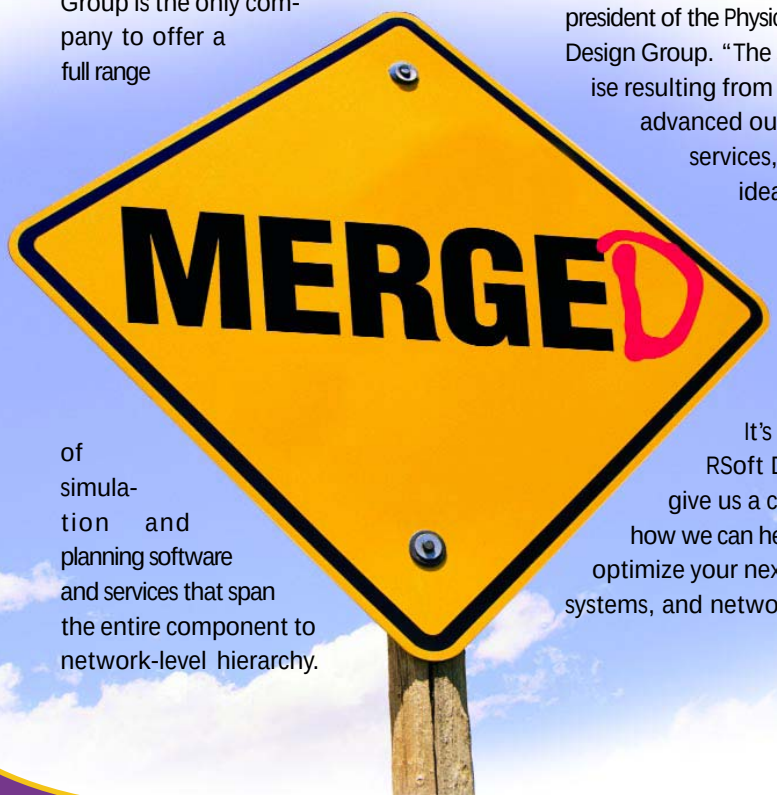
RSOFT Design Group

RSOFT REVIEW

Volume 1 Number 1

New and Improved
INTRODUCING RSOFT DESIGN GROUP

RSOFT Design Group, Inc. appears for the first time in public at this year's OFC and CTIA conferences. RSoft Design Group was created from the merger of RSoft, Inc. and Network Design Tools, Inc. (NDTI), a Telcordia Technologies spinout. The company offers a comprehensive suite of design and business analysis software solutions to the photonics and telecommunications industries. Combining RSoft's award-winning suite of physical-layer design tools with innovative network-layer planning and optimization tools from NDTI, RSoft Design Group is the only company to offer a full range of simulation and planning software and services that span the entire component to network-level hierarchy.



The company's software solutions cover four areas—Component Design, System Simulation, Network Modeling and Strategic Analysis. These tools are used by researchers, manufacturers, systems integrators, and service providers to address design challenges ranging from the physics of component design to the business implications of planning wired and wireless networks.

"With our merger completed, we've turned our attention to the development and introduction of new products, some of which will be demonstrated at this year's OFC and CTIA conferences, " said LuAnn Scarmozzino, president of the Physical-Layer Division at RSoft Design Group. "The shared technical expertise resulting from our merger has already advanced our existing products and services, as well as created new ideas and opportunities."

RSoft Design Group will preview its innovative new products at this year's OFC and CTIA conferences.

It's our debut! Stop by the RSoft Design Group booth or give us a call to learn more about how we can help you design, plan, and optimize your next-generation products, systems, and network services.

RSoft Design Group's software solutions cover four areas—Component Design, System Simulation, Network Modeling, Strategic Analysis.

WHAT'S INSIDE

Simulation tools present a real competitive edge

Gail Lalk

CEO, RSoft Design Group, Inc.

Welcome to the first issue of the RSoft Design Group Review! I want to take this opportunity to shed some light on the merger of RSoft, Inc. and Network Design Tools, Inc., and give you a sense of where RSoft Design Group sees itself in the marketplace.

