

Connecting Data Providers with Data Consumers: the 5GMETA Data Monetisation Framework

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Abstract—Vehicles produce a large amount of data which, together with the possibility offered by 5G, creates new opportunities for the development of applications and services. In this context, the 5GMETA Platform aims to establish a vehicle data monetisation environment taking advantage of the 5G-enabled low latency and faster communication between data sources. Data providers will easily make vehicles' data available according to current technical standards; Data Consumers will quickly and securely access high-quality data to design and develop new products and services. In both cases, data monetisation will create opportunities for companies' growth and for an improved quality of service for end users of mobility. The paper presents the business model for the market uptake of the 5GMETA Platform.

Index Terms—Data Monetisation, 5G, Business Models, Data Consumer, Data Producer

I. INTRODUCTION

Vehicles capture and generate large volumes of data about the driving dynamics, the environment, and the driver and passengers' activities. With the increased proliferation of connected and automated mobility applications and 5G/Beyond 5G networks which enable faster and easier access to information, the value of data from vehicles is getting strategic.

In this work, we describe the business model to commercialise a platform for data monetisation developed in the context of 5GMETA (Monetising car & mobility data for new Entrants, Technologies and Actors), an H2020 project running from September 2020 to February 2024. The 5GMETA Platform aims to leverage car-captured data to stimulate and facilitate the development of innovative products and services, exploiting the capabilities of the 5G network infrastructure. 5GMETA is a Platform as a Service (PaaS) solution consisting of an open, modular, flexible and trusted platform providing Internet of Things (IoT) messaging for Cooperative, Connected and Automated Mobility (CCAM) services and applications. The large amount of data that a single connected car can produce makes it not easy to deploy a centralised cloud-based solution that stores all data captured from many vehicles and make them available to external applications or services. A more sustainable and realistic approach would involve a platform for live data delivery. The 5GMETA Platform provides exactly this solution which consists of live

data delivery that allow users to continuously receive the data from the subscribed dataflows, with no storage service but the required memory buffering.

The paper is structured as follows. Section II briefly reports on the main works on data value, revenue streams and business models. Section III describes the data monetisation framework of the 5GMETA Platform, and section IV the proposed business model. Finally, section V reports some business opportunities for the 5GMETA Platform and Section VI outlines the conclusion.

II. LITERATURE REVIEW

The literature on data monetisation is mainly related to the value of data, data revenue stream and business models for data-driven applications and services.

According to [1], among the five dimensions of big data¹ [2], the value of data received less attention. In this regard, the authors made some examples of the high return of investments obtained when companies transformed raw data into a valuable source of information (i.e. Facebook semantic search engine based on natural language processing instead of keywords). Although the quantity of data is increasing, it is difficult for organisations to create value. The main difficulty is the generation of strategies. An analytical process to define strategies for data monetisation might consist of the following steps: define the business needs and relevant data, data preprocessing and descriptive statistics, model fitting, validation, results interpretation and visualisation [3].

In [4], the authors analysed how to create value from data in the automotive sector using the Vehicle Data Value Chain (VDVC) proposed by [5] and adapted from [6]. The VDVC consists of six stages: data generation, data acquisition, data preprocessing, data analysis, data storage, and data usage. Furthermore, it is possible to use data-enabled vehicle information systems before, during or after the trip or from inside the car or outside. However, [7] pointed out that data value is not an appropriate term for non-tangible products and proposed a Data Value Network (DVN). In the context of the DVN, the Demand and Supply as a Service (DSAAS) allows matching

¹volume, variety, voracity, velocity and value

demand and supply of data, finding datasets, informing on the dataset and their potential use and fostering the collaboration between actors.

The value proposition which is one of the components of the Business Model Canvas [8]², consists of products and services that generate value for a customer segment. In this regard, the value proposition map [9] implies identifying the pain relievers and gain creators for each product and service. The gain creators describe how the product and service create value (benefits) for the customer; the pain relievers describe how the product and service can help the customer to relieve the pain. For instance, in [10], mobility monitoring systems (product and service) allow optimizing traffic flows (gain creators) to address problems solved in a smart city (pain relievers). In [11], the authors propose a value proposition map based on Canvas to generate value from the Internet of Things (IoT). According to the authors, extracting knowledge from data generates value. Therefore, they identified applications in data mining and defined their value proposition.

