

GOVERNMENTS ENABLED WITH IPv6

IPv6 and Energy Efficiency in School Networks

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Intelen

Intelen
ENGAGING PEOPLE TO RETHINK



EU GEN6 Road show

IPv6 Pilot in Greece: “Energy Efficiency in School Networks with IPv6”



Objectives of Greek Pilot

- **Prove IPv6** as a service enabler
- **Raise energy awareness**
- **Engage school communities**
- **Adopt IoT philosophy**



IPv6 Pilot in Greece: “Energy Efficiency in School Networks with IPv6”

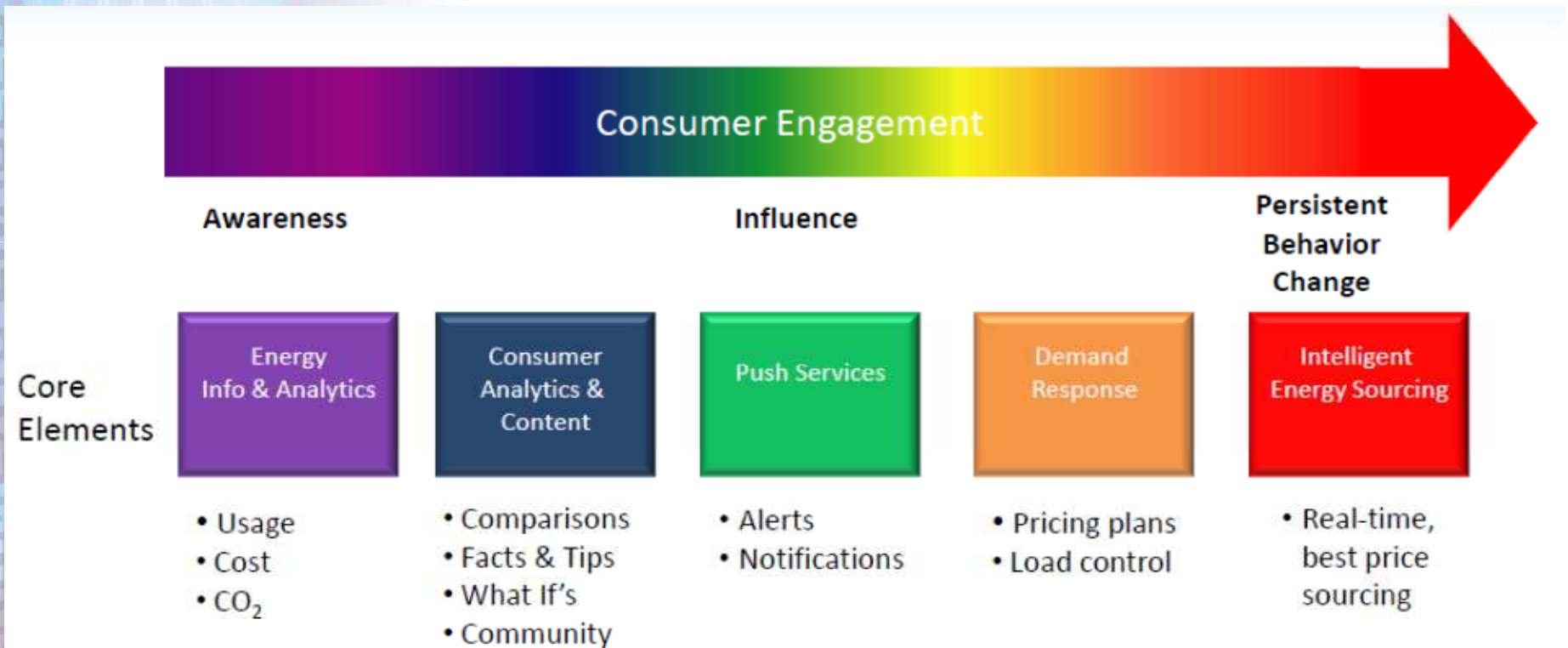


What is the VISION ?

To create an interactive pan-European Green Schools Network over IPv6 technologies where student communities interact, engage & learn from real data



IPv6-based IoT Engagement



Human engagement life-cycle

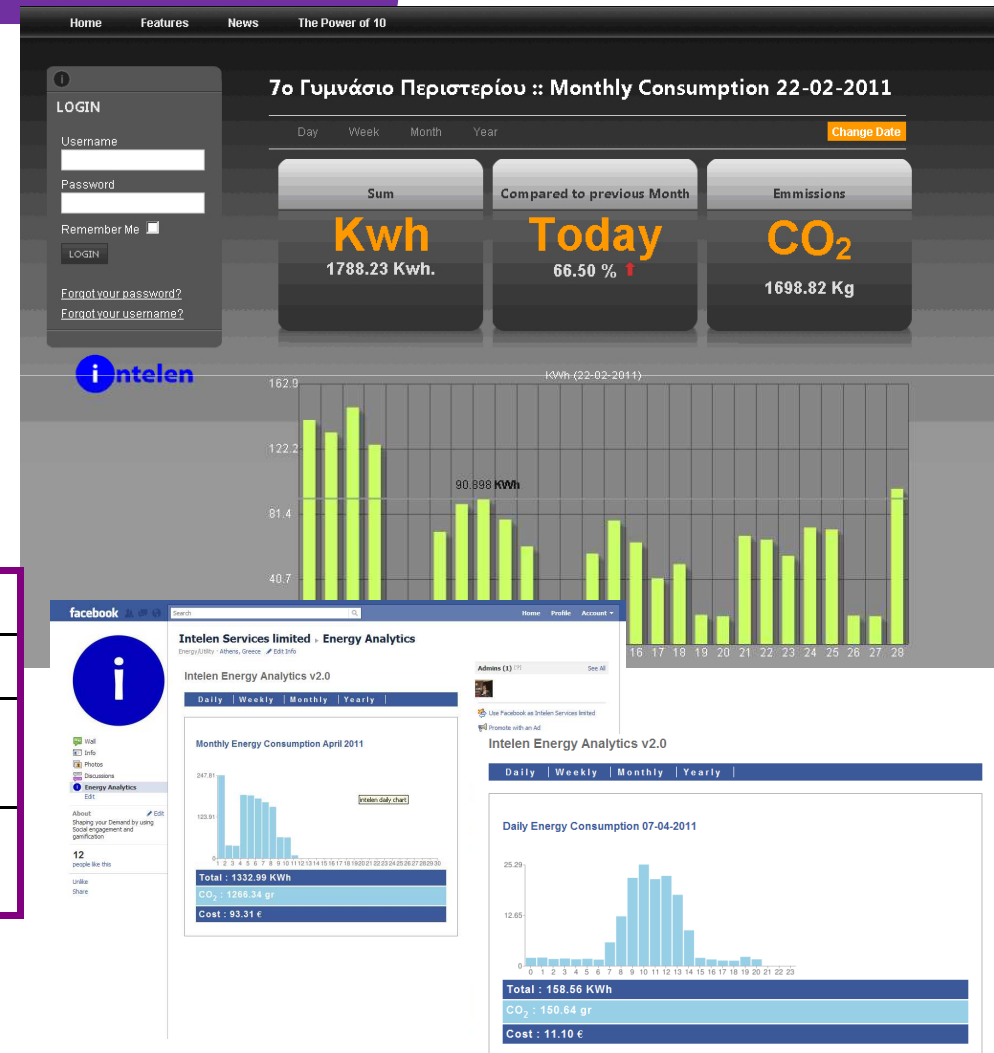
IPv6 Pilot in Greece: “Energy Efficiency in School Networks with IPv6”



