Locate, Map, Track. Indoors.

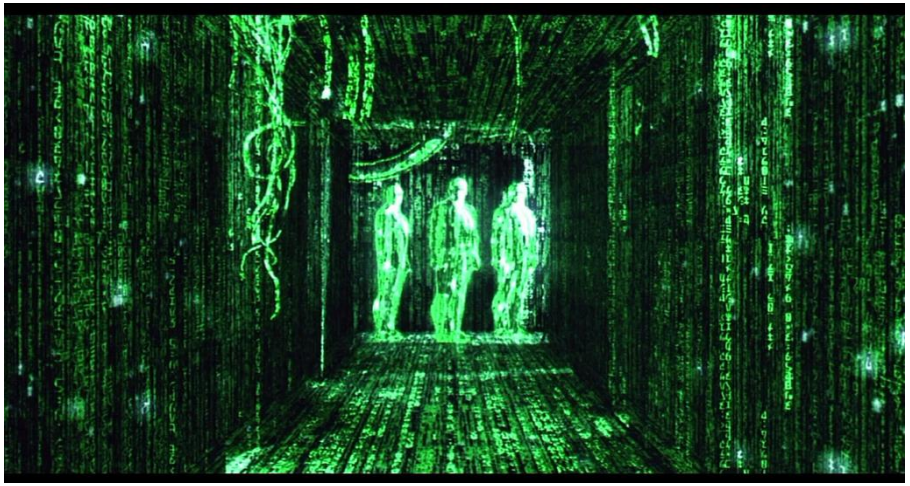
TRX Products and Services Developed with SBIR Program Support

TRX systems

LOCATE. MAP. TRACK. INDOORS.

