

Unsubstantiated Observations and Obnoxious Opinions

ICNP2001 panel session: "the end of the end to end argument?"

Brian Neil Levine

brian@cs.umass.edu

Department of Computer Science

UMass Amherst

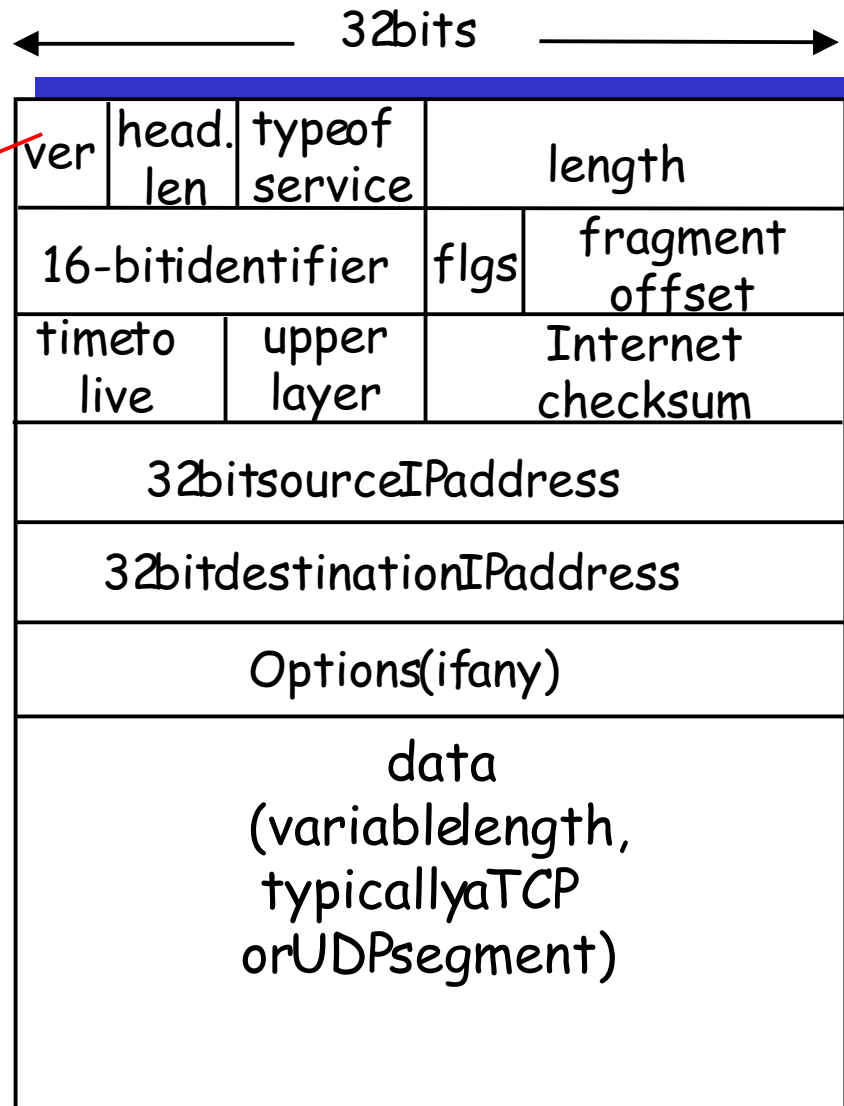


E2E

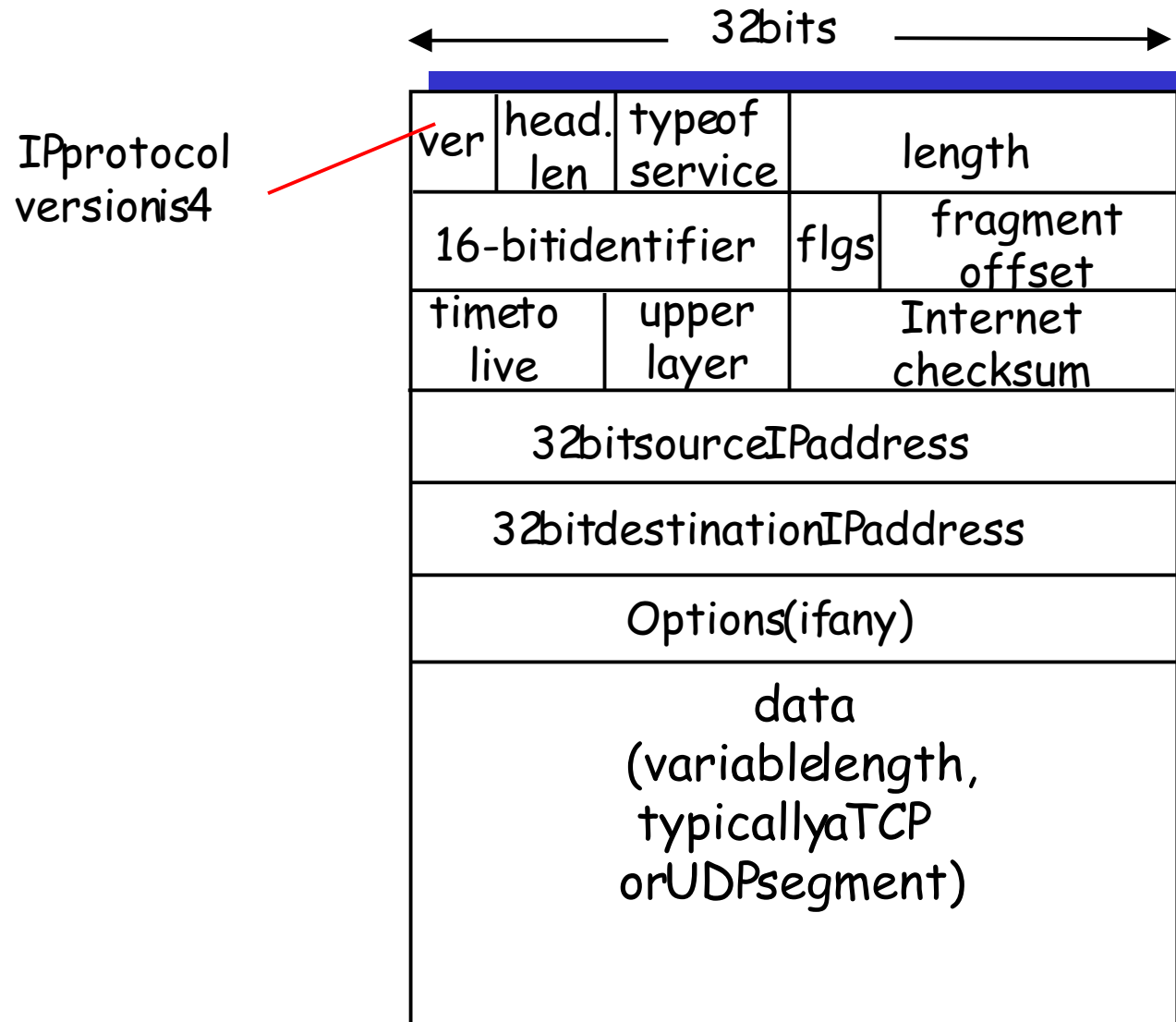
- ❑ Istheend-to-endargumentdead?
- ❑ Shouldwecontinuetotakeseriouslyconsideration ofwhetherourresearchisbestplacedinlower layerorinthe upper-mostlayerpossible?
- ❑ No.
- ❑ Thereisnopointinasking!

