Testing Wireless LANs: Notes from the Field

Craig J. Mathias • Principal
A Little About Me…

- Principal, Farpoint Group
  - Since 1991
  - Advisory services in wireless networking and mobile computing
- Engineer (OK, applied math/computer science)
- Member, IEEE and Society of Sigma Xi
- Columnist and product reviewer for the *CIO Executive Council* (IDG) and various sites at *TechTarget* and others
- Product reviews, testing, and features for *Network World*
- Blog: networkworld.com/community/mathias
- **Analyst** - in the business of predicting the future
  - Conclusions aren’t always important, but the reasoning behind them *is!*
  - *You’ve got to show your work…*
Our Topics for Today…

- Testing wireless LANs – objectives, issues, methodologies
- Benchmarking wireless LANs – options, techniques, pitfalls, best practices, and why this may matter less in the future
- Future directions and opportunities
  - Virtual benchmarking?
  - A (conceptual) practical tool
WLAN Testing and Benchmarking - Objectives

- Understanding both technologies and implementations
- Product development
- Product verification, tuning, optimization, compliance
  - Understanding what’s really going on…
- Comparative analysis
  - Product feature evaluation
  - Purchasing decisions
- Post-installation analysis and tuning
- A rich history of computer/network performance evaluation to build on
Testing and Benchmarking: Options

- Freespace – a statistical medium
  - Clients
  - Environment
  - Tools
  - Important to control variables; multiple runs and averaging
- Isolation – Chambers
  - Modeled environments
- Digital Modeling – the “virtual radio channel”
  - Theoretical
  - Virtual - based on behavioral analysis
- Key Variables
  - It’s never rate or range alone, but rather rate vs. range
  - In a particular environment (radio and physical)
  - For a particular application or application mix (load)
  - With a particular combination of transmitters and receivers
  - Location and motion
Benchmarking: An End-to-End Look

Transmitter

Radio Channel
- Antennas
- Range
  - Propagation
  - Obstructions
  - Fading
- Transmit Power
- Interference

Receiver

Source: Farpoint Group
Roaming: Large-Scale (N/G) Electric Trains

- Required for notebook PCs
- Could use HO-gauge with smartphones
Roaming/Fairness: Turntables

- Of the type found in jewelry cases and etc.
- Factors in motion (to some degree)
- Factors out antenna orientation (to a great degree)

- Robots could be used to pre-program travel paths and rates
Chambers

- Reasonably simple in concept and execution
- Easy to use
- Channel models and analytics
  - The real value
  - Is reality represented?
- Reproducible and consistent
  - Great for comparative work
  - And verification
- Auditable
Chambers: octoScope octoBox MPE

- Complete isolation – emulates environment
Given an analytical model of a wireless system, and a model of a given workload (type of traffic, duty cycles, etc.), do all evaluation and analysis in the digital domain.

- Example: Computational fluid dynamics
  - The digital wind tunnel
- Example: Digital physics, molecular modeling
- Example: Circuit simulation tools

But is this possible given the large number of variables and the fundamentally statistical (unpredictable) nature of wireless systems?

Merits further investigation.
Issues and Opportunities

- **Cost/ROI**
  - It may be easier to consider loads, geographic regions of demand ("hot spots"), and average/typical performance of an AP/system and then simply deploy, measure, evaluate, correct, and augment as required.
  - As is already the case with benchmarking tools and site surveys...

- **Ability to model inherently complex systems**

- **Increasing density, complexity**
  - Architectural, features, options settings, application mix, …

- **Synthetic workload characterization - tools**

- **Should we build basic benchmarking/verification into the standard?**
What I Want…

**Multi-Client Emulator**
- 1-n Clients
- Simulate Contention
- Simulate Range

**Server**
- Correlation Analysis

**Layer 1:**
Spectral Analysis

**Layer 2:**
Protocol Analysis (Packet Capture)

**Layer 3:**
IP Traffic Generator

Source: Farpoint Group
Conclusions

- Benchmarking and performance evaluation will remain *interesting* for the foreseeable future
  - All aspects of computer and communication technologies, not just wireless
  - Excellent tool for education, understanding, and innovation
  - Some value in product design and verification
- Not clear, however, if end-user production deployments will benefit
  - Like site surveys…
  - Cost/benefit analysis/justification required – labor-intensive
  - Better tools might help, though…
- Always – more variables than equations
Thank You!

Ashland Massachusetts USA
www.farpointgroup.com