# JOINT
# COMMUNICATIONS, NAVIGATION, IDENTIFICATION STIMULATORS (CNIS)

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## ABSTRACT

This paper provides a current review of a new installed system test facility (ISTF) capability for the Air Force and Navy. The requirements, design characteristics, and status of the joint-service Communications, Navigation, Identification Simulator (CNIS) developments will be covered along with their relationships with the Air Force's Avionics Test and Integration Complex (ATIC) and the Navy's Air Combat Environment Test and Evaluation Facility (ACETEF) ISTFs. These developments provide the services an interactive spatially, temporally, and tactically coherent signal environment for development and operational test and evaluation. The Joint Communications Simulator (JCS) and Joint Data Link Simulator (JDLS) capabilities, integration aspects, and development schedules (2000 IOC) will also be addressed. Finally, installed system test and evaluation concepts, both Air Force and Navy, using the simulators will be previewed to assist upcoming development programs in identifying potential applications.

## KEYWORDS

Interactive Coherent Simulation, Communications Navigation Identification Simulators (CNIS), Avionics Test & Integration Complex (ATIC), Air Combat Environment Test & Evaluation Facility (ACETEF), Installed Systems Test Facility (ISTF)

## SUMMARY

This paper provides a current review of a new installed system test facility (ISTF) capability for the Air Force's Avionics Test and Integration complex (ATIC) and the Navy's Air Combat Environment Test and Evaluation Facility (ACETEF) ISTFs. The background, requirements, and capabilities of the joint service Communications Navigation Identification Stimulator (CNIS) suite is summarized along with their relationship with the electronic combat (EC) test process. These developments provide the services an interactive, coherent signal environment for development and operational test and evaluation. Test concepts for the Joint Communications Simulator (JCS) and Joint Data Link Simulator (JDLS) are previewed to assist upcoming development programs in identifying potential applications. Installation concepts are also explained. The systems are described and development status (2000 IOC) addressed. The conclusion states that the systems can meet customer requirements, joint developments can and do work, and follow-on effort is needed to provide full completion. We wish to thank the folks at ViaSat, Raytheon Communications Systems, Mnemonics, AFFTC/EW (including TYBRIN), and Navy personnel at ACETEF (who actually have the lead on this CNIS development) for their efforts.

**BACKGROUND**
- **15 Year Old Need**
- **OSD ISTF CTEIP**
  - **CNIS**
  - **GRTG**
  - **IRSS**
- **CNIS Efforts**
  - **JCS**
  - **JDLS**
  - **Concept Val - 1994**
  - **Eng Dev - 1996**
  - **P3I Initiative**

## INTRODUCTION

The genesis of the CNIS effort began about 15 years ago with studies and prototype efforts. These activities led to several General Telephone and Electronics (GTE) simulators in the late 1980's and early 1990's. An Air Force (AF) requirements effort had been undertaken and almost completed in 1993 to consolidate AF requirements for a CNI stimulator. The driving requirements were for a coherent, closed-loop, interactive capability. (Coherency, in this case, means temporally and spatially consistent). The resulting set of requirements would serve as the focus for all subsequent AF developments and objectives. While several stimulators were developed during the early and mid 1990's and are in service today, they do not meet all the AF requirements. In parallel, the Navy (ACETEF) had initiated and was completing a Small Business Innovative Research program to develop a communications simulator.

In 1993, the Office of the Secretary of Defense (OSD) determined that the Air Force's ECIT program and the Navy's ACETEF upgrades were similar enough that efficiencies could be realized by a joint development effort in several areas. One of these areas was the CNI simulator and it, along with a Generic Radar Target Generator (GRTG) and an Infrared Sensor Stimulator (IRSS), were instituted as joint Air Force - Navy programs under OSD's Central Test and Evaluation Investment Program (CTEIP). The Joint CNI Simulator Concept Validation began in 1994, the CNI Requirements Document developed and coordinated in June 1995, updated in June 1996, and engineering development initiated in December 1996. The requirements stand today, although several could not be satisfied within the budget defined in 1993. A pre-planned product improvement effort has been proposed.

The CNIS program presently consists of two efforts: the JCS and the JDLS. A Joint Tactical Information Distribution System (JTIDS) simulator effort, originally included was dropped early for budget and priority reasons. The requirements and capabilities of the simulators are summarized below along with a short description of their role in the ISTF portion of the Electronic Combat Test Process.

**Communications, Navigation, Identification Simulator Requirements & Capabilities**

- **Communications, IFF, Navigation, Data Link Signals**
- **Coherent Signals & Simulation**
- **Signal Library**
- **Interactive Closed Loop (IFF, Nav)**
- **Free Space, Injected**
- **500 KHz - 18 GHz**
- **Phase, Amplitude AOA, 20 MHz to 2 GHz**
- **Standalone, Integrated**

- **Generate Data Links**
  - **TIBS**
  - **TRAP**
  - **TADIX**
  - **OTCIXS**
  - **LINK 4, 11**
- **Satellite Models**
- **SATCOM Receiver**
- **Standalone**
- **Integrated**

The basic requirements are described here and were derived during the early portion of concept development. A systems specification for the JCS was also developed. Although there were quite a few differences between the Air Force and Navy in both necessity and fidelity of several elements, we have grown together and the essential capabilities are in the current baseline. For those not familiar, the acronyms are defined later in the paper.

The foremost requirement is the need for coherency in the signals and simulations whether operating in a ‘standalone’ or an ‘integrated’ mode with the facility's real time executive (RTE). This requirement is being designed into the JCS, JDLS and the simulation executive associated with the ATIC's Benefield Anechoic Facility (BAF) and ACETEF infrastructures. The JCS simulator must support closed-loop interactive emissions. This has been a primary driver in the CNIS and the GRTG efforts to date, and final concepts are being definitized for the IRSS. One other major requirement for the simulators is the ability to provide the test article theater-level signal density based upon realistic scenarios. The data link requirements included specific links, scenario-based modeling, actual link reception, and standalone or integrated operations.

