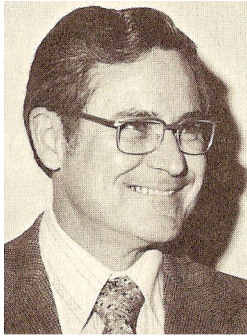


An Extract from the Presentation to the Financial Community Rancho Bernardo, California. May 1976

Criterion Manufacturing

W.F. Buster Vice President Computer and Communication Systems



The Data Processing Division facility which you will visit today was completed in 1968. From the outset, it was designed specifically for the manufacture of general purpose data processing systems and subsystems. It was apparent at that time that material handling and control was going to be a major factor in being able to produce systems at the most optimum cost. Actually, the material content of our products have progressed to the point now where it represents 75 percent of the total cost and direct labor, not counting burden, represents only about 5 percent of the total cost. With this relationship in mind, we spent most of our effort in managing the material part of the business, where we would be able to obtain the greatest impact on reducing the total product cost. This will be apparent when you visit our facility later this afternoon. The material handling building is highly automated, from the receiving dock through receiving inspection, storage location identification and put away. The material is moved and controlled by a series of automated conveyors and staging positions. The actual storage is divided into two areas, a relatively low density bulk storage area and an extremely high density automatic storage and retrieval system. The automatic storage and retrieval system (ASRS) is fully computer controlled and is operated from information which is transmitted by magnetic tape from the main inventory control system.

Individual components which are required for the scheduled daily production of the subassemblies are collected in shop order form. The shop orders have been previously identified by our manufacturing information system, which takes into account the final end unit schedule and the indentures of all the subassemblies required to produce the product at the required rate.

Over 7,000 part types are stored in the ASRS. During a typical day, about 1,000 line items will be picked and put into shop order form - all automatically. This operation averages about 100 line items per hour. Only sixteen people are required to run this system, where prior to the time it was installed we required 45 people for the same level of activity.

The inventory is divided into "A", "B" and "C" categories, where the "A" category, which represents 80 percent of the total inventory dollars, contains only 20 percent of

the total part types. By exercising very detailed and close control on "A" type inventory, we have been able to achieve four turns of the "A" inventory each year. This, in itself, represents a significant cost savings. When you consider that it costs approximately 30 percent of the value of inventory to control and maintain it during each year that it is on the premises, it becomes obvious that a reasonable investment and expense in obtaining a very high turns ratio has a fast payoff rate and results in lower overall product costs. A great deal of our management effort has been spent in this area.

We have also optimized the material flow through the factory. All of the printed circuit boards have been designed on a standard grid. This allows us to automatically insert all the major components including dual in-line packages which contain integrated circuits and axial lead components which are the passive elements such as resistors and capacitors.

After assembly and inspection, the boards are subjected to a comprehensive test. They are actually exercised as they would be exercised in a performing system, and the faults are identified at the board level, which can be repaired early in the production cycle.

After the systems have been assembled, more than 95 percent of the total errors in manufacturing and faults with components have been identified and corrected, and the remaining small percentage of problems are relatively easy to identify and correct in the unit and systems test area. This process reduces the total time required to manufacture the system and verify its operation.

The Criterion is very different from the Century systems. It uses a new circuit family, ECL, which has an operation speed of about two nanoseconds. It is constructed on 11" x 14" printed circuit boards, compared to the Century 300 which was manufactured using 4" square boards. Also, the logic complexity of the circuit elements is significantly higher than those used in the Century products.

For example, the average Century integrated circuit had approximately 30 logic elements per circuit, and the Criterion has circuits with as high as 5,000 elements per package. This allows us to produce physically small systems which have phenomenal logic complexity and capability. The Century 300 had about 2,000 logic boards, or printed circuit boards, and the Criterion has less than 50. The total number of integrated circuits in the Century 300 was 13,000, where there are about 5,000 in the Criterion.

A startling comparison is one of just physical size. There are seven relatively large cabinets in the Century 300 with 512,000 bytes of memory. In the Criterion, we can house a million bytes of memory, along with the processor and several controllers, all in the same small cabinet.

In order to provide you with an understanding of just what the Criterion is, what its systems architecture is, and the general design objectives established for the system, Tom Elrod, who is the Director of Engineering, Data Processing Division, will describe the Criterion in some detail.

What is Criterion?

T.H. Elrod Director of Engineering, Data Processing Division



During the next thirty minutes, I would like to review with you some of the highlights of the Criterion system, and to share with you some of the background which has made this major new product line possible.

There have been some dramatic advances in hardware and software technology and in system architecture in recent years, and I want to show you how NCR has exploited these advances in the Criterion System.

Hardware technology has changed primarily with respect to cost per function. Today we can offer powerful systems at low cost that permit users to develop applications which, until now, had been economically infeasible. Examples of this new technology are Emitter Coupled Logic (ECL) which has opened the way for faster processors, and the Metal Oxide Silicon (MOS) 4K x 1 memory chip which permits construction of large, low-cost main memories.

In the realm of software technology, we have witnessed the emergence of virtual storage as a valuable tool for both the software writer and the application programmer. We have also seen the adoption of higher level languages, structured programming, and systematic testing techniques, in a general trend toward what is often called "software engineering". By using these techniques in the development of new Criterion software, we have been able to achieve improved levels of functional capability, usability, and reliability in the software.

In system architecture, the key advances have been in the areas of firmware and distributed intelligence. Firmware is a relatively new technology which permits us to implement more easily and more efficiently many functions which, in previous systems, were implemented in hardware. Firmware has two main advantages. First, it permits one hardware machine to perform as several different "Virtual Machines," depending on the firmware it is executing. And, second, firmware is capable of implementing higher level "Virtual Machines" than were previously feasible just through hardware, so that in effect it takes over some of the repetitive functions previously performed by software, performing them, at much higher speed.

Firmware provides a trade-off between the speed of hard-wired functions in the processor and the flexibility of easily programmed functions. The hardware required in

a firmware-driven processor is less complex and as a result can be made faster and more reliable. The speed gained in this way is used to offset the multiple firmware commands which must be executed to provide complex functions.

The trend toward distributed intelligence is manifest in the way the system functions are distributed among several processors or intelligent controllers, each of which is driven by specific firmware. In Criterion, these distributed elements share the workload and communicate with each other across the Internal Transfer Bus, in order to operate as one harmonious system.

