



## Meeting Minutes 4



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**ACRONYMS LIST**

<b>Acronym</b>	<b>Description</b>
ADAS	Advanced Driver Assistance Systems
BSP	Board Support Package
CAPI	Coherent Accelerator Processor Interface
CE	Chaos Engineering
CNN	Convolutional Neural Network
COCO	Common Objects in COntext
CPS	Cyber-Physical System
CPU	Central Processing Unit
DiaB	Data centre in a Box
DSP	Digital Signal Processing
ES	Evolutionary Strategy
FPGA	Field Programmable Gate Array
HPC	High Performance Computing
HPE	Hewlett Packard Enterprise
GPU	Graphical Processing Unit
IoT	Internet of Things
ISA	Instruction Set Architecture
LC	Linux Container
RDMA	Remote Direct Memory Access
RDS	Remote Desktop Services
SaaS	Software-as-a-Service
SDR	Software Defined Radio
SOC	System On Chip
SOTA	State Of The Art
ULP	Ultra-Low Power
VDI	Virtual Desktop Infrastructure
VMS	Variable Message Sign

## EXECUTIVE SUMMARY

This document reports the meetings and the phone calls of the OPERA project for the period M29 (01/04/2018) to M36 (30/11/2018). This document would support the periodic report (D1.4) with the details about the actions and discussions taken during meetings and calls.

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

This document is the final report for the meeting and calls organized within the project.

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## 1 GENERAL ASSEMBLY MEETINGS

### 1.1 GENERAL ASSEMBLY – HAIFA – 6-7 JUNE 2018

#### 1.1.1 First day

##### General aspects

Things still to complete for the offloading and for the WP5 (workload management and consolidation on server side):

- Installation of the run-time environment (RTE) for FPGA on a container running on the HPE machine running on Dept. Isère.
  - Currently, Nallatech (Gallig R.) installed on the server (directly on the host) the software (RTE and the compiler — synthesis + place\_and\_route)
- Integration of the NEAVIA software for detecting and counting bicycles:
  - Development and integration of the software component, on ULP node, that enables the system to estimate if the computation can be done locally on the ULP or remotely on the accelerated server
  - Integration of the software for counting bicycles on the server side
- Complete the development of the workload balancer using PSO/GA/DE and make some initial test (maybe using a reduced number of nodes)
- Integrate this module in the simulation framework along with the work done on ECRAE allocator by Lubrano F.

##### Load estimator

Complex scenes are those where tiny-YOLO can fail in recognizing correctly the number of cycles:

- The local (ULP) algorithm can fail in case:
  - Too many cycles in the scenes (maybe the network over-estimated the number of cycles):
    - More than one goes to the remote server on datacenter
  - Many people compared to the number of detected cycles
  - Sometimes the network classifies a bike as a motorbike.
- Gallig, correctly, suggested to use and add as criteria to decide to “switch” the accuracy of the detection: for instance, the network correctly counted K bicycles over K persons, but the confidence on the detection (kind of accuracy) is very low.
- The system uses internal buffers to store the image captured and then this are send to the remote datacenter server.
- The architecture of the system is as follows: the Neavia software just exploits results generated by YOLO, so they are completely decoupled software module. This allows us to work on YOLOv3+FPGA independently from the Neavia software and also for they integration.
- No specific issues for creating a container that can run the YOLOv3 using the FPGA, and to receive the images from the ULP.

##### Open points

Offloading need to buffer on the server images too:

- We need to define FPS and size of the buffer

##### Traffic Monitoring UC

The test site 2 has also the moonshot (actually should be an HPE chassis) with FPGA board installed. The acceleration software infrastructure is not already completed. It also uses the new Orlando ST board.



### 1.1.2 Second day

#### Workload decomposition

##### WP5:

- Dirk pointed out the fact that the efficiency of the system is based on the measurement of the workload length: for this we need to read the metric defined in WP4 and be stuck on that.
  - We need to reflect this choice in terms of simulation tool used to simulate ECRAE + workload consolidation.
  - We need to talk more with Richard and Gallig to model in the simulation (CloudSim Plus)
  - Discuss with Richard and Gallig about the idea of modeling the FPGA power consumption with a hyperplane: sampling the space of resources and frequency is possible to generate a plane that approximates all the points (best fit plane => it is an approximation of a real data set of points. The more the real points are, the more accurate becomes the fitting plane). This is a common way of generating a model in physics, chemistry, etc.
  - We also need to link what we are doing (ISMB) in terms of simulation (ECRAE and workload balancer) with the use case:
    - Might be possible to try replicating the allocation of one of the VDI applications.

##### WP4:

- Dirk illustrated the progress on energy efficiency measurements as planned on WP4.
- He spent a lot of time to illustrate a research on the adoption of energy efficiency techniques in Dutch data centers:
  - This part has to be moved definitely on WP2—task on innovation potential
  - Not present this to the final review
- We need to link more this WP work with that carried out in WP5.

##### WP7:

- **VDI**: Luca and Davide de Santis explained the methodology used to measure the efficiency in terms of users/KWh in the VDI use case:
  - From the results and from the real measurements we have almost a linear relationship between the users and power/energy consumption.
  - No specific issues have been emerged regarding VDI use case. For this use case we need to complete the porting of the other two applications, also using TOSCA + OpenStack:
    - Wait Joel/Mike (IBM) for completing the containerization.
- **TRUCK**: the truck use case presented no specific issues. However, we need to correctly describe the advantage provided by the introduction of new hardware (HPE EL4000 + GPU):
  - The new hardware allows to process the orthophotos faster:
    - More energy-efficient, but the truck fuel saving is negligible; the advantage is the fact that photos can be processed faster and thus operators can act quickly than using the previous hardware (the operational chain is the same: drone image acquisition => processing orthophotos => sending orthophotos to the remote control room => decision making);
    - Lot of space in the rack is saved, so it would be possible eventually to remove one rack saving more power and space. This is something that would require engineering the other two racks.

##### WP8:

- Check with Richard/Gallig if we have some (several?) results for YOLOv3 on FPGA and ANN approach for preparing the journal paper on special issue.
- The number of posts, followers, etc. on the social media is lower than proposed:

- Need to improve significantly the social media dissemination:
  - Youtube channel of OPERA
  - Facebook and Tweeter

## 2 TECHNICAL SPECIFIC MEETINGS

### 2.1 ULP TECHNICAL MEETING GRENOBLE 15-17 MAY 2018

Intervention on test sites (ISERE/ ISMB/NEAVIA/ST/TESEO)

- Intervention on test site 1
  - Updating of the mini-PC and successful test of 3G link
  - Change of the optical sensor and adjustment of the optical view
  - Correction of connection on SecSoc Board
- Installation of the second prototype on test site 2
  - Installation of camera box with its specific mechanical support
  - Installation of the two antenna boxes (emitter and receiver) with their specific mechanical support
  - Installation of electrical circuit and electrical connection
  - Installation of Ethernet switch and communication connection to Moonshot server
- Basic test on test site 2
  - Successful ULP radio link and communication with Moonshot OK
  - Interface Orlando board and still under investigation

### 2.2 ULP TECHNICAL MEETING GRENOBLE 22 MAY 2018

Installation of FPGA board in the ISERE traffic management centre for the

- Installation of FPGA board on the Moonshot server in the ISERE traffic management centre
- Successful basic test and putting into operation

### 2.3 ULP TECHNICAL MEETING GRENOBLE 5 JUNE 2018

Test and debug to prepare final demonstration (ISERE/ ISMB/NEAVIA/ST/TESEO)

Intervention on test site 1

Control of optical lens

Change of an USB cable and of a tube

Test and optimization of the radio transmission

Test on test site 2

Test of local cycle detection by Orlando platform

### 2.4 ULP TECHNICAL MEETING GRENOBLE 4-5 JULY 2018

Technical meeting: Monitoring of energy on Moonshot server

Updating of the FPGA board for better energy monitoring

Second day: Technical meeting: test and debug to prepare final demonstration (ISERE/ ISMB/NEAVIA/ST/TESEO)

Test and debug of test site 1 : Investigation about the implementation of the SecSoc board in the camera box and USB connection for supply

Test and debug of test site 1: Interfacing between Orlando board and radio emitter

### 2.5 ULP TECHNICAL MEETING GRENOBLE 1 AUGUST 2018

Test and debug to prepare final demonstration (ISERE/ ISMB/NEAVIA/ST/TESEO)

Test and debug of test site 1

Replacing of SecSoc board and optical sensor

Optimization of interface board

Successful test of road event detection

Test on test site 2

Successful test of image acquisition and image transfer from Orlando board to Moonshot server

Preparation of installation of an energy autonomous system: test and validation of mechanical support, validation of electrical circuits.

