Riverbed

咨询订购：400-010-8885、 Support@riverbeds.com.cn

riverbed®
The Digital Performance Company

Modeling and Simulation
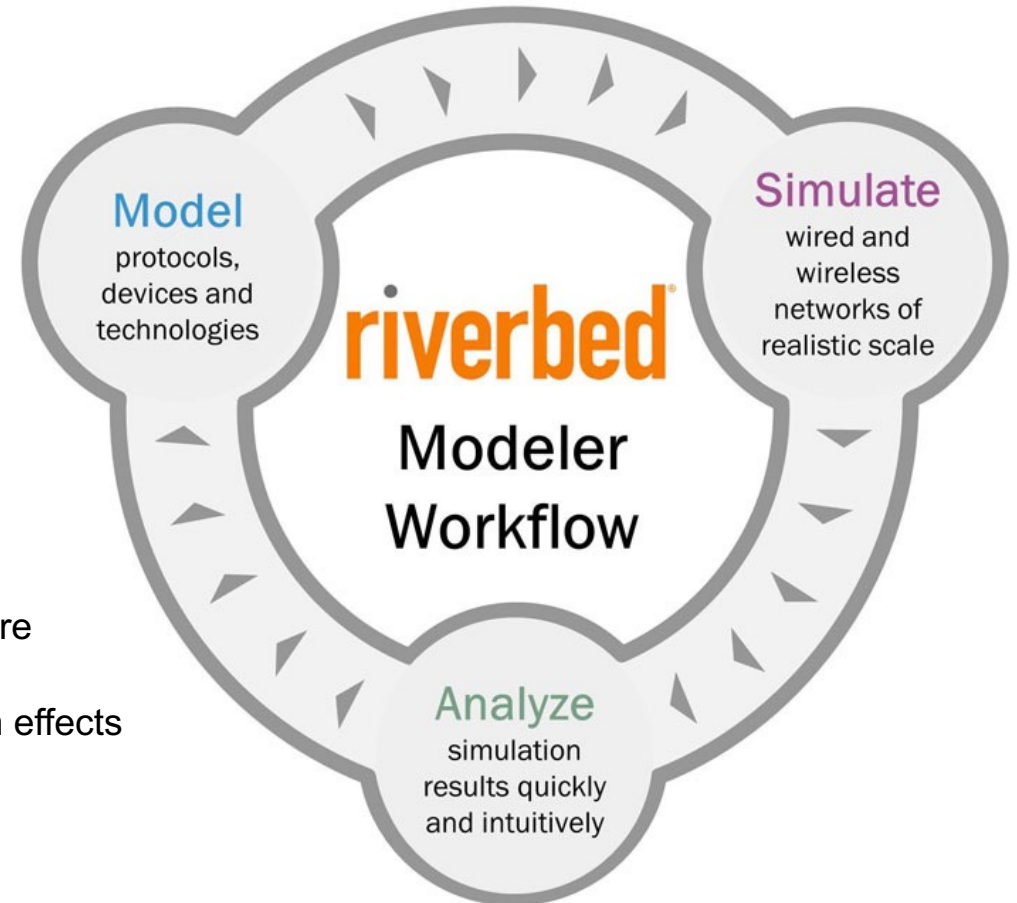
Modeling & simulation clients (partial list)

Alcatel-Lucent	General Dynamics	Oak Ridge National Lab
Alion Science and Technology	Generic Systems	Panasonic
Aperto Networks	Harris Corporation	Philips
AutoNetworks Technologies, Ltd.	Hewlett Packard	Raytheon
Avaya	Hitachi Ltd.	RF Monolithics
BAE Systems	Honeywell	SAIC
Boeing	Huawei	Samsung
Booz Allen Hamilton	Hughes Network Systems	Sandia National Labs
Cablevision	IBM	SELEX Communications SpA
CACI Federal Systems	Innovative Wireless Technologies	Singapore Ministry of Defense
Canadian Department of National Defense	Interdigital	Space & Naval Warfare Sys. Command
Cassidian Systems	Japan Broadcasting Corporation	SPARTA
China Aerospace Science and Industry Corp.	Japan Defense Agency	Syracuse Research Corporation
China Electric Power Research Institute	Joint Systems Integration Command	Textron Systems
Cisco Systems	Lockheed Martin	Thales e-Security
Cyber Warfare Development Group	MIT Lincoln Labs	TNO
Dassault Aviation	MITRE	U.K. Ministry of Defense
Defense Cyber Crime Center	NASA	U.S. Air Force
DISA	National Institute of Standards and Tech.	U.S. Army
EADS	NATO	U.S. Department of Homeland Security
Ericsson	NEC	U.S. Marine Corps
European Space Agency	Nokia Siemens Networks	U.S. Navy
Fujitsu	Northrop Grumman	Vodafone

