Εισαγωγή στον Προγραμματισμό

Εισαγωγική ενότητα (25%) : Βασικές έννοιες και τομείς της Επιστήμης Υπολογιστών 6η ομιλία

Παναγιώτης Τζουνάκης

Χειμώνας 2026



Τμήμα Μαθηματικών
Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



World Wide Web: Παρασκήνιο & Θεμέλια

Αντικείμενα παρουσίασης :

- Κέντρα Λειτουργίας Δικτύων (Network Operation Centers – NOCs)
- Οργανισμοί (Organizations)
- Σύλλογοι / Κοινότητες (Societies / Communities)
- Υποδομές (Infrastructures)
- Υπηρεσίες (Services)
- Δραστηριότητες (Activities)





World Wide Web: Παρασκήνιο & Θεμέλια

Στόχοι παρουσίασης:

- Present the most important real artificial network.
- Identify the infrastructures that make the web function.
- Identify the different interconnected networks. These networks are different, but there are harmonious correspondences which guarantee the overall functionality.





Σύντομο ιστορικό

http://en.wikipedia.org/wiki/History_of_the_Internet

Government-built Internet or private-sector-build?

NEITHER & BOTH! Nowadays,

Internet = "commons-based peer production."

Build by a human open, decentralized, peer network

+

Web is built on Top of the Internet





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Celebrating people who bring the Internet to life

HOME | INDUCTEES | NOMINATIONS | INTERNET HISTORY | SPEAKERS | PRESS | BLOG | ABOUT



HALL OF FAME HIGHLIGHTS...

The Internet's Early Networker

Everything old is new again for Ed Krol, author of The Hitchhiker's Guide to the Internet. Find out why in our exclusive interview. MORE

MEET THE INDUCTEES

HALL OF FAME HIGHLIGHTS

Lessons for Today in Internet's Past

Everything old is new again for Internet Hall of Fame inductee Ed Krol. The author of "The Hitchhiker's Guide to the Internet," one of the earliest non-technical guidebooks, and "The Whole Internet" book series, Krol helped create the web's early in...

MORE

In THEIR *own* WORDS

Venezuela's First Connection a Result of "Sheer Luck"



Ermanno Pietrosemoli is known as a pioneer, both for his efforts to connect Latin American to the Internet and for setting a world record for distance of a Wi-Fi signal.

MORE

IN *the* NEWS

APNIC Partners On Experiment to Improve DNS

ZDNet

An experiment is underway to better understand the security protocols protecting commonly used domain name system servers.

MORE

Internet HISTORY *Timeline*

Mapping inductees' defining moments in Internet history.

ARPA

ADVANCED RESEARCH PROJECTS AGENCY

1958

Sixty years ago, the U.S. government created the Advanced Research Projects Agency in response to the Soviet's Sputnik launch.

"INTERNET HISTORY TIMELINE"

BLOG

- Lessons for Today in Internet's Past — MAY 14, 2018
- APNIC Partners On Experiment to Improve DNS — MAY 4, 2018
- Venezuela's First Connection a Result of "Sheer Luck" — APRIL 18, 2018
- Ermanno Pietrosemoli on Building Global Internet Networks — APRIL 13, 2018
- Pun Tests New Innovations for Health Access in Nepal — MARCH 30, 2018
- The Power and Peril of Search Engines — MARCH 14, 2018
- Tracy LaQuey Parker Talks Internet Security Risks — MARCH 2, 2018

Presented by:

Internet Society

Tweets

Everything old is new again for Ed Krol, author of 'The Hitchhiker's Guide to the Internet.' Find out why in our ex... https://t.co/SSIY104TFI
— 3 days 19 hours ago

CONNECT *with* US

The Internet Society is a leading advocate for a free and open Internet, promoting the open development, evolution and use of the Internet for the benefit of all people throughout the world.

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http://www.internethalloffame.org/

Τμήμα Μαθηματικών
Αριστοτέλειο Πανεπιστήμιο Θεσ

INDUCTEES

2017 INTERNET HALL OF FAME INDUCTEES

GLOBAL CONNECTORS


Nabil Bukhalid


Ira Fuchs


Shigeki Goto


Mike Jensen


Ermanno Pietrosemoli


Tadao Takahashi


Florencio Utreras


Jianping Wu

INNOVATORS


Jaap Akkerhuis


Yvonne Marie Andrés


Alan Emtage


Ed Krol


Tracy LaQuey Parker


Craig Partridge

In this section:

- Inductees Alphabetically
- 2012 Inductees
- 2013 Inductees
- 2014 Inductees
- 2017 Inductees

http://www.internethalloffame.org/



Τμήμα Μ
Αριστοτέλειο



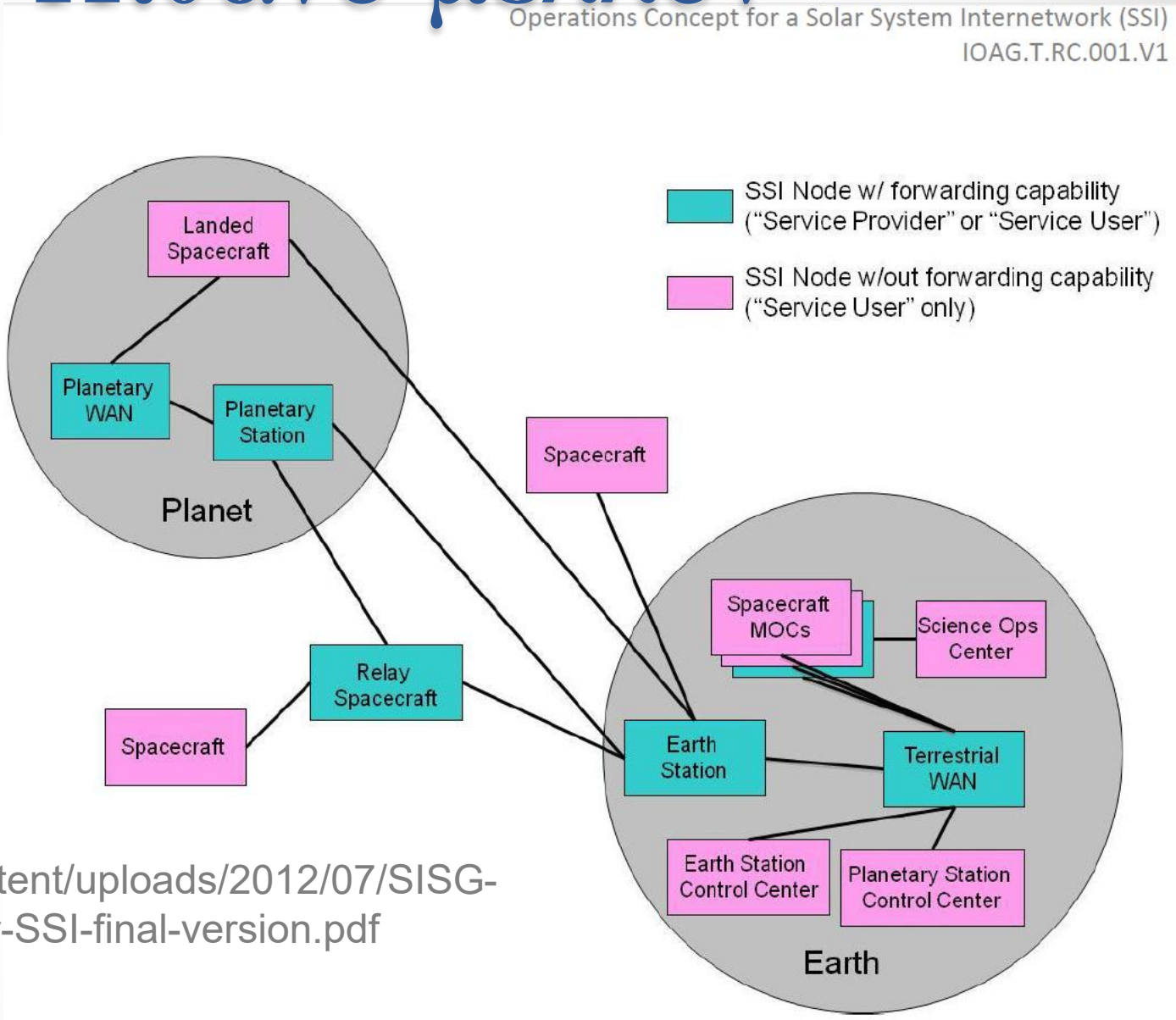
World Wide Web Hall of Fame @ First International Conference on the World-Wide Web (1994)

- Tim Berners-Lee, CERN
- Marc Andreessen, Netscape Communications Co., formerly at NCSA
- Eric Bina, Netscape Communications Co., formerly at NCSA
- Kevin Hughes, Honolulu C.C., now at Enterprise Information Technologies
- Rob Hartill, Los Alamos National Lab, formerly at U. Wales College at Cardiff
- Lou Montulli, Netscape Communications Co., formerly at U. Kansas



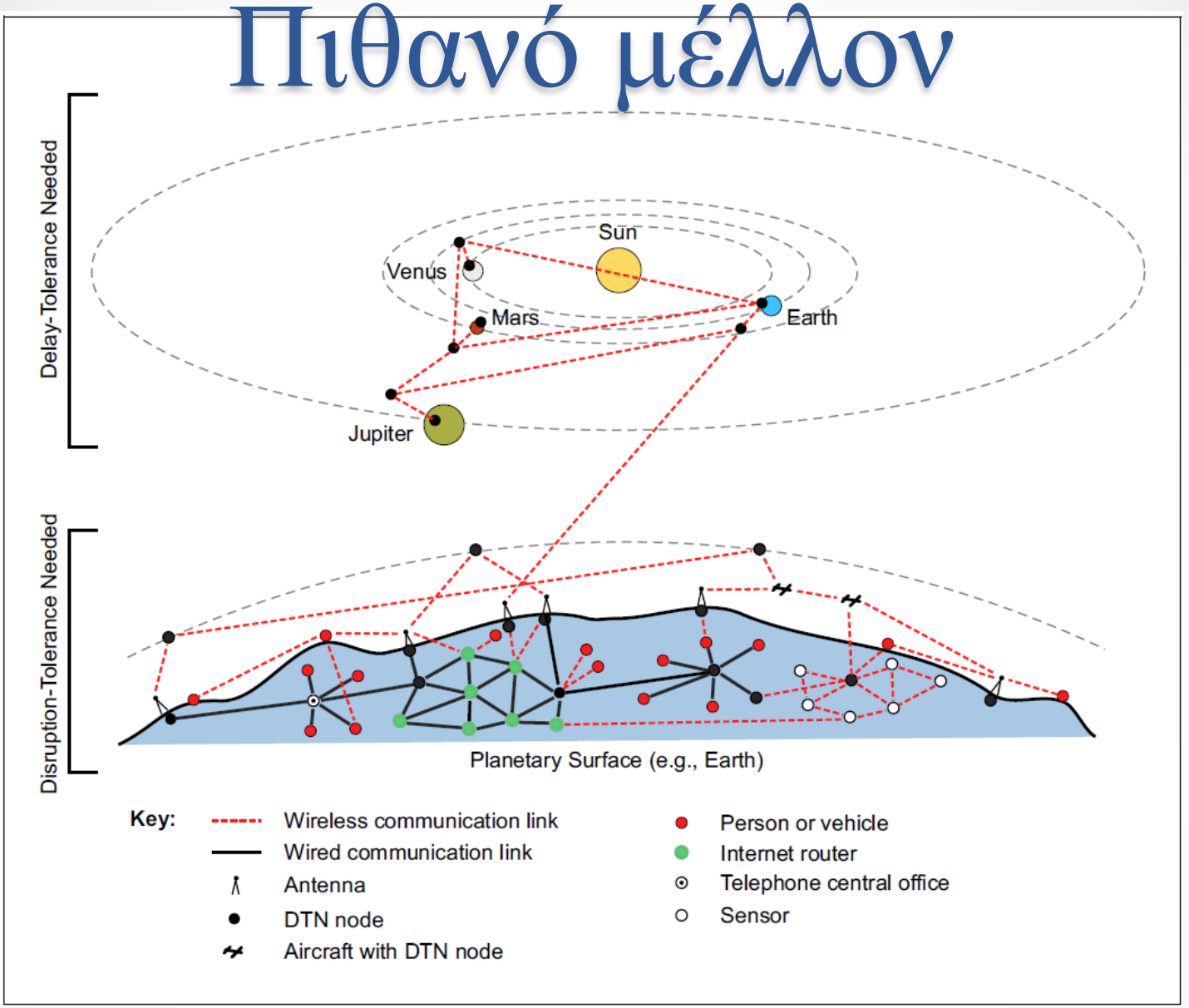


Πιθανό μέλλον



http://ipnsig.org/wp-content/uploads/2012/07/SISG-Operations-Concept-for-SSI-final-version.pdf

