

Εισαγωγή στον Προγραμματισμό

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

Παναγιώτης Τζουνάκης

Φθινόπωρο 2025



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

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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](#)

Internet HISTORY Timeline



1958

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

ADVANCED RESEARCH PROJECTS AGENCY

IN the NEWS

APNIC Partners On Experiment to Improve DNS



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

[MORE](#)

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

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.

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


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<http://www.internethalloffame.org/>



Τμήμα Μαθηματικών
Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης





INTERNET
HALL of FAME®

Celebrating people who bring the Internet to life

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SPEAKERS

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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



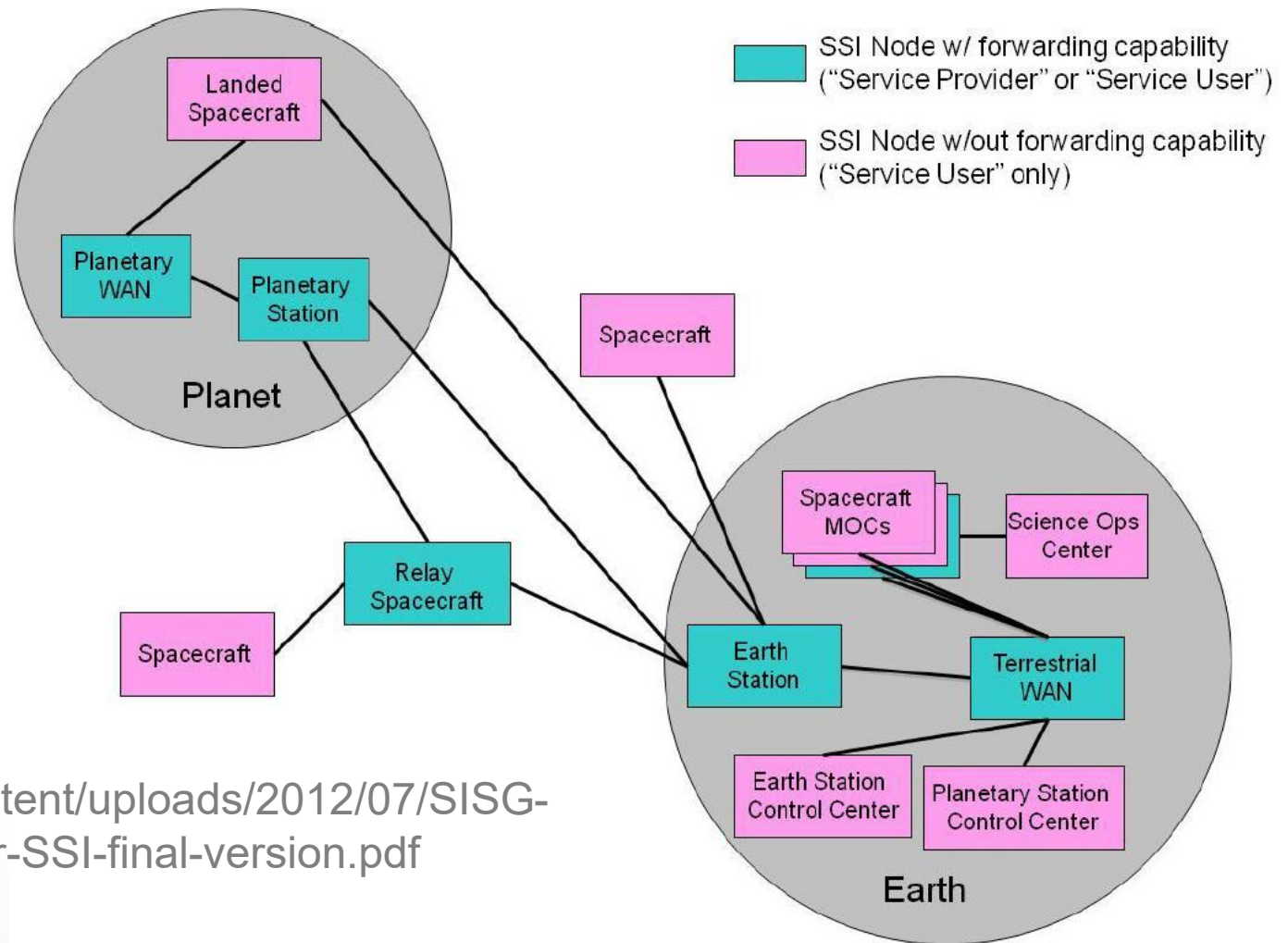
World Wide Web Hall of Fame @ First International Conference on the World-Wide Web (1994)

