OPERA

LOw Power Heterogeneous Architecture
for NExt Generation of SmaRt Infrastructure and Platforms
in Industrial and Societal Applications

Business Plan - Preliminary Report 1

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ACRONYMS LIST

Acronym	Description
UCs	Use Cases
UL	Ultra-Low
ULP	Ultra-Low Power
ISMB	Istituto Superiore Mario Boella
IIoT	Industrial Internet of Things
VD	Virtual Desktop
VDI	Virtual Desktop Infrastructure
CSI	Consorzio per il Sistema Informativo

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EXECUTIVE SUMMARY

OPERA project fits into the mission and scope of the H2020 ICT workplan for 2014 and 2015 aspiring to the European leadership in industrial technologies for the Ultra-Low Power computing devices and sensors enabling an ecosystem of heterogeneous devices and small form factor data centers. In this context, OPERA's vision is to deliver innovation on highly parallel, heterogeneous, reliable, low power, and secure systems leveraging both low power server-class processors and reconfigurable devices. While the former provide energy efficient processing power for the majority of the workloads, the latter offer the possibility of customizing and adapting hardware solutions over time to specific needs. The targets of innovation in OPERA are next generation LP servers and highly parallel embedded computer systems based on ULP architectures. Adopting a mechanism for selecting the best processing element for a specific task is fundamental for achieving good levels in energy efficiency. OPERA aims at exploiting such kind of mechanisms to orchestrate both general-purpose and reconfigurable devices. The OPERA vision is to integrate ULP smart devices into a platform that uses next-generation LP servers to remotely process the data and offering cloud-based services.

OPERA's added value to the project is the validation of the technological solutions on three different real-life workloads use-cases. By integrating and optimizing computing systems for energy efficiency at different levels of the computing continuum, OPERA envisages the creation of big opportunities for Europe.

OPERA project aims at supporting these ambitious challenges with technological innovation on three main aspects:

- Design next generation Low Power (LP) and Ultra-Low Power (ULP) systems,
- improve energy efficiency in computing by means of heterogeneous architectures,
- and provide smart and energy efficient solution for the interaction between embedded smart systems and remote small form-factor data centres.

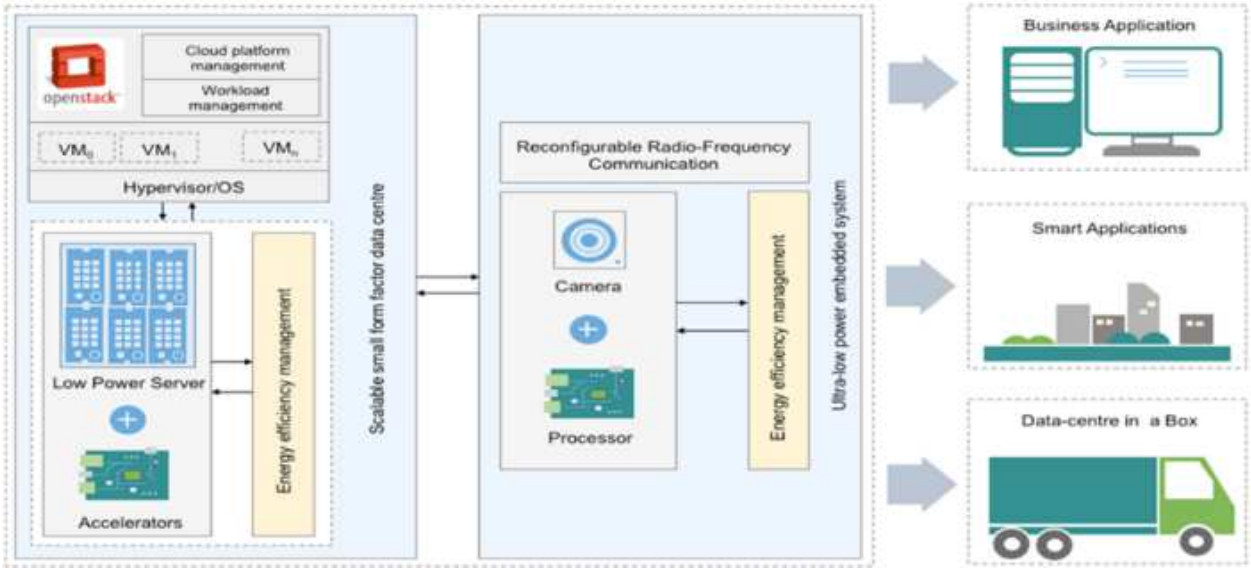


Figure 1 - Envisioned OPERA computing platform with the interaction between smart ultra-low power embedded systems and scalable low power datacentres.

The main target of OPERA is to apply an innovative technology in three different coherent domains of application, bringing significant benefits to daily life such as in traffic monitoring, cycles counting and situation awareness, but also in small form datacentre and virtual desktop which enable reaction capability in special events.

The main goal of the business plan for a research project is not much different from a typical industrial plan which encompasses to find the right strategy for the project, to find the market, segment, the business model, analyse all the risks and all the aspect regarding the project lifecycle.

Nonetheless business plans methodology has adapted formats and approaches to specific industry sectors and development stage. Research and assessments has been done in such respect and some evidence is reported in the bibliography used.

1 BUSINESS PLAN STRATEGY

OPERA has been considered a significantly innovative research project by the European community which selected it for financing and it is focused on Ultra Low Power and low power Heterogeneous Architectures for Next Generation of Smart Infrastructure and Platform in Industrial and Societal Applications.

The project has strong research goals that can be considered a base for a business model, for the specificity of technologies involved and the presence of several industrial partners that can rapidly integrate the research results into a business plan.

The main objective of a business plan is to respond to the following questions:

- What is the solution or innovation of the project
- Who are the partners involved in the project, describe the consortium
- Where the solution or innovation proposed by the project is applicable
- When: the timeline of the project with all the milestones and important steps
- How: all the methods and strategies to achieve the purpose of the project
- How much: the total amount of investments required by the project aggregating data from the partner of the consortium

The project merges together several heterogeneous technologies harmonized by a computing continuum paradigm, enabling the distribution of the workload on the different platforms optimizing the performances and the power consumption. These technologies are applied in three different but coherent domains as highlighted in the proposed use cases:

1. Traffic monitoring: Ultra low-power cyber-physical systems for urban traffic monitoring (Smart City). Security improvement through video monitoring for pedestrians detection, accident detection, animals, potential situation of risk; communications alert to vehicles (future VANET standard).
2. Data centre in a box (Truck): Mobile communication centre on a truck able to give autonomous network access for communications, internet via Satellite communications, Wi-Fi service provisioning, video live streaming from UAV, Italian Civil Protection DB replicas.

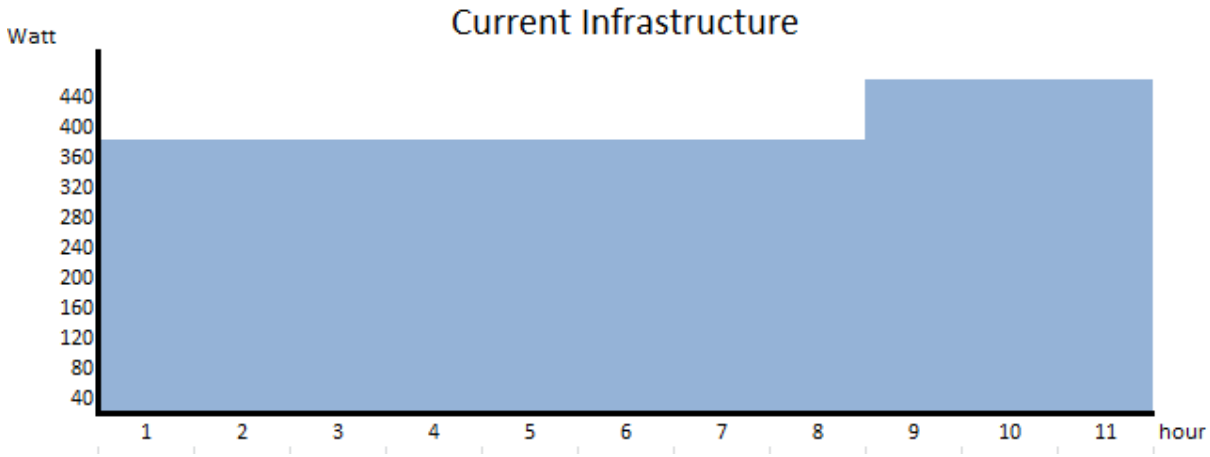


Figure 2 – Truck measurements – current infrastructure

Starting from this situation, thanks to OPERA Project we want to achieve the outcome represented in the Figure below.

