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# Issues Facing Wireless Sensor & Control Networks

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# Outline

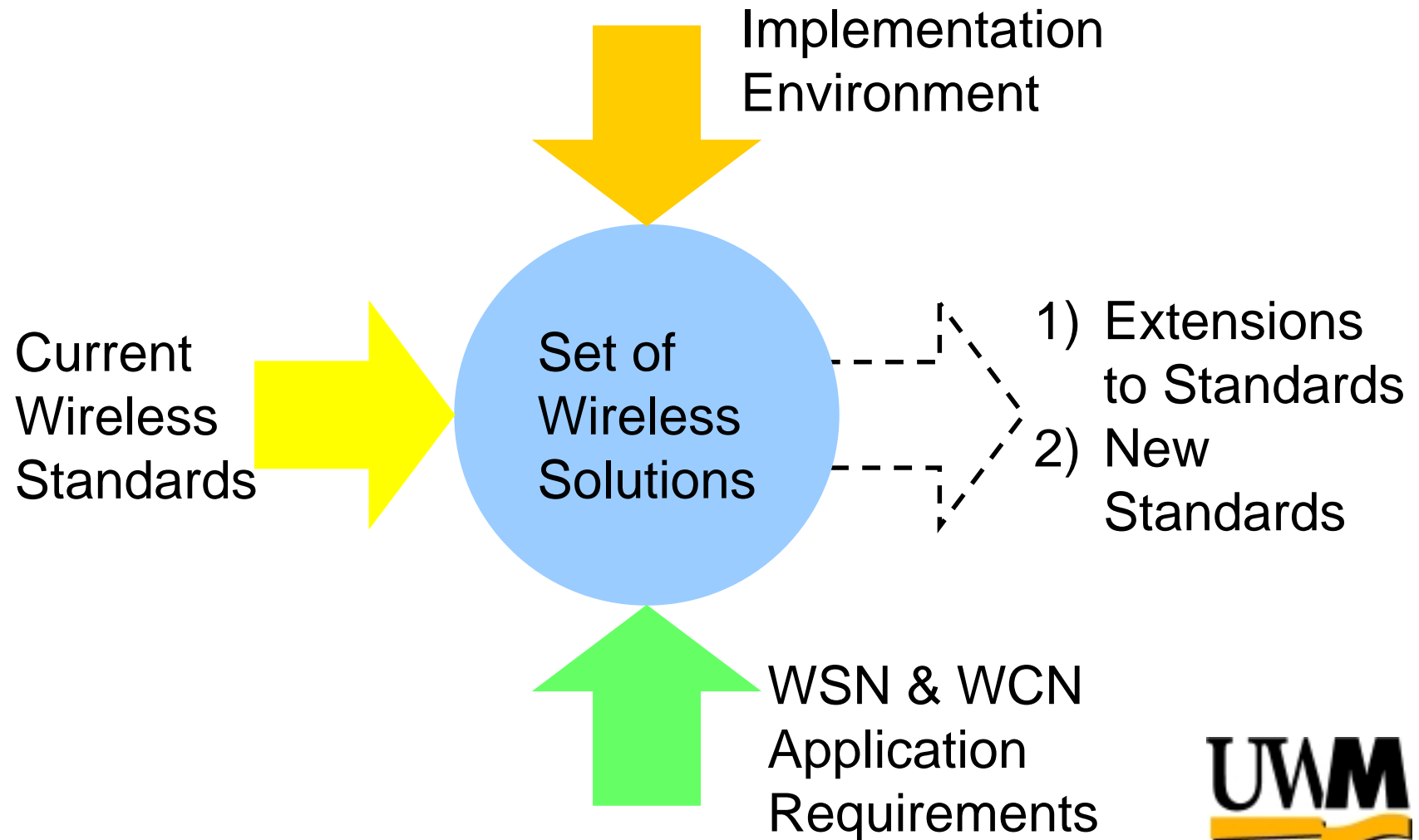
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- ▶ WSN & WCN Design Issues and Challenges
- ▶ Evaluation & Optimization Tool



