TCP-in-UDP

draft-welzl-irtf-iccrg-tcp-in-udp-00.txt

M. Welzl, S. Islam, K. Hiorth, J. You

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Motivation

- Parallel TCP connections between two hosts: Combining congestions controllers can be beneficial
  - Very beneficial: short flows can immediately use an existing large cwnd, skip slow start; also avoids competition in the network, and can support priorities (similar to some of the benefits of multi-streaming in e.g. SCTP)
- Previous methods were hard to implement + hard to turn on/off (Congestion Manager)
  - Can be made easier (minimize changes to TCP code)
- General problem with this: do parallel TCP connections follow the same path all the way?
  - Not necessarily, because of ECMP (or: any form of per-flow load balancing in the net)

Encapsulation

- This draft makes one concrete proposal (to be explained later)

- Other possibilities mentioned on the list (thanks!!)
  - Joe Touch: Not necessary
  - Tom Herbert:
    - IPv6 flow label
    - GUE

Enables one-sided deployment?!?! I love this!!! Does it really really work?

- Our conclusion: don't prescribe one method
  - Mention the possibilities

Coupled congestion control for TCP

- Basic idea similar to FSE in *draft-ietf-rmcat-coupled-cc*
  - Keep a table of all current connections c with their priorities P(c); calculate each connection's share as P(c) / Σ(P) * Σ(cwnd); react when a connection updates its cwnd and use (cwnd(c) – previous cwnd(c)) to update Σ(cwnd)

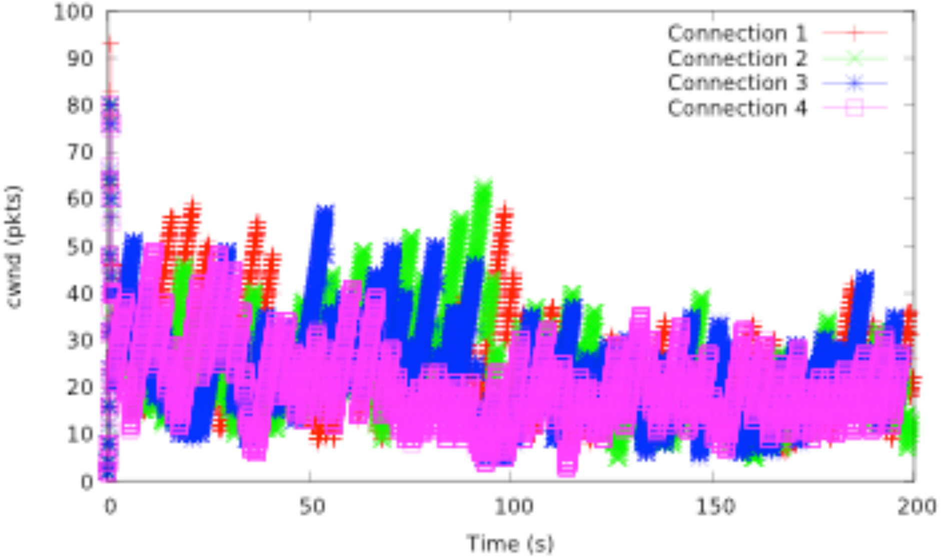
- Some TCP-specific differences
  - SS shouldn't happen as long as ACKs arrive on any flow ➔ only SS when <u>all</u> flows are in SS
  - Avoid multiple congestion reactions to one loss event: *draft-ietf-rmcat-coupled-cc* uses a timer
    - TCP already has FR, use that instead
  - Also, generally a slightly more conservative CC behavior than the algorithm in *draft-ietf-rmcat-coupled-cc*

First simulation results

(ns-2 using TCP-Linux, kernel 3.17.4)

