USER CONSULTATION PLATFORM 2018 – PLENARY SESSION MINUTES OF MEETING

Meeting Date	04.12.2018	**Time**	09:00 – 12:45
Meeting Called By	GSA	**Location**	Pharo, Marseille
Minutes Taken By	Marie-Laure Mathieu	**Next Meeting Date**	UCP 2019
Attendees	All participants to the 2018 User Consultation Platform		
Distribution (in addition to attendees)	UCP Plenary, GSA, Public		

Organisation	**Name**
EC	Matthias Petschke, Director of EU Satellite Navigation Programmes at DG GROW
GSA	Carlo des Dorides, Executive Director
EC	Christoph Kautz, Deputy Head of Unit J3 "Galileo and EGNOS – Applications, Security and International Cooperation," DG GROW
GSA	Gian Gherardo Calini, Head of Market Development
GSA	Fiammetta Diani, Deputy Head of Market Development
GSA	Nathalie Ricard, Head of EGNOS Service Engineering Team
GSA	Marco Caparrini, Galileo Service Evolution R&D Engineer

Agenda Items	**Presenter**
1. Opening	Gian-Gherardo Calini, GSA
2. Summary of the results of discussions in the Agriculture panel	Tamme Van der Wal, AeroVison
3. Summary of the results of discussions in the Surveying panel	Roberto Capua, Sogei
4. Summary of the results of discussions in the Timing & Synchronisation panel	Ilaria Sesia, INRIM
5. Summary of the results of discussions in the Aviation panel	Russel Dudley, European Regions Airline Association
6. Summary of the results of discussions in the Rail panel	Salvatore Sabina, Ansaldo STS
7. Summary of the results of discussions in the Road panel	François Fisher, ERTICO
8. Summary of the results of discussions in the Maritime and Inland waterways panel	Jean-Pierre Barboux, FDC
9. Summary of the results of discussions in the Mass Market panel	Philip Mattos, u-blox
10. Conclusions and next steps	Fiammetta Diani, GSA
11. Closure	Carlo des Dorides, GSA & Matthias Petschke, EC
Minutes of Meeting	

The Plenary session was opened by Gian Gherardo Calini, Head of Market Development Department at GSA, who thanked the participants for the fruitful discussions on Day 1, stressing the importance of the UCP findings for the EGNSS success. These inputs will indeed help maximise the EGNSS benefits for users, they will influence and shape the future EGNSS services, improve their adoption and hence increase the Return on Investment (RoI) of the programmes.

The objectives of the Plenary session were to:

- Present the findings of the different panel sessions;
- Share elements and identify possible synergies among the market segments;
- Bring the fora results to the attention of the EGNSS decision makers for careful consideration.

A panel of representatives of the EGNSS Programmes listened to the presentations and contributed to the follow-up discussions. The panel was composed of:

- Christoph Kautz, Deputy Head of Unit "Galileo and EGNOS – Applications, Security and International Cooperation" at DG GROW, European Commission;
- Fiammetta Diani, Deputy Head of Market Development at GSA;
- Nathalie Ricard, Head of EGNOS Service Engineering at GSA;
- Marco Caparrini, Galileo Service Evolution R&D Engineer.

Each market segment forum designated, during its meeting on day 1, a users' chairperson to present the outcomes of its session to the EGNSS Programme Management and to the audience of the Plenary. A common structure was followed for the different presentations:

- Highlights of Main Trends in the Market;
- Recommendations for the Report on [market sector] User Needs and Requirements (RUR) Update (Refinements of User Requirements, User Requirements for New/Emerging Applications);
- Research and Development (R&D) Priorities;
- Discussion on Enhanced EGNSS Services;
- Feedback on Back-up PNT Solutions when relevant.

Summary of the results of discussions in the Agriculture forum

Tamme van der Wal from AeroVision presented the conclusions from the Agriculture forum, which brought together **20 participants** from organisations and institutions dealing, directly and indirectly, with the use of Galileo, EGNOS and complementary solutions in different applications.

The Agriculture' User Community Representatives (UCR) have reaffirmed the **important role of GNSS within the Agriculture 4.0** context, whereby agricultural operations are steadily moving towards **increased integration**, **connectivity** and **digitization**. **Big Data**, **robotics**, and **IoT** are some of the **key trends** in the sector today and in the future. The key challenge in all this is to **combine data** coming **from different sources into actionable information** that brings concrete value to the users. Another major trend is the **use of UAVs** in agriculture whereby long-endurance units and HAPS may bring significant disruption going forward. Finally, new practices such as **inter-cropping and vertical farming are picking up.**

With regards to **User Requirements,** the UCP participants raised the importance of **introducing a language that can better resonate with users**, e.g. a more understandable explanation of integrity (and not simply the 10^{-3} current representation). On top of that, **repeatability** and **vulnerability** need to be explicitly covered in the Report on Agriculture User Needs and Requirements. Moreover,

quoted values of accuracy should be considered as absolute within an average of 95% of the time. Finally, **authentication** should be specifically discussed in contexts such as the upcoming geo-tagged photos for the new Common Agriculture Policy.

