

# One Control to Rule Them All: Coupled Congestion Control for RTP Media

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## Motivation: Why Do We Need Coupled Congestion Control

### Why Coupled Congestion Control

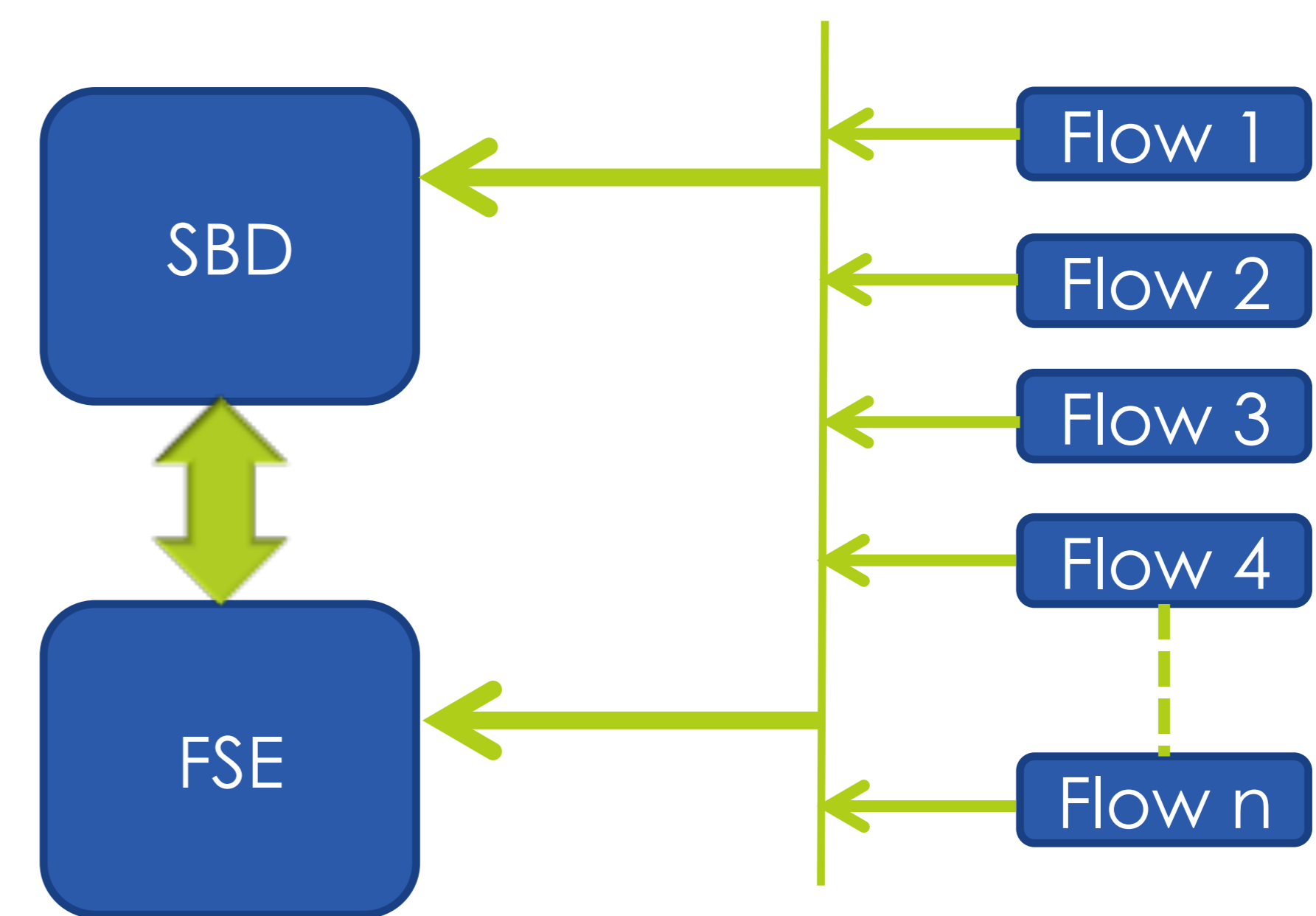
- The new "RTP Media Congestion Avoidance Techniques" (RMCAT) IETF Working Group intends to develop standards for RTP-based interactive real-time media.
- With the new WebRTC standard for interactive communication between web browsers – multiple flows are multiplexed over a single UDP port pair, they are normally regarded as a single flow inside the network and therefore treated in the same way.
- WebRTC being the major use case for these standards, RMCAT will also standardize methods for coupled congestion control, with the goal of having the best possible control over the send rate allocation. This means that congestion management can perhaps be readily applied for WebRTC.

