



MODULE

# SITL

System - In - The - Loop





# **SITL** System-in-the-Loop

The OPNET System-in-the-Loop (SITL) module provides an interface for connecting live network hardware or software applications to an OPNET discrete event simulation. It extends the scope of OPNET functionality by enabling technology testing and training. With the SITL module, your test bed will seamlessly merge both real and simulated worlds.

SITL facilitates the testing and training process by incorporating the effects of a simulated network environment. The prototype hardware or software application can interact with numerous virtual devices within the OPNET model, potentially avoiding the need for an expensive test lab.

- Perform developmental, interoperability, scalability, and conformance testing of prototype hardware and software applications.
- Create a virtual training facility for devices or applications interfacing directly with simulated network infrastructure containing numerous simulated devices.
- Study the behavior of prototype applications by deploying them on a simulated network topology.
- Analyze the performance of a new protocol deployed in a simulated network environment by injecting real network traffic.

## How it works

### PLUG

The "live" system is connected to a computer hosting an OPNET simulation via Ethernet or Wireless LAN.



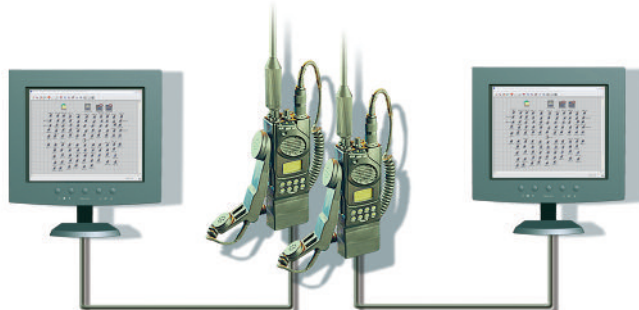
### CONFIGURE

The computer running the OPNET simulation can be connected simultaneously to multiple live devices through different network interfaces. The simulation contains one "Gateway" node for each live device, which transforms real packets into simulated packets and back, as they traverse between the real and simulated domains.



### RUN

When the simulation is started, packets flow in real-time between the live device and the simulation. Packets are captured, filtered, and converted into simulated packets in the OPNET simulation. The simulation must operate in real-time in order to guarantee the synchronization of the packet conversion and the inward flow of traffic.



In some cases, conversion models are required to decode conversation between live and simulated devices or vice versa. OPNET models are available to support packet conversion and simulation for IPv4, IPv6, ICMP, ICMPv6, OSPF, RIPv1, RIPv2, TCP, UDP, and FTP. Additionally, the OPNET modeling environment enables the development of custom protocol conversion models.

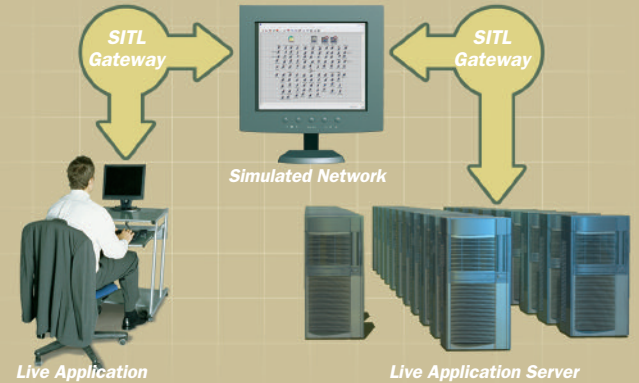
# SITL Simulation Approaches

## Live-Sim-Live

### Software Application Testing and Training

The primary use case for the **Live-Sim-Live** scenario is testing and training for software applications. In this scenario, a live prototype application interfaces with an OPNET simulation to create a virtual lab. This scenario allows developers to fine tune any IP-based application utilizing developmental and interoperability test exercises over a simulated network. Developers can also gauge the performance of an application as it is perceived by a user, with network effects such as latency, errors, etc. Using simulated network entities for software application testing and training provides multiple benefits:

