



Wireless Expertise

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Wireless Expertise Summary

- Technical experts with product development experience: Nortel, Blackberry, Alcatel-Lucent (Nokia):
 - Cellular radio: 3G, 4G LTE, 5G
 - WiFi and short range: 802.11, Bluetooth, ZigBee
 - V2X Connectivity, LPWAN modules
 - RF/Antennas, Baseband Processors, SoC and network systems
- 20 years experience in analyzing wireless patents:
 - Standards Essential Patents assessment: ETSI 3GPPP, IEEE 802.11 ax, ac
 - Evidence of use demonstration for litigation support, patent acquisition/sale
 - Expert witness in high profile litigations in the US
- Wireless testing lab in Ottawa (see following charts)
 - Live network testing of the cellular 4G, 5G and WiFi devices and network systems using state of the art test equipment
 - Base station emulator for mobile devices capability testing and standards conformance testing
 - Used extensively for infringement/non-infringement demonstration
- Track record in supporting clients in litigation/licensing, acquisition and sale of wireless assets
 - Leading telecom system vendors in Europe, Japan, US. Automotive OEMs and Tier 1 suppliers
 - Litigation law firms, Licensing firms

Wireless Test Lab - Unique Offerings

- Multiple solutions for Live and Emulator-based testing to chose from depending on requirements
- Experience with a variety of test equipment for user equipment and base station testing in the field and in the lab
- Database of past test results from tests conducted in Canada, US, Japan and Germany available for preliminary confirmation of features of interest
- Base Station vendor identification methodology and database of cellular vendor products deployed in North America, Japan and Germany

Testing in Support of Wireless Patents EoU

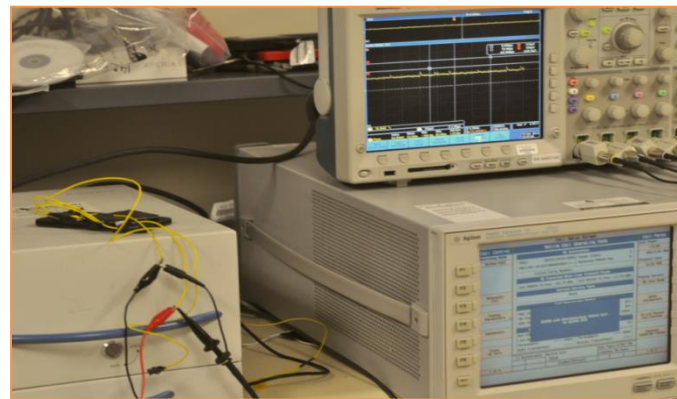
- **Standards-Essential Patents:**
 - Claim charts are developed by mapping claim elements on a Standards specification
 - Functional testing for method claims is desirable to demonstrate use in commercial systems
- **Patents which Read on Optional Standards Features:**
 - A product could be standards compliant but optional feature(s) may not be implemented at all or it may be turned on by an operator in certain conditions only
 - Functional testing is required to establish Evidence of Use
- **Patents which Read on Device Implementations:**
 - Product documentation analysis often assisted by Reverse Engineering and/or testing is required to establish Evidence of Use

