CONVINcE

M4.1.1

Demonstration of first functional versions of the power saving mechanisms

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EXECUTIVE SUMMARY

This document describes the contents of the Milestone 4.1.1. The document introduces the initial demonstrations for Work Package 4 that are planned to be presented in the mid-term review event. There are one or more demonstrations for each task of the WP.

In the first demonstration concerning Task 4.1, VTT showcases the power measurement and potential power savings based on execution parameters in video playback on Apple mobile terminals. The parameters include e.g. the type of parallelism in HEVC decoding and the number of threads used for processing.

The second demonstration by Sony Mobile (T4.2), presents a proof of concept for the collaborative architecture in a video streaming scenario. The scenario includes a mobile android terminal running a video streaming application and two server nodes; one for streaming video content and another for improving QoE per Watt in the mobile terminal.

The third demonstration from Ericsson (T4.2), presents a cloud gaming scenario, where the game is executed remotely in a cloud service and the displayed content is streamed back to the terminal. The approach has various advantages over local games, such as power savings at the terminal, fast and straightforward updates requiring no effort from users.

The fourth demonstration from TelHoc (T4.3), showcases video streaming with energy consumption measurements for various types of video encryption on Android phones. The user can choose different security and video codec settings and see how this affect performance and energy consumption. The system allows applications to dynamically adapt the video streaming service for optimizing performance, security and energy consumption.

In the fifth demonstration, University of Oulu (T4.3) demonstrates the video streaming in a multi-tier wireless sensor network, where low-power scalar sensors detect movement to trigger higher-power visual sensors to stream video content to the server. The demo shows the difference in power consumption between encrypted or non-encrypted video and different architectural options. The demonstrations are work-in-progress versions of the ongoing prototyping work at the partners.

At this phase, the demonstrations are partner-specific. The integrated demonstrations will be presented at the end of the project.

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1 DOCUMENT HISTORY AND ABBREVIATIONS

1.1 Document history

Version	Date	Description of the modifications
0.1	10/11/15	Initial version (Erkki/UO)
0.2	17/11/15	VTT modifications (Martti/VTT)
0.3	19/11/15	UO modifications (Pawani/UO)
0.4	20/11/15	Sony modifications (Rickard/Sony)
0.5	24/11/15	Ericsson modification (Miika/Ericsson)
1.0	30/11/15	CEA modifications, Final candidate (Erkki/UO, Alex/CEA)
1.1	10/12/15	Reviewed version based on reviewer comments(Erkki/UO)

1.2 Abbreviations

SSD	Solid-State Drive
HD	High Definition
HEVC	High Efficiency Video Coding
QoE	Quality of Experience
IP	Internet Protocol
Wi-Fi / WiFi	Wireless Fidelity (wireless local area network)
5G	5th Generation mobile networks
OSPF	Open Shortest Path First
SDN	Software-Defined Networks
IPv6	Internet Protocol version 6
FTP	File Transfer Protocol
FTPS	Secure File Transfer Protocol

2 INTRODUCTION

This document describes the contents of the Milestone 4.1.1. The document introduces the initial demonstrations for Work Package 4 that are planned to be presented in the mid-term review event. For Task 4.1, VTT demonstrates the effect of video processing in terminals to power/energy consumption. For Task 4.2, Sony Mobile demonstrates the concept of collaborative architectures between mobile terminals and mobile network nodes and Ericsson demonstrates a remote gaming concept. For Task 4.3, TelHoc demonstrates video streaming with energy consumption measurements for various types of video encryption on Android phones, and University of Oulu demonstrates the energy-efficiency of secure/non-secure video streaming in a multi-tier wireless sensor network. The demonstrations are work-in-progress versions of the ongoing prototyping work at the partners.

3 DEMONSTRATIONS

3.1 T4.1 - Video Processing

3.1.1 Video processing: Impact on energy consumption in terminals

In order to demonstrate the effect of video processing in terminals to power/energy consumption, VTT plans to showcase power measuring and potential power savings based on execution parameters in video playback on Apple mobile terminals (see Figure 1). The main platform will be Apple's heavy-duty laptop computer MacBook Pro 15'' RETINA employing 4-processor Core i7 chip with on-chip graphics processor and SSD mass memory. HD video will be processed with VLC media player and openHEVC software. The power/energy consumption of the chip will be measured with the Intel Power Gadget software. While the focus will be in the effect of execution parameters, e.g. type of parallelism in HEVC decoding and the number of threads used for processing to energy consumption, also the importance of video coding standards with right parameters is showcased assuming that the quality of video stays unchanged. Video transfer and its contribution to power consumption is not included in this demonstration.