The architecture of the Criterion has embodied many techniques that are proven and mature in other systems. By using this approach, the success of the product is much more assured. At the same time, the combination of techniques used in Criterion is unique and gives the product a distinct advantage when compared to other systems using only certain of the techniques. It is this combination of proven technologies in a unified architecture that we believe makes Criterion a unique and attractive price/performance competitor.

Product History

A basic ground rule of the Criterion system design from the start was full compatibility with existing NCR Century software and user programs. The product strategy was, and still is, to initially introduce the hardware to run existing software, and subsequently to introduce new software as a second step. This approach eases the migration path for the user and NCR. It is an approach that lowers the risk during such a major product introduction.

Ground rules for the new software system were that it should run existing programs without change, and that the customer would be able to convert to it with very little effort or cost. We have fully achieved the objective for compatibility of the hardware. This has been demonstrated by both our internal testing and the experience of the customer pilot installation where systems running on a Century 200 were moved to a Criterion 8550 with no changes to the system or application programs and the customer operator required less than two hours training.

In order to satisfy the compatibility requirement, it was decided that the new software Virtual Resource Executive (VRX) would utilize B-series code, either unchanged or, where necessary, modernized, to meet the interfaces expected by existing NCR Century B-series programs. The B4 operating system was chosen as the starting point for developing VRX. Alongside the existing or modernized B-series code, a new set of software interfaces was designed and implemented. The goal of this new code was to introduce new capabilities primarily in the areas of virtual storage, data management, telecommunications, and COBOL '74.

The current status of the product is that the Criterion 8550 and 8570 systems are both in production, and the first units have already been delivered to customers. These are running with Release 9 of Century B-series software. The first release of the new VRX software has been written, is currently in system test, and will be delivered to the first customer pilot site in November, 1976. The demonstration this afternoon will include operation of the VRX.

Criterion Hardware

The Criterion mainframe is self-contained in a single cabinet which houses the Internal Transfer Bus (ITB), and several processor, memory, and input/output control subsystems which fit on the bus, together with the power supplies. This cabinet occupies 9.8 square feet and thus the Criterion mainframe requires considerably less floor space than most present-day computer systems of equivalent power. You will see the contrast of size between Criterion and the Century during the demonstration this afternoon.

Most of the subsystems within the mainframe are implemented on 11" x 14" cards, and the primary logic circuitry is Emitter-Coupled Logic (ECL).

Internal Transfer Bus (ITB)

The focal point of the Criterion system architecture is the Internal Transfer Bus (ITB). It is a high-speed data path across which all Criterion subsystems communicate with each other: these include the Main Processor, the Service Processor, the Memory Subsystems, the Common Trunk Subsystems, and the Integrated Disc Controller.

The main advantage of a bus-oriented architecture is that it permits us to design hardware in a modular fashion, to satisfy a wide range of capabilities. When we need to add a certain hardware capability to the system (for example, a new type of peripheral controller, or a new type of main memory), we design it in the form of a subsystem that fits on the bus.

Thus future enhancements, as well as field upgrades, are easily implemented - they take the form of additional cards that are simply added to the bus back-panel. In addition, this hardware modularity eases the task of fault isolation and correction, contributing to high system availability.

The use of the bus architecture is an extension of a technique used in smaller, slower systems to reduce costs of system element interconnection. The use of the bus in Criterion is primarily to provide an open ended and flexible architecture. The 72 megabyte per second bandwidth of the bus provides a wide margin to avoid contention between subsystems for bus access and for fast data transfer between subsystems such as a processor and memory.

This open-ended design accommodates architectural extensions such as multiple processors, future I/O subsystems, and future integrated controllers and is especially suited to distributed processing applications.

Criterion Firmware

The use of firmware technology is a major departure from the Century architecture and I would now like to explain in a little more detail exactly what firmware is, and how it contributes to the Criterion system architecture.

Firmware is really a form of programmable hardware. In a firmware-based system such as Criterion, instead of having a processor with hard-wired control logic, we have a micro programmable processor executing firmware which is contained in a high-speed memory called a "control store." And we go one step further by making this a "writable control store," which is loaded with the required firmware from a flexible disc. Because we can tailor the firmware to perform exactly the required functions, this gives the system much more power and flexibility, and we can use one processor for a variety of

different functions, simply by selecting the firmware we load into its control store. Thus firmware gives the hardware a specific set of attributes or a "personality."

Firmware is used throughout the Criterion system for such functions as input/output control and microdiagnostics. Where the firmware interfaces directly to software, it takes the form of a "Virtual Machine." A virtual machine is simply a machine, implemented in firmware, which executes software. It may be designed to emulate, or execute programs like an existing machine, as is the case with the Criterion RS firmware which emulates an NCR Century and runs existing B-series software. Or it may take the form of a new machine designed to match the needs of new software or to reflect the attributes of a programming language. In this latter case, the existence of firmware permits the virtual machine to be designed to execute instructions much closer to the source language than was previously feasible with hard-wired logic. Virtual machine commands may correspond nearly one-for-one with the verbs of the higher-level language as is the case with the Criterion COBOL Virtual Machine. This results in greatly improved performance for COBOL programs.

The Criterion Virtual Storage (VS) firmware includes the COBOL Virtual Machine, as well as a virtual machine designed to match the needs of the new VRX operating system software. This VRX Virtual Machine is a superset of the NCR Century Virtual Machine, and, therefore, also satisfies the compatibility requirement that existing Century B-series programs must run under VRX.

The VS Firmware thus includes two virtual machines: COBOL and VRX.

These reside together in firmware control store, and are executed concurrently as required by the software. This we call "Multiple Virtual Machine" operation. The switching between virtual machines is performed in a very few processor cycles by a firmware routine, and does not involve any control store load process or program awareness while the switching is occurring.

Firmware can also give the Criterion the "personality" of other machines although only the Century and COBOL Virtual Machines are currently offered. I said earlier that firmware is used extensively throughout the Criterion system. If we review the various subsystems on the bus, we can see that several of them are firmware-driven: the Main Processor, the Service Processor, the Integrated Communications Module, and the Integrated Disc Controller. Each of these subsystems has firmware loaded into its writable control store as part of the start-of-day procedure, under control of the Service Processor.

Firmware is a central architectural element to Criterion and brings to the system great flexibility, extension possibilities, and performance improvements over traditional architectural approaches.