- Testing applications on network models derived directly from operational network device configurations
- Simulating the holistic effects of an actual test network rather than only fine tuning packet latency and discard ratios
- Assessing the interaction between users and applications with realistic network delays and errors
- Training users on live applications that are subject to realistic network effects

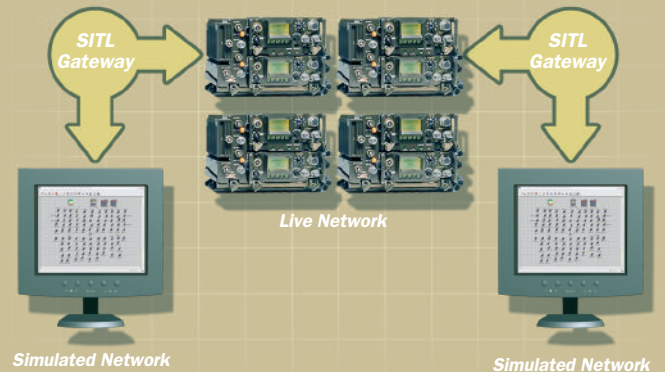


## Sim-Live-Sim

### Network Hardware Testing and Training

**Sim-Live-Sim** operations facilitate hardware testing and training. Hardware developmental, interoperability, and scalability testing, which is normally conducted by fabricating expensive prototypes, can be accomplished by populating the live network with a few prototype devices, such as radios, and then expanding the test bed to incorporate larger scenarios using two virtual networks. Using simulated network entities for hardware testing and training provides multiple benefits:

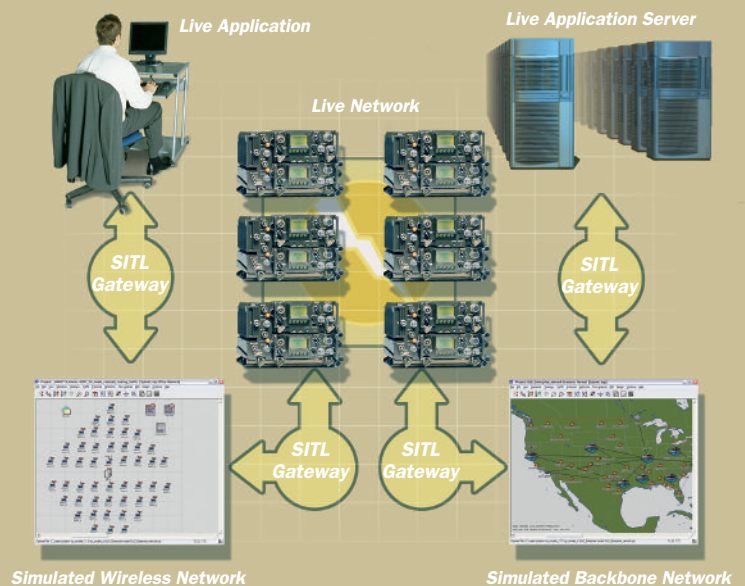
- Testing prototype devices with simulated control and data traffic
- Enabling test bed scalability well beyond the number of prototype systems available for test
- Allowing interoperability testing without removing legacy systems from operation
- Training users on new production devices that are subject to realistic network behavior



## Sample Scenario

SITL is extensible for larger, more demanding simulations that challenge the real-time simulation speed requirement. The "Daisy Chaining" feature allows various scenarios to be connected together so that the complexity of each simulation instance is reduced and real-time operation is possible. In the following scenario, the live client and server interchange live application messages through two OPNET simulations and a bank of live radios. The following sample configuration can be used for:

- Testing a live software application as it is transmitted over a set of live radios
- Training on a software application during a live transmission over live radios
- Testing live radio prototypes by driving real application traffic through them
- Training on a live radio as it interacts with other prototypes and routes live application traffic through it



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*(partial)*

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**solutions have been operationally proven in thousands of**

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**OPNET's simulation products have been the de facto**

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