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TEMS™ DISCOVERY NETWORK 11.0

(PREVIOUSLY TEMS™ VISUALIZATION PROFESSIONAL, DESKTOP EDITION)

BRIDGING THE OPTIMIZATION GAP



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AGENDA

- Product Overview
- TEMS Discovery Network – System Details
- What's New in TEMS Discovery Network 11.0
- What Was New in TEMS Visualization 10.1
- Feature Overview
- Common Feature Details
- Geo-Analysis Based on Google Maps
- Ericsson WCDMA GPEH Module Features
- Ericsson Tracing (UETR, MTR, UE Trace) Features
- Ericsson LTE Cell Trace Module Features
- NSN Megamon GEO WCDMA Module Features
- Huawei WCDMA Call Trace Module Features
- Huawei WCDMA PM Counter Module Features
- Ericsson GSM R-PMO Module Features
- Conclusion





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PRODUCT OVERVIEW



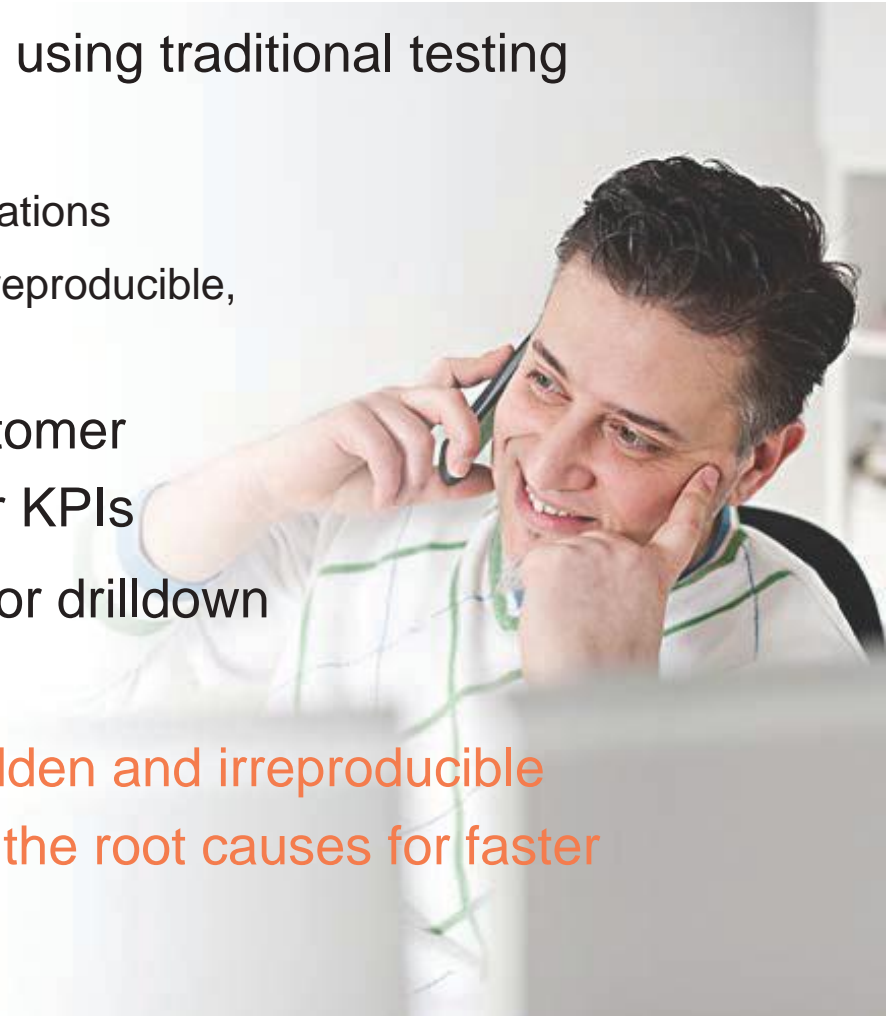
NEW CHALLENGES FOR THE WIRELESS OPERATOR

- **Bandwidth and Capacity**
 - Smartphones and App usage => Significantly heavy demand
 - High Capacity LTE Rollouts address the high bandwidth vs. low ARPU constraints
- **Operational Efficiency**
 - Increased complexity with multitechnology networks => increased operational cost for identification and resolution of problems
 - High cost of drive testing => Minimize drive tests
 - Need to resolve both voice and data issues simultaneously
- **Customer Experience (CX) Management**
 - Increased customer expectations of user experience
 - ARPU remains Low, smaller pool of new customer, higher competition for current subscribers => focus on minimizing churn
 - Subscriber-centric resolutions (network-centric less important)



CHALLENGES WITH COMPLEX NETWORK OPTIMIZATION

- Many QoS problems cannot be pinpointed using traditional testing methods and PM counter tools
 - Majority of issues occur in private, inaccessible locations
 - Issues that are 'sequence of events' specific are irreproducible, and stay hidden
- MTTR, operational effectiveness, and customer satisfaction suffer, causing churn and poor KPIs
- Statistical performance data do not allow for drilldown to details of individual call QoS issues
- **Need: Subscriber-focused visibility into hidden and irreproducible problems, with ability to quickly determine the root causes for faster resolution and optimization**



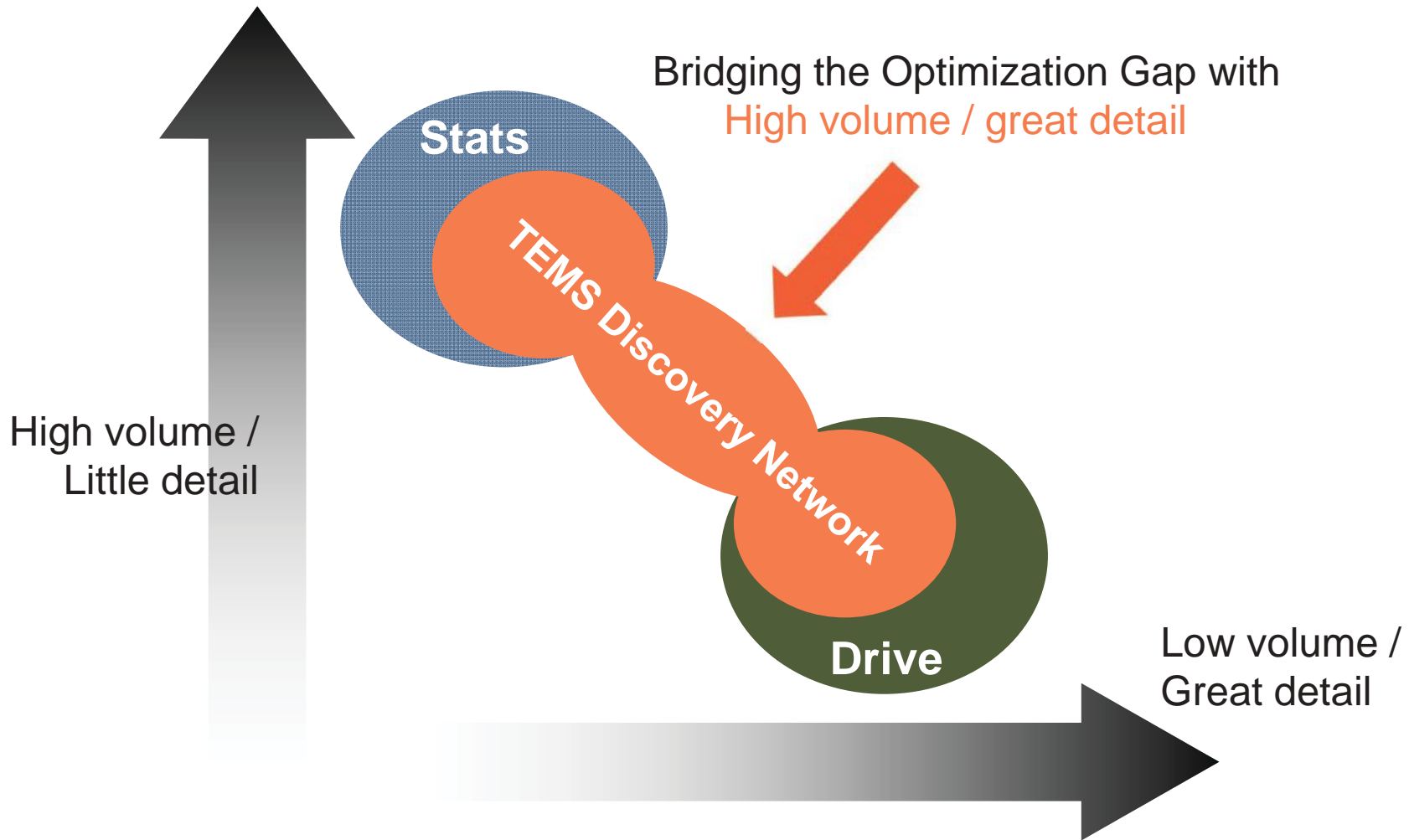
THE SOLUTION: TEMS DISCOVERY NETWORK

- Utilizes event data generated from large volumes of live subscriber traffic
- Bridges the gap between performance management and drive test solutions
- Cell, phone model, subscriber centric, and other advanced analysis, with ability to drill down to and geolocate individual calls
- Prioritize and Resolve larger volumes of problems, impossible to even identify before
- **Customer Experience Focused, Operationally Efficient, Multivendor and Multitechnology**



Troubleshooting and optimization based on live subscriber traffic

BRIDGING THE OPTIMIZATION GAP



BRIDGING THE OPTIMIZATION GAP

- **TEMS Discovery Network bridges the gap between traditional performance management solutions and drive test solutions**
 - Performance management tools offer an overview of all users, but provide limited levels of detail that are not easily actionable
 - Drive test tools provide a detailed view for troubleshooting but not enough data to ensure that all issues are captured

TEMS Discovery Network gives you access to all users and allows you to drill down to the actual calls or events causing problems. This leads to faster mean time to repair (MTTR) and other operational efficiencies, as well as more satisfied customers.

WHY TEMS DISCOVERY NETWORK

- Call Trace (Event) Data based Tool: Capitalizes on benefits of event data
 - **Optimization value of data source:** Subscriber-centric data allows homing in on issues more directly than w/ proxy subscriber via drive test, for more effective optimization / troubleshooting
 - Large volumes of data with full breadth of locations (indoor, outdoor, private, inaccessible), all phone models, all services, all times of day – resolve previously invisible issues
 - High level of detail with Layer 3 info and vendor's internal events; geolocate and visualize problem events in TEMS Discovery Network (overcomes limitations of cell-centric PM statistics)
 - **Cost effectiveness:** Zero to low cost of data collection helps reduce OPEX
 - **Holistic network view:** Increases operational efficiency by localizing and accurately quantifying problem elements such as cell, phone model, subscribers, services, etc.
- Allows VIP customer troubleshooting – protect revenue and reduce churn
- Prioritize issues based on qualitative and quantitative subscriber impact
 - Captures subscriber and problem density, unlike traditional methods

LOW COST, HIGH IMPACT OPTIMIZATION TOOL

- Free up engineers from routine data collection and analysis to focus on faster implementation of network optimization solutions
 - Reduce Cost of Collection: No cost to collect data
 - Reduce Cost via Automation: Automated data processing, automated analysis
 - Increase Impact:
 - Ability to go from high level statistics to comprehensive call analysis for large volumes of data, all integrated within a single tool
 - Geolocate and visualize subscriber calls and issues
 - Ability to handle large volume of data and longer periods of time needed for certain optimization procedures like neighbor optimization (example: at least a week of data needed to be judicious for neighbor-list changes)
 - Identify, investigate, and resolve hidden problems to reduce churn
 - Multidimensional analysis of issues – subscriber/group/VIP based, cell/cluster geography based, phone model/group based, service based



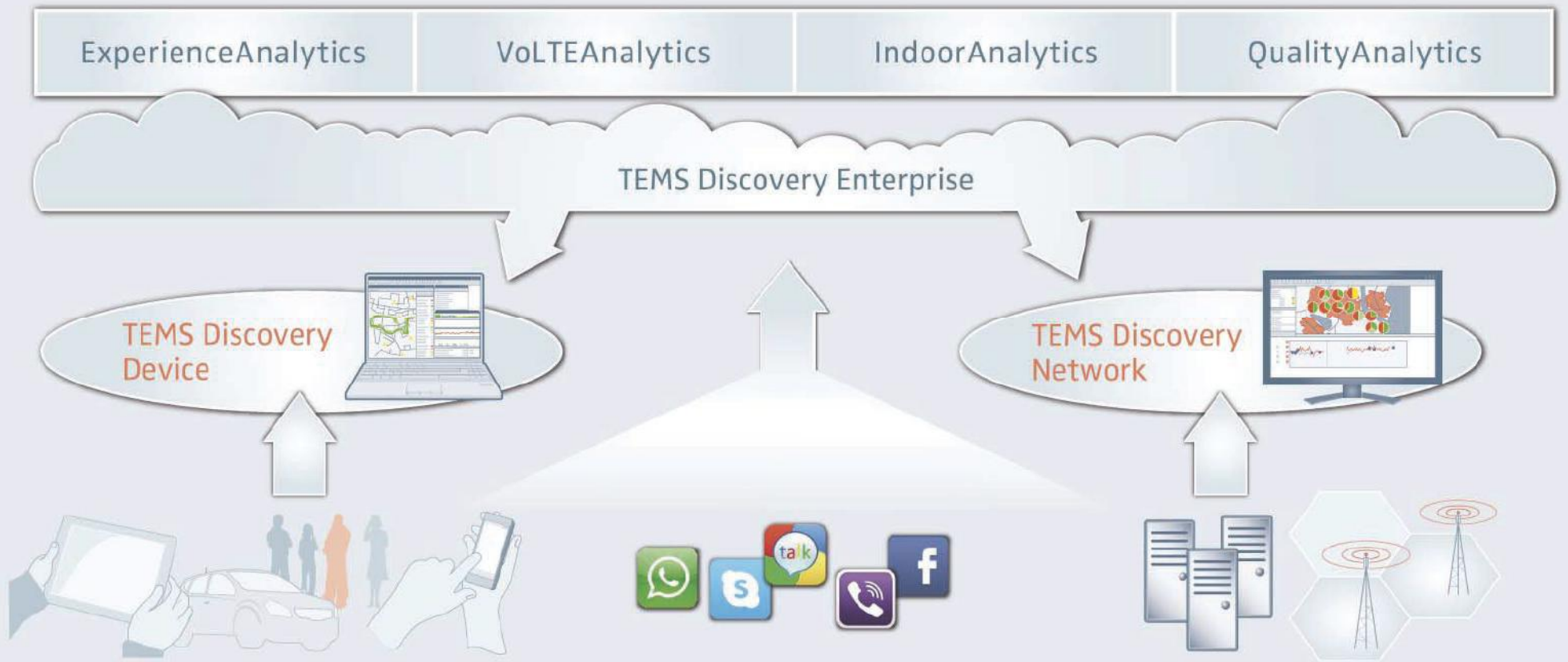
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TEMS DISCOVERY NETWORK – SYSTEM DETAILS



TEMS DISCOVERY – PRODUCT SUITE



TEMS DISCOVERY SUITE – TWO PLATFORMS

Desktop Platform

(Two Editions)

- Enables detailed drilldown analysis at call and message level
- Projects: One-time processing, Limited time periods
- TEMS Discovery Network: Call Traces and other OSS Data
- TEMS Discovery Device: Drive Test & Device Measurements

Enterprise Platform

(Single Platform with Unified Analytics Dashboard)

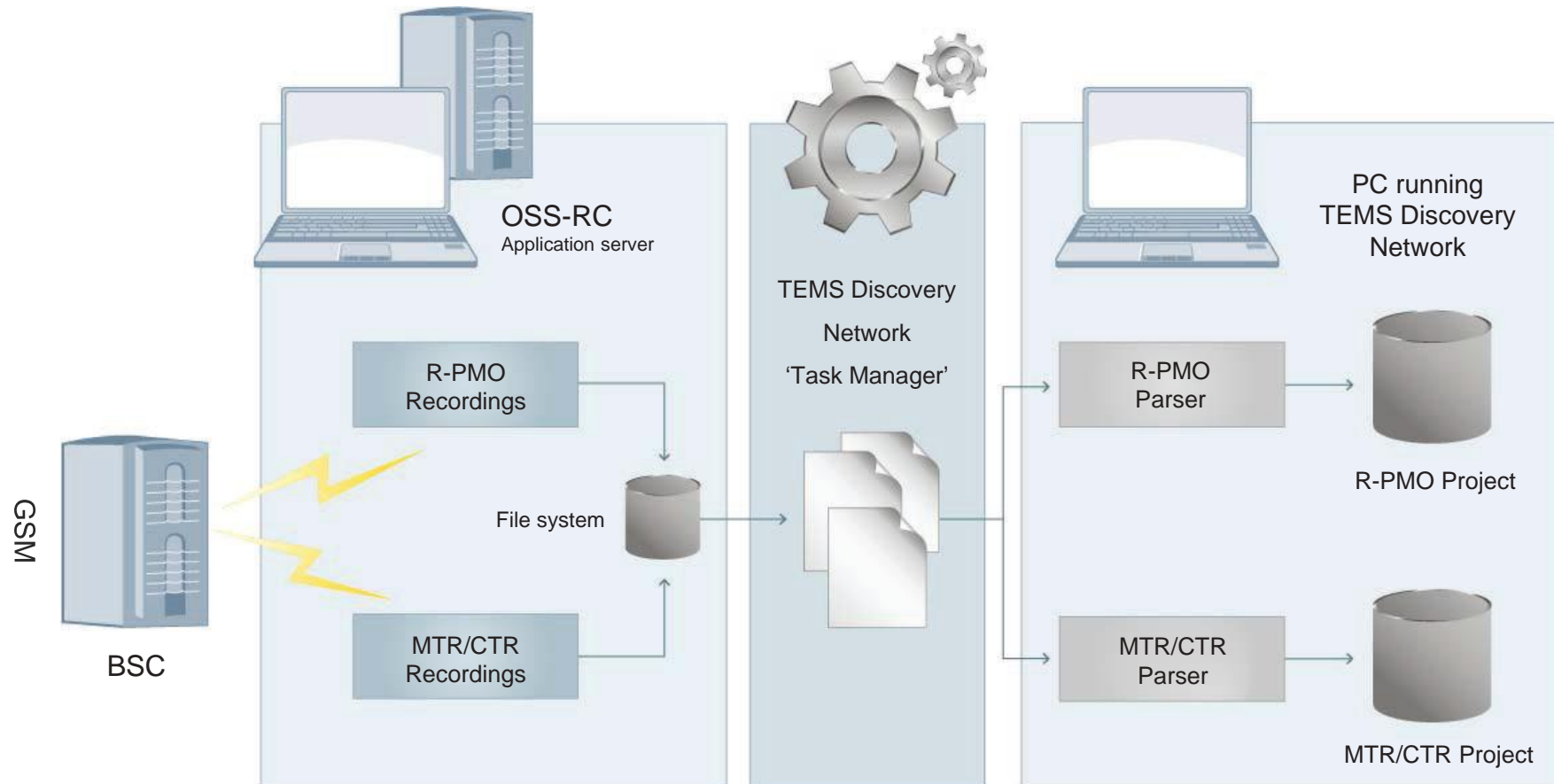
- Centralized server, Remote client deployment
- Scalable System Architecture
- 365 x 24 x 7 Monitoring, Processing, Automatic Aggregation
- Near Real-time insight into Network and Services
- Automated Analysis and Reporting of data from Devices, Network Elements, and Applications via 'Network' and 'Device' Modules (with Correlation, in future)
- Maximizes Operational Effectiveness
- Single Overview of Network for Entire Organization
- Interfaces with Desktop variants for Troubleshooting and Optimization

TEMS DISCOVERY NETWORK (DESKTOP PLATFORM)

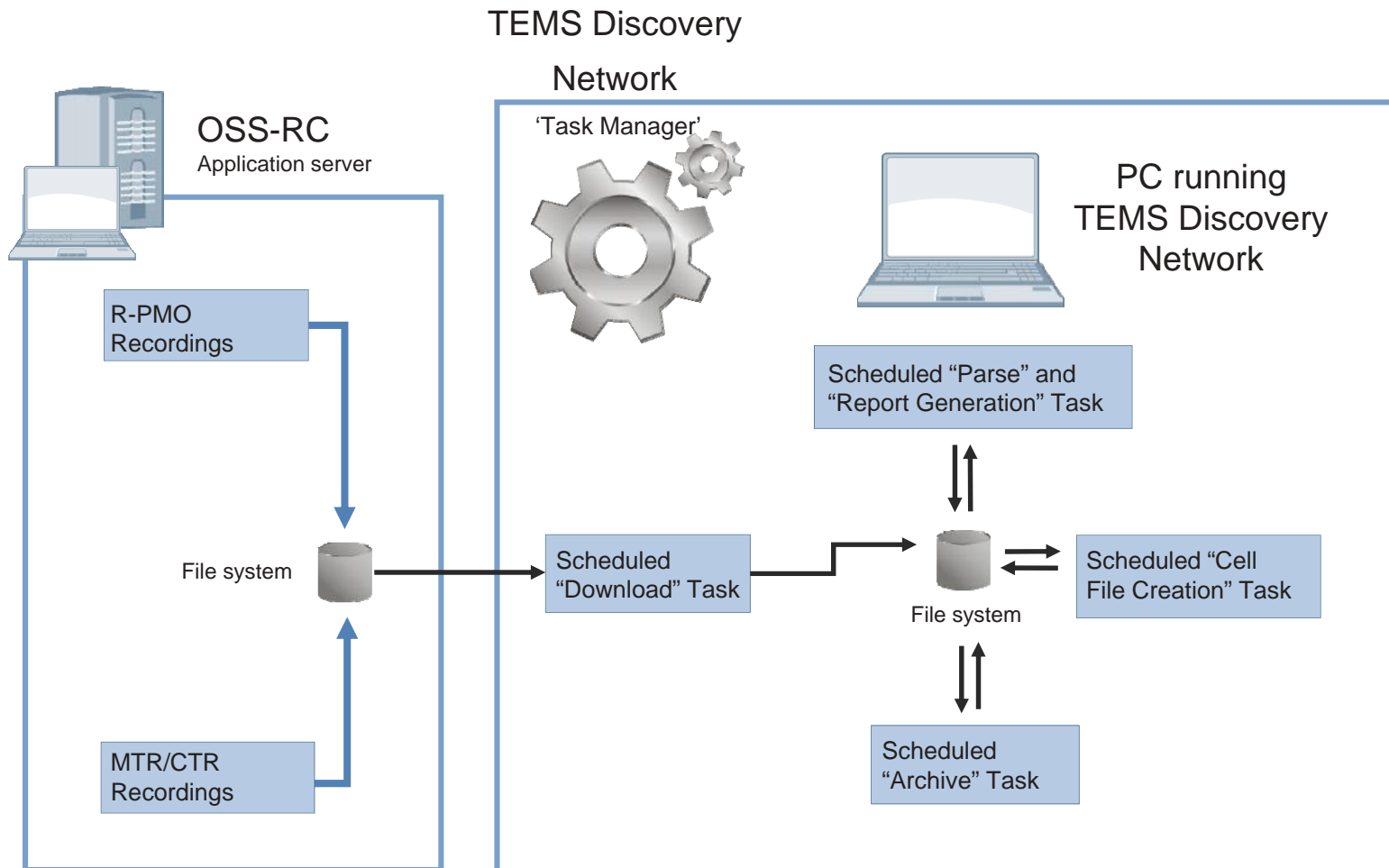
- PC-based, event data analysis tool: stand-alone or pooled options
- Supports GSM/WCDMA/LTE call trace data from Ericsson OSS, Huawei WCDMA call trace and PM counters, and NSN 'Megamon GEO Interface WCDMA' in two applications
 - **GSM Application:** Ericsson GSM R-PMO, MTR/CTR with Task Manager
 - **WCDMA, LTE and Tracing Application:** Ericsson WCDMA GPEH and UETR; Huawei WCDMA call trace and PM counters, NSN Megamon GEO Interface WCDMA; Ericsson LTE Cell Trace and UE Trace; and Ericsson GSM MTR (for multitechnology tracing)

Note: Ericsson GSM R-PMO and GSM CTR formats are not supported on the Enterprise platform

TEMS DISCOVERY NETWORK: GSM APPLICATION

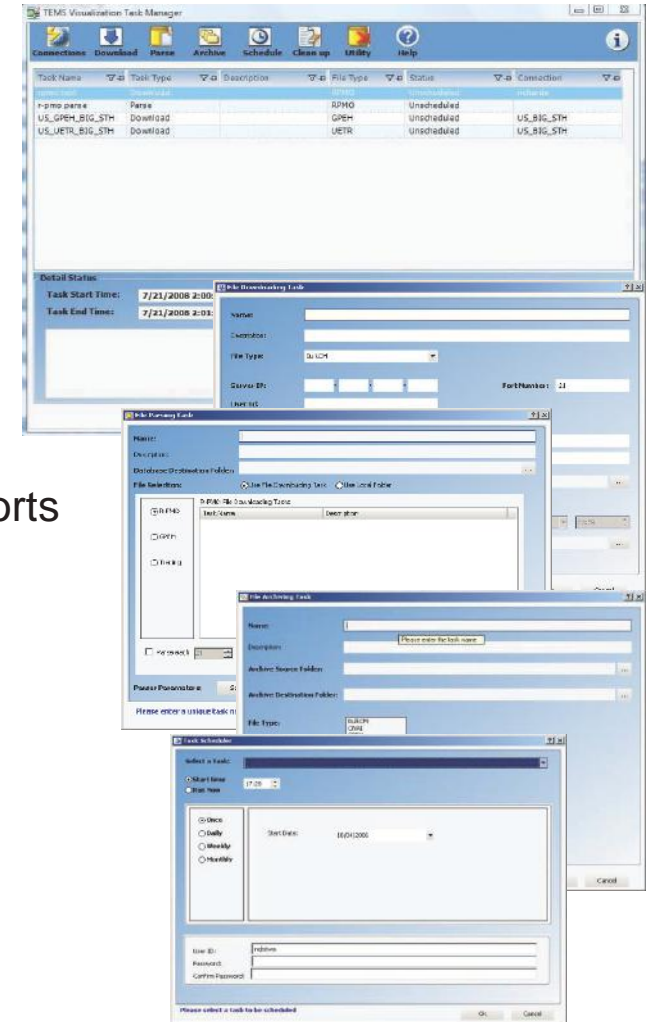


TASK MANAGER IN GSM APPLICATION

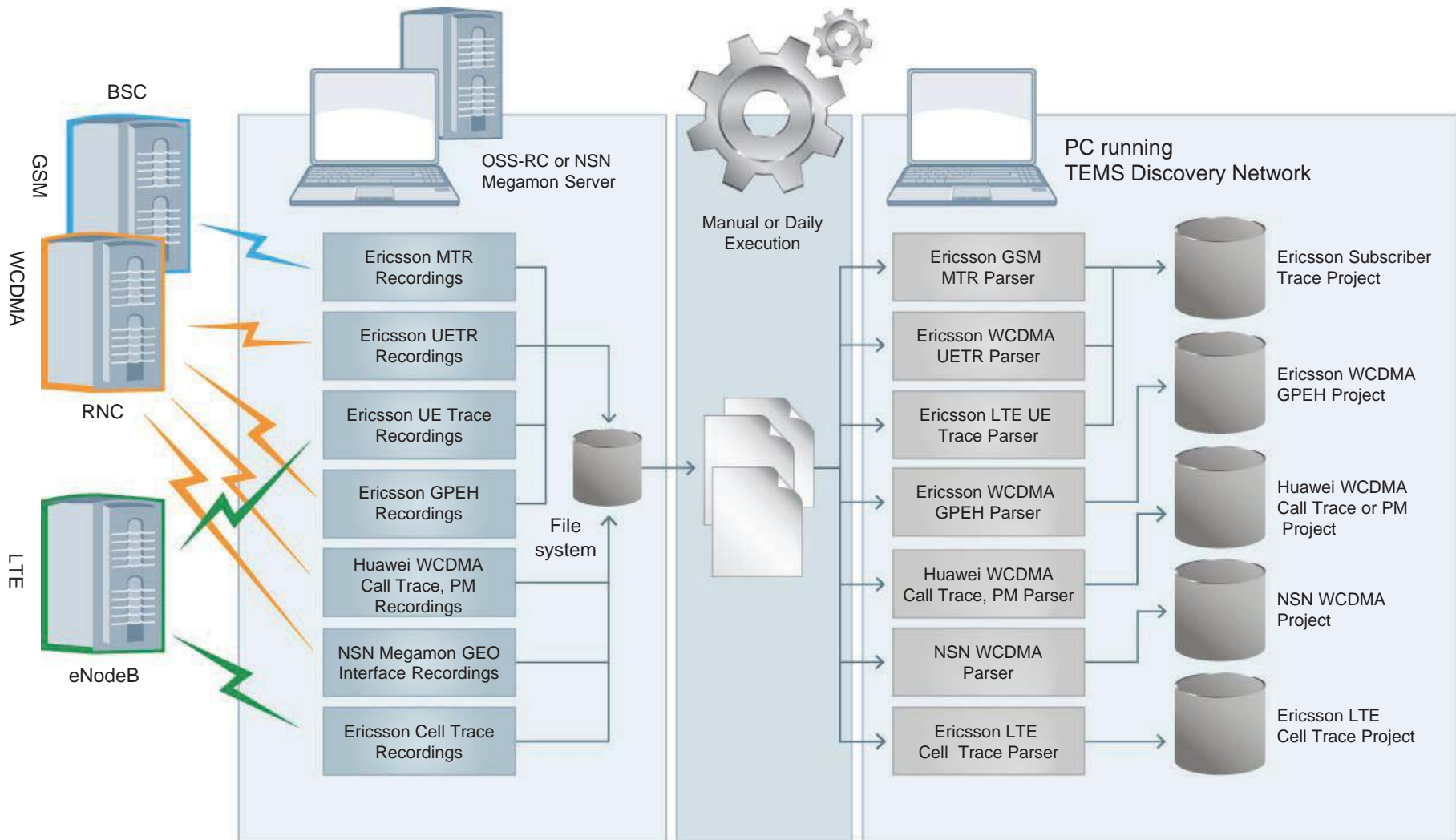


TASK MANAGER OVERVIEW

- Automated functions for improved efficiency
 - Collection of OSS recordings
 - Automatically connect to OSS and collect latest recordings
 - Creation of databases and reports
 - Automatically set up rules for data parsing
 - Automatically create cell files
 - Automatically create database summary and aggregated reports
- Archiving of old data
 - Automatically archive old data for easy housekeeping
- Possibility for centralized data management



TEMS DISCOVERY NETWORK: WCDMA, LTE & TRACE APPLICATION



TEMS DISCOVERY NETWORK: COMPARISON

	Desktop Edition: TD Network	TD Enterprise (Network Module)
Support for Ericsson WCDMA: GPEH, UETR	X	X
Support for Ericsson GSM: R-PMO, CTR (area formats)	X	
Support for Ericsson GSM: MTR (IMSI format)	X	X
Support for Ericsson LTE: Cell Trace, UE Trace	X	X
Support for Huawei WCDMA Call Trace Format, PM Counters	X	X
Support for NSN WCDMA: Megamon GEO Interface Format	X	X
Additional multivendor, multitechnology (2014-15 development)	X	X
Geolocation of Custom Events, RSCP, Eclo, Traffic with Filters	X	X
Rich Feature Set (e.g., Phone Model KPI, Dropped Call Analyzer)	X	X
Scalable Platform		X
Full Automation, Aggregation with Flexible Data Scope		X
High Performance (Suited for Larger Volumes)		X
Centralized Server-Client Architecture, with Analytics Dashboard		X
Troubleshooting, Optimization, Detailed Drilldown Analysis	X	via PC Client



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WHAT'S NEW IN TEMS DISCOVERY NETWORK 11.0



WHAT'S NEW IN TEMS DISCOVERY NETWORK 11.0

- New system releases supported
 - Ericsson GSM G13B, WCDMA W14A, LTE L14A
 - NSN Megamon GEO Interface WCDMA 1.1
 - Huawei WCDMA call trace recordings (R12-R13), and PM counters (R14-R15)
- Ericsson LTE Cell Trace Module
 - Completion of CSFB report to work from within the product itself
 - Coverage Area Optimization, with Distance vs. KPI Measurement Chart
 - Call Search with Outgoing CSFB and IMS Call Type categories
 - Exception Analysis: Adding LTE Redirection and Dropped Call events
 - Count individual eRAB releases, including VoLTE

WHAT'S NEW IN TEMS DISCOVERY NETWORK 11.0

- Ericsson WCDMA GPEH Module
 - Improved GPEH decoding performance
 - Service Usage Chart for an entire Phone Model Group
 - Maximum items in Phone Model Group and Subscriber Group increased from 250 to 500
 - CSFB in WCDMA: Information element to detect CSFB call added to Call List and Call Search options. Information element regarding redirection to eUTRAN info added to Call List
 - Additional descriptive text included in image export of Geo KPI maps

WHAT'S NEW IN TEMS DISCOVERY NETWORK 11.0

- Ericsson GSM R-PMO Module
 - Flag indicating DTM calls added to Call List and Call Search options.
 - KPIs for DTM Dropped Calls and DTM Drop Rate (%) added to Cell List and Phone List.
 - Tracking of Service during calls added to Call Messages: Tracks changes between Signaling, CS Only and CS + PS (DTM) on a per-message basis.
 - Service Usage Analyzer added: Possible to see Call Time and % Time in Signaling for 'CS Only' and 'CS + PS (DTM)' for selected calls or IMEI-TAC from Phone List.
 - 'Last Speech Codec Type' used in call added to Call List and Call Search options.
 - Added Basic Call Search option for a specific subscriber (full IMEI).
 - Added Advanced Search option for 'Drop after IRAT handover.'
- General
 - Support of TEMS .xml cell file format for GSM, WCDMA, and LTE

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WHAT WAS NEW IN TEMS DISCOVERY NETWORK 10.1



WHAT WAS NEW IN TEMS DISCOVERY NETWORK 10.1

- TEMS Discovery Network (Desktop Edition) is the upgrade path for TEMS Visualization ‘Professional’ users
- New system releases supported
 - Ericsson GSM G13B, WCDMA W13B, LTE L13B releases
 - Huawei WCDMA PM Counters for R14+ releases
- Ericsson LTE Cell Trace
 - Subscriber KPI Analysis
 - CSFB Performance Report
- Huawei WCDMA PM Counter Module
 - RNC KPIs and Time Chart
 - Cell KPIs and Time Chart
 - Capacity Analysis
 - Coverage Area Optimization: Overshooting Cells
 - Neighbor Cell Performance

WHAT WAS NEW IN TEMS DISCOVERY NETWORK 10.1

- Huawei WCDMA Call Trace Module
 - Support for Groups: Phone Model and Subscriber KPIs
- Ericsson WCDMA GPEH
 - RAB Usage Distribution by call and user
 - GPEH-Core Module is no longer available as a separately priced subset-module of the GPEH Module
- Ericsson GSM R-PMO
 - IMEI Based Call Search



