Understanding Data Compression

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Introduction

Data compression reduces the size of data frames to be transmitted over a network link. Reducing the size of a frame reduces the time required to transmit the frame across the network. Data compression provides a coding scheme at each end of a transmission link that allows characters to be removed from the frames of data at the sending side of the link and then replaced correctly at the receiving side. Because the condensed frames take up less bandwidth, we can transmit greater volumes at a time.

We refer to the data compression schemes used in internetworking devices as lossless compression algorithms. These schemes reproduce the original bit streams exactly, with no degradation or loss. This feature is required by routers and other devices to transport data across the network. The two most commonly used compression algorithms on internetworking devices are the Stacker compression and the Predictor data compression algorithms.

Before You Begin

Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

Prerequisites

There are no specific prerequisites for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Data Compression

Data compression can be broadly classifed into Hardware and Software compressions. Furthermore Software compression can be of two types, CPU−intensive or Memory−intensive.

Stacker Compression

Stacker compression is based on the Lempel−Ziv compression algorithm. The Stacker algorithm uses an encoded dictionary that replaces a continuous stream of characters with codes. This stores the symbols represented by the codes in memory in a dictionary−style list. Because the relationship between a code and the original symbol varies as the data varies, this approach is more responsive to the variations in the data. This flexibility is particularly important for LAN data, because many different applications can be transmitting over the WAN at any one time. In addition, as the data varies, the dictionary changes to accommodate and adapt to the varying needs of the traffic. Stacker compression is more CPU−intensive and less memory−intensive.

To configure Stacker compression, issue the command **compress stac** from the interface configuration mode. For more details, refer to the Command Lookup Tool .

Predictor Compression

The Predictor compression algorithm tries to predict the next sequence of characters in a data stream by using an index to look up a sequence in the compression dictionary. It then examines the next sequence in the data stream to see if it matches. If it does, that sequence replaces the looked−up sequence in the dictionary. If there is no match, the algorithm locates the next character sequence in the index and the process begins again. The index updates itself by hashing a few of the most recent character sequences from the input stream. No time is spent trying to compress already compressed data. The compression ratio obtained using predictor is not as good as other compression algorithms, but it remains one of the fastest algorithms available. Predictor is more memory−intensive and less CPU−intensive.

To configure Predictor compression, issue the command **compress predictor** from the interface configuration mode. For more details, refer to the Command Lookup Tool .

Cisco internetworking devices use the Stacker and Predictor data compression algorithms. The Compression Service Adapter (CSA) only supports the Stacker algorithm. The Stacker method is the most versatile, because it runs on any supported point−to−point layer−2 encapsulation. Predictor only supports PPP and LAPB.

Cisco IOS Data Compression

There are no industry−standard compression specifications, but Cisco IOS® software supports several third−party compression algorithms, including Hi/fn Stac Limpel Zif Stac (LZS), Predictor, and Microsoft Point−to−Point Compression (MPPC). These compress data on a per−connection basis or at the network trunk level.

Compression can take place on an entire−packet, header−only, or payload−only basis. The success of these solutions are easy to measure via compression ratio and platform latency.

Cisco IOS software supports the following data compression products:

- FRF.9, for Frame Relay compression
- Link Access Procedure, Balanced (LAPB) payload compression using using LZS or Predictor High−Level Data Link Control (HDLC) using LZS

- X.25 payload compression of encapsulated traffic
- Point−to−Point Protocol (PPP) using LZS, Predictor, and Microsoft Point−to−Point Compression (MPPC).

However, compression may not always be appropriate, and can be affected by the following things:

- **No Standards**: Although Cisco IOS software supports several compression algorithms, they are proprietary and not necessarily interoperable.

  Note: Both ends of a compression transaction must support the same algorithms.
- **Data Type**: The same compression algorithm yields different compression ratios depending upon the type of data undergoing compression. Certain data types are inherently less compressible than others, which can realize up to a 6:1 compression ratio. Cisco conservatively averages Cisco IOS compression ratios at 2:1.
- **Already Compressed Data**: Trying to compress already compressed data, such as JPEG or MPEG files can take longer then transferring the data without any compression at all.
- **Processor Usage**: Software compression solutions consume valuable processor cycles in the router. Routers must also support other functions such as management, security, and protocol translations; compressing large amounts of data can slow down router performance and cause network latency.

