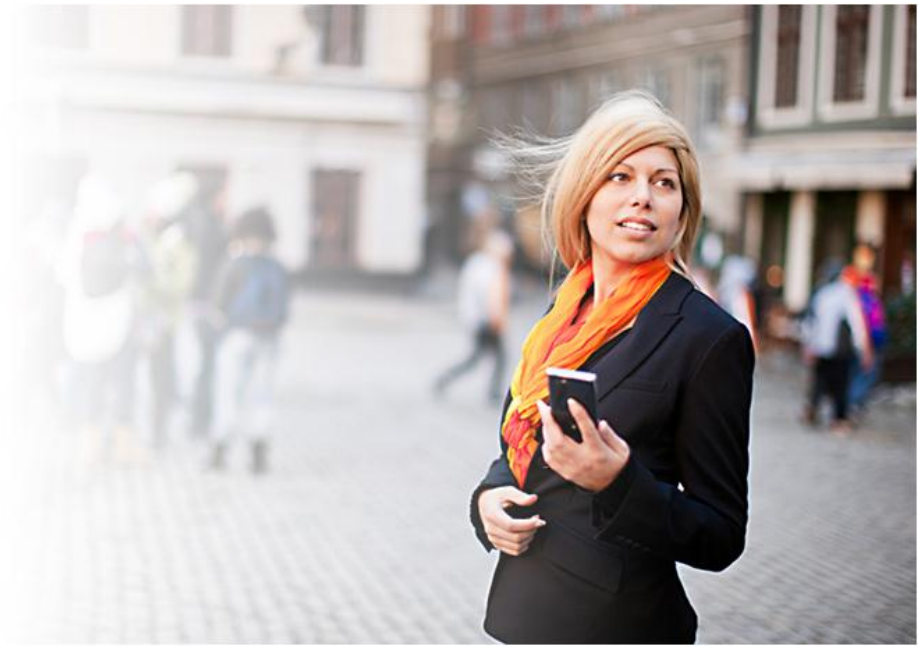
TEMS™ Pocket 14.1 Technical Product Description



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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 Ascom Network Testing 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 it using other tools in the Ascom Network Testing TEMS™ portfolio, or directly in the handset via logfile replay.

1.3 TEMS Pocket Packages

TEMS Pocket is implemented on a number of Samsung and Sony handset models, and is offered in a variety of packages:

- **Standard**[1]**:** Displays full RF measurements and signaling, but does not record information to logfile. Attractively priced, entry-level offering.
  - This package is suitable when test and verification are done in real time and there is no need to store data for post-processing.
- **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 Ascom FleetManager.
- **Premium:** The Professional and Remote packages combined into one.

TEMS Pocket 14.1 is available in all of these packages. The availability for selected older releases is tabulated below for reference:

TEMS Pocket Package	TEMS Pocket 14.1	TEMS Pocket 13.3	TEMS Pocket 12.4
Standard	✓	✓	✓
Professional	✓	✓	✓
Remote	✓	✓	
Premium	✓	✓	

1.4 Optional Features

- **POLQA** license option for AQM measurements.
- **SSL** license option for encryption of HTTP upload and email sessions.
- **Scanning** of mobile networks using an external DRT scanner (model no. DRT4311B).
- **Multi-device** TEMS Pocket configuration, where a *controller* device remote-controls the actions of a set of *agents*. License options exist for both of these roles.
- **VoLTE** license option for VoLTE calls.

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	Standard	Professional	Remote
POLQA	✓	✓	✓
SSL	✓	✓	✓

[1] Previously known as TEMS Pocket Classic.

TEMS Pocket Feature	Standard	Professional	Remote
Scanning (DRT)		✓	
Multi-device, controller	✓	✓	
Multi-device, agent	✓	Included	Included
VoLTE	✓	✓	✓
Indoor		Included	

1.5 Expansions

- The TEMS Pocket Standard package can be expanded to Professional.
- The TEMS Pocket Professional package can be expanded to Premium.
- The TEMS Pocket Remote package can be expanded to Premium.
- A TEMS Pocket device can be expanded with software for use with TEMS Investigation.

2 Recently Introduced Features in TEMS Pocket

2.1 What's New in TEMS Pocket 14.1

2.1.1 WCDMA Scanning with DRT4311B Scanner

Scanning with an external DRT4311B scanner is extended to WCDMA in this release. **CPICH pilot scans** can be performed, either manually or governed by a script. The measurements are presented in newly created WCDMA scan data views.

The strengths of this solution remain the same as for the existing LTE scanning:

- Handled by a separate device, the scanning is **independent** of other TEMS Pocket activities and can run in parallel with these.
- The scanner is lightweight with low power consumption, thus excellently **portable** and **resource-efficient** and ideally suited for in-building measurement.
- The scanner can be stowed in the **Small Backpack**, connected via USB to a TEMS Pocket phone which in turn communicates via Bluetooth with a TEMS Pocket Controller device.

2.1.2 New Action for Logfile Recording Start/Stop

Whether or not to record the execution of a script in logfiles has until now been a property set for the script as a whole. This property has been removed, and instead it is now possible to **turn logfile recording on and off at any point** in a script. This is done with a new "Logfile Recording" action, which can also affix user-defined tags to logfiles for purposes of categorization.

The reworked handling allows recording of multiple actions, or even an entire script execution, in the same logfile.

As a convenient means to preserve the old TEMS Pocket behavior if desired, a new option has been added to the general script settings which automatically encloses each measurement action within Logfile Recording "start" and Logfile Recording "stop" actions.

2.1.3 Custom Logfile Naming

A more elaborate logfile naming scheme is introduced as an option for indoor pinpointing. You can predefine a set of **logfile prefixes**, and then pick one of these at recording time for use in logfile names. You can also add further elements to the logfile name: a string representing yourself as **user**, and the GUID contained in the indoor **map set**.

2.2 What Was New in TEMS Pocket 14.0

2.2.1 New Device: Samsung Galaxy S4 GT-I9506

This phone is similar to S4 GT-I9505 (which remains as a supported TEMS Pocket device) but is in a **higher LTE category (4)** with a maximum downlink throughput of 150 Mbit/s.

- Frequency bands:
  - LTE 800 (Band 20), 850 (B5), 900 (B8), 1800 (B3), 2100 (B1), 2600 (B7)
  - WCDMA 850 (Band V), 900 (VIII), 1900 (II), 2100 (I)
  - GSM 850, 900, 1800, 1900
- Throughput categories:
  - LTE Category 4 (150/50 Mbit/s)
  - HSDPA Category 24 (42 Mbit/s), HSUPA Category 6 (5.8 Mbit/s)
  - GPRS/EDGE Class 12
- Real-time control capabilities:
  - RAT lock (LTE, WCDMA, GSM)
  - Band lock (LTE, WCDMA, GSM)
  - LTE EARFCN/PCI lock
  - WCDMA UARFCN lock
  - WCDMA disable handover
- Google Android 4.2.2
- WLAN 802.11 a/ac/b/g/n
- Integrated GPS with A-GPS support
- Chipset: Qualcomm Snapdragon 800 MSM8974
- CPU: Quad-core 2.3 GHz

2.2.2 New VoLTE Capable Device: Samsung Galaxy Note 3 SM-N900V

This is a VoLTE-capable device which in TEMS Pocket 14.0 replaced LG Lucid 2 VS870 as a TEMS Pocket device with that capability. The Galaxy Note 3 phone operates on **LTE and CDMA/EV-DO** networks and was the first TEMS Pocket device running **Android 4.3**.

This device is operator-locked to Verizon.

- Frequency bands:
  - LTE 700 (Band 13), 1700 (B4)
  - WCDMA 850 (Band V), 900 (VIII), 1900 (II), 2100 (I)
  - GSM 850, 900, 1800, 1900
  - CDMA 800 (BC 0), 1900 (BC 1)
- Throughput categories:
  - LTE Category 3 (100/50 Mbit/s)
  - HSDPA Category 24 (42 Mbit/s), HSUPA Category 6 (5.8 Mbit/s)
  - GPRS/EDGE Class 12
  - EV-DO Rev. A (3.1 Mbit/s)

- Real-time control capabilities:
  - RAT lock (LTE, WCDMA, GSM)
  - Band lock (LTE, WCDMA, GSM)
- Google Android 4.3
- WLAN 802.11 a/ac/b/g/n
- Integrated GPS with A-GPS support
- Chipset: Qualcomm Snapdragon 800 MSM8974AB v2
- CPU: Quad-core 2.3 GHz

2.2.3 Presentation of SIP Messages

As an aid to VoLTE call analysis, a **new data view** was provided listing SIP messages. It is similar in layout to the existing Layer 3 message view and lets you view full **plain-text decoding** of these messages, with highlighting of syntax elements to ease reading.

You can freeze the view to scroll through and study the SIP message flow at your leisure.

2.2.4 New License Handling with Global License Server

The Global License Server (GLS) solution for license management, previously in place for TEMS Investigation and TEMS Discovery, was adopted for TEMS Pocket as well.

As a TEMS Pocket customer, you will only use GLS to manage license **options purchased** at additional cost (POLQA, SSL, etc.). The fundamental TEMS Pocket licenses are preinstalled on the device. To install your premium license options, you log in to GLS through a Web interface and map the appropriate add-ons to your device.

GLS gives you a **bird's-eye view** of where all licenses in your pool of purchased items are allocated. Further, it allows you to easily and securely **move** licenses from one device to another to optimize their utilization.

A couple of aspects of the licensing as such also changed in TEMS Pocket 14.0:

- **Indoor** testing no longer requires a separate license option; it is included in the Professional and Premium packages.
- The **Controller** option is no longer included in the Professional package but is optional there. On the other hand, the Controller add-on can be transferred between devices in GLS, as described above.

2.2.5 LTE "EARFCN/PCI Lock" Control Function

This function locks the Samsung S4 GT-I9506 to **one Physical layer Cell Identity** on **one LTE EARFCN**. It is implemented in the TEMS Capability Control app used in conjunction with TEMS Pocket. The function needs to be combined with a RAT lock to LTE in order to take effect. On the other hand, **no reboot** of the device is required.

2.2.6 WCDMA “UARFCN Lock” and “Disable Handover” Control Functions

These functions too are enhancements of the Samsung S4 GT-I9506 control capabilities. Activated from the TEMS Capability Control app, the first function locks the phone to a specified WCDMA **UARFCN**, while the second **disables all kinds of handover** in a WCDMA network (thus in effect keeping the phone locked to the scrambling code it is using). **No RAT lock or device reboot** is needed for either function.

2.2.7 Refined Call Event Handling; CS Fallback Events

The generation of voice call events was thoroughly reworked and streamlined, with trigger conditions brought into the closest possible **agreement with TEMS Investigation**.

In the process, new predefined events were set up for **circuit-switched fallback** transferring VoLTE calls away from LTE, whether to WCDMA/GSM or to CDMA.

2.2.8 Improved Data View Navigation

The top-level screen with shortcuts to data view categories was replaced by a drawer-style **navigation menu** accessed from a new button on the action bar. When opened, the navigation menu pushes the data view to the right; after you make a selection, the menu is hidden again and the data view slides back into place.

Another navigation change is that **vertical swiping** between data view categories was **disabled**. To select a different data view category, you simply pick it from the navigation menu. A key reason for this change is to allow making individual views scrollable so that they can hold more contents (in future versions of TEMS Pocket).

On tablets, where screen real estate is not such a major concern, the existing design with permanently visible navigation icons on the left is retained.

2.2.9 Handling of Script Actions Exceeding Their Maximum Duration

For script actions generally it is possible to set a maximum duration, so that the action will stop executing if this time is exceeded. This functionality existed in previous versions. From TEMS Pocket 14.0 onward, for FTP, HTTP, and YouTube actions, you can specify whether an action halted in this way should be **regarded as successful or failed**. Either an “end” event or an “error” event will be generated depending on the setting chosen.

An additional event is generated to signify the **expiry** of the maximum action duration as such.

2.2.10 Withdrawal of Subset of TEMS Pocket 13.x Devices

The new Samsung S4 and Note 3 phones **replaced** all of the following older TEMS Pocket devices:

- Samsung Galaxy Note II SCH-I605
- Samsung Galaxy Note II SGH-I317
- Samsung Galaxy S III GT-I9305
- Samsung Galaxy S III SCH-R530M

- Samsung Galaxy S III SGH-I747
- Samsung Galaxy S III SPH-L710
- HTC One XL X325S
- LG Lucid 2 VS870 (succeeded by Samsung Galaxy Note 3 SM-N900V as VoLTE-capable device)

2.3 What Was New in TEMS Pocket 13.3

2.3.1 Multi-device TEMS Pocket: Controller/Agents

With TEMS Pocket 13.3 we launched a **multi-device measurement setup** where one "controller" device (preferably a tablet) controls the actions of a set of "agent" devices. A tailor-made backpack solution has been designed for carrying the agents – up to seven of these, optionally including a DRT scanner. The communication between controller and agents takes place over Bluetooth.

The point of this setup is to let you operate a whole battery of TEMS Pocket devices through a **single interface**. On the controller device you can start and stop scripts on the agents, and monitor the progress and status of each agent. You can position measurement data for all agents at once by pinpointing in the controller Indoor Map view.

2.3.2 YouTube Testing

In TEMS Pocket 13.3 you can test **download and replay of YouTube video** clips in TEMS Pocket. A special action takes care of this task, presenting the footage in a special "free-floating" view nailed to the foreground.

A host of value elements report on the performance of the HTTP streaming, and a freshly designed progress view keeps you updated on the unfolding of the YouTube session.

2.3.3 LTE RACH Analysis Data View

A new data view was introduced displaying parameters and data related to **RACH signaling and paging in LTE**. It is similar to existing RACH views for WCDMA and GSM and indicates, among other things:

- Reason for RACH signaling, type of RACH procedure.
- Preamble settings such as initial Tx Power, power ramping step size, and maximum number of preambles; during preamble transmission, Tx Power for current preamble.
- Outcome of RACH procedure.

2.3.4 Customizable Logfile Storage Location

If a device has multiple storage media available, for example, if it has an external memory card inserted in addition to its built-in memory, you can **select where to store** TEMS Pocket logfiles from TEMS Pocket 13.3 onward.

2.3.5 Caching of Cell Identities

Cell identities are reported rather infrequently from the network, and only for serving cells. A cell caching function added in TEMS Pocket 13.3 makes the presentation of cell identities **more comprehensive** by storing all cells that the device comes across, so that when the same cell reappears later on, its identity can be displayed immediately. This function operates in both LTE, WCDMA, and GSM networks.

2.3.6 Selective Wi-Fi Scanning

Wi-Fi scanning consumes considerable resources and will detract noticeably from the performance of Wi-Fi data transfer if performed continually. A new function was therefore introduced which allows you to **turn off** TEMS Pocket-induced Wi-Fi scanning while data is being transferred via Wi-Fi.

2.3.7 Customizable Value Element Display Formats

The presentation of value elements such as cell identities and LAC/RAC/TAC can be switched between **decimal and hexadecimal**. In some cases, additional and data-specific presentation formats are available, such as LTE PCI split into Group ID and Phy ID.

2.3.8 Dynamic Naming of Files Uploaded via FTP

When testing FTP upload, you can have each transferred file **named dynamically and uniquely** instead of using an unchanging static name. Dynamic file names are composed of the current date and time concatenated with the device serial number.

2.3.9 SIM-free/Flight Mode Start-up of TEMS Pocket

It is possible to start TEMS Pocket 13.3 **without a SIM** being present, or while the device is in **flight mode**. This allows you to record a logfile with the initial attach procedure that occurs when disabling flight mode and going into normal mode of operation.

2.4 What Was New in TEMS Pocket 13.2

2.4.1 LTE Scanning with DRT4311B Scanner

TEMS Pocket 13.2 introduced a unique in-building solution for high-performance, multi-technology **scanning** using an external scanner from DRT (model name: DRT4311B). This solution offers a significant reduction in weight and power consumption compared to traditional scanners, and it removes the need for a cumbersome laptop-based configuration. Simply hook up the lean and lightweight scanner via USB directly to your TEMS Pocket smartphone or tablet for a **discreet and super-portable** scanning setup, ideal for today's heterogeneous networks and for small-cell/DAS deployments.

As a first step, TDD and FDD LTE Reference Signal scanning was offered in TEMS Pocket 13.2. Scans can be either manual or scripted; in either case, as it is handled by a separate device, the scanning is completely **independent** of other TEMS Pocket activities and can run **in parallel** with these.

2.4.2 New Device: LG Lucid 2 (VS870)

This LTE/CDMA smartphone was the first TEMS Pocket device to support voice calls over LTE (**VoLTE**). *It has since been superseded.*

2.4.3 VoLTE Support

TEMS Pocket 13.2 saw the introduction of **VoLTE** voice call testing. Scripting of VoLTE calls is handled by the Voice and Voice MT actions. In the former, a new “Call type” setting determines whether to use a circuit-switched or packet-switched bearer.