Unsurpassed modeling & simulation

- Riverbed Modeler is the de-facto industry standard for:
  - Network design and performance analysis
  - Developing and optimizing protocols
  - Modeling mobility and wireless effects
- Riverbed Modeler is used worldwide by:
  - Defense organizations
  - Network equipment manufacturers
  - Universities, research organizations, and consortia
- Supports a broad scope of studies including:
  - Designing wired and wireless protocols and technologies
  - Testing and demonstrating equipment designs in realistic scenarios before production
  - Planning mobile network deployments that accurately incorporate terrain effects
  - Incorporating communications effects into war gaming

Model protocols, devices and technologies

Simulate wired and wireless networks of realistic scale

riverbed Modeler Workflow

Analyze simulation results quickly and intuitively

Modeling and simulation solution portfolio

riverbed® **Modeler**
Accelerating Network R&D

riverbed® **Modeler** Wireless Suite
Wireless Network Modeling & Simulation

**riverbed**® **Modeler** Wireless Suite for Defense
Modeling & Simulation for Defense Communications

riverbed 5

Riverbed Modeler

Key differentiating features

- Fastest discrete event simulation engine among leading industry solutions
- Scalable simulation environment including support for parallel and distributed simulation
- Hundreds of protocol and vendor device models with source code
- Open interface for integrating external object files, libraries, and third-party simulators
- Integrated GUI-based debugging and analysis
- System-in-the-Loop module for real-world testing with physical devices
- Customizable best-in-class GUI
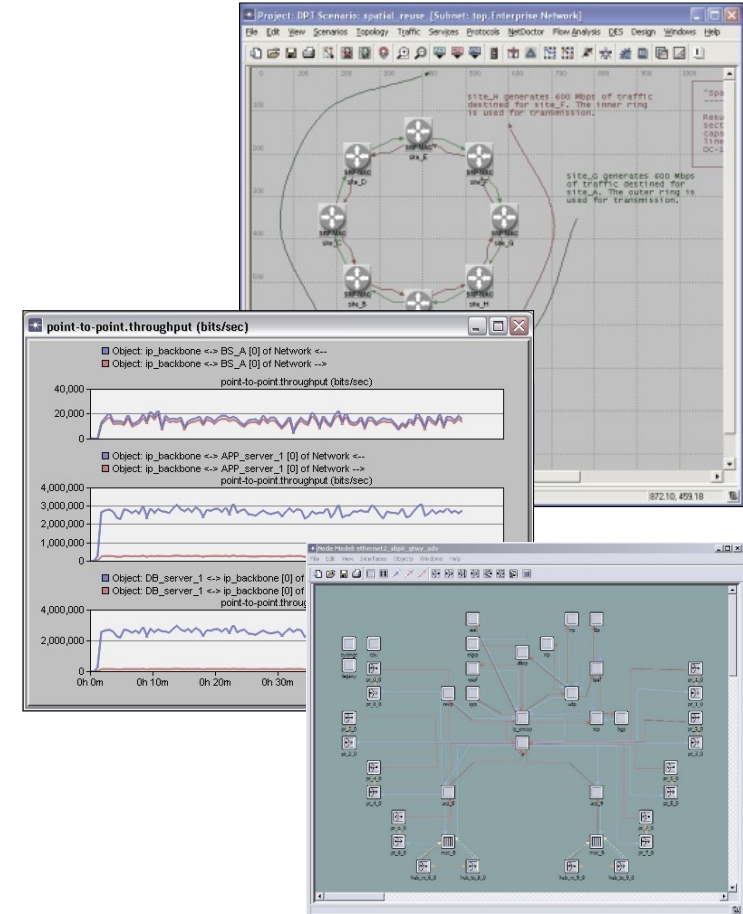
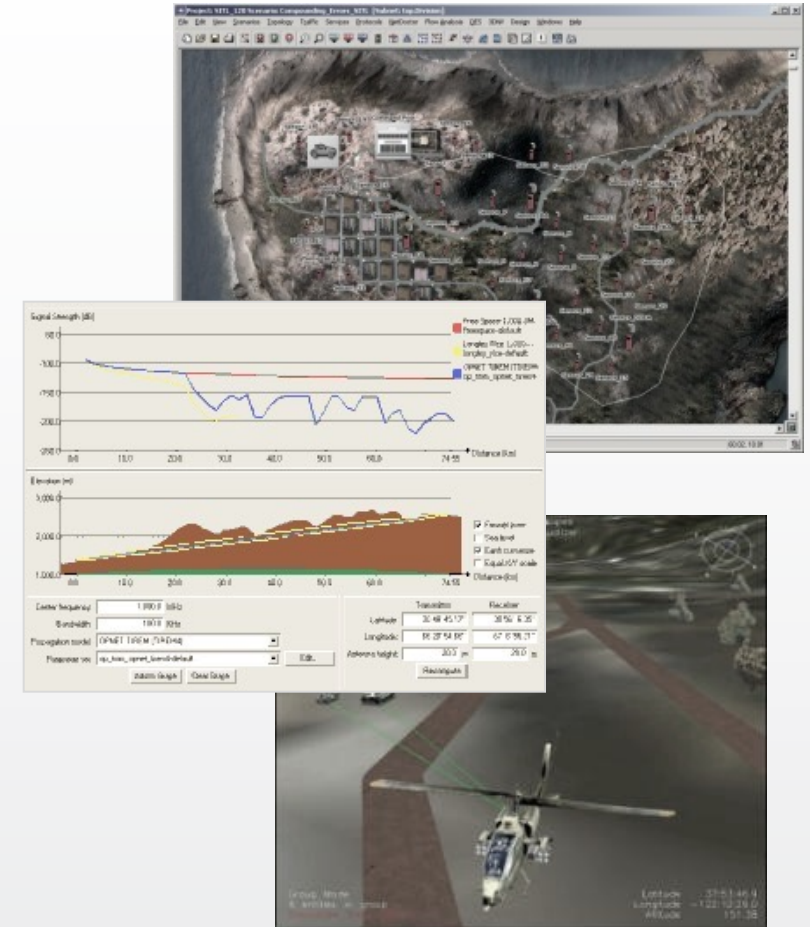Solution
Demonstration

