

Indoor standards baby steps

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Lauri Wirola, Dr. Tech.

Senior Specialist, Positioning Backend

Nokia Location & Commerce,

Map Platform, Cloud Core

outline

- Positioning – the technology challenge
- Case for standardization
- Brief history of location services standards
- Missing pieces
- Introducing OMA LPP Extensions
- Indoor Alliance
- Roadmap



positioning – the technology challenge



must work everywhere



environment is not an excuse

with(out) any connectivity



time to fix



always-on



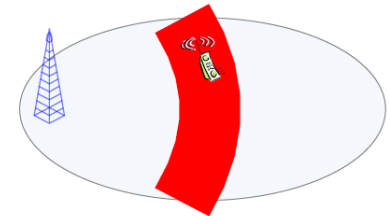
why standards

- Interoperability – bolts and nuts
- Scale through the industry commitment
- Together better solutions
- Return-of-investment through licensing

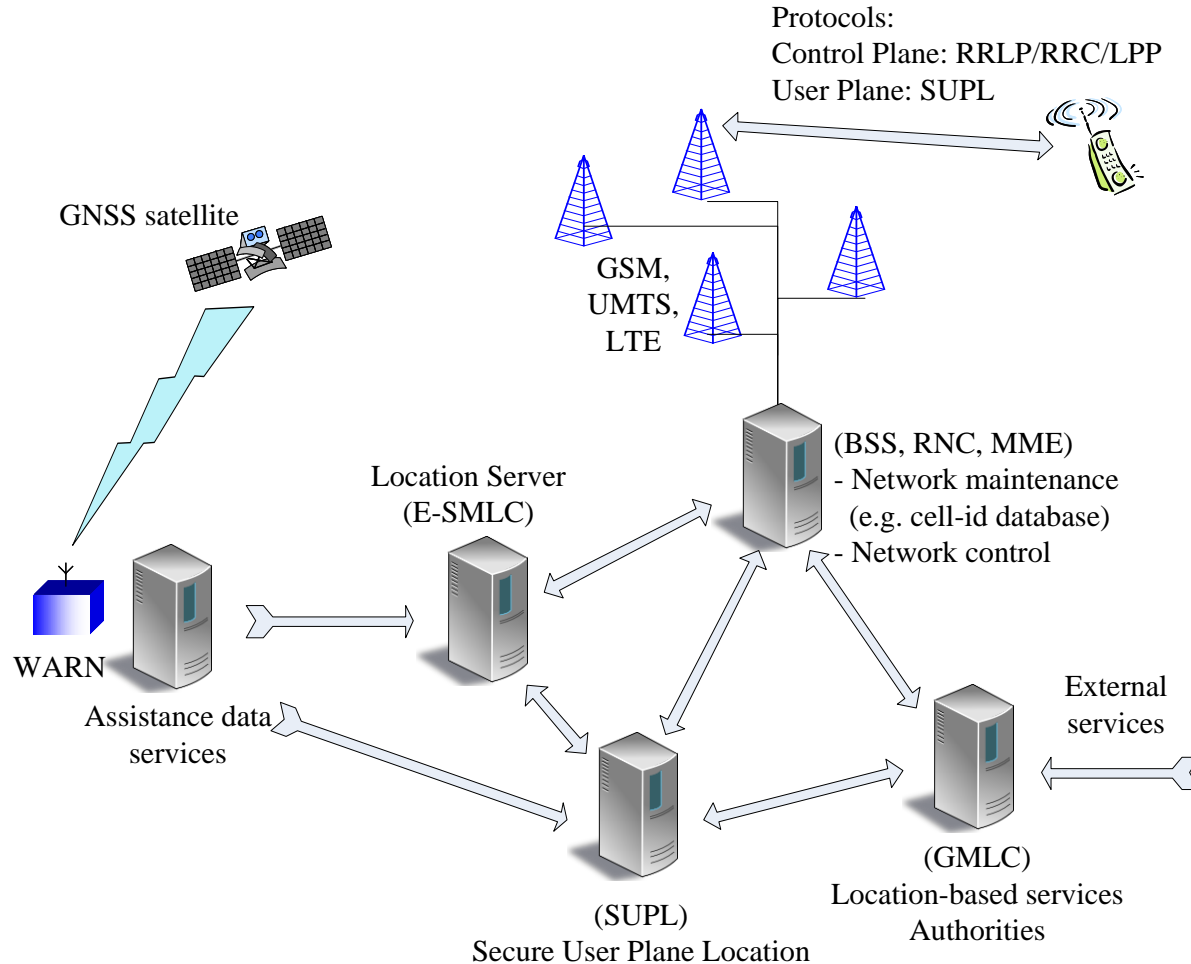


brief history of positioning standards

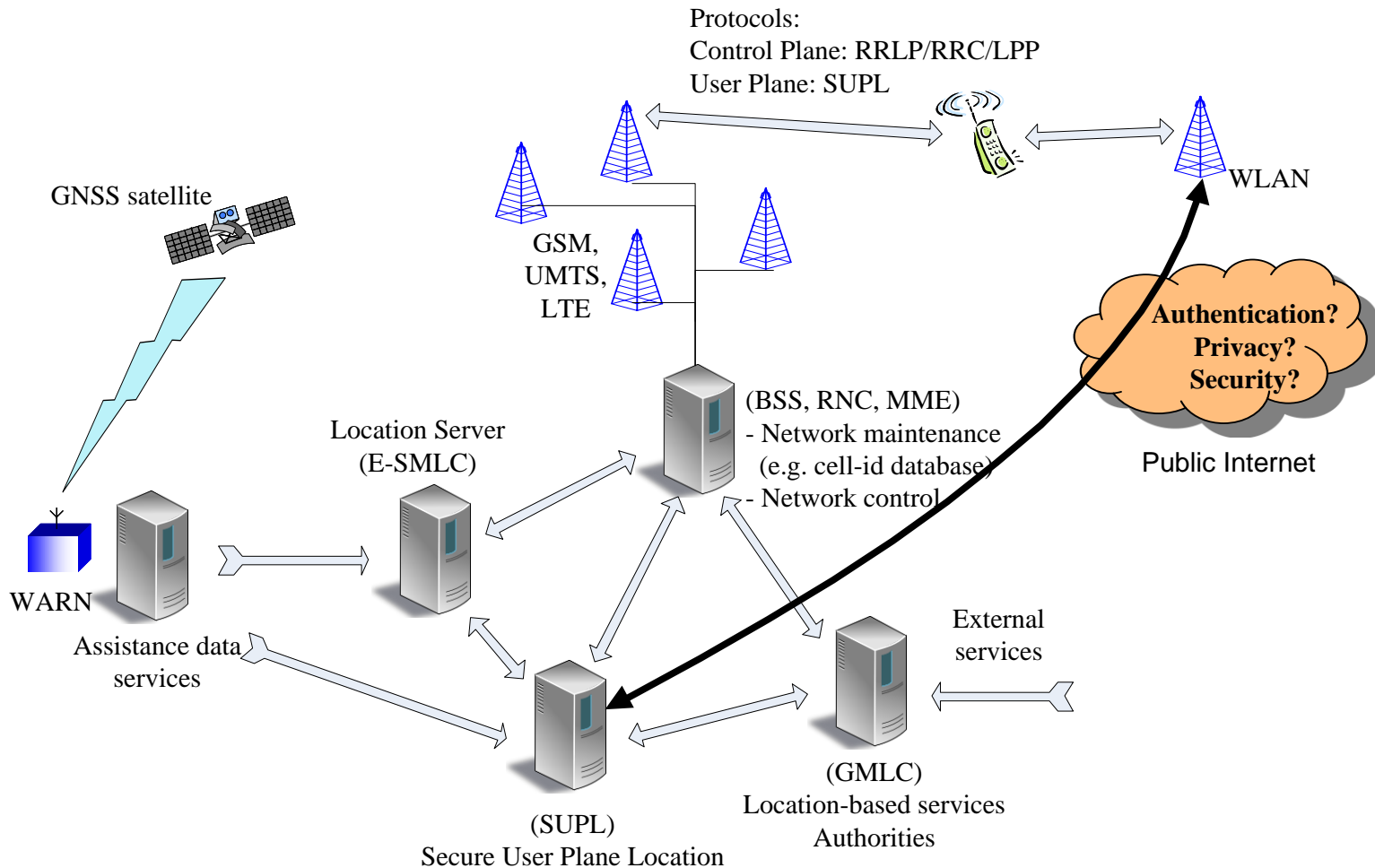
- Origins in the late 90's in the cellular networks
 - For GSM networks in *Alliance for Telecommunications Industry Standards*
 - For CDMA networks in *Telecommunications Industry Alliance*
- E911 mandate in the US
 - 67% 50m, 95% 150m
- Early standards dealt with the first GPS civilian signal
→ birth of Assisted GPS
- Later iterations (2004 - 2010) for 2G, 3G and 4G networks introduced the support for A-GNSS



