OPNET/Riverbed Modeler: Getting Started

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Lecture № 2

Outline

Introduction



3 Preferences

- 4 'Save As...' trouble
- 5 Getting started
- 6 Toolbar trouble

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Installation

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Introduction

- Alain Cohen, a 20-year-old MIT student, developed OPNET in 1986
 - Alain Cohen and his classmate Steven Baraniuk developed a prototype data network modeling and simulation system they called '**Optimized Network Engineering Tools**', or **OPNET** for short



 In 1986, Alain Cohen, along with his brother Marc and Steven Baraniuk, founded MIL 3, Inc. (Modeler 1.1)



- In 2000, MIL 3 changed its name to **OPNET Technologies**, Inc. and became a public company (Modeler 7.0)
 - Alain Cohen Chief Technical Officer (CTO)
 - Marc Cohen Chief Executive Officer (CEO)
- In 2012, OPNET was acquired by Riverbed Technology, Inc. for about \$1 billion USD (Modeler 17.5)





- Selected historical consolidated financial data
 - Significant investments in research and development (R&D)

	_	2012 (in the	isands	2011 except per sh	are am	2010	_	2009	_	2008
Consolidated Statement of Operations Data:		(,			,				
Revenue:										
Product	\$	85,820	S	72,392	\$	52,252	S	51,211	S	38,838
Product updates, technical support and services		62,299		53,392		47,264		43,067		34,787
Professional services		24,599		22,202		26,831		28,601		27,721
Total revenue		172,718		147,986		126,347		122,879		101,346
Cost of revenue:										
Cost of product		14,177		9,293		5,983		3,536		1,035
Product updates, technical support and services		5,922		5,260		4,859		4,665		4,514
Professional services		16,407		16,183		19,328		20,911		19,154
Amortization of acquired technology		2,159		2,050		1,835		2,172		1,486
Total cost of revenue		38,665		32,786		32,005		31,284		26,189
Gross profit	1	134,053		115,200		94,342		91,595		75,157
Operating expenses										
Research and development		37,781		34,718		32,043		30,791		27,471
Sales and marketing		55,413		48,733		43,181		42,533		39,357
General and administrative		12,948		12,947		11,011		11,857		11,747
Total operating expenses	1	106,142		96,398		86,235		85,181		78,575
Operating income (loss)		27,911		18,802		8,107		6,414		(3,418)
Total other income (expense), net		(87)		(151)		(70)		1,246		3,579
Income before income taxes		27,824		18,651		8,037		7,660		161
Provision (benefit) for income taxes		9,491		6,250		2,214		2,928		(372)
Net income	\$	18,333	S	12,401	S	5,823	\$	4,732	\$	533
Net income per share:										
Basic	\$	0.81	\$	0.57	\$	0.28	\$	0.23	\$	0.03
Diluted	\$	0.80	\$	0.55	\$	0.28	\$	0.23	\$	0.03

- The company's first product was **OPNET Modeler** a software tool for network **modeling and simulation** (M&S)
- Since then, it has been diversified to provide a range of solutions for:

Application Performance Management

- » AppTransaction Xpert
- » AppTransaction Xpert Packet Trace Warehouse
- » AppInternals Xpert
- » AppCapacity Xpert
- » AppSQL Xpert
- » AppSensor Xpert
- » AppMapper Xpert
- » Unified Communications Xpert

- » AppResponse Xpert Appliance » AppResponse Xpert Rover
- » AppResponse Xpert on RSP
- » AppResponse Xpert VMon
- » AppResponse Xpert v2000
- » AppResponse Xpert for ISR
- » AppResponse Xpert BrowserMetrix
- » OPNET Dashboards

Network Engineering, Operations & Planning

- » SP Guru Network Planner
 » SP Guru Transport Planner
- » IT Guru Network Planner
- » IT Guru
- » NetOne Bundle for Enterprises
- » VNE Server
- Report Server

luons & Planning

- » IT NetMapper
- IT Sentinel
- » SP Sentinel
- » OPNET nCompass for Enterprises
- > OPNET nCompass for Service Providers

