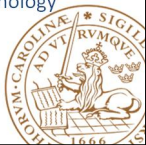


Network Layer

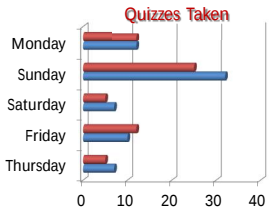
(and some Application Layer, too)

ETSF10 – Internet Protocols – 2011
Kaan Bür & Jens Andersson
Department of Electrical and Information Technology



To do now: "One minute paper"

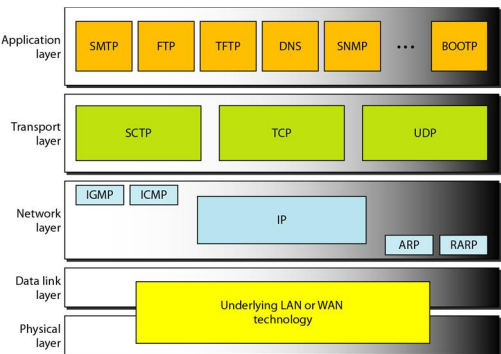
- Quiz #2 completed
 - Attendance: 59
- What was the most difficult question?
 - Discuss in pairs
 - Write it down



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2

TCP/IP model



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3

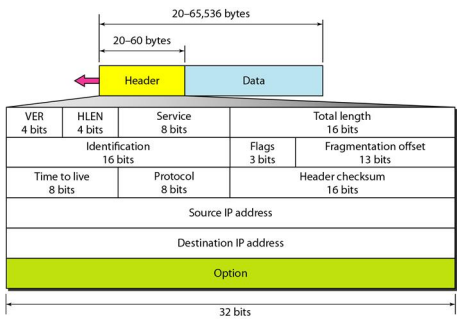
Network Layer

- Internet Protocol
 - IPv4 §20.2
 - IPv6 §20.3
 - Transition from IPv4 to IPv6 §20.4
- Address mapping, error reporting
 - BOOTP, DHCP §21.1
 - ICMPv4 §21.2
 - ICMPv6 §21.4
- Domain Name System (DNS) §25

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4

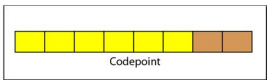
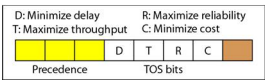
IPv4 datagram header and payload



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5

Service type vs. differentiated services

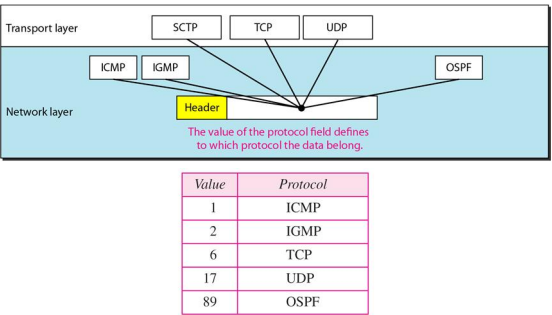


Service type		
Protocol	TOS Bits	Description
ICMP	0000	Normal
BOOTP	0000	Normal
NNTP	0001	Minimize cost
IGP	0010	Maximize reliability
SNMP	0010	Maximize reliability
TELNET	1000	Minimize delay
FTP (data)	0100	Maximize throughput
FTP (control)	1000	Minimize delay
TFTP	1000	Minimize delay
SMTP (command)	1000	Minimize delay
SMTP (data)	0100	Maximize throughput
DNS (UDP query)	1000	Minimize delay
DNS (TCP query)	0000	Normal
DNS (zone)	0100	Maximize throughput

