



## National Infrastructures for Research and Technology GRNET

Advanced e-Infrastructures and Digital Services  
for Public Administration, Education, Research,  
Health & Culture sectors



# GRNET's Mission

National Infrastructures for Research and Technology -  
GRNET's mission is to offer an integrated environment of cutting-edge technologies, model digital solutions, infrastructures and specialized expertise which contributes to the modernization and digital advancement of the overall citizen experience in the fields of Public Administration, Education, Research, Health and Culture.

# GRNET's Role (1)



State-owned company (SA) established in 1998, operating under the auspices of the Greek Ministry of Digital Governance.

- Promotes and implements the strategic goals of the Ministry of Digital Governance, designs and develops advanced information systems and e-Infrastructures to achieve Greece's Digital Transformation goals.
- Researches, develops, disseminates and promotes ICT solutions and provides advanced e-Infrastructures & Digital Services to the Greek academic, research institutions, public administration, culture and health organizations and their communities:
  - National and International connectivity;
  - e-Infrastructures & Digital Services include: networks, computing, storage, data centres
  - Implements and manages European, International and National Projects.
  - Provides international cross-connectivity through the GÉANT pan-European network and is the official National Research and Education Network (NREN) body for Greece.
  - Operates the GR-IX::The Greek Internet Exchange, the national neutral and non for profit infrastructure platform interconnecting all significant Internet players in Greece, (internet service providers, content providers etc).

## GRNET's Role (2)



- Offers an integrated environment of cutting-edge technologies and provides infrastructural and technology support to academic and research institutions, educational institutions at all levels, and to all public sector agencies and organisations.
- Develops, operates and promotes the National initiatives and portal for digital skills in Greece. A pilot project for the development of digital competencies and a central reference point for digital education.
- Carries out technological research and development on telecommunications networks and computing services.
- Advises and supports the Greek State in designing advanced information systems and infrastructures, designing, developing and maintaining advanced computing & network infrastructures and services, data centers, high performance computing system (HPC-ARIS), and the nation-wide fiber optic network.
- It is the main infrastructure/service enabler for Open Science in Greece and leader in a coordinated effort for development of electronic infrastructures and services in Southeast Europe and the wider region.

# Communities, Users @ Sectors: Public Administration, Education, Research, Health, Culture



## Organizations and Institutions

- ✓ Universities
- ✓ Research Centers
- ✓ Large Research Infrastructures
- ✓ Hellenic School Network
- ✓ Public Libraries
- ✓ Culture Centers
- ✓ Content Providers
- ✓ Public Administration sector
- ✓ Public Health Sector (Hospitals, Blood Donation/Transfusion Services)

## Types of Users

- ✓ Academic and Research Community users
  - ✓ Students, Professors, Researchers, Academic and Administration Management, Network Operations Centers (NOC), Technical Staff
- ✓ Health Sector users
  - ✓ Hospital: Doctors, Administration, Management, NOC, Technical
  - ✓ Blood Donor Volunteers
- ✓ Public Administration Officers
- ✓ Citizens

