SHARE SESSION REPORT

SHARE NO.	SESSION NO.	SESSION TITLE	ATTENDANCE
61	B584	The Personal Computer in a VM Environment	500

PROJECT	SESSION CHAIRMAN	INST. CODE
VMSM	Nancy Schiffmann	NII

Northwest Industries, Inc., R.E. Randolph Street, Chicago, IL 60601
(312) 236-8601

SESSION CHAIRMAN'S COMPANY, ADDRESS, AND PHONE NUMBER

THE PERSONAL COMPUTER IN A VM ENVIRONMENT

R. C. Heterick, Jr.

Design Automation Laboratory
Cowgill Hall
Virginia Tech
Blacksburg, Virginia 24061

Installation Code: VPI

VM System Management

B584

ABSTRACT

The personal computer is revolutionizing both the way we think about computing and how we are likely to use large computer systems in the future. Current host software support presupposes a "dumb" (generally a 327X type) terminal. This support is not only not necessary for intelligent network devices, but in fact, creates additional complexity in attempting to utilize the full set of features available on the personal computer.

A mixed environment where such host support features can be optionally available is needed. As the personal computer prolifierates, strategies for dealing with limited communication channels to the VM host need to be devised. Local area networks in the near term will have hundreds to tens of thousands of personal computers making occassional use of host services. A range of PC/VM-host software interface issues must be addressed if these networks are to have any chance of functioning effectively. The choice of where particular software elements are to reside is particularly important.

THE OPPORTUNITY

Around the turn of the century, a very clever English physicist, Clerk Maxwell, suggested a way to beat the Second Law of Thermodynamics. The Second Law has to do with entropy – the measure of the unavailability of useful energy in a system and its increase with time when the system is left to fend for itself. Maxwell said, in effect (this is a very liberal paraphrase):

- **Imagine a Demon, a small but very intelligent creature who can see molecules. Now imagine the Demon as the custodian of a gate between two containers of gas at equal temperature and pressure. By careful opening and closing of the gate, the Demon allows the faster molecules to move to one container, the slower molecules to the other. Over time, one container gets hotter and the other cooler, thus increasing the available energy in the system as measured by the temperature differential between the two containers. This increase in energy is accomplished by adding no new energy to the system (other than our smart Demon) – and we have circumvented the Second Law.**

Now I don't propose that we are about to repeal the Second Law, but it does seem that the personal computer may well be a Demon capable of tapping the latent energy in both our computing organizations and the people who do, or could, use them. The revolution in computing occassioned by the personal computer bids fair to be as significant as the original introduction of the computer itself. The "tool kit" of the professional employee has changed little since the times of Descartes and Issac Newton. The stock in trade of the architect is still a parallel

bar, triangles and pencil. The accountant still spends untold hours in laborious spread sheet computation, the results of which are manually transferred to other graphical and text formats. The engineer in the laboratory seldom has access to equipment that facilitates the transfer of test results into their final medium as reports and technical papers. With the exception of the telephone, typewriter and adding machine, the clerical support function has changed little from the description in a Dickens novel. The capital investment in equipment to support professional activities is little more than an electric typewriter and the office copier. Most statistics indicate that the equivalent investment for every farm and factory worker is over $30,000.

The advent of the low cost personal computer adds a dimension to professional and clerical occupations which may some day be seen to rank with the introduction of arabic numerals or the invention of printing. It is abundantly clear that the personal computer must – and will – become a fundamental and integral part of professional education. If the universities are facing this problem today, it will only be a few years before its impact is felt in business and industry. The critical problem facing our computing installations is the transition period to incorporate personal computing into their local networks.

It is easy to envision the personal computer as the Demon we might employ to harness some of the latent energy in our computer operations. Unfortunately we must also acknowledge that we have entered what appears to be a prolonged period of reduced computational budgets in the face of exponentially expanding demand. This situation is greatly exacerbated by continuing high inflation rates. The impact on the corporate computing operation could be severe. Funding for new initiatives will be increasingly difficult to secure and the cost of maintenance of current programs seems to be exponentially increasing.

