Recommendations for 5G enabled innovation development

Results from 1st 5G Policymakers' hackathon

2020

Contents

Executive Summary

The 5th generation mobile network (5G) is one of the technology breakthroughs that has the potential to create new industries, impact existing ones and change the way we live. Some of the technologies that will be enabled by 5G include: AI-controlled robots, distant surgical manipulations, autonomous trucks, smart cities, and many more. 5G is predicted to contribute $13.2 trillion to the global economy by 2035.[1]

Currently, there are approximately 50 commercial 5G network deployments in 27 countries. An additional 328 operators across 109 countries have said they are investing in 5G.[2]

While the 5G development and readiness is in high level, to enable the technologies which will use 5G networks, we still need to solve many connected issues related to policymaking (legislation, ethical principles, data protection, flexibility etc.).

To address these issues and to create a platform where country policies can be aligned among all Baltic Sea Region countries, the Ministry of Economics together with Electronic Communications Office of Latvia and with the support of Nordic Council of Ministers' Office in Latvia, European Commission Representation in Latvia and Latvian Mobile Telephone decided to organize the first 5G Policymakers' hackathon on 26th-27th of November 2019.

The 1st 5G policymakers' hackathon had two main goals:

1) To test the concept of policymakers' hackathon as a tool for better, faster policymaking process in Baltic Sea Region level, where the gap between innovation speed of public and private sector is reduced, as it simulates regulatory sandbox.
2) To create recommendations for the European Commission's and Baltic Sea Region policymakers to address current and future problems of 5G enabled innovations in Europe and Baltic Sea Region.

The hackathon gathered the policymakers, tech company representatives, lawyers and mobile data operators form Baltic Sea Region, to collaboratively think of how to enable: Cross border travel of autonomous cars & trucks; Cross border travel of unmanned aerial vehicles; Data in a smart city and Accident resolution.

The participants where split in teams using specific methodology to address the previously mentioned and point out how the European Commission and Baltic Sea Region countries should focus in terms of regulations, directives and investments.

Each team created a specific solution for one problem situation withing each vertical.

In terms of data in smart city: one of the teams pointed out that there is a need for innovation zones for smart city solution testing and provided guidelines of how they see they could be implemented. The second team which addressed the data issues worked on the solution where the local governments should create individual data sharing platforms, giving licenses for companies to receive specific data and for specific usage to create new businesses.

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[1] O'Halloran D., *What you need to know about 5G*, https://www.weforum.org/agenda/2019/12/what-you-need-to-know-about-5g/
[2] https://www.weforum.org/agenda/2019/12/what-you-need-to-know-about-5g/

In terms of accident resolution, the focus was on how to address the liability issue on the European Union(EU) level, and how to manage the data of autonomous or semi-autonomous vehicles. The team provided a data management solution which would use 5G and black box to safely manage the data.

In terms of cross border travel of autonomous cars & trucks, the team focused on how to enable tele-operated unmanned trucks and pointed out what needs to be addressed in terms of legislation and with investments to enable these trucks.

In terms of cross border travel of unmanned aerial vehicles, the team pointed out the need for common UTM(unmanned aircraft system traffic management) platform which would be closely integrated with ATM(Air Traffic Management system) and the need for government to support for UAV(unmanned aerial vehicle) tests to create and prove business cases.

The key conclusions from the hackathon suggests, that even though European Commission is creating solutions(like PSI Directive, European Network of U-space Demonstrators, and more) that tackle the problems that currently and in the future will delay the development of 5G enabled technologies, there are other ways how to solve these problems or to generate the ideas. The European Commission and Baltic Sea Region countries should continue and strengthen the collaboration between countries, projects and legislation to become the frontrunners in 5G enabled technologies.

Additionally, the 1st 5G Policymakers' hackathon proved that the concept of policymakers' hackathon is a necessary tool for a better policymaking, as the gap between innovation speed of public and private sector is reduced, thus simulating regulatory sandbox environment.

The key learning for improvement of the methodology of policymakers' hackathon, would be to focus on more specific legislative problems, thus creating more specific solutions for current and future problem situations.

The policymakers' hackathons should be used on local and regional level, to address current policy problems related to different problem situations.

1. Introduction

The 5th generation mobile network (5G) is one of the technology breakthroughs that has the potential to create new industries, impact existing ones and change the way we live. Some of the technologies that will be enabled by 5G include: Artificial Intelligence (AI)-controlled robots, distant surgical manipulations, autonomous trucks, smart cities, and many more. 5G is predicted to contribute $13.2 trillion to the global economy by 2035. [3]

5G will create the possibilities to address many of the current European Union (EU) issues like climate change and aging population. And the possibilities are unimaginable.

The spring of 2019 marked the start for commercially available 5G services. In South Korea, USA and several other countries the first commercial 5G networks have already been rolled out. The Nordic and Baltic region will, along with other countries in Europe, debut commercial 5G during 2019-2020, with subsequent rollouts over the coming years.[4]

European Commission admits that 5G will be one of the most critical building blocks of our digital economy and society in the next decade and Europe has taken significant steps to lead global developments towards this strategic technology.[5]

5G will provide virtually ubiquitous, ultra-high bandwidth, and low latency "connectivity" not only to individual users but also to connected objects. Therefore, it is expected that the future 5G infrastructure will serve a wide range of applications and sectors including professional uses (e.g. Connected Automated Mobility, eHealth, energy management, possibly safety applications, etc). 5G will also be the "eyes and ears" of Artificial Intelligence systems as it will provide real-time data collection and analysis. At the same time, it will bring the "cloud" to a new dimension by enabling the distribution of computing and storage throughout the infrastructure (edge cloud, mobile edge computing).[6]

But exactly how the current regulations are coping with the evolution of the technology? Are the industry and public sector moving in the same speed, to create an environment where regulations work hand in hand with businesses to protect the public in ways that also stimulate economic growth and foster innovation? Does industry understand the policymakers? Do policymakers understand the technologies?

To understand the current situation, challenges and point out possible solutions of how to enable the new technologies which will operate in 5G network, Ministry of Economics of the Republic of Latvia together with Electronic Communications Office of Latvia and with the support of Nordic Council of Ministers' Office in Latvia and European Commission Representation in Latvia, decided to try to answer these questions by organizing an innovative hackathon.

