INTEROPERABILITY SYSTEMS
INTERNATIONAL HELLAS S.A.

UNIVERSAL TEST AND TRAINING SYSTEM (UTTS) PRODUCT DESCRIPTION DOCUMENT

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1 SCOPE

1.1 IDENTIFICATION

This document provides a product description for the Interoperability Systems International Hellas S. A. proprietary Universal Test and Training System (hereinafter referred to as the UTTS).

1.2 UTTS OVERVIEW

1.2.1 Background

Over the past fifty years, the worldwide development and use of complex automated tactical command, control and communications systems (hereinafter referred to as tactical data systems or TDS) has resulted in the need for simulation based systems for testing of the TDS during development and post-delivery support, and simulation based systems for training of the TDS Operators. Further, within the TDS training environment, the need for mission training between and amongst several TDSs has been recognized. Figures 1.2.2-1 and 1.2.2-2 characterize typical configurations of a TDS for testing and training, respectively.

The simulation-based systems required for testing of a TDS have great similarities to the simulation based systems required for training the TDS Operators. Both types of systems have to provide the capability to stimulate the TDS's external interfaces with time-synchronized data reflecting a "real world situation" in accordance with the technical characteristics and protocols of the individual external interface. The requirement for time-synchronization of the external interface simulation is driven by the requirement to produce the interactions within the TDS that result from processing information that is near-simultaneously received from multiple external interfaces and operational interactions of multiple TDSs to and with the same real world situation.

The system for testing a TDS requires great detail in the fidelity of the external interface protocols implementation and the ability to introduce errors for "negative and protocol testing".

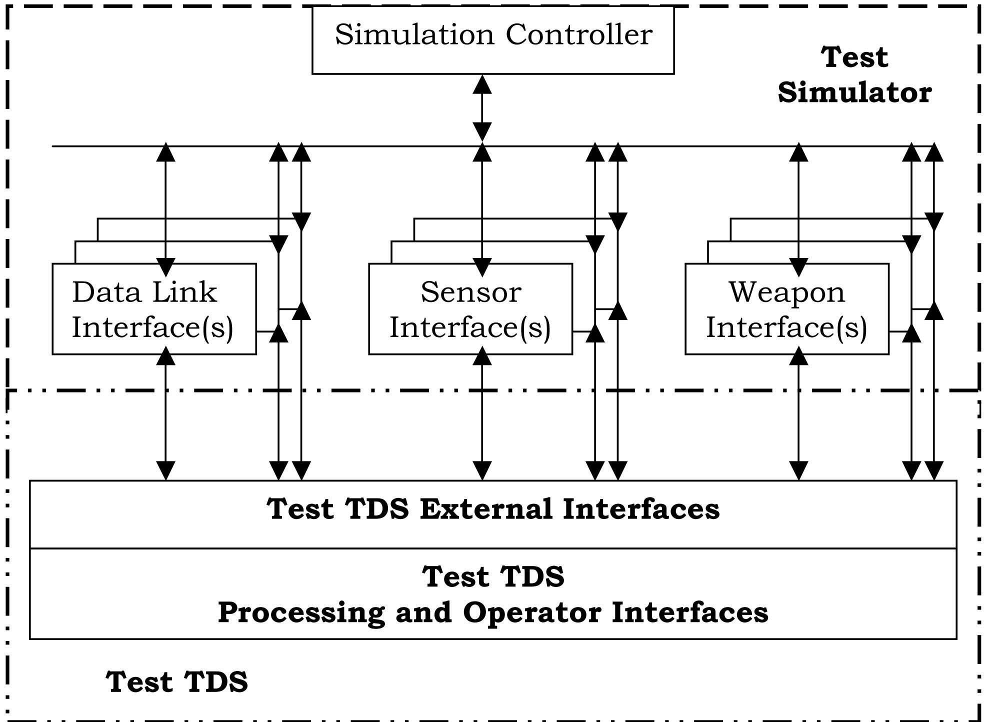

Figure 1.2.2-1: Typical TDS Test Configuration

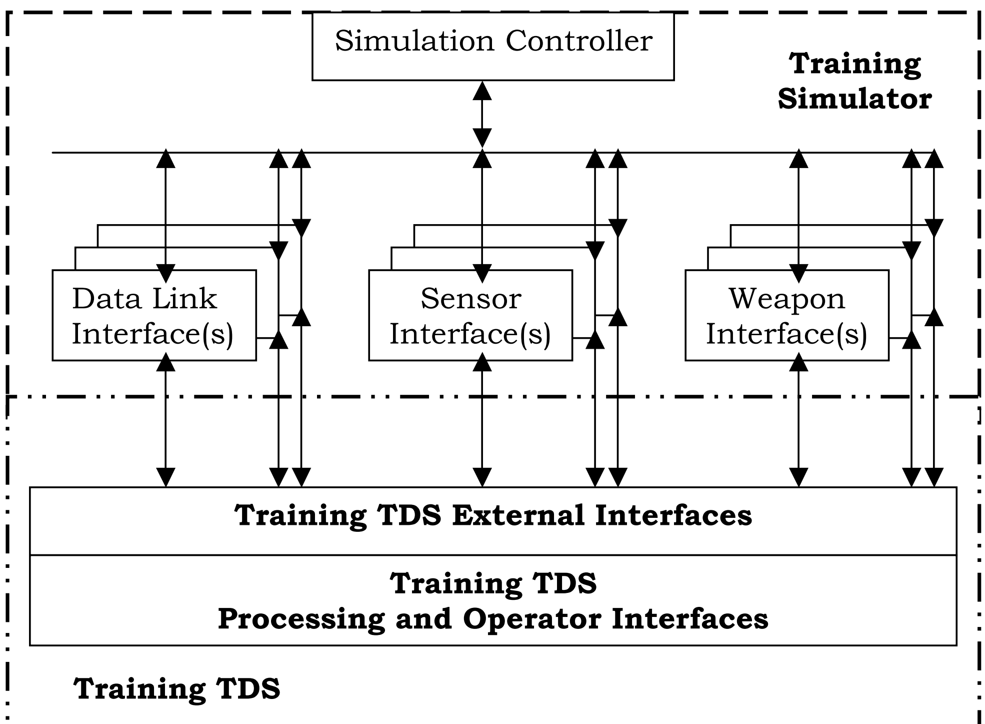

Figure 1.2.2-2: Typical TDS Training Configuration

The system for training the TDS operator may require more fidelity in interpreting the operational attributes of the real world situation (e.g., fidelity of radar simulation with regard to varying radar cross-sections of real world entities and line of sight performance). Additionally, the training attributes of the UTTS provide the means to interact with other trainers or simulators through the use of the IEEE standard Distributed Interactive Simulation (DIS) or High Level Architecture (HLA) protocols. The UTTS's external DIS/HLA capability allows the possibility of a combined training capability for multiple compatible systems.

