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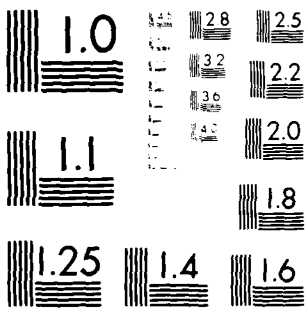

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MILCOM II

MILITARY COMPUTERS AND SOFTWARE

Finding a Partnership—

Department of Defense/Industry/Congress
For the Information Age

at the

Marriott Crystal Gateway Hotel
Arlington, Virginia

January 27–28, 1983

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AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

MILCOM II

MILCOM II

MILITARY COMPUTERS AND SOFTWARE

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PROCEEDINGS

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

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MILCOM II

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FOREWORD

INTRODUCTION

MILCOM I (January 1982) brought into focus from policy and management perspectives potential benefits from the near and midterm use of new technologies in military computer systems. It also brought to the surface a debate between whether future delay in implementing proposed new standards is intolerable or whether implementation further locks DOD into obsolescent equipment. MILCOM I raised the level of awareness of just how heated the debate can become. Differences were not papered over. While common objectives were recognized, consensus on an approach to resolution was not arrived at. With this situation as its baseline, MILCOM II addressed the next logical step - Finding a Partnership - Department of Defense/Industry/Congress- for the Information Age. The field of topics was expanded to cover logistics, technology insertion, and competition and was introduced by three eminent speakers to set the framework of top-level Congressional, Department of Defense and Industry concerns. Questions were posed to panels and panel members to draw out the widest offering of views on the panel topics.

At the luncheon during the first day, the speaker was MGen. Jack L. Hancock, USA(Ret.) Vice President, Wells Fargo Bank and former Commanding Officer, US Army Computer Systems Command. General Hancock spoke on the topic:"Military Computers and Software Procurement Policy and Design Flexibility - Commercial vs. Department of Defense - A Perspective!"

This report condenses the attempt of the symposium to reflect issues, identify interrelationships, and suggest ways by which this partnership can be strengthened.

SUMMARY

Accomplishment of the goal of finding a partnership for the Information Age could have been signaled by sufficient concensus to warrant a statement on partnership policy for Congressional, DOD and Industry consideration. Although this goal was not reached MILCOM II provided an encapsulated overview of the economic/security threat to the United States and of the Information Age. The initial views of Congress, DOD and Industry in response were presented. The domestic and foreign economic and competitive implications were sufficiently visible to point to the need for consideration at the national policy level.

In addition, MILCOM II developed significant analysis and discussion of logistics, technology insertion and competition as they bear upon a better partnership. The complexity of the views presented raised in turn procurement strategy questions. When coupled with the results of MILCOM I, the relationships brought out in MILCOM II provide the basis for a next step along the road towards an effective partnership.

MILCOM II confirmed that there is a "partnership", eg there are working relationships and there are subsets (Ada, VHSIC) which are working and should prove productive. The thrust of all discussions highlighted that the real question was where to head, and how to build upon the existing partnership. There was universal agreement on the need for a more effective partnership.

In spite of the generally endorsed need for a better partnership once the focus was on the working out of details there were expressions of discouragement at the continued and unyielding debate between the parties involving Congress, DOD, Services, and Industry. This debate turned on whether military computer and software development should continue on their present course or whether they should be modified, to a different structure more indicative of the changes already underway in the commercial world. There were in addition doubts expressed as to whether present cooperative actions (e.g.Ada,VHSIC) would lead to or away from partership and just how to proceed toward a partnership in view of the complexity of the interrelationships involved.

MILCOM II brought out or implied some potentially *fruitful suggestions* toward possible partnership.

** *Change the environment* from a debate between adversaries, each building logical support for his ex parte position, to a forum of more listening and weighing of other views.

** Orient future analysis and attack on this problem of partnership from agreed statements of goals and objectives and how these are different and in commercial and military centers.

** Address the interrelationships in the context of the system as whole rather than as pertaining only to the hardware computer and its software.

** Undertake a more comprehensive differentiation amoung standards and between standards, specifications, ad hoc commonalities, and waiver decisions.

** Sharpen the analytic description of these interrelationships and improve the analytic treatment of solutions by such things as strategy models or scenarios, long range cost projection models, cost benefit models, utilization/obsolescence models, and other techniques of this kind.

** Recognize that competition is not an absolute, but a variable which should be applied in a relative scale of potential benefits.

** Determine the extent to which a computer can and should be considered as a functional requirement in a system.

MILCOM II closed in an atmosphere of problems unsolved, and their impact on US national interest. It is clear more work must be done if an effective partnership is to be achieved. Some ideas for a MILCOM III to pursue the goal of a partnership are offered:

* Goals and objectives of the next 20 years in Military Computer and Software development.

* Melding of Military Computers and Software and the Information Age.

* Terms of Reference for a Partnership in the Military Computer and Software Community.

* Policy Adjustments to preserve the Partnership.

OPENING SESSION

INTRODUCTION

General Henry A. Miley, USA(Ret.), President of the American Defense Preparedness Association, in his opening remarks referred back to the previous year's MILCOM I which he found exciting and full of strong opinions. However, in the intervening year the political environment has changed significantly and perhaps dangerously. The main element of change was the loss of public concensus from several traditionally pro-defense groups. These traditional supporters of defense are now talking about gold plated systems, bungled acquisitions, defense stagnation and large budget cuts. This backdrop to MILCOM II placed pressure on the participants to insure that DOD, its service components and industry were in harmony. The theme for this conference was finding, not forging, a partnership.

SESSION I - KEYNOTE SPEAKERS

As keynote to MILCOM II, three Senior Executives from Congress, Defense and Industry discussed their perceptions of the military computer and software doctrine and the importance of finding a partnership. Several suggestions for overcoming the barriers were presented with a number of alternatives for action.

Senator Tower of Texas and Chairman of the Senate Armed Services Committee; Dr. Richard DeLauer, Under Secretary of Defense for Research and Engineering; and Dr. Lewis Branscomb, Vice President and Chief Scientist of IBM, each gave comprehensive views of the issue from their unique perspectives.

THE NATURE OF THE PROBLEM

Computing components have become an increasingly important factor in weapons systems performance. The narrowing of the US technological edge with the USSR is an issue of major concern. While the computer content of this narrowing is not yet a serious problem, it makes the partnership issue all the more important to our military strength in the long term.

There have been sharp disagreements between the members of this partnership over the management and planning of computer procurement, technology transfer, scientific exchanges and training of foreign students. (Senator Tower)

Congress is just not prepared to do the job. However, they tend to fill vacuums. In this area of ADP, computers and computer technology, Congress has indeed become involved. A partnership exists; the question is how the partnership is going to proceed. There are several examples, where DOD initiatives sit on the shelf because the market is not sufficient.

Even VHSIC (the DOD Very High Speed Integrated Circuit program) will take a long time to be inserted into the fielded systems. Technology Transfer and Export Controls are problems. We presently have an inability to get together and make the most use of our combined talents. The question isn't whether, but how to make the partnership work. (Dr. DeLauer)

Something more than the conventional military-industrial partnership is needed. Commercial industry, much of which has involvement with defense contracting, represents the majority of computer and software capability in this country. Universities do, and will, play a key role in advancing the technology, primarily through basic research and collaboration with commercial industry. On the government side, more than just DOD and the Congressional committies concerned with defense must be involved in the partnership. There is a critical need for public understanding of the way in which military and economic security both depend upon the total scientific and technological capability of the country.

