TEMS™ Pocket 22.0
Technical Product Description

Contents

1 Introduction

1.1 What Is TEMS Pocket?

TEMS™ Pocket is a handheld tool for **verification**, **maintenance**, and **troubleshooting** of mobile networks as well as for basic cell planning tasks. Built into a commercial mobile phone or tablet, TEMS Pocket collects measurements and events and presents them on the device display. The measurements can be stored for later analysis in other products such as TEMS™ Discovery and TEMS™ Investigation.

The combination of **small size** and **powerful testing** features makes TEMS Pocket a convenient tool for day-to-day monitoring of mobile networks, particularly in an indoor or pedestrian scenario. In addition, since the mobile device can function as the user's regular phone, TEMS Pocket provides a powerful way to find errors **without explicitly searching** for them.

TEMS Pocket is designed as an **integral part** of the device's user interface. This promotes continuous use by engineers and technicians, which translates into more time for them to detect, document, and solve problems. TEMS Pocket can be **integrated with other products** in the TEMS portfolio to form a complete network monitoring solution that allows reuse of information collected throughout an organization.
TEMS Pocket provides its users with a solution that is **efficient** and offers **good value**.

1.2 Overview of TEMS Pocket

TEMS Pocket is the ideal product for users who require:

- A real-time view of network quality.
- The ability to test indoors or in other pedestrian locations such as boats, trains, etc.
- Single-device drive testing capabilities through the use of outdoor satellite maps and audio notifications.
- A tool that is always available and ready to capture detailed network data, including RACH procedures.
- Automatic testing and verification of subscriber services and network quality of experience.
- The ability to share captured data on the mobile network by uploading the data to any FTP or HTTP server.
- The ability to capture data and post-process using other tools in the TEMS™ portfolio, or directly in the handset via log file replay.

1.3 TEMS Pocket Packages

TEMS Pocket is implemented on a number of Android handsets, and is offered in a variety of packages:

- **Professional:** Full set of features, comprehensive data collection, and support for all options and expansions.
  - This is the preferred engineering tool permitting both comprehensive in-the-field troubleshooting and in-depth retrospective analysis.
- **Remote:** Converts TEMS Pocket into an autonomous, unattended probe for use in monitoring or benchmarking, controlled by an TEMS Director Fleet.

1.4 Optional Features

- **P.OLQA** license option for AQM measurements.
- **SSL** license option for encryption of HTTP upload and email sessions.
- **Scanning** of mobile networks using an external PCTel scanner.
- **Multi-device** TEMS Pocket configuration, where a *controller* device remote-controls the actions of a set of *agents*. A license option exists for the controller role, and another one for connecting the controller to TEMS Director.
- **VoLTE** license option for VoLTE calls.
- **5G NR** license option for performing 5G NR measurements (requires a global Pocket Professional License).

These optional features are compatible with the product packages as shown in the following table (which also shows some features that are always included in certain packages):

TEMS Pocket Feature	Professional	Remote
Indoor	Included	
POLQA	✓	✓
SSL	✓	✓
Scanning (PCTel)	✓	
Multi-device, controller	✓	
Multi-device, agent	Included	Included
VoLTE	✓	✓
LTE antenna health check	✓	
5G NR measurements	✓ (requires global license)	

1.5 Expansions

- A TEMS Pocket device can be expanded with software for use with TEMS Investigation and/or TEMS Paragon.

2 Recently Introduced Features in TEMS Pocket

2.1 TEMS Pocket 22.0

2.1.1 New Devices

2.1.1.1 Support for Android 10

TEMS Pocket can now run on devices running Android 10. Please contact TEMS Support for information about your device.

2.1.2 New Features

2.1.2.1 Improved NB-IoT testing

TEMS Pocket is now prepared for more advanced NB-IoT testing by enabling AT-commands to be used to control the connected NB-IoT device.

2.1.2.2 Enhanced Band lock functionality

It is now possible to lock TEMS Pocket devices to more LTE Bands (Band 65 and higher)

2.1.2.3 Support for Band lock on Band 48

TEMS Pocket devices aimed at the US market can now be locked to LTE Band 48.

3 Key Features of TEMS Pocket

TEMS Pocket is an extremely powerful tool which is conveniently applied to verification as well as troubleshooting:

- **Smartphone testing** with devices based on Android, the world's leading mobile operating system.
- **Convenient verification** of various environments.
- **Air interface information collection** in log files with the same level of detail as in TEMS Investigation.
- **Service testing** with user-scripted behavior.
- **Indoor testing** with easy-to-use pinpointing and indoor building management.
- **Automatic transfer of data** to the back-end for quick and easy access to post-processing tools.

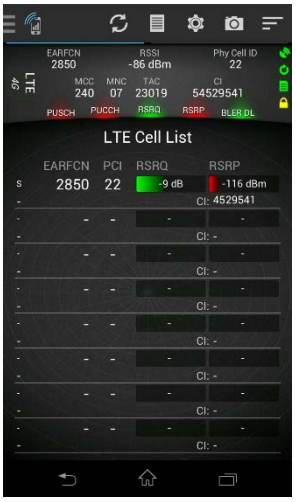
Radio Technologies
NR 5G
NB-IoT
LTE
WCDMA/HSDPA/HSUPA
GSM/GPRS/EDGE
CDMA/EV-DO
(Refer to Appendix A for full details on supported bands.)
Service Testing
CS voice calls (MO/MT), optionally with POLQA audio quality measurement (AQM)
VoLTE: Voice over LTE
VoWiFi : Voice over Wi-Fi
Voice call sequences (MO/MT calls; supported for both CS and PS)
CSFB and ECSFB
Data sessions: FTP download/upload, HTTP Get/Post, Streaming (YouTube, optionally with PEVQ-S video quality measurements), Email, SMS, Ping, Facebook, Twitter, Instagram, Whatsapp
Parallel services: One each of voice, AQM, Email, Facebook, FTP, HTTP, Instagram, Ping, SMS, and Streaming (YouTube) concurrently. This encompasses multi-RAB testing
Available bandwidth measurement with the Blixt™ algorithm
Mobile network scanning
Wi-Fi scanning
Wait (pause)
Logging
Scripted, manual, or triggered by pinpointing
Log file recording can be started and stopped at any point in a script
Same level of detail as TEMS Investigation log files
Log file replay
Log file upload to FTP, SFTP, or HTTP server
Custom log file tags for log file management and pre-processing
Filemarks can be inserted in log files during recording
Recovery mechanism for incomplete log files created if the recording is interrupted
Instant Reporting

PDF reports in near real-time directly after finished tests
Positioning
Integrated assisted GPS
Optional external GPS
Indoor positioning by pinpointing when GPS coverage is not available
Control
Control functions are listed below. For further details regarding control capabilities, see Chapter 8.
GSM: RAT lock, band lock, cell lock, cell multi-lock/cell prevention
WCDMA: RAT lock, band lock, cell lock (UARFCN/SC), UARFCN lock, disable handover
LTE: RAT lock, band lock, EARFCN lock, EARFCN/PCI lock
CDMA, EV-DO: RAT lock
Voice codec lock
Cell barred lock
Access class lock
APN control
Automation
Automated service testing with scripts
Script triggering by user-defined events
Automatic positioning of indoor maps using MapInfo files
Workflow in separate application for Single Site Verification
Presentation
Data views and graphs (line charts, histograms) showing essential radio and network parameters
Context-sensitive data views populated with relevant data only
Event view including call events
Layer 3 message view; SIP message view
Local and Agent messages on controller device
Events and messages can optionally be presented on an Android smartwatch
Custom views that are assembled by the user from scratch
Map views with presentation of test routes and events
Cells can be presented by name and plotted on maps after import of cell file
Identities of all encountered cells are cached so that they can be immediately presented when cells reappear later on
Convenience and Access
Highly compact – one of the smallest tools on the market
Over-the-air software updates
Collects data anywhere, including places not accessible to vehicles
Touch-screen navigation provides easy user interface
Mobile-friendly user manual and example scripts available on the device
Compatibility
TEMS Pocket log files can be post-processed in TEMS Director 1.x or later
TEMS Pocket log files can be post-processed in TEMS Discovery 12.0 or later (if the device is supported in TEMS Discovery)
TEMS Pocket log files can be loaded in TEMS Investigation 19.0 or later (for full details, see section 6.5)
Certain TEMS Pocket phones can also be used for data collection with TEMS Investigation (connect license required) – see connectable device list for details

TEMS Pocket can import MapInfo TAB files and JPEG maps from iBwave Design 5.3
TEMS Pocket can import IBWC files from iBwave Design 6.0
Indoor Testing
Preplanned routes for quicker indoor navigation and greater accuracy during recurring tests
Easy distribution and configuration of floor plans, routes, and geographical information through bundled map sets
Seamless navigation between buildings and floors during indoor testing
Automatic pinpointing saving up to 50% of measurement time

Regarding TEMS Pocket Remote, see chapter 13.

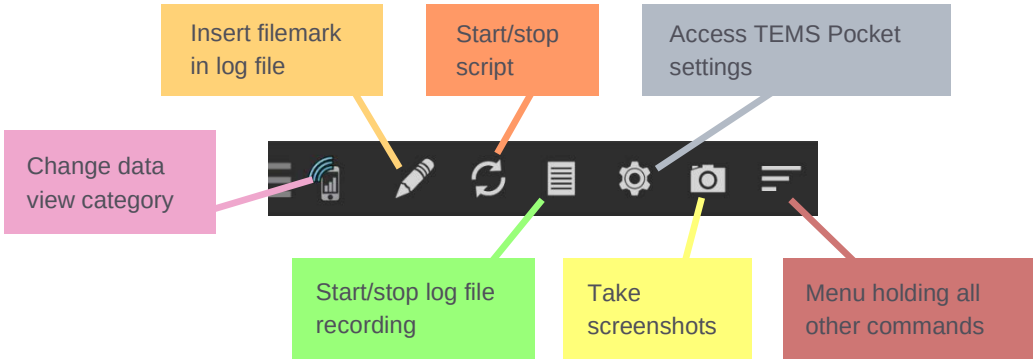
4 TEMS Pocket User Interface



On start-up, TEMS Pocket displays a cell list data view for the radio technology currently in use. Data views are given comprehensive coverage in chapters 11 and 12.
At the top of the TEMS Pocket screen, immediately below the Android status bar, is an **action bar** with a number of buttons. The set of buttons that appears is in part context-dependent. From here you can perform all actions and configuration tasks in TEMS Pocket, and also inspect some categories of data.

4.1 Action Bar

Here is how the action bar is used:



The **screenshot** function in TEMS Pocket captures all data views, storing them in the log file (if one is being recorded), or else directly in a folder on the device's internal memory card. This ability is particularly useful in TEMS Pocket Standard, since it allows the user to visually capture network and service information even without the ability to record log files.

4.2 Data View Header

See section 12.2.

5 Automation of Tests: Scripting

TEMS Pocket supports automation of testing with command sequences called *scripts*. The type of service to test and the necessary parameters for the service are defined in the script.

Scripts provide a powerful aid in troubleshooting by allowing engineers to run tests at a moment's notice.

5.1 Script Action Types

The following script action types are provided:

- FTP upload/download
- HTTP Get/Post
- Streaming (YouTube)
- Email
- SMS (Send and Receive)
- Facebook
- Instagram
- Twitter
- WhatsApp
- Ping
- ABM (available bandwidth measurement, Blixt)
- Voice (mobile-originated calls; CS or VoLTE)
- Toggle Wi-Fi On/Off
- Voice MT (receiving mobile-terminated calls)
- AQM (voice with audio quality measurement)
- Call sequence (sequence of MT + MO calls)
- Control function (applies one or more control functions)
- IP capture
- Mobile network scanning[1]
- Wi-Fi scanning
- Logfile recording
- Logfile upload
- Wait
- SynchPoint
- ODM Scripting

A special action type "Parallel" is provided for running **multiple services** concurrently: up to one each of FTP, HTTP, Streaming (YouTube), Email, ABM, Facebook, SMS, Ping, Voice, AQM, and log file upload.

The user starts and stops scripts manually from the TEMS Pocket action bar. Scripts can also be triggered by events: see section 5.3.

Scripts are stored on the device's internal memory card and can be freely transferred between different TEMS Pocket devices.

5.2 Guard Times

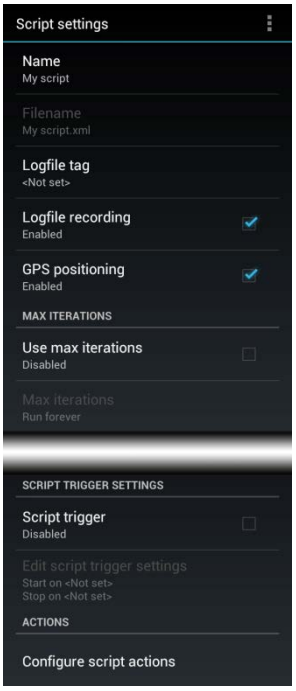
When running scripts in TEMS Pocket, guard times are automatically inserted between the measurement tasks in the script. This is to ensure that the **signaling** between measurements is also recorded to the log file and made

[1] With external scanner.

available for post-processing. The lengths of the pre- and post-guard periods are user-configurable; the default for both is 10 seconds.

Actions containing voice calls also have an adjustable “**repeat guard**”, by default set to 5 seconds. This guard period is inserted between repetitions of the action if you have configured the action to execute several times back to back.

5.3 Script Triggering and Other Script Settings



Top-level script settings

A script can be conditioned to start when an **event** of a specified type occurs. This can be a predefined event, or it can be a custom event indicating, for example, that the device has entered a particular geographical area (lat/long bounding box). Another event can be chosen to stop the script.
The script can be set to execute either indefinitely or a fixed number of times.
In composing your script, you also decide whether to enable **GPS positioning** and optionally specify distinctive **tags** to be added to log file names.
When starting a script, you can **disable selected actions** if you do not want to run them at this particular time.

6 Logfiles

6.1 Recording Logfiles

TEMS Pocket can record its measurements in logfiles containing the same richness of detail as logfiles recorded with all other TEMS products. The only TEMS data that cannot be obtained with TEMS Pocket is data requiring additional hardware that is not available with TEMS Pocket.

Air interface data as well as calculated quality-of-service KPIs are recorded in the handset. Guard times between measurement tasks (see section 5.2) ensure completeness of message signaling sequences.

TEMS Pocket logfiles are stored on the device's internal memory card, or alternatively on an external memory card if the device has one installed.

Example: For FTP over HSDPA, at a recording rate of 0.7 MB/minute2, an 8 GB card can accommodate approximately 8 days of continuous, 24/7 testing. With voice testing at 0.4 MB/minute, the card will accommodate 14 days of continuous, round-the-clock testing.

Every TEMS Pocket user is thus in a position to capture valuable data whenever the opportunity arises, using his or her regular handset. This greatly enhances the flexibility and efficiency of network monitoring.

In a script, log file recording can be turned on or off at any point.

The wide range of data that can be collected and displayed by TEMS Pocket is illustrated in chapter 12.

6.2 Tagging Log files

When composing scripts, you can define tags to be added to the name of each log file created, both a general, script-wide tag and action-specific ones. By default, log file names consist simply of date/time and the name of the script that was run (format: <script name>yyyymmddThhmmssZ.trp).

The tagging feature can be used together with the advanced scripting functions in TEMS Discovery to perform pre-processing on files tagged with customer-specific metadata, such as team, area, or campaign name. Tags can also be used to help sort and organize log files.

6.3 Working with log configuration

When performing high-speed data testing in LTE networks, logfiles tend to use large amount of data space. To keep the logfile size down, a log configuration for a Qualcomm devices is included in TEMS Pocket. It offers a predefined set of log masks, optimized for voice, data, or a combination of those two, keeping the logfile size to about a third of the unfiltered data size.

[2] Please note that the rates quoted are examples given for the purpose of illustration only. In practice, data volumes will vary widely depending on the service, network, and radio environment.

6.4 Replaying Log files in TEMS Pocket

Log files recorded with TEMS Pocket can be replayed in the application itself. During replay, the TEMS Pocket views are updated by the log file content exactly as in live mode, that is, exactly as if the data were being received from the network.

When you open a log file for replay, a panel with replay controls becomes available at the bottom of the screen. Tap “Show log file controls” to expose it:

The timestamps on the left and right indicate the times of day when the log file recording started and ended, respectively. The timestamp in the middle shows the point to which the replay has advanced, as also indicated graphically by the slider.
While the replay is paused, you can jump forwards or backwards in the log file, one second or one minute at a time, using the buttons **[< 1m], [< 1s], [1s >], [1m >].**

6.5 Post-processing Log files in Other TEMS Products

- TEMS Pocket log files can be post-processed in TEMS Discovery 12.0 or later.
- TEMS Pocket log files can be loaded in TEMS Investigation 19.0 or later.
  - Please note that zones in iBwave map sets cannot be displayed in other TEMS products.
  - For Replay of logiles with NR 5G content, TEMS Investigation 21.1 or later is required.

6.6 Uploading Log files

Log files created in TEMS Pocket can be uploaded to an FTP or HTTP/HTTPS server for further delivery to a post-processing tool, such as TEMS Investigation or TEMS Discovery.

Log file upload is performed in TEMS Pocket through a script in which you specify:

- **Upload path:** Path to an FTP, SFTP, or HTTP server directory where the files should be uploaded, for example: ftp://ftp.myserver.com/tems/pocketlogfiles.
- **User, Password:** User name and password on the server, if required.

Whenever this activity executes, TEMS Pocket tries to upload all log files found on the device’s internal memory card, then deletes all the files that were successfully uploaded.

Log file uploading can be used to report work progress directly from the field. It can also be used to fully integrate the collected data into TEMS Automatic, TEMS Discovery, or TEMS Investigation. Log files are compressed before they are transferred over the air in order to reduce upload time and save battery power.

Log file upload via HTTP is useful in situations where FTP access is not readily available, for instance because of company IT policies, or simply not preferred. As no standardized method exists for uploading files via HTTP, TEMS Pocket offers a very flexible configuration of the upload in order to support a wide variety of user preferences.

Note: HTTP log file upload using a secure connection through SSL requires a separate SSL license option in TEMS Pocket. This option is under embargo restrictions and can only be sold to certain countries. Without the SSL license option, HTTP uploads will be unencrypted.

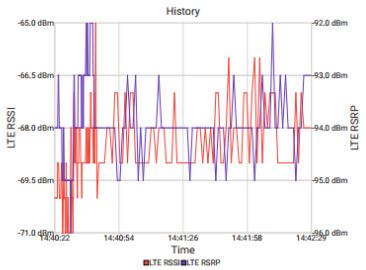
7 Instant reports

To create a quick overview over performed tests and measurements, TEMS Pocket can generate PDF reports in near real-time directly after a script has been executed.

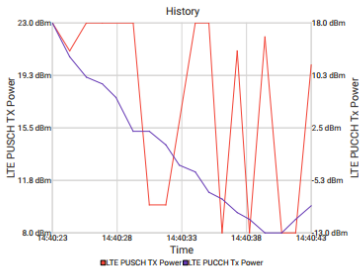
The Instant reports gives the tester an immediate summary of results. In turn, this allows the tester to determine if all necessary data has been collected, creating an opportunity to rerun tests, if required.

Generated reports can be displayed directly on the measuring device or transferred to and displayed on a computer.

Idle



UL



Examples of graphs in an Instant report.

8 Control Functions

Control functions in TEMS Pocket are used to modify the device's behavior in a cellular network. Control functions can be applied either manually or automatically during execution of a script.

8.1 List of Control Functions Supported

The following control functions exist in TEMS Pocket:

- RAT lock (5G NR/LTE/WCDMA/GSM; CDMA/EV-DO)
- Band lock (LTE/WCDMA/GSM)
- LTE EARFCN lock; EARFCN/PCI lock
- WCDMA cell lock (UARFCN, UARFCN + SC)
- WCDMA UARFCN lock; disable handover
- GSM cell lock/prevent (ARFCNs)
- GSM Single Cell lock
- Voice codec lock
- Cell barred lock
- Access class lock
- WCDMA fast dormancy control
- APN Change
- Radio Control (cellular and Wi-Fi interfaces on/off)
- Attach/Detach

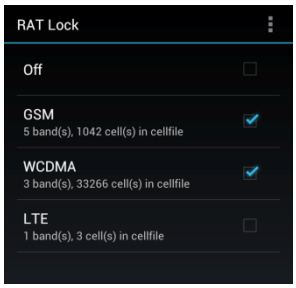
See the TEMS Pocket User Manual (Help) for precise information about which control functions are supported by each TEMS Pocket device.

8.2 User Interface Example: Cell Control

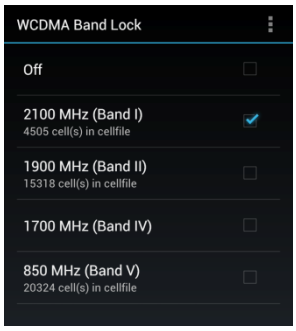
This section shows some of the dialogs for applying RAT, band, and cell locks.

8.2.1 RAT Lock

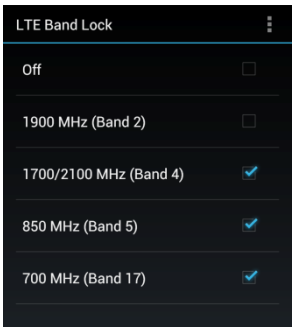
Multiple lock targets can be selected. If a cell file is loaded, the number of cells supported by the device is indicated for each band.



RAT lock

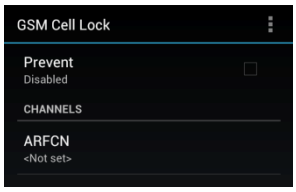


WCDMA band lock

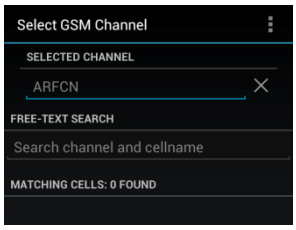


LTE band lock

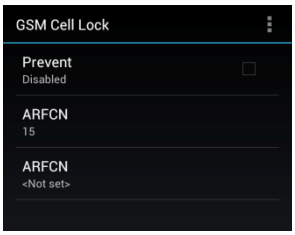
8.2.2 GSM Cell Lock



GSM cell lock: Lock/prevent flag



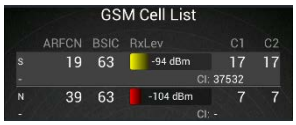
GSM cell lock: ARFCN selection. A loaded cell file can be searched for matching cells.



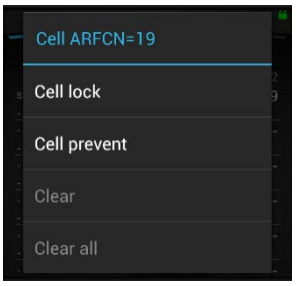
GSM cell lock: Further ARFCNs can be selected

The prevent option is basically an inverted lock, explicitly excluding a cell from being camped on. This is of great help when the set of cells you wish to lock on is large and the ones you wish to exclude are more easily enumerated.

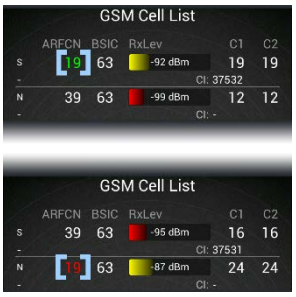
Cell locks can alternatively be applied from the *cell list data views* to any cells that appear there:



Cell tapped and held in the cell list



Context menu with cell control functions



Top: Device locked to cell (ARFCN) highlighted in green (19)
Bottom: Device prevented from camping on cell highlighted in red (19)

If a cell that you locked on has disappeared from the cell list data view, and you want to release the lock, you can always do this from the Control Functions menu.

Conversely, any actions that you perform from the Control Functions menu are immediately reflected by means of highlighting in the cell list data views.

WCDMA cell locks can be applied similarly.

8.3 Benefits of Control Functions

TEMS Pocket control functions allow the user to perform tests within minutes which would otherwise take hours or even days to perform. Running such **quick and non-intrusive** tests with TEMS Pocket does away with cumbersome altering of settings on the network side and eliminates the risk of affecting commercial users or introducing errors in the network configuration.

TEMS Pocket control functions are **real-time**, which means that they can be applied immediately any time the user wishes, either manually or automatically through scripting, perhaps interleaved with other testing or use of other TEMS Pocket features. In no circumstances is it necessary to reboot the device for a control function to take effect.

