Navy Combat System Simulation
Users Guide

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Computer Science Report No. RM-92-03
April 26, 1992

COMPUTER NETWORKS LABORATORY
UNIVERSITY OF VIRGINIA
NAVY COMBAT SYSTEM SIMULATION
USER'S GUIDE

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1. NAVY COMBAT SYSTEM SIMULATION

1.1 Purpose

The primary purpose of the system is to demonstrate the utility of using XTP and SAFENET in a typical Navy application. The displays and controls used in the system have been specifically designed to provide capabilities and functionality similar to the capabilities of standard Navy display consoles. This will provide Navy personnel and contractors with a familiar platform on which to judge the capabilities of the XTP protocol and the SAFENET architecture.

1.2 System Architecture

The system consists of a network of IBM PC/AT's or compatible systems based on the Intel 80386 or 80286 microprocessor (Fig. 1-1). Each system requires 640 KB of memory, a VGA graphics card, and a Microsoft Mouse (or compatible). Also, 80387 (or 80287) math coprocessors are recommended although not required.

The Navy Combat System Simulation network consists of one Track Environment Simulator and a set of Track Display Consoles. The Environment Simulator acts as a central database for calculating and updating the positions of environmental tracks (ships, planes, subs, etc.) in the system. The Track Display Consoles are used to display the current track data and allow interactive control of the track environment.

The Track Environment Simulator runs prescripted scenarios and transmits track data to all Display Consoles on the network. The Simulator also updates the track environment when it receives interactive control messages from the Display Consoles.

The Track Display Consoles provide displays and capabilities similar in functionality to standard Navy display stations. In addition, the Display Consoles allow the operators to interactively enter new tracks, modify existing tracks, and launch missile engagements.

1.3 Loading and Running the Simulation

To set up the Navy Combat System Simulation, the operator must load either a Display Console or the Track Environment Simulator on each of the PC/AT's on the network. The complete simulation system consists of one Track Environment Simulator and a set of Display Consoles.

Each system on the network must be configured so that it is identified by a unique XTP protocol address. To simplify loading, a set of batch files can be used to run the software and correctly set

addresses. The operator will type one of the batch file names at the DOS prompt on each PC/AT. The set of batch files is listed below:

TRACKSIM - loads the Track Environment Simulator
CONSOLE1
CONSOLE2
CONSOLE3 - loads a Track Display Console with a specific address.

This set of batch files allows the operator to load the system with a specific set of addresses. Appendix A contains a complete description of the software command line arguments for both the Track Display Consoles and the Track Environment Simulator if more explicit control of addressing is desired.

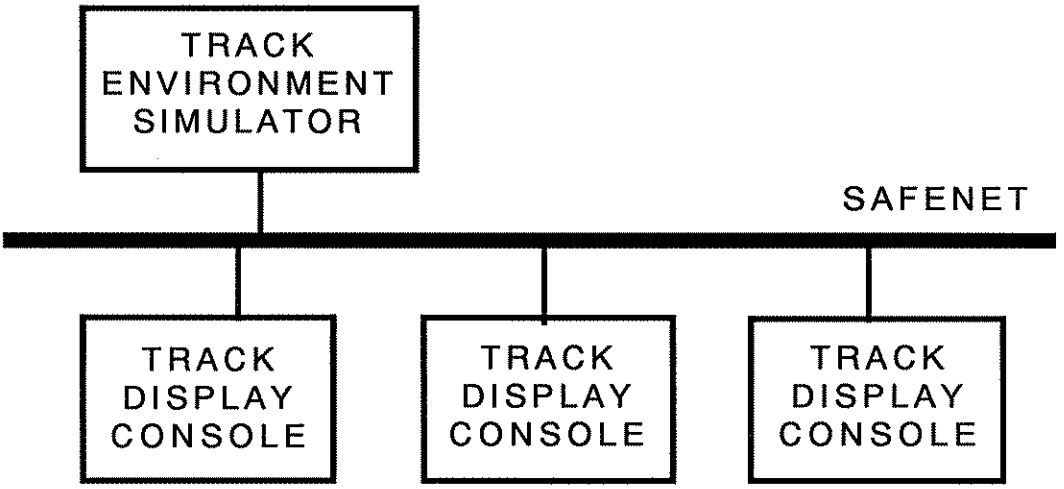


Figure 1-1: Network Configuration

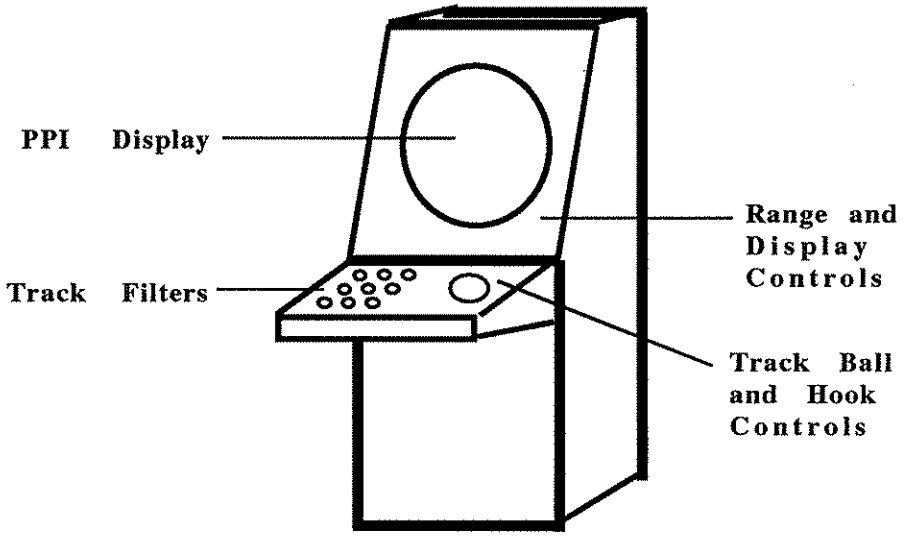


Figure 2-1: Typical Navy Display Station

2. OPERATING THE TRACK DISPLAY CONSOLES

2.1 Overview

The Track Display Console displays the current track environment and permits the operator to interactively respond to or change the current environment. This section will describe the capabilities of the Display Consoles and will provide detailed operating instructions. The controls and functions on the Display Console have been specifically designed so that they are similar to the controls found on standard Navy consoles (Figure 2-1). (Most functions are based on the capabilities of the AEGIS display stations, particularly the OJ-194 consoles.) In addition, Windows-style controls are used for interactive control actions such as track entry.

The Display Consoles have also been designed such that the entire system is mouse-driven and keyboard entry is unnecessary. Detailed instructions for using the mouse and the Windows-style controls are provided in Section 2.2. Operating instructions and descriptions of the Display Console capabilities are detailed in Section 2.3.

2.1.1 Layout of the Display Consoles

The layout of the Track Display Console is shown in Figure 2-3. The Display is divided into four main sections: the Title Bar, the PPI (Plan Position Indicator or radar scope) Display, the Menu Display, and the Track Data Display.

The Title Bar, across the top of the screen, displays the current time and contains the "EXIT" button which terminates the Display Console program. (Refer to Section 2.2.2.1 for a description of how the button controls are used.)

The PPI Display is the largest area on the display. This is the area in which track data is displayed using NTDS (Navy Tactical Data System) symbology. The display consists of four evenly spaced concentric range rings. The outer range ring is highlighted with degree marks for each angle of degree. The track symbols are displayed within the range circle. In addition, the current range scale is shown in the lower right-hand corner, and track data for the currently selected track is shown in the upper right-hand corner. For a complete description of the PPI Display, refer to Section 2.3.2.

The Menu Display area is the section containing button controls immediately below the Title Bar and to the left of the PPI Display. The Display Console is configured and interactive control functions are initiated using the Menu Display. Section 2.3.4 discusses the Menu Display controls in detail.

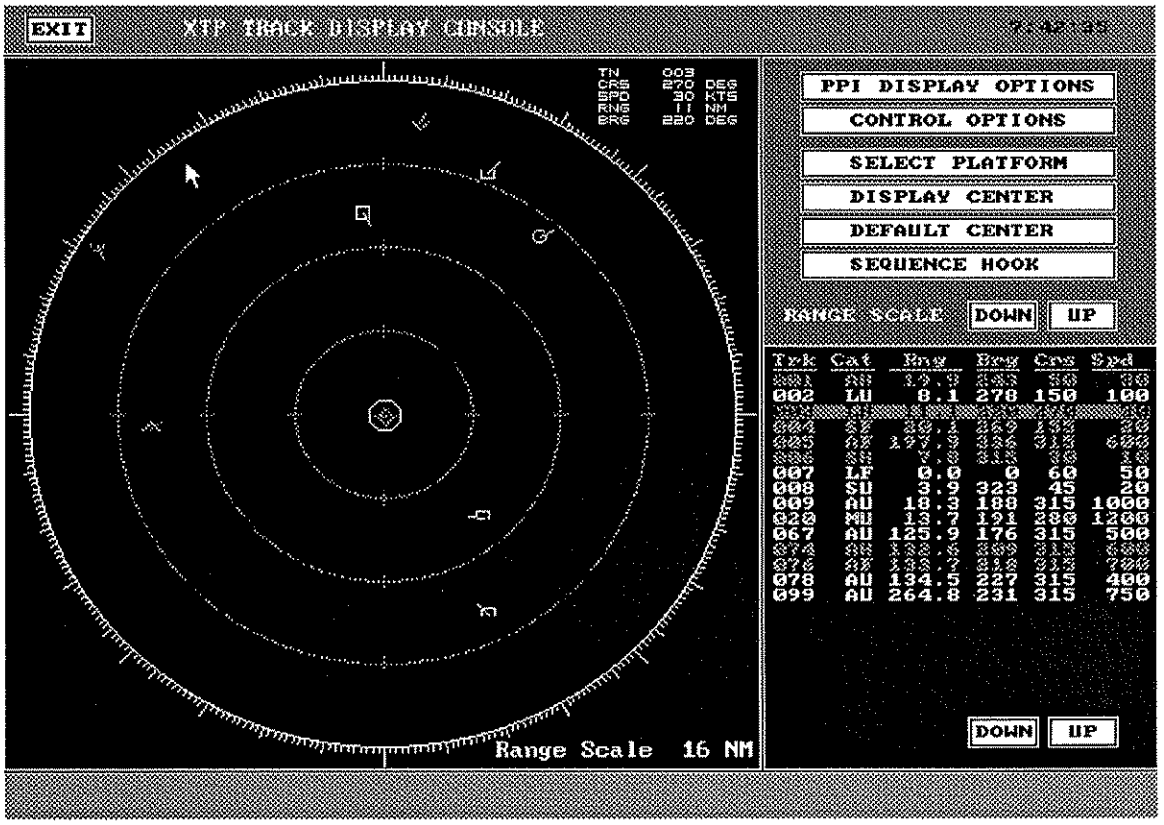


Figure 2-3: Track Display Console Layout

The last section of the screen is the Track Data Display area. This area displays track information for up to twenty tracks at a time. Data for other tracks can be displayed by clicking on the "UP" or "DOWN" buttons to display either the next or the last page of tracks respectively. Section 2.3.3 discusses the Track Data Display in greater detail.

2.1.2 Explanation of Navy Display System Terminology

To the uninitiated, Navy terminology often seems cryptic and confusing, and with good reason. This section is an attempt to define some of the terms which will be appearing throughout this document.

Track - A ship, submarine, aircraft, or missile that has been reported by a sensor system such as radar or sonar.

Platform - A ship, aircraft, or submarine that can be used for launching an attack.

Ownship - The ship to which you are assigned. This is the ship that you are physically attached to and are controlling.

PPI - Plan Position Indicator. This is the "radar scope" part of the display console where track symbols are displayed.

NTDS - Navy Tactical Data System. This is a Navy standard for data formatting and display.

NTDS Symbology - Standard Navy display symbology for representing various classes of tracks (Figure 2-2). The Display Console uses NTDS symbology to represent tracks on the PPI display.