The UTTS has been designed as a product that can be used for testing of a TDS and as a trainer for the TDS Operator. The UTTS has standard features that are germane to both a test and trainer system while system specific capabilities have been provided to accommodate the unique requirements of both the test and trainer system functions.

1.2.2 Purposes of the UTTS

The purposes of the UTTS are to provide:

a. A comprehensive time synchronized, simulation based, capability to test a TDS through stimulation of all of that TDS's external interfaces in an interactive environment.

b. A comprehensive time synchronized, simulation based, capability to train the operators of a TDS through stimulation of all of that TDS's external interfaces in an interactive environment.

c. The capability to effect composite team training between and amongst cooperating TDSs through the use of the DIS protocol or, in the future, through the use of the HLA protocols.

1.2.3 UTTS Architecture

The UTTS architecture is structured within the constraints of its hardware architecture and its software architecture as described in the following subparagraphs:

1.2.3.1 UTTS Hardware Architecture

The generic UTTS hardware and functional architecture is shown in Figure 1.2.3.1-1.

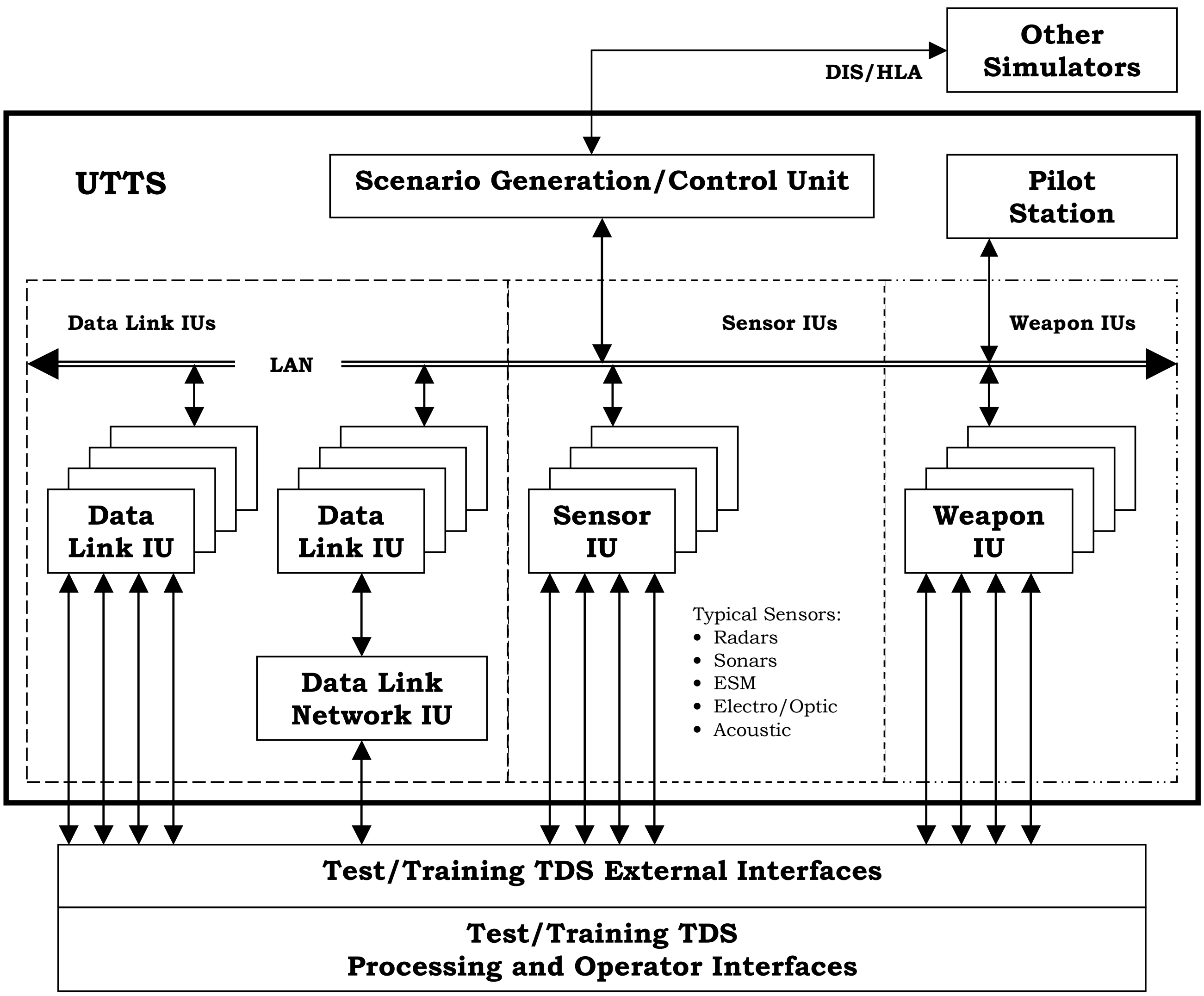

Figure 1.2.3.1-1: UTTS Generic Hardware and Functional Architecture

Following are brief functional descriptions of the hardware elements shown in Figure 1.2.3.1-1:

a. **Scenario Generation/Control Unit (SGCU)** provides the centralized control of the UTTS including Scenario Generation prior to the test/training session, Scenario Control during the test/training session and off-line support tasks such as Data Reduction. The SGCU can interoperate within a network of TDS simulators for multi-site test or training via the DIS or HLA protocols.

b. **Pilot Station (PS)** provides the means for an instructor to cause a simulated track to maneuver in response to an Operator Trainees direction. The simulated track can be any type of track (e.g., air, interceptor, ship, ground truck, etc).

c. **Data Link Interface Units (DLIU)** simulate the technical performance of, and provides human-machine-interfaces for operational interactions of, a TDS participating on a specific data link.

d. **Data Link Network Interface Unit (DLNIU)** provides the means to combine several DLIUs within the structure and protocols of a data link network (e.g., Link 11/TADIL A or Link 16/TADIL J).

e. **Sensor Interface Units (SIU)** can be provided for the sensor associated with the test/training TDS. Typically, the SIUs can include Radar Interface Units (RIU), Electro/Optical Interface Units (EOIU), Electronic Support Measures Interface Units (ESMIU), etc.

   The basic SIU provides the means to interpret the real world situational information furnished from the SGCU into sensor specific information and then converts that sensor information into an interface format and protocols compatible with the TDS's interface to that sensor.

   The fidelity of the simulation or emulation of the actual sensor's performance is customized to the requirements of the customer. If an Original Equipment Manufacturer (OEM) or compatible commercial simulator/emulator for the sensor exists, that commercially available simulator/ emulator can be integrated into the UTTS.

f. **Weapon Interface Units (WIU)** can be provided for the weapons that are directly associated with the test/training TDS.