All of this greatly increases efficiency for TEMS Pocket users and saves time and money.

8.3.1 Example 1: RAT and Band Lock

The RAT and band lock functions enable reliable and cost-efficient testing of all technologies and frequency bands in multi-technology networks. One highly relevant application today is to test new LTE bands as they are introduced in networks to increase capacity.

Without non-intrusive control functions like these at their disposal, operators can accomplish this kind of testing only by laborious means, such as making temporary changes to network or cell site configurations. These procedures may disturb subscribers; they could also introduce errors in the network, and they certainly take considerable time. Below are a few examples of how TEMS Pocket allows a tester to perform these tasks much more simply and incomparably faster:

Task	Time Taken **By Traditional Methods**	**With TEMS Pocket**
Lock on band	~30 min (requires network reconfiguration)	~1 min
Bar charts	several days (requires multiple, pre-ordered SIMs with distinct PLMN settings)	~1 min

Network reconfiguration is not really an option in the RAT case, since shutting down commercial network components (even briefly) would have an intolerable impact on subscribers. For band lock, on the other hand, network reconfiguration is the only “traditional” method available.

With its ability to lock devices to RAT and band at a moment’s notice, TEMS Pocket saves engineers all of the hassle just described, thus also eliminating the risk of network changes being made incorrectly or remaining by accident after the testing is done.

The TEMS Pocket control functions differ from certain other solutions which might require the device to reboot whenever a control function is to be applied. Such behavior means several minutes of lost time for the user on each occasion: waiting for the device to reboot, starting the test application, and finally

resuming tests. Limitations of this kind also prevent scripting of control functions, so that they cannot execute unsupervised in the background.

8.3.2 Example 2: Vocoder Lock

Vocoder lock is another control function that is unique to TEMS. This function allows the TEMS Pocket user to select which **voice codecs the device should report as supported** to the network. The network will then pick a codec to use for CS voice encoding from this subset alone. Each codec provides a different trade-off between audio quality and robustness to channel errors.

Again, the alternative to this non-intrusive solution is to change the configuration in the mobile network. This procedure is both time-consuming and costly, and moreover it may give rise to errors in the network or in measurement results.

Voice codec selection in TEMS Pocket can be **controlled in real time** before setting up each voice call. The function is easily accessible manually and can be automated by means of scripts. It can be combined with other control functions such as RAT, band, cell or channel lock to form powerful test sequences suitable for multi-technology networks.

Voice codec control as supported by TEMS Pocket is **the only practical way** to test individual voice codecs.

8.3.3 Example 3: Cell Barred Lock

By barring a cell, the operator can prevent commercial users from camping on that cell. A TEMS Pocket device, however, has the ability to ignore the access restriction and use the cell anyway. Tests can then be conducted in a controlled environment without interruptions. This increases the reliability of tests and promotes user efficiency, as alternative methods can be costly and error prone. Furthermore, the testing can be done with minimum impact on paying subscribers.

The TEMS Pocket cell barred lock function has three possible settings:

- Normal: Only non-barred cells can be used by the device. This is how commercial devices normally behave.
- All: All cells can be used by the device.
- Only barred: Only barred cells can be used by the device. This setting is intended for “controlled environment” testing as described above.

9 Events

TEMS Pocket displays **events** to indicate a variety of occurrences that are worthy of note. A large number of events are predefined; you can also define **custom** events of your own.

Predefined events in TEMS Pocket subdivide into the following categories:

- Radio events
- Session events (also includes log file recording events)
- System events (related to device operation)
- Custom events

See Appendix B for a full list of predefined events.

9.1 Event Log

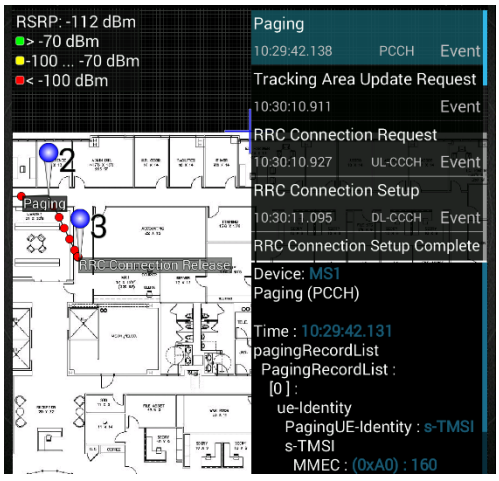
The main vehicle of presentation for events is the **Events data view**, where events are listed in chronological order with the most recent event on top. Tapping an event in this view expands it to also display event parameters. See section 12.10.1.

9.2 Presentation Options for Events

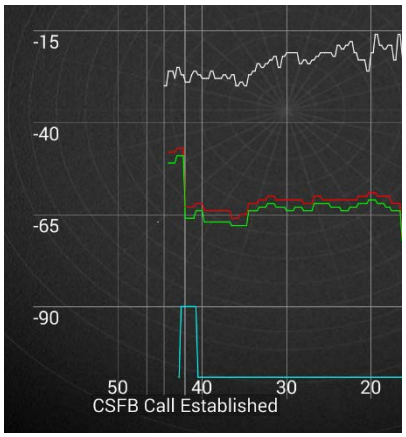
Besides being listed in the Events data view, events can be presented in a number of other ways. Each event type in TEMS Pocket can be announced by any combination of:

- Audio alerts, vibration alerts
- Popup messages (“toasts”), Android notifications (the latter can also be relayed to an Android smartwatch)
- Labels/markers in line charts and map views.

These presentation options are available for Layer 3 messages as well.



Events on indoor map. Details pane open for selected event; scrollable event list also shown

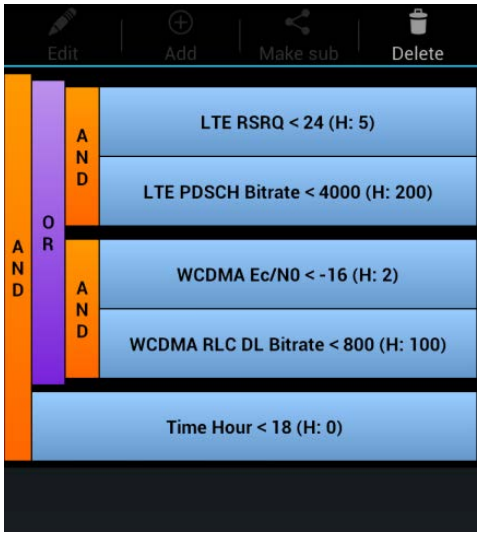


Events labelled in line chart

9.3 Custom Events

Besides the predefined events, it is also possible to create custom or user-defined events in TEMS Pocket. Custom events are based on TEMS Pocket value elements satisfying given conditions. Such conditions can be combined into complex Boolean expressions.

Each condition in a predefined event has a hysteresis parameter. The function of the hysteresis is to introduce a degree of inertia into the event generation, avoiding a profusion of generated events (“Ping-Pong” effect) in case of rapidly fluctuating measurement values.



Custom event consisting of Boolean expression. Stated informally, we want to trigger this event if the device is on either LTE or WCDMA, and the signal quality and the throughput are both “too low”; but only if this occurs before 6 p.m.

10 Some Further TEMS Pocket Functions of Special Interest

10.1 Audio Quality Measurement (AQM)

TEMS Pocket offers both **PESQ**, Perceptual Evaluation of Speech Quality, and **POLQA**, Perceptual Objective Listening Quality Analysis, as a methods of audio quality measurement that is up to the task of assessing today's complex and heterogeneous networks. POLQA, codified in ITU-T Rec. P.863, has been designed to address and eliminate a range of known weaknesses in the older PESQ algorithm.

TEMS Pocket provides a unique, best-in-class POLQA solution with two distinct advantages:

- The ability to control **device-specific audio-enhancing** functions such as noise suppression, audio stretch, comfort noise and gain control enables TEMS Pocket to measure true network quality, without characteristics of individual devices impacting the results. By making such settings uniform, MOS scores are made device-independent so as to convey a consistent and unbiased picture of the actual network quality.
- The user can prescribe which **voice codec** should be used by the phone. Normally, voice codec selection is mandated by the network and is beyond the user's control, unless changes are made to the network configuration. Such operations can be error-prone and might not even be feasible if the user is not in control of the network, as will often be the case when doing benchmarking.

POLQA as offered in TEMS Pocket has the following features.

- Measurements are conducted:
  - during **mobile-to-mobile** calls between two TEMS Pocket phones of the same model, or
  - during **mobile-to-fixed** calls between a TEMS Pocket phone and a CallGenerator.
- POLQA MOS scores for CS or VoLTE audio can be obtained at both ends in the mobile-to-mobile setup. In mobile-to-fixed AQM, the TEMS Pocket device calculates downlink POLQA scores, and the CallGenerator calculates uplink scores (if a Call Sequence action is run).
- Narrowband, wideband, and super-wideband voice codecs are supported.
- The use of POLQA is optional:
  - For mobile-to-mobile, each device calculating POLQA scores (can be both or only one) needs to have a POLQA license option.
  - For mobile-to-fixed, the TEMS Pocket device requires a POLQA license, and the CallGenerator needs to have a POLQA and CS voice license.

10.2 IP Packet Capture

With the movement towards OTT (over-the-top) services and migration of CS voice to packet-based VoIP, capturing application data is becoming increasingly important in order to understand subscriber experience.

Using TEMS solutions for packet capture, as opposed to using dedicated IP tracing applications, brings the major benefit of having the IP data **positioned** according to the user location, even in-building, and provided together with radio environment and radio bearer QoS data.

The user can choose to record IP data to an external file in .pcap format for easy IP-layer post-processing in Wireshark, and/or to a TEMS-internal format for comprehensive service KPI analysis (for example, SIP statistics) in TEMS post-processing solutions such as TEMS Discovery.

10.3 Mobile Network Scanning

TEMS Pocket has the ability to conduct scanning of mobile networks with a connected external PCTEL SeeGull IB*flex* or HB*flex* scanners. Details on supported technologies and scan methods are found in section 19.1.

Mobile network scanning can be either manual or scripted. In either case it is completely independent of other TEMS Pocket activities and never conflicts with any of these.

TEMS Pocket also support manual EPS scanning on PCTEL IBFlex scanners, for better detection of noise, interference problems, and intermittent signals. Scripted support will be added in a later release.

The output from scanning is presented in the data views shown in section 12.5.

10.4 Wi-Fi Scanning

Wi-Fi scanning can be controlled from within TEMS Pocket, either manually or by means of scripting. The effect of activating this scanning is exactly the same as when turning on Wi-Fi in the device's regular user interface. Scripted Wi-Fi scanning can be suspended during Wi-Fi data transfer so that the scanning does not detract from the performance of that service.

The output from Wi-Fi scanning is presented in the data views described in section 12.9.

Please note that a Wi-Fi access point with hidden SS ID will not show up during scanning, unless the device has been associated with that access point.

10.5 GPS Support

TEMS Pocket supports positioning either with the GPS device built into the device, or with an external GPS.

Recording position information in TEMS Pocket log files renders the files amenable to comprehensive analysis with mapping tools such as those found in TEMS Discovery and TEMS Investigation.

10.6 NB-IoT measurements

Users can now connect a supported Qualcomm based NB-IoT device to test and measure LTE NB-IoT networks with TEMS Pocket. Views in the Idle category are populated, and measurements are recorded to logfiles for further analysis in TEMS Investigation or TEMS Discovery.

From TEMS Pocket 22.0, the connected NB-IoT device can be controlled from a script to perform basic testing, and custom views can be created to view data from the NB-IoT device.

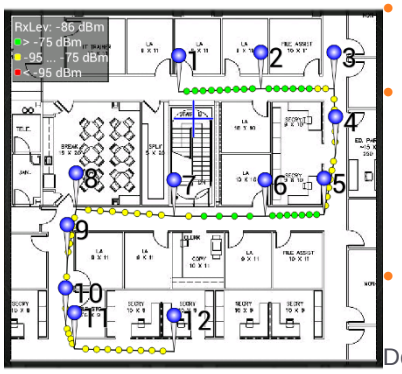
11 TEMS Pocket Map Views

11.1 Indoor Map: Pinpointing

The Indoor Map view enables import of background images and positioning of measurements in indoor locations and other places where GPS coverage is lacking. The positioning is done by pinpointing the test route in the Indoor Map view, thereby creating a log file archive (*.trp) containing the measurements (waypoints) and the map.

The procedure for using the Indoor Map function for pinpointing measurements is straightforward, and the general steps are described below:

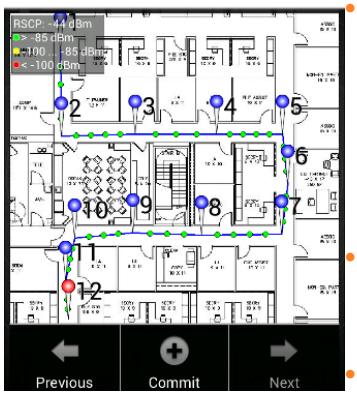
- **Obtain images:** First you need to obtain images of the environment that is going to be covered during measurement. For example, use the device's camera to photograph the emergency or evacuation plan for the relevant floor(s) of the building(s).
- **Add your images to a map set:** Select your floor plans or other background images that you want to use. The selected image files are added to a map set.
- **Specify TAB file:** You need to supply a MapInfo TAB file with the map set to enable geographical positioning of the map set.
- **Load indoor map set:** At the outset the Indoor Map view is empty. A grid is drawn in the view when no map set is loaded. Select the desired map set and load it into the Indoor Map view.
- **Pinpoint:** You can perform pinpointing in either of three ways:
  - **Manual pinpointing:**



    - Pan the map to position the crosshairs correctly.
    - Tap the Add pinpoint button to place a waypoint at the spot marked by the crosshairs. The waypoint is marked by a pin symbol and labeled with a sequence number.
    - Continue pinpointing at regular intervals along the route.

    Dot-shaped markers encoding a piece of RF data are plotted along the route. What data to plot is user-configurable.

- **Pinpointing with planned route:**



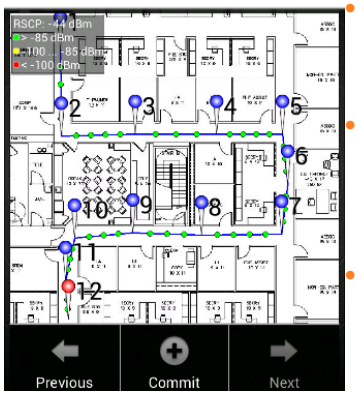
- First decide on a planned route to follow. You can either reuse an existing route stored with a map set (*.ibwc) or a TEMS Pocket log file (*.trp), or you can create a planned route from scratch using the TEMS Pocket route editor. This task is similar to manually pinpointing data as described above.
- Load your planned route, and go to the physical location marked by the first waypoint (highlighted in red).
- A panel with three buttons appears. Tap the Commit button to indicate that you are currently at the location of the first waypoint.
- Then tap Next to proceed to the next waypoint. When you have reached it, tap Commit again.
- Continue until you have finished the route. Tap the Previous button to move backwards along the route if needed.

This method allows quicker and easier navigation and pinpointing using only three buttons, eliminating the need to pan and zoom to insert waypoints. During final conversion to latitude and longitude, positions are interpolated over time. For this reason, you should maintain as steady a pace as possible when moving from one waypoint to the next.

The planned route feature can be used to create walk route instructions for teams in the field and also to ensure that the same route is used every time during recurring tests, such as before and after making changes to the network.

Your route will be recorded in a log file. Log file recording starts automatically when you start pinpointing and is ended when you stop pinpointing. After you stop pinpointing, a TEMS Pocket log file with extension .trp is created, and summary of the session appears on-screen.

- **Automatic Pinpointing:**



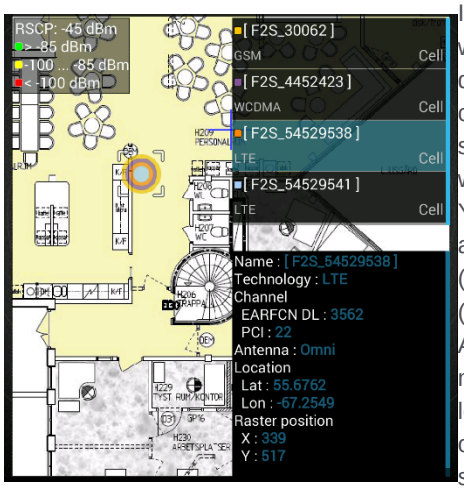
- First, manually mark two points on the map by panning the crosshair to your current location and add a pinpoint.
- Walk along the route where you want to perform the measurements with the device camera pointing towards the floor in about a 45-degree angle.
- The device will manually place pinpoints along the way.

Automatic pinpointing helps doing tests mirroring a normal walk while the user can move the focus from the device to the environment around. This makes the walk test more similar to a regluar walk than manual pinpointing.

Automatic pinpointing is available on all devices listed here, and require a separate license addition.

Regarding positioning of indoor map sets in TEMS Discovery, see Appendix D.

11.1.1 Presentation of iBwave Transmitter Files



If the iBwave map set contains transmitter files with data on indoor cell sites, TEMS Pocket will display these cells in the Indoor Map view. Each cell at a site is drawn in a unique color (in the screenshot, four omni cells as concentric circles), with cell names displayed in a legend (top right). You can tap a cell in the legend to show additional details on that cell in a pop-up panel (bottom right), including channel and cell identity (here, EARFCN and PCI for an LTE cell). An LTE cell with sufficient measured RSRP is marked as “healthy” by being colored green in the legend. A green checkmark also appears on top of the cell site. (This is not shown in the screenshot.)

11.2 Outdoor Map

The Outdoor Map view is intended for outdoor drive testing with access to GPS coverage. The view uses Google Maps or MapBox imagery (or Baidu on the Chinese market), and all of the following map types are available for display in TEMS Pocket: roadmap, satellite, terrain, and hybrid (satellite image with roadmap overlay).

Maps can be downloaded in advance and used **offline** when using MapBox as map provider.

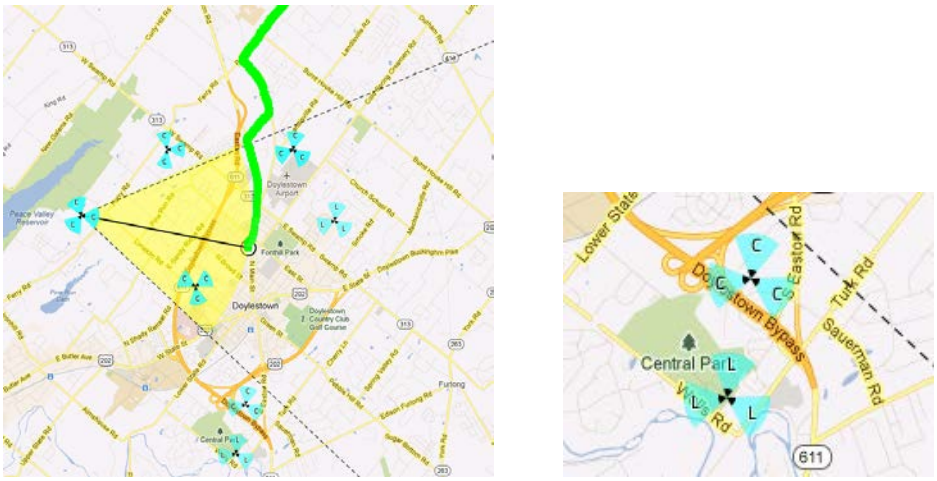
Routes can be plotted in live mode as well as in replay mode. The route marker color encodes a piece of RF data that is selected by the user.

When a cell file is loaded, **cell sites** can be displayed from that file. Each cell of a site is visualized as a cyan-colored sector extending from the site's position and covering an angle that corresponds to the cell beam width. When the TEMS Pocket device has an active network connection, a line is drawn from the device's current position to the serving cell or to each cell in the active set.

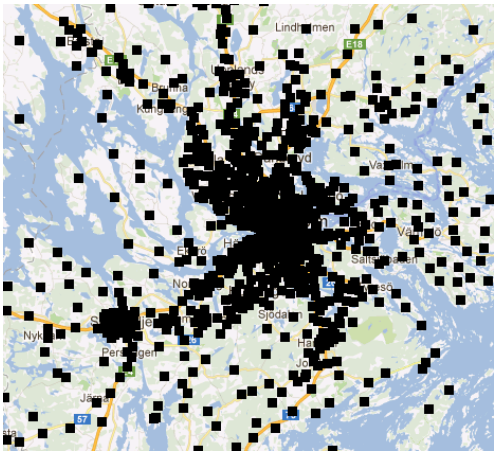
Map **layers** can be displayed selectively: Google Maps content, routes, cell sites for each RAT, and the serving cell tracker line.

Cached map content can be used, so that a continuous live connection to Google Maps is not required. It is possible to inhibit download of new map tiles during measurement to prevent such activity detracting from data throughput performance. Tiles already downloaded will continue to be displayed.

To allow for hands-off operation, the map can be set to automatically center on the user's position when traveling. If preferred, this behaviour can be switched to freestyle zooming and panning at the touch of a button.



Outdoor Map view. Left: Route (traced by green markers) with line pointing to serving cell whose beam width is highlighted in yellow. Right: Detail showing the two sites at the bottom of the left-hand map. The letter in each cell (sector) represents the RAT: C = CDMA, L = LTE.



When the Outdoor Map view is zoomed out far enough, cell site plotting is simplified to black squares that simply mark the site location. If you continue to zoom out, the plotting of cell sites is eventually disabled completely. This is done for reasons of readability and performance.

12 TEMS Pocket Data Views

TEMS Pocket has a very large number of data views for presentation of measurements. This chapter deals with all of these apart from the map views, which are the topic of chapter 11.

