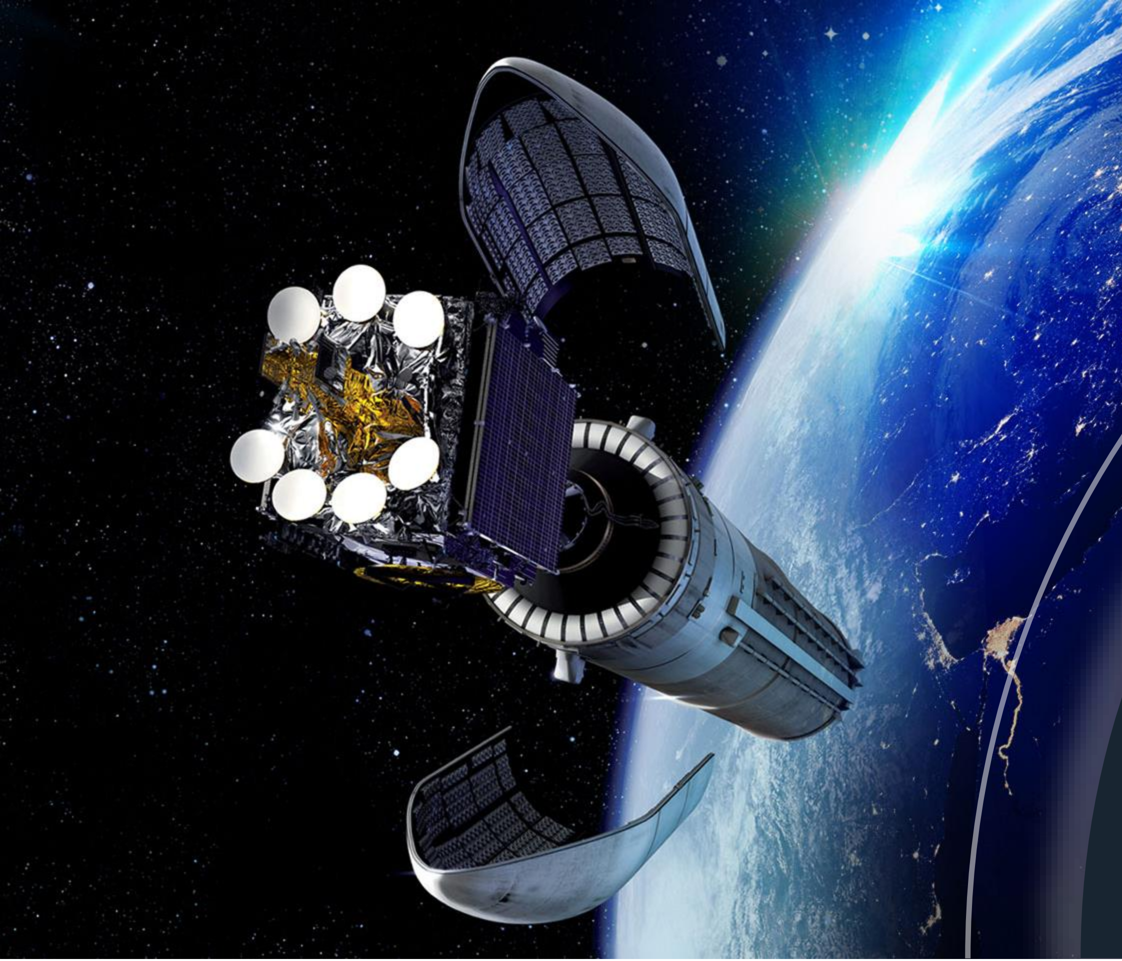

3GPP Process and How GNSS Interests Can Be Further Integrated With Their Work

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

3GPP A GLOBAL INITIATIVE

oma Open Mobile Alliance

To….

Main Example…

GSM

Apparent Proprietary implementations…

android | iOS | Windows 8 | rx networks | Skyhook Wireless

Indoor positioning : a Key example to understand

Radio Acces-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

Radio Access-Dependent techniques

Back to 3GPP! for 5G
A lot of Work Item open, for indoor positioning

Indoor positioning : a Key example to understand

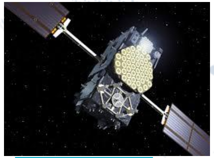
Driven by FCC Requirements Evolutions

Indoor…

Indoor technology is back in 3GPP Specifications!

