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D8.12 PrEstoCloud Showcase - Iteration 1

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Abbreviations

The following table presents the acronyms which are used in this deliverable.

Abbreviation	*Description*
CC	Consortium Coordinator
CCTV	Closed-Circuit Television
CM	Communication Manager
CT	Communications Team
CPU	Central Processing Unit
DM	Dissemination Manager
EC	European Commission
EU	European Union
GB	Gigabyte
IM	Innovation Manager
IoT	Internet of Things
ICMP	Internet Control Message Protocol
ISO	International Organization for Standardization
IT	Information Technology
IDS	Intrusion Detection Systems
IPsec	Internet Protocol Security
J2SE	Java 2 Standard Edition
JPPF	Java Parallel Processing Framework
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
MMH	Multi-Media Hub
MQTT	Message Queuing Telemetry Transport
NFV	Network Functions Virtualization
OS	Operating System
PoC	Point of Contact
QM	Quality Manager
QoE	Quality of Experience
QoS	Quality of Service
SDN	Software-Defined Networking
SME	Small and Medium Enterprise
SLA	Service Level Agreement
STM	Scientific & Technical Manager
TICS	Transport Information and Control Systems
TSDB	Time Series Database
UAV	Unmanned Aerial Vehicle
VM	Virtual Machine
VNF	Virtual Network Function
VPN	Virtual Private Network

1. Executive summary

The main objective of the PrEstoCloud project is to create substantial research contributions in the cloud and edge computing system environments and real-time Big Data technologies in order to provide a dynamic, distributed architecture for proactive resource management. To this end, the PrEstoCloud solution reaches the extreme edge of the network for efficient Big Data processing. In order to validate the applicability of the PrEstoCloud solution against real-world situations, three challenging, complimentary and commercially promising use cases (the LiveU/NAM media use case, the Aditess surveillance use case and the CVS logistic use case) have been also demonstrated in this project.

This deliverable presents the specification of the PrEstoCloud industry showcase to illustrate potentials of the PrEstoCloud project from an industrial perspective. This deliverable also comprises the presentation of all technologies which are prototyped by PrEstoCloud. Such technologies are highly important to address the whole spectrums of requirements for real-time, Big Data applications orchestrated upon modern types of frameworks such as edge and fog computing environments. Besides this, all requirements and feasibility constraints for the PrEstoCloud industrial showcase are discussed from different viewpoints: requirements and feasibility constraints for cloud utilisation, edge devices and with respect to Big Data.

Moreover, the suitability for all three use cases (the LiveU/NAM media use case, the Aditess surveillance use case and the CVS logistic use case), which can be considered as one of significant characteristics of the software product quality, is demonstrated according to ISO 25000 standard, also known as SQuaRE (System and Software Quality Requirements and Evaluation). The objective of ISO 25000 standard is to create a framework for the evaluation of software product quality.

In this deliverable, to support the project exploitation, we also demonstrate Nissatech Smart4Fit fitness system based upon the PrEstoCloud project that aims at improving trainees' performance and their safety using IoT wearables such smartwatches. Therefore, demonstrating Smart4Fit fitness system allows us to present the PrEstoCloud project to the wider public in a clear manner. During the next stages of the PrEstoCloud project, this fitness solution will be improved and extended to take advantages of the PrEstoCloud solution.

Finally, the preparation of promotion materials is explained in order to cover dissemination activities. Promotion materials planned, exhibited, distributed and showcased mainly in WP8 (dissemination and exploitation) include the PrEstoCloud poster, the PrEstoCloud brochure, the PrEstoCloud industry outreach, the PrEstoCloud Website and the PrEstoCloud social and community channel.

During the second and third years of the project, the PrEstoCloud showcase will be updated and the results shall be included in the deliverable D8.13 (PrEstoCloud showcase - Iteration 2 [M36]).

2. Introduction

The PrEstoCloud project makes substantial contributions in the domain of real-time data intensive applications orchestrated upon edge and fog computing frameworks. This project is aimed at providing a dynamic, distributed, self-adaptive and proactively configurable architecture for processing Big Data streams. After the first year of the project, the principal objective of this deliverable is to raise awareness about the PrEstoCloud project in industrial circles and to present achievements of the PrEstoCloud project to a wider public in a clear manner.

2.1. Scope of the deliverable

This deliverable presents a high-level overview of the initial industrial showcase based on the PrEstoCloud project. The showcase illustrates potentials of the project from an industrial perspective. This document includes the design of promotion materials as well as requirements needed to run the showcase. This deliverable represents the first iteration for the creation of the industrial showcase delivered in M12 and covers the showcase specification, the corresponding promotion materials and software. The second iteration will contain further implementation of these materials, and it will be delivered in M36.

2.2. Audience of the deliverable

The current deliverable is focused on three different target groups (see Figure 1): (i) general public, (ii) scientific and research communities and (iii) potential industrial customers.

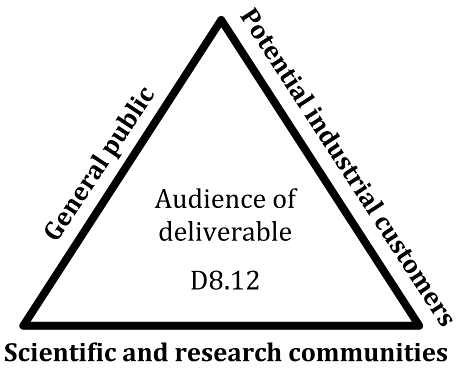


Figure 1: Audience of the deliverable D8.12

- **General public:** This deliverable is about cloud and edge computing, which are currently hot research topics in computer science. Nowadays, cloud computing is a widespread method for providing many different types of online services. Edge computing also is a new method of enhancing and optimising applications on the Internet to expand their data processing capability next to end-users or end-devices rather than at the faraway centralised datacentres. It is used to address the so-called Big Data problem as well. In order to take advantage of edge computing applications, all requirements that an end-user needs is to have any resource such as a laptop, mobile phone, tablets and sensors connected to the network and middleware software. Since it has potential for very wide uptake, we believe that this deliverable could be of interest to a very wide audience.
- **Scientific and research communities:** Since real-time Big Data processing applications developed for cloud and edge computing frameworks is at an early stage of development, this document may serve as a significant reference for further research in this field. This deliverable also strongly highlights different open challenges and technical issues in the current data-intensive applications orchestrated upon edge computing frameworks.
- **Potential industrial customers:** In this deliverable, the emphasis is placed on the companies and organizations who are interested in using the PrEstoCloud solution, for example integrating the PrEstoCloud solution into their new production process especially the real-time Big Data processing applications orchestrated upon edge computing frameworks.

2.3. Structure of the deliverable

The rest of this deliverable is structured as follows:

- Section 3 explains the modern technologies to be prototyped by the PrEstoCloud project. These technologies contribute to the addressing requirements for real-time, Big Data processing applications orchestrated upon edge and fog computing frameworks.
- Section 4 presents requirements for the PrEstoCloud industrial showcase. These requirements are divided into three different categories: PrEstoCloud requirements for cloud utilisation, PrEstoCloud requirements for edge devices and PrEstoCloud requirements with respect to Big Data.

- Section 5 describes feasibility constraints for the PrEstoCloud industrial showcase. These feasibility constraints are divided into three different categories: feasibility constraints for cloud utilisation, feasibility constraints for edge devices and feasibility constraints with respect to Big Data.
- Section 6 discusses the suitability of all three use cases (media use case, surveillance use case and logistic use case) defined for the PrEstoCloud project. This section contains functional requirements for each use case that need to be taken into account from the end-user's viewpoint are described. Functional requirements described in this section will be evaluated for the next round of the PrEstoCloud showcase deliverable which will be provided in M36.
- Section 7 provides a detailed description of the Smart4Fit fitness solution from the point of view of PrEstoCloud showcase.
- Section 8 presents promotion materials of the PrEstoCloud project, planned to be used from the start of the project.
- Finally, we conclude the document in Section 9, and discuss next steps of the project with respect to the PrEstoCloud Showcase.

The complete structure chart of this deliverable is also shown in Figure 2.

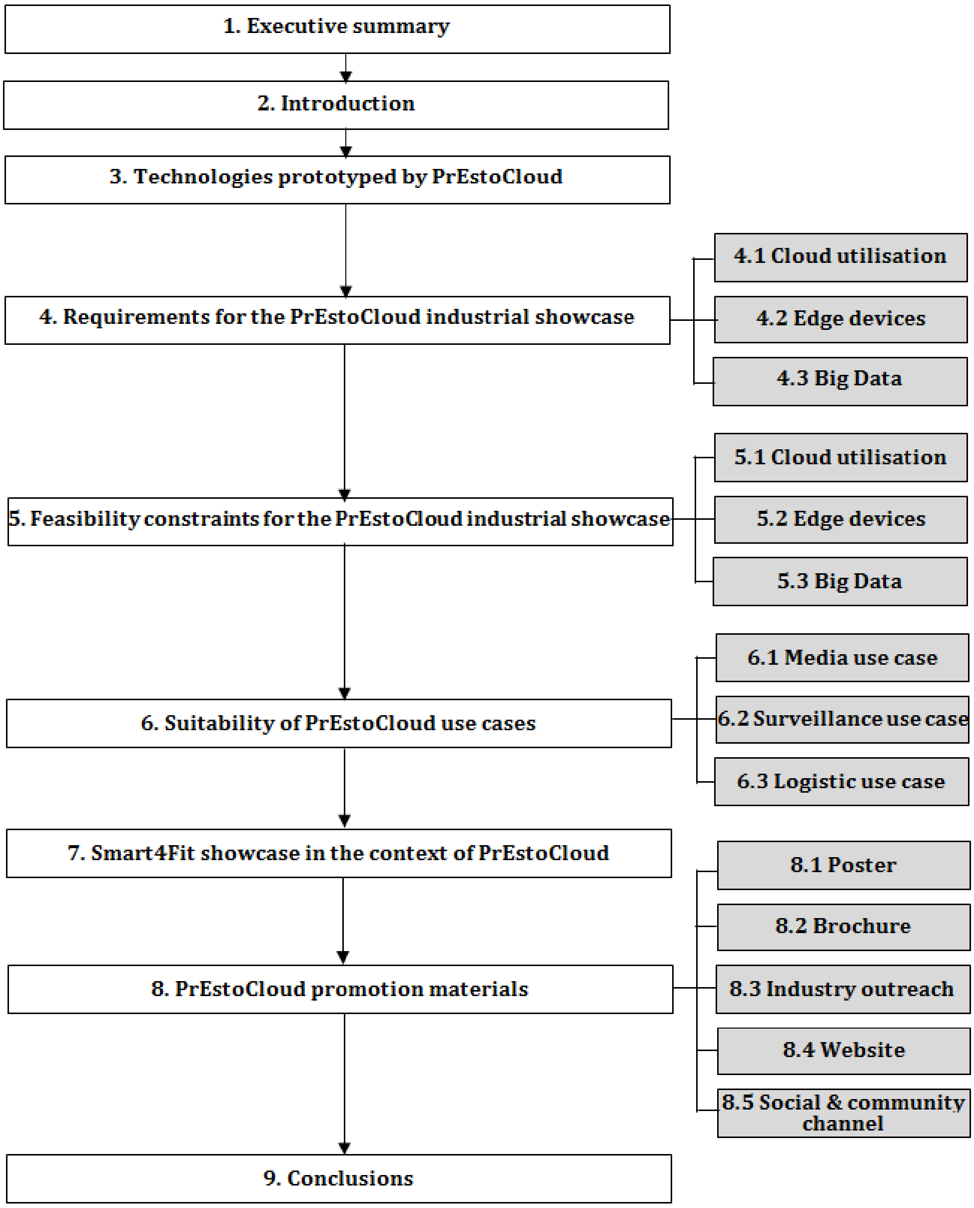


Figure 2: Deliverable structure chart

3. Technologies prototyped by PrEstoCloud

PrEstoCloud tries to overcome different challenges associated with real-time Big Data processing systems such as addressing time-sensitive changes in the execution environment and performing the adaptation at run-time, which has been recently recognised by industry. This project creates a novel computing and management solution for efficient deployment and execution of data-intensive applications orchestrated upon edge computing frameworks. The PrEstoCloud solution provides capabilities which allow such systems to benefit from important advantages including (i) development and deployment, (ii) integration and automation, (iii) data protection and privacy, (iv) cost optimisation, and (v) data management, as shown in Figure 3.