12.1 Data View List

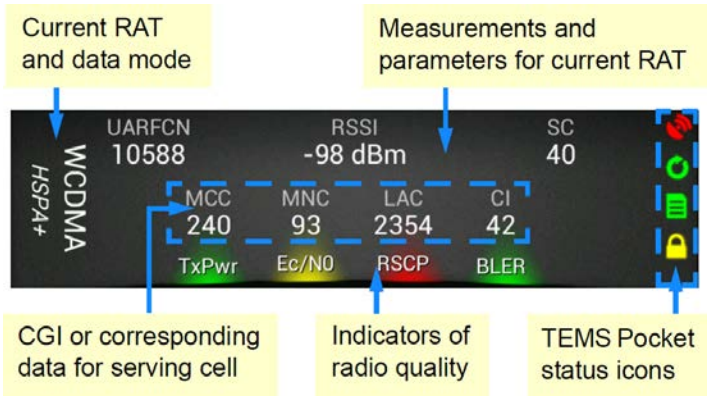
Data View Name	Displayed Contents
Idle Category	
GSM Cell List	ARFCN, BSIC, RxLev, C1, and C2 for GSM serving cell and neighbors
GSM Cell Line Chart	RxLev and RxQual for serving cell; RxLev for two strongest neighbors; device TxPower
WCDMA Cell List	UARFCN, scrambling code, E_c/N_0, and RSCP for WCDMA serving cell/active set and neighbors
WCDMA Cell Line Chart	UTRA Carrier RSSI; RSCP for serving cell; BLER; RSCP for two strongest neighbors; device TxPower
5G NR Cell List	Connectivity Mode, NR ARFCN, Band, PCI, Cell type and measurements for Serving Cell Beams (Index, RSRP, RSRQ and SINR)
5G NR Cell Line Chart	SsRsrp, SsRsrq and SsSinr in a Line Chart.
LTE Cell List	EARFCN, PCI, RSRP, and RSRQ for LTE serving cell and neighbors
LTE Cell Line Chart	E-UTRA Carrier RSSI; RSRP and CINR for serving cell; RSRP for two strongest neighbors; device PUSCH TxPower
LTE Cell Configuration	E-UTRA band, MME, and Physical Cell parameters for LTE serving cell; TDD parameters
CDMA Cell List	RF channel number, PN offset, E_c/I_0, and E_c for CDMA (1x) active, candidate, and neighbor sets
EV-DO Cell List	RF channel number, PN offset, E_c/I_0, and E_c for EV-DO active, candidate, and neighbor sets
Dedicated Category	
GSM Dedicated Mode	GSM dedicated mode radio parameters
GSM RACH Analysis	Parameters and data related to RACH signaling in GSM
GSM C/I List	List of GSM carrier to interface (C/I) ratio
WCDMA Dedicated Mode	WCDMA dedicated (connected) mode radio parameters
WCDMA RACH Analysis	Parameters and data related to RACH signaling in WCDMA
LTE Dedicated Mode	LTE dedicated mode radio parameters
LTE RACH Analysis	Parameters and data related to RACH signaling in LTE
LTE MIMO Measurements	LTE MIMO Measurements on antenna Rx1, Rx2, Rx3 and Rx4
eNB TX Antenna Difference	LTE eNB Tx1–Tx2 transmit power difference: per carrier in case of carrier aggregation
CDMA Perform	CDMA (1x) active mode radio parameters
EV-DO Perform	EV-DO active mode radio parameters
Scanning Category	
Scanning Status	Status of external scanner; progress of scripted scanning
NR scan views	NR scan data: one view for each scan type : RSSI and Signal Scan.
LTE scan views	LTE scan data: one view for each detected EARFCN, showing RSRP, RSSI, RSRQ, and CINR for found cells

WCDMA scan views	WCDMA scan data: one view for each detected UARFCN, showing RSCP, E_c/N_0, SIR, and delay spread for found cells
GSM scan views	GSM scan data: one view for each band where some ARFCN is detected, showing BSIC, RxLev, and C/I for each ARFCN
CDMA scan views	CDMA scan data: one view for each detected RF channel, showing E_c, E_c/I_0, aggr. E_c/I_0, and delay spread for found cells
EV-DO scan views	EV-DO scan data: one view for each detected RF channel, showing E_c, E_c/I_0, aggr. E_c/I_0, and delay spread for found cells
Data Category	
GPRS/EDGE Data	Parameters and data related to GPRS/EDGE
GPRS/EDGE RLC Thr'put	RLC/MAC throughput charts for GPRS/EDGE
HSPA Data	Parameters and data related to HSPA
HSPA RLC Throughput	RLC throughput charts for HSPA
HSDPA Modulation/ Packet Data Performance	HSDPA modulation scheme usage; MAC-HS uplink/downlink throughput; downlink TB size; downlink BLER
LTE Data	Parameters and data related to LTE data transfer
LTE PHY Throughput	Physical layer throughput charts for LTE
PDP Context Information	Information on current PDP contexts
eMBMS Information	eMBMS configuration and performance
RLP Throughput	RLP throughput charts for EV-DO
Test Status Category	
Script Progress	General progress of a script that is being executed
ABM Progress	Progress of scripted ABM testing
AQM Progress	Progress of scripted AQM testing
Call Sequence Progress	Progress of scripted voice call sequence
Email Progress	Progress of scripted email testing
Facebook Progress	Progress of scripted Facebook testing
FTP Progress	Progress of scripted FTP download/upload
HTTP DL Progress	Progress of scripted HTTP Get
HTTP UL Progress	Progress of scripted HTTP Post
Instagram Progress	Progress of scripted Instagram
Iperf Progress	Progress of scripted Iperf bandwidth testing
Logfile Upload Progress	Progress of scripted logfile upload
Ping Progress	Progress of scripted Ping testing
Scan Progress	Progress of scripted scanning
SMS Progress	Progress of scripted SMS testing
Synch Point Progress	Progress of scripted Synch Point synchronization
Twitter Progress	Progress of scripted Twitter testing
Voice Progress	Progress of scripted voice testing
Whatsapp Progress	Progress of scripted Whatsapp testing
YouTube Progress	Progress of scripted YouTube testing
Location Category	
Indoor Map	Indoor Map view
Outdoor Map	Outdoor Map view
GPS	GPS positioning data
Wi-Fi Category	
Wi-Fi	Wi-Fi states; signal strength/bandwidth of Wi-Fi networks detected
Wi-Fi Cell List	Strongest Wi-Fi access points detected
Custom Category	
(Five views, initially empty)	User-customized data views
Messages Category	

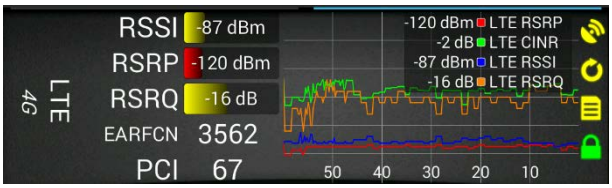
Events	Listing of events generated in TEMS Pocket
Layer 3 Messages	Listing of transmitted and received Layer 3 messages
SIP Messages	Listing of transmitted and received SIP messages
Statistics Category	
Service Session	Statistics on the outcome of service sessions
RAT Usage	Statistics on device RAT usage
Cell Usage	Statistics on device cell usage for each RAT
AQM Usage	Statistics on audio quality measurement by cell

12.2 Data View Header

In the topmost part of the data view is always shown a set of general data related to the cellular technology currently in use, as well as a column of icons reflecting the current status of TEMS Pocket.



TEMS Pocket also lets you configure a custom data view header for each technology alongside the default one. Sample custom headers are provided with the application, such as this one for LTE:



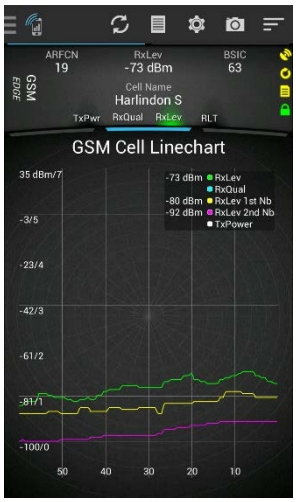
12.3 “Idle” Data View Category

12.3.1 GSM Cell List Data View

This data view displays the serving (**S**) cell and up to seven neighbor (**N**) cells in order of descending signal strength. The content includes:

- **ARFCN:** Absolute Radio Frequency Channel Number.
- BSIC: Base Station Identity Code.
- RxLev: Received Signal Level.
- C1: Pathloss Criterion C1.
- C2: Cell Reselection Criterion C2.

12.3.2 GSM Cell Line Chart Data View

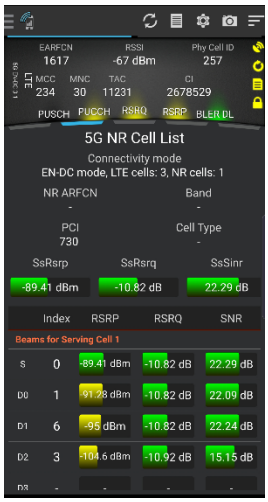


In this line chart, spanning the past 1, 2, 3 or 5 minutes (according to global settings) worth of measurements, are plotted:

- **RxLev:** Received Signal Level of serving cell in dBm.
- **RxQual:** Receive Bit Error Rate, RxQual, of serving cell.
- **RxLev 1st Nb:** RxLev of strongest neighbour (dBm).
- **RxLev 2nd Nb:** RxLev of second strongest neighbour (dBm).
- **TxPower:** UE Transmit Power (dBm).

The y-axis has both dBm and RxQual unit scale marks.

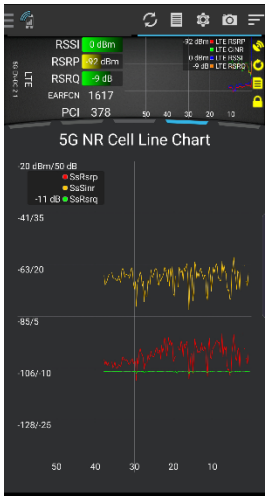
12.3.3 5G NR Cell List Data View



This data view displays information about the Serving 5G Cell and its beams:

- **Connectivity mode:** Information about the connected network mode and number of cells per technology.
- **NR-ARFCN:** New Radio Absolute Radio Frequency Channel Number.
- **Band:** 5G NR Band.
- **PCI:** Physical layer Cell Identity.
- **Cell Type:** Serving Cell Type consists of two parts, Serving Cell Group and Serving Cell Index. In non-standalone mode, an NR cell will always be in a secondary cell group (SCG), while the LTE cell is in a master cell group (MCG).
  - MCG1-1: Master Cell Group ID1 Cell ID1.
  - SCG1-16: Secondary Cell Group ID1 Cell ID16.
- **Index:** Beam Index.
- **RSRP:** Reference Signal Received Power (dBm).
- **RSRQ:** Reference Signal Received Quality (dB).
- **SINR: S**INR of primary serving cell (dB).

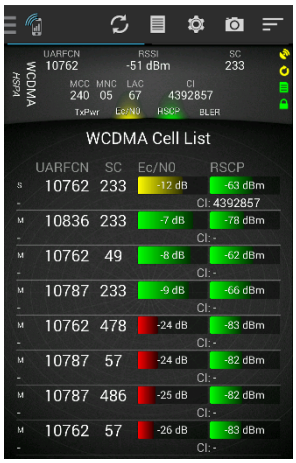
12.3.4 5G NR Cell Line Chart View



This data view displays a line chart displaying the following:

- **SsRsrp:** Synchronization Signal Reference Signal Received Power.
- **SsRsrq:** Synchronization Signal Reference Signal Received Quality.
- **SsSinr:** Synchronization Signal Signal to Interference plus Noise Ratio.

12.3.5 WCDMA Cell List Data View



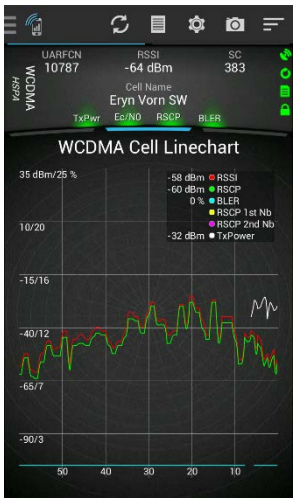
This data view displays up to eight cells, each belonging to one of the following categories:

- **S:** Serving cell (idle mode).
- **A:** Active set member (connected mode). In case of dual carrier HSPA, cells from both primary and secondary carriers appear here with equal priority.
- **M:** Monitored neighbor.
- **D:** Detected neighbor.

The categories are prioritized as listed above, cells from lower-ranking categories being displayed as far as space allows. Within each category, cells are sorted by descending E_c/N_0.

- **UARFCN:** UMTS Absolute Radio Frequency Channel Number.
- **SC:** Scrambling Code.
- **Ec/N0:** E_c/N_0 (dB).
- **RSCP:** Received Signal Code Power (dBm).

12.3.6 WCDMA Cell Line Chart Data View

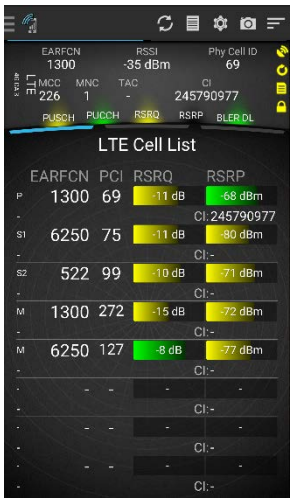


In this line chart, spanning the past 1, 2, 3 or 5 minutes (according to global settings) worth of measurements, are plotted:

- **RSSI:** Received Signal Strength, equal to UTRA Carrier RSSI.
- **RSCP:** Received Signal Code Power (dBm) of serving cell.
- **BLER:** Block Error Rate in percent, average taken over all downlink transport channels (DCH only).
- **RSCP 1st Nb:** RSCP of strongest neighbor (dBm).
- **RSCP 2nd Nb:** RSCP of second strongest neighbor (dBm).
- **TxPower:** UE Transmit Power (dBm).

The y-axis has both dBm and percent scale marks.

12.3.7 LTE Cell List Data View



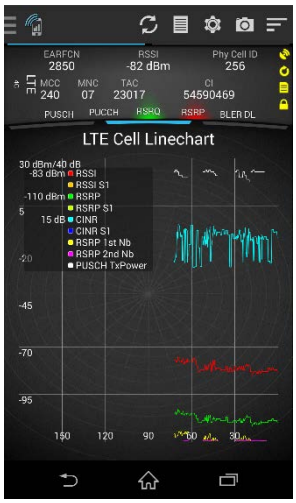
This data view displays up to eight cells, each belonging to one of the following categories:

- **S:** Serving cell (non-CA)
- **P:** Primary serving cell (CA)
- **S1-S2:** Secondary serving cells (CA)
- **M:** Measured neighbor (always used).

The categories are prioritized as listed above, cells from lower-ranking categories being displayed as far as space allows. Within each category, cells are sorted by descending RSRP.

- **EARFCN:** E-UTRA ARFCN (Absolute Radio Frequency Channel Number).
- **PCI:** Physical layer Cell Identity.
- **RSRQ:** Reference Signal Received Quality (dB).
- **RSRP:** Reference Signal Received Power (dBm).

12.3.8 LTE Cell Line Chart Data View

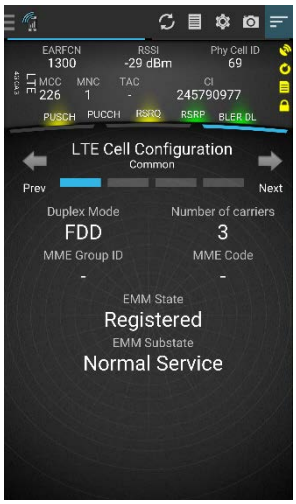


In this line chart, spanning the past 1, 2, 3 or 5 minutes (according to global setting) worth of measurements, are plotted:

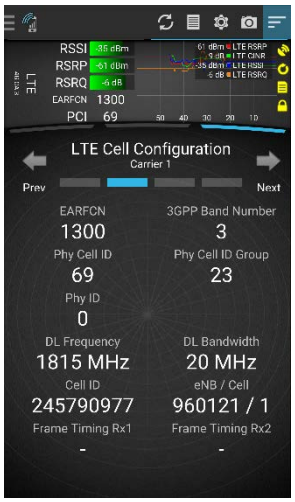
- **RSSI:** E-UTRA Carrier RSSI (Received Signal Strength Indicator) (dBm) for primary carrier.
- **RSSI S1:** E-UTRA Carrier RSSI (dBm) for secondary carrier when using Carrier Aggregation.
- **RSRP:** RSRP of primary serving cell (dBm).
- **RSRP S1:** RSRP of secondary serving cell when using Carrier Aggregation (dBm).
- **CINR:** CINR of primary serving cell (dB).
- **CINR S1:** CINR of secondary serving cell when using Carrier Aggregation (dBm).
- **RSRP 1st Nb:** RSRP of strongest neighbor (dBm).
- **RSRP 2nd Nb:** RSRP of second strongest neighbor (dBm).
- **PUSCH TxPower:** Transmit power on PUSCH.

The y-axis is labeled with both dB and dBm scale marks.
In case of carrier aggregation, RSSI, RSRP, and CINR are shown for both primary serving cell (no suffix in legend) and first secondary serving cell (suffix “S1” in legend). If you like to show info from other cells, use the Custom Data View option.

12.3.9 LTE Cell Configuration Data View



Common sub view



Carrier-specific sub view

Carrier-specific sub view: TD-LTE parameters (added at bottom)

This view deals with LTE serving cells. The data is organized into multiple sub views, where the first contains data common to all carriers, and the others (up to three) present carrier-specific data. The **Prev** and **Next** buttons are used to browse the sub views.

Common Sub view

- **Duplex Mode:** FDD or TDD.
- **Number of Carriers:** Number of LTE carriers in use (more than one in case of carrier aggregation).
- **MME Group ID:** Mobility Management Entity Group ID.
- **MME Code:** Mobility Management Entity Code.
- **EMM State, EMM Substate:** EPS Mobility Management state and substate.

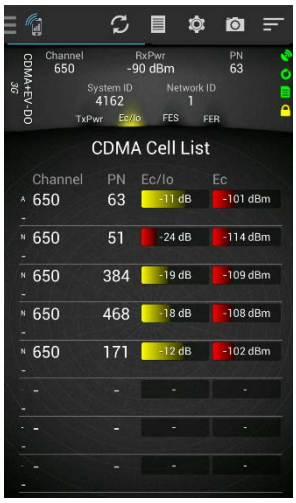
Carrier-specific Sub views

- **EARFCN:** EARFCN of carrier.
- **3GPP Band Number:** Number of E-UTRA band.
- **Phy Cell ID:** Physical layer Cell Identity, PCI = 3 × PCIG + PI.
- **Phy Cell ID Group:** Physical layer Cell Identity Group, PCIG.
- **Phy ID:** Physical layer Identity, PI.
- **DL Frequency:** Downlink frequency used in serving cell.
- **DL Bandwidth:** Downlink bandwidth of serving cell in MHz.
- **Cell ID:** ECI, E-UTRAN Cell Identifier.
- **eNB / Cell:** eNodeB and cell parts of ECI.
- **Frame Timing Rx1, Rx2:** Cell frame timing of serving cell as received on antennas Rx1 and Rx2 respectively.

TD-LTE specific parameters

- **TDD UL/DL Conf:** TDD uplink–downlink configuration.
- **TDD ACK/NACK Mode:** ACK/NACK feedback mode for TDD.
- **TDD Special Subfr. Conf:** TDD special subframe configuration.

12.3.10 CDMA Cell List Data View



This data view displays up to eight cells, each belonging to one of the following categories:

- **A:** Active set.
- **C:** Candidate set.
- **N:** Neighbor set.

The categories are prioritized as listed above, cells from lower-ranking categories being displayed as far as space allows. Within each category, cells are sorted by descending E_c/I_0.

- **Channel:** RF channel number.
- **PN:** PN offset.
- **Ec/Io:** E_c/I_0 (dB), signal-to-noise ratio.
- **Ec:** Received signal code power (dBm).

12.3.11 EV-DO Cell List Data View

A separate EV-DO Cell List data view is provided for EV-DO operation. This view has the same contents as the CDMA Cell List data view.

12.4 "Dedicated" Data View Category

12.4.1 GSM Dedicated Mode Data View

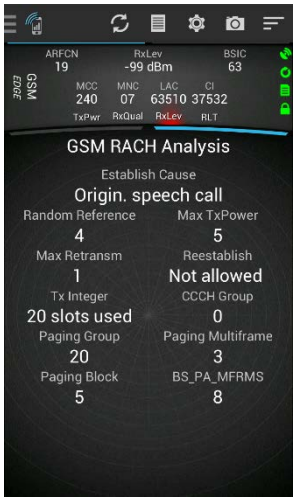
This data view displays GSM dedicated mode radio parameters for the current cell. In this view, the user can note the cell information sent by the network and observe how movements and used services affect the values presented. The data view contents include:

- **Channel Mode[3]:** FR, EFR, HR, AFR, AHR, CSD (circuit-switched data), and SIG (signaling only).
- **TCH ARFCN[7]:** Traffic Channel (TCH) or Stand-alone Dedicated Control Channel (SDCCH) or Packet Dedicated Traffic Channel (PDTCH).
- **RLT Ratio[7]:** Radio Link Timeout, current value divided by maximum (= start) value.
- **RxQual[7]:** Receive Bit Error Rate, RxQual; the scale is defined in 3GPP 45.008, section 8.2.
- **Timeslots[7]:** Number of timeslots in use.
- **Timing Adv[4]:** Timing Advance.
- **TxPower:** UE Transmit Power (dBm).
- **Channel Type:** One of BCCH, PBCCH, PDTCH, SDCCH, TCH/F or TCH/H.

[3] Only available on Qualcomm based devices.
[4] Only available on Qualcomm based devices.

- **Subchannel**[7]**:** Subchannel Number.
- **Ciphering**[7]**:** Ciphering Mode, one of {A5/1, A5/2, A5/3, GEA/1, GEA/2}.
- **Hopping**[7]**:** Use of frequency hopping.
- **HSN**[7]**:** Hopping Sequence Number.
- **MAIO**[7]**:** Mobile Allocation Index Offset.
- **Speech codec**[7]**:** Voice codec and codec rate.

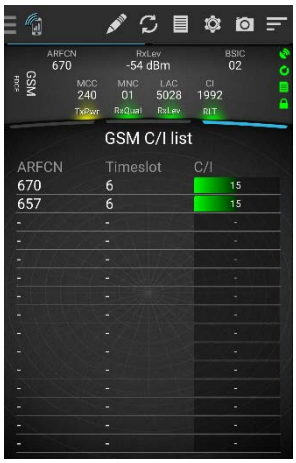
12.4.2 GSM RACH Analysis Data View



This view displays parameters and data related to RACH signaling and paging in GSM. The content includes:

- **Establish Cause**[7]**:** Establishment of cause in Channel Request message.
- **Random Reference**[7]**:** Random Reference in Channel Request message.
- **Max TxPower:** The maximum TX power level an MS may use when accessing on a Control Channel (CCH).
- **Max Retransm:** Maximum number of retransmissions.
- **Reestablish:** Call reestablishment allowed/not allowed in the cell.
- **Tx Integer:** Number of slots used to spread the transmission.
- **CCCH Group**[7] **/ PCCCH Group**[7]**:** The former of these appears for CS and the latter for PS data.
- **Paging Group**[7]**:** The mobile device's paging group.
- **Paging Multiframe**[7]**:** Paging multiframe.
- **Paging Blk Idx**[7]**:** Paging block index.
- **BS_PA_MFRMS**[7]**:** Number of 51-multiframes between transmission of paging messages to mobile devices of the same paging group.

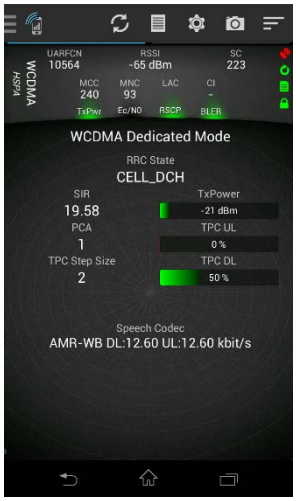
12.4.3 GSM C/I List



This view displays the GSM carrier to interface (C/I) ratio. The content includes:

- **ARFCN:** Shows the absolute radio-frequency channel number of the GSM carrier.
- Timeslot: Specifies which timeslot used (0-7).
- C/I: GSM Carrier to Interface ratio.
-

12.4.4 WCDMA Dedicated Mode Data View

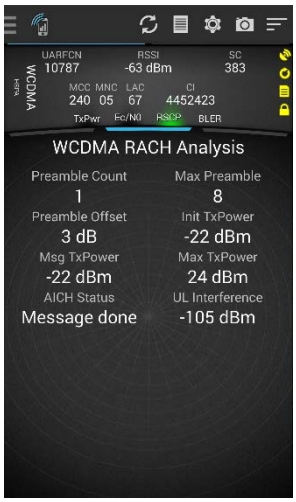


This data view displays WCDMA dedicated mode radio parameters for the current cell. In this view, the user can observe how changes in the radio environment affect certain parameters. The content includes:

- **RRC State:** One of {CELL_DCH, CELL_FACH, CELL_PCH, URA_PCH, Idle}.
- **SIR:** Signal-to-Interference Ratio (dB).
- **TxPower:** UE Transmit Power (dBm).
- **PCA[5]:** Power Control Algorithm, see 3GPP 25.331.
- **TPC UL[11]:** Transmit Power Control on uplink over the last 0.5 seconds: percentage of power control commands that were “increase” commands.
- **TPC Step Size[11]:** Transmit Power Control Step Size (dB).
- **TPC DL[11]:** Transmit Power Control on downlink over the last 0.5 seconds: percentage of power control commands that were “increase” commands.
- **Speech codec[11]:** Voice codec and codec rate.

[5] Only available on Qualcomm based devices.

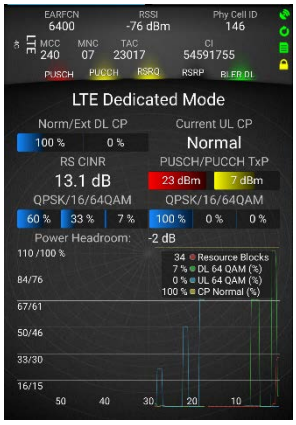
12.4.5 WCDMA RACH Analysis Data View[6]



This view displays parameters and data related to RACH signaling in WCDMA. The content includes:

- **Preamble Count:** Number of preambles used in this preamble ramping cycle.
- **Max Preamble:** Preamble Retrans Max, maximum number of preambles in one preamble ramping cycle.
- **Preamble Offset:** Power Ramp Step, power increase between consecutive preambles (dB).
- **Init Tx Power:** Preamble_Initial_Power, transmit power of first RACH preamble (dBm).
- **Msg Tx Power:** Transmit power of RACH preamble to which a response was obtained (dBm).
- **Max Tx Power:** Maximum allowed transmit power of RACH preamble (dBm).
- **AICH Status:** Acknowledgement of RACH preamble sent on Acquisition Indicator Channel (AICH). One of; {No ACK, Positive ACK, Negative ACK}.
- **UL Interference:** The UL interference parameter used to calculate Preamble_Initial_Power.

