Graphical Scenario Generation Tool (GSGT)

Dynamic Simulation (DYSIM) and

Simulation Driver Radar Recorder (SDRR)

User Reference Guide - TBFM Appendix

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1. Introduction

1.1. GSGT

The Graphic Simulation Generation Tool (GSGT) generates radar, non-radar, and combined radar/non-radar simulation for use by the National Airspace System (NAS) as a source of real time inputs, and facilitates the testing and integration of NAS and related subsystems. GSGT employs a Graphical User Interface (GUI) to aid in scenario development and is capable of automatically generating flight data messages.

GSGT also has the capability of creating scenarios for injection into the Time Base Flow Management (TBFM) system. When launched in TBFM mode, GSGT generates the initial flight plans and departure messages. All other flight data messages are generated dynamically when the scenario is executed.

1.2. DYSIM

The Dynamic Simulation (DYSIM) tool provides a capability to manipulate a scenario during execution and to interactively "pilot" the targets.

To support direct simulation injection into TBFM, DYSIM includes the executable tbfmDriver, which sends commands to Simulation Driver and Radar Recorder (SDRR) and also has an interface to TBFM's Simulation Interface Support (SMIF).

1.3. SDRR

SDRR is a simulation injection tool that can be configured to run in various environments. It allows injection of local, interfacility and surveillance messages, and provides a display of all related NAS, ARTS and surveillance facilities. The display provides message counts, device status and error messages.

For TBFM direct injection, SDRR is configured to connect to an En Route Data Distribution System (EDDS) device as an Air Route Traffic Control Center (ARTCC). SDRR can send Standard Terminal Automation Replacement System (STARS) Applications Interface Gateway (AIG) messages to TBFM over a multicast address. SDRR can also send Traffic Flow Management System (TFMS) Aircraft Situation Display to Industry (ASDI) messages to TBFM clients.

2. Scope

This appendix provides a description of the changes made to GSGT, DYSIM and SDRR for TBFM testing. For general usage information, please refer to the base documentation: User Reference Guide Final SGET Version 7.5.10.0 Revision 1 and Operation and Maintenance Manual SDRR Version 3.5.5 Revision 12

3. Setup

3.1. GSGT

3.1.1. Configuration

GSGT uses several environment variables for its configuration, such as to control location of scenarios and adaptation files.

Table 1. Environment Variables

Variable	Description
ADAPTATION_PATH	Path to where adaptations are located.
GSGT_WORK_PATH	Path to where scenarios are located.
WX_PATH	Path to where weather scenarios are located.

3.1.2. Starting GSGT software

To start GSGT from the command line, enter:

```
> gsgt
```

To launch a GSGT version that is not the default version, enter:

```
> /usr/local/gsgt.x.x.x.x/bin/gsgt
```

Note

Starting GSGT from a command line while inside the scenario directory will automatically open that scenario.

3.1.2.1. Parameters

GSGT can be started with various options which control its operation. The options are specified by typing **gsgt** followed by a dash or double dash and then the desired parameter.

Table 2. GSGT Parameters

Parameter	Description
--tbfm	TBFM mode for direct injection.
--wx --tbfm	Weather editor mode for injection into TBFM. In this mode, weather data will contain Geometric Height records and the grid type is set to 236.
-w, --wx or --wxMode	Standard weather editor mode.
-f, --nofullscreen	Not Full screen mode. GSGT will be started in a window roughly half the size of the screen.
-v, --version	Displays GSGT version
-h, --help	Display application parameters

3.1.2.2. GSGT Modes

GSGT operates in several modes that are tailored to specific functionality, such as TBFM mode for direct injection, or editing a limited portion of a scenario, such as weather.

Table 3. Modes of Operation

Mode	Description
Normal Mode	This mode is tailored for creating scenarios that inject into an En Route (ERAM) system as the facility under test.
TBFM Mode	This mode is tailored for creating scenarios that inject messages into a Time Base Flow Management (TBFM) system as the facility under test, via the En Route Data Distribution System (EDDS). The scenarios are executed dynamically to generate a set of non-radar messages per specification of EDDS and TBFM systems.
Weather Mode	This mode is designed for creating and editing weather scenarios. Weather scenarios are adaptation independent and can be included in any normal scenario for weather simulation.

