Lecture 2

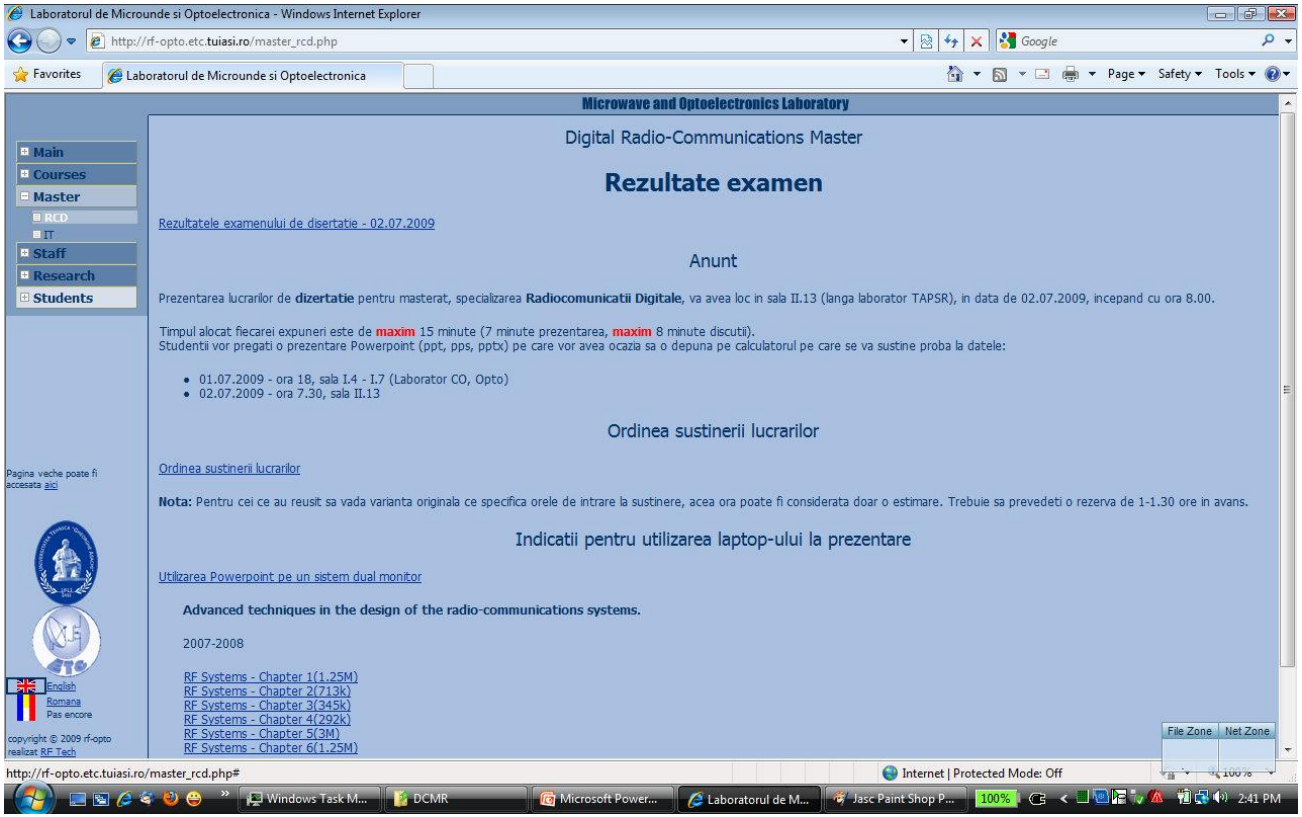
2012/2013

Internet Programming Techniques

Refresher

Documentation

- Microwave and Optoelectronics Laboratory
- http://rf-opto.etti.tuiasi.ro



Photographs

FLORESCU DAN-CONSTAN

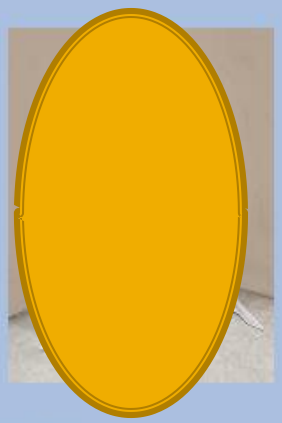
Date:

Grupa	5405 (2008)
Specializarea	Tehnologii si sisteme
Marca	3275

Note obtinute

Disciplina	Tip	Data	Descriere	Nota	Ob
DCMR	Dispozitive si circuite de microunde pentru radiocomunic				
	Nota	19/06/2009	Nota finala	10	
	Exam	19/06/2009	Examen DCMR	9	
	Tema	05/06/2009	Proiect DCMR	10	

FLORESCU DAN-CONSTA



Date:

Grupa	5405 (2008)
Specializarea	Tehnologii si siste
Marca	3275

Detalii

Finantare	Buget
Bursa	Bursa de Studii
Domiciliu	Iasi, judet Iasi
Promovare	Promovare Integrala
Credite	60
Media	8.86

