'' ROAD & AUTOMOTIVE MARKET SEGMENT SESSION MOM'S

Meeting Date	04.12.2025	**Location**	Prague
Meeting Called By	EUSPA		
Minutes Taken By	Name: Patricia Lopes Bautista, EY		
Representatives & Speakers	**EUSPA Representatives** **Katarzyna Porzuc, Market and Innovation Officer** **User Community Representatives (UCRs)** N/A **Speakers / Moderators** Giuditta Montesanti, *European Commission, DG DEFIS* José Luis Alcolea Coronel, *SpaceRISE Consortium* Olaf Eckart, *BMW AG/5GAA* Damian Lewis, *Viasat/5GAA* Savals Chakkamadathil, *SES* Alessandro Cardosso, *Eutelsat* Marco Bolchi, *EY* Johanna Tzanidaki, *AYA Consulting* - Moderator		
Distribution (in addition to attendees)	UCP Plenary session, EUSPA, Public		

AGENDA

Agenda Items	Presenter
1. Accelerating vehicle connectivity and the contribution of satellite communications/IRIS2	Giuditta Montesanti, European Commission José Luis Alcolea Coronel, SpaceRISE Consortium
2. State of the market	Olaf Eckart , *BMW AG/5GAA* Damian Lewis, *Viasat/5GAA* José Luis Alcolea Coronel, *Hispasat* Savals Chakkamadathil, *SES* Alessandro Cardosso, *Eutelsat*
3. User needs and requirements: discussion panel	Marco Bolchi, EY Olaf Eckart , *BMW AG/5GAA* Damian Lewis, *Viasat/5GAA* José Luis Alcolea Coronel, *Hispasat* Savals Chakkamadathil, *SES* Alessandro Cardosso, *Eutelsat*

SUMMARY

Summary

The SATCOM Road and Automotive panel of the User Consultation Platform (UCP) 2025 was held on December 4th, 2025, as a hybrid event in Prague, convened by EUSPA. The session gathered a diverse group of participants, including representatives from the European Commission, industry leaders (BMW/5GAA, Viasat, SES, Eutelsat, Hispasat), user community experts, and OEMs, with both onsite and remote attendance.

The event was structured into three main agenda items:

1. **Accelerating Vehicle Connectivity and the Contribution of Satellite Communications/IRIS²**: Keynotes from the European Commission and SpaceRISE Consortium introduced IRIS², the EU's flagship SATCOM programme, designed to deliver secure, resilient, and interoperable connectivity for both governmental and commercial automotive applications. IRIS² will operate as a public-private partnership, leveraging 5G and multi-layer satellite architecture (MEO, High-LEO, Low-LEO), with initial operational capabilities expected by 2030.

2. **State of the Market**: Industry speakers discussed the evolution from narrowband to broadband connectivity, the importance of open standards (3GPP), and the challenges of integrating satellite solutions into automotive platforms. Market research highlighted consumer demand for safety, security, and convenience, with willingness to pay for satellite services highest in regions with limited cellular coverage. Technical presentations addressed antenna requirements, chipset development, and the need for interoperability to avoid vendor lock-in.

3. **User Needs and Requirements – Panel Discussion**: The panel explored the split between proactive and cautious stakeholders in automotive SATCOM adoption. Key requirements for user terminals (UTs) include seamless network switching, low cost, compliance with standards, and compact size. Hybrid terrestrial-satellite solutions are favoured for safety-critical applications, while mass-market adoption is challenged by cost, integration complexity, and regulatory diversity. The discussion also covered business models, the role of OEMs, and the importance of standardization for scaling up connectivity solutions.

Major outcomes and key insights

- **IRIS² Programme**: Positioned as a strategic enabler for secure, resilient, and interoperable connectivity, supporting both government and commercial automotive use cases. The constellation will deliver services via a multi-layer satellite network, with a focus on open standards and dual-use capabilities.

- **Market Evolution**: The automotive sector is expected to be moving towards ubiquitous, seamless connectivity, with satellite communications filling coverage gaps and supporting disaster recovery. Adoption of 3GPP standards is critical for interoperability and mass-market integration.

