Smart Metering Use Case

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Introduction

This case study regards work in progress regarding the implementation of the Greek pilot within the framework of the GEN6 project (number 261584 - http://www.gen6.eu/home) that is co-funded by the European Commission under the ICT Policy Support Programme (PSP) as part of the Competitiveness and Innovation framework Programme (CIP). The current section actually is based mainly on the Deliverable D3.2 “Requirement Analysis for Power of 10” of the GEN6 project with the addition of some latest results of the project.

GEN6 shares the view that a democratic European society, with a strong and productive economy, requires service-oriented, secure, reliable and innovative government, at all levels independently of size and location used by all groups of citizens (elder, handicapped, youngsters, immigrants). Successful implementation of eGovernment can improve services, strengthen our societies, increase productivity and welfare, and reinforce democracy. This success will only be achieved by pursuing a long-term vision, with clear and sustainable objectives, with constancy and persistence, and with participation of all stakeholders: government, citizens and industry. GEN6 will contribute to these objectives in the area of communication and how to transition to IPv6 in the government area.

The Greek IPv6 pilot in Schools aims to demonstrate that IPv6 may become the leveraging technology for enhancing existing services or providing new services to the end users. In the context of GEN6, this pilot will investigate the benefits of establishing an advanced metering infrastructure over IPv4 and IPv6 and provide insights about the benefits of building IPv6 services.

The Greek IPv6 pilot in Schools is realized or supported by the following public authorities, research organisations and commercial companies:

- The Computer Technology Institute & Press “Diophantus” (CTI), under the supervision of the Minister of Education and Religious Affairs (www.minedu.gov.gr/), responsible for the administration and the daily operation of the Greek School Network, which provides advanced IT services to the primary and secondary schools in Greece,

- The Greek Research & Technology Network (www.grnet.gr), under the supervision of the Minister of Education and Religious Affairs (www.minedu.gov.gr/), responsible for providing networking and cloud computing services to the Greek academic and research communities,

- Intelen (http://www.intelen.com), a start-up company providing services to the Energy, Smart grid and ICT sector, such as smart metering, meter data management, etc.

The idea for the Greek pilot was based on recent statistics that indicate a high potential for energy saving in public schools in Greece and potentially in public infrastructures. Indicatively, reduction of more than 30% in the carbon footprint is stated in most cases. Through the implementation of the Greek IPv6 pilot, the deployed infrastructure will be extended and many problems that are related with the use of IPv4 for access to the smart energy meters will be outreached. This extension will provide a signal to European stakeholders that IPv6 technology can be “green” enabler.

School and Administrative Requirements

The selection of the schools participating in the pilot has been done based on the location of the schools and their detailed characteristics. The selected schools will be located across three adjacent prefectures (namely, Achaia, Korinthia and Attiki) within the Greek territory. Information regarding their interest in participation to the pilot and statistics for the number of students, the type of the school, their IT infrastructure as well as any related environmental activities has been collected through a detailed questionnaire.

Network Infrastructure Requirements

The basic abstract architecture of the GSN Network operated by CTI is shown in Figure 1. The majority of schools in Greece (close to 95%), are connected to GSN (and thus to the Internet) using ADSL technology. Nowadays, there is also a significant growth in the number of schools connected to GSN by using Ethernet technologies, mostly because GSN is currently pursuing to utilize as much as possible the optical Metropolitan Area Networks that have been deployed by several municipalities across Greece in the previous years.