The UCP has also produced a number of recommendations related to required **R&D Innovation Actions**. These include **synergies with other initiatives** such as Copernicus, sector-specific programmes such as the Inland Partnership for Research and Innovation in the Mediterranean Area (PRIMA) and the several ongoing public-private-partnerships (Joint Technology Initiatives, Joint Programming Initiatives, European Innovation Partnerships, etc.). In the same spirit, **better cross-coordination between research projects** was considered necessary. So, too, was the need to **focus** activities **on E-GNSS differentiators** and on **sector-specific awareness raising**.

The presentation at the Plenary concluded with an account of the **responses of the UCP to a fixed set of questions**. Thus, the participants had **no awareness of Advanced Receiver Autonomous Integrity Monitoring (ARAIM)**, but were keenly **looking into** Galileo **High Accuracy Service (HAS)**. The main driver there is performance and not cost. As far as the **Ionospheric Prediction Service (IPS) is** concerned, the panel participants found it to be **useful** as long as the information is offered in a "packaged" manner **alongside other data** that the farmers are already monitoring (e.g. weather data).

Discussion Highlights

The audience raised interesting points starting with a question on the projected lead time until farming becomes fully autonomous. Based on the experience of how long it took for other technological trends to penetrate the agricultural market, it is expected that it will take a few decades until a fully autonomous farming becomes a widespread reality. Another question concerned the use of machine learning for yield predictions, which is already being developed in integrated solutions using different sensors and data (incl. from Copernicus). Finally, the importance of regulation in the context of using UAVs was tackled. This is still a pertinent issue but has been increasingly looked into by actors such as EASA.

Summary of the results of discussions in the Surveying forum

Roberto Capua from Sogei presented the conclusions from the Surveying forum, which gathered approximately **20 participants** from various prominent European public (government, Non-Governmental Organisations, academic) and private organizations of different sizes and research/business areas.

Several trends in the surveying GNSS market were introduced:

- **Prices for high accuracy services and** receivers will continue to **go down**;
- Classical Network Real Time Kinematic (NRTK) services are moving towards **Precise Point Positioning (PPP)-RTK techniques and faster convergence time**;
- **Continuously Operating Reference Stations (CORS) networks** are becoming **less densified**, due to more precise local ionospheric and tropospheric estimation;
- **Cost-benefit analysis for** Galileo **HAS** is showing with very **positive** numbers for Europe.

It was proposed that a **new section** on E-GNSS proposition and the addition of **user stories/testimonies** has to be introduced into the next version of the Report on Surveying User Needs and Requirements. The requirements on **susceptibility to interference** has to be further elaborated, as well as the automatic **seamless indoor-outdoor transition**. **Open GNSS standards** (e.g. RTCM) for RTK, PPP, PPP-RTK has to be implemented by GSA.

Several proposals for additions, further analysis and changes in the report on user and requirements were proposed:

- When referring to the accuracies in the RUR document, the **dimension and confidence level**

of the accuracies has to be **specified explicitly** (e.g. 95%, 2DRMS, etc.);
- For Construction Machine Guidance: **specific applications need to be further detailed**;
- The term ''**Trustable**'' needs to be further quantified;
- **Convergence time** (time to first accurate fix) requirements need further analysis;
- Further **analysis on availability** (open sky vs harsh environment) is needed.

New user requirements on EGNSS are needed for the following emerging applications:
- **Drones** and **LIDAR integration in surveying**;
- **Simultaneous Localization And Mapping** (SLAM), especially in terms of mitigation of multipath, 3D-building map, real-time analysis, benefits of GNSS for SLAM and vice versa;
- EGNSS for **Building Information Modelling** (BIM)**, Mobile Mapping, Road and Railways Maintenance;**
- **Augmented Reality**.

The **R&D** section of the presentation focused on the **third frequency**, the impacts of multiple frequencies and multi constellation in harsh environment, **multipath mitigation through E5**, **reliability indicators** with different requirements (e.g. blind people guidance, cadastral applications), **Crowdsourcing and 3-D Cadastre**. The importance of the **Galileo's triple frequency**, **HAS, authentication** and **IPS** services were highlighted as well.

