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According to 5G-SOLUTIONS Quality Assurance Process:
1 month after the Task started: Deliverable outline and structure
3 months before Deliverable’s Due Date: 50% should be complete
2 months before Deliverable’s Due Date: 80% should be complete
1 months before Deliverable’s Due Date: close to 100%. At this stage it sent for review by 2 peer reviewers
Submission month: All required changes by Peer Reviewers have been applied, and goes for final review by the Quality Manager, before submitted
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<th>Description</th>
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<tbody>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>B5G</td>
<td>Beyond 5G</td>
</tr>
<tr>
<td>CJEU</td>
<td>Court of Justice of the European Union</td>
</tr>
<tr>
<td>DoA</td>
<td>Description of Actions</td>
</tr>
<tr>
<td>DPIA</td>
<td>Data Protection Impact Assessment</td>
</tr>
<tr>
<td>DPO</td>
<td>Data Protection Officer</td>
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<tr>
<td>eMBB</td>
<td>enhanced Mobile BroadBand</td>
</tr>
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<td>EAB</td>
<td>External Advisory Board</td>
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<td>EC</td>
<td>European Commission</td>
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<td>EEA</td>
<td>European Economic Area</td>
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<td>EU</td>
<td>European Union</td>
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<td>EPCIS</td>
<td>Electronic Product Code Information Services</td>
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<td>Grant Agreement</td>
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<tr>
<td>GDPR</td>
<td>General Data Protection Regulation – EU 2016/679</td>
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<tr>
<td>GS</td>
<td>Global Standard</td>
</tr>
<tr>
<td>IDE</td>
<td>Integrated Development Environment</td>
</tr>
<tr>
<td>IDEF</td>
<td>Integrated Definition Methods</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>IPSE</td>
<td>IoT Privacy, Security and Safety Supervision Engine</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>KOM</td>
<td>Kick Off Meeting</td>
</tr>
<tr>
<td>KVI</td>
<td>Key Value Indicator</td>
</tr>
<tr>
<td>LL</td>
<td>Living Lab</td>
</tr>
<tr>
<td>mMTC</td>
<td>massive Machine Type Communication</td>
</tr>
<tr>
<td>MS</td>
<td>Milestone</td>
</tr>
<tr>
<td>NDA</td>
<td>Non-Disclosure Agreement</td>
</tr>
<tr>
<td>P</td>
<td>Probability of a Risk</td>
</tr>
<tr>
<td>PM</td>
<td>Project Meeting</td>
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<td>PoC</td>
<td>Proof of Concept</td>
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<td>REP</td>
<td>Research Ethics Protocol</td>
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<td>RI</td>
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<td>Review Meeting</td>
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<td>RTD</td>
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<td>SAT</td>
<td>Social Acceptance of Technology</td>
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<td>SCC</td>
<td>Standard Contractual Clauses</td>
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<td>SCM</td>
<td>Source Code Management</td>
</tr>
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<td>SSH</td>
<td>Social Science and Humanities</td>
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<td>TM</td>
<td>Technical Meeting</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>UML</td>
<td>Unified Modelling Language</td>
</tr>
<tr>
<td>URLLC</td>
<td>Ultra-Reliable Low-Latency Communication</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
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<td>WP</td>
<td>Work Package</td>
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1 Executive Summary

This document identified as D10.4B and entitled “Report on Legal and Ethics Monitoring v2.0” is the result of activities performed in WP10, specifically under Task 10.5 “Legal and Ethics”, during the whole 5G-SOLUTIONS project lifecycle. In order to provide the reader with a self-contained document, the report includes a brief summary of the results described in D10.4A (the first version of the legal and ethics monitoring report).

This report highlights the occurring events during the project lifecycle which had a significant impact on legal and ethics aspects, and reports how effects of these events have been mitigated by adopting the Research Ethics Protocol and addressed with specific countermeasures. These events impacting the legal and ethics framework analysed in D10.4A.

The first version of legal and ethics monitoring report aimed at setting legal and ethics guidelines to drive the 5G-SOLUTIONS partners in their research activity, by establishing and creating awareness about ethics and legal concerns inside the consortium and creating a mindset shared among partners to prevent potential risks by applying a set of common methods and procedures for the project research process.

This final version of the report aims to collect and describe the effectiveness of guidelines and recommendations defined in the Research Ethics Protocol, by documenting occurred events and mitigated impacts. Specifically, after the release of the Research Ethics Protocol, the 5G-SOLUTIONS project has recognised the paramount of the ethics-legal-social dimensions for the implementation and deployment of such a disruptive technology, as 5G promises to be.

For this reason, the project has defined a novel methodology for the assessment of 5G technology and taking into consideration the social acceptance, namely Social Acceptance of Technology (SAT). This methodology has been presented in D1.4B and applied for the evaluation of the four Living Labs and of 5G-SOLUTIONS as a whole in D1.1B and in D7.3C (assessment of Multi Living Labs). These results have shown a positive propensity of the technological solutions to be adopted (i.e. score 73%).

Nevertheless, these results remarked potential room for improvement especially considering some specific ethics-social dimensions. This report describes the results of the in-dept analysis carried out to consider improvements from the ethics-social perspectives and related to 5G-based technology development and deployment.

The results of the project activities flowed into an update corpus of the Research Ethics Protocol to ensure compliance with the current and evolving legal, ethics and social framework. This corpus is extended with countermeasures and policy options, as well as a suggestion for providing EU countries with “Ethics Guidelines for Trustworthy 5G and Beyond”. These guidelines may be based on four ethics-social pillars (i.e. Awareness, Inclusivity, Sustainability and Trust) extending the 6G vision which currently considers three human-centred dimensions (i.e. Inclusion, Trustworthiness and Sustainability).

Ethics and social concerns, with related countermeasures (i.e. policy options), are summarised and presented in annex by using the EC Policy Brief template for external communication (e.g. policy makers).
2 Introduction

As already mentioned in the Executive Summary, this document is related to Task 10.5 “Legal and Ethics” and defines the Research Ethics Protocol to be followed by the partners within the whole lifecycle of the 5G-SOLUTIONS project.

2.1 Mapping Projects’ Outputs

Purpose of this section is to map 5G-SOLUTIONS Grant Agreement commitments, both within the formal Deliverable and Task description, against the project’s respective outputs and work performed.

Table 1: Adherence to 5G-SOLUTIONS GA Deliverable & Tasks Descriptions

<table>
<thead>
<tr>
<th>5G-SOLUTIONS Task</th>
<th>Respective Document Chapter(s)</th>
<th>Justification</th>
</tr>
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<tbody>
<tr>
<td>Management of the project ethics issues based on current EU legal and ethics framework.</td>
<td>Chapter 3</td>
<td>5G-SOLUTIONS established at the beginning of its project lifecycle the Research Ethics Protocol (REP), based on EU legal and ethics background frameworks. This chapter provides the summary of the first version of the REP, defined in D10.4A.</td>
</tr>
<tr>
<td>Monitoring of the project ethics issues based on the analysis of project research activities and identification of potential ethics and legal concerns.</td>
<td>Chapter 3, Chapter 4</td>
<td>During the project lifecycle, a set of relevant events occurred and were managed by adopting the REP, as well as by adopting the Social Acceptance of Technology methodology the consortium was able to identify relevant ethics and social concerns. This chapter describes these events and the enacted countermeasures to mitigate impacts, and the lessons learnt.</td>
</tr>
<tr>
<td>Delivery of the ethics and legal guidelines to drive the partners in their research activity.</td>
<td>Chapter 5</td>
<td>Based on the established REP, the Social Acceptance of Technology assessment and lessons learnt during the whole 5G-SOLUTIONS project lifecycle, this chapter provides the reader with countermeasures and policy options to tackle the potential project ethics, legal and social concerns in future 5G/B5G projects.</td>
</tr>
</tbody>
</table>
2.2 Deliverable Overview and Report Structure

The structure of this document respects the logical flow of the activities carried out on Task10.5, i.e.:

- After a brief introduction outlining the objectives of this deliverable D10.4B, chapter 3 “The Research Ethics Protocol” provides reader with an introductory paragraph on the Research Ethics Protocol established by 5G-SOLUTIONS at the beginning of the project lifecycle. This allows reader to have a self-contained document for all the ethics, regulatory and social concerns faced by the 5G-SOLUTIONS project. Moreover, this chapter reports and analyses the events and activities occurred during the 5G-SOLUTIONS project lifecycle and impacted the ethics and legal dimensions. This section describes the applied countermeasures and the lessons learnt;

- Chapter 4 “Towards an ethically-driven design of 5G technology” provides the benefits derived by the established ethics and legal framework, and its research ethics protocol, allowing the identification of ethics and social concerns, as well as the setup of a new development mindset;

- Chapter 5 “Ethics and social concerns and policy options” provides the final version of countermeasures and policy options for future projects dealing with 5G/B5G;

- The document closes with chapter 6 “Conclusions” by summarizing the results and objectives achieved by the Task10.5 and describing the relevant outcome of the 5G-SOLUTIONS project, i.e. the guidelines, countermeasures, recommendations and policy options.