big picture for cellular LCS standards

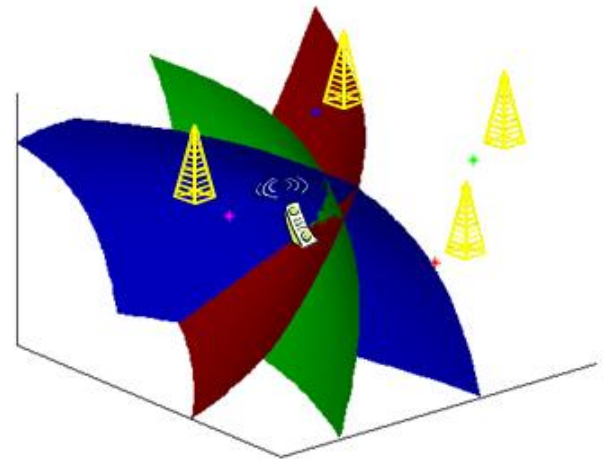


adding public networks

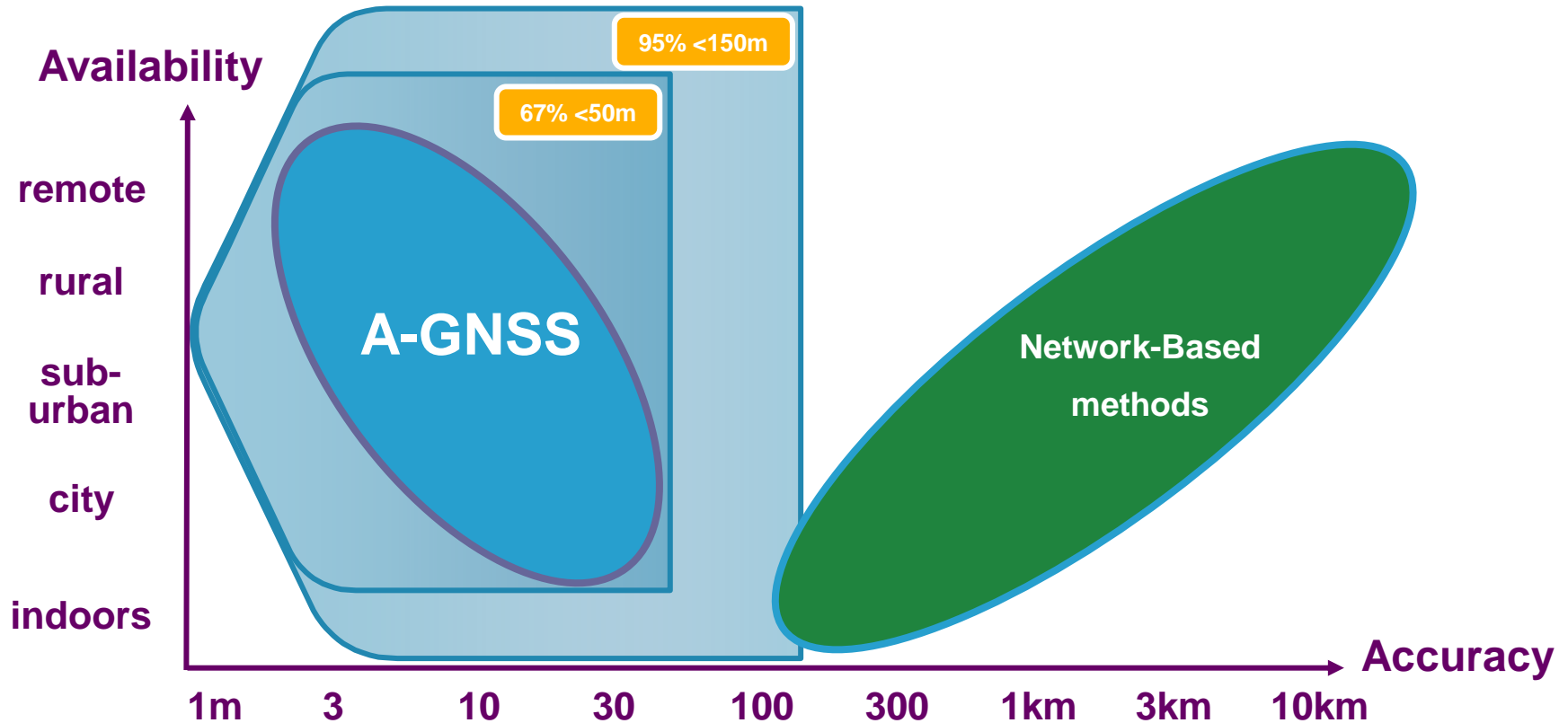


what exactly is there?