- 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

Operations Concept for a Solar System Internetwork (SSI)
IOAG.T.RC.001.V1



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

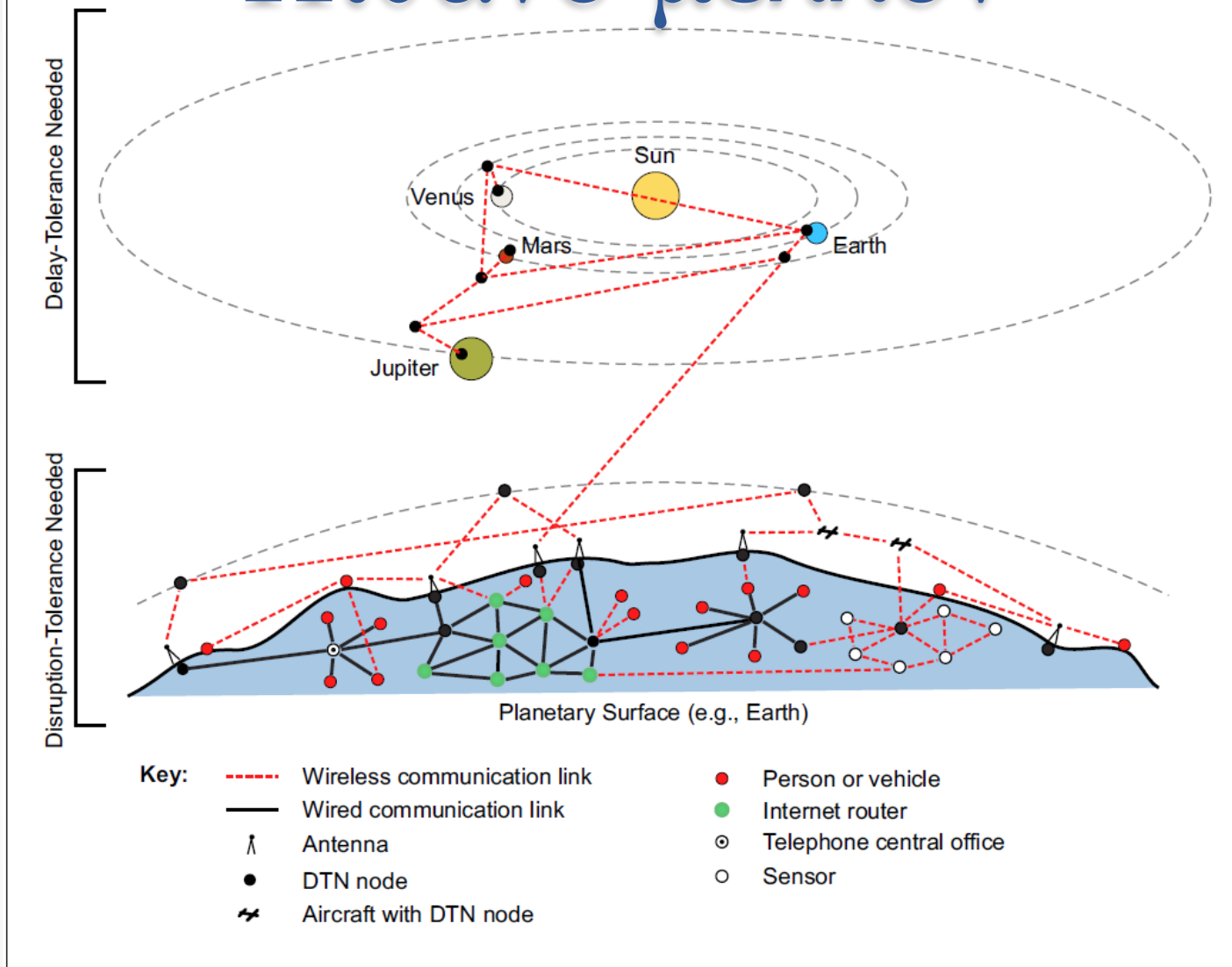


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Πιθανό μέλλον



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

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

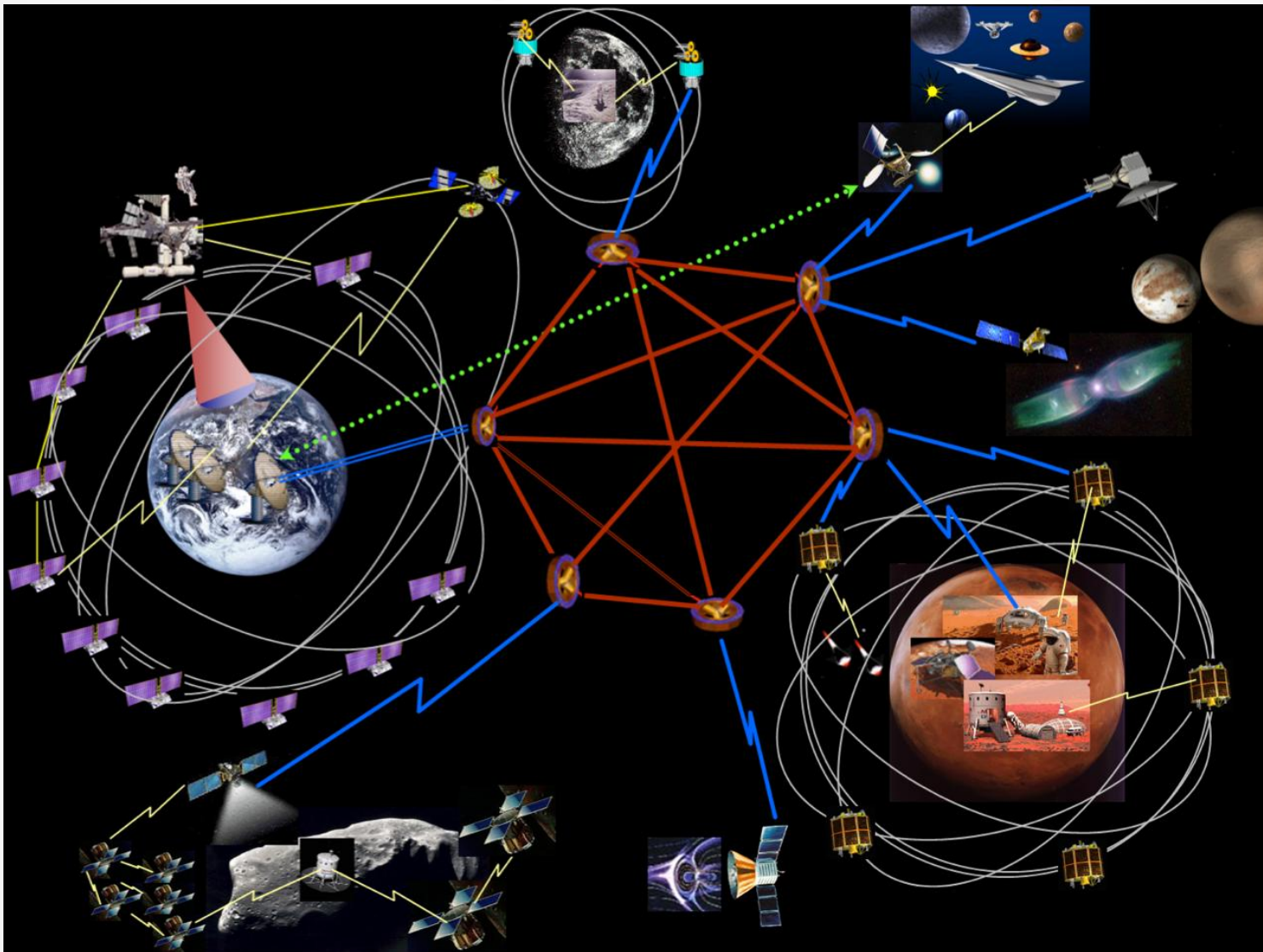


Τμήμα Μαθηματικών

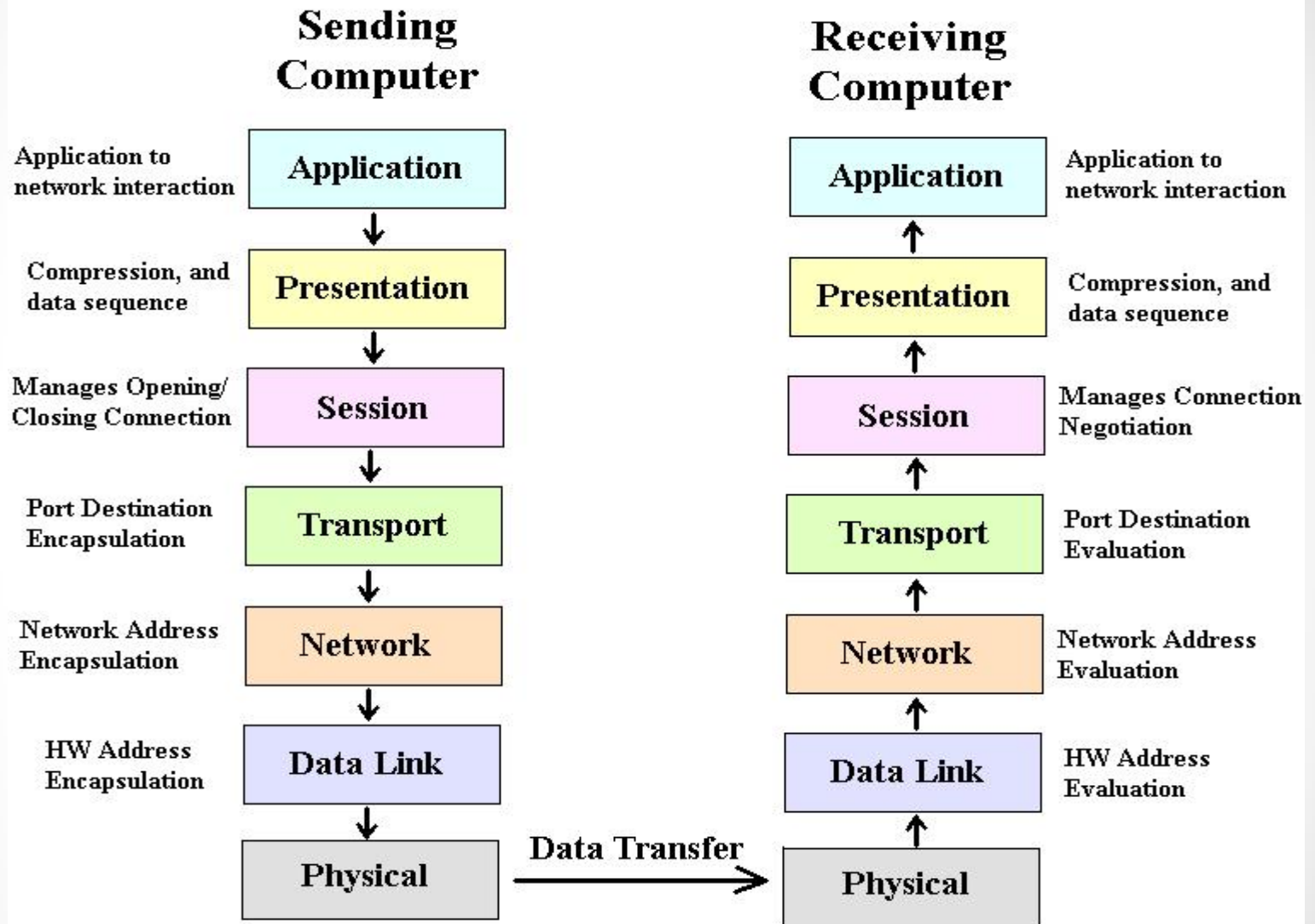
Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