- After the “References”, reporting the references used for the preparation of this document, four annexes are included. The first three annexes are part of the first version of the Research Ethics Protocol (D10.4A) and have been included in this document only for providing a self-contained Research Ethics Protocol. The last annex is the 5G-SOLUTIONS Policy Brief which, adopting the EC template, resumes the four identified ethics and social concerns and related countermeasures (i.e. policy options).
3 The Research Ethics Protocol

The analysis performed in D10.4A mainly considered the data available at that time, i.e. September 2019. So, it was mostly focused on:

i) definition of the ethics and regulatory framework based on available EU guidelines and regulations;
ii) identification of potential concerns for each Living Lab (LL) based on available description and assumptions.

The EU guidelines and regulations considered for the ethics and regulatory framework are:

4. Ethics in Social Science and Humanities (European Commission, DG Research and Innovation), 2018) [4]
10. Convention No. 108 of the Council of Europe for the Protection of Individuals with regard to Automatic Processing of Personal Data adopted on 28 January 1997, as well as the modernised “Convention 108 +” (April 2019) [10]
12. Directive on security of network and information systems (NIS Directive) (Directive (EU) 2016/1148 [12]) concerning measures for a high common level of security of network and information systems across the Union
13. Cybersecurity Act (Regulation (EU) 2019/881 [13]) of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification, repealing Regulation (EU) No 526/2013
15. European Code of Conduct for Research Integrity of ALLEA (All European Academies) [15].

On top of this background ethics and legal framework, the 5G-SOLUTIONS project defined guidelines, tools and countermeasures to be adopted by the project consortium to ensure ethics and legal compliance (see Figure 1).

For this purpose, the 5G-SOLUTIONS project performed a preliminary assessment, based on available documentation in September 2019 (mostly work-in-progress Living Labs and use cases specifications).
This assessment process identified four concerns (see Table 2) dealing with personal data processing procedures, as specified in the General Data Protection Regulation (GDPR).

### Table 2: Concerns for Living Labs

<table>
<thead>
<tr>
<th>Living Lab</th>
<th>Description</th>
<th>Legal/Ethics Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factories of the Future</td>
<td>This use case will use connected goods and diverse data collection scenarios with regard to industrial data</td>
<td>Industrial data confidentiality</td>
</tr>
<tr>
<td>Smart Energy</td>
<td>This use case will target Demand Side Management (DSM) with the potential access to changes in electricity use by consumers from their normal consumption as well as consumers profiling</td>
<td>Personal data protection and in particular users profiling</td>
</tr>
<tr>
<td>Smart Cities and Ports</td>
<td>This use case will be based on a smart network connecting sensors, machines and citizens to cloud-based internet of things (IoT) applications</td>
<td>Personal data protection and in particular users tracking</td>
</tr>
<tr>
<td>Media &amp; Entertainment</td>
<td>This use case foresaw a number of simultaneous users connected, generating content using cellular technology</td>
<td>Personal data protection and in particular users tracking</td>
</tr>
</tbody>
</table>

### 3.1 Ensuring compliance with safeguards

In order to monitor and ensure the compliance with the established ethics and legal framework, the 5G-SOLUTIONS project defined a set of safeguards, and specifically:

- **Identified an Ethics Panel**, chaired by Legal and Ethics Manager (Carmela Occhipinti from CyberEthics Lab., hereafter “CEL”), and composed by Pat O’Sullivan (from Inlecom, hereafter “ILS”) and Silvia Canale (from Ares2t, hereafter “A2T”);
- **Created a communication channel** for ethics consultancy, accessible via the email 5gsolutions-ethics@llistes.cttc.es;
• **Provided the consortium with appropriate procedures and templates** to ensure regulatory-compliant data treatment and human beings engagement, i.e. information sheet (see Annex 1), consent form (see Annex 2), and non-disclosure agreement (see Annex 3);

• **Organised awareness sessions during the plenary meetings** (i.e. Session in Athens 26-27 November 2019, Online Session 9-10 September 2020) and individual calls, to create awareness on ethics and legal perspectives and provide suggestions to specific requests on doubts from the partner;

• **Provided the consortium with specific modules and ethics/legal disclaimers** to arrange webinars and engage participants (e.g. webinars for Living Labs).

During the project lifecycle, the ethics and legal monitoring was appreciated by the consortium, and this allowed to establish a fruitful and collaborative environment. Indeed, this collaboration was successfully exploited not only for ensuring the ethics and legal concerns, but more and most for deriving benefits within the research activities as it will be explained in the next sections.

### 3.2 External event impacting legal and ethics aspects

#### 3.2.1 The Schrems II and Privacy Shield Invalidity

On **16th of July 2020** a relevant event occurred and impacted the 5G-SOLUTIONS project (and all the EU citizens as well): the Court of Justice of the European Union (“CJEU”) issued a very important judgment directly impacting **personal data transfer from the EU to the US** (Judgment Case C-311/18 - Data protection Commissioner vs Facebook Ireland and Maximillian Schrems – known as “Schrems II”).

This event established the invalidity of the Privacy Shield, i.e. the adequacy of decisions that so far represented the legal ground allowing the transfer of EU personal data to the United States of America (USA). The adequacy of decisions is the first level of data protection mechanism established by the EU Regulatory framework in the Regulation 2016/679 (GDPR). Therefore, its invalidity impacted most of the transfer to and treatment of personal data outside the European Economic Area (EEA), and specifically in the USA. Indeed, it is not infrequent for personal data to be collected from EU citizens and researchers in the EU and then transferred outside the EEA for research and innovation actions. While this is not illegal or problematic *per se*, this data transfer requires the compliance with additional rules and provisions of the GDPR (i.e. chapter V – Transfer of personal data to third countries or international organisations). In a similar situation, a second level of data protection mechanism comes to hand: the **Standard...**
**Contractual Clauses (SCC)** adopted by the EU Commission (art. 46, par.2 lett. C of GDPR). These are agreements drafted by the EU Commission providing requirements and safeguards that cannot be derogated by private parties and that can be filled by EU data exporters willing to transfer personal data outside the EEA to organisations that will then process those personal data.

### 3.2.2 Countermeasures to ensure regulatory compliance

Based on the analysis of the available official documents, CEL informed the Project Coordinator by email on August 3rd, 2020, and the involved partners in the project document management. Indeed, for sharing the documents, the partner ILS provided an instance of Teamwork. Being Teamwork an infrastructure managed by a US headquartered company, ILS promptly triggered an analysis of the data hosts and their location.

On August 4th, 2020, ILS obtained the necessary information: the signed agreement with Teamwork reported European headquarters in Ireland, nevertheless data for all projects are stored in USA servers. In order to ensure the regulatory compliance, ILS enacted the data migration process from USA to EU servers. This migration process was completed on August 21st 2020.

### 3.2.3 Lessons learnt and insights

This event remarked the paramount of transfer of EU personal data to third countries, as well as of privacy and data sovereignty concerns, when EU citizens and researchers deal with needs to collect, store, process and manage their digital data with digital infrastructures, which are mainly available in non-EEA countries (i.e. USA).

CEL, since the July 2020, follows the effects of the Schrems II judgement with great interest, and even if Standard Contractual Clauses (SCC) have been usually considered a solution to the Privacy Shield invalidity, nevertheless a lot of grey areas need to be clarified, as well as the most relevant data protection mechanism is still not available.

Nowadays, the EU and USA are moving towards the definition of new common safeguards to ensure privacy and data protection, but Maximilian Schrems always remarks doubts and analyses new potential actions. Very few projects (especially where ethics and legal concerns are not considered in the research activities), and customers have not awareness and comprehension of the implications of the Court’s decision, that is the risk of being non-compliant.

