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Foreword

This Technical Report (TR) has been produced by ETSI User Group (USER).

Modal verbs terminology

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Introduction

The present document has been produced by the STF 543 experts.

The concept of the full Project is to define 5-dimension model called "**ACIFO" The 5-dimension model is based on 5 sub-models defined as:**

- Architectural Model "**A**cifo": defines the global structure, including semantics and is optimized for the stated objectives.
- Communication (Relational) Model a**C**ifo: defines the exchange protocols, including HMIs (User) and APIs (provider) exchange and management protocols over three planes:
  - Management (Monitoring)
  - Control
  - Usage
- Information Model ac**I**fo: defines the different Profiles (User, device, service). The information covers the whole ecosystem (equipment, network, applications, services, HMIs, User, etc.) from the offer to the resources availability for Users, Providers and any other partners. It is a knowledge data base representing the whole ecosystem.

- Functional Model aci**F**o: defines services and service composition. The functionalities (the process) to compose any service based on "micro-service".

- Organization Model acif**O**: defines the role of any actor and which actor is responsible of each action. ("Who is doing what?").

These five dimensions should be shared by the user and the supplier/provider. For the user, it should be possible to define (or to choose) the level of autonomy and control for the personalized composition of services.

The four deliverables produced by STF 543 define the different dimensions:

- ETSI TR 103 438 (the present document) focuses on the Architecture and the Organization:

  - It includes the use cases and the results of the survey.

- ETSI EG 203 602 [i.5] focuses on the information and the functionalities:

  - It is dedicated to the user. It provides analysis and recommendations from the information and functionalities.

- ETSI TR 103 603 [i.6] addresses all the dimensions to the supplier, in order to produce the APIs according to the user expectations and whatever the number and types of additional suppliers.

- ETSI TR 103 604 [i.7] focuses on the communication and in particular on the HMIs.

For example, for Energy (production, distribution, consumption), the supplier will create an API for the user. The information will be exchanged between the supplier and the user but will not be used only by the supplier: the user will have access to all the information and will be able to use this information to optimize their energy consumption. This data base is a source to provide new services and new applications (for the user and for the supplier). One major challenge and constraint is to ensure that all the private data may be checked and monitored by the user (the contract needs to define clearly these points). The data are not used only by the supplier, the user should have access to the data and may refuse that the data be used or known → an interaction "cursor" between the user and the supplier defines the freedom (GDPR [i.8]).

The present document presents a new user environment based on a composition of personalized services. The structure of the present document is following:

- User context evolution to user at the heart of architecture (clause 4).

- User experience, maturity and expectations (clause 5).

- Overview, guide and reports objectives (clause 6).

- Ecosystem digital identification based on typical use-cases (clause 7).

- New vision illustrated by digital use cases for personalized Service composition and Interactions (clause 8).

1 Scope

The digital ecosystem includes all sectors of activity in which the user through smartphone, and objects are connected, that is to say capable, in addition to their main function, to send or receive information via a telecommunication network which allows to extend or diversify the functions of the smartphone and the object.

Connected objects fall, for example, in the fields of transport (connected vehicle), health (connected self-measurement), industry (connected tools), home automation (interactive electricity meter) or even daily life (connected watch).

This is why the notion that interests us in the digital ecosystem is that of considering that the user is at the heart of the architecture.

The present document focuses on the Architecture and the Organization dimensions of ACIFO, including User's QoE.

The present document details the following aspects to achieve a generic model:

- Overall results of the survey intended to collect information about user's experience, expectations and behaviours.
- User centric usages in digital ecosystem.
- New vision of digital "use cases".

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 301 549: "Accessibility requirements suitable for public procurement of ICT products and services in Europe".

[i.2] ETSI TR 103 304: "CYBER; Personally Identifiable Information (PII) Protection in mobile and cloud services".

[i.3] ETSI TR 103 309: "CYBER; Secure by Default - platform security technology".

[i.4] ISO 20000-1: "Service management system requirements".

[i.5] ETSI EG 203 602: "User Group; User Centric Approach: Guidance for users; Best practices to interact in the Digital Ecosystem".

[i.6] ETSI TR 103 603: "User Group; Guidance for providers and standardization makers".

[i.7] ETSI TR 103 604: "User Group; User centric approach Qualification of the interaction with the digital ecosystem".

[i.8] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

ACIFO: 5-dimension model, based on recommendations and common objectives for Users and Providers, giving the capability for the User to compose the needed services

NOTE: The 5-dimension model creates one unique and integrated solution.

micro-service: basic and simple service (with SoA properties) that be combined for the composition of services as expected by the User

NOTE: The basic concept behind this term is that each service performs a unique feature (e.g. for security, "authentication" is a micro-service, for discovery, "find" is a micro-service).

user-centric: user who is the heart of the ecosystem

NOTE: This means that the user constrains the whole environment, unlike other contexts where that is the application (application-centric), or network (network-centric) or the system (system-centric) which constrains the context.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

2FA	Two Factors Authentication
ACIFO	Architecture, Communication, Information, Functionality, Organization
API	Application Programming Interface
BYOD	Bring Your Own Device
CCTV	Closed-Circuit TeleVision
CES	Customer Effort Score
DNS	Domain Name System
GDPR	General Data Protection Regulation
GPS	Global Positioning System
GSM	Global System for Mobile communications
HMI	Human Machine Interface
HTTPS	HyperText Transfer Protocol Secure
IoT	Internet of Things
IP	Internet Protocol
IT	Information Technology
ITS	Intelligent Transportation System
M2M	Machine to Machine
NFC	Near Field Communication
NGN	New Generation Network
OS	Operating System
Paas	Platform "as-a-service"
PC	Personal Computer
QoE	Quality of Experience

QoS	Quality of Service
TV	TeleVision
UX	User eXperience
VM	Virtual Machine
WIFI	WIreless FIdelity
WLAN	Wireless Local Area Network

4 Nowadays User context

4.0 Introduction

The digital ecosystem should respond to new user requirements: "anywhere, anytime, anyhow, every service, everyone". The following question is asked: what are the conditions to achieve maximum agility and flexibility of services?

The evolution of architecture to "user centric" (clause 4.1) and to the new paradigm "as a service" in digital ecosystem (clause 4.2) defines a new user digital context.

4.1 Evolution of the context with the concept "user centric"

The first important notion of the context of the present document is that of "User-Centric" in a digital ecosystem. That is to say that this user is above all elements. First, the users want to be able to connect to several seamless heterogeneous networks to access the services. Connectivity does not stop at link establishment, connectivity does not just mean maintaining the link, but it should allow the user to be easily connected at all times during their moving, to any network for which having the rights of access and from any terminal.

The main impact of this approach is that the ecosystem is in the service of the user, unlike other approaches where the user should comply with different processing constraints (System Centric) or application (Application Centric), or more connections (Network Centric).

Indeed:

- "System Centric" (figure 1, (a)) is based on the OS (Operating System) supported by the hardware where it is installed. The applications run parallel on this OS thanks to the "Compiler" which makes the translation and the static optimization to have a better execution of service. Although today, it should be noted that to avoid re-translations for an application because of OS changes, virtualization (VM - Virtual Machine) is proposed to hide the heterogeneity of OS. With this middle layer (Hypervisor), applications can be used on any OS.
- "Application Centric" (figure 1, (b)) focuses on the application and considers it as the starting point. The whole process takes place, from the point of view of the application, without taking into account the preferences and changes of the different actors. Only options are considered.
- "Network-Centric" (figure 1, (c)) implies that the infrastructures of the network are at the heart of the architecture, they condition all requests for services. The heterogeneity of the network imposes different solutions for a requested service through a connection support.
- With a "User Centric" approach (figure 1, (d)), it is the user who is at the centre of the architecture, they should be able to personalize their services, access them dynamically through the accesses offered during their actions, according to the QoS (Quality of Service) desired. These are the properties that the digital ecosystem should offer.

To ensure all kinds of personalization, such as tracking the mobility of the user, take into account the user's preferences according to the location, adapted to the profile, designers can no longer be satisfied with a "client/server" application architecture with options. The designers need to build a chain of services with a personalized service logic. But this service logic can only be achieved if designers have composable services. It is therefore important to have a good approach to the service. A service is neither an application nor a transaction, let alone a system. ISO 20000-1 [i.4] defines it as "a composable service that should be a source of value for the consumer and the supplier".

Designers need to think about services differently. By having an architecture allows the user to do, if they wish, their own composition of service, with dynamic changes according to the proposals made to them, throughout moving.

In conclusion, today's user moves and changes environment (network access), changes terminals, desires seamless service continuity and end-to-end service QoS. The digital ecosystem should respond to "anywhere, anytime, anyhow, every service, everyone", with a concern for transparency and automation.

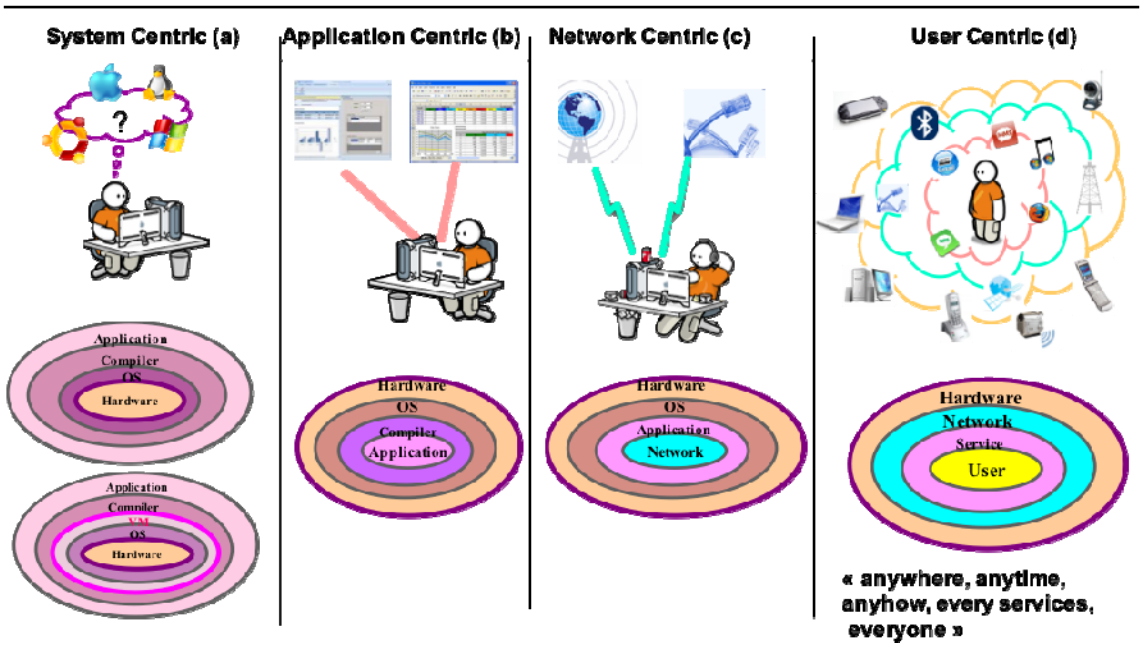

Figure 1: Evolution of the context, from System Centric to User Centric

4.2 User at the heart of the architecture that leads us to "as a service"

What does "as a service" mean?

