NAVY FLIGHT TEST

AND

THE REAL-TIME TELEMETRY PROCESSING SYSTEM

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ABSTRACT

The architecture and capabilities of Navy Flight Test's latest generation telemetry system are described. The Real-time Telemetry Processing System (RTPS) is the name ascribed to successive systems at the Patuxent River Navy Flight Test complex since 1973. This version of the system, dubbed RTPS IV, and the associated facility improvements will enable the Navy to support the next generation military fighter, the Joint Strike Fighter, and every other ongoing and planned Navy test program.

KEYWORDS

Real-time, Ground Station, Telemetry Processing, Flight Test

INTRODUCTION

Flight Testing has been conducted at the Naval Air Station, Patuxent River, MD (commonly referred to as "Pax River") since its creation in 1943. For the past 30 of those 60 years, Navy Flight Test has benefited from the ability to monitor tests in real-time, with successive jumps in productivity with succeeding generations of the ground station, collectively known by the name the Real-time Telemetry Processing System (RTPS). RTPS is recognized throughout the Navy flight test community as an essential productivity and safety of flight tool. It has handled tens of thousands of flights for virtually every Navy test program over its 30-year history.

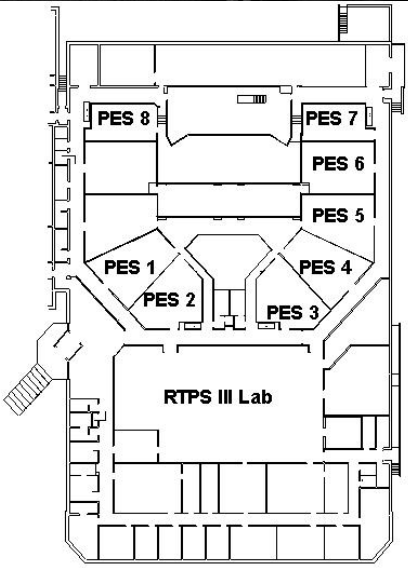
Telemetry transfers results from test aircraft to a team of flight test engineers at RTPS. In Project Engineer Stations, flight test results are instantly displayed on computer screens and strip charts. The test team analyzes the data to confirm that planned test points have been achieved and that it is safe to proceed. This ability to evaluate test points as they happen is at the core of the RTPS mission. Indeed, the mission is as focused today as it was in 1973, when the original Installation Bulletin (Xerox Corp) stated:
"*The RTPS was specifically developed ... for the primary purpose of reducing data turnaround time, improving quality and depth of testing, as well as providing immediate safety of flight information.*"

RTPS III - THE CURRENT SYSTEM

The current system was installed in 1988. It was developed by Computer Sciences Corporation, Lompoc, California under contract with the Naval Air Test Center at Patuxent River, MD. It consists of eight identical configurations of Encore computers, Aydin Monitor telemetry front ends, and Adage vector refresh displays. Silicon Graphics workstations and servers were added in 1995-96. The system resides at the Cedar Point complex at the Naval Air Station, Patuxent River. Each configuration can handle 4 PCM signals at 10 Mbits each and process 250,000 engineering unit converted measurements per second. An aggregate 2000 telemetered measurements can be processed. An additional 512 calculated measurements are produced by the Encore 32/97. The system is divided into two basic parts: the lab containing the computers and the project preparation and support functions; and the Project Engineer Stations which are operated by customer flight test teams. A PES is shown in Figure 1. The building is laid out as shown in Figure 2.

