GLOSSARY

Communication

This chapter discusses *communication* at a low level, especially the portions of manipulation of media to convey information. This doesn't discuss

- information, or securing the communication (see Information and Information Security glossary);
- Engineering in a broader sense see also the Engineering glossary
- *Generic reliability concepts.*

adaptive modulation
Usually are either fast or slow

ADSL
asynchronous digital subscriber line
Upload and download speeds differ; usually set so that data is sent faster to the home (up to 8Mbit/sec) than data sent from the home (up to 800Kbit/sec or 1.5Mbit/sec). ADSL simultaneously uses several channels between 25Khz and 1.1MHz, initially sent at a high power level. It works around equipment deterioration and noise with a combination of signal strength and frequency hopping. The receiving end of the ADSL can be no further than 3 miles from the central office (otherwise the signals are too noisy), and must be at least a few hundred feet from the central office (otherwise the signal is too strong and "bleeds" noise inside of the DSLAM). The more channels that can be used (i.e., aren't noisy) the higher the supported data-rate.

Standards: ANSI T1E1.413

see also *DMT*, *DSL, DSLAM, ISDN*

ADSL Lite
G.lite
The most common form of ADSL. It usually supports about 1.5Mbit/sec sent to the home and 500Kbit/sec sent from the home.

AGP
Pipelined requests, with separate lines for address and data; max 533Mb/second

PCI: non-pipeline, multiplexed address/data, 132Mb/sec

a-Law
Type of audio encoding. Related to μ-Law

John Bellamy, Digital Telephony, John Wiley & Sons, 1991, ISBN 0-471-62056-4

AMPS
advanced mobile phone service
This is the name of the "analog" phone service of the first generations of cell phones. AMPS used frequency division multiplexing (FDMA) – that is, each call had its own frequency, like with FM radio and CB's. Later generations used time division multiplexing (TDMA).

see also *bearer, TDMA*

analog digital services information
Provides for call waiting. Goes between X and a telephone to send visual instructions over analog phone lines.

analog line
24 lines = 3-12 circuits 2/3 normal

anisotropic
Not the same in all directions. Usually this means that Things have different speeds or costs in different directions. Common examples include roads, nerves, and phone system which offer better, faster, service in a few constrained directions and/or locations.

see also *met-glass.*

antenna shape, size, and structure indicate the wavelength and it's likely use

antenna array borrow from the description in the Computer Oct issue

ARPANET one of the indirect predecessors to the internet. Had few nodes, sponsors encouraged development of commercial packet networks: tymnet (McDonnell Douglas), Telenet (Spring), PSS etc

ATM
asynchronous transfer mode

A telecommunication standard that uses "cells" (fixed sized packets that are very small, at 48 bytes payload and 5 bytes header). It is intended to work on, for the day, high quality equipment with less than 1 bit error per 10^9 bits sent; rates higher than that result in a lower performance than promised. Because of its fixed cell size the standard measures include cell-rate and cell-rate peak. The system is built up in layers, from the lowest to the highest:

- Adaptation layer, including data headers and trailers
- Routing. The addressing borrows from OSI. Routing choose physical circuits, paths within a switch, and the virtual network.
- Switching: Fabric, grid and bus
- Network management: Framework. Interim local management interface
- Traffic management:

See also *ISDN, signaling system 7, SMDS*

The size is a compromise between the European and American schools on the ITU standardization committee. One preferred 32 bytes, the other 64; 48 being the middle ground that everyone disliked equally. This down-the-middle type of compromise is widely considered worse than either of the original options, and it is unlikely to be standard procedure in the future.

traffic management For quality of service purposes, each connection is classified into one of three categories based upon the type of data it is:

- Uniform Bit Rate (UBR). This is used for music and video, where the human perception would notice any variation in signal
- Variable Bit Rate (VBR). This is used for voice, which is intermittent and has a range of compression. It is also used for some high priority data.
- Available Bit Rate (ABR). In practice, the majority of the data on an ATM network. The equivalent of flying standby, most computer traffic fits into this category.

Congestion control

see also *buffering*

bandwidth For frequency division multiplexing – including the radio spectrum at the level of the FCC – this is the width of the frequency band a channel is allocated. It may be the maximum amount used within a time frame. May include the highest and lowest separation.

band zero Dedicated interstate lines

base station Main transceiver, at a fixed location. With cell phones, this is usually the Cell Tower.

basenet processor Qualcomm's basenet processors now run L4 μKernel

BCH Cyclic codes. Reed-Solomon codes are a subset.

beacon "signals that indicate the proximity or location of a device ors its readiness to perform a task. Beacon signals also carry several critical, constantly changing parameters such as power supply information, relative address, location, timestamp, signal strength, available bandwidth resources, temperature and pressure."

see also *GPS*

Sergei Gerasenko, Abhijit Joshi, Srinivas Rayaprolu, Kovendhan Ponnavaiiko, Dharma Argrawal, "Beacon Signals: What, Why, How, and Where?" Computer, October 2001 p108-110

cellular networks Used to link cell phone to an appropriate base station, "carry information such as a

	cellular network identifier, timestamp, gateway address, paging area ID, [etc]"
wireless LAN	"includes the traffic map, indicating availability of buffered packets for specific LAN nodes"
vessel search & rescue	country of registration, vessel ID

bearer

The telecommunication network (or type of network) used to carry a call. The "bearer" is what offers a set of services and provides the underlying capacity on telecommunication networks. Specifies such things as frequency bands, encoding modulation, exchange protocols, and interoperability standards. The telecom market is split into geographic market segments that roughly map to the bearers.

see also *call features, communication issues, walled garden, wireless value chain*

"Third Generation and Beyond Wireless Systems" P. Nicopolidis, G.I. Papadimitriou, M.S. Obaitdat, A.S. Pomportsis, Communications of the ACM*, V46N8, August 2003, p120-124*

***Table 1:** Wireless bearers and channel capacity*

Bearer	*Data Rate*	*Description*
CDPD cellular digital packet data		Some component suppliers include: Tellus, Novatel Wireless, Sierra Wireless
CDMA		Std: IS-95. Some component suppliers include: AirPrime. Sometimes called CDMA One to distinguish it from CDMA2000;
CDMA2000	~ 144Kb/s	Compatible with CDMA, and can be used as an air interface to 3G. The high data rate presumes low interference.
EDGE Enhanced Data Rates for GSM Evolution	~ 28.8Kbps	Std: UWC-136. GSM compatible, but also employs eight-phase shift-keying (8-PSK) allowing three bits to be sent for every one sent under GSM. Includes an Enhanced Circuit Switch Data mode.
EGPRS Enhanced GPRS	supposedly up to 473Kbps	Packet-switched mode of EDGE. Includes estimation of poor link quality and switches to GMSK
FLEX[1]	0.8Kb/s to 6.4Kb/s	The protocol was created by Motorola as an extension of alphanumeric paging services, has terrible reviews for service coverage and technology workability. Glenayre Technologies made end-user products.
G3		
GMTS	< 38.4 Kb/s	
GPRS General Packet Radio Service	< 28.8 Kb/s	
GSM General System for Mobile communication	9.6 Kb/s	Std: IS-136. Employs Gaussian Minimum Shift Keying (GMSK) on 200Khz channels. GMSK is more robust than most formats. Includes a burst format.
HDR High Data Rate		A data bearer for CDMA2000. If there low interference in a cluster is employs 16-Quadrature Amplitude Modulation (16-QAM) – that it is sends 4 bits at a time.
HSCSD	28.8 Kb/s	
iDEN		
IS-136		
PDC-P		
PHS		

[1] "Implementing FLEX Wireless Connectivity into Mobile Computers" Omid Tahernia, CSD Magazine, Sept 1998

Bearer	*Data Rate*	*Description*
TDMA		The old analog form of cell phones.
WCDMA Wideband CDMA	~ 3.84 Mb/s	Data Link Layers: ▪ Packet Data Convergence Protocol ▪ Broadcast/Multicast Control ▪ Radio Link Control ▪ FDD/TDD

bit energy Energy per bit

$$= \frac{S}{R}$$

$$= \frac{M_E}{M_k}$$

R data rate (bits/sec)

S Power at receiver (watts)

M_E message energy

M_k message information bits

see also message energy

bit error The majority of errors originating in a noisy channel are from at least on bit being change, or burst errors. The probability of no bit errors is:

$$P = (1 - P_e)^n$$

Where Pe is the probability of a single bit error. n is the number of bits in the frame.