Severals trends emphasize the interdependence of military and economic security. Our national security requirements cannot expect to stimulate needed long-range technology development based upon purchasing power alone. Commercial industry on the other hand depends upon the Federal Government for the investments that sustain the long range research conducted in our universities, national laboratories and company IR&D programs. A recent National Science Board report on university-industry research cooperation documents a resurgence of activity that bodes well for the future.(Dr. Branscomb)

BARRIERS AND IMPEDIMENTS TO ITS SOLUTIONS

The awareness of the importance of defense use of computers has not overcome several barriers. Vested corporate interests emphasize the short term on investments or parochial balance sheet considerations over the national interest. There are cases where excessive adherence by the Defense Department to military specifications interferes with the use of available and appropriate, although non-ruggedized, commercial equipment. These can impede efforts towards cost avoidance and improvements in mission performance. Bureaucratic red tape has evolved as a result of congressional legislation. Congress has acted to provide some relief; the success of this will depend on the responsive and effective exercise by DOD of its increased authority over procurement of nonembedded computers. In the FY83 Defense Authorization Bill Congress has recently blocked the implementation of DOD Instruction 5000.5X. Hopefully the intervention will promote rather than impede defense-industry cooperation.(Senator Tower)

The barriers are involved with how to proceed with making the existing partnership work. We need to set objectives, agree on what we expect to do and decide on how we're going to measure progress. The here and now problem of the partnership is DOD Instruction 5000.5X. The blockage and problem is driven by the issue of preserving software and created by different views over that issue.(Dr.DeLauer)

The size and competitiveness of the commercial market for computers require commercial companies to move new technology to market much faster than the defense community is usually able to match. This results in large parts of the technology spectrum being more advanced in shipped commercial products than in operational government programs, even where the government's technology requirements are high.(Dr. Branscomb)

THE ALTERNATIVES

In overcoming these obstacles there are three guidelines which can be drawn from the Ada(DOD's Higher Order Language Software program) and VHSIC program's success. First, flexibility on the part of DOD ADP planners and managers is an essential prerequisite to obtaining the best inputs from industry and consequently the most innovative solutions to the nation's military computing problems. Second, through its leadership in research and development funding, DOD can play a pivital role in stimulating industry to look beyond its near term problems and make investments whose long term effects will be to promote the national interest as well as maintain the viability of American computer industry. Third, it is imperative that parochial interests and opportunism of some in the computer industry not be permitted to supersede or preclude the realization of long overdue and necessary improvements in computer operations and supportability.(Senator Tower)

The DOD programs such as VHSIC and the n-th generation computer will provide a basis for more investment by the private sector than that provided by DOD. The industry, DOD and other agencies and the university are members of the partnership.

DOD's response to the Congressional questions regarding draft Instruction 5000.5X on Instruction Set Architecture(ISA) will justify and defend the initiative to standardize on an ISA. The Commerce Department and other proposals for legal limited partnerships for R&D have obtained a qualified antitrust clearance providing new awareness for cooperation and partnerships.(Dr.DeLauer)

DOD's VHSIC program, for example, is making an important contribution especially because it is tied to specific designs of potential military importance. The proposed DOD software initiative, STARS(Software Technology for Adaptable Reliable Systems) could have even greater benefits. In the long run, DOD should be able to move away from the need for Instruction Set Architectures and hardware standards if proper focus is given to the establishment of adequate and compatable software developement tools, the development of standard interface specifications at the run-time software level, and the developement of failure-free, self healing or highly fault tolerant architectures ... DOD should continue to stimulate computer technologies that may be important in future defense programs but do not today have large commercial markets. ...DOD should now begin to expand its investment (in Artificial Intelligence) in order to accelerate the reduction to useful practice of these areas. DOD should support a substantial effort by defense agencies such as DARPA to explore new machine organizations and architectures.(Dr.Branscomb)

PANEL I - LOGISTICS

The purpose of this panel was to develop the efforts needed to streamline the computer logistics situation. The panel addressed logistics of computer systems in the framework of unchanging need for reliability and maintainability but with dramatic changes in computers, automatic test systems and support; use of commercial computer systems to determine requirements for field C^3I; and the approach to making and marketing a successful personal portable computer.

SYNOPSIS

The objectives of computer logistics, which come together in high operational computer availability have not changed in the last 30 years. Computers have changed dramatically in increased performance and reliablitity and in reduced cost and size. This has opened up ways in which computer logistics is being and can be further strean d. This topic was explored in the logistics panel and referred to i ther panels. There question of standardization continues to thread thro MILCOM II panels and discussions. The ways in which the new hig omputer technology can help streamline logistics, as developed in COM II, are:

* Higher inherent reliability leading to fewer spare parts.
* Unit replacement rather than service intensive repair.
* Fewer technical personnel.
* Treatment of a computer as a "system function" within Integrated Logistic Support as well as in design, operation and technology insertion.
* Easement of some interface problems by using microprocessor interfaces.
* Reduced life cycle cost.
* Elimination of whole steps in the logistical train such as elimination of Avionics Intermediate Shop.
* Possible increase in cost effectiveness through use of "system standard" computer without requiring standardization over the whole range of Service or DOD computers.
* Higher system availability and reduced logistic support through affordable fault tolerant designs.

Logistical difficulties expected to be encountered in support of emerging commercial computer high technology in military systems are.

* Logistical multiplicity in supporting an expanding or uncontrolled proliferation of embedded computers.

* Discontinuance of commercial products incident to product cycles of 2 to 3 years in maintaining support of systems with life cycles of up to 20 years.

* Unsuitability of commercial mainenance support through licensees and/or retailers.

* Although support of Evolutionary Development Systems is feasable this type of support is not recommended for Milspec computer systems.
* Retailer support, although adequate for individuals, has not been adequate for large block buyers or in responding to warranties overseas.

* Standardization in the commercial sector varies from virtually complete standardization or high percentage commonality through combination of function, interface, bus and HOL standards to minimums of function, interface and HOL standards within different sub-sets of the commercial community. These standards do not cover much of Milspec requirements and commercial equipment covered by them may or may not meet military requirements.

INTRODUCTION

The requirements for computer fault detection and maintenance to insure reliability to perform as designed when needed has not changed since 1953. Computers have changed dramatically - reductions in cost and size by orders of magnitude with increased performance - in that period. The cutting edge of computer technology has moved from DOD to industry. Logistics and maintenance of chips is different from earlier repair and logistics so that we can consider repair of the machine by replacement of the machine. We use new terminology to indicate reliability and new computers are more fault tolerant and less service intensive than earlier machines. We may now view a computer, not as an entity, but as a functional requirement for the total job. Military computers must have the reliability to do their jobs when needed. Internal design doesn't make any difference as long as the computer will repeat the function and is cost acceptable. We may not need all milspec machines because commercial machines are much more reliable than they were years ago.(Mr. Robert Johnston)

Moderator
Mr. Robert Johnston
Director of Support Services
Star Technologies, Inc.

Panelists/Speakers
Mr. Tom A. Keller
Manager of ATE
Westinghouse ILS Division

Mr. Patrick Riedl
Vice President C3I Systems
BDM Corporation

Mr. Fred Brown
Director of Marketing
Osborne Corporation

SUMMARY

Mr. Keller

Automatic Test Equipment(ATE) to aid in maintaining required availability of miltary aircraft is a mixture of available milspec and commercial equipment assembled in a dual bus system architecture which is vertually identical amoung competing firms in the field. It is not basically a technical problem. The principal problems arise from the need to support aircraft with a service life of up to 20 years. The commercial elements of ATE will be continued for sale by manufacturers or venders only so long as they are profitable. Their termination may come as a surprise when they are discontinued. A substitute has to be found and integrated without changes to the operating system and Unit Under Test programs. The cost drivers are not computer repair, but doing what computer ATE has to do such as personnel training and positioning, reliability, mainainability, software with on-line compiling capability, documentation, and others in the ILS 15 requirements list. In this climate standardization helps ILS as it protects product configuration which solves a lot of ATE problems. Standardized elements include high speed bus, instrument control bus (IEEE 488), instrument microprocessor, computer interface (CIIL protocol), ATLAS (IEEE 416 or 716 subset), FORTRAN, JOVIAL, and computer ports (RS-232C). By having something like 1750A in the computer we can facilitate module substitution. Technology insertion is of great interest. An example is the microprocessor interface between CIIL bus and the instrument. Technology insertion will assist ATE expansion and contraction in the field. ATE architecture is not a technical problem. It is a support problem between the military and commercial sector. It should be useful across many systems with obvious general advantages. Contrary to the notion that standardization stifles competition, recent procurements in ATE have been intensely competitive. The problems with standards are more business than technical, and industry should look into how to be profitable in the presence of standards. Where one firm is influencial in setting standards, others have to adapt or fall out. In the MATE (Modular Automatic Test Equipment) program two highly competitive finalists came up with the exact same architecture.