Moreover, the usefulness of ethics and legal activities were recognised within the 5G-IA initiative, to which the 5G-SOLUTIONS belongs. Specifically, a contribution on “regulatory challenges of data management” is available in the “5G Ecosystems” paper [16] of the 5G IA Vision and Societal Challenges WG.

Therefore, this demonstrates that the presence of an ethics review panel in the EU research projects is strongly necessary; similarly the integration of ethics and regulatory tasks need be recommended, if not even considered mandatories, as of the definition of the proposals. Indeed, respect of ethics and regulatory principles lays the foundation for **responsible research and innovation**, as well as for boosting trustworthiness -a key factor in next generation networks – e.g. 6G.
4 Towards an ethically-driven design of 5G technology

The legal and ethics framework (established in WP10) laid the foundation for a new development mindset, defining an ethics-legal-societal approach used across many other research activities, i.e. the social acceptance of technology (SAT). This approach was initially defined in WP8 (i.e. market assessment) and eventually adopted and extended in the evaluation methodology in WP1 (for the assessment of the Living Labs) and WP7 (for the assessment of the Multi Living Labs).

Therefore, the social acceptance of technology (SAT) become the leitmotif of ethics-legal-societal approach during the whole 5G-SOLUTIONS project lifecycle, and throughout this long pathway, SAT methodology evolved. 5G-SOLUTIONS project is the unique project to have defined and validated 5G technology with a social acceptance model in the 5G-PPP context.

In its initial version (i.e. for market assessment), the SAT was conceived as a model identifying factors of all the three classic acceptance dimensions (i.e. socio-political acceptance, market acceptance and community acceptance), and then fitting with the PESTLE methodology as well. Even if it is recognised the interdependence of the three acceptance dimensions, each of them includes specific stakeholders and concepts. For this reason, while usually only two of these dimensions are adopted for the acceptance analysis, in 5G-SOLUTIONS it has been carried out an analysis of all the dimensions and its characterising factors. This analysis has led to what was called as “The hexagon of social acceptance” (see Figure 5): a model of observation, understanding of the main critical aspects and better evaluation of societal feedback in six fundamental steps, including the main aspects of 5G disruptive technology and its use on a large scale: i.e. Perception, Motivation, Awareness, Trust, Capacity Enabling and Accountability.

After its definition, this model was immediately disseminated through publications [17] [18] and received a lot of interest from the community of researchers. This interest spurred CEL to instantiate and validate its social acceptance model with dry-runs. A collaboration with the Living Lab “Media and Entertainment” allowed to define a process built on top of the legal and ethics framework and characterised by three-step assessments (see Figure 6):

1. **Desktop Analysis** – based on documentation of the use case or living lab to be assessed, and enabling the creation of informative material (i.e. explanatory information for non-experts);
2. **Quantitative Analysis** – performed through stakeholders’ engagement techniques (e.g. focus groups and workshops) and using informative material (e.g. infographics, infosheets and videos). This step enables the identification of concerns and feedback for the development and business processes;
3. **Qualitative Analysis** – performed through submission of identified concerns to experts’ judgement.
The validation of social acceptance model through dry-runs allowed a refinement of the model itself.

4.1 The Social Acceptance of 5G Technology assessment

Social acceptance is a key factor in the integration of disruptive technologies in the society [19]. The SAT (Social Acceptance of Technology) is a methodology that allows to individualise the most relevant elements that influence the social acceptance of a specific technology [20].

Since 5G is a socially disruptive technology, evaluating its social acceptance is extremely important. The 5G-SOLUTIONS project definitely represents a unique experience in the 5G-PPP context addressing societal concerns and considering the societal perspective at the same level of importance such as the technical and the business ones.

This allowed the 5G-SOLUTIONS project to establish a holistic validation approach where technical, societal and business perspectives are intertwined and work together for better identifying concerns, opportunities and improvements. This approach has been documented in a scientific paper [21].
Therefore, applying SAT to 5G is a process that benefits the development of this technology. SAT does not provide an objective analysis of the moral rightfulness of 5G, but it highlights the subjective value perception of stakeholders [20]. In this way, not only it is possible to assess the ethical and social concerns about the technology, but it is also possible to understand which countermeasures are necessary to change the social perceptions of 5G, therefore this analysis provides useful insights for refining the development and improvements of 5G technology (and beyond) towards more acceptable solutions for the benefit of the citizens and the whole society.

Based on the results of the 5G-SOLUTIONS project, where SAT methodology was applied, the following section provides insights about limitations and concerns that emerged in from our activities, as well as potential improvements and “policy options” relevant for the 5G technology area.

These policy options represent the final summary of the assessment process and research activities, based on analysis of (perceived and expected) risks and barriers, concerns, challenges and opportunities.
5 Ethics and social concerns and policy options

When it comes to disruptive technologies, their societal and political implications are often under evaluated. Indeed, disruptive technologies express their disruptiveness not only at the technical, but also at the societal level, and 5G is not an exception to it. Creating awareness on their pervasive transformational power, becomes essential, in order to design political and policy actions able to duly embrace such societal complexity.

<table>
<thead>
<tr>
<th>What is a socially disruptive technology.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5G is considered a socially disruptive technology. When a technology is disruptive, it cannot simply be integrated in the system, but it directly contributes to shaping the system, impacting most of the time also at the level of the societal value system.</td>
</tr>
</tbody>
</table>

The transformational impact of 5G at the societal and value level, and its implication for the political level, cannot be avoided; however, it can be managed, not only to create conditions for a wider acceptability, but also to produce a positive impact on society.

According to the SAT methodology [20], key values connected to ‘social disruptiveness’ are: expected spread of technology; change in the production process; and impact on the sociotechnical system. Multiple sources affirm that these values for 5G are extremely high [30]. 5G is an infrastructure that connects people, objects, services, and information and as such, it contributes to reframing societal relations and strongly transforming the production process. Moreover, in the case of 5G, its strong societal disruptiveness potential also depends on the fact that this technology gets to affects directly the societal value system.

McDermott [31] claims that part of this disruptiveness is due to the ambiguity of the ownership of 5G. The decisional system behind the infrastructural and service level of 5G is partly public and partly private. As a result of this cooperation amongst different actors, 5G is designed according to a combination of different values. Through the pervasiveness of 5G in society and its capacity to change the reality, such values are later transferred back to society, changing the set of values that underpin and circulate in society.

<table>
<thead>
<tr>
<th>Ethics and societal implications of data and information sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5G brings at another level the possibility of sharing data and information, factors at the basis of the transformation that led to the digital era. In particular, thanks to its low latency (the delay before a transfer of data begins), high data transmission rate and multiconnectivity, 5G is an excellent infrastructure to implement faster and larger IoT systems, consequently enabling the creation of a new level of surveillance possibilities. The political power of the technological surveillance has been already shown by multiple scholars, such as in the well-known work of Zuboff [34], therefore, surveillance can be mentioned as another key element of 5G with strong political implications, because from the point of view of social perception and acceptability, an association has been made between 5G and mass surveillance. Such an association shall be smoothed, showing from the communication point of view that 5G is not exploited as a mass surveillance tool, while from the technical side, IoTs systems shall be designed by considering privacy-by-design principles as depicted in art.25 of the GDPR [2].</td>
</tr>
</tbody>
</table>

Based on the evidences and analysis of the Living Labs (LL) contained in D1.1B [22] and of the Multi Living Labs (MLL) contained in D7.3C [23], as well as on relevant scientific reports, four main domains of ethics and social concerns emerged. Firstly, it is analysed the lack of citizens’ awareness (ES1) of the actual benefits of 5G. Secondly, discrimination and inequality (ES2) arise as problematic features of the 5G infrastructure. Moreover, the sustainability (ES3) of 5G technologies is analysed as a relevant topic. Finally, the trust (ES4) emerged as the key factor in the social acceptance of 5G. For each of these ethics and social concerns, possible countermeasures and policy options are identified.
5.1.1 Awareness

5.1.1.1 Concern

The lack of citizens’ awareness on the general impacts of 5G, and more specifically on related ethical aspects (including the use of personal data) is indicated as a main ethical concern in the “Privacy and security aspects of 5G technology” report [24] produced within this project. Awareness, indeed, is not only relevant in the privacy and security context, as usually reported in many technical reports (e.g. [25]), but also has a key role in the overall assessment and creation of 5G social acceptance. This is because the key parameter of social acceptance is trustworthiness [20], and it is not possible to achieve trust without awareness.