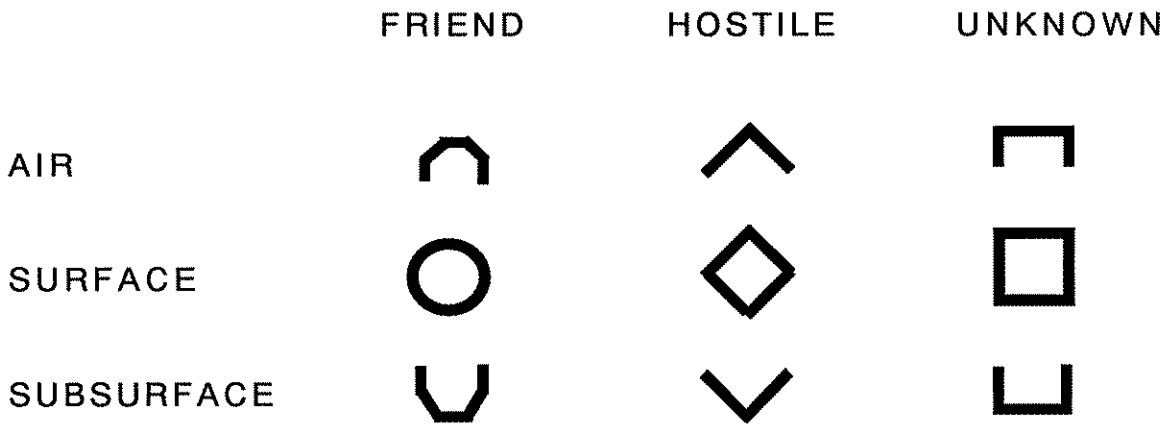


Figure 2-2: NTDS Symbology

Track Leaders - A short vector radiating out from the center of a track symbol indicating course and speed. On the Track Display Console, only course leaders have been implemented.

Hooking a Track - Moving the trackball (or mouse) cursor on top of a track symbol and clicking on the symbol. A circle will appear around the selected track indicating that the track has been "hooked". Data for the hooked track will be displayed and can be examined by the console operator.

Close Control - Hooking a track is also referred to as "bringing a track under close control". The "close control" track is the track that is currently hooked.

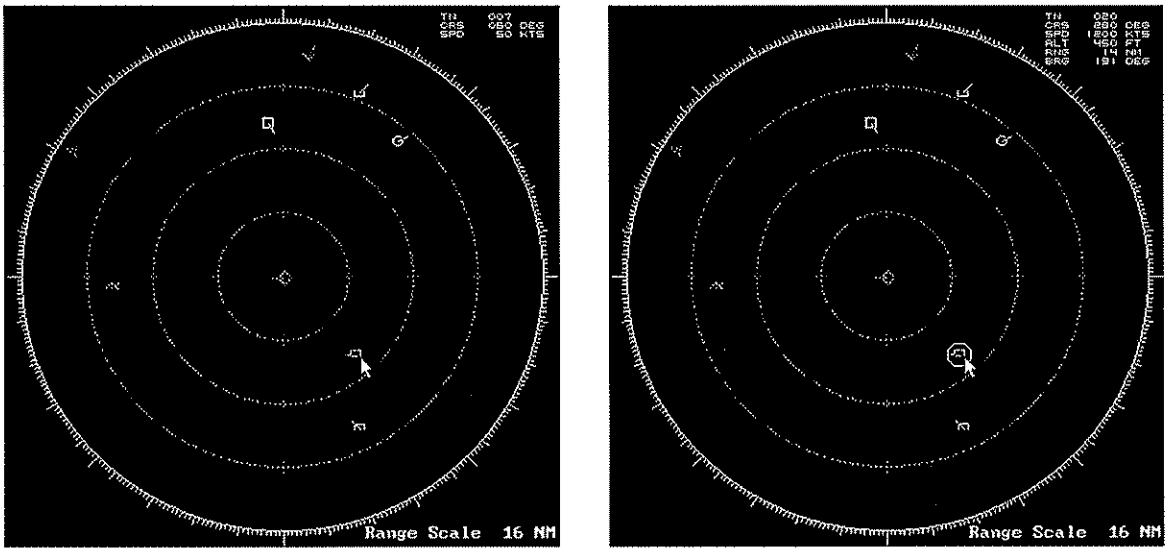
Track Sequence or **Hook Sequence** - On many display consoles, there is a button above the trackball which allows the operator to hook the next track being held by the combat system in a round-robin order. This is referred to as "sequencing the hook".

2.2 Console Controls

The purpose of the Track Display Console is to provide capabilities similar to the functions provided by standard Navy consoles and to permit the operator to interact with the current track environment. For ease of use, all operator input on the Display Console is mouse-driven and has been designed so that no keyboard input is required. There are two main classes of controls which are available on the Track Display Console, "hook controls" and "Windows-style controls". The "hook controls" are used for hooking a specific track. The "Windows-style controls" are used for configuring the Display Console and for interactively controlling the track environment. Specifics on how to use each of the classes of console controls are outlined in the following sections.

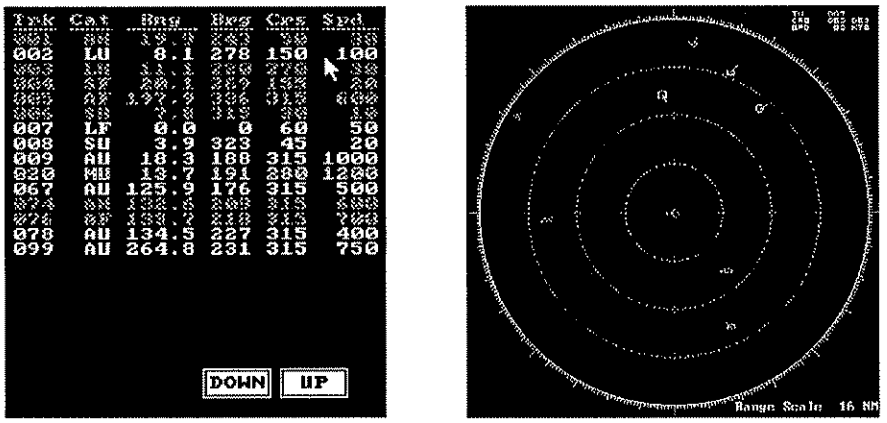
2.2.1 Hooking Tracks

There are two methods for selecting a track. The first method is to move the mouse cursor on top of a track symbol on the PPI display (see Figure 2-4(a)) and click the mouse button. A circle will appear around the "hooked" track and current track data for the hooked track will be displayed in the upper right-hand corner of the PPI display (see Figure 2-4(b)). If the mouse is clicked on the PPI display when there is no track near the mouse cursor, any track that was hooked will be deselected (i.e., the hook will be dropped).

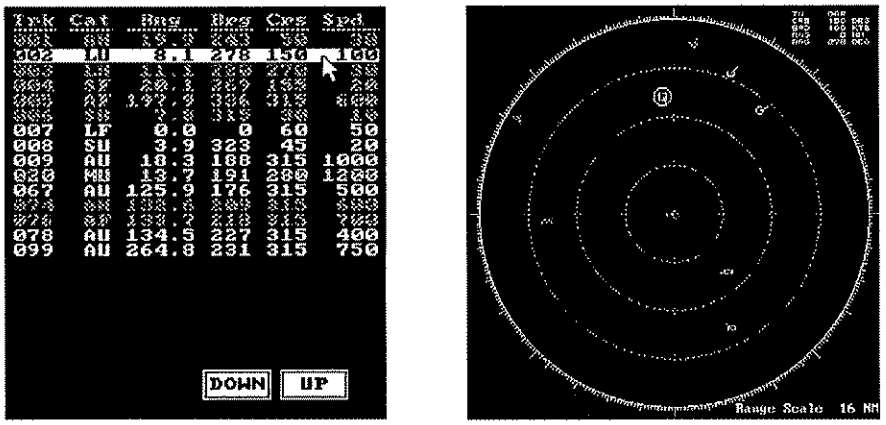


(a) Before clicking (b) After clicking

Figure 2-4: Hooking a Track on the PPI Display



(a) Before clicking



(b) After clicking

Figure 2-5: Hooking a Track on the Track Display

The second method for hooking a track (Figure 2-5) is to find a track of interest on the Track Data Display, move the mouse cursor to the line representing the track, and click the mouse button. The track symbol representing the selected track will be displayed as hooked on the PPI display and the line representing the hooked track will be highlighted on the Track Data Display.

Figure 2-6: Buttons

Figure 2-7: Toggle Boxes

2.2.2 Windows-Style Controls

The Windows-style controls are similar in appearance and function to the controls found in many popular graphics windowing applications. The four main classes of controls are buttons, toggle boxes, bearing selectors and slider selectors. Instructions on using each of the controls are provided below.

2.2.2.1 Buttons

Buttons (Figure 2-6) are the simplest of the windowing controls. The function of each button is written on the button. To perform the function provided by a specific button, the mouse cursor is moved onto the button, and the mouse is clicked. The button function will then be performed.

Two standard types of buttons found in various windows on the Display Console are the "OK" and "CANCEL" buttons. "OK" indicates that the current operation should be performed. "CANCEL" indicates that the current operation should be abandoned.

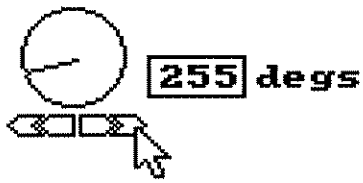
2.2.2.2 Toggle Boxes

Toggle Boxes (Figure 2-7) permit the operator to either select or deselect an option. If the toggle box contains an X, the option is selected (ON). If the box is empty, the option is deselected (OFF). To toggle the option represented by the toggle box, the mouse cursor is moved onto the toggle box, and the mouse button is clicked. If the toggle box was previously on, the box will now be displayed as off. Similarly, if the toggle box was off, the box will now be displayed as on.

(a) Original bearing

(b) Rough bearing selection

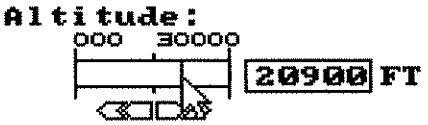
(c) Fine-tuning 1 degrees



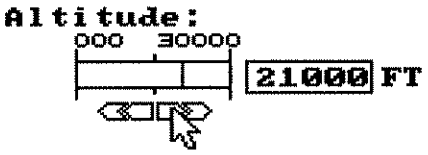
(d) Fine-tuning 5 degrees

Figure 2-8: Bearing Selectors

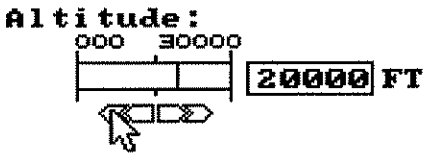
(a) Initial value



(b) Rough selection



(c) Fine-tuning



(d) More fine-tuning

Figure 2-9: Slider Selectors

2.2.2.3 Bearing Selectors

Bearing Selectors (Figure 2-8) are a little more complicated than the previously mentioned windowing controls. The bearing selectors and the slider selectors (discussed below) permit the console operator to enter data values without requiring use of the keyboard. The bearing selectors are used for inputting azimuth values between 0 and 359 degrees.

The current value of the bearing selector is displayed both graphically (by the angle of the bearing line within the circle) and textually (in the box next to the bearing circle). The selected bearing can be modified by either clicking the mouse within the bearing circle or clicking on the arrows below the bearing circle. Clicking within the circle selects the bearing closest to the point in the circle where the mouse cursor was positioned. This can be used for selecting a rough bearing. The arrows beneath the circle can then be used for "fine-tuning" the selected bearing. Clicking on the rightmost two arrows increments the selected bearing by 1 degree and 5 degrees respectively,

and clicking on the leftmost two arrows decrements the selected bearing by the same values.

2.2.2.4 Slider Selectors

Slider selectors (Figure 2-9) are used to select a specific value from within a range of possible values. The horizontal rectangle portion of the selector represents the range of possible values. The upper and lower bound values are displayed above the ends of the rectangle. The vertical bar within the horizontal rectangle, along with the text display next to the rectangle, shows the current value of the selector.

To choose a value, the operator can click within the horizontal rectangle or click on the arrows below the rectangle. The operation of the slider selector is similar to the operation of the bearing selector described above. Clicking within the horizontal bar selects the value nearest the value corresponding to the position of the mouse cursor. This gives a rough selection of the value. "Fine-tuning" is provided by clicking on the arrows beneath the horizontal bar. Unlike the bearing selectors, the slider selectors can have different values for the inner and outer arrows depending on the range of possible values. (For instance, a slider selector for representing the depth of a submarine may have the inner arrows change the depth by 10 feet, while the outer arrows change the depth by 100 feet.)

2.3 Console Displays and Controls

This section outlines all of the features and capabilities of the Track Display Console. All sections of the display console are discussed in detail and instructions for using all of the operator selectable control features are provided.

2.3.1 Title Bar

The Title Bar displays the name of the Display Console Program and the current clock time in hours:mins:secs format. The "EXIT" button is also provided in the upper left-hand corner. Clicking on the "EXIT" button will terminate the Track Display Console program and return to the DOS operating system.

2.3.2 PPI Display

The PPI Display (Figure 2-10) contains a "radar scope" display where tracks are displayed using NTDS symbology. The PPI Display consists of a set of four concentric range rings with the outer ring being marked off at each degree. The current range scale for the display is shown in the lower right-hand corner. The radius of the outer range ring is represented by the displayed range scale. Any tracks that are within the range scale from the current display center will appear on the PPI Display (if they are not being filtered; see Section 2.3.4.1.6 below). The PPI Display is updated once per second.