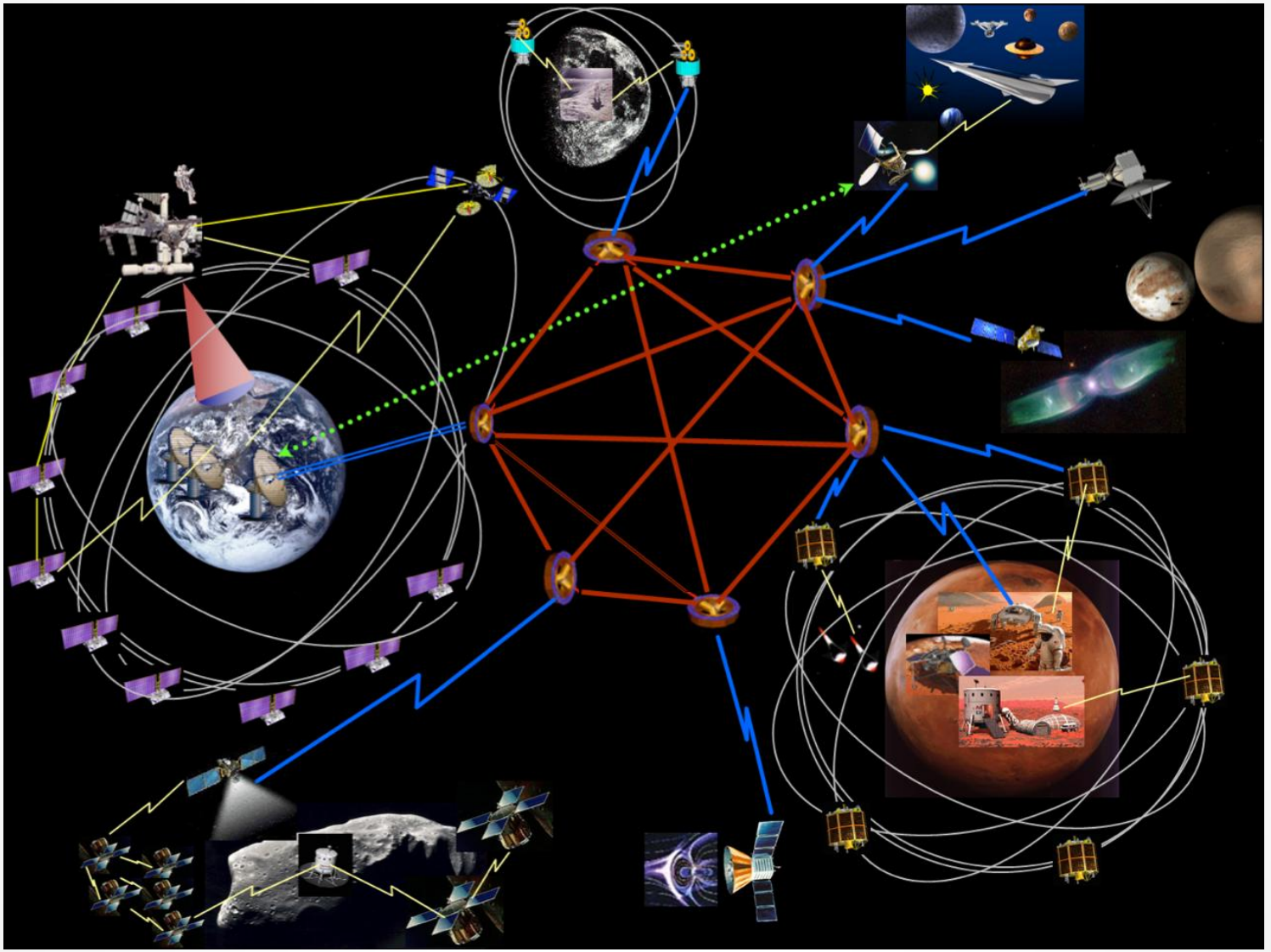
Πιθανό μέλλον



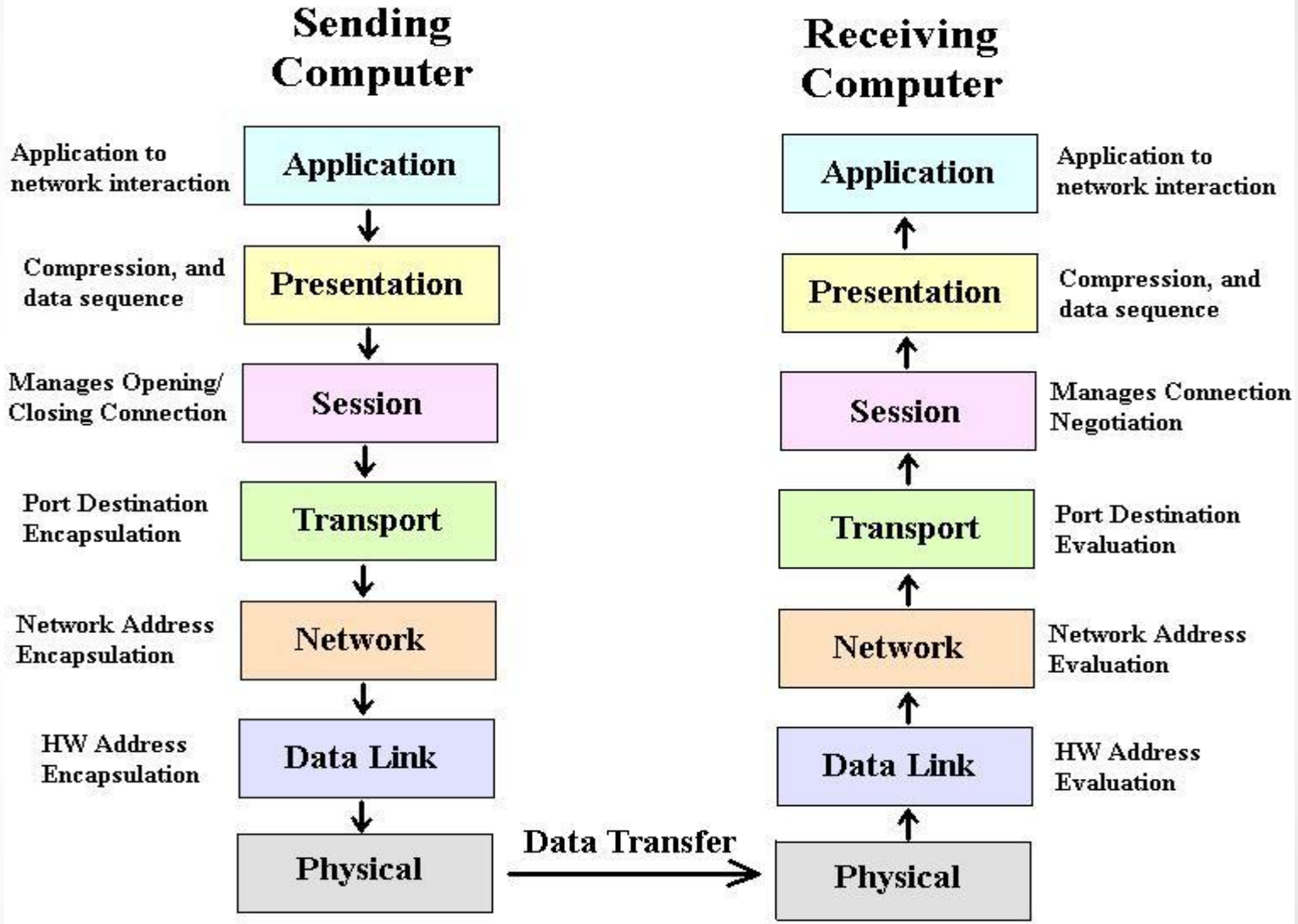
Delay- and Disruption-Tolerant Networks (DTNs): A Tutorial

http://ipnsig.org/wp-content/uploads/2012/07/DTN_Tutorial_v2.04.pdf

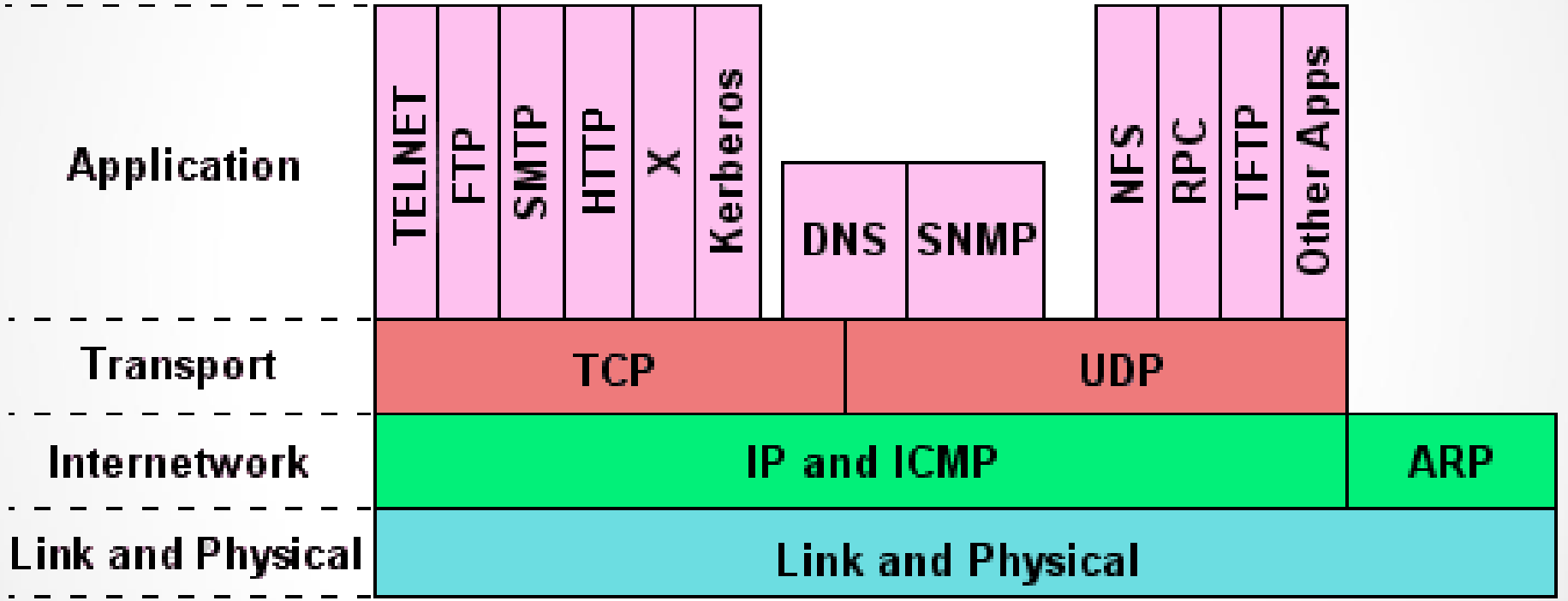
Update: https://www.nasa.gov/content/dtn
NASA Disruption Tolerant Networking