Only when the stakeholders are aware of the ethical and social implications of the 5G infrastructure, they can trust it. In this sense, it is important to foster awareness of the ethical and social implications of the 5G infrastructure and of the overall socio-technical system, in which this technology operates, and that includes all the elements and actors that are involved in it (e.g., users, mobile network operators, service providers, and infrastructure providers). Only when stakeholders are aware of the ethical and social implications of the 5G infrastructure, they can trust it. This is equally true for those telecommunication infrastructures or computational models and systems (e.g. AI and IoT) that are strictly bounded to 5G: increasing awareness on one of these elements leads to increased awareness on the other, and vice versa.

For instance, it is important to consider the use of IoT devices that exploit the low 5G’s latency, i.e. the delay before a transfer of data begins. Internet of Things (IoT) systems are extremely promising in many societal domains and 5G is an optimal infrastructure to implement them, but they also involve ethical issues that society is often unaware of [27]. In a similar way, AI models are strictly bounded to 5G, and their ethical implications consequently affect the trustworthiness of the 5G socio-technical system [26]. Therefore, the lack of awareness about 5G ethical aspects must be understood as a consequence of the lack of awareness about ethical issues related to both telecommunication and computational systems (as AI and IoT), and to the overall socio-technical system that surround the infrastructure.

5.1.1.2 Countermeasure: Spreading comprehensive accounts of the overall socio-technical system surrounding 5G infrastructure

Possible actions that could increase widespread awareness at the societal level about 5G ethical features comprise formulation and presentation of “comprehensive accounts of the overall system that surrounds 5G infrastructure”. Providing a clear, complete, and explicit overview of the constellation of elements and actors that compose the 5G socio-technical systems, (including AI and IoT systems), will help to explain with much more efficiency which are the key features of 5G, and consequently which will be the impact on citizens’ life.

Such an account shall outline relations and interdependencies among the elements of the systems, as well as their responsibilities. A transparent account of implications, benefits, risks and ethical concerns related to actors and elements of the system - infrastructures, products and services - shall be included. Overcoming too narrow and technical accounts of 5G, is essential to open a channel with a wider public, laying the foundation for a correct understanding of such a composite socio-technical system.

At this regard, as shown in the Multi Living Lab experience [23], it is important to refer to use cases that are close to citizens’ life contexts, avoiding to use examples that are too much domain-specific, or understandable just by sector specialists.
5.1.2 Inclusivity

5.1.2.1 Concern

5G is an ecosystem that comprehends multiple and heterogeneous stakeholders. This heterogeneity does not relate just to the level of stakeholders involved, but also the level of final users: citizens are not a uniform category that can be analysed without distinctions. In the SAT methodology, used in this project, user experience (UX) constitutes the first aspect to analyse in order to assess social acceptance [20]. This experience is inherently subjective and affected by social and psychological factors. Therefore, depending on the user’s background, he/she will have a different understanding of the benefits and risks of the technology.

Such heterogeneity shall be taken into account if citizens’ awareness constitutes an objective. Currently, according to Hernan & Ramirez-Figueroa [28], in the communication about 5G there is a fundamental lack of narratives able to represent minorities or vulnerable groups of the population. Narratives are an important vehicle to generate awareness on an individual level [29]. Indeed, if narratives do not adequately represent specific social groups, such groups may not receive the message properly, and will not develop sufficient awareness on that topic.

Beside the narratives, also design choices have an important role. Discriminative design negatively influences users’ perception, consequently altering awareness on the actual benefits of the product or service. Therefore, in the 5G context, achieving awareness on a comprehensive level is directly related to promote and achieve inclusiveness in both the design and narratives of the infrastructure.

5.1.2.2 Countermeasure: Fostering inclusive narratives and design to support awareness and wider acceptance

Avoiding discrimination and inequalities is as hard as important. Possible countermeasures to avoid the presence of these aspects include the formulation of inclusive narratives as a mean to enlarge the 5G communication target group as well as technology acceptance. At the same time, attention to design choices shall be always ensured, without assuming that users are a uniform group: being user friendly means that there is no citizen group that is excluded from the possibility of interacting correctly with the technology. Inclusive design and transparency can therefore help to avoid inequalities. It is therefore necessary to discourage policies that assume uniform capabilities on the part of users, while alternative forms of storytelling that can speak to minorities should be encouraged.

5.1.3 Sustainability

5.1.3.1 Concern

The impact of 5G at the societal level is widespread, but some issues are particularly relevant at the political level, such as for example the impact of 5G on landscape and nature, both from an aesthetic and an ecological perspective. 5G is an extensive infrastructure and it affects many species on the planet and the planet itself. In the short-term when a massive number of devices are deployed, Kizza [33] sustains that the production process of 5G artifacts lead to an increasing amount of e-waste, putting in danger the safety of the planet. This can initially counterbalance the benefits, in terms of efficiency and waste reduction, expected in the long-term by the 5G infrastructure in the production processes.

5.1.3.2 Countermeasure: Promoting a new research, development and innovation mindset based on principles of anticipation and responsibility towards future generations and the planet as a whole

The aesthetic level – the extent to which 5G may impact on the landscape – results especially in a matter of societal acceptability. In order to address this, it is necessary to integrate the 5G infrastructure with the appearance of the local environment so that it does not appear as too disruptive. More complex is the aspect ecological impact connected to the production of e-waste.
This requires the willingness to **overcome the traditional anthropocentric approach** to solutions and policy making, in favour of a **more ecological approach** within the political, policy or governance framework, especially for what concerns research and development policies. A new technology research, development and innovation **mindset** is necessary, which integrates the **principles of anticipation and responsibility** towards future generations and the planet as a whole, in this perspective, dedicated governance and monitoring systems should be put in place to supervise environmental sustainability compliance during the production processes, as well as for e-waste management and recycling.

### 5.1.4 Trust

#### 5.1.4.1 Concern

Above, we highlighted how social acceptance is highly influenced by the awareness and trust that society has in a certain technology – and that awareness also acts as a necessary **precursor** of trust. The creation of trust towards a technology is a complex process, and here we analyse which are the dimension to be taken into account in order to facilitate a conducive environment to generate trust. Traditionally, technology trustworthiness (including 5G’s) is often analysed and measured only through parameters that measure artefacts and their technical improvements, indicating for example the improved security of an infrastructure from external attacks [24]. Technical aspects are obviously essential elements in a technology, but are not sufficient to ensure full trust by society, for the following reasons.

**Trust concerns human relations and not only technical reliability.**

Trust is often conceived as a moral accord where one agent relies on the other, and the other second has the moral obligation to respect the accord [36]. The moral feature aspect, indeed, is what distinguishes trust from mere reliance [37]. For this reason, trust cannot be reduced to a technical feature meanly because it is difficult to conceive a moral accord with a technology [36].

Therefore, it essential to recognise that trust creation cannot depend only on technical characteristics (trusting 5G does not mean trusting the technology by itself), but shall include also the human agents that contribute to the functioning of the infrastructure [36], as well as the processes and procedures activated by these agents. In this way, it is possible to include and maintain the conception of trust between two moral agents. In summary, we shall consider trust as something related to the entire socio-technical system 5G technology is part of.

In a nutshell, technical trust regards only artefacts, moral trust regards only humans, while socio-technical trust regards and comprises both levels. In the idea of socio-technical systems, technologies are not conceived as simply devices intermediating between designers and users, but as hybrids between technical artefacts and social actors.

Identifying non-technical features with an impact on trustworthiness. Following this path, in order to comprehensively assess the perception that different users have on the reliability of the system, we shall focus on becoming aware of, and identifying, all non-technical features that can have high relevance on the level of trustworthiness, both at the individual and social level.

Considering the use of 5G for telesurgery [38] as an example: besides trust on the system security levels, we shall focus on patients’ trust in the actors that use 5G as a tool for such a delicate practice: patient’s trust and value perception of telesurgery is affected by element as the reliability of medical professionals, the setting the telesurgery, the extent of human control in the process, or knowledge about procedures.

All these elements affect the value perception of the patient. Through the SAT methodology, we aimed at capture this subjective value perception about the reliability of the technology, which in assessing trustworthiness, value perception is indeed as much relevant as the objective reliability obtainable through technical improvements.
5.1.4.2 Countermeasure: Identifying and properly manage non-technical features with an impact on trustworthiness

Trust creation depends on a complex combination of factors that include human and non-human agents, technical and non-technical features, and that relate to the quality of artefacts, the quality of processes and procedures, and the relationships amongst individual or actors within a system. All these aspects, together, compose the socio-technical system of a technology.