Firstly, it means that the user should be able to request any service in the digital ecosystem. But how to do this, when the ecosystem is very heterogeneous. Indeed, service providers have the equipment (PC, smartphone, tablet), which allow the access to the ecosystem; or the connected objects (sensors, etc.), which monitor the user. Then service providers have the networks, which allow the ability to optimize the delivery of the ecosystem.

The user should therefore first position themselves on the right service that offers expected objectives and budgets. However, the choice of services among service providers in a highly competitive and heterogeneous environment is not easy and a consistent understanding of all end-to-end services is needed.

That is why service providers need to understand this digital ecosystem with the new paradigm "as a service".

Thus, service providers can say, secondly, that:

- the user can, depending on the level of desired personalization, make the choice and if necessary make "the composition of service";
- suppliers can submit the offers, according to a variety of specialized services offered in "self-service" and then billed at consumption.

Figure 2: User's environment

Figure 2 shows a users' environment. Due to the number of services, applications, networks, terminals, it is needed for the user to be the heart of the architecture, in order to make the life simpler and to offer all the potential services with high quality of service, security, safety, etc.

The following concepts are presented in these conclusions:

- User is in the heart of digital ecosystem.
- Flexible offer is possible.
- A new " as-a-service" architecture.
- The service should be fully customized in order to answer to user expectations and needs through service composition.
- Easy use "anywhere, anytime, anyhow, every services, everyone".
- Service continuity for users.

The real user expectation is QoE (Quality of Experience) presented in clause 5.

5 User experience

5.0 Introduction

A survey has been carried out in order to collect information about user's experience, expectations and behaviours.

The survey results report to note the maturity in clause 5.1 and the expectations in clause 5.2.

5.1 User maturity

In the Digital paradigm, users have the ability to access a large number of digital services applications and contents covering almost every time and everywhere a big part of the daily life activities, personal or professional.

So, the question is: are the users able to master all these services by themselves, or at least are the users properly informed of what can be done with the subscriptions and equipment and what is consumed?

Maturity is mainly measured by the degree of knowledge of the user about the services available, **how to activate them**, **how to configure them, how to control them**.

A survey has been conducted during two and half months. The questionnaire (both in French and English), the results and analysis are available in annex A.

The main lessons are:

- Currently, setting up a smartphone is far from easy according to most respondents. More than half of them say that they do not know how to fully configure their smartphone, of which 15 % say they do not really know how to do it.
  It seems like the difficulty for setting a box is a little bit higher. The survey allowed to score what is called the CES (customer effort score).

- A lot of people (42 %) do not really know the differences between the successive generations of GSM technologies. This could lead to difficulties with the advent of 5G. Specially because according to responders, cellular parameters are more difficult to set than the Bluetooth™ and the WIFI connections.

The degree of maturity of the user is partly due to his involvement, his expectations of control, and of course the diversity and frequency of the used services:

- 34 % of people change the setting of their smartphone less than once a year.

- 56 % of survey respondents never or rarely get on line to the personal page of their fix subscription and it is quite the same for the mobile (53 %). Obviously, for these people, it is difficult to have a good level of knowledge and control.

But this maturity can be greatly improved by the level of information and help tools available, the transparent attitude of the supplier, the ease of use of the services, of their configuration and customization. From this point of view there is progress to be made:

- There is a very large majority of people who would like to be able to challenge much more the provider.

- It is currently difficult to make the own composition of services because of the low scalability of the offers, and there is few values to do that because of the tariff advantages of the package.

- Currently 23 % of respondents often or sometimes have problems with the invoices. For a mass market product, it is quite high value, and not very good for confidence between consumers and providers.

The architecture and software oriented next generation networks are able to improve the flexibility and dynamic management and control of the services.

This is why it is important to look at the maturity of uses in the digital ecosystem.

The second set of lessons of the survey focuses on the user expectations.

5.2 User expectations

The survey sought to know the expectations of users for non-functional but essential services for a good digital experience.

First of all, it can be seen that there is a clear willing to use new services as long as their benefits are clear. That is not the today for the internet of things.

Secondly, a series of questions were asked about some new possible services able to improve the digital experience on an NGN network:

- People would like to be informed when there is a risk to enter into an area with low or without coverage and may lose the continuity of service. Losing the continuity of mobile service on move is a problem for 90 % of people. This shows that communication everywhere and even on move is a standard request today for users:
  - more control on the battery life;
  - more control on the location data of their devices;
  - to find their professional configuration on different devices (for those who are in employment).
- 44 % of people would appreciate a service of bandwidth on demand fix line and 38 % on mobile line. The percentage of people interested and not interested by this service are quite the same.

Of course, security and privacy issues are in the heart of the confidence for the future digital ecosystem.

The survey shows there is a very large majority of people who would like to be able to challenge the provider on what could be called **"essential characteristics" of the contract**, i.e. privacy, security, quality and price.

6 Overview of the perimeter of the addressed problematic

6.0 Introduction

It is necessary to analyse the entire environment to understand the new challenges. In the context (User-centric approach in the digital ecosystem) user-centric domain, digital ecosystem and user interface (clause 6.1, figure 3) are defined. The problematic is at the intersection of these three domains in order to best meet the QoE. ACIFO structures the contents of Guide and Reports for User-centric approach in digital ecosystem (clause 6.2 and figure 4).

6.1 Overview

As part of "User Centric approach in the Digital Ecosystem", it has been identified three areas of interest that are:

- User centric (1).
- Digital Ecosystem (2).
- and user interfaces (3).

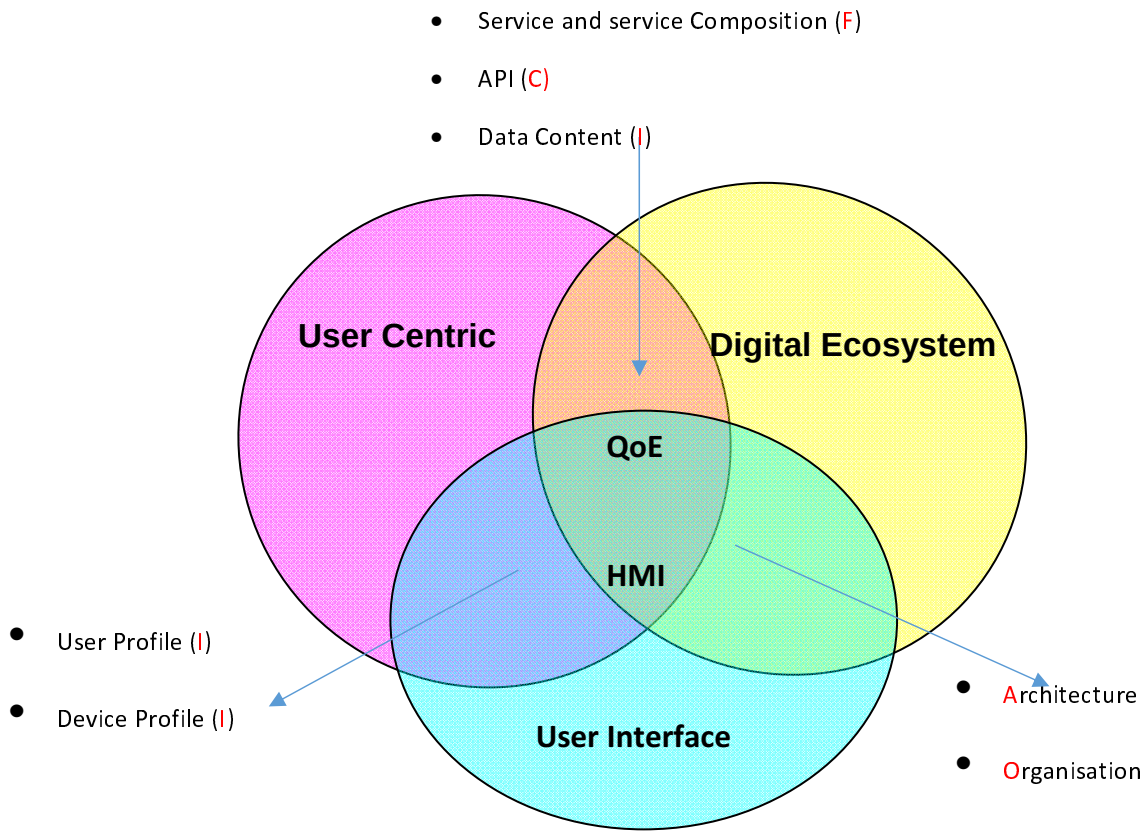

Figure 3: Perimeter of addressed problematic

1) **User centric:** this concept, as introduced previous, covers the approach where everything is developed around the user, which allows the user to access all the possibilities of the system through service components, which they can compose in a personalized way. This, during a session with continuity of quality of service (QoS). This concept has created new paradigms by introducing new ways to consume resources. With a "User centric" approach, the user is at the heart of the architecture. They should be able to customize his services, access them dynamically while they move and according to the desired quality of service (QoS).

2) **Digital Ecosystem:** represents the new digital environment where users evolve by considering all equipment, all technologies and their interactions. A digital ecosystem is a set formed by a community of services that interrelates with its environment. Components of the ecosystem develop a dense network of dependencies, of information exchanges to meet the user needs evolution. End consumers have service requirements that vary depending on their context which may vary over time. Important limitations inherent to the current "silo" based architectures (vertical architectures) and the lack of agility in our platforms and services infrastructure impose to think differently about making services.

   Mobility, ubiquity and services personalization are keywords that characterize the needs of digital applications, and should be taken into account by future service architectures.

   A **digital ecosystem** is an open socio-technical digital environment with self-organization capability, providing access to resources, and supporting collaboration, knowledge sharing and development of evolutionary business models, in an open environment which can span across different enterprise boundaries.

3) **User Interface:** is the software or the application on a platform that allows the user to interact with the equipment and services. User Interface has a more important role in the future ecosystem digital. It is described as the interaction and communication between human users and a machine via a human-machine interface (HMI).

The intersections of these three domains introduce the first modifications of the today context and the challenges tomorrow:

- **The intersection of the "user centric" and the "user interface"** contains the different profiles of the user and equipment to adapt to the new needs of the user. Thus, according to the possibilities offered by the equipment, the networks and the software platforms, a personalization is possible. Informational and functional elements are described in ETSI EG 203 602 [i.5].

