



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

## Business Plan - Preliminary Report 2



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**ACRONYMS LIST**

Acronym	Description
APRR	Autoroutes Paris-Rhin-Rhône
CPU	Central Processing Unit
CRIU	Checkpoint Restore in User Space
DCNN	Deep Convolutional Neural Network
DSP	Digital Signal Processor
F2F	Face2Face
FPGA	Field Programmable Gate Array
IO	Input Output
IoT	Internet of Things
IPR	Intellectual Property Rights
LE	Logical Elements (programmable logic components)
PO	Project Officer
SaaS	Software as a service
VDI	Virtual Desktop Infrastructure
W	Watt

## EXECUTIVE SUMMARY

This deliverable is part of the main one that will be submitted at the end of the project (M36) and in particular it contains the PO's recommendations of the midterm-review meeting made in Brussels in July 2017 that were:

- Set up the Intellectual Properties Rights (IPR) strategy
- Business plan more specific and clearly linked to the use cases
- Put the deliverable 8.11 in the context of the D2.5-2.6

The contributions needed are mostly from the industrial partners of the project. The partners to contribute are TESEO, STM, IBM, HPE, NEAVIA LACROIX and NALLATECH, who have to give information about the products and services that will be (or are already) commercialized, thanks to the OPERA project and who provide information about the market, prices and financial data, where possible.

### Position of the deliverable in the whole project context

The deliverable is the second update of the main deliverable that will be submitted at the end of the project in M36. Its main goal is to link the exploitation actions with the financial feasibility of the artefacts that will be deployed to the market thanks to the three use cases part of the whole project.

### Description of the deliverable

The main targets of the deliverable are to:

- Implement PO's recommendations from the last review;
- Insert more specific information in the business plan and clearly link it with the use cases;
- Put the business plan in context of deliverables 2.5-2.6.

Each chapter contributes to answer to these points and it is in continuous evolution while the project progresses.

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## 1 GLOBAL BUSINESS PLAN STRATEGY

This document includes an update of the description provided in the first deliverable [3] and the implementation of the recommendations after the midterm review made in July 2017.

Starting from the global strategy already described in the deliverable D8.7 [3] here a complete overview of the progresses made for the project business plan is presented.

The whole consortium has increased the effort in project awareness outside the consortium, attending several important industrial and scientific events, increasing the effort in developing and starting the commercialisation of some OPERA's technologies or started to find the way for commercialising the results of the research made in the project's use cases.

The aim of OPERA is continuing market innovations and try to place the solution of each use cases into the market, targeting the private and public sectors, in particular using the solutions provided by the traffic monitoring use case that could cover several markets and segments.

Also, the technologies involved in the use case of the truck are very innovative and market-ready., These technologies could really improve the actual situation in its field of application.

The cloud paradigm is increasingly widespread, but according to this model the providers are moving the most of computational effort, and the relative energy consumption, that was in customer premises towards the data centre. In fact, thanks to this pattern, the end users need a very simple thin client with just a browser to access to services, making it necessary to increase the number of servers, space and power needed at the suppliers' sites.

The OPERA project wants to improve this, by to introducing a solution guaranteeing the same number of concurrent end users, while consuming less energy.

To achieve this target OPERA intervenes in two ways. The first one is the use of HPE low power servers, that means a 4,3U chassis that can host 45 different cartridges, where a cartridge is a physical server that requires about 50W instead of 200W of a "traditional" server. The second one is the develop of software to move micro-services among servers with different CPU architectures. This migration is managed by the information gathered, not only before starting the service, but also in real-time during the execution of the services.

Thanks to the OPERA innovations, solution providers (like CSI), who offer their software solutions in the form of micro services (Open Source), will be able to dramatically increase the number of potential users, while reducing the hardware and energy costs of operation.

In the Virtual Desktop Infrastructure (VDI), the following targets are considered:

- Optimization of computational power;
- Optimization of power consumption;
- Avoid the use of commercial products for the management of the virtualization environment.

Following these targets in this use case there are a lot of possibilities for deploying the technologies tested during the research period. The IoT and Industry 4.0 markets require everyday a reduction of power consumption and the optimization of operations. In particular, one of the most useful segments for VDI Use Case is the Cloud Provider one.

### 1.1 IPR (INTELLECTUAL PROPERTY RIGHTS) MANAGEMENT

The handling of the IPR is very important to be defined and handled in each project, especially if some products born out from a research project are deployed to the market. After the PO's recommendations, the consortium has increased the focus on the IPR management in OPERA project. The first actions have been to identify the partners responsible for the management of this process, and the selection of the tools more suitable for this goal.

