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# 25 radical network research projects you should know about

T-ray-based computers, the truth about Googling and finding terrorists on the Internet
By Network World Staff and IDG News Service , Network World , 04/16/2008

While universities don't tend to shout as loudly about their latest   Sponsored by:
tech innovations as do Google, Cisco and other big vendors, their
results are no less impressive in what they could mean for faster,
more secure and more useful networking. Here's a roundup, in no
particular order, of some of the most amazing and colorful
projects in the works.

## 1. Exploiting  T-rays

Who needs electricity to run superfast computers when there's
terahertz radiation, or T-rays? University of Utah engineers have
reached deep into the electromagnetic spectrum to find this new
way to build circuits for computers that would run a thousand
times faster than today's gigahertz-speed computers. The
development involves creation of waveguides to send and
manipulate T-rays, also known as far-infrared light.

"We have taken a first step to making circuits that can harness or
guide terahertz radiation," says Ajay Nahata, study leader and associate professor of electrical and computer engineering, in a
statement. "Eventually – in a minimum of 10 years – this will allow the development of superfast circuits, computers and
communications."

## 2. Hybrids:  Computers,  not  cars

A multi-university research team funded by the Department of Defense is working to combine computer memory functions
typically performed by magnetic components and computer logic operations typically handled by semiconductor
components into a hybrid material. The benefit would be faster and more compact machines that chow down less power and
are less expensive to build.

"In this approach, the coupling between magnetic and non-magnetic components would occur via a magnetic field or flow
of electron spin, which is the fundamental property of an electron and is responsible for most magnetic phenomena," says
Giovanni Vignale , a University of Missouri physics professor in the College of Arts and Science, in a statement. "The
hybrid devices that we target would allow seamless integration of memory and logical function, high-speed optical
communication and switching, and new sensor capabilities."

The Department of Defense awarded a $6.5 million grant to the University of Iowa for the project. In addition to the Iowa and Missouri schools, also working on the project are researchers from New York University, University of California at Berkeley and the University of Pittsburgh.

### 3. Getting to bottom of Web searches

Web search might seem like a complex issue, but it really boils down to three basic kinds of searches: informational, navigational and transactional (related to buying something).

That's the word from researchers at Penn State University's College of Information Sciences and Technology and Australia's Queensland University of Technology who looked at more than 1.5 million queries from hundreds of thousands of search engines users.

The bulk of searches (80%) proved to be informational, with the other 20% split between navigational and transactional. The researchers used an algorithm that they say classified searches with a 74% accuracy rate.

"Other results have classified comparatively much smaller sets of queries, usually manually," said Jim Jansen, assistant professor in Penn State's College of Information Sciences and Technology, in a statement . "This research aimed to classify queries automatically.

The researchers' work is outlined in a paper titled "Determining the informational, navigational and transactional intent of Web queries" that will appear in the May issue of Information Processing & Management.

### 4. Mapping the whole Internet

Israeli researchers have created a topographical map of the Internet by enlisting more than 5,600 volunteers across 97 countries who agreed to download a program that tracks how Internet nodes interact with each other.

The result is "the most complete picture of the Internet available today," Bar Ilan University researcher Shai Carmi told the *MIT Technology Review*.

"A better understanding of the Internet's structure is vital for integration of voice, data and video streams, point-to-point and point-to-many distribution of information, and assembling and searching all of the world's information," Carmi and fellow researchers state in a new report published in the *Proceedings of the National Academy of Sciences*. "It may reveal evolutionary processes that control the growth of the Internet."

Carmi's research uses a program called the DIMES agent, which is downloaded onto volunteers' computers and performs Internet measurements such as traceroute and ping. The project's Web site promises that, along with providing a "good feeling," using the DIMES agent will provide maps to users showing how the Internet looks from their homes. Users of the program chat about their findings at this forum.

Another project that tracks Internet traffic growth is called the Minnesota Internet Traffic Studies (MINTS) site.

### 5. The Fluid Project

A handful of universities, including the University of Toronto and the University of California, Berkeley, is working to build a software architecture and reusable components that can make Web applications easier to develop and use. The Fluid Project's work focuses on user-centered design practices. Vendors such as Mozilla Foundation, IBM and Sun are also taking part.

The latest news out of the project is that a grant has been awarded to the Adaptive Technology Resource Centre at the University of Toronto from the Mozilla Foundation to promote DHTML accessibility and the adoption of ARIA (the W3C Web Accessibility Initiative's Accessible Rich Internet Applications specification).

### 6. Attila: one radio on many wireless networks

Today's wireless networks are in a rut: Most radios that form the networks can only work on one frequency band of the spectrum. If that band is glutted, glitchy or jammed, the radios are useless.

