Congestion Control for CCN/NDN.

It's all about the RTT-fairness

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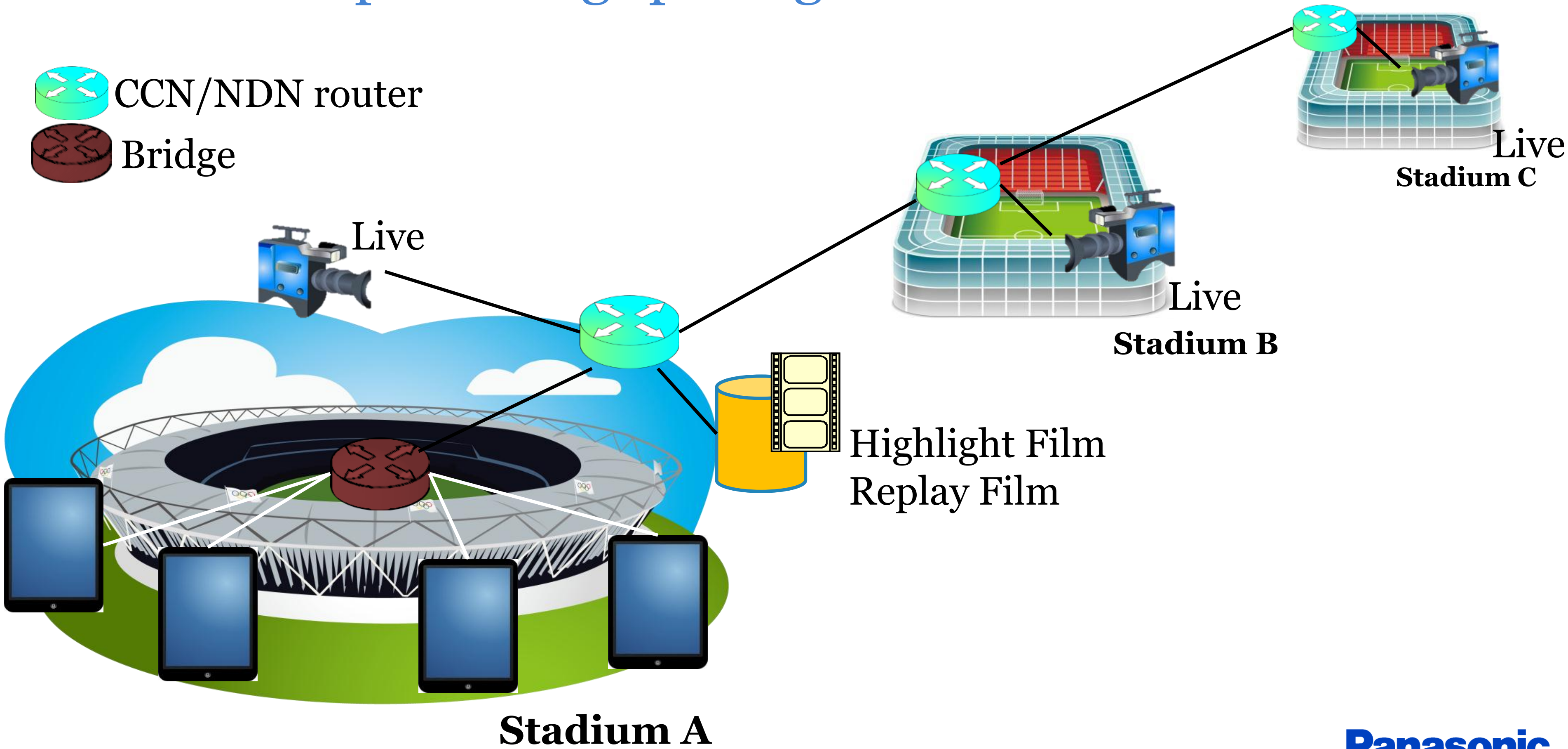
Target Use case of CCN/NDN