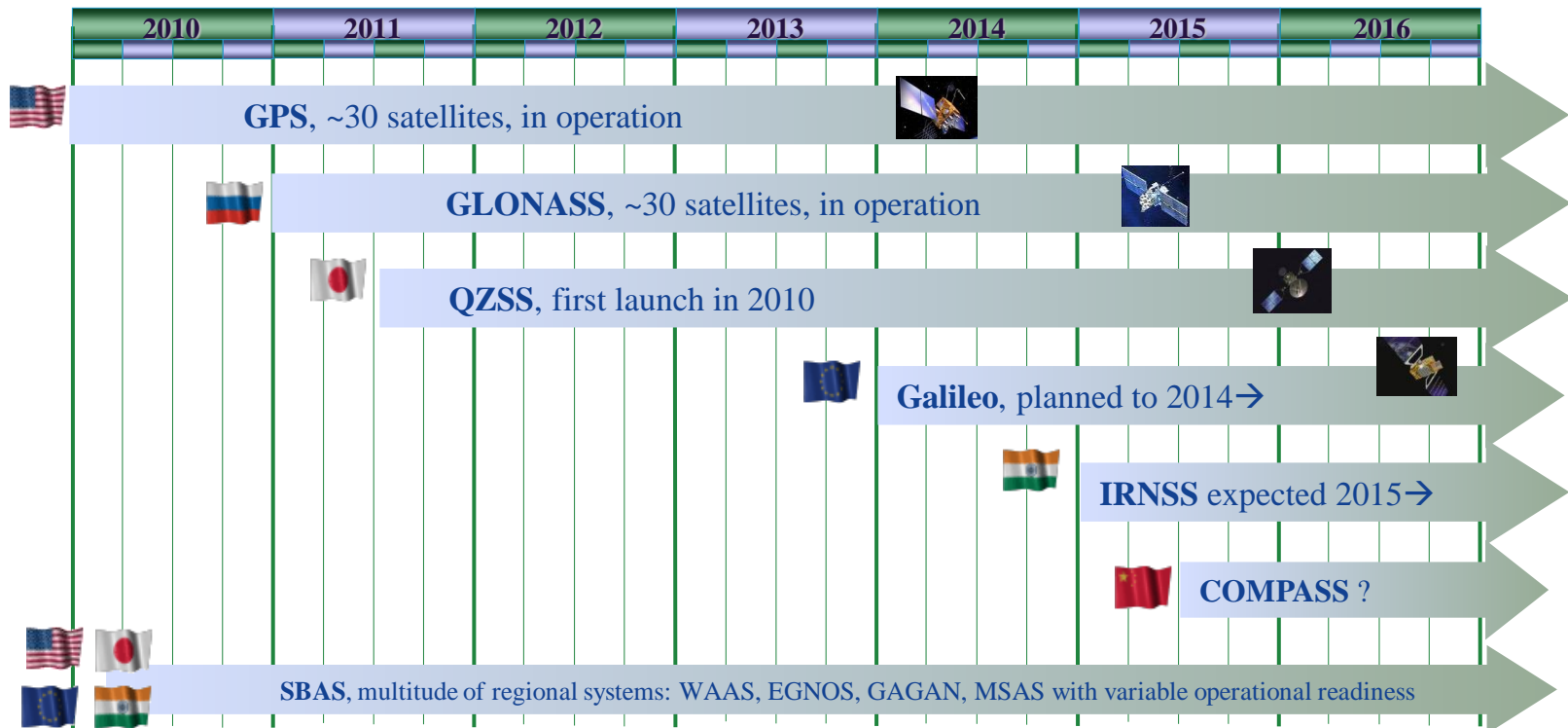
- Assisted GNSS
 - Reference time, reference location, orbits, clocks, ionosphere model
 - Acquisition assistance and measurements for server-based mode
- Enhanced Cell ID
 - Rx levels
 - Round-trip time, timing advance
 - Multiple flavors
- Hyperbolic time difference methods
 - Observed Time Difference of Arrival
 - Multiple flavors



standardized positioning technologies something missing?



interest in A-GNSS understandable



introducing LPPe

LTE Positioning Protocol Extensions

- The latest push with the positioning started in autumn 2009 in 3GPP with the LTE Positioning Protocol
- This was to define AGNSS and cellular positioning for the fourth generation networks (LTE and LTE-Advanced)
- At the same time a group of companies in Open Mobile Alliance decided to take the standards forwards
- The outcome was the OMA LPP Extensions Rel-1.0
- Builds on top of the LTE Positioning Protocol



vision for LPPe

- To bring all the already standardized technologies under the same umbrella
 - Basic AGNSS
 - Enhanced Cell ID for all the cellular/non-cellular networks
 - Hyperbolic time difference methods
- To bring the potential of professional-grade GNSS to the mass markets
 - Real-Time Kinematics – sub-meter relative accuracy
 - Precise Point Positioning – sub-meter absolute accuracy
 - Local ionosphere and troposphere models
- Crowd-sourcing data for Assisted GNSS
- Take the first steps in standardizing indoor-capable positioning methods