Optional Slides

Modeler Wireless Suite

- **Design advanced wireless protocols and next-generation technologies including:**
  - Wi-Fi (802.11)
  - WiMAX (802.16)
  - LTE (Long Term Evolution)
  - Satellite technologies
- **Predict protocol and application performance**
- **Plan mobile network deployments that accurately incorporate wireless propagation impairments**
- **Evaluate the effects of proprietary or customized antenna patterns in a network**
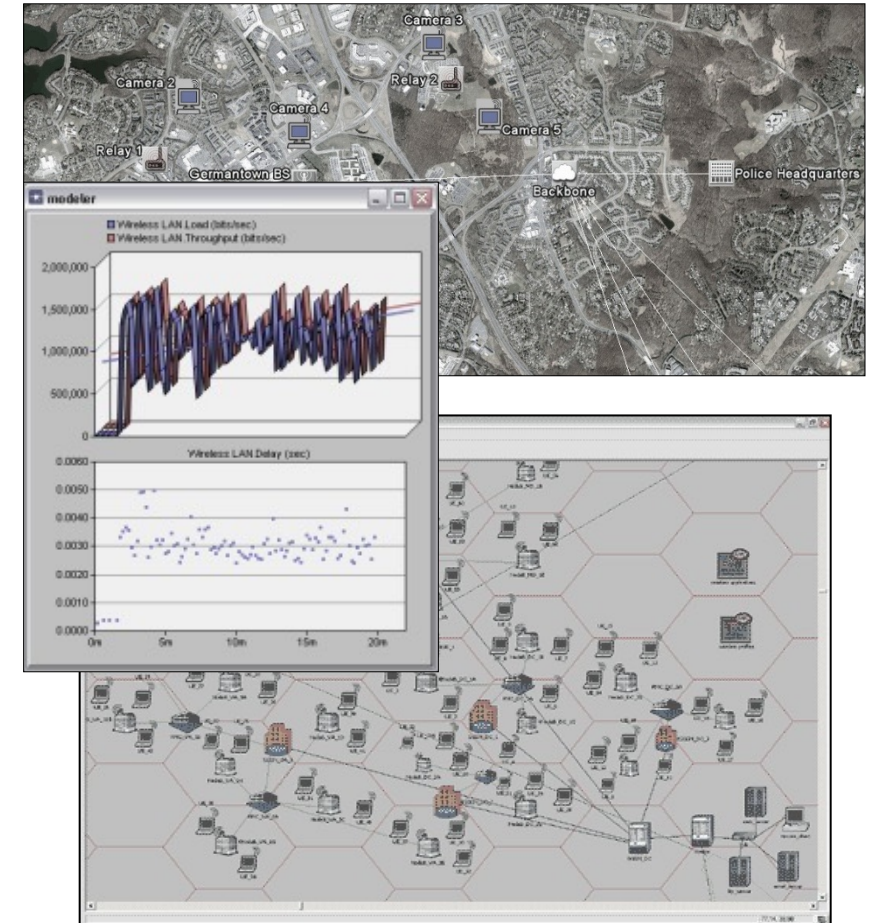
Modeler Wireless Suite for Defense

