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# TEMS™ INVESTIGATION 16.0

## Commercial Presentation



# PRODUCT OVERVIEW – CONCEPT



## MORE VALUE FOR MONEY

- Software subscription included in the offering
  - Get all TEMS Investigation 16.x releases
  - Frequent updates with new features and functionality
- The update service facilitates efficient administration processes
  - Automatic download from TEMS Investigation
  - Minimize administration work and waiting time
  - Quick access to the latest features
- Be updated, wherever you are
  - Requires an internet connection



Fast access to new features and functionality

## WHY ASCOM TEMS?

- Ascom has been involved in the **first successful commercial deployments of new mobile technologies for over 20 years**, from 2G to LTE, and now LTE Advanced, performing network tests as subscribers will perceive it
- Our experience in early deployments is built into the **industry leading TEMS™ portfolio**, made available to over **650 customers in 170 countries** to provide accurate, actionable results
- **Our network of vendor partnerships and access to mobile devices is the widest in the industry**, ensuring the best possible support for your specific needs
- The TEMS portfolio enables **consistency across testing, monitoring, analysis and competitive benchmarking requirements**, over the complete lifecycle of rollout and optimization

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## TEMS INVESTIGATION 16.0

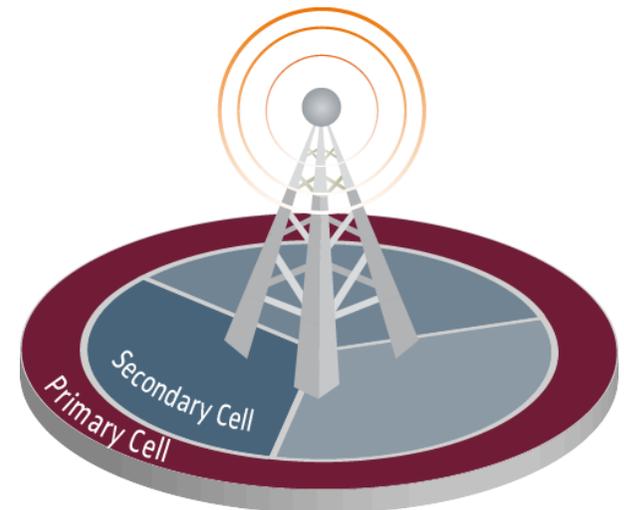
### Thought Leadership

- Carrier Aggregation
- VoLTE
- TD-LTE



# INTRODUCTION TO CARRIER AGGREGATION

- Carrier Aggregation is the first LTE Advanced technology expected to see wide deployment, enabling higher peak data rates and better utilization of fragmented spectrum
- Operators need to capitalize on LTE Advanced in a timely manner, addressing technical issues such as complex cell structures
- Ascom participated in the first commercial Carrier Aggregation deployments, working with the first infrastructure vendor to bring the technology to market



# USE CASES FOR TEMS INVESTIGATION

- **Deployment – Per Carrier**
  - Verify important parameters for primary and secondary cells to ensure successful Carrier Aggregation deployment
- **Optimization**
  - Identify coverage holes, and optimize spectrum resources to maintain smooth network operation
- **User Experience**
  - Troubleshoot end-to-end performance issues to monitor and improve user QoE
- **Signaling**
  - Check downlink and uplink signal strength for optimal coverage

Carrier Aggregation is happening NOW

# USE CASE: DEPLOYMENT – PER CARRIER

## ■ Strategy

- Antenna verification
- Parameter Setting
- eNB Installation

## ■ Objectives

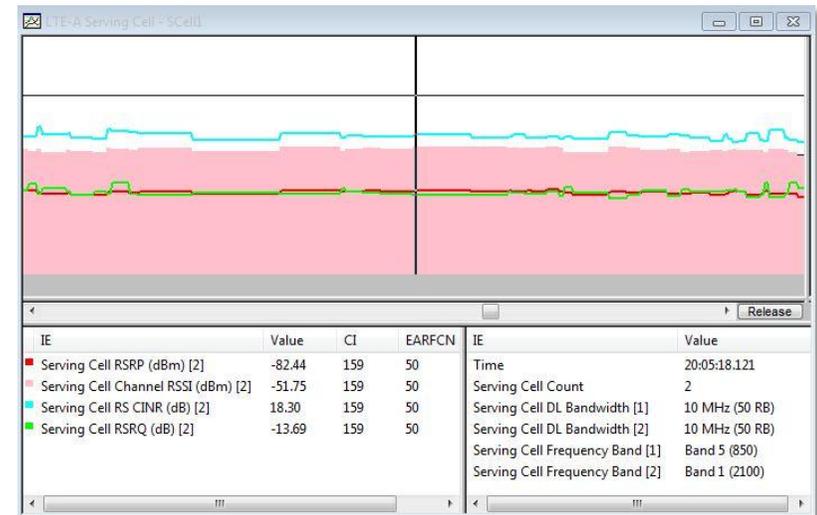
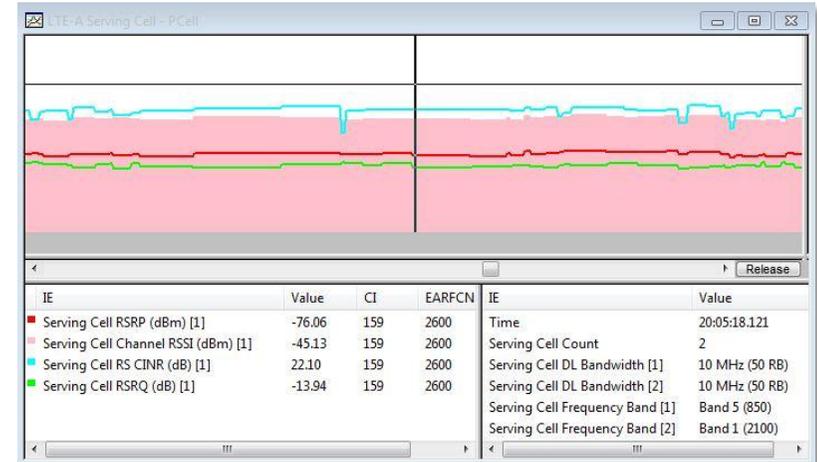
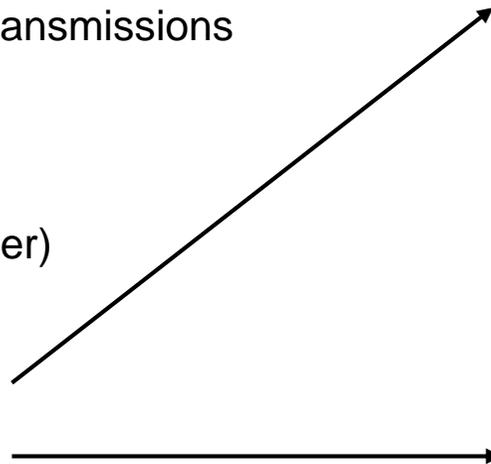
- Check coverage for both cells
- Deliver wide bandwidth transmissions
- Reduce interference