Modeling & Simulation

- » OPNET Modeler
- » OPNET Modeler Wireless Suite
- » OPNET Modeler Wireless Suite for Defense

- Customers:
- Service providers
 - British Telecom, Deutsche Telekom, France Telecom, Inmarsat, ...
- 2 Enterprises
 - Deutsche Post AG, FBI, Oracle, 20th Century Fox, Xerox, ...
- Setwork equipment manufacturers
 - 3Com Corporation, Cisco Systems, Ericsson, Fujitsu, HP, Nokia, ...
- Oefense and homeland security
 - Generic Systems Sweden Ab, NASA, US Air Force, US Army, ...
- Oniversities
 - University Program



Academic Research and Teaching With OPNET Software

• OPNET University Program (discontinued):

IT Guru

• Modeling of a broad range of network protocols and technologies

Ø Modeler

• IT Guru with source code for protocol and technology models

Modeler Wireless Suite

• Modeler with a broad range of wireless models

9 SP Guru Transport Planner

• Optical network planning and engineering

IT Guru Academic Edition

• Based on IT Guru

• Products available through the Riverbed University Program:

Modeler

- University Research Program
- https://www.cacetech.com/products/catalog/university.php

	Product Name	Price	Buy Now
7	Modeler U 802.16 (WiMAX) Model	\$504.00	Buy New
7	Modeler U IPv6 Model	\$504.00	Buy Now
7	Modeler U LTE Model	\$804.00	Buy Now
7	Modeler U MPLS Model	\$504.00	Buy Now
7	Modeler U Shared Code Module	\$504.00	Buy Now
7	Modeler U System-in-the-Loop Module	\$552.00	Buy Now
7	Modeler U UMTS Model	\$504.00	Buy Now
7	University Modeler Wireless Suite	\$804.00	Buy Now

Ø Modeler Academic Edition

- University Teaching Program
- https://cms-api.riverbed.com/portal/register

- Riverbed Modeler Academic Edition 17.5
 - Free for all users (registration required)
 - 6-month renewable license
 - Based on Modeler 17.5 (build 2014)
 - Replaces IT Guru Academic Edition 9.1 (build 2000)
- Restrictions:
 - Max. number of simulation events = 50 million
 - Max. number of all nodes = 80
 - Max. number of mobile(!) nodes = 20
 - Max. number of intermediate nodes = 20
 - No process and node editors
 - Microsoft Windows only
 - etc.
- \bullet modeler_ae_175A_PL7_13312_win.exe: \sim 600 MB

• Academic Edition software is created for introductory(!) level courses





• Riverbed Modeler Academic Edition 17.5 vs. **OPNET Modeler 14.5**

Select Product Modules				
Select the product modules you want to use.				
3D Network Visualizer GUI [No license]				
Automation [No license]				
eXpress Data Import [No license]				
Flow Analysis [No license]				
IPv6 Planning and Operations [No license]				
IT NetMapper [No license]				
Mainframe Characterization Editor [No license]				
NetDoctor [No license]				
OPNET TIREM GUI [No license]				
Planning and Design Module [No license]				
PSTN Flow Analysis [No license]				
Server Characterization Editor [No license]				
Shared Code Development [No license]				
SP NetMapper [No license]				
System Performance Module for BMC Performance Assurance [No				
System Performance Module for CA Unicenter [No license]				
System Performance Module for HP Open View [No license]				
Terrain Modeling [No license]				
Urban Propagation [No license]				
V Wireless [Available]				
QK Cancel				

