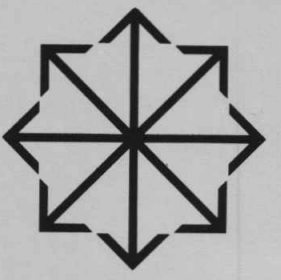
# CLUSTER ONE



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# An Overview of the Cluster/One(tm) System

## What is Cluster/One?

Cluster/One is an inexpensive distributed computer system based on independent personal microcomputers. Cluster/One creates a new dimension in low-cost computing. It provides many of the facilities of large time-sharing systems, but with the important advantage that the "terminals" are small computer systems, each with its own CPU and memory. A Cluster/One system can be configured with as many as thirty separate user stations. These stations are true personal computers, capable of independently running programs written in BASIC. Cluster/One stations can be Apple II, Commodore PET or Radio Shack TRS-80 computers. A Cluster/One system can have a mixture of these computers all working simultaneously, and does not have to be composed of entirely one type of user station.

In a time-sharing system each user has only a portion of the central computer available for executing his program, and if several users are running programs simultaneously, the demands can cause delays and a decrease in the response time and apparent computational speed of the system. With a Cluster/One system each user has the full resources of his individual computer available all the time, so there is little degradation when the system is heavily used by many users.

Cluster/One provides for the sharing of expensive resources... but not of the "computing" portion of a time-sharing system, which can be inexpensively provided by personal computers. Cluster/One provides a high speed, large capacity centrally located disk system to which all the individual stations are connected. The connection scheme makes it possible for any station to use, modify and maintain hundreds of BASIC programs on the central disk system. The sharing of programs eliminates the need for making separate copies for each user, and the physical handling and delays involved in passing tapes or diskettes from user to user. Each user can use a different program from the central library, or all users can work on the same program. Whenever a change must be made to a program only one copy need be changed. After that, all users have access to the updated version.

A Cluster/One system provides many new avenues for sharing resources. Subsequent releases of the Cluster/One system will give you the ability to install a central printer which is available to any of the user stations. Listings of programs can be made by any user, without physically switching the printer

from station to station or developing special interfaces for each different type of user station. Furthermore, when users request program listings they do not have to wait for the printer to be free or for their printout to complete before continuing to use Cluster/One or their own personal microcomputer. Listings are saved on the disk, and printed whenever the printer is available.

Users will also be able to share data files using future releases of the Cluster/One system software. Separate stations will be able to make inquiries or updates to common data kept on the central disk unit. They will also be able to keep secure files which cannot be accessed by other users. In the educational environment, for example, this can be used to store and update student grades. Add to that the ability to move programs from any one of the three supported personal computers to another without having to type in hundreds of lines of code, and you have some idea of what you can do with the Cluster/One approach.

## Cluster/One applications

Today's Cluster/One system is ideal for use in the classroom, laboratory or program development environment. With the availability of central data base support many new applications in the small business area will become feasible. Of course, since Cluster/One doesn't interfere with the use of cassettes or minidisks connected to each user station, existing applications written for stand-alone personal computers are possible right now.

In the classroom, a Cluster/One system lets everyone get down to work in a matter of seconds. Programs are loaded in a few seconds, a hundred times faster and much more reliably than from tape cassette. Students can be working on similar or identical programs, or doing independent work. They can save their own programs on the central disks, or by changing one of the two diskettes in the Cluster/One unit save a copy on a private disk. Disks cost about five dollars each, and can hold hundreds of programs. At the end of a class, everyone can save their work equally rapidly, with all programs verified automatically as they are written on the disk.

For laboratory use, each microcomputer station can be used to simulate experiments that are either expensive or dangerous to do. The graphical abilities of the supported microcomputers provide for excellent displays of equipment, graphs, charts and moving objects. Local laboratory instruments can also be interfaced to the user stations for data collection or monitoring. Much expensive laboratory equipment can be modelled using the microcomputer stations, instead of being purchased.

Users interested in developing programs for use on personal microcomputers will find that the Cluster/One system provides a large increase in personal productivity. Several stations can be modifying or testing a common library of programs. It becomes

easy to maintain backup copies, and the reliability of the large, full-sized floppy disks reduces the chances of accidental loss. The upcoming program transfer capabilities provide major support for the production of compatible software for the Apple, PET and TRS-80. Very large software systems can be run on a Cluster/One system, since one BASIC program can cause others to be loaded from the disk and executed. This facility can be used for tutorial applications such as instruction in computer programming, math exercises, reading drills, and so on.