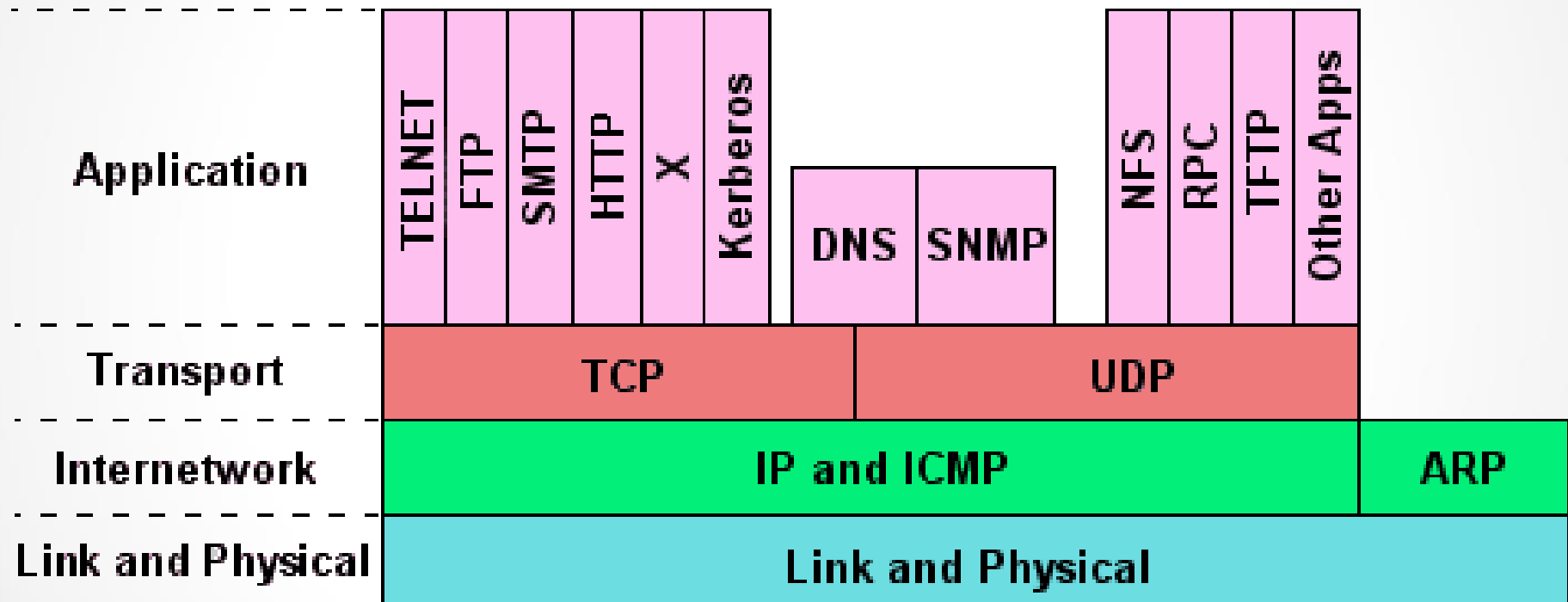
Update: <https://www.nasa.gov/content/dtn>
NASA Disruption Tolerant Networking



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, transceiver	Binary transmission signals and encoding. Layout of pins, voltages, cable specifications, modulation

OSI comparison 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)

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



Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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

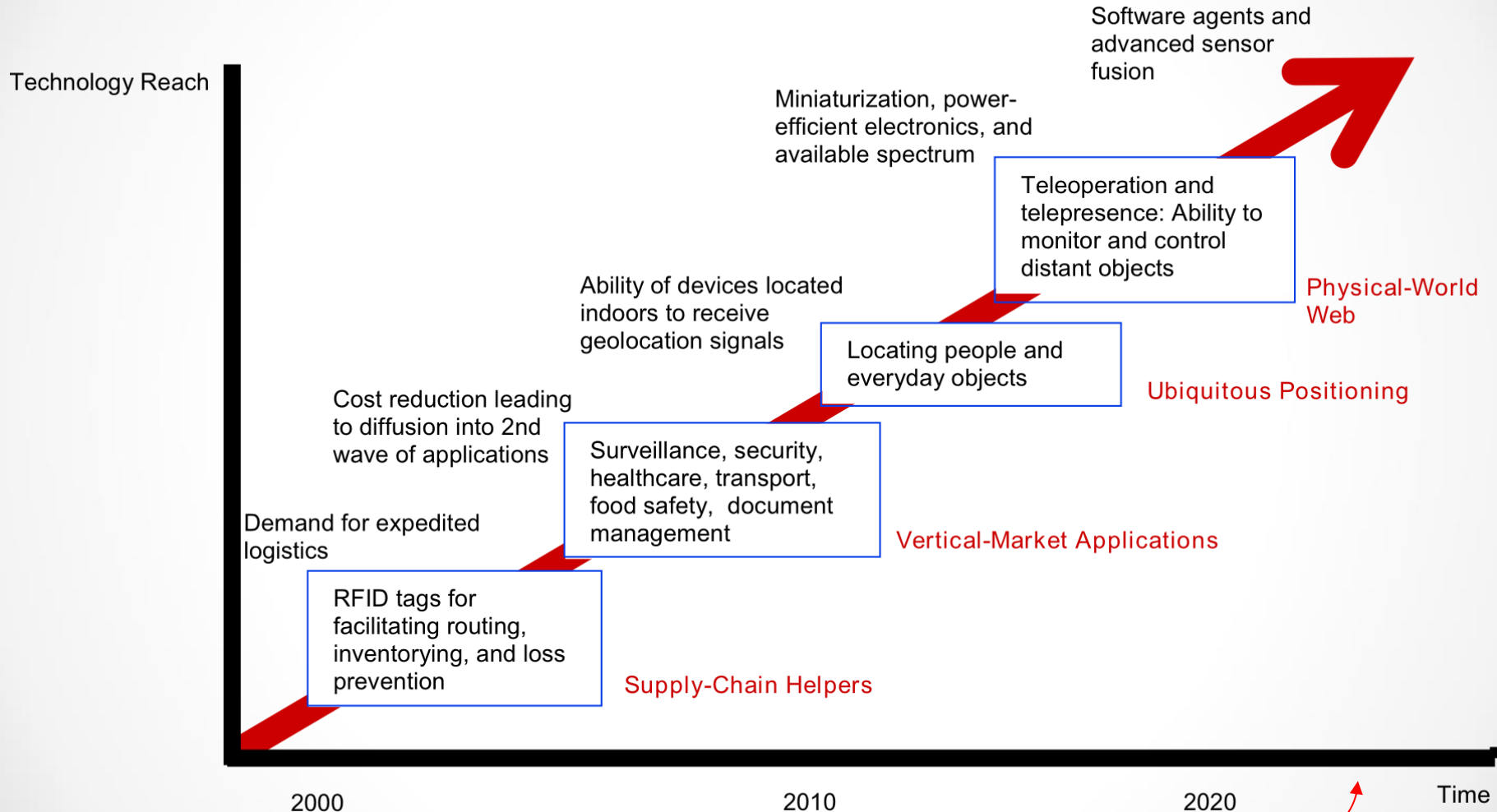
||
V

Broadband IP network



Εξέλιξη του Internet

TECHNOLOGY ROADMAP: THE INTERNET OF THINGS



Source: SRI Consulting Business Intelligence

Τμήμα Μαθηματικών

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



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

DECLARATION ON A QUANTUM COMMUNICATION INFRASTRUCTURE FOR THE EU

All 27 EU Member States

have signed a declaration agreeing to work together to explore how to build a quantum communication infrastructure (QCI) across Europe, boosting European capabilities in quantum technologies, cybersecurity and industrial competitiveness.