## Joint Communications Simulator Capabilities

The JCS provides coherent signal and simulation for multiple user-defined networks, interactive IFF and navigation in the free-space or injection modes, and phase angle of arrival capabilities. There is a 42-signal library encompassing wide band radar, navigation, and IFF signals and several narrowband data link signals. The system capacity is 2,000 emitters and 2,000 platforms, of which 400 can be mobile. Most of these have medium 4 degrees of freedom (4 DOF) kinematic fidelity and 2-dimensional antenna patterns. Within the 400 mobile platform set, 52 are supported with 6 DOF kinematics and 3-dimensional antenna patterns. The test article is also supported with 6 DOF kinematics and 3-dimensional antenna patterns.

Signal and scenario development, built-in-test (BIT), injection and free-space calibration, and data extraction capabilities are also provided. The system can operate either standalone or integrated with the ATIC or ACETEF RTE. Ownship navigation outputs are provided to facility assets for interfacing to the test article.

There are 96 digital signal generation channels, 16 in the Angle-Of-Arrival (AOA) subsystem and the remainder in the non-AOA subsystem and the Half-Height Carts (HHCs). The system covers frequency ranges from 500 KHz to 18 GHz. When delivered, it will support the full range in injection, 100 MHz – 2 GHz (extendible) in free-space and 20 MHz to 2 GHz in AOA injection over 32 ports.

We defined the following and used it as a design benchmark:

### Table 1 - JCS Signal Density

| **Primary Signal Of Interest (SOI) Type** | **Land** | **Air** | **Totals** |
|---|---|---|---|
| A-A Data Link | - | 8 | 8 (WB) |
| NAV | 18 | 150 | 168 (Pulse, WB) |
| IFF | 8 | 150 | 158 (Pulse, WB) |
| ATC | 4 | 100 | 104 (Pulse, WB) |
| Radar | 12 | (12) | 12 (Pulse, WB) |
| A-G/G-A Data Link | 2 | 2 | 4 (NB) |
| G-G | 49 | - | 49 (NB) |
| **Primary SOI Totals** | **93** | **410 (422)** | **503** |
| **Background SOI Type** | **Land** | **Air** | **Total** |
| Voice | 500 | 150 | 650 |
| Morse | 30 | - | 30 |
| TV | 5 | - | 5 |
| **Total Background SOI** | **535** | **150** | **685** |
| **Total Primary/Background** | **628** | **560 (572)** | **1188** |

## JDLS Simulator Capabilities

The data link simulator supports Tactical Receive Equipment and Related Applications (TRAP), Tactical Data Information Exchange System B (TADIXS-B), Tactical Information Broadcast Service (TIBS), Officer in Tactical Command Information Exchange System (OTCIXS), Link 4 and Link 11 blue data links. These were identified through our customer contacts. The system uses commercial off the shelf (COTS) Zebra gear that supports any of the receiver or transmitter types, permitting easy reconfiguration. Link 4 and OTCIXS are in the Navy system, Link 11 and TIBS are in the AF system. The system also has a self-contained scenario generation capability with satellite and sensor models.

## Electronic Combat Test Process

The electronic combat (EC) test process is an iterative process of prediction, test, evaluation, reporting, and updating at increasing levels of fidelity to ensure the product or system meets user needs. The CNI simulators are in development to fill the installed system test facilities void between the SIL, HITL and the OAR arenas. These systems provide an economical method to provide in depth engineering and operational evaluations of signal reception and processing, high signal densities, interference, and scenario and flight path variations. It builds upon earlier tests and infrastructures and does not supplant open-air testing. It does provide a secure, controllable, ground-based, realistic test environment for evaluating installed systems.

# TEST AND INSTALLATION CONCEPTS

## Test Concepts - Range

A multitude of testing is currently being accomplished at both the ATIC and ACETEF including antenna pattern measurements, electro-magnetic environmental effects (EEE), and electro-magnetic compatibility (EMC) on all types of equipment, even tractors. Traditional avionics and electronic warfare (EW) testing such as signal reception and processing, sensor correlation, and operator assessments are also conducted.

