Discussion of Indoor Location Standards

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Summary of Standards Activities (1/2)

3GPP / 3GPP2

- LTE OTDOA rolling out soon (AFLT been in place for ~10 years)
- Compass Standardization will hopefully start soon
- Femtocell solutions generally lack explicit location support
- Ramp up of WLAN related work (e.g. data offloading) that is also generally not concerned about location impacts

OMA

- SUPL 1.0 and 2.0 User Plane versions of 3GPP/3GPP2 Standards
- SUPL 3.0 and LPPe 1.0 just published and includes indoor positioning related requirements
- Work on LPPe v1.1 started recently and will add broadcast capabilities to LPPe

IEEE

802.11v

- Allows for location related information to be transmitted at the WLAN layer

802.11u

- Enables Service Discovery

IETF

- Working on spec for passing WLAN information (802.11v based)
- Civic Address extensions for indoor locals
- Relative Location with reference to a map document

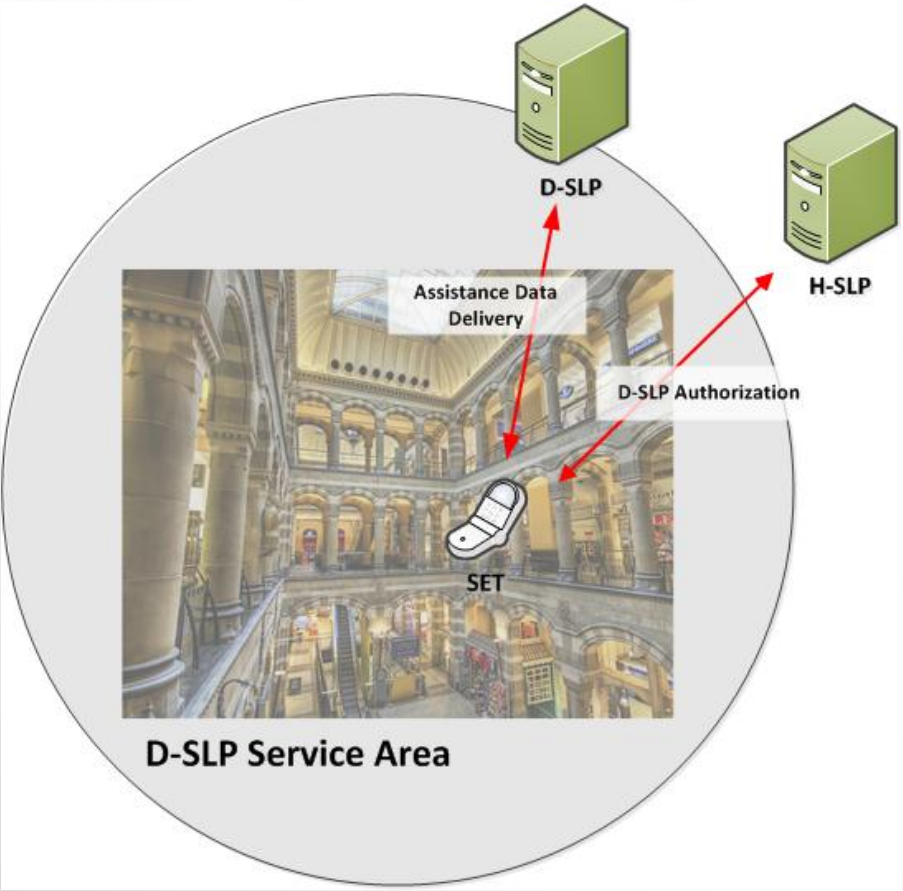
Summary of Standards Activities (2/2)