@FutureTechEU #EuroQCI



Quantum communication networks



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

<https://hellasqci.eu/>



Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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



Breakthroughs in Medicine

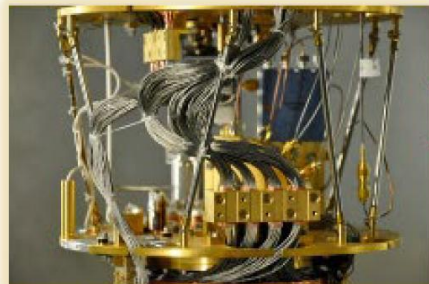


Image Credit: NASA Ames / John Hardman

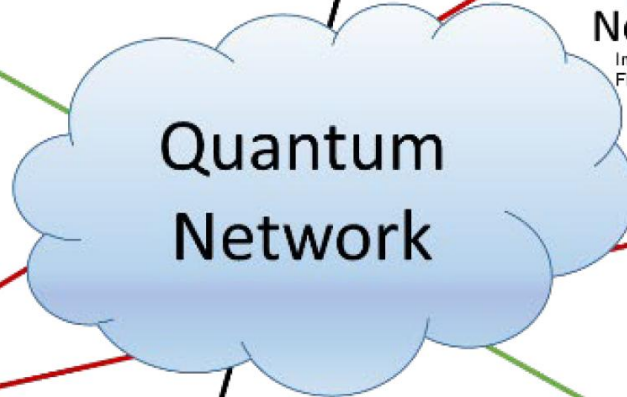
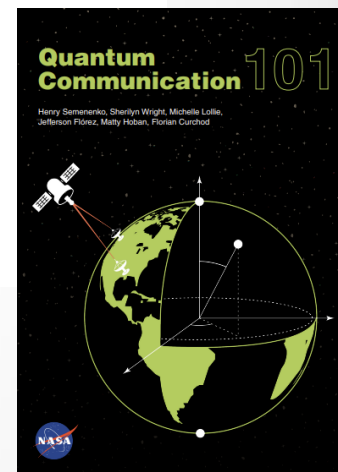


Image credit: NASA TDRS

Quantum Sensor
arrays may be used
to monitor local
aquifers

\$\$\$



Final Report

Workshop on Space
Quantum Communications
and Networks

Developing a Roadmap to Quantum Communications in Space
January 30 - 31, 2020
University of California, Berkeley
Berkeley, California 94720
30 September 2020

NIST National Institute of
Standards and Technology
U.S. Department of Commerce

<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>

Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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

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

<http://www.geant.org>

Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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)



Διοίκηση: Χρηματοδότηση

- Sources
 - AUPh annual budget
 - AUPh Research Committee
 - Competitive Research projects
- Indicative Expenditure categories
 - Hardware, software, equipment
 - Other / maintenance support
 - disposables
 - Personnel salaries
 - Travel expenses



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.

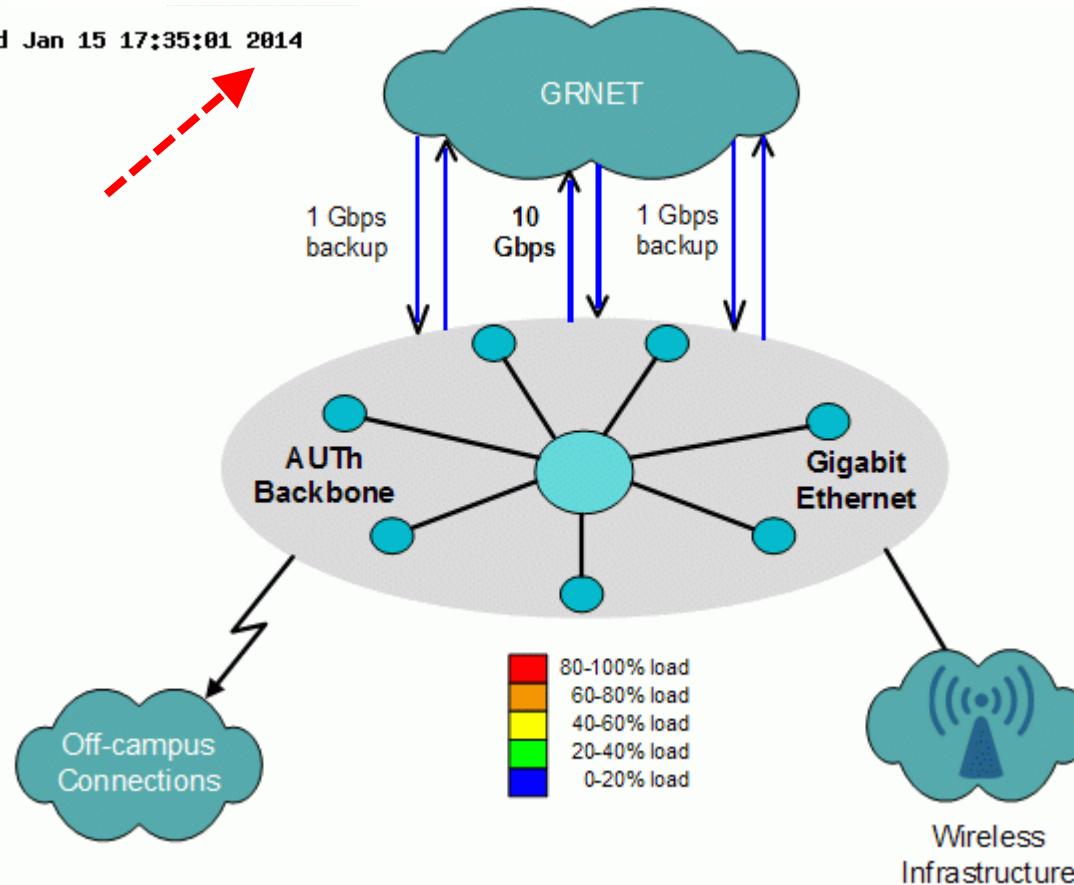
sch.gr



Wed Jan 15 17:35:01 2014



Διοδος
φοιτητικό Internet



Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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

Floor-Buildings	Building-Units	Cabling Tickets	IPs	Access Outlets	Access Ports	Access Nodes
Building: 06 - Διοίκησης						
Δεν υπάρχει open ticket						
Displaying all 119 access outlets						
Building-Floor	Outlet	Connected To	Status	Type	No. Tickets	
Διοίκησης 1ος	01		Not Connected	Office	none	
Διοίκησης 1ος	02		Not Connected	Office	1 Tickets	
Διοίκησης 1ος	03		Not Connected	Office	none	
Διοίκησης 1ος	04		Not Connected	Office	1 Tickets	
Διοίκησης 1ος	05		Not Connected	Office	1 Tickets	
Διοίκησης 1ος	06		Not Connected	Office	none	
Διοίκησης 1ος	07		Not Connected	Office	none	
Διοίκησης 1ος	08		Not Connected	Office	none	
Διοίκησης 1ος	09		Not Connected	Office	1 Tickets	
Διοίκησης 1ος	10	bld06f01-sw.00.05	Active	Office	none	
Διοίκησης 1ος	100	bld06f01-sw.03.25	Active	Office	none	
Διοίκησης 1ος	101	bld06f01-sw.02.27	Active	Office	2 Tickets	
Διοίκησης 1ος	102	bld06f01-sw.03.27	Active	Office	none	
		bld06f01-				

NOC: show - Mozilla Firefox

auth.gr https://nocweb.ccf.auth.gr/authdb/snmp/show/22752

SNMP Results

Switch:	bld06f01-sw	Module:	03	Port:	32
Model:	Cisco Catalyst				
Description:	Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 12.2(52)SE, RELEASE SOFTWARE (fc3) Copyright (c) 1986-2009 by Cisco Systems, Inc. Compiled Fri 25-Sep-09 08:49 by sasyamal Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 12.2(52)SE, RELEASE SOFTWARE (fc3) Copyright (c) 1986-2009 by Cisco Systems, Inc. Compiled Fri 25-Sep-09 08:49 by sasyamal				

Current vlan: 99

Current port speed: 100Mbps

Can't retrieve expected vlan (for subnets 99)