A GLOBAL INITIATIVE

WI 640018 : Study on Indoor Positioning Enhancements for UTRA and LTE



AGNSS

OTDOA

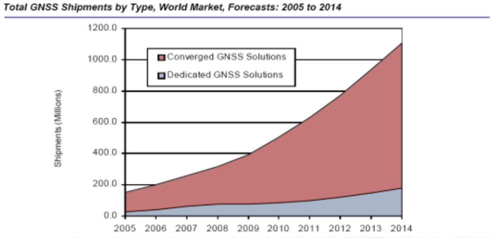
TBS

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?



ABI Research 2010

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

ThalesAlenia Space
a Thales / Leonardo company

3GPP in a Nutshell - Organisation

- **3GPP PCG (Project Coordination Group)**
  - **TSG RAN** Radio Access Network
    - RAN WG1 Radio Layer 1 Spec
    - RAN WG2 Radio Layers 2&3 specs
    - RAN WG3 lub spec, lur spec, lu spec UTRAN O&M requirements
    - RAN WG4 Radio Performance Aspects
    - RAN WG5 Mobile Terminal Conformance Testing
    - RAN WG66 Legacy Radio ASpects
  - **TSG SA** Service & Systems Aspects
    - SA WG1 Services
    - SA WG2 Architecture
    - SA WG3 Security
    - SA WG4 Codec
    - SA WG5 Telecom Management
    - SA WG6 Mission Critical Applications
  - **TSG CT** Core Network & Terminals
    - CT WG1 MM/CC/SM (Lu)
    - CT WG3 Interworking with external networks
    - CT WG4 MAP/GTP/BCH/SS
    - CT WG6 Smart Card Application Aspects

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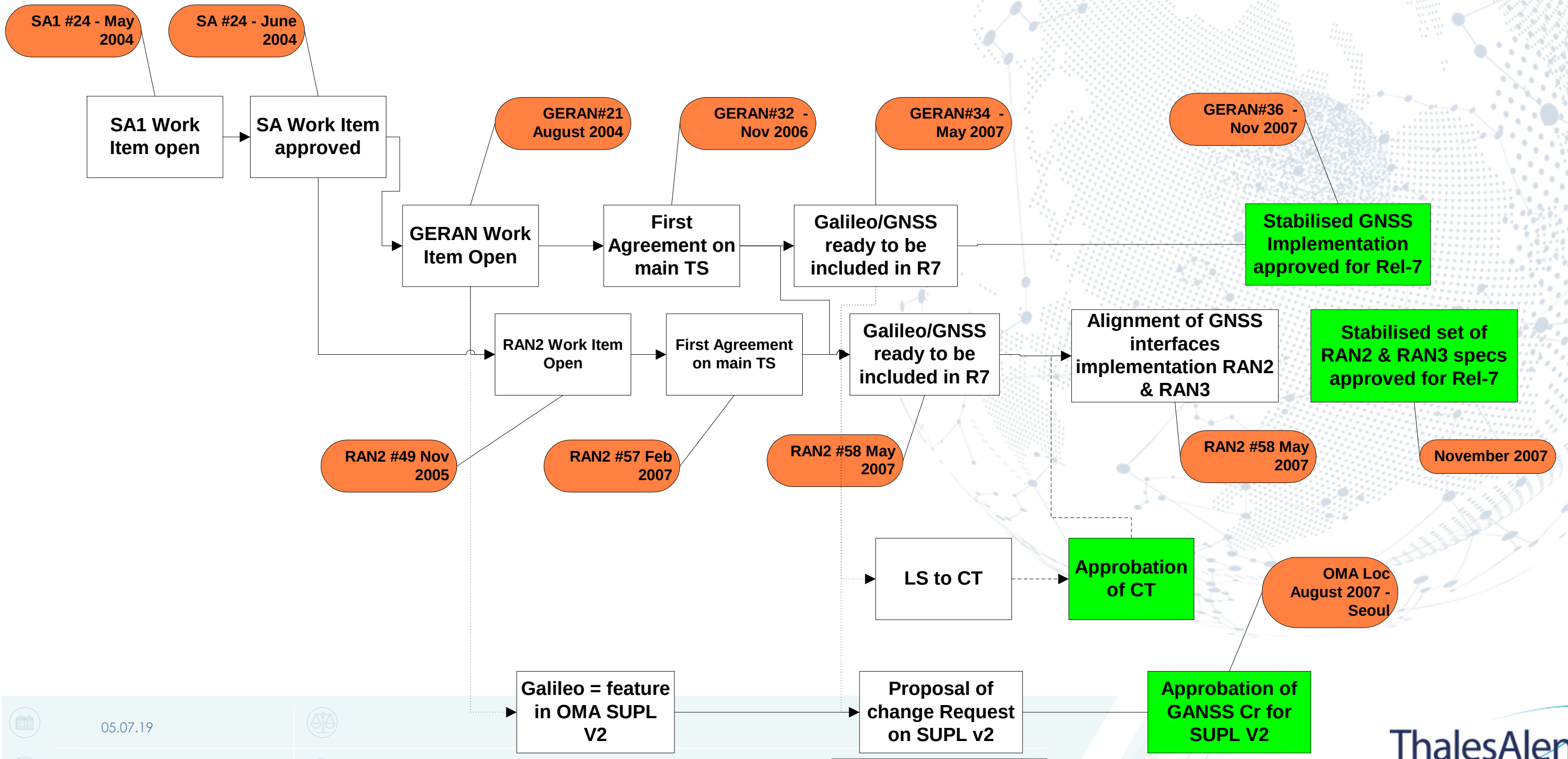
Example 1 : A-GNSS. An example to understand the process

