

QualNet[®]

Product Family

The technologies that support computer networks are bringing information to people in new and better ways every day. Emerging technologies like WiMAX, software-defined radios, and Voice over IP are just a few examples of advancements that will improve communication systems, and lives, dramatically.

Network simulation is a very efficient and cost-effective way to develop new network technologies. By building virtual networks in a lab environment, researchers can test, optimize, and integrate next generation network technologies at a fraction of the cost of deploying physical testbeds.

The design, development and management of network-centric systems is a complex science. The replacement cycle of most new technologies is 10 to 20 years, so most new technologies are deployed into legacy networks in a multi-stage technology rollout. Network modeling ensures that technologies are evaluated at a variety of stages of interoperability and with a broad mix of applications. This helps ensure that networks operate at the levels of performance they're designed to deliver.

QualNet

QualNet is network modeling software that predicts performance of networks through simulation and emulation. QualNet is the cornerstone for virtual networking labs that enable the deployment of a mind-boggling plethora of applications in wireless, wired and mixed network platforms.

The key to successful deployment of virtual networks is QualNet's speed, scalability, accuracy and portability. Speed of simulation enables fast results but more importantly, it enables real-time network simulation, which supports hardware-, software-, and human-in-the-loop simulation.

Scalability in QualNet is necessary for prediction of large network behavior of thousands of nodes. High fidelity network models are a necessity for detailed and accurate network performance prediction, but they are hard to support due to the computational load they create.

Portability to a number of computing platforms is key to meeting the speed, scalability, and accuracy requirements of a network model. By supporting sequential and parallel computing environments, as well as Unix, Windows, and Mac operating systems, QualNet can run on a computing environment with as much horsepower as necessary.

Finally, extensibility, or the ability to interface to other simulations and real networks, greatly increases the value of communication simulations.

Key Capabilities of QualNet

Speed. QualNet can support real-time simulation speed, which enables software-in-the-loop, network emulation, hardware-in-the-loop, and human-in-the-loop exercises.

Scalability. Supports thousands of nodes. Speed and scalability are not mutually exclusive with QualNet. QualNet has achieved real-time simulation for models of 3500 nodes.*

Model Fidelity. QualNet offers highly detailed models of all aspects of networking. This ensures accurate modeling results.

Portability. QualNet runs on a vast array of platforms, including Linux, Solaris, Windows XP, and Mac OS X operating systems, distributed and cluster parallel architectures, and both 32- and 64-bit computing environments.

Extensibility. QualNet connects to other hardware & software applications, such as OTB, real networks, and STK, greatly enhancing the value of the network model.

The QualNet Product Family

The QualNet product family consists of two main simulation products, QualNet Developer and QualNet Parallel Developer, plus a number of add-on model libraries.

QualNet Developer allows users to set up, develop, and run custom network models. A feature-rich visual development environment allows users to set up models quickly, efficiently code protocols with easy access to QualNet, and then run models that present real-time statistics and helpful packet-level debugging insight.

QualNet Parallel Developer has all the features of QualNet Developer for model creation, execution and visualization, plus the ability to achieve faster simulation speeds and greater model scalability. QualNet Parallel Developer runs on all modern computer platforms, from sequential computers to shared memory multiprocessors, including dual core systems, workstation clusters, and supercomputers. All QualNet libraries are available for parallel execution.

* This experiment took place on a cluster of 16 dual 2GHz Opteron systems connected by an Infiniband switch.

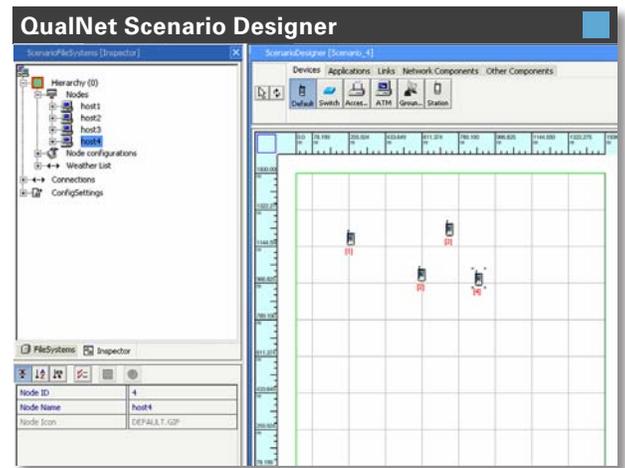
QualNet Model Libraries greatly extend the base capabilities of QualNet. From supporting specialized networks, such as MANET and satellite, to enabling network emulation and powerful 3-D visualization tools, QualNet Libraries add significant capabilities to QualNet Developer and QualNet Parallel Developer. All Libraries are available for sequential and parallel platforms.