Administratively set speed: Autodetect

Save

Autodetect Save

Current duplex status: Autonegotiate

Port status: Enabled

Admin duplex status: Autonegotiate

Current link status: Up

Autonegotiate change duplex

Outlet expected status(from db): Active

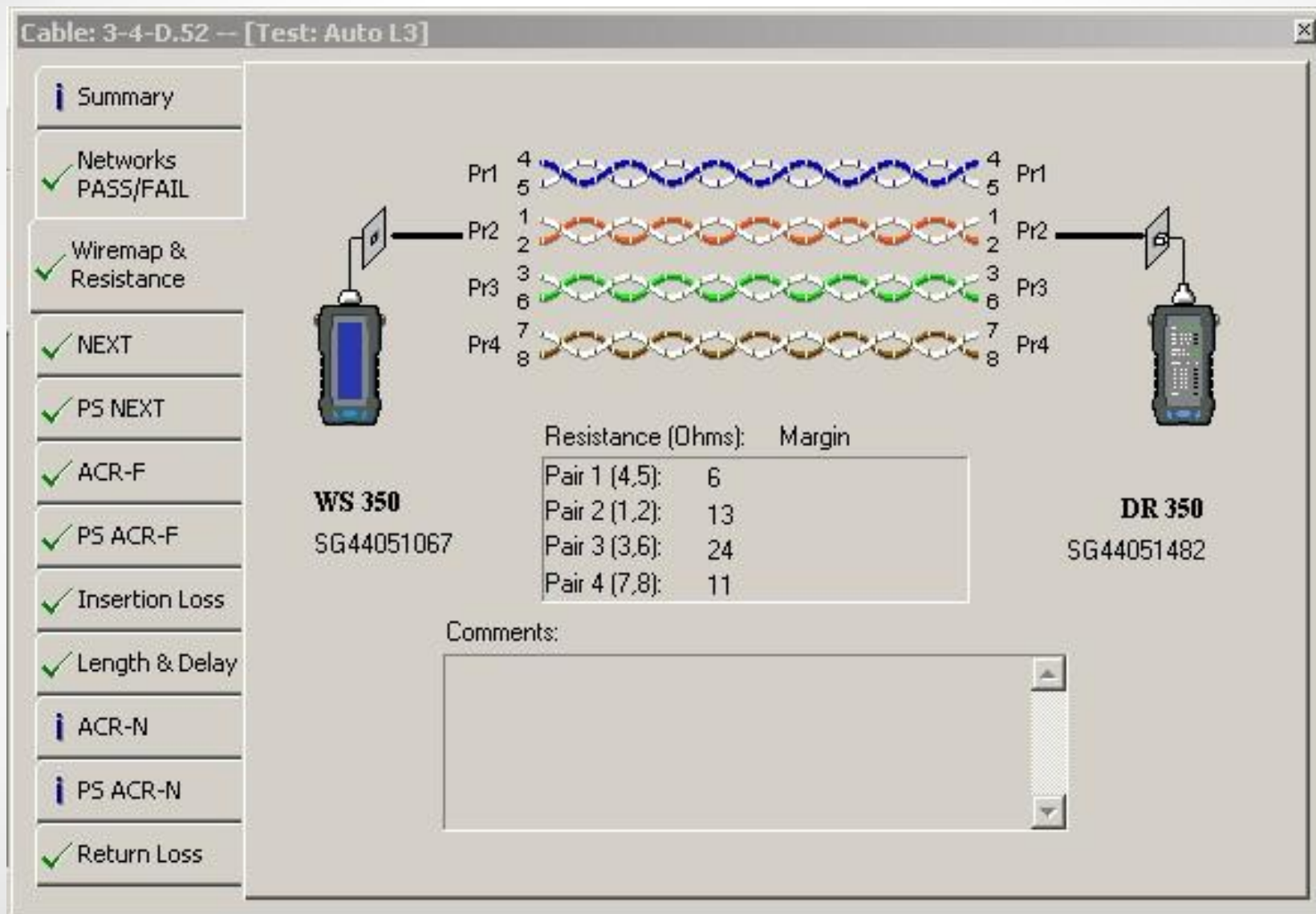
Toggle state

Done

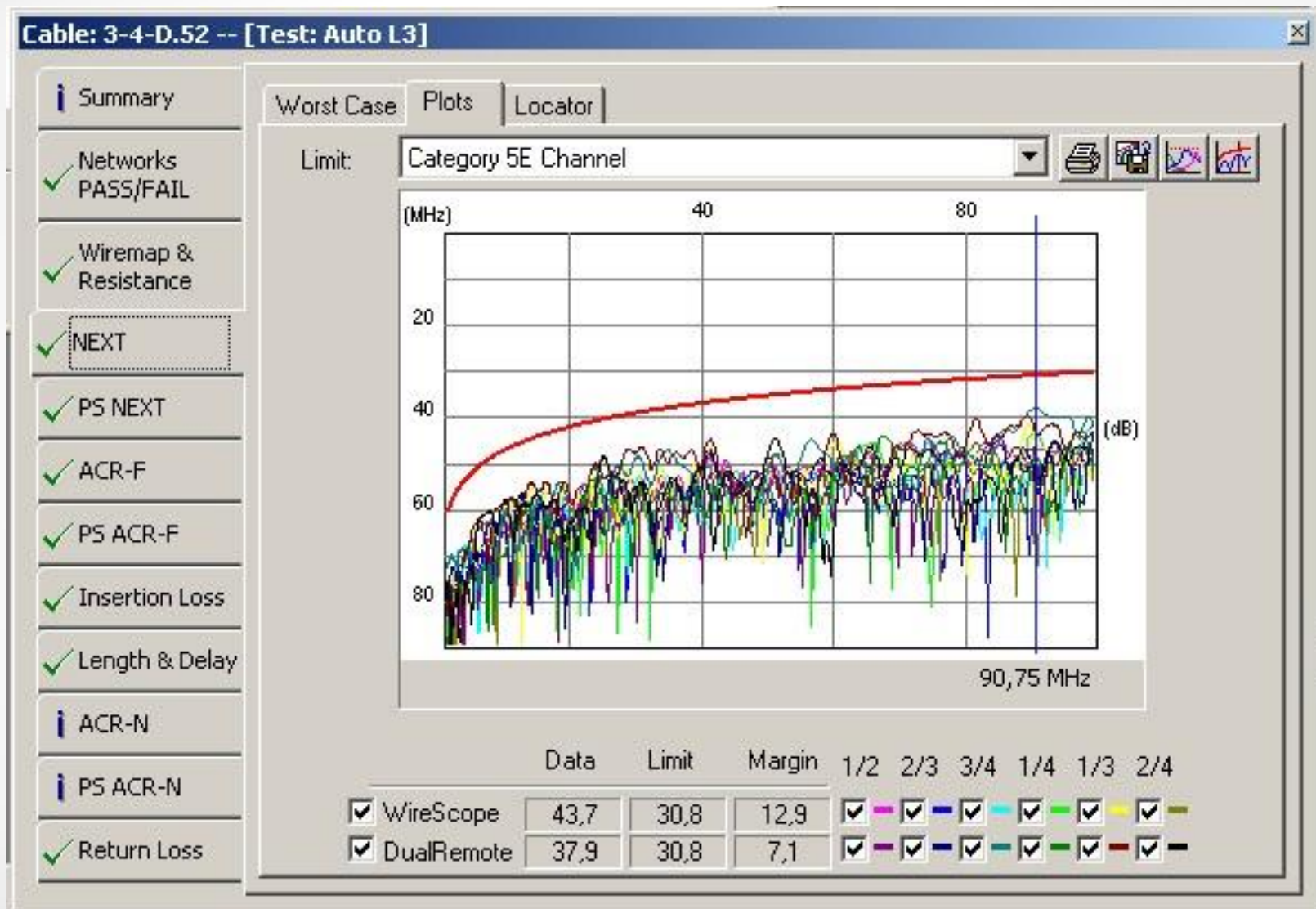
Tsiplakidis (PYKA 09/2009)	Παλιό τοπικό δίκτυο Διεύθυνσης Μηχανοργάνωσης	
Tsiplakidis (PYKA	Παλιό τοπικό δίκτυο	