The introduction of GNSS in Mass Market



Example 2 : Creation of ETSI SCN, before introducing to 3GPP

A new standards Group created
ETSI, TC-SES/SCN
(Sat. Navigation and Communication)

ETSI

- **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

TC-SES
GNSS Technology Standards

TC-SES
GNSS MOPS

oma Open Mobile Alliance

3GPP A GLOBAL INITIATIVE

cen

CENELEC

ITU

Objectives of SCN

1 Identification of features to be standardized

- Reinforced standards <u>location performances</u>
  - Availability (Indoor)
  - Accuracy
- <u>Integrity</u>
  - Even in bad reception conditions
- <u>Spoofing detection</u>
  - Detect spoofing on open signals
- <u>Interference and Jamming</u> 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 <u>interfaces</u> between sensors
  - Allows to build system based on open building blocks

4 Standardization of the minimum performances and associated Tests procedures

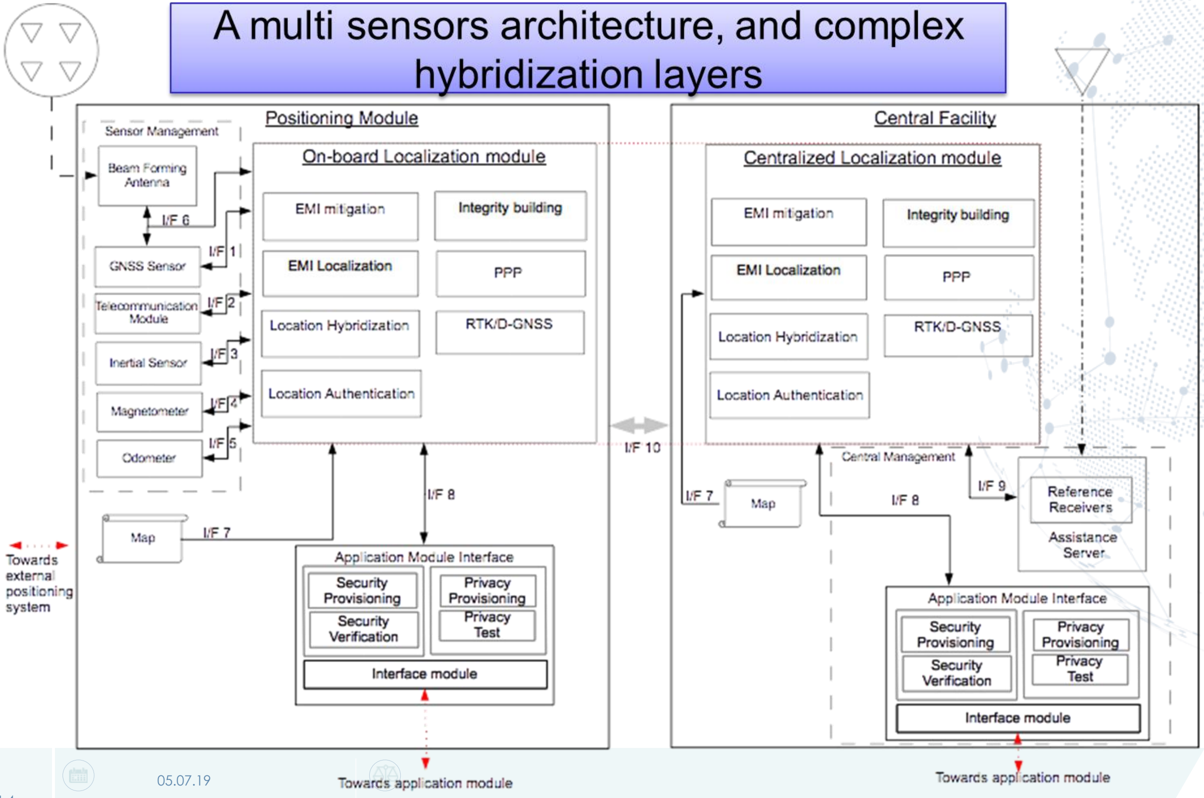
- Define the <u>minimum required performances</u> for each of the identified architecture
  - Define a set of conditions
  - Define the associated performances
- Define the test procedures for the whole location system
  - For each feature, based on the defined architecture