## ■ Realization

- DEPLOYMENT (per carrier)

**PCELL**  
Coverage  
Pathloss  
Timing  
Throughput

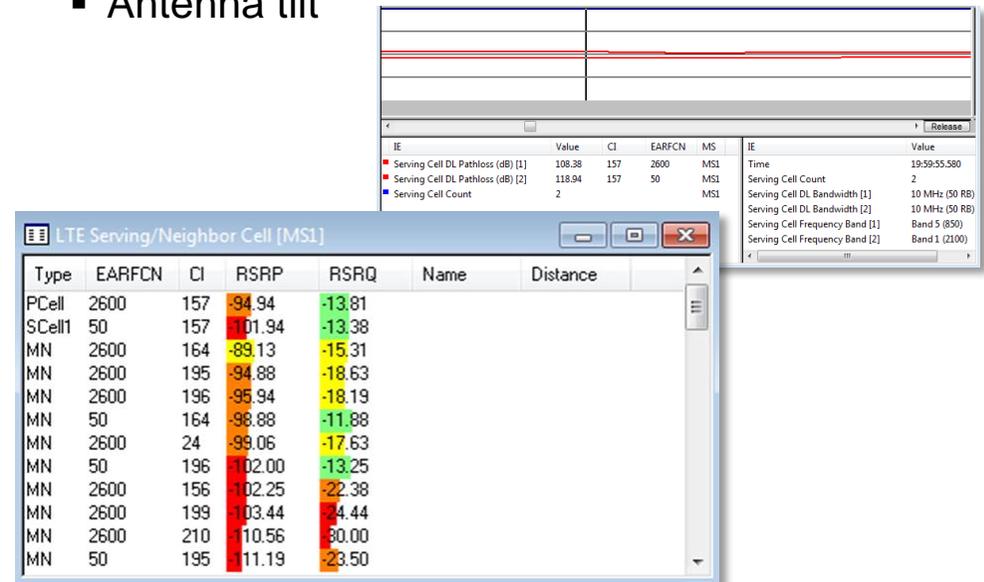
**SCELL**  
Coverage  
Pathloss  
Timing  
Throughput



# USE CASE: OPTIMIZATION

- Strategy
  - Capacity / coverage
  - Spectrum utilization
  - Cell border
- Objectives
  - Manage network coverage
  - Monitor site performance
  - Maintain data throughput
  - Control interference
  - Ensure better handover
  - Maintain peak data rate close to the cell borders

- Realization
  - Coverage / Pathloss
  - Neighbor measurements
  - Throughput
  - Inter-site performance
  - Antenna tilt



# USE CASE: USER EXPERIENCE

## ■ Strategy

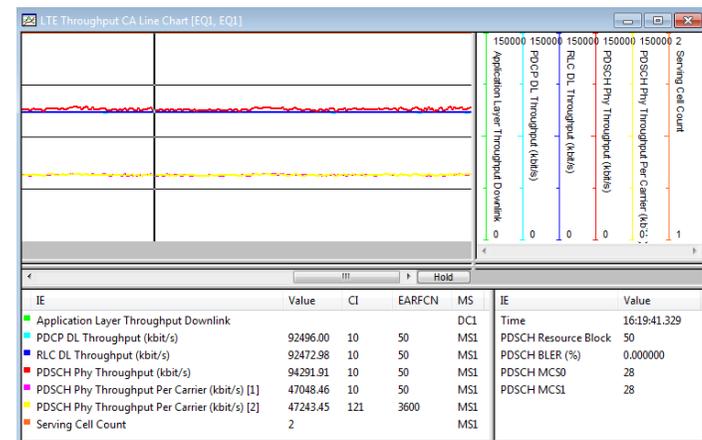
- Performance
- Service availability
- Validation

## ■ Objectives

- Troubleshoot end-to-end performance issues
- Ensure timely data delivery
- Monitor and improve user-perceived Quality of Experience

## ■ Realization

- Application Layer Throughput
  - Cat 4 and higher performance
- Troubleshooting
  - Throughput
    - Physical Layer
    - RLC Layer
    - PDCP Layer



# USE CASE: SIGNALING

## ■ Strategy

- Feature studies
- RAN/NAS procedures

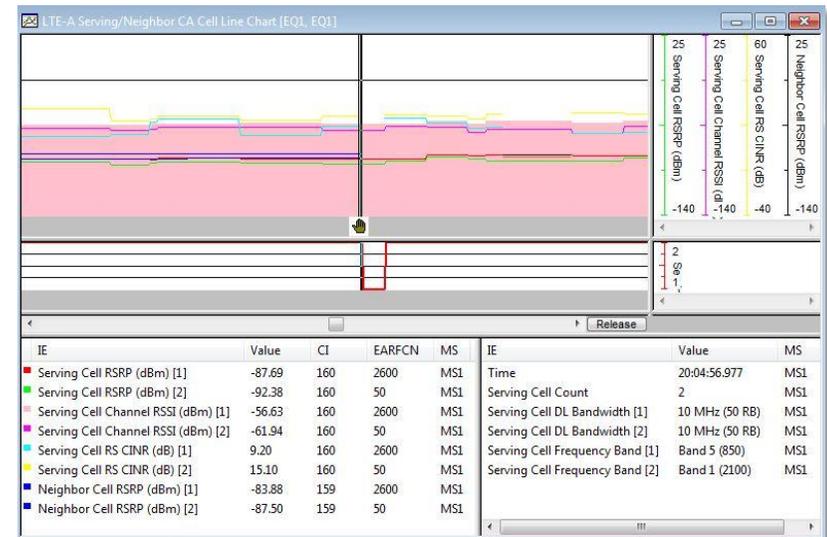
## ■ Objectives

- Test UE performance
- Ensure power and modulation quality
- Check downlink and uplink signal strength for optimal coverage

## ■ Realization

- CA Assignment
- UE Capabilities
- Events
- Handover mechanisms

20:04:56.895	MS1	ERRC	↑ Measurement Report (UL-DCCH)
20:04:56.947	MS1	ERRC	↕ RRC Connection Reconfiguration (DL-DCCH)
20:04:56.966	MS1	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)
20:04:56.998	MS1	ERRC	↕ System Information Block Type1 (DL-BCCH-SCH)
20:04:57.001	MS1	ERRC	↕ RRC Connection Reconfiguration (DL-DCCH)
20:04:57.002	MS1	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)



## INTRODUCTION TO VOLTE

- VoLTE is widely accepted as the preferred long-term solution for voice and messaging over LTE, offering significant advantages in performance and cost efficiency, and a superior option to compete with over-the-top providers.
- **Ascom is the leader in support for VoLTE deployments**, involved in all current rollout efforts, and offers a complete field-proven solution providing data visibility into the entire VoLTE network chain, across the IP domain, cellular RAN and IMS client.
- In addition to TEMS Investigation Ascom also offers a complete range of solutions to **test, monitor, benchmark, and analyze Circuit Switched Fall Back (CSFB)**.