- Real-time Video Streaming
  - Example: In big sports games



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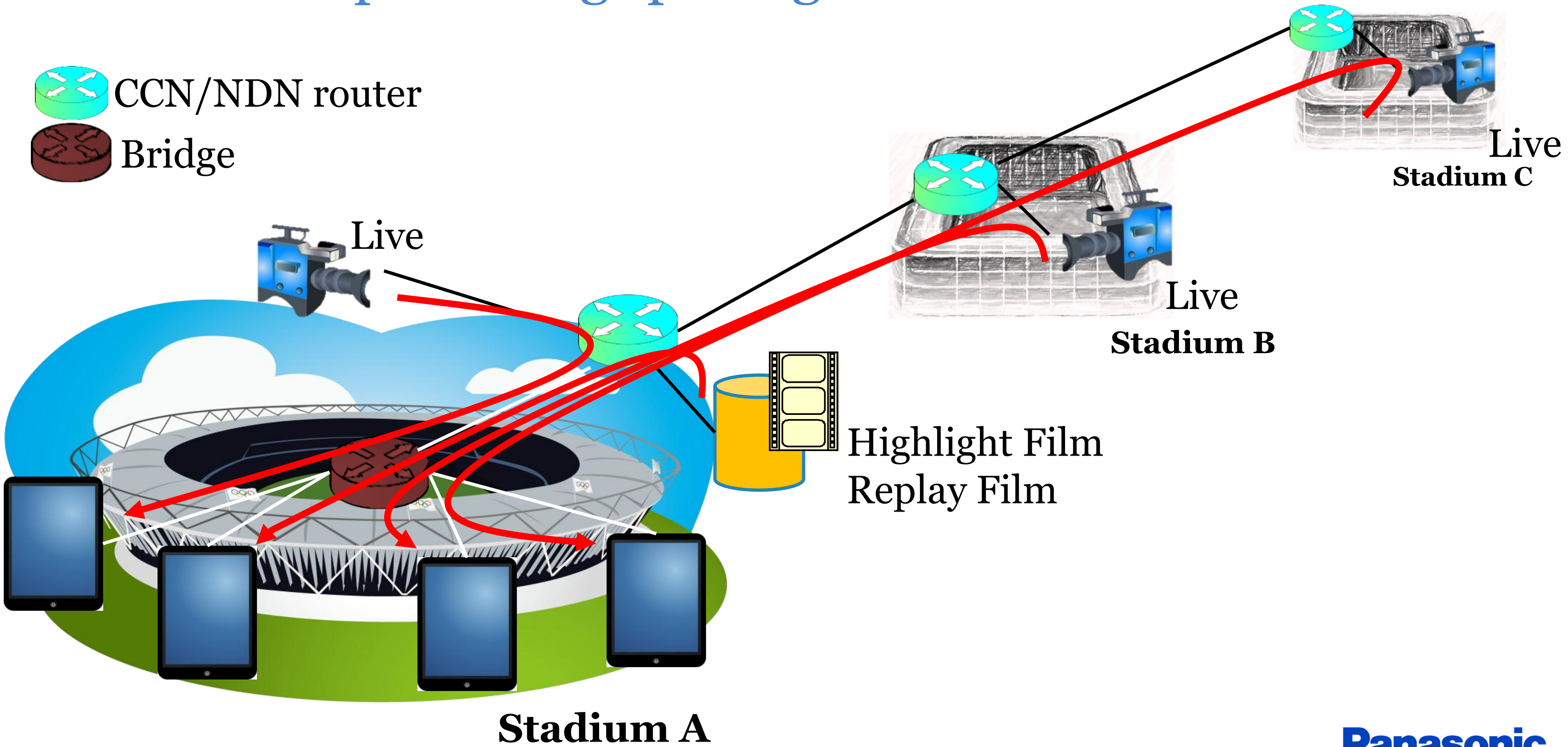

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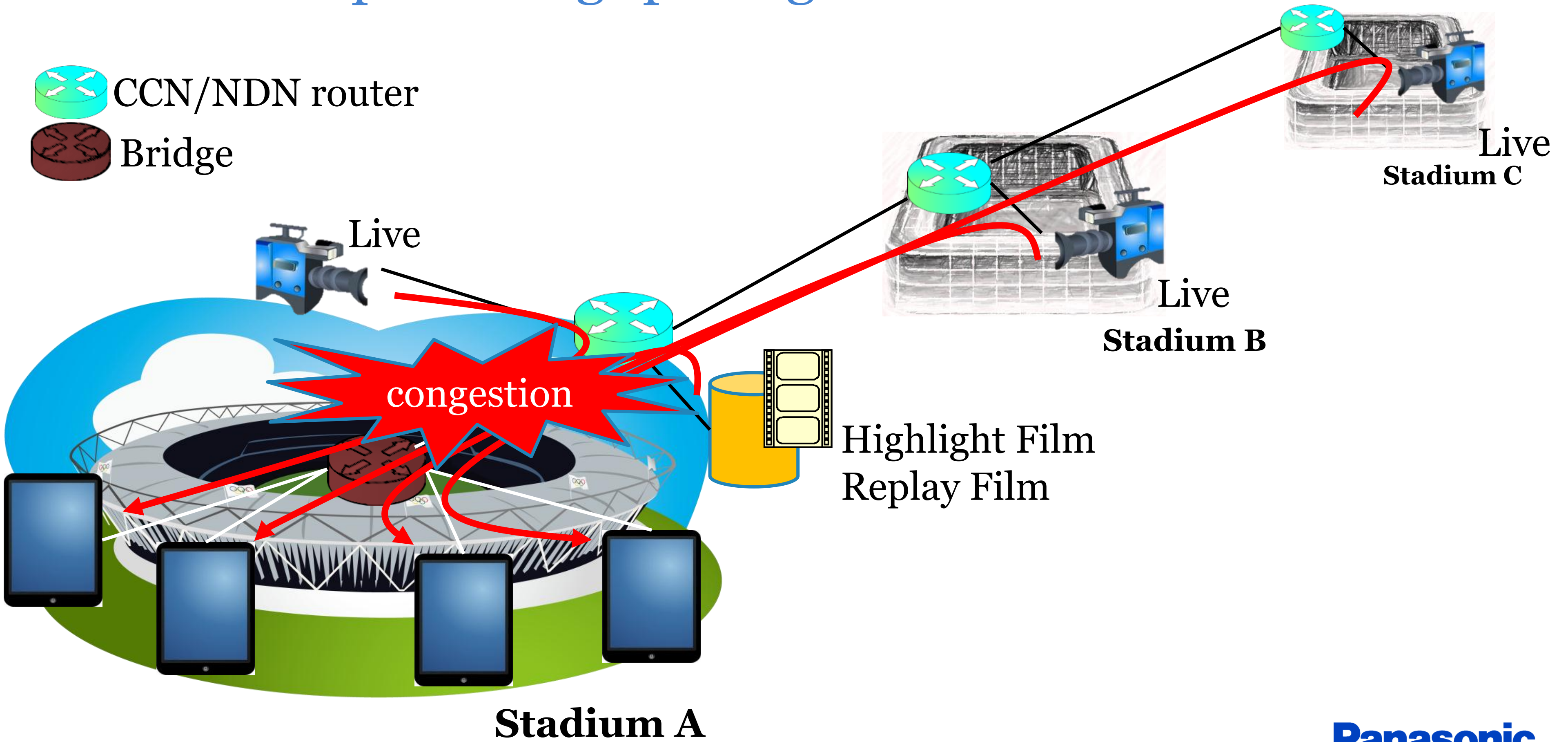