Nearly 40 years of tracking…in the movies…

Alien - 1979



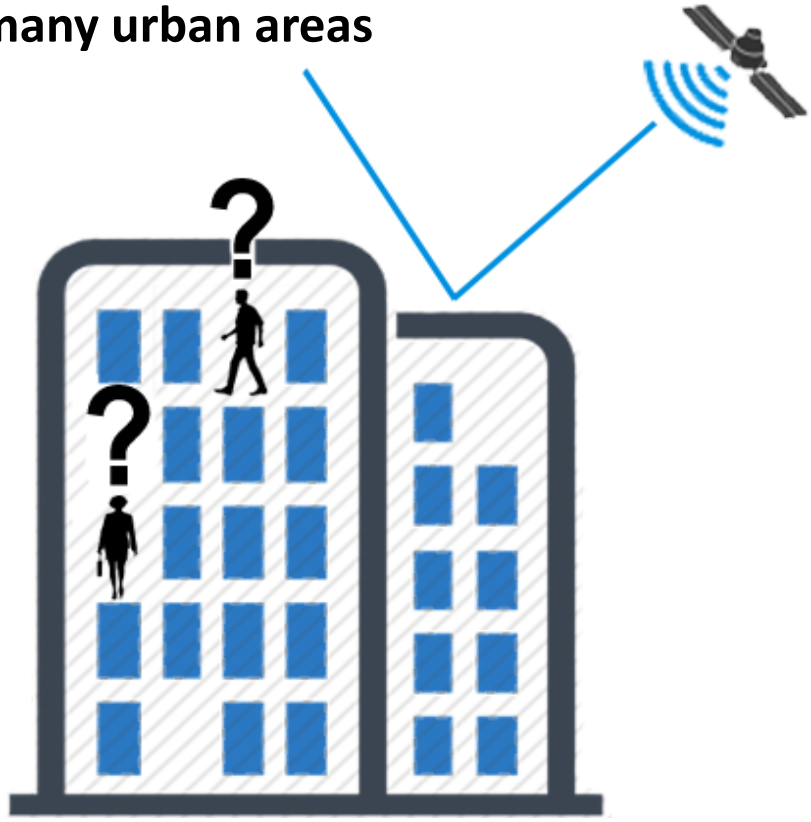
The Matrix - 1999

Minority Report - 2002

Jurassic World - 2015

Current Solutions Work Only For Venue Owners

GPS doesn't work inside buildings, underground or in many urban areas

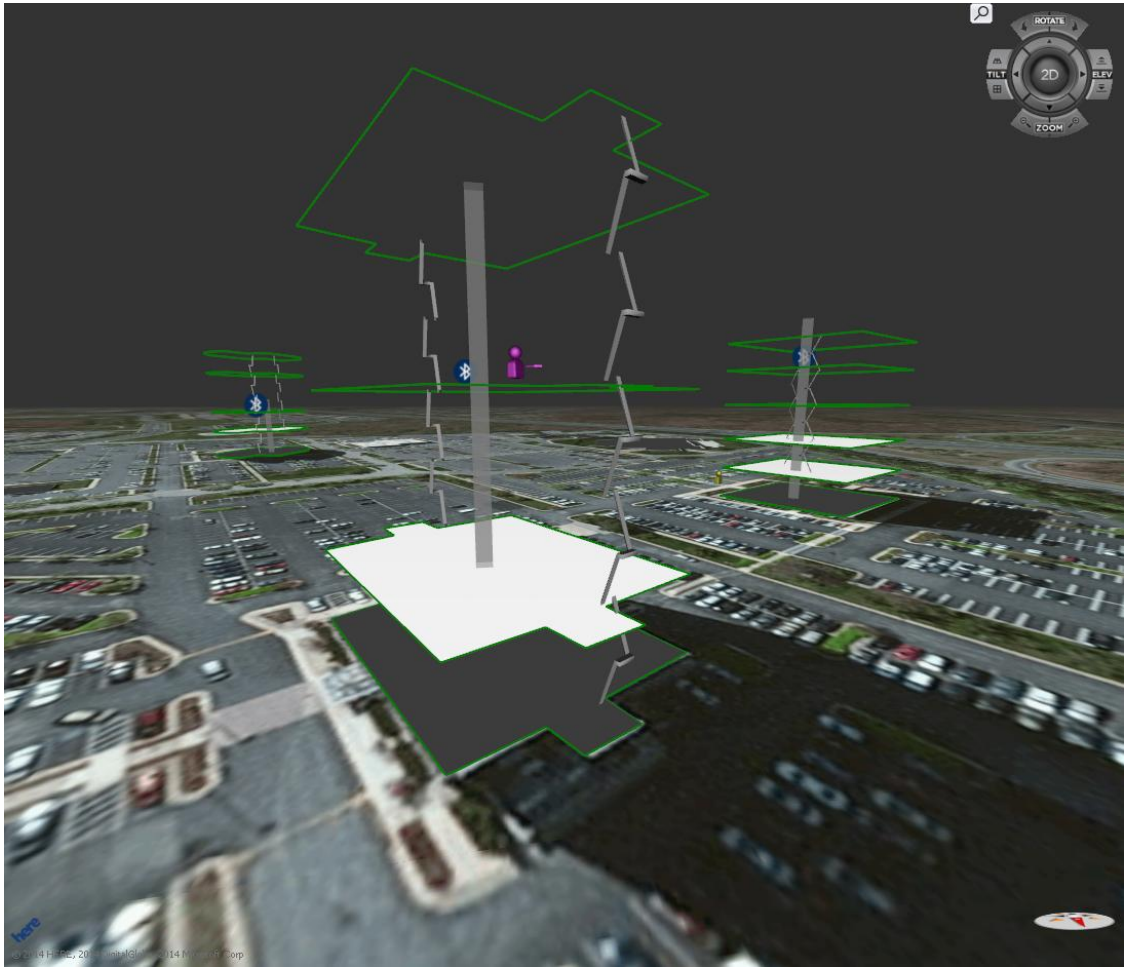


Wi-Fi Provides general location only if installed and mapped

Bluetooth focused on proximity and requires BT beacons in known locations

Must have accurate indoor mapping to deliver location in buildings you don't instrument

TRX's NEON Indoor Location Solution



Development Supported By:

NSF

DARPA

4

U.S. DEPARTMENT OF HOMELAND SECURITY

U.S.ARMY

MOTOROLA SOLUTIONS

Huge need for Indoor location and mapping today

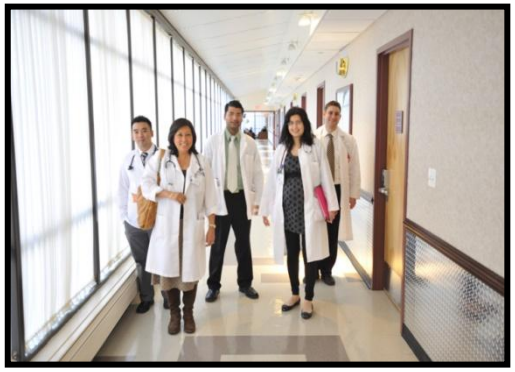
Police – public safety

Industrial workers

Private Security

Military

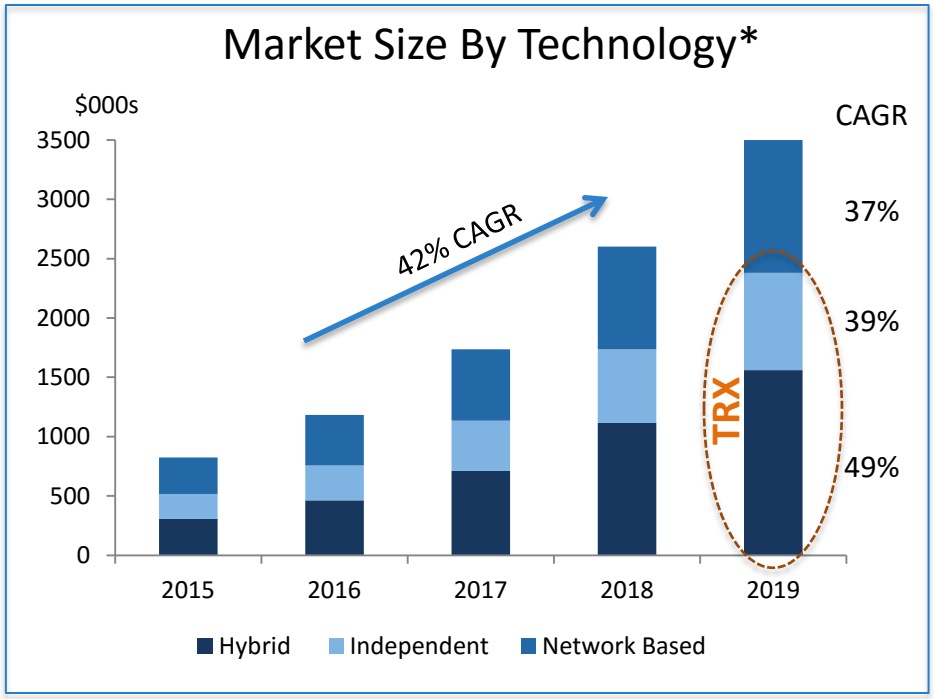
Signal Mapping



Enterprise Workflow

Ultimately this capability will be embedded in every mobile and industrial device.

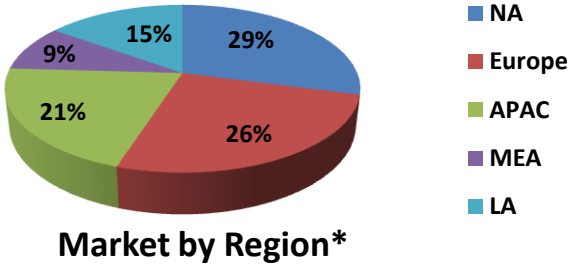
$3.5B Indoor Location and Mapping Mkt (42% CAGR)



- **$3.5B** worldwide market in 2019
- Independent and hybrid markets very addressable for TRX
  - Mapping and Navigation ~35%
  - LBS Analytics ~65%

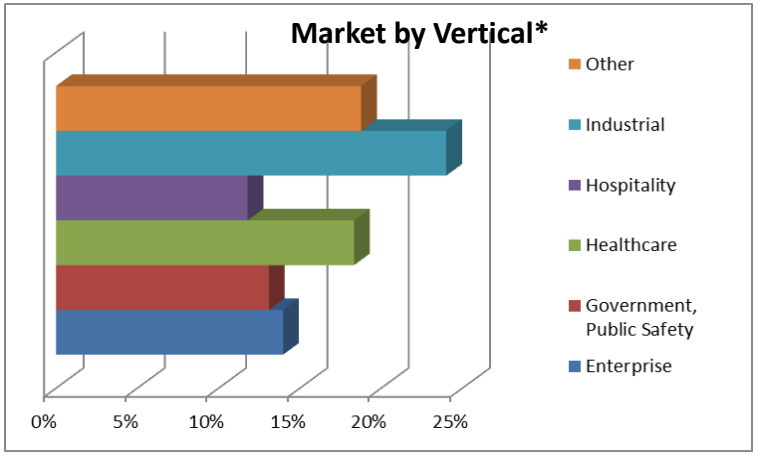
*Source: Markets and Markets 2014 report and TRX analysis