Mr. Riedl

The objective of the Evolutionary Development Program and the DOD Directive on major systems acquisition recognize that one problem - understanding of real requirements - is different for command and control systems. They have to be developed in an evolutionary way from considerations of a sequence of capability, test, change, and new capability. One such program uses an APPLE II computer in Europe to develop requirements at Corps and Division level for dispersed command posts. This is a "learn by doing" concept starting with desired operating capabilities, feedback, change, and great emphasis on procedure development where SOP's are no longer applicable. Advantage is being taken of industry investment in personal computers of the 16 bit class - APPLE II with new looks at MOTOROLA 6800 and INTEL 8086 as well as local area networks which are cheap and a key capability as well. These permit task reallocation for survivability. Commercial computers provided advantages in time-to-deployment and affordability and new concepts in sustainability compaired to MILSPEC equipment but were inferior in some aspects of survivability, security and adaptation to the operational environment. Most faults in the APPLE II computer were caused by operators opening the case and manipulating components. A new back plate was provided as were unique connectors, better power supply, and ventilation baffles. The next area of problems were part of the long time ADP power problems - differences in grounds, circulating ground currents, voltage spikes and improper operation of generators. Maintainability started with a trained team of four operators under a manager who could replace failed equipments. There was a float of major spares. The supporting contractor provided regular monthly service from CONUS. There was no general support level maintenance. One problem was that APPLE Company would not sell directly to the Army and has franchises for repair so the Army had to go third party contractors. Although APPLE is big in Europe, they were reluctant to honor warranties on equipment purchased in CONUS. The Army is sorting out what is good from the Evolutionary Development Program(EDP) equipment for possible adaptation for broader Army service use. It is planned to support EDP equipment through the Army general supply system using federal standard stock numbers. In general, however, the current support for EDP equipment is not recommended if the Army decides to deploy it for general Army use, prior to availability of MILSPEC equipment.

Mr. Brown

Evolutionary Development of Commercial Systems and Logistic Support for these Systems was presented through the example of the Osborne Computer. Over an approximately two year period sales are expected to reach $300 million. The computer is a 24 pound self contained portable unit comprising a CPU, CRT, two disc drives, I/O ports, modem port (with plug-in modem), an IEEE port, and a battery port. Bundled software is provided and includes WORD STAR word processing and mail merge, SUPERCALC electronic work sheet, CPM operating system, C BASIC, M BASIC, double density P system operating system and D BASE II. Distribution covers sales, service and support and is done by retailers. Recently large corporations and the government started buying in mass quantities and retail support for these customers is not adequate. Plans are to arrange for a large company with government sales and world wide organization to provide international sales, service and support. Osborne Computer is both a personal productivity system and a communication device with immediate plans for 3270 emulation, x.25, SNA availability and terminal disc formatting. "Retailer mentality" has a drastic (restrictive) impact on utilization of the system. On the concept that the equipment does not have to be the best, only adequate, and available, Osborne is on the "blunt" edge of technology - it has no intention of reinvention of any wheels, and uses only basic available components.

It does not offer new technology or write any software. It focuses on manufacturing,merchandising, and using as much commercial standardization as possible. It tries to avoid "analysis paralysis" where, as technology continually changes, by the time it's specified, technology has changed several times. Standardization and universitality are "musts". Osborne does not care what the standard is, it just wants standards and to avoid the rewriting of software which is causing prices to skyrocket. In absence of standards Osborne chooses packages on the basis of the two or three best choices for a function, while urging commercial and military committees to standardize. Although the military is only 5% of the community it is the largest single sector and has some power to dictate standards. Softwear emulation of an intelligent terminal is a "must", software should be independent of hardware and hardware should be universal. Military should accept and adopt new technology but it should be controlled, and specifications will decide distribution and logistical support.

PANEL II TECHNOLOGY INSERTION

The purpose of this panel was to find ways to preserve, to the maximum degree possible, the option for technology insertion. The panel addressed VHSIC insertion into existing products, VHSIC insertion and production engineering, systems approach to technology insertion, and VHSIC upgrades to the EMSP (Enhanced Modular Signal Processor).

SYNOPSIS

The presentation of the option of technology insertion was shown to be feasable at different levels from card or Line Replacement Unit to major system elements and for systems prior to or after Critical Design Review(CDR). The technology insertion in the latter catagory of more reliable functional computers or enhancements for performance upgrade requires thourough initial planning for this later contingency. The planning must include design, qualification, assimulation by users and logistical support. It cannot in general, be justified on the basis of cost savings. The insertion of new high computer technology into systems prior to CDR offer large possibilities of capitalizing on its advantages. Absolutely correct design and manufacture and the entire scope of planning in all parallel channels must be accomplished. This prospect is conditioned by the schedule of the parent combat system and the time that readiness of new technologies to join the main flow of development can be assured. In some cases of long-term system development a range of entry times for new technology has been provided for. These ways of inserting new technology, using the examples of VHSIC and VLSI, both require some assurance of both feasability and adequacy to perform the specified system fuctions. Underlying the whole issue of technology insertion is the absolute requirement for the strongest partnership between program manager and contractor so that all contingencies are forecast and surprises are eliminated. And this, in the presence of formidable pressure to "happen faster" and take more risks, is an absolute "must". Automation aids in design manufacturing and tests, and some relief from the "compartmentalization" of large system design are contingent requirements.

INTRODUCTION

The panel focused on technology insertion into existing products and systems which have passed the Critical Design Review rather than on new systems and products. VHSIC was used frequently as an example of technology insertion rather than constituting the subject of the panel discussion. It was intended that the discussions hold true regardless of the new technology and in some cases of the software area as well. (Mr. Joseph Fox)

The panel consisted of
Moderator
Mr. Joseph Fox
Chairman Software A&E, Inc.

Panelist/Speakers
Mr. Harley Cloud
IBM VHSIC Manager

Mr. Wilfred D. Geiger
Vice President Operations
Sperry Defense Systems

Mr. Gordon England
General Dynamics
Director of Avionics Systems

Captain Chris Robbins, USN
NAVSEA EMSP Project Officer

Panelist
Mr. Sonny Maynard
DOD VHSIC Program

SUMMARY
Mr. Cloud

Technology and how to apply technology effectively in systems design are key to success of VHSIC. VHSIC program is 21 months old, it is a stimulus to push DOD and industry into the Information Age and it is an excellent example of DOD-Services-Industry partnership to produce increased product performance. VHSIC program goals are to determine how to get LSI and VLSI into our systems and determine related cost schedule and risk. Evolution of digital logic technology in chips spans MSI in 1960 and LSI in 1975 to VLSI (1000 to 10,000 gates) in 1980, VHSIC I (10-30 K gates) in 1985 and VHSIC II (30-100K gates) in 1990. The size of VLSI chips is 16 times the size of MSI and VHSIC II chips will be slightly larger. "VHSIC-like" lies between VHSIC I and II. One VHSIC I chip will replace one or two cards (military description) using different methodology, reducing defect density and requiring correct (totally) design. VHSIC II chips will replace five or six cards with more emphasis on (totally) correct design. From 1972 to 1988 RAM bits/chip will go frm 4 to 512K, multi-processor gates from 2.5 to 100k and dimensions of basic elements from 80 to .5 microns. These will be made possible by progress improvements including lithography, single cell memory devices, structured design and testability. VLSI provides subsystems on a chip that were formerly cards or boxes. This requires strictly structured logic design; random logic design without some base is not productable. A macro approach is used to test functions and integrate them on a chip. Testability and assurance that the chip is working properly is a must. The problem in VLSI is not element density but how much can be wired up. A lot of I/O is needed; 240 on a chip of30,000 gates. Computer aided design (CAD) is necessary.

The system designer has to worry about the same things that the chip designer worried about. Thought has to be given at the outset as to how technology can be inserted in the future - bus orientation, control of interfaces and subsystems on a chip. We can no longer do point design. Structured methodology, less dependency on parts catalogs, less availability from vendors, CAD, and selective insertion (don't put in more than you have to) are all "musts." Benefits will be greater performance per volume, greater reliability, less cost per function and possibly maintenance free electronics. Program (and management) considerations include classification, technology protection, and greater emphasis on life cycle cost (where VLSI pay off is) instead of non-recurring cost, upfront schedule consideration, correct designs before release to manufacture and risk.

Reasons for technology insertion into todays products are improved performance, added storage capacity, added reliability, testability, and maintainability. This requires planning anticipated technology insertion which will be cost and (predominantly) performance driven. Requalification, impact on ILS and realism of schedules must be anticipated. The payoff in mature systems in the field is upgrade for increased capability and possibly correction of field problems (e.g. reliability). If we justify technology insertion on the basis of cost savings, even if it is done in parallel and broken in at the right time, the curve of total cost to date is perturbed by a new increment of non-recurring cost. The new envelope of cost-to-date may or will intersect the orgiinal curve at a point beyond the number of units planned for production. It is very difficult to get VLSI technology insertion pay-off by cost reduction.