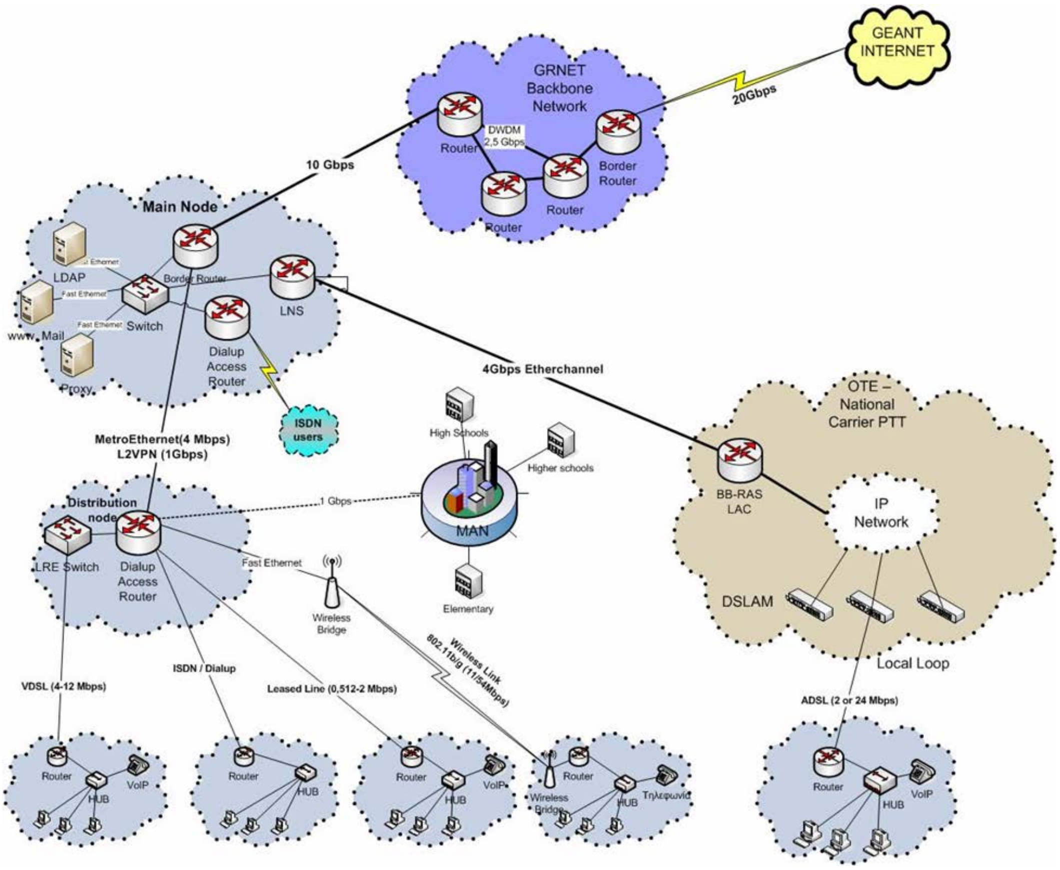

Figure 1: GSN Architecture

GSN has acquired one /47 and one /48 IPv6 address spaces from RIPE. The initial IPv6 addressing schema (subject to change in the near future) that has been made by the GSN's NOC within CTI is as follows: 2001:db8::1300/47 assigned to access network and 2001:db8::1302/48 assigned to backbone network.

The backbone network of GSN is fully IPv6 enabled including IPv6 support on all the point to point (p2p) links of the primary and secondary nodes of GSN, while the peering with GSN's ISP (GRNET) is also IPv6 enabled. On the access network, IPv6 has been enabled also for the ADSL users (95% of the users of GSN).

System & Data Management Requirements

Smart metering generally involves the installation of an intelligent meter, the regular reading and processing of energy-consumption data, and the provision of feedback on consumption data to the customer. A "smart" meter has the following capabilities: real-time or near real-time registration of electricity use, local and remote access to the meter (on demand), remote limitation of the throughput through the meter and interconnection to premise-based networks and devices.

The 'intelligence' of the meter is incorporated in the electricity meter. It has three basic functions: measuring the electricity used (or generated), remotely switching the customer offer and remotely controlling the maximum electricity consumption. The smart metering infrastructure in each building at the Greek IPv6 pilot consists of a consumption metering device (abbreviated CMD) along with its CT's (current transformer), a transmitter and the i-box. The i-box is a smart device that acts as a data bridge between the meter and the internet and is capable for a series of data analytics services.

