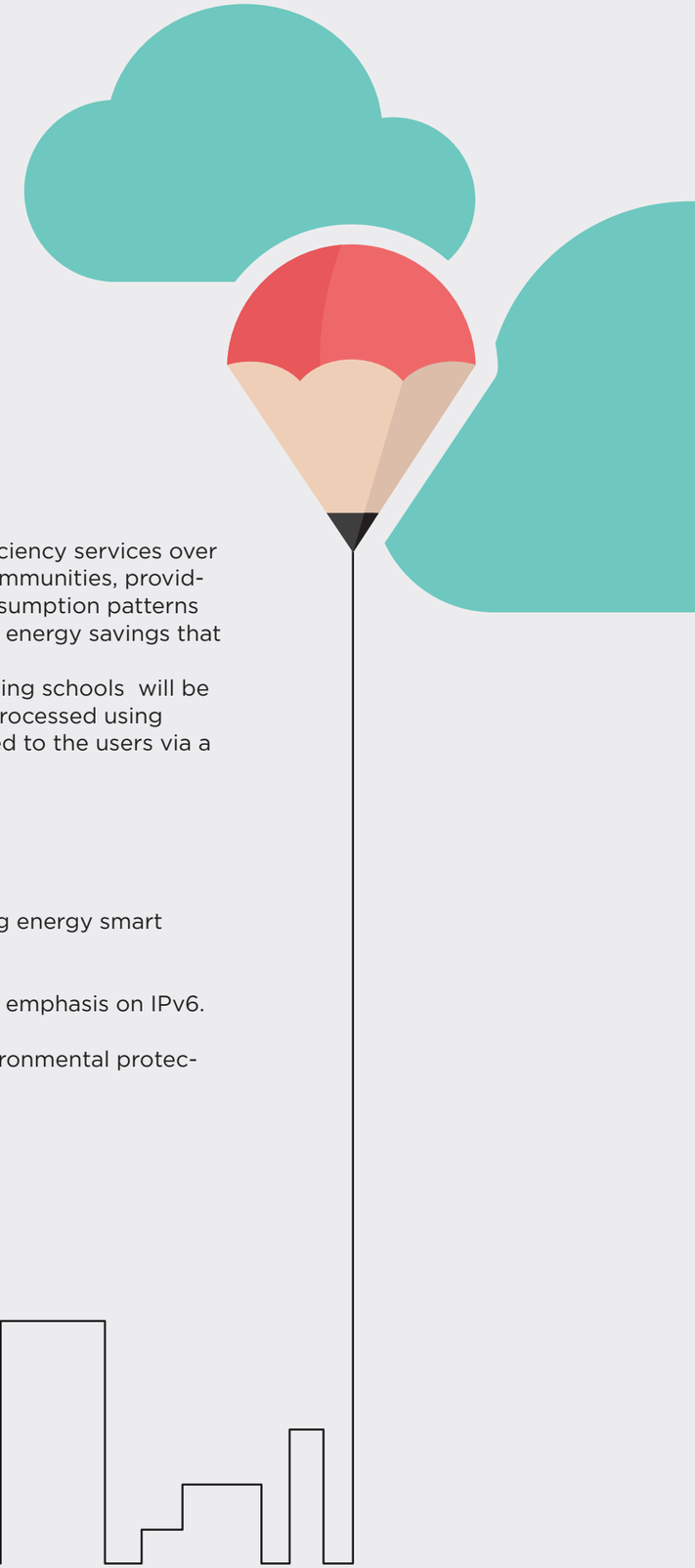
Energy efficiency in **school networks** with ipv6

GREEK IPV6 PILOT

Energy awareness & IPv6 @ schools



What is the pilot about?

The pilot implements real-time energy efficiency services over IPv6-enabled grids to local educational communities, providing students with information on their consumption patterns and raising awareness among them on the energy savings that behavioral changes may bring.
Energy related information from participating schools will be acquired using smart meters, stored and processed using scalable cloud computing and disseminated to the users via a secure communication channel.

Vision

- Raise energy awareness by interconnecting energy smart meters in selected schools intranets.
- Raise awareness in new technologies, with emphasis on IPv6.
- Mobilize school communities towards environmental protection purposes.

3 basic components

Community – Schools

Infrastructure – IPv6

Smart meter – Energy awareness

Pilot objectives

Raise energy awareness

- Mobilize student community towards environmentally-friendly behavioral changes.
- Reduce energy consumption and economic costbenefit.
- Demonstrate IPv6 as technology enabler for the provision of a new service.

Introduce innovative educational methods

- Self-training and student collaboration.
- Social bonds between communities in across diverse geographical areas.
- Interaction among students.
- Promotion of energy efficiency and sustainability campaigns into school community.