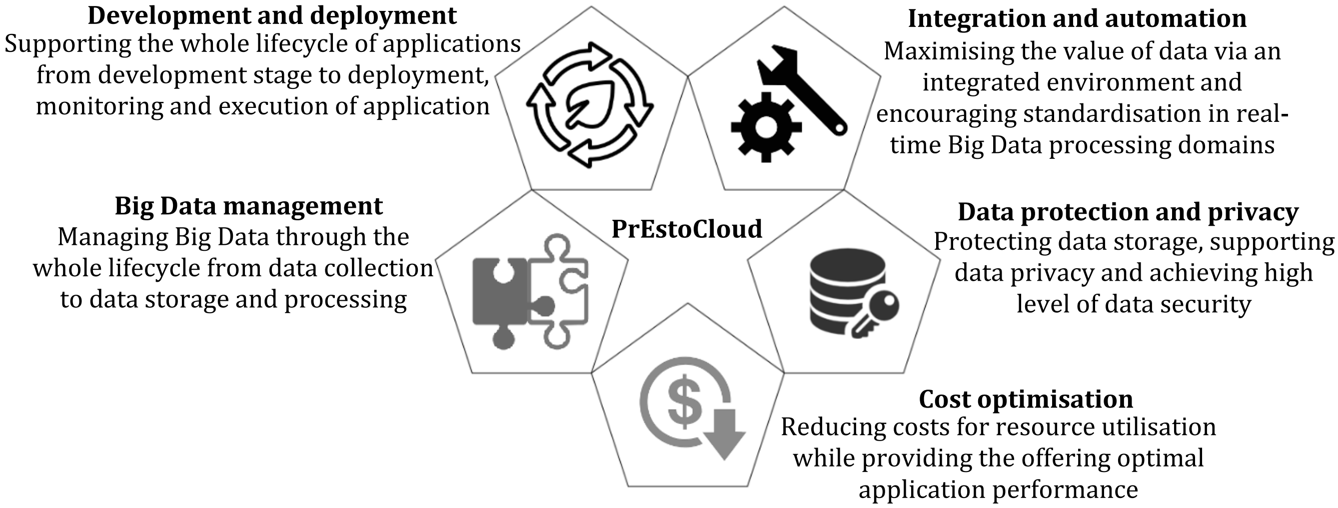


Figure 3: Capabilities provided by the PrEstoCloud solution

To this end, the PrEstoCloud project aims to prototype the following technologies which emerge to meet requirements for real-time Big Data environments within edge computing scenarios:

- **Technologies such as Oracle IoT platform[1] to improve the execution of data-intensive applications:** The PrEstoCloud project provides a new solution based upon edge computing frameworks for different purposes: (i) to securely and reliably collect data from different types of sensors; (ii) to efficiently perform real-time Big Data processing and predictive analytics on IoT events and streams; (iii) to seamlessly upgrade enterprise applications and practices with IoT data; and (iv) to appropriately standardise the integration of sensors/objects/devices with enterprise applications.
- **Technologies such as Amazon AWS IoT[2] to enhance the development productivity of data-intensive applications:** The PrEstoCloud project offers a new way of aiding data-intensive application providers to develop and customise their real-time Big Data processing systems based on edge computing frameworks. In the next decade, more than two billion sensors/objects/devices will get connected to the Internet. Therefore, this huge market obviously requires efficient solutions for deploying and customising such business-oriented real-time data-intensive systems.

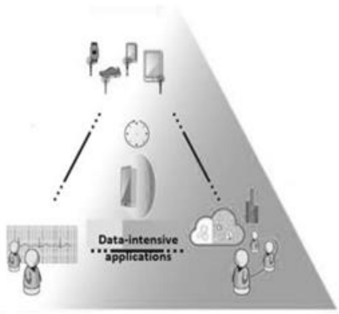
[1] Oracle IoT platform, https://www.oracle.com/solutions/internet-of-things/
[2] Amazon AWS IoT, https://aws.amazon.com/iot/

- **Technologies to monitor data-intensive applications deployed upon edge computing frameworks:** The performance of data-intensive applications deployed upon edge computing frameworks varies depending on runtime conditions such as the workload density, availability and reliability of virtualised infrastructures, network connection quality between end-users and servers, and so on. Therefore, tracking dynamic changes of execution environments provided by the PrEstoCloud solution on the fly is necessary to identify any deterioration of system health [1].
- **Technologies to facilitate location-aware and context-driven adaptation recommender systems:** As an important advantage of modern cloud-edge solutions such as PrEstoCloud, tracking end-users' information for example their location, mobility and operational environment can be useful in order to offer fully customised services. In this way, various constraints for proper behaviour of data-intensive applications (e.g. response time, security constraints, etc.) can be expressed during design-time, and further refined while running time, verified in real-time. This fact may appropriately support end-users' requirements and desires especially for data-intensive applications.

4. Requirements for the PrEstoCloud industrial showcase

Showcase requirements include requirements needed to achieve a demonstrable showcase in the context of the PrEstoCloud project. This includes a storyline with mock-ups of the PrEstoCloud solution, e.g., starting from proactive cloud resources management reaching the extreme edge of the network and step-by-step walkthrough of how real-time Big Data processing can be efficient, etc. Therefore as shown in Figure 4, requirements for the PrEstoCloud industrial showcase can be considered from three different points of view: (i) requirements for cloud utilisation, (ii) requirements for edge devices, and (iii) requirements with respect to Big Data.

Edge devices



Big Data **Cloud utilisation**

Figure 4: Three different categories of requirements for the PrEstoCloud industrial showcase

4.1. PrEstoCloud requirements for cloud utilisation

Below, we describe requirements for the utilisation of cloud-based PrEstoCloud infrastructures employed by the providers of data-intensive applications:

- **Access control for cloud infrastructure:** An access control method ensures that only authorised users gain access to the resources, data stored and the application running on the cloud-based infrastructure. Therefore, this requirement provides the security especially for the huge amount of data stored on cloud servers, and hence the data access control becomes significant for data-intensive applications. The security aspects of resources provisioned through PrEstoCloud is enhanced with context-aware access control that can be enforced for the access or configuration of resources or the processing outcomes of the applications.

- **Support for the live-migration of services:** If the cloud-based infrastructure offers the live-migration capability, a virtualised service running on the cloud infrastructure is able to migrate from a server to another one with different hardware features at run-time without any issue in operations. With the increasing maturity of cloud-based infrastructures, the demand for highly available data-intensive applications is growing. To this end, live-migration of virtualised services is an important characteristic of these solutions such as PrEstoCloud to cope with different problems for instance a single node failure or a situation when the system needs a bigger server to run tasks being carried out.

- **Potential possibilities for scaling:** In order to be able to handle increasing workloads, the cloud-based computational platform used by PrEstoCloud has to address the scalability requirement to be able to scale up from a few separate servers with a few cores to several strong servers if necessary.

- **Java Parallel Processing Framework (JPPF) support:** The Java Parallel Processing Framework (JPPF)[3] in the context of PrEstoCloud may be used as a freely available framework for executing concurrent tasks over a network of computing nodes orchestrated upon edge computing frameworks. To this end, there is a demand for a platform with Java 2 Standard Edition (J2SE) 5.0 or later, Apache Ant 1.6.2 or later and the latest version of the JPPF source code.

- **Docker engine support:** The PrEstoCloud solution may propose to use Docker containers as a new form of service virtualisation that facilitates deployment, instantiation, termination and migration of cloud-based applications, much more light weight and easier than VMs. Unlike VM-based virtualisation, the utilisation of containers does not need to boot up an Operating System (OS) for each container instance.

- **Support for cloud-based monitoring at the infrastructure-level:** A set of infrastructure-level metrics (e.g. CPU, memory, disk, etc.) related to cloud-based servers should be measured continuously whether by the infrastructure provider's monitoring probes or by the PrEstoCloud monitoring probes. Monitoring probes periodically send the monitoring data to the "Message Broker" component from which it can be distributed to any other PrEstoCloud component such as the "Autonomic Resource Manager".

- **Efficient use of network bandwidth:** Efficient use of network bandwidth through the PrEstoCloud solution will lead to providing a zero loss rate and low latency for the data-intensive application deployed to the cloud. A high-bandwidth network service is ideal for the deployment of cloud-based applications especially for Big Data scenarios since such scenarios require reliable and fast internet access to ensure the Quality of Service (QoS) of such applications. To this end, the PrEstoCloud architecture includes a component named "Workload Predictor" to attain efficient resource management through a real-time prediction of resources such as network bandwidth, etc.

4.2. PrEstoCloud requirements for edge devices

Below, we describe requirements for the utilisation of edge-based PrEstoCloud infrastructures employed by the providers of data-intensive applications:

- **Ad-hoc overlay network support:** In the context of the PrEstoCloud, there are situations where an ad-hoc overlay network may be used in order to allow the edge nodes to communicate directly with each other and exchange data. Therefore, the requirements for overlay networks such as high-level routing and forwarding or on-demand network configuration tasks should be addressed by edge devices.

[3] Java Parallel Processing Framework (JPPF), http://www.jppf.org/

- **Ability to be reached in spite of firewalls:** Specific network traffic such as ICMP packets are filtered by firewalls due to different security concerns. In such cases, the PrEstoCloud solution needs to reach every edge node regardless of whether using or not using packet filtering policies.
- **Computing capability:** Edge nodes needs to offer the computing capability to process tasks assigned. Edge nodes generally have hardware resource limitations in reality [2]. However in the PrEstoCloud project, these nodes should be capable of handling workloads at runtime. In this regard, the current industrial IoT deployments strongly rely on the availability of such edge nodes that should be able to execute jobs, highly energy efficient and easy to manage.
- **Support for edge-based monitoring at the infrastructure-level:** Infrastructure-level parameters (such as CPU, memory, disk, etc.) related to edge nodes need to be measured continuously by whether built-in monitoring system or the PrEstoCloud monitoring probes running on edge nodes. The monitoring system ceaselessly sends the edge nodes' monitoring data to the "Message Broker" from which it can be distributed to any PrEstoCloud component such as the "Autonomic Resource Manager" component.
- **Standardised edge resources:** Over the past few years, remarkable attempts have been performed to overcome the vendor lock-in challenge by standardisation of edge computing resources. Although, the current commercial industries rarely come up with solutions for offering general-purpose edge nodes involved in computation and data analytics. One of the main areas where PrEstoCloud findings contribute to standards relates to the management of intelligent edge devices used for advanced data analytics and control systems, and thus increasing the value of data and maximising the business impact.

4.3. PrEstoCloud requirements with respect to Big Data

In large-scale data-intensive environments, applications as well as monitoring entities generate massive amount of data which has to be collected, aggregated, stored and processed. For such applications, there is the requirement to collect and store large quantities of data. To this end, consideration should be taken into account on where and how to process data in order to overcome the problems of data volume, variety (diversified data types), veracity (uncertainties in the data) and velocity (timely response requirements). Thus, this fact poses other challenges for example the use of datacentres with strong hardware features (e.g. storage capacity and processing power), high-bandwidth configuration and flexible integration capabilities. There is therefore a need to specify virtualised storage capacity and also network communication configurations according to functional descriptions of the data-intensive application. The following list gives a number of specific requirements in order to use the PrEstoCloud solution applied for data-intensive applications:

- **Supporting high-throughput data transmission between data sources and computing infrastructures:** In order to improve the quality performance of data-intensive applications, high-bandwidth data transmission between data sources and computing infrastructures is desirable. However, renting very high-bandwidth or special connection links is not affordable for many businesses. To this end, the PrEstoCloud solution tries to provide the best possible performance for Big Data scenarios even using networks' bandwidth limitations.
- **Supporting diversified data content ranging from structured (e.g. data kept in a relational database) to unstructured data (e.g. video clips):** Because of the diversified data types generated by Big Data scenarios, the PrEstoCloud solution often needs to deal with not only traditional structured data (such as JSON-based numeric data), but also semi-structured or unstructured data (such as video, audio and images).
- **Supporting real-time data analytics:** A significant requirement for data-intensive applications is advanced real-time analytics on data streams coming from sensors and their contexts. Along these lines, one of main goals of the PrEstoCloud project is to introduce a novel platform which allows to carry out timely analytics over massive data efficiently.

