Emergency Services

Location-based Services

Location Surveillance

# Response to FCC Questions on Indoor and Vertical (Z-axis) Location Accuracy

August 2013

Global Leader in Wireless Location Solutions

Polaris Wireless

# Background

- The FCC has requested that Polaris Wireless provide information in three general areas:
  1. Near-term capabilities
     - Indoor location accuracy today and in the near-term future
     - Planned and ongoing improvements regarding obtaining z-axis location information
  2. Test Methodologies
     - Practical requirements
     - Test bed design and morphologies
  3. Cost Models for indoor location platform deployments

- The following slides contain Polaris Wireless responses regarding company efforts in each of the areas requested

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# Near-term Capabilities for Indoor Location

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# Indoor Location Accuracy Performance – Three Years & Beyond

| Indoor Environments | 67% Accuracy | 90% Accuracy | Yield |
|---|---|---|---|
| Dense Urban | 50m | 150m | 100% |
| Urban | 50m | 150m | 100% |
| Suburban | 50m | 150m | 100% |
| Rural | 50m | 150m | 100% |
| With indoor infrastructure (e.g., DAS antennas) | 30m | 100m | 100% |

Notes:

- System architecture: control plane solution with a hybrid of A-GNSS & Polaris WLS™
- Environment categories are as defined by CSRIC
- Deployment of LTE with O-TDOA measurements will have a positive impact on future indoor accuracy (the 2012 CSRIC test on upper floors was GSM only)
- Increased availability of Inter-RAT measurements and greater density of indoor antennas (e.g., DAS, metro cells, femto cells) will enable improved indoor location accuracy performance

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# Vertical Location (Z axis) Accuracy Performance – Three Years & Beyond

| Indoor Environments | 67% Accuracy | 90% Accuracy | Yield |
|---|---|---|---|
| All environment categories:<br>Dense Urban, Urban, Suburban, Rural | <5m | <5m | 100% |

- Projected improvements in vertical location accuracy, over current performance, will be driven by:
  - Higher penetration of indoor antennas, e.g., DAS, metro cells, femto cells etc.
  - Higher penetration of sensors in smart phones, e.g., altimeters etc.
  - Migration to/integration with user plane technologies such as Wi-Fi
  - Further optimization of the hybrid solution, A-GNSS and WLS, to account for multiple satellite constellations will enable improved horizontal & vertical accuracy

- With the projected improvements, Polaris Wireless expects to achieve floor-level vertical location accuracy performance across all indoor environments

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# Indoor Location Test Methodologies

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# Practical Requirements for Testing Indoor Location Accuracy

| # | Practical Requirements | Comments |
|---|---|---|
| 1 | Access to indoor environments (e.g., buildings, stadiums etc.) can be challenging due to permissions, entry-controls, and security/privacy concerns | • This could be problematic unless there is a clear directive from the FCC and an associated process, with full co-operation from the wireless operators, to create awareness amongst facility owners to allow access into various facilities<br>• Exceptions include secure govt. facilities etc. |
| 2 | Due to the great variability of the indoor environment, statistically meaningful indoor test results require a large number of indoor test points, ideally uniformly distributed throughout the indoor environment | • While this approach was not followed in the CSRIC trial due to cost and time constraints, in future trials this approach would provide a comprehensive set of statistically meaningful accuracy performance results |
| 3 | It can be challenging for test personnel to accurately and efficiently log the ground truth test location throughout various indoor environments | • Multiple approaches exist, some more time consuming than others, but Polaris Wireless has software and experimental protocols which demonstrate that this is doable |

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# Indoor Location Test Bed Design and Morphologies

- A well designed indoor location test bed should include the following dimensions:
  1. Environment type – dense urban, urban etc.
  2. Building type – high rise, stadium, campus, transportation hub etc.
  3. Building morphology (size and construction material) – e.g., large steel structure, mid size glass building, small wooden structure etc.
  4. Building structure type – open (e.g., airport terminal), closed (e.g., offices, hotels etc.)

- When all of the above dimensions are included in the test bed and there is reasonable diversity in building types being tested, then indoor test results can be extrapolated into other real-world environments and for other common building types
  - Note: The CSRIC indoor trial tested across a very limited set of building types

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# Proposed Indoor Testing Methodology

1. Test a large number of indoor test points, perhaps with a smaller number of calls at each test point, with test points uniformly distributed across the indoor environment for a statistically meaningful result

2. Adopt field proven test methodology #1 (outlined in the Polaris Wireless response to CSRIC testing information request in September 2012):
   - Method #1 – Active control software and building floorplan on handset, which is used to undertake a comprehensive walking tour of the building. Collected data is downloaded to a database at the conclusion of the testing. This method has the advantage of being highly mobile and discrete
   - Method #2 (alternate option) – Semi-automated solution that requires a laptop/tablet for data collection. Data is streamed in real-time between the handset and laptop/tablet. Due to the laptop/tablet, this method is less mobile and may raise security concerns among building staff

3. Test across a wider variety of building types and across various environments and morphologies

4. Perhaps scale back the suburban and rural testing for vertical location due to the lower number of multi-story buildings in those environments

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# Questions?

Polaris Wireless is the global leader in providing high accuracy, software-based, wireless location solutions. In standalone mode or as a Hybrid solution with A-GPS, Polaris Wireless enables a variety of value-added applications that work across device platforms, technologies, and air interfaces.


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Thank you.

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