- Design protocols and technologies to support the warfighter including:
  - MANET
  - HAIPE
  - Link-11 and Link-16 radios
- Plan mobile network deployments that accurately incorporate terrain effects
- Demonstrate technology designs in intuitive 3D scenarios
- Conduct realistic wargaming exercises by incorporating communications effects

Modeling & Simulation Solution
Feature Comparison

	Modeler	Modeler Wireless Suite	Modeler Wireless Suite for Defense
Fastest simulation engine among leading industry solutions	✓	✓	✓
Hundreds of protocol and vendor device models with source code	✓	✓	✓
Object-oriented modeling	✓	✓	✓
Comprehensive graphical user interface	✓	✓	✓
Discrete Event, Analytical, and Hybrid simulation	✓	✓	✓
GUI and simulation kernel: 32-bit and 64-bit	✓	✓	✓
Sequential and parallel simulation	✓	✓	✓
Source code version control	✓	✓	✓
Grid-computing support	✓	✓	✓
System-in-the-Loop for external interfacing	✓	✓	✓
Integrated debugging and analysis	✓	✓	✓
Scalable wireless simulations w/ terrain, mobility, & multiple path loss models		✓	✓
TIREM propagation model			✓
HLA interface for co-simulation			✓
3D visualization			✓

Modeler Architecture
Multi-level Hierarchy

- **Project Editor**
  - Create node and link objects to represent network topology
  - Lay out trajectories to define node mobility

- **Node Editor**
  - Represent protocol and application functions, and the flow of data internal to the device

- **Process Editor**
  - Use extended Finite State Machines to define protocol logic and control flow
  - C/C++ code controls the behavior of each state

