TENA Implementation at Pacific Missile Range Facility (PMRF) Paper

Mark Wigent
SAIC
Lead Engineer

Robert A. McKinley
TRAX International
Sr. Systems Engineer

ABSTRACT

PMRF provides a volume of space, which may include any combination of below-surface, surface, above-surface environments to safely test, gather data, and monitor in real time, the performance of systems being developed. This paper discusses how TENA implementation in range instrumentation; including radar, optics, video, GPS, and telemetry systems; will enhance data acquisition and distribution of systems under test. While details of this implementation plan are specific to PMRF, this approach can serve as a blueprint for TENA implementation at other ranges throughout the DoD.

KEYWORDS

TENA, JMETC, Interoperability, Sensors, Source Integration Server, Message-centric, Object Model

INTRODUCTION

The individual services of the Department of Defense (DoD) have maintained an infrastructure of test and training ranges in order to develop material and doctrine used by the war fighter. Each service has developed their respective ranges to best suit their operational areas. As a result, the test and training ranges have developed a number of different approaches to controlling instrumentation and disseminating data internally and externally to range systems and users. While this addressed requirements in the past, the advent of the Network Centric War Fighter throughout the services has precipitated a greater need for integrating the individual services in the operational arena. In the same manner, the test and training ranges must now become interconnected in order to provide truth data on the effectiveness of the new systems and doctrine under development. Introducing new testing systems to the ranges to meet this need can be expensive and time consuming due to the varied architectures and procedures present at the individual ranges. Generally, solutions developed at one range cannot be easily used elsewhere. Further complicating matters is the vast volume of data being generated as testing transitions from a mode of one system vs. another system on a single range, to a mode of systems vs. systems tests across an extensive geographical area. The resulting demand placed on Range Control and Data Distribution has severely tasked individual range capabilities.

The purpose of the ranges is to provide a volume of space, which may include any combination of below-surface, surface, above-surface environments to safely test, gather data, and monitor in real time, the performance of systems being developed. Using a combination of range instrumentation; including radar, optics, video, GPS, and telemetry systems; the range acquires the system under test, records test data, and using a small subset of the data, provides real time processing and display for flight safety, analysis, and event control. Interfaces exist between each of these individual components as well as to other ranges and test facilities.

TENA Implementation Goals

The purpose of TENA Implementation is to provide a capability that modernizes and enhances system control and data distribution. The TENA Implementation will provide the control functionality between instrumentation/sensors and display systems, data distribution, and core data processing. Specifically, TENA will provide a suite of applications that create a sensor-independent interface to control different range sensors, and provide data filtering and fusion capabilities critical for operations on the range; a data distribution scheme which will efficiently disseminate data critical to real time operations on the network, thus relieving network bandwidth limitations; core support modules that are easily transportable between ranges for generating data filtering, data fusion, and other critical real time processing modules; and a methodology for transferring data between the ranges using JMTEC. The TENA architecture is designed to operate within an individual range and as well as across multiple ranges and operational centers.

T&E Need

There is a need for a range control and data distribution architecture that supports integration of new instrumentation more rapidly and reliably than existing methods, and with reduced cost and effort. As previously mentioned, individual ranges have developed approaches to range control and data distribution, which are often range-specific and call for significant interface development when integrating new instrumentation and systems to the range environment. The emerging T&E need is for a reusable data fusion, filtering, and range control capability that is not range specific and which can be reused throughout the T&E community.

The goal of the TENA Implementation at PMRF is to meet this immediate need while providing a solid foundation to build upon for future requirements of Distributed Testing and Training exercises across the DoD ranges.

Design and Development Approach

PMRF continuously supports Navy Fleet Operations and T&E Missions and cannot assume the risk of not supporting these respective customers during the implementation of the TENA architecture. A test environment must be established to develop and test any future capability in parallel before any resulting product of this architecture is used in a production environment.

TECHNICAL APPROACH

The purpose of TENA Implementation is to enhance and modernize range control and data distribution systems. TENA Implementation will enhance range control and data distribution applications that support varied real time missions on range, standard real time interconnection and data exchange with other ranges, and accommodate rapid, reliable introduction of new sensors and systems to the range environment in a cost effective manner.