## Coupled Congestion Control

### Elements of Coupled Congestion Control

We have opted for an approach that minimizes the amount of necessary changes to existing applications. It involves a central storage element called "Flow State Exchange" (FSE). The elements of the proposed architecture for coupled congestion control are:

- Flow State Exchange (FSE)
- Shared Bottleneck Detection (SBD)
- Flows



## The Flow State Exchange (FSE)

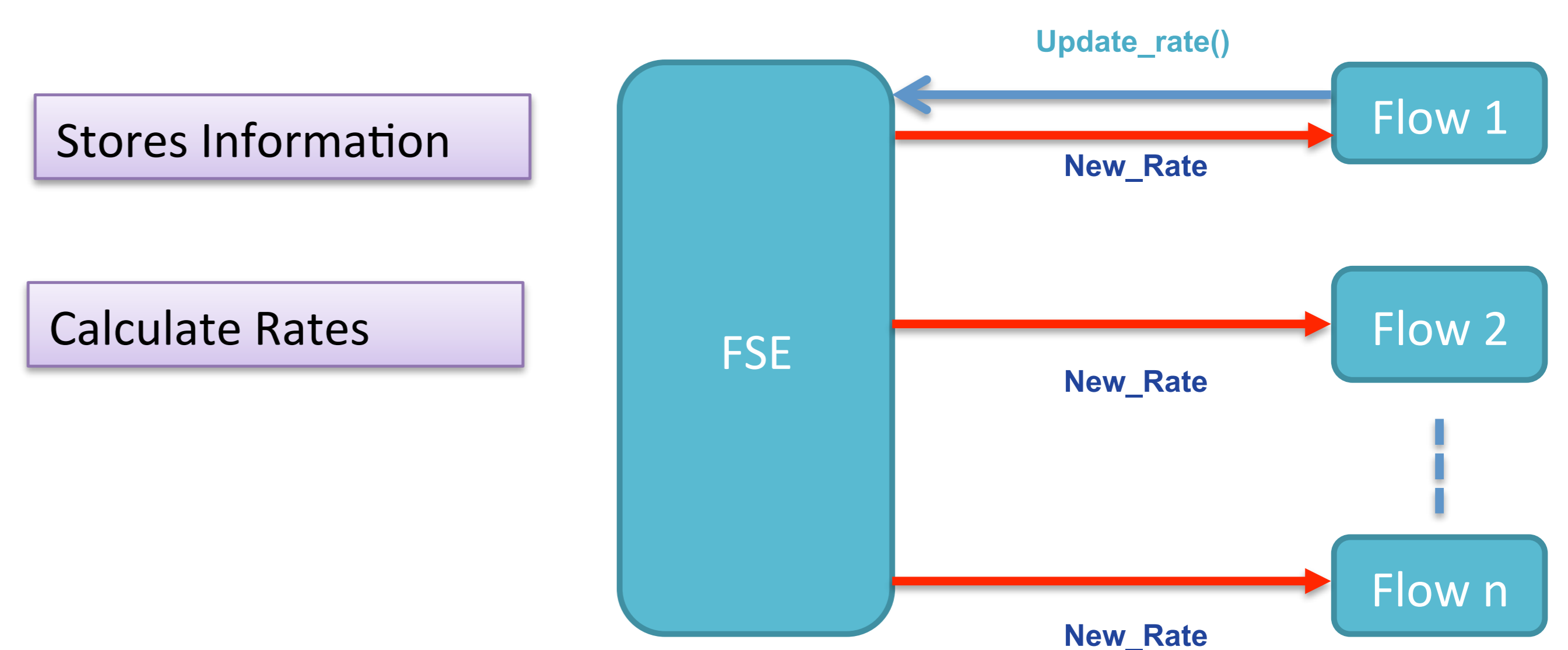
- The FSE is a storage element that can be implemented in two ways: active and passive.
- In the active version, it initiates communication with flows and the SBD.
- In the passive version, it does not actively initiate communication with flows and the SBD; its only active role is internal state maintenance.

