Coupled congestion control for RTP media

draft-welzl-rmcat-coupled-cc-02

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Flow State Exchange (FSE)

Hoping to have a draft by the next IETF
Previous version: only passive

- **Goal:** Minimal change to existing CC
  - each time it updates its sending rate (New_CR), the flow calls update (New_CR, New_DR), and gets the new rate
  - Complicates the FSE algorithm and resulting dynamics (e.g. need dampening to avoid overshoot by slowly-reacting flows)
Now added: FSE - Active

- Actively initiates communication will all the flows
  - Perhaps harder to use, but simpler algorithm and “nicer” resulting dynamics
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Active algorithm

• Every time the congestion controller of a flow determines a new sending rate CC_R, the flow calls UPDATE
  – Updates the sum of all rates, calculates the sending rates for all the flows and distributes them to all registered flows

• Essentially all that is left in this version:
  for all flows i in FG do
    FSE_R(i) = (P(i)*S_CR)/S_P
    send FSE_R(i) to the flow i
  end for

• Designed to be as simple as possible
  – Lacks 1 feature (to be included in the next version): immediately using the capacity freed by application-limited flows
Dynamic behavior: Rate Adaptation Protocol RAP (= rate-based AIMD)

With FSE

Without FSE
Dynamic behavior: TFRC

With FSE

Without FSE
FSE goals

- **Charter:** “Develop a mechanism for identifying shared bottlenecks between groups of flows, and means to flexibly allocate their rates within the aggregate hitting the shared bottleneck.”

  (requirement F34 in *draft-ietf-rtcweb-use-cases-and-requirements-12*)

  - This works perfectly
  - Also did in the previous version

- But: because this avoids competition between flows, we expect reduced queuing delay and loss as a side effect
Average queue length (RAP)

![Graph showing the relationship between average queue length and number of flows with and without FSE.]

- **Average Queue Length**
- **Number of Flows**

- **FSE**
- **Without FSE**
Packet loss ratio (RAP)

Packet Loss Ratio % vs Number of Flows

Graph showing the packet loss ratio (%) against the number of flows for two scenarios: FSE and Without FSE.
What’s going on?

• Queue drains more often without FSE
  – Thought behind expected benefits: coupling emulates one flow
    • But, e.g.: 2 flows with rate X each; one flow halves its rate: 2X $\rightarrow$ $1 \frac{1}{2}X$
  – When flows synchronize, both halve their rate on congestion, which really halves the aggregate rate: 2X $\rightarrow$ 1X
Current work

• Trying to fix this (proportionally reduce aggregate rate on congestion, but increase by delta/N)
  – Some issues, e.g. slow start

• Why do we have these problems?
  – Because all papers on RFC2140 etc. did not focus on reducing queuing delay
  – RFC2140 cwnd sharing probably has the same problem
Q&A