Conclusion: test site ready for the experimentation planned 4<sup>th</sup> to 7<sup>th</sup> of September

## **2.6 ULP TECHNICAL MEETING GRENOBLE 4-7 SEPTEMBER 2018**

Technical meeting: Final demonstration in the test site 1 – Installation of energy autonomous system in the test site 2 (ISERE/ ISMB/NEAVIA/ST/TESEO)

Test site 1: Final demonstration and measurement of the energy consumption

Diagnosis and intervention from WP3 team: intervention on hardware interface between SecSoc and Nucleo board (management of embedded switch, etc...), installation of automatic daily reset of radio receiver

Simultaneous successful transmission of alarm of detection of wrong way vehicle and measurement of the energy consumption

Simultaneous successful transmission of alarm of detection of congestion and measurement of the energy consumption

Test site 2: Installation of energy autonomous concept and test for proof of concept

Installation, connection and putting into operation of an energy autonomous system: solar panels, battery, battery management

Test of image acquisition and image transfer to the Moonshot / partial energy measurement of the energy management

## **2.7 ULP TECHNICAL MEETING GRENOBLE 14-15 NOVEMBER 2018**

Technical meeting – Final demonstration in test site 2

Test site 1: Last experimentation beyond the initial objective: Test of new hardware and software to optimize consumption of Nucleo-board (interfacing with radio emitter) to reduce energy consumption

No improvement – further development required

Test site 2: Test of cycle detection and counting by off-loading process

Implementation

Successful test of image from ULP embedded video platform to Moonshot server triggered by the detection of object

Real time measurement of the energy consumption of the embedded video-platform

Data collected for counting by software on Moonshot

## 3 PHONE CALLS

### 3.1 WORK PACKAGE CALLS

#### 3.1.1 WP2

ISMB organised the following audio calls in the context of WP2 activities.

##### 3.1.1.1 09-05-2018

#### Agenda

The audio conference was focused on progress of activities carried out in the WP2:

- Offloading, CNN implementation and software integration;
- Innovation potential updates;
- Lesson learned updates;

#### Minutes

CERTIOS updated on the activities regarding innovation potential:

- Deliverable D2.7 have been submitted in time, and finally contained an update view of potential innovative hardware and software solution that the OPERA consortium is developing and that can attract other stakeholders.
- Next iteration of this deliverable will integrate further inputs from our industrial partners (IBM, HPE and Nallatech).
- ISMB indicated that we started (as consortium) to schedule audio calls with the IPR manager, which suggested several points to highlight as results of the OPERA project, as well as providing large potential innovation:
  - ULP and reconfigurable antenna
  - Integration of HPE moonshot-EL chassis on CSI truck (willing of using it in operational environment -- ask for a maintenance service after the project end)
  - Nallatech board design

Regarding the offloading implementation:

- Acceleration of CNN (server side) using FPGA:
  - NALLATECH received the Nvidia DG-Station which will be used to train CNN models
  - We have a CNN version almost optimized and based on the latest release of the standard YOLO topology (YOLO version 3 -- Darknet-53).
- Integration with the software components:
  - Regarding the NEAVIA software that should be used to receive objects recognized by YOLO and provides bicycle counting there shouldn't be any issue.
  - However, we agreed to involve also ST to understand which features of pico-YOLO (on ULP device) are exposed to the software, and how to reproduce them through YOLOv3.
- Infrastructure for demonstrator:
  - We need to contact soon as possible Dept. Iseré to understand if the server (Moonshot) is available and if there is possibility to install an FPGA board.
  - Alternatively, we need to use another server where to create the service for receiving images from remote ULP.

### 3.1.1.2 20-06-2018

#### Agenda

This audio call is focused on the following updates:

- Offloading mechanism implementation:
  - CNN on FPGA: training status, open issues:
    - Measurements (power consumption, resource consumed on the device, frame rate, etc.)
  - Software integration (NEAVIA):
    - Triggering mechanism status, integration w/ YOLOv3, open issues
- OPERA general architecture:
  - MicMac acceleration status:
    - ANN on FPGA (measurements of performance, power consumption etc.)
    - Performance and measurement on Nvidia P4 GPU
- Innovation potential:
  - Update on activities, open issues
- Next deliverables:
  - Table of Content (to be defined and send to the coordinator)

#### Minutes

The audio meeting started regularly. Almost all the partners was attending the telco. Regarding the implementation of the CNN on the FPGA fabric, the design is completed and we are training the network (Yolo V3) using binary weights:

- A little bit less accurate than standard network using SP floating point weights
- Faster (it should reach higher frame-rates):
  - Actual frame-rate still not measured
- Trained using the DGX-station from Nvidia (some results available for the incoming event ISC-2018)
- Results very interesting and promising: good to be used in a Journal paper.

Regarding the creation of a power model for the FPGA to be used in the WP5 orchestration and simulation toolchain, it is feasible. Discussing w/ Nallatech (R. Chamberlain and G. Renaud) it would be possible to retrieve some data on FPGA consumption using BSP+BIST module(s). Power depends on the frequency, resources and the gates' activity (how many flips are generated), so the BIST module should be fine to stress the FPGA fabric in different conditions.

FPGA card power consumption on the installed HPE Moonshot chassis at Isère is not possible since it runs with the first version of the BSP.

Nallatech also worked a lot w/ HPE for providing a way to accelerate MICMAC code on FPGA:

- Only the ANN algorithm is used as a target for acceleration on FPGA fabric
- The current version (not fully optimized) can run faster than CPU version, but the initial results are lower (in terms of performance) than expected:
  - From an initial set of experiments (done by G. Renaud) it would be possible to gain more by instantiating 4 parallel kernels into the FPGA (the amount of resources consumed should be still feasible)
  - Some additional explanation provided in D6.8 and in D6.6

- Also, performance measurements don at CSI using an acceleration board based on the Nvidia P4 card:
  - Great performance improvement, but still requires some additional test:
    - It seems that only in the first part of the computation the GPU is used
    - Possible that this unexpected behavior is due by wrong settings.

Neavia is still proceeding with implementation and integration activity of the traffic monitoring software with the ULP device and the server side:

- The integration w/ YOLOv3 should be almost transparent
- It requires to understand the maximum frame-rate at which the server can work in order to calibrate the algorithm for tracking and counting bicycles
- It needs to discuss some detail w/ STM:
  - Better to set-up in the next weeks dedicated audio calls (STM, Neavia, ISMB, Nallatech)

Regarding innovation potential, the work is progressing and the 4th iteration has been started. More inputs expected from industrial partners.

Next deliverables are under control, and the ToC for each is expected by the end of the month as required by the coordinator (G. Urliini).

### 3.1.1.3 04-07-2018

#### Agenda

The agenda for this audio call is as follows:

- Offloading mechanism implementation:
  - System integration (NEAVIA + ISERE + ST):
    - NEAVIA software integration on ULP device (Orlando or SecSoC?)
    - Need to send the device to NEAVIA in order to complete SW integration
    - Integration w/ ISERE infrastructure
- Innovation potential:
  - Update on activities, open issues

#### Minutes

- Small recap of the situation (by ISMB) for the offloading mechanism implementation, to highlight the open points.
- Orlando board still under test on ST side.
- NEAVIA is waiting for the Orlando board, for starting porting the detection code on it, which should be sent by ST asap.
- NEAVIA signalled some issue in accessing the current board they already have in lab for testing.
- Understanding a kind of scheduling for the finalization of the whole offloading chain:
  - Next audio call, once received the board (Orlando -- ST), the estimation will be easy.
  - NEAVIA needs the access to the moonshot server in Iseré, also.
  - Need to ask to understand if it possible to access the measurement part/mechanism for power measurement.
- Innovation potential:
  - Is proceeding.
  - No specific issues signaled by CERTIOS.

### 3.1.1.4 18-07-2018

#### Agenda

The agenda for this audio call is as follows:

- Offloading mechanism implementation:
  - Update on the server installation and access
  - Update on the ULP implementation
- Any other open point

#### Minutes

Update on the offloading mechanism/architecture implementation:

- NEAVIA received the Orlando board along with the Nucleo board for starting developing on that (ULP side development of the offloading mechanism):
  - Repository with code/tool to flash the board with software
  - Open issue: need to understand where images are stored on board
- NEAVIA got the feedback from Isero for remotely accessing the Moonshot server and the FPGA:
  - Need to understand connection parameters (usr/passwd/ssh/vpn ?)
- YOLOv3 code with support for FPGA acceleration is online:
  - GitHub repository:
    - [https://github.com/daitarn4/accelerated\\_cnn/tree/branch\\_nalla/](https://github.com/daitarn4/accelerated_cnn/tree/branch_nalla/)
  - Need to give permission to NEAVIA to create a separated branch to load their code
  - NEAVIA asked to NALL to use also an online storage service (e.g., Dropbox) to share the weights used in the CNN to classify:
    - NEAVIA is planning (eventually) to use a reduced number of classes in order to improve the accuracy of the classification, just focusing on classes of interest for our use case
- TESEO confirmed that the cable connection between the SecSoC board and the mini-PC on the first test site is working:
  - Remote access is now available again for development purpose.
- Innovation potential activity: the activity and contributions expected from the partners are in line with the initial planning.