Enter Attila the Radio, invented by two researchers at Stevens Institute of Technology, in Hoboken, N.J. The concept is simple: Attila parcels out a stream of data packets over any and all available wireless spectrum at the same time. The packets could stream, for example, over a Wi-Fi mesh, Verizon's Code Division Multiple Access (CDMA) cell network, rival AT&T's Global System for Mobile Communications (GSM) airwaves, and over a WiMAX link.

Current prototypes use several radios, one for each of the networks being used, but the goal is a single radio. The future of Attila the radio lies now with Attila the company, formally known as Atilla Technologies, which was founded in 2005 by two Stevens Institute of Technology researchers.

## 7. Sniffing out insider threats

Researchers are developing technology they say will use data mining and social networking techniques to spot and stop insider security threats and industrial espionage.

Air Force Institute of Technology researchers have developed software that can spot insider threats using an extended version of automated document indexing known as Probabilistic Latent Semantic Indexing (PLSI). This technology can discern employees' interests from e-mail and create a social network graph showing their various interactions, researchers said.

The technology could help any organization sniff out insider threats by analyzing e-mail activity or find individuals among potentially tens of thousands of employees with latent interests in sensitive topics. The same technology might also be used to spot individuals who feel alienated within the organization as well as unraveling any worrying changes in their social network interactions. The researchers explain that individuals who have shown an interest in a sensitive topic but who have never communicated to others within the organization on this subject are often the most likely to be an insider threat.

The software can reveal those people either with a secret interest in that topic or who may feel alienated from the organization and so communicate their interest in it only to those outside the organization, researchers said. Another important signal of alienation or a potential problem is a shift in the connections between an individual and others within the organization. If an individual suddenly stops communicating or socializing with others with whom they have previously had frequent contact, then the technology could alert investigators to such changes.

The research team tested their approach on the archived body of messages from the liquidated Enron company e-mail system.

## 8. All about Twitter

University of Maryland students have written a paper called "Why We Twitter: Understanding Microblogging Usage and Communities" examining why people Twitter. Also known as microblogging, Twittering is a new form of communication in which users can describe their current status in short posts distributed by instant messages, mobile phones, e-mail or the Web," according to the paper's abstract.

The authors, Akshay Java, Xiaodan Song, Tim Finin and Belle Tseng, say the paper "presents our observations of the microblogging phenomena by studying the topological and geographical properties of Twitter's social network." They concluded that figuring out why individuals microblog is elusive, but that by analyzing an aggregate of data across a community can provide insight into why a group of people microblog.

## 9. Spotting phishers

Scientists at Carnegie Mellon University have developed an online game designed to teach Internet users about the dangers of phishing.

Featuring a cartoon fish named Phil, the game, called Anti-Phishing Phil, has been tested in CMU's Privacy and Security

Laboratory. Officials with the lab say users who spent 15 minutes playing the interactive, online game were better able to discern fraudulent Web sites than those who simply read tutorials about the threat.

The game focuses on teaching Internet users how to tell the URL of a fraudulent site from a legitimate one, officials say. It offers tips such as examining URLs for misspellings of popular sites, dissecting a Web address to understand where it's pointing to, and using Google to validate a URL against search results. More here.

### 10. RFID and the heart

Telemedicine researchers have been awarded a $400,000 grant to work on integrating RFID technology with cardiac sensor networks used to monitor patients' heartbeats.

The Rochester Institute of Technology says its work will make cardiac sensor networks more secure, reducing the chances of identity theft or other abuse. The work could also make the healthcare process work more efficiently by supporting RFID tags on medicine bottles, the school says.

"Telemedicine technology can greatly increase the quality of medical care while also decreasing healthcare costs," said Fei Hu, assistant professor of computer engineering at RIT, in a statement. "Through this project we hope to increase the integration of RFID into existing cardiac sensor networks, ensure the overall security of the system and promote the implementation of the technology in nursing homes and adult care facilities across the country."

### 11. Analyzing the "Dark Web"

Computer scientists at a University of Arizona lab have created a project called Dark Web that is designed to track and analyze the moves of terrorists and extremists using the Internet to spread propaganda, recruit members and plan attacks (click here to read our feature on cyberwar).

The project, which is funded by the National Science Foundation and other federal agencies, is led by Hsinchun Chen at the Artificial Intelligence Lab in Tucson. Dark Web's specialty is tracking massive amounts of information scattered across thousands of Web sites and in e-mail and other online programs. Spidering, link analysis, multimedia analysis and other techniques are used, according to the NSF.