Old reference project

- A 12 week project (Feb-May 11)
- Prove that through competition and games in Intelen & Facebook platform, a noticeable shape of demand can be achieved.

AVG Engagement time	23 min
AVG Playing time	3,6 hrs/day
AVG annual cost reduction during games	2.200 €
AVG energy reduction during games	29%

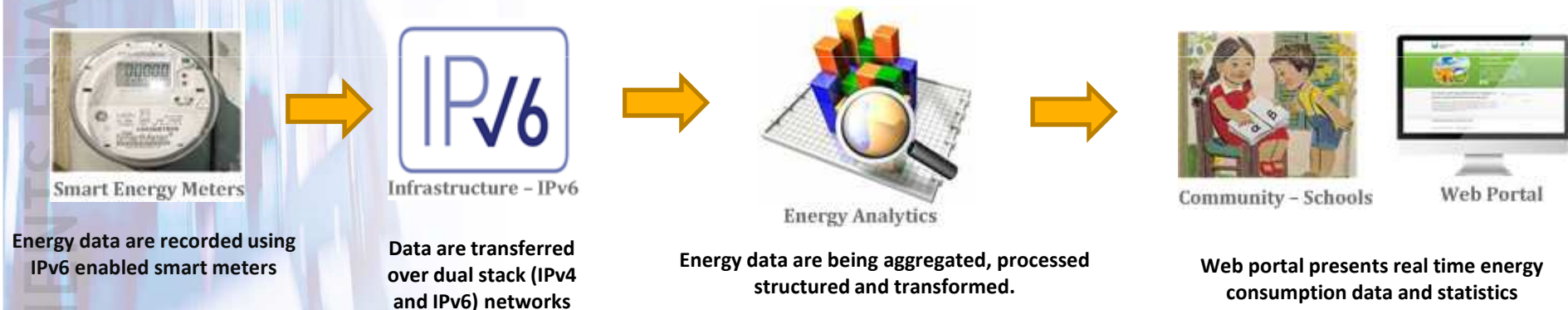


IPv6 Pilot in Greece: “Energy Efficiency in School Networks with IPv6”



Pilot

The pilot provides real-time energy efficiency services over IPv6-enabled networks to the local educational community



50 schools , 11500 students

IPv6 Pilot in Greece: “Energy Efficiency in School Networks with IPv6”

Pilot's Partners



IPv6 networks



The **Greek Research & Technology Network (GRNET)**, responsible for providing networking and cloud computing services to the Greek academic and research communities

energy metering

analytics

Intelen
DATA ANALYTICS FOR ENGAGEMENT SOLUTIONS

The **Intelen**, a start-up company providing services to the Energy and ICT sector, such as smart metering, meter data management

school communities

portal



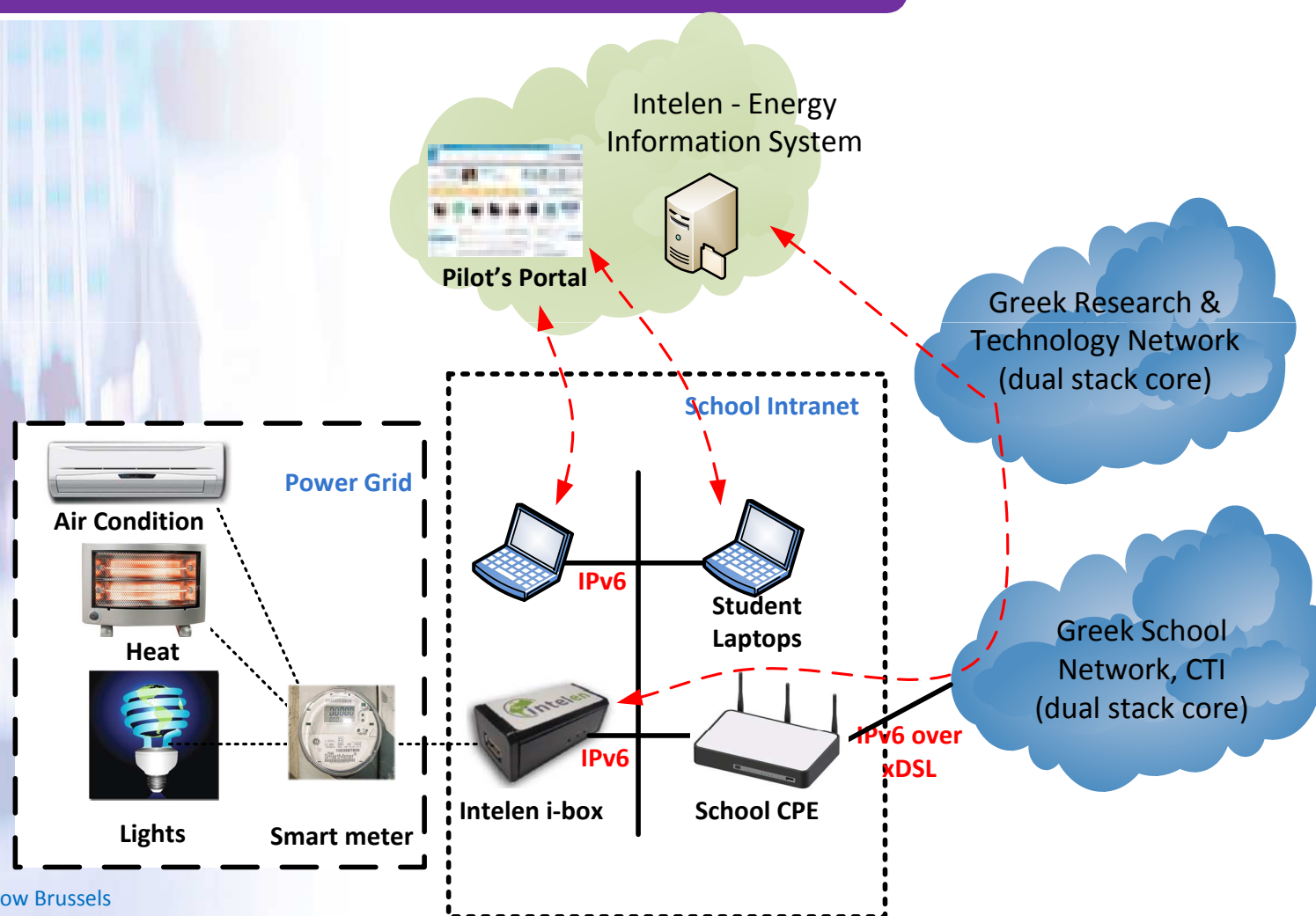
The **Computer Technology Institute & Press “Diophantus” (CTI)**, responsible for the administration and the daily operation of the Greek School Network

