Testing 4G Ahead of the Curve

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4GWE
4G WIRELESS EVOLUTION
CONFERENCE

Speakers

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Testing of the Emerging Wireless Technologies

System	Roaming, handoff, security, end-to-end QoS
MAC	Access protocols, scheduling, encryption, QoS
PHY	Signal integrity, BER, coding, beamforming

Feasibility   **Performance**

Field Test

Interoperability

Certification Testing
Vendor and Operator Alliances

- LSTI [LTE/SAE (Service Architecture Evolution) Trial Initiative]
  - Works with **3GPP**
  - Conducts conformance and interoperability testing of LTE products
  - Begins testing early in the development process
- The WiMAX Forum
  - Defines *certification profiles* on parts of the 802.16 standard selected for deployment
  - Conducts conformance and interoperability testing
- Wi-Fi Alliance
  - Defines and conducts certification testing for 802.11 based products
  - Focuses on interoperability testing

www.lstiforum.org

- The scope of LSTI testing is defined by 3GPP RAN5
  - IMS testing to be performed by Global Certification Forum (GCF), which provides independent 3G interoperability testing. GCF test cases are based on the work of RAN5.

- LSTI member companies include
  - Alcatel-Lucent, Ericsson, Orange, NXP Semiconductors, Samsung, Nokia, Nokia Siemens Networks, Qualcomm Inc, Nortel, T-Mobile, Vodafone, ZTE, Agilent Technologies Inc., Anritsu, China Mobile, Huawei, LG Electronics, Motorola, NTT DoCoMo, Rohde & Schwarz, Signalion, Telecom Italia, and Telefonica

WiMAX Forum

- IEEE 802.16 contains too many options
- The WiMAX Forum defines *certification profiles* on parts of the standard selected for deployment; promotes interoperability of products through testing and certification
- The WiMAX Forum works closely with the IEEE 802.16 *Maintenance group* to refine the standard as the industry learns from certification testing

WiMAX Forum™ Mobile System Profile

Release 1.0 Approved Specification

(Revision 1.6.1: 2008-04-01)

	Release 1.0	802.16e/TDD
	Release 1.5	802.16e/TDD and FDD
Future	Release 2.0	802.16m (IMT Advanced)

Wi-Fi Alliance

- Selects subsets of 802.11 standard for certification
- Focus
  - To be announced 802.11n certification
  - 802.11n Draft 2.0 certification, 2006
  - WMM (wireless multimedia) QoS certification
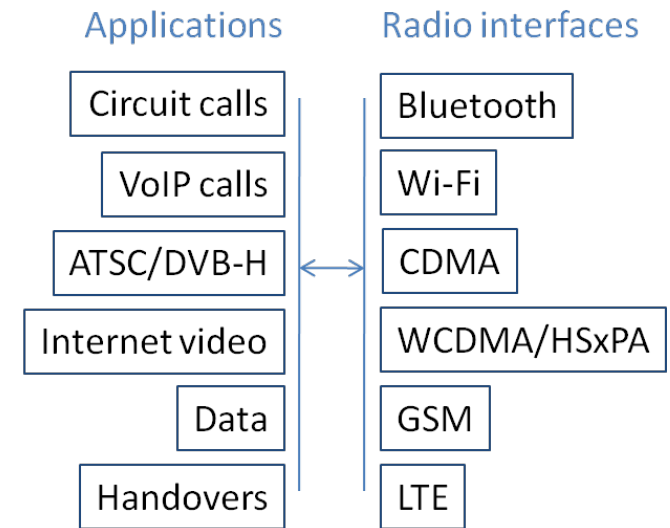 - WPA, WPA2 (wireless protected access) security certification

Typical Stages of Test (LSTI example)

- Proof of concept
  - Measure the PHY capabilities as defined in the standards
- Interoperability Development Testing (IoDT)
  - Early device form factors are tested with the network infrastructure to validate signaling between the device and the EPS core
- Interoperability Testing (IoT)
- Field Trials
  - Real-world deployment testing to verify over-the-air performance, handoffs between LTE base stations, and performance while moving at different vehicular speeds.

Test Challenges in the Modern World

- Variety and multitude of usecase scenarios to test
  - Mobility and roaming scenarios
  - Mobile applications
  - New radio interfaces
  - Interference between radios (e.g. Bluetooth® and Wi-Fi)
  - Variety of channel conditions
- Increasing diversity of metrics
  - Performance and responsiveness of mobile applications (throughput, delay, range)
  - Roaming functionality and speed
  - Simultaneous use of Bluetooth and other radios
  - Battery life in different usecase scenarios
  - New generation 3G and 4G radios running concurrently with traditional 2G devices

Applications

| Circuit calls |
| VoIP calls |
| ATSC/DVB-H |
| Internet video |
| Data |
| Handovers |

Radio interfaces

| Bluetooth |
| Wi-Fi |
| CDMA |
| WCDMA/HSxPA |
| GSM |
| LTE |

Exponential # of Use Cases to Test

Performance ⟷ Range
Battery life

Range
Channel conditions
Radio interfaces
Interference
Handover scenarios

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RF and Wireless Technology Experts

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