A Cluster/One system can be used in a drop-in computer center as a commercial venture. Both recreational and educational offerings can be provided at very low cost. Computer dealers can very effectively demonstrate and compare the capabilities of the Apple, PET and TRS-80 using a Cluster/One. The excellent response time (typically less than two seconds to load a program), and the size of the immediately accessible program library makes it a very effective sales tool. In a matter of minutes, one can demonstrate a great variety of different applications, including software offered for sale over the counter.

Cluster/One economy

Low cost personal computers provide individual microcomputer capability at the price of just a terminal alone. That's why a fully configured Cluster/One system costs only a fraction of what a time-sharing system costs. And in some ways Cluster/One surpasses a time-sharing system: for example, the ability to use animated graphics, and the instantaneous response for editing programs. Distributed processing gives better performance at a lower cost.

The ability to share a program library avoids wasting disk space which results from storing multiple copies of a program. For instance, if an 8 KB program is kept on 15 separate minidisks, one at each station, that one program uses up 120 KB of disk space- the size of one entire minidisk! The ability to share larger, eight inch floppy disks keeps system costs down, and simplifies maintenance. The same principle applies to the use of a central printer. A single higher speed and higher quality printer will serve far better and be much less expensive than several low-cost units.

There is also an ecomony gained from having only one copy of the operating system software which controls the disks and manages the simultaneous file access and printer support. The Cluster/One Disk Operating System exists only in the central unit, and doesn't require additional storage at each user station, a saving of typically 10 KB or more of memory that can instead be used for bigger programs, more data, better graphics or more complete documentation.

How do I use Cluster/One?

Learning how to access the central disk program library is very easy. The user need only issue simple commands at his personal computer, like the following:

```
@LOAD prog-name,disk#          e.g. @LOAD "LEMONADE"
@SAVE prog-name,disk#          e.g. @SAVE "KINGDOM",2
@RUN  prog-name,disk#          e.g. @RUN  "TRIG"
@LOSE prog-name,disk#          e.g. @LOSE "TEMP 12.7",2
@DIR  prog-name,disk#          e.g. @DIR  "TE*"
@OFF
```

All Cluster/One commands begin with an @ symbol, in order to distinguish them from the similar commands (LOAD, SAVE, etc.) which are builtin to each user station. (The built-in commands are still usable for accessing tapes or disks at each station.) The command formats are the same for all of the supported types of user stations.

The users can load a program from either diskette drive. The program is transmitted from the central unit to the memory of the requesting station at data rates that are hundreds of times faster than similar transmissions to a time-sharing system over telephone dial-up lines. Cluster/One automatically queues requests, so that if several stations load the same or different programs, they will all be delivered without "busy signals" or rejected commands. Once a program is loaded the user can then run it, list it, or edit it locally. Such actions thake place entirely within the individual station, since the program has been totally transmitted from the central unit into the local microprocessor.

A command such as @LOAD "ORBIT",2 will load the program ORBIT from the second disk drive. An error message appears on the user's video screen if the program doesn't exist on the specified disk, or if there is no disk placed in the drive. @RUN is equivalent to LOADing the program, and then issuing the local RUN command. @SAVE will put a copy of the current BASIC program into the disk library. A user cannot inadvertently destroy a copy already present in the library, since the @SAVE command will warn him if it already exists.

The @LOSE command will erase a program in the library, but if a diskette is "protected" (a notch is cut in disks for this purpose), files cannot be erased nor can new ones be saved. The @DIR command displays a list of program names on the user's video screen. This can be all programs on a diskette, or some requested subset. For example, @DIR "TE*" displays only those programs whose names begin with the letters "TE". The @OFF command is used to logically disconnect the user station from the central unit. This command is typically used prior to accessing local tape cassette or disk units connected to the user station.

Here is a sample session of a user who wishes to take a copy of a program he has on disk 2, test it, make some changes, save the new copy on disk 1, save it also on cassette tape, and then erase the original copy on disk 2.

| | |
|---|---|
| @LOAD "MY SPELLING",2 | user loads program from disk 2 |
| LIST, edits, RUN, etc. | user makes changes and debugs program |
| @SAVE "SPELLING 1" | user saves new copy as "SPELLING 1" on disk 1 |
| @OFF | disconnect from Cluster system |
| SAVE, CSAVE, etc. | make local copy on tape |
| @LOSE "MY SPELLING",2 | erase old version on disk 2 |

This is the way one user may be using the system. Of course, while this is happening all the other users are still able to load and save their programs in a similar fashion. It typically takes two seconds to fully load a program into a user station; saving a program takes about twice as long because the program must be written to the disk and then read back for verification.

