3D Location Indoor & Improved Location Outdoor
Problem

- When a First Responder is trapped inside a building or needs help and cannot describe their exact location other First Responders may not be able to respond to assist.
- Geolocation & Situational awareness is paramount in emergencies & incident management
- Today, GPS is used to provide that for the Outdoors with some success, however until now no solution has existed for the Indoors.
Required Elements for ‘Mission Critical’ Location Indoors

Mission Critical/Yield
- Ability to operate in the absence of power & withstand extreme weather conditions
- Ability to deliver location for every attempt

> 99% Yield

Horizontal Accuracy (‘x-y’ Axis)
- High accuracy (x-y)
- Identify building, Room/Zone, Store etc.

Vertical Accuracy (‘Z’ Axis)
- 1-3 Meter Vertical Accuracy
- Floor-level Positioning

Ubiquity and Consistency
- CONSISTENT experience in EVERY building within an entire metropolitan/suburban area
- Available in vast majority of end-user devices
‘GPS’ Performance Indoors

- An overlay network, dedicated to provide 3D (X,Y & Z axis) positioning with unique, proven floor-level vertical and horizontal accuracy
- Wide area coverage – can cover an entire market, much smaller than a Cellular Build
  - SF Bay Area is built to cover over 900 sq. miles with ~ 100 beacons
- Long-range, low-cost broadcast beacons placed on cell towers and rooftops – not building specific
  - Typical range 0.5-5 miles (depending on environment)
- Deployed and managed to deliver ‘Mission Critical’ (ability to withstand power outage & storms) location with multi-layer reliability
  - Beacon redundancy – Master & Slave Transmit
  - Battery backup to ensure continuity during power outages
- Complementary to GPS
- Designed to be built into phones standard – no accessories required
- Initial beacon network operational for six years in Top 47

MBS is essentially a network of low-cost terrestrial “satellites” broadcasting from roof-tops and towers

Current SF Bay Area Coverage
# Network Equipment

<table>
<thead>
<tr>
<th>NextNav Beacon</th>
<th>Beacon Interior</th>
<th>Omni Antenna</th>
<th>Weather Station</th>
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</thead>
</table>
| • Designed for deployment in unconditioned space  
  • Small form factor 37.78” H x 30.70” W x 19.68” D  
  • No special power requirements or backhaul  
  • Management link via LTE or POTS  | • Battery backup ensures continued operation without power  
  • Duel redundant power supply & components  
  • Internal rubidium clock backs up GPS  | • Low-impact omni antenna  
  • Eases zoning, and creates placement flexibility  
  • Omni antennas are ideal for location  | • Weather stations deployed across NextNav network  
  • Enables high-accuracy pressure altitude  |
Indoor Location & Navigation

Accurate Horizontal (X-Y) Tracking

- Delivers < 9 ft (3m) Vertical position (floor level) and <30 ft (<10m) Horizontal position.
- MBS signal provides location and navigation in any part within it’s coverage instantaneously
  - No building specific information required
  - Maps are optional
- No Pre-Planning required – Wide area system

Reliable Floor-Level Altitude (Z) Tracking

- 1.7 m – 80%

(Results based on latest CTIA/ATIS Testbed for Indoor Location Technologies)
3D Context & Visualization Service: Companion Service

- **3D Context Visualization Service**: Supports real time 3D tracking of 9-1-1 callers and first responders
  - Accurate 3D representations of all structures
  - Floor plans ingested into hosted platform where available

- In addition to visual display, supports user context information and other building details where available (e.g., address, floor, suite/room)
  - Could be integrated with Body Camera systems & other sensors

- Information can be displayed via web interface, dedicated tablet/phone application
  - Fully-featured UI: breadcrumbing, pan/tilt/zoom, prioritized identification of individuals or groups, buildings etc.

- APIs available for integration into existing tools and applications where preferred
User Experience – Video

Click to play or go directly to https://vimeo.com/222454215
E911 Requirement & Industry Benchmark

- **MBS - Reliable 3D location**
  - Independent of Venue
  - Independent of Broadband penetration
  - Works when power is out

**MBS Fixes:** Correct floor, building

- In 2015 FCC introduced new rules for location accuracy (indoor & outdoor) when dialing 911
  - Six year phase in for X-Y
  - 50m (164 ft) ‘X-Y’ – 80% of Calls
  - 3m (10 ft) ‘Z’ – 80% of calls (Desired)

- Based on Blind Government and Carrier Tests (AT&T & Verizon)
  - NextNav’s MBS technology is the only solution that meets/exceeds all FCC’s metrics in all environments
  - Proven floor level accuracy; < 6 ft (2m) vertical 80% of time
  - 99% Yield
MBS Service

MBS 3D location system, with beacon coverage designed to meet first responder objectives. Access to Spectrum

3D Context & Visualization service to enable real-time 3D tracking
- Hosted back-end service for tracking 9-1-1 callers and First Responders
- Tablet / phone and web-based applications for tracking First Responders at an Incident
- Ability to upload city and building maps
- 3D building model rendering

APIs for integration into first responder applications and workflows

Devices with MBS Built-In

GPS Independent Timing
- Presence of high precision Rb clock self-synchronizes MBS technology independent of GPS
- Provides LTE network hardening & GPS resiliency for FirstNet

Deployables for remote areas
Conclusion

• Satisfies Public Safety’s needs for ‘Enhanced Mission Critical Location with Z axis capability’
  – Only Mission critical location that delivers high precision X-Y-Z; GPS (Does not work Indoors), OTDOA (not accurate)
  – Best performing 3D location technology as demonstrated in CTIA/ATIS (2016) & FCC/CSRIC (2013) tests
  – Ability to withstand power outages & not dependent on Broadband penetration

• Technology designed for mass market applications
  – Mass market Chipsets with MBS capability coming into market from Tier 1 GPS chipset providers (e.g: Broadcom, Intel etc)
  – No impact to Overall Device cost (sub Dollar)
  – MBS enabled on server end by Ericsson and TCS
  – Technology standardized in 3GPP (Rel 13) and OMA (2.0.3)

• Using Context & Visualization Service will provide improved ‘Situational Awareness’ for First Responders

• Can provide a reliable backup to GPS in Urban Areas in a Commercial form factor

• Broadcast Network across multiple applications ensures lowest cost solution