See also *error-correcting codes*

burst error One error on each end of a string of bits

BitTorrent A file sharing network, comprised of:

- A file transfer protocol,
- Torrent servers that provide files (or portions of them),
- "Trackers," global directories of which servers have pieces of which files,
- Websites that acts as directories, advertising files available, other directories, trackers, and torrent servers,
- A ranking system to track file popularity and quality, and further promote more popular files, and
- Moderators, who remove uploads with lower reproduction quality, misnamed files or fakes; moderators in turn promote others to moderator status.

The purposeful efforts to provide sharing (such as space, or service access) and active administration often entail legal liability. This is true even if their fencing action didn't actual move stolen goods. For this reason, a variety of definitional dodges have been employed, each trying to redefine BitTorrent as solely the protocol and "not a network."

see also *common usage, PIM tree*

how it works What makes BitTorrent special is the key mechanisms it uses to spread the work around. Files are stored in chunks, and servers provide a list of chunks needed to piece together the original file. A secure hash of its contents identifies each chunk. When a download begins, the computer first gets the list of chunks, then a list of machines offering the chunks. It then begins to download a chunk from a "not busy" machine it can find. Typically, it uses different machine for each chunk, spreading the work out across several servers.

If Alice is offering a pirated version of "Lord Of The Rings," and both Bob and Charlie, want to download it. Alice begins by sending the first 1MB to Bob, and the second 1MB chunk to Charlie; Charlie gets the first 1MB from Bob, and the Bob gets the second 1MB chunk from Charlie. This continues in the obvious way. Such an approach reduces a

bottleneck in Alice's network capacity (where it is consumed sending redundant data), and how her computer handles the competition for multiple large transfers.

bitwise block transfer
bitblt

A memory transfer incorporating a series of shifts and masks to change word sizes. Explored at Bell-Labs and elsewhere, esp. for transferring data between machines with different word sizes.

block truncated
compression

1. Divide the image into blocks of mxn elements
2. Compute the mean and second moments on the block
3. Replace each element whose value is below the mean with an O, and those equal to or greater than the mean with a 1
4. The compressed value is the smallest packed binary representation of those elements and the following two values:

$$a = m_1 - \sigma d$$

$$b = m_1 + \sigma d$$

note:

$$d = \sqrt{\frac{q}{r-q}}$$

$$m_1 = r^{-1}\left(a(r-q) + bq\right)$$

$$m_2 = r^{-1}\left(a^2(r-q) + b^2 q\right)$$

$$r = m * n$$

$$q \geq mean$$

decompression

1. Get a,b and the packed representation for a block
2. Unpack the representation into an mxn block
3. Replace all the elements whose value is 0 with the value of a, and those whose value is 1 with a value of b

Bluetooth

"Bluetooth short-range radio technology provides low cost, low power, wireless connections for mobile computers and related devices. Originally envisioned for simple cable replacement, the Bluetooth stand has evolved to include the concepts of ubiquitous peer-to-peer computing and dynamic Personal Area Networks (PANs)."

Bluetooth employs much of the IrDA protocol

see also *flow control (credit-based), IrDA, Zigbee*

standard	?
frequency	2.4 Ghz
range	100m
data rate	1-2Mbps
output power	100mW
origins	Cell phone headset standardization

buffering

A buffer is used between different devices when they have (or benefit from) differing data rates. The minimum buffer size is the number of bytes it needs to hold until the sink catches up e.g. when the sink is temporarily disabled, and the source has a constant data rate. Buffering requirements can be reduced by:

- Matching, where possible, the rates of the sink and source
- Using flow control: disabling the source and speeding up the sink (e.g. burst mode), or minimizing its off time
- Improving the number of bits per error (bit error rates). If there are more errors, the more data needs to be held until those errors are corrected.

Windows applications allocate their message and event buffers (automatically in the standard libraries for GUI programs). This prevents a program from consuming all of the system resources by sending messages to an application (e.g. a console application) that doesn't service any queues.

see also *Balady's anomaly, congestion control, flow-control*

building automation
BACnet

23 virtual object types – analog input, binary output, schedule, calendar, schedule, etc. Objects are characterized by set of properties to represent the operation of the system or the operating parameters and commands. Messages have16 levels of priority.

A smoke detector would send a signal indicating smoke.

lonworks

Network of variables – one for each input and output. Commands set the variable. Bindings to variable state to trigger action; can be one to many, etc.

The last command received always has precedence over prior ones. Separate channels are used for more important commands – e.g. emergencies.

A fire alarm sends out a periodic signal indicating ok, or fire; without any signal it indicates fire.

burst mode

Taking control only for a short period of time – usually used for fast transfers, and multiple bursts are required to complete a transfer.

bus
arbitration

Technique for negotiating which device will be the master.

fairness

Each device gets an opportunity for control in the same proportions

linear arbitration

Control goes to the higher priority device until transfer is completed.

management

Technique for deciding how the bus will be controlled.

mastering

A technique that allows a device on the bus to control the data-flow tasks. Without mastering there is a dedicated device to handle control.

width

The number of bits that can be simultaneously transferred.

call features

Call features include:

- Blocking calls
- Return calls
- Tracing calls
- Caller identification
- Caller-ID blocking
- Call forwarding
- Priority ringing

see also *analog digital services information, caller identification*

caller identification

Works by the LATA sending out the text data display by phones and peripherals. The data comes in one of two levels, standard and enhanced. The standard service delivers the number. Enhanced service delivers the number and the name. It uses standardized signal format of DTMF and Bell-202 modem bursts between each of the phone rings.

see also *analog digital services information, call features, PBX*

call other info

- Buffer management (see *buffering)*
- Congestion – traffic too high for buffers, the
- Admission control
- Membership and account management
- Coarse-grain and fine-grain access control
- Usage recording and tracking
- Event notification
- Active user and service management

capacity

Given the total offered load (speed & data traffic), and the desired grade of service,

dimensioning determine the number of required channels to provide this. Formula: Erlang B.

CDDA

CDMA
code division multiple access
All users transmit on the same channel and at the same time. Each is assigned a unique code, usually a pseudo random number. The code rate is much grater than the actual data rate. The data signal phase modulates a carrier; the results are phase shifted by the code.

code types Prefixable, fixed rate, tree, sliding block (trellis)

cell phone
You can't just sell a cell phone in retail channels and have it work

Each carrier (sprint, AT&T, Verizon) qualifies (certifies) each for its network

Elegance, desirability are key factors

Willingness to redesign it for better performance on a carriers network

Consider built-in ability to list a catalog of Software packages and download them.

cell phone design
Flash memory: Permanent storage, contains OS code (kernel and major applications)

Flash, removable: Used for user data, programs, system data

RAM, Main memory. Used for process stacks and heaps, global variables, the OS stacks and heaps.