In order to complete the technical picture, I will review some of the details of the Criterion hardware subsystems.

The Main Processor is designed for fast interpretation and execution of object programs by firmware. The firmware executes out of a high-speed control store, which operates at the same cycle time as the main processor which is 112 ns. for the Model 8550 or 56 ns. for the Model 8570. Through the use of a pipeline, firmware instructions are executed effectively at the speed of one processor cycle per instruction.

The pipeline consists of three phases of instruction processing: Fetch, Interpretation, and Execution. Each phase requires one processor cycle; however, the pipeline is designed such that three firmware instructions are processed in parallel, one in each

phase. This is made possible by the fact that each instruction in the firmware instruction set, with a few exceptions, has been designed to complete within the three cycles. The pipeline organization has been utilized in much larger systems to achieve similar results and the Criterion brings this technique now to its system class.

Memory Subsystem

The Memory Subsystem consists of one or two memory interface units, each of which may control up to four 64,000 byte memory cards; these may be further extended to provide up to 1 megabyte of main memory in the Criterion 8570 Model.

Memory technology is perhaps the technology that has changed most rapidly in recent years with respect to cost. Today, by packaging the 4K MOS memory chip on 11" x 14" cards, we can attain a density of 64,000 bytes per card. When we take into account the cost of the necessary memory interface and control hardware, this works out to a cost of less than one-twentieth of the cost of the core memory first used in the NCR Century 200 in 1970, which itself was about one-half the cost of the original NCR Century rod memory in 1968.

Input/Output Subsystems

Peripherals which use the NCR Century common trunk discipline may be connected to the Criterion system through one of three types of common trunk: low-speed, medium-speed, or high-speed. The trunks have been designed for various processing requirements, and can be selected for the most economical peripheral configuration. Thus, most Century peripheral devices and controllers can be utilized in the Criterion system including the complete line of Century communications equipment and terminals.

The new 6590 Data Module Disc unit interfaces to an Integrated Disc Controller (IDC), which is another firmware-driven subsystem that connects to the bus. The Integrated Disc Controller, in fact, is basically the same hardware unit as the Service Processor, but is driven by different firmware designed specifically to perform disc control functions.

In addition to the communications capability of the Century 621-103 Multiplexor, which allows connection of one to 255 lines depending on line speed, the Criterion offers a one to ten line communication capability for smaller terminal systems. This capability is provided by an Integrated Communication Controller which connects to the bus. This controller uses a microprocessor to emulate the operation of the 621-103 and provides the same facilities to the program and communication lines.

Service Processor

The Service Processor operates in parallel with the Main Processor, and is concerned primarily with input/output control and diagnostics. It controls and drives the card reader, flexible disc, console CRT, and any hard-copy console devices. It also performs the firmware load function, where firmware is read from the flexible disc and distributed to each firmware-driven subsystem.

The Service Processor has primary responsibility for error control and system diagnostics, including a start-of-day diagnostic which is run as part of the initial firmware load process. Should a malfunction occur in the system, the Service Processor provides the tools for detection and isolation of the problem. The diagnostics operate at

the micro-program level and in addition to the usual fault detection and isolation facilities, offer two unique features.

One set of diagnostics are designed for customer operation. These programs can be loaded by the customer operator when errors are suspected. They will test the system and notify the operator if there is a failure and also display the most likely boards required to correct the failure. When the customer calls field engineering he can tell them what has been displayed and thus increase the likelihood of having the correct board for repair.

The second feature is Remote Diagnostics. By granting permission at the system console, the customer can allow connection of a remote CRT terminal as a dual console. The field engineer at this remote console can see all the console displays and through the terminal keyboard control the system operation of diagnostic programs. In this way, expertise deeper than that available at the customer's site or a local office can be utilized to solve the more difficult failure problems.

Criterion Software

The NCR Criterion is being offered as two different machines. With real storage firmware, it is an NCR Century machine which runs existing B-series software and user programs. With virtual storage firmware, it operates under control of the VRX operating system providing a virtual storage system.

B-series Software

The B-series Software offered with Criterion is the most current release and is currently operating at pilot Criterion customer installations. The B1, B2, and B3 operating systems are available to Criterion users, together with the full set of Century B-series compilers, utilities, and applied programs.

The initial pilot site experiences have been totally successful, and have proved beyond any doubt that the compatibility between Criterion and the NCR Century is real. I think we can claim that compatibility across NCR products has been, and remains, second-to-none.

Virtual Resource Executive (VRX)

With the VRX system we have maintained our commitment to compatibility, so that, by and large, any program running today on any NCR Century system will run as is, without recompilation, under VRX. Similarly, all files supported on NCR Century systems are supported under VRX, as are the B-series compilers, utilities, and applied programs. A few obsolete peripherals, such as CRAM and 655 Disc, are not supported under VRX; but files using those peripherals can be quickly and easily transferred to newer, fully compatible devices.

VRX, while remaining compatible, is a new software system, offering many significant features which make it competitive with any software system in the industry. VRX represents a large software effort and investment by NCR, and is the culmination of three years of intensive work.

One of the primary goals of VRX has been to improve the usability of our software, and thereby, to reduce the time and cost required for users to develop their computer applications. This we have done by making the system more automatic, more responsive, and more interactive.

The Virtual Resources Executive is called "VIRTUAL," because it supports two new capabilities: Virtual Machines and Virtual Storage. The Multiple Virtual Machine operation of the VRX and COBOL Virtual Machines has already been covered. Virtual Storage, or Virtual Memory, is new to NCR, but has been available on competitive systems for several years.

This approach reduces the cost to develop and maintain programs and improves reliability for both user programs and system software.

Burroughs has had its own form of virtual storage for many years, and IBM popularized virtual storage on a wide scale when it was introduced on the System/370 in 1972.

NCR's implementation of virtual storage in VRX is similar to the most sophisticated of IBM's several implementations known as OS/MVS, which is available only on systems renting for over \$30,000 per month. We consider our implementation of virtual storage to be a cost breakthrough. We are providing sophisticated capabilities on systems well below the cost of comparable competitive systems.

Another primary feature of VRX is a new data management system called the Criterion Access Method (CAM). Initially designed to support just Disc peripherals, CAM fully supports the input/output requirements of the COBOL '74 language. It supports three different file organizations: sequential, relative, and indexed. These three access methods permit file organizations to be designed in an optimum way for each specific application.

