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Trends and Hot Topics

RF Drive and Walk testing

TEMS™ Solutions

Peter Vungi
Ascom Network Testing

Knowledge of performance is necessary in order to improve

A race car needs to be tuned for maximum speed and traction

Information input is provided by:

- RPM gauge
- Speedometer
- Stopwatch (lap time)
- Engine sensors
- Temperature sensors
- Pressure sensors

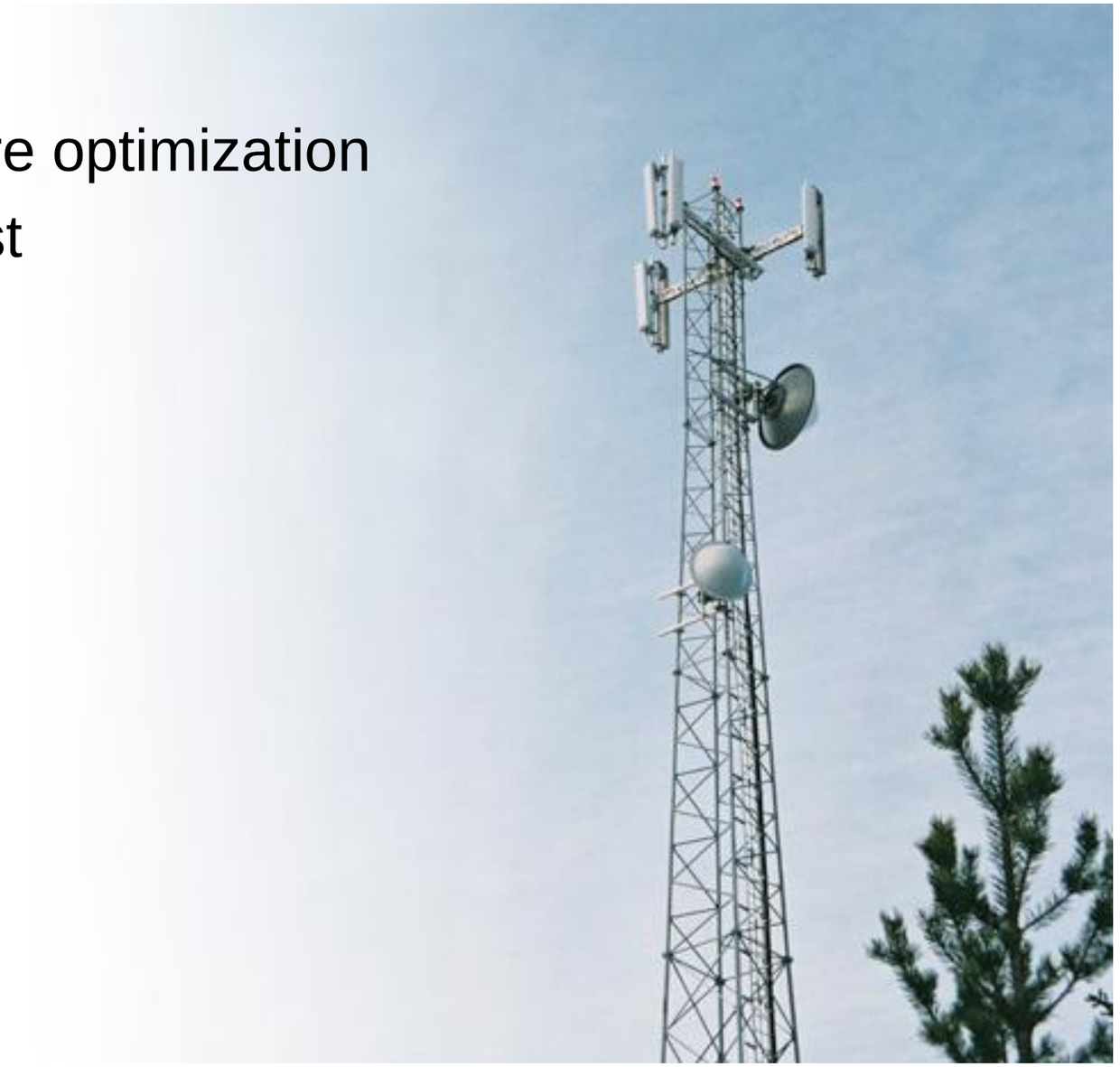
A sailing boat has to maximize the *velocity made good* (VMG)