The ability of our computing installations to react to new computing opportunities is significantly attenuated. Those installations that view this future with candor and prepare themselves to operate in it – to be adaptive if you will – have the opportunity to harness some of the latent energy in the computing complex and turn the current economic situation to the advantage of the entire organization.

If our computing installations do not quickly find a way to support networks of personal computers the lost opportunity costs for both them and their parent organizations will be significant. Most of the great technological advances of the continuing industrial revolution have amplified man's physical capacities. None of them have ever provided leverages of the order of one million-to-one, the order of the multiplier for current computer and communications technology (modern air transportation hardly represents a 600-fold increase over walking). The computer represents the first real opportunity to provide technological

leverage to man's intellectual capacities. The advantage for analytical, computational intensive tasks has been manifest for over 25 years. The typical office worker is as much (and perhaps more so) concerned with information related activities as with analytical tasks. The capacities of modern computer-communication technologies can directly assist many of these information intensive daily activities.

THE CHALLENGE

The thorny question that confronts those who are concerned with the management and operation of the corporate computing complex is, simply stated, how do we most effectively make this transition to networked support of personal computers. I elevate this question to preeminence because I believe the potential contribution of computing to the organization is obvious and clearly cost effective in both the short and long runs. Software, on the scale of both NASTRAN and VisiCalc, will continue to be produced in private and government research laboratories regardless of encouragement or organization in our corporate computer installations. Advancements in computer technology will continue unabated whether our central computer facilities take an active role or not. The critical question confronting our computing centers is the effective support of highly decentralized computing capability and the transfer of apparent control of the environment to each individual with his or her own personal computer.

Another reason for emphasizing the transfer rather than the creation of computer technology was rather trenchantly put 150 years ago regarding Babbage's Analytical Engine.

- **There is frequently a tendency, first to overrate what we find to be already interesting or remarkable; and, secondly, by a sort of natural reaction, to undervalue the true state of the case.**[1]

The problem is, and has been, not so much to sell the organization (and sometimes its computer center) on the value of the computer for performing analytic computations but rather to see the computer as more than the latest invention of the continuing industrial revolution – in fact, a tool useful in extending the human intellect.

The ultimate impact of the computer on most organizations is likely to be considerably more marked in terms of office automation, graphics of all sorts including microforms and eventually holography, sensor based telemetry of prototype and constructed systems, and the coalescence of an information intensive set of professional activities

---

[1] Ada Augusta, Countess Lovelace, Notes to *Menabra's Memoir*, 1842.

around "national" data sources. To be sure, we need continuing development in simulation, mathematical analysis, design automation and other computationally intensive activities, but it is in the informational, as opposed to computational, activities where computer science and technology will have the significant impact on our society through business and industry.

The work product of professionals is characterized by the individuality and idiosyncrasies of its originator. In fact, it is these facets of taste, style, originality, imagination and problem approach that determine the level of success achieved in most business and industrial endeavors. Such individuals adopt computer-based approaches only when it is clear that the computer will assist, not proscribe or inhibit, their creative activities. The task of our computing centers must be to integrate the personal computer into the daily activity of the professional as an "open" rather than "closed" system. The ultimate goal must be the incorporation of the personal computer into the normative "tool kit" of the professional. The Cartesian dualism is probably nowhere so manifest as in the professional. Marvin Minsky noted it some time ago when he observed:

- **A man's model of the world has a distinctively bipartite structure: One part is concerned with matters of mechanical, geometrical, physical character, while the other is associated with things like goals, meanings, social matters and the like.**[2]

The typical work habits of our professional employees reflects and epitomizes this concern with goals, meanings and social matters. All these, of course, are very personal and subjective. Consistent with the observations regarding individuality, it seems likely that each professional will desire a decision support system and computer-based workstation that can be "customized" or "tailored" to his or her own distinctive style of work. The personal computer is the logical and obvious candidate for the nucleus of this professional workstation.