In [12], the authors present a set of revenue models for data-driven services. The first possible revenue model introduces a *fee* to use the service or transfers the service or product ownership (*asset sale*). In the *subscription model*, the customer pays to access the service and can use it until the subscription is valid. In the *lending, renting or leasing* framework, the use of the asset and the related intellectual property is granted to the user for a limited period. *Advertising* implies that there is a fee for publicising products and services. There are also matchmaking platforms that facilitate the transactions between actors. In this case, a third party receives a payment (*brokerage fee, commission or transaction cut*). Lastly, the use of the service can be *free*. The proposed business model will consider these possible revenue schemes. Finally, the analysis of the key players operating in the market reveals two main categories of connected vehicle platforms: big corporates that focus their business model on the direct benefit for vehicle manufacturers and suppliers (e.g., enhancing customer experience) and small and medium enterprises whose business model focuses on the value created from data.

III. DATA MONETISATION IN THE 5GMETA CONTEXT

Data monetisation refers to measurable economic benefits from available data sources. It can also refer to the act of monetising data services. There are two primary paths to data monetisation. The first is *internal* and focuses on leveraging data to improve a company's operations, productivity, products and services. The second path is *external* and involves creating new revenue streams by making data available to customers and partners. Accordingly, the 5GMETA platform allows connecting Data Producers and Data Consumers, thus adding value to produced data. This can satisfy the needs of Data Consumers to access data for the services development and policies and the needs of Data Producers to exploit available

data. For both categories, the first and second paths of data monetisation are possible with the 5GMETA Platform.

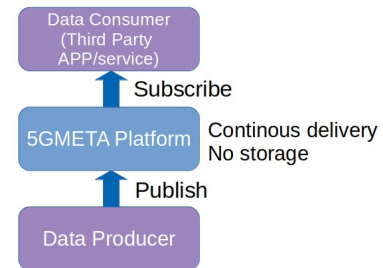
A. Data Providers and Data Consumers

Data Providers are those that will provide data to Data Consumers through the 5GMETA Platform: they will have a direct data monetisation benefit through the platform since – through it, they will have an economic advantage. They can be data owners if the data source is owned. All the potential "5GMETA Platform Operators" belong to this category (i.e., those organisations that collect data from data owners through independent agreements and use the 5GMETA Platform for data monetisation purposes). In this category we can mention Original Equipment Manufacturers (OEMs), road operators, cities, etc. *Data Consumers* are all actors that make use of the data processed through the 5GMETA Platform with the goal of creating new products and services. Data Consumer have also a data monetisation benefit, as they will have economic returns by selling data-enabled products and services to their customers. In this category, we can mention mobility service providers, application or service developers, insurance companies, start-ups and innovative SMEs, researchers, etc.

In some cases, the two categories can coincide. This is the case, for example, of vehicle manufactures that own data from vehicle sensors and want to consume processed data to develop new services or new products addressed to their clients. Another example is given by cities or municipalities that own sensors and – thanks to the 5GMETA Platform ability to process data – are willing to develop a new service for citizens.

The simplest case is depicted in Figure 1, in which one Data Consumer (a third-party application or service) subscribes to a dataflow, and a single registered Data Producer publishes data to this dataflow.

Fig. 1. Essential functionality of the 5GMETA Platform: connecting Data Producers and Data Consumers. Example with one Data Producer and one Data Consumer.



The 5GMETA Platform is a broker between Data Producers (vehicles or roadside units) and Data Consumers (third-party applications or services). However, the 5GMETA Platform is not a simple publish-subscribe broker, it also provides functions for data management, data monetisation, cybersecurity and data access. 5G, Cloud and Multi-access Edge Computing (MEC) are the Key Enabling Technologies (KETs) for this vehicle data monetisation framework.

²customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure

B. Data Monetisation through the 5GMETA platform

We can imagine the 5GMETA Platform as an enabler of a marketplace, where Data Producers and Data Consumers are able to interact. Therefore, the 5GMETA Platform satisfies the simple principle that Data Providers have data that they want to monetize, and Data Consumers can create new services with data provided by Data Providers.

Fig. 2. The 5GMETA Platform data value chain.

