QualNet Model Libraries By Layer

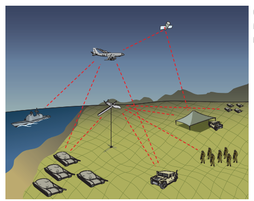
	Application Protocols	QoS Protocols	Transport Protocols	Queueing and Scheduling Models	Network Protocols	Routing Protocols	Multicast Protocols	MAC Protocols	Physical Models	Modulation Schemes	Propagation Models	Mobility Models	Device Models	Terrain Models	Interfaces
Developer Library ✓ : IPv6 Compliant (included with QualNet Developer)	ATM IP over ATM ✓ CBR ✓ FTP / Generic ✓ HTTP ✓ LOOKUP MCBR ✓ Super Application ✓ tcplib ✓ FTP ✓ telnet Traffic-Gen Traffic-Trace ✓ VBR		Abstract TCP ATM IP over ATM ✓ TCP ✓ TCP Dump ✓ TCP Variants ✓ Lite ✓ New Reno ✓ Reno ✓ SACK ✓ Tahoe ✓ UDP	CBQ ✓ FIFO RED RIO Round Robin SCFQ ✓ Strict Priority WFQ WRED WRR	ARP ✓ HDP ICMP ✓ ICMPv6 new IPsec IPv4 ✓ IPv6	Bellman-Ford RIP v1 v2 ✓ ng ✓ Static Routing	IGMP ✓ Static Multicast	✓ 802.3 / Wired Bus ✓ Gigabit Ethernet Abstract Satellite Faults Wired Point-to-Point Link Wireless Point-to-Point Link							STK/Connect
Multimedia & Enterprise Library ✓ : IPv6 Compliant	VOIP H225 H323 SIP	DiffServ Per Hop Behavior MPLS LDP RSVP-TE	VOIP RTCP RTP			BGP v4 ✓ BGP v6 (MBGP) new EIGRP HSRP IGRP OSPF v2 updated ✓ OSPF v3 new Policy Based Routing QOSPF Router Access Lists Route Map	DVMRP MOSPF PIM-DM PIM-SM	✓ Detailed Switch ✓ GARP ✓ GVRP ✓ Spanning Tree ✓ VLAN ✓ Switched Ethernet					Routers Switches		
Wireless Library ✓ : IPv6 Compliant						✓ AODV updated BRP DSR ✓ DYMO new Fisheye IARP IERP LANMAR LAR1 Mobile IPv4 ✓ OLSR Inria updated ✓ OLSRv2 new STAR ZRP	ODMRP	✓ 802.11 DCF ✓ 802.11 PCF ✓ 802.11e EDCA 802.11e HCCA new Aloha ✓ CSMA Generic MAC ✓ MACA TDMA	802.11a/g OFDM 802.11b DSSS Abstract PHY Antenna Models NMSA Omnidirectional Open ASCII Directional Steerable Beam Switched Beam Microwave Link	BPSK BPSK Turbo CCK DPSK DPSK Turbo DQPSK Forward Error Correction FSK FSK-Golay GMSK QAM QAM-Convolution	Pathloss 2-Ray Free Space Path Loss Matrix Fading Fast Rayleigh Rayleigh Ricean ITM Lognormal Shadowing Weather	Group Mobility Pedestrian Mobility new Random Waypoint File-based Mobility		1-degree DEM Cartesian DTED QualNet Building Format new	
Advanced Wireless Library (Requires Wireless Library)								802.16 802.16e new	802.16 new OFDMA new						
Military Radios Library (Requires Wireless Lib.)	MGEN PDEF SDF Threaded Comms							Link-11 † Link-16 † EPLRS new † SINCGARS new †						CTDB 7 new † CTDB 8 new †	
Cellular Library (Requires Wireless Library)	GSM Cellular				Abstract Layer 3 new GSM Layer 3			GSM	GSM			User Behavior new			
Propagation Libraries Each sold separately. (Require Wireless Library) — Urban								ALE †	ALE †		ASAPS †				
TIREM											TIREM †				
ALE/ASAPS											Urban new COST231-Hata new COST231-W-I new Street Microcell / Mobile-to-Mobile Model new				

new for QualNet version 4.0 updated for QualNet version 4.0 † Restricted to NATO / US or responsible agency. DoD authorization is necessary to receive these QualNet models.