### How it Works

- Every time a flow's congestion control mechanism would normally update its sending rate, the flow instead updates information in the FSE and performs a query on the FSE, leading to a sending rate that can be different from what the congestion controller originally determined.
- In the active version, the FSE additionally calculates the rates for all the other flows in the Flow Group (FG) and actively informs their congestion controllers with a callback function.
- In the passive version, FSE stores information from the flows, calculates rate and provides this calculated rate back.

## The Active FSE

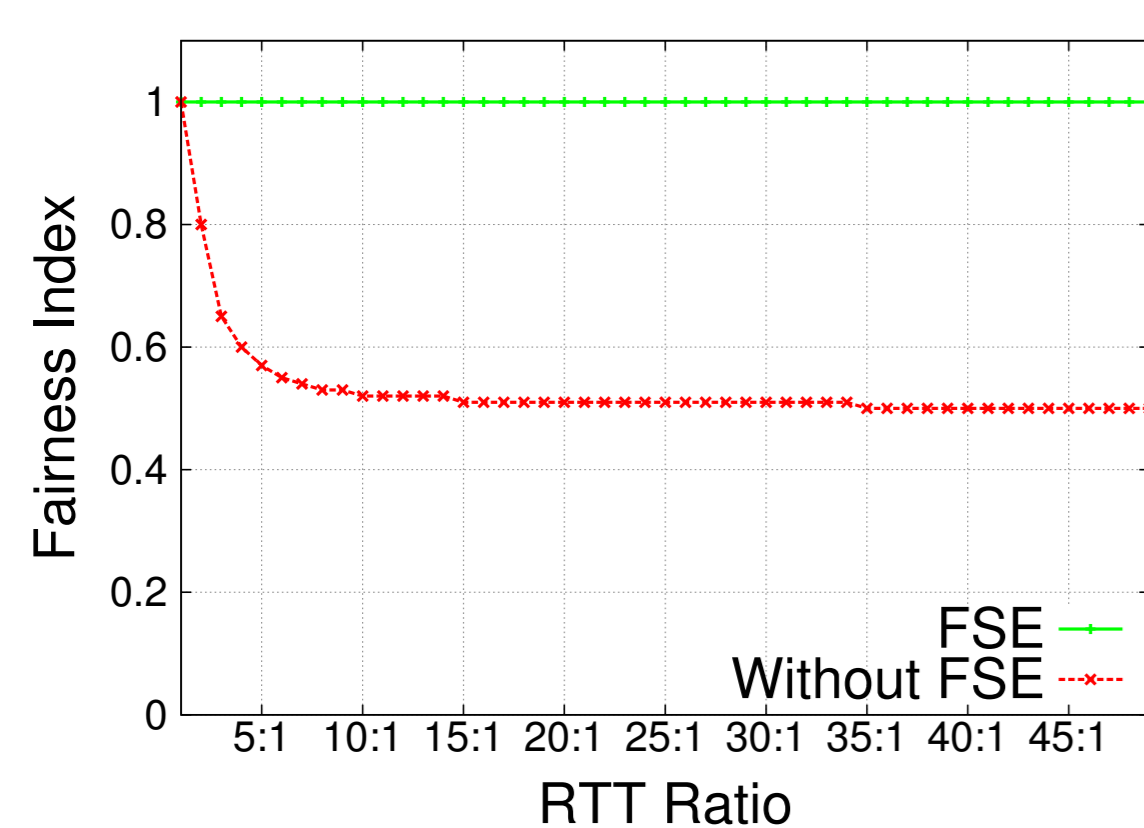
- Every time the congestion controller of a flow determines a new sending rate, the flow calls UPDATE.
- Updates the sum of all rates, calculates the sending rates for all the flows and distributes them to all registered flows.



