Modeling Directionality in Wireless Networks

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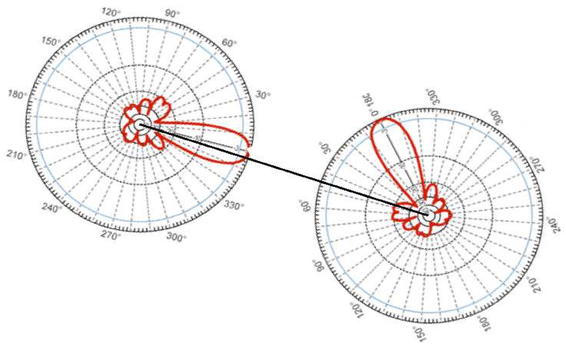
Problem and Motivation

• Increasingly, directional antennas are being used to improve the throughput and reach of wireless networks.

• Simulations and analyses often use simplistic radio models.

• Reality is very different – the effective directional variation of signal strength is environment-specific.

• *Antenna gain ≠ actual directional effect!*

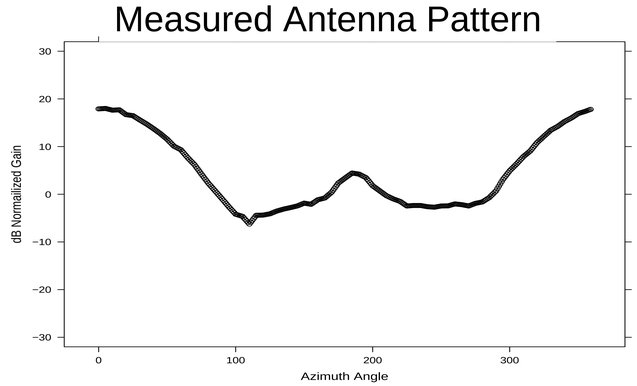


Measurements

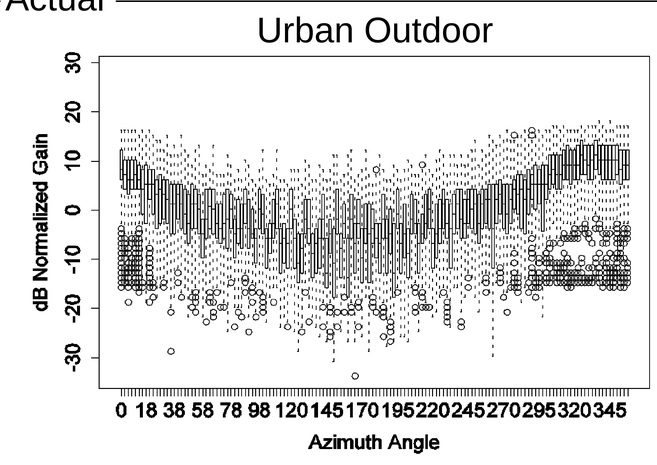
• We measured the signal attenuation between directional (phased array) and omni-directional (dipole) stations in several environments.

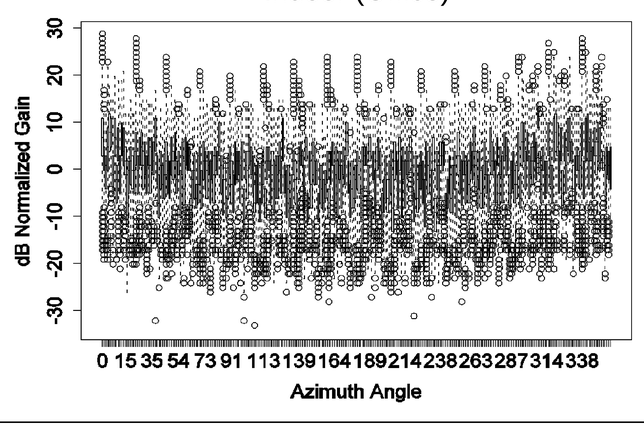
• RSS values were recorded using a simple packet-based data collection routine with commodity hardware and freely available software tools.

Nominal



Actual





Modeling

• Adding an environmental element to the propagation model significantly improves accuracy.

• A parametric model is derived by regression (SSE) fitting. This provides a *concise* and *reusable* characterization of the environment.

Conclusions

• We observe that propagation directionality is highly variable between (and even within) environments.

• Wireless networking research which utilizes simulation must use realistic models for propagation and directionality. This is especially true in the case of indoor networks, where environmental effects on directionality can be devastating.

• Direct measurement and parameterized fitting produce a more realistic and higher fidelity model than what is commonly used.

Accuracy

Standard Error

	Simple Model	Fitted Model
Indoor	8.9 dB	5.1 dB
Outdoor	7.6 dB	4.1 dB

The remaining error in the fitted model is very nearly Gaussian noise (zero mean and normally-distributed) and is *not correlated* with direction, position, or nominal gain. Error in the simple model is significantly correlated with all three.