# Benefits for all



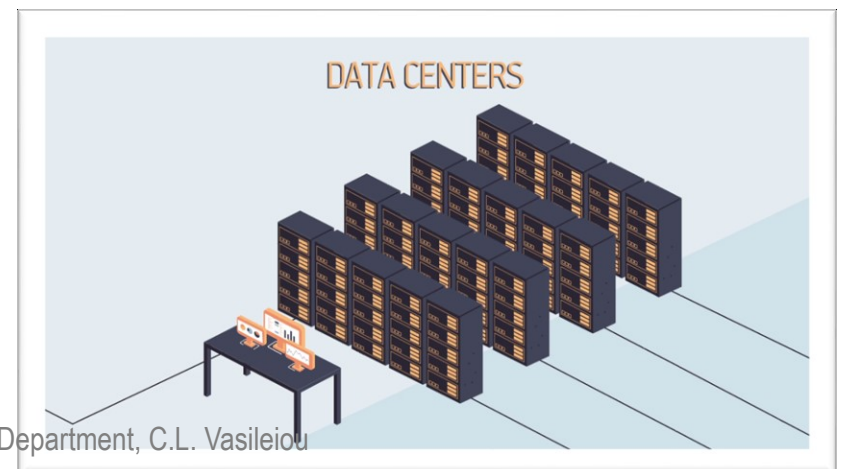
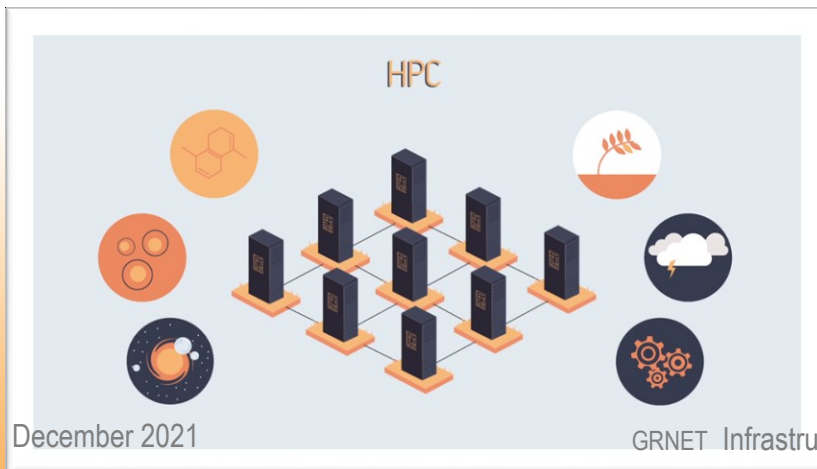
**GRNET offers an integrated environment of cutting-edge technologies, e-Infrastructures and digital services to its users, contributing to the:**

- Ministry of Digital Governance's goal to achieve Digital Transformation for the country, aiming to upgrade and improve the overall citizen's experience in receiving public services;
- implementation of the National Digital Strategy 2020-2025,
- empowerment of the research community and the growth of research activity in the country;
- enhancement of the educational processes, supporting the development of digital skills for all and improvement of the educational experience;
- constitution of a more extroverted Greek Research and Education community by offering equal participation opportunities for its members in ICT global actions;
- modernization of the Health sector and the improvement of the overall citizen's health service provision experience;
- shaping of new models of cooperation amongst public agencies, research and education communities, citizens and businesses;
- optimization in the use of Greek State resources in the sectors of Public Administration, Education, Research, Health and Culture.

# GRNET in numbers



- Connects all universities, research centers, academic organizations and a great number of hospitals
- Dark fiber backbone (Nx10 Gbps) + Access 1 || 10 Gbps per institution
- International connectivity through GÉANT network multiple 10 Gbps
- Operates the Greek Internet Exchange (GR-IX) node (as trusted third party) – peering all Greek ISPs and SPs up to multiple 10 Gbps (open, neutral)
- HPC: 444 TFlops HPC Tier-1 centre/ fat + GPU nodes, PRACE
- Public Cloud (~oceanos – over 400,000 virtual machines spawned)
- VPS VM provisioning (>400 VMs) Storage Services
- 6 DataCenters (NHRF, Minedu Marousi - Athens, Louros Arta, Heraklion Crete)
  - hosting: 84 racks, 1200+ servers, n\*10s thousands Virtual Machines, 9 PB of raw disk storage and 5 PB tape





# SERVICES

INTERNET



CLOUD COMPUTING



AUTHENTICATION &  
AUTHORIZATION



SECURITY



AUDIO



VOICE



VIDEO



**HPC-ARIS:**

[hpc.grnet.gr](http://hpc.grnet.gr)

**~okeanos:**

[okeanos.grnet.gr](http://okeanos.grnet.gr)

**ViMa:**

[vima.grnet.gr](http://vima.grnet.gr)

**GR-IX:**

[gr-ix.gr](http://gr-ix.gr)

**eduroam:**

[eduroam.gr](http://eduroam.gr)

**DIADOSIS:**

[diadosis.grnet.gr](http://diadosis.grnet.gr)

**Harmoni:**

[harmoni.grnet.gr](http://harmoni.grnet.gr)

**Blood Donor Registry:**

[bdr.gr](http://bdr.gr)

**ZEUS:**

[zeus.grnet.gr/zeus](http://zeus.grnet.gr/zeus)

**Eury-where:**

[eury-where.gr](http://eury-where.gr)

**e:Presence:**

[epresence.gr](http://epresence.gr)