educational methods

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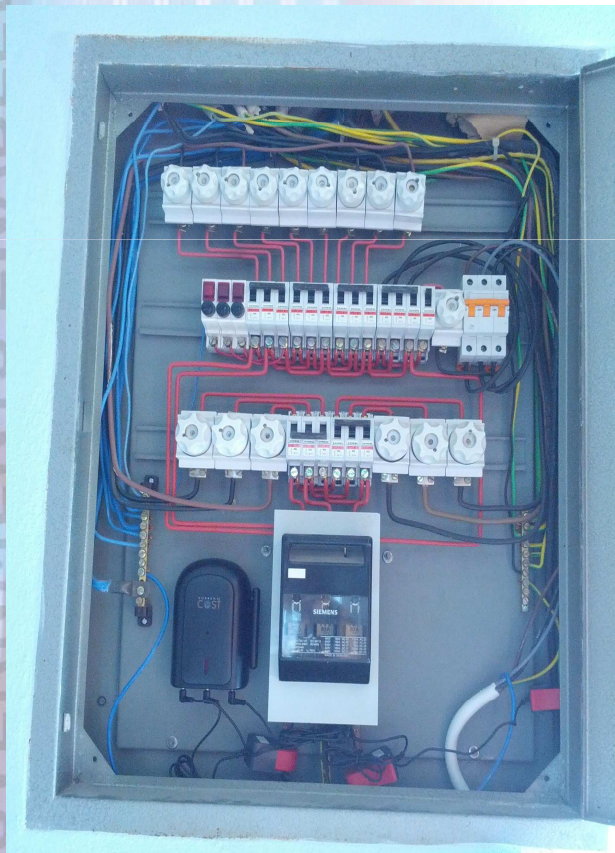


Technical Description



Energy Metering

- The smart metering infrastructure consists of a consumption metering device and the i-box
- The i-box is a network device that acts as a data bridge between the power meter and the school's router
- Both i-box and school router have IPv6 global address



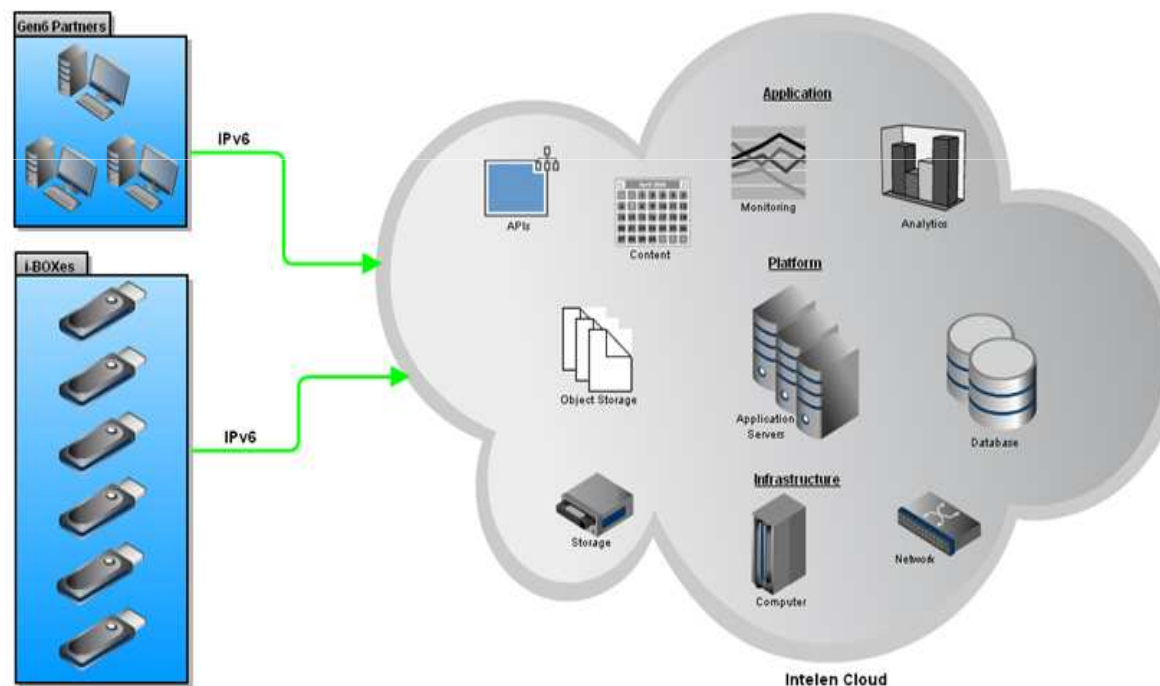
1510 Δημοτικό Σχολείο Αθηνών
Ημερ. Εγκατ.: 09/10/2013
Εγκαταστάτης: Λουκάς Ντούνης



Energy Analytics

Energy Information System in the cloud

- Energy data are being aggregated, structured and transformed
- Energy data are also correlated with other data (other schools, school area, student count, etc.)
- Calculations and data mining algorithms are performed



IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”



Networking Infrastructure

Backbone:

Based on 8 PoPs of GRNET

Distribution Network:

51 nodes

(8 main, 43 secondary)

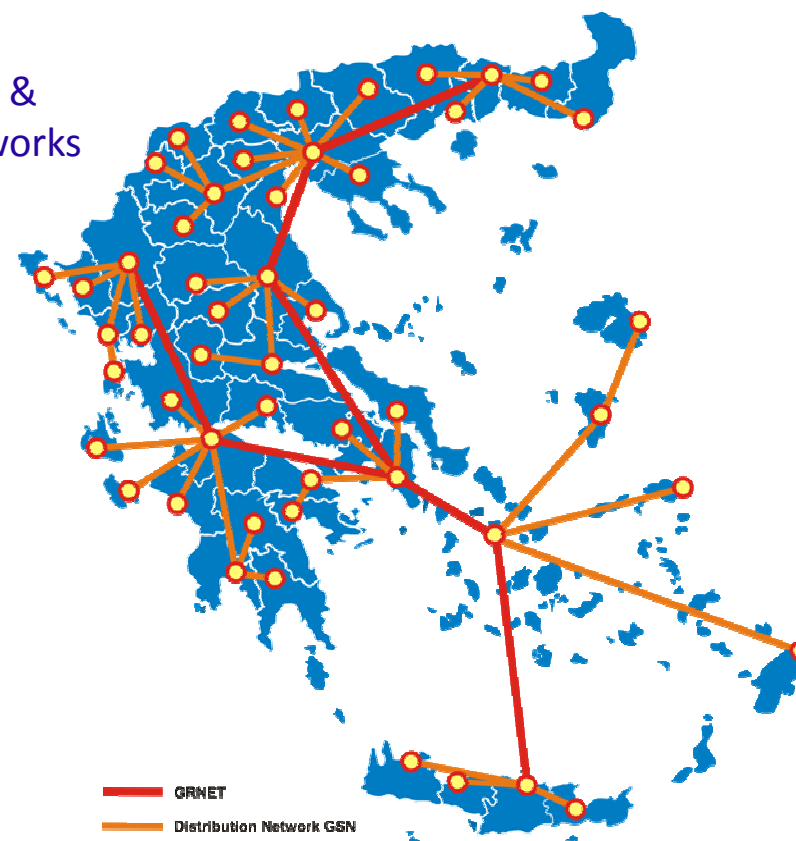
Access Network technology:

- ADSL
- Dialup (ISDN, PSTN)
- Leased Lines (SDSL, VDSL),
- Wireless
- Optical

Number of connected schools:

- 6k primary education
- 4k secondary education
- 0.5k administration offices

The GRNET backbone & GSN distribution networks are dual stack i.e. supporting both IPv4 and IPv6

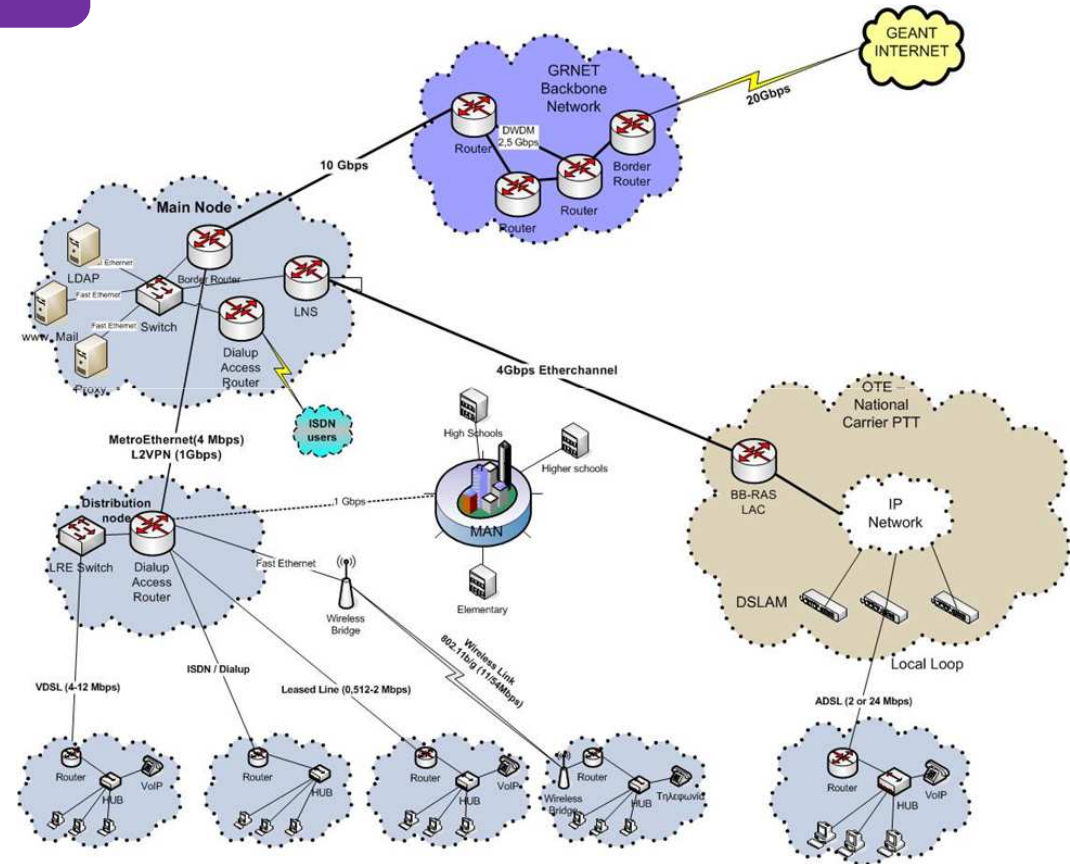


www.sch.gr

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Networking Infrastructure

- The GRNET backbone & GSN distribution networks are dual stack i.e. supporting both IPv4 and IPv6
- On the access network, IPv6 has also been enabled for 95% of GSN users



IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”

Web Portal – gen6.cti.gr



The screenshot shows the web portal for the Greek IPv6 Pilot project. The header includes the 'GREEK IPv6 PILOT' logo, social media icons for Facebook, Twitter, YouTube, and RSS, a search bar with the text 'Enter keyword', and flags for Greece and the UK. The navigation menu contains links for Home, GEN6, Energy Consumption, Educational Material, Activities, and Contact. The main content area features a large green banner with the title 'Energy consumption in schools' and a description of the pilot project. Below this, there is a section titled 'Real-time Monitoring of Energy Consumption into 50 Schools' with a detailed paragraph about the project's goals and a 'More»' link. A quote by Benjamin Franklin is also displayed.

