Network Traffic Evolution

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Example trace

Name	port	% bytes	% packets	bytes per packet
world-wide-web	80	????	????	????
netnews	119	????	????	????
pop-3 mail	110	????	????	????
. . .				

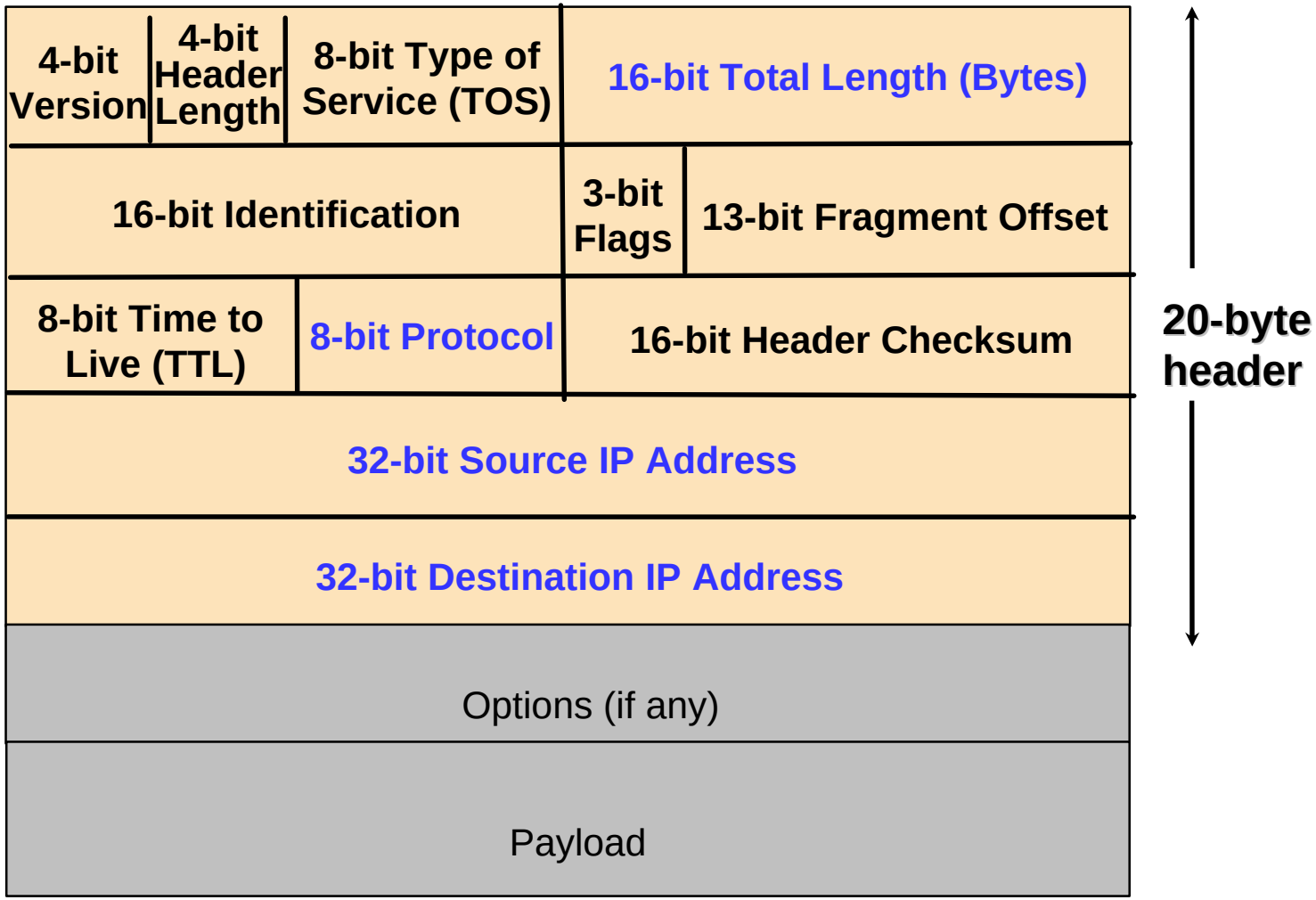
- How????

