



LIGHTPOINTE™

LIGHTPOINTE WHITE PAPER SERIES

*EtherPACK – Ethernet Lossless
Packet Compression*

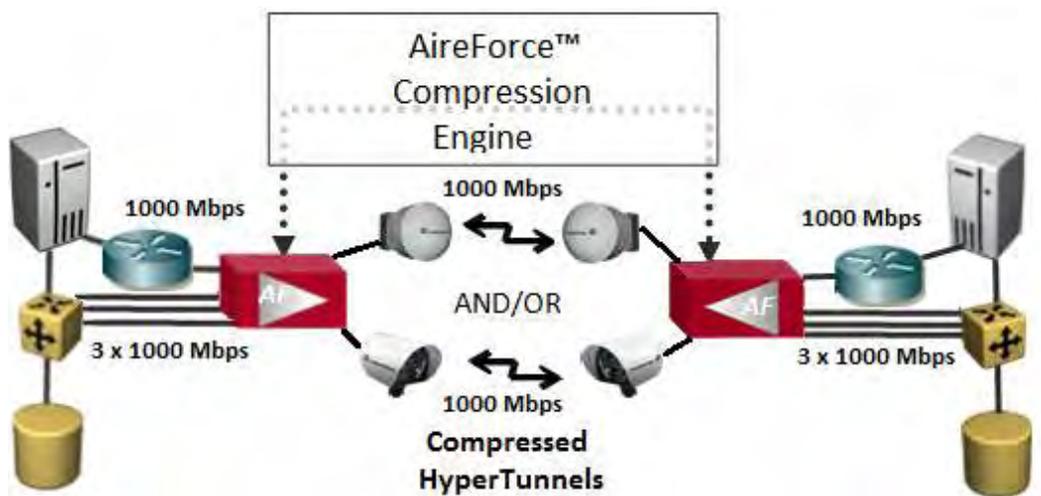


Introduction

AireForce™ EtherPack Compression Technology

Lossless compression technology has been adopted in the storage and computing solutions space for over a decade and applied in almost every form of storage medium (disk, tape, DCs, MP3s, USB, etc.). This technology generally offers a 2x to 4x increase in data storage efficiency and now, with the introduction of EtherPack compression, that same technology can be applied to networking. In the past, before the wide spread adoption of packet based Ethernet technology, most if not all MAN and WAN network connectivity was based on circuit switched technology. Due to issues with synchronous and asynchronous circuit communication compression technology was never widely adopted. It has, however, been used in special telecommunications applications such as facsimiles and modems, or in specialized transport links such as satellite communications for some time.

Ethernet is now a pervasive technology and has evolved from the LAN to the MAN, WAN and SAN. At the same time, Circuit Emulation has emerged as a replacement to traditional time domain based circuit connectivity, and packet switched based Ethernet services are offered to replace private line circuit services. These developments enable networks to leverage compression technology in all types of networking applications.



With the requirement for bandwidth constantly increasing there is a need for higher performance, low latency connectivity between enterprise campus buildings. As more applications evolve toward centrally hosted solutions, Metro Area Network (MAN) Service Providers are experiencing similar needs when trying to connect inner city buildings that are not connected to a MAN fiber network. By using high capacity Gigabit Ethernet optical wireless links based on free-space optics (FSO) technology and millimeter wave (MMW) radio transport solutions in combination with the AireForce high performance, real-time EtherPACK compression technology, transport capacity can be increased dramatically. In the application shown above the AireForce (AF) indoor units are connected to either a LightPointe optical wireless or MMW radio transceiver located at each side of the remote buildings to be interconnected. The network traffic is compressed and/or encrypted in "HyperTUNNELS" that can traverse various network types including IP, MPLS, VPLS, Metro Ethernet or Private Lines. Additionally, the HyperTUNNEL structure is transparent to upper IP/TCP/UDP layers.

