

# Mentor Consulting Improves System Reliability and Time-to-Market for Ericsson's Digital High-Speed System

*Mentor Consulting's high-speed system design expertise improves system reliability and reduces time-to-market for Ericsson's cellular radio exchange. By applying signal integrity analysis during the design phase, Mentor Consulting helps Ericsson achieve First-Pass Success™.*

A world-leading supplier of equipment for telecommunications systems and related terminals, Ericsson produces advanced systems and products for wired and mobile telecommunications in both public and private networks. Headquartered in Sweden, Ericsson offers a broader range of products than any other supplier of telecommunications equipment. Development within telecommunications is so rapid that Ericsson's product portfolio is completely renewed every two years. To keep pace, Ericsson rarely designs a new product completely from scratch. Instead, it maximizes the reuse of existing Intellectual Property (IP), integrating it into new product designs.

## High-Speed Analysis of the Entire System

The Ericsson design team applied the strategy of reusing IP in the redesign of a cellular radio exchange (CRE). The CRE, a purely digital system, accommodates three backplane assemblies, each consisting of one backplane and up to eight plug-in daughterboards. Ericsson wanted to redesign all but two of its daugh-

terboards and in the process migrate from TTL logic to CMOS logic, thus introducing faster switching times into the product. However, they also intended to reuse two TTL daughterboards as well as the CRE cabinet and the majority of its electrical connections, including the backplane. Although the backplane's clock speed was only 4 MHz, the high-speed logic on the new daughterboards switched with 3 ns edges, effectively causing the backplane to become a high-speed signal path between the daughterboards and connected assemblies. As such, it was subject to all the signal integrity pitfalls associated with high frequency, including ringing, crosstalk, and transmission line effects.

Since Ericsson's design engineers were already busy with other aspects of the project, they didn't have the time nor the personnel to resolve all of the high-speed design issues. Therefore, they decided to look for a vendor with the required high-speed tools and expertise, as well as the ability to transfer high-speed knowledge to their organization. Ericsson found

that Mentor Consulting could provide the tools, expertise, and personnel to successfully complete the project. The Mentor Graphics Interconnectix (ICX) products embodied a proven methodology for ensuring First-Pass Success on high-speed system designs. Mentor Consulting had both the experts to implement this methodology within Ericsson's design flow and the innovative consulting model — Knowledge-Sourcing<sup>SM</sup> — to transfer this knowledge to Ericsson.

## A Correct-by-Design High-Speed System

Ericsson engaged Mentor Consulting to do the physical design of the backplane and perform signal integrity analysis on the entire CRE system while migrating the design team to a leading-edge, high-speed



design and verification methodology. Mentor Consulting supplied the IBIS models for all components within the system, even those which were not redesigned, in order to perform signal integrity analysis on the entire system. By using the ICX products, Mentor Consulting was able to identify several significant signal integrity problems that would have caused system malfunctions.

Consequently, the joint team proposed several design changes to overcome these problems. Mentor Consulting analyzed and verified the optimal implementation of these design recommendations.

First, Mentor Consulting confirmed that the original signal return distribution was inadequate for the faster edge rates of the new logic drivers, causing severe crosstalk and compromising signal timing requirements. Mentor Consulting verified that a new cable connector configuration would improve the signal return.

Second, Mentor Consulting's analysis revealed that the series capacitor used in the backplane's termination scheme was no longer necessary with the new logic drivers in place. Therefore, the capacitors were removed, cutting costs and saving board space.

Removing the capacitors made the third design change possible. The analysis also uncovered a problem in the termination resistor configuration, which resulted in a high level of mutual inductance and compromised

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Larry Eckstein  
Ericsson

signal integrity. By replacing the original single in-line packs with series-type resistor packages, Mentor Consulting was able to reduce the mutual inductance and improve signal quality. In addition, Mentor Consulting optimized the values of the termination resistors to take into account the full spectrum of considerations, including maximum current, board and driver impedance, noise, and line delay.

#### A Significant ROI

“Mentor Consulting met and exceeded our expectations,” Larry

Eckstein, Project Engineering Manager at Ericsson, reports. “Mentor Consulting completed the signal integrity analysis for the entire system and the resultant backplane redesign on schedule. The backplanes are working so well that they are in great demand.”

By identifying signal integrity problems up-front in the design process, Mentor Consulting's high-speed system design methodology prevented costly delays. Ericsson didn't have to wait until the system was manufactured and tested to find out if it worked. Ericsson was able to cut material and production costs, reduce design iterations to a single pass, and get their product to market on time.

Finally, the Ericsson design team was exposed to a powerful new methodology for high-speed design that emphasizes prevention, not detection. “Mentor Consulting did a great job teaching us the high-speed design techniques and tools,” Eckstein says. “They were very willing to pass on whatever knowledge they gained or applied during this project. We were very impressed by the Mentor Graphics ICX products and by Mentor Consulting's high-speed design methodology,” Eckstein continues, “we would certainly consider using them again in a similar situation.”

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