Passive measurements

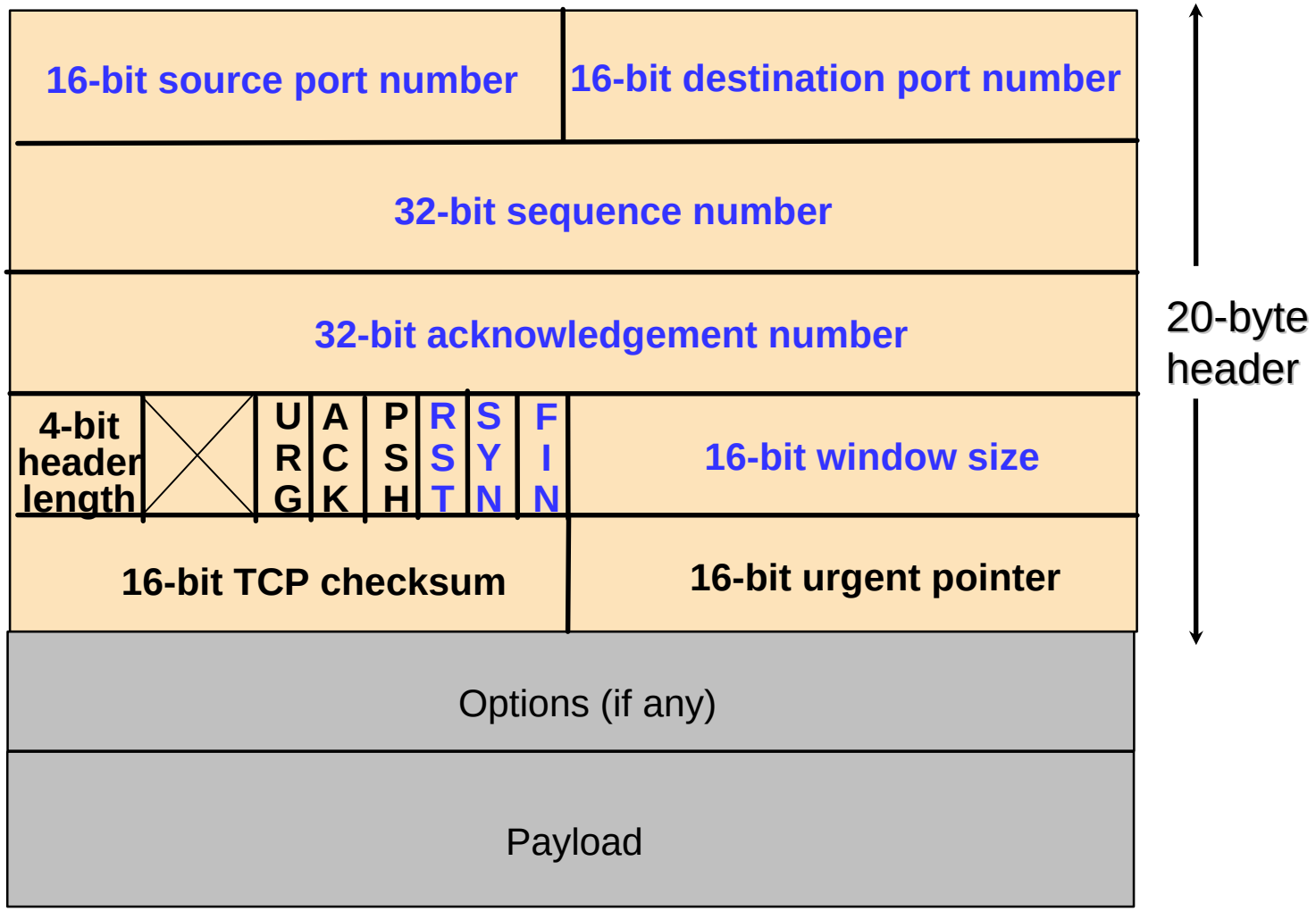
- Definition:
  - Observing traffic into the network
  - Computing metrics on the monitored traffic
    - In our case: Application Mix

- Packet monitors
  - Available data:
    - All protocol information
    - All content

IP Header Format



TCP header format



Tools

- ipsumdump
  - Good for quick summaries
- wireshark
  - Good for visual inspection of in depth details
- tcpdump
  - Good for in depth details
  - Basis for wireshark
- Bro
  - Good for in depth scripted analysis
  - Security analysis
  - Application analysis