indoor ingredients in OMA LPPe

- WLAN-based positioning



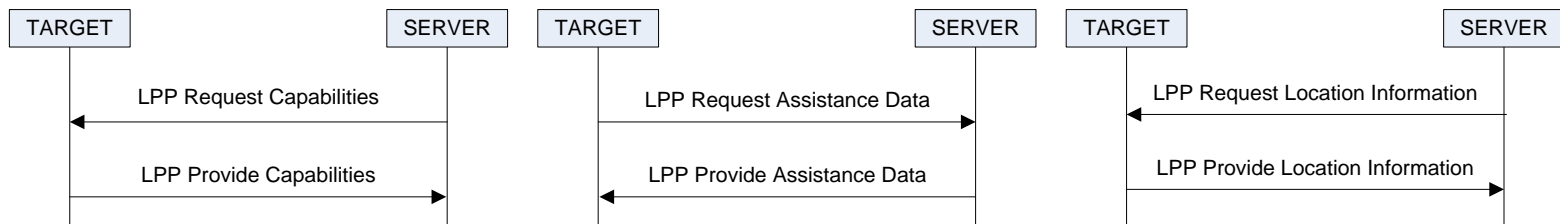
- Short Range Nodes



- Plus a couple of items more

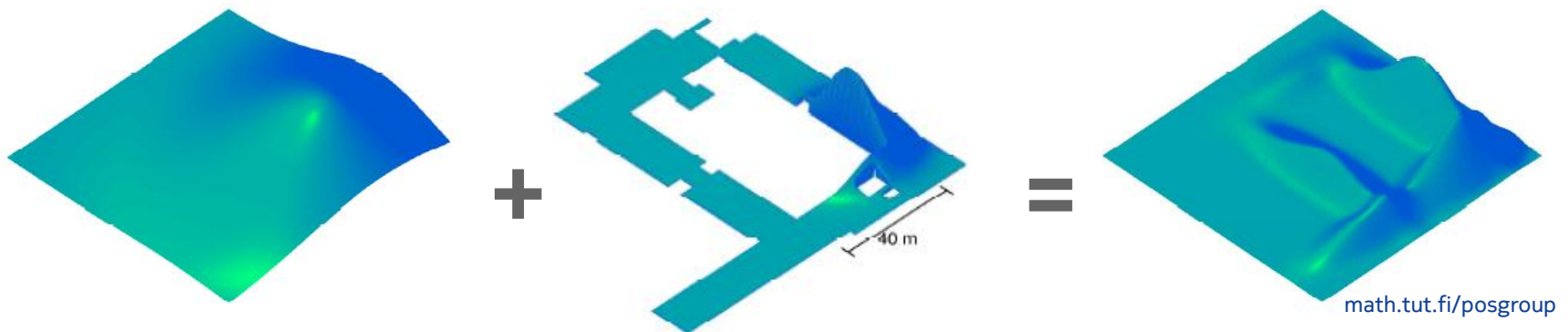
LPPe - WLAN-based positioning

- Before LPPe there was no proper WLAN positioning support in any standard
- Key features
 - device – server interaction for requesting WLAN-based position
 - device – server interaction for requesting WLAN assistance
 - WLAN APs for a server-defined area around the reference



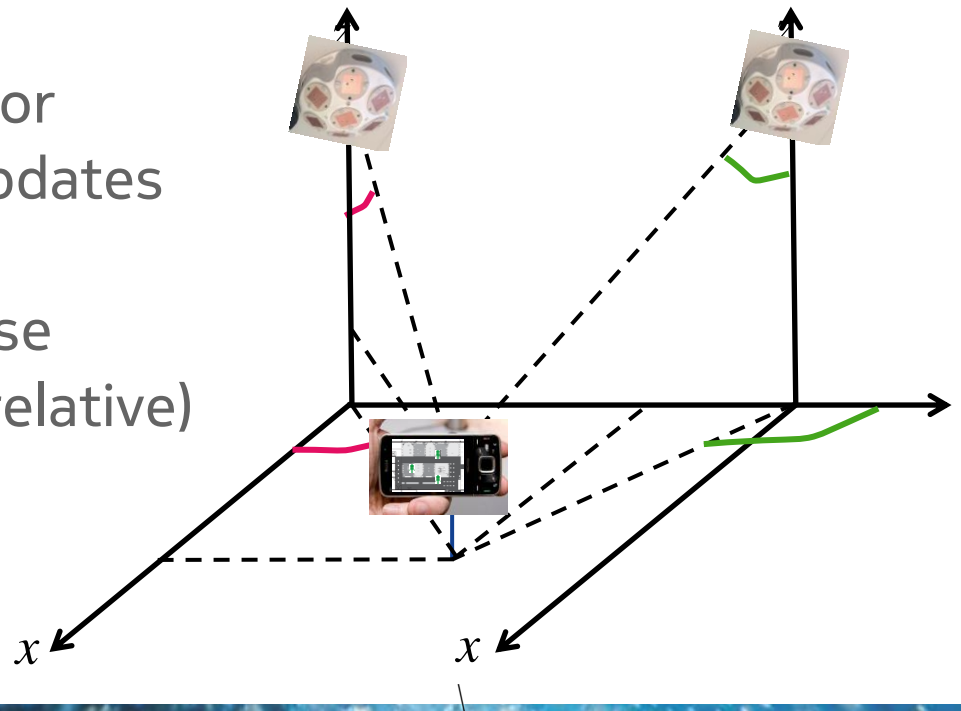
LPPe - WLAN support

- Single WLAN AP attributes
 - AP Location (Lat/Lon or civic address), Tx power, antenna gain, coverage area, ++other characteristics
- Coverage Area as the linear combination of Gaussians
 - Combines the coverage area thinking with the floor plans
 - Positioning simple as the weighted average or maximum a posteriori