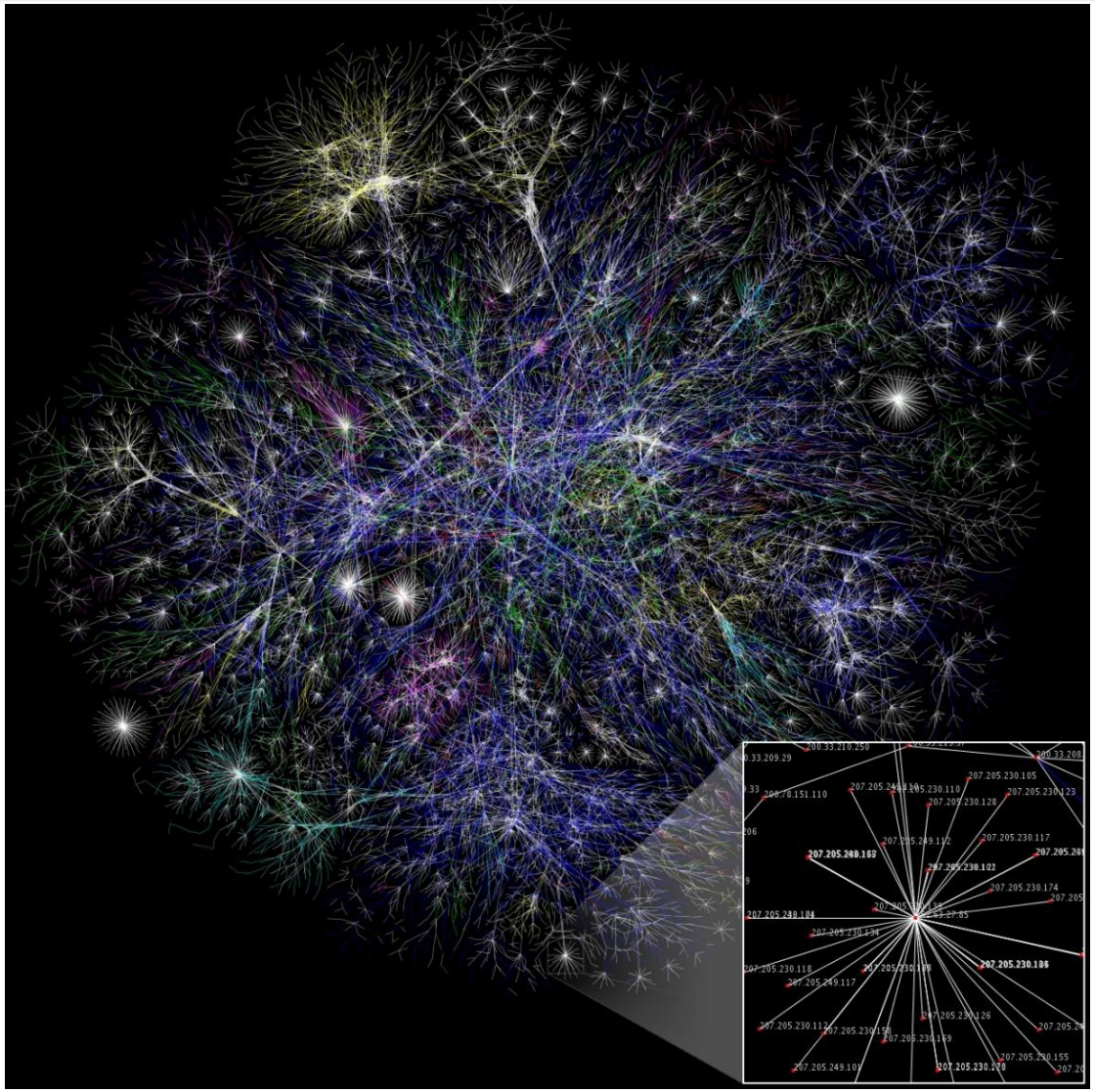
Homework

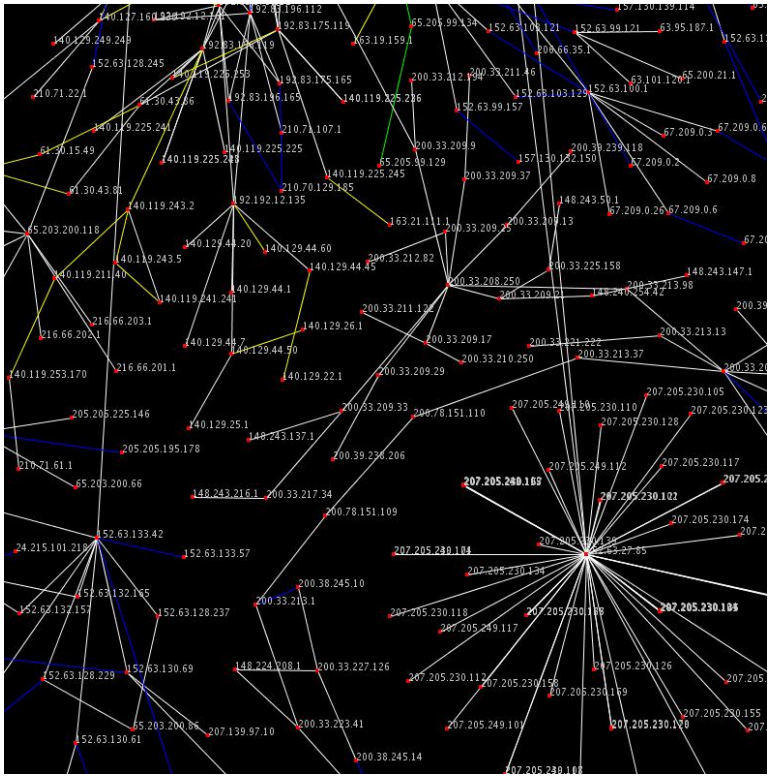
- Homework, lecture 2, mandatory presence, 25% grade
- Hour: 17.00-17.15

Impressive?

- Intel® Itanium® processors (codenamed Tukwila)
- 2 billions transistors on each CPU
- >3 billions operations per second
- **Low level of complexity, elementary operations**

World Wide Web





http://www.opte.org

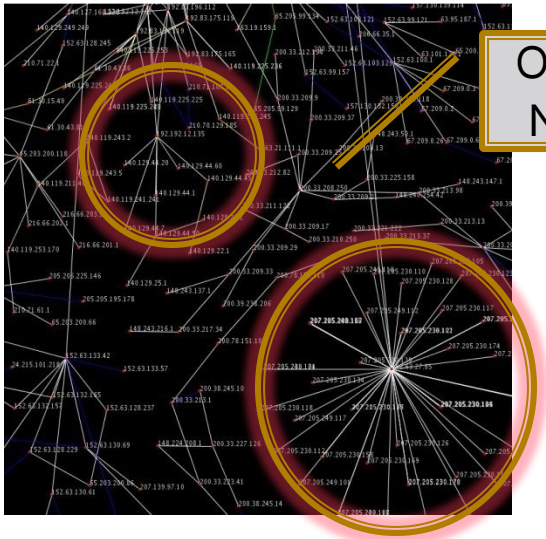
Continuare

TCP/IP

IP Address

- **IP = Internet Protocol**
- Internet Protocol Address (short: "IP")
- Numeric code used by IP for the **unique** identification of computers or devices on the Internet
- A succession of 4 numbers between 0 and 255 (4 bytes, $256 = 2^8 = 8$ bits) (IPv4 – version 4)
- Maximum combinations: 4.294.967.296
  - exhausted on February 3, 2011
- 81.180.222.18 = 01010001.10110100.11011110.00010010