Audio quality measurement during VoLTE calls can be done with the POLQA algorithm.

2.4.4 IP Capture from Device Modem

An additional option was introduced for IP sniffing. IP logs can be extracted not only from the Android IP stack but also from the **device modem** (that is, when the data transfer is done over a mobile network as opposed to Wi-Fi).

For **VoLTE**, it is essential to log IP data from the device modem to furnish input to KPI calculation in post-processing tools such as TEMS Discovery.

2.4.5 “Half-duplex” Mobile-to-mobile POLQA

In mobile-to-mobile calls between two TEMS Pocket 13.2 devices, POLQA voice quality scores can be computed **at both ends** during the same call. Each speech sentence is transmitted in both directions, enabling each device to calculate a POLQA score for it.

POLQA can be computed both for CS voice (except on CDMA) and for VoLTE.

2.4.6 Locking to Multiple RATs and Bands

The **RAT lock** control function was refined in TEMS Pocket 13.2 to permit locking of the TEMS Pocket device to a **subset of multiple** radio access technologies, not just to a single technology. For example, the device can be allowed to camp on GSM and WCDMA while being prevented from accessing LTE.

For **band lock**, the option of locking on more than one band already existed for LTE and WCDMA but was introduced for **GSM** as well.

2.4.7 Cell File Data Used as Guidance with Locking Functions

More ample use is made of **cell file data** in TEMS Pocket 13.2:

- When selecting a cell to lock on, you can **search** the cell file for parameter values as well as arbitrary text in cell names. The latter is especially helpful when you need to identify a cell based on its **location**. A cell turned up by the search can be picked as a lock target by a single-tap operation.
- In the RAT lock dialog it is shown for each RAT **how many bands and cells** the device supports for that technology. Similarly, for the band lock function, a cell count is given for each supported band.

2.4.8 Data Mode Indication

The “current RAT” string in the data view header was supplemented with an indication of data mode, meaning the **type of bearer** currently being used for data transfer. This can be either a mobile network bearer or Wi-Fi.

The TEMS Pocket data mode indication is much more **fine-grained** than the one given on the Android status bar: to give just one example, within WCDMA it distinguishes all of the following: 3G (non-HS), HSPA, HSPA DC (dual carrier), HSPA+, HSPA+ MIMO, HSPA+ DC, and HSPA+ DC MIMO.

2.4.9 WCDMA Fast Dormancy Control

Fast dormancy is a 3GPP mechanism designed to save smartphone battery as well as network resources by minimizing the time the device spends in power-consuming states. The mobile device initiates the procedure by sending a message to the network where it requests to end the current data session.

A new control function in TEMS Pocket 13.2 lets you decide whether to **allow or inhibit fast dormancy** in a WCDMA network. If you inhibit the mechanism, the device’s “session end” requests will be suppressed, so that the network will not receive them.

2.4.10 HTTP Post

HTTP Post offers an alternative route to testing **uplink performance**, with a Web server at the other end instead of an FTP server. The HTTP Post operation is handled by the same script action type as HTTP Get.

2.5 What Was New in TEMS Pocket 13.1

2.5.1 New Device: Samsung Galaxy S4 GT-I9505

TEMS Pocket 13.1 is available on Samsung’s Galaxy S4 model, the successor to the Galaxy S III.

- Frequency bands:
  - LTE 800 (Band 20), 850 (B5), 900 (B8), 1800 (B3), 2100 (B1), 2600 (B7)
  - WCDMA 850 (Band V), 900 (VIII), 1900 (II), 2100 (I)
  - GSM 850, 900, 1800, 1900
- Throughput categories:
  - LTE Category 3 (100/50 Mbit/s)
  - HSDPA Category 24 (42 Mbit/s), HSUPA Category 6 (5.8 Mbit/s)
  - GPRS/EDGE Class 12
- Real-time control capabilities:
  - RAT lock (LTE, WCDMA, GSM)
  - Band lock (LTE, WCDMA, GSM)

- Google Android 4.2
- WLAN 802.11 a/ac/b/g/n
- Integrated GPS with A-GPS support
- Chipset: Qualcomm Snapdragon 600 APQ8064T
- CPU: Quad-core 1.9 GHz

2.5.2 Sony Xperia LT25i with External Antennas

An **external antenna kit** is offered with TEMS Pocket on the Sony Xperia LT25i phone. The device is then permanently fitted with SMA female connectors on the back of the phone.

With an external antenna you can easily verify previously deployed antenna solutions, or find faulty cables, using only a mobile device. The antenna kit also includes a mini-antenna for normal handheld use; the phone's internal antenna, on the other hand, is permanently disabled in this configuration.

The external antenna solution is available with TEMS Pocket Professional and TEMS Pocket Standard.

2.5.3 TEMS Pocket Remote

TEMS Pocket 13.1 saw the introduction of a **new TEMS Pocket Remote package on the Android platform**. A TEMS Pocket running in Remote mode can be used as an unattended probe tasked with (for example) monitoring or benchmarking. The device is then controlled remotely from our Fleet Manager and does not expose the regular TEMS Pocket user interface.

The behavior of a TEMS Pocket Remote device as an autonomous probe can be flexibly configured on-screen, for example with regard to registration procedures and measurement data upload.

2.5.4 User-customizable Data Views

As a complement to the predefined data views, TEMS Pocket 13.1 comes equipped with a set of **blank views whose contents you customize yourself** in whatever way you like. The views are overlaid with a grid, which you populate piece by piece with a mosaic of the value elements you want to monitor.

You build these custom views from the same types of graphical elements that make up the predefined views:

- **Line charts** with or without a legend and labeling of axes.
- **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.

2.5.5 User-friendly Script and Map Set File Names

The file naming of scripts and map sets created in TEMS Pocket was changed to a more **human-readable format** to make files easier to find.

2.5.6 Max/Min Duration Timers in Script Actions

From TEMS Pocket 13.1 onward, script actions are equipped with maximum/minimum timers which can optionally be used to **control the action duration**. If the action duration reaches the stipulated maximum, the action is immediately ended. On the other hand, if the action completes in less than the minimum execution time, TEMS Pocket will wait until the minimum timer expires and only then continue.

2.6 What Was New in TEMS Pocket 13.0

2.6.1 New Device: Sony Xperia V LT25i

This is an Android smartphone operating on LTE, WCDMA, and GSM networks. With TEMS Pocket installed, it offers **extensive control functionality** for all of these technologies, including LTE RAT lock and LTE band lock.

The casing of the Xperia V LT25i is **water-resistant**, making the phone less susceptible to moisture damage in wet or damp environments.

- Frequency bands:
  - LTE 2100 (Band 1), 1800 (B3), 850 (B5), 2600 (B7), 800 (B20)
  - WCDMA 850 (Band V), 900 (VIII), 2100 (I)
  - GSM 850, 900, 1800, 1900
- Throughput categories:
  - LTE Category 3 (100/50 Mbit/s)
  - HSDPA Category 24 (42 Mbit/s), HSUPA Category 6 (5.8 Mbit/s)
  - GPRS/EDGE Class 12
- Real-time control capabilities:
  - RAT lock (LTE, WCDMA, GSM)
  - Band lock (LTE, WCDMA, GSM)
  - LTE carrier (EARFCN) lock
  - WCDMA cell lock (UARFCN/SC)
  - GSM cell lock/multi-lock, cell prevention
  - Vocoder lock
  - Cell barred lock
  - Access class lock
- IP logging
- Google Android 4.1

- Wi-Fi: 802.11 a/b/g/n
- Integrated GPS with A-GPS support
- Chipset: Qualcomm MSM9615
- CPU: Dual-core 1.4 GHz

2.6.2 New GPS: Garmin GLO

Garmin GLO™ is a combined **GPS and GLONASS** receiver with wireless Bluetooth connectivity. The GPS/GLONASS combination can receive positioning information from up to 24 more satellites than GPS-only receivers.

GLO supports a positioning update frequency of 10 Hz (10 updates per second). Many receivers on the market today only support 1 update per second, giving GLO higher location resolution which is suitable when traveling at vehicular speeds.

GLO has up to 12 hours of battery life and is easy to charge with the included USB cable.

2.6.3 New Device Control Function: LTE EARFCN Lock

The Sony Xperia LT25i and LT30a models come with the capability to lock on one LTE EARFCN (also known as **LTE carrier lock**). This function further expands the range of market-unique capabilities which continues to save TEMS product users untold hours in their daily work.

As operators are beginning to deploy additional carriers in their LTE networks in order to grow their capacity, LTE EARFCN lock enables them to do so more accurately, efficiently, and unobtrusively than is possible with alternative solutions.

Just like previously introduced control functions, the EARFCN lock can be applied in real time to an individual EARFCN (carrier). One initial reboot of the device is required to put the device in a state where it prevents or allows handovers, but when applying the function itself **no reboot is needed** – unlike other similar solutions, which require a reboot for every EARFCN change. TEMS Pocket allows the user to combine the locking capabilities with automated service tests, greatly increasing operational efficiency.

Note: The LTE EARFCN lock offered in TEMS Pocket 13.0 works differently compared to the WCDMA and GSM carrier lock features.

2.6.4 New Device Control Function: Access Class Lock

Sony Xperia LT25i and LT30a handsets are capable of controlling what **access classes (ACs)** they are members of. This feature allows the device to simulate an AC other than the one originally assigned to the USIM. In this way, a network can easily be evaluated with devices belonging to different ACs.

Access classes range from 0 to 15. Of these, 0–9 are default classes, whereas membership of ACs 10–15 entitles a device to make access attempts in various special situations: for example, “NW access emergency calls” (class 10) and “Security service” (class 12).

In TEMS Pocket, the user can simply check a box for each access class the device should be included in. Alternative ways to test the full range of ACs would require multiple different SIM cards and manual configuration of the handset, and would take significantly longer to set up and test reliably.

2.6.5 WCDMA Cell Lock (UARFCN and SC) on Sony Xperia LT25i/LT30a

For more than a decade now, the TEMS portfolio has been able to provide a unique type of locking functionality, designed and developed by Ascom with network testing specifically in mind. This is something unique in the industry.

In TEMS Pocket 13.0, **WCDMA Cell Lock** (UARFCN and SC) control capabilities were introduced on the Sony Xperia LT25i and LT30a phones. Like other control functions, this one can be applied in real time, and unlike those offered by some other solutions, its use **does not require a reboot** of the device.

It must be **noted** that in connected mode, WCDMA Cell Lock on Sony Xperia LT25i/LT30a works somewhat differently than on Sony Xperia arc S LT18i/a and other older TEMS Pocket devices. In idle mode, on the other hand, the function is similar. See section 7.4 for further details.

2.6.6 Mobile-to-mobile POLQA

TEMS Pocket 13.0 added convenient and cost-efficient **mobile-to-mobile POLQA capabilities** to Sony Xperia LT25i devices.

A mobile-to-mobile solution has a number of benefits compared to mobile-to-fixed solutions:

- No external hardware needed, just two devices with voice subscription.
- No need for a fixed call generator or landline, resulting in much easier setup at reduced cost.
- The entire mobile solution can travel with the user, measuring according to local conditions.
- Using a non-PSTN mobile call generator enables super-wideband measurements as landline calls are down-converted to narrowband speech.

Combined with the Ascom-unique capability of vocoder control, introduced in selected handsets in previous releases, the mobile-to-mobile POLQA solution becomes even more versatile, enabling efficient testing of the impact of specific voice codecs on audio quality.

Note: The device that places the call is the one that calculates the POLQA scores. A POLQA license is needed only for the calling device, not for the receiving device. Two POLQA licenses are needed only if the devices are to switch roles, taking turns to measure audio quality.

2.6.7 Voice MT Action: “Answering Service”

Part of the expanded AQM functionality in TEMS Pocket 13.0 (see section 2.6.6) is a new script action type “Voice MT”, used to **receive** mobile-terminated voice calls and play back speech sentences during these calls in order to measure audio quality (POLQA).

2.6.8 Super-Wideband POLQA

From version 13.0 onward, TEMS Pocket calculates POLQA scores for **wideband and super-wideband codecs**, such as AMR-WB. A 48 kHz sample rate is applied for all codecs operating with a sample rate higher than 8 kHz.

2.6.9 More Powerful Custom Events

Custom events were expanded with **boolean logic**, which lets the user combine simple value element conditions (of the form “RSSI < –90 dBm”) into complex AND/OR expressions up to five levels deep. A graphical user interface is provided for assembling and visualizing event expressions.

Any event can be used to trigger a script, as explained in section 2.6.10. Custom-made events can thus be set up to have scripts executed, for example, at specific times of day or in a particular geographical area. All RF and data throughput value elements are likewise available as building blocks in custom events.

2.6.10 Event-based Script Triggers

Script execution can be triggered by the occurrence of an **event**, either predefined or user-defined (custom events: see section 2.6.9). For example, the event can consist of a boolean expression which evaluates to true when the TEMS Pocket device enters a geographical area defined by a lat/long bounding box. Another possibility among many is to have scripts executed at specific times of day (e.g. “Time >= 2 p.m. AND Time <= 4 p.m.”).

A script that has been triggered by an event will stop any currently running script before beginning its own execution.

With scripts configured to run when given conditions are satisfied, TEMS Pocket can operate in a more unattended manner, allowing users to automate more of their testing.

2.6.11 Filemarks

Filemarks can be inserted in a logfile that is being recorded in order to **tag segments** of particular interest in the file, or just to note down some pertinent fact related to the recording.

2.6.12 Map Legend

TEMS Pocket 13.0 displays a **color legend** on both indoor and outdoor maps, indicating what measurement is being plotted and the color ranges used to encode its numerical values. This greatly enhances convenience and usability.

2.6.13 Embedded Quick Guide

Users can access a **Quick Guide** directly from the Help menu in TEMS Pocket. This Quick Guide walks new users through fundamental tasks such as how to record logfiles and navigate in-building environments, and includes helpful tips on how to operate TEMS Pocket efficiently. In this way beginning users are able to get started quickly with minimal training.

The TEMS Pocket Quick Guide is available in the same mobile-friendly format as the embedded User’s Manual.

2.6.14 Revamped Menu System

The TEMS Pocket menu system was reorganized in this release. The new design reflects Android design guidelines and best practices, and dovetails with the trend toward fewer or no hardware buttons on recent smartphones.

An **action bar** with buttons appears at the top of the screen, giving easy access to the most fundamental and frequently used functions such as script start/stop, logfile recording, and pinpointing.

2.6.15 Automatic Adaptation of Value Elements to RAT Transitions

In both indoor and outdoor map plotting, RAT-specific value elements are **automatically swapped** as the TEMS Pocket 13.0 device switches to a different RAT. This adaptation takes place with four basic measurement categories: signal quality, signal strength, RSSI, and physical uplink/downlink throughput. Specifically, the presentation alternates between the following value elements:

Technology	Signal Quality	Signal Strength	Signal RSSI	Physical DL/UL Throughput
GSM	RxQual	RxLev	RxLev	RLC DL/UL
WCDMA	E_c/N_0	RSCP	RSSI	RLC DL/UL
LTE	RSRQ	RSRP	RSSI	PDSCH/PUSCH
CDMA/EV-DO	E_c/I_0	E_c	RxPwr	RLP DL/UL

The automatic switching spares TEMS Pocket users the hassle of manually changing value elements in map plots. Yet another time-saver, this convenient feature also helps increase the user's understanding of the network technologies.

2.6.16 OtterBox™ Protection for Samsung Galaxy S III

*(Offered with Samsung Galaxy **S4** from TEMS Pocket 13.1 onward)*

All Samsung Galaxy S III TEMS Pocket 13.0 phones come with accessories from the market leader in phone protection. The **Otterbox Defender** series offers:

- Robust, three-layer protection withstanding drops, bumps and shocks.
- Built-in screen protector preventing scratches.
- Port covers keeping out dust and debris.
- Holster-style swiveling belt clip, also serving as desk stand.

3 Key Features of TEMS Pocket

TEMS Pocket is an extremely powerful tool, convenient for 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 logfiles 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.