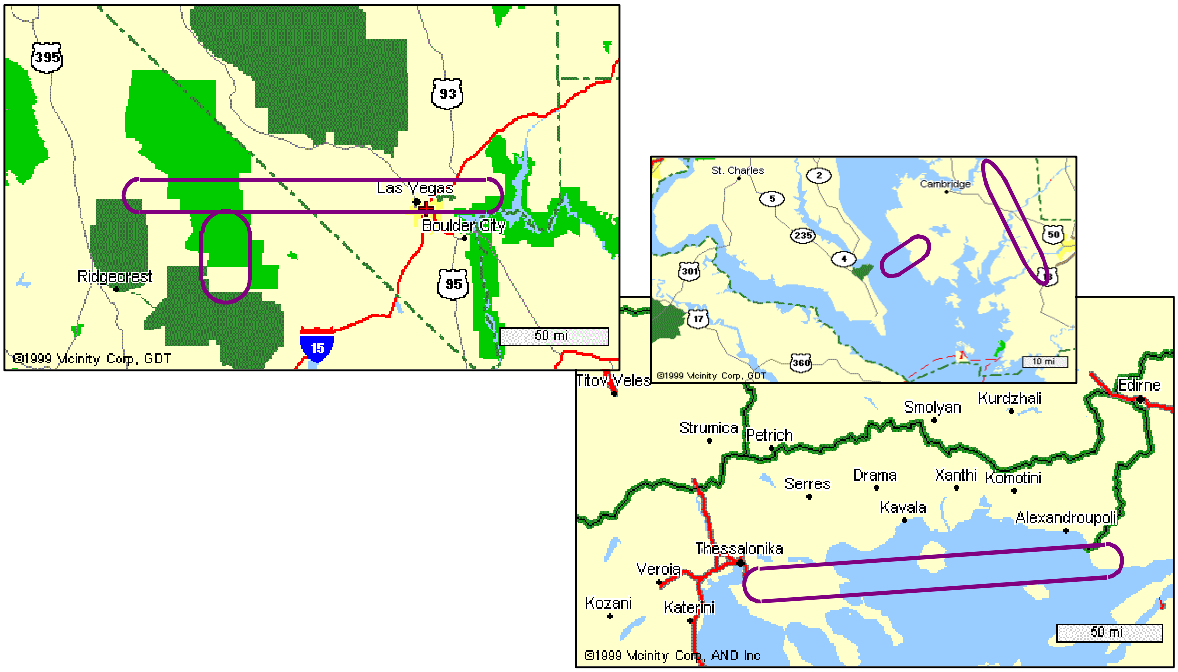


**Figure 1 - Replication/Extension Concept**

- **Range Replication**
- **Pre, Post-test**
- **Sensor System Performance**
- **Entire World**
- **Scenario, Signal, Tactics Flexibility**
- **Standard Operational Evals**
- **Multiple Avionics Configuration**

One of the primary test concepts this development addresses is the ability to replicate the environment systems ‘see’ when testing on the range.

This has been one of our priorities and, while not all signals will be available at delivery, essential signals have been identified and coordinated so effective and efficient ground tests can be performed in support of sensor and avionics system flight testing.

The JCS and JDLS simulators produce RF that is coherent in time, space, and information content. It provides a ‘real world’ RF environment to determine if a system or subsystem is operating properly and gives the tester the ability to troubleshoot installed system performance.

With the flight test data captured in a scenario, we will have the ability to conduct in depth, effective anomaly investigations, and develop a better understanding of the flight test results and their implication for the test article. Perhaps most interesting will be the opportunity to put the test article into various situations that essentially expand its avionics/electronic warfare envelope. This should especially be of interest to Operational Test & Evaluation personnel.

In addition, with the scenario-based coherent signal and simulation capability, the environment can be extended to representative situations throughout the world. Variations can be developed and the effects on the system analyzed. This gives the test customer the flexibility to easily set up situations anywhere in the world, alter the locations and characteristics of signals, and change the flight paths. These same scenarios can then be used with other test articles with different avionics configurations and the only changes required would be with the bus interface or intelligence updates.

This provides a very powerful, repeatable, and re-useable tool for the test community!

## Test Concepts – Joint Communications Simulator

- **Signal Detection, Patterns**
- **Sensor Performance**
- **Repeatable Scenario Environment**
- **Interference**
- **Anomalies**
- **Interactive Interrogations**
- **Situation Analysis**
- **Sensor Cueing & Slaving**
- **Information Fusion & Algorithms**
- **Open-air, Pre, Post-test**
- **Actual Hardware**

The current test applications are still available. Signal detection performance, antenna pattern measurements, sensor performance evaluations (with and without interference) are still available and improved from an operations standpoint. In addition, the simulators provide an important customer requirement - repeatability. Anomalous avionics sensor or system behavior can be thoroughly dissected and analyzed to determine exactly what is happening. Exact repeats, as well as small variations, are easily accomplished.

The interactive capability permits evaluation of interrogator and transponder performance, interrogator envelope, and any overload effects. The simulator can also generate a few radar signals, links between network elements, and characteristics (behaviors) of the various nodes. These can be programmed over a wide range of capabilities.

The ability to conduct high density situational awareness and fusion testing of installed integrated systems in a ground test environment offers significant leverage to the development, test, and user communities. Performance excursions may easily be constructed, conducted, and analyzed to determine and verify the performance envelope of the article from the sensor level to the system level.

## Test Concept – Joint Data Link Simulator

- **Link Reception / Patterns**
- **Repeatable Scenario Environment**
- **Interference**
- **Anomalies**
- **Interactive Interrogations**
- **Situation Awareness**
- **Sensor Cueing / Slaving**
- **Information Fusion / Fusion Algorithms**
- **Open Air Pre-, Post- Tests**
- **Actual Links**
- **Exercise Support**
- **Battle Management**
- **Secure, protected in Facility**

The data link simulator, while scenario-based and coherent for the strategic links is limited in the tactical links. It is primarily a message generator. However, it provides a link receive capability for the facilities. Such items as link reception, link margin, and antenna patterns are well within the capability of the facility and simulator. Further, it provides a scenario-based environment. It can be used to generate coherent off-board information for avionics systems evaluations of cueing, slaving, fusion or basic performance. It could also be used to assist in exercises or to bring in actual link data.

Either of the systems may operate in a standalone mode or integrated for multispectral testing. Operations can also be conducted in a free-space or injected RF environment.

The entire facility and the systems within are capable of secure and protected operations supporting collateral or higher classifications of testing.

As described later in the paper, a preplanned product improvement initiative has been proposed. A portion of the P3I effort is to expand the data link capability so tactical networks can be represented within the simulation. It would receive test article information and provide appropriate information, decisions, and timing within the simulator to permit a coherent network response to the test article's input for battle management assessments.

## Test Concept - Future

- **OSD combining DT with OT**
- **Contractor tests accepted**
- **Combined testing**
- **Simulation-based acquisition**
- **Parallel Deploy and Test**

With integrated operations, an entirely new spectrum of capabilities will be available to the evaluator. A coherent, multispectral environment with greatly increased signal density is both available and economically attractive for exploring and mapping the avionics performance envelope. There will also be increased ability to run multiple scenarios quickly and with the operator in the loop.