### 3.1.1.5 26-09-2018

#### Agenda

The audio call focuses on the following two main aspects:

- Status and progress of the offloading mechanism (server side HW/SW integration, smart camera sensor side SW/HW integration, etc.);
- Issues and open point regarding 'Potential Innovation' and the next deliverable (D2.8).

#### Minutes

The audio call started regularly. The two points scheduled for discussion have been addressed.

- Deliverable D2.8:
  - This deliverable is planned for the final release by the end of M36 (November), while the 1st internal review is scheduled by November, 1st. Thus, is necessary to push the partners, especially companies, to provides inputs:



- Ask to all the partners (push more company) to provide ASAP their inputs and contribution, and improvements to the ToC
- Refer to the online document:  
<https://drive.google.com/open?id=1E96kUw2PEqIPiorLT9Vt5mZ7wtLjRS9>
- This deliverable is deliverable is more focused on the exploitation of technologies and solutions set up and delivered in the project. So, less emphasis on which are the (potential) innovative aspect/technologies of the project, and more focus on how to exploit/explore them:
  - E.g., STM smart camera sensor (Orlando) + reconfigurable antenna, HPE Moonshot (actually the Edgeline server lineup), container migration (through the RDMA technology), Nallatech FPGA boards + Moonshot servers.
  - CERTIOS will present at INTELLEC-2018. The presentation is more in line with the expected content of the D2.8: the energy saving that potentially could be achieved by Europe, if data centers and company would use VDI-based technology as set up in OPERA (i.e., containerization/SaaS, container migration, energy-aware orchestration, heterogeneity within the data center).
- Status of the offloading mechanism implementation:
  - NEAVIA (D. Barbot) is trying to build the CNN YOLO-v3 as provided (latest version) by Nallatech (R. Chamberlain), but some issues have been experienced:
    - Remote connection w/ the ISERE Moonshot server is not working properly
  - NEAVIA has done some preliminary test of integration of its traffic monitoring tool with the YOLO CNN (older version than v3), but some work is still required to integrate the v3 with acceleration:
    - Ask to HPE (R. Gallig) and Nallatech (R. Chamberlain) for support.
    - There are two versions available of the software:
      - Tracking mode enabled: this should receive the stream of frame from the ULP device and processing them (it strictly depends on the availability on the test site -- test site 2 -- of the STM Orlando device);
      - Alone mode: in this case the system should be able to process frames already stored on the Moonshot. This should be the final version of the demonstrator (easier to setup and showing capability of the software) => we will ask to ISERE to provide a set of reference frame and a small recorded stream for testing purposes and demonstration. The reference frames should be in the range of 25-30 to have a good statistical relevance in terms of accuracy of detection.

### 3.1.1.6 10-10-2018

#### Agenda

The audio call focuses on the following two main aspects:

- Status and progress of the offloading mechanism (server side HW/SW integration, smart camera sensor side SW/HW integration, etc.);
- Issues and open point regarding 'Potential Innovation' and the next deliverable (D2.8).

#### Minutes

The audio call started regularly (the time schedule was postponed at 16.00-CET). The two points scheduled for discussion have been addressed.

- Almost all the open points regarding the implementation of the offloading mechanism have been solved. Two operating modes are available:
  - Tracking mode (on-line): this mode uses frames directly received from the ULP device to run the image processing.
  - Offline mode: this mode relies on a set of frames already loaded in a specific location on the moonshot server. This will be, most probably, the way we will demonstrate the server image processing and group of bicycle counting.
  - Still need to create the data set of reference frames and video stream for the demonstration purposes. Put pressure on Isere (J-C. Maisonobe)
- Deliverable D2.8 is in a good state, but urgently needs inputs from partners, especially industrial ones.
  - ISMB as WP2 leader will send an email to request contributions.

### 3.1.2 WP3

#### 3.1.2.1 2018-04-10

##### Minutes

###### Site 1

The box will be unmounted and checked in lab. Unmounting is planned for tomorrow (11/4/2018), an intervention by TESEO is planned. To be confirmed. With this intervention, it would also be possible to replace the prototype of SPI interface board with a more stable HW (TESEO).

Evaluation of the issues of the connection between RX Raspberry and Moonshot server (ISMB/ISERE).

An intervention by ISMB (April 23<sup>rd</sup> or 24<sup>th</sup>) is needed in order for checking the communication.

The availability of NEAVIA is required, at least remotely, in order to check the functionality of the new system. The presence of ST is not strictly required, but ST will try to do their best to be present.

###### Site 2

TESEO and ISERE should share the mechanical installation plan.

ST trained the Pico Yolo CNN for detecting bicycles.

Proposes dates for installation are the weeks of May 14<sup>th</sup> or 21<sup>st</sup>.

###### Power measurement

The deadline for power measurements for the whole chain with reconfigurable antennas (ISMB) is defined by the D4.3 deliverable. A list of tests should be defined. The deadlines for this contribution will be defined by NALLATECH and he will be included in all the next discussions on this topic.

###### New topics

Test site 3. Initially it was planned for June 2018, but it is very difficult to respect this deadline. ISERE's proposal is to have another installation like the site 2, on the road to Alpe d'Huez, on a track of Tour de France. If we will be able to install it before the Tour, that will start the July 7<sup>th</sup>, we can use the Tour for testing the detection.

In this case we will not have a wired network to transmit data to the server, so we need a 3G connection attached to the receiver. ISMB suggested to have an Ethernet cable for connecting the RX Raspberry to the 3G router.

### 3.1.2.2 2018-04-24

#### Minutes

Some of the invited attendees were not present because in Grenoble for fixing the last issues of the first installation site.

ST gave an update on status of bicycle detection application on Orlando:

- Training done
- Obtained weights are being processed for respecting the format Orlando requires

TESEO confirmed that all the problems of the SecSoC in site 1 should now be solved. The circuitry for turning on and off the Nucleo board with the WiFi module and the antenna is still to be developed.

NALLATECH asked to know the version of the Coco Dataset used for training the PicoYOLO, and the classes of objects that must be learned, to be sure they use exactly the same set of images and parameters for training the complete YOLO network. ST promised to send this information quickly.

### 3.1.2.3 2018-05-07

#### Minutes

It has been decided that CRC will not be checked between SecSoC and Nucleo on test site 1 but only between TX side and RX side.

Power switch for Nucleo + antenna is still not available in test site 1.

Installation of test site 2 will be done starting on Tuesday May 15th as programmed.

### 3.1.2.4 2018-05-22

#### Minutes

##### *Test site 1*

Completed the setup of the new MiniPC, fully functional and verified.

The full communication chain has been successfully tested from the SecSoC to the Moonshot server.

Still pending:

- Installation of new corrugates able to resist at the adverse weather conditions
- Installation of a USB cable for the connection of the Nucleo to the miniPC on the TX side
- Check of the lens, the received image is blurred

##### *Test site 2*

The communication from TX Nucleo transmitter to RX Raspberry and Moonshot has been tested.

The ability of Orlando to detect bicycle has been tested stand alone.

Still pending

- Test of the Orlando connected to the Nucleo
- Test of the full communication chain
- Evaluation of the remote control of the Orlando, actually difficult due to the design of the board

It has been specified that software for SecSoC and Orlando will be developed in WP3 and software for Moonshot will be developed in WP2.

### 3.1.2.5 2018-06-21

#### Minutes

### *Discussion on Deliverable D3.4 and update on the status*

The deliverable draft has been released to the consortium. The contributions from the other partners are urgent due to the incoming holiday period.

#### *Report on Orlando status*

The pico Yolo network currently detects bicycles, provides the instant value about the number of cycles detected (in each frame), and provides a confidence level of detection for each bicycle.

The implementation of the offloading decision is still missing. ST proposed a 'training on the job' to NEAVIA, at ST premises. This option will be evaluated and discussed in the next days.

On the communication side the tests conducted showed a successful communication with Nucleo and Wifi module. A final joined session of development should be organized in ISMB for the finalization.

#### *Decision on final configuration of test sites*

ISERE presented the proposal for the final configuration of the test sites 1 and 2.

For installation issues, it is preferable to install the autonomous system (with solar panels) on test site 2, even if the Orlando board, unlike the SecSoC board, has not been designed for low power consumption (only the Orlando SoC is ULP, not the board). The test site 2 in this case will demonstrate our capability to provide in any case an autonomous system. The measures that will be provided in this case will be done in lab, and related only to the SoC consumption.