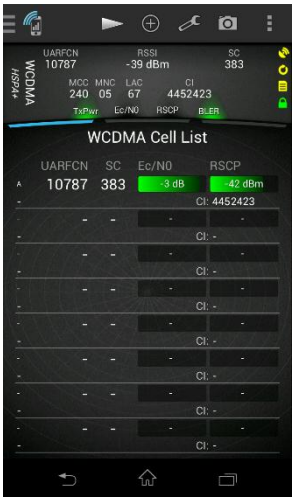
Radio Technologies
LTE
WCDMA/HSDPA/HSUPA
GSM/GPRS/EDGE
CDMA/EV-DO
(Refer to Appendix A for full details on supported bands.)
Service Testing
CS voice calls (MO/MT), optionally with POLQA audio quality measurement (AQM)
VoLTE: Voice over LTE
Data sessions: FTP download/upload, HTTP Get/Post, Streaming (YouTube), email, SMS, Ping
Parallel services: One each of voice, AQM, FTP, HTTP, Streaming (YouTube), email, SMS, and Ping concurrently. This encompasses multi-RAB testing
Mobile network scanning
Wi-Fi scanning
Wait (pause)
Logging
Scripted, manual, or triggered by pinpointing
Logfile recording can be started and stopped at any point in a script
Same level of detail as TEMS Investigation logfiles
Logfile replay
Logfile upload to FTP or HTTP server
Custom logfile tags for logfile management and pre-processing
Filemarks

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 for each device, see table in section 16.5.
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
Voice codec lock
Cell barred lock
Access class lock
Automation
Automated service testing with scripts
Script triggering by user-defined events
Automatic positioning of indoor maps using MapInfo files
Presentation
Data views and graphs (line charts, histograms) showing essential radio and network parameters
Context-sensitive data views populated with relevant data only
Layer 3 message view; SIP message view
Custom views that are assembled by the user from scratch
Event log including call events
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 14.1 logfiles can be post-processed in TEMS Discovery 10.0 or later (Streaming/YouTube requires version 10.0.3; DRT scanning requires 10.0.4) TEMS Pocket 14.1 logfiles can be loaded in TEMS Investigation 15.3 or later (WCDMA scanning requires version 16.1)
Certain TEMS Pocket 14.1 phones can also be used for data collection with TEMS Investigation 15.x or later

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

Regarding TEMS Pocket Remote, see chapter 12.

4 TEMS Pocket User Interface

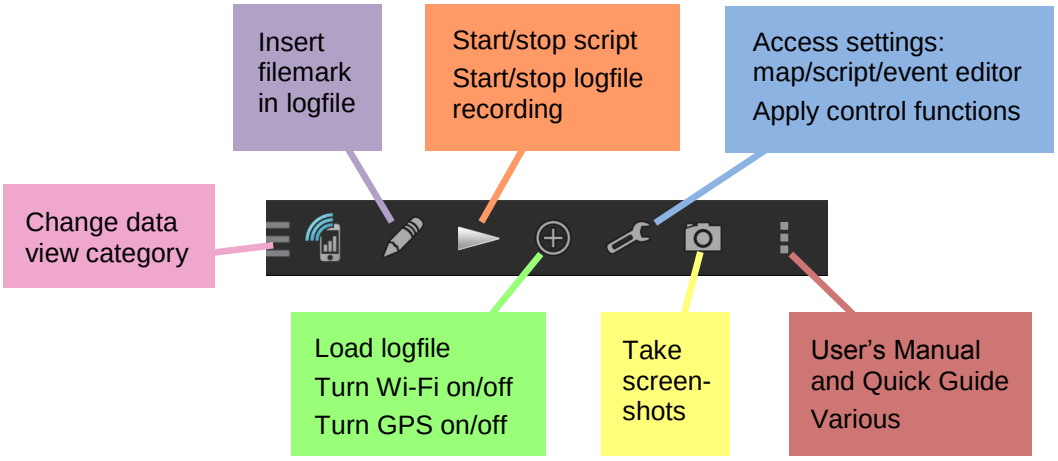


On start-up, TEMS Pocket displays a cell list data view for the radio technology currently in use. Data views are given comprehensive coverage in chapters 10 and 11.

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 fundamental actions and configuration tasks in TEMS Pocket, and also inspect some categories of data.

4.1 Action Bar

Below are some examples of how the action bar is used:



The **screenshot** function in TEMS Pocket captures all data views, storing them in the logfile (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 logfiles.

4.2 Data View Header

See section 11.2.

5 Automation of Tests: Scripting

TEMS Pocket supports automation of testing with command sequences called *scripts*. The type of service to be tested 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. Furthermore, in conjunction with automated logfile recording and FTP transfer, the scripts enable TEMS Pocket units to be used as handheld testing probes for TEMS Automatic in a semi-autonomous way.[1]

5.1 Script Action Types

The following script action types are provided:

- FTP upload/download
- HTTP Get/Post
- Streaming (YouTube)
- Email
- SMS (Send)
- Ping
- Voice (mobile-originated calls; CS or VoLTE)
- Voice MT (receiving mobile-terminated calls)
- AQM (voice with audio quality measurement)
- Control function (applies one or more control functions)
- IP capture
- Mobile network scanning[2]
- Wi-Fi scanning
- Logfile recording
- Logfile upload
- Wait

A special action type "Parallel" is provided for running **multiple services** concurrently: up to one each of FTP, HTTP, Streaming (YouTube), email, SMS, Ping, voice, AQM, and logfile 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.

[1] For fully autonomous monitoring, the TEMS Pocket Remote package is offered: see chapter 12.
[2] With external DRT scanner.

5.2 Guard Times

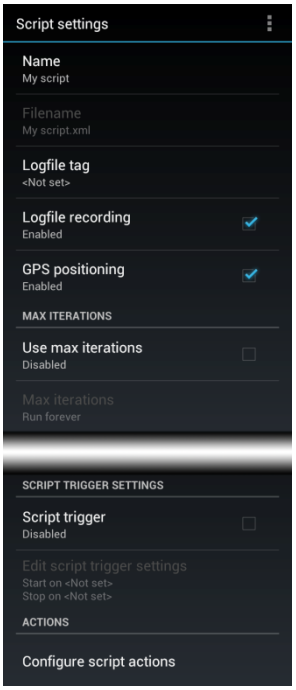
When running scripts in TEMS Pocket, guard times are automatically inserted between the measurement tasks in the script. This is to ensure that the signaling between measurements is also recorded to the logfile and made available for post-processing. The lengths of the pre- and post-guard periods are user-configurable; the default for both is 10 seconds.

5.3 Script Triggering and Other 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 logfile names.



Top-level script settings

6 Logfiles

6.1 Recording Logfiles

TEMS Pocket can record its measurements in *logfiles* containing the same richness of detail as logfiles recorded with TEMS Symphony or TEMS Automatic probes or with terminals connected to TEMS Investigation. 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/minute[1], 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, logfile recording can be turned on or off at any point.

The wide range of data that can be collected and displayed by TEMS Pocket 14.1 is illustrated in chapter 11.

6.2 Tagging Logfiles

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

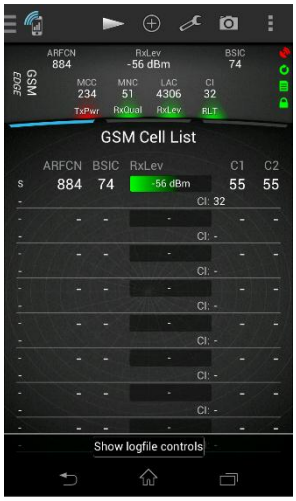
The tagging feature can be used together with the advanced scripting functions in TEMS Discovery to perform pre-processing on files tagged with customer-specific metadata, such as team, area, or campaign name. Tags can also be used to help sort and organize logfiles.

6.3 Replaying Logfiles in TEMS Pocket

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

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

[1] 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.



The timestamps on the left and right indicate the times of day when the logfile 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 logfile, one second or one minute at a time, using the buttons [**< 1m**], [**< 1s**], [**1s >**], [**1m >**].

6.4 Post-processing Logfiles in Other TEMS Products

- TEMS Pocket 14.1 logfiles can be post-processed in TEMS Discovery 10.0 or later (Streaming/YouTube requires 10.0.3; DRT scanning requires 10.0.4).
- TEMS Pocket 14.1 logfiles can be loaded in TEMS Investigation 15.3 or later (WCDMA scanning requires version 16.1).

6.5 Uploading Logfiles

Logfiles 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.

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

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

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

Logfile 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. Logfiles are compressed before they are transferred over the air in order to reduce upload time and save battery power.

Logfile 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 logfile 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 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.

7.1 List of Control Functions Supported

The following control functions exist in TEMS Pocket 14.1:

- RAT lock (GSM/WCDMA/LTE)
- Band lock (GSM/WCDMA/LTE)
- LTE EARFCN lock; EARFCN/PCI lock
- WCDMA cell lock (UARFCN, UARFCN + SC): See section 7.4
- WCDMA UARFCN lock; disable handover
- GSM cell lock/prevent (ARFCNs)
- Voice codec lock
- Cell barred lock
- Access class lock
- WCDMA fast dormancy control.

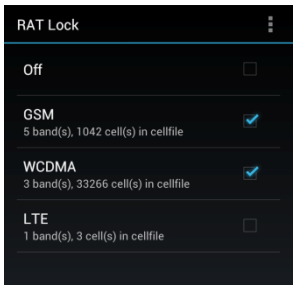
See section 16.5 for precise information about the set of control functions supported by each TEMS Pocket device.

7.2 User Interface Example: Cell Control

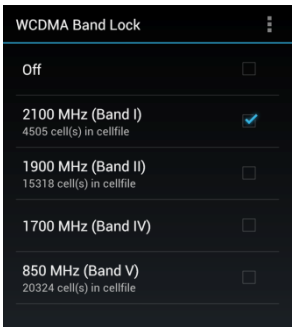
This section shows some of the dialogs for applying RAT, band, and cell locks.

7.2.1 RAT Lock

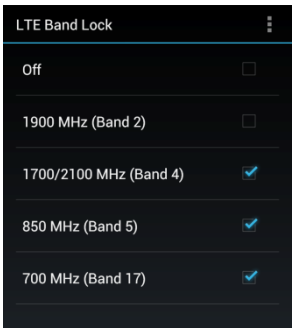
Multiple lock targets can be selected. If a cell file is loaded, the number of cells supported by the device is indicated for each band.



RAT lock

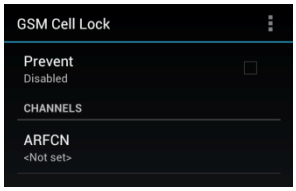


WCDMA band lock

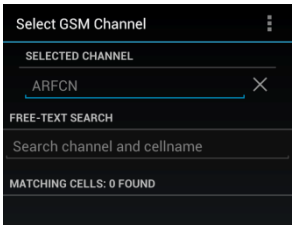


LTE band lock

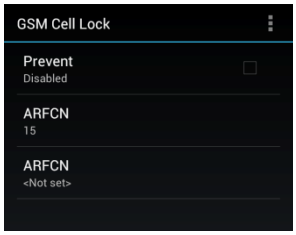
7.2.2 GSM Cell Lock



GSM cell lock: Lock/prevent flag



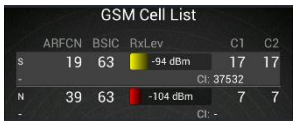
GSM cell lock: ARFCN selection. A loaded cell file can be searched for matching cells.



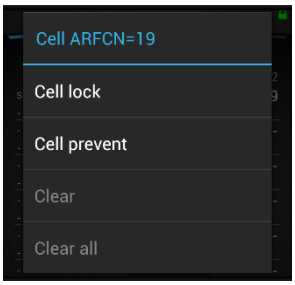
GSM cell lock: Further ARFCNs can be selected

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.

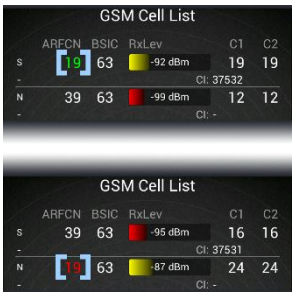
Cell locks can alternatively be applied from the *cell list data views* to any cells that appear there:



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.

7.3 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**.

7.3.1 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 testing 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.

7.3.2 Example 2: Vocoder Lock

Vocoder lock is another control function that is unique to Ascom. 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.

7.3.3 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.

7.4 WCDMA Cell Lock: Comparison between Xperia LT25i/LT30a and Older Xperia Models

In **idle mode**, the LT25/LT30 is straightforwardly locked to the selected cell or UARFCN. That is, the mechanism works just as for older devices.

In **connected mode**, WCDMA Cell Lock as applied to the LT25/LT30 has the following effect:

- The device encourages the network to include the selected cell (or any cell on the selected UARFCN, if no scrambling code has been specified) in the active set when the device comes close enough to measure on the cell.
- Once a desired cell has entered the active set, the device keeps it there until the connection drops. That is, no further soft or softer handovers are performed adding cells to the active set.

- Nothing in particular is done to have unwanted cells removed from the active set; this only happens naturally as the device reaches the boundary of a cell.

A good way to use the WCDMA Cell Lock function on the LT25/LT30 is as follows: Apply the function while the device is in idle mode to lock it to the cell or UARFCN you want to test. Then run your service testing. Only the desired cell, or cells on the desired UARFCN, will then be admitted to the active set.

8 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 14.1 subdivide into the following categories:

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

See Appendix B for a full list of predefined events.

8.1 Event Log

In the **event log**, events are listed in chronological order with the most recent event on top. Tapping an event in the event log expands it to also display event parameters.

You refresh the event log manually; there is no automatic refresh.

The event log can hold a maximum of 500 events. After this number has been reached, the oldest event is deleted from the log whenever a new event occurs.

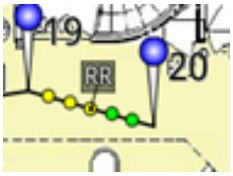
The event log is cleared automatically every time you start TEMS Pocket. You can also clear the event log manually at any time.

8.2 Presentation Options for Events

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

- Audio alerts
- Popup messages (“toasts”)
- Labels/markers in line charts and map views.

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



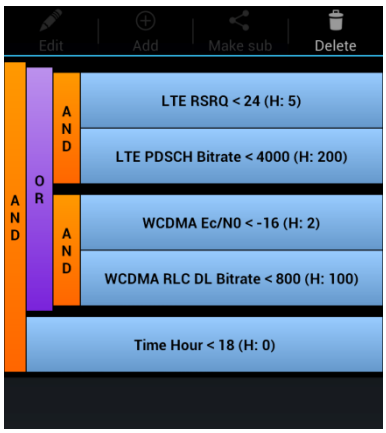
Event callout on map (“RR”)

Event labels in line chart

8.3 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.

9 Some Further TEMS Pocket Functions of Special Interest

9.1 Audio Quality Measurement (AQM)

TEMS Pocket offers **POLQA**, Perceptual Objective Listening Quality Analysis, as a method 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 uniforming such settings, 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 Sony Xperia LT25i devices, or
  - during **mobile-to-fixed** calls between a Sony Xperia LT25i and a CallGenerator.
- POLQA MOS scores for CS 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.
- 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.

9.2 IP Packet Capture

With the onslaught of 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.

9.3 Mobile Network Scanning

TEMS Pocket has the ability to conduct scanning of mobile networks with a connected external DRT4311B scanner. In TEMS Pocket 14.1, LTE Reference Signal scanning and WCDMA CPICH scanning are supported.

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.

The output from scanning is presented in the data views described in section 11.5.

9.4 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 11.9.

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.

9.5 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 logfiles renders the files amenable to comprehensive analysis with mapping tools such as those found in TEMS Discovery and TEMS Investigation.

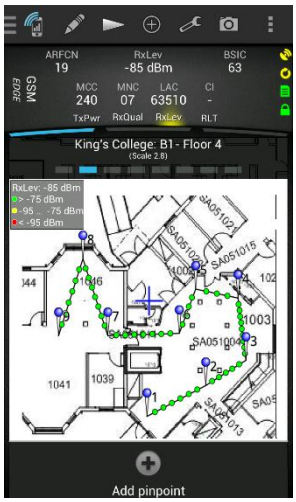
10 TEMS Pocket Map Views

10.1 Indoor Map: Pinpointing

The Indoor Map view enables import of maps 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 logfile archive (*.trp) containing the measurements (waypoints) and the map.

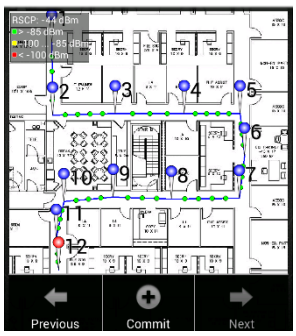
The procedure for using the Indoor Map function for pinpointing measurements is straightforward, and the general steps are described below:

- **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 two 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.

- **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 logfile (*.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 in the location of the first waypoint.
  - Then tap Next to proceed to the next waypoint. When you have reached it, tap Commit again.
  - Continue in this fashion until you have finished the route. If needed, you can move backwards along the route using the Previous button.

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 logfile. Logfile recording starts automatically when you start pinpointing and is ended when you stop pinpointing. After you stop pinpointing, a TEMS Pocket logfile with extension .trp is created.

