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Lempel–Ziv–Stac

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Lempel–Ziv–Stac (**LZS**, or **Stac compression**) is a [lossless data compression algorithm](#) that uses a combination of the [LZ77](#) sliding-window compression algorithm and fixed [Huffman coding](#). It was originally developed by [Stac Electronics](#) for tape compression,^[1] and subsequently adapted for [hard disk compression](#) and sold as the [Stacker](#) disk compression software. It was later specified as a compression algorithm for various network protocols. LZS is specified in the [Cisco IOS](#) stack.

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Standards

LZS compression is standardised as an INCITS (previously ANSI) standard.^[2]

LZS compression is specified for various Internet protocols:

- [RFC 1967](#) – *PPP LZS-DCP Compression Protocol (LZS-DCP)*
- [RFC 1974](#) – *PPP Stac LZS Compression Protocol*
- [RFC 2395](#) – *IP Payload Compression Using LZS*
- [RFC 3943](#) – *Transport Layer Security (TLS) Protocol Compression Using Lempel-Ziv-Stac (LZS)*

Algorithm

LZS compression and decompression uses an [LZ77](#) type algorithm. It uses the last 2 KB of uncompressed data as a sliding-window dictionary.

An LZS compressor looks for matches between the data to be compressed and the last 2 KB of data. If it finds a match, it encodes an offset/length reference to the dictionary. If no match is found, the next data byte is encoded as a "literal" byte. The compressed data stream ends with an end-marker.

Compressed Data Format

Data is encoded into a stream of variable-bit-width tokens.

Literal byte

A literal byte is encoded as a '0' bit followed by the 8 bits of the byte.

Offset/length reference

An offset/length reference is encoded as a '1' bit followed by the encoded offset, followed by the encoded length. One exceptional encoding is an end marker, described below.

An offset can have a minimum value of 1, maximum value of 2047. A value of 1 refers to the most recent byte in the history buffer, immediately preceding the next data byte to be processed. An offset is encoded as:

- If the offset is less than 128: a '1' bit followed by a 7-bit offset value.
- If the offset is greater than or equal to 128: a '0' bit followed by an 11-bit offset value.

A length is encoded as:

Length	Bit Encoding

2	00
3	01
4	10
5	1100
6	1101
7	1110
8 to 22	1111 xxxx, where xxxx is length - 8
23 to 37	1111 1111 xxxx, where xxxx is length - 23
length > 7	(1111 repeated N times) xxxx, where N is integer result of (length + 7) / 15, and xxxx is length - (N*15 - 7)

End marker [[edit](#)]

An end marker is encoded as the 9-bit token 110000000. Following the end marker, 0 to 7 extra 0 bits are appended as needed, to pad the stream to the next byte boundary.

Patents [[edit](#)]

Stac Electronics' spin-off [Hifn](#) has held several patents for LZS compression.^{[3][4]} These patents had lapsed due to non-payment of fees and attempts to reinstate them in 2007 had failed.

In 1993–94, Stac Electronics successfully [sued](#) Microsoft for infringement of LZS patents in the [DoubleSpace](#) disk compression program included with [MS-DOS 6.0](#).^[5]

See also [[edit](#)]

- [LZ77](#)
- [MPPC](#)

References [[edit](#)]

- ↑ [Stac Electronics](#)
- ↑ INCITS/ANSI X3.241-1994 - *Data Compression Method – Adaptive Coding with Sliding Window for Information Interchange*
- ↑ Friend, Robert C. "Hifn's Statement about IPR claimed in draft-friend-tls-lzs-compression, RFC1967, RFC1974, RFC2118, RFC2395, and RFC3078" ↗. Retrieved 21 July 2010.
- ↑ Friend, Robert. "Hifn's Statement on IPR Claimed in LZS and MPPC compression algorithms" ↗. Retrieved 21 July 2010.
- ↑ [Complaint for patent infringement and Demand for jury trial](#) ↗ by Stac Electronics v Microsoft Corporation

v · t · e	Data compression methods		[hide]
Lossless	Entropy type	Unary · Arithmetic · Golomb · Huffman (Adaptive · Canonical · Modified) · Range · Shannon · Shannon–Fano · Shannon–Fano–Elias · Tunstall · Universal (Exp-Golomb · Fibonacci · Gamma · Levenshtein)	
	Dictionary type	Byte pair encoding · DEFLATE · Lempel–Ziv (LZ77 / LZ78 (LZ1 / LZ2) · LZJB · LZMA · LZO · LZRW · LZS · LZSS · LZW · LZWL · LZX · LZ4 · Statistical)	
	Other types	BWT · CTW · Delta · DMC · MTF · PAQ · PPM · RLE	
Audio	Concepts	Bit rate (average (ABR) · constant (CBR) · variable (VBR)) · Companding · Convolution · Dynamic range · Latency · Nyquist–Shannon theorem · Sampling · Sound quality · Speech coding · Sub-band coding	
	Codec parts	A-law · μ-law · ACELP · ADPCM · CELP · DPCM · Fourier transform · LPC (LAR · LSP) · MDCT · Psychoacoustic model · WLPc	
Image	Concepts	Chroma subsampling · Coding tree unit · Color space · Compression artifact · Image resolution · Macroblock · Pixel · PSNR · Quantization · Standard test image	
	Methods	Chain code · DCT · EZW · Fractal · KLT · LP · RLE · SPIHT · Wavelet	
Video	Concepts	Bit rate (average (ABR) · constant (CBR) · variable (VBR)) · Display resolution · Frame · Frame rate · Frame types · Interlace · Video characteristics · Video quality	
	Codec parts	Lapped transform · DCT · Deblocking filter · Motion compensation	
Theory	Entropy · Kolmogorov complexity · Lossy · Quantization · Rate–distortion · Redundancy · Timeline of information theory		

Categories: [Lossless compression algorithms](#)

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