Example 1. Start GSGT in TBFM mode

```
> gsgt --tbfm
```

3.1.3. Adaptation

In the $ADAPTATION_PATH directory, individual subdirectories should be created for all necessary combinations of ERAM and TBFM adaptation. Within each subdirectory should be a file called adaptation.xml which will indicate the location of the ERAM and TBFM adaptation files. The locations of the ERAM and TBFM adaptation can be relative to $ADAPTATION_PATH or can be given explicitly if located elsewhere. Additionally, each STARS facility adapted within the TBFM adaptation for which AIG message injection is desired, should be defined in the adaptation.xml file.

Example 2. Contents of adaptation.xml file.

```
<adaptation>
   <eadp dir="eadp/t217a331">
      <tbfm dir="/opt/adaptation/eadp/ZTL_T4.6.0_adr312s2v6" >
         <stars eramName="AAA" >A80</stars>
         <stars eramName="CCC" >CLT</stars>
      </tbfm>
   </eadp>
</adaptation>
```

3.2. DYSIM (tbfmDriver)

3.2.1. Configuration

There is no configuration needed for DYSIM. However, in order for tbfmDriver to interface with the TBFM SMIF Application Program Interface (API), SMIF must be installed on the same processor. The default location for the SMIF executable is /opt/<smif_version>/bin/smif. In addition, the SMIF executable must be passed the name of configuration file, /opt/<smif_version>/etc/SMIF.config.

Example 3. Contents of an example SMIF.config file.

```
artcc.connections=ZTL

artcc.ZTL.cap.host=tbfm1
artcc.ZTL.cap.port=8080
```

```
artcc.ZTL.wdpd.host=tbfm1

dysim.connection.host=tbfmgsgt
dysim.connection.port=8081

CAP_QUERY=UPD&NEV=adp,con,oth,aid,cid,dnt,rtm,evt,aat,atm,dap,apt,fps,acs,typ,wcl,e
ng,bcn,spd,ara,ina,trw,drw,tds,cfx,ctm,etd,etm,est,a10,tcr,sid,mrp,rwy,tra,mfx,gat,
dfx,sfx,oma,ooa,o3a,o4a,cfg,cat,scn,tcs,idx,trk,eta,sta,sch,t2t*&ICAO_APT&TSIM
```

3.2.2. Starting tbfmDriver software

The tbfmDriver must be started from the command line while inside the directory of the GSGT scenario to be executed. To launch tbfmDriver with only the required parameters, enter:

```
> tbfmDriver --sdrrCmdDev=tcp:<sdrr_address>/<port #>
```

To execute a version of tbfmDriver that is not the default version, enter:

```
> /usr/local/dysim.x.x.x/bin/tbfmDriver--sdrrCmdDev=tcp:<sdrr_address>/<port #>
```

Note

The tbfmDriver must be started from a command line while inside the scenario directory to automatically open that scenario.

3.2.2.1. Parameters

DYSIM tbfmDriver can be started with various options which control its operation. The options are specified by typing **tbfmDriver**, then a double dash followed by the desired parameter.

Table 4. Parameters for tbfmDriver

Parameter	Description
--sdrrCmdDev=tcp:<sdrr_address>/<port#>	Directs tbfmDriver to send CMS messages in TCP format to SDRR at the named address & port. SDRR must be started with the corresponding parameter.

--rsi=<RSI>	Controls which portions of a scenario, as indicated by the record select indicator (RSI), to run. This parameter can be repeated for each RSI. Omitting this parameter results in execution of all RSIs.
--smifPort=<port#>	Defines the port for the DYSIM connection to SMIF. This must match the SMIF.config file.
--thMargin=<number_of_nautical_miles>	Sets the distance from the En Route Center boundary where tbfmDriver will start sending TH messages to SDRR. Value is in nautical miles. The default value is zero.
--nofullscreen	Not Full screen mode. tbfmDriver will be stared in a window roughly half the size of the screen.
--version	Displays tbfmDriver version
--help	Display application parameters

Example 4. Start DYSIM tbfmDriver with optional parameters

```
> tbfmDriver --sdrrCmdDev=tcp:tbfmsdrr-tbfm/9601 --smifPort=8081 --thMargin=20
--rsi=10 --rsi=20
```

3.3. SDRR

3.3.1. Configuration

SDRR uses several environment variables to set the locations of configuration files, scenarios and logs.

Table 5. Environment Variables

Variable	Description
`SDRR_CONFIG_PATH`	Location of SDRR configuration files (e.g., /usr/local/cfg).

Variable	Description
SDRR_SCENARIO_PATH	Location of SDRR scenario directories (e.g., /usr/local/scenarios).
SDRR_LOG_PATH	Location of SDRR log files (e.g., /usr/local/log).