The current fundamental need is education. The climate is right and VHSIC is a good example of industry, academic, DOD and Service participation to get a capability in place. A great need is for graduates to know how to design systems where others are concerned with physics, structured design and design languages. At present we have good knowledge of the physics, and fabrication of VLSI. Distributed systems and capabilities and limitations of VLSI need more attention. Considerably less, however, has been done in circuit design, system design, and system architecture. We have a way to go to arrive at confidence of risk reduction in VHSIC insertion and prediction of cost and reliability. Manufacturing yields must be improved. We have a wheel, it has some rough edges, but we are making progress.

Mr. Geiger

In discussing a systems approach to technology inserion it can be said that it has had tremendous visibility in recent years but is still not well understood. Technology insertion is not new but the advent of VHSIC makes it much more viable and its benefits more positive. It has been emphasized by VHSIC and its emphasis on industry has resulted in the VHSIC-like chip. The promise for military products now in production is significant in performance, reliability, maintainability, and cost. They are a strong motivation but there are issues to be faced by the program manager and the contractor in upgrading an existing design already in production - an evolutionary design upgrade.

In some cases initial design did not provide for design upgrades later. So "technology infusion" may be a more accurate term. Although technology insertion may occur at a variety of levels from system level on down, this discussion will be below the equipment level at the functional or line replaceable unit (LRU) level (e.g. in a computer replacement of memory, central processor, power supply, or I/O controller or an LRU within them). The purpose normally is to improve performance and operating characteristics of that functional element. Another type of insertion is supplementary addition to improve capability or utility (e.g. addition of I/O adapter module for expanded interface protocols).

Partnership between program manager and contractor for thorough understanding of the level at which insertion will take place is necessary because there are constraints on each and they vary according to the level. The key issue of technology insertion into an existing design is compatability because we are dealing with a partial new design or upgrade. The extent to which the original design remains unchanged will impact the new design. These impacts can be significant and far reaching on design as well as management over the qualification or requalification, introduction into production, test, documentation, introduction into operational use and ILS. Of immediate concern to the designer are hardware characteristics and the mechanical, electrical and functional interfaces which affect circuit cards, modules and interconnections. The original design may or may not have contemplated later enhancement. Many have not but most managers and designers now recognize the benefits, in this regard, of physical and functional modularity, time independant interfaces and expansion considerations.

Another management problem arises from the forethought (or lack of it) by the initial program manager and his procurement practices in the matter of definition and documentation of design. These may be insufficient for use by any but the original designer or a qualified second source. The program manager and contractor must define in specific detail the improvement goals in order to fully grasp the inplication of the compatability issue. VHSIC and VLSI potentially offer in the same physical package greater functionality, increased throughput, expanded storage capacity, greater input/output connectivity and a wider environmental tolerance. In addition potential technical cost and schedule risk improvements versus wholesale replacement of the system (are significant). These must be weighed and defined within constraints placed on the contractor by the program manager. Specific technologies of the enhancement must remain consistent with (unaltered) portions of the original design especially in compatable electrical-logic interface levels, packaging and mounting, cooling, functional interfaces, and testability. VHSIC and VLSI chips will require CAD, automated production and a common data base across them, and these must be updated to provide for the planned insertion. Operational and support software enhancement will be required and they must be backward compatable with the existing software. New hardware support may be required.

Beyond these, and the list goes on and on, the program manager has to give up-front consideration to test and reapproval for service use, factory up-grade or change over, repair philosophy, retraining, documentation, and configuration control. Technology insertion is not new and some companies have had experience in "technology transition." Lessons have been learned from it. There are military benefits, the process is forminable but it is workable, and it requires an absolute partnership between the program manager and the contractor.

Mr. England

From the perspective of a systems approach to technology insertion a first point on standardization is that computer ISA is not the issue. The real issue is development and support in the most economical way possible of a total weapon system. It makes no sense to have ten computer ISA's in a weapon system if one will do the job. This may happen if they are procured competitively. So it is a system issue, not a computer issue. The second point is that standardization on any given ISA is not important. What is important is having one that is adequate to do the job. There may be better ISA's than 1750A but 1750A is wholly adequate for general purpose processing on weapon systems.

The third point is that standardization is not an issue anymore. Twentythree companies are building 1750A chip sets and machines and it is already a standard whether 5000.xx is signed or not. The ISA is really a standard in place.

In looking forward, and using avionics as representative of electronics in general, design and support of avionics has changed very little since World War II. We have the same subsystems - radar, navigation, and communications. There is no trail in the technology which leads to the finished product of today. We still have the same subsystems and it is an organizational partitioning. We need computers in weapon systems to get the required performance, and we pay for it in terms of availability, supportability, and affordability. We lose some force effectiveness compared to potential. Not-mission-capable (e.g.30% down) is a loss of 30% of inherent capability designed into the product.

An overview of systems problems in avionics form a long and familiar list beyond the weapon system especially in major logistics. Further, every system is a new development and, while we have a lot of standardization, we have very little over the total of programs. With low production rates we don't get the volume to get the efficiency, cost reduction and quality we need. VHSIC is a component based program, and in looking ahead to its product (chips) we address the problem of how to fit them into weapon systems. VHSIC will provide the foundation and building blocks that permits a new approach to systems problems and their solutions. VHSIC will provide the key of a new chip that will do functions not feasible in the past and will do functions differently from the past.

One of the big changes will be packaging leading to hardware commonality, which will reduce costs and schedules and help maintain our technical lead. Considering a computer as an arbitrary grouping of functions, VHSIC will permit intergrated racks in an airplane in place of line replaceable units. This will lead to substantial logistical savings. Instead of subsystems we should develop functions. Many functions are common in all of our subsystems e.g. 1553 I/O. In the past they were all different. Now no company will develop a different 1553 interface. They will use the chip set. If agreement can be reached on packaging then everyone could use a common functional I/O.

Furthermore, once a computer is defined in terms of its main functions it is not necessary to package it in the classical manner. We can have common modules which do not have to be standard. There is a big difference. Standardization should be done at the function and the interface. This will provide both flexability in design and commonality; and the possibility of replaceable functional design. If we have powerful reliable VHSIC modules in the cost range of $10,000 and 2000 hour reliability, we may be able to eliminate the intermediate shop. We should start now with transparent designs which will accept VHSIC at the appropriate time. But initially use VLSI with agreement on functions and interfaces. We will have a lead by the time VHSIC is available. A thought on possible packaging is a grouping of modules and a common bus with I/O plugged in, rack mounted, various choices of backplane (for retrofit) and high speed bus (new design) wiring. Reliability can be finessed using fault tolerant architecture with "hot spares" where a few spares can support a wide range of functions implemented in common modules. Maintenance urgency is reduced; fixes can be made at a convienent time. Multiplex communications can benefit by multiplexing at the module level with parallel high speed buses to eliminate wiring and connection failures. Two level maintenance is a fall out of the VHSIC approach which permits self test at the module level, centralized storage, problem identification at the flight line and reduced dependency on the avionics intermediate shop (AIS). The applicability of VHSIC is very wide and all FB III functions can be performed by eleven VHSIC chips with spares. The AIS could be eliminated.

VHSIC will be applicable to retrofits and new designs across a wide range of programs. Here technology transparency is an issue to overcome obsolescence, which comes up when standards and commonality are mentioned. Again standards should be for functions and interfaces. Long life spares can be provided from current technology and multiple sourcing becomes possible. Complexity versus simplicity can be addressed by accepting the necessary complexity and implementing it in simple hardware. The potential payoffs from VHSIC in the systems program supplementing the current VHSIC component program are significant. Among the benefits would be improved incentive or challenge for American industry and an expanded area of competition. VHSIC is, above all, a system issue.

