**Request for Information (RFI)**

**Outline concept for development of Greek 5G corridors along the Greek territory that will serve the needs for Connected and Autonomous Mobility**

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1. **Introduction**

The “Connected Motorways” project serves the Gigabit Society targets for 2023 where “All urban areas and all major terrestrial transport paths to have uninterrupted 5G coverage”. The project includes the development of 5G networks that will provide coverage of all Greek motorways that are part of the Trans-European Transport Networks. The aim of the “Connected Motorways” project is to develop the necessary infrastructure that will serve the needs for Connected and Autonomous Mobility.

According to the European Commission, the annual benefit from the introduction of 5G in transport will reached EUR 8.3 billion for the EU in 2025, while for Greece it will generate revenues of EUR 2.3 billion in aggregate by 2030, provided that network deployment will launch in 2021.

The initiative is expected to accelerate private investments in supply chain, improve productivity of the transport sector, reduce road accidents, and limit greenhouse gas emissions. Europe’s 5G Action Plan sets ambitious objectives for pan-European deployment of 5G connectivity infrastructure along major transport paths by 2025. These “5G corridors” are expected to be a key enabler for connected and automated mobility and for the development of innovative ecosystems around cars and other means of transport.

EU is investing in 5G corridors trial projects (<https://5g-ppp.eu/5g-blueprint/>,<https://www.5g-routes.eu/>,<https://www.5g-mobix.com/>,<https://5gcroco.eu/>,[https://5g-ppp.eu/5gmed/,https://5g-ppp.eu/5g-carmen/](https://5g-ppp.eu/5gmed/%2Chttps%3A//5g-ppp.eu/5g-carmen/)), three of these 5G corridor trial projects were launched in September 2020. Altogether, they will contribute to the validation of 5G technology solutions for use cases in the field of Connected and Automated Mobility. They will also bring insights on service requirements and network deployment planning in view of the Connecting Europe Facility 2 Digital programme (CEF2 Digital). CEF Digital will provide financial support to the deployment of 5G corridors, with a focus on cross-border sections and other economically challenging areas.

Within the context of this RFI, the Ministry of Digital Governance seeks for the market view regarding the development of 5G networks that will provide coverage of all Greek motorways that are part of the Trans-European Transport Networks that will serve the needs for Connected and Autonomous Mobility. The response to this RFI should be submitted by.......... 2021.

1. **Scope of the project -Use cases**

The connected motorways that connect the critical infrastructure (airports, etc.) and the cross-border connections as well as the actual length of them that are part of the core Trans-European Transport Networks[[1]](#footnote-1)are illustrated in the table 1 below.

|  |  |
| --- | --- |
| **Motorway** | **Length (km)** |
| Egnatia Odos (Igoumenitsa- Thesalloniki – Kipoi Evrou) | 670 |
| A.T.E (Athens – Thessaloniki –Evzonoi) | 550 |
| Ionia Odos (Tsakona- Patra-Ioannina- Kakavia) | 417 |
| Olympia Odos (Athens – Korinthos – Patra) | 205 |
| Thessaloniki – Serres- Promachonas | 105 |
| Attiki Odos (Elefsina- El Venizelos International airport) | 64 |
| Central Peloponnisos (Moreas – Korinthos- Tripoli- Kalamata) | 205 |
| Central Greece  | 181 |
| **Total**  | **2,397 km** |

As stated in a relevant study[[2]](#footnote-2) of the European Commission, it is estimated that in 2025 the annual benefit from the introduction of 5G networks in transport will amount to EUR 8.3 billion for the EU, while for the country the benefit from the implementation of 5G networks in transport will contribute cumulatively until 2030, revenues of EUR 2.3 billion if the gradual development of the network starts in 2021.The proposal also covers the requirements arising from the LOI signed by the country, in the framework of Europe's 5G Corridors pilot projects for the Thessaloniki, Sofia-Belgrade: EL-BG-RS axis, via the Thessaloniki - Serres– Promachonas highway. It is noted that the project meets the 3rd recommendation of the text "Council Recommendation on the National Reform Program of Greece 2020 and the expression of the Council opinion on the Stability Program of Greece 2020[[3]](#footnote-3)", which states, among others: “[…] Focus on investment in green and digital transitions, in particular on secure and sustainable transport and logistics, clean and efficient energy production and use, environmental infrastructure, high-capacity digital infrastructure and digital skills. Improve the efficiency and digitization of public administration and promote the digital transformation of businesses”.

The scope of the project is to investigate, identify, and develop the required elements on network infrastructure so as to develop smart automobile capabilities along the Greek highways illustrated in the table above taking into account all complying to national, European, and international law and regulations (e.g., ITU, GDPR etc). In more detail the most dominant use cases adopted from 3rd Generation Partnership Project (3GPP) are as follows:

**- Vehicles Platooning**

Enables the vehicles to dynamically form a group travelling together. All the vehicles in the platoon receiver periodic data from the leading vehicle, in order to carry on platoon operations. This information allows the distance between vehicles to become extremely small, i.e., the gap distance translated to time can be very low (sub second). Platooning applications may allow the vehicles following to be autonomously driven.