- **The intersection of the" user centric" and the "digital ecosystem"** defines the links between the service request and the service offer. This is where should be found the possibility of service composition (Functional dimension). The user should be able to compose his service according to their needs, according to their position and according to their activities. This new vision is presented in clause 8. ETSI TR 103 603 [i.6] details these aspects in order to define the APIs (Communication dimension) according to the user expectations and data content (Information dimension).

- **The intersection of the "digital ecosystem" and the "user interface"** covers the architectural dimension. The architecture should take into consideration the customer's requirements, and should also take into account the performance factors (security, reliability and throughput) as well as the cost and budget constraints. User requirements include interface design, operational capabilities, and usability of the interface. Ecosystem requirements include hardware, networking, and the capabilities and constraints of the runtime environment. Architectural and organizational dimensions may be found in clause 7 of the present document.

The intersection of the 3 domains is Quality perceived by the user of services, QoE (Quality of Experience) and HMI (Human Machine Interface).

In our connected world, applications should interact with other applications and services, and run in different environments such as the cloud and mobile devices. The current monolithic designs of the past have been replaced by service-oriented software components that use structures, operating systems, runtime hosts, and networks to implement functions that were not yet known a few years ago. All applications are designed and developed with the objective of improving the quality of experience. Improving the quality of the experience cannot be achieved without taking into account all the needs of the user, the improvement of the digital ecosystem and its diversification as well as the improvement of the human machine interface.

HMI encompasses the underlying processes which produce the interactions, its design and implementation. The HMI can be described as the point of communication between the human user and the machine. ETSI TR 103 604 [i.7] details the User Interface.

6.2 User-Centric approach in digital ecosystem: Guide and Reports objectives

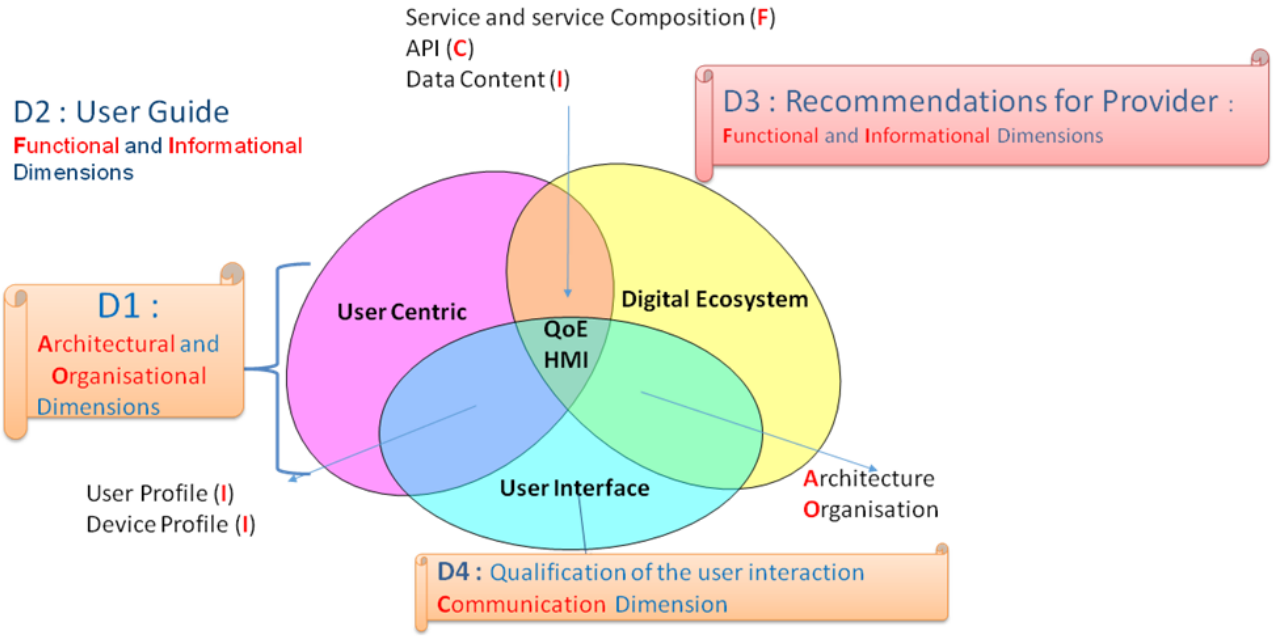

Figure 4: Objectives of Guide and Reports for User-centric approach in digital ecosystem

After having done and analysed, in clause 5, a survey to identify the user maturity and the user expectation in the digital ecosystem, the following deliverables objectives are proposed:

- Identify the characteristics of the different user environments: public, private and professional environments (e.g. taking into account the IoT, smart cities, wearables, etc.). See clause 7.
- Identify the typical use cases (e.g. Interactions on: home automation appliance; service selections between private and professional life; continuity of preferred from home to vacation location, etc.). See clause 8.
- Provide an ETSI Guide to the user to build his service composition with the appropriate quality of experience (QoE) and how to ensure his data privacy. See ETSI EG 203 602 [i.5].
- Provide a Technical Report to the providers and standards makers to ensure that each service component is provided with the information needed by the user to make an informed choice. See ETSI TR 103 603 [i.6].
- Provide a Technical Report for the qualification of the user interaction with the digital ecosystem (e.g. authentication, single sign on, composition, presentation, etc.). See ETSI TR 103 604 [i.7].

7 Ecosystem digital identification

7.0 Introduction

The objective, in this clause, is to be able to identify a suitable architecture for the new digital ecosystem. To do this, a table has been drawn up presenting a typology of use cases (clause 7.1). Some of them have been studied (clause 7.2). A general and generic framework is presented (clause 7.3) in order to address, in the following, the other dimensions of the context "user centric".

7.1 Digital Ecosystem Context

To be generic, the digital ecosystem should be at least based on three categories:

- IT;
- utilities; and
- IoT.

IT covers all computer applications and telecommunications applications.

Utilities concerns mainly the smart metering which is used in several domains, for example: smart grid, photovoltaic installation, water flow, silos stock calculation.

IoT with monitoring and automation aspects includes all connected objects and are classified in the IoT categories (table 1).

For each IoT application domain, a set of uses cases are given as example. The items in Bold in the table are detailed in the clause.

Table 1: Classification of the IoT categories

Digital ecosystems	Use cases
Smart Metering	Tank Level Smart Grid Photovoltaic Installation Water Flow Silos Stock Calculation
Smart Cities	Smart parking Structural Health Noise Urban maps Traffic congestion Smart lighting Wage Management ITS **Travel Management**
Smart Home entertainment & **monitoring**	**Video on demand**
Smart Domestic	Energy and water Use Remote Control Appliances Intrusion Detection Systems Art and goods preservation **Surveillance of pets**
Smart Retail	Supply Chain Control NFC Payment Shopping Applications Product Management
Smart Environment	Forest fire Detection Air pollution Avalanche Prevention Earthquake Early Detection
Smart Logistics	Shipmen Conditions Item Location Storage Detection Fleet Tracking
Smart Security	Perimeter Access control Liquid presence Radiation Levels Hazardous Gazes
Smart e-Health	Fall Detection Medical Fridges Sportsmen Care Patients Surveillance Ultraviolet Radiation
Smart Industry	M2M Applications Indoor Air Quality Temperature Monitoring Ozone Presence

The first four digital ecosystems (Smart Metering, Smart Cities, Smart Home entertainment & monitoring, and Smart Domestic) are chosen to be illustrated, through use cases, by a combination of process models, tables and text description in the next clauses.

It should be noted that a digital eco-system can be rich and diverse in what is included but also can be bare and minimal because it changes with the user and their requirements and needs.

Each digital eco-systems are made up of multiple interconnected use cases.

7.2 Use cases

7.2.0 Introduction

These chosen use cases aim to show how the different components are controlled and the user interaction. They use generic examples of the chosen scenarios with no references to actual named products and services.

Each Use case is made up of three parts the Service Table, the process model and the table of actors. The chosen use case are Smart Meters, Home Entertainment Services, Travel Management, Video on Demand and Surveillance of pets. The service tables identify the principle Agents and the interactions between them. The Process model diagrams illustrate the movement of data and information between the principle providers. It highlights the key activities and interactions within the process model between the different agents. The table of actors identifies the principle users and service providers and their network domains and the information connections between the service providers and the end-users.

The use cases inform the generic model of the User Centric General Framework which is made of four parts User Devices and M2M, User or device networks, Provider networks and provider service management. As well the typical use case identification (composition of personalized services) which are:

- use case A: eHealth independent living; and
- use case B: User interaction within multi-device environment.

7.2.1 Use Case: Smart Meters

7.2.1.0 Introduction

The home digital eco-system can be a single user or many. The use case will focus on single household. And how they interact with services and software applications by using devices. The devices may be single use or multi-use. The home digital eco-system is not confined to the geolocation of the home as many of services need access to external assets. Thus, whilst the eco-system may include smart home devices, home banking, entertainment, home shopping, the root of many of these services are outside the home.

The services can be solely in used in-house whiles others need access to resources outside the house. For example, smart metering for utilities are stand-alone in that they report usage of resources and how much money has been spent. Apart from when they send meters updates to the utility company. In theory they allow for better budgeting by allowing users to know accurately how much a household is spending on power or water. But a dedicated budgeting application needs to pull in data from a households banking services and other financial services the user might use often this is from the outside the house and can also be used outside the house. The user(s) is (are) consumer(s) but may also be producer(s) (e.g. energy, applications, etc.)

7.2.1.1 Services for Smart Meters

Table 2: Examples of services for Smart Meters

Services	Principal Agent	Assets/Resources	Interactions
Energy/water usage. Billing	Energy supplier Water/Sewage suppliers Metering companies. Maintain and check.	Supply networks. Collected Data. - Requires permission from customer for use and to share with 3rd parties.	Unless the user should supply metering, readings there is no direct interaction.
Energy, applications production	Energy supplier Metering companies. Friends or partners. Maintain and check.	Production networks. Facilitate interaction between households and providers Data collection and analysis of energy consumption	The user should control the production, the relationships with partners and collaborators.
Security (of the home digital eco-system)	Network Provider Device manufacture (secure-by-default).	Standards and regulations set by Govt bodies and NGOs. ETSI TR 103 304 [i.2]. ETSI TR 103 309 [i.3].	communication between the meter and the utility company.
Data protection and privacy	The companies that handle the metering, billing, data storage and transfer. Should follow data protection regulations.	Directive on Security of Network and Information Systems and the General Data Protection Regulation (GDPR) Regulation (EU) 2016/679 [i.8].	The energy supplier should obtain permission/consent from the bill payer to use for a stated purpose.
Special needs	Equipment, network providers.	Standards such as ETSI EN 301 549 [i.1].	The interaction means depend on the type of impairments and the special needs.
Budget control	Home user - single or multi-person household.	Meters - moving from 'dumb' to 'smart'.	If smart able to better monitor energy and water usage and cost. Still possible if dumb but requires greater effort to estimate cost and usage.