Programs are changing. Developmental and operational testing are combining within the DoD. Separate DT&E is no longer endorsed. Program budgets are too tight, assets too limited, and testing is moving towards simulation based acquisition (SBA) with less traditional evaluations and increased modeling and simulation throughout.

The community has to adapt; these simulators and the ISTFs offer the opportunity to use this new framework without large capital outlay by everyone. The benefits that can be derived from programs using these upgrades include reduced test costs, improved system understanding, and earlier issue resolution. In addition, efficiencies can be achieved by co-locating the entire test effort at one place. In addition to flight test capabilities, open air ranges, hardware-in-the-loop facilities, measurement facilities, and SIL capabilities, the ATIC and ACETEF will be the premier ISTFs in the world.

- **JSAF, F22, JSF, JPALS**
- **Upgrades:**
  - **F-16, F-15, F-18**
  - **C-135, EP-3, EA-6B**
- **UAVs, Ground Vehicles, Stations**

Two other uses offer significant potential. The first is for projects without dedicated SILs or HITLs that use complements of 'standard' components. Once the test cases and scenarios are defined, each configuration or 'type' can be evaluated against the same benchmark. Second, the ISTFs can provide an effective option for limited asset programs needing parallel deployment and combined testing. This provides an opportunity for simultaneous, multispectral stimulation, in a reactive mission level scenario, to thoroughly 'wring out' a system while it is being deployed 'in theater'. A breadboard, prototype, or pre-production unit could use the ISTF to evaluate the full spectrum of expected theater RF emissions.

Several programs are investigating use of these capabilities including the Joint SIGINT Architecture Family, Joint Precision Approach and Landing System, the F-22, and the Joint Strike Fighter. There is also, of course, the primary fighter and attack upgrades. Installed systems testing provides an excellent opportunity to determine the envelope of such equipment.

## Installation Concepts

There are two typical installations within the BAF for the test article: the turntable and the corner. Hoists are available at each location and the article can be hoisted or remain on the ground at either location. Test article rotation can be accomplished hoisted at both locations and on the ground at the turntable. The CNI simulators can support customer test concepts whether injected or free-space. Mixed modes, injection and free-space are planned for the JCS with the test article located typically under or on the corner hoist. Concepts are shown for the JCS; the JDLS would be similar except there is no phase AOA injection.

## Injection

Full injection operations on or above the turntable would have the JCS Control Station Subsystem (CSS) located in the CNI Lab on the west wall or out on the floor depending upon the test.

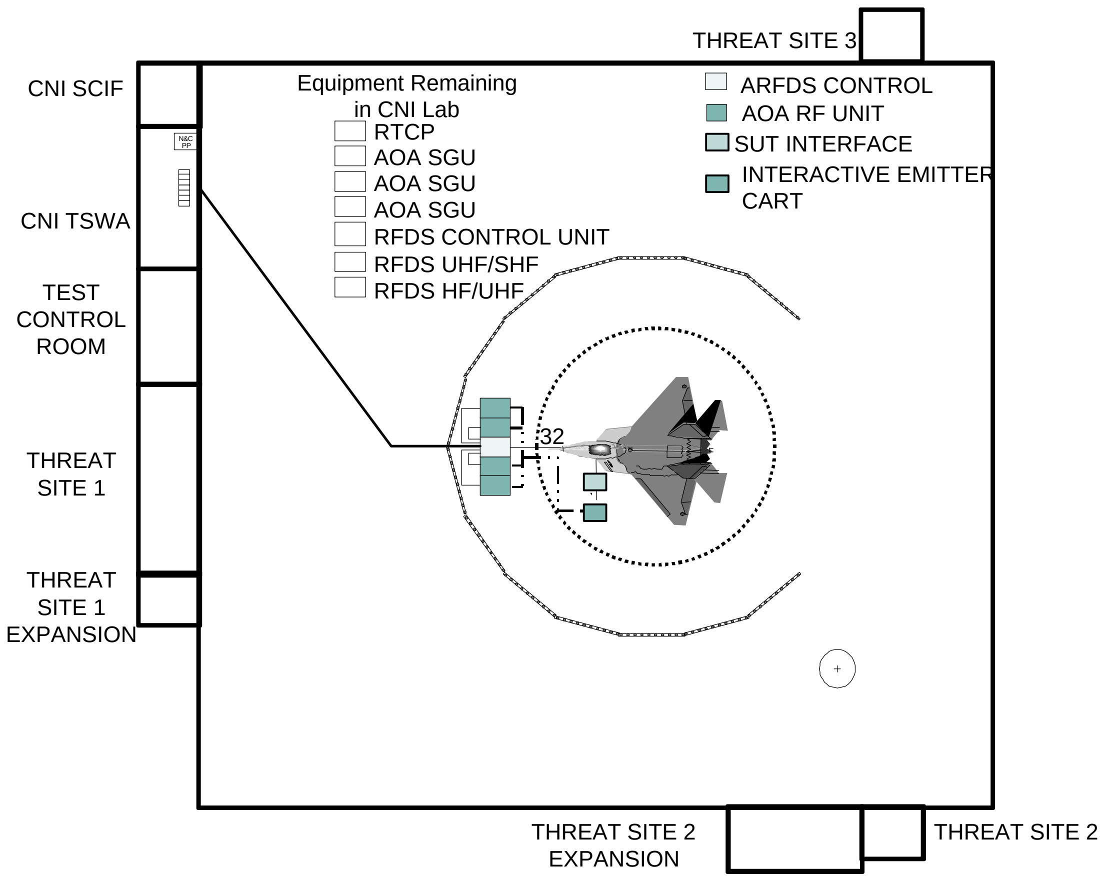


**Figure 2 – Benefield Anechoic Facility Injection Installation (Typical)**

For most injection operations, the CSS is in the lab where the infrastructure timing, control, and simulation interfaces are readily available. The AOA RF Distribution System (ARFDS) will be located on the floor because positioning under the turntable would require extensive relocation time and the line lengths would be too long. As stated earlier, a dynamic environment resulting from player actions and relations in pitch, roll, and yaw can be applied to the apertures. An alternate concept would be using the area around the corner hoist in the southeast corner of the BAF. Test articles can either be hoisted or not. Since the simulator is reasonably portable, it could be moved to Threat Site 2.

