Agilent E6476B/E6478A GSM/GPRS Air Interface Remote Monitoring System

Data Sheet







The Agilent E6476B/E6478A Air Interface Remote Monitoring System (RMS) is used to obtain key GSM / GPRS service performance measurements via remote probes in the network. The solution is sold as a system with remote probes that are installed in service or fleet vehicles, a system server, and an application server. The client software runs on a simple Web browser. Each probe can include up to two phones with a separate dedicated modem to transmit the measurement data back to the server.

Probes

The probes can be configured for GSM/GPRS. The probes support two phones with a separate dedicated modem to transmit data back to the server. A two-phone system is beneficial when doing termination testing as one mobile may call the other, thus eliminating the need for phone termination numbers back at the server. The system supports the following phones: Nokia 6340 (GSM), SAGEM 0T160 (GSM), SAGEM 0T19X (GSM/GPRS) and Motorola T720 (GSM/GPRS).

Each probe includes the following capabilities:

- Support for dual phones
- Separate GSM/GPRS modem for data transfer (Tri-band GSM 900, DCS 1800, and PCS 1900MHz Bands)
- Controller board
- GPS with dead reckoning
- 56 MB of non-volatile data storage on a Compact Flash card
- Permanent mount or magnetic mount RF antennas



Front of probe (with cover in place)



Front of probe (with cover removed)



Back of probe (with cover removed)

The probe connects to the ignition sense of the installed vehicle and is powered on and off when the vehicle is powered on and off.

| Voltage Range | 9-30 V |
|---------------|---|
| Vehicle (On) | Vehicle will be primary source of power |
| Vehicle (Off) | When the vehicle is turned off, the probe will write data to the local storage, transmit status information, and then shutdown. |

The attenuation between the phone and external antenna is nominally 8 dB. Additional attenuation is available as a kit. The kit includes a total of six attenuators - two of each attenuation value (one for each phone). The additional attenuation in the kit includes:

2 dB

4 dB

6 dB

Probe environmental requirements and reliability

The Probes meet portions of the SAE J1211 Environmental Practices for Electronic Equipment Design, including shock and vibration. SAE J1211 is the specification recommended by the Society of Automotive Engineers for recommended environmental practices. Typical product specifications include:

| Temperature (°C) | | | | | |
|---------------------------|---|--|--|--|--|
| Operating, Probe Only | -20°C to +60°C* | | | | |
| Operating, w/Phone(s) | See phone manufacturers specs. -40°C to +85°C | | | | |
| Non-Operating | | | | | |
| Humidity (%RH) | | | | | |
| Operating | 38°C | | | | |
| Soak | 98% for 10 days | | | | |
| Shock | Assume unit weight < 9 Kg | | | | |
| End-Use | Half sine waveform < 3 msec | | | | |
| Transportation | v=424cm/sec | | | | |
| | Trapezoidal waveform; min acceleration 50g | | | | |
| | Type 1 package •v=742cm/sec | | | | |
| Vibration | | | | | |
| Operating and functional | 5-500 Hz | | | | |
| (random) | 4-5 g estimated (not specified by SAE) | | | | |
| Survival swept (sinewave) | 1-1000 Hz | | | | |
| (0 to peak) | 1.5 g (dwell times not specified by SAE) | | | | |
| Survival (random) | 4-5 g estimated (not specified by SAE) | | | | |
| Surge Test | 1.2 x 50uS, 0.5/1 kV [IEC/EN61000-4-5] LIMITED | | | | |
| Fast Transients | IEC/EN 61000-4-4 | | | | |
| Radiated Emissions | E-Mark ; 95/54/EEC automotive directive emissions | | | | |
| Radiated Immunity | 3V/m 80-1000 MHz [IEC/EN61000-4-3] | | | | |
| Conducted Immunity | 3V, 0.15-80 MHz [IEC/EN 61000-4-6] | | | | |
| ESD | 0 to 25 kV survival, 0 to 15 kV functionality | | | | |
| | [HPETM 765] | | | | |
| | 4 kV contact, 8 kV air discharge [IEC/EN 61000-4-2] | | | | |

*Probe is rated to operate between -20°C and +60°C. Phone operation may very depending on the minimum and maximum temperature range of the selected phone.