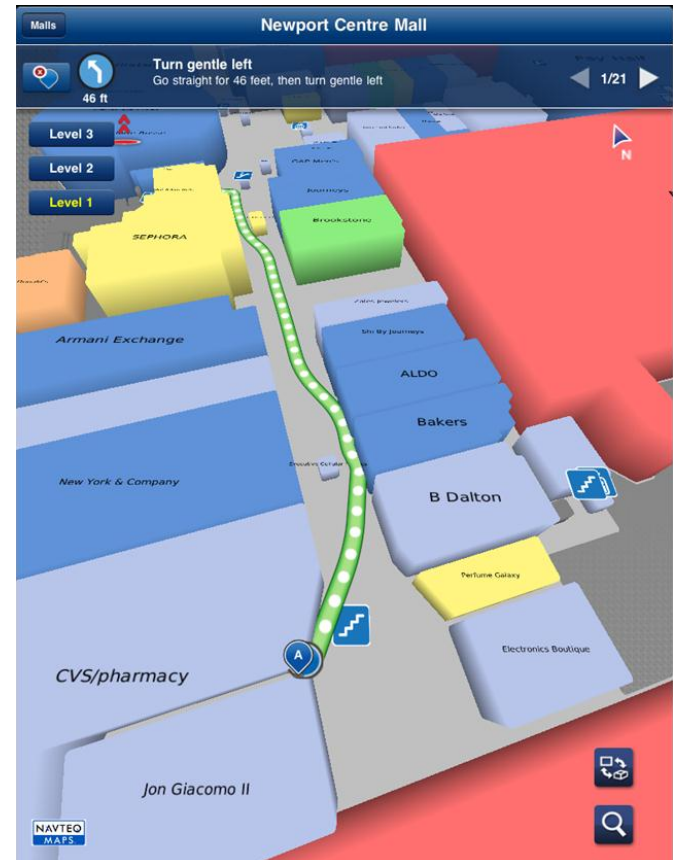
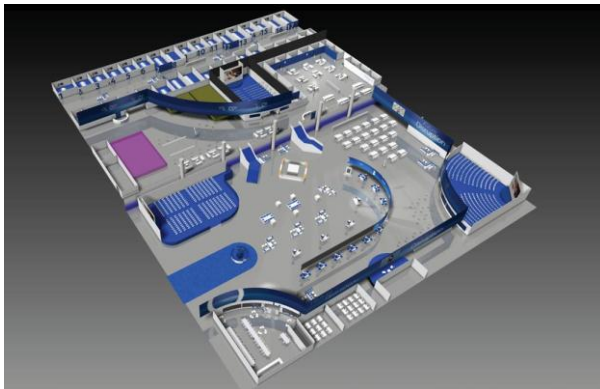
LPPe – short range nodes

- Short Range Nodes can be almost anything
 - RFID tags
 - Bluetooth tags or beacons
- Features supported
 - Node groups, e.g. per-floor
 - Requesting group data updates
 - Locations (abs, rel, civic)
 - Complex antenna response
 - Orientation (absolute or relative)



LPPe – other items

- Relative location change support
- Indoor map support as URI
- Reporting large amounts of measurement data to the server (crowd-sourcing)



Nokia Destination Maps™
(see maps.bing.com)