Discussion Highlights

It was discussed that the addition of an integrity indicator on the Galileo HAS, despite being of relatively low importance for the sector, would however be beneficial in certain applications, e.g. machine control. Also, clarifications were made why the EGNOS Signal-in-Space corrections are not the best and most sufficient tool for surveying and mapping – usually because the user needs clear view to the geostationary satellites. The EGNOS EDAS signal may be a better option, especially close to the RIMS stations, where cm-accuracy levels may be achieved. The trend towards survey-grade accuracy, capable to be achieved with common mass-market devices, was outlined by the Panel Rapporteur following audience question. Also, the provision of quality control of the crowdsourced data in surveying was discussed – e.g. in cadastral operations, surveying results are validated through existing control points on the field (the Italian example).

Summary of the results of discussions in the Timing & Synchronisation forum

Ilaria Sesia from INRIM presented the conclusions from the Timing & Synchronisation forum. The presentation is attached to the MoM.

The forum gathered **18 participants** with comprehensive market coverage in terms of applications and value chain. Overall, the group confirmed three **main trends** in the Time & Synchronisation community. There is an **emerging need for high accuracy** in time and synchronisation applications. An **increasing demand for calibration** of hardware equipment delays for both scientific and industrial applications is witnessed and **robustness** against spoofing and jamming is confirmed as needed.

The attendants discussed Timing and Synchronisation User Requirements for the following new or emerging applications: **5G**, a**utonomous vehicles**, **Digital Video Broadcasting** (DVB), **Data management centres** and **scientific applications**. All these applications share a **common need for calibration and robustness** with **different high time accuracy needs**, from millisecond down to nanosecond levels. Refinements and **quantification of User Requirements** from the first UCP were also debated with the following conclusions:
- Resilience: needs are to be addressed at application level taking into account GNSS with the different back-up solutions available (e.g. geo-stationary satellite for DVB, fiber optics for finance, Cesium clocks for data centers, etc.).

- Interference: cannot be easily quantified but a consensus was reached on the need to promote legislation on jammer prevention.
- Spoofing: robustness to spoofing shall be mapped against attackers' profile.

An overall consensus was reached on the high **interest of the Galileo Open Service Authentication** (OS-A) for the Time and Synchronisation user community. **Huge expectations** exist for this service and it should be provided as soon as possible. Moreover, it was agreed that **additional integrity information** with a certain level of confidence has to be provided by the system (as opposed to integrity flags). This may assist end-user devices to assess the usability of the signal depending on user requirements.

The panel participants agreed that there should be more R&D spending on technological challenges related to **security**, **costs optimisation** and **calibration**. This could take the form of large size R&D projects but, beyond the R&D support, free expert support and availability of trained engineers would be helpful to support the rapid development of solutions responding to the market demand. Two main **recommendations** were highlighted for the next UCP: the need to **exchange on Timing requirements with the other forums**, in particular with road and to **investigate the calibration requirements**. It was also mentioned that **back up needs** may change depending on different market applications and availability requirements and that specific back-up solutions **shall be included in future UCP** discussions.

Discussion Highlights

A question was raised on the current state of play of Galileo in the GNSS Timing receiver offer. It was clarified that the four GNSS constellations may already be used, including Galileo. Timing receivers can even be configured as "Galileo" only if required.

Regarding the timing needs for autonomous cars, the EC emphasised that an accurate and reliable synchronisation between sensors is needed to limit the overall position error of the vehicle. Moreover, commenting the future challenges of 5G deployment, the EC pointed out that an accuracy below 100 ns would be needed.

Summary of the results of discussions in the Aviation forum

Russel Dudley, from European Regions Airline Association presented the conclusions from the Aviation forum, which gathered more than 50 users and stakeholders representing European organisations, ANSPs, CAAs, airspace users, aircraft and avionics manufacturers, innovation and research communities.

Whilst no overall change is seen in the overall aviation priorities, the aviation panel noted the **growing demand for air travel** and the **increasing dependencies** being placed **on GNSS** across all fundamental elements of Air Traffic Management (ATM), namely Communications, Navigation and Surveillance. Therefore **development of an Alternative Positioning, Navigation and Timing** (A-PNT) **solution remains important** and needs to be defined before too much rationalisation of existing infrastructure takes place.

Overall, the attendants confirmed that the main trends affecting the Aviation community are:

- **The global move to Performance-Based Navigation (PBN)** for Navigation (NAV);
- **The push for Automatic Dependent Surveillance - Broadcast (ADS-B)** for Surveillance (SUR);
- **The emergence of drone operations** in the Very Low Level (VLL) airspace and mix with low level manned aviation.

The release of the PBN Mandate and the existence of the Special Position Identifier (SPI) Implementing Rule (IR) with the push for ADS-B equipage from an airborne perspective dominated.

The requirements for NAV and SUR in this respect are well known and have not changed although there is still a requirement to achieve the minimum performance levels defined by ICAO and reflected in the Aviation User Requirements. However, the group debated the impacts of NAV and SUR noting the **steady increase in dependence on GNSS** in these areas.

