5G for Connected and Automated Road Mobility in the European UnioN

Deliverable D6.1
Data Management Plan for 5G-CARMEN

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List of Acronyms

Term	Description
3GPP	Third Generation Partnership Project
5G	Fifth Generation
5GAA	5G Automotive Alliance
5G-PPP	5G Public Private Partnership
C2C-CC	Car to Car - Communication Consortia
C-ITS	Cooperative Intelligent Transport Systems
C-V2X	Cellular - Vehicle-to-Everything
CA	Consortium Agreement
CCAM	Cooperative, Connected and Automated Mobility
FAIR	Findable, Accessible, Interoperable and Reusable
EATA	European Automotive Telecom Alliance
GA	General Assembly/Grant Agreement
KIM	Knowledge and Innovation Management
IPR	Intellectual Property Rights
ITS	Intelligent Transport Systems
KIM	Knowledge and Innovation Management
KPI	Key Performance Indicator
LTE	Long Term Evolution
MEC	Mobile Edge Computing
NR	New Radio
SME	Small Medium Enterprise
V2X	Vehicle-to-Everything
WP	Work Package

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Executive Summary

The purpose of D6.1 is to define a Data Management Plan (DMP) for 5G-CARMEN and define the various aspects of that DMP within the wider H2020 DMP framework and the European Commission's Pilot on Open Research Data.

In Section 1 we get to introduce some core features of the 5G-CARMEN project along with a general framework for the concept of data management

In Section 2 we elaborate over the management of knowledge and we attempt to define a knowledge protection strategy. We briefly analyse the information flow within the project focusing on the project structure as split in different Work Packages and each WP's mission and co-dependencies. Following that we make an extended analysis on the outward information flow indicating communication targets that could possibly display an interest in the data generated by 5G-CARMEN project. Moreover, we define the main channels of communication along with the phases that the sharing of the project's data will occur. Finally, we refer to the Ethics and IPR frameworks that will be used by 5G CARMEN.

In Section 3 we address the Open Access Policy (OAP) framework by initially defining it and then referring to its benefits and structure. The basis of this discussion is the European Commission's wider H2020 framework and the relevant OA policies. We debate over the distinction between Basic and Applied research and their thin boundaries in the Age of Information. Then we identify the need for Research organizations and Companies to collaborate on research projects and the benefits acquired from that collaboration. Furthermore, we go deeper on our analysis elaborating over open-source licensing and open access policies for research data and publications

In Section 4 we define the Data Management Plan of 5G-CARMEN. First, we get to set the basic principles and guidelines according to EU directives and we define the requirements and limitations on FAIR data. Following that we present the DMP structure of 5G-CARMEN by primarily identifying the Information Data categories. Then we make an analysis regarding the flow, the storage, the sharing and the disposal of project data.

1 Introduction

1.1 Preamble

The 5G-CARMEN project is part of the 5G-PPP initiative and its objective is to promote the merging of roads and vehicles with the digital world creating always-connected, automated and intelligent "Mobility Corridors". The Bologna-Munich road networks will be the first deployment field for the 5G-CARMEN innovative architecture. 5G-CARMEN will advance the use of C-V2X based on 3FPP LTE and NR radio access, extending the activities foreseen by the European Automotive Telecom Alliance (EATA) and the 5G Automotive Alliance (5GAA) on connected and automated vehicles.

5G-CARMEN architecture will optimize road mobility regarding security, connectivity and autonomous driving and will employ the following synergistic applications of enabling technologies:

a) Hybrid radio access network for connected vehicles
b) Distributed and multi-layer network-embedded cloud
c) MEC-assisted range extension and interworking between C-V2X and C-ITS
d) Service-oriented predictive quality of service through end-to-end slicing
e) Precise positioning and time synchronization
f) Secure, multi-domain and cross-border service orchestration
g) 5G New Radio and new frequency bands

The project is expected to attract a number of stakeholders including car manufacturers, road operators, vehicle owners and local authorities since it will add further value to their business models and it is aligned with the agenda of the European 5G Action plan, which foresees uninterrupted 5G coverage in major roads.

1.2 General framework for data management

The search for knowledge, the need to answer even the toughest questions around the world surrounding us, was always one of mankind's greatest quests, thus science was born. The scientific community has always strived to generate research results and make them accessible to the world thus promoting a culture of inquiry and knowledge. From Archimedes, Einstein, Newton, Tesla to today's institutions, large corporations and SME's involved in research, sharing the acquired knowledge is still a task of great importance. Today, in the Information Age, the rate at which data is exchanged is tremendous. The internet has become a global and interactive database of knowledge where research results can be accessible to everyone and can be used for the collective progress of mankind aligned with the concept of the "public good".

Sharing research knowledge within the concept of the "public good" dictates that there is a world-wide online distribution of the peer-reviewed journal literature with free online access for every interested party from scientist to just people with inquiring minds. Access barriers should be removed to provide a fertile ground for further research, help to further improve our education systems and ensure that all humanity has equal opportunities in exploiting the results of that research.

According to 5G-CARMEN Grant Agreement (GA ID 825012), all involved partners must implement the Project effort as described in the respective GA and in compliance with the provisions of the GA and all legal obligations under applicable EU, international and national law.