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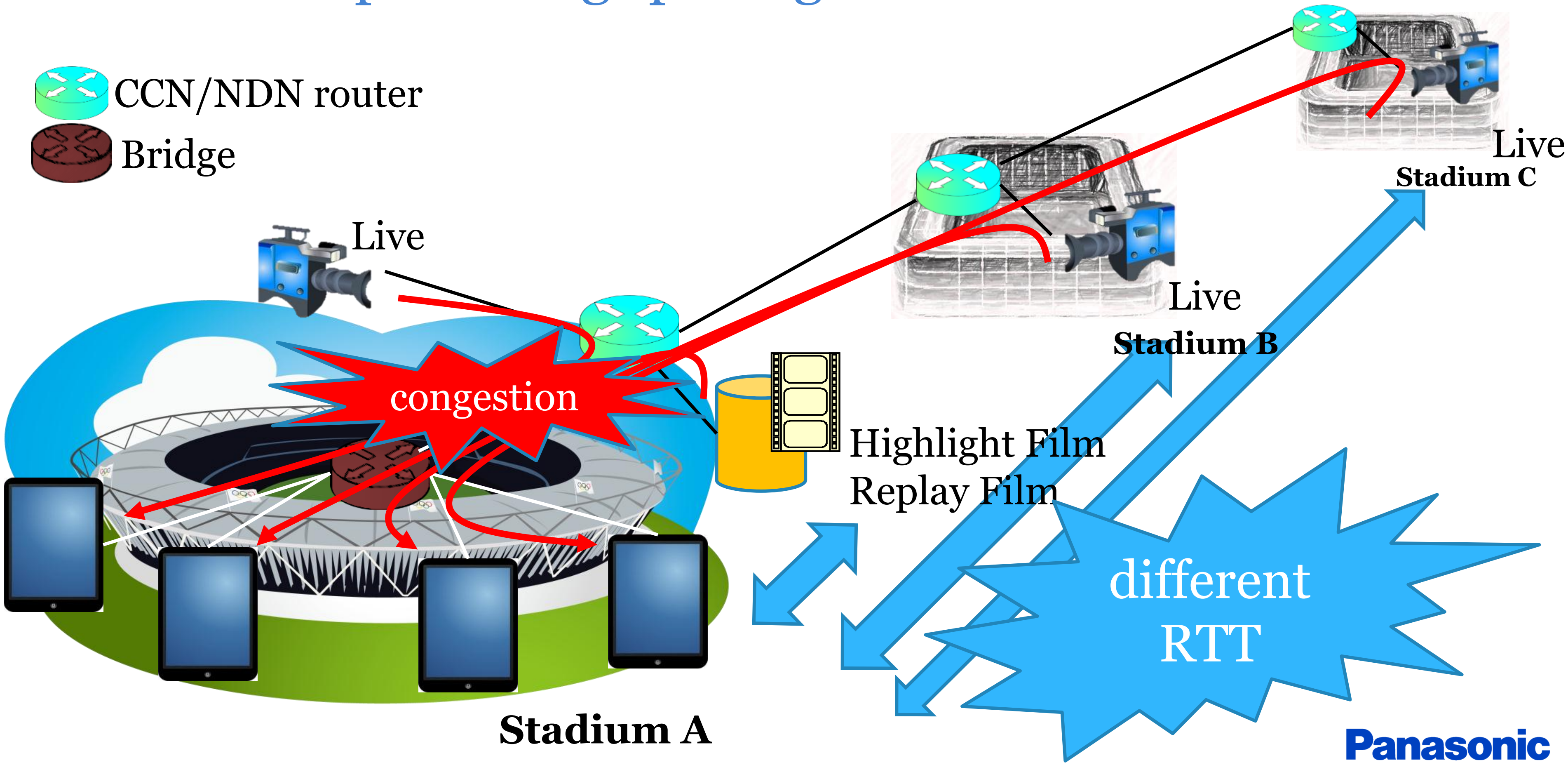


Congestion Control(CC) in CCN/NDN real-time streaming

- Targets
  - Keep low latency in transmission.
  - Keep best available video quality.

- Preferable features
  - Receiver Driven CC
    - We think Receiver Driven method can be more easy to scale.