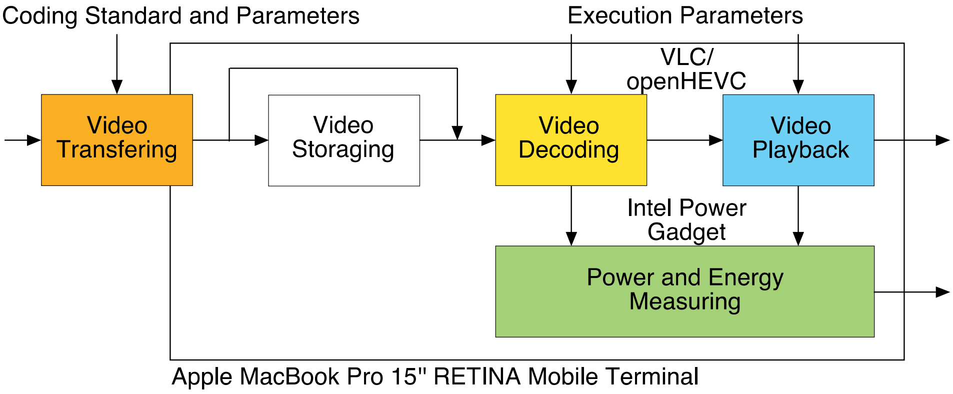


Figure 1. VTT T4.1 demonstrator setup

3.2 T4.2 - Resource usage and collaborative architectures

3.2.1 Video streaming: Energy savings using collaborative architecture

Sony Mobile has two demo setups to be showed. Both demonstrations are targeting to illustrate the concept of collaborative architectures between mobile terminals and mobile network nodes.

The main demonstrator is a proof of concept for the collaborative architecture in a video streaming scenario that Sony Mobile is analyzing within CONVINcE. The setup consists of a Sony Mobile android terminal running a video streaming application, i.e. an application that enables a consumer to watch videos on demand or live. The setup also includes two server nodes. One of the server nodes is the video streaming content server, which in a commercial video service e.g. may be located as a content server on the Internet. The mobile terminal and the content server is communicating for video streaming content delivery using an adaptive streaming protocol. Hence the content server is delivering video segments according to mobile terminal requests.

The second server is the novel part for the collaborative architecture, where a support node is targeted to be included in the mobile radio access network. This server is supporting the mobile terminal in its video segment selection, in order to improve QoE per Watt in the mobile terminal.

For the demonstration case the two server nodes are implemented in a laptop at two different IP ports, where they are reached by the mobile terminal via wireless communication (Wi-Fi).

The demonstration setup is illustrated in Figure 1.

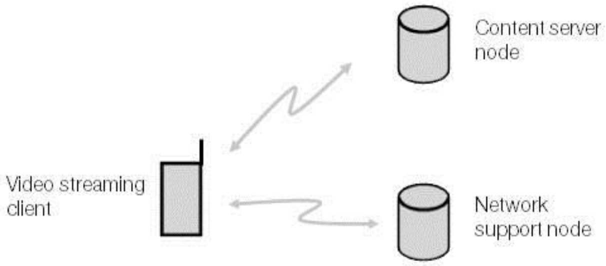


Figure 2. Sony Mobile T4.2 main demonstrator setup

The second demonstration is a demo video that shows two video playbacks as recorded smartphone screen shots. The two recordings have been captured for a scenario run as described in the main demonstrator setup, but where the network nodes have been reached via a loaded cellular network. The cellular network has been controlled in a lab environment, in order to fully control and repeat the level of background traffic load, and the applied attenuation and fading for the communication channel. Hence, the results are repeatable, and the comparison of the effects of the cellular support node can be verified. The demo video shows that the video playback quality can be improved with reduced video rebuffering events (when the local terminal video buffer is empty and the video playback stops). Worth noting is that this effort has been a first step to verify functionality, while the second step targeted is to apply developed power measurements tools to verify the resulting mobile terminal Quality of Experience per Watt impact.

