

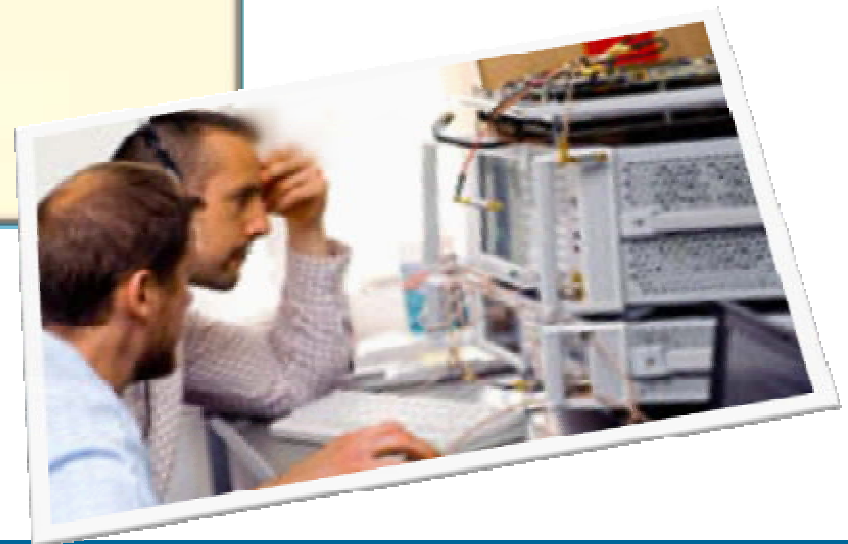
Various New Wireless technologies and test Solutions



Seung-Chul Shin
Application Engineer
Agilent Technologies

Agenda

1. HSPA+, E-EDGE
2. Battery drain test
3. A-GPS
4. DigiRF
5. Femtocell

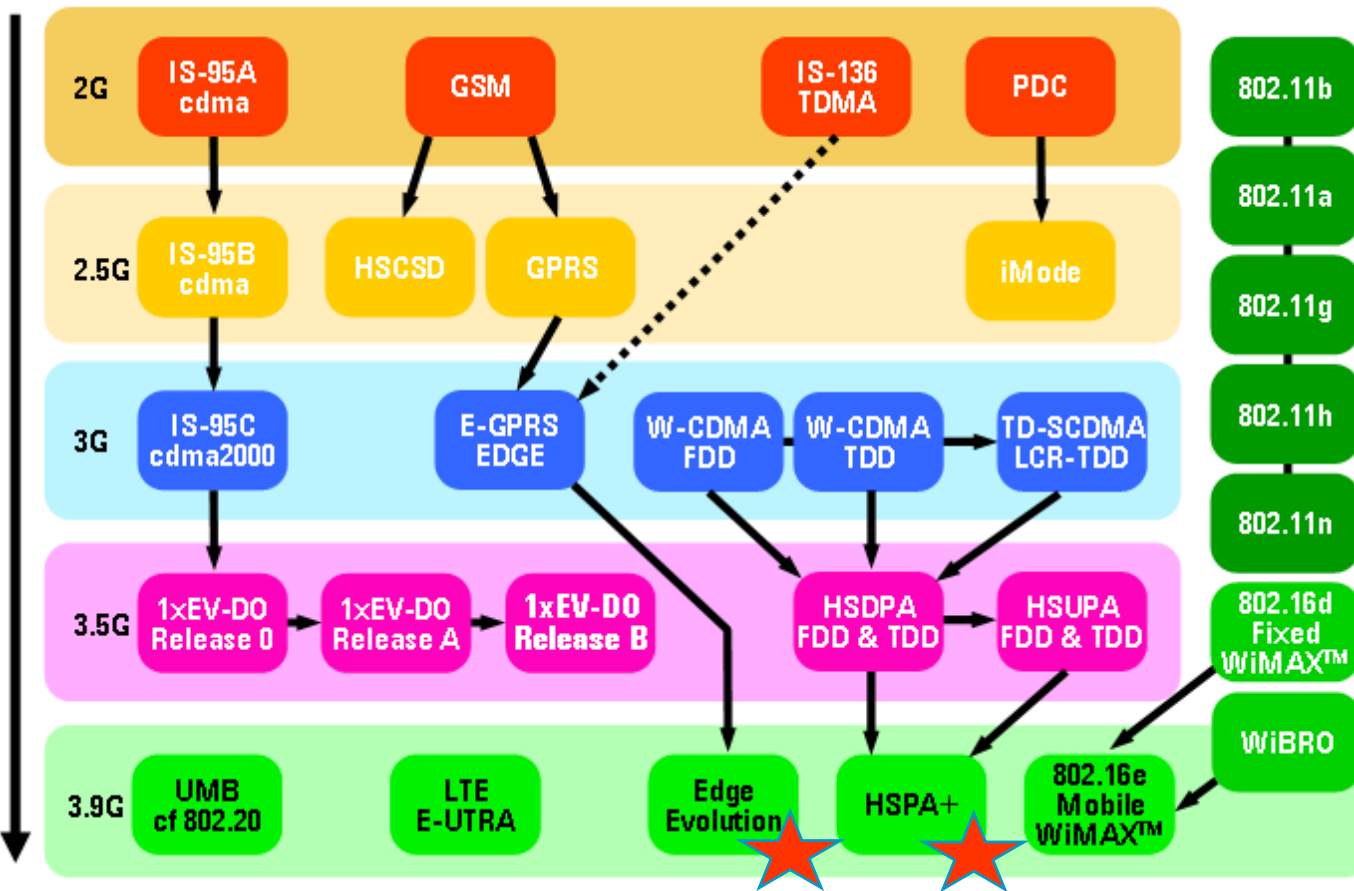


Enabling Market Drivers

- Mobile music growing to \$11B worldwide by 2011
- Mobile TV subscribers worldwide to exceed 460 Million by 2012
- Mobile broadband computing is a tremendous opportunity; 70M unit opportunity worth some \$50b in 2008
- Mobile workforce is growing – bandwidth & Speed to support enterprise applications necessary
- Most 3G operators currently have upgraded or plan to upgrade HSPA.



Cellular Communication Formats 2G to 3.9G



Why E-EDGE or HSPA+?
For Wireless Operators, Network Equipment Vendors:

Easier: Want to increase & improve the installed based network capacity & latency

Cheaper: Don't want to spend new investment to upgrade from 3G UMTS (WCDMA/HSPA) based network to the 3.9G LTE based one.

Quicker: Cannot wait for the LTE roll-out timing.



What's “HSPA (High Speed Packet Access)”?

Reminder of HSPA concepts

HSPA+

“HSPA” contains both “HSDPA” and “HSUPA”.

HSDPA: High Speed **Downlink** Packet Access

- Evolutional configuration for high rate packet data access for downlink.
- Introduced as a part of 3GPP Release-5, overlaid on the 3GPP Release-99 (W-CDMA)
- Applied the new “HS-” (or “hs-”) channels in PHY, TrCH, MAC layers.
(HS: High Speed (downlink))

HSUPA: High Speed **Uplink** Packet Access

- Evolutional configuration for high rate packet data access for uplink.
- Introduced as a part of 3GPP Release-6, overlaid on the Release-99 (W-CDMA) and Release-5 (HSDPA)
- Applied “E-” (or “e-”) channels in PHY, TrCH, MAC layers.
(E: Enhanced (uplink))



What's “HSPA+ (High Speed Packet Access)”?

Improvements to HSPA

HSPA+

HSPA+, (also known as: *HSPA Evolution*, Evolved HSPA, *I-HSPA* or *Internet HSPA*) is a wireless broadband standard defined in 3GPP release 7.

HSPA+ aims to provide data rates up to 42 Mbit/s on the downlink and 22 Mbit/s on the uplink

Uses MIMO technologies and higher order modulation to achieve these higher data rates.

It also introduces an optional all-IP architecture for the network where base stations are directly connected to the internet.

HSPA+ should not be confused with LTE, which uses a new air interface.



HSDPA (DL), HSUPA (UL) vs. HSPA+ (DL, UL)

Quick Comparison

HSPA+

		HSDPA (DL)	HSUPA (UL)	HSPA+ (DL)	HSPA+ (UL)
3GPP PHY Standard		Release-5	Release-6	Release-7	Release-7
Peak Data Rate		14 Mbps (best effort)	5.76Mbps (best effort)	21 Mbps MIMO:28/42 Mbps (best effort)	11.5 Mbps (best effort)
Multiple Access		CDMA & TDMA	TDMA & Scramble Code Corr	CDMA & TDMA	TDMA & Scramble Code Corr
Data Chan		Shared (Packet)	Dedicated (Packet)	Shared (Packet)	Dedicated (Packet)
	Modulation	QPSK, 16QAM (AMC)	BPSK	QPSK, 16QAM (2x2 MIMO AMC) & 64QAM (AMC)	BPSK, 4PAM (a.k.a 16QAM)
	Spread Factor (symbol / sec)	1x ~ 15x SF16 (1x240k ~ 15x 240k)	SF256 ~ 2xSF4 + 2xSF2 (15ksps ~ 2x960k + 2x1920k)	1x ~ 15x SF16 (1x240k ~ 15x 240k)	SF256 ~ 2xSF4 + 2xSF2 (15ksps ~ 2x960k + 2x1920k)
	Packet Retransmission	Hybrid-ARQ w. CC/IR	Hybrid-ARQ w. IR	Hybrid-ARQ w. CC/IR	Hybrid-ARQ w. IR
TrCH (Transport Channel)		HS-DSCH	E-DCH	HS-DSCH	E-DCH



Transmitter Testing

HSPA+

New items to be aware of:

Modulation Analysis & Code Domain measurement

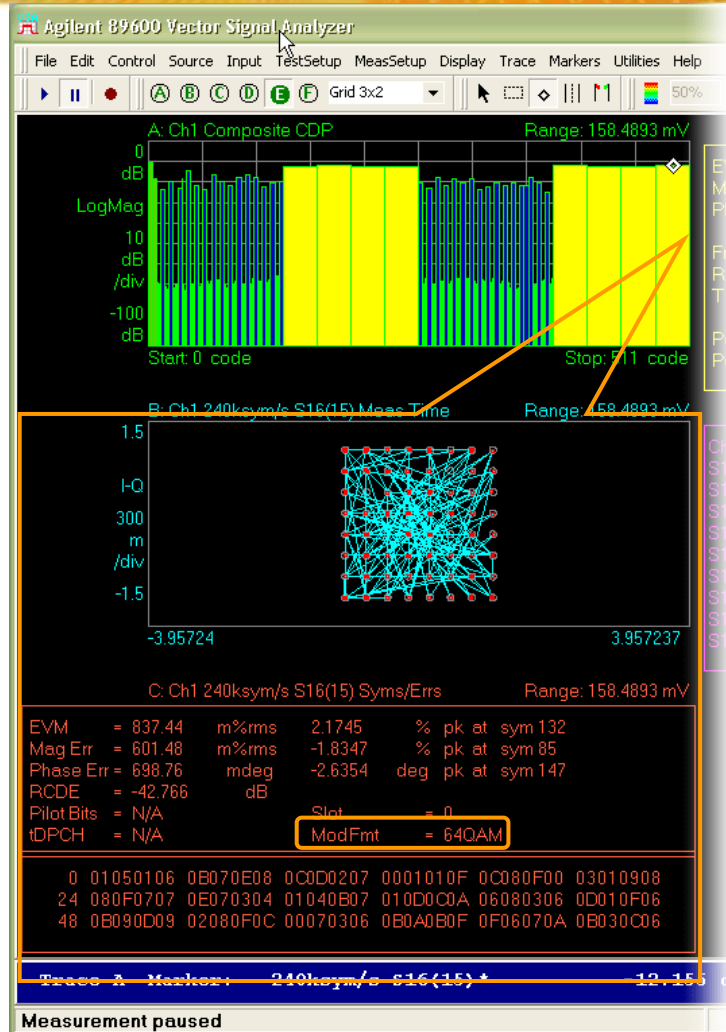
- Downlink Test Model 6 (HS-PDSCH in 64QAM)
- Downlink/Uplink Relative Code Domain Error (R-CDE)
- Uplink 4PAM-I/Q (like 16QAM)



New “Test Model 6” for 64QAM HSPA+ test

HSPA+

TS25.141 BTS Conformance Test: 6.1.1.4B Test Model 6



- Code set and locations are the same as the “Test Model 5 with 8 HS-PDSCH”, defined in 3GPP TS25.141 section 6.1.1.4A. The differences are:
 - All 8 HS-PDSCH code channels are modulated with 64QAM
 - Code power profile among HS-PDSCH and DPCH are slightly different.
- Test Model 6 is used for the new “RCDE” requirement, defined in 3GPP TS25.141 section 6.7.4.