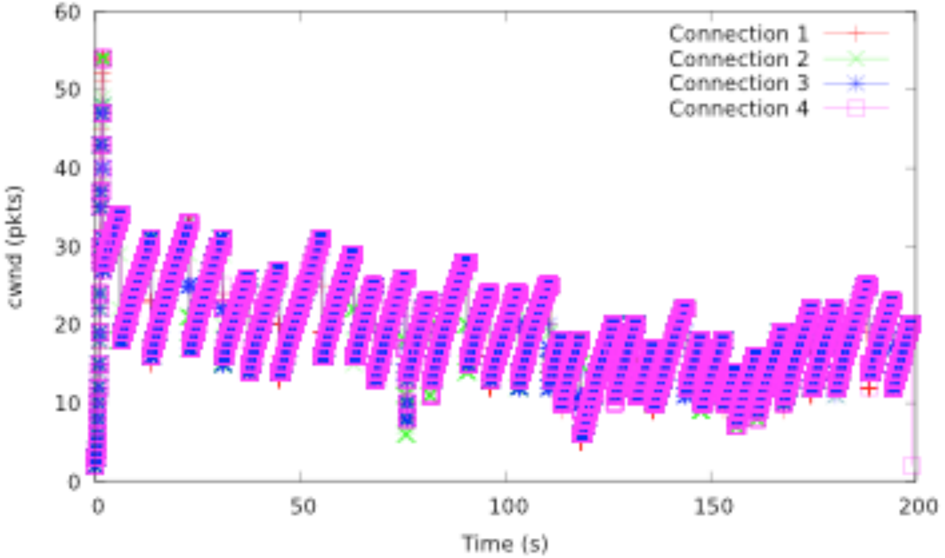
- 4 Reno flows, 10 Mb bottleneck, RTT 100ms; qlen = BDP = 83 Pkts (DropTail)
- TMIX traffic from 60-minute trace of campus traffic at Univ. North Carolina (available from the TCP evaluation suite); RTT of bg TCP flows: 80~100 ms