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

10.2 Outdoor Map

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

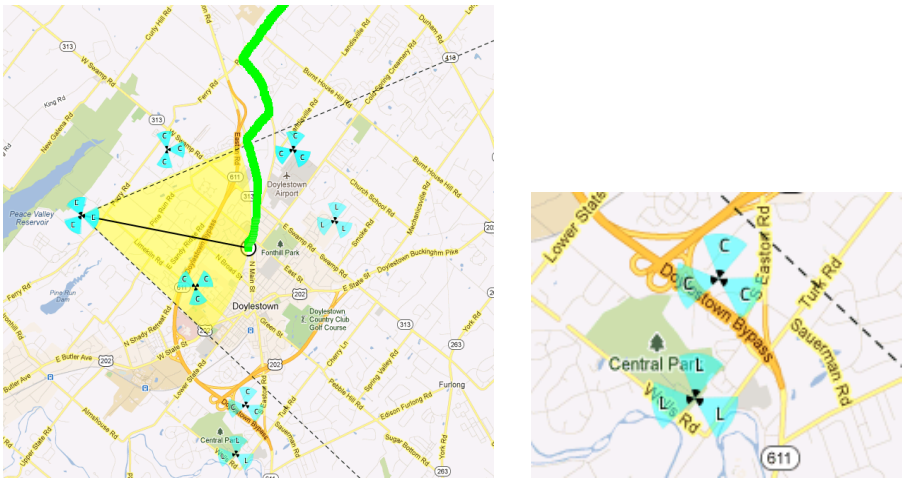
Routes can be plotted in live mode as well as in replay mode. The route marker color encodes a piece of RF data that is selected by the user.

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.

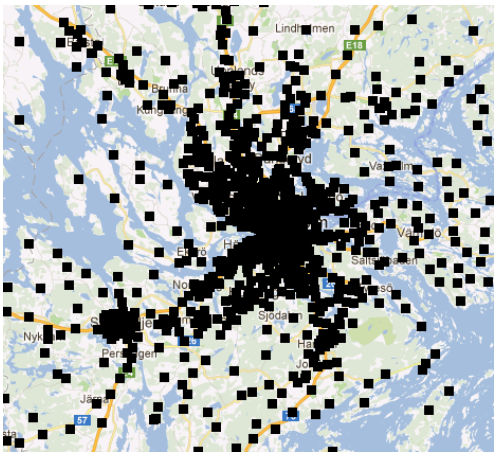
Map **layers** can be displayed selectively: Google Maps content, routes, cell sites for each RAT, and the serving cell tracker line.

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 behavior 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.

11 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 10.

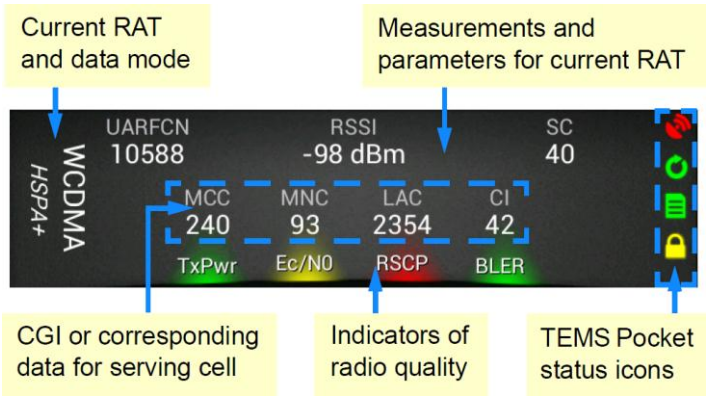
11.1 Data View List

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
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
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
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
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
LTE scan views (untitled)	LTE scan data: one view for each detected EARFCN, showing RSRP, RSSI, RSRQ, and CINR for found cells
WCDMA scan views (untitled)	WCDMA scan data: one view for each detected UARFCN, showing RSCP, E_c/N_0, SIR, and delay spread for found cells

Data Category	
GPRS/EDGE Data	Parameters and data related to GPRS/EDGE
GPRS/EDGE RLC Throughput	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
RLP Throughput	RLP throughput charts for EV-DO
Test Status Category	
Script Progress	General progress of a script that is being executed
AQM Progress	Progress of scripted AQM testing
Email Progress	Progress of scripted email 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
Logfile Upload Progress	Progress of scripted logfile upload
Ping Progress	Progress of scripted Ping testing
SMS Progress	Progress of scripted SMS testing
Voice Progress	Progress of scripted voice 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 and 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
Message Category	
Layer 3 Messages	Listing of transmitted and received Layer 3 messages
SIP Messages	Listing of transmitted and received SIP messages

11.2 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.



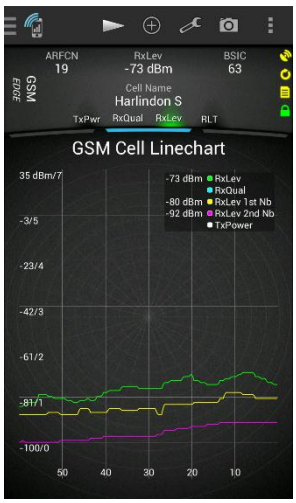
11.3 "Idle" Data View Category

11.3.1 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.

11.3.2 GSM Cell Line Chart Data View

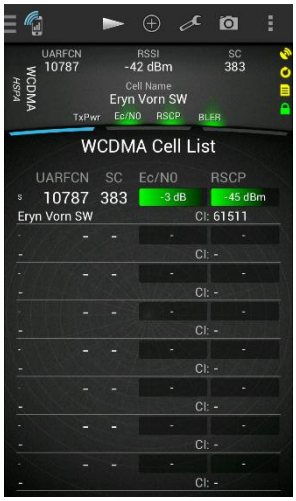


In this line chart, spanning the past 60 seconds' worth of measurements, are plotted:

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

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

11.3.3 WCDMA Cell List Data View



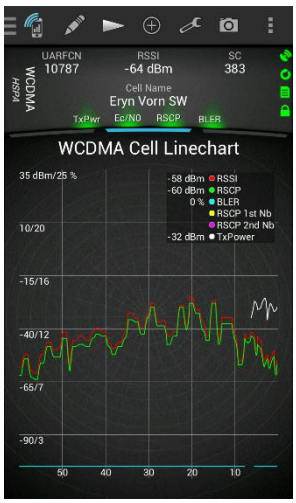
This data view displays up to eight cells, each belonging to one of the following categories:

- **S:** Serving cell (idle mode).
- **A:** Active set member (connected mode).
- **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).

11.3.4 WCDMA Cell Line Chart Data View

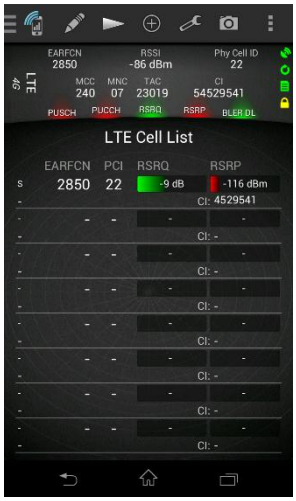


In this line chart, spanning the past 60 seconds' worth of measurements, are plotted:

- **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).

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

11.3.5 LTE Cell List Data View



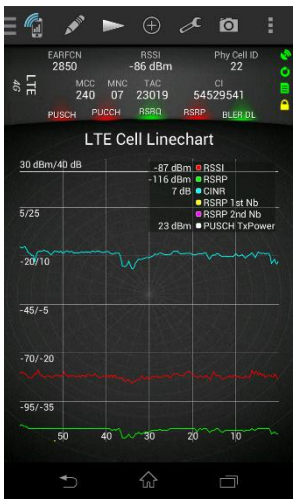
This data view displays up to eight cells, each belonging to one of the following categories:

- **S:** Serving cell (idle mode).
- **M:** Measured 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 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).

11.3.6 LTE Cell Line Chart Data View

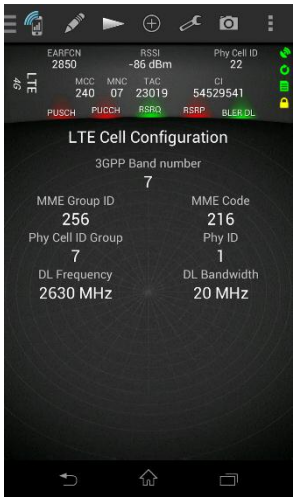


In this line chart, spanning the past 60 seconds' worth of measurements, are plotted:

- **RSSI:** E-UTRA Carrier RSSI (Received Signal Strength Indicator) in dBm.
- **RSRP:** RSRP of serving cell (dBm).
- **CINR:** CINR of serving cell (dB).
- **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.

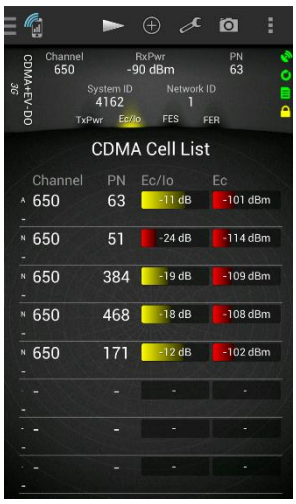
11.3.7 LTE Cell Configuration Data View



This view deals with the LTE serving cell.

- **3GPP Band Number:** Number of E-UTRA band.
- **MME Group ID:** Mobility Management Entity Group ID.
- **MME Code:** Mobility Management Entity Code.
- **Phy Cell ID Group:** Physical layer Cell Identity Group, PCIG.
- **Phy ID:** Physical layer Identity, PI in the relationship PCI = 3 × PCIG + PI.
- **DL Frequency:** Downlink frequency used in serving cell.
- **DL Bandwidth:** Downlink bandwidth of serving cell in MHz.

11.3.8 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).

11.3.9 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.

11.4 "Dedicated" Data View Category

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

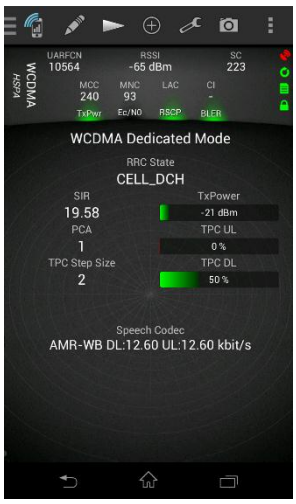
- **Channel Type:** One of BCCH, PBCCH, PDTCH, SDCCH, TCH/F or TCH/H.
- **Subchannel:** Subchannel Number.
- **Ciphering:** Ciphering Mode, one of {A5/1, A5/2, A5/3, GEA/1, GEA/2}.
- **Hopping:** Use of frequency hopping.
- **HSN:** Hopping Sequence Number.
- **MAIO:** Mobile Allocation Index Offset.
- **Speech codec:** Voice codec and codec rate.

11.4.2 GSM RACH Analysis Data View

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

- **Establish Cause:** Establishment of cause in Channel Request message.
- **Random Reference:** 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 / PCCCH Group:** The former of these appears for CS and the latter for PS data.
- **Paging Group:** The mobile device's paging group.
- **Paging Multiframe:** Paging multiframe.
- **Paging Blk Idx:** Paging block index.
- **BS_PA_MFRMS:** Number of 51-multiframes between transmission of paging messages to mobile devices of the same paging group.

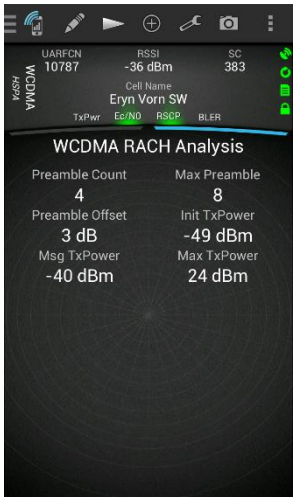
11.4.3 WCDMA Dedicated Mode Data View



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:** Power Control Algorithm, see 3GPP 25.331.
- **TPC UL:** Transmit Power Control on uplink over the last 0.5 seconds: percentage of power control commands that were “increase” commands.
- **TPC Step Size:** Transmit Power Control Step Size (dB).
- **TPC DL:** Transmit Power Control on downlink over the last 0.5 seconds: percentage of power control commands that were “increase” commands.
- **Speech codec:** Voice codec and codec rate.

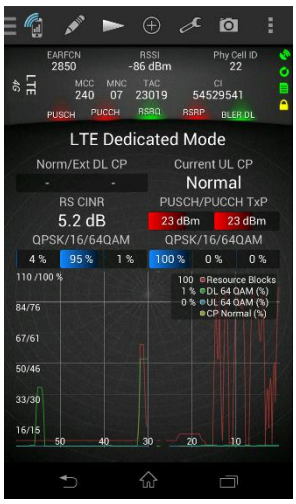
11.4.4 WCDMA RACH Analysis Data View



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

- **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).
- **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).

11.4.5 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)

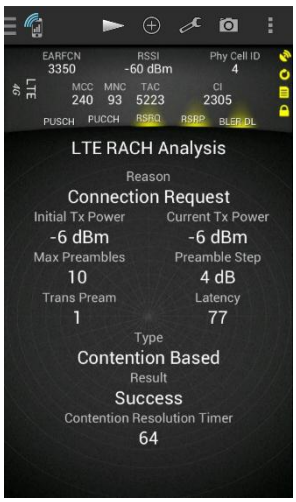
- **Current UL CP:** Type of cyclic prefix currently used on uplink: Normal or Extended.
- **PUSCH/PUCCH TxP:** PUSCH/PUCCH Tx Power.
- **QPSK/16/64QAM:** Percentage distribution of uplink modulation scheme usage (cf. downlink above).

Graph

This is a line chart tracking the following quantities over the past 60 seconds:

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

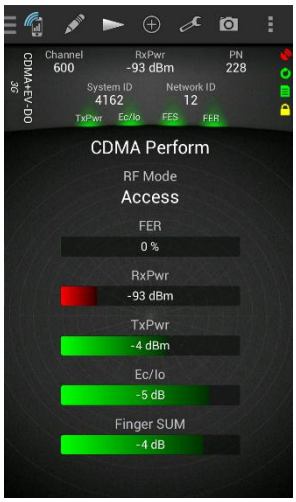
11.4.6 LTE RACH Analysis Data View



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.

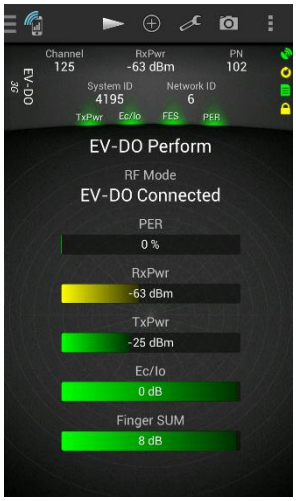
11.4.7 “CDMA Perform” and “EV-DO Perform” Data Views



CDMA Perform

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

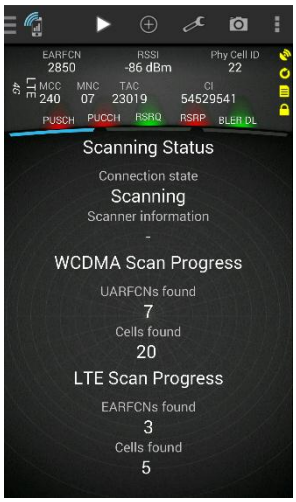
- **RF Mode:** Currently used technology and current device/AT state, for example, “CDMA Access” or “1xEV-DO Connected”.
- **FER:** Frame Erasure Rate (%); CDMA (1x) specific.
- **PER:** Packet Error Rate (%); EV-DO specific.
- **RxPwr:** Receive Power (dBm).
- **TxPwr:** Transmit Power (dBm).
- **Ec/Io:** Signal-to-noise ratio for strongest active set member (= topmost PN in CDMA Cell List data view, section 11.3.8; unit dB).
- **Finger SUM:** Finger Sum, total signal-to-noise ratio (E_c/I_0) for all Rake fingers (dB).



EV-DO Perform

11.5 "Scanning" Data View Category

11.5.1 Scanning Status Data View



This is a combined status and progress view for the external DRT scanner.

Scanning Status

- **Connection state:** For example, "Scanning" or "Disconnected".
- **Scanner information:** This field shows messages from the scanner.

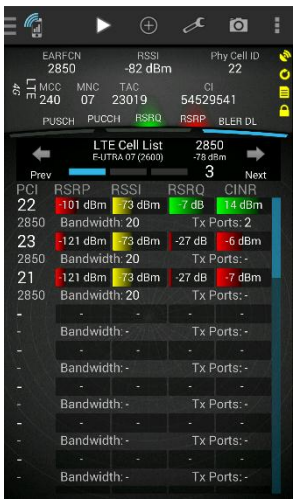
WCDMA Scan Progress

- **UARFCNs found:** Number of UARFCNs currently detected.
- **Cells found:** Total number of WCDMA cells currently detected on all UARFCNs.

LTE Scan Progress

- **EARFCNs found:** Number of EARFCNs currently detected.
- **Cells found:** Total number of LTE cells currently detected on all EARFCNs.

11.5.2 LTE Scan Data Views



These views are untitled. One view appears for each detected EARFCN, up to a maximum of 12. If more than 12 EARFCNs are detected, only the 12 strongest 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.