The organizers decided to create the 1st 5G policymakers' hackathon, where policymakers, tech company representatives, lawyers and mobile data operators

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[3] O'Halloran D., *What you need to know about 5G*, https://www.weforum.org/agenda/2019/12/what-you-need-to-know-about-5g/

[4] Målberg S., Edström A., *Cross-sectorial mapping of 5G testbeds,* 2019

[5] European Comission, *Towards 5G*, https://ec.europa.eu/digital-single-market/en/towards-5g

[6] Ibid.

would come together and assess the current problems and generate solutions for some of the 5G enabled problem situations: cross border travel of autonomous vehicles, cross border travel of unmanned autonomous vehicles, data management in a smart city and accident resolution.

The hackathon was an official side event of the 5G Techritory, the Baltic Sea Region 5G Ecosystem Forum. The main objective of the 5G Techritory is to team up for coordinated action to continue the development of a new open platform for the Baltic Sea Region to promote a sustainable 5G ecosystem in order to establish the region as a role model for building the European Gigabit society. [7]

Additionally, the hackathon aimed to increase the cooperation of Baltic Sea Region countries in terms of 5G infrastructure and policy development, to create and benefit from the 150 million citizen collaboration.

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[7] 5G Techritory, https://www.5gtechritory.com/story

2. Methodology

The 1ˢᵗ 5G policymakers' hackathon was an event where expert teams participated in a continuous problem-solving marathon(hackathon) from 9:00 till 20:30 on November 26 and from 9:00 till 17:30 on November 27. The hackathon format allows to most effectively address particular issues and in the 1st 5G Policymaker's Hackathon the hackathon format was used to address policy issues that blocks the usage of 5G technology to its fullest.

The main objective of the hackathon was to create regulatory recommendations for smoother 5G deployment and innovation implementation in the Baltic Sea Region countries, which will serve as ideal policy and will steer all the countries' policies in a unified direction.

The participants where hand-picked and cover all stakeholders – startups/companies, mobile operators, multinational companies from various sectors and policymakers from the Baltic Sea region. Mentors with a deeper understanding of technology or the way legal changes are implemented on a technical level, also took a part in the hackathon.

The format of the event was a hackathon: a design sprint-like event in which professionals are involved in development of solutions for defined or potential challenges. The goal of a hackathon is to create usable list of solutions with the aim of creating „a functioning product", in this case, practical policy making recommendations. The participants worked in teams and represented involved range of partners to develop solutions for defined or potential challenges, in this case, policy.

Each team "hacked" one problem situation and advised other teams by pointing out "bugs" in their solutions. The process was based on regular hackathon methodology: team sessions, presentations, feedback gathering from other teams, mentors and organizers.

The hackathon started with welcoming speeches and introduction from the organizers. Later the team members started to work together and tried to defy the problem, stakeholders and the goal of their team's problem situation. After that, teams started to work to formulate possible solutions and presented them to other teams for feedback. The first day ended with work on expanding one of the possible solutions and going through other team ideas, to point out the "bugs" in their solutions.

The second day started by presenting the "bugs" to each team, and work on fixing the bugs. After that, teams worked on finalizing their ideas and creating final presentations and deliverables.

5 teams took part in the event and they focused on 4 different problem situations:

•Cross border travel of autonomous cars & trucks

Description: Logistics and cargo transportations will be one of the first industries transformed by 5G enabled solutions like platooning and autonomous trucks. Cross border traveling of these trucks will pose new challenges, particularly, in cross-border safety regulations and transfer of cargo documentation.

•Cross border travel of unmanned aerial vehicles

Description: UAVs are fast growing field. With advances of 5G coverage UAVs will be able to carry out tasks on their own and also go across the borders. Existing regulation is limiting UAV's to being in eyesight of an operator. 5G will not only enable for UAVs to become autonomous but also ability to launch swarm of UAVs to carry out tasks like monitoring, search and rescue operations and small package delivery.

•Data in a smart city

Description: Smart cities are driven by data. Being able to adapt traffic lights, dispatch additional cleaning units to particular part of the city, monitor flow of people to understand weak spots in infrastructure, regulate last mile UAV delivery fleets. By working with different vendors city has to be able to control who is doing what (governing function) and also share this information with different parties like location of different delivery UAVs to avoid collisions (information hub function). Essentially smart city becomes a platform which gathers and shares the data. The same applies to smaller entities like ports, airports. How data are regulated and what are the needs in the context of 5G?

•Accident resolution

Description: 5G will connect technologies which will take care of some mission critical jobs from humans like driving, cargo handling, street cleaning and real-time monitoring. If things don't work well, there can be human fatalities. Autonomous cars can crash, UAVs break, algorithms have edge cases. Now behind every mission critical task there is human with share of responsibility. Who is responsible when autonomous car crashes – driver, car producer, developer of the algorithm? Or maybe there have been glitches in infrastructure which resulted in connection loss which lead to crash.

3. The Results of the 1st 5G Policymakers' hackathon
3.1. Innovation zones for smart city solution testing

The team

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The challenge

It is common, that innovative solutions need to be tested to prove the safety and benefits of the innovative solution. In some industries it is easy to test innovation, in others it is almost impossible.

For many smart city solutions it is necessary that the solutions are being tested in real-life testing environment, to prove that it is safe and to show the benefits of it(which is especially important in the case of public procurement). Unfortunately, the absence of real-life testing environments are one of the biggest (if not the biggest) challenges for innovative smart city solution creation, thus not allowing the local economies to use their full economical, ecological and social potential.

Smart city solutions address many social and economic issues, by helping the citizens of city, companies or municipalities to use smarter solutions, which save time, money, are more environmentally friendly or create new economic opportunities. Without a real-life testing environment, the time to market (commercialization speed) is increased and the solutions lose the competitiveness and society loses the benefits of innovative solutions.

For example, smart mobility solutions could address the growing issues of urbanisation and the decrease of traffic congestions. For example, in 2015 the road congestion costs for EU was 100 billion euros. [8]

Currently, the smart city solution creators and testers need to get permits from municipality, and the problem is that each municipality has their own procedure how to give the permission, thus slowing down the process for testing, as the procedures are not clear and aligned. Additionally, to test smart city solutions, it is rarely that one institution needs to grant permission, usually there is a need to get permission from many institutions.

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[8] *EUROPEANMOBILITYWEEK 2016: Sustainable transport is an investment for Europe* https://ec.europa.eu/transport/media/news/2016-09-16-european-mobility-week_en

Many institutions, agencies, departments don't know themselves how to allow the testing of innovative solutions in the cities, and the result depends on the institutions representatives' interests and initiatives to solve this problem.