Network Layer Interaction



Ad hoc Internet protocol stack



OSI Model

<< Back

Layer #	Name	Mnemonic	Encapsulation Units	Devices or Components	Keywords/Description
7	Application	All	data	PC	Network services for application processes, such as file, print, messaging, database services
6	Presentation	People	data		Standard interface to data for the application layer. MIME encoding, data encryption, conversion, formatting, compression
5	Session	Seem	data		Interhost communication. Establishes, manages and terminates connection between applications
4	Transport	To	segments		End-to-end connections and reliability. Segmentation/desegmentation of data in proper sequence. Flow control
3	Network	Need	packets	router	Logical addressing and path determination. Routing. Reporting delivery errors
2	Data Link	Data	frames	bridge, switch, NIC	Physical addressing and access to media. Two sublayers: Logical Link Control (LLC) and Media Access Control (MAC)
1	Physical	Processing	bits	repeater, hub, transciever	Binary transmission signals and encoding. Layout of pins, voltages, cable specifications, modulation

OSI comparision with TCP/IP Protocol Stack

OSI #	OSI Layer Name	TCP/IP #	TCP/IP Layer Name	Encapsulation Units	TCP/IP Protocols
7	Application	4	Application	data	FTP, HTTP, POP3, IMAP, telnet, SMTP, DNS, TFTP
6	Presentation			data	
5	Session			data	
4	Transport	3	Transport	segments	TCP, UDP
3	Network	2	Internet	packets	IP
2	Data Link	1	Network Access	frames	
1	Physical			bits	

Hosted at Novgorod State University

http://www.vlsm-calc.net/models.php





Εξέλιξη του Internet

1. Simplification of lower network layers, after the “Protocol Wars” (OSI, SNA, DECNET, appletalk, etc., ….. and TCP/IP) of the 1980s, and early 1990s.

“We reject kings, presidents and voting. We believe in rough consensus and running code.” :
David Clark at a 1992 talk describing the Internet Engineering Task Force





Εξέλιξη του Internet

2. Convergence of applications, technologies and networks

Voice Video Data Storage

||

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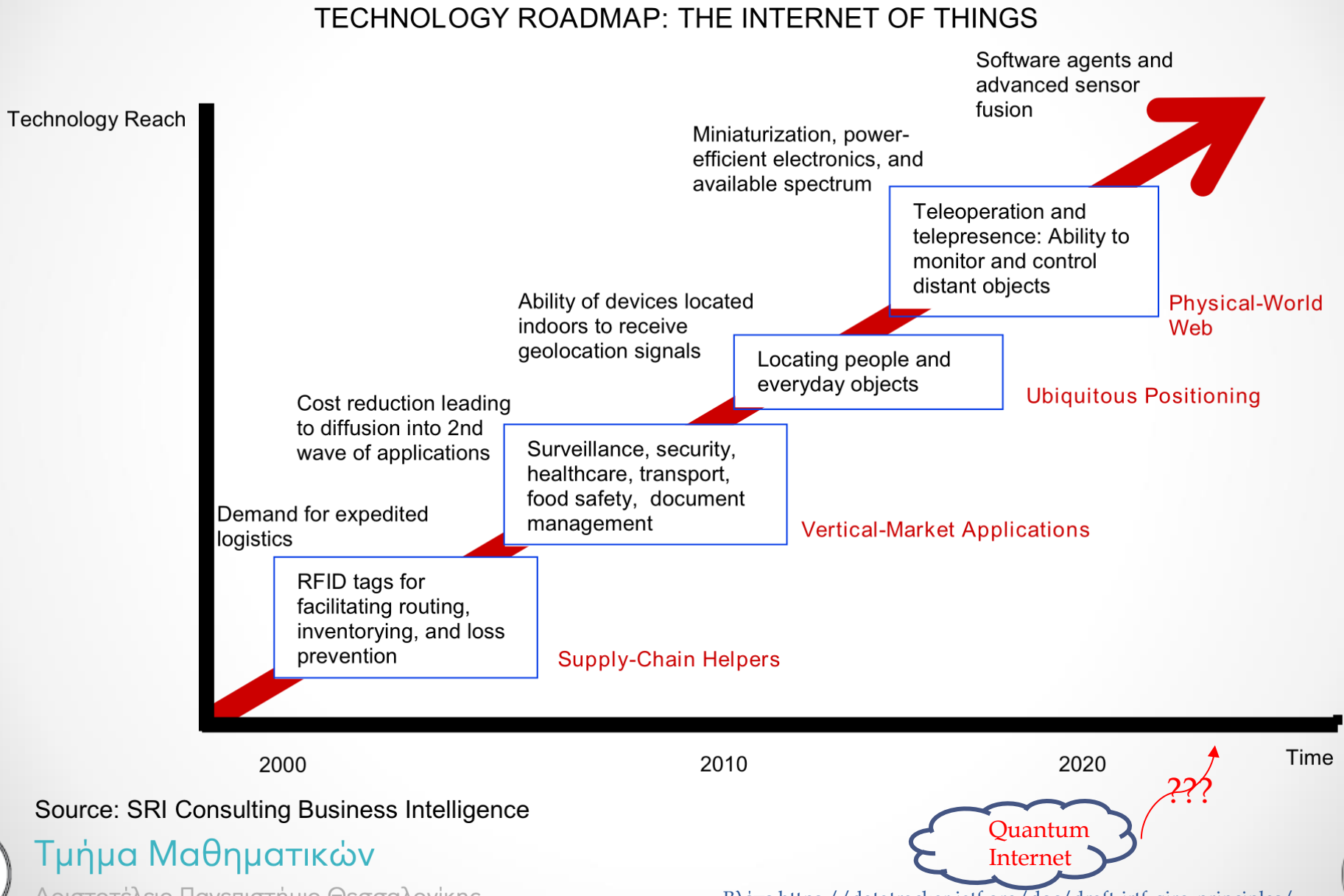
Broadband IP network

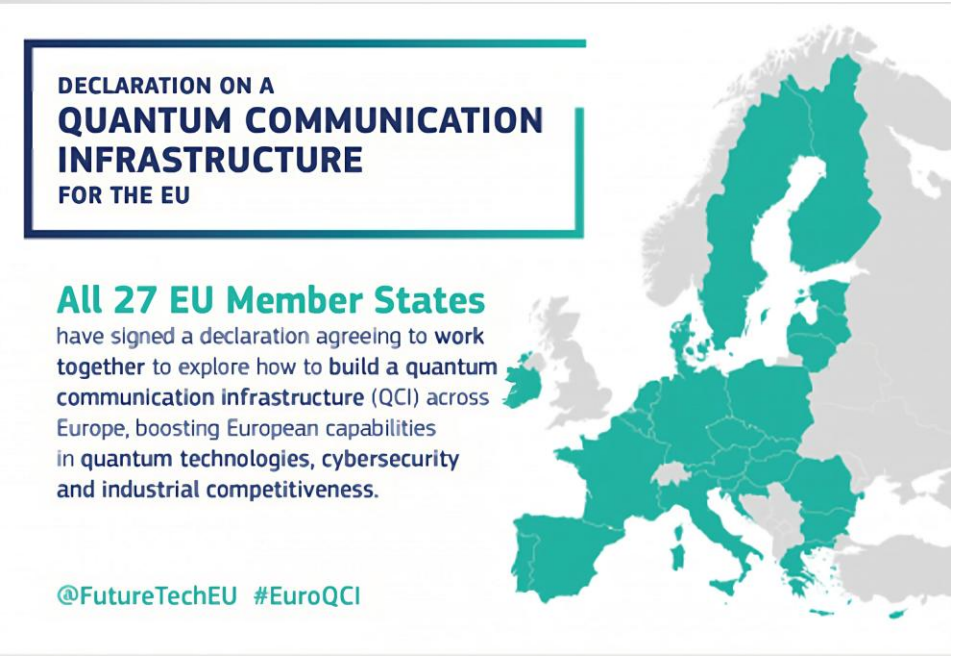
Εξέλιξη του Internet



Source: SRI Consulting Business Intelligence

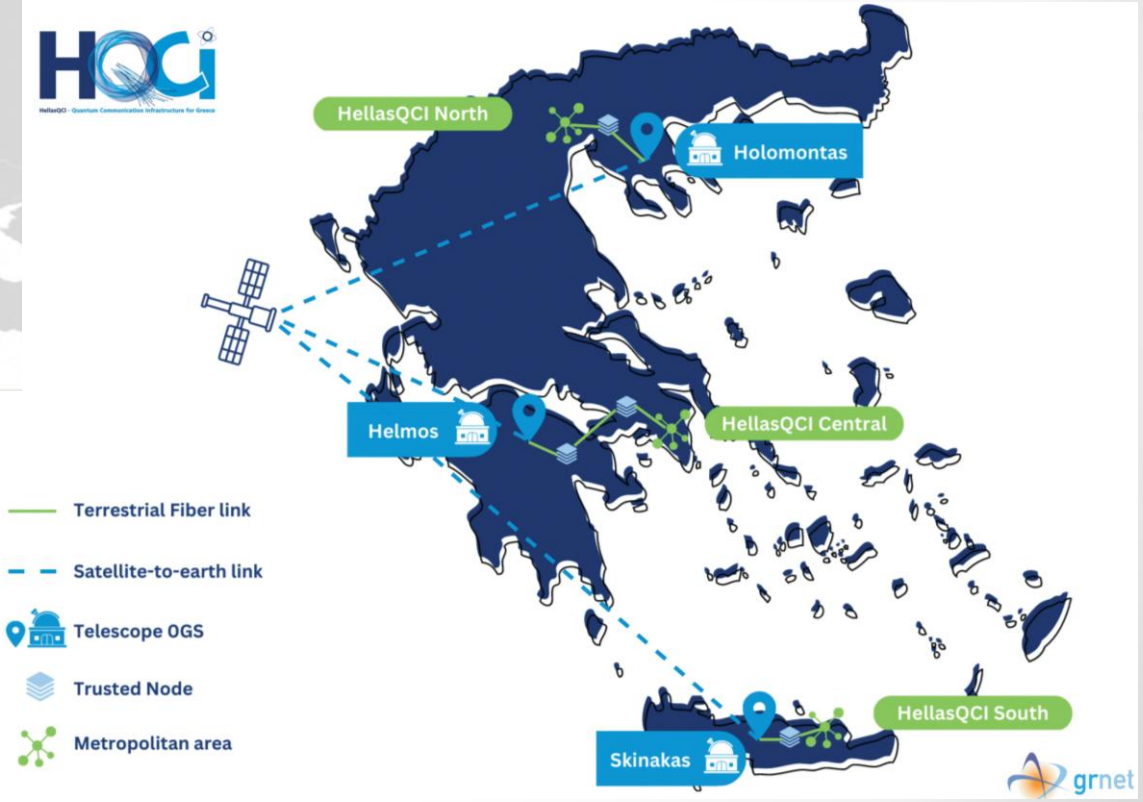
Βλέπε https://datatracker.ietf.org/doc/draft-irtf-qirg-principles/

2023-25: Τεχνολογίες και υποδομές κβαντικής επικοινωνίας στην Ευρώπη και στην Ελλάδα



https://qt.eu/ecosystem/quantum-communication-infrastructure

Quantum communication networks



https://hellasqci.eu/

A vision for the future space-based quantum network

$$$

Monetary transfers between financial institutions secured by Quantum Comm

Image credit: NASA TDRS





New Materials

Image credit: NASA/Marshall Space Flight Center

Researchers access the research power of centralized quantum computers and maintain confidentiality

Quantum Network



Breakthroughs in Medicine

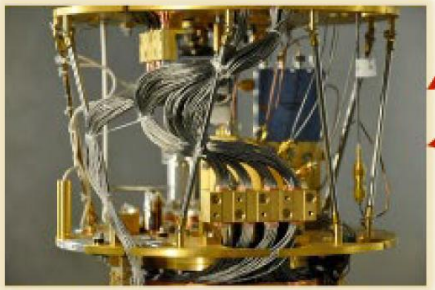


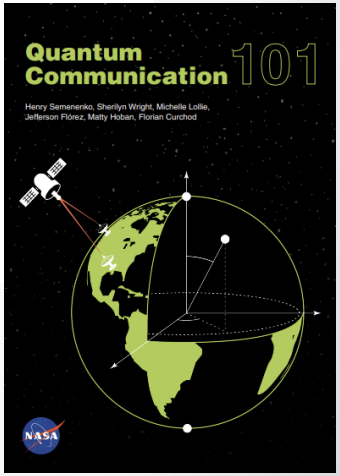
Image Credit: NASA Ames / John Hardman



Image credit: NASA TDRS

Quantum Sensor arrays may be used to monitor local aquifers

$$$





https://www.nasa.gov/centers-and-facilities/johnson/workshop-on-space-quantum-communications-and-networks-proceedings/

https://www.nasa.gov/wp-content/uploads/2024/07/quantum-communication-101-final.pdf

Εισαγωγή ευρυζωνικών υπηρεσιών (broadband services)

- High Return On Investment per user, leading to sustainable and (in long term) profitability
- Cut costs & increase productivity in public sector
- Sectors for immediate application: health, education, lift of social / geographical exclusions





Ευρυζωνικές υπηρεσίες

- Basic network services are prerequisite
  - DNS, directory services, e-mail, web, ftp, etc.
- Value added network services
  - Application & document sharing, video/audio only conference, video e-mail, online gaming, streamed video, digital music, VoIP, sync/async distance learning, etc.