8960 HSPA+ Roadmap for LA

Available Now (as of May 2009)

- 64QAM DL
- Layer 2 MAC-ehs/e/hs signaling
- Loopback to HSUPA or WCDMA
- H-Set 8 with 64QAM
- HSPA+ feature option on E1963A TA
- HSPA+ DL in FDD test and RB test modes
- HSPA+ DL IP data channel

For Future Consideration

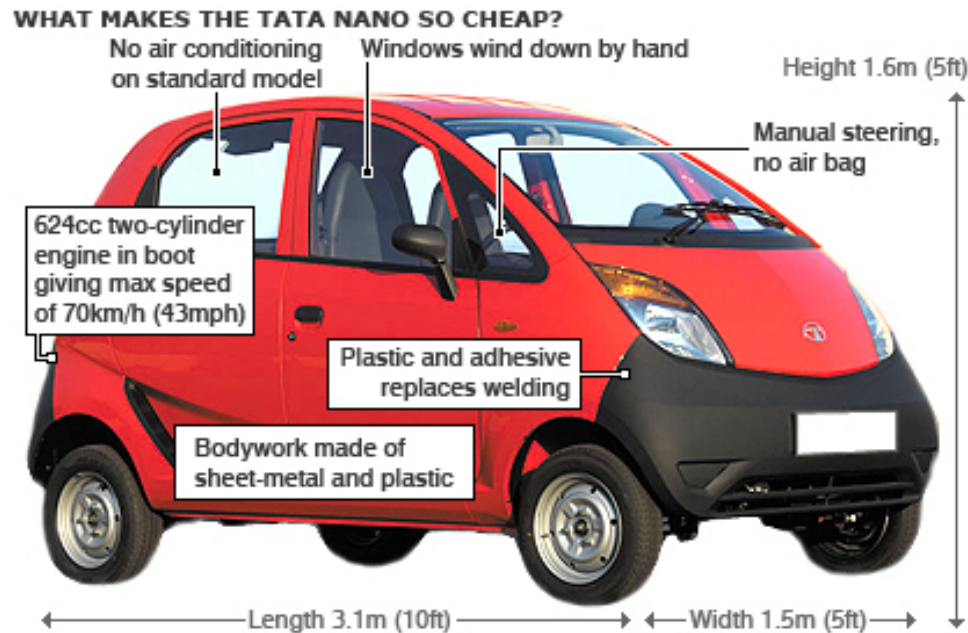
- 16QAM uplink with loopback
- 16QAM Tx measurements



Lets compare the battle for the mass car market to the cellular market. Quiz: Which is faster ?

Tata Nano
\$2,500

Bugatti Veyron
\$1,500,000



(EDGE Evolution <1Mbps)

(LTE ~300Mbps)



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Answer: It's ALL Relative



What's "EDGE Evolution"?

E-EDGE

EDGE = Enhanced Data rates for Global System for Mobile communications Evolution

EDGE Evolution = Enhanced Data rates for Global System for Mobile communications Evolution, Evolution

(also known as: E-EDGE (Evolved-EDGE), GERAN evolution)

- Standards working group uses the term REDHOT: Reduced symbol Duration, Higher Order modulation and Turbo codes
- Standards working group also uses the term HUGE: Higher Uplink performance for Geran Evolution
- Introduced as a part of 3GPP Rel-7



Improvements to EDGE

- Latencies are reduced by lowering the Transmission Time Interval by half (from 20 ms to 10 ms).
- Bit rates are increased and latencies down using dual carriers, higher symbol rate and higher-order modulation (16QAM and 32QAM as well as 8-PSK), and turbo codes to improve error correction.
- Signal quality is improved using dual antennas.

An EDGE Evolution terminal or network can support some of these improvements, or roll them out in stages.



8960 E-EDGE Roadmap

Available Now (as of May 2009)

- Reduced Transmission Time Interval (RTTI)
- Downlink Dual Carrier (DLDC)
- SSN-based fast Ack/Nack reporting (FANR)
- Wireless Protocol Advisor (WPA) support
- Time-based FANR
- Selectable UL ARFCN in DLDC

Planned for Release in Q4 2009

- EGPRS 2A downlink (16QAM, 32QAM)
- Evolved EDGE feature option for E1968A TA

For Future Consideration

- EGPRS 2A uplink (16QAM, 32QAM)
- DTM with RTTI, DLDC and FANR
- Two-box handovers with evolved EDGE



Battery Life is #1 Problem for Smartphones

To fully optimize battery life must consider battery drain at all stages of development: RF HW design, integration, SW apps, validation

Existing test processes do not use realistic test scenarios to simulate device battery usage.

➤ Must go beyond Talk Time testing to include more realistic testing for battery life

14565B Battery Drain software measures voltage and current characteristics → now can add real-world stimulus with the 8960.

Only Agilent provides a battery drain test solution that provides “User Profile” stimulus to enable real-world battery drain test.



Consumers are Frustrated... and Creative

Thread Tools ▾

Display Modes ▾

10-25-2008, 07:55 PM

#1

Michael982

Join Date: Oct 2008
Posts: 8
Thanks: 0
Thanked 1 Time in 1 Post

Actually, I prefer Yahoo.

my g1 gets pretty bad battery life, so i decided to find ways to extend it and ran across this

it shows a couple of simple but useful tips on extending the battery
<http://www.betanews.com/article/Maki...ble/1224792772>

im going to try the tips for now to see how much of a difference there is, if anyone else has some useful tips please post them here!!!

quote

10-25-2008, 11:17 PM

#2

Poseidon79

Join Date: Oct 2008
Posts: 8
Thanks: 1
Thanked 0 Times in 0 Posts

Actually, I prefer Yahoo.

Pretty much just like the iPhone 3G... turn off 3G, wifi, bluetooth, GPS, fetch less often. extra 1/2 day or so.

quote



User Profiles: Go Beyond Voice Usage

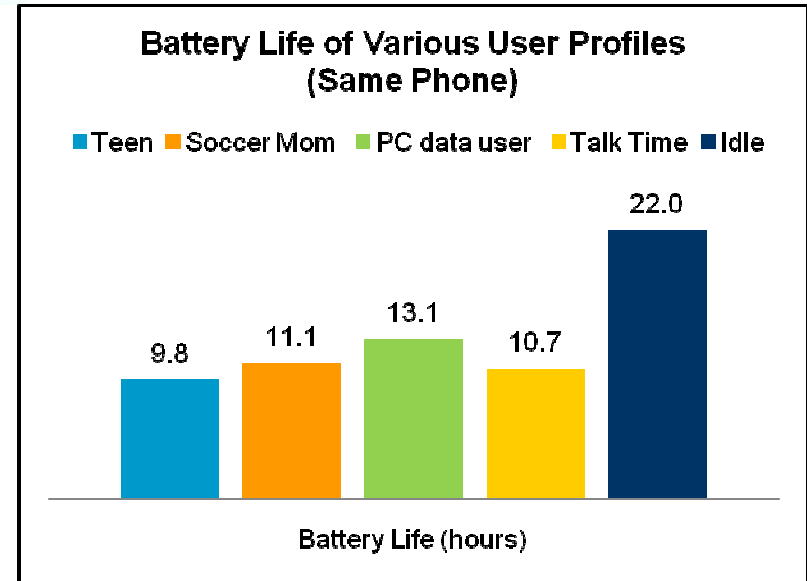
Stimulus	Teen	Soccer Mom	PC data user	Business user	Grandparent
Data Download	10%	10%	70%	20%	5%
Data Upload	0%	0%	20%	5%	0%
Content Type	http, streaming, UDP	Traditional talk time testing	ftp,http, UDP, streaming	ftp,http,UDP, streaming	http
Voice Usage	20%		0%	40%	90%
Modem Usage	0%	0%	100%	10%	0%
SMS Usage	60%	20%	0%	20%	5%
MMS usage	10%	0%	0%	5%	0%
E-mail	5%	5%	10%	50%	0%
Cell Mobility	Range: -95 to -30 dBm Occurrence: 50%	Range: -105 to -30 dBm Occurrence: 70%	Range: -85 to -30 dBm Occurrence: 15%	Range: -105 to -30 dBm Occurrence: 70%	Range: -95 to -30 dBm Occurrence: 50%
Handovers	40%	70%	15%	70%	50%
Back Light	70%	40%	20%	60%	20%



Battery Drain enhancements

Battery performance needs to be expanded beyond Talk Time to include realistic user profile testing

- Test with realistic user scenarios (simultaneous activities and user profiles)
- Provide empirical data to contrast, correlate, validate and support component models

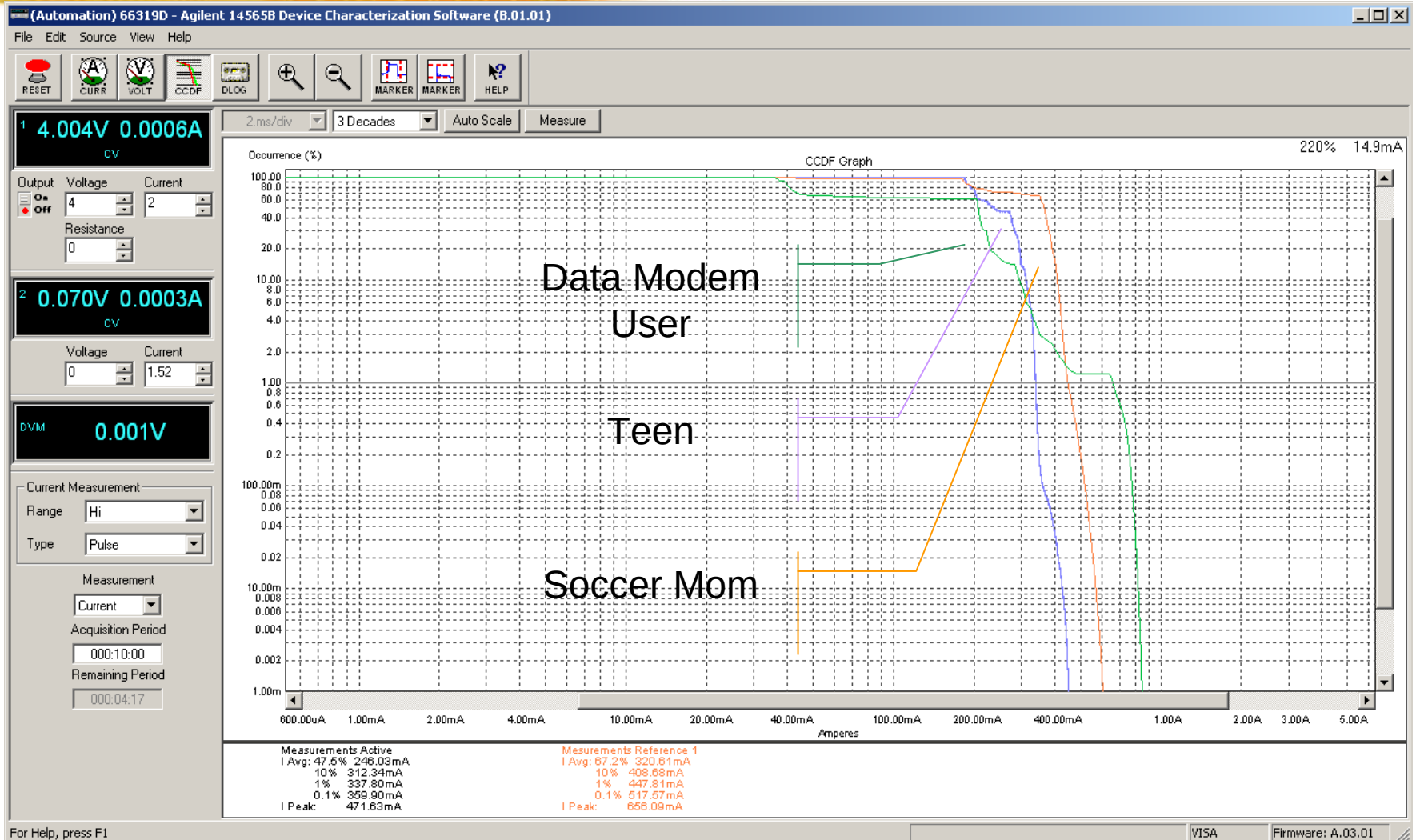


Each user will have a different experience using the same device.