# SUCCESS STORY

A major US mobile operator is partnering with Ascom to roll out VoLTE services rapidly across its 500+ LTE markets.

▪ **Challenge:**

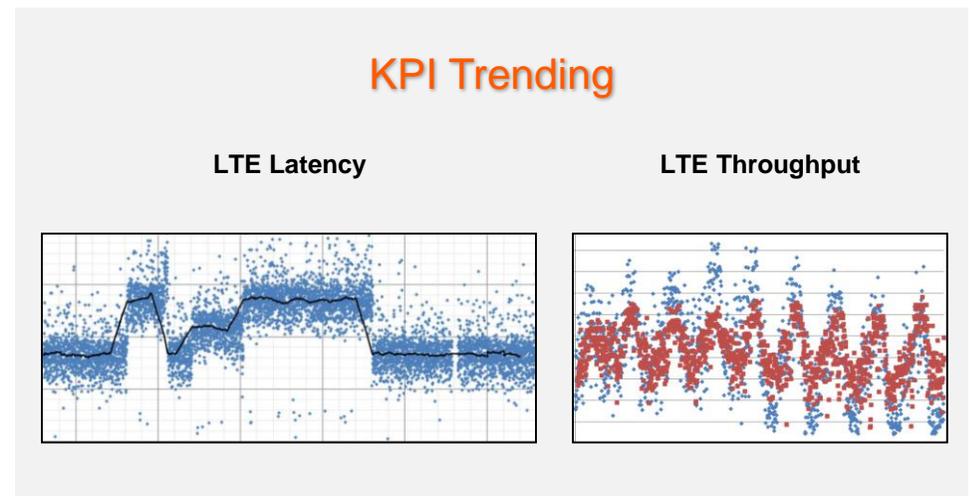
- Secure a smooth VoLTE network build out, transitioning voice service without subscriber or revenue impact
- Ensure interoperability with the legacy CDMA network
- Maintain target KPIs for voice quality, accessibility, and retainability

- Ascom provided a complete lifecycle solution to test, monitor, and report voice quality and service performance in real-time (anywhere) and 24x7 live (all the time) via various network probes:

- **Drive testing:** VoLTE service performance; RAN optimization; Launch readiness and Benchmarking
- **End-to-end active monitoring:** QoE trending; Node performance; Call types and “distance”

▪ **Result:**

- Successful identification and troubleshooting of network issues before launch
- A holistic view of VoLTE performance across network elements as they rolled out
- Tracking of end-to-end KPIs to ensure continuous maintenance of voice call quality



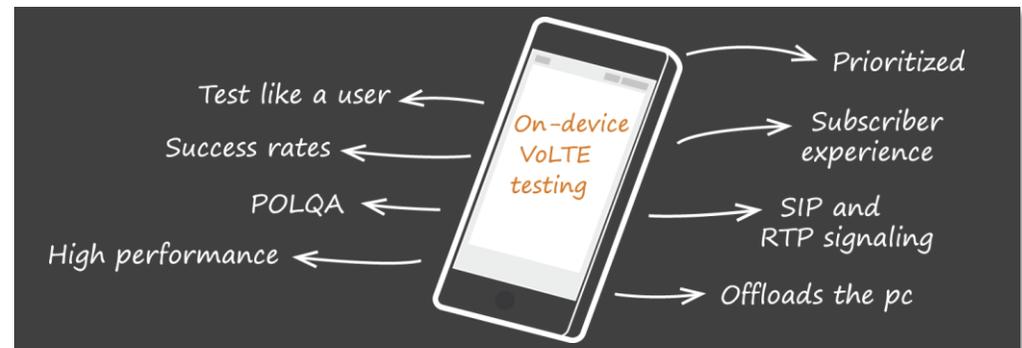
## USE CASES

- On-device Testing
  - Test VoLTE as a user via on-device VoLTE clients
- SIP Session Performance
  - Evaluate VoLTE performance KPIs, including SIP
- Protocol Stack Optimization
  - Drill down to each layer of the protocol stack and examine the parameter settings
- Voice Quality Testing
  - Measure Quality of Experience with P.OLQA
- VoLTE KPI Analysis & reporting
  - Provide a holistic view on the VoLTE network performance
- CSFB Monitoring
  - Monitor and analyze CSFB call quality down to the individual subscriber level

# ON-DEVICE TESTING

Ascom's flexible VoLTE solution includes a VoLTE client (On-Device Measurement Module) inside the terminal, capturing the true end-user experience.

- VoLTE call performance & Quality call control (MTSI/VoLTE client): dial/answer/hang-up, SIP registration, audio inject
- Analyze/troubleshoot: IP KPIs correlated with RAN L3 and RF KPIs
- Voice call quality: MOS (POLQA), client performance



# SIP SESSION PERFORMANCE

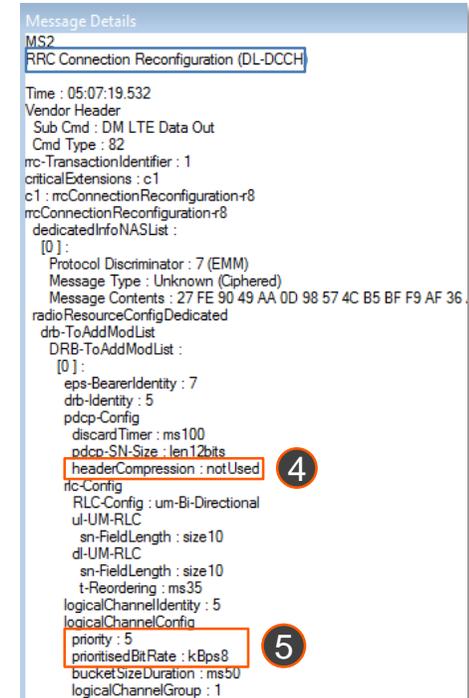
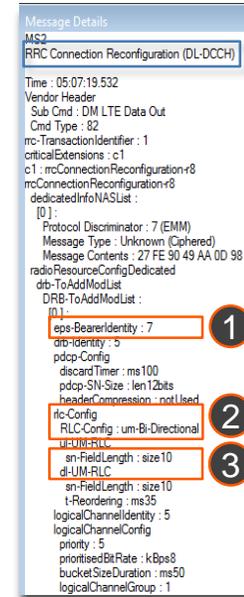
- VoLTE call quality is dependent on the LTE network handling high volume of concurrent “Session Initiation Protocol” (SIP) sessions per second.
- Ascom provides a simple and intuitive VoLTE performance evaluation reporting on SIP sessions and other important VoLTE KPIs:
  - Accessibility, Retainability
  - SIP signaling/IMS registration (SIP registration statistics)
  - LTE RRC connection statistics
  - LTE HO statistics
  - QCI verification
  - GBR DL/UL

This chart shows a performance evaluation of SIP transactions.  
 1-3): The highlighted SIP messages indicate media sessions established between user agents.