## The Cluster/One components

The Cluster/One system consists of both hardware and software. The central unit consists of a self-contained storage facility. It contains two disk drives for eight inch (full-size) flexible diskettes. There are two storage size options available: the single sided version which holds a total of 630 KB and the double-sided version which holds 1.2 MB. The recording media are eight inch flexible diskettes ("floppy disks"), which are soft-sectored, with 256 bytes per sector. Each single-sided disk holds about 100 average sized BASIC programs, and twice that amount available on double-sided disks. Thus you can have a library of up to about 400 programs on-line at all times, with more available in seconds by changing diskettes.

Housed with the two drives are power supplies, expanded RAM memory for the Queen control computer (described below), a floppy disk controller, a ClusterBus (tm) controller for transmitting and receiving information from the Drone stations, and associated electronics and cooling.

Each personal computer, called a Drone, requires some special hardware and software in order to communicate with the central control computer, called the Queen. This is provided in the form of plug-in boards in the case of the Apple and the PET, and a small mini-box for the TRS-80. No modification of any kind is made to the Drone computers; installation consists of plugging in boards and/or connecting cables. Contained in the ClusterBus interface is both hardware to drive the interconnecting cables which run between Drones and the Queen, and an additional software package in ROM which recognizes the new Cluster/One commands, and manages communications with the Queen.

The Queen plays a special role in overseeing the working of all the stations and is dedicated to this purpose. It is not available for use in a Drone capacity, since it must respond to the Drone requests, manage the disk files, and keep the printer busy whenever there are files to be printed.

In the current implementation the Queen is a Commodore PET. Its interface to the central storage facility is a short multiwire ribbon cable attached to the memory extension bus connector of the PET. The Queen is used to start the system and monitor its operation, and is also used for running various utility programs. The utilities, provided as part of the system software, are for maintenance functions such as initializing new diskettes, and making backup copies.

The Queen is connected to the Drone stations by means of a 26-wire flat ribbon cable which begins at the central unit, and then runs to the first station, from there to the second, and so on, to a maximum of fifteen units. Each unit can be any one of the three personal computers supported on the Cluster/One system, mixed in any order desired. An optional feature is available for installations which require more than fifteen stations; by providing a second ClusterBus channel, a second string of up to fifteen additional stations may be connected to the same Queen. The maximum length of any one bus (from Queen to farthest station) is 250 feet of cable. Data is transmitted over this hard-wired channel at 80,000 bits per second, which contributes to the fast response time. Elaborate error checking facilities are built into the Queen and Drone software to ensure that all data transmissions are reliable, even in the presence of a burst of electrical noise. In most cases, errors are automatically detected and the damaged portion of the data is retransmitted.

As mentioned, the physical connection of the ClusterBus interface and software ROMs is somewhat different for each microcomputer model. In the case of the Apple II, Nestar provides a card which plugs into a peripheral slot on the main board, and the ClusterBus in turn plugs into the card. For the PET, a card is provided which plugs onto the "IEEE" connector for the bus connection, and a second card which plugs onto the memory expansion port for the software. (Software for the new 16K and 32K PETs will be on a ROM which is plugged directly into spare slots provided by Commodore on those models.) For the Radio Shack TRS-80, a separate, self-contained box is supplied. A cable from the box connects to the expansion port on the basic keyboard unit or on the Radio Shack Expansion box, and the bus is connected to the new box.

Note that the ClusterBus is a proprietary data transfer and addressing scheme developed by Nestar Systems, and is not compatible with other bus schemes such as S-100, IEEE-488, UNIBUS, etc.

Nestar Systems provides its own special Disk Operating System, called Cluster/OS. It is available on a royalty-free

non-exclusive non-transferable license with the purchase of a Cluster/One system. Cluster/OS consists of the Queen master code, which includes a file system and communications protocol handlers; the Drone firmware, needed for communications between the Drone stations and the Queen; and a collection of Queen utility programs.