Captain Robbins

The Enhanced Modular Signal Processor (EMSP) is a very long range staged system development with VHSIC-level technology insertion planned for the middle and out years. It is a second generation upgrade of a previous signal processor and features parallel processing. It is in the class of super computer and the engineering development model will lie in the area between 80M and 200M multiplies per second and other comparable characterisics. A further objective is 800M multiplies per second and a selection of five configurations. It has been determined that a number of VHSIC chips would be appropriate to EMSP and are scheduled to appear at approximately the right time for insertion. These chips are 64k static RAM, crossbar switches, configurable gate arrays, multipliers, ALU's and four-port memories. While VHSIC science and physics is in good shape, VHSIC engineering is "all over the floor" at this time. Problems of insertion include inter-chip clock rate, inter-board clock rate, back plane clock rate, VHSIC chip interoperability and multiple power supplies. There will be very difficult packaging problems in the full scale engineering development model. A very substantial engineering effort will be required for VHSIC insertion. The projected threat over the next 20 years raises a requirement for surveillance improvement in the face of denial efforts by the probable opposition. Data processing requirements must grow in a linear relationship to offset signal denial. There is also a linear relationship between data processing and signal threshold in the presence of unwanted signals. Signal processing involves large numbers of a variety of mathematical operations to produce coherent signals for further use. There is great pressure to achieve this capability increase with no increase in foot-prints or space allocated to it.

Turning to software, there are two areas which must remain undisturbed by technology insertion - application programs and support software. In planning an aggresive technology insertion in EMSP it is necessary to organize a set of software interfaces that isolate the user software from the ISA specific software. In this case the program generation software has been isolated from the run-time software and that from ISA specific processes. We can do technology insertion without impacting user software and with minimum impact on system software. EMSP controlled interfaces include standard I/O, user data transfer network and sensor/data interfaces. EMSP is using a new programming philosophy ECOS (EMSP Common Operational Software) with a system level processing language. It consists of graph connections and notations, signal processing primative library, command program, SPL/1 compiler and SHELL (AN/UYS-2) operating system. The interface to the applications program is a level of abstraction above the HOL. ECOS could go to Ada or any other HOL. In machine realization the library programs load into the processors and are isolated from the rest of the system. At run time SHELL operating system schedules operations and execution of the modes. SHELL is included in the Data Transfer Network (DTN) and is stored in the AN/UYK-44 computers and will be stored in whatever comes from VHSIC program in this regard. The partitioning used in EMSP will permit VHSIC insertion without impacting user software and with only minor one-time impact to some of the remaining software. Hardware interfaces include sensor, DTN/processor and NTDS standard interfaces.

Western Electric was chosed from amoung seven team competitors comprising 23 firms in the most intensive computer competition the Navy has ever undertaken. The system consists of memories, crossbar switches and a number of processors. It has close resemblance to a telephone system and new modules can similarly be plugged in. In the first step of the program, front end modules will be interfaced to DTN followed by integration and test, and VHSIC insertion demonstration. The second step will, in parallel, investigate VHSIC and VHSIC-like chips for insertion into other modules with insertion where possible prior to Critical Design Review. Competition will be opened on this phase on interface, and performance, fit and function specifications. This will enable us to proceed to Level III EMSP with two orders of magnitude improvement and 1 to 1.5B multiplies/second by year 2000. EMSP program is doing the upfront planning for technology insertion which would otherwise be impossible and still meet our goals. This planning will take place in systems architecture, software architecture, and acquisition and there will be plenty of room for competition under any acquisition strategy the Navy adopts. It is a good approach to parallel processing and may be useful in other applications.

In answer · questions the following points were made;

-Although specifications on VHSIC chips have been published and are being upgraded, more information on functional definition and interface requirements is required by manufacturers. A central file user data is needed.

-From experience in going from MSI to LSI, the transition from LSI to VHSIC will require selecting and managing transparent module interfaces, interconnects and/or buses of sufficient capacity and testability for module operability.

-With 20 to 40mhz buses and well defined interfaces, technology exists to handle and integrate VHSIC chips/modules.

-In its attempts with SEM the Navy appeared to be working in the right area of "standard functions." Provided agreement can be made the areas for functional standardization are I/O, A to D conversion, processors, memory and power supplies. These should be done and we could agree on others if possible later.

-There are imperatives to make Phase I VHSIC insertion "happen faster." Phase II will expand from pilot line to technology insertion. Production improvement, hardening and sub-micron goals will be pushed so that program managers can better plan for insertion.

-Advanced Common Operating System (ACOS) in EMSP programs is a precursor of ECOS in an identical concept using current standards and hosted in AN/UYF-1. It was completed in December 1982 and will be put in one pilot application of SUBEX. It is exceeding goals and will approach 100% loading of arithmetic units. It may be the wave of the future and appears to have applicability to C^3I if that community can come up with applications (in the nature of primatives).

-No definite answers were given on Navy response to possible requests for involvement by Army or Air Force VHSIC contractors.

-Technology insertion requires up front planning in all of the system related areas. It requires compartmentalized design and more up front money. Units will cost more and our system does not yet allow for that.

MILCOM II - COMPETITION PANEL

The Competition Panel addressed the question: "What groundwork needs to be layed for an approach to provide vigorous competition?"

The panel consisited of:

Moderator:

Dr. James H. Babacock
Vice President, IRT Corporation

Panelists/Speaker:

Mr. Richard L. Seaberg
Vice President and General Manager
Sperry Defense Systems Division

Mr. Paul V. Halberg
Vice President, Tactical Systems Division
Magnavox Corporation

Mr. Dennis Paboojian
Vice President and General Manager
Military Computer Division
Rolm Corporation

Dr. Hillman Dickinson
President and Chairman
Technology System Associates

Mr. George Halloran
US General Accounting Office

Mr. Milton Worthy
Vice President, Governemnt Information Systems
Planning Research Corporation

The purpose of this panel was to examine ways to provide vigorous comptition in the defense computer market place. Several issues relevant to competition were identified and discussed.

* Will standardization lead to competitions driven primarily by price rather than technological innovation?

* Will non-US companies attempt a major thrust in the defense marketplace given standardized systems?

* What would be the impact of non-US companies being low bidders on our defense posture?

* Given standardization, will the non-defense products sector be a full participant in competitions? How important is it that they be full participants?

* Will the trend toward standardization for hardware and instruction set architectures preclude the United States from maintaining a technological edge in its defense posture?

* Will acquisition of US commercial and foreign technology by the Soviet Union and the Warsaw Pact countries, combined with standardization, lead to their achieving technical superiority in information systems of a defense nature?

Mr. Seaberg

Forums such as MILCOM II are valuable for exchange of ideas, even though it is unclear how a true partnership is to be accomplished. Competition is a reality independent of any given contractor's monopoly in a specific area. Improvement of the acquisition process for mission critical computer resources must include consideration of legislative, managerial, technological, financial, manufacturing, and operational factors. The Secretary of Defense has stated that competition is necessary to reduce cost, improve quality, and enhance the industrial base. Even so, sometimes competition is not practical. For example, sometimes no one else has the technology to unseat an incumbent, or budget, personnel, and investment constraints make competition impractical.

Standardization is strongly supported by Sperry for the following reasons.

Reduction in uncontrolled proliferation of hardware and software
Reduction in life cycle cost
Improved software availability
Reduced software developement and maintenance support costs
Improved combat system availability, survivability, and maintainability
Simplified logistics and training

As an example of this, the AN/UYK-43 and 44 procurement benefitted from prior practice and standard instruction sets. Sperry endorses instruction set architecture standardization. High order languages, such as Ada, are a step forward, but the impact has not yet been assessed.

With respect to price competitions, low bids often win, but it is worse to pay too little than too much if quality is to be maintained.

It is up to the acquisition manager to stress firm requirements criteria for performance, maintainability, and logistics. Careful proposal review is essential.

On the issue of technical infusion, issues of trades between performance and timely system acquisistion must be considered. Sometimes "new technology" is an excuse to "get well" on a contract.

Standardization and technology infusion are compatible and mutually supportive if a well planned acquisition process is established. Systems quality and reliability will continue to improve and time and cost can and will be reduced through standardization. Industrial investment in computer resources is more likely to occur in a standardization environment than in a laissez faire acquisistion strategy in an unstructured environment with ill-defined payoffs. Properly planned and supported standardization strategies will continue to provide a competitive environment. Although we have a long way to go, exchanges of ideas will make strides toward achieving the partnership we aim for.

Mr. Halberg

Addressed the competition should be viewed in the light of the need to reduce proliferation of equipment and data and to maintain a sufficiently modern fighting force. From a computer resource point of view, standardization does not (necessarily) lead to overly obsolescent hardware and software. However, there is feeling in and out of DOD that additional competition and incentives are needed for the standardization environment to encourage confidence. In the final analysis, this question is one of degree and not one of absolutes.

