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Tactical Digital Information Link-Test Report and Analysis on the Integration and Lexicon of Simulators (TADIL-TRAILS)

Paper 42
Experimentation

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ABSTRACT: Link 16 is a Communications, Navigation and Identification (CNI) system, intended to exchange surveillance and Command and Control (C2) information among various C2 and weapons platforms, which enhance the missions of each service. Link 16 is the primary NATO standard for the tactical datalink. NATO STANAG 5516/MIL-STD-6016C describes the TADIL J message formats and Link 16 network instructions. A protocol for simulating Link 16 in Distributive Interactive Simulation (DIS) and High Level Architecture (HLA) is in process of becoming a Simulation Interoperability Standards Organization (SISO) standard: SISO-STD-002-V2.9.6. The standard is scheduled to begin formal balloting in April 2005.

The Air Force Distributed Mission Operations Center of Excellence (DMOC) located at Kirtland AFB, New Mexico, has implemented the Distributed Interactive Simulation (DIS) portion of SISO-STD-002-V2.8. In addition, Northrop Grumman has implemented the Draft Link 16 Simulation Standard protocol on its Common Connection Device (CCD), and one such device is at the DMOC. The software followed the draft standard and modified the DIS Transmitter and Signal Protocol Data Units (PDUs) for Fidelity Levels 0 - 3. During the DIS standard implementation, valuable lessons on the design were provided to the SISO Standards Group, as well as recommended changes to the standard.

Two tests and one experiment, which incorporated the changes to the Link 16 standard, were conducted at the DMOC. The tests and experiment objectives were to verify and validate the DIS portion of the standard. The first test was conducted the week of 9 Dec 2002, the second the week of 24 Feb 2003. The experiment was conducted during the JEFX 04 SPIRAL 3 Test, 17 – 26 May 2004.

This paper presents the test results, experiment results, and lexicon of the Link 16 standard, in an effort to increase interoperability among C2 systems.

1. Introduction

At the Fall SISO 2002 SIW, 15 – 19 September 2002, Paper 02F-SIW-119, titled "TADIL TALES" described how Tactical Digital Information Link (TADIL) J could be modeled using the Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) protocols. Since then, the Link 16 Study Group was formed to study the possibility of creating a standard that would incorporate the existing DIS Signal Protocol Data Units (PDUs) into a standard that not only exchanges TADIL J data, but simulates the TADIL J network as well. The Study Group concluded that a standard was the best way to incorporate existing implementations, and also include an HLA solution. The Link 16 Product Development Group (PDG) was formed, and a draft standard has been produced. Meanwhile, the Air Force Distributed Mission Operations Center of Excellence (DMOC) located at Kirtland AFB, NM, was awarded Joint Synthetic Battlespace (JSB) Infrastructure Upgrade funding to develop and test the draft standard in March 2002. The Northrop/Grumman (NG) Common Connectivity Device (CCD) was modified to generate the DIS portion of the Link 16 Draft Standard Signal and Transmitter PDUs, referred to as DIS J. Tests have been conducted at the DMOC in September 2002, February 2003, and during the Joint Expeditionary Force Experiment (JEFX) 04 Modeling and Simulation (M&S) Operational Tests. The test results have provided valuable feedback on improvements to the DIS portion of the draft standard. The test plans, equipment used, and test results are described in detail in the following sections.

2. DIS J Test Plan

This section describes in detail the DIS J Test Plan. The test plan includes tests that verify basic DIS J protocol functionality, and also fidelity interoperability tests. The test plan is described in the following sections.

2.1 Basic Fidelity Level Operation Tests

In each of the DIS J tests described in this section, basic protocol functionality was verified. TADIL J messages were transmitted from each of the host systems and reception was verified on the opposite CCD. The ability of one system to act as Network Time Reference (NTR) and one system to act as a JTIDS Unit (JU) was also verified in Level 1 testing. Level 2 testing included verification of data transmitted in the appropriate timeslot, and Level 3 testing verified multi/crypto-netting.