- **Technical Challenges**: Integration of broadband SATCOM terminals remains a niche due to size, cost, and manufacturing scale. Advances in antenna technology and chipset development are needed for widespread adoption. Hybrid solutions are essential for meeting low-latency, safety-critical requirements.

- **Business Models**: The ecosystem is exploring new models for value and cost sharing, with OEMs and satellite providers considering direct contracts and differentiated offerings. Consumer willingness to pay is highest for essential services in areas with poor terrestrial coverage.

- **Standardization and Interoperability**: Industry consensus is that open standards (3GPP) are vital to avoid vendor lock-in and enable scalable, interoperable solutions. The shift from proprietary technologies to standard-based approaches is underway.

MINUTES OF MEETING

Welcome back and introduction to the afternoon session for road and automotive. Katarzyna Porzuc, EUSPA

Ms. Katarzyna Porzuc, Road and Automotive Segment Leader at EUSPA, welcomed participants to the second session of the Road and Automotive User Consultation Platform (UCP).

The afternoon focused on the role of SATCOM in CCAM, with the objective of exploring its future in the automotive sector and understanding how different segments of the value chain are driving market evolution.

Ms. Porzuc explained that the session would begin with keynote addresses from the European Commission and the SpaceRISE Consortium. These would be followed by discussions on the current state of the market, the roadmap for developing terrestrial and non-terrestrial technologies, the consumer perspective, and insights from NTN connectivity providers. After the presentations, an interactive panel discussion was planned to encourage questions from both in-person attendees and online participants.

Finally, Ms. Porzuc introduced the keynote speaker, Giuditta Montesanti.

Agenda Item 1 - Accelerating vehicle connectivity and the contribution of satellite communications/IRIS2. Giuditta Montesanti (European Commission) / José Luis Alcolea Coronel (SpaceRISE Consortium – Hispasat)

Ms Giuditta Montesanti provided an overview of IRIS², the new flagship programme from the European Union. Ms Montesanti explained that IRIS² is the infrastructure the EU ails to develop to meet growing connectivity needs. The initiative responds to the need to provide a secure and resilient governmental infrastructure at the EU level, ensuring interoperability through open standards, and enabling dual-use capabilities.

Ms Montesanti explained that IRIS² will operate as a public-private partnership, offering services through commercial partners for both light-government and fully commercial use, as well as hard-government services for governmental users. The service portfolio will include MEO, High-LEO, and Low-LEO layers. The core network will be based on **5G**, leveraging open standards to support a broad user base. Satellites will be interconnected via optical inter-satellite links, ensuring resilience and enabling direct user-to-user communication. The LEO layer will support IoT and new services.

The timeline foresees initial operational capabilities by 2030, with downstream applications developed in line with this schedule. The IRIS² constellation will deliver hard-government and light-government services for governmental users while enabling commercial services relevant to the automotive sector.

Mr. Alcolea Coronel introduced **SpaceRISE**, a consortium formed by the three main European operators, responsible for designing, delivering, and operating IRIS². This partnership combines public and private sector expertise to create a competitive system. Consortium members play two roles: as concessionaires and developers, and as investors who gain access to capacity rights. To achieve this, they rely on a core team of European subcontractors while keeping opportunities open to the broader European ecosystem through Requests for Information (RFIs) and Requests for Proposal (RFPs).

Q&A

Q (Egon Warkentin - Aumovio): *Does IRIS² support two-way communication (both upstream and downstream data flows), or is it limited to downstream connectivity only?*

A (José Luis Alcolea - Hispasat): IRIS² supports two-way communication, enabling both upstream and downstream data flows. It is designed as a broadband system capable of supporting a wide range of applications, with substantial data transmission in both directions. In addition, the infrastructure will provide space data relay capabilities, ensuring robust and flexible connectivity for diverse use cases.

Q (Egon Warkentin - Aumovio): *Will there be a need for specific hardware, or can you use off-the-shelf receivers?*

A (José Luis Alcolea - Hispasat): IRIS² is designed to offer SATCOM broadband connectivity through user terminals. We are not talking about direct-to-device connectivity yet. That is being tested for the future, particularly with the lower satellite layer, but we are not there yet. For now, the use cases are similar to Starlink.