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6

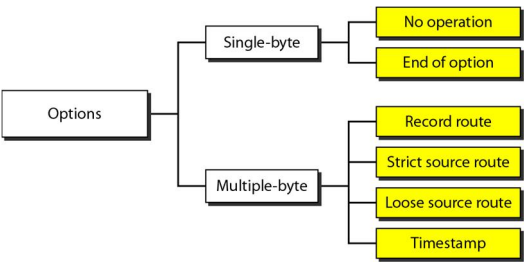
Protocol field



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7

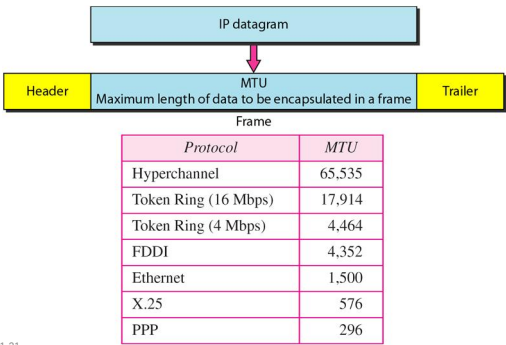
Taxonomy of options



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8

Maximum datagram size



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9

Fragmentation

- Needed when IP datagram size > MTU
- Performed by the router meeting the problem
- Defragmentation by destination host

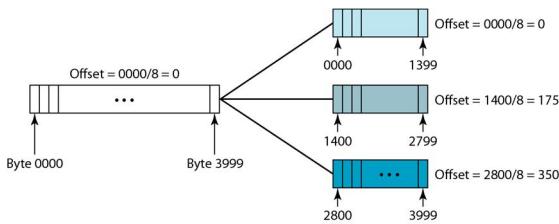


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10

Fragmentation offset

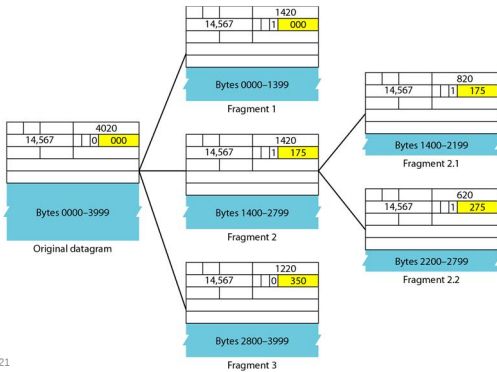
- Relative location of fragments
- 13 bits < 16 bits



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11

Fragmentation example

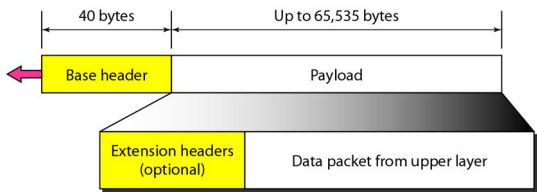


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12

IPv6 datagram header and payload

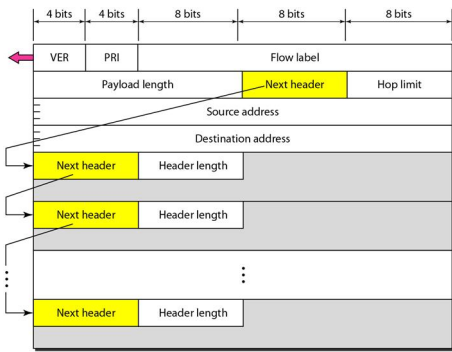
- Simpler base header
- Flexible for extensions
- New options (e.g. flow, security)



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13

IPv6 datagram header format



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14

Packet priorities

- 0 .. 7
 - Congestion controlled

Priority	Meaning
0	No specific traffic
1	Background data
2	Unattended data traffic
3	Reserved
4	Attended bulk data traffic
5	Reserved
6	Interactive traffic
7	Control traffic

- 8 .. 15
 - Non-congestion controlled

Priority	Meaning
8	Data with greatest redundancy
...	...
15	Data with least redundancy

