

Econet®  
Acom Computer local area network

## Acorn Computer local area network

### Introducing the Acorn Econet

Now there is a simple and cost-effective way to link up a series of microcomputers. It is the Econet system, created by Acorn Computers - the team which designed the BBC Microcomputer.

The Econet network system, which is only a fraction of the cost of comparable networks, allows up to 254 computers to communicate with each other and to share expensive resources such as printers or disc drives.

### In education

Computers in education have two main areas of applications: Computer Studies and Computer Assisted Learning. In both areas the Acorn Econet has a major contribution to make as a low-cost networking system.

A typical Econet installation allows fully interactive teaching and Computer Assisted Learning, as well as the sharing of disc storage and expensive peripherals.

The Econet has a number of commands that allow the teacher to take complete control of one, or more machines, without the target machine cooperating, or even being aware that control or surveillance is taking place. So the pupils' progress may be monitored throughout the lesson. The VIEW command allows the teacher to look at pupils' screens. The NOTIFY command allows the teacher to send messages across the network. The REMOTE command allows a pupil's computer to be instructed directly from the teacher's keyboard. These commands can be protected to prevent unauthorised use by the pupils, to stop copying, for instance, whilst allowing the teacher complete access. Shared peripherals may include printers, disc storage systems, teletext adaptors or second processors, among others. The Econet allows them to be shared amongst pupils requiring such devices. The low cost of the Econet makes this facility a tremendous advantage in educational computing installations.

Files on the disc can be automatically loaded either when the machine is switched on, or when a pupil 'logs on' to the file server under his name. This facility means that pupils can all share a particular CAL program as soon as the lesson starts, but they may also have their personal set of programs.

Of course, an Econet can be made larger than a single room, so that, for instance, there may be a station in a remote laboratory or simply a demonstration room. This means that experiments which require computer control may be initiated elsewhere or data received from a distant device connected to the network. Moreover, all of the computers on the network can be moved about to any location with an appropriate socket without changing the machine in any way, so equipment can be transferred from classroom to classroom.

### In industry

The Econet has tremendous scope for use in industrial applications. For example, the Econet can be incorporated into factory data collection systems. The majority of the data collection systems used in factories implement a master-slave system where a multi-tasking central computer polls data collection points continuously

A better scheme can be implemented using the Econet by distributing the processing power throughout the system. Each data collection point has its own microprocessor which collects and stores the data locally. Since any Econet station can originate a data transfer, the data collection points send their data to the central point only when a change in the data occurs. This eliminates the need for the central computer to poll the data collection points. Thus most software can be written as a single task in a high-level language, and a multi-tasking operating system is not needed.

The reliability of the system is excellent, since the failure of one station on the Econet does not affect the operation of the others; the differential line drivers give good noise immunity in a factory environment.

The low-cost nature of the Econet must not be overlooked as the relatively simple hardware required at each station makes it possible to incorporate the Econet into very inexpensive data collection units.

### In business

In the modem business environment, managers require immediate access to up to date information, easy internal communication within the company and low capital expenditure on overheads such as office equipment.

The Acorn Econet can be used as the heart of business systems that provide these requirements.

Information entered via workstations on the Econet may be stored in central disc filing systems that can be configured to allow open or restricted access to files. Having been entered, up to date information may be retrieved by those who need it. Moreover, data retrieved from storage may be processed at a station to give immediate results; for example, new data may be used in a financial planning program to give immediate confirmation of the progress of a particular business plan.

The Econet also allows the use of electronic mail; messages may be sent between stations using the NOTIFY command.

With the VIEW word processing program for the BBC microcomputer, the Econet's use of shared peripherals drastically reduces the spending required on office equipment, as one correspondence quality printer may be utilised by all the stations on the network.

Econet is highly reliable. The failure of one 'station' on the network does not affect the others. The system has been in use for over two years. Nearly 200 installations have been made so far.

## How Econet works

The Econet system is a bus-type network with all stations connected by a single cable. It is totally democratic. All stations have equal access to the network.

Traffic jams and collisions on the network are avoided by the introduction of three key elements to the system:

- o Before it transmits, each computer on the network automatically waits until there is a gap.

off, by chance, two computers do start transmitting simultaneously the collision will be spotted by the special detector in the Econet interface and transmission will be stopped.

- o Each of the computers involved will then retry. A 'collision-arbitration' algorithm ensures that no two computers go through the same sequence of actions.

These safeguards enable efficient use of the network with the minimum of retries.

