

Abstract

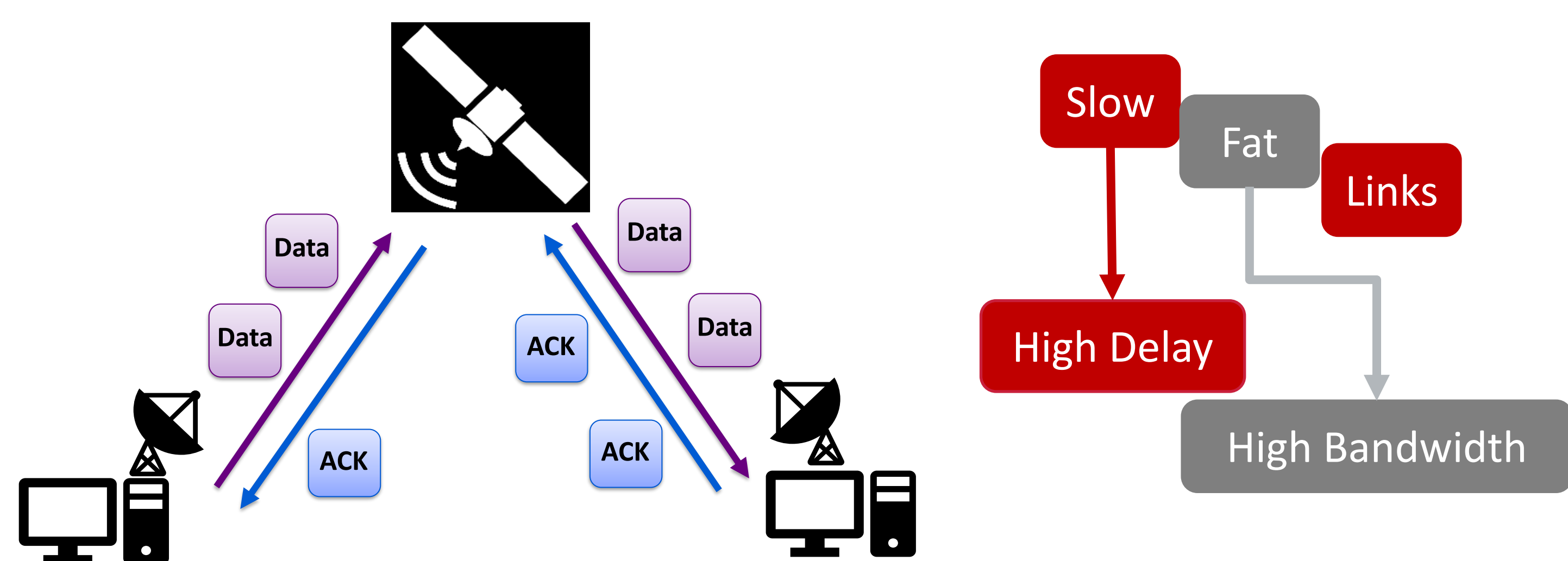
Motivation: Addressing premature or delayed slow start exits in current TCP implementations

Methodology: Introducing a novel technique based on sent and delivered byte comparison for precise slow start exit control