7.2.1.2 Process for Smart Meters

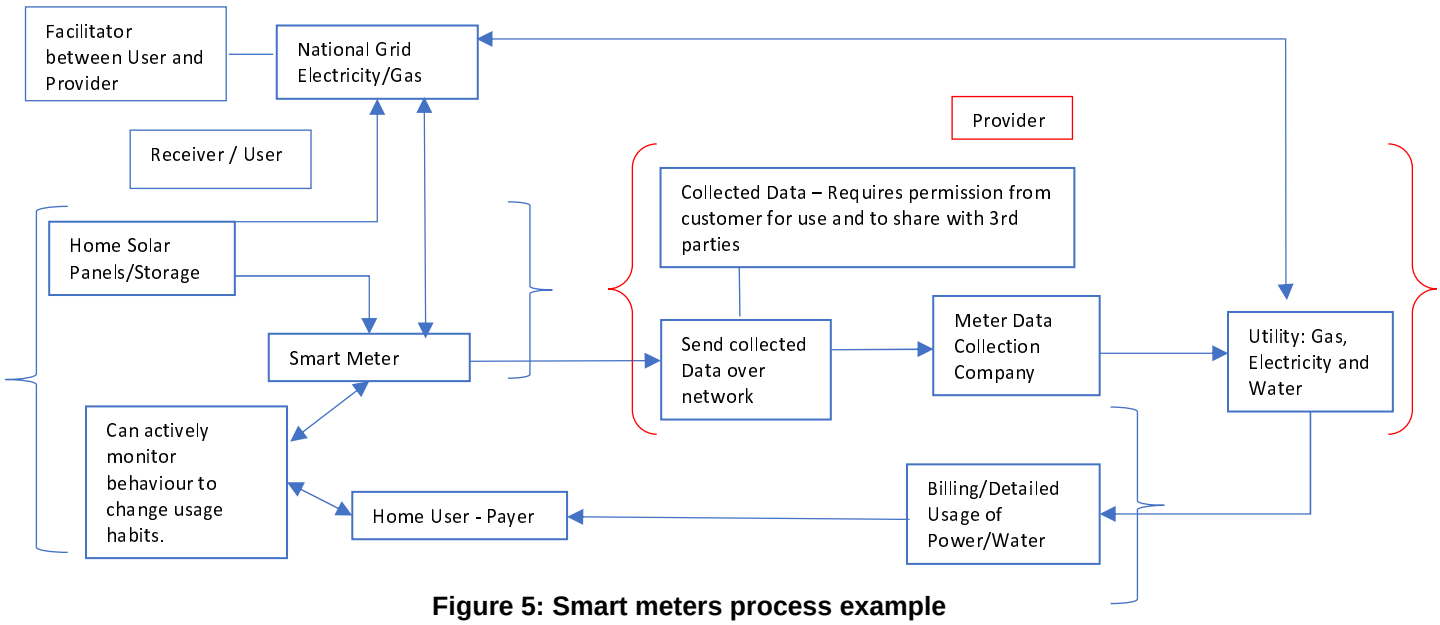

Figure 5: Smart meters process example

7.2.1.3 Actors for Smart Meters

Table 3: Example of actors for Smart Meters

End node-Users	Connector/Gateways	Network Servers	Service Providers
Smart Utility Meters Connected Home-Appliances IoT Devices Smartphones Desktop PC/Laptops Smart TVs	Modem Routers Phone Network Base Stations Public/Community Wi-fi networks	Internet Service Providers Telecommunication Providers Cloud Computing/Hosting Providers DNS Providers	Utility Companies Technology Companies Home Service Providers Application and Device Support Providers Cloud service Providers

7.2.2 User Interaction within the Smart City

7.2.2.1 Services for User Interaction within the Smart City

Table 4: Example of services

Services	Principal Agents	Assets/Resources	Interactions
Civic service providers and organizations	End-User	Smartphone/Web portal	How the user reports or gives feedback
Collection of data	Companies or organization involved in handling the collected data	Connected sensors/cameras/tracking devices or software	Remote means to gather data
Acting on collected data	Companies or organization responsible for providing solutions to problems shown by data	Tools, equipment and materials	The means to collect the data and analysis it to turn it into useful information
Security	Any company that handles the data collected	The data and information collected	How the company chooses to protect and handle the collected data under GDPR [i.8] and other regulations

7.2.2.2 Process for User Interaction within the Smart City

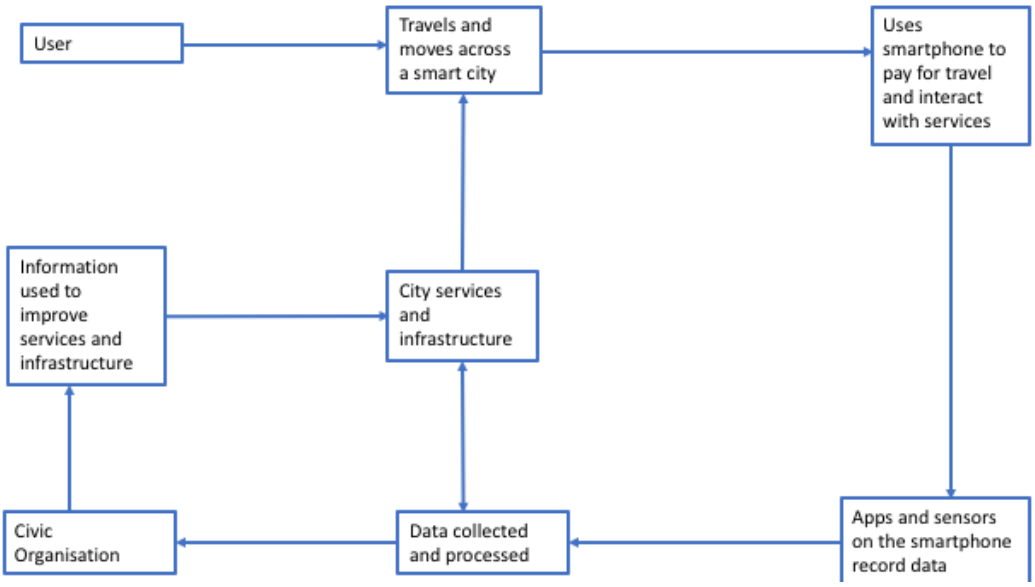

Figure 6: Example of User interaction process in Smart City

7.2.2.3 Actors for User Interaction within the Smart City

Table 5: Example of actors

End node-Users	Connector/Gateways	Network Servers	Application Servers
IoT Devices Smartphones Payment Systems Connected Smart CCTV Environmental Sensors Web-based sites to provide feedback and report information	Modem Routers Phones network Base Stations Public/Community Wi-fi networks WLAN	Internet Service Providers Telecommunication Companies Cloud Computing/Hosting Providers DNS Providers	Technology Companies Civic Service Providers Software License Providers Application and Device Providers Financial Process Providers Public Utility and transportation companies that support the function of a city Cloud Service Providers

7.2.3 Use Case: Travel Management

7.2.3.0 Introduction

The workplace digital ecosystem can be made up of a single user or many users. They can either have a clearly defined role or multiply roles within a business eco-system. The scale can change with the size of the business from a one-person operation carrying out all roles to hundreds of workers each having their unique role in a business. The user interaction and access with the different services should have common UX experience between different devices and tools. Services can include organizing of work schedules, travel to meeting/conferences, organization and co-operation of projects or work between different users within the same work environment. These services can be solely intra-business or inter-business. The user experience and interaction across smart city services and applications should be consistent and seamless. The user should experience no barriers when moving between different services.

The Smart city digital ecosystem is vast web of interconnected IoT devices, sensors, cloud computing, services and big data all brought together into the urban infrastructure. The end-user only interacts with a small part of the smart city digital ecosystem. The end-user benefits from the complexity of the smart city since the feedback of collected data from users can be used by planners and organizations to improve the user services and experience. Most of the time the end-user does not interact directly with the applications that make up the smart city. But for utility services and transport a user will interact with through dedicated applications or web portals in order to use them.

7.2.3.1 Services

Table 6: Example of services for Travel Management

Services	Principal Agents	Assets/Resources	Interactions
Booking firms.	Business user - single individual or multiple. Same or distinct roles.	Devices - use for work and to carrying out daily tasks.	When they book or propose travel arrangements.
There is a dynamic relationship between the users and the service providers. The user can have full autonomy, partial or none when interacting with the digital eco-system.			
Special needs.	Equipment, network providers	Standards such as ETSI EN 301 549 [i.1].	The interaction means depend on the type of impairments and the special needs.
Transportation (airlines, train services, bus/coaches, taxis, personal transport).	Company or organization the user works for. Made of different elements that are responsible running the company.	Software - access to sites and services.	Another part of the company can organize the travel for their workers. Or reimburse if a user has paid for travel out of their own pocket.
A business or provider can offer a composition of services to the users.	Transport companies.	Modes of transport.	How the user undertakes the travel.

7.2.3.2 Process for Travel management

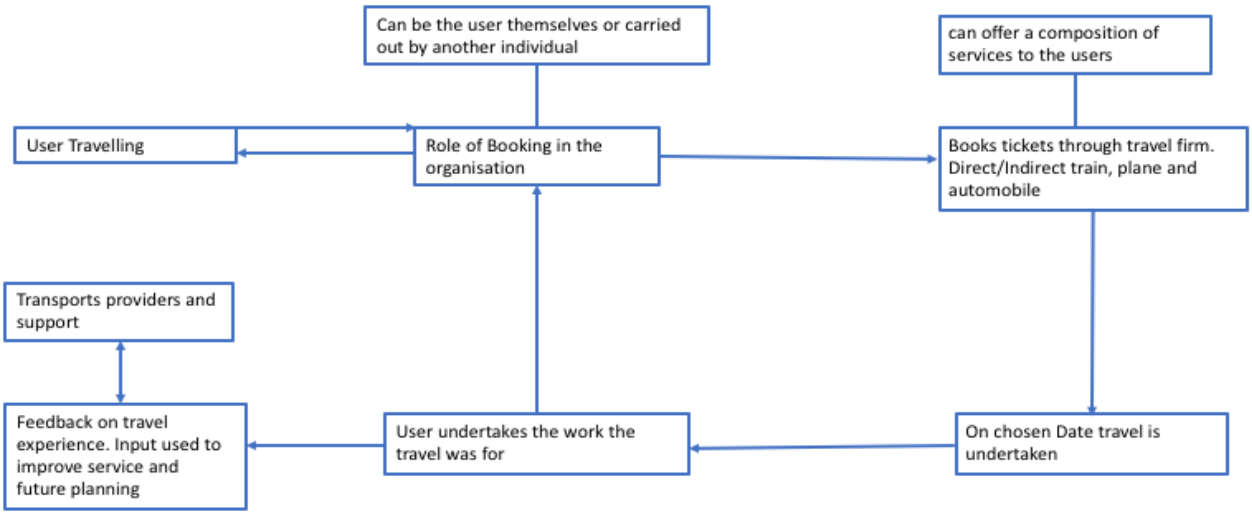

Figure 7: Example of travel management process

7.2.3.3 Actors for Travel Management

Table 7: Example of actors for travel management

End node-Users	Connector/Gateways	Network Servers	Service Providers
Bring Your Own Device (BYOD) Connected Work Appliances e.g. printing IoT Devices Smartphones Desktop PC/Laptops Conference Equipment Fax machine Payment Systems Payment	Modem Routes Phone Network Base Stations Public/Community Wi-fi networks Wide Local Area Network (WLAN)	Internet Service Providers Telecommunication Companies Cloud Computing/Hosting Providers DNS Providers	Technology Companies Business Service Providers Software License Providers Application and Device Support Providers Financial Process providers Public Utility and Transportation companies that support the function of businesses Cloud Service Providers

7.2.4 Use Case: Video on Demand for Home monitoring

7.2.4.0 Introduction

Figure 8: Example of devices for home monitoring

In this use case the user wishes to keep watch on home via a connected video camera.