As you may know, POMS (Performance, Optimization, Modeling, and Simulation) software is one of the few bright lights in an otherwise difficult technology market. One driver of this steady demand is that in uncertain economic times most companies focus on their core competencies and seek to extract higher margins from their core businesses. Simulation tools are being used by component manufacturers to significantly reduce product cycle times and increase the reliability of network components, while network optimization tools are helping network providers dramatically reduce their capital expenditure budgets and prove-in new technologies. Equipment suppliers are being asked by their customers to show where their equipment fits into the network hierarchy. In spite of a difficult economic environment, competitive players in the telecom industry know that rapidly evaluating and implementing new technologies is crucial for staying ahead of their competitors. In an environment where there are plenty of innovative ways to bring more capacity and more flexibility to their end-customers, these companies need POMS software.

POMS software provides robust, reliable and definitive solutions for companies in the telecommunications industry who want to stay focused on their core businesses and increase their competitive

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Metropolitan networks:

TECHNOLOGY COMES AT A COST

Metropolitan optical networks pose unique and challenging design choices. A metro network is dense, complex, and — in today's environment — rife with uncertainty about demands, new platforms, and even the longevity of SONET. And because the economics of metro networks are unique, network designers cannot simply interpolate long-haul networks and expect to optimize metro system and solution costs.

While metro planners have many options available in emerging technologies for these networks, the challenge is to optimize the costs of these technologies. Planners must:

- Accommodate uncertainties in traffic demands , because metro networks are not well characterized
- Manage the complexity of determining how to best apply new technologies for metro
- Develop definitive solutions, in which the cost-effectiveness of new technologies is tailored to the needs of the particular network

Mastering the metro network requires the ability to ascertain the best combination of features and

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Thoughts on 3G evolution:

RSoft Review (RR): Deploying third-generation wireless networks, or 3G, is a hot topic this year. What competitive advantages does 3G offer to innovative network providers?

Arnold: 3G offers the potential for cost reductions in voice services, the cellular and PCS providers' present bread and butter. It's also an enabling platform for delivery of present and future data services with a wide range of information rates and service quality requirements.

RR: Wireless service providers around the globe are still struggling with 3G implementation. What are a few of the major roadblocks?

Arnold: Equipment availability continues to be an issue. Service providers must stimulate demand for new services while evolving their networks to economically provide capacity for them. Also, in the US, the lack of additional spectrum complicates any 2G-to-3G evolution.

RR: What role does network planning play in successful 3G implementation?

Arnold: Network planning early in the deployment process can allow the service provider to consider the trade-offs between technology, service, and market needs and make early choices that don't preclude later opportunities. In the multi-rate multi-service 3G environment, network planning is critical to assure the network architecture can provide sufficient capacity in the right areas to support the planned rollout.

> ***"Backhaul costs can never be ignored– wireless is just LESS wire."***

RR: So, in turn, if a service provider is planning 3G evolution in isolated organizational silos — say Marketing, Engineering, and Finance — what kinds of problems might arise?

MEET PETE:

Pete Arnold, Principal Engineer at RSoft Design Group,Inc. has more than 30 years experience in wireless research and research management, including wireless propagation, technology, and systems analysis. Pete has over 25 published papers and talks in refereed journals and conferences, and has 12 patents on mobile and satellite wireless system architectures and technologies. We discussed the evolution of wireless networks with him.

Arnold: Unforeseen changes in out-year service and market plans can invalidate any early architecture and technology choices. But those choices constrain the evolutionary path for the network. An engineering plan based on purely engineering choices may not capture the differing network capacity/revenue trade-offs inherent in differing services.

RR: You're saying even an established service provider can be severely blindsided in such a situation?

Arnold: A large incumbent could miss the benefit of early deployment of 2.5G technology as a hedge against delayed demand for high-bandwidth services. In the U.S., lack of additional spectrum may create capacity bottlenecks in an existing 2G network as the service provider evolves the network to 3G technology.

RR: And a less-established player, trying to leapfrog from 1G to 3G…where do they begin?

Arnold: By asking themselves how they can capitalize on their lack of in-place

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Metropolitan Networks continued

functions for the minimum cost. RSoft Design Group has observed that obtaining a near-optimized solution requires wide-open design flexibility, combined with rigorous attention to the economics specific to metro networks. Designers must pay attention to:

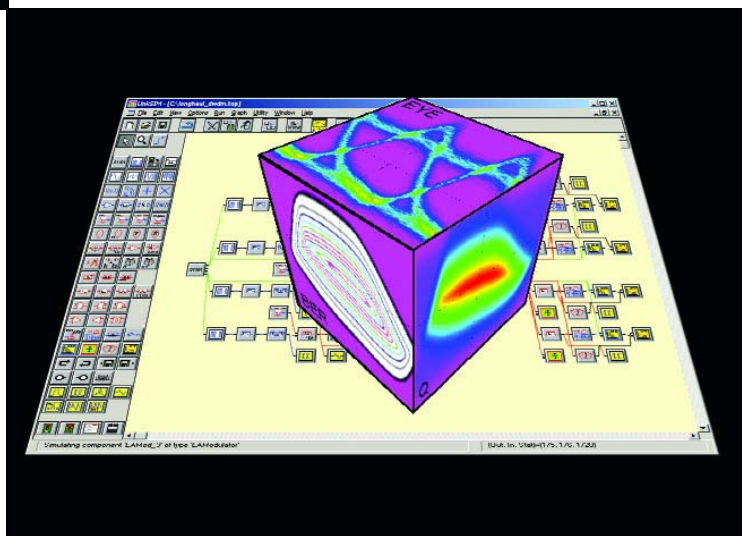
- **ADM Selection.** Because Add-Drop Multiplexers are the greatest expense of any metro network, placing the best combination of ADMs in the network is crucial
- **Topology Optimization.** Minimize network cost by optimizing fiber, structure, cable, amplifier, and regenerator usage
- **Existing Builds.** Consider the usability of embedded, planned, and potential rings before creating new systems
- **Flexible Demand and Equipment Rates.** Consider the use of any transport rate (including SONET, SDH, Gigabit Ethernet, and other data rates that may pop up in the market)
- **Flexible Specification of Rings.** Specify rings that may be bidirectional or unidirectional
- **Clustering.** Partition networks into clusters for more efficient network administration; and
- **DCS Hub Location.** Select hubbing locations for low demand rate grooming

Given the external drivers of demand uncertainty and the ceilings on operational costs, metro design requires the ability to run sensitivity analysis and create "what-if" scenarios, to see which solutions fit the needs of your organization or your customers. The bottom line: planning a metro network is certainly no walk in the park…but with the right approach, it shouldn't have to be a marathon either. –

Designing long-haul links with LinkSIM™'s new physical EDFA model

The accurate design and simulation of long-haul telecommunication links has just gotten easier with *LinkSIM*'s new physics-based model of erbium-doped fiber amplifiers (EDFAs). Whether adopting EDFAs for pre- and post-amplification, multi-stage signal regeneration, or power fiber amplifiers, lightwave engineers need to understand the impact of EDFA gain and noise characteristics on their system.

The effects of gain saturation and amplified spontaneous emission (ASE) can have a significant impact on link performance. A physical EDFA model is the best tool for understanding these phenomena. designer can choose a level of complexity consistent with available component data as well as required simulation accuracy. Furthermore, they can readily implement standard co- and counter-propagating pump configurations at 980 and 1480 nm through *LinkSIM*'s various optical sources and multiplexers. The model also supports performance-enhancing pump- and signal-recycling schemes. By designing EDFA-based links using *LinkSIM*'s full suite of simulation tools and models, a system engineer can study key measures of EDFA performance such as gain, noise figure, and output noise spectra. They can then assess the impact of these characteristics on overall system performance, including bit error rate (BER), eye diagrams, and more. –



LinkSIM's EDFA model provides a variety of pump and signal configurations to match most systems

In addition to supporting component specifications at multiple levels of complexity, *LinkSIM*'s EDFA model provides a variety of pump and signal configurations to match most systems. From the standard Giles-parameter model to a detailed spatially dependent description, a