The current document will be providing a Data Management Plan for 5G-CARMEN following the template recommended by the EC [1]. This DMP will be describing how data will be handled in terms of collection, organization, management, storage, security, back-up, preservation and sharing (where applicable). Proper data management is a necessary component of responsible conduct of research since it ensures the value of the research results and assists in sustaining that value for the years to come.

The purpose of 5G-CARMEN DMP is to make 5G-CARMEN data easy to discover and access, intelligible and interoperable so that it may be used beyond the core objectives of 5G CARMEN.

Please note the distinction between open access to scientific peer-reviewed publications and open access to research data:

- publications – open access is an obligation in Horizon 2020.
- data – the Commission is running a flexible pilot which has been extended and is described below.

5G-CARMEN will follow two different strategies for self-archiving repository: (1) the project website will host the repository, granting visibility at the end of the project as well; and (2) the consortium will consider the case of a centralised repository, such as Zenodo repository. In any case, the two options enable third parties to access, exploit, reproduce and disseminate at no cost.

2 Knowledge Management and Protection Strategy

2.1 Information flow within the project

The general description of the information flow within the project is depicted in Figure 1. WP2 provides requirements and specification to steer the technical work packages WP3 and WP4. Moreover, WP2 also provides input to the pilot work package WP5 in the form of refined scenarios and KPIs. Additionally, WP3 and WP4 will jointly cooperate to provide WP5 with the prototypes to be piloted over the Bologna-Munich Corridor. WP6 will receive inputs from WP5 and will use them to analyse the project impact and perform use-case cross validation and business modelling studies. The Project Management (WP8) and the Dissemination and Communications (WP7) work packages will run throughout the entire project interacting with the other work packages with the aim of ensuring smooth project execution and proper dissemination of the results.

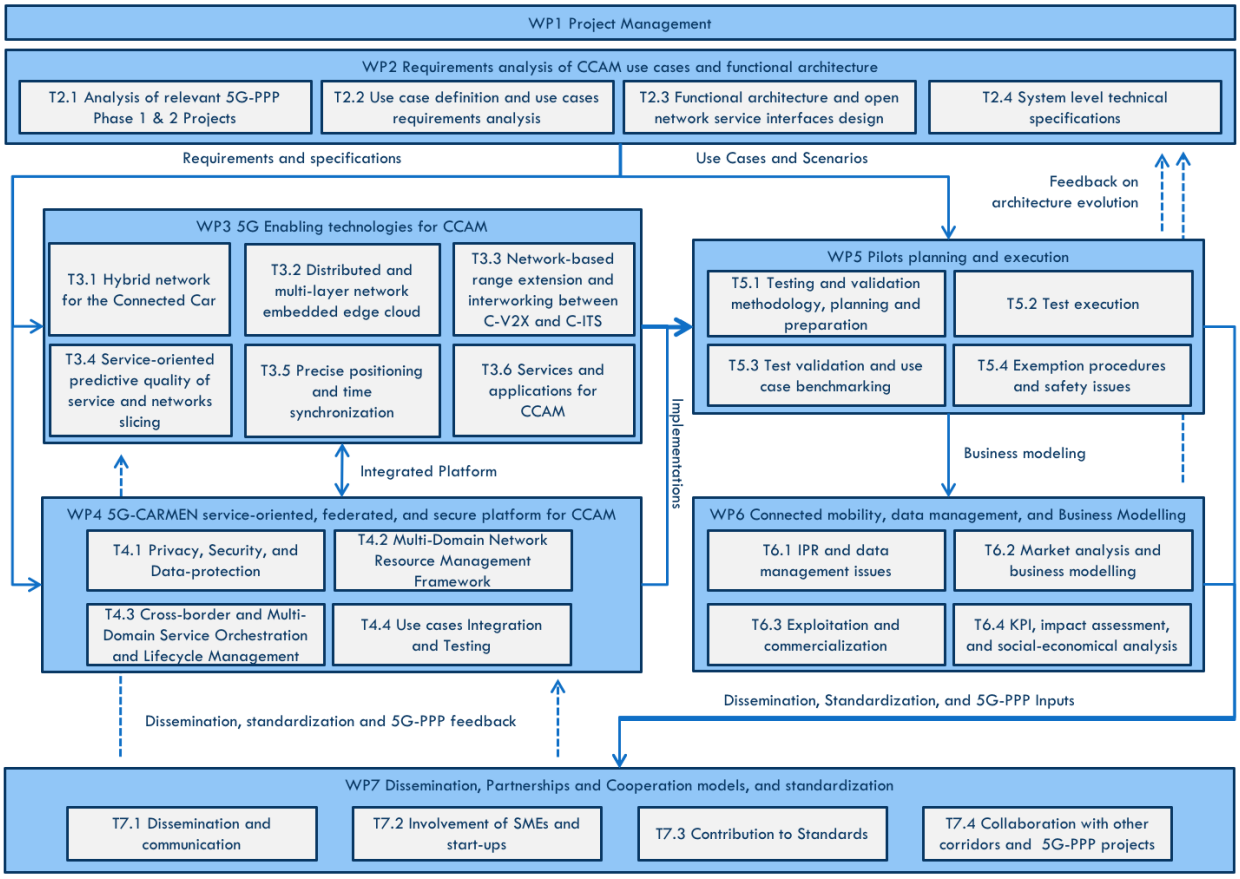

Figure 1: 5G-CARMEN interdependency between the WPs (5G-CARMEN Pert diagram)