2.2 Fidelity Interoperability Tests

Fidelity Interoperability Tests tested interoperability between each level. These tests included:

a. Level 0 and Level 1
b. Level 0 and Level 2
c. Level 0 and Level 3
d. Level 1 and Level 2
e. Level 1 and Level 3
f. Level 2 and Level 3

2.3 Multiple JU/NTR Test

Multiple JU/NTR Tests were conducted to verify the ability to locally simulate required JTIDS NTR information while continuing to exchange messages with participants at higher or lower levels of fidelity. Message passing was verified, as well local simulation of JTIDS data. The NTR interoperability tests that were conducted are:

- Two simultaneous NTRs, one JU (Fidelity Level 1)
- Two NTRs (passing over NTR), one JU (Fidelity Level 1)
- One JU (Fidelity Level 1), one JU (Fidelity Level 2), one NTR (Fidelity Level 2)
- Greater than Three JUs (mixed fidelity levels), one NTR (Level 1)

The test equipment used:

1. SLM – 16, Software Version 03.08.02.
2. CCD Version 02.02.08 Build 90
3. DS3, Version 01.10.01.
4. Simulyzer, Version 1.5. (Data Recorder)
5. MCE OM, Version 110.5
6. AOMI, Version 5
7. DISNAT, Version 1.2. (Data Recorder)
8. ADSI, Version 11.103.4

The network diagram is shown in Figure 1.

Other test attributes:

Virtual Test Location:	Southwest US
Exercise ID:	26
Air LAN Data Entity Port:	7000
EMT LAN Datalink Port:	4000

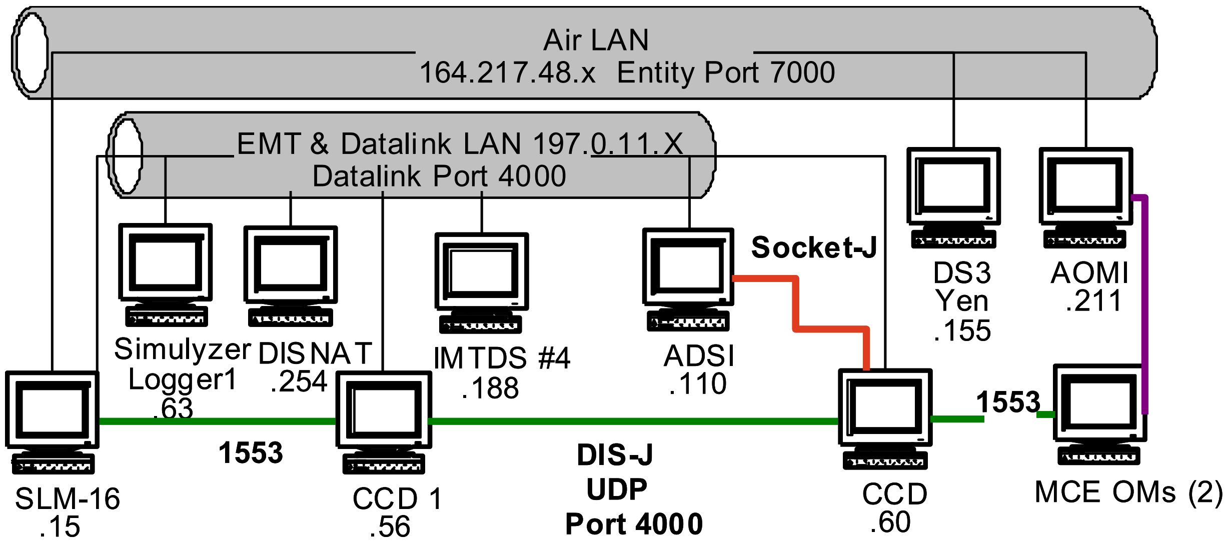

Figure 1. DIS J Network Diagram

MCE System Position: 39/28N 112/39/30W
MCE Radar (1) Position: 38/22N 114/33/30W
MCE JU/Track Block: 14/3200-3577
SLM-16 Position: 38/22N 114/33/30W
SLM-16 Sensor Range: 240NM
SLM-16 JU/Track Block: 42/4200-4377