Analyze technical perspective

- Enhance technical expertise.
- Leverage data streaming analysis.
- Enhance IPv6 service portfolio.

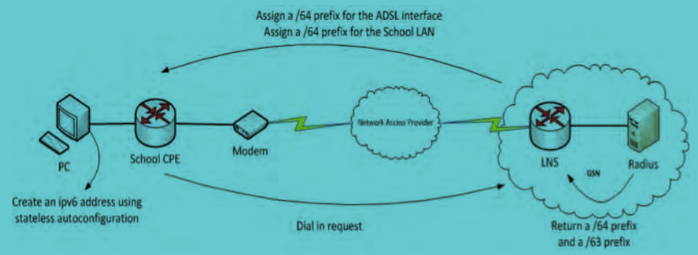
Greek school network

- Educational intranet of the Greek Ministry Of Education, Religious Affairs, Culture & Sports.
- Largest public network in Greece, using Greek and Research Network (GRNET) as backbone.
- Interconnects all ~16.000 primary and secondary schools over broadband network technologies, providing modern electronic services for e-learning, collaboration and content creation.

GSN and GRNET Network Topology

IPv6 in greek school network (GSN)

- GSN has acquired one /47 and one /48 IPv6 address spaces from RIPE.
- The GSN backbone network is fully IPv6 enabled.
- The GSN backbone network is dual stack i.e. supports both IPv4 and IPv6.
- On the access network, IPv6 interconnection has been activated for the ADSL users, i.e. for 95% of the schools.
- The peering with GSN upstream provider (GRNET) is also IPv6 enabled (dual stack).
- OSPFv3 has been selected as routing protocol for IPv6 interconnection within the GSN.



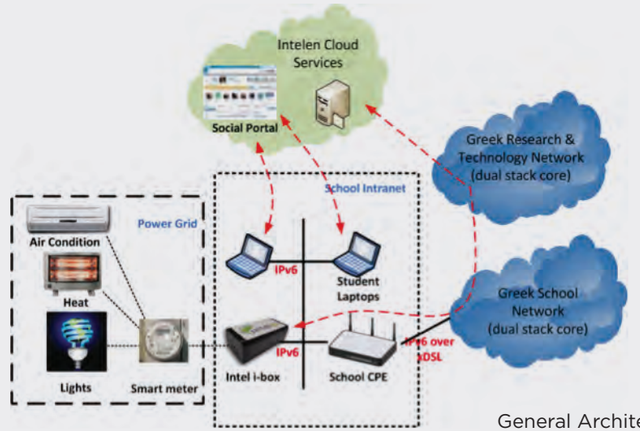
IPv6 assignment to a broadband connected school

Greek pilot's advanced metering infrastructure

The smart metering infrastructure of the Greek School Network pilot consists of:

- Energy power meters that forward energy consumption data to a Cloud Infrastructure.
- Each energy power meters that are connected throught Intelen's i-box to local school router.
- The i-box which acts as data bridge between power meter and local school router.
- A primary broadband (xDSL) internet IPv6-enabled connection in schools.
- Both i-box and school router have IPv6 global address using stateless auto configuration method (prefix delegation).
- A storage infrastructure that integrates near real time stream analysis.
- An interactive web site that allows secure access to energy consumption data and provides comparisons among schools.
- An end-to-end connectivity that is supported for management purposes.

Architecture

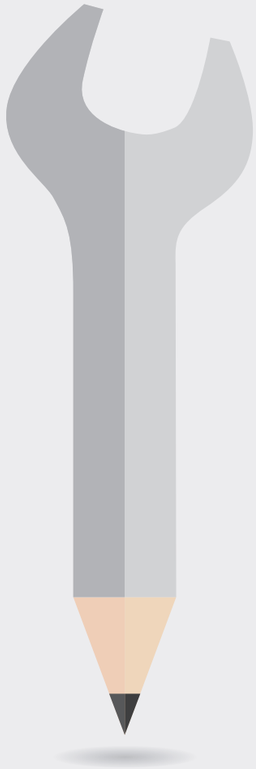


General Architecture

Smart Power Meters & IPv6

Smart meters are fully IPv6 enabled, using a global IPv6 address for connecting to GSN/GRNET network. This connectivity is succeeded by Intelen's iBox which is capable of:

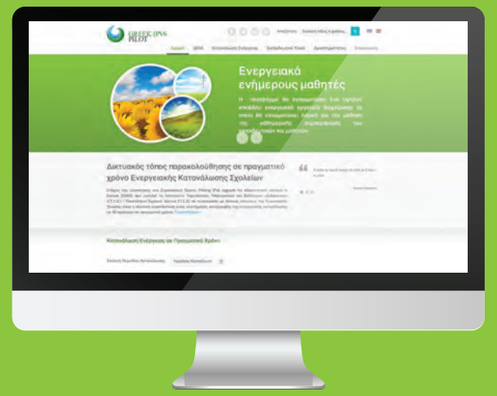
- Real-time or near real-time registration of electricity use.
- Local and remote access to smart meters.
- Acts as memory storage so that data are not lost in case of network or other errors.
- Performs error handling concerning the smart meters and the connectivity of the system.