Firmware upgrades are downloaded remotely via the modem from the server to the probe.

Server software license

The system requires a dedicated server and a server software license. Each server is specified to handle at least 50 probes. The server is based on a Linux operating system running Oracle(c) 9i Database Server.

Through the first half of 2004, the server will be hosted in a secure Agilent data center. The server specifications are:

- Database server Dell 6650
- Oracle 9i Database Server
- 16 GB RAM
- 2 TB Data Storage
- Application server Dell 2650

Application software license

The application software license is required. The application license allows a specific application to run on the server. In this case, the Air Interface RMS - GSM/GPRS application license may run on the server. This allows configuration of the probes for GSM/GPRS measurements as well as GSM/GPRS data visualization and transport.

System solution

The Air Interface RMS is designed to collect binned data across the network without the need to collect all details of the performance at each point for each probe. This provides information about the state of the network on a bin basis so statistically significant information can be obtained over time about the overall health of key areas of the network. However, for troubleshooting problems, it is often necessary to understand all the raw data including Layer 3 messages. When an alarm is triggered, all the data can be sent back to the server in a specified window of time before and after the alarm occurred. This "context" data allows operators to have the necessary raw measurement data available to troubleshoot problems.

Markets and zones and hierarchy

The Air Interface RMS is designed to support multiple markets residing on a single server. This allows for a view or comparison between different markets within the same organization. A market is a user-specified geographic area definable as a circle, rectangle, or a continuous polygon with an arbitrary number of vertices. A market is typically the wireless network managed under a regional or local management organization.



Market selection

Within each market, separate zones can be created. Zones are used for specifying where the probe will collect data, where the probe will transmit the data back to the server, or where a report should be generated.



Zone template list and zone definition page

Probes are assigned to a specific market and each market may have different configurations such as the context data window time. Additionally, each market may have a set of users defined by the administrator.

A summary of the hierarchy of the system in terms of server, market, zones, and appropriate user privileges is as follows:

- Server Corporate Administrator
- Market Definition 1 Market Administrator 1
 - Zone 1 User 1 through User N
 - Zone 2 Same as above User 1 through User N
 - Market Definition 2 Market Administrator 2
 - Zone 1 User 1 through User N
 - Zone 2 Same as above User 1 through User N

Additional information on zones is located in the schedule/zone area of the "Templates and configuration" section of this document. Additional information on user privileges is located in the "System Administration" section.

Templates and configuration

Templates are used to configure the probes. In actuality, the templates are assigned to probes and specific users can either change the templates assigned to the probes or create new templates and assign the new template to the probe(s).

The following templates are available in the Air Interface RMS:

- Binned Template
- Alarm Template
- Call Sequencing Template
- Schedule/Zone Template

Each probe is assigned one template per category (i.e., a probe cannot have two different binned templates assigned to it).

Binned and alarm template information

The following table lists the available binned and alarm triggered measurements available in the system. The listed measurements are dependent upon the phone you select for your system.

| GSM Functionality | 1 | | | | | |
|-------------------|--------|-------|--|--|--|--|
| Layer 1 | | | | | | |
| Measurements | Binned | Alarm | | | | |
| BSIC | Х | Х | | | | |
| RxLev_Full | Х | Х | | | | |
| RxLev_Sub | Х | Х | | | | |
| RxQual_Full | Х | Х | | | | |
| RxQual_Sub | Х | Х | | | | |
| FER | Х | Х | | | | |
| RLTC | Х | Х | | | | |
| Timing_Advance | Х | Х | | | | |
| DTX | Х | Х | | | | |
| Tx_Power | Х | Х | | | | |
| TimeSlot | Х | Х | | | | |
| Phone_State | Х | Х | | | | |
| BCCH | Х | Х | | | | |
| LAC | Х | Х | | | | |
| Cell_ID | Х | Х | | | | |
| тсн | Х | Х | | | | |
| MAIO | Х | Х | | | | |
| C1 | Х | Х | | | | |
| C2 | Х | Х | | | | |
| Call Processing | | | | | | |