Such cross-information exchanges and dependencies need to be monitored efficiently in order to have the project partners leverage on the available and developed knowledge within the project. To ensure a good communication among project partners an online file repository system is being used for internal information exchange facilitating the daily collaboration. Additionally, the project leverages WP-wise mailing lists allowing daily discussion and a video conferencing tool to host monthly project management meetings and weekly WP-wise meetings ensuring partners coordination and alignment in the technical work. Communication within the consortium is one of the main objectives of the project management which structure roles and responsibilities were described in the project management handbook deliverable [2]. Importantly, within the 5G-CARMEN management structure a Knowledge and Innovation Management (KIM) team have been appointed since the beginning of the project. The KIM team will ensure an effective innovation management developing and constantly updating both market analysis and a business plan for the results achieved by 5G-CARMEN. The KIM team also ensures the monitoring of IPR issues as regulated in the Consortium Agreement and explores. Opportunities of patenting will be considered and analysed; market relationships will be created and reinforced. The Consortium Agreement will provide rules for handling confidentiality and IPR to the benefit for the Consortium and its partners. Classified Documents will be handled according to proper rules with regards to classification, numbering and locked storing and distribution limitations. This team is chaired by the Innovation Manager and includes the Project Coordinator, the Technical Manager and the WP Leaders.

2.2 Outward information flow

2.2.1 Communication targets

5G-CARMEN's Communication Strategy identifies the following eight groups of entities as the Target Audience for the project. Open access to the project's results for these groups is critical to the success and further usage of the output of 5G-CARMEN.

Figure 2: Communication targets

For each target group a broad description is provided along with the benefit and goals that each group of Stakeholders will be focusing on in terms of content.

Table 1: Communication targets

ID	Target Group	Description	Stakeholder Interest
A	Industry, SMEs and Entrepreneurs	Stakeholders operating in fields related to the project such as automotive companies, telecoms and network operators, and SMEs and Entrepreneurs operating in the 5G domain	• Project results which will enable development of new products • Complementing the findings of 5G-CARMEN with internal knowledge to increase impact

B	5G Infrastructure PPP Programme Stakeholders	Participants as well as any stakeholder involved in the 5G Infrastructure PPP	• Finding synergies in tackling common issues • Enhancing benefit by combination of results • Co-organising events
C	Road operators and road infrastructure-related stakeholders	Road operators and related international entities, involved in the provision of physical and digital infrastructure to the activities of the project	• Cross validation of solutions through output of 5G Carmen. • Support findings related to the transition phase of CCAM • Definition of non-technical requirements
D	Technology Clusters	European initiatives and clusters, and research focused organisations	• Leverage of project's result into own research activities • Knowledge exchange and building through project events
E	Researchers and Academics	Stakeholders from Universities, research centres and R&D departments of industry entities	• Advancing research • Benefits in training personnel and students • Use-cases provide real life demonstrations of theoretical findings
F	Policy Makers	Policy-makers at any level, such as EC Directorates and Units, Ministries and Agencies	• Evaluation of existing or proposed legislation through perspective of project's innovations • Definition of future research requirements
G	Standards bodies and fora	Organisations focused on standardisation and industry fora	Input for standardisation activities
H	General Public	Any other stakeholder group or individual interested in the project	• Stimulate innovation in society as a whole • Understand and support European research activities

2.2.2 Communication channels

The dissemination approach has been designed to ensure open access to the stakeholder groups listed above. Several means of communication have been adopted for this purpose, ranging in technological effort and type and depth of reach; these can be broadly categorized into two areas: Events and Publications. A Web Portal and Social Media platforms have also been used to maximise the impact of the Dissemination channels.

Publications

5G-CARMEN Dissemination activities are aimed at reaching several targets audiences and are therefore varied and extensive. The following types of publications are part of the dissemination strategy:

- Articles in international peer-reviewed magazines and journals.
- White Papers published in synergy with the European Technology Platform Networld2020 and relevant industry fora. This is particularly targeted at facilitating stakeholder understanding of the project's approach and decision making.
- Promotional Material such as brochures, leaflets and flyers.
- Project Documentation: Deliverables and technical reports will be made publicly available through the Web Portal.
- Logo and Templates to support the identity of the project throughout its outputs
- Two electronic newsletters per year will be released

Events

Participation in events will allow project consortium members with direct experience in the project and related knowledge to directly reach target audiences. The following types of events are targeted for dissemination of the project's activities.

- Establishment of conferences and informative workshops
- Participation in industrial exhibitions
- Participation and contribution to international conferences
- Interactions with worldwide fora, institutes, and standardization organizations

Online Presence

The 5G-CARMEN Dissemination approach leverages the growing worldwide digitalisation trends to allow open access to its generated content. In particular a dedicated Web Portal has been designed and Social Media are being used to maximise reach.

The Web Portal provides content generated by the project such as reports and presentations for open access by the target audience. Moreover, it will include links to the project's Social Media channels to enable further content sharing. Also included on the Web Portal are dates and information about upcoming events, as well as general information about the project itself. Through the use of the Web Portal, the partners of the project will also be able to freely exchange data.