The QualNet Libraries consist of the following elements:

- ALE/ASAPs Library†
- Cellular Library
- Developer Library*
- HLA and Threaded Communication Library
- Interface to STK/Connect*†
- IP Network Emulation Library
- IPv6 Library*
- MANET Library
- Military Radios Library
- QoS Library
- Satellite Library
- Standard Library*
- TIREM Library†
- VoIP Library*
- WiMAX Library

* These libraries are included with QualNet Developer and QualNet Parallel Developer 3.9.5.

† These libraries require code from a third party.



Key Features of QualNet Parallel Developer

Real-time Simulation. Models can speed up and scale on parallel computing environments. For instance, a cluster of 16 dual 2GHz Opteron systems connected by an Infiniband switch achieved real-time speed for 3,500 nodes*.

Support for a Variety of Parallel Computing Environments. QualNet Parallel Developer runs on all modern computer platforms, from sequential computers to shared memory multiprocessors, including dual core systems, workstation clusters, and supercomputers.

Protocol Models are Pre-optimized for Parallel. There's no need to re-write code for parallel execution; all models come optimized for small and mid-size parallel processors and supercomputers. Also, the kernel and APIs are designed to facilitate parallel development.

Parallel Since Day One. QualNet was designed for parallel execution since the first line of code was written in 1999. Parallelizing a legacy sequential simulator has been shown to be difficult and ineffective.

* this scenario was carefully designed for optimum performance in terms of traffic, mobility, and partitioning.

Components of QualNet Developer & QualNet Parallel Developer

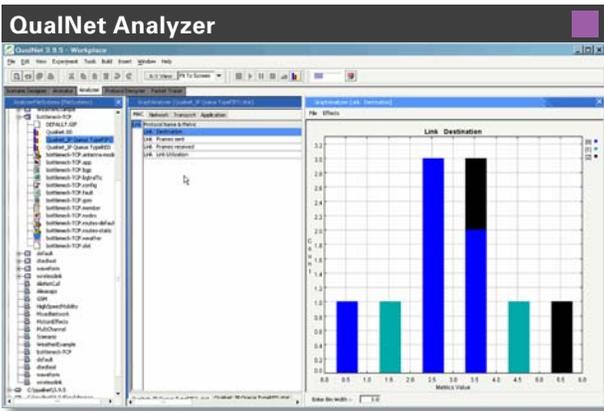
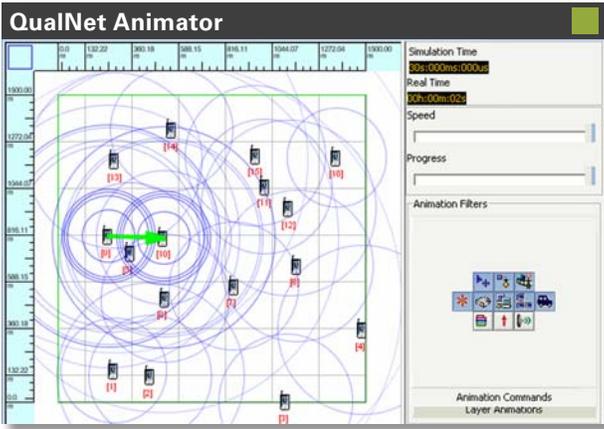
QualNet is a comprehensive set of tools with all the components for custom network modeling and simulation. The QualNet simulation engine is extremely scalable and can accommodate high fidelity models of networks of thousands of nodes.

QualNet makes good use of computational resources and models large scale networks with heavy traffic and mobility in reasonable simulation times. QualNet Parallel Developer takes speed and scalability to new levels through the use of dual-core systems, clusters, and supercomputers.

Even on laptop and desktop computers, QualNet has unrivaled speed and scalability. QualNet produces fast results for a thorough exploration of networking options. Real-time simulation is another powerful option with QualNet.

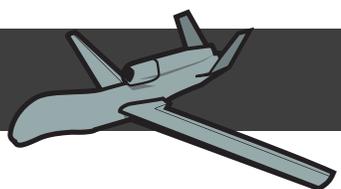
QualNet Scenario Designer

QualNet Scenario Designer is a model setup tool that allows users to set up geographical distribution, physical connections, and the functional parameters



The screenshot shows the QualNet Packet Tracer interface. It displays a detailed packet capture table with columns for Serial, Type, Check, Tracking Node, Tracking Prob., Sim. Time, Originating Node, Message Seq., Originating IP, and Action. The table shows a sequence of IP packets being sent and received between nodes.