Q (Xabier Banqué – Trimble): *Since you will leverage 5G, are you planning to include 3GPP considerations for positioning?*

A (José Luis Alcolea - Hispasat): For 5G, we are obliged to include some positioning capability. The question is the precision of these measurements and whether we will offer such services externally. It is a capability we need to deliver communication services, but we do not yet know if it will be offered commercially.

Positioning is becoming an integral part of 5G systems, as defined by ongoing work within 3GPP. The goal is to reduce reliance on GNSS by incorporating positioning capabilities directly into the 5G framework. This ensures that terminals can determine location using network-based measurements, enhancing resilience and enabling new services.

Q: Will 5G network measurements, as defined by 3GPP standards, enable accurate positioning for terminals without relying on GNSS?

A (José Luis Alcolea- Hispasat): Yes, we are working on this.

Q (Curtis Hay - GM): Are there restrictions on the use of IRIS² user terminals outside Europe?

A (José Luis Alcolea- Hispasat): No, LEO constellations are global.

Q: Will there be GEO satellites in IRIS²?

A (José Luis Alcolea- Hispasat): LEO is prioritized because it reduces latency, which is a major driver for targeting lower constellations. Regarding existing GEO satellites or future developments, there is another program called GovSatCom, which acts as a one-stop shop by pooling existing capacity and offering it to governmental users.

Agenda Item 2 – State of the market

Ms. Johanna Tzanidaki, the panel moderator, introduced the next part of the session, which focused on the state of the market. She welcomed the speakers: Mr. Eckart, Mr. Lewis, Mr. Alcolea, Mr. Chakkamadathil, and Mr. Cardosso, and outlined the objectives of this segment.

The discussion aimed to present the evolution of demand, moving from today's narrowband solutions toward future broadband connectivity. It also sought to highlight the consumer perspective and examine the approach of service providers to the automotive sector.

2.1 Olaf Eckart , *BMW/5GAA*

Olaf Eckart introduced the NTN roadmap developed by 5GAA, emphasizing the importance of a shared vision and common understanding among all stakeholders. He began with an overview of 5GAA and its role in advancing connectivity for the automotive sector.

Mr Eckart highlighted that connectivity is critical for modern vehicles: all cars are connected, and continuous connectivity is essential. Increasingly, applications are moving to the cloud, requiring constant access to systems, while

consumer demand for connectivity continues to grow exponentially. To meet these needs, automotive requires ubiquitous and seamless connectivity based on open standards, whereas satellite communication today remains largely proprietary.

He explained that automotive applications can be grouped into three categories:

- Narrowband / IoT
- Wideband
- Broadband

Given the long implementation timelines, Mr Eckart stressed the need to align on requirements now and collect them early. He referenced 3GPP releases, noting that automotive adoption typically lags 3–4 years behind the mobile phone market due to cost considerations. For example, while phones are already integrating Release 17, the newest BMW vehicles launching next year will include Release 16.

Mr Eckart shared insights from antenna parameter calculations:

- Narrowband and wideband services can operate in lower frequency bands without requiring Ku/Ka band.
- Broadband services, however, will require Ku/Ka band and phased-array antennas.

He noted that mass-market services could be enabled with small modifications under Release 17 and Release 18, while fully integrated broadband services will take longer to implement.

Finally, Mr Eckart posed key questions for the industry:

- What are the data traffic demands for automotive connectivity?
- How much traffic needs to be supported?
- How often will NTN (Non-Terrestrial Networks) be used?

He mentioned that 5GAA has launched a new working group to address these questions and drive alignment across stakeholders.

2.2 Damian Lewis, *Viasat/5GAA*

Damian Lewis, who leads advanced NTN services for automotive at Viasat, presented insights on market research and go-to-market strategies, developed in collaboration with 5GAA. He began with a brief introduction to Viasat and announced that a white paper will be released early next year. Viasat operates as both a narrowband and broadband provider and is exploring a direct-to-device (D2D) approach, aligned with standards and interoperability requirements.