The basic WIU provides the means to interpret the real world situational information furnished from the SGCU into weapon specific information and then converts that weapon information into an interface format and protocols compatible with the TDS's interface to that weapon.

The fidelity of the simulation or emulation of the actual weapon's performance is customized to the requirements of the customer. If an Original Equipment Manufacturer (OEM) or compatible commercial simulator/emulator for the weapon exists, that commercially available simulator/ emulator can be integrated into the UTTS.

1.2.3.2 UTTS Software Architecture

The UTTS software architecture accommodates multiple functional capabilities that can be activated from the SGCU. Certain of those functional capabilities can be used separately and independently on separate non-UTTS personal computers if the user so desires.

The **Scenario Generation Functions** only require the use of a personal computer with appropriate graphics and memory capabilities. The Scenario Generation Functions are included within the SGCU software as a part of the total UTTS capability.

The **Scenario Execution Functions** are associated with the conduct of tests or training. The Scenario Execution Functions software generally follows the UTTS functional architecture shown in Figure 1.2.3.1-1. The prepared scenario is executed within the SGCU

The **Data Reduction Functions** only require the use of a personal computer with appropriate graphics and memory capabilities. The Data Reduction Functions are included within the SGCU software as a part of the total UTTS capability.

1.2.4 UTTS Concept of Operation

The following subparagraphs provide a brief overview of the UTTS Concept of Operation. The definitive capabilities associated with the concept of operation are described in Paragraph 2, below.

1.2.4.1 Scenario Generation

The scenario generation process is based on the following hierarchy of activities:

a. A **Platform** is defined by a general shape that is depicted using up to three associated three-dimensional boxes, by the desired kinematics assigned to the platform and (if high fidelity is required for radar detection) by a planer definition of the radar cross-section of the platform (i.e., 360 degree profile with radar cross-section defined for every 10 degrees).

b. An **Emitter** is defined by its electro-magnetic, acoustic or geodetic emission type and characteristics.

c. A **Sensor** is defined by the sensor type and technical characteristics.

d. A **Weapon** is defined by its type, kinematics and technical characteristics.

e. A **Data Link** is defined by its general and specific characteristics to the extent required for emulation of the data links operation in a Data Link IU.

f. A **Decoy** is defined by its general and specific operational characteristic. Decoys can include chaff, flairs and other counter measures. ECM capabilities are, however, treated as emitters within the UTTS.

g. An **Entity** is defined by associating a Platform's characteristic with desired emitter(s), sensor(s), weapon(s) and data link(s) definitions.

h. A **Path** is predefined by a set of geographic points with associated speeds, headings and elevations. A path is used to define the movement of an entity and can be used within the basic scenario or for conditional events.

i. A **Track** is created by associating an entity with a path and adding certain kinematics plus load factor such as decoys. A track reflects the movement of the entity throughout the execution of the scenario.

j. An **Event** is defined by a requirement to change the status of the Scenario or of a Track at a specific time (e.g., activate/ deactivate a track, activate/deactivate a sensor, weapon or data link on a track, etc.

k. **Meteorological/Geographical information** such as maps of the operational area, wind, rain, sea state and cloud formations are defined with associated parameter and kinematics.

l. The **Scenario** is comprised of a collection of Tracks, Meteorological/Geographical Information, and Events for the period of the scenario.

A library of platforms, emitters, sensors, weapons, data links, decoys, entities and paths may be established. When a new scenario is created, the applicable libraries are imported into the scenario and edited according to the specific needs of the anticipated scenario. Thereafter, only the scenario specific libraries are associated with the specific scenario.

As a part of the Scenario Generation process, a scenario may be played to allow the SGO to visualize the scenario as it progresses over time. Time compression features are available to speed up the process of reviewing the scenario.

Once a Scenario has been defined that Scenario can be saved for retrieval at a later time for execution, editing or to be used as the basis for generation of a new scenario.

1.2.4.2 Scenario Execution

Upon powering on all of the applicable processors and IUs, the UTTS Scenario Control Operator (SCO) accesses and validates the scenario to be used for the exercise.

The exercise can begin at the start of the scenario or at any time within the overall duration of the scenario. If the start of the exercise is initialized to begin at a time other than the original start of the scenario, the scenario will execute through all of the events required to bring the scenario to the designated time. The time required to reach the starting point for the exercise will be dependent upon the exercise TDS's ability to receive and interpret the requisite information and activities required to bring the TDS to readiness for the actual start of the exercise.

Once the actual exercise is started, the scenario is executed by interpreting and executing all events required for each second of the exercise in second-by-second sequence until the exercise is terminated, paused or reaches the end of the scenario.

The SCO has the option to pause the scenario execution at any time. The scenario can be terminated at the time of the pause or resumed at the time of the pause.

Throughout the execution of the scenario the SCO has the option to edit the scenario and to activate the changes to the scenario within the execution of the on-going scenario. When the exercise is completed, the SCO has the option to save the edited scenario under the same title as the initial scenario or to save the edited scenario with a new title.

1.2.4.3 IU Interactions

Throughout the execution of the scenario, the SGCU continuously broadcasts DIS/HLA messages on the UTTS Local Area Network (LAN). Each of the connected IUs interprets all of the DIS/HLA messages that apply to its specified functionality in accordance with the IU's specified operational characteristics.

At the same time, each IU is interfaced to the appropriate external interface(s) of the TDS. The IU transmits and receives information to/from the TDS in accordance with the defined formats and protocols associated with the functionality of the IU.

If required by the functionality of the IU, a display and operator HMI capability is provided with the IU. This allows an IU operator to react to TDS Operator initiated actions/reactions that cannot be included within the scenario.

1.2.4.4 Pilot Station

In training systems where the TDS requires interaction between its Operators and the pilot of a track that may come under the TDS Operators control, a Pilot Station can be provided to facilitate the actions of the controlled track in response to voice commands. An Instructor who has voice contact with the appropriate TDS Operator must man the Pilot Station. More than one Pilot Stations can be used if the workload is anticipated to require the increased capability.

1.2.5 UTTS Customization

It is recognized that each UTTS customer will desire to have an UTTS that satisfies the specific needs of its target TDS. Accordingly, the UTTS's architecture has been designed to allow the development and use of standard products within the umbrella of that architecture and thereby allowing a deliverable UTTS to be adapted or customized to the customer's requirements. The use of standard DIS/HLA scenario interfaces exchange with the IUs and other connected test/training systems provides the means to deliver individual IU products for existing test/training systems that use the DIS/HLA protocols.

The Data Link IUs can be viewed as existing products that only have to be adapted to the specific customers implementation of the associated messages and data fields in accordance with the international standards that govern the data link. For customer specific data links, the base Data Link IU can be used and customized to reflect the specific messages, data field and protocol implementation of the customer's specific data link.

