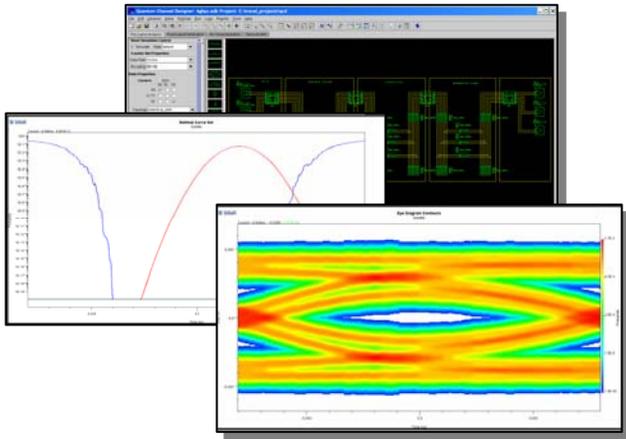


# Quantum Channel Designer™

High-Performance Serial Link Design & Analysis



## Overview

Quantum Channel Designer analyzes electrical performance of high-speed serial links to predict link Bit Error Rate (BER). The effects of channel impairments, crosstalk, TX/RX equalization, clock recovery and multiple jitter sources are included in both pre- and post-layout analysis, allowing complex designs to be validated before fabrication.

## Design Capture and Characterization

Quantum Channel Designer's graphical design editor is used to capture complex coupled channel designs including models for SerDes TX/RX IP and coupled transmission lines/vias/connectors. S-parameter blocks represent circuit sections solved with third-party field solvers or extracted from hardware measurements.

Accurate modeling is key to any form of simulation. SiSoft has developed proprietary techniques to accurately model behavior of coupled transmission lines and vias operating above 5Gbps, allowing them to be specified as parameterized elements. Quantum Channel Designer supports the IBIS Algorithmic Modeling Interface (IBIS-AMI) standard for SerDes TX/RX behavior, which provides both model interoperability and superior simulation performance while protecting the SerDes vendor's IP.

Designers can specify design parameters to be swept during analysis. This includes varying a simple parameter like the length of a transmission line segment, using alternate S-parameter models for a circuit element and sweeping a range of TX/RX equalization settings.

## Network Characterization

Channel analysis with Quantum Channel Designer occurs in stages, each of which provides feedback used to optimize the design. The first stage of channel analysis combines analog electrical models of the transmitter and receiver with the channel model to determine the channel's impulse response. Network characterization can use Quantum Channel Designer's internal circuit engine, use HSPICE to run time-domain simulation, use results from other analysis tools or incorporate measured data.

Characterization results are presented in both the time and frequency domains. Results can be plotted graphically or output in S-parameter format. Designers can compare channel characteristics against budgets for loss, crosstalk and ripple to optimize the channel's physical design before proceeding.

## Rapid Design Space Exploration

Statistical analysis combines the results of channel characterization with TX/RX equalization to predict the link's response. Quantum Channel Designer includes built-in models for different TX/RX equalization schemes and supports the IBIS-AMI standard for modeling a specific provider's IP.

Quantum Channel Designer's statistical engine directly computes eye diagram probabilities, running the equivalent of billions of bits' worth of simulation within seconds. Statistical eye diagrams are color coded to show probabilities, and can be displayed alongside traditional eye-contour plots and bathtub curves.

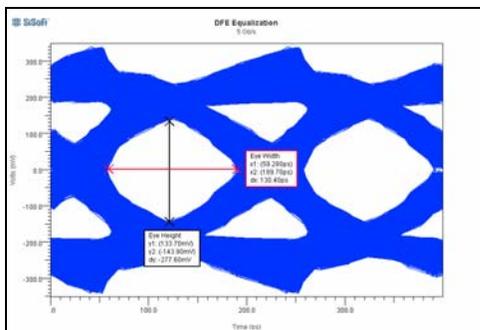
Statistical analysis allows large design spaces to be explored quickly. Designers can explore hundreds of combinations of channel parameters and TX/RX settings within minutes, quickly identifying potential solutions for more in-depth analysis. Peak Distortion Analysis (PDA) identifies worst-case pattern sequences to be explored with time-domain analysis.

Quantum Channel Designer's statistical engine computes probabilities for both equalized data and the recovered clock signal. These probabilities are combined using advanced techniques to predict the link's Bit Error Rate (BER).

# Quantum Channel Designer (continued)

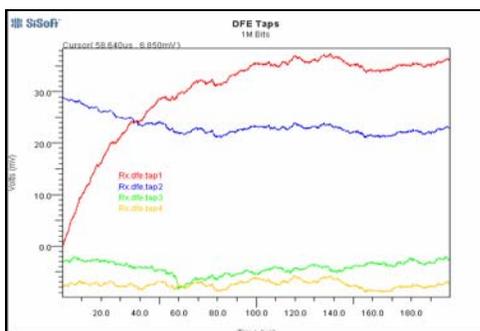
## In-Depth Analysis

Quantum Channel Designer's time domain engine provides the next level of design analysis, simulating the channel's response to specific data patterns. Time-domain analysis lets designers explore detailed issues including nonlinear equalization, time-varying behavior and the channel's response to specific combinations of encoding schemes and data patterns. Quantum Channel Designer's high-performance engine simulates at rates up to one million bits per minute, making 100 million bit simulations practical and providing enough data points to accurately predict link BER.



Decision Feedback Equalization (DFE) Results

Quantum Channel Designer includes built-in models for different equalization and clock recovery schemes. IBIS-AMI models are used to represent a specific provider's IP. Designers can control TX/RX equalization and clock recovery settings or allow models to self-optimize during simulation. Simulation results can plot internal TX/RX device settings as a function of time, showing equalizer settling time and how specific pattern sequences affect equalization and clock recovery loops.



Equalizer Tap Settings vs. Time (1M bits)

Time-domain simulation results are post-processed to produce bathtub curves, eye contour plots, statistical eye diagrams, clock probability distributions and link BER predictions.

## Modeling Noise Sources

Accurate prediction of link BER requires considering the effects of multiple noise sources including crosstalk, jitter on TX/RX reference clocks and effects of TX/RX power supply noise. Quantum Channel Designer allows these effects to be captured and incorporated into the calculation of the link's BER.

## Post-Route Design Validation

Serial links can no longer be physically isolated from other signals; crowding against other signals picks up crosstalk with varying spectral content. Quantum Channel Designer performs post-route design analysis to assess the effects of actual design routing and crosstalk. Aggressors with arbitrary encoding schemes, timing alignment, edge rates and data rates are analyzed to predict their effect on link BER.

## Standards-based SerDes Device Modeling

Model interoperability is a critical issue in current serial link design. Without SerDes IP modeling standards, IP and EDA vendors cannot provide tools to analyze a system with components from different vendors. IBIS-AMI models solve this problem, supporting both statistical and high-performance time domain analysis. SiSoft was a driving force behind the IBIS-AMI standard and was the first to offer tools based on these models.

## Backed by SiSoft's Experience in High-Speed Systems Design

SiSoft's consulting services group uses our software on some of the industry's most challenging designs every day. We have experience designing serial links at speeds up to 20 Gbps and can help ensure your design's success.

## Contact SiSoft

To learn more about SiSoft's products, contact [sales@sisoft.com](mailto:sales@sisoft.com) or visit our website at [www.sisoft.com](http://www.sisoft.com).