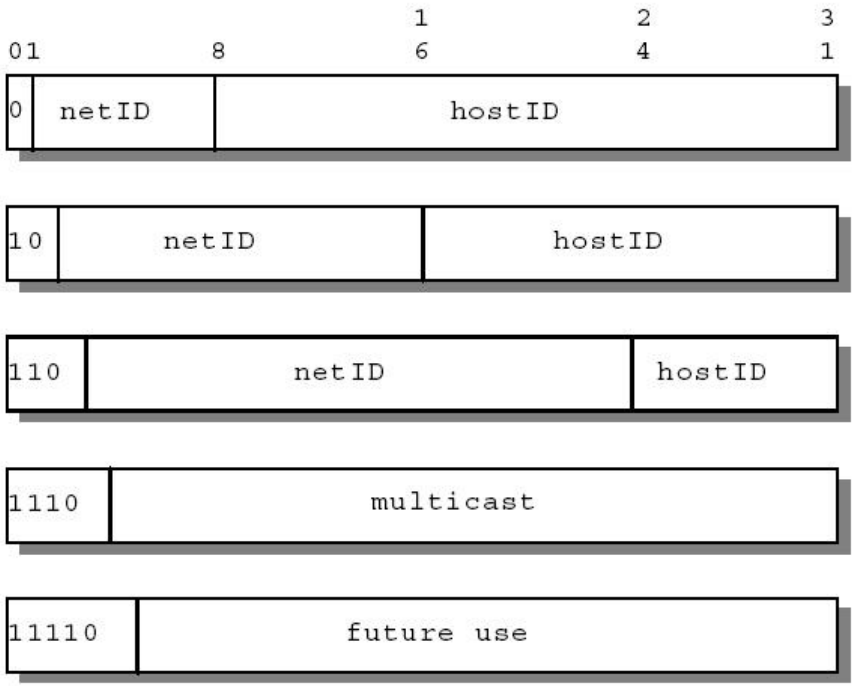
IPv4 Address



Organisation-NETWORKS

Adrese IP: Net | Host

Total: 32 bits = 4 bytes



IPv6 Address

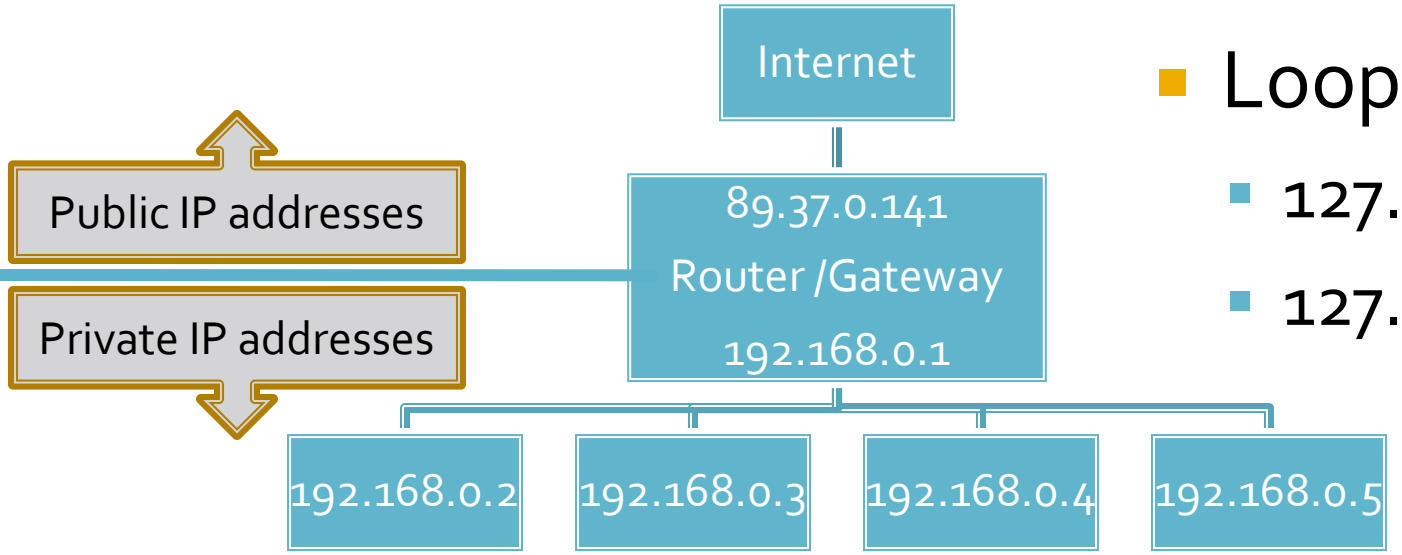
- IPv6 uses 128 bit addresses
  - 2^{128}, or approximately 3.4×10^{38} addresses
  - more than 7.9×10^{28} times as many as IPv4
- IPv6 addresses, consist of eight groups of 4 hexadecimal digits separated by colons,
  - 2001:0db8:85a3:0042:0000:8a2e:0370:7334
  - 4 hexadecimal digits: $16^4 = 65536_{10} = 2^{16} = 16$ bits
  - 8 groups × 16 bits = 128 bits
- the two protocols are not compatible, complicating the transition to IPv6.