FIGURE 1

FIGURE 2



RTPS IV – THE FUTURE SYSTEM

To meet the challenging workload coming in the near future, especially the Joint Strike Fighter, Pax River is developing and installing the next generation RTPS. The new system, entitled RTPS IV, will be phased in over the next two years. The project is currently in the fourth year of a six-year program to replace the system and overhaul the facility at Cedar Point. The new system is being funded primarily with $9.5 million from the Navy's Improvement and Modernization (I&M) program. This will provide the capacity for eight simultaneous flights. Additional funding is planned to increase capacity to ten. The Telemetry Branch development team, with an aggregate 200 years RTPS experience, is designing, assembling, programming, integrating and installing the system in-house. This approach allows state-of-the-art technology and customer recommendations to be incorporated much more readily than with the long lead-time turnkey procurements of previous systems. The capacity for ten simultaneous tests coupled with the ability to convert from one project to the next in a matter of minutes means RTPS IV will handle more than 25 highly complex yet totally different flight tests a day. The system has many new features as described below and has built-in compliance with applicable IRIG Telemetry Standards: Chapter 4 (PCM); Chapter 8 (1553); Chapter 9 (TMATS).

REMOTE SITE SUPPORT

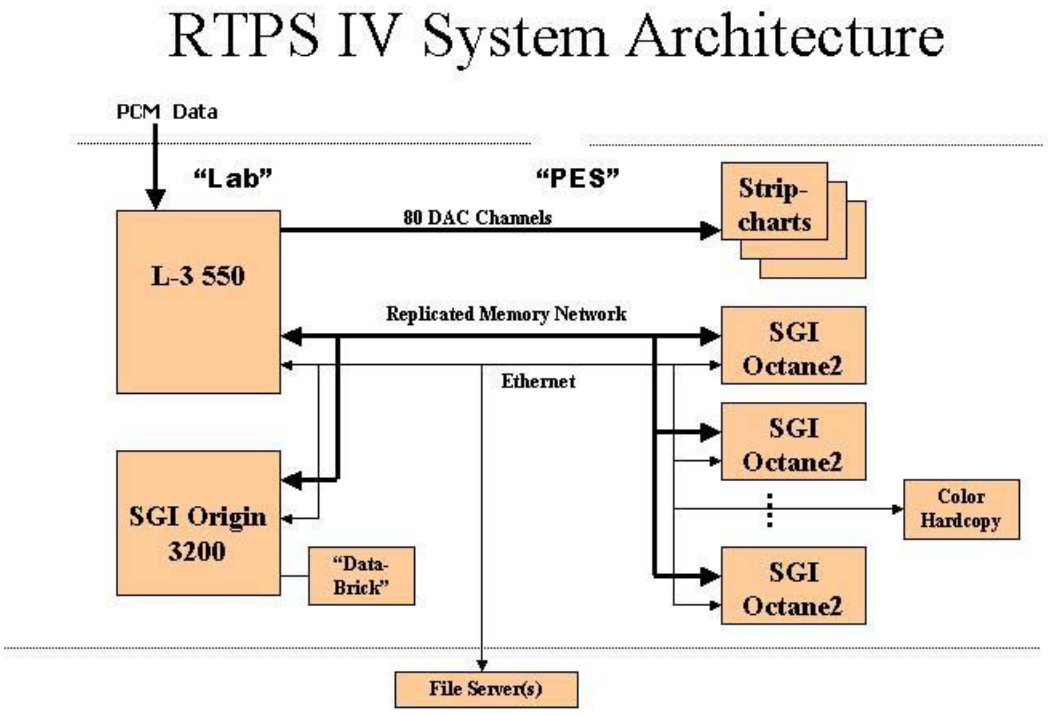
A key area being addressed by the RTPS IV project is remote site support. Pax River supports detachments aboard aircraft carriers and land-based sites with personnel and portable telemetry handling systems. As part of RTPS IV, the portable systems will be 100 percent compatible with the central system at Pax River. This will dramatically reduce preparation time needed for taking equipment into the field and will provide the same advanced features as the home system.

RELIABILITY FEATURES AND MAJOR EQUIPMENT

Reliability is the primary factor driving the architecture of the system. This is manifested at several levels: 1) There is no connection to the Pax River base-wide network (and consequently the Internet). 2) Each Project Engineer Station and its associated equipment is separate from the others. 3) Setup & Control and Data are handled by separate networks. An Ethernet network connects each PES to a central file server. Telemetered and computed data are distributed via replicated memory network (See Figure 3). 4) Each user within a PES operates an independent graphics workstation with access to 100% of the telemetered and computed results.