While big companies have the capacity to work with governments, municipalities and agencies responsible, the SMEs, academia and others in most occasions do not have the capacity. As SMEs account for 99% of all businesses in Europe, this results in unused potential, which could be attained by better legislation and more understandable processes for innovation testing. [9]

Also innovative procurement procedure needs to be improved to create a bigger demand for smart city solutions from the public sector thus addressing the social, economical and ecological problems that cities faces.

The solution

There are few solutions for this problem, but the most promising is the creation of economic and regulatory framework for innovation zones.

Currently, the smart city solution testing is mostly happening in 3 ways: 1) Individual agreements between the city and companies(time consuming); 2) Municipality testbeds – places where municipalities test different solutions, to identify the best one, to scale it in the whole municipality(the solutions that are being tested are already being used somewhere and are not really classified as innovative solutions); 3) Living labs – places where municipalities and companies test innovative solutions(but this solution still happens on project base and needs official approves for each test that company or academia what to test).

There is a need for a solution that would allow easier approval process for smart city solution testing which could also make it easier for SMEs and academia to apply.

The team suggests that there is need for innovation zones, areas withing cities where smart city solutions can be tested by the municipalities, SMEs and academia. These zones should be included in relevant legislations and the economic and regulatory framework for innovation zones should stipulate:

The economic and regulatory framework for innovation zones should stipulate:

- easier permit process for new solution deployment;
- process for getting permits and safety rules for all included parties are provided in one place and easy manner;
- more flexible legislation (could allow exceptions for testing purposes);
- easier data management rules(if necessary, but under supervision);
- funding for:
    - creation of necessary infrastructure;
    - innovation zone's management;
    - new initiatives with public interests;
- criteria for innovation zone creation/marking;
- harmonization with EU/international rules and regulations, and provide a possibility to give feedback for the creators for the regulations;
- providing more open data from public infrastructure.

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[9] *What is an SME?* https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

The procedure for implementing innovation zones could be the following:

1. <u>creation of national legislation that:</u>

   a) includes definition of innovation zones [e.g., in Latvia Start-up law];

   b) delegates the government to create innovation zone operational principles;

   c) enables private or communal (e.g., municipality) network;

2. <u>Creation of government regulation that:</u>

   a) delegates the municipalities to manage innovation zones;

   b) allocates financial resources and schemes for innovation zone management, infrastructure maintenance etc;

   c) stipulates the role (power) of NGOs, companies service providers involved in innovation zone;

   d) stipulates basic criteria for innovation areas;

3. <u>Municipality legislation that:</u>

   a) mark exact innovation zone territories, incl. suitability check;

   b) stipulates guidance on main topics (industries) to be facilitated in the zones, if necessary;

   c) stipulates public safety requirements in innovation zones;

   d) stipulates incentives for sharing data between the companies & public sector, if necessary;

   e) stipulate the governance system and innovation assessment system;

   f) describes the procedure to make impact assessment after innovation process;

The initiators for this process should be Ministry of Economy (or Ministry of Innovation for some countries) or other ministry depending on the particular type of focus for each country.

The roadmap of the implementation would be the following:

- within 6 months, Ministry of Economics(depending on country) initiates the process by creating a white paper of the framework of agreements, experiments, safety etc;
- within 12 months, the best cases are presented to EU and EU level guidelines for innovation zones are created;
- within 3 years, every country has an operation innovation zone, which enabled companies to test their smart city.

3.2. Accident resolution

The team

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The challenge

5G will connect technologies which will take care of some mission critical jobs from humans like driving, cargo handling, street cleaning and real-time monitoring. If things don't work well, there can be human fatalities. Autonomous cars can crash, UAVs break, algorithms have edge cases. Now behind every mission critical task there is human with share of responsibility. Who is responsible when autonomous car crashes – driver, car producer, developer of the algorithm? Or maybe there have been glitches in infrastructure which resulted in connection loss which lead to crash.

Current local laws of civil liability in EU countries don't fit to current technological environment, since in each country different civil liability principles exist(e.g. in EU vehicle concrete driver's liability is insured in case of CMTPL, while in remaining EU vehicle holder's liability). With involvement of other stakeholders, the liability concept gets much more complex, since accidents can be cause not only due to fault of traffic participants, but also due to fault in network or due to fault of manufacturer, thus principle that vehicle driver/holder should be liable for any accident becomes ill fitted.

Without addressing this issue, we are slowing down the process of technological development, as none of the involved parties are protected in case of accident. We are in need of civil liability laws that address the technological situation of the 21st century.

The solution of this challenge would have:

Economic impact. Solving the accident resolution problem, would enable faster, safer, commercially feasible usage of 5G enabled technology for business purposes, which would result in economic growth. It has been estimated that if half of the time we spend on the roads could be spent working, for example dealing with mails, an extra one billion euro added value would be created every day.[10]

Social impact. Autonomous technology is hard to comprehend for people. This results in fear and unwillingness to accept autonomous vehicle usage in public spaces. By creating a framework which would protect all involved parties, people would accept

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[10] Tschiesner A., *How cities can benefit from automated driving*, https://www.bosch.com/stories/economic-impact-of-self-driving-cars/

the technology faster. Additionally, autonomous vehicles will connect people better, by helping all social groups to travel faster, safer and cheaper.[11]

Ecological impact. Connected and autonomous vehicles will be more environmentally friendly, as they will use data to calculate routes and mobility that will decrease the congestion and save energy.[12]

Cultural impact. Autonomous vehicles and other 5G enabled technology will change the cities, commuters and possibly ways of how we use these vehicles.

On the other hand, if a solution is not found, it could result in slow deployment of autonomous technologies, or even restrictions of their usage in some countries, thus not enabling the countries to use the full economic, social, ecological, cultural benefits that 5G enabled autonomous technologies would provide.

To use all the benefits of 5G enabled autonomous technologies, accident resolution framework and regulation is necessary. Industry needs a solution which is:

- fast (currently investigation for accident involving autonomous vehicles takes 1-2 years on average);
- supports the implementations for technologies, without unreasonable liabilities;
- avoid increasing pressure to court system.

Involved parties include:

- vehicle driver or in some cases of fully self-driving cars operator;
- vehicle owner (responsibility to ensure that the car is secure);
- manufacturer or later Mobile accessibility as a service;
- repair shops;
- 5G operators;
- road infrastructure operator;
- aftermarket reseller;
- technical inspection;
- other traffic participants;
- insurer;
- ministry of transportation;
- Road Traffic Safety Directorate (or alternative organization).

The solution

The solution will not be simple, because many aspects should be considered.

