Link Balancing, Bonding & Steering at Scale for Hybrid Networks

Increase capacity, availability and control, with intelligent software-defined WANs

INTRODUCTION

Voice, data and video traffic continue to grow at a rapid pace across all satellite and wireless networks, driven by insatiable consumer and business demand to access networked and cloud-based services. Satellite service providers are challenged to meet these growth demands, especially when it comes to procuring satellite capacity. The challenge is three-fold: a lack of available bandwidth, fragmented frequency allocations, and relatively high cost for satellite bandwidth. Additionally, there are inherent limitations associated with VSAT equipment to support ever-higher throughput rates due to limited packet-per-second (PPS) processing capacities, antenna size restrictions, RF power maximums, and concurrent TCP session counts.

XipLink enables service providers to leverage existing infrastructure investments for generation of additional revenue, through incremental system capacity expansion, using additional links and diverse link types in combination to build hybrid networks.

LINK BALANCING & BONDING

Combining multiple links for scale and resiliency.

To support increasing demand for capacity, creative solutions are being implemented in order to boost performance within this constrained environment. Link Balancing and Bonding (LBB) — an operationally proven XipLink technology — helps overcome these constraints by aggregating up to 24 WAN links for additional bandwidth, while simultaneously providing traffic optimization benefits such as header/payload compression and Internet enhancements to exceed the aggregated baseline bandwidth.

Link balancing enhances bandwidth aggregation by allocating individual TCP sessions or UDP streams to the most appropriate link so as to proportionally load each link and thereby provide a consistent user experience for all users on all available links. Links in these deployments can be homogeneous, such as all GEO VSAT links, or heterogeneous in hybrid network scenarios.

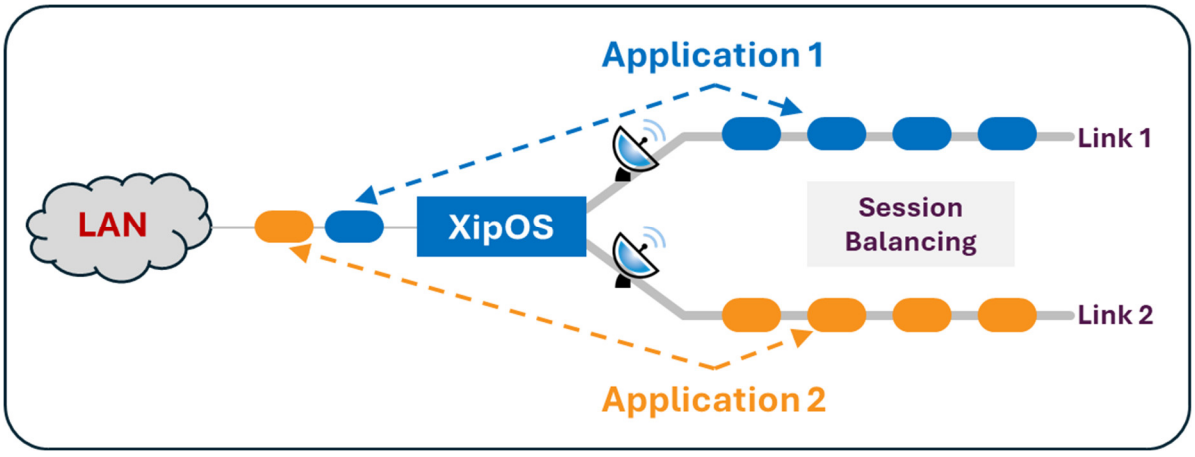


Figure 1: Link balancing, where uplink sessions or streams are assigned to the most available link.

Link bonding allocates any given packet to the least saturated link. When link bonding a single session such as a video conference, the required bandwidth for the stream may exceed the capacity of any one link. The bonding algorithm will therefore allocate packets among the selected links in the bonded group to achieve the desired capacity for the session. The XipLink system ensures proper packet sequencing on the receiving end for the bonded links.