The user subscribes to an on-line service. The user monitors the video camera and connects it to the personal network (Ethernet but more often WIFI) and supplies energy to it. The user installs the application on the smartphone. The account is created and the options and preferences are configured.

The user may keep watch on the phone via the application. The data are stored in the Cloud of the service provider.

7.2.4.1 Services for Video on Demand for Home monitoring

The complete transmission chain is built on:

- The user devices communicate in one way or both ways.

  When the user is at home, the user private network is used, when the user is out of house the connection is done through the operator network.

- The operator network, both for access network and Cloud network.

- On the other end the services of the service providers where the client data and preferences and stored.

The application providing the service and the billing service are located at the service provider. The service provider may have access to the client data for assistance or to provide (sell) new options.

7.2.4.2 Process for Video on Demand for Home monitoring

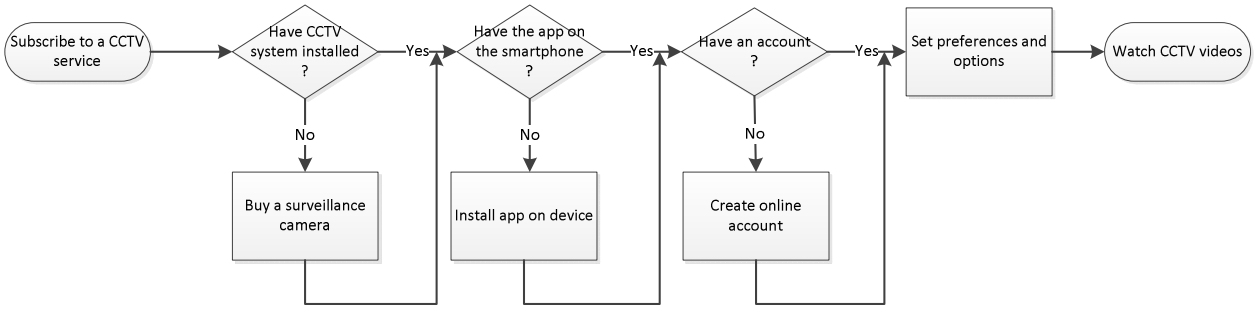

Figure 9: Example for home monitoring process

7.2.4.3 Actors for Video on Demand for Home monitoring

Table 8: Example of actors for home monitoring

End node-Users	Connector/Gateways	Network Servers	Service Providers
Video camera IoT Devices Smartphones Desktop PC/Laptops	Phone Network Base Stations WiFi networks	Internet Service Providers Telecommunication Companies Cloud Computing/Hosting Providers	Technology Companies Business Service Providers Software License Providers Application/Device Support Providers Cloud Service Providers

7.2.5 Use Case: Surveillance of pets

7.2.5.0 Introduction

Figure 10: Illustration of pets surveillance

As an example: the intelligent collar including a GPS chip and a real time following device. Some devices may also a communication with the pet (e.g. through a microphone/loudspeaker).

7.2.5.1 Services for surveillance of pets

The transmission process is the following:

- The user devices communicate in one way or both ways.

When the user is at home, the user private network is used, when the user is out of house the connection is done through the operator network.

For some usages such as 3G/4G or long distance network. The transmission is done through the operator network:

- The operator network, both for access network and Cloud network.
- On the other end the services of the service providers where the client data and preferences and stored.

The application providing the service and the billing service are located at the service provider. The service provider may have access to the client data for assistance or to provide (sell) new options.

7.2.5.2 Process for surveillance of pets

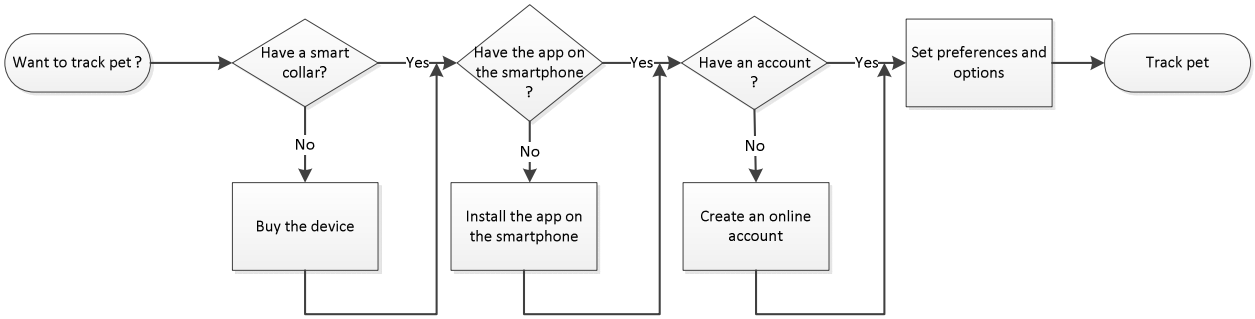

Figure 11: Example of pets surveillance process

7.2.5.3 Actors of surveillance of pets

Table 9: Example of actors for pets surveillance

End node-Users	Connector/Gateways	Network Servers	Service Providers
Smart Collar IoT Devices Smartphones Desktop PC/Laptops	Phone Network Base Stations WiFi networks	Internet Service Providers Telecommunication Companies Cloud Computing/Hosting Providers	Technology Companies Business Service Providers Application/Device Support Providers Cloud Service Providers

7.3 Generic model

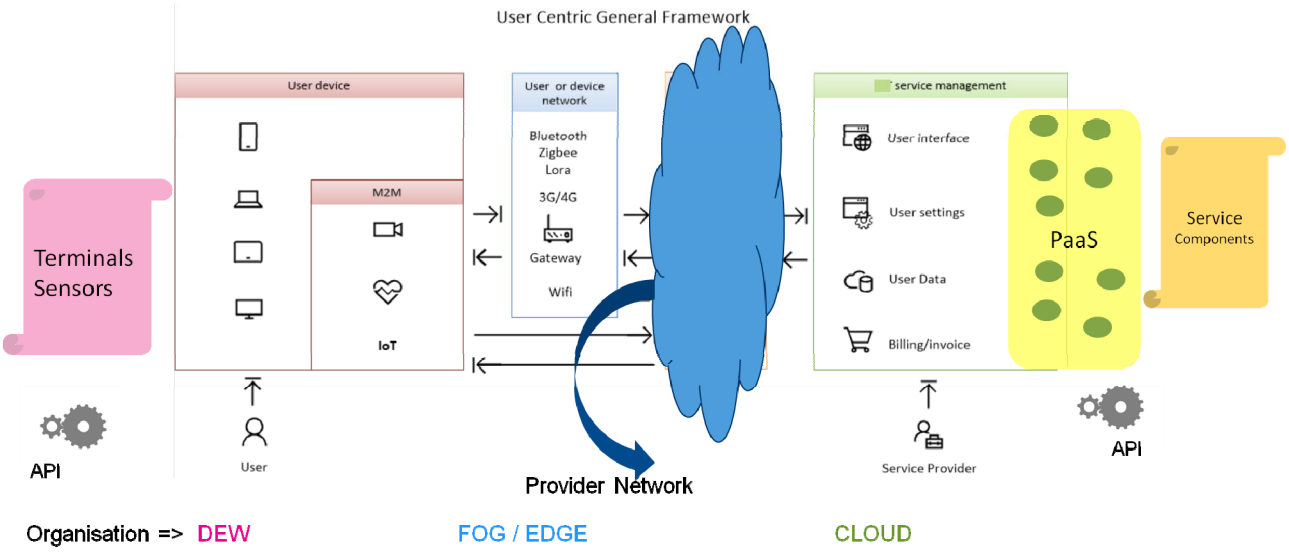

Figure 12: Generic Model

It can be seen that the use cases, which have been detailed, are always based on the same customer journey.

It can therefore draw a general diagram that is valid for all use cases online services in the digital ecosystem (with or without IoT).

At one end are the user's devices, including devices that communicate in one direction or in both directions.

In the centre, the user's private network at home or the 3G / 4G when travelling, or the long distance network in some cases of use.

Then the network of the operator in the broad sense.

At the other end, the service provider services in which the customer data and their preferences are stored.

There is also the data processing, that is to say the application that makes the service. There are also control and management services such as the billing service.

The service provider can access the customer's data in the context of assisting or selling new options.

The user data are both customer data but also data that the service provider can use for analysis and marketing purposes for which the problem of the GDPR arises.

Once this general framework is defined, **how does the user compose his service and how do service providers respond to different expectations?**

For M2M and IoT, this diagram shows that the automation should be maximum.

The user could in few simple manipulations configure his device.

The automation manages the whole process. The minimum user involvement is dedicated to setting configuration. Providers should propose process automation to make service use as simple as possible via a simple standard HMI.

The maximum user involvement is to design a service from the composition of basic services. The service providers should propose the appropriate APIs.

To make the use of the consumed services as simple as possible, as shown in ETSI EG 203 602 [i.5] a powerful information model with profiles that allow the maintenance of QoS and QoE is needed.

8 New vision of digital use cases for Composition of Personalized Services and Interactions

8.0 Introduction

In the digital world, interactive applications such as enterprise applications, Internet browsing, games, but also IoT and M2M applications require a high degree of interactivity. Therefore, these applications require a new approach:

- on the User side, for the evaluation of the quality of the experience (QoE), the interactivity measures, the resulting requirements on the Quality of Service (QoS) and the underlying Human Interface Device (HMI);
- on the Providers' side, the challenge lies in the interactions (inter and intra) with the application and the reactivity of the system. A more agile, more real time, more integrated system is needed.

Therefore, the applications need to be re-though. The two proposed important paradigms are the "as a service" which allows the composition of service as shown by the use case A "eHealth Independent Living" (clause 8.1) and the API which can be dynamic and open. An "most open" example is shown with the use case B "User interaction within multi-device environment" (clause 8.2).