	Teen	Soccer Mom	PC data user	Talk Time	Idle
Average Current (mA)	389	318	238	343	55
Peak Current (mA)	555	819	842	671	656
Battery Life (hours)	9.8	11.1	13.1	10.7	22.0

Assumes 1200 mAh battery capacity

Current Drain variations based on User Profiles



For Help, press F1

VISA

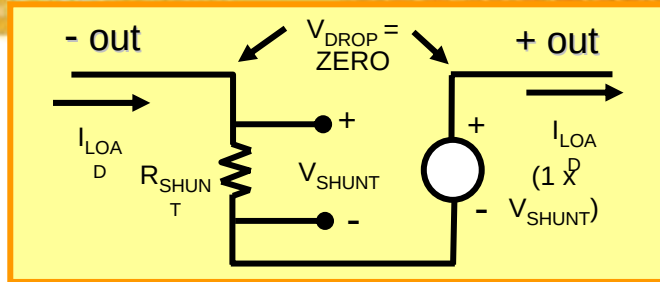
Firmware: A.03.01



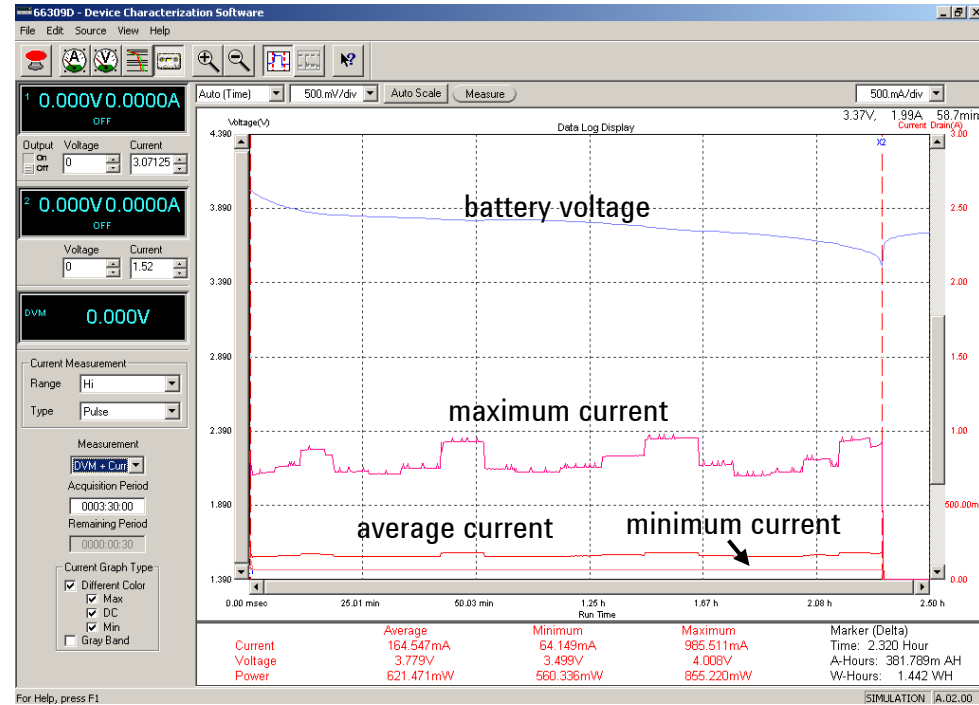
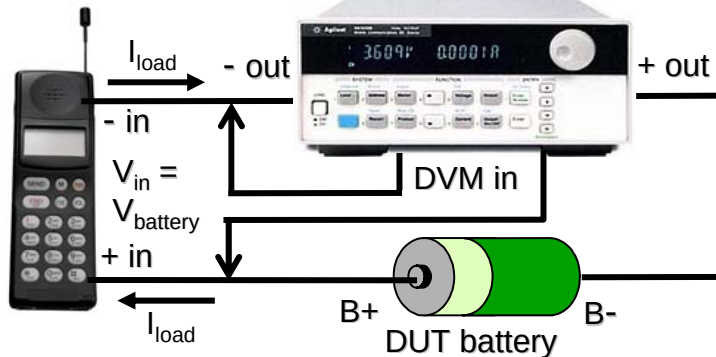
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Insightful Real World Battery Run-down Testing

Zero-burden active shunt concept



Output set to 0 volts



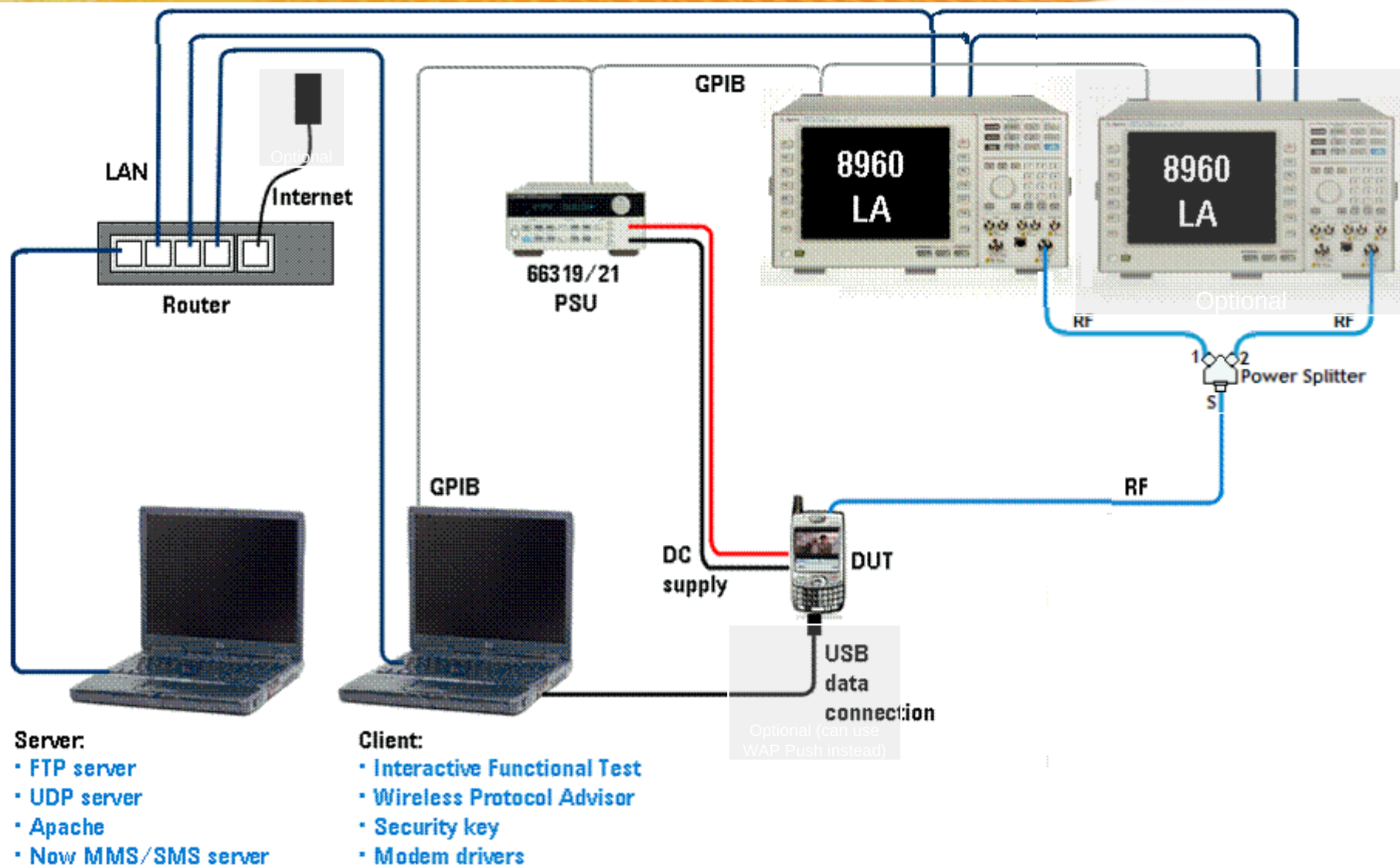
Agilent 66319B DC source output set to zero volts and connected in series becomes zero burden active shunt:

- Use actual DUT battery, real world results
- No shunt V drop, DUT sees full battery voltage
- DUT sees actual battery impedance only
- DVM input logs actual battery run-down voltage

Agilent 14565B software capturing the talk time battery run-down of a GSM handset :

- Characterize and validate DUT and its battery together
- Determine Amp-Hours and Watt-Hours actually delivered
- Verify low voltage shut-down termination

IFT (N5970A)/8960/14565B Solution Diagram



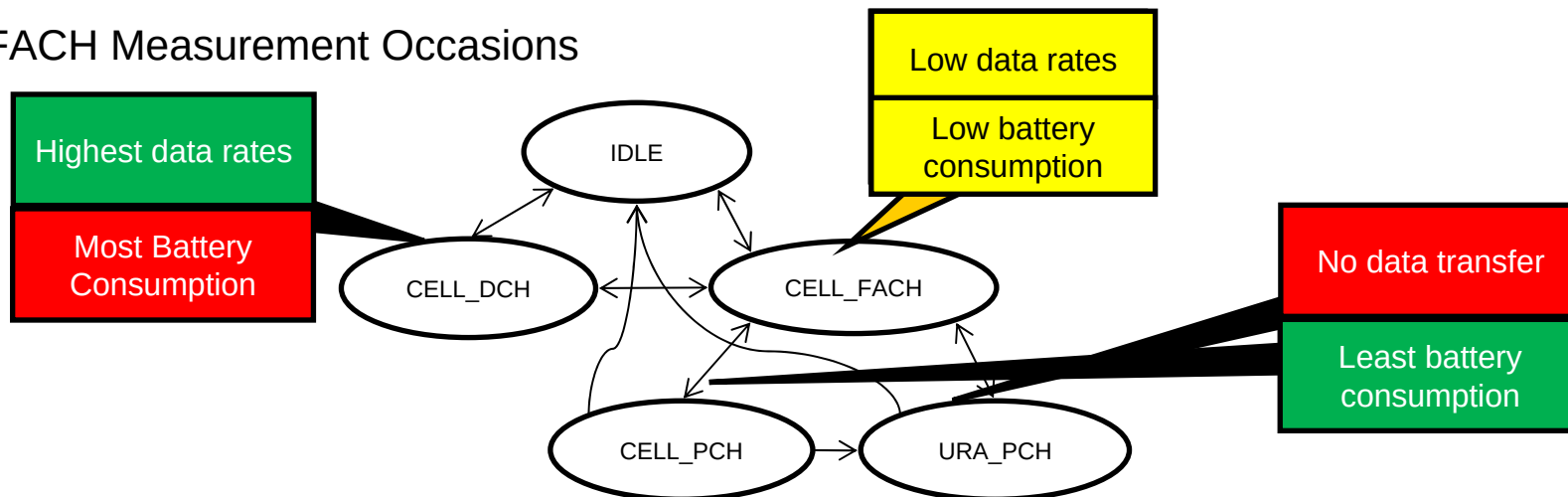
What's New with the 8960: Battery Drain

RRC state transitions: UE states defined for packet-switched data to provide high network capacity while optimizing user experience and device battery life

- Evaluate mobile transition behaviors between Idle, CELL_DCH, CELL_FACH, CELL_PCH, and URA_PCH
- Assess realistic battery life with different CELL_FACH timer scenarios

What's new May 2009:

- RRC state transitions with HSPA
- Automatic RRC state transitions based on settable inactivity timers
- FACH Measurement Occasions



Battery life tests

Current battery life tests do not take into account concurrent (or simultaneous) data-driven based activities

End-users are dissatisfied with device battery life

Wireless devices will continue to grow in complexity

Service Providers are changing their testing techniques

Use accurate “User profiles” for realistic prediction and validation of battery life of 3G mobile devices

Agilent is the only solution for real-world battery test

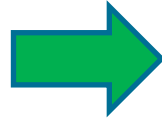
- User profile testing is enabled by the 8960's data test capabilities and IFT automation



Position Location using pure GPS vs. A-GPS

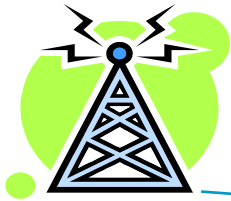
A mobile phone can use **GPS** satellites to calculate its location...**but**

- It takes a long time to find satellites (GPS time to fix up to 12.5 minutes)
- Accuracy is poor indoors/under cover
- It drains battery life



A-GPS (Assisted GPS) development was driven by U.S. FCC E911 requirement to quickly provide cell phone location to emergency call dispatchers. A-GPS provides the mobile with knowledge of the GPS satellites.

A-GPS brings the Time to First Fix down to seconds vs. **minutes**

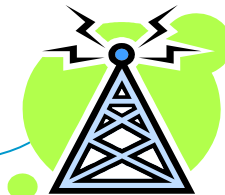


“assistance data” is provided by the base station to help the mobile find the GPS satellites more quickly.