Time	Eq.	Protocol	Name
05:07:18.839	DC2		↑ SIP INVITE Request
05:07:18.889	MS2	ERRC	↑ RRC Connection Request (UL-CCCH)
05:07:18.909	MS2	ERRC	↓ RRC Connection Setup (DL-CCCH)
05:07:18.913	MS2	ERRC	↑ RRC Connection Setup Complete (UL-DCCH)
05:07:18.915	MS2	EMM	↑ Service Request
05:07:18.979	MS2	ERRC	↓ Security Mode Command (DL-DCCH)
05:07:18.980	MS2	ERRC	↑ Security Mode Complete (UL-DCCH)
05:07:19.046	MS2	ERRC	↓ RRC Connection Reconfiguration (DL-DCCH)
05:07:19.047	MS2	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)
05:07:19.151	DC2		↓ SIP INVITE Response
05:07:19.484	DC2		↓ SIP INVITE Response
05:07:19.518	DC2		↑ SIP PRACK Request
05:07:19.532	MS2	ERRC	↓ RRC Connection Reconfiguration (DL-DCCH)
05:07:19.532	MS2	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)
05:07:19.532	MS2	ESM	↓ Activate Dedicated EPS Bearer Context Request (DL-DCCH)
05:07:19.534	MS2	ESM	↑ Activate Dedicated EPS Bearer Context Acceptance (UL-DCCH)
05:07:19.535	MS2	ERRC	↑ UL Information Transfer (UL-DCCH)
05:07:19.721	DC2		↓ SIP PRACK Response
05:07:19.744	DC2		↑ SIP UPDATE Request
05:07:19.994	DC2		↓ SIP UPDATE Response
05:07:22.763	MS1	ERRC	↓ Paging (PCCH)
05:07:22.766	MS1	ERRC	↑ RRC Connection Request (UL-CCCH)
05:07:22.802	MS1	ERRC	↓ RRC Connection Setup (DL-CCCH)
05:07:22.803	MS1	ERRC	↑ RRC Connection Setup Complete (UL-DCCH)
05:07:22.803	MS1	EMM	↑ Service Request
05:07:22.861	MS1	ERRC	↓ Security Mode Command (DL-DCCH)
05:07:22.862	MS1	ERRC	↑ Security Mode Complete (UL-DCCH)
05:07:22.930	MS1	ERRC	↓ RRC Connection Reconfiguration (DL-DCCH)
05:07:22.931	MS1	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)
05:07:23.006	DC1		↓ SIP INVITE Request
05:07:23.074	DC1		↑ SIP INVITE Response
05:07:23.093	DC1		↑ SIP INVITE Response
05:07:23.170	MS1	ERRC	↓ RRC Connection Reconfiguration (DL-DCCH)
05:07:23.170	MS1	ERRC	↑ RRC Connection Reconfiguration Complete (UL-DCCH)
05:07:23.170	MS1	ESM	↓ Activate Dedicated EPS Bearer Context Request (DL-DCCH)
05:07:23.170	MS1	ESM	↑ Activate Dedicated EPS Bearer Context Acceptance (UL-DCCH)
05:07:23.170	MS1	ERRC	↑ UL Information Transfer (UL-DCCH)
05:07:23.185	DC1		↓ SIP PRACK Request
05:07:23.195	DC1		↑ SIP PRACK Response
05:07:23.455	DC1		↓ SIP UPDATE Request
05:07:23.492	DC1		↑ SIP UPDATE Response
05:07:23.508	DC1		↑ SIP INVITE Response
05:07:23.750	DC2		↓ SIP INVITE Response
05:07:23.762	DC2		↑ SIP PRACK Request
05:07:23.817	DC2		↓ SIP PRACK Response
05:07:24.380	DC1		↑ SIP INVITE Response
05:07:24.480	DC1		↓ SIP ACK Request
05:07:24.702	DC2		↓ SIP INVITE Response
05:07:24.724	DC2		↑ SIP ACK Request
05:08:25.425	DC2		↑ SIP BYE Request
05:08:25.428	DC2		↓ SIP BYE Response

# PROTOCOL STACK OPTIMIZATION

- Ascom provides automated VoLTE diagnosis to support and troubleshoot voice communication issues between different protocol layers:
  - Enhanced Packet Core System Management (ESM), ESM Configuration, PDCP, RLC, MAC, PHY layers
  - Going from SIP SDP parameter to AMR codec info



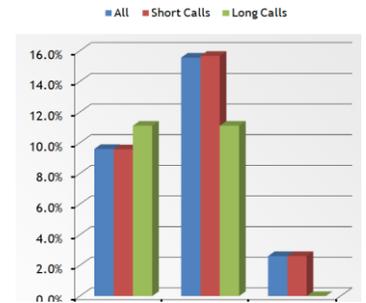
Drill down to each layer of the protocol stack and examine the parameter settings.

- 1). EPS dedicated
- 2). RLC mode
- 3). Voice (RTP+RTCP)
- 4). PDCP (RoHC)
- 5). MAC PRB

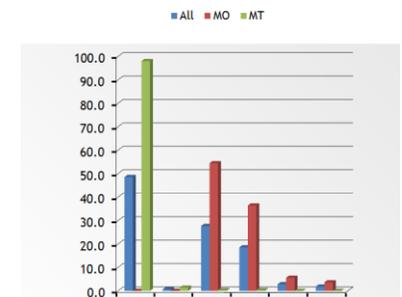
# VOICE QUALITY TESTING

- Operators need a robust methodology to measure voice quality and quantify the metrics that benchmark a user's experience.
- Ascom is the leading provider of network testing solutions designed to measure voice quality for CSFB and VoLTE
  - Voice quality: POLQA
  - Voice delay and other voice centric metrics (e.g. volume, echo, codec)
  - RTP latency and RTP packet loss
  - Handover interruptions (HOIT; within, to/from LTE from/to 2G/3G; (e)SRVCC)
  - MTSI client buffer status (re-buffering time, jitter)
  - Application throughput
  - PDSCH / PUSCH throughput

Session Setup Failure Ratio (%)