RAM, Battery backed up (optional): Used to store user data, programs, system data

channel
Metadata: in band, and out of band

Data stream format: message (with priority & type), packet, byte stream

Common types of unix channels: MessageQueue, Pipe, Socket, File, FIFO

Mapping storage to an IO channel: extra or mixed functionality, penalty

Channel control

Layers, top down:

- Compression: lossy, but smaller data representation
- Compaction: lossless, smaller data representation
- Encryption
- Correction Codec. Allows data to be sent thru a noisy channel reliably. For example a retransmission might occur if a negative-acknowledge is received or an ack is not received.
- Translation. Changes representation to one that can be accepted by a constrained channel.
- Modulation codec. Fed by pulse synchronization and carrier acq / generator
- Band distribution codec. fed by modulation.
- Pulse synch and carrier acq/control is fed by band distribution
- Symbol recovery
- Channel modeling
- Equalization

channel capacity Function of noise level and bandwidth

channel estimation Used by wireless and cable transceivers to estimate the amount of noise a channel has, how strong the signal will be at the receiver, the channels capacity, and if there is any contention for using the channel.

check and ignore Receives notifications for more events than it is interested in. To speed processing, it checks the type of event quickly to see if it is one that it should ignore.

cluster A set of cells. The cluster manages the RF frequencies used by the cells – each cell uses a different frequency so they do not have cross talk or compete with each other. (A cell is

subdivided into sectors, which have similar rules). The master in the cluster is used to direct the transmission power used by the cell phone transmitter.

code — see BCH

check codes — Checksums and CRC detect accidental misentry, and bit-errors (due to transmission channel errors). These are less complex and smaller value size than other methods, but do not detect intentional attempts (*breaks*) to corrupt the data stream. Digests and signatures. MD5 shouldn't be used in newer designs where SHA-1 (or other methods) can be used.

CODEC
coder / decoder — The opposite of a modem: this converts an audio signal (such as a voice or music) into a digital signal for purposes of storage of transmission on a digital network, and later converts it back into audio signal.

command systems — Synchronization words, error detection, error correction. Command types, command validation and authentication. Delayed commands.

common mode
rejection ratio — A measure of an instruments ability to ignore or reject interference from a voltage common to its input terminals relative to ground. Usually expressed in dB.

communications
geometries — Mesh, hub-spoke, point-to-point, broadcast, tree

See also *design principles*

issues
- Reliability
- Security
- Ease of Use and Access
- Cost
- Quality of Service
- Performance Characteristics

link figures
- EIRP - equivalent isotropic radiated power
- G/T
- Transponder Gain
- SFD
- Link Budget

congestion control — A type of flow control concerned with shared communication channels, especially when data to be transmitted has accumulated faster than it can be transmitted. Strategies include discarding data, avoiding congestion (by using feedback to the data's origin, prioritizing transmissions, requesting other transmitters to cease), and recovery.

see also *buffering, flow control*

CPRM
Content Protection for Recordable Media — Developed by The 4C Entity, LLC. The core concept is that a work (a movie, sound file, book, program, etc.) can have its access control fields (typically owner, read, write, etc.) extended. with a wide set of copyright management tags, indicating what you can and can't do with it. (The price points of sale). Some settings include the ability to restrict whether the (decoded or "encrypted") contents of a work can be transferred to another device, or a non-compliant device. Items or data without access controls have no restrictions.

Ed Nisley
www.4centity.com/tech/cprm/
Spec available at:
ftp://fission.dt.wedc.com/pub/standard/x3t13/technical/e00148r2.pdf

CPRM is in use by DVDs, Secure Digital memory cards, and is not mandatory. An SD card may not have any CPRM material on it. If it does, it may not allow access to such material without the proper key.

Licensed devices (such as DVD players) would have a key – provided upon contractual agreement and compliance testing –that allows them to access or decipher the contents. It employs a C2 Cipher – broadcast encryption, and one-way key algorithms – to prevent noncompliant devices from accessing those works.

In the case of hard disks, the specification never went beyond a draft proposal by Technical Committee T13 of National Committee for Information Technology Standards (NCITS). T13 is the AT Attachment interface standards group. The specification reserves a 16x3000 matrix of memory to be a read-only Mead Key Block, and a disk identifier is called a Media

www.t13.org
www.ncits.org

Unique Key. Two new ATA commands are introduced as well: Read CPRM, Read Media Key Block.

see also *access control list, capability based access control, discretionary access control, mandatory access control.*

cross-point switch
An n-by-n switch that connects one host to another host with a dedicated connection.

CRC
cyclic redundancy check
The feedback mechanism makes its state very dependent on a great deal of the past, allowing sensitivity to differences. The strongest of the generating polynomials allows detection of single and double-bit errors, and burst errors

see also *bit error, LFSR*

CSMA/CD
carrier sense multiple access, with collision detect
Allows multiple transmitters on a shared media by primarily detecting if someone else is currently transmitting (the carrier sense), and detecting if multiple parties transmitted at the same time (the collision detect), forcing a retransmission later.

CTCH
common traffic channel
Used in 3G. "Point-to-multipoint unidirectional channel for transfer of dedicated user information for all or a group of specified UE's."

Andreas Larsson, Henrik Jeppsson. "Designing 3G Systems." Dr. Dobb's Journal, May 2001.

cut-thru
Read destination address. Find the port for that address. Connect input port to that output port, so that very little of the packet is buffered (a bit of the header initially). Does not eliminate bad packets or collisions.

see also *wormhole routing*

modified cut-thru
Limited error check. Read only first 64 bytes to reduce collisions.

cyclades
Louis Pouzin

DAMQAM
dynamically adaptive multicarrier quadrature amplitude modulation
A system used in Telebit's Trailblazer modems. It used 512 channels, each 7.8125Hz apart; during the initial connection, the modem would test the channels (with the other end) to determine which channels were usable. Each channel would be modulated using two-phase DPSK (on noisy channels), 4- or 6-bit QAM (on the better ones). These modems were comparatively very fast at sending data, but the round trip latency was very high. This made the modems inefficient with protocols requiring feedback, such as TCP/IP, Kermit, X-modem, or interactive terminal sessions.

see also *DMT, DSL, QAM*

L. Brett Glass, "Under the Hood: Modern Modem Methods" Byte*, June 1989*

DCCH
dedicated control channel
Used in 3G. "Point-to-point bidirectional channel that transmits dedicated control information between a UE and the network. This channel is established through the RRC connection setup procedure."

Larrson (2001), ibid

DCH
dedicated channel
Channel used in 3G systems to carry "user or control information between the mobile device and the network"; bi-directional.

Larrson (2001), ibid.

DDR DRAM
double data rate DRAM
Similar to SDRAM except that it read and writes on both the rising and falling edges of the clock cycles, thus is twice as fast. The clock circuit is tied to a PLL to keep the data output tightly sync'd.

delay bound
"The delay bound is proportional to

- the burstiness of the source p_i, and
- the number of traversed nodes h_i, and
- inversely proportional to the bandwidth g_i allocated to the source.

Thus, when a delay requirement is to be met by a flow i, the higher the burstiness of a source and the number of traversed nodes, the larger the bandwidth g_i must be."

GMario Baldi, Fulvio Risso. "Efficiency of Packet Voice with Deterministic Delay." IEEE Communications Magazine. May 2000, p170-177.

delta coding Reduces a signal's required data rate by sending the difference from the previous value. The maximum representable frequency of the original decreases with the signals amplitude.

device control protocols A type of communication protocol used in performing telecommunications on internet-style networks. The issue is that telecom networks are rigorously designed to provide service under a wide variety of events, with less than about 5 minutes of service unavailability per year. Internet services are oriented towards low cost, frequently replaced equipment; their service averages about 8 hours of unavailability per month. Device control protocols are simplistic and used to establish connections using "phone numbers"

device profile Specifications for certain types of devices and device interoperability. Emphasis on being a subset of another profile.

see also *control point, discovery*

digital modulation Concerned with issues including spectral power density, bandwidth, data rate, and bit error rate.

see also BPSK, FSK, QAM, QPS

digital transmission on phones Over cable pairs uses a T1
Standard Digital Signal: DS1
Switching-Dynamic is done with a cross-point array
Network and Communication Channel signaling is done with SS7
Electrically it uses Synchronous Transmissions Signal-1 frame structure

see also *DSL, ISDN*

direction finding HF Circular disposed antenna array
picture

bearing to the signal is the result

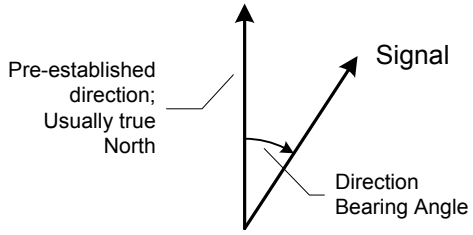


Figure 1: *Bearing*

direct sequence spread spectrum DSSS see *DSSS*

discovery Finding services and devices that we are interested in. Possibly by querying a control point or trigger by a signal.

discovery protocol The underlying data structures and protocols to implement the lookup service.