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15

Next header codes

L3/L4 protocols {

Code	Next Header
0	Hop-by-hop option
2	ICMP
6	TCP
17	UDP
43	Source routing

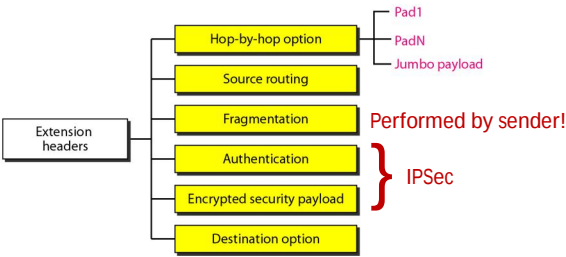
Security options {

44	Fragmentation
50	Encrypted security payload
51	Authentication
59	Null (no next header)
60	Destination option

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16

Extension header types

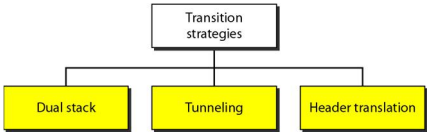


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17

Transition: IPv4 → IPv6

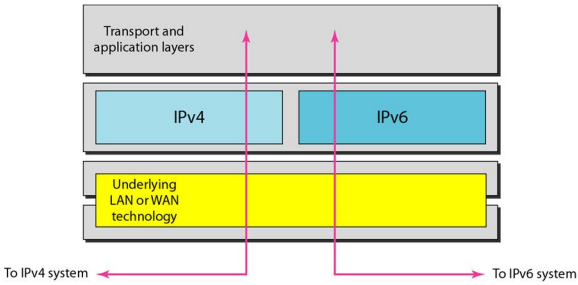
- Cannot happen overnight
 - Too many independent systems
 - Economic cost
 - IPv4 address space lasted longer than expected
- Coexistence needed



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18

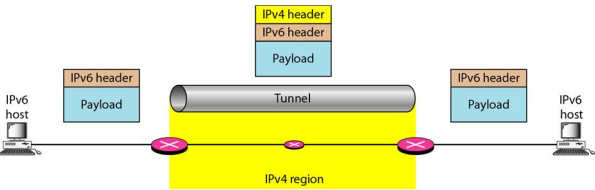
Transition: (1) Dual stack



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19

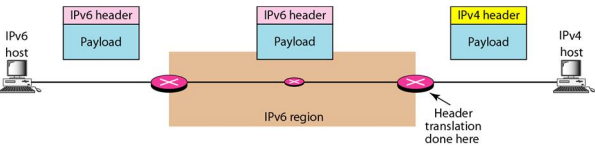
Transition: (2) Tunneling



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20

Transition: (3) Header translation

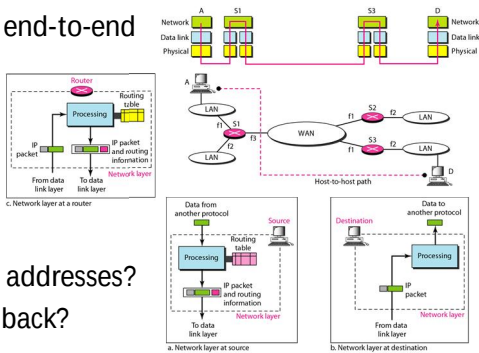


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21

Routing at network layer

- L3 is end-to-end

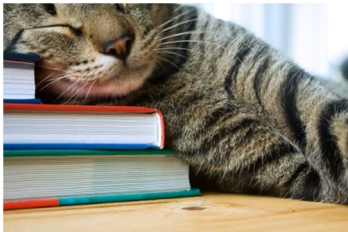


- Host addresses?
- Feedback?

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22

See you in 15' :)

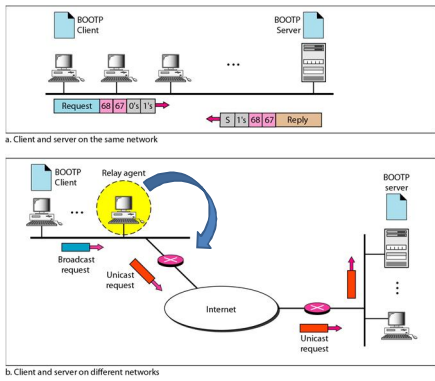


- After the break
 - DHCP
 - DNS
 - ICMP

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23

Bootstrap Protocol



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24

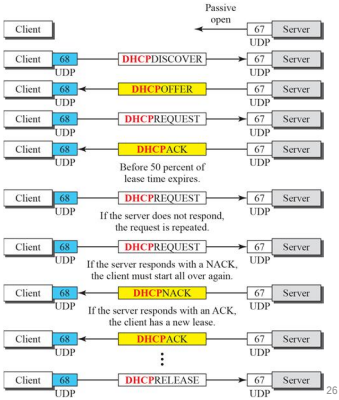
Dynamic Host Configuration Protocol

- BOOTP
 - Problem: Not dynamic
- DHCP
 - IP address allocation
 - Static or from pool
 - Network mask
 - Default gateway
 - DNS server(s)