- NA and Europe represent more than half of WW opportunity followed closely by APAC



Market by Region*

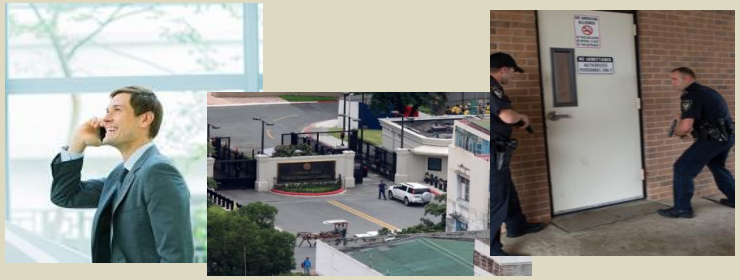
- Gov't, public safety, and military represents 12% of market opportunity
- Enterprise, industrial, and healthcare present large opportunities for TRX



NEON solution addresses large, dual-use market

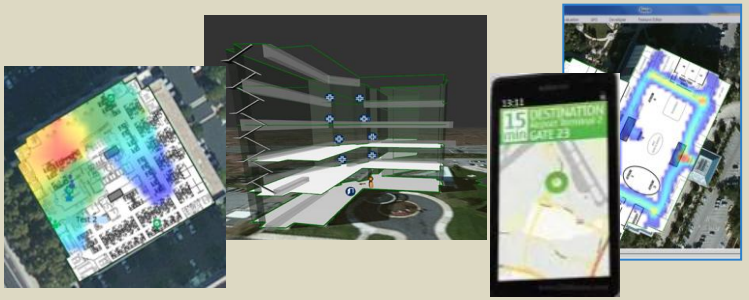
Began with Government Location Services for Situational Awareness and Safety (Like GPS)

Personnel Tracking and Location:
Security, Personnel Tracking, Commercial Building Navigation, Public Safety, Workforce Mgmt



Public Safety, Industrial, Commercial Platforms are Merging to Create a Large, Dual-Use Market

Mapping and Analytics:
3D Building Maps, Wi-Fi/Beacon maps, occupancy maps, building usage and routing



