3GPP Process and How GNSS Interests Can Be Further Integrated With Their Work

Michel Monnerat
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Place of Standardisation:
Are we moving away from a standardized world to a more proprietary one?

*Standardization* has always been presented as a key market enabler.

What about standards for Positioning?

**From key Standard Enablers**

Main Example...

Apparent Proprietary implementations...
Indoor positioning: a key example to understand

Radio Access
- Dependent techniques

Radio Access
- Independent techniques

Creation of a new Stds group...
Needs of standards for Interoperability with RAT.
This was the only enabler for innovation!
Industries created In Location Alliance

Back to 3GPP! for 5G
A lot of Work Item open, for indoor positioning
Indoor positioning: a Key example to understand

Driven by FCC Requirements Evolutions

Indoor technology is back in 3GPP Specifications!

AGNSS
OTDOA
TBS

WI 640018: Study on Indoor Positioning Enhancements for UTRA and LTE
Why 3GPP is at the center of many evolutions in GNSS?

Chipsets market is driven by LBS,
Very efficient and integrated chipset, but closed...

Large Variety of applications, needs low cost receiver (mainly developed for LBS), but adapted to the use...

How make Chipset integrated in more robust solutions?

A huge markets that could benefits from accessing low layers interfaces to build ad hoc solutions, with specific needs...
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3GPP in a Nutshell - Partners

http://www.3gpp.org

7 Organizational Partners
From Asia, Europe and North America

Market Representation Partners
offer market advice to 3GPP and to
bring into 3GPP a consensus view of
market requirements

Membership

570 Individuals members
❖ Manufacturers (Tx and Infra)
❖ Telecom Operators
❖ Applications developpers
❖ Even :
  - Polices
  - Environments companies

18 Market Representatives
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Example 1: A-GNSS. An example to understand the process

The introduction of GNSS in Mass Market

SA1 Work Item open
SA Work Item approved
GERAN Work Item Open
First Agreement on main TS
Galileo/GNSS ready to be included in R7
Stabilised GNSS Implementation approved for Rel-7

SA1 #24 - May 2004
SA #24 - June 2004
GERAN#21 - August 2004
GERAN#32 - Nov 2006
GERAN#34 - May 2007
GERAN#36 - Nov 2007

First Agreement on main TS

RAN2 Work Item Open
First Agreement on main TS
Galileo/GNSS ready to be included in R7
Alignment of GNSS interfaces implementation RAN2 & RAN3
Stabilised set of RAN2 & RAN3 specs approved for Rel-7

RAN2 #49 Nov 2005
RAN2 #57 Feb 2007
RAN2 #58 May 2007
RAN2 #58 May 2007
November 2007

Galileo = feature in OMA SUPL V2
LS to CT
Proposal of change Request on SUPL v2

OMA Loc August 2007 - Seoul
Stabilisation of CT

Approbation of GANSS Cr for SUPL V2

THALES ALENIA SPACE OPEN
Example 2: Creation of ETSI SCN, before introducing to 3GPP

Objective:
- Standardise a location system (Features, interfaces and performances), including hybrid positioning devices
- Place GNSS at the centre of the system
- Define needs and technologies for multi modal applications
- Standards developed under TC-SES/SCN can be seen as a basis for other groups

With consistence towards other standardisation bodies
Objectives of SCN

1. **Identification of features to be standardized**
   - Reinforced standards location performances
     - Availability (Indoor)
     - Accuracy
   - **Integrity**
     - Even in bad reception conditions
   - **Spoofing detection**
     - Detect spoofing on open signals
   - **Interference and Jamming robustness**

2. **Standardization of the architecture of a reference location system**
   - Architecture definition
     - Define the reference architecture to provide the identified features
   - Multi-Hybrid architecture
     - GNSS
     - Inertial sensors
     - Networks elements
     - ...

3. **Standardization of the interfaces between sensors**
   - Define the **interfaces** between sensors
     - Allows to build system based on open building blocks

4. **Standardization of the minimum performances and associated Tests procedures**
   - Define the **minimum required performances** for each of the identified architecture
     - Define a set of conditions
     - Define the associated performances
   - Define the test procedures for the whole location system
     - For each feature, based on the defined architecture

5. **Certification Process**...
   - Define the certification process based on minimum performances testing
     - Pass the tests procedures
   - Validate the application performances
   - Certify the system
Objectives of SCN: a full coherent set of standards

- ETSI TS 103 349:
  - GNSS-based location systems; Functional requirements
- ETSI TS 103 247:
  - GNSS Location Systems Reference Architecture
- ETSI TS 103 246:
  - GNSS Location System Performance Requirements
- ETSI TS 103 248:
  - Requirements for Location Data Exchange Protocols
- ETSI TS 103 249:
  - Test Specification for System Performance Metrics
Overview of Testing conditions for GNSS terminals

