Designing the future internet: Mobile-friendly internet that can handle billions of smart gadgets

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Credit: AI-generated image (disclaimer)

This century, our world will be flooded with hundreds of billions of smartphones, gadgets, sensors and other smart objects connected to the internet.

They will perform myriad services, such as monitoring our health, helping run households and boosting driver safety. At Rutgers, Dipankar "Ray" Raychaudhuri is at the forefront of efforts to redesign the internet to handle the enormous increase in traffic.

"The traffic that comes from mobile devices into the internet has been increasing exponentially. It used to be 10 percent five years ago – now it's over 50 percent," said Raychaudhuri, a distinguished professor in the Department of Electrical and Computer Engineering in the School of Engineering and director of the WINLAB (Wireless Information Network Lab).

"As a result, mobile wireless capacity is beginning to run out," he said. "That's why cellular operators have to give you data limits. When you try to use a mobile phone and you're downloading a web page, it stalls unexpectedly at times and you have to wait for the signal to improve. Also, there are all kinds of holes in the security system that need to be fixed."

In 2010, the National Science Foundation (NSF) launched a Future Internet Architecture initiative and invited academics to take a fresh look at the internet. Raychaudhuri and colleagues proposed a "MobilityFirst" project aimed at reimagining the Internet, winning major NSF funding.

The MobilityFirst project, now in its sixth year, includes experts at Rutgers, the University of Massachusetts-Amherst, Massachusetts Institute of Technology, Duke University, University of Michigan, University of Wisconsin-Madison and University of Nebraska-Lincoln. The NSF provided $3.275 million to Rutgers from 2010 to 2014 and $2.9 million since 2014, said Raychaudhuri, the project's principal investigator.

"The internet has a lot of duct tape on it," he said. "It works very well, but it has some limitations, especially when you try to do more mobile communications. How to re-architect the internet is a very ambitious goal."

The MobilityFirst project is centered on shifting from the current internet protocol (IP) – an elegant, address-based routing technology designed in the 1970s – to name-based routing, he said.

An IP address is a unique number for an internet device, according to the Internet Corporation for Assigned Names and Numbers (ICANN), which allocates the numbers used to route internet traffic to devices.

MobilityFirst's name-based approach would be a fundamental change. Names would represent people, mobile phones, internet devices, small sensors or any other objects connected to the internet, said Raychaudhuri, a native of India who received his master's and doctoral degrees in electrical engineering from the State University of New York, Stony Brook.

The benefits of MobilityFirst include more flexible services, better security, support for mobility across many technologies, efficiency and the ability to handle large volumes of traffic and data.

"We are not expecting to rip out the old internet," Raychaudhuri said. "The internet has a lot of nice properties that we don't want to lose. But one of the challenges for today's internet is that with all these different modes of communication, some of them such as mobility services, broadcasting or content delivery are not handled very efficiently, and this could lead to flooding the network with too much data."

The different modes of communication include the "Internet of Things" – a swiftly flowering field featuring smart objects, such as fitness

monitors and smart watches, home thermostats and lighting, smartphones and devices with sensors. Smart objects are expected to become pervasive in society, managing energy use in homes, monitoring food consumption, diagnosing health problems, monitoring cybersecurity and making driving safer, among other benefits.

Some 50 billion smart objects are anticipated by 2020, and 1 trillion sensors soon thereafter, according to the NSF.

"The Internet of Things has a lot of potential, but it needs fast and low delay networks that can ensure that data are received in time," Raychaudhuri said. "A lot of people are working on how to make cellular networks faster – so-called '5G' – and more functional, and many of the goals are similar to what we have in the MobilityFirst project."

Three MobilityFirst trials are underway or planned, including one with SES, a satellite services company with a Princeton office. SES is using the MobilityFirst system to deliver content closer to its users, reducing the cost and improving user experience.

The second trial – with the University of Wisconsin-Madison – will show how an internet service provider's circuits can be extended to offer mobile service. The third trial, led by the University of Massachusetts-Amherst in Texas, will look into how to do targeted emergency messaging in a disaster-recovery scenario, such as following a terrorism incident or a major hurricane like Katrina in 2005.

The Internet of Things also covers virtual reality and augmented reality, with people wearing special glasses that, for example, provide directions as they walk or show the stores in a shopping center, said Raychaudhuri, who joined Rutgers in 2001 after working at a startup company called Iospan Wireless in Silicon Valley, as well as the NEC USA C&C

Research Laboratory and Sarnoff/ RCA Laboratories, both in Princeton, New Jersey.

Provided by Rutgers University