The partners that will manage the process will be STM as project coordinator, and Teseo as leader of the business and exploitation management.

The EU commission provides an Intellectual Property Rights (from now IPR) management service and helpdesk, that can be useful in this process. This paragraph will contain the description of the process that will be adopted for handling the IPR strategy.

Teseo has started the interaction with the IPR helpdesk for understanding how to manage the IPR strategy and connect it with the whole project.

In the next updates of the business plan, as well as of the exploitation plan, the outcome of this interaction will be described.

The target for IPR strategy definition is the following, due to the European IPR helpdesk:

1. Trade mark (A particular word or sign to distinguish a product or some products)
2. Industrial designs (A particular design protected by a copyright)
3. Patents (exclusive right granted for the protection of inventions – products or processes)
4. Utility models (It is a right over the commercialisation of a protected invention)
5. Trade secrets (a confidential business information can be protected by a trade secret)
6. Copyright (is the right of the creator over his invention)
7. Databases (collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means)
8. Domain names (is the right to protect the internet address and locate a particular “subject” in a particular univocal way on the net)
9. Geographical indications (is a sign used on products having a specific geographical origin and whose qualities and/or reputation are attributable to that origin).

All these aspects will be adequately detailed, if applicable to the project, during the next months and in particular in the exploitation plan and then linked to the business plan, after contacts with the European IPR helpdesk.

A training session for Teseo and STM with the IPR helpdesk will be organised in the next few weeks after the answer of an IPR Manager.

## 2 INDIVIDUAL BUSINESS PLANS

This chapter presents the potential of the technologies and solutions developed by OPERA, and their usability in different market segments, as well as their potential possibilities for commercialization. OPERA has been recognised as a strong innovator from H2020 Innovation Radar, in particular from the “European Forum for Electronic Components and Systems” and was invited to attend the event realizing a video showing the innovations of the project last December 2017

In this chapter each partner is giving a description of the artefacts and solutions involved in each use case pertinent to the activities of the partner and how it is going to exploit the results internally, or into the market.

After the 1<sup>st</sup> <sup>1</sup>“Innovation Potential Meeting” ]and the 2<sup>nd</sup>“first implementation phase” the project was regarded as a potentially strong innovator also thanks to the impact that can have on the target markets which are considered for the deployment; in particular Industrial Internet of Things and Industry 4.0. considering that the project could target the industrial as well as the public sectors, many solutions are applicable.

Next, the business plan update for each industrial participant of the consortium will be presented.

### 2.1 STM

The business plan of STMicroelectronics related to the OPERA project progress and results, is connected to the devices that are used in the project. There are two main classes of devices:

- The research devices (not yet products of the STMicroelectronics portfolio) developed for the efficient video processing applications for the autonomous local devices
- The products of the STM32 family, used in the Nucleo platforms [1], connected to the Wi-Fi extension [2].

For the first class of devices the business plan is yet preliminary, because a product roadmap is not defined. The organization of STMicroelectronics that works in OPERA is a research division, and it does not have a budget to realize a product. This means that for these prototypes the business plan is to propose to the STMicroelectronics product divisions the results of the evaluation of the prototype and a potential market segment to be targeted. The division will evaluate the impact of a potential product, considering the market segment highlighted in OPERA (traffic monitoring and road management), as well as other potential markets.

Regarding the products used in the OPERA project, the business division that is already promoting the Nucleo family and the extension boards will receive the data acquired during the execution of the OPERA project, in relation to the use of the reconfigurable antenna that is driven by the Wi-Fi module. These data will be used to improve the promotion of the Nucleo devices and show the usage of them in a specific situation.

### 2.2 IBM

As an industrial partner, IBM’s contribution to the OPERA project is focused around obtaining relevant solutions related to enhancing efficiency through reducing power consumption in a cloud data center. IBM’s business plan related to OPERA is adopted from its internal exploitation (detailed in D8.10 [4]), in which IBM Business Units will be identified, that can adopt beneficial technologies. (etc. FV)

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<sup>1</sup> Held by Nallatech in Glasgow, 14<sup>th</sup> July 2016

<sup>2</sup> Made in the site chosen by Isere in Grenoble in June 2016 (M20) as planned

Since we are part of IBM’s Research Division, we do not own a line of business or have direct access to market channels. Instead, we must partner with various business units inside IBM that are interested in exploiting our technologies to improve existing products or services offered by IBM.

We plan to exploit our CRIU (checkpoint restore in user space) technology by improving the performance of cloud data services. CRIU can benefit cloud services by reducing start-up time of containers, and by enabling container migration which can be used to schedule cloud platform components on the most efficient available compute node.