Wireless Testing



Live Testing in a Mobile Operator's Network

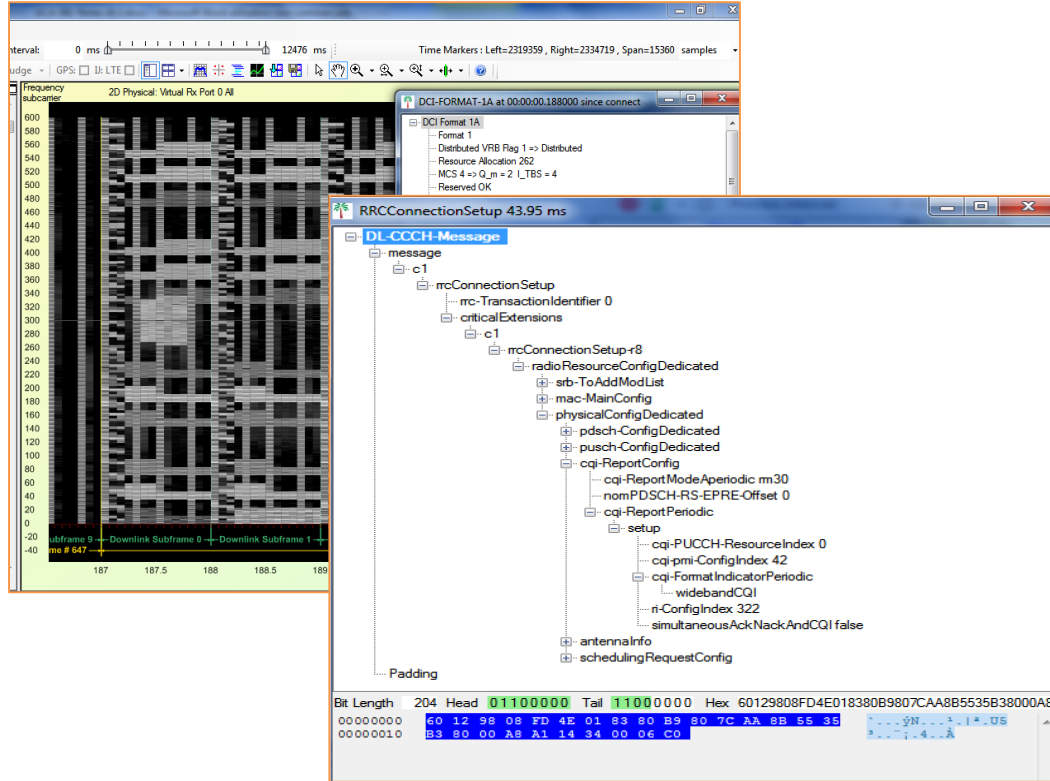
- 5G LTE, HSPA, WiFi
- Terminals and Base Stations
- PHY, Antenna/diversity, Layer 2, Resource Management, Mobility Management



Captive Testing using Systems Emulators in a Lab

- 5G, LTE, HSPA, WiFi, NFC, Bluetooth
- Terminals in controlled BST environment
- Multi-RAT Core Network
- Dynamic power management
- Protocol compatibility/interactions

5G & LTE Live Network Testing



Examples of Testing for Infringement

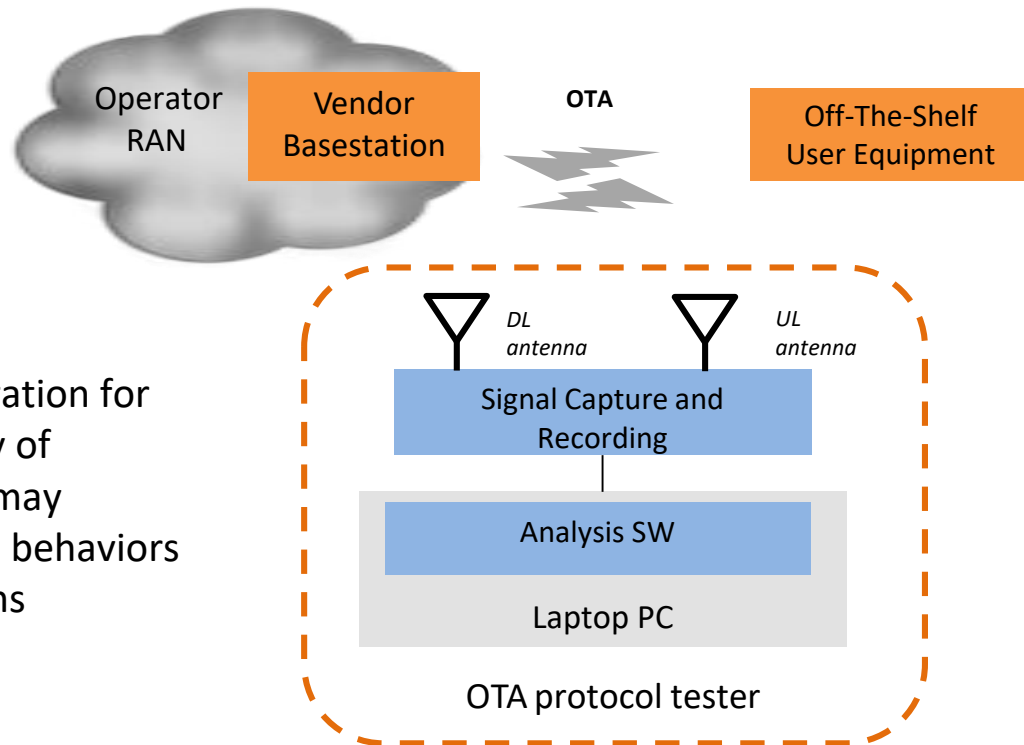
- CQI Measurements and Reporting
- Resource Blocs (RB) allocation
- QoS Treatment
- Sounding Reference Signals
- Static and Mobility conditions
- Capability Reporting
- Handover

