# Researchers push transmission rate of copper cables

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You may not be able to get blood out of a turnip, but according to Penn State engineers, you can increase the data transmission of Category-7 copper cables used to connect computers to each other and the Internet.

"Working with NEXANS, the company that manufactures the cable, we have examined the possibility of sending digital data at a rate of 100 gigabits per second over 100 meters of Category-7 copper cable," says Mohsen Kavehrad, the W.L. Weiss Endowed Chair professor of electrical engineering. "These are the current, new generation of Ethernet cables."

These cables are used to connect computers within a room or a building or to create parallel computing systems.

While the long distance lines of most Internet systems are glass fiber optic cables, which are very fast, copper cable is generally used for short distances.

"In home networks, for example, it is expensive to use fiber optic cabling," says Ali Enteshari, graduate student in electrical engineering who presented the team's methods to the IEEE High Speed Study Group today (Nov. 14) in Atlanta.

All transmission cables are limited by the distance they can transmit data without degradation of the signal. Before errors and interference make the signals non-recoverable, cable systems use repeaters – which are

similar to computer modems – to capture, correct or recover data, and resend it. The distance between repeaters depends on the cable and the approach used by the modem to correct errors.

"What we are offering is a less expensive solution and one that is easier to build," says Jarir Fadlullah, graduate student in electrical engineering.

Using information on specifications and characteristics of the cables from NEXANS, the researchers modeled the cable with all its attributes including modeling crosstalk. They then designed a transmitter/receiver equipped with an interference canceller that could transfer up to 100 gigabits using error correcting and equalizing approaches. Ethernet cable like the Category 7 is made up of four pairs of twisted wires shielded to reduce crosstalk. Category 7 is heavier weight wire with better shielding than Category 5 cable. Kavehrad's group did similar analysis on the Category 5 cables in 2003.

"A rate of 100 gigabit over 70 meters is definitely possible, and we are working on extending that to 100 meters, or about 328 feet," says Enteshari. "However, the design of a 100 gigabit modem might not be physically realizable at this time as it is technology limited. We are providing a roadmap to design a high speed modem for 100 gigabits."

The researchers believe that two or three generations in the future, the technology of chip circuitry will allow these modem designs to be built. Currently, chip design is at about 65 nanometers, but they expect in the next two generations to get to what is required, says Kavehrad.

The amount of data encompassed by 100 gigabits is amazing. The entire Encyclopedia Britannica contains 1 gigabyte of information. A byte is equivalent to 8 bits, so 1 Gigabyte is equal to 8 gigabits. A rate of 100 gigabits per second over 100 meters is the transmission of 12.5 Encyclopedia Britannica sets per second.

Source: Penn State

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