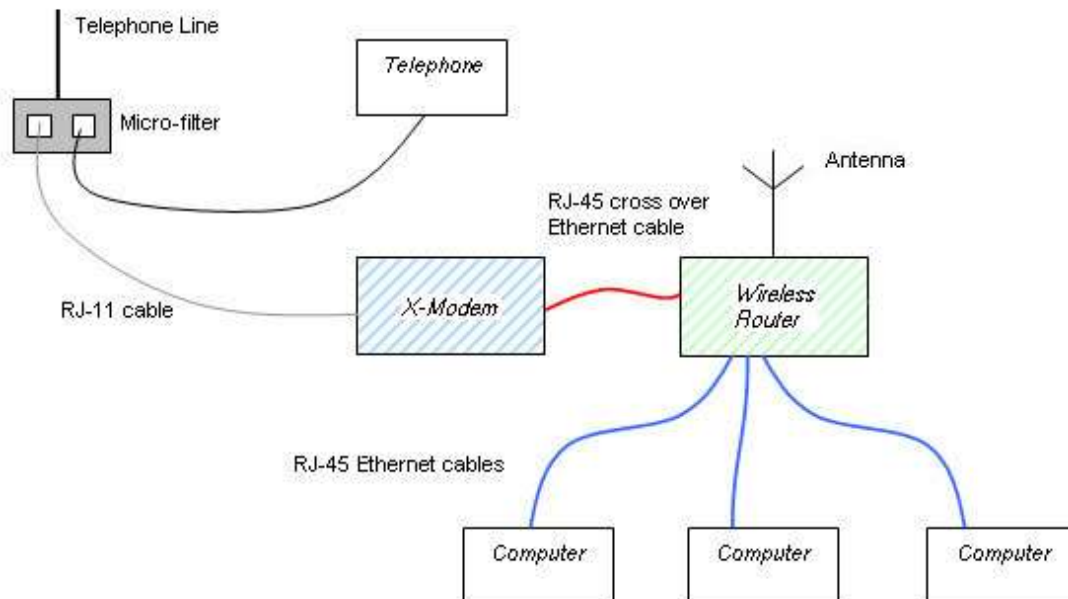# X-MODEM

It is a simple file transfer protocol developed as a quick hack by Ward Christensen for use in his 1977 MODEM.ASM terminal program. It allowed users to transmit files between their computers when both sides used MODEM. Keith Petersen made a minor update to always turn on "quiet mode", and called the result X-MODEM

X-MODEM became extremely popular in the early bulletin board system (BBS) market, largely because it was so simple to implement. It was also fairly inefficient, and as modem speeds increased this problem led to the development of a number of modified versions of X-MODEM to improve performance or address other problems with the protocol. Christensen believed his original X-MODEM to be "the single most modified program in computing history.

X-MODEM, like most file transfer protocols, breaks up the original data into a series of "packets" that are sent to the receiver, along with additional information allowing the receiver to determine whether that packet was correctly received.

The original X-MODEM used a 128-byte data packet, the basic block size used on CP/M floppy disks. The packet was prefixed by a simple 3-byte header containing a <SOH> character, a "block number" from 0-255, and the "inverse" block number—255 minus the block number. Block numbering starts with 1 for the first block sent, not 0.

XMODEM with 133 bytes packets with CRC
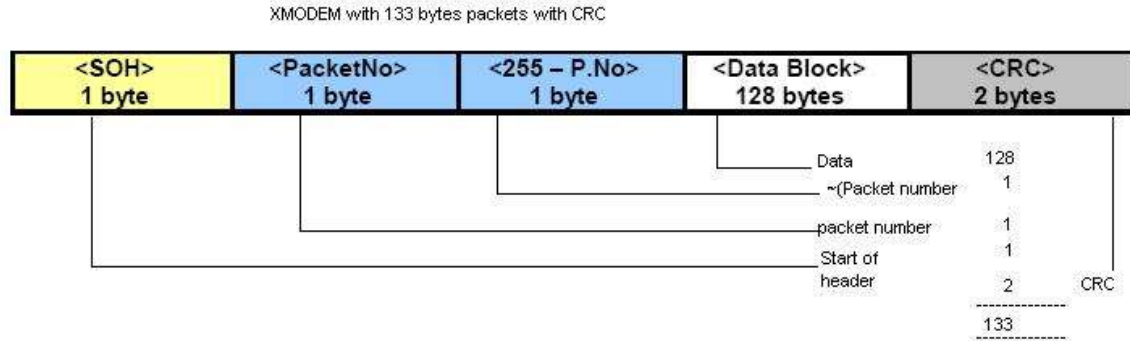
Files were transferred one packet at a time. When received, the packet's checksum was calculated by the receiver and compared to the one received from the sender at the end of the packet. If the two matched, the receiver sent an <ACK> message back to the sender, which then sent the next packet in sequence. If there was a problem with the checksum, the receiver instead sent a <NAK>. If a <NAK> was received, the sender would re-send the packet, and continued to try several times, normally ten, before aborting the transfer.

A <NAK> was also sent if the receiver did not receive a valid packet within ten seconds while still expecting data due to the lack of a <EOT> character. A seven-second timeout was also used within a packet, guarding against dropped connections in mid-packet.