We have identified some key figures inside these organizations and have presented our ideas and preliminary results. We have received generally positive feedback, but we need to complete the research in order to finalize any technology transfer that is to take place. There are always additional challenges when productizing research prototypes, and we will need to put a plan in place to make the transition smooth.

### 2.3 HPE

HPE provided hardware for all the three use cases:

- for the VDI use case, HPE provided several models of Moonshot cartridges (SoC);
- for the Traffic Management use case and for the DataCenter in a truck use case, HPE provided, together with Nallatech, a bundle consisting of an FPGA card connected to a Moonshot cartridge.

The involvement in the VDI use case is offering HPE the opportunity to target the improvements of the performance and power efficiency of the solutions offered to Service Providers and Cloud Providers.

The involvement in the Traffic Management and DataCenter in a Truck use cases is offering HPE the opportunity to develop an energy efficient solution targeting AI market.

### 2.4 NALLATECH

OPERA is an opportunity for Nallatech to target new customers by leveraging heterogeneous FPGA systems for specific workloads. The work being conducted on the hardware and software sides will enable new opportunities for Nallatech, by demonstrating FPGA capabilities in real world use cases.

Nallatech is the partner with the biggest grant on the project. The reason for this budget is design customization of a board which is tightly fitting OPERA requirements:

- heterogeneous compute
- power efficiency
- low latency inter-connection in-between servers.

Nallatech 385A-SoC and 385-OPERA are sharing components and R&D, as detailed in the following table. But there are also many differences as you would expect between a research project and a production and purchasable product.

Feature	385-OPERA	385A-SOC
Hardware design	Shared	Shared
Hardware validation	Specific	Yes
Hardware certification	Specific	Yes
Board Support Package	Specific	Generic
OpenCL support	Yes	No
Warranty and support	None	1 year extensible

The 385A-SoC is targeting IoT and network intelligence. One of the biggest advantages of 385A-SOC is coming from the embedded ARM CPU, which brings heterogeneity for compute but also allow to create autonomous designs. Autonomous designs enable to eliminate the need for a host CPU which add cost, complexity and increase the power consumed by the solution.

Following this principle, Nallatech has created an autonomous solution based on the 385A-SoC named the FPGA MicroNode.

- <http://www.nallatech.com/store/fpga-accelerated-computing/pcie-accelerator-cards/nallatech-385a-soc/>
- <http://www.nallatech.com/store/fpga-accelerated-computing/nallatech-fpga-micronode/>

This product has been made possible with the work conducted on OPERA project, as it is reusing the 385A-SOC board. Additional customization and board design have been implemented by working with end-customers to match their requirements.

The current MicroNode is designed for network analytics due to the IO ports but it could be transformed to other type of appliance by adapting the ports connected to the FPGA fabric. for instance, adding SDI will make it suitable to Video acquisition and pre-processing, while adding RJ45 PoE ports will make it relevant for video surveillance.

On the software side, MicroNode could also takes advantage of the effort conducted during OPERA on YOLO9000 CNN. This development could be adapted and reused to be integrated in a surveillance appliance, with or without the use of ULP intelligent cameras.

## 2.5 NEAVIA

Lacroix Neavia is a key player in smart road infrastructure. In the road surveillance business, Lacroix Neavia portfolio targets devices under high-constrained conditions, making cameras suited from freeways to isolated mountains roads. Those specific conditions require having both network accessibility and high energy efficiency. Cameras can then run autonomously using a solar panel and embedded smart software utilities for road condition evaluations. Thus, cameras can be deployed with more flexibility providing there is enough communication access and sunlight.

Lacroix Neavia is taking part to the traffic monitoring use case, for which activities are related to congestion and wrong way detection, and also cycles detection and counting. In the OPERA project, Lacroix Neavia provides its know-how in embedded software domain so that specific road use cases can be addressed, taking care of using efficient but limited hardware resources.

Through the OPERA project, Lacroix Neavia intends to push further the bounding of state-of-the-art products in road management. Taking advantage of new and efficient network and hardware architecture and developing specifically designed software allows new solutions to road use cases such as congestion, wrong way or specific condition detections to be brought to the road managers by Lacroix Neavia. Thus, road surveillance can be taken to another step which opens new insights into the future of road management appliances for a safer and smarter road usage.

## 2.6 TESEO

From the beginning of the project Teseo has understood the real potential of a research action like OPERA project and in particular “traffic monitoring use case” in which Teseo are leading. Here in particular the actual situation is more expensive because of high cost of:

- Infrastructure
- Maintenance
- Energy consumption.