Session Setup Time (s) - Distribution



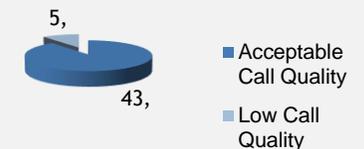
Low PESQ Category - Distribution



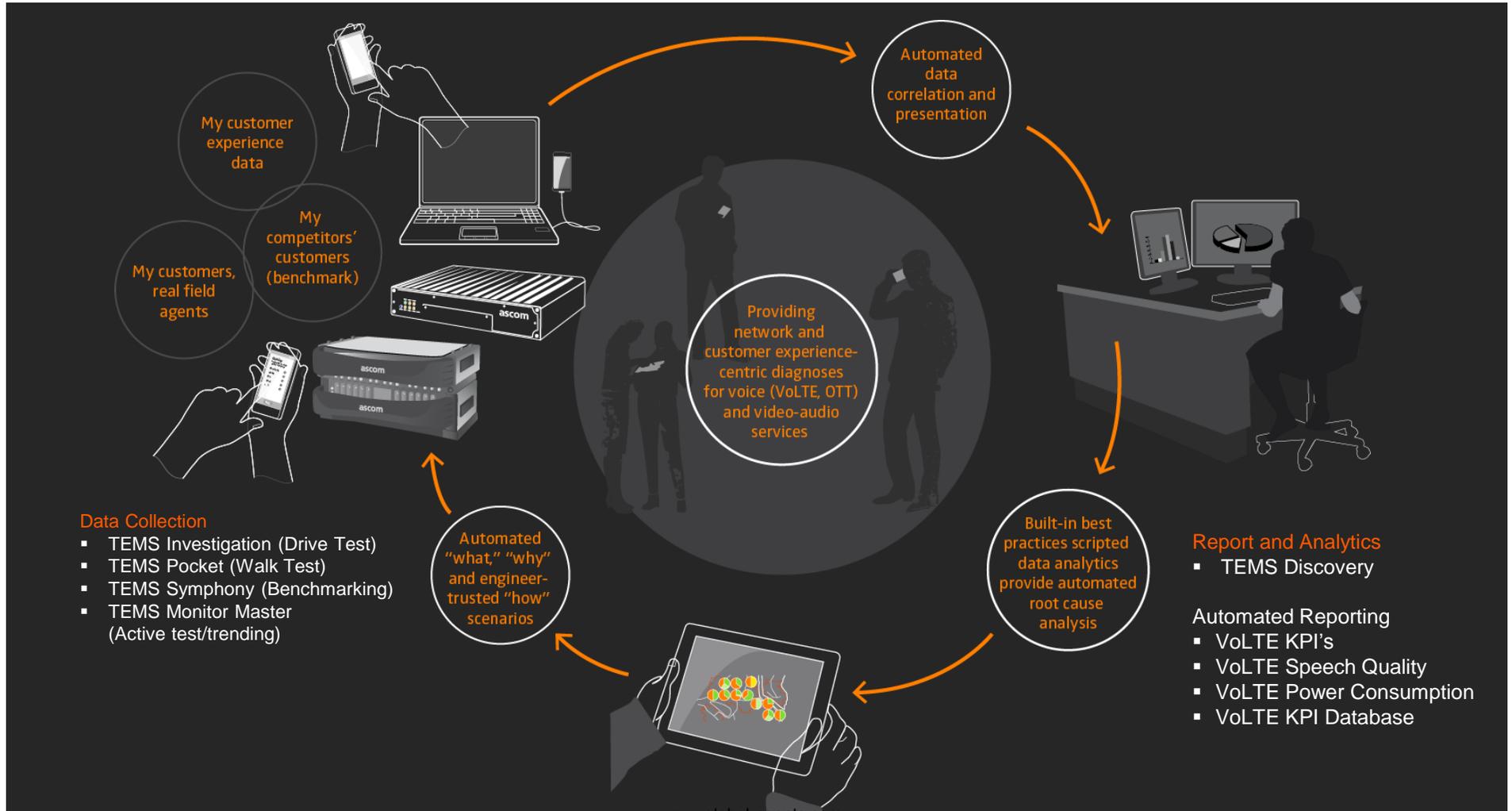
Accessibility Statistics, Integrity Evaluation and Analysis

## Acceptable Call Quality

MOS Threshold=2.7



# A COMPLETE ASCOM ECOSYSTEM FOR VOLTE



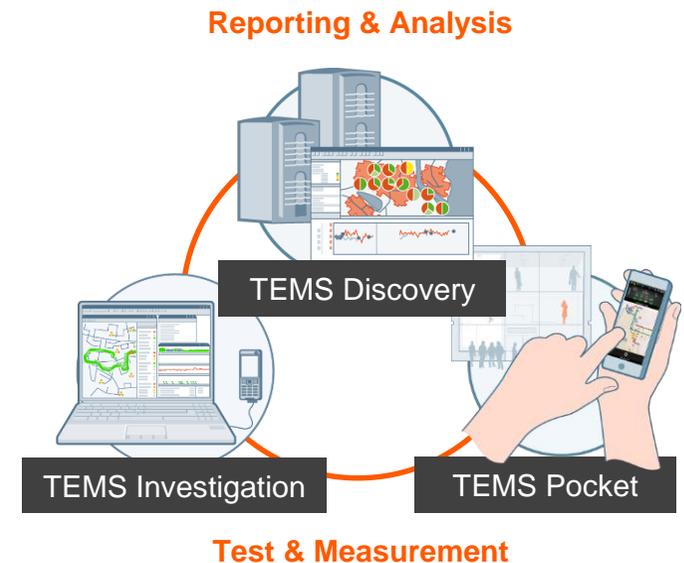
## INTRODUCTION – TD-LTE

- TD-LTE is a global standard, initially promoted as an evolutionary path from TD-SCDMA, but now being broadly deployed as an efficient use of unpaired spectrum and an attractive evolution path for WiMAX operators.
- **As the only non-Chinese vendor with a full competitive presence in China and R&D worldwide**, Ascom can support TD-LTE from several chipset vendors, and as the vendor of choice in the majority of TD- and FD-LTE rollouts offers complete support across the technology lifecycle.

# USE CASES

The TEMS Portfolio provides complete solutions to test, analyze and optimize network performance during both FDD and TDD LTE network rollouts

- **Broad Device Support**
  - The industry's most comprehensive device support
  - Quick additions of new devices
- **Interference Management**
  - Prevent and troubleshoot TD-LTE cell interference with PCI interference analysis
- **Performance Verification**
  - Ensure network time synchronization to prevent multi-access and cross-slot interference



*More than 60% of all LTE networks have been rolled out using Ascom TEMS solutions*

## USE CASE: COMPREHENSIVE DEVICE SUPPORT

- Ascom has the industry's broadest range of supported devices and is continuously expanding support.
- Currently supported device manufacturers:
  - LG, Samsung, Qualcomm, Huawei, HiSilicon, ZTE, Pantech, Sequans, Altair, Quanta, Sierra Wireless, PCTEL, DRT, Andrew and R&S scanners

### TEMS Investigation support iPhone® 5S and 5C for TD-LTE

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>▪ 5S (Model A1530)                     <ul style="list-style-type: none"> <li>▪ UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz)</li> <li>▪ GSM/EDGE (850, 900, 1800, 1900 MHz)</li> <li>▪ FDD-LTE (Bands 1, 2, 3, 5, 7, 8, 20)</li> <li>▪ TD-LTE (Bands 38, 39, 40)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>▪ 5C (Model A1529)                     <ul style="list-style-type: none"> <li>▪ UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz)</li> <li>▪ GSM/EDGE (850, 900, 1800, 1900 MHz)</li> <li>▪ FDD-LTE (Bands 1, 2, 3, 5, 7, 8, 20)</li> <li>▪ TD-LTE (Bands 38, 39, 40)</li> </ul> </li> </ul> |
|--|--|