- **Supporting large and advanced data storage:** Sensors and users which more and more are getting connected to the data-intensive applications produce huge volumes of data and therefore require solutions such as the PrEstoCloud project for advanced and large data storage systems capable of capturing, storing, modelling and analysing such large amount of data. Besides that, in conditions where the supply of data can drastically increase, it is also required to provide support for elasticity and modify configurations of the data storage system to maintain the essential characteristics.
- **Supporting privacy and security on sensitive data:** In the context of Big Data scenarios, ensuring data privacy and security have become paramount. The PrEstoCloud solution makes one step towards providing a novel framework to enforce privacy policies in large-scale data processing since this requirement is an urgent need for developing operational techniques to facilitate secure data-intensive computation.
- **Supporting the prevention of data loss or corruption:** In order to protect data, the PrEstoCloud solution closely monitors all sensitive data, whether it is in transit, permanently archived in a database, or temporarily located on a network host for fast retrieval or modification. To this end, PrEstoCloud continuously keeps all networks, storage and computing infrastructures in safe areas, it backs up data regularly, and so on.

5. Feasibility constraints for the PrEstoCloud industrial showcase

In this section key feasibility constraints for the PrEstoCloud industrial showcase are considered and defined according to three different perspectives as shown in Table 1. These constraints which need to be met are imposed by cloud utilisation, edge devices and Big Data processing tasks.

Table 1: Three categories of feasibility constraints for the PrEstoCloud industrial showcase

Category	Feasibility constraint
Cloud utilisation	Expensive cloud-based infrastructure
	Drastically changing workload scenarios
	Vendor lock-in problem
	Security concern
Edge devices	Edge devices are low power
	Edge devices need to be located in the proximity of end-users
	Internet connection
	Limited wireless bandwidth
	Conflicting desires of end-users
	Demand for improving data storage capacity
Big Data	Increasing computational burden over time
	Security and privacy of sensitive data
	Data locality
	Time-critical processing tasks

5.1. Feasibility constraints for cloud utilisation

Many organizations and companies have certainly benefited from cloud-based infrastructures allowing them to concentrate on their core business competence. However, there are different feasibility constraints in adapting such cloud utilisation as described below:

- **Expensive cloud-based infrastructure:** Bandwidth, storage and computing resources offered by cloud-based infrastructure providers are expensive. Moreover, in the cloud computing industry, some vendors try to lock-in their customers by employing proprietary whether software or hardware. Therefore, it would be expensive for customers to switch to another cloud vendor. To address this constraint, the "Resources Adaptation Recommender" component defined in the PrEstoCloud architecture considers context-aware edge-cloud adaptation recommendation, and therefore this component estimates additional factors such as cost that may influence adaptation decisions. Moreover, a specific function will be proposed by the "Application Placement & Scheduling Controller" to minimise the hosting cost while satisfying all placement constraints (e.g. hardware affinity, fault-tolerance, etc.) received from the "Application Fragmentation & Deployment Recommender".
- **Drastically changing workload scenarios:** Insufficient cloud-based infrastructures, which is called under-provisioning, allocated to the running application may unavoidably harm the performance and result in Service Level Agreement (SLA) violations, while over-provisioning may also cause cost waste and resource idleness [3]. This constraint has been a challenging issue due to runtime variations in workload density especially for drastically changing workload scenarios. To address this constraint, the "Workload Predictor" component defined in the PrEstoCloud architecture is able to predict the dynamic workload of the underlying cloud infrastructure at run-time, and hence enable refinement process for quality assurance.
- **Vendor lock-in problem:** This issue is a significant barrier to the adoption of multi-cloud computing frameworks, due to the lack of standardisation. However, limited numbers of research studies are conducted to analyse and highlight the complexity of vendor lock-in issue in the cloud environment [4]. For example, public cloud providers, such as Amazon AWS and Microsoft Azure, offer dedicated VPN (Virtual Private Network) solutions, so that their customers can use these public cloud infrastructures as an extension of their own private infrastructure. To address this constraint, the "Inter-Site Network Virtualization" component defined in the PrEstoCloud architecture uses standardised VPN technologies, such as IPsec and OpenVPN, to overcome the limitations of interoperability due to the implementation of proprietary protocols.
- **Security concern:** The loss of physical control over data which is stored on the cloud-based infrastructure or transmitted over the Internet is one of major concerns for different companies [5]. To come up with such a concern, utilisation of a private cloud may be helpful [6]. Moreover, the "Security Enforcement Mechanism" component defined in the PrEstoCloud architecture is able to enforce protection in the operational layer where the application is running on the cloud. This component is also responsible for improving the network security by instructing the deployment of VNFs (Virtual Network Functions) such as firewalls and IDS (Intrusion Detection Systems) virtual devices.

5.2. Feasibility constraints for edge devices

However edge nodes are resources which can process all the tasks instantly, they have relatively feasibility constraints when compared to the infrastructures in cloud-based datacentres. In scenarios of real-time data intensive applications orchestrated upon edge computing frameworks, the following constraints should be considered:

- **Edge devices are low power:** One of the PrEstoCloud project's aims is to leverage the edge for some computation and take advantages of low-latency. However, there is a constraint that edge devices are characterised by small computing power and they have hardware resource limitations in practice [7]. In the PrEstoCloud solution, the "Mobile On/Offloading Processing" component provides the interface for monitoring of edge devices (e.g. microcontroller-based, Android-based, lightweight Linux-based computers, etc.) by communicating with "On/Offloading Agent" installed on each edge device. This component is responsible for stop, start or migration of computational tasks from the edge side to the cloud in situations where the edge device is not able to handle the current workload any more.

- **Edge devices need to be located in the proximity of end-users:** In order to benefit from a low-latency response time for the application, edge devices need to be located in the proximity of end-users. This is the main reason that the PrEstoCloud solution allows the utilisation of the extreme edge of the network in order to run applications at run-time.
- **Internet connection:** Edge devices should be designed for continuous operations in execution environments with a permanent Internet connection. If the edge device has no internet connection for a while, the end-users have no access to the data stored on the cloud. With no persistent reliable Internet connection, possibilities in terms of PrEstoCloud may be limited to collecting data on the edge device, then automatically transporting it to the Internet for further data processing when the edge device gets connected to the Internet.
- **Limited wireless bandwidth:** Mobile edge devices usually are connected to the Internet through a low-bandwidth wireless network technology; however the system needs to allow the transmission of real-time streaming data such as video or audio. In the context of the PrEstoCloud project, minimising the latency through optimal utilisation of bandwidth will be reached with efficient deployment of application fragments.
- **Conflicting desires of end-users:** Various users may share an edge node in one region and they may have different desires for example conflicting desires of security and speed [7]. To this end, the PrEstoCloud solution is able to find the best trade-off between different benefits of the technique to process the real-time Big Data and its detriments.
- **Demand for improving data storage capacity:** Storage capacity has been considered always as a constraint for edge devices. To overcome this issue, it is possible to store and access the major portion of large data on the cloud through networks. In this way, considerable amount of storage space on edge devices can be saved because it can be sent and processed on the cloud. Moreover, the "Workload Predictor" component is also aimed at achieving efficient resource management through an accurate demand prediction of resources such as disk capacity, etc.

5.3. Feasibility constraints with respect to Big Data

Although Big Data analytics applications are notable tools which can help with significant business decisions, this research area has its own feasibility constraints as follows:

- **Increasing computational burden over time:** Over the last few years, billions of sensors or objects have been getting connected to applications on the Internet. This fact causes trillions of gigabytes of data being generated and processed by Big Data technologies such as the PrEstoCloud solution. As a consequence, such Big Data processing and analytics applications are facing with increasing computational burden which may result in poor quality of service or un-optimised utilisation of network infrastructures.
- **Security and privacy of sensitive data:** There have been concerns with the privacy and safety of sensitive data stored remotely. To overcome such concerns, in addition to the utilisation of the "Security Enforcement Mechanism" component defined in the PrEstoCloud architecture (explained in Section 5.1) to enforce protection in the operational layer where the application is running on the cloud, the PrEstoCloud solution may anonymise the data before storing the data on far-away servers, or it must protect the data from unauthorised users. For example, the PrEstoCloud solution is able to provide network virtualisation with necessary authorisation mechanisms.
- **Data locality:** This Big Data constraint is more important when data and computing are geographically dispersed. Data locality means moving computation closer to the data source. In

some cases, computational tasks are sent to resources where the data resides. According to the PrEstoCloud solution, data-intensive workloads can be decomposed into loosely-coupled parallel tasks. As a consequence, the utilisation of resources and scheduling can be improved.

- **Time-critical processing tasks:** The capability of processing the huge amount of data in a timely manner carried out by Big Data analytics applications is a constraint to be considered. Variety and growth of Big Data continues to pose challenges in the field of real-time techniques which are able to handle Big Data analytics. The PrEstoCloud solution is aimed at handling various forms of data analytics within reasonable time frames through a dynamic, distributed architecture for proactive resource management.

6. Suitability of PrEstoCloud use cases

According to ISO 25000[4], the functional suitability is one of core characteristics of the software product quality model that needs to be considered, shown in Figure 5.

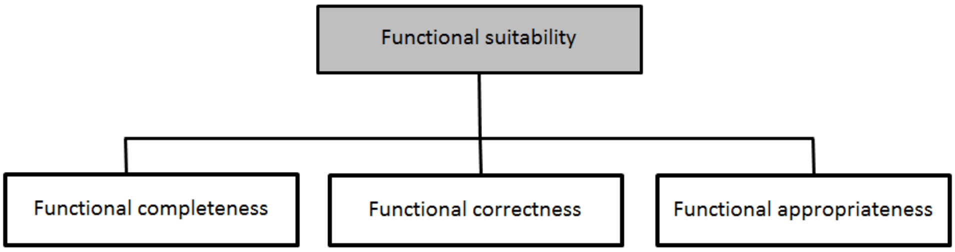


Figure 5: Functional suitability defined in ISO 25000 software product quality model

Functional suitability represents to what extent the software product satisfies functional requirements from the end-user's perspective while it is used. This significant characteristic is composed of three other sub-metrics:

- **Functional completeness:** It refers to the degree to which the system's functions can cover all the specified tasks and end-user's objectives.
- **Functional correctness:** It refers to the degree to which the system provides the correct results with the required degree of precision.
- **Functional appropriateness:** It refers to the degree to which the system's functions can facilitate the accomplishment of all the specified tasks and end-user's objectives.

Therefore, the evaluation of the PrEstoCloud solution's functional suitability is applicable for all three use cases defined in the project. To this end, the evaluation process for functional suitability [8] of use cases that is shown in Figure 6 can be used.

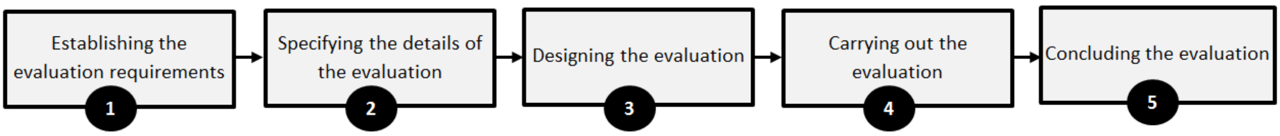


Figure 6: Evaluation process for functional suitability

[4] ISO 25000, http://iso25000.com/index.php/en/iso-25000-standards/iso-25010

The evaluation process consists of five steps as follows:

- **Establishing the evaluation requirements:** In the first step, the purpose of the evaluation is established, and the quality requirements of the system are defined. In this step, each use case should present their requirements and needs to start the evaluation plan.
- **Specifying the details of the evaluation:** In the second step, the decision criteria for quality metrics are determined. In this step, each use case should specify what metrics need to be measured to evaluate the requirements established in the previous step.
- **Designing the evaluation:** In the third step, evaluation activities are planned. In this step, each use case should present the scope of the evaluation in detail.
- **Carrying out the evaluation:** In the fourth step, the decision criteria are applied to quality metrics, and all measurements are carried out. It is the step where the greatest effort needs to be made. In this step, each use case should perform the measurements of metrics specified for functional suitability.
- **Concluding the evaluation:** In the last step, results of the evaluation are checked, and evaluation report is produced. In this step, each use case should prepare a detailed report giving the level of functional suitability reached. This report should present the results obtained in each of functional completeness, correctness and appropriateness.

6.1. Suitability of the media use case

The media pilot is aimed at a service for gathering videos from anywhere anytime, combining professionals and amateur video feeds, and in particular from whether planned or unplanned events. The general concept of the media use case is shown in Figure 7.

Figure 7: Illustration of the LiveU/NAM media use case concept

A live media platform called Media Cube offers personalised and flexible consumption of real-time stories by combining freelance reporting, traditional broadcasting and social media streams. The service includes contribution, distribution, and management of the service on the cloud. Suitability of the media use case will be evaluated based on the following requirements:

- **Application fragmentation and deployments:** High level of QoE and QoS for the live video streaming will be provided by optimisation of initial resource deployments and runtime resource management across edge devices, private and public clouds.

