Applications of Smart Antennas to CDMA Cellular Mobile Radio Networks

Martin J. Feuerstein

Metawave Communications
Redmond, WA
martyf@metawave.com
Tel: 425-702-5865

September 9-11, 1998

1998 ITS International Symposium on Advanced Radio Technologies

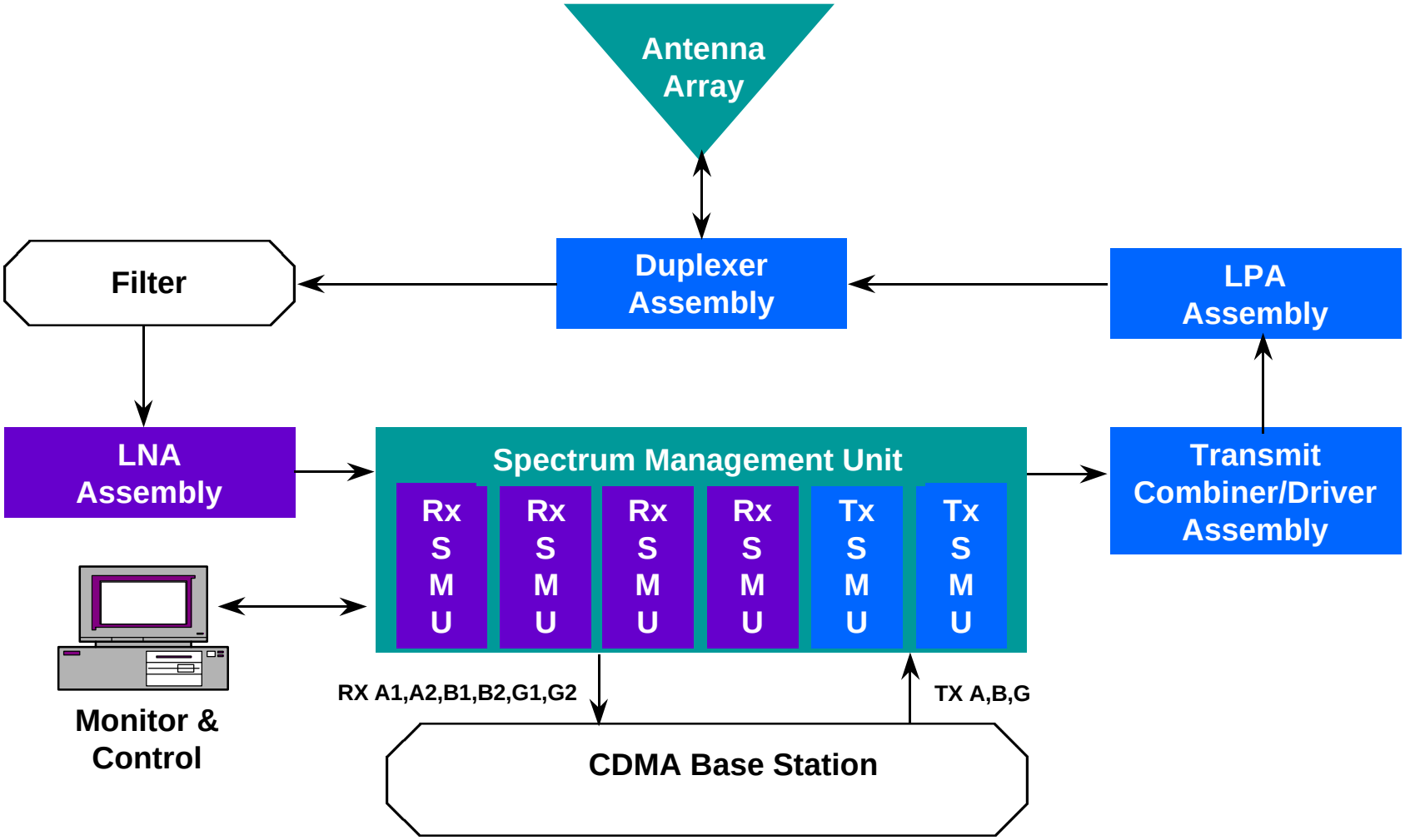
Outline

- Network Performance
- Smart Antenna Concepts
- Traffic Load Balancing
- Handoff Management
- Interference Control
- Field Trial Results
- Conclusions

