Founding the Computer Industry in Minnesota

Engineering Research Associates

by

Dr. Peter C. Patton

Naval Intelligence in WWII

- One of the great Allied successes of WWII was the breaking of Axis message codes.
- Three US Navy code breaking officers were encouraged to start a company to design and build specialized message decoding equipment after the war.
- A military glider factory in St Paul was just ending its wartime operations and was chosen for starting the new firm.

The Founders of ERA

- Howard Engstrom - vice president
- Charles Tomkins – vice president
- William Norris – vice president
- John Parker- president
- Engstrom, Tomkins, and Norris had been code breakers during the war.
- John Parker had been president of the Glider Factory

ERA Pioneers

- Dr Arnold Cohen – physicist
- Dr Sidney Rubens – physicist
- Jack Hill – engineer
- Frank Mullaney – engineer
- George Hardenbergh – engineer
- Jim Thornton - engineer
- Erwin Tomash – engineer & CBI founder
- Warren Burrell – engineer
- Earl Joseph – engineer & World Future Society
- Seymour Cray – engineer

Early ERA Products

- ERA built highly classified message encoding and decoding electronics for US government, until … Project 13!
- Project 13, or 1101 in binary, was a very early general purpose stored program computer, which could be …
- … *programmed* to flexibly emulate formerly hardwired message encoding and decoding equipment.
- ERA created and patented the first magnetic drum computer storage.

The Computer Revolution

- The ERA 1101 was followed by the ERA 1102 and then the ERA 1103.
- Meanwhile Eckert and Mauchly Corp in Philadelphia were building the UNIVAC I.
- And IBM was moving from electro-mechanical punched card machines to electronic computers.
- They offered the IBM 701 (14 sold) and IBM 702 (6 sold), and the ERA-designed IBM 650 Magnetic Drum Data Processing Machine (1500 sold), which really put computers on the map.

ERA Merged with Univac

- ERA computers then became the Univac Scientific Computer Series:
- The Univac 1103A, 1105.
- The Univac 1107 and the 1108.
- The Univac 1110.
- Univac then merged with Burroughs to form Unisys and the ERA style machines became the Unisys 1100 Series still being used world-wide.

The ERA Legacy

- A Univac 1103A at the University of Minnesota started the “U” on its path to becoming a world class academic computing innovator and host to the Charles Babbage Institute.
- The Univac Scientific and Bill Norris’ & Seymour Cray’s later Control Data computers solved problems that were intractable without them.
- The 1946 ERA start-up led to a $100 billion plus high-tech manufacturing component in the Minnesota economy.

