JAMI AND TENA – A FUSION OF GPS AND IP

Alvia Sandberg
Redstone Test Center
Missiles & Sensors Test Directorate
Redstone Arsenal, AL 35803
alvia.d.sandberg.civ@mail.mil

Caleb Morse
Redstone Test Center
Aviation Flight Test Directorate
Redstone Arsenal, AL 35803
anthony.c.morse4.ctr@mail.mil

Ryan Chandler
Redstone Test Center
Aviation Flight Test Directorate
Redstone Arsenal, AL 35803
ryan.l.chandler2.civ@mail.mil

ABSTRACT

The Joint Advanced Missile Instrumentation (JAMI) project has created a very effective high dynamic Time Space Position Information (TSPI) solution and the Test and Training Enabling Architecture (TENA) is a very effective way to share data over a network. Can JAMI and TENA work together? This paper answers that question.

INTRODUCTION

This paper will introduce a use case describing how the JAMI program produces TSPI data and uses TENA to distribute that data for various purposes. It will describe high level details of the data flow from the receiver on a test item through a software adapter tool that enables data publishing. It will also mention some real-time data awareness tools and applications used in this process.

THE BODY

Various test programs from the Army, Navy and Air Force as well as across the globe utilize JAMI hardware and software to obtain high dynamic TSPI data. The JAMI program developed a form of Differential Global Positioning System (DGPS) that uniquely applies to high dynamic vehicles such as missiles and rockets. This solved a technology gap to provide TSPI data in vehicles that have large shock and high velocities which result in large Doppler effects to solution data. JAMI created solutions and tools in the form of GPS receiver modules, ground station (GS) hardware and software to provide TSPI data for these high dynamic vehicles. There are many white papers, specifications and standards that document the details of all of the JAMI program elements and implementations so they will not be addressed in detail within this paper [1,2,3,4]. The special GPS receiver collects pseudorange measurements which can be augmented with Inertial Measurement Unit (IMU) data on the item under test. These measurements are then delivered to a GS via telemetry. The GS will apply correction data to the measurements in order to provide a real-time TSPI solution. Figure 1 depicts the flow from the item under test through the ground station.

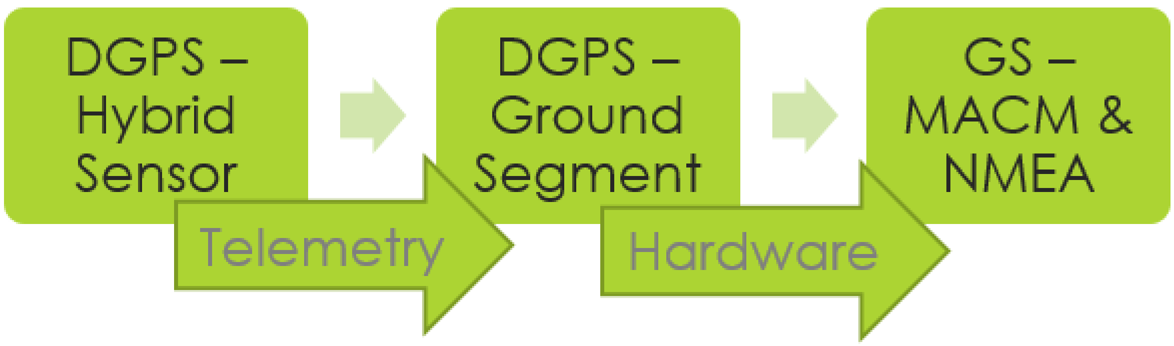

Figure 1 JAMI Data Flow Diagram

The data outputs from this GS DGPS solution are the Missile Application Condensed Message (MACM), also documented in RCC-264 [5], as well as National Marine Electronics Association (NMEA) [6] data. The MACM data is archived during a test event along with the ground station reference data in order to process the data following an event for further precision. The NMEA data is used for real-time situational awareness and is the data product used via TENA for that purpose.

TENA provides an architecture that allows data to be published and subscribed to using an Internet Protocol (IP) network. TENA provides this through tools that manage the network users and defines the object models through which data is published and subscribed to. These tools and object models are all described in more detail on the TENA website [7] and won't be described in much detail in this paper. TENA can also be used to pass NMEA data from a test site to a real-time situational tool such as SIMDIS [8] for TSPI track over map views. The NMEA data is published to an object model through the use of an adapter tool which this paper will describe below. The SIMDIS tool can subscribe to the object model data through a TENA middleware application that interfaces the SIMDIS tool to the data being published to a particular object model. The TENA object model that is being used for this data transfer is a TSPI specific one called the platform object model. All of this traffic is managed through a TENA tool called the Execution Manager and is always the first tool to run when performing any TENA link. The middleware for SIMDIS, the Execution Manager and the platform object model definition are all available from the TENA website. Figure 2 depicts the flow of data from a test item to SIMDIS.