**DIAVLOS:**

[diavlos.grnet.gr](http://diavlos.grnet.gr)

**Academic IDs:**

[academicid.minedu.gov.gr](http://academicid.minedu.gov.gr)

**FoD:**

[fod.grnet.gr](http://fod.grnet.gr)

**Security CERT:**

[cert.grnet.gr](http://cert.grnet.gr)

**Eudoxus:**

[eudoxus.gr](http://eudoxus.gr)

**APELLA:**

[apella.minedu.gov.gr](http://apella.minedu.gov.gr)

**ATLAS:**

[atlas.grnet.gr](http://atlas.grnet.gr)

**PYXIDA:**

[pyxida.grnet.gr](http://pyxida.grnet.gr)

**Unified Digital Portal**

[gov.gr](http://gov.gr)

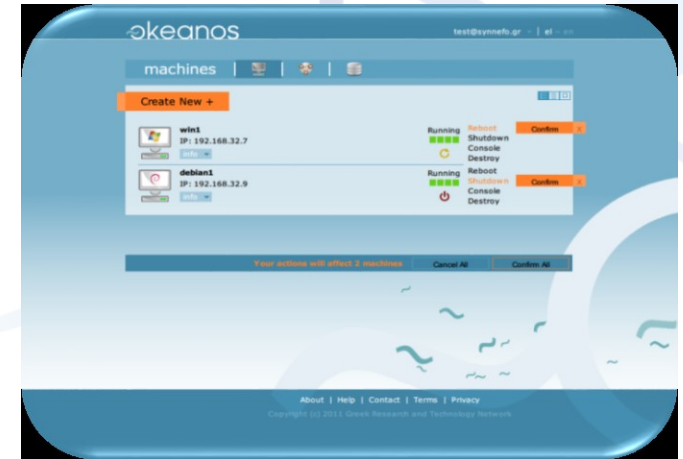


# GRNET: Advanced computational and storage services



## For the research and higher education community offers:

- Computing, Networks and Storage for all:
  - Universities, Research Centers, Institutes, Laboratories, Classes, Students, Researchers
- The possibility to supply a full computer operating system and network in seconds
- Development of Information Systems at minimum time, dynamic allocation in real time
- Distribution through the Internet (Amazon style- IaaS)
- Online file storage and syncing (Pithos+ Service)



# GRNET DataCenters

- GRNET is operating 6 Data Centers in 3 different locations in Greece offering Cloud Computing services (all 6 interconnected for geo protection disaster recovery ) to the Greek Academic & Research Community and Greek Public Administration:
  - The first Green Data Center in Greece next to Louros river, in Ipiros is powered by Renewable sources and cooled by river water achieving a PUE lower than 1.3.
  - Data center for Hospitals operates in Knossos, Crete, offering storage and cloud services
  - In NHRF the Data Center interconnecting GRNET with the Internet Universe is operated
  - HPC DataCenter Operates in Ministry of Education and Religion (Minedu)
  - Two more Data Centers (DC1 and DC3) operate in Minedu as well offering Cloud Services