The Track Display Console can display up to 100 simultaneous tracks. These tracks will be represented by NTDS symbology based on track category (air, surface, or subsurface). The identity (hostile, friend, or unknown) of each track will determine the track's color; hostile tracks are displayed as red, unknown tracks as yellow, and friendly tracks as green. Missile tracks will be displayed as orange air tracks with the missile's identity being determined by the identity of the platform that launched the missile. If a default platform (Ownship) has been selected, the default platform will be displayed as white (See Section 2.3.4.1.1).

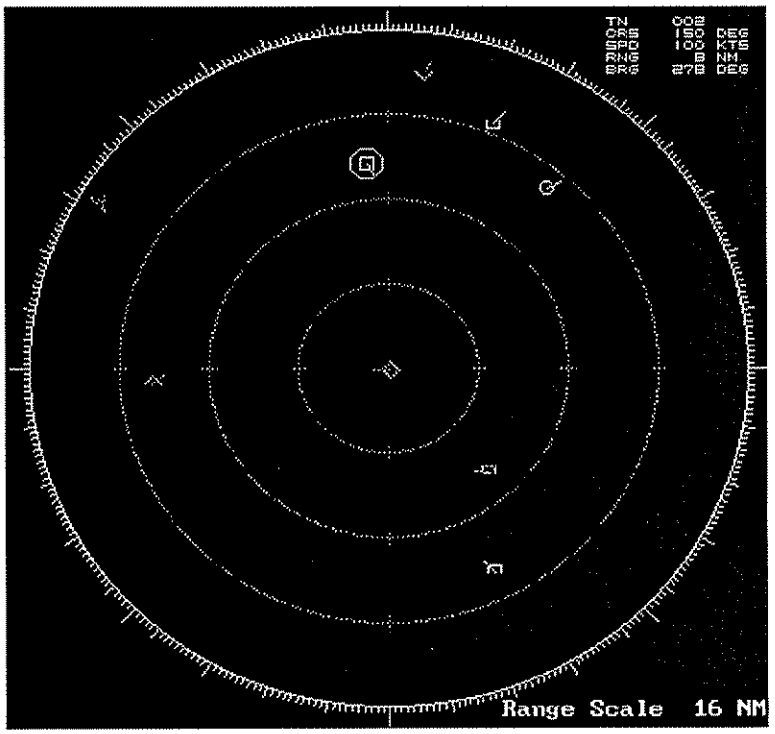


Figure 2-10: PPI Display

Also, if a track is hooked and appears on the PPI Display, a circle will be displayed around the track. Track course leaders may also be displayed based on operator selection (See Section 2.3.4.1.6 below).

If a default platform has been selected and no track is currently hooked, track data for the default platform will be displayed in the upper right-hand corner. This data will show the track number, course, and speed of the default platform. However, if a track is hooked, the track data in the upper right-hand corner will reflect the data for the hooked track. The data will show the hooked track number, course, speed, range and bearing of the hooked track from the default platform. Also, altitude or depth for the hooked track will be shown if the track is an air, missile, or subsurface track.

Hooking tracks (see Section 2.2.1 above) is the only operator action that can be performed from the PPI Display. Configuration of the PPI Display can be performed from the Menu Display area and will be discussed in Section 2.3.4.1 below. These configuration options include changing the PPI range scale, selecting a default platform, changing the display center, displaying track leaders, and filtering certain track categories and identities from being displayed.

2.3.3 Track Data Display

Figure 2-11: Track Data Display

The Track Data Display area (Figure 2-11) displays data on up to twenty tracks at a time in text format. The displayed track data is ordered by track number and shows for each track the track number, range from the default platform in nautical miles, bearing from the default platform in degrees, course in degrees, and speed in knots. The category and id of each track is also displayed as a two-character string. The first character represents the category (A:Air, S:Subsurface, L:Surface or Land, and M:Missile) and the second character represents the track's identity (H:Hostile, U:Unknown, and F:Friend). Each line of track data is also color-coded based on the symbol color used on the PPI Display (see Section 2.3.2 above). Also, the line of track data which represents the current hooked track will be highlighted in reverse video. The Track Data Display is automatically updated every second.

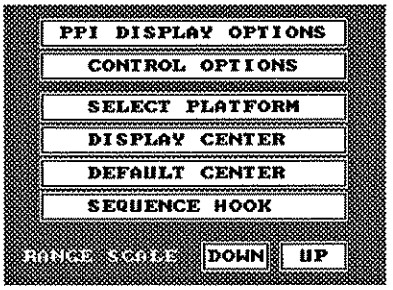


Figure 2-12: Menu Display Area/Main Menu

The Track Data Display area also contains two buttons, "DOWN" and "UP" which are used to page through the list of active tracks. The "DOWN" button displays the previous page of twenty tracks, and the "UP" button displays the next page of twenty tracks.

Tracks can also be hooked from the Track Data Display area (see Section 2.2.1 above). By clicking on a line of track data, the corresponding track will be hooked.

If a track is hooked from the PPI Display or via the "SEQUENCE HOOK" button (Section 2.3.4.1.4), the Track Data Display will be automatically updated so that the hooked track data appears in the Track Data Display. Also, if a new default track is selected (Section 2.3.4.1.1), all displayed track data will automatically be recalculated to show range and bearing with respect to the new default track.

2.3.4 Menu Display Controls

The Menu Display area (Figure 2-12) is the main area from which operator actions are performed. If an operator action (i.e., clicking on a button) causes a window to pop up, this new window will also be displayed in the Menu Display area. Also, windows which are too large to fit completely within the Menu Display area will overlap into the Track Data Display area.

The list of option buttons which is displayed in the Menu Display area when the Display Console is first loaded is known as the Main Menu (Figure 2-12). The functions that are provided on the Main Menu can be broken down into two groups: Navy display console emulation functions and interactive scenario control functions.

2.3.4.1 Navy Console Emulation Support

The first group of functions on the Main Menu provides direct emulation of operator selectable configuration capabilities provided by standard Navy display stations. One set of these functions emulates the dial selections found on many Navy consoles; these include such PPI display capabilities as choosing a specific track to serve as the center of the display, selecting the PPI range scale, and setting certain track display filters. Other functions emulate the "sequence hook" trackball button and allow the operator to select a track to serve as the default controlled platform or "Ownship". All of the console emulation functions are described in detail in the following sections.

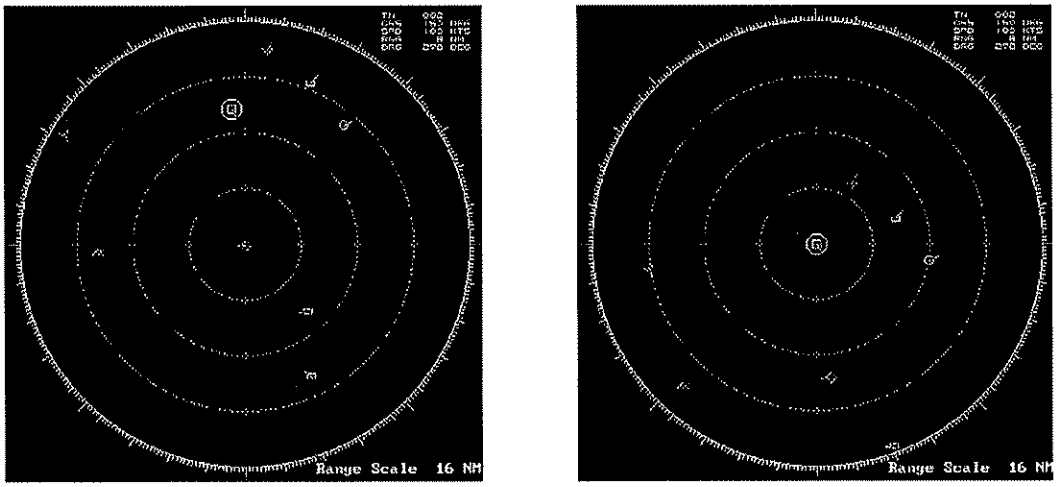
2.3.4.1.1 Selecting a Default Platform

The "SELECT PLATFORM" button on the Main Menu allows the operator to choose a track to serve as the platform representing his specific display console. (Another way of viewing this is that the operator is selecting a track to serve as "Ownship", the platform he is "stationed" on and is controlling.)

To select a default platform, the operator must first hook the track which he wishes to use as the default platform. Then, when the operator clicks on the "SELECT PLATFORM" button, the hooked track will be displayed as white and the hooked track becomes the new default platform. When a new default platform is selected, the track positions of all other tracks in the system are recalculated so that the ranges and bearings of all tracks are shown relative to the new default platform.

2.3.4.1.2 Display Center

The "DISPLAY CENTER" button on the Main Menu causes the currently hooked track to be centered on the PPI display, and all other tracks to be displayed relative to the centered track. Figure 2-13 shows an example of changing the display center.



(a) Hook the desired track (b) Display the track as center

Figure 2-13: Changing the PPI Display Center

2.3.4.1.3 Default Center

The "DEFAULT CENTER" button on the Main Menu causes the currently selected default platform (Ownship) to be centered on the PPI display.

2.3.4.1.4 Sequence Hook

The "SEQUENCE HOOK" button on the Main Menu allows the operator to cycle through the tracks in the system in a round-robin order. Each time the "SEQUENCE HOOK" button is clicked, the next highest numbered track above the currently hooked track (in round-robin order) will become the new hooked track. If the "SEQUENCE HOOK" button is clicked when no track is hooked, the lowest numbered track in the system will be hooked.

2.3.4.1.5 PPI Range Scale Selection

The PPI range scale can be changed by clicking on either the Range Scale "UP" or "DOWN" buttons on the Main Menu. The "UP" button will double the PPI range scale up to a maximum of 512 NM (nautical miles). Conversely, the "DOWN" button will halve the PPI range scale down to a minimum of 4 NM.

2.3.4.1.6 PPI Display Options

The "PPI DISPLAY OPTIONS" button on the Main Menu causes the PPI Display Control window (Figure 2-14) to pop up. The PPI Display Control window permits the operator to turn track leaders on or off and to select categories and identities of tracks to be filtered from the PPI display.

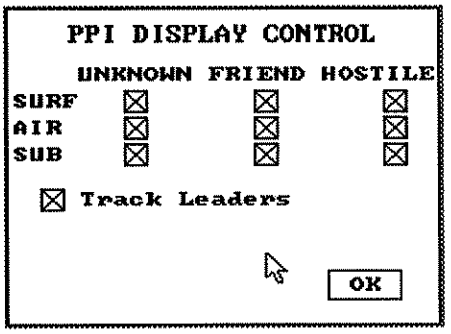
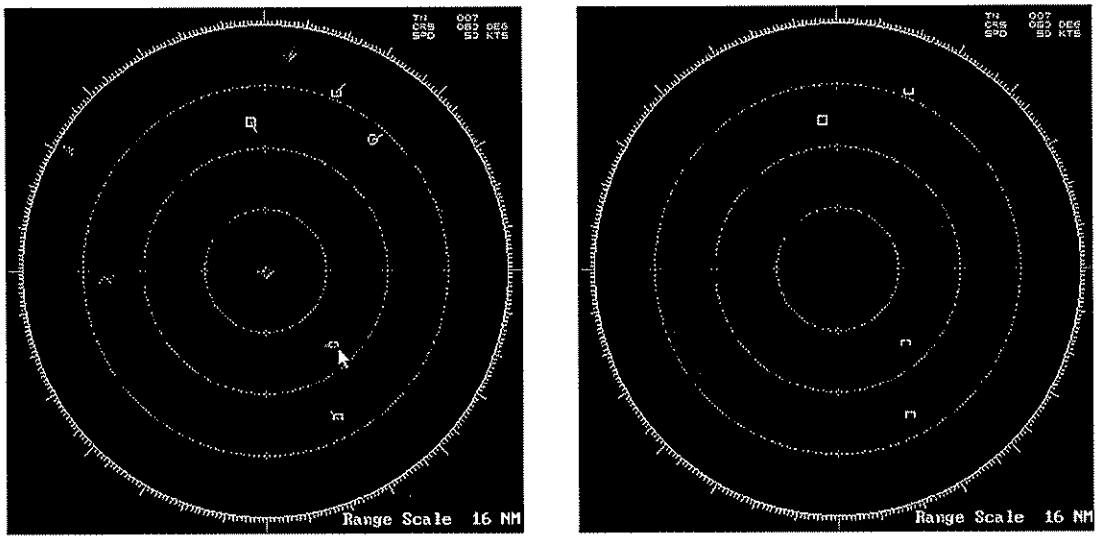


Figure 2-14: PPI Display Control Window

For the track filter toggle boxes, if a toggle box is on, tracks of the corresponding category and identity will be displayed on the PPI display. If a toggle box is off, tracks of the corresponding category and identity will not be displayed. Figure 2-15 demonstrates the effects of changing the display filters.

After all PPI display configurations have been selected on the PPI Display Control window, the "OK" button should be clicked. This will remove the PPI Display Control window and the Main Menu will be redisplayed.