Done

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



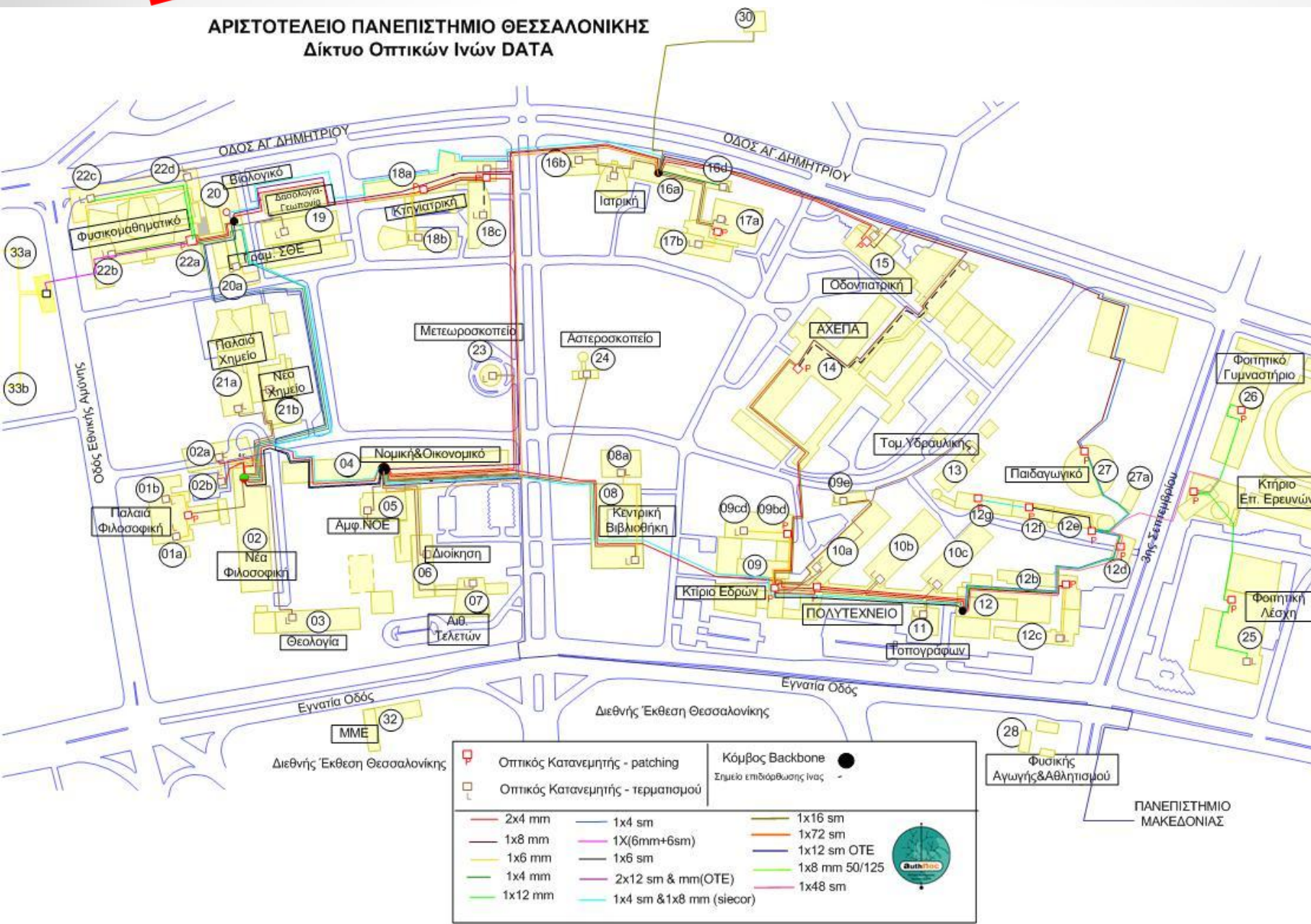
Cabling: Tools

- 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).

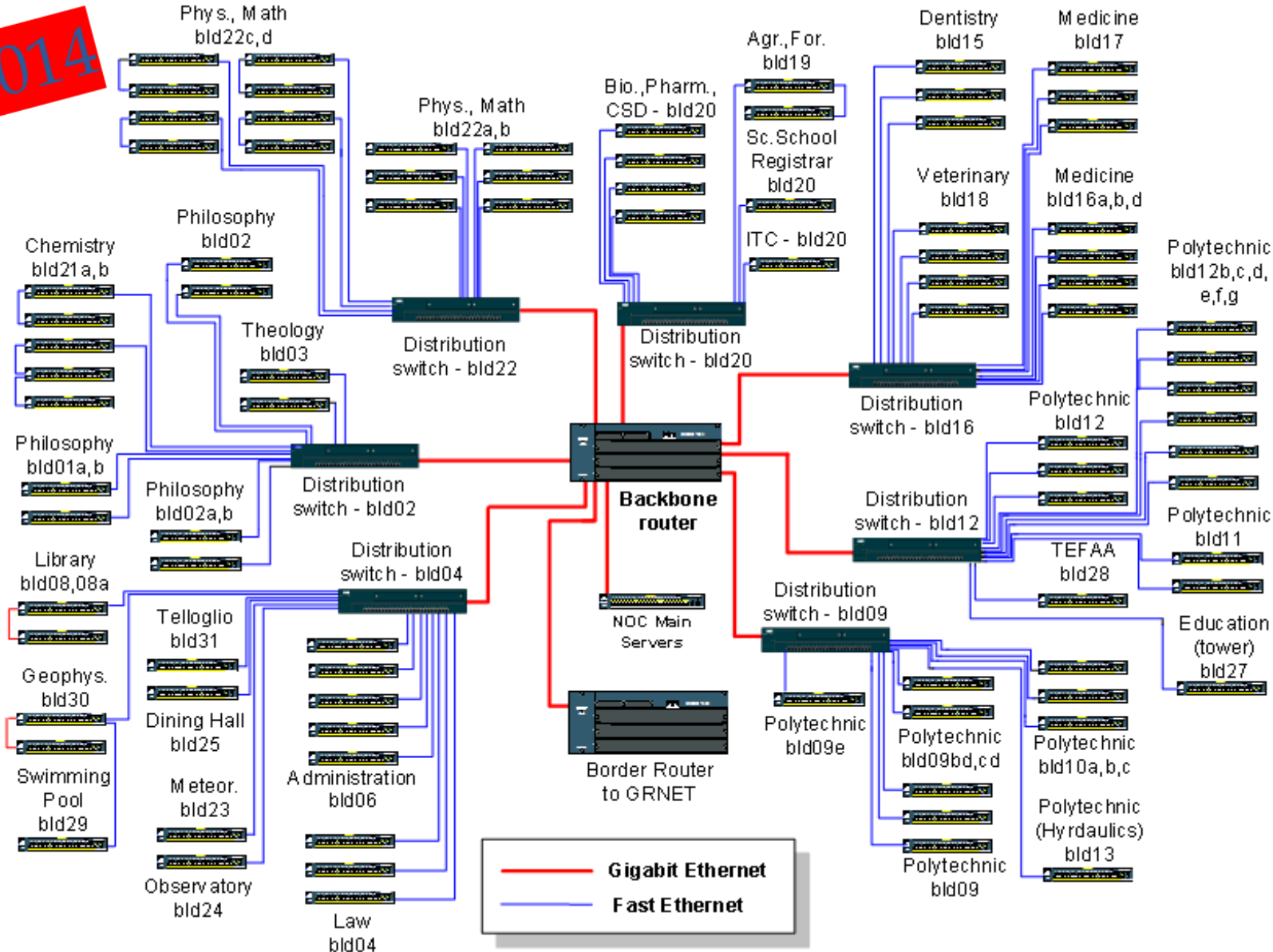


@2014 Fiber optics network at AUTh

ΑΡΙΣΤΟΤΕΛΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΟΝΙΚΗΣ
Δίκτυο Οπτικών Ινών DATA



@2014



Active components @ ATh

Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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

auth.gr 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

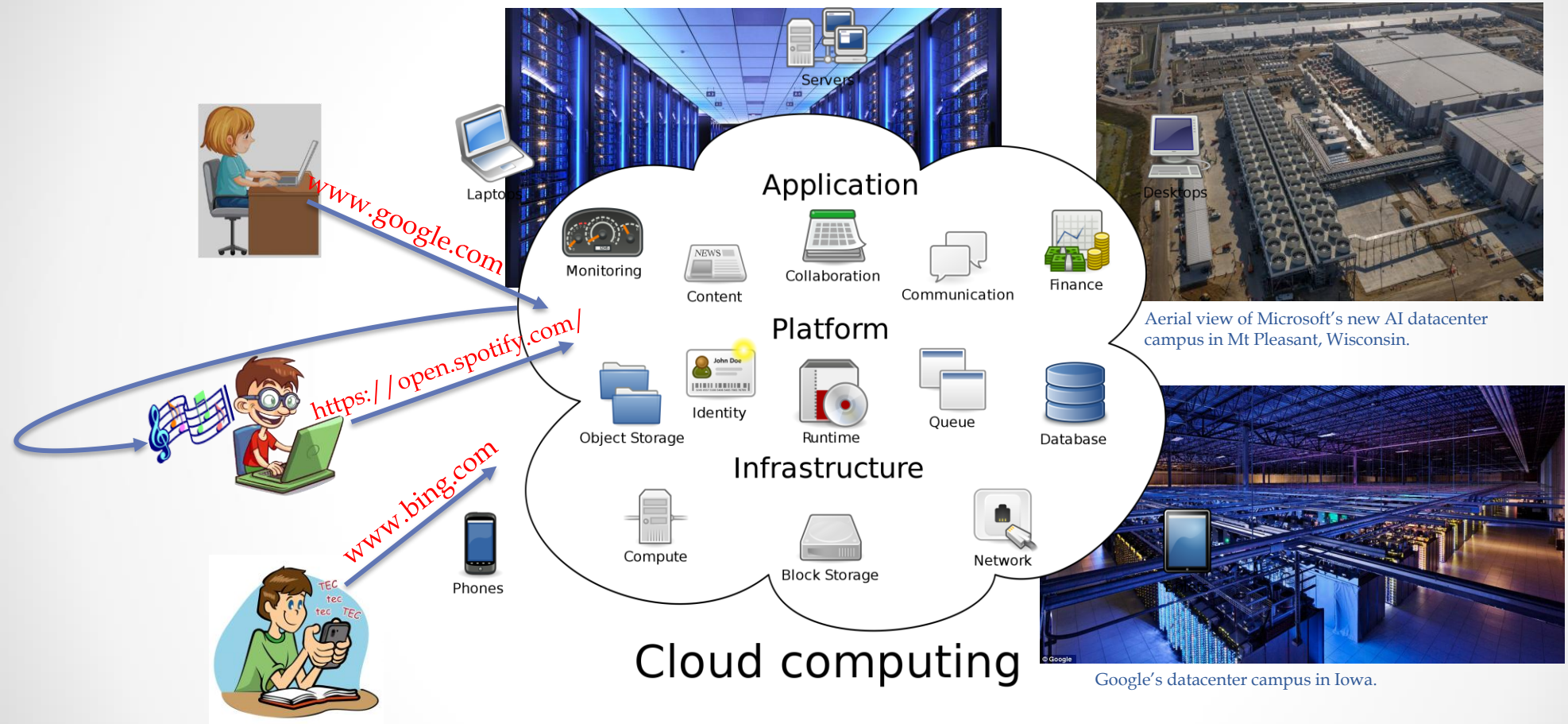
Tables -> Locations Contacts Event Policy Logs List Escalation Thresholds Users Nodes Links Interfaces sysNodes sysInterface ifTypes Services Enterprise Model Master Slave Slaves Toolset