8.1 Use Case A: eHealth Independent Living

8.1.0 Introduction

The eHealth digital ecosystem use case examines what is needed to enable home users with medical disabilities and/or old-age impairments with the aim to achieve independent living. This use case shares elements with the home and workplace digital ecosystem. The workplace digital ecosystem can be made up of a single user or many users. They can either have a clearly defined role or multiply roles within a business eco-system. The scale can change with the size of the business from a one-person operation carrying out all roles to hundreds of workers each having their unique role in a business. The user interaction and access with the different services should have common UX experience between different devices and tools. Services can include organizing of work schedules, travel to meeting/conferences, organization and co-operation of projects or work between different users within the same work environment. These services can be solely intra-business or inter-business. The user experience and interaction across smart city services and applications should be consistent and seamless. The user should experience no barriers when moving between different services.

The Smart city digital ecosystem is vast web of interconnected IoT devices, sensors, cloud computing, services and big data all brought together into the urban infrastructure. The end-user only interacts with a small part of the smart city digital ecosystem. The end-user benefits from the complexity of the smart city since the feedback of collected data from users can be used by planners and organizations to improve the user services and experience. Most of the time the end-user does not interact directly with the applications that make up the smart city. But for utility services and transport a user will interact with through dedicated applications or web portals in order to use them.

The services are classified in 2 categories:

a) daily cares and day-to-day activities; and

b) patient monitoring.

In the first (clause 8.1.1), the services deal with remote monitoring of health by doctors and automatic response with emergency services in case of accidents.

In the second (clause 8.1.2), they deal with daily cares, scheduling of care nurses or helpers between clients and care organizations, and better accessibility like greater use of voice interaction instead of touch/button interfaces.

The home users are not limited to the elderly but users with psychical disabilities or diseases share the same elements.

They both make use of devices and tools for accessibility.

Better accessibility like voice interaction and health monitoring can be by done by IoT Gateways to aid them in their day-to-day activities.

A continuous remote patient monitoring is essential to observe medical state of patients who are suffering from acute diseases, especially cardiovascular diseases.

Wearable wireless sensors provide a continual access to medical parameters of a patient.

IoT Gateways are located in every room in the house as a way to follow the patient. They are gathering sensors data.

They can provide real-time analytical services, prediction and alerts in case of emergency. They can recognize an abnormal user activity, by using algorithms, and are able to contact the rescue teams according to the type of emergency and to notify the nearest hospital of arrival.

These smart gateways make early recognition of deterioration more reliable by bringing the decision-making core and critical notifications closer to the patient.

This system is critical. Due to the constant incoming data in a continuous medical monitoring, the system may encounter problems such as latency in system response, data transmission and computations related to data analytics. Quality of service should be controlled from end to end.

8.1.1 Daily cares and day-to-day activities

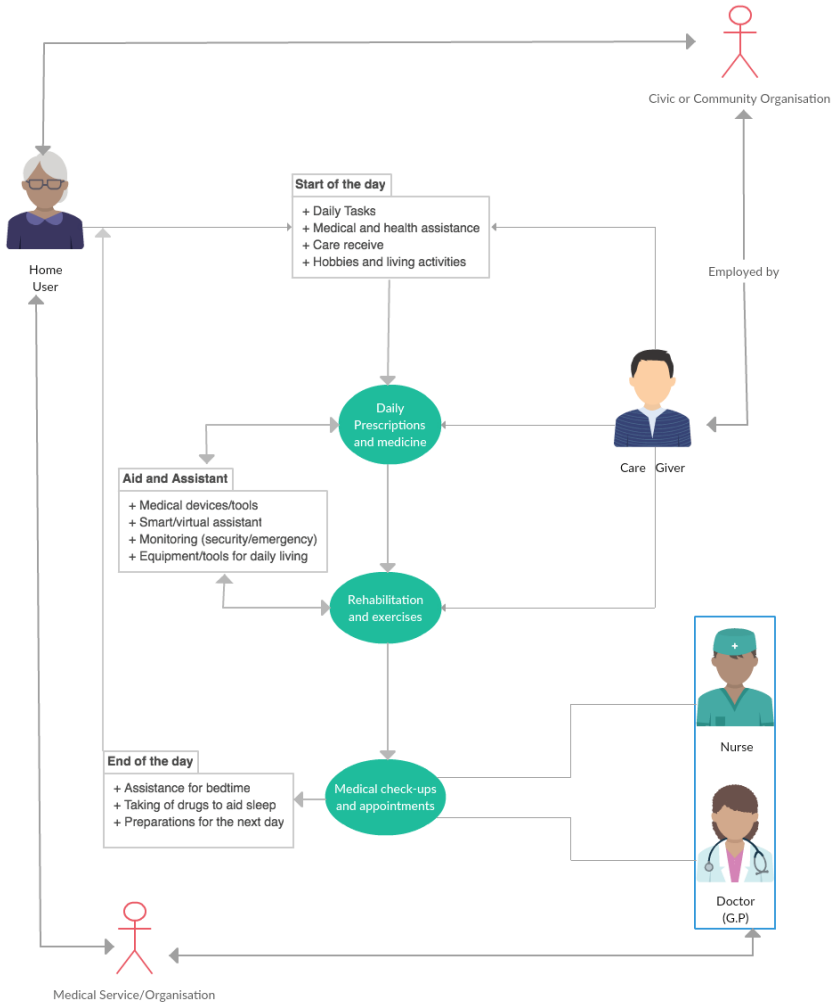

Figure 13: Activity diagram for daily cares and day-to-day activities

Nominal scenario for daily cares and day-to-day activities

Start of day:

Begins with the daily rituals of the end-user. They use their chosen devices to aid in getting up and organizing activities for the day.

Care giver:

They can be live in, a single visitor, or a revolving number of carers through the day or week. They can help to ensure that the end-user take their daily prescriptions and medicines. These can also be reminders that can be given by a smart device. They can also perform rehabilitation and exercises which are often vital to maintaining health. This is helped by devices that measure activity and status of heartrate/blood pressure/sugar levels etc. Which carers, nurse and doctors can use to track health over a period.

If scheduled medical check-ups and appointments:

Reminders can come through phone/tablet/watch. The appointment is carried out by a nurse and/or doctor who provide treatment, diagnosis and ensure well-being of the patient.

The role of the nurse is to give healthcare services to communities, families and individuals through communication, decision making, teaching and management of care services. So, they may attain, maintain, or recover optimal health and quality of life.

The role of the doctor is concerned with promoting, maintaining, or restoring health through the study, diagnosis, and treatment of disease, injury, and other physical and mental impairments.

Feedback - can be as often or as little as required. With it either being Scheduled or only when circumstances change for the end-user.

Civic organizations should provide resources and help that is appropriate to the requirements of the user. Informed through tests and advice from GPs.

Medical organizations assess whether the user needs to change the rehabilitation and/prescriptions for the user require to maintain their health which is a key part for independent living.

End of day:

Daily rituals of end-user: Set prompts and reminders on devices for the next day. Carry out night activities.

The user takes advantages of a personalization of services and their composition.

For example, a watch reminds the patient with a sound that he should take medication.

In this use-case, a service composition would include:

- services located on a watch for scheduling and medication reminding;
- services located in IoT gateways or Cloud for medication taking agenda.

Service compositions are thus personalized.

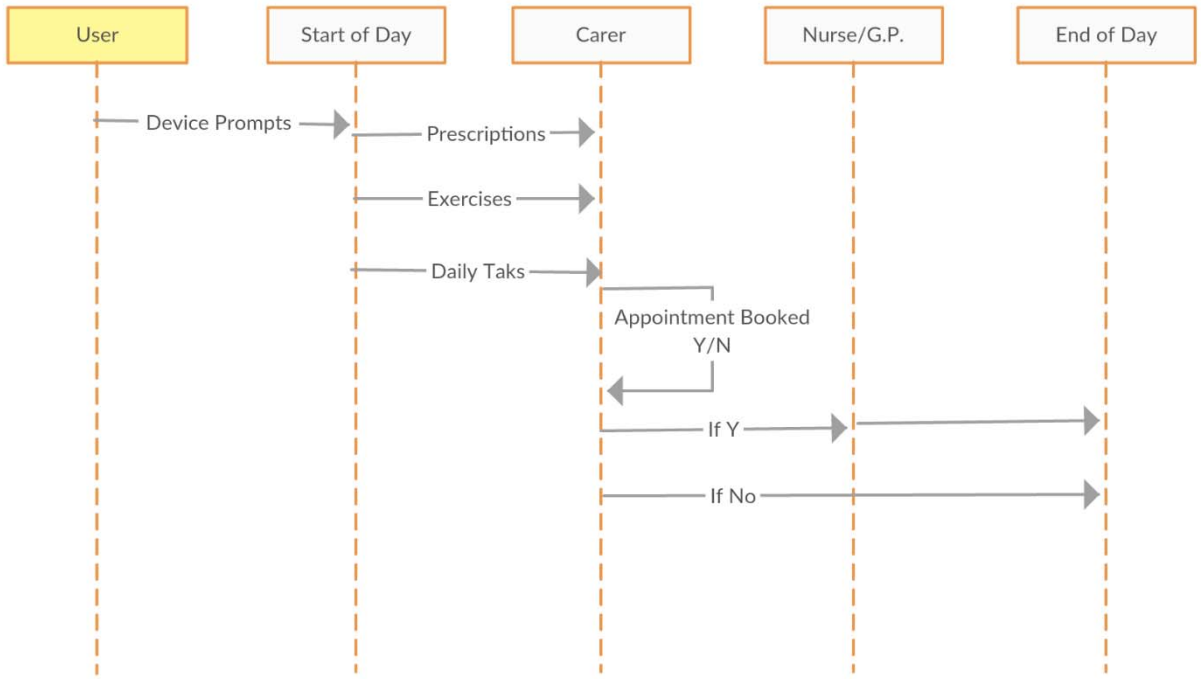

Figure 14: Sequence diagram

User Needed Resources for daily cares and day-to-day activities:

- Medical devices, household assistant devices, monitoring devices (security/visual aids).
- Smart/virtual assistant - a software and/or device agent that perform tasks or services for an individual.
- Personal equipment and/or household assistant devices.
- Computers/tablet/smartphone.
- Networks - telecommunications/internet.

- Civic/Medical applications for scheduling appointments, carrying out office work and data storage management.

8.1.2 Patient monitoring

Nominal scenario for patient monitoring:

- **Step 1 and 2:** Sensors send measures to the nearest IoT Gateway.
- **Step 3:** IoT Gateway analyse and make decision. His functions are as follows:
  - Monitor the current state of the patient.
  - Provide a means to predict future medical condition via machine learning methods and artificial intelligence algorithms.
  - Collect and aggregate data from the available sensors.
  - Implement data analysis.
  - Extract valuable information and knowledge from the incoming raw data.
  - Make decisions.
  - Detect emergency and make prediction.
  - Do data compression and encryption.
  - Adapt data capture frequency.