GREEK IPv6 PILOT

Home GEN6 Energy Consumption Educational Material Activities Contact

Energy consumption in schools

The purpose of the proposed action is the pilot installation of a recording system (smart energy meter) of 50 schools energy consumption in real time.

Real-time Monitoring of Energy Consumption into 50 Schools

In this context, the Greek pilot in GEN6, a European Commission funded project, aims to influence the behaviour of the local school communities by raising their energy awareness. As discussed herein, the pilot will provide real-time energy efficiency services over IPv6-enabled grids to the local educational community, providing students with information on their consumption patterns and raising awareness among them on the energy savings that behavioural changes may bring [More»](#)

“Energy and persistence conquer all things.”

Benjamin Franklin

IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”

Web Portal – gen6.cti.gr

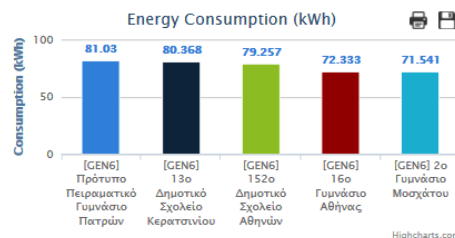


Real Time Energy Consumption Monitoring

Select Consumption Period

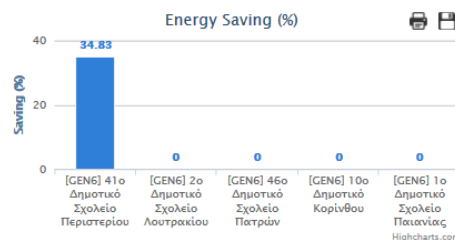
Energy Consumption (kWh)

	School Name	Consumption (kWh)
1	[GEN6] Πρότυπο Πειραματικό Γυμνάσιο Πατρών	81.030
2	[GEN6] 13ο Δημοτικό Σχολείο Κεραιτσινίου	80.368
3	[GEN6] 152ο Δημοτικό Σχολείο Αθηνών	79.257
4	[GEN6] 16ο Γυμνάσιο Αθήνας	72.333



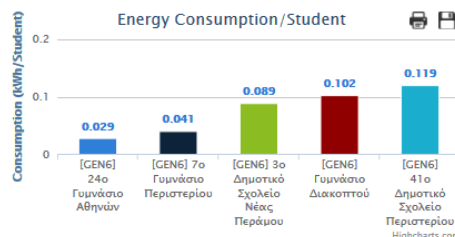
Compared to Previous Date Interval (%)

	School Name	Comparison (%)
1	[GEN6] 41ο Δημοτικό Σχολείο Περιστερίου	34.83
2	[GEN6] 2ο Δημοτικό Σχολείο Λουτρακίου	0
3	[GEN6] 46ο Δημοτικό Σχολείο Πατρών	0
4	[GEN6] 10ο Δημοτικό Κορίνθου	0
5	[GEN6] 1ο Δημοτικό Σχολείο Παιανίας	0



Energy Consumption/Student (kWh/Student)

	School Name	kWh/Student
1	[GEN6] 24ο Γυμνάσιο Αθηνών	0.029
2	[GEN6] 7ο Γυμνάσιο Περιστερίου	0.041
3	[GEN6] 3ο Δημοτικό Σχολείο Νέας Περάμους	0.089
4	[GEN6] Γυμνάσιο Διακοπτού	0.102
5	[GEN6] 41ο Δημοτικό Σχολείο Περιστερίου	0.119



More >

- Categorize schools based on their energy efficiency using KPIs

- Energy consumption (KWh)
- Energy consumption comparison to the previous day (%)
- Energy consumption / student / square meters (Kwh/student/m2)

- Consumption Period:

- Daily
- Weekly
- Monthly
- Yearly

IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”



Web Portal – gen6.cti.gr

Summary Table For Daily Energy Consumption

Period

Daily Energy Consumption

Search Schools

Name

Address

Type

All

Prefecture

All

Search

Clear

School Name	Number of Students	Energy Consumption / Student / m ²	Comparison to Previous Day %	CO ₂ Emissions
Αιγάλεω	10	0	-2.374	50.043
[GEN6] 49ο Γυμνάσιο Αθηνών	10	0	-6.422	65.359
[GEN6] 41ο Δημοτικό Σχολείο Περιστερίου	10	0	0.000	0.000
[GEN6] 23ο Γυμνάσιο Αθηνών	10	0	38.044	32.576
[GEN6] 27ο Δημοτικό Σχολείο Πειραιά	10	0	-4.555	57.133
Ασπροπύργου	10	0	-0.792	130.453
[GEN6] 1ο Δημοτικό Σχολείο Παιανίας	242	0	7.233	142.107
[GEN6] 1ο Γυμνάσιο Ραφήνας	10	0	0.000	0.000
[GEN6] 13ο Δημοτικό Σχολείο Κερατσινίου	10	0	-5.336	132.459