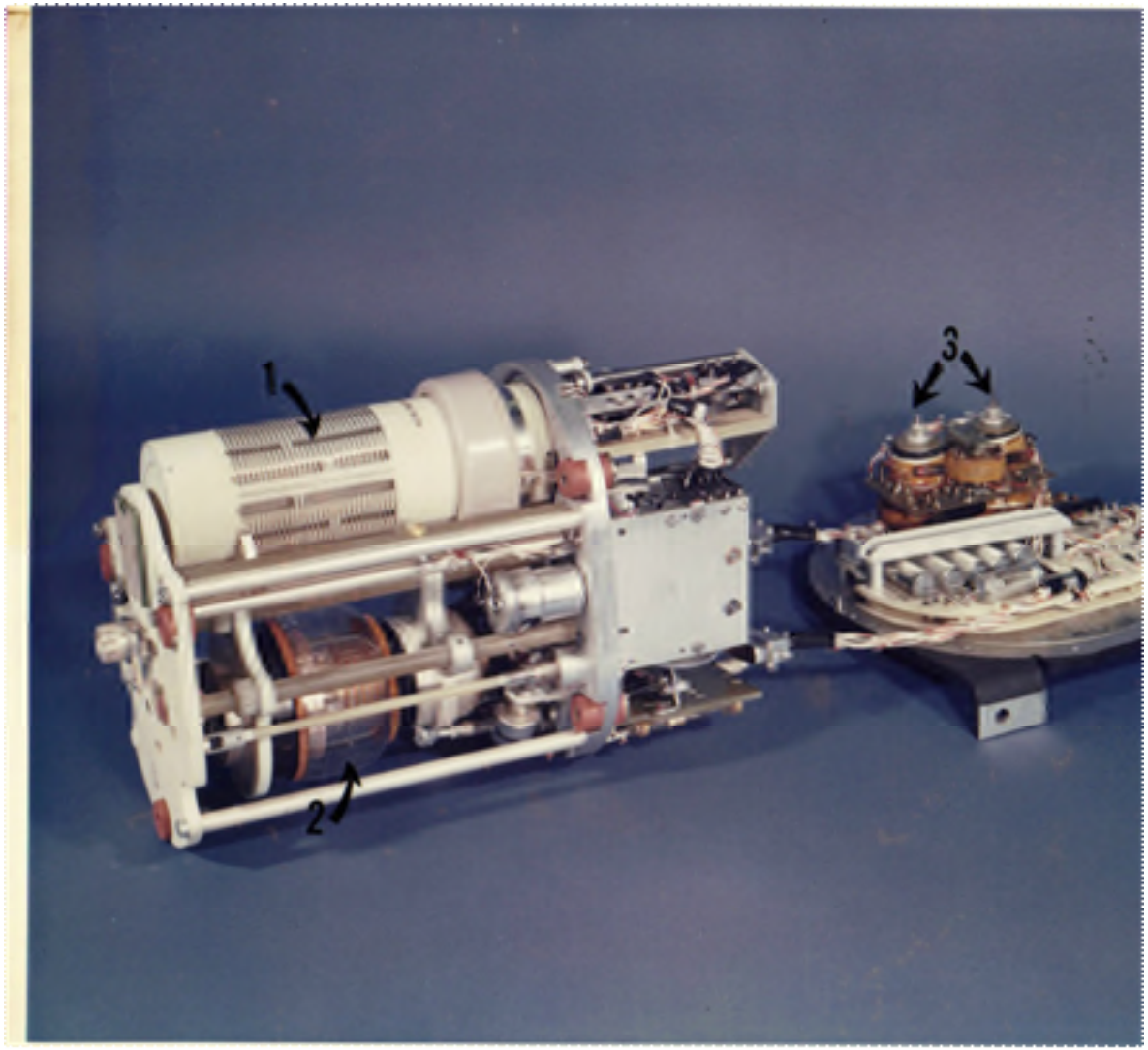
PRODUCT FOR SURVIVAL

MARC SHOQUIST

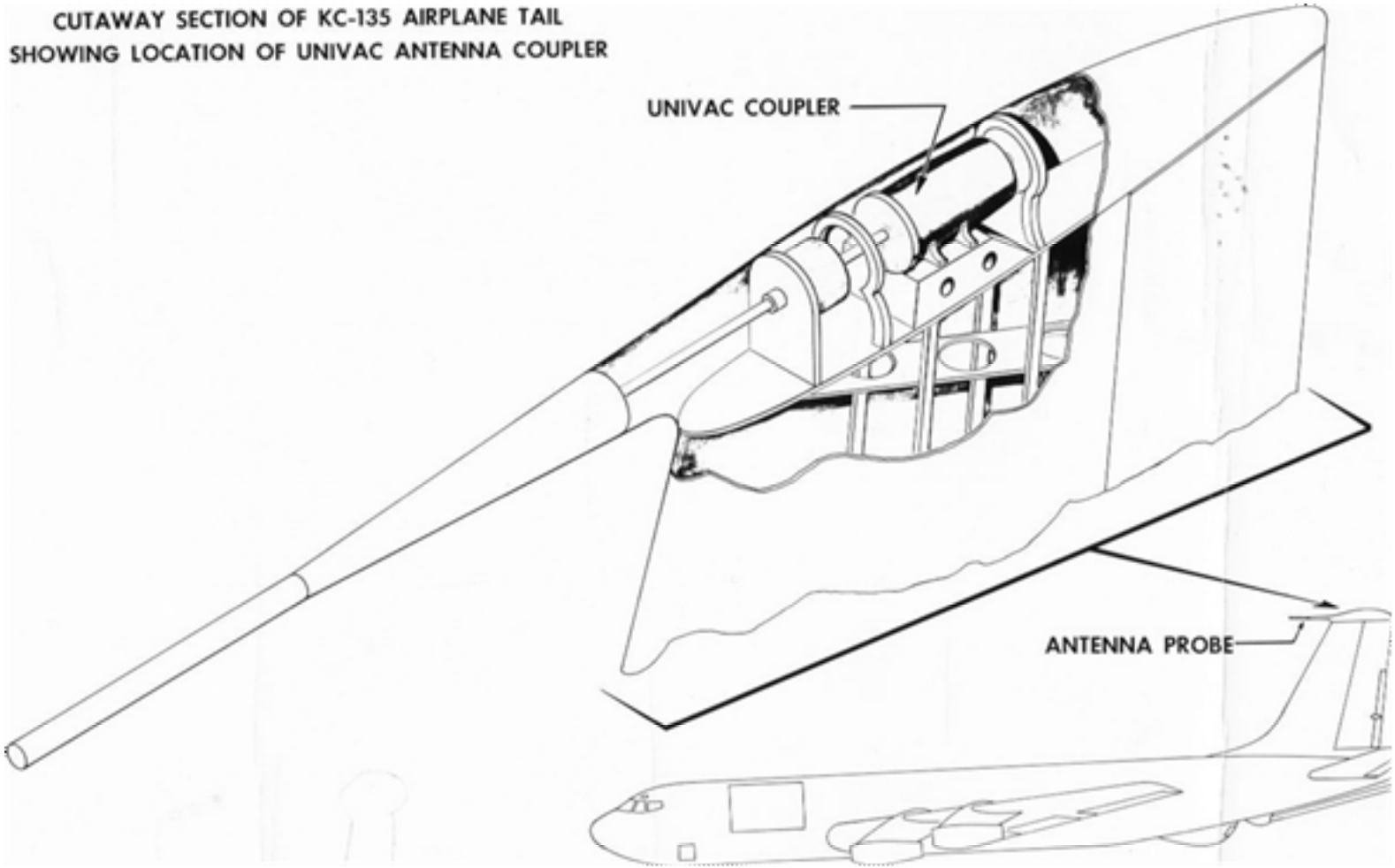
CIRCA 1953

- 1200 EMPLOYEES –MOSTLY UNDER 30
- GROWING RAPIDLY TO 5000 BY1956
- TW0 PLANTS WITH NEW PLANT IN 1956
- PRIMARY PRODUCTION PROGRAMS
- (ANTENNA COUPLER AND MEMORY DRUMS)

Antenna Coupler Unit



Antenna Coupler Installed



ANTENNA COUPLER

- PART OF AIRBORNE RADIO COMMUNICATION SYSTEM
- AUTOMATICALLY TUNES TO COUPLE RADIO TRANSMITTER TO THE ANTENNA
- USED INITIALLY ON MILITARY BOMBERS AND CARGO AIRCRAFT
- PRIMARY SUPPLIER TO BOEING ON 707 COMMERCIAL JET AIRCRAFT (1956-70)
- 0VER 12,000 PRODUCED 1953-1970