Standard ISA's and software to some degree, depending on the military service, are a fact and these facts should be recognized. Since each service is in a different stage of Standards development and with unique service problems; funding, manpower, and the use of previous developed S/W are all variables with which each service can best deal with its unique set of problems. However, with the advent of Ada, it is proposed that development of transition plans that can be reviewed and commented upon, including environments such as this ADPA meeting, will provide inputs to stimulate the competitive process.

Standard computer hardware implementations are important for those services which feel the necessity to put restraints on hardware proliferation. There are many computational problems and/or operational requirements that can be met with good efficiency by a standard hardware implementation. It is submitted that such "encouragement", with a STDS environment that is perceived as being fair, will bring forth additional competition and ideas plus the pressures from a number of such solicitations will allow and/or bring about more valid LCC comparisons (with the establishment of reasonable logistic and supply cost factors), competitive pressures on the standards (vice complacency), standard computer hardware and software innovations, updates and improvements, and opportunities for competitive innovation by industry (especially with time causing pressures on obsolescent equipment).

The introduction of Ada will eventually cause each service to procure a "New Standard Ada Computer". When this occurs, it is proposed that each service should delete the requirement for the previous Standard ISA. Each service's problems in transition will be unique, and questions (i.e., proposal solutions) about the capture of software and/or transition or translation to Ada will require the best minds in the industry to solve. But this transition offers opportunities to open up the procurement of Ada computers.

A more flexible waiver program appears necessary to stimulate the idea of fairness. In this regard, it is proposed that OSD either strongly encourage or dictate that the services provide a more independent evaluation of waivers to the standards requirements. At present, waivers are reviewed and recommendations forwarded by the same standards group that is charged with enforcement and encouragement of the standards.

Mr. Paboojian

Focusing on "An Approach to Provide Vigorous Competition Within an Ada Framework",there was a note of discouragement carrying over from MILCOM I and the vehemence expressed then. While somewhat less at MILCOM II, the parties seem as polarized as they were a year ago. The concern is that we all do not seem to be listening to each other. Unfortunately, this issue has turned into a debate in which people are trying to express logical, consistent arguments of their own as opposed to dealing with issues raised by other individuals.

The issue is not why we have standardization , but what the goals of standardization are. The key goal of the standardization program is to provide maximum leverage for the use of DOD's scarce resources. The challenge for DOD is to balance the stability and innovation while maintaining proper focus on the total computer systems requirements. Standardization can reduce the time required for systems integration to the extent that it provides mature software tools and software transportability and interoperability.

The way standards are applied to the components of the system has a major impact on the solution that will result in the development and procurement of these components as part of the system.

The development of Ada is a good example of this approach. The specifiers of Ada could have addressed only the compiler in a traditional way. But they went beyond that and attempted to define, at a functional level, how Ada would be used as part of the total computer solution. Ada is a total environment, a language system. It is a framework to accomplish the goals of a DOD computer systems standardization program - to maximize leverage of scarce DOD resources.

Turning to competition within an Ada framework, Ada is not just a compiler but is a complete software system, it can be a vehicle for accomplishing the goals of the computer standardization program by giving a framework to focus on as a total computer system.

The Rolm Ada Work Center is operating an implementation of the Ada concept described is in an Ada site today. That system will be validated as soon as the AJPO is ready to initiate the process. Formal validation has been applied for and is currently being scheduled.

Standardization can help DOD meet its goals by providing maximum leverage on scarce resources. The only question is how is standardization to be applied. Industry will make investments but only where the ground rules are in place to insure an adequate return on investment. Start time, as in sports, is important. Army prescribes specific milestone dates and for Ada and for all battlefield automation started after January 1, 1983 in AR 1000-1. If we want industry to invest its resources and only be compensated for that investment if, and only if, it is successful, then we can't change the rules or next time there won't be any players. In a climate of scarce resources, we must take advantage of a significant cost saving opportunity.

Dr. Dickinson

In some minds, the most important goal in the DOD program is to be able to fight on the battlefield if we ever have to, to do it efficiently and to save lives, and to do it under the stress of battle, not peacetime exercises. For one portion of the problem - the ground battlefield - standardization is essential to survivability. The number two problem in C^3I is lack of interoperability with the Allies with whom we will have to fight. If we cannot agree on standards, we cannot operate when we have to in the 32 NATO committees to get agreements to become interoperable. Yet we don't know what our own standards are and won't know what they will be for the next five years. It is an almost impossible task, especially considering the vital role of interoperability in C^3I systems. Survivability and interoperability should be the goals for C^3I systems. They are far more important than innovation. We don't need a great deal of innovation in battlefield C3I. We haven't even begun to apply innovation available ten years ago.

The computer system consists of hardware and asociated peripherals, software, maintenance personnel with their parts and supplies, operators and supervisors, users, and training and education of all associated personnel. This is the gross system that has to survive!

The possible causes of failure are, in peacetime unreliable hardware unreliable software, poorly trained maintenance personnel, poorly trained operators and users, and the cultural shock of introducing automation in the Army.

In wartime, there is also battle damage to hardware and killed and wounded personnel of all skills which must be considered.

Standardization appears to be the only solution. As personnel are lost, the remaining personnel must be rotated into the most critical places. As hardware is lost, the other hardware available must be cannibalized. Suppose G-2 and G-3 functions are separated (and they will be) by a kilometer or so, and consider the problems this can cause.

With respect to what not to standardize, if there is only one or a few of a kind, standardization is not indicated. This could be some airborne equipment or sophisticated intelligence or signal processing equipment. Innovation is desparately required in these instances, and waivers should be allowed and quick.

The role of the high order language (HOL) does not seem to be controversial, nor is the instruction set architecture in survivability. HOL is necessary, but it is not sufficient. It facilitates and permits standardization to a level where cannibalization of equipment and personnel is practical, but other things must be done.

The dialogue here should first of all consider how to survive, then how to achieve interoperability. Finally, innovation should be considered. When these factors are all resolved, we can move toward a true partnership.

Mr. Halloran

Claims for ISA were to save software, which was also the primary objective of Ada - to reduce software costs. The very important aspect of survivability of the computer in the battlefield was considered.

GAO looks at Ada as the way that DOD can get from being locked in to a vendor. GAO is saying that with the standard Ada language and standard interface and communication protocols, DOD can have a network of computers. DOD can go out to the vendors and say "If you want to sell us a computer, it has to speak Ada."

With standard interfaces, protocols, etc., the computer, in time, will become transparent to the user. The home computer industry is going to force this. These companies put products together from the most popular components. They are taking the most popular operating systems and data management systems and putting these products together. The American consumer is not going to put up for the next ten years with what DOD has in the past - having this proliferation of computer and hardware. The de facto standards will emerge and you will see the computer becoming like a hi-fi system.

We will have to rethink the concept of logistics in light of the changing times. Referring to the Army Apple system, there were problems in trying to deal with the Apple company. But should we be spending millions of dollars trying to set up a logistics system to provide spare parts for a $1,000 computer?

GAO feels there is no effective justification for military owned computer architecture because the majority cost category for life cycle cost for major information systems is software, and military computers can effectively use militarized versions of commercial computer architectures.

Mr. Worthy

Difficulties of getting our partnership going and the need to take note of what other people are doing in this area, have significant meaning for the United States. From an oblique point of view of competition and standardization within information and data processing systems in the foreign competition area, there are two kinds of foreign competition - internal and what we traditionally term foreign competition - Japan, France, and the rest of the Western World. And there is technological competition - competition going on in the Soviet bloc contries.

Another thing that is happening is competition from the governemt and the sevices which is beginning on a grass root basis. Individuals in uniform are bringing personal computers to duty stations to do things that the industry has not done - providing information systems that are personalized. And probably the last thing one wants to do is standardize information systems on the battlefield.

The question arises: "Should one really try to standardize an information system?" if a distinction is made between information processing and data processing - and it is essential that it be made and made accurately - standardization of information systems may be detrimental to the military and particulary in the battlefield situation, especially in wartime.

The whole intrastructure in this country-small industry that supplies big industry that supplies our economy-is being eroded and attacked by all sorts of industries, especially in the high technology area. You hear, and the media states, that Japan is an enormous threat to us. If they threaten the medium and small industries, they threaten the large industries and they threaten our economy.