Mr Lewis shared preliminary findings from a consumer driver survey conducted across 10 countries, with 1,606 respondents. The survey targeted individuals already engaged in connected environments, such as car owners planning to buy or lease a vehicle. The research focused on two key questions:

- How often will NTN be used?
- Which applications are most important for automotive?

The results indicate that achieving 80% penetration would require bundling applications such as safety and security, entertainment, convenience, and monitoring. Safety and security consistently ranked as the top priority. Respondents were also asked to consider the impact of losing access to these services, which highlighted their perceived importance.

Mr Lewis explained the feature matrix, noting a tension between mass-market appeal and premium pricing. Features that consumers consider essential for everyday use, such as safety and convenience, are widely desired but generate lower willingness to pay compared to high-end features like 4K video streaming or gaming. While some customers are willing to pay a premium for advanced services, these represent niche segments rather than the mass market.

Interestingly, 75% of respondents indicated they would pay extra for satellite services, though Lewis cautioned that this figure may be inflated due to sample bias. Willingness to pay was particularly high in regions with limited cellular coverage, suggesting that NTN services could fill critical connectivity gaps.

Finally, Mr Lewis addressed subscription factors, noting that broadband integration costs for OEMs are significant. The survey explored whether consumers would accept a one-time integration fee of $1,000, with responses varying by market and perceived value.

2.3 José Luis Alcolea Coronel*, Hispasat*

José Luis Alcolea provided background on Hispasat, before sharing reflections on 5G-NTN, IRIS², and automotive connectivity. He emphasized that the automotive industry requires ubiquitous connectivity, which satellites can deliver in two key scenarios:

1. **Extending coverage gaps** where terrestrial networks are unavailable.
2. **Disaster recovery situations**, ensuring resilience when terrestrial infrastructure fails.

Mr Alcolea explained that satellite operators have traditionally relied on proprietary technologies, creating vendor lock-in and incompatibility between terminals. This is a major barrier for automotive OEMs, which will not adopt systems tied to a single vendor. The solution lies in interoperability through 3GPP standards, achieved via a chipset-centric approach. In this model, chipset manufacturers ensure compatibility across satellite constellations, allowing OEMs to simply select a chipset and integrate it with an antenna without worrying about interoperability. Future 5G-NTN chipsets will guarantee compatibility with all compliant constellations.

On the demand side, 5GAA is defining use cases, as presented by Mr Eckart. On the supply side, Mr Alcolea described two types of NTN constellations:

- **Direct-to-Device (D2D)** using low-frequency bands, where typical terminals include smartphones or vehicles with omnidirectional antennas. These support narrowband and wideband services, though capacity is limited and LEO satellites must allocate beams strategically.
- **Broadband constellations** using **Ku/Ka bands**, as identified by 3GPP (Ku for FR1 and Ka for FR1/FR2).

For **D2D**, mass-market chipsets are already emerging. Major manufacturers like MediaTek and Qualcomm have announced support for Releases 17 and 18, leveraging their smartphone market dominance. OEMs can reuse existing antennas operating in L/S bands, minimizing assembly line changes.

For broadband, challenges remain. There is no dedicated chipset, and FR2 chipsets currently work in Time Division Duplex (TDD), whereas SATCOM uses different protocols. Moreover, there is no mass-market case for millimetre-wave use in terrestrial networks, evidenced by iPhones in Europe shipping with mmWave disabled. Antennas for broadband are large (around 20x20 cm), making integration difficult in vehicles with panoramic roofs. Even Tesla has not integrated Starlink, possibly due to cost and assembly line constraints. OEMs are unlikely to adopt solutions costing more than a few hundred euros, and chipset manufacturers will not invest without significant demand.

Mr Alcolea concluded by outlining IRIS²'s contribution:

- Full compliance with 5G-NTN standards, eliminating vendor lock-in.
- Two LEO layers:
    - High LEO for broadband services.
    - Low LEO with D2D payloads to validate use cases.

The focus will be on Low LEO, supporting D2D, NB-IoT, and broadband pilot projects, paving the way for future automotive connectivity.

