



User's Manual

10/3/2008



Revision History

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Contents

- Revision History 2
- Contents 3
- 1 Set Up 5
 - 1.1 Install STK..... 5
 - 1.2 Install QualNet..... 5
 - 1.3 Install SynQ..... 5
- 2 Licensing 6
 - 2.1 Trial version..... 6
 - 2.2 Licensing fees 6
 - 2.2.1 Usage license..... 6
 - 2.2.2 Maintenance fee..... 6
 - 2.3 License file 6
- 3 GUI Overview 7
- 4 Main Menu..... 8
 - 4.1 File 8
 - 4.2 Edit..... 9
 - 4.3 Run..... 9
 - 4.4 Window 10
 - 4.5 Help..... 11
- 5 Scenario 11
 - 5.1 File format 11
 - 5.2 Create 12

| | | |
|---------|-------------------------------------|----|
| 5.3 | Open | 12 |
| 5.4 | Save | 12 |
| 5.5 | Editing scenarios..... | 12 |
| 5.5.1 | STK or QualNet..... | 12 |
| 5.5.2 | SynQ..... | 12 |
| 6 | Objects..... | 13 |
| 6.1 | Facilities and vehicles | 14 |
| 6.2 | Network objects..... | 14 |
| 6.2.1 | Create nodes..... | 14 |
| 6.2.2 | Connect nodes | 14 |
| 6.2.2.1 | Point-to-point physical links | 14 |
| 6.2.2.2 | Router / hub..... | 15 |
| 6.2.3 | Node group | 16 |
| 7 | Network Simulation | 16 |
| 7.1 | Applications..... | 16 |
| 7.2 | Analysis..... | 18 |
| 7.2.1 | Visualization..... | 18 |
| 7.2.2 | Report / Graph..... | 19 |

1 Set Up

1.1 Install STK

Install Satellite Tool Kit (STK), which can be obtained from Analytical Graphics Inc. (AGI). STK 8.x is needed for SynQ. User must have STK/Integration, which comes with STK/X, or have a STK/4DX license. STK/Comm module is not necessary, but can be included to access additional features. User should contact AGI to obtain licensing and STK software.

1.2 Install QualNet

Install QualNet, which can be obtained from Scalable Network Technologies (SNT). QualNet 4.x is needed for SynQ. QualNet's graphic user interface (GUI) is not required, only the command line version of QualNet is needed. User should contact SNT to obtain licensing and QualNet software.

1.3 Install SynQ

Install SynQ*, which can be obtained from Trinnovations, using the following instructions:

1. Insert the CD disk into the CD-ROM drive.
2. Follow the direction prompts of the Autorun program to install the software, contact Trinnovations, or access a copy of the User's Manual.

OR

1. From the My Computer folder, click on the CD-ROM icon to open the drive and display the CD contents. The user may also locate and unzip the SynQ folder downloaded from the website.
2. Click on Setup.exe to run the installation program.
3. Follow the prompts displayed in the setup to complete the install.

***Technical Specifications:** SynQ™ is available for Windows NT, 2000, and XP. Minimum hardware configuration for the basic module is 256 MB of RAM, a 1 GHz processor, and 1.4 GB of free disk space.

2 Licensing

2.1 Trial version

Initially, a trial version of the SynQ software is available for all users who receive the CD or download the software online, allowing them free access to the tool for 30 days. This demo license is available by calling (951-719-3787) or emailing (synq@trinnovations.com). After this period expires, users need to purchase a usage license for the tool by calling (951-719-3787) or emailing Trinnovations (synq@trinnovations.com).

2.2 Licensing fees

2.2.1 Usage license

A usage license allows a single user to have access to the tool. This license is required to use the tool.