# WSN & WCN Design Challenge



# WSN & WCN Design Issues

## Standards

- Coverage Range
- Data Rate
- Multiple Access
- Cost
- Security
- Reliability
- E.g.
  - Bluetooth
  - IEEE 802.11
  - Multi-hop Ex.
  - Home RF
  - Cellular
  - 2.5-G Cellular

## Application

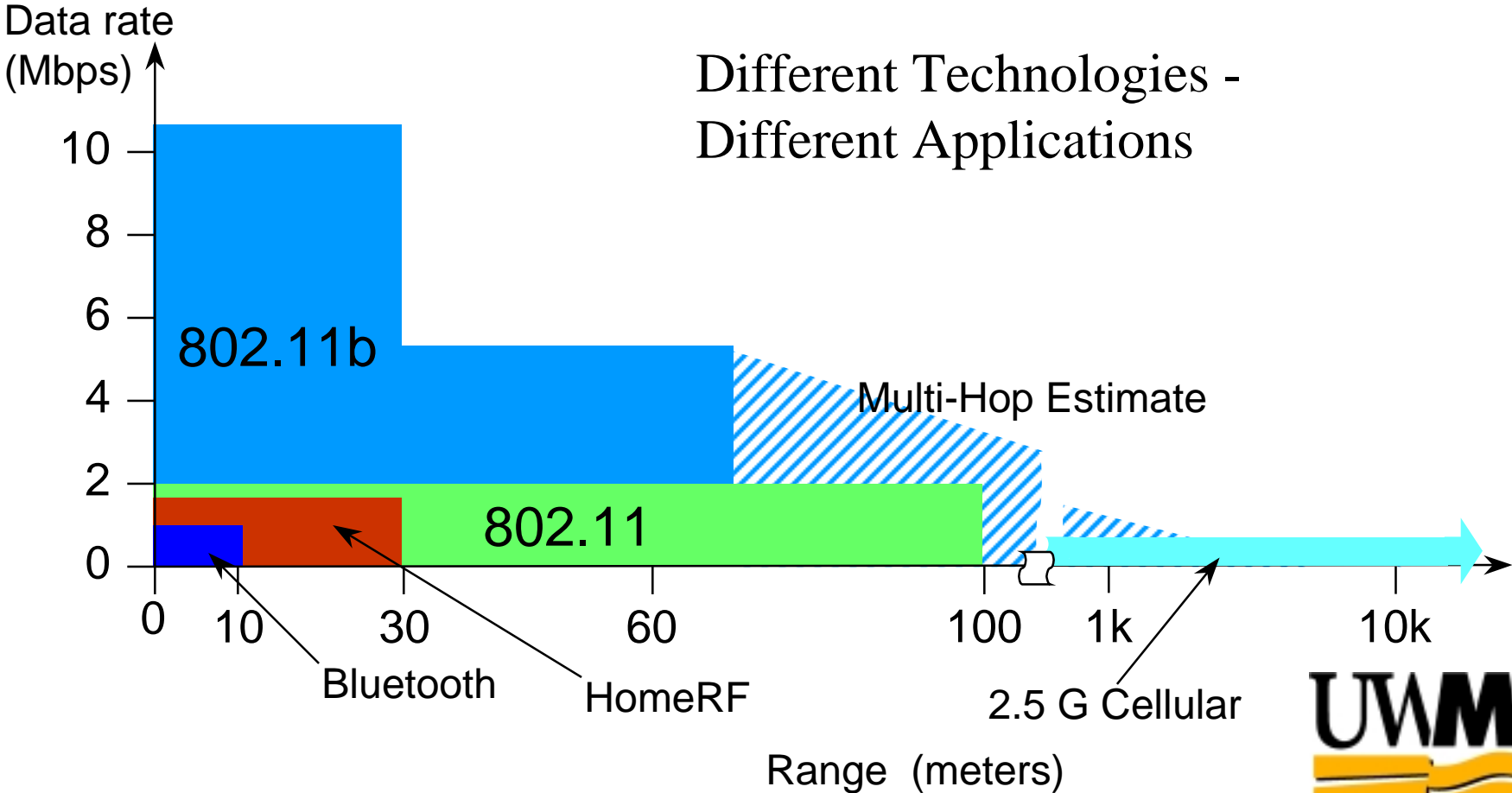
- Performance
  - Throughput
  - Latency
  - Etc.
- No. Nodes
- Distance between Nodes
- Reliability
- Security
- Cost
- Etc.

