Optimal Small Cell Deployment models

June 23rd , 2014

Small Cells in More than 30 States

Small Cell – Current Installations

Outdoor

Indoor

Enterprise Customers

Cost Efficient Availability

Small Cell Deployment: Flexible, Efficient, Scalable, Cost Effective, & Accountable

- Intervals need to Improve
- Venue Specific Solutions
- Wider Selection of Options
- Optimized Form Factor & Power Needs

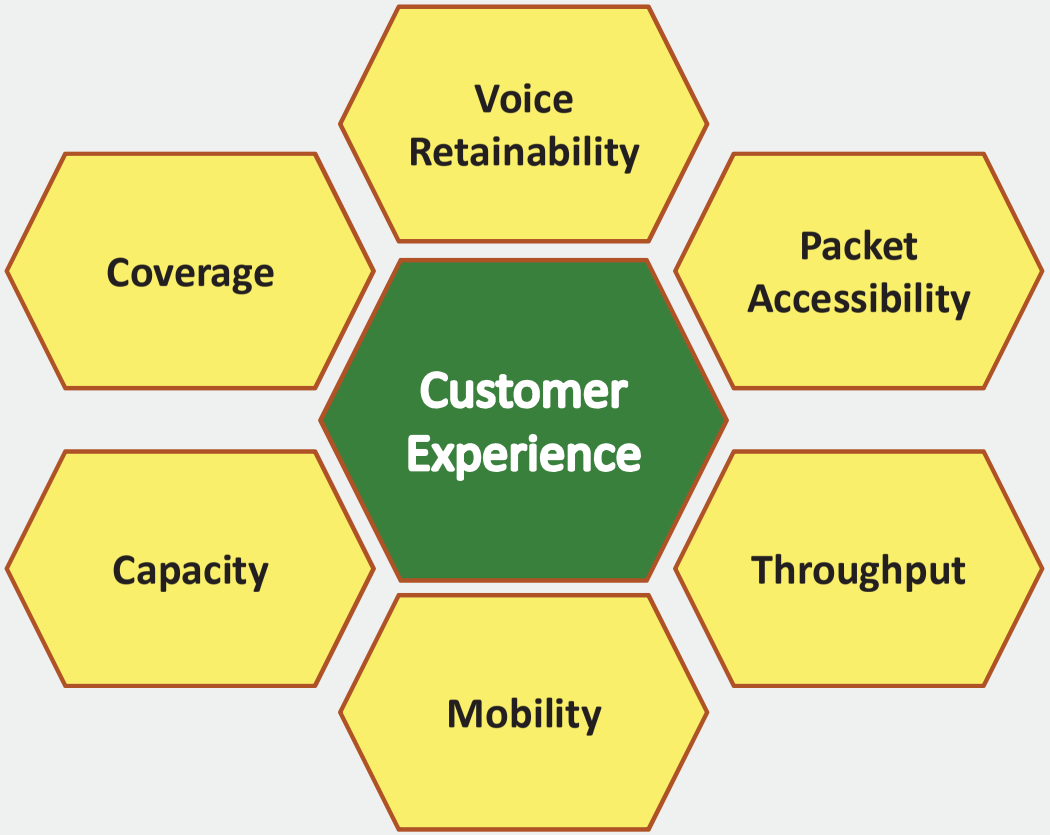
Small Cell Process Hot Buttons

- Contract
- Site Acquisition and Compliance
- Transport
- Manual methods, procedures and long SLAs
- Nice to have vs. Must have

How we are getting to 30 days

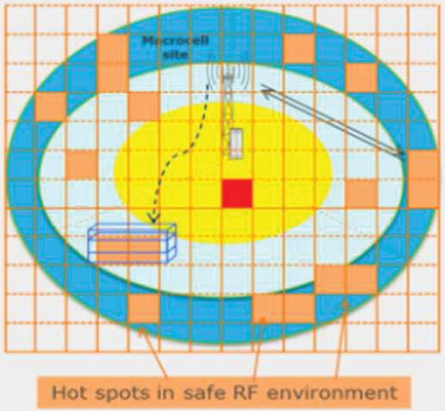
- **Streamline Steps** – Removal of steps not required for 1AP or AT&T Transport
- **Process Improvement** – Revised SLAs/Durations, removal of steps deemed unnecessary
- **Development** – IT and Network Enhancements in support of Automation and System Integration

Small Cell Deployments – What is success?