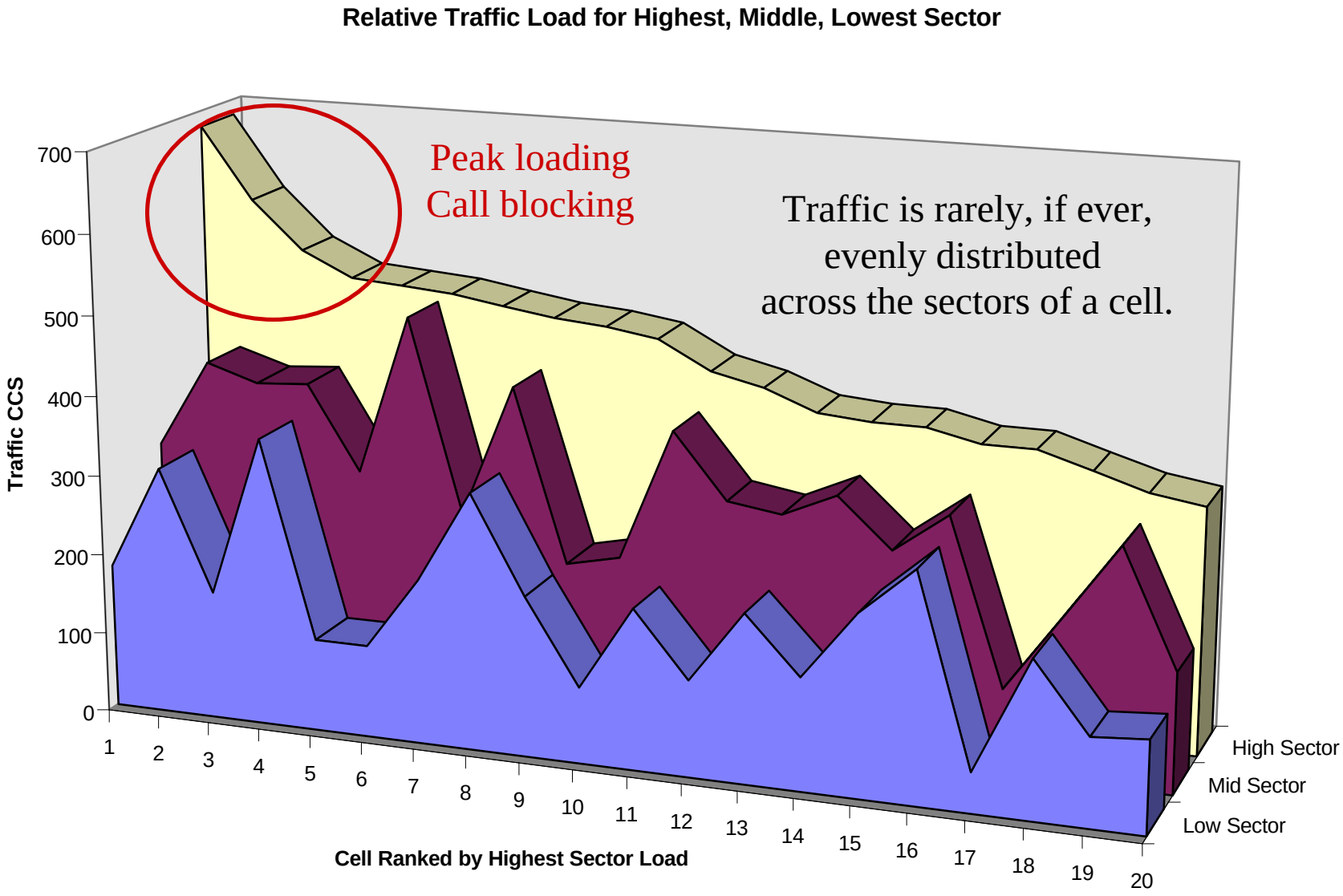
Network Performance

- **Interference Control**
  - Successful optimization, particularly for the forward link, is an iterative process of interference management
- **Dominant Servers**
  - Call originations, terminations, and handoffs are more reliable when dominant servers are present
- **Frequency Reuse Efficiency**
  - Forward and reverse link capacities are sensitive to the radio environment and local topography
- **Traffic Density Distributions**
  - Real-world traffic load distributions are extremely nonuniform and time-varying on differing scales
- **Shared AMPS and CDMA Antennas**
  - Compromises CDMA performance due to wider AMPS beamwidths and fixed-grid azimuth angles to support AMPS frequency reuse plan
  - Shared antennas often mandated by zoning boards and tower wind loading limitations

Smart Antenna Concepts



Traffic Load Balancing



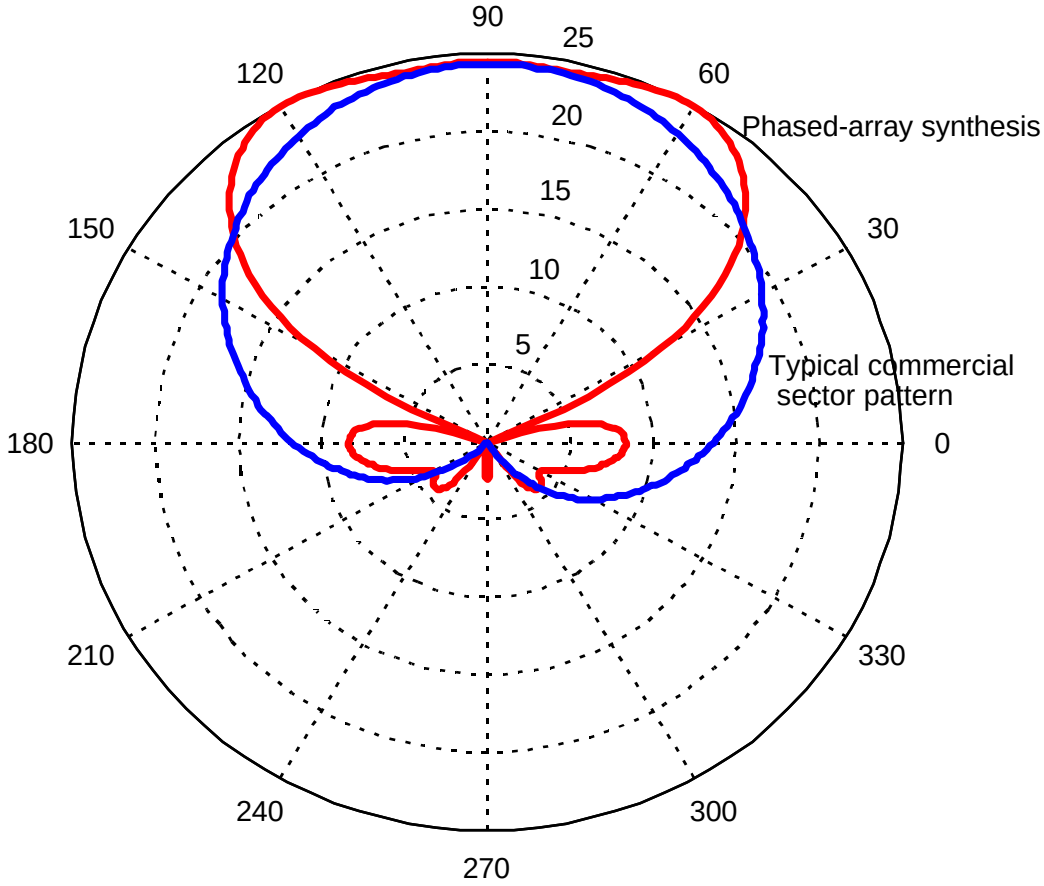
Handoff Management

Phased-array synthesis versus off-the-shelf commercial pattern
90 degree sector beamwidth