CUSTOMER BASE/COMPETITION

- BOEING
  - B-47 AND B-52 BOMBERS
  - C-97, KC-97, C-135, KC-135 CARGO/TANKERS
  - 707 SERIES COMMERCIAL JETS (40 AIRLINES)
  - AIR FORCE 1 VC-137 FLEET
- GENERAL DYNAMICS
  - B-36 AND B-58-BOMBERS
- LOCKHEED
  - C-130 CARGO
  - PC-3 NAVAL PATROL AIRCRAFT (1967-200?)
- COLLINS RADIO, RCA, MARTIN COMPETITORS

PROFIT CONTRIBUTION

- 12,000 UNITS AT $ 7000 AVERAGE PRICE ($ 84 MILLION)
- 1957 PEAK YEAR SALES OF $ 12 MILLION
  - 38 % OF DIVISION SALES OF ABOUT $ 32 MILLION
  - $ 4.8 MILLION COUPLER RETURN ON SALES
  - 88 % OF DIVISION RETURN ON SALES
  - 163 % COUPLER RETURN ON INVESTMENT
  - 13 % DIVISION RETURN ON INVESTMENT
- MOVED INTO NEW PLANT ON WEST 7TH ST. IN 1956

COUPLER STAFF

- ELECTRICAL/MECHANICAL ENGINEERS AND TECHNICIANS
- COMMUNICATIONS BACKGROUND
  - AMATEUR RADIO, MILITARY SERVICE, TV/RADIO REPAIR
- DIVISION LEADERS FROM COMMUNICTIONS FIELD
  - BILL NORRIS, CEO FOUNDER(MILITARY COMM.OFFICER)
  - CARL SWANSON, DIRECTOR (HEAD OF COMM. AT NWA)
  - FRAN BILTZ DEPT HEAD (MILITARY COMM. OFFICER)
  - FRED HARGESHEIMER, SALES HEAD (AMATEUR RADIO)

FRED HARGESHEIMER

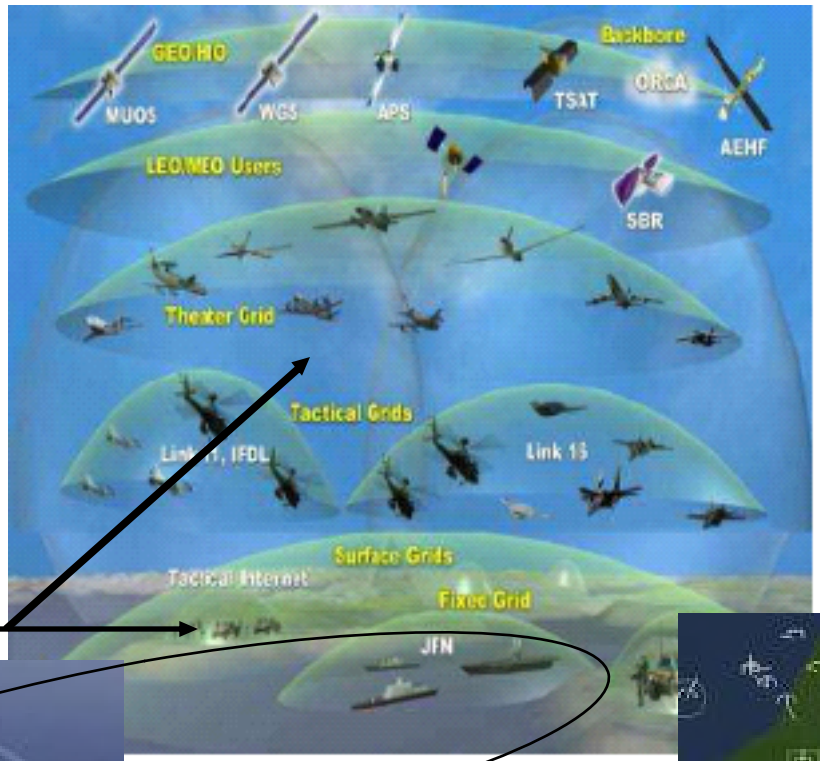
- ENGINEER, SALESMEN, WAR HERO, HUMANITARIAN
  - ALSO TEACHER, AUTHOR, ACTOR, TENNIS STAR
- P-38 PILOT WORLD WAR II
- SHOT DOWN OVER NEW BRITTON IN 1944
  - AFTER 31 DAYS AND INJURED, FOUND BY NATIVES WHO NURSED HIM BACK TO HEALTH FOR 6 MONTHS
- RETURNED IN 1960 AND FOUND NATIVES WHO TENDED TO HIM AND IN GRATITUDE PLANNED SCHOOL TO HONOR THEM
- STARTED SCHOOL IN 1963 AND WITH HIS WIFE
- RETURNED TO TEACH SCHOOL FROM 1970 T0 1974
- HAS RETURED TO THE SCHOOL MANY TIMES AND HAS RAISED FUNDS TO ADD TO THE FACILITY AND SUPPORT THE TEACHING STAFF

Remington Rand Univac
COMPUTERIZING THE US NAVY
Naval Tactical Data Systems
1940 – 1955-1962 - Present

John Westergren

Naval Tactical Data Systems (NTDS)