In either case, the test article would be 'tied' to the JCS for information and to provide ownship dynamics.

## Free Space

The same locations would be used for free-space applications. In most situations (except for very large aircraft), the test article would be hoisted. The CNIS would be located in the CNI Lab and the test unit would receive RF radiation from the CNIS through the I&GTC RF Free Space (RFFS) distribution system and low band antenna carts. Again, the test article is expected to provide information to, and receive ownship dynamics from, the JCS.

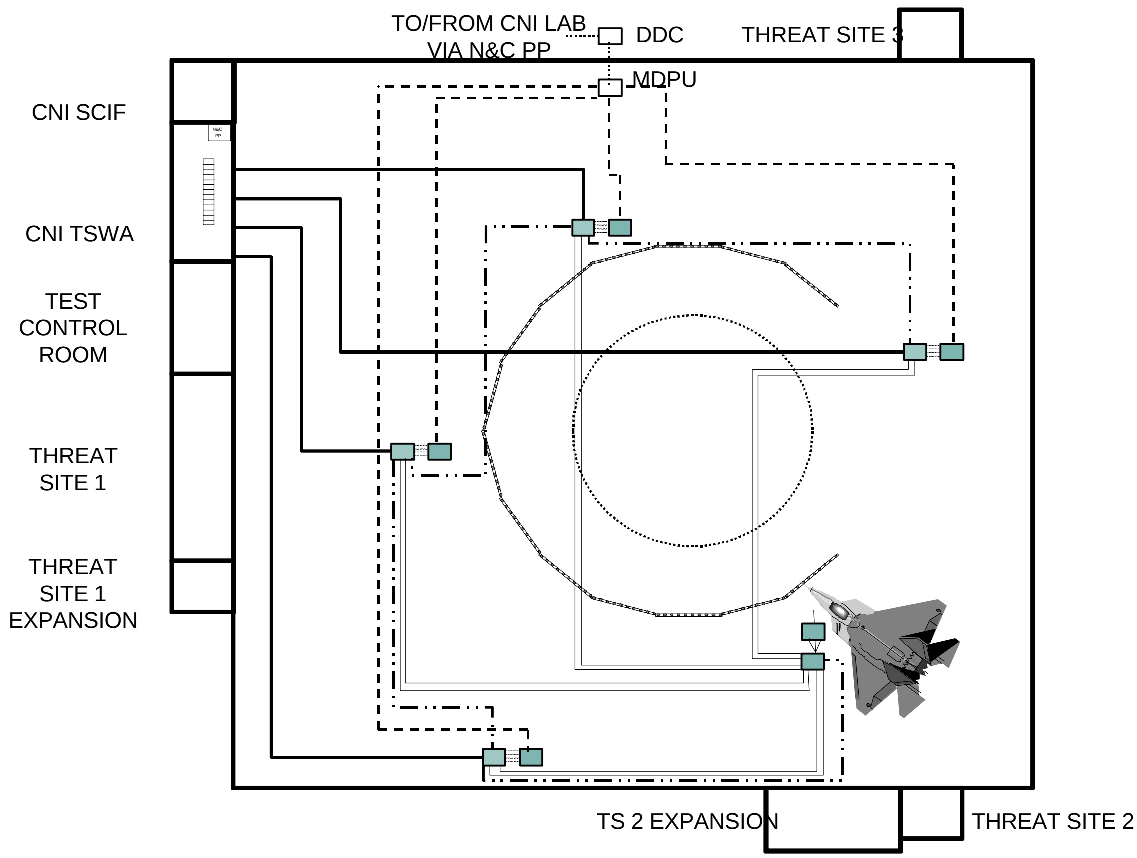


**Figure 3 - Benefield Anechoic Facility Free-Space Installation**

## SIMULATOR DESCRIPTIONS

### Joint Communications Simulator

The JCS provides all of the communications, navigation, and identification signals for the ATIC and ACETEF (with the exception of the GPS and blue data link signals). It is a coherent, closed-loop, interactive, rule-based simulator capable of providing mission to theater-level densities in the CNI domain. Its design supports 2,000 assignable emitters (100 interactive closed-loop), on up to 2,000 platforms (400 of which can be mobile). It provides a full development environment, from building the signals to defining the emitters to populating the platforms to defining the network structures, rules, and flight paths.

