

# LogiCORE PCI Module Is a Key Element in Voice over IP Applications

Silicon & Software Systems provides an elegant solution to Nortel Networks, using a Xilinx LogiCORE PCI module implemented in a Spartan-XL FPGA.

by Dara Hurley

Director, Hardware Systems Division  
Silicon & Software Systems  
dara.hurley@s3group.com

Voice over Internet Protocol (VoIP) offers companies and consumers enormous potential cost savings compared to traditional switched telephone networks. This emerging technology is enabling low-cost international telephony and remote teleworking (also known as telecommuting).

Nortel Networks, a pioneer in VoIP, has employed a LogiCORE™ PCI module in a Xilinx Spartan™-XL FPGA to improve service. The system architecture is shown in Figure 1. The system is based on the popular PC architecture. The network adapter receives data (containing compressed speech) from the Internet and passes the data to the DSP compression/decompression engine via the PCI bus. The digital speech is then routed back through a time-switched FPGA to the telecommunications network.

In the other direction, digital speech is routed from the telecommunications network via two Xilinx FPGAs to the DSP engine. An x86 CPU controls the system. The DSP engine uses a system memory, which is connected to the CPU local bus. The CPU provides IP packet processing, and data is transferred from the system memory to the network adapter using DMA on the PCI bus.

“Critical to the system performance is the PCI implementation,” said Eugene Garvin development manager of Nortel Networks “the DSP bus operates at a much slower speed than the PCI bus, so the realization of the bus must be optimized.”

Initially, Nortel used a simple approach: Data transfer was routed through the CPU and

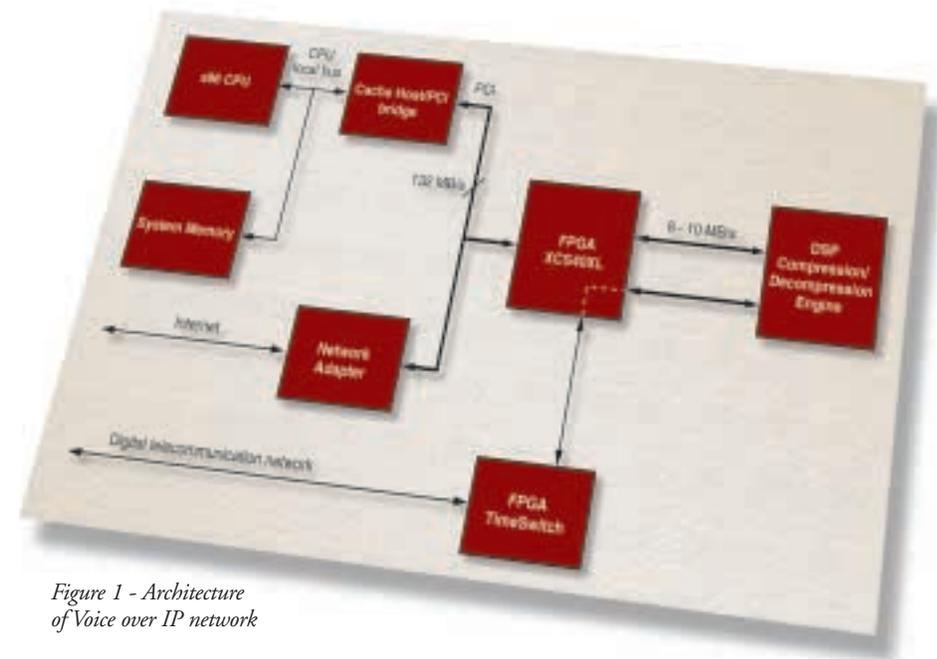


Figure 1 - Architecture of Voice over IP network

wait states were inserted in the PCI transactions to compensate for the different data rates. This approach, however, consumed too much of the PCI throughput, Garvin stated.

This is where Silicon & Software Systems (S3) stepped in and provided a more elegant solution. Silicon & Software Systems designed a DMA controller and FIFO data buffer, and integrated these along with a Xilinx LogiCORE PCI module into a Spartan-XL FPGA device (XCS40XL). The device also contained an interface between the time-division multiplexed (TDM) speech data from the telecommunications network and the data presented to the DSP compression/decompression engine. The designers used Spartan SelectRAM™ memory to create the dual-ported RAM-based FIFO buffer.

“Use of DMA and data buffering over the PCI bus has freed up the processor to do other necessary tasks,” Garvin reported. “It

also makes better use of the available PCI throughput, because it uses zero-wait-state burst transfers instead of one-word-delayed transactions.”

## About Silicon & Software Systems

Based in Dublin, Ireland, Silicon & Software Systems (S3) is a world-class electronic design service company. Since its inception 1986, Silicon & Software Systems has experienced rapid growth, penetrating markets throughout Europe, the US, the Middle East, and Eastern Europe. In the 1999 Data Quest survey, Silicon & Software Systems emerged as one of Europe's leading electronic design facilities. The company employs over 300 design engineers specializing in ICs, software, and hardware systems for the communication infrastructure, digital consumer, and wireless markets. To learn more about Silicon & Software Systems, go to: [www.s3group.com](http://www.s3group.com).