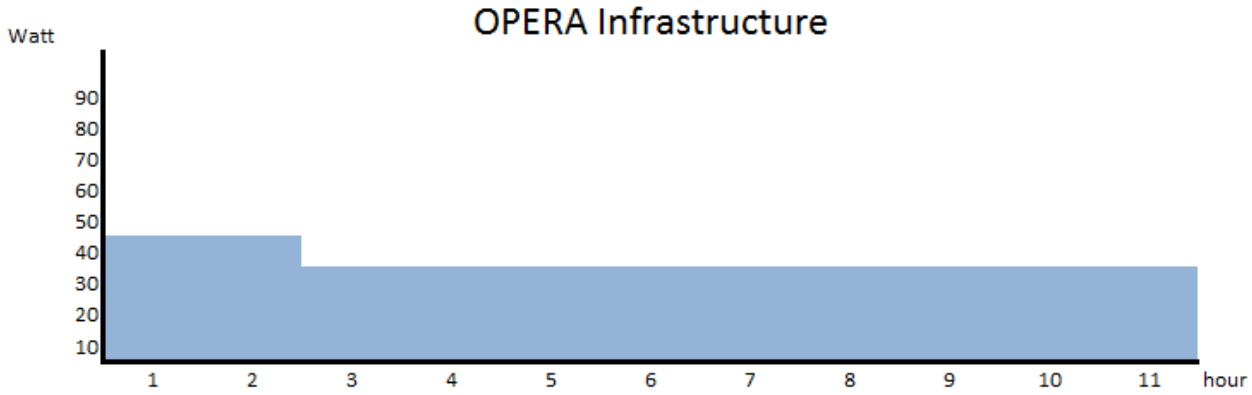


Figure 1 – truck measurements – opera infrastructure

Specifically we wish to complete the orthophoto elaboration within two hours and at the same time we wish an average power consumption about 40 Wh. After the elaboration (between hour 3 and hour 11) we want to guarantee the services of Server DOMINIO and Server RADIO with an average power consumption about 30 W.

Current Infrastructure = 8h*360W + 3h*440W = (2880 + 1320)Wh = 4200Wh

OPERA Infrastructure = 9h*30W + 2h*40W = (270+80)Wh = 350Wh

3. Virtual desktop: Low Power Computing solution for desktop virtualization at both, client and server side. Low Power thin client workstation in alternative to PCs and low power mini-server clustering in alternative to standard servers. 4000 end-users in a full operative condition for Turin City hall, 2000 end users for the Piedmont Region.

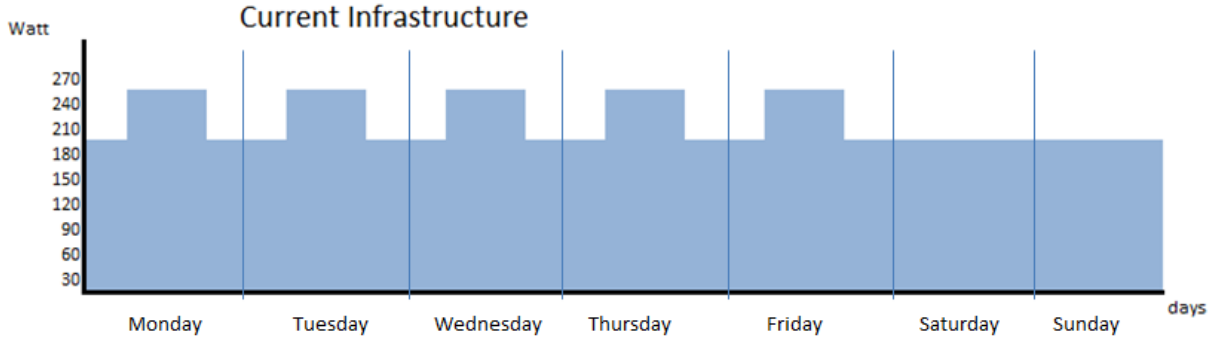


Figure 4 – VD measurements current infrastructure

Starting from this situation, thanks to OPERA Project we want to achieve the outcome represented in the Figure below:

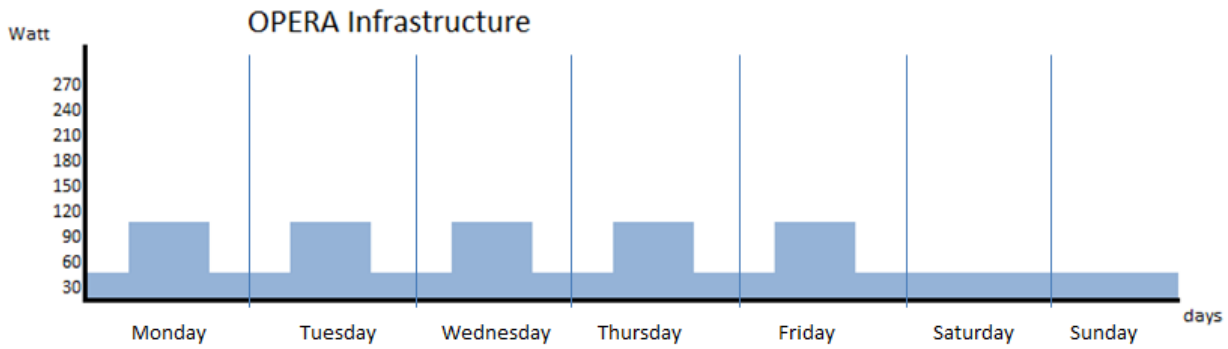


Figure 5 – VD measurements OPERA Infrastructure

Specifically, we want to reduce power consumption during working period (about 90Wh) but also during non-working period (about 30Wh), in this way considering a period of a week we can appreciate a very high reduction of power consumption for about 200 end-users:

Current Infrastructure: 0,64week*180W+0,36week*240W=201,6Wweek

OPERA Infrastructure: 0,64week *30W + 0,36week *90W= 51,6Wweek

The potential markets could be envisioned in Industry 4.0, Industrial Internet of Things and already existing markets where these technology are applied, and for each market, OPERA can deliver significant improvements the public and private segment.

Such improvement are not just related to the new technologies but also to the reduced Total Ownership Cost (investment plus lifecycle management costs) required for integrating it into real world which means affordability.

1.1 BUSINESS PLAN

The business plan is expected to be the document that provides an insight of the potential of a product/project showing the amount of resources available for the product/project, the market segmentation that the product/project wants to achieve, the adequate business model to use in order to maximize the results of the product/project. Build up an efficient commercialization roadmap in order to plan all the steps for following all the life cycle of the product/project and estimate all the possible risks related to the product/project (financial, commercial or production). For a research project the last aspects related to the way to market are not critical but are the essential elements that then enable industry to decide to further invest in transforming a research project into an innovation programme which aims to achieve marketable product prototypes.

The mission of Teseo is to lead this task in collaboration of all the industrial partners of the OPERA's consortium and define an efficient business plan strategy aligned with the exploitation plan.

At the date of publication of this version, the main objective of the document is to provide a first version of this business plan which highlights its structure and trajectory.

1.1.1 Exploitation and business plan - What is the purpose of OPERA

The purpose of OPERA is to deliver innovation on highly parallel, heterogeneous, reliable, low power, and secure systems leveraging both low power server-class processors and low power reconfigurable devices. While the former provide energy efficient processing power for the majority of the workloads, the latter offer the possibility of customizing and adapting hardware solutions over time to specific needs without physical infrastructure requirements.

In the following image are visually sketched the four main pillars of OPERA that are:

1. Hardware and Software Integration
2. Heterogeneous Hardware
3. Energy efficiency metrics
4. Validation under real-life workload

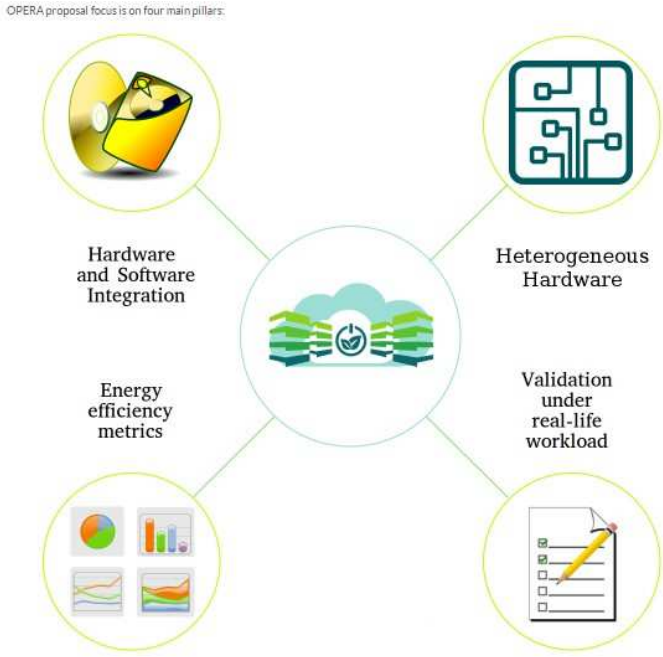


Figure 6 Main pillars of OPERA

1.1.2 Who is in the consortium

Opera's Consortium is composed of a complementary and synergic group of companies working in research and industrial field. In particular most of these companies are considered market leaders in the technologies used by the project.

The consortium is composed by ST Microelectronics, Istituto Superiore Mario Boella (ISMB), Teseo, IBM, HPE, Departement de l'Isère, Neavia, Consorzio per il Sistema Informativo (CSI), Certios, Nallatech and Technion.

The following paragraph describes the potential role of each partner in the business development process for OPERA outcomes.

ST MICROELECTRONICS: is a French-Italian multinational electronics and semiconductor manufacturer headquartered in Geneva, Switzerland. It is Europe's largest semiconductor chip maker based on revenue. The role of ST in the development of business is to provide the enabling technologies for ULP computing devices and products, with the support for the integration and development of new applications.

ISMB: is a research and innovation centre operating in the ICT domain. Today ISMB relies on the technological and process competences of around 150 researchers working in close cooperation with companies, academia and public administration. The potential of business relies for ISMB in the support that can provide, ruled by specific agreements, with the industrial partners.