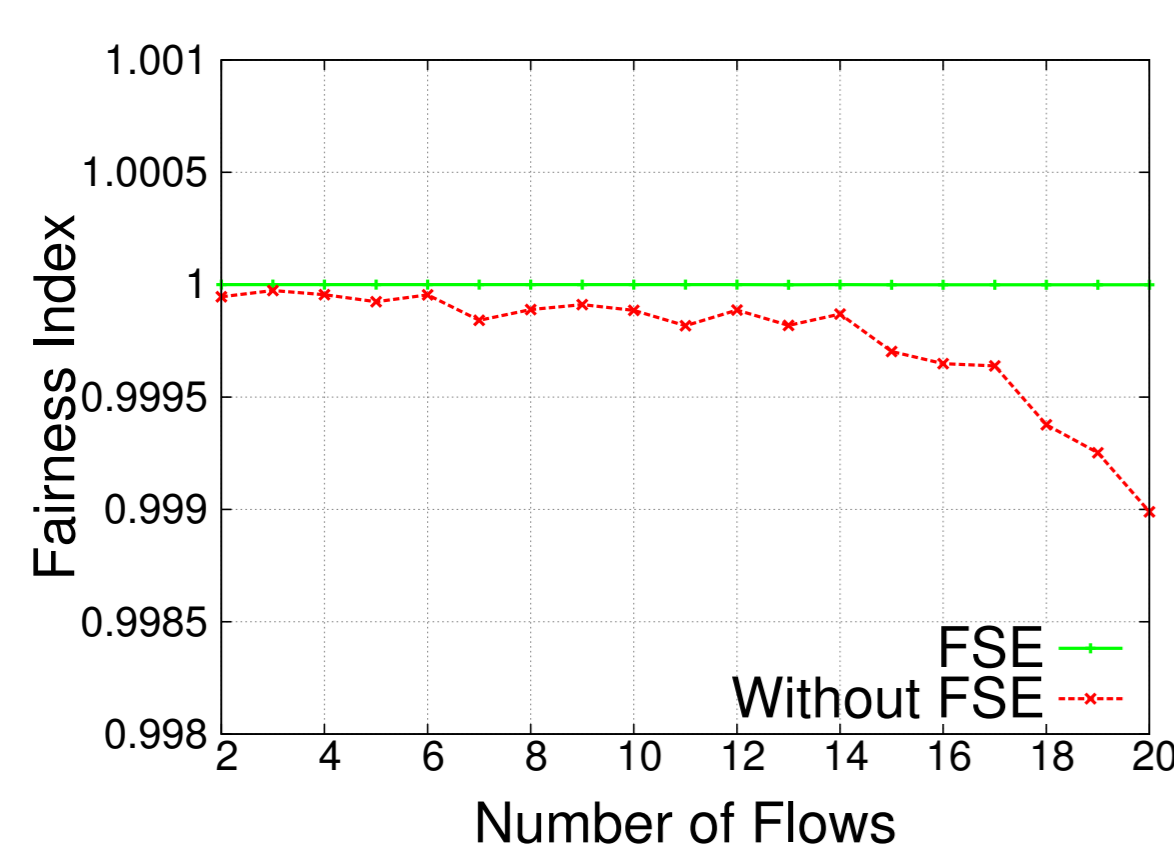
## Performance Evaluation of the FSE

- We implemented the FSE in ns-2 and simulated the behavior of congestion controlled flows using a dumbbell topology.
- The current implementation only supports two rate-based protocols: Rate Adaptation Protocol (RAP) and TCP Friendly Rate Control (TFRC).