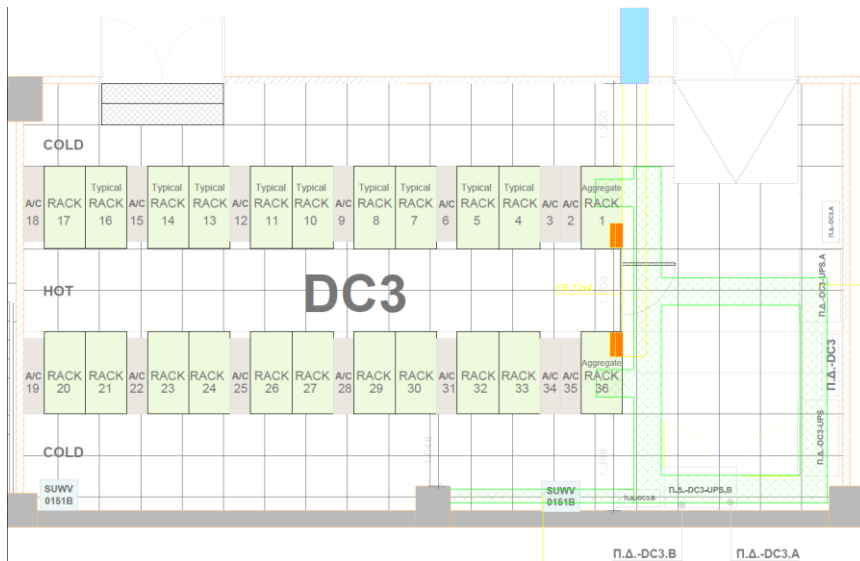
# Athens DCs affected by Forest Fires

- Data Centers affected are Tier II by Design, showing a total of 2 hours downtime accumulated during the last 6 years, namely less than half an hour per year
- Evolution to Tier III Data centers is being scheduled
- Installed Power sums up to 450 kW for DC1 and DC3
- Cooling Capacity is redundant (N+1) using chilled water and water to air in row exchangers
- Services hosted are crucial for Digital Transformation in Hellenic Public Sector

# GRNET's DC3

Layout

Typical Aspect



# August 3<sup>rd</sup> , 2021, The case

- Large forest fires in Attica area and Evia caused several issues (About 177,000 acres of forest area burned out in August 2021, in Attica) :
  - Large Smoke amounts restricted breathing for both humans and machines
  - Extensive damages over Public Power Distribution Network created heavy Power Quality fluctuation
  - Service delivery in GRNET's Athens Data Centers DC1 and DC3 jeopardized due to extreme conditions, namely Power and cooling

# GRNET DCs, Measures & Procedures

1. Data Centers are monitored 24 X 7 :
  - Remote monitoring systems are in place and TOC is on duty round the clock
  - BMS systems sent over e-mails in case of fault, according to fault severity
  - TOC escalates by phone should the case reach a predefined risk level
2. Procedures followed :
  - TOC reports daily on all issues
  - Data Center entrance is monitored and reported daily
  - Qualified GRNET engineers are trained to handle emergency cases following written procedures that cover all encountered (to date) issues.
  - Prime Directive: Uninterruptible Service provisioning

# August 3<sup>rd</sup> ,2021, The actual problem

1. Due to heavy Power Distribution Network fluctuation :
  - An average of more that 30 Voltage Surges within 10 minutes was encountered. Peak moments demonstrated 4-5 surges a minute
  - UPS batteries suffered a high frequency discharge / charge loop
  - UPSs brought to almost critical state.
  - Input power quality out of range
  
2. Due to Smoke clouds:
  - Fire detection systems started giving pre-alarm signs
  - Heat and Smoke affected Chiller's cooling capacity



# August 3<sup>rd</sup> ,2021, Action taken-1

1. Follow emergency procedures and measures
  1. Alert stakeholders on the case
  2. Fire detection systems set to manual : Prevention of accidental false fire alarm and extinguisher ignition
  3. Shifts on site established round the clock
  4. Power source forced to Local generator
  5. Emergency check on UPSs reveals issues :
    - Unexpected external battery breakers opening
    - Power Supply redundancy not as planned
  3. Resolve all UPS and chiller issues
  4. Patrol all support systems every hour, including Diesel reserves and consumption

# August 3<sup>rd</sup> ,2021, Action taken-2

1. Assuring Service Provisioning continuity
  1. Verify connectivity (Internet, Clients)
  2. Verify all support systems (UPSs, Chillers, in row cooling) run smoothly under auxiliary power
  3. Verify all IT systems run smoothly under auxiliary power
  4. Patrol all systems continuously (both remotely and on site) for likely disruptions / failures
  5. All shift personnel instructed to follow procedures should any further issue occur

# August 3<sup>rd</sup>, 2021, Analysis -1

## Root Cause

1. Forest fires disrupted Power network connections, while power demand in Athens area remained high
2. Above issues forced Power Network breakers to open due to overload while more energy sources were driven to feed demand. Probably switching on and off formed Network fluctuation
3. This caused UPS power input surging very often, forcing battery operation engagement on and off, cycling faster than expected for UPS operation
4. Therefore batteries were exhausted and breakers opening should be an expected consequence.