IP Address

- Public (routable, "rutabila" - RO)
  - visible on entire Internet
  - necessary for devices which **offer** data
- Private ("nerutabila" - RO)
  - invisible from outside
  - enough for devices which **receive** data
  - needs an device with public address (gateway, router) for access to the outside world

IP Address

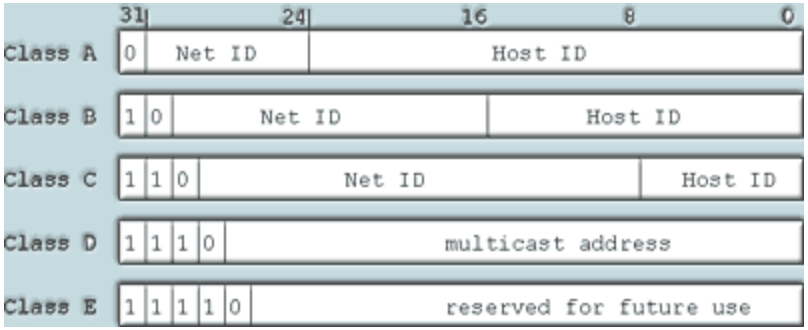
- IANA-reserved private IPv4 network ranges
  - 10.x.x.x – 1 class A network
  - 172.16.x.x – 172.31.x.x – 16 class B networks
  - 192.168.0.x – 192.168.255.x – 256 class C networks



- Loopback
  - 127.0.0.0/8
  - 127.0.0.1 = localhost

IP Address

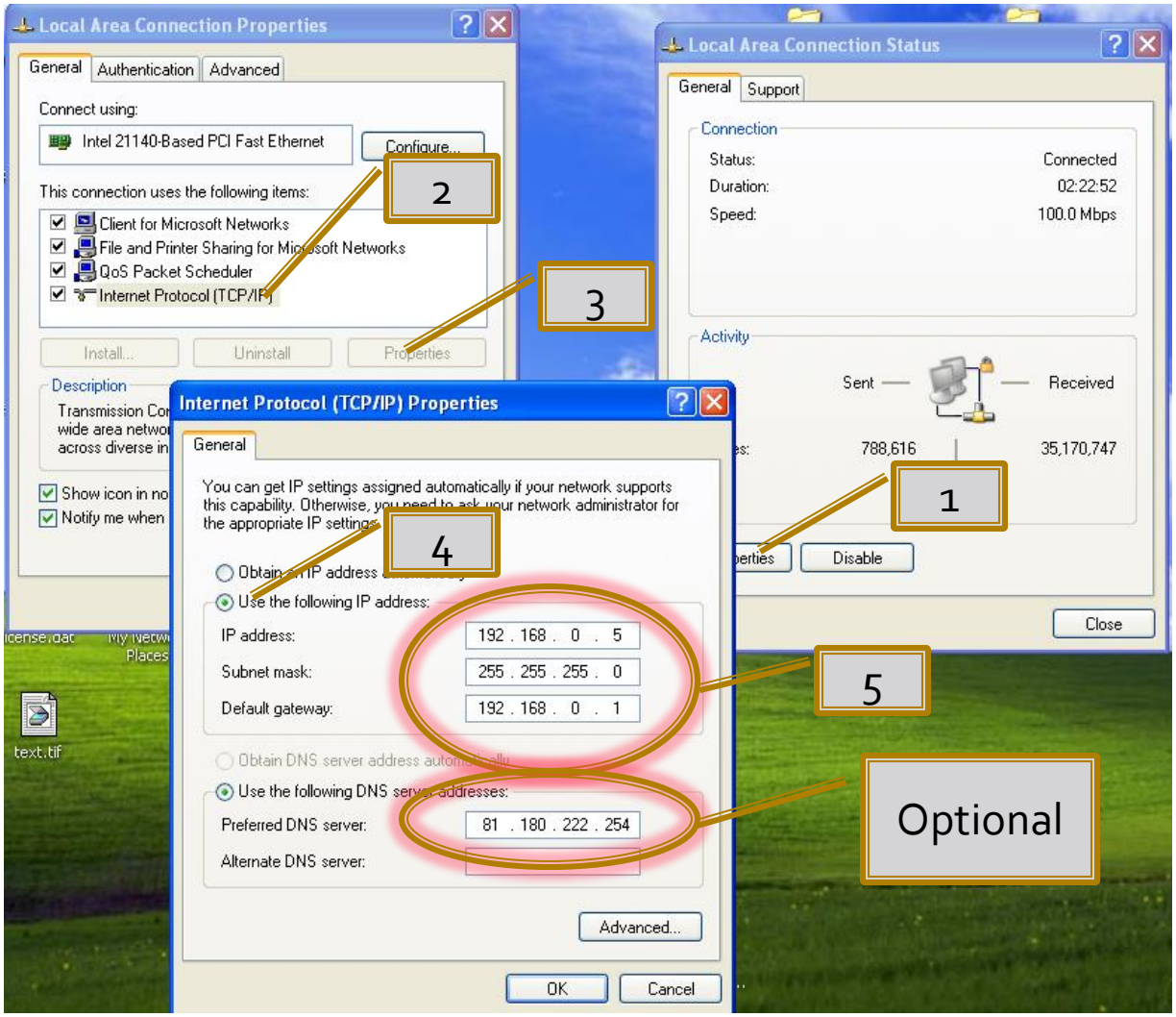
- IP Addresses:
  - Class A – 126 networks with 16.777.214 hosts each
  - Class B – 16.384 networks with 65.534 hosts each
  - Class C – 2.097.152 networks with 254 hosts each
  - Class D – multicast
  - Class E – reserved



TCP/IP configuration

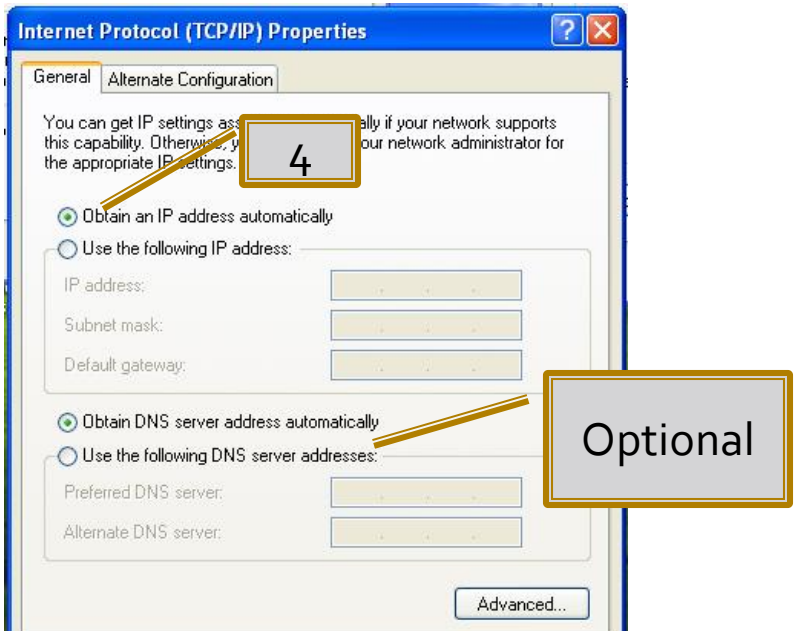
- Necessary data:
  - IP Address
  - Subnet Mask
  - Gateway
- Can be
  - static
  - dynamic (DHCP)
- DNS – optional