Information input is provided by:

- Steering compass
- Wind direction indicator
- Wind speed gauge
- Speedometer
- Tell-tales
- Log/GPS

Similarly, radio access networks require optimization and tuning tools to perform at their best

- Air interface probes
  - Phones
  - USB modems and PC cards
  - Scanners
  - Etc.
- Transport and core network probes
- Node statistics and counters
- Customers



- Handheld measurement tools
  - Indoor approach
  - Convenient
- Laptop based measurement tools
  - Connect external measurement probes
  - Quick support latest capabilities and devices
  - Flexible with multiple use areas
- Fully autonomous measurement tools
  - 24/7 measurements controlled from the office
- Dedicated benchmarking measurement tools
  - Large measurement scops

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- Experiences the network as subscribers do
  - Offer perspective needed to improve customer satisfaction
- Provides geographically positioned measurements

Introduction

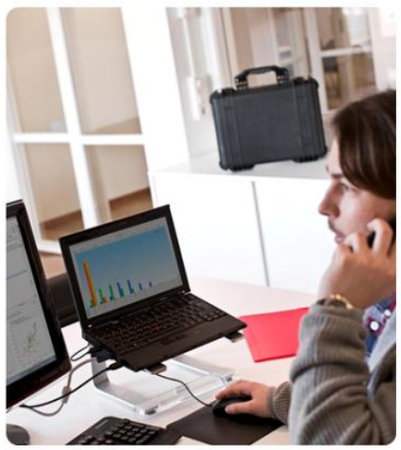
Measurements

Drive test tools

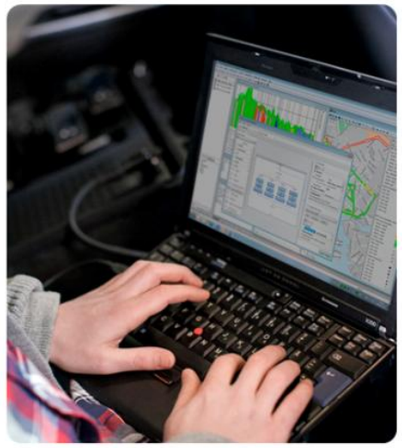
Use areas

SITE VERIFICATION AND ACCEPTANCE

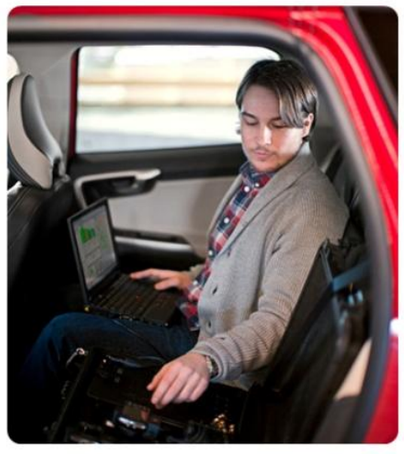
INITIAL TUNING



NETWORK ACCEPTANCE



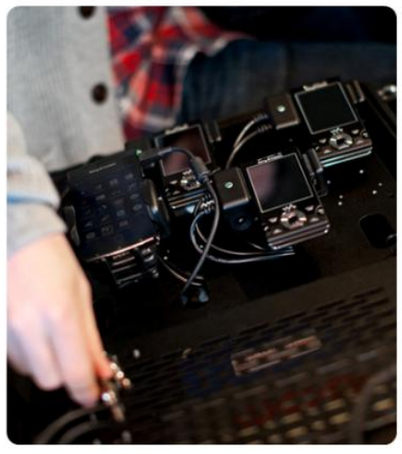
SERVICE QUALITY MONITORING



OPTIMIZATION

TROUBLESHOOTING

NETWORK VERIFICATION



BENCHMARKING

Trends & hot topics

- Generic
- Technology evolution
- Indoor measurements
- Speech quality assessment