5G CARMEN's website adopts modern design principles which, among other features, will provide the users with the most relevant material first, and ensures an optimal viewing experience.

The main Social Media Platforms selected for the project are Twitter and Linkedin. These have been deemed the most appropriate in terms of targeted reach and structure of content for the purpose of sharing the project's material. Social Media participation is expected to significantly rise once the outputs of the project's activities start to be shared through the dedicated profiles. The Social Media profiles used by the project are the following:

- Twitter: https://twitter.com/5g_carmen
- Linkedin profile: https://www.linkedin.com/company/5g-carmen/

2.2.3 Communication Phases

Four specific phases have been defined to enable the sharing of the project's contents. Each phase is related to specific groups of contents and related target audience, and as such will exploit a bespoke range of dissemination channels. In order to positively impact the standardization and ease of access of the contents, the phases are aligned to those of other projects within the 5G PPP Programme.

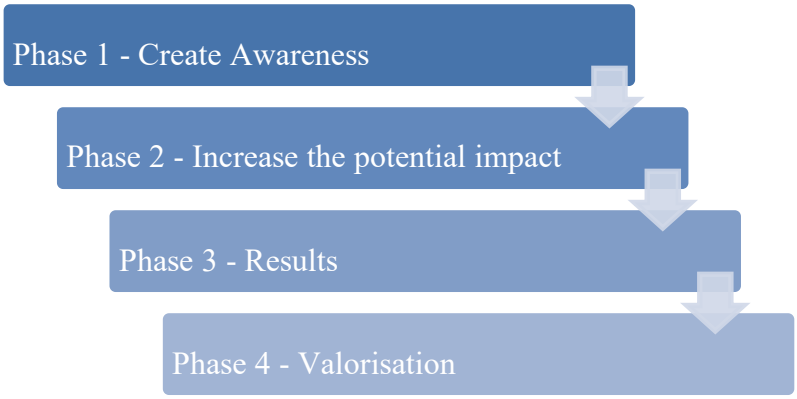

Figure 3: Communication Phases

During Phase 1, the objective of the Dissemination effort is to raise awareness about the project in general. As many 5G stakeholders as possible are targeted during this period. The awareness already raised by 5G PPP will be leveraged to increase outreach of the project. A workshop will be held following the start of the project's activities to communicate the roadmap of the ICT-18-2018 call.

In Phase 2, four use cases will be used to begin analysing the potential impact. The outcomes of this activity will be communicated to the Target Audiences raised during Phase 1. The main material expected to be

communicated in Phase 2 is the facility usage and testing of the pilot. This phase will be significantly impacted by a series of dedicated workshops with key stakeholders of the project.

Phase 3 will used to emphasise the results obtained by external entities as a result of the outputs of the project. The goal of this phase is to highlight the commercial viability resulting from the project, and to attract further external users.

Finally, in Phase 4 demonstrations will take place to selected target audiences, to highlight the final scientific and business findings of 5G CARMEN. Due to its content, this phase may take place after the project is concluded. This phase has the goal of attracting investors as a result of the results from external customers.

2.3 IPR Management

5G-CARMEN is a project with participants from many different countries, therefore a strategy to properly handle the data management and the IP ownership is an essential process to secure and protect value generated by the software tools. Considering that contract formalization of software takes the form of license agreements. Such agreements impose specific usage rules on third-parties that intent to make use of the software. Developing software can be defined as a creative task, relying on the coding and development abilities of a developer and also on the ability to translate the functional and operational requirements defined during the designing phase into a sequence of instructions. The figure as shown below Figure 4 describes a typical software development process and the multiple IPRs that can be generated.

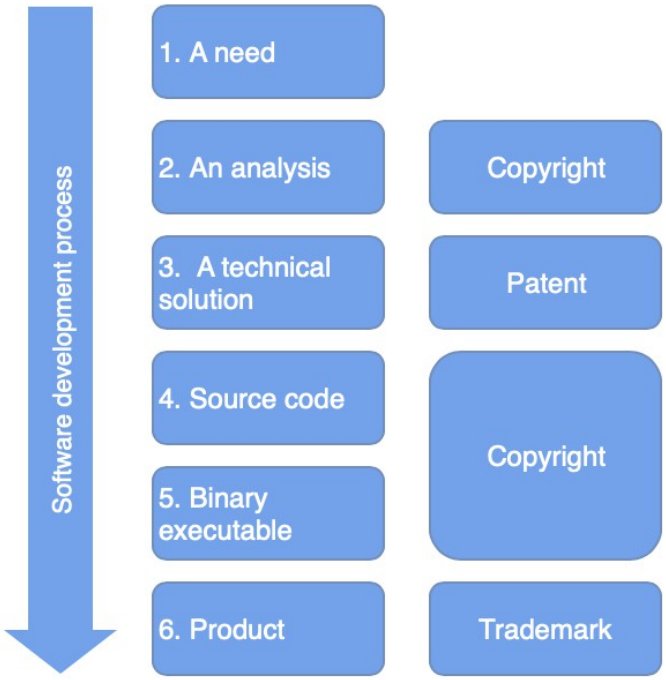

Figure 4: Software development process

The research data generated or created under the projects may include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, and images.