VRX includes new telecommunications software which supports two new programming interfaces for development of on-line systems; a Message Control System (MCS) interface, and a Low-Level Interface (LLI). The Message Control System is compatible with the COBOL '74 language, and provides a simple, terminal-insensitive interface to the application programmer. The Low-Level Interface is a more basic interface, giving the programmer more control over his telecommunications devices.

Two new compilers are provided with VRX: COBOL '74, and NEAT/VS.

The VRX COBOL '74 compiler is primarily a high-level implementation of the ANSI 1974 Standard. It produces object code for the COBOL Virtual Machine (CVM) which runs under VRX, and is designed to match the needs and characteristics of the COBOL language.

The NEAT/VS compiler is compatible with the NCR Century NEAT/3 language, and provides programming interfaces to the new software features available under VRX.

A new Link Editor is also supplied with VRX, to assist users in writing modular programs. The Link Editor binds together program modules written either in COBOL '74 or NEAT/VS, prior to program execution.

Throughout the design and implementation of VRX, a strong emphasis has been placed on performance and reliability. User programs should generally run faster under VRX than on comparable NCR Century systems. And the VRX software should prove more reliable and error-free than any previous NCR software system, due to the application of improved development tools, comprehensive programming and documentation standards, rigorous test programs and procedures and the modular structure of the programs.

I am confident that with VRX, NCR is offering a significant software advance which will attract both existing NCR Century users and users of competitive systems. This confidence is supported by our analysis of major software features, which shows that

VRX has a significant edge over competitive software systems in the same price range and compares favorably to systems priced much higher than Criterion.

The release of the VRX software as a second step in the release of the Criterion to the market is part of a planned phasing of the product introduction. The VRX software has been in development since late 1973. The software elements that make up the system completed individual test phases in December of last year and they have been in test as an integrated system since March of this year. The testing has gone well and we expect the pilot installation in November, 1976 to be a success.

Criterion Models

The basic Criterion 8550 system includes a 112-nanosecond processor with 128KB of main memory, an integrated 600-card/minute reader, a 1,200-line/minute printer, and two 100-megabyte 658 disc units. Under as-year lease agreement, it rents for \$5,900 per month. Memory can be expanded in 64KB increments to 512KB.

The basic Criterion 8570 system includes a 56-nanosecond processor with 256KB of main memory, a 600-card/minute reader, a 1,200-line/minute printer, and three 100-megabyte 658 disc units. Under a 5-year lease agreement, it rents for \$10,300 per month.

Most Century peripherals and terminals can be transferred directly to Criterion systems. This includes the 656, 657, and 658 disc units.

A new type of disc unit, the 6590 Data Module Disc, is available with Criterion. The 6590 has a capacity of 70 megabytes or 140 megabytes per dual disc unit; it has an 885KB/second transfer rate, and an average access time, including latency and seek time, of 35.1 milliseconds.

Three other new peripherals are available with Criterion. These are a 600-card/minute card reader, a 1,000-character/second paper tape reader, and a 173-character/second matrix printer.

I would like to give you some perspective on performance of the Criterion.

We have analyzed performance of the product throughout the development project. Simulation models and similar methods were used in the early phases to predict the performance and as elements became available we have measured their actual performance. The correlation between the predicted performance and measured performance has been very high and gives us high confidence in the performance that will be seen in customer applications. Still, system performance is a complex interaction of many complex factors and simple statements about performance can be misinterpreted. The most meaningful statement I can make at this time is the result of measured performance of actual system operation using customer programs. These results show the 8550 to be about 20 percent faster than an equivalent configuration Century 201 running the B1 Executive and about 30 percent faster running the B3 Executive.

We expect more significant improvements in performance when executing under VRX with the COBOL Virtual Machine, but have not fully qualified our test results at this time.

The Future

Whenever a manufacturer introduces a major new series such as Criterion, the product provides a cost-performance advantage over competitive systems. But, with Criterion, I

think the advantage is so striking that I am confident it will create a significant impact in the market for many years to come.

What, then, of the future? If competitors respond with price cuts and new product announcements, how will this affect our position?

Well, I can tell you that we also anticipate significantly improved cost-performance in Criterion systems over the next few years, based on manufacturing learning curve cost improvements and on planned enhancements to the product line.

Taking, as an example, the cost of memory, we can anticipate a further reduction in cost within the next two years with the availability of a 16K x 1 bit MOS memory chip. With the Criterion bus architecture, we are well equipped to take advantage of such developments: we will simply implement memory cards with the new memory chip, and they will plug into the bus back-panel.

We also anticipate the release of other Criterion models in the future to fill out the line and we fully intend to announce multiprocessor versions of Criterion. Here again, the bus architecture lends itself very well to such extensions. And we expect further integrated controller developments for future Criterion peripherals.

Further advances in the areas of firmware and software are also planned, with new or extended virtual machine emulators, further releases of VRX software which will emphasize the areas of transaction processing and data base management, and vocational application packages to meet specific customer needs.

In summary, I believe that with Criterion we are in an excellent technological position to respond to any future competitive development for many years.

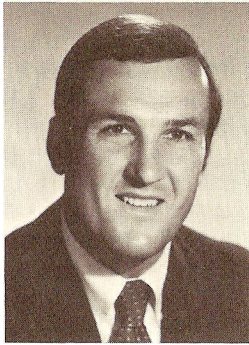
I would now like to introduce Mr. Gil Williamson, Vice President of CI/MEG Marketing who will discuss Criterion Marketing.

**Meet the new NCR generation ... the
Criterion.**



Criterion Marketing Program

G.P. Williamson



I believe that with what you have seen today of the Criterion, you can begin to sense some of the excitement we feel about it. We set out, very simply, to give the medium-to-large scale user everything he might want in a system. We have succeeded in providing a combination of all of the best in current, proven, state-of-the-art technology. The corporate marketing strategy for the Criterion is two-pronged. First, it is to satisfy the needs of our current user base. Second, it is to attract new users within those markets we serve.

The cornerstone of this strategy is price-performance. Very basically, the Criterion offers a great deal more performance for a little more money. This price-performance advantage is as appealing to current NCR users as it is to users of competitive equipment.

At the same time, we will continue to actively pursue the smaller user and the first time user with highly competitive offerings like the 299 and new 499 Data Processing Systems, the Century 8200 Minicomputer, the recently announced Century 75 and the more powerful Century 101 and 151 systems.