IBM: is a global multinational technology and services corporation. IBM manufactures and markets computer hardware, middleware and software, and offers infrastructure, hosting and consulting services in areas ranging from mainframe computers to nanotechnology, cognitive computing and cloud. OPERA innovations have great potential to contribute to IBM business by allowing to improve cloud infrastructure and services towards lower power consumption. On the other hand, IBM's participation in OPERA contributes to projects innovations by enabling next generation computational services to run on heterogeneous architectures. IBM team in OPERA facilitates workload migration between different architectures to be leveraged by the orchestration software to improve overall power efficiency.

HPE: is an American global information technology company. It develops and provides a wide variety of hardware components as well as software and related services to consumers, SMBs and large enterprises, including customers in the government, health and education sectors. HPE has been working on innovative technologies for small form factor datacentre since 2013 through the Moonshot project. This hardware solution has grown up with heterogeneous architectures in mind and, with the explosion of IoT, it has recently been evolving to become an intelligent edge device for aggregating data and doing analytics as close as possible to the "things". Moonshot platform is part of the base component for OPERA to enable driving top efficiency in dense and power constrain environments.

NALLATECH: is a leading supplier of FPGA accelerated computing solutions. Today Nallatech utilizes latest-generation FPGAs to dramatically increase performance-per-watt over traditional computing architectures, while leveraging high level design tools to reduce time-to-market. Nallatech brings 24 years of expertise in FPGA-centric computing, tools, IP and application-optimisation to the OPERA project. Specifically, the design of a new class of FPGA/SOC accelerator and high level tools to allow advanced compute applications to be optimised for HPE and IBM platforms.

Support Packages (BSPs) that provide software Engineers with the utilities needed to accurately control and monitor power consumption.

TECHNION: The Technion – Israel Institute of Technology is a public research university in Haifa, Israel. The university offers degrees in science and engineering, and related fields such as architecture, medicine, industrial management and education.

CSI: is the Information System Consortium for the management of ICT services in Piedmont PAs. CSI works in all sectors: from health to production activities, from cultural heritage to administrative systems and from the territory to professional training and employment.

NEAVIA: has a unique mastership of multi-sensor detection, data acquisition devices, embedded processing, critical information transmission to communication platforms. Being always at the service of infrastructure managers, Neavia improves their duty. Neavia offers a comprehensive range of smart cameras designed for low energy consumption and thus supplied by solar panels. The business scope will be enlarged with lighter installation infrastructure benefiting from OPERA low power architecture.

Neavia expertise also covers global detection systems. State of the art of such systems excludes video solution because of energy limitation but this shall not be true anymore with OPERA benefits.

CERTIOS: was born when it became evident that the growth of remote processing and storage of data brought a new responsibility to a very young industry. Since the start, Certios has built experience, knowledge and a vision, and share this with clients. Certios carries out research activities. It leads and participates in several different types of research projects; all ICT, datacentre and Cloud related. Research examples are:

- ICT market analysis for remote ICT processing and storage
- Developments and new technology in ICT infrastructures, innovations
- Feasibility study of improvements of datacentres, in terms of costs, environmental sustainability, energy and quality
- Find new ways to measure, indicate performance to help the industry to improve its performance
- Improvement of procurement of datacentre services.

Certios is focussed on the energy efficiency part of the IT-infrastructure of its customers. It renders advice on how to prepare for the future developments, how to reduce costs and increase business value at the same time. Certios has helped prepare departments to make a valid business case for IT-infrastructure improvements, often resulting in datacentre refit or relocation. Activities in where Certios accepts the project lead. It helps organizations to improve their tenders for IT-infrastructure related products and services. Most of the Certios activities are structured as projects.

TESEO: is a system integrator, designer of low power instruments and equipment, leading EMC and tier 2 defence and aerospace system integrator. The company is recognised as a highly specialised technology solution provider for industry, including automotive, transportation and telecommunication industries.

ISERE: is a local authority in the Rhône-Alpes region in the south-east of France named after the river Isère. In the business development the Department can be a potential customer for the deployment of OPERA devices as manager of a 5100 km road network. Considering the diversity and the high traffic issues of its road network (road serving Grenoble urban metropolis, high traffic issue road network serving the ski resort and the high mountain passes, interurban roads), Isere is involved in a road innovation policy (including V2X) and can enable to test a large panel of use case as final end-user.

1.1.3 Where OPERA can propose the technology

Three main target markets for OPERA results can be identified in:

1. **Industry 4.0**: refers to the 4th Industrial Revolution. After the steam, electricity and IT, this time is Internet that is going to totally change the production system. Thanks to the so called Internet of Things and cyber physical systems, it is estimated that, in 2020, at least 60 billion intelligent objects will be online. This is the heart of the Smart Factory: the real time connection between humans, machines and objects; a concept that is far away from the innovative process Information Technology of the last century. The challenge of the Smart Factory is to take on the variability and the uncertainty of the entities involved in the supply chain, from the supplier to the customer, by taking into account all the entities, conditions and situations like production line, times, breakdowns, delay, change in technology, and so on. A Smart Factory shall be able to adapt itself in real time to the market requests in order to become as competitive as possible. In order to obtain this, a fluid and constant communication is necessary: from the market, to determine what has to be manufactured, and from the floor to coordinate the activities and to promptly react to unexpected events. In this environment, every cyber physical entity will be able to work intelligently and perform the required activity at the maximum efficiency.
2. **Industrial Internet of Things (IIoT)**: is a computing concept that describes the idea of everyday industrial physical objects being connected to the internet, being able to identify themselves to other devices and able to exchange information among them and their data users. The term is closely identified with RFID as the method of communication, although it also may include other sensor technologies, wireless technologies or QR codes. The IIoT is significant because an object that can represent itself digitally becomes something greater than the object by itself. No longer does the object relate just to its user, but is now connected to surrounding objects and database data. When many objects act coordinated at once, they are known as having "ambient intelligence."
3. **Markets directly related to the OPERA use cases**: the three use cases (UCs) that have been selected in the OPERA project, provide the scenarios for the application of the technologies involved in the computing continuum. From this viewpoint, applications (and thus, as a consequence, related markets) where the acquisition and analysis of images and video are of primary importance represent a potential target for the developed ultra-low power (ULP) systems. For instance, unmanned vehicles (e.g., drones, self-driving vehicles, etc.) can benefit from technology developed in OPERA such as ULP computing node and reconfigurable antenna. Reconfigurable antenna technology can be exploited to tackle mobile telecommunication applications and markets (e.g., next 5G communication systems). Similar considerations can be applied for the technologies developed for the VDI and Truck UCs. Traditional cloud computing service providers will greatly benefit from innovation carried out by new OPERA high-density low power servers, strong integration of accelerators, and the capability of distributing the workload in a new and smart way. In addition, such set of technologies open the door to a set of new services that can be implemented on top of more efficient datacentre nodes, as well as remote and distributed ULP smart objects. The end users of the project for each market could be either the Public Administration companies or private companies, adopting the coherent technologies that OPERA is aiming to develop through the research project.

1.1.4 Milestones for the success of the project

The project is started in December 2015 and will complete its activities in November 2018. The total project duration is 36 months, with four intermediate milestones as following: M10 (Requirements), M20, M28, M36.

During the lifetime of the project there are 4 defined milestone to reach:

1. Requirements definitions of the overall architecture and FPGA design implementation (M10)
2. Architecture, harmonization, interoperability and use case first phase implementation (Traffic monitoring, Truck and Virtual Desktop) (M20)
3. Architecture, harmonization, interoperability and use case second phase implementation (Traffic monitoring, Truck and Virtual Desktop)(M28)
4. Final release (M36)

For all the milestone the connection with the business plan is to define the resources involved for reaching the milestone, partners involved in the realization of the prototype and the general status of the prototype.

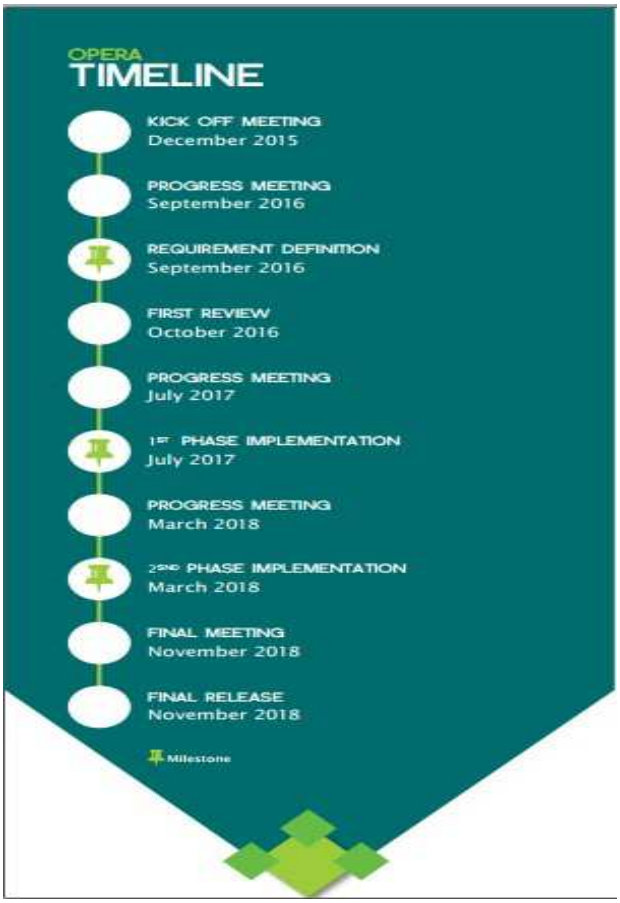


Figure 7 OPERA's timeline

1.1.5 How OPERA wants to achieve the targets

In a context of continuous and rapid technological changes, the OPERA strategy is to act as a market innovator in terms of energy savings, monetary savings, savings in terms of space and remarkable performance boost; all offering of different technologies between them but perfectly integrated. Another target could be to create a nice market where to offer the product of enter a nice already existing.

