R. A. Erdrich, 2nd Experiences Article

by Richard A. Erdrich, 'Dick'
Editing by John Skonnord, formatted by Lowell Benson.

INTRODUCTION

Mr. Erdrich was employed by UNIVAC, Sperry, Unisys Defense Systems, and Lockheed Martin in the Twin Cities for 47 years! After the Legacy Committee was formed in late 2005, retirees and employees were asked to write brief career summaries. There was absolutely nothing brief about a 47-year career, so Dick asked John Skonnord of Lockheed Martin {publications department} to assist in putting together stories of his almost five decades of career work history.

In December 2024, Dick gave Lowell a disc containing 17 stories along with text sheets and photographs – we've decided to post them in three articles as shown in this Table of Contents. I, Lowell, feel quite fortunate to have been directly associated with him during several of his 16-bit computer stories.

Contents

Formatted for the Legacy Anthology with Microsoft Word.

In addition to these specific career stories, Dick has contributed items to the Legacy Anthology chapter 44, Interfaces; chapter 51, 24-bit Computers; chapter 52, 32-bit CPUs; chapter 54, 16-bit Computers; chapter 57, AF computers; and Our Stories posted June 2010, 200 Nanosecond Memory edited by Lowell Benson with text inputs from Curt Hogenson, **Dick Erdrich**, Don Mager, Ken Pearson, et al..

1.0 30-BIT COMPUTER STORIES

Posted for February 2025; First of a trilogy of Dick Erdrich's 47-years with the Legacy companies focuses on his 30-bit computer experiences. Other people have contributed to the 30-bit 'Legacy', https://vipclubmn.org/CP30bit.html.

2.0 16-BIT COMPUTER STORIES

Posted for March 2025; second of a trilogy of Dick Erdrich's 47-years with the Legacy companies focuses on his 16-bit computer experiences. Other people have contributed to this 16-bit 'Legacy', https://vipclubmn.org/cp16bit.html.

2.1 ADM_1616

This shows the first Advanced Development Model (ADM) 1616. This picture was taken either in late 1969 or early 1970.

Following the conclusion of the CP-890 project I had done some continuation engineering work and led the technical effort for the MTAG project (Module Test Adapter Group) which allowed testing of CP-890 modules in a CP-890 chassis. I was then assigned to work for Glen Kregness on a quasi-IRAD (Internal Research and Development) project labeled 1616 development. I believe the Type Number originally indicated 16 Registers of 16-bits. It could also have been 16K (of memory). I call it a quasi-IRAD effort because in those days, at least to my knowledge, no IRAD money was ever spent on projects that stood any chance of going into production. This architecture was the first pure General Register architecture in the company and might have been influenced by the AN/UYK-7 multiple accumulator sets. It fit very nicely into the "Mini-Computer" definition that was being pushed hard by commercial vendors, principally Digital Equipment Company (DEC). It was the last of the hard-wired processors to come out of the Plant 5 engineering group. All following designs were micro-controlled. Being a hard-wired design it was faster than competitive micro-controller designs and also had independent Input/Output control logic which was common for UNIVAC military computers but unusual in non-UNIVAC commercial computers.

I think I arrived on the project about the time the first ADM was being built. Glen Kregness had done most of the design, but he might have had some help from Bruce Olson. Bob Beljeski was the project technician - I believe he built the cards and assembled the computer. I was chartered with helping Glen during checkout and the detailed design of the Unary instructions. Glen had included them in the instruction set but hadn't gotten around to designing them. I'm not quite sure where Bruce fit into this before I arrived but after we had a couple of ADMs assembled; he spent most of his time on the road demonstrating our 1616 computer to potential customers both commercial and military.

One unique aspect of this effort was the first use of Medium Scale Integrated circuits. Glen apparently liked the Signetics 8200 family as quite a few of them were used along with the more mature TI 7400 family of Small-Scale Integration parts. I believe that Glen designed most of the I/O Controller, but Bruce may have had more of a hand in that. The ADMs all used a commercial core memory. I know that a Data Products product was used, and I think there was one other company, maybe Fabri-Tec, that had a product that would fit and interface. The ADMs just used a single core memory board (the box would hold 4) with 4K words of 16-bits. They traveled with Bruce for many months and eventually ended up as controllers for special functions in the basement computer center at the Eagan plant. There was at least one in use in 1996 when I needed to retrieve some data from a back-up tape and saw an ADM still in use.

