Basics of RF Data Collection for In-Building Wireless Systems

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About Us

Founded in 2003, Solutelia has emerged as a leader in **network test** and **measurement solutions** and is known for its innovative approach towards data collection and processing methods that have not changed for over 20 years. Its award-winning *Wireless Intelligence on Demand* or WINd® platform has *redefined virtualized testing* of the network with features like *LivePlots™* and *LiveProcessing™*. With active remote control and monitoring capabilities of **M2M** devices, Solutelia brings efficiency to your door step. Solutelia has a **solid background in RF** engineering services as well and it is this deep rooted experience that has allowed WINd® to be a very intuitive tool.

Shortlisted Finalist

What is Benchmark & CW Testing?
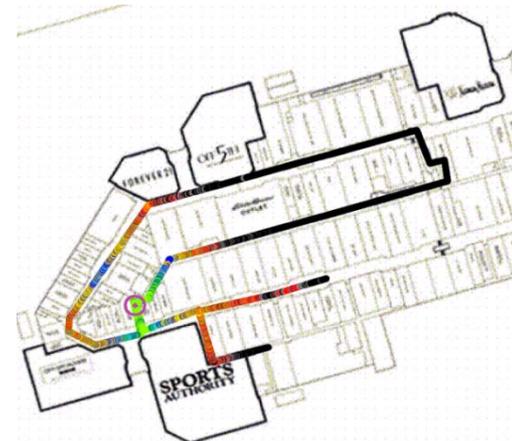
VENUE TESTING

BENCHMARK TESTING

Assess current coverage and quality of the network

Why?

- *Competitive benchmarking*
- *New design*
- *Network Optimization*
- *Network Performance*

CONTINUOUS WAVE TESTING

Assess propagation and design implications for the network

Why?

- *Determine propagation for correct antenna placements*
- *Tune propagation model*

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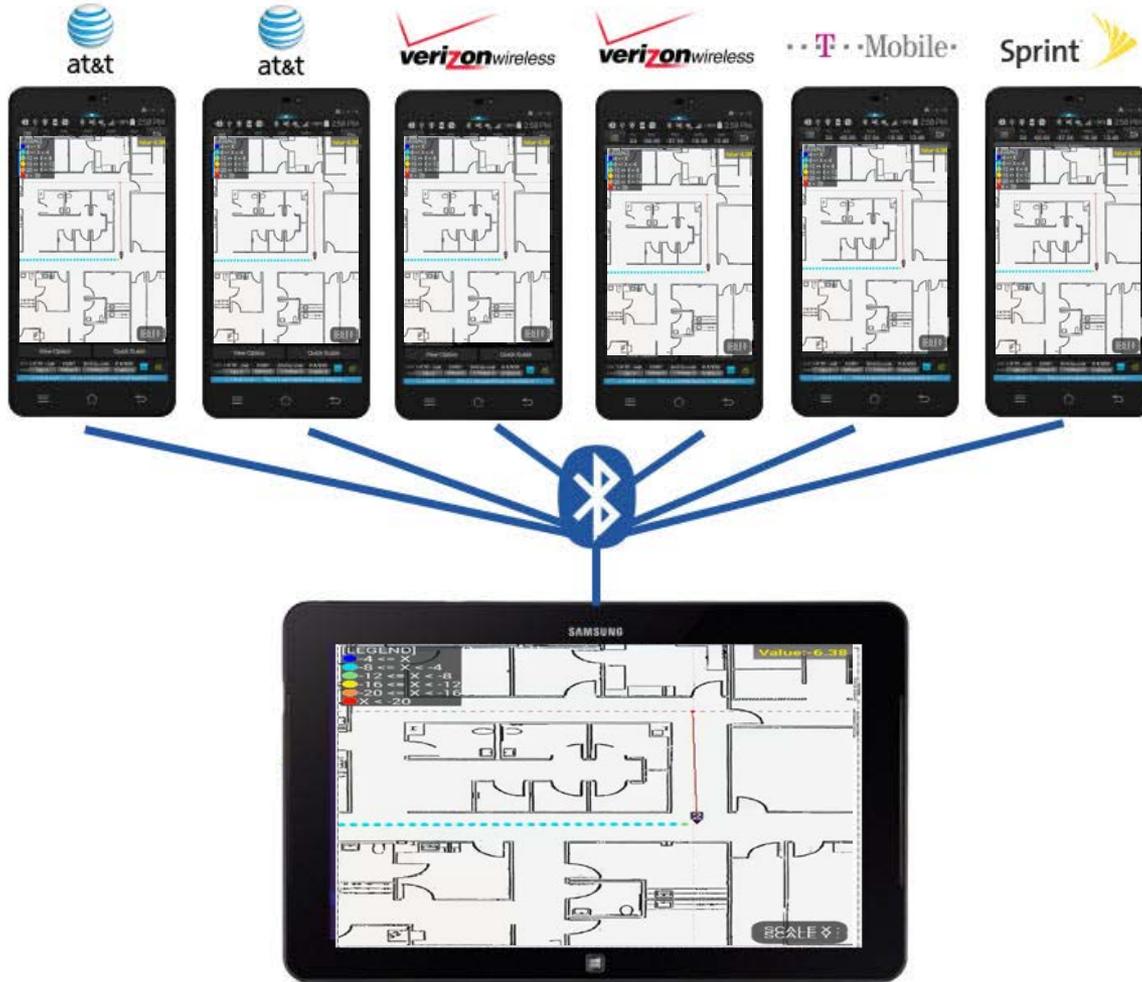
Why is Benchmark Testing Important