RTPS IV consists of L3 Communications 550 telemetry front ends with Silicon Graphics display workstations and servers, Astro-Med Everest and Western Graphtec strip charts, Metrum tape recorders, and 4 50-inch flat plasma video displays. A block diagram is provided as Figure 3.

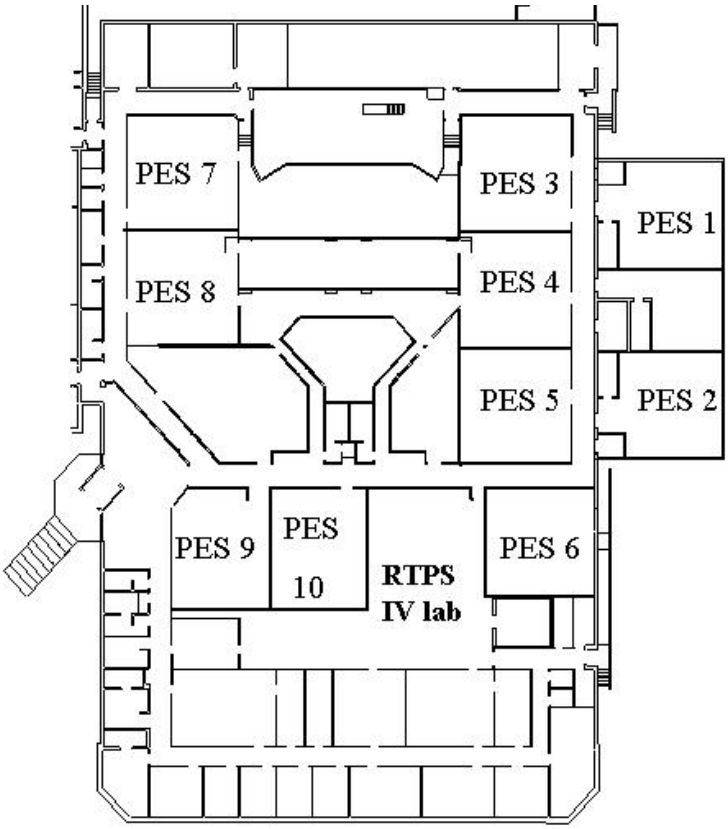
FIGURE 3



PROJECT ENGINEER STATIONS

Among the more visible changes are the size and shape of the remodeled Project Engineer Stations (PES). Each of the eight rooms will be 50 percent larger (34'x30') and all rooms will be the same rectangular shape as compared to the different pie-wedge shapes of the current rooms (see Figures 4 and 2). This will make each PES large enough for 35-40 project engineers as required by the larger projects such as JSF. An addition to the facility will add space for two PES rooms. The entire addition will be capable of supporting Top Secret missions.

FIGURE 4



The basic building block of each station is a user console as depicted in Figure 5. Each console provides two identical independent Silicon Graphics Octane2 displays and a video repeater monitor. The use of monitors mounted on swing arms allows full use of the top surface.