The aim of the “TM use case” is to reduce all the aspects providing a complete solution that could reduce:

- Infrastructure costs
- Maintenance costs
- Energy consumption.

Teseo, thanks to his plurennial experience in the system integrator field, is in charge to build up the external case for the “TM use case” and providing a “plug and play” solution ready to be deployed in the field. So, the final target of Teseo is to commercialise the artefacts that the use case will produce into the following markets and market segments:

- Traffic monitoring (highway and motorway)
- Smart cameras (cycling detection)
- Pattern detection.

## 3 GLOBAL BUSINESS PLAN ACTIVITIES

### 3.1 EXECUTED ACTIVITIES

#### 3.1.1 STM

The results obtained so far in the OPERA project related to the use of the SecSoC processor have been communicated to an STMicroelectronics product division that develop ASICs for specific applications.

In particular, the porting of video processing applications executed on the SecSoC and the promising results of the detection has enabled the definition of a new device development. The use of the DCNN accelerator that will included in the final phase of the project will drive the finalization of the product architecture in order to cover the requirements expressed by ISERE, a potential customer of this type of product.

#### 3.1.2 IBM

Throughout 2017, we have briefed key figures inside IBM on OPERA technologies that can improve energy utilization of the data center. In the process, it was revealed that CRIU technology we develop as part of OPERA has the most potential to impact IBM.

In the 3<sup>rd</sup> Quarter of 2017, we engaged with the cloud business unit to discuss the use of CRIU to improve their service offerings. We have identified the specific service that can be improved (Spark) and the specific improvement we aim at (speeding up Spark job start up).

#### 3.1.3 HPE

Since we are part of HPE pre-sales organization we don't have access to market channels. We have identified the right contacts in our Sales organization to which we will present our results.

#### 3.1.4 NEAVIA

Lacroix Neavia promoted the OPERA project both to Lacroix people and externally. Thus, preparing the F2F meeting in the headquarters in Saint-Herblain (around 300 people) from the 21st to the 22nd of November 2017, several actions were taken including dissemination of documents and videos explaining the OPERA project to the employees.

In a same way, Lacroix Neavia took part to the Lacroix Top 100 Convention from the 29th to the 31st of January 2018. During this event, all innovative business units of Lacroix group show new products and upcoming technological solutions. In those respects, an insight into OPERA presented low power feasibility for road monitoring use cases, including state-of-the art approaches like neural networks. Thus, an extension of existing product was presented based on the OPERA spirit with both local processing and remote expert system for confirmation of road incidents detections.

In addition, Lacroix Neavia took part to the ATEC ITS France from the 24th to the 25th of January 2018 during which innovations for smart mobility are discussed in conferences and projects are presented to 1,500 participants including local authorities and road managers.

#### 3.1.5 TESEO

From the beginning of the project, Teseo has made several activities for

1. promoting OPERA project and
2. understanding the effectiveness innovation rate of the project, in particular in the use case where TESEO is mainly involved in (Traffic Monitoring).



The results are that there is a great potential in various sectors of application like Intelligent Traffic monitoring solutions. For this reason, Teseo has presented the OPERA project in APRR (company part of EIFFAGE Group and leader in highway and motorway sector in France) and thanks to this presentation TESEO has obtained the chance to present OPERA to ITS 2017 at EIFFAGE stand and the “European night of Researchers 2017”. The potential of the market is very high thanks to all the directions that all the sectors involved are taking toward to very smart solutions and a society 4.0, because the main target of Industry 4.0 market is not only to automatize and simplify all consumer’s daily life, but also go toward a society that could be smart and designed for every need.

### 3.1.6 NALLATECH

Since the beginning of the project, Nallatech has built solution showcases to demonstrate technologies which are linked to OPERA researches.

Having autonomous systems, such as Nallatech FPGA MicroNode, enables Nallatech to prove to customers the superiority of heterogeneous hardware based on FPGA, in term of performance as well as efficiency.

This hardware solution, combined with the work done on Docker containers, brings FPGA as a good candidate for large edge and cloud deployments, as presented during HiPEAC 2018 workshop in Manchester.

## 3.2 FUTURE ACTIVITIES

### 3.2.1 STM

The plan for the next period is:

- provide more results to the product division
- discuss with Neavia Lacroix, Teseo and Iserre for their potential interest in the development of a new family of products.

### 3.2.2 IBM

Upon identifying the first specific service to be improved with CRIU technology we develop as part of OPERA, we are now working out the plan of creating a prototype implementation for that use case. In addition, we will continue to identify and meet with additional cloud service offering owners to make sure they are aware of the OPERA project, and the technologies that we and the other partners are developing. We are actively looking for exploitation opportunities within the company that can lead to business impact.