If needed, in case of emergency:

- **Step 4:** IoT gateway call rescue teams.
- **Step 5:** IoT gateway reserve a hospital room.
- **Step 6:** IoT gateway send information to the referring physician.

The user takes advantages of a personalization of services and their composition.

In this use-case, a service composition would include:

- services for continual access to medical parameters of a patient;
- services located in IoT gateways for analyse and decision making; and
- services for rescue team and hospital alerting.

Service compositions are thus personalized.

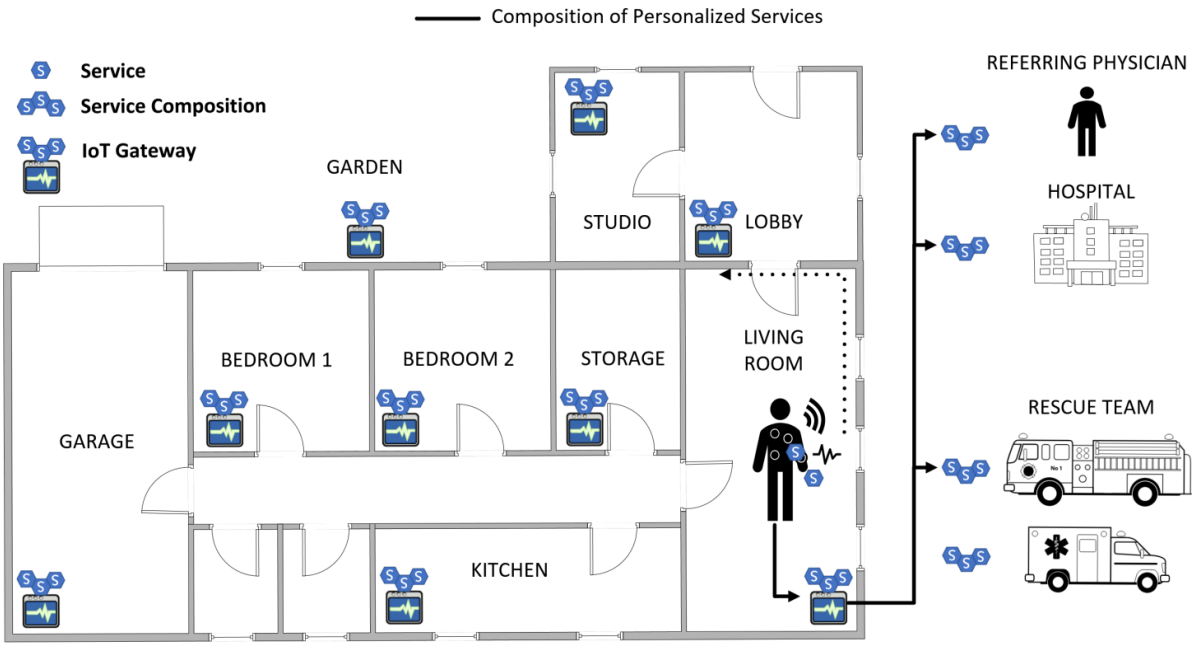

Figure 15: Digital eco-system for patient monitoring

User needed resources for patient monitoring:

- Internal and external network infrastructure.
- IoT gateways distributed in all relevant places.
- Wearable sensors.
- Composition of personalized services.

EXAMPLES: 1) The confidentiality of the composition with specialized services could be reinforced.

2) The user can also warn a trusted person.

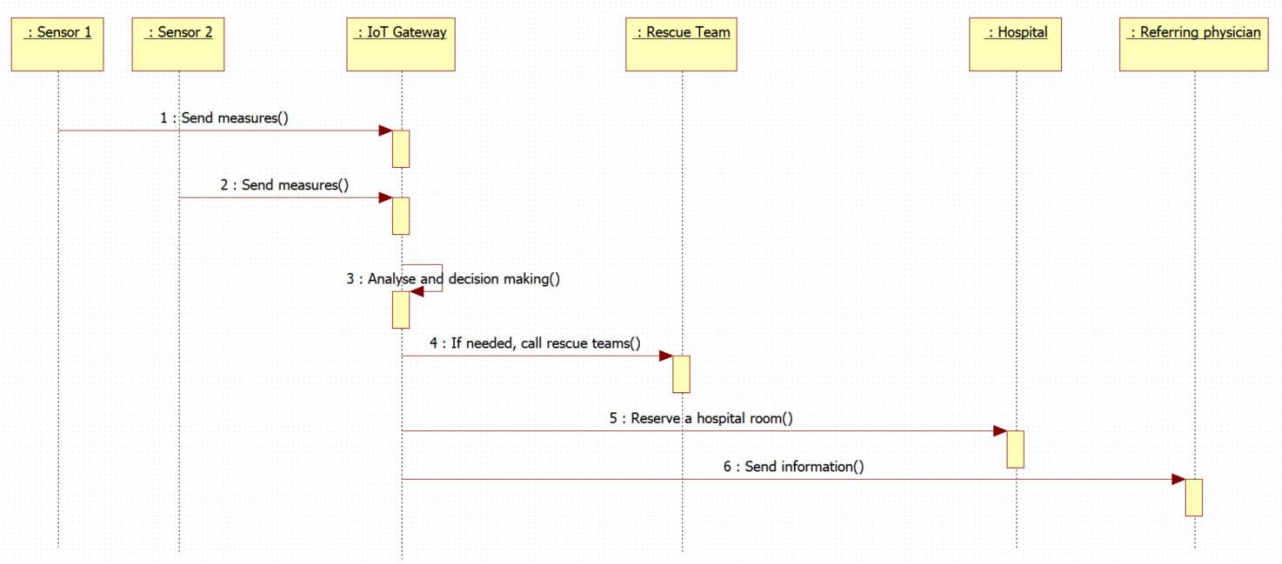

Figure 16: Sequence diagram

8.2 Use Case B: User interaction within multi-device environment

This use case shows a user interaction within multi-device environment.

It gives an application access to services that other devices provide on a local network.

It allows applications to request services by specifying a type of service and the name of a device instance that provides the desired type of service.

It allows users to identify other devices on the local network that support the services an application requests. This is useful for a variety of peer-to-peer applications such as file sharing or multi-player gaming.

Devices supported include printers, webcams, HTTPS servers, and other mobile devices.

The key is service discovery. Applications need to listen to service broadcasts on the network to see what services are available and filter out anything the application cannot work with.

Note that the increasing number of devices make them difficult to assemble to achieve a common goal.

Nominal scenario:

- **Step 1 to 5:** The user asks the devices who has the capabilities of printing a document (Print services).
- **Step 6 and 7:** Devices who are not concerned by this question, do not respond. Printer 1 and Printer 2 answer the question. They inform the user that they have this capability and give their features (QoS, location, etc.).
- **Step 8:** According to their features, the user chooses a printer (example Printer 1) and run the print command.

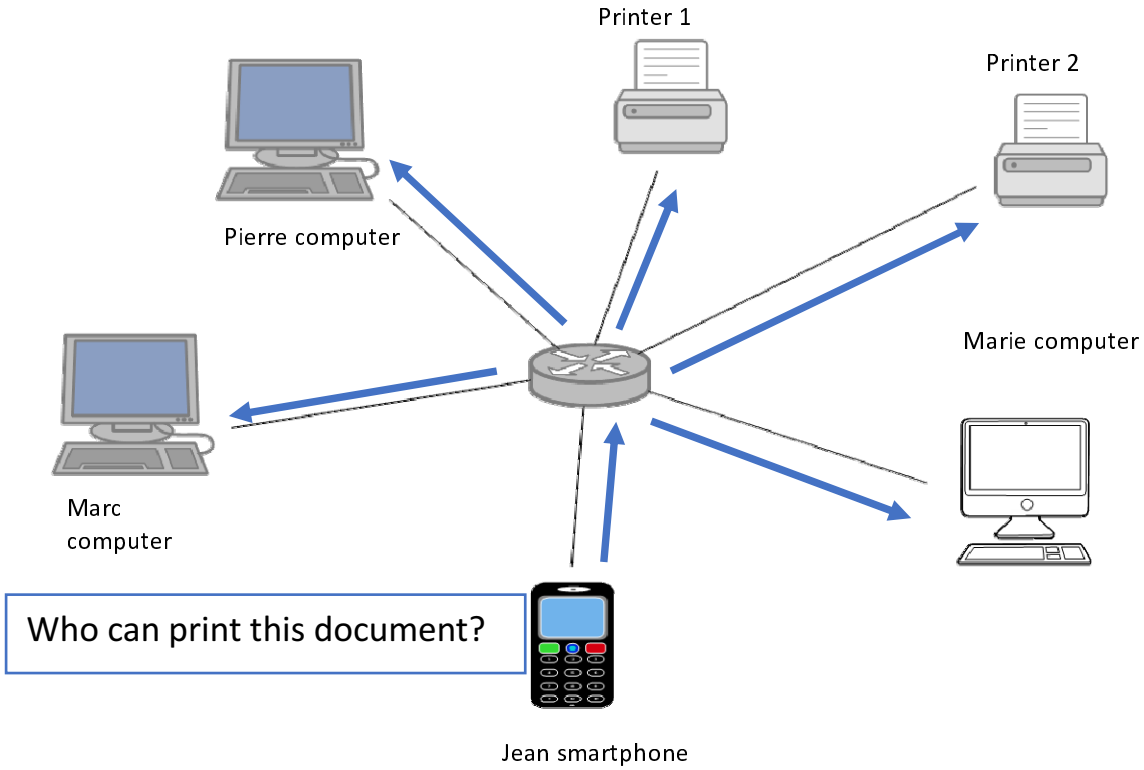

Figure 17: User interaction within multi-device environment

User needed resources:

- Internal and external network infrastructure.
- Connected devices.

- Composition of personalized services between the user and the device including the researched service.

Service discovery is the base for a personalized composition. Once the services are discovered, they can be assembled to form a composition.