11.5.3 WCDMA Scan Data Views

These views are untitled. One view appears for each detected UARFCN, up to a maximum of 12. If more than 12 UARFCNs are detected, only the 12 strongest 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.

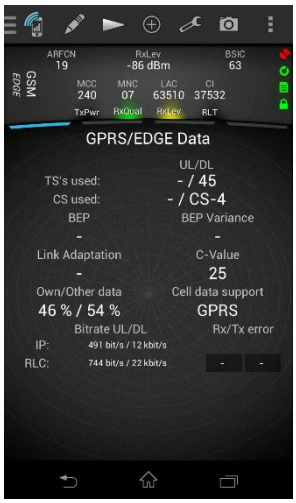
Main body of view

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.

11.6 "Data" Data View Category

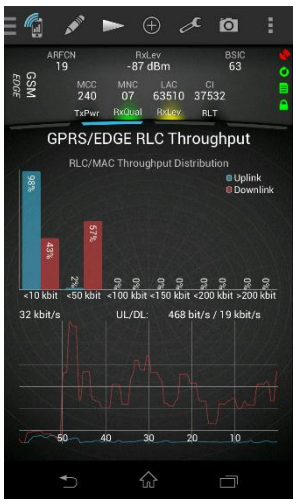
11.6.1 "GPRS/EDGE Data" Data View



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

- **TSs used:** Timeslots used on uplink and downlink.
- **CS used:** Channel coding schemes (GPRS) or modulation coding schemes (EGPRS) used on uplink and downlink.
- **BEP:** EGPRS mean bit error probability.
- **BEP Variance:** EGPRS bit error probability variance.
- **Link Adaptation:** EGPRS link adaptation algorithm: Automatic Repeat Request Mode {ARQ1, ARQ2}.
- **C-Value:** EGPRS C Value.
- **Own/Other data:** 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:** RLC level only. Updated once every second.
  - **Rx error:** % of data blocks erroneously decoded on downlink.
  - **Tx error:** % of data blocks retransmitted on uplink.

11.6.2 GPRS/EDGE RLC Throughput Data View



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

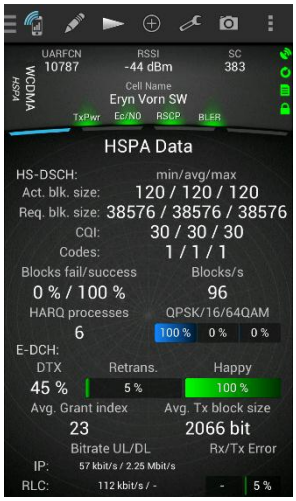
Top chart

- 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 60 seconds on uplink (blue) and downlink (red).

11.6.3 "HSPA Data" Data View

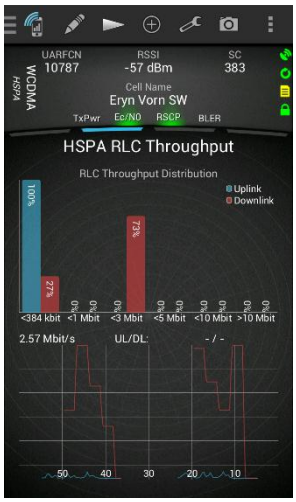


This view displays performance metrics and statistics for HSPA data transfer.

- **Act. blk. size:** Actual HS-DSCH transport block size in bits: minimum/average/maximum.
- **Req. blk. size:** Requested transport block size in bits (corresponding to minimum CQI): minimum/average/maximum.
- **CQI:** Minimum/average/maximum value of CQI (Channel Quality Indicator).
- **Codes:** Number of channelization codes used on the HS-DSCH: minimum/average/maximum. Obtained with HSPA+ enabled devices.
- **Blocks fail:** Block error rate on HS-DSCH for first retransmission. Updated once every second.
- **Blocks success:** Percentage of blocks on HS-DSCH that were transmitted successfully on first attempt (zero retransmissions). Updated once every second.
- **Blocks/s:** 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.
- **QPSK/16/64QAM:** 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:** 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:** Average transport block size in bits on E-DCH.
- **Bitrate UL/DL:** IP- and RLC-level throughput on uplink and downlink. All of these figures are updated once every second.
- **Rx/Tx Error:** 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.

11.6.4 HSPA RLC Throughput Data View



This view presents RLC throughput for HSPA data transfer.

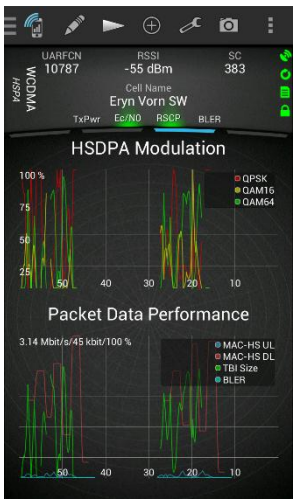
Top chart

- 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 60 seconds on uplink (blue) and downlink (red).

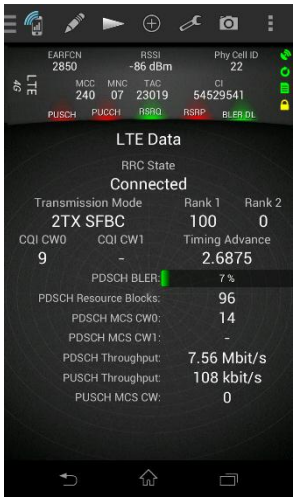
11.6.5 HSDPA Modulation/Packet Data Performance Data View



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

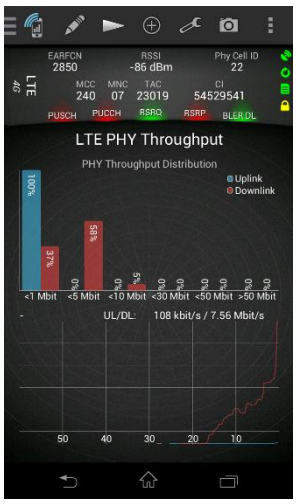
- **HSDPA Modulation chart:** This chart shows HSDPA modulation scheme usage (QPSK vs. 16-QAM vs. 64-QAM).
- **Packet Data Performance chart:** This chart shows MAC-HS throughput on uplink and downlink, HS-DSCH transport block size, and downlink transport channel BLER (average).

11.6.6 "LTE Data" Data View



- **RRC State:** "Idle" or "Connected".
- **Transmission Mode:** Downlink transmission mode, e.g., "2TX SFBC" (Two Tx antennas, space-frequency block coding).
- **Rank 1, Rank 2:** Percentage of time during which the Rank Indication (RI) has had the value 1 and 2, respectively.
- **CQI CW 0, CQI CW 1:** Best value of Channel Quality Indicator for code word 0 and 1, respectively.
- **Timing Advance:** Timing Advance value.
- **PDSCH BLER:** Block error rate on Physical Downlink Shared Channel.
- **PDSCH Resource Blocks:** Number of resource blocks on PDSCH.
- **PDSCH MCS CW 0, PDSCH MCS CW 1:** Modulation Coding Scheme for code word 0 and 1 (respectively) on PDSCH.
- **PDSCH Throughput:** Throughput on PDSCH.
- **PUSCH Throughput:** Throughput on Physical Uplink Shared Channel.
- **PUSCH MCS CW:** Modulation Coding Scheme on PUSCH.

11.6.7 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).

Bottom chart

- This is a line chart tracking Phy-level data throughput over the past 60 seconds on uplink (blue) and downlink (red).

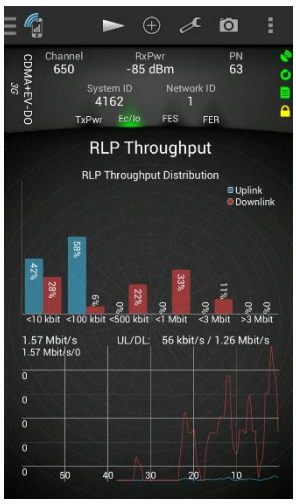
11.6.8 PDP Context Information Data View

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).

11.6.9 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 60 seconds on uplink (blue) and downlink (red).

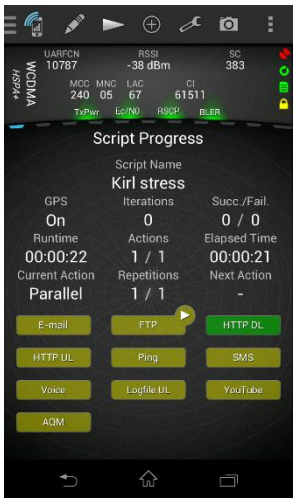
11.7 "Test Status" Data View Category

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.

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

11.7.1 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.

11.7.2 AQM Progress

- **Mode:** AQM mode chosen in action settings, for example “POLQA Narrowband DL”.
- **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.

Graph

Histogram showing AQM score distribution for the current repetition of the AQM action.

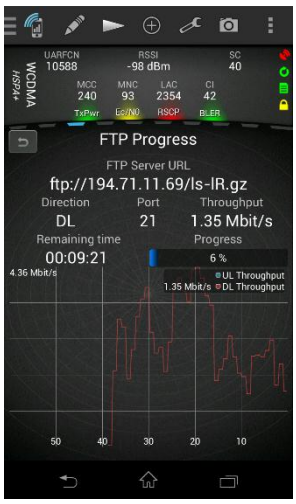
11.7.3 Email Progress

- **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.

11.7.4 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.
- **Throughput:** Current uplink/downlink application-level FTP throughput.
- **Remaining Time:** Estimated remaining time of the FTP session.
- **Progress:** Percentage of the FTP data transfer that has completed.

Graph

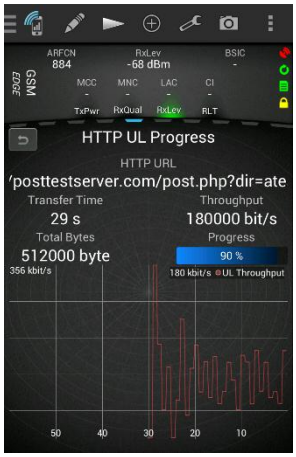
Line chart of uplink/downlink application-level FTP throughput.

11.7.5 HTTP DL Progress, HTTP UL Progress

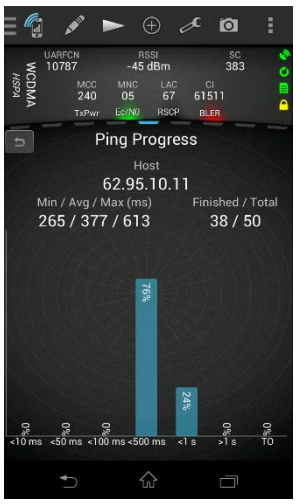
- **HTTP URL:** The URL being downloaded from or uploaded to.
- **Transfer Time:** Duration of the current HTTP session in seconds.
- **Throughput:** Current downlink/uplink application-level HTTP throughput.
- **Total bytes:** *(UL)* Total amount of data transferred during the session.
- **Progress:**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

Graph

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



11.7.6 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).

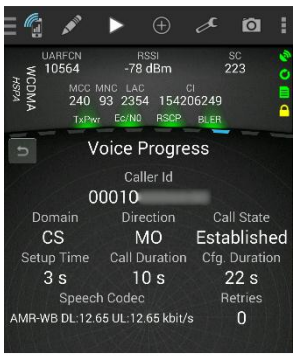
11.7.7 SMS Progress

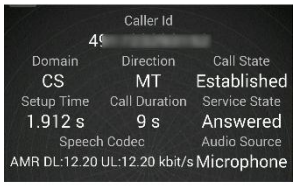
- **Phone number:** Number of SMS recipient.
- **Type:** Always “Send” in this TEMS Pocket version.
- **Success / Failure / Total:** Number of successfully sent SMS messages / Number of failed SMS messages / Total number of SMS messages to be sent in the current repetition of the SMS action.
- **Access delay:** Time from SMS send start until RP-ACK is received from the network: minimum/average/maximum.
- **End-to-end:** Time from SMS send start until a delivery report is received from the network: minimum/average/maximum.

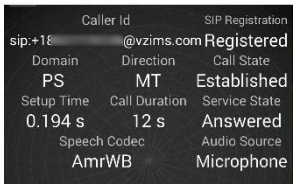
Graph

Histogram of access delay and end-to-end times for the current repetition of the SMS action. The “TO” bin on the far right represents timeouts and failures.

11.7.8 Voice Progress



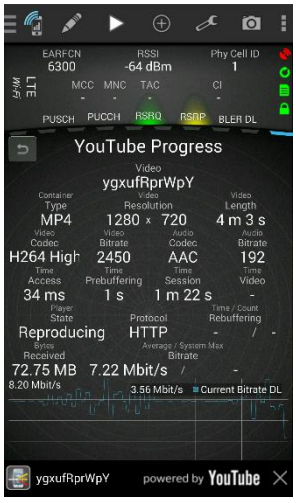




Three use cases shown: CS and MO; CS and MT; PS and MT.

- **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.

11.7.9 YouTube Progress



Video window hidden at bottom of screen

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 window visible

- **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.

11.7.10 Logfile Upload Progress

- **Logfile in transfer:** Name of logfile currently being uploaded.
- **Files:** Number of logfiles uploaded / Total number of logfiles to be uploaded.
- **Remaining Time:** Estimated remaining time of the Logfile Upload action.
- **Progress:** Upload progress, stated as the percentage of logfiles in the current batch that have been uploaded.

Graph

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

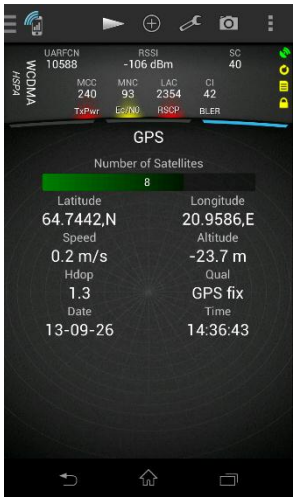
See section 6.5.

11.7.11 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).

11.8 “Location” Data View Category

11.8.1 GPS Data View

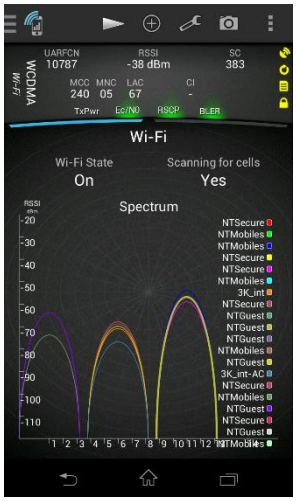


This data view displays position-related information:

- **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.

11.9 “Wi-Fi” Data View Category

11.9.1 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.

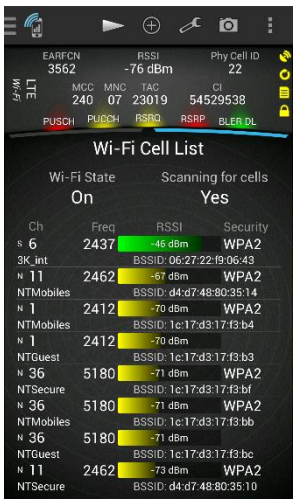
Spectrum graph

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 (in the screenshot, the greenish yellow lobe on the right).

The height of a lobe indicates the RSSI (dBm) 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.

11.9.2 Wi-Fi Cell List Data View



- **Wi-Fi State, Scanning for cells:** See section 11.9.1.

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.

11.10 "Layer 3" Data View Category

11.10.1 Layer 3 Messages Data View

Message list

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.

By default this view is automatically refreshed, with each new message appearing at the top of the list. However, to be able to study the message flow at your leisure, you can freeze the data view by dragging the message list gently downward. While the view is frozen, further dragging actions cause the message 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 messages that have been sent and received after you froze the view. In a logfile, these messages 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 message list. The view is then updated with all messages that were queued while the view was frozen.

Message list with one message expanded

You can also tap a message from 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 signaling 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.

11.10.2 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 11.10.1.

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.

11.11 “Custom” Data View Category

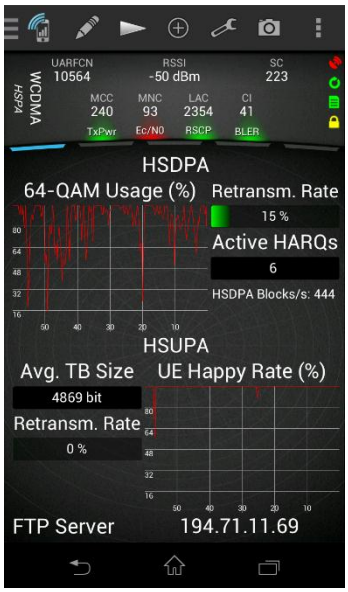
This data view category holds empty data views whose contents you assemble according to your current needs and preferences. Up to five such custom views can be populated.