	QoS Capabilities	MAC Capabilities	Physical Capabilities	Device Capabilities	Propagation Models	Interfaces
Satellite Library (Requires Wireless Library)	Dynamic Forward Signaling Rate new Dynamic Return Signaling Rate new Filtered Bandwidth Limiting new Strict Traffic Bandwidth Limiting new	Multiple Return Links per Forward Link new Ranging Overhead Support new Request-grant Scheduler new Send When Ready	Configurable Reed-Solomon Viterbi Threshold-based Packet Reception	Processor Payload updated Gateway-based Services updated Multi-beam Satellite new	Abstract Propagation new Free-space Propagation	
Standard Interfaces Library						DIS HLA
Network Emulation Interface Library						IP Network Emulation (IPNE)

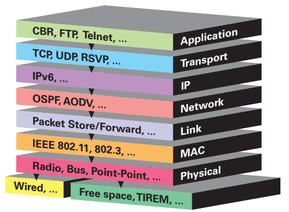
new for QualNet version 4.0 updated for QualNet version 4.0

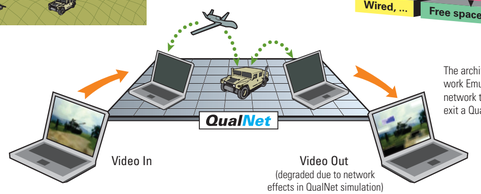
QualNet's Model Libraries support a wide range of wired and wireless commercial networks, including Gigabit Ethernet, WiFi, WiMAX, and cellular.



QualNet's Model Libraries support a wide range of military and homeland defense networks, such MANET and satellite.

QualNet's model architecture is based on the layers of the ISO stack. APIs between each layer enable modularity and maintain suitability for parallel execution.





The architecture of QualNet's IP Network Emulation interface allows real network traffic to seamlessly enter and exit a QualNet simulation.

