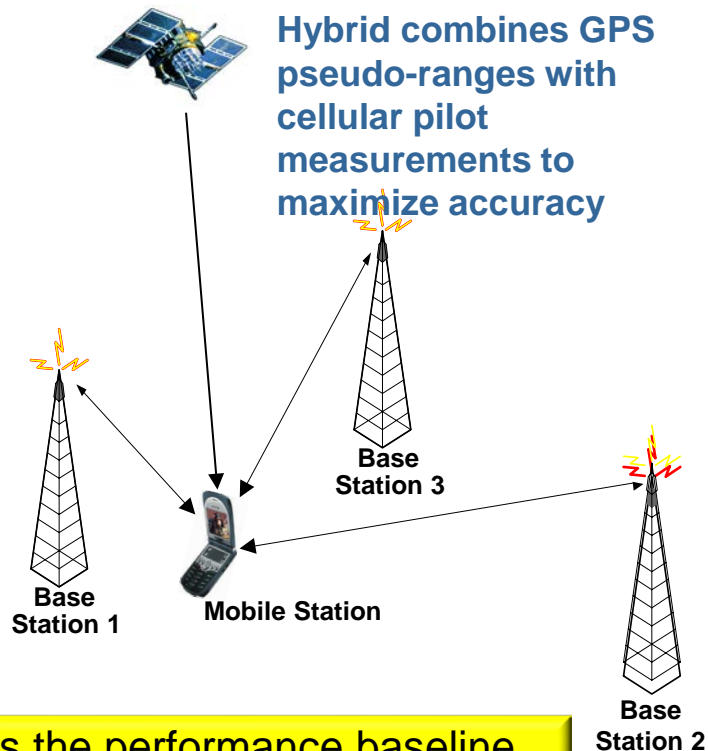


APCO International

Discussion on E911 Location Accuracy and Dispatchable Location

- Works outdoors and indoors
- Outdoor fixes rely predominantly on GPS measurements and highly accurate GPS-only fixes are produced
- Hybrid fixes use both GPS pseudo-ranges and CDMA Pilot measurements in the same trilateration calculation when an insufficient number of GPS pseudo-ranges are available for a GPS-only fix
- Hybrid allows the maximum accuracy when a GPS-only solution is not possible (e.g., two or fewer GPS pseudo-ranges are available)
- Hybrid, perhaps AFLT only in some cases, allows for indoor coverage and nearly 100% yield.
- Enhanced Cell ID (E-CID) and Cell ID (CID) provide 100% yield
- Carriers without AFLT today just use GPS E-CID, and CID



This positioning technology represents the performance baseline

From The CSRIC Report – Emulated live 911 Performance on real networks

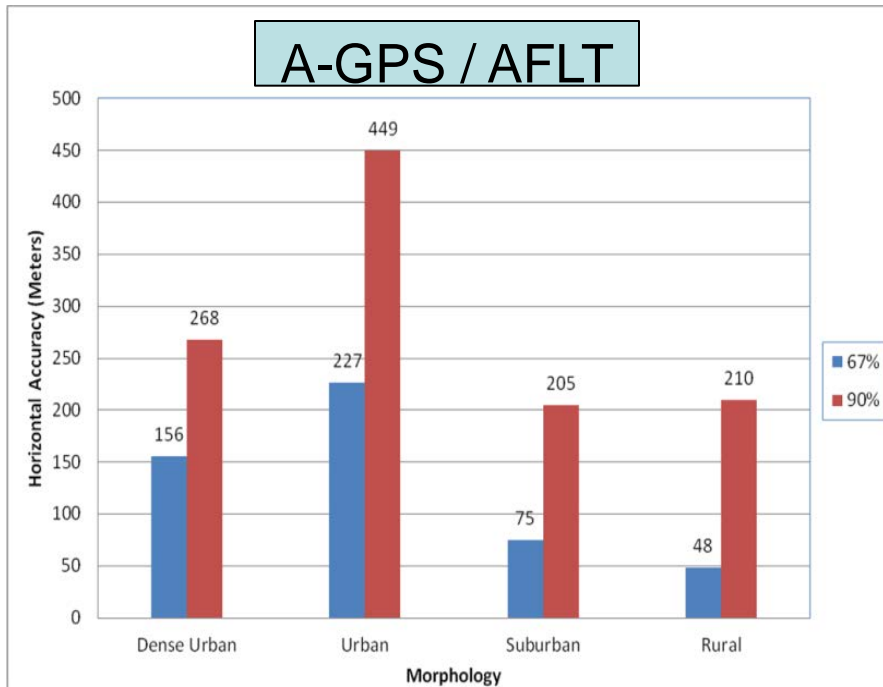


Figure 6.1.2-7. Indoor Accuracy by Morphology for Qualcomm

Newer ranging methods, such as OTDOA and Wi-Fi, will improve E911 indoor performance

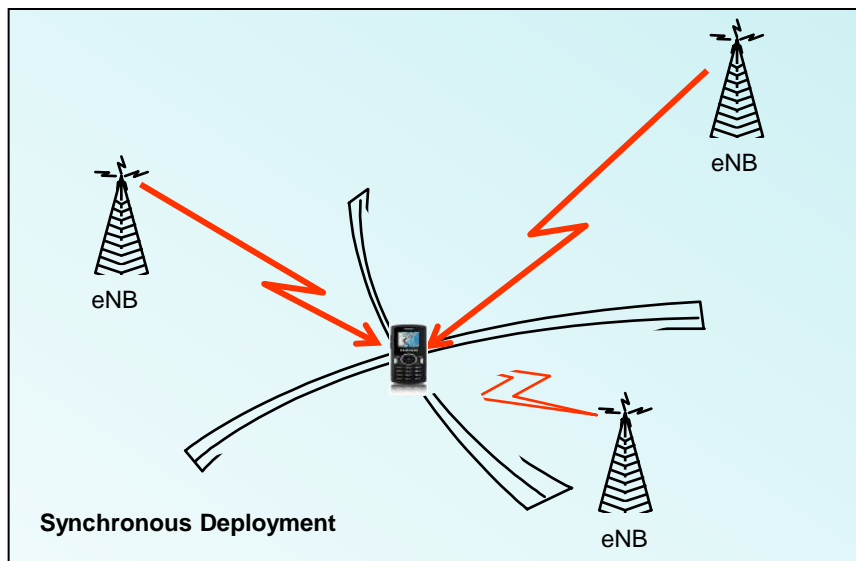
Dispatchable Location will provide complementary approach to locating the caller