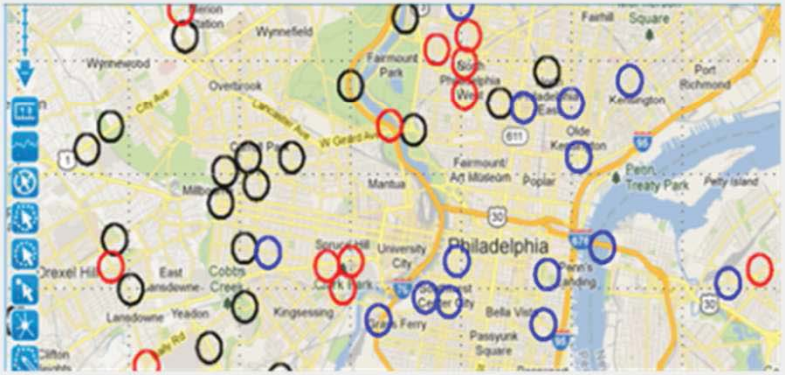


Deploying New Tools

State-of-the-art radio propagation and mathematical programming models to determine the optimal locations to place small cells

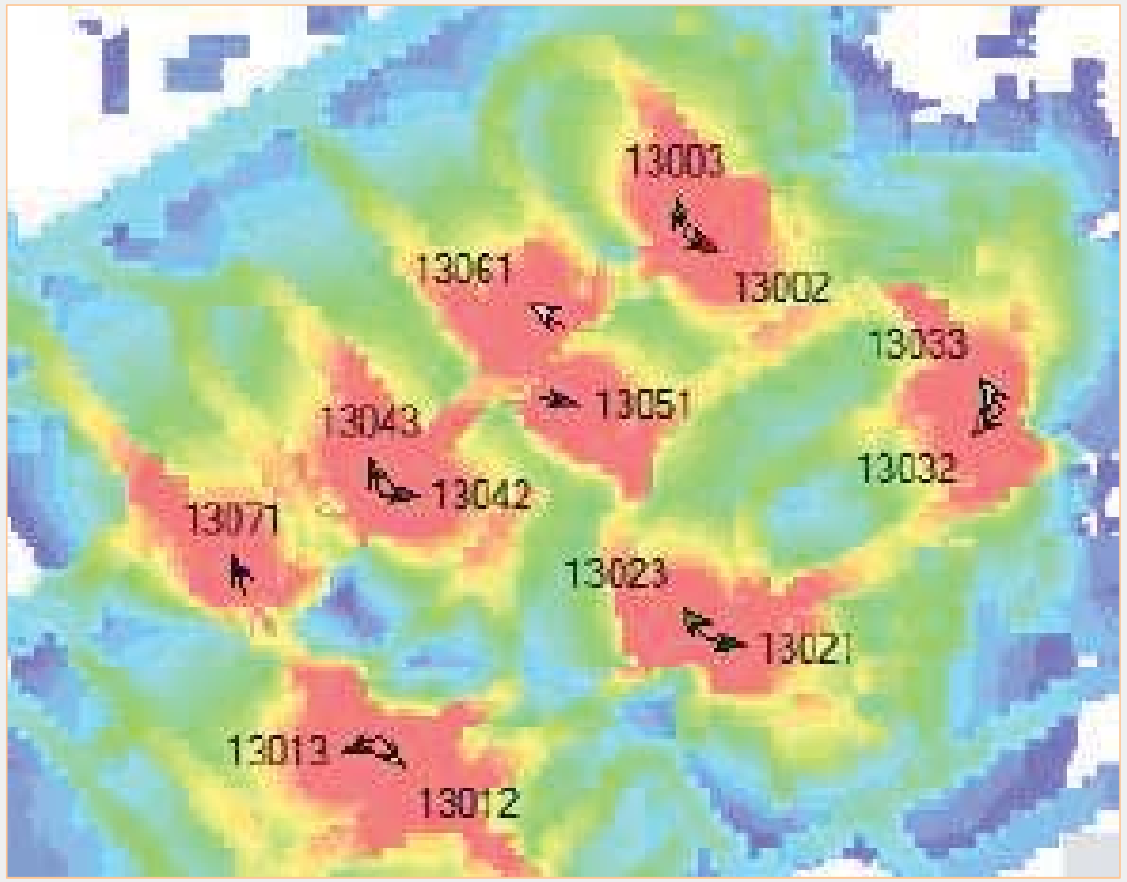


Defining Outdoor Opportunities

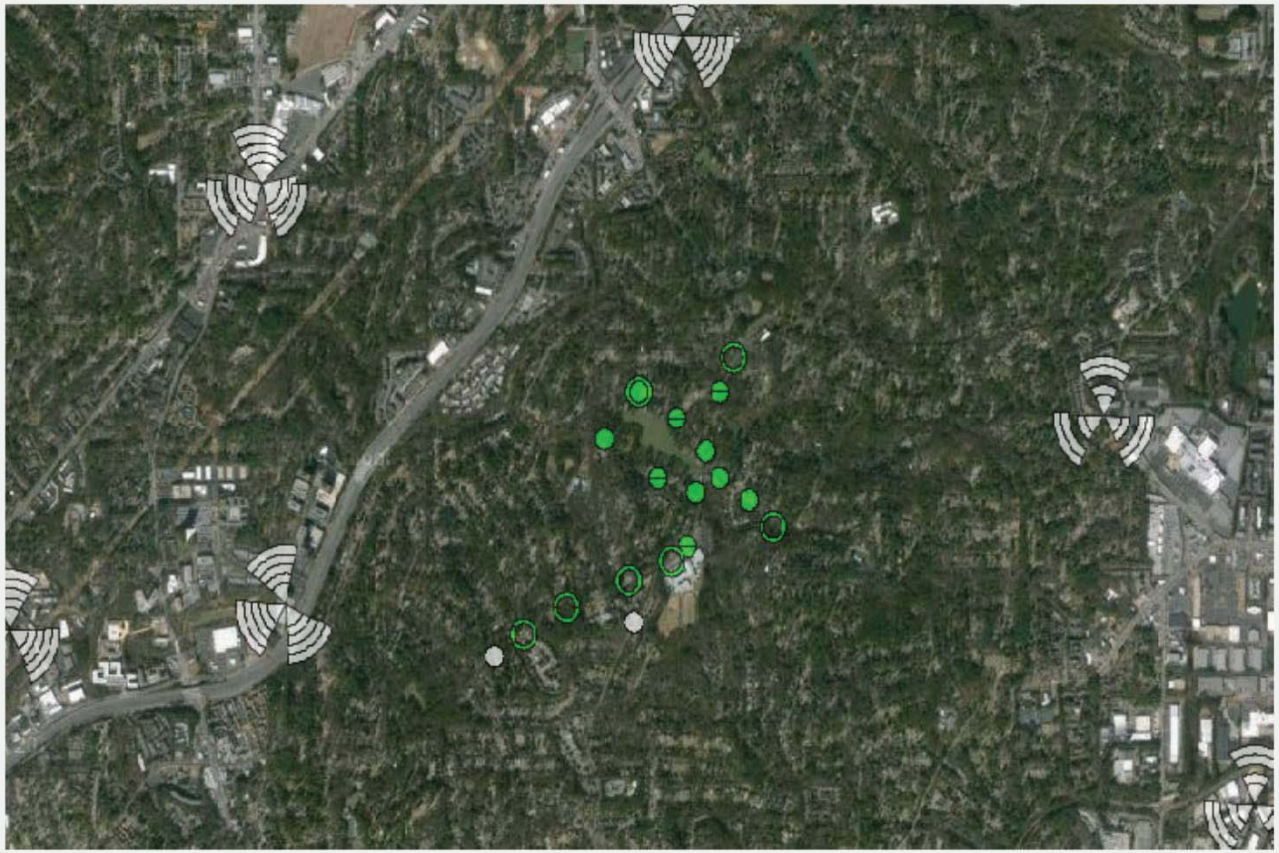


Identifying In Building Opportunities

Interaction with the Macro Network

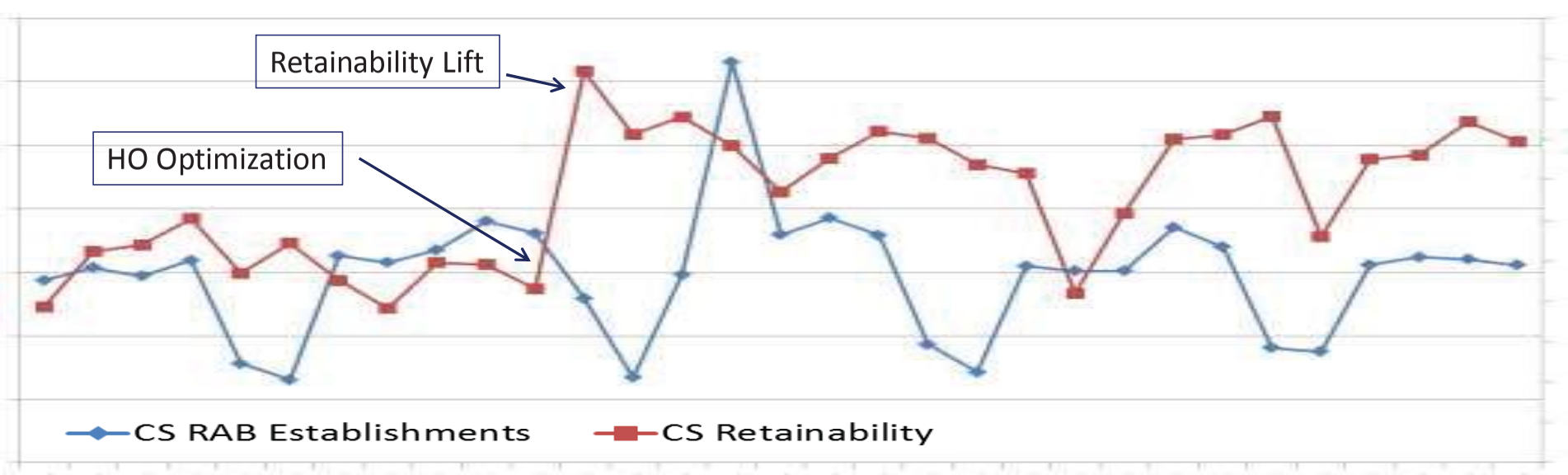


Macro Network HO - Mobility



- 22 Small Cells in Suburban Cluster
- Dense Foliage
- Busy Road through Center of Cluster
- Residential Streets Leading in and out of Cluster