food for thought : location information

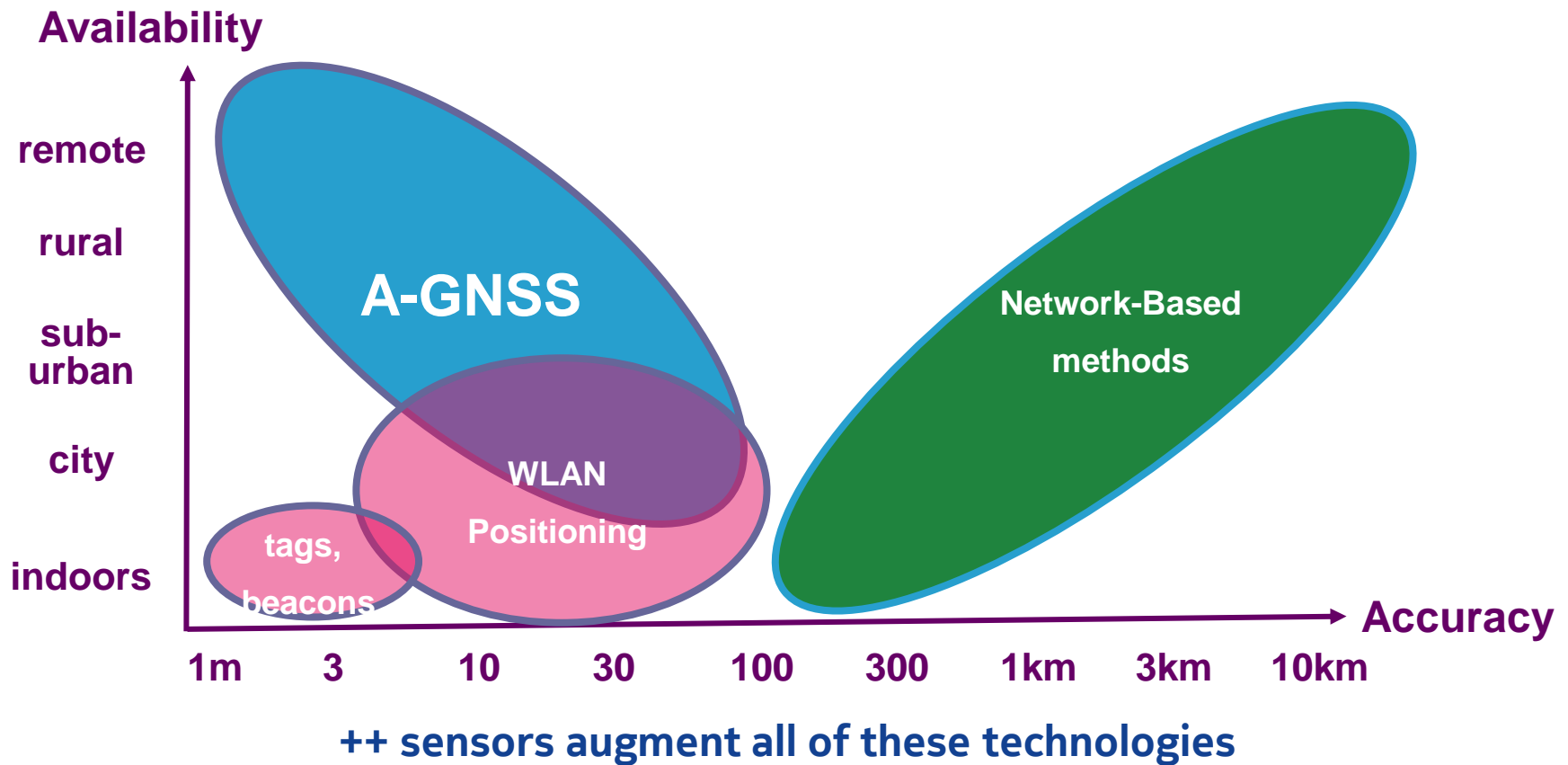
- Indoor location also brings about new requirements for expressing location
- IETF standard RFC5139 (PIDF-LO)
- OMA LPPe refers to RFC5139
- Example:


```

      <country>FI</country>
      <A3>Tampere</A3>
      <A4>Hervanta</A4>
      <A6>Visiokatu</A6>
      <HNO>1</HNO>
      <PC>33720</PC>
      <BLD>Hermia 6</BLD>
      <FLR>3</FLR>
      <ROOM>B352</ROOM>
      <PLC>OFFICE</PLC>
      <SEAT>C</SEAT>
      
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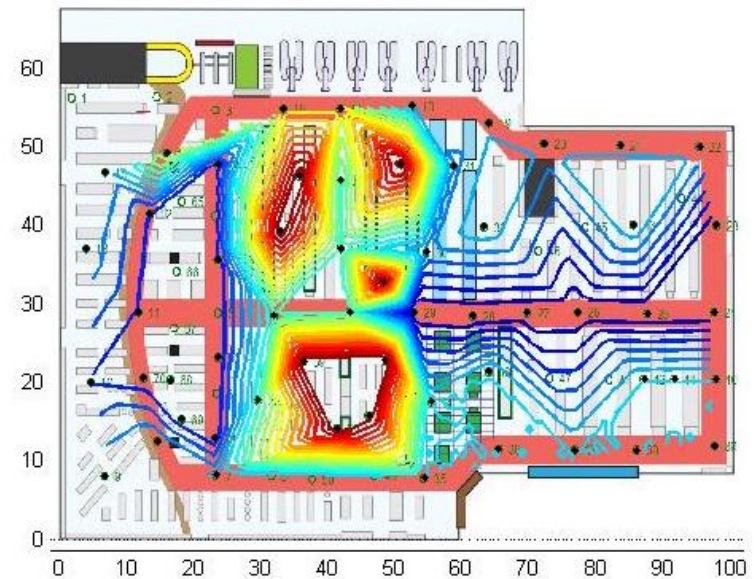
Label	Description	Example
country	country, identified by the two-letter ISO 3166 code	US
A1	National subdivisions (state, region, province, prefecture)	New York
A2	County, parish, gun (JP), district (IN)	King's County
A3	City, township, shi (JP)	New York
A4	City division, borough, city district, ward, chou (JP)	Manhattan
A5	Neighborhood, block	Morningside Heights
A6	Street	Broadway
PRD	Leading street direction	N, W
POD	Trailing street suffix	SW
STS	Street suffix	Avenue, Platz, Street
HNO	House number, numeric part only	123
HNS	House number suffix	A, 1/2
LMK	Landmark or vanity address	Low Library
LOC	Additional location information	Room 543
FLR	Floor	5
NAM	Name (residence, business or office occupant)	Joe's Barbershop
PC	Postal code	10027-0401
BLD	Building (structure)	Hope Theatre
UNIT	Unit (apartment, suite)	12a
ROOM	Room	450F
PLC	Place-type	office
PCN	Postal community name	Leonia
POBOX	Post office box	U40
ADDCODE	Additional code	13203000003
SEAT	Seat (desk, cubicle, workstation)	WS 181
RD	Primary road or street	Broadway
RDSEC	Road section	14
RDBR	Road branch	Lane 7
RDSUBBR	Road sub-branch	Alley 8
PRM	Road pre-modifier	Old
POM	Road post-modifier	Extended

standardized positioning technologies with LPPe 1.0



next steps – OMA LPPe 2.0

- Accurate barometer assistance for floor detection
 - Floor detection is a tough challenge
- *Reduced* indoor maps for indoor positioning
 - Positioning, visualization and content have different requirements
- Image-based positioning
 - Exchange of key features