- New Access Networks
 - 4G/LTE
 - Wi-Fi
- New Positioning Methods
 - 4G/LTE Observed Time Difference Of Arrival (OTDOA)
 - A highly detectable LTE reference signal designed to outperform 3G solutions
 - Wi-Fi Positioning
 - Signal strength and ranging measurements available for E911 positioning
- New Network Topologies
 - Wi-Fi data offloading
 - Small / Femto cells
 - Both are a powerful positioning asset for wireless operators
- Dispatchable Location
 - The “Gold Standard” – Use of these new networks / topologies as well as BT beacons

- Penetrates buildings – deep indoors
- Ranging is possible from cell towers giving a position indoors
 - 3G/AFLT showed we have indoor coverage
 - 4G/LTE networks with OTDOA will improve indoor accuracy
 - 4G/LTE positioning coverage for mobile user base will grow quickly
- Leverages existing infrastructure to do positioning
- Leverages LTE modem
 - No new handset hardware required
- Leverages trusted, accurate cell tower base station almanac of wireless operators
- Multiple bands available for ranging
- Strong ecosystem exists

Observed Time Difference of Arrival (OTDOA)

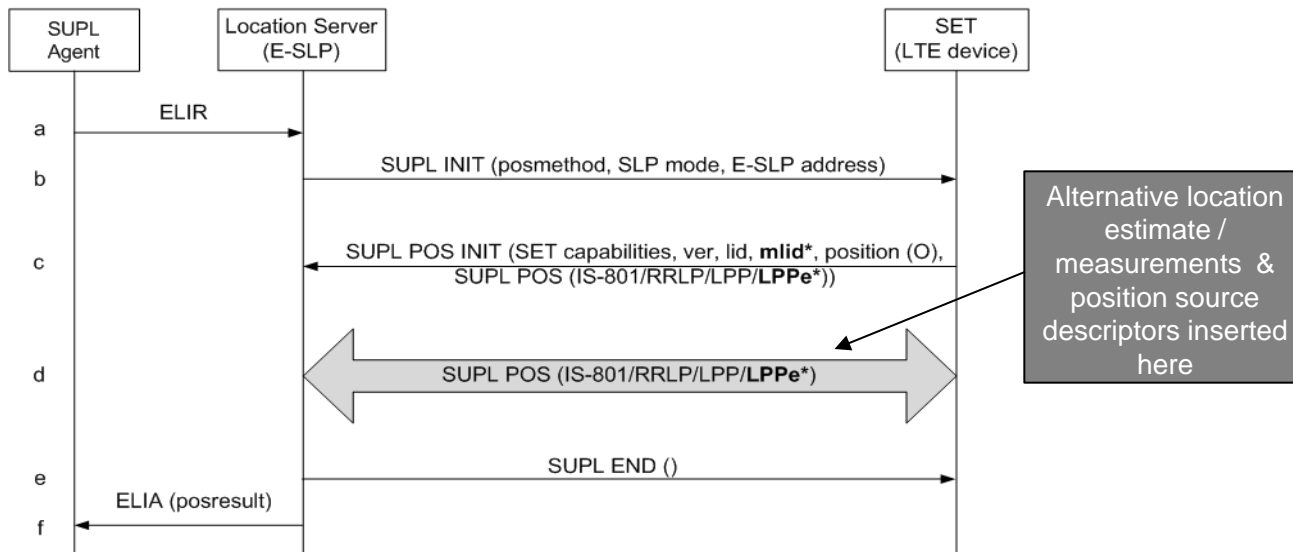
- Downlink positioning method (similar to AFLT) – but for 4G/LTE networks
- The mobile measures the difference in time of arrival of the new LTE signal between multiple base station pairs
- Designed to outperform AFLT (higher bandwidth, increased hearability, inter-frequency, etc.)
- OTDOA will be a useful indoor positioning technology



- Wi-Fi and BT information may be used to supplement cellular indoor positions
 - Specifications exist for:
 - How to report Wi-Fi MAC address, signal strength and time measurements along with the cellular and GPS information
 - How to report BT Identifiers
 - How to send back an alternative (potentially consumer LBS) position to the server, be it from sensor aided, device specific database solutions, etc.
- Challenges
 - Multiple decentralized databases of unvalidated accuracy exist today
 - The need for and the issues with creating centralized database(s)
- Targeted / Phased Rollouts Possible
 - Wi-Fi Data Offloading provides the carriers with managed Wi-Fi databases to use for location
 - Leverage the forming National Emergency Address Database (NEAD)
- Wi-Fi and BT solutions can be cross checked
 - Validate Wi-Fi / BT solution against solution from OTDOA / AFLT / A-GPS methods

E911 UP Call Flow with WLAN Support

From The CSRIC Report



- LPPe carries Wi-Fi and BT information
- LPPe allows for a position to be returned as well, geographic or civic
- LPPe carries uncompensated barometric pressure data
- SUPL shown here, but LPPe is equally applicable to a control plane solution

Thank You