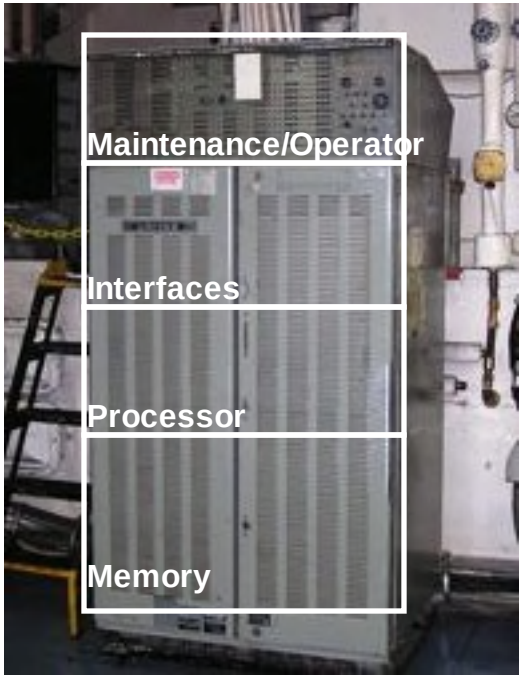
- Original 1955 concept was to connect ships at sea with real-time tactical situational information
  - Plans for expansion to land (MarineTDS) and air (AirTDS) were part of concept



- Provided tactical and situational awareness of the entire area

- Foundations were laid here in Minnesota for today's Global Information Grid, Joint Forces Network (JFN), etc.
  - Remington Rand Univac, St. Paul, developed the computer and was the system designer for NTDS: at the time they were the only producer of a programmable digital computers

Computer Comparison – Then & Now

AN/USQ-20B NTDS Computer Note 1 (about the size of a typical refrigerator)	**Dell XPS-420® Desktop**	**Palm Trio® SmartPhone**
		
Interfaces 4.8MBytes/sec	10/100/1000Mbyte Ethernet 10 USB ports (1.5MB/port) Audio/Visual port	Voice/Video 1 USB port Blue Tooth WiFi GPS
200K Instructions/sec 250Khz cycle time	1.2Ghz cycle time	
130KBytes Core, Random Access	3GBytes, Random Access 320GBytes, Hard Drive 16MBytes, SemiConductor Cache	256MBytes, Random Access
$600,000.00 (approx – 1964$)	**$500.00 (approx – 2008$)**	**$250.00 (approx – 2008$)** **[2 year service contract]**

Note 1: The last of this model was removed from service in 1994, still doing the NTDS job: the ships were decommissioned.

Technology, driven by the military/NTDS, demanded digital, programmable unit computers/processors, memories and interfaces that have now become part of everyday life.

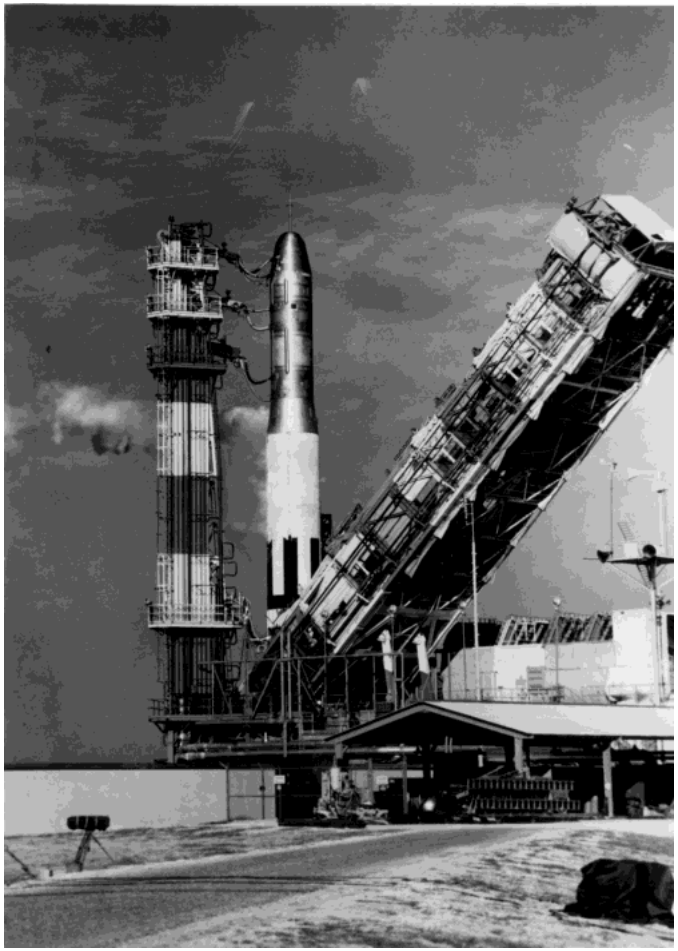
Minnesota Computers in the Military and Space Program