2.2 AN/UYK-15

This is the first UYK-15, a militarized version of the 1616 computer. This was more than just a packaging effort. The functional design had not been totally completed or tested when the contract was signed with ITT-Gilfillian in Van Nuys, CA. It was to be used as a controller in the development of the SPS-48 Radar. Unfortunately, a $125,000.00 penalty clause for late delivery had been agreed to by our management. Fortunately, it did not include delivery of the CORDIC function, a coordinate conversion algorithm that Glen had chartered me with designing. It was to be delivered on site later. Still, this was a new architecture with no existing test software and uncertainty in its operation other than simple routines generated by a newly developed compiler (Ultra16). We had about 4 months to finish the job, so Bob Beljeski and I started building it while Chuck Mamer and Bill Jennings started writing the test software. We finished before the deadline by working 12-hour days and 7-day weeks. Unfortunately, during the acceptance demonstration, we missed our instruction time requirement by nanoseconds. It was so close that we even had the scope recalibrated hoping there was enough there to cover it. No luck. At this point management got involved and we found out that the date we were aiming for had been an internal “stretch” date and that we had more time available. The customer went back to California, and we got a couple of weeks to tweak clocks and do some margin testing before settling on a final clock frequency. When the customer came back we improved the instruction execution time requirement by 10%.

Bob Beljeski and I traveled to Van Nuys a few months later to install the CORDIC design in the ITT-Gilfillian UYK-15. The computer had been running without problems, but it was plain to us that they were never going to install it in the production cabinet as it was installed in the prototype. It all became clear later in the year. ITT-Gilfillian had essentially copied the UYK-15 design into their hardware and no longer had a need for our computer. They got theirs in the end though because I believe the Navy forced them to use the UYK-7 as the beam controller for the initial 48 installations and later forced them to use the UYK-43.

2.3 UYK-15_2

These are the production versions of the UYK-15 following Qualification Testing changes. UNIVAC won the competitive contract for the SSN Integrated Radio Room project and supplied two of these for each system. The initial system development work was done with this type of unit but the procurement competition for a Navy Standard Minicomputer occurred during this time and the UYK-20 was used in the fielded system. Four UYK-20s were needed to replace the two UYK-15s. The hard-wired logic design of the UYK-15 was about 50% faster than the UYK-20 and, given the fact that the CPUs micro programmable controller also served as the I/O controller, under high I/O bandwidth conditions brought the processor to a stop. The 1616 design used in the UYK-15 had an independent I/O Controller and in most installations had an independent port into a four-port memory.

I had done a four-port memory front end design for Project Outboard which was primed by Sanders Associates. A second half-sized cabinet was added below the unit pictured and the memory buses were daisy-chained (a tough trick) from the top cabinet to the expansion cabinet. The Sanders RF signal processing system used the fourth port. Virtually all of the production UYK-15 installations used the expansion cabinet as that provided a total of 64K x 16-bit words and the ability to DMA (Direct Memory Access) from other system equipment.

As in the Integrated Radio Room case, the fielded system switched to AN/UYK-20s, the Navy Standard small computer which was replacing CP-789 (Type 1218) in some systems. This required a DMA capability to be written into the UYK-20 requirements. I don't know of any existing pictures of the AN/UYK-15 with the expansion cabinet.

A surprisingly large number of these machines were delivered. I wasn't aware of all of them because, unless some special design work was needed, the factory would build them on order and ship them without engineering knowing anything about them. I did get involved with some installations though, mainly when the customer wanted on-site assistance with either initial installation or troubleshooting. Eventually several field service guys came up to speed and did most of the traveling. Bob Beljeski, our Engineering Technician during the design and initial build phase, was quite interested in the design of the computer logic so I held private class with him during the checkout of both 1616s and UYK-15s thus he eventually was able to travel to customer sites for technical support. This allowed me to work on new projects and spend more time at home.