2.4 Savals Chakkamadathil*, SES*

Savals Chakkamadathil introduced SES, which operates more than 100 satellites across multiple orbits, including GEO and MEO, and collaborates with partners in the LEO segment. SES provides services in media and broadcast as well as global network solutions.

He outlined key trends shaping future connectivity needs for vehicles:

- Digitalization of automotive systems.
- Electrification, becoming a core part of the automotive mix.
- Autonomy, with the challenge of moving from Level 2 to Level 3 automation.

- On-demand mobility services, shifting from car ownership to mobility-as-a-service, which increases demand for real-time information and entertainment.

The market requires ubiquitous connectivity, particularly for V2X (Vehicle-to-Everything) communication. While modern cars rely on terrestrial networks, NTN will play a critical role in filling coverage gaps and ensuring resilience. SES aims to address this through a global, multi-band, multi-orbit network based on open standards, dynamically routing traffic to the best network capability depending on application and data needs.

He noted that companies like Tesla have moved all services to the cloud, which requires significant investment. SES is pursuing partnerships, such as agreements with SoftBank and Cubic Telecom, leveraging GEO satellites to deliver connectivity solutions.

2.5 Alessandro Cardosso, *Eutelsat*

Alessandro Cardosso presented Eutelsat's capabilities, highlighting its LEO constellation through OneWeb, the only non-US, non-Chinese LEO network. Eutelsat is transitioning into a connectivity provider, following its 2023 merger with OneWeb, to deliver broadband services using Ku-band for user links and Ka-band for feeder links.

Currently, Eutelsat provides connectivity for mobile vehicles, primarily through niche solutions for emergency services, border patrol, and buses. Existing LEO terminals weigh around 15 kg, but a new 9 kg model is under development, capable of delivering 200 Mbps downlink and 30 Mbps uplink. For trains, Eutelsat is developing an innovative terminal with a compact design of 8 cm, aimed at improving integration.

Mr Cardosso described Eutelsat's phased approach:

- Gen 1 constellation transitioning to Next-gen IRIS².
- Launching GEN1R (Replenishment) with 100 satellites currently being built by Airbus to ensure service continuity.
- Committing to 340 additional satellites to bridge the gap until IRIS² deployment.
- GEN1E (Enhanced) will include hosted payloads and upgrades to ground infrastructure, preparing for higher speeds and 5G integration. Qualcomm is the chipset provider for this evolution.

IRIS² will deliver 150 Mbps downlink and 100 Mbps uplink, supported by digital beam coverage, enabling flexible allocation of power and capacity where demand is highest.

Agenda Item 3 – User needs and requirements: discussion panel

3.1 Marco Bolchi, EY

Marco Bolchi presented the preliminary results of the SATCOM consultation for road and automotive, conducted in preparation for the UCP. The study combined expert interviews with a targeted survey of OEMs and Tier 1 suppliers. Findings show that the automotive industry is split between stakeholders who are proactively integrating satellite connectivity and those who remain cautious, often due to concerns about cost and integration. SATCOM is recognized as offering significant value for both passenger and commercial vehicles, enabling differentiated services, predictive maintenance, and new revenue streams, but faces challenges such as high upfront costs, integration complexity, and diverse regulatory requirements.

A central theme is the role of user terminals (UTs), with a preference for hybrid solutions that combine terrestrial and satellite connectivity. However, there are differing views on whether a single UT can address all use cases, given constraints like size, power consumption, and integration with vehicle architecture. The most important requirements for UTs are seamless network switching, low cost, compliance with standards, and compact size.

Automotive use cases for SATCOM range from safety-critical functions, which require low latency and stable bandwidth, to premium services like entertainment that drive higher bandwidth demand. Achieving the low latencies needed for safety applications will require hybrid terrestrial-satellite solutions, as NTN alone cannot meet these

requirements. The findings highlight the promise of SATCOM for automotive connectivity but also underscore the need for further technical development, standardization, and validation before mass-market adoption can be realized.