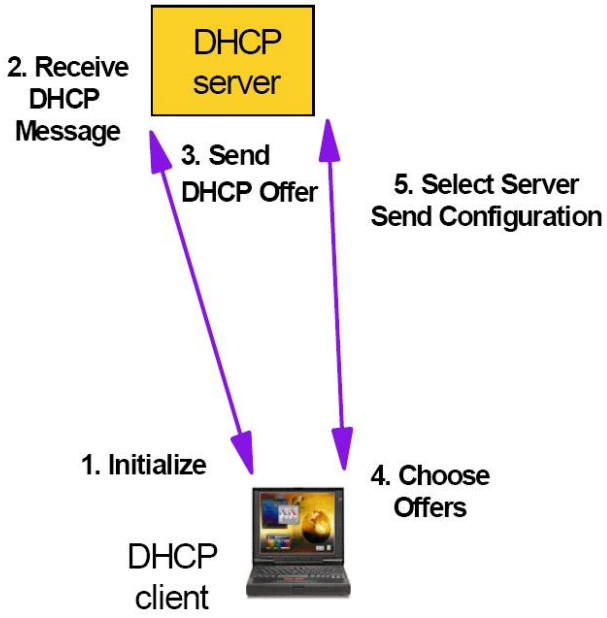
TCP/IP static



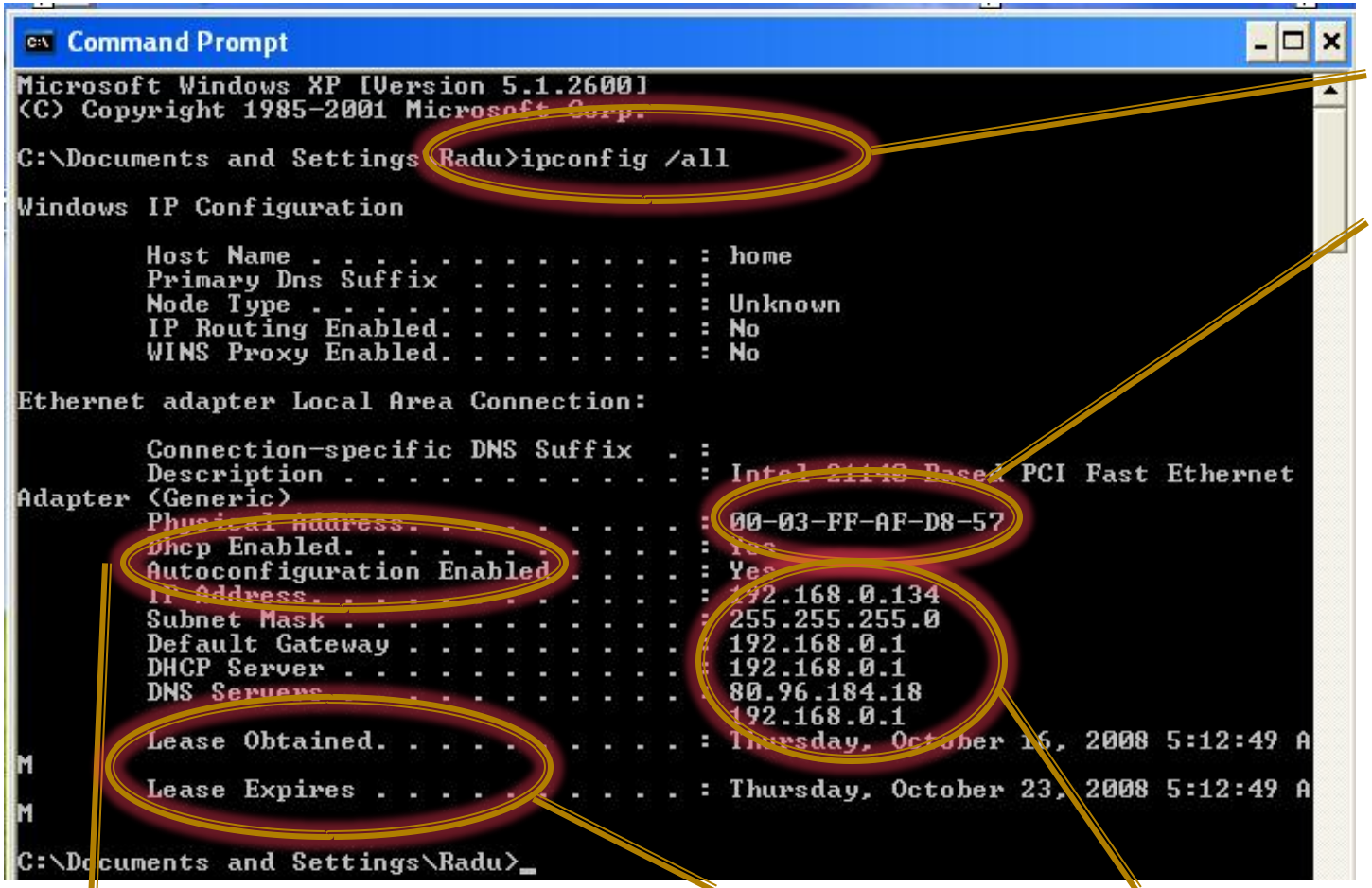
DHCP

- **Dynamic Host Configuration Protocol**
  - Permits reuse of available IP addresses
  - Necessary data available automatically
  - Needed the presence in the network of the supplier of that data : DHCP server





Ipconfig



ipconfig /all – all network interfaces

MAC (Media Access Control)

DHCP ?