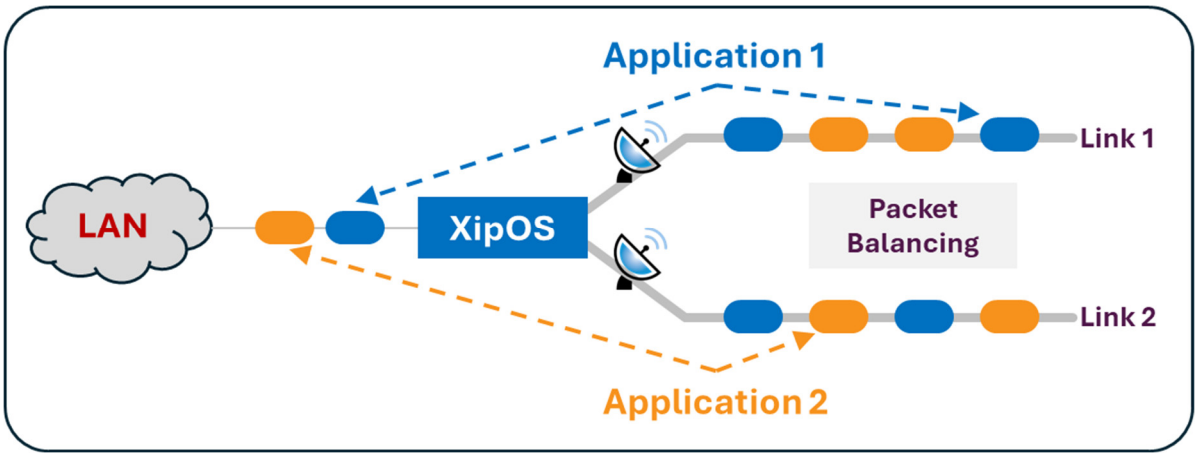


Figure 2: A link bonding, where uplink packets are assigned to the most available link.

Capabilities

- Aggregates up to twenty-four links of any supported topology to achieve more capacity
- Fairly and evenly distributes TCP sessions and UDP streams over these links
- For sessions or streams exceeding a single link's capacity, users can bond multiple links
- Complete recovery and session persistence upon both link failure and link restoration
- Optimizes traffic while simultaneously performing the balancing or bonding function
- Dynamic, automatic rebalancing of existing traffic between links for faster and fairer balancing

Link balancing and bonding of network traffic is transparent to the end user and installs into the network with minimal reconfiguration. XipLink's solution balances traffic flows using session information found in network and transport protocols (TCP and UDP), thus requiring no topology changes from the customer. Link balancing algorithms use intelligent selection criteria to assign — and when necessary reassign — TCP sessions or UDP streams to links based on quality and capacity. For bonding deployments, the solution balances traffic on a packet-by-packet basis while maintaining the intended packet sequencing.

As a link's capacity fluctuates due to changing channel conditions, XipLink's *Real-time Link Intelligence* algorithm tracks link availability, quality, and capacity. XipLink's congestion and rate control algorithms adapt intelligently for each session, and fairness is maintained by moving flows between links within seconds of a change detection. Session migration takes place without any noticeable interruption to the user, and flows maintain the same path whenever possible to maximize prompt, in-order delivery. Thus, link balancing and bonding technology can be used to increase network availability with session persistence, while addressing limitations such as bandwidth availability or scale.

A key market differentiator for XipLink is the ability to automatically redistribute and rebalance existing traffic load dynamically and intelligently, based on current traffic conditions. This ability provides a faster and more accurate load balancing mechanism than relying purely on the establishment rate of new traffic flows to rebalance the traffic across multiple links.

There are several key link balancing and bonding features and benefits as part of XipLink's solution:

Increased Capacity	Combine multiple links into one large bandwidth pool.
Real-time Link Intelligence	Automatically detect changes in link availability, quality, and capacity.
XipOS Optimizations	Benefit from compression techniques, QoS/shaping, TCP Acceleration, Packet Coalescing, and Application Aware classification.
Multiple Link Types	Optimize any IP link - VSAT (GEO, MEO, LEO), 4G/LTE, 5G, Fiber, Microwave, etc.
Smart Session Assignments	Constantly measure the bandwidth of each link and assign flows proportionally. Recovery based on QoS parameters and priority.
Automatic Re-Assignment	Assign flows to the best-performing link, such that both session and overall performance are maximized, but are also re-adjusted as necessary on the fly.
High Availability	Increase availability - fail over from primary link to secondary link - without changes to network address hierarchy, thereby improving recovery time.
Session Persistence	Maintain active TCP sessions upon link switch, or failover to backup link.
Visibility	Generate detailed statistics on the health and performance of each link.
Transparency	Use of LBB is transparent to end-users, like other XipOS technologies.

XIPLINK INTELLIGENT TRAFFIC STEERING

Sophisticated control of traffic and applications in complex hybrid networks

Building upon the powerful foundation of XipLink's LBB technology, Traffic Steering provides the capability to select specific traffic types or applications and differentially steer those across appropriate links, depending upon the status and health of those links. Building upon XipLink's powerful, hierarchical QoS architecture, users can define filter rules based on IP, port, protocol, DSCP, VLAN ID, VLAN priority or combinations of these fields to select specific traffic to be processed. Each such group of selected traffic may be configured with specific steering rules, in addition to the chosen acceleration and optimization policies.

Some examples of the benefits of combining QoS and traffic steering across multiple links are:

- Steering latency-sensitive traffic, such as voice, to lower latency (e.g. LEO) or more reliable links
- Steering lower-priority bulk traffic to lower cost links, such as Ka-band HTS or LEO
- Managing multiple traffic types in hybrid GEO, MEO, and LEO environments
- Offloading overflow traffic during link saturation, such as from terrestrial microwave to satellite
- Managing traffic in mobile environments with transient satellite and wireless link availability

XipLink's Real-time Link Intelligence mechanism for each link in a group, combined with tight integration of XipLink's QoS, XipOS can balance traffic over highly dissimilar links. XipLink's Real-time Link Intelligence is independent of protocol and enables accurate balancing of any traffic type.

