Real-time Link Intelligence

Automatically Track Link Bandwidth and Quality

INTRODUCTION

Networks and wireless links have evolved to become much more dynamic. Beam switching, Adaptive Coding and Modulation (ACM), Satellite handover (LEO/MEO) and changing traffic patterns all drive the need for dynamic and adaptive QoS to deliver on application performance and SLAs.

XipOS real-time Link Intelligence is a capability within XipLink's Multi-Orbit SD-WAN feature set, supporting automatic adaptation of the entire Quality of Service framework to dynamic and reconfigurable network topologies.

Real-time Link Intelligence quickly adapts to bandwidth increases and capacity reductions. Key link metrics such as bandwidth, latency and quality are used to implement rate control and manage buffer bloat, thereby delivering enhanced QoE.

Capabilities

- Monitors links for quality in real-time – bandwidth, link goodput, queuing delay (each direction), loss percentage
- Dynamically adjusts the entire QoS to match changing link rates
- Ensures links are not overdriven, to deliver SLA compliance
- Automatically learns link parameters in real-time
- Actively monitors & manages system latency to control buffer bloat
- Ideal for links with varying bandwidth like LEO or ACM based networks

OPTIMIZING MULTI-ORBIT SD-WAN LINKS

XipLink's real-time Link Intelligence feature helps overcome challenges often encountered with link technologies in today's increasingly software-defined wide area networks, when the available bandwidth and link characteristics have become highly dynamic and reconfigurable.

Some typical examples of factors that can affect the available bandwidth and link characteristics are:

- Satellite handover in LEO or MEO networks
- Beam switching to support mobility, such as maritime applications
- Adaptive Coding and Modulation for higher frequencies
- Signal strength, noise and interference
- Load and network congestion causing available capacity to change
- Terminal/modem configuration
- Throttling by network operators

KEY BENEFITS

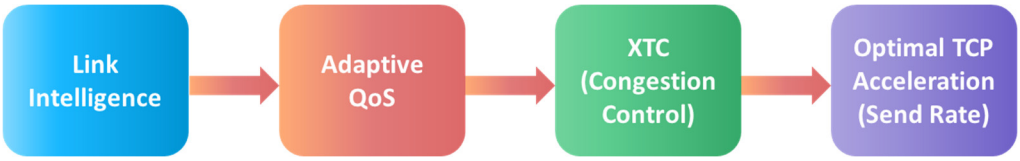
- Automatic, for reduced OPEX
- Saves time, money & resources
- Controls latency for better QoE
- More capacity for faster speed
- Higher network availability

HOW IT WORKS

The real-time Link Intelligence feature automatically discovers the available bandwidth and measures the quality of a link. Working in conjunction with XipLink's proven Adaptive QoS, Traffic Steering and XipLink Transport Control (XTC) schemes, it ensures optimal network performance and utilization. Real-time Link Intelligence will not only show benefits for TCP traffic, but also for non-TCP services.

TCP acceleration relies on network metrics for optimal user experience. The most important metric is the available bandwidth for one or more TCP sessions. The available bandwidth is governed by XipLink's QoS mechanism, which can be changed dynamically on any class while carrying traffic. For optimal performance the maximum transmit rate should be set to the current available bandwidth of a link. Otherwise, a TCP session might not utilize all available bandwidth, or it can cause retransmissions due to overdriving of a link, which would degrade the throughput and end user experience.

The introduction of real-time Link Intelligence allows XipOS to automatically determine the correct maximum sending rate and adjust the Dynamic QoS accordingly. The selected XTC algorithm then functions within the QoS parameters to manage TCP per-session behavior, as illustrated below.



Non-TCP traffic, such as real-time applications like VoIP, perform optimally when network buffering and overall delays are kept to a minimum. The buffering on a link can be managed by adjusting the Dynamic QoS's Max TX value for a non-TCP class. This occurs automatically to minimize buffering and incurred latency when Real-time Link Intelligence is enabled. Additionally, to ensure high priority network services are protected, the QoS must be set at or below the available link bandwidth; Real-time Link Intelligence ensures this relationship is continually enforced.

Even encapsulated TCP, where the network does not see the TCP traffic within other protocols such as IPsec, GRE or GTP, will benefit from real-time Link Intelligence managing the rate at which network equipment and modems receive data. This will allow the inner protocols to perform optimally by ensuring they have the required bandwidth and reduced latency.

Real-time Link Intelligence can leverage user traffic metrics or dedicated probe traffic if necessary, when user traffic is minimal, to determine the available bandwidth and quality of a link. Unidirectional rate, delay and loss metrics provide inputs for the real-time Link Intelligence algorithm, serving as proxies for available bandwidth, all-source latency and BER plus PLR respectively.

The real-time Link Intelligence algorithm is based on a controller mechanism which adjusts the sending rate (Max Tx) of a parent QoS class to maintain measured metrics within the configured range of one or more setpoints. The setpoints that can be configured are as follows:

Delay setpoint (ms): Allowable incurred buffer delay, over and above base propagation delay. This supports adequate buffer space in network equipment to saturate the available link bandwidth, without causing unnecessary over-buffering, added delays or packet loss.