2.2.2 Maintenance fee

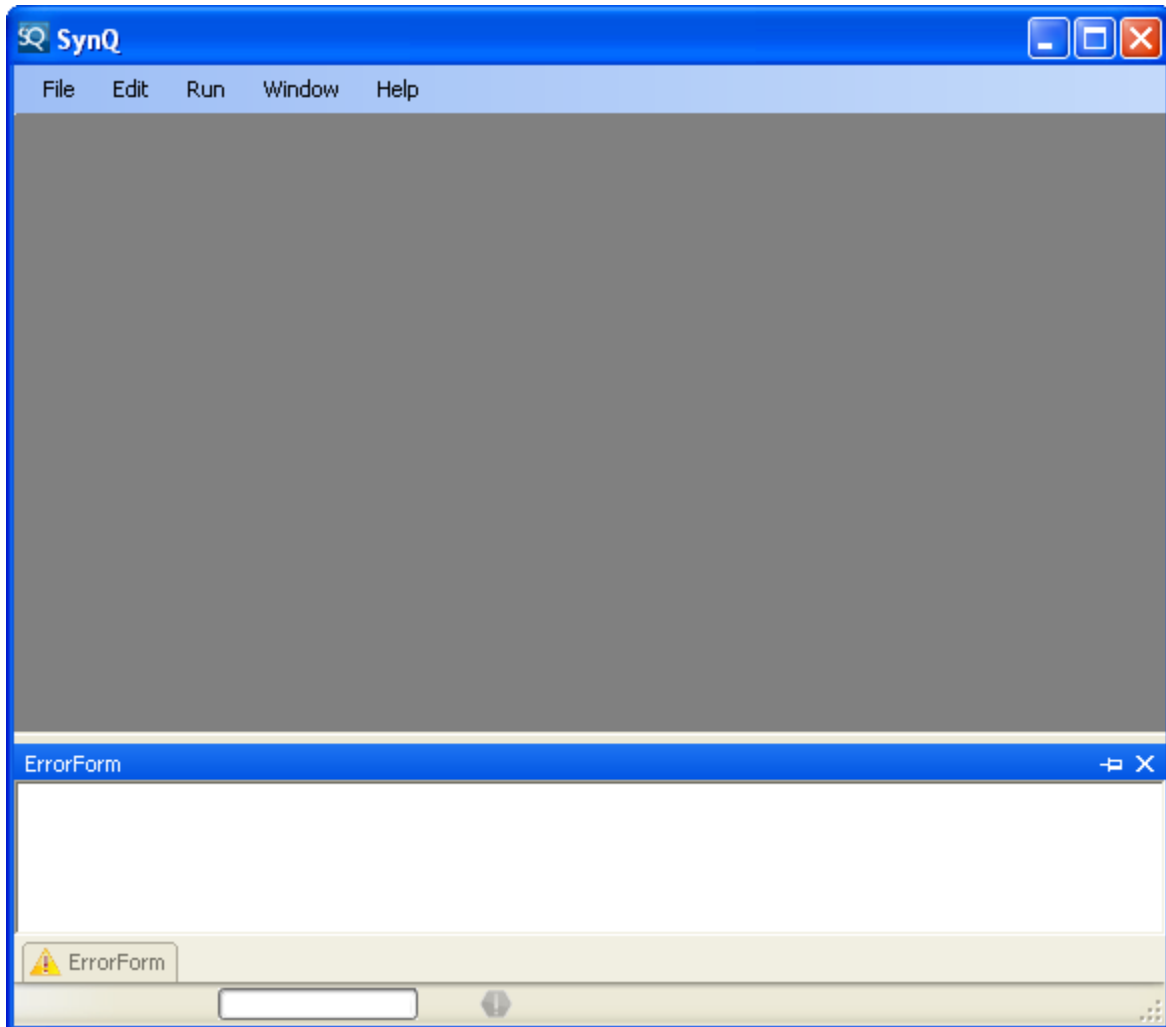
When chosen in addition to the usage license, this fee covers software support, fixes, and upgrades for 1 year. This fee is not required to use the tool, but can be renewed annually and is highly recommended.

2.3 License file

Licenses are distributed as files that must be installed in the Lic folder included in the SynQ program files on your computer. Once SynQ is installed on a computer, this folder can be found at C:\Program Files\Trinnovations\SynQ\Lic.

