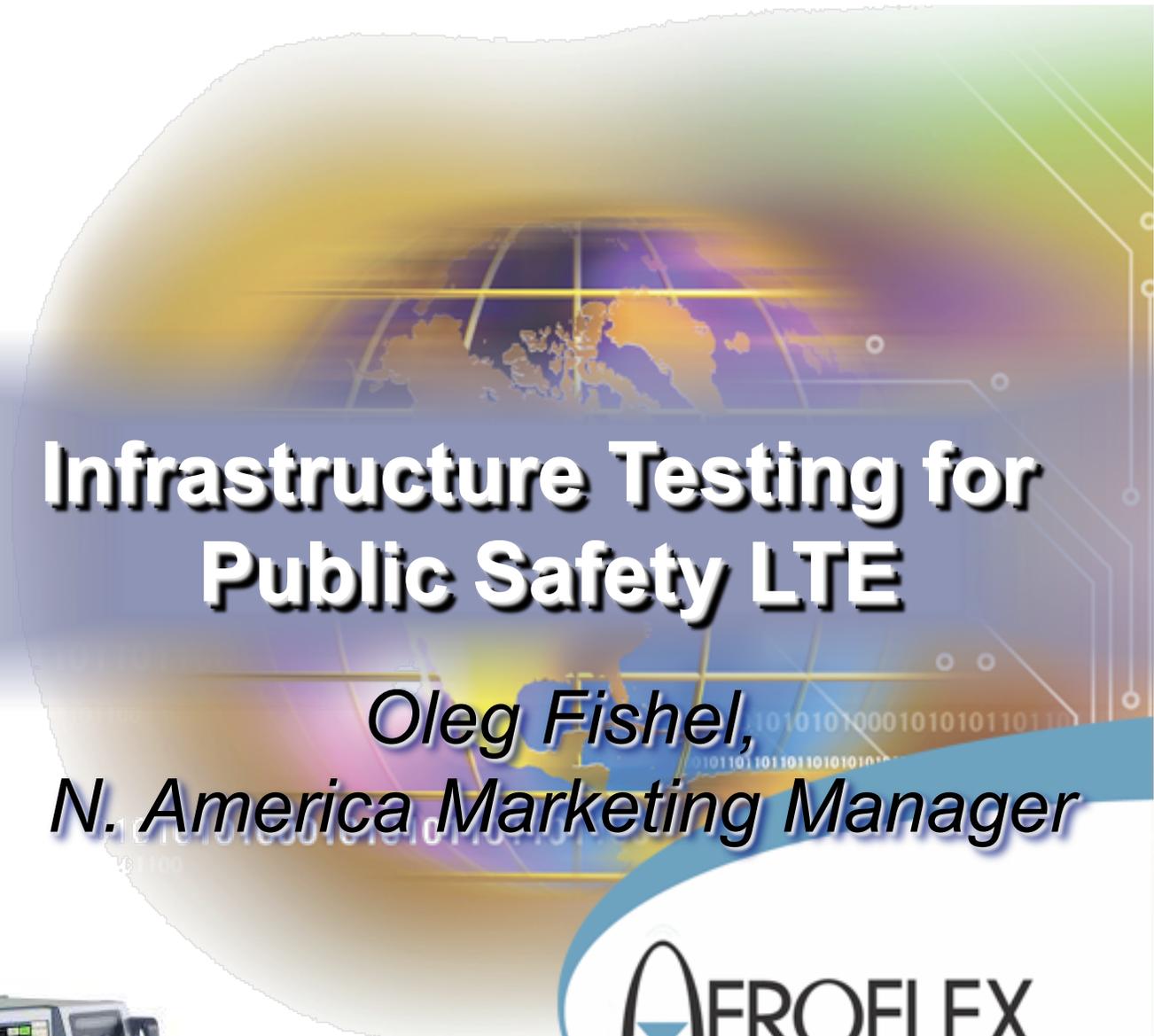# PSCR Demo/Eval Network Stakeholder Meeting

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Infrastructure Testing for Public Safety LTE

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AEROFLEX

Aeroflex Solutions

- **70 years of RF test experience**
- **Market Leader for public safety test equipment (TETRA)**
- **Market Leader for 3GPP Test Mobiles (Ubinetics)**
  - **TM500**
    - LTE support since early 2007
    - Used to test eNBs from all major manufacturers (WCDMA to HSPA+ and LTE).
    - HSPA++ and LTE-A coming soon
- **Market Leader for LTE Multi-Mode Device Testing**
  - **7100 = Cost, functionality and flexibility**
- **RF Parametric Testing (IFR/Marconi Instruments)**
  - **Signal Generators / Signal Analysers**
  - **Manufacturing Test**
- **Service and repair (Willtek)**

Introduction

- FCC and PSCR are working with each other to ensure waiver network equipment is in the PSCR Demonstration Network.

