Delay Aware Packet Scheduling (DAPS) and receiver's buffer blocking in CMT-SCTP

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Context and problem definition

Context:

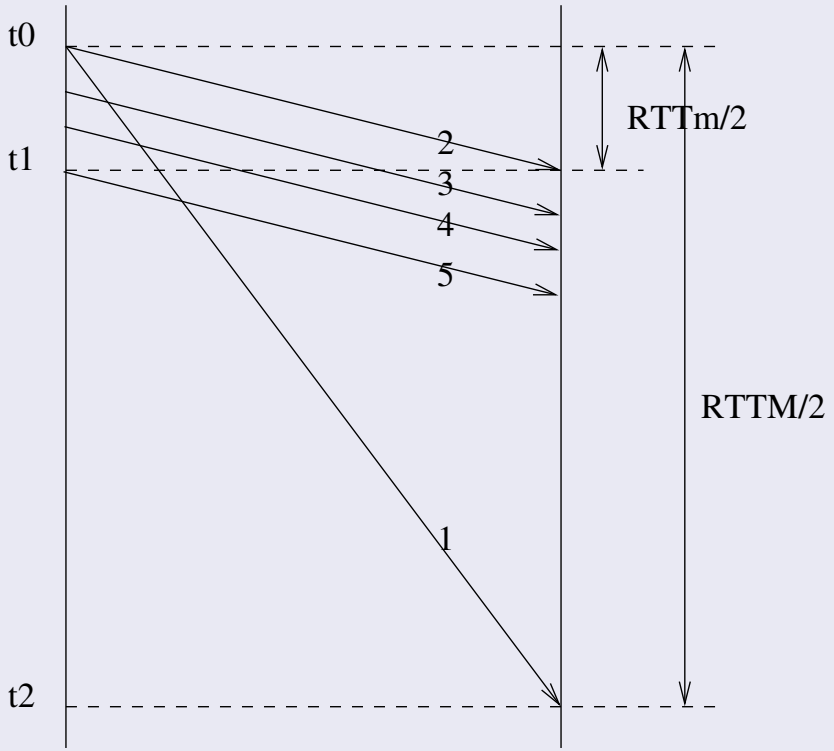
- many recent studies on ways to adapt TCP to the multi-path data transfert;
- we focus on Concurrent Multipath Transfer Using SCTP Multihoming (solution proposed may be transfered to MP-TCP);
- asymmetric heterogeneous network conditions: receiver's buffer blocking issues (out of order packet arrival).

Content of the presentation:

- measure the receiver's buffer blocking time;
- propose a solution (adaptation of CMT-SCTP scheduler) for that specific issue;
- compare CMT-SCTP with and without our scheduler, Delay Aware Packet Scheduler.

Overview

Maximum blocking time with CMT-SCTP



Events

- at $t0$: (1) $TSN(2) \ldots TSN(N_{chunk})$ on path $mRTT$ - (2) $TSN(1)$ on path $MRTT$;
- at $t0$: $RWND$: block state;
- at $t1$: reception of $TSN(2)$;
- at $t2$: reception of $TSN(1)$ - packet forwarded to app.;

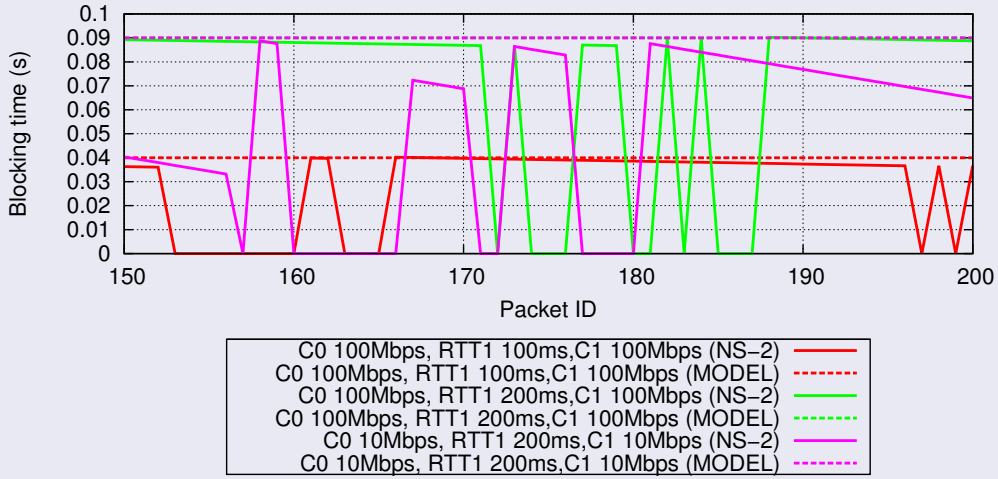
$$T_{maxblock} = t2 - t1$$
$$T_{maxblock} = \frac{RTT_{MRTT}}{2} + \frac{L*8}{C_{MRTT}} - \frac{RTT_{mRTT}}{2} - \frac{L*8}{C_{mRTT}}$$

