The Modular Instrumentation Family

Defense and Industry Applications

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To effectively meet the needs of today's fiscally constrained mission, Department of Defense (DoD) agencies have developed critical ways to do more with less. One way organizations advance in testing is by using modular instrumentation to perform a wide array of data collection, storage and processing across various platforms. The author has explored several broad functions of modular instrumentation within the context of collecting data for government and commercial applications.

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GPS location
Speed
Fuel levels
Tire pressure
Fluid levels
Ride quality
passengers
System reliability
Maintenance sched
System updates
Accelerometer data
Blast survivability
Rollover prevention

The key benefit of ADMAS: It is designed to collect data that can provide valuable, additional insight into the performance of a system undergoing test.

Family of Medium Tactical Vehicles (FMTV) and High Mobility Multipurpose Wheeled Vehicle (HMMWV) on test course at Aberdeen Proving Ground, Maryland.
U.S. Army photo.

Defense and Commercial Platforms

It should come as no surprise that the DoD operates under increasing fiscal constraints and that creative and resourceful Service members and civilians find additional ways to do more with less each day. This is nowhere more evident than at the U.S. Army Aberdeen Test Center (ATC) at Aberdeen Proving Ground, Maryland, where ATC leads a critical effort with its "multi-commodity" approach to testing. This philosophy strives to effectively use integrated testing—performing the greatest possible range of analysis, across an entire platform, through the use of a common instrumentation set.

This common instrumentation, known as the Advanced Distributed Modular Acquisition System (ADMAS), is designed to facilitate rapid data collection, mass storage and near-real time data processing. ADMAS is versatile, supports a wide range of real world applications and is an extraordinarily useful resource for Major Range and Test Facility Bases, like ATC, that supply test efforts across the DoD, other government agencies and commercial industries.

ADMAS Versatility

ADMAS is a complex family of modular instrumentation. With its flexible design, it is available in many sizes, shapes and capability configurations to allow it to be quickly customized to meet a wide variety of rapidly changing test requirements across multiple commodity areas.

The key benefit of ADMAS: It is designed to collect data that can provide valuable, additional insight into the performance of a system undergoing test. Regardless of size, shape or capability configuration, ADMAS instrumentation collects information from systems and sensors that indicate how a product is functioning.

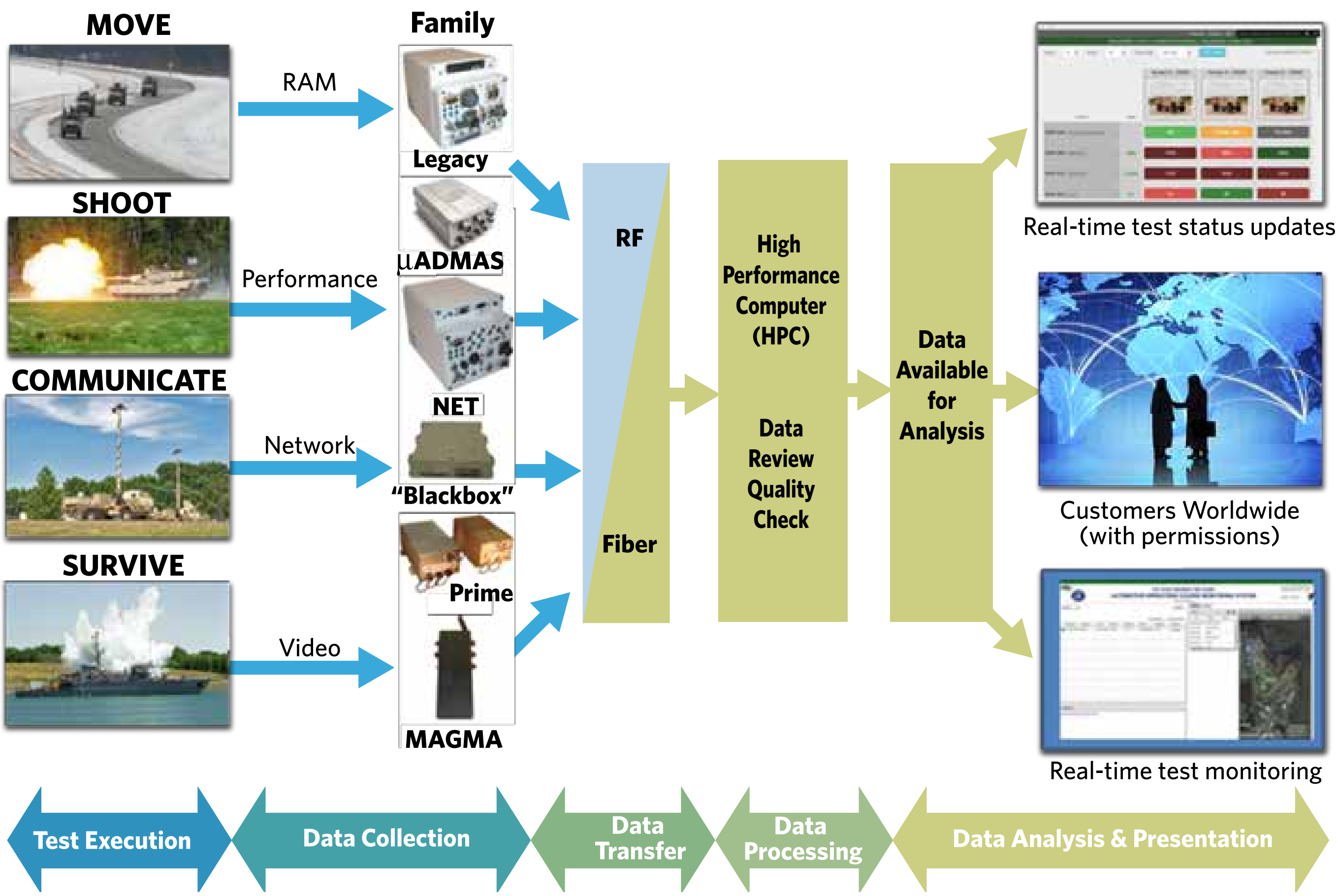
"We break down the information we collect into two main categories, 'data' which are raw engineering measurements such as Global Positioning System location, speed or oil pressure, and 'metadata' which are used to provide more context to the data and to describe factors about the test that may not be obvious in the raw data, such as weather conditions or terrain profiles," said Ryan Stowell, the leader of ATC's ADMAS efforts. "Both data and metadata are critical to getting a complete picture of how the system was being tested."