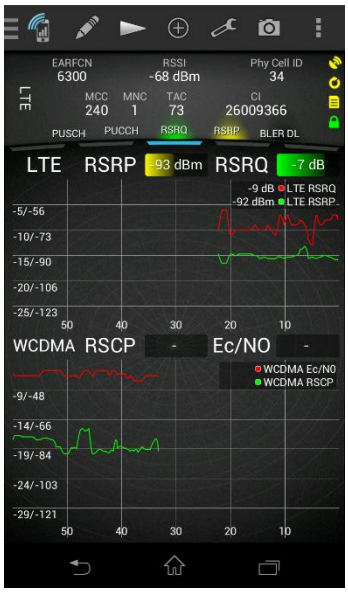
You add pieces of data to a custom view by selecting a rectangular area (of any size you like) in the grid, then picking a value element to show in that space and specifying the mode of its presentation. Custom views are built from the same types of graphical elements that make up the predefined views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

- **Line charts** with or without labeling 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.

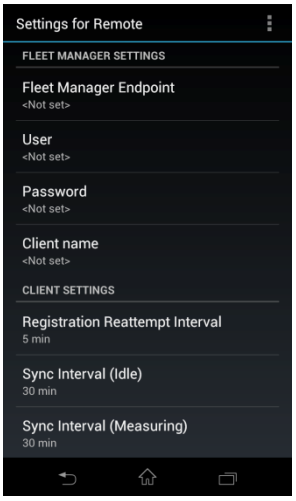
Left: Selection of HSDPA and HSUPA value elements, with the FTP server IP used for testing added at the bottom.

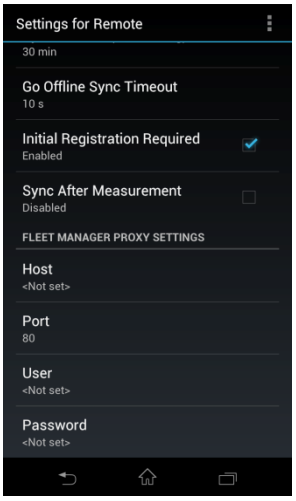
Right: Fundamental signal strength/signal quality metrics for LTE and WCDMA side by side. Such an arrangement is ideal for studying 4G–3G RAT transitions.

12 TEMS Pocket Remote

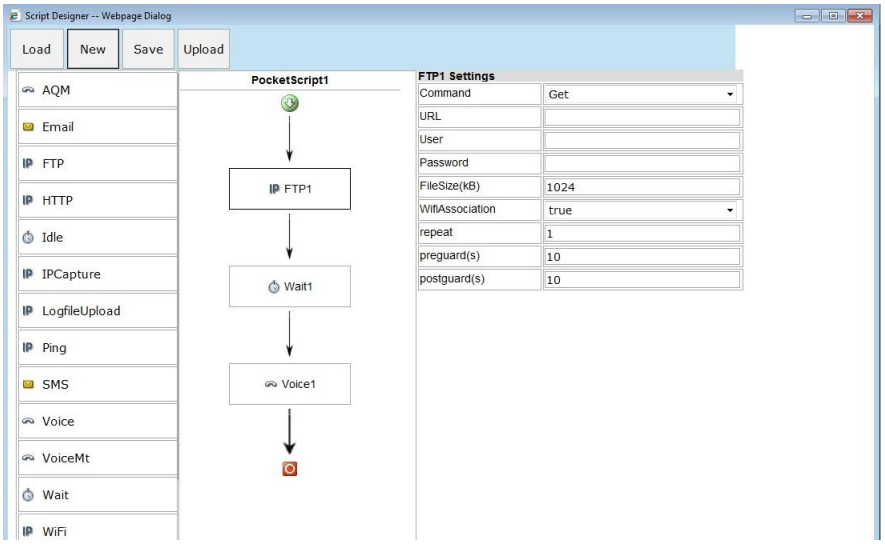
A TEMS Pocket device running in Remote mode is meant to be used as an autonomous, unattended probe. The device is then controlled remotely from Ascom's Fleet Manager, from where it is assigned orders to perform monitoring or benchmarking.

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 Fleet Manager's script editor:

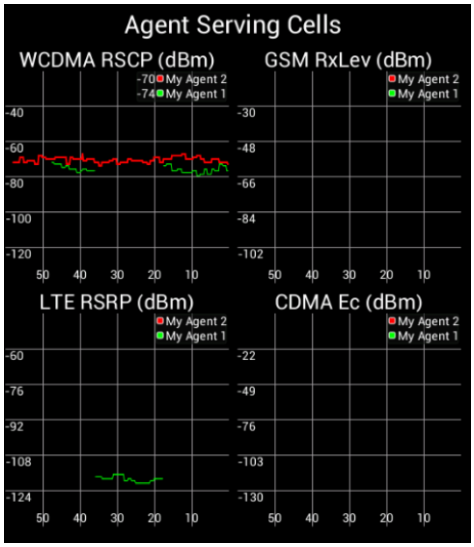


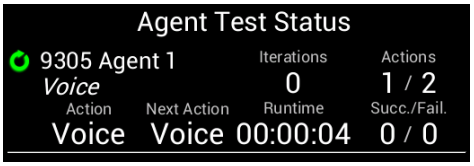
13 Multi-device TEMS Pocket

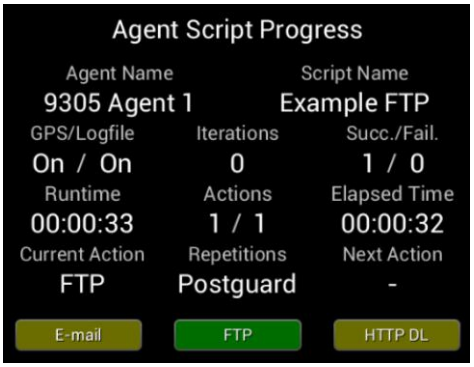
In a multi-device TEMS Pocket configuration, one master unit, called the **controller**, is used to remote-control up to six other devices, called **agents**. The controller device should preferably be a tablet, but it can also be an ordinary phone. The communication takes place via Bluetooth. A backpack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

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 logfile recorded by each agent will include both the map set used and the waypoints created. In other words, from the controller you position your data for all agents at once.

Logfiles recorded by the agents are **stored locally** on each agent device. Using the Logfile Upload script action, you can then have the agents transfer these logfiles wherever desired.

14 Interoperability With Cellular Network Equipment

TEMS Pocket 14.1 is interoperable with the technologies and bands specified in Appendix A.

15 Where to Learn More

For additional information concerning TEMS Pocket and other products in the Ascom Network Testing portfolio, please visit us on the Web at www.ascom.com/networktesting.

16 Appendix A: Device Capabilities

16.1 LTE Capabilities

Feature	Sony		Samsung: Galaxy Models			
	Xperia V, LT25i	Xperia T, LT30a	S4, GT-I9505	S4, GT-I9506	Note 3, SM-N900V	Note, GT-N8020 (tablet)
LTE 700 (Band 13)					✓	
LTE 700 (Band 17)		✓				
LTE 800 (Band 20)	✓		✓	✓		✓
LTE 850 (Band 5)	✓	✓	✓	✓		
LTE 900 (Band 8)			✓	✓		✓
LTE 1700 (Band 4)		✓			✓	
LTE 1800 (Band 3)	✓		✓	✓		✓
LTE 1900 (Band 2)		✓				
LTE 2100 (Band 1)	✓		✓	✓		
LTE 2600 (Band 7)	✓		✓	✓		✓
LTE category (max DL/UL data rate in Mbit/s)	**3** (100/ 50)	**3** (100/ 50)	**3** (100/ 50)	**4** (150/ 50)	**3** (100/ 50)	**3** (100/ 50)

16.2 UMTS Capabilities

Feature	Sony		Samsung: Galaxy Models			
	Xperia V, LT25i	Xperia T, LT30a	S4, GT-I9505	S4, GT-I9506	Note 3, SM-N900V	Note, GT-N8020 (tablet)
WCDMA 850 (Band V)	✓	✓	✓	✓	✓	✓
WCDMA 900 (Band VIII)	✓		✓	✓	✓	

Feature	Sony		Samsung: Galaxy Models			
	Xperia V, LT25i	Xperia T, LT30a	S4, GT-I9505	S4, GT-I9506	Note 3, SM-N900V	Note, GT-N8020 (tablet)
WCDMA 1900 (Band II)		✓	✓	✓	✓	✓
WCDMA 2100 (Band I)	✓	✓	✓	✓	✓	✓
WCDMA AWS (Band IV)		✓				
GSM quad-band	✓	✓	✓	✓	✓	✓
HSDPA category (max data rate in Mbit/s)	**24** (42)	**24** (42)	**24** (42)	**24** (42)	**24** (42)	**24** (42)
HSUPA category (max data rate in Mbit/s)	**6** (5.76)	**6** (5.76)	**6** (5.76)	**6** (5.76)	**6** (5.76)	**6** (5.76)
GPRS Class	**12**	**12**	**12**	**12**	**12**	**12**
EDGE Class	**12**	**12**	**12**	**12**	**12**	**12**
HR/FR/EFR	✓	✓	✓	✓	✓	✓
WCDMA/GSM AMR	✓	✓	✓	✓	✓	✓
AMR-WB GSM	✓	✓				
AMR-WB WCDMA	✓	✓	✓	✓	✓	✓

16.3 CDMA Capabilities

Feature	Samsung Galaxy Note 3, SM-N900V
CDMA 800 (BC 0)	✓
CDMA 1900 (BC 1)	✓
EV-DO	Rev. A, 3.1 Mbit/s

16.4 Wi-Fi Capabilities

- 802.11 a, b, g, n: All supported devices
- 802.11 ac: Samsung Galaxy S4 GT-I9505, S4 GT-I9506, Note 3 SM-N900V

16.5 Control Functions

Feature	Sony		Samsung: Galaxy Models[1]		
	Xperia V, LT25i	Xperia T, LT30a	S4, GT-I9505	S4, GT-I9506	Note, GT-N8020 (tablet)
LTE RAT lock	✓	✓	✓	✓	✓
LTE band lock	✓	✓	✓	✓	✓
LTE EARFCN lock	✓	✓			
LTE EARFCN/PCI lock				✓	
WCDMA/GSM RAT lock	✓	✓	✓	✓	✓
WCDMA/GSM band lock	✓	✓	✓	✓	✓
WCDMA cell lock	✓	✓			
WCDMA UARFCN lock				✓	
WCDMA: disable handover				✓	
GSM cell multi-lock, cell prevention	✓	✓			
Voice codec lock	✓	✓			
Cell barred lock	✓	✓			
Access class lock	✓	✓			
WCDMA fast dormancy control	✓	✓			

[1] Samsung Galaxy Note 3 SM-N900V currently does not have any control functions.

16.6 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, Voice MO/MT[1], Voice with AQM, Parallel services, IP capture[1], Mobile network scanning, Wi-Fi scanning, Wait
Data recording	✓
Passive measurements	Scripted start/stop, optionally triggered by user-defined events
Filemarks	✓
Automatic data upload	✓
Logfile compression	✓
Logfile replay	✓
Network events	✓
Custom events	✓
Outdoor map view	✓
Indoor map option	✓
Cell site display	✓
Internal GPS	✓
External GPS	✓

Feature	Sony	Samsung
	Xperia V LT25i	All Supported Devices
AQM (POLQA)	✓	
External antenna	✓	
IP capture	✓	✓

[1] Voice MT and IP capture not supported on HTC One XL.

16.7 Comparison of TEMS Pocket 14.1 (Xperia V LT25i) and TEMS Pocket 7.3 (W995)

This section compares the functionality of TEMS Pocket 14.1 as implemented on the Sony Ericsson Xperia V LT25i with that of TEMS Pocket 7.3 built on the Sony Ericsson W995 phone.

Feature	TEMS Pocket 7.3 Sony Er. W995a/i	TEMS Pocket 14.1 Sony Xperia V LT25i
General		
Line charts	✓	✓
Bar charts		✓
Outdoor map		✓
Screenshot function	✓	✓
Logfile recording	✓	✓
Logfile replay	✓	✓
Automatic data upload	✓	✓
Custom logfile tags	✓	✓
Automated/scripted tests	✓	✓
Passive logging	✓	✓
Network events	✓	✓
Data session events	✓	✓
Custom events		✓
Filemarks	✓	✓
Event-based logging	✓	✓
Layer 3 message presentation		✓
Indoor		
Manual pinpointing	✓	✓
Data plotting on indoor map	✓	✓
Pre-planned routes		✓
IBWC map sets		✓
Automatic zoom		✓
Service testing		
FTP	✓	✓
HTTP	✓	✓
Email		✓
SMS		✓
Ping		✓
IP capture		✓

Feature	TEMS Pocket 7.3 Sony Er. W995a/i	TEMS Pocket 14.1 Sony Xperia V LT25i
RTSP/Streaming	✓	
Streaming (YouTube)		✓
WAP/HTML	✓	
MO voice	✓	✓
MT voice	✓	✓
Voice with AQM		✓
Idle	✓	✓ (Wait action)
Wi-Fi scanning		✓
Multi-RAB (CS + PS)		✓
Parallel services (multiple)		✓
Technologies		
LTE		✓ Bands: Section 16.1
WCDMA 850	a	✓
WCDMA 900	i	✓
WCDMA 1900	a	
WCDMA 2100	a, i	✓
GSM 850/900/1800/1900	✓	✓
LTE category		3
HSDPA category	8	24
HSUPA category	5	6
EDGE class	10	12
GPRS class	10	12
Voice codecs		
AMR WCDMA/GSM	✓	✓
AMR-WB WCDMA	✓	✓
AMR-WB GSM	✓	✓
EFR	✓	✓
FR	✓	✓
HR	✓	✓
Control functions		
RAT lock	✓ WCDMA, GSM	✓ LTE, WCDMA, GSM
Band lock	✓ WCDMA, GSM	✓ LTE, WCDMA, GSM
LTE EARFCN lock		✓

Feature	TEMS Pocket 7.3 Sony Er. W995a/i	TEMS Pocket 14.1 Sony Xperia V LT25i
GSM cell lock/multi-lock, cell prevention	✓	✓
WCDMA cell lock	✓	✓
Ignore cell barred	✓	✓
HS capability control	✓	
Vocoder lock	✓	✓
Access class lock		✓
Scanning		
LTE Reference Signal scan		✓[1]
WCDMA network scan	✓	
WCDMA CPICH scan	✓	✓
GSM scan	✓	
GPS		
External GPS	✓	✓
Internal GPS	✓	✓
Antennas		
External antenna	✓	✓
Internal antenna	✓	✓

[1] With external DRT scanner.

16.8 Comparison of Cell and Carrier Lock Capabilities

Cell and Carrier Lock – Use Cases	Ascom, Sony Er. Xperia arc S LT18i/a	Ascom, Sony Xperia V LT25i/T LT30a	Ascom, Samsung Galaxy S4 GT-I9506
WCDMA idle mode			
Force reselection to cell	✓	✓[1]	No
Force reselection to UARFCN	✓	✓	No
Stay on cell	✓	✓	No
Lock on UARFCN	✓	✓	✓[2]
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	✓	✓	✓[2]
Lock on UARFCN	✓	✓	✓[2]
Prevent handover to cell	✓	No	No
Prevent handover to UARFCN	✓	No	No
LTE idle mode			
Force reselection to EARFCN	N/A	✓	✓[2]
Stay on EARFCN	N/A	No	✓[2]
Lock on PCI	N/A	No	✓[2]
LTE connected mode			
Stay on EARFCN	N/A	✓[3]	✓[2]
Lock on PCI	N/A	No	✓[2]
General			
Maximum number of cells	∞/50[4]	1[1]	1
Maximum number of UARFCNs/EARFCNs	∞/12[4]	1	1
Use function without restarting device	✓	✓	✓
Automate usage via scripts	✓	✓	Planned
Interleave with other control functions	✓	✓	Planned
Control in real time	✓	✓	Planned

[1] Cell must be in network-reported neighbor list.
[2] Applied in TEMS Capability Control app (supplied with TEMS Pocket).
[3] Inter-frequency handover must be disabled using TEMS Capability Control app.
[4] Qualcomm/ST-Ericsson chipset.

17 Appendix B: Predefined Events in TEMS Pocket 14.1

This appendix lists all predefined events in TEMS Pocket 14.1.

