Autosophy: an alternative vision for satellite communication, compression, and archiving

Klaus Holtz, Eric Holtz, Diana Kalienky at Autosophy
602 Mason #305, San Francisco, CA, 94108, holtzk@autosophy.com, www.autosophy.com

ABSTRACT

Satellite communication and archiving systems are now designed according to an outdated Shannon information theory where all data is transmitted in meaningless bit streams. Video bit rates, for example, are determined by screen size, color resolution, and scanning rates. The video "content" is irrelevant so that totally random images require the same bit rates as blank images. An alternative system design, based on the newer Autosophy information theory, is now evolving, which transmits data "contend" or "meaning" in a universally compatible 64bit format. This would allow mixing all multimedia transmissions in the Internet's packet stream. The new systems design uses self-assembling data structures, which grow like data crystals or data trees in electronic memories, for both communication and archiving. The advantages for satellite communication and archiving may include: very high lossless image and video compression, unbreakable encryption, resistance to transmission errors, universally compatible data formats, self-organizing error-proof mass memories, immunity to the Internet's Quality of Service problems, and error-proof secure communication protocols. Legacy data transmission formats can be converted by simple software patches or integrated chipsets to be forwarded through any media - satellites, radio, Internet, cable - without needing to be reformatted. This may result in orders of magnitude improvements for all communication and archiving systems.

Keywords: Satellite communication, Autosophy, Information theory, Self-learning data networks, Error-proof memory, Universal data formats, Mixed multimedia, Quality of Service (QoS), data compression, encryption.

INTRODUCTION

The great visionary and science fiction writer Arthur C. Clarke first published the idea of satellite communication in 1945 (Wireless World Magazine: "Extra-terrestrial Relays"). He later described an advanced version of an Internet-like archive as a "virtual department store" (Rendezvous with Rama). Both ideas have now become essential technologies for modern society. His most famous vision, however, was the talking, self-learning, self-aware computer HAL (2001 A Space Odyssey), which was bragging that no 9000 computer had ever failed or supplied erroneous information. Arthur Clarke's vision of self-assembling and self-replicating data networks was amazingly accurate. He wrote: "In the 1980's Minsky and Good had shown how neural networks could be generated automatically self-replicated in accordance with any arbitrary learning program. Artificial brains could be grown by a process strikingly analogous to the development of a human brain. In any given case, the precise details would never be known, and even if they were, they would be millions of times too complex for human understanding". Why don't we have HAL like computers by now? Do we lack the knowledge, the hardware, or just the will to build such systems? On April 15, 1977 Klaus Holtz published a paper "Here comes the brain-like, self-learning, no-programming, computer of the future" at THE FIRST WEST COAST COMPUTER FAIRE in San Francisco. A patent 4,366,551 for self-learning networks was filed in 1975. Both publications already described several self-learning data networks based on a newly evolving "Autosophy" information theory. This means, that in the early 1970's we had a choice of two paradigms, the programmed data processing computer or self-learning brain-like machines. Unfortunately, we chose the wrong path to develop faster and faster computer, with ever more complex software and operating systems, instead of brain-like self-organizing and failure-proof systems. It may be difficult to accept that our entire communications infrastructure and the programmed data processing computer are based on a wrong (Shannon) information theory that evolved from primitive telegraphy and computer communications. It is still being taught at our universities, though no known biological creature communicates this way. Correcting that mistake may cause a true renaissance in both communication and archiving.

A new "Autosophy" theory has meanwhile slowly evolved during the last 30 years and is now ready to replace all multimedia communications and the programmed data processing computer. This will have a profound impact on satellite communications, data archiving, and all other forms of communication. Both the theoretical knowledge and the required hardware are now becoming available for a next generation of self-learning, self-organizing, and failure-proof "Autosopher". From there it may be only small steps towards self-learning intelligent robots, like HAL, and eventually to true Artificial Intelligence. This may provide enormous commercial opportunities.

Satellite Data Compression, Communications, and Archiving II, edited by Roger W. Heymann, Charles C. Wang, Timothy J. Schmit, Proc. of SPIE Vol. 6300, 63000H, (2006) · 0277-786X/06/$15 · doi: 10.1117/12.674753

WHAT IS "INFORMATION" AND "COMMUNICATION"?

Satellite communication and archiving systems may be designed either according to the conventional Shannon theory or according to the newer Autosophy information theory. This will yield entirely different results and operational features.

Information Theories	Shannon	Autosophy
Input / output data is used as:	Quantities	Addresses
The data is used for:	Arithmetic	Learning
Communication is with:	Meaningless bit streams	Universal 64bit data-content codes
The best transmission media is:	Fixed bandwidth channels	Packet switching Internet
Bit rates are determined by:	Symbol volume (ASCII or pixels)	Data content (motion, complexity)
Most efficient data type is:	Meaningless bits	Perceptible (text, sound, video)
The purpose of information is:	Remove uncertainty	Create knowledge (teaching)
Data compression is always:	Lossy (causing data distortions)	Lossless or perceptibly lossless
Encryption methods:	Pseudo random number generators	Custom hyperspace libraries
Archive data storage is:	Linear	Hyperspace saturating
Most memory devices are:	Random Addressable Memory RAM	Content addressable CAROM
Memory reliability is:	Single point system failure	Self-healing, failure-proof DECAM
Software is generated by:	Programming	Education (like children)
The scientific methods are:	Equations	Algorithms
Electronic devices are:	Programmed computer	Learning Autosopher (brain-like)
Best system architecture is:	Platform-centric (mainframe)	Network-centric (Internet)

Figure 1. Comparing the conventional Shannon theory with the newer Autosophy theory

SATELLITE COMMUNICATION AND ARCHIVING: A SYSTEMIC PROBLEM

Satellite data communication and archiving is only one of several media, including cable, radio, cellular telephone, or the packet switching Internet. An integrated solution should allow data to be forwarded from media to media without needing to be reformatted. The solutions should be hardware-independent to allow the communication or archiving hardware, such as television screens, to evolve into larger and larger screens with better color resolution and higher scanning rates, without having to change the imaging standards. Most of today's problems with satellite communication, the Internet, and data archiving can be traced to the lingering effects of the outdated Shannon theory. There are many issues to be resolved, where solving one problem should not cause problems with other issues.