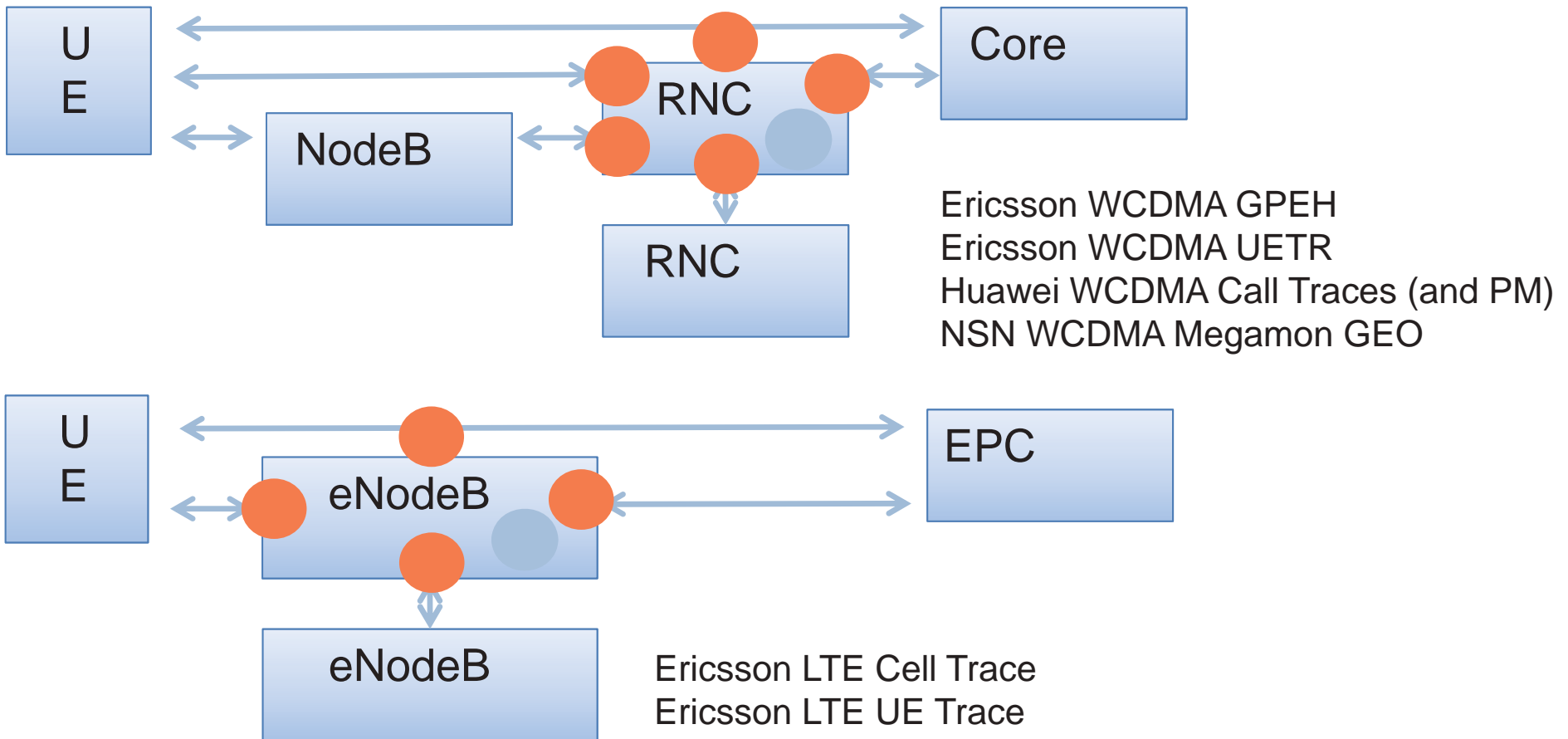
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FEATURE OVERVIEW



MAIN DATA SOURCE – EVENT DATA



Note: 2G Event at BSC not shown in example

- 3GPP Messages (Ericsson, Huawei, NSN)
- Internal Information (Ericsson, some Huawei & NSN)

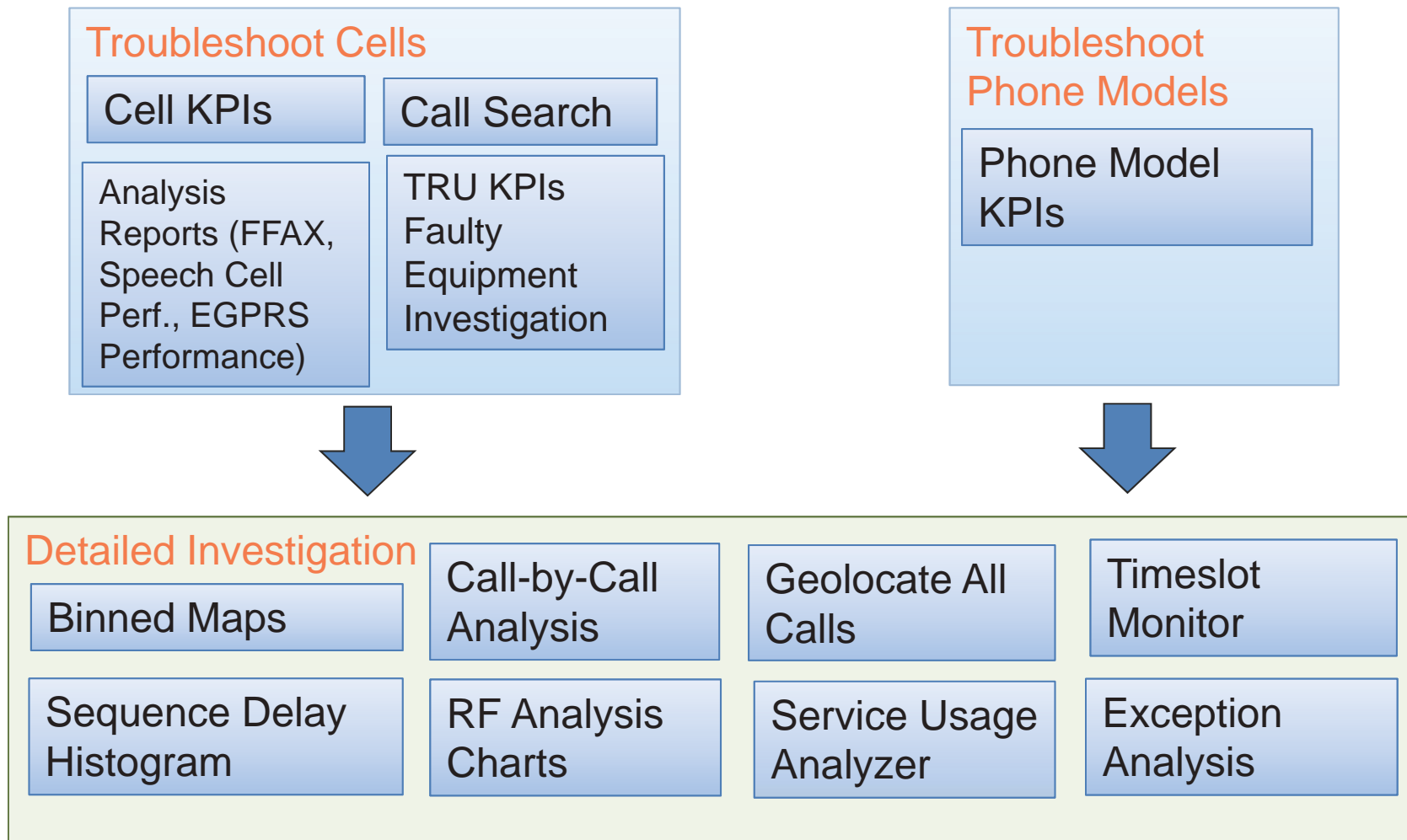
EVENT DATA – UNIQUE BENEFITS

- Subscriber-centric virtual drive test data using all traffic
 - Recording functions **built into** the network nodes (or server in NSN case)
 - Can record **large volumes** of traffic in an area of cells at **minimal costs**
 - **All traffic** – outdoor or indoor, rural or urban, private and inaccessible areas
 - **All services, traffic types:** including CS speech, R99 data, HSPA data
- Highly detailed
 - External events – 3GPP protocol messages (RRC, RANAP, RNSAP, NBAP)
 - Internal events – more details than available from the protocol analyzer
 - Uplink and downlink radio measurements
- Per-call analysis
 - Follow message sequences
 - Correlate information from different parts of a call
 - Analyze details missing from PM statistics counters

ERICSSON GSM MODULES OVERVIEW

- Real-Time Performance Monitoring (R-PMO): Supports binary format output from OSS-RC4 with up to 500 cells per recording
- Mobile Traffic Recording (MTR)
 - Text format from OSS and Binary format from BSC supported
- Cell Traffic Recording (CTR): Text format from OSS supported
- Records event data for traffic in an area of cells (R-PMO) or specific cell (CTR) or specific subscribers (MTR)
- TEMS Discovery Network now post-processes Ericsson GSM 07A – G13B releases
 - Supports R-PMO & CTR (GSM app only); MTR (both TDN applications)(TEMS Discovery Enterprise – Network Module: Supports only GSM MTR format)

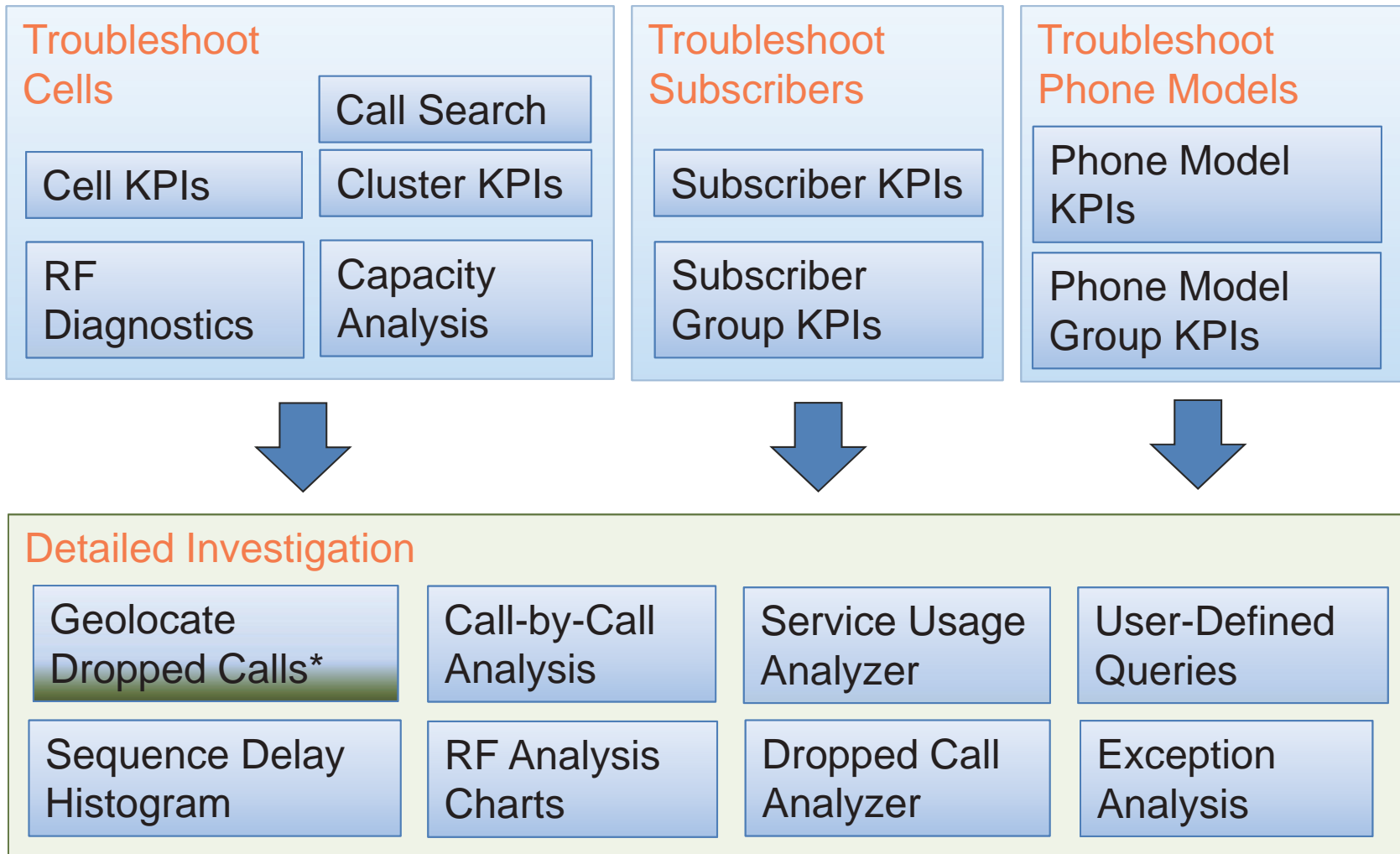
GSM R-PMO MODULE – TROUBLESHOOTING



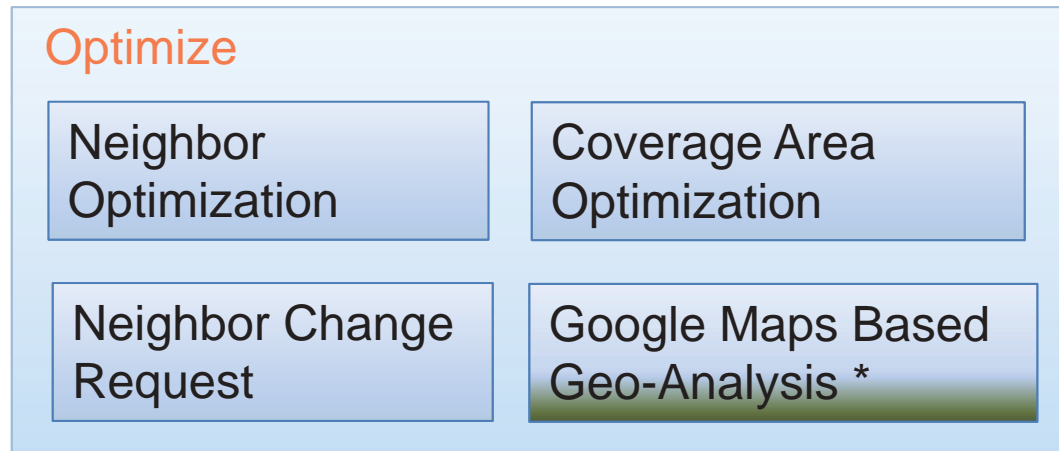
ERICSSON WCDMA MODULES OVERVIEW

- General Performance Event Handler (GPEH)
- User Equipment Traffic Recording (UETR)
- Event data recording function in the Ericsson RNC and OSS-RC
- Records event data for traffic in an area of cells (GPEH) or specific subscribers (UETR)
- Similar to Iu/Iub/Iur probes but more cost-effective and RNC internal events and information is available
- TEMS Discovery Network now supports GPEH and UETR for W11A – W14A releases.

WCDMA GPEH MODULE – TROUBLESHOOTING



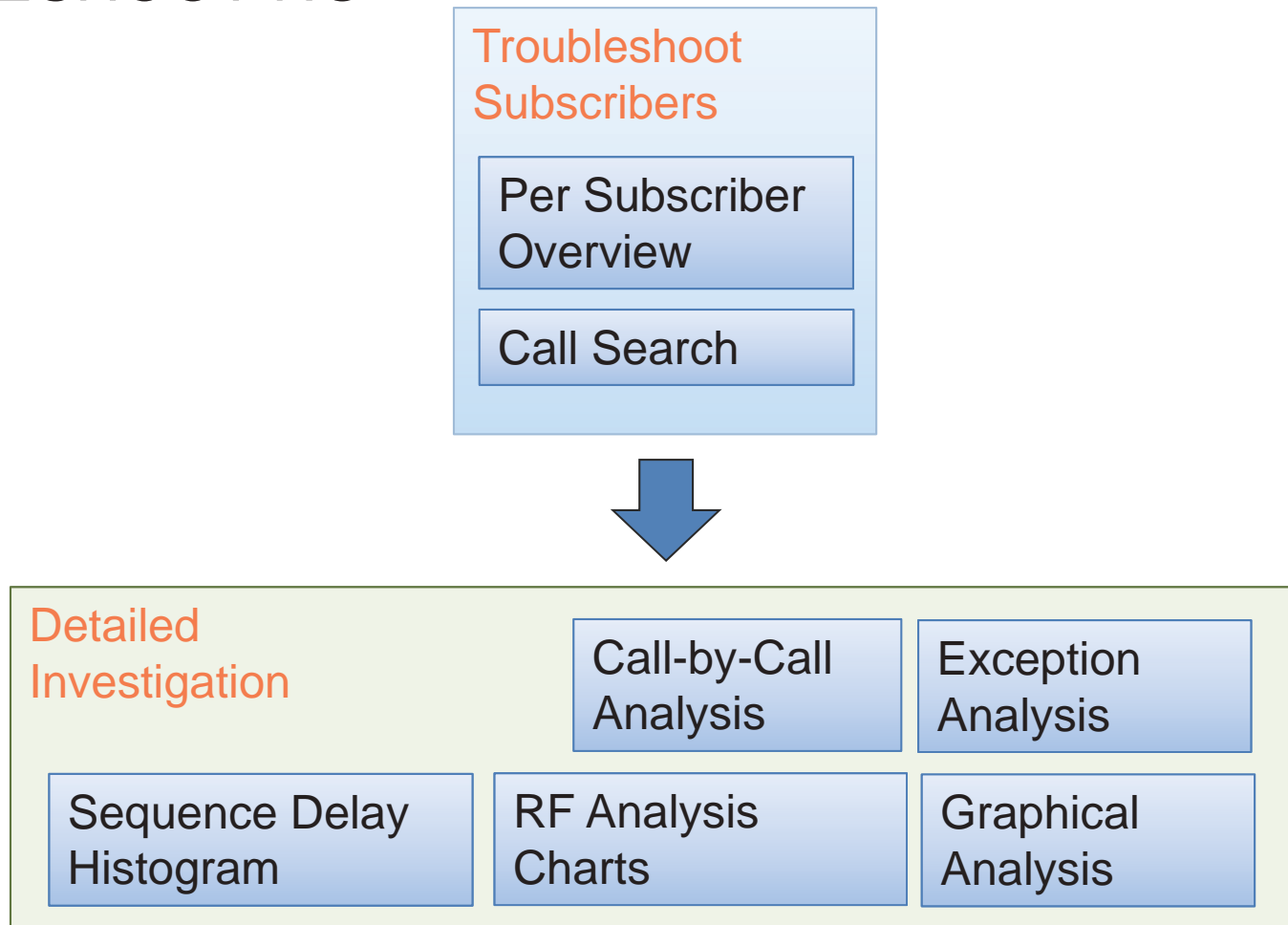
WCDMA GPEH MODULE – OPTIMIZATION



Options for GPEH

* Available via Module 'GPEH Geolocation'

WCDMA UETR, LTE UE TRACE AND GSM MTR MODULES – TROUBLESHOOTING

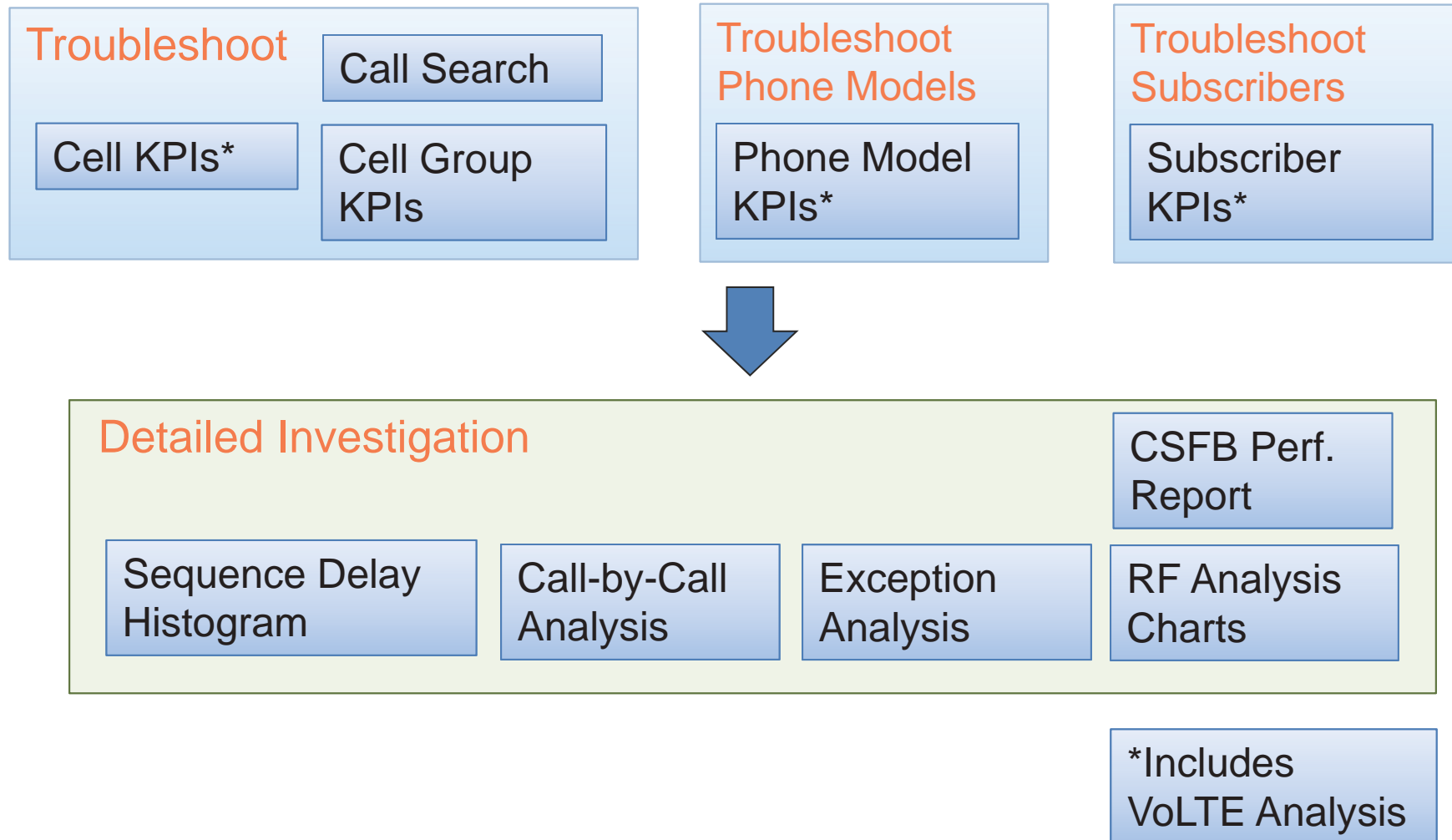


ERICSSON LTE MODULES OVERVIEW

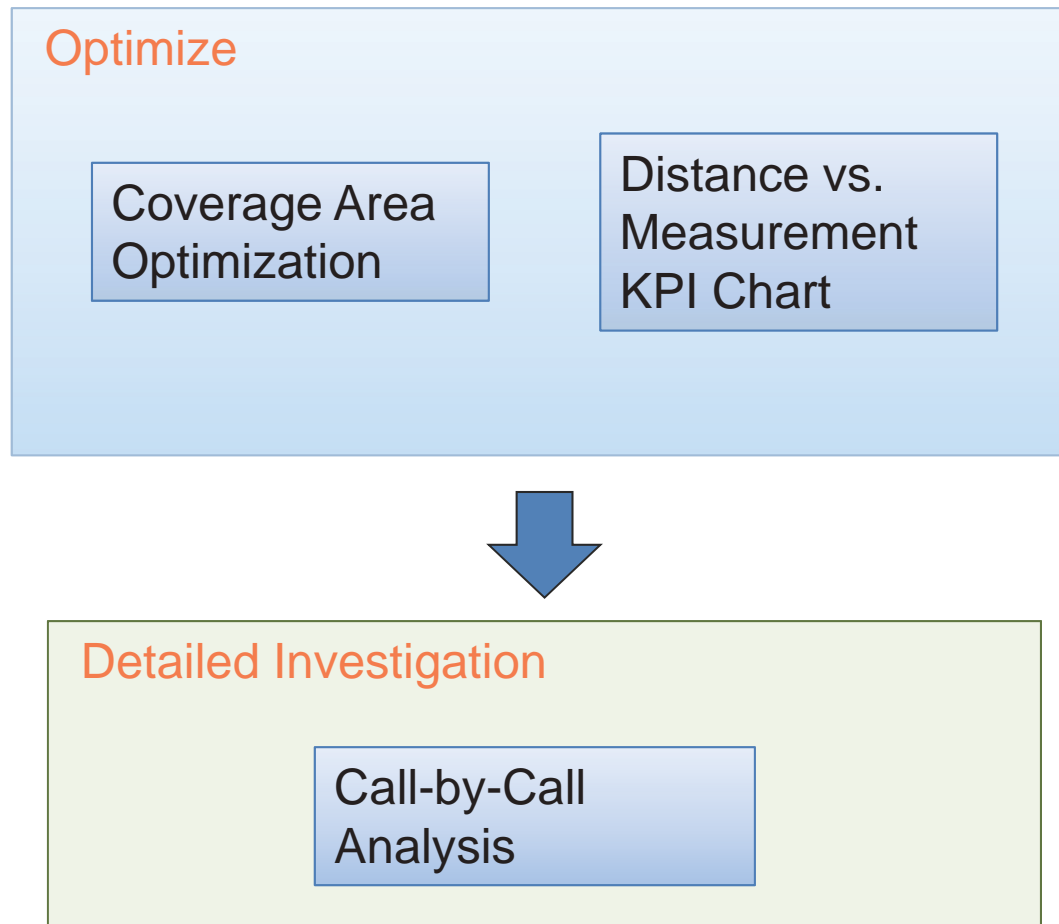
- Event data recording function in the Ericsson eNodeB and OSS-RC
- Records event data for traffic in an area of cells (Cell Trace) or specific subscribers (UE Trace)
- Similar to S1/X1/Uu probes but more cost-effective, and eNodeB internal information is available
- TEMS Discovery Network now supports LTE Cell Trace, UE Trace and LTE MME CTUM (Cell Trace User Mapping) L12B-L14A Format



LTE CELL TRACE MODULE – TROUBLESHOOTING



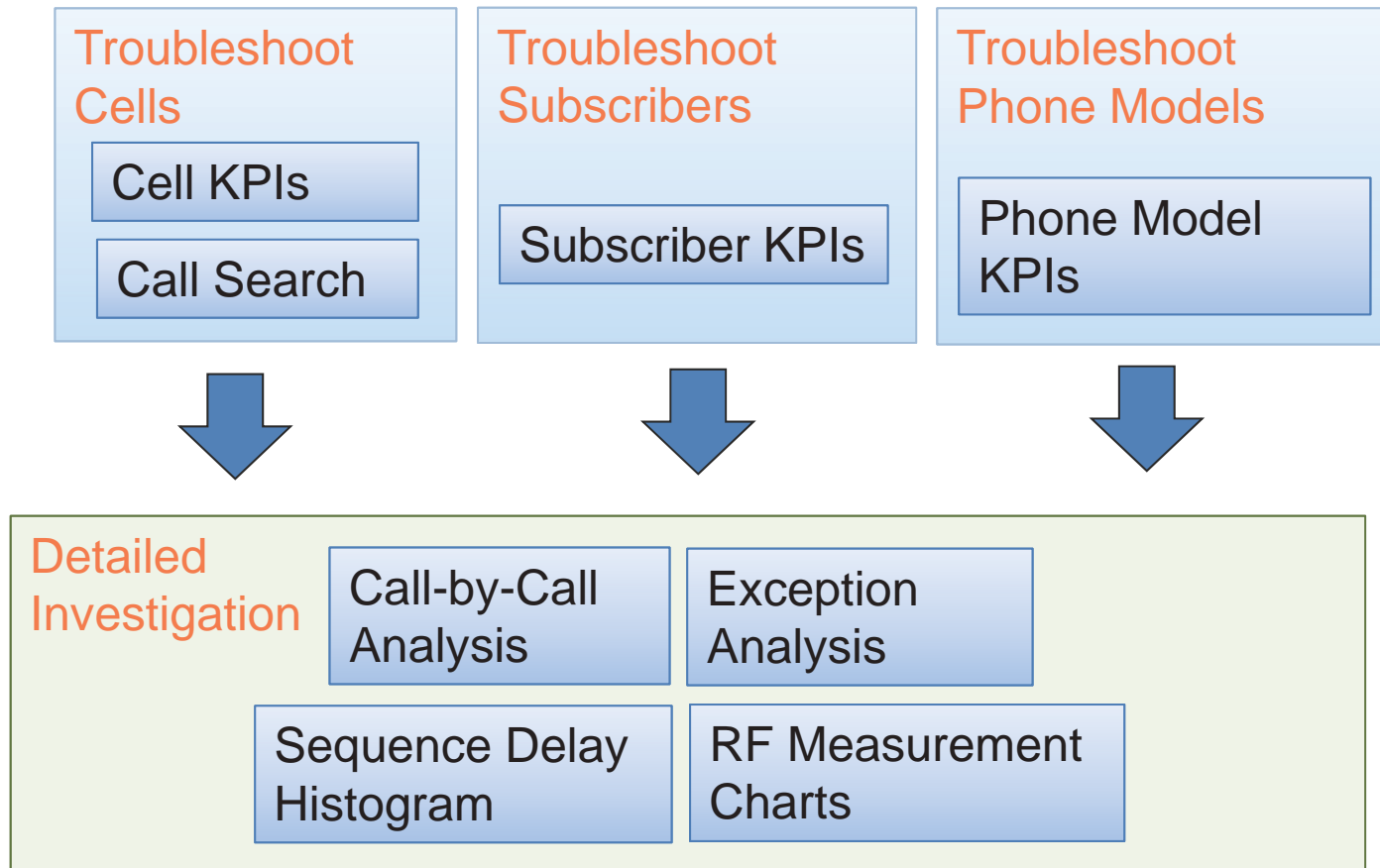
LTE CELL TRACE MODULE– OPTIMIZATION



NSN MEGAMON GEO INTERFACE WCDMA MODULE OVERVIEW

- Event data recording function in the NSN Megamon GEO Interface (streaming)
- Records event data for traffic in an area of cells or subscriber recordings
- Similar to lu/lub/lur probes but more cost-effective, and includes some internal information like changes in radio bearers
- TEMS Discovery Network 11.0 supports the NSN Megamon GEO Interface for WCDMA 1.1 release
- **Important:** TEMS Discovery Network can process only the GEO Interface output. It does not process the RNC-ICSU logs or Megamon output directly, and requires the NSN approved GEO Interface method for data collection

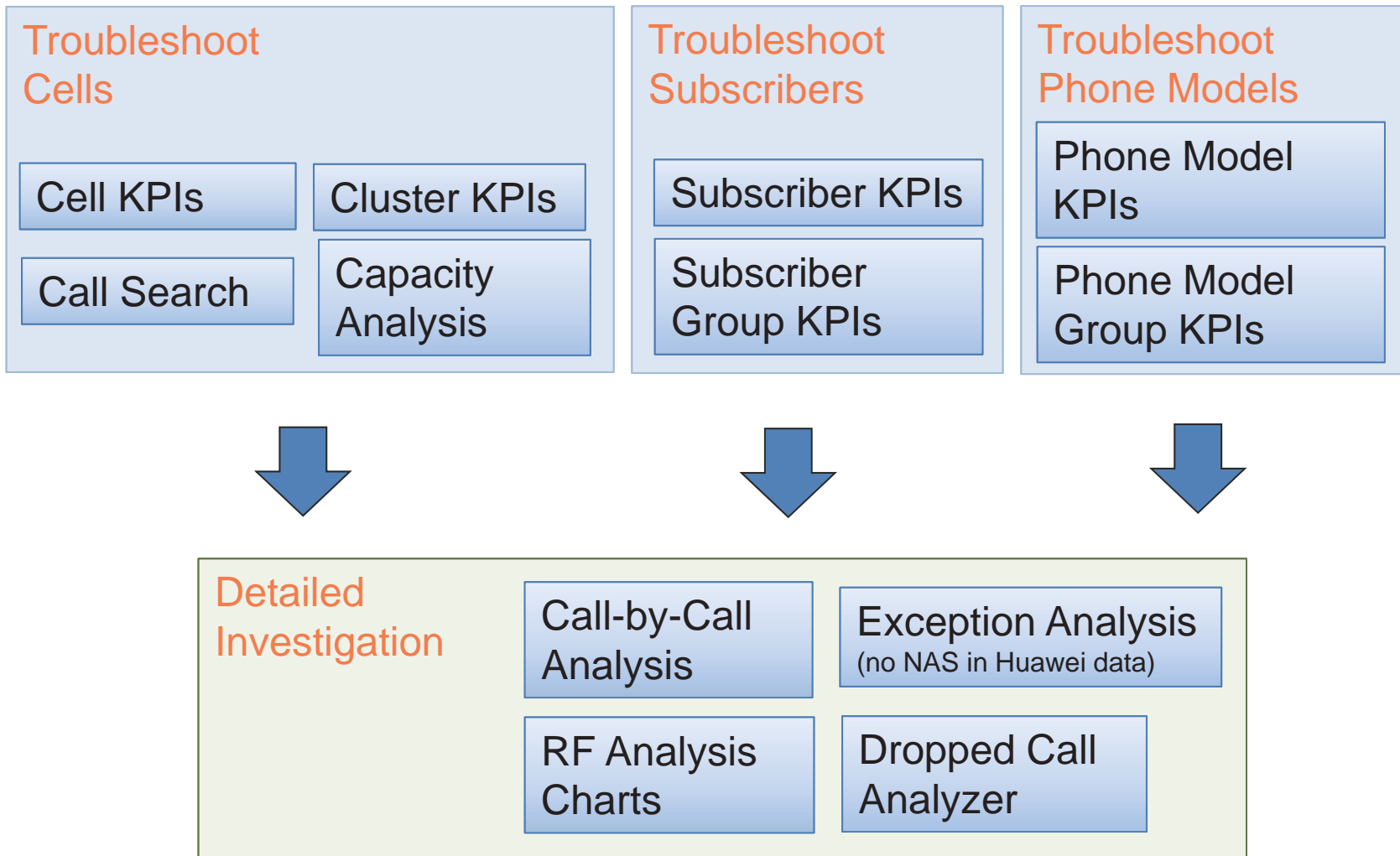
NSN MEGAMON WCDMA MODULE – TROUBLESHOOTING



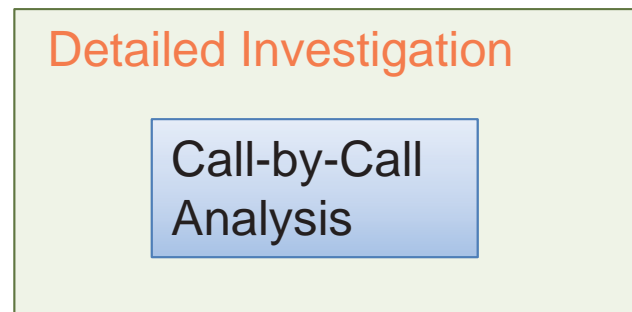
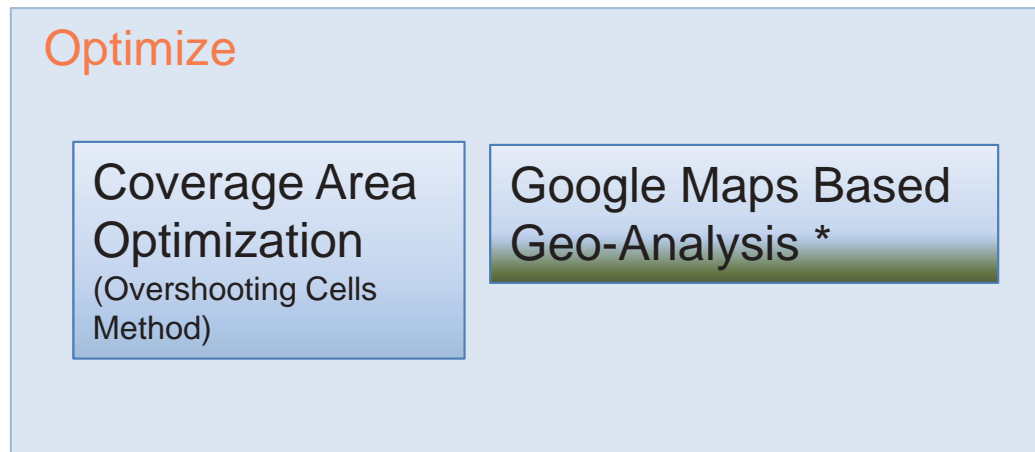
HUAWEI WCDMA CALL TRACE MODULE OVERVIEW

- WCDMA Call Trace data recording at RNC supported (e.g., PCHR, Performance Call History Recordings)
- Records all calls in an RNC, providing a processed call-record with some events
- Similar to lu/lub/lur probes but more cost-effective, and includes some internal information like dropped call causes
- TEMS Discovery Network supports the Huawei WCDMA Call Traces (R12-R13, with integration support)
- **Important:** The call traces supported do not have a dependency on Huawei Nastar (e.g., exported Nastar PCHR call traces), and support the raw call trace data collected at the RNC.

HUAWEI WCDMA CALL TRACE MODULE – TROUBLESHOOTING



HUAWEI WCDMA CALL TRACE MODULE – OPTIMIZATION



Option for Huawei

* Available via 'Huawei PCHR Geolocation' Module



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COMMON FEATURE DETAILS



WORKFLOW FOR COMMON FEATURES

- Select area for analysis
- Select time period for analysis

Scope Selection



- Analyze statistics created from events
- Select/search calls for analysis

Cluster/Cell KPI

Phone Model/
Subscriber KPI

Call Search

Exception
Analysis

Sequence Delay
Histogram

- Quickly find exceptional events
- Time delay between any 2 messages

- Analyze RF performance per cell

RF Analysis
Charts

Call-by-Call
Analysis

- Analyze calls message by message

Network Performance Problem

With existing counter data, poorly performing cells can be found, but other tools are needed to identify the root causes of issues like dropped calls.