Προσφορά ευρωζωνικών υπηρεσιών

There is no single “killer application”!!!

SOLUTION: services ‘bouquets’:

- High speed
- “always on” characteristic
- flat fee

Ταξινόμηση υπηρεσιών

- security & data services
  - VPN, firewalls, parental controls
- entertainment
  - Video on Demand, Music on Demand, Internet Radio
- Advanced telecommunications
  - VoIP, Video telephony, mobility
- Tele-control / smart buildings
  - security, surveillance, utility management





Οργάνωση

- Networks (Classes A – E, + CIDR, IPv4/IPv6)
- Autonomous Systems (AS)
- Network Operations Centers (NOCs)
- Internet Operation =

"Collaboration, Collaboration, Collaboration"!!!

Since 9/2010 the Task Force on Network Operation Centers (TF-NOC) brings together NOC managers, engineers, developers, operators, controllers and project managers interested in NOC functions ...

See ~~http://www.[illegible].org/activities/tf-noc/~~

https://wiki.geant.org/display/SIGNOC/SIG-NOC+Special+Interest+Group+-+Network+Operations+Centre

http://www.geant.org





Οργάνωση

- Staff:
  - roles (request routing, specialized addressing of requests)
  - coverage (place – time of response / address of issues),
  - Jurisdiction – responsibilities (administrative boundaries, obligations)
- NOC organization (centralized hierarchy, distributed structures, external assignments)
- Integration of tools and methodology of work





Οργάνωση

- Profile of network users and NOC services
- A framework of NOC obligations against users (Service Level Agreements - SLAs, Service usage Regulations)
- Methods – Tools to communicate with users and manage them





Διοίκηση

Internet governance : shape the evolution and use of the Internet

Who? Governments, private sector, civil society

How? Develop and apply

What? norms, rules, decision-making procedures, and programs





Διοίκηση: Όργανα διακυβέρνησης

- Internet Assigned Numbers Authority (IANA) ==>> Internet Corporation for Assigned Names and Numbers (ICANN)
- Regional Internet Registries (RIRs)
  - ARIN, RIPE NCC, APNIC, LACNIC, AfriNIC
- Internet Society (ISOC)
- Internet Architecture Board -->> ISOC
- Internet Engineering Task Force (IETF) -->> ISOC
- Internet Engineering Steering Group (IESG)
- Internet Research Task Force
- Internet Research Steering Group
- Internet Governance Forum





Internet bodies

- Internet Engineering Task Force (IETF)
- Internet Assigned Numbers Authority (IANA)
- ICANN - the Internet Corporation for Assigned Names and Numbers
- Internet Society (ISOC)
- Number Resource Organization
- Regional Internet Registry (RIR)
- Internet Research Task Force (IRTF)
- Internet Architecture Board (IAB)

United Nations bodies

- Internet Governance Forum
- World Summit on the Information Society
- Working Group on Internet Governance





Internet & Web standards

- Recommendations published by the World Wide Web Consortium (W3C)
- Internet standard (STD) documents published by the Internet Engineering Task Force (IETF)
- Request for Comments (RFC) documents published by the Internet Engineering Task Force

  Internet Draft -> Proposed Standard (RFC) -> Internet Standard
- Standards published by the International Organization for Standardization (ISO)
- Standards published by Ecma International (formerly ECMA)
- The Unicode Standard and various Unicode Technical Reports (UTRs) published by the Unicode Consortium
- Name and number registries maintained by the Internet Assigned Numbers Authority (IANA)





Αντικείμενα εργασίας στα NOC

1) Monitoring:

- Traffic monitoring
  - Observation and measurement of the evolution of the traffic on an interface or line.
- Fault monitoring
  - Checking and tracing of failures and errors in network equipment and lines.
- Physical Infrastructure monitoring
  - Observation of physical parameters like temperature, humidity, open doors, etc.
- Flow monitoring
  - Observation of the sets of packets passing a point in the network during a certain time interval.
- Routing monitoring
  - Viewing of the IP routes from/to an AS and the routing protocols employed.
- Multicast monitoring
  - Observation of multicast topology and availability.
- Logging
  - Storage of the records of events from devices.





Αντικείμενα εργασίας στα NOC

2) Problem management:

- Alarming
  - Getting warnings about problems or incidents.
- Diagnostic
  - Following a procedure in order to identify the source of a problem.
- Sniffing/analyzing
  - Investigating inside the packets of data to find the origin of a problem or malfunction.

3) Performance management

- Passive or active measurement of the throughput of a connection to analyze its efficiency.

4) Multi-domain management

- Management of connections that traverse several management domains.

5) Reporting and statistics

- Querying of data sources for reference and statistics.





Αντικείμενα εργασίας στα NOC

6) Ticketing

- Process for the tracking of incidents, problems or tasks

7) Change management

- Controlling and recording of changes in values, technologies, etc.

8) Configuration management and backup

- Control and backup of the configuration for the routers, switches and other pieces of equipment.

9) Chat/communication/coordination

- Communication with people, either in the same institution or in other institutions.

10) Knowledge management/documentation

- Storing and sharing knowledge information to improve the efficiency in an organization.

11) Security management

- Control of physical and logical resources to avoid third parts from attacking the resources of an institution.





Αντικείμενα εργασίας στα NOC

12) Inventory management

- Organization and control of information about an institution's devices, materials and products.

13) Resources management

- Organization and control of logical resources such as IP addresses, AS numbers, circuits numbers, topology documentation, etc.

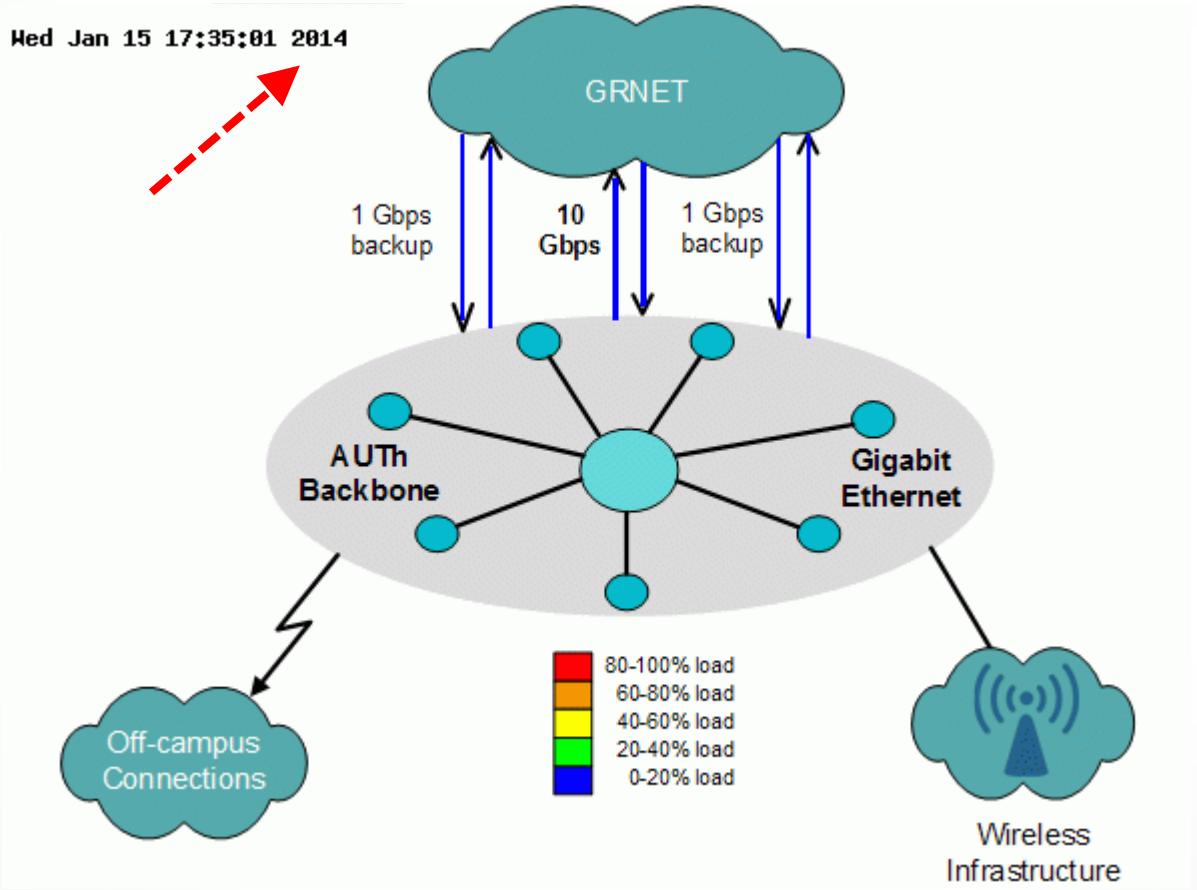
14) Out-of-band access

- Access to the network devices of an institution from an external network





Internet infrastructures at A.U.Th.



The Network

- Intranet:
  - Networking for secretariats, datacenters, etc.
  - 10.0.0.0 , 192.168.0.0
- Internet (IPv4):
  - 155.207.0.0 (AUTH-NET)
  - 192.104.147.0 (AUTH-TO-OTHERS)
  - Autonomous System: AS-5470
  - auth.gr, απθ.gr
- Internet (IPv6 enabled):
  - ID: W1-GR-00002188





The Network

- Infrastructures at AUTh (fiber optic cabling, wireless links, switches, routers, servers, etc.)
- Services maintained and offered at AUTh (e-mail, voice, video, web services, etc.)
- E-infrastructures/“middleware”: LDAP, PKI, AAI)
- Tools for administration and monitoring of the network (netcop, nagios, etc.)