3. September 2002 Test Results

The CCD implementation of the draft DIS-J protocol performed well throughout testing and met all required objectives for the Air Force Agency for Modeling and Simulation (AFAMS) JSB implementation project, though discrepancies at varying levels of fidelity were found. Most of the JTIDS effects specified in the DIS-J draft standard were demonstrated, and effects that were not fully implemented are planned for follow-on acceptance testing. Some scheduled tests were unable to be performed because development efforts in those areas were not complete. The test results completed are described in the following sections.

3.1 Fidelity Level 0 Test Results

The CCDs exchanged data correctly. The ability to simulate an NTR was demonstrated. Simulyzer verified that multiple JTIDS messages were contained within a single Signal PDU. DIS Signal PDU and Transmitter PDUs from the CCDs were verified to have correct DIS Exercise ID, Site, and Application ID on the DISNAT logger. A discrepancy with the CCD's 1553 interface to the MCE OMs kept all tracks from the SLM-16 from being seen inside the MCE OMs. It was verified that all messages were received on the MCE's CCD, though not all tracks were displayed (or were displayed in incorrect positions). Three tracks out of every ten were either not displayed or were displayed with incorrect positions. This error was reproduced in testing in other fidelity levels and was diagnosed using CCD1 playing back a SLM-16 recording to CCD and the CCD1 monitoring the MCE 1553 databus.

3.2 Fidelity Level 1 Test Results

All test steps were successful. Both systems worked as NTR and the JTIDS header information in the Signal PDU and the modulation parameters in the Transmitter PDU were verified to be correct. Operation with a third JU (ADSI) was verified. The SLM-16 generated some additional Non-C2 JUs and the MCE demonstrated the ability to take control of the fighter aircraft and send them datalink control orders. This demonstration occurred when 5 units were in the simulated JTIDS network.

3.3 Fidelity Level 2 Test Results

Most test steps were successful, though the option to change the wait time for each timeslot was not observed. This feature was not planned for testing, though it is planned to be a part of the full DIS-J implementation. Observed data rates were in accordance with the loaded NDL. Further detailed testing will be required when development is complete. The ADSI was unable to participate and receive data; because the CCD has not yet implemented the ability for Level 1 (the current fidelity level for "dumb" hosts) to interoperate with Level 2 or greater participants. At one point during the testing, the MCE did not display data generated from the SLM-16, though it was verified that the CCD was receiving all messages. A reset of the MCE system corrected this problem, which was not duplicated during testing.

3.4 Fidelity Level 3 Test Results

Most test steps were successful, including basic testing of the Message Security Encryption Code (MSEC) and Transmission Security Encryption Code (TSEC). Since only the "default" TSEC for a net was supported during testing, Northrop Grumman will need to complete support for inspecting the TSEC for each NPG. One discrepancy was noted with the CCD's use of the TSEC variable. The MCE was able to enter the net even when the default TSEC was changed on the SLM-16 which was acting as NTR. This discrepancy will be resolved before the final delivery of the DIS-J implementation.

3.5 Fidelity Interoperability Test Results

Level 0 and Level 1 Interoperability Testing: All test steps were successful. Level 0 and Level 1 participants were able to fully exchange messages.

Level 0 and Level 2 Interoperability Testing: This test was unable to be run due to incomplete development. The ability for Level 2 or greater participants to accept wildcard timeslot information had not been implemented. Features specific to the CCD implementation of the draft DIS-J standard were discussed. It was decided that users shall have the option of whether Level 2 or greater participants shall use a receive timeslot when receiving data from Level 0 or 1 participants.

Level 0 and Level 3 Interoperability Testing: This test was unable to be run for the same reasons as Level 0 and Level 2 test.

Level 1 and Level 3 Interoperability Testing: This test was unable to be run for the same reasons as Level 0 and Level 2 test.