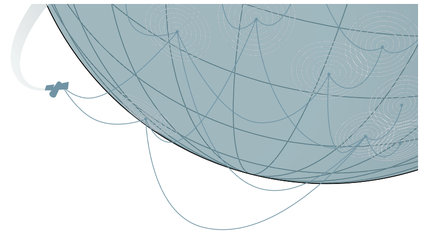
QualNet Model Libraries Alphabetized

Model Name	Explanation	Library
2-Ray Pathloss	2-Ray Pathloss Propagation Model	Wireless
802.11 a/g OFDM	802.11 a/g Orthogonal Frequency Division Multiplexing	Wireless
802.11 DCF	802.11 Distributed Coordination Function Medium Access Control Protocol	Wireless
802.11 PCF	802.11 Point Coordinated Function Medium Access Control Protocol	Wireless
802.11a/g	802.11a/g Physical Model	Wireless
802.11b	802.11b Physical Model	Wireless
802.11e EDCA	QoS Extension to 802.11 MAC - Enhanced Distributed Channel Access	Wireless
802.11e HCCA	Hybrid Coordination Function Controlled Channel Access MAC Protocol	Wireless
802.16 MAC	802.16 MAC for fixed broadband wireless	Advanced Wireless
802.16 OFDMA PHY	The OFDMA PHY model of 802.16	Advanced Wireless
802.16e MAC	802.16 MAC extensions for mobile broadband wireless	Advanced Wireless
802.16e OFDMA PHY	OFDMA PHY extensions for 802.16e	Advanced Wireless
802.3 / Wired Bus	802.3 / Wired Bus Medium Access Control Protocol	Developer
Abstract Layer 3	Abstract Network Model	Cellular
Abstract PHY	Abstract Physical Model	Wireless
Abstract Satellite	Abstract Satellite Physical Model	Developer
Abstract TCP	Abstract Transmission Control Protocol Application Protocol	Developer
ALE	Automatic Link Establishment Medium Access Control and Physical Model	ALE / ASAPS Propagation
Aloha	Aloha Medium Access Control Protocol	Wireless
AODV	Ad-hoc On-demand Distance Vector Routing Protocol	Wireless
ARP	Address Resolution Protocol	Developer
ASAPS	Advanced Stand Alone Prediction Service Propagation Model	ALE / ASAPS Propagation
ATM	Asynchronous Transfer Mode Multi-layer Model	Developer
Bellman-Ford	Bellman-Ford Routing Protocol	Developer
BGP v4	Border Gateway Protocol Routing Protocol	Multimedia & Enterprise
BGP v6 (MBGP)	Multiprotocol Border Gateway Protocol Routing Protocol	Multimedia & Enterprise
BPSK, BPSK Turbo	Binary Phase-shift Keying Modulation Scheme for 802.11a/g and 802.16 with and without Turbo Coding	Wireless
BRP	Bordercast Resolution Protocol Routing Protocol	Wireless
Cartesian	Cartesian Terrain Model	Wireless
CBQ	Class Based Queueing Model	Developer
CBR	Constant Bit Rate Traffic Generator	Developer
CCK	Complementary Code Keying Modulation Scheme for 802.11b	Wireless
COST231-Hata	COST-231 Hata Propagation Model	Urban Propagation
COST231-W-I	COST-231 Walfish-Ikegami Propagation Model	Urban Propagation
CSMA	Carrier Sense Multiple Access Medium Access Control Protocol	Wireless
CTDB 7, 8	Compact Terrain Database 7, 8 Model	Military Radios
DEM	1-degree Digital Elevation Model Terrain Model	Wireless
Detailed Switch	Detailed Layer 2 Switch Model	Multimedia & Enterprise
DiffServ	Differentiated Services Quality of Service Protocol	Multimedia & Enterprise
Directional	Directional Antenna Physical Model	Wireless
DIS	Distributed Interactive Simulation Framework	Standard Interfaces
DPSK	Differential Phase-Shift Keying Modulation Scheme for 802.11b	Wireless
DPSK Turbo	Differential Phase-Shift Keying Modulation Scheme with Turbo Coding for 802.11b	Wireless
DQPSK	Differentially Encoded Binary Phase-shift Keying Modulation Scheme for 802.11b	Wireless
DSR	Dynamic Source Routing Protocol	Wireless
DSSS	Direct Sequence Spread Spectrum Physical Model	Wireless
DTED	Digital Terrain Elevation Data	Wireless
DVMRP	Distance Vector Multicast Routing Protocol	Multimedia & Enterprise
DYMO	Dynamic MANET On-demand Routing Protocol	Wireless
EIGRP	Enhanced Interior Gateway Routing Protocol	Multimedia & Enterprise
EPLRS	Enhanced Position Location Reporting System	Military Radios
Fast Rayleigh Fading	Fast Rayleigh Fading Propagation Model	Wireless
Faults	Enable/Disable Interfaces or Nodes	Developer
FIFO	First In First Out Queueing and Scheduling Model	Developer
Fisheye	Fisheye Routing Protocol	Wireless
Forward Error Correction	Forward Error Correction for Modulation Schemes	Wireless
Free Space Pathloss	Free Space Pathloss Propagation Model	Wireless
FSK, FSK-Golay	Frequency Shift Keying Modulation Scheme with and without Golay	Wireless
FTP, FTP/Generic	File Transfer Protocol Application Protocol, Generic FTP Application Protocol	Developer
GARP	Generic Attribute Registration Protocol for switch	Multimedia & Enterprise
Generic MAC	Generic Medium Access Control Protocol	Wireless
Gigabit Ethernet	Gigabit Ethernet Medium Access Control Protocol	Developer
GMSK	Gaussian Minimum Shift Keying Modulation Scheme for Cellular GSM	Wireless
Group Mobility	Group Mobility Model	Wireless
GSM	Global System for Mobile communication MAC Protocol	Cellular
GVRP	GARP VLAN Registration Protocol for switch	Multimedia & Enterprise
H225 VOIP	A key protocol for Voice Over Internet Protocol	Multimedia & Enterprise
H323 VOIP	A key protocol in the H.323 architecture for Voice Over Internet Protocol	Multimedia & Enterprise
HDP	Hierarchical Distributed Protocol	Developer
HLA	High Level Architecture Simulation Framework	Standard Interfaces
HSRP	Hot Standby Router Protocol	Multimedia & Enterprise
HTTP	HyperText Transfer Protocol Application Protocol	Developer
IARP	Intrazone Routing Protocol	Wireless
ICMP	Internet Control Message Protocol	Developer
ICMPv6	Internet Control Message Protocol for IPv6	Developer
IERP	Interzone Routing Protocol	Wireless
IGMP	Internet Group Management Protocol	Developer
IGRP	Interior Gateway Routing Protocol	Multimedia & Enterprise
IP Network Emulation	Internet Protocol Network Emulation Interface	Network Emulation
IP over ATM	Internet Protocol over Asynchronous Transfer Mode Network Model	Developer
IPSec	Internet Protocol Security	Developer
IPv4	Internet Protocol Version 4 Network Protocol	Developer
IPv6	Internet Protocol Version 6 Network Protocol	Developer
ITM	Irregular Terrain Model Propagation model	Wireless