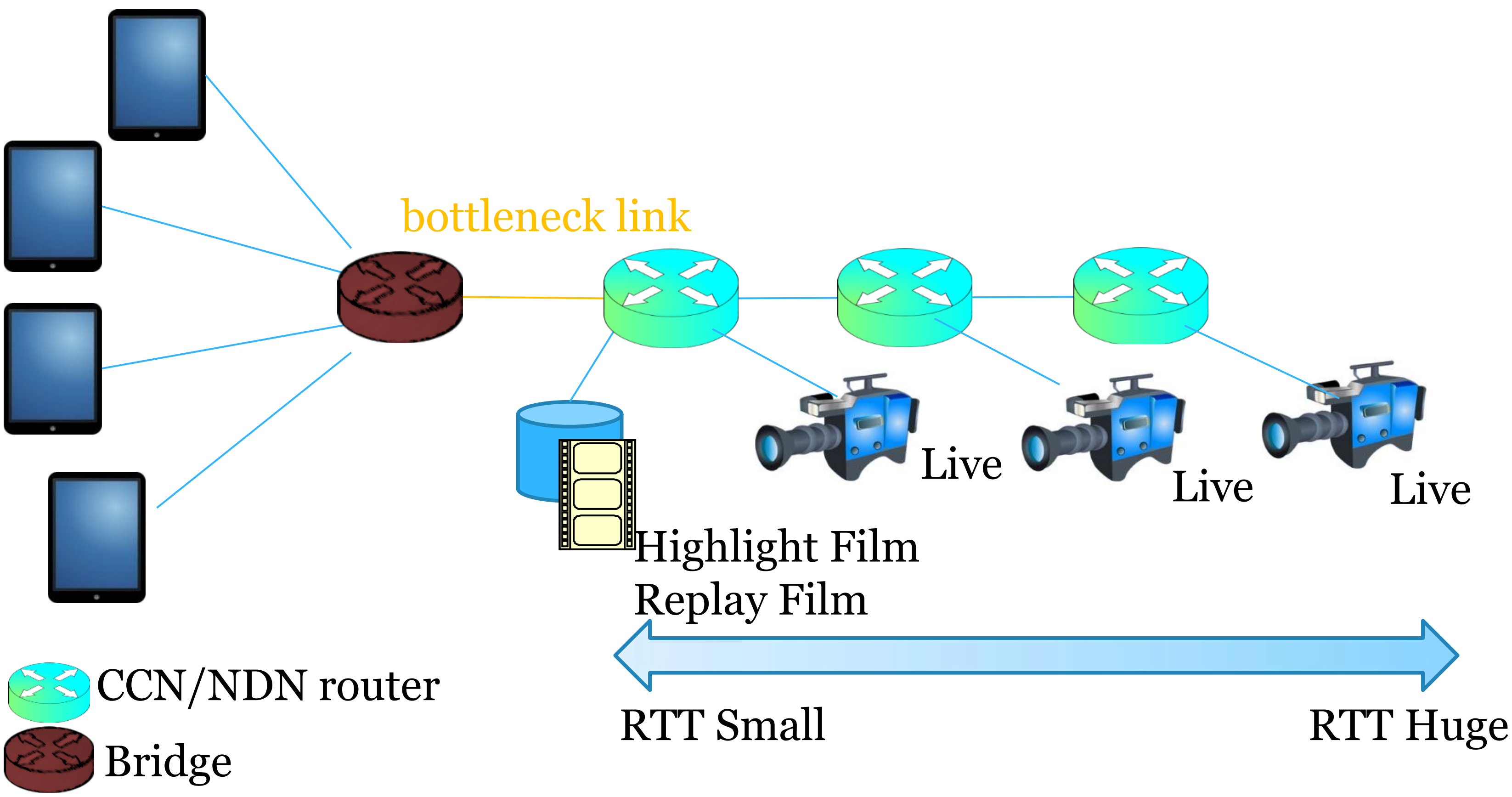
Receiver Driven CCs are based on AIMD approach

- AIMD based Consumer-driven approach
- [1] Giovanna Carofiglio, et al. Icp: Design and evaluation of an interest control protocol for content-centric networking. INFOCOM NOMEN Workshop, 2012.
- [2] Stefano Salsano, et al. Transport-layer issues in information centric networks. ACM SIGCOMM ICN Workshop, 2012.
- [3] Somaya Arianfar, et al. Contug: A receiver-driven transport protocol for content centric networks. IEEE ICNP, 2010
- Live Video distribution
- [4] Ciancaglini V., et al. CCN-TV: A Data-centric Approach to Real-Time Video Services. Advanced Information Networking and Applications Workshops. 2013.
- [5] Derek Kulinski, and Jeff Burke. NDNVideo: Random-access Live and Pre-recorded Streaming using NDN. In Technical Report http://named-data.net/techreport/TR007-streaming.pdf