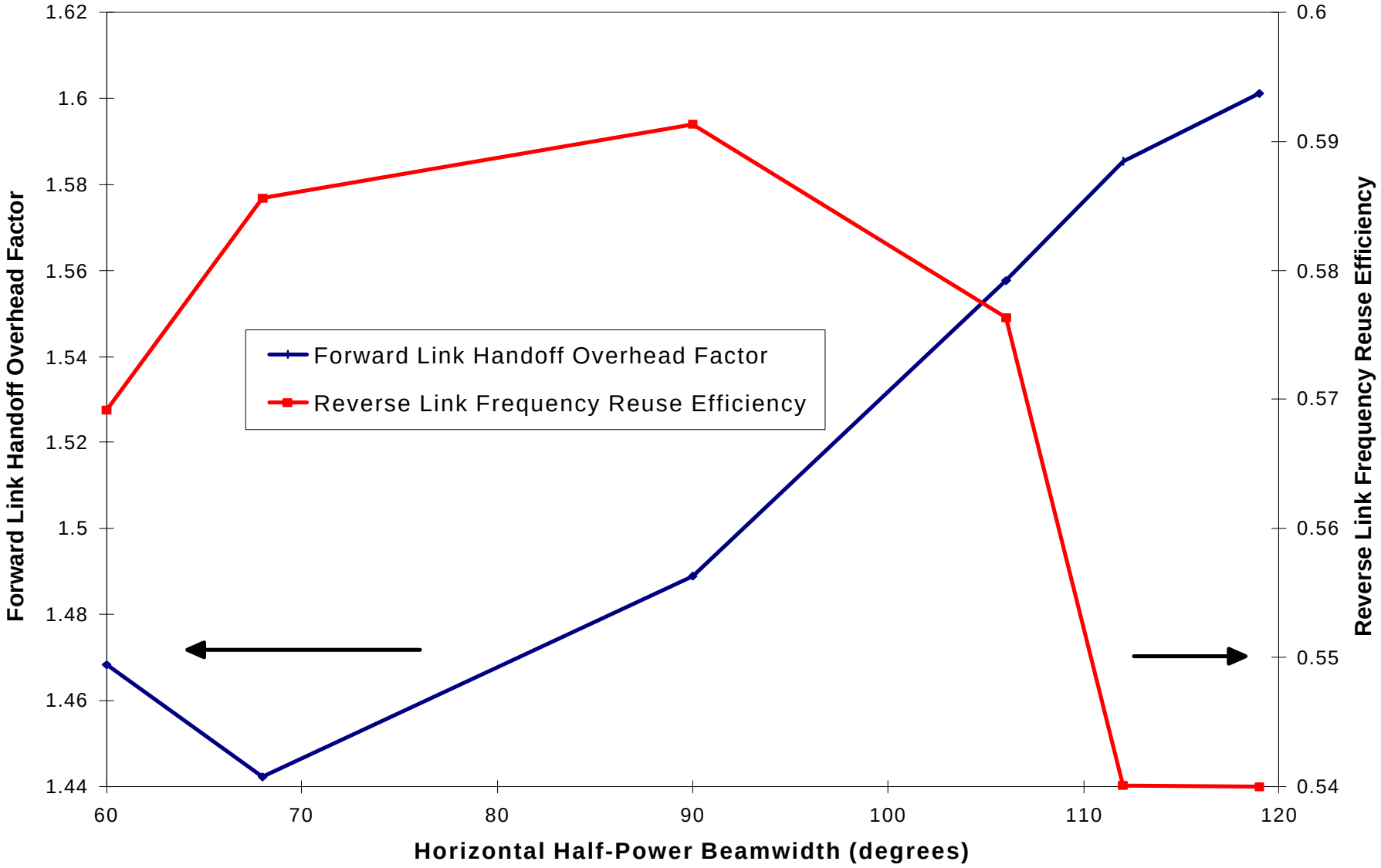
Synthesized sector using phased-array to create pattern with sharp main beam rolloff.

Tight rolloff is critical to managing interference and controlling handoff in CDMA networks.