To foster trust (and then acceptance) of 5G technology at the socio-technical level, we shall first focus on identifying all those non-technical features that affects society’s value perception of the technology, and then showing citizens, through transparency and proper communication, that also these elements of the system are trustworthy (not just those related to the 5G technology per se).

The more trust they have in individual elements (single actors, institutions, procedures and requirements, stakeholders, technical features) the more trust they will have in the entire infrastructure.

5.1.5 Summary of concerns and options

For the sake of clarity and the benefit of readability, this document provides a summary of the identified ethics and social concerns, as well as the relative suggested policy options.

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>ES - Ethics and Social Concerns</th>
<th>PO - Policy Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWARENESS</td>
<td>ES1: Lack of citizens’ awareness on general impacts of 5G</td>
<td>PO1: Spreading comprehensive accounts of the overall socio-technical system surrounding 5G infrastructure</td>
</tr>
<tr>
<td>INCLUSIVITY</td>
<td>ES2: Heterogeneity of citizens and lack of inclusive narratives and design in relation to 5G</td>
<td>PO2: Fostering inclusive narratives and design to support awareness and wider acceptance</td>
</tr>
<tr>
<td>SUSTAINABILITY</td>
<td>ES3: Impact of 5G on landscape and nature, both from an aesthetic and ecological perspective</td>
<td>PO3: Promoting a new research, development and innovation mindset based on principles of anticipation and responsibility towards future generations and the planet as a whole</td>
</tr>
<tr>
<td>TRUST</td>
<td>ES4: Trust concerns human relations and not only technical reliability</td>
<td>PO4: Identifying and properly managing non-technical features with an impact on trustworthiness.</td>
</tr>
</tbody>
</table>

5.1.6 Towards an EU Ethics Guidelines for Trustworthy B5G

The analysis shows the importance of considering 5G as a disruptive technology also in the social and ethical context. Thus, the need emerges to create European guidelines for the ethical development of next generation mobile (NGM) networks (beyond 5G – B5G), in line with what has been done with artificial intelligence [39]. The implementation of 5G is indeed only a preparatory step to the arrival of the even more disruptive 6G and beyond. If the European Union wants to deal responsibly with the increasing development of these key infrastructures for society, and if European Union recognises the paramount played by 5G and B5G infrastructures as fundamental enablers for a digital and sustainable Europe, it must use the experience of 5G to obtain ethical and social guidelines for B5G networks.

These guidelines should be both flexible and rigorous: flexible because the fast development of those infrastructures does not allow to forecast exactly all their features, and rigorous because the current analysis of 5G showed the importance of the ethical and social concerns that arise from B5G networks. For example, the aforementioned domains (i.e. Awareness, Inclusivity, Sustainability, and Trust) would certainly take an important role in these guidelines. Also, methods such as SAT would be extremely useful to evaluate the social acceptance of B5G networks and create guidelines that can help to increase it. Indeed, Trustworthiness, Inclusion
and Sustainability (see Figure 8) are three pillars for the coming NGM networks, as remarked in available reports from first 6G projects (e.g. D1.2 from Hexa-X [40]).

![Image of Trustworthiness, Inclusion and Sustainability](image)

**Figure 8**: Trustworthiness, Inclusion and Sustainability - pillars for 6G. Source: [40]

The experience carried out in the 5G-SOLUTIONS project remarks that trustworthiness is not simply linked or derived from the implementation of security mechanisms within the communication. Security is mechanism and a tool to ensure a human right, that is the privacy. Therefore, while security supports privacy and compliance with ethics and regulatory frameworks, it may not be neglected that trustworthiness is intertwined with social aspects as well, and that awareness (with transparency too) contributes to boost acceptance of technology, its wider adoption.

For this reason, the ethics and regulatory framework established in the 5G-SOLUTIONS, based on the above-mentioned rationales, suggests considering the **four ethics-social pillars** for the NGM networks, as shown in Figure 9. These pillars integrate and extend the vision of 6G projects and initiatives (e.g. Hexa-X and 6G-IA [25]), which are moving towards the evaluation of ethics and societal values (i.e. KVI - Key Value Indicator) – overcoming the usual focus on technical and business performances (i.e. KPI - Key Performance Indicator) - and can provide countermeasures and opportunities for future sustainable development of networks.

![Image of Ethics-Social Pillars](image)

**Figure 9**: The four ethics-social pillars for the NGM networks
6 Conclusions

This document is the second and final version of the report on legal and ethics monitoring activities performed in T10.5 “Legal and Ethics” during the whole lifecycle of the 5G-SOLUTIONS project.

The first version of the report, released at the beginning of the project (D10.4a – M4), identified 15 main references (i.e. international ethics standards, legislations and codes regarding the legal and ethics concerns) that lay the foundation for the 5G-SOLUTIONS legal and ethics background framework.

Most of these references repealed already existing regulations and/or directives, as well as these coming into force during the project lifecycle (e.g. new EU Cybersecurity Act published on June 7th 2019 and come into force on June 27th 2019), demonstrating the relevance of the argument and how background framework is still evolving and requires to be continuously monitored for ensuring the compliance of project activities with respect to current EU legal framework and research ethics concerns.

Based on this background framework and the description of use cases/scenarios, the first version provided a list of potential legal and ethics concerns (i.e. Industrial data confidentiality and personal data protection). For that first version, the description of use cases/scenarios and living labs, it was used the information gathered from D1.1A and D1.4A. In that version, a set of templates were defined in order to address legal and ethics concerns (i.e. personal data protection and confidentiality of project information), the involvement of an External Advisory Board (EAB), as well as participants of Living Labs (in case of end-users external to the project consortium) composing the 5G-SOLUTIONS Research Ethics Protocol:

1. Anonymous Informed Consent Template (see Annex 1)
2. Non-Anonymous Informed Consent Template (see Annex 2);
3. Non-Disclosure Agreement for the External Advisory Board (see Annex 3)

The legal and ethics monitoring activities moved forward with the creation of awareness of the established Research Ethics Protocol, which can be considered such as “ethics guidelines for research and responsible innovation of 5G technology”. Indeed, awareness sessions (i.e. Session in Athens 26-27 November 2019, Online Session 9-10 September 2020) have been arranged in order to make the project partners aware about the potential ethics and legal concerns, enabling a positive and collaborative development mindset.

These awareness sessions have overcome expected goals, indeed new collaborations have been established with partners in different and interconnected work packages:

- **WP8** (dealing with the market assessment) where it was identified the need for a “technology acceptance model” (TAM) methodology for considering multidimensional assessment factors. As a consequence of this, the project defined the “Social Acceptance of Technology” (SAT) methodology;
- **WP1** (dealing with the technical and business validation) where SAT methodology was better defined and applied for the validation of living labs and their use cases. As a consequence of this, stakeholders’ engagement with webinars, focus groups and roundtables allowed to capture key ethics and social concerns impacting the social acceptance of living lab use cases.
- **WP9** (dealing with the communication and dissemination) where SAT methodology results were publicly documented and shared with adoption of informative material (i.e. infographics, infosheets, videos) for a wider audience (i.e. avoiding technical jargons). Papers presenting the SAT methodology and its application in the 5G-SOLUTIONS project were published as well (e.g. [21] [24]).

In a sort of “giving back”, based on the results of the SAT methodology and the ethics and regulatory framework, this document analysed ethics and social concerns which may impact Key Value Indicators [25] for 5G and B5G technology (and consequently impact social acceptance and wider adoption), and suggested policy options to improve on-going and future policies, regulations, technology development and operations.
Specifically, four main domains of ethics and social concerns emerged: i) Awareness; ii) Inclusivity; iii) Sustainability; and iv) Trust. This updated Research Ethics Protocol identified four ethics and social concerns and relative four policy options, as safeguards for future developments.

Indeed, while it is interesting the current research activity addressing the societal challenges in 5G/6G-IA and a white paper [25] identified Key Value Indicators (KVIs) to be evaluated in conjunction with the technical and business Key Performance Indicators (KPIs), the lack of a multidisciplinary approach is still tangible.

Social Science and Humanities (SSH) more and more will have to play a relevant role in disruptive technology development due to the impact this technology has in everyday life of citizens. If citizens don’t comprehend which are the benefits and risks of tools and technologies, inevitably and instinctively they can have good and wrong perceptions and therefore they can raise barriers.