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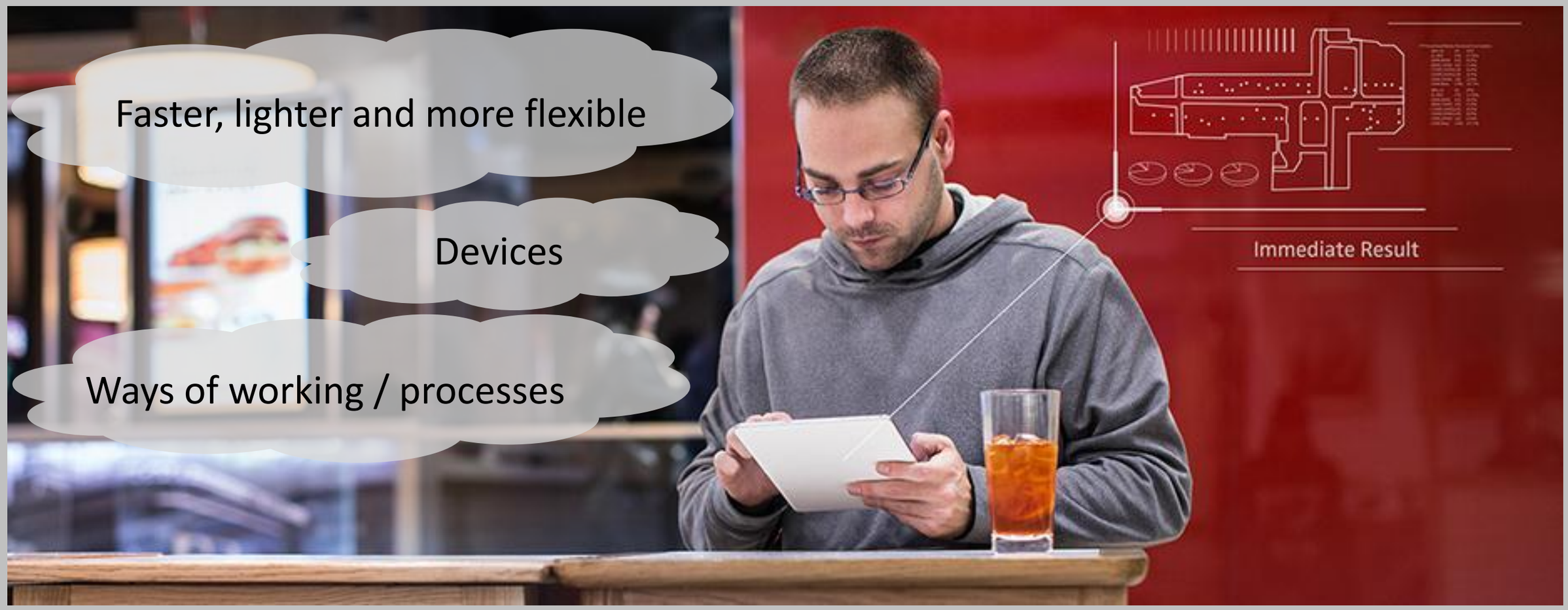

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Technology evolution - support for LTE throughout the complete lifecycle

