

# S2Focus™

**General Dynamics C4 Systems  
Simulation Systems**  
12001 Research Parkway, Suite 500  
Orlando, FL 32826  
(866) 244-2377

**ABSTRACT:** This paper discusses the S2Focus™ product offerings from General Dynamics. The S2Focus product line includes a Learning Management System (S2Focus LMS) and a software development environment for distributed simulations (S2Focus SimTools). The S2Focus LMS is a fully configurable and customizable web application for tracking multiple users' learning plans based on SCORM content with extensions that allow for integration into distributed simulations. S2Focus SimTools is an easy to use distributed modeling and simulation development environment composed of highly configurable and extendable base components. The S2Focus suite of products can be used as individual components to augment the specific needs of an existing simulation, modeling, or learning system or combined to accomplish multiple simulation related functions including exercise management, monitoring and analysis as well as user progress tracking.

## 1. Introduction

S2Focus is a Commercial-Off-The-Shelf (COTS) suite of products that are derived from over 10 years of continuous product advancement. S2Focus provides the critical infrastructure necessary for conducting distributed simulations and training. Key capabilities include data recording, data analysis, data filtering and control, data visualization, mission planning, learning content management, and user progress tracking. (see Figure 1).

S2Focus products include a Learning Management System (S2Focus LMS) and a software development environment for distributed simulations (S2Focus SimTools). The S2Focus LMS is a fully configurable and customizable web application for tracking multiple users' learning plans based on SCORM 1.2 content with extensions that allow for integration into distributed simulations. S2Focus SimTools is an easy to use distributed modeling and simulation development environment composed of highly configurable and extendable base components.

### 1.1 Benefits

As a low cost Commercial-Off-The-Shelf (COTS) tool suite, S2Focus reduces barrier-to-entry by providing core simulation and training technologies while at the same time providing an attractive alternative to home grown training and simulation solutions. Due to the separation of functionality into components S2Focus can be re-used in a variety of simulation and training environments. The separation of components within

the S2Focus product line also means that users can incorporate S2Focus capabilities into existing solutions.

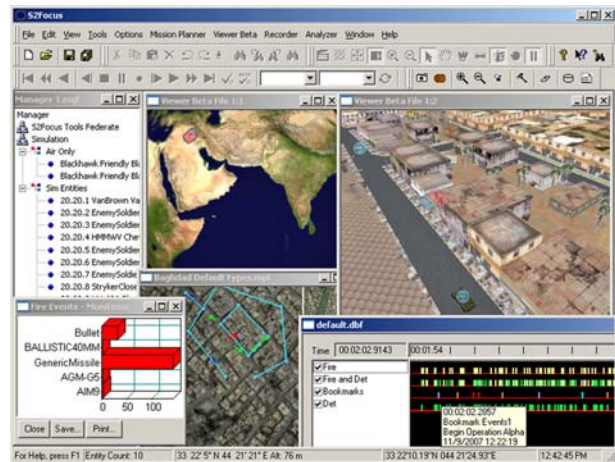


Figure 1 S2Focus Application

### 1.2 Interoperability

S2Focus SimTools is a fully HLA/DIS compliant simulation tool suite and as such is interoperable with OOS, ModSAF, OneSAF Test Bed (OTB), JCATS, STAGE, ITEMS, STRIVE, and any other HLA or DIS simulations. Full support for the SimTools components is available on Windows platforms and Linux platform support is currently available for some components. Linux support is being added continuously.

S2Focus LMS is SCORM 1.2 compliant and as it is a web service, it can support users under any platform with a generic web browser.

### 1.3 Functional Components

The S2Focus infrastructure is composed of a collection of interoperable software components. Components are broken into two main product genera, S2Focus Simulation Tools (S2Focus SimTools) and S2Focus Learning Management System (S2Focus LMS). Each component is highly configurable and encapsulates core functionality in such a way that it can be used, as is, to accomplish common domain objectives. Each component also provides a mechanism such that its functionality can be extended by the user to meet the needs of their specific application.