1 - 29 of 29 items10 | 25 | All1

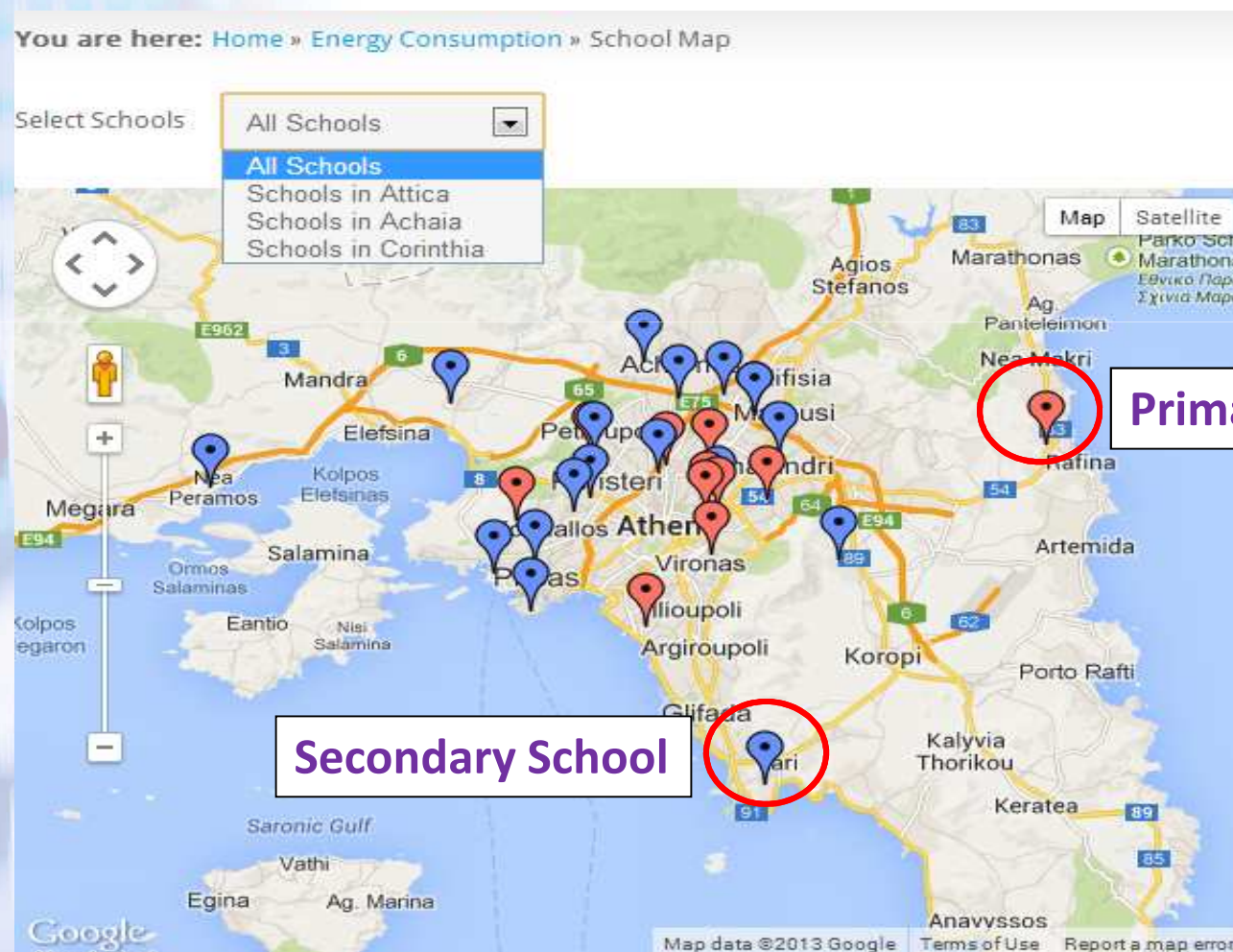
Search schools with various criteria

Search schools with various criteria

IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”



Web Portal – gen6.cti.gr



IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”



Web Portal – gen6.cti.gr

Period:

Date:

[GEN6] 1ο Δημοτικό Σχολείο Παιανίας

Γ.Κατσιμίχα, 19002, Παιανία

242

142 (m²)