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

A multi sensors architecture, and complex hybridization layers



- **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)

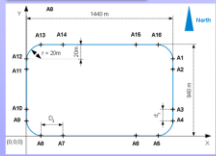
With a common understanding on Vocabulary

Environments & Use cases

Environment type
Open area
Rural area
Suburban
Urban
Asymmetric area
Industrial area

Static

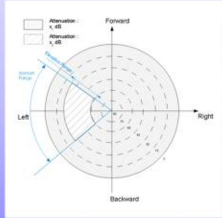
Dynamic



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

Initial relative Delay [m]	Carrier Doppler frequency of tap [Hz]	Code Doppler frequency of tap [Hz]	Relative mean Power [dB]
0	Fd	Fd / N	0
X	Fd - 0.1	(Fd-0.1) /N	Y

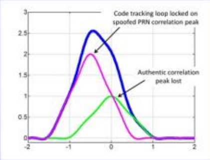
NOTE: Discrete Doppler frequency is used for each tap.

Interference conditions

Define interferences level,
And types of interferences

Spoofing Conditions

Only threats already described in literacy…



Ref. = 000x-000xxxxxxx
Ref. Modèle = 83230347-DOC-TAS-EN-004

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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

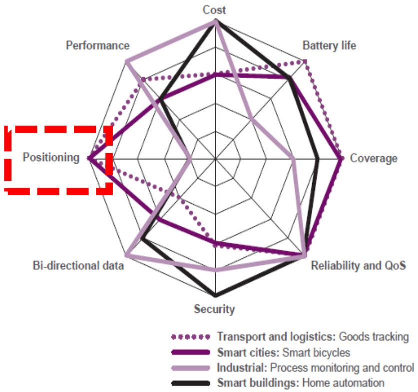
S1-172133 : **hybrid positioning capabilities for high accuracy use cases**

3GPP : A lot of on-going work on Positioning & Synchronisation

The New Challenges :

Note: dates above refer to official 3GPP release freeze (ANS.1 freeze)

Low Power consumption for IoT



Device and connectivity requirements for sample IoT use cases.