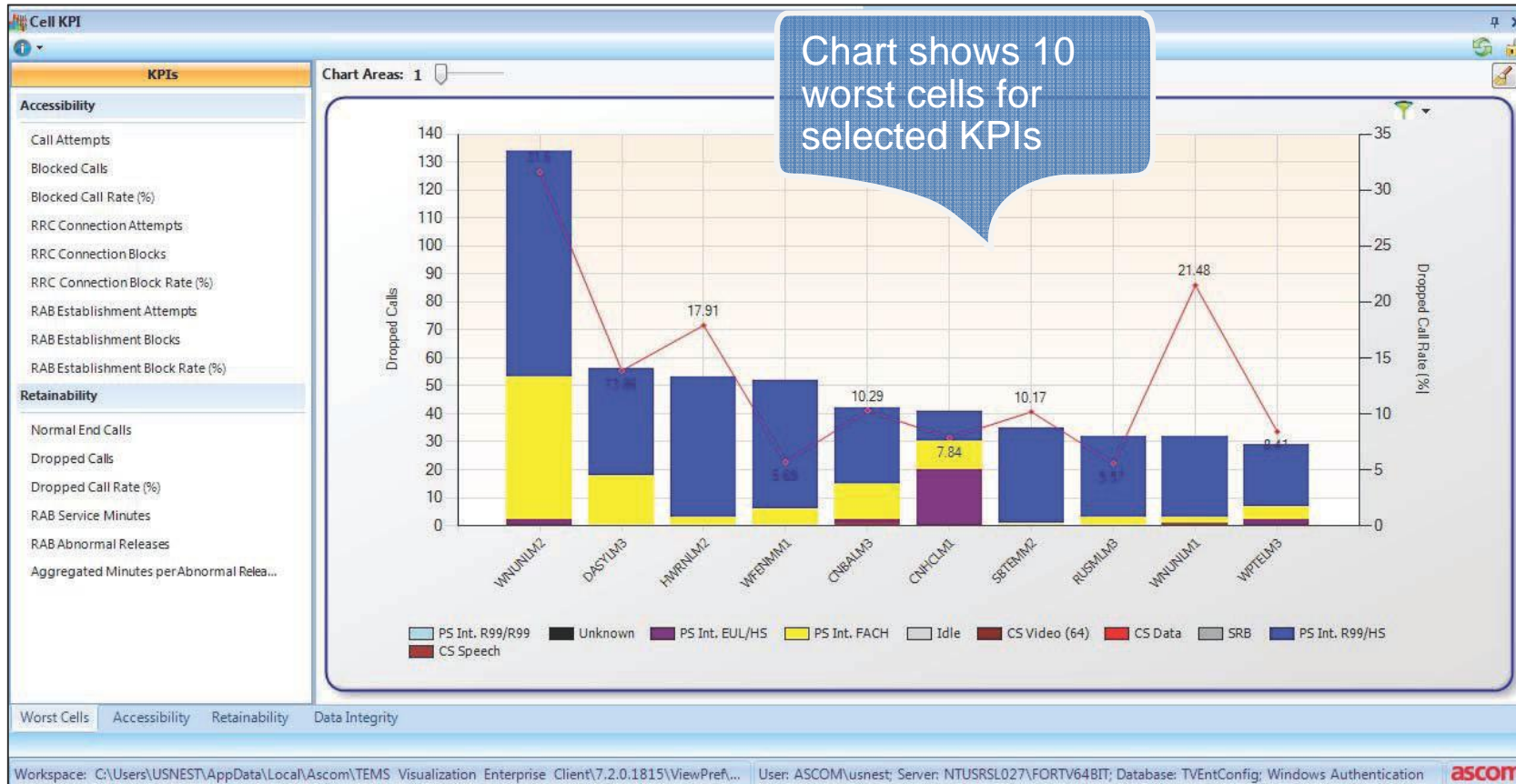
TEMS Discovery Network Solution

Cell KPIs
Cluster KPIs

CELL AND CLUSTER KPIS (1 OF 4)

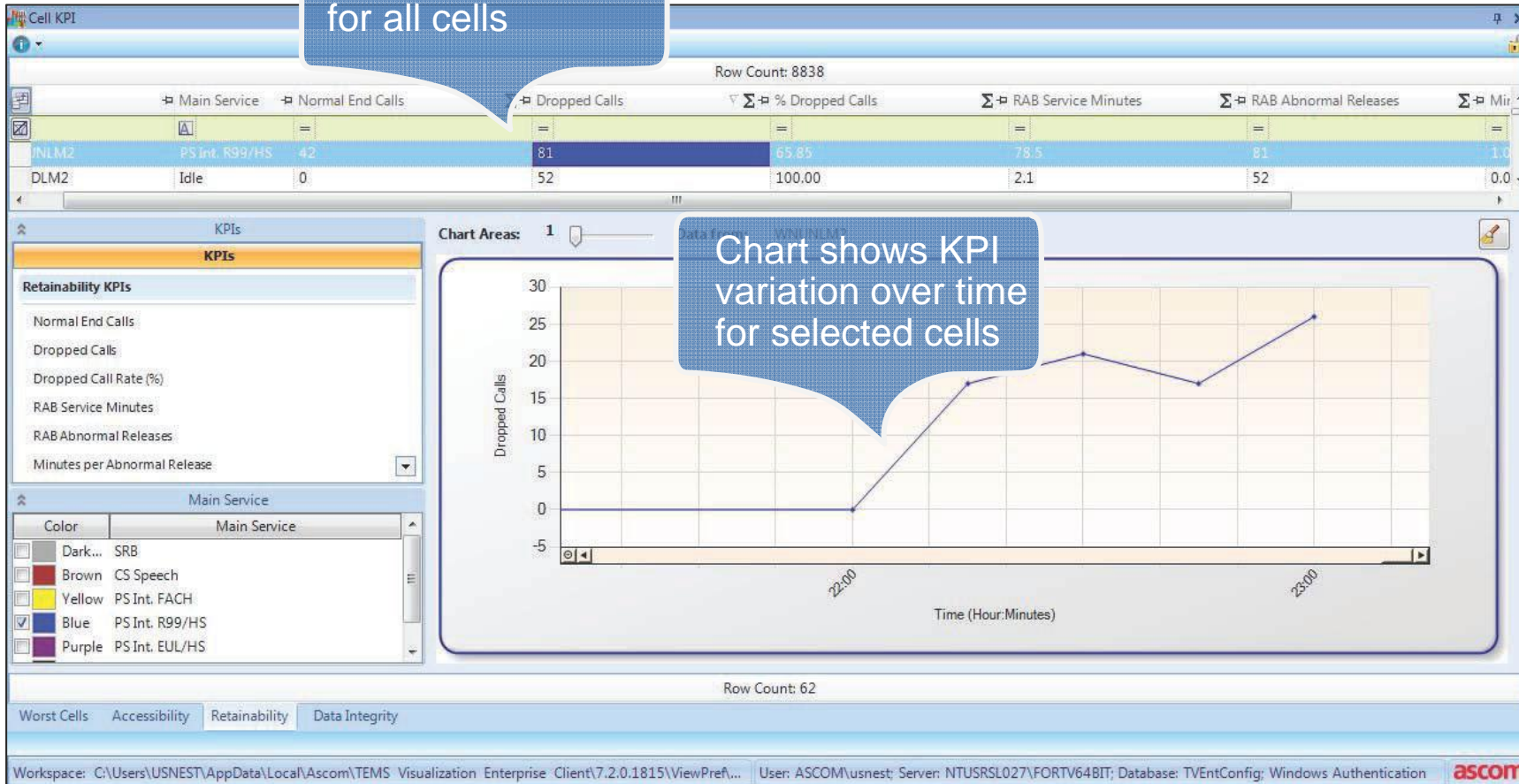
- Quickly identify worst-performing cells and clusters
 - Drill down immediately for advanced and detailed troubleshooting
 - KPIs (counters) aggregated from Ericsson GPEH, Ericsson LTE Cell Trace, Huawei WCDMA and NSN WCDMA Megamon GEO Interface data
 - Per cell for:
 - Accessibility
 - Retainability
 - Mobility
 - Data integrity (including high-speed data)
 - Per main service type for WCDMA (CS speech, PS Interactive R99, PS Interactive High Speed, etc.), per CQI for LTE
- For Ericsson GPEH WCDMA, also geolocate dropped calls on the map

CELL AND CLUSTER KPIS (2 OF 4)



CELL AND CLUSTER KPIS (3 OF 4)

Grid shows KPIS for all cells



The screenshot displays the 'Cell KPI' application window. At the top, a grid shows KPI data for all cells. A callout bubble points to the grid with the text 'Grid shows KPIS for all cells'. The grid has columns for 'Main Service', 'Normal End Calls', 'Dropped Calls', '% Dropped Calls', 'RAB Service Minutes', 'RAB Abnormal Releases', and 'Mir'. Two rows are visible: one for 'INLM2' (PS Int. R99/HS) and one for 'DLM2' (Idle). Below the grid, a 'KPIs' panel on the left lists various metrics like 'Normal End Calls', 'Dropped Calls', and 'RAB Service Minutes'. A 'Main Service' color selection panel is also present. To the right, a line chart titled 'Chart Areas: 1' shows 'Dropped Calls' over time. A callout bubble points to the chart with the text 'Chart shows KPI variation over time for selected cells'. The chart's y-axis ranges from -5 to 30, and the x-axis shows time from 22:00 to 23:00. The chart shows a fluctuating line representing the number of dropped calls. At the bottom, a status bar shows 'Row Count: 62' and navigation tabs for 'Worst Cells', 'Accessibility', 'Retainability', and 'Data Integrity'. The footer contains workspace and user information, along with the 'ascom' logo.

Main Service	Normal End Calls	Dropped Calls	% Dropped Calls	RAB Service Minutes	RAB Abnormal Releases	Mir
INLM2 PS Int. R99/HS	42	81	65.85	78.5	81	1.0
DLM2 Idle	0	52	100.00	2.1	52	0.0

CELL AND CLUSTER KPIS (4 OF 4)

The screenshot displays a network management interface with a map of cell towers and two data tables. A blue callout bubble points to the 'Import Clusters' button, and another points to the 'Troubleshoot cluster performance' text.

Import or create clusters

Troubleshoot cluster performance

Cluster	Normal End Calls	Dropped Calls	% Dropped Calls
My Cluster	14274	68	0.47
My 2nd cluster	8593	18	0.21

Cell	Main Service	Normal End Calls	Dropped Calls	% Dropped Calls	Main Serv
D35938L3	PS Int: FACH	0	7	100.00	21.4
D1988AL1	PS Int: R99/HS	13	6	31.58	6.0
D3593AL1	PS Int: R99/HS	7	3	30.00	4.7
D44978L1	PS Int: EUL/HS	0	3	100.00	6.7
D64238L2	PS Int: EUL/HS	7	3	30.00	63.3
D3593AL1	PS Int: EUL/HS	0	2	100.00	14.8
D3593AL3	CS Speech	21	2	8.70	37.4
D2778AL1	CS Speech	17	2	10.53	29.3
D4393AL2	Idle	0	2	100.00	0.5
D4393AL2	PS Int: R99/HS	106	2	1.85	34.0

Network Performance Problem

No way to tell if a few poorly performing phone models are causing a large part of the network's performance problems.

TEMS Discovery Network Solution

Phone Model KPIs

Phone Model Group KPIs

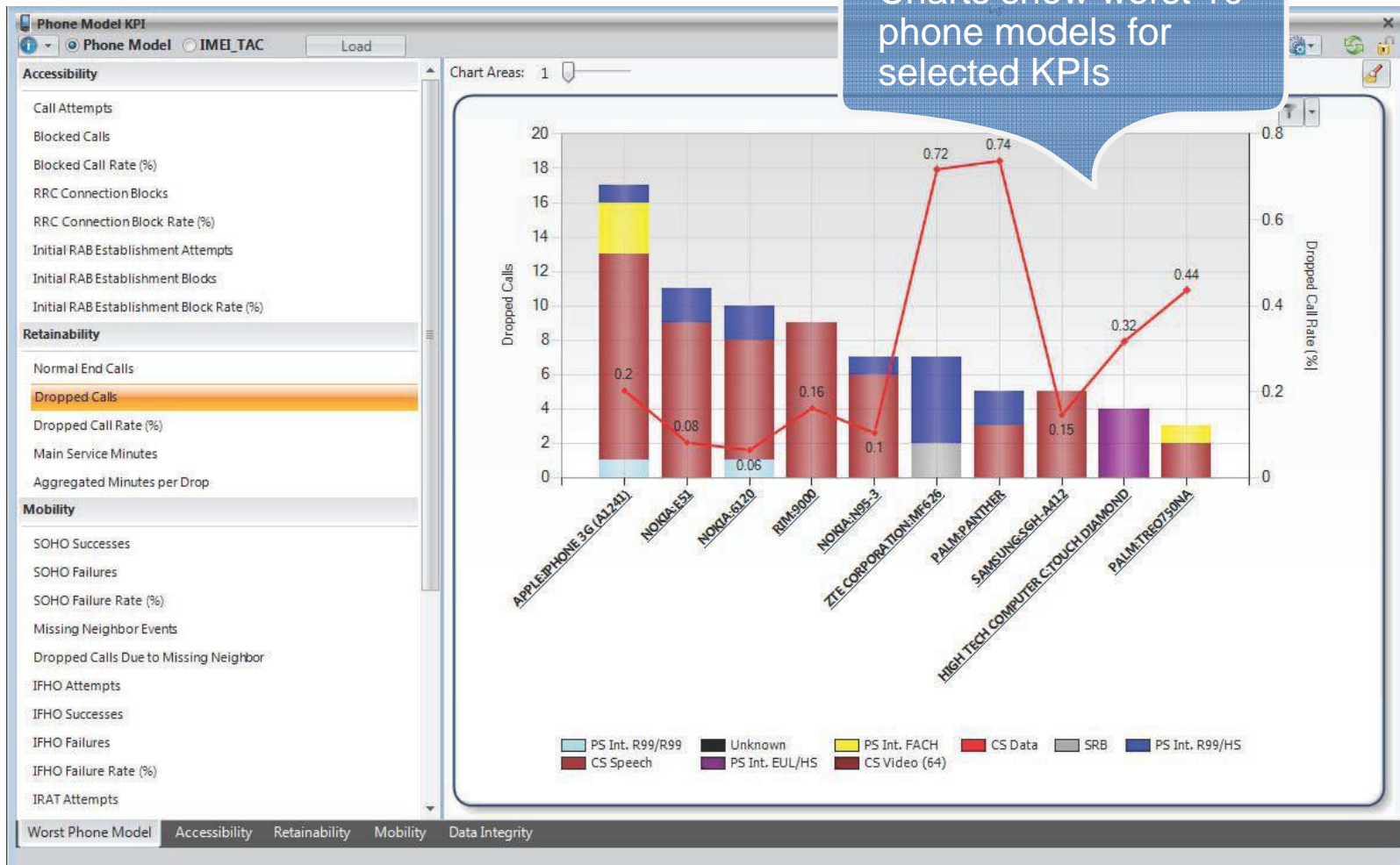
PHONE MODEL AND GROUP KPIS (1 OF 3)

Determine if a minority of phone models are causing a majority of issues

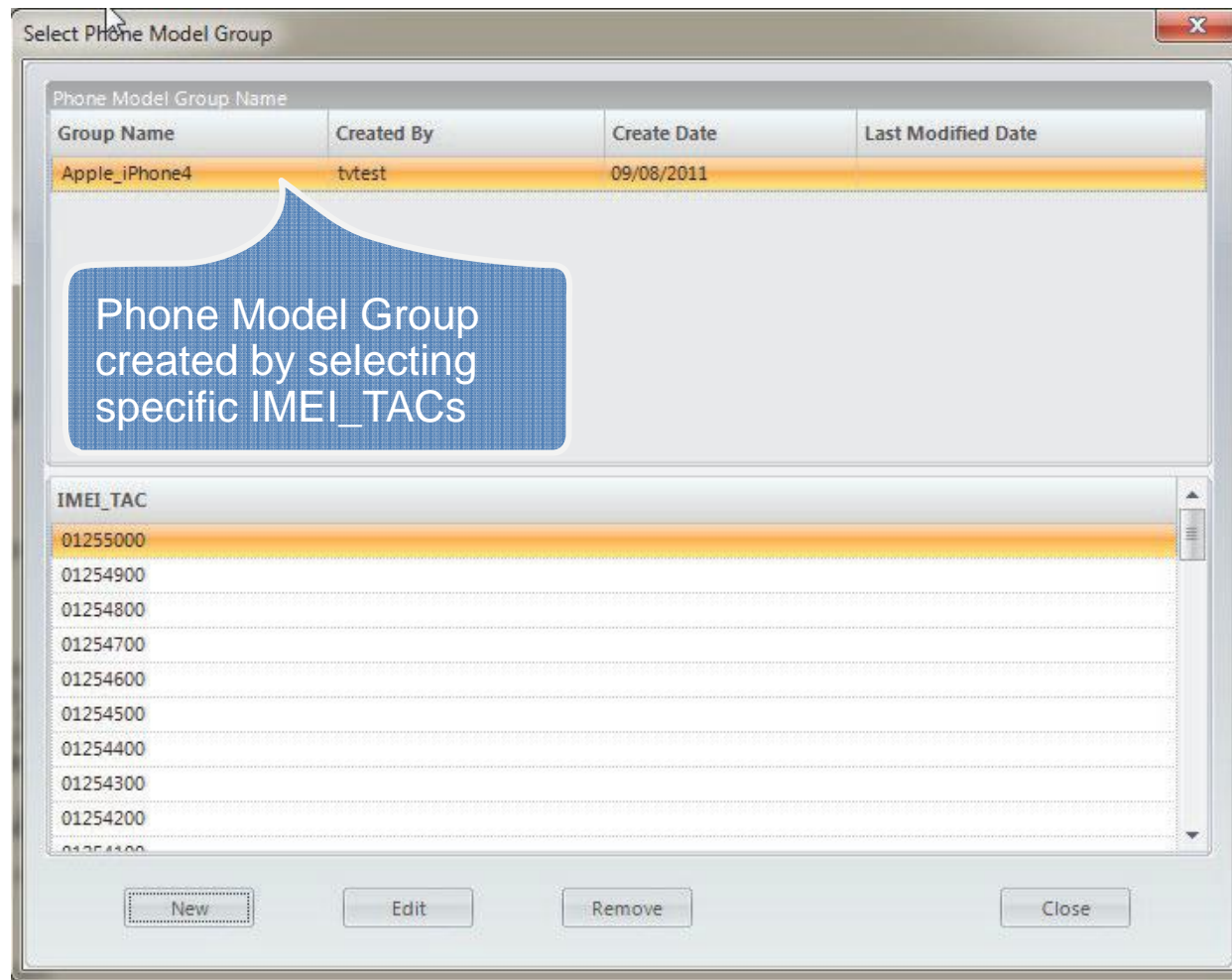
- Same set of KPIs as in cell KPIs
 - Phone Model KPIs available for Ericsson WCDMA GPEH, Ericsson LTE Cell Trace, Huawei WCDMA and NSN WCDMA Megamon GEO Interface data
- Load in phone model lookup file or analyze performance per IMEI-TAC
- Phone model and manufacturer also shown when available
- Investigate performance problems for specific phone models and services/RAB type combinations
- **Phone Model Group KPIs** allow grouping into single category (e.g., certain iPhone models) for grouped analysis
- Same drilldown to other features for advanced and detailed troubleshooting

PHONE MODEL AND GROUP KPIS (2 OF 3)

Charts show worst 10 phone models for selected KPIs



PHONE MODEL AND GROUP KPIS (3 OF 3)



The screenshot shows a dialog box titled "Select Phone Model Group". It contains a table with the following data:

Group Name	Created By	Create Date	Last Modified Date
Apple_iPhone4	tvtest	09/08/2011	

Below the table is a list of IMEI_TAC values:

- 01255000
- 01254900
- 01254800
- 01254700
- 01254600
- 01254500
- 01254400
- 01254300
- 01254200
- 01254100

At the bottom of the dialog are four buttons: "New", "Edit", "Remove", and "Close". A blue callout box points to the "Apple_iPhone4" row in the table, containing the text: "Phone Model Group created by selecting specific IMEI_TACs".

Network Performance Problem

No way to tell if performance problems in a cluster are caused by one or two users who have “bad” phones.
No way to monitor the performance for groups of users such as TEMS™ Automatic units or important corporate customers.

TEMS Discovery Network Solution

Subscriber KPIs
Subscriber Group KPIs

Note: Subscriber KPI feature is now available for Ericsson LTE

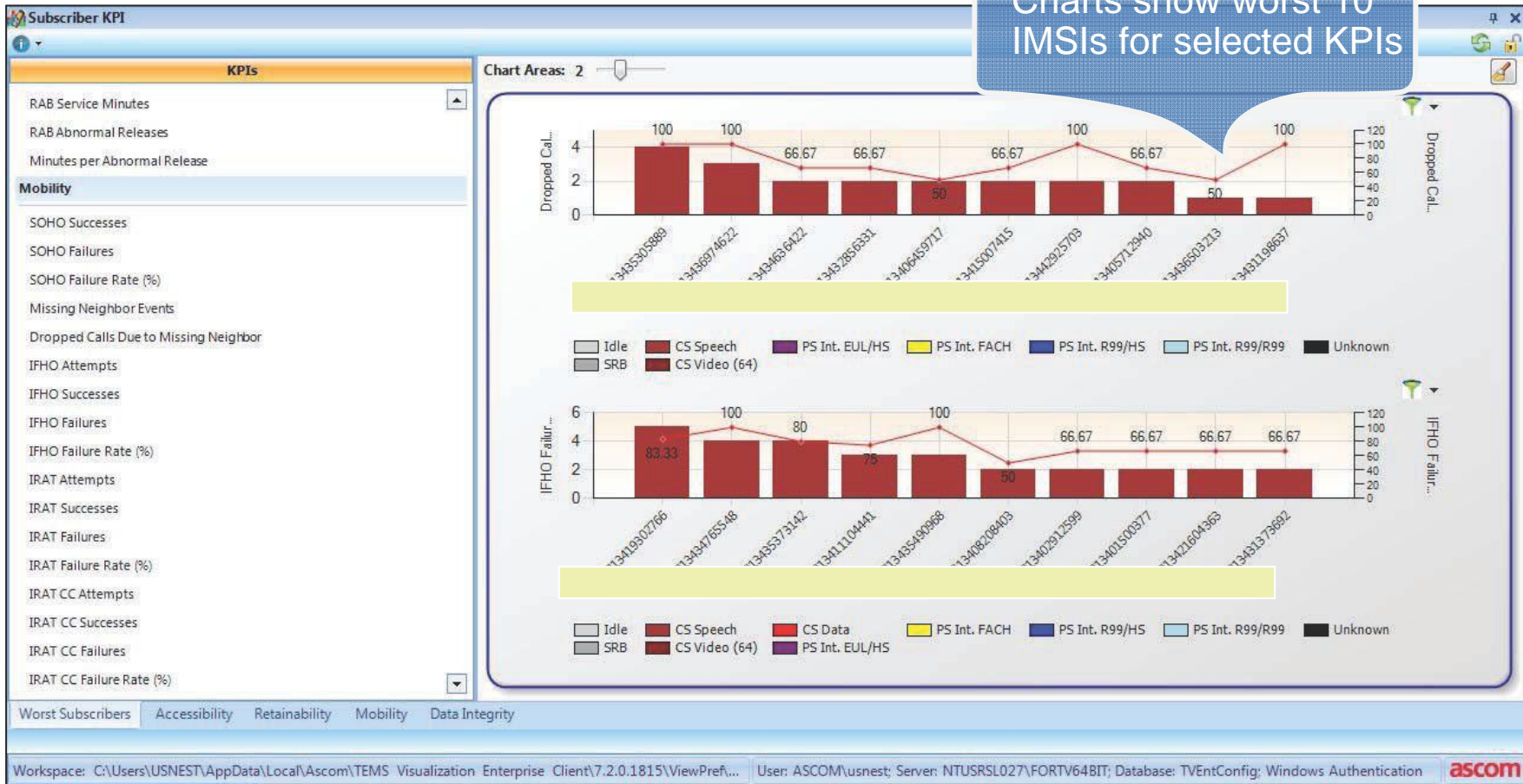
SUBSCRIBER KPIS (1 OF 2)

Determine if a minority of subscribers are causing a majority of issues

- Same set of KPIs as in cell KPIs
 - Subscriber KPI Analysis available for Ericsson WCDMA GPEH, Ericsson LTE Cell Trace, Huawei WCDMA and NSN WCDMA Megamon GEO Interface data
- Investigate performance problems for specific subscribers and groups of subscribers, with easy identification of the worst IMSIs
- Same drilldown to other features for advanced and detailed troubleshooting

SUBSCRIBER KPIS (2 OF 2)

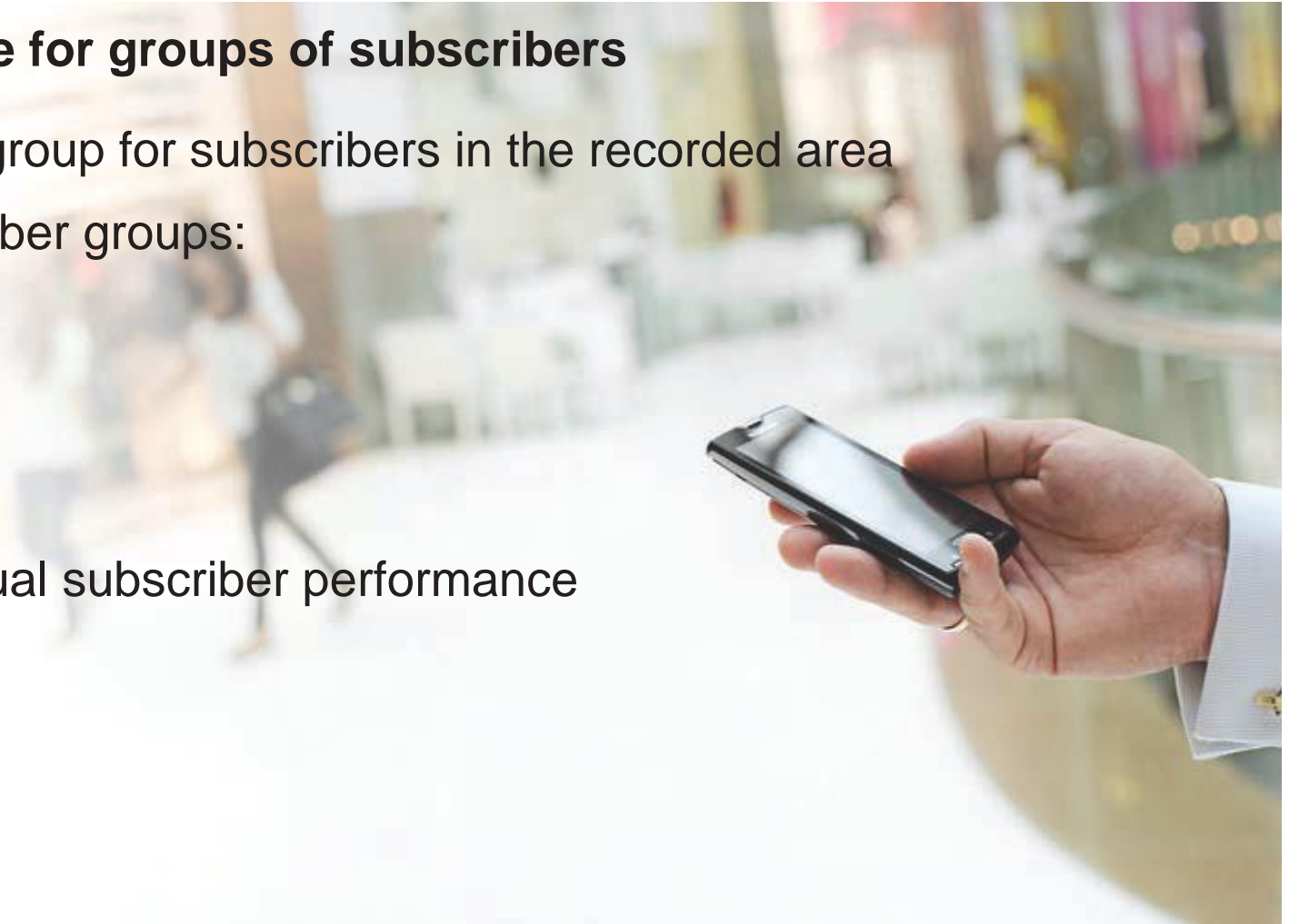
Charts show worst 10 IMSIs for selected KPIs



SUBSCRIBER GROUP KPIS (1 OF 2)

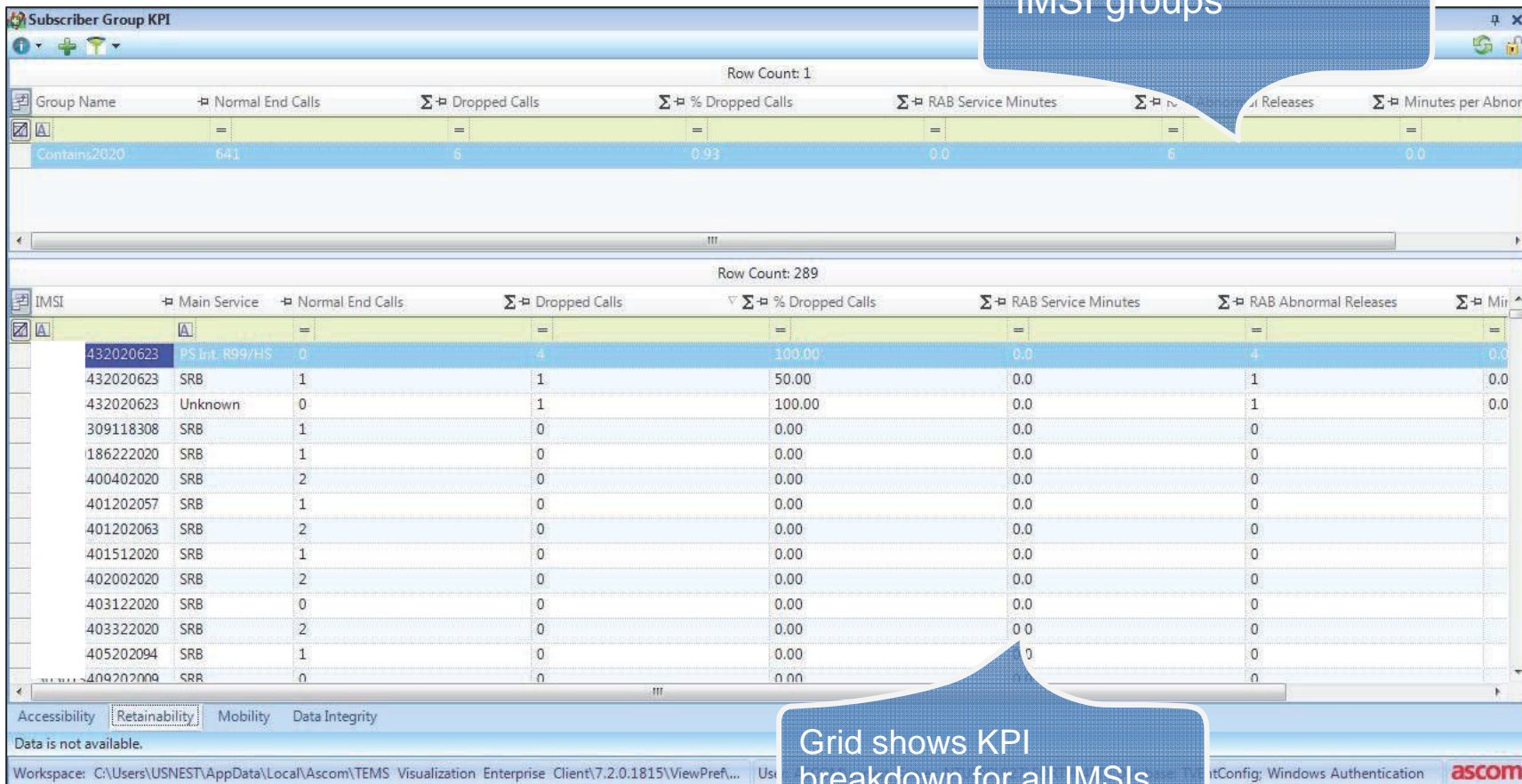
Monitor performance for groups of subscribers

- Calculate KPIs per group for subscribers in the recorded area
- Examples of subscriber groups:
 - TEMS Automatic units
 - TEMS™ Pocket units
 - Corporate clients
 - VIP subscribers
- Drill down to individual subscriber performance



SUBSCRIBER GROUP KPIS (2 OF 2)

Aggregated KPIs for IMSI groups



The screenshot displays two data tables in a software application. The top table, titled 'Subscriber Group KPI', shows aggregated data for a group named 'Contains2020'. The bottom table shows a detailed breakdown of KPIs for individual IMSIs within that group.

Group Name	Normal End Calls	Dropped Calls	% Dropped Calls	RAB Service Minutes	RAB Abnormal Releases	Minutes per Abnorm
Contains2020	641	6	0.93	0.0	6	0.0

IMSI	Main Service	Normal End Calls	Dropped Calls	% Dropped Calls	RAB Service Minutes	RAB Abnormal Releases	Minutes per Abnorm
432020623	PS.Int. R99/HS	0	4	100.00	0.0	4	0.0
432020623	SRB	1	1	50.00	0.0	1	0.0
432020623	Unknown	0	1	100.00	0.0	1	0.0
309118308	SRB	1	0	0.00	0.0	0	0.0
186222020	SRB	1	0	0.00	0.0	0	0.0
400402020	SRB	2	0	0.00	0.0	0	0.0
401202057	SRB	1	0	0.00	0.0	0	0.0
401202063	SRB	2	0	0.00	0.0	0	0.0
401512020	SRB	1	0	0.00	0.0	0	0.0
402002020	SRB	2	0	0.00	0.0	0	0.0
403122020	SRB	0	0	0.00	0.0	0	0.0
403322020	SRB	2	0	0.00	0.0	0	0.0
405202094	SRB	1	0	0.00	0.0	0	0.0
409202000	SRB	0	0	0.00	0.0	0	0.0

Grid shows KPI breakdown for all IMSIs in selected group

Network Performance Problem

Existing data sources do not provide enough details or information from real subscribers to allow the root causes of problems to be found.

TEMS Discovery Network Solution

- Detailed Investigation
- Exception Analysis
 - Call-by-Call Analysis
 - RF Charts

EXCEPTION ANALYSIS (1 OF 2)

- **Summary of all events in primary databases**
 - Analyze exception events – examples:
 - System release events
 - NAS failure messages
 - System block events
 - Channel switching failures
 - Drill down to determine if problems are for specific:
 - RAB types
 - Exception classes or cause values
 - Mobile phones or mobile types
 - Send to call analysis feature for detailed analysis



EXCEPTION ANALYSIS (2 OF 2)

TEMS Discovery Network generated events

Event Name	Event Sub Class	Occurr
Additional RAB Abnormal Release		1
Additional RAB Establishment Failure		1
Additional RAB Establishment Success		2176
Blocked Call		508
Blocked Call	Load Sharing	2051
Blocked Call		508

Analyze by NAS messages*

Message Type	Occurrences	Call Count
LOCATION UPDATING REJECT		
Routing area update reject		
Attach reject	66	66
Attach request	5	5
	2	2

For Ericsson GPEH, UETR, LTE Cell Trace, UE Trace, Huawei WCDMA or NSN WCDMA Megamon GEO events

Message Name	Message Group	Occurrences	Call Count
INTERNAL_ADMISSION_CONTROL_RESPONSE	RNC	614962	23028
INTERNAL_CALL_SETUP_FAIL	RNC	234	234
INTERNAL_CHANNEL_SWITCHING	RNC	407128	28
INTERNAL_CMODE_ACTIVATE	RNC	1984	
INTERNAL_CMODE_DEACTIVATE	RNC	3191	
INTERNAL_FAILED_HSDSCH_CELL_CHANGE	RNC	35	
INTERNAL_FAILED_TRANSITION_TO_DCH	RNC	1	
INTERNAL_HSDSCH_CELL_SELECTION_NO_CELL_SELECTED	RNC	1668	
INTERNAL_IFHO_EVALUATION	RNC	1407	
INTERNAL_IFHO_EXECUTION	RNC	1367	
INTERNAL_IFHO_EXECUTION_ACTIVE	RNC	1353	1447
INTERNAL_IMSI	RNC	525298	496488
INTERNAL_MEASUREMENT_HANDLING_EXECUTION	RNC	3937	1838
INTERNAL_RAB_ESTABLISHMENT	RNC	148242	
INTERNAL_RAB_RELEASE	RNC	2302	

Drill down by cause value and RAB types; Send to call-by-call analysis.