The wireless device looks for the GPS satellites and determines its location



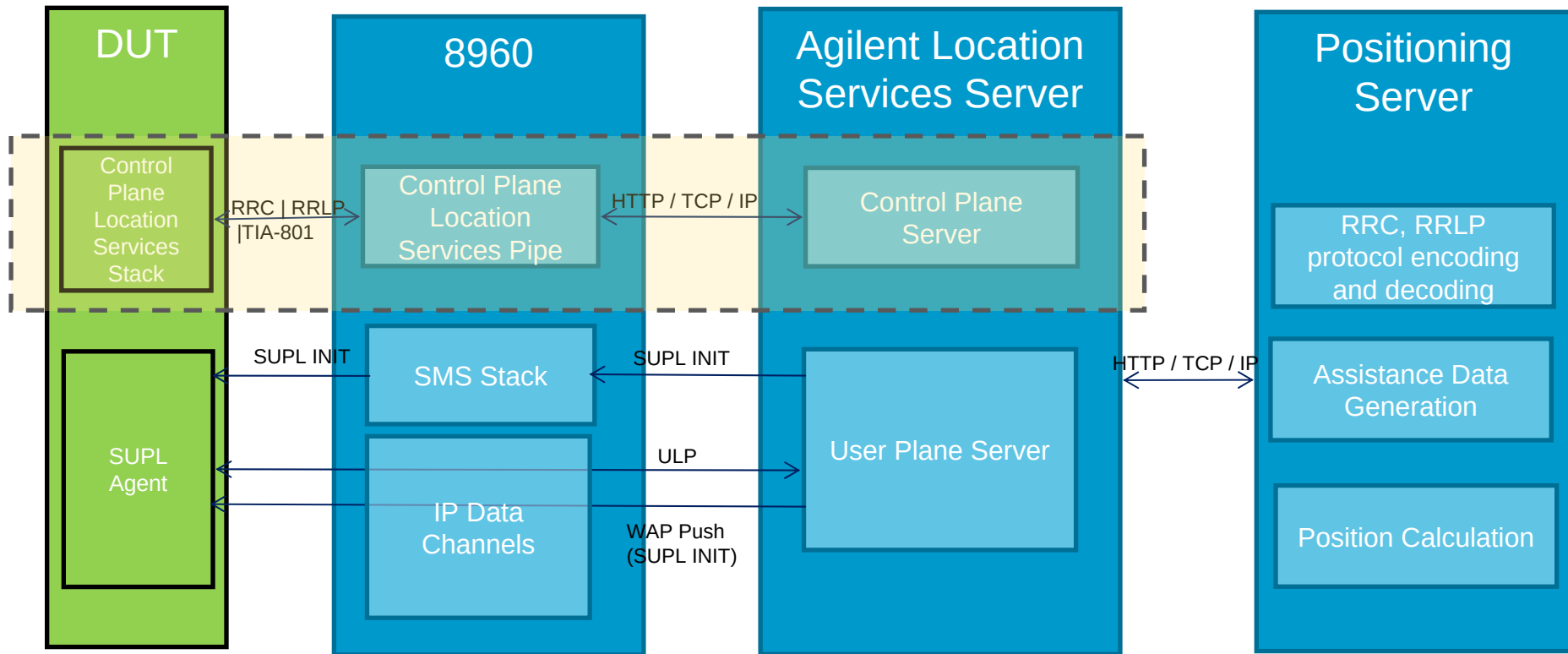
The wireless device then reports its location back to the base station



A-GPS Control Plane vs. SUPL (Secure User Plane)

2 methodologies for sending and receiving assistance data:

- Control Plane
- SUPL



A-GPS Test Requirements

Service Providers are using A-GPS as a basis for revenue-generating services.

Want assurance that cellular calls do not interfere with A-GPS performance

TIS (Total Isotropic Sensitivity) Testing

Required by key US Service Providers

Repetitive A-GPS sensitivity measurements over varied antenna positions

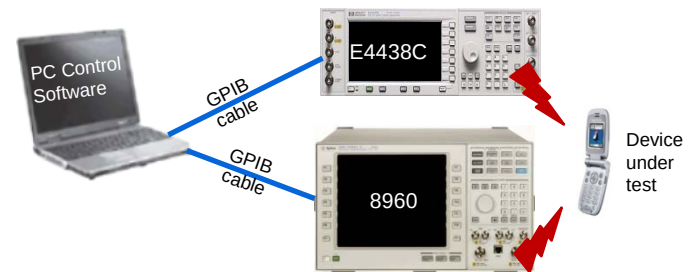
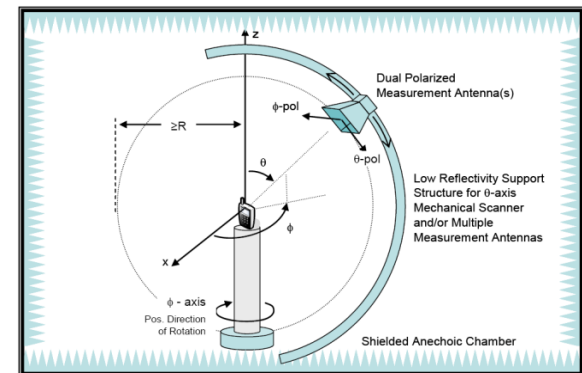
CTIA provides standardized method of test and requirements

Bench-Top Functional Testing

Validates general A-GPS functionality

- Does device see the right # of satellites?
- Is device reporting proper satellite ID?
- Is the carrier to noise ratio reported acceptable?

FIGURE A-7 TYPICAL SETUP - CONIC CUT - FREE SPACE



Agilent A-GPS Test Solution



Types of Assistance Data Messages Supported:

- 2G A-GPS Testing: 8960 supports piping of RRLP assistance data message.
- 3G A-GPS Testing: 8960 supports RRC assistance data message.
- No SUPL server support

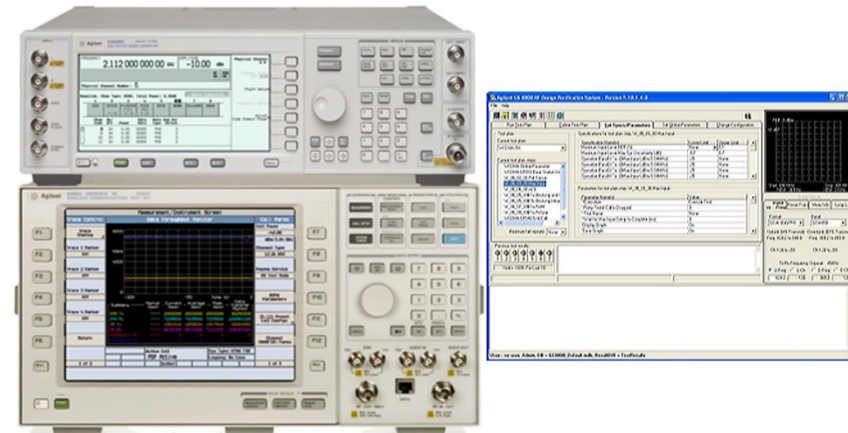
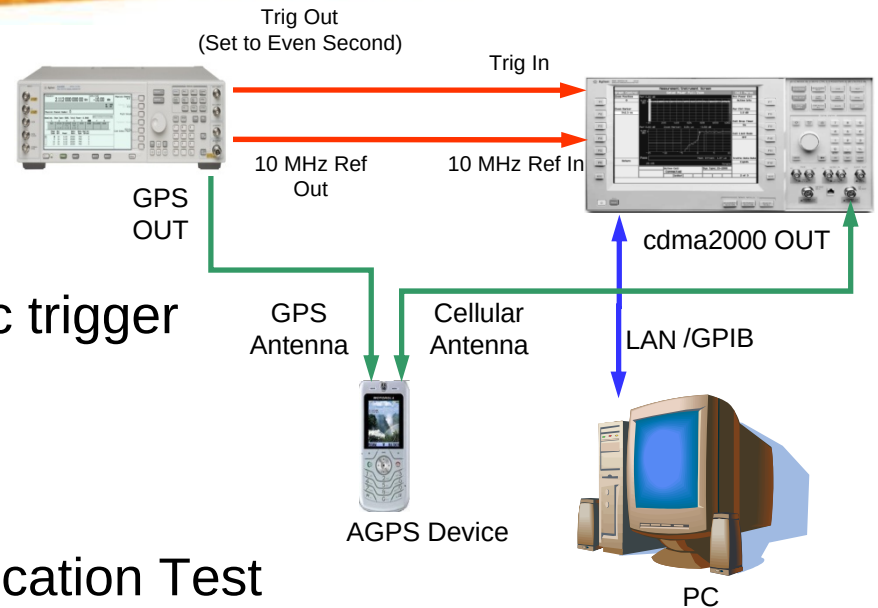
Test results:

- GPS Time of Week (TOW)
- Number of Satellites
- Satellite Identification (ID) Number
- Time to First Fix (TTFF)
- Carrier to Noise Ratio (C/No)



What's New with the 8960 for A-GPS testing

- A-GPS now supported for cdma2000:
 - A-GPS message pipe
 - Settable system time external sync trigger
- A-GPS enhancements for UMTS
- GS-9000 Lite Bench-Top Design Verification Test System



GS-9000 Lite A-GPS test example with WCDMA

Agilent GS-9000 A-GPPS Design Verification Test System - Version DVT.0.9.0.0

File Help

Run Test Plan Define Test Plan Set Specs/Parameters Set Global Parameters Change Configuration

Test control
Current test plan: AGPS_Demo_NA

Run Test Plan
View Test Conditions

DUT Serial Number

Test Title Measured Value

- ✓ WCDMA Origination Passed PASS
- Testing AGPS Nominal Accuracy Test
- ✓ Time to First Fix = 5.00 sec
- WCDMA CP010 Base Station Initiated Call 0.00 sec
- ✓ Time Advance =
- AGPS Nominal Accuracy Test MSB Result
- ✓ Longitude -84.3834543 degree
- ✓ Latitude 33.7498498 degree
- ✓ Distance Error 12.6940619 meter
- ✓ Longitude Actual -84.3833360 degree
- ✓ Latitude Actual 33.7500050 degree

Result = "800000010221F917886542017FFF921FF380"
Current Scenario File = AGPS_0008E_16SEP
Total RF Power = -40.9691001300806dBm

Previous test results
1 2 3 4 5 6 7
Yield = 90% For Last 10

Passed

Passed = 31 Failed = 0 Test Time = 98.62 Sec

Test Title	Measured Value	Lower Limit	Upper Limit	Pass/Failed
WCDMA End Ca...	PASS	PASS	PASS	PASS

User : no user, Admin, DB = GS8800_Default.mdb, ResultDIR = RunTime

Calculated Time to First Fix (TTFF)

Longitude and Latitude reported by the wireless device

Distance Error calculated based on reported longitude and latitude versus actual longitude and latitude



A-GPS Testing Using the Agilent 8960

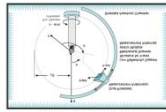
Functional
Testing



GS-9000 Lite Bench-Top Design Verification Test System

8960 LA, E4438C ESG, PC SW with test scripts

- A-GPS pipe for UMTS and cdma2000
- SUPL Server (Available standalone July 2009, integrated with system late 2009)



Over the Air TIS Antenna Testing

Industry partner antenna chamber with 8960 LA + E4438C ESG

- 8960 integrated into chamber test solutions from ETS-Lindgren and Satimo
- Presently integrated with UMTS LAs, currently working on cdma2000 integration



Pre-Conformance Testing

GS-9000 (8960 LA and E4438C ESG) planned 2009

- Provides 3GPP-specified test validation
- SUPL Server

Pre-Conformance
Testing

Additional 8960 functionality: Single channel GPS source for GPS receiver calibration – emulates a single satellite (available in the test application and lab application)