In Europe, France is doing something of interest which is a challenge to us. They are conducting experiments in education, with many American educational innovators, including information scientists and people from MIT (notably Dr. Seymour Pappert). France, although conservative in many ways, takes a great radical lurch every two centuries (and one is about due) to undergo a radical change in how it looks at the world. There is a deliberate policy in France to become an information oriented society.

The Soviet bloc countries are undergoing a similar kind of research, but not to the extent it is being done in the Western World. Hungary and Poland are doing extremely valuable work in computer architectures and particularly in artificial intelligence. There are several position papers which indicate that the Soviet Union is going to rely very heavily on artificial intelligence and a very rigorous type of software they will use for their military systems.

In summary, we in this room and the military are faced with competition from our own internal world, which is good, but also faced with competition from outside our country.

Question and Answer Session

Recalling that a sure way to get in trouble in Congressional hearings is for the services to say different things, a possible way to further the partnership we need is, as a first step, for industry and the military to get their act together first.

Mr. Peter Smith of the British Embassy, gave a UK perspective on the standardization issue. Although both US and UK/NATO countries make major thrusts in technology, UK and US have had great success with standardization policies centered around 1553 and 1750. Two of the three companies making LSI according to 1553 are UK companies. We are concerned to see that standardization and interoperability do not suffer in the NATO sense.

In answer to the question "Where does MCF lock the Army into one Vendor?" it was brought out that the Army program appears very parallel and similar to the Navy experience. The Navy had competition back in 1969-70 in getting the development of the UYK-7 and the UYK-20. Then they went for their second phase like MCF will plan to do in 1986 or 87. Then the Army will have parallel development for MCF2 during 5-7 years of production of MCF. That appears to be very similar to what the Navy has experienced. At that time, you will be locked in to whoever wins from TRW, Raytheon or RCA. And we will be spending $200M every time you go through this phase of re-inventing computers.

Summary of Competition Panel

Opinions expressed in the competition panel ranged from full support of standardization at the first level to flexible approaches depending on need, to endorsement of high order languages as an appropriate level for standardization.

Opinions were divided with respect to the need for standardization on the battlefield. One point of view held that standardization provides the flexibility needed to reconstitute systems and to thus provide for survivability. Another held that standardization inhibits flexible, personalized systems.

The foreign challenge to the US was emphasized as partially bypassing the US computer industry if innovation and flexibility is not allowed.

CLOSING/WRAP UP PANEL

From the view point of industrial and commercial experience heavy in instrumentation and less so as a defense computer supplier, Mr. Beckett, the moderator, cited his experience in addressing corporate need for some direction in standards activity. He has participated in an ADPA committee on Electronic Test Equipment (which faced similar problems to MILCOM I and II), looked at the problems of greater use of off-the-shelf test equipment in the Defense Department and produced some successful results and chaired the of CODSIA Task Force 13-82 which will shortly report to DOD on "Achieving DOD Information Systems Compatability."

The panel consisted of.
Moderator

Mr. Jack Beckett
Hewlett-Packard Company

Panelists/Speakers

Mr. Anthony R. Battista
Professional Staff Member
House Armed Services Committee

Dr. Edith Martin
Deputy Undersecretary of Defense for
Research and Technology

Panelist

Mr. George Halloran
US General Accounting Office

Mr. Battista made the following points from the point of view of his position as a professional staff member to the HASC.

* Having participated in MILCOM I and having read the GAO report, he came to the conclusion that with advances in technology in the semiconductor industry,this is not a good time to standardize on ISA, nor to run the risk of precluding technology insertion and stifling competition. We have a problem in the battlefield today that needs solving but not by standardization.

* Therefore he recommended to the chairman of HASC to ask DOD not to promulgate 5000.5x pending a complete review of what is available today and what it means to the man on the battlefield if the UVK 43/44, MIL STD 1750A and MCF programs proceed on plan.

* Looking at a computer ISA today, system implementation and physical characteristics appear paramount. It is questionable in the light of the success with Ada if the answer is to standardize on hardware. Rather,

standardization at the HOL level should be encouraged.

* Comparing the IBM 360 and the Russian computer which copied it, the ISA and implementation are mirror images of the 360, but the physical characteristics are very different. US Army has 60 odd computers in the battlefield and logistics has to be improved. If ISA is standardized and MCF proceeds, the question arises whether the logistic problem will be solved by virtue of standardization at the architecture level. It does not appear that it will.

* There is "technology push" in the computer/semiconductor industry with changes occuring in months rather than years, and obsolescence compressed to two years. Last year, one example was a 90,000 devices/chip, with 270,000 devices in a 3 chip micro main frame which was optimized to execute Ada, or parts of it. Recently another chip appeared with 455,000 devices on it. This revolution is different from 20 years ago. Then, a ship had to carry 15% spares and the Navy had to worry about the logistics "tail". Today with inexpensive chips the logistics problem has to be re-evaluated. We have to be concerned about mandating obsolescence in DOD as a result of our policies.

* Mr. Battista disagrees with people in DOD with respect of standardization. It is too complicated a problem with too much impact on the future to make a quick decision on standardization at the ISA level and perhaps stifle competition for the next 5 to 7 years. The winner of the MCF competition will be in good shape. The losers will point out the Army is being locked in to a vendor. The SIRCS program was a (Navy) case in point.

* Mr. Battista said the staffs on Capital Hill are impartial and but "computer ignorant"; however they are not stupid and they can be educated. It is also true that the legislative work load results in a small share of effort that can be devoted to computer standardization issues. The perspective from the Hill is that DOD is making a mistake on 5000.5. There appeared to be some here who felt that 5000.5 was a fait accompli, and that DOD would submit a report to Congress and then implement 5000.5. Congress controls the authorization for implementation and there has to be a partnership. Congress wants to work with DOD and industry to come up with a policy that will stimulate competition for the future, provide for technology insertion and solve some of the logistics problems. As Senator Tower indicated, we need a partnership with flexibility.

* It is a mutual partnership and the parties have to down and work out the solution on 5000.5x. Neither can ignore the other. DOD should be commended in going forward with Ada. It is a potential solution to many problems. It will bring down the DOD software mortgage cost.

* There is concern that in the implementation of Ada each user will go his way and we will have many different Ada's. A lot of firms are spending their money developing Ada compilers compatable with their families of machines. If 5000.5x is accepted there is a question as to how the firms will react in terms of interest in OSD and how to invest their own money.

* His recommendation is not to promulgate 5000.5. There is no new data to support a rescinding of this position. Congress needs new data to keep current. It will digest this data and take it under consideration. It is not a decided issue at this time.

* The main reason for Congress entering this situation was to insure DOD did not make a move which would lead to obsolescence with DOD lagging behind the commercial sector in both semiconductor and computer technology. Three years ago Congress initiated VHSIC with money to get DOD started in the very high speed integrated circuit business. The Hill supported it 100% because this kind of technology has to go into our weapon systems.

* Even though VHSIC has to get the price of chips down, he sees no one signing up for VHSIC, nor for Ada. It is not being used in new systems and no one in OSD is mandating its use.

* We want to keep DOD current with the commercial world, provide for technology insertion and maintain a competitive environment, and we want solutions to the logistic support problem.

Dr. Martin made the following points from the perspective of her transition from industry to government:

* 5000.5x is an item of great interest. It has been around a long time and it is good to give the context in which it was proposed and a status report as of MILCOM II.

* The currently perceived national security threat is different from what it was in the 1950's so military requirements are different. We attempt to meet them directly or indirectly by increasing automation and sophistication.

* The problems in the military area are different. The system life cycle is longer: 10 to 20 years. We have difficulty in making systems that are interoperable because some are at the beginning of their life cycle, and some are at the end. We observe symptoms of problems, rather than problems directly.

* Recognition of these problems led to DODI 5000.29 which said in effect "get control of the embedded computer resource problem" and said nothing about requiring the use of the latest technology.

* Control of embedded computer resources involves a number of relevant factors. The objectives of standardization or control were to reverse or overcome the symptoms of problems identified earlier and to make a positive change in things we could observe.

* In looking at options open to OSD for change, levels were identified where standardization could be imposed and thereby change some of the symptoms of earlier problems.

* The next step leading toward control was DOD/5000.31 which led to Ada and is moving along very well. The requirement was to use high order languages, choose from a small list and ultimately converge on a single language.

* 5000.5 used a similar logic but was different in that it did not intend to converge to a single ISA, but rather a list of ISA's that would involve relatively small risk and a list that would require a relatively small number of support systems at any given point in time.

