

Watching the Waist of IP [Deering98a]

CSci551: Computer Networks
SP2006 Thursday Section
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Key ideas

- why IP?
 - what are the problems with it
 - or the challenges facing it
- argues for a *simple* protocol
 - hourglass and narrow waist
- consider alternatives to IP

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IP (v4)

```

0      1      2      3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |Type of Service|      Total Length      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification         |Flags|  Fragment Offset  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol    |     Header Checksum     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Options                    |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

```

[Postel81a, figure 4]

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Why a single, narrow protocol?

- Deering wants IP to be the single, narrow waist of the hourglass
- Why single:
 - for interoperability: to allow people to talk, they must use the same language
- Why narrow:
 - imposes few constraints on what link layers you build over
- what is the downside of narrow?
 - may not get functionality (ex. reliability)

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What are the key IP properties?

- small and simple
 - connectionless datagram
- (single and narrow)
- global addressing
 - all hosts have an IP address
 - uniform addresses (32-bits)
 - routing is easy (just route on address, to the destination)
 - optimization: subnetting (hidden hierarchy in the IP address)
 - in principle, you can send to anyone

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Why does global addressing matter?

- (or what was enabled by global addressing?)
- world wide web
 - URLs map to servers anywhere
- peer-to-peer
 - only possible because everyone can talk to everyone else

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What breaks global addressing?

- new protocols (like IPv6, or better: ATM)
- Network Address Translation (NAT)
 - outside (1 address) -- BOX-- inside (several computes)
 - can't easily contact computes behind the NAT box
- Deering's point
 - breaks some applications
 - changes the fundamental design of the internet

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Why add to or change IP?

- lack of addresses
 - look at IPv6 AND NAT to fix
- do new stuff
 - QoS, multicast, reliability, performance

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IP (v4)

```

0      1      2      3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-----+-----+-----+-----+
|Version| IHL |Type of Service| Total Length |
+-----+-----+-----+-----+
| Identification | Flags | Fragment Offset |
+-----+-----+-----+-----+
| Time to Live | Protocol | Header Checksum |
+-----+-----+-----+-----+
| Source Address |
+-----+-----+-----+-----+
| Destination Address |
+-----+-----+-----+-----+
| Options | Padding |
+-----+-----+-----+-----+

```

[Postel81a, figure 4]

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IPv6

```

+-----+-----+-----+-----+
|Version| Prio. | Flow Label |
+-----+-----+-----+-----+
| Payload Length | Next Header | Hop Limit |
+-----+-----+-----+-----+
| Source Address |
+-----+-----+-----+-----+
| Destination Address |
+-----+-----+-----+-----+

```

from [Deering95a]

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IPv6

```

4.3 Hop-by-Hop Options Header
+-----+-----+-----+-----+
| Next Header | Hop Len |
+-----+-----+-----+-----+
| Options |
+-----+-----+-----+-----+

Jumbo Payload option (alignment requirement: 4n + 2)
+-----+-----+-----+-----+
| 128 |
+-----+-----+-----+-----+
| Jumbo Payload Length |
+-----+-----+-----+-----+

4.3 Fragment Header
+-----+-----+-----+-----+
| Next Header | Reserved | Fragment Offset |
+-----+-----+-----+-----+
| Identification |
+-----+-----+-----+-----+

4.4 Destination Options Header
+-----+-----+-----+-----+
| Next Header | Hop Len |
+-----+-----+-----+-----+
| Options |
+-----+-----+-----+-----+

from [Deering95a]

```

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What about Other Networks?

- examples of other nets
 - sensor nets
 - optical networks
 - wireless
 - cell phones
- use IP or not?
 - yes of course--- one viewpoint
 - ex: cell phone world going IP in every handset
 - or maybe not:
 - ex: optical may prefer circuit switching0

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Other questions/observations?

- some of the strange terms don't matter (today)
 - like LANE, NHRP, etc.\