DMA direct memory access A method by which data can be transferred to or from the computer memory to a device while the main processor does something else. A DMA is a special purpose processor, designed to control most of a buses interactions.

See also *bitwise block transfer.*

DMT discrete multi-tone An implementation of ADSL that uses several channels to carry data. Each is 4.3125KHz wide. 256 channels are sent to the home, and the home sends 32 channels. Each channel has a carrier, called a tone, which is modulated with data. When a connection to the central office is being established, the DSLAM at the home measures the strength and quality of each tone and reports the information to the central office. This information is used to select which channels and strengths will be usable. The home

See also *ADSL, channel hopping*

DOCSIS
data over cable service interface specification

The standard method to use the internet over a cable TV connection. Specifies a shared media system very similar to Ethernet.

See also *CableLabs specification*

DPSK
differential phase-shift keying

A bit – or group of bits – corresponds to a phase transition. For example, a shift right in the phase diagram would be a 1 (no matter what the origin or resulting phase is) and a 0 would be no shift. In phase-shift keying (PSK) the phase corresponds to the bit or group of bits. PSK is requires well-synchronized clocks to properly identify the phase. DPSK modulators often include a scrambler (and demodulators include a corresponding descrambler). This scrambler's purpose is to make the distribution of bits consistent; otherwise, the lack of phase transitions (e.g. from sending a zero in the earlier example) may cause problems.

see also *phase shift keying (PSK)*

DSCH
downlink shared channels

Used in 3G systems. "Shared by several UEs and carries dedicated control or traffic data; used in TDD operation only." *Larsson, ibid*

DSLAM
DSL access multiplier

A kind of "modem" for DSL access, sometimes called a DSL router. It connects a LAN to a DSL line.

DSS1
digital subscriber signaling system #1

The lower transmission layer of ISDN and ATM. Based on OSI model. Information, such as the voice, is sent on the 64 Kbit/sec bearer channels (called B channels). Layers information flow on a 16Kbit/sec control channel (always called the D channel):

1. Messages
2. Link Control Protocol
3. Protocol Message Structure

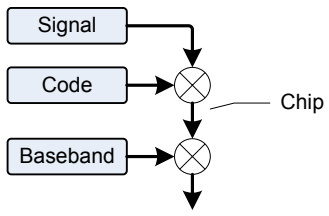
Line (DSC): 2B1Q line code and signal. Frame format, synchronization words, super frame.

see also *ATM, ISDN*

DS-SS
direct sequence spread spectrum

Spreads a signal's bandwidth by re-arranging the data stream with a pseudorandom code. This forms the code division in CDMA. The code is periodic, created by logic gates, and has mathematical relationship the transmitter and receivers must both know. It otherwise is "random," having no harmonic (or coupling) relationship with other signals or sources. This allows the signal to avoid or recover from interference with other transmitters, or noise sources. While the signal is hard to detect (by 3rd parties) it takes more bandwidth than FH-SS and it takes longer to get the transmitter and receiver synchronized.

see also *FH-SS, spread spectrum*



The code increases the transmitted data rate, with a larger bandwidth. It is possible that only a portion of the signal to be received, and all may be briefly not received. The known part of the signal (code) allows the receive to decide what the user data signal was.

The wider bandwidth – and known portions of the signal --

advantages

More resilient to noise and jamming; lower power to get a signal thru.

DTCH
dedicated traffic

Used in 3G. "Point-to-point, uplink/downlink channel, dedicated to one UE, for the transfer of user information." *Larsson, ibid.*

channel

ECID Unique device id for iphones

EMBARC
electronic mail broadcast to a roaming computer

A wireless communication service offered by Motorola during the early 90's. It was nationwide, and based on paging technology. It allowed emails to be sent to a PDA or embedded computer. Its primary feature was that an email cost the same, regardless of the number of recipients. It was intended to allow, for example, software and/or database updates to field equipment, without requiring human service.

see also *FLEX*

EMI
electromagnetic interference

Coupling Modes:

- Common-mode coupling: ground impedance, ground loop, and field to cable
- Differential-mode coupling: cable to cable, field to cable
- Ground common-impedance coupling

epicene pronoun

error control strategy Specifies how error are determined (e.g. time-outs, explicit notifications) and what will be done when an error occurs (usually a retry).

automatic repeat Use a systematic code only.

Retransmission strategy: the sender is required to retransmit data to correct for missing or corrupt data. The receiver may request a retransmission (e.g. a "not-acknowledge"), the sender may infer a retransmission (by what has not been acknowledged), or the sender may retransmit on a schedule (a carousel approach, where the data will `come around again')

see also *checksum, CRC, parity*

error correcting codes
ECC

Two elements of classification

1. Automatic Repeat Request (ARQ), and Forward Error Correction (FEC)
2. Block codes or convolution codes.

Stages in encoding:

1. Encoder (e.g. RS)
2. Interleaver, to scramble symbols, spreading any burst error out (to improve recovery, since most schemes have harder times fixing errors that are closer to each other)

See also *trellis-coded modulation*

code rate Code rate is n/k

n: number of output bits
k: number of inputs bits

concatenated code Using more than one encoder in parallel, and appending the results. See *product code*

convolution code Works on per input symbol, not block, but it is more convenient to treat them as a block. Systematic codes are a type of convolution code.

forward Forward error correction techniques allow corrupted to be recovered with retransmission. Use a linear-block code, and possibly a systematic code.

Reed Solomon: corrects burst errors
Viterbi: corrects evenly distributed errors

see also *Reed-Solomon, Turbo codes*

interleaver Permute the data bits. It is the deinterleaving that is more important: a run of corrupt bits is spread out into smaller broken runs, making recovery easier. Turbocodes use pseudo-random (wrt to the channel) interleavers

linear block code $y=xG$
x: vector of input vector bits (in a block)
G generator matrix

y: output vector

see also *Hamming, Golary, Bose-Chaudhuri-Hocquenghem (BCH), Reed-Solomon*

product codes — Feeding the output of one encoder into the input of another.

puncturing — Drops certain outputs of the coder to increase the rate

soft-input/soft-output decoders

systematic codes — Append a check code onto the end.

Ethernet — A shared media (bus) networking method. Utilization peaks about 35-40%

see also *CDMA, Token Ring*

excitation frequency — "The frequency of sound as emitted at the source." *Elliot,* ibid

fading
Rayleigh — A signal comes back thru multiple paths, and interferes with itself. This happens with a moving transmitter or receiver. The solution is increase the data rate and make the packet size smaller – to ensure that packet is likely to get thru before the signal corrupts it.

FC/AL
fibre channel, arbitrated loop — Storage networks lowest layers of transport. Block-access protocol, with SCSI-like behaviour including tags, etc. HIPPI, Point-Point vs Arbitrated Loop vs Switches

FDMA
frequency division multiple access — Orthogonal and offset. Each user is allowed a unique channel (sometimes defined as a unique center frequency). Multiple signals can be simultaneously accessed.