**- Advanced Driving**

Enables semi-automated or fully-automated driving. Longer inter-vehicle distance is assumed. Each vehicle and/or RSU (Road Side Unit) shares data obtained from its local sensors with vehicles in proximity, thus allowing vehicles to coordinate their trajectories or maneuvers. In addition, each vehicle shares its driving intention with vehicles in proximity. The benefits of this use case group are safer traveling, collision avoidance, and improved traffic efficiency.

**- Extended Sensors**

Enables the exchange of raw or processed data gathered through local sensors or live video data among vehicles, RSUs, devices of pedestrians and V2X application servers. The vehicles can enhance the perception of their environment beyond what their own sensors can detect and have a more holistic view of the local situation.

**- Remote Driving**

Enables a remote driver or a V2X application to operate a remote vehicle for those passengers who cannot drive themselves or a remote vehicle located in dangerous environments. For a case where variation is limited and routes are predictable, such as public transportation, driving based on cloud computing can be used. In addition, access to cloud-based back-end service platform can be considered for this use case group.

**- Vehicle quality of service Support**

Enables a V2X application to be timely notified of expected or estimated change of quality of service before actual change occurs and to enable the 3GPP System to modify the quality of service in line with V2X application’s quality of service needs.

**- Situation Awareness**

Enables Back Situation Awareness for emergency vehicles public service (BSA).

Use of Vehicle sensors and state sharing (VSSS) creates in-advance awareness about adverse weather conditions or other detected hazards.

**The implementation of smart driving will reduce car accidents and human losses**. With 5G the data will be reliable enough for vehicles to receive details about upcoming speed restrictions and adjust their speed accordingly while the next step would be their fully automated course. For example, through a pop-up window on the dashboard, the driver is notified that for the next 100 km there is strong signal coverage and an external service provider can safely take control of the car. In essence, the driver will be able to rest while the car is remotely controlled. An on-board computer can combine vehicle data with that of other vehicles to create its own real-time direct environment map and check whether other vehicles (including those not visible to the driver) are on a possible collision course. The vehicles involved can then receive a specific command such as braking or acceleration to prevent a collision. In Greece[[4]](#footnote-4) in 2018 there were10,737 road accidents with a total of 700 fatalities, i.e., a rate of 6.5%, and the total number of injured exceeds 13,000. In fact, in the four years 2015 to 2018 the average number of accident deaths in Greece is 762 people a year while the total injuries involved in a car accident amount to an average of 14,347. For example, based on studies[[5]](#footnote-5), use of V2X technology would mean at least 520 fewer lost human lives.

**Moreover, with smart driving it is foreseen that road transport will be improved in time, cost and CO2 emissions improving the environmental footprint of transport.** Driving in an array can allow trucks to drive closer to reduce wind resistance, achieving a reduction in fuel consumption and CO2 emissions. It has been shown that an array of three trucks, which is moving at a speed of 80 km/h, 4 meters between vehicles, consumes 15% less fuel. If the distance between trucks is reduced to 2 meters, then fuel consumption is reduced by 25% for the same speed. Reducing the distance between vehicles can also increase road traffic capacity, mitigating congestion and CO2 emissions[[6]](#footnote-6).

**Final new sources of revenue from Connected and Automated Mobility services (CAM) are expected.** The development of 5G networks supporting autonomous vehicle traffic on motorways will lead to the emergence of new business models and revenue sources. The main roles of relevant business models include end-users, CAM service providers, network provider, and motorway operator. End users will be required to pay a CAM user fee to their respective providers, part of which is attributed to the network provider (end of use of a data connectivity service).

**Questions**

1. Are you interested in deploying 5G network to provide CAM services?
2. What is the roll-out cost of a 5G network serving the abovementioned CAM use cases covering the highways of table 1? Please specify the technical specifications for each use case.
3. What do you believe will be the most effective 5G infrastructure deployment scenario CAM services? (e.g., participation of road operators, a joint MNOs venture, passive/active sharing or third-party infrastructure providers)
4. What are the possible investment and business models (revenues, payback period) for CAM services in Greece?
5. Do you believe that the state should be involved in the project of 5G network deployment for CAM services (e.g., through a Public Private Partnership)? If yes, please specify the collaboration model, contract duration and funding scheme.

What CAM services do you think could be provided under the motorway and freeway coverage obligations (Annex 1) included in the 5G spectrum usage rights?

Given the obligations of Annex 1 and taking into account your answers to questions 2 and 3, what is the additional equipment and cost to cover the abovementioned CAM use cases for the highways described in table 1?

How would CAM service deliver a major contribution to civil protection ?