A method dubbed Writeprint is used to strip away the anonymity of terrorists online by analyzing language, semantic and other features of content and comparing it with other content posted across the Internet. Authors can be identified and new information published by the authors can be flagged as it is posted and spread. One recent study by the Dark Web team identified stories and videos used to train terrorists in building improvised explosive devices.

Not that the terrorists are unaware they're being watched.

"They can put booby-traps in their Web forums," Chen said in a statement, "and the spider can bring back viruses to our machines."

### 12. Really, really fast wireless

Scientists at the Georgia Electronic Design Center (GEDC) at the Georgia Institute of Technology have designed a system that can transfer data at 5Gbps at a range of 5 meters.

Joy Laskar, the GEDC's director, says many of the products designed for the 60GHz band initially will be marketed to consumers for home use, because businesses are more likely to take wait-and-see attitudes with new technology that hasn't yet proved reliable. Even so, he says he can imagine several business applications for multigigabit networks, especially in the field of large-scale data transfer. "Imagine that you have a portable device that's essentially an evolved iPod that has hundreds of gigs of storage," he says. "One scenario would be to have several kiosks around an office that could wirelessly send information to your device."

Separately, a team of engineers at Georgia Tech Research Institute (GTRI) is taking a new approach to phased-array antennas that the developers say could enable an ultra-wideband device to do the job of five regular antennas.

The Fragmented Aperture Antenna has already demonstrated a 33-to-1 bandwidth, blowing by the 10-to-1 ratio of conventional systems. Researchers say a 100-to-1 ratio might not be far off for use in radar and communications environments.

### 13. Real bandwidth management

University of California at San Diego computer scientists say they have developed a TCP-based bandwidth management system that works across global networks.

The "flow proportional share" algorithm created by Barath Raghavan and his teammates is designed to enable a group of rate limiters to work together, providing better availability of network applications, including Web sites.

"With our system, an organization with mirrored Web sites or other services across the globe could dynamically shift its bandwidth allocations between sites based on demand. You can't do that now, and this lack of control is a significant drawback to today's cloud-based computing approaches," said Raghavan, a Ph.D. candidate in the Department of Computer Science and Engineering at UCSD's Jacobs School of Engineering.

The work is described in a paper called "Cloud Control with Distributed Rate Limiting".

### 14. Doing away with digital clutter

MIT researchers have come up with a way to measure visual clutter, a breakthrough that could help everyone from fighter pilots to Web site designers.

The scientists published a paper in the *Journal of Vision* that explains their work. The impetus for the work was that "we lack a clear understanding of what clutter is, what features, attributes and factors are relevant, why it presents a problem and how to identify it," says Ruth Rosenholtz, principal research scientist at MIT's Department of Brain and Cognitive Sciences.

Another issue is that clutter is perceived differently by different people, so coming up with a universal measure of what's hard or easy to pick out in a display is challenging. The model devised takes into account such factors as color, data and contrast.
The researchers tested their model on people looking at a map, trying to find an arrow saying "You are here," for example. Rosenholtz plans to offer the MIT team's visual clutter tool to designers as part of a continuing study. You can test out the level of clutter in a display yourself by going here .

### 15. Finding pictures of needles in haystacks

Penn State researchers have developed software they say tags images upon uploading to Yahoo's Flickr or other photo systems but also automatically updates those tags based on how people interact with the photos.

This could greatly improve searching for images, the researchers say.

"Tagging itself is challenging as it involves converting an image's pixels to descriptive words," said James Wang, lead researcher and associate professor of information sciences and technology, in a statement. "But what is novel with the 'Tagging over Time' or T/T technology is that the system adapts as people's preferences for images and words change."

In recent tests the system was shown to correctly annotate four of every 10 images. It still needs work, but is an improvement over an earlier Penn State-developed system dubbed Automatic Linguistic Indexing of Pictures-Real Time that analyzed pixel content to suggest tags. The new software, which relies on machine-learning, is described in more detail in a paper called "Tagging Over Time: Real-world Image Annotation by Lightweight Meta-learning." The researchers say accuracy of the new system can grow from 40% to 60% as it learns from user behavior.

### 16. Videoconferencing made for Dr. Phil

While videoconferencing has proven its worth for corporate meetings and distance learning, researchers say the technology

could also play a big role in mediating disputes between coworkers, neighbors and family members.

Researchers from the University of Bath in the United Kingdom interviewed a dozen conciliators to determine their views on what it would be like to use video technology in their jobs. The researchers say video holds the promise of being useful because it can better translate the emotional state of the parties involved and reduces possible intimidation when parties are in the same room.