**Only TEMS™ Investigation tests with iPhone®**

# TD-LTE DEVICES,CHIPSET AND MODEM

## Device

iPhone 5s A1530/5c A1529 (iOS7)  
 Samsung GT-i9308D (Galaxy S III)  
 DC-E3100  
 Huawei E398s  
 Huawei E3276  
 Quanta LU220  
 Qualcomm FFA9200 Global TDD (FFA-9200-0-5)  
 Quanta 1K31  
 Sequans SQN3120-USB-3T  
 ZTE MF820T  
 ZTE MF880  
 PCTEL SeeGull EX FLEX  
 PCTEL SeeGull MX TD-LTE  
 PCTEL SeeGull EX Mini TD-LTE Band 41 (6235A)  
 PCTEL SeeGull EX Mini TD-LTE Band 38/40 (6232A)  
 Rohde & Schwarz TSMW Radio Network Analyzer  
 Transcom NT205x

## Vendor

Apple  
 Samsung  
 Altair  
 Huawei  
 Huawei  
 Quanta  
 Qualcomm  
 Quanta  
 Sequans  
 ZTE  
 ZTE  
 PCTEL  
 PCTEL  
 PCTEL  
 PCTEL  
 Rohde & Schwarz  
 Transcom

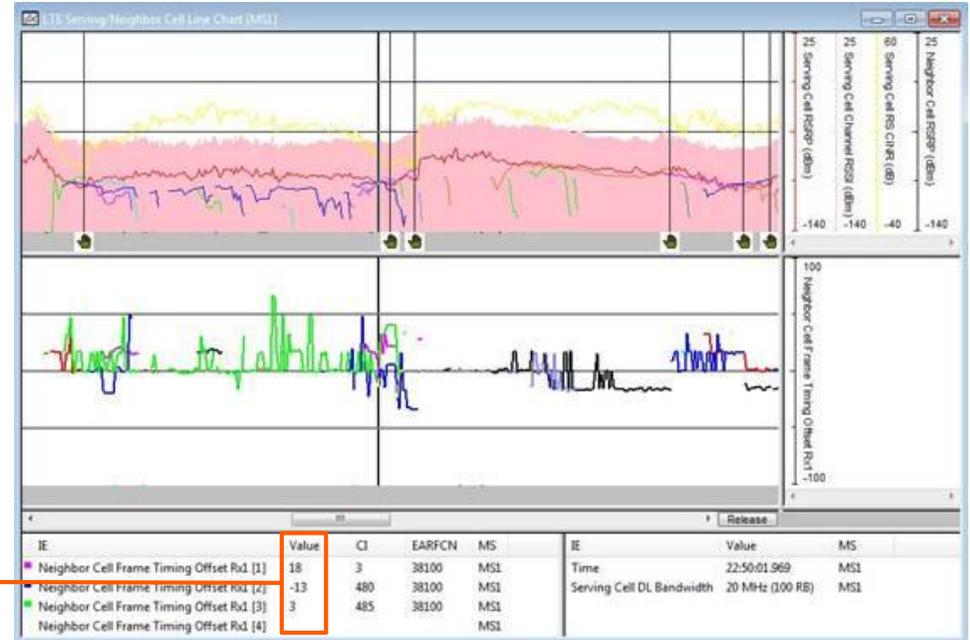
## Device Type

Smartphone  
 Smartphone  
 Data Card  
 Scanner  
 Scanner  
 Scanner  
 Scanner  
 Scanner  
 Scanner

[ TD-LTE ]

# USE CASE: PERFORMANCE VERIFICATION

Network time synchronization is a requirement for TD-LTE systems to prevent multi-access and cross-slot interference.



This frame timing chart indicates “good enough” performance, since the offset is well below the length of the normal cyclic prefix of 144 Ts units.

Frame timing display in TEMS Investigation

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## TEMS INVESTIGATION 16.0

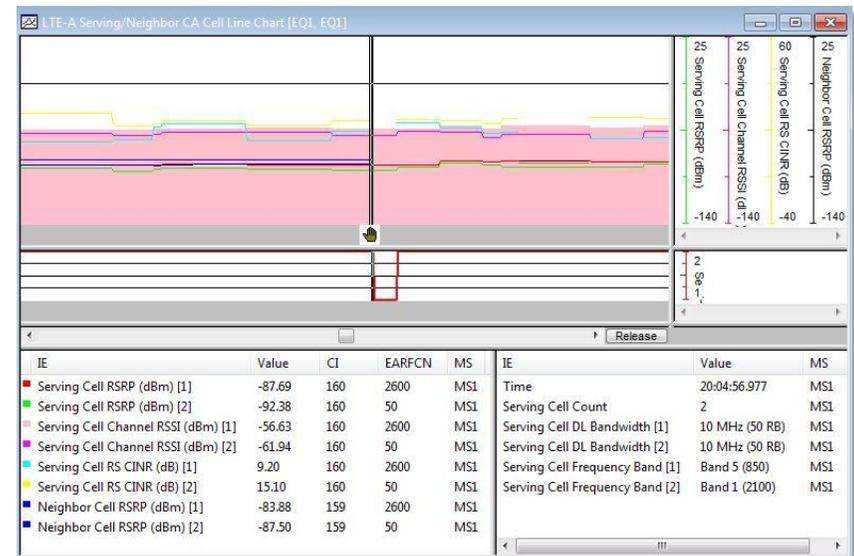
### What's New

- Technology Enhancements
- New Terminals and Scanners
- Usability Enhancements



# CARRIER AGGREGATION

- A richer set of data
  - New Serving Cell information measurements:
    - On Secondary Cell: Bandwidth, Downlink Frequency, and Downlink Pathloss
    - Band added for both Primary and Secondary cell
  - Neighbor cell information also given for neighbors on secondary carrier.
  - PDSCH physical throughput split by carrier.



# YOUTUBE ONDEVICE TESTING

- User-perceived video streaming can now be monitored in TEMS Investigation
- Utilizes same test functionality as available in TEMS Pocket
- Monitor performance and stats
  - Video Resolution, Video Length, Codecs used (Audio and Video)
  - Bitrates for Audio and Video
  - Session information such as timers (Start and stop), interruption count and duration
- Event generation for KPI calculations
  - Start /Stop and State (“Prebuffering”, “Reproducing”, or “Rebuffering”)
  - Reproduction start delays and failures
  - Streaming service accessibility
  - Streaming Error



YouTube OnDevice – Test EXACTLY like a user

# SAMSUNG GALAXY S4 GT-I9506 ASCOM SUPPLIED DEVICE

- Important features:
  - Supporting LTE Cat. 4 (150Mbps)
  - PCI Lock capable on LTE
- Technology/Frequency Band:
  - LTE 800/850/900/1800/2100/2600 (Band 20,5,3, 8,1,7)
  - UMTS/HSPA 850/900/1900/2100
  - GSM/GPRS/EDGE 850/900/1800/1900
- Throughput capabilities
  - LTE Cat. 4 (150/37.5 Mbps)
  - HSDPA Cat. 24 (42 Mbps)
  - HSUPA Cat. 6 (5.8 Mbps)
  - GPRS/EDGE Class 12
- Ascom capabilities
  - RAT / Band lock
  - LTE EARFCN / PCI Lock
  - Flight Mode control
  - Supporting ODM testing for customer experience
    - YouTube
    - Blixt™
    - SMS
- Other information
  - Google Android 4.3
  - Qualcomm 1.9 GHz MSM9615
  - WLAN 802.11 b/g/n