FH-SS
frequency hopping spread spectrum — A technique, common with some forms of cell-phones, is to continuous change the frequency channels used in the spread-spectrum group. This allows channel distortions to be avoided if not entirely, quickly. FH-SS has the drawbacks that it is difficult to implement properly, while it avoids interference it is worse that DS-SS at handling the interference, and its signal is definitely not hidden.

see also *DS-SS*

flow-based routing — Packets (cells) for a virtual circuit are routed faster by mapping the flow to output port. IP doesn't have a flow identifier until after the virtual circuit is established.

The flow is often identified by the combination of source address, port, destination address and port. The mapping is usually a hash table.

flow-control
credit-based — Credit-based flow control works by each transmitter tracking the number of free buffers on the receiving end. The receiver initially announces the minimum number of buffers dedicated to the virtual channel, and periodically announces changes to the number of buffers (to indicate that some were consumed by the receiver).

1. Party A tells B the number of buffers it can use (this is called extending credit). A must not overextended itself – it can't offer buffers to more than one other party, and at least one extra buffer is reserved to receive management information.
2. B is responsible for tracking the number of packets it has sent; if B sends more than A has extended, A may drop them.
3. A may periodically send management info to B, indicating the number of packets more it may send. A does this as it frees up buffers, or when B's has sent less bytes than expected, creating enough room to buffer more packets

see also *buffer management, congestion control*

frame relay
ANSI T1.606 — A replacement for the X.25 packet switching system. It is akin to TCP/IP. It employs a variety of QoS mechanisms and congestion avoidance that were sufficient to stave of ATM competition

frequency detection

If there are points in time when you need to recognize just one frequency, consider employing Goertzel's algorithm Otherwise use FFT or Harmond

see also *power spectrum*

FSK
frequency shift keying

Different tones or frequencies are used to represent different symbols being sent.

see also *PSK*

gateway

Converts between transport-level protocols

GSM
Channel Categories

Broadcast channels:

- Broadcast control channel
- Frequency correction channel
- Synchronization channel

Common control channels

- Paging channel
- Access grant channel
- Random access channel

Dedicated control channels

- Standalone
- Dedicated
- Control channel

Slow-associated control channel

Fast-associated control channel

see also *bearer, signaling system 7, wireless*

Hamming distance

The number of bits that differ

Hartley-Shannon law

$$C = B\log_2\left(1+\frac{S}{N}\right)$$

where
C = maximum channel capacity (bits/sec)
B = channel bandwidth (Hz)
S = Signal power (watts)
N = Noise power (watts)

Helmhotz coil

HPPI
High Performance Parallel Interface

A local area network intended to be used as the IO interface to supercomputers. At 100 MB/sec for 32-bit buses (twice that for 64-bit installations), it was fast and often used with Real-Time Graphics. Only a small number of computers were on the network. It uses a programmable cross-point switch to connect one computer to another.

Jennings (2001) ibid

Compare with *CDMA*.

iBEC

iPhone

iBSS

Boot file firmware for the iPhone

Infiniband

A replacement for FCAL and PCI; switched IO. Never really took off in 2002. There are switches and routers available for it. RDAM, queue-pair messages.

instrument landing system

Localizer for horizontal guidance (108-112Mhz), glide slope (328-335Mhz), two marker beacons (75Mhz), and uses a two-tone (90, 150 Hz) balance system to computer position relative to the desired track.

integrity it hasn't been modified – or detecting it if it has. This is also concerned with replay or reordering of messages.

see also *checksum*

intelligent network New phone system standard developed, in the 1990s, to supplant Signaling System No. 7.
Conceptual Model

- Service plane
- Global function plane
- Global service plane
- Distributed functional plane
- Physical plane

Network Elements

Network Systems

Service Negotiation and Management

- Service-independent functionality or shared functions
- Service negotiations
- Service management
- Service assurance support
- Service assurance architecture

see also *signaling system no. 7*

internet 1975, Louis Pouzin and Cerf worked on packet switching standard, International Telegraph and Telephone Consultative Committee. They couldn't penetrate the bureaucracy. Cerf went back and designed TCP/IP

see also NREN

IrDA

standard	?
range	1-2m
data rate	4Mbps
power	100 mW/sr

ISDN Interfaces 2B+D, and 23B+D. Uses the Digital Subscriber Signaling System #1 (DSS1). A-law data is XOR'd with 0x55 prior to transmission, so that the empty line is an alternating bit pattern (to improve clock recovery) rather than 0's.

Jay Duncanson, Joe Chew, "The Ultimate Link?" Byte July 1988 p278-286

North American and Japan ISDN use uLaw for companding.

see also *ATM,DSS1, T1*

ISDN broadband One of the names for ATM.

jamming Inserting noise into channel

jitter Makes sound have dropouts or stutters; makes video jerky with poor audio. Jitter is one of the factors governing minimum buffer size (the others being window size and the amount of data expected). Buffers hold data, smoothing delivery to downstream video and sound subsystems.

Amitava Dutta-Roy, "The Cost of Quality in Internet-Style Networks" IEEE Spectrum *2000, p57*

"Jitter, which is another way of saying latency variation, has many causes, including:

- Variations in queue length
- Variations in the processing time needed to reorder packets that arrived out of order because they traveled over different paths.
- Variations in the processing time need to reassemble that were segmented by the

source before being transmitted”

see also *latency*

LATA
local access transport area

Calls within that area
Calls between that area
Routing algorithm

latency

The satellite delay effects. With two-way calls, introduces subtle to awkward pauses and echoes. People seem to respond at the wrong time and/or talk over each other.

LFSR
linear feedback shift register

The feedback makes it very sensitive to a long history, making repeated sequences very unlikely. This also makes digest more sensitive to changes. Often used in:

- Spread-Spectrum
- Galois error-correcting systems
- Random number generators
- Stream-ciphers

see also *CRC*

Berlekamp-Massey

Given the output of a LFSR it can produce the shortest LFSR that reproduces it.

link budget

system losses, propagation effects, Ground State performance, frequency selection

Eb/No

Sources of noise, effects of noise

Noise Temperature, Noise Figure

Signal to noise ratio

Bit error rate

link margin

LIS
logical IP subnet

mesh network

example BitTorrent (a logical mesh network)

message energy

$M_E = \int_0^{M_T} dt\, m(t)^2$

$m(t)$ message in time space

M_T message duration

see also *bit energy*

modal damping ratio

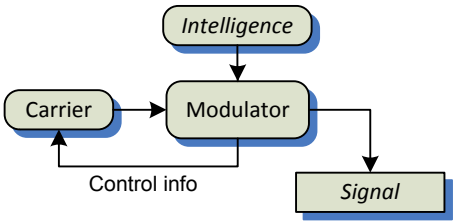
“The ratio of the damping in acoustic mode to the critical damping. (The damping ratio is inversely proportional to the Q factor, which is widely used in electrical circuits to describe the sharpness of a resonance curve, of say, voltage versus frequency.)” *Elliot, ibid*

modal overlap

“The number of modes whose natural frequencies fall within the bandwidth of any other mode. (A mode’s bandwidth is the frequency range over which its response is within 3 dB below its response at its nature frequency.)” *Elliot, ibid*

modulation

Figure 2: *Modulation*



MPEG4

Can have multiple video streams, a scene graph to overlay videos on top of others. BIFS decoder

multiple access
multiplexing

Transfers streamed data simultaneously across both the address and data line. Some systems can detect "contention," (see CSDMA) allowing for optimistic high speed access. All systems use a collision avoidance system. There are several that divide access up, some by time, frequency, or by master controller. Because once a transmission has begun, it can not be preempted, most multiple access systems involve 3 phases: prioritizing its outgoing transmissions, handling contention, and then transmitting the data.

see also *CDMA*, *CSDMA*, *FDMA*, *TDMA*

music parameters

sonic brilliance, octave, cadence, frequency range, fullness of sound, chord progression, timbre, bend (variations in pitch at the beginning and end of the same note).

network

Topology: how connected
Routing: movement in space (space allocation)
Flow-control: movement in time, scheduling (time allocation)

NREN
National Research and Education Network.

ca 1992. Commonly called "Internet". A specialized communication system that allows every delusional belief system to be located, identified, and cross-referenced. Since the scope has exceeded the previous capabilities of broadcast and telephone networks, there has been a marked increase in the level of delusional incidence as well as the destructive range of members. The mechanisms native to NREN are particularly well suited for both leaderless and leader-based organization. Current Defense Department projections indicate that NREN's principal goal – the elimination of the Zionist Conspiracy – will be fully achieved by the millennial mark, three years ahead of the scheduled Armageddon.