3.2.2 Remote gaming: Energy savings using computational offloading

Ericsson demonstrator is related to cloud gaming. The key idea is that users play games using a remote desktop, i.e., by streaming the game video from the cloud. We illustrate the concept using a phone, wifi access point and a remote server as shown in Figure 3.

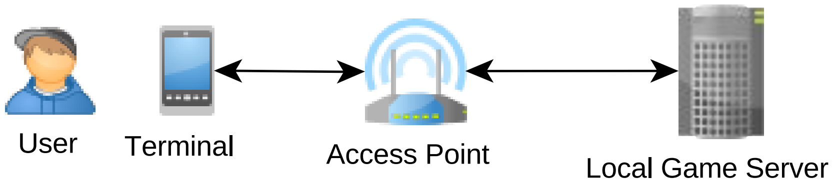


Figure 3. Ericsson T4.2 demonstrator set up

The user connects using his terminal to the game server that is located in the same local wifi network. The connection occurs using the GamingAnywhere client that is basically a game-optimized remote desktop client. At the local game server, GamingAnywhere server serves the client using a game. The user can start playing the game using an gamaped (x-box controller) that relays the controls to the server using so called usbip protocol.

This approach has various advantages over local games, for instance, potential power savings at the terminal, avoiding of download-install-update cycles, faster deployment of game updates and anti-piracy measures for game vendors. To avoid the common pitfall of real-time services, i.e., long latency, we propose the remote gaming service to be deployed near the network access point of the user. In the context of cellular networks and 5G, the game service could be deployed near the base station.

The demonstrator is based on manual set-up procedure in order to demonstrator the basic concepts. The whole process of connecting and launching games will be automatized later during the project.

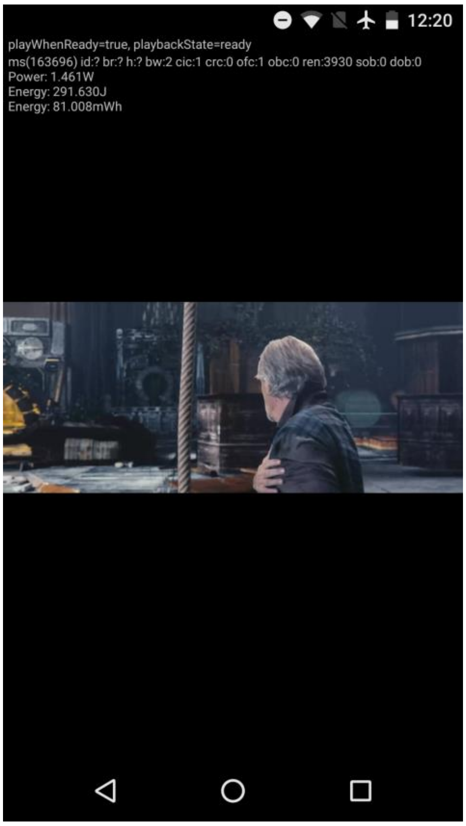
3.3 T4.3 - Security and privacy

3.3.1 Video streaming: Energy consumption measurements for various types of video encryption

TelHoc will demonstrate an Android application that demonstrates Video streaming with energy consumption measurements for various types of video encryption on Android phones, see Figure 4.

This Android application displays the short film “Tears Of Steel” with instantaneous energy consumption figures. The user can choose different security and video codec settings and see how this affect performance and energy consumption.

The video stream may be coming from either (cloud) server or edge cloud, where the edge cloud may be a local raspberry Pi device.. We are working on dynamically switching between encryption levels, video codecs/bitrates , basically allowing to set preferences that the streaming application will adhere based on current device values. This will allow the application to dynamically adapt the video streaming service based not only on pure performance, but to also consider security and energy consumption and to globally minimize these. Figure 4 shows the UI of the Android Demo App and Figure 5 illustrates the demonstration setup.



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playWhenReady=true, playbackState=ready
ms(163696) id:? br:? h:? bw:2 cic:1 crc:0 ofc:1 obc:0 ren:3930 sob:0 dob:0
Power: 1.461W
Energy: 291.630J
Energy: 81.008mWh
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Figure 4. TelHoc Android demo app showing current video consumption data.