- **Spatio-temporal processing**: Quality of video streaming for large crowded events will be improved by the creation of ad-hoc network in order to enable connecting amateur users to the infrastructure provided by the PrEstoCloud solution.
- **Security enforcement and inter-site network virtualisation**: The security of the communication will be enhanced in an easy manner since different cloud-based computing nodes and servers all are running on a single virtualised network.

Thus, the media use case is relevant as it depends on these technologies. Besides mentioned above, the following requirements can be evaluated for the suitability of the media use case:

- **Multi-Media Hub (MMH) processing at edge**: It shall be extended to video processing and to WebRTC streaming.
- **On premise and on cloud offloading:** Offloading tasks from paid cloud-based resources to on premise resources can be used to optimise costs of services.

6.2. Suitability of the surveillance use case

Current surveillance systems in enterprise facilities and public places produce massive amount of video content while operating at a 24/7 mode. There is an increasing need for the real-time processing of such huge video data streams to provide a quick summary of interesting events that are happening during a specified time frame in a particular location.

The surveillance use case aims at the application of a smart surveillance system that uses video and audio sensors for the automated detection of events using data analytics. Analytics algorithms will have the ability to be deployed either on the cloud or on the edge of the surveillance infrastructure. The general concept of this use case is presented in Figure 8.

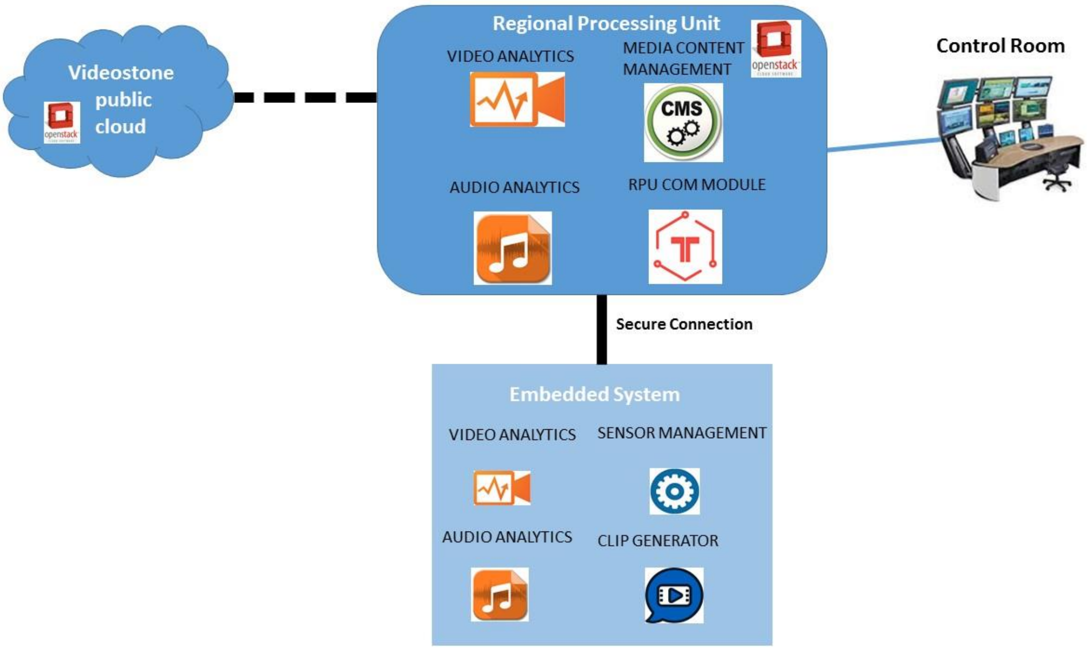


Figure 8: Illustration of the Aditess surveillance use case concept

The application logic of the surveillance use case is to gather video and audio streams from the cameras (fixed CCTV system and movable UAV cameras), store and process the video files in cases such as perimeter protection, no trespassing of security areas, detection of screaming and gunshot events.

The primary detection of these types of security threats will be based on a camera-built embedded system with computing and storage resources. Additionally, processing of the acquired data can take place on cloud infrastructures as well as other processing layers between cloud and edge. The suggested infrastructure for this usage will take place in three different layers: the camera-build embedded system, the regional processing units and the cloud-based infrastructure (public or private). The suitability of the surveillance use case is based on the following operational requirements:

- **System availability**: By the exploitation of the available resources and considering the capability of on-demand and real-time service migrations, the system should be available close to 100% and in any case no lower than 99.9%.
- **Handling of multiple video streams:** Similar to the first requirement in terms of resources, the system should be able to concurrently process multiple video streams from different sources. At least 50 percent of sensors should be served at any given time.
- **Threat detection/notification**: The detection latency should be constrained under a specific threshold, for instance less than 10 seconds. The PrEstoCloud solution should be able to provide the necessary computational resources in order to accommodate more demanding algorithms.
- **Maintain operational cost**: Efficient utilisation of edge and cloud resources is necessary to optimise the operational cost.
- **Transmission and storage requirements**: Addressing the requirement of multiple video streams is essential to transmit and store multiple video streams from different sources.

In addition to the above requirements, the suitability of this use case will be considered based upon the following cloud requirements as well:

- **Capacity**: The Aditess surveillance system should be able to supply an on-demand self-service in order to balance supply and demand for the provided service. Therefore, it can make changes as and when they are needed for example increasing service capacity on demand according to the current workload density.
- **Scalability**: In some surveillance environments such as large cities, the number of cameras may possibly exceed to even thousands of devices. In such situations, not only providing appropriate response time is important, but also optimising resource utilisation needs to be taken into consideration by the scalable Aditess surveillance system.
- **Privacy and security**: Ensuring data security and privacy is a significant concern addressed by the Aditess surveillance system. To this end, application-specific privacy requirements should be met during the design phase of the software.

6.3. Suitability of the logistic use case

The CVS logistic use case presents a transport logistic system with advanced real-time data-intensive analytics on telematics data streams (e.g. acceleration, breaking speed limit, concentration, manoeuvring, etc.) coming from vehicles and their contexts (e.g. traffic jam, next rest station and traffic light, etc.) at the edge of the network. This system extracts important information through real-time analytics which will allow better manual, semi-manual or even automatic decision making. It is important to determine how the CVS logistic system behaves in order to meet functional needs of stakeholders (e.g. driver, logistic centre, vehicle owner, and so on), shown in Figure 9.

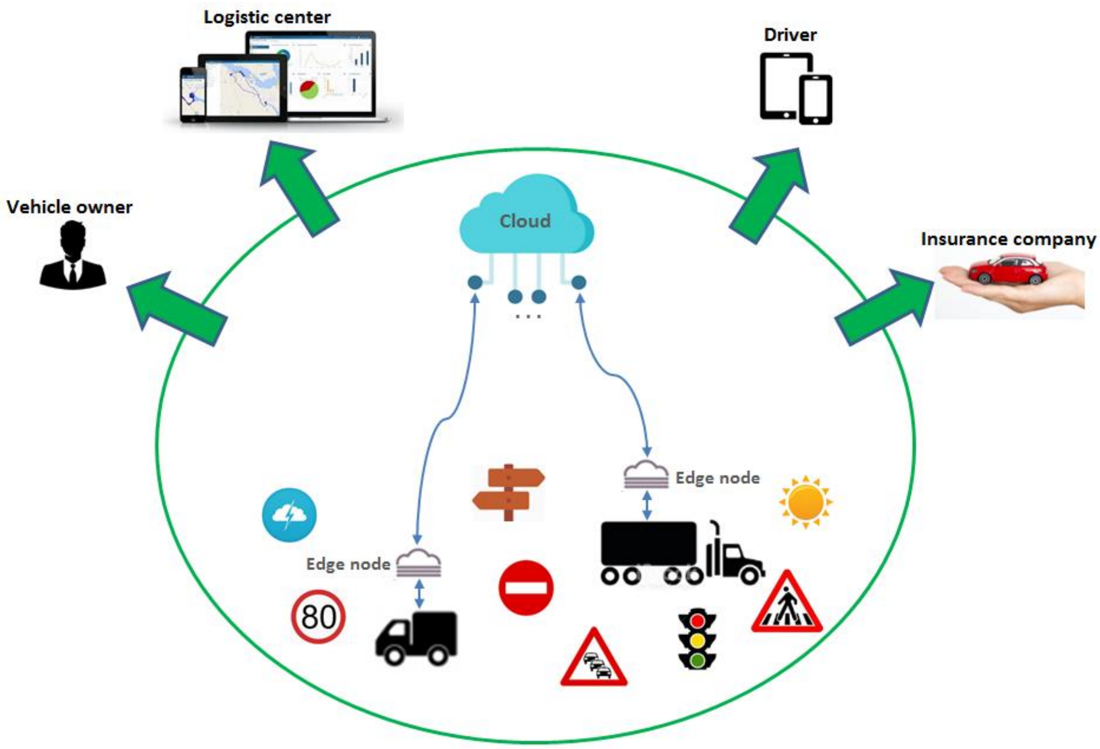


Figure 9: Illustration of the CVS logistic use case concept

In this section, all functional requirements from the end-user's perspective that should be considered in the evaluation process for the suitability of the CVS logistic use case are described. The international standard ISO 17287[5] (Road vehicles - Procedure for assessing suitability for use while driving) considers ergonomic aspects of transport information and control systems (TICS). In this process standard, suitability is described as the usability of the system which supports the driver to perform the primary driving task while driving. Drivers require ease of use and high functionality, and they do not expect the system to result in unsafe driving situations. However this standard does not recommend any specific variables to evaluate the suitability of the system, the term "suitability" focuses on the following aspects in addition to the efficiency[6]:

- **Interference with the driving task:** This aspect is the adverse influence on the driver's ability to deal with the vehicle and the environment. It is necessary to design the system in a way that it would not interfere with the driving task, or the interference would be kept to a minimum level and avoided in critical situations.
- **Controllability:** This aspect is the degree to which drivers can influence the system's function such as initiation, termination, repetition, adaptation and so on.
- **Ease of use while learning about the system:** Since some features of the system may be used not often, or may be used by drivers who are initially unfamiliar with the system, acquiring knowledge and learning skills are important.

Apart from those three aforementioned functional requirements to be taken into account from the end-user's viewpoint, the following functional requirements also need to be evaluated for the suitability of the CVS logistic use case:

[5] ISO 17287, https://www.iso.org/standard/30597.html
[6] Efficiency is in relation to the accuracy with which drivers achieve intended objectives.

- **Real-time view:** The notifications and suggestions displayed to the end-users should be updated at a minimum of once per second through e.g., on-screen display or via voice.
- **Legislative compliance:** The CVS logistic software product should comply with all current EU applicable safety and health legislative requirements[7].
- **Smart phone or tablet installation:** The CVS logistic software product should be hosted a smart phone environment, e.g. iOS or Android.
- **Data privacy and authorisation:** The CVS logistic software product should provide a solution for the pre-authorisation of end-users such as using authentication mechanism via login credentials and session management capabilities.
- **Reporting facility:** The CVS logistic software product should provide collected results described in an updated informative report at any time and at all levels of abstraction.
- **Out-of-vehicle sensory data:** In addition to the in-vehicle sensory data, the CVS logistic software product should be able to take into consideration also out-of-vehicle sensory data such as live weather condition, current road speed limit, next rest station and so on.
- **Long-term storage of data:** The end-users of the CVS logistic use case should be able to preserve historical data such as driver's profiles, alerts, suggestions, and so on at least for one week.
- **High availability:** The CVS logistic software product should provide a highly available solution. A high degree of availability, over 99%, needs to be provided by the CVS logistic use case, due to operational criticality of services which has to be provided for this use case.

7. Smart4Fit showcase in the context of PrEstoCloud

Nissatech[8] as a partner in the PrEstoCloud project is an innovation-driven SME with strong international cooperation. Its vision is becoming an East European leader in developing advanced Information Technology (IT) solutions for real-time processing usable in various business areas such as fitness industry. In the context of PrEstoCloud, Nissatech offers a fitness solution called Smart4Fit[9]. The Smart4Fit project is aimed at improving and enhancing all trainees' performance, effectiveness and their safety by using wearables such as smartwatches. Functioning of the Smart4Fit showcase in the context of the PrEstoCloud architecture is illustrated in Figure 10. Over the next two years of the PrEstoCloud project, the Smart4Fit showcase will be improved and extended according to the PrEstoCloud solution.