Technical Details and Primary Results

The pilot includes the installation of IPv6-enabled smart energy meters to fifty (50) public schools in Greece with the parallel upgrade of the existing networking infrastructure aiming to fully support the installation of IPv6 enabled smart meters and the provision of IPv6 services to the GSN's end users. The installed smart energy meters within each school will clearly -in real time- illustrate to the students the correlation between their actions and energy consumption/CO_2 emissions of their schools, providing significant motivation for behavioural changes. The main goal is to reduce the schools' energy bills and carbon footprint by at least 10% and to offer real-time energy efficiency services, over IPv6. Furthermore, the pilot focuses on positively affecting the students' behaviour and raising awareness over IPv6 as well as environmental issues.

The pilot provides an IPv6-only service targeting to end-users and stimulates them to use IPv6. In parallel to the increase of the energy awareness of the school communities, IPv6 awareness will be also increased based on the proper dissemination of the selected technologies for the implementation of the pilot and the provision of direct access to the students for viewing real time energy consumption data from the smart meters. The energy power meters installed in schools forward energy consumption data (over IPv6) to Intelen's cloud infrastructure. The cloud infrastructure integrates near real time stream analysis while an interactive web platform allows secure access to energy consumption data (Figure 2).

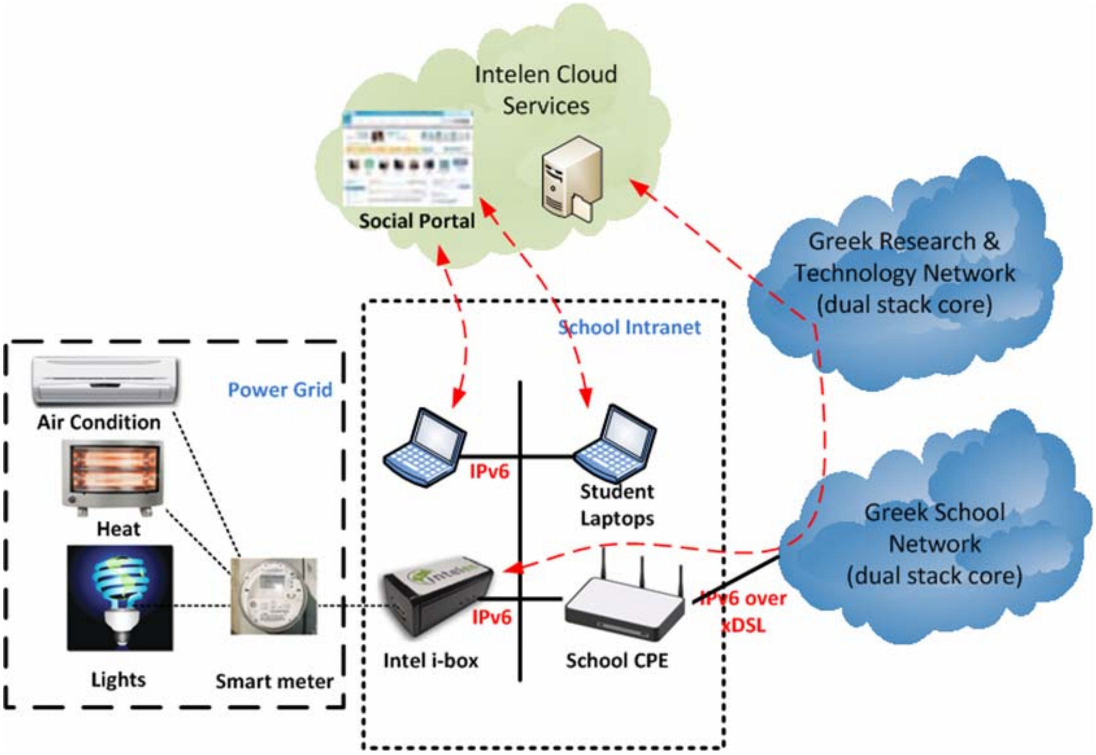

Figure 2: GSN Architecture

Based on initial results from the deployment of smart meters at 10 (out of the 50 schools), it is measured that the total energy power savings for these 10 school units over a period of 10 weeks was 12.234 KWh. The calculated monetary benefit is 3.500€, when the electricity school price for energy unit is 0,12€ per KWh. The extrapolated power saving