A lot of these boxes went into RC-135 Aircraft. Some of the systems were run by E-Systems in Greenville, TX and E-Systems in Garland, TX. At the time these were classified programs at various security levels and the number of boxes delivered may never have been published. I spent time at Offutt AFB in Omaha, NE, being briefed on and off the various programs during pre- deployment testing and was surprised at the number of aircraft that had two UYK-15s aboard. I also traveled to Utah several times where the UYK-15s were used as controllers for the Combat Angel program. A pair of them were installed in C-130s as Drone Control Computers long before the current unmanned aircraft systems were conceived. These systems were being built by our military sister division in Salt Lake City, now a part of L3 Communications.

2.4 1616 SIOC

This shows one of the ~65 of the 1616s sold to National Data Corporation in Atlanta sometime in the early 70s. It was probably one of the biggest purely commercial sales made by the Sperry UNIVAC military division. They were used to front-end the commercial 494 computers that National used to run their inventory control outsourcing business.

The thing that made these computers unique was the incorporation of a programmable Serial I/O Controller (SIOC). Glen Kregness was intrigued with the idea of using the 16-bit memory cell as a shift register of n length. The serial communications business used a lot of shift registers of many different lengths and several protocols. From the hardware standpoint, putting these shift registers into memory chips would save a significant amount of space. Glen had theorized that a small set of Instructions could run in the I/O Controller Chain Program to configure each channel and perform context switches when sync was locked, and protocol comparisons were met. I was given the job of trying to design the logic to fit into the existing I/O Controller space. Glen didn't think there was any chance that it would fit the existing I/O Controller chassis so there wasn't a tremendous amount of pressure on me to get it done. At the time we were between projects, and I needed something to keep busy anyway.

I took about six months to complete the detail design with some significant changes in the architecture occurring along the way and did manage to squeeze it all onto the I/O Controller chassis (No room to spare). I added several instructions to perform the protocol tests, things that would be considered the forerunners of embedded flow control, and was able to control the channel interface cards such that we could hook up with any telephone/modem available at the time. With the ability to operate with a frame size of n-bits (including 1!), synchronous or asynchronous protocol, *n*-number of sync words (possibly all different value), at speeds up to 1.2 MBPS the design got some attention. The highest data rates being used at the time were 9600 Bits Per Second (BPS) and that was rare because the telephone system would only provide 3000 BPS (on a good day). Most of the systems we were interfacing with were running at 2400 BPS which meant that we could run all 16 full duplex channels and still have 15% idle time. Most systems never came close to being pushed.

The build and checkout occurred with normal difficulty but, considering that I was pushing the envelope on component capability, did result in a good running box. We initially replaced an I/O Chassis in an Advanced Development Model (ADM) with the new design and got a test-software effort going. I think that we built four of the ADMs and Bruce Olson had dragged them all over the country to trade shows and conferences. They were a little smaller than a TV set so he could carry them as checked baggage without having to be concerned with going through shipping or receiving departments. One time he did go through some kind of shipping department on a trip to Canada. During the transfer someone had driven a fork lift arm through one side of the computer. It was fixable. It wasn't long after the first box was running that we got the order to modify another ADM. I don't know how the connection occurred, whether it was one of Bruce's connections or a marketing or systems effort, but the Marine Corp wanted two of these boxes to use in developing their new Communications Security (COMSEC) capability.

We modified another ADM, and I took the two of them out to Camp Pendleton and spent a week with the Marines demonstrating the capabilities of the design. It's interesting to note that when the RFP for the UYK-20 Navy Standard Mini Computer was issued there was a requirement for Variable Character Length Serial (VACALES) that was based on the capability of the 1616 SIOC. The UYK-20 requirement was a small part of the capability of the 1616 SIOC but it threw a wrench into the competitor's designs and served to strengthen our capability on meeting the requirements and ultimately winning the contract.

The sale to National Data Corporation (NDC) was done by marketing. I can't remember who the marketer who pulled it off was, but it opened the door for productizing the 1616 and the Satellite Serial I/O Controller (SSIOC). This generated the design effort needed to create the SSIOC which was another SIOC without a processor chassis and required an independent port into memory. This provided another 16 full duplex channels and was the standard configuration delivered to NDC. The biggest problem we had with the NDC job was in getting the commercial on-site Customer Service Department to maintain the 1616. It wasn't manufactured by the commercial division, so they disclaimed any responsibility. I think they were persuaded by NDC to take on the responsibility when the sale of future UNIVAC 494s was discussed.