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DigRF v4 Overview

- Multi gigabit high speed serial interface to connect BB and RF-ICs
- Bus specification in mobile devices
- Mobile Industry Processor Interface (MIPI) Alliance, active standard body with key IC and handset vendors as board members
- Multilane (x2)
- Packet & protocol based
- Power saving modes and fast wake up

intel



TEXAS
INSTRUMENTS



MOTOROLA

NOKIA
Connecting People



MIPI® Alliance

www.mipi.org

Protocol
Standard

DigRF
v4

DigRF
v3

CSI
Camera
Interface

DSI
Display
Interface

Physical
Standard

M-PHY

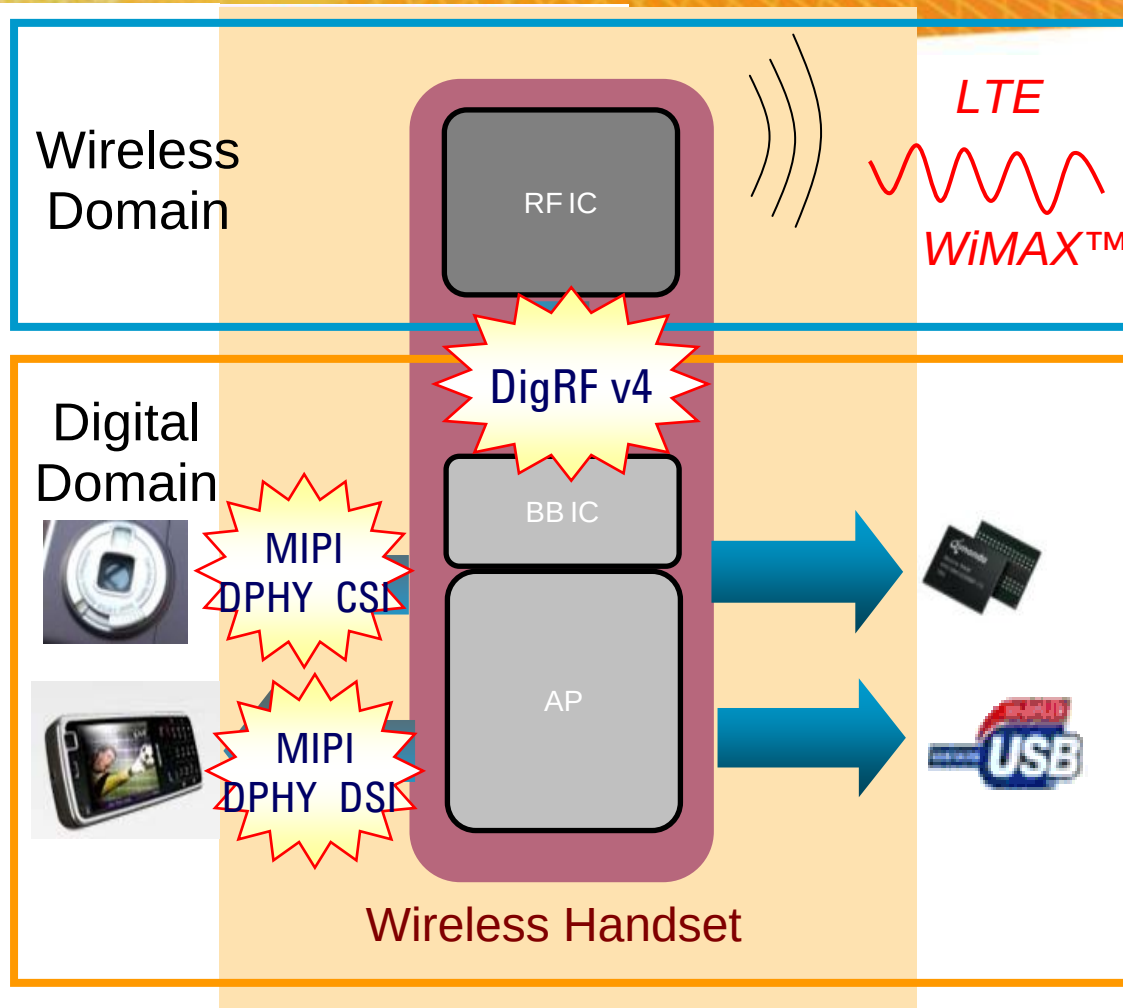
D-PHY



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MIPI® Standard Digital Interconnects



intel®



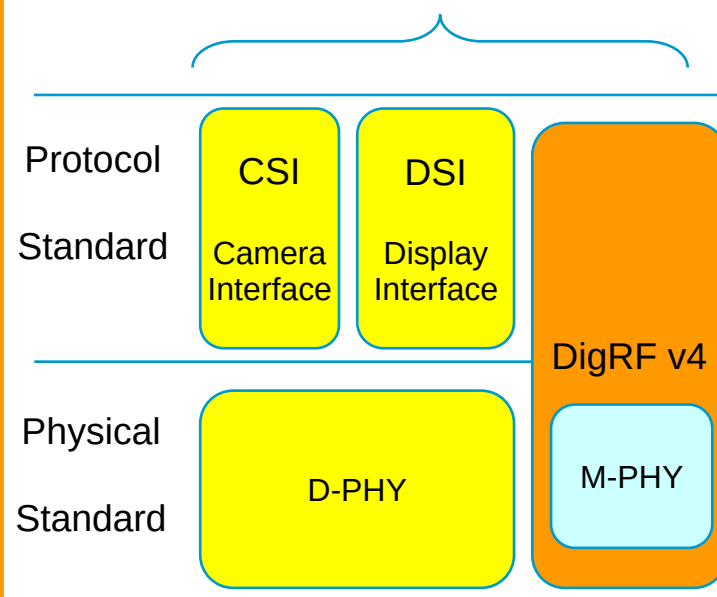
NOKIA
Connecting People

TEXAS
INSTRUMENTS



MIPI® Alliance

www.mipi.org



Agilent is a Contributor Member of the MIPI® Alliance

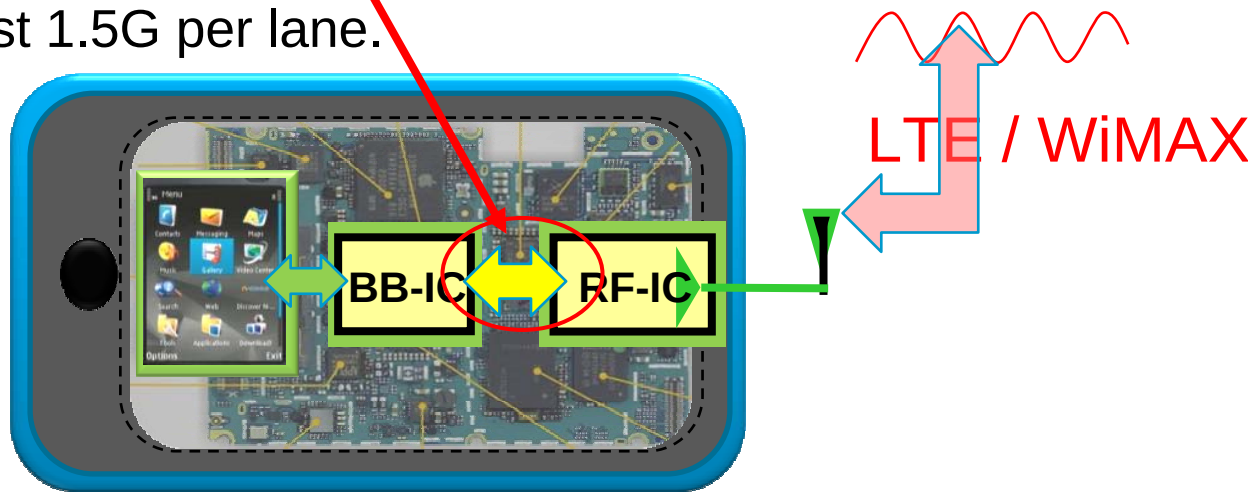


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What is the impact of DigRF v4 on LTE & WiMAX™ ?

- 3.9G mobile communication standards (LTE, WiMAX) will enable downlink speeds of over 300 MBit/s in MIMO configurations
- LTE requires 1.2 GBit/s net bandwidth on the link between BB-IC and RF-IC (plus control overhead)
- DigRF v4 is the next generation high speed digital protocol that connects a BB-IC and RF-IC in a mobile device, enabling data rates of at least 1.5G per lane.



DigRF v4 is an enabling technology for LTE and WiMAX™



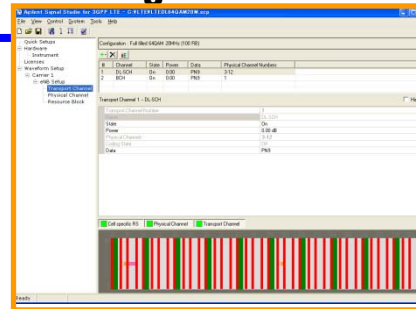
Agilent Solutions for DigRF v4

World first DigRF v3/v4 tester including cross-domain tests with RF, SG and SA

N5343A RDX - DigRF v3/v4 tester for simulation, lane/protocol analysis, and monitor DigRF links of RFIC/BBIC



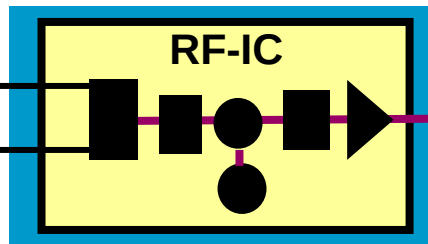
Signal Studio



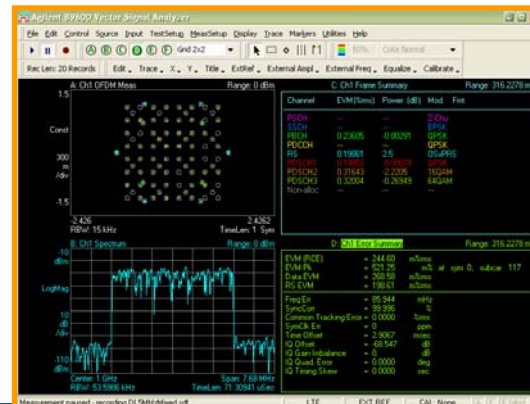
Signal Generator



Tx
Rx



Vector Signal Analysis



Signal/Spectrum Analyzer



LTE / WiMAX™

W-CDMA/HSPA
GSM/EDGE

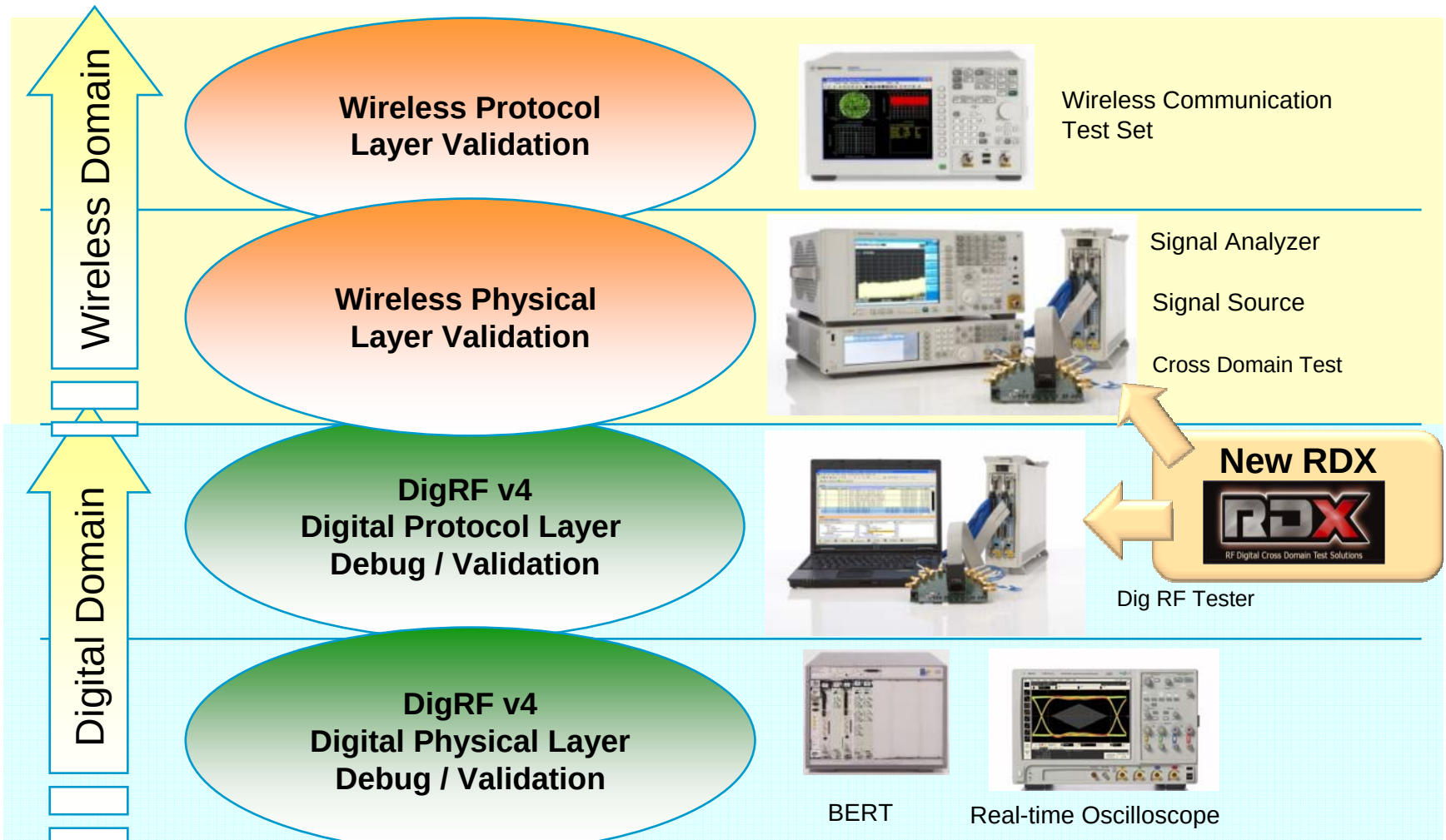
Easy-to-use signal creation & analysis tools for both digital and RF wireless with common software platforms



