



Chalmers University of Technology
Department of Computer Science and Engineering
Division of Networks and Systems

Computer Communications

Network Address Configuration

COMPUTER COMMUNICATIONS

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1. Purpose

This lab aims to understand the network addressing, by building and configuring a local large network with a number of PCs. Your group will participate in the work by configuring two PCs on your workplace which will be connected to the other groups' PCs. You will proceed and divide the large network into several subnets.

In addition, you will be introduced to a basic configuration of an IP router that works with dynamic routing. You will also use the programs PING and TRACERT as tools in the troubleshooting of TCP/IP-based networks.

2. Overview

The assignment should be performed according to the procedures outlined below with the use of equipment in the lab. The following tasks will be performed:

- Configuration of Windows PCs with connection to a Peer-to-peer LAN.
- Building a larger network with other groups, and then apply IP subnetting.
- Running a number of commands to verify and diagnose the network.
- Use of Wireshark (or Observer) to monitor local traffic.

3. Preparation at home

The following tasks should be performed at home by each lab group (two students) before the lab session and a written report must be shown to the teachers to be approved prior starting the lab work. **Note that there is no enough time during the lab to do the preparatory work!**

1. In chapter 4 read subsection 4.4.2 in the book (pages 374-381 in 5th ed.) or (pages 364-371 in 6th ed.) about IP addressing. In the lab, we will create a network, with a 24-bit prefix and an 8-bit host part (aaa.bbb.ccc.ddd/24).
2. In order to practise subnetting, prepare by giving a fully worked answer for this home assignment.

A network has been given a CIDR block of IP addresses 198.77.48.0/23 to be assigned to hosts/interfaces connected within the network. Assume that the network will be divided into four equal-size subnets.

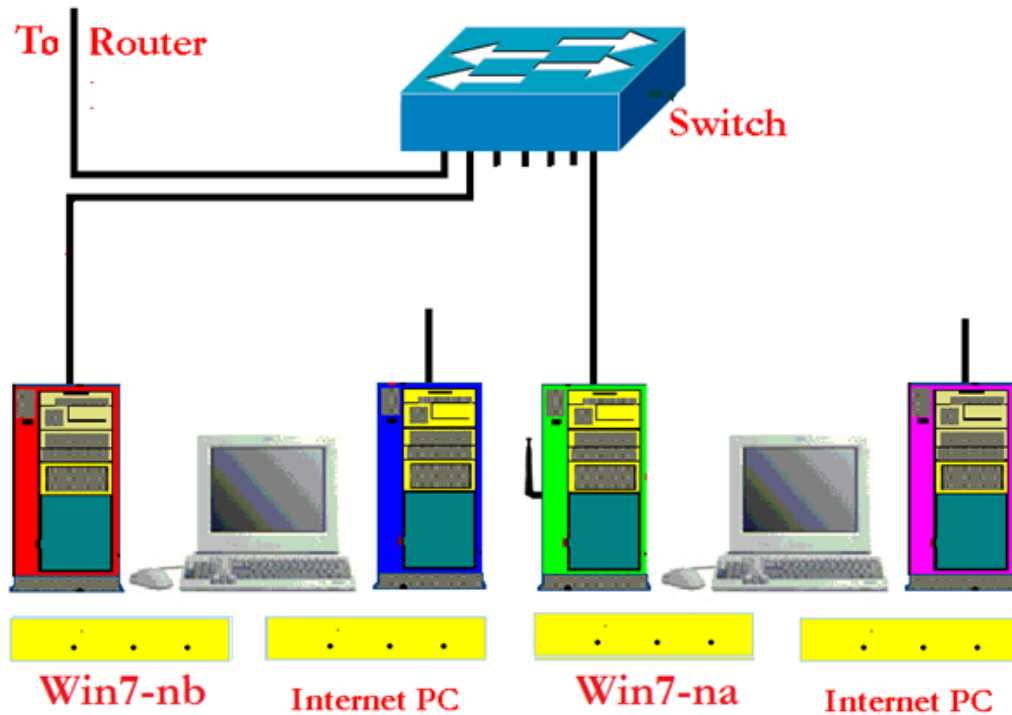
How many host addresses will be available for each subnet? Give in order the IP address of each of these four subnets. What is the subnet mask? Give the range of IP addresses of the second subnet in order.

3. Investigate the following commands which can be used for diagnosing a network; **route**, **ping**, **ipconfig** and **tracert**. What do they do? Try to explain their functionality in words such that another student who has never seen the commands can understand what they do and why/when he/she would use it.

These commands can be run on a Windows system (on Unix/Linux systems, **ifconfig** and **traceroute** are used instead of **ipconfig** and **tracert**). More information about the commands can be obtained on Windows by hitting "F1" (help) on the desktop or by typing; for example "**ping /?**" in a command window. On Unix/Linux systems, more information can be obtained from the on-line manuals; "**man ping**".