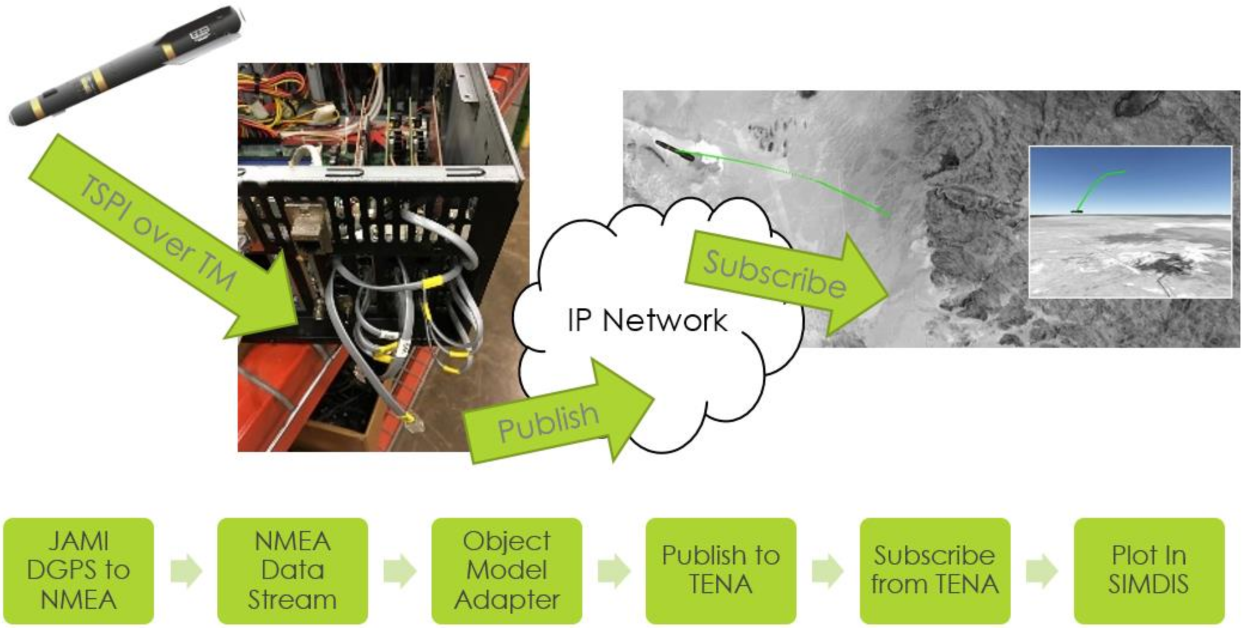

Figure 2 Test Item to SIMDIS Data Flow Diagram

Now that the data flow has been briefly described, the remainder of this paper will describe the object model adapter tool. Like most software programs, the object model adapter has many features and components including a Graphical User Interface (GUI) as well as various data manipulation, archiving and display capabilities. Its features were designed to be as simple as possible. The main window of the object model adapter which is titled the "Map Listing" is shown in Figure 3 and simply guides the user through the process of sending "A Data Source" to "A Data Target" that looks like some data type such as "A TENA Object Model".