Traffic Steering is supported by a new configuration model and user interface. To simplify and streamline configuration, a modular object-oriented approach that models real-world elements has been adopted. Using software defined network (SDN) techniques, physical entities such as links are defined directly in terms of base bandwidths and delay, rather than those parameters being part of the general system configuration. Networks, traffic groups, and optimization policies are also defined in a modular manner with an emphasis on developing custom-selectable elements. Paths between networks, over specific links, for selected traffic, using specified optimization policies, may then be leveraged to define the network. All object types use GUI-based templates and are thus reusable across the configuration, both on a given device and across the entire system or network.

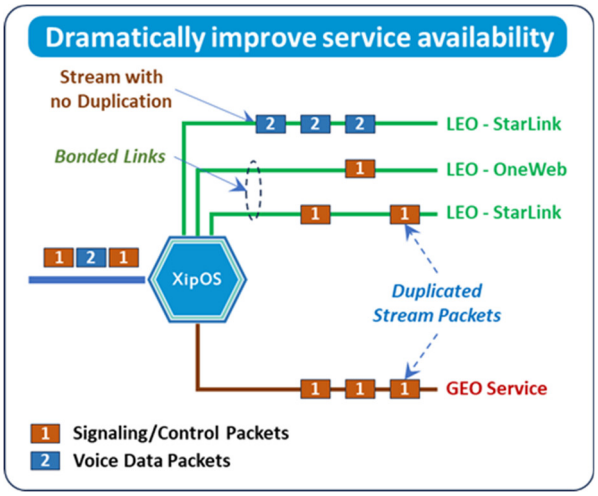
Supporting this new configuration paradigm is a completely refreshed, cleaner, and more responsive user interface of the XipLink Management System (XMS). The user interface allows direct expression and configuration of real-world characteristics,

leading to a more intuitive user experience. Expanded template support and reusability reduces repeat configuration steps and minimizes data entry errors. Changes to configurations are made on a central unit, then are applied to other related units that share a network. For example, a link can be reconfigured from a hub unit, and changes to the configuration will be distributed to related remotes sites in the network without the need to re-enter that same information repeatedly.

XIPLINK SELECTIVE STREAM DUPLICATION

Dramatically increase application reliability - Duplicate specific application/stream across specific links

Many enterprises are deploying multi-orbit networks consisting typically of Low-Earth Orbit (LEO) and Geo-Stationery Earth Orbit (GEO) links. LEO networks provide several advantages, including lower latency, higher speeds, and cost efficiency. However, they also present challenges, such as inconsistent performance due to lossy links and limited Quality of Service (QoS) controls. This inconsistency can disrupt applications requiring a stable connection, such as voice and video communications, often leading to poor service quality and breaches of Service Level Agreements (SLAs).



XipLink's selective stream duplication addresses these challenges by allowing the duplication of any stream across two or more links on an application-by-application basis. This feature is particularly valuable for ensuring the reliability of critical applications like control plane traffic. By duplicating control plane packets, applications such as voice and video can maintain their integrity even in the face of network disruptions. The combination of more robust GEO links with LEO links, when used for duplicating control plane traffic, enhances overall service reliability. As a result, users experience significantly improved service quality and greater assurance of SLA compliance.

Selective stream duplication is a powerful tool for enhancing performance of mission-critical traffic in multi-path network environments, increasing resiliency and availability of critical applications for end users. This functionality is ideal for ensuring resilience of signaling, control plane or high value voice/video real-time applications.

CONCLUSION

Link Balancing, Link Intelligence Traffic Steering, Hybrid multiple hub, multi-gigabit scaling and XMS.

XipLink has been delivering Link Balancing and Bonding (LBB) solutions to the marketplace for a decade, to enable higher availability and scale, while also leveraging the ever-increasing flexibility of hybrid networks. XipLink's LBB supports the steering of sessions/streams (link balancing) or packets (link bonding), and uses Real-time Link Intelligence to automatically and dynamically discover link availability, health, quality, and capacity.

In XipOS 6, the solution evolved from a single, global LBB policy to a user-defined set of Traffic Steering policies applicable to specified Traffic Groups. This delivers fine-grained application-level control over which links are used for what traffic, and under which conditions. Also in XipOS 6, XipLink's new object oriented and centralized configuration paradigm, as well as the XipLink Management System (XMS) unify and simplify all system configuration.

With XipOS 7, XipLink continues the evolution to introduce multiple hub and multi-gigabit scaling for its balancing and steering technology. By introducing hybrid mode, users can benefit from the best of LWT and tunnel-less technologies simultaneously, while a completely tunnel-less configuration can offer a simpler and more transparent network when LWT features are not required. Taking all of these capabilities to the next level, new internal load balancing enables XipLink's balancing and steering to deliver multi-gigabit speeds without requiring the effort, cost, and potential complexity of external load balancing solutions.