th>
<th>1 8 5</th>
<th>0</th>
<th>I D L</th>
<th>M R</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 8 2</td>
<td>- 0 4</td>
<td>0 0 1 2 7</td>
<td>0 0</td>
<td></td>
</tr>
<tr>
<td>1 3 V</td>
<td>0 1 8 3</td>
<td>0 0 0 1</td>
<td>0 6</td>
<td></td>
</tr>
</tbody>
</table>

### Current RX dbm

### Current FER
Entering the Nokia Maintenance Display

- Enter *3001#12345 MENU
- Scroll down to Field test
- Press Select
- Scroll up to Enabled
- Press OK
- Power the phone off and on
- You should now be in Field test mode
## Maintenance Display Screens of Nokia Handsets

The following screens appear in field test mode on Nokia HD881 series of Handsets:

### Screen 1: General

<table>
<thead>
<tr>
<th>CSST</th>
<th>CS State</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXXX</td>
<td>Idle: PN Offset, TFC: #Actv, FER</td>
</tr>
<tr>
<td>RSSI</td>
<td>RSSI dBm</td>
</tr>
<tr>
<td>CCCC</td>
<td>Paging Channel #</td>
</tr>
<tr>
<td>RX</td>
<td>RX power, dbm</td>
</tr>
<tr>
<td>TX</td>
<td>TX power, dbm</td>
</tr>
</tbody>
</table>

### Screen 2: Paging CH Info

<table>
<thead>
<tr>
<th>CSST</th>
<th>CS State</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGCH</td>
<td>Paging Channel #</td>
</tr>
<tr>
<td>CURSO</td>
<td>Current Service Option</td>
</tr>
<tr>
<td>FER</td>
<td>Frame Error Rate</td>
</tr>
</tbody>
</table>

### Screen 4: NAM Info

<table>
<thead>
<tr>
<th>OwnNumber</th>
<th>Mobile MIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESN</td>
<td>Mobile Station ESN</td>
</tr>
<tr>
<td>P</td>
<td>Preferred Sys 1=AMPS, 2=CDMA</td>
</tr>
<tr>
<td>A</td>
<td>Operator Selected (1=A, 2=B, 3=both</td>
</tr>
</tbody>
</table>

### Screen 5: NAM Info

<table>
<thead>
<tr>
<th>PPCA</th>
<th>Primary Channel A</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPCA</td>
<td>Secondary Channel A</td>
</tr>
<tr>
<td>PPCB</td>
<td>Primary Channel B</td>
</tr>
<tr>
<td>SPCB</td>
<td>Secondary Channel B</td>
</tr>
<tr>
<td>L</td>
<td>Local Use</td>
</tr>
<tr>
<td>A</td>
<td>Access Overload Class</td>
</tr>
</tbody>
</table>

### Screen 6: BS & Access. Info.

<table>
<thead>
<tr>
<th>SID</th>
<th>Current SID</th>
</tr>
</thead>
<tbody>
<tr>
<td>NID</td>
<td>Current NID</td>
</tr>
<tr>
<td>DBUS</td>
<td>DBUS (Handsfree?)</td>
</tr>
</tbody>
</table>

### Screen 7: BS Protocol Rev. Level

<table>
<thead>
<tr>
<th>BASE#</th>
<th>BASE_ID (sys par msg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_REV</td>
<td>P_REV (sync msg)</td>
</tr>
<tr>
<td>MIN_P_REV</td>
<td>MIN_P_REV (sync msg).</td>
</tr>
</tbody>
</table>

### Screen 8: Time Information

<table>
<thead>
<tr>
<th>CSST</th>
<th>CS State</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMDDYY</td>
<td>Date from System Time</td>
</tr>
<tr>
<td>HHMMSS</td>
<td>System Time</td>
</tr>
</tbody>
</table>
**Nokia Maintenance Display Screens (continued)**

### Screen 9: Acquisition Information

<table>
<thead>
<tr>
<th>TA</th>
<th>TADD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD</td>
<td>TDROP</td>
</tr>
<tr>
<td>TC</td>
<td>TCOMP</td>
</tr>
<tr>
<td>TT</td>
<td>TTDROP</td>
</tr>
<tr>
<td>WW1</td>
<td>Active Window</td>
</tr>
<tr>
<td>WW2</td>
<td>Neighbor Window</td>
</tr>
<tr>
<td>WW3</td>
<td>Remaining Window</td>
</tr>
</tbody>
</table>

### Screen 10: Active Set (#1-3)

<table>
<thead>
<tr>
<th>PPN</th>
<th>Pilot PN Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>Ec/lo in 1/2 db units</td>
</tr>
<tr>
<td>K</td>
<td>Keep? 1</td>
</tr>
<tr>
<td>PPN</td>
<td>Pilot PN Offset</td>
</tr>
<tr>
<td>EC</td>
<td>Ec/lo in 1/2 db units</td>
</tr>
<tr>
<td>K</td>
<td>Keep? 1</td>
</tr>
<tr>
<td>PPN</td>
<td>Pilot PN Offset</td>
</tr>
<tr>
<td>EC</td>
<td>Ec/lo in 1/2 db units</td>
</tr>
<tr>
<td>K</td>
<td>Keep? 1</td>
</tr>
</tbody>
</table>

### Screen 11: Active Set (#4-6)

<table>
<thead>
<tr>
<th>PPN</th>
<th>Pilot PN Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>Ec/lo in 1/2 db units</td>
</tr>
<tr>
<td>K</td>
<td>Keep? 1</td>
</tr>
<tr>
<td>PPN</td>
<td>Pilot PN Offset</td>
</tr>
<tr>
<td>EC</td>
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### Nokia Maintenance Display Screens (continued)

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<th>Screen 14: Neighbor Set (#11-15)</th>
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Nokia Maintenance Display Screens (continued)

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| Screen 24: Codec Registers         |