The block numbers were also examined in a simple way to check for errors. After receiving a packet successfully, the next packet should have a one-higher number. If it instead received the same block number this was not considered serious, it was implied that the <ACK> had not been received by the sender, which had then re-sent the packet.

Problems

X-MODEM was written for CP/M machines, and bears several marks of that operating system. Notably, files on CP/M were always multiples of 128 bytes, and their end was marked within a block with the <EOT> character. These characteristics were transplanted directly into X-MODEM. However, other operating systems did not feature either of these peculiarities, and the widespread introduction of MS-DOS in the early 1980s led to XMODEM having to be updated to notice either a <EOT> or <EOF> as the end-of-file marker.

For some time it was suggested that sending a <CAN> character instead of an <ACK> or <NAK> should be supported in order to easily abort the transfer from the receiving end. Likewise, a <CAN> received in place of the <SOH> indicated the sender wished to cancel the transfer. However, this character could be easily "created" via simple noise-related errors of what was meant to be an <ACK> or <NAK>. A double-<CAN> was proposed to avoid this problem, but it is not clear if this was widely implemented.
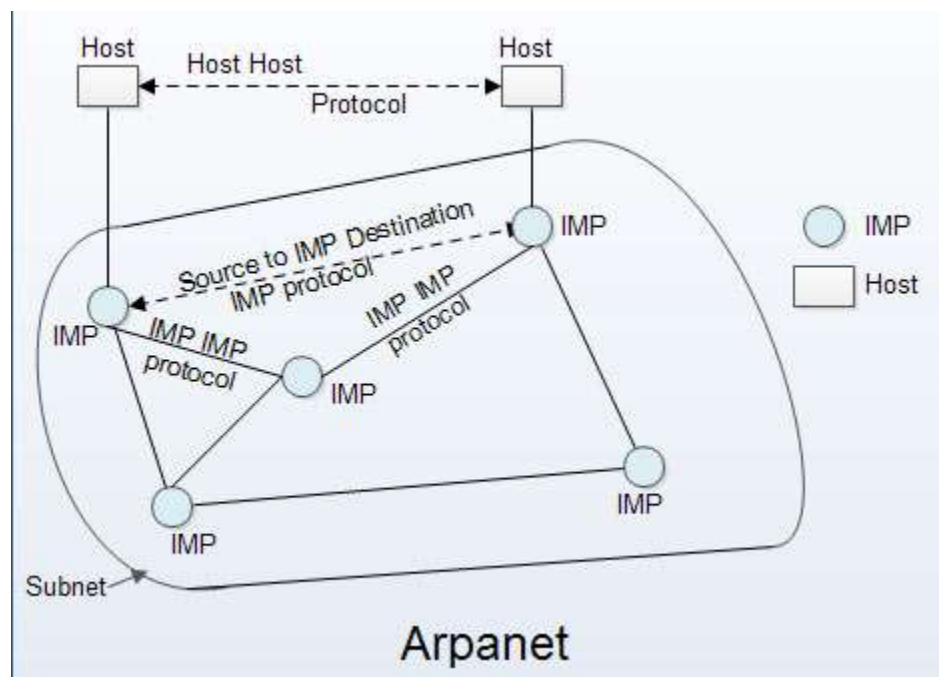
ARPANET

It started in 1960s funded by Advanced Research Projects Agency (ARPA), an organization of the US Defense Department and, therefore, named as ARPANET.

ARPANET was built to accommodate research equipment on packet switching technology and to allow resource sharing for the Department of Defense's contractors. The network interconnected research centers, some military bases and government locations. It soon became popular with researchers for collaboration through electronic mail and other services.

It is basically a WAN. It was developed by the ARPA (Advanced Research Project Agency) in 1968 which is the research arm of 000.

• ARPANET was designed to service even a nuclear attack.

• Before ARPANET, the networks were basically the telephone networks which operated on the circuit switching principle.

• But this network was too vulnerable, because the loss of even one line or switch would terminate all the conversations.

• ARPANET used the concept of packet switching network consisting of subnet and host computers.

• The subnet was a datagram subnet and each subnet consists of minicomputers called IMPs (Interface Message Processors).

• Each node of the network used to have an IMP and a host connected by a short wire.

• The host could send messages of upto 8063 bits to its IMP which would break them into packets and forward them independently toward the destination.

• The subnet was the first electronic store-and-forward type packet switched network. So each packet was stored before it was forwarded.

Arpanet

• The software for ARPANET was split into two parts namely subnet and host.

• In 1974 the TCP/IP model and protocol were invented specifically to handle communication over internetwork because more and more networks were getting connected to ARPANET.

• The TCP/IP made the connection of LANs to ARPANET easy.

• During 1980s so many LANs were connected to ARPANET that finding v hosts became increasingly difficult and expensive.

• So DNS (Domain Naming System) was created for organizing machines into domains and map host names onto IP address.

• .In 1983 the management of ARPANET was handed over to the Defense Communications Agency (DCA) which separated the military portion into a separate MILNET.

• By 1990 the ARPANET was shut down and dismantled, however MILNET continues to operate.