Level 2 and Level 3 Interoperability Testing: Most test steps were successful. Both participants were able to be NTR (at different times) and both the SLM-16 and the MCE were able to exchange data. It was discovered that systems that send data to the CCD via serial or non-DIS socket interfaces are unable to act as NTR, and currently send/receive data at fidelity Level 1. In the current version of the CCD, this is unable to be changed, though this will change when the CCD adds the capability to load an NDL locally for "dumb" hosts that are unable to send the NDL to the terminal simulator. This is not a problem with the draft standard, but a challenge with the nature of the CCD being able to act as a terminal simulator for multiple systems with multiple input protocols.

3.6 Multiple JU/NTR Test Results

Two Simultaneous NTRs, one JU (Fidelity Level 1): All but one step was successful: The Multiple NTR Step. Normal operation would show the ADSI jump from network to network, due to two NTRs. The ADSI did not jump from network to network for two reasons. First, the CCD does not currently implement NTR functionality for serial and non-DIS socket interfaces. This shall be implemented before development is complete. Second, NTR functionality (Network synchronization ID) is not currently fully implemented. This will be corrected for the final delivery of the DIS-J implementation.

Two NTRs (passing over NTR), one JU (Fidelity Level 1): All test steps were successful. The two NTRs were able to pass NTR between the units and were able to display each unit's data. This will need to be re-tested after the discrepancy in the previous test is corrected.

One JU (Fidelity Level 1), one JU (Fidelity Level 2), one NTR (Fidelity Level 2): This test was unable to be accomplished due to the CCD being unable to accept data at fidelity Level 2 participants from fidelity Level 1 participants. This test will be accomplished when development is complete.

Greater than three JUs (mixed fidelity levels), one NTR (Fidelity Level 1): This test was unable to be accomplished since all participants generated by the SLM-16 would be at the same fidelity level as well as the CCD's previously noted challenges with fidelity interoperability.

3.7 Analysis of Test Results

Fidelity Levels 0-1 are ready for general community use. The data collected on each CCD confirmed proper message exchange at Levels 0 and 1. Each TADIL J message sent by CCD using Signal and Transmitter PDUs was displayed correctly on CCD1 for both levels of fidelity.

Levels 2 and 3 are still in software development and were unable to complete testing. It is expected that by November 2002 Fidelity Levels 0-2 will also be ready for general community use. There are several areas that will need to be completed for this implementation to be considered a "reference" implementation:

- Fidelity Level 3 and associated effects will need to be completed.
- Fidelity Level 4 will need to be implemented, once the Link-16 PDG completes specifying the Fidelity Level.
- HLA implementation of the standard, once the Link-16 PDG completes work specifying "HLA-J".
- Local NDL capability for hosts/interfaces with no capability to send the NDL to the CCD will need to be added to the CCD. This will allow low fidelity hosts to participate in simulated JTIDS networks.

Additional analysis of each DIS Signal and Transmitter PDU was not possible at this time because software development for the DISNAT Logger Signal and Transmitter PDU DIS J templates was not completed. DMOC currently has tools that log PDUs and can decode the raw binary message, but this test showed the need to validate and diagnose compliance with the protocol. Also, since the CCD was the only machine capable of transmitting and receiving DIS J, and there was no capability to decode these messages, improper implementation could go undetected. However, the DISNAT Logger software development will be completed in time for the JEFX 04 test.

4. February 2003 DIS J Test Results

In February 2003, another DIS J test was conducted at the DMOC. The test plan used was the same as the September 2002 test. Each test that was conducted in September 2002 was conducted again in the February 2003 test. The Test equipment and software versions were also the same. The CCD software version was also the same, however, additional capability was completed, and errors from the previous test were corrected. The recorded results are described in detail in the following sections.