Understanding how KVI can impact the social sphere of human beings, definitely requires the inclusion of SSH experts in the research and innovation activities. In this way, it will be possible to identify not only the KVI, but mainly the social concerns and how these can be addressed with countermeasures before introducing new technology in the market.

For this reason, it is highly desirable that European countries focuses on defining “EU Ethics Guidelines for Trustworthy 5G/B5G” recognising the paramount of this relevant technology enabler, as European countries did for Artificial Intelligence [39].

The next calls, especially the one for “societal challenges” in Smart Network and Services, might be an opportunity for this important achievement.
7 References


[22] 5G-SOLUTIONS, «D1.1B - Definition and analysis of use cases/scenarios and corresponding KPIs based on LLs,» 2022.


Annex 1
Anonymous Informed Consent Template

5G-SOLUTIONS for European Citizens
Information Sheet

5G-SOLUTIONS is a 36-month EU-funded project with the purpose of conducting advanced field trials of innovative and thematically diverse digital services that require 5G capabilities and performance in the vertical domains of Factories of the Future, Smart Energy, Smart Cities, Smart Ports and Media & Entertainment, directly engaging with end-user actors, so as to validate the technological performance of 5G technology in successfully serving them, as well as validate the business models and potential of these use cases prior to commercial deployment.

You are invited to join the 5G-SOLUTIONS research project to take part of the 5G-SOLUTIONS field study. Please take whatever time you need to read and understand the following text. The decision to join, or not to join, is up to you. If you agree with the content, sign the consent form hereafter.

The aim of this activity is to [ADD HERE THE DESCRIPTION].

Your participation is voluntary and free-of-charge and it will take you [ADD HERE THE TIMEFRAME] minutes/hours. If you accept to participate, you will be asked to [ADD HERE DETAILS].

No risks are foreseen for your participation to this activity. [IN CASE OF FORESEEN RISKS, ADD HERE DETAILS].

The project may stop the field study or take you out of the field study at any time they judge it is in your best interest. They may also remove you from the field study for various other reasons. They can do this without your consent. On the other hand, you are free to stop participating at any time without any obligation.

5G-SOLUTIONS will collect information for the purposes of the 5G-SOLUTIONS project. Only information that is necessary to address the central purpose of the research will be recorded, and the data will be anonymised at the point of collection. Such information will be treated as strictly confidential and handled in accordance with the provisions of the “Charter of Fundamental Rights of the EU” (2007/C 303/01), “Convention 108+” of the Council of Europe for the Protection of Individuals and “General Data Protection Regulation” (EU Regulation 2016/679).

The information will be processed for statistical purposes in an aggregated form. The statistical data and the aggregated information may be disseminated in journals, papers, conferences or events. In any case, your name or any information that could identify you or relate to your identity will not be linked with the research materials.

If you have any questions about the field study or the project itself, any problems, unexpected physical or psychological discomforts, any injuries, or think that something unusual or unexpected is happening, you are free to contact Mr./Ms. [ADD HERE THE CONTACT PERSON] at [ADD HERE THE CONTACT DATA – EMAIL – PHONE NUMBER].

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Grant Agreement No 856691.
After reading the Information sheet and voluntary deciding to take part of the project activity, participants shall sign the following Informed Consent Form. Since the form contains personal data, it has to kept secure by the activity organiser.

5G-SOLUTIONS for European Citizens

Informed Consent Form

I [ADD HERE THE PERSON NAME and SURNAME] agree to voluntary participate to the 5G-SOLUTIONS field study.

Yes ☐ No ☐

I have read the Information Sheet, and understand what the field study involves.

Yes ☐ No ☐

I understand that if I decide at any time that I no longer wish to take part in this field study, I can notify the researchers involved and withdraw immediately, without any obligation.

Yes ☐ No ☐

I understand that confidentiality and anonymity will be maintained regarding my personal information and it will not be possible to identify me at any research stage in the project.

Yes ☐ No ☐

I have had the opportunity to have all my questions answered to my satisfaction. I’ve been informed of the data governance given by the 5G-SOLUTIONS project.

Yes ☐ No ☐

A copy of the information sheet and this signed consent form will be given to the signee.

Date ____________________________ Signature of Subject or Representative ____________________________

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No 856691.
Annex 2
Non-Anonymous Informed Consent Template

5G-SOLUTIONS for European Citizens
Information Sheet

5G-SOLUTIONS is a 36-month EU-funded project with the purpose of conducting advanced field trials of innovative and thematically diverse digital services that require 5G capabilities and performance in the vertical domains of Factories of the Future, Smart Energy, Smart Cities, Smart Ports and Media & Entertainment, directly engaging with end-user actors, so as to validate the technological performance of 5G technology in successfully serving them, as well as validate the business models and potential of these use cases prior to commercial deployment.

You are invited to join the 5G-SOLUTIONS research project to take part of the 5G-SOLUTIONS field study. Please take whatever time you need to read and understand the following text. The decision to join, or not to join, is up to you. if you agree with the content sign the consent form hereafter.

The aim of this activity is to [ADD HERE THE DESCRIPTION].

Your participation is voluntary and free-of-charge and it will take you [ADD HERE THE TIMEFRAME] minutes/hours. If you accept to participate, you will be asked to [ADD HERE DETAILS].

No risks are foreseen for your participation to this activity. [IN CASE OF FORESEEN RISKS, ADD HERE DETAILS].

The project may stop the field study or take you out of the field study at any time they judge it is in your best interest. They may also remove you from the field study for various other reasons. They can do this without your consent. On the other hand, you are free to stop participating at any time without any obligation.

5G-SOLUTIONS will collect information for the purposes of the 5G-SOLUTIONS project. Only information that is necessary to address the central purpose of the research will be recorded. Your personal data will not be transferred outside the 5G-SOLUTIONS Consortium and, in any case, they will not be transferred outside Europe. Your personal data will be securely stored and retained for the lifetime of the project and safely deleted afterwards. All collected information will be handled in accordance with the provisions of the “Charter of Fundamental Rights of the EU” (2007/C 303/01), “Convention 108+” of the Council of Europe for the Protection of Individuals and “General Data Protection Regulation” (EU Regulation 2016/679).

More details about 5G-SOLUTIONS privacy policy can be found at the following link [ADD HERE THE LINK TO THE 5G-SOLUTIONS WEBSITE PAGE].

If you have any questions about the field study or the project itself, any problems, unexpected physical or psychological discomforts, any injuries, or think that something unusual or unexpected is happening, you are free to contact Mr./Ms. [ADD HERE THE CONTACT PERSON] at [ADD HERE THE CONTACT DATA – EMAIL – PHONE NUMBER].

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After reading the Information sheet and voluntary deciding to take part of the project activity, participants shall sign the following Informed Consent Form. Since the form contains personal data, it has to kept secure by the activity organiser.

5G-SOLUTIONS for European Citizens
Informed Consent Form

I [ADD HERE THE PERSON NAME and Surname] agree to voluntary participate to the 5G-SOLUTIONS field study.

Yes ☐ No ☐

I have read the Information Sheet, and understand what the field study involves.

Yes ☐ No ☐

I understand that if I decide at any time that I no longer wish to take part in this field study, I can notify the researchers involved and withdraw immediately, without any obligation.

Yes ☐ No ☐

I have had the opportunity to have all my questions answered to my satisfaction. I’ve been informed of the data governance given by the 5G-SOLUTIONS project.

Yes ☐ No ☐

I voluntary consent with the processing of my personal data in accordance with the provisions of the “Charter of Fundamental Rights of the EU” (2007/C 303/01), “Convention 108 +” of the Council of Europe for the Protection of Individuals and “General Data Protection Regulation” (EU Regulation 2016/679).

Yes ☐ No ☐

A copy of the information sheet and this signed consent form will be given to the signee.

Date ____________________ Signature of Subject or Representative ____________________

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Grant Agreement No 856691.
Annex 3
Non-Disclosure Agreement for the External Advisory Board

Dear Project Coordinator of 5G-SOLUTIONS,

As agreed during the proposal phase, I accept to take part in the 5G-SOLUTIONS External Advisory Board, hereafter EAB.

I have been informed about 5G-SOLUTIONS, that is an ICT-19’s flagship 5G-PPP project that has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No. 856691, supporting EC’s 5G policy by implementing the last phase of the 5G-PPP roadmap. It aims to prove and validate that the 5G capabilities provide prominent industry verticals with ubiquitous access to a wide range of forward-looking services with orders of magnitude of improvement over 4G, thus bringing the 5G vision closer to realisation. This will be achieved through conducting advanced field trials of 20 innovative use cases, over 5G-EVE and 5G-VINNI facilities in Italy, Norway, Greece, Ireland and Belgium directly involving end-users across five significant industry vertical domains: Factories of the Future, Smart Energy, Smart Cities, Smart Ports and Media & Entertainment.