Currently, NTN is not yet widely adopted in the market. The consultation also revealed a segmentation between OEMs and users who are strategically engaged and those who are still evaluating the key question for automotive: whether there is a clear return on investment.

Q&A

Q (online to José Luis Alcolea - Hispasat): *You mentioned that security has been considered in the IRIS² system design, but could you elaborate on how safety requirements for automotive applications are being addressed in the constellation design? For example, how do you ensure redundancy, fault tolerance, and reliability to meet ISO 26262 or similar automotive safety standards?*

A (José Luis Alcolea - Hispasat): The IRIS² system incorporates multiple security layers, primarily designed for authorized users such as governmental and military entities. There are two main types of security: "hard-gov," which provides robust, high-assurance security for critical governmental applications, and "light-gov," which offers a different level of protection for less critical use cases. While the security architecture is well-defined, the specific safety requirements for automotive applications, such as redundancy, fault tolerance, and reliability in line with ISO 26262, are still under consideration. The constellation's design aims to provide high availability and resilience, but further work is needed to fully align with automotive safety standards and to ensure that the system can support the stringent requirements of the automotive sector.

Q (from Ms Tzanidaki to Mr Eckart): *How important are standards for what we are discussing today?*

A (Mr Eckart): Standards are essential for the entire industry. They help avoid vendor lock-in and prevent dependence on a single supplier. Broad industry adoption of satellite connectivity will only happen if there is full interoperability and scalability, which can only be achieved by following recognized standards such as those set by 3GPP. A few years ago, satellite communications were largely proprietary, but now most satellite operators actively participate in 3GPP meetings and working groups. The industry's mindset has shifted, and there is now widespread support for open standards as the foundation for future developments.

Q (Mr Hay):. *For an OEM looking to leverage NTN, the simplest starting point seems to be selecting a chipset that supports 3GPP Releases 17 and 18 and ensuring the antenna is compatible. From this perspective, it appears relatively straightforward for both narrowband and wideband implementations. What are your thoughts on this approach?*

A:

Mr Eckart: The main challenge is that these chipsets are only just becoming available. The first Release 17 chipsets were introduced this year, with initial demonstrations taking place in May in Paris. However, it typically takes several years for new chips to be integrated into platforms and for those platforms to reach the market. Antenna integration is another critical aspect. According to 3GPP, three types of antennas are relevant: terrestrial omnidirectional antennas, non-terrestrial antennas for frequencies up to 6 GHz, and antennas for frequencies above 10 GHz. It is generally easier to integrate antennas for frequencies below 6 GHz with existing terrestrial solutions, but challenges remain, such as managing polarization and other technical factors. Achieving this level of integration would not be possible without standardization.

Mr Lewis: it is important to clarify that Release 17 initially focused on data, with voice capabilities being a priority for the next year. The availability of Release 17 is only the first step; the entire ecosystem must evolve to turn this technology into a practical capability. The 5GAA brings together the whole ecosystem, which helps accelerate progress. Release 17 allows OEMs to begin development, but they must consider whether to adopt it now or wait for Release 18 or 19, depending on their product timelines and strategic goals. Release 20 is expected to bring even broader capabilities, especially for wideband applications, so OEMs need to plan their roadmaps accordingly.

Mr Cardosso: moving to broadband represents a significant leap for providers as well. It remains a niche use case, and even leading companies like Tesla and Starlink have not yet integrated such terminals into their vehicles, highlighting the technological and integration challenges. For example, large antenna arrays (25x25 cm) raise questions about where and how these can be fitted into vehicles.

Q (Aumovio): *Is it feasible to have the vehicle itself act as an antenna for lower bandwidth applications in the future, similar to how GNSS antennas are sometimes installed inside the car while the receiver is on the roof? If the antenna is placed inside the vehicle, what are the implications, especially considering the more complex environmental conditions? How do equipment suppliers view this, and what are the commercial and technical considerations?*

A:
Mr Cardosso: for lower bandwidth applications, it is technically possible to use smaller antennas operating at lower frequencies. Aftermarket solutions for in-vehicle connectivity already exist, particularly for consumer use. However, if the main use case is handset devices, aftermarket solutions may be less practical due to installation limitations and the need for optimal antenna placement. For commercial vehicles, there are more opportunities, and deployment does not necessarily have to wait for full NTN interoperability.