A holistic Autosophy system design could address and solve all the following problems at once:

1 Universally compatible Multimedia protocols for all future communication hardware and operating systems.
2 Media-independent data formats for wire, radio, cellular telephone, satellite, and the Internet.
3 Solving the Quality of Service (QoS) problems for real-time data including live video and sound on the Internet.
4 Mixing all data (live video, sound, text, still images, and random bit files) in the Internet's packet stream.
5 Universally compatible hardware-independent data formats that will never become obsolete.
6 Combining sensor data from many sources into a coherent picture.
7 High lossless data and video compression to reduce bandwidth requirements.
8 Disturbing visual effects caused by conventional lossy video compression (JPEG, MPEG, Wavelets, Fractals).
9 Resistance to transmission errors including: lost data, gaps, and jamming, in noisy communications media.
10 Latency effects in video and sound caused by software encoding and decoding delays.
11 Virtually absolute security including: sender authentication, denial of data interception, and detecting deception.
12 Reliability problems: single point failures bringing down a whole communications system or platform.
13 Large volume mixed multimedia data recordings and archiving for later playback.
14 Converting data formats from incompatible legacy applications by software patches or chipsets.

SHANNON VS. AUTOSOPHY COMMUNICATION AND ARCHIVING

Claude Shannon published “A mathematical Theory of Communication,” in 1948, which defined “communication” in binary digits, or bits and bytes. All data (ASCII characters, pixels, or analog samples) are regarded as "quantities," to be converted into binary digits for transmission in meaningless bit streams. This method allows for "lossy" data compression only, where data compression will inevitably cause data distortion or loss of resolution.

This method of communication evolved in an age of primitive telegraphy and computer communications via noisy transmission lines or radio. The theory is still being taught in our universities even though it is obviously not the way biological creatures communicate.

Conventional data processing computers are essentially programmed adding or calculating machines that during the last two centuries evolved from mechanical calculators into electronic computers. However, it has long been realized that our own brains do not behave like calculating machines or computers. Our self-learning, self-organizing brains require no programming or supervision of internal functioning. Processes that are easy for a computer, such as numerical calculations, are very difficult for us. While, on the other hand, learning and pattern recognition, very easy for a human child, is exceedingly difficult for computers. Clearly, computers and our brains work according to entirely different principles. Computers will not evolve towards Artificial Intelligence, only mere simulations.

In 1974 Klaus Holtz developed the Autosophy information theory, in which all data items are regarded as "addresses" to define or create quanta of knowledge, called "engrams," in self-learning hyperspace knowledge libraries. Communication uses address codes, called "tip," each identifying an engram in the receiver's hyperspace library that can represent any amount of data. Information is only that, which is not already known to the receiver and which therefore may creates new knowledge in the receiver's libraries. The purpose of a communication is to create new knowledge in the receiver, in effect to teach it something. That provides very high lossless data compression and unbreakable encryption for satellite communication and all other forms of communication.

The new theory may also lead to a next generation of brain-like, no- programming, and failure-proof archives. The system would behave like a "black box" to organize its own internal operations without human programming or supervision. The operations are based on self-learning hyperspace data networks that grow like data crystals or data trees in special self-organizing and self-repairing memories. There are seven known types of self-learning networks, each implementing a different learning mode. In 1988 a hardware model of a self-learning "Autosopher" text archive was built to verify the theory. While self-learning, brain-like machines have remained in the laboratories, Autosophy data compression algorithms are widely used in virtually all Internet communications, including theV.42bis compression standard in modems, and the gif and tif lossless image compression methods. When self-learning autosopher finally emerge from the laboratories they will have a profound impact on all computing and communication.

A SYNERGY OF SIX AUTOSOPHY INNOVATIONS

Satellite communication and archiving systems require immense, ever growing, bandwidth and storage capacities. Using conventional Shannon technology would require the launching of new satellites, having a limited operating time, and requiring a new slot in the ever more crowded Clarke Orbit. Satellite communication systems should be integrated with the Internet to allow forwarding of data via radio, cellular telephone, or cables, directly by satellite links or through ground stations. Lossless data compression and impenetrable security is no longer an option but a necessity. Communication and archiving systems can be improved by orders of magnitude by converting the systems to the Autosophy theory. This will require some research and development but the effort will be well worth it. All improvements can be made on the ground without requiring the launching of new satellites. The six research-innovation projects, shown below, require different sets of expertise, where each project by itself may greatly improve communication and archiving capability, but the full benefit will be realized only by a synergy of all six innovations.

1 **Autosophy data content communication**. In effect sending only that which is necessary by the receiver to reconstruct the original data without data distortions or loss of resolution.

2 **Self-assembling hyperspace knowledge libraries**. There are seven known classes of self-learning Omni Dimensional Networks, each providing a different learning mode. More networks may be discovered in the future including leaning modes not possible in the human brain.

3 **Perceptible information coding**. Information should be encoded according to what can be perceived by the human sense organs, instead of meaningless bit and bytes arbitrarily determined by the hardware or sensor resolution.

4 **Universal hardware-independent 64bit data formats**. These new codes will greatly improve transmission efficiency and prevent any future data record from becoming incompatible.

5 **Self-organizing failure-proof mass memories**. These memories may be printed on thin stainless steel foil spools to provide immense error-proof hyperspace data storage, at low cost, while consuming very little energy.

6 **Secure communication protocol**. An improved version of the Internet's TCP/IP protocol, using two check codes, may provide universal future communication protocols including unbreakable encryption, sender and receiver identification, and instant detection of intrusion or deception.

AUTOSOPHY DATA "CONTENT" COMMUNICATION

Autosophy communication methods transmit data content or "meaning" in engram address codes, called "tip", where each tip transmission may represent any amount of data. This is in contrast to the conventional Shannon methods where communication is with binary digits, called bit and bytes, transmitted in hardware-determined meaningless bit streams. Autosophy methods can provide very high "lossless" data compression and built-in unbreakable encryption.

Figure 2. Autosophy video content communication

In conventional Shannon video communication each image is scanned, pixel by pixel, and transmitted in meaningless bit streams. The bit rate is determined by the hardware i.e. the number if pixels on the screen, the color resolution (bit/pixel), and the scanning rate (frames/second). The image content is irrelevant so that totally random noise (snow) images require the same bit rate as blank or static video images.