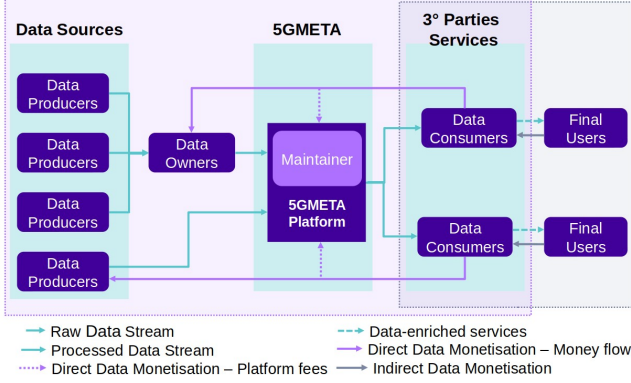


Figure 2 shows an overview of the data value chain (blue arrows) and of the data monetisation flows (violet and grey arrows). Data providers have interest in monetising their data. Therefore, they make their raw data available through the 5GMETA Platform to potential data consumers. The 5GMETA Platform, through its services and functionalities, processes such raw data (without storing it) and provides it to Data Consumers. Raw data is now enriched data. Data Consumers will make use of enriched data to develop new services to be addressed to final users of mobility data.

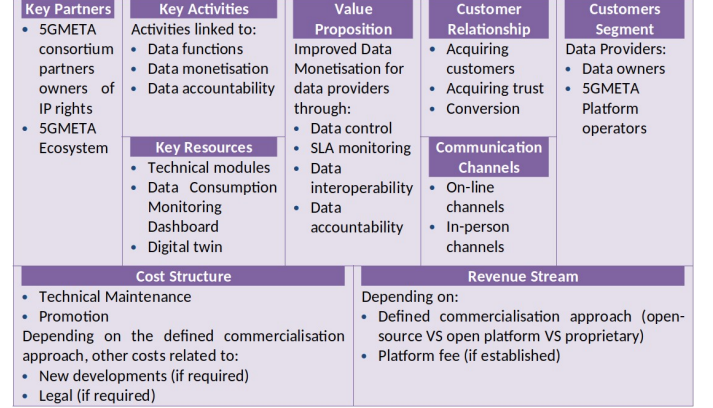
The main monetisation flow is represented by the unbroken violet arrow which shows money flows that Data Consumers are going to pay for enriched data. Such payment is addressed to Data Providers, who have a direct monetisation benefit. The amount of such money flow will be defined by the Data Providers themselves based on individual agreements independently done with data owners.

The dotted violet line represents a platform fee that may be introduced for covering the 5GMETA Platform costs, or as a source of revenue for the 5GMETA Platform Maintainer. The platform fee will strongly depend on the business decisions of the organisation that will manage the actual exploitation of the 5GMETA Platform. For instance, it may be decided that the platform fee will be zero for all customers segment, or that it will be a percentage linked to the data transferred or fixed based on a subscription model or based on the category of data consumers. This platform fee is considered as a direct data monetisation benefit for the 5GMETA Platform Maintainer. The grey arrow represents the potential money flow addressed to the data consumers who, thanks to the enriched data, have developed new products or services that will be “sold” to their clients. In this case, we will call such flow as an “indirect monetisation” flow enabled by the 5GMETA Platform.

IV. BUSINESS MODEL FOR THE 5GMETA PLATFORM

The main goal of the 5GMETA Platform is to allow Data Providers of the automotive sector to monetise data by taking advantage of the 5G-enabled low latency and faster communication between data sources. These data can serve different scopes, especially when combined with other sources of information, such as infrastructure data, geographical data, or weather data.

Fig. 3. The 5GMETA platform business model.



We describe the high-level strategy for the future follow-up and commercialisation of the 5GMETA Platform through the Business Model Canvas (see Figure 3) which defines the uptake of the platform by Data Providers (including data producers and data owners), i.e., all those actors to which we refer in the left side of Figure 2.