Model Name	Explanation	Library
LANMAR	Landmark Routing Protocol	Wireless
LAR1	Location-Aided Routing Protocol	Wireless
Link-11	Link-11 Military Radio Model	Military Radios
Link-16	Link-16 Military Radio Model	Military Radios
Lognormal Shadowing	Lognormal Shadowing Propagation Model	Wireless
LOOKUP	LOOKUP Application Protocol	Developer
MACA	Medium Access Collision Avoid Medium Access Control Protocol	Wireless
MCBR	Multicast Constant Bit Rate Traffic Generator	Developer
MGEN	Multi-Generator Toolset by US Naval Research Laboratory	Military Radios
Microwave Link	Microwave Link Physical Model	Wireless
Mobile IPv4	IP Mobility Support	Wireless
MOSPF	Multicast Open Shortest Path First Multicast Protocol	Multimedia & Enterprise
MPLS:LDP	Label Distribution Protocol for Multiprotocol Label Switching	Multimedia & Enterprise
MPLS:RSVP-TE	Resource Reservation Protocol with Traffic Engineering extensions for Multiprotocol Label Switching	Multimedia & Enterprise
NMSA	NMSA Antenna Physical Model	Wireless
ODMRP	On-Demand Multicast Routing Protocol	Wireless
OLSR Inria	Orthogonal Frequency-division Multiplexing Physical Model	Wireless
OLSRv2	Optimized Link State Routing Protocol ported from INRIA implementation	Wireless
Omnidirectional	Omnidirectional Antenna Model	Wireless
Open ASCII	Open ASCII Antenna Model	Wireless
OSPF v2	Open Shortest Path First Routing Protocol Version 2	Multimedia & Enterprise
OSPF v3	Open Shortest Path First Routing Protocol Version 3	Multimedia & Enterprise
Path Loss Matrix	Path Loss Matrix Propagation Model	Wireless
PDEF	Platform Description Files Simulation Framework	Military Radios
Pedestrian Mobility	Pedestrian Mobility Model	Wireless
Per Hop Behavior	Per Hop Behavior Quality of Service Protocol	Multimedia & Enterprise
PIM-DM, PIM-SM	Protocol-Independent Multicast Protocol: Dense Mode and Sparse Mode	Multimedia & Enterprise
Policy Based Routing	Policy Based Routing Protocol	Multimedia & Enterprise
QAM	Quadrature Amplitude Modulation Scheme	Wireless
QAM-Convolution	Quadrature Amplitude Modulation Scheme with Convolution	Wireless
QOSPF	Quality of Service Extensions to OSFP Routing Protocol	Multimedia & Enterprise
QualNet Building Format	QualNet Building Format Terrain Model	Wireless
Random Waypoint	Random Waypoint Mobility Model	Wireless
Rayleigh Fading	Rayleigh Fading Propagation Model	Wireless
RED	Random Early Detection Queueing Model	Developer
Ricean Fading	Ricean Fading Propagation Model	Wireless
RIO	Random Early Detection In/Out Queueing Model	Developer
RIP ng	Routing Information Protocol - next generation	Developer
RIP v1, v2	Routing Information Protocol Routing Protocol versions 1 and 2	Developer
Round Robin	Round Robin Scheduling Model	Developer
Route Map	Route Map	Multimedia & Enterprise
Router Access Lists	Router Access Lists	Multimedia & Enterprise
Routers	Router Device Model	Multimedia & Enterprise
RTCP VOIP	RTP Control Protocol for Voice Over Internet Protocol	Multimedia & Enterprise
RTP VOIP	Real-Time Transport Protocol for Voice Over Internet Protocol	Multimedia & Enterprise
Satellite	Satellite Model	Satellite
SCFQ	Self-clocked Fair Queueing Model	Developer
SDF	Simulation Description Files Simulation Framework	Military Radios
SINCGARS	Single Channel Ground and Airborne Radio System Model	Military Radios
SIP	Session Initiation Protocol for Voice Over Internet Protocol	Multimedia & Enterprise
Spanning Tree	Spanning Tree for switch	Multimedia & Enterprise
STAR	Source Tree Adaptive Routing Protocol	Wireless
Static Multicast	Static Multicast Protocol	Developer
Static Routing	Static Routing Protocol	Developer
Steerable Beam	Steerable Beam Directional Antenna Model	Wireless
STK/Connect	Interface to STK/Connect	Developer
Street Microcell Model	Street Microcell / Mobile-to-Mobile Propagation Model	Urban Propagation
Strict Priority	Strict Priority Scheduling Model	Developer
Super Application	Super Application Protocol	Developer
Switched Beam	Switched Beam Directional Antenna Model	Wireless
Switched Ethernet	Switched Ethernet Medium Access Control Protocol	Multimedia & Enterprise
Switches	Switch Device Model	Multimedia & Enterprise
TCP	Transmission Control Protocol Transport Protocol	Developer
TCP Dump	TCPDump Compatible Trace	Developer
TCP Variants	Lite, New Reno, Reno, SACK, and Tahoe Transmission Control Protocol Variants	Developer
tcplib	A Library of Internetwork Traffic Characteristics	Developer
TDMA	Time Division Multiple Access Medium Access Control Protocol	Wireless
telnet	TELNET Remote Access Protocol	Developer
Threaded Comms	Threaded Communication Model	Military Radios
TIREM	Terrain Integrated Rough Earth Model	TIREM Propagation
Traffic-Gen	Traffic Generation Application Protocol	Developer
Traffic-Trace	Traffic Trace Application Protocol	Developer
UDP	User Datagram Protocol Transport Protocol	Developer
User Behavior	User Behavior Mobility Model	Cellular
VBR	Variable Bit Rate Traffic Generator	Developer
VLAN	Virtual LAN Protocol	Multimedia & Enterprise
VOIP	Voice Over Internet Protocol Model	Multimedia & Enterprise
Weather	Weather Effects Propagation Model	Wireless
WFQ	Weighted Fair Queueing Model	Developer
Wired, Wireless Point to Point Link	Wired and Wireless Point to Point Link Physical Model	Developer
WRED	Weighted Random Early Detection Queueing Model	Developer
WRR	Weighted Round Robin Scheduling Model	Developer
ZRP	Zone Routing Protocol	Wireless