This will be achieved thanks to the expertise of all partners of the consortium and the supply of ultra-low power next-generation technologies in all the use cases involved in OPERA.

All this can be summed up under the point of view of:

1. Architecture: heterogeneous, reconfigurable, low power and ultra-low power integrated components that can works together into the 3 different use cases;

2. Computing platform: that consume less energy than the current ones, take up less space and have a speed of processing of the data greater. All this in order to offer an integrated solution that brings real added value to the end user;

3. Energy efficiency: thanks to the use of particular technologies that take advantage of a greater amount of resources only when the complexity of the operation requires it.

The performance target for the Truck use case is to reduce the processing of the Orthoimage generation from 11 hours to 2 hours. Assuming no overall increase in power this equates to an energy saving of 5.5x. The FPGA/moon-shot server configuration used for this purpose will have a significantly lower power footprint than the current implementation with the overall power saving expected to well in excess of 10x.

To reach all the milestone preview during the lifecycle of the project for the validation in real life scenarios, the consortium has to cooperate to be ready for the 2 implementation phases and the validation one. This will be possible only by organizing meetings, discussions, progress meeting, etc.

1.1.6 How much resources OPERA has

The global amount financed by the European Commission is 6.5M€, and the following table reports the breakdown by partner and by cost nature.

It should be reminded that over 5.2 M€ are direct investment costs for achieving OPERA research targets.

NUM	PARTICIPANT SHORT NAME	PARTNER TYPE	COUNTRY	Average €/PM	MM	DIRECT COST
1	ST	PB	IT	€ 5.920	75	€ 564.000
2	IBM	PB	IL	€ 9.834	73	€ 764.882
3	HPE	PB	FR	€ 10.000	40	€ 540.000
4	NALLATECH	PB	UK	€ 10.000	66	€ 780.000
5	ISMB	OR	IT	€ 5.400	73	€ 439.200
6	TECHN	OR	IL	€ 4.073	59	€ 290.307
7	CSI	PA	IT	€ 5.500	47	€ 293.500
8	NEAVIA	SME	FR	€ 7.719	52	€ 446.388
9	CERTIOS	SME	NL	€ 7.950	52	€ 443.420
10	TESEO	PB	IT	€ 7.600	53	€ 457.800
11	ISERE	PA	FR	€ 6.500	31	€ 242.500
						€ 5.261.997

1.2 LINKS WITH EXPLOITATION PLAN

The exploitation of the project, that will be described in the separate set of deliverables D8.6 - D8.10 - D8.2, will evaluate the impact of the researches conducted in the OPERA project on the evolution of products and markets, as well as the impact on further research activities in this field. The business plan

described in the current version of the document is mostly focused on the potential developments from the OPERA activities, providing the guidelines for the industrial partners in order to plan and realize products and businesses based on the research results. The support of the academic partners will fertilise additionally such effort, including the integration of its technology contributions into the foreseen products.

The target is also to have a good exploitation of the results achieved during the evolution of the project perfectly in line with the timeline. So is necessary to organise audio calls, face to face meetings, for monitoring all the evolutions of the project.

1.3 ACTIONS FOR THE MAXIMIZATION OF BUSINESS PLAN STRATEGIES

This documents should be considered and a coordinated summary that has been populated with all the actions identified for enhancing the strategies which aim to reach the target functionalities in markets, segments or customers.

To achieve the strategic targets set by the project, has to understand the situation current target market, studying the greatest impact aspects such potential, saturation, current and potential revenues, current and potential costs. All this to see if there might still be space available for the innovative technological solution offered by OPERA.

For every target market we have to study the following aspects:

- Current situation
- Level of technological progress
- Replacement products on the market
- Position of the main competitors

Nallatech:

Current situation: As part of the Opera hardware technology an FPGA device is to be used to function as both an acceleration device and common interface between IBM power and HP moon-shot. The SOC Arria 10 FPGA device was chosen as it was shown to be the best fit in terms of performance, heterogeneity and programmability (OpenCL).

Level of technological progress: The chosen SOC FPGA device has been used as part of a PCIe device created by Nallatech which also includes high speed serial connections for connecting IBM and HP systems. This device has so far undergone basic hardware testing and integrated into the Moonshot server. The OpenCL tool flow has been ported to the device and will allow the rapid development of software for the Truck use case going forward.

Replacement products on the market: At present there are no replacement products on the market that exhibit all of the features provided by the Opera SOC PCIe accelerator. Therefore any replacement would consist of multiple market placed products in order to meet the equivalent functionality. This would be at the detriment of performance, power and cost. It would also be unlikely to be compatible with the Opera use cases.

Position of the main competitors: Intel and Xilinx are the only vendors to manufacture large SOC FPGAs. Xilinx's tool flow is not at a sufficiently high enough level to be competitive with the Intel OpenCL offering and therefore currently not competitive given the scope and programmability requirements of the Opera project.

STM:

The Ultra-Low power STMicroelectronics platform used in the project is an R&D System On chip that integrates ST processors used in several ST products and a set of accelerators for specific video processing applications. The resulting system is a proof of concept for the fields demonstrated in the OPERA project as well as for other markets that require high computation capabilities with a very limited

power budget. In addition a small form factor is provided, enabling the creation of small, wearable devices.

The target markets in this case are many, and identified by the system integration that will use the ST chip.

Neavia:

For autonomous video detection system market:

Current situation: the energy autonomous video sensors are recently developed and commercialized: typically it is 3G video sensors which are supplied by photovoltaic panels and which transmit data by using 3G cellular phone network. They are mostly used to transmit reduced image flow (typically 1 CIF image per several minutes). Automatic detection can be available on the system but it is not very commonly used. Consequently the energy supply installation is systematically sized to face the energy consumption required by the transmission of data rate by 3G. The required civil engineering installation keep bulky and expensive: typically 80 to 120 m^2 solar panels coupled with a several kilograms battery are required (commonly between 10 and 30 kg): The solar panel has to be installed in a stack fixed on a concrete mass to, and so heavy battery required an electrical installation at the bottom of the stack.

Consequently this autonomous camera are dedicated to a few high issue isolated areas, mainly for use cases based on low image rate (as monitoring of the road network for snow removal operations). But energy consumption of video sensors operating automatic detection of road event or singularities is not enough optimized to reduce and make cheap the civil engineering infrastructure and to initiative innovative traffic monitoring process based on automatic detection.

Level of technological progress: the ideal target of the OPERA project for the traffic monitoring use case was energy autonomous system required as small solar panels as possible (as indicative below 20 dm^2), and as light batteries as possible (as indicative the weight of the whole system has to be below 3kg, battery has to be below 1kg). To reach the target the energy consumption has to be significantly decreased in comparison to the current state of the art (a minima below à 0,5W, instead of 3 to 7 W currently)

In the same time the system has to support one or several automatic detection of critical road event (congestion, incident, natural event, …) or road singularities (vulnerable users as cycle, pedestrian…), and has to alert the road manager by transmitting an alarm coupled with a short video stream for doubt dispelling and/or additional analysis. Typically a 20s to 1mn video stream could be required.

The expected result is a new capability to monitor the road network by becoming able to detect and simultaneously or not simultaneously road event or singularities in a large number of areas. Energy autonomous ultra-low power technologies and automatic detection limiting the required data transmission enable to deploy the video sensors in a large number of areas, including isolated area. The automatic detection increases the capacity of the road management center to monitor a large number of areas across the road network. The OPERA innovations improve the traffic management by supplying both innovative equipment or infrastructure and innovative operating modes.

Replacement products on the market: benefits from ULP design will enable introduction on the market of a brand new generation of video solution for road applications. Firstly, it will reduce drastically energy needs and thus will lead to much more compact video solution. The benefits will also allow embedding video solution in product without any video solution today. One can think of traffic lights or public lighting equipment. Today those equipment cannot embed such video solution due to electrical needs and/or energy storage needs. Those hurdles will be overcome by the use of ULP platform as develop in Opera project. This breakthrough on the market should allow massive use of video solution in the scope of road monitoring and should open the door to new use cases. One can think of V2X business where

video solutions are not present today. Having road infrastructure with relevant and compact video solution will allow pushing in the car some video scenes useful for the driver: dangerous situation, pedestrian crossing detection…

Position of the main competitors: compact autonomous video detection system OPERA base coupled with low infrastructure engineering shall result in a disruptive autonomous video solution. State of the art solution from competitor can't compete in term of energy need and thus compactness.

HPE:
Current situation: Customers interested in video transcoding, IoT and hosted desktop, are looking at low-power and dense solutions. HPE Moonshot and EdgeLine have been designed for that kind of use-cases and are shipping for a few years. For OPERA project, some refinements have been done for ruggedizing the chassis (Truck), the compute monitoring (Redfish) and the heterogeneous compute (FPGA, ARM and X86).