The value of this type of device was not lost on the commercial marketing folks, however. During the NDC build-out one of our engineers, a young kid named Lou Carlson (I guess we were all young at the time!), I believe from North Dakota State, had been offered a job at our commercial division in Salt Lake City. He took the job and had knowledge of the 1616 computer and the SSIOC. Within a year a new product was being pushed by UNIVAC commercial marketing, the Data Communications Processor (DCP). The initial product was the DCP-10 which I believe was the equivalent of a stand-alone 1616 SIOC in a commercial cabinet. They eventually built -20s, 30s, 40s, and 50s. I talked to Lou during one of my trips to Salt Lake City and he told me that the model differences involved the number of channels supported and the memory capacity. They could eventually handle 256 full-duplex channels where the maximum capability of 1616 units was 64.

Another big user of the 1616 SIOC was the Jet Propulsion Laboratories (JPL) in Pasadena, CA. They had bought some standard 1616s for doing photo enhancement work but became aware of the SIOC when they hired one of our field service guys, Irv Dirksen, to support their system. They had communication links to all parts of the world taking in data from receiving stations that were visible to spacecraft for limited periods of time. Rather than tying up a dedicated piece of equipment which would sit idle during blackout times the 1616s could be switched to another link and kept busy. I don't know how many units they bought but an indication of "many" was a documentary I saw on PBS sometime in the 90s showing work going on at JPL. One of the scenes showed a big relay rack with many panels of switches and indicators with a placard on the top identifying the unit as the "1616 SWITCH PANEL".

One thing I was aware of at JPL was the need for a unit running a 256K BPS interface to a photo mapping satellite. The satellite had two data channels that were transmit-only so the 1616 unit only had to receive a max of 512K BPS. This was about half the capability of the design and about as much data as was ever pushed through it.

An interesting aside to this saga, and one I was never aware of until I looked up the UNIVAC DCP series on the web, was the use of these devices during the initial development of the DARPANET, now the Internet. JPL was one of the lead developers of the DARPANET and undoubtedly used the 1616 unit's versatility to develop protocols. Some of the earlier forums concerning net operation repeatedly reference the UNIVAC DCP in their discussions so I assume that until the protocols had stabilized into what we have today the ability to move from one protocol to another by software was of great value.

This effort was a perfect example of the "build a better mousetrap" adage but we never saw it for what it was at the time.

2.5 MUTT

The MUTT, Miniaturized Universal Tape Transport, came about because we had I/O interfaces of varying voltage levels and protocols for all our computers. I can't remember who turned me on to design this thing, but it may have been Lowell Benson. Sometime in the 70s, Lowell and I found ourselves with no project to work on. Lowell was an aspiring project manager, and I, an aspiring logic designer (with some credibility by this time). He needed someone to manage, and I needed something to design. He put on his marketing hat and went looking for work while I stayed home and took care of the details. We were quite successful and managed to keep busy for some time. We called our group "The Drain", meaning that any jobs that were too small for the high-powered program managers to take on would flow down to "The Drain." {sic: Dick said, "You bag 'em and I'll skin 'em."$_{LAB}$}

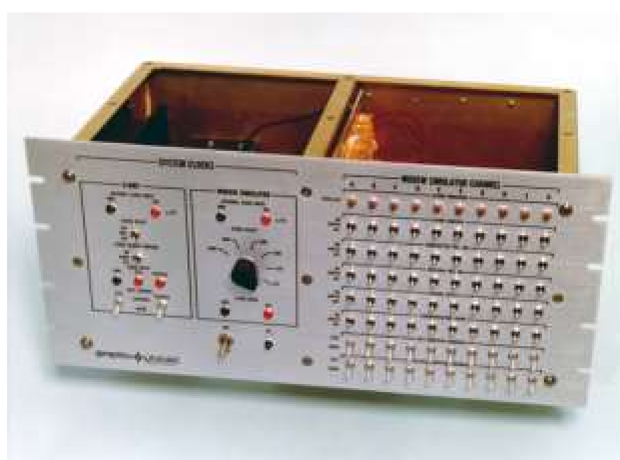
The MUTT was only going to be an engineering one-of box to allow us to go someplace and bring our own paper tapes along just in case there were no paper tape readers available. It was quite common on operational systems, particularly airborne systems, to boot the systems from mag tape. There were a few systems that retained the operational software in core (remember, all the boxes at that time had core memories) and if you wanted to reload core you physically removed it and took it to the shop or to a secure room.

