RSoft Design Group produces design software for the telecommunication industry, specifically for optical system simulation and network planning. These advanced tools enhance and accelerate user modeling capabilities and provide real field design scenarios using extensive industry specifications. Our users include optical component and equipment manufacturers, system integrators, service providers, as well as government labs and academic institutions.

Whether you are interested in maximizing performance, minimizing costs, reducing time-to-market, fast-prototyping, or analyzing multiple what-if scenarios for optical communication networks, these tools will become an inseparable partner and the secret of your success.

RSoft Design Group currently markets four software packages for the simulation, analysis, and planning of telecom systems and networks:

**OptSim** — Simulates a broad range of optical communication systems

**ModeSYS** — Simulates multimode optical communication systems

**MetroWAND** — Models network design, network engineering and network-planning

**Artifex** — Simulates discrete event networks through the Petri Nets formalism

**Key Features of OptSim**

*OptSim* provides the unique capability of simulating optical systems in both the time and frequency domains. Infinitely long bit sequences as well as Coarse WDM systems can be simulated with the highest efficiency. More than 600 models are readily available to setup a wide range of optical communication systems, including nonlinear fiber, VCSEL laser, SOA, EDFA, EYDFA and Raman amplifier models. New models can be created incorporating, among others, MATLAB®, C/C++, FORTRAN and Java code, allowing legacy code to be reused with minimal effort. An impressive set of validations and an extensive customer base demonstrate the accuracy of *OptSim* results. *OptSim* can also be integrated with the RSoft Component Design Suites for a total application solution.

**Key Features of ModeSYS**

*ModeSYS* fully simulates multimode optical systems by taking into account the transverse mode profile propagating through the system. This unique capability ensures a correct signal shape and eye diagram and allows accurate performance estimates to be obtained. The inclusion of spatial effects into multimode models within a system-level simulation framework combines the accuracy of a device-level simulation and the efficiency of a system-level simulation. *ModeSYS* provides, among others, the following key analyses: system bandwidth, launch condition including offsets, arbitrary fiber index profile, coupling, chromatic and modal dispersion, differential mode delay, and encircled flux.

**Key Features of MetroWAND**

*MetroWAND* uses high-level models to determine where ring and mesh topologies are most economic, given the network connectivity, traffic demands, and optical equipment constraints. *MetroWAND* ’s automated design approach is useful during both the planning and maintenance aspects of network design. Before a network is physically realized, an optical equipment manufacturer can use *MetroWAND* to reduce the time needed to create
many ‘what-if’ scenarios as a part of a proposed network design solution for RFP and RFQ responses. Vendor’s equipment libraries and design rules can be built into the tool so that the creation and demonstration of viable design scenarios is possible even by a non-specialist. Once a network is in place, MetroWAND can be used by service providers to accomplish their day-to-day network planning activities including network growth studies and network optimization.

**Key Features of Artifex**

Artifex provides an innovative modeling and simulation environment for design and optimization issues like protocol dynamics, control mechanisms, switching or recovery mechanisms, optical layer interactions, and logical behavior of network elements such as routers, switches, WDM, optical cross-connects. Artifex is used to design discrete-event systems, with a visual representation of the dynamics. Accurate and self-documented reference models of system dynamics, structure, and data give early feedback to the system engineers, developers, and end users reducing the time to develop the system as well as demonstrate prototypes quickly.

**Computer Platforms and System Requirements**

Currently the above System and Network tools are available on both Windows and Linux platforms. Minimum system requirements for running the software vary depending on the application, but typical applications can run on a typical desktop computer. For further information on both software and hardware requirements, please contact RSoft Design Group.

For more information beyond this overview, please refer to the individual product sections. Please note that all products are licensed and sold as separate packages.
ModeSYS™ Multimode Simulation Platform

**ModeSYS™** was developed to support the design, analysis, and simulation of multimode optical communication systems. With a primary focus on data communication applications, **ModeSYS** allows users to evaluate both temporal and spatial attributes of optical signal propagation. The software enables the accurate analysis of an electromagnetic field starting from its generation at a laser, coupling into and between optical components such as multimode fibers, and ending with its detection at a photoreceiver. **ModeSYS** is a unique tool offering advanced capabilities that are unavailable anywhere else.