Cabling: Activities

- Study and supervision of new installations and expansions of network cabling infrastructure
- Location and repair of faults and maintenance of network cabling structure
- Maintenance and cleaning of network node locations
- Operation of the Cabling Management System (CMS) and data entry to it





Cabling: Activities

- Monitoring and administration of Uninterruptible Power Supplies (UPS) for NOC
- Study, supervision and maintenance of electrical power facilities in NOC and network premises
- Study and supervision of air conditioning facilities (NOC premises, data centers and network node locations)





Network Documentation

- Floor plans including network outlet positions (in Visio)
- Imprinting of copper distribution boxes in .doc format
- Imprinting of fiber optic distribution boxes in .xls format
- Data structures for network outlets per building, per floor in MySQL DB. Web based management application (NOCWeb).
- Files of measurement data and respective viewers for outlet certification



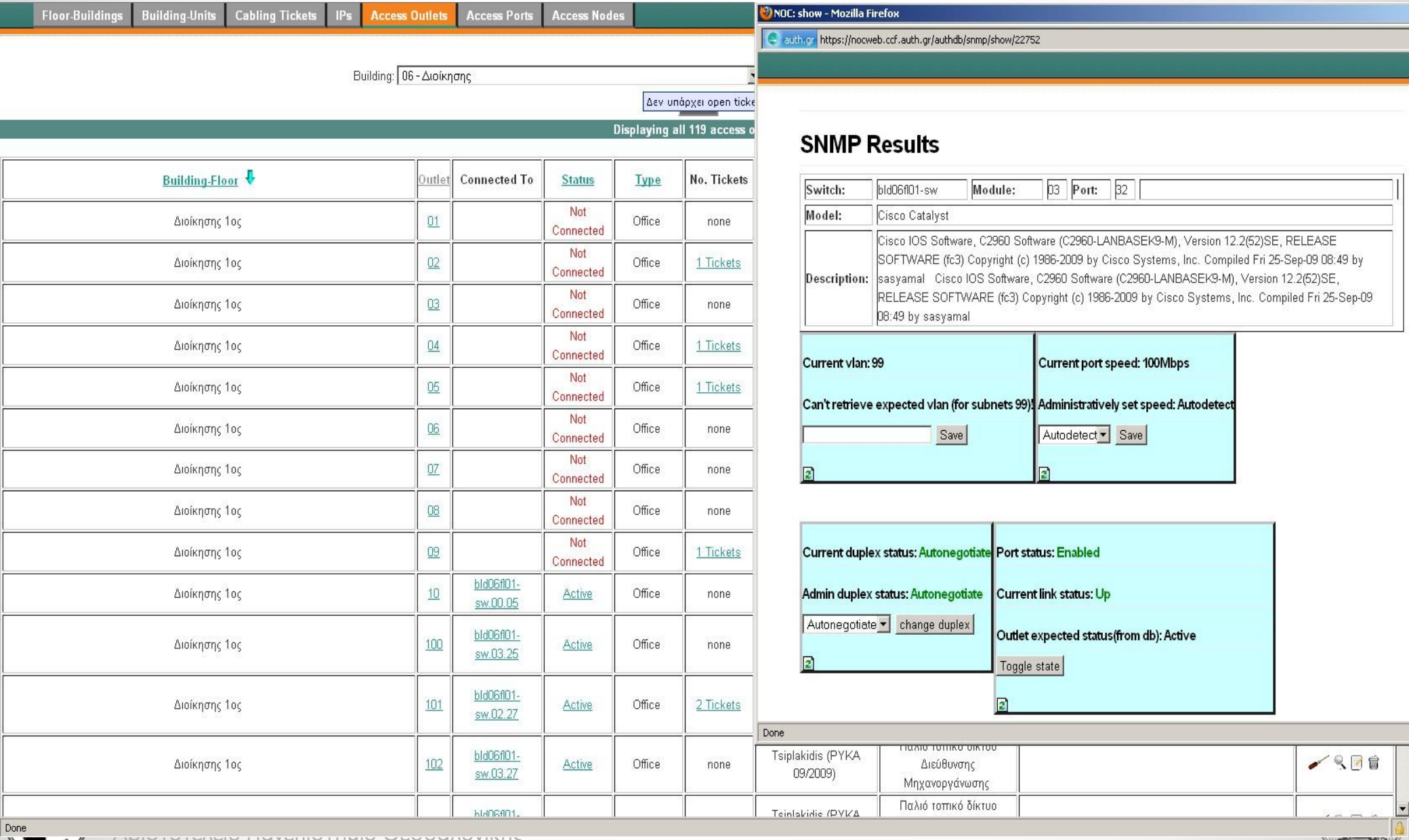


Floor plan with network outlets

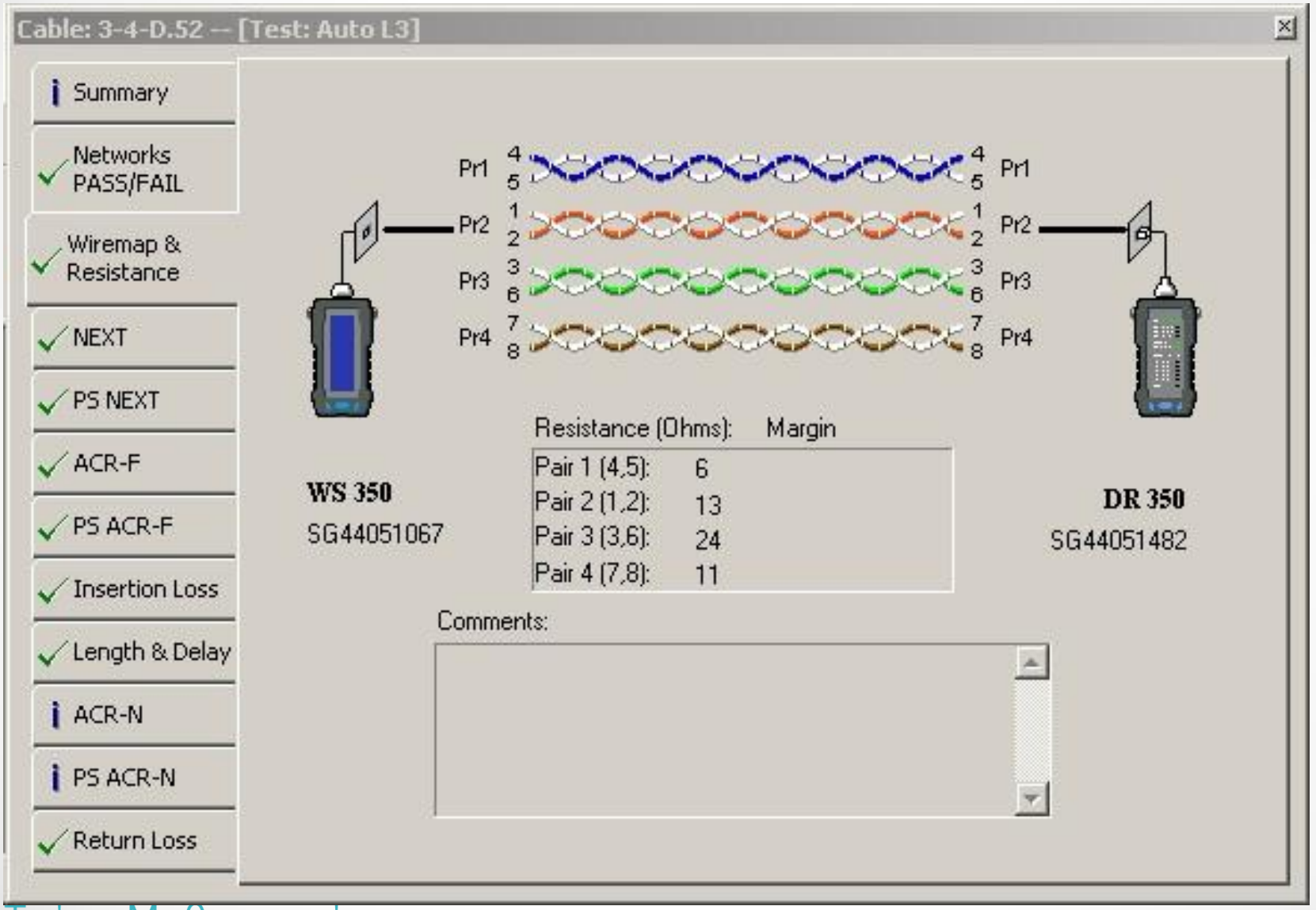


Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης
Τμήμα Μηχανικών Χωροταξίας και Ανάπτυξης
Βέροια- Κτίριο Α (γραμματεία)

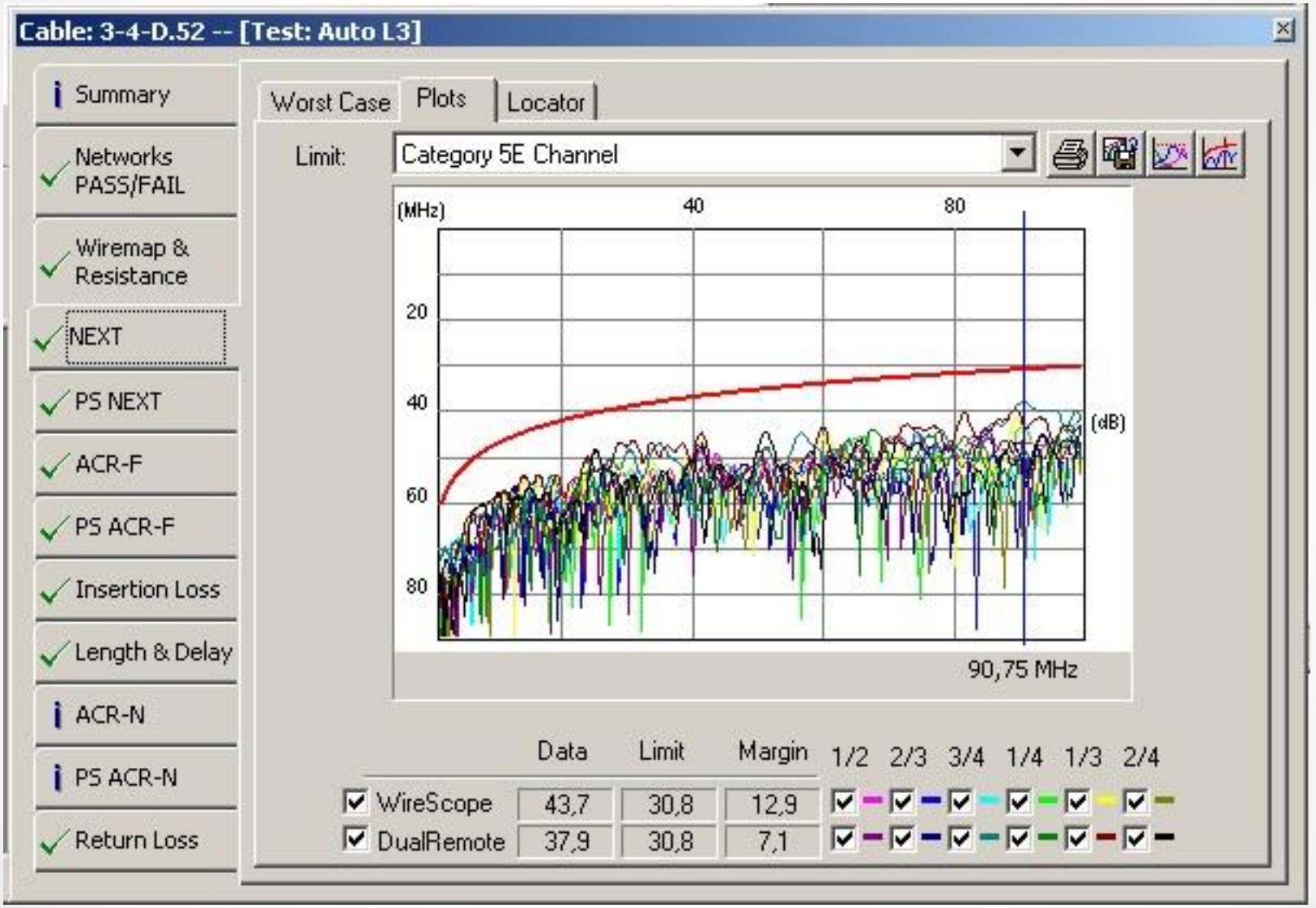
Web/DB based outlet



Outlet measurement &



Outlet measurement & certification



Cabling: Problem solving

- Registration of user problems through ticket opening from helpdesk.
- Locating faulty network outlets by checking data bases, floor plans, distribution boxes files and certification measurements
- Technician on site call
- Check of cabling and outlet
- Damage repair