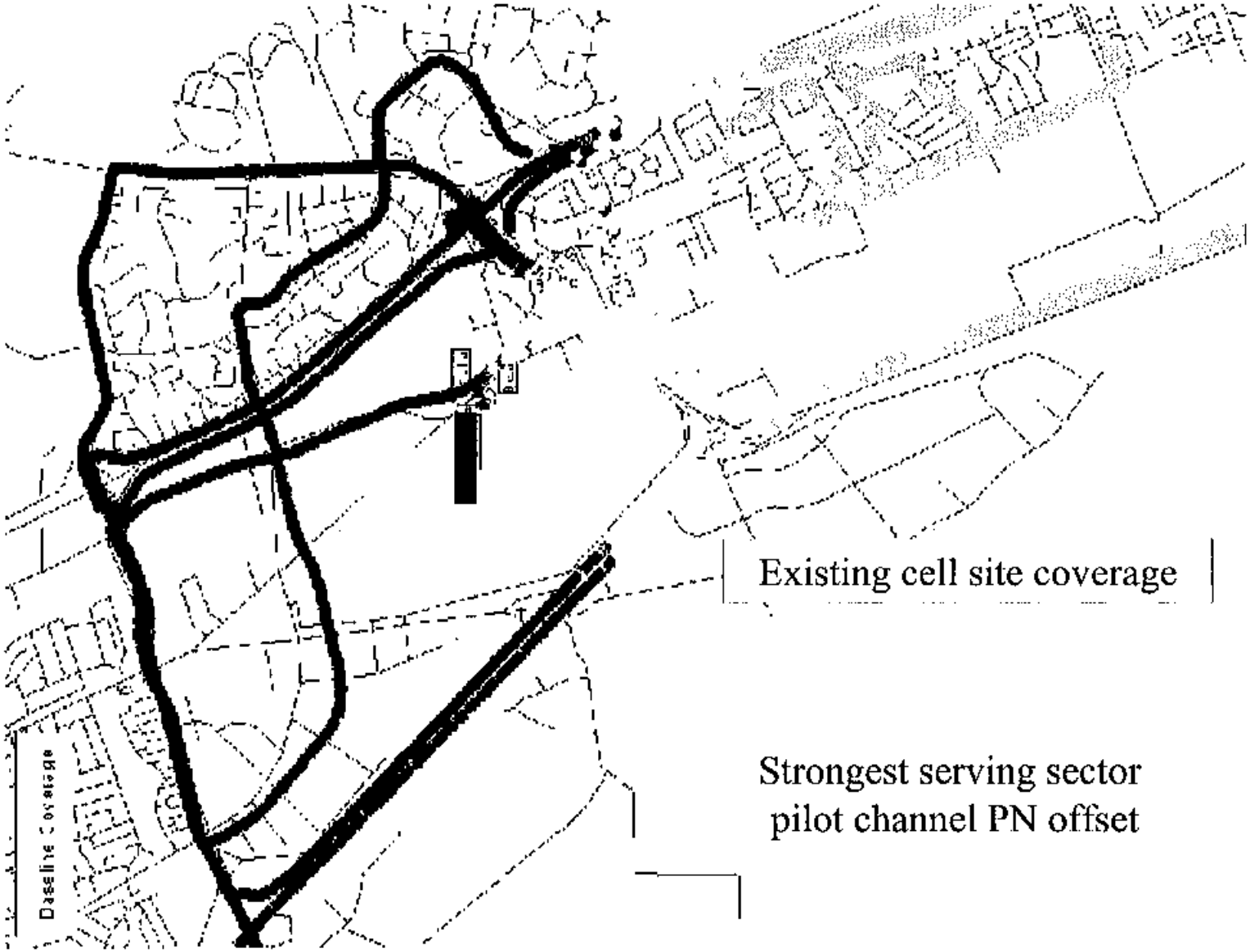
Handoff overhead and frequency reuse efficiency are strong functions of the antenna patterns.