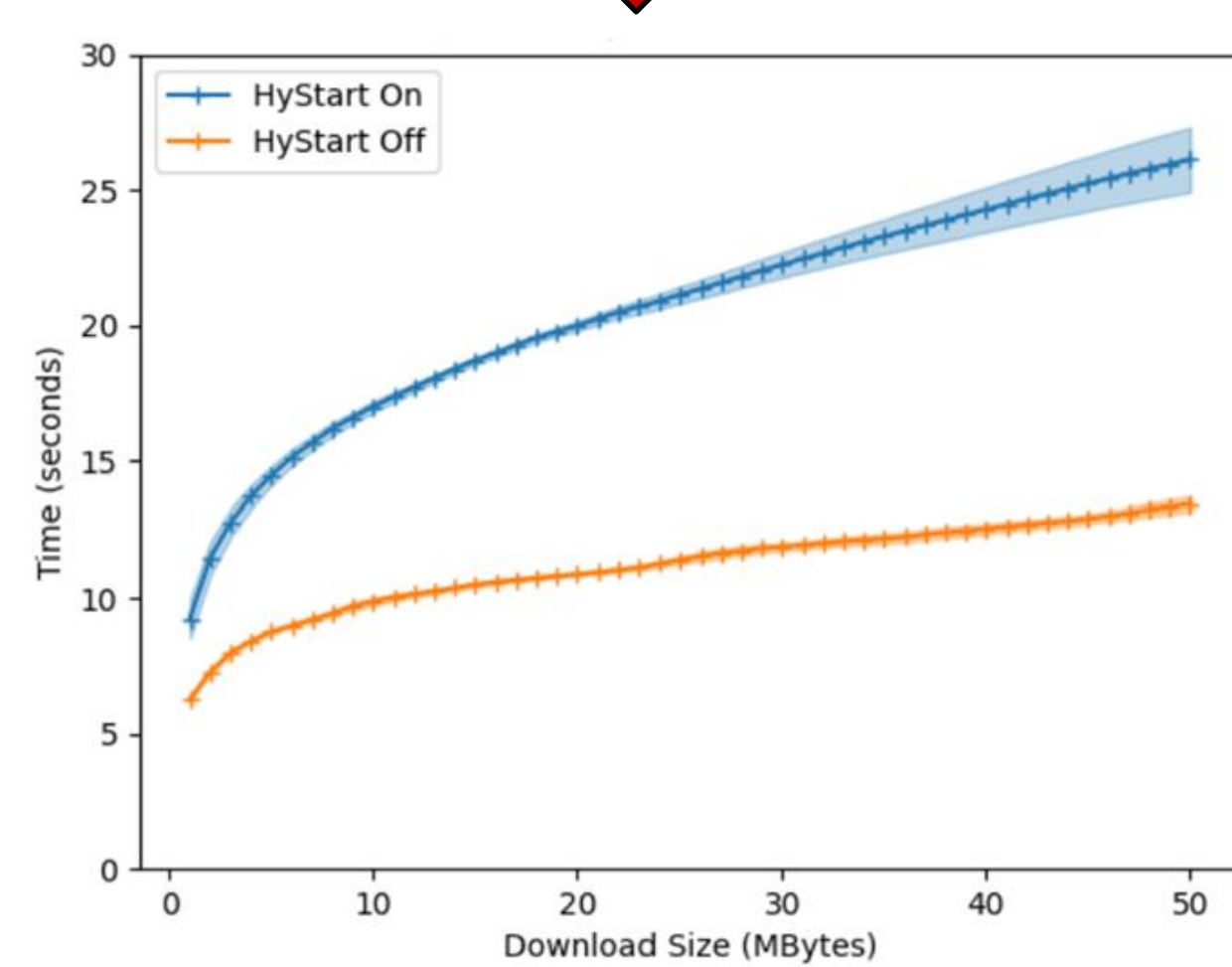
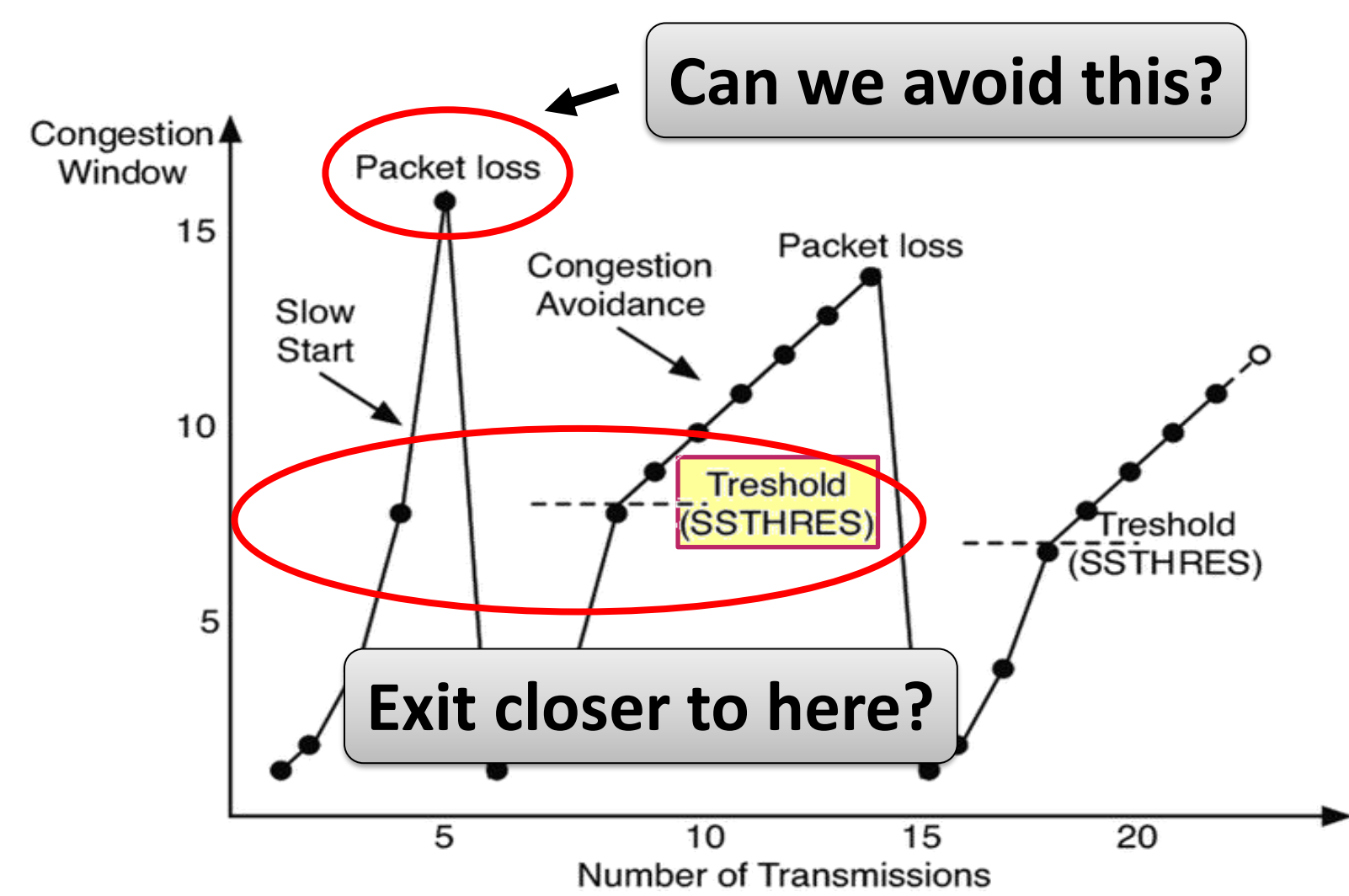
Evaluation: Testing on commercial satellite links, GEO and LEO links