On the test site 1 a full measurement will be conducted on the field.

#### *Inclusion of power saving descriptions from other documents (D4.3)*

There is a remark from NALLATECH that deliverable D4.3 will include power saving descriptions from other deliverables, introducing some repetitions.

#### *Action points*

ST to add the holidays to the calendar and request the same to the partners

Discussion with ISERE for planning the installation of autonomous system

Plan a visit in ISMB for debugging the Orlando integration

### **3.1.2.6 2018-07-06**

#### **Minutes**

##### *Site 1*

The problem appears to be due to the 2 USB cables. Existing cables are 12 meter long, with a repeater in the middle. They are no longer working. New 20 meter cables (with repeater) do not work (probably they are too long). For test, the SecSoC was connected to a shorter (1 m) cable and worked correctly. A proposal is to move the mini PC to the top of the pole, in order to have a shorter USB cable. Another proposal is to check if 12 meter USB cables can be available soon, and use them at least as temporary solution. Any new USB cable can be tested in lab before going to the installation site.

##### *Site 2*

A problem is apparently related to GPIO cables and steering part supply which, when connected to the WiFi module, prevent the Orlando + Nucleo + WiFi module from working correctly. Many tests have been done on site on July 3rd and this is probably one of the cause of malfunction. ISMB has been asked to provide ST with a complete electrical characterization of the switch and steering part that is connected to the WiFi module, to understand if this can be sustained by Orlando + Nucleo + WiFi module. ISMB should send to ST all the items necessary for reproducing the problem.

Orlando + Nucleo + WiFi module connected to the antenna without the steering part worked correctly, the packets were sent to the RX side, but the packets were not received by the MoonShoot server. Isero has been asked to perform some simple tests of the connection between the RX Raspberry and the MoonShoot. This connection worked some weeks ago but a new test is now necessary after the results obtained on the field.

It has been proposed to spend some days (first week or second week of September) in Grenoble for fixing all installation problems, but before that date all possible problems must be tested/fixed in lab.

Currently, now both sites are not working. NEAVIA asked to fix those problems soon, the other partners replied that they will do their best to try to solve at least the problems of site 1, but this also depends on the supplier of USB cables. NEAVIA also asked to have Orlando + Nucleo installed on test site 2 before August to take real videos from the scene. ST replied this is hardly possible because they prefer to have everything working correctly on the Orlando side before installing the board, to avoid physical intervention each time the Orlando FW must be updated. ST proposed to use videos taken by Isero or someone else on the site, even if they will be different from the ones Orlando could take, but this is a possible temporary solution. NEAVIA should receive Orlando + Nucleo soon for use in their labs.

### **3.1.2.7 2018-07-17**

#### **Minutes**

It has been agreed that ST will go to ISMB site to check existing problems between Orlando boards, Nucleo, WiFi module and antenna before going to Grenoble on August 1st.

TESEO will check USB cables before going to Grenoble on August 1st. Also, it will propose a solution for locking the box that will contain the Orlando to prevent it from being opened. Without this, ST explained that the Orlando board cannot be left in the box unattended.

NEAVIA asked some questions about the protocol used by the Orlando to send the packets to the Nucleo. These questions will be answered by email by ST.

### **3.1.2.8 2018-08-28**

#### **Minutes**

TESEO asked ST details about the GPIOs that could be used on the SecSoC for enabling turning on/off the radio.

TESEO was asked to provide the functionality to turn on and off the radio by using GPIOs on SecSoC by next meeting in Grenoble beginning of September.

NEAVIA says current situation of test site 1 is complex to deal with because the firmware cannot be updated remotely since the conditioning board (necessary for this purpose) is in TESEO labs because it needs to be fixed after problems found on site.

TESEO found the problem of the conditioning board of test site 1 being due to two wires which are not soldered correctly.

TESEO devised a possibility to lock the box of test site 2, which could allow ST to install the Orlando board there.

A proposal for the agenda (related to WP3/WP7) of next meeting in Grenoble beginning of September was drafted during the call.

### 3.1.3 WP4

#### 3.1.3.1 2018-04-30

##### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components SecSoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- NALL is in charge to collect input - status?
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

##### Minutes

- Minutes previous call

No comments.

- Task 4.2 progress in memory management, progress in application profiling

A discussion started around the datasets. The datasets available to Technion are too limited now it looks like these sets are not gaining anything from mounting the sets to the FPGA, Idan asks what datasets Neavia is using? According to Damien NEAVIA is not using MicMac. Richard has seen other datasets from MicMac, from HPE. Richard also wrote some software himself in order to speed up the Micmac on the FPGA. That will be ready this week. Working with ANN, Richard is making optimized algorithms for acceleration of FPGA. Dirk suggests that Idan could use the same datasets for the memory mapping. The conclusion was that HPE, Nallatech and Technion continue to work on these matters by finding each other in the coming weeks and exchange progress.

- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input).

Power management can start as soon as the measurement data from the use cases are available. We need to catch up with the data collection. Richard is attending the other WP calls in order to keep an eye on the progress regarding this aspect (measurements). There are no worries for exceeding deadlines yet. Dirk indicates that he just received measurements of antenna energy use (Dirk will send it to Richard and Simone). See the published D7.2, lots of data in tis deliverable.

- Task 4.4 progress in interconnect development and energy measurements.

Not a lot of developments to discuss/report. IBM is trying to get the RDMA working, indirectly enabling to make the measurements.

#### 3.1.3.2 2018-05-14

##### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]

- use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
- use case traffic management (status measurements components SecSoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- NALL is in charge to collect input - status?
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No reactions with regard to minutes previous call
  - Task 4.2 progress in memory management, progress in application profiling.
- Task owner Technion is still happy with the progress and timelines even though we couldn't hear Idan well. In the chat box his remarks were promising: Idan expects to inform us on tangible results soon. All things that were discussed last meeting are progressing. Nothing new to report.
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)

Measurements are coming in. Task owner Nallatech is still happy with the progress and timelines.

Task 4.4 progress in interconnect development and energy measurements. Task owner Joel (IBM) didn't attend this meeting, so no 'latest news' item here.

#### 3.1.3.3 2018-06-19

##### Agenda

Task 4.3. progress in measuring the effect of efficiency measures.

##### Minutes

This call is used to discuss status and progress in D4.3 specifically and any issues that prevent progress. Richard explained that the real work on compiling the results from the use cases is just beginning since the use cases are ending. All partners have considerable effort allocated to 4.3, a serious concern is an overlap and duplication with other deliverables (WP7 use cases). Especially when we consider the remarks of the reviewers in a midterm review, D4.3 must not only report the efficiency but a measurement methodology, the effect of the energy efficiency methods and relation with the development cycle.

As proposition we can:

1. Mention on D4.4, the fact that the deliverable was plan for an FPGA interconnect plus measurements and due to the Altera-Intel issue, it was not possible to provide some measurements.
2. A proposition will be to put on D4.3 all measurements, methodologies and analysis coming from use cases, Certios analysis.
3. For the D4.4 describe as contribution the workload migration among heterogeneous machines (mention by Joel).

We can envisage a light overlap.

#### 3.1.3.4 2018-06-25

##### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]

- use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
- use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

### Minutes

- No comments to the minutes of last meeting.
- Task 4.2 Progress in memory management, progress in application profiling.

Working on the deliverable table of content. Question: do we need to repeat the content of the intermediate results, or only new content? Olivier: Integration is needed, but the method is by referencing the intermediate document. The energy harvesting work has seen many changes from the initial assumptions. Details should come from ISMB and TESEO (Roberto and Simone). Please keep Olivier and Jean Christoph in the loop through copying in the Email.

- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input).

Richard Chamberlain could not be in the call today, we had a lengthy call last Monday to discuss status and progress. There has been extensive Email going around, A serious concern is an overlap and duplication with other deliverables. (WP7 use cases). Especially when we consider the remarks of the reviewers in midterm review, D4.3 must not only report the efficiency but a measurement methodology and relation with the development cycle.

- Task 4.4 progress in interconnect development and energy measurements.

Progress is on track, as presented in the F2F the protocols RDMA and IP have been implemented on the ConectX5 card. Issue: Overlap in D4.3 and D4.4. This is a critical issue between D4.4 and 4.3. A comparison between 2 protocols for connecting the heterogeneous systems (IP and RDMA). The Connetix5 should be good for this. Cross-platform compiler is not able to work with Power, but is able to work for intel and ARM Post copy migration might work FROM Intel to ARM.

- Actions points

DHH: setup a dedicated between Richard, Joel, Alberto, Dirk to resolve the issue.

- Closing remarks

Quality of both D4.3 and 4.4 need to be guarded, strategy needs to be determined ASAP. Need to provide Summary and table of contents before the next WP4 call. State of the art can be described now, strategy can be discussed. Define additional measurements if needed.