CAUSE_VALUE	EXTENDED_CAUSE_VALUE
CAUSE_VALUE_NOT_APPLICABLE	EXTENDED_CAUSE_VALUE_NOT_APPLICABLE
CELL_UPDATE_IN_DRNC	
NODE_INTERNAL_FAILURE_6	
PROCEDURE_TIMEOUT	
PROCEDURE_TIMEOUT	
CAUSE_VALUE_NOT_APPLICABLE	EXTENDED_CAUSE_VALUE_NOT_APPLICABLE
CAUSE_VALUE_NOT_APPLICABLE	EXTENDED_CAUSE_VALUE_NOT_APPLICABLE
CAUSE VALUE NOT APPLICABLE	EXTENDED CAUSE VALUE NOT APPLICABLE

* Huawei WCDMA Traces do not contain NAS messages

CALL-BY-CALL ANALYSIS (1 OF 2)

- Direct drilldown from many other features or result of search for specific calls
- Find patterns in calls and the sources of problems
 - Same users
 - Same message sequences
- Easy-to-use views
 - Call List view gives summary of call-level information
 - Call Messages view allows calls to be followed message by message
 - Measurement view shows timeline of radio quality measurements, data throughput, and events
 - Details view shows full information for individual messages



CALL-BY-CALL ANALYSIS (2 OF 2)

The screenshot displays the 2TEST software interface for call-by-call analysis. It is divided into several main sections:

- Map:** A satellite map showing the location of the call. The coordinates are Longitude: -77.045252 and Latitude: 38.858394. The map shows a residential area with streets like Columbia Pk E and various landmarks.
- Measurement Chart:**
 - Measurement Selection:** Lists selected cells: RSCP_CELL4, CPICH_EC_NO_CELL_1, CPICH_EC_NO_CELL_2, and CPICH_EC_NO_CELL_3.
 - Event Selection:** Includes Call End, Soft Handover Addition, Soft Handover Deletion, and Soft Handover Repl...
 - Details:** Shows the time 10:02:18.217.
 - Chart Areas:** Two line graphs showing signal strength over time. The top graph is for RSCP_CELL1 and the bottom graph is for CPICH_EC_NO_CELL_1. The x-axis is labeled 'Time (Hours Minutes Seconds)' and the y-axis shows signal strength values.
- Call Analysis Table:** A table with 5 columns: Timestamp, Message, Event, Event Subclass, and Cause. It shows a sequence of events for a call on 2009-08-26 at 10:02:18.213.

Timestamp	Message	Event	Event Subclass	Cause
2009-08-26 10:02:18.213	INTERNAL_SOFT_HANDOVER_EVALUATION			
2009-08-26 10:02:18.217	INTERNAL_SOFT_HANDOVER_EXECUTION	Soft Handover ReplaceCurrent...		
2009-08-26 10:02:18.533	RRC_MEASUREMENT_REPORT			
2009-08-26 10:02:18.597	INTERNAL_SOFT_HANDOVER_EVALUATION			
2009-08-26 10:02:18.597	INTERNAL_SOFT_HANDOVER_EXECUTION	Soft Handover Deletion Success		
2009-08-26 10:02:18.600	INTERNAL_ADMISSION_CONTROL_RESPONSE			
2009-08-26 10:02:18.887	INTERNAL_SOFT_HANDOVER_EXECUTION	Soft Handover Addition Success		
2009-08-26 10:02:19.453	RRC_MEASUREMENT_REPORT			
2009-08-26 10:02:19.453	INTERNAL_SOFT_HANDOVER_EVALUATION			
- Message Details:** A detailed view of the 'INTERNAL_SOFT_HANDOVER_EXECUTION' event, showing parameters such as EVENT_PARAM_SCANNER_ID, EVENT_PARAM_EVENT_ID, EVENT_PARAM_UE_CONTEXT, and EVENT_PARAM_TRIGGER.

RF CHARTS – WCDMA

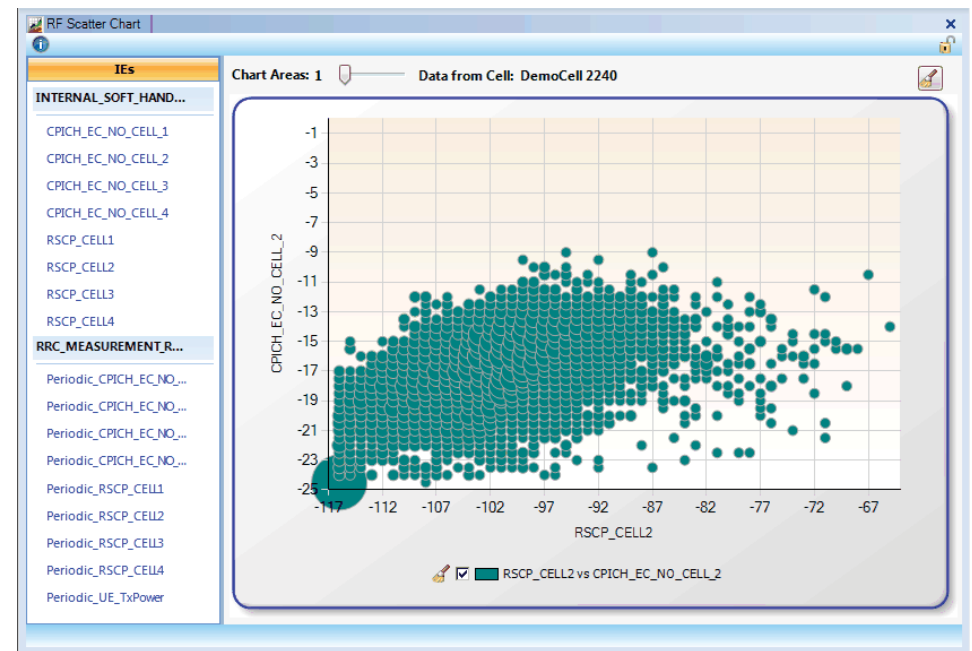
FOR RADIO MEASUREMENT PERFORMANCE EVALUATION

Distribution Chart



- For showing distribution of RF measurements
- Periodic (MRR-W) or from soft handover evaluation

Scatter Chart



- For showing relationship between RF measurements
- Size of bubble shows count of pairs of values
- Periodic (MRR-W) or from soft handover evaluation

RF CHARTS – LTE

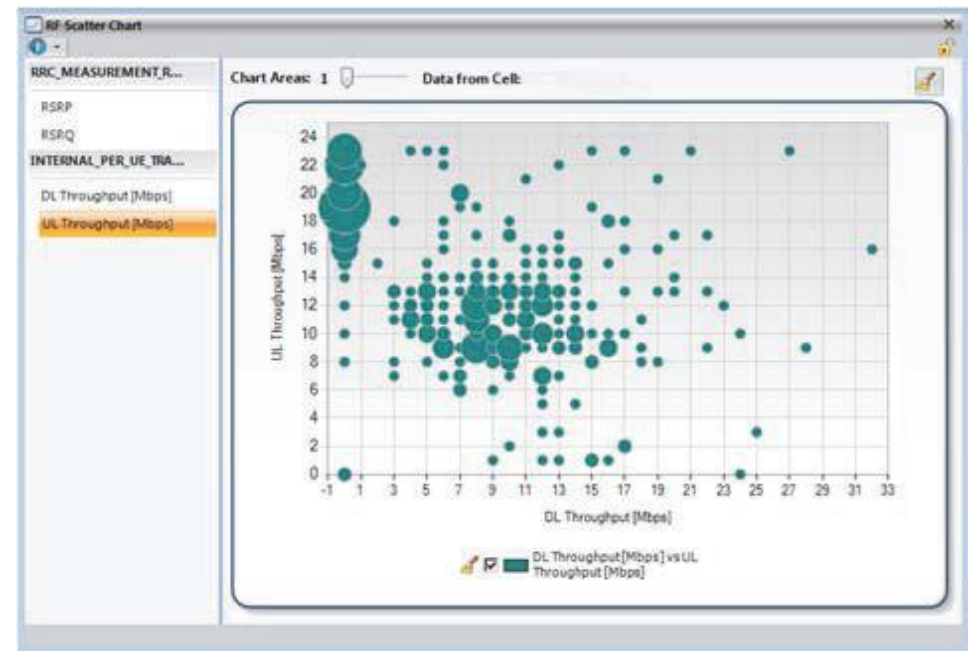
FOR RADIO AND THROUGHPUT PERFORMANCE EVALUATION

Distribution Chart



- For showing distribution of RF measurements
- Includes throughput measurements

Scatter Chart



- For showing relationship between RF measurements
- Size of bubble shows count of pairs of values
- Includes throughput measurements

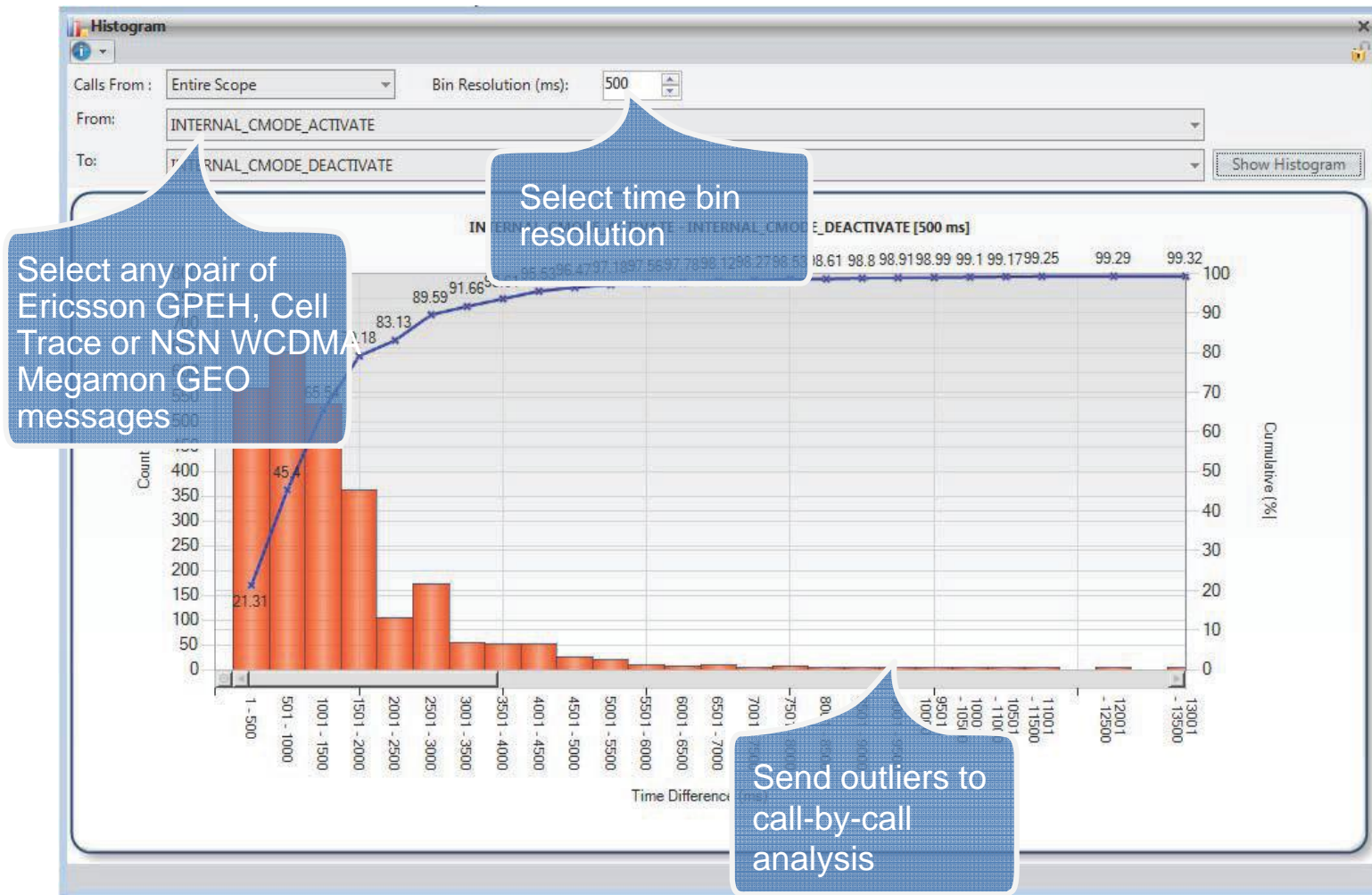
Network Performance Problem

Difficult to find problems with delays in message sequences which affect subscriber perception of the network.

TEMS Discovery Network Solution

Detailed Investigation
▪ Sequence Delay Histogram

SEQUENCE DELAY HISTOGRAM



REPORTING AND AUTOMATED SUBSCRIPTIONS

- Reports in Excel, PDF, or Word – Client triggered (also automated subscription managed by server administrator in TEMS Discovery Enterprise - Network)
- Currently available for Ericsson WCDMA GPEH, Huawei WCDMA, Ericsson LTE Cell Trace and Ericsson UETR/MTR formats
- Available Report Templates:
 - Performance Summary Report (Ericsson GPEH and Huawei WCDMA)
 - Cell Performance Report (Ericsson GPEH)
 - Executive Report (Enterprise Only, click-through interactive for GPEH)
 - Subscriber Trace Report (UETR + MTR trace formats currently)
 - CSFB Performance Report (via LTE Cell Trace + WCDMA GPEH combined project analysis)
- Built on SQL Server Reporting Services platform
- Automated, scheduled reports delivered by email (Enterprise – Network only)
- Ad-hoc generation of reports at client for selected project and scope

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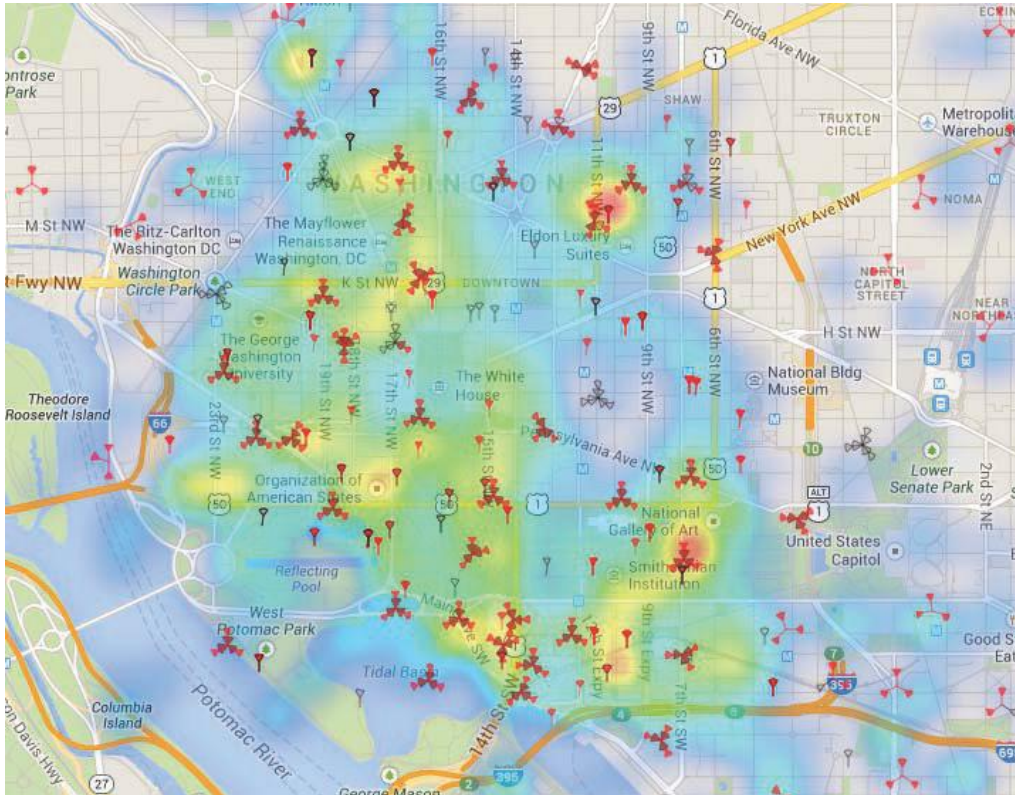
GEO-ANALYSIS BASED ON GOOGLE MAPS

(Currently available in Ericsson GPEH and Huawei WCDMA modules)




GEO MAPS EXAMPLE: TRAFFIC DENSITY

- Heat maps, Binned Maps, Create Custom KPIs, Map Filtered Selection
- Traffic Density (Hot Spots), RSCP, Eclo filtered by Events, Selection



Legend

Traffic Density-All Traffic-Call Starts HEAT



>= Metric Max: 142

>= Metric Min: 10

Select Layer Display Options:

Bin Size: 50m

Opacity: 40%

Display Threshold: 10

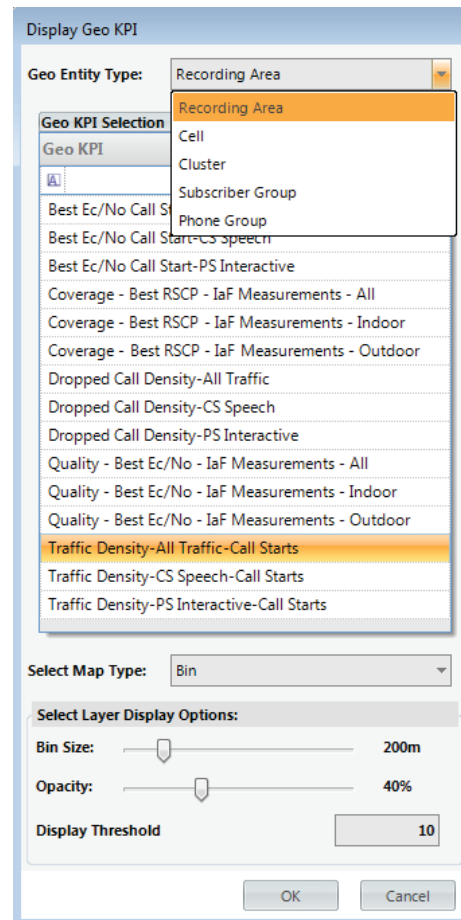
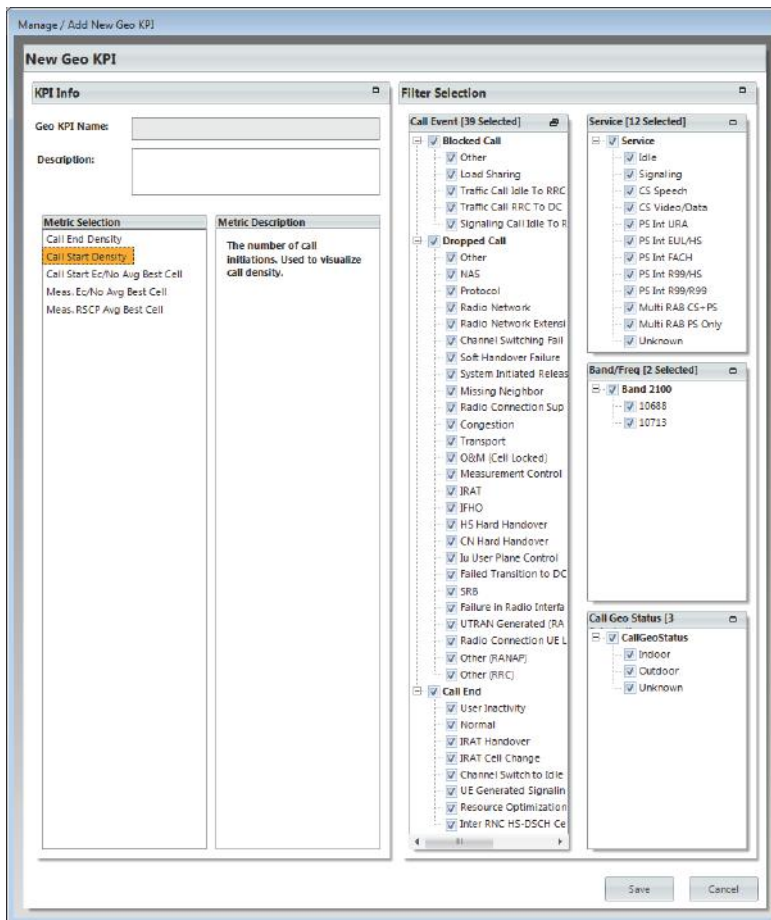
Apply

Layer

- WCDMA Cells
 - 10688
 - 10713
- Call Start Density
 - Traffic Density-All Traffic-Call Starts

GEO MAPS: USER-DEFINED GEO KPI CREATION

- Select Metric and Filters: Service, Band/ Frequency, Call End Type



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ERICSSON WCDMA GPEH MODULE FEATURES

(Includes some features for Huawei WCDMA)



PERFORMANCE SUMMARY REPORT (1 OF 1)

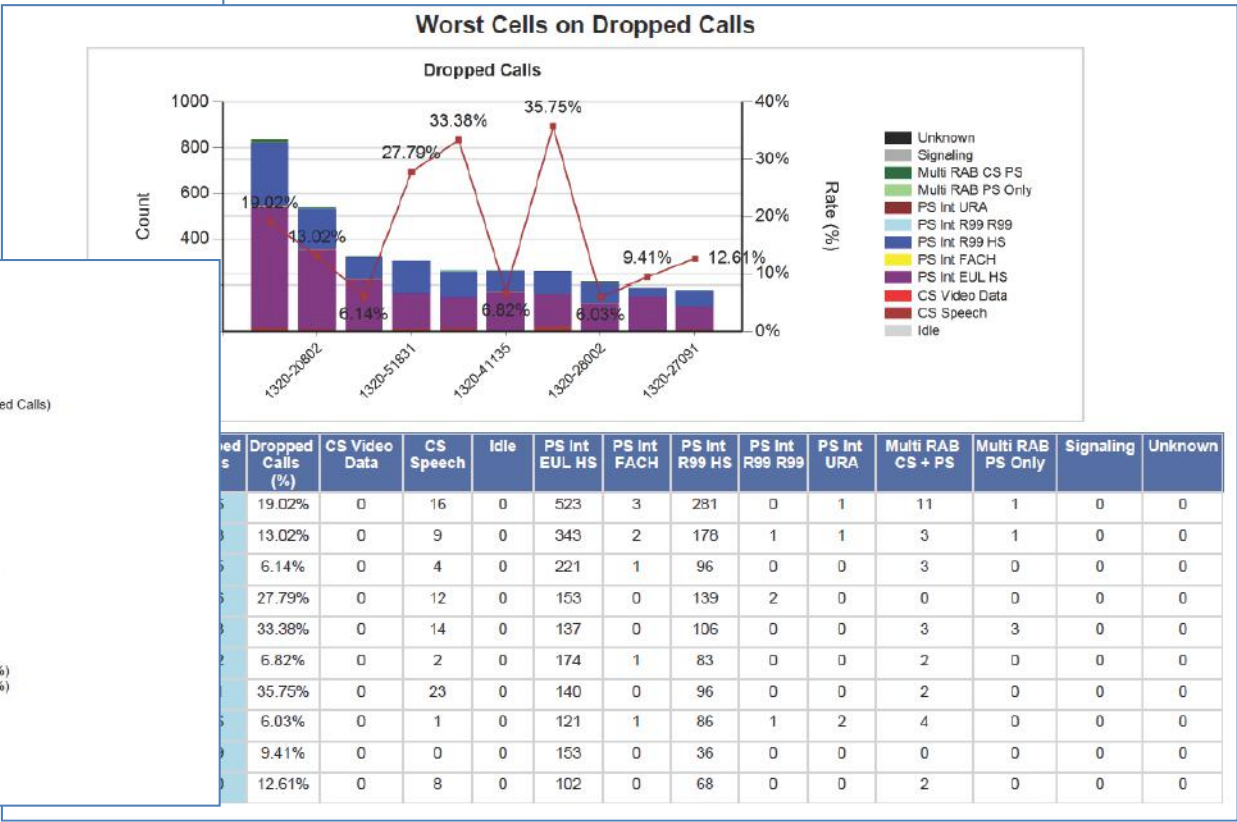
Report available for Ericsson GPEH & Huawei WCDMA

Performance Summary Report

Report Time: 9/8/2011 4:12:48 PM
 Reporting Period: 08/22/2011 ~ 08/22/2011
 Project: Demo
 Description: Demo

Table of Contents

- Retainability Reports**
 - Worst Cells on Dropped Calls
 - Dropped Calls Analyzer (for Top 3 Cells with Worst Dropped Calls)
 - All Dropped Calls – Summary by SubClass/End RAB
 - Worst Subscribers on Dropped Calls
 - Worst Phone Models on Dropped Calls
- Accessibility Reports**
 - Worst Cells on RRC Connection Blocks
 - Worst Cells on Initial RAB Establishment Blocks
 - Worst Subscribers on Initial RAB Establishment Blocks
 - Worst Phone Models on Initial RAB Establishment Blocks
- Capacity Reports**
 - Worst Cells on Peak UL Channel Element Consumption (%)
 - Worst Cells on Peak DL Channel Element Consumption (%)
 - Worst Cells on Peak UL Interference (dBm)
 - Worst Cells on Peak Non-HS DL Power Consumption (%)



Network Performance Problem

Difficult to find and diagnose RF problems that do not trigger alarms. Examples are LNA faults and swapped feeders which result in downlink / uplink imbalance.

TEMS Discovery Network Solution

RF Diagnostics

RF DIAGNOSTICS* (1 OF 2)

- Cells with RF issues are automatically identified
- For each cell, the number of calls affected by each RF issue is calculated:
 - Out of coverage
 - High DL interference
 - High UL interference
 - UL/DL imbalance
- Possible causes for each RF issue are also evaluated
- Assists with identifying site installation issues, parameter-setting problems, broken equipment, cells covering too far, and handover issues
- Sends affected calls to call analysis for more-detailed investigations

** Requires the OSS-RC feature MRR-W.*

RF DIAGNOSTICS (2 OF 2)

Statistics for selected RF issues

Cell	Total Calls Evalu	% High DL Interf	High DL Interf	% Pilot Pollution	% Overshoot	% Missing SOH	% SOHO Block	% SOHO Failure	% Unmonito
DemoCell 19376	684	5.41	37	24.32	5.41	10.81			2.70
DemoCell 0805	440	5.91	26	53.85	3.85	3.85			3.85
DemoCell 18756	1182	5.41	64	51.56		1.56			6.25
DemoCell 4108	831	6.14	51	17.65		1.96			1.96
DemoCell 0261	750	6.27	47	44.68		4.26			4.26
DemoCell 3720	685	6.28	43	48.84		13.95			9.30
DemoCell 3724	615	5.85	36	25.00		8.33			
DemoCell 6067	544	6.25	34	38.24					
DemoCell 15031	529	5.86	31	32.26		3.23			3.23
DemoCell 3719	450	6.44	29	44.83		3.45			10.34

List of issues

- RF Issues
- Out of Coverage
- High DL Interference
- Capacity Issues
- DL Resource Usage

Statistics for possible causes

KPI	Value
Ec/No 95% Confidence Interval Maximum	-12.56
Ec/No 95% Confidence Interval Minimum	-20.40
Ec/No Average	-16.48
Ec/No Samples Count	152
Ec/No Standard Deviation	1.96
RSCP 95% Confidence Interval Maximum	-82.47
RSCP 95% Confidence Interval Minimum	-105.45
RSCP Average	-93.96

Thematic map

Map showing cell locations and coverage areas. Legend for High DL Interference Affected Calls:

- 52 to 64 (2)
- 39 to 52 (13)
- 26 to 39 (40)
- 13 to 26 (188)
- 0 to 13 (1440)

Network Performance Problem

Can get an overview of cells with resource issues from counter data but have no way to drill down to see detailed resource usage over time.

TEMS Discovery Network Solution

Capacity Analysis

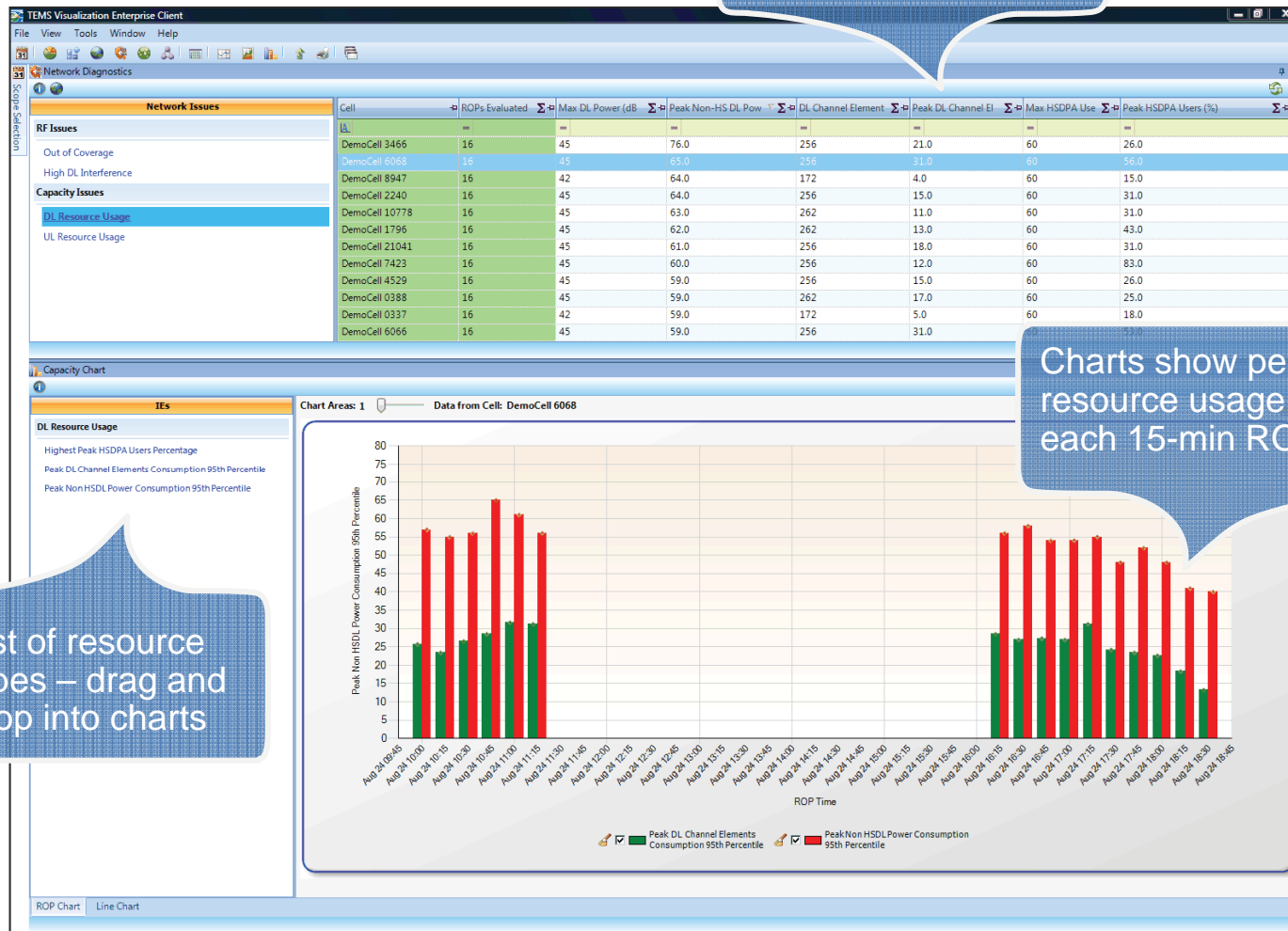
CAPACITY ANALYSIS (1 OF 3)

- Cells with resource issues are automatically identified
- For each cell, peak values are calculated for critical resource types
- Downlink resource types:
 - DL power
 - DL channel elements (hardware)
 - Number of HSDPA users
- Uplink resource types:
 - UL interference
 - UL channel elements (hardware)
 - Number of EUL users
- Drilldown into detailed charts with very high resolution

Note: Capacity analysis available for Ericsson GPEH & Huawei WCDMA

CAPACITY ANALYSIS (2 OF 3)

Peak resource usage for each cell during entire scope



List of resource types – drag and drop into charts

Charts show peak resource usage in each 15-min ROP

CAPACITY ANALYSIS (3 OF 3)

The screenshot displays the TEMS Visualization Enterprise Client interface. The top section, 'Network Diagnostics', contains a table with the following data:

Cell	ROPs Evaluated	Max. DL Power (dB)	Peak Non-HS DL Pow	DL Channel Element	Peak DL Channel El	Max HSDPA Use	Peak HSDPA Users (%)
DemoCell 3466	16	45	76.0	256	21.0	60	26.0
DemoCell 6068	16	45	65.0	256	31.0	60	56.0
DemoCell 8947	16	42	64.0	172	4.0	60	15.0
DemoCell 2240	16	45	64.0	256	15.0	60	31.0
DemoCell 10778	16	45	63.0	262	11.0	60	33.0
DemoCell 1796	16	45	62.0	262	13.0	60	33.0
DemoCell 21041	16	45	61.0	256	18.0	60	33.0
DemoCell 7423	16	45	60.0	256	12.0	60	33.0
DemoCell 4529	16	45	59.0	256	15.0	60	33.0
DemoCell 0388	16	45	59.0	262	17.0	60	33.0
DemoCell 0337	16	42	59.0	172	5.0	60	33.0
DemoCell 6066	16	45	59.0	256	31.0	60	33.0

The bottom section, 'Capacity Chart', shows four line graphs for the time period 8/24/2009 10:45:00 AM. The graphs track the following metrics:

- CONSUMED_CREDITS_DL (Green line, 0-100)
- DL_NON_HS_TX_POWER (Orange line, 0-80)
- CONSUMED_CREDITS_UL (Green line, 0-300)
- NUMBER_OF_USERS_ASSIGNED_TO_PHYS_HS_CHAN (Red line, 0-30)

Line charts show variation of resource usage in selected ROPs

List of resource types – drag and drop into charts

Network Performance Problem

Difficult to find the root cause of dropped calls.