Result: Achieving a high success rate in exit point selection over satellite connections

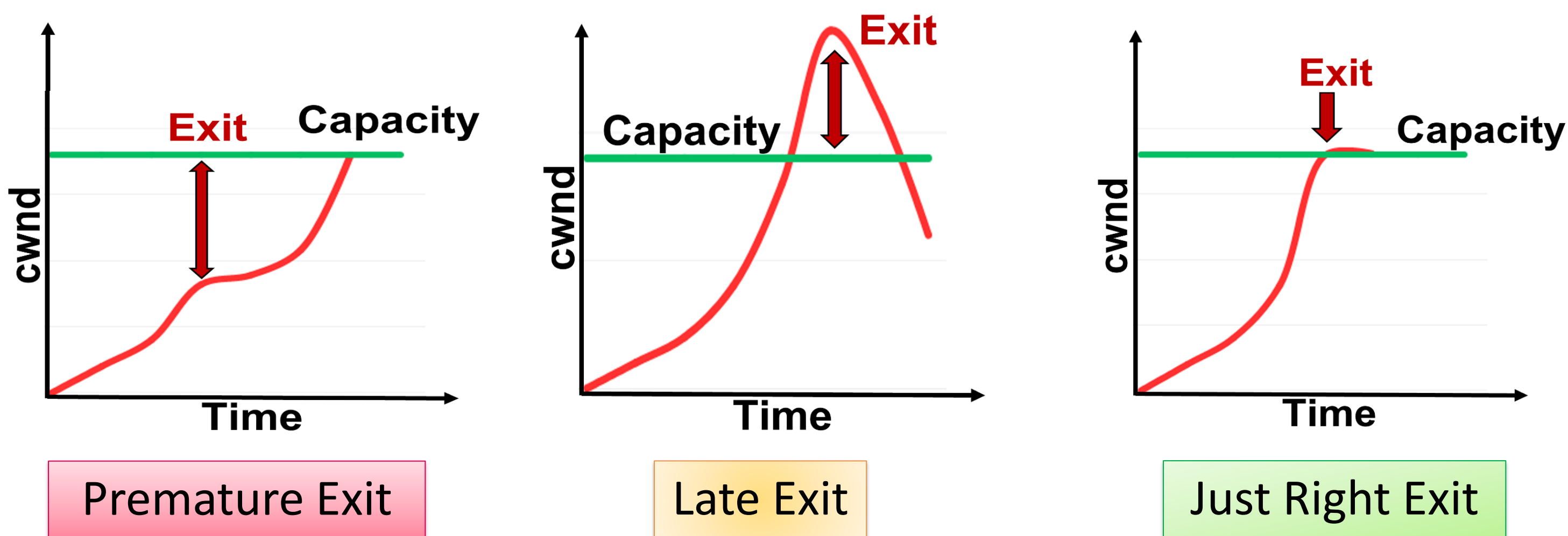
Introduction



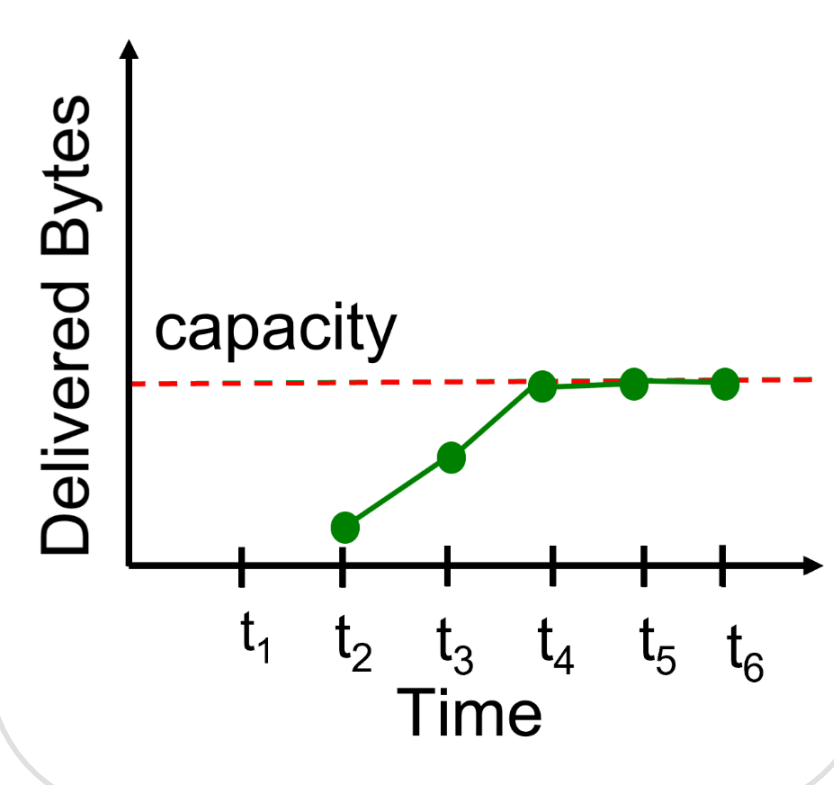
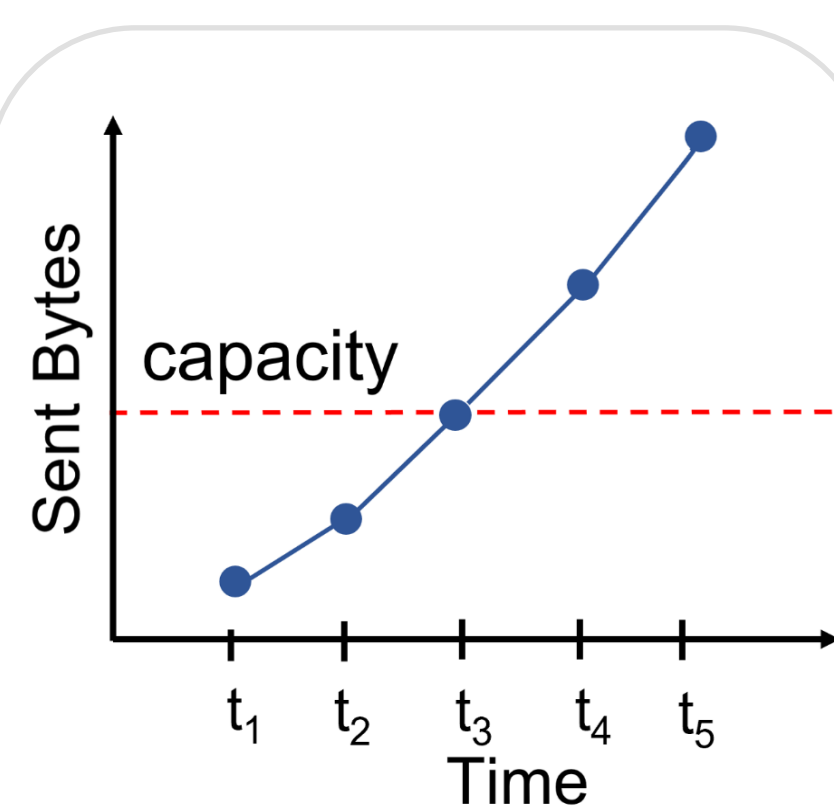
Hystart