(a) All tracks are displayed (b) Filtered tracks and no leaders

Figure 2-15: Configuring the PPI Display

2.3.4.2 Interactive Scenario Control Options

The second group of functions selectable from the Main Menu allow the operator to interactively control and modify the currently active track environment. Clicking on the "CONTROL OPTIONS" button on the Main Menu brings up the Track Control Options window (Figure 2-16). From this window, the current track environment can be modified interactively if a scenario is being run on the Track Environment Simulator. (Refer to the discussion of the Track Environment Simulator in Section 3 for further information.)

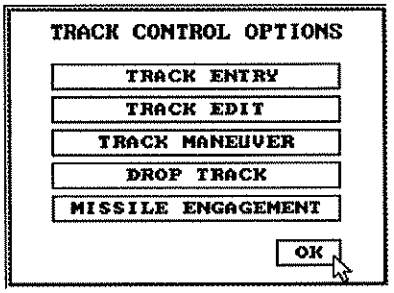


Figure 2-16: Track Control Options Window

From the Track Control Options window, the operator can enter, edit, maneuver, or drop tracks. Also, the operator can engage and launch missiles at specific tracks. Detailed instructions for using each of the interactive control options are discussed in the following sections.

When the operator selects a track control option, a message is sent to the Track Environment Simulator instructing the Simulator to modify the current Track Environment. (Refer to Section 4 for an overview of the message traffic between network units.) Because the Track Environment Simulator is responsible for maintaining and updating the track environment, if the Track Environment Simulator has not been loaded or if no scenario is being run, all operator actions from the Track Control Options window will be ignored.

Clicking the "OK" button on Track Control Options window will exit the window and return to the Main Menu.

2.3.4.2.1 Track Entry

The Track Entry window (Figure 2-17) is brought up by clicking on the "TRACK ENTRY" button on the Track Control Options window. This window allows the operator to set up and inject a new track into the current track environment.

The operator can select the category, identity, course, speed, range, bearing, and altitude or depth of the new track. The allowable speed, altitude, and depth are dependent on the track category selected.

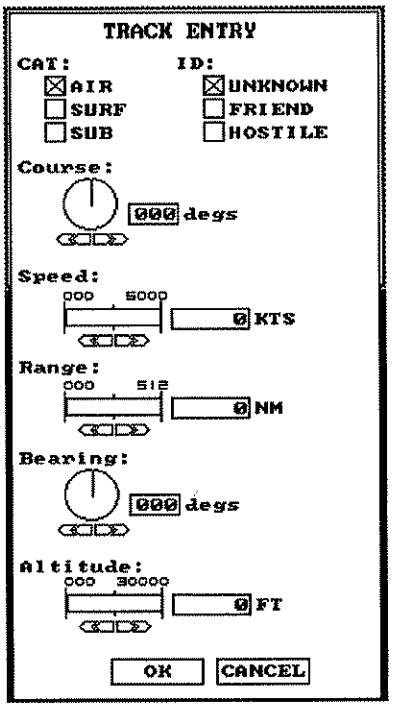


Figure 2-17: Track Entry Window

Table 2-1 lists the allowable speed and altitude/depth ranges based on the category of the track. The range and bearing selected for the new track will be relative to the position of the current default platform (Ownship).

If the operator decides not to enter a new track, he can click the "CANCEL" button which will remove the Track Entry window and return to the Track Control Options window without entering a new track. Otherwise, after the operator has properly set up the parameters for the new track, he can select the "OK" button which will cause the new track data to sent to the Track Environment Simulator and be injected into the current track environment (unless there are already 100 active tracks in the environment in which case the message will be ignored).

2.3.4.2.2 Track Edit

The "TRACK EDIT" option on the Track Control Options window is similar in function to the "TRACK ENTRY" option discussed above. In order to edit a track, the operator must first hook the track he is interested in modifying. If no track is hooked when the "TRACK EDIT" button is clicked, a message window pops up requesting the operator to hook a track. If the operator has hooked a missile track, a message window will be displayed stating that missile tracks may not be edited. If the operator has hooked a non-missile track, the Track Edit window will pop up (Figure 2-18).

From the Track Edit window, the operator will be able to selectively modify any of the track's parameters. This window is similar to the Track Entry window discussed in Section 2.3.4.2.2 above. One difference between the two windows is that the current parameters of the track being edited are displayed for each window control option. Also, parameters will not be changed unless the toggle box in front of a particular option is selected.

After the operator has selected the parameters he wishes to change, the "OK" button should be clicked. This sends the new track parameters to the Track Environment Simulator in order to update the

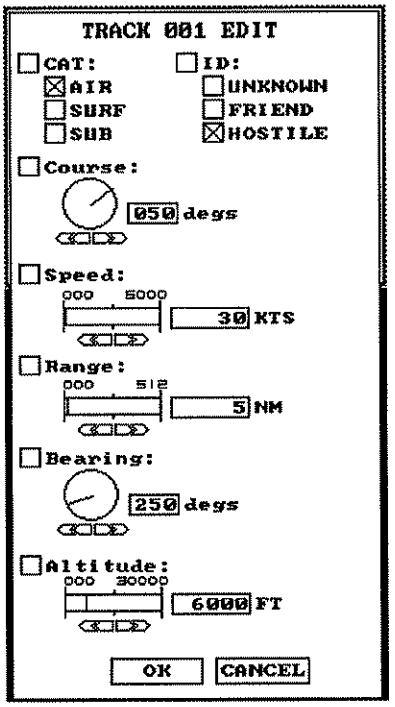


Figure 2-18: Track Edit Window

Category	Speed (knots)	Alt/Depth (ft)
AIR	0 to 5000	0 to 30000
SURFACE	0 to 200	0
SUB	0 to 200	0 to 15000

Table 2-1: Speed and Alt/Depth Ranges

track environment to reflect the entered changes. If, on the other hand, the operator decides not to modify the track, he may click on the "CANCEL" button to remove the Track Edit window and return to the Track Control Options window.

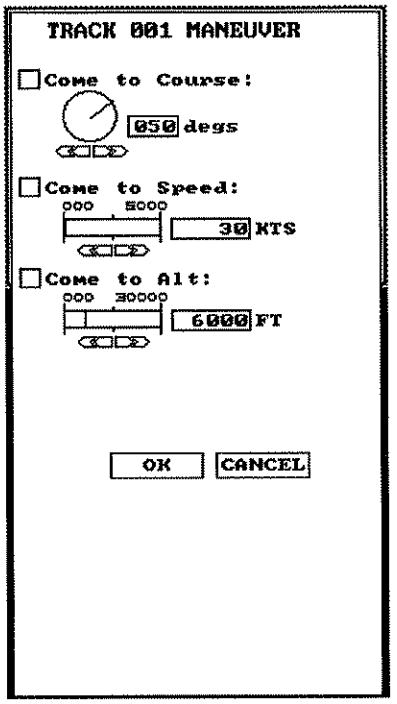


Figure 2-19: Track Maneuver Window

2.3.4.2.3 Track Maneuver

The "TRACK MANEUVER" button on the Track Control Options window is used to enter track maneuvers involving course, speed, and altitude or depth changes. In order to maneuver a track, the track to be maneuvered must be hooked. If no track is hooked, a message window will be displayed requesting the operator to hook a track to maneuver. Also, since only non-missile tracks are allowed to be maneuvered, if a missile track is hooked, a message window will be displayed stating that missile maneuvers are not permitted. If a non-missile track is hooked, the Track Maneuver window will be displayed (Figure 2-19).

From the Track Maneuver window, the operator can enter course, speed, and altitude or depth maneuvers. The ranges of speed and altitude/depth maneuvers are based on the category of the track being maneuvered. Each of the maneuver option controls reflects the current parameters of the track being maneuvered. As on the Track Edit window discussed above, the toggle box in front of each maneuver option must be selected in order to activate that particular maneuver. Default maneuver rates are shown in Table 2-2. These rates cannot be changed from the Track Display Consoles but can be modified from the Track Environment Simulator (Section 3).

When the operator has selected the proper parameters for the track maneuver, the "OK" button should be clicked. This sends a message to the Track Environment Simulator containing the entered maneuver characteristics and permits the Simulator to begin maneuvering the track as requested. If the operator decides not to enter a track maneuver, he will click on the "CANCEL" button which removes the Track Maneuver window and returns to the Track Control Options window.

Climb/Dive Rate	:	100 ft/sec
Turn Rate	:	10 degs/sec
Acceleration	:	10 knots/sec

Table 2-2: Default Maneuver Rates

2.3.4.2.4 Drop Track

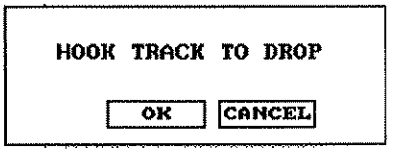


Figure 2-20: Drop Track Window

The "DROP TRACK" button on the Track Control Options window allows the operator to delete a track from the track environment. When the button is clicked, a message window pops up requesting the operator to hook the track which he wishes to drop (Figure 2-20). Clicking on the "OK" button will send a message to the Track Environment Simulator requesting that the hooked track be removed from the track environment. The "CANCEL" button allows the operator to abort the operation, removes the message window, and returns to the Track Control Options window.

2.3.4.2.5 Missile Engagement

The "MISSILE ENGAGEMENT" option on the Track Control Options window permits the operator to launch missiles from the default platform (Ownship) to intercept and destroy other tracks in the track environment. If a default platform has not been selected, missile engagements cannot be performed and a message window will be displayed informing the operator (Figure 2-21). If a default track has been selected, a missile will be launched against the currently hooked track. (If no track is hooked or the default track is hooked, a message window will pop up giving the operator the opportunity to hook a track to be engaged. See Figure 2-22.)

Figure 2-21: No Default Platform Message Window

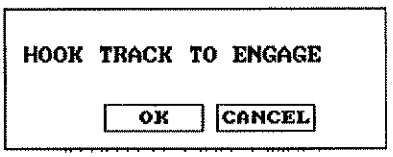
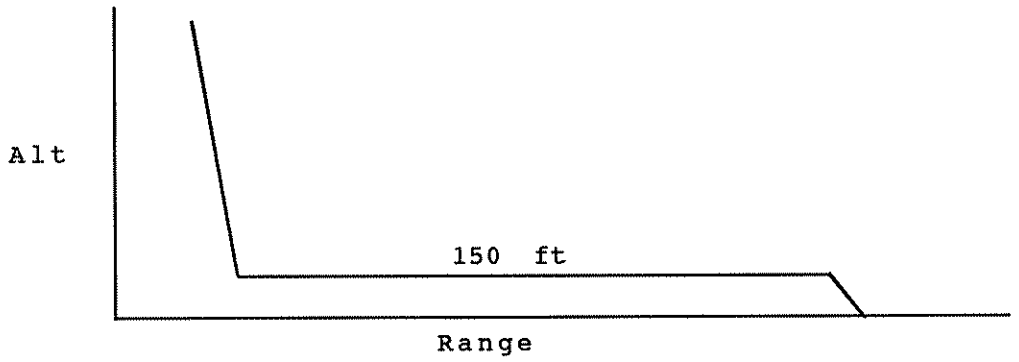


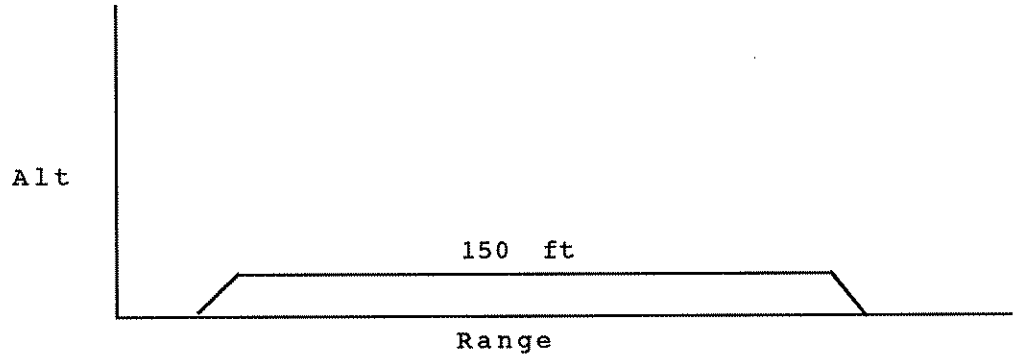
Figure 2-22: Hook Track Message Window

When a missile engagement is performed, a message is sent to the Track Environment Simulator which initiates a missile track and maneuvers it to attempt to intercept and destroy the engaged target track. The particular missile model used in the system is based on a cruise missile flying at Mach 2 with a cruising altitude of 150 feet. For each missile in the system, an intercept point with the intended target is calculated (if one exists) and the missile is flown towards this intercept point. If no intercept point exists, the missile will maneuver towards its target's current position. The exact missile flight profiles being used in the Simulator are shown in Figure 2-23.