For aircraft distress tracking, the UCP confirmed **the importance of the existence of the Galileo Return Link Service (RLS)**. The need for tracking is reflected at ICAO level within Annex 6 and requirements in European regulation which have a similar objective to determine an aircraft's point of impact and limit the corresponding search radius. With the Galileo RLS, the capability to exchange certain messages with SAR teams and the end user exists but **the messages still need to be clearly defined** and limited to a specific set to avoid confusion. **A new function to inform the operator about the aircraft being in distress is also needed** and could be put in place.

An area that had not previously been addressed was the **GNSS requirements for drones**. Since the 2017 UCP, many different activities have been advanced with respect to drones to determine the GNSS requirements to enable the integration of drones with other airspace users and as part of the U-Space concept. The group confirmed that **accuracy requirements horizontally and vertically** for the positioning system supporting drones operations should be in the **sub-metre level** with corresponding **increases in performance for integrity, continuity and availability**. Based on these initial user requirements, the need for GNSS performance to support drone operations is now understood and these factors should be reflected **in an updated Report on Aviation User Needs and Requirements**.

The **new developments** proposed were **widely supported** including the **IPS** where some stakeholders expressed **interest to participate in trials using the service**. The attendants saw **clear benefits in the development of ARAIM** to improve approach performance at a global level without the need for ground infrastructure. The availability of the **HAS was of interest to the drone community**, but it was questioned whether data existed to determine if the service would be reliable enough for the flight dynamics of drone operations.

The aviation stakeholders supported the UCP and noted the **need for the RUR to support future aviation service developments**. The role of **R&D** in this process was clearly emphasised.

Discussion Highlights

In relation to ADS-B, it was commented that there are cost implications for the ANSPs for the roll out in a coordinated manner to achieve the surveillance picture that is required to provide the services required by ICAO. Therefore, this is an area which still needs to be monitored.

Regarding distress and aircraft tracking, the UCP aviation forum confirmed the need for the Return Link capability of Galileo supporting the identification of aircraft. Additional work needs to be done to define the operational concept under which the Return Link will be used for remote activation of ELTs. This needs to be clear for pilots including an indication when remote activation has occurred.

With regards to HAS support for drones, some surprise was expressed by the aviation stakeholders noting that the convergence time needed to support the high accuracy service may be too long for aviation purposes. However, it was confirmed that subject to additional tests it may indeed be of interest, **but the technical details of the service were not fully known by the aviation community to be able to draw conclusions at this stage.** It was highlighted that the drone community performance requirements are such that there is a possibility that the HAS may be a solution, provided it is able to maintain a link given the flight dynamics of drone operations.

Finally, considering on one hand the ICAO requirements on monitoring of GNSS performance and on the other hand, the existence of RAIM and augmentation, it was highlighted that the Ionospheric Monitoring Service is potentially of benefit for a radiation assessment perspective for crew and systems operating continually at altitude.

Summary of the results of discussions in the Rail forum

Salvatore Sabina from Ansaldo presented the conclusions from the Rail forum, which gathered around **30 participants**, most of them involved in R&D actions devoted to the introduction of GNSS into rail and ERTMS.

The attendants acknowledged that the requirements description could benefit from the participation of a larger audience, including users of GNSS for applications other than signalling. As a preamble, the UCRs agreed that the **requirements that are discussed until now concern positioning functions and not GNSS components** in order to cope with user needs and existing specifications when available. The work performed in the R&D projects focus on the definition of an architecture based on a GNSS receiver but also other sensors or algorithms if requirements cannot be fulfilled with GNSS only.
The definition of the Minimum Operational Performance for Railway receivers remains an important issue addressed in the ongoing projects but not finalized at that step of work.

Applications of GNSS in the rail domain cover a large diversity of domains: service to passenger, information for a better operation of the system (e.g. monitoring of vehicles, of assets, of defaults on tracks), trackside worker protection and signalling in the framework of ERTMS in Europe but also for applications outside Europe. The user requirements review started with non ERTMS related requirements: e.g. passenger information, asset or cargo monitoring. The list of identified applications is long with potential overlapping. Thus, the group recommended **merging some of the applications with similar requirements and uses** in order to avoid redundancy and confusion.

Some tables of the Report on Rail User Needs and Requirements require changes in order to reflect in a more precise way the different uses or scenarios of uses of positioning. As an example, accuracy can differ for passenger information depending on the market: classical passenger trains, or mass transit. For some other applications, architectures are not decided yet and requirements will differ depending on the choice. As examples, one can mention train integrity, or trackside worker protection. The recommendation of the UCRs is to identify the different solutions in order to address differently the requirements for each case.