Set of reference performances:
- Horizontal Accuracy
- Vertical Accuracy
- Availability of required accuracy
- Precise GNSS time restitution
- Time-to-first-fix
- Position Authentication
- Interference Localization
- Robustness to Interference
- GNSS denied survival
- GNSS Sensitivity
- Position Integrity Protection Level
- Position Integrity Time-to-Alert (TTA)

Environments & Use cases:
- Environment type:
  - Open area
  - Rural area
  - Suburban
  - Urban
  - Asymmetric area
  - Industrial area
- Static
- Dynamic

Considering also Failures, & external threats

Masking conditions:
- Define sky conditions
- All along a trajectory

Multipath conditions:
- Extension of 3GPP specifications (TS 34.172)
- With various levels of MP

Interference conditions:
- Define interferences level
- And types of interferences

Spoofing Conditions:
- Only threats already described in literacy...
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3GPP : A lot of on-going work on Positioning & Synchronisation

4G and 5G : towards better and better positioning techniques for a built-in Positioning....

- Battery saving
- Critical information to be retrieved
- Crowd sourcing to serve many applications (smart cities, etc...)
- Fast and low cost deployments of small cells

Examples:
- RP-160538: Indoor Positioning
- RP-161260 : Positioning Enhancements for IoT
- SP-150044 : Enhancing Location Capabilities for Indoor and Outdoor Emergency Communications
- S1-172133 : hybrid positioning capabilities for high accuracy use cases
3GPP : A lot of on-going work on Positioning & Synchronisation

The New Challenges :

Low Power consumption for IoT

High Accuracy

In 5G, network based positioning in three-dimensional space should be supported, with accuracy from 10 m to <1 m at 80% of occasions, and better than 1 m for indoor deployments. Tracking of high speed devices will be required to provide this location accuracy in a real-time manner.”

“5G network based localization should be able to cooperate with other/external techniques (e.g. with capability to pull data from partner sources) to further improve accuracy. The overall cost of network-assisted localization should be comparable to or lower than the current external means (e.g. satellite systems) or 4G solutions to acquire the location information.”

Next Generation Mobile Network Alliance

Synchronisation of Small Cell

Space diversity in CoMP and 5G to

- Increase the data rate
- Decrease the power consumption

Need

Accurate and reliable Synchronisation means

Figure 1: hyper-dense networks
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Major Threats on GNSS

Spoofing: Situation is even worse...

Interferences: A major threat for critical applications

Major Threats on GNSS

Interferences: A major threat for critical applications

Spoofing Becoming Taught on YouTube

US UAV hacked and shot down in Iraq

Spoofing: Situation is even worse...

Growing Interference & Jamming Threat

From Unintentional Interference...but raising some concerns...

2006

2014

Alert raised by DOT through a VOLPE report: "Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System"
Interference Monitoring: A part of the solution

- Interference monitoring requires the deployment of high cost infrastructure
  - Interference is by nature local
  - Need a dense infrastructure
  - High cost to protect a large region!

- Example of solution:
  - GAARDIAN from CHRONOS Tech.
  - www.gaardian.co.uk

- Best Solution
  - Use a crowd sourcing approach!
Interference Monitoring via Crowd Sourcing

1 - MDT

Minimization of Drive Tests (MDT feature)

- Automatic monitoring of the Network State
- Use User Terminal to
  - Evaluate the coverage
  - Verify the QoS
- The Network Measurements are
  - Made by each UE (User Equipment)
  - Geolocalised
  - And Reported to the RAN
- 2 modes
  - Real Time (Immediate MDT)
  - Off line (Logged MDT)

Introduced in 3GPP Rel 10.

- Geolocalisation can use GNSS if available
  not to impact battery

Need to be extended to for additional information on GNSS to build an interference map

But the framework is defined!
Interference Monitoring via Crowd Sourcing

2 – Synchronisation of Femto Cell

5G Networks evolve towards Femto Cell

- In order to improve the
  - The throughput
  - The power consumption for a given throughput

- Space diversity is used

- This requires Synchronisation

- GNSS is the most economically efficient solution to synch each eNodeB (even in bad reception conditions)

- Comes to a dense network of GNSS sensors
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Conclusion

- Smartphones drive the market of GNSS chipsets
- It represents a dense “source” of sensors deployed everywhere
- 3GPP rules the technologies and protocols used in Telecommunications
- Telecommunications operators already understood
  - that using UE is an advantageous economic option to get an image of the network coverage rather than implementing drive tests
- This led to the development of the MDT (Minimization of Drive Tests) feature in 3GPP
- MDT could be the right framework to implement GNSS interference monitoring provided that
  - A consensus is found in 3GPP
  - A method to limit the impact on the UE battery is proposed