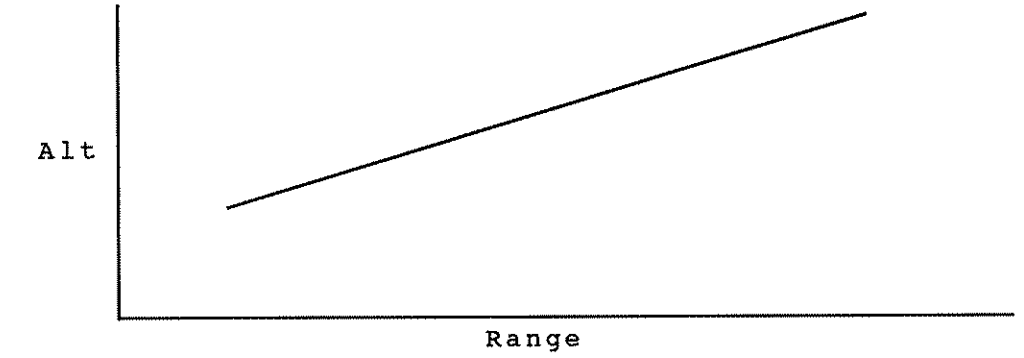
When a missile comes within 1000 yards of its intended target, the missile will detonate destroying both itself and its target. Currently, the only two ways a track can avoid being destroyed by a missile launched against it are either to outrun the missile or to shoot down the pursuing missile with another missile.



a) Air-to-Surface



b) Surface-to-Surface



c) Air-to-Air

Figure 2-23: Missile Flight Profiles

3. OPERATING THE TRACK ENVIRONMENT SIMULATOR

3.1 Overview

The Track Environment Simulator is the processor on the network where the global track environment is maintained, updated, and periodically distributed to the active Track Display Consoles on the network. The processor can simulate up to 100 tracks with track position updates for all tracks at least once per second. The tracks in the simulated environment can be initiated and modified by any of three different methods: by data entry from Simulator track control windows, by remote operator action at a Display Console on the network, or by the loading and running of a scripted scenario file.

This section describes the layout, displays, controls, and functionality of the Track Environment Simulator. Descriptions and details of all of the Simulator controls and displays are provided in Section 3.2. Running scenarios at the Simulator is the simplest way to initiate and control the track environment and a complete guide to setting up scenario files is contained in Section 3.3. This guide includes all scenario script commands and formats. Section 3.4 then discusses the internal details of several important Simulator functions including track updates, missile engagement processing, and network message traffic processing.

3.1.1 Layout of the Track Environment Simulator

The main display of the Track Environment Simulator is shown in Figure 3-1. The Simulator display consists of a 43x80 character text-only screen divided into several sections.

The main section of the display, consisting of the top half of the screen, is the Menu Display area. The title and version number of the Simulator is shown at the top of this area and the current menu is shown in the upper left-hand portion of the area. The bottom half of the Menu Display area is used for displaying pop-up windows. (Menus, menu selections, and pop-up windows are discussed in Section 3.2.2 below.)

The boxed display area in the upper right corner of the screen is the Status Display area. This area shows the current system and scenario times in hours:minutes:seconds format, the name of the current loaded scenario (if any), and the current scenario status (active, inactive, or paused). The displayed system time is the time since the Simulator has been loaded, and the script (scenario) time displays the current running time of the scenario if a scenario is being run. (If no scenario is active, the script time is displayed as 00:00:00.00.) There are also two other pieces of debug information which have been left on this display due to their utility in detecting problems: the size of free memory, and the number of times per second the simulator is able to complete its main processing loop.

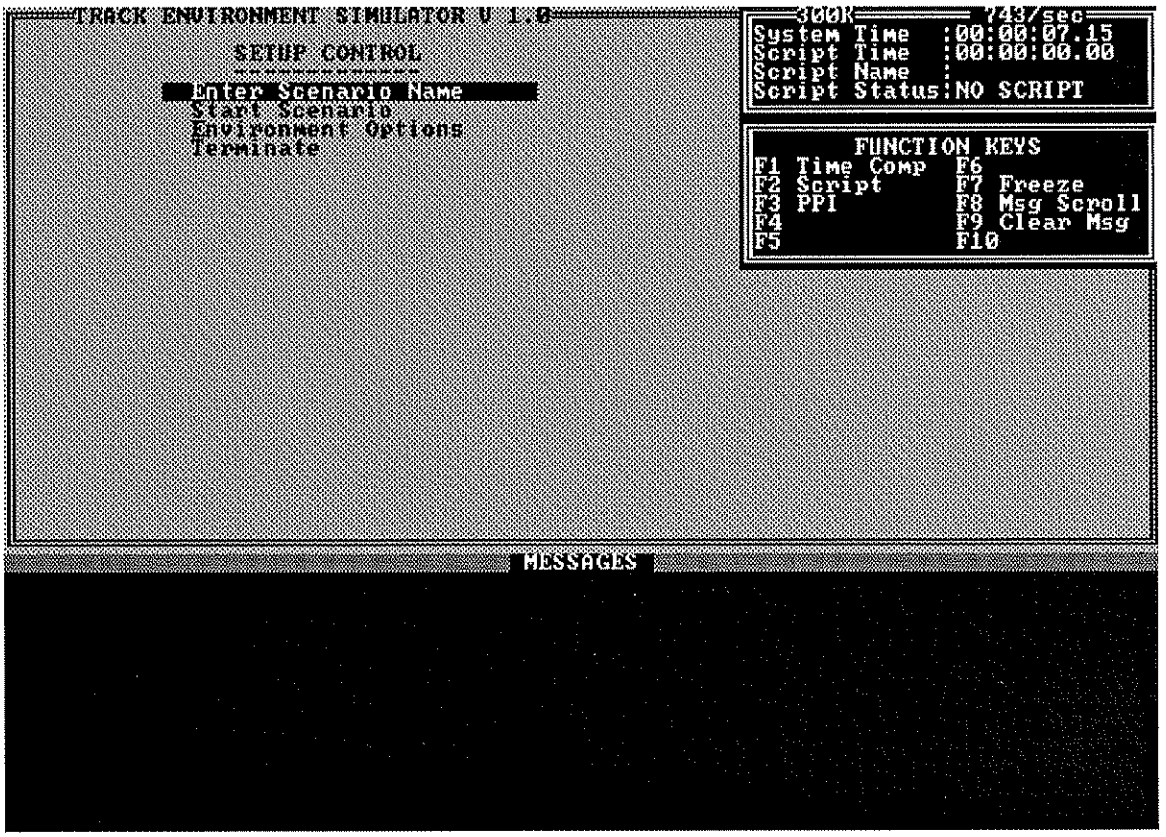


Figure 3-1: Track Environment Simulator Display

Immediately below the Status Display area is another boxed display area which shows the current Function key definitions. The functions for each defined function key are described in detail in Section 3.2.1 below.

The last area of the Simulator display is the Message and Alert area. This area is the large black section in the lower half of the screen. The area is used to display informational and error messages generated by the simulator. Whenever a message or alert is generated, it will be displayed with a time tag indicating when the alert occurred. If a scenario is running when an alert occurs, the current script time will be displayed as the time tag, otherwise, the system time will be used.

3.2 Simulator Controls and Displays

The keyboard is used for all operator entries and controls on the Simulator. The keyboard interface has been designed so that the controls are similar to the controls found on many other text windowing applications. In particular, except for data entry on some of the pop-up windows, the function keys, the arrow keys, and the ESC and Enter keys are the only keys used for moving around on menus and selecting control options. The details of all interactive Simulator functions are described below.

3.2.1 Function Keys

Figure 3-2: Function Keys

The function keys defined in the Function Key area (Figure 3-2) provide several useful capabilities. The function provided by each of the defined keys is outlined below:

F1 Time Comp : This key is used to select a time compression value for the current scenario in order to allow "fast forwarding" of the scenario. The running speed of the current scenario is doubled each time the function key is pressed. The speed can be doubled up to 8 times the normal speed and then will wrap around to normal speed the next time the function key is pressed. Each time the key is pressed, a message is written to the Message and Alert Area specifying the current time compression factor.

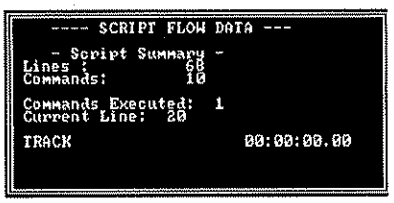


Figure 3-3 Script Window

F2 Script : This key brings up a pop-up window (Figure 3-3) displaying data on the currently loaded scenario. The window displays the name of the current scenario, the number of scenario commands in the scenario, and (if the scenario is running) the number of commands that have been executed and the name and script time of the last executed command. The Scenario Status window can be removed by hitting the ESC key.

F3 PPI : This key brings up a simple graphics PPI (Plan Position Indicator) display for debugging purposes (Figure 3-4). Tracks within 32 nautical miles of the center of the track environment will be displayed on the "radar scope" display using NTDS symbology.

F7 Freeze : This key temporarily freezes the Message and Alert area display. This can be useful for reading alert messages when a large number of alerts are being generated and quickly being scrolled off the display. To reenable scrolling, the function key should be selected again.

F8 Msg Scroll : This key scrolls backwards through the list of alerts which have been written to the Message and Alert area. A queue of the last 30 messages is maintained so that previous alerts can be recalled. This can be useful for finding a specific alert such as when a specific track was destroyed by a missile.

F9 Clear Msg : This key clears the Message and Alert area. All messages in the area and in the message buffer will be erased and lost. A practical use for this feature is for clearing all messages prior to running a new scenario.

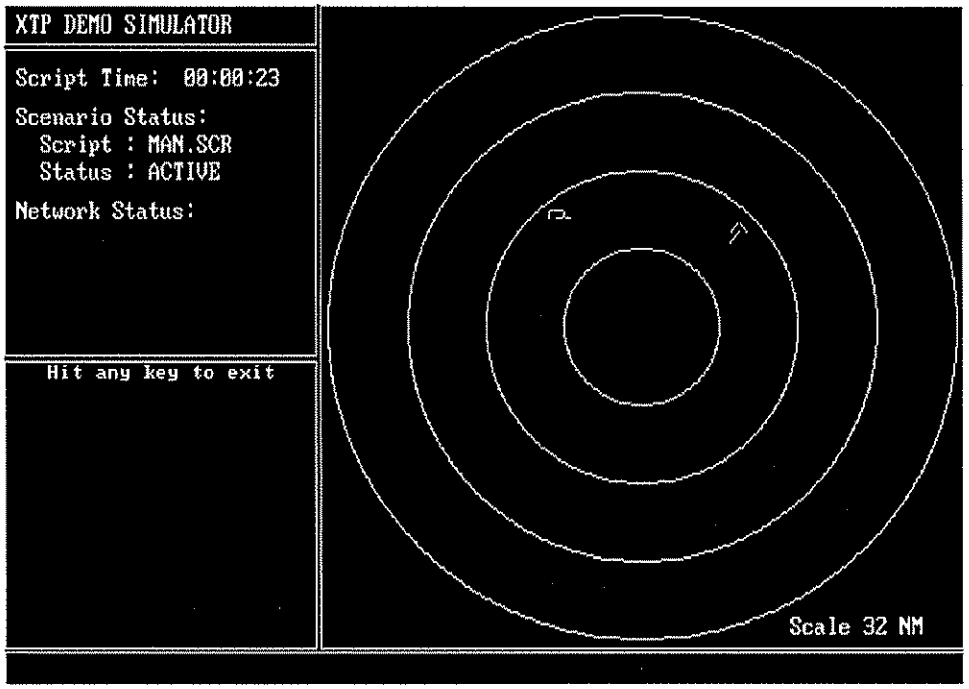


Figure 3-4: Simulator PPI Display

3.2.2 Menus

Most of the operator functions are accessed via the Simulator menu displays. The operation of the menus are simple and straightforward. The Up-Arrow and Down-Arrow keys are used to move to the previous and next menu item respectively in a round-robin order. The current option on the menu will be highlighted. The Enter key is then used to select a particular menu selection. Each of the Simulator menus is discussed below.

3.2.2.1 Setup Control Menu

The main menu displayed when the Simulator is first loaded is the Setup Control Menu (Figure 3-5). This menu allows the operator to load a scenario, run a scenario if it has already been loaded, go to the Environment Control Menu, or terminate the Simulator. The functions provided by each of the menu options are outlined below.

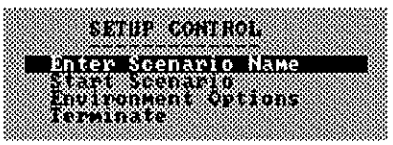


Figure 3-5: Setup Control Menu

Enter Scenario Name : This option will bring up the Scenario Load pop-up window (Figure 3-6). This window allows the operator to enter the name of a scenario to be loaded. The name of the scenario is entered in the text entry block in the window. If the operator wants to load a scenario, he will hit the Enter key to attempt to load the specified scenario script file. The ESC key can be used if the operator wishes to exit the window without entering a new scenario.