Beyond technical feasibility, OEMs must consider whether such solutions can be monetized. For example, if a chipset supplier offers a $200 product for integration, OEMs need to determine if consumers are willing to pay extra for the hardware and an ongoing subscription for connectivity. For satellite operators, the automotive sector is highly attractive because mass-market adoption would drive chipset development and create opportunities for other segments.

The discussion also touched on business models. For instance, Tesla charges a monthly fee for connectivity in some markets, and access to certain vehicle features depends on maintaining that subscription. This highlights the need for OEMs to rethink how they package and sell connected services, moving beyond simply selling the car to offering ongoing value through connectivity.

Mr Eckart: connectivity is a foundational enabler for new services. Current shark fin antennas have limited data capacity, but the next generation, such as flat, omnidirectional panel antennas, will support much higher throughputs and enable wideband applications even at lower frequencies. Bringing satellite services to the mass market will require advances in both antenna technology and integration.

The panel agreed that while the focus is often on the vehicle, it is equally important to ensure that satellite providers and constellations (such as LEO operating in S/L bands) are ready to support these services. For broadband applications, challenges remain, particularly with integrating larger Ku-band terminals, but technical innovation aims to make broadband less of a niche offering.

In summary, deploying in-vehicle antennas for lower bandwidth is technically feasible and already happening in some cases, but scaling up to mass-market, higher-bandwidth applications will require phased adoption, careful consideration of business models, and close coordination between OEMs, equipment suppliers, and satellite providers. OEMs must also plan for a long-term roadmap, considering which constellations and frequency bands will best meet their needs over the next decade.

Q (Xavier Banqué): *In the business model for automotive satellite connectivity, who is ultimately responsible for paying the bill—the driver or the OEM?*

A:
Mr Eckart: explained that most current costs are associated with terrestrial networks, and satellite connectivity is primarily used to fill coverage gaps, such as for IoT or critical applications that require permanent connectivity. Since terrestrial coverage is the baseline, the real question is how much users are willing to pay for the additional coverage that satellite provides. It's not as simple as adding a proportional cost on top of existing expenses.

Mr Lewis: costs must be passed on to the customer, but the customer pays only for features that add clear value. For example, safety systems that require ubiquitous connectivity may become a basic expectation, while premium services

can be offered as add-ons. The ideal business model for satellite providers is to be paid for providing service only when it is needed, such as during emergencies or in areas with limited terrestrial coverage.

For OEMs, the challenge is how to pass on these costs while differentiating their offerings. They may charge for premium broadband services but must carefully consider how to communicate the value to customers and structure pricing so that it is both competitive and sustainable.

Q (Pere Molina): *Is it just a matter of time before we have broadband-capable vehicle terminals that are small enough for practical integration? Additionally, considering the close relationship between smartphones and cars, could we use the phone's connectivity and positioning capabilities as a substitute for dedicated vehicle hardware, and how far can this approach go?*

A:
Mr Cardosso: for the first question, the development of smaller, more efficient broadband terminals is indeed a matter of time and ongoing technological progress. Advances in satellite constellations and waveform efficiency, such as those anticipated with IRIS², are expected to enable the integration of smaller terminals into vehicles. However, for now, broadband solutions remain expensive and niche, typically appealing only to customers with significant coverage gaps who are willing to pay a premium for dedicated hardware.

Mr Eckart: terminal miniaturization is progressing and that it is technically feasible to achieve good links with smaller antennas. For example, Viasat's mobile terminal size has decreased from 60x60 cm to 20x20 cm in a short period. While the physics are promising, bringing these solutions to market remains a technical and economic challenge, especially when balancing cost, size, and performance.

Mr Alcolea: more cautious view, only a small fraction of 3GPP specifications is currently implemented in available chipsets and antennas. Without large-scale manufacturing, on the order of millions of units, costs will remain high, and progress will be slow. The ecosystem needs both chipset and antenna manufacturers to commit to mass production before significant cost reductions and widespread adoption can occur.