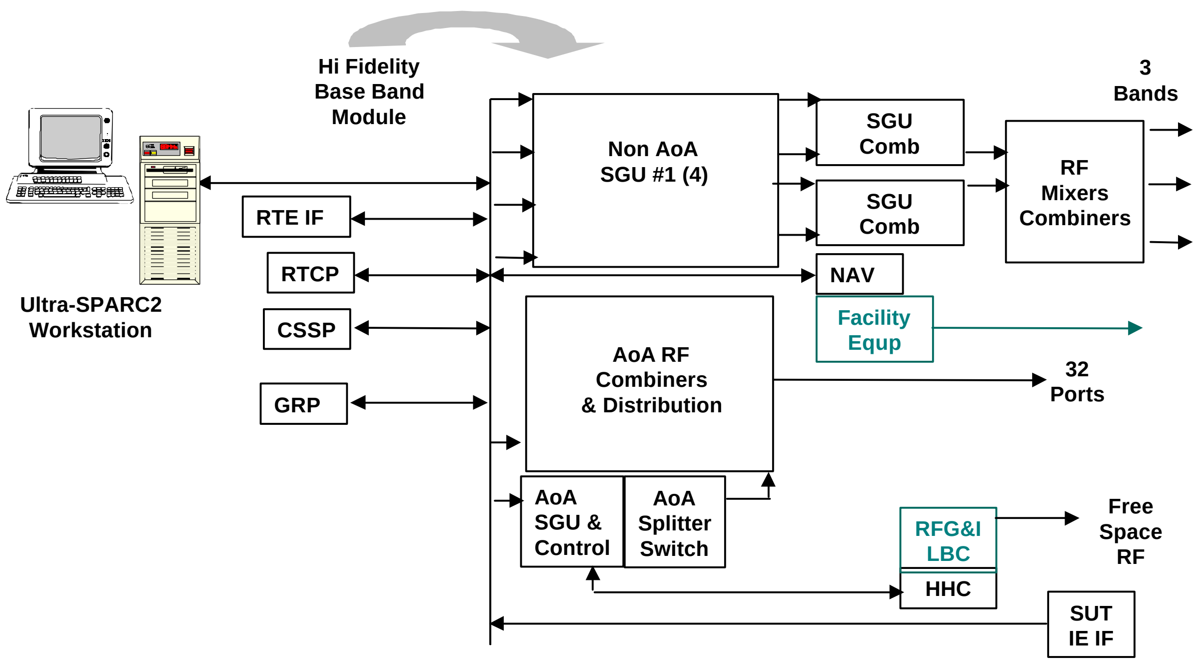


**Figure 4 - Joint Communications Simulator**

The JCS, in its standalone configuration, provides all of the elements necessary to accomplish an interactive, closed-loop test. The workstation provides the man machine interface (MMI) to develop the signals and antenna patterns, allocate them to emitters, assign emitters to platforms, laydown the platforms to initial geographic reference points, and generate the rules for the players, simulated organizations, delays, and scenario. The Real Time Control Processor (RTCP) will include two primary items, the Geometry Relation Processor (GRP) and the Coherent Signal Simulation Processor (CSSP). These form the heart of the simulation and control aspects and provide the foundation on which the rule-based simulation proceeds.

The simulation will be able to support both the test article and at least 50 virtual platforms with 6 DOF kinematics. Any remaining virtual platforms will be supported with 4 DOF kinematics. In addition, the system will be able to provide multiple 3-dimensional receive and transmit antenna patterns for both the test article and high fidelity virtual players. Two-dimensional antenna patterns are provided for any remaining platforms.

The JCS has an update rate of 100 Hz that it achieves through a 20 Hz frame rate and extrapolations for motion, attitudes, signal propagation and AOA effects up to 100 Hz.

The system will provide non-AOA RF emitters from 500 KHz to 18 GHz with 1 Hz resolution through multiple mixers and combiners in three or four bands. The lowest band runs from 500 KHz to 400 MHz, the second from 400 MHz to 2 GHz, and the third from 2 GHz to 18 GHz. A fourth 'mid-band' range, from 2 GHz to 6 GHz, can be provided as an option. Maximum output will be -20 dBm for connection to the I&GTC's RF distribution and free-space system or combined with the AOA output as background signals. The dynamic range will be 100 dB; outputs will be coherent in time and provided at the proper amplitude (considering range and propagation losses) up to the maximum output power.

- **JCS Waveforms, RF**
  - **User Definable**
  - **AM,SSB, FM**
  - **PSK, FSK, Pulse**
  - **Frequency Hopping**
  - **500 KHz - 18 GHz (1 Hz)**
- **Non AOA**
  - **3 Bands**
  - **< 1 dBm Amplitude**
- **AOA Phase / Amplitude**
  - **20 MHz - 2 GHz**
  - **32 Output Ports**
  - **< 6° RMS Electrical**
  - **< 1 dBm Amplitude**
  - **<0.25° AOA**

Waveforms will be user definable and will simulate both analog and digital CNI and some electronic warfare (EW) waveforms. These include amplitude modulation (AM), quadrature amplitude modulation (QAM), double sideband (DSB), quadrature double sideband (QDSB), Single sideband (SSB), independent sideband (ISB), and frequency modulation (FM) analog signals with double modulation (external audio or digital information) for the AM, DSB, and FM signals. The digital signals include phase shift keying (PSK), frequency shift keying (FSK), amplitude shift keying (ASK), QAM, pulse position modulation (PPM), and pulse. The JCS will also be able to support spread spectrum emissions with frequency hopping. The simulator is being designed to produce any signal within a comprehensive signal list. About 40 signals are to be included in an emitter library at the time of system delivery, based upon the needs of the customers anticipated at IOC. The support necessary to expand this list (within the basic characteristics of the stimulator) will be available for our customers as their needs change.

The Signal Generation Units (SGUs) generate waveforms digitally within the High Fidelity Base Band Module (HFBBM). Each HFBBM has four parallel programmable modulators (PPMs) or channels. The AOA SGU has 4 HFBBMs and the non-AOA SGU has 20. The units convert from digital to IF for upconversion. The SGU processors calculate antenna gains and atmospheric loss between emitters and apply this information to the signal. They will also provide time sharing for the signal sources, timing information as seen by the test article, doppler, and power level and record any pulse group dropouts. The signal is then upconverted, amplified, combined and distributed in the RF Distribution System (RFDS) for RF injection.