### Fairness Index



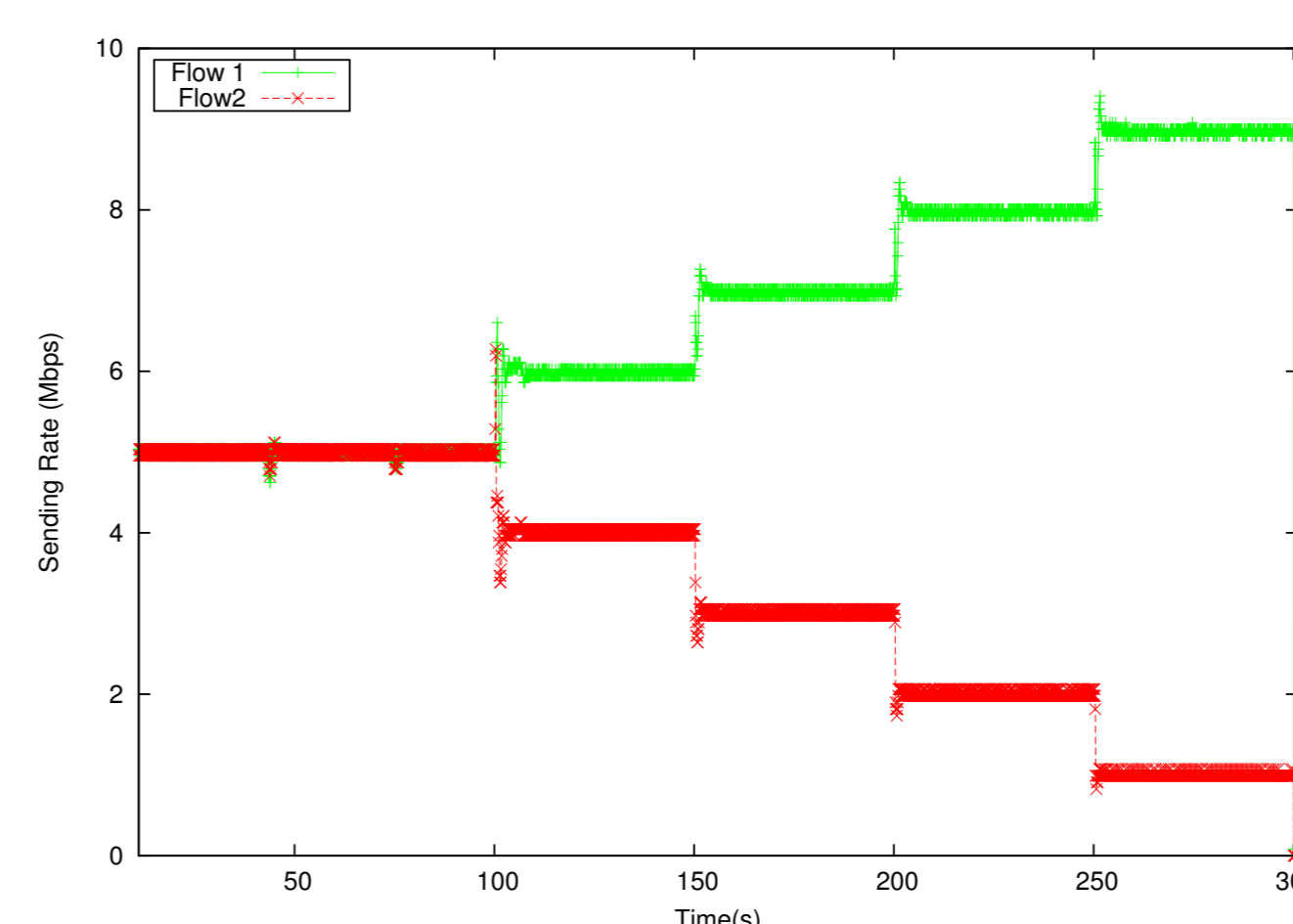
The fairness index for 2 RAP flows as the RTT ratio is varied; the positive influence of the fairness for the FSE-controlled flows is noticeable.



The positive influence of the fairness index for the FSE-controlled flows when the number of RAP flows with homogeneous RTTs is varied.