12.4.6 LTE Dedicated Mode Data View



This data view displays LTE dedicated mode radio parameters for the current cell. In this view, the user can observe how changes in the radio environment affect certain parameters. The content includes:

Left-hand column (downlink)

- **Norm/Ext DL CP:** Percentage distribution of downlink cyclic prefix usage: Normal (left) vs. Extended (right).
- **RS CINR:** Reference Signal CINR.
- **QPSK/16/64QAM:** Percentage distribution of downlink modulation scheme usage: QPSK vs. 16-QAM vs. 64-QAM.

Right-hand column (uplink)

- **Current UL CP:** Type of cyclic prefix currently used on uplink: Normal or Extended.
- **PUSCH/PUCCH TxP:** PUSCH/PUCCH Tx Power.
- **QPSK/16/64QAM:** Percentage distribution of uplink modulation scheme usage (cf. downlink above).

Graph

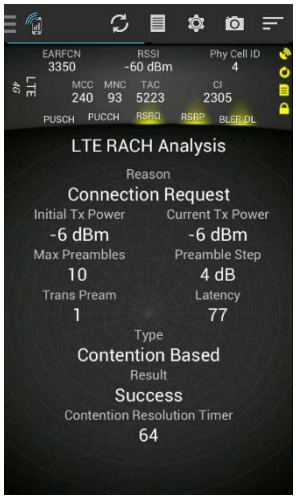
This is a line chart tracking the following quantities over the past 1, 2, 3 or 5 minutes (according to global settings):

- **Resource Blocks:** PDSCH resource block allocation.
- **DL 64 QAM, UL 64 QAM:** 64-QAM usage rate (in %) on downlink and uplink.

[6] Only available on Qualcomm based devices.

- **CP Normal:** “Normal” cyclic prefix usage rate (in %) on downlink.
- **Power Headroom:** Power headroom indicates how much transmission power left for a UE to use in addition to the power being used by current transmission. It can be described by this formula: **Power Headroom = UE Max Transmission Power - PUSCH Power = Pmax - P_pusch**

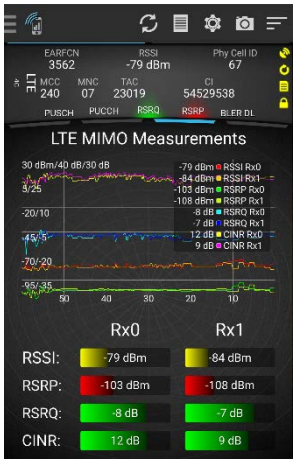
12.4.7 LTE RACH Analysis Data View



The view displays parameters and data related to RACH signaling in LTE.

- **Reason:** Reason for RACH signaling. This is indicated for each RACH attempt.
- **Initial Tx Power:** Transmit power of first RACH preamble (dBm).
- **Current Tx Power:** Transmit power of current RACH preamble (dBm).
- **Max Preambles:** Maximum number of preambles in one preamble ramping cycle.
- **Preamble Step:** Power ramping step size, power increase between consecutive preambles (dB).
- **Trans Preambles:** Number of transmitted preambles in current RACH procedure.
- **Latency:** Time between Random Access Request and last successful Random Access Response.
- **Type:** RACH procedure type: “Contention Free” or “Contention Based”.
- **Result:** RACH procedure result.
- **Contention Resolution Timer:** MAC contention resolution timer expressed as a number of subframes.

12.4.8 LTE MIMO Measurements Data View



This view presents the difference for RSSI, RSRP , RSRQ and CINR between the receiver antennas Rx0 and Rx1.

Line chart:

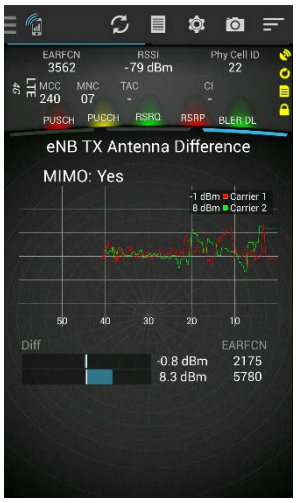
One curve is plotted for each RSSI, RSRP, RSRQ and CINR for each receiver antenna.

The line chart shows Rx0 and Rx1 differences over the last 1, 2, 3 or 5 minutes (according to global settings).

Bars:

The elements in the first column shows the values of RSSI, RSRP, RSRQ and CINR collected on the receiver antenna Rx0. The second column contains the corresponding values for the receiver antenna Rx1.

12.4.9 eNB TX Antenna Difference Data View[7]



The view shows the difference in cell-specific reference signal (RS) power between the eNodeB's Tx1 and Tx2 antennas (average taken over Rx1 and Rx2 receiver antennas). Each presented value is further averaged over 20 samples in the time domain. Given for each carrier separately in case of carrier aggregation.

Graph

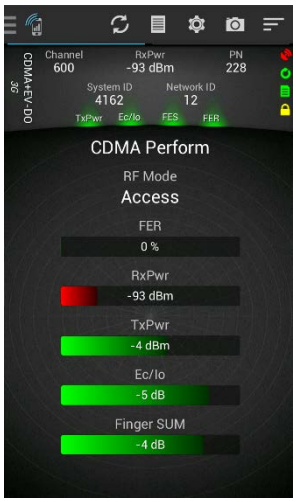
Above the graph, a text string indicates whether MIMO is being used (Yes/No). One curve is plotted for each carrier. The line chart shows the Tx1–Tx2 difference over the last 1, 2, 3 or 5 minutes (according to global settings).

Bottom part

Row 1: Carrier 1; Row 2: Carrier 2; etc.

- **Diff:** Tx1–Tx2 RS power difference, displayed as a bar and as a numeric value. Equal to rightmost value in line chart.
- **EARFCN:** EARFCN of carrier.

12.4.10 "CDMA Perform" and "EV-DO Perform" Data Views

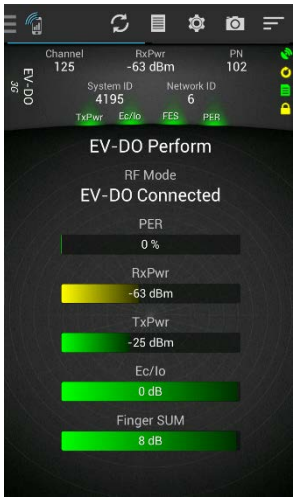


CDMA Perform

These views display CDMA (1x) and EV-DO active mode radio parameters.

- **RF Mode:** Currently used technology and current device/AT state, for example, "CDMA Access" or "1xEV-DO Connected".
- **FER:** Frame Erasure Rate (%); CDMA (1x) specific.
- **PER:** Packet Error Rate (%); EV-DO specific.
- **RxPwr:** Receive Power (dBm).
- **TxPwr:** Transmit Power (dBm).
- **Ec/Io:** Signal-to-noise ratio for strongest active set member (= topmost PN in CDMA Cell List data view, section 12.3.8; unit dB).
- **Finger SUM:** Finger Sum, total signal-to-noise ratio (E_c/I_0) for all Rake fingers (dB).

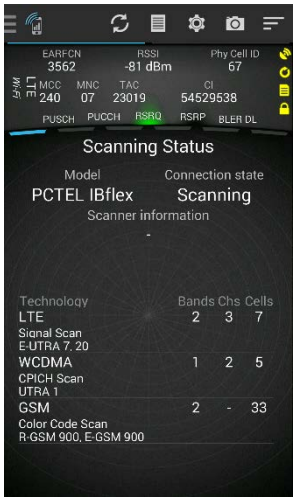
[7] Only available on Qualcomm based devices.



EV-DO Perform

12.5 “Scanning” Data View Category

12.5.1 Scanning Status Data View



This is a combined status and progress view for scanning with an external scanner.

Top part

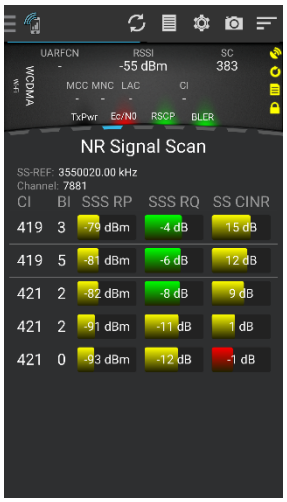
- **Model:** Scanner model.
- **Connection state:** One of: “Off”, “Connecting”, “Connected”, “Scanning”, “Disconnecting”, “Disconnected”.
- **Scanner information:** This field shows messages from the scanner.

Bottom part

For each technology on which at least one scan is in progress, the following is indicated:

- **Technology:** Cellular technology, type(s) of scan being performed, and scanned bands.
- **Bands:** Number of scanned bands where at least one channel is currently detected.
- **Chs:** Total number of channels currently detected. Not used for GSM, where only **Cells** are needed.
- **Cells:** Total number of cells currently detected.

12.5.2 NR Signal Scan Data View



NR Cell ID and Beam Index of the 8 strongest beams per SS Burst are shown in this view. For each Beam SSS RP, SSS RQ and CINR are shown.
Cells are sorted by decreasing SSS RP, starting with the first NR Cell and all its beams (even if some beam(s) have a lower SSS RP then another cell). The cell list is scrollable and can hold up to 30 cells.

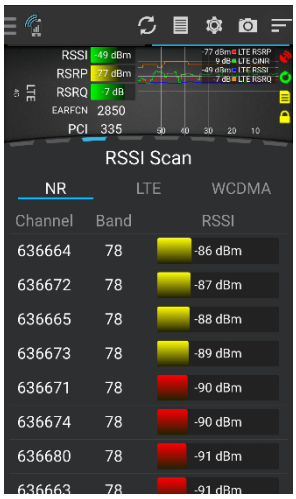
- CI: NR Cell Identity.
- BI: Beam Index.
- SSS RP: Secondary Synchronization Signal Received Power (dBm).
- SSS RQ: Secondary Synchronization Signal Received Quality (dB).
- CINR: Reference Signal Carrier to Interference-plus-Noise Ratio (dB).

12.5.3 LTE Signal Scan Data Views

One view appears for each detected EARFCN, up to a maximum of 12. If more than 12 EARFCNs are detected, only 12 will appear in the presentation.
Top part (immediately beneath header)
Shows the EARFCN, the E-UTRA band to which it belongs, and the E-UTRA Carrier RSSI. Below this data is a string of position indicators, where the highlighted indicator shows the position of the current view in the sequence of LTE scan data views. To the right of these indicators is displayed the number of EARFCNs currently detected.
Main body of view
Cells are sorted by decreasing RSRP. The cell list is scrollable and can hold up to 30 cells.

- **PCI:** Physical layer Cell Identity. PCI = 3 × PCIG + PI.
- **RSRP:** Reference Signal Received Power (dBm).
- **RSSI:** E-UTRA Carrier RSSI (Received Signal Strength Indicator) in dBm.
- **RSRQ:** Reference Signal Received Quality (dB).
- **CINR:** Reference Signal Carrier to Interference-plus-Noise Ratio (dB).
- **Bandwidth:** Detected bandwidth of this EARFCN.
- **Tx Ports:** Number of Tx signals detected.

12.5.4 RSSI Scan Data Views



The RSSI Scan Data View can display information received during RSSI scans on different technologies: NR, LTE or WCDMA. The technology used for the current RSSI scan is marked by underlining the technology with a blue line.
Main body of view
Cells are sorted by decreasing RSSI. The cell list is scrollable and can hold up to 30 cells.

NR tab:

- Channel: Scanned NR-ARFCN.
- Band: NR Band.
- RSSI: Received Signal Strength Indicator in dBm.

LTE tab:

- Channel: Scanned EARFCN (E-UTRA Absolute Radio Frequency Number).
- Band: E-UTRA Band.
- RSSI: E-UTRA Carrier RSSI (Received Signal Strength Indicator) in dBm.

WCDMA tab:

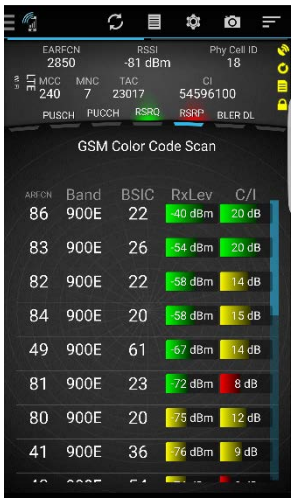
- Channel: Scanned UARFCN (UTRA Absolute Radio Frequency Number).
- Band: UTRA Band.
- RSSI: RSSI (Received Signal Strength Indicator) in dBm.

12.5.5 WCDMA CPICH Scan Data Views

One view appears for each detected UARFCN, up to a maximum of 12. If more than 12 UARFCNs are detected, only 12 will appear in the presentation.
Top part (immediately beneath header)
Shows the UARFCN, the UTRA band to which it belongs, and the UTRA Carrier RSSI. Below this data is a string of position indicators, where the highlighted indicator shows the position of the current view in the sequence of WCDMA scan data views. To the right of these indicators is displayed the number of UARFCNs currently detected.
Main body of view
Cells are sorted by decreasing RSCP. The cell list is scrollable and can hold up to 30 cells.

- **SC:** Scrambling Code.
- **RSCP:** Received Signal Code Power (dBm).
- **Ec/N0:** E_c/N_0 (dB), signal-to-noise ratio.
- **SIR:** Signal-to-Interference Ratio (dB).
- **Spread:** Delay spread, time in µs between the first and last E_c/N_0 peaks that are above the PN threshold. This is a measure of the signal spreading due to multipath propagation.
- **CFO:** Center Frequency Offset (Hz).
- **Rake fingers:** Number of decoded Rake fingers.

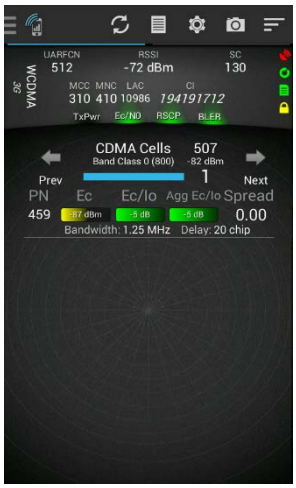
12.5.6 GSM Color Code Scan Data Views



The view displays scanned GSM band where at least one ARFCN has been detected.
Cells are sorted by decreasing RxLev. The cell list is scrollable and can hold up to 50 cells.

- **ARFCN:** Absolute Radio Frequency Channel Number.
- **Band:** GSM band.
- **BSIC:** Base Station Identity Code.
- **RxLev:** Received Signal Level (dBm).
- **C/I:** Carrier-to-interference ratio (dB).

12.5.7 CDMA PN Scan Data Views



One view appears for each detected RF channel, up to a maximum of 12. If more than 12 RF channels are detected, only 12 will appear in the presentation.
Top part (immediately beneath header)
Shows the RF channel, the CDMA band to which it belongs, and the RF channel I_0. Below this data is a string of position indicators, where the highlighted indicator shows the position of the current view in the sequence of CDMA scan data views. To the right of these indicators is displayed the number of RF channels currently detected.
Main body of view
Cells are sorted by decreasing E_c. The cell list is scrollable and can hold up to 30 cells.

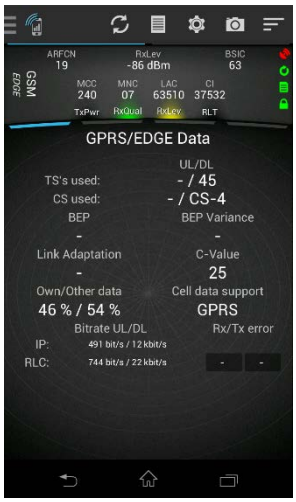
- **PN:** PN offset.
- **Ec:** Received Signal Code Power (dBm).
- **Ec/Io:** Peak E_c/I_0 (dB), signal-to-noise ratio.
- **Agg Ec/Io:** Aggregate E_c/I_0 (dB).
- **Spread:** Delay spread, time in chips between the first and last E_c/I_0 peaks that are above the PN threshold. This is a measure of the signal spreading due to multipath propagation.
- **Bandwidth:** Detected bandwidth of this RF channel.
- **Delay:** Pilot delay in chips.

12.5.8 EV-DO PN Scan Data Views

These contain the same data as the CDMA PN scan data views but for EV-DO.

12.6 “Data” Data View Category

12.6.1 “GPRS/EDGE Data” Data View

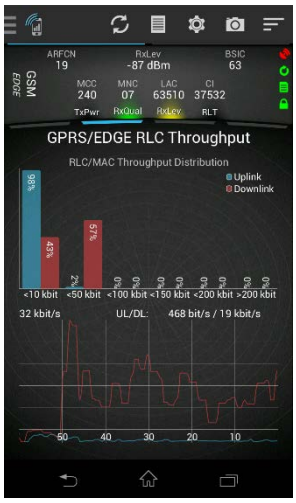


This view displays performance metrics and statistics for GPRS/EGPRS data transfer.

- **TSs used**[8]**:** Timeslots used on uplink and downlink.
- **CS used**[8]**:** Channel coding schemes (GPRS) or modulation coding schemes (EGPRS) used on uplink and downlink.
- **BEP**[8]**:** EGPRS mean bit error probability.
- **BEP Variance**[8]**:** EGPRS bit error probability variance.
- **Link Adaptation**[8]**:** EGPRS link adaptation algorithm: Automatic Repeat Request Mode {ARQ1, ARQ2}.
- **C-Value**[8]**:** EGPRS C Value.
- **Own/Other data**[8]**:** Own data/Other data ratio during last multiframe.
- **Cell data support:** Technology supported in cell: GPRS or EGPRS.
- **Bitrate UL/DL:** IP and RLC/MAC level throughput on uplink and downlink. All of these figures are updated once every second.
- **Rx/Tx error**[8]**:** RLC level only. Updated once every second.
  - **Rx error:** % of data blocks erroneously decoded on downlink.
  - **Tx error:** % of data blocks retransmitted on uplink.

[8] Only available on Qualcomm based devices.

12.6.2 GPRS/EDGE RLC Throughput Data View



This view presents RLC/MAC throughput for GPRS/EDGE data transfer.

Top chart

- This histogram shows the distribution of RLC/MAC-level data throughput on uplink (blue) and downlink (red).

Bottom chart

- This is a line chart tracking RLC/MAC-level data throughput over the past 1, 2, 3 or 5 minutes (according to global settings) on uplink (blue) and downlink (red).

12.6.3 "HSPA Data" Data View

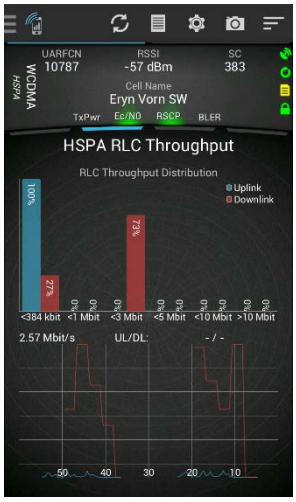
This view displays performance metrics and statistics for HSPA data transfer.

- **Bitrate UL/DL**[11]**:** IP- and RLC-level throughput on uplink and downlink. All of these figures are updated once every second.
- **Rx/Tx Error**[11]**:** RLC level only. Updated once every second.
  - **Rx Error:** Percentage of data blocks erroneously decoded on downlink.
  - **Tx Error:** Percentage of data blocks retransmitted on uplink.
- **Act. blk. size**[9]**:** Actual HS-DSCH transport block size in bits: minimum/average/maximum.
- **Req. blk. size**[11]**:** Requested transport block size in bits (corresponding to minimum CQI): minimum/average/maximum.
- **CQI:** Minimum/average/maximum value of CQI (Channel Quality Indicator).
- **Codes**[11]**:** Number of channelization codes used on the HS-DSCH: minimum/average/maximum. Obtained with HSPA+ enabled devices.
- **Blocks fail**[11]**:** Block error rate on HS-DSCH for first retransmission. Updated once every second.
- **Blocks success**[11]**:** Percentage of blocks on HS-DSCH that were transmitted successfully on first attempt (zero retransmissions). Updated once every second.
- **Blocks/s**[11]**:** Total number of blocks to be received on the HS-DSCH during the latest one-second period.
- **HARQ processes:** Number of active HARQ (Hybrid Automatic Repeat Request) processes on the HS-DSCH.

[9] Only available on Qualcomm based devices.

- **QPSK/16/64QAM**[11]**:** Percentage distribution of downlink modulation scheme usage: QPSK vs. 16-QAM vs. 64-QAM.
- **E-DCH:**
  - **DTX:** DTX rate (%) on uplink.
  - **Retrans.:** Number of retransmissions on E-DPCCH/E-DPDCH divided by the number of TTIs.
  - **Happy**[11]**:** Happy rate (%), i.e., the percentage of TTIs where the UE was happy, as defined in the 3GPP specifications.
  - **Avg. Grant index:** Average value of Serving Grant Index.
  - **Avg. Tx block size**[11]**:** Average transport block size in bits on E-DCH.

12.6.4 HSPA RLC Throughput Data View[10]



This view presents RLC throughput for HSPA data transfer.

Top chart

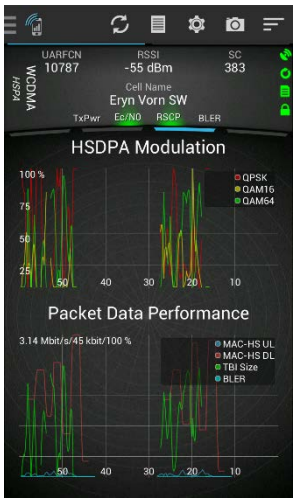
- This histogram shows the distribution of RLC-level data throughput on uplink (blue) and downlink (red).

Bottom chart

- This is a line chart tracking RLC-level data throughput over the past 1, 2, 3 or 5 minutes (according to global settings) on uplink (blue) and downlink (red).
-

[10] Only available on Qualcomm based devices.

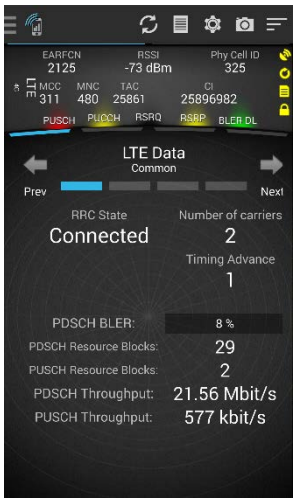
12.6.5 HSDPA Modulation/Packet Data Performance Data View[11]



This view holds line charts tracking various HSDPA and other packet data related quantities.

- **HSDPA Modulation chart:** This chart shows HSDPA modulation scheme usage (QPSK vs. 16-QAM vs. 64-QAM).
- **Packet Data Performance chart:** This chart shows MAC-HS throughput on uplink and downlink, HS-DSCH transport block size, and downlink transport channel BLER (average).

12.6.6 "LTE Data" Data View



Common sub view

This view deals with LTE data transfer. The information is organized into multiple sub views, where the first contains data common to or aggregated over all carriers, and the others (up to three) present carrier-specific data. The **Prev** and **Next** buttons are used to browse the sub views.

Common Sub view

- **RRC State:** "Idle" or "Connected".
- **Number of Carriers:** Number of LTE carriers in use (more than one in case of carrier aggregation).
- **Timing Advance[11]:** Timing Advance value.
- **PDSCH BLER:** Block error rate on Physical Downlink Shared Channel. Aggregated over all carriers.
- **PDSCH Resource Blocks:** Number of resource blocks on PDSCH. Sum taken over all carriers.
- **PUSCH Resource Blocks:** Number of resource blocks on Physical Uplink Shared Channel (primary carrier).
- **PDSCH Throughput:** Throughput on PDSCH. Sum taken over all carriers.
- **PUSCH Throughput:** Throughput on PUSCH (primary carrier).

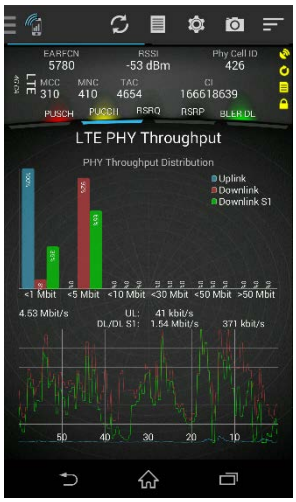
[11] Only available on Qualcomm based devices.