#### 1.3.1 S2Focus SimTools

The S2Focus SimTools components provide the basic functional needs of distributed simulations. Communication between S2Focus SimTools components is provided by the S2Focus Network Interface, which is itself an autonomous component. Each of these components (on the Windows platform) is implemented using the Document/View architecture for multiple views of a document instance, and is launched from within the S2Focus framework. In some cases components can also run independent of the framework or imbedded into 3<sup>rd</sup> party applications. All components provide an object oriented Application Program Interface (API) as part of the standard install.

S2Focus SimTools components include:

- Framework (component and GUI services)
- Network Interface (simulation interface)
- Protocol Bridge (joining simulations)
- Viewer (Visualization)
- Recorder (data recording/playback)
- Mission Planner (mission planning/execution)
- Analyzer (data analysis)
- Manager (simulation and tool monitoring)

#### 1.3.2 S2Focus LMS

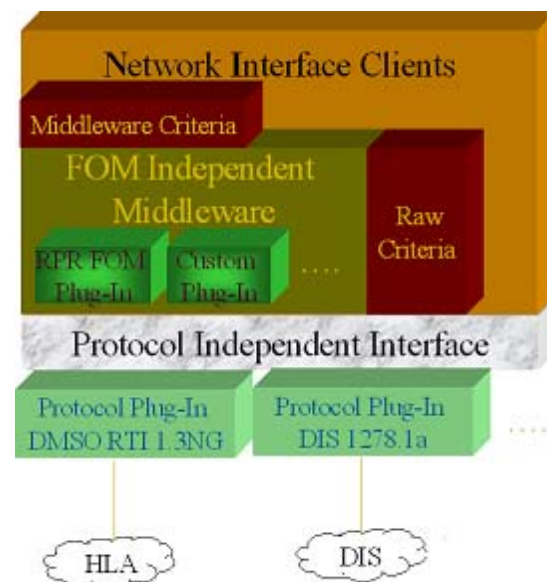
The S2Focus LMS provides a distributed learning environment. It uses common web technologies that are 100% web browser based for platform independence. Features include; User/Role management, Self-paced learning, Assessment, Progress Tracking and Reporting, and SCORM 1.2 compliance. The S2Focus LMS also provides the ability to support simulation based training while embedded on an actual tactical system or on a remote server.

## 2. S2Focus™ Components

This section details the operation and design of each S2Focus component. This separation of capabilities logically divides S2Focus into autonomous functional groups. These components may be separated or combined within an application but are typically sold as a bundled group. See the section Licensing Options for breakdown of capabilities mapped to items on the price sheet.

### 2.1 Network Interface

The Network Interface (NI) provides an HLA-centric, FOM dependent and FOM independent, protocol independent interface to network-based simulations (see Figure 2). All S2Focus components implement an NI interface when receiving data form a simulation network or receiving remote controls form other S2Focus components. Applications which implement an NI interface are referred to as NI Clients.



**Figure 2 NI Architecture**

All NI Clients are shielded from the particular RTI version, vendor, or protocol. NI Clients using the Middleware interface are also shielded from FOM specifics by the use of a FOM plug-in. A user wishing to access FOM functionality not provided in the NI middleware implementation must write a middleware plug-in to support the extended FOM capabilities. Raw clients are FOM dependent (change in FOM may affect NI Client code) and they have access to any data defined within the FOM being used.

NI Client developers may register objects on the network, update object attributes, and remove these

objects during the simulation. NI Clients may receive object discovers, attribute updates, and object remove events from other networked-based simulators by registering listeners with the NI. Listeners are also available to register for interactions and interactions may be sent by the NI Clients.

### 2.1.1 Network Interface features

- Classes for interfacing to the Federation, Federate, and Federate Ambassador
- Management Object Model Information (MOM)
- Byte Swapping Utilities
- Simulation Time
- Coordinate system conversion
- Dead reckoning
- Infrastructure to extend or create new simulation protocol plug-ins
- Infrastructure to extend, or create, new FOM plug-ins
- Smoothing algorithms
- Middleware to support objects with Time-Space Position Information (TSPI), Weapon Fire and Munitions Detonation interactions
- Object Databases
- Time Management
- Object ownership

### 2.1.2 Protocol Plug-in

The protocol plug-in provides simulation protocol independence. One plug-in is required for each protocol used in a simulation. S2Focus currently supports the DIS, HLADirect, and HLA DMSO protocols see Figure 2. Additional protocol plug-ins may be created via the NI API.