You have already seen some of the features of the Criterion that are at the basis of our claim to superior performance.

A few competing systems may use ECL; others may employ interleaved MOS memory with error detection; a few make limited use of firmware, some may approach the internal speeds of the Criterion; the bus architecture is used in some minicomputer systems; larger systems may boast of virtual machine capabilities or extensive diagnostics or on-line program development.

However, no system has combined so many of the latest, proven state-of-the-art features as the Criterion.

Taken by itself, the Criterion, will indeed establish a standard by which the systems of the late 70's and early 80's will be judged. From a technological point of view, it is clearly the system to beat.

However, the Criterion should not be considered separately. Superior technology, no matter how attractive, does not sell systems. Solutions to problems sell systems. In this

regard, the Criterion is only a part - an attractive and important part - of the solution-oriented NCR marketing effort.

The exciting point about the Criterion is that it brings its highly attractive and highly marketable combination of features to an already existing, total systems offering, an offering that is based on our knowledge of the customer's operations and problems; an offering that is based on a comprehensive library of proven applications that address those problems; based on our ability to talk the customer's language, our ability to support and maintain the system, and our commitment to compatibility and the development of better ways of doing things.

Consider, for example, an order for a Criterion that crossed my desk last week. This was from a leading manufacturer of computer peripheral equipment, an IBM System 3 Model 10 user which had outgrown the system. As you know, converting from the System 3 to an IBM 370 system involves a good deal of work. In the eyes of the user, it would be just as easy to convert to another vendor's equipment as it would be to stay with IBM.

To solve their problem, they looked at a full range of competing equipment.

For example, they said they looked at the new DEC system. One officer told me it was a highly attractive system from a price-performance point of view. But, he said, they did not have the application programs. The Criterion, on the other hand, has a complete series of modular, manufacturing-oriented application programs, mature, proven, seasoned programs that can be implemented immediately.

Other vendors, he said, spoke in general systems terms. Our industry specialist, a man who spends all his time in the manufacturing sector, however, talked about production scheduling, about inventory material requirements, sales forecasting - topics that struck a responsive chord, displaying a knowledge of the industry that to this very sophisticated customer was far more impressive than the technology of the Criterion. The customer's summary of the selection process ran something like this.

Before they had heard NCR's initial presentation, we were number seven on their list. After they had been introduced to the Criterion, we moved up to the top three. After they had seen our application programs, we were number one.

This sale not only serves to illustrate the impact of selling total systems with full service support, but the impact of the vocationalization effort. Our salesmen are now more knowledgeable about the needs of the customer and NCR total systems to solve problems; they are more mature from an industry and a system point of view, and they will be more successful.

So yes, the Criterion is a highly attractive piece of gear, but it is only when it is considered within the context of the complete NCR marketing effort that its true potential can be judged.

That total marketing effort includes industry specific programs, and extensive support and maintenance capabilities. Within that context, the Criterion's combination of better performance, attractive price, and compatibility, plus our service and support capabilities will enable us to offer more to our current user base and enable us to add new users to that base.

Our approach to the current NCR user base, which includes over 5,000 Century system users, emphasizes compatibility.

Most existing files, application programs and peripherals can be used without modification on the Criterion. As a virtual Century machine, the Criterion runs existing Century programs faster and more efficiently. For example, in our pilot installation at

Dart Warehouse Corporation, a leading Los Angeles based distribution services firm, installation of a Criterion processor resulted in a 16•23 percent increase in throughput. They are using the same programs and same peripherals, but they are getting more performance.

Improvements in throughput will, of course, depend on the nature of the current system. If the current system is peripheral bound, for example, the improvement will not be as dramatic as the increase experienced in a CPU oriented application.

Our goal is to make the transition to the new system as smooth as possible.

To accomplish this, it is our policy not to release new hardware and new software together. In doing this, we will first prove to the user that the hardware does what we say it will do; we will give the user experience with the system and then the user will have the option of moving into newer, more sophisticated environments such as virtual storage and the COBOL Virtual Machine at his convenience.

A smooth transition for the user also means a smooth transition for NCR. It is a more manageable and a more profitable approach because it obviates many of the growing pains that normally accrue to both user and vendor when too much that is new is released at one time.

Our strategy for the current user of NCR equipment also stresses the Criterion's ability to grow in small modular increments and its flexibility to accommodate change.

Criterion is a forward looking system which nicely matches the needs of an industry that is moving more deeply into distributed processing, on-line processing and data base management systems.

Reliability is rarely mentioned in a sales presentation. It is usually assumed that one computer is as reliable as another. However, a very strong selling point for the Criterion in any communications-based environment is its reliability. Most hardware failures are mechanical connection failures such as cables and plugs. Through the use of high density circuits and packaging, the number of connections has been dramatically reduced resulting in extremely high reliability.

In addition, the Criterion automatically runs comprehensive system diagnostic tests at the start of day, the time when most failures occur. An added level of protection is provided through the use of remote diagnostic techniques which can enable an engineer here in Rancho Bernardo to actually operate and test a Criterion anywhere in the United States.

As communications based systems move into vital areas of the customer's operations, up-time is no longer simply a percentage figure, it is an absolute necessity.

Up-time for on-line systems in hospitals for example must be 100 percent.

Our MEDICS 'systems requires twin Century processors so that one is available for back-up. The reliability of the Criterion is such that it may eliminate the need for a back-up processor.

What the Criterion can mean to a current NCR user can perhaps be best illustrated by reviewing one of the first Criterion orders we received from a hospital. St. Anthony's is one of the largest hospitals in Denver. It is a twin campus, 700-bed facility, employing about 2,800. You may recall that its "Flight for Life" helicopter rescue unit received national attention earlier this year for its role in evacuating victims of a gondola car accident at a Colorado ski resort.

The hospital has been using a Century 200 system and is currently operating two full shifts a day in their EDP center. They are running a full complement of NCR batch hospital application programs.

The Criterion 8570 that they have ordered will triple their processing power with a cost increase of only 60 percent. They will be able to cut back to a single shift and they will be able to add new applications including on-line capabilities using NCR terminals. They will be able to run existing programs with modification, they will have gained added power, and in the Criterion's features, they will have a foot in the future so that at their option they can grow into some of the more powerful processing techniques. The hospital, for example, is now in a position to realistically consider our MEDICS on-line communications systems. This would not only increase our computer revenues, it would mean additional sales of approximately 100 terminals that would be needed by a hospital the size of St. Anthony's.