| Measurements | Binned | Alarm |
|------------------------|--------|-------|
| Assignment_Complete | Х | Х |
| Assignment_Failure | Х | Х |
| Handover_Command | Х | Х |
| Handover_Complete | Х | Х |
| Call_Attempts | Х | Х |
| Origination_Failures | Х | Х |
| Valid_Calls | Х | Х |
| Call_Drops | Х | Х |
| No_Service | Х | Х |
| %_Origination_Failures | Х | |
| %_Dropped_Calls | Х | |

| %_No_Service | Х |
|-------------------|---|
| ldle_Mode_Handoff | Х |

| GPRS Data Functionality | | | | | | | |
|---------------------------------------|--------|-------|--|--|--|--|--|
| Measurements | Binned | Alarm | | | | | |
| RLC_Throughput_Downlink | Х | Х | | | | | |
| RLC_Decode_Error_%_DownLink | Х | Х | | | | | |
| CS1 through CS4 (Uplink and Downlink) | Х | Х | | | | | |
| RLC_Throughput_Uplink | Х | Х | | | | | |
| RLC_Retransmission_%_Uplink | Х | Х | | | | | |
| Connect_Speed | Х | Х | | | | | |
| Time_to_Connect | Х | Х | | | | | |

Alarm data

Any alarm that is created can be set to also include the following "context" data:

- None (no additional raw measurements are included with the alarm)
- Moderate (all additional raw data except Layer 3 data is included with the alarm)
- Full (all additional raw data including Layer 3 data is included with the alarm)

| e r | Alarm Setu | p | | | | | |
|-----------------------|------------|--------------|---|-----------|-------------|------------|-------------------|
| et • | E E |)escription | Measurement Type | Operation | Threshold | Severity | Context Data |
| kmarks | | | Add Intercept | < 🔻 | 0 | Low 💌 | None 💌 |
| inistration • | | | Add Intercept Bad Replies | AUE | | | |
| out | | | Breakdown Time | m List | | | |
| | Delete | Description | Connection Failures Drop Intercept Dropped Cell | Operatio | n Threshole | l Severity | y Context Data |
| | × | Low Power | Free Storage | < | -100 dBm | Low | None |
| | × | High FER | Power 12v a | te > | 10 | Medium | Full |
| ilent Technologies | × | Dropped Call | Dropped Call | > | 0 | Critical | Full |
| C opyright 2002, 2003 | × | Blocked Call | Blocked Call | > | 0 | Critical | Full |
| | <u> </u> | (| SAVE TEMPLATE | CANCEL | | | |

Alarm Template page with selectable context data options.

For alarms and context condition, the following context window may apply and can be set by the administrator. It should be noted that the context window is settable on a market wide basis - not on an individual alarm basis:

| Pre-Alarm Context Data Window | Post-Alarm Context Data Window |
|-------------------------------|--------------------------------|
| 15 seconds | 15 seconds |
| 30 seconds | 30 seconds |
| 45 seconds | 45 seconds |

| 60 seconds | 60 seconds |
|-------------|-------------|
| 75 seconds | 75 seconds |
| 90 seconds | 90 seconds |
| 105 seconds | 105 seconds |
| 120 seconds | 120 seconds |

Multiple alarm statements can be contained within one alarm template. Additionally, as described above, alarms may contain different levels of context data. For example, an alarm template may contain:

- Dropped Call Alarm with full set of context data
- Blocked Call Alarm with moderate set of context data
- High FER Alarm with no context data

Additional information on binned datasets and alarm data can be found in the "Visualizing data on the map" section of this document.

Call Sequencing Template

The Call Sequencing Template provides the ability to specify the call sequence of the phone in the probe. Selectable criteria in the Call Sequencing Template are:

- Minimum Inter-Call Distance (meters) Minimum distance between successive calls
- Call Mode Voice
- Call Number Phone number the mobile dials during to setup the call
- Idle Duration Amount of time between each call
- Maximum Setup Duration Amount of time to set the call up before a new sequence begins
- Call Duration Amount of time the call is in active mode
- Repeat sequence forever or specified number of times

Schedule/Zone Template

The probe can collect data and transmit the data back to the server at times specified by the administrator. The data can be collected for every half-hour interval from 00:00 to 24:00 hours. This can also be specified for active calls, idle calls, or both active and idle calls. The data can be transmitted to the server for every half-hour interval from 00:00 to 24:00 hours.