Terminals Tested:

- Over 50 models of 5G and LTE-enabled phones, laptops and notebooks

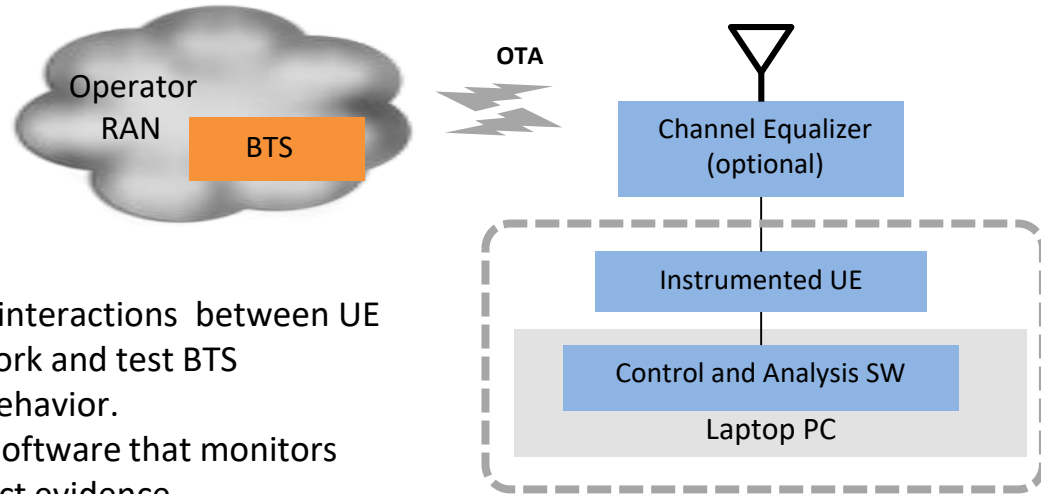
Live testing performed in Canada, US, German and Japanese operator networks

General Live Network Testing Configuration



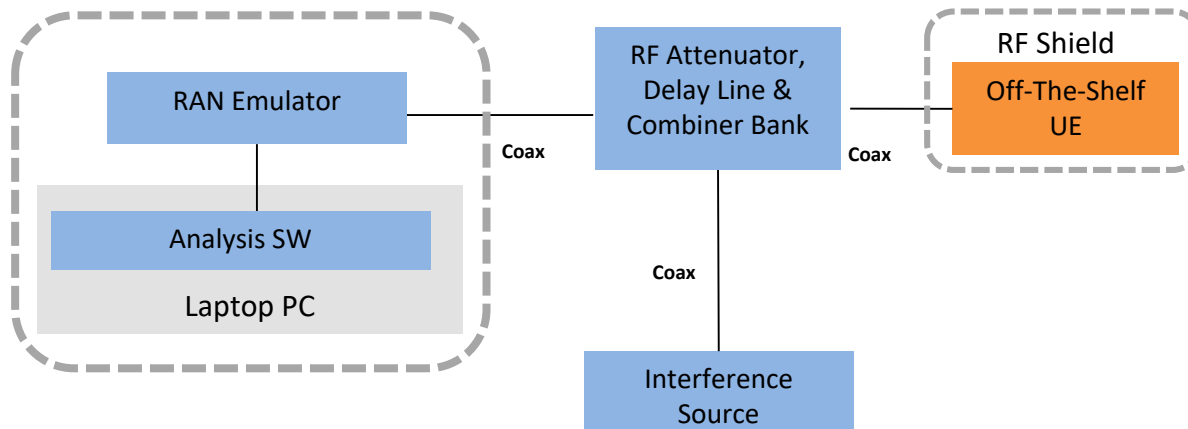
- Flexible configuration for testing in variety of conditions that may “induce” system behaviors covered by claims

5G, 4G/LTE and 3G/HSPA Live Network Testing of Infrastructure and/or UE



- Allows monitoring protocol interactions between UE (User Equipment) and network and test BTS (Base Transceiver Station) behavior.
- Instrumented UE that runs software that monitors baseband processor to collect evidence.
- TEMS (Test Mobile System) Investigation Software on a laptop.

5G, 4G/LTE and 3G/HSPA Captive Testing of UE



- Instrument can emulate multiple Node Base Stations, other RAN nodes, Core Network.
- Can cover multi-RAT scenarios.

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