per school year (40 weeks) is 48,936 KWh. The power energy saving results in Kwh from ten schools after the period of ten weeks is presented in Table 1. Furthermore, in Figures 3 and 4, there are depicted indicative screenshots from the real-time energy consumption data collected through the developed cloud-based monitoring infrastructure.

School Name	Power Saving
1st High School Haidariou	16,38%
8th Primary School Vyrona	18,51%
70th Primary School Athens	29,93%
10th Primary School Haidari	25,68%
7th High School Haidari	27,77%
152th Primary School Athens	29,43%
7th High School Peristeri	29,70%
8th Primary School Dafni	25,68%
1/7th Primary School Athens	24,02%
59th High School Peristeri	28,92%

Table 1: Power saving results from ten schools in the Athens area

Figure 3: Real time energy consumption data from an installed smart meter

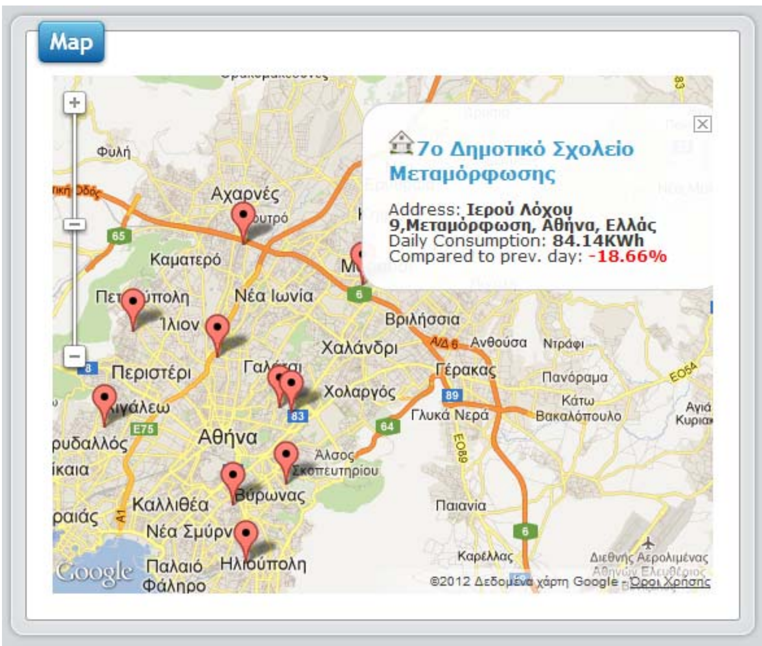

Figure 4: Interactive maps providing an overview of the installed smart meters

Conclusions

In this use case, a thorough analysis regarding IPv6 as a “green” enabler in GSN based on the installation of IPv6 power meters in a small proportion of schools spanning among three prefectures of Greece is made. The basic architecture of the deployment as well as the main technologies used are described, focusing on the exploitation of IPv6 characteristics for the real-time management of the smart meters and the proper presentation of the collected data. Based on the primary results, it is shown that reduction in energy consumption up to 30% may be achieved in public schools in Greece. It is important to note that in addition to the installation and the management of the infrastructure, proper dissemination actions targeting at increasing the environmental awareness of the Greek school community are also considered crucial.

The pilot, upon successful implementation and dissemination of the results, may constitute a point of reference for wider implementation, targeting in reducing energy consumption based on the provision of IPv6-only services.