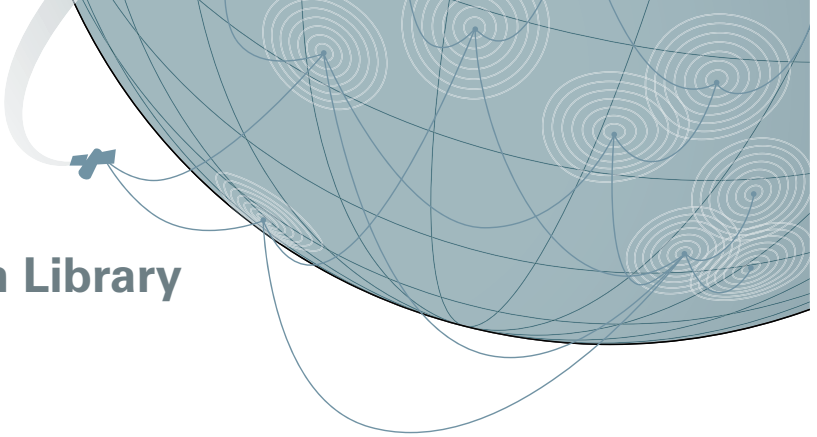
QualNet®

Urban Propagation Library



Recent developments in wireless communication technologies are unifying networks, connecting airborne wireless devices to on-ground wireless devices. To ensure high Quality of Service of such networks, engineers must estimate network connectivity and performance by accurately predicting signal strength. Signal strength is primarily influenced by obstructions in the propagation path observed at the receiver.

While propagation environments are broadly classified into categories such as open ground, urban, suburban, or hilly, the obstacles in a propagation path most directly influence signal strength, regardless of the environment's categorization. Accurate prediction of signal strength therefore requires that the propagation environment be characterized with high spatial resolution. Identifying propagation paths between communicating nodes in urban areas is particularly challenging due to diverse terrain features ranging from tall buildings to narrow streets.

QualNet's propagation models includes a collection of pathloss models that predict signal strength for heterogeneous airborne wireless networks and on-ground nodes located in an urban environment.

Models

The Urban Propagation Library is aware of terrain features and selects either a 1) freespace, 2) line-of-sight (LoS), or 3) non-line-of-sight (NLoS) model depending on the propagation path between the transmitter and the receiver. Different models are chosen for each transmitter-receiver pair and can be dynamically changed as the node positions change.

The following propagation models are included in the Urban Propagation Library:

Free-Space Air-to-Air Model: This model addresses the situation when both nodes are located above the horizon of an urban canyon.

COST231 Walfish-Ikegami Model: This model is used when one node is located in an urban canyon and the other is located at heights comparable to building heights. Variants for both LoS and NLoS communication are available.

Street Microcell Model: The Street Microcell model is appropriate when nodes are located in adjacent streets in an urban canyon. The communication can take place through LoS or NLoS propagation, with NLoS propagation occurring due to diffraction from a building corner.

Street Mobile-to-Mobile Model: This model calculates path loss between the source and destination pairs communicating across several building obstacles.

COST231 Hata Model: This model addresses the situation when base-station-to-mobile-station scenario has a large cell size (i.e., a transmitter-receiver separation larger than 1 km), and works for • small to medium sized cities, large cities, suburban areas, and open rural areas.

Key Features of QualNet Developer

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. QualNet 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.

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

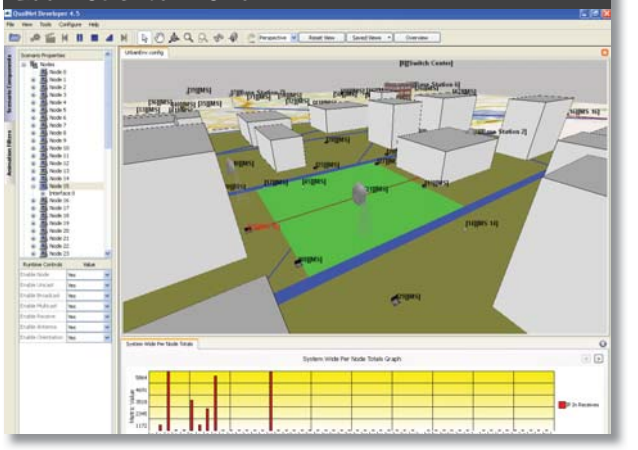
Model Variables

QualNet calculates pathloss through a number of variables representing the urban terrain conditions and node geometry. The following table summarizes the major parameters.

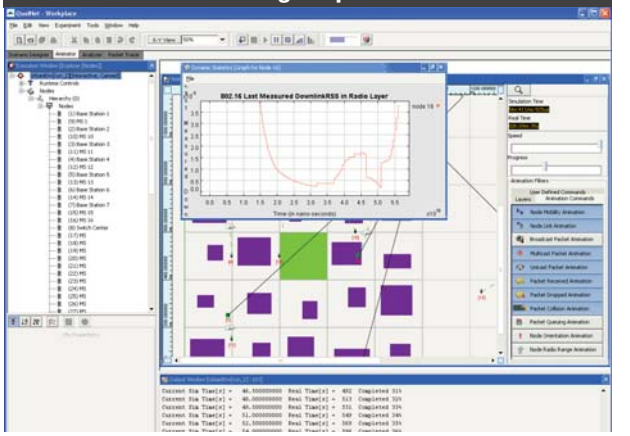
Urban Propagation Parameters

- Terrain Database
  - Average Roof Height
  - Maximum Roof Height
  - Minimum Roof Height
  - Average Street Width or Building Separation
  - Orientation of the Receiver Node with Respect to Transmitter.
  - Number of Buildings in the Propagation Path
  - Distance between the Transmitting Node and the Building Corner
  - Line of Sight Status in Propagation Path
- Height of Node from the Ground
- Transmission Antenna Height
- Receiving Antenna Height
- Distance Between Transmission and Receiver
- Carrier Frequency
- Mobile Station Antenna Height
- Road Orientation
- Base Station Antenna Height
- Wavelength

QualNet Urban Terrain



QualNet Urban Building Map



How to Buy

The Urban Propagation Library is available for QualNet Developer 4.5 as a free-standing model library. Other model libraries that may complement the Urban Propagation Library include:

- Developer Library (included with QualNet Developer),
- Wireless Library, for 802.11, MANET and terrain effects (included with QualNet Developer),
- Advanced Wireless Library for 802.16 and 802.16e, and
- Multimedia and Enterprise Library for QoS (included with QualNet Developer).