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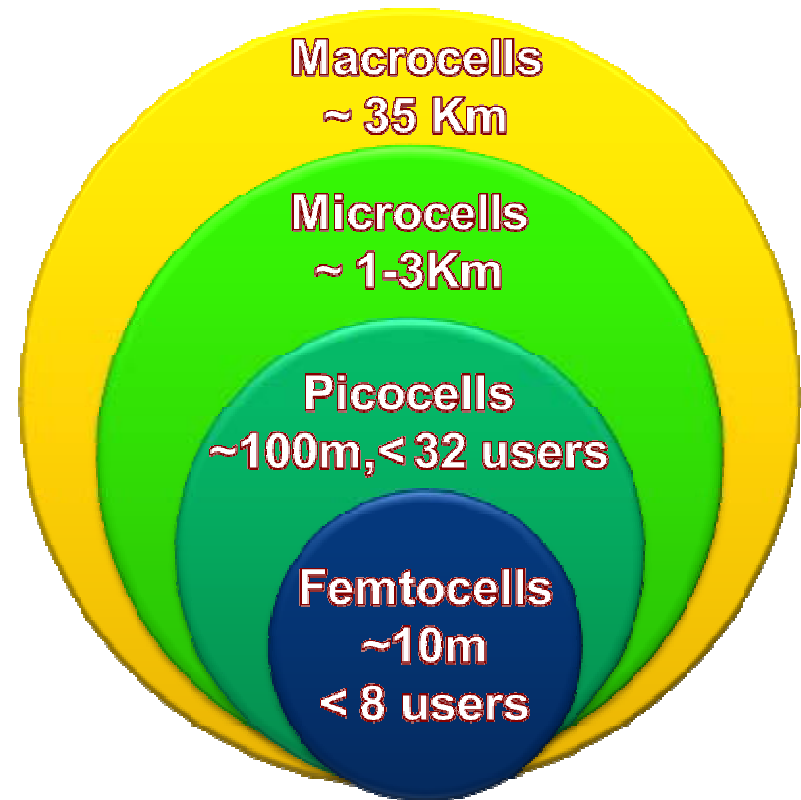
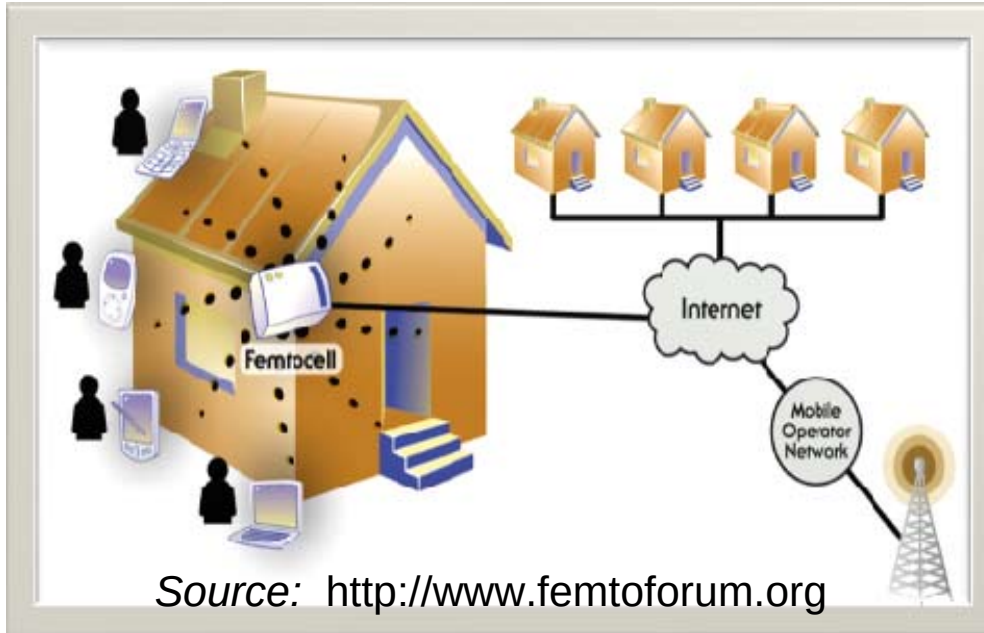
Technology Domains and Test Phases

The dual protocol stack



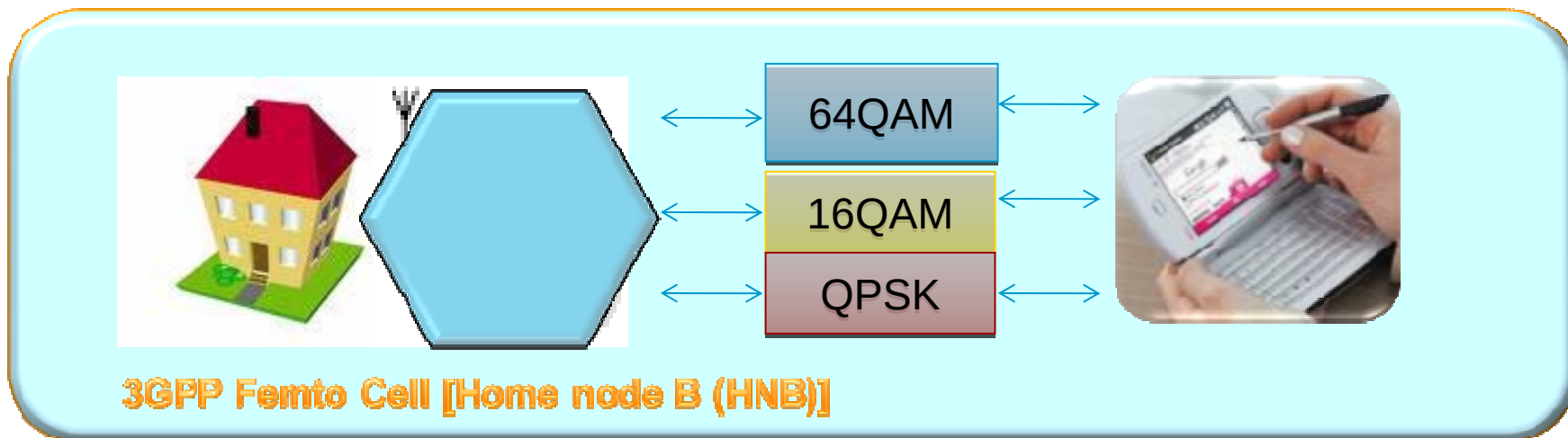
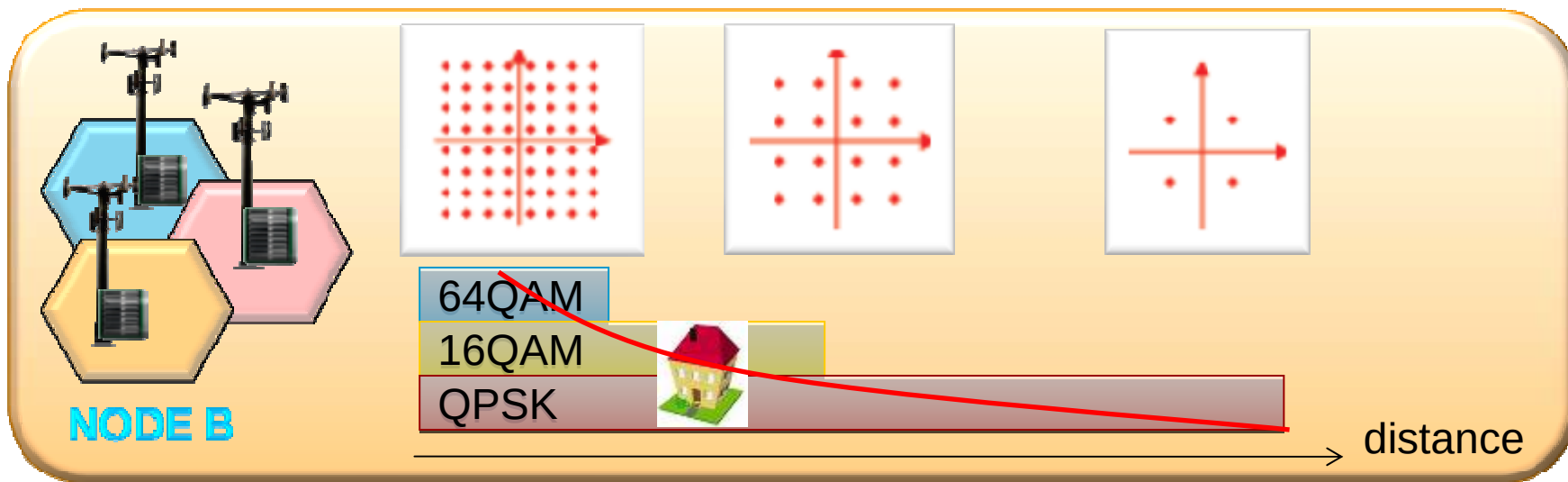
What is a Femtocell?

Femtocells are low-power wireless access points that operate in licensed spectrum to connect standard mobile devices to a mobile operator's network using residential DSL or cable broadband connections.



Why Femtocells?

Node B vs. Femtocell (HNB)



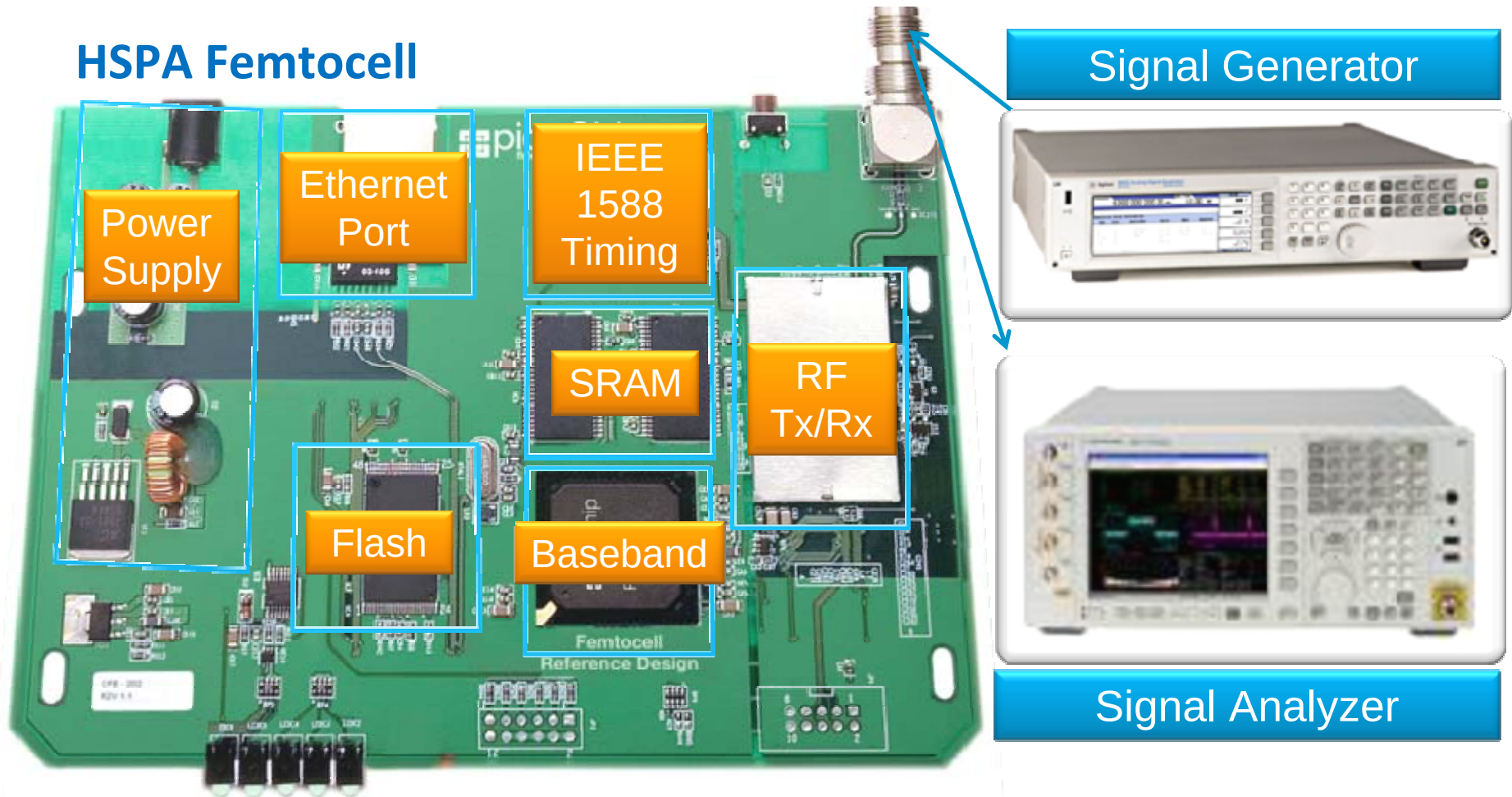
Why Femtocell?