- Terrain Blocks Macro Coverage

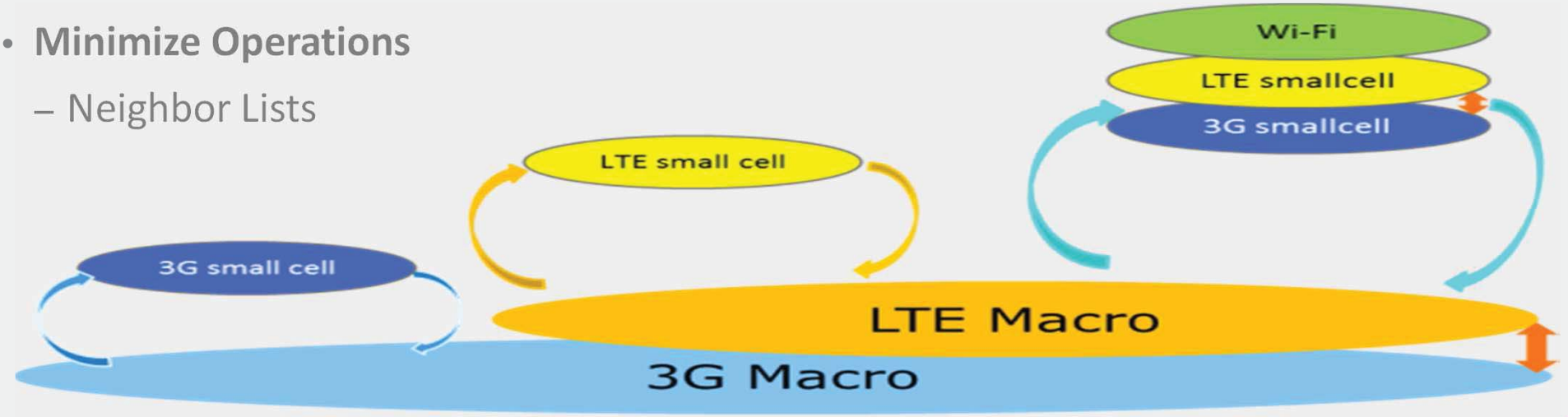
Performance with HO



- MAHO Based HO – Balance Coverage and Quality Thresholds
- Avoid Ping – Pong with the Macro
- Blind HO: Priority Neighbors with Fallback to MAHO
  - CAUTION Blind HO works best with very predictable target HO cells

Layer Management

- **UE Camping Priority (Technology and Frequency Band)**
- **Best user experience**
  - Maximize Mobility Robustness & User Throughput
  - Maximize Stay on Preferred Layer
  - Minimize Inter-Layer Transitions & Inter-Technology Transitions
- **Minimize Operations**
  - Neighbor Lists



Small Cell Technology – Investment

Small Cell Deployment Requires significant investment and planning

- Handsets require updates when adding bands.
- The small cell network must interact with the Macro network. Network interfaces must be developed and updates are required each time there is a change.

Risks

- Once the small cell network is deployed to improve customer service, customers will not appreciate a degradation of service if license is not renewed.
- Investment could be stranded.
- Once bands are added to handsets, it reduces the ability to add additional bands.