"Most of the conciliation to sort out disputes between employees is done by phone because for the conciliator, who may have as many as 70 or 80 cases to deal with at once, it can be difficult, costly and slow to arrange to see people in person," said Department of Computer Science Director of Studies Leon Watts in a statement. "In situations of high conflict, it can be hard to get to the real issues, to judge what people really care about, on the phone. So using a video link, in which the conciliator can in addition see each of the disputing parties, is a step forward: it gives them new options for appreciating parties' depth of concern about different issues."

The increased availability of broadband services and improved video quality combine to make widespread videoconferencing feasible, the researchers said. The researchers plan to work with a conciliation training organization to spread the word on videoconferencing.

### 17. Vocal Joystick

University of Washington researchers have developed software designed to let those who can't work a handheld mouse use their voice instead to navigate the Web.

"There are many people who have perfect use of their voice who don't have use of their hands and arms," said Jeffrey Bilmes, an associate professor of electrical engineering, in a statement. "There are several reasons why Vocal Joystick might be a better approach, or at least a viable alternative, to brain-computer interfaces."

The Vocal Joystick detects sounds 100 times a second, relying on vowel sounds to move in one direction or another and moving faster or slower depending on voice volume. "K" and "ch" sounds are used for mouse clicks and releases. Some wonder why speech recognition technology might not be better, but the University of Washington researchers say it would be too slow since it would rely on drawn-out, discrete commands. ( Watch a video of how Vocal Joystick works here.)

The tool can be used for Web browsing, as well as for playing video games and even drawing on a screen.

### 18. Measuring boredom

The National Science Foundation is funding research that could enable computers to respond to your levels of frustration or boredom. In other words, we're talking about "mind reading" technology.

Tufts University researchers are exploiting near-infrared spectroscopy technology that uses light to pick up on your emotional cues by monitoring brain blood flow.

Of course, for now you need to wear a funky headband to make it work (the headband "uses laser diodes to send near-infrared light through the forehead at a relatively shallow depth — only two to three centimeters — to interact with the brain's frontal lobe," according to Tufts.)

### 19. Better computer building blocks

A University of Maryland researcher has come up with a method that he says could one day be used by companies to build nanoscale computer and cell phone components faster and less expensively.

Ray Phaneuf , associate professor of materials science and engineering at the A. James Clark School of Engineering, compares his idea to self-assembly processes in nature such as crystallization.

Phaneuf has built a photolithography- and etching-based template that nature can use to assemble atoms into predefined patterns for creating things such as laptop semiconductors, wearable device sensors and cell phone components. His work

has focused on silicon, typically used for computer components, and gallium arsenide, which is common in cell phone parts.

"While we understand how to make working nanoscale devices, making things out of a countable number of atoms takes a long time," Phaneuf said in a statement . "Industry needs to be able to mass-produce them on a practical time scale." Such devices could even be used some day in building the "qubits" that serve as the basis of advanced quantum computing machines, Phaneuf said.

Phaneuf's work focuses on silicon and gallium arsenide components. Silicon is the prevalent material for components in computers while gallium arsenide is used more often in cell phones.

## 20. Good Samaritans

Dartmouth researchers say they were surprised to find that Good Samaritans – those people who update the online Wikipedia encyclopedia when just passing by – are actually as reliable as regular, registered users of the site.

The researchers examined the quality of Wikipedia content based on how long it persisted before being changed or corrected. Wikipedia's archive of edits and user reputation allowed for the research to be done.

"This finding was both novel and unexpected," said Denise Anthony, associate professor of sociology, in a statement. "In traditional laboratory studies of collective goods, we don't include Good Samaritans, those people who just happen to pass by and contribute, because those carefully designed studies don't allow for outside actors. It took a real-life situation for us to recognize and appreciate the contributions of Good Samaritans to Web content."

Sean Smith, associate professor of computer science, added: "Wikipedia is a great example of how open-source contributions work for the greater good."

The researchers' findings are presented in a paper called "The Quality of Open Source Production: Zealots and Good Samaritans in the Case of Wikipedia."

## 21. Honeybees and the Internet

Honeybee intelligence can be used to improve the speed and efficiency of Internet servers by up to 25%, according to Georgia Institute of Technology researchers.

Honeybees somehow manage to efficiently collect a lot of nectar with limited resources and no central command. Such swarm intelligence of these amazingly organized bees can also be used to improve the efficiency of Internet servers faced with similar challenges, researchers said. A bee dance-inspired communications system developed by Georgia Tech helps Internet servers that would normally be devoted solely to one task move between tasks as needed, reducing the chances that a Web site could be overwhelmed with requests and lock out potential users and customers.