Carrier-specific sub view

Carrier-specific Sub views

- **EARFCN:** EARFCN of carrier.
- **3GPP Band Number:** Number of E-UTRA band.
- **Nr of Tx Ant:** The number of Tx antennas for this carrier.
- **Transmission Mode:** Downlink transmission mode, e.g. “4 / Closed-loop spatial multiplexing”.
- **Rank X**[12]**:** Percentage of time during which the following quantities have had the value 1 - 4:
  - *Left (“D”):* Actual Rank Indication (RI) on PDSCH.
  - *Right (“C”):* Rank Indication feedback from UE sent on PUSCH or PUCCH.
- **CQI CW 0, CQI CW 1:** Best value of Channel Quality Indicator for code word 0 and 1, respectively.
- **PMI**[7]**:** Precoding Matrix Indicator (actual value used).
- **PDSCH Resource Blocks**[7]**:** Number of resource blocks on Physical Downlink Shared Channel.
- **PDSCH BLER**[7]**:** Block error rate on PDSCH.
- **PDSCH MCS CW 0**[7]**, PDSCH MCS CW 1**[7]**:** Modulation Coding Scheme for code word 0 and 1 (respectively) on PDSCH.
- **PDSCH Throughput:** Throughput on PDSCH.
- **PUSCH MCS CW:** Modulation Coding Scheme on PUSCH.

12.6.7 LTE PHY Throughput Data View



This view presents physical layer throughput for LTE data transfer.

Top chart

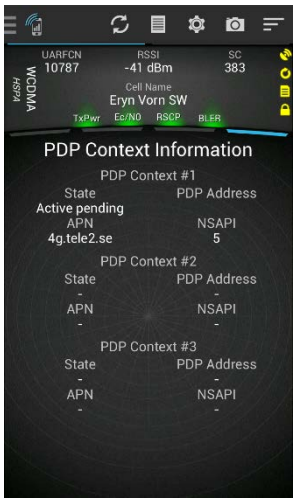
- This histogram shows the distribution of Phy-level data throughput on uplink (*blue*) and downlink (*red*). In the CA case, the red bar represents the primary serving cell, and the *green* bar represents the secondary serving cell.

Bottom chart

- This is a line chart tracking Phy-level data throughput over the past 1, 2, 3 or 5 minutes (according to global settings) on uplink (*blue*) and downlink (*red*). Here, too, an additional curve is drawn in *green* for the secondary serving cell in a CA configuration.

[12] Only available on Qualcomm based devices.

12.6.8 PDP Context Information Data View

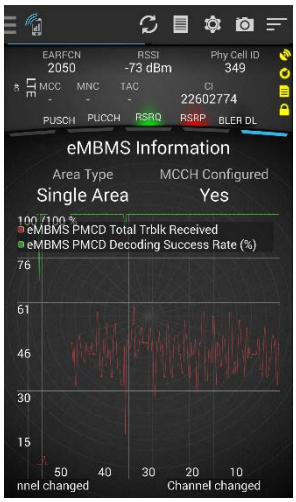


This view displays information on current PDP contexts (up to three).
The top screenshot shows the view for GSM and WCDMA, while the bottom screenshot shows the LTE view.

- **State:** PDP context state (active or inactive)-
- **PDP Address** (used in GSM/WCDMA) or **PDN Address** (used in LTE).
- **APN**, Access Point Name.
- **NSAPI**, Network Service Access Point Identifier (used in GSM/WCDMA) or **EBI**, EPS Bearer ID (used in LTE).

For CDMA no information is displayed in this view, since the PDP context concept does not exist in that technology.

12.6.9 eMBMS Information Data View[13]



This view shows data on the configuration and performance of eMBMS, Multimedia Broadcast Multicast Services (MBMS) delivered over LTE.

- **Area Type:** Indicates whether the eNodeB belongs to one eMBMS area or to several such areas.
- **MCCH Configured:** Indicates whether or not a Multicast Control Channel is configured.

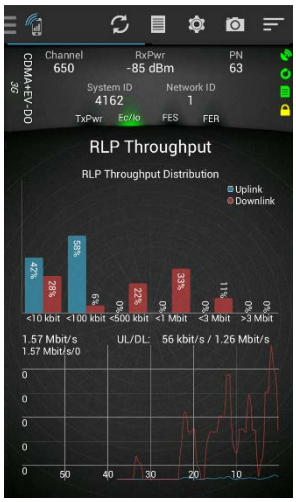
Graph

The line chart tracks the following quantities over the past 1, 2, 3 or 5 minutes (according to global settings):

- **eMBMS PMCH Total Trblk Received:** Number of PMCH transport blocks received per second.
- **eMBMS PMCH Decoding Success Rate (%):** Percentage of PMCH transport blocks that were successfully decoded (CRC pass).

Also plotted in the line chart are the events “eMBMS Bearer Activated” and “eMBMS Bearer Deactivated” (among other events).

12.6.10 RLP Throughput Data View



This view presents RLP throughput for EV-DO data transfer.

Top chart

This histogram shows the distribution of RLP-level data throughput on uplink (blue) and downlink (red).

Bottom chart

This is a line chart tracking RLP-level data throughput over the past 1, 2, 3 or 5 minutes (according to global settings) on uplink (blue) and downlink (red).

12.7 “Test Status” Data View Category

These data views show the progress of a script that is executing.

- The Script Progress data view gives general information on script progress, independent of what types of action are being run.
- The other data views in this category contain action-specific progress and service performance data. For certain action types, a graph is plotted which scrolls from right to left in real time.

[13] Only available on Qualcomm based devices.

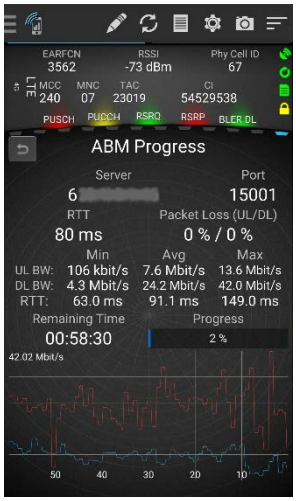
When the script is stopped, these views are cleared, and all counters are reset.

12.7.1 Script Progress Data View

- **Script Name:** The name of the script that is currently running.
- **GPS:** Use of GPS.
- **Iterations:** Total number of completed script iterations.
- **Succ./Fail.:** Total number of successfully completed script actions / Total number of failed script actions.
- **Runtime:** Total elapsed script execution time.
- **Actions:** Index of current action in list of actions / Total number of actions in script.
- **Elapsed Time:** Elapsed execution time for current action.
- **Current Action:** Type of current action.
- **Repetitions:** Index of current repetition of action / Total number of repetitions to perform (as specified in script setup).
- **Next Action:** Next action in script.

Tap one of the buttons at the bottom to jump to an action-specific progress view. When an action of a particular type is executing, the corresponding button is tagged with a “play” symbol. In some cases, more than one button is thus tagged: for example, Voice and AQM while a Call Sequence action is running.

12.7.2 ABM Progress



- **Server:** IPv4 address of Blixt server.
- **Port:** The port on which the Blixt server listens for requests.
- **RTT:** Round-trip time in ms: the time taken by ABM packets to travel from the TEMS Pocket device to the ABM server and back. Last reported value (as opposed to statistics below).
- **Packet Loss (UL/DL):** Percentage of ABM packets that were lost on the uplink (from the UE to the ABM server) / on the downlink (from the ABM server to the UE). These figures are averages over the current repetition of the ABM action.
- **UL BW:** Measured available bandwidth on the uplink, min./avg./max.
- **DL BW:** Measured available bandwidth on the downlink, min./avg./max.
- **RTT:** Round-trip time, min./avg./max.
- **Remaining time:** Time remaining of the ABM action.
- **Progress:** Percentage of the ABM action that has been completed.

Graph
Line chart of uplink/downlink available bandwidth.

12.7.3 AQM Progress

- **Direction:** Mobile-originated or mobile-terminated.
- **Type:** Measurement setup: Mobile-to-mobile or mobile-to-fixed.
- **Algorithm:** Bandwidth of the transmitted speech that is considered by the POLQA algorithm: narrowband or super-wideband.
- **Speech Codec[14]:** Voice codec and codec bit rate currently used in the AQM CS voice call.
- **Min / Avg / Max:** Minimum, average, and maximum AQM score for the current repetition of the AQM action.
- **Current:** Current AQM score.
- **Count:** Number of AQM scores computed during the current repetition of the AQM action.
- **State:** Current state of device. One of “Recording”, “Injecting” (playing speech sentence), “Idle”, or “Resync”.
- **Meas. Duration:** Elapsed measurement time / Configured measurement duration in action settings (both given in seconds). Only the actual measurement is timed; call setup and the like are not included.
- **SPD RTT/One way:** Speech path delay in ms. **SPD RTT** (round-trip time) is the time it takes for the speech to travel from the receiving party to the calling party and back to the receiving party again. **SPD One way** is defined as half of **SPD RTT**. Obtained during MT calls only.

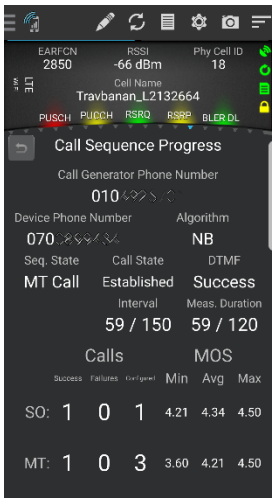
Graph

For an AQM action, the histogram shows the AQM score distribution for the current repetition of the AQM action.

For a Call Sequence action, the distribution pertains to execution of the action as a whole.

[14] Only available on Qualcomm based devices.

12.7.4 Call Sequence Progress

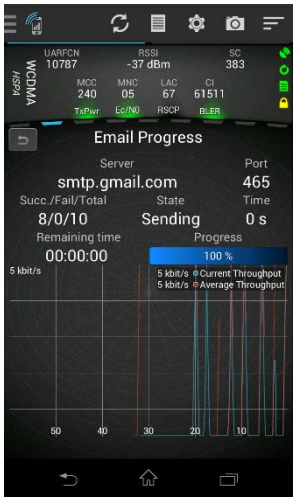


- **Call Generator Phone Number:** Phone number to the CallGenerator acting as other party in the calls. Regarding input format for international calls, see section "Phone Settings".Device Phone Number: Phone number of the TEMS Pocket device itself.
- **Algorithm:** The AQM algorithm set for the current call: “PESQ”, “P.OLQA NB” (narrowband) or “P.OLQA SWB” (super-wideband). See section "AQM Setups". Regarding PESQ and POLQA in general, see section "The PESQ and POLQA Algorithms".
- **Seq. State:** State of call sequence execution. One of: “SO Call”, “MT Call”, “MO Call”, “Waiting”, “Cancel Call”, “Aborting”.
- **Call State:** One of: “Attempt”, “Setup”, “Established”, “Ended”, “Blocked”, “Dropped”.
- **DTMF:** State of DTMF signaling. One of: “Sending”, “Success”, “Failure”.
- **Interval:** Time elapsed of current interval / Interval length. For the precise meaning of “interval”, consult section "Single-service Measurement Actions: Voice".
- **Meas. Duration:** Time elapsed of current measurement period / Maximum measurement duration. Note that the maximum shown here may be lower than what is set in the script (namely, if the configured duration is too long to fit within the Interval timeslot).

Bottom part
Table showing call success and MOS statistics:

- for SO calls
- for the current iteration of the Call Sequence action
- for the entire Call Sequence action (i.e. spanning all iterations if applicable).

12.7.5 Email Progress



- **Server:** IP address or host name of SMTP server.
- **Port:** The port on which the SMTP server listens for requests.
- **Succ./Fail/Total:** Number of emails successfully delivered/Number of emails whose delivery failed/Total number of emails to send.
- **State:** State of SMTP client, for example “Preparing”, “Connecting”, “Sending”, “Finished”.
- **Time:** Time elapsed for the email that is currently being sent.
- **Remaining Time:** Estimated remaining time of the email session.
- **Progress:** Percentage of the email data transfer that has been completed.

Graph
Line chart of current and average application-level throughput during the email transfer.

12.7.6 Facebook Progress

- **Current Operation:** Type of Facebook operation currently in progress.

The remainder of the view details, for each operation type:

- **Time:** Time required for the last completed operation of this type.
- **Status:** Status of an operation of this type that is currently running, or outcome of the last operation completed of this type.

12.7.7 FTP Progress

- **FTP Server URL:** Name and full path of file being uploaded/downloaded over FTP. The server can be specified by an IPv4 address (12-digit number) or a plain-text name.
- **Direction:** FTP session type (UL or DL).
- **Port:** The FTP server port used.
- **Finished / Started / Total Instances:** Number of finished / Number of started / Total number of parallel FTP downloads.
- **Remaining Time:** Estimated remaining time of the FTP session.
- **Progress:** Percentage of the FTP data transfer that has completed.

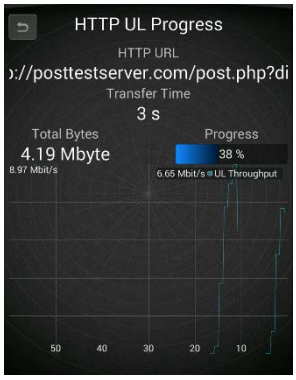
Graph

Line chart of uplink/downlink application-level FTP throughput.

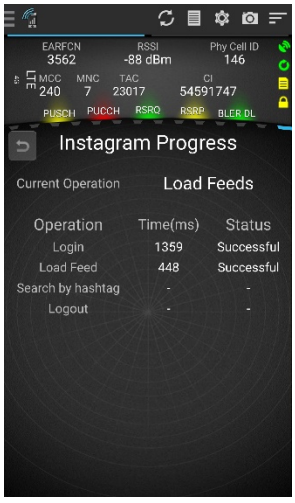
12.7.8 HTTP DL Progress, HTTP UL Progress

- **HTTP URL:** The URL being downloaded from or uploaded to.
- **Transfer Time:** Duration of the current HTTP session in seconds.
- **Total bytes:** *(UL)* Total amount of data transferred during the session.
- **Progress:** *(UL)* Percentage of the file upload that has completed.

Graph
Line chart of downlink/uplink application-level HTTP throughput.
For HTTP download, if the on-device HTTP client is used, a floating window appears on top of the progress view, showing downloaded content.



12.7.9 Instagram Progress



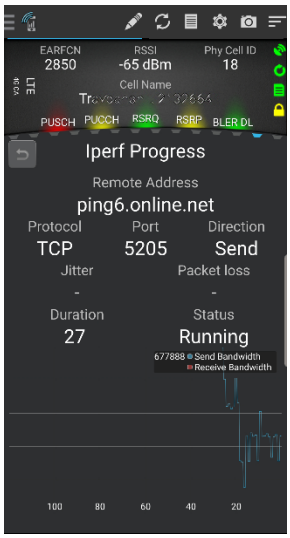
Current Operation: Type of Instagram operation currently in progress.

The remainder of the view details, for each operation type:

- **Time:** Time required for the last completed operation of this type.
- **Status:** Status of an operation of this type that is currently running, or outcome of the last operation completed of this type.

The view is cleared upon completion of a Instagram action.

12.7.10 Iperf Progress



- **Remote address:** Address or IP-address to the Iperf server.Protocol: Either UDP or TCP.
- **Port:** Port used to connect to the Iperf server.
- **Direction:** Either Send or Receive.
- **Jitter:** The mean deviation (in ms) of the difference in packet spacing at the receiver compared to the sender, for a pair of packets.
- **Packet loss:** Packet retransmissions (in percent). The value is updated once every second.
- **Duration:** Testing duration time in seconds.
- **Status:** Status of test progress.

The Line chart in the bottom of the screen displays **Send Bandwidth** and **Receive Bandwidth** over time.

12.7.11 Logfile Upload Progress

- **File in transfer:** Name of log file currently being uploaded.
- **Logfiles to send:** Log files can be uploaded selectively based on the concept of TEMS Pocket *sessions*; the current setting is shown here.
- **Files:** Number of logfiles uploaded / Total number of logfiles to be uploaded.
- **Send file list:** “Yes” means that before the actual logfiles, one text file is sent for each TEMS Pocket session conducted, listing the logfiles to be uploaded.
- **Keep local copy:** “Yes” means that log files will be kept on the device in a directory “/uploaded” after the upload. “No” means that logfiles are deleted from the device after being uploaded.
- **Remaining time:** Estimated remaining time of the Logfile Upload action.
- **Progress:** Upload progress, stated as the percentage of log files in the current batch that have been uploaded.

Graph
Line chart showing application-level FTP or HTTP(S) throughput for the logfile upload.
See section 6.6.

12.7.12 Ping Progress

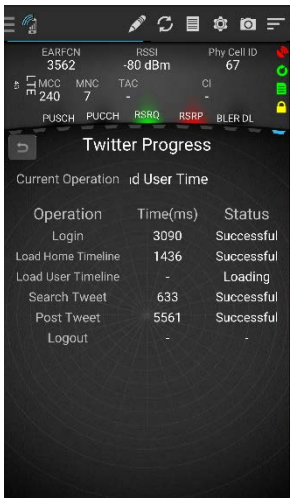
- **Host:** The URL of the host being pinged.
- **Min / Avg / Max (ms):** Minimum/average/maximum ping round-trip time for the current repetition of the Ping action. Timeouts and errors are left out of account in these statistics.
- **Finished / Total:** Number of finished pings/Total number of pings to be sent in the action.

Graph
Histogram of ping round-trip times for the current repetition of the Ping action. The “TO” bin on the far right represents timeouts (no response within the specified maximum time to wait).

12.7.13 SMS Progress

- **Phone number:** For Send, the number of the SMS recipient. For Receive, it's empty.
- **Type:** “Send” or "Receive". (Swipe left/right to change the view.)
- **Success / Failure / Total:** Number of SMS send or receive attempts that succeeded / failed / are specified in the current repetition of the SMS action.

12.7.14 Twitter Progress

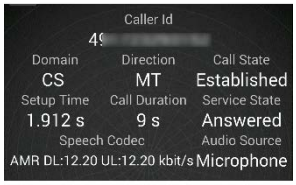


Current Operation: Type of Twitter operation currently in progress.

The remainder of the view details, for each operation type:

- **Time:** Time required for the last completed operation of this type.
- Status: Status of an operation of this type that is currently running, or outcome of the last operation completed of this type.
- The view is cleared upon completion of a Twitter action.

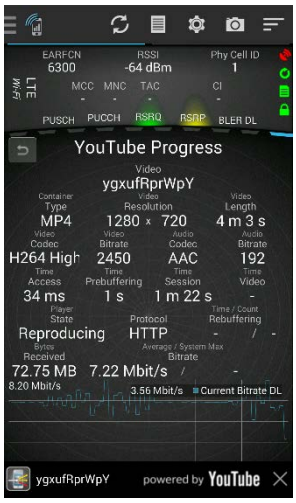
12.7.15 Voice Progress



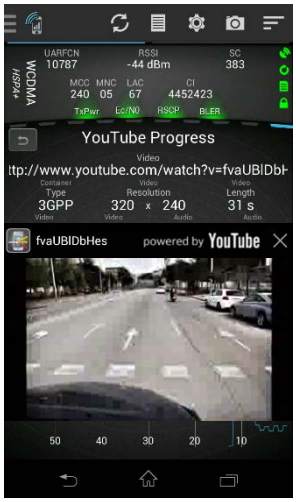
Three use cases shown:
1) CS and MO;
2) CS and MT;
3) PS and MT.

- **Caller Id:** Phone number or identity of the other party in the call.
- **SIP Registration:** *(PS only)* One of “Registered”, “Unregistered”.
- **Domain:** CS or PS.
- **Direction:** MO (mobile-originated) or MT (mobile-terminated).
- **Call State:** One of: “Attempt”, “Setup”, “Established”, “Ended”, “Blocked”, “Dropped”.
- **Setup Time:** Call setup time in seconds. This time is computed at the application layer.
- **Call Duration:** Duration of the call so far in seconds.
- **Cfg. Duration:** *(MO call)* Total call duration configured in script setup.
- **Service State:** *(MT call)* One of: “Waiting”, “Incoming call”, “Answering”, “Answered”, “Playing sound”, “Disconnected”.
- **Speech Codec:** Voice codec and *(for CS only)* codec bit rate currently used in the call.
- **Retries:** *(MO call)* Total number of retries made during the current call.
- **Audio Source:** *(MT call)* Regular microphone audio or AQM sentence playback.
- **DTMF State:** State of DTMF signaling. One of: “Sending”, “Success”, “Failure”, “Monitoring”.
- **DTMF Left:** Number of DTMF tones left to send / Total number of DTMF tones to be sent.

12.7.16 YouTube Progress



Video window hidden at bottom of screen



Video window visible

The video is displayed in a floating window that can be moved freely up and down the screen. (On a tablet, the video window can be dragged around both horizontally and vertically.)
If you move the video window all the way to the bottom, the video footage itself is hidden, and only the YouTube title bar with the clip id remains visible. This is handy when you want an unobstructed view of the TEMS Pocket user interface.

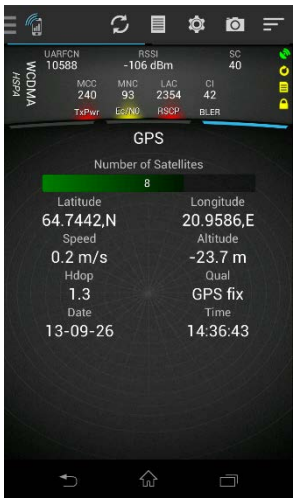
- **Video:** YouTube video id.
- **Container Type:** Video container format. One of FLV, MP4, 3GPP, or WebM.
- **Video Resolution:** Horizontal and vertical resolution.
- **Video Length:** Length of the video in hours, minutes and seconds.
- **Video Codec:** Type of compression used on the video.
- **Video Bitrate:** Video bitrate in compressed format.
- **Audio Codec:** Type of compression used on the audio.
- **Audio Bitrate:** Audio bitrate in compressed format.
- **Time Access:** Time from sending of GET request until an answer is received.
- **Time Prebuffering:** Time spent prebuffering the video.
- **Time Session:** Time from sending of GET request to end of replay.
- **Time Video:** Time from display of first video frame to end of replay.
- **Player State:** “Prebuffering”, “Reproducing”, or “Rebuffering”.
- **Protocol:** HTTP or HTTPS.
- **Time/Count Rebuffering:** Total time in seconds spent on rebuffering / Total number of GET requests for the same video. These statistics are shown at session end.

12.7.17 Progress of Other Actions

The remaining action types do not have a progress screen, since their execution does not have a well-defined progression, or it is not very interesting to display (e.g. Wait).

12.8 “Location” Data View Category

12.8.1 GPS Data View

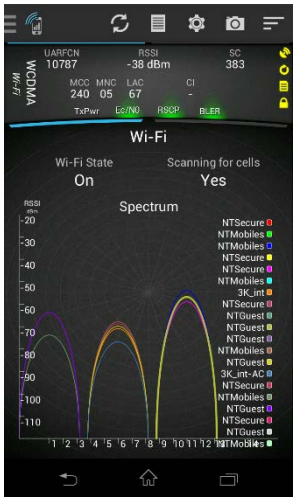


This data view displays position-related information:

- **Number of Satellites:** The number of satellites the GPS currently sees.
- **Latitude, Longitude:** Latitude and longitude given in decimal degrees.
- **Speed:** Speed in meters per second.
- **Altitude:** Height above sea level in meters.
- **Hdop:** Horizontal dilution of precision, HDOP.
- **Qual:** Reads “GPS fix” if GPS fix obtained, otherwise left blank (“-”).
- **Date:** Date (“yy-mm-dd”).
- **Time:** Time of day (“hh:mm:ss”). Note that the time is given in UTC.

12.9 “Wi-Fi” Data View Category

12.9.1 Wi-Fi Data View



- **Wi-Fi State:** Indicates whether the Wi-Fi function in the device is active or not.
- **Scanning for cells:** Indicates whether Wi-Fi scanning is currently active.

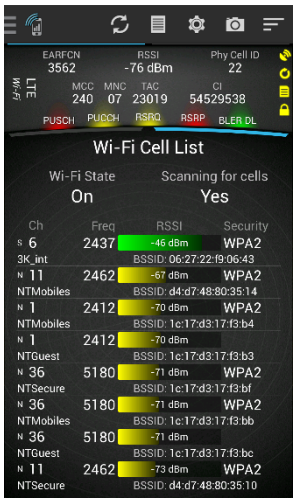
Spectrum graph

Here is shown the result of Wi-Fi scanning. Each detected Wi-Fi network is visualized as a lobe labeled with the network name (SS ID). The network the device is currently connected to is drawn with a thicker line (here, the greenish yellow lobe on the right).