{Shown with a 120pin connector (used for CP-890), in the case at the left was the 90-pin connector (used with the CP-642A, et al') and an 85-pin connector used with the CP-901, AN/UYK-7, etc. The cases four middle 25-pin connectors were for -15v, -3V, or +3v interfaces per Mil-Std 1397 plus RS-232 serial. LABenson}

When I designed it I had a wild idea about generating the timing for the various interfaces. At a minimum it had to support the1397 interfaces available at the time, NTDS Slow, Fast, and ANEW. It also supported the RS-232 and MIL-188C serial interfaces. With a limited amount of card space to work with (the modules and power supply are under the cover holding up the tape winder) I decided to eliminate a master clock and all the sequencing that we would have traditionally used to do this and used one-shot flip-flops. The Signetics 9602 was a relatively new dual one-shot and they were used for all the timing in the design. There was an unwritten law in engineering at the time that R-C (Resistor Capacitor) controlled devices were not to be used in any digital designs, but I figured that the rule was intended for deliverable equipment and didn't apply to this test equipment. So, I used the new part and did the design using the formula that was provided in the part spec for all my timing circuits. Bob Beljeski did the assembly and we checked it out very quickly. It worked great. The biggest problem we had was finding enough computers around to check out all the interfaces. Eventually we were able to get enough time in the Manufacturing Final Assembly and Test area (the Test Area) to check out all the interfaces. In doing this we were questioned by a lot of Field Service guys about the MUTT, the most common comment being "I want one." Later, Field Engineering management found some money to produce the thing and what this picture shows is a production unit. I was told by one of the Field Service guys that between 30 and 40 were built with some of them being sold to customers. The 9602-circuit clocking design worked beautifully.

2.6 Modem Simulator

This was the TAOC Modem simulator I designed for that project sometime in the 70s. I think this was during the time that Lowell Benson and I were operating as "The Drain." I don't really know how many little projects we did during that time, and I was surprised when I was given the photos of the MUTT and TAOC Modem simulator.



This design simulated all the modems in the system and provided all the control signals needed to verify that the software drivers and the associated hardware interfaces were working. It used a wire-wrapped circuit module for the control circuitry which was made up of standard 5400 TTL IC's.

It was always my feeling that the mechanical components needed to build the box cost more than the electrical components.

I don't know how many of them were built but these pictures seem to be of a production box that is intended for installation in a relay rack as part of the system. It may have been a part of the included test equipment. I don't even remember doing checkout of it but the design was pretty simple and it might have gone straight into the system.

3.0 ADVANCED TECH COMPUTERS

Posted for April 2025; third of a trilogy of Dick Erdrich's 47-years with our Legacy companies focusing on his Advanced Technology computer experiences.

EPILOGUE

Dick and Lowell met in the fall of 1972 when we were assigned to develop enhanced features for the type 1616 and AN/UYK-15 computers. Our department manager was Robert 'Bob' Oulicky. Our work site was in the Plant 5 mezzanine as was the CP-890 support team led by Ray Dombeck. Other engineers came and left as the projects required different skill sets: Bob Beljeski, Technician; Don Shore, Mechanical Engineer; Bob Jablonski, Electrical Engineer; …

Not included in Dick's stories is that we packaged a 1616 into a special cabinet with an IBM 8-bit Byte serial interface and called it the 3760 Communications processor. The production was transferred to Salt Lake City and was the predecessor to the DCP-10 that Lou Carlson designed. https://vipclubmn.org/cp16bit.html#3760 relates the re-packaging of a Type 3760 computer into a system for the German Navy.

We also had repackaged the AN/UYK-15 into a 19" rack mounted assembly for the Army's Counter Mortar project.

Then a migration of the engineers working in plant 5 to plant 8 in Eagan where we were re-organized into a group working for Engineering Manager Mel DeBlauw.