Luo's Research Advances Processor Technology

Make Information—and More Information—Go Faster, Safely

"This is an interesting problem," says Yan Luo, "how to explain very technical concepts in common language."

Fortunately for his students, Luo, assistant professor in the Electrical and Computer Engineering Department, explains things very well. Luo teaches a required undergraduate course in microprocessors and a graduate course on advanced computer architecture.

Computer architecture is also the focus of Luo's research, particularly the processors that are specialized for network or packet processing. Packets are bunches of information and, as they travel through the Internet, they reach different processing locations.

"With all the new applications, such as Voice over Internet Protocol (VoIP), these new requirements make the processing more complicated," explains Luo. "We are working on speeding up the processing by using multiple programmable units on a single chip. Of course, that raises issues: how to partition the work, power consumption and heat." Most of all, the system must be "scalable," so that increasing numbers of packets can pass through nodes without losing speed.

Intel has made a $25,000 grant to Luo for a project using a network processor to build a scalable deep packet inspection system—that is, to closely and carefully inspect packets for viruses or malicious code as they are processed. Luo intends to show the work can be done on an intelligent processor.

Intel has made an equipment grant to Luo's second major research area: wireless mesh network routers. A little explanation is in order.

Walk around campus and you'll come across posters advertising wireless "hot spots"—areas in which you can operate a laptop to access the Internet without plugging in. These wireless domains work because each access point is connected to the Internet through wiring.

Wireless mesh network routers, on the other hand, are connected wirelessly to each other and only one is connected by wire to the Internet. The routers forward packets to other network routers wirelessly, offering tremendous flexibility in setup.

"Some products are based on this technology already," says Luo. "The most important unsolved issue is scalable bandwidth, so speed doesn't diminish with volume." One of Luo's graduate students is developing intelligent routing algorithms to build up the network cooperatively.

Interesting applications include disaster relief, in which the first responders can deploy wireless nodes, perhaps attached to cameras and environmental sensors, that provide information to the command center. Luo is working on sensor networks with the Center for Network Information and Security, directed by Computer Science Prof. Jie Wang.

Small sensor nodes, deployed in networks, can be used for environmental monitoring or to monitor the status of patients in hospitals or in their homes.

▲ Yan Luo with a network processor

"The sensors could capture bioinformation that is transmitted through a low-power, low-range wireless network," says Luo. "We're working to develop even smaller, programmable nodes to carry and direct more information."

Luo is also part of a team at the Center for Atmospheric Research that is working to adapt and upgrade existing radio frequency instruments, the Digisondes. Says Luo, "Our efforts are to make the data acquisition and processing in their radio plasma monitoring based solely on digital technology."