The height of a lobe indicates the RSSI of that Wi-Fi network.

The width of a lobe represents the network’s allotted transmission bandwidth. The numbers on the x-axis are the channel numbers defined in the Wi-Fi standard. Along the x-dimension is thus also visualized the overlap between Wi-Fi networks.

12.9.2 Wi-Fi Cell List Data View



- **Wi-Fi State, Scanning for cells:** See section 12.9.1.

The rest of the view shows Wi-Fi access points detected by Wi-Fi scanning. Up to eight access points are displayed, each belonging to one of the following categories:

- **S:** Serving.
- **N:** Neighbor.

The categories are prioritized as listed above, neighbors being displayed as far as space allows. Within each category, cells are sorted by descending RSSI.

- **Ch:** Channel number.
- **Freq:** Channel center frequency in MHz.
- **RSSI:** Received Signal Strength (dBm).
- **Security:** Wi-Fi security protocol: one of {WPA2, WPA, WEP} or none.

12.10 “Messages” Data View Category

When using TEMS Pocket in Controller mode, the “Messages” Data View is splitted into two views; “Local Messages” presenting messages from the controller device and “Agent Messages” presenting messages from the connected agents.

12.10.1 Events Data View

Event list

This data view lists *events* generated by TEMS Pocket in order to inform you of various noteworthy occurrences. Regarding events in general, see chapter 9.
By default this view is automatically refreshed, with each new event appearing at the top of the list. However, to be able to study the event flow at your leisure, you can freeze the data view by dragging the event list gently downward. While the view is frozen, further dragging actions cause the event list to scroll. The scrolling bar on the far right shows your current position in the list.
While the view is frozen, the notification bar (blue) at the top of the list indicates the number of new events that have occurred after you froze the view. In a log file, these events are recorded normally, independently of the data view state.
To return the data view to live mode, tap the Scroll to top link on the notification bar, or scroll manually all the way to the top of the event list. The view is then updated with all events that were queued while the view was frozen.

Event list with one event expanded

You can tap an event in the list and have all additional information carried by the event displayed inline as an expansion of the event list item.

12.10.2 Layer 3 Messages Data View

This data view lists Layer 3 messages transmitted and received by the TEMS Pocket device. All technologies are covered; that is, whatever subset of GSM, WCDMA, LTE, CDMA, and EV-DO the device supports.
The view has the same freezing mechanism and other interactivity features as the Events view, as described in section 12.10.1.

Message list

Message list with one message expanded

You can tap a message in the Layer 3 message list and immediately see the full contents of the message in a human-readable format.
By displaying the full message contents you can troubleshoot signalling issues directly in the field, for example by viewing MIB or SIB configurations, or get detailed information on things like RRC procedures in GSM, WCDMA, LTE, and CDMA.

12.10.3 SIP Messages Data View

This data view lists SIP messages transmitted and received by the device.
The view has the same freezing mechanism and other interactivity features as the Layer 3 Messages view, as described in section 12.10.2.
When you tap a SIP message, its contents are displayed in plain-text decoded form. This presentation, too, is similar to that in the Layer 3 Messages view.

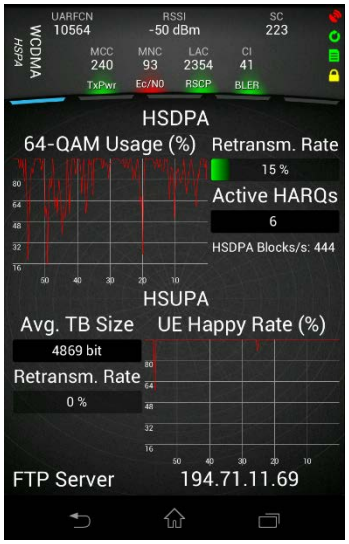
12.11 “Custom” Data View Category

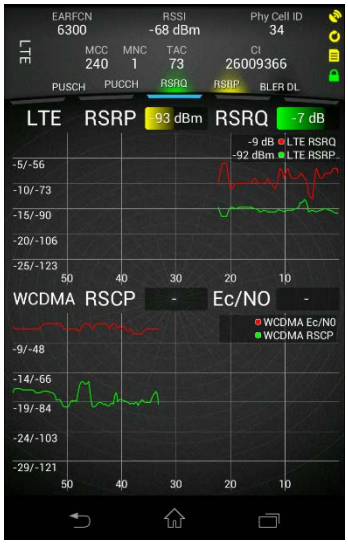
This data view category holds empty data views whose contents you assemble according to your current needs and preferences. Up to five such custom views can be populated.

You add pieces of data to a custom view by selecting a rectangular area (of any size you like) in the grid, then picking a value element to show in that space and specifying the mode of its presentation. Custom views are built from the same types of graphical elements that make up the predefined views (except that bar charts are not available):

- **Line charts** with or without labelling of axes. It is possible to plot several value elements in the same chart.
- **Value bars** whose length and color represent the current value of a parameter or measured quantity. The value and unit are also printed as text on top of the bar.
- **Value labels** presenting value elements as text only.
- Static **text labels** describing the data seen in the view.

The result is a mosaic of textual and graphical value elements. Below are two examples of what a custom data view might look like:





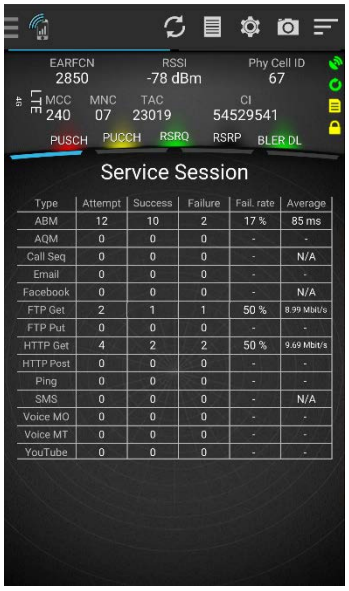
Custom data views. Note how graphical and textual elements can be sized and juxtaposed arbitrarily.

Left: Selection of HSDPA and HSUPA value elements, with the FTP server IP used for testing added at the bottom.

Right: Fundamental signal strength/signal quality metrics for LTE and WCDMA side by side. Such an arrangement is ideal for studying 4G–3G RAT transitions.

12.12 “Statistics” Data View Category

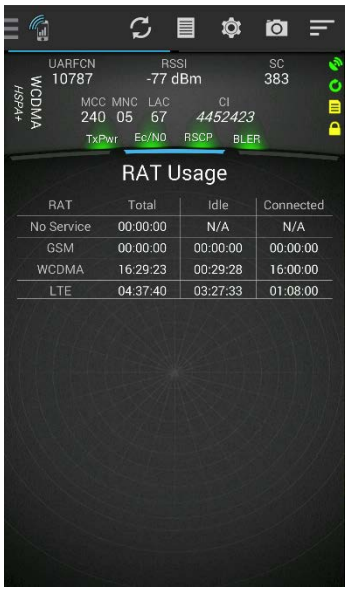
12.12.1 Service Session Data View



Here are shown statistics on scripted service sessions.

- **Type:** Type of service.
- **Attempt:** Number of attempted sessions.
- **Success:** Number of successfully completed sessions.
- **Failure:** Number of failed sessions.
- **Fail. rate:** Percentage of sessions that failed.
- **Average:**
  - ABM: Average round-trip time.
  - AQM: Average MOS score.
  - Call sequence: Not applicable.
  - Email, FTP, HTTP, YouTube: Average application-level throughput.
  - Facebook: Not applicable.
  - Ping: Average round-trip delay.
  - SMS: Not applicable.
  - Voice: Call setup time.

12.12.2 RAT Usage Data View

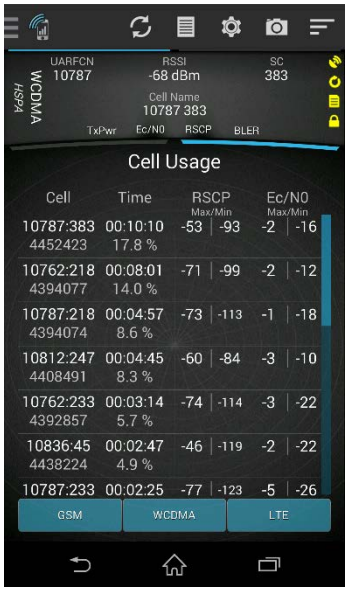


This part shows statistics on the device's RAT usage. For each RAT is shown the following:

- **Total:** Total time spent using this RAT.
- **Idle:** Time spent in idle mode.
- **Connected:** Time spent in connected/dedicated mode.

An additional row is provided for the time spent in "No service" state.
All RAT statistics can be given either as absolute time (hh:mm:ss) or as percentages.

12.12.3 Cell Usage Data View

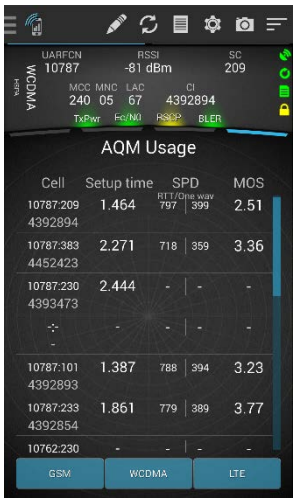


This view shows statistics on cell usage. The current serving cell or strongest cell in the active set always appears on top, while other cells are ranked according to the total time they have been used. The list is scrollable and can hold up to 16 cells.
Separate statistics are maintained for each RAT supported by the device when running TEMS Pocket. To switch the view to a different RAT, click the corresponding button at the bottom of the view.
For each cell, the following data is given:

- **Cell** column: Channel and code (e.g. UARFCN:SC for WCDMA); cell identity (not shown for CDMA/EV-DO).
- **Time** column: Time spent on this cell; also expressed in percent of the total.
- *Third* column: Highest and lowest signal strength measured, e.g. RSCP (dBm) for WCDMA.
- *Fourth* column: Highest and lowest signal quality measured, e.g. E_c/N_0 (dB) for WCDMA.

For cells that are not uniquely identified (for example, if the SC is obtained but not the UARFCN), only the Time column is populated, and the remaining columns are invalid.

12.12.4 AQM Usage Data View



This view shows statistics on audio quality measurement by cell. The current serving cell or strongest cell in the active set always appears on top, while other cells are ranked according to the total time they have been used. The list is scrollable and can hold up to 16 cells.
Separate statistics are maintained for each RAT supported by the device when running TEMS Pocket. To switch the view to a different RAT, tap the corresponding button at the bottom of the view.
For each cell, the following data is given:

- **Cell:** Channel and code (e.g. UARFCN:SC for WCDMA); cell identity (not shown for CDMA/EV-DO).
- **Setup time:** Average call setup time for AQM calls.
- **SPD:** Average speech path delay in ms, round-trip (RTT) and one-way (defined as half of SPD RTT).
- **MOS:** Average AQM (POLQA) score.

For cells that are not uniquely identified (for example, if the SC is obtained but not the UARFCN), only the Time column is populated, and the remaining columns are invalid.

13 TEMS Director integration

TEMS Pocket is designed to provide flexibility, reliability and performance. The platform architecture has been designed with a central processing and managing server, TEMS Director, which can manage and control a large number of remote probes via TCP/IP. TEMS Pocket in Remote and Controller Mode can be connected to TEMS Director.

13.1 TEMS Director – Central Management System

TEMS Director forms the central hub of the system, where it performs the following functions:

- Probe and modem management (including remote commissioning by SMS and software updates)
- User management (roles / permissions / access)
- Test script creation and editing: Script Designer
- Test deployment and scheduling via Work Orders. Work Orders also include any data the tests need and tags (meta information) you want to associate with their results
- Test and device monitoring: the Remote Client View option
- Reporting dashboards
- Data storage in the backend servers
- Data analysis: the TEMS Director - Analytics Base option
- Additional reporting: the TEMS Director - Analytics option
- Custom dashboards, filters, data sources and more.

See the TEMS Director Technical Product Description for more information.

13.2 TEMS Script Designer – Test Modeling

The TEMS Script Designer enables quick and easy test modeling through its drag-and-drop interface, allowing prewritten modules called **Activities** (such as “FTP” and “HTTP”) to be linked together and configured to form deployable test scenarios.

With multiple configuration options for each Activity, it’s easy to create a test to emulate typical user interactions.

Scripts are controlled by Script Triggers that specify when to start and stop them - triggered when a specified Event occurs. Triggers include date and time and Events such as HTTP Error or Battery Low.

See *Chapter 10, Scripting* for more information on scripting and the Script Designer.

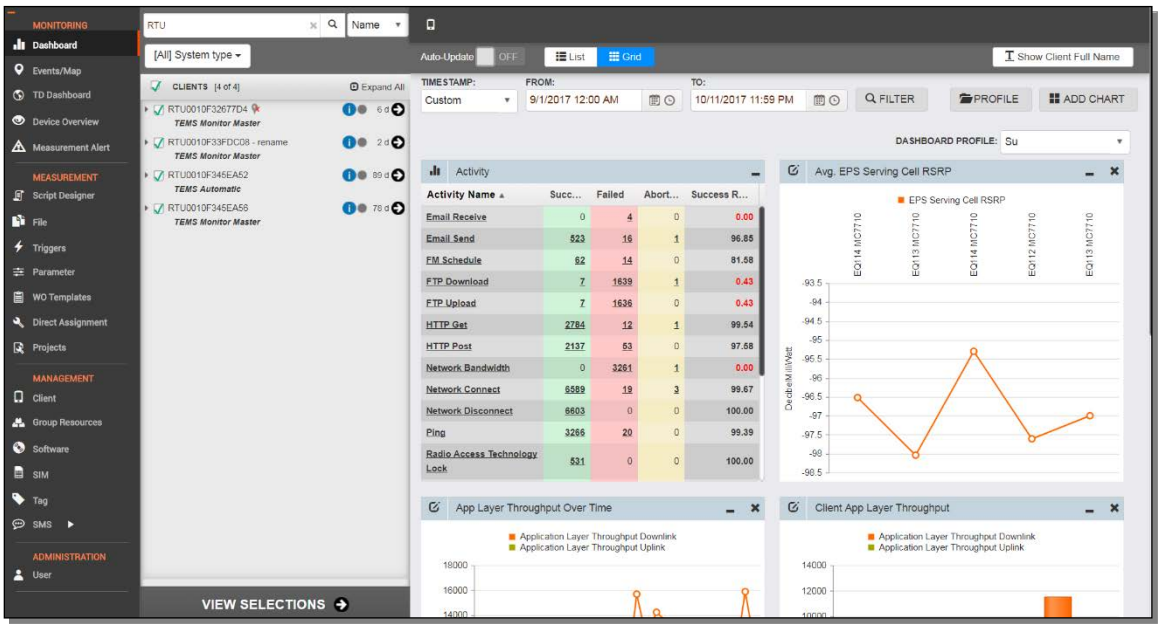
13.3 TEMS Director Back End - Data store

TEMS Director backend servers process measurement data from the distributed probes and consolidates it into a data warehouse structure for long-term storage and analysis. This is a highly scalable and robust solution based on a Microsoft Server. It can handle hundreds of incoming reports per minute, from hundreds of probes.

13.4 TEMS Director - Fleet Dashboards

TEMS Director - Fleet provides two main sets of standard Dashboards to present your results, with options to filter by date and time:

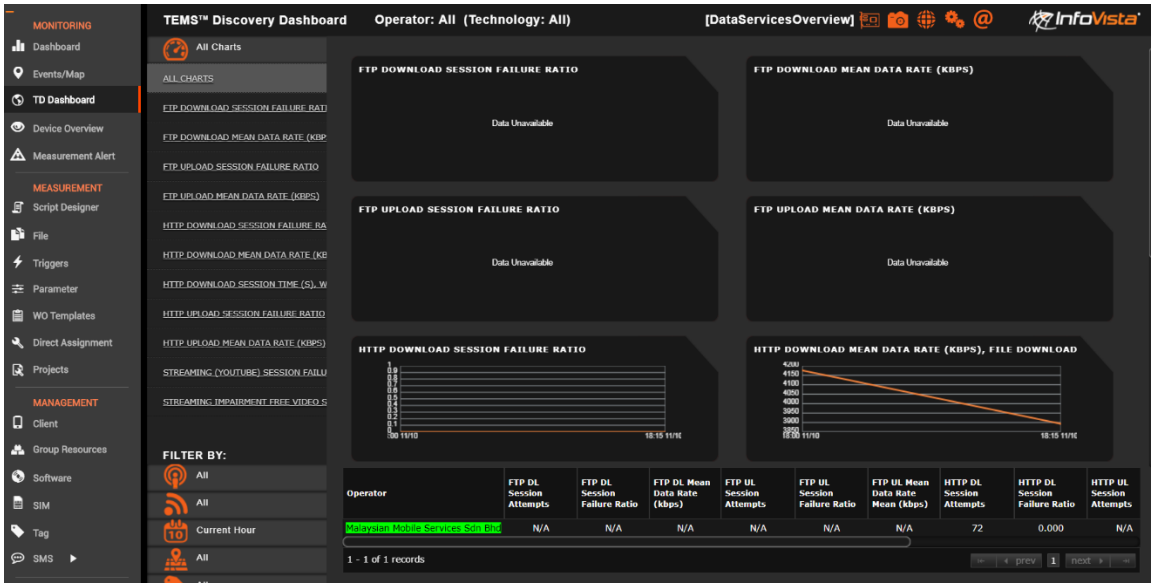
The **Device Overview Dashboard** displays standard and custom charts for key KPIs and Performance Counters for the selected probes:



The Device Overview Dashboard

The Device Overview Dashboard is displayed by selecting the **Dashboard** option from Management menu.

The **Analytics Dashboards** - part of the **Analytics** option - summarize display post-processed data from across your network:



The Analytics Dashboard - Data Services Overview

The Analytics Dashboards are supplied as part of the TEMS Director - Analytics option and are displayed by selecting the **TD Dashboard** option from the **Management** menu.

13.5 TEMS Director - Analytics

The TEMS Director - Analytics option provides two main features:

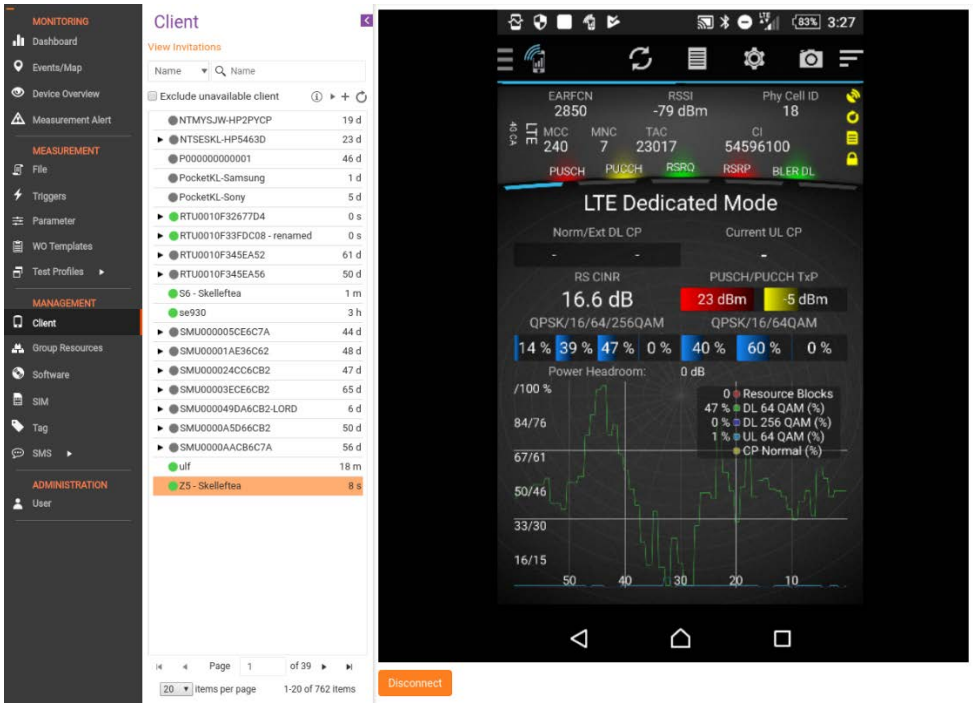
Enhanced post-processing of results

Enhanced presentation of results, via additional dashboards and custom dashboards

See the *TEMS Director Analytics TPD* for more on this option.

13.6 Remote Control

TEMS Pocket devices can be remote controlled from TEMS Director.



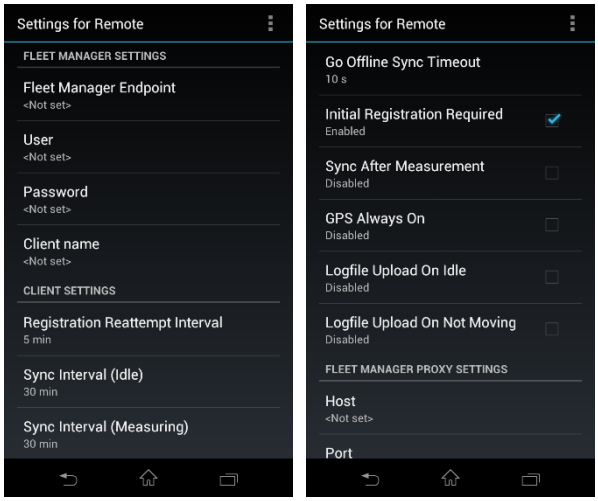
Remote control of TEMS Pocket from TEMS Director Fleet enables full control of the Pocket User Interface and device from a remote location.

Remote control are supported by TEMS Pocket 17.1.1 and later.

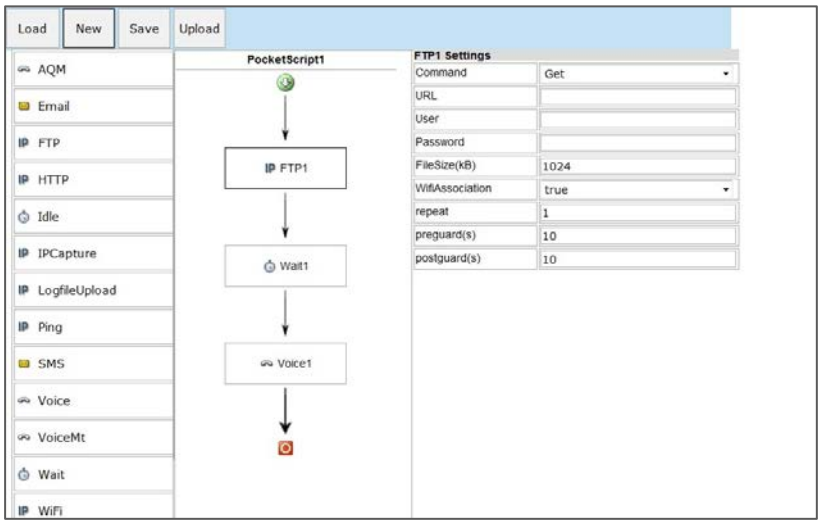
14 TEMS Pocket Remote

A TEMS Pocket device running in Remote mode is meant to be used as an autonomous, unattended probe. The device is then controlled remotely from TEMS Director Fleet, from where it is assigned orders to perform monitoring or benchmarking.