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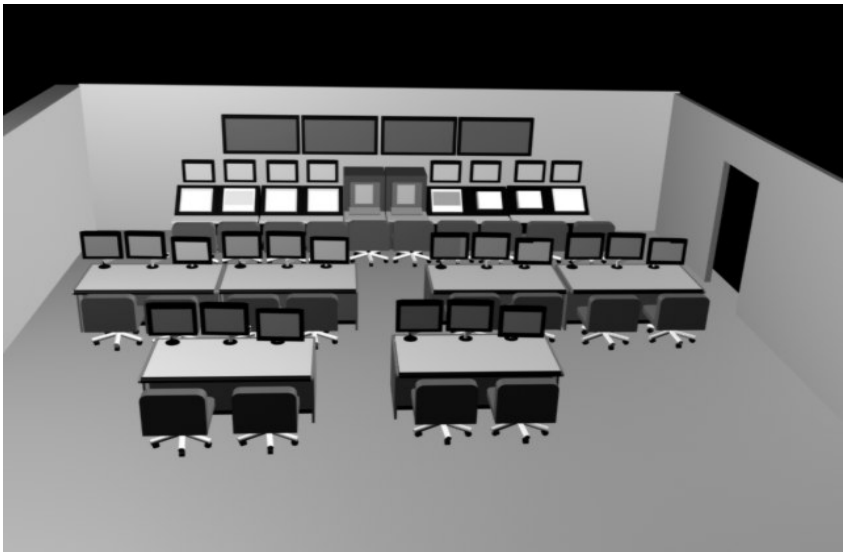
FIGURE 5

Two additional console types are shown in Figure 6. Traditional Western Graphtec paper strip chart units are provided as well as Astro Med Everest display/recorders. The Everest provides a hybrid video/paper display.

The consoles are arranged in a classroom configuration (see Figure 7).

FIGURE 6

FIGURE 7



Other remarkable changes will vastly improve the utility of the rooms. A new video routing capability will allow any of monitor displays, the video portion of the Everest strip charts, or external video sources to be viewed at any of the consoles as well as any of the four large plasma displays suspended at the front of the room. Figure 8 shows the displays. Each workstation will provide independent real-time analysis and display and an innovative data recall capability. The recall feature allows any engineer to review data independently and perform intensive intermaneuver analysis, while real-time monitoring continues at the other workstations. This will provide a new dimension in safety of flight as test conductors can make more informed decisions regarding proceeding to the next test point.

FIGURE 8

COMPUTATIONAL CAPABILITIES

Of critical importance to test program productivity are the improvements in applications software capacity and data throughput. Applications software is the means by which RTPS is customized for each project and is at the heart of the ability to handle all Navy test projects no matter how varied the test requirements. Pax River has developed hundreds of computational functions, dozens of display types, and many major specialty packages, most notably the highly sophisticated flutter analysis package. RTPS IV will increase the capacity for executing these programs substantially in multiple dimensions. First, room displays, which host project-specific graphics such as aircraft schematics and frequency domain plots, will be increased from seven to fourteen. Second, the number of parameters computed from telemetered measurements will be increased by a factor of 20 (from 512 to over 10,000). And third, computing power for complex analysis routines will be dramatically increased. The L3 550 will handle traditional "derived" measurements (those computed based on a combination of telemetered measurements. The SGI Origin 3200 will available for more complex computations. The SGI Octane2's will each be able to handle any display formatting computations. Data throughput capacity will also be dramatically improved: total aircraft instrumented measurements will be increased from 2,000 to over 30,000; data handling rates from 250,000 to 2 million samples per second; and Pulse Code Modulation (PCM) transmission from ten to thirty megabits per second.

POST-FLIGHT FEATURES

Post-flight data distribution has always played a key role in the productivity of test programs. With RTPS IV, full compatibility between real-time and post-flight systems will be designed-in and provide rapid turnaround of test results. The data recall capability identical to that in the Project Engineer Station will also be provided to post-flight users. A high volume Storage Area Network is being added in summer 2003 to collect and house all telemetered and derived results. Planned development will make the SAN accessible via secure network connection from flight test engineers' workspaces.

CONCLUSION

The first of the ten planned RTPS IV Project Engineer Stations has already been constructed and is supporting flight tests. A 3500 sq. ft. addition to the facility is well underway and is expected to be complete this summer. Conversion of existing spaces in the facility will begin in July 2003. A major effort to re-host the complex array of displays and computational functions to the new system is underway. The entire transition from old to new is expected to be completed by the end of 2004, at least a year ahead of the arrival of the Joint Strike Fighter.

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