# Research Report Summary

## *"Striking a Balance Between Bufferbloat and TCP Queue Oscillation in Satellite Input Buffers"*

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## Summary:

Satellite communication links are generally the only way to provide digital transmissions in remote regions (e.g. Pacific islands). Unfortunately, the long distances between ground stations and orbiting satellites cause the normally-trivial propagation delays to significantly impact network performance. This affects all transmissions across the link, but has a disproportionately large impact on smaller application payloads because each data stream is affected equally by propagation delay (regardless of its size).

This can have a devastating effect on TCP congestion control, which buffers data transmissions in order to reduce network latency. Buffer sizes are determined by the amount of network latency, which TCP measures by analysing acknowledgement packets – a process that becomes less accurate if such packets experience large delays. This isn't normally a problem because the packets are very small, but the large propagation delays of satellite links create significant delays that make accurate measurements impossible.

The research performed by Speidel and Quan revealed that this problem can be by addressed by using smaller input buffer sizes, with the size reduction being proportionate to the number of large data streams across the link. This preemptive approach of managing buffer size significantly reduces queueing delays, by reducing the maximum buffer sojourn time and instead relying on packets to be retransmitted. This prevents large data streams from filling up the buffer (thereby blocking other streams), and instead provides each stream with an equal (albeit reduced) likelihood of its packets entering the buffer.

## Key Points:

1.) TCP uses dynamic buffers to regulate traffic across network links. Larger buffers prevent packet loss on congested networks, but can cause inconsistent network performance on slower links.

2.) Satellite communication links experience higher latencies due to large propagation delays. This has a disproportionately large effect on the smaller, high-volume data packets used to manage TCP buffers.

3.) Queue management algorithms used on satellite links should reduce their typical buffer sizes based on the number of large data streams across the link. This prevents such streams from selfishly filling input buffers, thereby enabling fairer use of network bandwidth.

## Questions:

1.) Will this buffer management technique become obsolete when Low-Earth Orbit (LEO) satellite communication links become common?

2.) Why does this problem not occur on very long cable links with large transmission delays?

3.) How does this technique compare to the process of actively rationing buffer space for data streams?