In Autosophy video communication, in contrast, the code rate is determined by the video content (motion and complexity) where totally random noise images would require excessive code rates while static or blank video images would require no transmissions at all. There cannot be any fixed "compression ratio" calculation. Compression is the hardware (the product of the number of pixels on the screen, bit per pixel, and scanning rate) divided by content (motion and complexity), or Shannon bit rates divided by Autosophy code rates. Compression is approximately the colored pixels in the left image divided by the colored pixels in the right image shown in Figure 2.

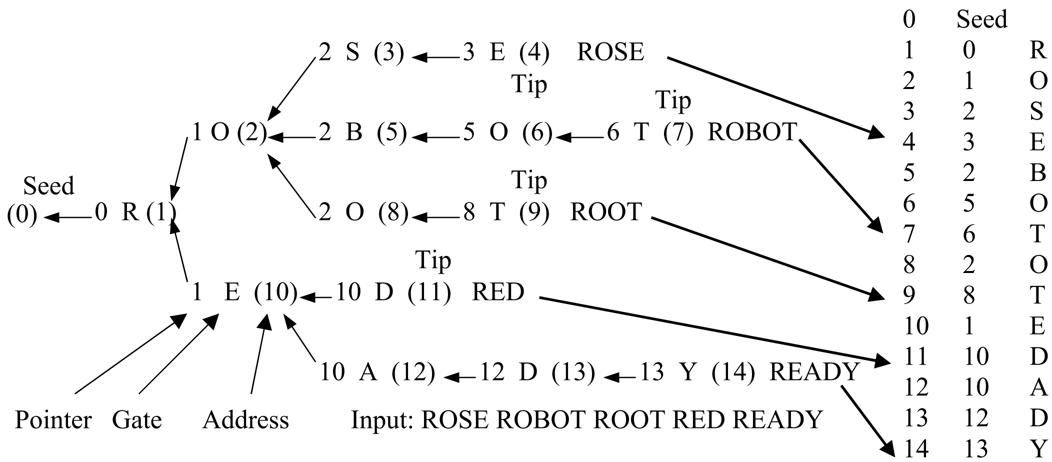
Converting conventional Shannon video to Autosophy video, for satellite communication and archiving, can be done by slow software (about 1 image frame per second) or in real time using integrated chipsets. This is only a temporary solution. Television cameras and monitors will eventually become available, which would generate and accept the universal 64bit codes, to make conversion unnecessary.

Autosophy television requires an image buffer in both transmitter and receiver, which contains the current video frame. A new input video frame, from the television camera, is scanned and compared with the current image frame to detect the pixels whose brightness or color has changed more than a perceptible limit. The newly changed pixels are stored into the image buffer. Non-changing pixels are ignored. The screen location addresses of the changing pixels are accumulated in a change buffer. The encoding process combines the changed pixels into clusters using a fixed hyperspace knowledge library. The output is a universal 64bit code defining a group of changing pixels in a cluster that can be anywhere within the output image frame. The video codes are randomly mixed with other data codes (representing sound, text, or random bit files) for storage or transmission. The receiver retrieves the image cluster from the 64bit code using a duplicate fixed hyperspace library. The changing pixel clusters are used to update small areas in the output image buffer. The output image buffer is then scanned at arbitrary intervals to the output monitor.

The packet rate in Autosophy television depends only on the video content, i.e., motion and complexity in the video images. The video hardware (i.e., the screen size, resolution and scanning rates) becomes irrelevant. This is analogous to human or biological vision. A blank or static video image would require no packet transmissions at all. On the other hand, totally random noise video images (snow) would require excessive packet rates. Most video images are composed of larger areas of mostly equal brightness and color. Also, moving objects in the video usually change many adjacent pixels at the same time instead of changing single pixels. The changing pixels can be combined into cluster (16 pixels per cluster) to combine several changed pixels into a cluster code. Simple, evenly colored video images therefore require fewer packet transmissions, therefore increasing data compression performance. Defensive strategies are used to temporarily reduce the code rates for very rapidly moving video to avoid overloading a limited channel bandwidth.

SELF-ASSEMBLING HYPERSPACE KNOWLEDGE LIBRARIES

Hyperspace knowledge libraries are grown, from sample data files, to provide true mathematical learning. The process can be imagined like the growing of data trees or data crystals in a memory device without human programming or supervision. The knowledge libraries are usually generated by automated software in a computer. This requires sample data such as text files or images. There are seven known classes of self-learning hyperspace libraries, each providing a different learning mode. Only the serial networks, shown in Figure 3, is currently used in commercial applications, such as the V.42bis compression standard in Internet modems or the gif and tif lossless still image compression method. These initial primitive applications can be greatly improved to provide data compression and encryption for all mixed multimedia communication and archiving applications.



<u>SERIAL NETWORK LEARNING ALGORITHM</u>

MATRIX [POINTER] GATE] (The MATRIX is a working register in the hardware)

Start: Set POINTER = Seed (= 0)

Loop: Move the next input character into the GATE

If End Of Sequence (a SPACE character) then output the POINTER as a Tip code; Goto Start

Else search the library for a matching MATRIX

If found then move the library ADDRESS where it was found to the POINTER; Goto Loop

Else, if not found, then store the MATRIX into a next empty library ADDRESS;

Move the library ADDRESS where it was stored into the POINTER: Goto Loop

<u>SERIAL NETWORK RETRIEVAL ALGORITHM</u>

MATRIX [POINTER] GATE]

Start: Move the input Tip code into the POINTER

Loop: Use the POINTER as a library ADDRESS to fetch a next MATRIX from the library

Push the GATE into a First-In-Last-Out (FILO) stack

If the POINTER = Seed (= 0) then pull the output data from the FILO stack; Goto Start

Else Goto Loop

Figure 3. Serial hyperspace library example and algorithm

The serial network, in Fig. 3, provides an example of true mathematical "learning", according to the Autosophy information theory. A new unit of knowledge is created by new information (GATE), related to already established knowledge (POINTER), which may then create a new "engram" (ADDRESS) as an extension to that which is already known. The process can be imagined like the growing of data trees or data crystals. A stored tree network consists of separate nodes, where each ADDRESS represents an engram of knowledge. The library ADDRESS is a mathematical equivalent to a point in omni dimensional hyperspace. The content of each library ADDRESS is unique and can be stored only once. One cannot learn what one already knows. The network starts growing from an arbitrarily pre-selected SEED ADDRESS. Data transmissions use "tip" codes, which are the node ADDRESSES at the final tip of the tree branches. Each transmitted tip ADDRESS code may represent any length data string. The data strings are later retrieved from the tip codes, in reverse order, by following the POINTER trail back to the SEED ADDRESS.