3 GUI Overview

Open SynQ by clicking on SynQ in the start menu's program option, or clicking on the shortcut icon displayed on the desktop. Once open you will see the following window:



The SynQ GUI is a simple interface with many features. Most menu items and options can be completed using any of the following actions: a single click, double click, or right click. In addition, for ease of use, many of the options are located in several areas. For example, right-clicking on the object in the window provides access to reports, settings, and zoom features on the various toolbars, while clicking on objects in the 2D and 3D window provides the same options.

4 Main Menu

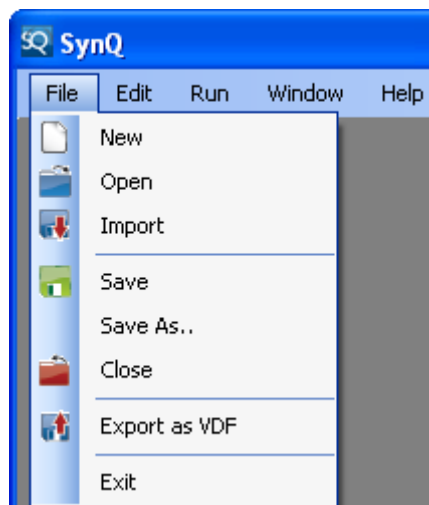
The top of the SynQ window includes 5 major menu options: File, Edit, Run, Window, and Help.



4.1 File

The File option on the Main Menu allows the user to do the following:

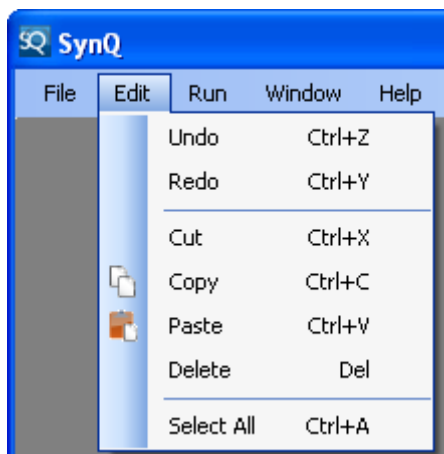
- **New** - Create a new SynQ config file (.snq).
- **Open** - Open an existing SynQ config file (.snq).
- **Import** - Import a STK and/or QualNet scenario into SynQ.
- **Save** - Save changes to the SynQ config file (.snq).
- **Save As** - Save the SynQ config file (.snq) with a new name.
- **Close** - Close the SynQ config file (.snq).
- **Export as VDF** - Export the SynQ config file (.snq) as an interactive 4-D visual display format file (.vdf).
- **Exit** - Exit the program.



4.2 Edit

The Edit option on the Main Menu allows the user to do the following:

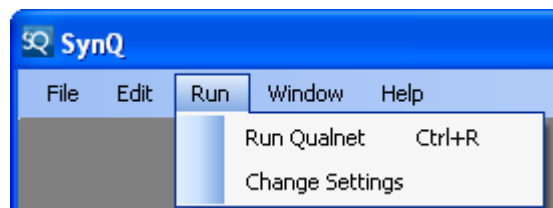
- **Undo** - Undo the previous action or command.
- **Redo** - Redo the action or command that was undone.
- **Cut** - Cut the selected object.
- **Copy** - Copy the selected object.
- **Paste** - Paste a cut or copied object.
- **Delete** - Delete the selected object.
- **Select All** - Select all objects within the file.



4.3 Run

The Run option on the Main Menu allows the user to do the following:

- **Run QualNet** - Run the scenario using QualNet.
- **Change Settings** - Change the settings used to run the scenario.