4.1 Fidelity Level 0

All test steps were successful. The CCDs exchanged data correctly. The ability to simulate an NTR was successfully demonstrated. Verification of multiple JTIDS messages contained within a single Signal PDU was also recorded and verified on Simulyzer. DIS Signal PDU and Transmitter PDUs from the CCDs contained the correct DIS header information, which was verified on the DISNAT logger. All messages were received on the MCE's CCD, and all tracks were displayed in their expected position. The errors seen in the September 2002 test were not seen in this test. All fixes were verified.

4.2 Fidelity Level 1 Test Results

Again, all test steps were successful. Both systems worked as NTR and the JTIDS header information in the Signal PDU and the modulation parameters in the Transmitter PDU were verified. The SLM-16 generated some additional F-14s as non-C2 JUs. The MCE took control of the fighter aircraft and send them datalink control orders, specifically J10.5 and J10.6 messages. All JTIDS messages were recorded and verified on CCD and CCD1.

4.3 Fidelity Level 2

All test steps were successful, and the option to change the wait time for each timeslot was tested. When the wait time was changed to 0 milliseconds (ms), the MCE lost all tracks, but the SLM-16 did not. The wait time was adjusted back to the original value, and all tracks were seen in the MCE and SLM-16. Observed data rates were in accordance with the loaded NDL.

4.4 Fidelity Level 3

All test steps were successful, including basic testing of the MSEC and TSEC. Again, only the default TSEC for a net was supported during testing. Northrop Grumman had not completed the development to support inspecting the TSEC for each NPG. When the SLM-16 MSEC default value in its NDL was changed, the MCE was able to enter the network, but not receive any track data. When the value was changed back, the MCE entered the network and received track data. When the SLM-16 TSEC value was changed in its NDL, the MCE was not able to enter the network.

4.5 Fidelity Interoperability

Level 0 and Level 1 Interoperability Testing: These tests were repeated and again, all test steps were successful. Level 0 and Level 1 participants were able to exchange messages successfully.

Level 0 and Level 2 Interoperability Testing: This was the first time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 2 and NTR, and the MCE was sent to Level 0. Messages were exchanged bi-directionally and verified. Then, the SLM-16 was set to Level 0, and the MCE was set to Level 2 and NTR. Again, both units exchanged TADIL J messages successfully.

Level 0 and Level 3 Interoperability Testing: This was the first time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 0. Both units entered fine synchronization, and both units exchanged TADIL J messages successfully. Then, the SLM-16 was set to Level 0, and the MCE was set to Level 3 and NTR. Again, both units exchanged messages successfully.

Level 1 and Level 2 Interoperability Testing. This was the first time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 2 and NTR, and the MCE was set to Level 1. The SLM-16 entered the network as the NTR. Both units entered fine synchronization, and both units exchanged TADIL J messages successfully. Then, the SLM-16 was set to Level 1 and the MCE was set to Level 2 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully.

Level 1 and Level 3 Interoperability Testing. This was the first time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 1. Both units entered fine synchronization, and both units exchanged TADIL J messages. Then, the SLM-16 was set to Level 1 and the MCE was set to Level 3 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully.

Level 2 and Level 3 Interoperability Testing: All test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 2. Both units entered fine synchronization, and both units exchanged TADIL J messages successfully. Then, the SLM-16 was set to Level 2 and the MCE was set to Level 3 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully. In addition, both participants were able to be NTR (at different times) and both the SLM-16 and the MCE were able to exchange data successfully.

4.6 Multiple JU/NTR Test Results

Multiple JU/NTR Tests were not conducted during the February 2003 test, due to time and resource limits.

4.7 Analysis of Test Results

Fidelity Levels 0-3 are ready for general community use. The data collected on each CCD confirmed proper message exchange at Levels 0 through 3. Each TADIL J message sent by CCD using Signal and Transmitter PDUs was displayed correctly on CCD1 for both levels of fidelity. For fidelity Level 0 and Level 3 interoperability test, both CCDs were able to exchange messages successfully. Analysis showed that the CCD set to Level 3 was able to compensate the lower fidelity CCD (Level 0) by properly accommodating the fields set to wildcard values, specified by the standard. This was true for Level 1 to Level 3 and Level 2 to Level 3 fidelity test. These tests prove that different levels of fidelity can interoperate and exchange messages correctly.