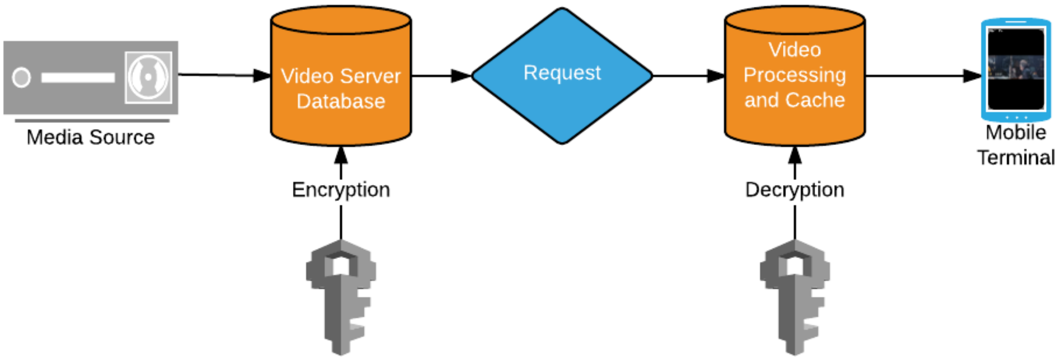

Figure 5. TelHoc T4.2 video demonstration setup.

3.3.2 Video surveillance: Energy-efficient video delivery from wireless sensor network

Preliminary work demonstrates the video streaming in a multi-tier wireless sensor network. In the network setup, Tier 1 and Tier 2 respectively contain the scalar sensors and visual sensors. In this particular network setting scalar sensors detect the movements of the objects and sends the advertising messages to trigger the visual sensors. When a Tier 2 sensor detects an advertising message, it starts to capture a short video and send it to the server as encrypted data. Energy measurements are taken into account for encrypted and plain video deliveries over 3G network via FTP and FTPS protocols and for one-tier and two-tier sensor network structures. The scenarios are implemented with Libelium Waspmote sensor platform. Figure 6 illustrates the demonstration setup.

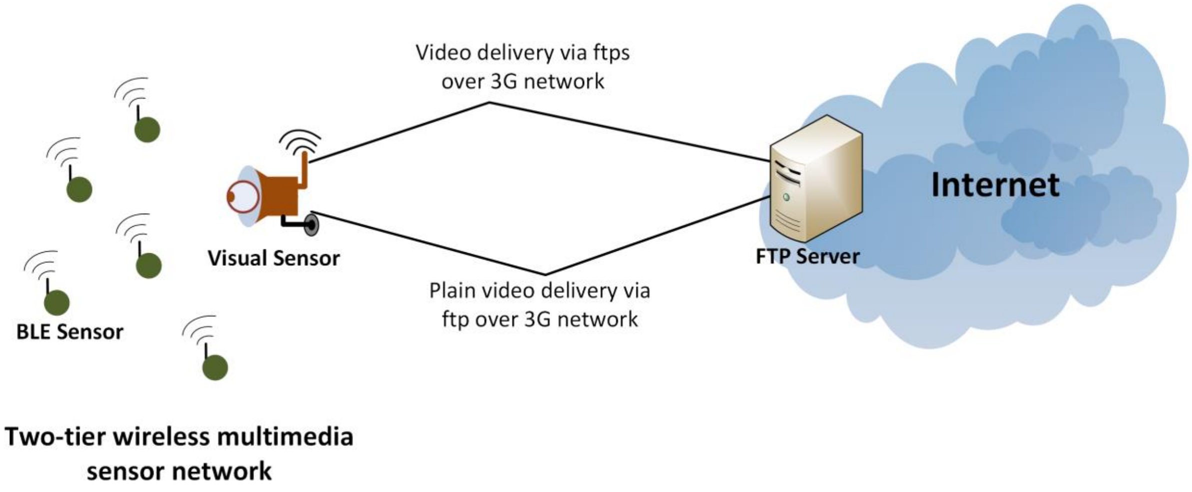

Figure 6. UO T4.3 demonstrator setup.

4 CONCLUSION

This document described the contents of the Milestone 4.1.1. The document introduced the initial demonstrations for Work Package 4 that are planned to be presented in the mid-term review event. There are one demonstration for Task 4.1, two demonstrations for Task 4.2, and two demonstrations for Task 4.3. The demonstrations are work-in-progress versions of the ongoing prototyping work at the partners. At this phase, the demonstrations are partner-specific. The integrated demonstrations will be presented at the end of the project.