The IP datagram format Now

IP protocol
version is 4



The IP datagram format in the year 2101



GradStudentstakenotice

- ❑ The last chance you had to change the network layer was years ago, probably sometime before MTV went on the air.
- ❑ It may be interesting to decide how services can be more efficient at the current network layer, but it's an academic exercise.
- ❑ **Levine's observation: the Internet is an unstoppable force that has become an immovable object.**
 - The Internet is growing at an enormous rate, but the network layer it carries is unchangeable.

Historical Argument

- ❑ Past efforts at the network layer:
 - Multicast, IPv6, Interserv/ Diffserv, etc.
- ❑ Successful end-to-end efforts:
 - the web/HTTP, napster /gnutella/morpheus
- ❑ Services that are performed end-to-end are quick to deploy, cheap and don't involve the IETF or any other mafia.

- ❑ **Levine's Golden Rule:** Do things end-to-end and you'll get no argument from anyone.
 - You might lose 8.34221717% overhead.
 - You might actually do something useful with the Internet.

Run as fast as you can

- ❑ The network layer has become fixed, and the transport layer is on its way.

Examples:

- ❑ Changes to TCP are increasingly small tweaks to subtle mechanisms at only one end.
 - **Tahoe** -> **Reno** -> **NewReno** -> limited transmit
- ❑ Despite the discovery of security problems with TCP, no changes will ever be made.
 - TCP Daytona
- ❑ The requirement of TCP-friendliness has put a stranglehold on other transport services.

Run to another layer

- Given that no one who works on Internet networking cares about the link layer
 - (number of papers on link layer at this conference zero)
- people are running scared to the application layer where they can effect change.

- Eventually there will be so many layers present on the Internet, a new field will develop called **Internet Archaeology** : the study of historic layers of internet strata in order to infer cultural aspects of the peoples who created them.

The Tower of Babel

- ❑ As time goes on, the tower of protocols will continue to grow taller in order to escape the IETF and industry, who will race to freeze each layer.
- ❑ **Levine's advice:** The most interesting areas of study right now are where the E2E argument doesn't apply.
- ❑ Which basically means **peer-to-peer networking**
 - Overlay networks
 - New services: privacy, censorship-free publishing, content sharing, multiplayer games.
 - Ad hoc routing and mobile applications

Making money with you'rend of the network

- ❑ While we are all bound by peer-review, commercial ventures are not.
- ❑ There is money to be made from being unfriendly and unfair. tcp-
 - morpheus parallel downloads
- ❑ **Bobby's corollary** : the network maybe fossilized, but you can mess with it for \$\$\$ at you'rend of the network layer as long as it's invisible to others. e.g., NAT boxes, Layer 4/7 switches.

AdhocNetworking

- Adhocnetworking is so popular because the hosts are the routers.
 - There are no existing services to break.
 - There exist no adhoc networks in fact.
 - It's the dream of everyone who want to break the end-to-end argument.

- **Levine's prediction:** Adhocnetworking will continue to be a hot topic for as long as researchers feel they have an opportunity to mess with the layers and break the end-to-end argument; after that time they will build overlays and move on.

Summary

- ❑ The end-to-end argument is interesting, and probably a good argument.
- ❑ Networking researchers love to break layers because all we care about is performance (and not security, deployability, or usefulness)
- ❑ The commercial and political realities of the Internet create an environment where it's impossible to change lower layers.
- ❑ Creating overlay networks and more layers end-to-end makes violating layers easy.
- ❑ So the point is moot.