A plug-in created via the NI API serves to implement the NI interfaces, seen by the NI Client, for a particular protocol. For example, suppose an NI Client exists that executes within a simulation using either the HLA or DIS plug-ins. Suppose a new protocol becomes the standard simulation protocol. NI Client code does not need to change in order to interoperate with this new protocol. However, a new protocol plug-in must be created to provide meaningful interoperation between the NI Client and simulation.

### 2.1.3 FOM Plug-in

Provides simulation FOM independence to NI Clients using the Middleware interface. One plug-in is required for each FOM used in a simulation. S2Focus currently supports the Real-time Reference FOM (RPR-FOM). Additional FOM plug-ins may be created via the NI API.

Any existing FOM plug-in can be extended to accommodate changes (e.g. new object and interaction classes) in the FOM the plug-in interfaces to.

### 2.1.4 Criteria Filtering

A Criteria filter provides the ability for an NI Client to limit the quantity of received simulation data by specifying some constraint. Criteria filters may operate at either the Middleware or RAW level. Multiple examples of each are provided.

As an example the class name Criteria filter can be used to discriminate objects based on an object type. Suppose an NI Client is only interested in M1A1 tanks, and F-15 aircraft. By creating a Criteria based on these classes, the NI Client will be aware of only those simulation objects whose class type matches the Criteria.

The attribute value Criteria filter can be used to discriminate objects based on an object's attribute value. Suppose an NI Client may be interested only in simulation objects with a location attribute that is within a specified distance from battlefield location. By creating a filter based on this attribute and value, the NI Client will be aware of only those simulation objects whose location matches the Criteria.

## 2.2 Recorder

The Recorder component provides the ability to record, and playback simulation data. Record and playback functionality is implemented as a raw NI Client, hence the recorder is protocol independent. In other words, the Recorder is capable of recording simulation data using one protocol (e.g. DIS), and playing back the recorded log file using a different protocol (e.g. HLA). Limited capability exists for recording and playing back of data on different FOMs however only data shared between FOMs will be re-played, this functionality follows the same rules as the Protocol Bridge component.

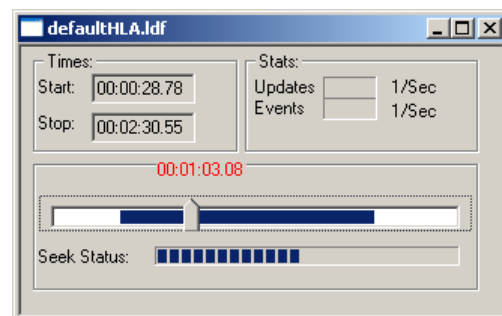


Figure 3 Recorder Dialog

The Recorder can be executed as a component from within the S2Focus framework or from the command line external to the S2Focus framework. The Recorder's API allows for user to access information about logged data and also modify a log file's contents.

### 2.2.1 Recorder Features

- LDIF compliant HLA log format
- FOM independent
- Protocol Independent record/playback
- VCR type controls
- Ability to play a log file at any start time
- Multiple play speeds
- Play forward and backward
- Step forward and backward
- Command line interface

### 2.3 Viewer

The Viewer provides the visualization solution for monitoring of live exercises and log file playback during debrief. The interface allows for multiple two- and three-dimensional views of a simulation exercise. Using these views, a user can unobtrusively navigate a simulation exercise, while displaying varying levels of simulation information. The Viewer provides visual effects including time of day, and weather. It also has the ability to support augmented reality effects such as transparent buildings and Night Vision. Support for manipulation of non-terrain objects is also provided, including turret and muzzle articulation, smoking and flaming effects, lifeform stances and object animations. View objects can be depicted using standard military symbols and generic object icons. Objects can also be selected for viewing and aggregated if part of an echelon structure.