It is that type of situation, plus the combination of very strong product, software and support features that we believe will enable the Criterion to play a major role in first retaining and then expanding our current user base.

We believe that NCR's commitment to compatibility is just as appealing to non-NCR users as it is to our own user base.

For example, the approximately 20,000 users of IBM System 3 Model 10 and 15 systems face several upgrading problems if they wish to grow into larger IBM Systems. They are not compatible. It means that it is just as easy for them to convert to Criterion as it is to stay with IBM - only they get a better machine for their money, they get a continuing, proven commitment to compatibility and they get industry specific programs that address their specific problems.

To a certain extent, this upgrade problem exists with many other sites using other types of competing equipment. They have reached the end of the line with their systems and they are in the market for a more powerful system. They owe it to themselves to see what the Criterion is all about.

Another strong selling point for the Criterion is its ability to accommodate change. With the convenient and efficient internal transfer bus, growth and change are as simple as adding or replacing circuit boards. The flexibility inherent in firmware is also a warranty for the user that when new concepts are developed or new standards adopted, the Criterion can adapt to those changes, easily and inexpensively.

There is one more important general trend in EDP I would like to touch on before describing how the Criterion fits into each of our markets. That is the trend toward the rising cost of software. Many EDP sites are rapidly approaching, or have already reached the point where software costs are exceeding hardware costs as a percentage of their total budget.

How does NCR approach this challenge? First, in our selected markets, we have concentrated our resources on total systems development. We have the software. It is modular, which means that it can be implemented in stages, one part at a time. Each module complements and adds to other modules so that a group of modules comprise a closely integrated, total system with interaction between modules.

The existence of these programs and the way in which they are designed will constitute increasingly attractive selling points as the cost of software development for the user continues to accelerate. In this vein, the on-line program development feature of the

Criterion is also very appealing. It means quick access to the system for compiling and debugging; it means sizeable reductions in the cost per line of coding.

One of the most gratifying developments with the Criterion has been the internal speeds we are getting in the COBOL virtual mode. The speeds on executions of standard mixtures of COBOL commands are comparable to those of super-class systems. This will mean fast compiles, fast execution, reduced program size and the facility for run time error checking.

This boils down to improved programmer efficiency and a generally higher level of productivity. It also points the direction for future software development at NCR. It means that as our applied software effort moves more and more toward COBOL, we will be moving into an environment in which we have a very strong competitive edge. I should note here that the Criterion in no way constitutes an across the board, frontal assault on every other computer system in existence.

Under our vocational organization, we have chosen not to be all things to all people. We have chosen to concentrate our resources on select markets. These are markets to which we can bring something unique, a combination of things no one else can match. In these select markets, which are some of the most rapidly growing in the EDP industry, we do offer a total system approach. In retailing, for example, the Criterion represents a significant enhancement to our total systems effort. That effort includes the more traditional EDP role as well as the merging communications based POS systems. The Criterion, with a front-end communications processor, can act as the application controller for the NCR Online Retail Credit Authorization and Communications System which controls the granting of all credit sales and monitors and supervises the credit collection function.

Distributed processing, requiring both the communications and data base capabilities of the Criterion is also coming into its own in retailing. An example of this type of application is our Purchase Order Management System now under development. It is designed to control the retailer's most critical asset - his inventory. It will control the movement of merchandise from the time a purchase order is written by a store until that merchandise is finally sold.

As you will be hearing from Mr. Ben-Yehuda in a few moments, NCR is very much in the data communications business, particularly in the network control business. The Criterion is ideally suited to serve as the central application controlling device in such large networks.

One of the most significant advantages that the Criterion can bring to these communication's applications is its reliability.

In many cases the system will be interacting directly with the customer at the point of sale. It will not only record and process data - it will participate in the actual event, speeding the transaction. The retailer's primary concern in going to these new systems is reliability. There is very little margin in the retailer's mind for downtime on a busy Saturday sale day. The reliability features mentioned earlier will have a strong appeal for the retailer.

Trends in NCR's second major market, the financial services industry, also demand a highly efficient, powerful system with extensive data base and communications capabilities.

The financial services industry is becoming more competitive, as both commercial banks and thrift institutions vie for the individual customer's deposit funds. One means

to attract these funds is through offering a greater variety of services - in effect bringing customers and their deposits closer together through the convenience of electronic funds transfer systems. At the basis of all these new electronic services is a data base management system. Through its Central Information File System for commercial banks, and its on-line real-time loan and savings systems for the thrift industry, NCR has pioneered such concepts.

The Criterion offers compatibility with these programs, which represent a tremendous investment on the part of financial institutions. And for the new NCR user, the Criterion can provide an immediate entry into EFT with ready and proven industry application software.

As part of a complete systems philosophy, Criterion uses the full range of NCR financial terminals, including the newly released Modular Terminal System - a microprocessor based transaction processing system that ranks second in importance only to the Criterion in terms of important new products we will be releasing this year. Given my review of the CI/MEG markets earlier, there is no need to discuss the advantages the Criterion lends these markets, except to emphasize that the Criterion release could not have been timed more opportunely. It caps several years of intensive software systems development, which has provided NCR with a complete family of manufacturing applications; the finest series of application programs for wholesale distributors in the industry; a strong position in the healthcare field; leading edge installations in the transportation field, comprehensive recordkeeping and instructional systems for educators, and carefully tailored systems for governmental agencies and municipalities.

If anything, I believe we may have underestimated the appeal of the Criterion as a machine. We knew it would be good, we knew it would be a highly attractive piece of equipment; but the reaction to date, the interest and excitement both inside and outside the company has exceeded our expectations.

Speaking as a salesman, what the Criterion gives us in a very powerful one-two punch: an exciting new system, backed by a total systems effort.

I cannot help but think that we will be seeing a pattern develop along the lines of those specific Criterion orders I mentioned earlier.

No one thinking about a computer can ignore a 56 nanosecond processor, ECL, MOS memory, bus architecture, firmware, COBOL Virtual Machine, compatibility, on-line program development or diagnostics. The combination is just too powerful a drawing card.

It establishes a highly favorable presence, a more willing and receptive ear.