THE PERSONAL COMPUTER

It is not difficult to envision our next generation of employees showing up for work with their independently owned personal computers. In fact, we can expect an increasing number who will have a personal computer at home and will desire access to the corporate computer network from their home computer. Clearly the entry cost of the next generation of 16 bit micros will be in the $1000 (and significantly

---

[2] Marvin L. Minsky, "Matter, Mind and Models", *Proceedings of the International Federation of Information Processing Congress*, 1965, Volume 1, pp. 45-49.

less) range. At least for the near term, the favored architecture will be 8086/8088 based, with an evolving DOS. For my purposes here I will use PC to mean this architecture and you may take the IBM PC as representative of this class of micros – certainly it has quickly asserted itself as the *de facto* industry standard.

The observations that follow are based on several assumptions:

- There are several configurations of workstation and supporting hardware that will typically populate our corporate offices.
- Underlying all configurations will be a set of common functions including mail, messages, text editing, document composition, date base query, file transfer and primitive graphics.
- A significant effort will be required to investigate, evaluate, integrate and develop software for the prototype workstations.
- The PCs must exist in a network of various other computer resources dedicated to computation, design automation and graphics, printing, data management, library resources, archival storage, etc.

At this point one can recognize several configurations for the professional workstation. A significant group of professionals are working in problem areas encompassed by the term design automation. This group includes architects, mechanical and electrical engineers. This group requires a highly graphics oriented workstation capable of supporting a variety of I/O devices including digitizers, light pens, auxiliary keypads and multiple graphic screens. In many cases dedicated hosts will play an important role with this professional workstation.

There will be a laboratory configuration which is capable of supporting an array of sensor-based monitoring equipment in addition to base communication and computation functions of all workstations. Simple access to A/D and D/A applications will significantly change the manner in which many people will use their PC-based workstation.

There is need for a workstation designed for the manager and planner that incorporates a range of software, not part of the previous workstations, which facilitates queries to large data bases located on remote hosts. There are, of course, many other variants one might wish to identify – and that is one of particularly appealling features of the PC.

Underlying all the workstation types is the basic office machine. This is the configuration we can expect our next generation of clerical, secretarial and casual users to opt for. The basic machine will be

easily, obviously, and broadly expandable, subject to significant additions of both software and hardware. The basic workstation will also be capable of being acquired by any employee at a cost which will not inhibit his or her opportunity to have a PC at home as well as at the office.

It is clear that a number of ergonomic factors will effect the choice of workstation configuration. We can expect that the personal computer will be used by the student considerably more intensively than textbooks are currently used, and used by office personnel considerably more than the telephone, filing cabinets and typewriter put together. The comparatively poor resolution of color monitors has led many personal computer users to opt for the monochrome when only one monitor could be afforded. Plasma display devices offer the promise of improvement of the visual quality of text and larger, bit-mapped screens. Until a more ubiqutious display becomes economically feasible we can expect a great deal of diversity in the display capacity of PC-based workstations. The pluaristic computing society being created by low cost personal computers will increase the necessity of simplified, and probably more iconic, modes of input. Support for mouses, digitizers and plotters will be commonplace for the PC user.

The multiplicity of subtle-to-gross differences in current personal computer offerings promises to be a significant problem for computing installations. Where users are free to chose the personal computer offered in their favorite color, luggage material or whatever – the problem of integration into the local area network will shift from difficult to impossible. It hardly seems likely that the next five years will see a standardization of either the operating system (too much is in ROM) or protocols for networking.

A personal computer is generally so easy to get started on that many of our users will begin acquiring them with the naive intention of running only "BIFFLEBANG" as a stand-alone application. Experience shows that it is only a matter of weeks, hardly ever more than months, before those very same users show up at the computing center's doors with a request (demand?) for network support to the mainframes. Attempting to support every brand's particular nuances will lead to chaos. Designing general support to the lowest common denominator configuration will lead to outright rebellion. Clearly, workstation support and interfacing will have to move to the front-end and be greatly simplified in definition and expanded in capability.