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25

DHCP operation

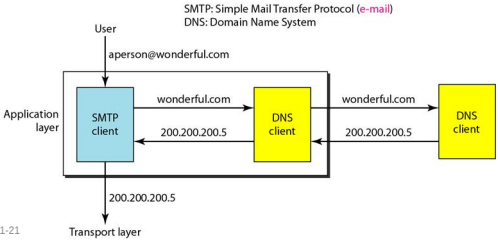


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26

Domain Name System

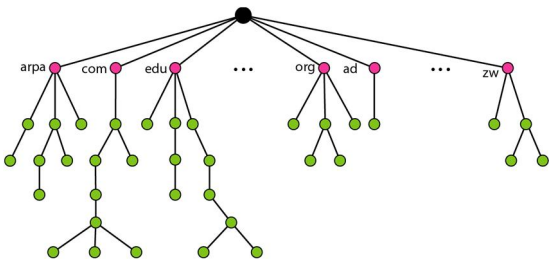
- DNS
 - Internet's telephone book: Address ↔ name
 - Who's responsible for which service?



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27

Domain name space

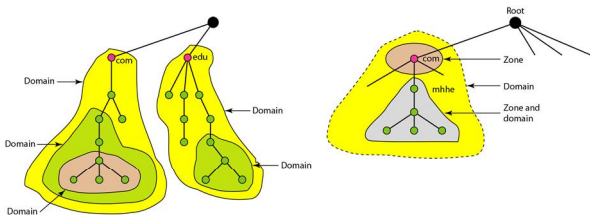


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28

Domains, subdomains, zones

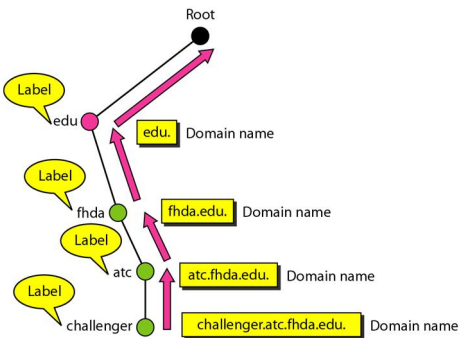
- Domain
 - Subtree of DNS
- Zone
 - Servers' control area



