EtherPACK – Ethernet Lossless Packet Compression

Improving network performance of all applications with “Accelerated Secure Ethernet” technologies.
AFORE Accelerated Ethernet Technology

Lossless compression technology has been adopted in storage and compute solutions space for over a decade, applied in almost every form of storage solution (disk, tape, DCs, MP3s, USB, etc.). This technology generally offers 2x to 4x increase in data storage efficiency and now that same compression technology can be applied to networking. In the past most if not all the MAN and WAN network connectivity was based on circuit technology and due to issues of synchronous and asynchronous circuit communication, compression technology was widely never adopted although it has been used in special telecommunications applications such as facsimiles, modems, or specialized transport links such as satellite.

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

As more applications evolve towards centrally hosted solutions, there is a need for higher performance, low latency managed connectivity between locations where data is stored. In the application shown above the ASE to ASE connectivity is a compressed and/or encrypted in “VirtualWIREs” that can inter-work over various network types including IP, MPLS, VPLS, Metro Ethernet or Private Lines and supports rates from 10M to 50M to 1Gbps. The VirtualWIRE is transparent to upper layers (IP/TCP/UDP).
AFORE’s EtherPACK – Ethernet Lossless Packet Compression

EtherPACK is wire-speed packet data compression technology that significantly reduces bandwidth requirements and lowers inter-connectivity costs for metropolitan and wide area networks, while accelerating data transfer performance. At the same time, its implementation as part of AFORE’s Accelerated Secure Ethernet (ASE) technology suite enables application-friendly ultra low and jitter 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.

AFORE’s ASE EtherPACK technology optimizes Ethernet link performance. It has ability to compress (any traffic, for instance, both local area network data traffic and native storage area network block traffic, types at wire speed on multiple ports simultaneously. The flexible optimization engine ensures extremely low latency, dropped packet immunity and rich statistics/SLA monitoring, the key requirements for high performance networking applications.

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 inter connect and is implemented independent of the services and applications layer. Often large data solutions are scaled via a hierarchy of dedicated networking targeted to specific functions addressing specific needs such as: “desk top 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 2:1 for each compression engine instance, though 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 as well as protocol headers, are compressed, leading to more efficient efficiencies. As a result, even already compressed data (such as VoIP) can be further compressed enabling more efficient use of network resources. The figure below 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:

AFORE’s EtherPACK technology is implemented in purpose build hardware engines enabling ultra low latency performance. The figures below show the ASE latency for both small and large (Jumbo) packet sizes. Since the ASE offers compression (EtherPACK) and encryption (EtherSAFE), 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. AFORE 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 many applications evolve to hosted service models, the need to deliver high capacity, high performance, and low latency managed connectivity will continue to grow. AFORE’s Accelerated Secure Ethernet technology and product solutions optimizes network performance. Its ability to compress (EtherPACK), error protect (EtherCORRECT) and encrypt (EtherSAFE) any traffic type on multiple ports at wire speed is unique. The flexible optimization engine ensures extremely low latency, dropped packet immunity and rich statistics/SLA monitoring, the key requirements for high performance networked applications.