Not coupled



- Link utilization: 68%
- Loss: 0.78%
- Average qlen: 58 pkts

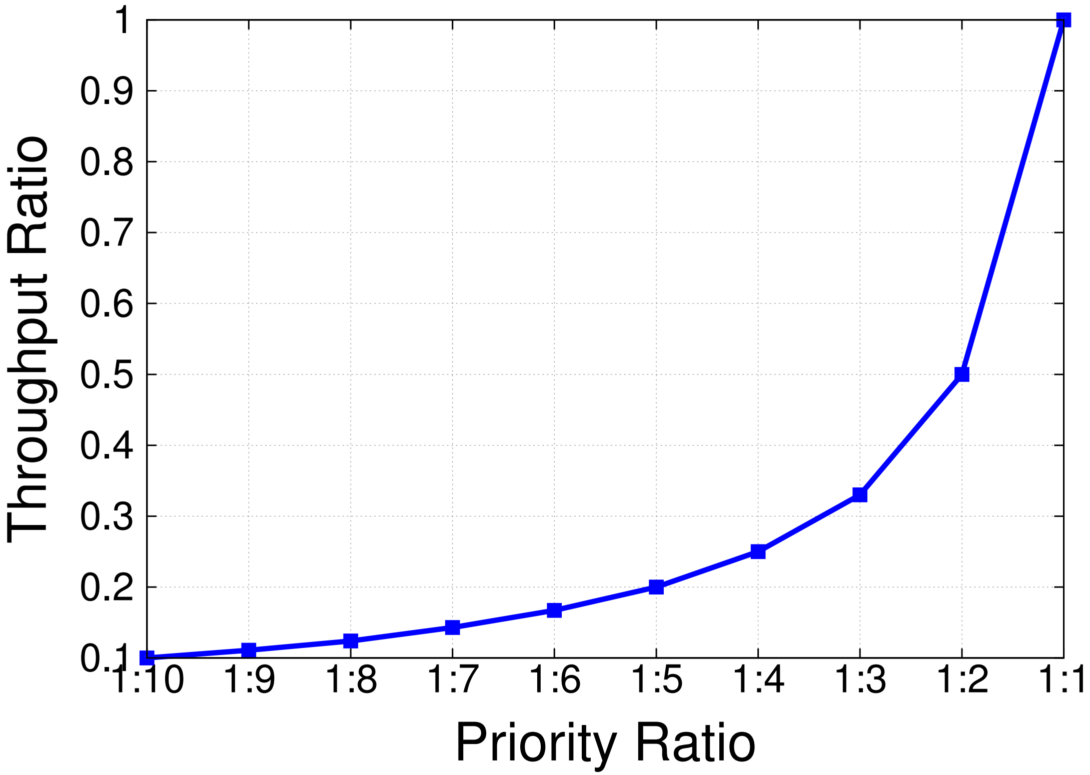
Coupled



- Link utilization: 66%
- Loss: 0.13%
- Average qlen: 37 pkts

First simulation results - prioritization

- 2 Reno flows, 10 Mb bottleneck, RTT 100ms; qlen = BDP = 83 Pkts (DropTail)
- TMIX traffic from 60-minute trace of campus traffic at Univ. North Carolina (available from the TCP evaluation suite); RTT of bg TCP flows: 80~100 ms



Encapsulation: TCP-in-UDP (TiU)

- Avoid Packet size overhead
  - Avoid MTU problems

- Some ideas on TCP-over-UDP encapsulation shown in *draft-denis-udp-transport-00* and *draft-cheshire-tcp-over-udp-00*
  - *Suppress TCP checksum and TCP urgent pointer field and set 0 for URG flag: we do that*
  - *Suppress TCP src and dst ports (rely on UDP ports only): we do that too, but… want to multiplex!*
    ➔ still need ports in some form

Encapsulation: TiU (Contd.)

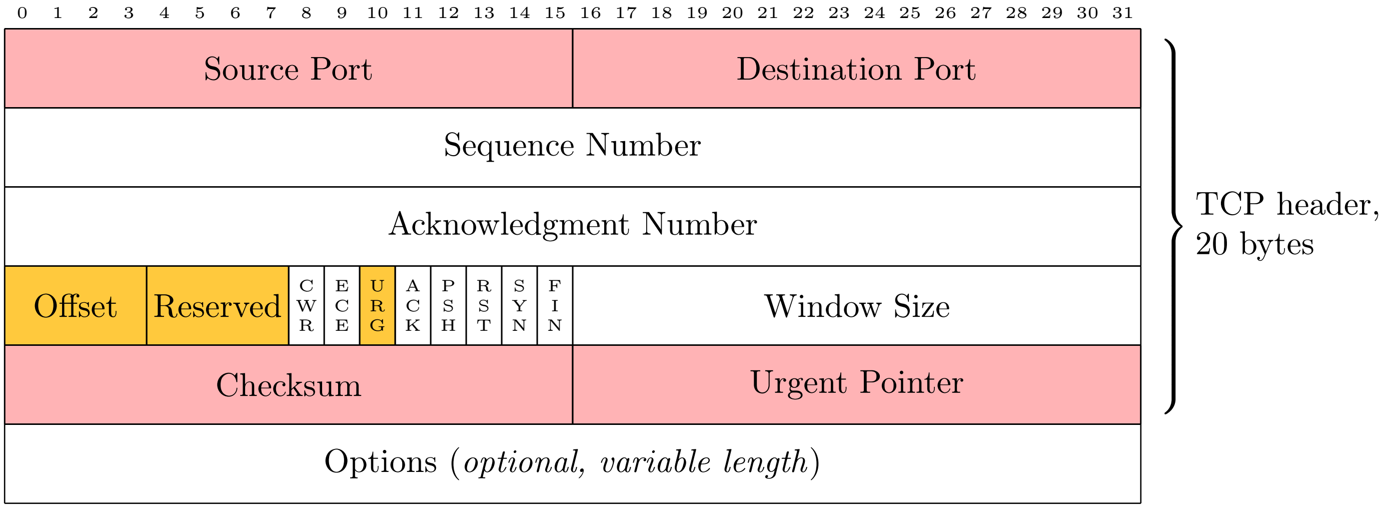


Figure 1: Standard TCP header. Fields on red background are removed by TCP-in-UDP, those on orange background are modified.