From data collection perspective it is necessary, that:

1. a virtual black box is implemented in the edge (5G Node, to have a decentralized solution to mitigate privacy and cyber security risks;
2. data is maintained by all 5G operators(it is their obligation), while requiring that state should facilitate accessibility to road infrastructure to install 5G cells;

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[11] European Parliament, *Self-driving cars in the EU: from science fiction to reality*, https://www.europarl.europa.eu/news/en/headlines/economy/20190110STO23102/self-driving-cars-in-the-eu-from-science-fiction-to-reality

[12] Teffer P., *How the EU commission got tunnel vision on self-driving cars*, https://euobserver.com/science/143367

3. manufacturers or service providers(all stakeholders involved, include road infrastructure providers) are obligated to submit data copy to decentralized environment;
4. a system for law enforcement authorities and insurers or other clearly defined stakeholders is created, so they can access data and define accessible volume;
5. a technical standard is created explaining which data have to be submitted to virtual Blackbox, to ensure that source data are processed, and processed data are transferred (to ensure technical interoperability, unified interpretation and limit volume of data);
6. a requirement is created for the manufacturer to fix that accident has occurred (which are defined) that source data should be sent to black box in case of accident and define period for which data should be collected;
7. it is ensured that virtual black box in case of notification on accident, requires source data form other metadata;
8. road situation awareness should be improved by the traffic safety institution using the data from the traffic participants.

From liability perspective it is necessary, that:
1. there is a common EU regulation, instead of directive to ensure high certainty and clear rules;
2. new principles on liability division are set, instead of deciding on one sole person being liable, having possibility to have shared liability;
3. there is a new set of liability for special solutions for caravan driving and other semi-automated solutions;
4. an AI tool is created which based on data fed in black box, makes fast preliminary decision on liability division between vehicle drivers, manufacturers, road maintainer. Presumed that this decision is enforceable and correct until challenged and proven by other evidence;
5. a system is created in which insurer of vehicle has to pay indemnity based on decision provided with assistance of AI, which human has to validate. Such decision can be challenged in competent body;
6. a system is created for black box to receive enough information so it could determine liability share for driver, vehicle manufacturer, vehicle maintainer, 5G service provider, road maintainer, technical inspection, other traffic participants;
7. a system is created where the administrative and criminal liability can be based on decisions based on AI.

From unified technical standard perspective, it is necessary, that:
1. EU regulation is created which establishes clear rules, what are requirements for autonomous cars to participate in traffic (e.g. need to have common security standards how secure systems should be);
2. a unified technical standard is created that defines when liability shifts from driver to manufacturer/service provider etc in case of accident caused by vehicle;
3. a unified technical standard is created that is applied for aftermarket cars or any vehicles after their guarantee has expired which ensures that vehicle continues to comply with technical standard. If vehicle cease to comply, it should be

treated as regular vehicle and all liability lies on the driver, if possible. If it is not feasible, vehicle is banned from traffic.
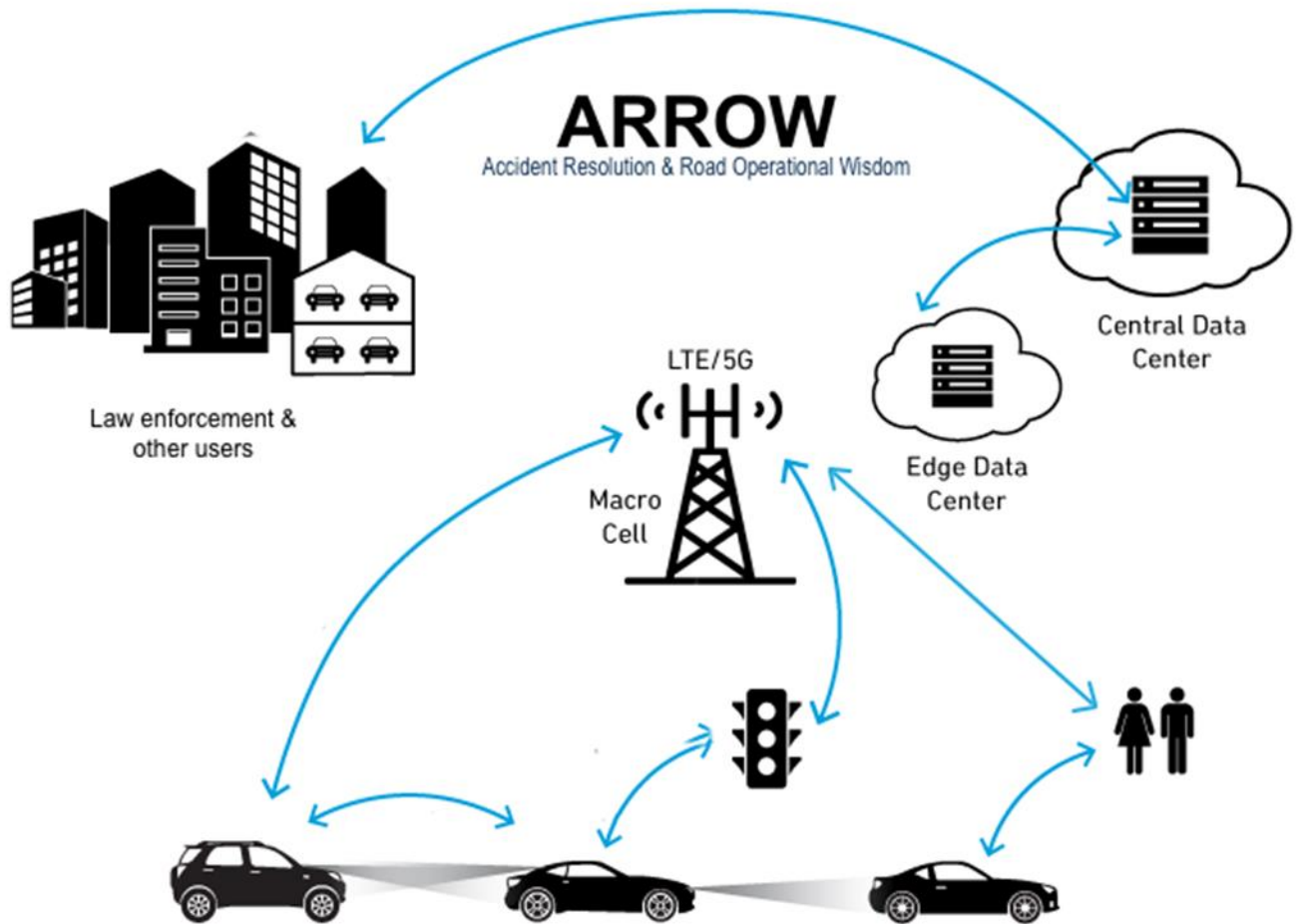
Visualisation of the solution from the technological and data transfer perspective