Time to download objects of different sizes



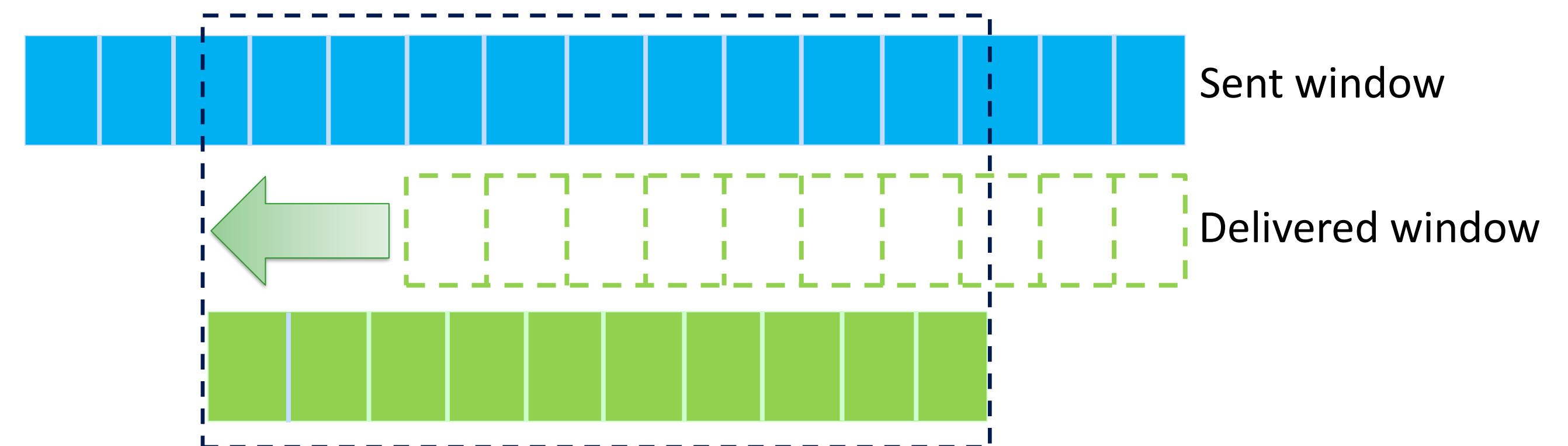
- Sent bytes promptly acknowledged within the next RTT, maintaining synchronization until capacity exceeds
- A significant drop in delivered bytes signals congestion window limit for safe slow start exit.



- Challenge: Variable RTTs on satellite links.
- Scalability: Incremental deployment with server-side implementation and minimal per-flow resources.

Methodology

- Use information of log file
- Monitor the sent and delivered bytes over a large time window, considering RTT variations
- Aggregate data in smaller time bins and combine them to approximate the entire window, minimizing per-packet storage requirements
- Slide window per bin
- Shift back the delivered bytes in time by the current RTT to account for the one-RTT delay in acknowledgment



