Ann. Telecommun. (2009) 64:595–599
DOI 10.1007/s12243-009-0129-7

"Positioning and telecommunications" in the world

Nel Samama

1 A brief introduction to positioning (source "Global Positioning", Nel Samama, Wiley)

Among the numerous technical solutions to positioning, Global Navigation Satellite Systems (GNSS) have a special place. This is mainly due to the fact that they have brought such simplicity of use and low cost that many applications and domains have taken advantage of positioning; for example, civil engineering, the tracking of animals and, of course, car navigation and Location-Based Services (LBS) intended to provide geo-based applications to users.

Initially designed for military purposes, the American Global Positioning System (GPS) has found a large public use, both for professional and mass market applications. This success largely exceeded the hopes of its designers and was mainly due to the incredible performances provided to users. Positioning rapidly became a new way to carry out many tasks that demanded considerably more effort than previously. This success, especially for GPS, has led to a strategic problem: if one imagines the deployment of positioning in domains such as transportation, telecommunications or safety, then it is of vital importance to share the management of a global positioning system. This was indeed the problem of the European Union: the decision to launch Galileo, the future European constellation, was closely related to strategic options. This was also the case for GLONASS, the Russian constellation launched in the 1980s, and for COMPASS, the future Chinese satellite-based navigation system.

The original goal of GPS was to allow positioning in environments with no local or regional ground infrastructure or where the deployment of an infrastructure would be difficult, e.g., at sea or in the desert. Of course, the problem of positioning did not start with satellites and many previous techniques were used. The success of GPS in many applications, mainly transportation, means that satellite-based navigation has entered the public mind, although it still has many limitations. Some limitations, such as coverage, availability or even integrity are being largely dealt with in the scientific and industrial GNSS communities.

2 European Union's research activities related to positioning (source: European GNSS supervisory authority and European Space Agency)

The European Union fully recognises its responsibility in the definition and promotion of important research activities, in particular by encouraging undertakings that include small and medium-sized enterprises (SMEs), research centres and academic institutions. Priority is given to areas and projects where European-level funding and co-operation are of particular importance.

During the period between 2007 and 2013, the European Commission's Seventh Framework Programme for Research and Technological Development (FP7) brings the major research-related EU initiatives together under a single comprehensive programme, playing a crucial role in reaching the Union's goals defined in the Lisbon agenda of growth, competitiveness and employment. It is a key pillar]

N. Samama (✉)
Institut Télécom, Télécom SudParis,
Evry, France
e-mail: nel.samama@it-sudparis.eu

for the European Research Area (ERA), along with a new Competitiveness and Innovation Framework Programme (CIP), education and training programmes, and structural and cohesion funds for regional convergence and competitiveness.

2.1 GNSS research under FP7 (source: European GNSS Supervisory Authority)

To ensure optimal exploitation of results, GALILEO research and development activities under FP7 are managed by the GSA (GALILEO Supervisory Authority), based on certain important underlying principles. First, these activities should build upon work carried out under previous research programmes, especially the GALILEO development programme FP5, FP6 and ESA's GALILEOSat in order to fill in the remaining gaps and move towards strategic objectives. Second, FP7 GNSS R&D should create real benefits for its stakeholders. The return on public investment will be assessed on the basis of these benefits, which includes overall economic value, strongly correlated with time-to-market of project outputs.

Also, FP7 should correctly position research activities within the innovation chain. One natural field of investment for FP7 is the setting up of public enablers of GALILEO/EGNOS[1] service adoption. This will include the certification of systems and applications, standardisation of system elements, especially regarding user segment technologies, and development of security-related elements. Another natural field for investment is the preparation of system evolution, laying the groundwork for mission definition and system requirement updating, based on the timing of system renewal, user demand evolution and cost efficiency.

FP7 will support the development of applications of wide public interest that will improve the quality or the efficiency of public services across the EU or that could become relevant instruments for the implementation of EU policies. It will also support the development of other GNSS applications, taking into account the following:

- ➢ Expected impact in terms of market penetration and economic value
- ➢ Funding of high-potential and high-risk applications which are less likely to attract private investment
- ➢ Adequate balance of risks within the FP7 project portfolio.

Finally, within the scope of FP7, the GSA aims to create new tools such as networking, global visibility and support the engagement of SMEs willing to invest in GNSS.

[1] The European Geostationary Navigation Overlay System, EGNOS, is the European contribution to Satellite Based Augmentation Systems, SBAS, to GPS.

2.2 ESA navigation projects (source: European Space Agency)

Satellite navigation systems are changing the way in which one travels from place to place, whether by land, sea or air and whether in remote areas or through congested city streets. Within a few years, all mobile phones will incorporate global positioning receivers as a standard. The combination of being able to send a text message by mobile phone, together with one's precise location, will have far reaching implications.