Overlap D7.3 with 4.3; 4.3 defines the methodology for measuring, D7.3 acts on this methodology.

### 3.1.3.5 2018-06-27

#### Agenda

Resolution of overlap D4.3 and D4.4:

1. Quality of both D4.3 and 4.4 need to be guarded, the strategy needs to be determined ASAP
2. Closing remarks

#### Minutes

The issue was clarified, to recap the call and elaborate on what D4.3 will contain: The strategy adopted for the D4.3 is to focus this document on "The argued for and chosen methods, models and ways to define and monitor energy efficiency will be proven." The reality is that there is only one model, namely, the input queue length as an indicator of efficiency. The applicability of this model and the theoretical results are proven and discussed in WP5, D5.7 specifically (by Alberto).



D4.3 will therefore focus on proving that our way of monitoring energy efficiency works, and the methods used to achieve energy efficiency are effective - the methods used are grouped per use case:

#### Truck use case:

The Truck use case primarily focuses on the use of heterogeneity. Several experiments were run: photoscanPRO on old system as the baseline

- photoscanPRO without hardware acceleration;
- photoscanPRO with GPU acceleration;
- MicMac without acceleration;
- MicMac with FPGA acceleration.

Both the results and the details of how these experiments were conducted, are part of D4.3.

The GPU, unlike the FPGA card, has no power monitoring capabilities, all measurements have been derived from total systems measurements. The experiments do however show that heterogeneity is an extremely important method for achieving both speeds as well as energy efficiency. The measurements performed with the communication applications in the same truck use case show that the addition of heterogeneity does not have a severe adverse effect other application running on the same hardware.

#### Traffic management:

The traffic management use case shows a combination of many methods that were suggested in D4.1

- Heterogeneity;
- power management;
- workload management;
- directional antenna use.

The baseline was determined for both a single camera as well as a total system baseline by examining the current setup of the traffic management center in Grenoble. Component measurements during the course of the project (the traffic congestion detection) showed that the energy use (power draw) of the SecSoc board was minor compared to the energy used by the communication logic. From this, three critical design decisions were made:

1. power should not simply be supplied through the USB interface on the SecSoc board. Care should be taken that the USB logic on the board is not powered since this logic consumes considerable amounts of energy;
2. to not make the camera reachable from the TMC, the camera only sends information;
3. to power down all communication logic when is being sent.

Experiments showing the performance of the camera in the field still have to be done, this will be combined to show autonomy by installing solar panel and battery on the current test site 2 and measuring power draw vs time during the camera bicycle counting test. The workload management feature of the camera is proven by the offload estimator; in the bicycle counting use case. The application logic will determine that an image is complex and start the offload process.

The decision to do this is based on the fact that the Camera, in order to be autonomous (see D4.2 energy harvesting) needs to stay significantly below 1 Watt average power draw. Analysis of complex images would require the implementation of the full YOLO v3. For this, more CPU power and memory would be needed. The electronics supporting these requirements would simply require too much power (this needs to be verified - Richard).

The offloading itself is again an implementation of heterogeneity (running YOLO on FPGA) measurements on the performance of the Moonshot with FPGA analysing complex images to obtain bicycle count still needs to be performed (Richard), using a directional antenna improves energy efficiency for medium distances and enables long distance communication.

The directional antenna is able to setup WIFI connections over up to 1 km distance. The energy used for long distance communication should be compared with a conventional antenna. Measurements of antenna gain might exist, but details of this need to be included in D4.3. Best image to show would be a power VS distance chart. Richard, check whether this data exists and if it is experimental or theoretical. End of the line the antenna performance should be given in bytes/Joule (check with 4.1).

### The VDI use case

The VDI use case was setup to demonstrate workload management in a heterogeneous environment. It also uses modern power management features that are a part of the Moonshot system. This last part is shown by the power draw in idle situation, but these features are not a part of the OPERA development. The object of OPERA is to be independent of these features and further lower the depth of the (near) IDLE power draw situation by moving applications in this situation (where input queues are empty) to a very low power system of low capability. The near idle workload might still generate a measurable CPU load on this low capability system.

In order to demonstrate this, OPERA (co)developed:

1. a cross platform compiler; this is not a direct energy efficiency method but is needed for the ability to do postcopy migrations over heterogeneous nodes. The working of the cross compiler was published
2. we developed a workload manager WP5, the working is detailed in D5.7
3. we developed a method for postcopy migration
4. we developed a communication channel based on FPGA (ConnectX) this was originally supposed to be on the Nallatech FPGA card using the serial interconnect

Richard, this is where you need to detail the serial interface link power usage, as stated this experiment remains to be done

- This is also where the modified Riser card used to do power measurements on the connectX need to be described as well as the experimental method to determine the effect of the Protocol on the transfer cost of an application. All details for this rest with Joel. After that, all details will appear in D4.4, final conclusion (with reference to D4.4) can be included in D4.3. D4.1 states that a protocol choice is a method for energy efficiency thus the prove of this method should also feature in D4.3. The discussion on why CAPI was not used should be part of D4.4 (if not published earlier). Experiments on postcopy migration over IP and RDMA still need to be done, but Joel is very well positioned to conclude this in the near future. The VDI case has done experiments using load generation and also instituted measurements of the production environment.
  - the production environment forms the baseline, Richard to chase details;
  - experiments using moderate load on the Moonshot platform using the containerized applications generated with the cross-platform compiler. This is a homogeneous system test, Richard to chase details;
  - after analysing this test, it was deemed to be unfavourable to the OPER project, the Moonshot was tested with a similar load as the production environment and was thus very underutilized. As a result, the load generator was used to its maximum, leading to a new efficiency number for the VDI case, but still on X86 only. Richard, be careful here because in the F2F Haifa this was presented, but the reported number contains a linear extrapolation of lower load numbers. The linearity needs to be argued, as it cannot be proven... ;
  - Additional experiment is needed to show the effect of heterogeneity:  
I propose to use the same application suite compiled for ARM containerised and running on a ARM platform (or Moonshot cartridge) and measuring again from low load to medium load (CPU max 60% level) This experiment is a new addition and needs to be communicated to CSI.
- Actions points  
@Joel, please inform CSI in the WP5 call about the need for an additional (unplanned) experiment.

### 3.1.3.6 2018-07-09

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No comments to the minutes of last meeting.
- Task 4.2 (Idan, Technion) Not present in the call
- Task 4.4. (Joel, IBM)

Work on the PCI interposer will be completed before this holiday. Pagefault demonstration will also be completed this month.

- Task 4.3, Richard Chamberlain, Nallatech)

Previous action points for DH Harryvan:

- 1) setup call between Richard, Joel, Alberto, Dirk.
- Quality of both D4.3 and 4.4 need to be guarded, strategy needs to be determined ASAP. Need to provide Summary and table of contents before the next WP4 call. State of the art can be described now, strategy can be discussed. Define additional measurements if needed. This action has been taken, the overlap has been resolved..
- 2) Set up call between JC, Richard, Dirk to discuss possible overlap D7.3 with D4.3

Call with Isere has been concluded: 4.3 defines the methodology for measuring, D 7.3 acts on this methodology and presents results only. This action has been taken, the overlap has been resolved.

Current status: a new setup for D4.3 has been published on Google drive for review. This document contains the base documentation for the measurements in the Traffic Management Use case Review by D.H. Harryvan and J.C. Maisonobe still needs to be done, a possible delay caused by both of them being on holiday in July.

- Action point

Richard to chase VDI experimental results

- Closing remarks
- Additional question from Damien: Who is responsible for power measurements in the traffic management use case:
  - Moonshot measurements: Isere;
  - Lab measurements: lab owner (ISMB for the ISMB lab etc.);
  - FPGA measurements on CNN acceleration: These need to be done on the latest version of the FPGA, inside Nallatech lab. Therefor Nallatech is responsible for these experiments and measurements.

### 3.1.3.7 2018-07-23

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No comments to the minutes of last meeting.
- Task 4.2: Idan was not participating in the call. We skipped this task.
- Task 4.3: Richard is still chasing Luca for containerization input, and is waiting for input from Idan. Even though Damien was on the call, he couldn't be heard, unfortunately; Richard raised the issue of who is responsible for the power measurements of the design: ST or Damien? This issue needs to be resolved and Richard will be in contact for that.
- Task 4.4: Joel was not on the call. We skipped this task.

### 3.1.3.8 2018-08-06

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No comments to the minutes of last meeting.
- Task 4.2 and 4.3.

Task 4.2 is almost ready, Idan is mostly busy with WP5; action Idan and Richard to decide if any 4.2 results will be reported in 4.3. Current status: issues with power monitoring of the FPGA card were identified and resolved. Measurement results are expected this month. Additional measurements on the VDI use case using an ARM cartridge are delayed due to holiday, Action Richard, to keep pressure on.