The Sensor IUs and Weapon IUs present a wider variation of implementations because the interfaces to the target TDS are not, in general, standardized at the international or country level. They are, in fact, virtually Original Equipment Manufacture (OEM) defined and can vary widely in their interface requirements. An exception to this general statement exists in the area of some Air Traffic Control radars and Air Defense search radars where some national and international standardization of their interfaces has occurred. These standardization efforts provide the possibility to offer existing products where those standards are applicable.

Further exacerbating the multiplicity of Sensor and Weapon IU interfaces is the breadth of potential customer requirements with regard to the fidelity of simulation or emulation of the Sensor's or Weapon's performance. In general, the testing requirements for a system development do not require high fidelity in the Sensor or Weapon IU simulation; those testing requirements are more oriented to the functionality and implementation of the interfaces messages and protocols. Conversely, the training requirements of a system may be deemed to require high fidelity in the modeling of the Sensor or Weapon performance to facilitate more exactly the interactions between the TDS and the IU. The specific capabilities related to Sensor and Weapon IUs are addressed in paragraphs 2.3.3 and 2.3.4, respectively, of this Product Description.

2 UTTS CAPABILITIES

2.1 SCENARIO GENERATION

The purpose of scenario generation is to define a time oriented sequence of events (actions) between and among operational entities within a specific geographic and meteorological environment.

The basis of the scenario is the concept that all operational entities can be defined by their platform, emitters, sensors, weapons, data links and decoy characteristics. Essentially, this combination of entity characteristics is obtained by associating a defined platform with its attributes (emitters, sensors, weapons, data links and decoys).

An entity can then be associated with a path of its expected movement in the scenario. That movement path with its entity is referred to as a Track.

Various actions can be defined for the Track or the operational environment. Those actions can be turning on/off emitters, sensor and/or data links; activating weapons including the weapons sensors, launching/firing the weapon and (if applicable) creating a new track based on the weapon's projectile, missile or torpedo; and changes in winds, weather and sea state; etc.

The Actions required to effect movement of a Track and the Action related to the track noted above are all combined into a series of time specific events that the Scenario executes in time sequence. Generally, the granularity of event execution is at one-second intervals with multiple events occurring for each second. If the scenario cannot execute all of the defined events within a specific second, the remaining events are carried forward into the next second's events.

The following paragraphs provide brief descriptions of the foregoing processes and some element of support task associated with Scenario Generation:

2.1.1 Platform Definition

The platform can be designated as an air, surface (maritime), subsurface, ground or space platform with a specific Platform Identification.

The basic platform shape is defined by up to three three-dimensional boxes where the Scenario Generation Operator (SGO) determines the dimensions and relative positioning of boxes to represent the general shape and size of the platform.

If the UTTS's fidelity requirements dictate, the UTTS can calculate the planer (360 degree) radar/sonar/infra-red cross-section of the platform with 10-degree increments or the SGO can enter the radar/sonar/infra-red cross-section manually.

The SGO is required to enter platform specific information with regard to kinematics and operational restrictions such as fuel capacity/available.

Once a platform has been defined, it can be filed within the scenario and/or within a library. A platform within the scenario can be accessed from its file and reused or modified to define another platform for use in the scenario.

2.1.2 Emitter Definition

The emitter can be designated as IFF/SIF transponders, communications, acoustic (subsurface), acoustic (ground), geodetic (ground) or infrared with a specific Emitter Identification. An emitter can be designated as an

Electromagnetic Counter Measures (ECM) as related to it basic designation (e.g., Radar ECM or Communications ECM).

Radars, IFF/SIF interrogators and sonars are treated as Active sensors within the UTTS (See paragraph 2.1.3)

The directional aspects of the emitter can be specified (i.e., omni or a directional sector of X-degrees on each side of a bearing where the bearing can be associated with the placement of the emitter on a platform).

The technical characteristics of the emitter can be specified to the level of detail required for its use in the scenario.

Once an emitter has been defined, it can be filed within the scenario and/or within a library. An emitter within the scenario can be accessed from its file and reused or modified to define another emitter for use in the scenario.

2.1.3 Sensor Definition

A sensor can be designated as an Active or a Passive sensor. Radars, IFF/SIF interrogators and sonars are Active sensors with acknowledged emitter characteristic; but, for convenience, the Active sensors are treated as sensors within the UTTS. The Passive sensors can be electromagnetic, acoustic (subsurface), acoustic (ground), geodetic (ground), optical or infrared. Each sensor is given a specific Sensor Identification.

The directional aspects of the sensor can be specified (i.e., omni or a directional sector of X-degrees on each side of a bearing where the bearing can be associated with the placement of the sensor on a platform).

The technical characteristics of the sensor can be specified to the level of detail required for its use in the scenario. For radars the technical characteristics can be simplified to provide the maximum effective range for detecting air and/or surface entities for low fidelity requirements or can require all related parametrics required to calculate the detection of entities based on a defined “radar range equation”. Further, positional information produced by a sensor can have two predefined ambiguities designated to accommodate the actual ambiguity of measurement and the potential of sensor position and alignment errors. This feature ensures that the UTTS simulation accommodates the real-world variance in positional information and the factors that require "data registration" among data link participants.

In UTTSs with high sensor fidelity requirements, sensor malfunctions can be defined within the constraints that their interfaces to the host TDS allow communications of those malfunctions.

Once a sensor has been defined, it can be filed within the scenario and/or within a library. A sensor within the scenario can be accessed from its file and reused or modified to define another sensor for use in the scenario.

2.1.4 Weapon Definition

The weapon can be designated as gun, bomb or missile with a specific Weapon Identification. If the weapon has active sensor(s) and/or emitter(s), the sensor(s) and emitter(s) information is associated with the Weapon.

The directional aspects of the weapon can be specified (i.e., omni or a directional sector of X-degrees on each side of a bearing where the bearing can be associated with the placement of the sensor on a platform).

The technical characteristics of the weapon can be specified to the level of detail required for its use in the scenario. Specifically, if the weapon is a missile, a specific platform can be associated with the weapon and the firing of the weapon will result in the activation of the missile as a new air-entity with its associated pre-defined track profile.

In UTTS's with high weapon fidelity requirements, weapon malfunctions can be defined within the constraints that their interfaces to the host TDS allow communications of those malfunctions.

Once a weapon has been defined, it can be filed within the scenario and/or within a library. A weapon within the scenario can be accessed from its file and reused or modified to define another weapon for use in the scenario.

2.1.5 Data Link Definition

A data link is defined by the parameters required to allow initialization of a Data Link IU within the scenario.

Typically, data link definitions are related to international data link standards and are accessed from existing files at the onset of the scenario definition. Once the appropriate existing files are inducted into the scenario, those files can be adapted to the scenario's needs and become specific to the scenario.

If a new data link definition is required the capability to customize the characteristics is provided.