The obligations to disseminate results (Article 29.1 of the GA) and to provide open access to scientific publications (Article 29.2 of the GA) do not, in any way, change the obligation of consortia to protect results, ensure confidentiality obligations and the security obligations or the obligations to protect personal data, all of which still apply. The project CA defines all the guidelines that regulate the access rights to the different IPRs,

both for the contributed background and for the foreground or results. These guidelines describe the rights any of the actors have on the IPRs involved in the project. The actors that come into play can be distinguished essentially in two categories: project partners, and external parties.

As the project evolves and the research progresses, datasets may be created and may be subject to changes or updates in terms of the types, formats, and origins of the data. Furthermore, the way the data is named or made accessible may change according to consortium policy changes and/or identification of potential for exploitation by project partners.

3 Open Access Policy

3.1 OAP: Definition, benefits, and general framework

Open access (OA) refers to the practice of providing online access to scientific information that is free of charge to the end-use and reusable. "Scientific" refers to all academic disciplines. In the context of research and innovation, "scientific information" can mean [3]:

a) Peer-reviewed scientific research articles (published in scholarly journals), or

b) Research data (data underlying publications, curated data and/or raw data).

There are two main categories that can be identified within the general context of research:

a) **Basic** which refers to academic research focusing on providing results of scientific interest. Basic research is intended to be accessible and access to that is usually made via publications.

b) **Applied** which refers to research supported by companies to provide results that will increase their value and make them more competitive in their industry. Companies expect a return on their investment in applied research thus they tend to protect the value of that research by using patents and trade secrets.

In Horizon 2020 Universities and companies are encouraged to collaborate on research projects towards producing higher value research results. Combining those two worlds creates insight diversity connected with a strong background of both academic and industry-related knowledge. Through that collaboration universities are able to expand their scientific interests in more industry specific sectors like telecoms, ICT and biotechnology. On the other hand, companies get to collaborate with high caliber academic institutions that can provide scientific insights, high quality research techniques and methodologies and eventually innovative solutions to industry problems. Small and medium companies usually do not have the knowledge base and the resources to radically innovate. Those actors can benefit from participating in consortiums that engage in research projects since those partnerships provide them with the required capacity to best leverage their own resources towards innovation.

As a result of the Academic-Industry partnership the borders between Basic and Applied research have become quite thin. Research Organizations (RO) are moving from the context of Basic to the one of Applied research, thus publishing research results is being replaced by elaborating patent opportunities. Through that process ROs display an active interest in extracting the optimum amount of value from their research. However, making research results available to the public is still of the essence. The two mainstream vehicles used for that process are patent applications and journal publications. With the advancement of the Information Technology that provided easier and broader access to the Internet, defensive publications and the open access model were added as alternative vehicles for knowledge sharing.

The Open Access Model provides free Internet access to research articles and is considered to be a very effective system for broad dissemination and access to research data and publications thus accelerating scientific progress worldwide. It is a revolutionary policy on access to scientific information that can be structured to also include access policies for private companies. An open access model can be beneficiary for those companies in the

context of facing scientific fraud, enhancing data quality, increasing the value added by the research results and reducing the resources spent on duplicate research.

The process of establishing Open Access requires that every discrete or individual producer of scientific knowledge commits to that purpose by contributing with research results, source materials, digital representations, raw data and meta data. Open access contributions have to meet two conditions [4]:

a) The authors and right holder(s) of such contributions grant(s) to all users a free, irrevocable, worldwide, right to access to and a license to copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose, subject to proper attributions of authorship (community standards, will continue to provide the mechanism for enforcement of proper attribution and responsible use of the published work, as they do now), as well as the right to make small numbers of printed copies for their personal use.

b) A complete version of the work and all supplemental materials, including a copy of the permission as stated above, in an appropriate standard electronic format is deposited (and thus published) in at least one online repository using suitable technical standards (such as the Open Archive definitions) that is supported and maintained by an academic institution, scholarly society, government agency, or other well established organization that seeks to enable open access, unrestricted distribution, interoperability and long-term archiving.

The concept under which the Open Access Model operates is to ensure free, without barriers access to scientific literature for readers. There are two access options provided by the European commission [3]. Commission Recommendation 2018/790 of 25.04.2018 on "An accompanying Commission Recommendation sets out a complete policy framework for improving access to, and preservation of, scientific information" [5].

a) Gold Open access: Articles are immediately made accessible online by the publisher. Up front publication costs can be eligible for reimbursement by the European Commission

b) Green Open Access: Researchers make their articles available through an open access repository no later than six after publication.

The European Commission has suggested that Member States take a similar approach to the results of research funded under their own domestic programs. That step aims to empower the innovation capacity of the EU and provide its citizens with fast, free and unobstructed access to scientific research results.

5G-CARMEN aligns with the context of the Open Access Model and more specifically with the directives of a hybrid Open Access Model. Considering on a case-by-case basis if green or gold open access is to be used.

3.2 OA to Open-Source licensing

The output of several deliverables can include contributions to Open-Source projects. Such contributions could involve contribution in code, documentation, operational management and other processes. A number of partners maintain and develop Open-Source projects under permissive licenses such as MIT, BSD or Mozilla Public License. Open-Source projects in the domain 5G are exceptionally beneficial to the community since they bring the telecommunications technology closer to the public. SMEs especially benefit since they use such projects as a development platform to test and deploy services. The following table is a comparison between Open-Source licenses that will be used throughout the 5G-CARMEN project.