- **Other Editors**
  - Packet Format, Antenna Pattern, and Modulation

Project Editor

Node Editor

Process Editor

Open Model Source Code
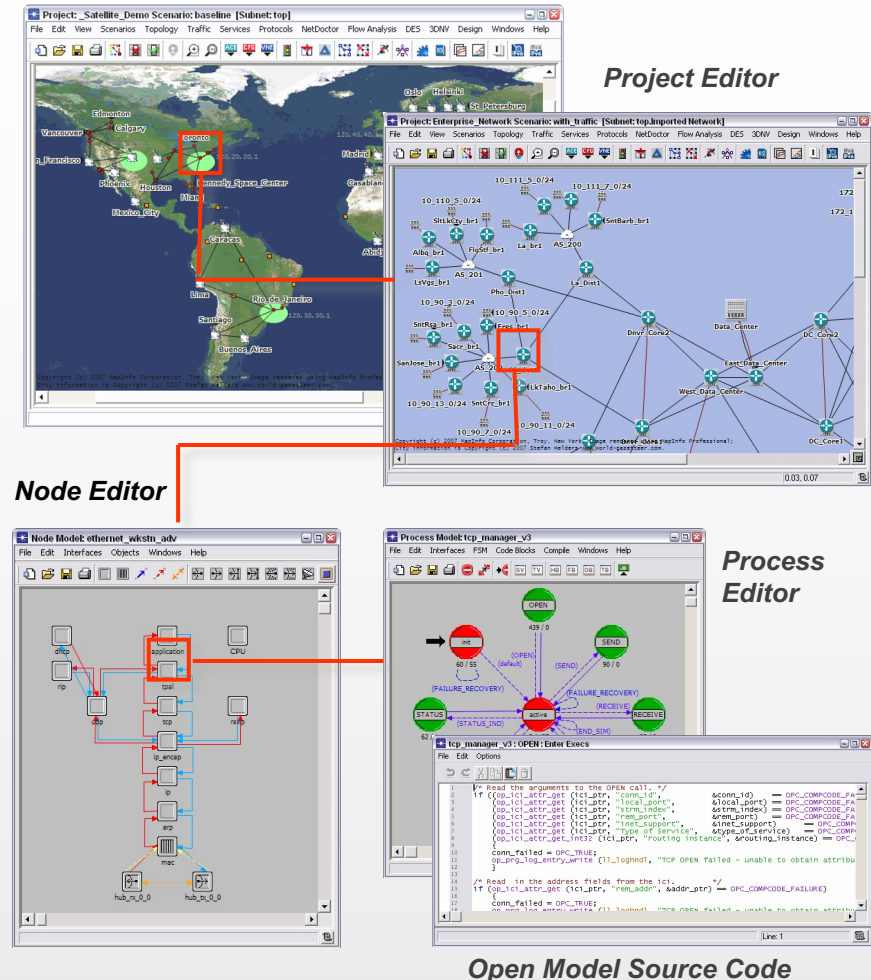
Model libraries

- **Standard**
  150+ built-in protocol & vendor device models
  - Transport: TCP (ECN, New Reno, Reno, SACK, Tahoe), UDP
  - Network & Routing: BGP, EIGRP, HAIPE®, IGRP, IP, OSPF, OSPFv3, RIP, RIPng
  - MAC: 802.1p, ATM, Ethernet (802.3u,z,ad,ae), Spanning Tree, VLAN
  - Wireless: MANET (AODV, DSR, GRP, OLSR, OSPFv3, TORA), Mobile IPv4, Mobile IPv6, TDMA, WLAN (802.11a,b,e,g), ZigBee
  - Vendor devices: Alcatel-Lucent, Cisco, Extreme, Foundry, HP, IBM, Intel, Juniper, Motorola, NEC, Nortel, Sun

- **Specialized**
  Selected protocol models available separately
  - IPv6, MPLS, UMTS, WiMAX, and LTE (model development consortium)

- **JCSS**
  100+ military protocol and device models for DoD & approved contractors
  - Compatible with all Modeler solutions
 - Satellites and earth terminals, encryption devices, multiplexers, tactical radios, etc.

- **Contributed**
  Models contributed by Riverbed users
  - 1,000+ universities using Riverbed software & 25,000+ academic users