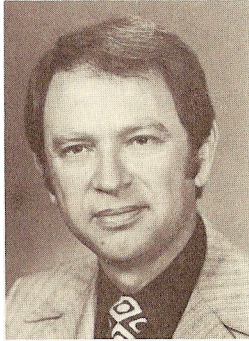
- and then we begin talking about the customer's problems in a language he understands,
- about solutions to problems, that he may have just left sitting on top of his desk,
- about industry applications that address these problems, applications that are on the shelf, proven at hundreds of sites, ready to be quickly and economically implemented,
- about 20,000 field engineers - one in every four NCR employees to service and maintain his equipment,
- about a highly sophisticated communications capability,
- about an R&D budget that has doubled in the last five years and will double again by 1980.

That approach is working today and it will continue to work - to the extent that I believe that upward adjustments in our forecasts are going to become a way of life.

Much of what I have discussed has either implied or explicitly mentioned data communications as an important part of our future. It is my pleasure to introduce Mr. Ben-Yehuda, General Manager, Special Systems Division, who will offer you an insight into our activities in this area.

Special Systems Division

Amnon Ben- Yehuda General Manager



The Special Systems Division is relatively new at NCR, having been formed in October 1973. The Special Systems Division is involved in large-scale transaction oriented mainframe systems and in extensive communication systems; systems which are larger and more complex than the standard Criterion configurations. I would like to briefly describe the Division's background, operating charter, some key activities and relevance to the new Criterion system.

The Special Systems Division is an outgrowth of NCR's development activities in the early seventies, leading to the successful installation of one of the world's largest on-line banking systems at the Sumitomo Bank of Japan. For background information purposes, let me briefly describe highlights of this system:

It consists of two major computing centers, in Tokyo and in Osaka, between which they control some 190 banking branches and 5,000 terminals, located throughout Japan, on a real-time basis. Seven million customer accounts are being maintained on-line. The system can handle field updates and inquiries through terminals at response times not exceeding five seconds. The Osaka system has a capacity of 300,000 transactions per hour, and the Tokyo system has a capacity of 200,000 transactions per hour. This is one of the largest systems of its kind in the world.

There were two major system product developments associated with this project:

1. The Century 350 mainframe and TOX software: Both hardware and software are oriented towards achieving a high-capacity transaction-oriented system. It also provides for high reliability and several levels of back-up, system flexibility, and an attractive cost/performance ratio. The Century 350 configuration is highly flexible; nine processors can be interconnected in a true multi-processing environment. With all its excellent on-line capabilities, the system also maintains full compatibility with the standard NCR batch software, which can run concurrently with the on-line jobs.

2. The C-721 Communications Processor: This is a high capacity communications processor, based on NCR's standard minicomputer, which is being used as both a Front End to the C-350 and a Branch Controller for terminals in the bank's branches. This product is available only as a part of a total system offering. An extensive Communications Network System has been installed throughout Japan to effectively control data transmission between terminals and computer centers. Several levels of back-up provide for a highly reliable system.

Another aspect worth mentioning is the Program Management philosophy used throughout this project, which I will discuss in more detail later on. It was this management approach which enabled our company to complete the complex and extensive systems developments within a very short timetable of less than three years, and within the budget target.

NCR's success at Sumitomo did not just stop there. Today there are some twenty banks in Japan who are using the same system. In addition, the same system has been installed in three of NCR's on-line data centers in the United States. And the same system concept is being carried over to the Criterion.

The Special Systems Division was formed in 1973, to further capitalize on the systems technologies and program management know-how acquired from this significant development program.

The Division's charter is to program manage a number of advanced systems development programs for a select number of sophisticated customers; thus, increasing the leverage of the Company's standard product lines. All our projects are with and for specific customers. Our activities help us derive new product fall-outs and other benefits which are applicable elsewhere in our product line.

Almost by definition, our Division is involved in two prime system areas, although not restricted to them:

1. Large-scale transaction-oriented mainframe systems (formerly the C-3 50, the Criterion in the future).
2. Communications network systems.

We operate through and jointly with our marketing organizations throughout the world. When SSD becomes involved in a new project, we assume a full program management responsibility for its technical and business aspects. We establish joint implementation teams consisting of the Division's personnel and Marketing's, and quite often the customer's. We operate closely with the customers in a manner which contributes to effective communications.

The bulk of our activities are in systems and software developments, and in staging of customers' systems on our site for extensive systems integration testing prior to delivery. This testing concept greatly reduces the amount of time it takes to install complex systems in an acceptable manner.

The Division is not involved in hardware manufacturing activities. It can best be described as a captive systems house, which allows NCR to expand in new market areas in a selective and controlled risk environment.

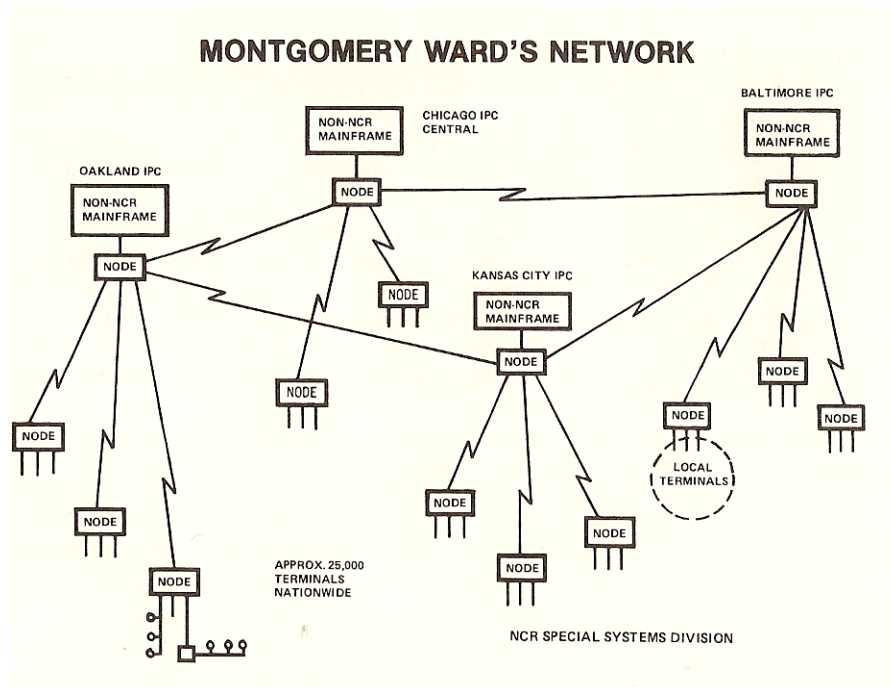
We are now located in Torrey Pines, and you will have the opportunity to visit our facilities later on this afternoon.