- Additionally the PSCR has pointed to the industry standard PTCRB process as a minimum standard for devices on the network (User Equipment).

- There is no corresponding body or process for infrastructure validation.

- How will the PSCR validate infrastructure equipment for their network?

Commercial Device Test Process

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3GPP — A GLOBAL INITIATIVE

GCF — Global Certification Forum

PTCRB — PCS Type Certification Review Board

- RF Conformance (36.521-1)
- Protocol Conformance (36.523)
- RRM Conformance (36.521-3)

OPERATOR SPECIFIC TESTS

- Supplementary RF
- Supplementary Signaling
- Data Throughput
- Data Retry
- SMS
- OTADM
- UE-UICC
- Radiated Performance

"Real World" Tests

- Network IOT
- Field Testing
- PSCR

- **PSCR points to this 3GPP/PTCRB process for UE testing.**

- *The "Real World" tests will be run in the PSCR evaluation network.*

Commercial Infrastructure Test Process

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3GPP

→ • RF Conformance (36.141)
  • Protocol Conformance (???)

→ **OPERATOR SPECIFIC TESTS**

→ **"Real World" Tests**

• **There is no complete test process for the PSCR to use.**
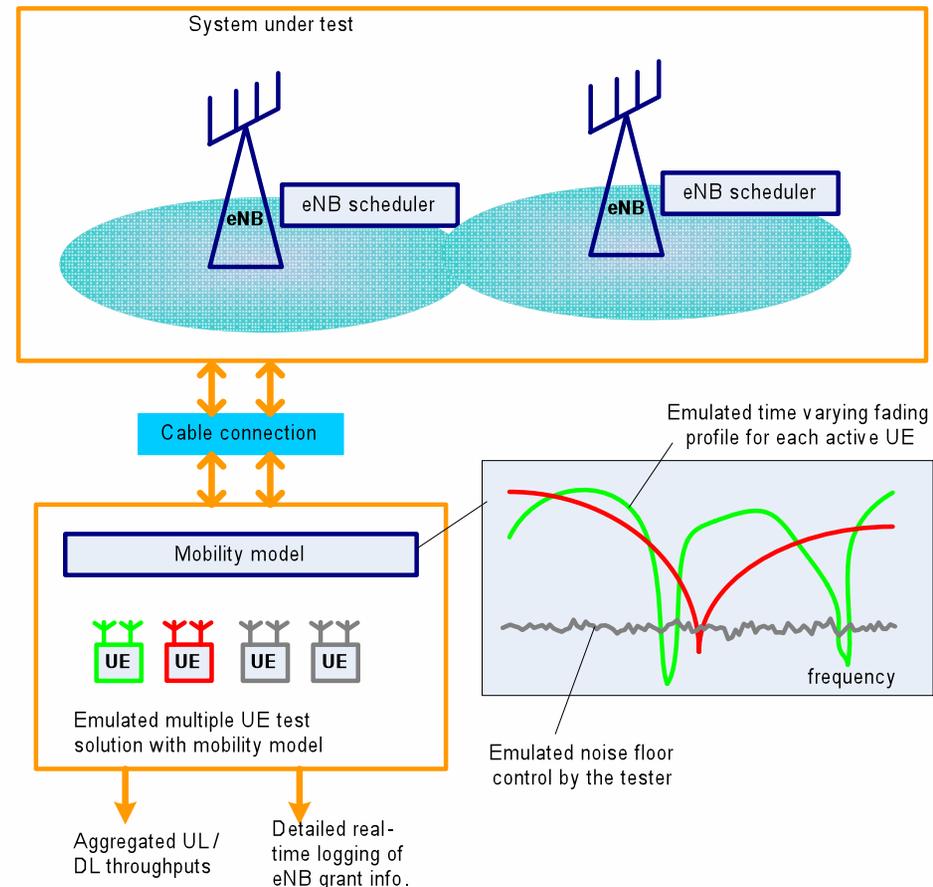
Why test infrastructure?