## Environment

- RF Propagation Factors
- Single vs Multiple Installation Sites
- Site Variability
- Node Placement
- Point to Point vs Multi-point Coverage
- Mobility

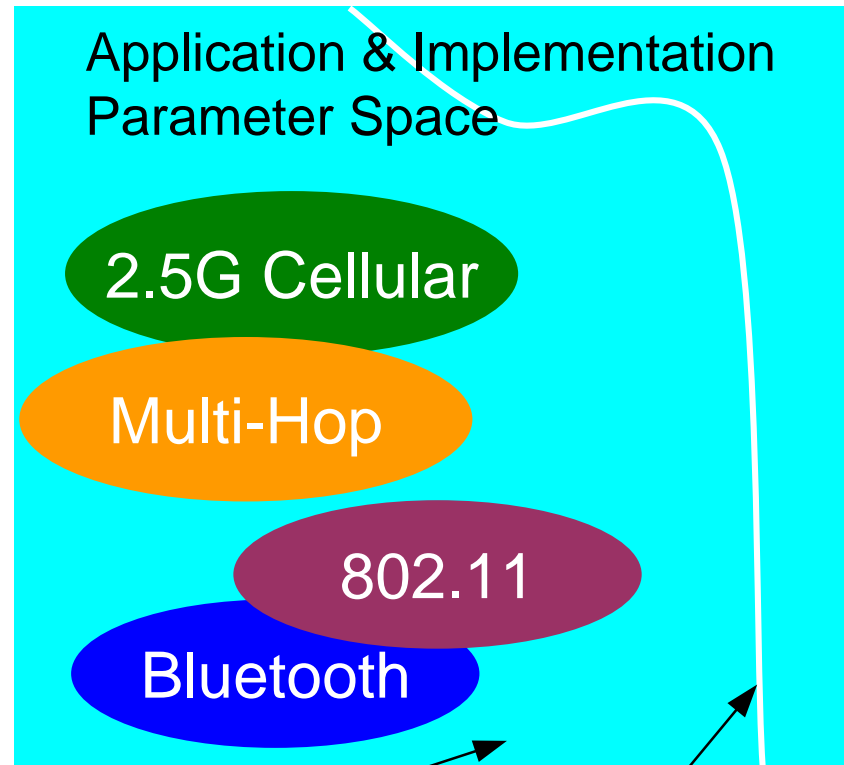


# Data Rate vs. Coverage Range Example



# WSN & WCN Solutions

- ▶ Current applications satisfied by current technology?  
Extensions to current technology?
- ▶ Regions not supported/with interest for new wireless technology?
- ▶ Evaluation tools -  
“optimal” solution?  
Solution feasibility?