When the operator attempts to load a scenario file, the Simulator will attempt to find the named file. If unsuccessful, an error message will be displayed in the window. If successful, the Simulator will try to load the scenario script file by reading one script command at a time from the file. The window display will show the number of loaded commands, loaded subcommands, and the number of lines read from the file. If an error is encountered in the file, the line number where the error occurred will be displayed in the window. If no errors are found in the script file, the file will have been successfully loaded and the Script Name and Script Status in the Status Display area will be updated to reflect the loaded scenario name with a status of INACTIVE. Once a scenario has been loaded, the ESC key is used to remove the window and return to the Setup Control Menu. (Refer to Section 3.3 for details on scenario script commands.)

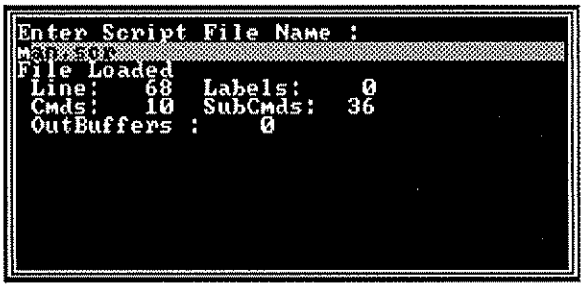


Figure 3-6: Scenario Load Window

Start Scenario : If the current scenario status is displayed as INACTIVE in the Status Display area (i.e., a scenario has been loaded), the loaded scenario will be activated and begin executing. The script time will begin incrementing and the script status will be display as ACTIVE. The track environment will reflect the loaded scenario commands and will be updated and transmitted to the Display Consoles on the network on a one second periodic. (Refer to Section 3.3 for details on scenario script commands.) Also, the Run Control Menu (Section 3.2.2.2) will be displayed once the scenario is started.

Environment Options : This option will bring up the Environment Options Menu (Section 3.2.2.4) which allows the operator to inspect, enter, and edit track data and track maneuvers.

Terminate : This option is used to exit the Track Environment Simulator and return to DOS.

3.2.2.2 Run Control Menu

The Run Control Menu (Figure 3-7) is used as the main control menu when a scenario is active. The options on the menu allow the operator to stop or pause a scenario, go to the Environment Options menu, or terminate the Simulator. The functions provided by each of the menu options are outlined below.

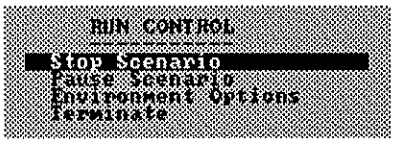


Figure 3-7: Run Control Menu

Stop Scenario : The current active scenario will be halted and no further updates of the track environment or transmissions of track file data on the network will be performed. The script status on the Status Display will be shown as INACTIVE, and the Setup Control Menu (Section 3.2.2.1) will be displayed.

Pause Scenario : The current active scenario will be paused and no updates of the track environment or transmissions of track file data on the network will be performed until the scenario is activated again. The script status on the Status Display will be shown as PAUSED, the script time will stop incrementing, and the Pause Control Menu (Section 3.2.2.3) will be displayed.

Environment Options : This option will bring up the Environment Options Menu (Section 3.2.2.4) which allows the operator to inspect, enter, and edit track data and track maneuvers.

Terminate : This option is used to exit the Track Environment Simulator and return to DOS.

3.2.2.3 Pause Control Menu

The Pause Control Menu (Figure 3-8) is displayed when a scenario is paused. The menu options permit the operator to stop or continue the scenario, or terminate the Simulator. The functions provided by each of the menu options are outlined below.

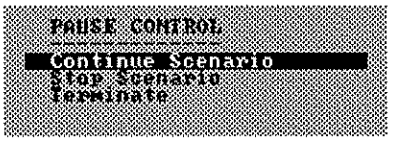


Figure 3-8: Pause Control Menu

Continue Scenario : The current scenario will be reactivated and will begin executing from the point where the scenario was paused. On the Status Display, the script status will be shown as ACTIVE and the script time will increment normally. Track updates and track file message transmissions to the Display Consoles on the network will also resume and the Run Control Menu (Section 3.2.2.2) will be displayed.

Stop Scenario : The current paused scenario will be halted. The script status on the Status Display will be shown as INACTIVE, and the Setup Control Menu (Section 3.2.2.1) will be displayed.

Terminate : This option is used to exit the Track Environment Simulator and return to DOS.

3.2.2.4 Environment Control Menu

The Environment Control Menu (Figure 3-9) allows the operator to inspect and modify the current track environment. The operator can enter and edit track parameters and set up and modify track maneuvers. The functions provided by each of the menu options are outlined below.

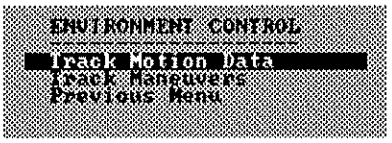


Figure 3-9: Environment Options Menu

Track Motion Data : This option brings up the Track Number Entry pop-up window (Figure 3-10) which allows the operator to specify a track number to inspect or edit. Valid track numbers are in the range 1 to

100. If an entry outside of this range is entered, the value will not be accepted and the entered value will be displayed as blinking in reverse video.

Figure 3-10: Track Number Entry Window

If an acceptable value is entered, the Track Edit pop-up window (Figure 3-11) will be displayed containing the current track data for the track being edited.

The Track Edit pop-up window allows the operator to edit the track parameters of a particular track. The Up-Arrow and Down-Arrow keys are used to move among the entry items in the window. For the last four items in the window, the entries are of a special type called toggle entries. When the cursor is moved to one of these entry lines, the cursor is placed in the middle of two brackets ("[ ]"). To change the value of the entry line, the Left-Arrow or Right-Arrow keys are used to select a new value. To activate the track, the Activate option must be set to YES. (The value of the Movement field is not currently used but was intended to be used to allow track position updates relative to another track in the Simulator.)

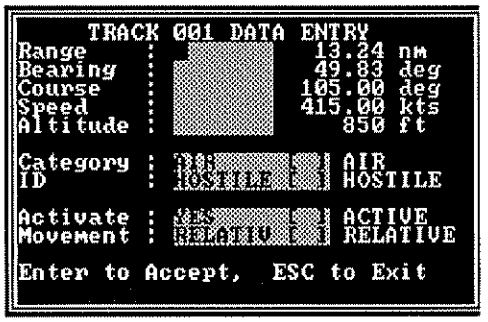


Figure 3-11: Track Entry Window

After all desired changes have been made, the operator will hit the Enter key to accept the changes. If any entered values are out of range, the entry field will be displayed in blinking reverse video to alert the operator. All accepted values will then be displayed as the current values for the track. After all changes have been completed, the ESC key is used to exit from the Track Edit window and return to the Environment Options Menu.

Track Maneuvers : This option brings up the Track Number Entry pop-up window (Figure 3-10) which allows the operator to specify a track number to maneuver. Valid track numbers are in the range 1 to 100. If an entry outside of this range is entered, the value will not be accepted and the entered value will be displayed as blinking in reverse video. If an acceptable value is entered, and the entered track is active, the Track Maneuver pop-up window (Figure 3-12) will be displayed containing the current maneuver data for the track.

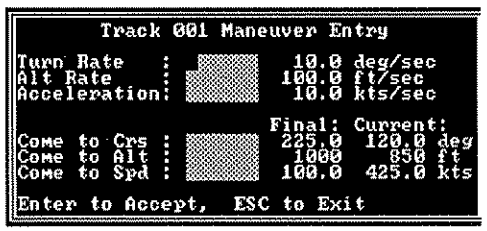


Figure 3-12: Track Maneuver Window

The Track Maneuver window displays the current track maneuver parameters and allows the operator to enter new maneuver parameters. When all new parameters have been entered, the operator will hit the Enter key to accept the changes. If any entered parameters are out of range, the entry field will be displayed in blinking reverse video to alert the operator. All accepted changes will be displayed as the new maneuver parameters for the track. After all changes have been completed, the ESC key is used to exit from the Track Maneuver window and return to the Environment Options Menu.

Previous Menu : This option will remove the Environment Options Menu and return to the previously displayed menu. If the script status is ACTIVE, the Run Control Menu (Section 3.2.2.2) will be displayed. Otherwise, the Setup Control Menu (Section 3.2.2.1) will be displayed.

3.3 Scenario Scripts

Loading and running scripted scenarios is the simplest method for setting up a desired track environment. This section provides a detailed guide to creating and modifying scenario script files for use with the Track Environment Simulator. Appendix B contains a set of example script files demonstrating scenario scripting capabilities.

3.3.1 Scenario Formats

The scenario files used by the Simulator are ASCII text files containing a list of scripted commands. The script commands all have the same format which is given below. In addition, comments can be placed in a script file by putting a semicolon as the first character in a line with the comment following the semicolon. All script commands are case-insensitive and have the following basic format:

<Time Tag> <Command> <SubCommand List>;

where:

<Time Tag> is either one of two different formats:

1. The simplest is merely the word DEFAULT. This form of the time tag specifies that the script command consists of data which should be initialized prior to running the scenario (e.g., this is default track environment data).
2. The second format consist of two parts: (1) a valid time in hours:min:seconds format of the form HH:MM:SS.SS between 00:00:00.00 and 23:59:59.99 and (2) a one character modifier, either A, D, or U.

The following rules specify when the scenario command will be executed:

- A -- at absolute script time HH:MM:SS.SS
- D -- at delta script time HH:MM:SS.SS since the last A or U script command was executed.
- U -- at delta script time HH:MM:SS.SS since the last A or U script command was executed.

Note: Currently, time tagged commands in a script file MUST appear in the proper order in the file or they will not be executed properly.

<Command> is any of the valid command names: TRACK or ENGAGE.

<SubCommand List> is a list of valid subcommands of the general form:

```
(
      (SubCommand  Value)
      (SubCommand  Value)
          "          "
          "          "
)
```

The valid subcommands and value ranges are given in Section 3.3.2 below.

Refer to Appendix B for examples of the script command formats which have been described above.

3.3.2 Script Commands

Currently, there are only two scenario script commands defined for the Track Environment Simulator: the TRACK command and the ENGAGE command. A description of each command and subcommand is provided in the sections below.

3.3.2.1 TRACK Command

The TRACK command is used for defining track parameters for specifying the track environment for the Simulator. Each TRACK command should contain a TID subcommand as the first subcommand in the subcommand list in order to explicitly define the track number the subsequent track data is intended for. A complete list of all valid subcommands is provided in Table 3-1 below.

SubCommand	Value Range	Description
TID	1 to 100	track number
RANGE	0 to 512 NM	range in nautical miles
BEARING	0 to 360 degs	bearing in degrees
XPOS	-1000 to +1000 NM	x position in nautical miles
YPOS	-1000 to +1000 NM	y position in nautical miles
ZPOS	0 to 100000 ft	z position in feet
ALTITUDE	0 to 100000 ft	altitude in fee
COURSE	0 to 360 degs	course in degrees
SPEED	0 to 3600 kts	speed in knots
COME_TO_CRS	0 to 360 degs	maneuver course in degrees
COME_TO_SPD	0 to 3600 kts	maneuver speed in knots
COME_TO_ALT	0 to 100000 ft	maneuver altitude in feet
TURN_RATE	0 to 180 deg/sec	turn rate in degrees/second
ACCEL	0 to 500 kts/sec	acceleration in knots/second
ALT_RATE	0 to 10000 ft/sec	alt rate in feet/second
CAT	SUB / SURFACE / AIR / MISSILE	track category
ID	HOSTILE / FRIEND / UNKNOWN	track identity
STARTTIME	max 23:59:59.99	track start script time
STOPTIME	max 23:59:59.99	track stop script time

Table 3-1: TRACK Subcommands

The default track parameters prior to scenario loading are:

```
ALT_RATE     100 ft/sec
TURN_RATE     10 deg/sec
ACCEL         10 kts/sec
STARTTIME   00:00:00.00
STOPTIME    24:00:00.00
```

(All other track data is zeroed.)

Example:

```
00:01:00.00 A TRACK ( (TID 001)
                      (RANGE       18.5 )
                      (BEARING      135 )
                      (COURSE       270 )
                      (SPEED        500 )
                      (ALTITUDE    6000 )
                      (CAT        AIR    )
                      (ID         HOSTILE) );
```

3.3.2.2 ENGAGE Command

The ENGAGE command is used to initiate a missile engagement. The format of the command is that a missile will be launched from a source track to intercept a destination track. The list of the subcommands is shown in Table 3-2 below.