Driver – Network evolution

Solutions address 4G network challenges

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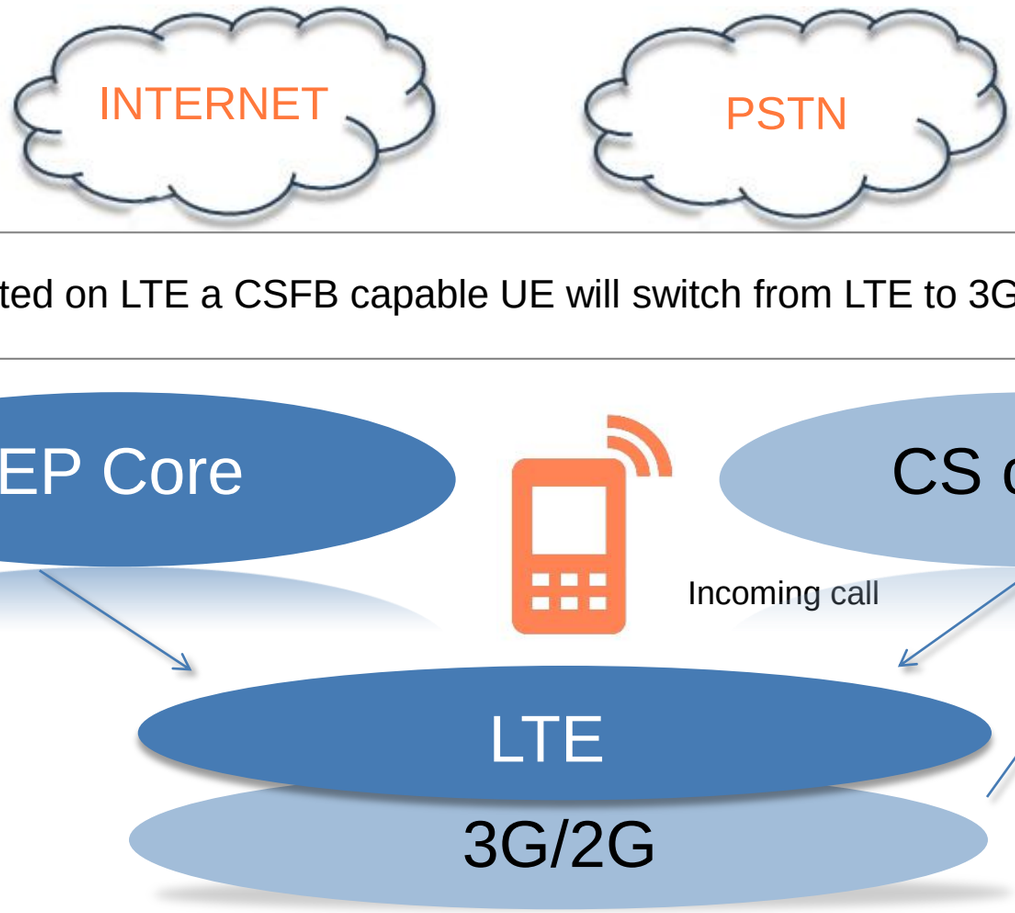
Circuit Switch Fallback