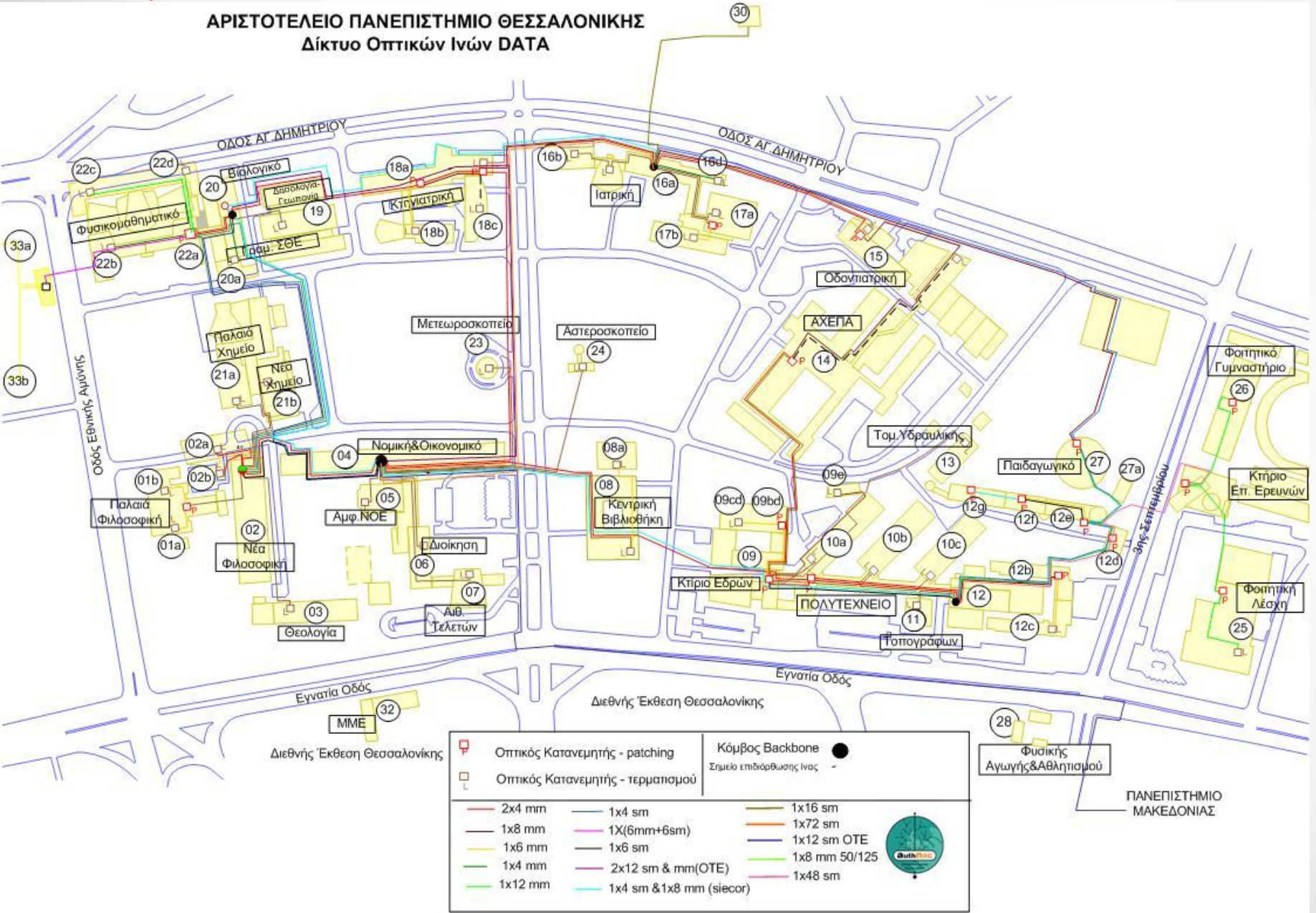
Cabling: Tools

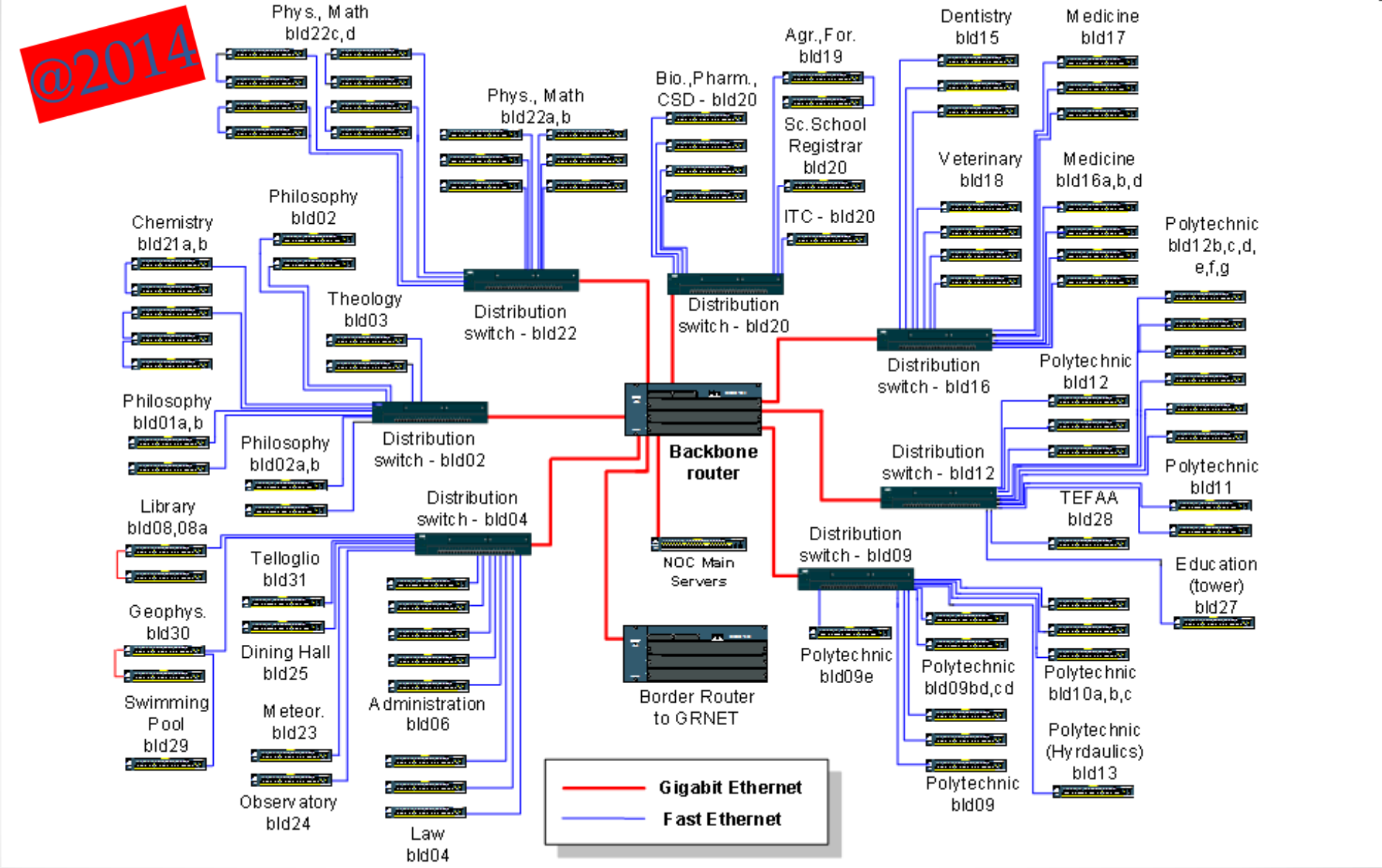
- Fiber and copper cabling control instrument (cable tester).
- Network function control instrument (network tester).
- Tools to terminate copper (UTP) outlets
- Tools to terminate cables at patch panels in network nodes.
- Various small tools for UTP and power cabling (stripper, screw drivers, multimeters, etc).





@2014 Fiber optics network at AUTh





Active components @ AUTh

Activities

- Routers and ethernet switches
- Connections to remote units
- Connections to the Internet through GRNET
- Detection and resolution of security and network abuse incidents (“in-house” software development)
- Installation and configuration of firewalls
- Network traffic and usage statistics (MRTG, IP accounting)





Activities

- IP telephony and Voice over IP
  - Call switching to other academic institutions
  - Telephony provision to 4 remote units
  - IP telephony for NOC
- "Contact Center" for NOC helpdesk (serving AUTh and Greek School Network users)
- Wireless LANs (hundreds of access points under NOC administration)
- Dial-up service (through PSTN)
- 2nd level support for the GSN





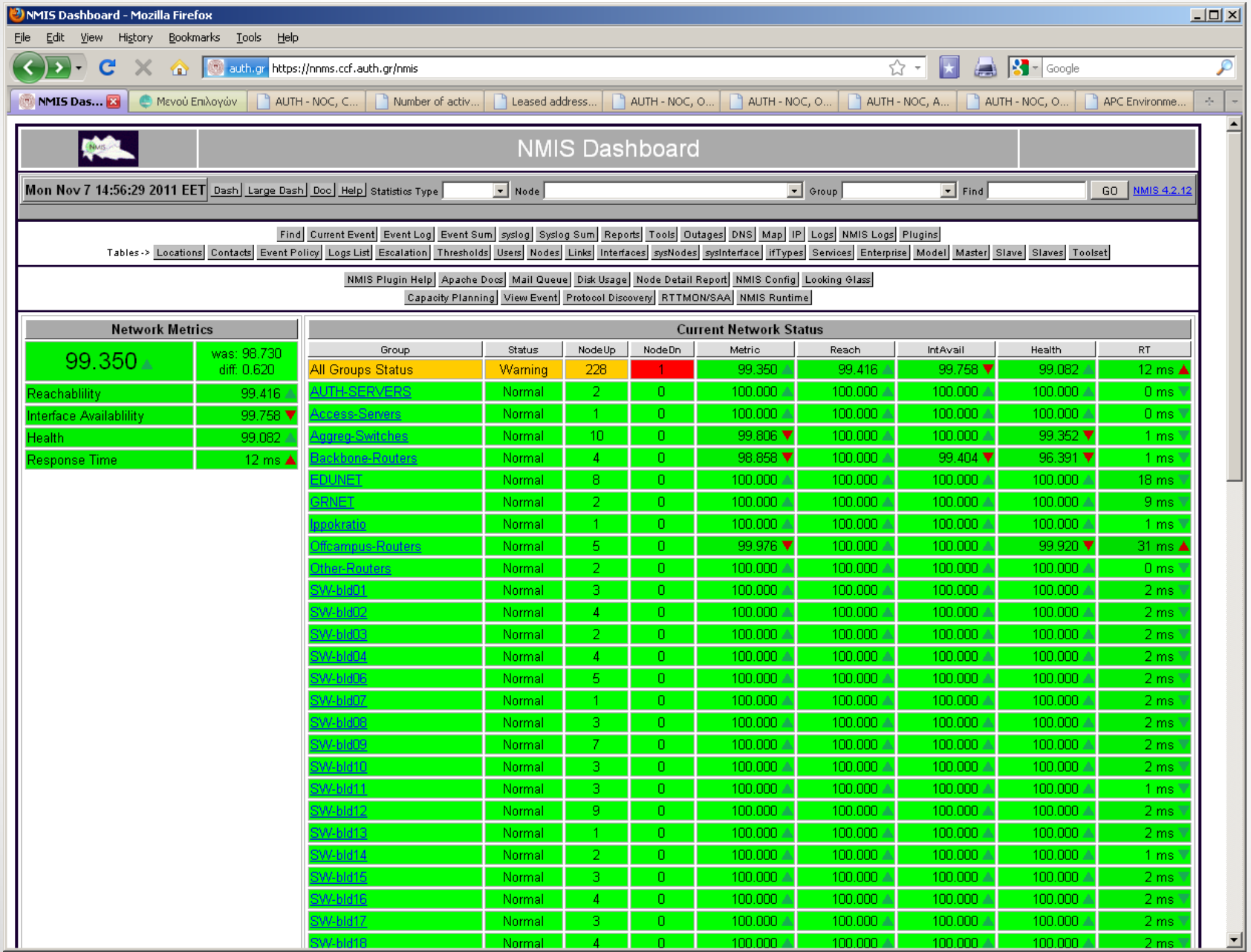
Platforms for management & services

- Network Monitoring:
  - NMIS (freeware)
  - Scripts developed “in-house”
- Statistics:
  - MRTG, Cacti, RRDtool, nfdump (freeware)
  - Scripts and sw application developed “in-house”
- Telephony & telephone user helpdesk system
  - Cisco Unified Communications Manager
  - Contact Center Express (Cisco)
- Access points Management
  - Wireless LAN Controller (Cisco)
  - Wireless Control System (Cisco)