FCC	• CSRIC WG3 is working on three reports: • Outdoor location accuracy testing • Indoor location accuracy testing • Leveraging commercial location based services (e.g., WLAN positioning) for E911
TTA	• Several activities ongoing related to WLAN based indoor location • RTT ranging – client / server signaling, RSSI between APs • Wi-Fi AP DB Data Sharing Interface
Worldwide Web Consortium (W3C)	• Geo-location API has achieved widespread browser implementation • Published a first draft of a technical specification for the representation of "Points of Interest" information on the Web • Device Orientation specification in Last Call stage and an implementation exists in Android Ice Cream Sandwich
Open Geospatial Consortium (OGC)	• Indooor GML SWG just formed which is working on a standard for representing navigation routes, etc
Femto Forum	• Published White Paper on “Femtocell Synchronization and Location” • Develops “Rich Location API”

Open Mobile Alliance (OMA) – SUPL and LPPe

- OMA introduced support for indoor navigation in its recent Enablers Secure User Plane Location (SUPL 3.0) and LTE Positioning Protocol Extensions (LPPe 1.0)
- The goal of SUPL 3.0 and LPPe 1.0 are to improve the user experience through better service and new features, specifically including, improved Indoor Location Accuracy
  - Addresses the special requirements arising from indoor location issues
  - An example of such is the support for floor level information as well as the use of relative instead of global coordinates
- The building blocks for indoor navigation support in OMA are:
  - Decentralized Location Server (D-SLP: Discovered SUPL Location Platform) for Assistance Data Delivery and Position Calculation.
  - Positioning Protocol supporting indoor navigation relevant assistance data (map information, AP information, etc.).
  - D-SLP is part of SUPL 3.0 and the positioning protocol supporting indoor navigation is LPPe 1.0.

OMA SUPL Network Architecture for Indoor Positioning



SET: SUPL Enabled Terminal
H-SLP: Home SUPL Location Platform
D-SLP: Discovered SUPL Location Platform

- It is assumed that the H-SLP cannot provide adequate support for Indoor Positioning and therefore public venues (malls, hospitals, train stations, etc.) may choose to provide their own Indoor Positioning Location Server (D-SLP).
- The SET discovers a local SLP (D-SLP) which is able to provide Indoor Positioning service within a defined service area (e.g. a shopping mall).
- The SET requests authorization for accessing the D-SLP from its H-SLP.
- The H-SLP authorizes access within a defined service area, access network, and time window.
- While the SET is within the service area, time window and the authorized access network of the D-SLP, it may access the D-SLP and obtain Indoor Positioning Services.
- The Signaling between D-SLP and H-SLP uses OMA SUPL ULP.
- Indoor Positioning signaling is carried within OMA SUPL ULP message containers in OMA LPPe messages.
- The D-SLP discovery mechanism is out of scope of SUPL

IEEE 802.11v

- Wireless Network Management (WNM) standard for the IEEE 802.11 family of standards
  - Enables management of stations in a centralized or in a distributed fashion (e.g. monitoring, configuring, and updating) *through a layer 2 mechanism*

- The WNM services include (among others) Location Services:
  - Request/Response paradigm
  - Location Configuration Request and Response frames enable STA's to configure a collection of location related parameters for Location Track Notification frames
  - The AP can indicate that it can provide location data to support applications such as emergency services
  - Location Services also provide the ability for STAs to exchange location information using Radio Measurement Request and Response frames
  - The protocol supports exchange-by-value and exchange-by-reference mechanisms
  - The location value can be exchanged in Geospatial and Civic formats

IEEE 802.11v

- 802.11v supports basic location measurements for
  - Cell-ID (AP Location)
  - Signal Strength
  - Time-Based Methods (i.e. T(D)OA)
- Components in 802.11v to support Location Services
  - Radio Measurement Request/Response frames (extended from 802.11k)
    - Types:
      - » Local: “Where am I?”
      - » Remote: “Where are You?”
      - » 3rd Party: “Where is He/She?”
    - Location Value: Geodetic, civic (reference point with relative location and map image), or location reference (URI)
  - Location Configuration Request/Response frames
    - Provides the ability to configures a STA for (subsequently) sending Location Track Notification frames for the purpose of tracking the receiving STA’s location
    - Upon successful configuration, the receiving STA starts transmitting Location Track Notification frames based on the Location Configuration Request frame parameters
  - Location Track Notification frame
    - Reports various radio/location related parameters
      - » Transmit Power, Antenna Gain, Received Signal to Noise Indicator (RSNI), Received Channel Power Indicator (RSCPI), Velocity, Time of Departure (TOD), Beacon Measurement Report