Drawbacks of AIMD approach

- Lack of RTT-fairness cause problem

Network topology for Live streaming in Big Game



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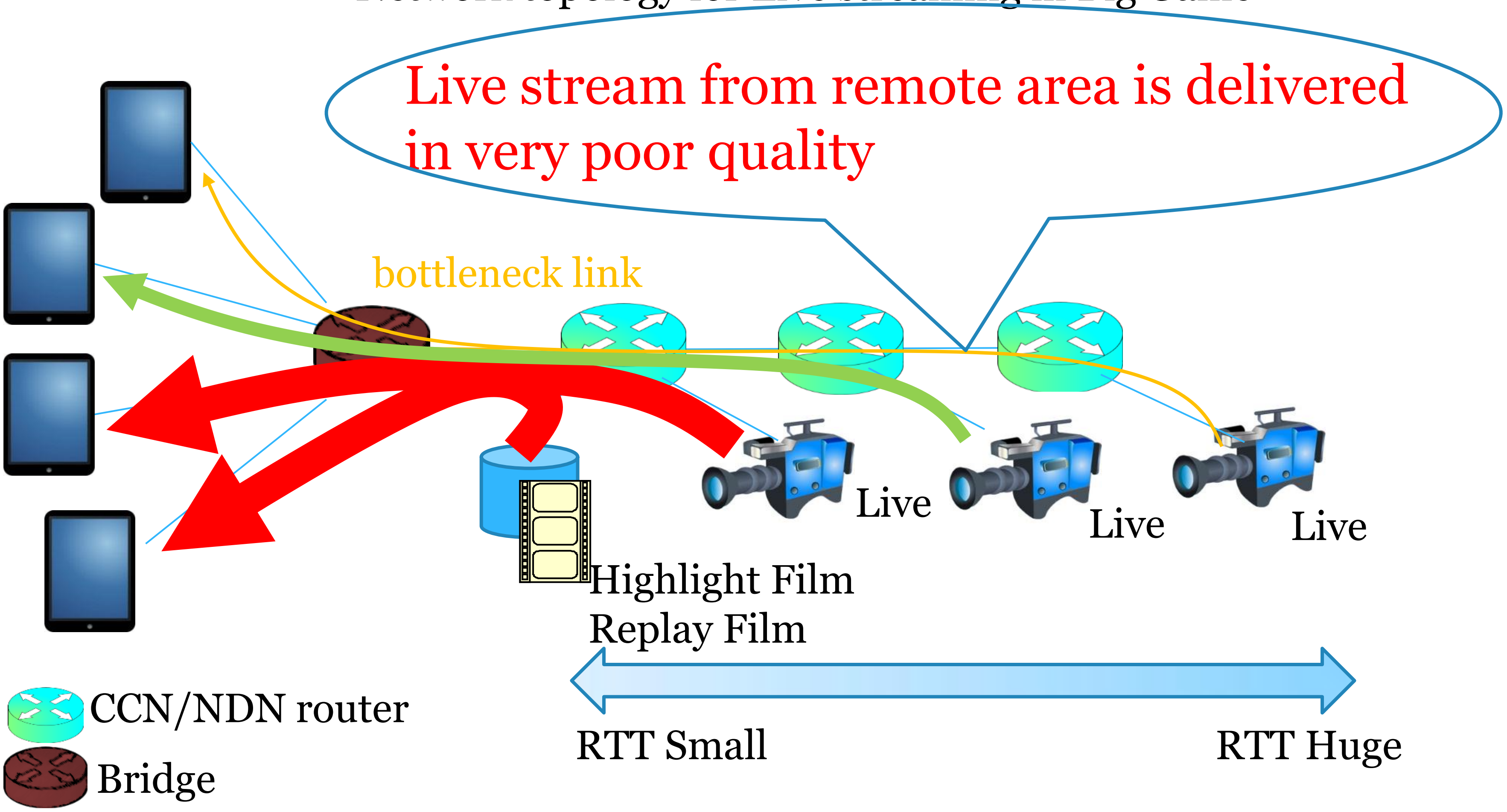
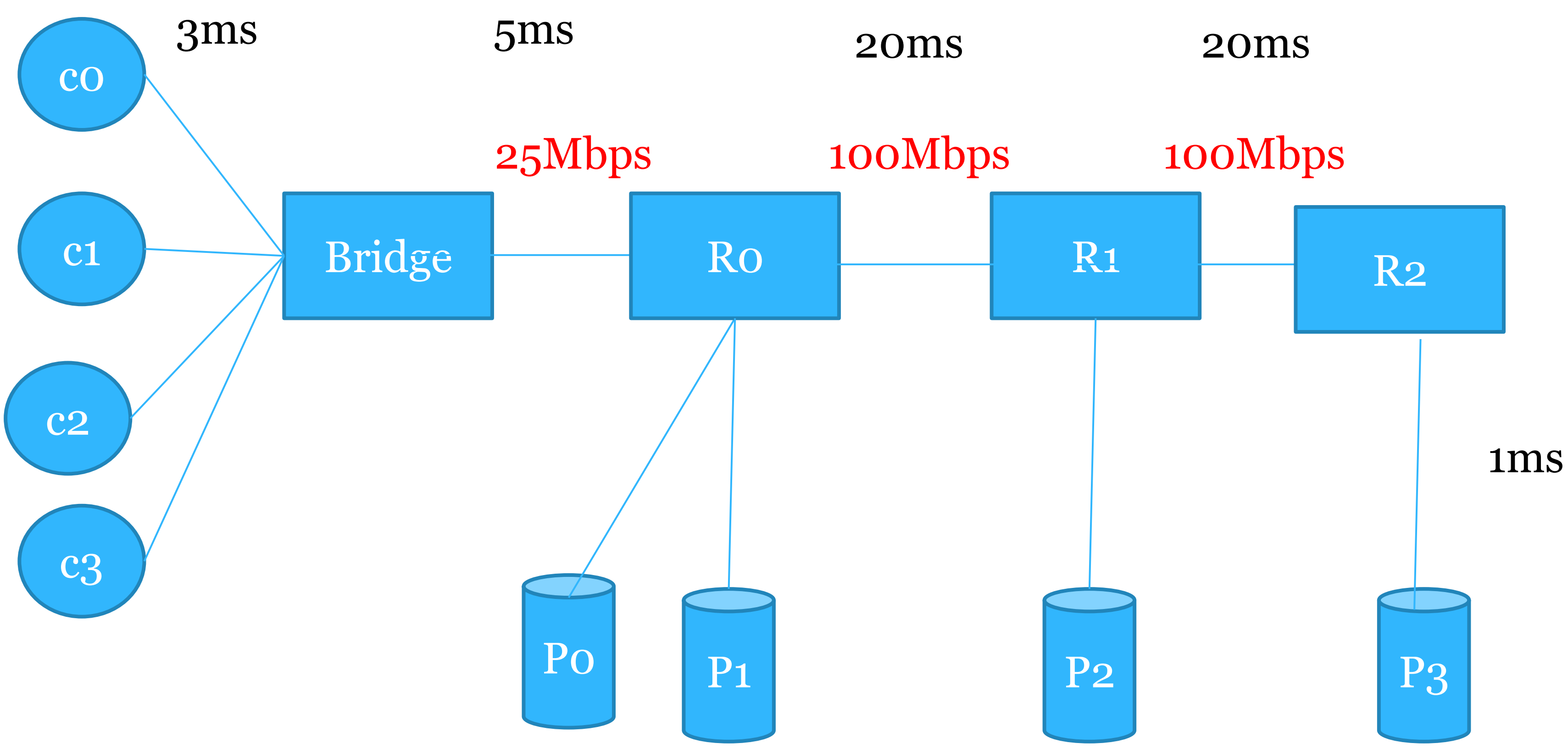