- **Verify basic LTE requirements.**
  - **How do we know it's an LTE base station?**
- **Ensure basic RF parametric performance**
- **Interoperability with different devices.**
- **Marketing vs. actual performance.**
- **Interoperability with other network equipment.**
  - **Many different vendors can be used in public safety.**
  - **The roughly 50,000 public safety entities can create 50,000 interoperability scenarios.**
- **Ensure public safety needs are met.**
- **Verify real world "over the air" performance.**

- **RF Conformance against 3GPP 36.141.**

- **LTE protocol test requirements:**

  – **Environment**
  – **Call setup**
  – **Authentication**
  – **Sub-layer**
  – **MIMO**
  – **Automated boundary tests**
  – **Scheduler**
  – **Handover**
  – **Interference management**
  – **Encryption and Security**
  – **Capacity and load tests**
  – **Stability tests**

System under test

eNB scheduler

eNB

eNB scheduler

eNB

Cable connection

Mobility model

UE UE UE UE

Emulated multiple UE test solution with mobility model

Aggregated UL / DL throughputs

Detailed real-time logging of eNB grant info.

Emulated time varying fading profile for each active UE

frequency

Emulated noise floor control by the tester

Operator Infrastructure Testing - 2

- **Interoperability Testing and Plug-fests**
  - Real world environments.
  - Test against a variety of mobile terminals.
  - Test against vendor's infrastructure equipment.
  - Test against different core network elements in live network configurations.
  - The laboratory testing is typically a pre-requisite for invitation to "real world" test activities.

- **Field and Drive Testing**
  - Field testing with either real or emulated mobile devices in mobility scenarios.
  - Typically setup exactly as will be deployed in small subset of network.
  - Testers drive around a pre-determined path.
    - Verify handover scenarios, interoperability scenarios, performance limitations, etc.

- **Final Acceptance**
  - Operator will roll out infrastructure only after it has passed all tests.
  - To limit risk and costs operators often cap number of vendors to 2 or 3.

Public Safety Considerations

- Public safety is different than a commercial network.

- No single, official operator to set operator specific requirements.

- Cannot limit infrastructure vendors.

- Different feature priorities
  - Cell Barring
  - Cell Reservation
  - Special Access Classes
  - User Pre-emption
  - Application Pre-emption
  - Etc.

- Very few network infrastructure vendors have implemented the parts of the standard outside of commercial requirements.

- Natural disasters, terrorist attacks, plane crashes, etc. require a network and user interaction very different from every day life.
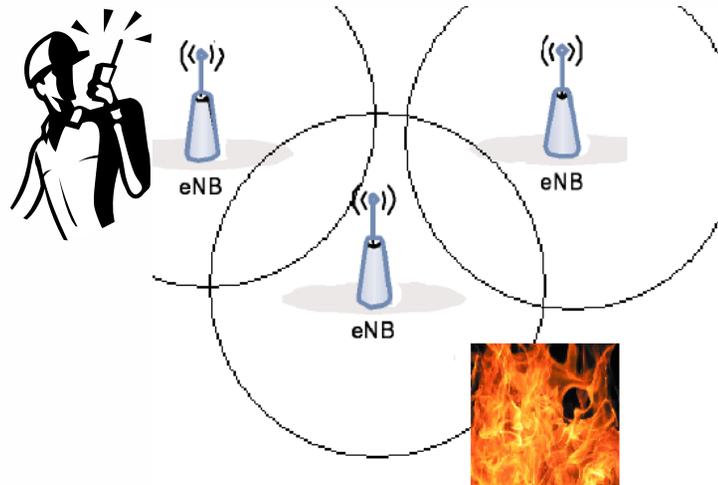

- The emergency area may be located at cell edge and bring an abnormal number of users to the area, thus putting significant strain on the network.

- This network strain cannot bring service down in the emergency.

- Complete in-building penetration and ubiquitous coverage is a requirement.

- A combination of femtocells, network repeaters and mobile picocells will be required.