* Comparing levels of standardization and objectives of control in matrix form, intersections were identified where standardization would achieve a baseline objective. A DSB Panel identified intersections where controls were in place and where further controls should be imposed on work underway, if all of the objectives were to be attained.

* This appeared logical, easy, and scientific, but some factors-sociological, economical or political-apparently were left out. They were clearly not technical.

* 5000.5 was placed before Congress and objections were raised. Amoung them was "continuation of current policies (presumably 5000.5x) would result in obsolescent, unreliable computers in our weapon systems, and little meaningful competition." Also the "DOD standardization plan is very high risk and significantly reduces competition." Testimony was given for 5000.5. The result was that DOD was asked to do another study and, in the meantime delay 5000.5.

* Congress agreed that computer proliferation had caused a serious logistics support problem in DOD, and they requested, as a final report item, a plan to resolve it. Congress was, in addition concerned about our weapon systems effectiveness as a result of ISA standardization. These are reasonable questions that need satisfactory answers.

* This brings us to MILCOM II. There were three very good articles recently in the Baltimore Sun on 5000.5. They were on page one, and not indicative that the controversy is dying down.

* Contradiction appears to have been the hallmark of discussions of 5000.5 in MILCOM I. 5000.5 has been debated for 7 years and all arguments have been aired. We are no closer to unanimous decisions than when we started. The DOD report to Congress will be good, and it will be finished. But argument will continue and we will still see that many do not recognize that 5000.5 was proposed as a method of managing change, and not as a standardization program of any duration.

* Standardization has its place. 5000.5x is not a standardization program but a mechanism for managing technological change. One ISA

would be ideal but it is not feasable. Three is better than five which is better than 10 or 100. We don't know what the right number is, but it should be a small, controlled number.

* Right now we are dissipating valuable time of valuable people. We need thoughts and actions of the community moving in other directions. Let us become partners and put the energy into managing change. We don't want to say, "leave the negotiating table" but we have been there a long time and its time to be moving on and taking a fresh look.

* The US has had two weapon choices - high volume or high technology and we cannot go back on the decision to use high technology.

* High technology includes computers, and software. Computers are important to our military capability and we are experiencing problems in that area. Charts and studies show that, and show that computer demand and cost are increasing.

* There are a multiplicity of problems, not a single problem and not a single solution. We are going to have to take a diversified approach toward getting control of our embedded computer resources. We have no other option. We cannot spend all of our time on ISA's. We have in addition to the 5000.5 sponsorship, the Software Initiative and VHSIC and related problems. There are many challenges for technology insertion, Ada, and for the STARS(Software Technology for Adaptable Reliable Systems) initiative. The goals and objective are many and formidable. Much help from the community, research and development is needed. STARS will be vertically managed like VHSIC and envisions using many tools available in the commercial sector. Emphasis is on technology transition into our own systems. Part of this will be done by a Software Engineering Institute, which will help greatly in taking results from research and putting them into practice.

* We have cost, size, qualification and other challenges in VHSIC. We want to use CAD software as a first approach, and reduce design turnaround time 100 to 1, and yield enhancement 10 to 1.

* DARPA is looking at a 5th generation computer with many questions and multiple alternatives to pursue.

* We need to be partners to solve these many challenges. We have no option but to succeed.

The moderator Mr. Beckett, noted one differnce between MILCOM II and MILCOM I is that there is a clear cut expression from all parties to achieve a partnership.

Numerous answers to questions from the audience and comments from the panelists brought out the following points.

** In one instance where a chip was selected for a new DOD program which implements a subset of Ada,it was a year late. Earlier references to this chip were not an endorsement but an example of what technology is achieving today. The point of 290,000 gates on a chip executing a subset of Ada and with ISA optimized to the execution of Ada, is impressive. Someone will do it. What is important is what the technology has produced and we should not lock ourselves into a standard (recognizing differences between HASC staff and DOD interpretation). When limits on the number of ISA's (one, two, three or more) are imposed, that is standardization for standardizations sake.

** We are shooting ourselves in the foot. When the report on 5000.5 is submitted to Congress we will still dissipate our energies, and go back to shooting ourselves in the foot. Today's problem is managing insertion of technology. Yet, we are moving out on programs that will be in place years from now, and we can manage technology insertion and vote the money to implement it. We have spent hundreds of millions of dollars on Ada and on VHSIC, yet when will DOD tell the many AN/UYK-43 and 44 users that they must be converted to Ada. Congress voted money for all of these programs with no provision for Ada and technology insertion. Can funding rightfully be withdrawn from these programs this year because they don't achieve the results congress hopes to get? In answer, Congressional caveats were placed on these programs. In MCF, continuation was authorized to finish Advanced Development because the team is in place and the desire for parnership is there. Expenditures for full scale engineering development were not authorized. In AYK/14, the report provided authorization to get the data package to proceed with second sourcing but didn't go forward with second sourcing. Contingencies were placed on authorization of funds while trying to avoid chaos. Congress has the right to deny funds this year but is hoping for an objective analysis of available technology, insertion and competition. Congress would not be inconsistent to deny authorization this year, but there are qualifiers. Compliance with Ada is of principle concern to Congress. Only MILSTAR has signed up with Ada. There are proof programs for VHSIC but no one has signed up to use VHSIC. It emanates from the "fear factor". Program managers don't want to embark on high risk but they should, at this stage of the game. Consequently, DOD weapons are lacking in current technology. Congress pulled DOD into VHSIC and feels DOD should be more adamant in forcing Ada and VHSIC on the services, and asking for their plans.

In response, it was stated nobody is going to have to tell the Navy to use Ada. It is in RFQ's that are on the street. The Navy fully intends to use Ada and the Navy is teamed up with the Army, and will using the Army's front end compiler and as many of Army Ada products as possible. The Navy will develop two Ada products. There is a two year lapse between POM submission and time of initial action in response. The Navy intends to use Ada, has assigned people and is moving. The DOD response stated that DOD has millions of dollars on Ada and is looking for every option for new starts. Some are add-ons to existing systems (e.g. WWMCCS and WIS upgrade). This raises all the problems of multilanguage which we may not be able to address with confidence. Ada is on track and will be used by the services.

Another problem is the one of a "lot of fanfare but no parade" as in the chip case cited earlier. It had problems and if DOD had proceeded on the basis of "fanfare," expecting it to achieve all of its goals and requirements, we would have to put some program managers in very awkward positions. Although DOD wants the latest and greatest technology, care in decisions is mandatory in cases of long lasting effect. If the chip had been chosen, DOD would have had to finance the correction of deficiencies and could not expect Congress to appropriate money for it. This problem can not be treated casually- it is not black and white- it is gray. DOD is trying to urge program managers away from extreme conservatism to consideration of more risk sharing. Progress is being made. The DOD disagreed that it is behind commercial technology. However examples were given of more readiness for risk acceptance and cases of success in the commercial world. Comparitively, the services may take up to 20 years where recent commercial aircraft developments were done in 2 years. Program managers should not be forced to take unproven technology, but an indicatior would be more of them signing up subject to satisfactory proof of technology. MILSTAR is doing this and we should have more of this.

Turning to the Navy comment that the Navy embedded computer objective seems to stretch out 10 years ahead of attainment the Navy track record in digital computing is far from sterling, stated one panelist. A case was the carrying of CMS into the CMS-2 era. The Navy's program looks like fanfare and no parade. On the other hand, there is fanfare and parade in home computers, tv-sets and interchangeable tape utilization. Although the real-time world is different, we should close up on the commercial sector the panelist argued.

The moderator made the points that two decades ago technology impetus came from DOD and the space program. Today it is reversed. If commercial technology leadership is not fed back to defense, we do have a problem.

** The HASC panelist commented that provided we can effect this feed back we have an advantage of "spin off" over our probable adversary. Spin off needs to be encouraged and improved, especially with the Defense budget being under pressure, and the adversary with many new systems in stages of development. We need a common approach among us. An industry comment pointed out that through competition in industry, if one company doesn't do it, another will, and successful ones make economic decisions about technology and take risks. That does not occur in DOD. Every year Ada is delayed, it will cost $1.5B. We cannot afford this in a situation of scarce resources. DOD response was that Ada is proceeding well, and throwing more money at it will not speed it up. Regarding the question of whether or not it was necessary to settle 5000.5 before achieving a partnership. DOD felt it has been discussed to death. There is no chance of unanimous consensus. Let's get on with meeting the other challenges, and establishing a partnership.

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