SubCommand	Value Range	Description
SOURCE_TID	1 to 100	source track number
DEST_TID	1 to 100	destination track number

Table 3-2: ENGAGE Subcommands

Each ENGAGE command should contain exactly one SOURCE_TID and one DEST_TID subcommand which should be different values.

```
Example:    00:01:30.00 A ENGAGE ( (SOURCE_TID 001)
                                   (DEST_TID   002) );
```

3.4 Simulation Functions

The major functions provided by the Track Environment Simulator are track motion modelling, missile engagement modelling, and generating and processing network message data. Each of these functions is detailed in the sections below.

3.4.1 Track Updates

The simulator provides track motion modelling for up to 100 active tracks at a time. Currently, the simulator updates 50 tracks every half second. This provides a worst case of each track being updated once per second for a maximum track load of 100 tracks.

The simulator uses a Flat Earth algorithm for calculating track positions. Track maneuvers are also supported via preset climb/dive rates, turn rates, and accelerations. Also, currently, no sensor modelling (radar, sonar, etc...) is implemented and all active tracks are visible to all other tracks in the simulated environment.

Track parameters can be entered and modified by any of three methods: via scripted scenarios, via interactive entry from the simulator, or via track messages from Display Consoles on the network.

3.4.2 Engagement Processing

Currently, the only engagements which have been implemented are missile engagements. The missile model being used is a simple Mach 2 cruise missile with a cruise altitude of 150 feet. This cruise missile model is used for all air-to-surface and surface-to-surface engagements. For surface-to-air and air-to-air engagements a simple straight line to intercept model is used.

The model calculates the intercept point with the target based on the target's course and speed. If an intercept point exists, the missile flies towards the calculated intercept point. Otherwise, if no intercept point exists, the missile will fly toward the target track's current position. When the missile comes within 1000 yards of the target track, the missile will detonate destroying both itself and the

target track. If the target track is dropped (by either being deactivated or being shot down by another missile) before the missile intercepts the target track, the pursuing missile will self-destruct.

In the current version of the simulator, missile engagements can be initiated either via scripted engagement commands or interactively by operator action at an active Display Console.

3.4.3 Network Functions

When a scenario is active, the simulator builds and transmits a track file message containing parameters (track number, position, course, speed, category, and id) of all active tracks in the simulated environment. This message is multicast to all active Display Consoles on the network on a one second periodic.

The simulator also receives and processes track environment control messages from the Track Display Consoles whenever a Display Console operator performs an action which requires modification of the track environment. The simulator checks for and processes new received messages twice per second. If multiple messages are received in the same half second, the messages are processed in the order in which they were received by the simulator. (This is only an issue in the rare case where two operators both modify the same track at the same time.) Also, if messages are received when no scenario is active, the messages will be ignored since there is no active track environment to be modified.

The track control messages and the processing that is performed for each message are described below:

Drop Track -- If the track specified in the message is active, the track is removed from the environment. (See Section 2.3.4.2.4.)

Track Entry -- If there are fewer than 100 active tracks in the environment, a new track is created based on the kinematic parameters contained in the message. (See Section 2.3.4.2.1.)

Track Edit -- If the track specified in the message is active, the track is modified to reflect the changes contained in the message. (See Section 2.3.4.2.2.)

Track Maneuver -- If the track specified in the message is active, the track is maneuvered based on the maneuver parameters contained in the messaged. (See Section 2.3.4.2.3.)

Missile Engagement -- If the attacking track and the engaged track specified in the message are both active, and if there are fewer than 100 tracks in the environment, a new missile track is created which is targeted to attempt to intercept the engaged track. (See Section 2.3.4.2.5.)

4. NETWORK MESSAGE TRAFFIC OVERVIEW

The message traffic between the Track Environment Simulator and the Display Consoles is outlined in Figure 4-1. The Track Environment Simulator provides track file data for all 100 tracks in the simulated environment at a one second periodic rate. This data is multicast to all Display Consoles active on the network. The Display Consoles update their track displays once per second to reflect the latest received track data. Figure 4-2 shows the format of the track file message including descriptions of each field in the message.

The Display Consoles can also send interactive environment control orders to the Track Environment Simulator based on operator selections on the Display Consoles (Section 2.3.4.2). These orders will then be processed by the Track Environment Simulator and changes to the environment will be reflected in the next track file messages multicast to the Display Consoles. Interactive control orders include track drop requests, track entry requests, track edit requests, track maneuver requests, and missile engagement requests. The formats of the control order messages and descriptions of each message field are provided in Figures 4-3 through 4-7. (See Section 3.4.3 for a discussion of the processing performed by the Track Environment Simulator for each received control order message.)

The network bandwidth requirements for the Navy Combat System Simulation are extremely light with a worst case load of less than 4 KB of message data per second. The main load on the network is the periodic track file message (of size 2808 bytes) which is multicast at a one second rate. In addition, each of the Track Display Consoles on the network can contribute no more than one message (with a maximum length of 46 bytes) each second to the traffic on the network. This light load on the network allows the Navy Combat System Simulation to be run on various network architectures and eliminates the need for a dedicated network.

NETWORK MESSAGE TRAFFIC:

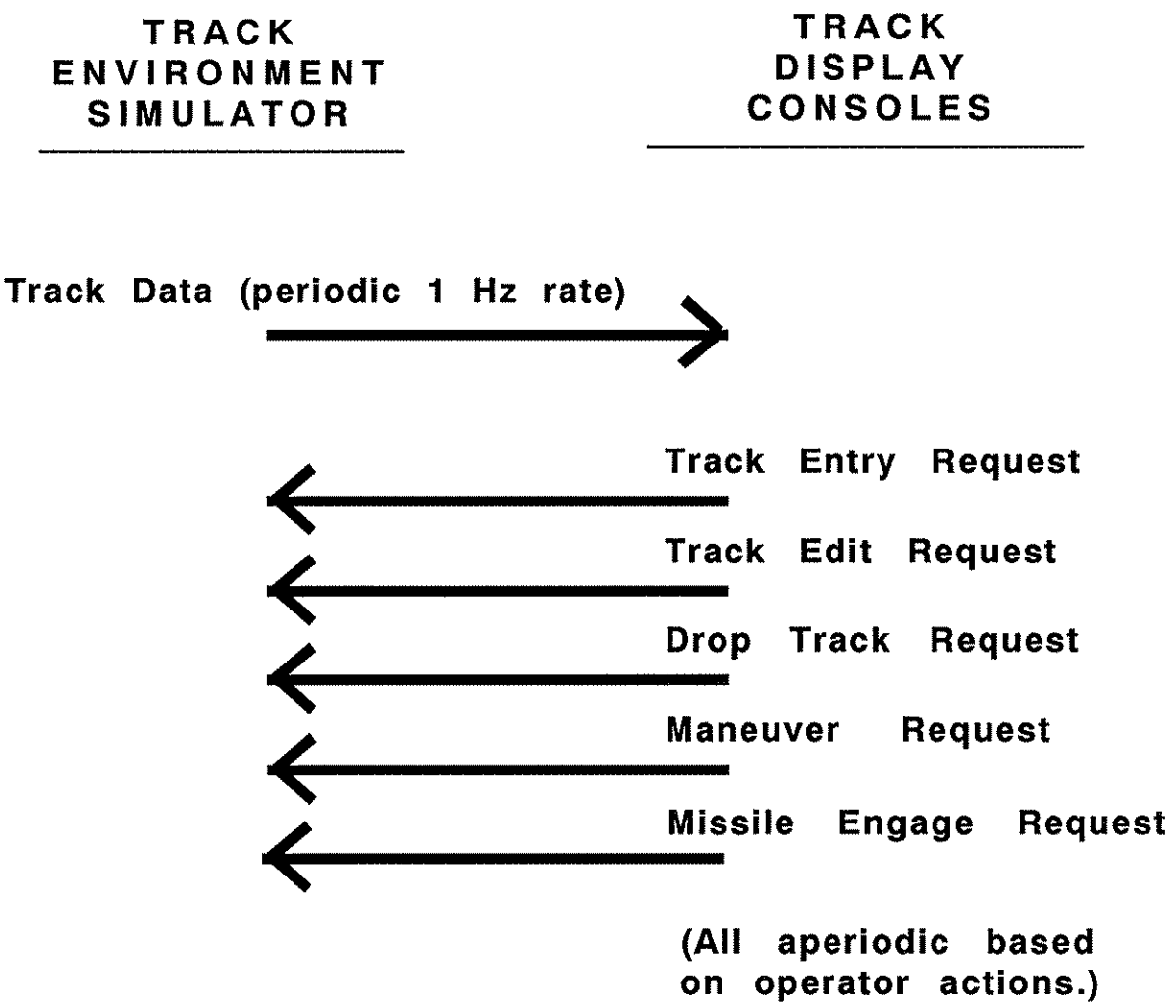
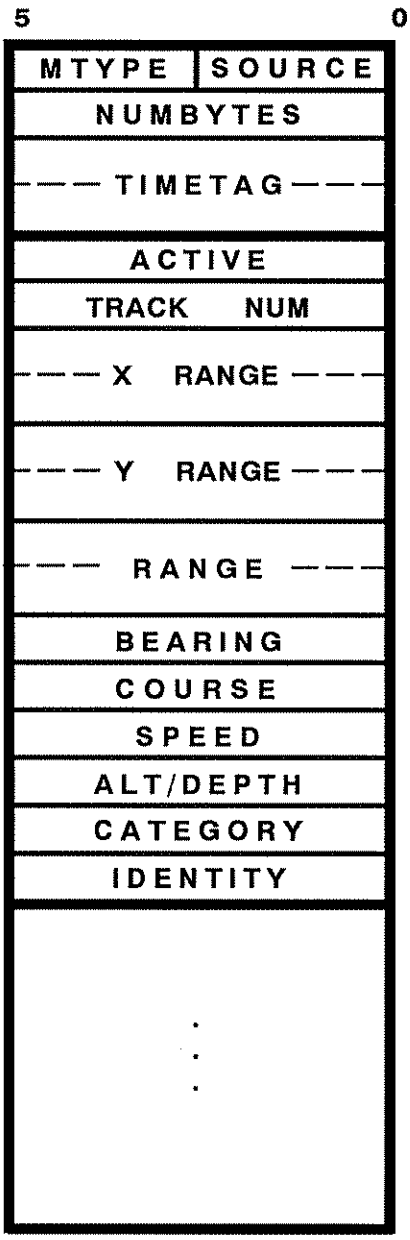


Figure 4-1: Network Message Traffic



Header :

- Message Source = 0 (Simulator)
- Message Type = 0
- NumBytes in Message (2808)
- TimeTag in 1/1024 seconds

Track 0 Data :

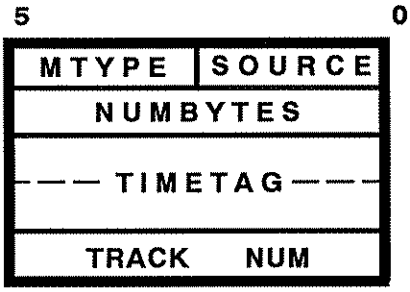
- Track Active Flag (0 or 1)
- Track Number (0 to 99)
- X Range in yards
- Y Range in yards
- Range in yards
- Bearing in 1/100 degrees
- Course in 1/100 degrees
- Speed in 1/10 knots
- Altitude or Depth in yards
- Category of Track
  - 0 = Air
  - 1 = Surface
  - 2 = Subsurface
  - 3 = Missile
- Identity of Track
  - 0 = Hostile
  - 1 = Unknown
  - 2 = Friend

Data for Tracks 1 through 99

Timing: Multicast to all Track Display Consoles at a 1 Hz rate.

Bandwidth Requirement: about 3K/second (2808 bytes/second)

Figure 4-2: Track Environment Simulator Track File Message

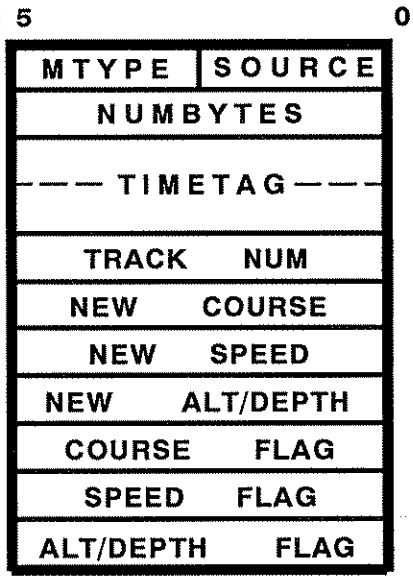


Message Source = 1 (Console)
Message Type = 32
NumBytes in Message (10)
TimeTag in 1/1024 seconds

Track Number to Drop (0 to 99)

Timing: Aperiodic based on operator action.