- **The Purpose** of Venue RF Benchmark Testing is to develop a clear picture of the external macros (signals) penetrating the venue. The collected data helps us characterizing existing:
  - 1) External macros and their amplitudes
  - 2) Commercial Carrier Channels, their frequencies, and available services (i.e.2G, 3G and/or 4G)
  - 3) In-band Intermodulation frequencies; their amplitudes, timing and cycles
  - 4) Thermal/ambient noise floor

- **The impact** of this data to the design includes:
  - 1) Reduces cost of system by designing coverage and capacity only where necessary
  - 2) Guarantees successful Quality of Services (QoS)

- **The risks** of not doing it include:
  - 1) Over engineering (increased costs)
  - 2) Poor performance & QoS (associated with a loud and/or noisy RF system)
  - 3) Increases costs associated with system design, parts, integration, testing and maintenance

- **Other reasons to Benchmark a network include:**
  - 1) Test network QoS across a large number of network operators, device types, and wireless technologies – LTE, UMTS, Wi-Fi, etc
  - 2) Perform drive and/or walk tests, as well as attended and unattended tests to collect the business intelligence needed to match or surpass competitors' coverage and quality
  - 3) Meet SLAs with subscribers, business customers, and regulatory agencies
  - 4) Monitor KPIs, such as blocked calls, dropped calls, data throughput, failed data connections, to help engineers and operations staff improve network quality

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Why is CW Testing Important?

- **The Purpose** The purpose of CW Testing is to:
    - 1) Finalize and calibrate the iBwave propagation model
    - 2) Validate the sector & zone boundaries
    - 3) Characterize attenuation between adjacent levels
    - 4) Test the propagation characteristics of the antenna, specific to the venue and location under test
    - 5) Test Sector to Sector RF leakage (Validate Sector/Zone Seams, propagation overlaps)

- **The impact** of this data to the design includes:
    - 1) A reliable design that will perform as predicted
    - 2) Assure proper sectorization is maintained and best servers don't overlap
    - 3) Validate proper antenna and transmit power assumptions have been made
    - 4) Gain capacity due to proper power control

- **The risks** of not doing it include:
    - 1) Hand over failures
    - 2) Lost capacity
    - 3) Best server imbalances
    - 4) Poorly selected and constructed network infrastructure
    - 5) Network rip and replacement

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What tools do I need for Benchmark Testing?

UE Device Based Data Collection Software

Scanning Receiver

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What tools do I need for CW Testing?