The system can specify specific collection and transmission zones as well. There is one zone per template for collecting the data and one zone per template for transmitting the data back to the server. These zones can be different or the same and can be a subset of the market area or the entire market area. Collection and transmission zones can be created as rectangular or circular zones.

Assigning templates to probes

Each probe is assigned a template from the four categories of templates. Therefore, a probe can be setup in different ways including recording binned data only, recording alarm and context data only, or a combination of the two.

Visualizing data on the map

The system allows multiple layers to be viewed on the map at one time. Data is visualized using a combination of binned data and alarm data. Alarm data is transmitted back to the server and visualized as soon as data services are available to send the alarm information back to the server. Binned data is calculated via a batch process on a nightly basis.

Binned data

Binned data is in 100-meter bins and is semi-transparent so street maps and additional information can be viewed under the binned data. Binning is performed on both the probe and server. Data from the probe is binned prior to sending the data to the server. The information on the probe per bin includes items such as Maximum, Minimum, Average, and number of samples. A nightly batch process is performed to take all the binned data from all the probes during the day and determine the bin values for each bin across the network.

Binned data can be displayed in the Web browser with the following modes when available:

| Statistic1 | Date Range | Time of Day |
|---------------------------|--------------|---------------|
| Maximum | Yesterday | Busy Hour |
| Minimum | This Week | Non Busy Hour |
| Mean | Last Week | Full Day |
| Average | This Month | |
| Standard Deviation | Last Month | |
| Count (Number of Samples) | This Quarter | |
| Mode (Most Common) | Last Quarter | |
| | This Year | |
| | Last Year | |

In addition to the above methods to plotting a binned dataset on the map, there is also the ability to evaluate and compare one dataset with another dataset. For example, this would apply when doing a delta plot of signal strength between this week and last week. The available comparisons operations when evaluating two datasets are:

- Delta
- Ratio

¹ Not all modes apply. The modes available depend on the binned data selected. For example, when plotting BSIC, the statistic of average does not apply.



Data set selection data dialog

Alarm data

Alarm data consists of five separate categories of alarms and are displayed as triangles with different colors. Different alarms that are created on the alarm template page can be classified as one of five alarm types to be displayed on the map. The five categories are:

- Critical
- Severe
- High
- Medium
- Low

Alarms are transmitted and displayed as soon as an alarm is triggered and data services are available to send the alarm information back to the server.

In many cases, visualized binned data is used in conjunction with visualized alarm data to find and solve network problems. When drilling down into an alarm, associated measurements are available in the Web page to help determine the additional measurements made at the specific location and occurrence of the alarm. When the associated measurements aren't enough, drill down details are available. Drill down context data can be exported to:

Third party post processing tools as an CSV exported file with binary coded Layer 3 messages.

All the raw data from the alarm during the context window is available in the CSV file. The available raw data includes all the measurements included in the binned data table on page 7 and 8 as well as additional data available from the phone used in the system. This includes serving cell and neighbor cell information.

Visualizing and clearing alerts

Alarms can be visualized in two ways:

- On the Map page using the different severity classifications and the tool-tip
 - On the Alert List page

•

The Alert List page provides a list of alarms that has occurred in the system. These alerts can be filtered by:

- A specific zone including the prior map extents of the map page
- A specific severity
- Both a specific zone and specific severity

Alarms can be cleared by picking specific alarms on the alert page or by selecting all the alarms filtered by the above conditions and clearing all checked alarms.



Provides alarm filtering and clearing

Reports

A number of reports are included in the solution. These reports can include busy-hour information and 24-hour information for various additional time periods such as this week, last week, this month, last month, etc. Each report provides information per zone, including the entire market.

Administrators can change the thresholds associated with the measurement category.