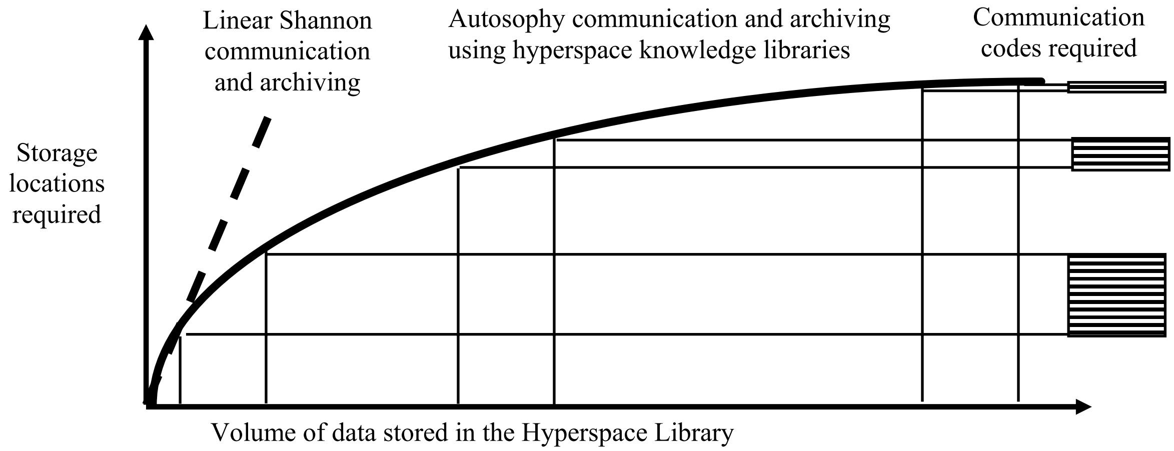


Figure 4. Hyperspace data storage and communication

Hyperspace knowledge libraries can provide both very high lossless data compression and unbreakable encryption for security. Shannon communications and archiving are examples of extreme inefficiency because they lack a library.

In conventional Shannon communication and archiving all data items (text characters or pixels) are treated as quantities to be transmitted in meaningless bit streams or stored in a linear memory device. Transmitting or storing twice as many data items, for example, would require twice as many data bits and twice the storage capacity.

In Autosophy communication and archiving, in contrast, only that which is not already known by the receiver, i.e. that what is not already in the receiver's libraries, needs to be transmitted or stored. A hyperspace library will store every data or image pattern only once, because one cannot learn what one already knows. Already stored data or image patterns will compress the storage of new input patterns. The larger the libraries become the fewer codes need to be transmitted or stored in an archive. The storage requirement in a large library will saturate to increase both communication compression ratios and the storage efficiency in large archives.

Hyperspace libraries for communication are usually grown, from sample data (text samples or images) by an automated software program. The program will extract the most common data patterns, such as text words or imaging pattern using a bubble-sorting algorithm. It will then deliver the output library in a computer file or disc. The library may then be transmitted to all authorized users in encrypted Internet Email files. Only receivers with the correct library will be able to retrieve useful data. Open, non-encrypted, communications can use "generic" libraries, which are pre-grown in a lab, and available either in the software or embedded in the communication hardware devices.

PERCEPTIBLE INFORMATION CODING

The image or video "quality" in conventional communication systems is determined by the "hardware" parameter, such as: the number of pixels on the monitor, the color resolution in bit per pixel, and the scanning rates in frames per second. Any improvement in the hardware parameter is supposed to increase the video "quality" whether or not it is actually perceptible by the human eye. In Autosophy perceptible information coding, in contrast, only that which is actually perceptible by the human eye is being transmitted. Information that cannot be seen or heard by the human receiver simply does not exist and therefore need not be transmitted. Human sense organs have a logarithmic perception profile, where the image or video "quality" is determined by the principle of the "minimum perceptible difference".

A human weightlifter, for example, may test two weights to determine whether they are the same or of different weight. Small weights require small differences in order to be detectible. Larger weights require more differences in weight so that the larger the weight the more difference in weight is required to detect the difference. The same principle is true for our other senses, such as vision and hearing. The brighter a pixel becomes the more difference in brightness is required to detect a change in color or brightness. The louder a sound the more difference in sound intensity is required to detect a difference. Since the purpose of "information" in Autosophy is to "create knowledge" in the receiver any transmission that is not detectible, not seen or heard, by the receiver is useless and need not be transmitted. This can lead to great lossless data compression for practical satellite transmission and archiving systems. "Lossless compression" in Shannon communication means that every data bit must be reproduced. In Autosophy systems "lossless" means that the "difference" to the original data pattern cannot be detected by the intended receiver.