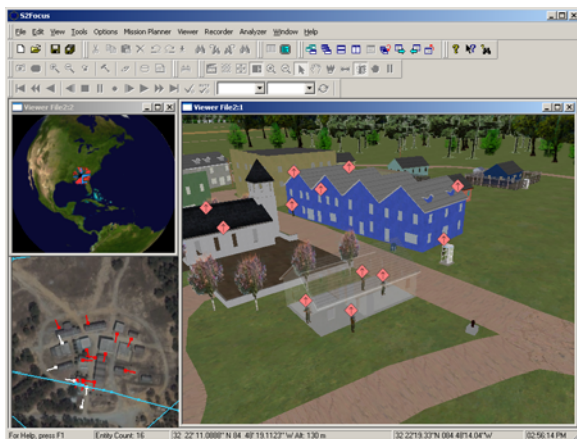


Figure 4 Viewer Component 2-D and 3-D views

### 2.3.1 Extending the Viewer

The Viewer can be executed as a component from within the S2Focus framework, as a stand alone application, or embedded within a 3<sup>rd</sup> party C++, Java, or C# application. The extensive API allows for component control of almost all viewer features, including modifying weather effects, visualization effects, object creation/destruction and GUI creation. Several examples are included in with the viewer install to assist the user in plug-in and application development.

Capabilities in the viewer are broken into high level operations allowing for quick development without an intimate understanding of 3-D rendering technologies. In addition separation of the rendering engine from the API permits the viewer interface to remain constant while allowing rendering technologies to improve independently.

Supported platforms are Windows and Linux. Some functionality is not available on both platforms, such as the C# interface and embedded operation in the S2Focus Framework (Windows only).

### 2.3.2 Imagery sources

Imagery is loaded into the viewer using a terrain configuration file. This supports OpenFlight derived visual databases and multiple formats of 2-D imagery. Support for large data sets is provided though the NIMALoader stand alone application which converts CIB, CADRG, and ADRG data into viewer loadable ECW files. These ECW files are internally georeferenced and are displayed automatically on the globe without individual configuration. In the even that a Web Map Service (WMS) server is available the Viewer provides a WMS plug-in which can stream imagery data from the server and load it onto the globe view. This is particularly beneficial when dealing with large data sets for multiple users on a single network.

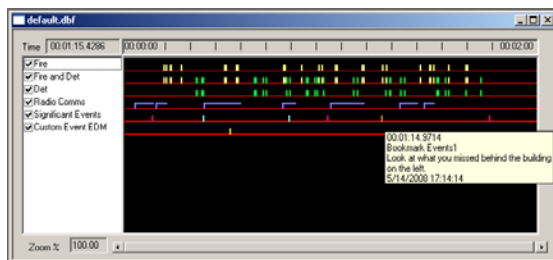
### 2.3.3 Viewer Features

- API to extend graphics capability
- C++, C#, and Java API interfaces for extending visual capabilities and embedding into 3<sup>rd</sup> party applications
- Supports rgb, bmp, 3df, 5551, cdb, dds, ecw, and tga texture formats
- Displays Entities and Interactions (fire and detonation lines)
- OpenFlight, IVE, TerraPage, and other Model & Database Support
- Dynamic Terrain Loading
- Night Vision mode

- UAV emulation (Provided example)
- Appearance effects (Multiple Damage States, Smoke, Flames, Missile Trails, Dust)
- Weapon Effects (Detonations)
- Customizable Fog (linear, exponential, exponential squared fog modes)
- Able to attach camera to any entity
- Dismounted Soldier support (animation states)
- Multiple Camera Modes (Cockpit, Observer, Map, Free)
- WMS imagery support
- ECW file creation from CIB, CADRG and ADRG
- Rendering of ECW files to the globe view
- Creation of 3-D terrain from 2-D image file

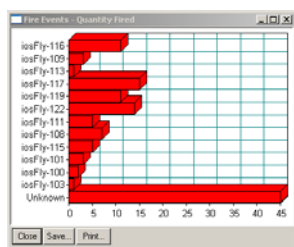
## 2.4 Analyzer

The Analyzer component collects, displays, and analyzes recorded, and real-time simulation data. It includes two views: a Report View that displays event information in a tabular form, and an Event View that displays event information as markers on a trace (see Figure 5).



**Figure 5 Analyzer Event Timeline**

The Analyzer is customizable, and includes an API for the developer to create custom plug-ins that capture, process, and display exercise information. A basic Bar Chart object is included in the API (see Figure 6), and the plug-in developer can use this chart to display real-time exercise information. The API also provides the developer with the ability to create a plug-in that is based on either the NI Middleware, or NI Raw interface.