NTSC

A 60Hz standard for encoding color video signals. Used in North America, Canada, Japan, and most of South America

one-third octave spectrum

"A graph of the sound power contained in each 1/3 octave frequency band of a spectrum."

Elliot, ibid

packet
frame

The header and trailer around the data in a packet; the exact structure is governed by the protocol. A variety of information is stored in the header and trailer, usually error control, routing, size.

switching

Data is transmitted by means of addressed packets. Transmission channel is occupied for the duration of the packet

reassembly

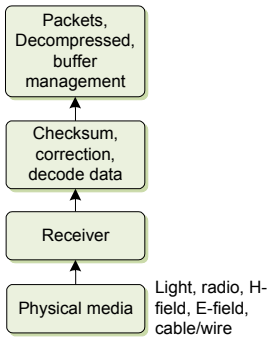
Reassembly a complete message, in proper order, from the window of packets received.

windowing

Allows multiple packets to be sent before a reply is expected. The size of the window is often negotiated. The window holds the packets – which may be out of order or missing packets.

loss

"Packet loss: Network devices, like switches and routers, sometimes have to hold packets in buffered queues when a link gets congested. If the link remains congested for too long, the buffered queues will overflow and data will be lost."



Dutta-Roy ibid

PAL
phase alternation line

A 50hz composite color video standard used in many parts of the world. The phase alternation makes the signal relatively immune to certain distortions, compared to NTCS. PAL is employed in Western Europe, India, China, and some

	Middle East countries.	
path loss free space	$Path\ Loss = 20\log 4\pi\frac{r}{\lambda}$	
PBX Private Branch Exchange	Typically receives the last 2 to 4 digits of a dialed number so that the PBX can route the phone call to the proper phone (or an "extension" management system) Direct In-Dial Operation (DID) Foreign Exchange Service.	
PCI peripheral component interface	A bus that allows concurrent bus-mastering, pipe-lining IO queue, full burst-mode, and multiplexing.	
PDH plesiochronous digital hierarchy	Being replaced by the synchronous digital hierarchy. 2.048 Mbit/s, but split into 32 virtual channels: 30 for voice (bearer's, or b-channels), and 2 signaling and synchronization. Each channel works at 64Kbit/s each	
propagation standard atmosphere	troposphere & constituents ray propagation effective-earth radius see also *path loss*	
nonstandard atmosphere	subrefraction, superrefration, types of ducting metereological processes involved	
PSK receiver design	Carrier recover Phase slips Ambiguity resolution Different coding Data detection Clock recovery Bit count integrity	
pulse stuffing	A time-division multiplexing term. Bits are added to one stream of data so its rate is the same as the master clock's.	
QOS quality of service	"QOS refers to an aggregation of system performance metrics. The foremost important of these are: ▪ Availability… ▪ Throughput… ▪ Packet loss… ▪ Latency .. ▪ Jitter."	*Dutta-Roy* ibid
radio communication systems	wireless: media interface: antenna & amplifier, laser, optoelectrical, coil h-bridge, amplifier. FHSS and modulation	
bluetooth LE	easy connection	
cell	talk to tower to negotiate power (time code division prevents collision)	
wifi	transmit at high power so that everyone in the local net can detect a collision. Wifi config sucks	
Rambus DRAM	Similar to SDRAM except that it read and writes on both the rising and falling edges of the clock cycles, thus is twice as fast. As the data rate increases, rules about the wire-length (all must be the same length), balancing and other properties to keep signal clean.	

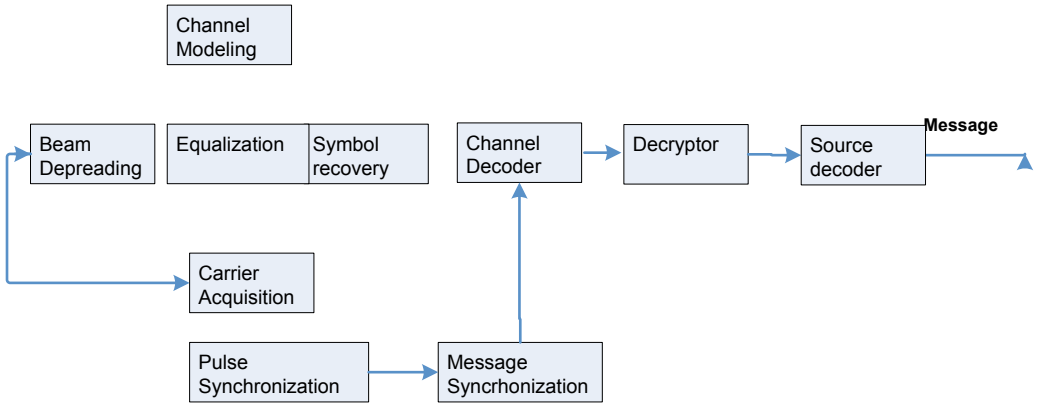
RDRAM also uses a packet-based signaling technique

RBOC
Regional Bell Operating companies

Inter-exchange carrier services

see also *LATA, PBX*

receiver



Reed Solomon coding

Symbols are usually bits,

m: block length
N is the total number of symbols per codeword; the length of the output
R is the number of check symbols per codeword
The original data is a block of N-R symbols,

Field Polynomials determines the order of the elements in the finite field. Depends on the number of bits per block.

Generator polynomial starting root.

See also *BCH*

Irving S. Reed, Gustave Solomon "Polynomial Codes over Certain Finite Fields" 1960, Journal of the Society for Industrial and Applied Mathematics.

decoding

Much more complex than encoding. The steps are:

1. Syndrome calculation. Input symbols are divided into the generator polynomial, the errors are the remainders. The check symbols force this. If there are non-zero remainders (errors), passed to the next stage (otherwise out)
2. Euclid algorithm. Find factors of the remainder.
3. Chien search. Repeatedly check these against the input symbols, (evaluate polynomials) finding the errors and correcting them. May flag failure to recover

RF components

HPA, SSPA, LNA
Up/down converters
Intermodulation
Band limiting
Oscillator phase noise

RFID

see also *remote keyless entry*

router
global

Handles the broad outline, and assigns system wide traffic.

detailed

Do final routing.

Restricted (channel). Assigned boundary conditions by the Global Router, then compiles it, channel by channel. The channel is modeled as a contiguous block of routing space, pins as two sides.

Area. Pre-wires are treated as blockages. Done incrementally. Maze: Divides the chip

into sections and uses BFS to search, grid by grid, to determine the routes.

Line-probe. Look for the quickest & easiest way to connect two points directly.

specialized — Handles special circumstances.

RS-170 — The encoding standard for 60hz black-and-white television signals. This is used as the for most monochrome video equipment.

RS-170A — Technical standard for NTSC Color TV

SAN
storage area network — The Area is local vs iSCSI (over ethernet), FCAL over optics and copper. Most systems effectively have a limit on the number of outstanding IOs, and the write is even slower. Database and transactions often come down to a few key writes before the flurry of IOs. Hard to make the rest of the system without focusing on those, and it is hard to make those fast – easier with micro-Controllers where you can make this SRAM.

SAS
serial attach SCSI — Beyond SATA

SAS_2 — Mathematic software contrast with MATLAB and Simulations.