The range system architecture that exists at PMRF is shown in Figure 1, which highlights all the major systems and interfaces on the range. This depiction of PMRF's range system architecture includes three major groups of components: sensors and instrumentation which generate data, systems and applications within the Real Time Computing Center (RTCC) which generally process data, and finally, systems within the Range Operation Control Center (ROCC) which includes various display and analysis systems. Sensors reside in a number of geographically disparate locations, including Barking Sands, Makaha Ridge, Kokee Park, and finally, MATSS, which is a mobile platform designed to extend sensor coverage at sea, over the horizon from land-based assets. In addition there are undersea sensor ranges at PMRF which will be candidates for TENA Implementation. This will allow for future connection of PMRF fleet operations with exercises conducted worldwide.

Data distribution is accomplished over the iNet network, which provides physical interconnection between the various sites and systems. Distributed data processing occurs' local to the sensors themselves within the Source Integration Server (SIS) for each sensor or within the telemetry data processing units. Other data processing occurs in a more centralized manner within PMRF's RTCC and ROCC, which both reside at Barking Sands Building 105. Several external communications mechanisms exist over DREN, SDREN, and STE connection.

Overall Implementation Strategy

The overall implementation strategy will employ a phased approach over three years. Areas of development will be the range data distribution architecture and key software modules/applications in the PMRF Real Time Computing Center (RTCC), the Source Integration Server (SIS), and the current PMRF physical communication/data network (iNet).

The first project phase, which will be conducted over 12 months, will focus on system development, with an emphasis on the portions of the range architecture that produce, process, and distribute data.

Closest to the range sensors, NGRC&DD will develop a distributed data processing unit which provides an interface between the sensor and range distribution network and which performs a distributed data processing capability, including data fusion and filtering. This will be a key component in next generation range control. Within the PMRF architecture, this unit is known as a Source Integration Server (SIS). The NGRC&DD will enhance the SIS to operate as part of a standardized range control and data distribution system that can be used throughout the T&E community. The TENA-SDA, working in conjunction with PMRF, will lead the SIS development phase.

Within the data processing components of the range architecture, range control applications will be enhanced to provide a more standardized and modular mechanism for data processing and distribution. Specific applications to be enhanced at PMRF include N-Station, Instant Impact Prediction (IIP), In The Box (ITB), T-25, and Operational Dashboard real time software modules. Together these applications perform the functions of data distribution, fusion, and prediction at PMRF.

As previously stated, PMRF has a requirement to continue to support a variety of test and training missions during the time the NGRC&DD project will be executed. In order to enable development, integration, and testing of the new data distribution architecture and real-time computing applications concurrently with

PMRF operations, the project will stand up a “sandbox” development and test environment within the PMRF network infrastructure. This development and test environment may include existing VLANs or sub networks at PMRF, such as the tNet, and it may also include new VLANs or subnets that are connected to, but sufficiently isolated from, PMRF operational network to ensure that development and testing activities do not adversely affect ongoing PMRF test and training operations. Due to current saturation of PMRF networks, the project will augment PMRF’s current network with new equipment. It is anticipated that the NGRC&DD development/test network will have components in the Real Time Computing Center, Range Operations Control Center and Makaha Ridge. The design of this development/test network will be accomplished in parallel with an existing network upgrade project led by NSWC Corona, so that the NGRC&DD test infrastructure will be fully integrated with the remainder of the new network infrastructure. Existing, unused fiber between Makaha Ridge and PMRF Building 105 will be used to support testing of the NGRC&DD technologies.

The second phase of the project, which will take 12 months, will focus on integration and testing of the NGRC&DD in parallel with legacy applications at PMRF in a non-operational context. Whereas testing in the first phase of the project will be conducted in a development/laboratory environment, testing in phase 2 will occur within the PMRF network infrastructure. This phase will begin by integrating the enhanced SIS, TENA optics system, and enhanced range control applications into the range environment. Information assurance and network performance analysis will occur concurrently. The enhanced systems will be tested in parallel with PMRF legacy applications and systems in a non-operational mode. Technical risk to PMRF operations will be minimized through the use of both logical network and temporal separation from critical operations. Performance of the next generation range control and data distribution system will be assessed and enhanced, as required, during this phase.