The European Space Agency supports the development of many of the innovations in satellite navigation technology. The various projects span the following wide range of applications:

- ➢ Location-Based Services (LBS) and Personal Mobility
- ➢ Road
- ➢ Rail
- ➢ Maritime
- ➢ Aviation
- ➢ Multi-modal Transport and Remote Asset Tracking
- ➢ Emergency Management and Law Enforcement
- ➢ Indoor Positioning
- ➢ Technology and Facilities Development

2.3 A specific comment on indoor positioning (source: European Space Agency)

GPS has become an emerging and important positioning source for a wide range of applications, many of which go far beyond the traditional transport sector, i.e. personal mobility including dense urban, indoor, and outdoor applications. Practically all of the current applications rely on the GPS signals, sometimes also exploiting regional or local augmentations to increase accuracy. As applications also move into safety-critical areas where service reliability is of concern, users and service providers alike are becoming aware of the importance of service qualities and ultimately service guarantees.

Although GNSS is capable of providing accurate location in areas where the satellite signals are available, this is unlikely to be the case inside all buildings and urban canyons, hence, if exploited, indoor navigation is not only a promising market but also seen as an essential local area augmentation for GPS, EGNOS and Galileo.

2.4 Coordinated approach (source: European GNSS Supervisory Authority)

To reach these objectives, the GSA will coordinate its activities with the European Space Agency (ESA) research

and development programmes not only to avoid overlaps but also to optimise the overall outcomes of the programmes from the two agencies. GNSS research activities will take into account other EU activities with potential synergies in terms of applications and systems including, for example, the Global Monitoring for Environment and Security (GMES) and EU satellite telecommunications programmes. Ongoing coordination with other EU programmes managed by DG RTD, DG INFSO and DF TREN will also be maintained.

3 Examples of European projects

3.1 Application of Galileo In the LBS environment (AGILE) FP6 (source: GSA, European GNSS Supervisory Authority)

3.1.1 'AGILE' workshop demonstrates LBS progress (29 October 2007)

In the very near future, the integration of accurate handheld positioning signal receivers within mobile telephones, personal digital assistants (PDAs), portable computers and the like will bring GNSS services directly to individuals, transforming the way we work and play. In the run-up to GALILEO's launch, European EGNOS services will already allow businesses and governments to tap in to this huge potential market.

3.1.2 The AGILE workshop in Turin

According to AGILE coordinator John Hanley of LogicaCMG, the project's aim was to assess the global LBS market, the technological and organisational state of the art, and demonstrate a pre-commercial EGNOS-based LBS application. "The message is that the LBS sector is moving forward," said Hanley. "We see lots of enthusiasm among the major players, but there needs to be further stimulation. We need to keep stressing the social benefits, we need political and legislative support, and we need to keep moving on technical issues." Hybridisation, said Hanley, remains a key concept. "Both the existing GPS and the new GALILEO systems will ultimately be parts of a larger multiple GNSS system. Being able to use these systems in combination, along with other systems like EGNOS, will increase the added value of any one system on its own."

Stefano Scarda of the European GNSS Supervisory Authority (GSA) reaffirmed EU support for work being carried out by AGILE and other similar projects, also stressing the crucial role of the business community. "We still have real technical and institutional issues to resolve," he said, "but GALILEO will happen. The public sector will continue to play a key role, but the private sector will also have to be involved, and, given the great potential for economic benefits, we do not see a problem in making this happen."

Participants in the Turin workshop discussed a variety of LBS issues, including regulation and standardisation activities, business and market potential, LBS success stories and expectations for the future. Then, AGILE partners took the presentation outdoors, demonstrating their new precision location system. Using small handheld devices, users navigated around the Telecom Italia premises with surprising ease. Features of the new application include:

- ➢ Integration of existing GPS, network-based positioning technology and WiFi
- ➢ Assisted GPS technology
- ➢ Simulation of application-specific GALILEO enhancements
- ➢ First implementation of Secure User Plane Location (SUPL) protocol version 2.0.

Hanley says the workshop was targeted at a select group of interested parties. This meant all of the attendees had a chance to try out the new application.

3.1.3 Targeting business

Meanwhile, Daniel Arthur of ESYS stressed the need for quick action on more and better applications. "Return on investment is a basic condition for market growth," he said. "We are just now starting to see major moves by the big industrial players in this field, but the next step has to involve more widespread adoption of simple but compelling applications." And, says Arthur, GALILEO will be an important part of upgrading future navigation services. "GALILEO will have a huge impact," he said, "boosting application quality and accelerating the improvement of the user experience."