17.1 Device-related Events

Battery Low
External Scanner Connected
External Scanner Disconnected
Low Disk Space
GPS Connected
GPS Disconnected
GPS Position Found
GPS Position Lost

17.2 Radio Events

Event Category	Event Names
Call events: 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
	System Changed

17.3 TEMS Pocket Related Events

Event Category		Event Names		
General		Filemark		
		"Start" events	*"End" events*	*"Error" events*
Script		Script Start	Script End	–
		Script Iteration		
Session	General	Maximum Duration Triggered *(max duration reached for script action)*		
	AQM	AQM Start	AQM End	AQM Error
	Email	Email Start	Email End	Email Error
		–	Email Send Success	Email Send Failure
	FTP	FTP Start	FTP End	FTP Error
	HTTP Get	HTTP Start	HTTP End	HTTP Error
	HTTP Post	HTTP Upload Start	HTTP Upload End	HTTP Upload Error
	IP capture	IP Capture Start	IP Capture End	–
		"Start" events	*"End" events*	*"Error" events*
	Logfile recording	Logfile Start	Logfile Stop	–
	Logfile upload (FTP)	Upload Start	Upload End	Upload Error
	Logfile upload (HTTP)	HTTP Upload Start	HTTP Upload End	HTTP Upload Error
	Parallel	Parallel Start	Parallel End	Parallel Error
	Ping	Ping Start	Ping End	Ping Error
	Scanning (of mobile network)	Scan Start	Scan End	Scan Error
	SMS	SMS Start	SMS End	SMS Error
		–	SMS Send Success	SMS Send Failure
	Voice (MO)	Voice Start	Voice End	Voice Error
	Voice MT	Voice MT Start	Voice MT End	Voice MT Error
	Wi-Fi scanning	Wi-Fi Enable	Wi-Fi Disable	–
	YouTube	YouTube Start	YouTube End	YouTube Error
		YouTube Video Start	YouTube Video End	YouTube Video Error

18 Appendix C: Automatic Processing of TEMS Pocket Logfiles in TEMS Discovery

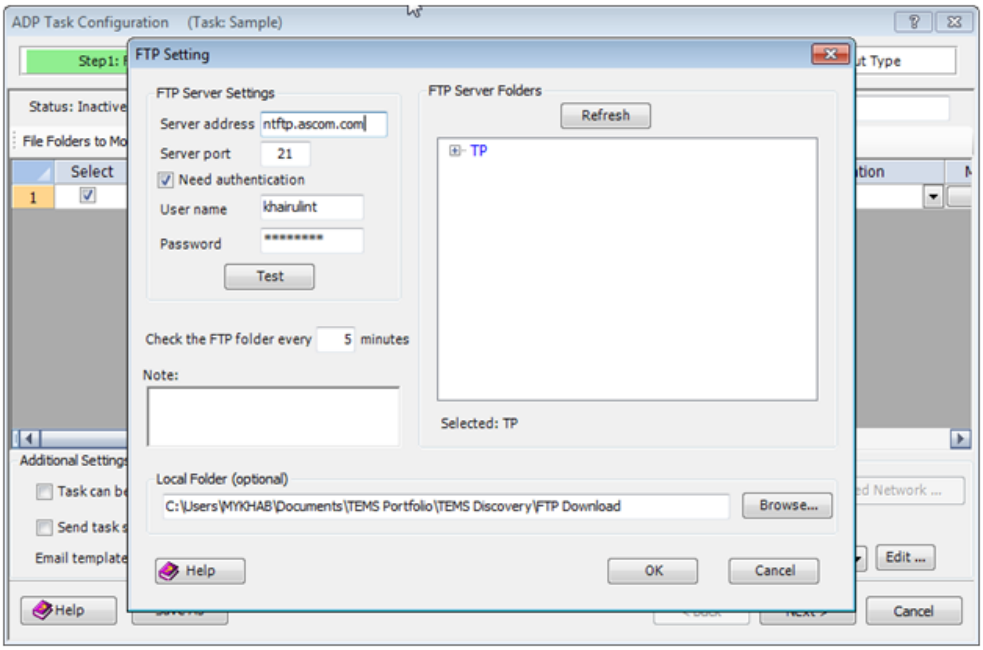
Logfiles created in TEMS Pocket can be uploaded to an FTP server, as described in section 6.5.

In TEMS Discovery, an automatic data processing (ADP) task can monitor this FTP server directory for incoming logfiles, 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.

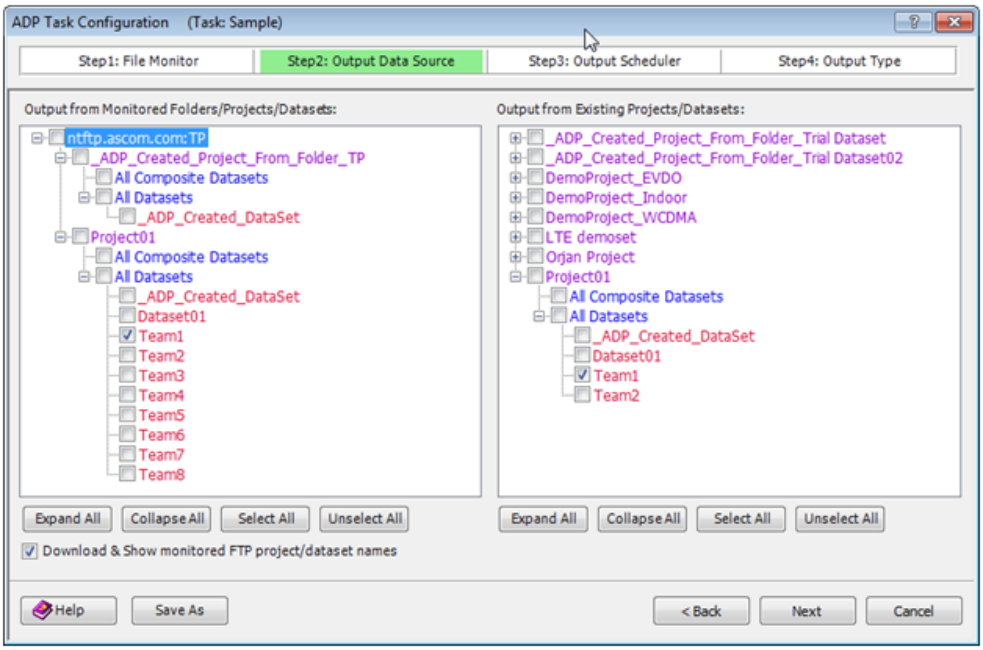
Step 1:

Specify the directory on the FTP server to monitor for incoming logfiles.



Step 2:

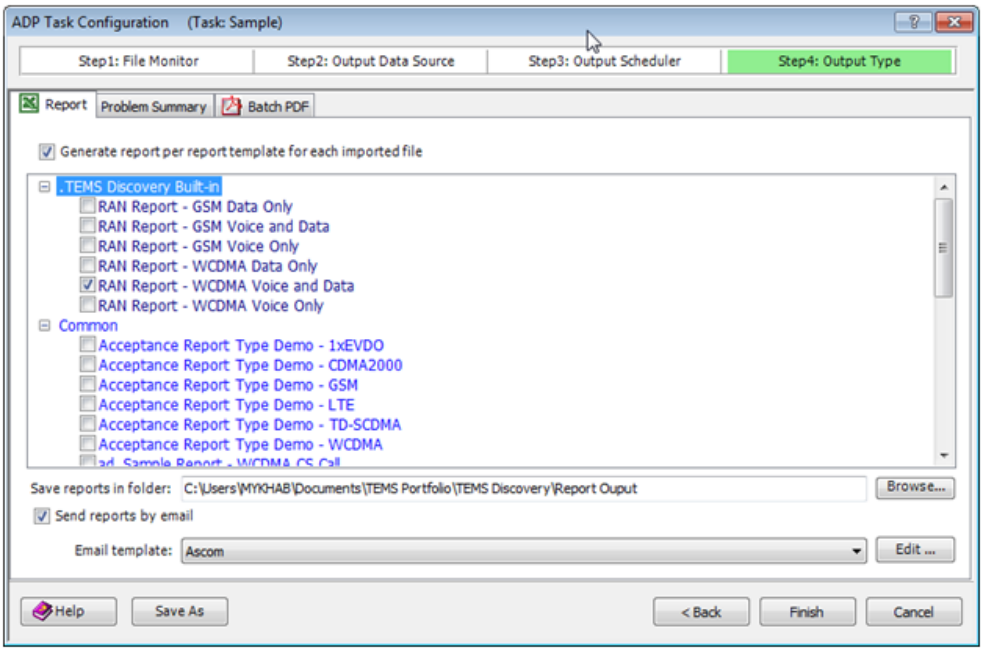
Here you decide on the output data source where your automatically processed logfiles should be saved in TEMS Discovery. You specify the project and dataset that will contain your logfile data.



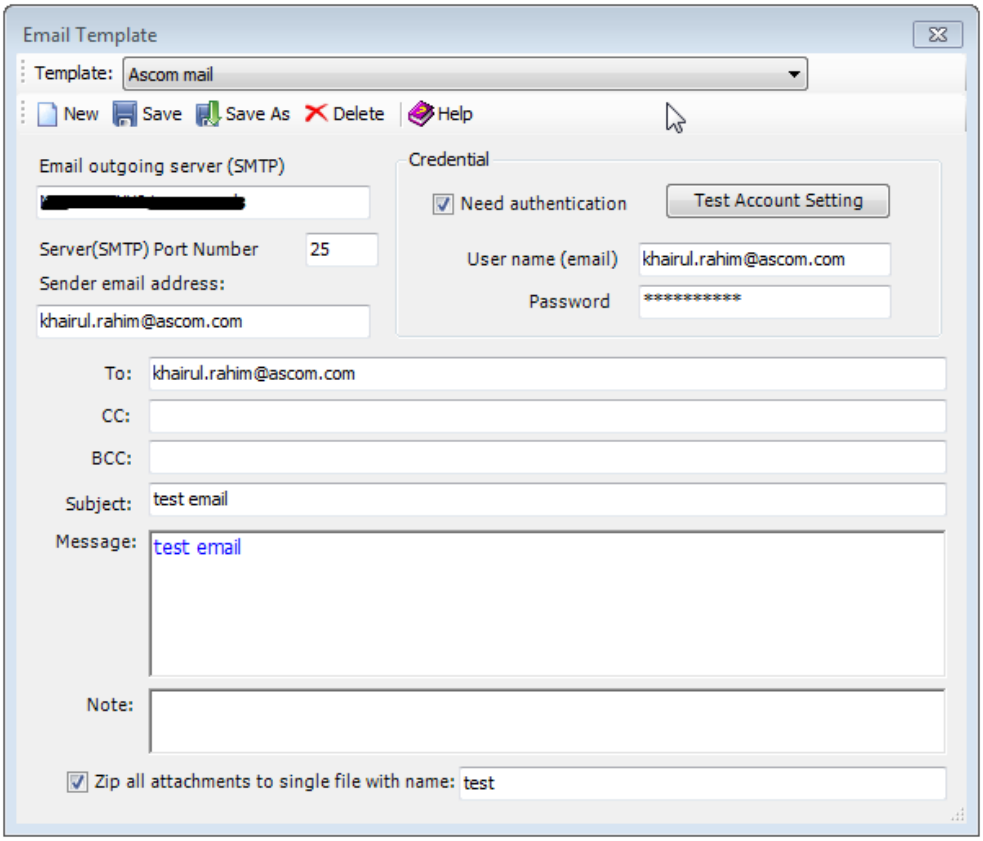
The first time you allow data to be uploaded to a specific project and dataset, you select it among the projects and datasets listed in the left-hand pane. The next time you specify the output data source, you may select the project and dataset from the list in the right-hand pane.

Step 3:

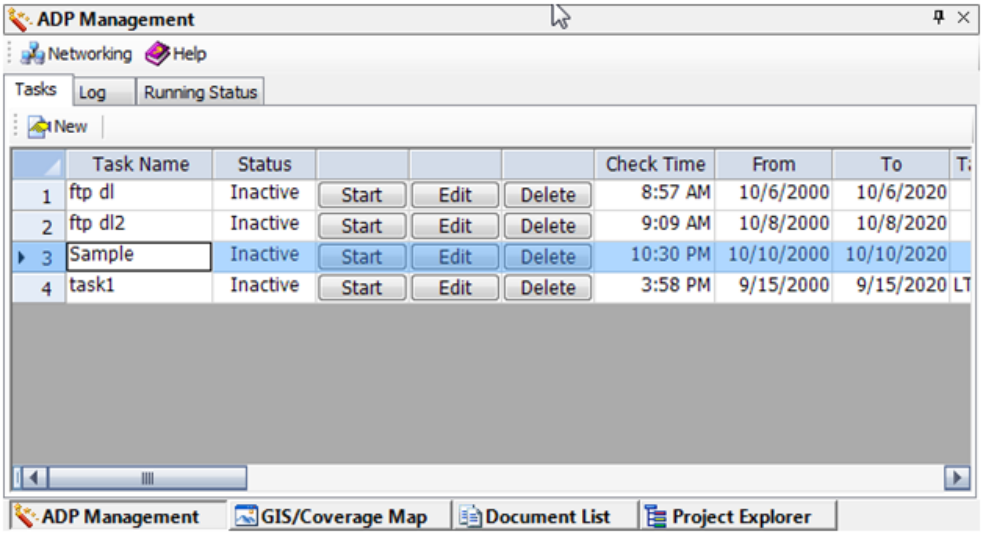
Assuming you have scheduled the task (under Output Scheduler), the last step is to specify whether you would like a report with the newly processed data, in Excel or as PDF. The output could also be subject to study in Problem Summary.



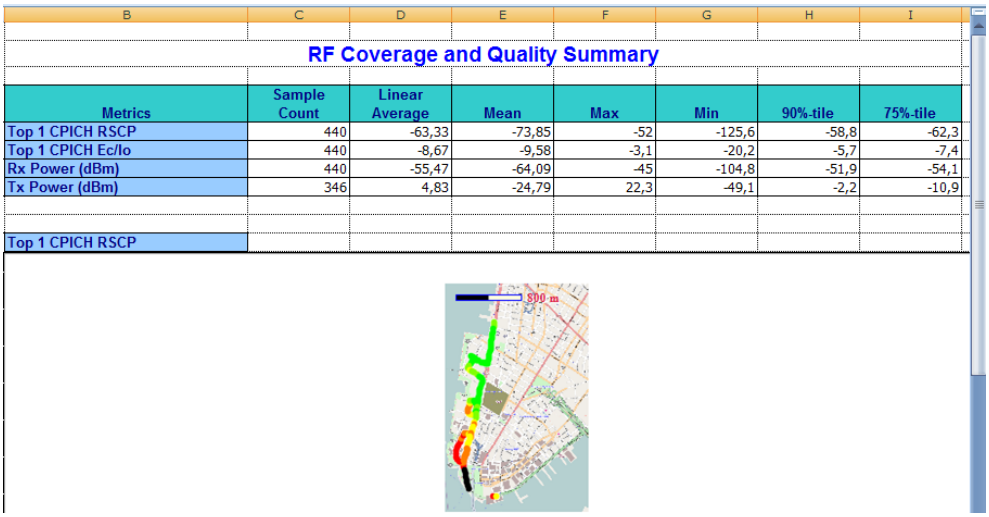
The report could then be sent by email using a predefined email template.



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

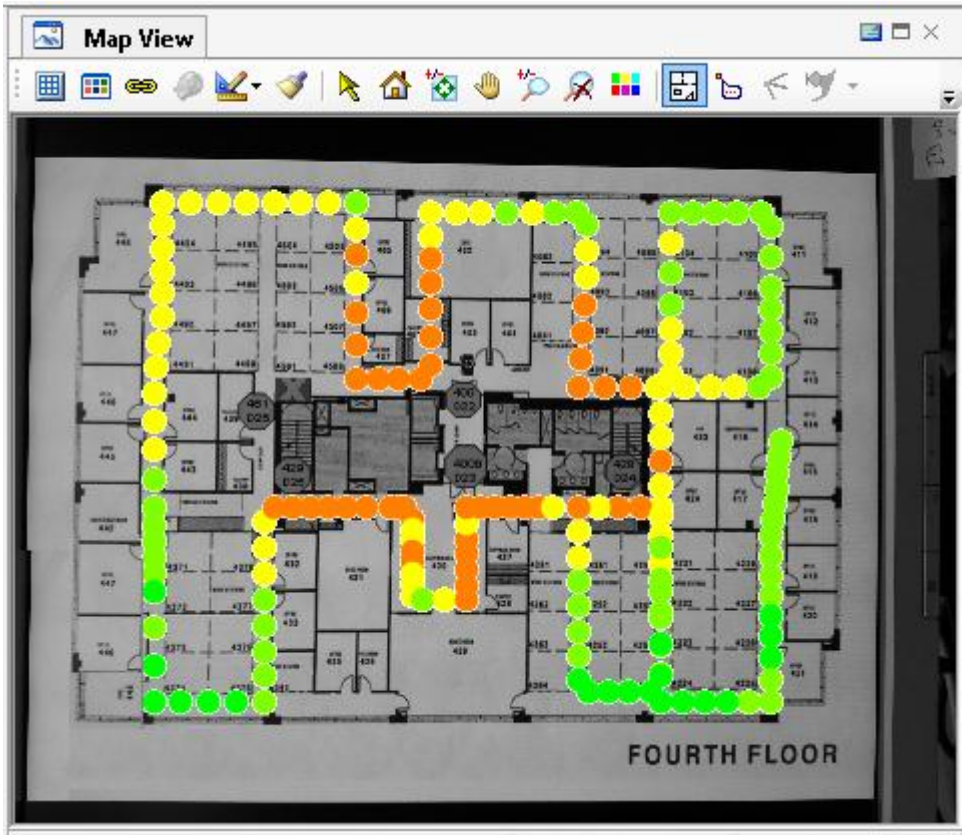
Top 1 CPICH RSCP

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

19 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 logfile.