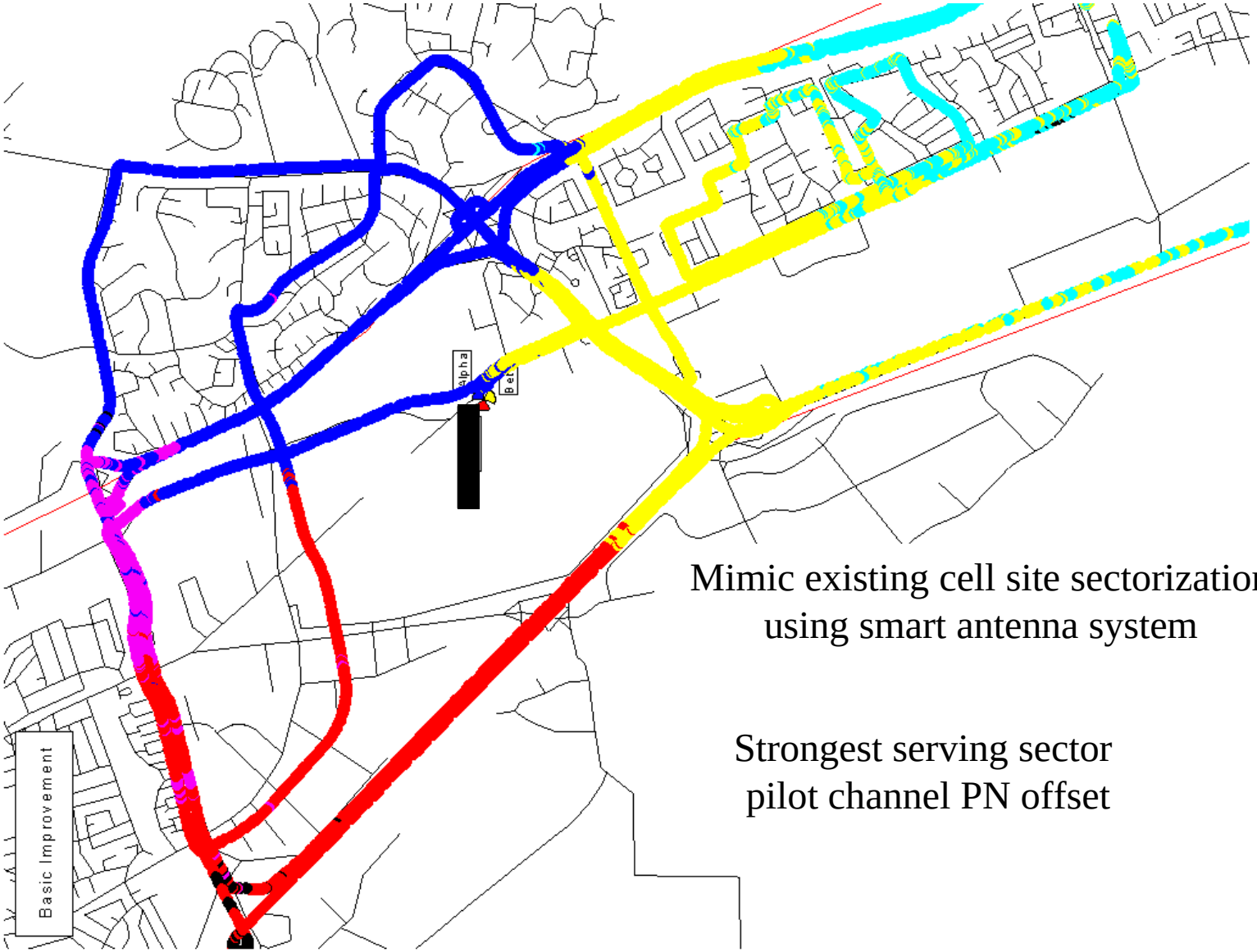
Interference Control



Field Trial Results: Baseline Case



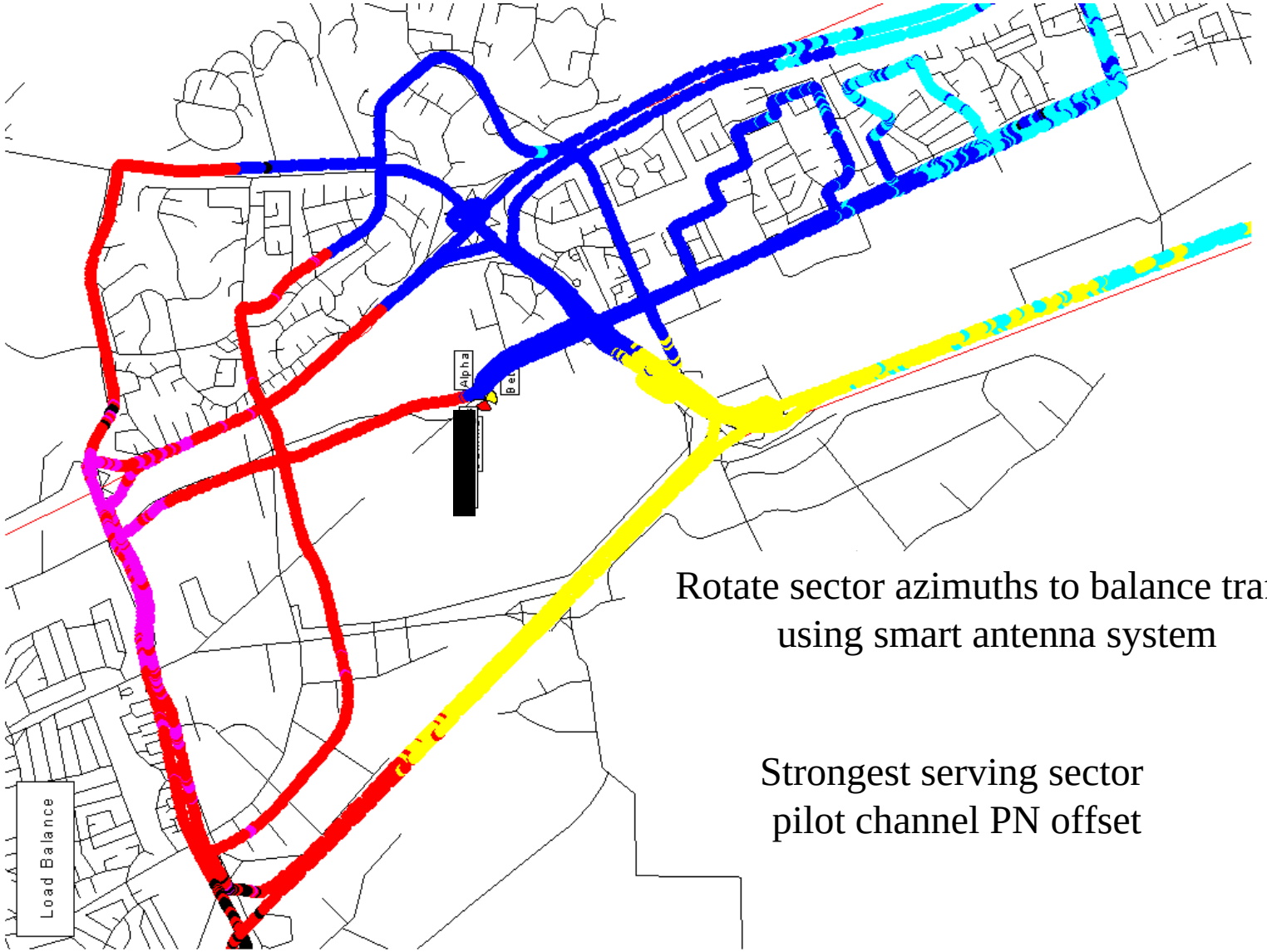
Field Trial Results: Basic Case



Mimic existing cell site sectorization using smart antenna system