**ModeSYS** is a standalone tool that can be fully integrated with **OptSim™**, sharing a GUI and simulation engine as a fully integrated part of the RSoft Optical Communication Design Suite. By combining **ModeSYS** with **OptSim**, optical communication systems that include both single-mode as well as multimode components can be efficiently simulated and designed.

### Applications

**ModeSYS** is a powerful tool for the system-level analysis of standardized multimode optical communications technologies such as 1 Gb and 10 Gb Ethernet and Fibre Channel, as well as the study of proprietary optical data communication platforms. It has a number of valuable applications for specification, design, and simulation of optical components and systems for multimode optical communications. The impact of multimode component properties and their variations on system performance can be efficiently simulated and analyzed, enabling the development of specifications and standards, optimization of designs, and more.

**ModeSYS** addresses modeling requirements for simulation of multimode systems and components, including:

- ▼ Semiconductor lasers
- ▼ Laser/fiber coupling and offsets
- ▼ Multiplexing
- ▼ Multimode fiber with a variety of index profiles, including standard step-index and graded-index as well as user-defined arbitrary profiles
- ▼ Fiber/fiber and fiber/receiver coupling and offsets
- ▼ Transceiver/fiber pair encircled flux (EF)
- ▼ Fiber differential mode delay (DMD)
- ▼ Modal and chromatic dispersion (MD, CD)
- ▼ Intersymbol interference (ISI)
- ▼ Effective modal bandwidth
- ▼ Signal analysis
- ▼ Signal spectra
- ▼ BER estimation

### Simulation Techniques

In multimode communication systems, modal dispersion is a key limiting factor for system throughput. Different propagating modes in the fiber have different group velocities, leading to modal dispersion, pulse spreading, and intersymbol interference at the receiver. The excitation of the modes of the fiber has a strong effect on the system performance, and is strongly dependent on the
launch conditions of the laser output into the fiber. ModeSYS can be used to simulate these launch conditions in 3 dimensions, taking into account the translational offsets \((\Delta x, \Delta y, \Delta z)\) between the laser and fiber as well as their rotational offsets \((\phi_x, \phi_y, \phi_z)\). Simulations can then be performed to determine the system impact of the launch conditions, to determine if a transceiver/fiber pair meet the encircled flux requirements of a telecommunications standard, and to analyze the differential mode delay (DMD) of a fiber with a given index profile and the effective modal bandwidth (EMB) of the fiber.

ModeSYS component models not only address their temporal characteristics, but also their spatial characteristics. The software effectively integrates system-level and device-level modeling approaches to combine the speed of system-level simulations with the accuracy of device-level simulations. Because ModeSYS performs device-level modeling within a system simulation infrastructure, the extremely detailed spatial field calculations are implemented in a manner that allows a very straightforward system-level analysis.

The signal representations in the simulations include both temporal waveforms and spatial modes. Each spatial mode launched into a multimode fiber has its own temporal waveform associated with it, facilitating accurate simulation of both the temporal and spatial propagation of the optical signals through the system. This approach supports the simulation and analysis of not only single-channel multimode systems, but also multi-channel systems utilizing multiplexing techniques such as coarse wavelength division multiplexing (CWDM), for example. ModeSYS also includes an internal mode solver to enable the simulation of arbitrary index profiles in multimode fibers. This capability can be utilized to simulate the system performance impact of index profile perturbations and imperfections in multimode fiber. One such application of this scenario is in the development of specifications and standards for high speed optical communications over multimode fiber such as 10 Gigabit Ethernet over FDDI-grade fiber.

ModeSYS also provides interfaces to device-level tools such as BeamPROP for more detailed device-level modeling of multimode components in conjunction with the system simulations. For custom model development, ModeSYS also provides interfaces to third party tools such as MATLAB® and an application programming interface (API) for custom user model development in languages such as C/C++.

**Analysis**

Simulation results include plots of signals, spectra, and various analysis results. Some of these are listed below:

- Transverse optical field plots
- Signal plots
- Eye diagram plots
- BER curves
- Signal spectra plots
- Fiber bandwidth
- Differential mode delay (DMD)
- Encircled flux (EF)
- Radial power distribution
- Deterministic and statistical component parameter sweeping

![Example Encircled Flux (EF) plot along with the design specification EF mask.](image)

Power-delay characteristics and associated eye diagrams after 300m for two different launch conditions into 50\(\mu\)m diameter multimode fiber: 25\(\mu\)m offset launch (left) and 20\(\mu\)m offset launch (right).