One of the major problems falling to our computing centers will be to evaluate the integration of software, hardware and communication features and to propose a migration path for upgrading the basic configuration for casual users to the specific configurations required for work in speciality areas. The centers will need to evaluate, through

performance testing, issues regarding required storage and disk space for effective operation, availability of software interfaces between personal computer packages and also between personal computer software and VM network hosts. In addition to identifying the basic workstation configuration, software complement and migration path to the more specialized workstations, it will be necessary to identify, assemble and begin to develop the code necessary to integrate workstation packages and facilitate host communication.

The centers will also have to deal with the problem of introducing new employees to their workstation. There are a number of companies in the business of developing good introductory materials which will introduce them to the hardware/software potentials of their professional workstation. The centers will have to customize this and add a brief introduction to mail, messages, text editing, host-workstation file transfer and some introduction to the architecture and expansion potential of their personal computer.

THE VM ENVIRONMENT

The workstation configuration and migration issues present problems related to costs and personal computer capabilities. The more difficult problems lie in the networking area when the personal computer is recognized as a fundamental part of a network supported by VM hosts. The major portion of software written for the network hosts which interface with the user make the assumption that the user has a "dumb" 327X type terminal. Consequently the host software performs all sorts of useful tasks for the terminal, including screen control. These tasks are not only not necessary for an "intelligent" device such as the personal computer, but actually are a hinderance to its effective use.

One of the implications of providing software which expects a "dumb" device is that the more common, personal functions of messages, mail, document composition, PROFS-like scheduling and calendar features all rely upon the host for establishment of transmission and storage protocol, source and destination resolution and input formatting. Access to these most commonly and frequently used software facilities is predicated on the assumption of a "dumb" terminal and inhibts the user from utilizing the local intelligence of the personal computer. The communications load in the network is thereby exacerbated as well.

Clearly, most of the functions of a system such as PROFS should be resident on the PC, not the VM host. Such a point of view raises the complication of access to data, calendars for instance, which is distributed and quite possibly not even connected to the network when initially desired. Eventually we must design software that recognizes that VM/CMS is only one, albeit an important one, resource in a network of intelligent resources.

In general, there needs to be an extremely high degree of compatibility of application and system support software between the PC and the VM/CMS host. Many of us have probably labored through the problem of how to print a Wordstar of Easywriter file on the VM system printers. The basic functions of DCF and SCRIPT must be a fundamental part of the PC software complement or we will surely create two camps of computer users who do not converse with each other. If forced to choose between the PC and the VM/CMS system I expect most users will opt for the PC and choose from a plethora of network products available for the PC to do their communication. What we all want, and need, is the capacity to use the best features of both the PC and VM/CMS.

I have found one of the most irritating features of using the PC with emulation on a VM/CMS host to be the lack of screen control. Responses to simple queries are interspersed with screen control sequences which the intelligent device could, and probably would prefer to, supply itself. In order to avoid receiving the screen formatting protocols the user is forced through the additional steps of composing a host file, transmitting the file from the host, and deciding what to do with it when received at the personal computer. While this problem is not insurmountable, its currently unresolved state makes the use of the personal computer in a VM network unwieldy at best, uneconomic at worst.

The user community in the university setting is probably not too unlike many corporate complexes. For at least the next five years it seems likely that many users of the host systems will continue with "dumb" terminals (secretarial and clerical personnel for instance) while many with personal computers will desire access beyond the local host. In addition to the growing national services such as *The Source* we can expect to see a continuation of special purpose time sharing with value added servers and the growth of discipline-oriented networks among researchers or professionals working in certain areas. There will continue to be a need for some services which can only be provided by a host system, be it the local host or a national service.

In most settings this dual source of service will continue for several reasons.