5. JEFX 04 Test Results

The JEFX 04 M&S Operational test was conducted 12 – 16 July 2004. The test results are described in detail in the following sections. Additional test equipment used in this test was the RedSim data logger. The DISNAT logger was recently upgraded, and had the capability to record and decode the DIS J Transmitter and Signal PDUs. The network setup for this test was different in two ways. First, the EMT LAN was not used, and Simulyzer, ADSI, and IMTDS were not used. Second, there was no 1553 connection between CCD and CCD1. All messages between CCD and CCD1 were sent on the DIS LAN.

The equipment used:

1. SLM – 16, Software version 03.08.02.
2. CCD Version 02.02.08 Build 90
3. DS3, Version 01.10.01.
4. RedSim, version 1.5. (Data Recorder)
5. MCE OM, Version 110.5
6. SRI, Version 1.1
7. DISNAT, Version 1.2. (Data Recorder)

Changes in the network diagram are shown in Figure 1.

Other test attributes:

Exercise ID: 26
Air LAN Data Entity Port: 3232

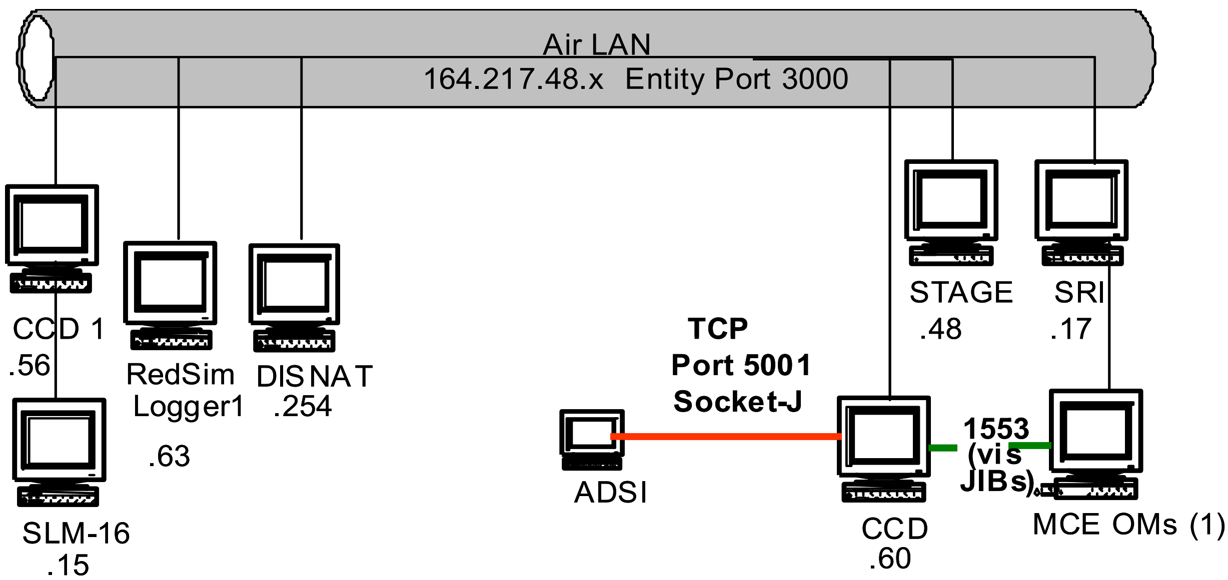

Figure 1. JEFX 04 DIS J Network Diagram

5.1 Fidelity Level 0 Testing

All test steps were successful. The CCDs exchanged data correctly. The ability to simulate an NTR was successfully demonstrated. Verification of multiple JTIDS messages contained within a single Signal PDU was also recorded and verified on the DISNAT and RedSim data loggers. DIS Signal PDU and Transmitter PDUs from the CCDs contained the correct DIS J information. The Transmitter PDU contained the proper information for Modulation Parameters 1 through 5. The Signal PDU contained the proper DIS PDU header information, and all fields showed the proper default values for fidelity Level 0. All messages were received on the MCE's CCD, and all tracks were displayed in their expected position. The errors seen in the September 2002 test were not seen in this test. All fixes were verified.