[7] Safety in the automotive sector, https://ec.europa.eu/growth/sectors/automotive/safety_en
[8] Nissatech, https://www.nissatech.com/
[9] Smart4Fit, http://smart4.fit/

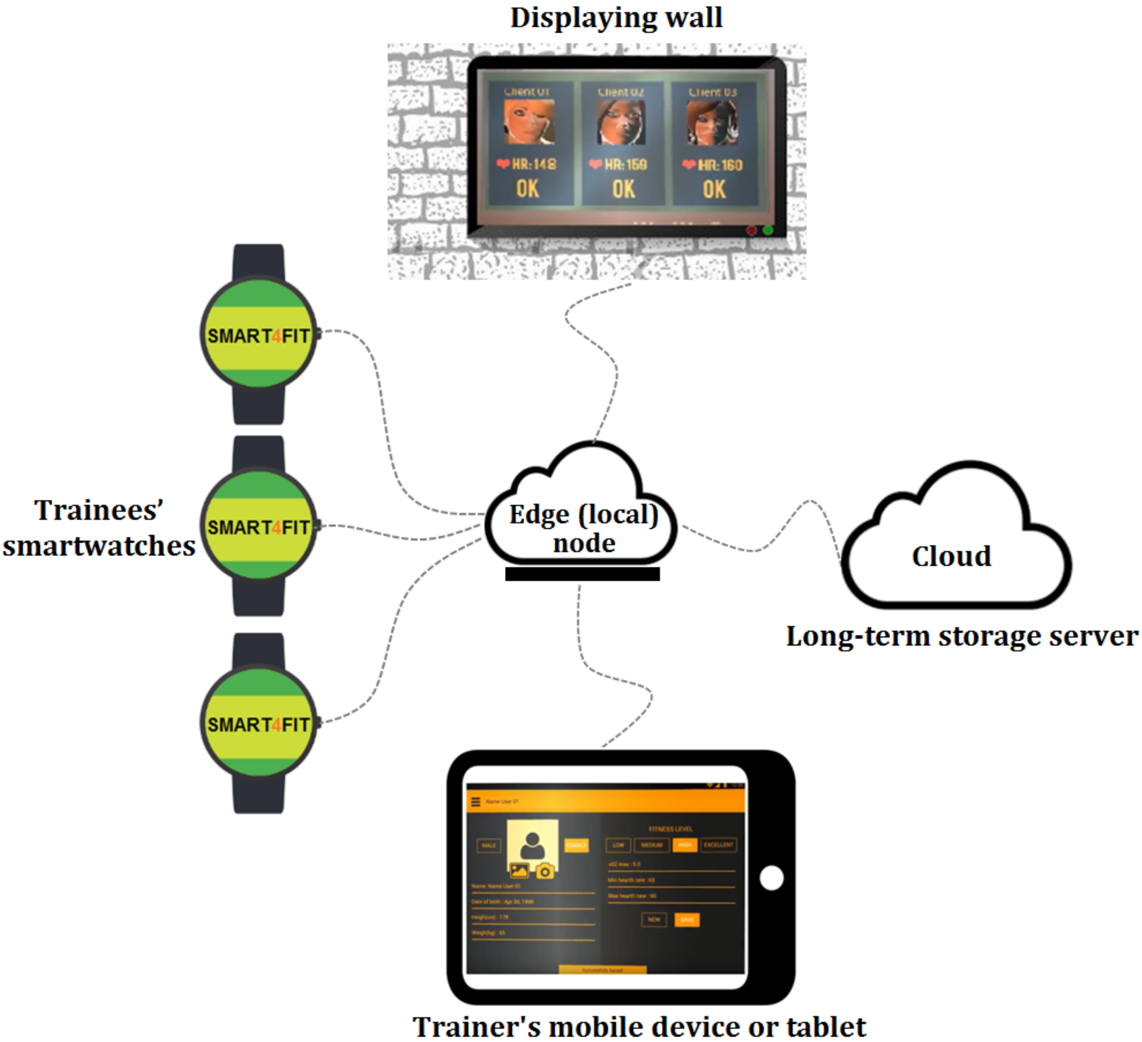


Figure 10: Functioning of the Smart4Fit showcase in the context of PrEstoCloud

Smart4Fit enables coaches to manage training sessions more efficiently and offer trainees a higher degree of personalization, better monitoring of the progress and effectively achieving the fitness goals. Smart4Fit can (i) monitor performance of trainees and other relevant training data through smartwatches, (ii) locally process the monitoring data taken during the training session on an edge (local) node to provide highly personalised experiences at run-time, (iii) displaying real-time monitoring data on the wall (real-time visualisation) and showing trainees' performances and other relevant information on the trainer's mobile device or tablet (master application) and (iv) transfer the monitoring data to the server on the cloud to run Big Data analytics in order to get useful recommendations for managing monitored entities.

Generally, the lack of Internet access is not considered as a barrier to run Smart4Fit. However, the long-term storage of measured values on the cloud can complete offline data analytics. The edge (local) node is designed to run upon both online and offline mode. This node sometimes has access to the Internet connection. To this end, there is no need to have a special Internet connection such as very high bandwidth capabilities to transmit the monitoring data to the cloud, and this fact helps us decrease network costs.

7.1. Smart4Fit scenario as fitness solution

When the Smart4Fit fitness system executes, the showcase will proceed at three stages (i) before the training session, (ii) during the training session and (iii) after the training session.

7.1.1. Before the training session

The fitness instructor uses a tablet or mobile device to start the Smart4Fit coach app. The trainer would like to make the training schedule for the next week. The system already has all trainees' profiles, exercises and training plans. The trainer decides to add some new exercises in order to refresh the training plans.

The trainer assigns each of the training plans to the specific time and day, and fills the entire week with the training sessions. Since training plans are assigned to the people now, the coach can personalise and adjust the training plans to meet needs of each trainee and tailor the training to their needs. By adjusting their min and max heart rate, number of repetitions and difficulty level of some exercise, it is possible to have the trainees with various ages, goals and fitness level at the same training session.

At the beginning of the training session the coach confirms that all trainees have arrived and provides them smartwatches where trainees can see their profile pictures. The trainees should wear smartwatches during the entire session. When trainees confirm that smartwatches are on their hands, the coach can start the prepared training. Everything is automatized during the training. The system follows the setup made by the coach. The smartwatch app notifies trainees when the next exercise or the pause starts. It shows what the current exercise and the next exercise should be, as well as heartrate and calories burned. It also shows an animated image of the next exercise, so that trainees can remember how exactly exercise performs.

7.1.2. During the training session

All the relevant data, collected with the help of smartwatches, are processed by the edge (local) node over time. Recently, IoT sensors especially wearable devices such as smartwatches have been gradually gaining popularity. In Smart4Fit, smartwatches are able to continuously measure different parameters (e.g. trainees' heart rate, performance and other relevant training data). Smartwatches are modular system and each part of this solution can be extended or changed based on the club's preferences. It should be noted that the solution is also compatible with all Android-powered smartwatches. Using Android-powered smartwatches used for Smart4Fit, a simple user interaction is required. Moreover, smartwatches should be able to automatically recognise the trainee's activity status (e.g. walking, running or being highly active) without pressing any button to define the start or end time of the activity. Furthermore, the smartwatch's battery system should be last long enough, while it is also significant how long it takes to recharge the smartwatch's battery.

The results are displayed on the wall and the master application running on the trainer's mobile phone or tablet. This provides both the trainer and trainees the real-time monitoring data about trainees' performances and other relevant training data. The master application is deployed on the trainer's mobile device or tablet. In addition to the displaying wall, this application provides real-time alerts if a trainee is out of his or her heart rate zone or if it exceeds the highest allowed heart rate, and so forth. This master application allows the trainer to manage the training sessions, monitor every trainee over time with the personalised training setup, and get informed about the real-time measured data about trainees' performances and other relevant training data.

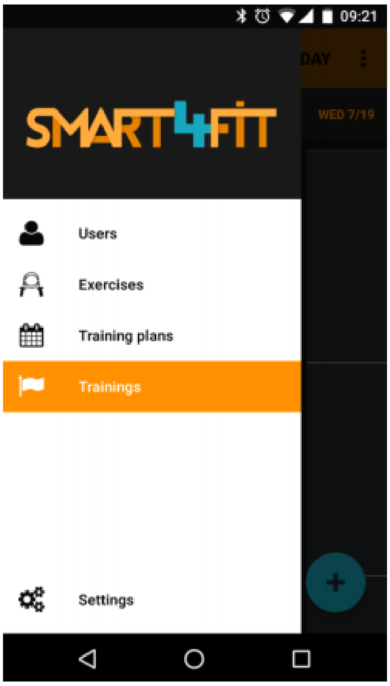
Both the master application and displaying wall provide real-time alerts if someone is out of his or her heart rate zone or if it exceeds the highest allowed heart rate for instance. All this allows the coach to monitor each of trainees in real-time with the personalised training setup particularly made for them. So in a way, Smart4Fit offers the individual personalised training to be done in the group in the comfort of social environment. It also greatly lowers the cost of personalised trainings.

7.1.3. After the training session

After the training session, the trainer and trainees may look at the training data and see the results. To this end, a personal data analytics system as one of the key features of Smart4Fit is developed. Personal data analytics system analyses all the relevant training data (past and present) on demand and allows us to know what was unusual during the training, what were the anomalies (if any) and even what is the level of the fitness-progress of each trainee. It can also tell the fitness instructor if the personalised training plan was too hard or easy for specific trainee all for the purpose of achieving more adequate training for the next time. The monitoring data measured during the training session can be transferred to the centralised repository on the cloud to run Big Data analytics in order to further analytics and get useful recommendations for efficiently managing training sessions.

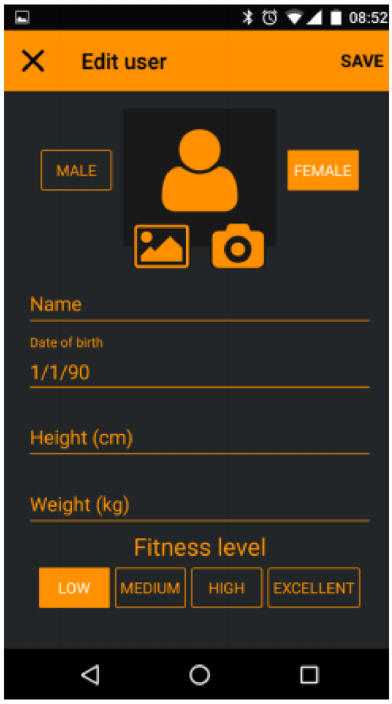
7.2. Smart4Fit coach app

The Smart4Fit coach app is a master application and supposed to be used on devices such as mobile device or tablet that allows the trainer to use it during the training session. Figure 11 provides various screenshots of the Smart4Fit coach app along with short explanations on how it works.

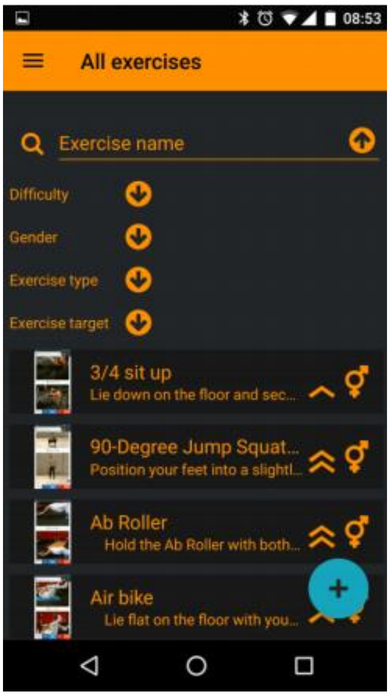


Menus used by fitness instructors

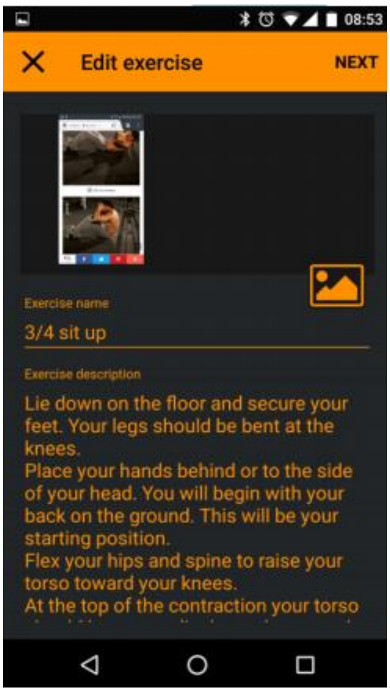
List of users where trainer can create or edit existing user profiles



