IEEE Works on Energy-Efficient Ethernet

The IEEE has begun developing a standard to make Ethernet connections more power efficient. This could save the many companies that use the technology—particularly large organizations with thousands of Ethernet ports—millions of dollars annually.

The IEEE has formed the Energy Efficient Ethernet Study Group (http://grouper.ieee.org/groups/802/3/eee_study) to evaluate methods to reduce energy use by quickly decreasing link speeds during periods of low utilization.

EEE could help reduce energy consumption in servers, PCs, and laptops, but the greatest benefit to LAN operators would be from use in switches, routers, and other network equipment, said study group member and University of South Florida associate professor Ken Christensen.

Implementing the technology in Ethernet network interface cards in the US alone could save companies between $300 million and $450 million per year, estimated Bruce Nordman, a member of the study group and a researcher with the Lawrence Berkeley National Laboratory.

In all direct US uses, EEE could save about $25 billion per year, added Christensen.

The US has about 40 percent of the world’s servers but a lower percentage of Ethernet ports, so global savings probably would be about $75 billion annually, he added.

This doesn’t include savings from reducing the cost of cooling Ethernet systems, an important consideration for data centers, he noted.

EEE will probably use Rapid PHY Selection, he explained, a concept that, if fully developed, would define the mechanism for switching Ethernet network devices’ data rates, depending on how heavily the link is being used. Once developed, RPS could request link rate changes and then synchronize speeds throughout a system via a quick media-access-control frame handshake.

EEE would also require a control policy to determine when the data rate should change. For example, Christensen explained, although reducing link rates might save energy, switching too frequently could create system overhead that would hurt performance. Thus, he said, a control policy might keep a link at a higher data rate for a number of seconds or minutes after utilization drops before decreasing it.

For the approach to work, both ends of an Ethernet link would have to support RPS, which functions symmetrically.

RPS could be used for all Ethernet data rates, with the greatest energy savings occurring in reducing 10 gigabit per second links to 1 Gbps and lowering 1 Gbps links to 100 or 10 Mbps, Christensen explained.

A Gigabit Ethernet-enabled laptop could switch to 10 Mbps when at rest, 100 Mbps during low-bandwidth activities such as Web surfing, and 1 Gbps when downloading large files or streaming video.

While EEE would be helpful, other issues are also important for reducing Ethernet-related energy consumption, said Marty Hagen, information systems manager for the Rocky Mountain Institute, a nonprofit organization that promotes the efficient use of energy and other resources.

“Often the power supply in an Ethernet switch is so wasteful that it dwarfs the power needed to run the Ethernet ports themselves,” he explained. “So while increasing the efficiency of Ethernet networking is desirable and should be pursued, it alone will do relatively little.”

The IEEE expects the EEE Study Group to become a task force by July. The standard could be ready at the end of 2009 or mid-2010, said Christensen.

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The IEEE’s proposed Energy Efficient Ethernet standard would cut energy use by quickly reducing Ethernet link speeds during periods of low utilization. In one proposal, EEE could request link rate changes and then synchronize speeds throughout an Ethernet system via a quick media-access-control frame handshake.
New Software Visually Displays Musical Structure

Dmitri Tymoczko, assistant professor of music at Princeton University, once used to take sculptures created from pieces of foam, scissors, and tape to his lectures to demonstrate the geometric structure of music. Now, he has written software that will more clearly show and explain these relationships in multiple dimensions.

According to Tymoczko, academics and others have had trouble representing music’s complex structural properties. He noted that not even musical notation adequately shows the two essential properties of Western musical composition: harmonic structure and counterpoint, in which two simultaneous melodic lines form a coherent series of harmonies.

The challenge is to accurately represent the changing relationships between chords, arrangements of scales, and notes during the course of a musical piece.

Tymoczko said he has created a geometrical model to make these relationships “pop out.” Projecting musical structures into a complicated, multidimensional geographic space makes important concepts easier to grasp, he explained.

For example, his model uses line segments to display voice leadings, which are mappings from the notes of one chord to those of another. This clearly shows a musical piece’s chord progressions.

The software represents musical relationships geometrically via quotient spaces theory, which describes concepts at different granularities and abstraction levels.

Tymoczko said he began by using his new approach to map a few simple musical ideas and then expanded to more complex concepts.

To meet the key challenge of translating between the languages of mathematics and music, he used vendor Cycling’74’s Max/MSP, a graphical programming environment for developing music, audio, and multimedia software.

Predicting the research’s long-term uses is difficult, according to Tymoczko. So far, he noted, he has used the software to teach musical concepts to people who aren’t musicians.

Teachers could also use software to help build physical models of musical geometry—which students could manipulate, thereby perhaps causing notes to be played—just by touching them, he said. Also, he added, following the way a musical piece’s geometry changes over time could provide important or interesting insights.
Hitachi Researchers Develop Powder-Sized RFID Chips

Hitachi’s Central Research Laboratory has developed radio-frequency identification chips the size of individual pieces of powder.

Hitachi spokesperson Gerard Corbett said the Mu RFID chips measure 0.05 millimeters × 0.05 mm × 5 micrometers and are thus the smallest and thinnest RFID chips to date.

By making the chip smaller, he explained, Hitachi is containing the cost and weight issues that could hinder widespread RFID-technology deployment.

“The first RFID chips were about 2 square inches and cost about $2,” said analyst Carl Howe of Blackfriars Communications, a market research firm. “Smaller chips are cheaper to make and cheaper to deploy.”

A typical piece of copy paper is about 0.1 mm thick, twice the depth of the new Mu chip, Howe noted. Therefore, he said, the chip could be embedded in paper and be used in applications such as passports.

Also, said Hitachi spokesperson Masayuki Takeuchi, the chips could be used to authenticate financial documents such as gift or stock certificates.

In addition, Howe noted, the devices could be popular with the military and other large organizations that must track many items or products.

Typical RFID systems consist of small radio chips in embeddable or attachable tags. The chips store small amounts of data about an item or person, such as a product price or employee code, price information, system-access privileges, and a brief description.

The systems also typically include readers that provide the chips with power, recognize their unique emitted signals, and either display information such as product prices or act on data by, for example, admitting a person to a building.

RFID thus is frequently used in place of product bar codes, as well as in settings such as employee identification badges for building access and car keys.

Hitachi used the silicon-on-insulator process—in which the substrate, normally made only of silicon, consists of a monocrystalline silicon layer, an insulation layer, and another silicon layer—to make the Mu chips so small. The substrate insulation enables circuit elements to be near one another without causing the electrical interference that normally occurs when the elements are too close.

The new Mu chip stores 128 bits of data and transmits it at about 20 milliseconds at the 2.45-GHz frequency. It thus stores and transmits the same amount of information as the previous 0.4-mm square Mu chip, which is about the size of the period at the end of this sentence.

However, unlike the bigger chip, the new device is too small for an onboard antenna, so it needs an external one that can be mounted on the item to which the chip is attached.

According to Corbett, “The new Mu chip will likely reach commercialization in 2009.”

News Briefs written by Linda Dailey Paulson, a freelance technology writer based in Ventura, California. Contact her at ldpaulson@yahoo.com.

Editor: Lee Garber, Computer, l.garber@computer.org

Hitachi has developed an RFID chip the size of a piece of powder. The Mu chip sits on a host item, such as a passport page or stock certificate, and stores data. An RFID reader powers up the chip, acquires its data, and sends the information to terminals or servers, which either display the material or use it to take some type of action.