Table 2: Comparison of Open Source Licenses.

Term	MIT	Mozilla Public License	Apache	GNU
Popular	✓	✓	✓	✓
License Type	Permissive	Permissive	Permissive	Strong Copyleft
Jurisdiction	Not Specified	Not Specified	Not Specified	Not Specified
Grant patent rights	X	✓	✓	X

Patent retaliation clause	X	✓	✓	X
Modification	✓	✓	✓	✓
Distribution	✓	✓	✓	✓
Liability	X	X	X	X
Warranty	X	X	X	X
Private Use	✓	✓	✓	✓
Disclose source	X	✓	X	✓

3.3 OA Management of Research Data

Open access to research data refers to the right to access and reuse digital research data under the terms and conditions set out in the Grant Agreement. Research data refers to information, in particular facts or numbers, collected to be examined and considered as a basis for reasoning, discussion, or calculation. In a research context, examples of data include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. The focus is on research data that is available in digital form. Users can normally access, mine, exploit, reproduce and disseminate openly accessible research data free of charge. Open access provides a number of benefits that align with boarder access to research data, such as 1) build on previous research results; 2) encourages collaboration; 3) speed up innovation and 4) involve citizens and society.

Currently, the consortium expects to make most of the 5G-CARMEN research data and dataset openly available. The consortium expects to make the dataset available through the project's repository (which is foreseen to support versioning). 5G-CARMEN will follow two different strategies for self-archiving repository: (1) the project website will host the repository, granting visibility at the end of the project as well; and (2) the consortium will analyze the case of a centralized repository, such as Zenodo repository. In any case, the two options enable third parties to access, exploit, reproduce and disseminate at no cost. The repository is maintained by the project coordinator and access to it is authenticated. Access to the repository will be enabled through a web interface that only allows download of the dataset (i.e. it will not be possible to delete, upload, check-out or commit other files). Figure 5 displays Open access to research data as part of the dissemination and exploitation plan of the H2020 projects.

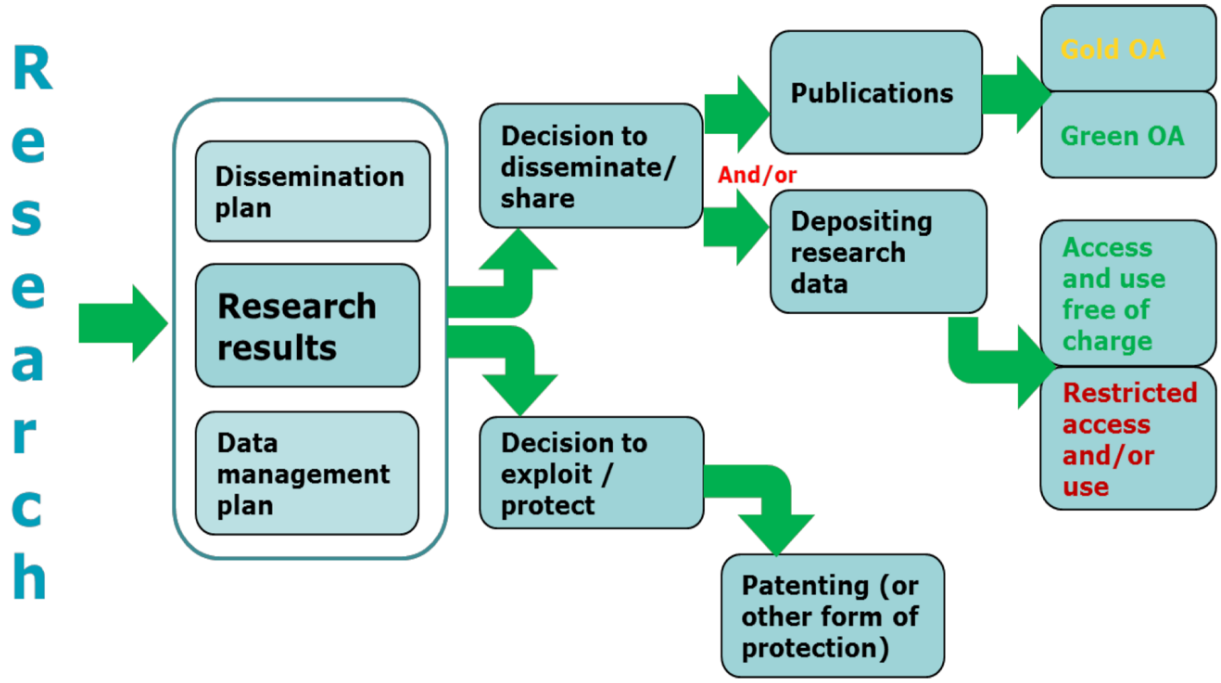

Figure 5: Open access to research data [6]

4 Data Management Plan

4.1 Principles-Guidelines

The European Union enables Open Innovation by encouraging projects funded under the European Union Framework Programme for Research and Innovation Horizon 2020 to provide open access (free of charge, online access for any user) to research data generated in the context of H2020 projects. Starting from projects funded under the 2017 Work Programme, all H2020 projects are encouraged to be part of the Open Research Data Pilot (ORD pilot) in an effort to provide even wider access to scientific facts and knowledge, while also improving and maximizing access and re-use of research data generated therein. At the same time, ORD pilot takes into account the need to balance openness and protection of scientific information, commercialisation and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions. In this direction, the possibility for a project to opt out the ORD pilot is available before project submission or during project execution **Error! Reference source not found.**. The 5G-CARMEN consortium has decided to opt out from the ORD pilot process.