Drawbacks of AIMD approach (preliminary simulation)



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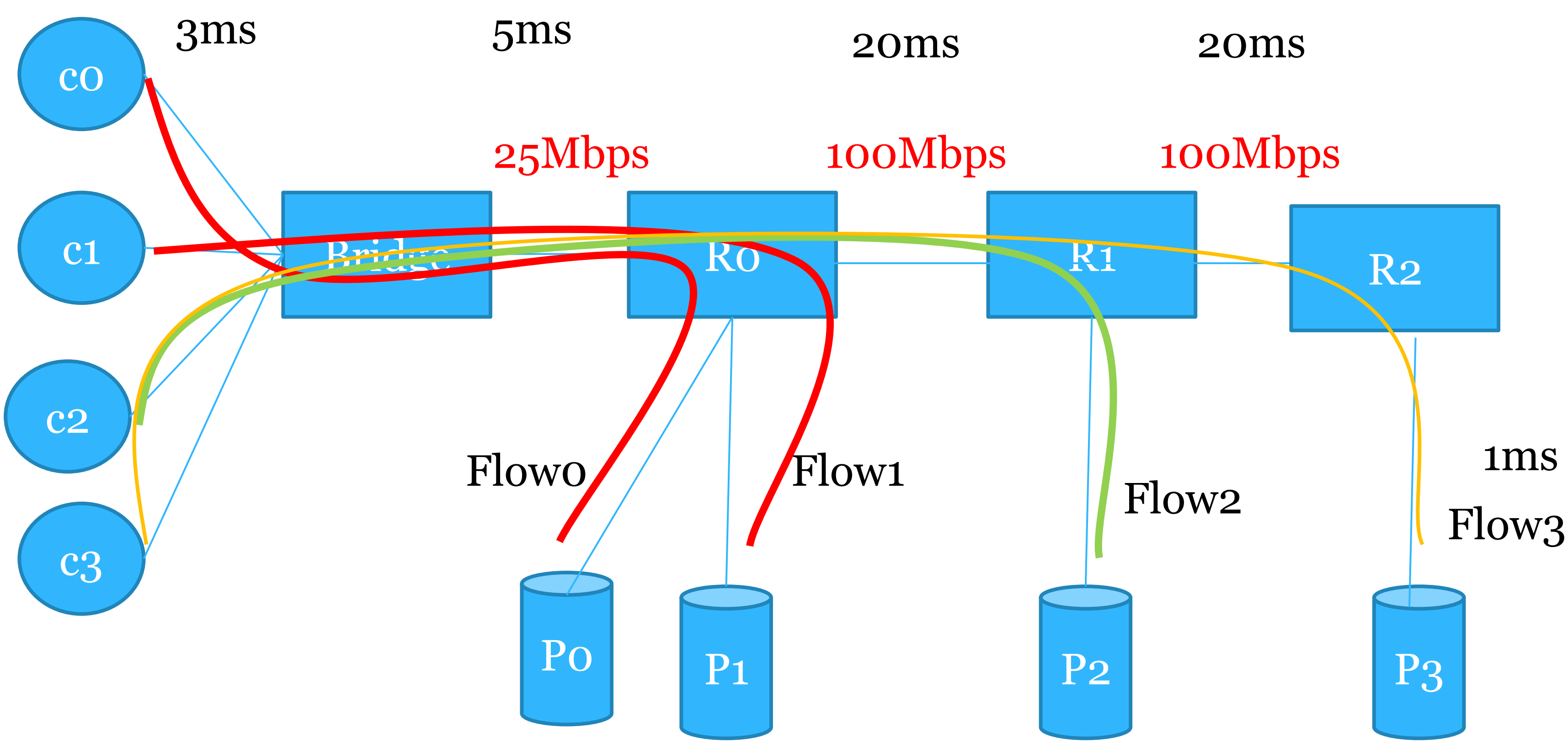

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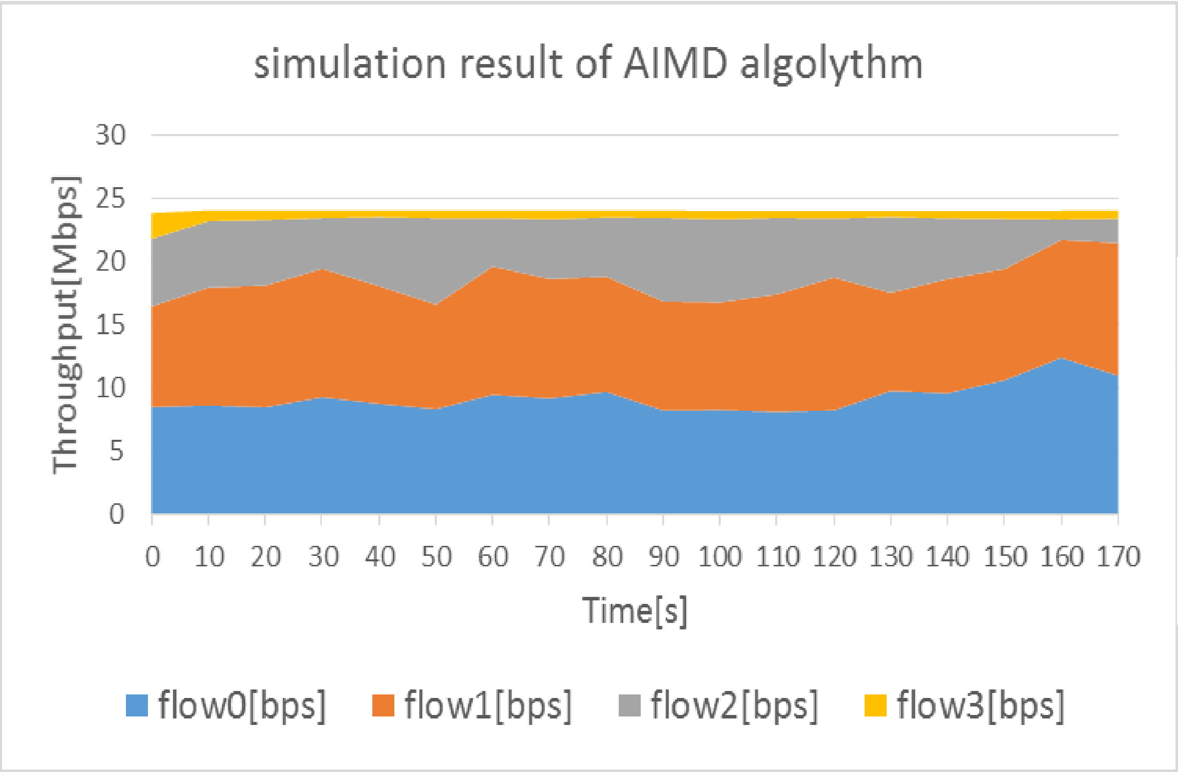
simulation result