1. How would CAM services deliver a major contribution to green mobility?

**Annex 1**

**Coverage obligations according to 5G Auction fulfilled in December 2020**

**700MHz and 2GHz bands**

1. For the provision of voice and data services, using all radio frequency bands to which each provider is entitled, within three (3) years from the entry into force of the right:
* Coverage of at least 99% of all population and at least 95% of population of each regional unit of the country,
* Coverage of 95% of the total land area of the country,
* Coverage of 95% of the marine area,
* Coverage of 95% of motorways[[7]](#footnote-7),
* Coverage of 90% of European[[8]](#footnote-8)and national[[9]](#footnote-9)roads and highways
* Coverage of 95% of the rail networks Athens-Patra and Athens-Thessaloniki
1. For the provision of broadband services, using all radio frequency bands which each provider holds, a nominal transmission rate of at least 100 Mbps on the downlink:

within three (3) years from the entry into force of the right:

* Coverage of geographical areas where at least 60% of the country's population resides
* Coverage of 60% of national[[10]](#footnote-10)highways and motorways
* Coverage of 60% of the rail networks Athens-Patra and Athens-Thessaloniki
* Coverage with a maximum delay (one-way latency) of ten milliseconds (10ms) between the terminal and the corresponding base station, 95% of the major Greek national motorways
* Athens – Thessaloniki –Evzonoi motorway
* Central Peloponnese (Moreas) motorway
* Olympia Odos
* Ionia Odos
* Egnatia Odos
* Central Greece motorway
* Attiki Odos
* Northern Crete motorway

within six (6) years from the entry into force of the right:

* Coverage of geographical areas where at least 90% of the country's population resides
* Coverage of 90% of national highways[[11]](#footnote-11) and motorways[[12]](#footnote-12)
* Coverage of 90% of the rail networks Athens-Patra and Athens-Thessaloniki

In addition, the Hellenic Telecommunications and Post Commission (EETT) has set the obligation, within five (5) years from the entry into force of the right, using all radio frequency bands which each provider holds, for the provision of broadband services of at least 100 Mbps nominal bitrate to cover 95% of the population living in the municipalities where mobile broadband coverage has not reached 95% of population yet.

**3400 – 3800 MHz band**

For the provision of voice and data services, using all radio frequency bands which each provider holds, within three (3) years from the entry into force of the right:

* Radio coverage of at least 20% of the country's population and network development in at least two (2) administrative districts of the country,
* Obligation to install at least three hundred (300) base stations within five (5) years from the entry into force of the right.
* Provision of broadband services with nominal transmission rate of at least 100 Mbps in downlink with a maximum delay (one-way latency) between the terminal and the corresponding base station of ten milliseconds (10ms), using all the frequency bands on which each operator holds the right:
* within three (3) years from the entry into force of the right, to cover 60% of the major Greek national motorways
* Athens – Thessaloniki –Evzonoi motorway
* Central Peloponnese (Moreas) motorway
* Olympia Odos
* Ionia Odos
* Egnatia Odos
* Central Greece motorway
* Attiki Odos
* Northern Crete motorway
* within six (6) years from the entry into force of the right, to cover 95% of the abovementioned major Greek national motorways
1. <https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/abouttent.htm>, <https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/maps_upload/annexes/annex1/Annex%20I%20-%20VOL%2023.pdf> [↑](#footnote-ref-1)
2. Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe [↑](#footnote-ref-2)
3. COUNCIL RECOMMENDATION of 20 July 2020 on the 2020 National Reform Programme of Greece and delivering a Council opinion on the 2020 Stability Programme of Greece, (2020/C 282/08) [↑](#footnote-ref-3)
4. Road traffic accidents: year 2018, ELSTAT, January 2020 [↑](#footnote-ref-4)
5. 5G Americas White Paper: Cellular V2X Communications Towards 5G, 2018 [↑](#footnote-ref-5)
6. Mackenzie, Don Wadud, Zia and Leiby, Paul, “A first order estimate of energy impacts of automated vehicles in the United States [↑](#footnote-ref-6)
7. Motorways of Greece subject to 2015’s ministerial decision(Official Gazette 253/ΑΑΠ, 2015) [↑](#footnote-ref-7)
8. Official Gazette 2631/τ. Β'/2008, Coding and numbering of Greek Trans European Road Network [↑](#footnote-ref-8)
9. List of national roads (Official Gazette 319/τ. Β'/1963) & list of additional national roads(http://dlib.statistics.gr/Book/GRESYE\_02\_2007\_00001.pdf) [↑](#footnote-ref-9)
10. List of national roads (Official Gazette 319/τ. Β'/1963) & list of additional national roads(http://dlib.statistics.gr/Book/GRESYE\_02\_2007\_00001.pdf)

Motorways of Greece subject to 2015’s ministerial decision(Official Gazette 253/ΑΑΠ, 2015) [↑](#footnote-ref-10)
11. List of national roads (Official Gazette 319/τ. Β'/1963) & list of additional national roads (http://dlib.statistics.gr/Book/GRESYE\_02\_2007\_00001.pdf) [↑](#footnote-ref-11)
12. Motorways of Greece subject to 2015’s ministerial decision(Official Gazette 253/ΑΑΠ, 2015) [↑](#footnote-ref-12)