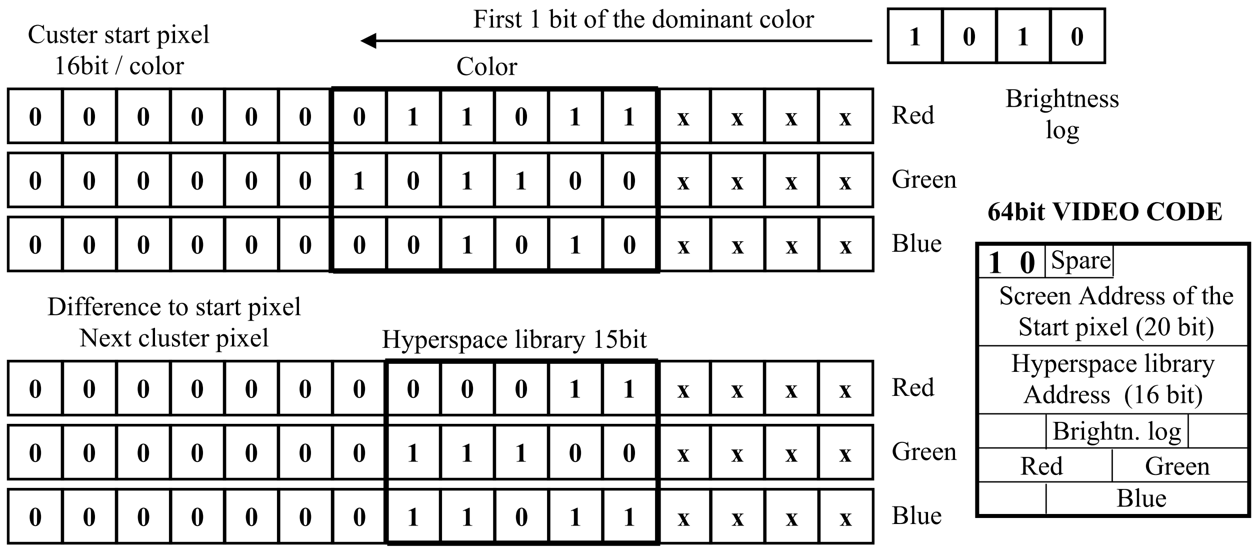


Figure 5. Perceptible lossless video encoding

Autosophy 64bit video codes, shown in Figure 5, may represent a cluster of many pixels at a virtually 16bit/color resolution. Only the changing or moving pixels are encoded for transmission. The overall brightness of a cluster start pixel is determined by its dominant color. The 6bit per color portion of the start pixel ignores all brightness values of less than 1% because they are not visible to the eye. The difference in color of adjacent pixels are then scanned and encoded into up to 16 pixels per cluster using a hyperspace library of the most often encountered patterns. The result is very high visually lossless compression, which may actually improve the observed image or video quality.

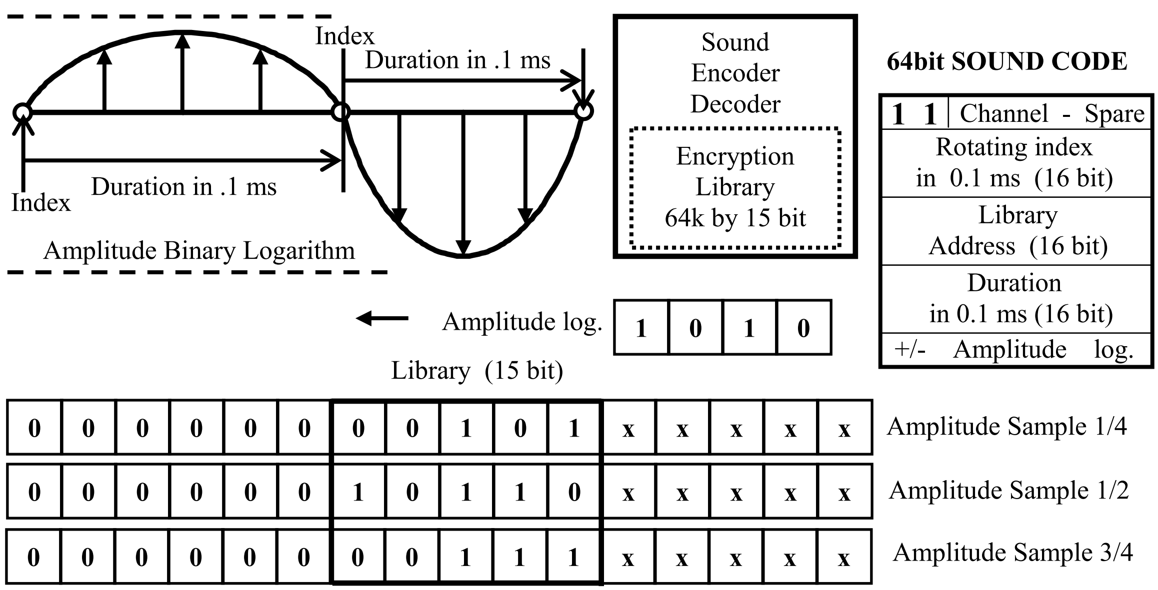


Figure 6. Perceptible lossless sound encoding

Autosophy 64bit sound codes, shown in Figure 6, each represent an analog waveform of any frequency or amplitude. Each waveform is defined by 5 samples plus Index and Duration values to reconstruct the waveform in the receiver. The result is high auditory lossless sound compression depending on the sound "content". Simple low frequency sound, such as human speech, would require much fewer 64bit code transmissions than more complex high frequency sound, such as music. Only that what can actually be heard by the human ear needs to be encoded and transmitted.

UNIVERSAL HARDWARE-INDEPENDENT 64BIT DATA FORMAT

Internet data traffic is now at a similar state of development as shipping was a hundred years ago. In the old days cargo was shipped in separate bags or boxes, which were loaded onto ships, trains, or trucks by longshoremen or packers. The cargo had to be reloaded with each change in carrier, according to the size of the cargo hold. Most goods, in contrast, are now shipped in standard size containers, loaded onto standard container ships, and distributed via standard trucks and trains. No special handling is required during the shipping process.

The Internet could emulate that method by defining a standard 64bit code for all types of data including real time video, sound, text, and random bit files. The data can be encrypted and compressed, but with only the final receiver needing to know how to decrypt and decompress it. Data codes should be routable from carrier to carrier (e.g., from cellular telephone to radio, to satellites, and through the Internet) without needing to be re-formatted. The 64bit codes can be randomly mixed together and stuffed into standard packets, such as the Internet's TCP/IP packets. Other packet sizes may be used in the future. The packets are then put onto the networks for delivery. The packets may arrive at the receiver with unpredictable delays and in unpredictable order. So, each container has embedded timing stamps, which allow for the real time reconstruction of live video with synchronized sound. The packets may also contain error checking codes but with only the ultimate receiver requesting re-transmission of defective packets.