Serial	Type	Check	Tracking Node	Tracking Prob.	Sim. Time	Originating Node	Message Seq.	Originating IP	Action
1	TCP		10.001383416	1	0	N/A			SEND
2	TCP		10.001383416	1	1	N/A			RECV
3	IPV4		10.001383416	1	1	N/A			ENCAP
4	IPV4		10.001383416	1	1	N/A			RECV
5	IPV4		10.001383416	1	1	N/A			SEND
6	IPV4		10.001383416	1	1	N/A			RECV
7	IPV4		10.001383416	1	1	N/A			SEND
8	IPV4		10.001383416	2	0	N/A			ENCAP
9	IPV4		10.001383416	2	0	N/A			RECV
10	IPV4		10.001383416	1	1	N/A			RECV
11	IPV4		10.001383416	1	1	N/A			SEND
12	IPV4		10.001383416	1	1	N/A			RECV
13	IPV4		10.001383416	2	0	N/A			RECV
14	IPV4		10.001383416	2	0	N/A			SEND
15	IPV4		10.001383416	2	0	N/A			RECV
16	IPV4		10.001383416	2	0	N/A			RECV
17	IPV4		10.001383416	1	0	TCP			ENCAP
18	IPV4		10.001383416	1	0	TCP			RECV
19	IPV4		10.001383416	1	0	TCP			RECV
20	TCP		10.001383416	2	4	TCP			SEND
21	TCP		10.001383416	2	4	TCP			SEND
22	IPV4		10.001383416	2	4	TCP			ENCAP
23	IPV4		10.001383416	2	4	TCP			RECV
24	IPV4		10.001383416	2	4	TCP			RECV
25	IPV4		10.001383416	2	4	TCP			SEND
26	TCP		10.001383416	2	4	TCP			RECV
27	TCP		10.001383416	2	4	TCP			RECV
28	IPV4		10.001383416	1	7	TCP			ENCAP
29	IPV4		10.001383416	1	7	TCP			ENCAP
30	IPV4		10.001383416	1	9	TCP			SEND



of the network nodes. Using intuitive click and drag operations, the user can also define network layer protocols and traffic characteristics down to each node.

QualNet Animator

QualNet Animator offers in-depth visualization and analysis. As simulations are running, users can watch traffic flow through the network and view dynamic graphs of critical performance metrics. Users can also assign jobs to run in batch mode on a faster server and view the animated data later.

QualNet Protocol Designer

QualNet Protocol Designer allows users to create a protocol skeleton, plug it into the simulator, and then add it to the GUI for use with QualNet Scenario Designer and Animator. QualNet's protocol models are provided in source form C/C++, arming developers with a solid library on which to build new network functionality.

QualNet Analyzer

QualNet Analyzer is a statistical graphing tool that displays hundreds of metrics. Users can choose to see pre-designed reports or customize graphs with their own statistics. Real-time statistics are also an option, where users can view metrics as they are generated while a simulation is running. Multi-experiment reports are also available. All graphs are exportable to spreadsheets.

QualNet Packet Tracer

QualNet Packet Tracer is a packet-level visualization tool for viewing the contents of a packet as it goes up and down the network stack. This is a valuable debugging tool.

Interface to STK/Connect*

QualNet has the ability to connect to Satellite Tool Kit and other 3D visualization tools to enable very realistic 3D visualization.

* STK and Satellite Tool Kit are copyrights of Analytical Graphics Incorporated (AGI).

Minimum System Requirements for QualNet Developer

CPU

- x86 compatible (including Pentium, Xeon and Athlon)
- amd64 compatible (including Opteron, Athlon 64, and Pentium/Xeon EM64T)
- Sun UltraSPARC family
- Apple PowerPC G5

Operating Systems

Microsoft

- Windows 2000/XP
- Windows XP x64 Edition

Linux

- Red Hat 7.3, 9 and Fedora Core 2 for Intel x86 are officially supported
- Red Hat Enterprise Linux Versions 3, 4 and SUSE Linux 9.1 are officially supported on 64-bit platforms
- Other distributions of Linux are known to work with QualNet

Sun

- Sun Solaris 8
- Solaris x86 is not supported for QualNet version 3.9.5

Apple

- Mac OS X 10.4

Memory

- 64 MB free for LAN-size simulations without GUI
- 256 MB free for LAN-size simulations with GUI
- 2-4 GB free for a large network (1,000+ nodes)

Disk space

- 300-500 MB free disk space depending on installation options

Java

- Sun Java 2 SDK, Standard Edition 1.4.2 is officially supported. The SDK, not the JRE, is required to run QualNet GUI tools.
- Versions of Java from vendors other than Sun are not officially supported.

Compiler

Windows

Microsoft Visual C++ 6.0 and later is required if you modify source code or include add-ons.

Unix

The GCC version that matches your operating system is required to install QualNet.

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