5.2 Fidelity Level 1 Testing

Again, all test steps were successful. The ability to simulate an NTR for both systems was successfully demonstrated. Verification of timeslot of information contained within a single Signal PDU was also recorded and verified on the DISNAT and RedSim data loggers. The Transmitter PDU contained the proper information for Modulation Parameters 1 through 5. The Transmitter PDU recorded from CCD showed the modulation parameters were correctly set for NTR, transmitting terminal secondary mode, fine synchronization, and the random number for the network synchronization ID. The Signal PDU contained the proper DIS PDU header information, and all fields showed the proper default values for fidelity Level 1. The SLM-16 generated some additional F-14s as non C2 JUs. The MCE took control of the fighter aircraft and sent datalink control orders, specifically J10.5 and J10.6 messages.

5.3 Fidelity Level 2 Testing

All test steps were successful, and the option to change the wait time for each timeslot was tested. When the wait time was changed to 0 milliseconds, the MCE lost all tracks, but the SLM-16 did not. The wait time was adjusted back to the original value, and all tracks were displayed in the MCE and SLM-16. Observed data rates were in accordance with the loaded NDL. All DIS J PDUs were logged and verified using the DISNAT logger. DIS Signal PDU and Transmitter PDUs from the CCDs contained the correct DIS J information for Level 2 fidelity. The Transmitter PDU contained the proper information for Modulation Parameters 1 through 5. The DISNAT Logger verified that the Signal PDU contained the proper DIS PDU header information, and all fields showed the proper values for the NPG, net, and timeslot identification in accordance with the draft standard for Level of Fidelity 2. The DISNAT logger verified that the MSEC and TSEC values were wildcard. The CCD display also showed that messages were assigned to individual timeslots.

5.4 Fidelity Level 3 Testing

All test steps were successful, including basic testing of the MSEC and TSEC. Again, only the default TSEC for a net was supported during testing. Northrop Grumman had not completed the development to support inspecting the TSEC for each NPG. When the SLM-16 MSEC default value in its NDL was changed, the MCE was able to enter the network but not receive any track data. When the value was changed back, the MCE entered the network and received track data. When the SLM-16 TSEC value in its NDL, the MCE was not able to enter the network. Observed data rates were in accordance with the loaded NDL. Again, all DIS J PDUs were logged and verified using the DISNAT logger. DIS Signal PDU and Transmitter PDUs from the CCDs contained the correct DIS J information for Level 3 fidelity. The Transmitter PDU contained the proper information for Modulation Parameters 1 through 5. The DISNAT Logger verified that the Signal PDU contained the proper DIS PDU header information, and all fields showed the proper values for the NPG, net, and timeslot identification.

5.5 Fidelity Interoperability Testing

Level 0 and Level 1 Interoperability Testing: These tests were repeated and again, all test steps were successful. Level 0 and Level 1 participants were able to exchange messages. The DISNAT logger recorded the Signal and Transmitter PDU pairs. Each Signal and Transmitter PDU pair had the correct DIS header values for fidelity Levels 0 and 1.

Level 0 and Level 2 Interoperability Testing: This was the first time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 2 and NTR, and the MCE was sent to Level 0. Messages were exchanged bi-directionally and verified. Then, the SLM-16 was set to Level 0, and the MCE was set to Level 2 and NTR. Again, both units exchanged TADIL J messages successfully.

Level 0 and Level 3 Interoperability Testing: This was the second time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 0. Both units exchanged messages successfully. Then, the SLM-16 was set to Level 0, and the MCE was set to Level 3 and NTR. Again, both units exchanged messages successfully.