In terms of outward appearance, TEMS Pocket Remote is essentially TEMS Pocket Professional without the latter's network diagnostics user interface (as described in the rest of this document). TEMS Pocket Remote does however have a user interface of its own, which is used to fire up and configure the client connection to the back-end:

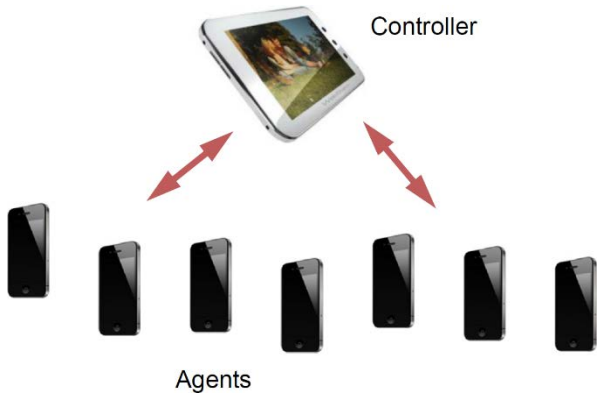


TEMS Pocket scripts can be created in the script editor included in TEMS Director Fleet:



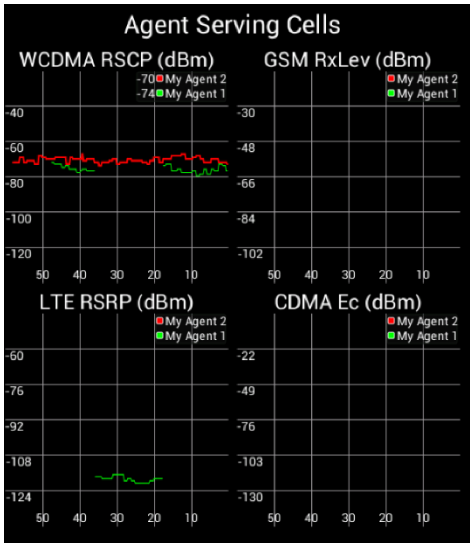
15 Multi-device TEMS Pocket

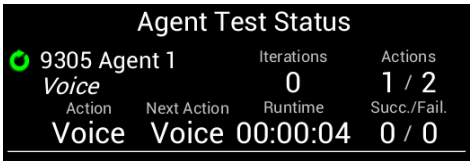
In a multi-device TEMS Pocket configuration, one master unit, called the **controller**, is used to remote-control other devices[15], called **agents**. The controller device should preferably be a tablet, but it can also be an ordinary phone. The communication takes place via Bluetooth. A backpack designed for carrying the agents is available as an accessory.

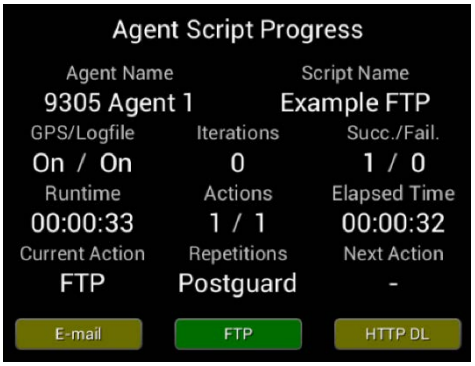


From the controller you can:

- **assign** scripts and map sets to agents
- **order** agents to start and stop measuring
- **monitor** agents' status. Some examples of controller status views are shown below.







When **pinpointing** in multi-device mode, you mark the waypoints in the controller's Indoor Map view. These positions are then pushed out to all agents, so that the log file recorded by each agent will include both the map

[15] Please note that direct Bluetooth connection supports up to six (6) devices. If a larger amount of devices are connected, some of the devices will act as proxies, which may affect the performance of the Multi-device TEMS Pocket setup. Therefore, it is recommended to connect maximum six (6) devices per controller.

set used and the waypoints created. In other words, from the controller you position your data for all agents at once.

Log files recorded by the agents are **stored locally** on each agent device. Using the Log file Upload script action, you can then have the agents transfer these log files wherever desired.

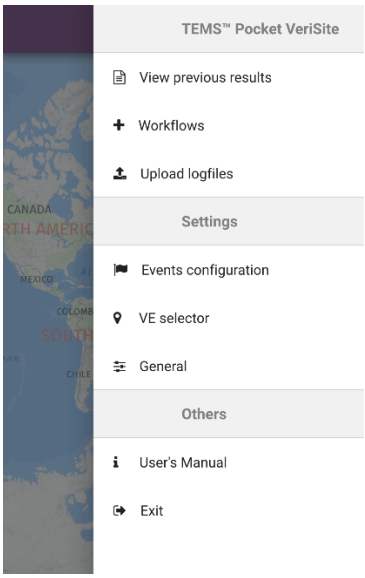
16 VeriSite User Interface

A separate user interface has been introduced with TEMS Pocket. The VeriSite application is a part of TEMS Pocket designed to offer a step-by-step workflow for Single Site Verification for LTE, WCDMA or GSM. It provides an automated workflow procedure including a pre-selected set of control functions, which guides the user through the process of performing integration-level testing on site. The VeriSite application covers registration, mobility and stationary test cases. Instant reports can be generated and uploaded to a server.

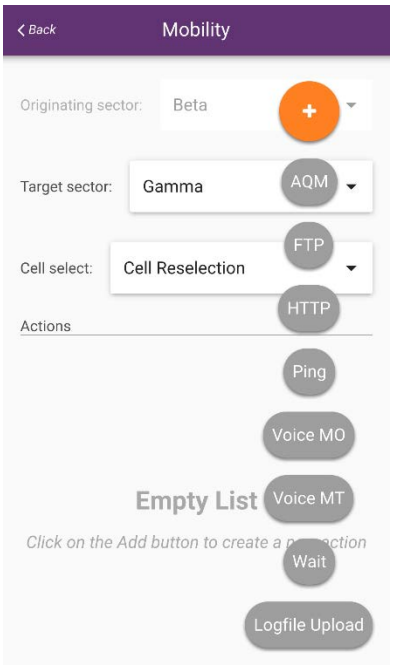
Workflows can be configured remotely from TEMS Director Fleet or manually on the device.

The VeriSite application is installed together with TEMS Pocket (but need a separate license option to run) and will not run unless both applications stay intact on the device.

When you start the VeriSite application, it displays a map view centered on your current location. The map displays all imported cell locations and lets you select which one to perform test on.

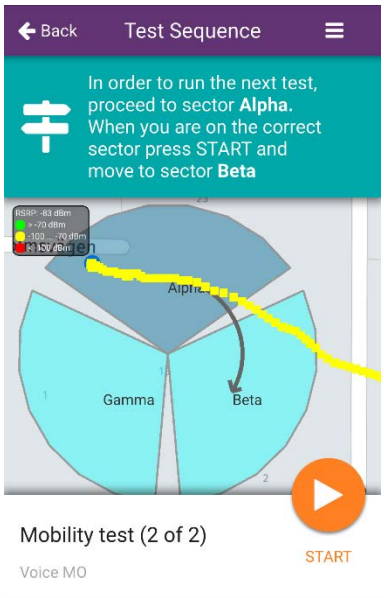


A menu button is located in the top bar. When tapping this button, the application menu slides in from the right side of the screen.

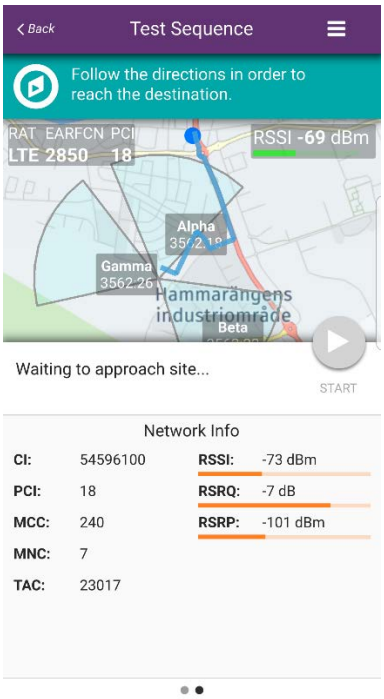


The application supports Inter RAT tests, registration tests, mobility tests (where you move from one sector to another), and stationary tests.
The available actions are the same in both mobility and stationary tests:

- AQM
- FTP
- HTTP
- Ping
- Voice MO
- Voice MT
- Wait
- Logfile Upload



During workflow execution, the application guides you through the testing process by instructions given on the screen and directions given on the map and performs the planned actions and applies selected control functions.
This makes is possible for a person without deeper technical knowledge to perform on site testing.



Network information is given to the user information in an information bar during test execution.

17 Interoperability with Cellular Network Equipment

TEMS Pocket is interoperable with the technologies and bands specified in Appendix A.

18 Where to Learn More

For additional information concerning TEMS Pocket and other products in the TEMS portfolio, please visit us on the Web at www.infovista.com.

19 Appendix A: Device Capabilities

For information about UE capabilities, please refer to the TEMS Pocket Device Specification for this release.
Note: While TEMS Pocket supports the use of dual SIM devices, it only supports SIM Slot 1 on these devices.

19.1 External Scanner Support

Feature	PCTel IBflex™	PCTel HBflex™
NR 5G Signal Scan	✓	✓
NR 5G RSSI scan	✓	✓
LTE signal scan	✓	✓
WCDMA CPICH scan	✓	✓
CDMA PN scan	✓	✓
EV-DO PN scan	✓	✓
GSM Color Code Scan	✓	✓
RSSI scan (all technologies)	✓	✓
EPS (manual)	✓	✓

19.2 General TEMS Pocket Functions

Feature	All Supported Devices
Data views	✓
Graph views	Line charts, distribution charts
Screen capture	✓
Service testing and other measurements	FTP, HTTP, YouTube, Email, SMS, Ping, ABM, Voice MO/MT, Voice with AQM, Parallel services, IP capture, Mobile network scanning, Wi-Fi scanning, Wait
Data recording	✓
Passive measurements	Scripted start/stop, optionally triggered by user-defined events
Filemarks	✓
Automatic data upload	✓
Log file compression	✓
Log file replay	✓
Network events	✓
Custom events	✓
Outdoor map view	✓
Indoor map option	✓
Cell site display	✓
Internal GPS	✓
External GPS	✓
Android localization	✓
IP capture	✓

19.3 Comparison of Cell and Carrier Lock Capabilities

Cell and Carrier Lock – Use Cases	Infovista, Qualcomm-based Samsung devices with cell lock functionality	Infovista, Shannon-based Samsung devices with cell lock functionality
WCDMA idle mode		
Force reselection to cell	No	✓
Force reselection to UARFCN	No	✓
Stay on cell	No	✓
Lock on UARFCN	✓	✓
Prevent reselection to cell	No	No
Prevent reselection to UARFCN	No	No
WCDMA dedicated mode (Cell DCH)		
Force handover to cell	No	No
Force handover to UARFCN	No	No
Stay on cell	✓	✓
Lock on UARFCN	✓	✓
Prevent handover to cell	No	No
Prevent handover to UARFCN	No	No
LTE idle mode		
Force reselection to EARFCN	✓	✓
Stay on EARFCN	✓	✓
Lock on PCI	✓	✓
LTE connected mode		
Stay on EARFCN	✓	✓
Lock on PCI	✓	✓
General		
Maximum number of cells	1	1
Maximum number of UARFCNs/EARFCNs	1	1

Use function without restarting device	✓	✓
Automate usage via scripts	✓	✓
Interleave with other control functions	✓	✓
Control in real time	✓	✓

20 Appendix B: Predefined Events in TEMS Pocket

This appendix lists all predefined events in TEMS Pocket.

20.1 Device-related Events

Battery Low
External Memory Card Error
GPS Connected
GPS Disconnected
GPS Position Found
GPS Position Lost
Low Disk Space

20.2 Radio Events

Event Category	Event Names
Call: GSM/WCDMA, CDMA	Blocked Call Call Attempt Call Attempt Retry *(CDMA)* Call End Call Established Call Setup Dropped Call
CS fallback, LTE to GSM/WCDMA or CDMA	CSFB Call Attempt CSFB Call Established CSFB Call Setup
Other (all technologies)	Cell Changed Channel Changed Data Mode Changed RAT Changed

20.3 SIP Events

These events are generated in the course of VoLTE calls.

Event Category	Event Names
SIP registration	SIP Registered SIP Registration Failure SIP Unregistered
VoLTE call	SIP Blocked Call SIP Call Attempt SIP Call Attempt Retry SIP Call Established SIP Call Setup SIP Dropped Call SIP End Call

20.4 TEMS Pocket Related Events

Event Category		Event Names		
		"Start" & misc. events	*"End" events*	*"Error" events*
Script		Script Start Script Iteration Maximum Duration Triggered *(for script action)*	Script End	Script Error
Session/ Operation	ABM	ABM Start	ABM End	ABM Error
	AQM	AQM Start	AQM End	AQM Error
		Call Sequence Start	Call Sequence End	Call Sequence Error
	Control function *(application of)*	Control Function Start	Control Function End	Control Function Error
	Controller/Agent	Agent Connected Agent Script Start	Agent Disconnected Agent Script End	–
	Email	Email Start	Email End	Email Error
		–	Email Send Success	Email Send Failure
	Facebook	Facebook Start	Facebook End	Facebook Error Facebook Operation Error
	TEMS Director *(interacting with TEMS Pocket Professional)*	TEMS Director Start	TEMS Director End	TEMS Director Error
		TEMS Director Info	TEMS Director Downloaded Files	TEMS Director Warning TEMS Director Critical
	FTP	FTP Start FTP Connected To Server	FTP End FTP End Session After Time FTP Transfer Complete	FTP Error
	HTTP Get	HTTP Start	HTTP End HTTP End Session After Time	HTTP Error
	HTTP Post	HTTP Upload Start	HTTP Upload End HTTP Upload End Session After Time	HTTP Upload Error
	Idle	Idle Start	Idle End	Idle Error
	Indoor measurement	–	Antenna Verification Result	–
	Instagram	Instagram Start	Instagram End	Instagram Error Instagram Operation Error
	IP capture	IP Capture Start	IP Capture End	IP Capture Error
		"Start" & misc. events	*"End" events*	*"Error" events*
	Log file recording	Log file Start	Log file Stop	Log file Error

	Filemark		
Log file upload (FTP)	Upload Start	Upload End	Upload Error
Log file upload (HTTP)	HTTP Upload Start	HTTP Upload End	HTTP Upload Error
Parallel *execution (of multiple tasks)*	Parallel Execution Start	Parallel Execution End	Parallel Execution Error
Ping	Ping Start	Ping End	Ping Error
	External Scanner Connected	External Scanner Disconnected	–
Scanning *(of mobile network)*	Scan Start LTE Scan Start WCDMA Scan Start GSM Scan Start CDMA Scan Start EV-DO Scan Start	Scan End	Scan Error
SMS	SMS Start	SMS End	SMS Error
	SMS Send Start	SMS Send Success	SMS Send Failure
	SMS Receive Start	SMS Receive End	SMS Receive Failure
Synchronization *(of TEMS Pocket data with FTP server)*	Synchronize Start	Synchronize End	Synchronize Error
Twitter	Twitter Start	Twitter End	Twitter Error Twitter Operation Error
Voice MO	Voice MO Start	Voice MO End	Voice MO Error
Voice MT	Voice MT Start Voice MT Call Received	Voice MT End	Voice MT Error
Whatsapp	Whatsapp Start Whatsapp Error	Whatsapp End Whatsapp Operation Error	Whatsapp Mean RTT
YouTube	Wi-Fi Start	Wi-Fi End	Wi-Fi Error
	YouTube Start	YouTube End	YouTube Error
	YouTube Video Start	YouTube Video End YouTube Session Timeout	YouTube Video Error

21 Appendix C: Automatic Processing of TEMS Pocket Log files in TEMS Discovery

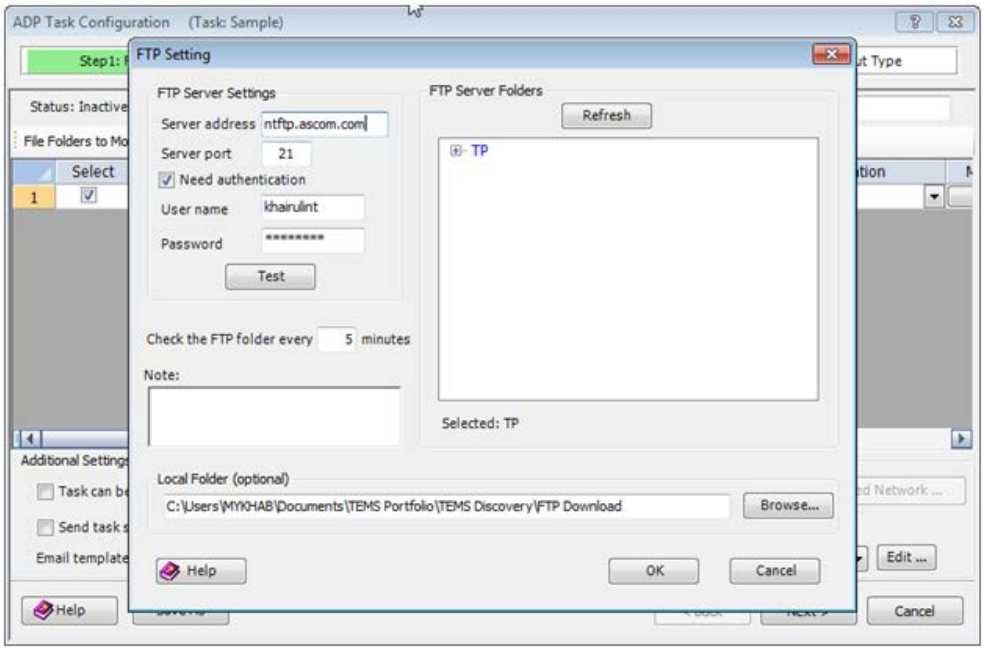
Log files created in TEMS Pocket can be uploaded to an FTP server, as described in section 6.6.

In TEMS Discovery, an automatic data processing (ADP) task can monitor this FTP server directory for incoming log files, process the files that arrive, and import them into a project and dataset in TEMS Discovery.

The following is a description of the procedure for initiating such an ADP task in TEMS Discovery.

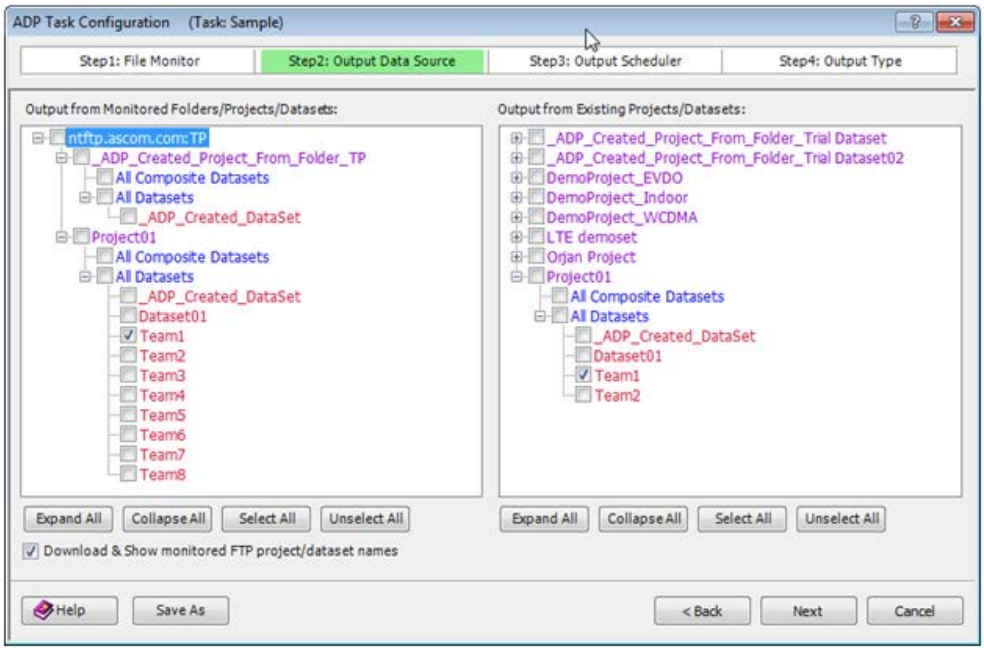
Step 1:

Specify the directory on the FTP server to monitor for incoming log files.



Step 2:

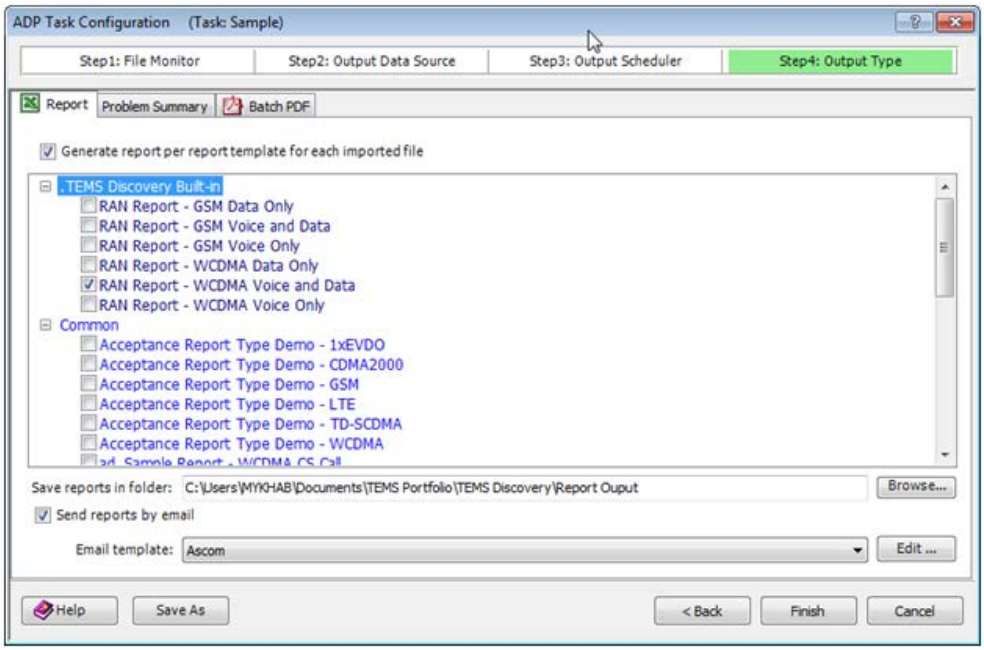
Here you decide on the output data source where your automatically processed log files should be saved in TEMS Discovery. You specify the project and dataset that will contain your log file data.



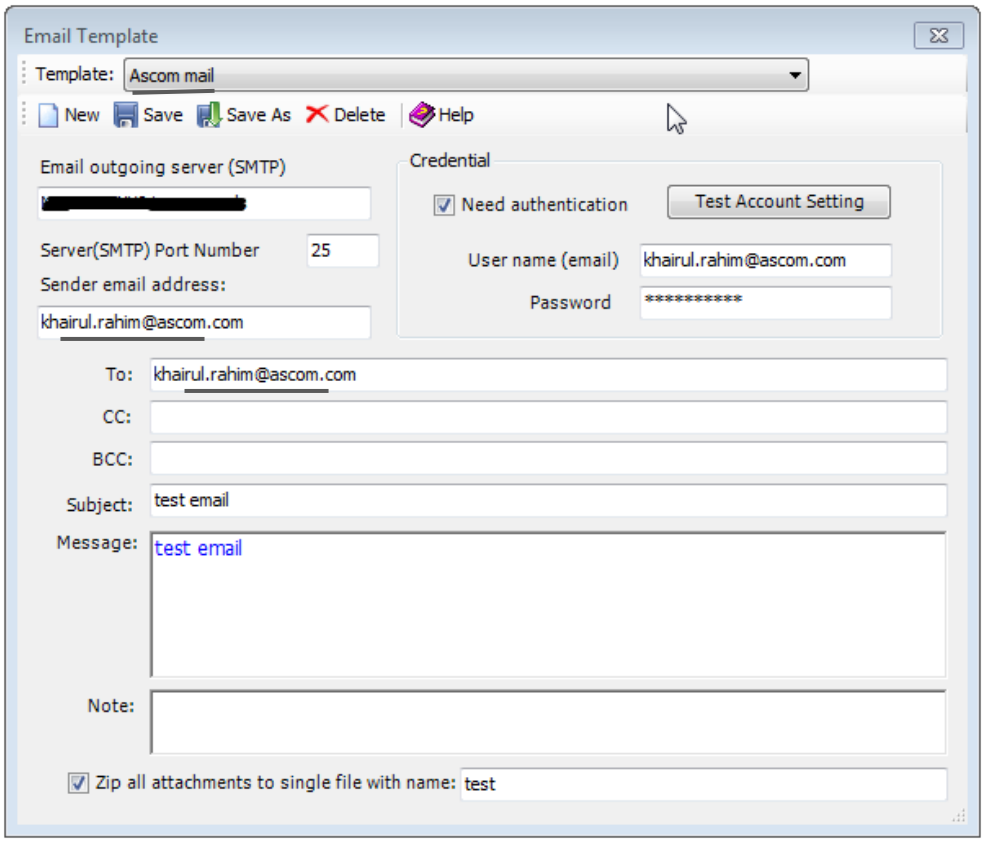
The first time you allow data to be uploaded to a specific project and dataset, you select it among the projects and datasets listed in the left-hand pane. The next time you specify the output data source, you may select the project and dataset from the list in the right-hand pane.