Level of technological progress: HPE hardware used for OPERA is now fully approved and tested for production-used. Additional testing will be made to ensure electrical signals and thermal of Nallatech FPGA SoC board follow HPE recommendation to be qualified. The NEBS level 3 certification to ensure the chassis inserted in the truck is compliant with high temperature inlet and high vibrations is also on-going.

Replacement products on the market: The solution designed for OPERA is either replacing standard x86-servers or appliances based on proprietary hardware and software stacks.

The traditional approach which leverage dual socket systems with no or non-energy efficient accelerators is very versatile and can be an answer for many workloads but is very rarely optimized when it comes to the power usage.

When it comes to hardware appliances, the development cost associated with such product is so expensive that it required a very large and slowly moving market to justify the initial investment. Some of these appliances can be replaced by the heterogeneous and efficient solution designed through OPERA. Video processing is a perfect example.

Position of the main competitors: There is very little competition on the market of image reconstitution for industrial product or end to end solution. NVidia is selling development kits (such as the Jetson TX2) which also provide a very good level of performance for a limited power envelop. Kontron also provide dense solution for video but lack the heterogeneous story which, in itself, guaranty the level of efficiency required for such solution.

For Virtual Desktop Infrastructure, most of the competitors (such as Dell, Cisco and Lenovo) are answering with standard systems based on dual Xeon E5 (100Watt+), which represent 80 % of the overall compute market. For the last 2 years, at HPE, we observe a growing demand for customers to alternate and optimize solutions for VDI, going from less than 2% to 25% in the banking sector.

2 MARKET ANALYSYS

This chapter has the objective to define the potential market for OPERA output and the economic size of the market, the possible market trends, and main competitors in general for the technology used and for each use case. The eventual competitive advantages if there are.

The potential markets of OPERA, as said, could be Industry 4.0, Industrial Internet of things and the markets where a similar OPERA technology is already provided; all related into the segment of ultra-low power technologies. OPERA main competitors could be all the players that have as of today a significant market share and that are investing to preserve their market leadership.

For the Traffic Monitoring use case OPERA has into the consortium the Departement de l'Isère (CGI) that is an end user which operates in the traffic monitoring market, so it is expected to achieve a precise idea of the effective benefits, potential revenues and real costs.

The main add value of OPERA in the traffic monitoring use case is to improve the roads traffic management by monitoring more largely the road network: more diversified information will be collected and transmitted to the road management centre from more areas.

- In a first time the same public budget could be used to deploy more equipment's, including in areas where the deployment of sensors cannot be considered for the moment. Cost saving concerning connection to grid, civil engineering works could be used for cheaper and more efficient installation, and personnel devoted to the surveillance of the output of the cameras. Several thousand of ultra-low power sensors could be added to the high power existing video sensors on the 5 100 km of the ISERE network, and could be monitored from the road management centre thanks to the embedded automatic detection software. These technologies could be possibly deploys across the more than 5 000 000 km European road network.
- In longer period more and more innovative solutions could encourage the road managers to deploy more massively the video sensors across the road network, in particular if the coupling with centralized server enable to make merge new use cases: very sophisticated real tile detection (as electrical bikes or snow covered surface detection), monitoring of road infrastructure (bridges, tunnels), analyses of historical data by using big data technologies, among others.

The add value concern the improvement of the traffic monitoring: The deployment of the OPERA solution enable to monitor more densely the road traffic monitoring, which enables:

- The reduction of the risk of accidents (detection of wrong way vehicle, detection of cycle): The main add value is to preserve the human life (less death, less injuries), the second add value is to remove the financial impact of these accidents.
- - The reduction of the effects of the traffic congestion (and more generally of the traffic events): OPERA solutions contributes to improve the real time road operation and rather to improve the real time information for the road users. It improves the comfort of the road users, the circulation of goods and people.
- the improvement of efficiency of the public policies by providing statistical data (as cycle counting for example): it enables the development of a more efficient support to the economic activities as tourism.
- The improvement of commercially viable innovations. In the Netherlands similar experiments have been done by commercial makers of bicycles (Sparta, Batavus). Experiments were aimed to find out the usage of the E-Bikes. Needs of the makers to interact with the bicyclist directly by getting user date. Answers were found for questions like: how often does the bicyclist uses her or his E-Bike? How many operating hours does the battery lasts, what is the quality of the battery in winter (and

can we suggest the owner a replacement?). For the resellers, this experiment was interesting for the fact that they got informed that their clients were cycling nearby, which resulted in smartphone offers to have their bike checked-up. For the tourism sector it was an interesting experiment as well; to get informed that a group of cyclists is nearing, may make someone interested to offer them coffee and cake, to lure the cyclist to their pub or restaurant. There are numerous applications and therefor markets that may be unlocked, thanks to detecting cyclist and getting to know more about them.

Internet of Thing is still considered as an emerging market and it is the fastest growing sector. Gartner has estimated the number of connected devices at 8.4 Billion units in 2017 to be growing to more than 20 Billion by 2020. Estimated spending on IoT solution is about 3,000 Billion by 2020. On OPERA project, 2 of the use-cases can be considered or are related to IoT:

- Truck, with the drones acting as “things” as sending data to a mobile datacentre for processing.
- Traffic monitoring with the intelligent cameras doing live analytics but also providing data to a core location where deeper analytics and data correlation can take place.

Embedded compute in vehicles is a growing market with billions of dollars of investment from all large automotive companies but also from companies such as Intel which acquired Mobileye for 15 Billion $.

The hardware architecture defined for the truck use-case is also an innovative way for broadcasting companies to acquire, encode and stream very high quality video feeds from mobile datacentres to cover sport events, for instance. In 2017, almost 3 quarters of the Internet bandwidth is consumed by video. With the increase of the end devices video resolution, new standards (such as HEVC) are emerging to reduce the amount of required bandwidth. Those standards require lot of compute power which cannot be fulfil at descent price and energy usage by pure x86 platforms. This is where a heterogeneous solution, combining traditional CPU and FPGA brings a perfect and flexible solution. HPE is currently working with companies such as Nokia and Ericsson to OEM this solution as an alternative to very expensive hardware appliances. The addressable market for 2017 is in 10s of Million $ as many broadcaster sur as Comcast are currently renewing their infrastructure to support the increasing demand but also upcoming video standard (as 4K HDR).

Virtual Desktop Infrastructure (VDI) is a promising market opportunity gaining attention over the last several years and waiting for enabling technologies to mature. Back in 2012 Gartner has made several predictions regarding the future of virtualized desktop computing and stated that by 2013 40% of all corporate desktops will be virtualized and desktop virtualization market will be worth $1.8 billion. Despite many have seen the value in VDI vision, it did not turn into ubiquitous reality as fast as it was predicted because major technology enablers were missing. Now, as Cloud Computing gets traction, VDI vision experiences a revival and promises even stronger growth than what was originally predicted. For example, in 2016 Gartner and other analysts expected the hosted virtual desktop market to grow to 76 million users by the end of the year and forecast anywhere from 8.9% CAGR up to 27%, depending on what was counted as VDI, during the period 2016-2020.

Companies like IBM can gain two-fold benefit from VDI market readiness: first, by reducing the corporate desktop costs by sensible amounts; second, by creating hosted VDI and Digital Workspace offerings to its customers. Leveraging OPERA innovations, IBM can potentially benefit even more by lowering the operational costs of its VDI services.

[to be exploited more in due course of the project with more data for each use case]

2.1 MARKET SEGMENTS

This chapter covers the market segments where we can apply the ultra-low power and low power technology in public and private sectors.

The segments of the 3 target markets for OPERA are:

- Education

- Financial institutions

- Civil protection

The segments listed above are to be considered only as an example of those as a possible target for the OPERA technologies. During the lifetime of the project this analysis will be exploited with other indication of other segments.

HPE: VDI has been a 2-digit growing market in the last 3 years. Education and Financial institutions are the fastest growing segments nowadays. Security coming with remote desktop solutions is a real benefit for them as the data never leave the datacentre, only pixel streams are used in-between the resources in the datacentre and the user.

The work being done on heterogeneous compute inside OPERA is also key for High Performance Computing (HPC) and Internet of Things (IoT). Power usage being a real hassle on the edge computing but also in the biggest datacentres where the input feed is, most of the time, limited to 10 or 20MW. Customers are looking to fit as much computing capacities as possible inside this hard-constrained power envelop and going heterogeneous is key to be optimized.

IBM: is strategically invested in several business segments where OPERA outcomes can be leveraged to benefit company's performance. First, it is the Technology Services and Cloud Platforms segment, specifically its Infrastructure Services area. In this area, IBM is interested in making its Cloud Infrastructure and Services efficient and capable to sustain various demanding workloads, such as Cognitive Computing, Big Data processing, and Business Analytics. Power efficiency resulting from cross architecture workload migration technology developed in OPERA can enable IBM Cloud Platform to become more competitive in the market. Additional market segment of outmost importance to IBM business that can be influenced by OPERA outcomes is the segment of Systems, both hardware and OS. OPERA adds important technology advances at these fundamental levels and can potentially help IBM systems to become more efficient, agile, and better integrated into modern ITC ecosystems.