## MORE TERMINALS

- Verification of new devices
  - Samsung Galaxy S4 SHV-E330K (LTE-A CA Band 3 and 8)
  - Samsung Galaxy S4 SHV-E330S (LTE-A)
- Other enhanced devices since 15.x
  - Samsung Note 3 (SM-N900V) VoLTE
  - LG G2 (VS980) Cat. 4, VoLTE
  - LG G2 (D801) Cat. 4, VoLTE



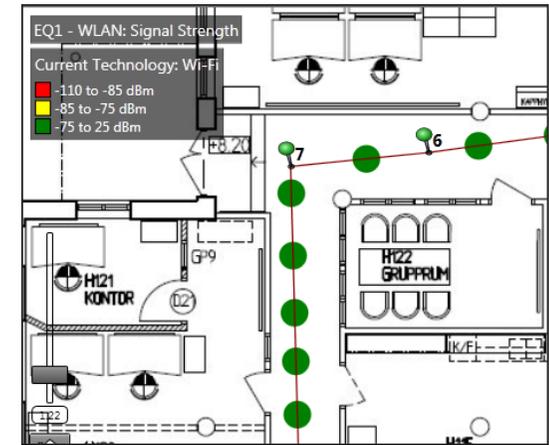
# ROHDE & SCHWARZ SCANNER ENHANCEMENTS

- LTE Reference Signal scanning with R&S TSMW scanner is now supported
  - **2 × 2** (2 Rx, 2 Tx) MIMO
  - **2 × 4** (2 Rx, 4 Tx) MIMO
- Information elements are now on par with other MIMO scanners
  - RSRP and RSRQ are then presented separately for each Rx–Tx combination
  - Possible to analyze performance factors
    - Condition number
    - Estimated channel matrix rank
    - Estimated throughput
- Now possible to add scripted TSMW scans
  - LTE RS
  - WCDMA CPICH
  - GSM RSSI
- CGI IE's updated from system info on
  - GSM
  - WCDMA



# INDOOR POSTPROCESSING

- The Pinpoint Window now plots Information Elements
  - Live mode
  - TEMS Investigation Logfile replay
  - TEMS Pocket Logfile replay
- A new simple way to display information
  - No need to position TEMS Pocket data
  - Information elements such as “Signal Strength” or “PHY Throughput Downlink”
  - At any time, only the element based on the current RAT is displayed



## OTHER NEW FEATURES

- **Optimized IP Sniffing with Lower Processing Load**
  - Live IP collection not visible in the GUI
  - IP Protocol Reports written directly to the logfile
  - User can optionally select to see collection real-time but at a performance cost
- **Flight Mode Control function**
  - Available for most smartphones
  - Allows test scenarios where IMS registration or re-registration on the network is needed
- **More Flexible Licensing for Qualcomm Chipset Based Devices**
  - Allow users to connect and use latest devices
  - Collects data according to technology license available
    - Example: HSUPA testing in UMTS networks can now be performed using LT25i without having LTE technology, allowing access to advanced lock functionality and high performance device at reduced cost.
- **New Information Elements Showing PC CPU and Memory Usage**

[ ]

# TEMS INVESTIGATION 15.X

## Highlights From This Release Series



## ASCOM'S BLIXT TECHNOLOGY WINS AWARD

**Ascom Network Testing is being recognized for its innovative, industry-leading product, Blixt™**

- Winner of 2013 Fierce Innovation Awards: Telecom Edition
  - Unique operator-reviewed awards program from the publishers of *FierceWireless*, *FierceTelecom*, and *FierceCable*
  - Judges evaluated submissions based on the following criteria: **technology innovation, financial impact, market validation and end-user customer experience**
- Blixt™ – A Patent Pending Technology
  - Reduce the cost and time required to test network performance and deploy new capacity by estimating the available bandwidth
  - Reduce drive testing requirements related to throughput testing by at least **50%**
  - Test capacity on a live network without significantly impacting subscriber service
  - Two new Blixt™ servers deployed



*“The Fierce Innovation Awards celebrate the companies who are **on the cutting edge of innovation** in the wireless, wireline and advanced TV and network sectors of our industry”*

## TEMS INVESTIGATION 15.X – HIGHLIGHTS

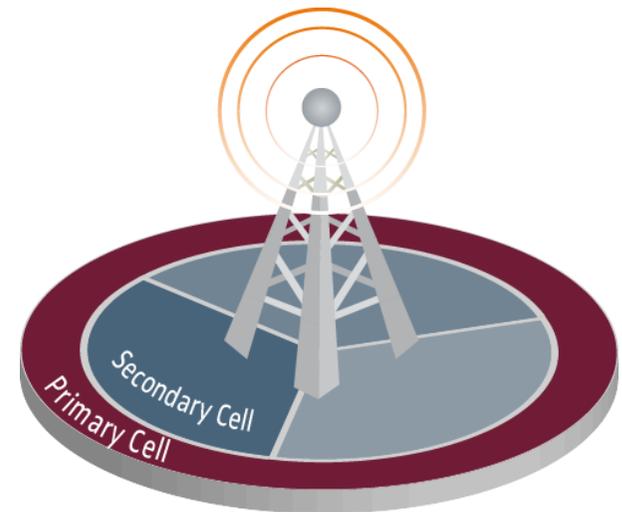
### ▪ **New service testing capabilities**

- HTTPS now supported – download testing over secure connection
- HTTP Streaming – Video sharing site testing
- HTTP Post – UL Measurements
- IMAP support
- IPv6 Support
- Ping improvements – Allowing fragmentation / do not fragment flag to be set
- Generic Qualcomm chipsets enhancements
- Devices can be connected to TEMS Investigation via Wi-Fi Internet sharing instead of USB cable (applicable on selected devices)

# TEMS INVESTIGATION 15.X – HIGHLIGHTS

## ▪ **Technology enhancements**

- Introducing LTE ADVANCED (LTE-A)
  - Takes LTE to the next level – fulfilling 4G requirements as defined by ITU
- LTE MIMO
  - Deployments allow more efficient use of existing spectrum
  - Mimo support on PCTEL MX
- SRVCC measurements
  - Analyze control plane handover performance (VoLTE)
- VoLTE enhancements – VoLTE IP decoding



# TEMS INVESTIGATION 15.X – HIGHLIGHTS

## ▪ Usability enhancements

- Enhanced logfile management
  - Immediately capture anomalies discovered in real-time with the quick recording feature
  - Easily manage logfile size with user configurable settings
- RouteUtility™ enhancements
- Quickly determine if all TX antennas are performing as expected
- Display predefined routes on map for simplified drive testing
- Global license server – Enhanced control over your licenses
- New logfile search utility
  - Save time analyzing only logfiles containing relevant data
- New logfile split utility
  - No need to pause your logging anymore
- Voice dial script activity has been simplified
- New CallGenerator supporting mobile terminated calls