Validation blocking time

Worst case model

C0 (Mb/s)	C1 (Mb/s)	RTT1 (ms)	$T_{maxblock}$ Model
10	10	100	0.040
50	10	100	0.041
10	50	100	0.039
100	100	100	0.040
50	150	100	0.039
150	50	100	0.040
10	10	200	0.090
50	10	200	0.091
10	50	200	0.089
100	100	200	0.090
50	150	200	0.089
150	50	200	0.090

NS-2

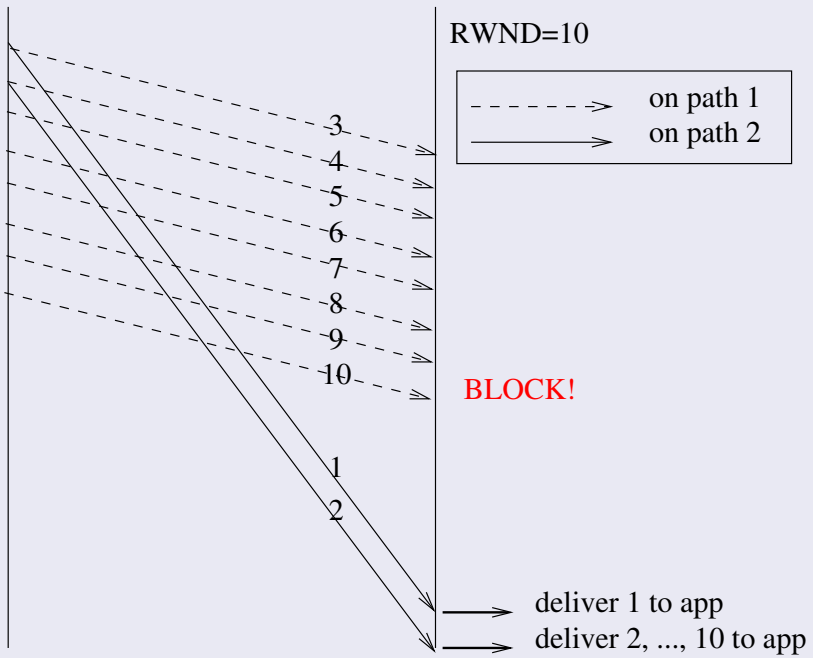


We measure an important blocking time in the context of asymmetric links. We propose to adapt the scheduling in CMT to reduce this delay which may "block" the receiver's buffer.