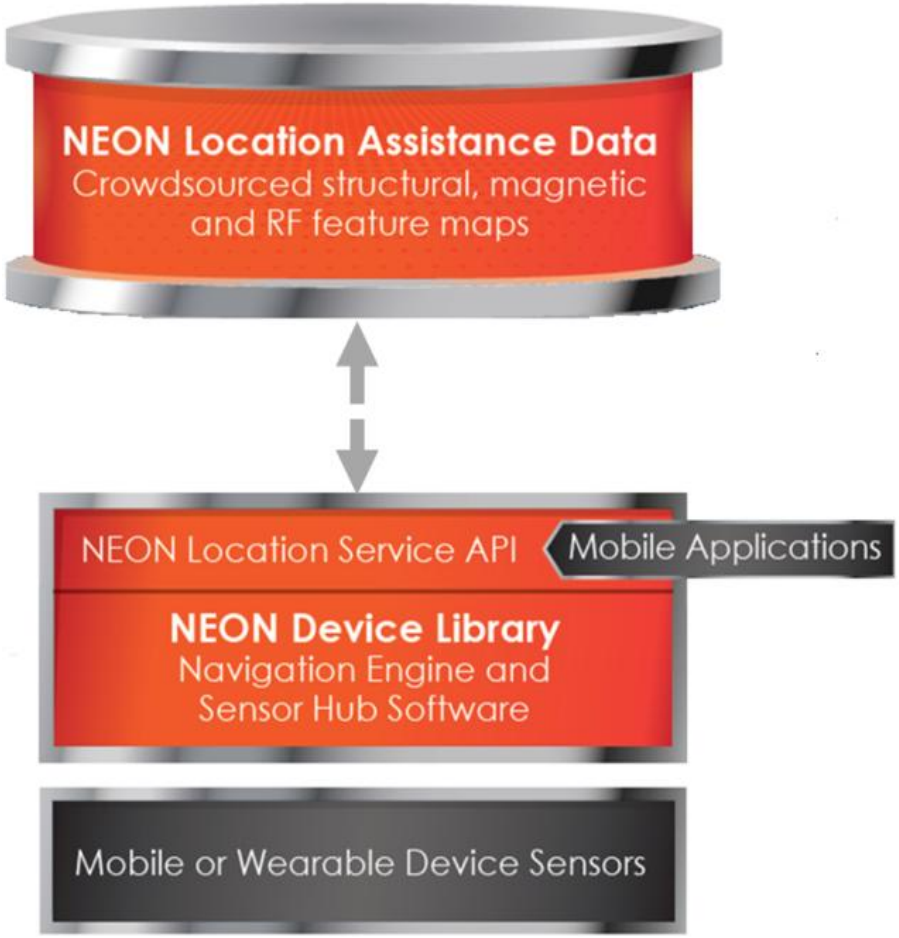
SBIR Funding Support

- Received SBIR investment from the National Science Foundation, DARPA, and the US Army (CERDEC, STTC)
- Triangulated that funding with angel and venture sources, and customer funding (sales) to develop two core technologies
  - *Indoor Location* – development of sensor fusion and constraint algorithms to support infrastructure-free tracking of individuals
  - *Collaborative Mapping* – development of crowd sourced mapping of location assistance data

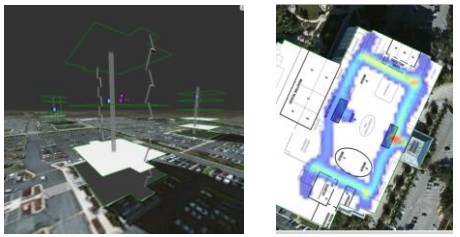
Investment Notes

1. Significant early development risk
2. High level of R&D investment
3. Public safety & security markets

NEON Indoor Location Service



- Cloud-based Location Assistance Data



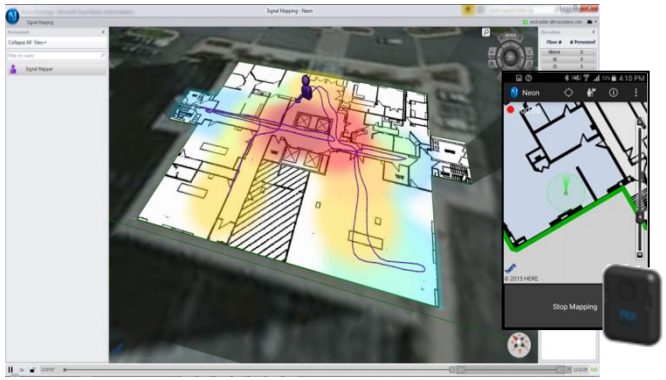
- Sensor fusion, ranging, and mapping software

Solid IP position including 10 patents issued in the US, 9 internationally, 29 pending

NEON Location-Based Applications

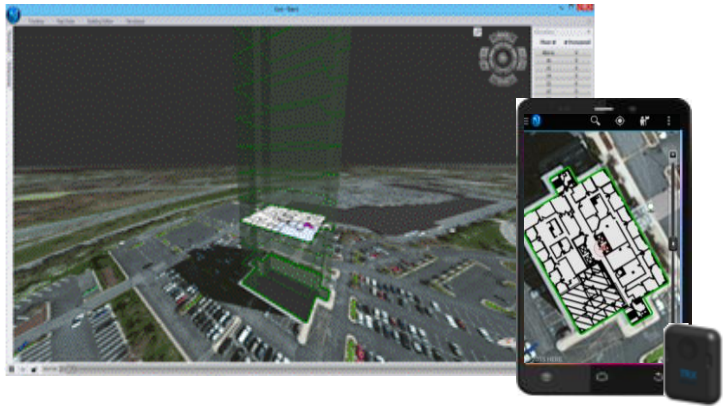
NEON® Signal Mapper

Real-time 3D location for indoor test and measurement, sensor data collection, indoor mapping applications



NEON® Personnel Tracker

Comprehensive indoor location solution for public safety, industrial, and enterprise applications



Example Commercialization Partner: Anritsu

Application Note

Anritsu envision:ensure

In-building Mapping with the Anritsu S412E LMR Master and the MA8100A Series TRX NEON® Signal Mapper

Introduction

In-building wireless communications are essential to provide communications for law enforcement activities, for emergency medical treatment, for fire suppression, for carrying on the business of government, and for providing communications in time of disasters. There is abundant news of in-building events where public safety personnel have been called in to resolve problems and to support health and welfare needs. In all of these cases, effective and reliable communications are necessary for these professionals do their jobs effectively.