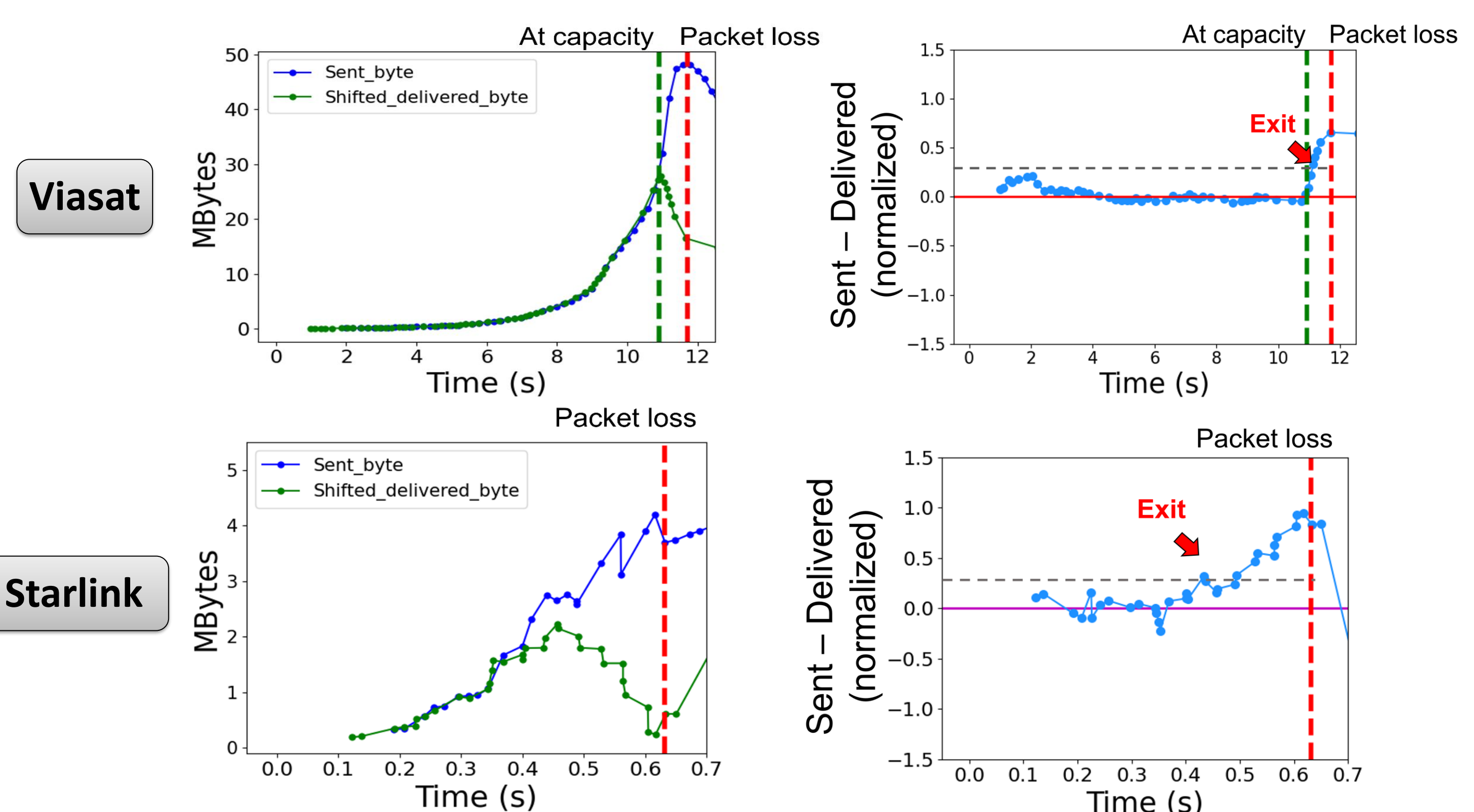
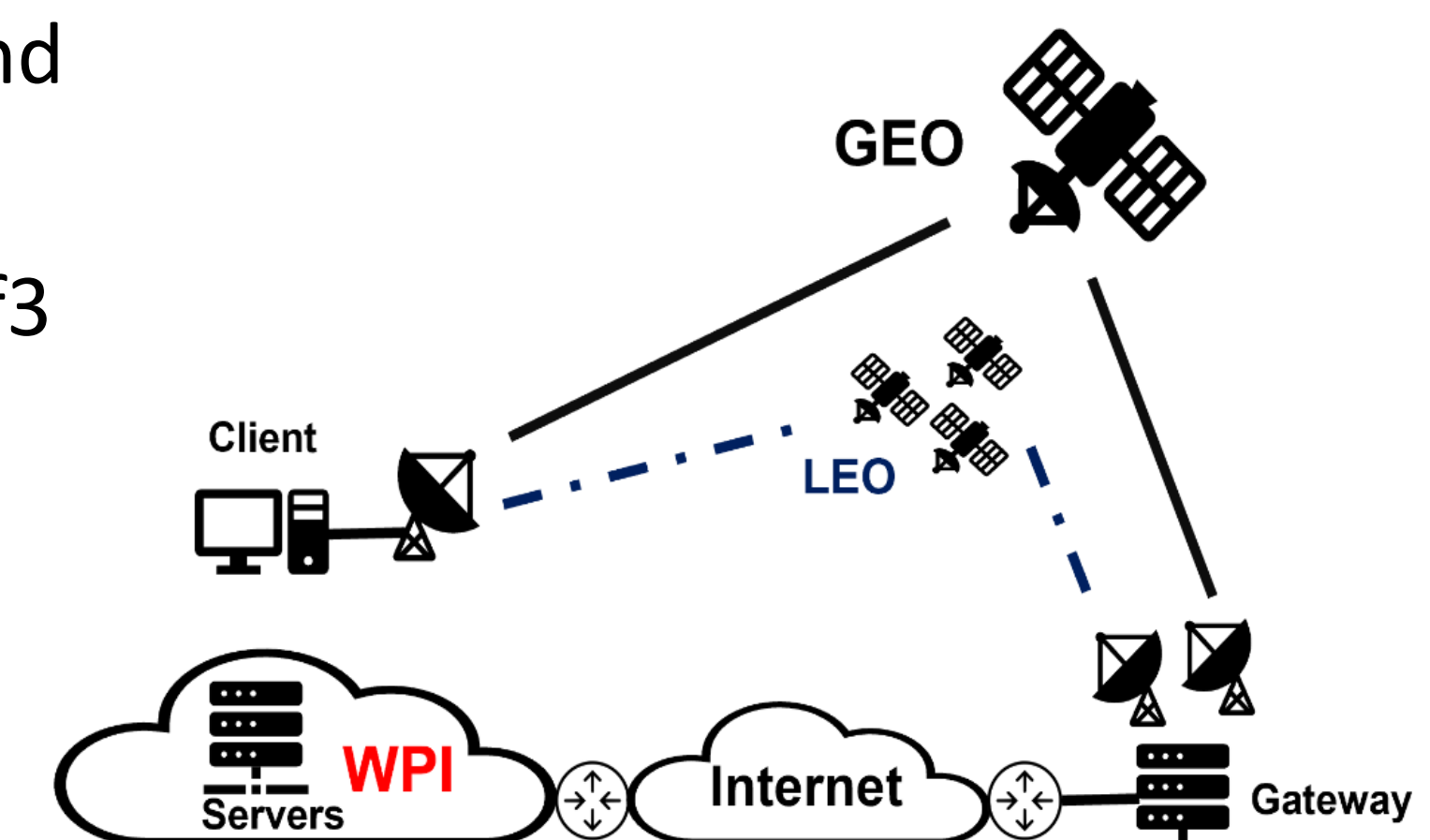
- Calculate and normalize the difference between the total bytes sent in the previous RTT and the total bytes delivered in the current RTT

$$Normalized_difference = \frac{(Sent_byte - Delivered_byte)}{Sent_byte}$$

- Set the ssthresh to the current cwnd, if this normalized difference is greater than the threshold, which causes slow start to exit.

Results

- Evaluate SEARCH over Viasat and Starlink testbeds
- Several bulk downloads using Iperf3
- Select Window size about 3.5RTT
- GEO:2000ms LEO: 200ms
- Select 10 equal-length bins
- Set threshold to 0.25



Link	Runs	JR_exit (%)	cg (s)	ex (s)	dp (s)	hr (s)
GEO	213	64.6	11.0	12.4	18.1	5.7
LEO	131	52.0	0.5	0.6	0.7	0.1

Conclusion and future work

- Hystart on: Exit too early, underutilization
- Hystart off: Exit too late, overshooting, packet loss
- SEARCH: accurately detects a good slow start exit point
- SEARCH is server-side only, and uses a large window to account for link variance and bins to accurately approximate with low overhead
- Future work:
 - Sensitivity analysis of our parameter (window size, bin size, threshold)
 - Using only delivered byte
 - Approximation per packet in last bin



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