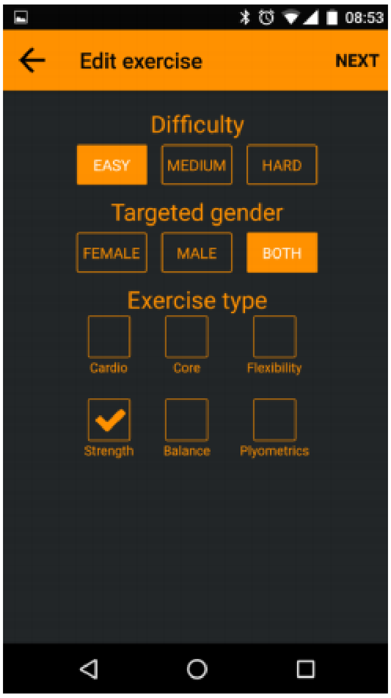
Creating or editing a user profile



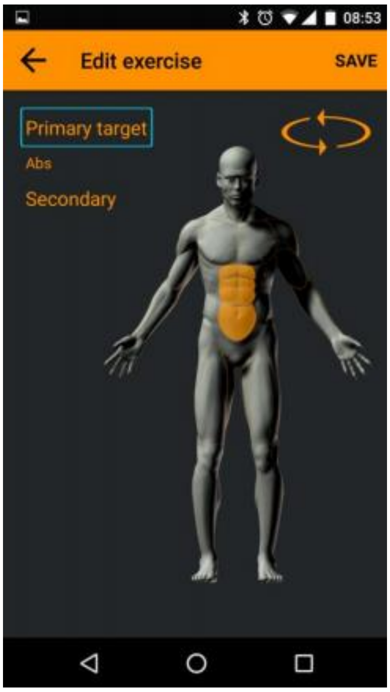
List of created exercises and search-filters to navigate them easier



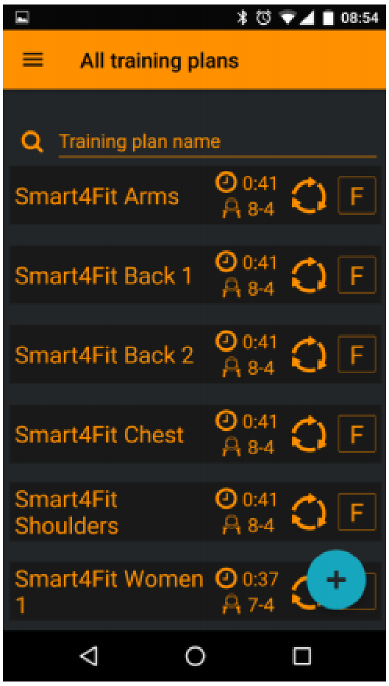
Creating or editing exercises with image, title and description



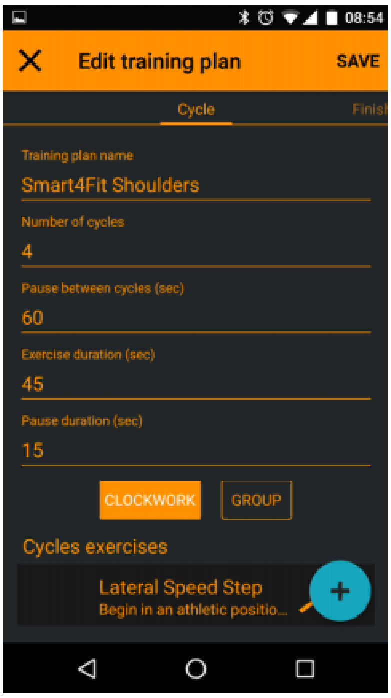
The main characteristics of an exercise



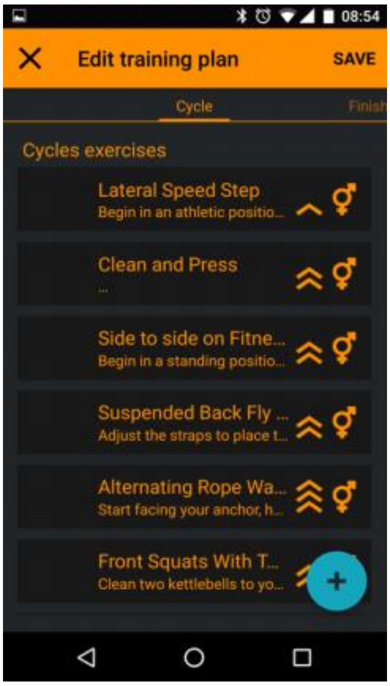
Setup of targeted muscle groups



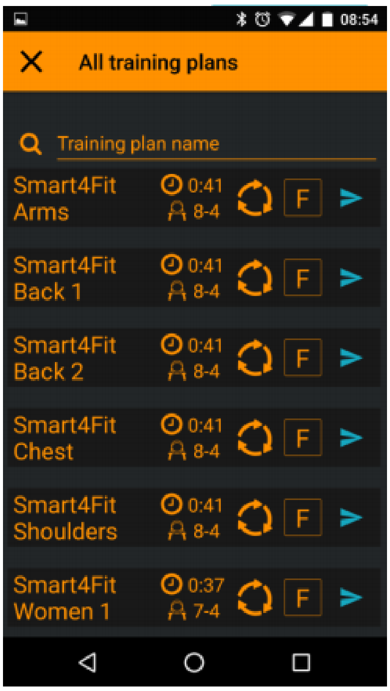
List of training plans and the basic info about them



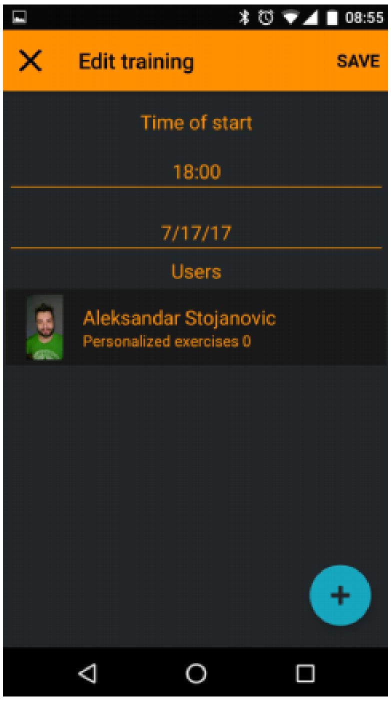
Creating or editing training plans



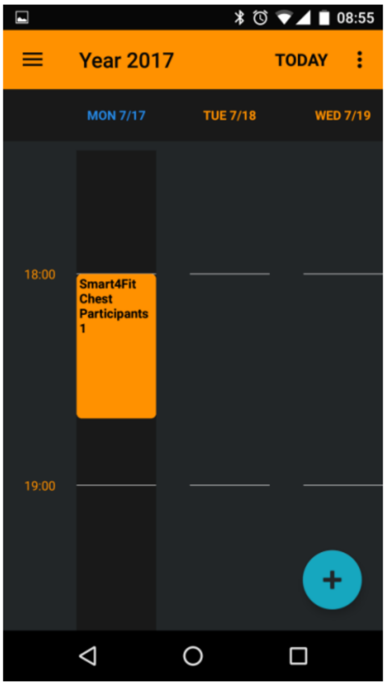
Editable list of exercises which build up the training plan



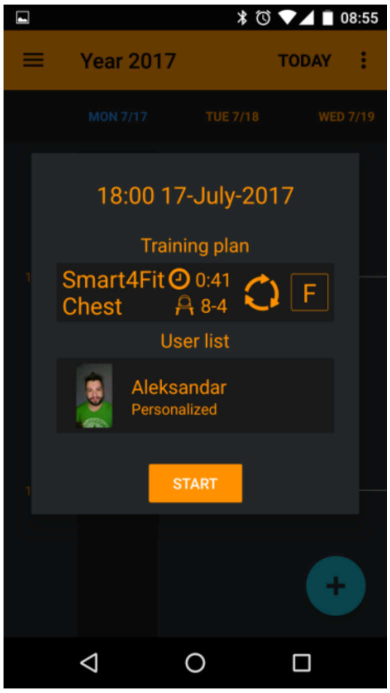
Creating training session with list of training plans ready to be scheduled



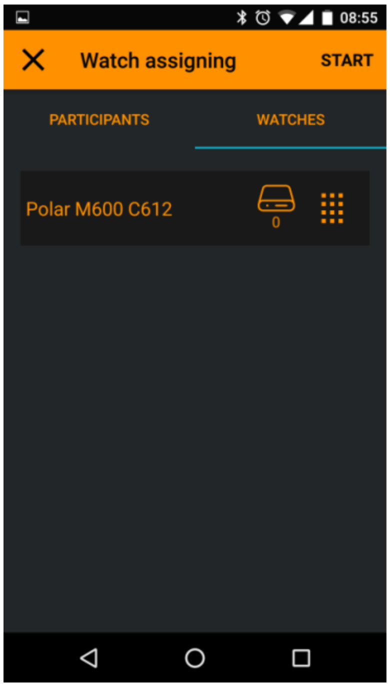
Scheduling the date and list of trainees for particular training plan



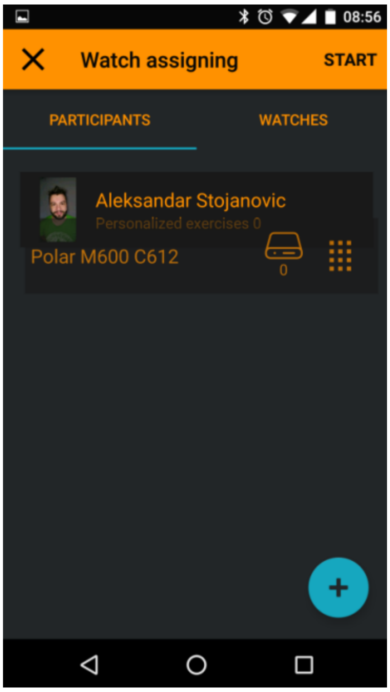
All created training sessions appear on the calendar



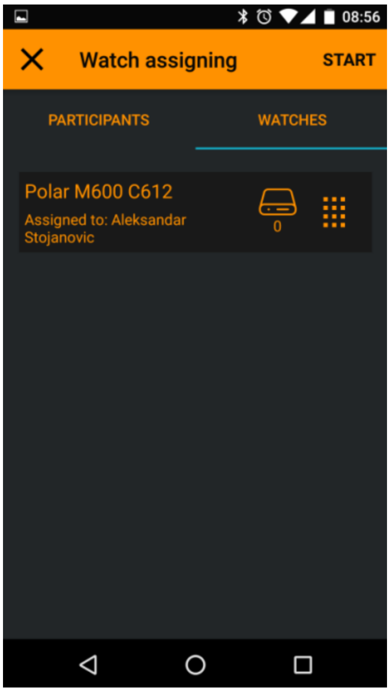
By selecting a training in the schedule, a start bottom appears



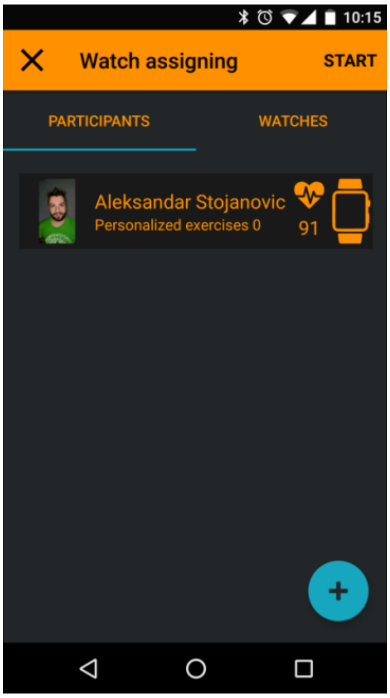
List of smartwatches connected to a particular device



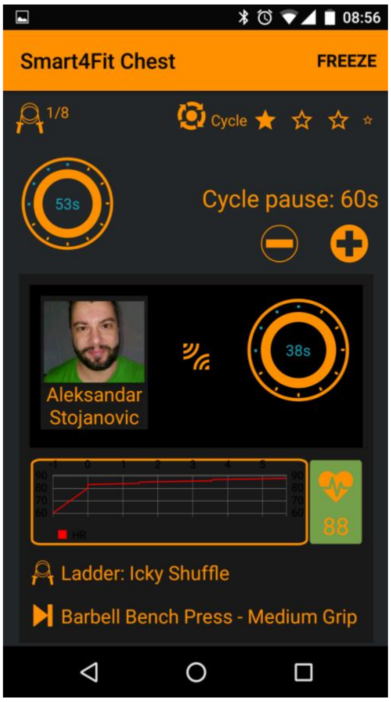
Drag & drop method for assigning the watch to the trainee



Confirmation if a watch is successfully assigned to the trainee



Training session can be started



Important data that helps the instructor to do real-time monitoring during training. This is the typical trainee section showing: current exercise, next exercise, time to the next exercise, heart rate with the graph and possibility to freeze the training if needs be or prolong the pause between exercise cycles.