QualNet®

Model Libraries



QualNet Model Libraries greatly extend the base capabilities of QualNet. From supporting specialized networks, such as MANET, WiMAX, and satellite, to enabling hardware-in-the-loop and powerful 3-D visualization, QualNet Libraries add significant capabilities to QualNet Developer. All Libraries operate on sequential or parallel platforms.

The QualNet Model Libraries consist of the following elements:

- **Developer Library***, included with QualNet Developer, for modeling a large variety of networks, including WANs, LANs, IPv6, abstract satellite and for interfacing with STK/Connect †,
- **Wireless Library** for 802.11a/b/g and mobile ad-hoc networks,
- **Multimedia and Enterprise Library** for modeling WANs, VOIP, queueing, scheduling, MPLS, and other Quality of Service capabilities,
- **Advanced Wireless Library**** for 802.16 and 802.16e, also known as WiMAX,
- **Cellular Library**** for modeling GSM cellular networks,
- **Standard Interfaces Library** for integrating to a number of military simulators to QualNet via HLA or DIS,
- **Network Emulation Interface Library** for hardware-, software-, and human-in-the-loop simulation,
- **Military Radios Library**** for Link-11, Link-16, EPLRS and SINCGARS networks,
- **Satellite Library**** for modeling satellites and ground nodes,
- **Propagation Library: TIREM** ** † for terrain and propagation effects based on the Terrain Integrated Rough Earth Model,
- **Propagation Library: Urban** ** for urban pathloss and terrain effects, and
- **Propagation Library: ALE/ASAPs** ** for modeling the ALE military radio and propagation effects.

* Developer Library is included with QualNet Developer.
** You must own the Wireless Library to purchase these libraries.
† These libraries require code from a third party.

Key Capabilities of QualNet Models

- C/C++ models are modifiable because they come in source form
- Models come pre-optimized for parallel execution
- Model development is easy due to well-defined APIs that streamline incorporation into QualNet
- Models can be compiled before delivering to others to protect intellectual property and prevent misuse