TEMS Discovery Network Solution

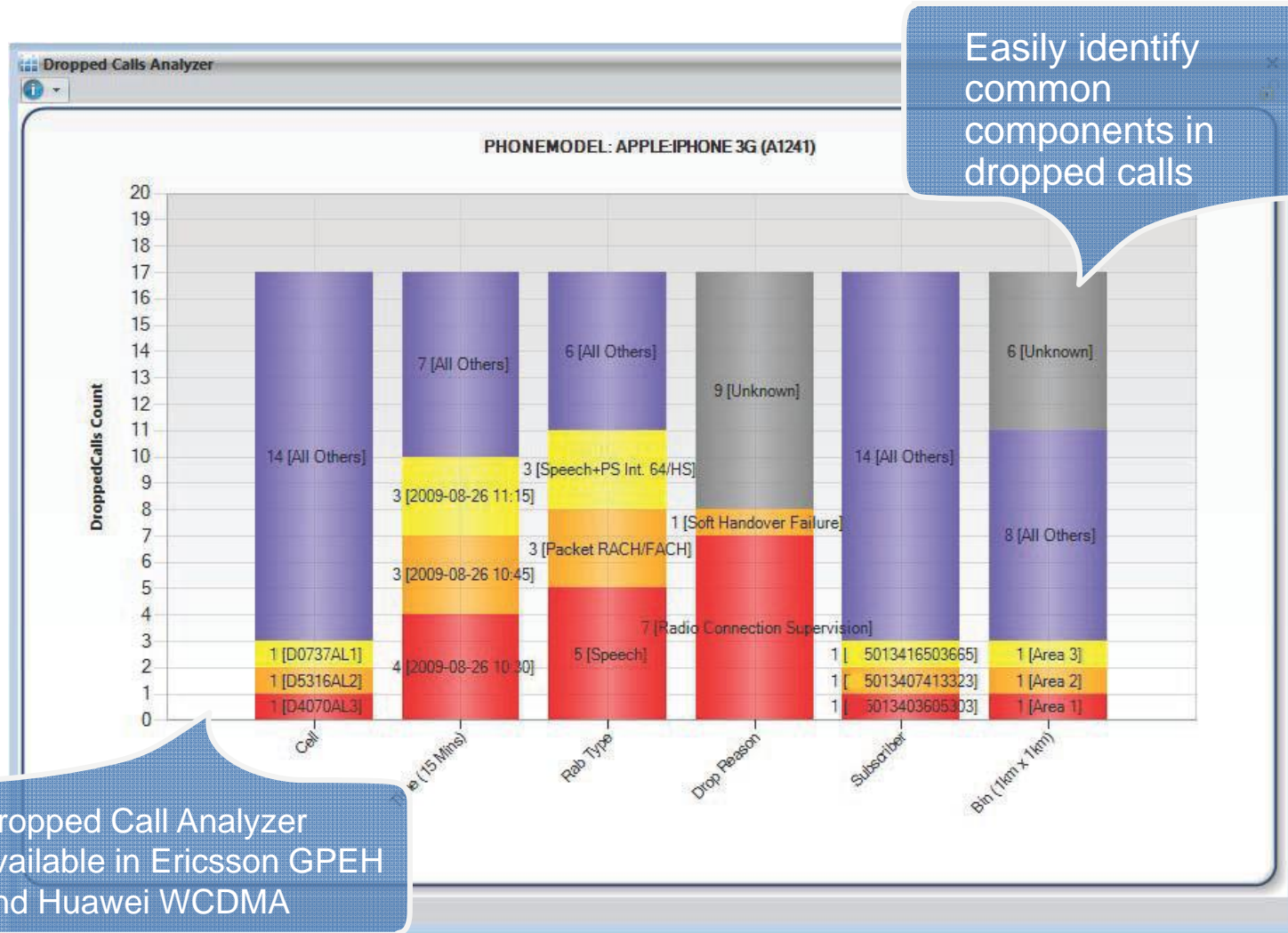
Detailed Investigation

- Dropped Call Analyzer
- Geolocate Dropped Calls

DROPPED CALL ANALYZER (1 OF 2)

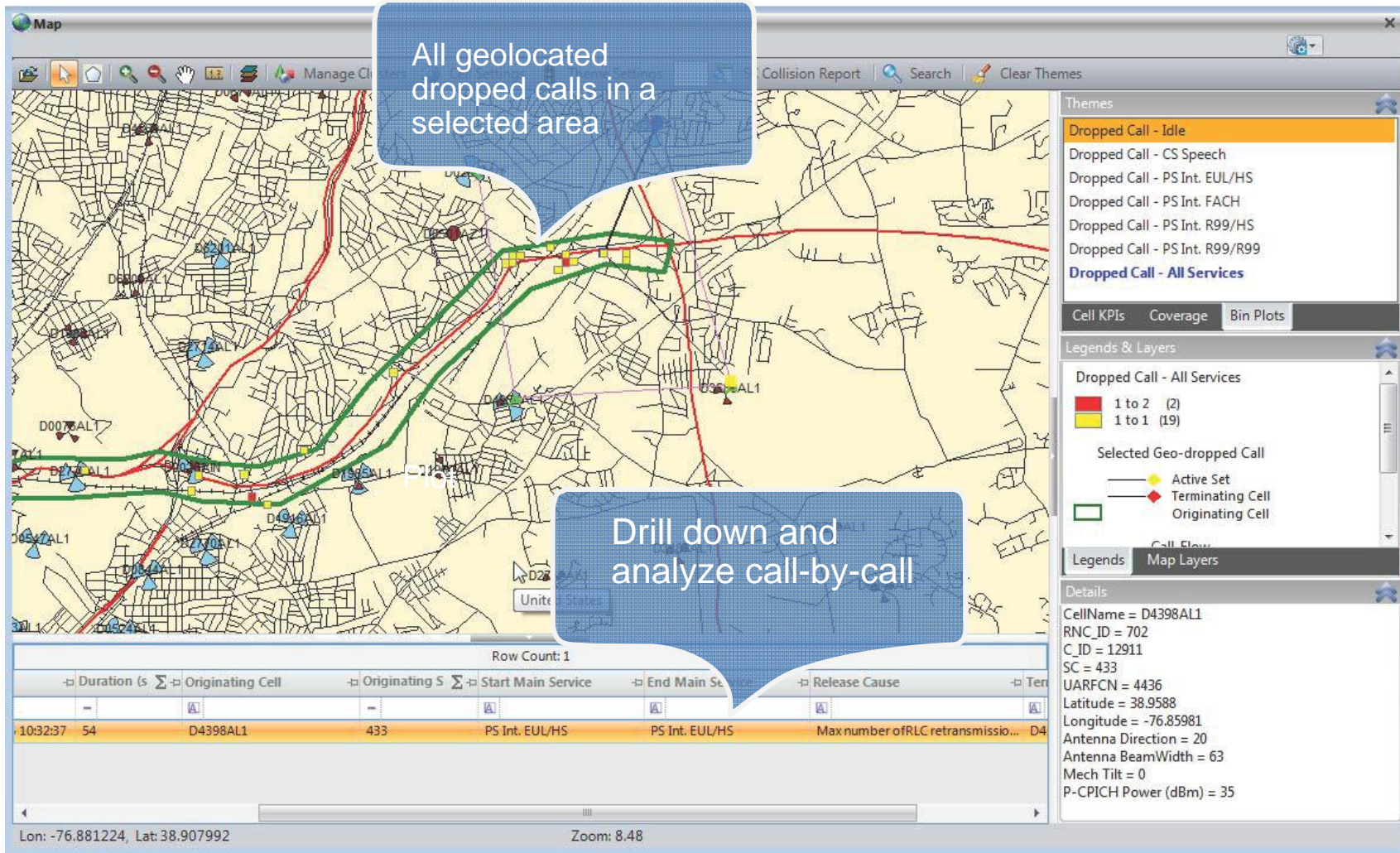
- Investigate cells or phone models with a high number of dropped calls
- Efficiently identify common components for the dropped calls. Are all the drops actually for the same?...
 - Cell (when investigating dropped calls per phone model)
 - Subscriber
 - Phone model or IMEI-TAC (when investigating dropped calls per cell)
 - Time period
 - Drop reason
 - RAB type
 - Location (1km by 1km grids)
- Drill down directly for a selected component
 - Geolocate dropped calls
 - Send to call-by-call analysis

DROPPED CALL ANALYZER (2 OF 2)



Dropped Call Analyzer available in Ericsson GPEH and Huawei WCDMA

GEOLOCATION – VIRTUAL DRIVE TESTS



All geolocated dropped calls in a selected area

Drill down and analyze call-by-call

Themes

- Dropped Call - Idle
- Dropped Call - CS Speech
- Dropped Call - PS Int. EUL/HS
- Dropped Call - PS Int. FACH
- Dropped Call - PS Int. R99/HS
- Dropped Call - PS Int. R99/R99
- Dropped Call - All Services**

Cell KPIs Coverage Bin Plots

Legends & Layers

Dropped Call - All Services

- 1 to 2 (2)
- 1 to 1 (19)

Selected Geo-dropped Call

- Active Set
- Terminating Cell
- Originating Cell

Legends Cell Flow Map Layers

Details

CellName = D4398AL1
RNC_ID = 702
C_ID = 12911
SC = 433
UARFCN = 4436
Latitude = 38.9588
Longitude = -76.85981
Antenna Direction = 20
Antenna BeamWidth = 63
Mech Tilt = 0
P-CPICH Power (dBm) = 35

Duration (s)	Originating Cell	Originating S	Start Main Service	End Main Se	Release Cause	Ter
10:32:37 54	D4398AL1	433	PS Int. EUL/HS	PS Int. EUL/HS	Max number ofRLC retransmissio...	D4

Row Count: 1

Lon: -76.881224, Lat: 38.907992 Zoom: 8.48

Network Performance Problem

Complex performance issues could be investigated using the powerful GPEH data but it is difficult to run own queries on the data.

TEMS Discovery Network Solution

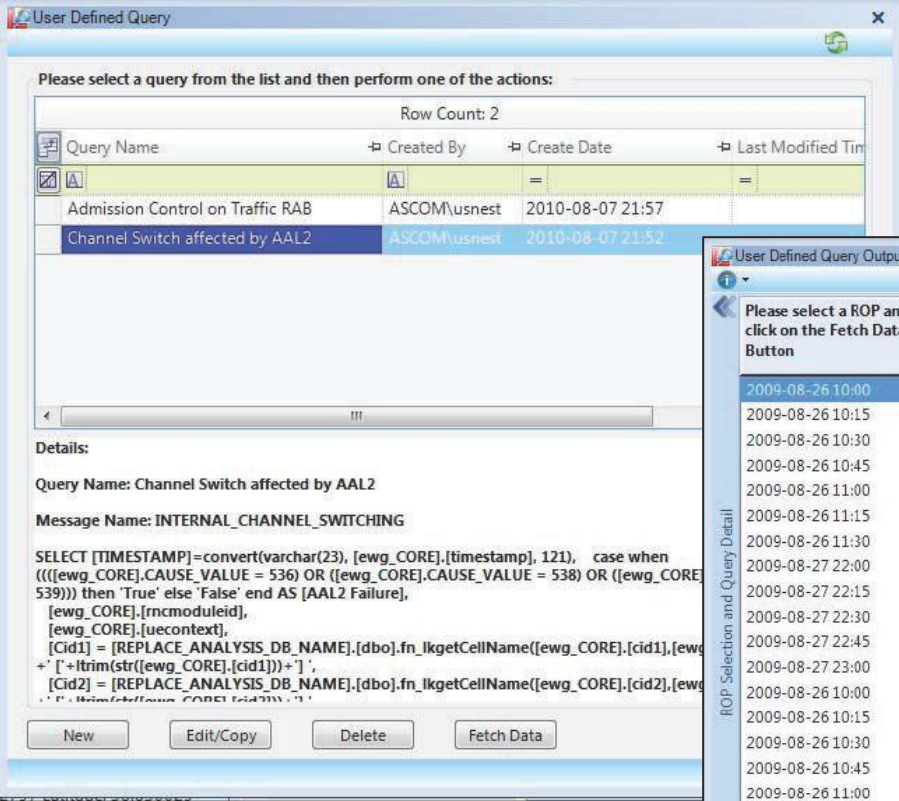
Detailed Investigation
▪ User-Defined Queries

USER-DEFINED QUERIES (1 OF 2)

▪ **Create your own queries on raw GPEH events**

- Query raw data for all occurrences of any decoded GPEH event
- For each occurrence, determine if expressions are true or false – based on any set of conditions on the information elements
- Associate call-level information with each occurrence of the GPEH event (IMSI, IMEI-TAC, duration, current cell, etc.)
- Queries are stored on server and can be shared with other users
- Examples:
 - All abnormal releases of traffic RABs due to issues related to SOHO
 - All channel switching failures caused by lack of transmission resources
 - All RRC connection requests in a cell with $E_c/N_o < -10$ dB

USER-DEFINED QUERIES (2 OF 2)



User Defined Query

Please select a query from the list and then perform one of the actions:

Query Name	Created By	Create Date	Last Modified Time
Admission Control on Traffic RAB	ASCOM\usnest	2010-08-07 21:57	
Channel Switch affected by AAL2	ASCOM\usnest	2010-08-07 21:52	

Row Count: 2

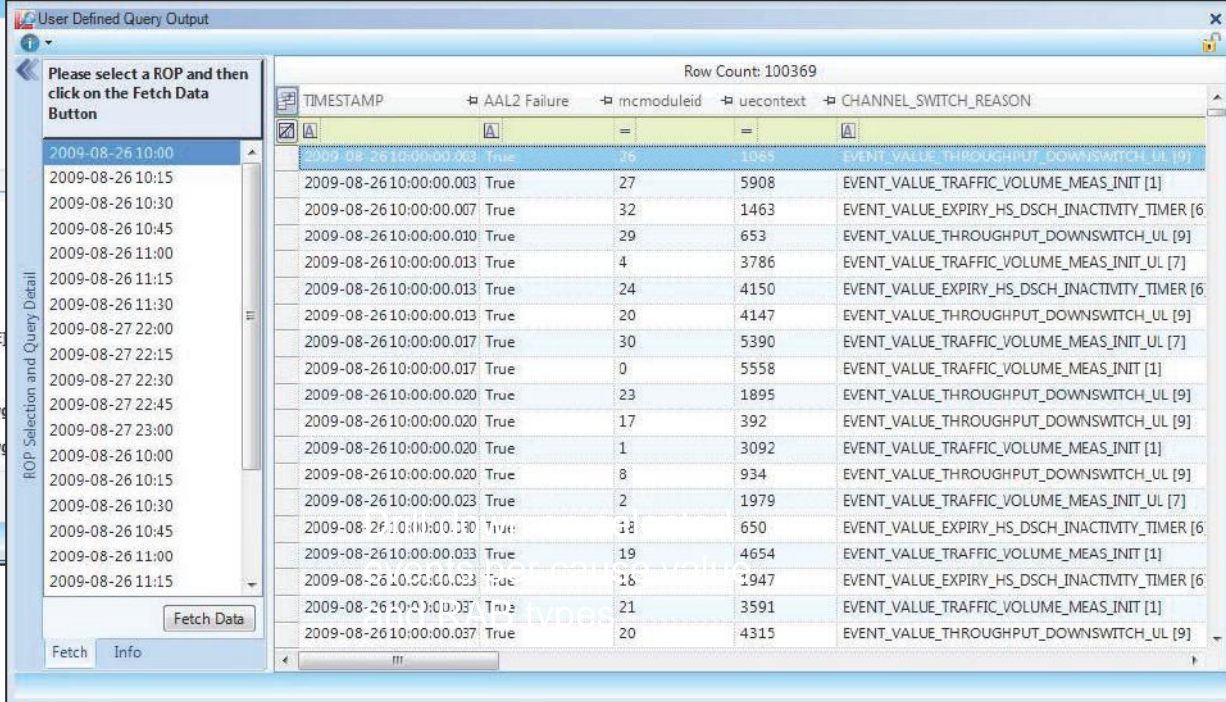
Details:

Query Name: Channel Switch affected by AAL2

Message Name: INTERNAL_CHANNEL_SWITCHING

```
SELECT [TIMESTAMP]=convert(varchar(23), [ewg_CORE].[timestamp], 121), case when
((([ewg_CORE].CAUSE_VALUE = 536) OR ([ewg_CORE].CAUSE_VALUE = 538) OR ([ewg_CORE].CAUSE_VALUE = 539))) then 'True' else 'False' end AS [AAL2 Failure],
[ewg_CORE].[mcmoduleid],
[ewg_CORE].[uecontext],
[Cid1] = [REPLACE_ANALYSIS_DB_NAME].[dbo].fn_lkgetCellName([ewg_CORE].[cid1],[ewg_CORE].[uecontext],
'+ [+Itrim(str([ewg_CORE].[cid1]))+ '],
[Cid2] = [REPLACE_ANALYSIS_DB_NAME].[dbo].fn_lkgetCellName([ewg_CORE].[cid2],[ewg_CORE].[uecontext],
'+ [+Itrim(str([ewg_CORE].[cid2]))+ ']
```

Buttons: New, Edit/Copy, Delete, Fetch Data



User Defined Query Output

Please select a ROP and then click on the Fetch Data Button

Row Count: 100369

TIMESTAMP	AAL2 Failure	mcmoduleid	uecontext	CHANNEL_SWITCH_REASON
2009-08-26 10:00:00.003	True	26	1065	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.003	True	27	5908	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT [1]
2009-08-26 10:00:00.007	True	32	1463	EVENT_VALUE_EXPIRY_HS_DSCH_INACTIVITY_TIMER [6]
2009-08-26 10:00:00.010	True	29	653	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.013	True	4	3786	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT_UL [7]
2009-08-26 10:00:00.013	True	24	4150	EVENT_VALUE_EXPIRY_HS_DSCH_INACTIVITY_TIMER [6]
2009-08-26 10:00:00.013	True	20	4147	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.017	True	30	5390	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT_UL [7]
2009-08-26 10:00:00.017	True	0	5558	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT [1]
2009-08-26 10:00:00.020	True	23	1895	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.020	True	17	392	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.020	True	1	3092	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT [1]
2009-08-26 10:00:00.020	True	8	934	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]
2009-08-26 10:00:00.023	True	2	1979	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT_UL [7]
2009-08-26 10:00:00.030	True	18	650	EVENT_VALUE_EXPIRY_HS_DSCH_INACTIVITY_TIMER [6]
2009-08-26 10:00:00.033	True	19	4654	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT [1]
2009-08-26 10:00:00.033	True	16	1947	EVENT_VALUE_EXPIRY_HS_DSCH_INACTIVITY_TIMER [6]
2009-08-26 10:00:00.037	True	21	3591	EVENT_VALUE_TRAFFIC_VOLUME_MEAS_INIT [1]
2009-08-26 10:00:00.037	True	20	4315	EVENT_VALUE_THROUGHPUT_DOWNSWITCH_UL [9]

Buttons: Fetch Data, Fetch, Info

Network Performance Problem

Neighbor lists from planning tool do not enable optimal performance in a live network.

Introductions of second and third carriers in network have made KPI metrics worse.

TEMS Discovery Network Solution

Neighbor Optimization

- Intra-frequency
- Inter-frequency
- IRAT

INTRA-FREQUENCY NEIGHBOR OPTIMIZATION (1 OF 2)

- Optimizing the WCDMA neighbor plan is a central optimization activity that is done using live traffic in TEMS Discovery Network.
 - Existing neighbors section
 - Statistics on existing neighbor usage and unmonitored neighbors
 - Used to delete unused neighbors and optimize selection priority
 - Missing neighbors section
 - Statistics on missing neighbors as reported by mobile phones
 - Used to add missing neighbor relations
- Statistics for large numbers of busy hours can be accumulated
- All information is graphically displayed on a map for easy analysis
- Sends affected calls to call analysis feature if more-detailed investigation is needed

INTRA-FREQUENCY NEIGHBOR OPTIMIZATION (2 OF 2)

Remove unused existing intra-frequency relations

Neighbor	Existing Neighbor	Select
D0919BL1	D6094BL3	8
D0919BL2	D6423BL1	11
D0919BL2	D2292BL2	10
D0919BL2	D0547BL2	9
D0919BL3	D4393BL3	8
D0919BL3	D3122BL1	1
D0919BL2	D5812BL2	5
D2292BL2	D0919BL2	18

Missing Neighbors

Best Server	Missing Neighbors	Missing Neighbor	Missing Neighbor.SC
D0919BL2	2	D2770BL3	185
D6408AL1	6	D5846AL1	386
D0312AL1	3	D1082AL1	338
D6948BL1	2	D4954BL2	321
D3264BL1	1	D6635BL3	452
D6325AL1	4	D0802AIN	223
D6690AL2	11	D3122AL2	368
D0837AL1	8	D1957AL2	154

Linked to map

Add missing intra-frequency neighbors

INTER-FREQUENCY NEIGHBOR OPTIMIZATION (1 OF 2)

- **Improve second and third carrier performance**
 - Existing neighbors section
 - Statistics on existing IFHO neighbor usage
 - Used to delete unused neighbors and optimize selection priority
 - Candidate neighbors section
 - Algorithm determines if there are missing or down-prioritized IFHO relations
 - Used to add missing neighbor relations or change selection priority
- All information is graphically displayed on a map for easy analysis
- Sends affected calls to call analysis feature if more-detailed investigation is needed

INTER-FREQUENCY NEIGHBOR OPTIMIZATION (2 OF 2)

Remove unused existing inter-frequency relations

Linked to map

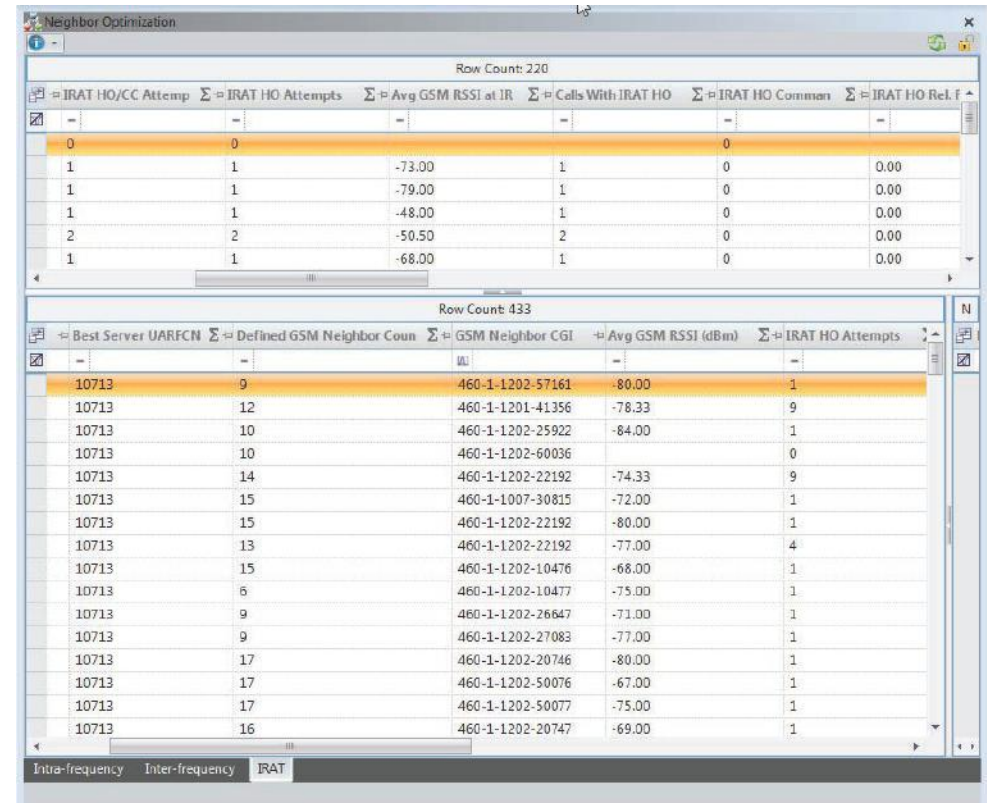
Add missing inter-frequency neighbors

Server UARFC	Defined IFHO Neigh	IFHO Neighbor
4412	32	D1882AL1
4412	32	D1932AL1
4412	32	D0345AL1
4412	32	D1882AL2
4412	32	D1848AL2
4412	28	D3604AL1
4412	23	D4397AL1
4412	31	D4397AL3
4412	32	D1065AL1

Best Server	Candidate Neighbor	IFHO Candidate Neig	Total IFHO Succes
D6797BL3	D1882AL1	4436	3
D6201BL3	D4569AL2	4436	6
D0265BL1	D0265AL3	4436	2
D0265BL2	D0501AZ1	4436	3
D1882BL1	D0127AL2	4436	4
D1932BL1	D1932AL2	4436	4
D0341MBA	D0265AL3	4436	18
D6948BL3	D6948AL2	4436	5

IRAT NEIGHBOR OPTIMIZATION

- **Ensure service continuity across technology border**
 - Identify unused GSM neighbors
 - Identify poorly performing GSM neighbors
 - Identify missing GSM neighbors
- Geographic representation on map



The screenshot displays the 'Neighbor Optimization' software interface. It features two data tables with various columns and a row count of 220 for the top table and 433 for the bottom table. The bottom table is currently selected.

Best Server UARFCN	Defined GSM Neighbor Count	GSM Neighbor CGI	Avg GSM RSSI (dBm)	IRAT HO Attempts
10713	9	460-1-1202-57161	-80.00	1
10713	12	460-1-1201-41356	-78.33	9
10713	10	460-1-1202-25922	-84.00	1
10713	10	460-1-1202-60036		0
10713	14	460-1-1202-22192	-74.33	9
10713	15	460-1-1007-30815	-72.00	1
10713	15	460-1-1202-22192	-80.00	1
10713	13	460-1-1202-22192	-77.00	4
10713	15	460-1-1202-10476	-68.00	1
10713	6	460-1-1202-10477	-75.00	1
10713	9	460-1-1202-26647	-71.00	1
10713	9	460-1-1202-27083	-77.00	1
10713	17	460-1-1202-20746	-80.00	1
10713	17	460-1-1202-50076	-67.00	1
10713	17	460-1-1202-50077	-75.00	1
10713	16	460-1-1202-20747	-69.00	1

CHANGE REQUESTS

- Collect additions / removals / selection priority changes from other sections
- Generate XML file for direct load into OSS planned area
- Or export to Microsoft Excel for import into other CM tools



Network Performance Problem

A lot of performance issues in the network are caused by overshooting cells and overlapping coverage, but these areas are extremely difficult to detect and locate.

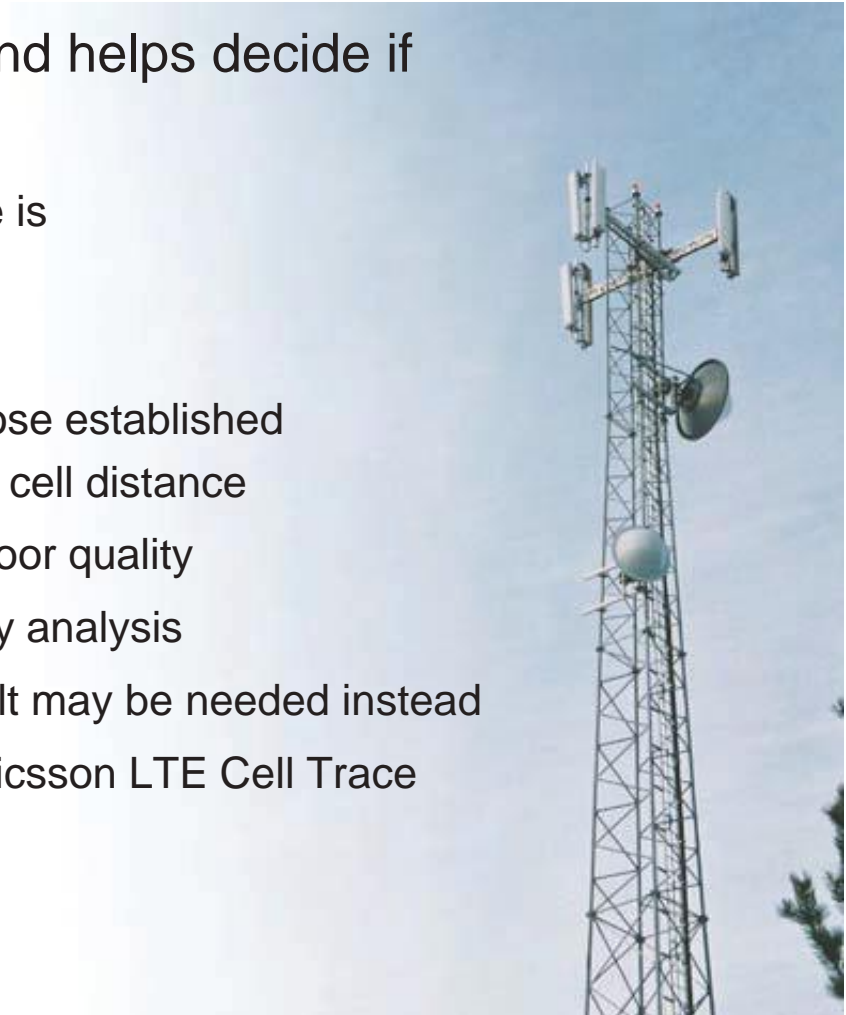
TEMS Discovery Network Solution

Coverage Area Optimization

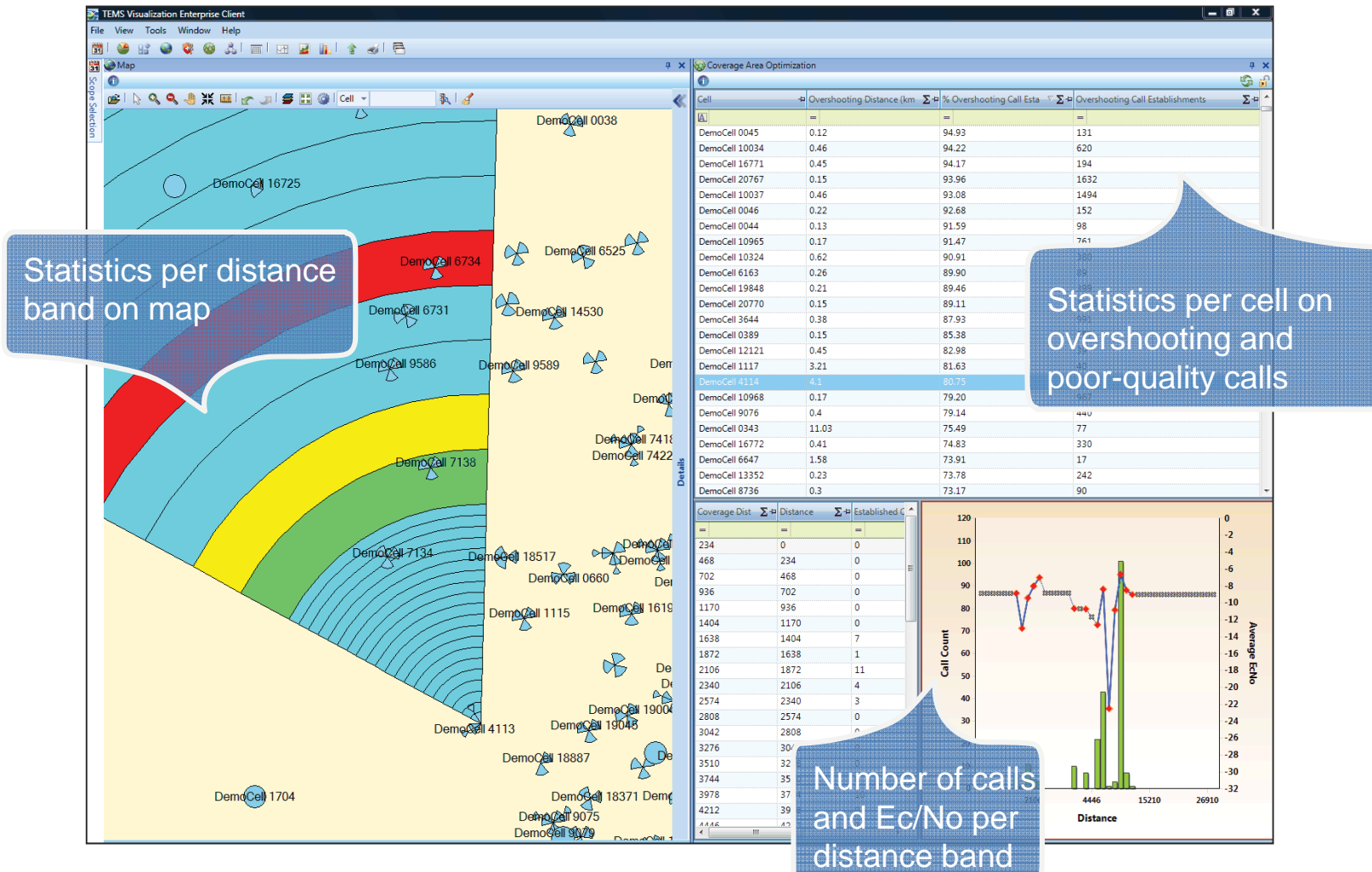
- Overshooting Cells
- Pilot Pollution

OVERSHOOTING CELLS (1 OF 2)

- Automatically identifies overshooting cells and helps decide if down-tilt is needed
 - For each cell an estimated overshooting cell distance is calculated
 - For each cell the following statistics are calculated:
 - Number and percentage of overshooting calls – those established farther from the base station than the overshooting cell distance
 - Number and percentage of calls established with poor quality
 - Results are presented on maps and in charts for easy analysis
 - Use together with missing neighbor feature – down-tilt may be needed instead
 - Note: Overshooting Cell Analysis also available in Ericsson LTE Cell Trace and Huawei WCDMA module



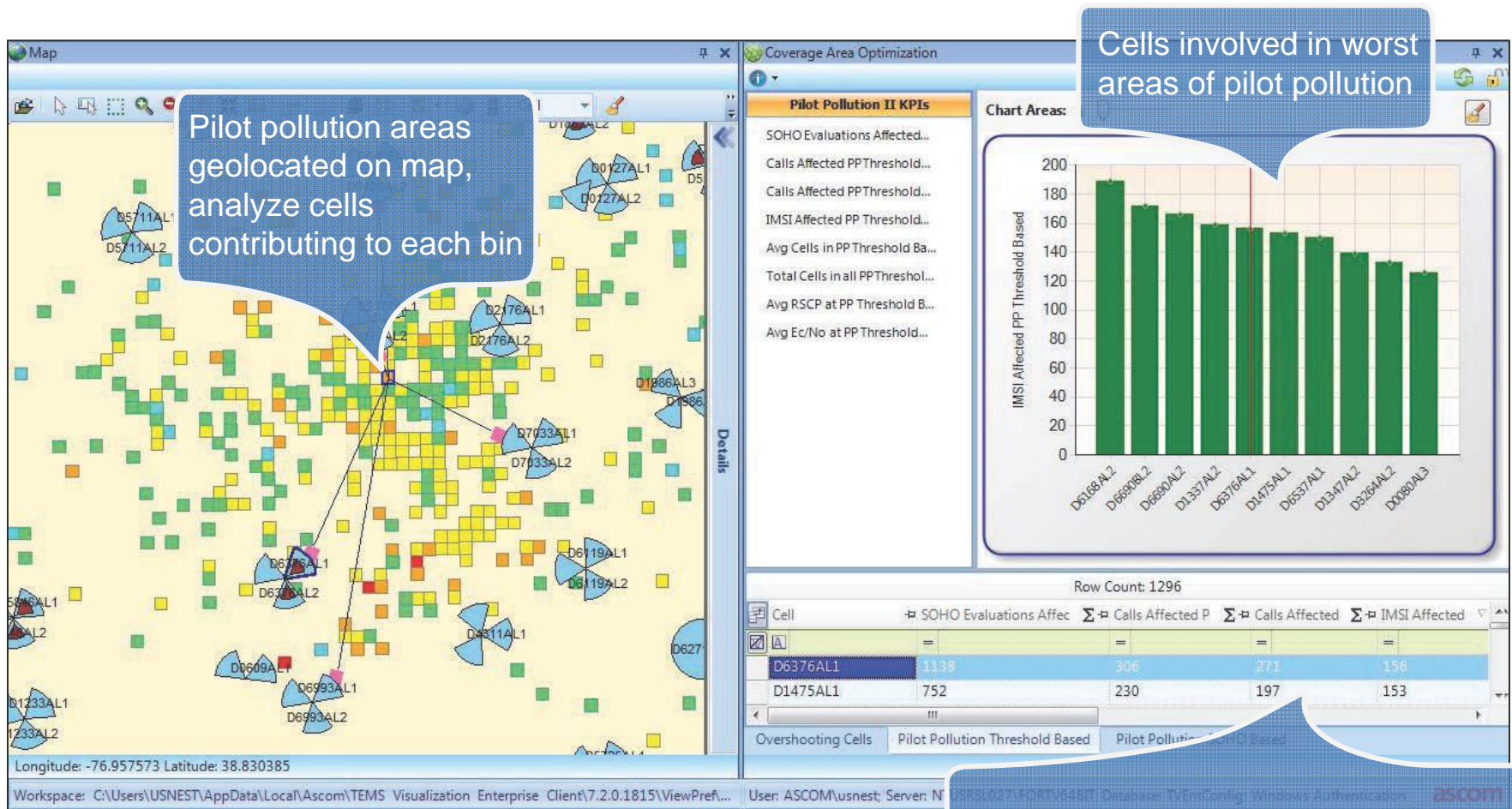
OVERSHOOTING CELLS (2 OF 2)



PILOT POLLUTION (THRESHOLD-BASED) (1 OF 2)

- Automatically identifies areas of pilot pollution and allows users to geolocate these areas on the map
 - Based on measurement reports for soft handover
 - Thresholds are numbers of cells within a dB range
 - Example: the existence of four or more cells within 5dB triggers pilot pollution
- Statistics on RSCP and E_c/N_0 help determine if down-tilt or new site is needed

PILOT POLLUTION (THRESHOLD-BASED) (2 OF 2)



Pilot pollution areas geolocated on map, analyze cells contributing to each bin

Cells involved in worst areas of pilot pollution

Number of pilot pollution events where the cell involved plus the number of calls and IMSI are affected

Pilot Pollution II KPIs

- SOHO Evaluations Affected...
- Calls Affected PPTreshold...
- Calls Affected PPTreshold...
- IMSI Affected PP Threshold...
- Avg Cells in PP Threshold Ba...
- Total Cells in all PPTreshold...
- Avg RSCP at PP Threshold B...
- Avg Ec/No at PP Threshold...

Chart Areas:

IMSI Affected PP Threshold Based

Cell ID	IMSI Affected PP Threshold Based
D6168AL2	185
D6680BL2	170
D6680AL2	165
D1337AL2	155
D6576AL1	150
D1475AL1	145
D6537AL1	140
D1347AL2	135
D3264AL2	130
D0080AL3	125

Row Count: 1296

Cell	SOHO Evaluations Affec	Calls Affected P	Calls Affected	IMSI Affected
D6376AL1	1138	306	271	156
D1475AL1	752	230	197	153

PILOT POLLUTION (SOFT HANDOVER-BASED)

Alternative method to identify cells involved in pilot pollution

- Based on soft handover replacement
- Can be used if all measurement report data is not available

- All information is graphically displayed on a map for easy analysis.
- Sends affected calls to call analysis feature if more-detailed investigation is needed.