Ipsumdump (subset)

```
anja% ipsumdump -h
'Ipsumdump' reads IP packets from tcpdump(1) files, or network interfaces,
and summarizes their contents in an ASCII log.

Usage: ipsumdump [CONTENT OPTIONS] [-i DEVNAMES | FILES] > LOGFILE

  -t, --timestamp           Include packet timestamps.
  -s, --src                 Include IP source addresses.
  -d, --dst                 Include IP destination addresses.
  -S, --sport               Include TCP/UDP source ports.
  -D, --dport               Include TCP/UDP destination ports.
  -l, --length              Include IP lengths.
  -p, --protocol            Include IP protocols.
      --id                  Include IP IDs.
  -g, --fragment            Include IP fragment flags ('F' or '.').
  -F, --tcp-flags           Include TCP flags word.
  -Q, --tcp-seq             Include TCP sequence numbers.
  -K, --tcp-ack             Include TCP acknowledgement numbers.
  -W, --tcp-window          Include TCP receive window (unscaled).
      --udp-length          Include UDP lengths.
  -L, --payload-length      Include payload lengths (no IP/UDP/TCP headers).
      --payload             Include packet payloads as quoted strings.
      --payload-md5         Include MD5 checksum of packet payloads.
      --capture-length      Include lengths of captured IP data.
…
Data source options (give exactly one):
  -r, --tcpdump             Read tcpdump(1) FILES (default).
  -i, --interface           Read network devices DEVNAMES until interrupted.
```

Tcpdump (subset)

```
Usage: tcpdump [options] [filter expression]
general options:
    [-c packetcount ]
input options:
    [-i interface ] | [ -r input dumpfile name
                      [ -P passphrase or - for stdin ]]
    [-F filterfile ] [ -s snaplength ]
binary-output options:
    [-w dumpfile(base) [ -W dumpfile slice size ]
                      [ -P passphrase or - for stdin]]
ASCII output options:
    [-n]: do not resolve hostnames
    [-M]: output in machine-readable format
    [-v]: increase verbosity (e.g. prints checksums)
    [-e]: print linklayer information
    [-X]: full-packet output in hex-format
    [-A]: print packet payload as ASCII
    [-S]: absolute TCP sequence numbers
…
```

Tcpdump output
(three-way TCP handshake and HTTP request message)


```
23:40:21.008043 eth0 > 135.207.38.125.1043 > lovelace.acm.org.www: S
617756405:617756405(0) win 32120 <mss 1460,sackOK,timestamp 46339
0,nop,wscale 0> (DF)

23:40:21.036758 eth0 < lovelace.acm.org.www > 135.207.38.125.1043: S
2598794605:2598794605(0) ack 617756406 win 16384 <mss 512>

23:40:21.036789 eth0 > 135.207.38.125.1043 > lovelace.acm.org.www: .
1:1(0) ack 1 win 32120 (DF)

23:40:21.037372 eth0 > 135.207.38.125.1043 > lovelace.acm.org.www: P
1:513(512) ack 1 win 32256 (DF)

23:40:21.085106 eth0 < lovelace.acm.org.www > 135.207.38.125.1043: .
1:1(0) ack 513 win 16384

23:40:21.085140 eth0 > 135.207.38.125.1043 > lovelace.acm.org.www: P
513:676(163) ack 1 win 32256 (DF)

23:40:21.124835 eth0 < lovelace.acm.org.www > 135.207.38.125.1043: P
1:179(178) ack 676 win 16384
```

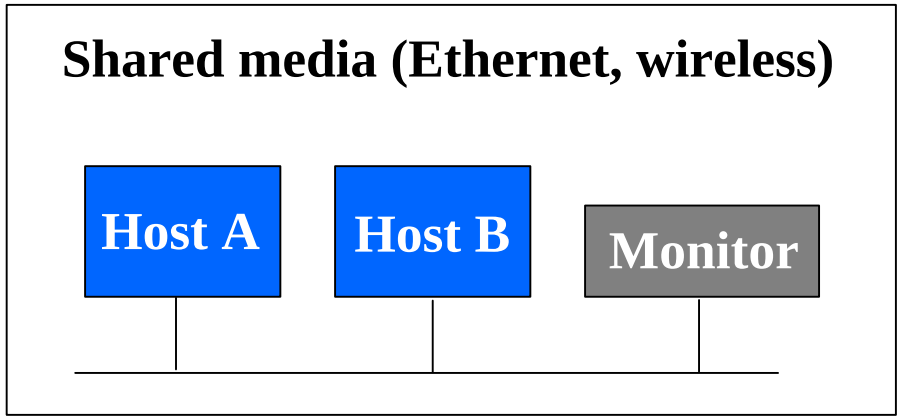
Wireshark (subset)