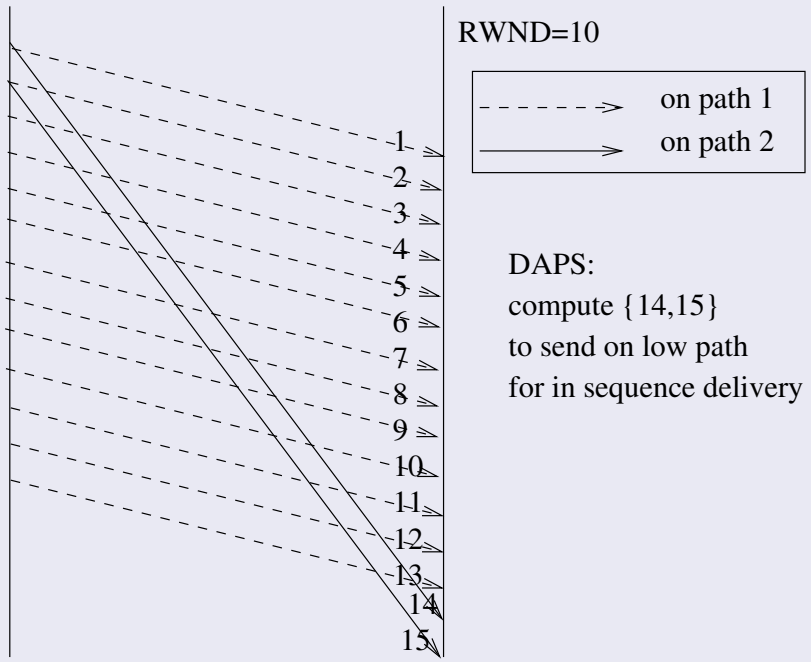
Overview

Delay Aware Packet Scheduling

CMT

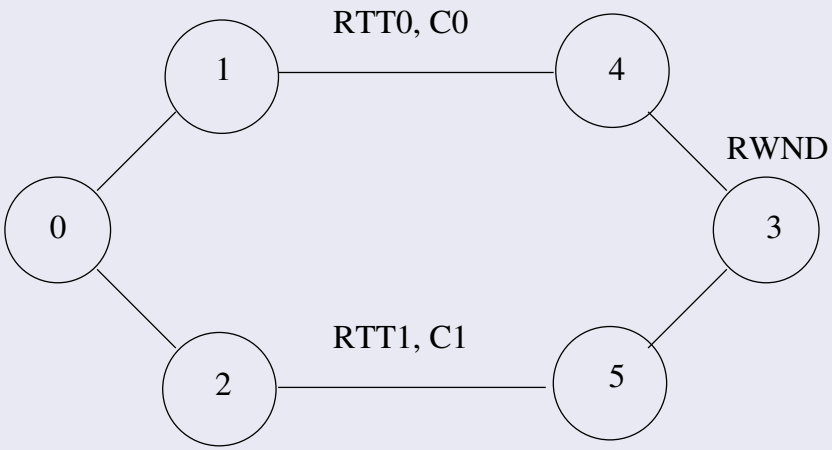


DAPS



DAPS performance

Butterfly



Parameters

$RWND = 655kB$; $L = 1500B$;
$RTT0 = 20ms$;
$C0 = [1Mbps; 1.5Mbps]$;
$RTT1 \in [100; 200]ms$;
$C1 \in [500kbps; 1Mbps]$

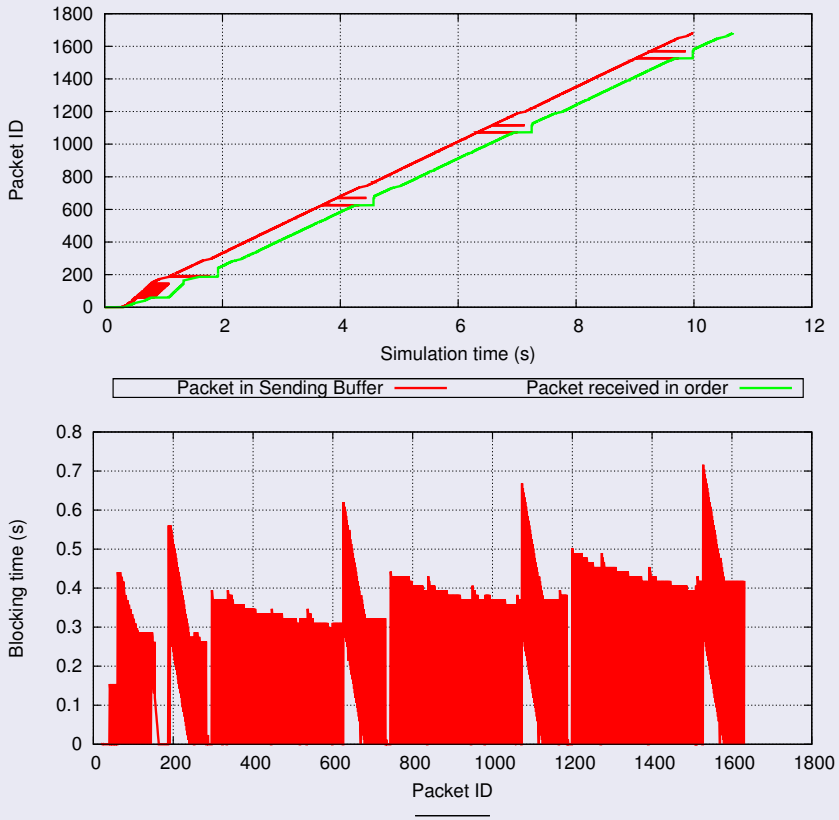
Asymmetry is defined as:

$A = (C1.RTT1)/(C0.RTT0)$

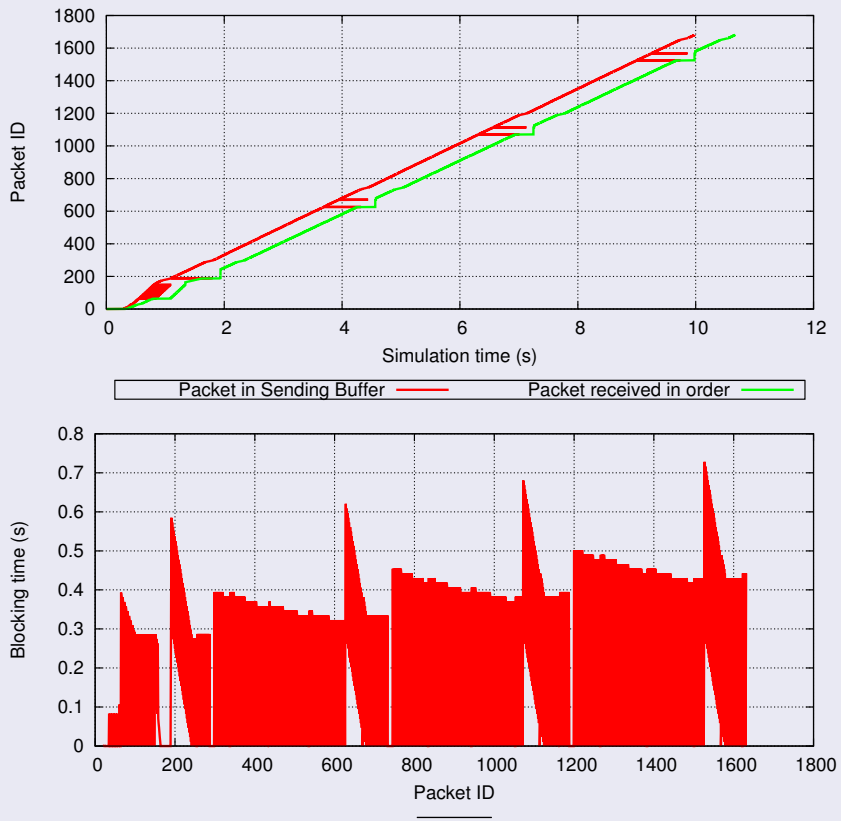
Case	C0 (Mb/s)	C1 (Mb/s)	RTT1 (ms)	A
1	1	1	100	5
2	1	1	200	10
3	1.5	0.5	200	3.33