Available reports include, but are not limited to, the following:

- Bin Coverage
- Number of unique probes in zone
- Total bins in zone
- Percentage of bins covered in zone (total, passive, active)
- Time Event
- Number of unique probes in zone
- Call attempts (total, % successful, % dropped)
- MOU
- Erlangs
- Bin Data Scorecard
 - Percentage of bins blocking per various thresholds
 - Percentage of bins dropping per various thresholds

- Service quality including no service and FER above threshold
- Signal strength above various thresholds
- Bin GPRS
 - Percentage of bins DL_Throughput above various thresholds
 - Percentage of bins DL_Error above various thresholds
 - Percentage of bins UL_Throughput above various thresholds
 - Percentage of bins UL_Retransmission % above various thresholds
 - Signal strength above various thresholds

| Rep Rep Title: Perio Run I | oort / Report Li od: Date: | st Binned I This Yea 01/01/20 10/30/20 | Data Sco ir 02 08:00: 02 17:57: | orecard :00 GMT :07 Ame | to 01/0 rica/Lo | 1/2003 08 s_Angele | 3:00:00 G es | k⊋ MT | | | |
|--|----------------------------------|--|--|-------------------------------|--------------------|-----------------------|-----------------|---------------|----------|----------|----------|
| 24 | riour | Dr | opped C | Call | B | locked (| Call | Service | Quality | Signal S | Strength |
| | Zones | < 4% | < 10% | ye > 30% | > 30% | < 4% | ge < 10% | No Service | BER > 5% | > .70 | < .95 |
| | Santa Rosa | 74.6% | 74.6% | 25.4% | 0.0% | 100.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| - | Healdsburg | n/d | n/d | n/d | n/d | n/d | n/d | 0.0% | 0.0% | 0.0% | 0.0% |
| R | ohnert Park- Cotati | n/d | n/d | n/d | 0.0% | 100.0% | 100.0% | 0.0% | 0.0% | 84.2% | 0.0% |
| | denotes no | data for | the cell | | | | | | | | |

Binned data scorecard report

System administration

There are different levels of control and user access for the Air Interface RMS. Every user has a separate login name and password. Available groups and associated functionality are listed in the table below:

| Group | Privileges |
|-------------------------|---|
| User | Can view but not modify anything in the system. |
| Expert | Includes all privileges in the "User" group and can clear alarms, create/modify/edit/delete templates, and can configure probes |
| Market Administrator | Includes all privileges in the "Expert" group and can adjust market configuration parameters, add/modify/remove users from the market, add/remove probes from system, view audit entries |
| System Administrator | Includes all privileges in the "Market Administrator" group and can create/modify/edit/delete markets |

All users can alter their own passwords.

Administrators have access to system audit capabilities. This allows administrators to understand which users have logged into the system, which users have made changes to the system, and when changes have occurred.

Computer hardware

The Agilent E6476AB/E6478A Air Interface Remote Monitoring System is an enterprise wide system. To visualize the data, configure the probes, or make use of the system, a Web-enabled computer will be required. The system requires a PC with Internet Explorer. The minimum requirements are listed below.

Minimum PC requirements

- Pentium® processor (400 MHz Pentium III)
- Windows® 98, Windows 2000, or Windows XP
- Internet Explorer 5.5 or higher
- 128 MB RAM

Service and Support Training

Training

Startup assistance is provided with a system purchase. This includes consulting and user training. In addition to user training, Agilent offers System Administrator and Advanced Troubleshooting training.

Services

A range of services is available to help deploy the system. The services range from customer self-install, to collaborative install, to Agilent complete installation. In addition to the installation services available, Agilent can provide additional consulting services such as assistance with system use, measurement interpretation, and custom reporting. Agilent services include:

- Project management
- Solution architect
- Technical consulting

Technical support

One year of online technical support is provided with a system purchase. Subsequent years require a support contract, renewed annually.

Warranty

One-year warranty on hardware components is included with the Agilent E6476B system. Extended warranty and maintenance agreements can be included in the annual support contract.

Related Literature

Agilent E6476B/E6478A Air Interface
Remote Monitoring SystemProduct Overview 5988-6482ENMaximize engineering resources with
Agilent's Air Interface RMSPhoto Card5988

5988-5640EN

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