

# Terrestrial Beacon System

3D Indoor Geolocation

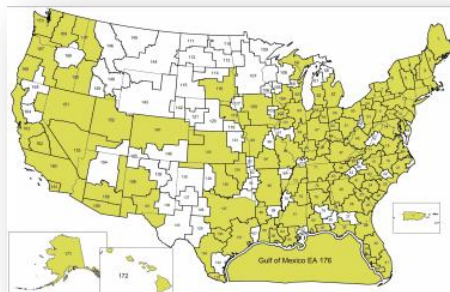
February 17, 2015

## Positioning Network Operator



- 3D location service offered metro-wide
- Dedicated to positioning using proven Terrestrial Beacon System technology
- GPS-like performance, indoors

## Supporting Assets in Place



- Nationwide spectrum licenses (93% POP coverage)
- Initial network deployments across 47 CMAs
- Technology is becoming an open standard (ICD published, 3GPP and OMA work underway)

## Multi-Use System



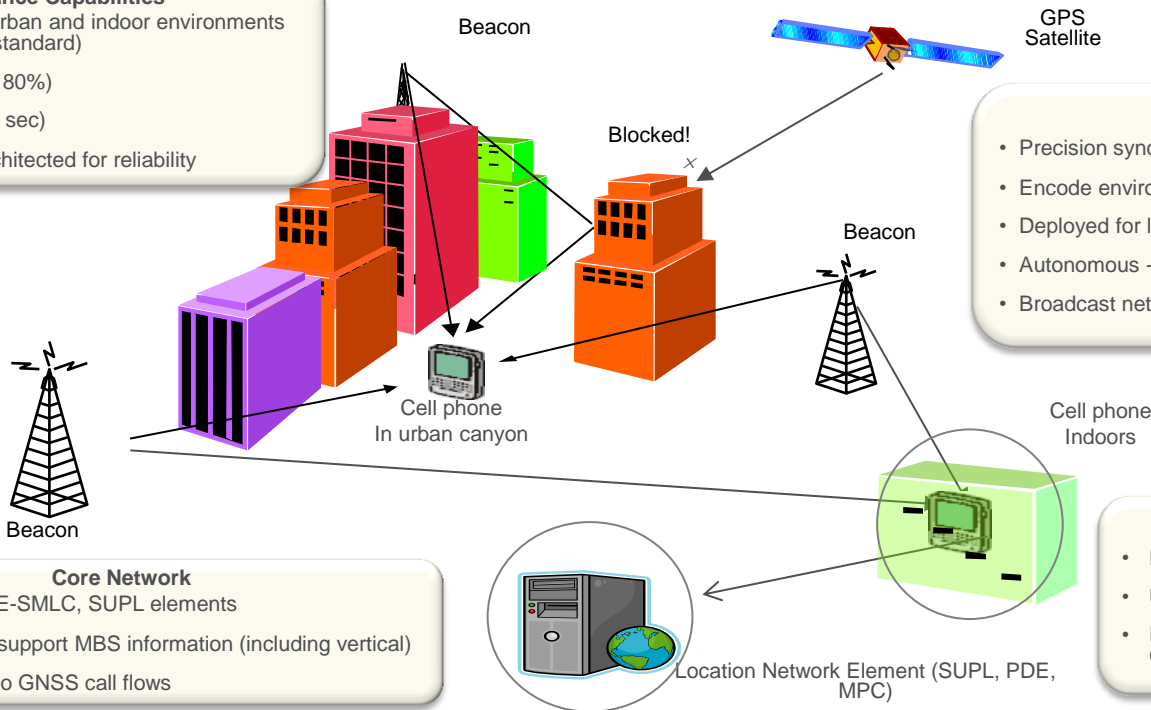
- Overlay system can be used by many applications and networks – efficient economics
- Ideal for E911, public safety, mission-critical and critical infrastructure applications
- Also supports consumer, enterprise and precision timing applications, among others

- CSRICIII testing and the robust record in 07-114 provide useful indicative data about challenges, solutions and testing in wireless E911 geolocation
- GPS with cellular aiding works poorly in urban morphologies – gpsOne (excluding cell sector-based positioning) demonstrated only 76% indoor yield, and about 16% accuracy
  - Even with a blend of outdoor calls, new approaches will be required
  - Future cellular positioning enhancement may vary by implementation, and incentives could be adverse (revenue generating spectrum vs. positioning accuracy)
- All technical solutions (address-based or coordinate-based) must prove accuracy in a structured test bed
  - Accuracy by morphology (urban, suburban, rural etc.) is established for each technology
  - Allows reasonable projection of results to counties with differing urban/suburban/rural mix (eg. San Francisco vs Alameda)
- Dispatchable Location of caller is Gold Standard (not address of nearby access point)
  - Differing DL technologies provide differing levels of accurate location of caller (vs access point)
  - In absence of accurate DL, vertical location information is critical in urban areas
  - NEAD database not permitted for commercial purposes, and must address privacy and cyber-security issues
- FCC has empowered the local PSAP's nationwide to become the 'eyes' and 'ears' of the bureau and monitor performance

# Terrestrial Beacon System

## Performance Capabilities

- Accurate location in urban and indoor environments (meets Year 6 E911 standard)
- Precise altitude (<3m 80%)
- Fast time to first fix (6 sec)
- Managed network architected for reliability



GPS Satellite

Beacon

Blocked!

Beacon

Cell phone  
In urban canyon

Cell phone  
Indoors

Beacon

## Core Network

- Utilizes existing E-SMLC, SUPL elements
- Modifications to support MBS information (including vertical)
- Nearly identical to GNSS call flows

Location Network Element (SUPL, PDE, MPC)

## Broadcast Beacons

- Precision synchronization
- Encode environmental data for vertical
- Deployed for location
- Autonomous - no backhaul – and small form factor
- Broadcast network, with no capacity constraints

## Receivers

- Firmware upgrade to GPS digital baseband
- UE-based or UE-assisted computation of location
- Reduced power consumption compared to A-GNSS



- TBS presents a powerful, standards-based alternative for metropolitan-area 3D positioning as demonstrated in the CSRIC trials
  - TBS is able to meet potential new indoor location standards with a wide margin, and provides hard evidence that a 3m vertical accuracy standard has been achievable since 2012
  - Full standardization of technology is underway in 3GPP and OMA, and ICD is a public specification
  - Eliminates positioning burden and costs on communications systems (e.g., LTE) and spectrum
  - Wide-area architecture ensures ubiquitous availability of service and provides comprehensive 3D coverage until (if / when) dispatchable location is available everywhere
- New technologies will be required to meet performance metrics as specified by the FCC
  - Likely Year 3 and definitely Year 5 will be a challenge
- Greater transparency and accountability for E911 in the R&O
  - Local PSAP's are empowered to monitor performance on a continual basis