DHCP- temporary lease

IP status

CIDR notation

- CIDR notation is constructed from the IP address and the prefix size, the latter being equivalent to the number of leading *1* bits in the routing prefix mask (subnet mask).
- The IP address is expressed according to the standards of IPv4 or IPv6. It is followed by a separator character, the "/" character, and the prefix size expressed as a decimal number.
- Subnet mask examples
  - /8 : 255.0.0.0 ⇨ 16,777,216 addresses
  - /24 : 255.255.255.0 ⇨ 256 addresses
- CIDR notation examples
  - 198.51.100.1/22 ⇨ 198.51.100.0 ÷ 198.51.103.255
  - 10.4.12.0/22 ⇨ 10.4.12.0 ÷ 10.4.15.255

Subnetworking

- Example for a /24 network

Prefix size	Network mask	Available subnets	Usable hosts per subnet	Total usable hosts
/24	255.255.255.0	1	254	254
/25	255.255.255.128	2	126	252
/26	255.255.255.192	4	62	248
/27	255.255.255.224	8	30	240
/28	255.255.255.240	16	14	224
/29	255.255.255.248	32	6	192
/30	255.255.255.252	64	2	128

Purchase of IP addresses

- ICANN – Internet Corporation for Assigned Names and Numbers
  - RIPE – Réseaux IP Européens
    - RoTLD – Romania Top Level Domain **www.rotld.ro**
  - ARIN – American Registry for Internet Numbers
  - APNIC – Asia-Pacific Network Information Center
- Fixed price, non-profit (Expenses only)
- Transition to IPv6, ongoing

Purchase of IP addresses – 2009

TIP BLOC ALOCAT	LUNGIME BLOC	COST USD (FARA TVA)
A	<128	50
B	129-256	75
C	257-512	175
D	513-768	225
E	769-1024	275
F	1025-1536	350
G	1537-2048	400
H	2049-3072	800
I	3073-4096	1200

RoTLD:

“Acesta reprezintă taxa pentru serviciul de alocare şi înregistrare a acestor adrese la RIPE. Adresele IPv4 fiind limitate nu se vând ci se aloca temporar atât timp cât este nevoie (justificatã) de ele. RIPE verificã sistematic aceste alocări.”

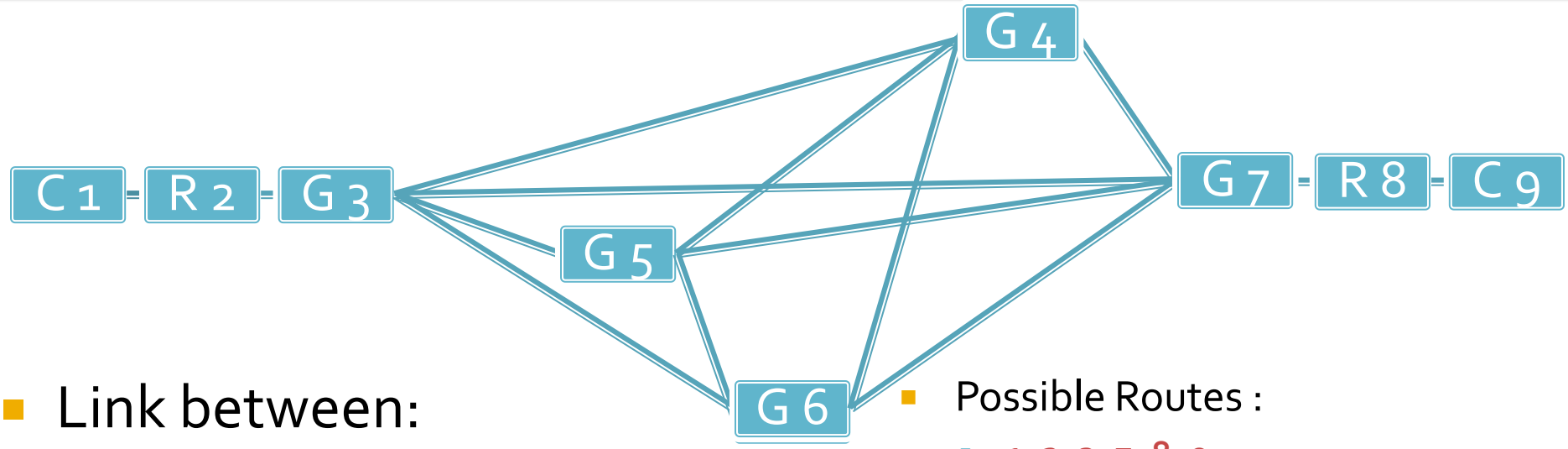
Purchase of IP addresses – 2012

Dimension IP Block	Assignment Fee (EUR)	Annual fee (EUR)
256	120	60
512	150	75
1024	300	90
2048	600	110
4096	1200	150

RIPE

On 14 September 2012, the RIPE NCC began to allocate IPv4 address space from the last /8 of IPv4 address space it holds.