## Limitations and Restrictions

### Language support

The only language supported is Microsoft BASIC, also known as Commdore BASIC, Applesoft (in firmware) and Radio Shack Level II BASIC. There are no plans currently to support other languages. Also note that totally unrestricted use of PEEKs and POKEs to access hardware registers in a user station can interfere with ClusterBus communications, and must be done with care.

### The ClusterBus

The ClusterBus is a hardwired commnications system, and not a telephone dial-up system. This is done both for economy (a modem at each end of the phone line is not required and line usage charges are not incurred) and to provide extremely high speed communications compared to dial-up facilities.

### Program size limitations

Almost all BASIC programs which run on a standalone supported personal computer will run when connected to Cluster/One. Cluster/One does use about 256 bytes of RAM storage in each Drone which conceivably could be required by unusually large programs. (On each type of supported user station this storage is taken from different locations. Details can be supplied if required.) The basic Cluster/One system will handle BASIC programs whose tokenized text does not exceed about 16,000 bytes, or about 400 to 800 statements. This limitation will be removed in future releases.

### Use of Ports

The ClusterBus connection uses certain hardware ports in each user station. They are therefore not available when the system is operational. For example, the ClusterBus interface occupies one peripheral slot on the Apple, and attaches to the IEEE and memory expansion ports on the PET.

### Computers supported

No personal computers other than the Apple, PET and TRS-80 are supported currently. Nestar Systems is considering support of new microcomputers as they become available from current manufacturers or from others. There are no plans for a general S-100 ClusterBus interface and accompanying software support at this time.

## Coming attractions

The entire Cluster/One concept is designed for growth. The basic Cluster/One system is expandable through the addition of replacement software releases, distributed on diskettes, and through new hardware offerings.

## User stations

One means of growth is offered through the addition of user stations to an existing system. An installation may prefer to have user stations primarily from one manufacturer, but can utilize selected stations as desired for their special purpose features. Nestar will support new personal computers as they appear on the market and demonstrate their reliability and cost effectiveness.

## File support

Cluster/One support is offered only for program files in this release. Data file support (both sequential and random access files) will be available in third quarter 1979. At that time, Cluster/One will also provide a means for users to have protected files to permit or restrict others from reading or adding data to their files.

## Cross loading of programs

Cluster/One supports any mixture of Apples, PETs, and TRS-80s operating at the same time. Cross loading of programs from one machine type to another is not supported in this release. This restriction will be removed in a release scheduled for the third quarter of 1979, at which time programs can be moved from one machine to another of a different type. Of course it will be the responsibility of the user to make any changes required due to differences in the exact form of BASIC provided on the various personal computers. Changes may also be required due to difference of features (in particular the area of graphics) available on the different types of supported user stations. Programs using only "standard" BASIC features, however, will be transportable without modification.

## Printer support

Fully spooled printer support will be available in June 1979. A choice of printers will be supported, connected via an RS-232 serial interface. The printers will range from a low-cost electro-sensitive model operating at about 160 characters per second (under $1000 with interface), to faster dot-matrix hard copy printers with tractor feed, and full 132 column width (about $2000). In either case, the single printer is connected to the Queen unit, and output from the Drones will be placed in disk files and saved for printing when the printer becomes free. Users need not tie up a Drone station while waiting for listings from

the printer. One printer can then support not only many stations, but is available from all three supported microcomputers using one common interface on the Queen unit.

Large capacity hard disks

Nestar Systems plans to introduce a hard-disk system, using eight inch non-removable Winchester technology drives, in the beginning of 1980. This will provide about 15 to 30 Megabytes of on-line storage capacity. With this increase many business applications which are limited by the capacity of floppy disks become possible.

Beyond the 250 foot limit

The electrical interface to the ClusterBus today limits the total cable length for each set of 15 stations to about 250 feet. Nestar is pursuing a different scheme, based on a single coaxial cable, as in cable TV, which will permit communications over thousands of feet without sacrificing speed. When that subsystem is available, individual stations can be spread over a much larger area, in separate departments of a company, for instance, instead of being restricted to one central computer resource room or laboratory site.

The new Queen

Cluster/One uses a Commodore PET as the central control computer in charge of managing all the disk file requests, printer support and utility operations. At this time it is the cheapest readily available unit that does the job. Nestar plans to offer a version of Cluster/One which has a processor inside the basic disk unit during the fourth quarter of 1979. At that time the Queen computer can be retired for use as a Drone station. A factory upgrade will be available for installation of a built-in processor. System operations will be conducted using any one of the Drone stations as a temporary system console.