Week 8 Lecture 1

Network Layer: Data Plane + Control Plane

# NAT: network address translation (very important)

**Private addresses**

10.0.0.0/8 (16,777,216 hosts)

172.16.0.0/12 (1,048,576 hosts)

192.168.0.0/16 (65536 hosts)

The above IP addresses are not routable. A network IP address that is not private is public

Diagram

Description automatically generated

The NAT-enabled router does not look like a router to the outside world. Instead, the NAT router behaves to the outside world as a single device with a single IP address. In Figure 4.25, all traffic leaving the home router for the larger Internet has a source IP address of 138.76.29.7, and all traffic entering the home router must have a destination address of 138.76.29.7.

Suppose a user sitting in a home network behind host 10.0.0.1requests a Web page on some Web server (port 80) with IP address 128.119.40.186. The host 10.0.0.1 assigns the (arbitrary) source port number 3345 and sends the datagram into the LAN. The NAT router receives the datagram, generates a new source port number 5001 for the datagram, replaces the source IP address with its WAN-side IP address 138.76.29.7, and replaces the original source port number 3345 with the new source port number 5001.

When generating a new source port number, the NAT router can select any source port number that is not currently in the NAT translation table. NAT in the router also adds an entry to its NAT translation table. The Web server, blissfully unaware that the arriving datagram containing the HTTP request has been manipulated by the NAT router, responds with a datagram whose destination address is the IP address of the NAT router, and whose destination port number is 5001. When this datagram arrives at the NAT router, the router indexes the NAT translation table using the destination IP address and destination port number to obtain the appropriate IP address (10.0.0.1) and destination port number (3345) for the browser in the home network. The router then rewrites the datagram’s destination address and destination port number and forwards the datagram into the home network.

**Disadvantages**

* NAT violates the architectural model of IP:
  + Every IP address uniquely identifies a single node on Internet
  + routers should only process up to layer 3
* NAT changes the Internet from connection less to a kind of connection-oriented network
* NAT possibility must be considered by app designers, e.g., P2P applications

**Advantages**

* range of addresses not needed from ISP: just one IP address for all devices
* can change addresses of devices in local network without notifying outside world
* can change ISP without changing addresses of devices in local network

Graphical user interface, application

Description automatically generated

10.248.15.210 means it is a private IP address, the WAN side IP address is 129.94.8.210.

# Table Description automatically generatedIPV6 (not included in exam)

* initial motivation: 32-bit address space soon to be completely allocated.
* IPv6 datagram format:
  + fixed-length 40-byte header
  + no fragmentation allowed

Network layer, control plane

5.1 Introduction

5.2 routing protocols

* link state
* distance vector