SATA
serial ATA — Low-cost & enterprise drives. Single attachment. Lower cost than FCAL

scanned linear array — A line of tiny LED or other emitters that "sweeps" (possibly via a mirror) rapidly back and forth to create a virtual image.

SCSI — low-cost & enterprise type drives. The block command set includes:

- Block layout, extents vs discrete addresses
- EMC NAS HighRoad (MPFS multipath file system)

The SCSI object command set:

- OSD: object based storage devices
- Object Id's
- Compact storage layout, complex parameters to describe striping patterns
- Object's have a security capability required for accessing the data on the OSD's

SDR use

carriers

use of signal band

detect cellphones

decode GSM (not voice)

SDRAM
synchronous DRAM — Data is input on the rising edges of the two-edge external system clock cycle. Synchronous refers to being on tied to the clock line. Offers higher data rates than asynchronous DRAM, and allows pipelined access to memory.

signal processing
uses of

sources of noise by type

Identify hum, overtones

Environment & Reflection

- interference & reduced by performance

Signaling System No. 7 — The standard telephone service protocol, developed in the 1970's. It employed the plesiochronous digital hierarchy.

Architecture

- Service Switching Point (SSP)
- Signal Transfer Point (STP)

- Service Control Point (SCP)
- Signaling Link (SL)

Network Services

- Level 1: Links
- Level 2: Services. Signal Unit Formats – MSU, LSSU, FISU, Unit error control
- Level 3: Services. Signaling message structure and format. Signaling connection control part (SCCP) services.

Network Services Part

- Message Transfer Part
- Signaling Connection Control Part

Message Transfer Part

- Signaling data link level
- Signaling function link level
- Signal units
- Message types and structure
- Network node information
- Network management message types
- Link and route management
- Traffic management

Signaling Connection Control Part

- Routing and Discrimination
- Global title routing
- Subsystem management

see also *intelligent network*

signal to noise ratio

The ratio of total signal to noise expressed in decibels (dB) The larger the number better.

$$SNR = 20\log\frac{rmssignal}{rmsnoise}$$

see also *signal to noise and distortion ratio*

signal to noise and distortion ratio

The ratio of the input signal to the sum of noise and harmonics

$$SINAD = 20\log\frac{rmssignal}{rmsnoise + harmonics}$$

SIP session initiation protocol

Announces who is online or allows finding out who is online, and how they are available.

SMDS

Before ATM

sound field

"A region containing sound waves." *Elliot,* ibid

sound pressure level

"A logarithmic measure of the mean square acoustic pressure expressed in decibels, with a reference pressure of 20 μPa rms. (Normal conversation at 1 meter has a sound pressure level of about 60 dB, a vacuum cleaner about 80 dB, and large industrial machines 100-120 dB, or close to the threshold of pain.)" *Elliot,* ibid

Free space sound pressure level: dB SPL = 20 log (P/ 200 u dyne/cm^2)

speech quality

inflection (change in pitch) of accented syllables, end of sentence.

coarticulation

tonal sounds: all vowels sounds, definite pitch that depends on inflection of voice

syllable inflection: accent or stress on a particular syllable

phrase inflection: overall pitch pattern for the phrase (question, exclamation, ordinary)

percussive sound: no pitch, short (e.g. p or t)

atonal: no pitch, no tone, but any duration (e.g. s, or f) depending on speed of speech

coarticulation

Store a diphone (sound sample) for every possible pair of phoneme sounds. Most important between tonal sounds.

spread spectrum

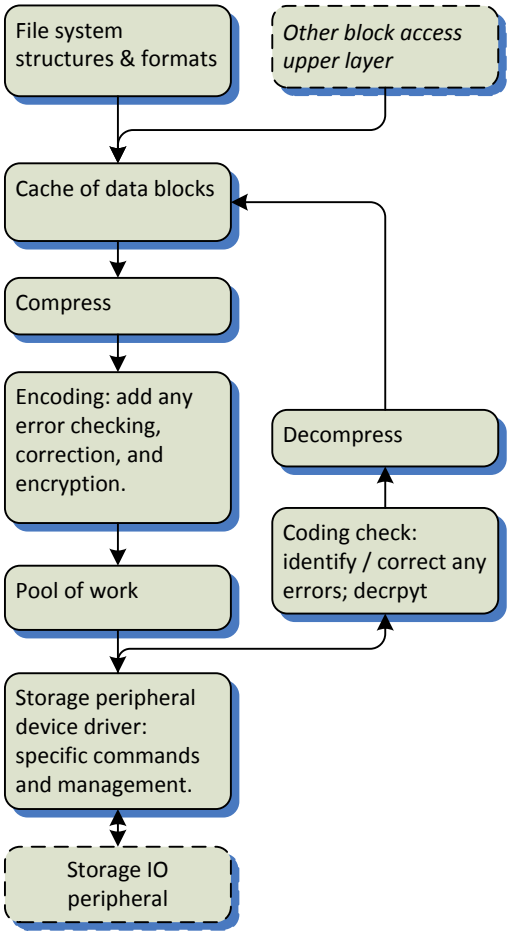
a family of techniques that increases a signals bandwidth to make it resistant to interference and jamming. This robustness often lowers the power requirements to transmit a signal.

see also DSSS (*direct sequence spread spectrum), FHSS (frequency hopping spread spectrum), and time sequence spread spectrum*

storage communication

Storage blocks are *cacheable*, allowing mechanisms to reduce traffic on the IO channel.

Figure 3: *Storage IO stack*



store and forward

Buffers the complete packet. Performs CRC error check. Then drops or sends thru the appropriate port

see also *cut-thru*

streaming A transfer of continuous sequences of data instead of having to start over with a new packet or out-of-order.

system metric Capacity of the system; arrival process model – the timer interval; load on the system; scheduling method, service discipline; job mix – distribution of jobs among sub classes.

T1 line 24 outside lines, 1 circuit-board in a PBX. Named for the section of the specifications (including the ANSI specifications) that define its operations.

TCP/IP mobile IP developed by IBM

TDMA
time division multiple access Useful for isochronous data. All users on the same channels, each assigned the total bandwidth for a limited time. Guard times – unused slots – buffer against interference.

text scanner Optical character

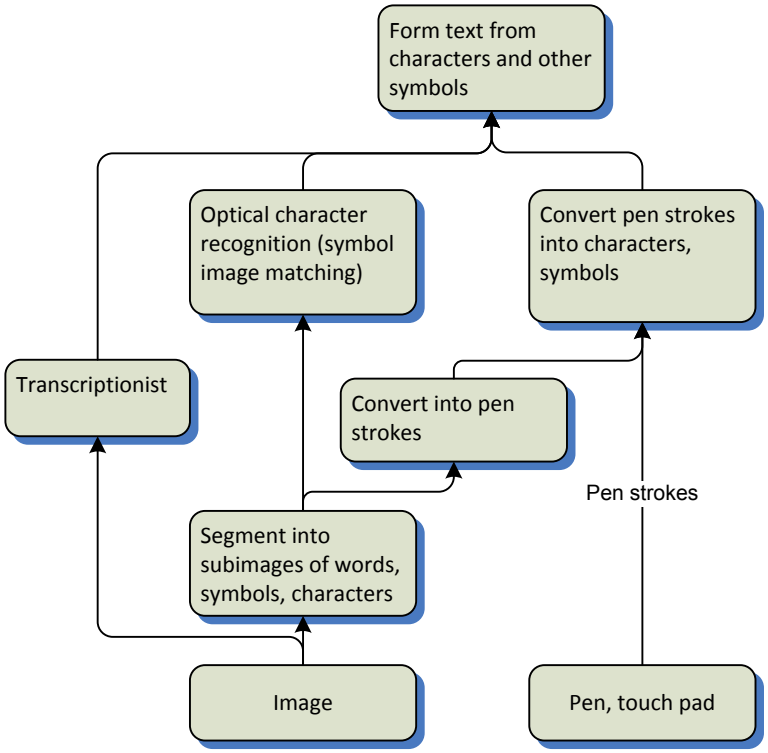


Figure 4: *Levels of processing in scanning a text*

pen stroke description Direction lists:

- A list of n,e,s,w movements
- A list of nw,ne,se,sw movements
- A list of movements in terms 0, 45, 90, 135, 180, 225, 270, 315 deg movements

Two lists of positions – one of the x coordinates, one of the y coordinates (binned down)

Although not every character may be recognized – especially with cursive – the word as a whole may be recognized as a whole (

The number of symbols used, which symbols are variations; what the spacing is. The number of symbols per word. Erasures and corrections. Repetition of words, and phrases.

token ring

Uses many flags, counters and timers for performance, management, and reliability. Token ring's peak utilization is about 75%-80%

transmitter

trunk

A trunk from the central office. Passes the last 2 to 4 digits of listed directory number to PBX

turbo codes

Systematic, linear block codes. Encoders use two or more parallel-concatenated constituent encoders. Decoders incorporate two or more soft-input soft-output decoders, with a pseudo-random interleaver, and iterative decoding.