As member of EAB, I commit to participate either physically or remotely at least in the four Advisory Board meetings, which will be organized during the project lifetime. I will also give advice on technology transfer matters. I also understand that there will be no additional funding from the project for these activities, nor it will be necessary for our organization to sign the project’s Consortium Agreement or any related contractual document.

Stated that … all information in whatever form or mode of transmission, which is disclosed by a Party (the “Disclosing Party”) to any other Party (the “Recipient”) in connection with the 5G-SOLUTIONS Project during its implementation and which has been explicitly marked as “confidential”, or when disclosed orally, has been identified as confidential at the time of disclosure and has been confirmed and designated in writing within 15 days from oral disclosure at the latest as confidential information by the Disclosing Party, is “Confidential Information”.

I undertake without prejudice to any commitment of non-disclosure for a period of 5 years after the end of the Project, and in particular:

- not to use Confidential Information otherwise than for the purpose for which it was disclosed;
- not to disclose Confidential Information to any third party without the prior written consent by the Disclosing Party;
• to return to the Disclosing Party on demand all Confidential Information which has been supplied to or acquired including all copies thereof and to delete all information stored in a machine-readable form.

Furthermore, I shall promptly advise the 5G-SOLUTIONS Project coordinator in writing of any unauthorised disclosure, misappropriation or misuse of Confidential Information after it becomes aware of such unauthorised disclosure, misappropriation or misuse.

On the other side, accepting this letter, the Project undertakes that provided feedback will remain strictly confidential among the consortium partners and will be anonymized in case of sharing with third parties, according with General Data Protection Regulation (Regulation EU 2016/679, 27th April 2016).

Finally, I reserve the right to abandon the EAB at any moment with the sole obligation to communicate this fact to the Project Coordinator two weeks before the effective date.

Sincerely,

Date

Signature of Subject or Representative
Annex 4
5G-SOLUTIONS Policy Brief
TOWARDS AN ETHICALLY-DRIVEN DESIGN OF 5G AND BEYOND TECHNOLOGY

Project title: 5G-SOLUTIONS - for European Citizens
Call: H2020-ICT-2018-20 (Industrial Leadership)

EXECUTIVE SUMMARY

5G is a disruptive technology, and as such it expresses its disruptiveness not only at the technical, but also at the societal level. The transformational impact of 5G at the societal and value level, and its implication for the political level, cannot be avoided; however, it can be managed, not only to create conditions for a wider acceptability, but also to produce a positive impact on society. During the last five years an impressive effort was put in place to setup, test and validate 5G infrastructures, achieving considerable improvements in terms of technical performances. While technological development has advanced, a number of ethical, legal and societal issues have emerged, which require careful attention. Some of these, such as for example social resistances and scepticism, may act as barriers to societal acceptance and wider adoption, risking to jeopardise all research and innovation efforts done so far. This policy brief summarises the experiences and lessons learnt emerged from the 5G-SOLUTIONS project. Its aim is highlighting a few priority ethical and societal aspects that need to be considered to ensure a harmonious deployment of 5G solutions, taking into account needs and expectations of society, as well as environmental and sustainability concerns. Based on the evidences and analysis of the Living Labs conducted within the project, as well as on relevant scientific reports, four main domains of ethics and social concerns emerged, for which possible countermeasures and policy options have been proposed:

1. **Lack of citizens’ awareness** on the general impacts of 5G, and on the socio-technical system surrounding the technology.
2. **Lack of sufficiently inclusive representation** of final users’ heterogeneity in 5G narratives and solution design.
3. **Environmental risks** linked to increasing amount of e-waste.
4. **Focusing exclusively on technical reliability and characteristics** is not sufficient to gain and generate social trust.
INTRODUCTION

Over the last forty years, four generations of mobile networks came to hand enabling society to be anywhere anytime connected. While the first generation (1G) introduced a service of wireless telephony, representing an exciting and expensive novelty for a restricted number of citizens (therefore a status symbol), the last fourth generation (4G) enabled a broadband wireless service and therefore internet connection anywhere and anytime, now accessible to more than 60% of the global population. During the last decade, data communication has been increasingly performed through mobile networks (more than 73% of web services are accessed “on the move” according to Eurostat 2020), and the number of smart devices interconnected has been growing exponentially, overcoming now the number of the world global population.

In a similar scenario, network performances play a paramount role to make such a huge amount of devices’ connections possible. That is why during the last five years an impressive effort was put in place to setup, test and validate 5G infrastructures, the fifth-generation (5G) mobile network, establishing and breaking records in terms of latency (the delay before a transfer of data begins), bandwidth (maximum transfer capacity of a network), throughput (amount of data that can be sent and received within a specific timeframe), device density (maximum amount of connected devices within a specific area) and reliability (degree of quality that a product, system, or service will perform its intended function adequately for a specified period of time, or will operate in a defined environment without failure).

However, while technological development steadily progressed towards the Next Generation Mobile network (6G and beyond), a number of important human and societal factors have emerged, which shall not be neglected.

Currently, the lack of sufficiently clear and accessible information on 5G technology and on its governance ecosystem has resulted into episodes of social resistances and scepticism, which risk to jeopardise all research and innovation efforts, acting as barriers. Creating awareness on its pervasive transformational power becomes essential, in order to design political and policy actions able to duly embrace such societal complexity.

1 ABOUT THE PROJECT – 5G solutions for European citizens

The 5G solutions for European citizens project (5G-SOLUTIONS, https://5gsolutionsproject.eu) was funded in the context of the 5G Infrastructure Public Private Partnership (5G-PPP), supporting the development of EU 5G policy. Its objective is to prove and validate that 5G can enable a wide range of forward-looking services with orders of magnitude of improvement over 4G. The technology was validated with real end-user actors through 5G Infrastructure facilities (e.g. 5G-EVE and 5G-VINNI). Twenty innovative use cases were trialled on the field across four significant industry vertical domains: Factories of the Future, Smart Energy, Smart Cities and Ports, Media & Entertainment.

With respect to other 5G-PPP projects, 5G-SOLUTIONS project introduces a holistic assessment by considering three intertwined dimensions: i.e. technology; business; ethics and social aspects.

Therefore, while measuring and assessing the technical aspects and enabling capacity (e.g. throughput, latency, bandwidth, peak data rate, device density), use cases were also evaluated in terms of future commercialisation potential (e.g. opex costs reduction, new business models) and by analysing ethics, legal, social concerns with an impact on the social acceptance of 5G technology, consequently on its wider adoption and deployment.

2 A FRAMEWORK TO IDENTIFY AND TACKLE ETHICS, LEGAL AND SOCIAL ASPECTS IN TECHNOLOGY DEVELOPMENT

The 5G-SOLUTIONS project established an ethics and legal framework to support experimentation in the different use cases. Based on preliminary specifications of the use cases, the project conducted a first ethics and legal assessment identifying potential concerns, and related countermeasures, in matter of i) collection and
TOWARDS AN ETHICALLY-DRIVEN DESIGN OF 5G TECHNOLOGY

processing of personal data during the field trials and ii) collection and processing of confidential data during the research activities.

The framework is based on available EU guidelines and regulations, including inter-alia the Charter of Fundamental Rights of the EU (2007/C 303/01 [1]), General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679 [2]), and Horizon 2020 Programme Guidance How to complete your ethics self-assessment (2019) [3].

Based on this continuous monitoring, a final assessment has been carried out which allowed 5G-SOLUTIONS to identify four main ethics concerns and related suggested policy options.

3 ETHICS AND SOCIAL CHALLENGES

3.1 Awareness

**Ethics and Social Concern 1: Lack of citizens’ awareness on general impacts of 5G**

The lack of citizens’ awareness on the general impacts of 5G, and more specifically on related ethical aspects (including the use of personal data) is indicated as a main ethical concern in the “Privacy and security aspects of 5G technology” report [4] produced within this project. Awareness, indeed, is not only relevant in the privacy and security context, as usually reported in many technical reports (e.g. [5]), but also has a key role in the overall assessment and creation of 5G social acceptance. This is because the key parameter of social acceptance is trustworthiness [6], and it is not possible to achieve trust without awareness.