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ERICSSON TRACING DATA SOURCE FEATURES

(GSM MTR, WCDMA UETR, LTE UE TRACE)

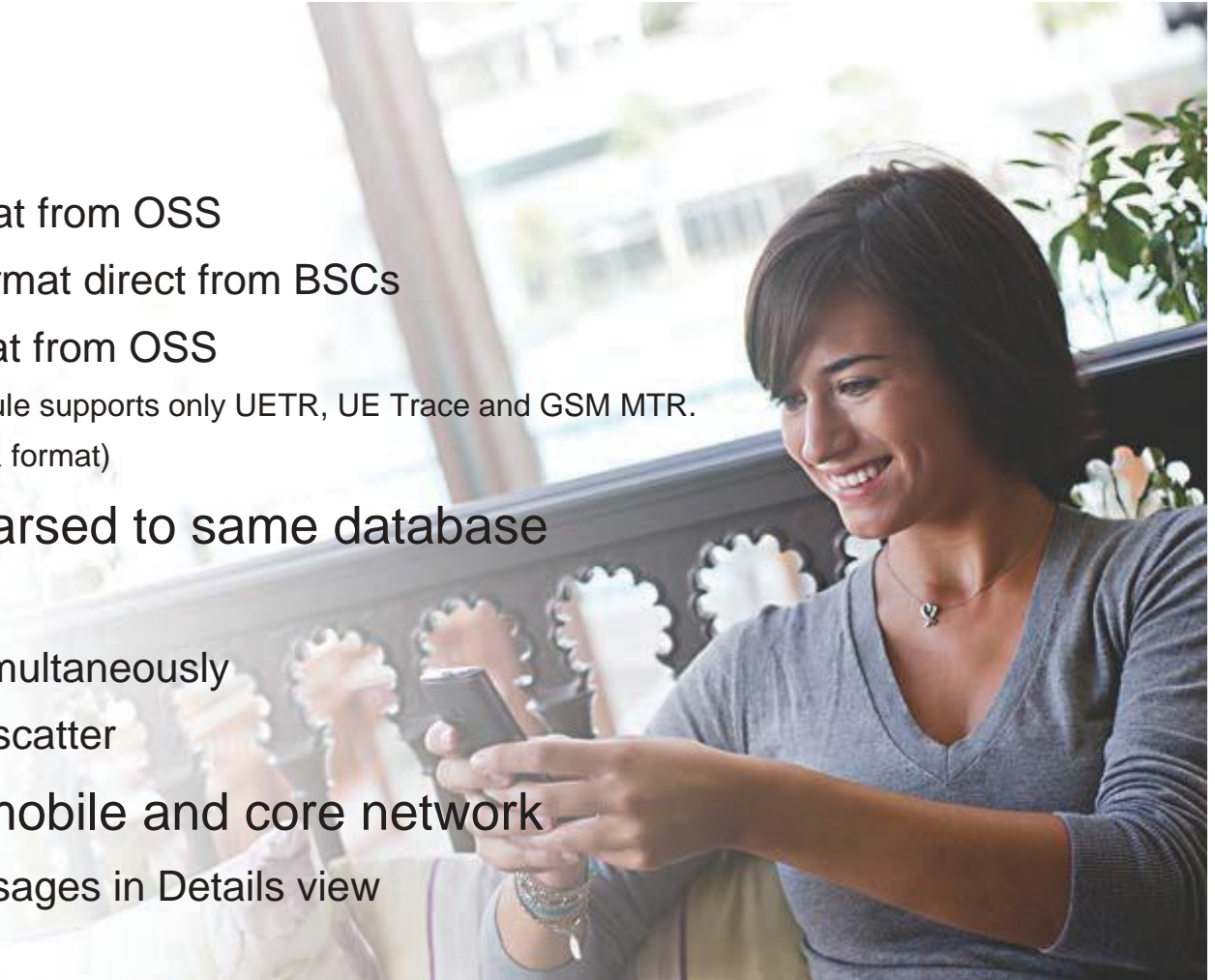


TRACING DATA SOURCE HIGHLIGHTS

- Support for system release
 - WCDMA UETR W11A - W14A
 - LTE UE TRACE L11A - L14A
 - GSM MTR 07A-G13B text format from OSS
 - GSM MTR 07A-G13B binary format direct from BSCs
 - GSM CTR 07A-G13B text format from OSS

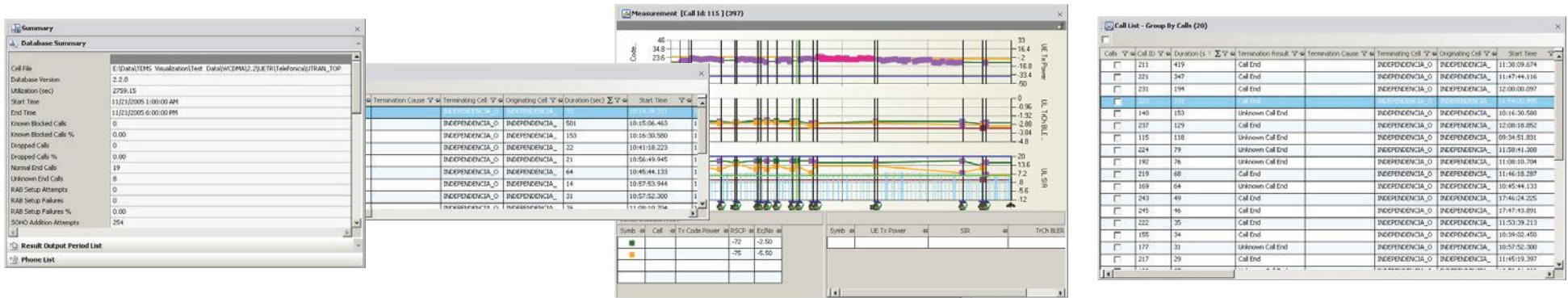
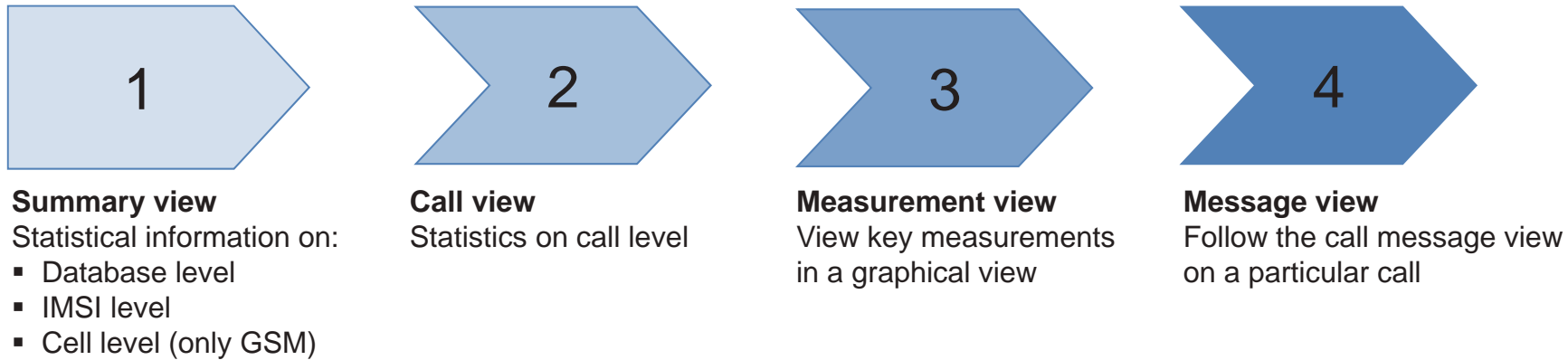
(TEMS Discovery Enterprise – Network Module supports only UETR, UE Trace and GSM MTR. The Desktop variant also supports GSM CTR format)

- MTR, UETR & UE Trace parsed to same database
 - IRAT trace possibility
 - View MTR, UETR, UE Trace simultaneously
 - Charts: histogram, distribution, scatter
- Follow signaling between mobile and core network
 - Selected decoding of NAS messages in Details view



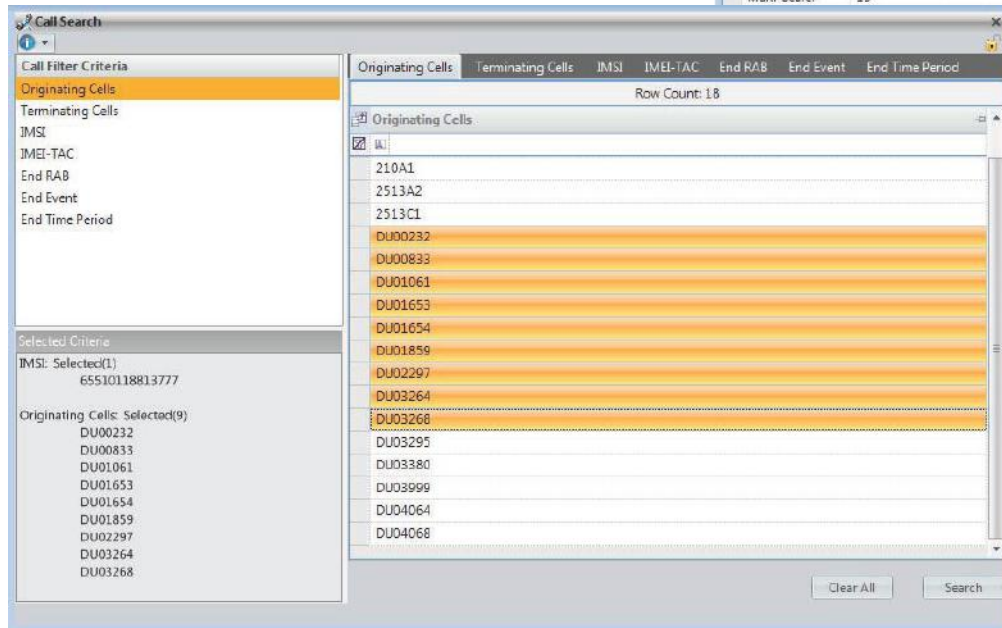
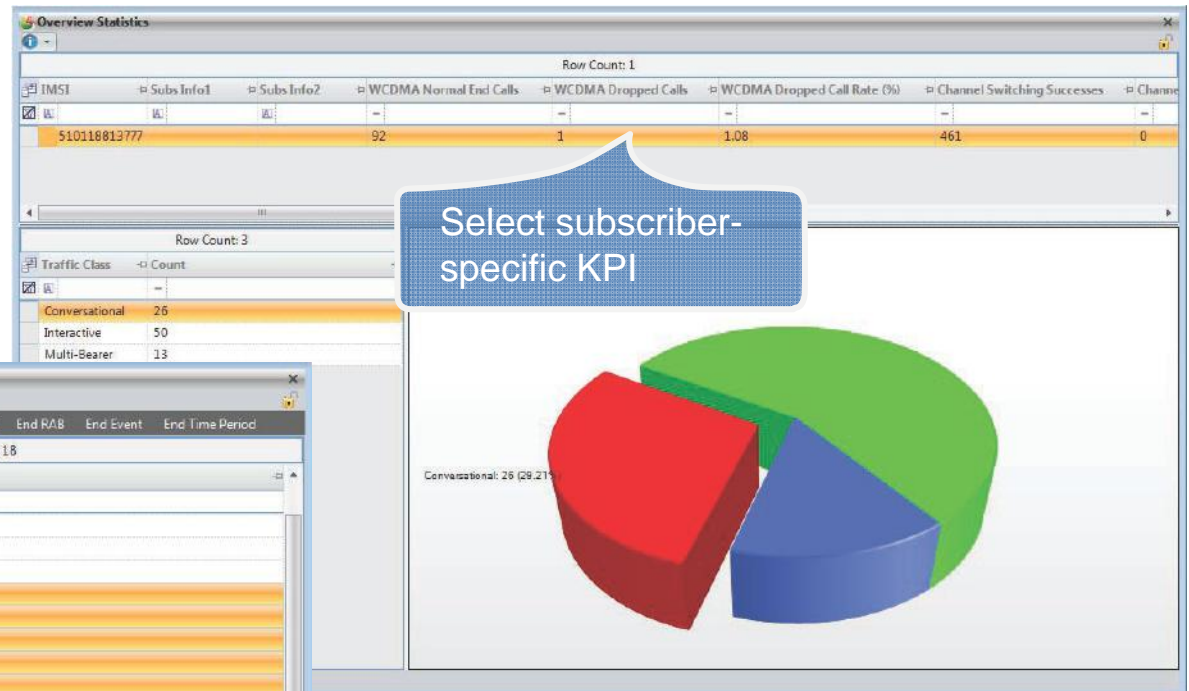
USING THE TRACING DATA SOURCES

Follows same workflow as **Common Features for Area Recording**



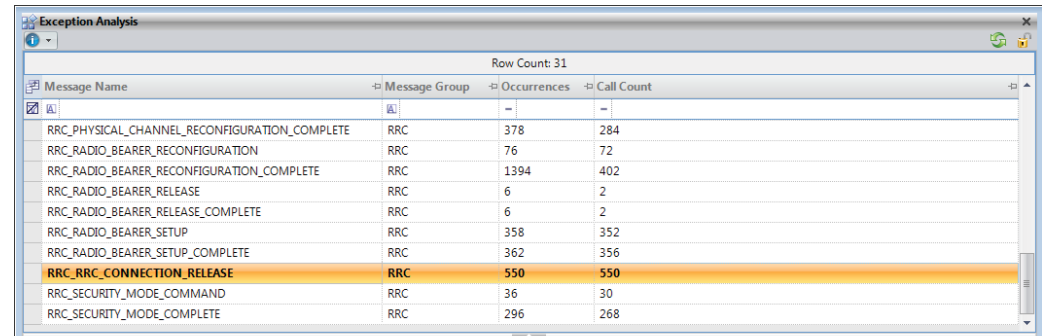
HIGH-LEVEL TROUBLESHOOTING FEATURES

- Per subscriber overview
- Search for specific calls using multiple filters

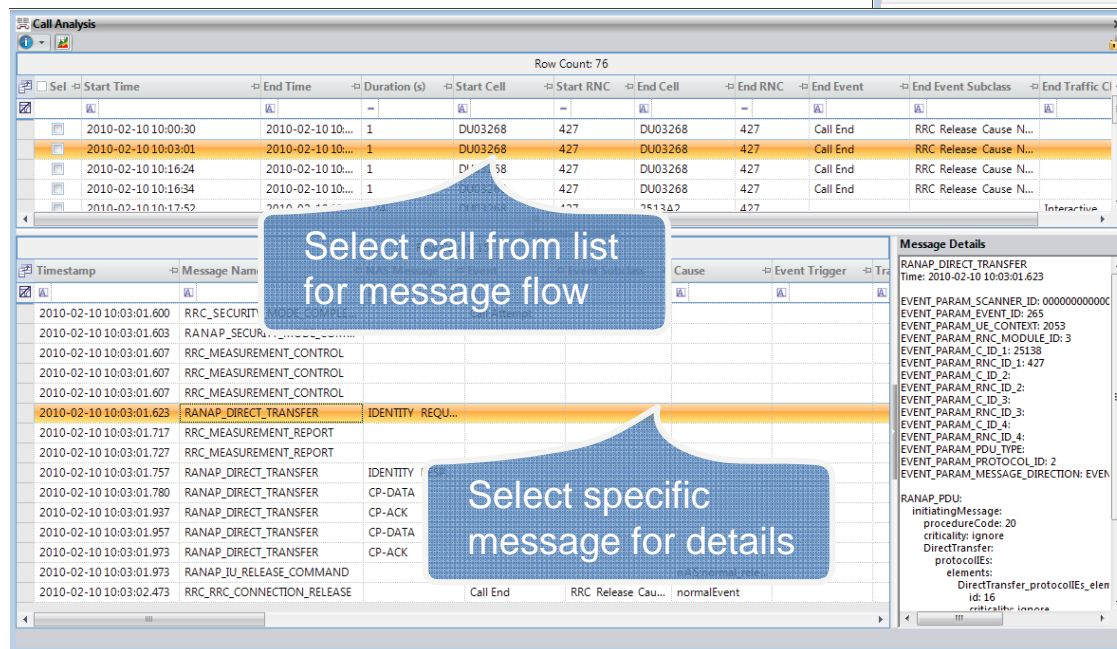


DETAILED INVESTIGATION FEATURES (1 OF 2)

- Exception Analysis
- Call-by-Call Analysis
- Graphical Analysis (next slide)



Message Name	Message Group	Occurrences	Call Count
RRC_PHYSICAL_CHANNEL_RECONFIGURATION_COMPLETE	RRC	378	284
RRC_RADIO_BEARER_RECONFIGURATION	RRC	76	72
RRC_RADIO_BEARER_RECONFIGURATION_COMPLETE	RRC	1394	402
RRC_RADIO_BEARER_RELEASE	RRC	6	2
RRC_RADIO_BEARER_RELEASE_COMPLETE	RRC	6	2
RRC_RADIO_BEARER_SETUP	RRC	358	352
RRC_RADIO_BEARER_SETUP_COMPLETE	RRC	362	356
RRC_RRC_CONNECTION_RELEASE	RRC	550	550
RRC_SECURITY_MODE_COMMAND	RRC	36	30
RRC_SECURITY_MODE_COMPLETE	RRC	296	268



Select call from list for message flow

Select specific message for details

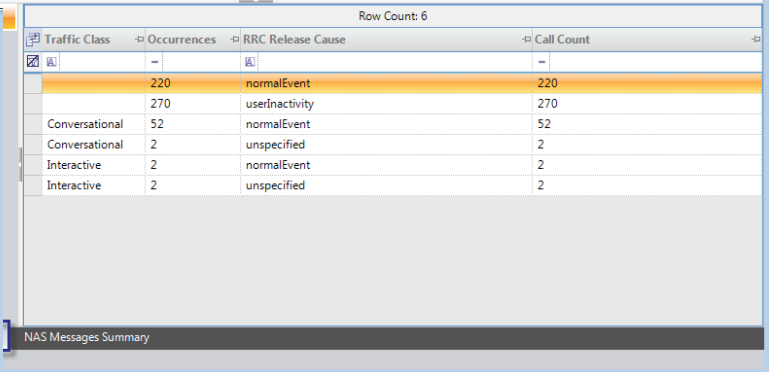
Timestamp	Message Name	Cause	Event Trigger
2010-02-10 10:03:01.600	RRC_SECURITY_MODE_COMPLETE		
2010-02-10 10:03:01.603	RANAP_SECURITY_MODE_COMPLETE		
2010-02-10 10:03:01.607	RRC_MEASUREMENT_CONTROL		
2010-02-10 10:03:01.607	RRC_MEASUREMENT_CONTROL		
2010-02-10 10:03:01.607	RRC_MEASUREMENT_CONTROL		
2010-02-10 10:03:01.623	RANAP_DIRECT_TRANSFER	IDENTITY REQ...	
2010-02-10 10:03:01.717	RRC_MEASUREMENT_REPORT		
2010-02-10 10:03:01.727	RRC_MEASUREMENT_REPORT		
2010-02-10 10:03:01.757	RANAP_DIRECT_TRANSFER	IDENTITY /	
2010-02-10 10:03:01.780	RANAP_DIRECT_TRANSFER	CP-DATA	
2010-02-10 10:03:01.937	RANAP_DIRECT_TRANSFER	CP-ACK	
2010-02-10 10:03:01.957	RANAP_DIRECT_TRANSFER	CP-DATA	
2010-02-10 10:03:01.973	RANAP_DIRECT_TRANSFER	CP-ACK	
2010-02-10 10:03:01.973	RANAP_IU_RELEASE_COMMAND		
2010-02-10 10:03:02.473	RRC_RRC_CONNECTION_RELEASE	Call End	RRC Release Cau... normalEvent

Message Details

RANAP_DIRECT_TRANSFER
Time: 2010-02-10 10:03:01.623

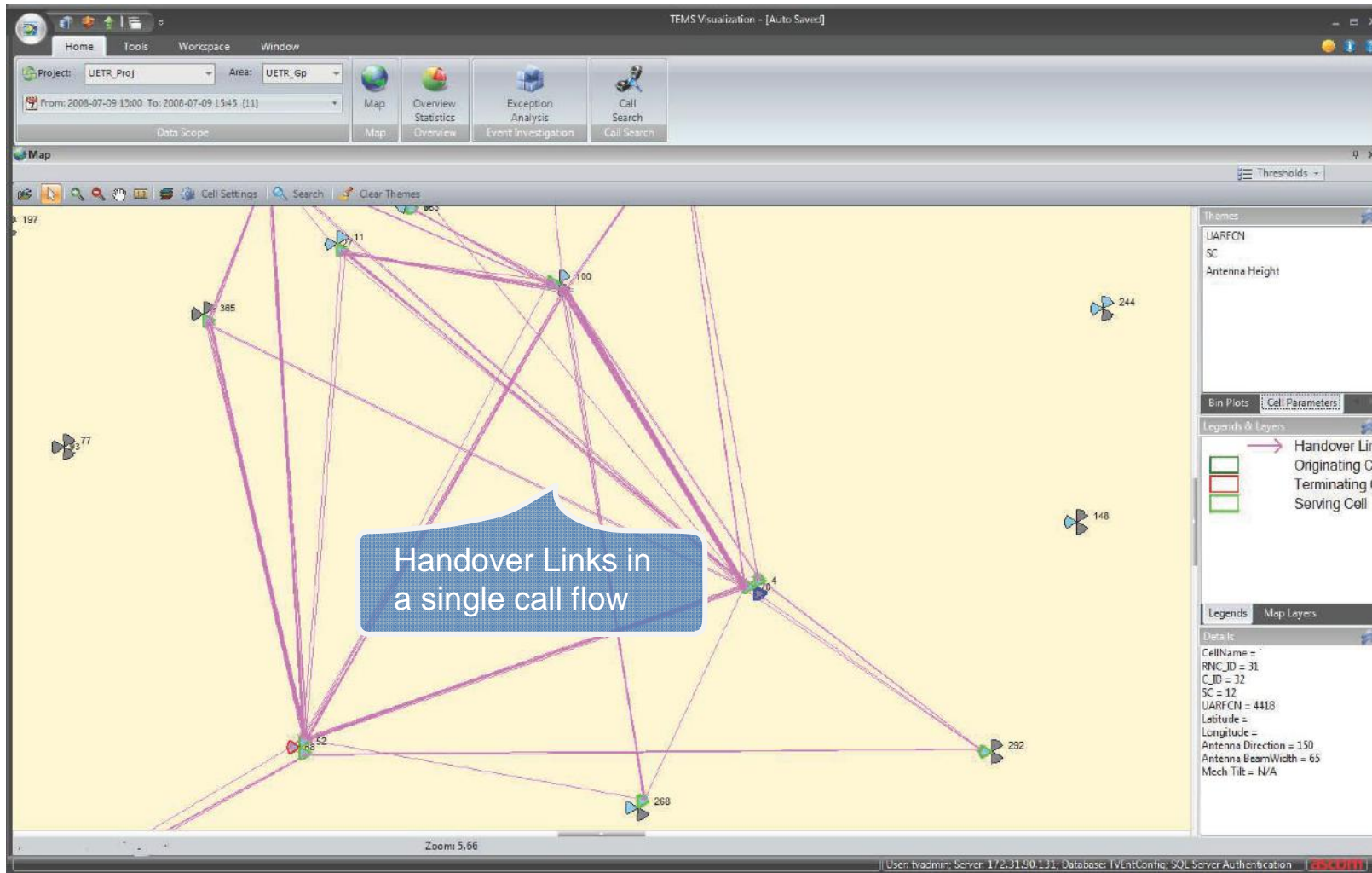
EVENT_PARAM_SCANNER_ID: 000000000000
EVENT_PARAM_EVENT_ID: 265
EVENT_PARAM_IE_CONTEXT: 2053
EVENT_PARAM_RNC_MODULE_ID: 3
EVENT_PARAM_C_ID_1: 25138
EVENT_PARAM_RNC_ID_1: 427
EVENT_PARAM_C_ID_2:
EVENT_PARAM_RNC_ID_2:
EVENT_PARAM_C_ID_3:
EVENT_PARAM_RNC_ID_3:
EVENT_PARAM_C_ID_4:
EVENT_PARAM_RNC_ID_4:
EVENT_PARAM_PDU_TYPE:
EVENT_PARAM_PROTOCOL_ID: 2
EVENT_PARAM_MESSAGE_DIRECTION: EVEN

RANAP_PDU:
initiatingMessage:
procedureCode: 20
criticality: ignore
DirectTransfer:
protocolIEs:
elements:
DirectTransfer_protocolIEs_e1en
id: 16
criticality: ignore



Traffic Class	Occurrences	RRC Release Cause	Call Count
	220	normalEvent	220
	270	userInactivity	270
Conversational	52	normalEvent	52
Conversational	2	unspecified	2
Interactive	2	normalEvent	2
Interactive	2	unspecified	2

DETAILED INVESTIGATION FEATURES (2 OF 2)



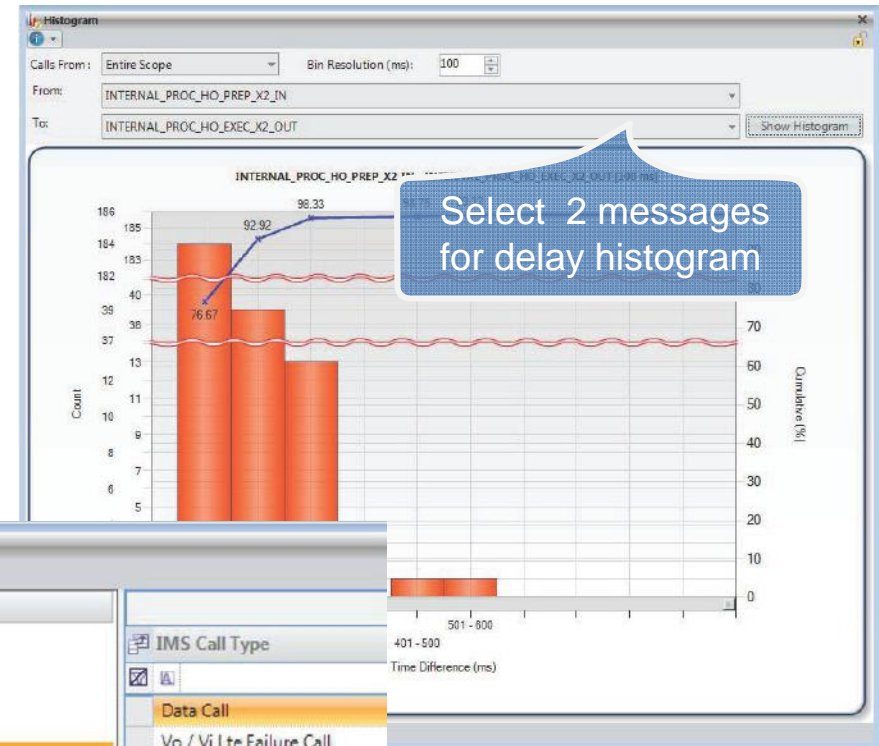
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ERICSSON LTE CELL TRACE MODULE FEATURES



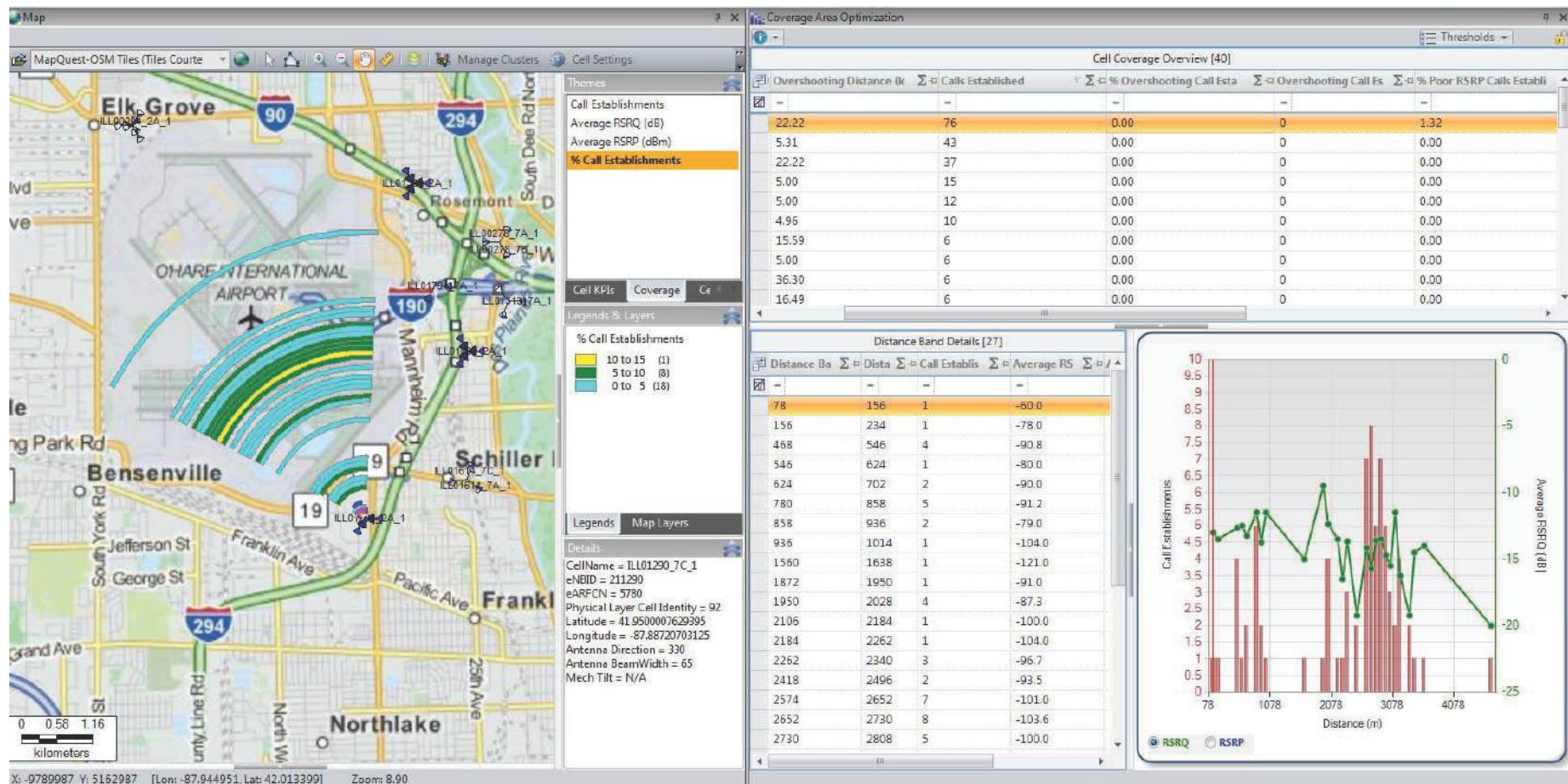
TROUBLESHOOTING AND INVESTIGATION FEATURES

- All features previously listed in section ‘Common Feature Details’
 - Cell and Cell Group KPIs
 - Phone Model KPIs
 - Subscriber KPIs (New)
 - VoLTE Analysis: For above KPI Analyses
 - Call Search
 - Sequence Delay Histogram
 - Call-by-Call Analysis
 - Exception Analysis
 - RF Analysis Charts
 - Coverage Area Optimization
 - Distance vs. KPI Meas. Chart
 - CSFB: Performance Report

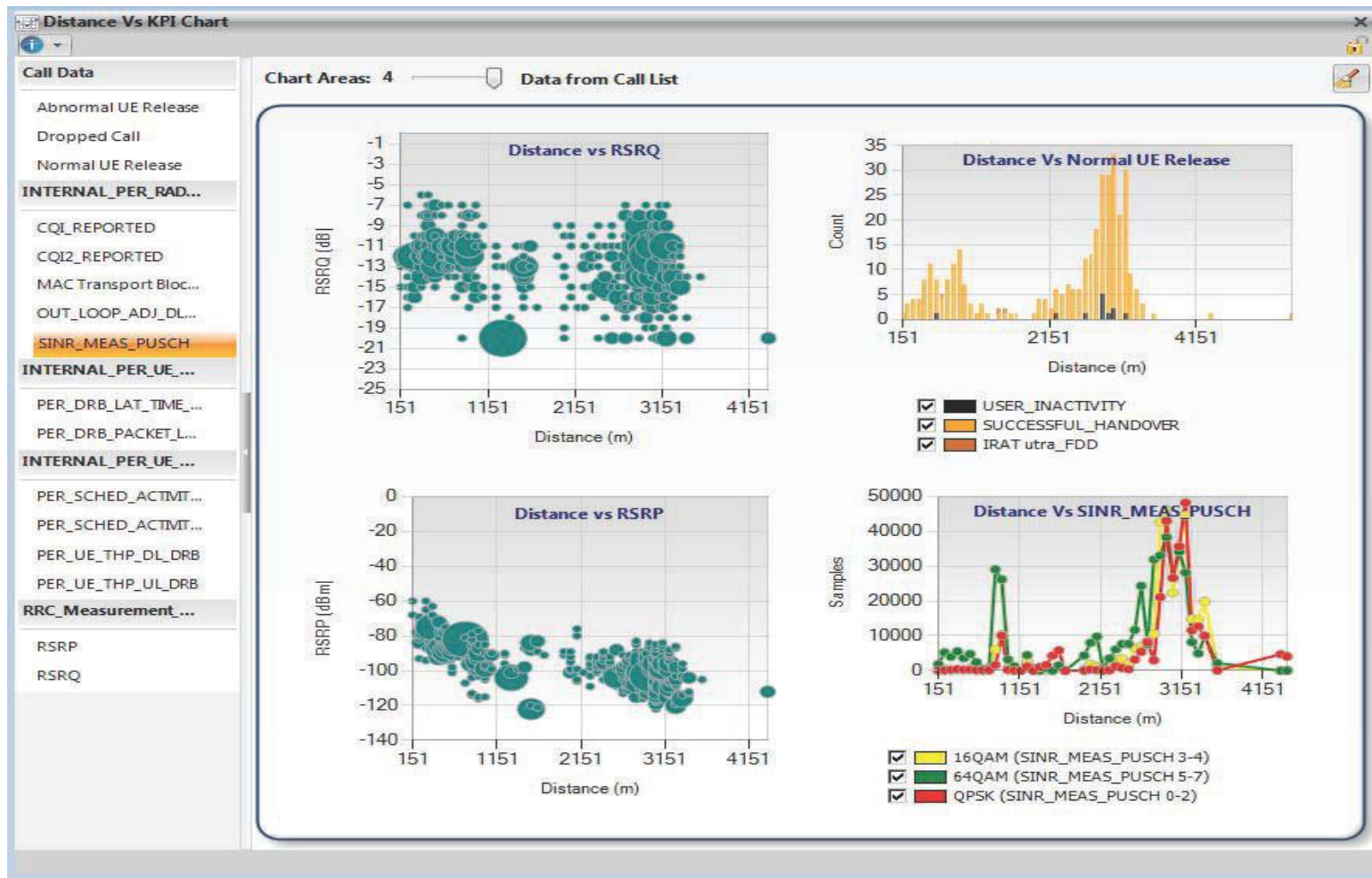


LTE COVERAGE AREA OPTIMIZATION

- Similar to 3G Coverage Area Optimization

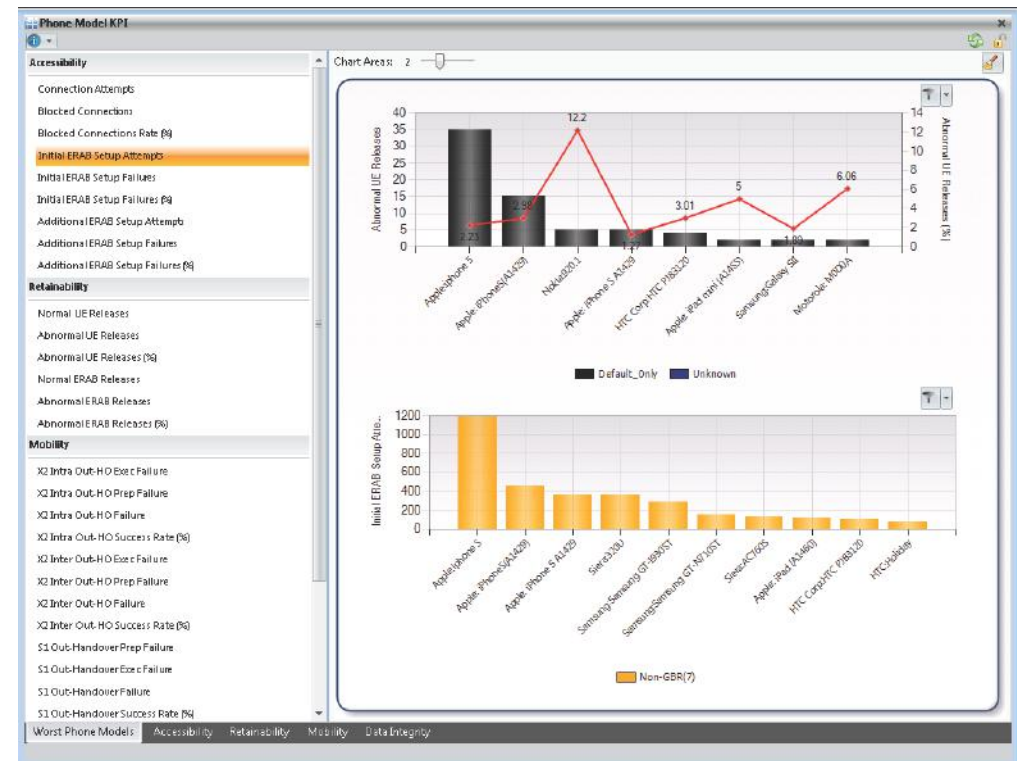


DISTANCE VS. KPI MEASUREMENT CHART



LTE PHONE MODEL KPI

- Typically, IMEI not known in the eNodeB
- IMEI lookup taken from MME data and correlated with LTE Cell Trace data
- Analyze Performance on per Phone Model basis
- KPIs for whole connection, per Service
- KPIs for individual eRAB per QCI (e.g., for VoLTE, QCI = 1)