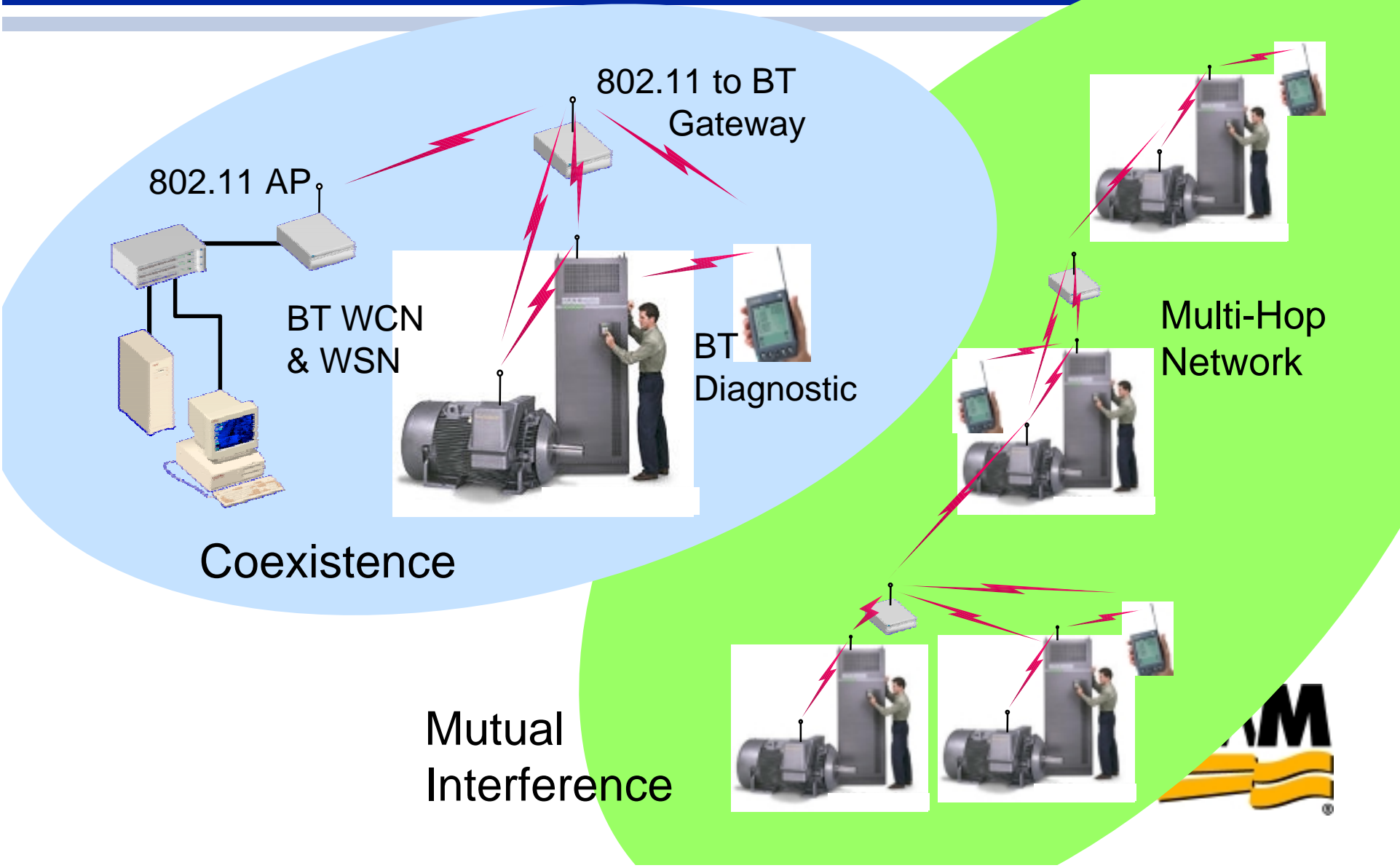


Feasible  
Solutions Exists

Theoretical  
Bound



# ISM Band Coexistence & Mutual Interference