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29

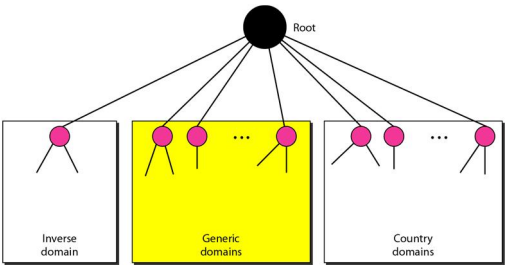
Domain names and labels



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30

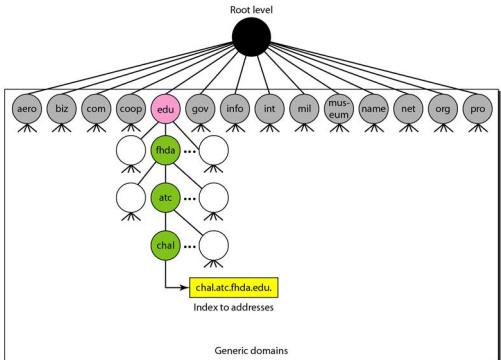
Internet domains



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31

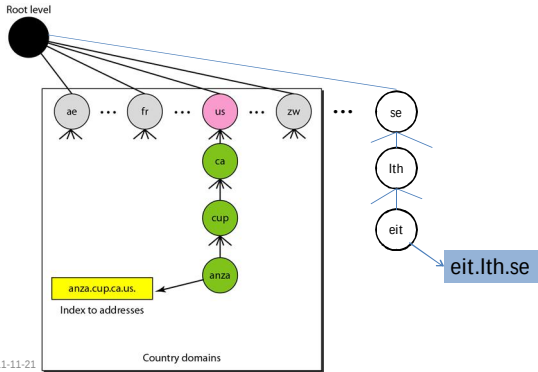
Generic domains



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32

Country domains

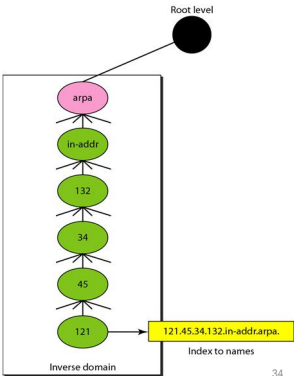


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33

Inverse domain

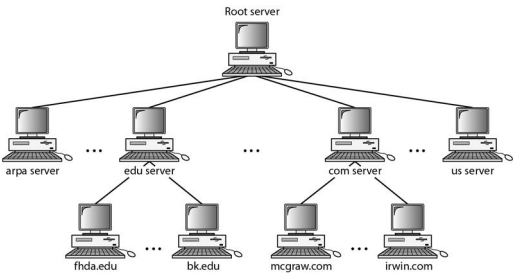
- Address → name
- Used by servers
 - authorisation



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34

Hierarchy of domain name servers



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35

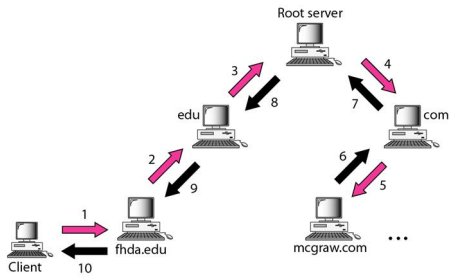
Domain name resolution

- Action of address mapping
 - Client = resolver
 - Server = DNS
- One server cannot have all the answers!
 - How to ask others?
 - What to do with the answer?

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36

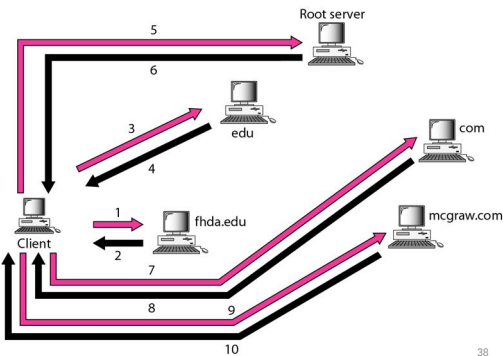
Recursive resolution



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37

Iterative resolution



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38

Caching

- Boost efficiency
 - Remember what you've learned
- Local host / client
- DNS servers
- Zone transfer
 - Request data of a zone
 - From primary to secondary DNS server

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39

Adding new domains

- Apply with IP address & domain name
 - Must be unique
 - Must be registered
- Registrars
 - Commercial entities
 - Manage the DNS database
 - Accredited by ICANN
 - Internet Corporation for Assigned Names and Numbers

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40

Dynamic DNS

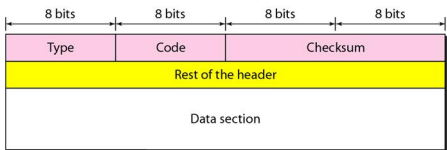
- Host may move around
 - Change of IP address
- New binding (IP address ↔ Name)
 - DHCP updates primary DNS server
 - Primary server updates zone
 - Secondary servers notified