- Weaker indoor coverage at high carrier frequency
- Provisioning of higher data rates for many users by macro cellular coverage
- WLAN/VoIP competition by hybrid WLAN/UMTS terminals
- Backhaul cost to macro sites for high HSPA data rates
- Site acquisition and installation in urban and rural environments
- Network planning and operation



Femtocell Hardware & Test Considerations

HSPA Femtocell



Source: <http://www.picochip.com>



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3GPP Home Node B (HNB): Rx Test requirement

Subset only

Femtocell 25.820 ver 8.2.0	Base-Station 25.104 ver 8.5.0	Specification	HNB Value BER shall not exceed 0.001	Local / Med / Wide range Node B Values BER shall not exceed 0.001
5.4.5.1	7.2.1	Reference sensitivity level	-107dBm	-107dBm/-111dBm /-121dBm
5.4.5.2	7.3.1	Dynamic range	-57dBm	-77dBm/-81dBm /-91dBm
5.4.5.3	7.4.1	Adjacent channel selectivity (ACS)	-91dBm	-101dBm/-105dBm /-115dBm
5.4.5.4.1	7.5.1	<u>Blocking characteristics:</u> Minimum Requirement	-101dBm	-101dBm/-105dBm /-115dBm
5.4.5.4.2	7.5.2	<u>Blocking characteristics:</u> Minimum Requirement - Co- location with GSM900, DCS 1800, PCS1900, GSM850 and/or UTRA FDD	-101dBm	-101dBm/-105dBm /-115dBm
5.4.5.4.3	7.5.3	<u>Blocking characteristics :</u> Minimum Requirement - Co- location with UTRA-TDD	-101dBm	-101dBm/-101dBm /-115dBm
5.4.5.5	7.6.1	Intermodulation characteristics	-101 dBm	-101dB/-105 dBm/-115dBm



3GPP 25.104 ver 8.5.0 2008-12



3GPP Home Node B (HNB): Tx Test requirement

Subset only

Femtocell 25.802 ver 8.2.0	Base-Station 25.104 ver 8.5.0	Specification	Proposed Value	Current Value
5.4.4.2	6.2.1	Maximum Output Power	20 dBm (without MIMO) 17dBm (with MIMO)	38 dBm [Medium range] 24 dBm [local area]
5.4.4.3	6.3.1	Frequency Error	± 0.25 ppm	± 0.1 ppm [Med range] ± 0.05 ppm [Wide range]
5.4.4.4.1	6.6.3.2.1	Spurious emissions - Protection of the BS receiver of own or different BS	same	-82dBm
5.4.4.4.2	6.6.3.4.1	Spurious emissions - Co-existence with co-located and co-sited base stations	same	-70dBm [pico 900/850] , -82dBm
5.4.4.4.3	6.6.3.7.1.1	Spurious emissions - Co-existence with UTRA-TDD	same	-52dBm



3GPP 25.104 ver 8.5.0 2008-12



Agilent Technologies

Femtocell with GPS or AGPS

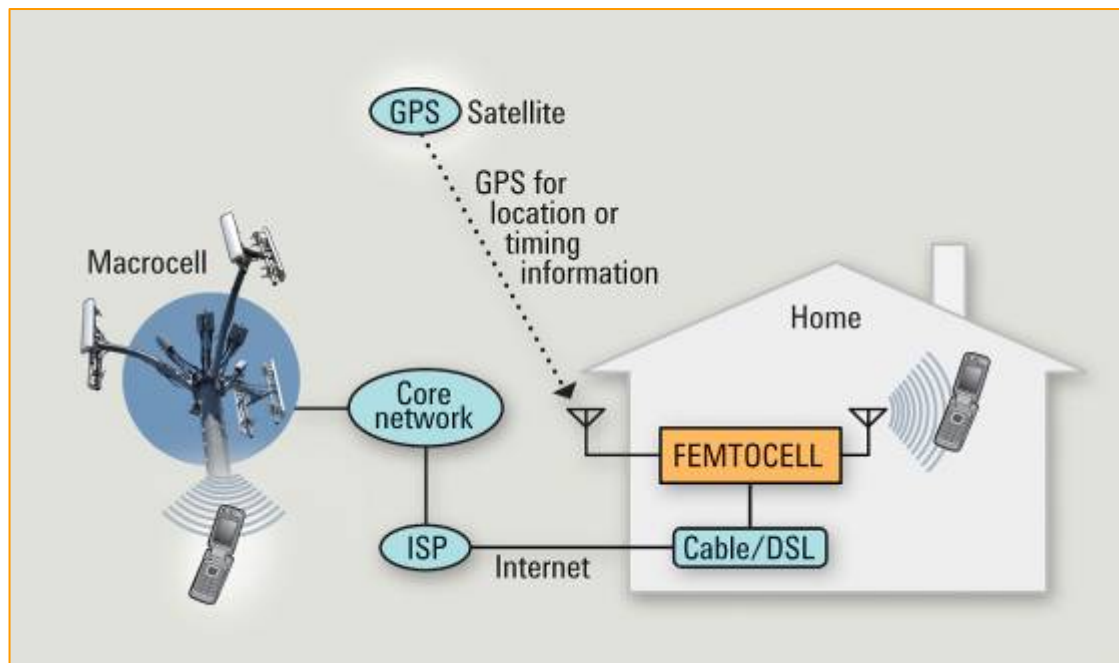
3GPP 34.171 Terminal Conformance Specifications

Why GPS?

- E911- USA emergency location assistance
- System timing & frequency
- Location licensing capability

GPS Rx Verification Tests

- Time To First Fix (TTFF)
- Receiver Sensitivity
- Static Navigation Accuracy
- Reacquisition Time
- Radio-Frequency Interference



Femtocell Test Considerations

Use an Access Point or a Base Station test strategy?



Test Considerations	WLAN	Femtocell	Macro BTS
Cost of Device	Low	Low	High
Volume	High	High	Low
Licensed Spectrum	No	Yes	Yes
Conformance Test	Minimal	Yes	Yes
Multi-format	No	Yes	Yes

Femtocell

- Low Cost Device
- High Volume
- Licensed Spectrum
- Conformance Test
- Multi-format

Test Strategy Implications

- must reduce overall cost of test
- must streamline Mfg test
- meet strict RF requirements
- validate complex functions
- need flexible measurement solutions

Test Solution Implications

- low cost
- high speed, high quality
- high performance
- complex signaling/simulation
- scalable capability & performance



Agilent Femtocell RF Test Solutions

For R&D & Manufacturing

PXB MIMO Rx Tester



MXG Vector Signal Generator



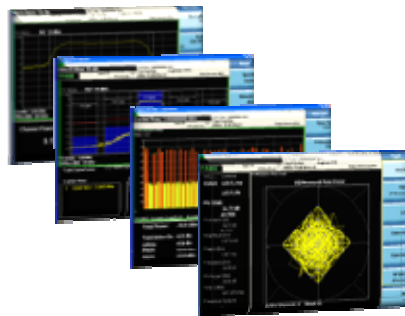
MXA/EXA Signal Analyzer



Signal Studio



Measurement Applications



Scalable Test Solutions

- tailor the capability & performance from single channel to MIMO
- easily upgrade as your test needs evolve
- multi-format application support
 - **W-CDMA, HSPA, LTE, GSM/EDGE, CDMA2000, 1xEV, WiMAX, GPS, WLAN, etc...**

High Performance

- power, accuracy, distortion performance, EVM, dynamic range, bandwidth...

Fast

- switching speed
- measurement speed

Low Cost of Ownership

- best price/performance value
- outstanding reliability minimizes downtime in MFTR
- low maintenance & repair cost
- unrivaled worldwide service & Application Engineer technical support



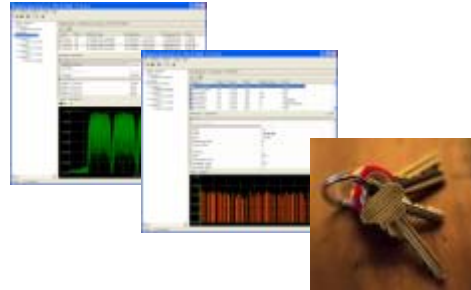
Agilent Femtocell RF Test Solutions

Scalable Test Solutions – only buy what you need

PXB MIMO Rx Tester



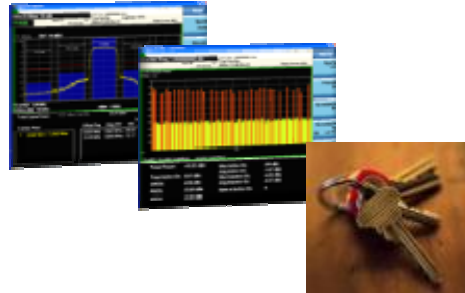
Signal Studio



MXG Vector Signal Generator



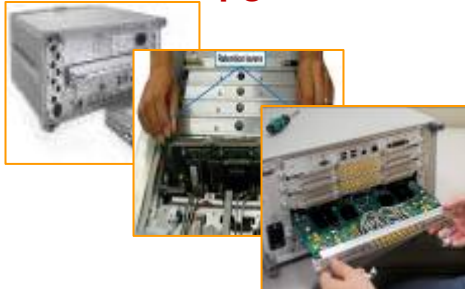
Measurement Applications



MXA/EXA Signal Analyzer



Hardware upgrades



Applications

- W-CDMA/HSPA, LTE FDD & TDD, WiMAX
- GSM/EDGE, cdma2000, 1xEV-DO, WLAN ...

PXB

- From single channel to 2x4 & 4x2 MIMO
- Real-time fading → 1 to 8 channels
- Baseband generator (BBG) → 1 to 4 BBG's
- Leverage existing MXG/ESG/MXA for RF I/O

MXG

- Frequency, Power, Dynamic Range, Switching Speed...
- Bandwidths: 30 → 60 → 125 MSa/s
- BBG memory: 8 → 64 Msa
- Waveform licensing → 5 to 500 waveforms

MXA/EXA

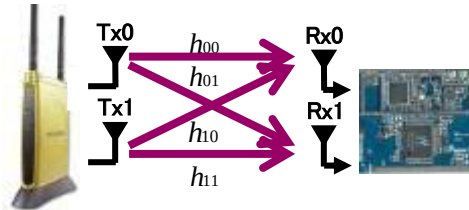
- Frequency, Pre-amp, Noise Figure, Electronic attenuator, SACM, Phase Noise...
- Bandwidth → 10MHz, → 25MHz
- 89601A Vector Signal Analyzer software inside
- Analog baseband IQ inputs



Agilent Femtocell RF Test Solutions

High Performance

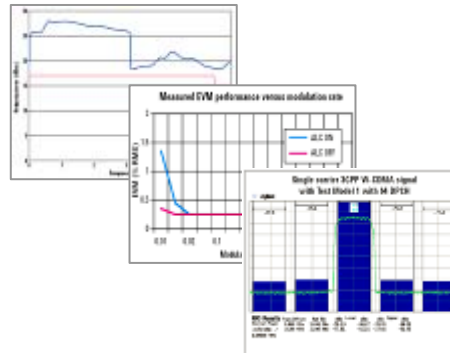
PXB MIMO Rx Tester



PXB

- 2x2, 2x4, & 4x2 MIMO in one box
- Up to 8 real-time faders & 4 baseband generators (BBG)
- Up to 120 MHz real-time fading BW
- Up to 24 paths per fader
- 120 MHz BW & 512 MSa of memory per BBG