K Select Product Modules				
Select the product modules you want to use.				
☑ 3D Network Visualizer GUI				
ACE Analyst Module				
ACE Decode Module				
Advanced ACE Capabilities				
Automation				
eXpress Data Import				
Flow Analysis				
IPv6 Planning and Operations				
IT NetMapper [No license]				
Mainframe Characterization Editor				
NetDoctor				
OPNET TIREM GUI				
Planning and Design Module				
PSTN Flow Analysis				
Server Characterization Editor				
SP NetMapper [No license]				
System Performance Module for BMC Performance Assurance [No				
System Performance Module for CA Unicenter [No license]				
System Performance Module for HP Open View [No license]				
I lerrain Modeling				
V Wireless				
<u>Q</u> K <u>Cancel</u>				

 'We have renamed our products to better describe what they do and reinforce how they are part of an integrated solution called the Riverbed Application Performance PlatformTM.' http://www.riverbed.com/products/



- OPNET/Riverbed solutions enable organizations to optimize their investment in network R&D:
 - Develop proprietary network protocols and technologies
 - Evaluate enhancements to standards-based protocols
 - Test technology designs in realistic scenarios before production
 - Increase R&D productivity and accelerate time-to-market
- OPNET/Riverbed Modeler a de facto industry standard for network M&S

• Hierarchical GUI-based editors

• Intuitive and user-friendly modeling environment

High-fidelity modeling

- Hundreds of protocol and vendor device models with source code
- Different aspects of wireless communication, including RF propagation, antenna modeling, signal modulation, node mobility, and interference

Scalable simulation

- Parallel discrete event simulation kernel
- Grid computing support for distributed simulation

Sophisticated analysis

• Integrated GUI-based debugging and analysis tools

Integrating live network and application behavior

- Optional module (SITL) to interface simulations with live systems
- Open interface for integrating external files, libraries, and other simulators (e.g., MATLAB)

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Installation

- Supported platforms:
 - Microsoft: Server 2008, Server 2012, XP, Vista, 7, 8, 8.1, 10
 - Linux: Red Hat
- C++ compilers:
 - Microsoft: Visual Studio 2002, 2003, 2005, 2008, 2010, 2013
 - Linux: gcc 3.4 or higher
- OPNET/Riverbed software does not work with number representation different from **English**
 - The reason is the different decimal separator: 'point' in English, 'comma' practically in all others

• Windows 7: Control Panel \Rightarrow Clock, Language, and Region \Rightarrow



• \Rightarrow Region and Language \Rightarrow Format: **English (United States)**



- Installation order:
 - C++ compiler
 - Setting environment variables
 - Software
 - Models
 - Documentation
- All OPNET/Riverbed products must obtain a license prior(!) to their execution
- Licensing modes:
 - Standalone
 - Floating serve licenses from this computer
 - Floating access licenses from remote server

- Enabling optional product modules
 - Access to these modules will depend on your licenses



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• If you forgot to enable certain modules, you can still do it later



- At the time of first installation, OPNET/Riverbed generates several new folders on your computer:
- C:/Program Files/OPNET/ or C:/Riverbed EDU/
- C:/Users/<user name>/op_admin/ contains backup (bk), temporary (tmp), log files, etc.
- Sc:/Users/<user name>/op_models/ contains user-created files
- Output: C:/Users/<user name>/op_reports/ contains reports

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• OPNET/Riverbed Modeler is composed of multiple editors, each of which opens in its own window



• Managing preferences



• **Preferences Editor** – allows to change software preferences

Preferences Editor - C:\Users\RAD\o	p_admin\env_db14.5			
Search for:		Anywhere Find		
Arrange by Groups 💌		C Advanced view		
Em Al	Name	Value 🔺		
B 3DNV	3DNV	_		
Hun Automation	Delay for Entity Creation	1		
B Dashboard	Destroy Decorations at End	TRUE		
Design Action	Display product overlay in 3D Visualizer	FALSE		
Discrete Event Simulation	💥 Earth Geocentric Model	right_sphere		
H Flow Analysis	Entity Mapping Library	opnet_3dnv_default_mapping		
B Import	HLA Fed File Name	<nul></nul>		
Licensing	HLA Federation Name	OPNET_3DNV		
H Miscellaneous	Launch 3D Network Visualizer	FALSE		
NetDoctor	Launch 3DNV Communication	FALSE		
Netcop	Mapping Library Initialization Argument	<nul></nul>		
Product Performance	Maximum 3DNV Messages per Second	0		
B Project Editor	A DDD FOM V	·		
B Reporting				
Infinite Traffic	Preference Information			
Troubleshooting	Name: Delay for Entity Creation	<u> </u>		
VINE Model Accelerator	value: I			
WINDER CEN				
-	Description: Number of seconds to wait bet	ween the creation of RTI objects		
	and the generation of the object	ts' initial position. 📃 🗨		
	<u>O</u> K <u>C</u> ar	cel <u>Apply</u> <u>H</u> elp		