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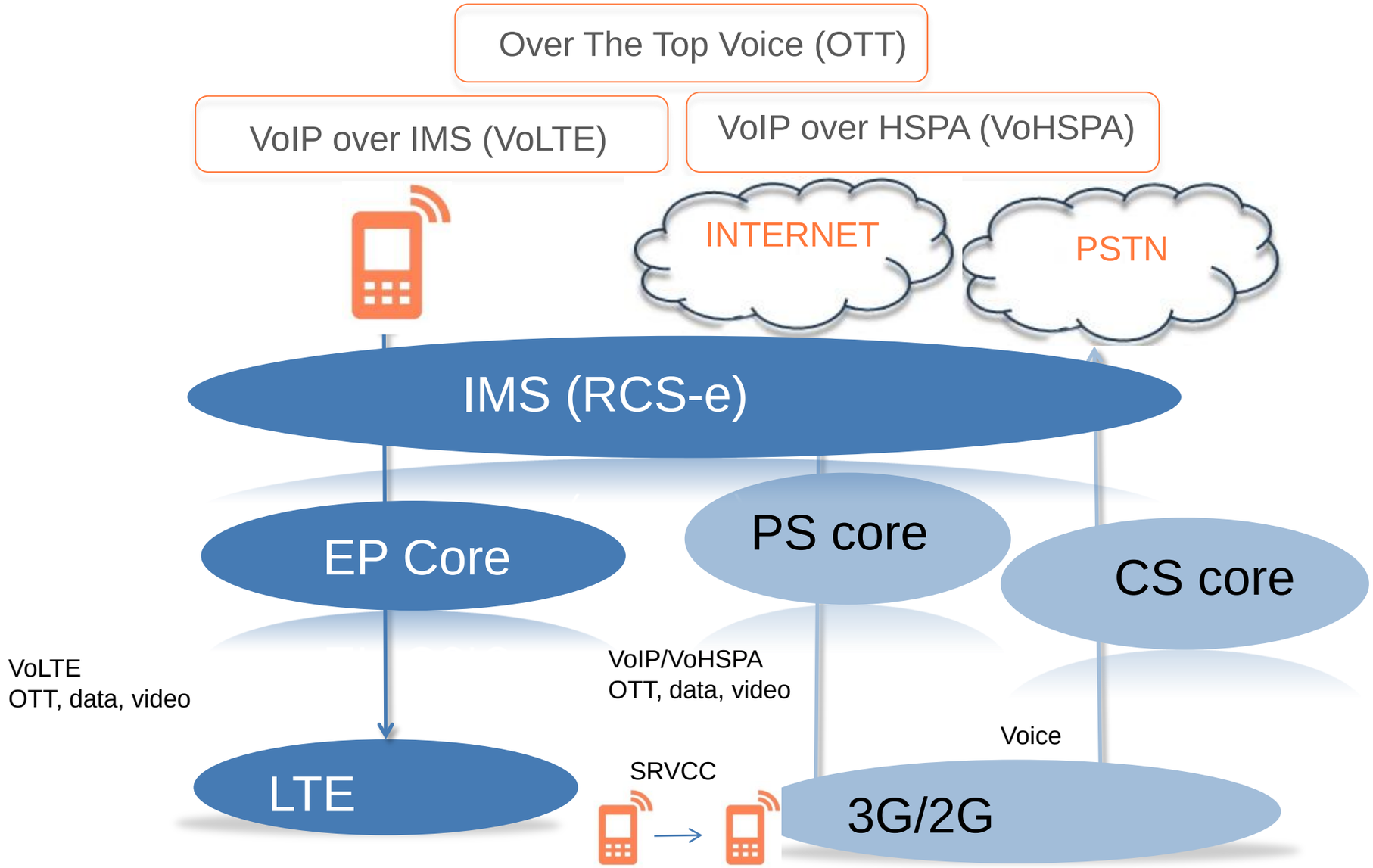

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VoLTE deployment challenges

- **VoLTE is complex**: effective troubleshooting requires insight into interactions between the device, the radio network, and the IMS core, often involving connections to legacy technologies

- Network evolution - Rapid LTE network introduction not always optimized for voice
- Subscriber expectations - VoLTE must meet or exceed CS voice performance
- Alternative Solutions - OTT voice services may be seen by subscribers as viable, low cost alternatives to VoLTE
- Technology challenges - Integrated, end to end IMS functionality must be tested from the device through the network

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Ascom VoLTE solution

- Ascom’s RAN data collection starts with an “OnDevice” VoLTE client inside the terminal, capturing the true end-user experience

- We have the **widest industry network of vendor partnerships**
- Ascom is the leader in support for VoLTE deployments, with more than **20 VoLTE rollouts currently supported around the world**, including all Tier 1 US operators
- **We offer a complete, field-proven solution** to ensure a high quality customer experience