2.1.6 Decoy Definition

The UTTS provides the capability to define chaff and flairs that can be deployed by an entity. The decoy's kinematics are defined by the SGO.

2.1.7 Entity Definition

The association of a platform with emitters, sensors, weapons, data links and decoys defines an entity. The entity is given a unique Entity Identification.

Once an entity has been defined, it can be filed within the scenario and/or within a library. An entity within the scenario can be accessed from its file and reused or modified to define another entity for use in the scenario.

2.1.8 Path Definition

A path is defined by a series of point that are in relative positions with relationship to each other and with regard to the sequence in which the path moves through the points. Each point can have an assigned position relative to the position at the start of the pattern, an assigned time relative to the time at the start of the pattern, and an optional absolute altitude.

A conditional path may be defined with its assigned time being start time and point being dependent on the position of an Action Track as defined in a conditional event (See paragraph 2.1.11c).

Once a path has been defined, it can be filed within the scenario and/or within a library. A path within the scenario can be accessed from its file and reused or modified to define another path for use in the scenario.

2.1.9 Track Definition

A track is defined by associating an entity with a position on a path and operational information such as initial position, initial velocity, country of origin, IFF/SIF codes, call sign, etc. A Point track is defined without a path. The entity's initial position and heading determine the starting point and orientation of the path. Figure 2.1.9-1 depicts the processes of track definition.

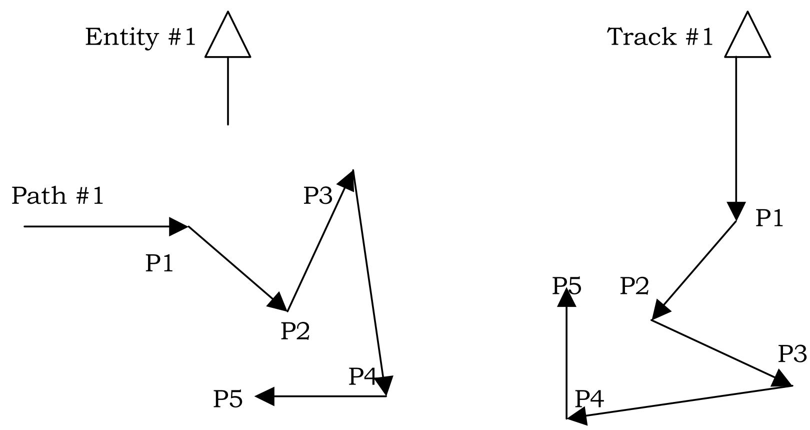

Figure 2.1.9-1: Track defined by Entity and Path

As a part of the track definition process, the UTTS performs automatic checks with regard to the compatibility of the selected entity and path. Those checks include validation that the selected entity's kinematics allow the entity to accomplish the specified parameters for each point (e.g., speed versus time on point validation). Once the track has been defined, the SGO can modify or adapt the track's path without having to change the initial defining path.

If a track is intended to be a stationary entity (i.e., the entity will not be required to move on a specified path), a track can be designated by defining an entity with no path.

The track initiation/start time can be defined in reference to the scenario time.

Once a track has been defined, it can be filed within the scenario. A track within the scenario can be accessed from its file and reused or modified to define another track for use in the scenario.

2.1.10 Meteorological/Geographic Definitions

The UTTS provides the means to accomplish the following Meteorological and geographic definitions for the scenario:

a. Define, or associate from file, a **Digital Map** for all or a part of the Operational Area. The digital map may have elevation contour lines if high fidelity line-of-sight calculations are required.

b. Assign **Winds** between mean sea level and 100,000 feet in 10,000-foot increments. The winds are applied for the complete Operational Area and can be changed by scenario event or manually by the Scenario Control Operator (SCO).

c. Assign **Sea State** as defined in twelve levels and applied for the complete Operational Area. The Sea State can be changed by scenario event or manually by the SCO.

d. Assign **Cloud Area** in 10 nautical mile squares, with associated altitude range (two values) and lateral velocity. The density of the cloud cover is defined in 10 levels.

e. Assign **Rain Areas** in 10 nautical mile squares, with associated altitude (single value) and lateral velocity. The density of the rain is defined in 10 levels.

Once the geographic and Meteorological information has been defined, it can be filed within the scenario and/or within a library. The geographic and Meteorological information within the scenario can be accessed from its file and reused or modified to define other geographic and Meteorological information for use in the scenario.

2.1.11 Event Definition

Events are defined to accomplish the dynamics of the scenario. An event is specified to be accomplished at a specific time (either in scenario time or conditional time) with definition of the required action.

Events within the scenario are defined in three categories

a. Track Events

b. Scenario Events

c. Conditional Events

as discussed in the following subparagraphs:

2.1.11.1 Track Steering Events

Track steering events are defined by the track's path definition including changes in track position, speed, heading and/or altitude and are accomplished automatically without definition of separate scenario events.

Track steering event timing is derived from the track definition.

2.1.11.2 Scenario Events

Scenario events are defined for a specific scenario time and executed within one-second in reference to that scenario time.

Scenario events include, but are not limited to:

a. Changes in track (entity and path) definitions.

b. Taking manual control of a track with the ability to change the entity position, positions, speed, heading and/or altitude. When a track is taken under manual control, the associated entity becomes independent from the previously defined path parameters and thereafter requires manual definition of any further changes in entity or path requirements.

c. Define the state of a track as Active, Invisible or Inactive where:

(1) **Active** connotes that the track can be seen as a part of the real-world situation.

(2) **Invisible** connotes that the track entity is moving on the track path but is not seen in the real-world situation.

(3) **Inactive** connotes that the track entity is neither moving on the track path nor seen in the real-world situation.

d. Activation or Deactivation of a track's emitters, sensors, weapons, data links and/or decoys.

e. Firing of a track's weapons (including launching of missiles).

f. Changes in track IFF/SIF data.

g. Activation or Deactivation of a track's sensor or weapon malfunctions.

2.1.11.3 Conditional Events

A conditional event is defined with regard to conditions that might exist between two tracks and the action of one of those tracks when the condition(s) occur. For the purpose of this description, the track that performs the action in response to the condition is called the "Action Track" and the track that triggers the conditional event is called the "Precipitator".

Any track can be designated as a Precipitator as long as it has not been previously designated as an Action Track.

One or more tracks may be designated as Action Track given that they have not been previously designated as a Precipitator.

For a conditional event, the Precipitator is associated with one or more Action Tracks, the trigger condition is defined for each Action Track, and the actions to performed by each Action Track is defined.

The event that triggers a conditional event can be one or more of the following:

a. The distance between the Action Track and the Precipitator becomes equal to or less than a defined Distance Threshold.

b. The distance between the Action Track and the Precipitator becomes equal to or less than a defined sensor range from the Action Track's.

