

Modernizing Flight Test Cockpit Display Functionality Using IADS RTStation

Ben Kupferschmidt¹, Rocco Docimo¹

1: Curtiss-Wright, 15 Terry Dr., Newtown, PA 18940, USA

Abstract: In this paper, Curtiss-Wright will describe how we have upgraded an existing nEUP-2000 engineering unit processor installation with our new NXDP-4000 next-generation data processor. The NXDP offers the ability to use the full desktop version of IADS RTStation onboard a test aircraft. This allows the pilot or onboard flight test engineers to take advantage of IADS sophisticated data visualization and analysis capabilities to display critical data in real-time.

Keywords: Real-Time, Data Analysis

1. Introduction

Many flight test programs need to perform real-time data processing onboard an aircraft. There are several use cases where this is a valuable capability. The most common is the desire to show the pilot or co-pilot some critical information from the flight test data acquisition system. This information can help verify the aircraft's proper operation during testing. Another common use case is for larger aircraft or helicopters that have flight test engineers onboard using standard laptop PCs or rack mounted PCs to view data. But there are applications where a more rugged solution is necessary. For these cases, the pilot or engineer needs a rugged onboard data processing unit that can receive data from the data acquisition system, perform calculations on the measurements of interest, and display the results.

2. Earlier Engineering Unit Processor Products

Curtiss-Wright has introduced two previous generations of onboard data processing products. Our first-generation data processing product operated as a CAIS master bus card that was part of the master CAIS DAU in a traditional, non-networked data acquisition system. This system could only process data directly

from the CAIS PCM Format up to 5 Mbps. This original data processing product was based on a rugged small board computer running Linux with custom data processing software. It was introduced around 2003 and had very limited processing and display capabilities.

Our second-generation engineering unit processor (EUP) product used an upgraded hardware architecture based on a TI OMAP3530 processor. This was a type of ARM processor that was common in cell phones in the late 2000s, prior to the smartphone revolution. We again used custom software running on Linux to process the data and display information. Since this second generation EUP product had greater processing capabilities it was able to process incoming PCM data at up to 8 Mbps and display a much larger number of parameters on multiple display widgets of different types. The second generation EUP also supported receiving a single stream of DARv3 Ethernet traffic as an alternative to a traditional PCM input.

On both the first and second-generation EUPs, the QT cross-platform C/C++ development framework was used for data processing and the displays. One of the big advantages of using QT was its ability to compile and run the same code on both Linux and Windows. This allowed us to embed the setup software for the EUP directly into our TTCWare system setup tool and show the user a live preview of what their displays would look like using the same code on both the desktop PC and the embedded EUP.

The second-generation EUP came in several form factors and several display output options. It was available as a card for Curtiss-Wright's CDAU/WDAU/nDAU data acquisition system and as a standalone network device called the nEUP-2000.

There was also a version that was integrated into our Network to PCM Gateway product called the nGWY-2000EU. Most of these variants offered a VGA output with resolutions up to 1280x1024.

3. Introducing The NXDP

Thanks to the significant advances in computing technology over the past decade, Curtiss-Wright can now introduce our third-generation Engineering Unit Processor product, which we call the NXDP or Next Generation Data Processor. The NXDP product line offers a new approach to onboard data processing that is dramatically more capable than the earlier EUP products. Instead of a low-power cell phone processor, the NXDP uses Intel x86-compatible CPUs and runs Microsoft Windows® 11. By running Windows on an x86 processor, we can avoid custom software and instead run the full desktop version of IADS RTStation. RTStation provides industry-leading data visualization and rich data analysis capabilities that far exceed what was possible on the traditional EUP products.

Since the NXDP hardware has vastly more processing power than the second-generation EUP product, it can simultaneously process multiple separate data streams, extract and process many measurements, and display the results in real-time. The NXDP is based on Curtiss-Wright's well-proven DuraCOR line of rugged mission computers which provide a rich assortment of interfaces including digital HDMI video output and multiple 1 Gigabit Ethernet inputs.



Figure 1: NXDP-4000 Hardware

By using the IADS RTStation software for data processing and visualization, we gain many benefits over the traditional EUP products. RTStation supports multiple simultaneous data sources over Ethernet.

Ethernet traffic is not limited to a single format like DARv3 but instead supports many data types, including DARv3, Chapter 10 UDP, iNET-X, IENA, and TmNS. It can also interface with a wide range of Decom products to receive PCM data. RTStation offers a sophisticated built-in library of data processing functions that are optimized for flight test applications. It also includes many displays, including high-performance strip charts and many types of gauges. RTStation can perform complex calculations like Fast Fourier Transforms (FFTs) in real time and display the results using Power Spectral Density (PSD) displays.