4.2 FAIR data: Requirements and limitations

The data generated during and after all projects should follow the FAIR data principles that require that data are Findable, Accessible, Interoperable and Reusable. These requirements don't affect implementation choices and don't necessarily suggest any specific technology, standard, or implementation solution. In this direction, H2020 project shall adopt methodologies for data generation, collection and sharing so as to ensure the following:

- data are findable due to the exploitation of metadata for convenient data discovery and of standard persistent and unique identifiers (such as DOIs).
- data are openly accessible, where this is possible; adequate justification is required to be provided if otherwise. Towards this, projects shall use methods and tools for providing access to data along with any required complementary pieces of information, such as guidelines for repository access and use.
- data are interoperable and allow for data exchange and re-use among researchers due to the extended and targeted exploitation of standardized data representation formats, vocabularies, etc. or mappings when the former is not possible.
- data re-use is promoted through clarifying licenses.

To ease the application of FAIR data and, therefore, maximise the research data openness, the EC suggests various standards and standardised processes that can be exploited towards the adoption of the FAIR principles **Error! Reference source not found.**. Indicatively, several standardised metadata vocabularies covering a wide set of domains are listed in the Metadata Standards Directory **Error! Reference source not found.**, while EUDAT B2SHARE **Error! Reference source not found.** provides a built-in license wizard that facilitates the selection of an adequate license for research data.

The FAIR principles have been generated with the purpose of improving the best practices for data management and data curation. On top of this, FAIR aims to describe the principles in order to be applied to a wide range of data management purposes, whether it is data collection or data management of larger research projects regardless of scientific disciplines. With the endorsement of the FAIR principles by H2020 and their implementation in the guidelines for H2020, the FAIR principles serve as a template for lifecycle data management and ensure that the most important components for lifecycle are covered. This is intended as an implementation of the FAIR concept rather than a strict technical implementation of the FAIR principles.

The FAIR concept implementation of each project is documented in a Data Management Plan (DMP), which is a key element of good data management. DMPs help shape the data management life cycle principles to be followed by an H2020 project, as described above. Such documents are created during the first 6 months of a project and they are appropriately refined through its course so as to fulfil evolving requirements. The 5G-CARMEN consortium is expected to adhere to the conditions laid out in the 5G-CARMEN Data Management Plan below, in which all details related to management of 5G-CARMEN research data are specified.

4.3 DMP structure

The use of innovative information technologies raises many questions concerning the right of individuals to determine how their personal information may be used. We, as 5G-CARMEN, consider this right to be of immense importance. Data protection issues when handling the personal data of test drivers, collaborators and partners will be taken into account. Personal details will only be recorded, processed or used if this is permitted by law or if the person involved has given permission. We are committed to the principles of sparing use of personal data and transparency in data processing. In order to accomplish this, we have a detailed Data Management Plan (DMP) in place. This approach ensures a consistent and appropriate level of data protection throughout 5G-CARMEN project.

Our DMP consists of a living document which describes the data management life cycle for all data collected, processed and generated in a H2020 project. This plan outlines how data will be created, managed, shared and preserved throughout the project, providing arguments for any restrictions which apply to any of these steps. Data protection involves data which is either in digital or physical form. This DMP aims to prevent unauthorized disclosure of information, which can occur in many different forms: release, transfer, dissemination, or other communication in an oral, written, electronic, or any other way. A potential recipient of unauthorized information could be any person or entity. This DMP will also provide a set of guidelines to minimize the impact and provide auditability in case this is required.

There are five technocentric categories that can define the life cycle of Critical Information Data: 1) Creation; 2) Storage; 3) Usage; 4) Transmission, and 5) Deletion. Figure 6 illustrates the life cycle of critical data inside an organization.

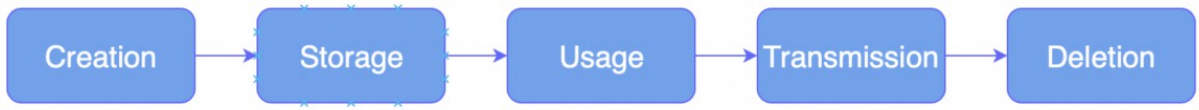

Figure 6: Critical Data lifecycle

The processes which will be implemented in relation to data protection are divided into the following categories:

- Storage of digital data
- Storage of physical data
- Sharing of data
- Data disposal, deletion and destruction

4.3.1 Storage of digital data

Securing stored data involves preventing unauthorized people from accessing it as well as preventing accidental or intentional destruction, infection or corruption of information. While data encryption is a popular mechanism, it is just one of many techniques and technologies that can be used to implement a tiered data-security strategy. Steps to secure data involve understanding applicable threats, aligning appropriate layers of defence and continual monitoring of activity logs taking action as needed. This means that a multi-tier approach needs to be adopted from all the partners.