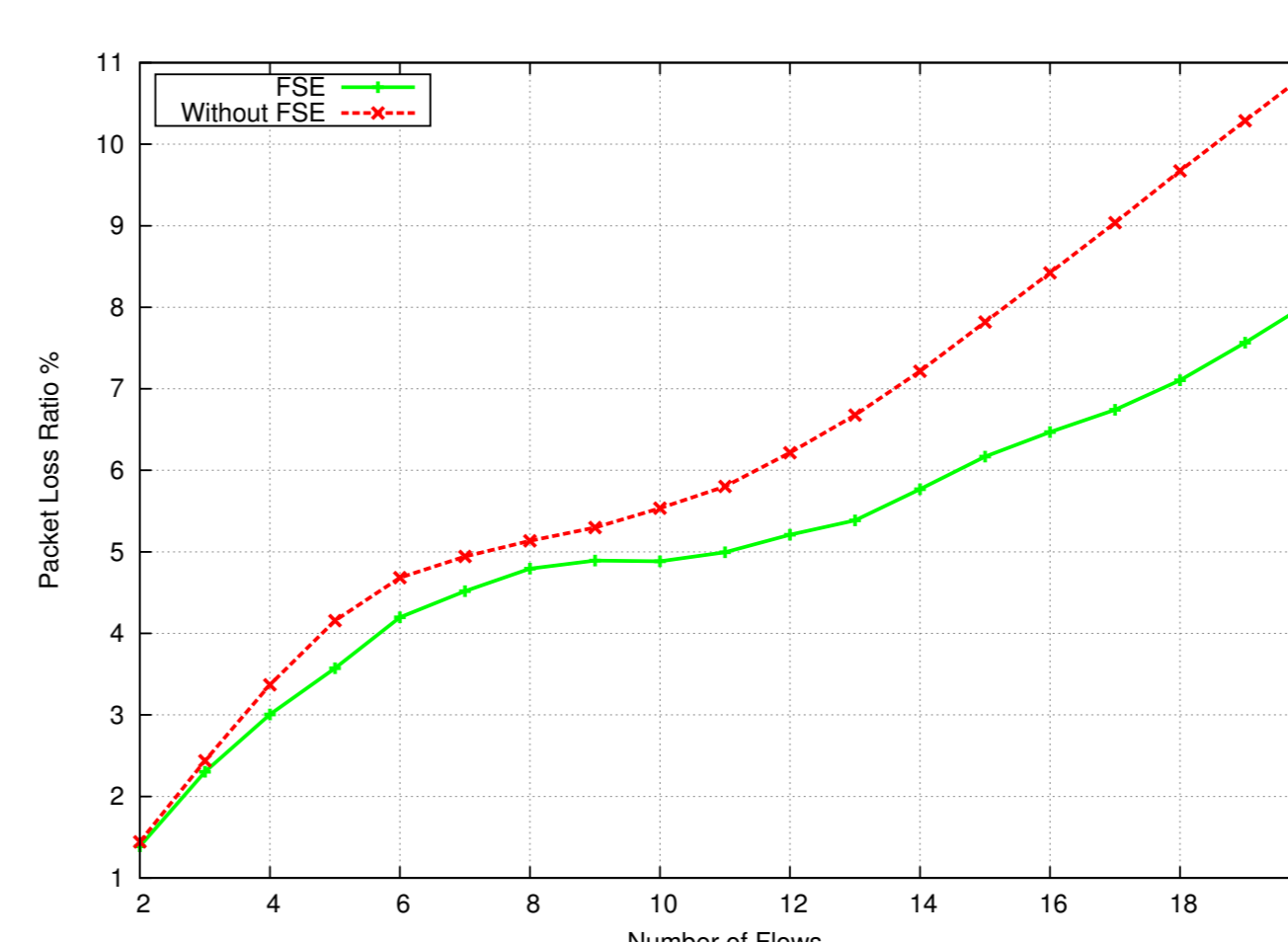
## Performance Evaluation of the FSE

### Prioritization



- The FSE can calculate and assign rates based on the priority.
- A high priority flow can easily get the desired rate from the FSE.

### Packet Loss Ratio



The loss ratio gain with the FSE increases with the number of RAP flows.

## References

- M. Welzl, S. Islam, and S. Gjessing. (2013) Coupled congestion control for rtp media. Internet draft [work in progress]. [Online]. Available: <http://tools.ietf.org/html/draft-welzl-rmcat-coupled-cc-02>