Step 3:

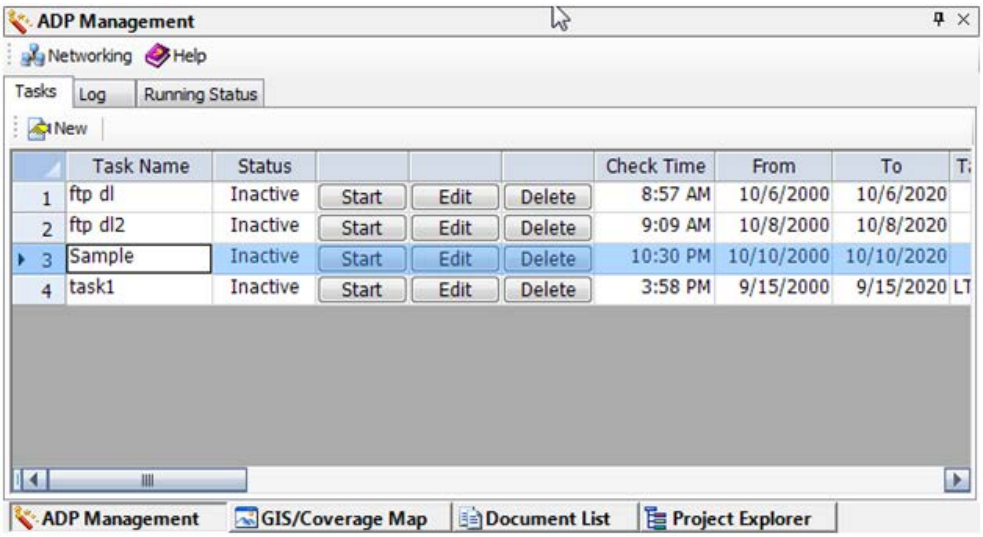
Assuming you have scheduled the task (under Output Scheduler), the last step is to specify whether you would like a report with the newly processed data, in Excel or as PDF. The output could also be subject to study in Problem Summary.



The report could then be sent by email using a predefined email template.



The created automatic data processing task is now listed in the ADP Management view. From here you can start, edit, or delete your task, and check the running status.



The layout and contents of the report depend on the template selected; an example of an Excel report extract is shown below.

RF Coverage and Quality Summary

Metrics	Sample Count	Linear Average	Mean	Max	Min	90%-tile	75%-tile
Top 1 CPICH RSCP	440	-63,33	-73,85	-52	-125,6	-58,8	-62,3
Top 1 CPICH Ec/Io	440	-8,67	-9,58	-3,1	-20,2	-5,7	-7,4
Rx Power (dBm)	440	-55,47	-64,09	-45	-104,8	-51,9	-54,1
Tx Power (dBm)	346	4,83	-24,79	22,3	-49,1	-2,2	-10,9

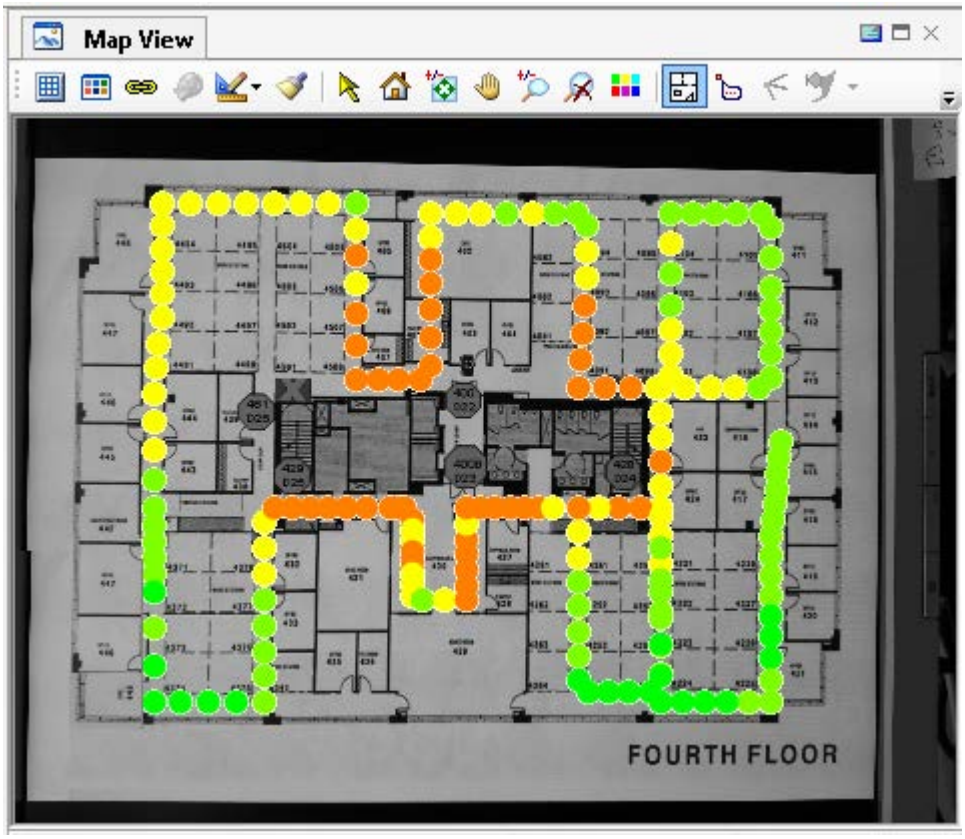
Top 1 CPICH RSCP

Such generated reports can then be distributed to anyone anywhere in the organization.

22 Appendix D: Positioning TEMS Pocket Indoor Measurements in TEMS Discovery

Indoor measurements from TEMS Pocket are saved in a *.trp file containing an indoor map (for example, a floor plan drawing) and the actual measurement samples (waypoints). This *.trp file is uploaded to an FTP server and from there imported into TEMS Discovery (or TEMS Investigation) just like a regular drive test data file, as described in Appendix B. The file can also be imported manually into TEMS Discovery like any other log file.

Once imported and processed in TEMS Discovery, any data can be dragged and dropped into the map view, displaying both the measurement samples and the corresponding floor plan. Those samples can be analyzed as they appear without having a valid geographical position; see the figure below.

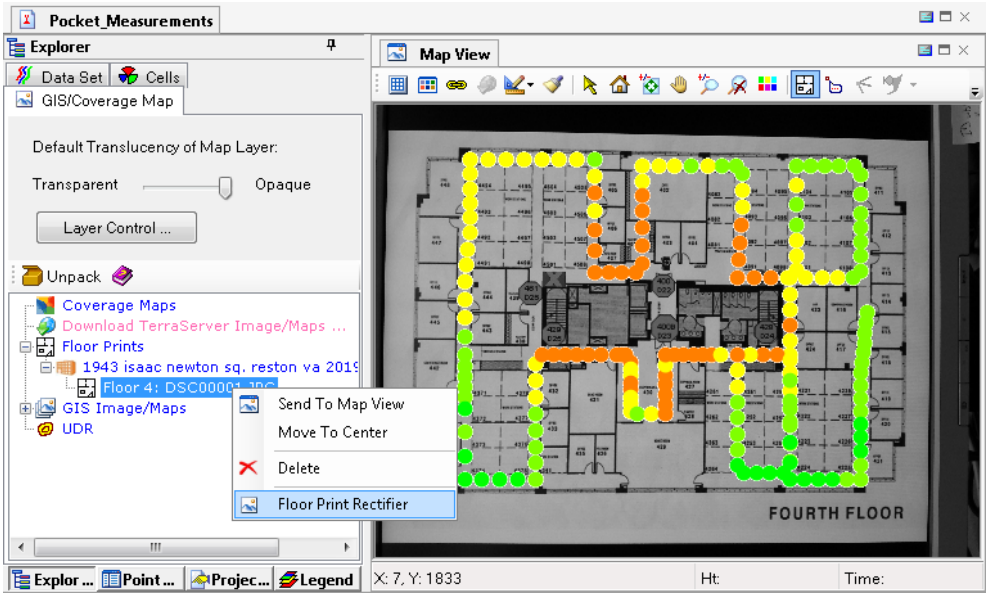


If the indoor measurement samples (waypoints) are positioned inside TEMS Discovery, they are displayed like ordinary outdoor drive test data along with other GIS and cell configuration data. The indoor measurements from TEMS Pocket can thus be analyzed in a more realistic way, in relation to outdoor measurements.

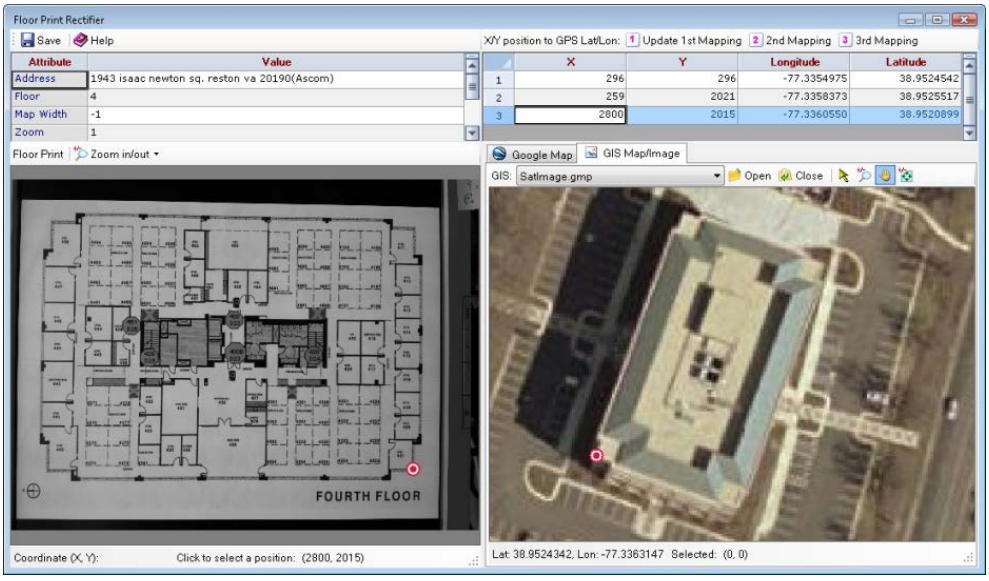
To position the indoor measurements, follow the procedure described below.

When any data is dragged and dropped into the map view, the floor plan appears with the selected data samples plotted.

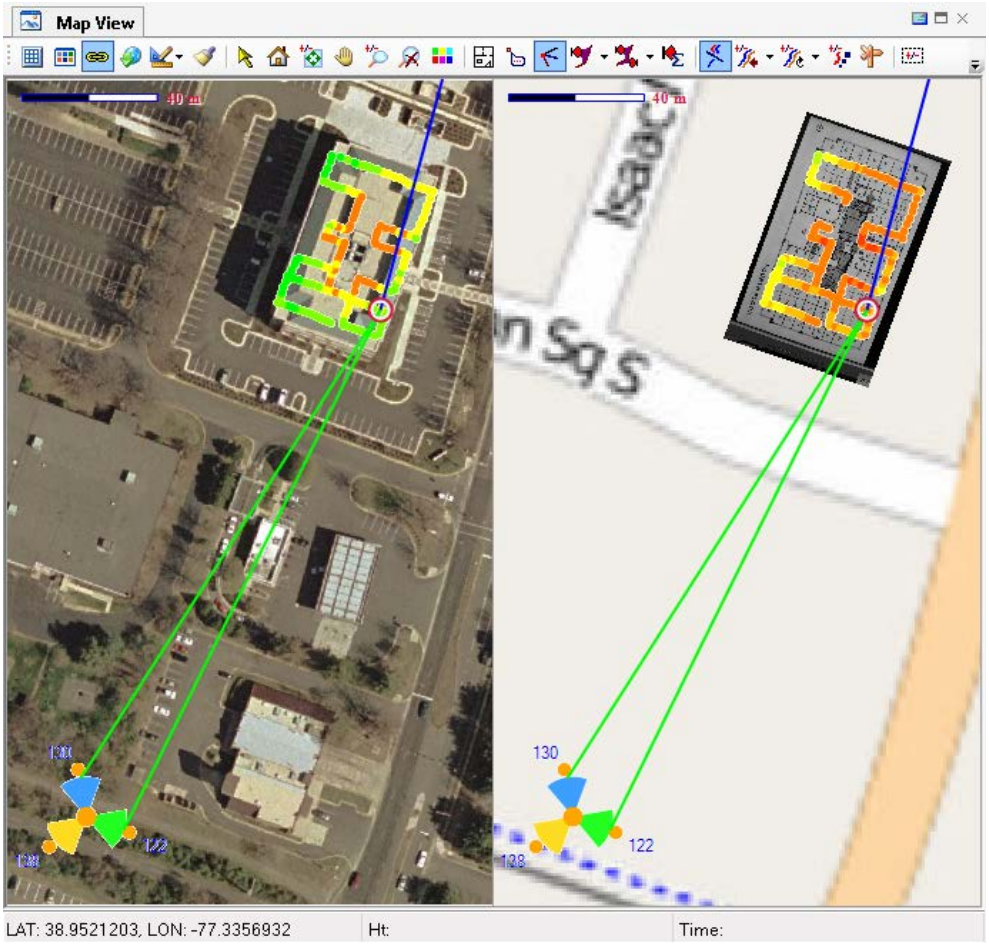
- To position these measurements in relation to the actual building, right-click the floor plan in the Explorer, GIS/Coverage Map tab, and select Floor Print Rectifier.



- Now mark the corners of the floor plan and the corresponding corners of the building in the map image. After identifying three valid geographical positions in this fashion, click Save.



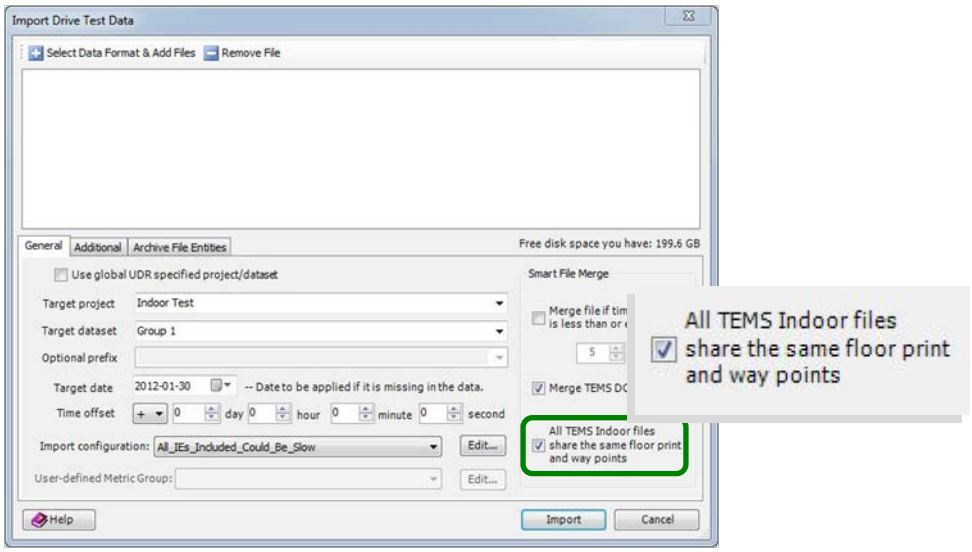
- On completing the geo-rectification procedure, you can display indoor measurement data just like data from regular outdoor drive tests, along with other GIS and cell configuration data.


Map View
40 m
40 m
130
122
LAT: 38.9521203, LON: -77.3356932
Ht:
Time:

23 Appendix E: Reusing Positioning Data for Multiple Devices in TEMS Discovery

This appendix discusses the practicalities of using TEMS Discovery to assign positioning data from one data-collecting device to a set of other devices that accompanied it along the same test route.

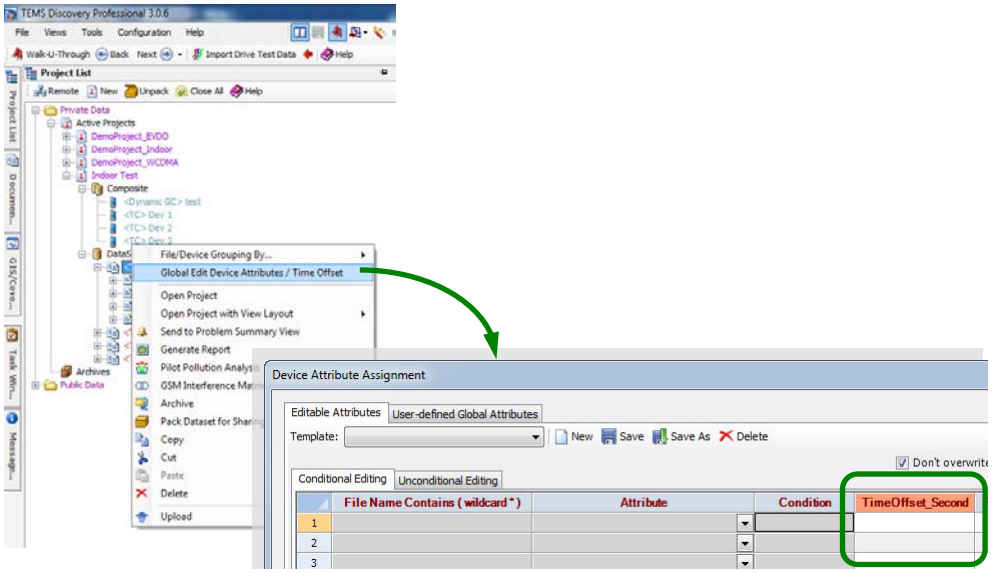
- Before starting your test, make sure all TEMS Pocket devices are carefully synchronized in time.
- Perform your test.
- Then launch TEMS Discovery and import the TEMS Pocket log files just created into that tool. Create a TEMS Discovery data set containing all of these files. Check the checkbox named **All TEMS Indoor files share the same floor print and waypoints**.



If the devices were, in the event, not perfectly time-synchronized during measurement, you can still fix this in TEMS Discovery by introducing manual time offsets:

- In the Project List pane, right-click your TEMS Pocket data set and select **Global Edit Device Attributes / Time Offset** from the context menu.
- In the dialog that appears, enter the appropriate time offset for each log file in the **TimeOffset_Second** column. All data in these files will then be nudged forward or backward in time accordingly.

See the screenshots on the next page.


TEMS Discovery Professional 3.0.6
File
Views
Tools
Configuration
Help
Project List
Private Data
Active Projects
DemoProject_EVDO
DemoProject_Indoor
DemoProject_WCDMA
Indoor Test
Composite
File/Device Grouping By...
Global Edit Device Attributes / Time Offset
Open Project
Open Project with View Layout
Send to Problem Summary View
Generate Report
Archive
Copy
Cut
Paste
Delete
Upload
Device Attribute Assignment
Editable Attributes
User-defined Global Attributes
Template:
New
Save
Save As
Delete
Conditional Editing
Unconditional Editing
File Name Contains (wildcard *)
Attribute
Condition
TimeOffset_Second

24 Appendix F: Integrating TEMS Pocket with iBwave Design 5.3

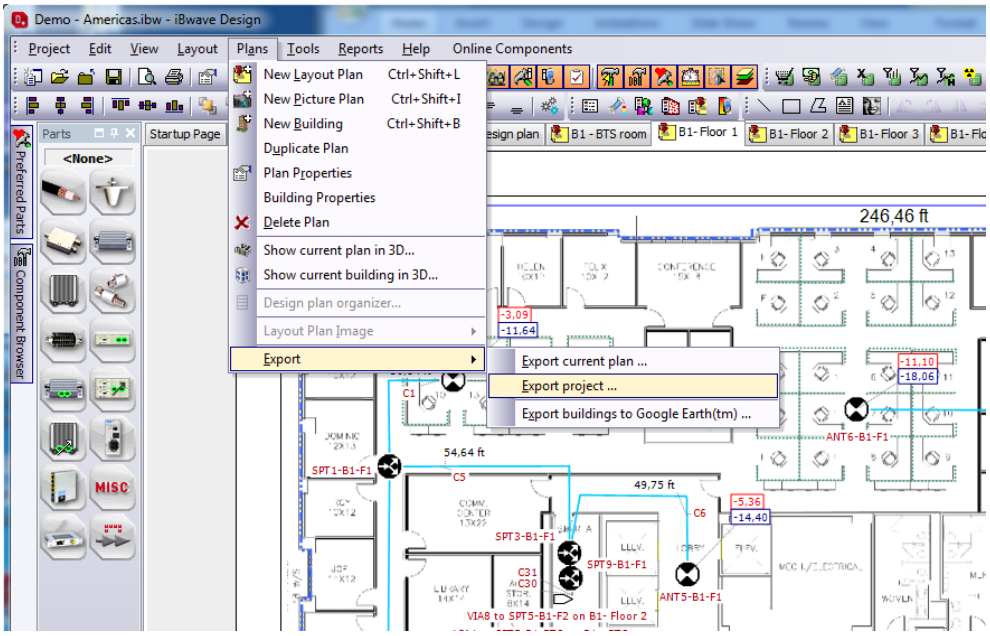
iBwave Design is an in-building project management tool that enables the user to plot coverage and propagation charts, track equipment cost, and manage the project activities surrounding deployment of in-building wireless networks.

In iBwave Design version 5.3, it is possible to export both floor plans and their associated geographical positioning data. This data can be imported into TEMS Pocket, providing easy access to accurate building floor plans and automatic configuration of their geographical position.

The following description outlines the steps required to export the necessary information.

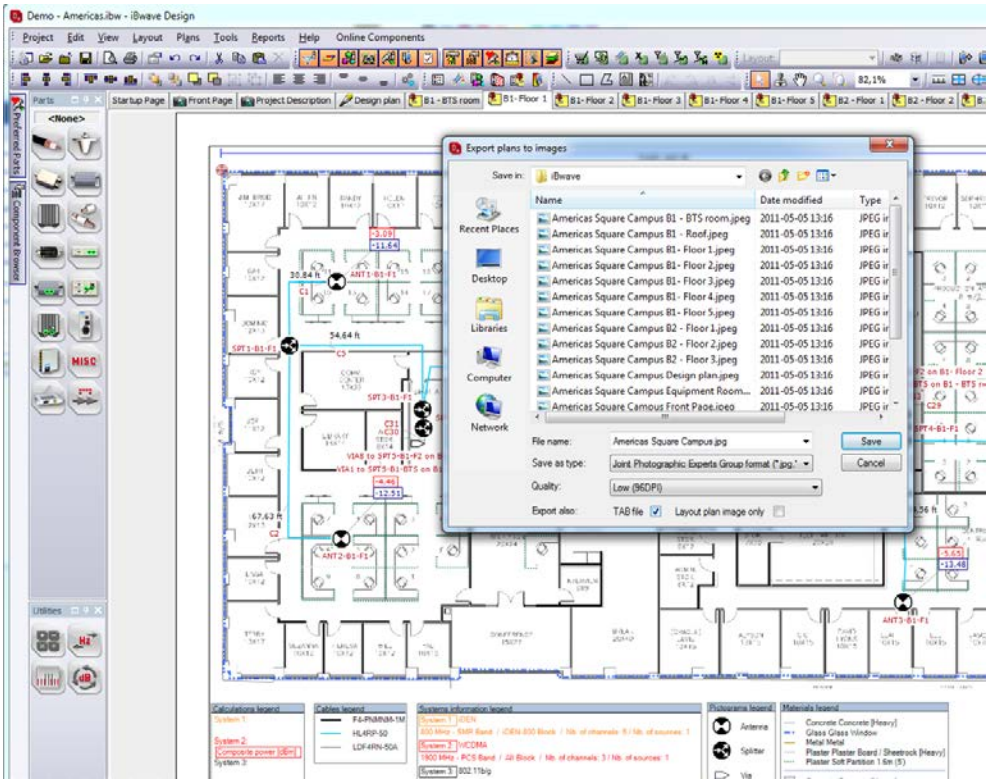
Step 1:

Open iBwave Design and in the menu pane select Plans → Export. You can export the selected plan only or the entire project. Select what is most applicable.



Step 2:

At the bottom of the export dialog is a “TAB File” checkbox. Checking this box will also export the MapInfo TAB files. If the box is unchecked, only the floor plan images will be exported.



Step 3:

Transfer the files to the internal memory card of the TEMS Pocket device, and create a map set in TEMS Pocket. MapInfo files will be imported automatically as they are located with the map and have the same name.