**Figure 6 Analyzer Chart**

In addition to providing an API, the Analyzer stores simulation data to a - Access database. This allows the

user to perform data analysis, either offline, or during a simulation. Data analysis may include user-defined Access queries and/or reports.

The Analyzer connects to the Access database via an ODBC connection. The Analyzer is capable of connecting to any database as long as there is an accompanying ODBC software driver installed on the host system for the database. Reports are generated using plug-in report generators and templates. A Microsoft PowerPoint report generator is provided for easy debriefs and student review. This product can also be included in a user Take Home Package.

The Analyzer has built-in support, via two supported plug-ins, for detecting simulation Weapon Fire and Munitions Detonation events. Also provided are Event Detection Modules for Radio Communications, Bookmarks, and several others all of which are provided as examples.

### 2.4.1 Analyzer Features

- Report generation to Microsoft PowerPoint
- Event data stored in Microsoft Access Database
- Event Detection Module plug-in architecture
- Remote capability to conduct debriefs while a live exercise is being monitored provides instructors the ability to debrief students before an exercise has ended
- Real-time automated chart generation
- Customizable timeline
- Remotely Controllable

## 2.5 Manager

The Manager component allows the user to monitor and control objects on the network, such as entities participating in an exercise (see Figure 7), as well as local and remote simulation tools using the S2Focus Tools FOM and HLA Direct™ simulation protocol.

A plug-in interface is provided for extending the managers functionality, this is typically performed by sending interactions on the simulation network or viewing detailed information about a particular object displayed in the manager tree view. Common uses of the manager are to control S2Focus components on distributed machines, monitor simulation entities by narrowing down specific groups of entities on a single federate and viewing multiple simulations simultaneously though the use of multiple federate branches from the main tree.

The Manager incorporates Criteria filtering, and groups objects based on the configured criteria.

Federates can be created as Middleware or RAW NI Clients and different criteria is available depending on which is chosen. Raw criteria supports class name and attribute value Criteria filters, Middleware Criteria offers filtering on high level middleware attributes such as velocity, force id, or damage state, for entities and document name, mode, or host for simulation tools.

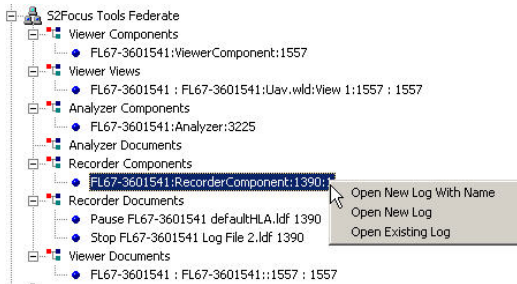


Figure 7 Manager Window

### 2.5.1 Manager Features

- View entities in exercise
- Filter based on user definable criteria
- Example: Filter based on type, force, status, speed, etc...
- Focus on geographical location or Force-ID.
- Remote Control of tools and/or simulation objects
- Extensible to provide custom criteria or controls

### 2.6 Mission Planner

The Mission Planner provides a means to plan a mission by defining and laying down platforms (e.g. UAVs, E8s, etc.), and providing routes for the platforms to follow. Once the mission is planned, the Mission Planner simulates the movements of the platform entities (see Figure 8). Simulations can be run at real-time, fractional time or up to 100 times real-time. Basic platform interactions are provided including engagement algorithms and unit movement patterns.

Platforms actions and interactions can be scripted within the engine to occur immediately, at a specified times or at waypoints along a route. Platform behaviors are defined by plug-ins to the Mission Planner engine. Basic platform models are provided as examples and can be derived from to implement specific behaviors. Provided examples include Land Entities, Lifeform entities, Air Platforms, and several sensor models. A more advanced UAV Entity derived from the Air Entity is also provided as an example of controlling a mission planner platform form events external to the mission planner engine.

The Mission Planner engine is separate from the Mission Planner application and as such can be embedded into 3rd party applications. Currently there are two interfaces to the simulation engine, the first is as a framework component with full capability for adding entities, scripting events, creating routes, etc. and the second is command line interface for executing a simulation based on a previously saved mission planner file.