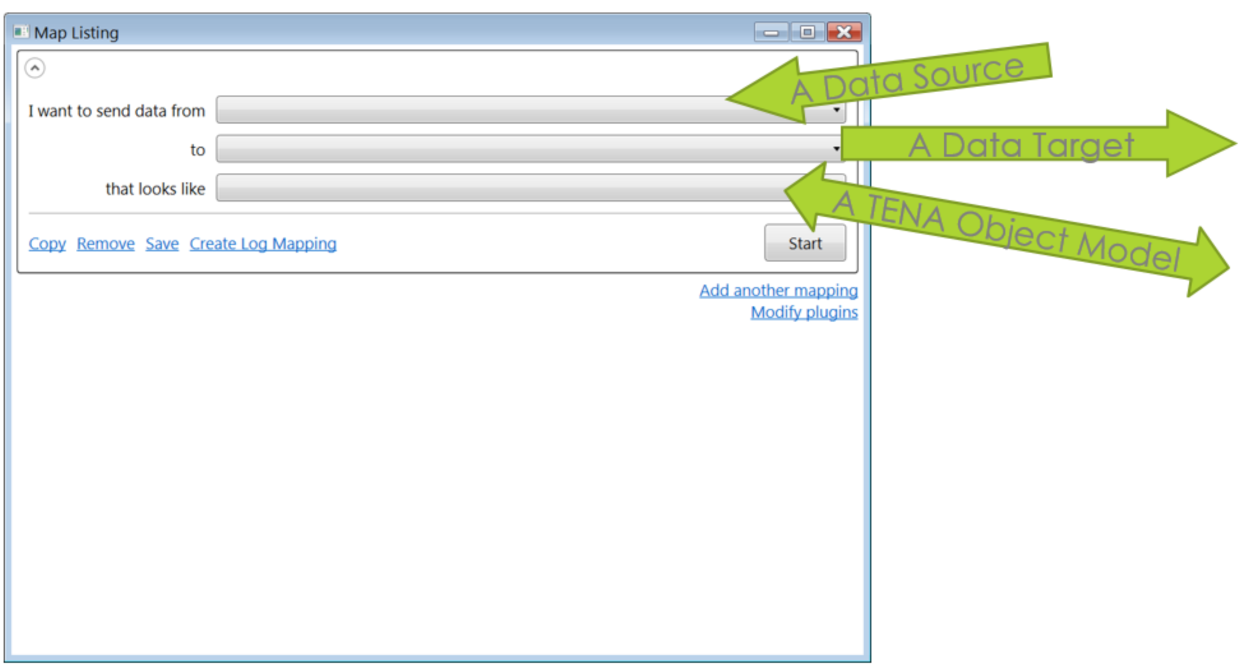

Figure 3 Object Model Adapter Map Listing GUI Screenshot

A data source can be multiple things to the adapter tool, such as a file or input device. For the NMEA data used in JAMI for real-time tracking purposes it is most likely a computer RS-232 communications (COMM) port. Once the data source is identified as an NMEA 0183 type in the drop down menu, all the normal RS-232 characteristics (baud rate, parity, data bits and stop bits) can be identified according to whatever source is providing the data. In the future, this may become a certain type of IP packet structure providing the data. However, at present, the JAMI ground station provides NMEA data via RS-232.

A data target can also be multiple things to the adapter tool, such as a log file or diagnostic IP broadcast. For this NMEA use case, it is simply identifying the critical systems on the network through IP addresses and port numbers. The selection for data target would be “TENA” from the GUI drop down menu in this NMEA use case. This allows for the identification of which system is running the execution manager and what is the IP/port of the device publishing data. This information is used behind the screens to tell other TENA clients how to talk to the system publishing data.

Finally, it’s important to select what the data looks like. For this use case, it will look like a “TENA Platform” which is the selection from the dropdown menu. The platform object model is the best object model to match the NMEA data parameters to a generic vehicles (or platform items) TSPI parameters.

The adapter tool will now allow the user to define the platform object parameters and properties. Some properties are set by just providing a value, or text in the field provided within the GUI. Some properties have a fixed set of values that can be selected from a drop-down menu in the GUI. Other properties such as the “Position (Latitude)” property are expected to be mapped to an NMEA message parameter like the GGA:Latitude value.

The adapter tool also provides the ability to transform property values prior to publishing them. The easiest example of this would be if you knew the data source provided a value in feet and the data target was expecting meters. For that particular example, a property transform exists to translate the data from feet to meters. The default transform setting is titled “Identity” which simply means no transform is occurring and the property will be published as is when received from the data source.

Once all the properties are mapped, clicking “Start” in the GUI will start multiple processes. The adapter tool will be listening to the data source for any property updates and updating each property in the GUI with the latest values. It will also be publishing these property values to anything subscribing to them across the network. In the case where SIMDIS is used to subscribe to these values, it is possible to configure SIMDIS with a layer of maps and a huge database of various icons or models to attach each instance of TSPI data to.

CONCLUSIONS

This paper briefly highlights one simple use case involving JAMI and TENA. JAMI is a great way to get TSPI data from high dynamic sources and TENA is a great method to transport that data across a network for real-time situational awareness. The fusion of the two can be a very savvy test and evaluation toolset. The next generation of JAMI plans to add multiple frequencies, constellations and IP based communication methods. TENA is primed and ready to continue being a vehicle to transport this TSPI data into the future. The adapter tool described in this paper need only be modified to handle whatever new message structure or protocols that the next generation moves to. Also, tools such as the SIMDIS mapping tool provide many new possibilities in the arena of graphical situational and data awareness.

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