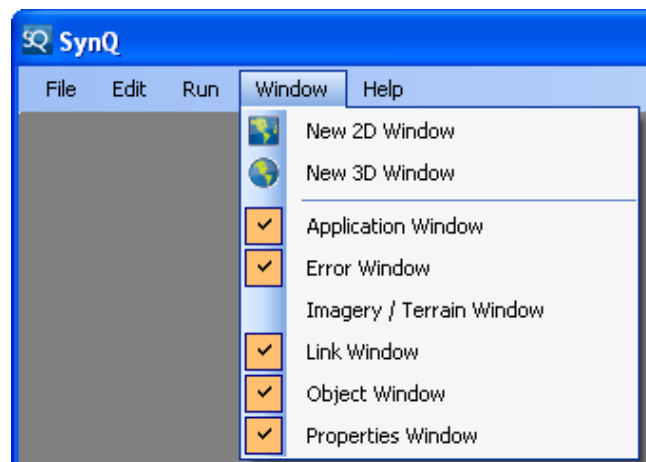


4.4 Window

The Window option on the Main Menu allows the user to customize the windows they may view within SynQ. By default 2D (map view), 3D (globe view), application, error, link, object, and properties windows are displayed.

Unselect a checked window to remove it from view.

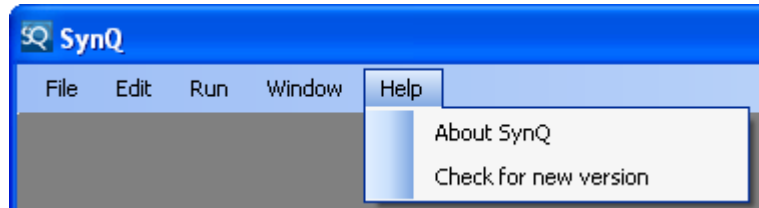
- **New 2D Window** - Open a new window containing a 2D map.
- **New 3D Window** - Open a new window containing a 3D globe.
- **Application Window** - View the application window, which contains all applications (or demands) on the network. This includes traffic on the network, such as constant bit rate, HTTP, VOIP, FTP, and more.
- **Error Window** - View the error window, which contains any errors SynQ has during execution.
- **Imagery / Terrain Window** - View the imagery / terrain window, which is not shown by default. This window contains the terrain and imagery used for both visualization and analysis.
- **Link Window** - View the link window, which contains all point-to-point physical links.
- **Objects Window** - View the object window, which contains all physical objects in a scenario (except for physical links). This window can contain aircraft, facilities, ground vehicles, missiles, satellites, ships, routers, switches, and wired and wireless networks.
- **Properties Window** - View the properties window, which contains the editable settings of the currently selected object in any of the other windows.



4.5 Help

The Help option on the Main Menu allows the user to do the following:

- **About SynQ** - View information about SynQ, including version number.
- **Check for new version** - Check for updates to SynQ.



5 Scenario

The starting point of SynQ is creating a scenario or opening an existing scenario. Scenarios are the containers in which all objects (nodes, satellites, network links, etc.) are created and simulated. Use the following instructions to either create a new scenario or open an existing scenario, as well as save any scenarios created or edited using SynQ.

5.1 File format

All files used and created in SynQ are SynQ config files with the .snq extension. These files contain 3 components, which in combination create a SynQ scenario. Since SynQ is the integration of work between QualNet and STK, SynQ saves the entire STK scenario in the directory under a sub-folder labeled "S", and the QualNet scenario under a sub-folder labeled "Q". In addition, a file is saved in the main directory including the characteristics of how to map one file to the other. This process allows users to open the files in their respective programs, either STK or QualNet, as described in section 5.4. All files (except for imagery and terrain) are saved in a plain text (or human readable) file.

5.2 Create

1. Click **File > New** to create a new SynQ file.
2. Select the location and name for the new file, then select **Save**.

5.3 Open

1. Click **File > Open** to open an existing SynQ file.
2. Select the .snq file to open in SynQ by double-clicking on the file or choosing the file and selecting **Open**.

5.4 Save

1. Click **File > Save** to save the scenario as a SynQ file.
2. Enter a name for the new .snq file being saved, or save over an existing file.