Figure 8 Mission Planner Window

### 2.6.1 Mission Planner features

- Create any number of entities of any type
- Create any number of Routes and assign to one or more defined entities
- Define any number of Waypoints for a Route, and define location, speed, and altitude at each waypoint
- Define the force, initial speed, orientation, location, and delay start time for each entity
- Position entities and waypoints via a 2-D graphical interface
- Add additional platform behaviors by extending base objects
- Replay simulation at above and below real-time for quick analysis.

### 2.7 Voice Communicator

Voice Communicator transmits and receives audio data through the simulation network, allowing two-way communications between active participants. Data is sent using standard simulation protocols and in addition to the signal interactions/PDUs the appropriate transmitter objects are created on the network. Several audio encoding formats are supported including CVSD, MULAW and uncompressed PCM. A single instance can support communications on up to ten simultaneous communication channels. Multiple instances of the Voice Communicator can be run on the same network to capture radio communication events from even more communication channels.

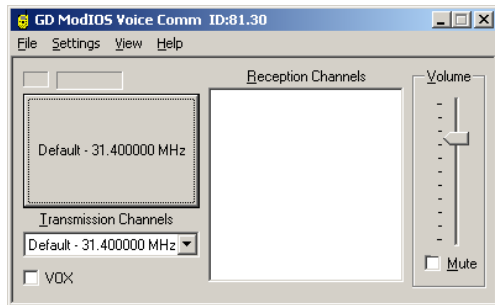


Figure 9 Voice Communicator

The Voice Communicator may be controlled remotely from other Simulation Tools through its SIMAN control interface. Monitored radio IDs and frequencies can be queried and set, as well as the transmit frequency and the play back volume. Communications meta data can also be set though it doesn't modify the send data, these meta parameters include transmission power, crypto key, and bandwidth.

Execution of the Voice Communicator can be with or without a GUI. When used without a GUI Voice Communicator is controlled exclusively through the remote interface. Typically Voice Communicator is run without a GUI when another application is simulating the user interface of another communication device such as a tactical radio or cell phone.

### 2.7.1 Voice features

- Adjustable VOX threshold
- Joystick controls for push to talk
- Can use custom made GUIs to emulate communications devices
- Remote control from 3rd party applications
- Compression formats include CVSD, MULAW, PCM
- 10 simultaneous communication channels

## 2.8 Learning Management System

The S2Focus Learning Management System (LMS) is a SCORM 1.2 compliant learning environment. It provides a core set of functionality for user management, SCORM 1.2 course management, and user/course statistical reporting. The LMS also provides additional capabilities for integrated training with simulation exercises.

The LMS is designed to provide a standard interface that is used to develop web applications allowing customers to create or modify graphical user interfaces. The web interface is designed using a Model-View-Controller front end leveraging the Java Server Faces technology allowing for flexible navigation. Textual configuration files are used to provide LMS with the

ability to make minor changes without the need for a recompile of the source code.

The LMS can operate in one of three modes/configurations distributed, classroom, or embedded. The distributed mode is the typical client server configuration, where the server can be running on any computer that is accessible by the client application. For the classroom mode the LMS is configured run where multiple students are taught using instructor lead, self-paced and hands on techniques. In the embedded mode the LMS runs on the tactical machine and integrates with the tactical software.

When operating in the embedded mode the LMS is loaded in to the actual system along side the tactical software. The LMS can easily be integrated into an existing system with little or now change to the system, depending on the program requirements. The same is true for new programs that integrate the LMS as part of their solution from the very beginning. With platform independence the LMS can operate on all major operating systems with minor configuration changes.

### 2.8.1 Learning Management System features

- SCORM 1.2 Compliant
- User Management (Add, Remove, Modify)
- Course Management (Import, Delete, Assign)
- User Progress Tracking
- Simulation Exercises
- Roles Based Access
- User and Course Statistical Reporting
- Database Abstraction
- Platform Independence (Requires JRE)
- JEE 5 Architecture

## 3. Hardware and Software Environment

The S2Focus application is designed for use on low cost Windows and Linux based computers. In addition, efficient and effective 3-D visualization is achieved using readily available graphics cards. Extending S2Focus requires Microsoft Visual C++ 2003 Service Pack 1. See Figure 10 Hardware and Software Environment for a complete list of hardware and software requirements.