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

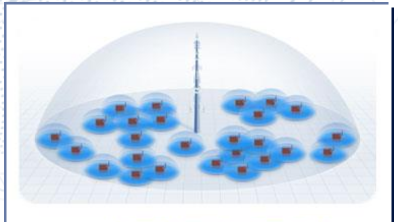


Figure 1: hyper-dense networks

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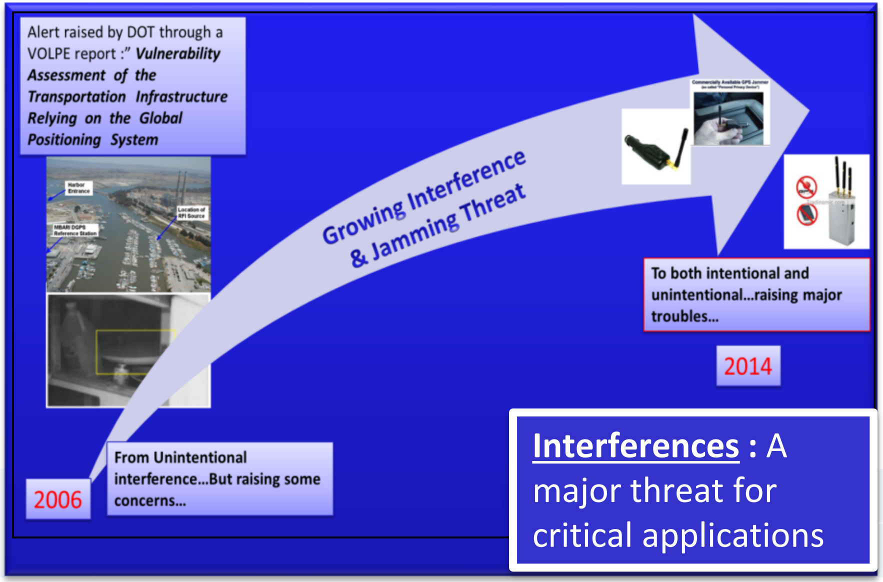
Major Threats on GNSS



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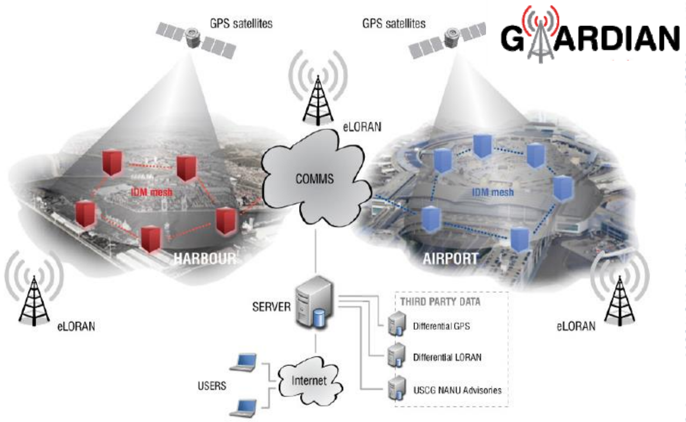
a Thales / Leonardo company Space

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

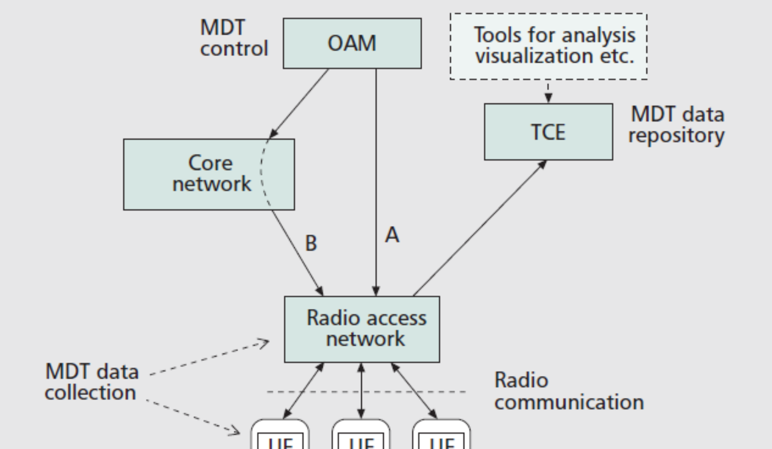
1 - MDT

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



IEEE Communications Magazine • November 2012

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

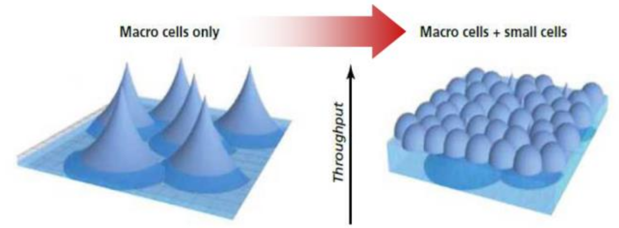
But the framework is defined !

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



Applications	Frequency accuracy	Time synchronisation	Note
LTE – FDD	50ppb	NA	Same as 2G and 3G
LTE – TDD	50ppb	+/- 1.5µs	<3km cell radius
		+/- 5µs	>3km cell radius
LTE – Advanced	16ppb	<1.5µs	Concerns COMP Still under discussions at 3GPP to decrease the number

- 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