The SDRR configuration file is used to set the addresses and ports for all interfacing devices. To connect to an EDDS server, the value of the "listenAddress" is the address of the processor running SDRR or an alias for an SDRR eth subinterface address in the /etc/hosts file. On the EDDS server, the configuration file /opt/ssr/hid_address.adp should have the same address or alias for the E1 attribute. To use an alias, the associated IP address must be listed in the EDDS /etc/hosts with the same alias as on the SDRR side. To inject AIG messages directly into TBFM, each STARS site should be added to the SDRR configuration file with the facility name as it is adapted in ERAM adaptation (e.g., "aaa" instead of "A80" for Atlanta approach control) and the multicast addresses and ports defined in the TBFM adaptation.

Example 5. Contents of an example SDRR config.xml file.

```
<root>
   <comment>Comment text</comment>
   <sources>

      <tfms name="tfms" ip="" port="17010" />

      <eramsim name="ztl">
         <eddserver port="50020"  listenAddress="tbfmsdrr01">
      </eramsim>

      <eramsim name="zme">
         <eddserver port="50021"  listenAddress="tbfmsdrr01">
      </eramsim>

      <aigInjector name="aaa" >
         <dataSet id="7"
device="(multi://224.100.100.100:8500?ttl=62&amp;interface=eth1+multi://224.100.101
.100:8500?ttl=62&amp;interface=eth1+/usr/local/log/a80.ds7.jvn)" />
         <dataSet id="8"
device="(multi://224.100.100.100:9000?ttl=62&amp;interface=eth1+multi://224.100.101
.100:9000?ttl=62&amp;interface=eth1+/usr/local/log/a80.ds8.jvn)" />
         <dataSet id="9"
device="(multi://224.100.100.100:9500?ttl=62&amp;interface=eth1+multi://224.100.101
.100:9500?ttl=62&amp;interface=eth1+/usr/local/log/a80.ds9.jvn)" />
```

```
         <dataSet id="10"
device="(multi://224.100.100.100:10000?interface=eth1+multi://224.100.101.100:10000
?interface=eth1)" />
      </aigInjector>

      <aigInjector name="ccc" >
         <dataSet id="1"
device="(multi://224.100.100.100:8001?ttl=62&amp;interface=eth1+multi://224.100.101
.100:8001?ttl=62&amp;interface=eth1+/usr/local/log/clt.ds1.jvn)" />
      </aigInjector>

   </sources>
</root>
```

3.3.2. Starting SDRR software

For TBFM direct injection, SDRR must be started from the command line in order to set the "--cmdDev" parameter. To launch SDRR, enter:

```
> sdrr --cmdDev=tcps:<sdrr_address>/<port#> --start --utc <sdrr_config.xml> -n
```

To launch a version of SDRR that is not the default version, enter:

```
> /usr/local/sdrr.4.2.0.eng/bin/sdrr --cmdDev=tcps:<sdrr_address>/<port#> --start
--utc <sdrr_config.xml> -n
```

3.3.2.1. SDRR Parameters

SDRR can be started with various options which control its operation. The options are specified by typing **sdrr** followed by a dash and then the desired parameter.

Table 6. Program Parameters

Parameter	Description
--cmdDev=tcps:<sdrr_ip_address>/<port#>	Directs SDRR to listen for CMS messages from tbfmDriver in TCP format on the named address & port. The DYSIM tbfmDriver must be started with the corresponding parameter.
--start	Commands SDRR to start running as soon as it comes up.

Parameter	Description
--utc	Use system time for scenario messages, not the scripted scenario timestamps.
<sdrr_config.xml>	The SDRR configuration xml file argument is required to start the SDRR software. A relative path of /usr/local/cfg/ is assumed, unless a full path beginning with "/" is used.
-n, --noscenario	Start SDRR with config file only, without loading an SDRR scenario. Injections will come from tbfmDriver.
-f, --nofullscreen	Not Full screen mode.
-v, --version	Displays tbfmDriver version
-h, --help	Display application parameters.

Example 6. Start SDRR for direct injection into EDDS/TBFM

```
> sdrr --cmdDev=tcps:tbfmsdrr-tbfm/9601 --start --utc ztl_config.xml -n -f
```

4. GSGT in TBFM Mode

4.1. Main Window

In TBFM mode, the main GSGT Window is essentially unchanged. The one exception is that there is no menu option for Export, which is not needed for dynamic direct injection.