Building the Air Force's and NASA's Confidence 1956 – 1970

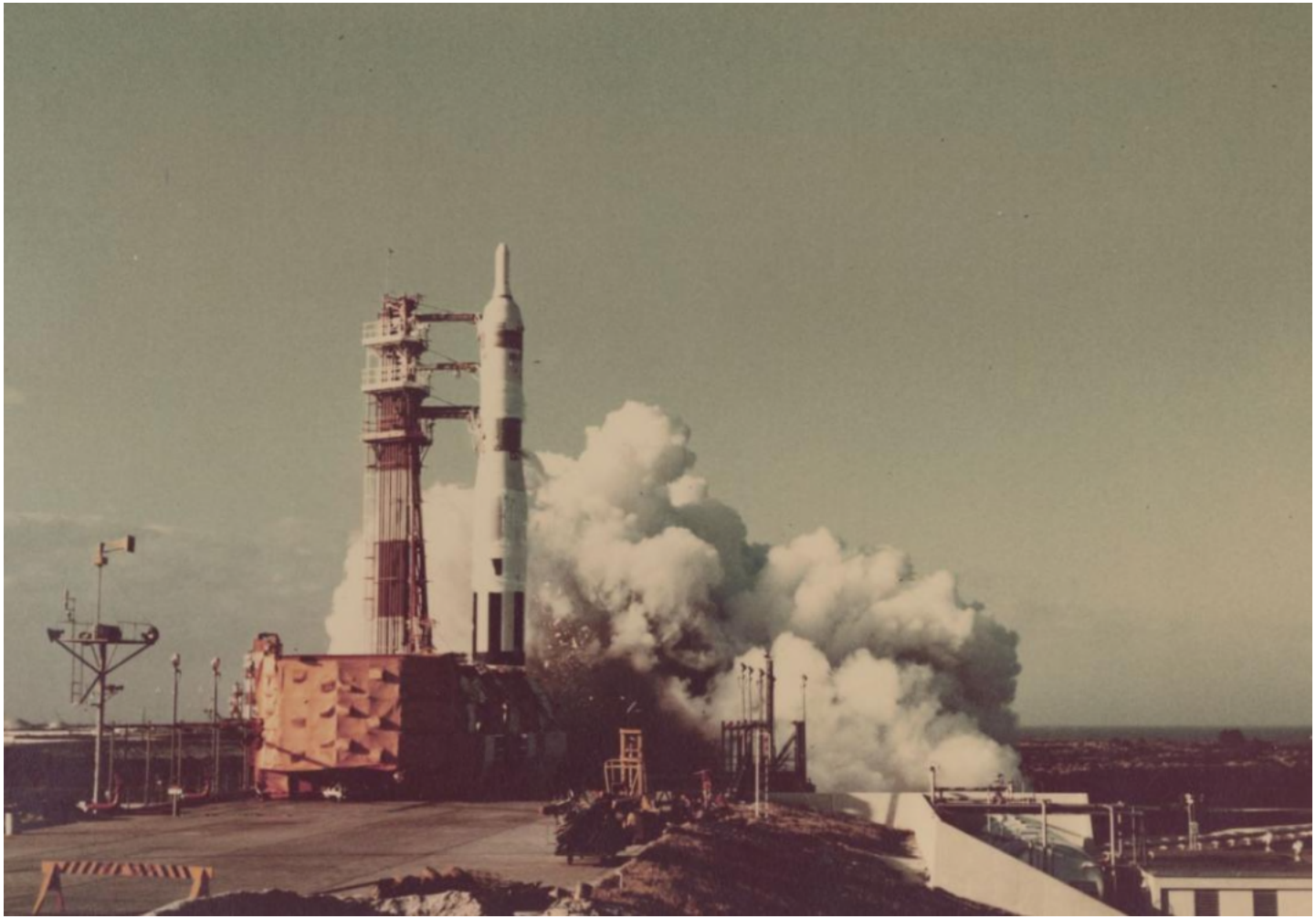
Bernie Jansen

Athena Digital Guidance Computer

Titan I

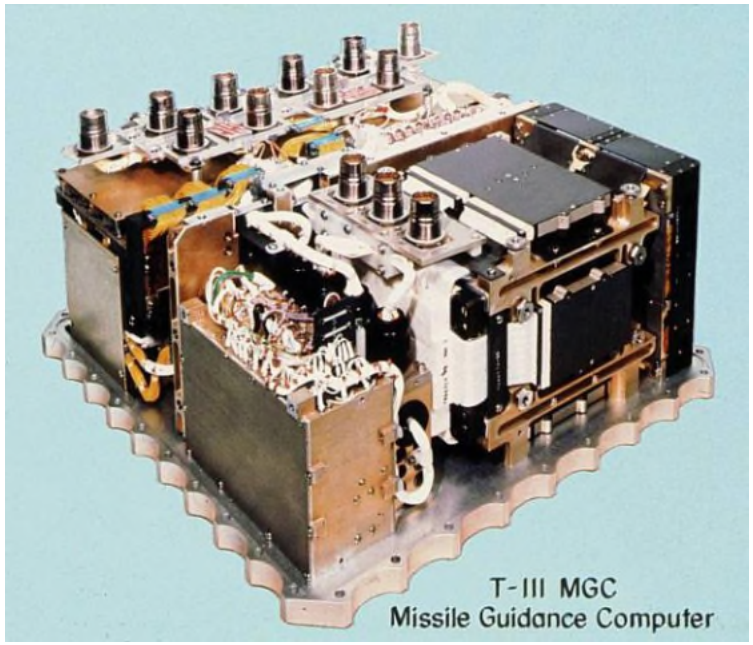


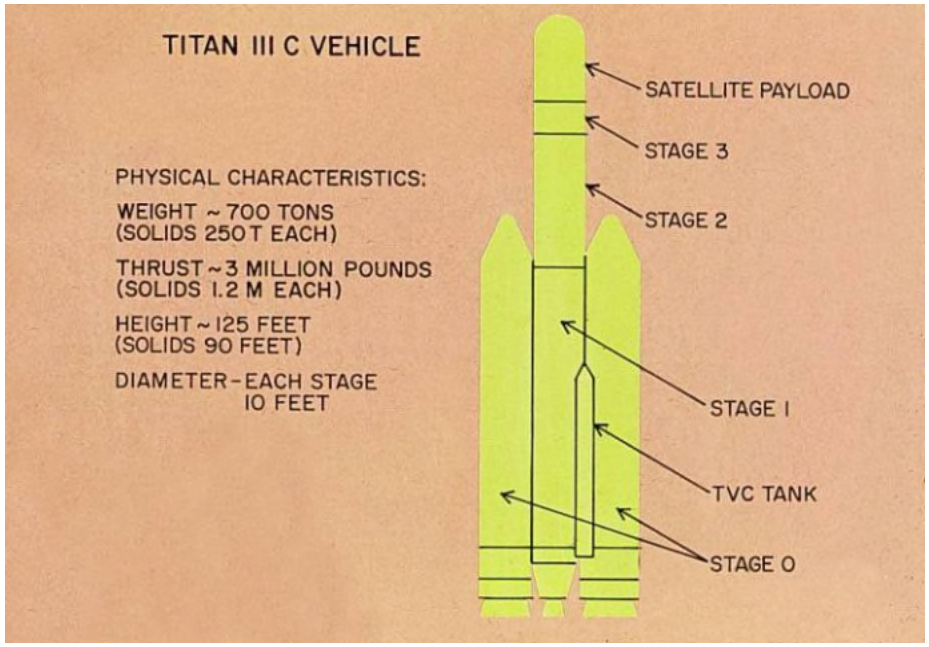
Titan I



Thor Delta

T-III MGC and Titan III C





AUTOMATING AIR TRAFFIC CONTROL

Jack Sater

Early Air Traffic Control - From NTDS to ARTS

Jack Sater

Retired Director, Air Traffic Control Engineering

"The FAA was put in contact with Univac by the Navy, who wanted to show Congress that their work on NTDS should continue to be funded because it also had application to civilian efforts, such as ***Air Traffic Control***."

