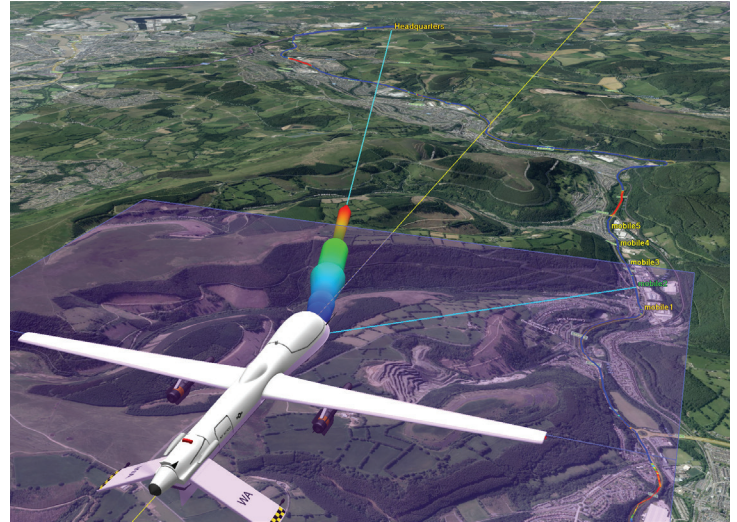


AGI STK / SCALABLE Networks Interface

Bringing High-Fidelity Advanced Network Modeling To The Mission

SCALABLE Network Technologies provides network design, modeling and analysis tools, cyber training systems, and engineering support. EXata®/QualNet network simulation platforms extends virtual network models to include complex mobility of nodes in 3D space and high fidelity modelling of radio signal propagation and path loss due to antenna orientation and movement. The EXata/QualNet interface for STK combines network performance evaluation with the dynamic platform models, wireless link calculations, and mission visualization environment of STK to better analyze how network performance impacts the mission.

With the SystemsTool Kit (STK) / SCALABLE Network Technologies Interface, users are able to directly integrate their STK scenarios with SCALABLE NetworkTechnologies modeling tools to rapidly understand a proposed network's anticipated performance and feasibility within STK's highly realistic mission scenarios. Extending STK's complex physical modeling to include SCALABLE's packet-level analysis of a network's behavior, mission systems designers can realize a deeper understanding of how interconnected, dynamic systems perform and work together to provide network resiliency and achieve mission success.



With STK addressing dynamic analysis problems such as:

- Where are assets and how are they oriented?
- What can the assets "see" and when can they "see" them?

Integrating STK with the QualNet or EXata network simulation platforms extends virtual network models to include:

- **Complex mobility of nodes in 3D space**
- **High fidelity modeling of radio signal propagation and path loss due to antenna orientation and movement**

QualNet | EXata

Application Layer

MAC Layer

PHY Layer

- Time
- Data rate
- TX Power
- Modulation

PHY Layer

- S/N
- BER
- Eb/No

STK

Antenna Object

- Position
- Gain
- Altitude

Path Loss Models

- Urban
- Freespace
- Two-Ray

Integration Workflow



For each time increment in a scenario simulation:

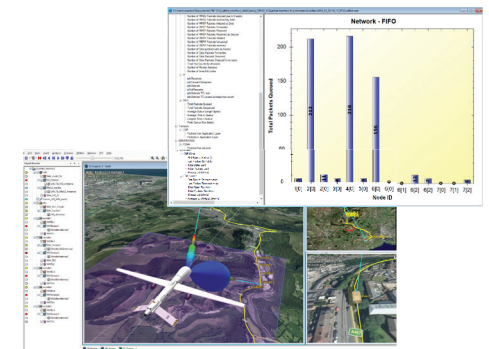
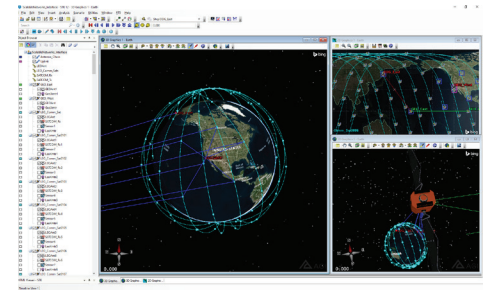
- A QualNet | EXata entity passes a transmit request down the protocol stack from the Applications layer through the MAC layer to the PHY layer, handing off parameters
 - Time
 - Transmit power
 - Data rate
 - Modulation
- The STK antenna module incorporates position, altitude and gain to compute the path loss, and passes parameters back to the receiver
 - Signal-to-Noise ratio
 - Eb/No (energy per bit to noise power spectral density ratio)
 - Bit error rate

SCALABLE + AGI Integration Offers:

- Better prediction of performance in the operational environment by establishing highly realistic mission scenarios
- Increased confidence and productivity during conceptual design, requirements validation, field test planning and analysis, and operations
- Tailored design and operations of the communication system specific to the needs of each mission
- Improved levels of fidelity in the analysis of mobile communications

Functional Comparison: QualNet | EXata & STK

		
Node Mobility & Orientation	<ul style="list-style-type: none"> • File • Group Mobility • Pedestrian • Waypoint • Random • User Specified Orientation (Azimuth and Elevation) 	High fidelity monitoring of the performance and dynamics of: <ul style="list-style-type: none"> • Aircraft • Missiles • Satellites • Other Mobile Nodes
Antenna Model	<ul style="list-style-type: none"> • Omnidirectional • Switched Beam • Steerable Beam • User-defined 	<ul style="list-style-type: none"> • Pre-defined Models (dipole, hemi, etc.) • User-defined • Dynamic Pointing Coupled to Node Motion & Orientation
RF Channel Model	<ul style="list-style-type: none"> • Free Space • Two-Ray • ITM • TIREM • Statistical Urban • Empirical Urban • Suburban 	<ul style="list-style-type: none"> • Free Space • Two-Ray • TIREM 3.20 • Deterministic Urban • 7ITU Atmospheric Models • Crane 1985 • Custom Scripts
Network Simulation	Full network Protocol Stack and Network Device Simulation	Physical Layer Connectivity of Wireless and Wired Networks
Communications Performance	<ul style="list-style-type: none"> • Packet Latency • TDrops • Tracing • 41 Network Statistics Sets Across Entire Protocol Stack 	High Fidelity RF Link Availability and Quality <ul style="list-style-type: none"> • Signal-to-Noise Ratio • Eb/No • UsBit Error Rates
Mission Model	Communications only	Integrated Modeling of Communications, Vehicles, and Other Non-communications Assets
Earth Model	Flat or Spherical	Oblate Spheroid
Celestial Modeling	-NA-	Moon, Planet, Stars
Other	<ul style="list-style-type: none"> • Radio Energy/Battery Model • Network Security Models 	<ul style="list-style-type: none"> • Full Motion 3D Animation • Integrated Geospatial Data Visualization • Photo-realistic 3D Mobile Node Modules



Application Example

Mission Plan Description

- A convoy is traveling in theatre
- Vehicles intercommunicate by radios
- One vehicle has a communications link to a UAV in the region which acts as a radio relay to remote HQ

Issue

- Does all data get to HQ?

Co-simulation Solution

STK Contributions

- Mission scenario construction
- UAV platform performance
- UAV route design
- Communications link availability

QualNet Contributions

- Network protocol simulation
- Application traffic simulation
- Data latency, dropped packets, etc.

The integration between QualNet | EXata and STK is a true co-simulation. SCALABLE and AGI have each added specific integration functionality to their respective products that ships standard "out of the box".