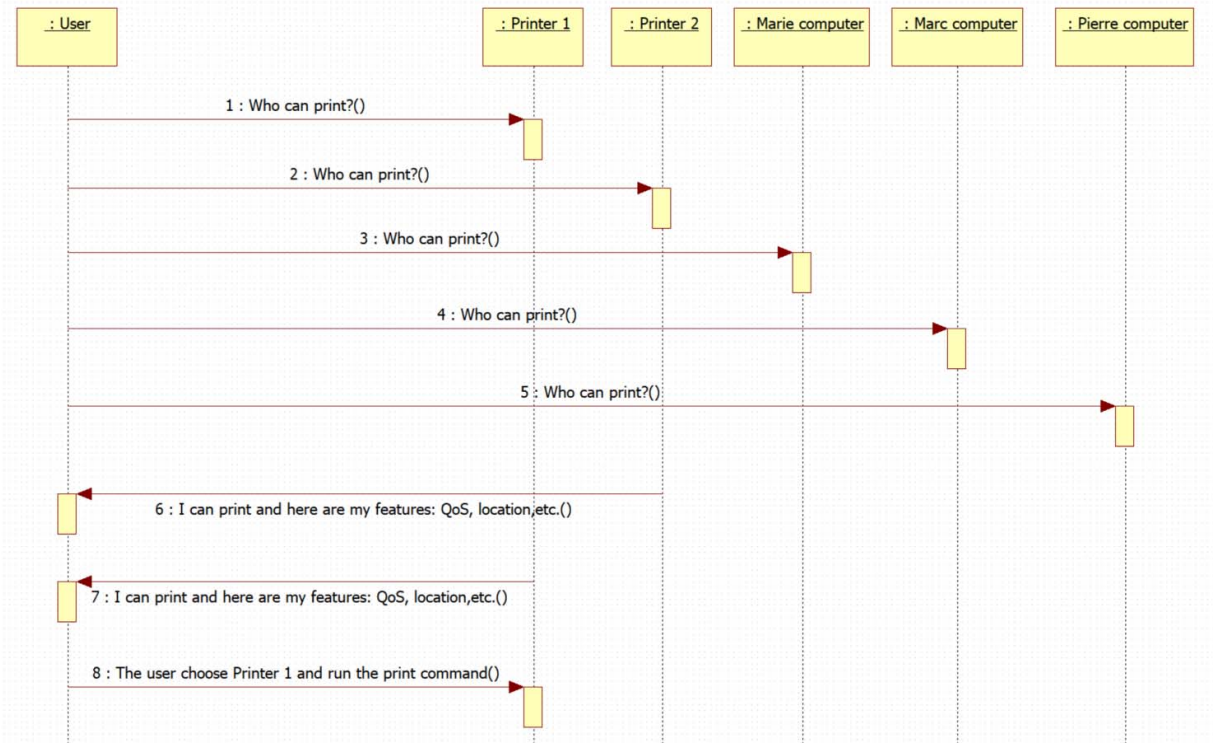

Figure 18: Sequence diagram

9 Conclusions

Our world is evolving very quickly for digital services and the ecosystem reflects two different images: on one hand a simplification in access to a lot of "intelligent" services and on the other hand the platform complexity.

What is the consequence for all the actors?

For the user, who is at the centre of the architecture of this digital ecosystem, for whom the HMI is essential et whose actions to obtain the wanted services, will move from to press a button or to parameter the application towards composing the own application or session from a Service Platform. To identify the needs, expectations and developments axes, a survey has been performed among users and several use cases have been analysed.

For technology suppliers, mobile operators, MVNOs, aggregators, IoT and M2M platform providers, the question is: What strategy and what technologies to stay competitive? To answer this question, new technologies have been studied with the paradigm "As a service" and APIs.

In this context, more and more "User Centric", with the user at the centre of the architecture, the user should be able to access from anywhere, by any means, every time to any service. He/she is expecting a perfect continuity of the personalized services taking into account his/her preferences. Facing users, the providers should reconsider their organization to answer to this request of "fully connected", all the time and from anywhere. The question is: How could be created this interaction and what is the relevant architecture for this cooperative communication?

Realistic implementations of IoT and M2M environments have been designed in different domains, including product enginery, marketing, Health, sports, security but the adaptability of these implementations will be guaranteed only if:

- QoE evaluation is effective to be adapted to different user profiles and different environments.
- Offer development which today is centred on applications becomes "service centred" to offer the needed flexibility dynamicity and adaptability on the Paas (Platform "As-a-service").

Annex A:
Description of the survey

The survey has been produced both in French and in English.

The survey, results of the survey and analysis are contained in archive tr_103438v010101p.zip which accompanies the present document.

The main results are summarized in clause 5 of the present document.

Annex B:
Additional Use Cases

B.0 Introduction

These use cases were originally developed alongside the use cases in the main text. They were deemed to be surplus to requirements for the main body of the report. They are kept here as additional information and to show the many diverse areas where a user-centric digital eco-system can be applied to. How the user interactions with IoT Devices and Smart Cities will become an important design consideration that will need to be understood in order for the user to have the best quality of experience when interacting with IoT devices and Smart Cities services in the future.

B.1 User Interaction with IoT Devices

B.1.1 Services

Table B.1: Example of services for User interaction with IoT devices

Services	Principal agents	Assets/resources	Interactions
Network and Internet Providers	End-User (single/household)	IoT Device	Set-up and use the IoT for a general specific function
Device usage and support	Device Manufacturer Support	Smartphones	Can be used as means to control and interact the IoT device
Technology Companies cloud support	Application Provider	Device connected hubs	Central hub to update and change the settings of IoT devices
Security	Any company that provides the service offered by the IoT device	The User data and billing information connected to the IoT device	How the company chooses to protect and handle the collected data under GDPR [i.8] and other regulations

B.1.2 Process model of User Interaction with IoT

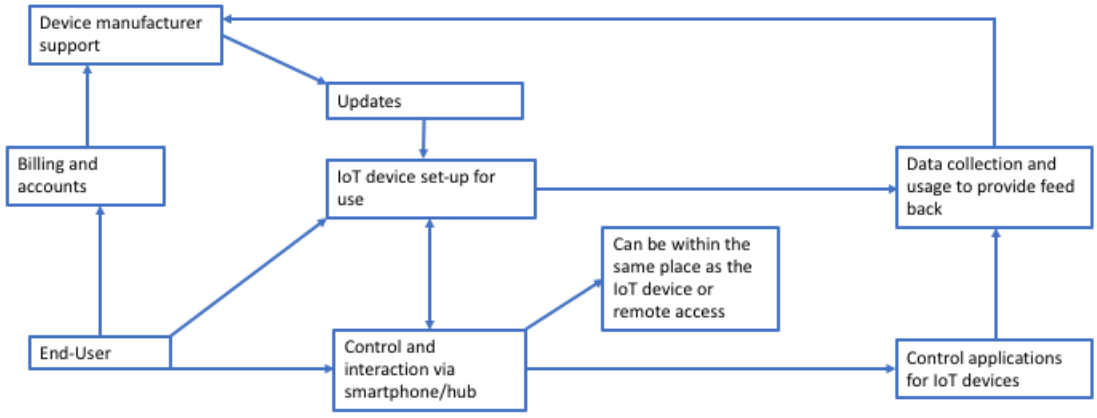

Figure B.1: Example of process for user interaction with IoT

B.1.3 Actors of User Interaction with IoT

Table B.2: Example of actors for user interaction with IoT

End node-Users	Connector/Gateways	Network Servers	Application Servers
Smart Utility Meters Connected Home-Appliances IoT Devices Smartphones Desktop PC/Laptops Smart TVs	Modem Routers Phone Network Base Stations Public/Community Wi-fi networks	Internet Service Providers Telecommunication Providers Cloud Computing/Hosting Providers DNS Providers	Utility Companies Technology Companies Home Service Providers Application and Device Support Providers Cloud service Providers

B.2 Use Case: SmartHome Entertainment Services

B.2.1 Services

Table B.3: Example for Smart Home Entertainment Services

Services	Principal Agents	Assets/Resources	Interactions
Entertainment	Household - single user or multiple.	Network devices - modems/routers Remote control.	Access to chosen streaming service and consumption.
Internet access	Internet Providers (IP) Can give internet connections and give bundles of media entertainment packages.	Users Devices - TVs (smart/dumb), computers (portable/not), smartphones, tablets. Games consoles (if they support it), traditional set-top boxes. Screens.	Setting up access on chosen devices. Are they shared with friends or families?
Over the air broadcasting. - Screen share with TV to other devices	Entertainment and Media Providers.	Internet Browser. Means of access without dedicated application or devices.	Security - controlling access / 2FA. Protection of customer billing information and data.

B.2.2 Process for Home Entertainment Services

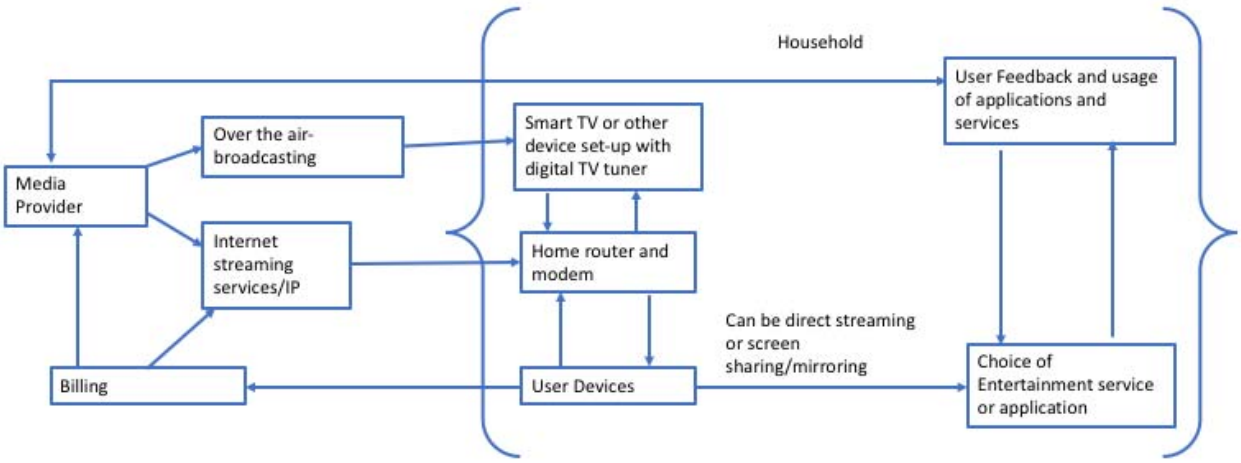

Figure B.2: Example of home entertainment process

B.2.3 Actors of Home Entertainment Services

Table B.4: Example of home entertainment actors

End node-Users	Connector/Gateways	Network Servers	Service Providers
Chosen User services and/or applications User Devices - laptops/Desktops/ tablets/smartphone/ games console Household devices - Smart TVs/streaming devices or dongles	Modem Routers Phone Network Base Stations Public/Community provided networks	Internet Service Providers Telecommunication Providers Cloud Computing/Hosting Providers DNS Providers Over the air broadcasting	Technology Companies Home Service Providers Application and Device Support Providers Cloud service Providers Media Providers

Annex C: Bibliography

ETSI TS 102 165-1: "CYBER; Methods and protocols; Part 1: Method and pro forma for Threat, Vulnerability, Risk Analysis (TVRA)".

ETSI EG 202 009-2: "User Group; Quality of telecom services; Part 2: User related indicators on a service specific basis".

Annex D:
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