Project 2: IP addressing

Department of Computer Science
University of Stellenbosch
7600 Stellenbosch
South Africa

1 Overview

In this project students will implement two of the three modules below (1) IDT (2) NAT or DHCP.

1.1 IP Data Transfer (IDT)

IP data transfer is achieved by a host sending packets to another host located either on the same network or on a remote network using the ARP and RARP protocols. RARP(Reverse Address Resolution Protocol) is used to translate a physical MAC address to a logical IP address while ARP(Address Resolution Protocol) is used to translate a logical IP address to a physical MAC address. The algorithm im-plemented by a host

H1 to find another host H2 is as follows

1. H1 uses the netmask to check if H2 is on the same local network.
2. If H2 is on the same network as H1, then H1 uses ARP to obtain the MAC address of H2 and H1 sends the message to H2 using the Ethernet protocol.
3. If H2 is it not on the local network as H1, then H1uses ARP to obtain the MAC address of the gateway. H1 sends the message to the gateway which will send the message to H2.

The objective of this tutorial is to emulate RARP and ARP message exchange as defined by the IETF (find the relevant

RFC on the IETF web site).

1.2 Network Address Translation (NAT)

IPv4 addresses are four octets totalling 32 bits of address space. Despite the use of clever address management techniques such as address space classification or CIDR , the address space is becoming exhausted. Network Address Translation (NAT) is an important aspect of IP address management that allows system administrators to overcome this limitation by combining the use of private addresses defined by RFC1918 at the company-side and public Internet addresses on the Internet side.

NAT requires that the router connecting a LAN to the Internet has two IP addresses: A private address defined by

RFC1918 on the LAN side and a public IP address assigned by an ISP at the Internet side. The advantage of NAT is address space conservation; its disadvantages are slowing down data transmission and limiting the number of sessions to the router to slightly less than 65, 000 at any one time.

1. A host H1 sending a packet to a host H2 on the Internet will include the source IP, source port, together with the destination IP address and port number.
2. The router adds an entry into a table it keeps. The table maps each private IP address into a temporarily assigned globally unique IP address. The globally unique IP address is written into the packet header and the packet is sent to H2. When packets are returned from H2, the NAT table is consulted: the locally unique IP address is written into the packet header and the packet is sent to H1. The objective of this tutorial is to emulate NAT message ex-changes and the mapping performed by a router to maintain the message exchange between two hosts located one on a LAN and one on the Internet.

1.3 Dynamic Host Configuration Protocol(DHCP)

Defining addresses and configuration settings on each computer or peripheral is one of the main tasks of an Internet implementing TCP/IP which may lead to an immense administration work. The exhaustment of the IP addressing space by the large number of computer involved in the Internet is another problem addressed by the DHCP (Dynamic Host Configuration Protocol).

DHCP simplifies the task of defining an addressing system and setting up the correct address on each workstation

and server of an intranet. DHCP is used to centrally allocate and manage TCP/ IP configurations of client nodes by

- defining a DHCP server that allocates the addresses and maintain a database and DHCP clients
- defining pools of TCP/ IP addresses, which are then allocated to client PCs by the server. These pools are called scopes in DHCP terminology
- setting configuration like the subnet mask, default router and DNS server that are required to make TCP/ IP work correctly
- working across most TCP/ IP routers and allocating IPs according to the subnet the request came from. This means you won't need to reconfigure a PC that is moved from one subnet to another
- allowing addresses leasing for periods of time - an IP address that is not used for the duration of the lease is returned to the unallocated pool. This helps recover TCP/ IP addresses that are no longer used.

The objective of this tutorial is to emulate DHCP message exchanges and the maintenance of the database used by DHCP clients.

1.4 Specification of Messages

For each of the two selected modules, students are required to define the type of messages exchanged between client and server programs.

1.5 Client and Server programs

For each of the two selected modules, students are required to write client and server programs emulating the underlying network concept: IDT, NAT or DHCP. No authentication or error detection messages are required.

1.6 Implementation Constraints

- Client and server programs will be developed in C,C++ or Java.
- The code must be (1) clearly written, (2) easily understandable, (3) neatly formatted and (4) self documenting.

References

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Prentice Hall PTR, Fourth Edition, ISBN 01 30341517, 2002.

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References

[1] J. Knudsen, "Java Cryptography", *O'Reilly & Associates, First Edition, ISBN 1-56592-402-9,* 1998.