Figure 11: Smart4Fit coach app screenshots

7.3. Smart4Fit architecture in the context of PrEstoCloud

Figure 12 presents an overview of the proposed architecture to make an effective solution for the Smart4Fit fitness system. As an example in this figure, there are two training groups. Each training group has its own edge (local) node which represents the associated edge infrastructure able to act on the raw monitoring data taken from trainees (e.g. their heartrate and calories burned, performance, etc.). These operations on the edge node can be collecting, aggregating and processing the local data streams in real-time to provide personalised experiences at run-time. The edge node as an intermediary can also send the data to the centralised repository deployed on the cloud. The centralised repository deployed on the cloud can be used for the long-term storage of data and further analysis on the collected data which can be conducted.

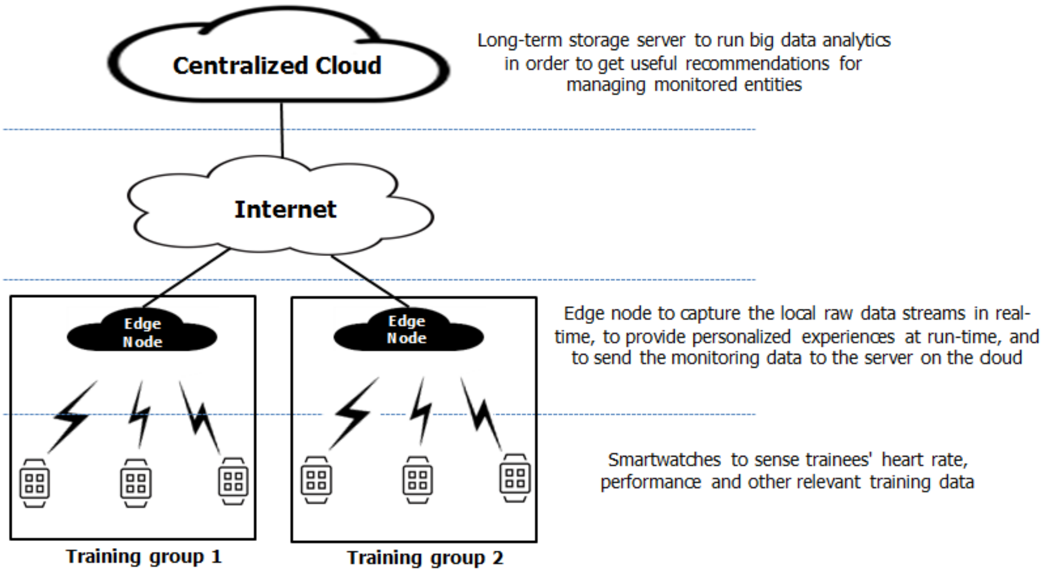


Figure 12: Architecture of the Smart4Fit showcase in the context of PrEstoCloud

In Figure 12, an edge node represents a local system as the data capturing service. This edge node is able to act on raw data sent by trainees' smartwatches. It collects, aggregates and processes the local data streams in real-time to provide personalised experiences at run-time. For example, it can generate real-time alerts in case if a trainee is out of the heart rate zone prescribed for him. This layer is a place where the computing resources are being used near to the end-users or so-called trainees. The principle of using the edge node is to analyse time-sensitive data closer to the location where these data streams are collected.

The centralised cloud-based infrastructure shown in Figure 12 is applied for the purpose of long-term storage of monitoring data. In this way, the Smart4Fit solution is able to not only analyse the training data on demand processed by the edge node, but also inspect all the data (past and present) performed by the server in the cloud. In this way, Smart4Fit allows us to know what is unusual during the training, what situations can be perceived as anomalies, and how the fitness-progress of the trainee is going on by passage of time.

The Smart4Fit system is able to continuously evaluate trainees' performance, personalise user experience, offer a more personal and accurate assessment for each trainee. Furthermore, it should be capable of predicting trainees' performance improvements or drops. For this purpose, Smart4Fit needs to perform time series Big Data analysis. Therefore, it needs access to historic time-stamped values of metrics. The easiest solution is to store the measured data taken from the health training sessions in a long-term storage system for managing very large amount of structured data, developed exactly for this purpose.

8. PrEstoCloud promotion materials

This section presents promotion materials of the PrEstoCloud project, planned to be used from the start of the project. PrEstoCloud promotion materials serve as communication tools for facilitating the understanding of the project among all audiences (general public, scientific and research communities, and potential industrial customers) and also keeping them updated on the project's progress. During the reporting period several different communication activities has been already realized. Tools such as PrEstoCloud poster and brochure, PrEstoCloud industry outreach, PrEstoCloud Website and specific social media have been especially planned to involve all audiences to this end. Moreover, besides one local press release announced by Software AG in the local German press, one press release has been announce focussed on the PrEstoCloud Big Data application scenarios and distributed in the local press of all partners' countries.

8.1. PrEstoCloud poster

The initial PrEstoCloud poster, shown in Figure 13, has been presented for the dissemination of the project's aims and goals, primarily at http://prestocloud-project.eu/new/documents/PrestoCloud-poster.pdf. A second version of the PrEstoCloud poster is planned to be released after the end of the development phase in December 2018.

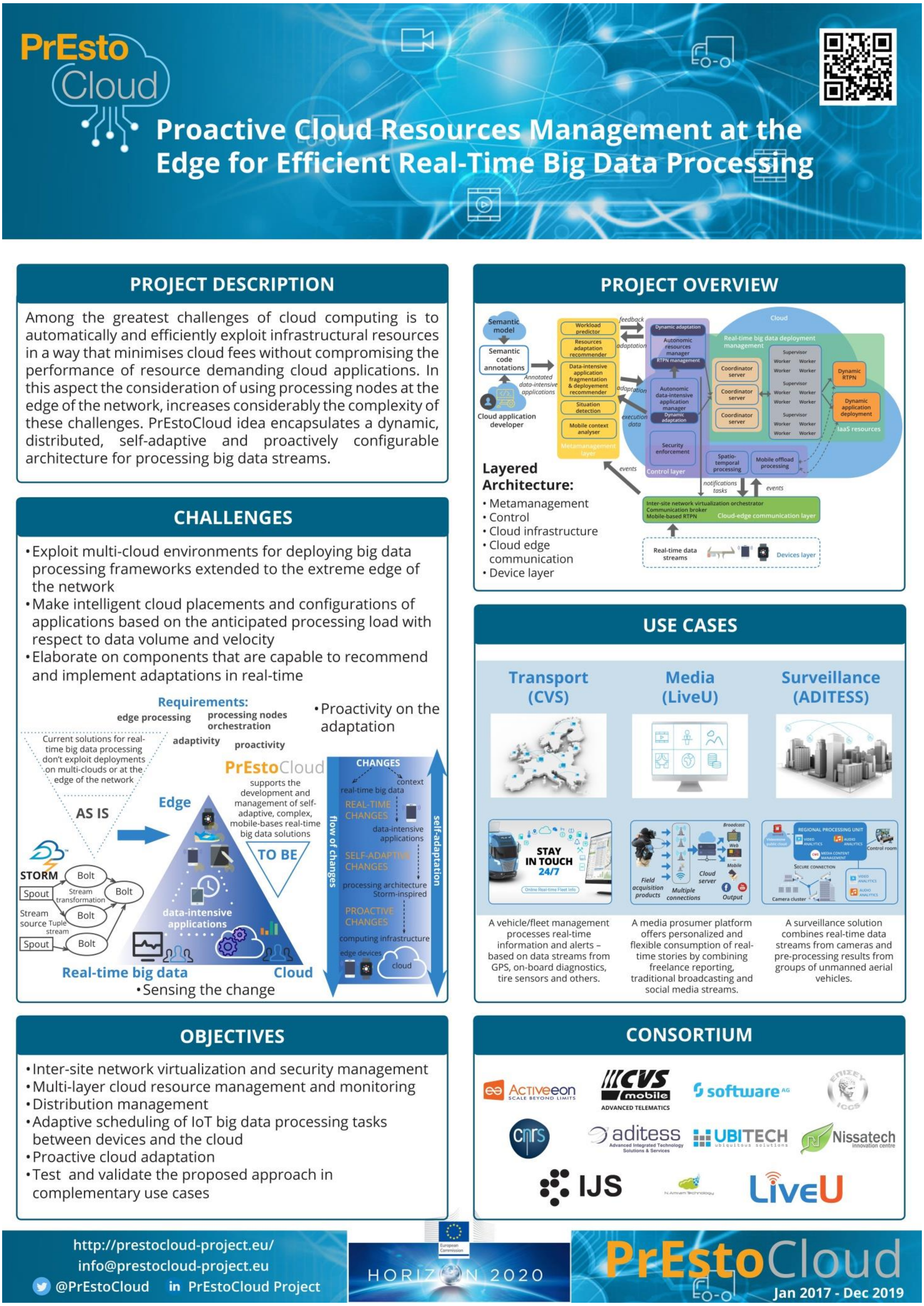


Figure 13: PrEstoCloud poster

8.2. PrEstoCloud brochure

As soft copy, the PrEstoCloud brochure, shown in Figure 14, provides the main message of the project, and it has been widely distributed at fairs, workshops, conferences, etc.

Figure 14: PrEstoCloud brochure

8.3. PrEstoCloud industry outreach

During the first year of the project, PrEstoCloud and its initial technological results have been presented to industry. The preferred aim of these activities is that industry adopts outcomes of PrEstoCloud into products and services. The use cases and the proof-of-concept prototypes such as Smart4Fit are valuable instruments to introduce PrEstoCloud at business gatherings and industrial conferences.

Slovenian European parliament organised an innovation gathering called FeelTheFuture[10] round table in Ljubljana on October 13, 2017. Marija Komatar from the CVS Mobile partner, who is representing Marko Grobelnik from the JSI partner, Digital champion of Slovenia, participated in this FeelTheFuture ministerial event on Digital European Agenda and its potential (see Figure 15).

[10] The first FeelTheFuture round table, https://feelthefuture.si/?lang=en

Figure 15: CVS and JSI presenting the PrEstoCloud project in the first FeelTheFuture event

The Paris Open-Source Summit[11], shown in Figure 16, the leading European event about free and open-source software, occurred on December 5-6, 2017. Its ambition is to expose the technological innovations, the reality and the economic dynamism of its solutions and their societal impacts. At this event, the ActiveEon partner held an exhibition space for two days, where the PrEstoCloud project and relevant ActiveEon's products were presented. The PrEstoCloud project was highlighted through a presentation at the session "FLOSS and Collaborative Innovation" about collaborative R&D publicly funded projects to highlight success factors and the role of open-source software in facilitating open innovation [9].

Figure 16: Paris Open-Source Summit

CloudWATCH Summit 2017 held in Amsterdam on the 20th of September 2017 was a unique conference organised by CloudWatchHub[12]. It brought policymakers, SMEs and start-ups together to understand how cloud computing could be an enabler of innovation, growth and jobs in the Digital Single Market. During the one day event, the attendees heard from pioneering SMEs, industry leaders and policy experts on how the European cloud computing market will be shaped in Europe over the next 3 years. At this event, PrEstoCloud was showcased at the poster session (shown in Figure 17) where it was displayed along with other H2020 projects.

[11] Paris Open Source Summit 2017, http://www.opensourcesummit.paris/
[12] CloudWatchHub, http://www.cloudwatchhub.eu/

Figure 17: PrEstoCloud was showcased at CloudWATCH Summit 2017

As shown in Figure 18, the CVS Mobile Company as a sponsor of Telematics Conference SEEurope held on the 28th of September 2017 in Bratislava, Slovakia presented advanced telematics solutions such as the PrEstoCloud project. For seven years, Telematics Conference SEEurope is the only telematics-focused conference and exhibition in Southeast Europe. It brings together more than 120 key stakeholders from commercial telematics. With carefully selected speakers Telematics Conference SEEurope represents the best opportunity to hear about the latest achievements in telematics, logistics and transport and also about the particularities of the regional market and how to become a regional player.