3.3. Cross border travel of autonomous cars & trucks

The team

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The challenge

5G is expected to significantly progress the performance of autonomous vehicles by providing real-time connectivity and flexible mobile network services addressing automated mobility needs everywhere. However, the seamless provision of connectivity and the uninterrupted delivery of services along borders also poses interesting technical challenges. The situation is particularly challenging given the multi-country, multi-operator, multi-telco-vendor, and multi-vehicle-OEM scenario of any cross-border layout.[13][14]

With the 5G Action Plan for Europe (5GAP), the EU aims at achieving 5G deployment along the main transport corridors in the EU, with appropriate 5G coverage for autonomous vehicles in all Member States by 2025.[15]

There are many reasons why the development of cross border travel of autonomous cars and trucks are important. One of the reasons is the impact on economical growth. Currently in EU, road transport accounts of 76.7% of total inland freight transport (expressed in tonne-kilometres). This means, that by creating a good environment for autonomous trucks and cars, EU's economy would increase dramatically. Autonomous trucks will bring down the costs about 4 times, while increase the distance driven in a day by 2.5 times. This means faster and cheaper mobility of goods and services.[16][17]

The problem is that the development of level 3-4 automation truck (and car) environment in Baltic Sea region and in Europe is not that fast as it could be.

Usually, the autonomous driving environment is evaluated by four categories: policy and legislation, technology and innovation, infrastructure and consumer acceptance.

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[13] Connected automated driving, *Launch of three 5G Corridor trial projects,* https://connectedautomateddriving.eu/mediaroom/launch-of-three-5g-corridor-trial-projects/

[14] 5GCroCo, *5G Cross Border Control,* https://5gcroco.eu/

[15] Fischer F., *5G for cross-border and urban connected and automated mobility,* https://www.eurescom.eu/news-and-events/eurescommessage/eurescom-message-winter-2019/5g-for-cross-border-and-urban-connected-and-automated-mobility.html

[16] Eurostat, *Modal split of freight transport, % in total inland freight tonne-km,* https://ec.europa.eu/eurostat/databrowser/view/t2020_rk320/default/table?lang=en

[17] Wang B., *Economic Impact of Self-driving Trucks,* https://www.nextbigfuture.com/2019/04/economic-impact-of-self-driving-trucks.html

At the moment, the focus should be to address the issues related to the first step of automatization: truck platooning(semi-automated driving). Truck platooning seems as the first step to move to fully autonomous trucks. Platooning is the middle ground of autonomous and manual trucks, as at least the first truck needs a human driver, which can oversight the whole platoon. The truck platooning increases the amount of cargo delivered by one person.

At the moment truck platooning is not at the level where this technology could be tested and used on public roads, but it should be supported from the policymakers' side to prove the concept, understand the risks better and to make this concept socially acceptable.

Currently, most policymakers understand the concept of truck platooning and there are developments from public sector and industry side within the EU roadmap of truck platooning. That is why the hackathon team decided to focus on issues that will come later in the process of full automation: semi-autonomous tucks, which will be mainly autonomous, but with remote human interference and supervision using 5G networks and infrastructure.[18]

Currently, all focus should be on technology and infrastructure. European countries should develop policy and legislation, infrastructure that enables creation and testing of different level autonomous trucks and cars, including platooning.

The team decided to focus on infrastructure(connectivity) issues, as European countries approaches are fragmented and that is slowing down the progress of cross border travel of autonomous trucks. Good news is that many countries are addressing this issue. For example, in Baltic States with *Via Baltica* digital corridor.[19]

But by enabling cross border travel of (semi or fully) autonomous cars and trucks, it could create many economic, social, ecological and cultural benefits.

Economic impact. As it is with accident resolution, the solution for issues related to cross border travel of autonomous cars and trucks, would enable faster, safer, commercially feasible usage of 5G enabled technology for business purposes, which would result in economic growth. Fields like logistics would be the most impacted by the solution of the current cross border travel issues as autonomous trucks will bring down the costs about 4 times, while increase the distance driven in a day by 2.5 times. This means faster and cheaper mobility of goods and services[20].

Social impact. Cross border travel of autonomous trucks and vehicles will bring the societies closer together. It will be easier, safer and cheaper to travel and to share goods.

Ecological impact. Connected and autonomous vehicles will be more environmentally friendly, as they will use data to calculate routes and mobility that will decrease the congestion and save energy.[21]

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[18] Connected automated driving, *ACEA released EU Roadmap for Truck Platooning,* https://connectedautomateddriving.eu/mediaroom/acea-released-eu-roadmap-truck-platooning/

[19] 5G Techritory, *The Digital Baltic Road memorandum will accelerate the deployment of 5G mobile communications network in the Baltics,* https://www.5gtechritory.com/2018news/the-digital-baltic-road-memorandum-will-accelerate-the-deployment-of-5g-mobile-communications-network-in-the-baltics

[20] Wang B., *Economic Impact of Self-driving Trucks,* https://www.nextbigfuture.com/2019/04/economic-impact-of-self-driving-trucks.html

[21] Teffer P., *How the EU commission got tunnel vision on self-driving cars,* https://euobserver.com/science/143367

<u>Cultural impact:</u> The development of cross-border travel of autonomous trucks will enable people to travel more and to share their culture wider, with products or services.

The solution

As many of the challenges faced on the road have unique, tail-style properties, it's unrealistic to expect autonomous vehicles to be able to handle 100% of all the situations they will encounter. Consequently, the deployment of fully autonomous vehicles at scale doesn't seem to be possible without the ability for a human operator to remotely take over the vehicle with a robust and safe tele-operation solution.

Obviously, fully unmanned vehicles (but tele-operated) would also have the same requirement for safety and robustness. While existing tele-operation solution work on 4G, they cannot provide the necessary guarantees in terms of safety and robustness. The low latency, high bandwidth and QoS properties of the 5G network seem to be providing the building blocks for such safe and robust solutions.