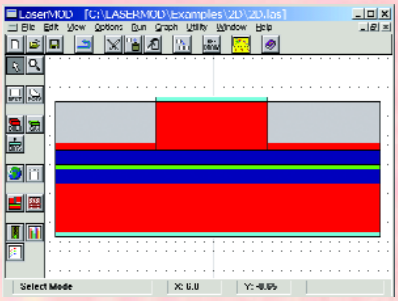
TOOLS FOR TODAY AND TOMORROW

Preview new products and up and coming products at OFC and CTIA

new tools for today

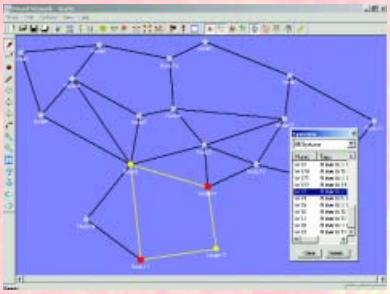
LaserMOD™

An integrated CAD package, *LaserMOD*™ is used for laying out active device cross-sections, selecting material parameters, generating nonuniform grids, running simulations, and plotting results. The tool is focused on Fabry-Perot laser cavities, but has been designed to be extendible to VCSEL and DFB structures in the future. Physical models include a comprehensive MQW gain calculation. Both steady-state and time-dependent carrier transport are simulated, for accurate modeling of device dynamics. *LaserMOD* also considers hot-electron effects, incomplete carrier-capture within the quantum wells, current spreading, and spatial and spectral hole burning phenomena. Outputs include L-I and I-V curves, near and far field, charge and current distributions, energy bands and band structure, and transient response.



MetroWAND™

Network modeling tool *MetroWAND*™ is built specifically for metro applications. *MetroWAND* is a vendor-neutral strategic network-planning tool that simulates and analyzes SONET/SDH and DWDM systems in metropolitan environments. Its flexible equipment, cost, and demand models are designed to locate cost-effective DWDM and SONET/SDH rings in the network backbone. MetroWAND allows for quick, iterative analysis — running 50 nodes in just minutes, and provides spreadsheet-ready solution and system costs.



BroadbandSWAT™ WirelessSWAT™

A family of strategic wired and wireless analysis tools, *SWAT* provides a comprehensive analysis tool designed to help planners, engineers, technologists, business and marketing people rapidly, but thoroughly, develop network and service plans including detailed technical and business analysis. All access networks and services, wired and wireless, are covered via *BroadbandSWAT;* or wireless via *WirelessSWAT*. Program includes the complex interrelated traffic, capacity, propagation, equipment and operations calculations.*SWAT* produces reports covering a variety of key elements, such as discounted cash flow, capital/expense flow, and network loads and typically runs a network study on the order of 15 seconds.

preview tools for tomorrow at OFC

See us at OFC and learn about these exciting new developments

GratingMOD™

Whether you need to analyze a known grating structure or synthesize a structure from a known spectrum, *GratingMOD* can help. The software can model many devices that incorporate gratings, including gratings for laser wavelength stabilizers, pump reflectors, gain equalizers, dispersion compensators and various kinds of filters. This tool can handle gratings with arbitrary cross sections, including optical fiber, channel waveguides, diffused waveguides, and slab waveguides.

BandSOLVE™

A fully integrated add-on component to *BeamPROP* and *FullWAVE, BandSOLVE* automates and simplifies the calculation of photonic band structures for a large class of optical components. *BandSOLVE* deals with a large range of standard crystal lattices in one, two or three dimensions, including FCC, BCC, diamond, logpile and Yablanovite lattices. Using the standard *BeamPROP* CAD interface, users can quickly create lattices of the desired shape and unit cell. The simulation engine automatically determines the appropriate path through the Brillouin zone of the crystal and generates the band structure diagram. The software also allows the study of "reduced band structures", and cavity mode properties to capture the behavior of guided modes in PC waveguides.

LambdaSIM™

Quickly simulate and evaluate the performance of different component design and specifications at the network level using *LambdaSIM*. This tool is based on the wavelength-domain simulation (WDS) approach developed at Telcordia Technologies for large scale optical network modeling. *LambdaSIM* uses a signal representation that is complementary to the conventional time/frequency domain representation used in *LinkSIM* and similar products. It models optical power, noise and crosstalk in the wavelength domain. *LambdaSIM* easily handles both static networks and networks with dynamic changes that are often responsible for transient network impairments. The dynamic simulation capability of the tool allows you to evaluate how the network responds

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(Peter Arnold continued)

legacy infrastructure. It's possible that their lack of embedded infrastructure could lead them to a more rapid evolutionary rollout to 3G than would be economical for an established player.

RR: What role do equipment manufactures play in this planning environment?

Arnold: Manufacturers must characterize their products realistically and in enough detail to permit accurate assessments of competing technology and architecture solutions. The increasing flexibility and adaptability of manufacturers' product lines to support wide-ranging future services and service quality needs will, in turn, place increasing demands on the fidelity of network planning tools.

RR: You've used RSoft Design Group's *WirelessSWAT*™ to study 3G evolution. Have you found some case studies that might give readers reason to pause?

Arnold: We've seen studies demonstrating that uncertainties in future market demand may greatly increase the riskiness of early adoption of new technology. We've also seen examples of new technologies that lose much of their cost-effectiveness in a mixed voice/high-rate data services environment.