The use of EGNOS and EDAS remains an important enabler. The STARS project has shown that local threats degrade GNSS performance and, specially, integrity in railway environments. Another conclusion is that a GNSS-standalone solution even augmented with EGNOS cannot answer to railway requirements. Important R&D activities shall:

- Continue the work with the users on the definition of the service to be provided by EGNOS including the service provisioning aspects;
- Investigate possibilities of alternative transmission of the EGNOS information for future use in rail, based on the conclusions of the STARS project.

ARAIM or other RAIM algorithms are identified as another **R&D activity to be performed** by the railway community. A first action will be to evaluate the potential of existing solutions in the railway domain in the X2Rail2 project. Then, some work shall be focused if needed on the definition of a Railway-RAIM. **High accuracy** has been discussed by the UCRs as necessary for applications such as surveying, and for safety-relevant ones requiring track identification.

Discussion Highlights

Regarding the alternative transmission of EGNOS information, it was explained that ERTMS already relies on radio communication based on GSM-R and GPRS. Thus, the discussion in the ongoing projects, if augmentation data are available through the Radio Block Centre (RBC), is to use this

existing safe communication channel in order to keep the costs as reduced as possible but also to address the security issue thanks to the existing data protection and acknowledged mechanisms.

It was underlined that railway stakeholders (in the Shift2Rail program) are working on the definition of a GNSS-based architecture that will address the local errors as well as the computation of an appropriate protection level. An agreement has been reached during the UCP to work with a top-down approach that will assign the functional requirements at subsystem levels based on this architecture. It will then be possible to determine the Tolerable Hazard Rate (THR) required for each of the subsystems avoiding over-specifications and thus to define the requirements expected from EGNOS.

The sharing of responsibilities was then tackled. The architecture proposed will use SBAS under the responsibility of GNSS service provider for common mode error management. Events caused by local environments will be handled under the responsibility of railways. This scheme will require an agreement between the different stakeholders. Finally, the involvement of the rail infrastructure managers and operators to the UCP was appreciated as they are necessary to understand and define the user requirements. Their involvement is as well important, through the projects, to define railway MOPS.

Summary of the results of discussions in the Road forum

François Fisher from ERTICO presented the conclusions from the Road panel, which gathered 28 participants with good coverage of different user categories. The presentation is attached to the MoM.

Overall, the following key trends were observed: a) In **safety critical applications**, automated driving is still on top of the agenda. It is also the application with the most stringent requirements; b) **considering smart mobility** applications, in public transport, on-demand mobility represents an important use case of GNSS, where availability, continuity and trustability are the most relevant requirements.

Several requirements yet to be referenced in the Road RUR were validated.

- Concerning **Traffic and Safety Warning applications**, the accuracy requirement (3 m) is deemed correct for Day 1 applications, but more advanced services (e.g. lane-level traffic and safety warnings should have a more stringent requirement (i.e. 1 m).
- Concerning **automated driving**, availability of 99.9% is correct as long as it is interpreted as “the best possible availability”, since the positioning engine needs to be operational at all times. Concerning integrity, participants stated that new research suggests that levels of confidence should target 10-15 m of protection level at Integrity Risk 10-7.
- The requirements of **payment critical applications** were confirmed;
- **Smart mobility** and **regulatory critical applications** were agreed to be separated as only the latter category of applications requires integrity. Also, when smart mobility and payment critical applications converge, requirements should be harmonised.

User requirements for emerging applications were also discussed. As regards **Safety critical applications**, the user requirements of automated shuttles are slightly less stringent than the ones of other automated driving applications, because of operation in a more controlled scenario. Moving to **Regulatory critical applications**, eCall extension to other forms of transport (with focus on motorbikes) brings in safety opportunities along with some implementation challenges, in particular in terms of accuracy requirements, which might be more stringent and apply to both the vehicle and the driver. Finally, considering the **GNSS technology state of the art**, new active antennas might provide significant mitigation against jamming, but they are still cost-sensitive for the industry.

In the Road forum, the **enhanced GNSS services** were also discussed. Concerning the **High Accuracy Service**, a target accuracy performance of 20 cm as of 2020, based on Galileo infrastructure, is welcomed by the industry. However, Time to First Fix for high accuracy remains a major challenge. When moving to **ARAIM**, the significant relevance of local errors limits ARAIM potential impact. However, a possible **Ionospheric Prediction Service** is deemed to be useful for the industry to know when GNSS positioning and timing is less reliable.

Considering **Research and development priorities**, it was confirmed that automated vehicles should still be the top priority in terms of application areas. More into details here is need of **support actions for standardisation** to achieve the definition of what **integrity** means for road users. **Innovation actions for large scale pilots** are **still relevant**. Also, alignment of efforts by different Commission services involved in automated driving pilots will further boost their effectiveness. **Prize competitions** could foster the emergence of innovative SME/entrepreneurs focusing on niche applications in connected and automated driving (e.g. entertainment apps).