The highest compression ratio is usually reached with highly compressible text files. Compressing data can cause performance degradation because it is software, not hardware compression. While configuring compression, use caution with smaller systems that have less memory and slower CPUs.

Cisco Hardware Compression

Cisco 7000 Platforms

CSA performs hardware−assisted high performance compression for Cisco Internetwork Operating System (Cisco IOSTM) compression services. It is available for all Cisco 7500 series, 7200 series, and RSP7000 equipped 7000 series routers.

CSA provides high performance compression at the central site. It is able to receive multiple compression streams coming from remote Cisco routers using Cisco IOS software−based compression. CSA maximizes router performance by offloading compression algorithms from the central processing engines of the RSP7000, 7200, and 7500, (using distributed compression) allowing them to remain dedicated to routing and other specialized tasks.

When used in the Cisco 7200 Series router, the CSA can offload compression at any interface. If used on the VIP2, it offloads compression at the adjacent port adapter on the same VIP only.

Cisco 3620 and 3640 Platforms

The compression network module dramatically raises the compression bandwidth of the Cisco 3600 series by off−loading the intensive processing that compression requires from the main CPU. It uses a dedicated, optimized co − processor design that supports full−duplex compression and decompression. The compression is at the link layer or Layer 2 and is supported for PPP and Frame Relay.

Low−speed WAN compression can often be supported by the Cisco IOS software executing on the main Cisco 3600 series CPU. For the Cisco 3620, this bandwidth is well below T1/E1 rates and for the Cisco 3640, it approaches T1 rates. However, you cannot achieve these rates if the Cisco 3600 system has other processor−intensive tasks to execute as well. The compression network module off−loads the main CPU so that it can handle other tasks while raising the compression bandwidth on both the Cisco 3620 and the Cisco

3640 to 2 E1 full duplex (2 x 2.048 Mbps full duplex). You can utilizee this bandwidth for a single channel or circuit or spread across as many as 128. Examples range from an E1 or T1 leased line to 128 ISDN B channels or Frame Relay virtual circuits.

Cisco 3660 Platforms

The Data Compression Advanced Integration Module (AIM) for the Cisco 3660 Series uses either of the two available Cisco 3660 internal AIM slots, ensuring that external slots remain available for components such as integrated analog voice/fax, digital voice/fax, ATM, channel service unit/digital service units (CSU/DSUs), analog and digital modems.

Data compression technology maximizes bandwidth and increases WAN link throughput by reducing frame size and thereby allowing more data to be transmitted over a link. While software−based compression capabilities can support fractional T1/E1 rates, hardware based compression off−loads the platform's main processor to deliver even higher levels of throughput. With a compression ratio of up to 4:1, the Data Compression AIM supports 16−Mbps of compressed data throughput without imposing additional traffic latency − enough to keep four T1 or E1 circuits full of compressed data in both directions simultaneously. The Data Compression AIM supports LZS and Microsoft Point−to−Point Compression (MPCC) algorithms.

Cisco 2600 Platforms

The Data Compression AIM for the Cisco 2600 Series uses the Cisco 2600's internal Advanced Integration Module slot, so that external slots remain available for components such as integrated CSU/DSUs, Analog Modems, or Voice/Fax Modules.

The Data Compression AIM supports 8Mbps of compressed data throughput without imposing additional traffic latency, and it supports LZS and Microsoft Point−to−Point Compression (MPCC) algorithms.

Related Information

- **T1/E1 & T3/E3 Technical Support**
- **WAN Compression FAQs**
- **The show compress Command**
- **Compression Service Adapter for Cisco 7000 Series Routers**
- **SA−Comp/1 and SA−Comp/4 Data Compression Service Adapter Installation and Configuration**
- **End−of−Sale Announcement for SA−COMP/1**
- **Technical Support − Cisco Systems**

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