5.5 Editing scenarios

5.5.1 STK or QualNet

Users may open the “S” folder saved by SynQ directly in STK. The scenario is similar to what is viewed in SynQ; however, it would be missing objects (e.g., links, routers, etc.) which are constructs of QualNet and not recognized by STK. Similarly, the “Q” folder saved by SynQ can be opened in QualNet.

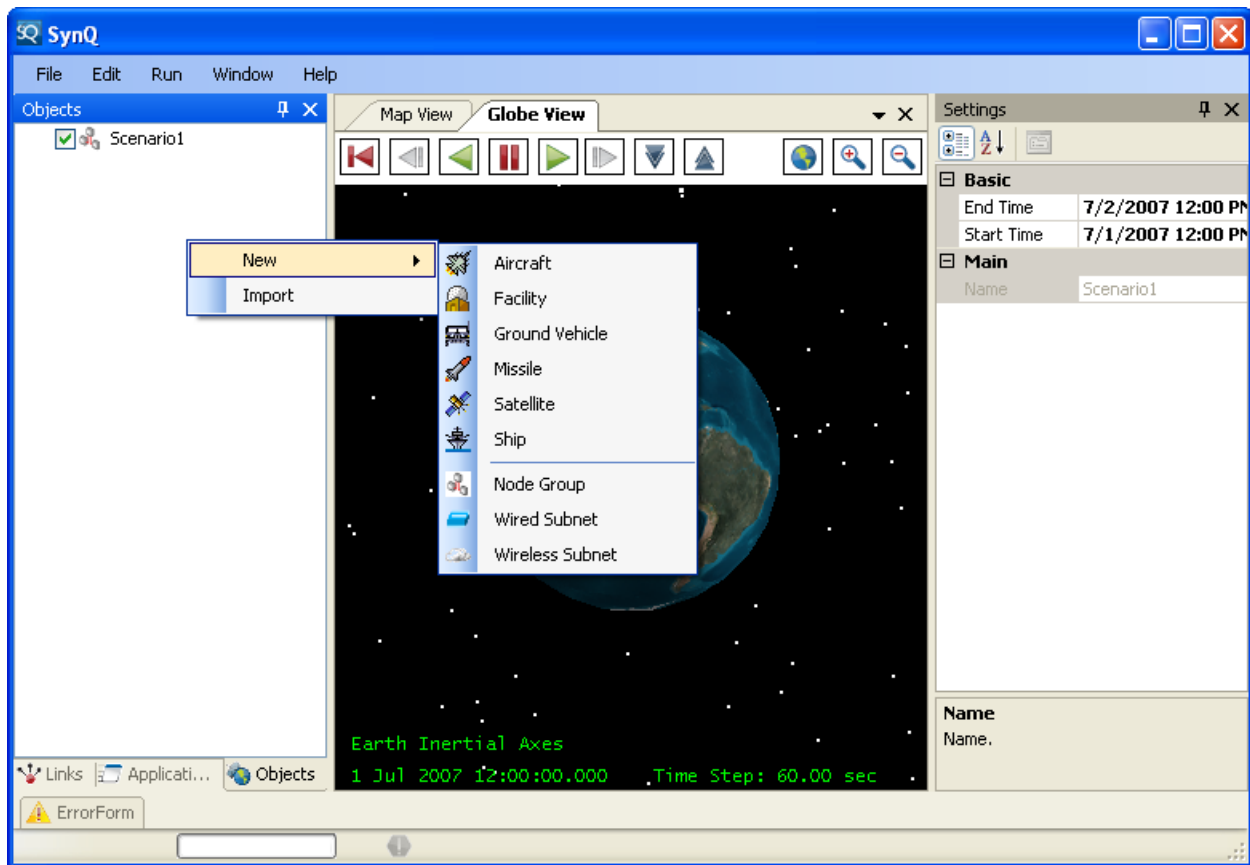
If edits are made to a scenario using STK or QualNet, upon opening the scenario in SynQ, the user will be prompted to either merge the changes or pick how to resolve a conflict made by the changes to the scenario. This allows users the flexibility of editing scenarios in all 3 tools - STK, QualNet, or SynQ.