Strongest serving sector pilot channel PN offset

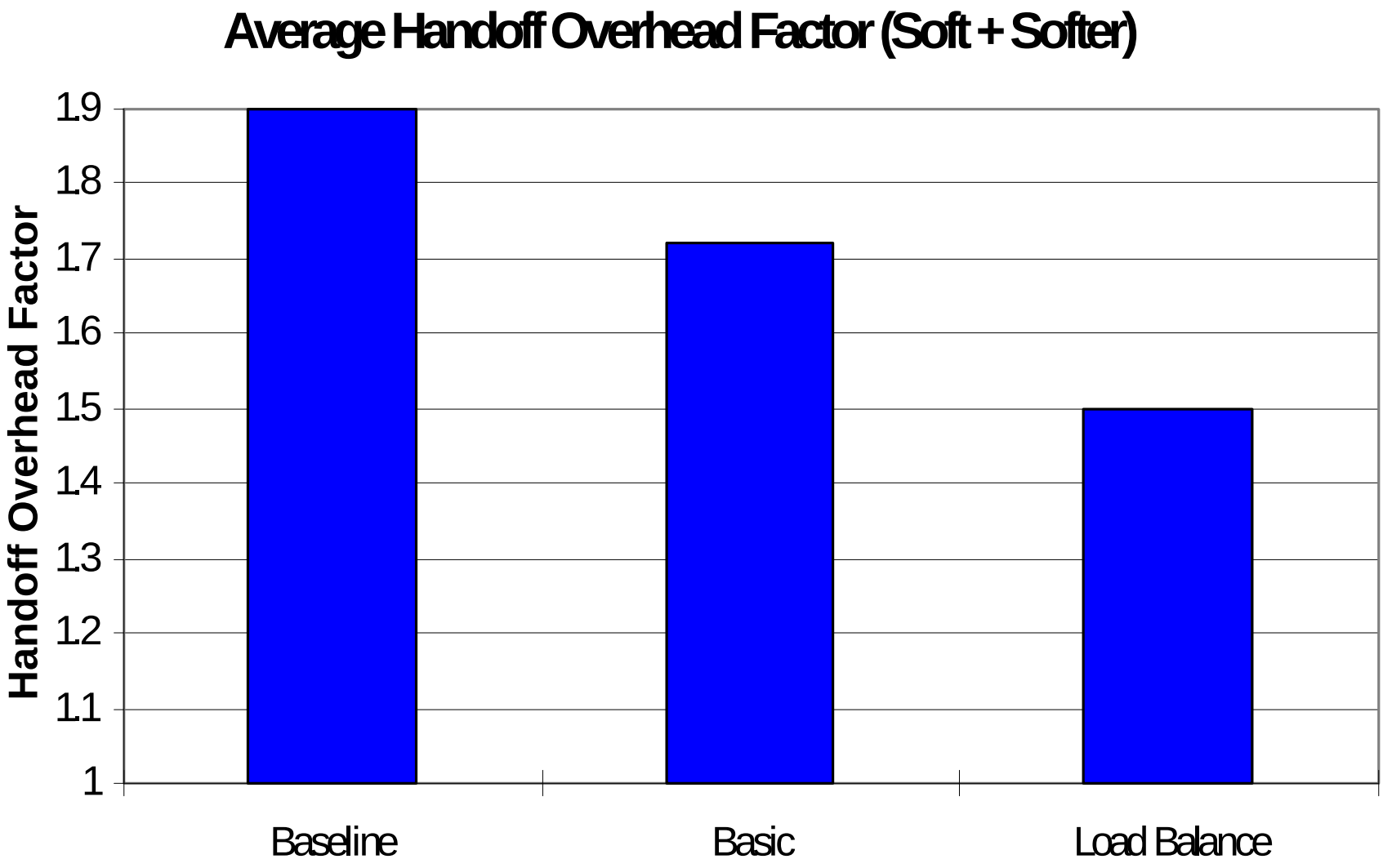
Field Trial Results: Load Balance Case



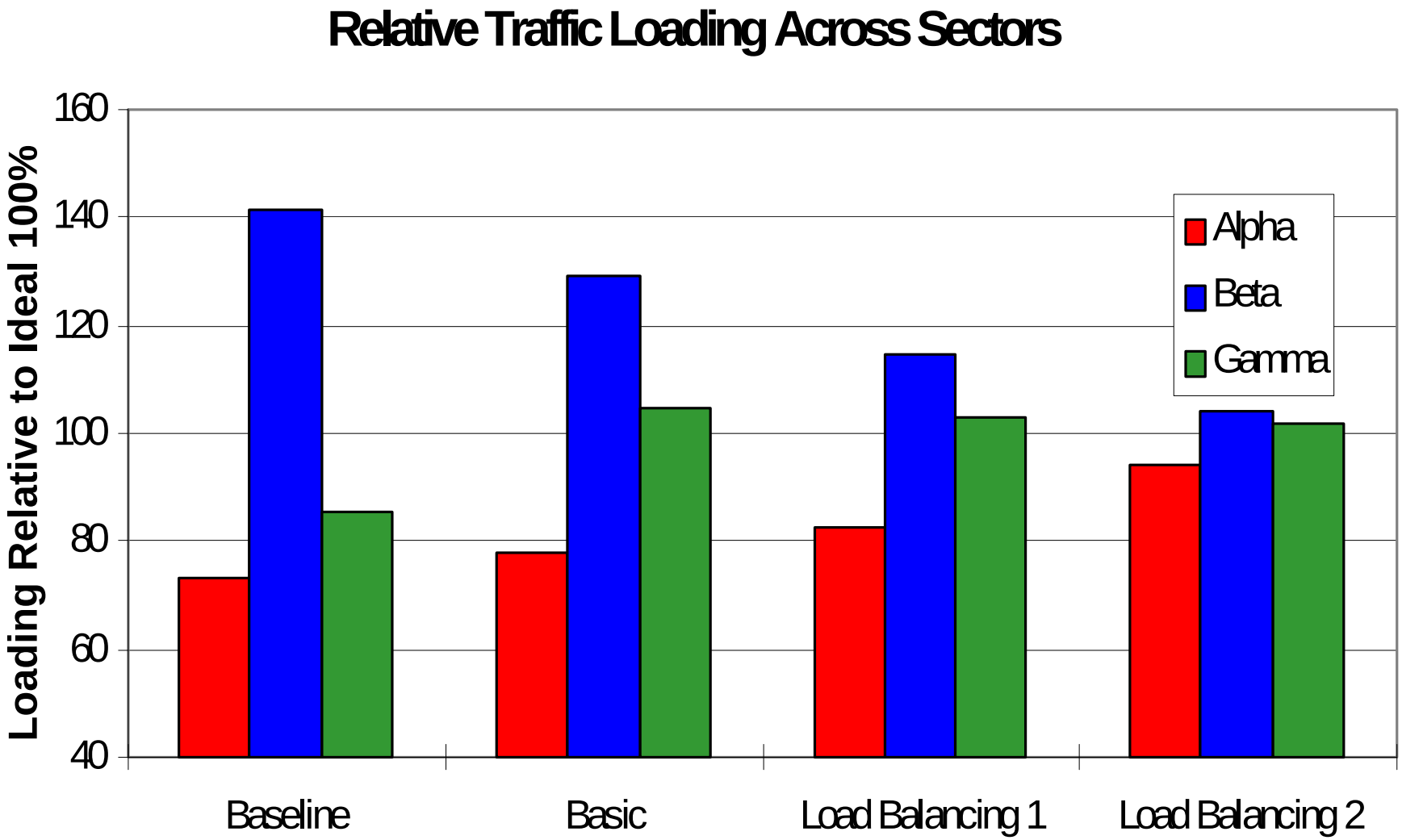
Rotate sector azimuths to balance traffic using smart antenna system