To enable the process of tele-operated unmanned truck development, several things need to be addressed beforehand:

- creation of policy requirements for robust tele operation as a prerequisite for legal use on the public roads across the EU will foster and nurture the nascent autonomous vehicles industry with the EU. Additionally, there should be EU level regulations or directive that address safety issues that should be aligned across Europe: planning of routes and border crossing in general; cyber incidents; mandatory reaction to and incorrect read of traffic signs; connectivity issues; liability issues;
- while 5G should not be explicitly required by the policy — to not prevent potential other innovative solutions — most actors of the tele-operation domain would naturally opt for the 5G network as the building block and infrastructure layer of their solution. That is why additional support from the EU and countries for 5G infrastructure development is necessary;
- within next years, there will be need to raise awareness among member states on the necessity of harmonized legislation with uniform requirements on safety and road use for autonomous trucks and as well to start lobbying, so all Member states can open their roads and identify, if continuity of the electronic communications services along the main transport routes exist and if road infrastructure should be improved to support autonomous trucks;

To address some aspects of the regulation that is needed for tele-operated trucks, the team proposed some ideas:

<u>Planning of route and border crossing in general:</u>

- centralized official information (national contact point) is needed to be communicated with the vehicle and operator, dealing with: traffic laws, requirements for road use (safety, environmental), road taxes etc.;
- road taxes could be automated;
- information format should be standardized, should be interoperable functional;
- pre-check and authorization that one fulfils the conditions (certificate);

- automation of this should be possible, regularity could be a concern if not automated;
- communication between authorities necessary;

Cyber incidents:

- prevention and road use regulations in terms of security requirements (standards, certification, audits mandatory at regular intervals);
- update checking and audit of this should be mandatory;
- rules on what to do after a suspected event: manual takeover by the driver, if possible. Guidelines of what the consequences on liability and insurance should be in case of cyber incidents;
- mandatory to inform appropriate parties, including police, not only manufacturers;

Mandatory reactions to an incorrect read of a traffic sign:

- driver should take over after warning that something did not read right. Consequences on liability and insurance to be considered;
- the choice or interpretation should always lay on the safest option (60 vs 80: 60 kmph), if not possible then based on liability law;
- mandatory to inform traffic information centre about any incident;

Connectivity issues:

- cooperation between providers is needed to solve connectivity issues at border. Can be dealt with through bilateral agreements or industry self-regulation;
- roaming for cars: non-consumers and non-phones, huge volume, needs further regulation;
- cars/trucks should also be able to work without connection or without being interconnected through the internet, but in another technical manner. Must be mandatory to have this functionality;

Liability issues:

- EU rules on liability of AI, or specifically connected cars/trucks based on ethics principles, who is liable: manufacturer, company writing the software, car itself (own patrimonium);
- if only national rules, may be needed to apply rules of the country of presence;
- additionally, the role of insurance should be changed for this specific situation.

3.4. Cross border travel of unmanned aerial vehicles(UAVs)

The team

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The challenge

Unmanned aerial vehicles, or UAVs, represent a rapidly developing sector of aviation with a great potential to create new jobs and economic growth in the EU. It is estimated that by 2030 UAVs will create 100'000 new jobs and create 30 billion Euro additional value to the economy of EU.[22]

UAVs can perform many tasks that humans can't, tasks that are too risky for humans or UAVs can do it faster. The UAVs are available and will be available to preform many tasks like emergency response; humanitarian aid and disaster relief; conservation monitoring; disease control; weather forecast; waste management; construction planning and many more.[23]

Currently, in most countries, the rules allow only UAV flights in visual sight and it is allowed to fly UAVs in specific places and times.[24]

Current regulation is overly limiting and difficult to be implemented in practice. E.g., operation of UAV flights beyond visual line of sight (BVLOS) are allowed only with specific licenses, which are not easy(time consuming) to get, and when the demand will grow, it will be much harder to create a new solution, thus the challenge should be addressed soon.

While current rules allow to use UAVs in many of the previously mentioned cases, it is possible only if the UAV is controlled by a human, and the flight is in the visual line of sight of the operator (with few exceptions).

To use the full potential of airspace and boost the economy of EU, the Europe should think how to enable small aviation even further. And we need to start thinking about the future where autonomous UAV flights will be a crucial part of our economy and lives.

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[22] Council of the European Union, *Infographic - Ensuring UAV safety: Win-win for EU consumers and economy,* https://www.consilium.europa.eu/en/infographics/UAVs/

[23] CB Insights, *38 Ways UAVs Will Impact Society: From Fighting War To Forecasting Weather, UAVs Change Everything,* https://www.cbinsights.com/research/UAV-impact-society-uav/

[24] UAV Rules, *National Information Sources,* https://UAVrules.eu/en/professional/authorities

Additional to the economic benefits (new business models, faster delivery, new jobs) which further development of UAV environment would provide, it will also have social and ecological benefits.

From social perspective, the further development of UAV environment could integrate people from distant regions into general population at least partially. This could be done by providing faster deliveries to rural areas. UAVs will also provide better safety for citizens, for example, when law enforcement agencies will use them to prevent crime.

From ecological perspective, the wider use of UAV will create many ecological benefits: UAV deliveries will lower the congestion on the roads. UAVs are already being used for detecting pollution in Port of Riga and monitor wildfire.

If the UAV environment for autonomous or BVLOS UAV flights will not be developed by the EU member states, it will likely result in EU purchasing UAV solutions from third countries that have developed them.

The solution

Currently the development of UAV environment and achieving the full potential of airspace to boost the economy of the EU is happening slow, due to many uncertainties regarding safety and commercial factors:

- collision with other objects;
- data and property safety;
- lack of business cases.

It is worth to mentioned, that currently there are many issues that needs be solved before the cross-border travel of UTMs will be actual problem. The first step is to align internal travel of UAVs. That is why in terms of policy and investment development the Baltic Sea Region countries and EU should be addressed on a cross-border level, while the testing, proof-of-concept and proof of business cases should be addressed on a local level.

The team suggested that to use the full potential of airspace and boost the economy of the EU, the Europe will need a complex UTM(unmanned aircraft system traffic management) platform, which will integrate all the information in one place and address the previously mentioned problems. This platform would enable faster development of UAV environment and related business models, while protecting all involved parties.

The involved parties would be aviation agencies, air navigation service providers, law enforcement agencies, telecommunication operators, municipalities, ministries, UAS users, land and infrastructure owners, Data State Inspectorate (or other institution depending on country), hardware and software manufacturers, meteorology centres and others.

The idea of the UTM platform is as all information gatherer and manager. UTM platform would inform all involved parties about UAV flight near them, possible changes, weather forecasts and everything else that is necessary in terms of safety for all involved parties.

