# TCP: Miscellaneous Issues

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# Implementation/Miscellaneous Details

# Sequence Number Wrap Around

- Seqno field is 32 bits; Advtwindow is 16 bits
  - 2^32 >> 2 * 2^16 (assumes in order packet deliver)
- Best effort service model; Packets do have a MSL (e.g. 120sec).
- Need to ensure the sequence number doesn't wrap around within 120sec
  - What is this a function of?
  - How fast data is being transmitted

MSL is 2 min

| Link Type | Bandwidth | Time until wraparound |
|---|---|---|
| T1 Link | 1.5 Mbps | 6.4 hours |
| Ethernet | 10 Mbps | 57 minutes |
| T3 | 45 Mbps | 13 minutes |
| Fast Ethernet | 100 Mbps | 5.7 minutes |
| OC-192 | 10 Gbps | 3.4 sec |
| OC-768 | 38 Gbps | 0.9 sec |

100 Mb → 1 sec

$2^{32}$ Byte - ?

$\frac{2^{32} \times 8 \text{ sec}}{100 \times 10^6}$

↓

minutes

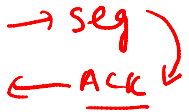
Solution: Uses the 32-bit timestamp option field in addition to the sequence number field.

64-bit identifier: lower order: Seqno field, higher order: time-stamp field

# RTT Calculation

- Earlier implementations measured RTT at a clock granularity of 500ms


- Options: 32-bit timestamp
- Sender stamps the segment with the actual system clock (32 bit)




- Receiver echoes the time back in the ack

# Keeping Pipe Full

- Advertised window is allocated 16 bits (Rcv buffer can hold 65536 Bytes)

Solution: Window Scaling Option

Specify a scaling factor as part of the options field

| Link Type | Bandwidth | BDP (RTT=100ms) |
|---|---|---|
| T1 Link | 1.5 Mbps | 18.7 KB |
| Ethernet | 10 Mbps | 125 KB |
| T3 | 45 Mbps | 562 KB |
| Fast Ethernet | 100 Mbps | 1.2 MB |
| OC-192 | 10 Gbps | 125 MB |
| OC-768 | 38 Gbps | 475 MB |

# Summary

- Looked at how TCP implements flow and congestion control in the context of the sliding window protocol
- Looked at other miscellaneous details
- Concludes TCP and the transport layer