With Flow id (5 bits) we can multiplex 2^5 = 32 parallel connections

We use TiU SYN/SYN-ACK options to map ports to FID

Offset change: related to STUN [draft-cheshire-tcp-over-udp-00]

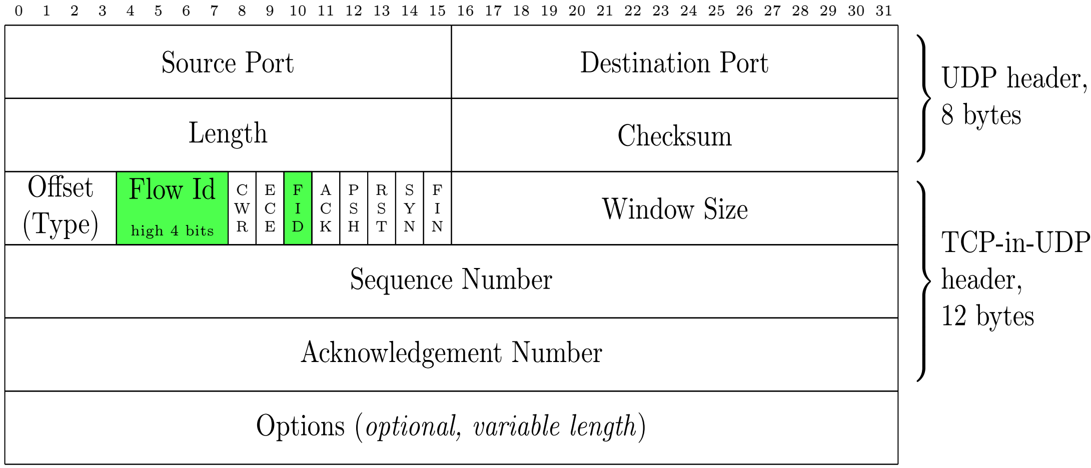


Figure 1: Compressed TCP-in-UDP header. The Flow Id split-field is highlighted in green. Notice that the port numbers in the UDP header are those of the tunnel, *not* the TCP connection.

Set up

- Happy eyeball for TiU
  - Put port-FID-mapping options in TiU-SYN and SYN/ACK

- Client
  1. Send UDP/TiU-SYN packet on TiU port
  2. Send TCP SYN
- Server (we write both)
  - Process UDP/TiU-SYN before processing TCP SYN

- UDP en-/de-capsulation added to TCP header processing
  - Just before sending, first when receiving
  - Small code change; normal TCP otherwise!

What this encapsulation (but also GUE) can give us

- A TCP that can easily evolve ☺
  - Maybe good as an intermediate experiment platform?
- Some benefits related to STUN [draft-cheshire-tcp-over-udp-00]
- Possible to support other transport protocols too [draft-cheshire-tcp-over-udp-00]
- In-line SPUD support without MTU problems: when the sender inserts SPUD, take SPUD header size into account for MSS calculation

Disadvantages

- Blocking / rate limiting of UDP
  - QUIC is going to help here, but only for ports 80 and 443 ☹

- Prevents ECMP, but ECMP can be a good thing
  - It’s a socket option, maybe only use it when you expect to have many short flows or when priorities are important?

Current state

- Encapsulation
  - Finished for FreeBSD kernel

- Coupled-cc
  - Under development (simulations)
  - Rudimentary code being developed for FreeBSD, so should be easy to incorporate algorithm updates

Questions?