The action(s) to be performed by the Action Track can be one or more of the following:

a. Changes in speed, heading and/or altitude.

b. Maneuver in accordance with an assigned path. When a maneuver is defined an option is provided to maintain the maneuver path or to return to the original track path.

c. Deploy designated Decoy(s).

d. Activate or Deactivate ECM, ESM and/or Radar.

e. Change Radar mode.

f. Fire Weapon or Launch Missile at the Precipitator.

If more than one action is defined for the Action Track, the time between each action must be specified with time stated relative to the initiation of the conditional event. More than one scenario actions can be specified to happen at the same time.

2.1.12 Scenario Definition

The scenario definition is completed when all of the desired tracks with their entity characteristics and events have been defined, the Meteorological/Geographic conditions have been defined, and the Scenario and Conditional events have been defined.

Once a scenario has been defined, it can be filed. The scenario can be accessed from its file for execution or to be modified to define another scenario.

2.1.13 Scenario Definition Support Functions

To facilitate efficient scenario definition several support features are incorporated into the UTTS

2.1.13.1 Graphic Display and HMI

The SGCU is provided with a Graphics Display Unit (GDU) and accompanying Human-Machine-Interfaces (HMI) specifically designed to aid the SGO in the definition of the scenario. For each of the scenario definition tasks, a template is provided. Each template is structured for it specific task with drop-down menu and pick-lists where appropriate. In the area of path definition, the points can be defined with a series of mouse action in interaction with the GDU. Once the points are defined, their locations can be adapted by a hook and drag feature. Point information is accommodated with a template that can be accessed via a mouse function.

2.1.13.2 Real-World Situation Display

As the tracks are defined, the SGO has the option to display the tracks on the GDU with the selected map. This feature allows the SGO to catch obvious mistakes such as a track that is supposed to be a ship having a path that moves over land or a ground track that is moving over a sea.

The display of the tracks can be shown with the complete track (entity and path) or only with the entities visible.

Normal TDS type of symbology, track labels and velocity vectors can be displayed. The track position is extrapolated from the last updated position to its current position based on the track velocity and the time since the last position update. The track display position is updated at least once every five-seconds.

2.1.13.3 Scenario Trials

A scenario trial capability is provided with the following selectable options:

a. **Go to** a specified scenario time (either forward or backward in time) by executing all scenario events up to the specified time.

b. **Forward** which starts execution from a specific time and run the scenario forward at normal speed.

c. **Single-step-Forward** by executing the events that are defined (if any) for the current second of scenario time.

d. **Fast-Forward** that runs the scenario as fast as possible.

e. **Freeze** the motion and time of the scenario at the moment or designated time.

f. **Resume** the motion and time from the Freeze state.

When a scenario trial is executed, conditional events are not triggered.

2.1.13.4 Scenario Editing

At any time during the scenario generation process, including the scenario trial, the SGO can halt the current activity and edit any portion of the existing scenario.

2.1.13.5 File/Folder Management

The UTTS provides File/Folder Management capability that allows the SGO (and SCO) to create, move, copy, store and retrieve files/folders within the UTTS system.

2.2 SCENARIO EXECUTION

2.2.1 General Scenario Execution Philosophy

The UTTS scenario execution philosophy embodies the following concepts of operation:

a. The simulation execution is distributed between and amongst the Scenario Generation/Control Unit (SGCU) and the simulation Interface Units (IU) using DIS/HLA as the communications media.

b. The SGCU and IUs have the capability to independently and separately execute the specific actions/events required within their specific functionality.

c. The SGCU provides and maintains the time synchronization for scenario execution amongst the participants.

d. The SGCU has execution responsibility for generation and maintenance of the Real World Situation through execution of Track Events and selected portion of the Scenario and Conditional Events.

e. All IUs have access to the Real World Situation via the SGCU DIS/HLA reporting of the information on the UTTS Local Area Network.

f. An IU executes the Scenario and Conditional Events that specifically relate to the functionality of the IU.

g. If, in the process of scenario execution, an IU is required to vary a track's scripted performance from the initial scenario (e.g., taking manual control of a track in response to direction from the host TDS operator), that IU assumes responsibility for future simulation related to the track and reporting of that track to the other UTTS participants.

2.2.2 Scenario Initialization

Once the SGCU and all related IUs have been powered-up, the SCO selects the desired scenario from file. The exercise time-of-day (as opposed to scenario time) can be specified by the SCO. The related scenario information and events are provided to the IUs and time synchronization is established among all of the UTTS units (SGCU and IUs).

If data recording is required, that function can be initiated for:

a. Events executed in the UTTS.

b. Individual IU interface messages to and from the host TDS (data link, radar, weapon, etc).

The SCO specifies the Start Time for the scenario and the scenario is executed at high speed up to that Start Time where the scenario is frozen. The SCO can then Start (resume) the scenario execution at the normal real-time execution rate.

2.2.3 Scenario Control

The scenario execution controls available to the SCO are:

a. Start execution at a specified scenario time

b. Start execution of the scenario

c. Freeze scenario

d. Go to a specified scenario time (forward only)

e. Resume scenario execution from a “freeze” or “go to” state

f. Terminate scenario execution

g. Initiate, Stop or reinitiate data recording.

2.2.4 Scenario Execution Simulation Functions

2.2.4.1 Track Movement Simulation

Simulation of track movement is accomplished in consideration of the following parameters:

a. Current track position (including altitude/depth) with reference to the desired track position.

b. The time at which the desired track position must be reached.

c. Track speed.

d. Acceleration/Deceleration Rates

e. Climb/Dive Rates

f. Turn Rates

If any of the parameters do not allow the track to reach the desired position at the required time, the UTTS warns the operator and allows the track to progress to a point that is the nearest point that it can reach at the specified time. (Note, this feature is available during scenario generation as well as scenario execution.

2.2.4.2 Missile/Weapon Simulation

A simulated missile projectile can be launched/fired either by a scenario event, by a conditional event or by the manual action of the SCO. The missile's projectile's simulated movement is determined by the missile projectile platform characteristic.

A missile will follow the movement of its designated target within the limits of the missile platform characteristics.

If a radar guided missile can detect more than one candidate target, the missile will follow the movement of the target with the largest radar cross section.

The missile/weapon can be triggered (exploded) by proximity, position or manually. When it is triggered or its duration expires (e.g., a missile runs out of fuel), the missile/weapon projectile is deleted. The missile's/weapon projectile's effectiveness is determined and so reported on the DIS/HLA network.

2.2.4.3 Malfunction Simulation

Malfunction Events are included within a scenario, or manually initiated, for the presence of a malfunction that can be communicated to the host TDS via the respective IU's defined interface to the TDS or for malfunctions that cause changes to the simulated capabilities of the IU.