In addition, should a customer desire to have another system provide a signal or waveform, the AOA SGU will be able to switch signal input from the JCS internal source to the external source for splitting, upconverting, amplifying, and combining. The AOA control processor calculates and applies the appropriate phase and amplitude to the 16 signals for distribution to the 32 port combiners. The output may be used to drive one or a set of apertures.

The AOA signal generation and RF distribution subsystem provides full phase and amplitude control over 32 output ports to provide time, spatial, and phase coherency. The AOA capability will cover frequencies from 20 MHz to 2.0 GHz, with a dynamic range of 80 dB and a relative (port-to-port) attenuation of up to 40 dB. The design provides independently selectable and programmable phase control of Ports 2 to 32 (relative to Port 1) from -180 to 179 degrees in 1 degree steps based upon a real-time AOA calculation with antenna pattern data. The electrical phase error between Port 1 and Ports 2 to 32 is specified at <4° RMS over the full range of input frequencies and programmable offsets with no attenuation and < 6° between Port 1 unattenuated and Ports 2 to 32 at maximum attenuation. The output power range will be -40 dBm to -120 dBm. The RF distribution for injection into the test article will be provided with phase matched cables.

The JCS will interface with the test article for information exchange to obtain event sequencing and modes and to provide ownship dynamics. The interface to obtain test article information is through the Interactive Emitter Chassis (IEC) VME backplane and a customer-provided bus interface card. With this interface, the JCS can accommodate those systems that have autonomous capabilities. Ownship navigation information is provided by the JCS navigation processor to shared memory, then through an organic facility interface such as MIL-STD 1553 to the test article.

For free-space emanations, the signal is provided to the I&GTC RF Free Space Low Band Cart (LBC) system for free-space radiation. Each JCS HHC uses a processor, HFBBM, mixer, and combiner from the non-AOA SGU complement restricting the test operations that can be conducted simultaneously.

## Joint Data Link Simulator

The JDLS is a result of coalescing requirements, test utility, and COTS performance capabilities. The JDLS will be based on a Mnemonics ZEBRA system that has been modified to run with external scenario control. The Zebra system provides a fully compliant VME transmitter/receiver, message processors, and embedded crypto for a number of strategic and tactical data links. It will form the modular building blocks for the simulator, providing the capability to transmit and receive TRAP, TADIXS-B, TIBS, OTCIXS, Link 4 and Link 11 data links. The Navy populated their ZEBRA with TRAP, TADIXS, OTCIXS, and Link 4. The AF selected TRAP, TADIXS, TIBS, and Link 11. The JDLS scenario generation capability provides satellite and sensor models to simulate observing the same environment that are being used to simulate the test article. A programmable time interval will be used to delay transmission of observed events reported over the data links to simulate how they would be reported by real world systems. In an integrated test, the JDLS and other stimulators can be used to evaluate the test article's capability to use off-board information with information obtained through its own organic sensors. Off-board information may be used to cue sensors or provide identification information for a track developed with organic sensors.

Simulation for Link 4 and 11 is limited to message handling and actual link transmissions.

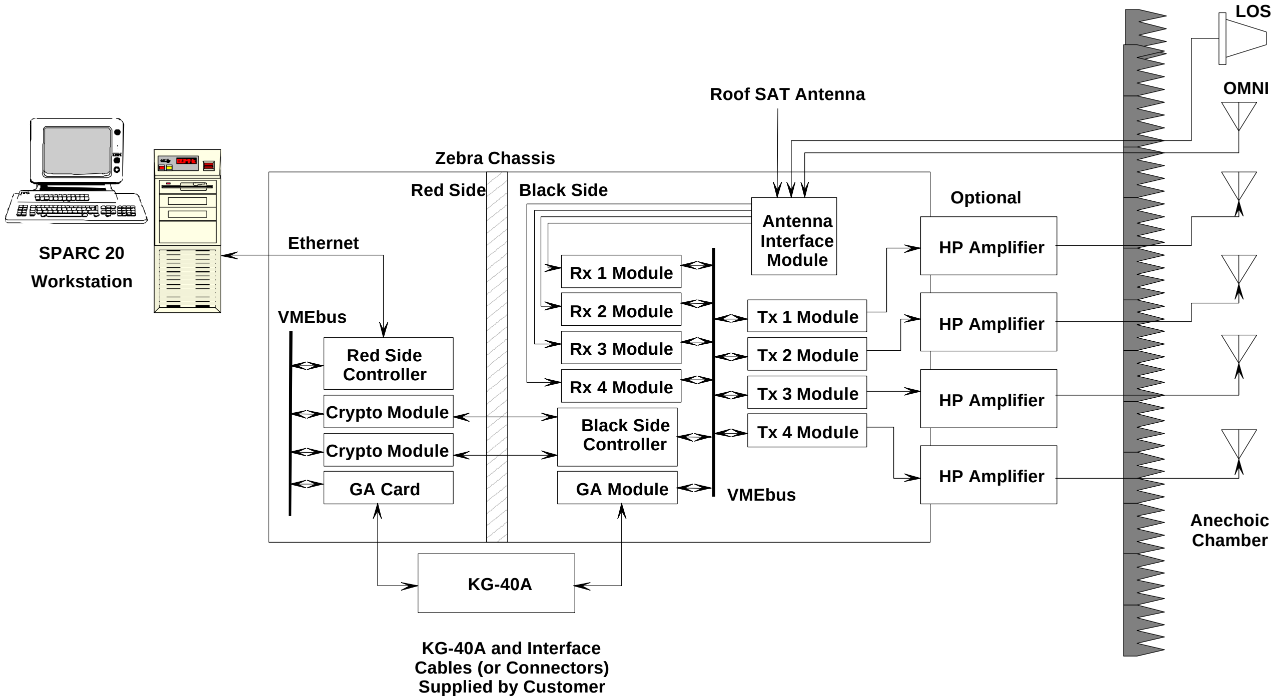


**Figure 4 - Joint Data Link Simulator**

The system will have all the elements necessary to operate in a standalone configuration, including workstation, stimulator, outside antennae, and the cabling to connect the antennae to the stimulator and from the stimulator to the test article's antenna port. Phase angle of arrival is not required for the JDLS.