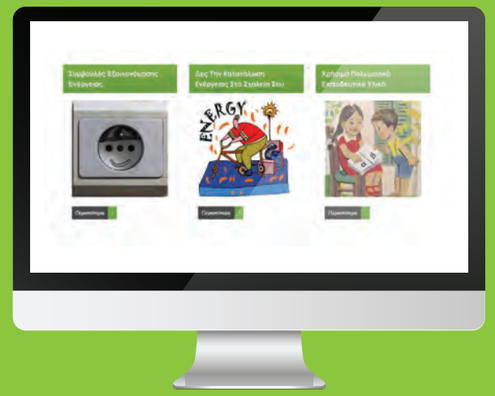
Energy analytics

- Energy consumption data from energy meters are being collected every 15 minutes.
- The raw energy data are sent to Intelen's Meter Data Management (MDM) system where they are being processed.
- In MDM system raw energy data are being aggregated, structured and transformed so as to feed all functionalities and services in a generic way.
- Inside the MDM system energy data are also enriched with data on other school characteristics (school area, student count, etc.).
- In there, all the calculations and data mining algorithms are taking place for the correlation of energy measurements with measurements from temperature sensors.

Web platform



Presents real time energy consumption data from the Advanced Metering Infrastructure.



Provides educational material about the IPv6 protocol and energy saving tips.

Promotes "energy competitiveness" among students from different schools.

Real-time energy monitoring

Energy awareness

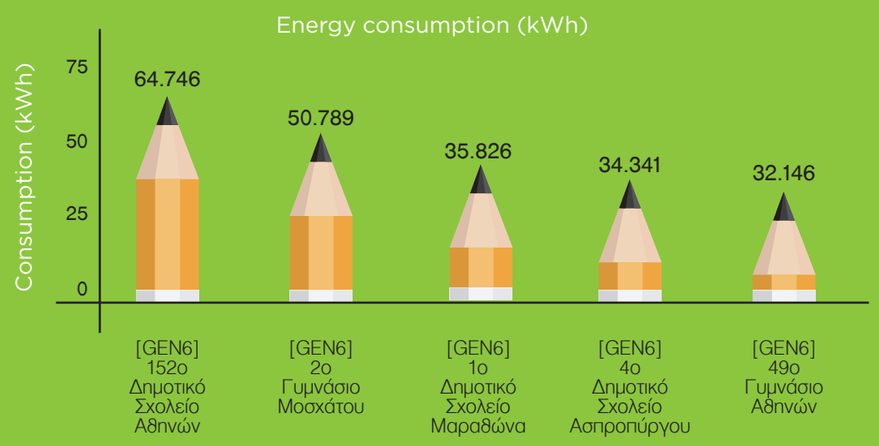
- Users know in near real time (15′) the energy consequences of their actions and behavior
- This motivates them towards adopting specific actions and behavior that could lower their energy consumption

For better understanding of complex energy data their display has been enriched with

- Animations and graphical statistics
- Historical data
- Comparative school energy data
- Information on the best performing school

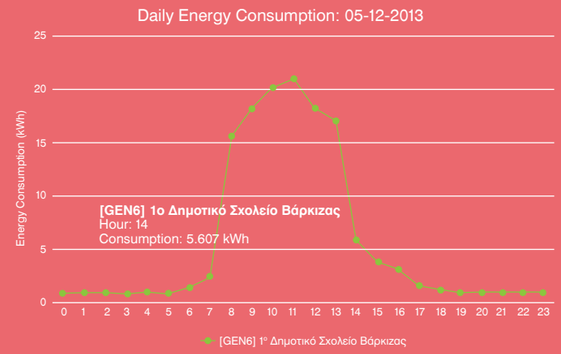
Categorize schools based on their energy efficiency using Key Performance Indicators (KPIs)

- Energy consumption (KWh)
- Comparison of energy consumption to that of the previous day or month (%)
- Energy consumption vs student population and school area (Kwh/student or Kwh/m2)



Detailed energy monitoring

Graphical representation for daily, weekly, monthly and yearly energy consumption.



