Overview

With the advent of High Throughput Satellite (HTS) and ever-growing beam capacities, it is now possible to transmit more than a Gigabit per second over a single satellite beam. However, such large throughput may exceed the individual transmit / receive capacity of the ground-based modem equipment. Further complicating the issue is the use of ACM (Adaptive Coding and Modulation) where a link or links are adjusting their MODCODs (Modulation and Coding) in real-time, thereby dynamically changing the link capacity on a per carrier basis.

Solution: HX Series Dynamic Load Balancing

Solving this issue, Comtech now offers the HX product to its portfolio of WAN Optimization (WANOp) solutions. The HX offers a dynamic traffic load balancing function either flow or packet based. The HX creates a single virtual Layer 2 connection ("trunk"), grooming together multiple individual links or paths between two network end-points while ensuring that packets sequencing remain the same. Such implementation avoids packet re-ordering and enables to operate with parallel paths of different speed and latency at very high throughput rate. It also enables to add Comtech's FX WANOp software function in-line either before or after the load balancer, between the load balancer and the modem (for example: performing load balancing between a terrestrial and satellite link with WANOp, or for scalability purpose).

Typical Users
- HTS Satellite Service Providers
- GEO Satellite Service Providers (transponder bonding)
- Multi-modal Service Providers and ISPs

Common Applications
- Satellite Broadband Internet Backhaul (Maritime, Rural, Mobility)
- 4G/LTE Mobile Backhaul
- Fiber/Terrestrial satellite backup with load-sharing

Below is an example of a High Availability (HA) satellite hub site using two redundant 1+1 HX-5020c load balancers, and FX-5020c or FX-1010c WANOp appliances with end-to-end path redundancy:
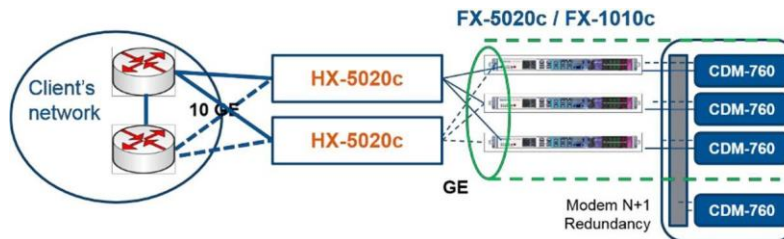
Typical High Bandwidth Satellite ISP Point of Presence (PoP) Implementation

Transponder Fragmentation and Link Bonding

Another issue facing incumbent Satellite Service Providers operating GEO satellites is transponder fragmentation. Today customers require large transponder capacity which is not necessarily available as one piece, though the capacity might be available globally across the operator's satellite. This leaves Satellite Service Providers with stranded capacity and sub-optimal use of their assets. Comtech's HX can solve this problem by aggregating individual smaller pieces of transponder capacity as one virtual transponder link (bonded link), which could even be located across different bands or satellites, thus offering solutions that meet customers demand and leverage unused Satellite Service Provider assets.

Mode of Operation

The HX is designed to operate on high capacity links (backhaul trunks), supporting hundreds of thousands of user flows and multi-gigabit per second capacity. Unlike commonly available load-balancers from the market, the HX may also operate on a packet per packet basis, without any specific flow information (encrypted traffic for example), as well as with a mix of links of various latencies (from a few ms to several 100s ms), and capacity (up to 1 Gbps per link).

The HX may operate with SCPC modems point to point links, as well as with Hub type networks (Comtech HEIGHTS systems)

The HX can be directly connected to the modems, with or without a front-ended Comtech PEP appliance, or with the PEP appliances connected between the load balancer and the modem for each link, thus achieving maximum virtual link capacity.
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The HX load-balancer includes link fault detection and trunk self-healing capabilities: links that are detected not operational (failed connections or too many errors) are automatically removed from the bundle and the traffic is redirected on the other remaining operational links. Meanwhile, the HX continues to probe the link in error and will automatically put back the link into service within the bundle when the defined appropriate conditions are met.