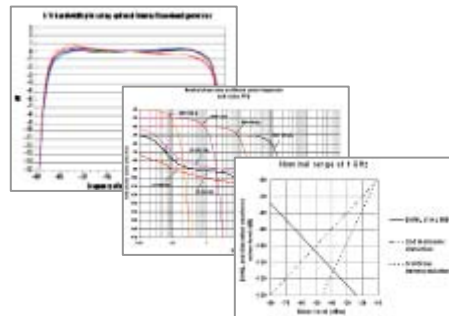
MXG Vector Signal Generator



MXG

- High output power → up to +23 dBm
- Best ACPR → up to -73 dBc W-CDMA TM1 64 DPCH
- Excellent EVM → 0.8% W-CDMA 1 DPCH
- 100 MHz BW & 64 MSa of memory
- MIMO/RF coherency options

MXA/EXA Signal Analyzer



MXA/EXA

- TOI (@ 2GHz): +15/+13 dBm
- DANL (@ 2GHz): -151/-146 dBm/Hz
- ϕ Noise: -103/-98 dBc/Hz (@10 kHz offset)
-133/-130 dBc/Hz (@ 1 MHz offset)
- W-CDMA ACLR: -73/-68 dBc (@5 MHz offset)
- Analysis BW: 10MHz or 25MHz



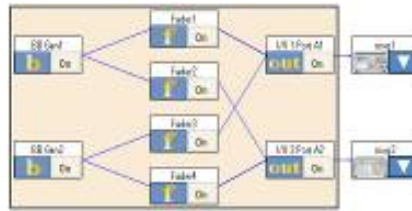
Agilent Femtocell RF Test Solutions

Fast Switching & Measurement Speed

PXB MIMO Rx Tester



Reconfigure in Seconds



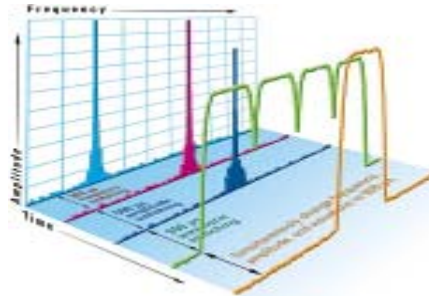
PXB configuration change

- Switch from SISO → MIMO in seconds
- Automated Digital Power Calibration completed in seconds

MXG Vector Signal Generator



Simultaneously Switching



MXG switching speed

Frequency, Amplitude and Waveform:

- SCPI mode ≤ 1.2 ms
- List mode ≤ 900 μ s

MXA/EXA Signal Analyzer



Measurement Speed



MXA/EXA measurement speed

- Mode/Measurement Switch <75 ms
- Marker Peak Search <4 ms
- Remote sweep and transfer <12 ms
- Local update <8 ms
- Fast ACLR ($\sigma = 0.2$ dB) <11 ms



Agilent Technologies

Agilent Femtocell RF Test Solutions

Low Cost of Ownership

PXB MIMO Rx Tester



MXG Vector Signal Generator



MXA/EXA Signal Analyzer



PXB

- Save critical development/verification time with fast digital calibration and standards base MIMO setup
- Leverage existing MXG/ESG/MXA for RF I/O

MXG

- Maximize uptime MTBF of 116,000 hrs
- Low-cost parts and labor
 - Any assembly <\$1K USD Refurbished exchange program
 - Post-repair calibration NOT REQUIRED

MXA

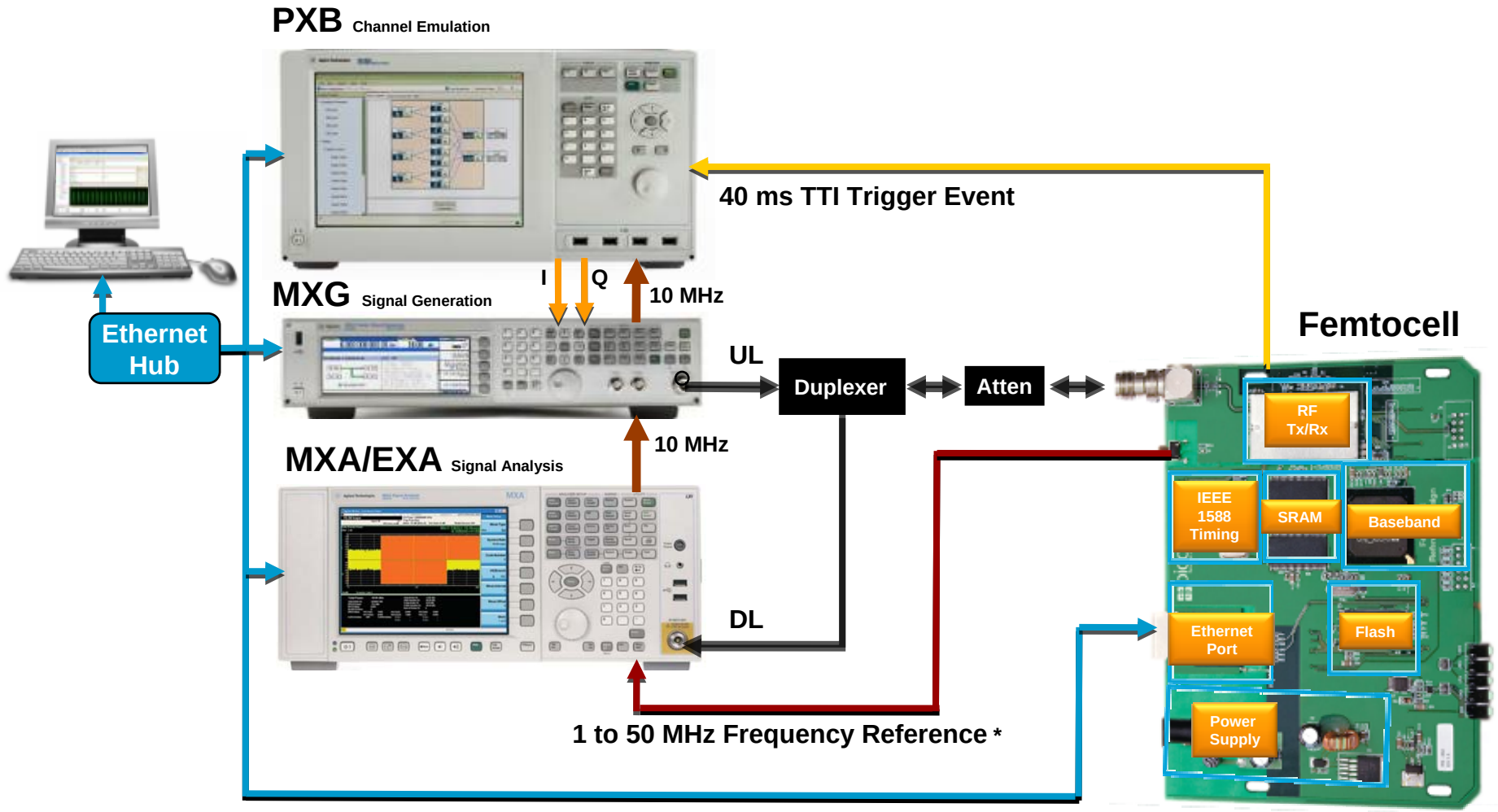
- Maximize uptime MTBF of 102,000 hrs

Agilent Support

- Maximize efficiency with local application engineer technical support
- Minimize turn around time with local service centers



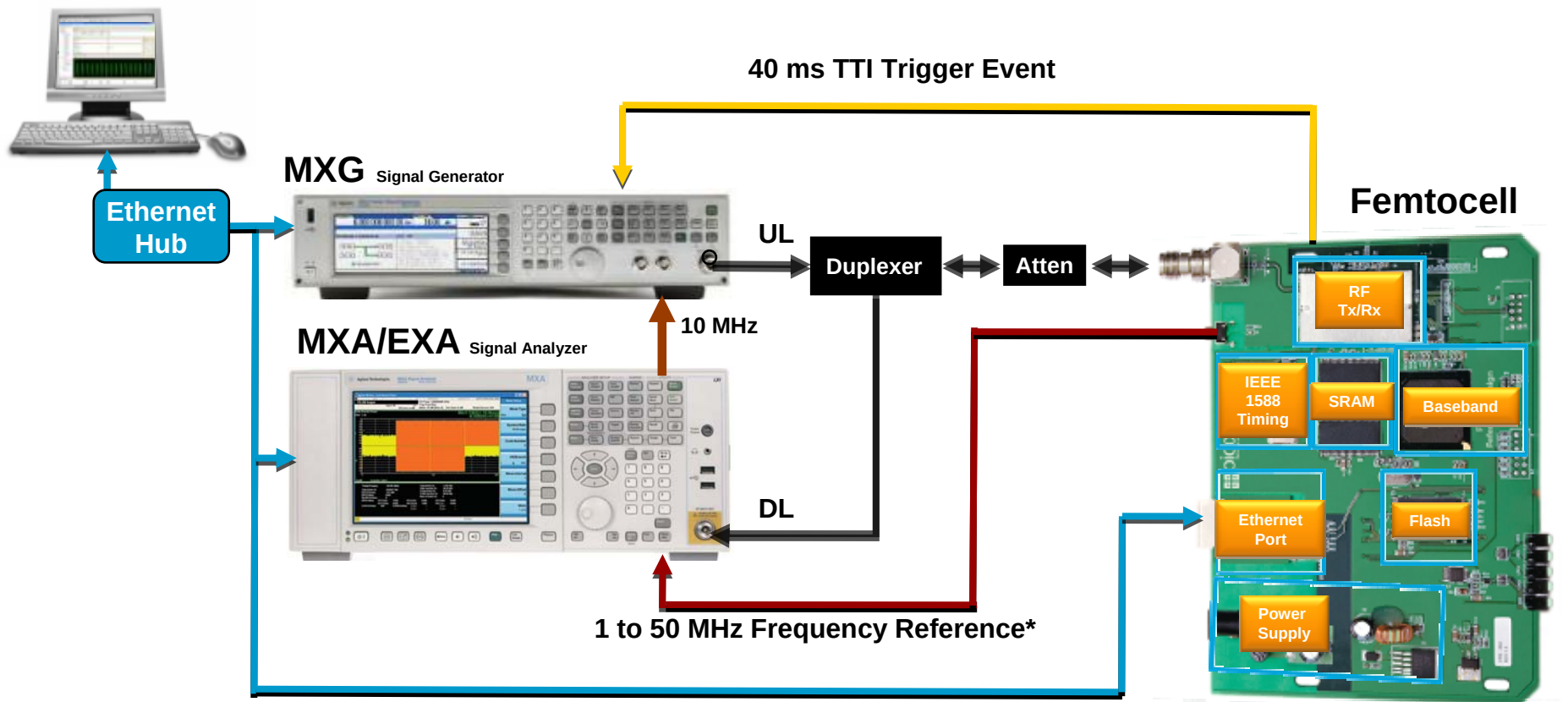
Femtocell Tx/Rx RF Test Setup for R&D With Channel Emulation



* EXA can support 10 to 20 MHz with special option N9010AS-R13

Source: <http://www.picochip.com>

Femtocell Tx/Rx Test Setup for Manufacturing



Source: <http://www.picochip.com>

* EXA can support 10 to 20 MHz with special option N9010AS-R13

Summary

Agilent Has The Right Tools for Femtocell RF Test

PXB MIMO Rx Tester



MXG Vector Signal Generator



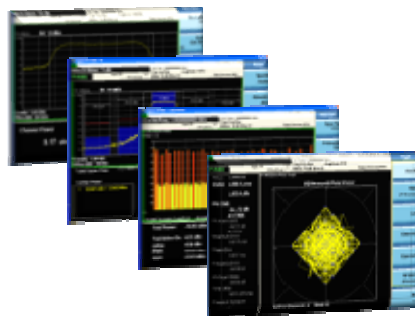
MXA/EXA Signal Analyzer



Signal Studio



Measurement Applications



- Scalable solutions offer best price/performance value
- Industry leading speed
- Multi-format support now and in the future
- Low cost of ownership
- Backed by Agilent world wide service & support



Agilent's Position in Femtocell Technology

www.agilent.com/find/femtocell



The World's Premier Measurement Company

- **provide femtocell test solutions** for RF tests, digital signal analysis, and network drive signaling test .
- is represented on the **3GPP standards committees**
- is the **only company** that provides all the **cross-domain test capability** for new-generation radio products which feature direct "digital to RF" architectures
- **collaboration** with key chipset suppliers & reference design houses
- **common scalable platform** across protocol and RF solutions for development, functional, and conformance test solutions