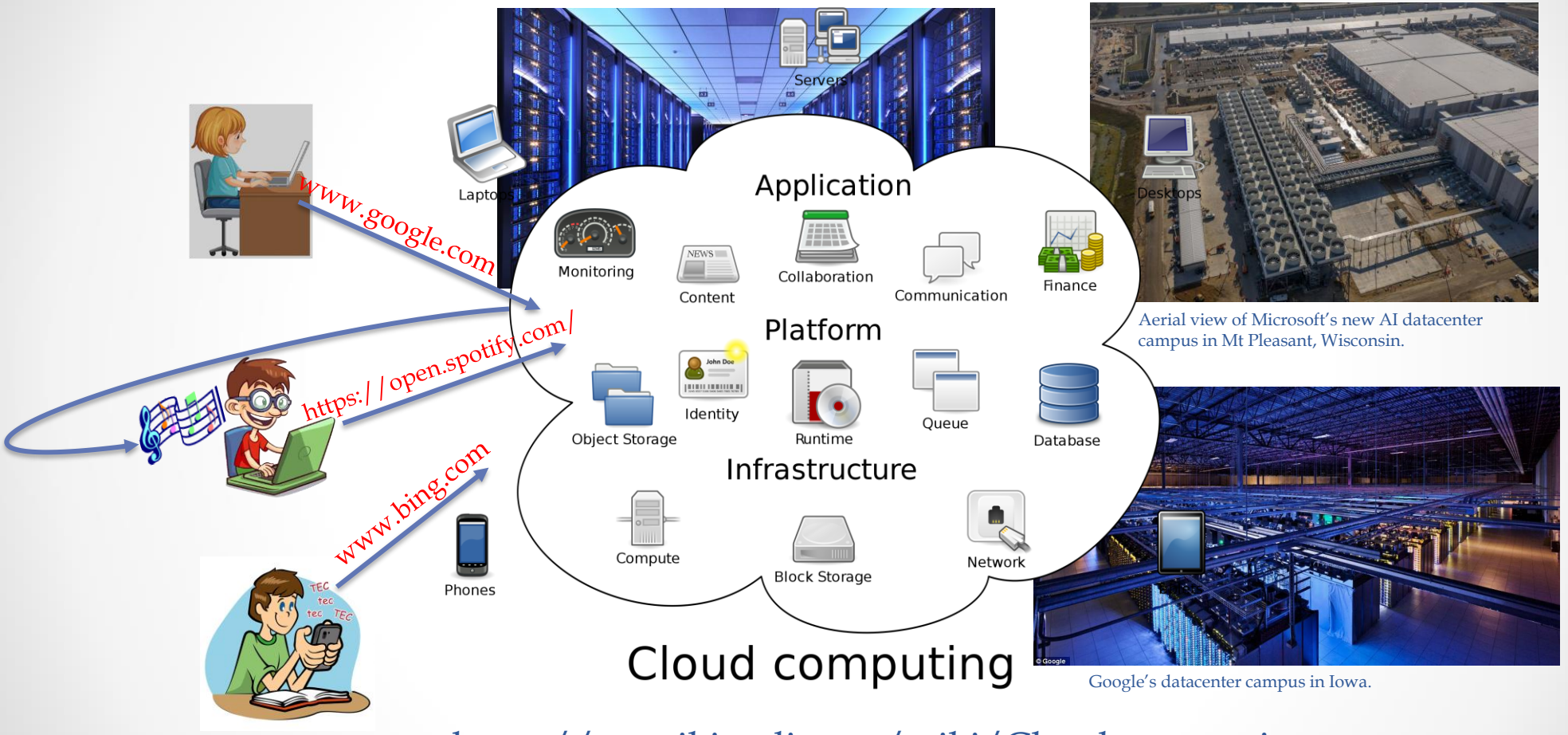




NMIS


NMIS Dashboard - Mozilla Firefox
File Edit View History Bookmarks Tools Help
https://nnms.ccf.auth.gr/nmis
NMIS Dashboard
Mon Nov 7 14:56:29 2011 EET
Dash Large Dash Doc Help Statistics Type Node Group Find GO NMIS 4.2.12
Find Current Event Event Log Event Sum syslog Syslog Sum Reports Tools Outages DNS Map IP Logs NMIS Logs Plugins
Tables -> Locations Contacts Event Policy Logs List Escalation Thresholds Users Nodes Links Interfaces sysNodes sysInterface ifTypes Services Enterprise Model Master Slave Slaves Toolset
NMIS Plugin Help Apache Docs Mail Queue Disk Usage Node Detail Report NMIS Config Looking Glass
Capacity Planning View Event Protocol Discovery RTTMON/SAA NMIS Runtime
Network Metrics
99.350
was: 98.730
diff: 0.620
Reachablility 99.416
Interface Availablility 99.758
Health 99.082
Response Time 12 ms
Current Network Status
Group Status NodeUp NodeDn Metric Reach IntAvail Health RT
All Groups Status Warning 228 1 99.350 99.416 99.758 99.082 12 ms
AUTH-SERVERS Normal 2 0 100.000 100.000 100.000 100.000 0 ms
Access-Servers Normal 1 0 100.000 100.000 100.000 100.000 0 ms
Aggreg-Switches Normal 10 0 99.806 100.000 100.000 99.352 1 ms
Backbone-Routers Normal 4 0 98.858 100.000 99.404 96.391 1 ms
EDUNET Normal 8 0 100.000 100.000 100.000 100.000 18 ms
GRNET Normal 2 0 100.000 100.000 100.000 100.000 9 ms
Ippokratio Normal 1 0 100.000 100.000 100.000 100.000 1 ms
Offcampus-Routers Normal 5 0 99.976 100.000 100.000 99.920 31 ms
Other-Routers Normal 2 0 100.000 100.000 100.000 100.000 0 ms
SW-bld01 Normal 3 0 100.000 100.000 100.000 100.000 2 ms
SW-bld02 Normal 4 0 100.000 100.000 100.000 100.000 2 ms
SW-bld03 Normal 2 0 100.000 100.000 100.000 100.000 2 ms
SW-bld04 Normal 4 0 100.000 100.000 100.000 100.000 2 ms
SW-bld06 Normal 5 0 100.000 100.000 100.000 100.000 2 ms
SW-bld07 Normal 1 0 100.000 100.000 100.000 100.000 2 ms
SW-bld08 Normal 3 0 100.000 100.000 100.000 100.000 2 ms
SW-bld09 Normal 7 0 100.000 100.000 100.000 100.000 2 ms
SW-bld10 Normal 3 0 100.000 100.000 100.000 100.000 2 ms
SW-bld11 Normal 3 0 100.000 100.000 100.000 100.000 1 ms
SW-bld12 Normal 9 0 100.000 100.000 100.000 100.000 2 ms
SW-bld13 Normal 1 0 100.000 100.000 100.000 100.000 2 ms
SW-bld14 Normal 2 0 100.000 100.000 100.000 100.000 1 ms
SW-bld15 Normal 3 0 100.000 100.000 100.000 100.000 2 ms
SW-bld16 Normal 4 0 100.000 100.000 100.000 100.000 2 ms
SW-bld17 Normal 3 0 100.000 100.000 100.000 100.000 2 ms
SW-bld18 Normal 4 0 100.000 100.000 100.000 100.000 2 ms

Πίσω από το υπολογιστικό νέφος…



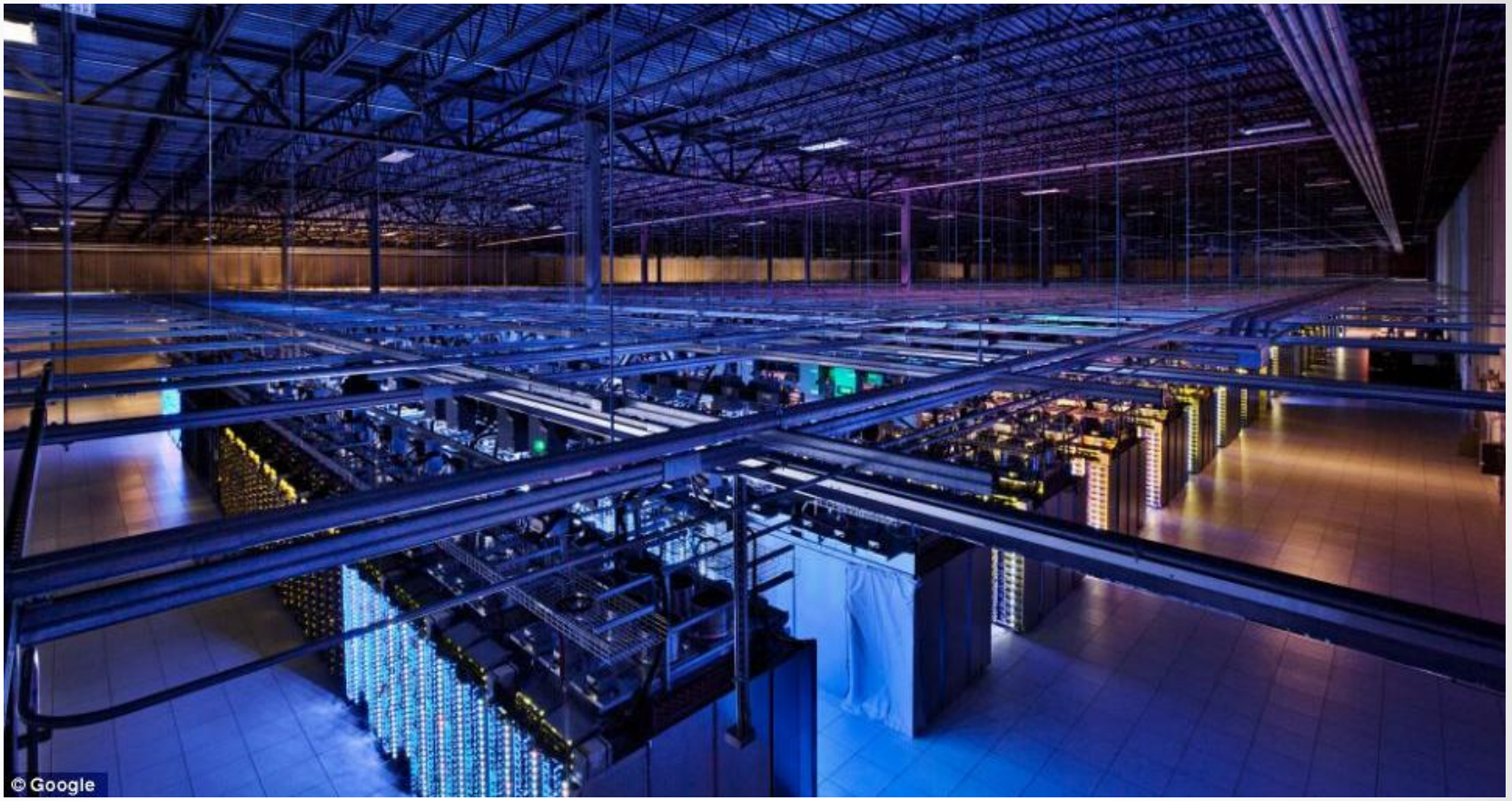
Aerial view of Microsoft's new AI datacenter campus in Mt Pleasant, Wisconsin.