# August 3<sup>rd</sup>, 2021, Analysis -2

## Remedy

1. Switch to Diesel generator eliminated power input issues
2. Cleaning chillers from smoke and carbon particles (washing with water under pressure) restored proper cooling efficiency (important in a 34o C night)
3. Following procedures ensured service delivery continuation

## Lessons Learned

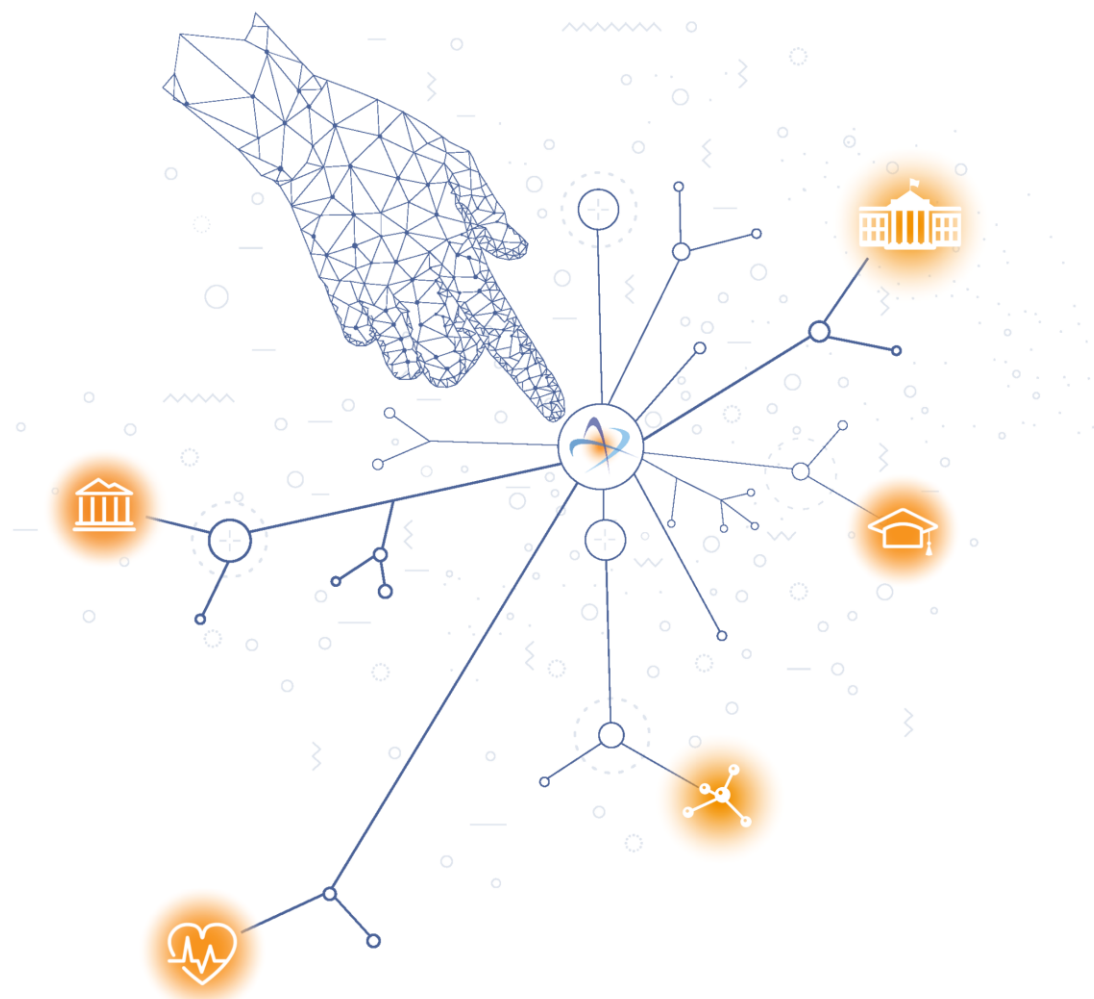
1. Monitoring 24 x 7 a datacenter is good practice
2. Ups Power supply is subject to input conditions
3. Electronic surveillance is great but human intervention is needed in emergencies
4. Datacenter operations and design can and should always improve
5. Extreme situations require extreme measures

# Lessons Learned

## Conclusions

1. Service delivery must be uninterrupted, even under hard situations
2. Following Documented procedures ensures Datacenter Operations even in hard situations
3. Implement lessons learned and evolve
4. There is always ground for improvements in Data Center Operations, schedule it!

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[info@grnet.gr](mailto:info@grnet.gr)

