

## There's more to NEXRAD than meets the eye

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It was nearing 10 p.m. EDT on Sunday, Aug. 23, 1992 when the National Weather Service's WSR-88D radar, located in Melbourne, Fla., observed a tropical cyclone gathering force in the Atlantic Ocean. As Hurricane Andrew revved up for its fierce attack on southern Florida, it was the first hurricane to be observed by a National Weather Service (NWS) WSR-88D in an operational setting. All through the night the WSR-88D, also known as the Next-Generation Weather Radar (NEXRAD), tracked the hurricane and enabled weather forecasters to accurately project the storm's path and authorities to issue evacuation orders to threatened areas.

The WSR-88D, built by Paramax Systems Corporation, is the newest NWS radar system. This advanced Doppler radar system determines in real-time not only the size and intensity of a storm but also wind speed and direction. As a result, weather forecasters can now obtain high-resolution data on hurricanes, tornadoes, flash floods and other storms within minutes.

{Editor's note: Paramax is one of the VIP Club's heritage companies.}



To achieve this, NEXRAD uses a specialized high-performance computer—an advanced programmable signal processor originally developed by Unisys for use in military systems—to extract reflectivity and Doppler velocity data (called “base data”) from raw radar returns. From the signal processor, the base data moves in digital form along high-speed data communication lines to a radar Product Generation Computer which uses sophisticated meteorological algorithms to generate user products. These products, which include both tabular and graphical information, are then transmitted to user positions and workstations for display and analysis. Among the most important products are easy-to-read graphical presentations of Doppler data which use a technique called false-color imagery to show observed wind speeds and directions. False-color imagery assigns different hues to the various wind speeds within an air mass. Cool colors, like blue and green, are normally used to indicate air movement toward the radar; warm reds and oranges show air movement away. The Radar Product Generation computer also processes the radar data to develop an overall picture of storm dynamics and severe weather potential. Automatic alarms call attention to predicted danger areas and display the system's assessment of a storm's potential severity. The result is a color-graphic profile of the weather mass, along with its predicted behavior.

NEXRAD systems have proved themselves repeatedly over the past several years, but never more decidedly than during Hurricane Andrew's August rampage through southern Florida. According to Bart Hagemeyer, meteorologist-in-charge at Melbourne, portions of Hurricane Andrew were observed on the Melbourne WSR-88D for more than 24 consecutive hours Aug. 23-24. “We were surprised at how much detail about Andrew's structure was evident even at long range in reflectivity data,” he said.

The NEXRAD program was begun in 1979 when the U.S. Departments of Transportation, Defense and Commerce joined forces to produce advanced weather radar units that would provide a national warning network to aid the NWS, an agency of the National Oceanic and Atmospheric Administration. Initially, three companies—Unisys (then Sperry), Raytheon and Ford Aerospace—were selected to perform systems definition studies in preparation for the design and production of NEXRAD systems. Unisys and Raytheon were subsequently selected to compete in a validation phase. Unisys and, specifically, Electronic Systems, used its expertise in high-speed computing and real-time software and its high-reliability manufacturing capabilities to provide a cost-effective, technically superior solution.

In the 13 years in which Paramax has been involved with the NEXRAD program, teamwork and strategic alliances across the divisions have paid off. Systems Development in Great Neck, N.Y., serves as the prime contractor and is responsible for the design and delivery of a totally functional, integrated system. Electronic Systems provides signal-processing hardware and software. Information Systems at Ivyland, Pa., provides and supports all other NEXRAD software. The NEXRAD hardware supplied by Electronic Systems includes Programmable Signal Processors (PSPs), Hardwired Signal Processors (HSPs) and other Radar Data Acquisition (RDA) electronic modules. Clearwater Operations is responsible for manufacturing and testing these units, with Printed Circuit Board Fabrication performed at Shepard Road Operations. Electronic Systems Hardware and Software Engineering organizations continue to provide training and support, especially as it relates to the Signal Processing Program and diagnostic software which executes in the PSP. Electronic Systems Hardware Engineering is also currently performing a technical oversight function, interfacing with Motorola Corporation which is developing new communication modules for NEXRAD systems.

“The Electronic Systems technical expertise in software, firmware and production hardware, coupled with a strong comprehensive quality program, has made Electronic Systems one of the best NEXRAD subcontractors,” said John Fox, director, Program Management, NEXRAD Operations. “The entire Electronic Systems team continues to do an outstanding job in the production of signal processors and radar data acquisition modules.”

Electronic Systems’ involvement in the program began in 1982 with an investigation into the feasibility of using a programmable signal processor in the NEXRAD system. Electronic Systems first came under contract in May 1983, and less than a year later demonstrated a prototype Programmable Signal Processor, with a full complement of operational software running real-time and accurately processing simulated radar signals. “We showed what a small, dedicated and highly skilled team can achieve,” said systems engineer Dr. Ray Artz, who shared project engineering responsibilities with hardware engineer Rick Martin (now director of Hardware Engineering) during most of the NEXRAD development. “Our three hardware engineers (Vince Splett, Tom Erickson and Tim Lee) architected the processor and developed and demonstrated 11 new board types in less than nine months! Our software engineers Les Nelson and Bob Ellingrod were ahead of their time in using advanced information-hiding techniques to improve software reliability, and in developing and using a complete PSP register-level simulation to check out all code prior to the brief four weeks available for software integration. And, of course, the support we received from Prototype Manufacturing was outstanding.” By the fall of 1986, the first prototype NEXRAD radar was completed in Bloomfield, Conn., the major “test site” for NEXRAD systems.

Electronic Systems provided valuable integration support. In mid-1987, with less than two weeks remaining on the NEXRAD Validation Phase contract, Electronic Systems was asked to lead a Tiger Team to demonstrate improved Doppler processing capabilities. The team worked around the clock, demonstrated significantly enhanced system performance and solved, in days, problems which had been plaguing the prototype NEXRAD system for months. This effort has been cited as critical for the subsequent Unisys production award. Based on its demonstrated performance, Electronic Systems work scope was increased to include productizing and manufacturing the HSP and building additional RDA modules.

To date, 10 systems have been installed {Editor's note – 1992 when the paper was written.}, with more than 150 Doppler radars set for installation in the United States and at overseas military bases.

Serving and protecting the public are among the goals of those agencies that deploy NEXRAD. Dr. Elbert W. "Joe" Friday, Jr., director of the National Weather Service, said, "The news of NEXRAD is not only upbeat, but it represents the most significant improvement to weather forecasting in my 31-year career. And we're still making positive improvements. Every time we look at storms with this system, we see more information."

"The radar has achieved significant successes that prove the value of this new forecasting tool in saving lives, property and money," said Dale C. Hutchinson, vice president of NEXRAD systems, Systems Development division. "We look forward to installing the rest of the systems over the next four years as we go into full-scale production." A NEXRAD system will be installed in Eden Prairie, Minn., in the third quarter of 1994.

{Editor's notes: See section 2 of <http://vipclubmn.org/sysgovernment.html> for this story from Les and experiences from others.}