## A typical Econet network

A typical Econet network would consist of the following:

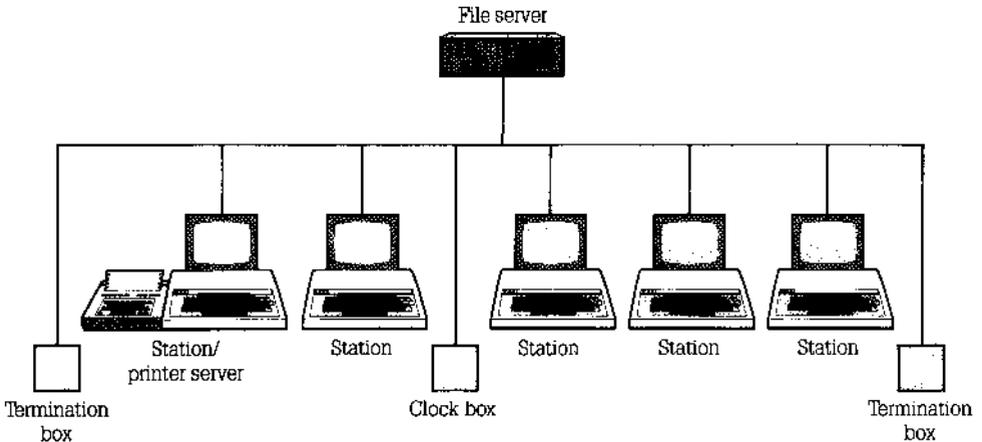
- o microcomputer 'stations' (up to 254 in each network).
- o 'File server, which organizes disc files for the network.
- o Clock box, which synchronises the network.
- o Two termination boxes, which mark each end of the network.

Where a printer or disc drive is used one of the microcomputers in the network has to be dedicated as a 'printer server' or 'file server' though either can revert immediately to being an ordinary computer if discs or printer are not required.

### File server

The file server can be a BBC Microcomputer with second 6502 processor and disc system or an Acorn System 3, 4 or 5. Shared and public files can be held on a disc system. Private files, as the title implies, can only be accessed by the user who created them. In the same way users can only delete their own files.

All files are held in directories and each user has a 'user's root directory', which leads them to their own files.



A typical network layout

### Printer server

When a printer is used one of the stations has to be dedicated as a printer server. In a simple set-up this could be an ATOM or BBC Microcomputer running the print server program. Files sent to the station will be printed immediately if the printer is free. If not, the message 'BUSY' will be sent back to the station on the network which sent the file. It is also possible to have a system which puts files in a queue until the printer is free.

### Clock and termination boxes

Each network needs one clock and two terminators, which are connected to the network.

## Linking up to the network

The Econet interface's simple design ensures reliability and low cost.

BBC Microcomputer - the interface is fitted to the main circuit board, either before delivery or at a later stage by a dealer.

ATOM - the interface is on a narrow board which connects internally to the ATOM.

Acorn Systems - a Eurocard interface board is available for connection to any of these systems.

Computers on the network are connected together by two twisted cables with screen. Sheathed cable such as BICC type CS7227 and readily available 5 pin 180 degree DIN plugs and sockets are recommended.

The computers communicate with each other using a simple, low-level protocol. Here is an example of how it works:

o Computer A checks that the network is free and sends a 'scout' message to computer B. The 'scout' contains the destination address, source address, control byte and port number.

o Assuming there was no collision during transmission of the scout, computer B checks if any receive requests are available from computer A on port B. If a message is expected a short reply message is sent to station A saying the main data can be sent. o Computer A sends the data to computer B.

o Finally computer B sends a short message indicating the data was received successfully

## Software

There are three types of network software:

1 Econet interface software, in 8K EPROM for the BBC Microcomputer, and 4K EPROM for the ATOM and for SYSTEMS. The software consists of Network Filing System (NFS) and low-level primitives that are used

either by the NFS or for the implementation of special-purpose protocols by user programs.

2 File station software, which controls disc storage and supports shared filing system for all users.

3 Printer station software, which is either EPROM for BBC Microcomputer or disc program with ATOM.

## Network Filing System

The Network Filing System (NFS) takes over from the resident filing system when it is selected as the current filing system. The NFS provides a set of commands that replace the equivalent cassette or disc filing system commands; in addition it provides several special commands for performing functions associated with the network.

For example:

\*VIEW Displays a copy of the screen of the specified station.

\*REMOTE Takes over a specified station. The master system becomes a terminal to the slave system whose keyboard is disabled.

"NOTIFY Sends a single line message to the specified station.

## Special features of Econet

- o Full high level software facilities
- o High speed data transfer
- o Simple 4-wire cable interconnection
- o Up to 500 metres separation
- o Compatible with all Acorn computers
- o Ideal for classroom and small business use
- o No restrictions on shape of network

## Advice

For full details and advice on how Econet can help you contact:

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