Network Navigation Capabilities

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As a leading supplier of GPS navigation products for the military, IEC is very familiar with the limitations of GPS:

- Indoors
- Urban canyons
- Dense foliage
- Subterranean
- Jamming

Most of these applications involve groups of users who are (or can be) connected in a communications network.

IEC’s navigation approach takes advantage of this, allowing the sharing of navigation data to collaboratively navigate all members of the network.
Requirements for Network Navigation

• Approach for navigation in GPS-challenged environments must utilize ‘all-sensor’ navigation
  - GPS
  - RF ranging
  - Magnetometer
  - Altimeter
  - IMU
  - Pedometry

• For widest application, network navigation cannot require any infrastructure
  - No beacons, pseudolites, HDTV towers, ...

• Navigation algorithms must optimally integrate all sensor data
Advanced 3-D Locator (A3DL) Network

Indoors

Urban

GPS
• IEC has developed an algorithmic approach which satisfies all of these requirements - DCN
  - Fully decentralized
  - Mathematically optimal
  - Integrates all sensor data
  - No infrastructure required

• Navigation data is shared across the network
  - RF ranging establishes relative location of network nodes
  - Allows sensor data at one node to improve location of other nodes

• Accurate navigation can be achieved at every node even in scenarios where no single node can navigate autonomously
Applications for DCN

- DCN is useful for navigating each member of a group in scenarios where navigation data is sparse and distributed across the network
  - Urban warriors
  - Firefighters and first responders
  - Spacecraft
  - Swarms
  - Unmanned vehicles
  - Jammer location
Advanced 3-D Locator

- IEC has a contract with DHS S&T to develop the Advanced 3-D Locator
  - Locate firefighters in a building to 6m (3m goal)
  - Navigate in three dimensions
  - Provide display to incident commander
  - Provide 25 units for evaluation

- Technology for urban warriors is almost identical
A3DL Equipment

Data Recorder purchased from third party

Advanced 3-D Locator
IEC has performed numerous demonstrations of its DCN technology using prototype hardware.

Four-node demo
- 2 nodes outdoors, stationary
  - GPS, RF ranging, altimeter
- 1 node indoors, stationary
  - GPS, RF ranging, altimeter
- 1 node roving indoors/outdoors
  - GPS, RF ranging, altimeter, IMU, magnetometer
Testing at L-3 Com Anaheim, CA Facility
Altitude Performance for 4-Node Demo

![Graph showing altitude performance over time](image)
Number of Observations at Mobile Node

GPS
RF Ranging
Altimeter
Incident Commander Display

Advanced 3D Locator

Homeland Security
Summary

• IEC has demonstrated a new technology for navigating members of a network where navigation data is sparse
  - Indoors
  - Dense foliage
  - Jamming
  - Urban canyons
  - Subterranean
• DCN requires no infrastructure
• Solves navigation problem for many applications
  - Urban warriors
  - Firefighters/first responders
  - Jammer location
  - Unmanned vehicles
  - Swarms
  - Spacecraft