Scalable wireless modeling & simulation

- Wireless effects simulated include:
  - RF propagation
  - Interference and jamming
  - Transmitter/receiver characteristics
  - Node mobility including handover
  - Interconnection with wired transport networks
- All wireless characteristics seamlessly integrated with higher layer protocol models
- Fully customizable and modular Transceiver Pipeline™ framework
- Import supported for terrain data in DTED, USGS DEM, and OpenFlight formats
- Full suite of propagation models including:
  - CCIR
  - Free Space
  - Hata
  - Longley-Rice
 - TIREM v3 and v4
  - Walfisch-Ikegami
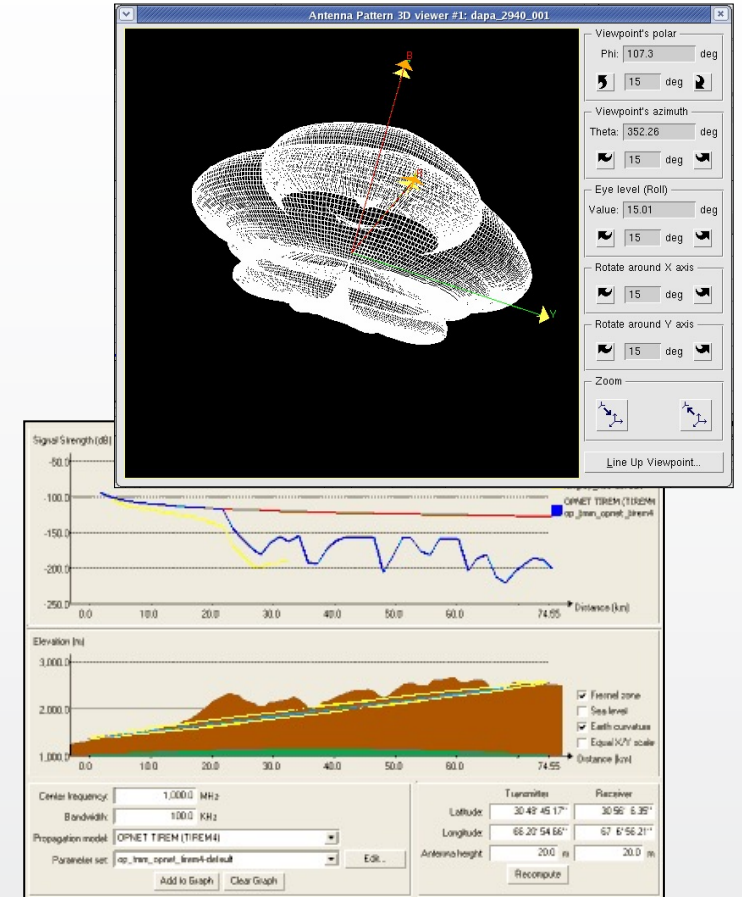
Exclusive integrated analysis & debugging

- **Integrated analysis environment offering advanced and easy-to-use capabilities**
  - Automatic and efficient data collection and presentation
  - Simulation replay to correlate results with network behavior
  - Graphs, tables, and raw data export

- **Convenient integrated debugging**
  - Event and source level
  - Graphical debugging with animation
  - Live statistics from simulation run
  - Checkpoint/Restart: save simulation state and restart from that point
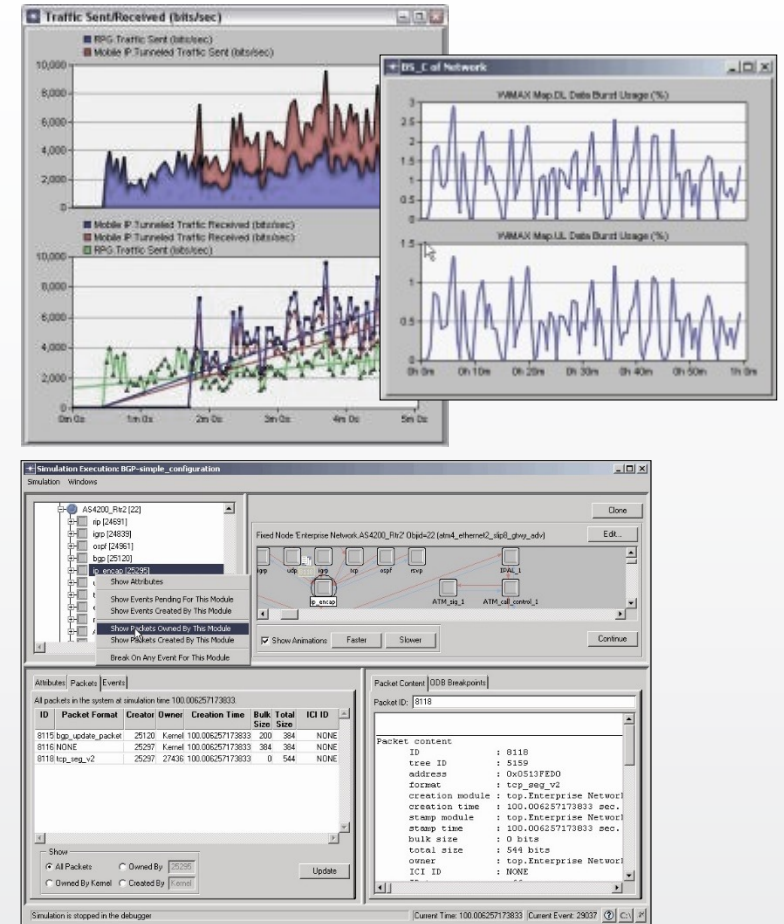
Intuitive 3d visualization