Figure 4-3: Track Display Console Drop Track Request Message

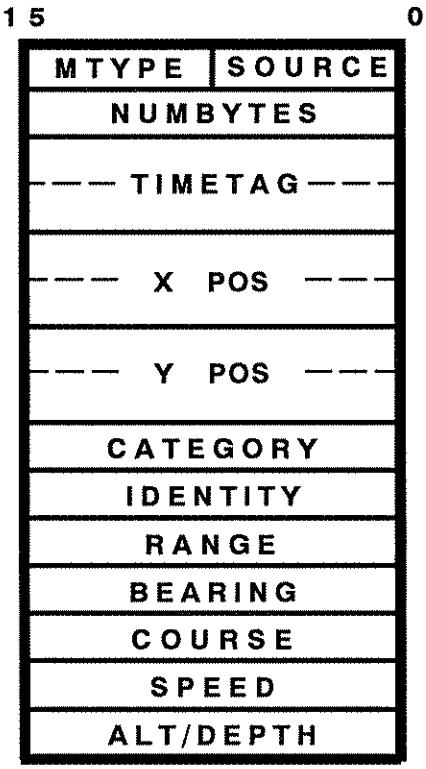


Message Source = 1 (Console)
Message Type = 33
NumBytes in Message (22)
TimeTag in 1/1024 seconds

Track Number to Maneuver (0 to 99)
Come to Course in degrees
Come to Speed in knots
Come to Altitude or Depth in yards
Course Maneuver Flag (0 or 1)
Speed Maneuver Flag (0 or 1)
Alt/Depth Maneuver Flag (0 or 1)

Timing: Aperiodic based on operator action.

Figure 4-4: Track Display Console Maneuver Request Message

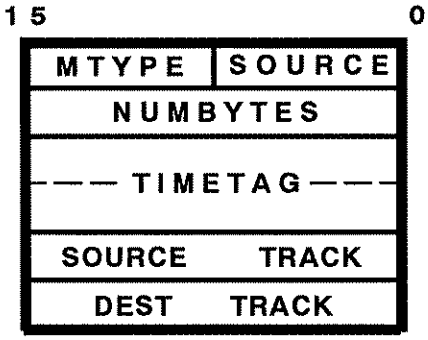


Message Source = 1 (Console)
Message Type = 34
NumBytes in Message (30)
TimeTag in 1/1024 seconds

Display Center X Position in yards
Display Center Y Position in yards
Track Category
0 = Air
1 = Surface
2 = Subsurface
3 = Missile
Track Identity
0 = Hostile
1 = Unknown
2 = Friend
Track Range from center in NM
Track Bearing from center in degrees
Track Course in degrees
Track Speed in knots
Track Altitude or Depth in yards

Timing: Aperiodic based on operator action.

Figure 4-5: Track Display Console Track Entry Request Message

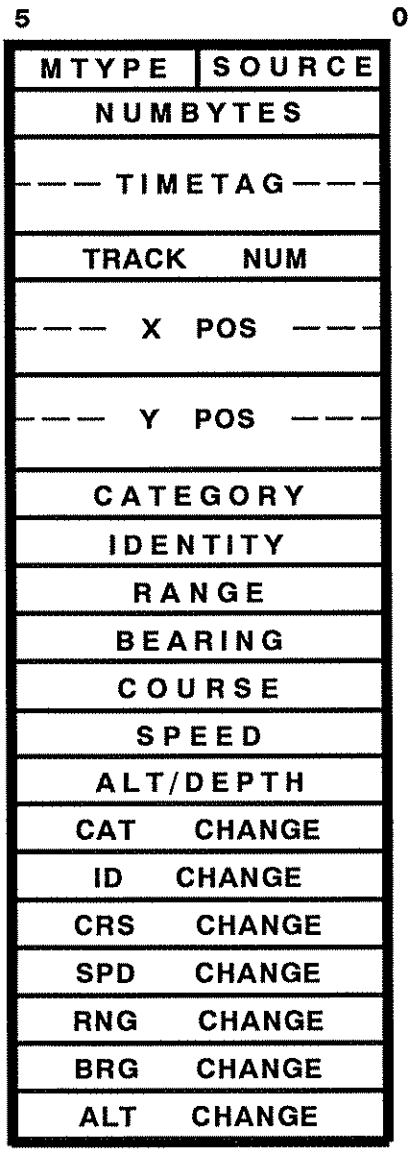


Message Source = 1 (Console)
Message Type = 35
NumBytes in Message (12)
TimeTag in 1/1024 seconds

Source Track Number (0 to 99)
(The track which will launch a missile.)
Destination Track Number (0 to 99)
(the track which is being engaged.)

Timing: Aperiodic based on operator action.

Figure 4-6: Track Display Console Engagement Request Message



Message Source = 1 (Console)
Message Type = 35
NumBytes in Message (46)
TimeTag in 1/1024 seconds

Track Number to Edit (0 to 99)
Display Center X Position in yards
Display Center Y Position in yards
New Category
0 = Air
1 = Surface
2 = Subsurface
3 = Missile
New Identity
0 = Hostile
1 = Unknown
2 = Friend
New Range from center in NM
New Bearing from center in degrees
New Course in degrees
New Speed in knots
New Altitude or Depth in yards
Change Category Flag (0 or 1)
Change Identity Flag (0 or 1)
Change Course Flag (0 or 1)
Change Speed Flag (0 or 1)
Change Range Flag (0 or 1)
Change Bearing Flag (0 or 1)
Change Altitude/Depth Flag (0 or 1)

Timing: Aperiodic based on operator action.

Figure 4-7: Track Display Console Track Edit Request Message

APPENDIX A: SOFTWARE CONFIGURATION

The Navy Combat System Simulation consists of the following set of programs:

PPIXTP.EXE : Display Console program
TSIMXTP.EXE : Track Environment Simulator program
NETBOOT.EXE : XTP driver software

To load and activate a program on the network, the NETBOOT program is run with the proper command line arguments to properly configure the specific system. NETBOOT sets up the XTP driver software and then spawns either the Display Console or Track Environment Simulator program. The allowed command line arguments for the NETBOOT program are listed below:

-Ggroup_name	: specifies a group name to use for multicast ("johns" is the default).
-Naddress_name	: specifies the local address ("john_A" is the default).
-Daddress_name	: specifies the address of the Simulator ("john_D" is the default).
-Pport_number	: specifies the port number to use (1 is the default).
-S	: specifies that the Track Environment Simulator software should be loaded. (The default is that the Display Console software will be loaded.)

The Track Environment Simulator or the Display Console software can also be run in standalone mode (not connected to the network) by specifying the **-d** argument following the program name. (The formats are **TSIMXTP -d** and **PPIXTP -d** respectively.)

APPENDIX B: SAMPLE SCENARIO SCRIPT FILES

```
;
;
;  MNVR.SCR  --  This scenario file initiates two air tracks which
;                perform several maneuvers.  Each air track then
;                fires a missile at the other track.  The tracks
;                continue to maneuver until they are destroyed by
;                the other track's missile.
;
;

;
;  Set up initial track data for Track #1.
;

DEFAULT TRACK ( (TID 1)  (RANGE 16)
                         (BEARING  45)
                         (COURSE   220)
                         (SPEED    300)
                         (ALTITUDE 2000)
                         (CAT      AIR)
                         (ID       HOSTILE)  );

;
;  Set up initial track data for Track #2.
;

DEFAULT TRACK ( (TID 2)  (RANGE 16)
                         (BEARING  315)
                         (COURSE    90)
                         (SPEED    400)
                         (ALTITUDE 1000)
                         (CAT      AIR)
                         (ID       UNKNOWN)  );

;
;  Track #1 begins a maneuver at 30 seconds into the scenario.
;

00:00:30.00 A TRACK ( (TID 1)
                         (ALT_RATE       20)
                         (COME_TO_CRS    45)
                         (COME_TO_SPD   600)
                         (COME_TO_ALT   100) );

;
;  Track #1 fires a missile at Track #2 at 35 seconds into the scenario.
;

00:00:35.00 A ENGAGE ( (SOURCE_TID 1)
                       (DEST_TID   2) );
```

```
;
;  Track #2 begins a maneuver at 40 seconds into the scenario.
;

00:00:40.00 A TRACK ( (TID 2)
                       (TURN_RATE       5)
                       (COME_TO_CRS   315)
                       (COME_TO_SPD   200)
                       (COME_TO_ALT    50) );

;
;  Track #2 fires a missile at Track #1 at 45 seconds into the scenario.
;

00:00:45.00 A ENGAGE ( (SOURCE_TID 2)
                      (DEST_TID 1) );

;
;  Both tracks continue maneuvering until they get shot down.
;

00:00:50.00 A TRACK ( (TID 1)
                       (ACCEL          25)
                       (COME_TO_CRS   225)
                       (COME_TO_SPD   100)
                       (COME_TO_ALT  1000) );

00:01:00.00 A TRACK ( (TID 2)
                       (COME_TO_CRS   135)
                       (COME_TO_SPD   500)
                       (COME_TO_ALT  2000) );

00:01:10.00 A TRACK ( (TID 1)
                       (COME_TO_CRS    45)
                       (COME_TO_SPD   600)
                       (COME_TO_ALT   100) );

00:01:20.00 A TRACK ( (TID 2)
                       (COME_TO_CRS   315)
                       (COME_TO_SPD   200)
                       (COME_TO_ALT    50) );

00:01:30.00 A TRACK ( (TID 1)
                       (COME_TO_CRS   225)
                       (COME_TO_SPD   100)
                       (COME_TO_ALT  1000) );

00:01:40.00 A TRACK ( (TID 2)
                       (COME_TO_CRS   135)
                       (COME_TO_SPD   500)
                       (COME_TO_ALT  2000) );
```

```
;
;
;  TIME.SCR  --  This scenario file demonstrates different
;                time tag values and modifiers.  Two tracks
;                are active when the scenario starts and one
;                additional track is initiated every 10 seconds
;                up through 70 seconds into the scenario.  At
;                80 seconds, one of the tracks will drop out.
;

;
;  Set up Track #5 to be active as soon as the scenario starts.
;  The track will drop out at 1:20 (80 seconds) into the scenario.
;

DEFAULT TRACK ( (TID 5)  (RANGE     10)
                         (BEARING   100)
                         (COURSE    280)
                         (SPEED     400)
                         (ALTITUDE 6000)
                         (CAT       AIR)
                         (ID        HOSTILE)
                         (STOPTIME 00:01:20.00)  );

;
;  Set up Track #6 before the scenario starts but don't turn it
;  on until 1:10 into the scenario.
;

DEFAULT TRACK ( (TID 6)  (RANGE       10)
                         (BEARING    200)
                         (COURSE      20)
                         (SPEED      500)
                         (ALTITUDE  9000)
                         (CAT        AIR)
                         (ID        FRIEND)
                         (STARTTIME 00:01:10.00)  );

;
;  Set up Track #7 to be active as soon as the scenario starts.
;

DEFAULT TRACK ( (TID 7)  (RANGE     10)
                         (BEARING   300)
                         (COURSE    120)
                         (SPEED     600)
                         (ALTITUDE 12000)
                         (CAT       AIR)
                         (ID        UNKNOWN)  );
;
;  Track #10 turns on at 10 seconds (absolute time) into the scenario.
;
```

```
00:00:10.00 A TRACK ( (TID 10) (RANGE      5)
                       (BEARING   30)
                       (COURSE   210)
                       (SPEED     30)
                       (CAT      SURFACE)
                       (ID       HOSTILE)  );

;
;  Track #11 turns on at 20 seconds into the scenario (10 seconds
;  after the last command with an A modifier).
;

00:00:10.00 D TRACK ( (TID 11) (RANGE      5)
                       (BEARING  120)
                       (COURSE   300)
                       (SPEED     20)
                       (CAT      SURFACE)
                       (ID       FRIEND)  );


;
;  Track #12 turns on at 30 seconds into the scenario (20 seconds
;  after the last command with an A modifier).
;

00:00:20.00 U TRACK ( (TID 12) (RANGE      5)
                       (BEARING  210)
                       (COURSE    30)
                       (SPEED     10)
                       (CAT      SURFACE)
                       (ID       UNKNOWN)  );

;
;  Track #15 turns on at 40 seconds into the scenario (10 seconds
;  after the last command with a U modifier).
;

00:00:10.00 U TRACK ( (TID 15) (RANGE      15)
                       (BEARING   100)
                       (COURSE    280)
                       (SPEED      15)
                       (ALTITUDE  600)
                       (CAT       SUB)
                       (ID       HOSTILE)  );

;
;  Track #16 turns on at 50 seconds into the scenario (10 seconds
;  after the last command with a U modifier).
;

00:00:10.00 D TRACK ( (TID 16) (RANGE      15)
                       (BEARING   200)
                       (COURSE     20)
                       (SPEED       5)
```

```
                        (ALTITUDE  900)
                        (CAT       SUB)
                        (ID       FRIEND)  );

;
;  Track #17 turns on at 60 seconds into the scenario (absolute time).
;

00:01:00.00 A TRACK ( (TID 17) (RANGE       15)
                        (BEARING    300)
                        (COURSE     120)
                        (SPEED       10)
                        (ALTITUDE   120)
                        (CAT        SUB)
                        (ID       UNKNOWN)  );
```