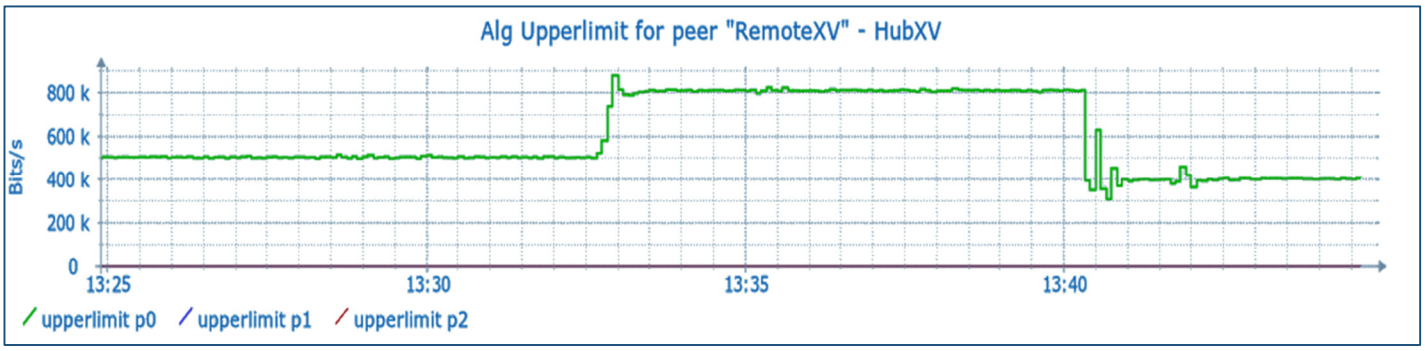
Loss setpoint (%): Percentage of acceptable packet loss on the link, which can be due to inadequate buffer space on network equipment or corruption due to a non-negligible bit error rate.

Note that the algorithm will control the uplink and downlink separately using one-way metrics. The above description is for a specific direction, for example remote site to hub site or vice versa.

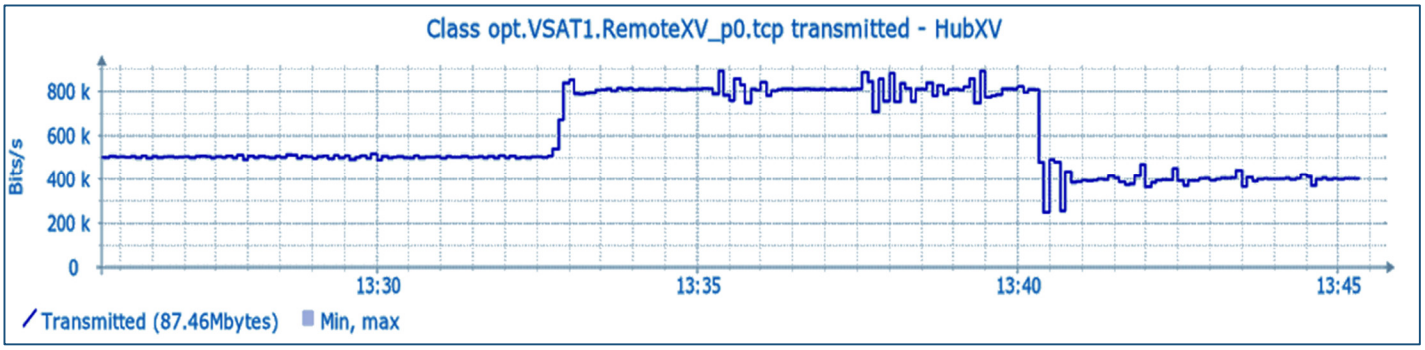
REAL-TIME LINK INTELLIGENCE IN PRACTICE

Below is an example of how the maximum transmission rate is adjusted on a variable bandwidth link, based on feedback provided by real-time Link Intelligence.

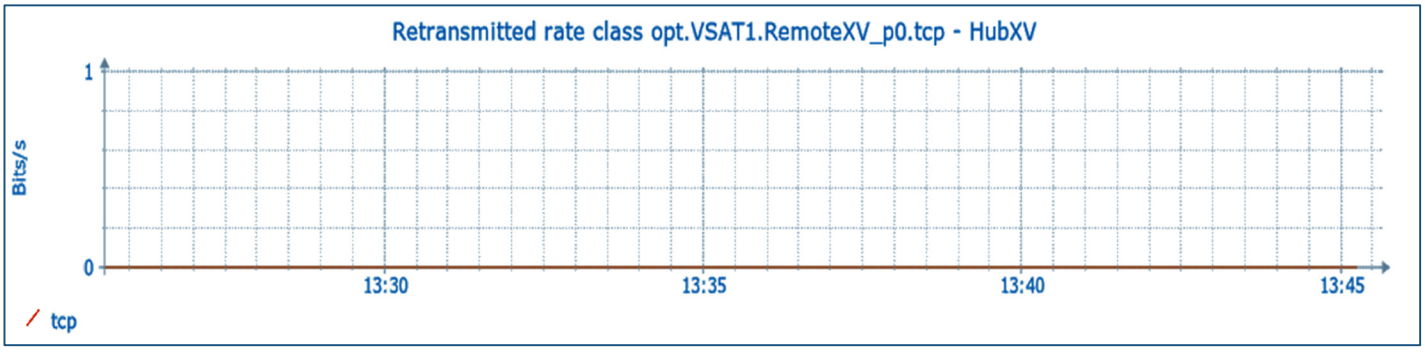
Estimation of available bandwidth: The algorithm discovers a 60% bandwidth increase and makes the capacity available to traffic within 15 seconds, while adapting to a 50% capacity reduction virtually instantaneously.



Traffic transmitted onto the link: Transmitted traffic very closely tracks the estimated capacity of the wireless link.



No retransmissions are observed: When the estimated bandwidth changes there are no retransmissions due to how the well-integrated TCP acceleration is seamlessly adjusted in concert with the overall QoS (as described earlier):



Please note:

- Real-time Link Intelligence supports both point-to-point links as well as star topologies and relies on XipLink's Lightweight Tunnel (LWT) technology. XipLink's LWT is available in all fully featured XA and XV products.
- Modem buffer configurations are important and should be configured according to at least the Bandwidth Delay Product (BDP) of a link for best performance and results.