Bell Labs and FCI Demonstrate 25gb/S Data Transmission Over Electrical Backplane Connectors

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Doubles previous transmission rates and could lead to achieving 100 Gb/s Ethernet over electrical backplanes

Lucent Technologies' Bell Labs and FCI today announced the successful demonstration of 25 Gb/s data transmission over an electrical backplane using a Bell Labs-developed new signaling architecture and FCI's AirMax VS optical connector system. This is more than twice the highest transmission rates that have been demonstrated to date over electrical backplanes and is a significant step towards achieving 100 Gb/s Ethernet (4 x 25 Gb/s) over electrical backplanes.

"100Gb/ Ethernet over electrical backplanes is important because it will allow us to further scale today's data networks to support future high bandwidth applications such as movies on demand, telemedicine and military communications," said Martin Zirngibl, director, Photonic Networks Research, Bell Labs.

"We are extremely pleased that our AirMax VS backplane turned out to be an enabler of this ultra-high speed technology," said John Burkett, FCI Product Manager. "While the flexibility and cost of AirMax VS has made it a winner at 2, 3 and 6 Gb/s, it is the connector's superior electrical performance that makes it the most attractive choice - and sometimes the only choice - at 10Gb/s and above."

The new application of duobinary signaling — a technique that uses three electrical signal levels to represent binary code in a communications transmission — to high-speed electrical backplanes - a circuit board that acts as a backbone to connect different elements in the electronic card cages used in network switches and computing platforms — was first documented by researchers Jeffrey Sinsky, Andrew Adamiecki and Marcus Duelk, of Bell Labs Photonic Networks Research group at the IEEE International Microwave Symposium in June 2004, and later in a paper published in the January 2005 issue of IEEE Transactions on Microwave Theory and Techniques.

"The group has demonstrated performance at 10 Gb/s over several different legacy backplanes, and is supporting a movement to use this technique as part of the IEEE 802.3ap standard for 10G PHY (physical layer) Ethernet over backplane," said Mary Mandich, a technical manager in Lucent's Network Hardware Integration Research Department.

"We are always looking one step beyond," said Jeffrey Sinsky, lead researcher on the duobinary effort at Bell Labs. "In order to demonstrate 25Gb/s, we needed a connector with carefully controlled impedance characteristics, which prevents signals from bouncing back and forth, plus low crosstalk. We also need a signaling technique that can compress bandwidth without requiring excessively complex hardware. Our duobinary signaling technique combined with FCI's AirMax VSR connector proved to be a successful recipe for achieving 25Gb/s transmission speeds."

FCI's AirMax VS® connector achieves extremely low loss at frequencies up to 15GHz by using air as a dielectric, an insulator that resists electrical current. "The connector's novel design does not require metal shields, yet exhibits lower crosstalk than existing shielded high-speed connectors," said Dana Bergey, manager of FCI's Signal Integrity

Group. "Lucent was able to achieve this result due to the superior performance of the FCI AirMax VS connector in combination with Lucent's ultra-high speed duobinary system architecture."

Lucent's duobinary signaling architecture for electrical backplane systems takes advantage of the "natural rolloff" tendency of a backplane instead of fighting it like traditional approaches, and uses it to help shape the data bits and provide a clean signal at the receiver. "With a small amount of additional pre-emphasis and equalization to correct the frequency response — technologies that already are commonly used with today's communications transmitter and receivers - the output signal at the backplane requires only half the required bandwidth of traditional systems. And, we can convert the signal from duobinary format back to a traditional format using high-speed integrated circuit (IC) technology," said Andrew Adamiecki, a researcher with Bell Labs.

The team achieved error-free performance at 25Gb/s over electrical traces as long as 24 inches using a backplane made with FR4 laminate — an industry standard material.

About the AirMax VS Connector System

The AirMax VS connector system offers high speed computing and network system designers more versatility in structuring their backplane signal routing due to its use of air as the dielectric between adjacent conductors. This one-of-a-kind solution facilitates high signal density while exhibiting the industry's lowest insertion loss and lowest crosstalk, all without the use of costly and space-consuming metal shields. AirMax VS's Insert Molded Leadframe Assembly (IMLA) enables the same connector to be used for Differential Pair signals, Single Ended signals or power. It is the only high speed backplane connector that allows for any allocating of signals within one connector, so customers' systems can grow from 2.5 Gb/s to 25 Gb/s without necessitating redesign of the

basic platform.