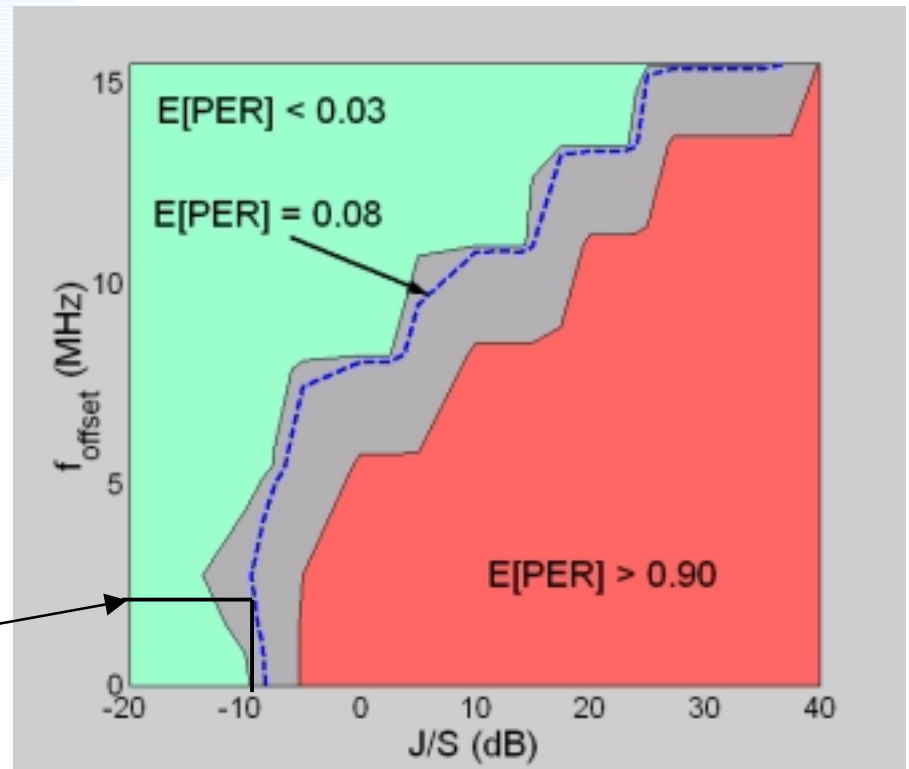
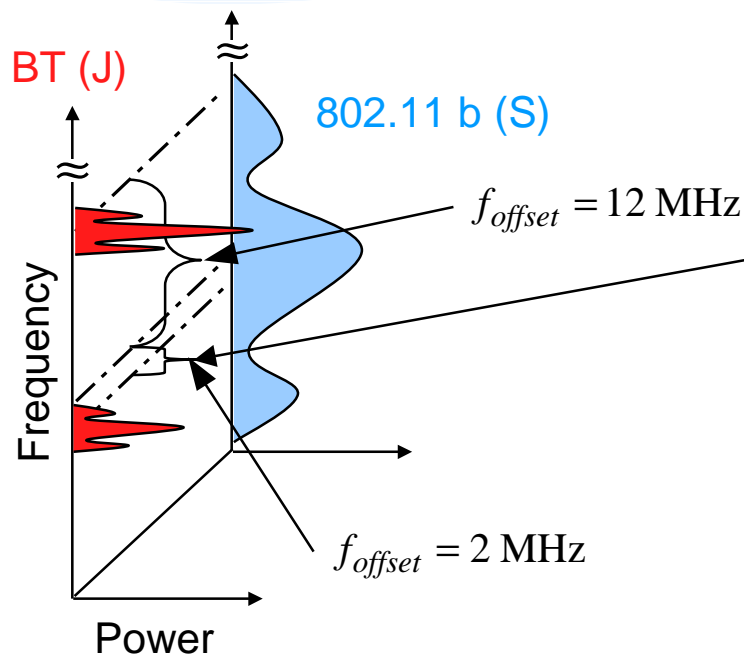
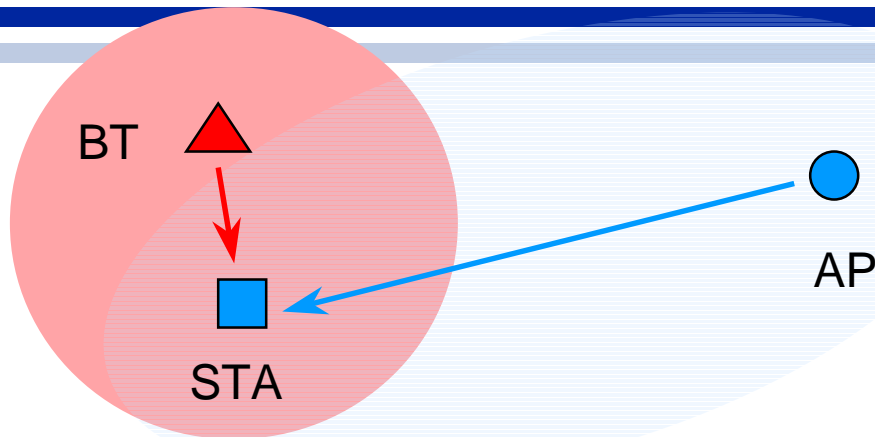
# Evaluation & Optimization Tool Development