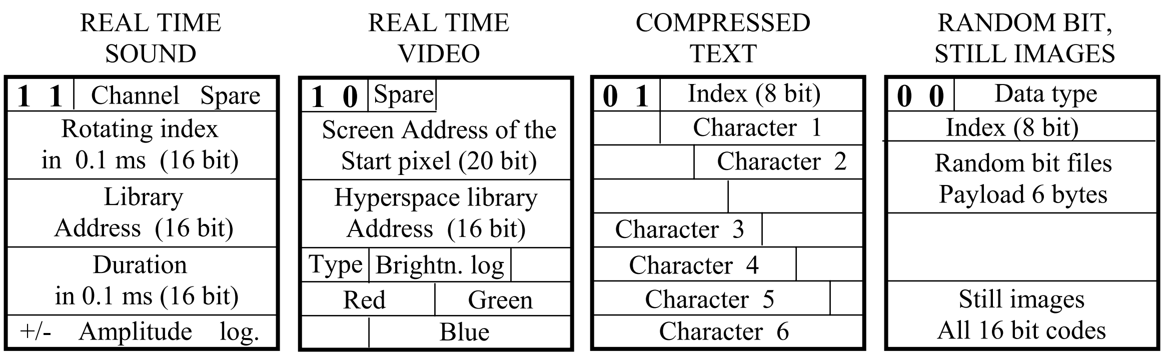


Figure 7. A universal 64bit code standard for all types of mixed data on the Internet

A 2bit header defines the type and priority of the data. Real-time sound has the highest priority. Live video requires a lower priority because of its inherent resistance to packet latency and transmission errors. Text data, still images, or random bit files can be transmitted with low priority because they are not time dependent. All these types of data are randomly mixed together into larger packets for transport via the Internet's TCP/IP or any other future protocol. Lower priority containers may be delayed until data traffic in higher priority containers has eased. All data codes contain their own control, timing, and error checking codes.

Sound codes (11) transmit sound by cutting waveforms at the analog zero crossing point. Each 64bit code would represent a waveform in the sound stream. Sound codes must be randomly mixed with video codes to achieve synchronized sound. Lower frequency simple sound, such as speech, would require fewer codes than higher frequency complex sound, such as music. Silence would require no code transmissions at all. Only sound that can be heard by the human ear needs to be transmitted.

Video codes (10) would each insert a small cluster of up to 16 full color pixels (16bit/color) anywhere within the output image. Only moving portions of the video are transmitted. The video camera and monitor may both have entirely different image formats, image sizes, color resolution, or scanning rates and yet always remain compatible. This allows television technology to evolve towards larger and larger screens and higher resolution, while using a universal media independent protocol.

Text codes (01) use a mixture of either 9bit or 18bit codes. A 9bit code represents a single ASCII character or random bit data, while an 18bit code represents a whole text word of many characters. The system uses a pre-grown hyperspace library, which contains the most common words in a language. Virtually unbreakable security can be achieved when using private hyperspace encryption libraries.

Random bit codes (00) transmit compressed still images or other random bit files from legacy formats. Still images use 16bit codes for any-sized images at any resolution. Random data types may be random bit codes, computer programs, encryption library downloads, or any other unknown data formats. A 6bit "data type" field allows up to 64 different data types or separate data files to be simultaneously transmitted and mixed in the same channel. An 8bit index is required because data packets may be received out of sequence on the Internet's intermittent packet stream.

SELF-ORGANIZING FAILURE-PROOF MASS MEMORIES

The new Autosophy archives would require enormous capacity, non-volatile, Content or Random Addressable memories, such as the memory disclosed in Patent 5 576 985. The memory units must be small enough to fit into mobile robots and consume very little power so as to require no cooling and conserve the limited power of mobile robots. When Autosophy archives evolve from mere information access systems to robots able to physically interact with human beings, then near-absolute reliability becomes essential even in cases of severe physical damage to the robots. A malfunctioning robot may cause severe physical damage and injury to human beings. In the new memory devices the input-output data determines or creates its own storage nodes in the memory. Once the simple learning algorithms have been set up, then there is no need for programming or outside supervision of the internal operations.

A Content Addressable Read Only Memory (CAROM) may be printed on thin foils using Poly-Silicon Thin-Film-Transistor (TFT) technologies. An archive memory may consist of very thin stainless steel foil, which is wound into a spool the size of a roll of toilet paper. Tiny thin-film transistors and printed wiring are deposited onto the foil through vacuum deposition in a continuous roll-to-roll industrial process yielding very inexpensive mass memories.

Both the electronic autosopher and the brain store multimedia "information" in a saturating omni dimensional hyperspace format, in which any node may be located anywhere in the memory device. Memory repair is far beyond human intelligence. Repairing an individual hyperspace memory node is just as impossible as repairing individual neurons in the brain. The systems act like a sealed "black box" to organize and repair their own memory operations.

Examples of self-repairing dual redundant information storage are found in double ledger accounting and the DNA helix. In double ledger accounting every transaction is recorded twice, as a gain and as a loss. Errors in one ledger can be corrected from the other ledger to obtain error proof accounting. In biological DNA, information is stored in two strands wound together into a helix, where each strand contains the same information but in a complementary form. Autosophy archives store information in two spools, a male (RAM) and a female (CAM), each containing the same information in a complementary format. An error in one spool is automatically repaired from the complementary spool. Automatic self-repair and self-healing facilities can also be used for rejuvenation and cloning of robot memories. Removing one spool and replacing it with an empty spool will cause a robot to automatically restore the information from the remaining spool into the empty spool. The removed spool may then be inserted into a second robot, together with an empty spool, to produce a robot clone with the same knowledge and "personality." Rejuvenation involves double cloning allowing old robots to be rejuvenated without loss of information.

SECURE POST TCP/IP COMMUNICATION PROTOCOL

A next generation satellite communication system or the Internet could include revolutionary improvements to the TCP/IP protocol. This would provide error-free communications with virtually impenetrable security for all mixed multimedia communications.