1. Transmitters – Praxym 12 dB

2. Receiver – Scanning Receiver

3. Antenna – Galtronics Pear™ 5542 Omni-Directional

4. Tripod – That can reach ceiling height 10'-12'

5. Spectrum Analyzer – Anritsu S322E

6. Coax Cables – 6 feet

7. RF Splitters

8. RF Connectors

9. Laser Distance Measurer – Bosch DLR130
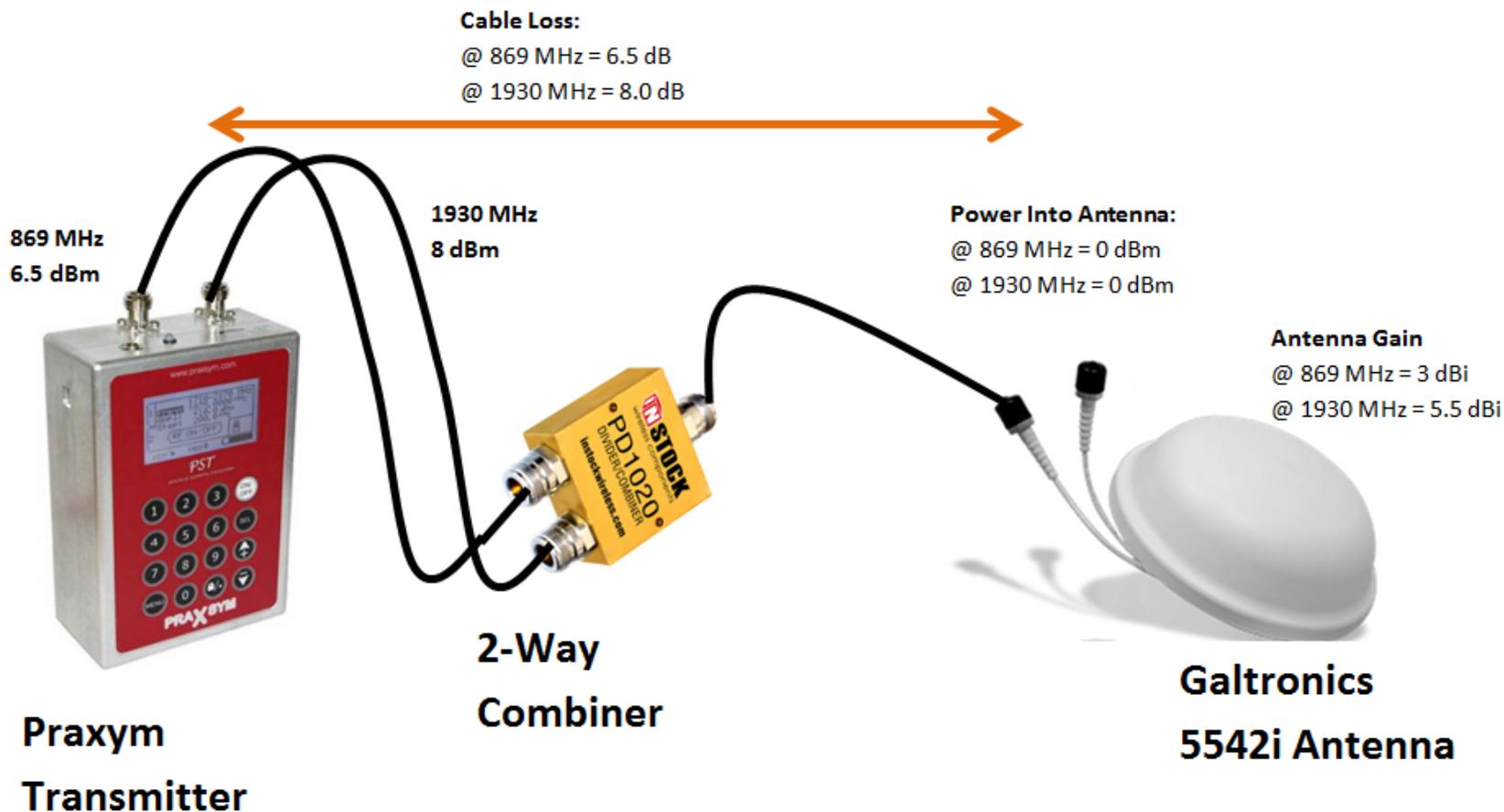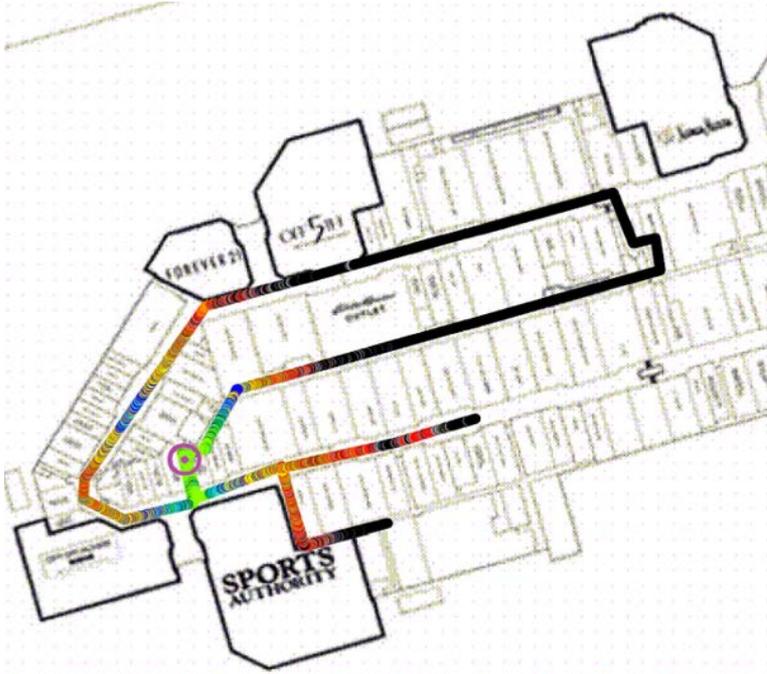
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CW Testing