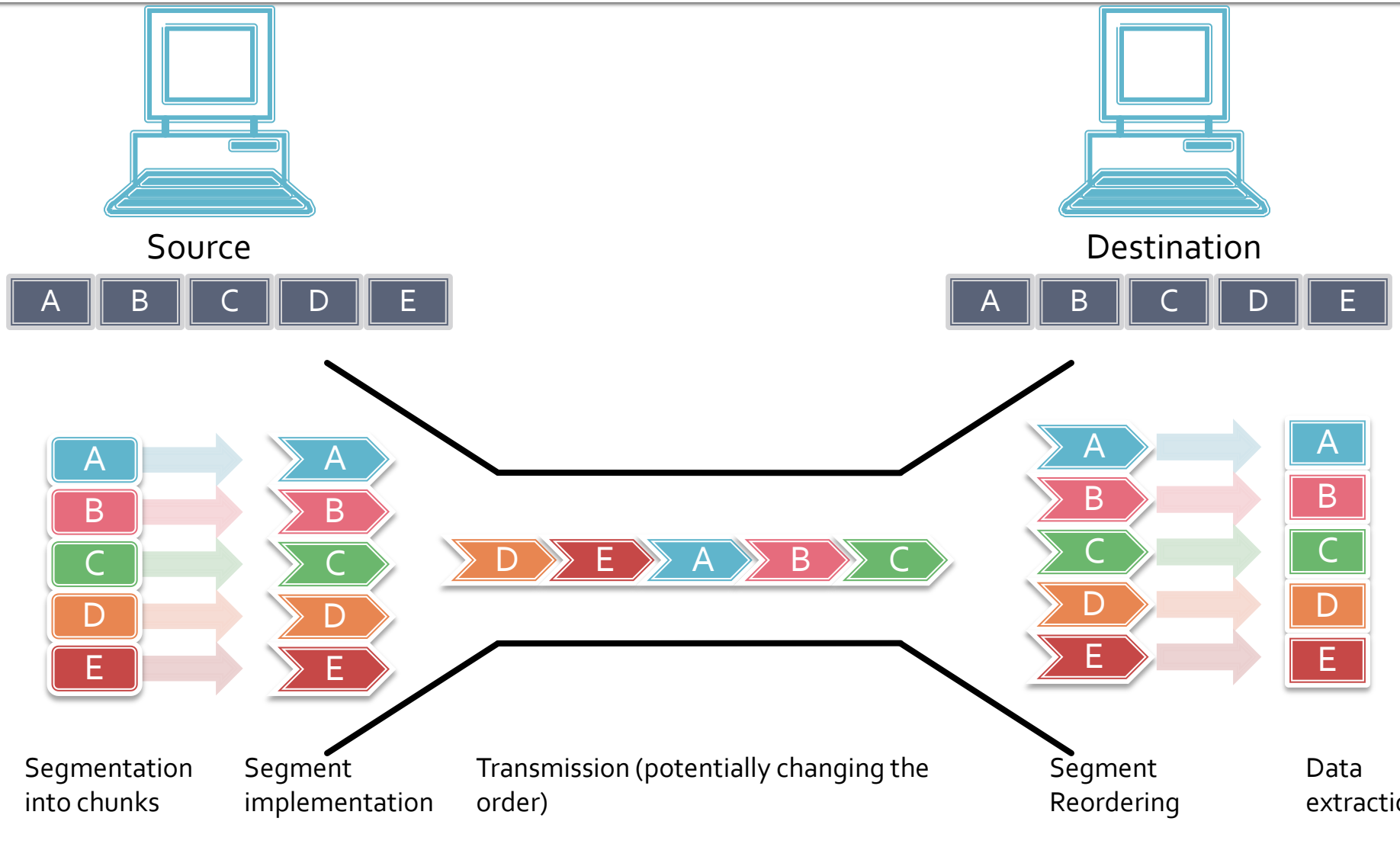
Packet switching - TCP



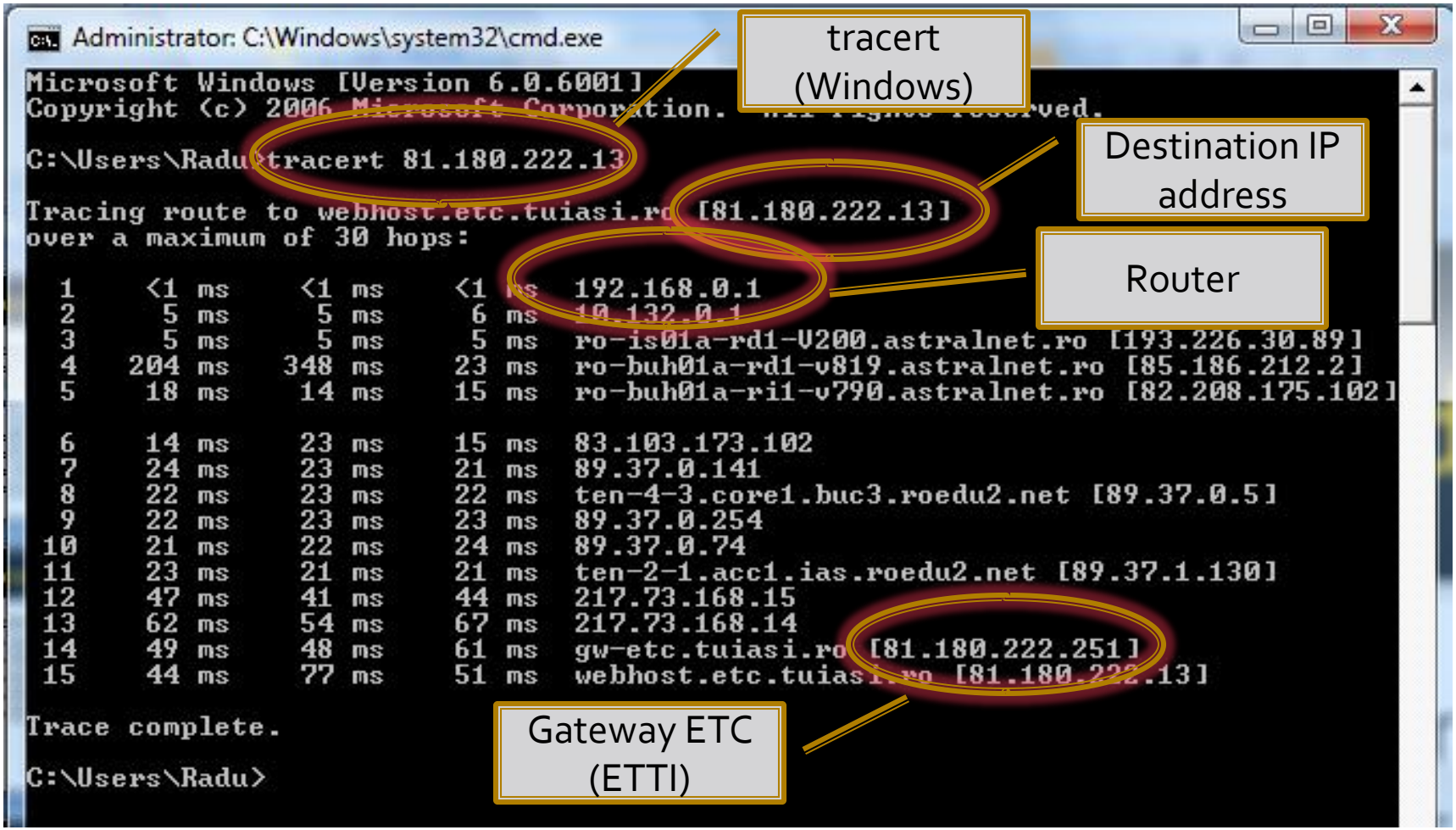
- Link between:
  - Computer C1 serviced by router R2 and gateway G3
  - Computer C9 serviced by router R8 and gateway G7
- Essential Nodes:
  - R2, G3,
  - G7, R8