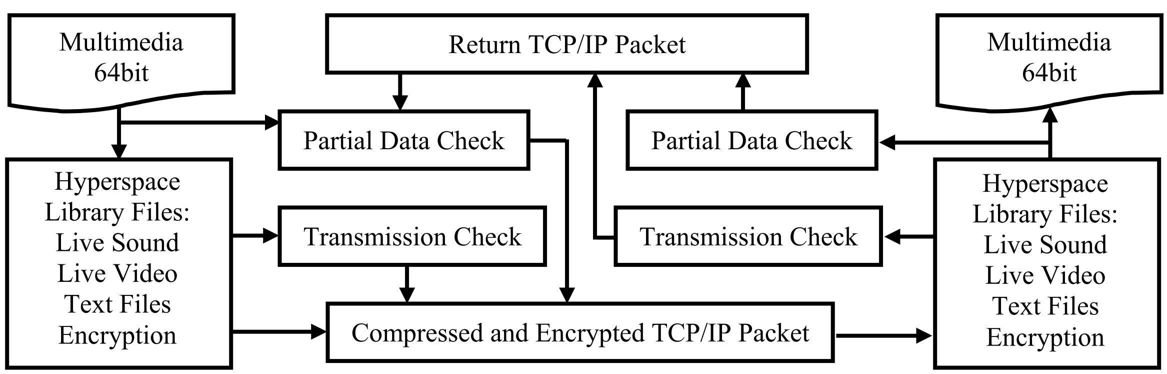


Figure 8. A new post TCP/IP communication protocol

The next generation communication protocol may use a universal 64bit data format that may be forwarded from media to media (wire to radio, to satellites, through the Internet) without needing to be reformatted. Each communication terminal would use one or many pre-grown hyperspace libraries. Open, non-encrypted, communications would use "generic" libraries that are supplied to anyone in the communications software packages. Encrypted communications would use custom hyperspace libraries that are grown by software from data samples. The libraries may be downloaded in encrypted format to all authorized communication partners via the Internet.

Each packet would generate two communication check characters. The TRANSMISSION CHECK character is a checksum of all the transmitted codes in a packet. It confirms that a data stream was transmitted without errors. The DATA-CHECK character is a checksum code that is generated from the data retrieved from the hyperspace library. Both check characters are returned to the transmitter as in the TCP/IP protocol. If both check characters match then the packet transmission was successful without errors. If both check characters don't match then a normal communications error has been detected. The data packet is ignored or repaired by a normal TCP/IP packet retransmission. If the TRANSMISSION CHECK character matches and the DATA-CHECK character is incorrect, then an attempted break-in or deception is detected. Only a receiver in possession of the correct encryption library could generate the correct DATA-CHECK code. This both confirms correct data reception by the receiver, and that the receiver is authorized to receive the data. Instant detection of break-in or deception would allow for instant countermeasures, such as ignoring the transmissions or tracing the transmission through the Internet to its source (its telephone number).

IMPROVEMENTS TO SATELLITE COMMUNICATION AND ARCHIVING

Redesigning satellite communication and archiving systems according to the Autosophy information theory may cause orders of magnitude improvements in system performance. It may eliminate most current communication problems at once. All changes may be made on the ground without requiring changes to existing satellites in orbit. Satellite communication and archiving systems could become more integrated with the Internet and existing infrastructure.

High lossless data compression may replace a single existing satellite with a fleet of virtual satellites. Compression ratios depend on the type of data being transmitted ranging from an average 3:1 for text data to more than 100:1 for normal video.

Impenetrable security through unbreakable "codebook" encryption using custom grown hyperspace libraries may allow carving a separate private Internet from the public Internet. There is no conflict with existing TCP/IP protocols or any future protocols.

Transmitting 64bit "meaning" codes or "data content" assures that no data file will ever become incompatible. Legacy data formats may be converted to the 64bit format by simple software patches or tiny chipsets for real time data such as video or sound. Sensors, video cameras, or microphones will eventually output and accept 64bit format data to make conversion a temporary requirement.

Merging of knowledge in Autosophy archiving means that only that which is not already known by the receiver needs to be transmitted. This will allow many worldwide archives to interchange and merge their information.

Immunity to the Internets Quality of Service problems would allow data transport through all media - satellites, radio, cellular telephone, and fiber optics - without having to reformat the data.

RELIABILITY PROFILES: COMPUTER VS. AUTOSOPHER

In conventional communication and archiving systems a single hardware, software, or memory failure may cause a total systems malfunction. The reliability profile resembles a very long chain in which a break in any link will cause a total failure. The longer the chain becomes, the higher the probability of a failure. The Mean-Time-Between-Failures (MTBF) is calculated from the number of components in the system and the failure probability of each component. The larger a system becomes the higher the probability of a failure. Autosophy systems, in contrast, have a living tree-like reliability profile. Cutting a few leaves or branches from a tree will damage a tree but it will continue functioning and eventually repair itself by re-growth of the still functioning branches. A very large tree will repair itself in the same way so that a very large tree is just as reliable as a small tree. In network-centric systems, like the Internet, a terminal failure will only cause a localized failure in communications. The terminal may be replaced or the terminal may use alternate media, such as cellular phones, satellites, radio, or wireless Internets. The new Autosophy based systems may cause orders of magnitude increases in reliability to become virtually error-proof.

CONCLUSIONS

Conventional communication and satellite systems were developed as the only available option at the dawning of the computer age. Communication was concerned mainly with squeezing as many signals or bits as possible through very noisy transmission channels. Information was wrongly defined by the Shannon information theory, as binary "quantities" measured in bits and bytes, transmitted in meaningless bit streams. This outdated theory is still being taught at our universities, even though there is no evidence of any living creature actually communicating in this way. These early systems will soon be replaced by modern network-centric packet-switching systems, such as the Internet, the Global Information Grid, or the future Information Superhighway.

Unfortunately for us technological developments have greatly outpaced theoretical understanding and information theories. Most experts are still trying to solve the many problems on the Internet or satellites communication systems using Shannon's solutions, i.e., more and more bandwidth, separate encryption, lossy data compression techniques, and more complex layer protocols. This approach is very expensive and will ultimately not be successful. Any small advance will cost more and more money and yielding less and less progress.

Future systems designs based on the Autosophy information theory, in contrast, will be able to solve virtually all communication and archiving problems and open the way to a new generation technology. This may provide enormous commercial opportunities for replacing virtually all our present communications infrastructure and replacing the programmed data processing computer with brain-like, self-learning, and failure-proof autosopher. There is no doubt that the Autosophy paradigm will eventually replace all Shannon based applications.