NEAVIA: OPERA embedded video platform can address road traffic management issue if the ultra-low power technologies enable to collect video information from miniaturized, ultra-light and consequently cheap installation : it could enable to monitor in real time more systematically the different areas across the the road network and to collect more and more diversified installation thanks to the embedded smartness. For the road managers OPERA can provide a significant to the ITS (Intelligent Transport System) to implement the smart cooperative road. One essential target is to decrease drastically the required civil engineering installation, by using very light energy autonomous installation (below the kg): in this case OPERA embedded technologies could address significant needs of different type of road managers (including all the type of the interurban roads, where the requirement of ultra-low power energy autonomous solution is critical) for congestion management, event detection and treatment, road user information, meteorological condition monitoring, etc…

Coupling with other centralized servers technologies could possibly address lot of issues of road managers considering statistical for public policies, monitoring of road infrastructures, etc… Such use cases should be more investigated, including the use of big data technologies.

Other use case can be investigated, as embedded application in public transport to monitor public transport frequenting and to improve users control and pricing (an example of issue is to count getting in passengers and getting out passengers at each station for example, or to identify the travel of each users for a more accurate pricing)

[to be exploited more in due course of the project with data related to the KPI to use to measure the possible performance for each target sector]

2.2 COMPETITORS

In this chapter the main argument is to define OPERA major competitors offering the same technology and operating in the same market and have a significant market share. Competitors has been selected taking into account the top three.

The major competitors for the use case Virtual Desktop are Microsoft, Amazon, Oracle, Citrix and VMware.

The major competitors for the Traffic monitoring use case are Axis, Magsys Dinaf, Inspectrum, FIGO, Goudappel, Brimos, VISense and Eagletek.

As end-user Isere can use different technologies which could address the same functional needs:

- Video sensors with automatic detection of incident: NEAVIA, MAGSYS, CITILOG: CITILOG provide very sophisticated automatic detection system connected to the grid, MAGSYS provide autonomous camera required large solar installation. NEAVIA (to be completed by NEAVIA
- Magnetic sensors for detection of vehicle as inductive loop (STERELA, FARECO, SIGNATURE SYSTEMS, SFERIEL) or as magnetometer (SENSYS, HIKOBE), magnetic sensors for detection of cycle (ECOCOMPTEUR), radars (SFERIEL, iCOMS) These technologies can be competitors to video solution to collect road data. These sensors can be low power, but cannot necessarily provide such information as video detection coupled with local high level image treatment, in particular for the detection of event.
- Thermal sensors (FLIR): These sensors can be easily used for the detection of event but are not ultra-low power.

Isere has not identified any supplier who combines video detection and ultra-low power micro servers and severs technologies for traffic monitoring use cases and who can address the panel of use cases treated with ultra-low power technologies in the OPERA project. But to face the competitors, the OPERA solution has to target ultra-low power level (largely below 1W), robustness, compactly and cheapness target, and obviously high quality level of detection of road event or singularities.

The major competitors for the use case Truck are PhotoScanPro (for Orthophoto), Canon (for camera equipment)

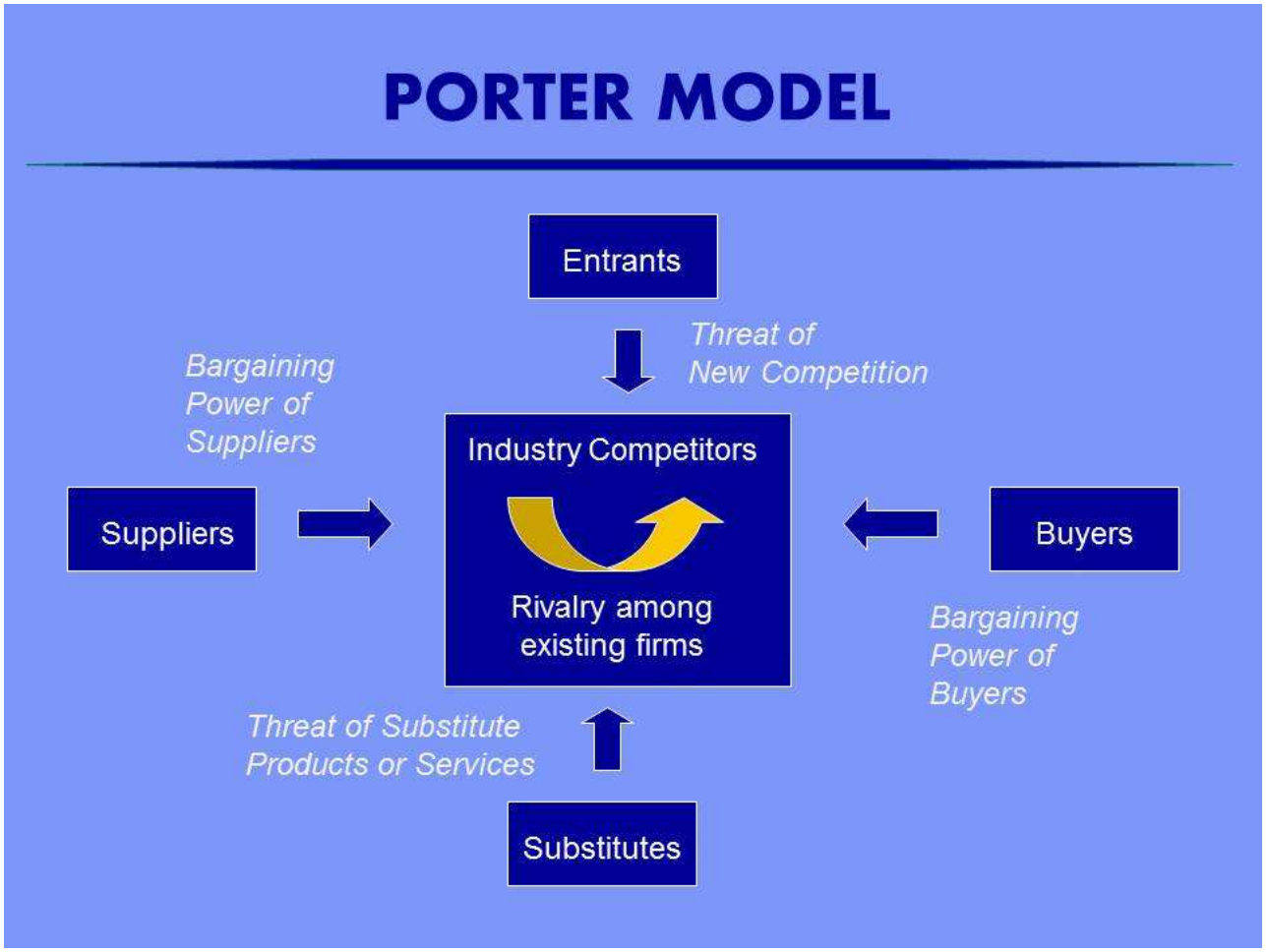
Competition could also come from Nvidia who is targeting embedded market with their Jetson TX2.

3 BUSINESS MODEL

Defining the business model we have to select first the project's marketing strategy, the main client or clients and the right strategy to use.

OPERA is trying to achieve a frog-leap competitive advantage which means a relevant improvement on existing technology in heterogeneous architectures and computing continuum field consisting in low power and high performance envelope, time saving, energy efficiency, space saving and costs saving in a medium-long period.

An still currently effective method to evaluate the right business model is widely considered the Porter's five forces analysis. Published for the first time in 1980[1] such framework for analysing a business strategy development compared to the level of competition within an industry is still simple to understand and comprehensive in the assessment.



Suppliers: it is crucial to know the bargaining power of the suppliers, this information give us the visibility of the cost we will have with the suppliers.

Buyers: bargaining of the buyers is the ability of buyers to put the firm under pressure, which also affects the customer's sensitivity to price changes. Another important information is to know how many costs I have to estimate for reaching my buyers and increase their loyalty rate.

[1] Porter, M.E. (1980) Competitive Strategy, Free Press, New York.

Entrants: Threat of new entrants depends from different factors like existing barrier to entry, capital requirements, government policy, access to distribution, customer loyalty and industry profitability.

Substitutes: Threat of substitutes consists in how many substitutes products there are in the market.

Industry Competitors: Threat of competitors consists in knowing the rate of competitiveness of the market

Who	Suppliers	Buyers	Entrants	Substitutes	Competitors
ST	In this area the design and the production is done by ST, so the supplier can be only for materials and for integration of subsystems. In the project this role is covered principally by Teseo	ST aims to provide a general purpose platform, for a variety of potential integrators. In the field of OPERA any company integrating video surveillance cameras can be interested (Neavia is a good candidate to represent the potential buyer)	It is difficult to foresee any Entrants because the costs of design and production are very high. The market share needed to be profitable is high	Similar embedded processors, but without a specific vocation to the heterogeneous platform for ULP videocomputing	Texas Instruments, Intel, NXP among other semiconductor companies
IBM	IBM does HW and system design but outsources fabrication at most cases, focusing on developing SW and value add services.	IBM customers are offered differentiated value add services that they often cannot obtain from any single source otherwise.	IBM plays in well-defined business segments where barriers for entry are high. Entrants capable to compete with IBM are thus entrants are rare.	IBM's holistic approach to its Technology and Services portfolio makes it harder for substitute to threat IBM business on all fronts. Specific solutions and technologies providers are better of partnering as part of IBM ecosystem than competing	IBM's main competitors in segments relevant to OPERA are Microsoft and AWS, while additional players can pose a threat, e.g. Google, Oracle, Rackspace, etc.
HPE	Hardware design and production is done by HPE. Collaborative	Customers with needs for very dense and low power solution. Many Moonshot	We don't see any entrants in this type of portfolio. Due to the	There are similar products on the market but none of them is capable	NVidia is working very hard to get their devices into vehicles.