### 3.2.3 HPE

As a result of involvement in the VDI use case, HPE is planning to create marketing related materials in which HPE will present the results from the OPERA project in order to support the offerings for Service Providers and Cloud Providers, targeting energy efficient SaaS solutions.

As a result of involvement in the Traffic Management and DataCenter in a Truck use cases, HPE is planning to develop guidelines for qualifying applications that are suitable for the bundled Moonshot/FPGA energy efficient solution.

### 3.2.4 NEAVIA

Upcoming activities include further communications and presentations of the OPERA project to the road managers and local authorities, for a better understanding of the impact it could have on the future of smart road management appliances.

2019 roadmap already includes a brand-new generation of camera based on ST platform and will benefit from lessons learnt during the OPERA project.

### 3.2.5 TESEO

TESEO, continuing the activities started since the beginning of the project, intends to present OPERA in the EIFFAGE Group showing the progresses made during the two implementation phases and the results achieved focusing on the research nature of the project.

For this reason, TESEO will be present again in APRR (Firm of Eiffage Group) showing the evolution of the project as well as the results after the second implementation phase.

In parallel, TESEO will continue dissemination activities, attending for the 2<sup>nd</sup> year the following events:

- ITS (Intelligent Transport Systems) World Congress 2018 in Copenhagen, 17-21 September. This event is the most important one on intelligent transport systems and in 2018 will be the world congress.
- European Night of Researchers 2018

### 3.2.6 NALLATECH

Nallatech is currently building a plan to identify what subdomains would benefit the most from the work conducted during OPERA. Edge deployment is a strong target, as demonstrated in the Truck and traffic monitoring use cases.

The value for Nallatech is not only in the hardware platform, it is also on the ease of automation and management as well as in the value-add features offloaded to the FPGA.

For instance, the work done on Machine Learning is replicable to other domains. Nallatech will identify the candidates which could easily benefit from the optimization.

New Nallatech FPGA board designs might also gain from what has been discovered during OPERA. The ratio in-between the multiple components (LE, DSP, memory, IO) might be adjusted to achieve even better performance.

## 4 EVALUATION OF IMPACT

This chapter explains how the consortium has individuated and evaluated the innovation potential and the markets where to deploy the technologies involved.

In a first stage were individuated as main markets “Industry 4.0” and “Industrial Internet of Things”. After accurate analysis, in order to enhance the innovation potential of the Nucleo board or CRIU server, the consortium has investigated and individuated other additional markets and segments to be deployed explained in deliverable D2.6 [6].

The focal content of the deliverables related to the innovation potential of the project already submitted (D2.5 [5] and D2.6 [6]) are briefly summarized here.

### 4.1 MARKETS

The evaluation of where the OPERA innovative results will have the most impact by being applied most successfully, led to the following markets as already analysed in the D2.6 [6]. In particular, extra markets to place the project’s solutions are:

- **CPU Design:** a huge market with basically two big players like IBM and Intel in continuous evolution
- **Cloud Solutions Providers:** Providers like “CSI” that could offer better solutions respect the actual ones
- **Sensor industry and monitoring of public infrastructure:** could provide new solutions to monitor in particular road network and more generally public infrastructure (road network, electrical grid, gas network, water network).
- **Environmental management:** The embedding of local processing power and autonomous decision making greatly diminishes the amount of data that is sent and stored from the camera to a sensor
- **Cold Storage:** Alternate the power consumption only if needed to prevent lock-in situations.

### 4.2 MARKET SEGMENTS

Starting from the previous deliverable [3] where the main markets have been identified, the market segments more suitable for the contribution of OPERA project results, according also to the Innovation potential deliverables 2.5 and 2.6, are:

- Oil and Gas industry (HPC in the OPERA fit out)
- Maintenance industry, drones (checking planes, as a part of maintenance of air planes)
- Other Industries; in need of mobile platform, high computations. Edge.
- Customers without a datacenter (ship, car, plane, submarines)
- Cyclomedia (a la Google, but measured).
- IT service providers

The potential of these markets is very high and OPERA’s solutions could really improve the actual situation thanks to some several advantages like:

- Less costs of infrastructures
- Less energy consumption
- Less maintenance costs related to less infrastructures and possibility to anticipate errors or locks

The general idea is to hit the private and public entities using for instance for the Traffic Monitoring use case thanks to Conseil Général de l’Isère or APRR that are big players of the “traffic monitoring sector

and smart cameras” sectors. In particular Isère could help the consortium to reach Public Administration sector and APRR the private one.

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