LIS565 Lecture 5

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Reading

Comer chapter 5–9

Tanenbaum, chapter 5

Casad, Hour 9 and 10

IP datagram

consists of a header part and a data part. The header has at least 5 "words" each of them is 32 bits long.

The total datagram may be up to 64 kbytes long.

The IP datagram header word 1

- Version number (4 bits)
- IHL, header length in 32 bit words (4 bits)
  - minimum value 5
  - what is maximum value?
- Type of service (1 byte)
  - precedence field (3 bits)
  - flags D, T, R (3 bits)
  - remainder not used
- total length of data in words (16 bits)

IP datagram header word 2

- Identifier (16 bits)
- unused bit
- Don't fragment flag
- More bits flag (fragment size > 576 bytes)
- Fragment offset (13 bits)
  - what is the maximum number of fragments
  - what is the maximum length (all fragments added)?

IP datagramm header word 3

- Time to live (1 byte), counts hops at a router
- Protocol field used by upper layer (1 byte), RFC1700 assigns numbers to protocol e.g. UDP, TCP
- header checksum (2 bytes)

IP datagram header word 4 & 5

- Sender IP address
- Receiver's IP address

Routing on the Internet

Routing is the process of choosing a path over which to send packets. A router is a device making that choice.

There are more than 160 RFCs written on the topic, thus it is very complicated.

routing tables

Table-driven IP routing uses a routing table, of the form

$N \| R$

where N is is a network and R is the IP address of the next router.

link a network with a destination. on wotan, a simple host

```
Kernel IP routing table
Destination Gateway     Genmask
localnet    *           255.255.255.0
default     148.4.2.66  0.0.0.0
```

On a router, i.e. a host that is connected to several networks, the routing table is MUCH more complicated.

routing algorythm

extract IP address *D* from datagram and compute network part *N*, decrement TTL

if the router is connected to *N*, send to the destination

else if there is an entry for *N* in the network table, send it to its router

else send to the default route.

If the delivery is to a small-packet network, fragment the packet.

protocols for building routing tables

they can be build by hand, but it is a pain in the arse

for dynamic updating between routers, there are two basic protocols

- distance vector routing
- link state routing

we only look at the former here.

distance vector routing

when a new router comes along, it knows that its neighbours are 1 hop away.

asks the neighbours' routing tables, looks for the shortest path to each network, and then adds one to the number of hops required to get there.

Internet Control Message Protocol

ICMP allows to deliver error messages when there is a network problem.

Tells the sender that there is a problem, in the hope that they take action to avoid making the problem worse.

It can only report the problem to the sender, not to an intermediate router that may be at fault.

ICMP message

Guess what, it has a header and a body, both wrapped in an IP datagram.

Header starts with 8-bit “type”, then an 8-bit “code” that has more information about the type.

Then comes a 16-bit checksum.

All error messages also contain the first 64 data bits of the datagram causing the error.

examples

- echo request is type 8
- echo reply is type 0

used in the ping utility to find out if a host is reachable.

- time exceeded is type 11

used in the traceroute utility