- Visualize network behavior by overlaying communications effects onto a dynamic 3D scenario
- 3D Network Visualizer (3DNV™) provides visualization for wireless effects such as:
  - Link connectivity
  - Terrain masking and other propagation impairments
  - Ad hoc routing performance
  - Mobile network performance
  - Antenna coverage
- OpenFlight terrain and entities are realistically rendered in 3D
- Custom API included for advanced visualization
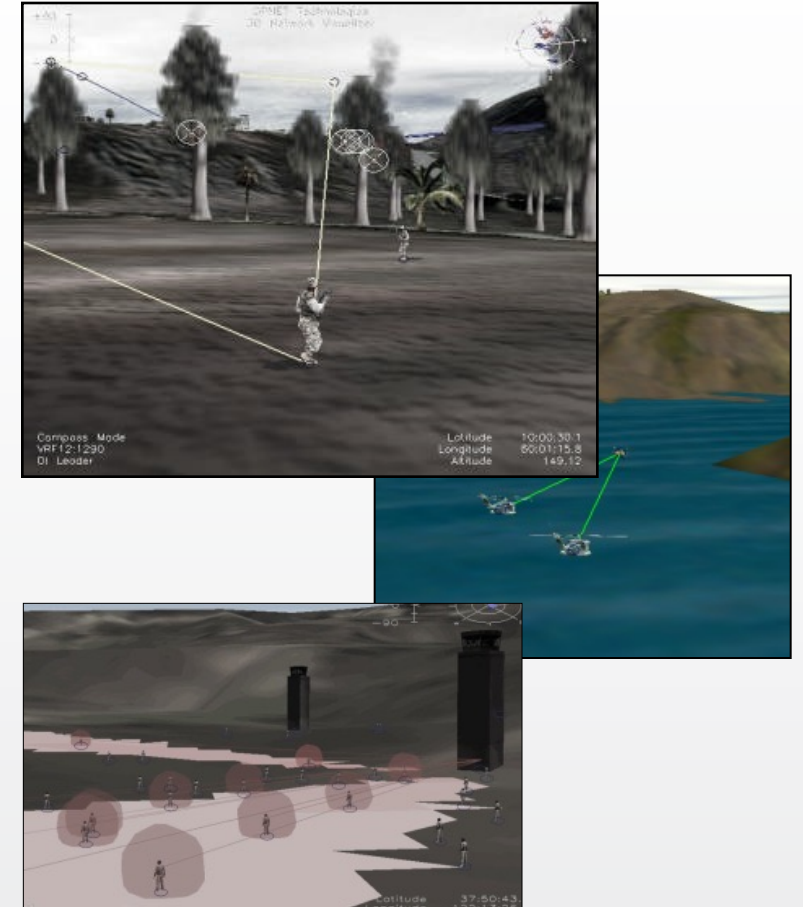
Accelerating simulation run-time

- Reduce simulation run-time by executing simulations in parallel
- Ensure statistical validity by distributing simulation runs with varying parameters to multiple computers
- Leverage powerful remote processors to run simulations that need more resources than are available on your local computer

Distribute simulations to remote computers

Monitor simulations on local machine

Leveraging specialized simulators with co-simulation

- Co-simulation enables users to leverage other specialized simulators with Riverbed Modeler and get the "best of both worlds"
- Co-simulate SteelCentral with other simulators using:
  - High-Level Architecture (HLA)
  - Co-simulation API
  - Extensible Transceiver Pipeline (e.g., co-simulation with MATLAB)
- Co-simulate with multiple software platforms including:
  - Naval Systems Simulator
  - AGI Satellite ToolKit (STK)
  - MAK VR Forces
  - Mathworks MATLAB
  - US Army OneSAF
  - Motorola Wireless Valley
  - Custom FoF/SAF simulators

Integrating live network & application behavior

- **Leverage the AppTransaction Xpert Real Application Simulation module to:**
  - Model real traffic in the simulated environment using captured packet traces
  - Diagnose application performance bottlenecks in simulations
- **Utilize the System-in-the-Loop module to:**
  - Connect live network hardware or software applications to an Riverbed discrete event simulation
  - Analyze the effects of a live system on an Riverbed simulation or vice versa
  - Assess application performance over any network infrastructure model