In order to maximize the load balancing accuracy and throughput of each individual links, the load balancer monitors each link in real-time for load and capacity -MODCOD and symbol rate- , allocating new flows based on the link with the maximum capacity available, or, if needed re-balancing established flows. That information is directly collected from the modems, therefore accounting for the effect of ACM on each individual link (critical when operating in Ka or Ku band, which is commonly the case of HTS satellites).

Key Benefits

- Enables to scale satellite links to match the capacity requirement of high throughput / high capacity backhaul links (up to 4 Gbps)
- Compliant operation with PEP appliances providing acceleration and other flow base processing functions
- Can be integrated with Comtech's WANOp solution in one single appliance for sub 1 Gbps bundle aggregate capacity
- 100% Layer2-Layer3 Transparent ("Wire-like" operation): can operate with Layer 2 or Layer 3 "single flow" encrypted traffic;
- Jumbo frames and multiple Layer 2 stacks support (VLANs, MPLS, L2 & L3 VPNs)
- Enable cost effective high capacity asymmetric satellite links with mix of one-way TX and two ways TX/RX carriers
- Enable to share main (terrestrial) and backup (satellite) always-on transmission capacity, for high availability connectivity
- Real-time dynamic traffic load balancing with ACM enabled Comtech EF DATA modems (MODCOD, Symbol rate)
- Plug&play operation - minimal configuration, and no layer 3 IP routing information required
- High Availability platform (power supply redundancy, 1+1 system redundancy, path redundancy)

HX Modes of Operations

The HX load balancer can be implemented in several ways:

- **Link bonding (point to point)** – Delivering one virtual link aggregated capacity up to 4 Gbps (up to 800 Mbps with integrated FX PEP function)

Layer-2 Ethernet Virtual Link with N+1 Redundancy
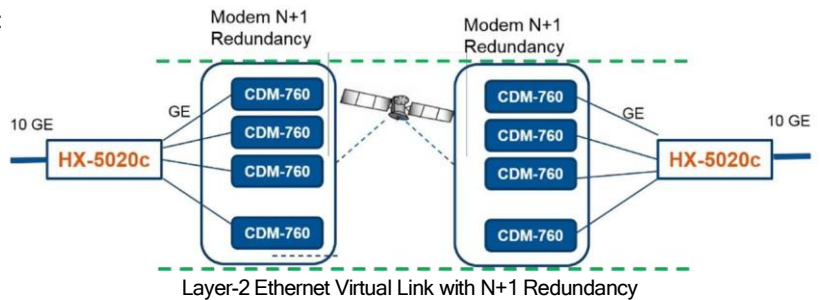
- **Link bonding (point to multipoint) with PEP** – Delivering multiple virtual links aggregated capacity of different capacity, of up to 800 Mbps (Combined HX/PEP function), or 1.5 Gbps with dedicated FX6020c appliance.


Layer-2 Ethernet virtual link
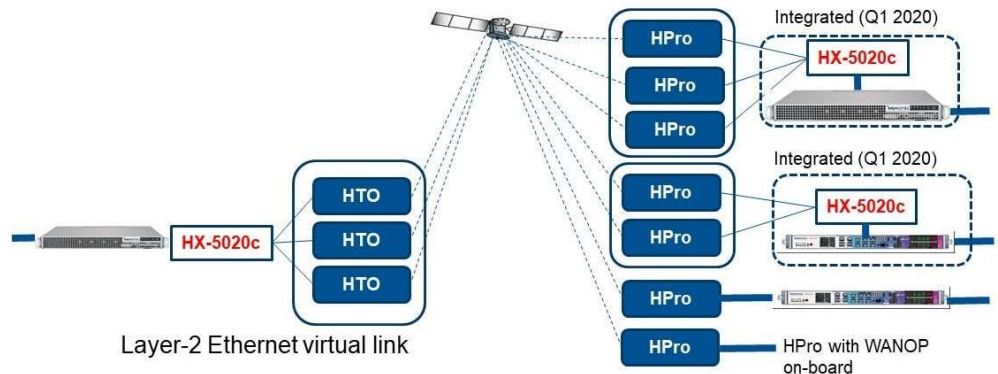
- **Load balancer** (flow based) – In this case, the PEP function (or any other flow processing server function) is located between the load balancer and the WAN, enabling to deliver aggregated link capacity up to 4 Gbps with Comtech PEP function (FX appliance).