- Task 4.4

Joel is on holiday from august 2nd until august 22nd. Work on the PCI interposer was to be completed before this holiday. Pagefault demonstration was also to be completed this month. Current status unknown.

### 3.1.3.9 2018-08-21

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No comments to the minutes of last meeting.
- Task 4.2 (Idan, Technion)

The task is almost ready, Idan is mostly busy with WP5. Action Idan and Richard: to decide if any 4.2 results will be reported in 4.3.

- Task 4.3, Richard Chamberlain, Nallatech)

Current status: issues with power monitoring of the FPGA card were identified and resolved. Measurement results are expected this month. CNN and ANN code power measurements on the FPGA have been conducted and are reported in the D4.3 document. Minimum power (only the BSP running) 23 Watt, max around 45 Watt. The discussion in this call centred around the possibilities to completely power down the PCIe slot. The reason is similar to the reason for shutting down the antenna in the ULP camera. The power to the card is high compared with the power use of the Moonshot cartridges. Thus, keeping the possibility for (near) instantaneous container migration result in a relatively high power draw of the system. (the cluster will have 2 FPGA cards. It is unlikely that the advantages of container migrations in terms of power and energy outweigh the disadvantage (power) of having the two FPGA cards in the cluster.

- Additional measurements on the VDI use case using an ARM cartridge are delayed due to holiday, Action Richard: keep pressure on.

This action was taken, but resulted in the observation that the ARM cartridge is not the lowest energy platform. Another option will be discussed in the next VDI call. Richard released a document framework for D4.3 highlighting what contribution needs to come from who. Overall, Richard is confident that the task is on track.

- Action points:

Dirk to comment on the D4.3 framework; Richard to comment on the Intelec paper from Dirk.

### 3.1.3.10 2018-09-03

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)

- use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
- use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
- use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

#### Minutes

- No comments to the minutes of last meeting.
- Task 4.2

Task is almost ready, Idan is currently collating all contributions. Idan summarized today's 4.2 related issues in Email:

1. I noticed that you're waiting for some feedback from TESEO feedback, so I suggest that TESEO will be the 2nd reviewer for this deliverable. Giulio: currently STM is the 2nd reviewer for deliverable 4.2. Can you please update the reviewing plan and switch STM and TESEO for D4.2?
2. The currently installed transmission module operates at quite low rates: 50 kbps rather than 1 Mbps as we expected. This inefficiency reduces the autonomous time from seven to five days. Unfortunately, we don't have enough time to identify and fix the problem. We thus agreed that D4.2 should clearly explain that, while there is still room for improvement in the current antenna module, the energy harvesting module meets the specifications we defined.
3. ISMB+TESEO+ISERE are working on the last integration and testing activity and should be able to finalize their part of D4.2 by the end of next week. ISMB & TESEO: we will send the camera-ready version of D4.2 by September 15. Please be ready for reviewing the deliverable as quickly as possible.

- Task 4.3

Richard released a document framework for D4.3 highlighting what contribution need to come from who. Input is being received from all partners. Overall, Richard is confident that the task is on track.

- Task 4.4

The PCI interposer does not work, giving the time left in the project the work on the interposer is abandoned and the use of the card is assumed to be independent of the protocol used. Joel Nider (IBM) sent draft version D4.4: other than previously expected, there is no energy advantage of varying protocols. Theoretically, CAPI might have brought an advantage and this is discussed in 4.4.

- Action points
  - Dirk to send Email to Giulio about measuring camera energy use in field
  - Dirk to read and comment on D4.4.

#### 3.1.3.112018-09-17

##### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]

- use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

### Minutes

Today we have focussed on the state of the deliverables.

- No comments to the minutes of last meeting.
- Task 4.2

Task leader Idan finishes the final version today. Reviewer will be ISMB. Simone and Alberto will execute this task. According to Olivier the review has already started. All is on time.

- Task 4.3

Task leader Richard is waiting for ST to add contribution. Only after receiving this, Certios will be able to contribute the conclusion. Richard has escalated this issue with Giulio, since last week, several times.

- Task 4.4

Task leader Joel is not joining the call, but we all have seen the document to being sent around, and it is in the review state.

### 3.1.3.122018-10-01

#### Agenda

- Minutes previous call
- Task 4.2 progress in memory management, progress in application profiling
- Task 4.3 progress in measuring the effect of efficiency measures (Timelines D4.3 and further assign input)
  - use case Truck (status MicMac profiling and acceleration) [linked to "heterogeneity" through FPGA]
  - use case VDI (status load generation >4000 users) [linked to "heterogeneity", "power aware workload management", and "high speed interconnect"]
  - use case traffic management (status measurements components secsoc/antenna) [linked to ULP, heterogeneity, reconfigurable antenna]
- Task 4.4 progress in interconnect development and energy measurements
- Actions points
- Closing remarks

### Minutes

This is the final WP4 online meeting. All of the WP4 deliverables have been delivered.

- No comments to the minutes of last meeting.
- Task 4.2: Deliverable submitted.
- Task 4.3: Deliverable submitted.
- Task 4.4: Deliverable submitted.
- Action points:
  - previous action points:
    - Dirk to send Email to Giulio about measuring camera energy use in field : Done
    - Dirk read and comment on D4.4 : Done, also done by Dirk as 3th reviewer for D4.2 and D4.3
  - new action points:
- Closing remarks

Since all WP4 deliverables have been submitted, it has been decided to stop the WP4 bi-weekly calls. All persons attending do have a role in WP2, specific action is requested from the WP4.x leasers to start

contributing to the final version of the innovation potential found on google drive under WP2/WP2 deliverables/2.8.

### 3.1.4 WP5

#### 3.1.4.1 10-04-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)

##### New

- Technion: on schedule
  - Completed the memory allocator code (based on dlmalloc)
  - There is an open issue with the loader (ld) - order of initialization
  - Even the loader itself calls dlsym which can call malloc, which is not yet initialized yet!
  - To avoid this issue with existing memory allocators, the loader (ld) always loads glibc first
  - Also the implementation in C++ causes additional issues
  - The library will back memory areas with huge pages (2MB or 1GB instead of 4KB) - this will save TLB misses
  - Using profiling tools to analyze under various page sizes & conditions
- IBM: discovered bug in PPC64 implementation of Mellanox ConnectX-5 driver
  - Driver works ok on x86, so we will continue our development on that arch
  - Mellanox is starting to debug on PPC64
  - We are now focusing on integration of user-space RDMA implementation into the CRIU tool to support remote page faults during post-copy migration
- CSI: everything ok
  - Working with ISMB to generate TOSCA descriptor - biggest outstanding issue
  - Have already completed the 2nd cycle measurements

#### 3.1.4.2 03-05-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)

##### New

- Technion: Still some loading problems (dlsym can call malloc) - this is the current issue being worked on
  - Building a model based on their tool (Memomania)
  - Planning a publication at ASPLOS (August deadline)
- CSI: nothing outstanding at this time
  - IBM to decide on delivery date for containerized version of OpenXchange
- ISMB:
  - Integrated containerized version of OwnCloud into OpenStack (for managing the instances)
  - Will provide a TOSCA descriptor for this application
  - Simulator: tested first version of allocation policy (greedy strategy)
  - Used CloudSim+ to test (power-aware) policy vs current OpenStack allocation strategy
  - Paper accepted to CISIS on this topic

#### 3.1.4.3 17-05-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)

##### New

- Technion: has challenges making their malloc implementation thread-safe



- After that, it will be ready for integration with ISMB
- Still aiming at ASPLOS publication, after which time the code should be made public
- IBM: Mellanox has fixed the problem with the RDMA kernel API
  - We are now free to progress on both the user-space implementation as well as the kernel implementation of remote page faults over RDMA
  - Both implementations are 70-80% complete

#### 3.1.4.4 14-06-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)
- 3 months left before D5.6, D5.7, D5.8, D5.9, D5.10

##### New

- ISMB: TOSCA file for OwnCloud nearly complete (T5.1 + T5.4)
  - Default scheduling policy (from OpenStack)
- ISMB: Simulation (T5.2)
  - Using same TOSCA file
  - Workload consolidation - dynamic reallocation of application components
  - Deployment on testbed is dependent on simulation results
- IBM: completed PoC of remote page faults in kernel mode + user mode (T6.5)
  - Working on containerization of OpenXchange (to be delivered 06/28) - check if it is possible to use LXC rather than LXD for compatibility with OpenStack (T5.1)
  - Working on integration of user mode RDMA page faults with CRIU (T5.4)
- Technion: finishing memory allocator (T5.5)
  - Still some bugs to fix
  - Will be ready in approximately 1 week
  - Next step to collect results
- CSI: OpenXChange in 2 weeks is ok - next step to install & take measurements

#### 3.1.4.5 28-06-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)
- 3 months left before D5.6, D5.7, D5.8, D5.9, D5.10