- ▶ Analytical Model
- ▶ Three Stage Approach
  - ▶ Characterize interference - Signal Stationarity
  - ▶ Characterize One-on-One
  - ▶ Characterize Multiple Interferers in an arbitrary environment
- ▶ Empirical Results
  - ▶ Model Development
  - ▶ Substantiate Model

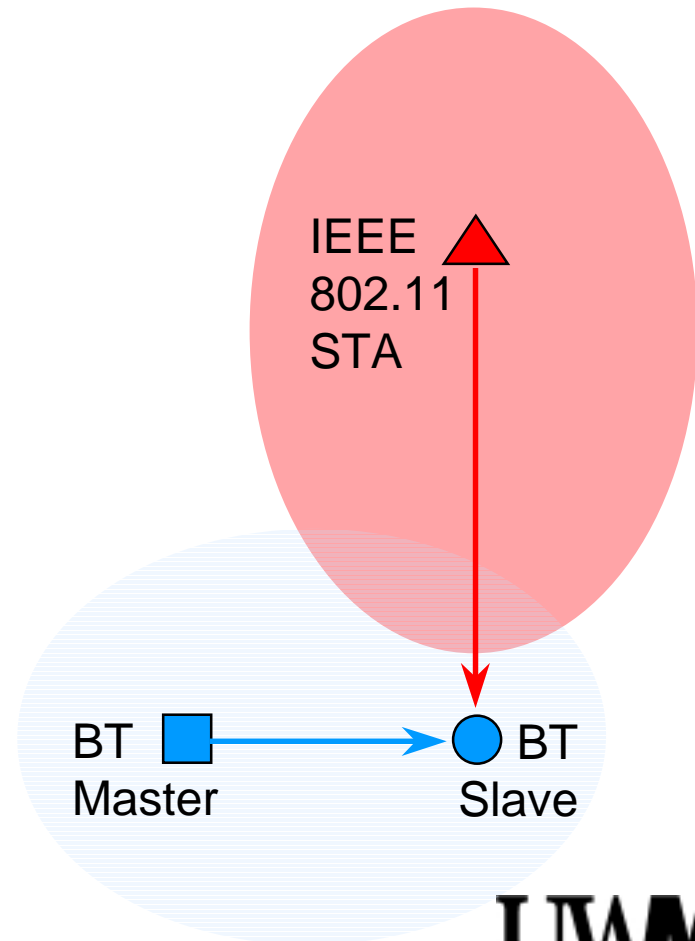
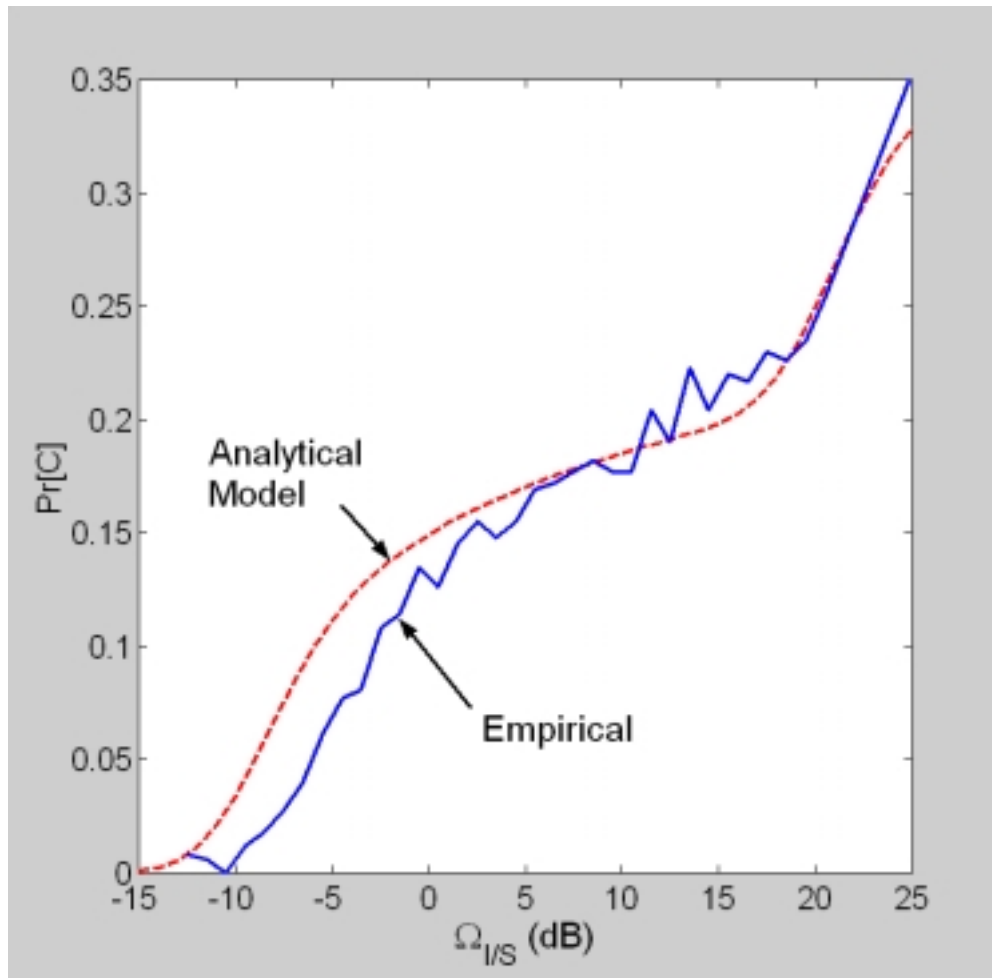