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		Current Network Status								
		Group	Status	NodeUp	NodeDn	Metric	Reach	IntAvail	Health	RT
99.350	was: 99.730 diff: 0.620	All Groups Status	Warning	228	1	99.350	99.416	99.758	99.082	12 ms
Reachability	99.416	AUTH SERVERS	Normal	2	0	100.000	100.000	100.000	100.000	0 ms
Interface Availability	99.758	Access Servers	Normal	1	0	100.000	100.000	100.000	100.000	0 ms
Health	99.082	Aggreg-Switches	Normal	10	0	99.806	100.000	100.000	99.352	1 ms
Response Time	12 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
		Ippokratu	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-bld05	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...



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



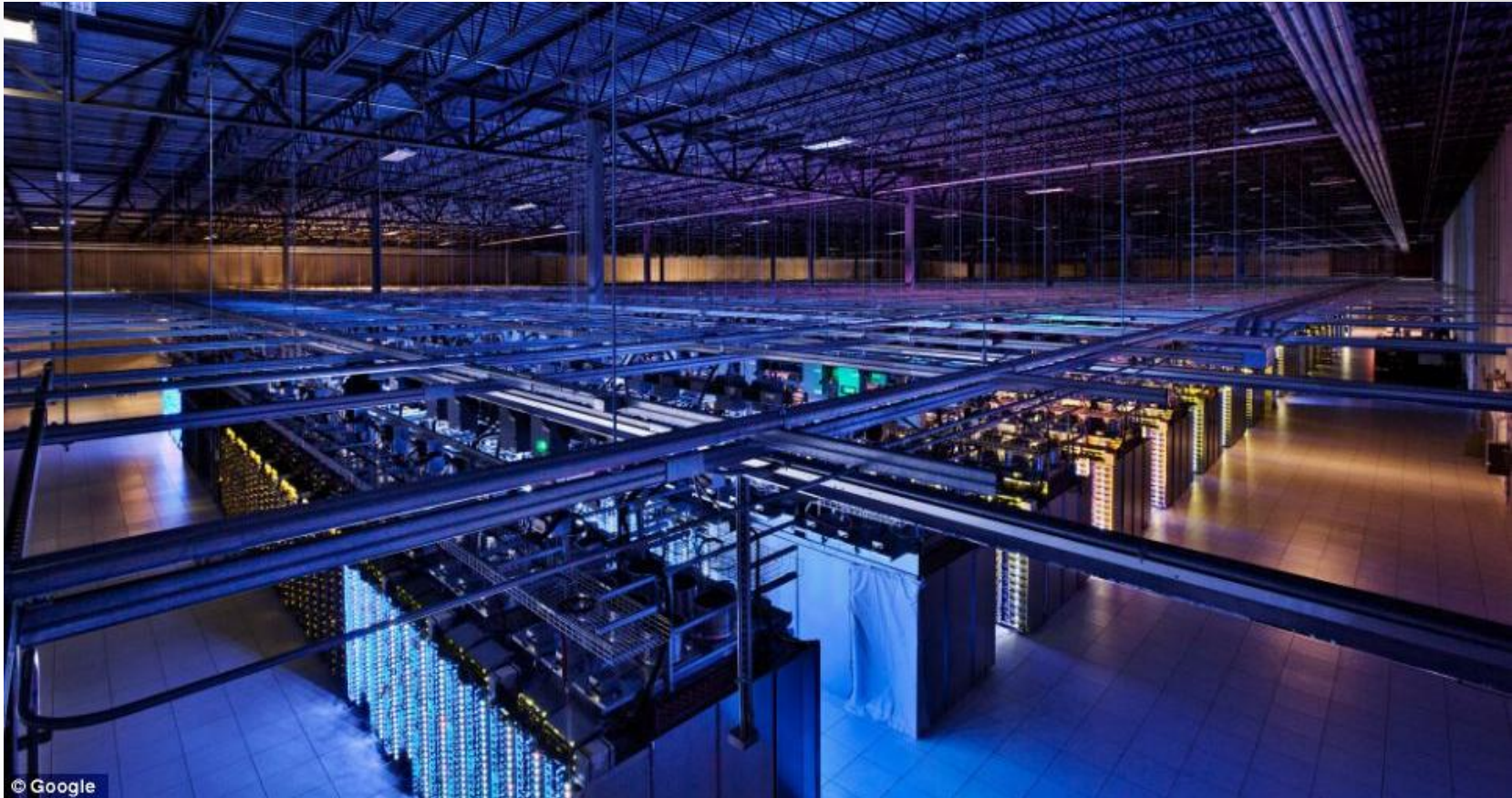
Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



Google 115.000 m² Datacenter @ Iowa

Council Bluffs,
Iowa



Πόση ηλεκτρική ενέργεια καταναλώνει κάθε ώρα; Ισχύς $\approx 400\text{MW}$ ($\approx 75\%$ 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



Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



Datacenter @ Ministry of Education



Τμήμα Παιδαγωγικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης



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



Landscape of services

Personal

User authentication is required in order to access services:

NOC, ITC, University Library,
Secretariats, other Service
Providers

Network Access

Connection to AUTHnet

- Wired
- Wireless
- Through a secure channel



Web services

Website development
AUTH and NOC

Infrastructure for website hosting
Other AUTH units

Interfaces development
Press news, tele-education

Directory services, e-university

Voice and Video

Cooperative activities

- telephony
- Video transmissions
- teleconference



The Greek School Network (GSN)

- Largest public network in Greece
- Connects more than 14.300 schools, 3.400 educational units and libraries
- Closed educational intranet - 1.300.000 students' 160.000 teachers' **safety** is a primary target.
- Value added network services for the education
- Based on open source development
- User support and training for the services GSN provides
- Network infrastructure complementary to GRNET
- **Broadband** access GSN is a central target