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Troubleshooting VoLTE

- VoLTE call quality is dependent on the network correctly handling a high volume of concurrent Session Initiation Protocol (SIP) sessions
- **VoLTE performance evaluation** reporting on SIP sessions and other important KPIs:
  - Accessibility, Retainability
  - SIP signaling/IMS registration (SIP registration statistics)
  - LTE RRC connection statistics
  - LTE HO statistics
  - QCI verification
  - GBR information

- Quantify and benchmark user experience using robust methodologies:
  - Voice quality: POLQA
  - Voice delay and other voice centric metrics (e.g. volume,
    echo, codec)
  - RTP latency and RTP packet loss
  - Handover interruptions (within LTE, (e)SRVCC to 2G/3G)
  - MTSI client buffer status (re-buffering time, jitter)
  - Application throughput
  - PDSCH / PUSCH throughput
- Solutions used during deployment can be utilized for subsequent QoE benchmarking and monitoring, using consistent KPIs

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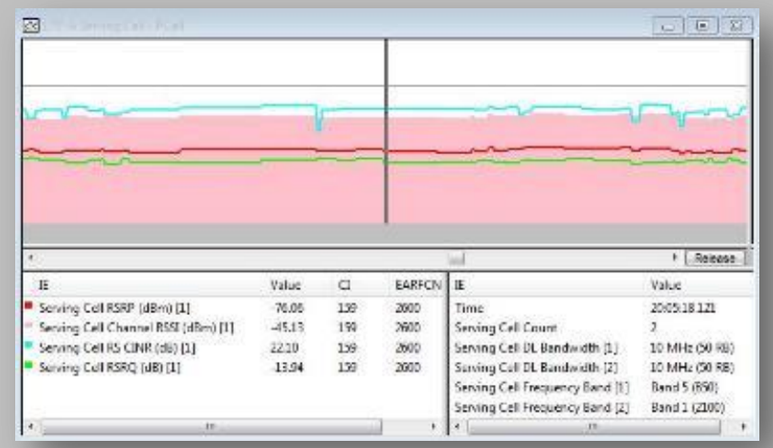
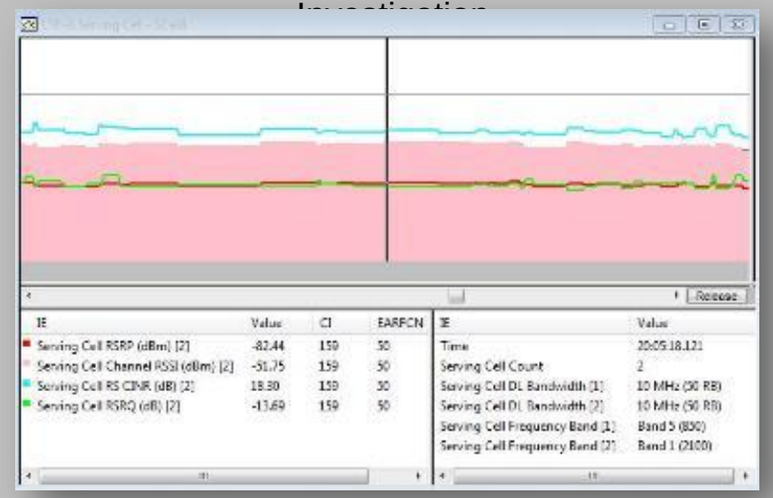
Carrier aggregation – first step of LTE-Advanced

- Enables higher peak data rates and better utilization of fragmented spectrum
- Ensure successful Carrier Aggregation deployment
  - Antenna verification, carrier coverage, parameter setting, eNB installation, etc.
- Optimize network performance
  - Identify and solve potential problems, maximize utilization of existing resources
  - Consider capacity, coverage, spectrum utilization, throughput, performance at cell border
- User experience
  - Monitor service availability, service quality and end-to-end performance