##### New

- All ToCs for upcoming deliverables have been completed and uploaded to GDocs
- TECH: implementation complete (!) starting to run experiments
- IBM: Completed instructions for OpenXchange - delivered to CSI
- CSI: will start to look at containerization doc (OpenXChange)
  - Will check to see if there is a problem to run on additional architectures (i.e. ARM)
- IBM: will start containerization of LibreOffice (hopefully soon - working hard on other tasks such as 6.5)
- Richard - needs input for D4.3
- ISMB - couldn't join because of travel to ISC

#### 3.1.4.6 12-07-2018

##### Agenda

- Status (TOSCA, simulator, malloc, containerization)
  - TOSCA file for OwnCloud
  - Simulator
  - Containerization/CRIU
  - malloc

- 2 months left before D5.6, D5.7, D5.8, D5.9, D5.10

#### **New**

- CSI couldn't attend because of summer vacations
- Technion writing towards ASPLOS submission w/ initial results
- TOSCA integration w/ OwnCloud
  - TOSCA file complete
  - Facing integration issues with version of OpenStack installed @ CSI vs. translator module
- Integrating greedy strategy for initial container allocation
  - Already have results from the simulation
  - Working on integration with OpenStack
  - Also looking at algorithm for dynamic balancing - a derivative of swarm algorithm (PSO)
- IBM close to integration of RDMA page faults with CRIU tool (user space implementation)
  - Investigated kernel implementation as well, but working on one at a time

#### **3.1.4.7 26-07-2018**

##### **Agenda**

- Status (TOSCA, simulator, malloc, containerization)
  - TOSCA file for OwnCloud
  - Simulator
  - Containerization/CRIU
  - malloc
- 2 months left before D5.6, D5.7, D5.8, D5.9, D5.10

#### **New**

- IBM: Completed integration of server side RDMA with CRIU
  - End-to-end migration is working (Redis KV-Store)
  - Next step: taking measurements
- ISMB: TOSCA for OpenExchange - Francesco is reporting problems automating installation
  - Cannot make snapshots of containers running on OpenStack, which are required
  - Francesco will give a more detailed description of the problem to see if we can find a way around it
  - Alberto is working on the dynamic load balancing solution - has some preliminary results on the simulator (250 node data center)
  - Need to see how to integrate dynamic balancing into Francesco's module
- CSI: Having problems installing Ubuntu 16 on ARM (currently Ubuntu 14 works) - not sure if this is enough for OpenStack - investigating and working with HPE

#### **3.1.4.8 23-08-2018**

##### **Agenda**

- Status (TOSCA, simulator, malloc, containerization)
  - TOSCA file for OwnCloud
  - Simulator
  - Containerization/CRIU
  - malloc
- Deliverables due now! D5.6, D5.7, D5.8, D5.9, D5.10

#### **3.1.4.9 06-09-2018**

##### **Agenda**

- Deliverables due now! D5.6, D5.7, D5.8, D5.9, D5.10

#### **New**

- **5.6**

- Francesco will provide the last missing point
- 
- **5.7**
  - ISMB is looking how how to do the final integration
  - Contributions will be ready in a few days (by Sunday?)
- **5.8**
  - ISMB started, asked for contributions from IBM
- **5.9**
  - ISMB started, received contributions from IBM
- **5.10**
  - Already submitted paper to ASPLOS - waiting for response
  - Doing final changes to D5.10 - will be ready on time
- CSI:
  - Doesn't have the mellanox cards
  - Also can't change OpenStack
- Certios
  - We still must ensure that we test on the ARM platform for WP4 (more on this later)

### **3.1.4.1020-09-2018**

#### Agenda

- Deliverables due now! D5.6, D5.7, D5.8, D5.9, D5.10

#### New

##### **5.6**

- Got the review from Certios & Olivier - preparing final version now (release on Monday for final comments/additions)

##### **5.7**

- ISMB added more contributions - needs to be copied to Word
- Still waiting for internal reviews

##### **5.8**

- ISMB has submitted for internal reviews
- IBM to review on Sunday
- Gallig@HPE will do the review too

##### **5.9**

- ISMB has submitted for internal reviews
- Gallig has already reviewed
- Preparing next version now

##### **5.10**

- Technion submitted for review
- Damien@lacroix has reviewed & sent comments
- Preparing for 2nd review

### **3.1.5 WP6**

#### **3.1.5.1 2018-04-03**

#### Agenda

- Review progress of MICMAC acceleration

#### Minutes

- Nallatech has created a simple brute force approach for ANN acceleration, that should yield some performance improvement over the existing code. This will be the minimum solution for accelerating MICMAC, but will be limited in performance by the structure of the MICMAC code. Solution has been simulated but not yet implemented on hardware. Final acceleration to be determined.

### **3.1.5.2 2018-05-02**

#### **Agenda**

- Present update of MICMAC code to group.
- Check status of tasks for all partners.
- AOB

#### **Minutes**

- HPE/NALL have the FPGA code integrated into MICMAC software and running on Moonshot server Grenoble. Functional testing ongoing to be complete soon. Plan for testing FPGA code to be drawn up by HPE for presenting initial results at F2F in Israel. HPE are updating the technical MICMAC report.
- IBM still waiting on kernel space fix for RDMA transfers by Mellanox.

#### **Actions**

- Ask CSI to send full MICMAC data sets to Idan for workload testing.

### **3.1.5.3 2018-05-14**

#### **Agenda**

- Review actions from last meeting
- Verify status of MICMAC port
- AOB

#### **Minutes**

- NALL have updated approach due to original approach being invalid for most cases! Replaced with a brute force approach. Should still be of reasonable performance, however accuracy is significantly improved over original.
- Mellanox has fixed the problem with kernel driver.

#### **Actions**

- NALL to test power monitoring ARM software and pass over to Vlad for full testing  
HPE to monitor power of edgeline server when ANN is run with no FPGA for baseline creation.

### **3.1.5.4 2018-06-14**

#### **Agenda**

- MICMAC update. ANN testing?
- Status of deliverables D6.6 & D6.8
- AOB

#### **Minutes**

- D6.6 undergoing internal review at Nallatech. No update from HPE on D6.8.
- IBM progressing with various publications regarding OPERA work.

### **3.1.5.5 2018-07-09**

#### **Agenda**

- Deliverable update
- AOB

#### Minutes

- D6.7 FPGA Prototype testing -final release: CNN offload and the MICMAC acceleration to be added to deliverable.
- D6.5 (IBM) Due M35: TOC complete. Work required RDMA into CREU (Target end of July). Macro benchmark, versus TCPIP and RDMA. Modifications required to Connect-X 5 driver source to perform RDMA library to interact correctly.
- AOB: HPC benchmarks to be added to publication of work to make it more appealing to the HPC community. (Check point restart, more focused at HPC).

#### *3.1.5.6 2018-08-06*

##### Agenda

- Update on final deliverable progress
- AOB

##### Minutes

- D6.8 is progressing, including some additional experiments to generate power results for D4.3.
- Redfish monitoring for D4.3. Check if rev2 is required for redfish on sysfs or if rev1 card is adequate

##### Actions

- Send Gallig instructions for setting BSP v2 and access to sysfs.

#### *3.1.5.7 2018-08-21*

##### Agenda

- Review actions from last meeting.
- Progress update on deliverables

##### Minutes

- Redfish monitoring for D4.3. Check if rev2 is required for redfish on sysfs or if rev1 card is adequate. Send Gallig instructions for setting BSP v2 and access to sysfs.
- Gallig has arranged a visit to the US Redfish team end of September (23rd-30th).
- Plan to loan Nallatech's Rev2 card to HPE no later September 15th for RedFish development.
- Deliverables progressing well.

##### Actions

- Measure base power with monitoring turned off.
- Send Gallig instructions for power monitoring software with Rev2 card in September.

#### *3.1.5.8 2018-09-05*

##### Agenda

- Review actions from last meeting

##### Minutes

- Measure base power with monitoring turned off is done.
- Send Gallig instructions for power monitoring software with Rev2 card in September: This will be done once all testing from deliverables are complete.
- WP6 Deliverable progress.

### 3.1.5.9 2018-09-20

#### Agenda

- Review actions from last meeting
- WP6 Deliverable progress.
- Review HPE progress on Rev2 385-O installation in Grenoble.

#### Minutes

- Card is setup in Grenoble and working correctly. Gallig is able to retrieve power monitoring data ready for RedFish integration after US trip next week to resolve outstanding issues.
- Send Gallig D6.7 to help with final HPE deliverable D6.9 and ensure no unnecessary overlap.
- D6.7 is complete, reviewed and has been submitted to project coordinator

### 3.1.5.10 2018-10-03

#### Agenda

- Review actions from last meeting

#### Minutes

- Send Gallig D6.7 to help with final HPE deliverable D6.9 and ensure no unnecessary overlap. Done.
- Status of RedFish integration: No further updates to report on top of that reported in D4.3. Status of D6.9 deliverable: IBM will complete deliverable D6.9. Results have been obtained and deliverable is on course to be completed for first review middle of October.
- It was agreed by all partners that WP6 meetings should now conclude.