- These additional network infrastructure nodes will need to be taken into account for future public safety test scenarios.
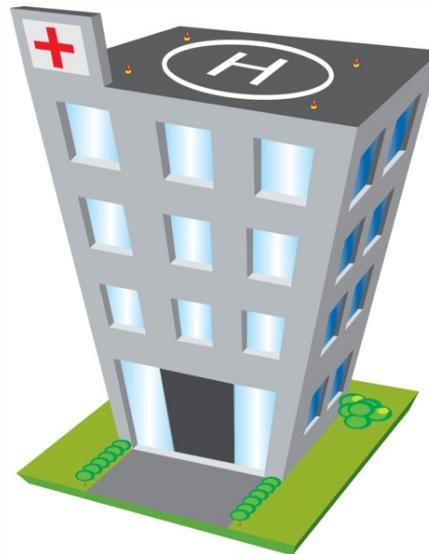
Public Safety Specific Tests

- The PSCR has proposed a list of public safety specific scenarios.
  - Voice interoperability with existing LMR systems.
  - Public Safety user's dual technology networks interoperability.
  - Collect and convey subscriber unit location data in real time.
  - Location data should be accessible to appropriate applications.
  - Meet the same minimum location data information requirements as current systems.
  - One-to-many communications capabilities to outside network users.
  - Tests customized for femtocell and picocell installations.

- Measurements outside of current 3GPP specification.
  - Outgoing Adjacent Band Interference
  - In Coming Adjacent Band Interference
  - SNR vs BLER
  - SNR vs CQI
  - SNR vs Throughput
  - Cell Loading
  - 2nd Order Harmonic Interference
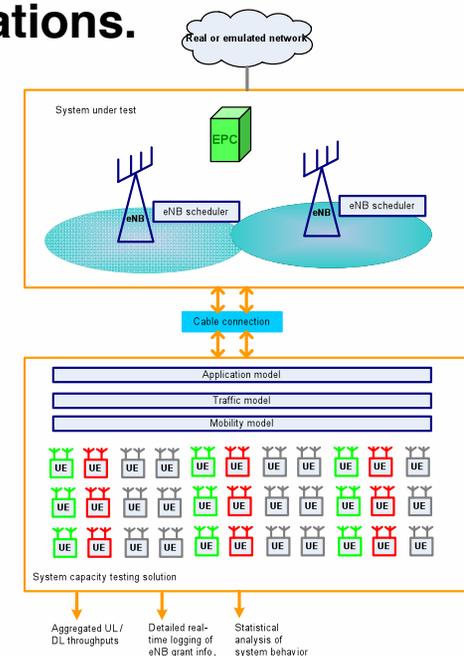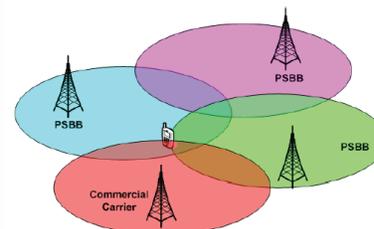
Aeroflex Proposed Test Process

3GPP → • RF Conformance (36.141)
• Protocol Conformance (???)

→ **PSCR SPECIFIC TESTS** ?

→ **PSCR Evaluation Network**

Aeroflex proposes:

- **PSCR will communicate the required tests for entry to evaluation network.**
    - **Subset of tests currently run in industry.**
        - **Input from commercial operators and vendors.**
    - **Public safety specific tests as listed in current PSCR specs.**
- **PSCR evaluation network entrance criteria.**
    - **Vendor must pass required tests to enter PSCR network.**
    - **Vendor can use independent lab or their internal lab if acceptable to PSCR.**
- **Public safety entities will be provided a list of vendors that have entered the network.**

Conclusion

- **High speed, fully interoperable, nationwide public safety network is now being realized.**

- **By leveraging the lessons of the commercial network operators and the very powerful PSCR demonstration and evaluation network, the national public safety network can be rolled out successfully.**

Aeroflex Solutions

- **TM500 UE Simulator**
  - *Used in Module/Subsystem development, test, integration, regression and Network verification.*

- **Provides features not available on 'real' terminals.**
  - *1 UE → 1000 UEs*
  - *Full stack or layered operation (at L1, L2, L3, and Application)*
  - *Fully automated control & data logging*
  - *Operation in the lab or over the air*

  - **Software Defined Radio Platform**
    - *Fast and flexible development process*
    - *Supports all the 3GPP specified Bands*
    - *Keep up with fast evolving 3GPP standards*
    - *Can support customised features*
    - *New functionality → software releases*

  - **'Industry standard' for 3GPP base station testing**

Thank you