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.

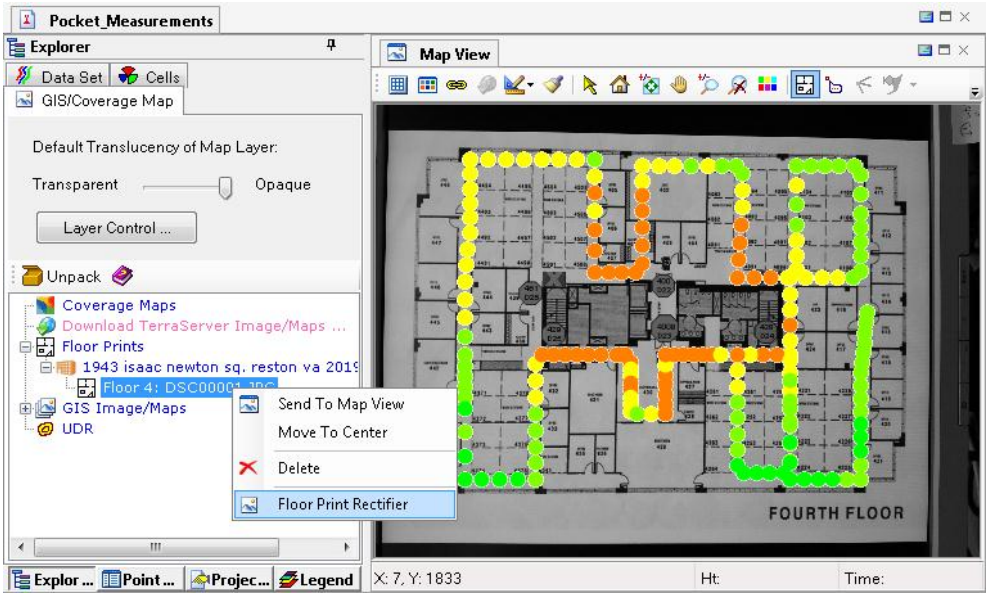


If the indoor measurement samples (waypoints) are positioned inside TEMS Discovery, they are displayed like ordinary outdoor drive test data along with other GIS and cell configuration data. The indoor measurements from TEMS Pocket can thus be analyzed in a more realistic way, in relation to outdoor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

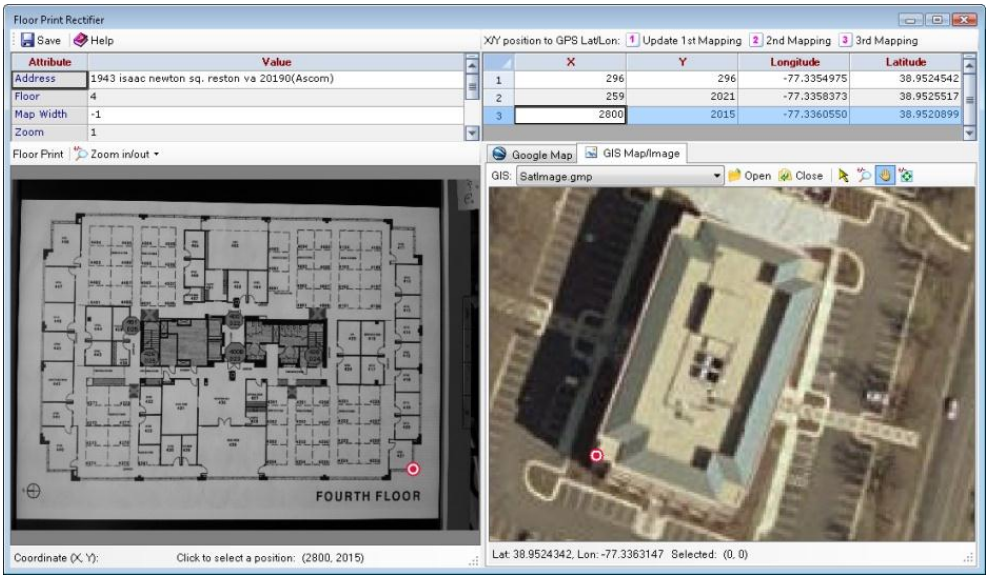
To position the indoor measurements, follow the procedure described below.

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

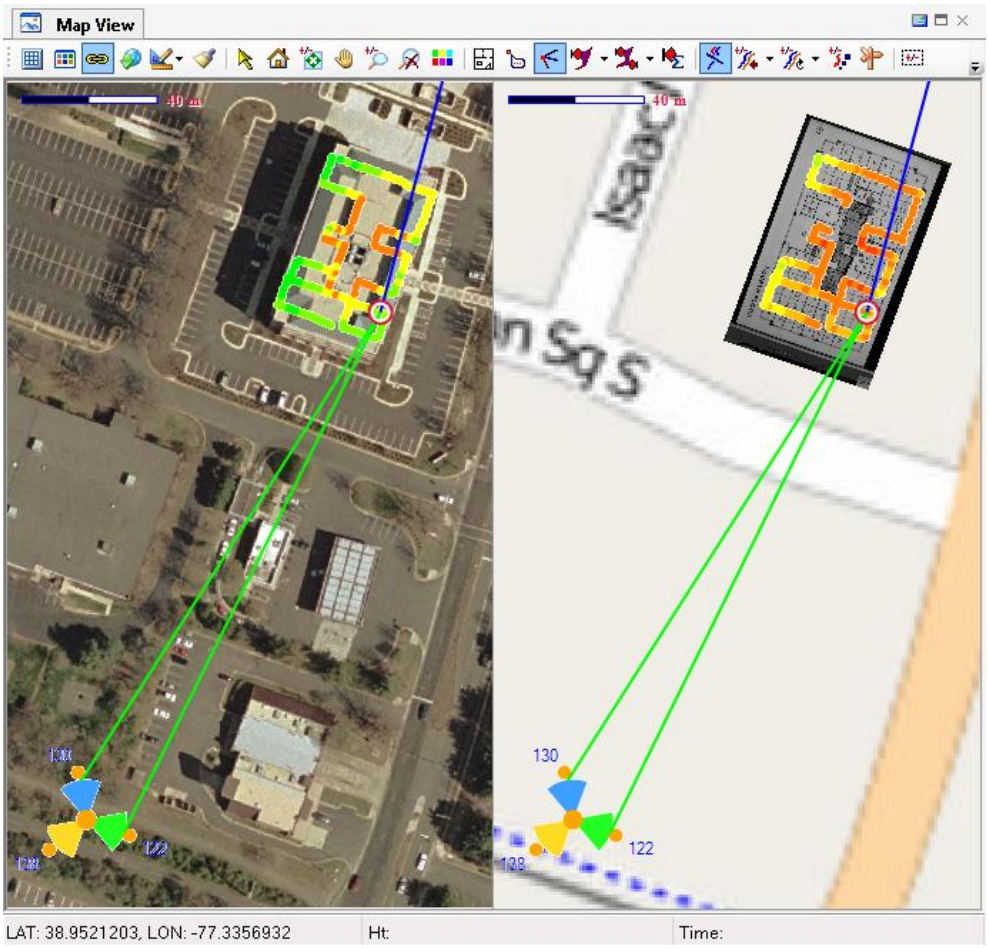
- To position these measurements in relation to the actual building, right-click the floor plan in the Explorer, GIS/Coverage Map tab, and select Floor Print Rectifier.



- 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.



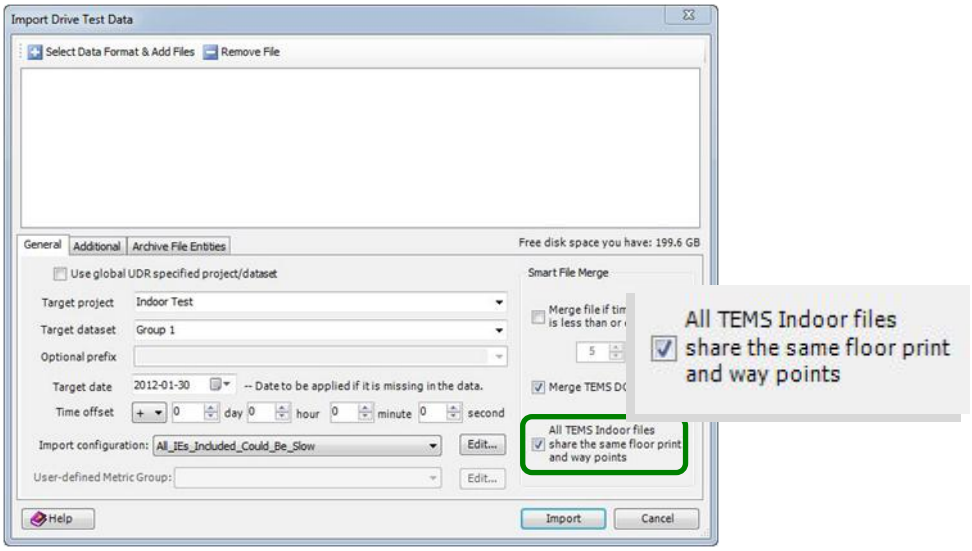
- On completing the geo-rectification procedure, you can display indoor measurement data just like data from regular outdoor drive tests, along with other GIS and cell configuration data.


Map View
40 m
130
122
128
LAT: 38.9521203, LON: -77.3356932
Ht:
Time:

20 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 device to a set of other devices that accompanied it along the same test route.

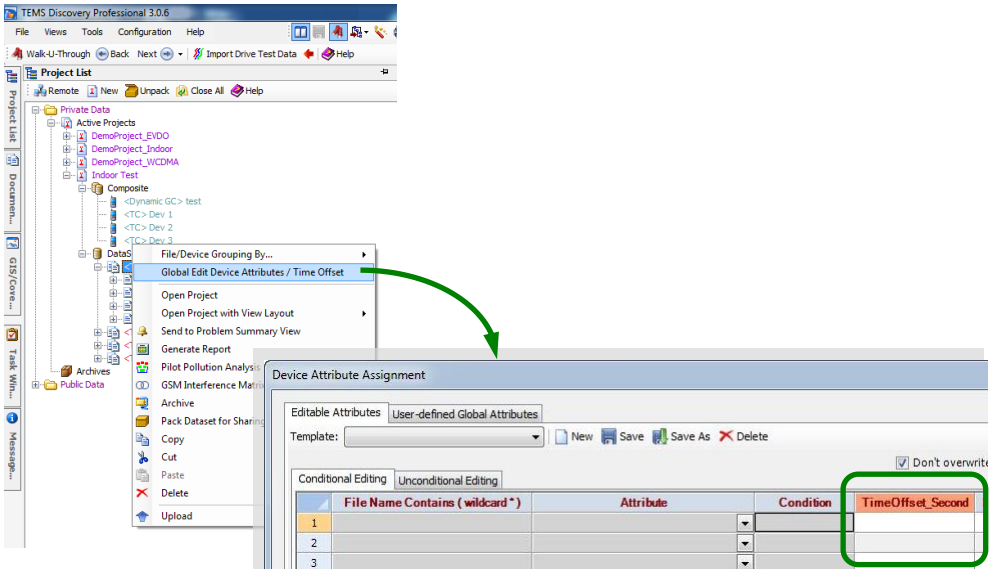
- Before starting your test, make sure all TEMS Pocket devices are carefully synchronized in time.
- Perform your test.
- Then launch TEMS Discovery and import the TEMS Pocket logfiles just created into that tool. Create a TEMS Discovery data set containing all of these files. Check the checkbox named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



21 Appendix F: Integrating TEMS Pocket With iBwave Design 5.3

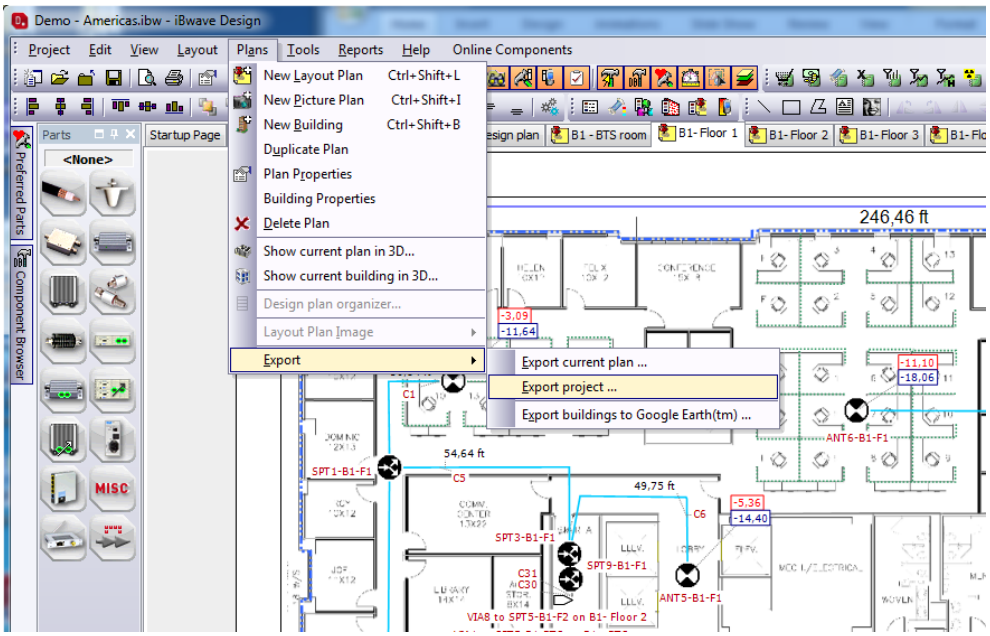
iBwave Design is an in-building project management tool that enables the user to plot coverage and propagation charts, track equipment cost, and manage the project activities surrounding deployment of in-building wireless networks.

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.

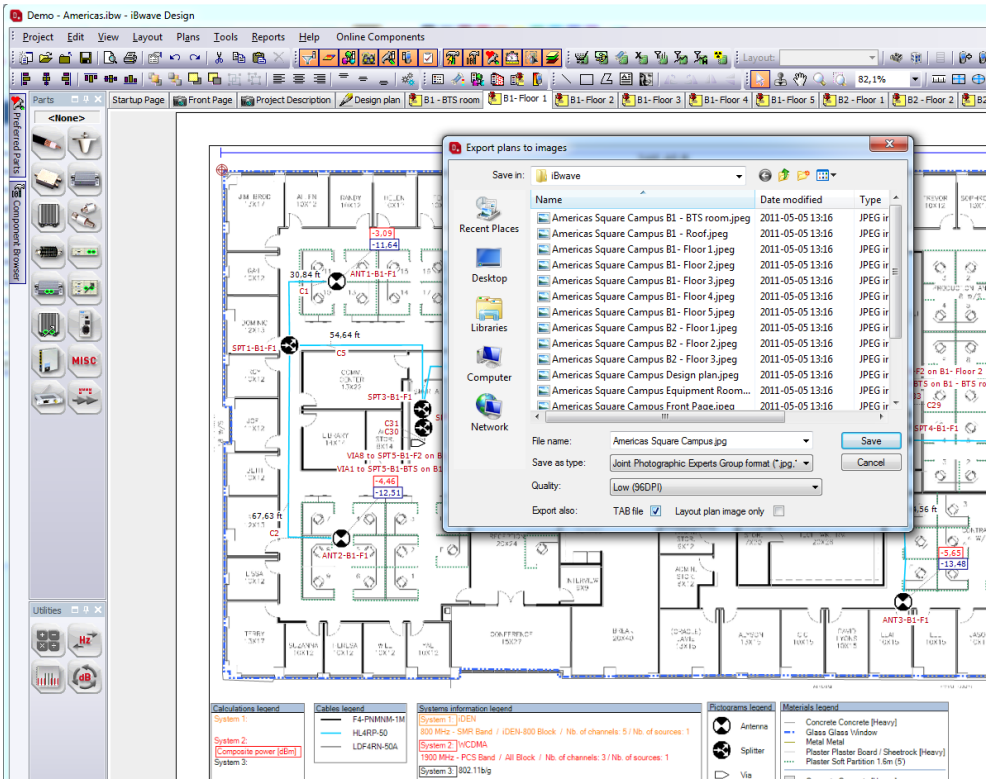
Step 1:

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.