	work done with Nallatech, IGN and CSI only impact the software side (RedFish, MicMac).	chassis are currently being sold for remote visualisation. EdgeLine targeting customers looking to perform more compute at the edge.	disruptiveness of such solution, the cost to enter that market is high and the return on investment is hard to achieve.	of either hosting a full heterogamous architecture or being installed at the edge.	Supermicro and Kontron are also shipping micro servers but only targeting limited workloads such as video transcoding.
CERTIOS	Certios has no suppliers.	We see buyers here as our existing datacenter industry/public customers, interested in what advantages the OPERA products may be able to provide extra value to their operations. They have the need to get informed. Competition from buyers: Buyers may have or acquire the knowledge, skils and experience Certios is selling.	As a consultancy organization, people make the business, instead of the company. Knowledge, skills and experience is hard to copy; for new entrants the barrier for entrance in the market is high.	There are tools and eventually even artificial intelligence, self-learning machines, management decision support systems that un future may more often replace the work Certios sells.	Certios operates in a niche and the completion is defined by the market definition. The niche market is small and competitors are therefor hard to identify.
NALLATECH	The design and production of the FPGA/SOC hardware is carried out by Nallatech. HPE and IBM are working collaboratively with Nallatech to integrate and test the new hardware in Moonshot	Customers whose applications benefit from the combination of FPGA and ARM processor technologies can utilise the Nallatech hardware and tools to port and optimise a variety of	FPGA technology is disruptive in the high performance computing market. There are very few companies with the skills and resources necessary to deliver data center-class	Intel have plans to integrate FPGA fabric within their Xeon processors, however this is understood to be many years away and is unlikely to be openly programmable by customers. It	Nallatech's FPGA products compete with Nvidia GPUs and Intel Xeon Phi accelerators.

	and Firestone platforms.	compute-intensive applications. Best buyers are those with severe Size, Weight and Power (SWAP) contraints – as is the case for the Truck use case	platforms. Entrants are likely to be very few, with high risk of failure.	is more likely that Intel will provide black box libraries that customers can buy, then run to achieve performance. Customers can inadvertently damage or crash computing platforms supporting FPGAs.	
NEAVIA	Neavia delivers software for Opera dedicated to video detection for road monitoring. Neavia has no external suppliers for software development, only libraries supplied by ST.	Neavia targets customers with needs for low power video solution. Such customers are either public infrastructure manager (LD38 is a good example) or private road manager (motorway managers).	Neavia don't foresee any entrants in this type of market due to the disruptiveness of such solution. Some entrants may rely on the same platform but having already a developed solution shall kept Neavia ahead from competition.	Neavia don't foresee any substitute solution with same level of performance in term of ultra-low power solution.	None of Neavia competitors can compete in term of ultra-low power video solution. Those existing competitors may use the same platform but having already a developed solution shall kept Neavia ahead from competition.
TESEO	No major risks related to suppliers are foreseen because none of them will have any control on the value added processes or parts. Competitive advantage know-how will	The product will have to target the customers that can extract the best benefits from the innovation which are related to the total cost of ownership. This customers are in a first instance government infrastructure	TESEO is a new entrant in this market because current market is dominated by product that, not being low-power and autonomously intelligent, require significant	As far as we are aware at this stage there are no incoming substitutes for such innovative and low power solutions. Competitve intelligence should be made in due course, it should be expected that	Key competitors will be the current market player. The market is still quite fragmented and populated by SME's. We do expect that the innovation results from

	be protected.	management entities (such as CGI) or infrastructure concession companies (such as APRR).	investment and have high exploitation costs. The current products cannot find wide adoption due to these limitations.	once the innovation will move into a higher TRL and get close to prototyping conditions may change.	the research will provide a significant competitive advantage on both low power, on-board intelligence and smart-connectivity.
CSI	HPE is the supplier of chassis/server for VDI and Truck Use Case. Nallatech is the supplier of FPGA Card for VDI and Truck Use Case. ISMB provides the Tosca Descriptor for VDI Use Case. IBM provides software for Containers Migration for VDI Use Case. HPE provides the Micmac code on FPGA card.	The aims are these ones: 1. The first one is the use of the new server generation in order to reduce power consumption. 2. The second one is the use of Micmac.	The number of Entrants about server potentially could be high. Instead the Entrants about FPGA card and open source software for orthophoto elaboration are few.	In this moment it's not possible to find alternatives to this type of hardware and software.	CSI is an Italian Agency that works only for public bodies, then it does not have any competitors about these type of services.

Table 1 – SWOT analysis for Partner

Porter analysis is good only for the side of the project where the consortium is using an existing technology because this give a good starting point an vision on the competitive position of OPERA in the market taking in count the costs of suppliers, the costs for reaching the customers, the substitutes in the market and the main competitors.

For the research side of the project this is not valid because of the research nature of the project, and as is each research, it couldn't give an exact estimation of the costs and possible revenues, but is a good analysis for knowing the possible value added in an existing market or a new one.

[to be exploited more in due course of the project and potentially re-oriented to markets once individual data are gathered]

4 ROADMAPS

This chapter will discuss the steps to be made for any prototyping, industrialization, commercialization of the solutions offered by OPERA.

At the time of preparing the document we are in line with the creation of various prototypes for each use case with the installation prediction field of the prototype in May 2017.

For STMicroelectronics the first step in the definition of a business plan is to identify all (as much as possible) potential markets for the computing platform, in order to increase the amount of devices sued. This step is crucial in order to cover the huge production costs associated to the development of a ST product that in this case will be a family of SoCs. The markets can be fragmented, but the common need of them should be correctly identify in order to realize a product capable to fulfil many different requirements form different sectors.

The activity conducted in OPERA in terms of market analysis is for ST crucial, in order to evaluate the potential of an R&D chip before bringing it to the product level maturity.

The most important roadmap to be developed are:

- prototype product roadmap
- industrialization roadmap
- commercialization roadmap

In the following paragraphs the development of these roadmaps.

4.1 FROM PROTOTYPE TO PRODUCT ROADMAP

Let now trace the steps for realizing the prototype for each use case and the roadmap for reaching the goals.

Here below the status of the prototypes for each partner:

STATUS	Traffic monitoring	Truck	Virtual Desktop
TESEO	The prototype is in the finalization status, all the parts are ready to be connected and integrated.		
IBM			Technology enablers for the prototype are under development.
HPE	Hardware will be installed on M16. The software features will be increasing over month (from re-routing video streams to adding long-term archiving and analytics)	Beta hardware has been used from CSI datacentre starting M14 to work on the migration of communication components. Hardware is now production grade and will be integrated into the truck on M16. Software will be ported in multiple phases starting on M18 for the initial one.	Systems have been deployed in CSI datacentre on M14. They are already in use for the initial calibration work.
ST	The SecSoC system on chip is an R&D chip mature enough (TRL 7) to be used in field trials.		
ISMB	Prototype under testing and validation		

ISERE	In the first cycle we will be able to test an ultra-low power embedded video solution to detect traffic congestion and wrong way vehicle across a high traffic suburban road (road serving the entry of the urban metropolis GRENOBLE). Detection of event will be transmitted in real time to the road management centre. The aim is to demonstrate under real life condition the capacity to have an automatic detection of traffic road event by using only energy autonomous system under realistic economical conditions : no connection to the grid or wired network, relatively cheap and compact installation (supplied by solar panels below W) The energy autonomous system is not achieved. In the following cycle, the hardware integration has to be improved to converge with cheaper and more compact installation, to take all the add value of the ultra-low power solutions. More advanced use cases as cycle detection and counting will be tested, and use cases are tested under winter conditions. Endly cycle detection functionalities could be used to technically test more advanced solution based on the coupling between the different OPERA technologies : embedded micro servers and centralized server		
CSI		In the first cycle, we'll be able to move the current services on Moonshot and a part of Micmac code on FPGA Card. The aims are two. The first one is the reduction of the power consumption, thanks to the replacement of the	In the first cycle, we'll be able to define the Tosca Descriptor to deploy containers for OwnCLoud Service and the development of the code for Container Migrations between hardware with the same architecture. During

		current hardware with another one that requires less energy to provide the same services. The second one is the reduction of the elaboration time, thanks to the FPGA card where we can move a part of the current computational elaboration. In the second phase we want to migrate most of the Micmac code on FPGA Card. Finally, at the end of the third cycle we want to introduce an additional FPGA card to reduce the orthophoto processing and an additional cartridge to increase high availability.	the evolution of the project, we'll be able also to move containers among hardware with different architectures.
NEAVIA	SW algorithms have been modified taking into account ST ULP platform limitations in terms of available resources. To be able to test before integration with HW, algorithms have been ported to current existing HW. Congestion algorithm is available whilst wrong way and cycle are under validation. Additional pieces of SW for webcam pointing and detection parameterization are also available for ST platform.		
CERTIOS	The role of Certios was to research Models and Methods associated with Energy efficiency metrics. As published in Deliverable 4.1, these Metrics have been defined and corresponding Models and methods for measuring efficiency improvements in the Traffic Monitoring use case are described in the deliverable.	The role of Certios was to research Models and Methods associated with Energy efficiency metrics. As published in Deliverable 4.1, these Metrics have been defined and corresponding Models and methods for measuring efficiency improvements in the Truck use case are described in the deliverable.	The role of Certios was to research Models and Methods associated with Energy efficiency metrics. As published in Deliverable 4.1, these Metrics have been defined and corresponding Models and methods for measuring efficiency improvements in the VDI use case are described in the deliverable.