Load Balancing with PEP
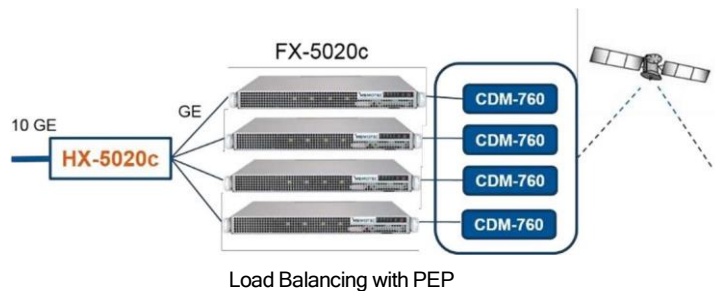
HX Load Balancer Features

- Support up to 12 ports GE load balanced
- GE or 10GE (optical, electrical) LAN connectivity
- Packet based or Per flow session-based (Layer 4) dynamic load balancer
- Support for asymmetric bandwidth (TX/RX), one-way (TX only) and different speed / latency links
- Support for mixed satellite and terrestrial combined link bundle
- Support for point to point and point to multipoint (Hub and Spoke, shared outbound carrier) network topologies
- Support of real-time individual variable link throughput (modem links with ACM)
- Multi-layer 2 and 3 protocols combination Layer 4 session flow load balancing support
  - VLANs (Single VLAN tag)
  - QinQ (two VLAN tags)
  - MPLS (zero [NULL], one or two labels,   per direction)
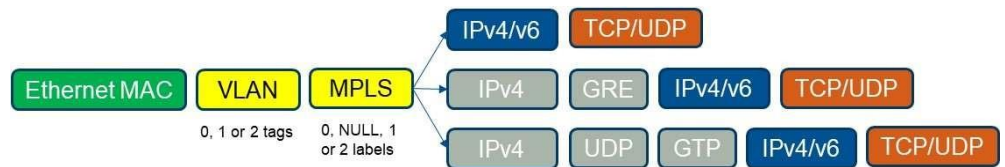
- Full Layer 2-Layer 3 LAN-WAN transparency
- Support of both IPv4 and IPv6 dual stack operation
- Jumbo Ethernet Frame support (up to 9,000 bytes MTU)
- One-touch network operation (No Layer-2 or Layer-3 network information required or configuration)
- Standalone operation or combined with integrated WANOp features (Refer to Memotec FX data sheet)
- Dual path LAN connectivity (for path redundancy)
- Optional 1+1 system redundancy
- Configuration option for single link line bypass (LAN1 to WAN1) - Available for 2 or 6 ports WAN configuration only
- Management and Operation
  - WEB GUI, CLI
  - Simple "one touch" configuration
  - Out-of-band management interface
  - Network Traffic Statistics
  - Comtech NetVue Operation (configuration, supervision)

Specifications

Model	HX-5020c
Form Factor	1RU
Weight	15.5 lbs (7 kg)
Dimensions (h x w x d)	1.7" x 17.2" x 16.9" (43 x 437 x 429 mm)
Nb Ethernet ports	2, 6 or 12 GE RJ45 Balanced Ports Choice of 2x GE RJ45 or 2 SFPs GE/10GE MMF - LAN ports 2 GE RJ45 ports [MGT, AUX]
Path Redundancy (LAN, WAN)	Yes
Rack Mount Kits	Built-in
Traffic processing capacity in Mbps (aggregated TX+RX)	4,000 standalone - 800 with FX WANOp combined features
MTBF at 25C	6.2 years (including hot-swap power supplies)
Power Supply - UL Approved, FCC Compliant	Hot Swap 1+1 AC Power Supplies Auto (100V-240V) Power consumption: 400W max.
Power Supply Safety/EMC Certifications	FCC Part 15 Subpart B Europe/CE Mark ROHS, UL (CA, US)
Environmental	Operating temp 10 - 35°C Storage temp -40 to 70°C Operating relative humidity 8 - 90% (non-condensing)

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