Total Consumption (kWh)	135.031
Number of Measurements	96
Completeness of Measurements (%)	100.00
Comparison To Previous Day (%)	*-3.67*
CO2 Emissions	114.777

[GEN6] 1ο Δημοτικό Σχολείο Βάρκιζας

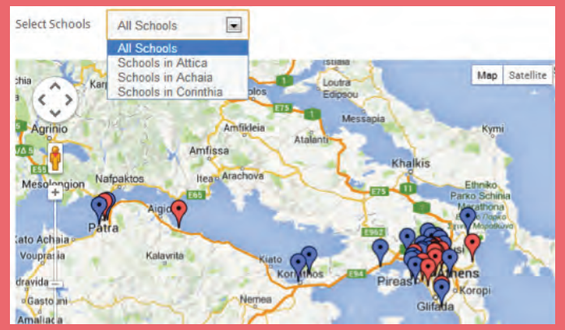
Τιτάνων 14, 16672, Βάρη-Βάρκιζα

216

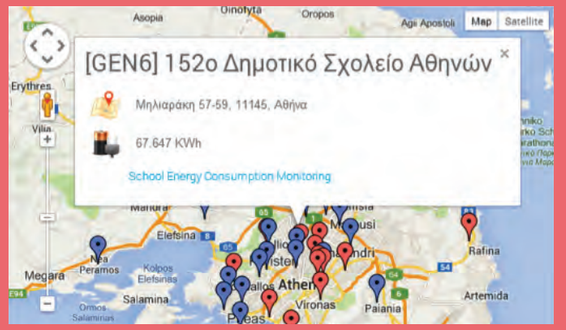
258 (m²)

13 °C
Wind: 4km/h
Humidity: 80%
Sky is Clear

Geospatial Schools Map



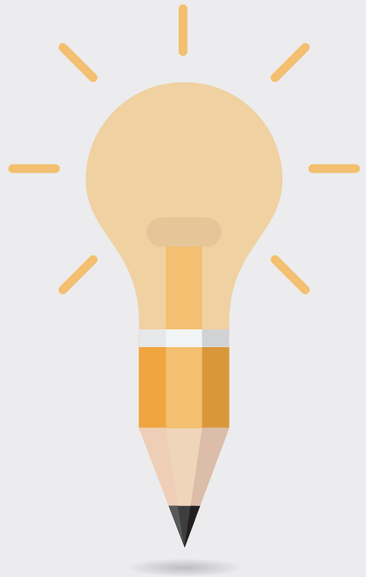
Associates geo-information with schools energy profile through an interactive map



Daily energy consumption, quick navigation to detailed monitoring for every school

Innovative Educational Methods

- Self-training of individual students
- Collaborative efforts among diverse student groups within a school
- Strengthening of social bonds between school communities acros diverse geographical areas
- Understand the correlation between human actions and energy consumption and CO2 emissions
- Understand how to reduce energy needs without sacrificing comfort
- Exchange ideas and best practices



IPv6 as a “Green” Enabler

IPv6 technology as a “green” enabler offers a variety of benefits such as:

- Easy integration of smart sensors in the networking infrastructure (6LoWPAN).
- No need for use of NAT gateways and dynamic IPs that reduce the overall availability of the service and increase maintenance costs.
- Support of autonomic network characteristics (auto-configuration, ad-hoc communications, bootstraping of the infrastructure).
- End-to-end communication and management of the smart sensors - no need for physical access for management purposes à cost reduction.
- Increase the overall system security.
- Effectively accesss control to the application servers and the energy smart meters.

Further Opportunities

- Interconnect more (all) schools
- Introduce more services to the school community
- Involve other governmental organisations and extend to other governments buildings
- Develop IPv6-enabled sensor labs, e.g. metorological
- Disseminate best practices and cooperate with others
- Apply similar principles to other European countries
- Advanced services create new challenges for the design teams and operations

GREEK IPv6 PILOT
powered by partnership

Computer Technology Institute and Press "Diophantus"

Greek Research and Technology Network S.A.

Intelen
DATA ANALYTICS FOR ENGAGEMENT SOLUTIONS

Work was partially supported by the European Commission
as part of the project «Governments Enabled with IPv6 (GEN6)».
GEN6 is about stimulating EU-wide deployment of IPv6
by means of best practices and guidelines.

National pilots to make a step further in IPv6 deployment in different sectors.
Cross-border pilots to demonstrate EU-wide interoperability of IPv6.
Communication activities and road shows to ensure dissemination
in public administrations and with other relevant stakeholders.

GREEK IPV6 PILOT

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