Figure 1. School Complex to In-Building Map

The role of enforcing in-building public safety needs (e.g., # occupants in a room) typically falls to the local fire marshal's staff. They rely on building codes and standards from the National Fire Protection Association (NFPA). Wireless communications standards are covered under NFPA 72 and NFPA 1221. Both standards prescribe periodic measurements to assure communications. For more information go to *http://www.nfpa.org*.

Figure 2. NFPA 1221 website

Historically, public safety communications were mostly based on powerful, external high site transmitters to supply sufficient signal levels to reach into buildings. Modern energy efficient building construction and increasing reliance on anytime, anywhere communications are causing installation of public safety radio enhancement systems. These systems, known in the technical community as Distributed Antenna Systems (DAS) take the external high site signals, amplify them and evenly distribute the signals throughout the building. For a description of the many differing technical approaches for DAS systems see "Understanding IBW Solutions", Anritsu document 11410-00885A.

This application note describes how to make in-building RF measurements to determine communications coverage.

Example Commercialization Partner: Motorola

NEON® Personnel Tracker Now Available with Motorola LEX L10 Mission Critical LTE Handhelds

Posted by Jeff Kunst on Tue, Mar 22, 2016

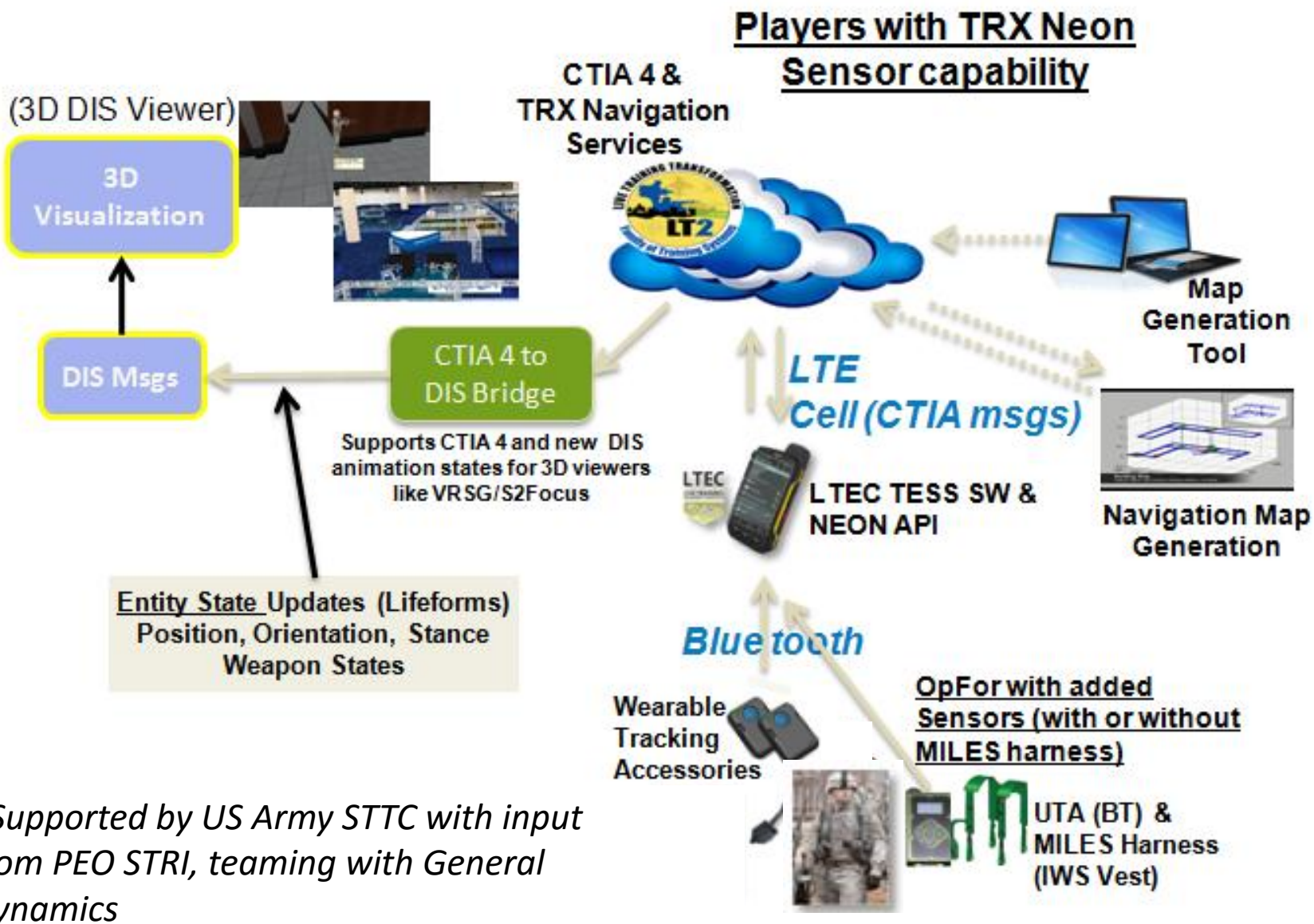
Tweet | Share 39 | Like Share 5 | G+1 0

Today, we are very excited to announce the availability of the NEON® Personnel Tracker application that is now fully interoperable with the Motorola Solutions LEX L10 Mission Critical LTE Handheld. The TRX-Motorola solution extends location and mapping indoors to deliver seamless tracking of personnel in critical public safety, security and industrial applications. The NEON-LEX L10 integrated solution to be showcased at the International Wireless Communications Expo (IWCE), March 23rd and 24th, at the Las Vegas Convention Center (Motorola Solutions booth #1029).

Motorola's LEX L10 is a customizable and intelligent communication device purpose-built to enable first responders to work faster, safer and smarter. The LEX L10 addresses unique public safety requirements including a display that prioritizes information based on user status and activity, a covert operation mode, a design that supports one-handed operation, dual 1 Watt front-facing speakers, tri-microphone noise and echo cancellation, and a dedicated PTT button for fast voice collaboration.