- Flow 3 takes only 690kbps of the 25Mbps link



	RTT	Average Throughput
Flow 0	9ms	9.3Mbps
Flow 1	9ms	9.2Mbps
Flow 2	29ms	4.9Mbps
Flow 3	49ms	690kbps

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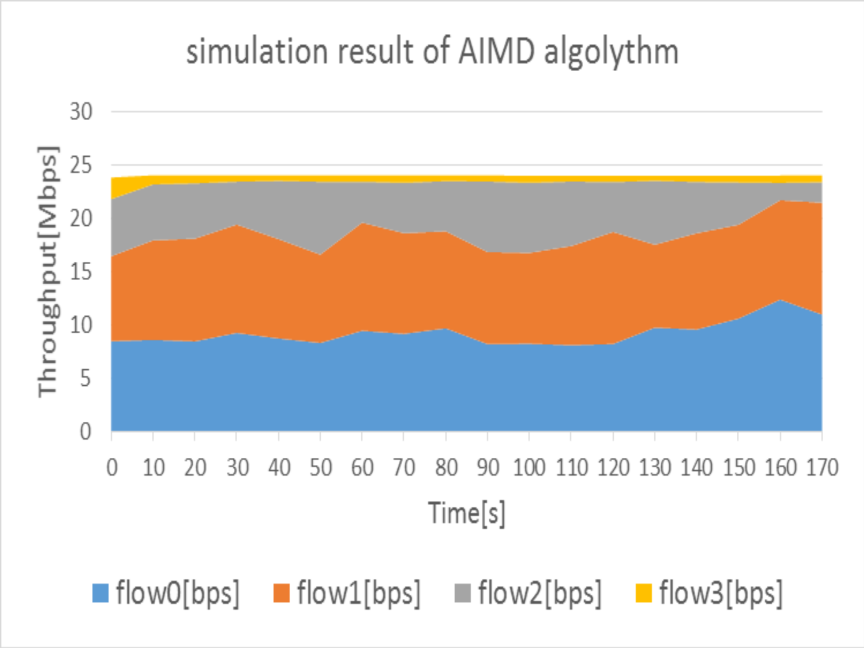
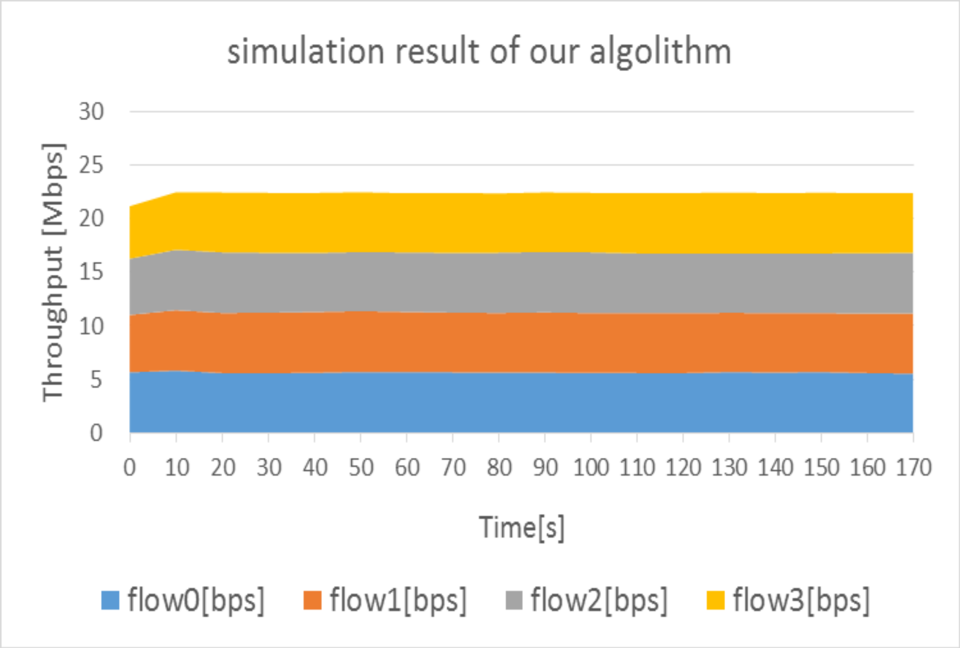
Panasonic Approach for CC

- Targets
  - Keep low latency in transmission.
  - Keep best available video quality.