UTM usage to address the data and property safety:

For the UAVs to fly safely, they need to use sensors and cameras, to collect and analyse information for their surroundings. From data safety perspective, it is important to know what kind of data is being collected and for what purposes. There have been incidents where UAVs have been used for crime, by collecting information about a specific place before a robbery. With a complex UTM platform, it will be easy for data state inspectorate, law enforcement agencies, citizens, land and infrastructure owners to know, where the UAVs are, and who owns/operates the UAV, thus allowing to provide the transparency of UAV operations. It is important to mention, that if this kind of UTM platform is created, all UAV operators/owners will need to use it. Only then the UTM platform would provide safety. The UTM platform should be easily accessible by app for all citizens. If they will spot a suspicious UAV activity near their property, they could look in the app, who's UAV is it and what kind of purpose it fulfils and inform the law enforcement agencies if necessary.[25]

UTM usage to address UAV collisions with other objects:

Currently UAV usage rules are strict to protect the general aviation. There is reason for it, but the rules should be more flexible, so they would allow wider use of UAVs. For example, one of the common rules is that UAVs cannot be used within a specific distance near the airport. This rule is valid even if there is no aviation traffic in the place where the UAV operator would like to use the UAV.

This could be solved if the UTM platform would link the civil aviation (UAV flights) with Air Traffic Management system which keeps the information about the general aviation. This would allow real time estimation if the UAV could be used in certain territories or if the specific rule is valid at the exact moment (or according to UAV's flight plan).

The development of 5G could play an important role in this, because it will enable faster information update between the UAVs and the UTM platform, thus allowing the UAVs to respond faster to the environment including the Air Traffic Management system.

5G will enable faster communication with all the traffic participants, and with usage of other technological developments, like artificial intelligence (AI), they will much faster spot anomalies and provide quicker response if necessary.

Business cases to create UTM platform:

A creation of European or BSR region wide joint UTM platform, which would integrate all the information previously mentioned, would be expensive and to have the political support, a business cases and clear estimations of the economical impacts are needed.

One of the current roadblocks for the UAV environment development is lack of understanding of the business possibilities, effect on economies and risks.

In terms of risk evaluation, there should be a system of how to evaluate UAV or UAV service safety, so they could be used in places where there could be collision with people or properties. Currently, policymakers don't believe the safety of UAVs, but

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[25] Hicks M*., Criminal intent: FBI details how UAVs are being used for crime,* https://www.techradar.com/news/criminal-intent-fbi-details-how-UAVs-are-being-used-for-crime

industry doesn't know what kind of experiments should be made to prove the safety of the solutions. There is no clear system or process how the proof of concept should be delivered to change the current rules.

The team suggests that to prove the economic impact of UAVs and to evaluate risks, the policymakers should support pilot tests of UAVs (cross country and locally) by creating legislative sandboxes for tests, and possibly create funding to encourage research in this field.

The team pointed out that one of the projects that could benefit from UAV usage, and safe millions of Euros of government money, would be UAV applications in maintenance of railway infrastructure.

As Baltic countries are working on the *RailBaltica*[26] project, which will connect Baltic countries to European railway system, early ideas for UAV usage can be integrated in the project.

For example, currently the railroads are maintained and analysed by humans inspecting certain parts of the railway. This is slow and expensive process. This could be solved by using UAVs with machine vision which would analyse or send the data via 5G networks for analysis and initiate the necessary response.

But this cannot be done, because of the current rules of aviation and the different rules between the countries. For example, to evaluate the whole rail line, the UAV will need to be used in cities.

A complex UTM platform which would be connected or integrated with ATM platform would solve some or most of the previously mentioned problems that are limiting the usage of UTMs.

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[26]*Rail Baltica – Project of the Century,* http://www.railbaltica.org/about-rail-baltica/

3.5. Data management in a smart city

The team

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The challenge

In the EU, the public sector is one of the most data-intensive sectors. Thus, it holds vast amounts of data, known as public sector information (PSI). 'Open' public data are PSI that can be readily and widely accessible and re-used, sometimes under non-restrictive conditions.[27]

Allowing public sector data to be re-used for other purposes, including commercial ones, can:

- stimulate economic growth and spur innovation: public data has significant potential for re-use in new products and services;
- help address societal challenges with the development of innovative solutions such as in healthcare or in transport;
- enhance evidence-based policymaking and increase efficiency in public administrations;
- become a critical asset for the development of new technologies, such as artificial intelligence (AI), which require the processing of vast amounts of high-quality data;
- foster the participation of citizens in political and social life and increase the transparency of government.

Unfortunately, new and complex policies for data management hinders the sharing of data which public institutions have, which results in lack of data-based innovations. The new General Data Protection Regulation (GDPR) is not truly understood by all public institutions, thus not all the data that could be shared is shared.

The public trust should be gained, by creating and promoting good cases where innovation has been created by using public data, which benefits the citizens. So, the challenge is increase the trust of citizens and to enable data-based innovations in an unpredictable multi-stakeholder environment.

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[27] European Comission, *Open data*, https://ec.europa.eu/digital-single-market/en/open-data

The solution

The team points out that they see 3 factors that would help to create new solutions using data:

1) adapting new standards on interoperability. EU wide format, interface and even semantic standards;
2) creation of local (country level) data sharing platform, where 2 types of sharing exists: Voluntary commercial sharing (to improve the business); Obligatory public sharing/PSI. This platform should provide open and closed data (potential user need approval) to allow everyone to see the possibilities of data available and create business models accordingly;
3) Creation of a governance model that would create trust for the public. The model should: monitor use cases & data usage for sustainable development goals; allow the usage of data but maintaining the public trust; provides transparency & correct communication to citizens.

To test this solution, the team decided to hypothetically apply a different data sharing model, to test if it would be possible to create "smarter" trash management system.

The team decided that a good case scenario for data sharing could be proven by creation of an city app, where a citizen can see his utility service usage per month and personalized trends that show the money spent and receiving suggestions from the app on how to be more efficient and save money.

This app would be a part of shared data cooperation platform, a space where a company, by showing a legitimate value proposition, can obtain different data to use for developing new innovative products or optimizing existing ones (possibly by receiving a license), thus increasing the company's competitiveness. Also, for sharing the company's data, the government and municipality is able to offer different incentives, such as tax reliefs or legislative exceptions for different innovative solution testing in urban territories, which is critical for creating innovative products and services for cities.

The municipalities and the government are working for the people and it is expected to meet the expectations of modern citizens and companies. By creating a shared data cooperation platform and a creative, almost gamified, application for the city, municipality with the backing from the government, can make its services more cost and resource efficient as well as giving back a great value for the received data to the citizens and companies alike.