Figure 2: NXDP-3000 Hardware

As a standard Windows PC, the NXDP platform is open to expansion if desired, and IADS RTStation offers a built-in API called IADS Read to make it easy for customers to write their own software that can read processed data from IADS. Some examples of possible types of processing include the ability to create a subset of the incoming data that IADS receives, perform calculations on the data in real-time, and output only the results as a separate data stream. This could allow high-data rate measurements to be processed onboard and reduced to a much lower rate processed output, saving on limited telemetry bandwidth.

RTStation also supports ActiveX-based user displays. This allows users to create their own displays and integrate them into IADS RTStation. If the user has custom displays that have already been developed for their ground-based IADS installations, then the same displays can be used on the NXDP which saves development time and effort.

For the initial product release, Curtiss-Wright will be offering two versions of the NXDP. The first is the smaller, lighter, and lower power NXDP-3000 which

is intended as a pilot display tool. And the second is the high performance, larger NXDP-4000, which is intended for onboard flight test engineers or applications that require more data processing capabilities.

Table 1: Specifications For NXDP-3000 and NXDP-4000

Specification	NXDP-3000	NXDP-4000
CPU	Intel Atom x6400E 4 Core at 2 GHz	Intel Xeon W-11865MRE at 2.8 GHz
RAM	16 GB DDR4	32 GB DDR4
Graphics	Intel UHD	Intel Iris Xe GPU
Storage	1 TB SSD	1 TB SSD
Size	5.3" x 5.2" x 1.96" 13.5 cm x 13.2 cm x 5 cm	6.2" x 6.7" x 3.3" 15.8 cm x 17.1 cm x 8.3 cm
Weight	2 lbs. 0.9 kg	5.5 lbs. 2.5 kg
Power	Less than 25 Watts	Less than 65 Watts
Cooling	Conduction, No Fans	Conduction, No Fans
Operating Temperature	-40°C to +71°C	-40°C to +71°C

4. Upgrading An Existing nEUP-2000 Installation To NXDP-4000

Curtiss-Wright has an existing fighter jet test program that uses the nEUP-2000 with a network data system containing multiple Axon and KAM-500 chassis. This system natively outputs iNET-X data which is not directly supported by the nEUP-2000. In order to route the data to the nEUP-2000, the Axon's AXN/ENC/401 card is used to generate a PCM output containing selected data from the iNET-X streams. This PCM output is then connected to the PCM input on the nEUP-2000. This extra step increases the complexity of setting up the data acquisition system, but the customer has been able to use it successfully for several years.

Now, the customer wants to increase the amount of data that they are processing beyond the abilities of the nEUP-2000. We have proposed the NXDP-4000 as a suitable replacement. The 1 Gigabit Ethernet port on the NXDP-4000 allows it to receive data from all of the data acquisition systems on the flight test network.

Since IADS RTStation natively supports iNET-X data, we can eliminate the need to generate the intermediate PCM Format while allowing the user to easily access any measurement in the data system and display its value on the cockpit display.

Another benefit of the NXDP-4000 is that RTStation natively understands the DAS Studio XidML file, which makes it easier to transfer the setup of the data acquisition system to the NXDP-4000. Configuring the displays is done via a desktop copy of IADS RTStation, and then the configuration is loaded into the NXDP-4000 along with the XidML file.

Based on their preliminary testing, the customer has been very pleased with this new solution. The NXDP-4000 offers far greater processing capabilities and simplifies the user setup. Plus, the customer already uses IADS RTStation for their ground data processing and visualization. Using the same software onboard the aircraft allows the pilot and the ground controllers to see similar screens, which improves situational awareness during flight testing.

5. Other Use Cases For The NXDP

Next, we will review a few other use cases where the NXDP can offer significant improvements for onboard data processing versus earlier solutions. The EUP product's limited processor capabilities limited the type of calculations that could be performed. The much more capable NXDP processors make it possible to perform real-time FFTs on multiple measurements at the same time. This allows for sophisticated frequency analysis to be done during flight. This can be very useful for measurements that require very high data rates since the final result of the frequency analysis is much smaller than the raw data which makes it easier to transmit to the ground during flight.

Another useful application for the NXDP is fusing data from multiple measurements into a single derived calculation. For example, airspeed can be calculated by reading several pressures and applying temperature compensation. IADS RTStation can easily perform this calculation.

Finally, there are several benefits to using the IADS RTStation software. First, the flight test engineers or the pilot onboard the test vehicle can view the same IADS screens as the ground mission controllers. This

improves efficiency and simplifies communication. Secondly, since IADS RTStation supports client/server operation, it is possible to use the NXDP as a server for a small set of IADS client workstations. This would allow multiple onboard flight test engineers to view and analyze data during a test flight.

6. Conclusion

The NXDP offers significant improvements over previous engineering unit processors. The increased processing power, combined with the sophisticated

IADS RTStation software, provides the flight test community with a powerful new tool for onboard data analysis and visualization.

7. References

- [1] Telemetry Standard, Range Commanders Council Document IRIG-106-22, Chapters 4, 10, 21, 22, 23, 24, 25, 26, 27, and 28, May 2022.