5.5.2 SynQ

Users may make changes to .snq files by opening the file with SynQ and making any necessary changes to the scenario.

6 Objects

SynQ can handle many different object types simultaneously. For example, high fidelity propagators can be used alongside high fidelity network simulation. The main window is the Objects window, which is located on the left side of the screen by default. Right-click in the Objects window and select **New**, to view the different types of objects that can be created for the scenario, as seen in the image below.



6.1 Facilities and vehicles

SynQ treats each object as a network element, where it can be defined as a router, hub, or node and host/pass traffic through the network. The following are the different types of objects that can be added to a scenario:

- **Aircraft** - mobile node with altitude defined by waypoints
- **Facility** - stationary node defined by single position
- **Ground vehicle** - mobile node with 0 altitude defined by waypoints
- **Missile** - mobile node with launch and landing point or launch and initial conditions
- **Satellite** - mobile space-based object defined by orbital elements
- **Ship** - mobile node with 0 altitude defined by waypoints

6.2 Network objects

6.2.1 Create nodes

Nodes are automatically created when a facility or vehicle is created, since all objects in SynQ are treated as network elements.

6.2.2 Connect nodes

Objects/nodes must be linked to each other for communication. This is accomplished through either point-to-point physical links in the Links window or a router/hub in the Objects window.

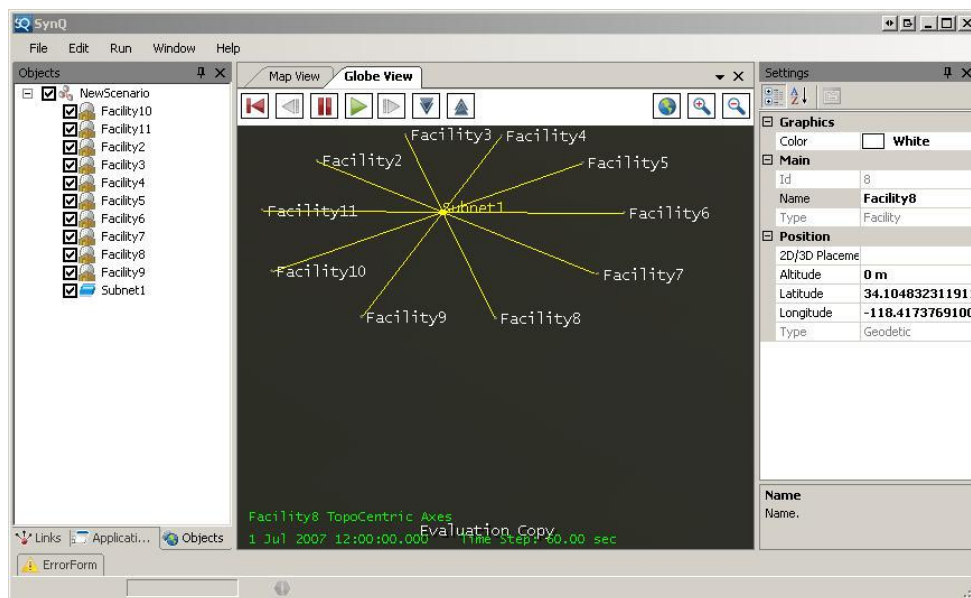
6.2.2.1 Point-to-point physical links

1. Select the Links window.
2. Right-click and select **New** to create a new connection.
3. Select the new connection in the Links window to use the Properties window on the right side of the screen to change the settings for this connection.

6.2.2.2 Router / hub

1. Select the Objects window.
2. Add a new wired or wireless subnet by right-clicking in the Objects window and selecting **New > Wired Subnet** or **New > Wireless Subnet**.
3. Once the wired or wireless subnet is created, nodes must be added to that network. This can be accomplished using one of the following methods:
 - Use the 2D map view or 3D globe view to double click on objects and include them in the selected network, or
 - Use the Settings window, which lists all nodes that are part of the selected network. Click on the ... beside Nodes in this window to add or remove objects as part of the network group.