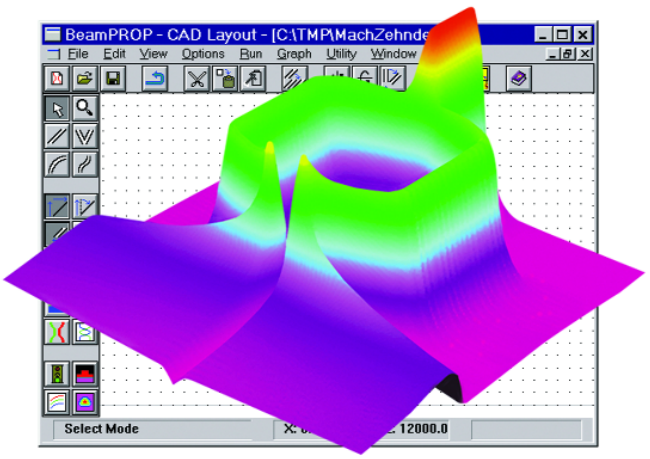
RR: Any parting thoughts?

Arnold: Planning for the evolution of PCS and cellular access networks is a complex process. The most strategically important planning decisions must often be made early in the deployment process, and involve consideration of market, service and technology options.

RR: Thanks Pete. We'll see you in Orlando at CTIA Wireless 2002, Booth #5591. –

UNIFIED FRAMEWORKS FOR PHOTONICS SIMULATION

Physical modeling of photonics devices, components, systems, and networks encompasses a range of simulation methodologies, each with differing assumptions for approximating the underlying problem. For example, beam propagation methods (BPMs) for modeling planar lightwave circuits (PLCs) typically treat spatial characteristics in a detailed 3D manner, but make other approximations for efficient calculation. Similarly, analysis of optical communication links, while treating the time-behavior of the signal carefully, usually ignores or compresses the spatial information.



Efficient simulation tools must be based on the methodology best suited to the type of problem. However, one can still develop software frameworks that allow problems to be defined in a consistent manner. This simplifies the end user's life because it allows the user interface to be largely independent of the underlying simulation methodology.

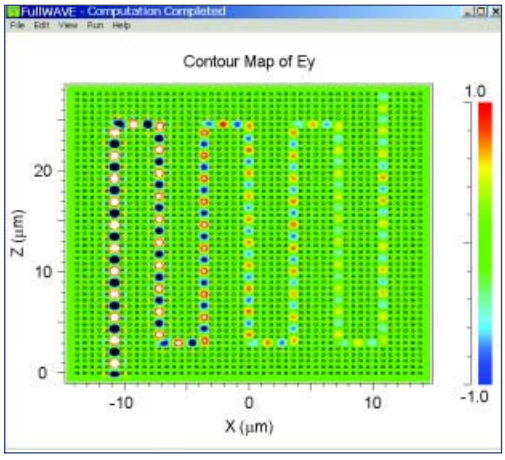
For example, all of RSoft's products for passive photonic device and component design are based on a single framework: the *BeamPROP*™ CAD Framework for Photonics. This system allows the 3D geometry and materials information representing a photonic component (e.g. a fiber device or PLC) to be described within one flexible and easy-to-use tool. From this tool, the appropriate simulation methodology can then be selected and employed to readily analyze a wide variety of problems. For example, propagation in PLCs or mode-solving can be done by the *BeamPROP* BPM engine, full electromagnetic analysis of nanoscale structures can be performed in the *FullWAVE* FDTD simulator, band structures of photonic crystal components can be calculated by *BandSOLVE*, and filter spectrums for fiber-Bragg-gratings can be determined or synthesized in *GratingMOD*. Where appropriate, information may be passed between different simulations as needed. For tools that are admittedly complex, such a unified approach drastically simplifies the learning process and increases the productivity of the user.

Similar unification of methodologies can be employed at the system/network level. This will be the subject of an upcoming article. –

Clustering multiple PCs to speed large FDTD simulations

RSoft's *FullWAVE*™ component design tool employs the Finite Difference Time Domain (FDTD) method of simulation, a full-vectorial, rigorous solution of Maxwell's equations. Version 2.0, released just last year, introduced the ability to perform simulations distributed over a network of computers, providing improved simulation speed and increasing the maximum addressable problem size.