• Example 1: If Wireshark is installed after Modeler, then be sure to update the 'External Decoder Program' preference

Preferences Editor - C:\Users\RAD\o	p_admin\env_db14.5		
Search for: External Decoder Program		Anywhere	→ Eind
Arrange by Groups			Advanced view
E- AL	Name	Value	<u>^</u>
ACE	ACE.Decode		
	External Decoder Program	<null></null>	
		<nul></nul>	
		Browse	
	•		•
	Preference Information		
	Name: External Decoder Program		_
	Value: <null></null>		
			_
	Development development	_	
	Tagi and external decoder program	п.	•
	Lac external decoder prod		
	<u> </u>	ancel Ap	ply <u>H</u> elp

• Specify the path and filename of the program used to generate protocol decodes

Preferences Editor - C:\Users\RAD\o	p_admin\env_db14.5	
Search for: External Decoder Program		Anywhere <u>Find</u>
Arrange by Groups		C Advanced view
E- Al	Name	Value 🔺
ACE	ACE.Decode	
	External Decoder Program	C:\Program Files\Wireshark\Wires
	I	
	Preference Information	
	Name: External Decoder Program	-
	Value: C:\Program Files\Wireshark\W	ireshark.exe
	Description: Ace external decoder program.	_
	Tao: ace external decoder prog	
	<u>Q</u> K <u>C</u> an	cel <u>A</u> pply <u>H</u> elp

• Example 2: 'Model Directories' – user-friendly preference name; 'mod_dirs' – technical name (tag)



op models – the default folder to store user-created project files



• The order in which the directories are listed in the 'mod_dirs' preference is very important!



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'Save As...' Trouble

• The primary model directory (bla-bla-bla) does not exist. Attempts to save new models will fail until the problem is corrected. ③



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Network Modeling & Simulation
'Save As...' Trouble (cont'd)

• Edit \Rightarrow Preferences \Rightarrow mod dirs \Rightarrow Find



• Delete \Rightarrow OK



'Save As...' Trouble (cont'd)

 $\bullet \ \mathsf{Apply} \Rightarrow \mathsf{OK}$



'Save As...' Trouble (cont'd)

• Done! 🙂



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- OPNET/Riverbed uses a 'project-and-scenario' approach to model networks
- **Project** a collection of network-related scenarios, each of which explores a particular aspect of the network design
 - All projects contain at least 1 scenario
- **Scenario** a single instance of a network
 - Typically, a scenario presents a unique configuration for the network
 - The term 'configuration' can refer to different aspects such as topology, protocols, applications, traffic, and simulation settings

- **OPNET/Riverbed simulation workflow**
- Create a baseline scenario
 - Build a network topology
 - Add traffic
 - Choose statistics to be collected
 - Run the simulation
 - View the results
- 2 Duplicate the scenario
 - Make changes
 - Re-run the simulation
 - Compare the obtained results
- Sepeat №2 if needed

• 2 file browsing methods



 General file chooser – allows searching of all the mounted storage devices on the current computer

🔣 Open				
Look in:	op_models	•	← 🗈 💣 💷 ◄	
	Name	*	Date modified	Туре
op_models		No items match you	r search.	
std				
Documents				
Computer				
Desktop				
	•			•
	File name:		•	Open
	Files of type:	Project Files (*.prj)	-	Cancel
				1.