- Features
  - RTT based bandwidth estimation
  - Timer based interest rate control

Comparison with AIMD approach





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Conclusion and our Activity

- RTT fairness is the point we must consider

- Our activity
  - Implementation on NDNVideo (done)
  - Implementation on NDNRTC (ongoing)
  - Submitting Paper to IEICE

Thank you

appendix

Proposed method

Receiver driven

1. Measure RTT on receiving each Data packet

2. Calculate average RTT in each short period

3. Control Interest sending rate in each short period

- *AvgRTT* ≦ *(RTTmin + jitter_offset)* or *Consecutive AvgRTT decrease*

  $$pps_{now} \leftarrow pps_{prev} + \alpha / \sqrt{pps_{prev}} \qquad (\alpha \geqq 1)$$

- *Consecutive AvgRTT increase* or *Packet loss*

  $$pps_{now} \leftarrow pps_{prev} - \beta \cdot \sqrt{pps_{prev}} \qquad (0 < \beta < 1)$$

AvgRTT : Average RTT in each short period
RTTmin : Minimum RTT
pps : Number of sending Interest packet per second

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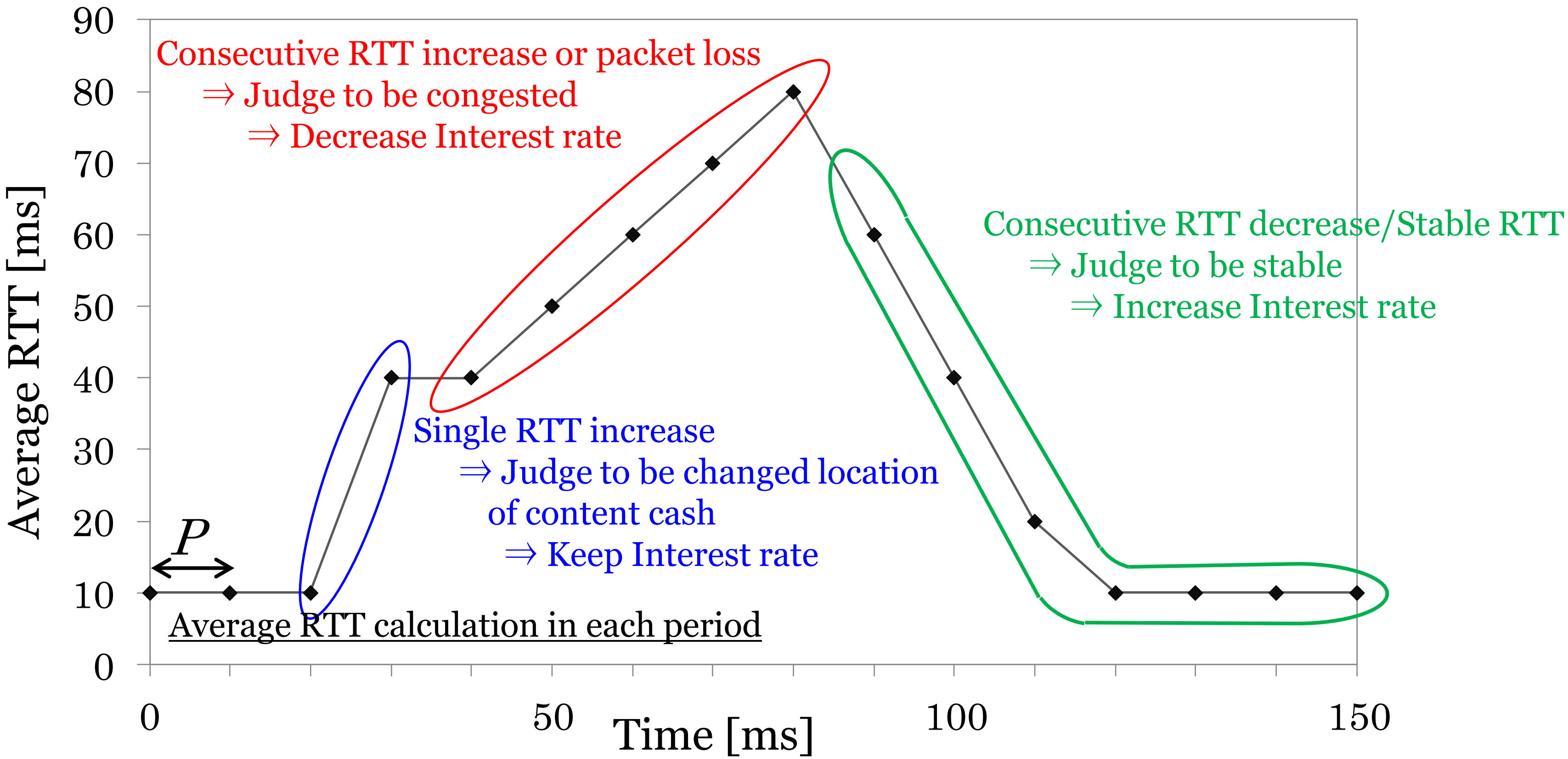
Distinguish consecutive RTT change and unexpected one



Increase Interest rate

$$pps_t \leftarrow pps_{t-P} + \alpha / \sqrt{pps_{t-P}}$$

Decrease Interest rate

$$pps_t \leftarrow pps_{t-P} - \beta \cdot \sqrt{pps_{t-P}}$$

Interest sending interval

$$interval = \frac{s}{x \cdot pps_t}$$

ppt_t	Number of Interest packet in one second
P	Constant period of estimation
s	Content chunk size [byte]
x	Pre-defined constant value