Cable Loss:
@ 869 MHz = 6.5 dB
@ 1930 MHz = 8.0 dB

869 MHz
6.5 dBm

1930 MHz
8 dBm

Power Into Antenna:
@ 869 MHz = 0 dBm
@ 1930 MHz = 0 dBm

Antenna Gain
@ 869 MHz = 3 dBi
@ 1930 MHz = 5.5 dBi

Praxym Transmitter

2-Way Combiner

Galtronics 5542i Antenna

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CW Testing Set Up

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Understanding Scope & Best Practices

Benchmarking: Understanding the Scope of Work & Best Practices

- **Venue Type:** Know your venue. Is it a mall, hospital, large convention center, airport, or an outdoor campus? This will give you an idea of how much time will be needed to complete your data collection.

- **Number of Floors:** How many floors does your venue have? Does your customer want you to test every floor, every other floor? There's no fixed rule on how many floors to test, but it is generally acceptable to collect data on a few floors on the top, middle, and bottom floors of a tall high rise building. Your customer may ask you to walk every 2nd or third floor. Other venue types such as airports, malls, convention centers, will need data to be collected on all floors unless specified otherwise.

- **Access Coordination:** Make sure you have coordinated access to the venue with your customer. Certain venues may require you to carry your company ID badges. Arrive at the venue well in advance so you have enough time to prepare for your testing.

- **Floor Plans & Geocoding:** Request for floor plans ahead of time which will give you time to geocode them if required.

- **Data Collection Tools** – Confirm with your customer if a specific data collection tool needs to be used.

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Understanding Scope & Best Practices

Benchmarking: Understanding the Scope of Work & Best Practices

- **Bands/Technologies to Collect:** Have a clear understanding of what bands/technologies and for which carrier are being requested. Determine if you have a specific channel list from the customer or do you need to perform a blind scan. If you need to perform a blind scan, make sure you arrive at the venue well in advance to give you time for it.

- **Scanner or UE Based:** What is the purpose of the data collection? Is it pre-design or post-build data collection? Does the customer want UE or scanner data or both?

- **Multiple Walks or Single Walk:** Plan ahead to determine how many walks you will need? Do you have enough devices to minimize your walks? How many channels are you loading on your scanner?