Asymmetry: 5

DAPS Case 1

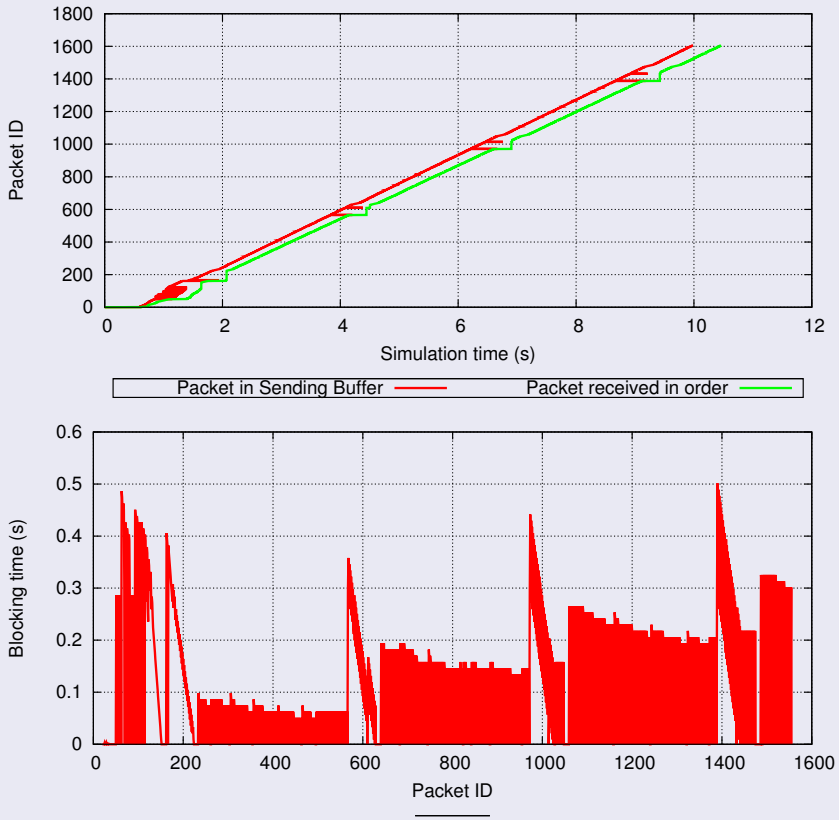


CMT Case 1

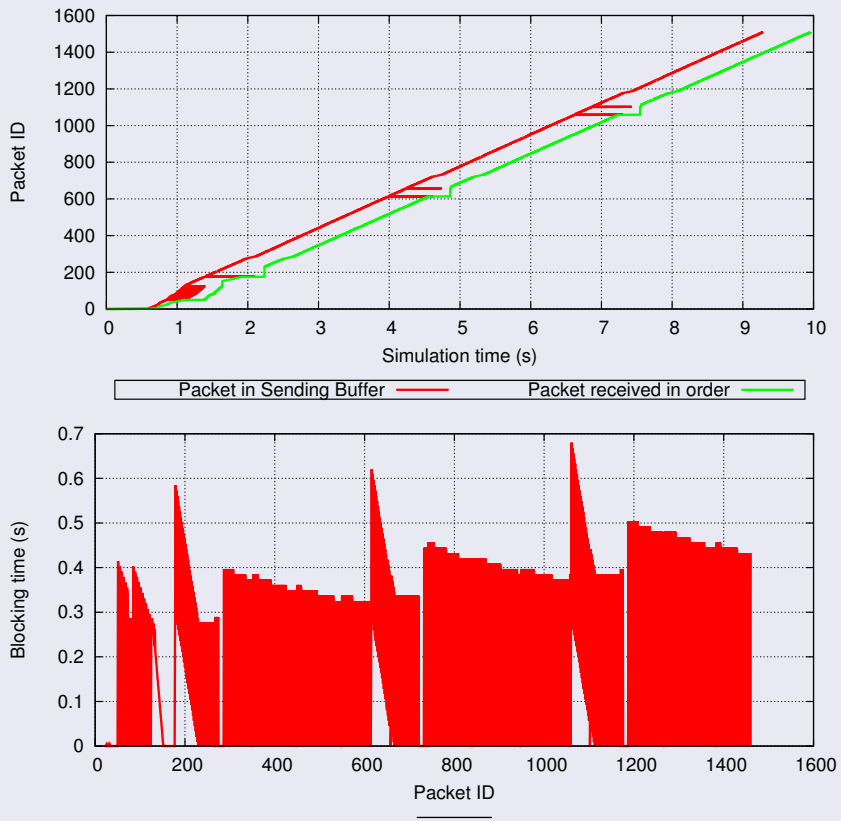


Asymmetry: 10

DAPS Case 2

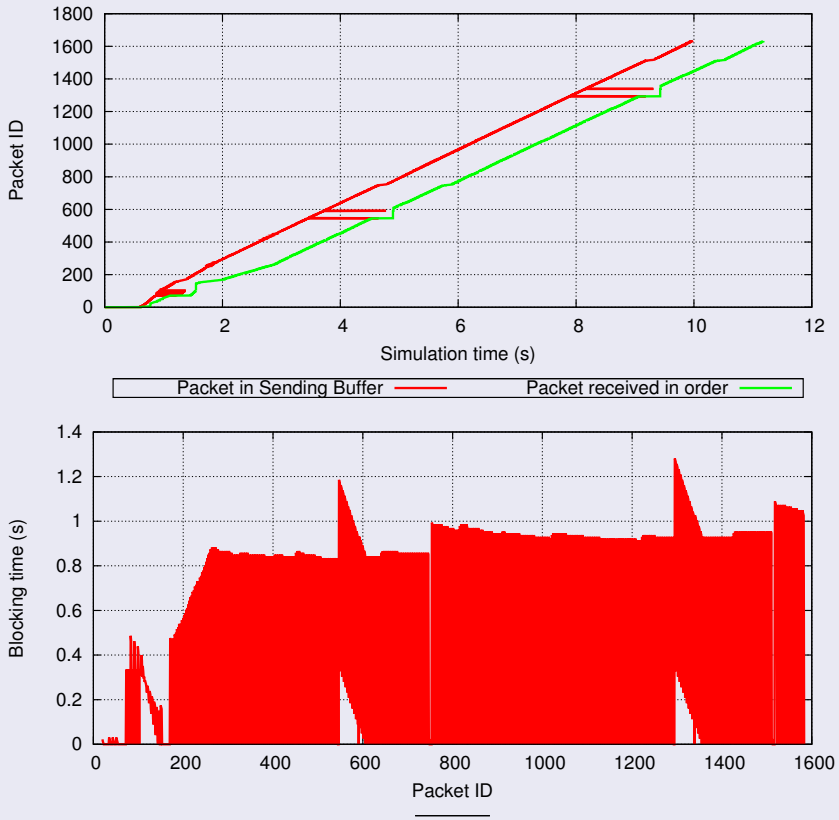


CMT Case 2

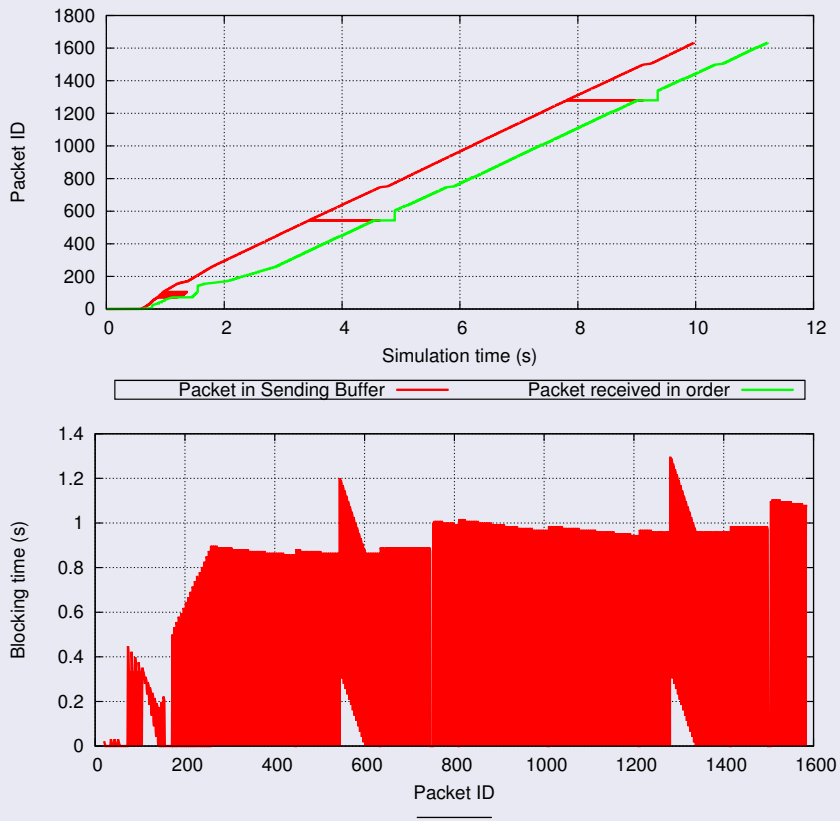


Asymmetry: 3.33

DAPS Case 3



CMT Case 3



Overview

DAPS Performance: first conclusions

- In case 2 (Asymmetry: 10), DAPS provide serious improvements;
- In case 1 (Asymmetry: 5), improvements are limited (without doing worse than CMT-SCTP);
- In case 3 (Asymmetry: 3.33), improvements are limited.

The performance of DAPS are related to:

- the Asymmetry of the links;
- the receiver's buffer, which we will later investigated on to improve the algorithm.