The following image presents a wired subnet group with all nodes connected. By default, wired connections are displayed using a solid yellow line, while wireless connections are displayed using a green dotted line.



6.2.3 Node group

A user may create a new object as a node group, which allows the user to lay down 1000s of interconnected stationary or mobile nodes with a few mouse clicks. With this option, a command and control center or set of nodes in the field can be created quickly.

1. Select the Objects window.
2. Add a new node group by right-clicking in the Objects window and selecting **New > Node Group**.
3. Specify the appropriate settings for the node group in the pop-up window that appears. These settings include the following:
 - type of center node (wired, wireless, node)
 - location of the center node (lat/long)
 - number of nodes in group
 - node type
 - distribution type (radial or random)
 - radius of node placement
4. Once the settings have been specified, SynQ will create the nodes, add the central network element, and connect all objects to the centralized object.

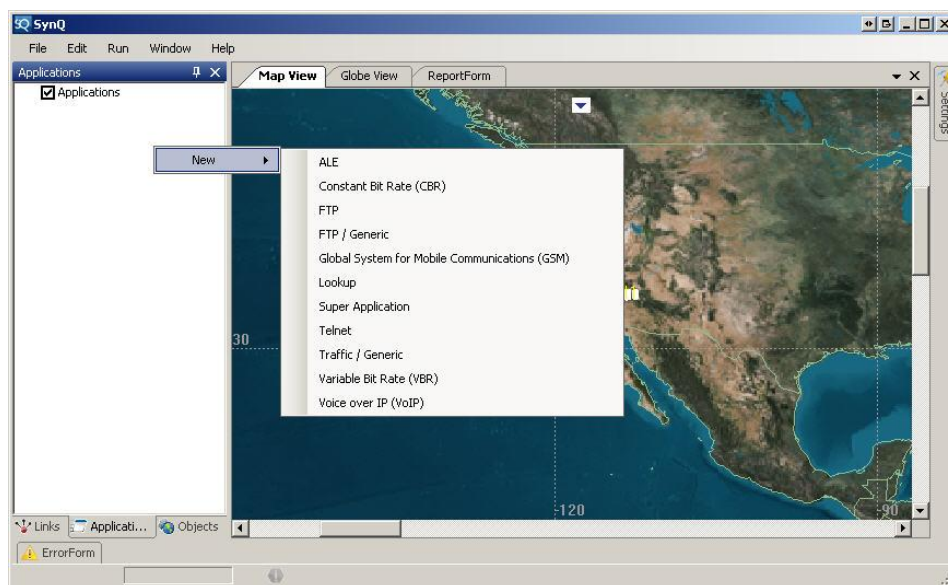
7 Network Simulation

7.1 Applications

The most important step to running a network simulation is to place network traffic or determine the application to be used in communicating via the network. The application traffic is a virtual object in the scenario. Only after a scenario is run will the results of traffic be displayed for analysis. Multiple applications can exist between any two nodes. Application is an end-to-end setup. The network lay down, routing algorithms, and position of objects will determine what nodes or links will be used to pass the traffic.

1. Select the Applications window.

2. Right-click in the Applications window and select **New**.
3. Select the type of traffic you want to place in the network from the types of application traffic listed:
 - **CBR** - constant bit rate (similar to ping)
 - **FTP** - file transfer protocol
 - **FTP / Generic** - file transfer protocol
 - **GSM** - Global System for Mobile communications
 - **Lookup** - request and response application (similar to HTTP)
 - **Super Application** - a super set that includes all other applications. Every application listed here and many others can be built from Super Application
 - **Telnet**
 - **Traffic Generate**
 - **VBR** - Variable Bit Rate
 - **VoIP** - Voice over IP
4. Select the application listed in the Applications window to use the Properties window on the right side of the screen to change the settings for this connection.
5. Click on the ... next to Destination Node in the Settings window to specify the receiving node for network traffic.
6. Click on the ... next to Source Node in the Settings window to specify the sending node for network traffic.