- Possible Routes :
  - 1, 2, 3, 7, 8, 9
  - 1, 2, 3, 4, 7, 8, 9
  - 1, 2, 3, 5, 7, 8, 9
  - 1, 2, 3, 6, 7, 8, 9
  - 1, 2, 3, 5, 6, 7, 8, 9
  - 1, 2, 3, 5, 4, 7, 8, 9
  - 1, 2, 3, 5, 6, 4, 7, 8, 9
- Route chosen depending on **instantaneous** traffic congestion and nodes' availability

TCP Segment (Packet)



Trace route applications (tracert)



Domain names

- "letter" translation of IP addresses for easy handling by human users
- Dedicated computers (DNS – Domain Name Server) implement an complementary, hierarchical network, for the bidirectional translation: Domain Name ⇔ IP address
  - **rf-opto.etti.tuiasi.ro** = 81.180.222.13

DNS

- **Domain Name System**
- Allowed characters:
  - English alphabet leters
  - digits
  - "-"
- Fully Qualified Domain Name
  - domain_name.top_level_domain.
  - typically the final dot (signification = root) is omitted
- Top Level Domain
  - country code: ro, fr, uk, us, etc.
  - generic: biz, com, info, name, net, org, pro (IANA)
  - sponsored: gov, edu, mil, int etc.

DNS - purchase

- ICANN – Internet Corporation for Assigned Names and Numbers
  - RIPE – Réseaux IP Européens
    - RoTLD – Romania Top Level Domain **www.rotld.ro**
  - ARIN – American Registry for Internet Numbers
  - APNIC – Asia-Pacific Network Information Center
- Costs
  - .ro – 61USD (VAT included) – lifetime (**51,26 USD + VAT (24%) ≈ 63.56 USD -** ?)
  - .com, .eu ≈ 10$/an
- "first come, first served"
- Harris' Lament: "all the good ones are taken!"
- In case of conflict, arbitration by ROTLD, RIPE, IANA + Official Justice system

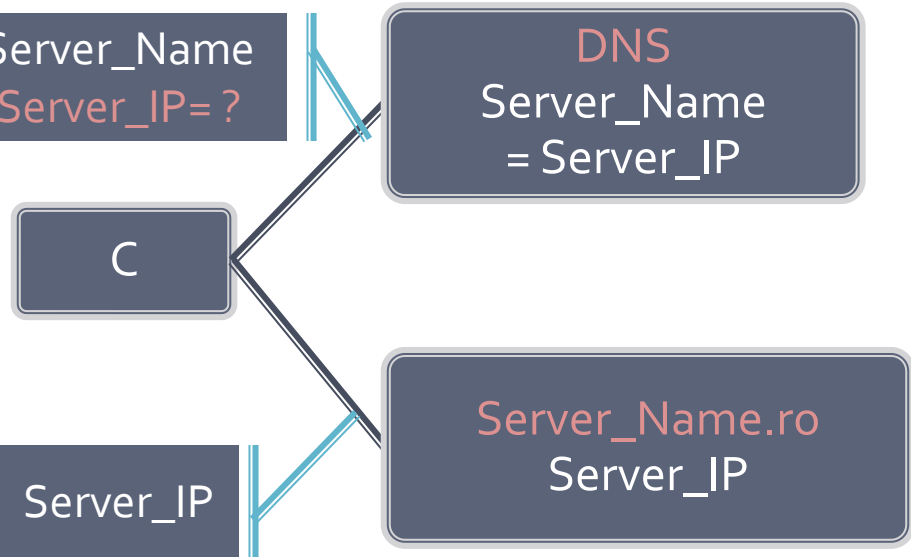
DNS - subdomains

- Subdomain creation are up to the domain owner
  - "tuiasi.ro" : domain registered by TUIasi, implemented by RoTLD, controlled by TUIasi
  - "etti.tuiasi.ro" : subdomain implemented by TUIasi, controlled de ETTI
  - "rf-opto.etti.tuiasi.ro" : subdomain implemented by ETTI
- Typically the prefix (automated or not) is indicative of the type of data/application available: www, ftp, gopher etc.
- More domain/subdomain names can share an IP address
  - rf-opto.etti.tuiasi.ro = 81.180.222.13
  - www.etti.tuiasi.ro = 81.180.222.13

Access to data using domain names

- Example: Access to rf-opto.etti.tuiasi.ro:

- All DNS servers implemen
  a cache for the DN ⇔ IP fo
  faster access
- local cache can be administered
  - ipconfig /flushdns (Win)



URL

- **Uniform Resource Locator**
- Form: service://host:port/path/file.ext
  - service:// – application (protocol) to access on the host: http://, ftp://, telnet://, file://
  - host – domain name or IP address
  - :port – port used for communication: some have defaults: (ftp – 21, http – 80, ssh – 22, telnet – 23)
  - path – path into the directory tree, from the root of the host
  - file.ext – name of the file on the host system
- Example: http://rf-opto.etc.tuiasi.ro:80/ui/Lucrari/Lucrarea1/Lucrarea1.html

Contact

- Microwave and Optoelectronics Laboratory
- http://rf-opto.etti.tuiasi.ro
- rdamian@etti.tuiasi.ro
- Homework, lecture 6, mandatory presence, 25% grade