File chooser organized by model directories – displays only folders known to the program



• Riverbed Modeler Academic Edition 17.5 vs. OPNET Modeler 14.5: opening an existing project

🚺 Open				×	🔣 Open		Project Files (*.prj) Network Whiteboard Files (*.wb.xml)		×
Look in:	op_models	•	🗢 🗈 💣 📰 •		Look in	: 🔰 op_models	ACE Hies (".atc.m) ACE Whiteboard Files (".aed.m) Server Characterization Files (".sce.m)	-	
	Name	*	Date modified	Туре		Name	Mainframe Characterization Files (* mce m) Node Model Files (* nd m)	ed Type	e
op models		No items match your s	earch.		oo models		Process Model Files (* pr.m) Link Model Files (* k.m)		
							Path Model Files (*.path.m)		
					std		ETS Source (C code) Files (*.ets.c)		
example_networ							ETS Source (Python code) Files (* py)		
					Desumente		External Source (C++ code) Files (*.ex.cpp)		
					Jocuments		Header file (C/C++, h) files ("h) Header file (C++, hpp) files ("hpp)		
Documents							Pipeline Stage (C code) Hies (".ps.c) Pipeline Stage (C++ code) Files (".ps.cpp)		
					Computer		Network Model Files (*.nt.m) Probe Model Files (*.pb.m)		
Computer					·		Simulation Sequence Files (*.seq) Antenna Pattern Files (*.pa.m)		
					Desktop		External System Definition Files (*.esd.m) Filter Model Files (*.fl.m)		
	•			· · ·		•	Environment Files (* ef) Generic Data Files (* off)		· ·
Desktop	File name:		-	Open		File name:	ICI Format Files (* ic.m)	Oper	n
	Files of type:	Project Files (*.prj)	•	Cancel		Files of type:	Modulation Curve Files (".nd.m)	Cano	;el
		Project Files (*.prj)			63		PDF Model Files ("pd.m)		
							Protile Library Files (".ppl.m) Wireless Domain Model Files (*.wdomain.m)		

• Creating a new project



• Enter the desired project and scenario names



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• Startup Wizard: Initial Topology



• Startup Wizard: Choose Network Scale



• Startup Wizard: Select Technologies



• Startup Wizard: Review



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• **Project Editor** – used to create and configure the simulation study



• New Scenario... – creates a new empty(!) scenario

🔣 Project: project1 Sc	enario: scenario1 [Subnet: top]				
File Edit View Sc	enarios Topology Traffic Services Protocols NetDoct	or Flow	Analysis (DES 3DNV	Design Windows
neip	New Scenario Ctrl+Shift+N		Г Г-		[
i 🔁 🚍 🖨	Duplicate Scenario Ctrl+Shift+D	r 🔅	📸 🕹 🛙	2 🛃 🗍	
W175° W150°	Manage Scenarios				
N75°	Previous Scenario Ctrl+ Up				Bod Next
1	Next Scenario Ctrl+Down				Tura vest
- Sugar	Switch To Scenario	too b		•	
N50*	Scenario Components	TOUL			
	User Defined Reports		Fixed Node	1000	
	Network Difference Report		Fixed Node	1008 10Ba	
N20*	Object/Attribute Difference Report				
	Live Object/Attribute Difference		Fixed Node	Applic	
0.	Model Completeness Analysis				
	Generate Network Inventory Summary		Ewod Mede		
and the second			Fixed Node		
\$25°	Generate Scenario Web Report	vtch	Fixed Node		•
	Generate scenario Bitmap		Fixed Node		Logical Subnet
	View Associated Output Tables		Fixed Node	Ether	
S50*	ethemet2_slp8_tirewall	_	Fixed Node	Firew	Satellite Subnet
			Fixed Node	IP Rc	
			Fixed Node	Ether	•
S75*	IP Attribute Config		Fixed Node	Ether IP-lay	Mobile Subnet
	- 🕅 IP VPN Config		Fixed Node		6
	I I Im(x) io32 cloud		Fixed Node	POC	Subnet
(a) 2016 Hard	Create right-angled link			,	
City information is Co	pyright (c) 200 Model Details Create Custom Model			Clos	se Help
1.	1				109.6028.00