Typically it concatenates the input, one encoding of the input, and a interleave-then-encoded input.

Claude Berrou, Alain Glavieux, Ecole Nationale Superieure des Telecommunications de Bretagne

Adrian Barbulescu, What a Wonderful Turbo World, *http://people.myoffice.net.au/~abarbulescu/*

UPC system digits

0 92,000 manufacturers, 8,000 locally assigned numbers
1 reserved
2 random-weight consumer products
3 Drug products
4 In-store marking without formal definition
5 UPC coupons
6 Manufacturer ID numbers
7 Manufacturer ID numbers
8 reserved
9 reserved

USB
universal serial bus

Descriptors. More than one descriptor is typically employed by a device. They are tree structured. Progressively provides additional specification of abilities. Provides alternate resource options. Use a map of other descriptor or configuration set.

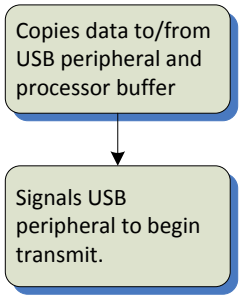


Figure 5: *Packet transmission layer of USB*

storage device (MASS profile)

Data is sent over the bulk transfer protocol

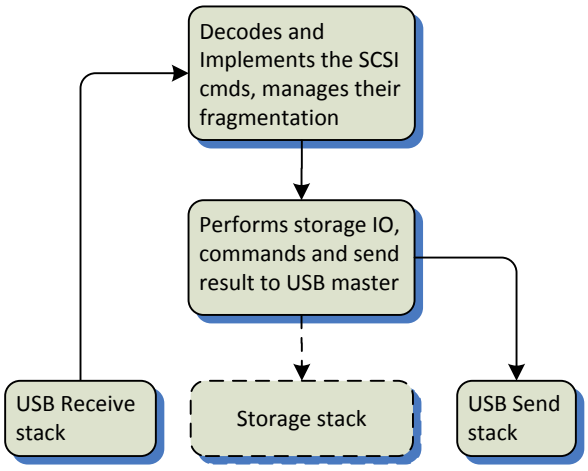


Figure 6: *USB stack for mass storage devices*

UWB
ultra wideband

UWB Forum: 1.3Gbps; max range of 3m

WiMedia Alliance: 480Mbps, 10m,

14.500Mhz wide bands. Channels have 3 bands each
Band 1: 3,432 MHz
Band 2: 3,960 MHz
Band 3: 4,448 MHz
Band 4: 5,016 MHz
Band 5: 5,544 MHz
Band 6: 6,072 MHz
Band 7: 6.600 MHz
Band 8: 7,128 MHz
Band 9: 7,656 MHz
Band 10: 8,184 MHz
Band 11: 8,712 MHz
Band 12: 9,240 MHz
Band 13: 9,768 MHz
Band 14: 10,296 MHz

standard	802.15.3a?
frequency	3.1 – 10.6 GHz
range	3m - 10m
media multiplex method	Orthogonal frequency-division multiplexing
data rate	100-500 Mbps
output power	1 mW
origins	Mixed

viterbi

Estimates the probability of different possible "inputs" that could have created the received (or similar) codeword, and chooses the most likely. The tracking of different possibility is very similar to a Djikstra algorithm. How much needs to be tracked?

walled garden

The telecom carriers will provide only a little bit of info, and not really allow much access to the Internet. Want a nick for every transaction, and "revenue sharing" is a tough sell.

see also *bearer*

WiFi

standard	IEEE 802.11.a,b,c
frequency	802.11a: 5Ghz, 802.11b: 2.4Ghz, 802.11g: 2.4GHz
range	802.11a: 20m, 802.11b: 110m, 802.11g: 50m
Data rate	802.11a: 54Mbps, 802.11b: 11Mbps, 802.11g: 54Mbps
output power	802.11a: 40-800mW, 802.11b: 200mW, 802.11g: 65mW

WINCS

WWMCCS Intercomputer Network Communication Subsystem

wireless communication

audio, optical, radio, other

wireless
stack

The current wireless stack looks like

- WAE, the Application Layer
- WSP, the Session Layer
- WTP, the Transportation Layer
- WTLS, the Security Layer

- WDP, the Transport Layer
- Bearer

see also *bearer, modulation, Ultra-wideband Wifi, Zigbee, Z-Wave*

physical layer

The physical layers can be

- optical,
- radio: Bluetooth, ultrawideband USB, wifi, zigbee, Z-wave, audio (audible, ultrasonic), H-Field, E-Field

These have differences in handling media mulitplexing, propagation (see *propagation)* handling multipath (reflections), sensitivity to environment conditions and noise (see *link budget*)

see also *modulation*

multiplexing methods

Direct sequence spread spectrum

orthogonal frequency-division multiplexing

transport layer security (WTLS)

Based on SSL (now known as TLS). It is intended to provide the following features

- Data Integrity
- Privacy
- Authentication (terminal to Application Services)
- Denial of Service protection thru replay protection and reject of packets

value chain

- Content Providers
- Portal
- Wireless ISP (OmniSky, Palm.Net, RIM)
- Carriers (Vodafone, DoCoMo,Cingular,
- Technology enabler
- Device (such as the phone)
- Infrastructure

WWMCCS

World Wide Military Command and Control Systems

XMODEM

1. Receiver sends out a series of NAK characters at 10second intervals. Sender will send out data packet:
    a. SOH, Block number, One's complement of block number, 128 bytes of data, checksum byte. (Sum of each data bytes)
2. Receivers sends ACK if passed checksum, NAK if it didn't. The sender will resend on NAK.
3. Sender sends next packet or EOT.

see *coding*

Zigbee

see also *Bluetooth, flow-control (credit-based)*

standard	IEEE 802.15.4
frequency	868Mhz (Europe), 915Mhz (Americas) 2.4 Ghz (Worldwide)
Range	2.4 GHZ: 10 m indoor, 200m outdoors other: 30m indoors, 10000m outdoors
Media Multiplex Method	Direct Sequence Spread-Spectrum
Data rate	250Kbps 2.4Ghz; 40Kbps 868 Mhz, 20 Kbps 868 Mhz.
Security	AES128
Topology	Mesh, all nodes can connect to and communicate

directly with each other.

Nodes Up to 65536 nodes, but should limit to 3,000.

origins Came from the failed HomeRF initiative

Zwave Zensys, 9.6kbps, 915Mhz, mesh topology (any node can be a repeater) Used for X10 home control

"Data Translation 1994 Product Handbook" Data Translation 1994 800-525-8528

Physics of Information Technology, Neil Gershenfeld 2000, Cambridge University Press

"Sources of failure in the Public Switched Telephone Network" D Richard Kuhn, IEEE Computer April 1997, p31-36