ADMAS Data Flow

The data collected from all tests using ADMAS instrumentation are stored in a database that provides the unique and powerful capability to look through the history of an individual system as well as across different platforms for evaluations and comparisons among systems. Stowell explains that the information can then be used by system developers to make critical product improvements.

The goal of the ADMAS family of instrumentation is to improve DoD's overall testing capability. This includes not

Figure 1. ADMAS Multi-Commodity Test Data Flow



only the collection of data but transportation, processing and storage as well. Collected ADMAS data are processed by way of an intricate central computing hub called a Defense Supercomputing Resource Center (DSRC). The DSRC at Aberdeen, one of five developed by the U.S. Army Research Lab, allows access through high-speed secure networks and provides accessible mass storage for volumes of data. Using this computing center capability allows agencies to process immense quantities of information on multiple computer cores in mere hours, versus the days or weeks required in using only a single computer. The principal benefit of this increased turnaround time is faster, more apt results, using fewer resources, and near-real time relevance in testing for the varied platforms ADMAS supports.

Real-World Applications

In a test, data are critical in demonstrating and predicting how the system will perform in real-world environments. Engineering data collected, processed and stored are used for many practical applications such as identifying logistical requirements, predicting reliability and maintenance schedules and aiding in future system updates and designs.

ADMAS is used not only for developmental testing but also captures Soldier data through operational testing and theater operations. ADMAS instrumentation has been provided to war theaters such as Iraq and Afghanistan since 2010. An ADMAS called "black box" was designed specifically for collecting data from Mine-Resistant Ambush Protected (MRAP) vehicles in theater.

The black box system was developed using the existing ADMAS architecture to meet the precise requirements of collecting data in a dynamic theater setting. More than 1,200 major MRAP systems have been instrumented with black boxes providing data on more than 267,000 miles—demonstrating systems use under operational conditions.

One extremely important ADMAS feature is that, in addition to basic automotive data (engine parameters, terrain profiles, ride quality information and environmental temperatures), black box captures ballistic accelerometer data that can be used to characterize a system's response to an explosive impact or rollover. Every blast survivability test on a vehicle at ATC is instrumented with ADMAS so data from in theater

Every blast survivability test on a vehicle at ATC is instrumented with ADMAS so data from in theater can be compared to controlled test data.

Boeing 747 undergoing cargo hold vulnerability testing at Aberdeen Proving Ground's Philips Army Airfield in Maryland.
U.S. Army photo.

can be compared to controlled test data, ultimately making systems safer and more resilient for Service members and even commercial users.

Broad Defense and Industry Applications

While the Army boasts a long history of developing, using and improving instrumentation to collect data, ADMAS' versatile application renders it valuable in virtually every DoD arena. In fact, ATC began using the Legacy ADMAS in 1999 after a run during previous years with its predecessor, the Vehicle Performance Recorder. Yet modern instrumentation now is used at many other DoD test centers and in the Network Integration Evaluation. Another 300 systems have been installed with instruments at training sites such as the Marine Corps Air Ground Combat Center in Twentynine Palms, California, for identifying system reliability in long-term training applications.

As a Major Range and Test Facility Base, ATC is a national asset sized, operated and maintained to provide test services to DoD, other federal agencies, state and local governments, allied foreign governments and commercial entities. Consequently, ADMAS models are designed for various types of applications, including traditional tracked and wheeled vehicles, man-portable equipment, unmanned aerial vehicles, watercraft, helicopters and planes. And because it is designed to be architecturally open and flexible, it can even be used on commercial vehicles and nonvehicular applications such as communications equipment and robotic platforms.

One of the first collaborative uses for ADMAS instrumentation was a joint Army-Department of Transportation-private industry project that provided instruments for commercial tractor-trailer trucks. The instrumentation was designed to collect data about the trucks and the driving conditions as they traveled throughout the United States. Data from the trucks automatically were transferred to the test center daily. As they moved, data were concurrently processed and stored but, most importantly, gave the joint partners the needed input for vehicle fleet analysis.

ADMAS also has been used on several U.S. Navy projects designed to collect data on how ships operate under various conditions. The data provide insight into key nautical improvements. Furthermore, micro ADMAS units have been successfully used in several unmanned aerial vehicle systems in critical events.

Conclusion and Outlook

Whether in MRAPs, tractor trailers or unmanned aerial vehicles using black box or mico ADMAS, accurate test data are imperative for the DoD's critical decision-making process. ADMAS instrumentation's flexibility, reliability and ease of use can help testers conduct concurrent, multicommodity testing to save time and resources while providing developers the opportunity to easily identify areas of improvement. ADMAS instrumentation is thoughtfully designed to meet these data-collection needs. Because the Army owns the complete design of ADMAS software and hardware, it is well positioned to be able to meet the rapidly changing requirements of future DoD and commercial industry systems.

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