NEON Personnel Tracker delivers indoor and outdoor location improving command effectiveness and safety for public safety and security personnel. The application uses the NEON Indoor Location Software to provide location in both 2D and 3D, as well as tracking and visualization of personnel in indoor and outdoor environments such as basements, complex buildings and urban canyons. Accurate tracking is accomplished using NEON's patented algorithms, which combine data from all available device sensors including inertial, magnetic, pressure, light, Bluetooth, WiFi and any available GPS signals to calculate location.

Rapid Innovation Fund: Integration of GPS-Denied/Indoor Location With US Army Training Architecture



**Supported by US Army STTC with input from PEO STRI, teaming with General Dynamics*

Transition Funding

- NSF (TECP, Phase 2B), and DOD Enhancement Programs
  - Provide not only funding but also vehicles for conversations with partners and investors
- Rapid Innovation Fund
  - Excellent commercialization program supporting both maturation and integration with end customer
- Private Sources
  - Growing a scalable business is typically going to require additional sources of funding

Management Challenges

- Regulations – procurement, auditing, reporting, salary caps, overhead limitations, rate mgmt, etc. drive need for more experienced finance leads, take management time
- Managing Programs AND Products - Maintaining single-focus startup culture while managing program transitions
- Preserving ability to "pivot" – maintaining flexibility in response to market experience

TRX Experience: SBIR Program Managers are Excellent - Supportive, Flexible, Creative….

Experienced Management; World Class Team

- ***CEO, Carol Politi*** - Marketing, product development, and sales for mobile apps, services, infrastructure. Experienced entrepreneur.
- ***CTO & co-founder, Dr. Carole Teolis*** - Internationally recognized navigation expert, built expert team, created core IP, and secured initial funding.
- ***VP Engineering & co-founder, Ben Funk*** - Technical innovator. Expert in wearable electronics, embedded sensor fusion, RF and mapping.
- ***VP Product and Business Development, Jeff Kunst*** – Broadly experienced entrepreneur. Technologist with expertise in mobile technology, RF and wireless networks.

Board Members

Gil Blankenship (Co-founder TRX, BOD member, Chairman TSi, UM EE Professor), **Bill Armistead** (New Dominion, MCI - VC & finance), **Jean-Luc Abaziou** (CEO TSi, Highland Capital, Ericsson, Alcatel), **Reese Schroeder** (Motorola Solutions Ventures – Observer)

Locate, Map, Track.
Indoors.

www.trxsystems.com

TRX systems

LOCATE. MAP. TRACK. INDOORS.