GSN operations

- 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**



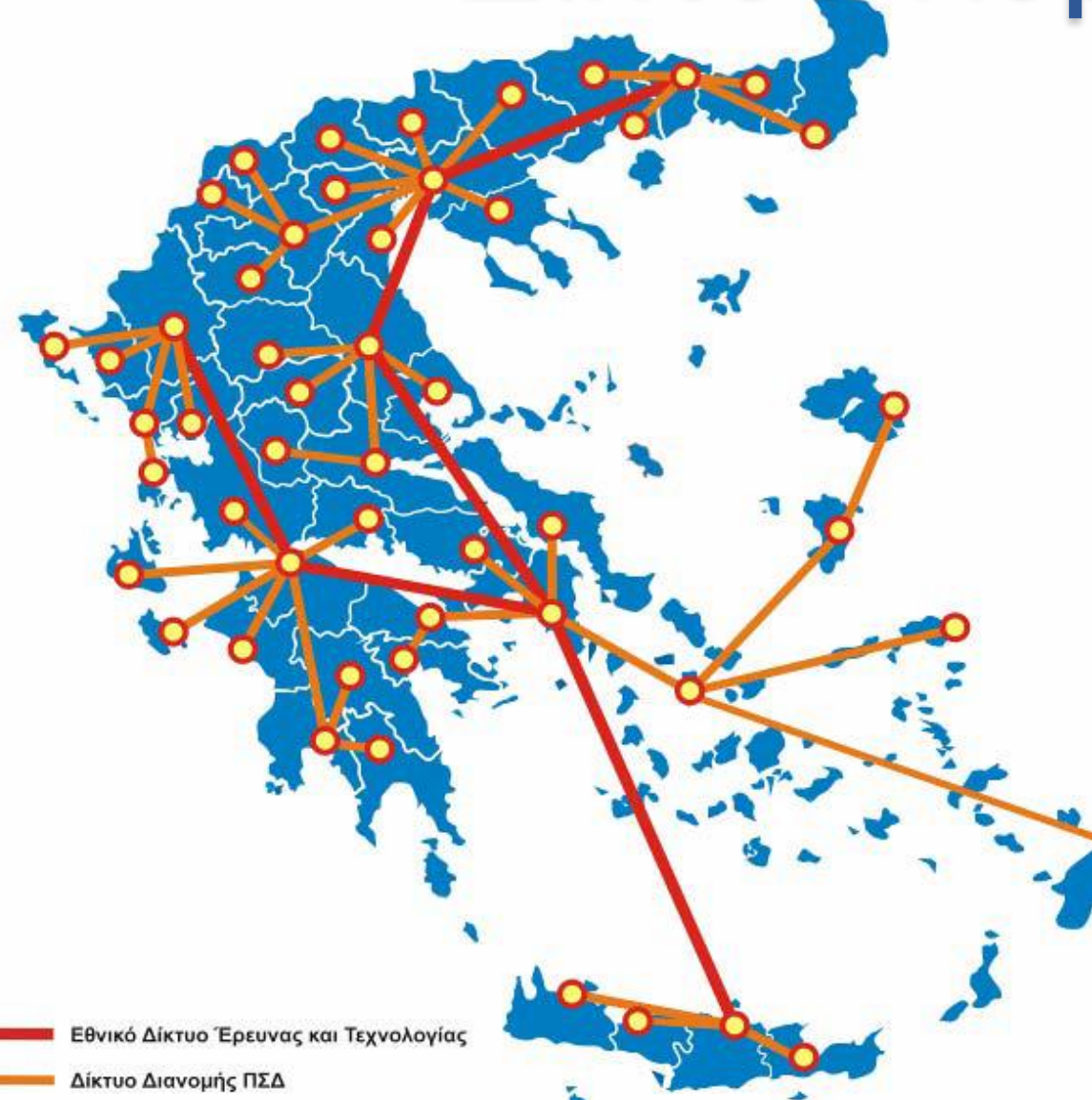
Δίκτυο Κορμού

Δίκτυο Κορμού: παρέχεται από το ΕΔΕΤ

- very good collaboration
- complimentary operations
- minimizing OPEX

Δίκτυο Διανομής: 51 nodes installed inside OTE premises

Gigabit interconnections to GRNET in more than 10 major cities



Εθνικό Δίκτυο Έρευνας και Τεχνολογίας
Δίκτυο Διανομής ΠΣΔ



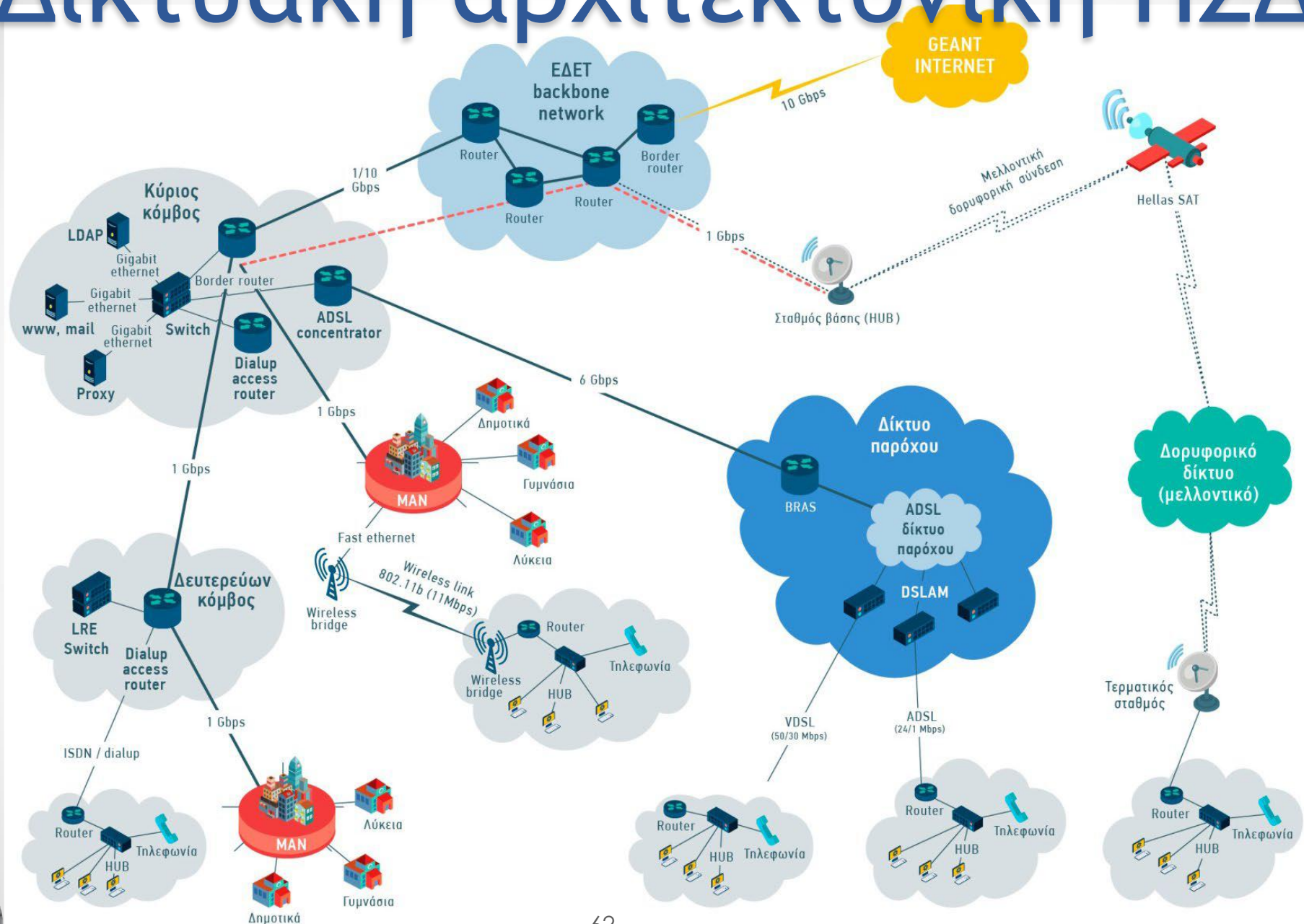
Τμήμα Μαθηματικών

Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης

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



Δικτυακή αρχιτεκτονική ΠΣΔ



User helpdesk

- **Provides assistance to AUTh and GSN users**
 - Handles user requests and provides help to solve technical problems
 - Organizes briefings, collects, organizes and presents statistics for NOC services
 - Coordinates training activities and edits training material
 - Creates user manuals and provides information for NOC services (telephone and on counter at AUTh campus)



Relevant Movies!

Lo and Behold, Reveries of the Connected World (2016)
<http://www.imdb.com/title/tt5275828/>

The Circle (2017) <http://www.imdb.com/title/tt4287320/>

Zero Days (2016) <http://www.imdb.com/title/tt5446858/>

Banking on Bitcoin (2016) <http://www.imdb.com/title/tt5033790/>

Deep Web (2015) <http://www.imdb.com/title/tt3312868/>

Trust Machine: The Story of Blockchain (2018)
<https://www.imdb.com/title/tt7407496/>



Ερωτήσεις & Απαντήσεις