I would like now to briefly discuss some of the Division's current activities.

A major program I wanted to review here is the NCR's Data Communications Utility system (DCU) which is currently being installed by Montgomery Ward on a nationwide basis. This system is providing Montgomery Ward with a single, integrated, nationwide data communications system linking approximately 25,000 terminals, numerous remote batch systems and four major Information Processing Centers located in Chicago, Kansas City, Oakland and Baltimore.

This contract epitomizes what the Special Systems Division is all about, and therefore it is worth elaborating some more. Montgomery Ward has been a major user of NCR's POS terminals for some time. Concurrently it has also been a user of IBM mainframes in its four IPC locations. With the glowing emphasis of

MONTGOMERY WARD'S NETWORK



on-line applications, requiring the POS terminals and the computer mainframes to operate interactively, the competitive battles between Montgomery Ward's two prime vendors has reached a peak.

IBM's thrust was to extend system control from the mainframes out toward the terminals, covering it all under a single and a unique umbrella. NCR's thrust was to propose the DCU, which provides for a self-contained, independent, environment between the user's computers and terminals. It gives the user full flexibility in separately choosing the terminals and computers of greatest advantage to him. The NCR proposal offered Montgomery Ward a much greater degree of flexibility, as well as being more

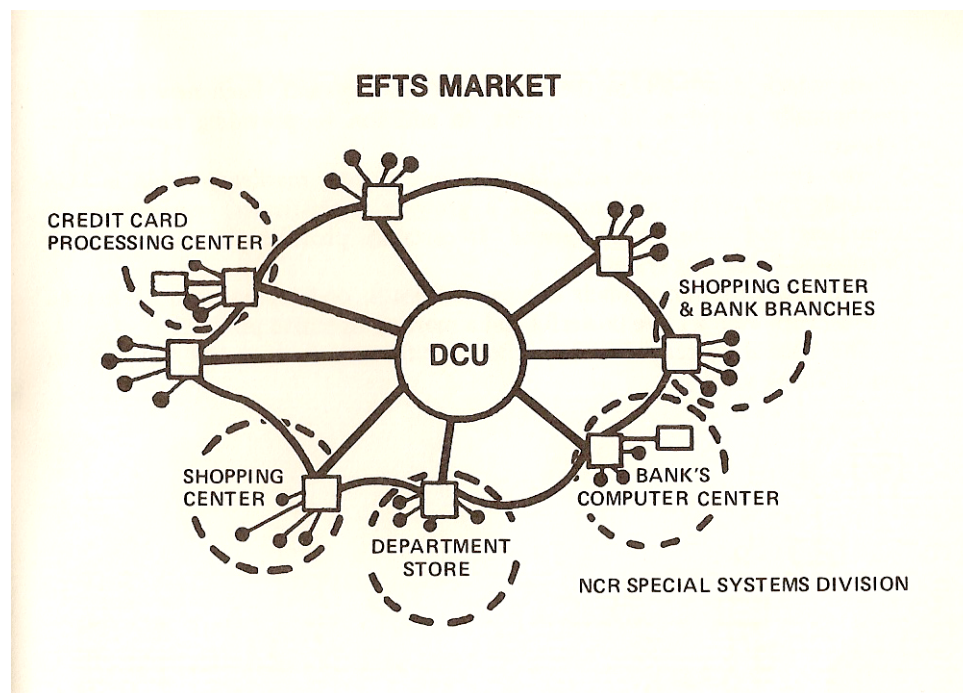
economical. Being on the ground floor of a new system development effort, Montgomery Ward has also had the opportunity of making valuable inputs towards the DCU system specifications.

The nodes in this system consist of the C-721 Communications Processor.

The system will allow any devices connected to it, terminals or computers, to communicate with all other devices just like a public telephone system which allows all subscribers to dial-up all other subscribers. It will provide for error control, message switching, store-and-forward, automatic load levelling and automatic rerouting of messages in case of breakdowns.

This contract represents a significant thrust by NCR into the growing communication network arena. The DCU solves many of Montgomery Ward's problems as a modern retailer. It will allow Montgomery Ward to handle credit sales for its customers on a nationwide basis. It will also reduce its total communications costs by eliminating redundancy and unnecessary circuits. It will distribute the data processing tasks in a more sensible and economic manner. Obviously, it will also provide the nucleus for an Electronic Fund Transfer System (EFTS).

EFTS MARKET



The DCU has already been selected by several other large customers, but their disclosure is still premature. Let me describe to you one such user, an "unnamed" foreign telephone company.

This telephone company will install the DCU across its country as a digital public utility service. User's, such as banks, retailers and manufacturers, will buy digital transmission services on an "as needed" basis. The telephone company intends to install these

"nodes", consisting of C-721 Communications Processors, in dense shopping centers and other high activity areas. Users' terminals and computers will be interfaced to the nearest nodes. This is analogous to your telephone receiver being connected to the nearest PBX or Telephone Switching Center. With this approach, several, or many, users can use the DCU concurrently.

It is worth noting that this telephone company has selected NCR's DCU for two key reasons:

1. The DCU's desirable and competitive characteristics.
2. The DCU's capabilities of interfacing to the various NCR terminals, which in turn make the DCU services highly marketable by the telephone company. So, both NCR and the telephone company are gainers.

We expect the DCU to play an important role in the EFTS marketplace. By its nature and definition, it provides an interface for diverse terminals and computers, both NCR's and others, which is the hallmark of the EFTS system. The DCU can provide the link to merchant shops in a shopping center, banking branches, banks' computer centers, department store POS terminals, credit card processing centers, and so on. Certainly, NCR is not unprepared to play a major role in this arena.

In summary, we have been very effective at leveraging our development efforts which date back to the Sumitomo Bank system. Each new project is economically sound in its own right, in addition to providing new systems fall-outs.

The DCU system not only protects our current market position in POS terminals, but effectively supports a growing sophisticated marketplace in computers and terminals in general. It certainly provides the nucleus for a Distributed Processing system.

The new Criterion extends our capabilities in on-line, transaction-oriented systems, with even a more powerful and a more competitive product.

The Special Systems Division is looking forward to an active and exciting period.
Thank you.