4.2. Scenario Editor

The Scenario Editor has the following tabs:

- Preferences
- Targets
- Radars
- Service Volumes
- MLATs
- RSIs
- System Commands

4.2.1. Target Editor

The Target Editor has several changes for TBFM mode. In the Main tab, the Dynamics pane – including Aircraft Type (AChar), Speed and Flight Level (Flevel), and the Aircraft pane – including the number of aircraft and Heavy indicator, have been removed. In the Dysim tab, the pilot Symbol text box and the PPEs and Prompts panes have been removed. A new Dynamics tab replaces the Route and Events tabs.

The new Dynamics tab is made up of three panes – Flight Plan, Flight Dynamics and Events. The Flight Plan pane includes the AChar drop down, Speed and Flevel text boxes, as well as the Route text box. The Flight Dynamics pane includes a new Macro text box and "Populate Macro from FP Route" and "Show Flight Path" buttons. The Events pane can be used to create target events in the same way that was previously done in the Events tab. The one major change regarding events is that accompanying NAS messages are not automatically generated, but can be manually scripted using the Messages tab.

The Macro text box allows a target to deviate from the route that is used to generate the flight plan. Furthermore, when adaptation is loaded that includes TBFM terminal waypoints in addition to the ERAM XML data, the Macro text box can be used to create a terminal route. Along with terminal waypoints, the terminal route can include altitude and speed restrictions and Radius-to-Fix (RF) turn segments. Valid Macro route elements are:

Table 7. Macro Route Elements.

Route Element	Format
Position:	FIX or [+|-]dd:dd:dd.dd, [+|-]ddd:dd:dd.dd
Altitude:	/ddd[~ddd]
Speed:	ddd[~dddd]
Hdg:	->Hddd
Drop target:	DROP
Alt Restriction:	[altRestr:D:AOA:dddd.d] for “at or above”, [altRestr:D:AOB:dddd.d] for “at or below” or [altRestr:D:AT:dddd.d] for “at altitude”
Speed Restriction:	[spdRestr:D:AT:ddd.d] (always “at” speed)
RF Turn:	FIX1{flyOver} FIX2{rf:R:ddd.d} for right turns or FIX1{flyOver} FIX2{rf:L:ddd.d} for left turns and ddd.d is the outbound heading

The Messages tab of the Target Editor behaves as in standard mode except that only a very limited set of flight data messages are automatically generated. The initial flight plans and departure messages, where needed, are created when auto-derive is selected. When the scenario is executed with the DYSIM tbfmDriver, the NAS FP messages are converted into CMS FH and HX messages and AIG flight data messages for direct injection. The NAS DM messages are converted into CMS AH and DH messages. Also, any manually scripted NAS AM messages (with the exception of field 02 amendments) are automatically converted to CMS AH messages at runtime. Updates to AIG flight data must be manually scripted.

Within the Messages tab, the Generic Message Editor and the CMS Message Editor have a new “Outgoing” check box. This allows any CMS message of AIG flight data message to be manually scripted for direct injection. Selecting the “Outgoing” check box reverses the Source and Destination devices.

5. DYSIM tbfmDriver

5.1. Main Window

The tbfmDriver Main Window is made up of a main menu bar, date and time clocks and multiple display tabs. The menu bar includes the following options:

- Start
- Start At
- Close

The current date and system time are displayed in the upper right corner of the main window. When a scenario is running, the scenario time is also displayed.

The display tabs are:

- Status
- Dysim
- <facility 1>
- <facility 2>

  …
- <facility n>
- SMIF

5.1.1. Status Tab

The status display tab is separated into two parts. The left side shows the Device Status. All devices connected to tbfmDriver are listed and color coded to indicate connection status. The right side contains a System Log where all system messages, such as status, warnings and errors are displayed.

5.1.2. Dysim Tab

The Dysim tab is separated into three parts. The upper portion of the left side is used to display the Active and Inactive tabs. The lower portion of the left side displays the Quick command input area. The right side of the Dysim tab displays a large map area that includes a menu bar (View and Find), Flight level selector, Zoom control, Range indicator, and status or measurement bar (when invoked) along the bottom.

The Active tab shows a list of all currently active targets; and the Inactive tab shows a list of all currently inactive targets. Both lists include columns for Time, ACID, BCN, and aircraft Type and can be sorted by clicking on the column headers. In the Active tab, double clicking on a target opens a control dialog for the selected target. The control dialog consists of a Commands tab, a Messages tab

and an information line which displays the current altitude, heading, true air speed and beacon code for the target. The Commands tab includes a “Save macro” button, a command text box and a list of the currently executing and queued commands. The Messages tab includes a drop down box for selecting a message type, a source text box, a message contents text box and a list of injected and pending messages for the target.