PER CARRIER



Primary serving cell linechart in TEMS™ Investigation



Secondary serving cell linechart in TEMS™ Investigation

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Testing on pedestrian terms

- Driver: Massive small cell deployments
- Challenge: Evaluating subscriber experience in a network with multiple technologies, frequency bands and subscriber device models
  - No GPS coverage
  - Limited or no persistent power supply for equipment
  - Reduced weight capacity and little storage space
  - Need for discreetness and non-intrusiveness
- Strategy:
  - Handheld test solutions offer convenience and discreetness
  - Use equipment handling solutions designed for in-building network testing
  - Use modern scanners designed for in-building
  - Using the latest floor plans and cell locations to facilitate accurate results

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Support small cell deployment from initial site visit to optimization and monitoring

1. Initial Site Visit

- Collect floor plans

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- Collect macro and existing in-building site coverage
- Collect site requirements & architecture constraints

2. Network Design

- Create DAS design
- Generate prediction maps
- Create BOM for procurement

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- Create planned survey route

3. Installing

- Need architecture plan
- Need equipment specification
- Need installation instructions
- Sweep tests

4. Commissioning

- Turn on radios

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- CW tests
- Prediction tuning
- Service validation (Data, Voice, etc)
- RAN Tests

5. Optimization

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- Identify problem spots
- Troubleshooting
- Implement & verify changes
- Verify Quality of Service

6. Operation/Monitoring

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- Autonomous systems
- Fixed or mobile measurement probes
- Re-occuring walk test
- Reporting
- DAS & Event Monitoring

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Collaborate with the indoor planning processes

Ensure accurate test results by using the latest site information

Compare Actual vs Planned
Cell Location and Building Layout

Network Planning & Design Team

Collaboration

Data Collection Team

Reduce the number of site visits by streamlining process

Feedback Site Measurements for Prediction Tuning

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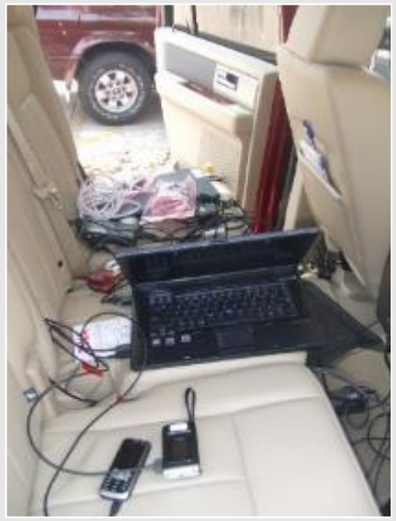
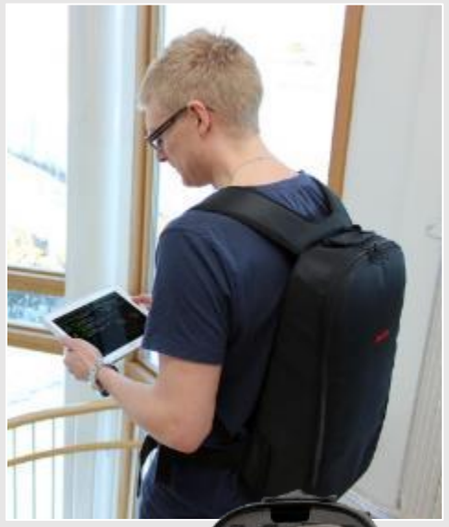
Indoor testing made simple: evolution of drivetesting into pedestrian walktest





