NARC: Network-Attached Reconfigurable Computing for High-performance, Network-based Applications

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ABSTRACT

Network-Attached Storage (NAS) is a widely deployed technology in a variety of settings such as data centers that provides a reasonably cost-effective, powerful, and scalable solution to data storage requirements. As opposed to server-based, direct-attached storage, the NAS concept features storage systems that are directly attached to the network and reduce various limitations that traditional high-end storage servers impose on cost and flexibility. Researchers at the University of Florida have adapted this concept to hardware-based reconfigurable computing (RC) systems to similarly achieve a cost-effective, flexible, powerful, and scalable means in which to quickly and easily integrate PLDs such as FPGAs into high-performance, network-based systems, from small-scale embedded systems to large-scale distributed systems. We have coined the term NARC, or network-attached reconfigurable computing, in describing this novel concept.

The team at the University of Florida has recently completed a year-long effort to design, build, and evaluate several working prototype boards for NARC. Each board connects on the front side to an Ethernet network and on the back side to one of several FPGA development boards from Xilinx. The NARC board currently features a Fast Ethernet controller and transceiver, a 32-bit ARM processor running Linux to handle the TCP/IP protocols, a dual-port memory subsystem, control mechanisms to enable configuration and use of the FPGA hardware remotely over the network, as well as a growing selection of test applications. The NARC's flexible architecture allows future versions to include any type of back-end FPGA board to be attached to ever faster Ethernet variants (e.g. Gigabit or 10 Gigabit Ethernet) or other network protocols, with future plans for integration of all components onto a single board or device. This presentation will describe the prototype design effort pointing out numerous lessons learned. We will also showcase some of the many application areas in which we believe the NARC concept can be effectively applied, such as in-situ network traffic analysis and deep packet processing for security, deployment into legacy and future military systems such as aircraft or smart munitions for advanced processing, as well as NARC's first conceived role as a cost-effective resource in RC-enabled distributed computing systems such as clusters. Finally, the presentation will include several case studies to highlight the efficacy and efficiency of the NARC in performing useful tasks as compared to traditional servers on the network.

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