Finally, **back-up solutions for PNT** were also discussed. For the most challenging application (automated driving), it is important to clarify that some technologies are already in use today as a complement, rather than a back-up of GNSS. These complementary technologies (e.g. cameras, HD maps, motion sensors) bring value to reach a minimum performance in the case of absence of GNSS. However, there is no single technology that could potentially meet the required full performance globally similarly to GNSS.

Discussion Highlights

Regarding the requirement of 10-15 metres of protection level at Integrity Risk 10-7, it was discussed that there are similarities between the requirements of Road and Rail. It was also argued that with the integrity concept coming from aviation, refinement of the concept is required for its application in Road, similarly to Rail. Another point of contact between the two segments is that in both, integrity is relevant not only as regards GNSS but also for the overall positioning solution. In line with this point, it was remarked that the Road users are not yet in a position to link their need to trust the positioning solution with the quantitative meaning of GNSS integrity and continuity.

A question on the service provision, service guarantee and service model for GNSS was asked, but this topic was not discussed in the Road forum. However, it was reported that such discussions were held in the frame of the work on eCall. Finally, it was also asked whether triple frequency could solve potential issues related to stringent requirements in terms of time to first fix. It was answered that the work of the panel focused on the challenges and requirements rather than on the possible solutions, but indeed time to first fix (and convergence) can be demanding, if associated also with high accuracy, in specific scenarios of automated driving. It was anyway remarked that, to date, most GNSS chipset are single or dual frequency in the Road segment

Summary of the results of discussions in the Maritime and Inland Waterways forum

Jean-Pierre Barboux from FDC presented the conclusions from the Maritime and Inland waterways (IWW) forum.

The forum gathered **32 participants** with comprehensive market coverage in terms of applications and value chain. Overall, the attendants confirmed six **main trends** in the maritime sector: the increasing demand for **autonomous vessels (manned and unmanned);** the need for **resilient PNT;** the use of **sensor fusion**; the interest for **portable Search And Rescue beacons** (PLB) **with return link** capabilities and **Automatic Identification System (AIS)-enabled;** the increasing use of **drones to support surveillance** and the **confirmed need for robustness** against spoofing and jamming.

The maritime and inland waterway users provided feedback on the **refinement of the user**

requirements.

For **SAR operations**, portable AIS-enabled beacons are becoming popular. The final rescue stage requires accuracy down to 1 m. The return link is also very important for SAR and remote activation of the beacons may also be very relevant for the maritime sector.

For **IWW, bridge collision warning systems** require horizontal accuracy of 20 cm, vertical accuracy of 10 cm and heading of 0.3 degrees. The requirements for **navigation in ports** shall also be updated. Horizontal accuracy at the last stage of berthing needs to achieve 5 cm and berthing impact speed needs to be below 0.2 knots.

The use of automated straddle carriers in **port container terminal operations** will normally require horizontal accuracy of 1 m to support its autonomous driving system but 20 cm is required when entering in a specific row to handle containers. Vertical accuracy of 2 m is required for locating containers in a specific stack but centimetre accuracy is required for container handling.

New applications such as **vessel-to-vessel operations and Unmanned Surveying Vehicles (USV)** are expected to improve the efficiency of maritime operators but their requirements might be also more stringent, typically requiring multi-frequency/multi-constellation, integrity, high accuracy, authentication and standardised communications.

An overall consensus was reached on the high interest of the **Galileo RLS** for the SAR user community and the interest in **exploring additional uses for the RLS.**

Galileo Open Service Navigation Message Authentication (OS-NMA) can play an important role as differentiator in the maritime sector by enhancing the GNSS robustness and security and **EGNOS v3** and **Galileo HAS** will enable new maritime applications.

The UCP participants agreed that on the short term, there should be more **R&D spending** on enhancing the confidence of the maritime sector on the **GNSS robustness** but also on the research of GNSS applications to provide **fuel consumption optimisation**. On the long term, **unmanned and autonomous vessels** will become more relevant, therefore, continuous R&D spending should be allocated to this application as well to ensure the readiness of the sector for this technology.

There is a **high dependency on GNSS in maritime** but the impact of a potential GNSS outages (e.g. positioning, timing and synchronisation) needs to be further analysed. With respect to back-ups for positioning, IALA already published a recommendation on the requirements for these systems (cf. document ref. R-129).

Discussion Highlights

. It was clarified that the maritime requirements are classified in general navigation requirements and specific operations requirements. For general navigation, the continuity requirements are based on the IMO regulation. For the specific operations, the continuity requirements have a variable duration defined according to the type of operations. In both cases, continuity requirements are kept in the Report on Maritime and Inland Waterways User Needs and Requirements and the discussions within the UCP 2018 did not identify the need to update these requirements.