EtherPACK - Lossless Ethernet Packet Compression

Interconnecting buildings in enterprise campus environments and/or metropolitan area networks can be a very challenging, time consuming, and expensive project. This is particularly true when bandwidth requirements are high and transmission capacities that require the buildings to be connected to an optical fiber based network. Unfortunately there is still a significant discrepancy between bandwidth requirements and the actual infrastructure in place to connect buildings via a fiber-based infrastructure. For example, in the United States only approximately 14% of all commercial buildings with more than 20 employees are connected to a fiber network. Fortunately, for campus and metropolitan area buildings that are within line-of-sight, there are alternative high capacity wireless solutions that eliminate the need for optical fiber connectivity. Two technologies that are of particular interest when considering Gigabit speed connectivity options are free-space optics and millimeter wave transmission. Both technologies allow for the transmission of full duplex Gigabit Ethernet traffic. LightPointe has a full line of optical wireless and millimeter wave products for line-of-sight, point-to-point Gigabit Ethernet transmission up to several kilometers. For more information visit <http://www.lightpointe.com/products/>

Customers interested in installing a new solution, or upgrading an existing LightPointe optical wireless or millimeter wave system, are now able to increase the over-the-air transmission capacity beyond Gigabit Ethernet levels by using the LightPointe AireForce system. Based on LightPointe EtherPACK technology, the AireForce system performs wire-speed packet data compression that significantly increases the transmission capacity. At the same time, the AireForce system enables application-friendly, ultra low latency performance making it suitable for a wide variety of networking applications including data replication for inter Data Center connectivity and voice trunking. EtherPACK is based on industry standard algorithms adapted for networking.

EtherPACK technology not only significantly increases transport capacity, but also optimizes Ethernet link performance. It has the ability to compress any traffic, for instance, both local area network data traffic and native storage area network block traffic, at wire speed. It performs this action simultaneously on multiple networking ports. The flexible optimization engine ensures extremely low latency, dropped packet immunity and rich statistics/SLA monitoring.

EtherPACK is application agnostic offering transparent packet compression at the Ethernet Layer 2 level and therefore is transparent to upper layers. EtherPACK is the ideal compression technology for network interconnectivity and is implemented independent of the services and applications layer. Often, large data solutions are scaled via a hierarchy of dedicated network devices targeted to specific functions and addressing specific needs such as: “desktop apps”, local area network (LAN), wide area network (WAN) infrastructure, data center infrastructure (LAN/SAN), centralized hosted applications and operations support systems. EtherPACK lossless transparent packet compression offers improved performance for Business and Storage applications running over both LAN (Ethernet) and SAN (Fibre Channel).

A typical compression ratio is 4:1 for each compression engine instance but much higher ratios are possible depending on the type of data. In real life deployments, ratios in excess of 10:1 have been realized. The payload, including protocol headers, is compressed, leading to improved efficiencies. As a result, even already compressed data (such as VoIP) can be further compressed and consequently enable a more efficient use of network resources. The

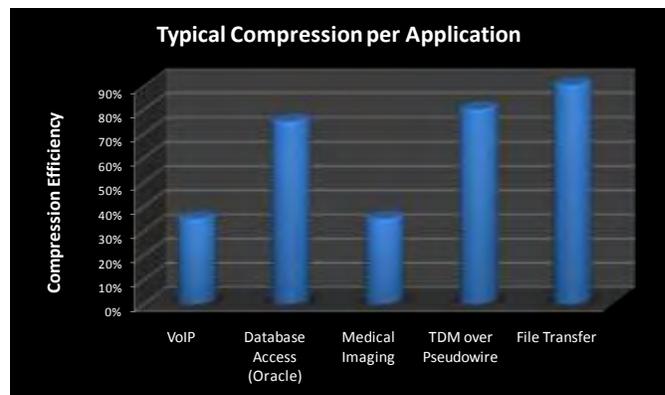


diagram on the right shows some typical measured compression efficiencies, by application.

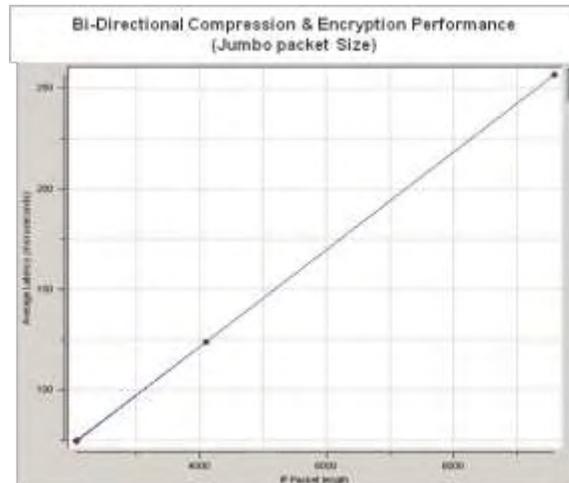
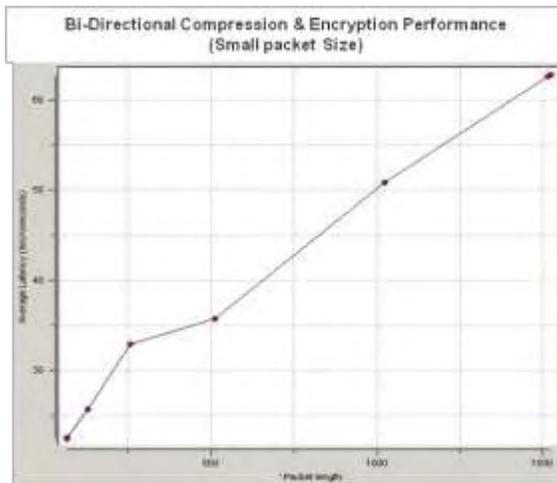
EtherPACK - Technical Description

