Next generation internet will arrive without fanfare, network architects say

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Venkataramani says there will be no hour when someone flips a switch to move us all over to the new Internet. Instead, the transition will be gradual, one small group at a time. Each new app or piece of software will be adopted safely by ever widening circles of users, until one day the old Internet will just be gone and a new one, more deliberately designed and built than the old one, will be up and running. Credit: UMass Amherst

Someday soon, the world will migrate away from the old, original Internet to a new, next-generation Internet with far better security, greater mobility and many other improved features, but most of us will never know the change has occurred, says computer science researcher Arun Venkataramani of the University of Massachusetts Amherst.

"There will be no flag day, no hour when someone flips a switch to move us all over to the new Internet. Instead, the transition will be gradual, one small group at a time," he explains. "Each new app or piece of software will be adopted safely by ever widening circles of users, until one day the old Internet will just be gone and a new one, more deliberately designed and built than the old one, will be up and running. It will be seamless."

Venkataramani is the lead architect for one of the many research teams funded by the National Science Foundation (NSF) who are now developing and testing next-generation hardware, software and applications to address difficult, systemic shortcomings of the old Internet. He and colleagues at UMass Amherst recently received a two-year, $1.35 million NSF grant for the next phase of the MobilityFirst project.

MobilityFirst researchers at UMass Amherst, in collaboration with colleagues at seven other partner institutions, will field-test the new architecture through three deployments: a context-aware emergency notification system coordinating with the CASA network of weather radars and the National Weather Service for end users in Texas; a content delivery network of public broadcasting stations and the PennREN network in Pennsylvania, and a wireless service provider, "5Nines," in Madison, Wis.

Today's Internet, really a network of networks, grew slowly, as an

overlay on top of the telephone system, Venkataramani says. Its users trusted one another and did not foresee its tremendous success, nor the need to guard against malware, hostile denial of service (DoS) and other attacks that are common today. "As a result, the Internet continues to remain vulnerable to severe attacks that can be launched by adversaries with very little resources," he points out.

"In fact, even a benignly misconfigured router can result in outages of large portions of the Internet or high-value web services. It is frightening to even think about the havoc that a maliciously motivated ISP or a nation-state indulging in cyberwarfare could wreak."

"The Internet's designers left security out of the design process, and it is nearly impossible now to retrofit its multi-layered protocol stack with security," he adds. "The same is true of mobility. Neither mobility nor security were pressing concerns in the early days, but both require fundamental changes to Internet architecture. That's what our project, MobilityFirst, is about." Mobility refers to an end user being able to seamlessly stay connected to the Internet on different devices over time, for example while moving from a home computer to the car to the workplace.

Because researchers cannot run experiments on the real Internet and risk disrupting production networks, online services and end-users, they began creating a national testbed called the Global Environment for Network Innovations (GENI). On it, they can try new routers, servers and apps without disrupting the existing Internet.

Venkataramani explains, "Experimentally validating new ideas in realistic settings is an essential part of science and engineering research. However, validating Internet architecture presents a chicken-and-egg problem: we cannot get stakeholders today to adopt the new architecture without a convincing validation with real users at large scales, but such a

validation requires adoption in the first place. GENI allows evaluation of entire Internet architectures at the scale of a nationwide ISP and lets stakeholders incrementally test and adopt the new architecture."

An example of a new feature enabled by MobilityFirst is called "context-based communication," which generalizes name- or address-based communication. For example, MobilityFirst allows an emergency notification application to send a targeted emergency message specifically to an affected location such as a football stadium or cars traveling west on the Massachusetts Turnpike. It can also customize different messages to different people, for example, one warning to senior citizens and a different one to first responders.

One of the planned field trials of MobilityFirst led by UMass Amherst, in coordination with the National Weather Service and the CASA radar testbed in Texas, will demonstrate the effectiveness of context-based hazardous weather warning apps, the lead architect says.

MobilityFirst is a collaboration of UMass Amherst with Rutgers, Duke University, the University of Michigan, MIT, the University of Nebraska-Lincoln and the University of Wisconsin-Madison.

Provided by University of Massachusetts Amherst