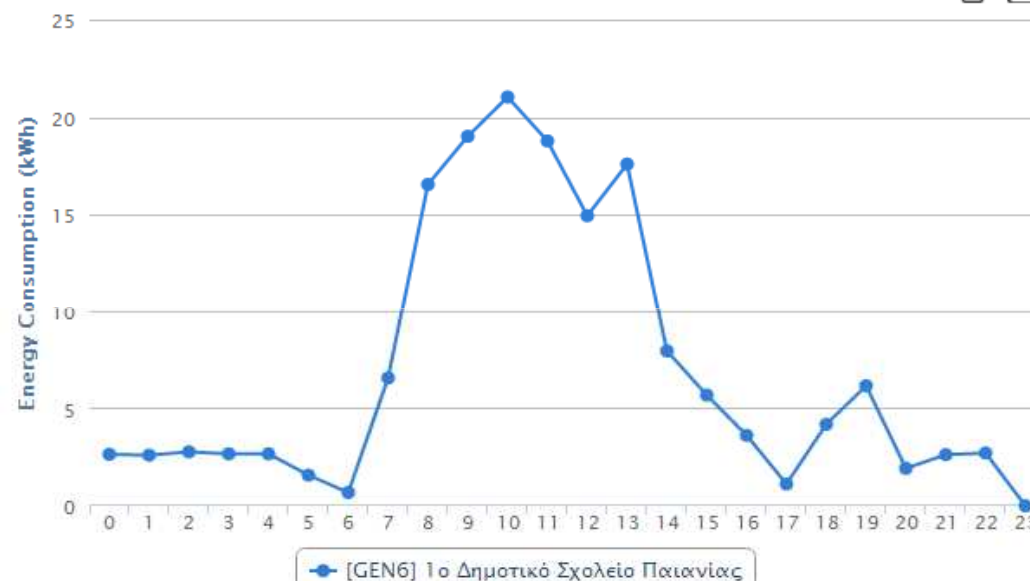
17 °C

Wind: 2 km/h

Humidity: 67 %

broken clouds

Daily Energy Consumption: 9-10-2013



Highcharts.com

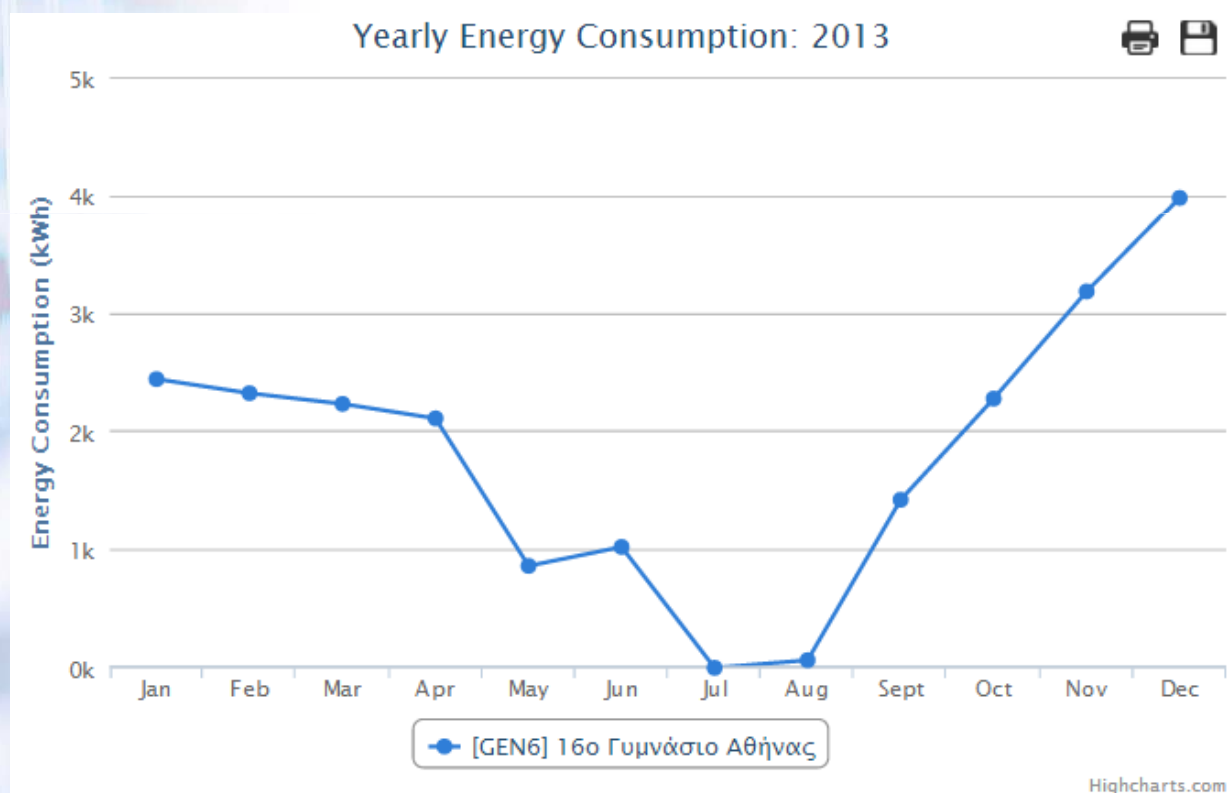
Total Consumption (kWh)	162.665
Number of Measurements	87
Completeness of Measurements (%)	94.57
Comparison To Previous Day (%)	4.64
CO ₂ Emissions	138.265

IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”

Web Portal – gen6.cti.gr



Schools with more than one year of energy data !!!





Networking Infrastructure

Benefits of IPv6 / problems with IPv4

- IPv6 removes the limitations imposed by the IPv4 address shortage
 - Every school has a NAT / PAT gateway due to address shortage
 - Difficult to debug interconnection problems
 - IPv6: Enough address space for every school and pupil!
- P2P applications do not work with servers behind PAT
 - Multimedia e-learning and peer-to-peer virtual collaboration applications
 - IPv6: Easier P2P application development



Networking Infrastructure

Benefits of IPv6 / problems with IPv4

- Management and security issues
 - Deployment procedures in large numbers (auto-configuration of CPE routers and PCs)
 - Address fragmentation resolved
 - Easier aggregation of classes of users
 - Security (based on ACLs) simplified using the IPv6 addressing schema
- Innovation – Expose to new technologies
 - Today’s school pupils are the future engineers
 - IPv6 allows the development of new advanced services that exploit features unique to IPv6 environments, such as enhanced security, multicast or mobility, QoS, etc
 - Multiply the impact of other IPv6-enabled networks in Greece

“Energy Efficiency in School Networks with IPv6”



Goals Analysis



Action

Encourage students to come up with ideas and reduce their energy footprint



Word Spreading

Challenge students to spread the word and engage their family and community into adapting environmentally friendly habits



“Energy Efficiency in School Networks with IPv6”



Green Agents Recruitment

IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”

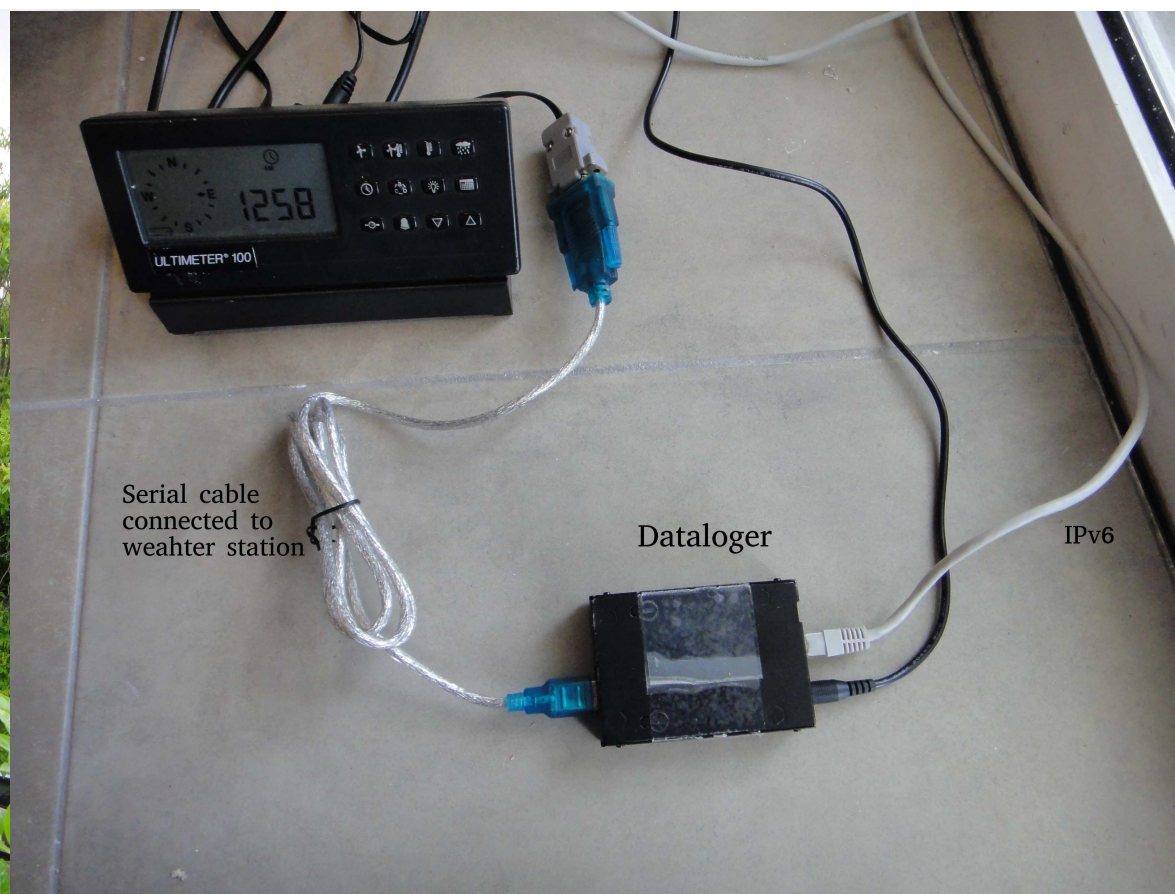
Current status

- Completion of installations in 50 schools in Attica, Achaia, Corinthia
- Collection of energy consumption data over IPv6 from the existing systems
- Dissemination activities in schools
- **Install other kind of sensors (e.g., weather related) to schools**