Early ATC Genealogy

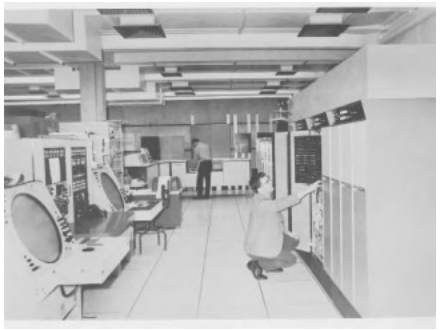
NTDS

FAA's Project Beacon

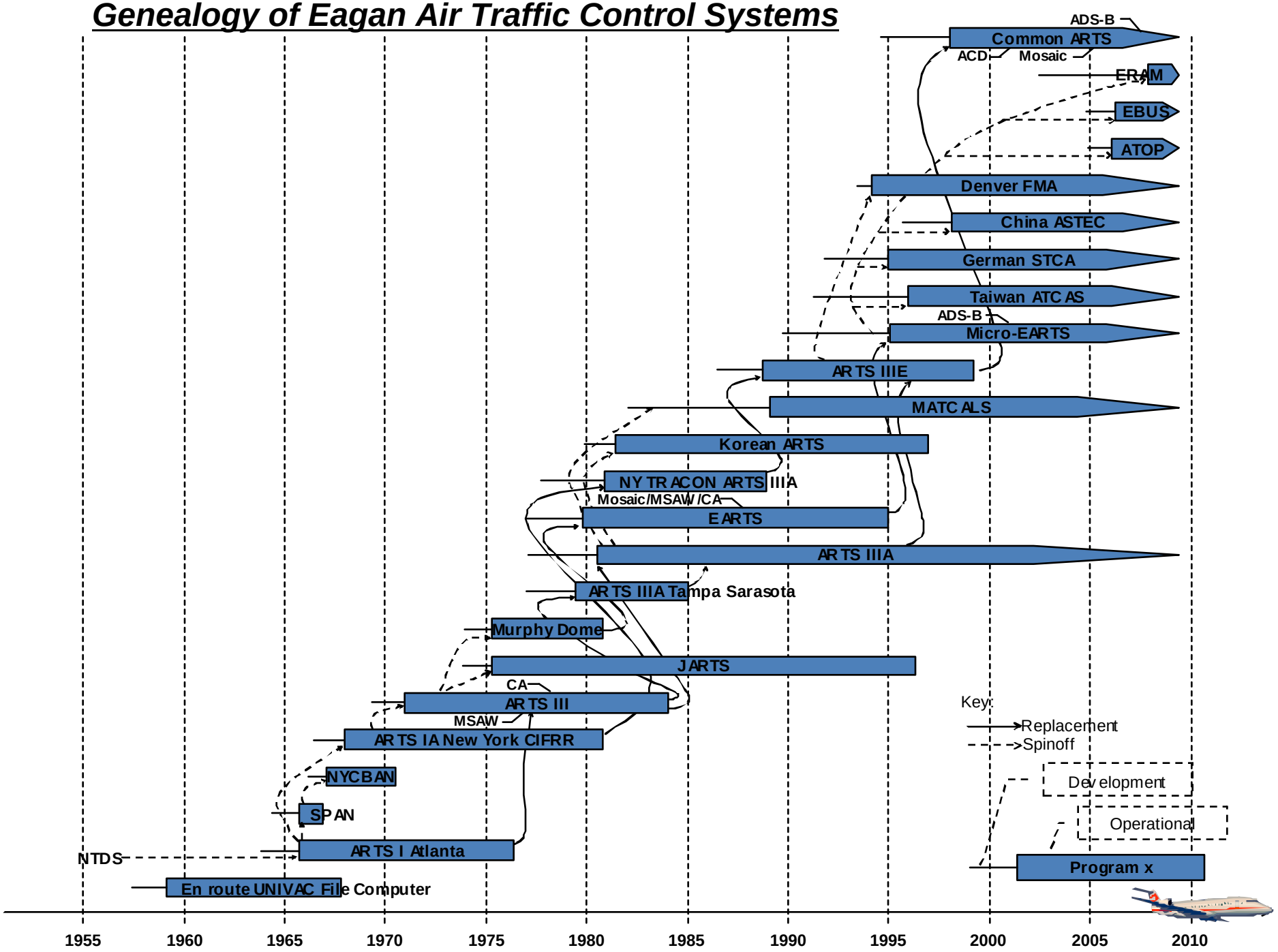
Atlanta ARTS I
1963 award

NY CIFRR ARTS IA
1966 award

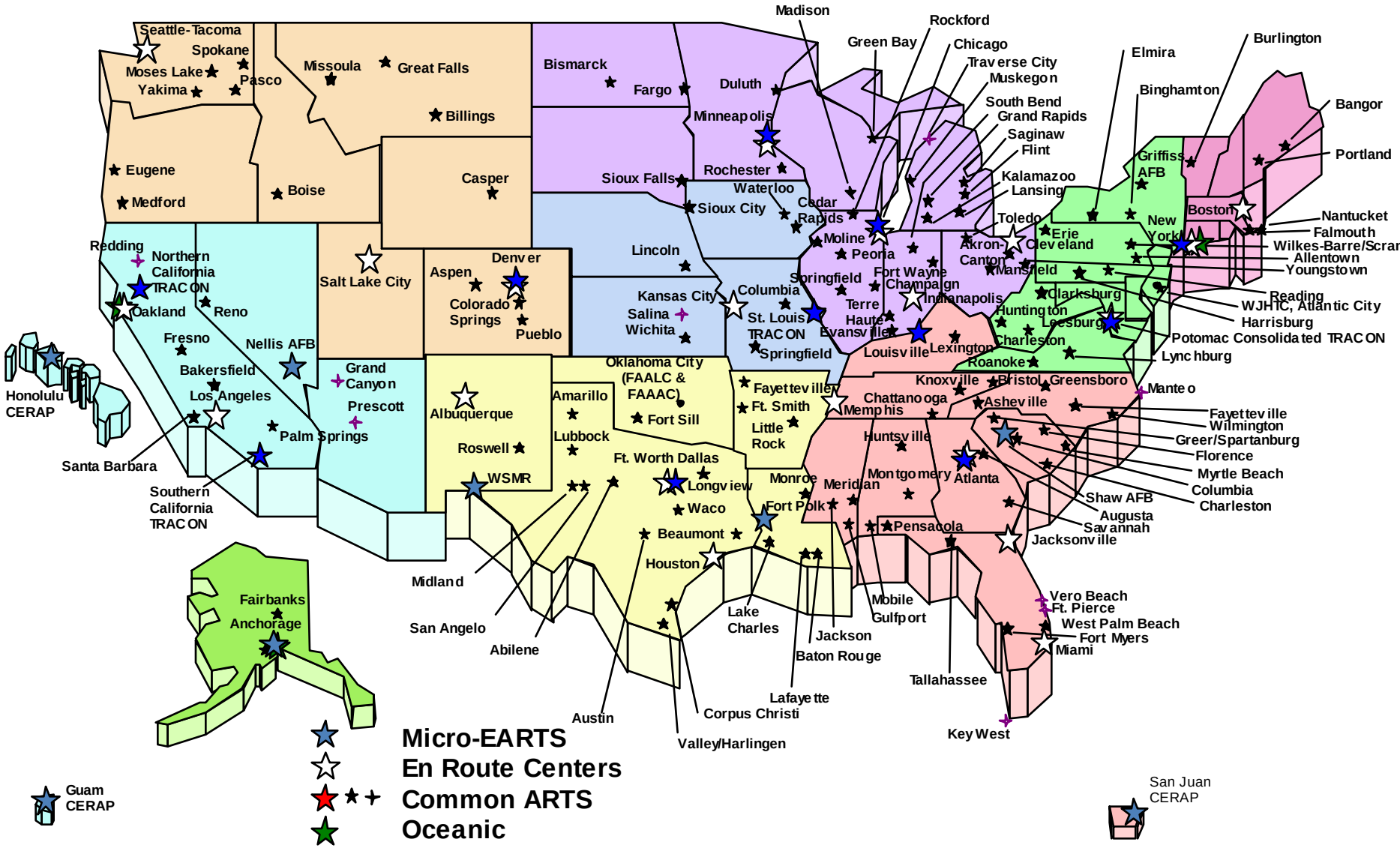
ARTS III
1969 award
64 U.S. sites



Genealogy of Eagan Air Traffic Control Systems



Today's Lockheed Martin Terminal, Enroute and Oceanic FAA ATC Systems



Minnesota Computing Technology in Commerce
BUSINESS ACHIEVEMENTS IN THE COMMERCIAL WORLD

Ron Smith

Minnesota Computers and Aviation

From Airline Reservations in 1958

To the 2008 Olympics

Minnesota Computers in Government

From the City of Minneapolis

To the Internal Revenue Service

Minnesota Computers in Science and Technology

From Oil Exploration in the 1960s

To the Space Shuttle in 2008

Minnesota Computers Around the World

From Australia

To Africa

To Brazil

São Paulo Water Supply

To England

WHERE WE GO FROM HERE

Brian K. Toren

Futurist

Remington Rand Univac

Univac

Sperry Univac

Unisys

Fissure Corporation

Computer Futures - Outline

- ★ Present Technology
- ★ Applications in 10 to 15 Years
- ★ Nanotechnology
- ★ Applications in 15 to 30 Years
- ★ Quantum Computers
- ★ Wrap Up

Computer Futures – The Computer

- ★ Multiple computers printed on a chip
- ★ Trillions of operations per second
- ★ Low power consumption
- ★ Computers and displays will be printed on a flexible plastic sheet.