EtherPACK is based on industry standard ALDC (Adaptive Lossless Data Compression) technology that achieves lossless data compression and can be applied to data at rest (storage) and data in-flight (networking). The ALDC set of algorithms use a data structure called a History Buffer where incoming data is stored and compared to previous data in the same History Buffer. An ALDC encoding process and an ALDC decoding process both initialize this structure to the same known state and update it in an identical fashion. Consequently, these two histories remain identical, so it is not necessary to include history content information within the compressed data stream. Incoming data is entered into the History Buffer. Each incoming byte is compared with all other bytes previously stored in the History Buffer. Compression results from finding sequential matches. At the beginning of the encoding process the History Buffer is empty. The result of not finding any matching bytes in the History Buffer is that the Compressed Data Stream contains only Literals. Bytes are encoded as Literals until a matching sequence of two or more bytes occurs. As the History Buffer fills, it becomes increasingly possible for the encoder to represent incoming data by encoding it as a Copy Pointer for a string already present in this History Buffer. This is the principal mechanism by which ALDC algorithms are able to achieve compression.

The EtherPACK implementation includes a final packet comparison function that compares the compressed frame with the uncompressed frame and if the compressed frame is not shorter, then it sends the original frame. The EtherPACK also includes performance metrics and counts for the “In Compress Frames”, “In Compress Octets” and “Out Compress Octets” which is summarized in “15 Minute Bins” and “24 Hour Bins” including Average and Maximum Compression Ratio as part of the EtherANALYTICS feature set.

EtherPACK latency specification:

EtherPACK technology is implemented in purpose built hardware engines, enabling ultra low latency performance. The figures below show the latency figure for both small and large (Jumbo) packet sizes. Since the AireForce system offers compression (EtherPACK) and encryption (EtherCRYPT), the test results include the latency for both the compression and encryption engines. For small packets of 64 bytes the latency is less than 20 microseconds. For 1522 byte packets the maximum two-way latency is 63 microseconds (31 usec latency for one way). For jumbo 9600 byte packets the maximum two-way latency is 215 microseconds (105 usec latency for one way).



Summary

EtherPACK - Ethernet Lossless Packet Compression - technology has been used extensively in storage applications to improve the efficiency of stored, at rest data at the file, block, and frame level. The LightPointe AireForce system has adapted the same lossless packet compression technology in purpose built hardware engines for networking applications targeting in-flight data to better enable next generation network concepts of cloud computing and data center virtualization. As applications evolve, the need to deliver high capacity, high performance, and low latency connectivity in the campus enterprise and metropolitan area access market will continue to grow. The LightPointe AireForce platform optimizes network performance and secures network traffic through its unique ability to compress (EtherPACK), and encrypt (EtherCRYPT) any traffic type on multiple ports. The flexible optimization engine ensures extremely low latency, dropped packet immunity and rich statistics/SLA monitoring.

About LightPointe

LightPointe was founded in 1998 and has become the global market leader for high capacity wireless outdoor bridges with over 5000 systems deployed in over 60 countries worldwide and in vertical markets such as Health Care, Education, Military & Government networks, large and small campus enterprise networks, Wireline and Wireless Service Provider networks. Over the last 10 years the company has established a unique diversified product portfolio based on high capacity Free Space Optics (FSO) and Millimeter Wave (MMW) technology. With more than 10 patents granted in the FSO, RF/MMW and in the hybrid bridging solution space LightPointe has established a strong IP and patent portfolio position manifesting the company's technology leadership position.

LightPointe has a long list of global customers including but not limited to Wal-Mart, DHL, Sturm Foods, Siemens, Sprint, AOL, FedEx, BMW, Lockheed Martin, Dain Rauscher, Barclays, Nokia, Deutsche Bank, IBM, Corning, Cisco, Huawei just to mentioned a few. For more information please visit the Lightpointe website at www.lightpointe.com