Mr Chakkamadathil: the question is not just about time, but also about choice and scale. With powerful enough satellites, it is possible to use smaller terminals for broadband but achieving this requires both technological advances at the satellite level and sufficient market demand to drive down costs through scale. If an OEM commits to large-scale deployment, the resulting economies of scale could make small, affordable broadband terminals a reality.

Mr Lewis: with one hundred million vehicles shipped annually, the market potential is high. If satellite cannot fill the broadband gap, another solution will eventually emerge, as cellular networks alone will not provide universal coverage. The evolution of connected vehicles over the past decade suggests that significant change is possible, even if the path is not yet clear.

On the second question, while smartphones currently provide connectivity and positioning for many vehicles, there are limitations. Satellite communications require a clear line of sight, and the car's structure can interfere with signal reception—issues that are less problematic for dedicated vehicle antennas. While leveraging smartphones is convenient, especially for consumer applications, dedicated vehicle hardware offers greater efficiency and reliability, particularly for high-throughput or safety-critical services.

In summary, the panel agreed that smaller, more efficient broadband vehicle terminals are likely to become available over time, but achieving mass-market adoption will require advances in both technology and manufacturing scale. While smartphones can supplement vehicle connectivity in some cases, dedicated vehicle hardware remains essential for robust, high-performance satellite communication.

Q (Mr Spaanderman): *Regarding scalability, is it feasible to start with just one or two OEMs, or is broad participation necessary from the outset? Additionally, from an OEM perspective, is it practical to work with multiple connectivity providers, or is it preferable to rely on a single partner?*

A:
Mr Lewis: explained that their business model does not depend solely on the automotive sector; they serve a wide range of markets, including industrial IoT, government, and UAVs, with narrowband services already well established. While direct-to-device automotive connectivity is an exciting opportunity due to its potential scale, gradual adoption is acceptable, and having several early adopters is ideal. Not all OEMs are alike, and customer demand for connectivity is a growing trend. The presence of roaming partners also supports flexible business models.

Mr Eckart: described their approach to connectivity procurement: they typically contract with mobile network operators (MNOs) to provide a certain level of service, leaving it to the MNOs to fill coverage gaps, sometimes by partnering with satellite providers. While BMW could wait for MNOs to take the lead, there is value in being proactive. MNOs are increasingly active in the antenna market and are engaging with satellite operators to enhance coverage.

Mr Chakkamadathil: highlighted the potential influence of global OEMs, suggesting that if two or three major OEMs collaborate, they could unlock the market for satellite connectivity. The business model for terrestrial networks is well established, with operators owning spectrum and value cascading up the chain. For NTN, the model could be different, potentially allowing OEMs to play a larger role in the value chain by contracting directly with satellite providers, rather than following the traditional terrestrial model.

Mr Lewis: further differentiated between Starlink and the broader SATCOM industry, emphasizing that satellite operators do not view MNOs as competitors and cannot replace them. Given OEMs' ongoing reliance on MNOs, direct contracts between OEMs and satellite providers are likely to remain rare and limited to niche cases.

Mr Eckart: added that, from a practical standpoint, they prefer to use a single telematics control unit (TCU) with one SIM card that supports all services, ensuring quality and cost efficiency. Introducing separate TCUs for different services would increase complexity and cost, which is not viable for mass-market vehicles. The distinction between niche and mass-market solutions is critical, and OEMs must carefully balance integration, cost, and service quality as they consider new connectivity options.

Closing remarks

Ms Tzanidaki highlighted the ongoing business model dilemma facing the industry, emphasizing the need for continued dialogue and innovation to address how value and costs are shared across the ecosystem.

Ms Porzuc reflected on what had been a very eventful day, expressing gratitude to all users, speakers, and panellists who contributed their time and insights. She also thanked both the onsite and online audiences for their engagement. Katarzyna stressed that this consultation is just the beginning, reaffirming EUSPA's commitment as the user agency to listen to stakeholders and support the EU Space Programme. She concluded by noting that all presentations and minutes from the session will be made available for reference on the official website.

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