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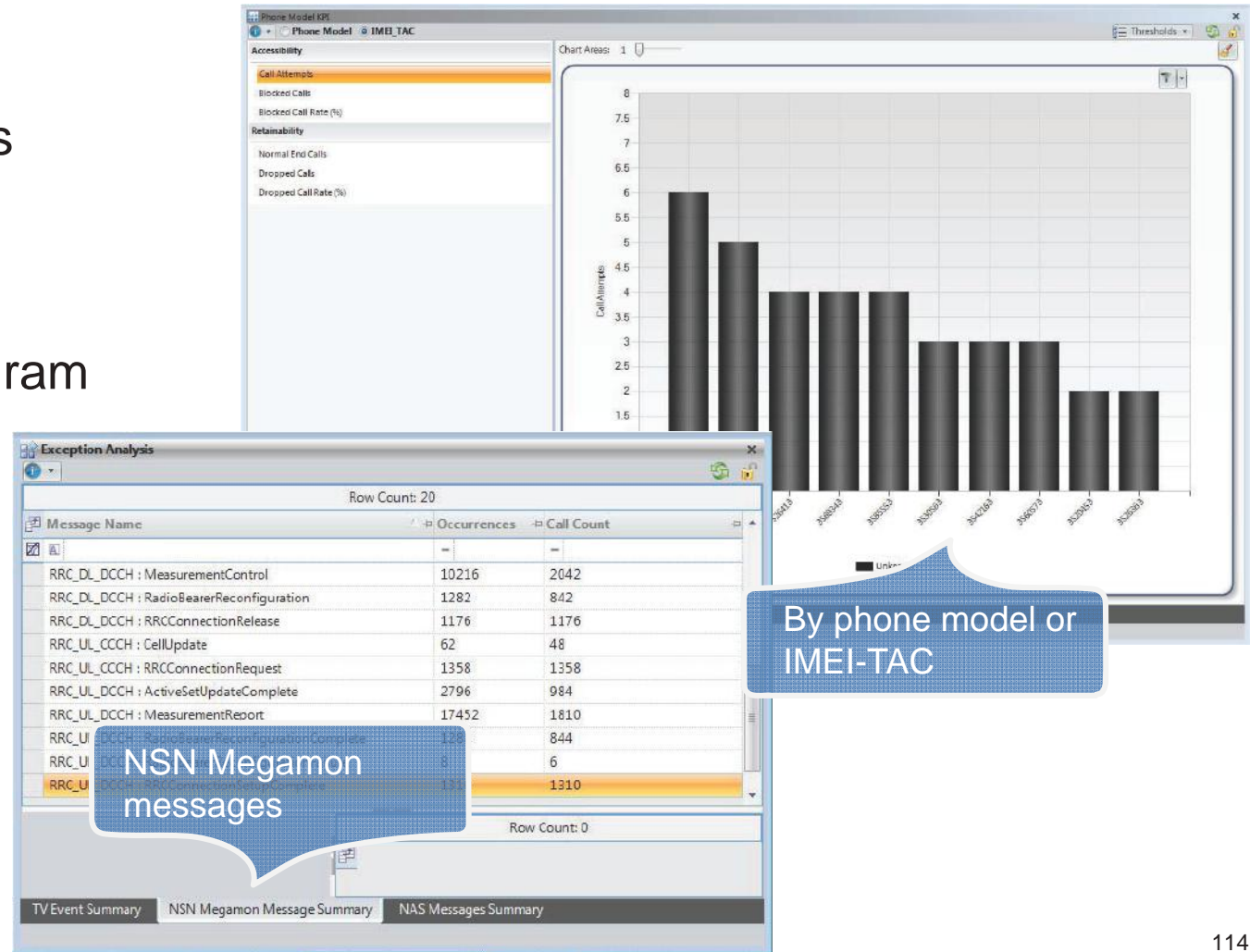
NSN MEGAMON GEO INTERFACE WCDMA MODULE FEATURES



TROUBLESHOOTING AND INVESTIGATION FEATURES (1 OF 2)

- Cell KPI Analysis
- Subscriber KPI Analysis
- Phone Model Analysis
- Overview Analysis
- Sequence Delay Histogram
- Exception Analysis
- Call-by-Call Analysis
- Call Search

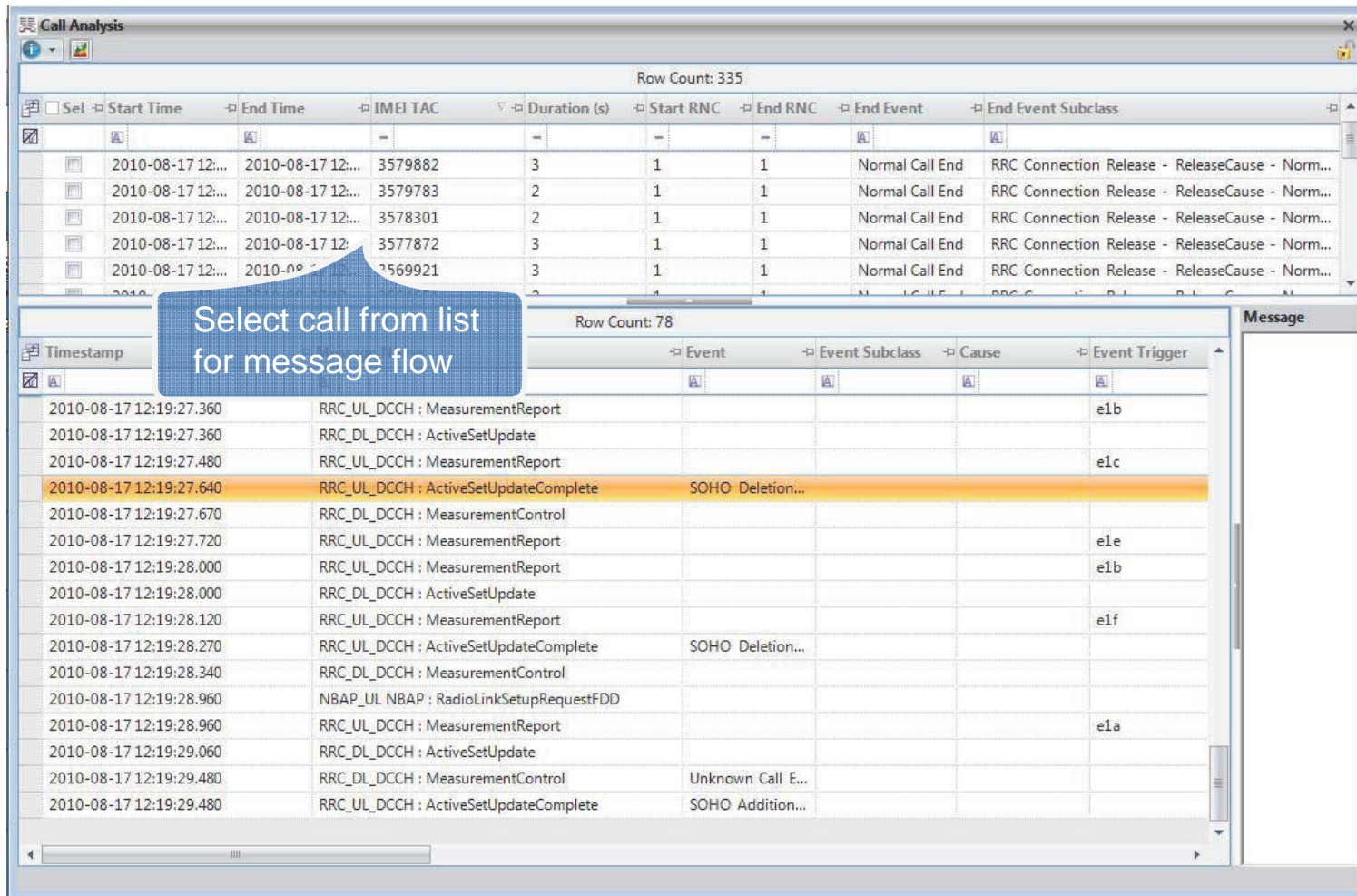
(see 'Common Features' for details on above listed NSN WCDMA features)



The screenshot displays two main windows from the NSN Megamon interface. The top window, titled 'Phone Model KPI', shows a tree view on the left with categories like 'Accessibility' (Call Attempts, Blocked Calls, Blocked Call Rate (%)), 'Retainability' (Normal End Calls, Dropped Calls, Dropped Call Rate (%)), and a bar chart on the right titled 'Chart Areas: 1'. The bar chart shows 'Call Attempts' for various phone models, with the highest value around 6. The bottom window, titled 'Exception Analysis', shows a table with columns for 'Message Name', 'Occurrences', and 'Call Count'. The table lists various RRC messages and their counts. A blue callout box points to the 'RRC_UL' row, which has 1310 occurrences and 1310 call counts. Another blue callout box points to the bar chart, stating 'By phone model or IMEI-TAC'.

Message Name	Occurrences	Call Count
RRC_DL_DCCH : MeasurementControl	10216	2042
RRC_DL_DCCH : RadioBearerReconfiguration	1282	842
RRC_DL_DCCH : RRCConnectionRelease	1176	1176
RRC_UL_CCCH : CellUpdate	62	48
RRC_UL_CCCH : RRCConnectionRequest	1358	1358
RRC_UL_DCCH : ActiveSetUpdateComplete	2796	984
RRC_UL_DCCH : MeasurementReport	17452	1810
RRC_UL_DCCH : RadioBearerReconfigurationComplete	128	844
RRC_UL	1310	1310

TROUBLESHOOTING AND INVESTIGATION FEATURES (2 OF 2)



The screenshot displays the 'Call Analysis' window with two main data tables. The top table, titled 'Row Count: 335', lists call records with columns for Start Time, End Time, IMEI TAC, Duration (s), Start RNC, End RNC, End Event, and End Event Subclass. The bottom table, titled 'Row Count: 78', shows message flow details with columns for Timestamp, Event, Event Subclass, Cause, and Event Trigger. A blue callout box points to a specific row in the message flow table, indicating the selection of a call for further investigation.

Start Time	End Time	IMEI TAC	Duration (s)	Start RNC	End RNC	End Event	End Event Subclass
2010-08-17 12:19:27.360	2010-08-17 12:19:27.360	3579882	3	1	1	Normal Call End	RRC Connection Release - ReleaseCause - Norm...
2010-08-17 12:19:27.360	2010-08-17 12:19:27.360	3579783	2	1	1	Normal Call End	RRC Connection Release - ReleaseCause - Norm...
2010-08-17 12:19:27.480	2010-08-17 12:19:27.480	3578301	2	1	1	Normal Call End	RRC Connection Release - ReleaseCause - Norm...
2010-08-17 12:19:27.640	2010-08-17 12:19:27.640	3577872	3	1	1	Normal Call End	RRC Connection Release - ReleaseCause - Norm...
2010-08-17 12:19:27.670	2010-08-17 12:19:27.670	3569921	3	1	1	Normal Call End	RRC Connection Release - ReleaseCause - Norm...

Timestamp	Event	Event Subclass	Cause	Event Trigger
2010-08-17 12:19:27.360	RRC_UL_DCCH : MeasurementReport			e1b
2010-08-17 12:19:27.360	RRC_DL_DCCH : ActiveSetUpdate			
2010-08-17 12:19:27.480	RRC_UL_DCCH : MeasurementReport			e1c
2010-08-17 12:19:27.640	RRC_UL_DCCH : ActiveSetUpdateComplete	SOHO Deletion...		
2010-08-17 12:19:27.670	RRC_DL_DCCH : MeasurementControl			
2010-08-17 12:19:27.720	RRC_UL_DCCH : MeasurementReport			e1e
2010-08-17 12:19:28.000	RRC_UL_DCCH : MeasurementReport			e1b
2010-08-17 12:19:28.000	RRC_DL_DCCH : ActiveSetUpdate			
2010-08-17 12:19:28.120	RRC_UL_DCCH : MeasurementReport			e1f
2010-08-17 12:19:28.270	RRC_UL_DCCH : ActiveSetUpdateComplete	SOHO Deletion...		
2010-08-17 12:19:28.340	RRC_DL_DCCH : MeasurementControl			
2010-08-17 12:19:28.960	NBAP_UL_NBAP : RadioLinkSetupRequestFDD			
2010-08-17 12:19:28.960	RRC_UL_DCCH : MeasurementReport			e1a
2010-08-17 12:19:29.060	RRC_DL_DCCH : ActiveSetUpdate			
2010-08-17 12:19:29.480	RRC_DL_DCCH : MeasurementControl	Unknown Call E...		
2010-08-17 12:19:29.480	RRC_UL_DCCH : ActiveSetUpdateComplete	SOHO Addition...		

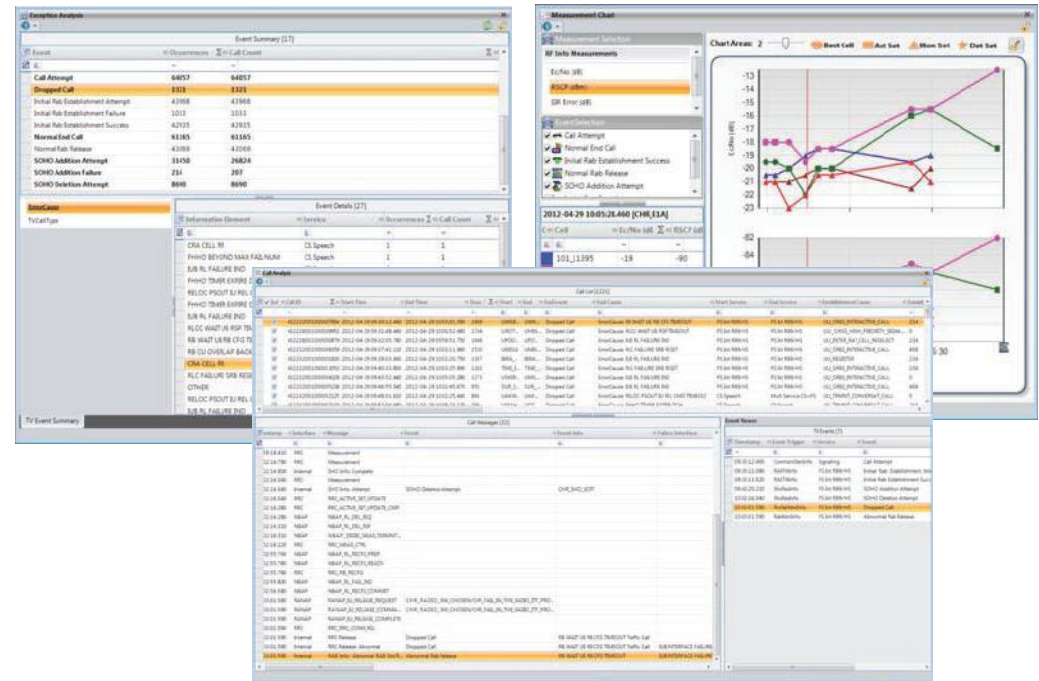
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HUAWEI WCDMA CALL TRACE MODULE FEATURES



TROUBLESHOOTING AND OPTIMIZATION FEATURES

- Cell KPI Analysis, Cluster KPI
- Subscriber KPI & Group Analysis
- Phone Model & Group Analysis
- Call-by-Call Analysis, Search
- Overview Analysis
- Exception Analysis
- Capacity Analysis
- Dropped Call Analyzer
- Coverage Area Optimization (overshooting cells)
- Geolocation and Geo-Analysis based on Google Maps



(see 'Common Features' and 'Ericsson GPEH' section for details on above listed Huawei WCDMA features)

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HUAWEI WCDMA PM COUNTERS MODULE FEATURES



HUAWEI WCDMA PM COUNTERS MODULE

Troubleshoot RNCs

RNC KPIs

RNC Time
Chart

Troubleshoot Cells

Cell KPIs

Capacity Analysis

Cell Time
Chart

Neighbor Cell
Performance

Optimize

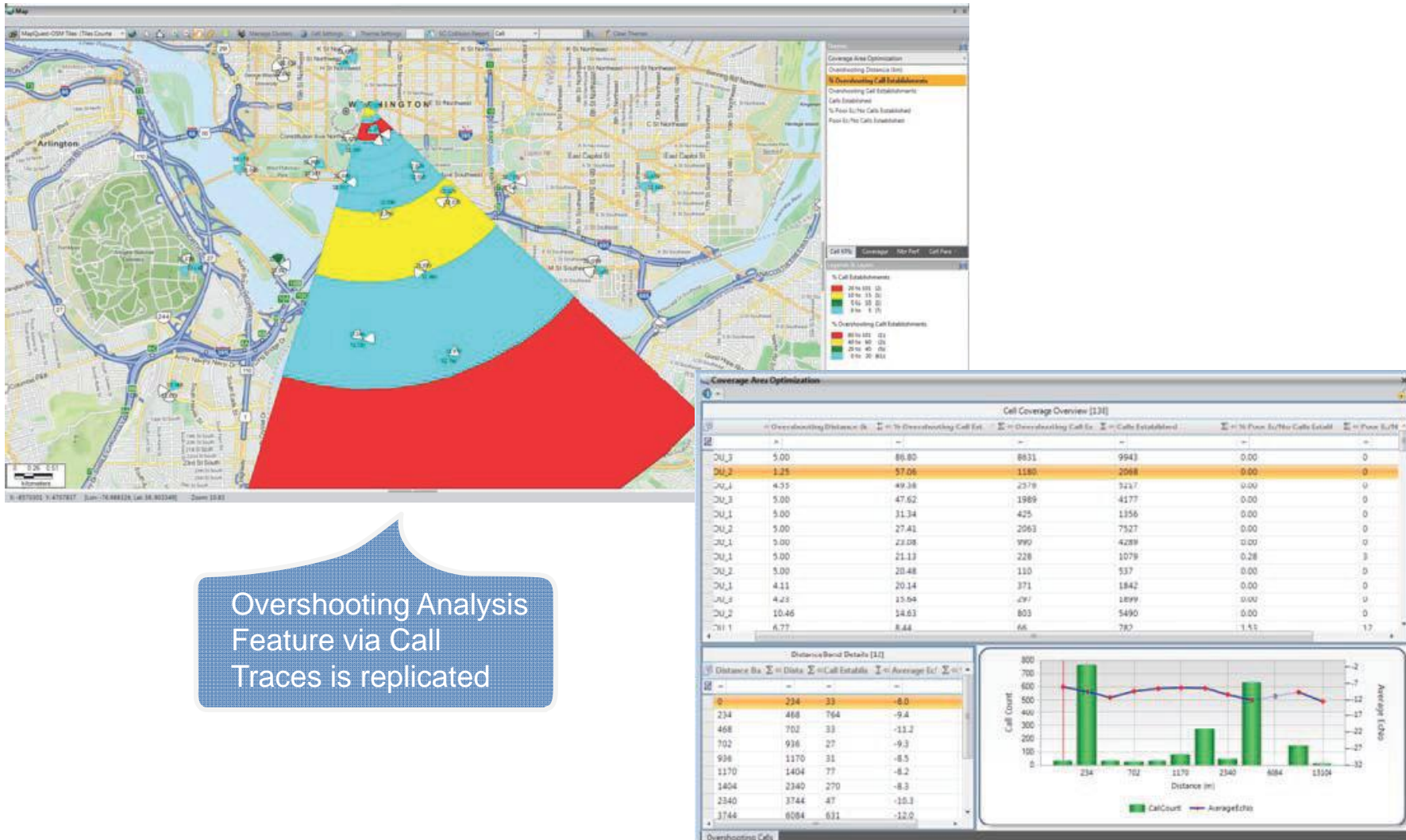
Coverage Area
Optimization
(Overshooting Cells
Method)

DRILLDOWN: CELL KPI, TIME CHART, NEIGHBOR PERFORMANCE

The screenshot displays the 'Cell Performance KPI' software interface, which is used for monitoring and analyzing mobile network performance. The interface is divided into several sections:

- Cell Performance KPI Table:** A table showing KPI groups (Overview, Accessibility, Service Integr..., Retainability, Traffic, Mobility) and their values for various cells. A context menu is open over the table, offering options like 'Send to Cell Time Chart', 'Send to Capacity Time Chart', 'Filter By Selection', etc.
- Chart KPI:** A bar chart titled 'PS HSDPA Thr User Mean (kbit/s)'. It shows the mean throughput for various cells. Statistics provided: Min: 196.84, Max: 925.16, Median: 519.31, Avg: 513.86, Standard Deviation: 167.29.
- Cell Time Chart:** Two line charts showing throughput over time. The top chart is 'PS HSDPA Mean User Throughput' and the bottom is 'PS HSPA Mean User Throughput'. Both charts show throughput in kbit/s and MByte/s over a 30-minute period.
- Neighbor Performance Table:** A table showing performance metrics for a specific cell (SPRP0070U_2) at different time stamps. A context menu is open over this table, offering options like 'Show Neighbor Performance on Map', 'Filter By Selection', etc.
- Map:** A map showing the geographical location of the cell and its neighbors, with performance data overlaid on the map.

ANALYZING OVERSHOOTING CELL COVERAGE



Overshooting Analysis Feature via Call Traces is replicated



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ERICSSON GSM R-PMO MODULE FEATURES

(AVAILABLE ONLY ON DESKTOP PLATFORM OF TEMS DISCOVERY)



BASED ON REAL-TIME PERFORMANCE MONITORING

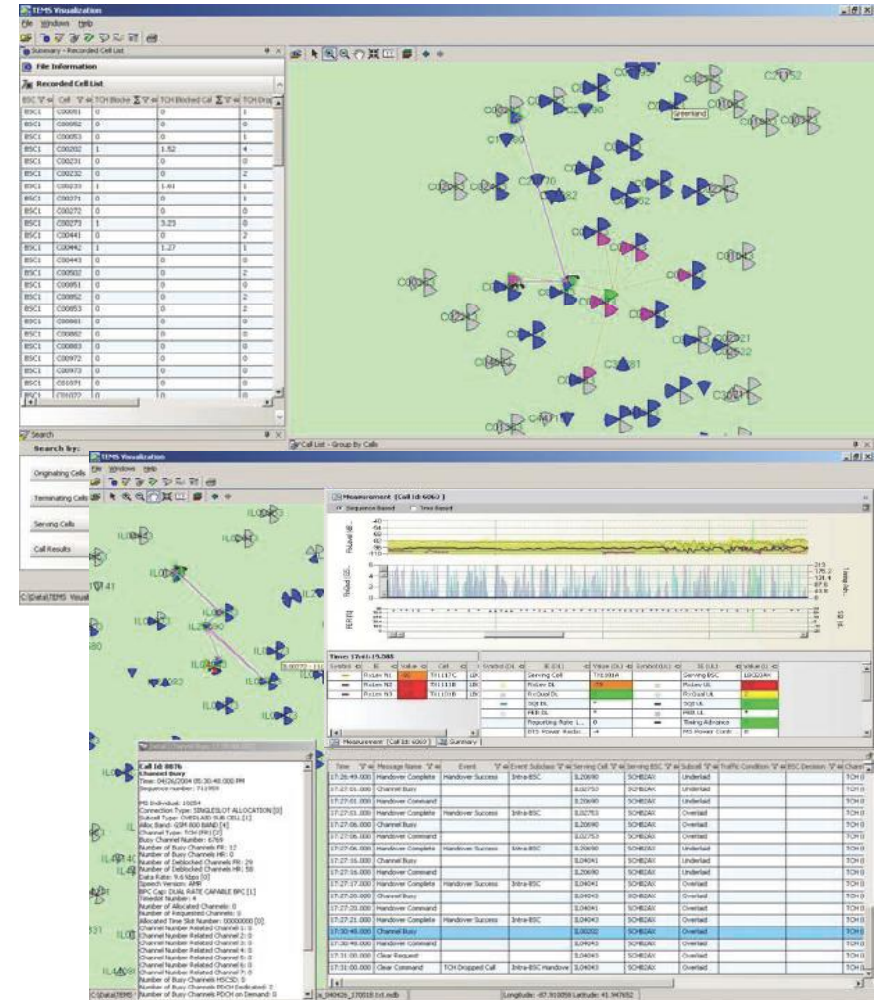
- R-PMO is an optional feature in OSS-RC: collects up to 500 cells per recording
 - Collects event data in real time
 - Displays instant feedback on network performance
 - Instantly shows the effect of troubleshooting efforts
 - Generates large volumes of network data
 - Supported in Desktop Edition: R-PMO & CTR (GSM application), MTR (both applications) for Ericsson GSM 07A – G13B releases
 - Currently Enterprise - Network edition does not support Ericsson GSM R-PMO & CTR formats (Only MTR is supported)
- Gives operators a complete look at network performance, from the statistical level down to individual calls, fast browsing per call and per sector, together with powerful filtering capabilities, to help the user pinpoint problem cells and areas

KEY FEATURES

- Estimated positioning
- Non-air interface dropped call statistics
- Per TX/RX statistics
- Per TX/RX radio performance statistics and charts
- Cell timeslot monitor (including per timeslot statistics)
- Phone list (based on IMEI)
- Distribution and scatter charts for radio measurements
- Histogram for time difference measurements
- EGPRS Performance Analysis
- Pre-defined reports: Cell Performance Report, Database Summary Report (e.g., top 10 cells)

CALL EVENT ANALYZER

- Analyze individual calls in detail
 - Find calls with problems
 - Dropped calls
 - Handover problems
 - Call-flow problems
 - Quality problems
 - Drill down and track
 - Message sequences
 - Handover sequences
 - Radio measurements
 - BSC internal cause codes



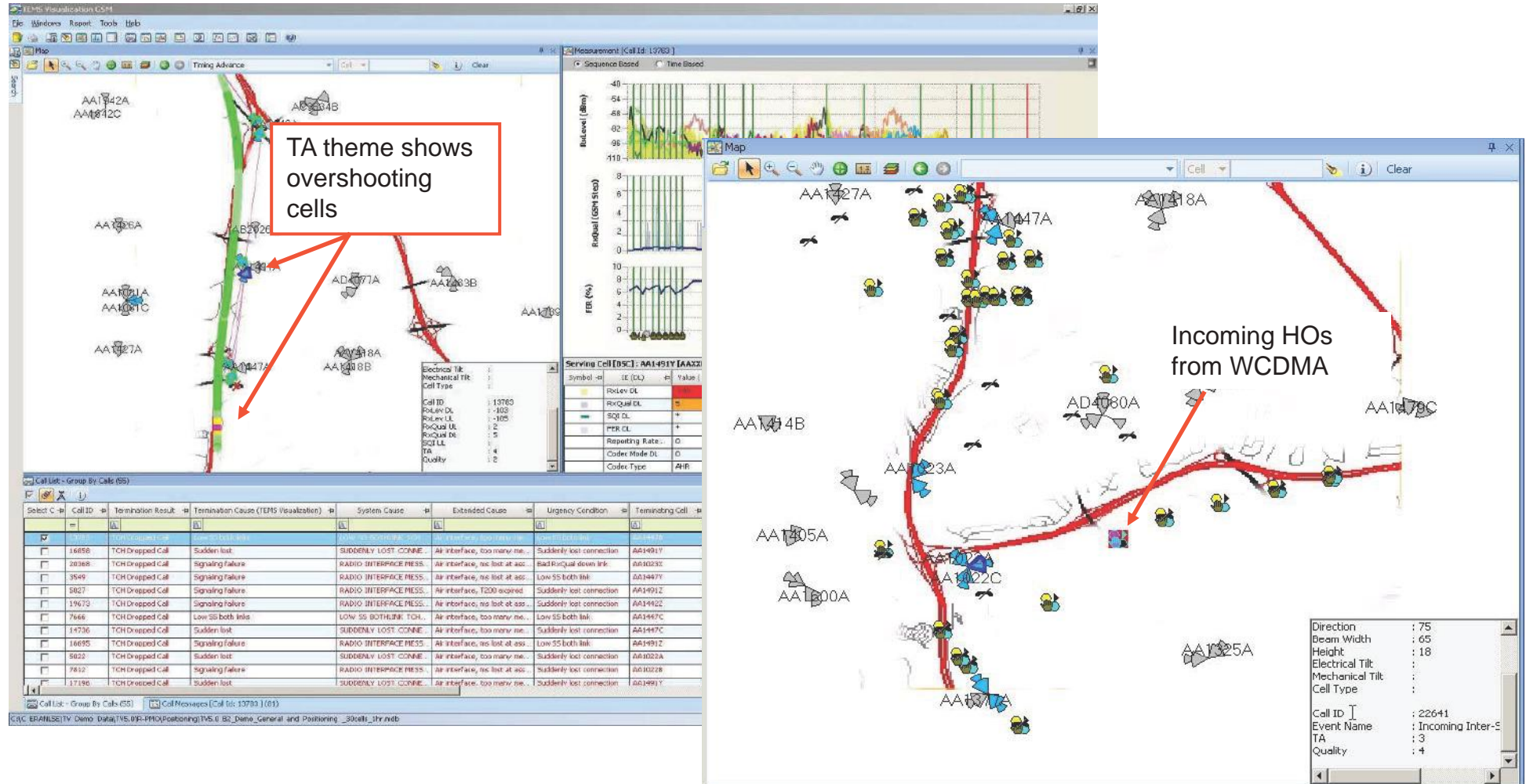
The screenshot displays the Call Event Analyzer interface with several key components:

- Recorded Call List:** A table listing various BSCs and their associated call statistics.
- Network Map:** A geographical map showing the movement of a mobile station between various Base Stations (BTS) and Base Station Controllers (BSC).
- Call Event Log:** A detailed log of call events, including handovers, channel changes, and call completions, with associated timestamps and BSC identifiers.
- Measurement Graphs:** Visual representations of signal strength and other radio parameters over time.
- Call Details Panel:** A panel providing specific information about a selected call, such as the originating and terminating cells, serving cells, and call results.