The community was also interested about the use of integrity in the maritime sector and to know if EGNOS would play a role in the sector. In maritime, integrity (i.e. warnings that GNSS signals cannot be trusted) is delivered through the IALA DGNSS systems. There are studies ongoing to investigate the possibility of update the existing DGNSS systems to transmit EGNOS derived corrections to support maritime operations. This is a way on the short to medium terms to use the DGNSS systems as they are. Also, there have been studies in the last two years investigating the use of EGNOS v3 to provide a protection level directly to maritime users in different environments in the future and it estimated that safety service for the maritime sector could be available from 2025.

Summary of the results of discussions in the Mass Market forum

Philip Mattos from u-blox presented the conclusions from the Mass Market panel.

The forum gathered 36 participants with comprehensive coverage in terms of value chain. Forum discussions confirmed the following **main trends** in the Mass Market community: **GNSS is hybridised** with other technologies (including Wifi, LP WAN, 5G, inertial sensors and UWB) to achieve ubiquitous positioning and desired accuracy. The top **three most growing applications** are **robotics**, **people and asset tracking**, and **safety and emergency and m-health**.
The recommended **refinements of User Requirements** are as follows. For **accuracy**, a confidence level of 95% was agreed across all applications. Regarding **coverage**, the level of availability of PNT in urban canyons and under canopy should be kept at the confidence level of 95%. Moreover the requirements for **indoor positioning** are split into light indoor (below 5 metres from window) and deep indoor to enable GNSS to partially address the requirement. The requirement **Robustness against environmental conditions** should be removed. The requirements **Robustness against interference** and **Robustness against spoofing** cannot be easily quantified and should be kept at qualitative level.

Analysis of requirements for **Robotics** and **Augmented Reality**, two emerging markets in Mass Market, led to the following conclusions. All these applications share a common need **for high level accuracy (<1 m)**. Regarding TTFF requirements, there are two distinct categories of users: **"prosumer users"** are willing to **trade off shorter TTFF for higher accuracy**. **"Leisure users"** require a very short TTFF (<10s). **Spoofing-proof solutions are interesting** especially for robots that carry valuable load. Finally the **ability to operate in urban canyons and indoor** is fundamental.

An overall consensus was reached on the high interest in the **Galileo Open Service Authentication** and the **High Accuracy Service**. **Ionospheric Prediction Service** is however considered not relevant for the Mass Market community. Regarding Galileo Service Centre (GSC), recommendations included the inclusion of a **roadmap of upcoming documentation** on **GSC website**, a **Service Level Agreement** (SLA) for **almanac** and **ephemerides data** provision and the reduction of time between the occurrence of an incident and the publication of a **Notice Advisory to Galileo Users** (NAGU).

Hybridisation with LP WAN and other sensors, TTFF improvements and developments using machine learning are the key areas to develop innovative chipset and receiver technologies. The main challenges for mass market innovation are **ubiquity** (avoiding loss of signal**), power consumption reduction** together with **short TTFF** and **trustability (resilience to spoofing and jamming)**.

R&D support schemes must better take account of the fast time-to-market necessity and must increase the EU competitiveness. **Funding below €500 k**, available on a **continuous** basis, is the support needed for Galileo adoption and to close the gap of funding for SMEs. Moreover **new tools** should be added on top of H2020 and FE, for instance to **support the industrialisation** and **commercialisation phases**.

Discussion Highlights

Regarding the publication of NAGU, the GSA enquired whether the interest is in the real performance or in the commitment on this performance. **A UCR argued that they detected the issue with the satellites in 10 minutes while it took several hours before the information was published on GSC website.** The mass market community therefore recommends **GSC to provide preliminary information of any observed problem very rapidly**.
Commenting the main challenges for mass market innovation, i.e. power reduction, short TTFF and trustability, the GSA informed that these features are the core of discussions for Galileo evolution.

Many points of convergence between the mass market and the surveying requirements were highlighted and it was asked whether there could be a synergy for the implementation of augmentation networks. It was pointed out that the mass market is not asking for the stringent accuracy of 2-3 cm required in the surveying domain. Moreover another difference between the two segments is that there are far more users in the mass market segment than in surveying. It is therefore important that the type of communications mechanism that will be used is one direction.

Conclusions and Next Steps

To conclude this session of presentations to the Plenary, it is worth noting the clear consensus among the panels that the UCP is a very useful exercise and that participants are eager to contribute to the future UCP editions.