# TEMS INVESTIGATION 15.X – HIGHLIGHTS

## ■ New terminals and equipment

- iPhone 5 (iOS7) – **Unique to TEMS Investigation!**
- Nokia Lumia 521 (HSPA+, MetroPCS)
- Sierra Wireless AC771S (CDMA/LTE, Sprint/Clearwire)
- LG Lucid 2 VS870 (CDMA/LTE, Verizon)
- Samsung Galaxy S3 GT-i9308D (TD-LTE, China)
- Samsung Galaxy S4 SGH-M919N (UMTS/LTE, T-Mobile)
- Samsung Galaxy S4 SCH-R970 (CDMA/LTE, USC)
- Samsung Galaxy S4 LTE GT-i9505
- Sony Xperia V LT25i with LTE control capabilities
- HTC One XL
- External antenna – Connect custom antennas to Sony Xperia LT25i
- introducing PCTeL EXflex



Supporting the latest devices

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# TEMS INVESTIGATION 14.X

## Highlights From This Release Series



# TEMS INVESTIGATION 14.X – HIGHLIGHTS

- Continued preparation for HetNet
- On-device testing – test the customer experience
- Automatic neighbor relation (ANR) monitoring
- Full support of TEMS Pocket
- Technology enhancements:
  - Improve your CDMA network with Code Domain Scanning
  - Regional Editions program extended, and focused efforts for selected customers
  - Continued LTE technology enhancements

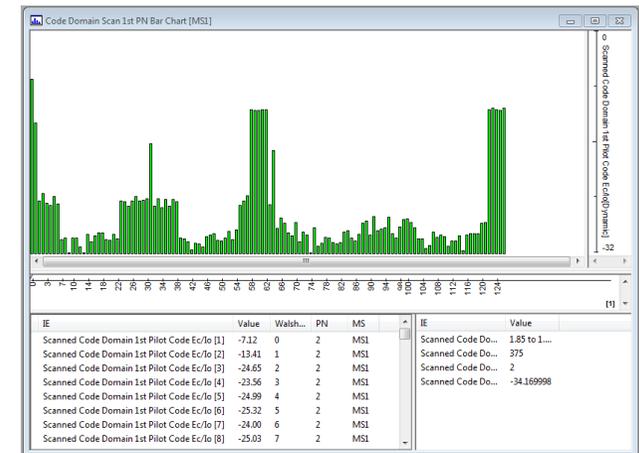
**LTE ANR Information [MS1]**

IE	Value
ANR Feature Group Indicators	
ANR LTE Configured	Yes
ANR Intra-frequency LTE Activated	Yes, PCI: 38
ANR Inter-frequency LTE Activated	
ANR Inter-RAT LTE Activated	
ANR Cell To Report CGI	38
ANR Reported Cell	38[6300]
ANR Reported CGI	MCC: 240, MNC: 1, CellIdentity: 26009888, TrackingAreaCode: 73

**Events**

Time	Eq.	Event	Info
11:35:00.026	MS1	EPS Transmission Mode Changed	Transmission mode changed to Tm2-Transmit Div.
11:35:01.512	MS1	EPS Transmission Mode Changed	Transmission mode changed to Tm3-Transmit Div.
11:35:01.874	MS1	EPS Transmission Mode Changed	Transmission mode changed to Tm2-Transmit Div.
11:36:41.089	MS1	EUTRAN ANR Neighbor Reported	Intra-frequency neighbor reported
11:36:44.613	MS1	EUTRAN Intra-frequency Handover	Intra-frequency Handover (EARFCN 6300), from...
11:36:48.616	MS1	EUTRAN Intra-frequency Handover	Intra-frequency Handover (EARFCN 6300), from...
11:36:55.514	MS1	EPS Transmission Mode Changed	Transmission mode changed to Tm3-Transmit Div.



# TEMS INVESTIGATION 14.X – HIGHLIGHTS

- Service testing enhancements
  - POLQA for CS voice and M2M CS
  - Service control designer – In charge of measurements
  - Scripted scanning
  - Periodic user-defined events
  
- Usability enhancements
  - Save time and number of drives by utilizing UE control functionality
  - Hardware device time addition
  - Optimized logfile recording
  - Flexibility in pinpointing
  - Scripted lock to UARFCN
  - New common TEMS logfile format – Increased visibility, flexibility and functionality

POLQA®



# TEMS INVESTIGATION 14.X – HIGHLIGHTS

- Analysis and reporting enhancements
  - Save time with extended export capabilities
- New terminals and equipment
  - Broadest device support in the market
  - CallGenerator 1.x – A multitalented voice tester
  - ACU R2 – Uniform voice testing for the future
  - New equipment case – Protecting equipment, promoting efficiency



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# TEMS INVESTIGATION 13.X

## Highlights From This Release Series



## TEMS INVESTIGATION 13.X – HIGHLIGHTS

- New cost-efficient measurement solution for mobile-to-mobile audio quality assessment
- Enhanced VoIP testing functionality
- 64-bit Windows 7 support
- Technology enhancements
  - Introducing CDMA/EV-DO Rev. B measurement and analysis capabilities
  - LTE enhancements
- Usability enhancements
  - Automatic software update service
  - New utility facilitating easy and efficient management of service and scanner settings
  - Quick start with new workspace selection window



# TEMS INVESTIGATION 13.X – HIGHLIGHTS

- Service testing enhancements
  - Introducing TD-LTE scanning and service testing
  - Data service performance verification with generic device
  
- New terminals and equipment
  - Expanded scanner portfolio
  - Support for Samsung Galaxy S 4G
  - Introducing TD-LTE scanning and service testing
  - Verification of new UMTS and CDMA devices
  - New smartphones: Sony Ericsson Xperia arc (LT15i/LT15a)
  - Support for Nokia C7
  - Rohde & Schwarz TSMW Universal Radio Network Analyzer



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# TEMS INVESTIGATION 12.X

## Highlights From This Release Series



# TEMS INVESTIGATION 12.X – HIGHLIGHTS

- Technology enhancements
  - Extensive LTE enhancements with additional devices
  - AQM/PESQ improvements for CDMA
- Service testing enhancements
  - Iperf-based TCP/UDP bandwidth performance measurements
  - Automatic filemarks in service control
  - VoIP events
  - Redesigned service control tool (intuitive flow chart concept)
  - Parallel data services on same device
  - Concurrent FTP file transfers on single devices
  - Video streaming and mobile TV quality measure (MTQI)
  - Full-reference speech-quality measurements for VoIP



# TEMS INVESTIGATION 12.X – HIGHLIGHTS

- Usability enhancements
  - Status control monitor
  - New equipment tab in navigator for efficient control and management of devices
  - Worksheet copy and change of equipment number
  
- New terminals and equipment
  - Introducing Android-based smartphones – Sony Ericsson X10 and X10a
  - Additional Samsung, LG and Qualcomm LTE devices
  - Nokia C5
  - CDMA/EV-DO phones and USB modems
  - Expanded scanner portfolio



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THANK YOU!