A. Value Proposition

The design of the 5GMETA Platform allows for transformation and monetise a vast volume of data. It considers internationally accepted standards and specifications from the players in 5G standardisation, such as the 5G Automotive Association (5GAA), 3rd Generation Partnership Project (3GPP), 5G Infrastructure Public Private Partnership (5G PPP), and European Telecommunications Standards Institute (ETSI). The 5GMETA Platform ensures secure and private mass data distribution from several sources. Concerning data ownership, the data owners have complete control of their data, sharing and utilisation. The 5GMETA Platform facilitates the Service Level Agreements management and monitoring between Data Providers and Data Consumers. It ensures interoperability thanks to standards and APIs to ease the universal processing of CCAM services and applications. Finally, the 5GMETA Platform allows accountability of the consumed data through a “Data Consumption Monitoring Dashboard” that configures service and application subscriptions.

B. Key Partners and Customers of the 5GMETA Platform

The customers of the 5GMETA Platform are Data Producers (i.e. data owners) and – in general, all the potential 5GMETA Platform operators (i.e. all those who could provide and share data through the 5GMETA Platform). Data owners, especially

OEMs, must have good motivation to share vehicles' data through the 5GMETA Platform. A risk could be the unwillingness of data owners to share data: the approach to attract them shall lead to win-win situations.

The 5GAA White Paper³ identifies five examples of stakeholders' collaboration models relevant to 5G Connected and Automated Mobility (CAM) infrastructure deployment and use. Based on the White Paper, a preliminary roadmap for the uptake of the 5GMETA Platform by stakeholder communities can consist of three steps.

- 1) The first step is acquiring customers and increasing awareness in the initial phase. This objective implies implementing strategies to get stakeholders aware of the 5GMETA Platform such as promoting 5GMETA among other stakeholders across Europe and new community user groups in different domains.
- 2) The second step is to activate and acquire the trust of existing communities and enrich the customers' experience. It implies providing customer support during the usage of the 5GMETA Platform services and providing an onboarding program to users of the 5GMETA Platform services. The onboarding program should include tutorials and webinars to help users understand the platform and its features.
- 3) The third step is to convert users into customers. Every business-customer relationship aims to generate interest, drive engagement, build a bond with the platform and funnel all of it into successful conversions. To foster a strong customer relationship in the long run, open access to the 5GMETA Platform can encourage the adoption of the tool, enabling the creation of new products and services thanks to the feedback and recommendations of users.

C. Channels and Customer Relationships

The strategy to ensure that potential customers uptake the 5GMETA Platform is the communicate and disseminate the 5GMETA Platform through online channels. The primary online touchpoint is the 5GMETA website, containing all the information about the platform, the upcoming and past events, promotion material such as target group flyers, webinars, emails, e-blasts, social media channels, journals (such as 5G-PPP Annual Journal). Furthermore, it is fundamental to implement leadership activities to push policymakers to facilitate the deployment of the required connectivity infrastructure. More importantly, regulatory bodies should promote and regulate the data-sharing culture to motivate and incentivise OEMs to share data. Further relevant events (congresses, hackathons) shall promote the 5GMETA Platform and establish in-person interaction with the platform.

D. Key Resources and Key Activities

The 5GMETA Platform can count on the functionalities provided by its technical modules and on the tools that will

support and enforce its usage. The technical assets of the 5GMETA Platform are the most relevant resources of the business model. In general, the key activities of the 5GMETA Platform, related to the data functions, are the data processing (aggregation, anonymisation, conversion), data privacy and security management (preserving access to data and services, trust on different infrastructures and local components), data and metadata normalisation, accountability, management of APIs and data slicing management.

5GMETA is a solution consisting of an open, modular, flexible, and trusted platform providing IoT messaging for CCAM services and applications. More specifically, Table I describes the functionalities of the 5GMETA Platform to facilitate data monetisation for data owners.

TABLE I
FUNCTIONALITIES OF THE 5GMETA PLATFORM.

1	Metering of the processing assets in the MEC allocated for a third-party application considering the contracted computing instance type.
2	Metering of the volume of data received from or sent to the 5GMETA Cloud Platform.
3	Metering of the volume of data received from or sent to the 5GMETA MEC Platform by third-party applications hosted in a MEC.
4	Registering the consumption of individually licensed dataflows.
5	Expanding the license models to cover more business cases.

A *Data Consumption Monitoring Dashboard* comes with the 5GMETA Platform and allows accomplishing monetisation activities for data producers and data consumers.