Originally, the CNIS program contained two data link stimulators, one for strategic links and one for tactical links. However, JCS requirements were deemed more important by AF customers, and the desire, at the time, for the tactical links was low. Thus, action was taken in 1995 to eliminate the JTIDS capability from the suite. Since that time, the JTIDS need has resurfaced as new requirements were identified; unfortunately, the budget was insufficient. The JTIDS capability is a key part of the P3I initiative.

The primary requirement is a coherent free-space RF capability. The first step will be to define architecture options, interfaces and integration effort necessary to provide a JTIDS capability. Initially, a set of JTIDS terminal equipment, JTIDS Test Device (JTD), and a workstation with government furnished software were envisioned. However, this will not provide effective scenario-based coherency, but is a near term option to accomplish compatibility tests and possibly aid with integrated avionics tests.

## STATUS REPORT

All CNIS efforts are on contract including recent additions to the JCS for a collateral security capability and the integration with the facility RTEs. The PDRs and CDRs have been completed and factory integration and test are underway. The JDLS has been completed and delivered to the ACETEF for final acceptance.

### Joint Communications Simulator

| | |
|---|---|
| • **JCS** | |
| • **Start** | **Jul 95** |
| • **PDR** | **Aug 97** |
| • **CDR** | **Feb 98** |
| • **Delivery** | **Feb 01** |
| • **IOC** | **May 01** |

The initial JCS contract was awarded in July 1995, and the final contract was awarded 10 December 1996. The Preliminary Design Review was completed in August 1997 and the Critical Design Review in February 1998.

The JCS effort has completed the hardware fabrication for everything in the baseline program. The only remaining items are the interactive emitter, the HHCs for the free-space capability, and the additional processors for the RTE and navigation interfaces. The later tasks have just begun and the software builds reflect the recent schedule additions of these tasks. Basic scenario initialization software has been completed; the GRP and offline built-in-test Computer Software Configuration Items (CSCIs) will complete in May 1999. The AOA RFDS and the wide-band signals should complete in November 1999, the Coherent Signal and Simulation Processor (CSSP) should complete in January 2000 and final integration will begin. The last software build, with the full scenario, signal library, and remote terminal operations is scheduled for May, 2000.

Factory system integration will begin next spring and complete with acceptance and delivery scheduled for February 2001. The RTE addition was delayed for top-level definitions and several extra iterations with the dual AF/Navy interface definitions. Verification and validation (V&V) will be accomplished in parallel with the factory integration using special test equipment, organic test personnel for evaluation, and oversight by the V&V team.

- **JDLS**
  - **Start** **Jul 95**
  - **DR** **Jun 97**
  - **Delivery** **Aug 99**
  - **IOC** **Oct 99**

As some customers have expressed a desire to use the system in the summer or fall of 2000, accelerated delivery of the free-space portion with the collateral signal set is being investigated and appears feasible.
We anticipate no further additions at this point that would affect delivery.

The JDLS contract began in July 1995. All hardware and preliminary acceptance have been completed. The equipment is transferring from the contractor's facility to ACETEF for final acceptance and training. Upon completion, one set will be shipped from ACETEF to the ATIC for installation and checkout. Integration discussions were conducted between Mnemonics and both facilities to define the interfaces necessary for the JDLS to operate in an integrated mode. An interface control document has been developed, but further efforts will be necessary.

## Preplanned Product Improvement

- **JCS**
  - **Jamming & Phenomenology**
  - **Signals, Channels, Processing**
- **Advanced Data Link Simulator**
  - **Scenario-based, coherent**
  - **Multiple networks, participation**

As the program progressed through the hardware and software development, the team acquired a much deeper understanding of the signals, their roles, and evaluation options offered by scenario-based simulation. There is a definite need for higher performance, greater functionality, better fidelity and increased density.

More important, there are still shortfalls meeting the original needs for jamming and scenario-based blue data links. These capabilities are necessary to satisfactorily evaluate advanced fusion systems or those using state-of-the-art off-board links.

A joint effort has been proposed to continue with a preplanned product improvement effort to close the holes and provide the performance necessary for the T&E infrastructure to be ready for the evaluations in 2002-2007. The mid-year review is next week.

# CONCLUSION

- **CNIS**
  - **Provides powerful, flexible, economic T&E**
  - **Online in 2001**
  - **Supports test customer dates**
  - **Infrastructure Interfaces defined**
- **Joint Program is working**
- **CNIS P3I Program**
  - **Complete 1993 Requirements**
  - **Taking new additions**
- **john.hull@edwards.af.mil**
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We believe we are ideally postured to complete the effort and provide system developers and modifiers a powerful, flexible, and economic tool to improve their test and evaluation programs. The schedule supports our test customers and we expect to be on line and supporting tests in the first quarter of 2001. We are also, as stated previously, investigating an early delivery of the JCS free-space capability with the collateral signal set. We have defined and initiated design and development toward a RTE interface point that is extremely similar between the AF and Navy and the facilities are developing toward that same interface point.

We just want you to know that we believe the joint programs can and do work. We have weathered quite a few discussions and issues and have established a process and team that is responsive to technical requirements, schedules, and customers.

Our P3I effort is going forward and we are taking requirements for this effort. Please contact either John Kriz or myself and we will get them included.

We hope to see you in the future. Please give us a call at 661-277-1551 (John Hull) or 301-342-6117 (John Kriz.