Strongest serving sector pilot channel PN offset

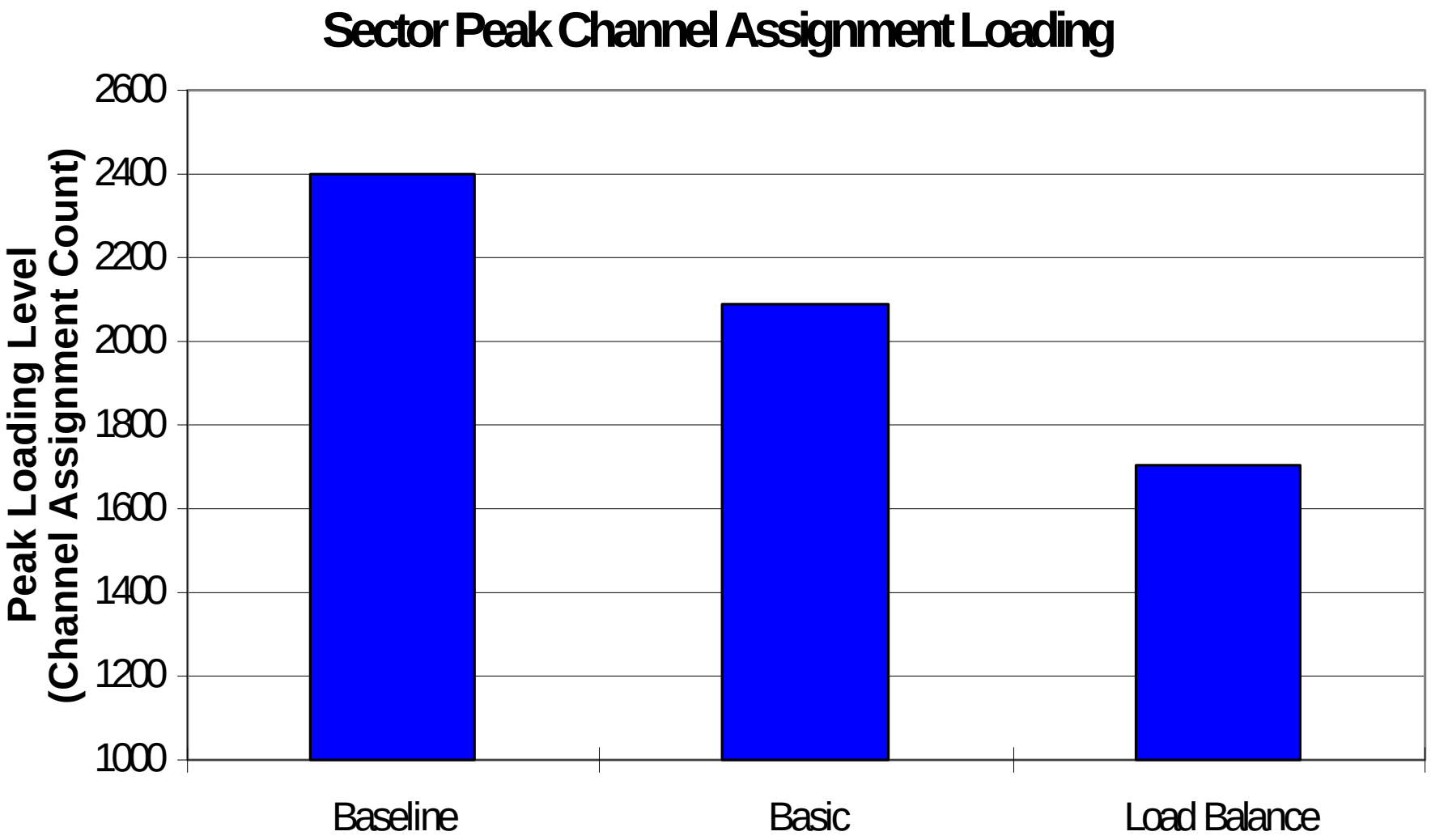
Field Trial Results: Handoff Overhead



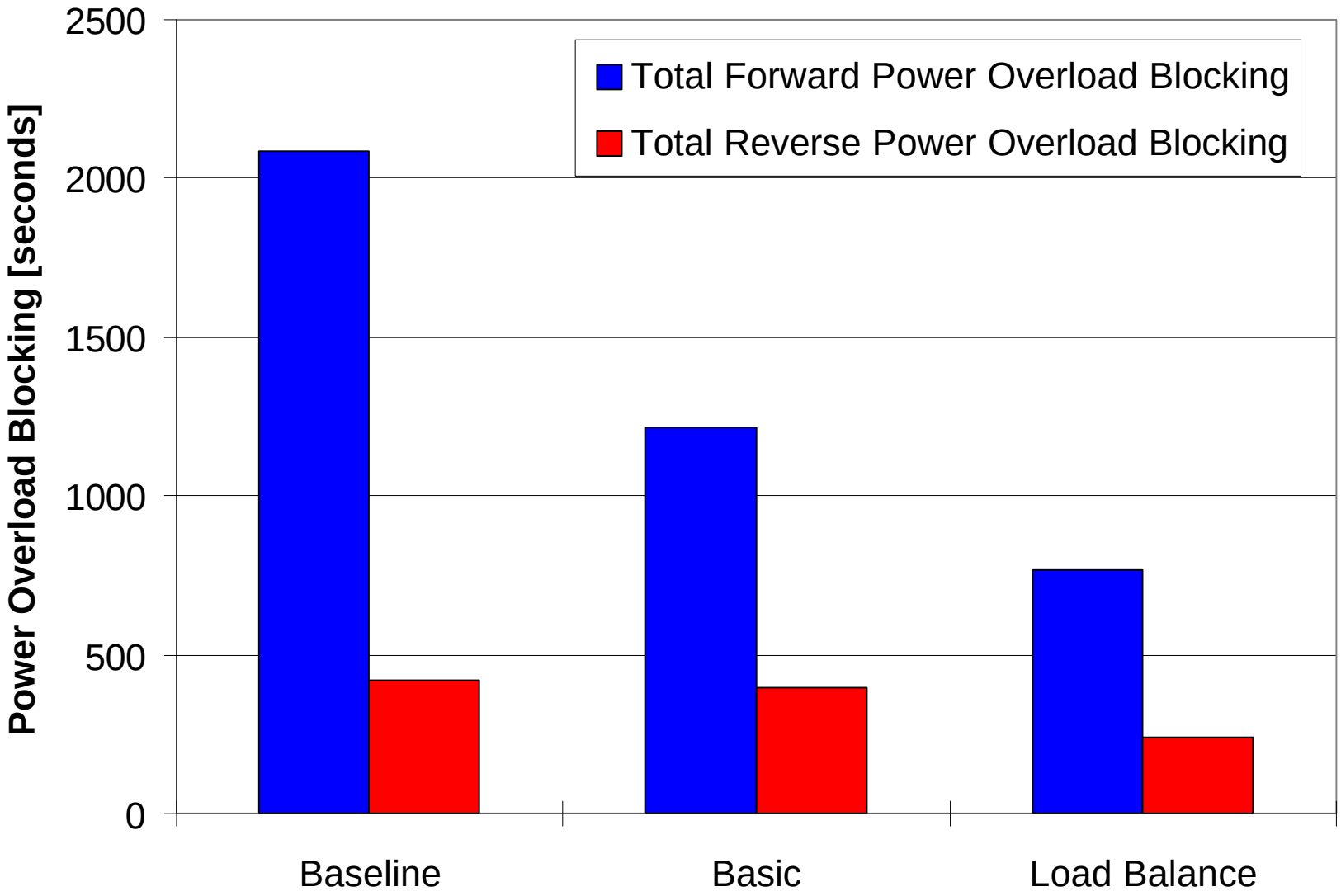
Field Trial Results: Traffic Load Balancing