Figure 18: Telematics Conference SEEurope

The PrEstoCloud project organised successfully the special session entitled "Intelligent systems and services for cloud accessible, data-intensive computing, ISS-CLOUD" in the 8th IEEE International Conference on Information, Intelligence, Systems and Applications (IISA 2017)[13], in Larnaca, Cyprus, 28-30 August 2017 (shown in Figure 19). The special session focused on the integration of cloud computing with mobile services, which enables the development of systems that provide resources and services on an on-demand basis, process big data collected from mobile sensors, and support IoT with massive cloud-based backend. Such systems may employ computational intelligence methods, utilise artificial intelligence approaches as well as decision making techniques for enhancing the effectiveness and efficiency of computing infrastructures, increasing security and data privacy while making infrastructure configuration, deployment and maintenance easier. Moreover, two of the PrEstoCloud partners (ICCS and ADITESS) participated in this session with two papers. The first paper [10] described early work on managing the seamless offloading of computation effort between cloud and edge resources. And the second paper [11] proposes the requirements stemming from the use of cloud and edge computing resources for wide area video surveillance.

Figure 19: The IISA 2017 Conference

The 7th International Conference on Cloud Computing and Services Science, CLOSER 2017 (see Figure 20), focused on the emerging area of cloud computing, inspired by some latest advances that concern the infrastructure, operations, and available services through the global network. Further, the conference considered as essential the link to services science, acknowledging the service-orientation in most current IT-driven collaborations. ICCS participated in this conference that was held in Porto from the 24th to 26th of April. A joint (ICCS, Activeeon and Nissatech) conference publication [12] entitled "PrEstoCloud: Proactive Cloud Resources Management at the Edge for Efficient Real-Time Big Data Processing" was presented. This paper essentially discussed the main challenges which PrEstoCloud aims to address, and also it provides details on the PrEstoCloud vision that encapsulates a dynamic, distributed, self-adaptive and proactively configurable architecture for processing Big Data streams. This paper argued on the advantages of combining real-time Big Data, mobile processing and cloud computing research in a unique way that entails proactiveness of cloud resources use and extension of the fog computing paradigm to the extreme edge of the network.

Figure 20: The CLOSER 2017 Conference

[13] The IISA 2017 Conference, http://iisa2017.unipi.gr/

The 2017 Internet Measurement Conference (IMC)[14] was a three-day event focusing on Internet measurement and analysis on 1-3 November in London. The conference was sponsored jointly by ACM SIGCOMM and ACM SIGMETRICS. IMC 2017 was the 17th in a series of highly successful Internet Measurement Workshops and Conferences. CNRS presented a poster about the PrEstoCloud results in this event. The work presented allows to measure available bandwidth between different data centres, using a much cheaper approach than the traditional iperf tool [13]. Indeed, iperf relies on bulk transfers, which can prove costly in pay-as-you-go IaaSs. The proposed approach is based on the Pathload tool, and controlled experiments with Mininet. The observed results demonstrate that Pathload results were often similar to those of iperf, but with more time variability.

8.4. PrEstoCloud Website

The PrEstoCloud Website is available at the following link: http://prestocloud-project.eu/

The Website is aimed at attracting the attention of all audiences (general public, scientific and research communities, and potential industrial customers) and properly showing the main purpose of the PrEstoCloud project. Figure 21 represents the PrEstoCloud Website structure so-called site map. This structure is under improvement and further sections may be introduced at later stages of the PrEstoCloud project.

One central element of the website is the blog. It is very suitable for attracting visitors and new interesting parties to the website. Each partner takes turn to provide blog posts every three weeks. The content will consists of summaries of current or recent deliverables, main findings, applied innovations and methods, added values, the use of technologies, topic of interest, relevant to PrEstoCloud aspects, etc.

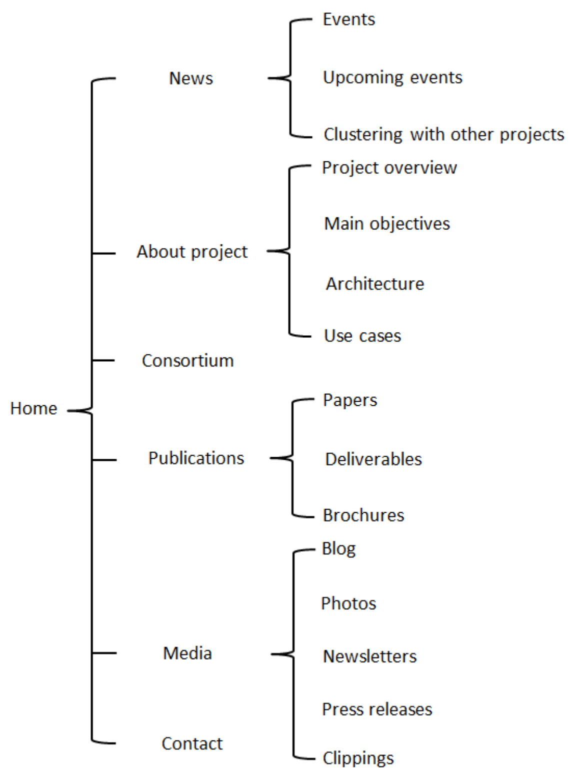


Figure 21: PrEstoCloud Website structure

[14] The 2017 Internet Measurement Conference (IMC), https://conferences.sigcomm.org/imc/2017/

In addition to introducing the PrEstoCloud project in each project partner's websites, the PrEstoCloud project is appropriately presented on the Information Management Unit's Website[15], Institute of Communication and Computer Systems (see Figure 22). The mission of this institute is to enable the development of knowledge-driven organisations. This unit promotes scientific results, such as the PrEstoCloud project, in order to enable value creation in e-business.

Figure 22: PrEstoCloud presented in the Information Management Unit's Website

8.5. PrEstoCloud social and community channel

Social media plays a significant role in the communication process. A PrEstoCloud LinkedIn group[16] (shown in Figure 23) and a Twitter account[17] (shown in Figure 24) were created as well as a Facebook Group[18] was set up. Through such social media channels, all project partners are presenting the PrEstoCloud advances and news, and they provide therefore a platform to discuss and participate in the widely spread cloud and edge business and research communities.

[15] Information Management Unit, http://imu.ntua.gr/project/prestocloud
[16] PrEstoCloud LinkedIn Group, https://www.linkedin.com/in/prestocloud-project-678a28145/
[17] PrEstoCloud Twitter Account, https://twitter.com/prestocloud
[18] PrEstoCloud Facebook Group, https://www.facebook.com/groups/119938801943429/about/

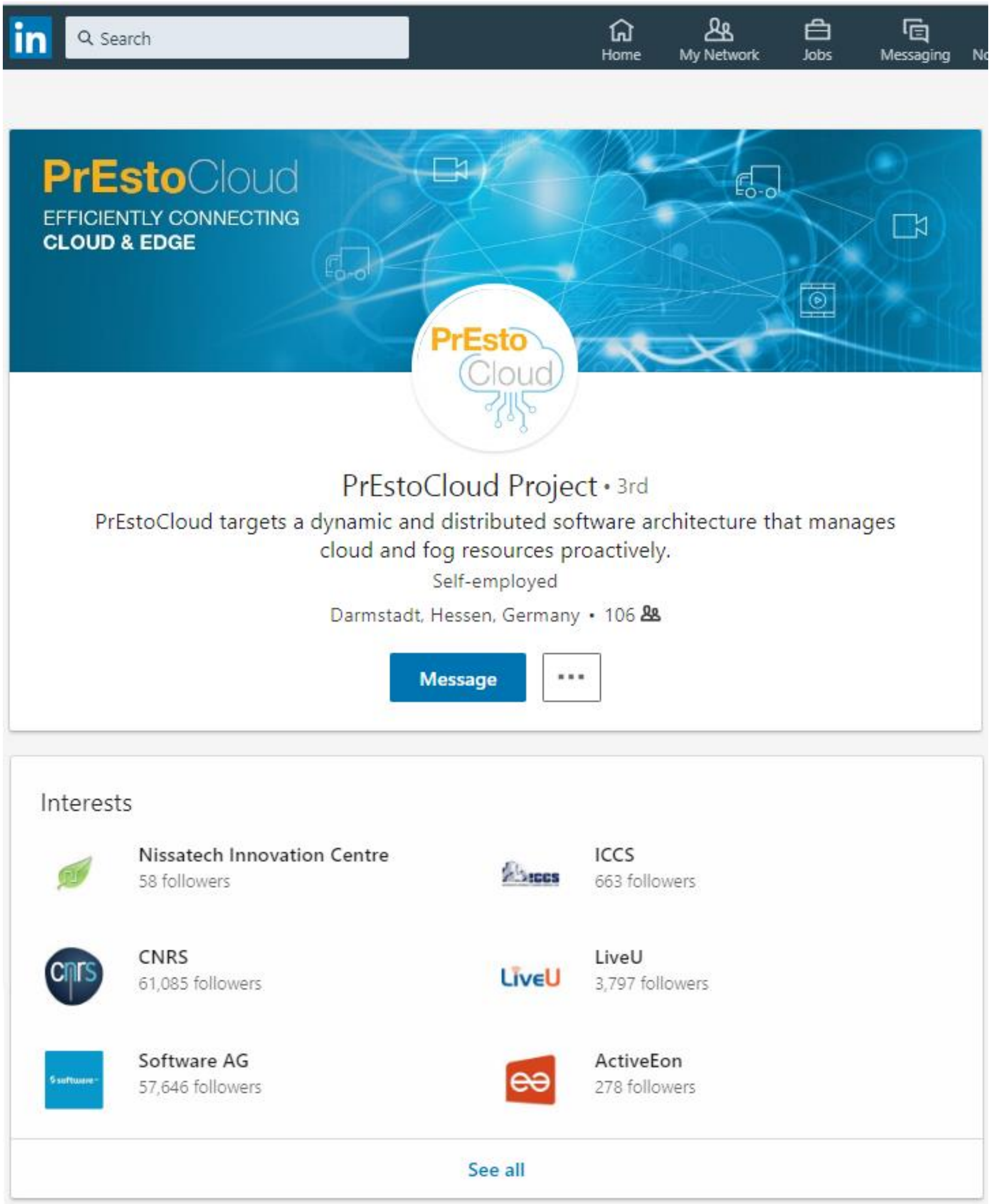


Figure 23: PrEstoCloud LinkedIn group

Figure 24: PrEstoCloud Twitter account

8.6. PrEstoCloud newsletters

Two newsletters, listed in Table 2, have been prepared so far to be released on a special distribution list. These newsletters are posted on the PrEstoCloud Website, where interested parties have the possibility to subscribe. These newsletters provide appropriate news and explanations about the project progress, and also include PrEstoCloud's industrial perspectives. Further releases are planned to be distributed during the next stages of the PrEstoCloud project.

Table 2: Two releases of the PrEstoCloud newsletter

Release number	URL
Release 1	http://prestocloud-project.eu/newsletters/issue-1.html
Release 2	http://prestocloud-project.eu/newsletters/issue-2.html

9. Conclusions

According to WP8 (dissemination and exploitation), this deliverable establishes a showcase to illustrate potentials of the PrEstoCloud project from an industrial perspective. A significant activity to cover the project exploitation and business plan is the PrEstoCloud showcase. Therefore, this deliverable plays a fundamental role in exploitation.

This deliverable presents all technologies which are prototyped by the PrEstoCloud project. These technologies are meant to address the whole spectrums of requirements for real-time, Big Data applications orchestrated upon modern types of frameworks such as edge and fog computing environments.

- Technologies to improve the execution of data-intensive applications.
- Technologies to enhance the development productivity of data-intensive applications.
- Technologies to monitor data-intensive applications deployed upon edge computing frameworks.
- Technologies to facilitate location-aware and context-driven adaptation recommender systems.

Furthermore, this deliverable highlights all requirements and feasibility constraints for the PrEstoCloud industrial showcases. In the context of the PrEstoCloud project, such requirements and feasibility constraints are considered from different viewpoints thoroughly explained in this deliverable:

- Cloud utilisation
- Edge devices
- Big Data

Moreover, a detailed description of the PrEstoCloud solution's suitability is presented for each of the LiveU/NAM media use case, the Aditess surveillance use case and the CVS logistic use case. Functional suitability of each use case represents to what extent the provided software product may be able to satisfy functional requirements from the end-user's perspective.

In this deliverable, the Smart4Fit fitness system is demonstrated as an example for the current PrEstoCloud showcase to support the project exploitation. Smart4Fit enables coaches to manage their training sessions more efficiently and offer trainees a higher degree of personalisation, better monitoring of trainees' progress and effectively achieving the fitness goals by using IoT wearables such as smartwatches. During the next steps of the PrEstoCloud project, the Smart4Fit showcase will be improved and extended according to the PrEstoCloud solution.

More importantly, PrEstoCloud can attract funding as a result of its promising growth, and it can potentially become an international market leader in the area of developing and executing real-time data-intensive applications orchestrated upon modern frameworks such as edge and fog computing environments.

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