- Improvements to radio channel models for WLAN APs
 - Pathloss models
 - Rx field models
 - 3D
- Enabling standardized-way to crowd-source



indoor alliance

Industry Players Announce Indoor Positioning Alliance 23-Aug

- Focuses on high accuracy, low power consumption, mobility and usability
- 29 (Nov-2012) companies across industries to drive innovation, market adoption and ecosystem creation
- Founding members include: Nokia, Qualcomm, Broadcom, Samsung, CSR, et al.
- Any organization/company free to join
- Primary solutions are based on low-energy Bluetooth 4.0 and WLAN

indoor alliance - purpose

"An ecosystem of industry players to stimulate innovation, enhance service delivery, and accelerate the market adoption."

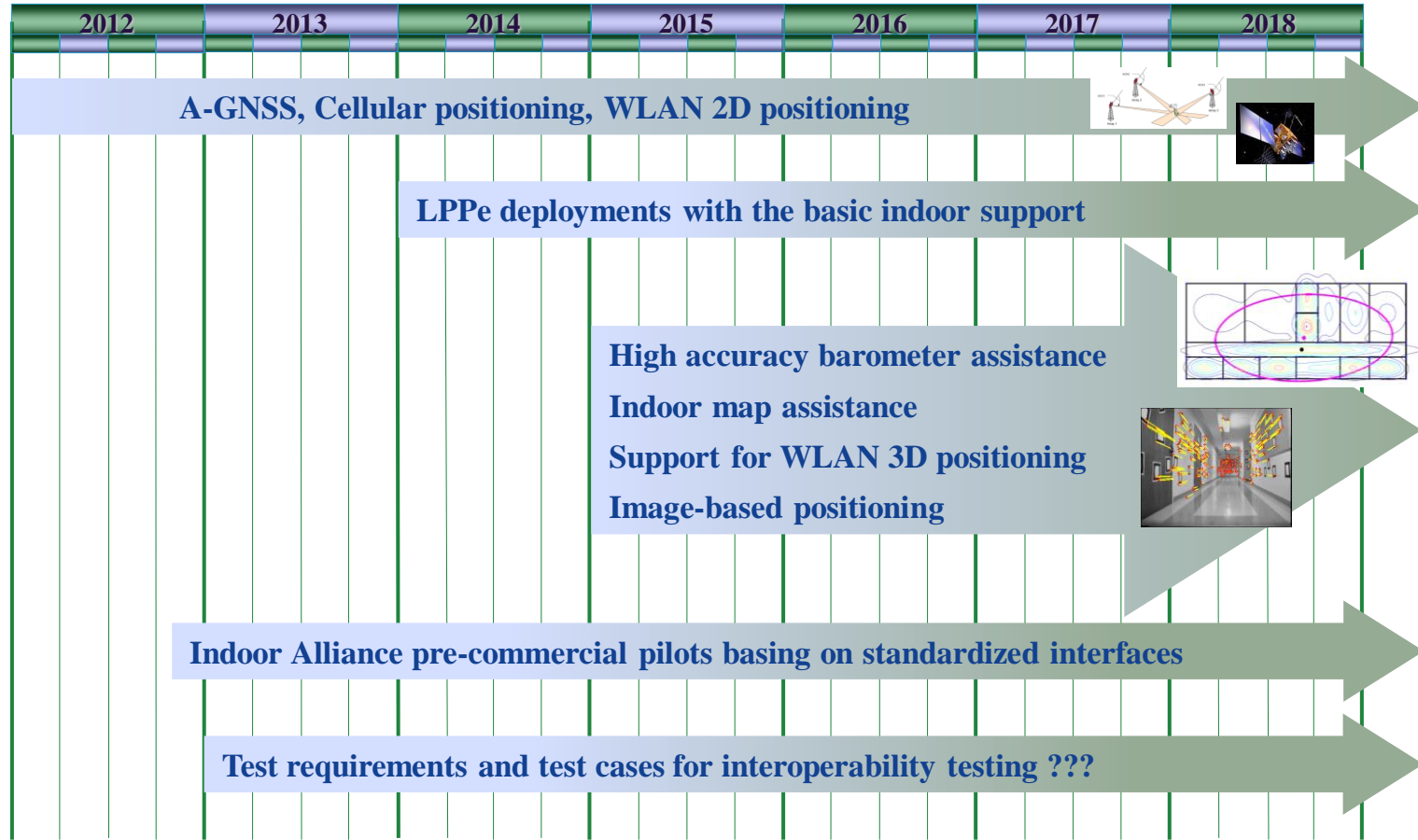
"Common technical understanding of key enablers, components, interfaces and standards needed for e-2-e solution."



"Most promising services and use cases to be verified jointly from business and solution point of view."

"Jointly built testbed to measure the value of services and to verify technical interoperability"

roadmap



research view

- Standards work scoops ideas from the research
- Those ideas and methods that can be scaled and implemented (!) may end up in global standards
- End-to-end thinking relevant in research
 - device \Leftrightarrow air interface \Leftrightarrow server
- OMA LPPe also suitable for research purposes
 - supports proprietary extensions for quick prototyping

key messages

- AGNSS and cellular network –based methods are now well established in the standards
- Indoor positioning taking its first steps in the standards forums
- Slow progress due to the scattered technology landscape – no clear winner in sight and no reference E2E solutions
- OMA LPPe 1.0 provides solid foundation to progress
- Forums like 3GPP, OMA and IETF all have their roles
- Industry alliances bring together key players as well as organizes and prioritizes work in the different forums

Thank you!

Time for Q & A !

52° 31' 54\" N,
13° 23' 28\" E

42° 21' 2\" N,
71° 4' 17\" W

41° 53' 3\" N,
87° 38' 19\" W

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