## 3.1.6 WP7

For the task 7.1, related to traffic monitoring use case, two types of meeting was organized

- Bi-weekly phone meeting done in coordination with WP3
- Meeting in the field to install, debug and test the prototype in real conditions

The physical meetings are presented in chapter 2.

### 3.1.6.1 29-05-2018

#### Status of demonstration of road event detection on test site 1

Debug of alarm transfer--> ISMB is investigation the code sent by NEAVIA

Intervention on 30th May--> Postponed the 5th of June

#### Status of test of cycle detection on test site 2

Status of software development on Orlando board by WP3

Communication between Orlando and Nucleo operate, completion of protocol in progress

Installation planned the 5th of June

Intervention on 30th May (configuration of 3G router) --> Postponed the 5th of June

#### Preparation of F2F meeting

Brief review

Discussion about open issues

Deadline for software development: impact on test

Activities in summer period

Energy autonomous system for test site 3--> Last data in D4.5 p25/35

Evaluation of energy efficiency--> discussed with ST/CERTIOS

OK for ULP video Platform

ISERE gave data about current Baseline in Isere

ISERE can not gave energy consumption of current automatic detection of event (can not be distinguish from permanent video stream transfer)

- CERTIOS confirm that the consumption of Moonshot and FPGA can be evaluated easily from EMS of Moonshot

- Not Baseline for off-loading process: Validated

### **3.1.6.2 12-06-2018**

#### **Status about test site 1**

Status about investigation to transmit alarm : input from ISMB, NEAVIA

--> Software issues should be solved : ISMB sent answer the 31st May

--> Problem with USB cable is : no communication since 25th May

--> ISERE and NEAVIA do a test this afternoon

--> If required intervention to change USB cable will be planned as quick as possible

#### **Clarification of a new timeline**

Clarification of a deadline to test cycle detection on Orlando board : input from WP3

Clarification of a deadline to test cycle counting on Orlando board : input from WP3

Clarification of a deadline to test load estimator: input from WP3

Organization of a task force in the test site to put into operation local cycle counting

→ ST/ISMB will do test next week

ST/ISMB/ISERE with embedded support of TESEO/NEAVIA will do test week 26 (25-29 June)

#### **energy autonomous system**

Status about supply of Orlando board

Status about sizing of energy autonomous system on test site 2

Clarification of a deadline to install energy autonomous system

Clarification of a deadline to install energy measurement system

Organization of a task force in the test site to put into operation energy autonomous system: who?when?

--> TESEO will provide plan/sizing of energy autonomous system week 25 (18-22 June)

--> ISERE/TESEO will correct/validate installation of energy autonomous system target date : week 26 (25-29 June)

--> TESEO will install energy autonomous system week 27 (02-05 July)

#### **Off loading process**

Clarification of a deadline to test cycle detection on Moonshot : input from NALLATEC

Clarification of a deadline to test cycle counting on Moonshot: input from NEAVIA

Clarification of a deadline to test load estimator: input from WP3

Organization of a task force in the test site to put into operation off loading process: who?when?

### **Presentation of energy efficiency improvement results in D7.3**

Clarification of a deadline to integrate calculation of energy efficiency improvement of "global system" for real time detection of road event

Investigation about methodology to present results about energy efficiency improvement of OPERA loading process in D7.3

#### **3.1.6.3 26-06-2018**

##### **1-Timeline**

Definition of an intervention required on test site 1:

Change of USB cable and modification of radio module management to optimize the energy consumption optimization

Finalization of test about detection of congestion and detection of wrong way vehicles

Date: 4<sup>th</sup> of July

Participant: ISERE/ST/TESEO/ISMB/NEAVIA

Test on site 2

Deadline to test cycle detection (pico-YOLO) and transmission of counting data to Moonshot: to be fixed by WP3

Deadline to test cycle counting (pico-YOLO & tracking): impact of integration of Orlando board environment on deadline (see WP3 minutes): to be fixed by WP3

Deadline to test load estimator: impact of integration of Orlando board environment on deadline (see WP3 minutes): to be fixed by WP3

Energy autonomous installation

Presentation of calculation for sizing energy autonomous system

Validation of installation on test site 2

Deadline for installation (only if installation is validated): 1<sup>st</sup> August

Test on Moonshot

Deadline to test cycle detection (YOLOv3): to be fixed by WP5

Deadline to test cycle counting (YOLOv3 & tracking): to be fixed by WP5

### **Presentation of Output expected for D7.3**

Collection of feedback from each partners

Collection of output for D7.3

Real time detection of road event

Energy consumption: deadline to install energy measurement system in the field (TESEO/ST/ISERE)

Comparison with Baseline: deadline to calculate baseline and OPERA consumption for global system (see ISERE)

Cycle counting by off- loading process

Deadline for measurement in labs: see WP3



Deadline for measurement in Moonshot: see WP5

Comparison with (partial) Baseline

#### **3.1.6.4 20-09-2018**

##### **Review of key target of D7.3**

Results about test site 1 have to be clarified (in particular for wrong way vehicle)

Results about test site 2 are still expected

Achievement of demonstration of cycle counting by Orlando

Achievement of demonstration of cycle counting by off-loading process

Operation in energy autonomous mode

Status with HPE/NALL/NEAVIA required

##### **Comment about energy measurement**

Giulio validates results, last results of labs are required for complete interpretation

Energy measurement on test site 2 can be used if completed by measurement in labs

##### **Status about input from WP3**

Test site 1

HW: status about test site 1

SW: status about evaluation of wrong way vehicle

Issues about embedded switch for embedded upload of software

ISERE and NEAVIA have to clarify status about results

Test site 2

HW: supply of Orlando board

SW: cycle counting

SW: off-loading process

--> Investigation planned next week (tracking software sent by NEAVIA and received by ST/ISMB)

--> Demonstration planned middle October

##### **Organization of next experimentation week**

2<sup>nd</sup> or 3<sup>rd</sup> week of October

ISERE/ST/ISMB/TESEO/NEAVIA/ HPE?

Last opportunity to collect strictly required results - each technological brick required

#### **3.1.6.5 02-10-2018**

Status about WP3 requirements required by WP7

Status about WP3 task to implement switch for Nucleo board to reduce energy consumption of embedded video platform on test site 1

Software and hardware development in progress

Status about WP3 task to implement Orlando board

Test of supply of the board done

Status about WP3 task to develop software module to implement cycle counting: tracking

Preparation of meeting in the field: organization of access to test site for the second week of October

### **3.1.6.6 16-10-2018**

Status about WP3 requirements required by WP7

Organize a call next week on Wednesday afternoon to check the status

Provide some data to the server (images) for the testing of the software on that side

Provide preliminary data for D7.3

Test the behavior of the ULP node with the cycle tracking mechanism from NEAVIA and the storage of some images

Postpone the intervention in Grenoble to the first week of November, starting from 5/11.

Check all the needed actions during the intervention

Preparation of WP3 meeting in the last demonstration planned in 23<sup>rd</sup> of October

### **3.1.6.7 Task 7.2 and 7.3**

We didn't organize specific calls for T7.2 (Truck Use Case) and T7.3 (VDI Use Case) because we discussed the topics about them during WP4 and WP5 calls. We did that for different reasons:

- during the other calls there were all the involved partners and the arguments were related also to T7.2 and T7.3
- time optimization

## **3.1.7 WP8**

For the WP8 following the list of calls made during the last period:

### **3.1.7.1 26-06-2018**

Agenda:

Restarting by weekly calls

Overview about the progresses made during last months

Table of content for next deliverables for the end of July 2018

Situation of the website from communication and dissemination side

Purchase order by 50% between TESEO and ISMB for a publication in a magazine

### **3.1.7.2 10-07-2018**

Agenda:

Analysing social media statistics after Haifa F2F

Input for updating/improving the website

### **3.1.7.3 24-07-2018**

Agenda:

Discussion about the new videos release

Update of communication and dissemination KPI

Updated the consortium with the publication made by a Sole24Ore magazine

#### ***3.1.7.4 07-08-2018***

Agenda:

Availability of the new video made by CSI, internal discussion

Diffusion plan on social medial

General updates

#### ***3.1.7.5 05-09-2018***

Toc for the last deliverables round of WP8

General updates

Discussion about new papers

#### ***3.1.7.6 18-09-2018***

Agenda:

Discussion about the ToC of last round deliverables

Discussion about the communication plan KPI

Discussion about dissemination plan KPI