Compared with the way server banks are commonly run, the honeybee method typically improves service by 4% to 25% in tests based on real Internet traffic, researchers said. Internet servers typically have a set number of servers devoted to a certain Web site or client. When users access a Web site, the servers provide computing power until all the requests to access and use the site have been fulfilled. Sometimes there are a lot of requests to access a site -- for instance, a clothing company's retail site after a particularly effective television ad during a popular sporting event -- and sometimes there are very few. Predicting demand for Web sites, including whether a user will access a video clip or initiate a purchase, is extremely difficult in a fickle Internet landscape, and servers are frequently overloaded and later become completely inactive at random.

Bees tackle their resource allocation problem (such as a limited number of bees and unpredictable demand on their time and desired location) with a seamless system driven by "dances." Here's how it works: The scout bees leave the hive in search of nectar. Once they've found a promising spot, they return to the hive "dance floor" and perform a dance. The direction of the dance tells the waiting forager bees which direction to fly, the number of waggle turns conveys the distance to the flower patch; and the length conveys the sweetness of the nectar. The bee/Internet research was published in the *Bioinspiration and Biomimetics* journal.

## 22. Pushing 100Gbps copper networks

Penn State engineers are trying to push relatively short Category-7 copper cables to support digital data speeds up to 100Gbps.
The idea would be to enable copper cables within a room or building, perhaps being used to interconnect servers, to handle data rates typically reserved for fiber-optic links. The trick has been coming up with a transmitter/receiver that uses error correcting and equalizing methods to can cancel interference better than traditional systems.

"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," said Ali Enteshari, graduate student in electrical engineering, in a statement. "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."

Mohsen Kavehrad , a professor of electrical engineering at Penn State, says his team is working with NEXANS, the company that makes the cable. "These are the current, new generation of Ethernet cables," he says.

## 23. Drivers wielding cell phones

We've seen or heard about drivers on cell phones causing accidents. But research from the University of Utah also shows that such drivers are also responsible for slowing traffic flows.

Those talking on cell phones tend to drive more slowly on freeways, pass slowgoing vehicles less frequently and generally take longer to get from one point to another, the researchers found. This can cost society in terms of lost productivity, fuel costs and more, the researchers concluded.

"At the end of the day, the average person's commute is longer because of that person who is on the cell phone right in front of them," said University of Utah psychology Professor Dave Strayer, leader of the research team, in a statement. "That SOB on the cell phone is slowing you down and making you late."

The research is based on a PatrolSim driving simulator.

Meanwhile, don't feel so smug about how safety conscious you are by using a hands-free cell phone in the car: Carnegie Mellon University researchers say you're still likely to be distracted.

The researchers used brain imaging to show that even just listening to a cell phone while driving cuts by more than a third your attention to driving. Subjects inside an MRI brain scanner were tested on a driving simulator and were found to weave, similar to if they were under the influence of alcohol. The study (featuring cool colorful brain images) showed lessened activity in the brain's parietal lobe, which is called upon for spatial sense and navigation, and occipital lobe, which handles visual information.

## 24. Open source on bug patrol

An open source tool is being readied for release this year that its creators say could dramatically speed software development and improve software quality.

Computer scientists from the National Institute of Standards and Technology and the University of Texas at Arlington credit the use of "combinatorial testing" for their breakthrough.

The trick is being able to quickly test interactions of up to six variables. The work stemmed from research into what really causes bugs in software. The researchers found that it is more often caused by problematic interactions between a few variables rather than a bunch even if a program, such as an e-commerce application, features hundreds of variables.

Findings of this latest software debugging research are described in several presentations, one by NIST researchers and another by University of Texas researchers

Developers interested in getting your hands on code should contact NIST's Raghu Kacker.

### 25. Geeks and glasses

Who knew? People who wear glasses are not stereotypical geeks or nerds. At least according to a study released by Australian vision researchers.

The scientists claim this is the first time a study looked into personality and nearsightedness or myopia. Participants were analyzed using a state-of-the-art measure of the five major personality factors (openness, conscientiousness, extroversion, agreeableness and neuroticism), administered by psychologists from the University of Melbourne.

Researchers concluded: "The long-held view that myopic persons are introverted and conscientious may reflect intelligence-related stereotypes rather than real correlations. Furthermore, the predictive characteristic of intellect, subsumed in openness, appeared to be representative of a previously reported link between IQ and myopia rather than personality and myopia."

"We have literally busted the myth that people who wear glasses are introverted or have particular personality characteristics. They are more likely to be agreeable and open, rather than closed and introverted," said Paul Baird of the University of Melbourne's Centre for Eye Research Australia in a release.

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