Only when the stakeholders are aware of the ethical and social implications of the 5G infrastructure, they can trust it. In this sense, it is important to foster awareness of the ethical and social implications of the 5G infrastructure and of the overall socio-technical system, in which this technology operates, and that includes all the elements and actors that are involved in it (e.g., users, mobile network operators, service providers, and infrastructure providers). Only when stakeholders are aware of the ethical and social implications of the 5G infrastructure, they can trust it. This is equally true for those telecommunication infrastructures or computational models and systems (e.g. AI and IoT) that are strictly bounded to 5G: increasing awareness on one of these elements leads to increased awareness on the other, and vice versa.

**Policy Option Ethics and Social 1: Spreading comprehensive accounts of the overall socio-technical system surrounding 5G infrastructure**

Possible actions that could increase widespread awareness at the societal level about 5G ethical features comprise formulation and presentation of “comprehensive accounts of the overall system that surrounds 5G infrastructure”. Providing a clear, complete, and explicit overview of the constellation of elements and actors that compose the 5G socio-technical systems, (including AI and IoT systems), will help to explain with much more efficiency which are the key features of 5G, and consequently which will be the impact on citizens’ life.

Such an account shall outline relations and interdependencies among the elements of the systems, as well as their responsibilities. A transparent account of implications, benefits, risks and ethical concerns related to actors and elements of the system - infrastructures, products and services - shall be included. Overcoming too narrow and technical accounts of 5G, is essential to open a channel with a wider public, laying the foundation for a correct understanding of such a composite socio-technical system.

At this regard, as shown in the Multi Living Lab experience [7], it is important to refer to use cases that are close to citizens’ life contexts, avoiding to use examples that are too much domain-specific, or understandable just by sector specialists.

3.2 Inclusivity
Ethics and Social Concern 2: Heterogeneity of citizens and lack of inclusive narratives and design in relation to 5G

5G is an ecosystem that comprehends multiple and heterogeneous stakeholders. This heterogeneity does not relate just to the level of stakeholders involved, but also the level of final users: citizens are not a uniform category that can be analysed without distinctions. In the SAT methodology, used in this project, user experience (UX) constitutes the first aspect to analyse in order to assess social acceptance [6]. This experience is inherently subjective and affected by social and psychological factors. Therefore, depending on the user’s background, he/she will have a different understanding of the benefits and risks of the technology. Such heterogeneity shall be taken into account if citizens’ awareness constitutes an objective. Currently, according to Hernan & Ramirez-Figueroa [8], in the communication about 5G there is a fundamental lack of narratives able to represent minorities or vulnerable groups of the population. Narratives are an important vehicle to generate awareness on an individual level [9]. Indeed, if narratives do not adequately represent specific social groups, such groups may not receive the message properly, and will not develop sufficient awareness on that topic.

Beside the narratives, also design choices have an important role. Discriminative design negatively influences users’ perception, consequently altering awareness on the actual benefits of the product or service. Therefore, in the 5G context, achieving awareness on a comprehensive level is directly related to promote and achieve inclusiveness in both the design and narratives of the infrastructure.

Policy Option Ethics and Social 2: Fostering inclusive narratives and design to support awareness and wider acceptance

Avoiding discrimination and inequalities is as hard as important. Possible countermeasures to avoid the presence of these aspects include the formulation of inclusive narratives as a mean to enlarge the 5G communication target group as well as technology acceptance. At the same time, attention to design choices shall be always ensured, without assuming that users are a uniform group: being user friendly means that there is no citizen group that is excluded from the possibility of interacting correctly with the technology. Inclusive design and transparency can therefore help to avoid inequalities. It is therefore necessary to discourage policies that assume uniform capabilities on the part of users, while alternative forms of storytelling that can speak to minorities should be encouraged.

3.3 Sustainability

Ethics and Social Concern 3: Impact of 5G on landscape and nature, both from an aesthetic and ecological perspective

The impact of 5G at the societal level is widespread, but some issues are particularly relevant at the political level, such as for example the impact of 5G on landscape and nature, both from an aesthetic and an ecological perspective. 5G is an extensive infrastructure and it affects many species on the planet and the planet itself. In the short-term when a massive number of devices are deployed, Kizza [10] sustains that the production process of 5G artifacts lead to an increasing amount of e-waste, putting in danger the safety of the planet. This can initially counterbalance the benefits, in terms of efficiency and waste reduction, expected in the long-term by the 5G infrastructure in the production processes.

Policy Option Ethics and Social 3: Promoting a new research, development and innovation mindset based on principles of anticipation and responsibility towards future generations and the planet as a whole

The aesthetic level – the extent to which 5G may impact on the landscape – results especially in a matter of societal acceptability. In order to address this, it is necessary to integrate the 5G infrastructure with the appearance of the local environment so that it does not appear as too disruptive. More complex is the aspect ecological impact connected to the production of e-waste. This requires the willingness to overcome the
traditional anthropocentric approach to solutions and policy making, in favour of a more ecological approach within the political, policy or governance framework, especially for what concerns research and development policies. A new technology research, development and innovation mindset is necessary, which integrates the principles of anticipation and responsibility towards future generations and the planet as a whole, in this perspective, dedicated governance and monitoring systems should be put in place to supervise environmental sustainability compliance during the production processes, as well as for e-waste management and recycling.

3.4 Trust

Ethics and Social Concern 4: Trust concerns human relations and not only technical reliability

Above, we highlighted how social acceptance is highly influenced by the awareness and trust that society has in a certain technology – and that awareness also acts as a necessary precursor of trust.

The creation of trust towards a technology is a complex process, and here we analyse which are the dimension to be taken into account in order to facilitate a conducive environment to generate trust.

Traditionally, technology trustworthiness (including 5G’s) is often analysed and measured only through parameters that measure artefacts and their technical improvements, indicating for example the improved security of an infrastructure from external attacks [4]. Technical aspects are obviously essential elements in a technology, but are not sufficient to ensure full trust by society, for the following reasons.

Trust concerns human relations and not only technical reliability.

Trust is often conceived as a moral accord where one agent relies on the other, and the other second has the moral obligation to respect the accord [11]. The moral feature aspect, indeed, is what distinguishes trust from mere reliance [12]. For this reason, trust cannot be reduced to a technical feature meanly because it is difficult to conceive a moral accord with a technology [11].

Therefore, it essential to recognise that trust creation cannot depend only on technical characteristics (trusting 5G does not mean trusting the technology by itself), but shall include also the human agents that contribute to the functioning of the infrastructure [11], as well as the processes and procedures activated by these agents. In this way, it is possible to include and maintain the conception of trust between two moral agents. In summary, we shall consider trust as something related to the entire socio-technical system 5G technology is part of.

Policy Option Ethics and Social 4: Identifying and properly manage non-technical features with an impact on trustworthiness

Trust creation depends on a complex combination of factors that include human and non-human agents, technical and non-technical features, and that relate to the quality of artefacts, the quality of processes and procedures, and the relationships amongst individual or actors within a system. All these aspects, together, compose the socio-technical system of a technology.

To foster trust (and then acceptance) of 5G technology at the socio-technical level, we shall first focus on identifying all those non-technical features that affects society’s value perception of the technology, and then showing citizens, through transparency and proper communication, that also these elements of the system are trustworthy (not just those related to the 5G technology per se).

The more trust they have in individual elements (single actors, institutions, procedures and requirements, stakeholders, technical features) the more trust they will have in the entire infrastructure.

4 Conclusions

This document aims to provide policy makers with a summary of the most relevant challenges and policy options to be considered when dealing with 5G (and beyond) technology.
### Challenges | Policy Options
---|---
Lack of awareness of ethical issues related to the system | Spreading comprehensive accounts of the overall socio-technical system surrounding 5G infrastructure
Heterogeneity of citizens and lack of inclusive narratives and design in relation to 5G | Fostering inclusive narratives and design to support awareness and wider acceptance
Impact of 5G on landscape and nature, both from an aesthetic and ecological perspective | Promoting a new research, development and innovation mindset based on principles of anticipation and responsibility towards future generations and the planet as a whole
Trust concerns human relations and not only technical reliability | Identifying and properly managing non-technical features with an impact on trustworthiness

The analysis shows the importance of considering 5G as a disruptive technology also in the social and ethical context. Thus, the need emerges to create European guidelines for the ethical development of next generation mobile (NGM) networks (beyond 5G – B5G), in line with what has been done with artificial intelligence [13].

### References


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