Table 8 Target Control Commands

Command	**Format**
Altitude: *rate – ft/m*	->Addd[~ddd]
Altitude: *expedited/reduced climb rate*	->Addd[+|-]
Heading: *rate – deg/s*	->H[RL+-][ddd][~ddd]
Heading: *expedited/reduced turn rate*	->H[RL+-][ddd][+-]
Speed: *rate – k/s*	->Vddd[~ddd]
Speed: *expedited/reduced acc*	->Vddd[+-]
BCN:	->Bdddd
Drop target:	->D
Hold:	->HOLD[:LR][:Dd][:Edd] where D indicates the leg length in minutes and E indicates the duration in minutes
AltRestriction:	->altRestr:[DC]:[AT|AOA|AOB|BLK]:dddd
SpdRestriction:	->spdRestr:[DC]:[AT|AOA|AOB|BLK]:dddd

RF Turn:	FIX1{flyOver} ->RF:FIX2:[LR]:ddd.d and ddd.d is the outbound heading
MaintainCurrentHdg:	->MAINTAIN

where d indicates a digit and ~ indicates a rate.

Right click on a target in the Inactive tab to display options to Release, Delete or Transfer Comm. Selecting the Release option causes the target to become active; it is removed from the Inactive list and added to the Active list. Selecting Delete removes the target. The Transfer Comm. Option is not applicable in tbfmDriver.

The Quick command area can be used to enter run-time target control commands and route commands in the same way as the command dialog.

The Map Display area displays the facility adaptation and targets once a scenario is running. The Map Display behaves in the same way as the GSGT Main Window map display. The map can be recentered and zoomed in and out. Map Elements can be displayed using the View and Find menu options. Information boxes can be displayed for map elements such as sectors, airports, routes, etc. The status/measurement bar can be displayed along the bottom of the map.

5.1.3. Facility Tabs

The <facility n> tabs are labeled based on the airspace of the currently running scenario. These tabs display all of the messages that are sent to SDRR.

5.1.4. SMIF Tab

The SMIF tab displays all messages exchanged between tbfmDriver and the SMIF API.

6. SDRR

6.1. Main Window

The SDRR Main Window is made up of a main menu bar, date and time clocks and message display tabs. The menu bar includes the following options:

- Windows
- Start
- Start At
- Help
- Close

The current date and system time are displayed in the upper right corner of the main window. As soon as SDRR is started, a runtime clock is also displayed. Note that this runtime is not synched to the start of the scenario running in the tbfmDriver.

The message display tabs are:

- Status
- ERAMSim (when configured)
- AIG (when configured)
- TFMS (when configured)
- Dynamic Input

6.1.1. Status Tab

The status tab is separated into two parts. The left side shows the Device Status. All devices connected to SDRR are listed and color coded to indicate connection status. The right side contains a System Log where all system messages, such as status, warnings and errors are displayed.

6.1.2. ERAMSim Tab

The ERAMSim tab displays messages sent to and received from EDDS. A window is displayed for each ERAM facility that is included in the SDRR configuration. The menu bar on each facility window includes three options: “Send IT”, “Send Msg” and “Meter List”. Selecting the “Send IT” menu option causes an IT message to be sent to EDDS. Selecting the “Send Msg” menu option opens a dialog where any freeform CMS message can be entered and sent to EDDS. Selecting the “Meter List” menu option opens a window that displays meter fixes, aircraft IDs, meter times, delays and speed advisories sent by TBFM.

6.1.3. AIG Tab

The AIG tab displays STARS messages sent to TBFM. A window is displayed for each STARS facility that is included in the SDRR configuration. These windows have a tab for each of the configured AIG datasets.

6.1.4. TFMS Tab

The TFMS tab displays ASDI messages sent to TBFM.

6.1.5. Dynamic Input Tab

The Dynamic Input tab displays status information including port statistics and dynamic message statistics.

7. Acronyms

AIG	Applications Interface Gateway
ASDI	Aircraft Situation Display to Industry
API	Application Program Interface
CMS	Common Message Set
DYSIM	Dynamic Simulation
EDDS	En Route Data Distribution System
ERAM	En Route Automation Modernization
GSGT	Graphic Simulation Generation Tool
NAS	National Air Space
RF	Radius-to-Fix
RSI	Record Select Indicator
SDRR	Simulation Driver Radar Recorder
SMIF	Simulation Interface Support
STARS	Standard Terminal Automation Replacement System
TBFM	Time Based Flow Management Program
TFMS	Traffic Flow Management System
XML	Extensible Markup Language