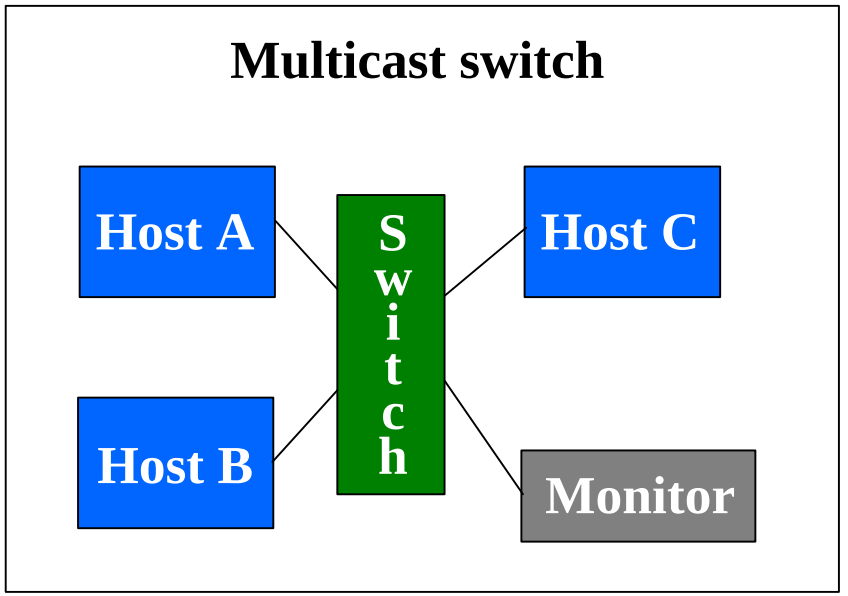
```
Usage: wireshark [options] ... [ <infile> ]

Capture interface:
  -i <interface>           name or idx of interface (def: first non-loopback)
  -f <capture filter>      packet filter in libpcap filter syntax
  -s <snaplen>             packet snapshot length (def: 65535)
  -S                       update packet display when new packets are captured
…

Capture stop conditions:
  -c <packet count>        stop after n packets (def: infinite)
…

Input file:
  -r <infile>              set the filename to read from (no pipes or stdin!)

Processing:
  -R <read filter>         packet filter in Wireshark display filter syntax
  -n                       disable all name resolutions (def: all enabled)

User interface:
  -g <packet number>       go to specified packet number after "-r"
  -m <font>                set the font name used for most text
  -t ad|a|r|d|dd|e         output format of time stamps (def: r: rel. to first)
  -X <key>:<value>         eXtension options, see man page for details
  -z <statistics>          show various statistics, see man page for details
```

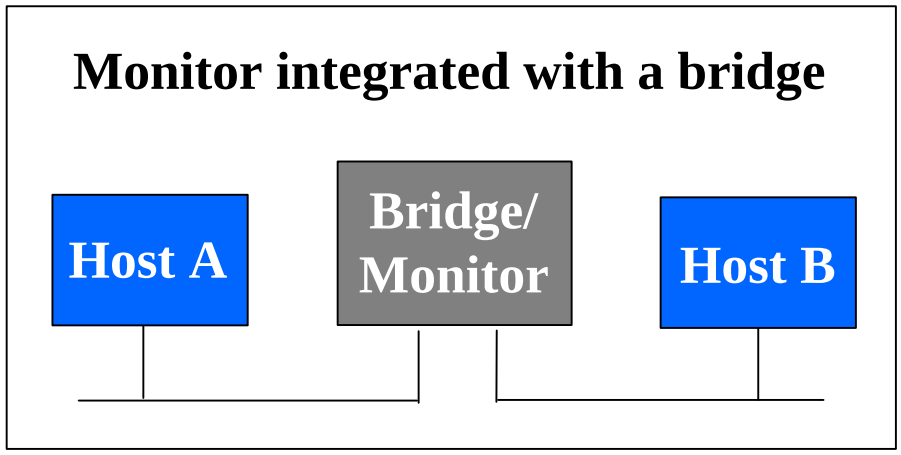
Selecting traffic

- Filter to focus on a subset of the packets
  - IP addresses/prefixes (e.g., to/from specific Web sites, client machines, DNS servers, mail servers)
  - Protocol (e.g., TCP, UDP, or ICMP)
  - Port numbers (e.g., HTTP, DNS, BGP, Napster)
- Collect first n bytes of packet (snap length)
  - Medium access control header (if present)
  - IP header (typically 20 bytes)
  - IP+UDP header (typically 28 bytes)
  - IP+TCP header (typically 40 bytes)
  - Application-layer message (entire packet)

Monitoring a LAN link







Monitoring a WAN link