Fiammetta Diani wrapped-up the key findings raised in the presentations and during the discussions:

- High Accuracy is no more a matter of specialists but a transversal need across the different segments including even mass market.
- Several challenges need to be tackled including offering a convergence time that suits all the segments: e.g. delivering corrections not only on E6 but also on other channels and providing more tailored signal matching for instance low power requirement for IoT applications.
- The authentication features offered by Galileo services are increasingly welcomed even in the agriculture domain for the upcoming geo-tagged photos for the new CAP.
- New promising usages of the Galileo SAR return link service are foreseen with the remote activation of the beacon, not only in Aviation but also in Maritime.
- The interest for the Ionospheric Prediction Service was raised for more segments than initially expected.
- Rail and Road users would want a guarantee that they can trust the position provided and need more interactions with system designers to clarify an quantify the concept of integrity.
- R&D priorities identified in the different segments will be carefully taken into account including the need to give special attention to SMEs involvement in future calls.

Regarding the next steps, Fiammetta Diani explained that the UCP findings will be refined with the view to be used to feed GSA service engineering processes. GSA may get back to the user communities to clarify some of the requirements. The UCP 2018 inputs will be sorted in classes depending on their degree of feasibility: ‘

- The ones that can be implemented with current systems and services;
- Those that will be implemented in the already planned evolutions of the systems;
- Requirements that could be considered in future systems’ evolutions.

Feedback on implemented actions following fora’s suggestions will be provided at the next UCP.

Last but not least, Fiammetta Diani, warmly thanked all the participants for the valuable inputs and her team for the tremendous work for preparing this event.

Closure

Mr. Carlo des Dorides, Executive Director at GSA, pointed out the remarkable attendance of more than 200 participants for this second edition of the UCP gathering representatives from all stakeholders of the downstream market: user organisations, researchers, chipset and Rx manufacturers. These interactions with the users' communities are extremely important for GSA that learns from them. Several tangible outputs building on this relationship can be highlighted:

- The EGNSS Users Satisfaction Survey, recently issued on GSA website;
- The Market and Technology Reports;
- The Reports on User Needs and Requirements, eight living documents addressing the user needs in the different sectors.

Mr. des Dorides pointed out that identified R&D priorities will strive the proper use of financial tools such as Horizon 2020 and Fundamental Elements funds and possibly these funds will be increased.

He concluded his speech by announcing the start of what is called "My Galileo Apps Competition", which is a new initiative that aims to develop Apps that prove the benefits of using Galileo. The gradual involvement of 30 teams is envisaged. The winner will be awarded a 100 k€ prize.

Finally, Carlo des Dorides wished to reiterate the thanks to the participants for their high commitment to the success of this event and looked forward to the third edition of the UCP.

Matthias Petschke, Director of EU Satellite Navigation Programmes at DG GROW, concluded the event. He warmly thanked all those who contributed to set-up this very successful UCP and all user communities' representatives for their valuable contributions. He recalled that Galileo is a demand-driven programme. The EC has therefore been listening very carefully to the debates and will follow-up on the users' suggestions and requests to enhance the EGNSS services and prepare the second generation of Galileo. The Galileo SAR, RLS and OS authentication services and the democratisation of high accuracy are key features for users and will be provided as a matter of urgency.

Mr. Petschke highlighted the huge variety of projects with strong business cases that can emerge from GNSS referring to the various initiatives presented by start-ups in the frame of the EGNSS Accelerator Bootcamp.

He recalled that 10% of the GDP rely on the availability of GNSS signals. We are therefore not here among specialists and experts dealing with a niche market. It is a quite essential market for the EU economy and a critical infrastructure to reach EU strategic autonomy. This should be increasingly communicated and we all have a role to play in making everyone aware how relevant EGNSS technology is.

The EC is currently working on the Multiannual Financial Framework (MFF) for the next financing period (2021-2027). For the time being 9.7 billion € have been allocated to EGNSS in the proposal for the Space Regulation. This budget is important though barely what is needed for ensuring continuity and systems evolution. The point needs to be clearly made, with everyone's support, that more budget is required in the MFF to ensure the proper market uptake of Galileo and EGNOS and support to EU GNSS Industry in the competitive landscape.

Matthias Petschke thanked again all the participants and closed the UCP 2018 event.

Annexes & Attachments
Attachment 1 - Agriculture Panel Discussions Results Summary Presentation Attachment 2 - Surveying Panel Discussions Results Summary Presentation Attachment 3 - Time & Synchronisation Panel Discussions Results Summary Presentation Attachment 4 - Aviation Panel Discussions Results Summary Presentation Attachment 5 - Rail Panel Discussions Results Summary Presentation Attachment 6 - Road Panel Discussions Results Summary Presentation Attachment 7 - Maritime and Inland Waterways Panel Discussions Results Summary Presentation Attachment 8 - Mass Market Panel Discussions Results Summary Presentation

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