Component	Required	Recommended
Operating System	Windows 2000 Linux RedHat 3 Update 6	Windows 2000 or greater Linux updates available
Processor	Intel Pentium 4 1GHz	Intel Pentium 4 dual core
Memory (RAM)	512 MB	1024 MB
Hard Drive Space	150 MB*	400 MB
Mouse	Any	3 Button w/Scroll
Network Card	Yes (10Mb)	Yes (1000Mb)
Sound Card	None	Yes
Video	Open GL v1.1 compliant 16 bit color Viewer Specific: High performance 3D 64 MB Texture support Latest OpenGL drivers	Open GL v1.1 compliant 32 bit color Viewer Specific: Nvidia Geforce 3D 256 MB Texture support Latest OpenGL drivers
Software Development C++	Microsoft Visual Studio 2003 SP 1	
Software Development C#	Microsoft Visual Studio 2005 SP 1	
Software Development Java	Sun Java JDK 6	
Third party software	environment. Not necessary if using DIS or HLADirect protocols	

\* depends on installed options

Figure 10 Hardware and Software Environment

### 4. Licensing Options

S2Focus can be purchased as a suite license which includes the majority of the available S2Focus capabilities. Items not provided in the suite license are Voice Communicator, and S2Focus LMS. It is also possible to purchase some portions of the S2Focus SimTools capabilities without needing to purchase the entire S2Focus suite. The following table (Figure 11) indicates which portions of the S2Focus Simulation Management Software Suite can be purchased as individual components. Licensing of the S2Focus LMS and Voice Communicator are not provided as part of the S2Focus SimTools Suite and each has its own line item in the product pricing sheet, therefore they are not included in the following table.

Licenses are controlled via a USB dongle attached to the machine running the S2Focus software, or in the case of a Site license the network license server. These dongles are transportable between machines and are covered under the Maintenance and Support Contract against breakage.

		S2Focus Licensed Product As listed in price sheet		
		S2Focus™ Simulation Management Software Suite	S2Focus™ 3D Viewer Component	S2Focus™ Network Interface Component
S2Focus™ Components As described in this document	Network Interface	Yes	Execution only	Yes
	Recorder	Yes		
	Viewer	Yes	Yes	
	Analyzer	Yes		
	Manager	Yes		
	Mission Planner	Yes		
Components sold individually, not as part of the S2Focus™ Simulation Management Software Suite				
	Voice Communicator	ModIOS®/Voice Communicator		
	Learning Management System	S2Focus™ Learning Management System		

Figure 11 Product capabilities matrix

### 4.1 Volume license options

S2Focus publishes a pricing schedule for referencing part numbers to products and prices. This schedule also identifies the 3 tiers of license purchase available from S2Focus. These are Seat Licensing for individual licenses, Site Licensing for groups of up to 10 collocated S2Focus machines being served from a single network license, and Program Bundled Licenses for quantities between 10 and 5000 where machines are being used on a single program. In the case of Single and Site licenses there is a volume discount program available for multiple purchases of the same license.

### 4.2 Maintenance and Support

Maintenance and support requests are to be communicated to the S2Focus team via designated representatives. Maintenance and support includes minor releases, bug fixes, and support. Reference the ModIOS / S2Focus Software Maintenance and Support Agreement. In the case of the Site and Program Bundled Licensees the first year of Maintenance and Support are included in the initial purchase. The license will not expire after Maintenance and Support has expired however no updates to the product or any technical support will be available.

### 5. Points of Contact

**Gary Hall, Technology Manager**

Phone: 407-823-7017

Mail: [Gary.W.Hall@gdc4s.com](mailto:Gary.W.Hall@gdc4s.com) or [S2focus@gdc4s.com](mailto:S2focus@gdc4s.com)

**General Support and Sales**

Toll Free: 866-244-2377

Orlando: 407-823-7000

Mail: [S2focus@gdc4s.com](mailto:S2focus@gdc4s.com)

### 6. References

- [1] "S2Focus Introductory Training", General Dynamics C4 Systems
- [2] "S2Focus Network Interface Training", General Dynamics C4 Systems
- [3] "S2Focus 2.8 Help Documentation, General Dynamics C4 Systems

*Windows, Access, and Power Point are a registered trademarks of Microsoft Corporation in the United States and other countries.*