ESTIMATED POSITIONING (1 OF 2)

- Algorithm based on enhanced CGI and Timing Advance (TA) together with recursive smoothing
- Estimated position for every measurement result
 - Plot RxLev, RxQual, SQI, TA every 0.48 seconds
 - For all of the CS traffic recorded in one cell or selected calls
 - Find locations of poor coverage or overshooting cells
- Estimated position for some TEMS Discovery Network events
 - TCH normal call end, TCH dropped call, incoming HO from UTRAN, etc.
 - Find out if all dropped calls in a cell occur in approximately the same position
 - Find locations of poor WCDMA coverage (where incoming handovers from UTRAN occur)

ESTIMATED POSITIONING (2 OF 2)



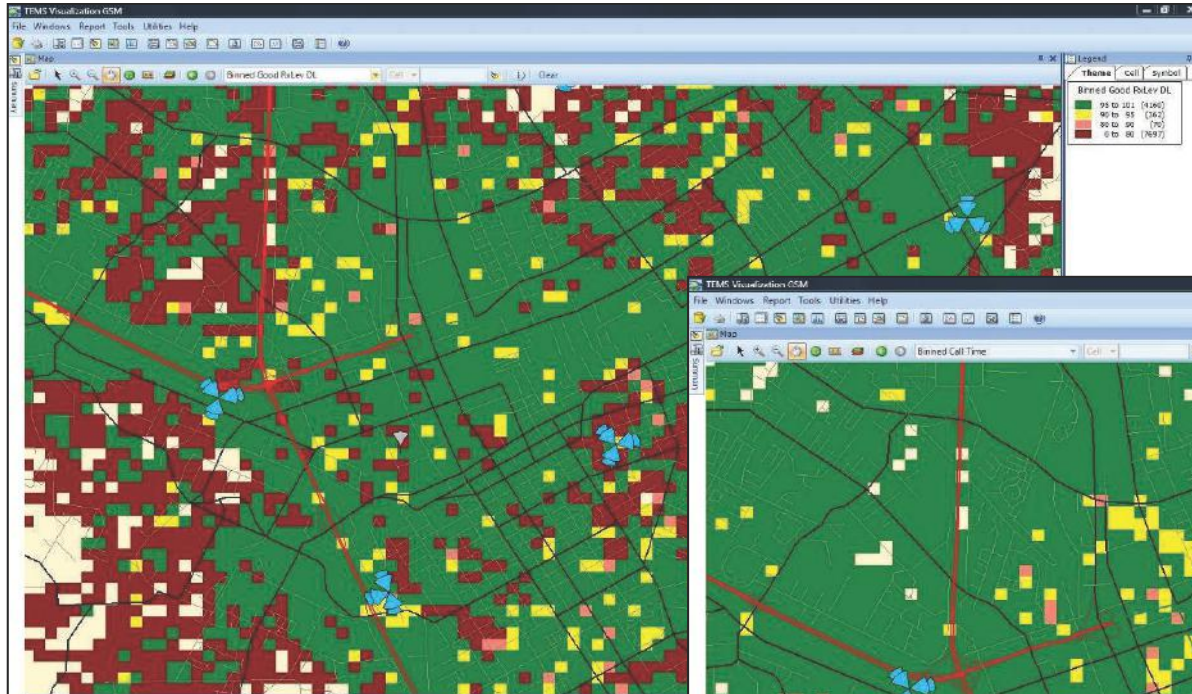
BINNED MAPS (1 OF 3)

- Group estimated position data into geographic bins
- Create binned maps which show the actual:
 - Coverage
 - Quality
 - Uplink speech quality
 - Traffic density
 - Dropped call locations
- Analyze all traffic, including indoor mobile devices, in the recording
- Find locations of poor coverage and high traffic
- Export formats
 - For display in TEMS Discovery Network (MapInfo workspace)
 - For display in Google™ Earth (kml format)



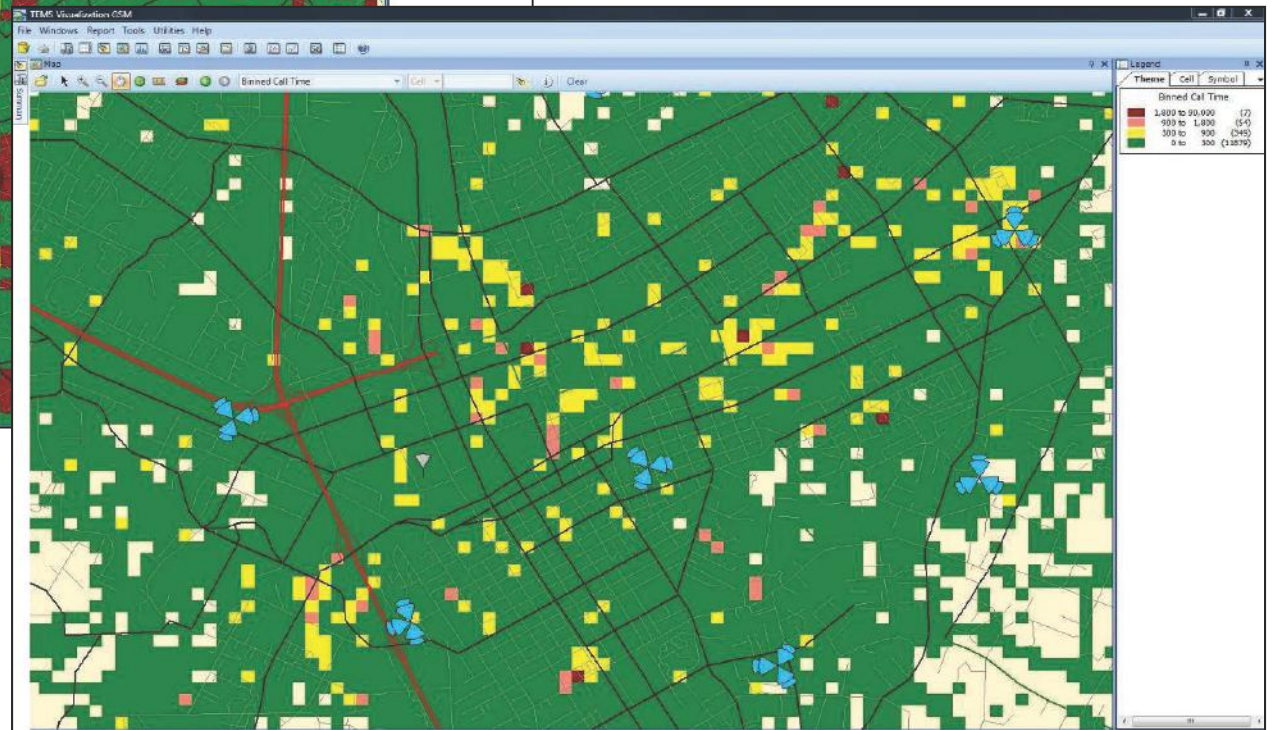
[GSM R-PMO MODULE FEATURE DETAILS]

BINNED MAPS (2 OF 3)



RxLev DL

Call Time



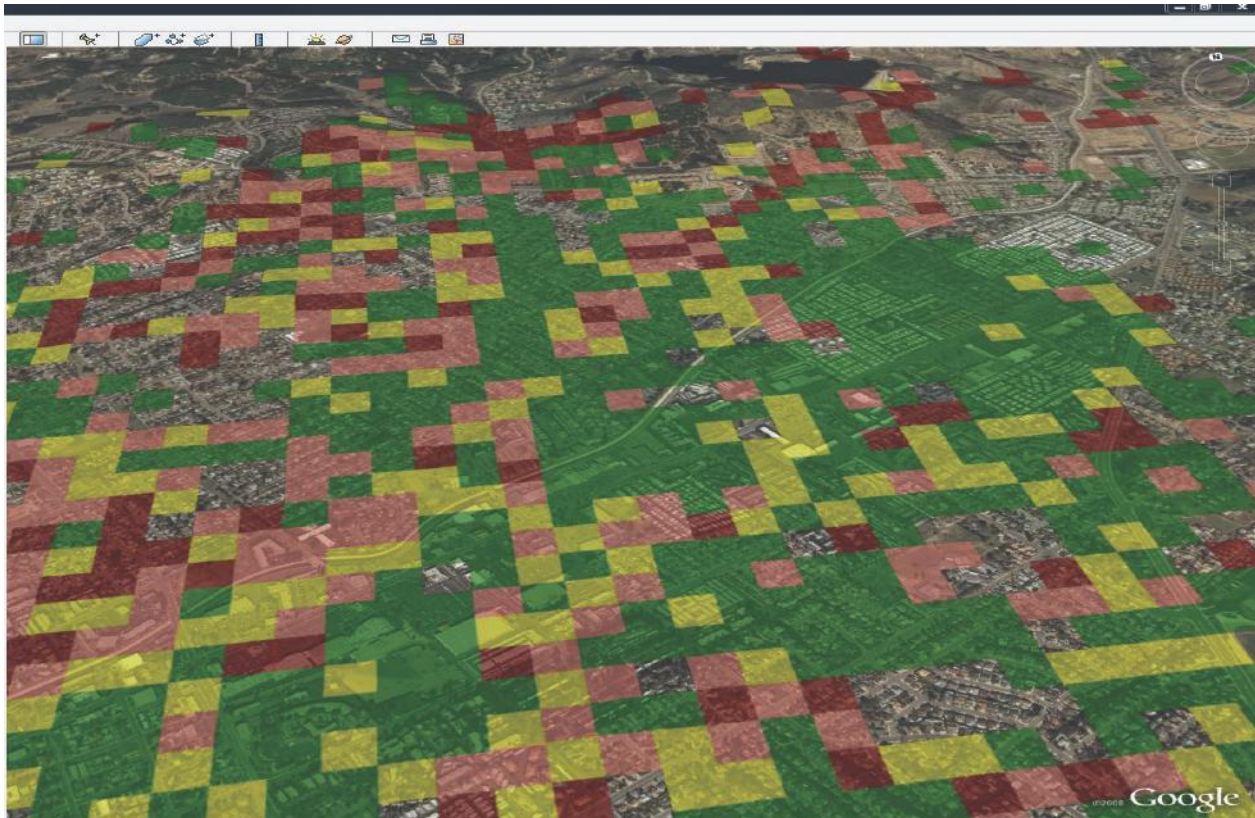
[GSM R-PMO MODULE FEATURE DETAILS]



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BINNED MAPS (3 OF 3)

In Google™ Earth

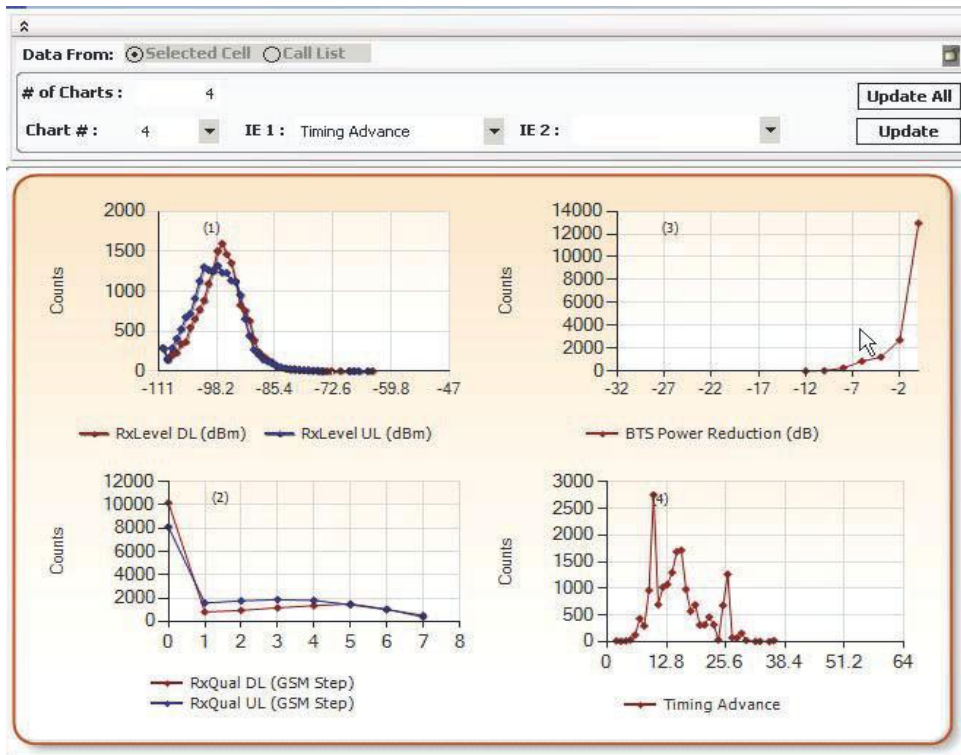


RxLev UL

DISTRIBUTION AND SCATTER

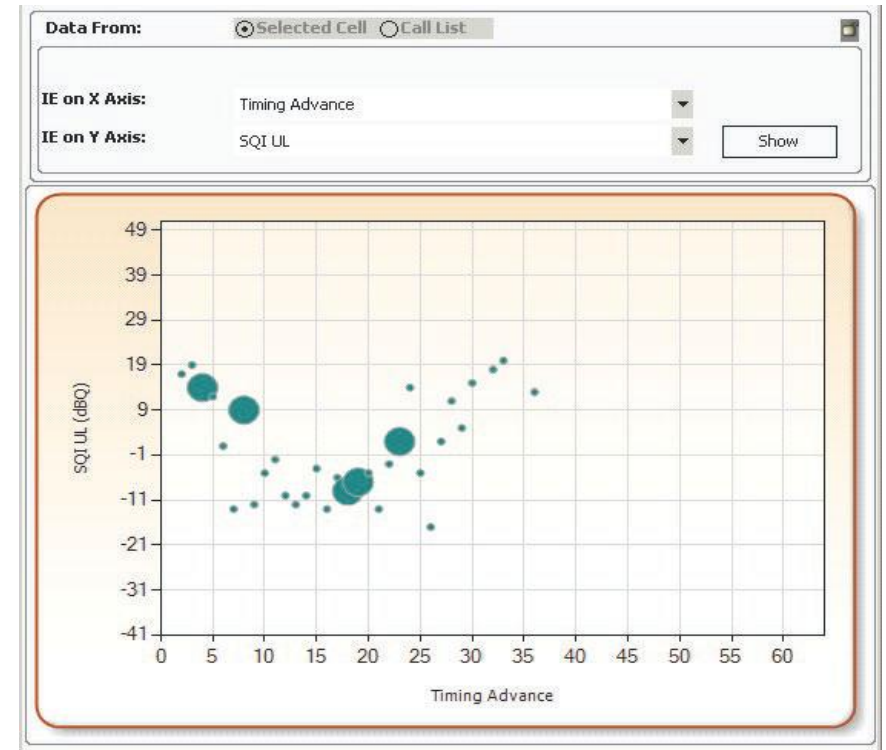
Charts for radio performance evaluation

Distribution chart



Maximum six separate charts

Scatter chart



Size of bubble shows count

FAULTY EQUIPMENT ANALYSIS

Problem	Where Visible
Non-radio problem (e.g., transmission) causing dropped calls	Per-cell statistics for non-air interface dropped calls
Degradation in radio (TX or RX) performance	Per TX and per RX statistics and distribution / scatter charts <ul style="list-style-type: none">▪ Dropped calls and incoming handover failures▪ Pathloss difference▪ RxLev A – RxLev B*▪ RxQual UL and DL Call Event Analyzer for all calls that end on a specific TX or RX

* OSS-RC feature FFAX required

NON-AIR INTERFACE DROPS

Extended drop causes (R12 and later)

AIR INTERFACE T200 EXPIRED
AIR INTERFACE UNSOLICITED DM RESPONSE IN MULTIPLE FRAME ESTABLISHED STATE
AIR INTERFACE SEQUENCE ERROR
AIR INTERFACE EXCESSIVE TA
AIR INTERFACE TOO MANY MEASUREMENT GENERATIONS MISSING
AIR INTERFACE MS LOST
AIR INTERFACE TOO MANY MEASUREMENT GENERATIONS MISSING AND EXCESSIVE TA
AIR INTERFACE CONNECTION FAILURE TO MS AT HANDOVER

A-INTERFACE TERRESTRIAL RESOURCE UNAVAILABLE
A-INTERFACE TERRESTRIAL RESOURCE ALLOCATED
A-INTERFACE SCCP DISCONNECTION INDICATION
A-INTERFACE RESET CIRCUIT FROM MSC
A-INTERFACE TERRESTRIAL RESOURCE FAILURE
HW TRANSCODER RESOURCE FAULT
HW EQUIPMENT FAILURE
HW GS FAULT
ATER TRANSMISSION SETUP FAILURE RESOURCE NOT AVAILABLE
ATER TRANSMISSION SETUP FAILURE TIMEOUT ON ATER
ATER SCCP CONNECTION FAILURE
ATER RESET CIRCUIT FROM MSC
ATER TERRESTRIAL RESOURCE FAILURE
OTHER OPERATIONAL RECOVERY FAILED
OTHER PREEMPTED
OTHER RAB BEING CREATED OR IS ABOUT TO BE DELETED
OTHER RECONFIGURATION OF BTS EQUIPMENT 1
OTHER RECONFIGURATION OF BTS EQUIPMENT 2
OTHER TAS SYSTEM ERROR
OTHER TRXC FAILURE
OTHER TGC CHANGEOVER FAILURE
OTHER NO RADIO RESOURCE AVAILABLE
OTHER
ABIS LAPD LINK DISTURBANCE
ABIS LAPD LINK FAULT
ABIS TRA OR TRANSMISSION DEVICE FAULT
ABIS BTS FAULT REPORT CLASS1
ABIS TRANSMISSION FAULTURE

Traditional drop causes

EXCESSIVE TA
SUDDEN LOST CONNECTION
LOW SS BOTHLINK
LOW SS DOWNLINK
LOW SS UPLINK
BAD RXQUAL BOTHLINK
BAD RXQUAL DOWNLINK
BAD RXQUAL UPLINK
NO URGENCY CONDITION

Non-air interface

PER TX/RX STATISTICS

Stats per TX

TCH drop rate
HO failure rate...

Physical and logical TX

Stats per RX

TCH drop rate
HO failure rate...

Physical RX

Sub Freq/ cell MAIO	HOP	0	1	2	3	4	5	6	7
U 0	Y	23029		22444	22613	20682	22958	20508	23016
Abis Rate:									
U 2	Y	22850		19350	21827	13347	20979	20306	
Abis Rate:									

Sub Freq/ cell MAIO	HOP	0	1	2	3	4	5	6	7
U 0	Y	23029		22444	22613	20682	22958	20508	23016
Abis Rate:									
U 2	Y	22850		19350	21827	13347	20979	20306	
Abis Rate:									

Summary

- Database Summary
- Logfile List
- Recorded Cell List
- Phone List
- TRU List

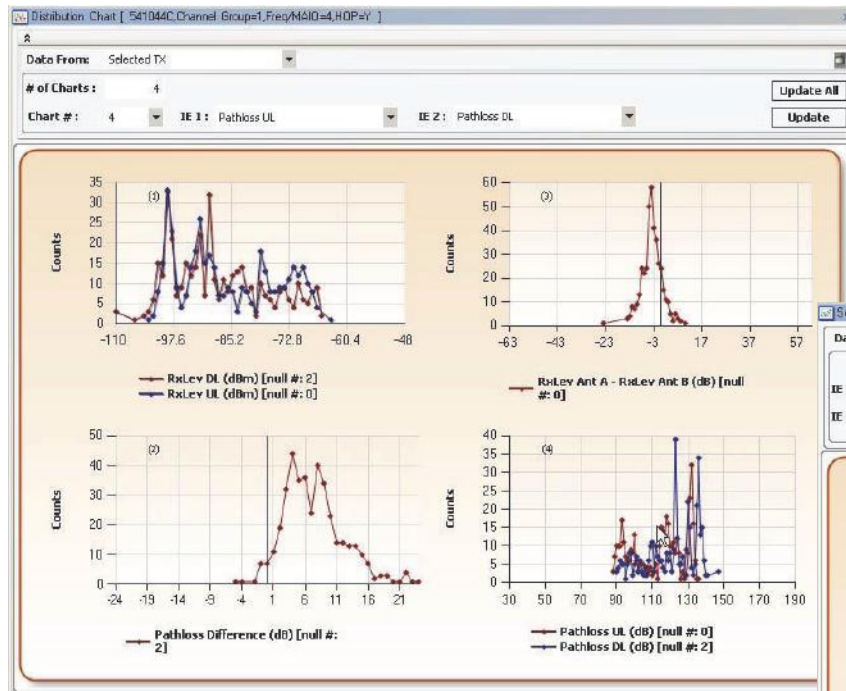
BSC	Cell	Subcell	Cha	Freq	HOP	TCH Dropp	TCH Dro
SDCAB05	FF1491Y	Underlaid	1	2	Y	1.54	4
SDCAB05	FF1498X	Underlaid	1	2	Y	1.63	4
SDCAB05	FF1447Y	Underlaid	0	151	N	60.00	3
SDCAB05	FF1447Z	Underlaid	1	2	Y	1.09	3
SDCAB05	FF1491Z	Underlaid	1	4	Y	1.23	3
SDCAB05	FF1023X	Underlaid	1	0	Y	3.85	2
SDCAB05	FF1498A	Underlaid	1	2	Y	2.60	2
SDCAB05	FF1022Z	Underlaid	1	0	Y	4.76	1
SDCAB05	FF1022B	Underlaid	1	0	Y	1.32	1
SDCAB05	FF1023Y	Underlaid	1	0	Y	12.50	1
SDCAB05	FF1023A	Underlaid	1	0	Y	1.49	1
SDCAB05	FF1081Y	Underlaid	1	2	Y	2.04	1
SDCAB05	FF1377Z	Underlaid	1	0	Y	1.47	1
SDCAB05	FF1377B	Underlaid	1	0	Y	1.30	1
SDCAB05	FF1442Y	Underlaid	1	0	Y	1.47	1
SDCAB05	FF1447Y	Underlaid	1	1	Y	3.03	1

Summary

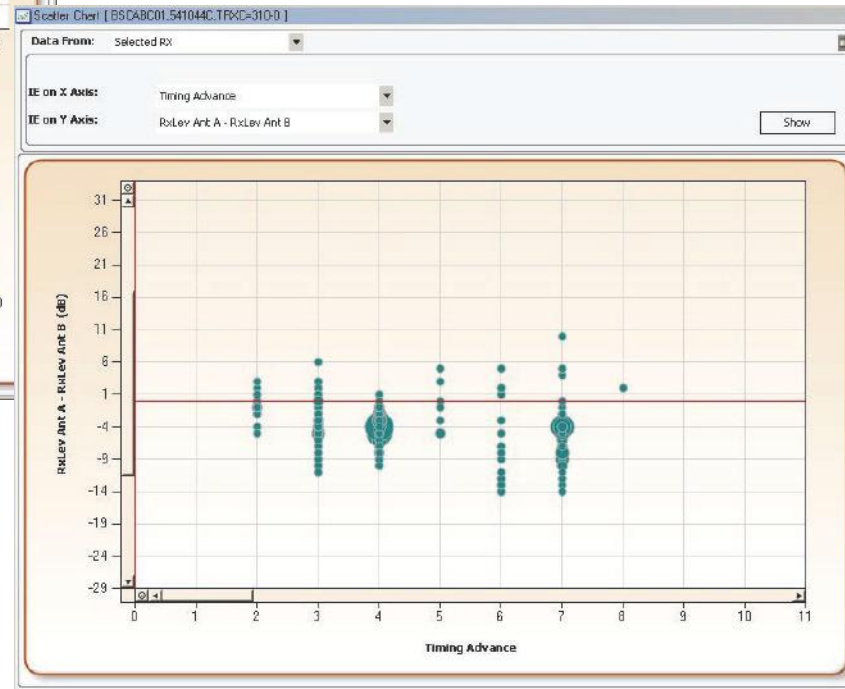
- Database Summary
- Logfile List
- Recorded Cell List
- Phone List
- TRU List

BSC	Cell	TRXC (TG-LTRXC)	Cha	TCH Dropped Calls	TCH Dropped Cal Rate
SDCAB05	FF1498X	19-2	1	4	1.69
SDCAB05	FF1491Y	52-8	1	4	1.54
SDCAB05	FF1447Y	43-3	0	3	100.00
SDCAB05	FF1447Z	44-6	1	3	1.09
SDCAB05	FF1491Z	56-3	1	3	1.23
SDCAB05	FF1498A	21-2	1	2	2.60
SDCAB05	FF1023X	69-1	1	2	3.85
SDCAB05	FF1442Y	11-5	1	1	1.47
SDCAB05	FF1081Y	27-6	1	1	2.04
SDCAB05	FF1447Y	43-7	1	1	0.55
SDCAB05	FF1447Y	43-8	1	1	3.03
SDCAB05	FF1447Z	44-9	1	1	3.33
SDCAB05	FF1447C	47-1	1	1	0.34
SDCAB05	FF1022Z	66-9	1	1	4.76

PER TX/RX CHARTS



Note: TX statistics not valid for baseband hopping



TIMESLOT MONITOR

Analyze channel allocation down to the timeslot level

- Timeslot monitor
 - Make sure your AMR, HR/FR, OL/UL are allocating the resources correctly
 - See how the cell behaves when congested
 - Display ABIS rate

The screenshot displays the 'Timeslot Monitor' window for TX1420A. It features a main grid for channel allocation, a detailed view for a selected timeslot (17:56:19.305), and a statistics panel.

Main Grid (Timeslot Allocation):

Sub Freq	cell	HOP	0	1	2	3	4	5	6	7
U 6	Y		947		857					
Abis Rate:			75	3	9188					
U 3	Y								6495	
Abis Rate:									6603	
U 0	Y		8985	9051	8730	9203		9293	8089	9360
Abis Rate:			FIX	FIX	FIX	FIX		FIX	FIX	FIX
U 9	Y				1957			7724	9310	
Abis Rate:								7049	FIX	
U 12	Y									
Abis Rate:										
U 18	Y									
Abis Rate:										
U 15	Y				9273					
Abis Rate:					FIX					

Detailed View (17:56:19.305):

Channel Type	Unknown	EFR	HR	FR	AMR	Blocked	Abis Rate (K)
YCH SIG	Idle	PDCH (D)	PDCH (D)	HSC D			8 16
							32 64

Statistics:

Sub Freq	cell	HOP	0	1	2	3	4	5	6	7		
U 3	Y		1.90%	2/105	0.0%	0.0%	3.3%	0.0%	0.0%	4.5%	0.0%	0.0%
U 0	Y		0.44%	1/227	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	0.0%	0.0%
U 9	Y		2.00%	1/50	0.0%	0.0%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%
U 12	Y		0.00%	0/22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Channel Allocation Table:

Time	Action	Subcell	Freq/MA
17:56:11.417	Busy	Underlaid	0
17:56:11.577	Busy	Underlaid	6
17:56:12.449	Busy	Underlaid	9
17:56:13.505	Available	Underlaid	6
17:56:14.841	Busy	Underlaid	6
17:56:15.177	Available	Underlaid	15
17:56:15.489	Available	Underlaid	0
17:56:15.921	Busy	Underlaid	0
17:56:15.921	Busy	Underlaid	15
17:56:17.409	Available	Underlaid	0
17:56:18.481	Busy	Underlaid	0
17:56:18.969	Available	Underlaid	9
17:56:19.305	Available	Underlaid	9
17:56:19.929	Busy	Underlaid	0
17:56:20.209	Available	Underlaid	9
17:56:23.625	Available	Underlaid	0
17:56:23.937	Available	Underlaid	0
17:56:24.257	Available	Underlaid	0
17:56:25.041	Busy	Underlaid	0
17:56:26.697	Available	Underlaid	15
17:56:27.817	Busy	Underlaid	0
17:56:28.129	Busy	Underlaid	0
17:56:28.929	Available	Underlaid	6
17:56:31.689	Available	Underlaid	0



TIMESLOT STATISTICS

Analyze channel allocation down to the timeslot level

- Timeslot statistics
 - Identify TRX HW problems
 - Dropped calls/TS
 - Handover failure/TS

The screenshot displays the 'Timeslot Monitor' interface for cell MA10. It shows a grid of channel types (Unknown, EFR, HR, FR, AMR, Blocked) across timeslots 0-7. Below this, a table shows the 'Channel Type' and 'Abis Rate (K)' for each timeslot. The 'Abis Rate (K)' table shows values for 'Unknown' and 'Blocked' channels. The bottom section shows 'Statistics' for 'Dropped Call' and 'Incoming Handover'.

Sub Freq	HOP	0	1	2	3	4	5	6	7
U 6	Y	947	857	9188					
Abis Rate:		FIX	FIX						
U 3	Y				6495				
Abis Rate:					FIX				
U 0	Y	8985	9051	8730	9203	9293	8089	9360	
Abis Rate:		FIX	FIX	FIX	FIX	FIX	FIX	FIX	
U 9	Y		1957		7724	9310			
Abis Rate:					FIX	FIX			
U 12	Y								
Abis Rate:									
U 18	Y								
Abis Rate:									
U 15	Y		9273						
Abis Rate:			FIX						

Channel Type	Unknown	EFR	HR	FR	AMR	Blocked	Abis Rate (K)
Unknown	8	16					8 16
Blocked						32	64

Sub Freq	HOP	0	1	2	3	4	5	6	7
U 3	Y	1.90%	0.0%	0.0%	3.3%	0.0%	0.0%	4.5%	0.0%
		2/105	0	0	1	0	0	1	0
U 0	Y	0.44%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	0.0%
		1/227	0	0	0	0	0	1	0
U 9	Y	2.00%	0.0%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%
		1/50	0	1	0	0	0	0	0
U 12	Y	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		0/22	0	0	0	0	0	0	0

Statistics	Dropped Call	Incoming Handover
Dropped Call		
Incoming Handover		

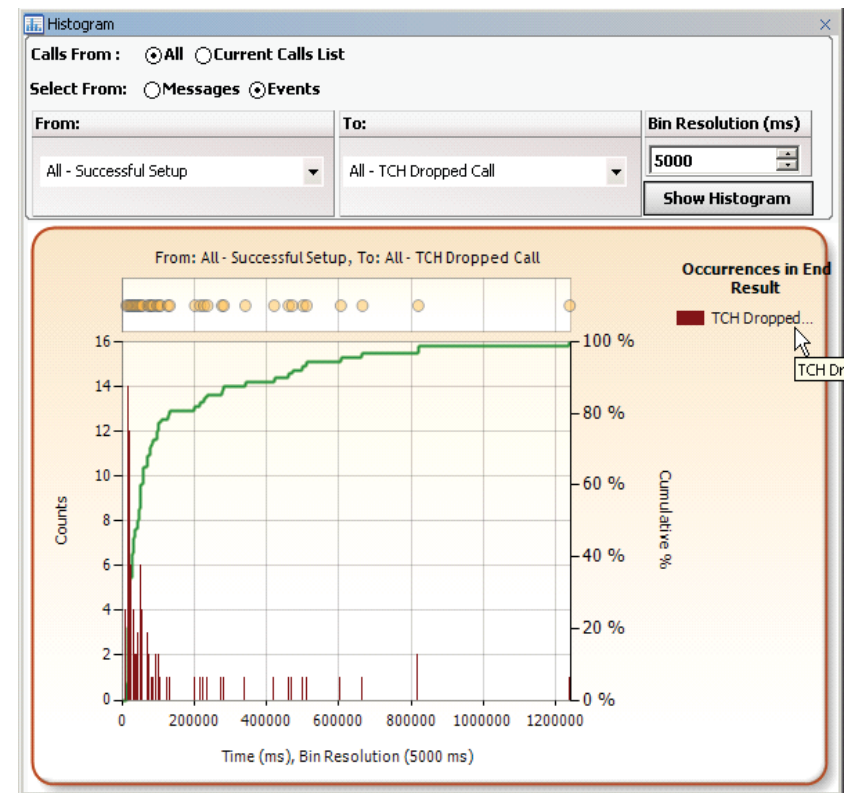
PHONE LIST

- Lookup table translates the IMEI TAC to manufacturer and model
- Summary statistics on IMEI TAC
- Filtering on IMEI TAC



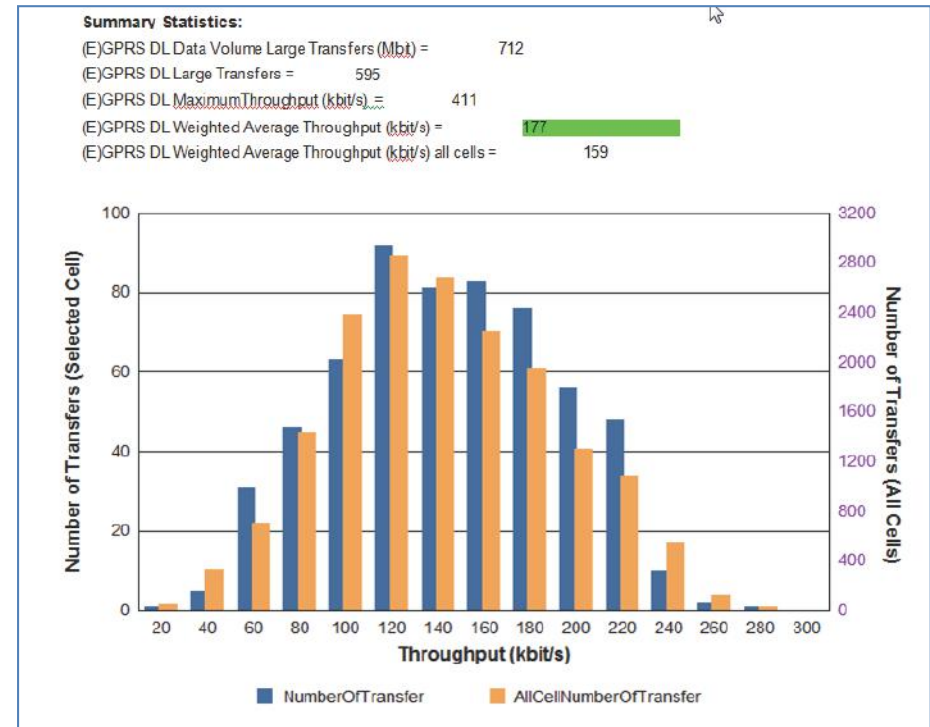
HISTOGRAM

- Chart for time difference calculation
- Analyze the time difference between any two events or messages in the database
 - Average time between handovers?
 - Call setup time?
- Stacked bars based on Call End Result
- Send to Call List



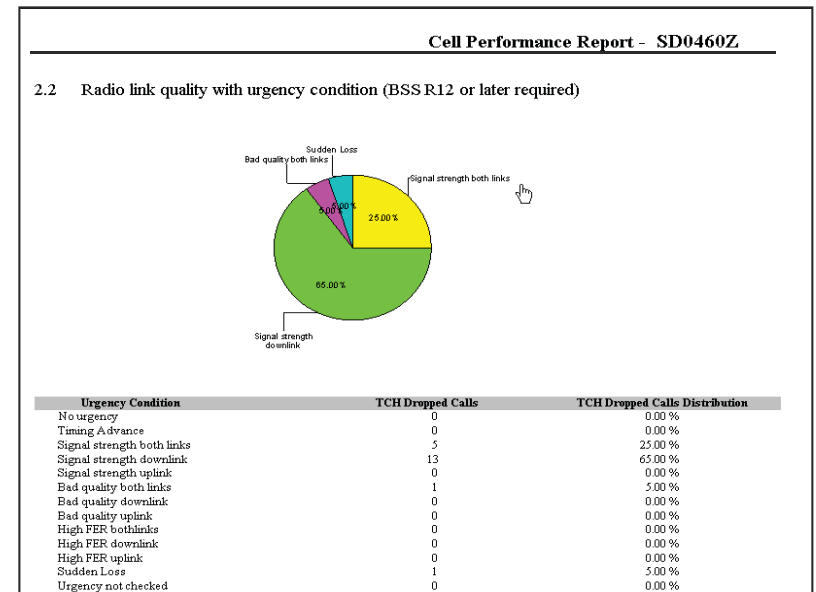
EGPRS AND GPRS PERFORMANCE ANALYSIS

- Summary Statistics per cell for EGPRS and GPRS Performance
- Analyze poor throughput, latency and buffer discard issues



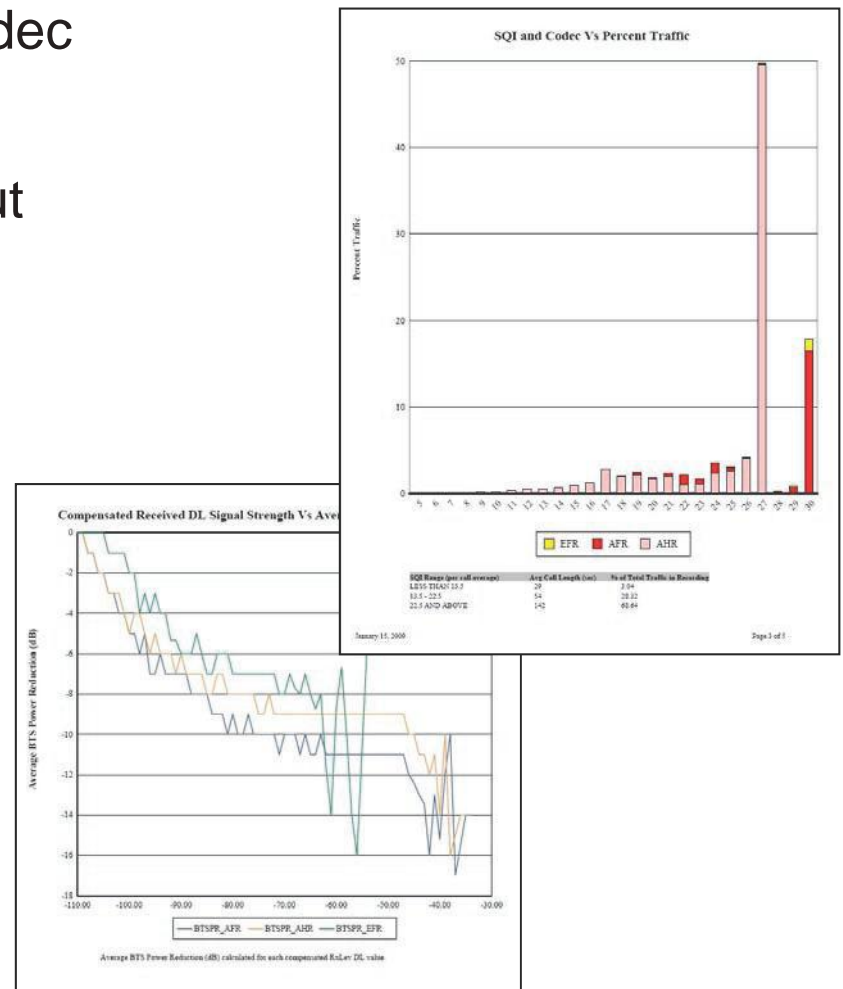
CELL PERFORMANCE REPORT

- Coverage and interference analysis
- Equipment problem analysis
- Drops with same serving cell sequence analysis



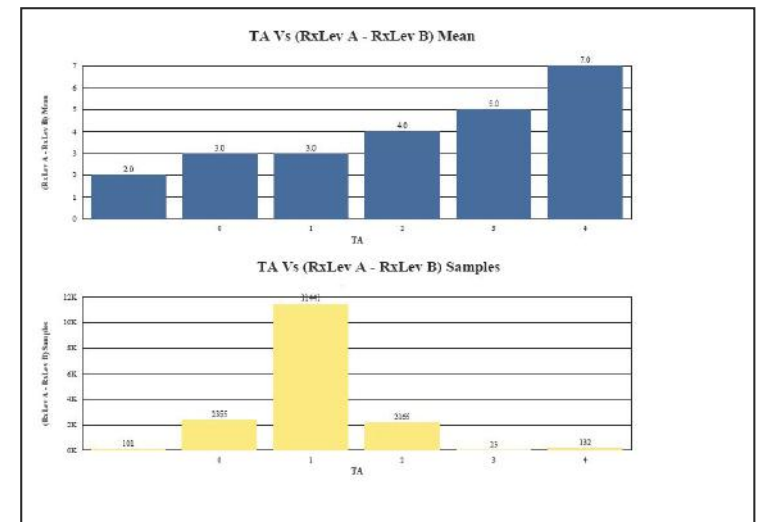
SPEECH QUALITY REPORT

- Analyze speech quality performance per codec for the whole database with AMR codec
- Estimate speech quality performance without AMR codec
- Analyze impact of BTS power control



FFAX REPORT

- Find problems in antennas and feeder branches
- Analysis of differences in signal strength measured simultaneously on the different receive branches
- Reports on different levels
 - Cell level summary (No. of samples, Mean, Std. Dev.)
 - RX level (No. of samples, Mean, Std. Dev)
 - Cell level at each TA value (No. of samples, Mean)
- Indicates vertical misalignment of antennas if difference increases or decreases with TA



Requires FFAX feature to be active in OSS-RC



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CONCLUSION



CONCLUSION

- TEMS Discovery Network (desktop edition) is primarily based on the event data from network nodes.
- Call-level data for large numbers of subscribers provides powerful troubleshooting and optimization capabilities.
- TEMS Discovery Enterprise (Network Module) takes this to the next level by:
 - Handling increased data volumes with a centralized, scalable server-client architecture
 - Automating data processing, monitoring and analysis: 365 x 24 x 7
 - Interfaces with desktop variants for troubleshooting and optimization
- More cost-efficient, subscriber-centric, operationally effective, and provides more-detailed information than passive probes and other traditional optimization methods to drastically improve KPIs and reduce churn for complex, multivendor, multitechnology networks of today

TEMS Discovery Network – The Solution for Today's Challenges!



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Against the background of these uncertainties readers should not rely on forward-looking statements. Ascom assumes no responsibility to update forward-looking statements or adapt them to future events or developments.



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По вопросам приобретения программных продуктов Ascom и сопровождения решений обращайтесь к сотрудникам 2test по телефону: +7 495 215-57-17 или по электронной почте: info@2test.ru.