Computer Futures – Mass Memory

- ★ Disc memory replaced by solid-state memory.
- ★ Trillions of bytes will cost pennies.
- ★ Will be embedded on most computing devices, PDAs, cameras etc.

Computer Futures – Power Supplies

- Quick charge Batteries (1 min charge)
- Photovoltaic operation and charge
- Flexible Material Charge (piezoelectric)
- Fuel Cell Batteries
- Printed Batteries

Computer Futures – Input/Output

- ★ Wireless
- ★ Voice
- ★ Touch Screens – control, text & graphics
- ★ Projection – Keyboard & Display (2D & 3D)
- ★ Position and Movement Sensitive
- ★ Ultrahigh resolution printers for documents
- ★ 3D printers for objects
- ★ Internet Appliances (IA) – cheap, wireless internet access.
- ★ No more S/W purchases, all S/W on line, with pay per use

Computer Futures – Packaging

- Mainframes and supercomputers will be housed in familiar, but smaller cabinets, probably liquid cooled
- Desktops will be desk ornaments
- Full function PCs with dozens of CPUs will be pocket sized
- Powerful Computers incorporated into glasses, cell phones, PDAs etc.

Computer Futures –Basic Uses

- ★ Supercomputer – far more powerful & accurate simulations mean: better more accurate weather forecasts, better economical forecasts, enhanced scientific and technological research
- ★ Mainframe – database host, internet servers, IA accessed applications processor
- ★ Desktops and PCs, gone, replaced by IAs

Computer Futures – Applications, Consumer

- In the Home – Command Central
- All appliances interconnected, access via the internet
- Automated checkout at stores – no clerks
- Auto-cars via GPS using on-board lasers & radars
- Electronic Newspaper – Renews every AM
- Electronic Books – bendable, look & feel real, can be read in the dark, downloaded from internet
- Sports – health monitors built into sports wear, sports gear enhancements, e. g. computers on bicycles
- Entertainment – do it yourself TV programming
- All electronic games internet based

Computer Futures – Applications, Commercial

- Retail – Radio Frequency Identification
- Manufacturing – closed/sealed/lights out factories
- Services – Internet enables work from home
- Internet – all application programs on line & accessed via Internet Appliances
- Internet Backbone – all satellite with gigabyte speeds to the home
- Advertising – targeted and more personal, based on choices made by consumer with suggestions provided on request.

Computer Futures – Applications, Financial

- Banking – cashless society
- Stock Market – more computer control with automated buy/sell
- Personal Finances – more control over personal finances with computer analysis and tailored financial advice
- Unbreakable Cryptography (until the advent of the quantum computer)
- Total Surveillance with face/voice ID

Computer Futures – Nanotechnology

- ★ Nanometer means 1 billionth of a meter
- ★ Nanotechnology means the creation of computer circuitry that is only a few atoms in width and depth
- ★ Nanotechnology means computers the size of molecules
- ★ Nanotechnology means emulating the human brain in a computer.

Computer Futures – Nanotech Computers

- Nanotechnology means a revolution in electronics
- A supercomputer can be printed on an 3X5 card
- Computers and sensors can be integrated into clothing, paint, shingles, muscles, etc.
- Nano-wires small enough to have quantum properties will assemble themselves into simple circuits

Computer Futures – Nanotechnology

- ★ Computers in personal information cards with retina scan identification
- ★ Computers in intelligent electronic paper for books and newspapers
- ★ Computers in eyeglasses for heads up TV (3D) and earbuds for music
- ★ Computer embedded in the brain and powered by proteins in the body
- ★ (all with internet access)

Computer Futures – Nanotech Applications

- Real (natural) control of prosthetics
- Artificial eyes near human resolution
- Computer robots will fly through your body scraping cholesterol off of artery walls
- Computer robots will monitor and repair cells
- Computer robots will hunt down and kill cancer cells & tumors
- Computer robots will build diamonds out of the carbon atoms in a sheet of paper
- Self assembling robots

Computer Futures – Quantum Computers

- ★ What – computers the size of atoms
- ★ How – quantum weirdness using "Qbits." 1 Qbit (atom) equals 1 processor.
- ★ Where – presently in labs – 2 or 3 bit words
- ★ Why – super-duper computers with results in seconds and minutes, not hours or days
- ★ When – 2050?
- ★ What For – simulations, cryptology, research and analysis, global brain?

Computer Futures – Conclusion

Computers will be more ubiquitous than ever, all aspects of life will be affected by computers.

The changes in technology, life and lifestyle in the next 25 years will dwarf all changes that have occurred in the past 75 years.

Computer Futures – Quantum Computers

The future as outlined is possible, and because of the insatiable curiosity of the human species probably will happen. Both good things and bad things can occur because of these technological advances.

It is within our power as humans to insure that the good things happen.

LEGACY VIP CLUB
St. Paul, Minnesota
ERA,
Remington Rand,
UNIVAC, Sperry,
Burroughs,
UNISYS,
PARAMAX, LORAL,
Lockheed Martin
1945=>Today

150 YEARS of STATEHOOD
1858 · 2008

Bon Voyage