• Duplicate Scenario... – creates a new identical(!) scenario

Roject: project1 Scenario: se	cenario1 [Subnet: top]					
File Edit View Scenarios	Topology Traffic Services	Protocols NetDoo	tor Flo	w Analysis	DES 3DNV	Design Windows
Help New S	Scenario	Ctrl+Shift+N				
🗐 📂 🖬 🎒 👘 Dupli	icate Scenario	Ctrl+Shift+D	× %	🔆 🏄 💷	🖻 🌌 🙂	2
W175° W150° Mana	age Scenarios					
N75° Previo	ous Scenario	Ctrl+Up				Ded Net
Next !	Scenario	Ctrl+Down				- End Next
Switc	h To Scenario		·			
N50* Scena	ario Components		•			
liters	Defined Reports			Fixed Node	1000	
Netw	ork Difference Report			Fixed Node	10Ba	
Objec	ct/Attribute Difference Report			Dural Nucle		
Live	Object/Attribute Difference			Fixed Node	Ascer	
0° Mode	el Completeness Analysis					
Gener	rate Network Inventory Summa	ry		Fixed Node		
Gener	rate Scenario Web Report			Fixed Node		
\$25° Gener	rate Scenario Bitman		vtch	Exed Node Exed Node		Lonical Subnat
				Fixed Node		
View	Associated Output Tables	d'a sinil firewall		Fixed Node Fixed Node	Ether	W
	etheme	t32_hub		Fixed Node	Ether	Satellite Subnet
		t4_slip8_gtwy		Fixed Node Fixed Node	IP Ro Diter	(*)
\$76*	etheme	t_wkstn		Fixed Node	Ether	Mobile Subnet
		oute Config		Fixed Node	IP-lay	
		oud		Fixed Node Fixed Node	IP Q	•
	•				•	Subnet
Copyright (c) 2016 MapInfo Corp	Create right-angled link	·				
(Model Details Create	Custom Model			Clos	se Help
li.						109.60, -28.00

• Switch to Scenario - allows switching to a specific scenario



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• Manage Scenarios ... - organizes all scenarios within the project



• Scroll the mouse wheel up or down to zoom in and out



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Toolbar Trouble

• **Toolbar** – contains buttons used to invoke certain operations



• Configure Toolbar / Reset to Default

Project: project1 Scenario: scenario1 [Subn File Edit View Scenarios Topology T Help	tt top] affic Services Protocols NetDoctor Flow Analysis DES 3DNV Design Windows
Configure Toolbar Arriticate operations The first and Toolbar Arriticate operations The first and Toolbar The first and Toolba	부 부 부 별 한 가 A ISS XI X 사 값 값 같 값 값 고 IS A ISS XI X 가 있 같 값 값 값 ISS XI X 가 있 같 값 값 ISS XI X 가 있 같 값 ISS XI X N ISS XI X X X X X X X X X X X X X X X X
	Add Separator >>> Configure/Run Discrete Event Simulation (DES) Configure/Run Disgra Action Configure/Run Autonation Tasks Configure/Run Autonation Tasks Configure/Run Autonation Tasks Web Open Reput Server Home More Rup L L Generate Network Invertory Summary
<u>د</u>	Launches wizad to assess the readness of network Morates an existing network to 11∿6 Morates an existing network to 11∿6 locn: [ove_rigration
Reset to Default	QK

• Show/Hide Toolbar



• Float Toolbar



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Floating



Close



• And it's gone ③



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• Show Toolbar



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• And it's back ③



Done!



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Ø Bibliography

Bibliography

• Unlike Modeler Academic Edition, Modeler includes detailed product documentation


Bibliography (cont'd)

• OPNET/Riverbed documentation is stored as an HTML file



Bibliography (cont'd)

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