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Operating Systems

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Lecture 7:

Networking with Linux

Host configuration

- MAC address (hardware) – 00:00:0c:1f:a5:d8
- IP address – 192.168.45.15
- Network mask – 255.255.0.0 or /16
- Default router IP address – 192.168.45.1
- DNS server IP address – 8.8.8.8
- Linux computer – workstation, server, router

Testing network connectivity

- ping IP-address
 - tracert IP-address
 - nslookup
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- ping 8.8.8.8
 - tracert 72.163.4.161

Encapsulation of IP packets into Ethernet frames

- DA – destination MAC-address ($MAC_{\underline{y}}$)
- SA – sender MAC-address ($MAC_{\underline{x}}$)
- Type/Length – 0x0800 – encapsulated IP
- IP-header: options and
- Source IP (IP_x)
- Destination IP (IP_y)
- Content of IP-packet
- FCS – frame checksum

Address resolution protocol ARP/RARP

- ARP maps IP-address into MAC-address
- ARP table: (IP, MAC, options, time)
- ARP procedure: search in table, if not found send a request, receive reply & upgrade table
- Broadcasting request to MAC ff: ff: ff: ff: ff: ff
- Removing records on ageing time
- RARP maps MAC-address into IP-address

Network mask

- CIDR IP-address structure: (network,host)
- Mask defines the border – number of bits of network address
- Bit mask: 255.255.192.0.0
- Number mask: /18
- Suppose IP_x sends packets to IP_y
- How to find current network address: IP_x & mask
- Whether IP-address IP_y belongs to current network: $IP_y = IP_x \& \text{mask}$

Default router

- If destination IP_Y belongs to the current network – local delivery using MAC_Y found via ARP
- If destination IP_Y does not belong to the current network – delivery using a sequence of routers starting from default router IP_G
- IP_G is mapped using ARP into MAC_G
- Encapsulated packet is delivered to IP_G

Domain name server address

- `/etc/resolv.conf`
- DNS maps *domain name (DN)* into IP-address
- Host sends to DNS-server a request containing DN_Y
- DNS-server replies with IP_Y
- Information exchange using (IP_X, IP_Y)
- DNS servers: primary, secondary, and caching
- Hierarchy of names and DNS distributed data base – zones (root etc, www.vistula.edu.pl)

Configuring network interface

- ifconfig -a
- ifconfig -a interface
- ifconfig interface address netmask address
- dhclient -r
- ifconfig eth0 10.0.5.11 netmask 255.255.255.0

Configuring routing

- Manual routing tables
- Protocols of dynamic routing: RIP, OSPF, BGP
- Daemons of dynamic routing: routed, gated

>netstat -n

>*route add net* IP IPG *netmask* NM METR

>route add 192.168.2.0 192.168.2.2 netmask 255.255.255.0 4

Sockets

- 7 layers of OSI-ISO
- Transport protocols of TCP/IP: TCP, UDP
- Port – integer number assigned to a process
- On Internet, pairs of applications communicate – client and server
- A connection is completely defined by a pair of sockets $((IP_x, P_x), (IP_y, P_y))$
- Servers – well defined numbers of services (ports): 25 – smtp (e-mail), 80 – http (www)
- Clients – random ports > 1028 (4096)

Starting Internet servers

- Individually in rc files of runlevel 3
- Server is permanently running in a number of copies
- Using super-server xinetd
- Server is started on demand – first request
- Configuring xinetd - /etc/xinetd.conf
- socket_type, wait, protocol, user, server