Customizing the SteelCentral Environment

- Create product extensions
- Construct custom applications/integrations
- Create specific workflows to facilitate model configuration, enable selective Modeler functionality, etc.
- Tailor network visualization and user interface
- Example: ODK can be used to customize the Riverbed Modeler GUI so that new menu items appear when a network scenario is invoked

Case study
Reducing time-to-market for 3G network equipment

- Datang Mobile is a leading telecommunications equipment manufacturer in China
- Datang Mobile promotes the Time Division-Synchronous Code Division Multiple Access (TD-SCDMA) standard for 3G mobile communications
- Datang Mobile uses SteelCentral Network R&D solutions to:
  - Model the entire TD-SCDMA network architecture from the physical layer up to the applications layer
  - Study network performance under various conditions
  - Validate network equipment designs by importing real traffic data into the simulation

"By validating our device designs in Modeler we are able to deliver state-of-the-art equipment to the market quicker and at a lower cost."

Bi HaiZhou, Assistant to GM - Systems & Standards Department, Datang Mobile

大唐移动
DTmobile

riverbed

Case study: enhancing realism in wargaming simulations

- **General Dynamics UK Limited (GDUK) is a leading defense contractor and complex systems integrator**

- **GDUK has integrated Riverbed Modeler with BLaDE, its specialized force-on-force simulator**

- **GDUK uses Modeler to simulate communications effects including:**
  - Protocol behavior
  - Interference
  - Terrain masking
  - Jamming

"[Using Riverbed Modeler] we can now represent the reality of battlefield communications in our defence project simulations, enabling us to better support our customers."

Andy Cullington, Technology Manager - Mission Systems, General Dynamics UK

GENERAL DYNAMICS
United Kingdom Limited

Case study
Accelerating R&D of Wimax base stations

- NEC is a leading international network equipment vendor
- NEC Network Laboratories in Germany develops a core component of NEC's WiMAX base station
- Design objective is to maximize network capacity while delivering optimal QoS
- NEC leverages SteelCentral Network R&D solutions to:
  – Design a proprietary QoS scheduler based on 802.16e-2005 SOFDMA
  – Simulate WiMAX network deployments and analyze custom statistics to validate designs

"By modeling our cutting-edge technology in Riverbed Modeler we are able to cut costs and accelerate time-to-market."

Dr. Xavier Pérez Costa, Project Leader, NEC Network Laboratories

NEC

Case study
Developing Cutting-edge Airborne Networking Systems

- Clean Earth Technologies (CET) conducts state-of-the-art R&D and test & evaluation (T&E) on military C4ISR systems

- CET supports Northrop Grumman, a global defense and technology company, in developing airborne networking communication systems

- CET leverages SteelCentral solutions to:
    - Simulate the performance of different protocols and applications over a battlefield network
    - Validate the behavior of communication devices in tactical networks such as EPLRS

"The ability to incorporate real terrain data into the [Riverbed Modeler] simulation enables us to optimize our network and device designs to accurately reflect battlefield conditions."

Aris Galanopoulos, Director - Advanced Network Systems, Clean Earth Technologies

Riverbed professional services
Modeling & Simulation Support

- Modeling, simulation, and performance optimization of networks, devices, and protocols including HAIPE, IPv6, MANET, VoIP, and WiMAX
- Best practice methodologies for modeling including independent validation and verification (V&V) of custom models
- On-site staff augmentation
- Custom solutions development
  - Network planning and optimization
  - API and co-simulation programming
  - System-in-the-Loop customization and integration
  - Process model development
  - Unique visualization capabilities
  - HLA (High-Level Architecture) and DIS (Distributed Interactive Simulation) integration

Network-centric operations & warfare programs supported
partial list

- Airborne Networking
- Future Combat Systems (FCS)
- High Assurance IP Encryptor (HAIPE)
- Internet Protocol Version 6 (IPv6)
- Joint Network Management System (JNMS)
- Joint Network Node (JNN)
- Joint Tactical Radio System (JTRS)
- Navy FORCEnet

- Navy/Marine Corps Internet (NMCI)
- Network-Centric Enterprise Services (NCES)
- Network Common Operating Picture (NETCOP)
- Network Warfare Simulation (NETWARS)
- Transformational Communication Architecture (TCA)
- Transformational Communications Satellite - Mission Operations System (TMOS)
- Warfighter Information Network – Tactical (WIN-T)

Thank You

riverbed