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41

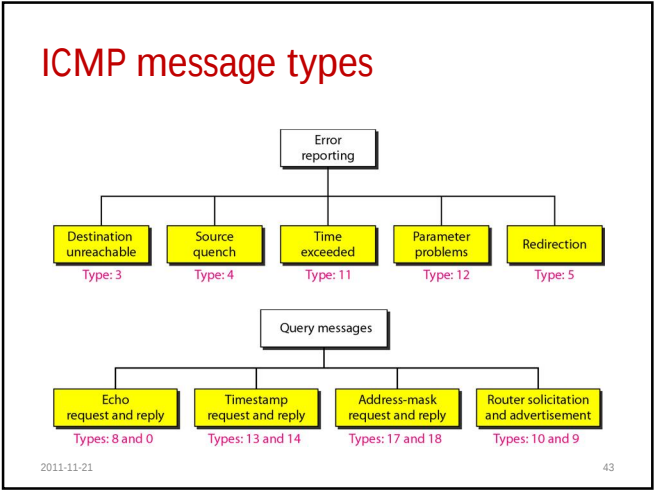
Internet Control Message Protocol

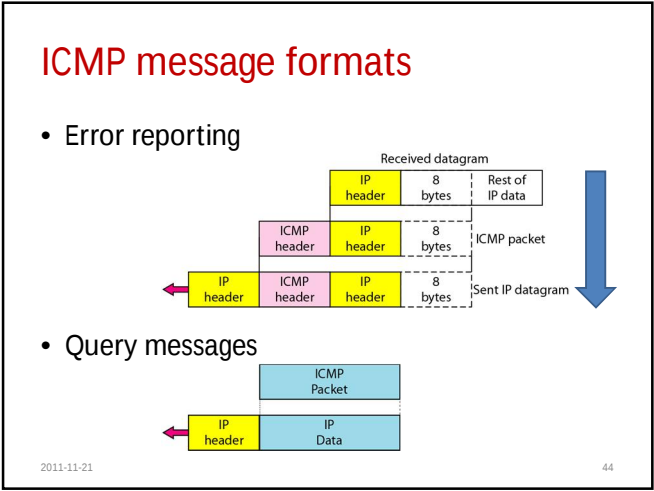
- ICMP
- Support protocol for IP
 - Error reporting
 - Query

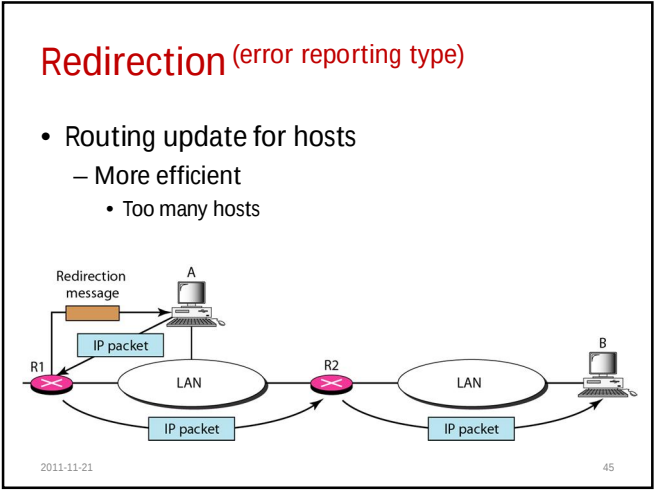


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42

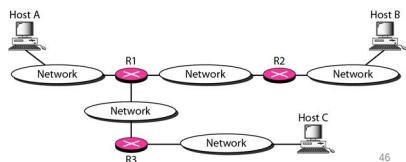






Echo request and reply (query type)

- Network diagnostics
 - IP layer
- Debugging tools
 - Ping
 - Traceroute



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46

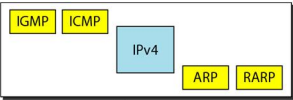
Changes to ICMP

ICMPv4

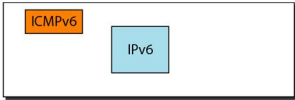
- Some unused functions

ICMPv6

- Same principle
- Some new functions
- Convergence
- Suits IPv6 better



Network layer in version 4



Network layer in version 6

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47

Tomorrow's lecture

- Internet security
 - IPSec §32.1
 - SSL/TLS §32.2
 - Firewalls §32.4
- Voice over IP
 - RTP/RTCP §29.6-7
 - VoIP §29.8

+

Introduction to DNS lab

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48