Internet Engineering Task Force (IETF) – GEOPRIV (1/2)

Geographic Location/Privacy (GEOPRIV) Working Group

- Handles protocols and standards for location determination, provisioning, and disclosure.
  - For determination, the specifications provide information to be used to determine location, but in general don't describe how the information is used to do so.
  - Originally limited to location distribution but expanded to include assistance data and client-side measurements for server-based location determination, as well as other extensions.
  - Also working on relative location (used for indoor location), civic address extensions, and various other issues.
  - Does not develop location-determining technology; however, develops protocols/extensions to represent and transmit data used to determination location

RFC 5139 - Revised Civic Location Format for Presence Information Data Format Location Object (PIDF-LO)

- Defines XML format for representation of civic location
  - » Updates the civic location format in RFC 4119 to include in-building information (apartment, room, seat (desk, cubicle, workstation))
    - RFC4119 provides a way to specify an addressable civic location, naming the country, region, city, street name, etc.
- Format to be supported in SUPL 3.0

Internet Engineering Task Force (IETF) – GEOPRIV (2/2)

- [draft-rosen-geopriv-pidf-interior-01] Interior Location in the Presence Information Data Format – Location Object
  - Related to RFC 5139, and defines explicit tags for interior building location such as "BLD" (building), "UNIT", "ROOM“
    - An example of where the RFC 5139 BLD/FLR/UNIT/ROOM doesn't work is an airport. Interior location may be given as Terminal 2, Concourse A, Gate 27
- draft-ietf-geopriv-held-measurements-01 - Using Device-provided Location-Related Measurements in Location Configuration Protocols
  - Allows device and server to exchange data useful for location determination, e.g., device measurements, GNSS assistance
  - Defines request/provide location-related measurement data to a Location Information Server (LIS)
  - Includes (among others) 802.11 WLAN measurements (similar to SUPL 2.0 ULP):
    - » location of the access point, flight time, transmit power, rcpi (received channel power indicator), rsni (received signal to noise indicator)
    - » Updates to WiFi measurement structure (based on 802.11v)
- [draft-ietf-geopriv-relative-location-00] Relative Location Representation
  - Extends PIDF-LO for the expression of location information that is defined relative to a reference point (which is expressed with a civic or geodetic representation)
    - Offset is expressed in meters and a directional vector
    - Can include an URI to a document that can contain a map/floorplan/illustration ('map') upon which the relative location can be plotted
      - » Maps can be simple images, vector files, 2-D or 3-D geospatial databases, or any other form of representation understood by both the sender and recipient

Wrap-Up

- 3GPP/3GPP2 have addressed satellite and terrestrial positioning of the mobile user but without the stated goals for indoor vs outdoor per se, very high accuracies, or specific indoor related aspects
  - And while AFLT and the soon to be launched OTDOA, as well as A-GNSS, most certainly can provide position estimates for users indoors, not all use cases can be addressed with the current accuracy levels
  - 3GPP/3GPP2 have arguably neglected fully leveraging femto cells and WLAN interworking as a cornerstone for a broader standards based positioning solution
- Over the past many years a multitude of disjoint standardization efforts targeting indoor positioning and navigation have occurred
  - WLAN ranging, extended reference systems, relative positioning, etc
- OMA is starting to define a reasonably complete solution, especially for WLAN based solutions
  - Probably the best standard organization to allow for all the necessary standardization for the indoor location ecosystem to avoid fragmentation as it evolves
- Qualcomm recommends that 3GPP, 3GPP2, OMA, IETF, IEEE, et al and the member companies cooperate at a the requirements and systems level to avoid fragmentation of the indoor location ecosystem

Thank You

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