The proper method of storage and the appropriate community along with levels of access for privileged users are important considerations for comprehensive protection. Improperly stored information along with overly permissive accounts are a centralized theme in many high-profile breaches. Partners within the 5G-CARMEN will follow a specific set of guidelines to comply with the project's main requirement for storage of digital data.

Term	Description
Requirement	**Data-in-storage must be protected from unauthorized access, modification and loss.**
Measure to be implemented by all partners	• Data availability must be guaranteed. • Confidential data must be stored using access protection. • Strictly confidential information must only be stored in an encrypted mode • Confidential data must not be stored in online services that are not approved by the 5G-CARMEN Consortium. • Any exception from this measure must explicitly be approved • Modifications to data with high integrity requirements must be documented and approved by the partners.

4.3.2 Storage of physical data

Physical data refers to data assets which are physically manifested, such as paper documents or the physical manifestation of digital assets, such as printed copies of emails. Physical data has unique challenges when it comes to its protection. An important security factor of physical data is where it is physically located. Locations with poor physical security greatly increase the likelihood of data compromise. A significant challenge is that the physical data cannot be accessed in a controlled and encrypted way, in the same manner as their digital counterparts. Physical data usually displays information in plain text, which can be deciphered by any malicious onlooker. Therefore, it is important to implement a number of security processes when accessing and modifying it, in order to comply with 5G-CARMEN's security requirements.

Term	Description
Requirement	**Storage of physical data must be protected from unauthorized access, modification and loss.**
Measure to be implemented by all partners	• Physical access to confidential data must be access controlled. • Physical access to confidential data must be recorded. • Physical data when replicated or copied must be clearly indicated as a copy. • A record of copies of physical data must be kept.

4.3.3 Sharing of data

Data sharing in the context of 5G-CARMEN refers to the process of making confidential data available to authorized partners. To prevent impact on the confidentiality and integrity of data while it is being shared, a set or processes will need to be adopted between all partners. The processes not only improve the integrity and confidentiality of data, but also the auditability trail in cause of compromise. Shared confidential data is often copy-protected to prevent the creation of unauthorized copies from malicious actors.

Term	Description
Requirement	**Data must only be exchanged in the context of a legal framework, and/or research need and while ensuring confidentiality.**
Measure to be implemented by all partners	• For the exchange of confidential data, only services approved by 5G-CARMEN must be used. This applies in particular to online services. • Strictly confidential data sent by email must be encrypted. • Encryption/Decryption keys and other access mechanisms need to be communicated between the partners in a secure manner. • A process will be implemented to rotate keys and access controls in case of compromise.

4.3.4 Data disposal, deletion and destruction

Protecting confidential and sensitive data from accidental disclosure is of paramount importance. A key area in data security is the disposal of confidential data, in both electronic and paper formats. Confidential information discarded in the trash or recycling bin is legally and effectively open to anyone. Additionally, so is any data stored on discarded or donated computer technology, like hard drives and thumb drives, once the devices are thrown away or donated to charity. Electronic data kept beyond its usefulness invites mischief or accidental breach. The secure disposal, deletion, and destruction of data aims to make data unrecoverable from other parties.

Term	Description
Requirement	**Data which is no longer needed* must be disposed of, deleted or destroyed (**Not needed means not needed for research processes and not subject to the time period for storage).
Measure to be implemented by all partners	• Confidential paper documents which are no longer needed must be disposed of using data protection boxes or shredded. • Confidential data which is no longer needed must be (securely) erased. • Data storages of mobile end devices and data carriers which are no longer needed must be (securely) erased. • If it is not possible to erase data storages of mobile end devices or data carriers then the end device or the carrier must be destroyed. • Tamper-resistant hardware platforms such as secure elements, secure enclaves, SIMs, etc., which are used to store confidential data must be destroyed.

4.4 Ethics

The 5G-CARMEN consortium is to respect the framework that is structured by the joined provision of:

a) The European Regulation 2016 regarding "Protection of natural persons with regard to the processing of personal data and on the free movement of such data" [10]

b) Horizon 2020 Ethics guidelines [11]

The 5G-CARMEN project partners will abide by professional ethical practices and comply with the Charter of Fundamental Rights of the European Union.

An extended analysis regarding data protection and ethical issues and requirements can be found at D1.1 and D1.2 that address the following points relative to the DMP:

- Processing of personal data (D1.1 section 2.2)
- Data protection of voluntary interviewed participants (D1.1 section 3.1) which includes a description of the processes of
    - Obtaining consent
    - Recording and storing consent
- Particular categories of personal data (D1.2 section 3)
- Data protection officer (D1.2 section 5)
- Protection of personal data in 5G-CARMEN (D1.2 section 6)

References

[1] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm

[2] 5G-CARMEN Project Deliverable D8.1, "Project Management Handbook", February 2019

[3] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/open-access_en.htm

[4] Berlin Declaration to Open Access to Knowledge in the Sciences and Humanities

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0790

[6] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

[7] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf

[8] http://rd-alliance.github.io/metadata-directory/

[9] https://b2share.eudat.eu/

[10] https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32016R0679

[11] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/ethics_en.htm