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IPv6 IoT Sensors



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IPv6 IoT Sensors

ContikiRPL - Mozilla Firefox

ContikiRPL x Sensor interface x +

[2001::212:7400:16c0:6462]

Neighbors

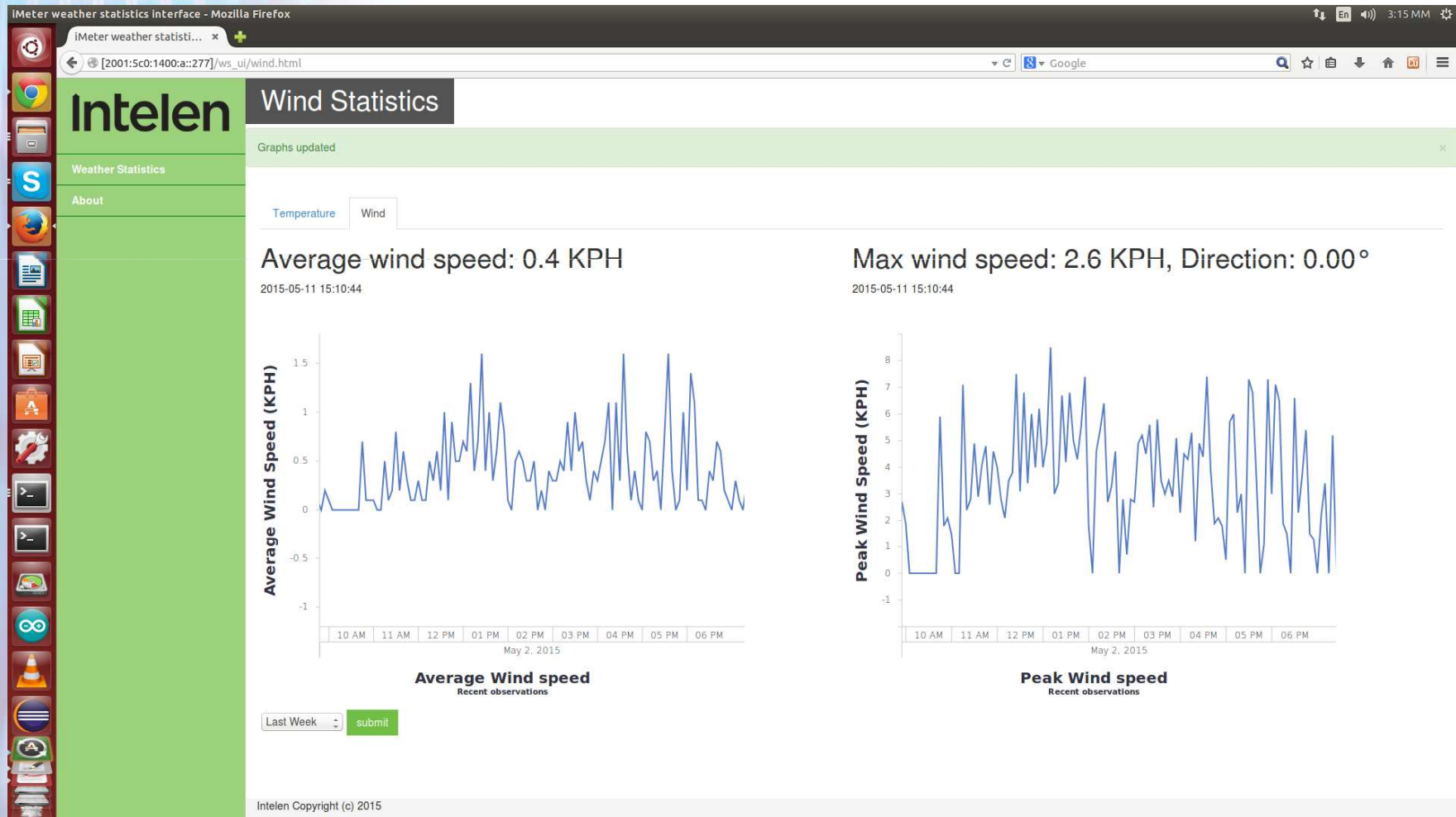
fe80::212:7400:16c0:681a

Routes

2001::212:7400:16c0:681a/128 (via fe80::212:7400:16c0:681a) 16711420s

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IPv6 IoT Sensors



Mobile App



Social actions



Social motivation



School meters & IoT Sensors



Public energy data portal

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Intelen**BIG**

intelen ▾



Intelen**BIG**
PROFILE

SELECTED GAME

Sustainability Game ▾

Konstantinos ▾



Overview



My Stats



Prizes



Join Game



Mobile Preview



Help

START
11-15-2013

END
03-15-2014

Game Rank

#1

Days Left



BUILDING

Block of appartments USA

DIVISION

App A.1-0-

Points

1.234

Awareness

98%

Engagement

65%

Effectiveness

98%

This dashboard was generated on 09/12/13 at 3:24:34 pm // [Refresh dashboard now](#)

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IPv6 Pilot in Greece “Energy Efficiency in School Networks with IPv6”



Conclusions

- **IPv6** can become an **enabling technology**
- **IPv6** in support of **Sensor grids**
 - Higher Security
 - Easier interoperability and fast installation
 - Bi-directional communication
- **IPv6** in support of **IoT**
 - Bigger address space, everything connected
 - Point-to-point control and access tunneling to real time data
- **Energy Efficiency in Schools pilot** has a **huge impact**
 - 50 Greek Schools, with about **11500 students !!!**
- **Inform the student communities in real time**
 - how much energy is consumed by their actions
- **Change students' behavior** towards environmental protection
- **Reduce energy** consumption

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Thank you!

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www.gen6-project.eu

gen6.cti.gr