4. IP Address Configuration and Subnetting

You will be working with equipment in a closed environment where the equipment has no connection to the external world. The two PCs labelled **Win7** will only be used. The figure below shows the equipment at every workplace in the laboratory.



Exercise 1: Your computers are configured in a **Peer-to-peer LAN** connection. Find out what IP addresses the two Windows computers have by using, for example, the command `ipconfig /all` on the Command Prompt (you may need to run `cmd` first).

Win7- a:

Win7- b:

Network mask:

What is the corresponding binary representation of the IP address of one of the PCs?

Decimal:

Binary:

What part of the IP address represents the network prefix and respectively the host part?

Network prefix:

Host part:

What is the IP address of the default gateway, and what is the computer's MAC address?

Gateway Address:

Physical Address:

Exercise 2: Assume hypothetically that you are given an address subspace 200.150.100.0/24 that will be used to configure the local network in the lab. What would be the class for the network address 200.150.100.0/24 according to the classful scheme? What is the mask in decimal notation? Explain.

Now you are going to assign a new IP address to your computer (for each Windows PC at your workplace). Your computer's new address should be 200.150.100.x where x is replaced by the last three digits you find on the computer's red label (pasted on the PC box). For example: the label **P01-40** means x=140.

New IP address:

The address can be changed from "Network" which you can find on the desktop or the control panel. Right-click on "Network" and choose Properties. The window of "Network and Sharing Center" will be shown and then with "Change adapter settings" select the connection "Peer-to-peer LAN" for your local area network (all other adapters should be disabled). Right-click on it and select "Properties". Now you can see a number of properties for this connection. Select "Internet Protocol TCP/IPv4" and look at the parameters that you can configure.

Change manually the computer configuration to use the new address! Also look at the other TCP/IP parameters that are possible to change (but leave them as they are) and try to explain them.

After changing your computer's IP address, **ping** to the other computer's IP address (at the same workplace) i.e. your neighbour's computer in your group.

How many IP packets are sent in total when you run ping? -----

How many bytes are in each packet that the operating system uses by default for ping? ---

What information do you get from running the ping? The answer must be the interpretation of the result and not a copy of what is displayed.

Now **ping** to a computer at another group's workplace (ask about the new address).

Does it work? -----

Why doesn't the router forward packets although it is still connected to your switch?

Note: You have changed the IP address of your computer; specifically the network part which results in that the network part of the computer's IP address differs from that of the router interface's IP address.

Exercise 3: Next step is that you will interconnect your network to other groups' networks using switches to build one single IP network for all computers in the lab allowing them to communicate directly.

Note: Switches on the mounting rack, are marked as switch-1, -2, -3, and so on. Switch-1 is used to connect the PCs of the first workplace, switch-2 for the second, etc.

Connect your switch with another group's switch using crossover cable. Begin with making sure that many switches in the laboratory are connected to each other (hopefully all switches!). Test the network and make sure it works within few minutes!

Double-click on the icon on your desktop "Network" in order to browse the groups/computers connected together with your workgroup. (Microsoft Windows runs a protocol that allows computers to announce their presence to other computers by sending broadcast messages on the network. The result from these announcements can be seen using "Network" functions but it can take some time for this to update.)

What groups/computers do you see? Give some examples.

Ping another group's computer. Discuss about what has happened when the switches are interconnected. All computers are now interconnected and belong to one large IP network.

Explain why computers in your vicinity can be reached **directly** by your computer.

Note that currently there is no default gateway for the new IP network.

What would be the purpose of adding a default gateway to this network?

Exercise 4: The single IP network will be reconfigured into a number of subnets. You will be working to divide the address space (200.150.100.0/24) into 8 subnets, i.e. to create one subnet for each group (or one per workplace). You will again change the IP address of your computer, making your network part different from all other groups.

As mentioned before you will create 8 subnets out of the larger IP network. This is sufficient for connecting each group's computers together and still leaves plenty of room for computers within each subnet.

How many bits will be used for the subnet part (subnet mask)? -----

How many bits will be used for the host part in each subnet? -----

Complete the following table which shows the address details for each subnet.

SN#	Subnet Address	Host IP Addresses	Broadcast Address
1	200.150.100.0	200.150.100.01 Up to 200.150.100.30	200.150.100.31
2			
3			
4			
5			
6			
7			
8			

What does it mean when an IP address has the host part as all zeroes, 200.150.100.0/27?

What does it mean when an IP address has the host part as all ones, 200.150.100.31/27?

Exercise 5: You will now perform a logical separation of the subnets. Group 1 should use subnet 1. Group 2 should use subnet 2, etc. Leave the **first** available host address for the router interface (probably) connected to your subnetwork, i.e. for the default gateway. One computer should use the **second** IP host address in the subnet and the other uses the **last** IP host address in the subnet.

My subnet:

Network mask:

Select valid IP addresses for your computers (according the above instructions).

Computer 1:

Computer 2:

Default Gateway:

Configure your computers with these IP addresses. Make sure to configure with the new network mask!