Firstly, it is most necessary to adopt standards, e.g. on interoperability and security for data formats, interfaces/ APIs and even semantics. Policymakers task is to set up and manage a data broker / data sharing platform by starting local – Smart Cities. Reference implementations and standards can help. Gathered and shared data depends on the sector or service – sharing can be voluntary (citizens/ private companies) or obligatory (public sector services).

Each data platform needs a governance model for lightweight monitoring of data usage (including data needs – anonymous/pseudonymous) as well as licensing the companies for receiving specific data. Governance model is set up by the municipality, including the government and sectorial representatives for all around stakeholder involvement and coordinated strategy implementation.

4. Recommendations

Innovation zones for smart city solution testing

- The Baltic Sea Region countries/cities should continue to experiment with the creation of innovation zones and exchange experiences about different concepts of innovation zones or testbeds for smart city solutions. Only by collaboration between cities and governments, the Baltic Sea region can use the potential of the whole region.
- The European Commission should encourage and support the development of innovation zones or test beds for smart city solutions, as many of these solutions would help the countries and EU to achieve economical, social and ecological goals.
- The European Commission should continue and increase the importance and focus of smart city solutions to achieve economical, social and ecological goals.

Accident resolution

- The European Commission (or each country separately) should create an initiative for a common regulation for data management of autonomous vehicle (if possible, also UAVs) solutions. As an example there could be "Arrow" concept, which was created during the hackathon and focuses on fast and safe settlement of liability disputes.
- The European Commission (or each country separately) should create a common regulation for liability, which would ensure high certainty, clear rules and a common approach (as these technologies will bring the countries closer together). Additionally, there should be directives for innovation zones or test beds and information about settlement of liability disputes. Additionally European Commission (and each country separately) should encourage the usage of modern technologies in the public sector, for example, in case of liability, AI could be used to give a preliminary decision of liability and indemnity (assuming, that the AI can get all the data from the accidents of the black box of autonomous technologies). The long-term focus should be of the development of a system where administrative and criminal liability will be based on the decisions based on AI.
- There should be EU wide standard for autonomous vehicles, that includes security standards, data sharing standards, standards for aftermarket cars or any vehicles after their guarantee has expired. If vehicle cease to comply, it should be treated as regular vehicle and all liability lies on the driver, if possible.

Cross border travel of autonomous cars & trucks

- The European Commission needs to create policy requirements for robust tele operation as a prerequisite for legal use on the public roads across the EU will foster and nurture the nascent autonomous vehicles industry with the EU. Additionally, there should be EU level regulations or directives that address safety issues: planning of routes and border crossing in general; cyber incidents; mandatory reaction to and incorrect read of traffic signs; connectivity issues; liability issues.

- As the 5G will probably be the main network for the tele-operated unmanned trucks, the European Commission and the Baltic Sea Region countries should continue the support of road digitalization with 5G networks on cross-border level.
- The European Commission and the Baltic Sea Region countries need to raise awareness among member states on the necessity of harmonized legislation with uniform requirements on safety and road use for autonomous trucks and as well to start lobbying, so all Member states can open their roads and identify, if continuity of the electronic communications services along the main transport routes exist and if road infrastructure should be improved to support autonomous trucks.

Cross border travel of unmanned aerial vehicles (UAVs)

- The European Commission and the Baltic Sea Region countries should continue and improve the support for UAV business case development. The support should be legislative and financial. Without the right environment for proof-of-concept tests, the EU will not be frontrunner in the UAV technology and business model development.
- If wider use of UAVs (manual or autonomous) is a part of EU's future mobility plans, the European Commission should continue the development of unified UTM platform which would be closely integrated with ATM platform to allow safe and predictable UAV flights. In case autonomous UAV flights, an integrated platform between UTM and ATM, is a must.
- The development of 5G networks should also be aligned with the UAV development plans in EU, to enable fast communication between the UTM platform, ATM platform and all involved parties.

Data management in a smart city

- The Baltic Sea Region countries should adopt common standards, e.g. on interoperability and security for data formats, interfaces/ APIs and even semantics. This would allow a common development of innovative services and faster and safer expansion of data driven businesses in the Baltic Sea Region.
- The Baltic Sea Region countries should create individual data sharing platforms where open data and closed data would be shared, and where public institution would be the data broker: giving licenses for companies to receive specific data and for specific usage. This platform would allow the companies and academia to see all the available data sets (on title level) and allow them to ask permission to use them for specific purposes.
- The Baltic Sea Region countries should gain the public trust, by piloting the system by creating small level solutions where data driven innovation has been created, that have helped the public to reduce costs, or to achieve sustainable development goals.

5. Next steps

The 1st 5G Policymakers' hackathon can be perceived as a successful event, where two important things could be considered as the outcome:

1) Recommendations for the European Commission's and Baltic Sea Region policymakers to address current and future problems of 5G innovations in Europe and Baltic Sea Region.
European Commission and Baltic Sea Region countries have the opportunity to tackle the identified problems beforehand and benefit from the market of 5G which is predicted to contribute $13.2 trillion to the global economy by 2035.

2) Proof of concept, that policymaking hackathon is a great tool for collaboration between all stakeholders. The hackathon created an environment which is similar to regularity sandbox, as regulatory institution and private sector can more easily identify the outcomes that please both sides, which is not possible in current environment. This reduces the current gap between the private sector (fast innovator) and public sector (slower innovator).
The policymakers' hackathons should be used on local and regional level, to address current policy problems related to different problem situations.

The next steps for the hackathon include:

1) Sharing the recommendations with responsible departments of European Commission, relevant ministries and public institutions of Baltic Sea Region countries. The recommendations should be used as a suggestive material for shaping the policies, planning funding and making legislative changes related with 5G enabled innovations.

2) The 5G policymakers' hackathons should be considered as a tool, to tackle local challenges for 5G enabled innovations.

3) The 5G policymakers' will be a regular event on a Baltic Sea Region level, to further address the challenges of 5G enabled innovations on a regional level and steer all country policies in the same way. The Baltic Sea Region countries will benefit from common rules and plans, as it would create a market of more than 150 million inhabitants, which would be a significant step to lead global developments towards this strategic technology.

The 2nd 5G Policymakers' hackathon will happen withing 5G Techritory which aims to continue development of an open platform that would help promote a sustainable 5G ecosystem in the Baltic Sea Region in order to establish the region as a role model within the European Gigabit Society.