When a radically new theory replaces an older, well-established theory then new and unexpected applications will appear opening the way to entirely new industries. Autosophy-based machines will shortly replace virtually all Shannon-based technologies, essentially our entire communication infrastructure. It will also replace the programmed data processing computer with brain-like self-learning and failure-proof autosopher. Self-learning machines may greatly exceed human intelligence and open the way to self-organizing intelligent robots. This may eventually evolve into true Artificial Intelligence. The new machines may even have learning modes that are not available in our own brains.

The following applications may be imminent:

Satellite communication and archiving systems based on the Autosophy paradigm will soon overcome most problems caused by the outdated Shannon methods. It may provide virtual immunity to the Internet's Quality of Service problems for integrated, media-independent communication. Very high lossless data compression may improve existing satellite performance, i. e. replacing an existing satellite with a fleet of virtual satellites. Operational performance improvement may exceed 100:1 compression based on the data content. It may also provide unbreakable encryption for impenetrable security. All system modification may be made on the ground, by software patches or small chipsets, avoiding any modifications to the satellites in orbit.

Universal Internet Multimedia will allow the mixing of all data types, such as video with synchronized sound, still images, text, and random bit data. All data types are randomly mixed in the Internet's intermittent packet stream while avoiding the Quality of Service (QoS) problems. No data transmission or data file will ever become incompatible because of changes in the hardware or in the operating systems.

HDTV Internet television will become possible because of the very high video and sound compression. All video transmissions will be compatible regardless of screen size, color resolution, frame rates, or image formats.

Error-proof memories may provide enormous storage capacities at low cost, small size, and very low power consumption. The memory modules are all solid state, with no moving parts, housed in very rugged sealed containers, for application in rugged environments and even in outer space. The memories are self-organizing, self-checking, self-healing, self-repairing, and even self-cloning and self-rejuvenating.

Self-learning robots will require no programming. They may never fail or produce wrong information even after suffering severe physical damage. The robots may be self-repairing, self-healing, and even self-replicating.

Artificial intelligence may provide unlimited learning capacity in archives combined with virtually absolute reliability. This may provide virtually unlimited intelligence and learning modes that are not possible in our own brains. Archives may communicate with us in grammatical speech using logical reasoning.

REFERENCES

1. For information, tutorials, patents, and technical paper downloading use the Internet website www.autosophy.com. For a larger search of Autosophy research use the keyword "autosophy" in your search engine.
2. Klaus Holtz, Eric Holtz, Diana Kalienky, "Universal Autosophy data formats for network-centric systems". Defense Transformation and Network-Centric Systems. Proceedings of SPIE Vol. 6249 62490Z (2006)
3. Klaus Holtz, Eric Holtz, Diana Kalienky, "Self-Organizing and Self-Repairing Mass Memories for Autosophy Multimedia Archiving Systems": Replacing the Data Processing Computer with Self-Learning Machines based on the Autosophy Information Theory. 2nd International Conference on e-Business and Telecommunication Networks: ICETE 2005, Volume II, Reading, England - October 3-7, 2005.
4. Klaus Holtz, Eric Holtz, Diana Kalienky, "Replacing the Data Processing Computer with Brain-like Learning Machines": a new Communication and Computing Paradigm based on the Autosophy Information Theory. International Conference on Advances in the Internet, Processing, Systems, and Inter-disciplinary Research: IPSI - 2005 USA Cambridge, July 7 - 10, 2005. ISBN: 86-7466-117-3

5. K. Holtz, E. Holtz, D. Kalienky "Autosophy data/image compression and encryption". SPIE 49th Annual Meeting, Optical Science and Technology, Mathematics of Data/Image Coding, Compression and Encryption VII, with Application. Denver Colorado, Aug. 4, 2004
6. K. Holtz, E. Holtz, D. Kalienky "Autosophy Failure-Proof Multimedia Archiving". IS&T's 2004 Archiving Conference, San Antonio Texas, April, 2004
7. K.Holtz, E. Holtz, D. Kalienky "Universal Hardware-Independent Data Formats for Real-Time Multimedia Communications". CCCT'03 International Conference on Computer, Communication and Control Technologies. July 2003, Orlando Florida.
8. K. Holtz, E. Holtz, D. Kalienky "Replacing Data Processing Computer with Self-Learning Autosopher: Impact on Communication and Computing" SCI 2003 The 7th World Multiconference on Systemics, Cybernetics and Informatics. July 2003, Orlando FL.
9. K. Holtz, E. Holtz "Autosophy Still Image Compression" IS&T/SPIE Electronic Imaging Science and Technology, Internet Imaging 1V, SPIE Vol. 5018, Santa Clara, CA, Jan. 20, 2003.
10. K. Holtz, E. Holtz, "The Emerging Autosophy Internet" SSGRR 2002s, L'Aquila Italy Aug. 2, 2002 www.ssgrr.it/en/ssgrr2002s/papers.html, Paper 140
11. K. Holtz, E. Holtz. "Autosophy Internet Video" IS&T/SPIE Electronic Imaging Science and Technology, Internet Imaging III, SPIE Vol. 4672-13, San Jose, CA, Jan. 21, 2002.
12. K. Holtz, E. Holtz, "An Autosophy Image Content-Based Television System". IS&T's 2001 PICS Conference Montreal Canada, 2001.
13. K. Holtz, "Advanced Data Compression promises the next big Leap in Network Performance" EUROPTO'98, SPIE 3408, Zurich, Switzerland, 1998.
14. K. Holtz, "Autosophy Information Theory provides lossless data and video compression based on the data content," EUROPTO'96 / SPIE-2952, Berlin Germany 1996.
15. U.S. Patent 5,917,948 "Image Compression with Serial Tree Networks"
16. U.S. Patent 5,576,985 "Content Addressable Read Only Memory" (CAROM)
17. K. Holtz, "Packet Video Transmission on the Information Superhighway using Image Content Dependent Autosophy Video Compression," IS&T's48th, Washington DC, 1995.
18. U.S. Patent 4,366,551 "Associative Search Method"
19. C. Shannon, "A mathematical Theory of Communication," Bell Telephone B-1598, July 1948.