Table 2 – Prototypes situation

[to be exploited more in due course of the project]

4.2 INDUSTRIALIZATION ROADMAP

After the construction of the prototypes, partners can move into testing phase acquiring real hard data. Such data will provide a closed-loop feedback for research adjustments to partners and hopefully drive

partners to consider investing with the next phase which will lead then to the industrialization of the research results.

In this section there are all the steps to follow for putting onto the market once validated the prototype, these steps are as follows:

- Identification of the project purpose
- Design of the product: costs of the design
- Optimization: how much integrated the product/s is
- Validation check at the end

Nallatech: has been tasked with rapidly developing an FPGA SOC prototype card to be ready by M15 to allow the porting of the MICMAC code to proceed as early as possible and meet the timeline of the overall project. Nallatech received and tested the initial prototypes early in 2017 (M13-M15). This includes the development of a beta OpenCL software tool flow and support utilities in order to program and access the card.

Nallatech is looking to productise this device at the end of 2017. This will be at extra cost to Nallatech and involve the productisation of the OpenCL tool flow and probable hardware refinements. It will also involve qualifying the product in particular servers. Any improvements will feedback into the Opera project at no cost to Opera. The productised version will not include the host channel communications provided with the Opera prototypes, as this was a unique capability developed for use within Opera. The Redfish work being undertaken is unlikely to be ready in time to feature in the productisation. It maybe will possible that Nallatech will start to support Redfish in future products as a result of the work undertaken in OPERA.

IBM: as part of OPERA IBM develops enhanced cross-architecture workload migration capabilities that can become part of IBM Cloud Platform to benefit client facing service offerings. OPERA outcomes are not planned for direct productization but for own usage as part of common cloud infrastructure. To become part of IBM infrastructure services, OPERA outcomes will have to be validated through thorough evaluation and quality assurance processes, both by Open Source community and by the IBM product teams. In addition, integration into IBM platform management and control planes will be required.

HPE: The hardware components in used on the solution designed for the VDI use-case are not dedicated to OPERA and are already available for some times. In most of HPE reference architectures, Citrix and Microsoft are the software partners of choice by providing an end-to-end software solution. The software architecture defined in OPERA provides an innovative and disruptive Open-Source solution. Government and Education customers are interested in such design and promoting this in a brand-new reference architecture available from HPE mobile workspace web site could open new business opportunities.

Providing a full hardware and software (Redfish) support of Nallatech FPGA board into the EL4000 chassis together with the Moonshot m510 cartridge opened new opportunities for embedded compute at the edge. Video acquisition, IoT and machine learning are potential markets where this solution will be promoted.

4.3 COMMERCIALIZATION ROADMAP

Plan the eventual steps for the commercialization of the product after the creation of the prototype, the demonstration etc.

[to be exploited more in due course of the project once first use case test data will be available]

4.4 PRODUCTS

The research results should drive in a medium term to new products prototypes which embed the real and innovative potential achieved by OPERA: Heterogeneous architectures, high density datacentre, computing architecture orchestration.

The “products” of OPERA will be the results of all the research, studies and applications in the use cases considered by OPERA, embedding all the low power and ultralow power available technology, resilient and configurable technologies as well.

[to be exploited more in due course of the project once first use case test data will be available]

5 FINANCIAL PROJECTIONS

One of the most important point of an efficient business plan for industry is an efficient financial projection in term of sales forecast (if the product will be sold), investments needed for covering the cost (financial distribution of the resources), complementary or parallel projects, national programmes.

Only by analysing the target market and its segments may be conducted in-depth analyses about the financial projections related to future product offered for sale. At the moment the project is in the construction phase of the first prototypes, once verified the operability of the prototype will carry out financial analysis on whether or not the commercialization of the product.

The Consortium has not yet identified all the market segments in which to operate, more detailed analysis will follow in the next update of the document.

To try to sound out the market, the Consortium will hold a working session with Another European project in June.

For this point OPERA will organise a workshop named “Thematic Session” in cooperation with M2DC (i.e., a H2020 project that aims at providing technological solutions that are in line with those proposed by OPERA, and that can be thus complementary), during the next HiPEAC Computer Systems Week – CSW (Autumn). The main topic of the proposed thematic session will be focused on low power and heterogeneous architectures for the next generation Cloud and Cyber-Physical infrastructures. Besides OPERA and M2DC, further H2020 funded project will be invited to present their vision on next generation of datacentres.

In June, during the ISC-2017 conference, OPERA is planning to show currently achieved results, as well as the main project and technological solutions developed in the project, thanks to a booth space provided by HiPEAC.

[to be exploited more in due course of the project]

5.1 RISK ASSESSMENT

Businesses face all kinds of risks, some of which can cause serious loss of profits or even bankruptcy. But while all large companies have extensive "risk management" departments, smaller businesses tend not to look at the issue in such a systematic way.

Risk means that there is a chance that you won't receive a return on your investment. It is an exposure to danger to your bottom line. When you are in business, you need to consider the kinds of events that could pose a risk to your business and take steps to mitigate them.

Identify the financial, commercial and production risks for each use case involved in the project.

For identifying the possible risks for each use case we used a highly visual tool such as the SWOT analysis.

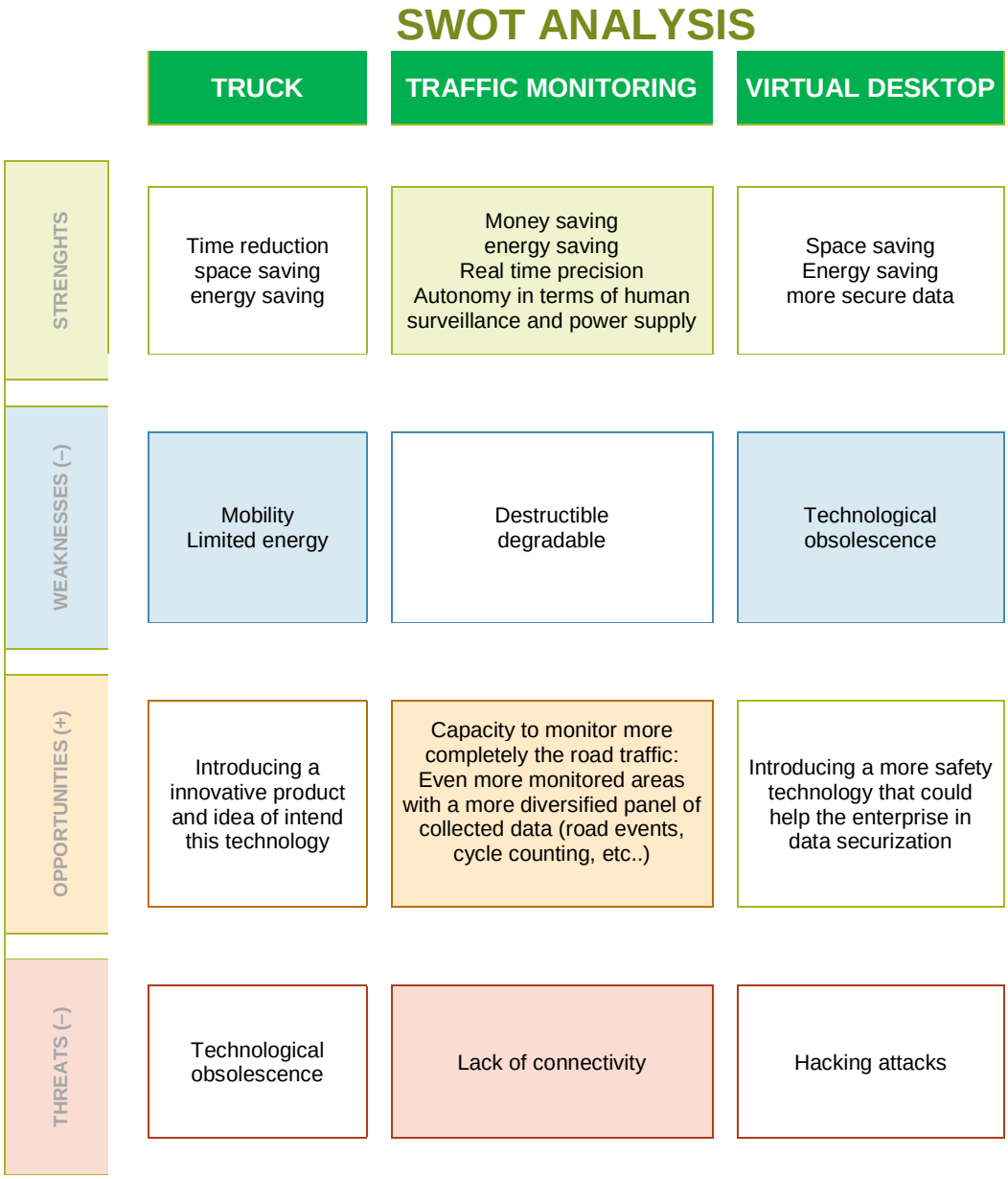


Figure 8 - SWOT analysis

[to be exploited more in due course of the project with also the mitigation of risks]

6 ACTIONS AFTER THE END OF THE PROJECT

This chapter will be populated during the execution of the project and will identify the actions to be taken after the end of the project in order to bring the results of OPERA in new projects and products. And this will be possible if the project will pass to Innovative Action (IA) status.

7 BIBLIOGRAPHY

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