E. Budget Structure of the 5GMETA Platform: Cost and Revenues

The budget is relevant because it drives the organisation's funding. It will tell stakeholders how much money is needed and when it is needed. The capability to gather people, equipment, and materials depends on the expected revenues. Second, a budget provides the basis for activity cost control. By measuring the actual cost against the approved budget, members can determine if the 5GMETA Platform is progressing according to the plan or if corrective actions are needed. The cost and revenues of the 5GMETA Platform influence its sustainability.

The 5GMETA Platform requires considering the main existing approaches for commercialising software. Commercial software is produced for sale and serves commercial purposes. Commercial software can be proprietary software or free and Open-Source Software (OSS). OSS implies that a source code is freely available for possible modification and redistribution because the copyright holder grants users the rights to use, study, change, and distribute the software and its source code to anyone and for any purpose. On the other hand, proprietary software is "non-free" because its creator exercises a legal monopoly thanks to copyright and intellectual property law to exclude the recipient from freely sharing the software or modifying it.

Among the possible choices, there is the possibility of an open platform. In computing, an open platform describes a software system based on open standards, such as published

³https://5gaa.org/content/uploads/2019/07/5GAA_191906_WP_CV2X_UCs_v1-3-1.pdf

and fully documented external application programming interfaces (API) that allow using the software to function in other ways than the original programmer intended, without requiring modification of the source code. A third party could add functionalities using these interfaces. An open platform can consist of software components or modules that are either proprietary or open source, or both. A developer could add features or new functionalities that the platform vendor did not previously conceive. An open platform allows the developer to change existing functionality, as the specifications are publicly available open standards.

The 5GMETA Platform could consider four different commercialisation strategies which strongly influence the business model for the 5GMETA Platform.

- 1) The 5GMETA Platform can be proposed both as an open-source software (in a version for technical experts) and as a proprietary software (in a version for non-technical experts).
- 2) The 5GMETA Platform could be an open platform, made of both proprietary and open-source modules (each module of the platform will be clearly defined according to their open-source or proprietary nature).
- 3) The 5GMETA Platform can be an open platform with only open-source modules.
- 4) The 5GMETA Platform can be mainly an open-source software. If customers require additional functions and services, these shall be paid.

The cost and revenue structure will depend on the choice between the different commercialisation approaches presented above. In all cases, there is a cost related to technical maintenance. If the platform includes additional or personalised features, there will be additional costs for the technological development, personnel and other infrastructure or systems. If there is a need for some proprietary software, there may be the need to consider costs linked to the protection of Intellectual Properties (IPs). Other costs are related to the promotion, advertising and the potential legal expenses that may be incurred (e.g., for managing contracts and agreements linked to IP Rights management).

The revenue stream structure includes the initial investment provided by the European Commission (till the end of 2024). In the case of an open-source model, customers can install the software for free. If there are additional or personalised features, these can be provided in exchange for a fee. If there are proprietary features, it will depend on the owner's choice. The choice of establishing a platform fee depends on the commercialisation model. Other revenue streams are advertising, sponsors, donations, and additional public funding.

V. OPPORTUNITIES ENABLED BY THE 5GMETA PLATFORM

The 5GMETA Platform provides services that allow data owners to have economic returns from data they offer to third parties. As a result, by facilitating the interactions between data owners and data consumers, the 5GMETA Platform establishes a marketplace ecosystem based on value-added

data. The facilitated exploitation of available mobility data through the 5GMETA Platform will have additional positive externalities for society, mainly due to the improved service offered by third parties Data Consumers and facilitated collaboration between different actors. The involvement of new players in the CCAM ecosystem remarkably contributes to economic development.

There are several stakeholders who benefit from the monetisation of vehicles' data. Data can generate new revenues, reduce customers' related costs, improve customers' satisfaction and increase safety and security [13], [14].

TABLE II
OPPORTUNITIES OF THE MONETISATION OF VEHICLES' DATA THANKS TO THE 5GMETA PLATFORM.