- Current systems used on the host will take time to convert to the personal computer.
- When they are converted they will add a cost to the personal computer which will be difficult to absorb in existing budgets.
- Many of these converted software systems will require hardware which may not be part of the basic office workstation.

- For at least the next five years it is likely that the local area networks in most installations will continue to be overloaded.
- A standard solution to the multiple update problem in distributed computing environments is not available.

These and a host of similar problems will continue to perpetuate a network environment which contains both "dumb" and intelligent devices.

A network of personal computers will accelerate the demand for software that is compatible with what exists on the local host. This compatibility must extend to the point of "clone" editors, mail facilities, etc. Many of the services currently provided by host VM systems need to be moved to the personal computer. These services at the most basic level include mail, editing, document composition, calendars, etc. There *must* be host compatibility with escape sequences, tags, etc. There must be some form of network address routing available on a host to facilitate sharing mail, documents, homework assignments, etc.

I use the term host to mean a network service machine, generally a system running VM. Such a system might be a personal computer appended to the network as a service machine. Such an environment might have significant ramifications in reducing the cost to communicate in the local network. At any rate, the personal computers must have sufficient software tools to interface with some network directory. This capacity appears to be totally incompatible with the prevailing philosophy driving host software development. The host must serve as an information repository with indexing, storage and retrieval tools which facilitate general searches on keywords, author, etc.

Current VM systems are poorly equipped to handle the massive spool files that will develop when thousands of employees have personal computers. The problem of preserving the integrity of communicated mail and files needs to be addressed. If only 5,000 personal computer users want to backup one file per day the load on the communication network will be exceptional.

Network service machines, in addition to facilitating "bulletin board" and similar sorts of public information services may useful in limiting the number of copies of general distribution documents which must flow through the network. In a similar vein, we need to investigate mechanisms for avoiding all personal computer users from having to be "registered" host userids – perhaps having access to only a limited number of host services.

There are a number of forms which inter-user communication will take.

- PC user - PC user

- host user - PC user
- host "service" - PC user

All these forms need to be handled in the network. The variety of inter-user communication forms assumes increasing importance when the constrained communication facilities available in most installations is considered. Users with microcomputer experience are unanimous in their appraisal that 1200 baud is too slow. When only slower speeds (less than 9600 baud) are available, it will frequently be necessary for the user to move to the data, rather than moving the data to the user. Some form of emulation (we currently use the Yale product) will be absolutely necessary. When it is clear that higher speed data transmission is necessary we will need to investigate the use of "service" machines and the characteristics of the software to perform unattended file transfer. Where possible, we need to develop a way to permit the PC to run in "auto-answer" mode to facilitate other functions sending it mail and perhaps even querying its files. It would be highly desirable to find a way to permit it to treat VM minidisks as a logical extension of PC disks and correspondingly, permit VM/CMS users to access PC disks. The mulitiplicity of PC disk formats will certainly be a major problem here. Another aspect of this problem is the capacity to do data compression/decompression.

The communication problem is exacerbated in this network environment where we don't expect the users to have printers on their personal workstations. Questions of output device compatibility are already serious in most installations. We need to investigate font availability and compatibility, the combining of text from multiple contributors, document composition facility compatibility between the host and the personal computers and the viability of transmitting source rather than formatted documents.

Personal file backup appears to be one of the major problems confronting the network of personal computers. We can expect many users to desire to use the host as the primary backup support for personal computer files. This is another point at which network "service" machines may play an important role.

The foregoing represents only a cursory first stab at the nature of problems presented VM systems by the proliferation of PCs in our networks. We must begin to address and solve these problems or our users will rapidly migrate away from VM/CMS into suboptimized solutions that may do irreparable damage to the coherency of corporate computing activities. Increasingly, we must view VM/CMS as the "Big Switch" in our corporate computing enterprise that provides those communication and hardware services not cost effective on the PCs in our network. If we choose to view VM/CMS as "the answer" rather than as a facilitator

of service we will see our installations lost to a plethora of incompatible, uncontrolled personal computers.