Google's datacenter campus in Iowa.

https://en.wikipedia.org/wiki/Cloud_computing

Google 115.000 m^2 Datacenter @ Iowa

Council Bluffs, Iowa



Πόση ηλεκτρική ενέργεια καταναλώνει κάθε ώρα; Ισχύς ≈400MW (≈75% αιολική ενέργεια)
Πόσα ηλεκτρονικά απόβλητα παράγει κάθε έτος; 2M τόνοι παγκοσμίως από όλα τα datacenters

Πηγές:
https://techcrunch.com/2014/04/22/google-signs-a-407-mw-wind-energy-deal-for-its-iowa-data-center/
https://www.grcooling.com/blog/3-ways-to-manage-e-waste-from-data-centers/
https://www.supermicro.com/white_paper/DataCenters_and_theEnvironmentDec2019.pdf

Datacenter @ Ministry of Education





AUThs' Central Datacenters at NOC: economies of scale at the University level

- Strategy
- Infrastructures
- Blade servers
- Network Attached Storage (NAS)
- Virtualization





Strategic issues

- Data protection
  - Central repository (storage consolidation)
  - Synchronization between two points (replication)
- Protection from hardware failures
  - Protection from faults in HW (servers + disks)
  - Live virtual machine migration
- Optimum resource exploitation
  - processor, memory, storage, network
  - Dynamic management
  - Easy allocation
- Economies of scale





Το Πανελλήνιο σχολικό Δίκτυο(ΠΣΔ)

- Το μεγαλύτερο δημόσιο δίκτυο πανελλαδικά
- Συνδέει (2026) **14.416 σχολεία**, **159** διοικητικές μονάδες και 1.079 άλλες μονάδες (ΓΑΚ, ΠΕΚ, βιβλιοθήκες κ.α.)
- Κλειστό εκπαιδευτικό intranet με **1.000.000** μαθητές, **183.200** εκπαιδευτικούς
- Η **διαδικτυακή ασφάλεια** περιλαμβάνεται στους κύριους στόχους.
- Δικτυακές υπηρεσίες προστιθέμενης αξίας για την εκπαίδευση
- Βασισμένο σε ανάπτυξη ΕΛΛΑΚ
- Υποστήριξη και εκπαίδευση χρηστών στις παρεχόμενες υπηρεσίες
- Δικτυακές υποδομές συμπληρωματικές με του ΕΔΕΤΕ
- Η **ευρυζωνική** πρόσβαση περιλαμβάνεται στους κύριους στόχους.





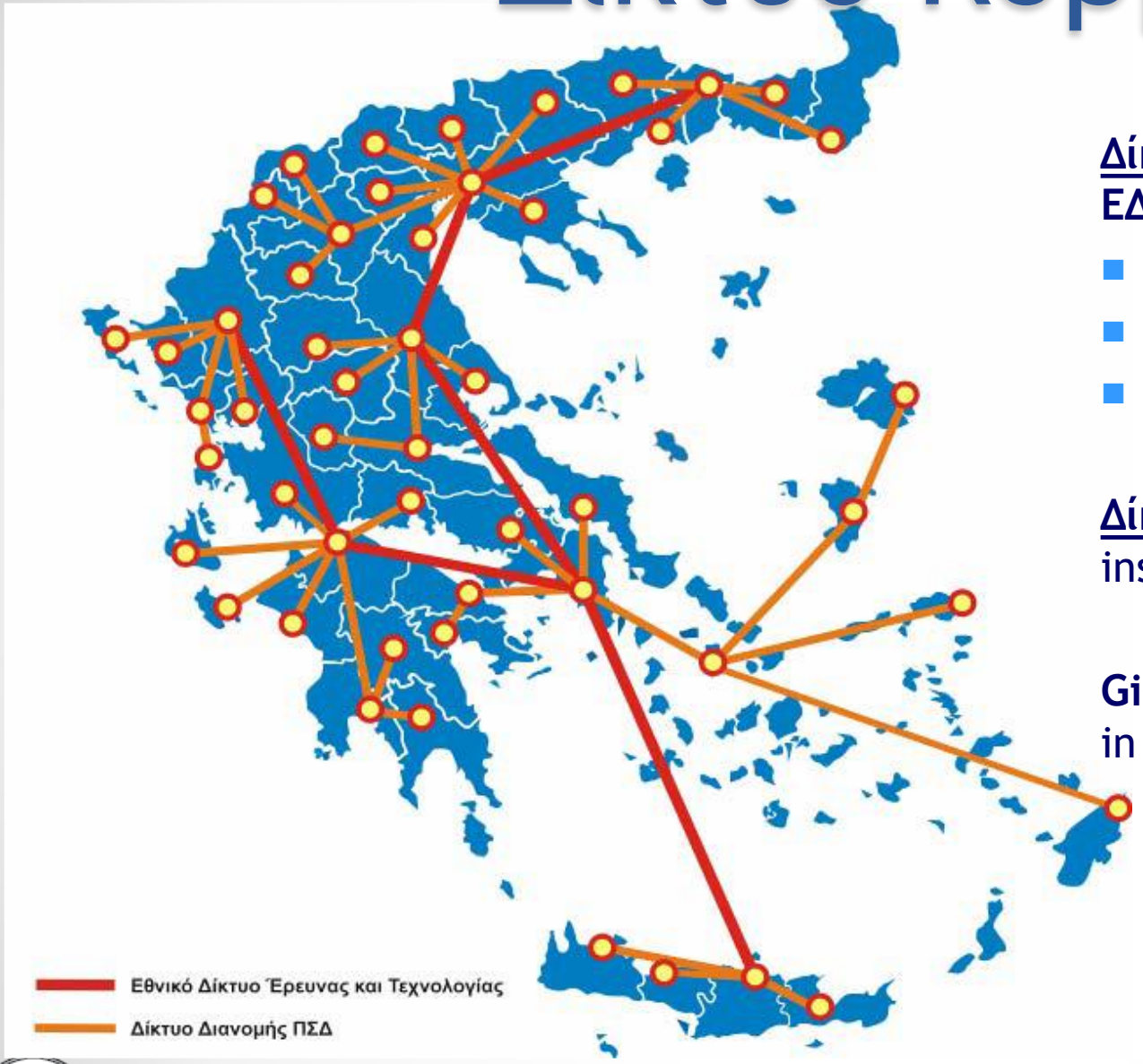
Λειτουργίες ΠΣΔ

- **Part of ministry's strategic planning to introduce and utilize ICT in education**
- **Implemented by a cooperating human network:**
  - Ministry of education
  - 2 Research Centers, 9 Universities, 2 TEI
  - AUTH participates through NOC which is responsible for:
    - User helpdesk (at Thessaloniki, Pella, Serres)
    - Service Level Agreement (SLA) framework for ICT services
    - Computer Security Incident Response Team - CSIRT for the GSN
- **Best Practice at a national and international level**





Δίκτυο Κορμού



<u>Δίκτυο Κορμού</u>: παρέχεται από το ΕΔΕΤ

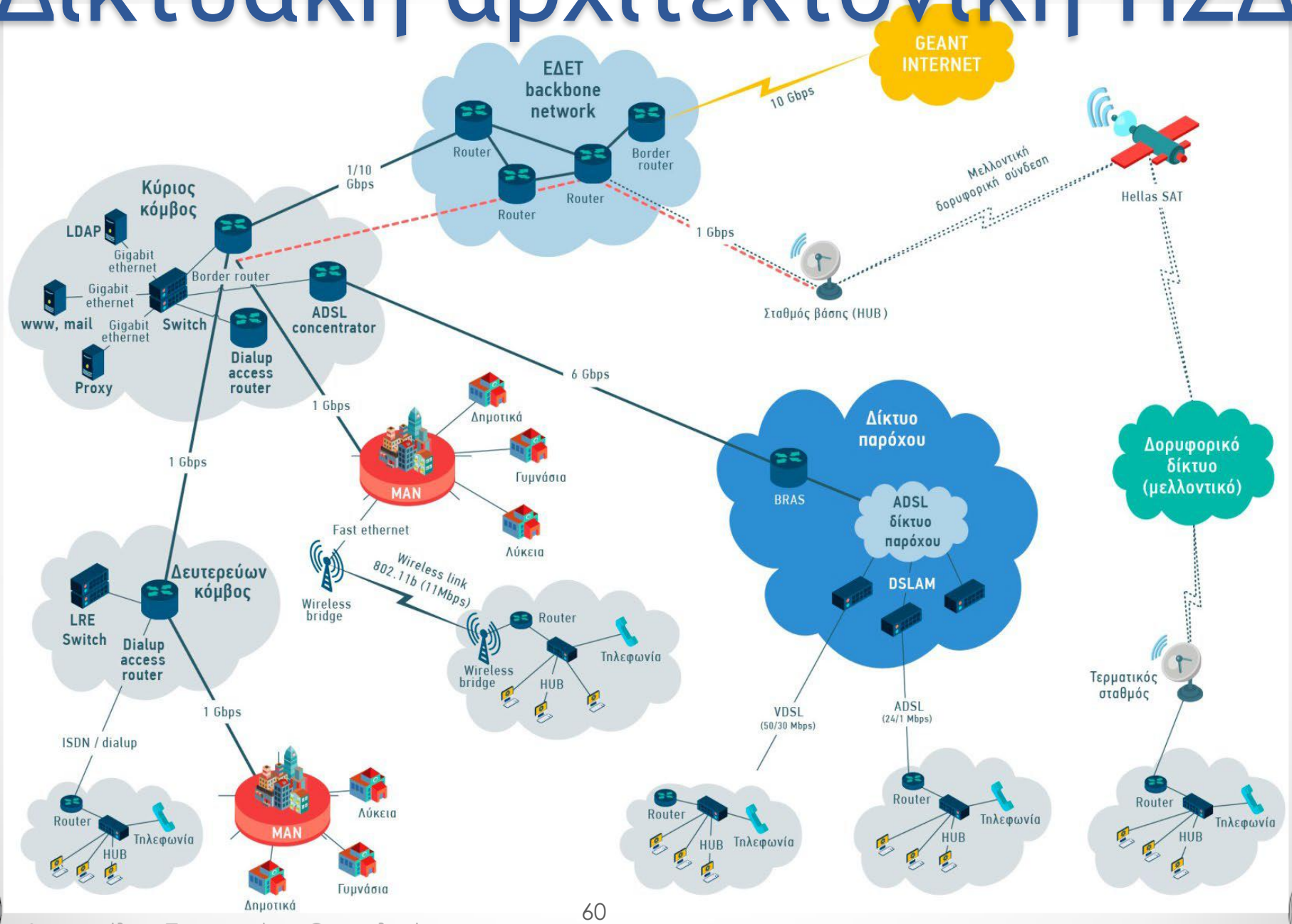
- very good collaboration
- complimentary operations
- minimizing OPEX

<u>Δίκτυο Διανομής</u>: 51 nodes installed inside OTE premises

Gigabit interconnections to GRNET in more than 10 major cities

Πηγή: https://www.sch.gr/wp-content/uploads/2009/09/PSD_Ipodomes_GR.pdf

Δικτυακή αρχιτεκτονική ΠΣΔ



 Πηγή:https://www.sch.gr/wp-content/uploads/2020/01/GSN_Detailed_Memo_EN_February_2020-1.pdf

Ερωτήσεις & Απαντήσεις