- **Which KPIs to Collect:** Confirm with the customer, which KPIs need to be collected. Following are generally accepted KPIs:

  - **Pre Design Collection: Signal Strength, Signal Quality, Cell ID/Pilot**
    LTE – RSRP, RSRQ, PCI
    UMTS – RSCP, Ec/Io, PSC
    EVDO/CDMA – Ec, Ec/Io, PN

  - **Post Build Collection: Signal Strength, Signal Quality, Cell ID/Pilot, Throughputs**
    LTE – RSRP, RSRQ, PCI, UL & DL Throughput
    UMTS – RSCP, Ec/Io, PSC, UL & DL Throughput
    EVDO/CDMA – Ec, Ec/Io, PN

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Understanding Scope & Best Practices

Benchmarking: Understanding the Scope of Work & Best Practices

- **Test Settings:** When collecting data with UEs, always confirm test settings. What file size to download and upload? It is usually acceptable to download a 10M file and upload a 3-5M file.

- **Existing DAS:** Is there an existing DAS, repeater, or microcell at the venue that needs to be turned off before your scheduled walk? Confirm with the customer.

- **Walk Paths:** Have you confirmed walk-paths with the customer? If no walkpaths have been provided, use your judgement to perform your walk test. Make sure you are covering both the outer edges (closer to the windows) and inner areas of the floor (closer to the center). If you are performing multiple walks, try to keep the walk-paths identical.

- **Deliverables:** Does your customer need deliverables imported in a specific format such as a Power Point presentation? This will need additional effort on your part, so make sure you have the customers format information.

- **KPI Legends:** Does your customer require specific thresholds and color schemes for KPI legends? If yes, make sure you confirm those legends.

- **Log File Naming Convention:** Is there a specific file naming convention you need to adhere to?

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Understanding Scope & Best Practices

CW Testing: Understanding the Scope of Work & Best Practices

- **Number of Test Points:** You need to know how many individual CW tests need to be conducted per floor. You should request a detailed CW test plan from the designer.

- **Antenna Type:** Confirm what type of antenna is needed omni or directional? Make sure you have the specification sheet for the antenna. Also confirm if the customer will be providing the antenna for testing or are you expected to bring one.

- **CW Frequencies:** The CW scope must include frequency bands for which CW tests need to be performed. Customer may require tests on all four bands – 700 MHz, 850 MHz, 1900 MHz, 2100 MHz or just two bands – one high, one low.

- **Power Levels:** Scope should identify either the amount of power to be injected into the test antenna or the antenna EIRP. This will determine what type of transmitter you will need. Estimate the power requirements using the EIRP formula ahead of time so you can ensure you are taking the right transmitter.

- **Test Locations & Walkpaths:** A detailed CW plan must indicate locations of the floor plan along with the walkpaths for each location.

- **Log File Naming Convention:** Is there a specific file naming convention you need to adhere to?

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When to use a Scanner and UE?

UE Vs Scanner Comparison

Criteria

Measurement Speed	Lower resolution due to limited battery and processing power	Resolution can be as much as 50X times higher than UEs
Supported Bands	Limited bands supported by handsets	Large number of bands supported by scanners
Dynamic Range	Lower dynamic range therefore cannot detect very low power signals	Can detect very low power signal in presence of high power signals

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When to use a Scanner and UE?

UE Vs Scanner Comparison

Criteria		
Form Factor/Weight	Light weight, easy to handle	Tend to be heavier and bulky
User Experience KPIs	Can measure UE Tx Power, UL/DL data throughput, dropped calls etc.	Cannot measure these KPIs
Cost	Lower cost for devices, but licensing, data testing cost involved	High equipment cost. Scanners are expensive

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When to use a Scanner and UE?

UE Vs Scanner Comparison

Criteria		
Network Interaction	Registers on the network and provides true insight into user experience	Scanners are passive and do not interact with the network
Chipset Dependence	Handsets are chipset specific – Qualcomm, Exynos	Chipset independent
Timing/Accuracy	Lower measurement accuracy compared to scanner.	Higher measurement accuracy compared to UEs

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When to use a Scanner and UE?

When to use UE and when to use a scanner?

Criteria	UE	Scanner
Pre-design/ Pre-build data collection	✓	✓
Post-build data collection	✓	✓
UL/DL Throughput testing, UE Tx Power	✓	

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Thank you.

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