At the time that the malfunction is required by the scenario, or manually initiated, the responsible IU limits its performance to reflect the malfunction and reports the malfunction to the TDS.

If the malfunction would prevent the IU's communications with the TDS, the IU ceases to communicate with the TDS.

2.2.4.4 Special Test System Simulation

2.2.4.4.1 Negative Testing Simulation

When testing a host TDS, the initial benefit of the UTTS is to validate the correct processing of the TDS's interfaces. This type of testing often requires testing of illegal message, illegal data fields within the message or illegal sequencing of the messages.

Accordingly, the UTTS provides the means for an IU to transmit illegal messages, data elements and sequencing of messages.

2.2.4.4.2 Data Extraction, Recording and Reduction

The UTTS provides the means to extract, record and reduce the messages that are exchanged via DIS/HLA and the defined interface between each IU and its respective TDS interface.

A capability to display on-line reduction is provided.

The recorded data can be reduced off-line on a PC.

The reduction process provides the means to filter the reduction at least by interface/link, direction of flow (transmit/receive), time period, Track Number, Identification, and message type.

2.2.5 <u>Scenario Execution Support Functions</u>

2.2.5.1 On-Line Scenario Changes

The UTTS provides the means to dynamically change a scenario during the scenario execution. All changes on-line changes to the scenario can be recorded. The following subparagraphs describe the types of on-line changes that can be made to a scenario.

2.2.5.1.1 On-Line Track Creation

The UTTS provides the means to define a track during the scenario execution. The process of on-line track definition is exactly the same as used for scenario generation.

2.2.5.1.2 On-Line Track Change

The UTTS provides the means to change any parameter associated with a track's definition with the following stipulations:

a. Changes that define a new path for the tracks will overwrite all of the remaining features of the original track path from the time that the change is activated.

b. Changes that cause a deviation in the track's original path without defining a subsequent path will invalidate the remainder of the track's original path and require additional on-line changes to vary the path required at the time of the change activation.

c. Changes that will not affect the track's path will not affect the remainder of the track's path.

2.2.5.1.3 On-Line Event Changes

The UTTS provides the means for on-line event changes including:

a. Creation of new events

b. Deletion of existing events

c. Changes in the requirements for existing events

2.2.5.2 Saving Old, New or Adapted Scenarios

Once a scenario's execution has been completed or terminated, the SCO is provided the capability to:

a. Save the original scenario without any changes.

b. Save the revised scenario with the same identification as the original scenario.

c. Save the revised scenario with a new identification.

2.3 INTERFACE UNITS

2.3.1 General Interface Units Characteristics

In general, IUs can be classed as either collocated or remote IUs where:

a. **Collocated IUs** are physically within close proximity of the host TDS (e.g., ESM system and certain radars, sonars or weapon systems) and are associated with the track that defines the host TDS. That association allows the IU to derive its positional information and movement (if any) from the TDS's track.

b. **Remote IUs** are physically separated from the host TDS and require the association with a defined track from which their positional information and movement (if any) are defined.

For normal fidelity (as opposed to high fidelity) requirements, the following characteristic can be associated with an IU:

a. **Air, Surface, Subsurface and Ground Reporting Radii** that define the maximum distance from the IU to where the associated sensor is able to detect the category of track and thereby start reporting the track on the interface. Note: Track quality is assigned on the basis of distance from the IU.

b. **ESM Reporting Radius** that defines the maximum range for an ESM systems detection of an emitter. Reporting of ESM bearings and fixes can be selected as automatic or manual.

c. **ECM Reporting Radius** that defines the maximum range from which an ECM emitter can impact a sensor on the IU. Reporting of ECM bearings and fixes can be selected as automatic or manual.

d. **IU Positional Bias** that defines the positional off-set to be associated with the IU's scenario position and the position used to report the IU's and local sensor track positions. The IU positional bias is imposed to reflect the conditions that require data registration and/or gridlock on the data links.

e. **Track Position Reporting Error** that is a random error term to accommodate the errors inherent in positional measurements and tracking algorithm projections.

When reporting a track on the IU interface, the IU extrapolates the last scenario provided track position to the time of transmission on the IU interface and then, if necessary, applies the IU positional bias and track position reporting error as appropriate.

Within the context of an IU's functionality, the UTTS provides a tactical display and HMI features that allow an IU operator to view the operational situation "as seen by the IU" and to interactively operate with the host TDS operator(s).

2.3.2 Data Link Interface Units

The standard Data Link IUs (DLIU) include Link 1, Link 11/TADIL A, Link 11B/TADIL B, Link 14, ATDL-1, IJMS and Link 16/TADIL J. Additionally JREAP and VMF are scheduled for development as well as Link 22. Non-standard DLIU are available or can be created to meet the need of the TDS for which the UTTS is intended.

Each DLIU provides the means to specify data link specific parameters and to activate/deactivate the data link in accordance with the link's required protocols.

Transmit and receive filters are accommodated in accordance with the data link and TDS system requirements.

Each DLIU is provided with an independent capability to interact with the TDS to the extent that the TDS has implemented the subject data link capabilities.

For UTTS testing requirements, the capability to insert illegal messages, data elements and message protocols is provided.

2.3.3 Sensor Interface Units

2.3.3.1 General Sensor Interface Units

The provision of sensor IUs in the UTTS is generally dictated by the Customer's requirements. Those requirements can run from basic simulation of the defined sensors interface with the TDS to very faithful emulation of the sensors performance parameters and interaction to sensor control commands.

Some Customer's may have an existing sensor simulator for which UTTS adaptation to the real world situation injection and simulator control is required rather than the actual simulation of the radar performance and/or the direct interface between the TDS and the sensor.

Where sensor IUs have been previously developed for the UTTS, those sensor IUs can be offered with the UTTS at a cost saving to the customer.

2.3.3.2 Radar Interface Units

2.3.3.2.1 General Radar Interface Unit Functionality

Provision of a general Radar IU normally only requires adaptation of the general IU capabilities noted in paragraph 2.3.1, tailoring of the IU to meet mode related changes to the radars performance and provision of the specific interface required for interfacing with the host TDS.

The general Radar IU is typically adequate for a UTTS that is going to be used for testing. The general Radar IU's use for training is at the discretion of the Customer.

Modern radars may have embedded tracking algorithms. The general Radar IU does not attempt to emulate tracking algorithms, however the Track Position Reporting Error factor can be adapted to reflect the effects of such algorithms.

2.3.3.2.2 High Resolution Radar Interface Unit

The definition of a high resolution Radar IU is typically driven by the Customer definition with regard to the fidelity requirements desire from the Radar IU simulation/emulation of the radars performance and the level of the Customer's desire for faithful adherence to line-of-sight obscuration.

The adherence to the fidelity of radar performance is typically driven by application of the radar range equation with specific parameters associated with the radar, the radar cross-section of the observed tracks and potential impact of meteorological factors (rain or clouds). The specific radar range equation required might be general in nature or a Customer provided adaptation of the equation that reflects the specific performance of the radar in its different modes of operation.