Level 1 and Level 2 Interoperability Testing. This was the second time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 2 and NTR, and the MCE was set to Level 1. The SLM –16 entered the network as the NTR. Both units entered fine synchronization, and both units exchanged TADIL J messages. Then, the SLM-16 was set to Level 1 and the MCE was set to Level 2 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully.

Level 1 and Level 3 Interoperability Testing. This was the second time this test was conducted, and all test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 1. Both units entered fine synchronization, and both units exchanged TADIL J messages. Then, the SLM-16 was set to Level 1 and the MCE was set to Level 3 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully.

Level 2 and Level 3 Interoperability Testing: All test steps were successful. The SLM-16 was set to Level 3 and NTR, and the MCE was set to Level 2. Both units entered fine synchronization, and both units exchanged TADIL J messages. Then, the SLM-16 was set to Level 2 and the MCE was set to Level 3 and NTR. Again, both units entered fine synchronization and exchanged TADIL J messages successfully. In addition, both participants were able to be NTR (at different times) and both the SLM-16 and the MCE were able to exchange data.

5.6 Multiple JU/NTR Test Results

No Multiple JU/NTR tests were conducted because of time and resource limits. These will be conducted at a later time, and the test results will be reported in subsequent papers.

5.7 Analysis of Test Results

These tests verified again that fidelity Levels 0-3 are ready for general community use. The data collected on each CCD confirmed proper message exchange at Levels 0 through 3. Each TADIL J message sent by CCD using Signal and Transmitter PDUs was displayed correctly on CCD1 for all levels of fidelity. Also, the DISNAT logger displayed each Transmitter and Signal PDU pair and DIS PDU Header and associated fields for each Transmitter and Signal PDU. These results showed that when the Transmitter PDU was set to TSA Levels of fidelity 0 1, 2, and 3, the associated Signal PDU pair showed the proper values for that fidelity level. Also, when the each CCD was set to different levels of fidelity, they could still exchange messages correctly by detecting each other's level of fidelity and processing the messages correctly.

6. Conclusions

The DIS J portion of the standard was thoroughly tested, and these tests proved that TADIL J messages can be exchanged using DIS J, and that a TADIL J network can also be simulated. Also, the requirement that different fidelity levels should interoperate was successfully implemented.

The goal of the SISO Standard was to bring together the different implementations of TADIL J Signal PDU messages, and also provide a way to simulate the TADIL J network. Another goal was to allow participants at different levels of fidelity to interoperate, so that each could participate, no matter what level of fidelity the simulator has in sending and receiving TADIL J messages. The test results in this paper prove that these goals have been achieved.

7. Acknowledgments

We thank the DMOC, all DIS J test and support personnel, the JSB Infrastructure Upgrade Project for sponsoring the DIS J Implementation work, the JEFX 04 M&S Director for adding this experiment to JEFX 04, and the DMOC for sponsoring this paper. Additionally, we extend our thanks to Mr. Adin Burroughs, Northrop/Grumman, Mr. Mark Crnarich, Northrop/Grumman Programmer, Mr. Tom Brown, LMC, DMOC's Chief Engineer, Mr. William Elliott, DMOC's Technical Advisor, Maj. Morello, DMOC's Director of Operations, and Lt. Col Phillips, DMOC's Commander.

8. Biography

Mr. SORROCHE has 17 years professional experience; ten of which are in Modeling and Simulation. He currently works at the DMOC as the Exercise Engineering Integrated Product Team Lead for distributed exercises, and has been the Engineering lead for the DMOC for JEFX 04, Millennium Challenge 02, JEFX 2000, JEFX 99, EFX 98, and many Blue Flag and VIRTUAL FLAG exercises. He is the Vice Chair for the SISO Tactical Data Link Study Group, and the Chair for the Link 16 Product Development Group. Mr. Sorroche is a recipient of the Fall 2002 SIWZIE Award for paper 02F-SIW-119 titled "TADIL TALES." He has a Bachelors and Masters of Science in Electrical Engineering from New Mexico State University. He is a member of Tau Beta Pi and Eta Kappa Nu Honor Societies.

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