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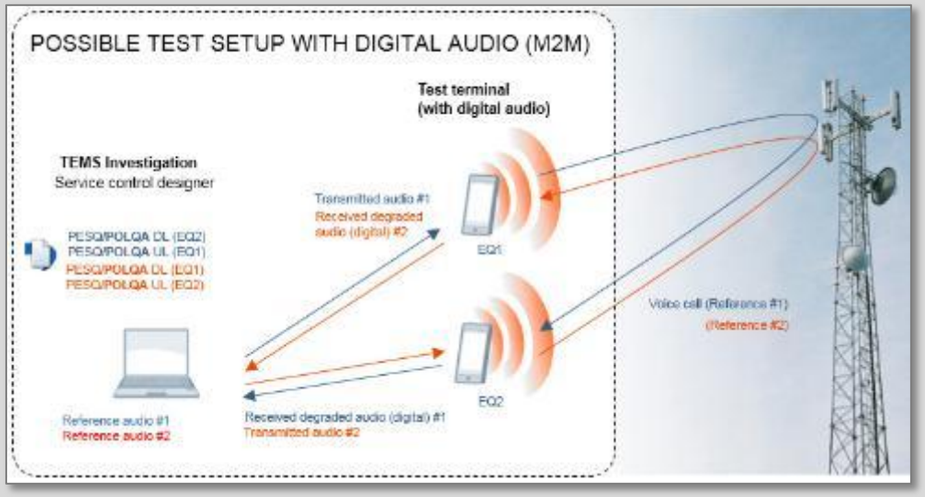
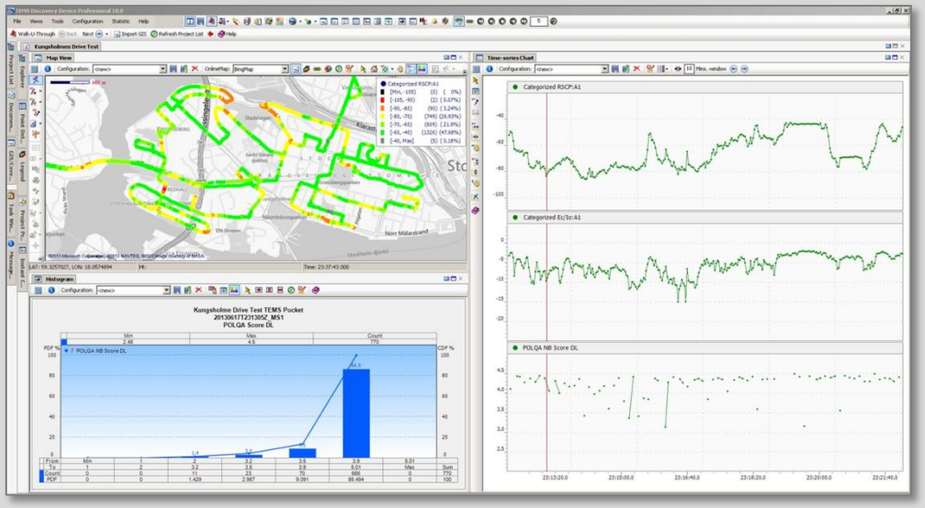
Increased interest in speech quality measurements

- Driver: VoLTE deployment and Core network evolution
  - Does the speech quality meet expectations?
  - Impact on speech quality in conjunction with network changes
- Utilize POLQA (Perceptual Objective Listening Quality Analysis)
  - Voice quality testing standard for fixed, mobile and IP-based networks
  - Intrusive and perceptual algorithm designed to mimic human speech perception
  - Compares the transmitted original speech signal and the degraded received speech signal in order to provide a prediction of the quality
- On device measurements, external digital/analog audio converter (ACU R2) or digital audio





TEMS Product portfolio

If you have questions or, are interested in more information please visit us today at the Livingston stand (#2)

The TEMS™ Portfolio

Radio Network

- TEMS™ Investigation for comprehensive testing
- TEMS™ Pocket for portable and indoor use
- TEMS™ Automatic for autonomous service quality monitoring
- TEMS™ Symphony for competitive benchmarking
- TEMS™ Discovery for custom and near real-time post-processing

End-to-End Assurance

- TEMS™ Monitor Master for end to end assurance

Thank you!