The third phase of the project, which will also be executed over a 12-month period, will include demonstration of the NGRC&DD capability in an operational environment at PMRF. As in phase 2, the enhanced systems will be tested within PMRF network infrastructure, but in this instance the NGRC&DD will be tested concurrently with legacy systems during PMRF operations. This phase may begin with testing and demonstration of the enhanced system in “shadow mode”, with legacy and next generation range control systems operating in parallel. Later in this phase, the NGRC&DD capability may operate as the primary range control and data distribution mechanism on the range.

The Test and Training Enabling Architecture (TENA) will be used throughout the project as an underlying data distribution mechanism. The use of TENA will reduce development and sustainment costs, reduce integration time, and increase interoperability and robustness of the NGRC&DD capability.

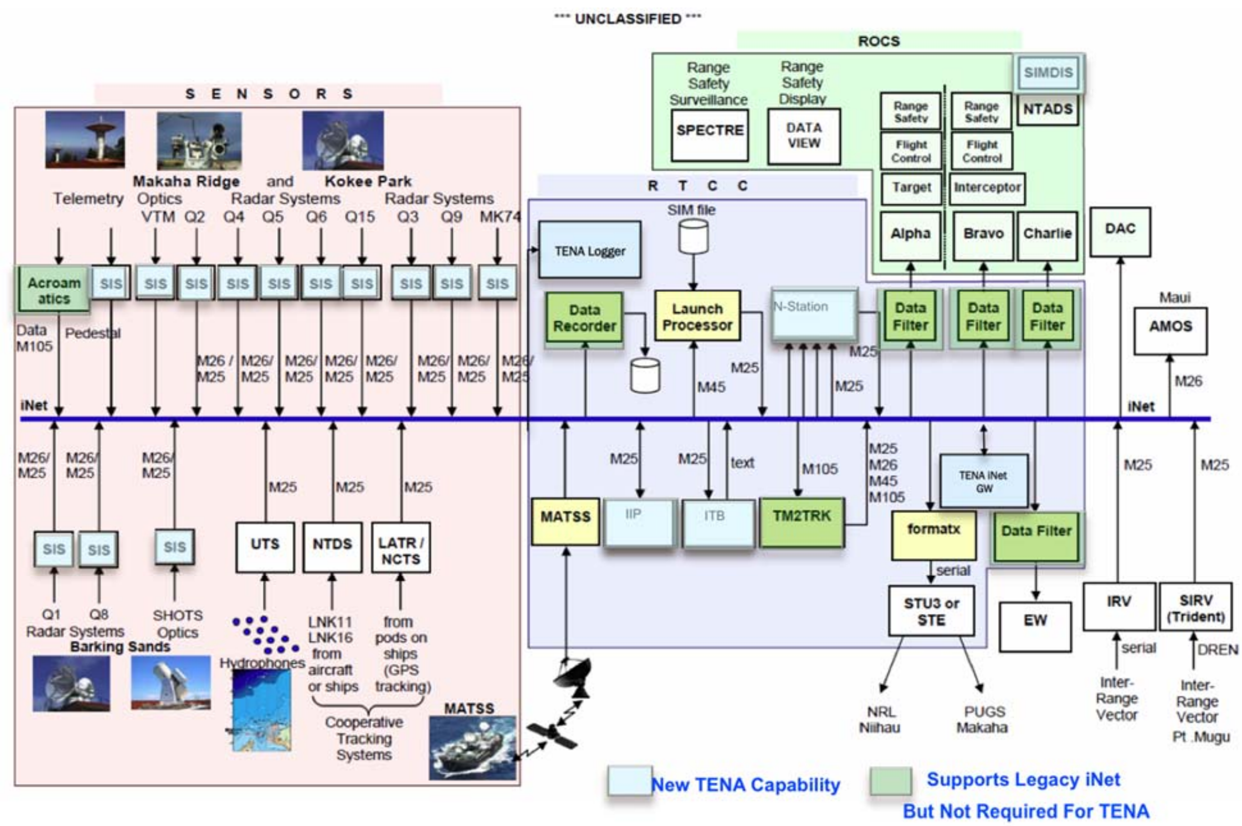

Figure 1. PMRF Range Architecture