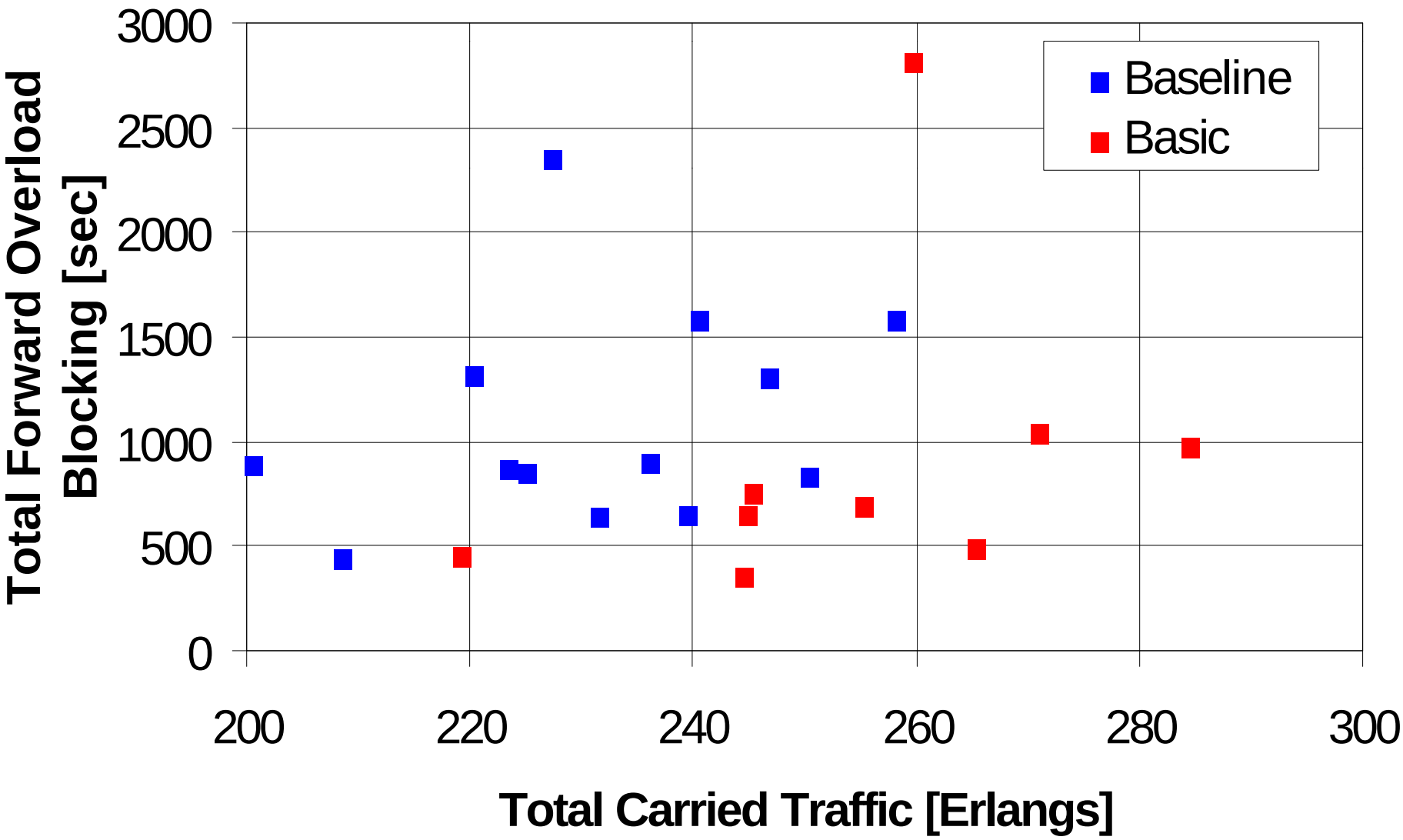
Field Trial Results: Peak Load Reduction



Field Trial Results: Power Overload Blocking



Field Trial Results: Overload vs Traffic



Conclusion

- **Dual-mode smart antenna as a non-invasive add-on for collocated CDMA and AMPS cell sites**
- **Share same physical phased-array antenna structure but allow completely independent sectorizations**
- **Synthesize custom sector radiation patterns**
  - Azimuth pointing angles
  - Beamwidths and rolloffs
  - Sculpted coverage
- **Field trial results indicate**
  - Smaller handoff overhead factor
  - More balanced traffic loading
  - Lower peak sector loading levels
  - Reduced power overload blocking