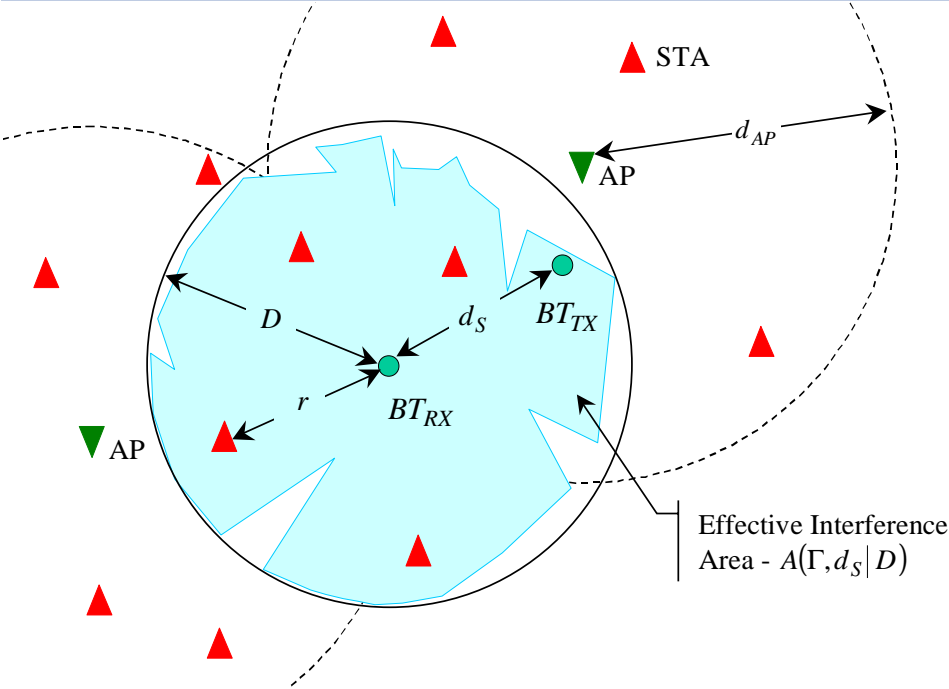
# Characterizing Interference - Empirical Study



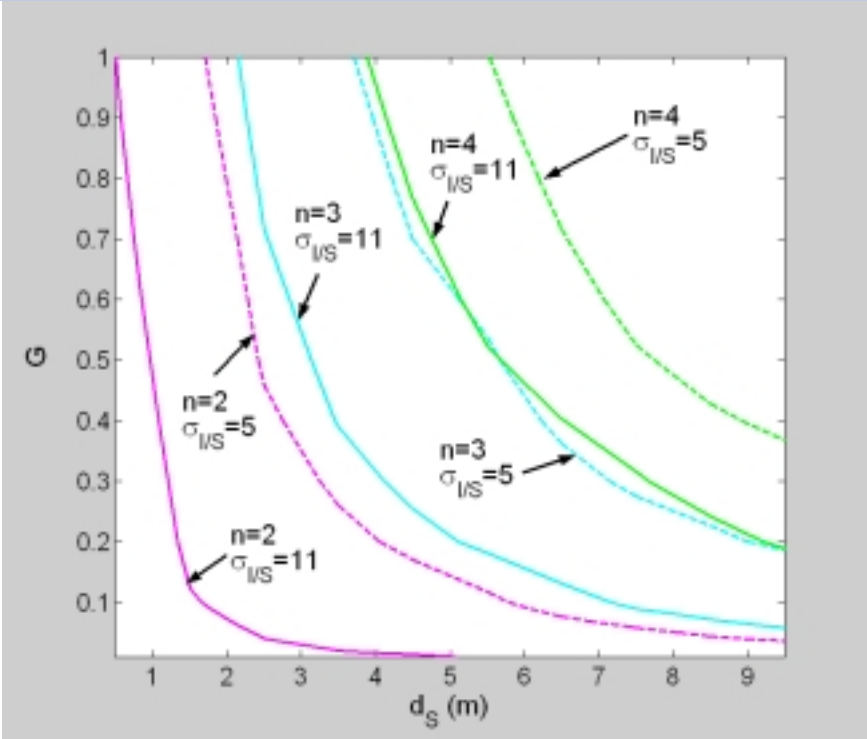
# One on One Analytical Model & Empirical Study



# Multiple Interferers & Arbitrary Environment



Location Installation Variability  
implies  
RF Propagation Variability



Multiple Variable Analysis



# Summary

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- ▶ WSN & WCN present unique challenges to wireless industry
- ▶ Application/Installation Requirements
  - ▶ Current Wireless Technology
  - ▶ Extension to Current Technology
  - ▶ New Technology & Standards
- ▶ Evaluation tools to evaluate/optimize wireless network utilization