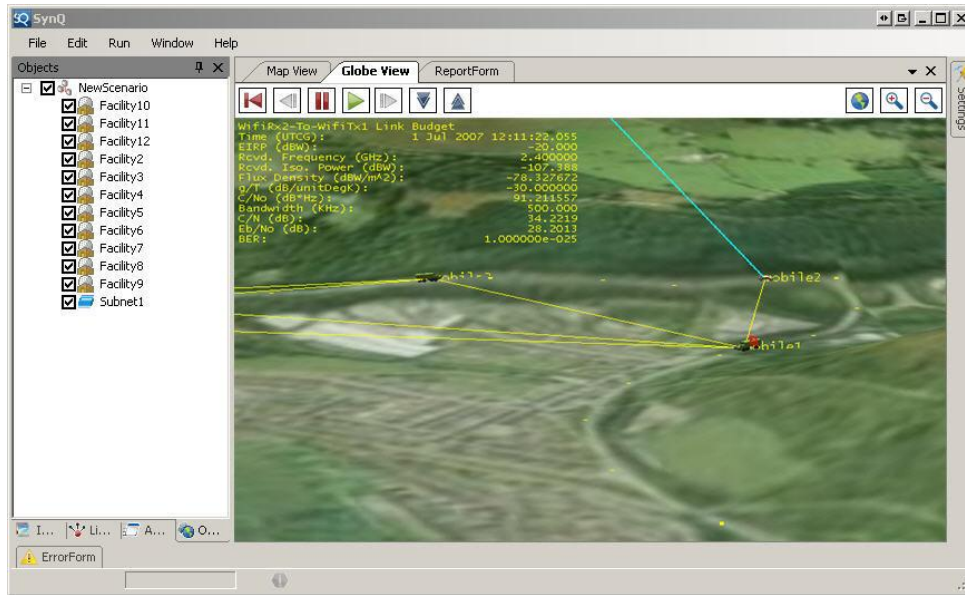
7.2 Analysis

SynQ is a mix of continuous equations and discrete events, combining these seamlessly into one application. As objects are created, continuous geometry and mathematics are run to calculate the position and orientation of objects. Once all objects are created and placed in a scenario, along with the complementary network elements, the simulation can be run. Running the simulation is where the discrete event elements are simulated, aggregated, and analyzed. To run the simulation and perform the analyses, click on **Run > Run QualNet** on the Main Menu. The result of the run is visualization of network traffic and reports that show bandwidth, dropped packets, and delays.

7.2.1 Visualization

The visualization of a simulation includes packets being passed between objects, radio distance, and queue usage. A unique feature of SynQ is the ability to both lay down a network and analyze network traffic in a 2D and 3D environment. SynQ allows the user to play, rewind, and pause the results of a simulation to understand how nodes are affected by placement, and analyze highly dynamic simulations.

Click on the **Map View** tab for 2D visualization of the scenario, or the **Globe View** tab for 3D visualization of the scenario (as shown in the following image). The 3D visualization includes models for objects, terrain, imagery, and lines between objects to indicate communication.



7.2.2 Report / Graph

SynQ provides detailed reporting for physical layer and network layer events. All reports in SynQ are printable and can be exported into excel or plain text. The following includes instructions to run a report and an image of a report created in SynQ.

1. Select the Objects window.
2. Right-click on an object and select **Report/Graph**.
3. Specify the properties of the graph or report, which includes both single object statistics (i.e., latitude/longitude/altitude, sun angles, and queue depth), or multiple object statistics (i.e., access from one object to another, messages sent between two nodes, delay between two nodes, etc.)
4. In addition, users may select the various reports to include from the physical layer (i.e., access, sun, etc.) or network layer (i.e., number dropped messages, queue, etc.).