The consortium was made up of more than 20 different companies and research centres.

3.2 Wireless hybrid enhanced mobile radio estimators (WHERE) FP7 (source: CORDIS FP7)

3.2.1 Abstract

To increase ubiquitous and mobile network access and data rates, scientific and technological development is more and more focussing on the integration of radio access networks (RANs). For an efficient usage of RANs, knowledge of the position of mobile terminals (MTs) is valuable information in order to allocate resources or predict the allocation within a heterogeneous RAN infrastructure. The main

objective of WHERE is to combine wireless communications and navigation for the benefit of the ubiquitous access for a future mobile radio system. The impact will be manifold, such as real-time localisation knowledge in B3G/4G systems that allow them to increase efficiency. Satellite navigation systems will be supplemented with techniques that improve accuracy and availability of position information. The WHERE project addresses the combination of positioning and communication in order to exploit synergies and to improve the efficiency of future wireless communication systems. Thus, the estimation of the position of MTs based on different RANs is the main goal in WHERE. Positioning algorithms and algorithms for combining several positioning measurements allow to estimate the position of MTs. Appropriate definitions of scenarios and system parameters together with channel propagation measurements and derived models will allow to assess the performance of RAN-based positioning. Based on the performance of RAN positioning, location-based strategies and protocols will be developed in order to optimise as well as to cross-optimise different OSI layers of communication systems and RAT selection policies. Performance assessment of the algorithms is provided by theoretical studies and simulations. Hardware signal processing will provide a verification of the performance of dedicated algorithms under realistic conditions. All the tasks are covered by different work packages, which are in close interaction to ensure an integral research of positioning and communications.

The consortium consists of more than fifteen different companies and research centres.

4 Main research activities in the world (sources: ENC–GNSS2009 and ION GNSS 2009 conferences)

4.1 ENC–GNSS 2009

Since its inception 13 years ago the European Group of Institutes of Navigation (EUGIN) has organised a yearly European Navigation Conference–Global Navigation Satellite Systems (ENC–GNSS), which is hosted by a different EUGIN country member every year. The Conference objective is to create an opportunity to exchange news and information about the technological progress in the Radio navigation sector, with the emphasis on satellite, ground segment and user segment technologies in the frame of the Global Navigation Satellite System. In 2009, the Conference was held in Naples from May 3–6.

The complete programme can easily be found on the Internet, but let us summarise and set out the main topics:

1. Applications: Aviation, Land and Mobility, Marine, Space
2. Galileo signals and GPS/Galileo interoperability
3. Augmentation such as EGNOS, GBAS, etc.
4. Technical aspects such as Multipath, Interference, (software) receivers, RTK, PPP, etc.
5. Hybridisation: INS/GPS, Multi-sensors, UWB, Pseudolites, etc.
6. Certification
7. Indoor
8. Integrity

In addition, the Status of National and International Navigation Satellite Programmes were presented in plenary sessions.

4.2 ION technical meetings

The Institute of Navigation hosts three technical meetings each year: The International Technical Meeting in January; the Annual Meeting in June; and the Satellite Division Technical Meeting, ION GNSS, in September. In 2009, the ION–GNSS 2009 will be held from September 22 to 25, at the Savannah International Convention Center, Savannah, Georgia

The complete programme can easily be found on the Internet, but let us summarise and set out the main topics:

1. Applications: Marine, Military, Land, Space, Aviation, Time, Scientific
2. Galileo signals and GPS/Galileo interoperability
3. Augmentation
4. Technical aspects such as Simulation, Multipath, Interference, (software) receivers, RTK, PPP, Antenna, etc.
5. Hybridisation: INS/GPS, Multi-sensors, Alternatives to GNSS and Back-ups, Wireless sensor networks, etc.
6. Urban and Indoor, Portable navigation devices
7. Integrity
8. GLONASS and other GNSS

In addition, a very interesting session entitled “GNSS Extensions to Deep Indoor Navigation—What Solutions Will Prevail?” ended the conference.

4.3 Comments

Beside limited differences, it is obvious that the topics dealt with on both sides of the Atlantic are quite similar. One has

also to note that ENC proposes about 250 presentations where more than 400 papers are available at ION. In Europe Galileo, and hence any certification related to it, is of great importance, whereas other GNSS, Back-ups and alternatives to GNSS are more important in the USA. From both sides, it appears that the GNSS community is well aware of the limitations of purely GNSS techniques. Note that the Wireless Sensor Networks dedicated session at ION is an interesting orientation concerning the linkup between positioning and telecommunications. At a time when key companies such as Nokia seem to be deeply involved in positioning, this is a clear glimpse of a new era where combined optimisation between the two domains will probably emerge in the near future.