Stakeholder	Opportunities
OEM	Sell connectivity-related options and services (infotainment, navigation) and offer more customer-tailored services.
Insurers	Improve their offering thanks to a better understanding of the drivers' behaviours.
Roadside assistance providers	Manage distress calls in real time from vehicle sensors and automated alerts, optimise the dispatching of rescue vehicles, and analyse accident data.
Infrastructure operators (e.g. billing road operators and recharging players)	Optimise the geographic deployment of their services.
Start-ups and application developers	Create new applications and interfaces.
Mobility providers and fleet management firms	Improve vehicle allocation, recharge and fleet operations.
Retailers and service centres	Use vehicle data to optimise sales networks.
Public sector	Improve urban traffic management and road safety.

Table II shows some examples of opportunities of the monetisation of vehicles' data thanks to the 5GMETA Platform.

A. Opportunities for 5GMETA use cases and from hackathon ideas

During the 5GMETA Project, three use cases have been studied and the enabled business opportunities and commercial ideas have been defined. The R&D Live Training Loop is about using vehicle data in real-time for R&D purposes without downloading them. The use case Networking Parking analyses sensor data using 5G technologies, such as edge computing, slicing, etc. Driving Safety & Awareness provides emergency services and information related to safety, such as road conditions. Moreover, during the first 5GMETA hackathon (Turin, 2022) concrete examples of how the platform can be used were discussed: participants proposed innovative solutions involving the 5GMETA platform in the context of one of three challenges: comfort and safety of road users; roads and mobility of the future; user-centric services. For each use case and hackathon commercial idea, business models have been designed based on the traditional business model Canvas scheme [8]. From these, it emerges the opportunity to

fully exploit the amount of data generated in this industry and what innovation the 5GMETA Platform can bring to potential business cases.

Regarding the value proposition of new services, the gathering, transmission and aggregation of large amount of available data from connected vehicles and other connected sensors is the engine of all innovative 5GMETA-enabled business models. All this is possible thanks to 5G network capabilities.

The repeated need to use the MEC architecture for high-performance computing and low-latency applications is a key resource. Lastly, OEMs will need a standard way of acquiring and sharing data in a secure and cost-efficient environment. Therefore, they should not create their ecosystem. Tier 1 suppliers, especially sensors producers, have interest in acquiring data to improve their processes and pursue new business venues, such as additional services based on data analysis and data reporting. Communication service providers can facilitate better connectivity and partnerships when it comes to 5G communications through vehicles or even user data from smartphones. Furthermore, Universities and Research Institutions have a great interest in these technologies and have the capabilities to shape technology, optimise it and introduce new applications and use cases in society.

VI. CONCLUSION

The paper has addressed the potential approaches for the uptake of the 5GMETA Platform to leverage car-captured data and stimulate and facilitate the development of innovative products and services. The proposed business model evidences the potential economic impacts of the platform. However, there is a need for a potential risks and barriers assessment related to the 5GMETA Platform introduction in the market and to consider the competition with other products, mainly platforms created and owned by OEMs, and the establishment of the initial customer base. Data Producers, especially OEMs, are not easily convinced to share data with external platforms. Furthermore, the regulation does not help in this direction (e.g., GDPR or privacy issues) because of unclear data ownership regulations.

A competitive advantage of the 5GMETA Platform will be the linkage to the EU Horizon Europe programme, the 5G PPP partnership, the CCAM Association and the support by EU policy and industrial bodies. Data Producers connected during the project duration, e.g., the actors involved in demo sites and actors engaged through the dissemination strategy, are the initial customer base. From the technical perspective, the well-documented 5GMETA Platform APIs allow the integration with the most used cloud platforms. A communication strategy emphasising the 5GMETA Platform's capabilities to enhance data monetisation and to optimise and decrease company costs related to data monetisation will help deal with the potential reluctance to make data available through the 5GMETA Platform. Key communication messages will highlight the 5G and MEC availability, the provision of data licencing opportunities, and the functionalities for data integrity, security, and availability. In addition, lobbying and standardisation activities may

also support the new technologies adoption. On one side, the 5GMETA Platform strongly relies on existing standards; on the other, the uptake strategy will push 5GMETA as a standard way to exchange automotive data. In this regard, there is a need for strong collaboration and feedback iteration processes with relevant regulatory bodies.

Finally, this paper highlighted how the 5GMETA platform provides services that allow data owners to have economic returns from data they offer to third parties. The business case analysis helped to identify revenue typologies and the related benefits and impacts for the involved stakeholders.

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