Start the program Wireshark (or Observer) to begin capturing the network traffic. (When using Observer; select <Use **Time Limited Function Demo**>.)

Send a **ping** from your computer to the neighbors' computer. What is the result?

Now **ping** to a computer at another group's workplace (ask about the new address after subnetting).

Does it work? ----- The results:-----

Why or why not? Explain.

Try to find the IP addresses of all computers on the network using Observer's "Discover Network Names" function or using Wireshark. (If using Observer, select Tools → Discover Network Names and then press the green start button.) Observer will show also all MAC addresses in a table. With Wireshark you have to search for them in the captured packets using the promiscuous mode.

What IP addresses of computers can you find on the network? Give some examples.

Collect some statistics about network usage with the “Statistics → Pairs Statistics (Matrix)” command in Observer. This command displays graphically all interfaces the application (Observer) has seen on the network and draws a line between pairs of interfaces that it has seen communicating. Why do you not see traffic between the other groups’ computers?

Discuss the advantages and disadvantages of using this kind of logical grouping of hosts by subnetting although hosts are physically still connected using switches on the network.

What is the difference from using physically separated subnets instead?

What will be needed to allow communication between hosts belonging to different subnets?

Exercise 6:

Restore the computers’ IP configuration to the original one as it was before you changed it. Use the same configuration as when you came into the classroom. Remove the crossover cables from the switch.

5. Routing and Router Configuration

Router configuration is outside the scope of this course, but we will now look at how the router is configured. The router is configured to be your default gateway and receives all traffic from your network that is destined for other networks.

Exercise 1: On the PC **Win7-na** run **telnet** to the default gateway (router's interface) of your LAN to see the router's configuration. Start Telnet (in a command window) to connect to your router. The address of the default gateway is the address of your router's interface for your LAN (and can also be found on the network diagram).

The first password is "**cisco**". After successful authentication you are in user mode where some of the router settings can be checked. To configure the router, another login is required using the "**enable**" command and the password "**class**". Now you are working in privileged mode and configuration is possible. NOTE: for more information about privileged mode contact the lab instructor. Please don't try any router configuration!

If an error is made when configuring the router, it may not be possible to connect to it over the network anymore. Therefore, the router has a console interface (with a dedicated serial communication cable), which is always possible to use. Double-click on the icon on one of the PC **Win7-nb** desktop named "Router_n" (where n is the number of your workplace) to open a Windows "Hyper Terminal" to communicate directly with the router in console mode. The login and passwords are the same as above.

You will now investigate two router commands: "**show run**" and "**show ip route**". Try these commands using both the telnet session and the console.

Exercise 2: Execute the command **show run** (showing running configuration). Try to figure out the output. In case you need help, please ask your lab instructor regarding how to interpret the output. Which router interface belongs to your network and what IP address does the interface have?

What routing protocol is configured and for what networks?

Run the command **show ip route** (showing routing table). What are the networks (prefix and mask) that your router has directly connection with?

Select another group's LAN and determine the route to that LAN from the routing table.

How many hops away is the LAN according to the routing table? (Cisco routers show the metrics using [120/x] notation where x is the metric as hop count.)

Compare the number of hops to what you would get by examining the network topology. Are they equal? Why or why not?

Now check how your Windows system routes packets. Use the command **route print**.

What information do you get? Try to analyse the output and write down the relevant information. Please give answer in **your own words**, no numbers **only interpretation** of the routes listed.

Hint: Each row in the routing table is telling "to reach a destination/netmask use next-hop (gateway) and packets are sent through this interface". This information is called a "route". Your task is to explain the "routes" that your computer has information about. No copies of the displayed values, just a brief description of each important route!

Run the command **tracert** from your computer to a computer in the other group's LAN. Check the trace hop by hop and look at the network topology.

How many hops do you get? How does this compare to the distance metric provided by the router when you run <show ip route>?

Exercise 3: Start Wireshark in order to capture local traffic. Run the command **tracert** again but to a computer in another group and answer the following questions.

What protocols and the messages are involved in the operation and are used when you run <tracert>? (You may need to analyse the captured packets).

Do a <ping> to the same computer while still capturing. What messages are used?

The ping command accepts as an argument, the size of the (dummy) data to send: <ping -l size computer>.

Experiment with some different sizes and observe the difference in the packets sent on the network and captured by Wireshark.

Choose size of 1 byte and check the content of the captured packets.

Now choose size of 4000 bytes and check the content of the captured packets and how they are sent.

How much is the **overhead** introduced by the protocols (compare the amount of **data** in an ICMP message with the total number of bytes being sent over the Ethernet cable)?

Continue to capture packets by Wireshark and filter to display only RIP-packets. What source and destination IP addresses are used for the RIP messages sent by your router on your LAN? Examine the different parts of the IP header of one packet.

Examine the different fields of the RIP message itself. What RIP version is used? What routing information is included in RIP message?