The line-of-sight obscuration capability is typically defined with a Customer defined digitized map that provides contour information to the level of accuracy required. If structural obscuration has to be provided, the Customer should provide the details of the structural items.

The customization for a high resolution Radar IU is typically unique and the availability of a standard product is rare.

2.3.3.2.3 Radar Interface Unit Video Support

The interface between a Radar IU and the TDS are generally accomplished via digital protocols. However, the occasional TDS may require an analog/PPI. The UTTS can be provided with an off-the-shelf Radar Video Simulation Module (RVSM) that provides PPI video to the TDS.

2.3.3.3 Electronic Support Measures Interface Units

Electronic Support Measures (ESM) systems vary widely in their capabilities and the libraries applied to the information developed within the systems. Further, the ESM system's Original Equipment Manufacturers (OEM) are reluctant to share performance related information.

At the same time, the OEMs have recognized that simulators that reflect the performance of their systems and the interface to the host TDS are generally required.

Accordingly, wherever possible, the preferred UTTS ESM IU is a combination of an OEM provided simulator and an UTTS unique application that provides the real world situation information to the OEM simulator in a mutually agreed format. The use of DIS/HLA as the communications media within the UTTS should simplify the interface development requirements between the UTTS and the ESM simulators as the OEM adapt to using DIS/HLA as well.

2.3.3.4 Other Sensor Interface Units

The variations in other sensor types and fidelity requirements preclude a generic approach other than the fact that the general IU approach noted in paragraph 2.3.1 is normally used as a point of departure for a sensor IU. The specific sensor type and fidelity requirements become the basis for development of the IU.

Wherever possible, the use of an OEM simulator driven by the DIS/HLA protocols is the preferred approach to providing the sensor IU; it is most often the cost-effective solution.

2.3.4 Weapon Interface Units

2.3.4.1 General Weapon Interface Units

Weapon systems vary widely in their interface and performance characteristic. It is not uncommon for a weapon system to have more than one sensor interface, a command and control interface and a firing/launching interface. With the potential for multiple interfaces and functional requirements, the Weapon IUs are frequently the most complex for implementation.

Wherever possible, it is suggested that an OEM simulation unit with DIS/HLA capability be used to achieve the Weapon IU.

2.4 PILOT STATION

The Pilot Station capability should be viewed as a generic capability that allows an Operator/Instructor to independently direct a track in response to voice commands from the TDS Operator. It is most often used in the Air Command and Control environment to accomplish basic air traffic control, air strike control and interceptor control training. However, the generic nature of the Pilot Station does not preclude its use in Surface, Sub-surface or Ground environments.

Operation of the Pilot Station is simply based on the "pilots" taking control of a track and thereafter causing the track to accomplish the commands of the TDS Operator. It is noted that once a track has been manually acquired, the pilot has the option to return to the original track path at a point that is forward in scenario time or to have all residual events related to the path of the track discarded and the track must remain under the control of the pilot until it is dropped or the exercise is terminated.

The HMI associated with the Pilot Station provides the complete Real World Situation to the pilot and can be structured to provide mission specific aides to allow the pilot to control multiple tracks.

It is noted that the pilot is subject to the same or more workload in comparison to the TDS Operator(s) providing the direction for track(s). Accordingly, the number of Pilot Station in a UTTS has to be determined with such consideration.

2.5 DATA LINK NETWORK SIMULATOR UNITS

Recognizing that some data links operate in a network environment and that the basic UTTS architecture envisages one DLIU for each unit participating on a data link, it is necessary to provide the means for multiple DLIU's participation in a networked data link. Further, the functional associating of the DLIU must result in a single interface to the TDS that provides the electrical and interface protocols associated with the modem, encryption device and network protocols. The following subparagraphs address the UTTS network simulation capabilities for Link 11/TADIL A and Link 16/TADIL J and IJMS.

2.5.1 Link 11/TADIL A Network Simulation Unit

The Link 11/TADIL A (ANSU) interfaces with multiple Link 11 DLIUs that, with the TDS, form the Participating Units on the Link 11/TADIL A network. That interface is via an Ethernet LAN.

The ANSU Network Functions controls the Link 11 DLIUs with regard to transmission sequencing. When one of the Link 11 DLIUs transmits, all of the other Link 11 DLIUs and the TDS receive the transmission.

When it is time for the TDS to transmit on the link, the ANSU signals the TDS to transmit and the TDS sends its messages to the ANSU as if the ANSU was a DTS. The ANSU then passes those messages to the Link 11 DLIUs for receive processing.

The ANSU DTS Functions react to the messages received over the DTS control line and provide "DTS" status to the TDS via the control line. The DTS Functions are programmed to make the ANSU appear as a DTS to the TDS.

2.5.2 Link 16/TADIL J and IJMS Network Simulation Unit

The Link 16/TADIL J and IJMS Network Simulation Unit (JNSU) interfaces with multiple Link 16/IJMS DLIUs that, with the TDS, form the JTIDS Units on the Link 16/TADIL J and IJMS network. That interface is via an Ethernet LAN.

The JNSU Network Functions controls the Link 16/IJMS DLIUs with regard to transmission sequencing. When one of the Link 16/IJMS DLIUs transmits, all of the other Link 16/IJMS DLIUs and the TDS receive the transmission.

When the TDS transmits on the link, the TDS sends its messages to the JNSU as if the JNSU was a MIDS Terminal. The JNSU then passes those messages to the Link 16/IJMS DLIUs for receive processing.

The JNSU MIDS Terminal Functions react to the messages received from the TDS and provide MIDS Terminal status to the TDS. The MIDS Terminal Functions are programmed to make the JNSU appear as a MIDS Terminal to the TDS.

2.6 SYSTEM SUPPORT FUNCTIONS

2.6.1 Data Link Extraction, Recording and Reduction

Specifically for the testing environment, the UTTS provides the means to extract and record all messages transmitted and received by a DLIU.

The recorded messages can be reduced on-line or off-line on a Personal Computer.

The reduction programs allow the operator to optionally select the format of reduction from binary, octal, hexadecimal or man-readable. The man-readable format is provided in the English Language

The reduction programs allow the operator to filter the reduction by time period, data link type, transmitted messages, received messages, message type, track number, etc.

3 ADDITIONAL INFORMATION

Software modules are sold on a license basis and quantity discounts apply. For additional information and pricing options contact:

Mr. Bruce Brady
Director, Business Development and Marketing
Interoperability Systems International Hellas S.A.
25 Tichis Str.
16777 Hellinikon
Athens, Greece

Tel: +30 210 964 7756 Ext. 3203
FAX: +30 210 963 4892
Email: bruce.brady@isihellas.gr