BeamPROP™, RSoft's Beam Propagation Method (BPM) tool, is the tool of choice for many waveguide problems since it provides both speed and accuracy with comparatively minimal demands on computational hardware. On the other hand, an FDTD-based package such as *FullWAVE* must be used for nanostructures — for example, photonic crystals and ring resonators cannot be modeled with BPM. Generally, nanostructure-based devices are much more compact than waveguide-based devices of similar function, so they have great potential in allowing denser integration of components, resulting in the reduced costs necessary to drive our industry forward. *FullWAVE* can also be used in conjunction with *BeamPROP* to validate BPM results and to conduct hybrid simulations using both BPM and FDTD.



While FDTD is a powerful technique, it generally requires considerably greater computational resources (memory and simulation time). On a typical PC, 2D, FDTD calculations are usually feasible for nanostructures and small waveguide devices, but for 3D calculations the size of the problem is limited. For example, consider a 3D, FDTD simulation of a typical ring resonator 15 µm x 15 µm x 10 µm in size with a sub-micron bus-ring gap. Assume a free-space wavelength of 1.55µm and a material index of 3.4. For an accurate simulation, the grid spacing must be much smaller than both the physical wavelength and the smallest geometrical feature. In addition, the 3D,

FDTD simulation produces a rigorous solution of all six field components at each time step for every grid point in space. The required memory for such a simulation is several GB, more than that available in a single PC, and the simulation time is impractically long.

One solution to this dilemma is to perform an approximate 2D simulation, but depending upon the structure geometry, important 3D effects may be missed. Cluster computing offers a more elegant solution by combining the computational resources of several PCs, resulting in more memory available for the simulation and a dramatic decrease in simulation time.

The new clustering feature in *FullWAVE*, which is available in both the Windows and Linux environments, has been tested on as many as six PCs. It results in an almost linear relationship between the number of participating computers and the increased speed and maximum problem size. This feature will continue to grow in importance as both the power of the PC and the demand for accurate FDTD simulations of large-scale devices evolves.

LambdaSIM continued

to changes, such as channel add/drop, channel reconfiguration, fiber cuts, changing power levels, and protection switching in transparent optical networks. *LambdaSIM* can rapidly simulate networks with thousands of components. The tool has undergone substantial validation as part of its use in the designing and understanding of the Multiwavelength Optical Network (MONET) project in Washington DC. *LambdaSIM* is built on a new Ptolemy-based dataflow simulation framework.

IN THE MEDIA

Two articles by RSOFT employees were featured in the media recently. Reprints of these articles are available at our booth or on the Web : www.rsoftdesign.com.

Design, optimization of planar lightwave circuits using CAD tools

By Matthew Frank, Daniel Herrmann, and Zhengyu Huang

***Lightwave,* March 2002 p. 108-115.**

Dispersion-management modeling resolves system-design issues

By Jigesh K. Patel

***WDM Solutions*, March 2002 p. 43-48**

IN BRIEF

Visit us at OFC 2002 Booth #2701

Workshop/Showcases

- ***Simulation tools for System, Device and Network Modeling Workshop (W206)***
  (March 18 at 4:30 pm, Hilton Pacific C)
- ***Simulation/Design of Optical Links***
  (March 19 at 2:00 pm, Room 204A)
- ***Simulation/Design of Waveguide Components Such as PBGs***
  (March 19 at 3:00 pm, Room 204A)
- ***Modeling the Metro Network***
  (March 20 at 8:30 am, Room 204A)

CTIA Wireless 2002 Booth #5591 Hall D-2

COMPONENT DESIGN TRAINING Throughout the Year

May 15, 16, 17th, 2002, Ossining, NY
BeamPROP/FullWAVE

August 14, 15, 16th, 2002, Ossining, NY
BeamPROP/FullWAVE

October 23, 24, 25th, 2002, Ossining, NY
BeamPROP/FullWAVE

November 2002 (Date TBD), San Jose, CA
BeamPROP/FullWAVE

Gail Lalk continued

positioning. As companies seek software solutions, they are smart to look for software vendors that can offer in-depth understanding of their specific design issues as well as the breadth-of-knowledge that allows them to frame their design solutions in the context of the entire network hierarchy. RSoft Design Group offers a family of design tools that provides precisely this combination, with unparalleled depth-of-knowledge in device physics and network optimization and breadth that spans from device design to business tradeoffs of technology investments. I invite you to read more about our products and call us with your most challenging design issues.

Ask about our international training seminars!

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