Computer Scientists Take the â€œWhyâ€# out of WiFi

Why isn't my wireless working? Is yours? – Computer Scientists Respond

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Stefan Savage is a UCSD computer science professor and one of the leaders of the UCSD wireless monitoring project.

"People expect WiFi to work, but there is also a general understanding that it's just kind of flakey," said Stefan Savage, one of the UCSD computer science professors who led development of an automated, enterprise-scale WiFi troubleshooting system for UCSD's computer science building. The system is described in a paper presented last week in Kyoto, Japan at ACM SIGCOMM, one of the world's premier networking conferences.

"If you have a wireless problem in our building, our system automatically analyzes the behavior of your connection - each wireless protocol, each wired network service and the many interactions between them. In the end, we can say 'it's because of *this* that your wireless is slow or has stopped working' - and we can tell you immediately," said Savage.

For humans, diagnosing problems in the now ubiquitous 802.11-based wireless access networks requires a huge amount of data, expertise and time. In addition to the myriad complexities of the wired network, wireless networks face the additional challenges of shared spectrum, user mobility and authentication management. Finally, the interaction between wired and wireless networks is itself a source of many problems.

"Wireless networks are hooked on to the wired part of the Internet with a bunch of 'Scotch tape and bailing wire' - protocols that really weren't designed for WiFi," explained Savage. "If one of these components has a glitch, you may not be able to use the Internet even though the network itself is working fine."

There are so many moving pieces, so many things you can not see. Within this soup, everything has to work just right. When it doesn't, trying to identify which piece wasn't working is tough and requires sifting through a lot of data. For example, someone using the microwave oven two rooms away may cause enough interference to disrupt your connection.

Yu-Chung Cheng is a computer science Ph.D. student at UCSD and lead author on the SIGCOMM 2007 paper describing an automated, enterprise-scale WiFi troubleshooting system for UCSDâ€™s computer science building.

"Today, if you ask your network administrator why it takes minutes to connect to the network or why your WiFi connection is slow, they're unlikely to know the answer," explained Yu-Chung Cheng, a computer science Ph.D. student at UCSD and lead author on the paper. "Many problems are transient - they're gone before you can even get an admin to look at them - and the number of possible reasons is huge," explained Cheng, who recently defended his dissertation and will join Google this fall.

"Few organizations have the expertise, data or tools to decompose the underlying problems and interactions responsible for transient outages or performance degradations," the authors write in their SIGCOMM paper.

The computer scientists from UCSD's Jacobs School of Engineering presented a set of modeling techniques for automatically characterizing the source of such problems. In particular, they focus on data transfer delays unique to 802.11 networks - media access dynamics and mobility management latency.

The UCSD system runs 24 hours a day, constantly churning through the flood of data relevant to the wireless network and catching transient problems.

"We've created a virtual wireless expert who is always at work," said Cheng.

Within the UCSD Computer Science building, all the wireless help-desk issues go through the new automated system, which has been running for about 9 months. The data collection has been going on for almost 2 years.

One of the big take-away lessons is that there is no one thing that affects wireless network performance. Instead, there are a lot of little things that interact and go wrong in ways you might not anticipate.

"I look at this as an engineering effort. In the future, I think that enterprise wireless networks will have sophisticated diagnostics and repair capabilities built in. How much these will draw from our work is hard to tell today. You never know the impact you are going to have when you do the work," said Savage. "In the meantime, our system is the ultimate laboratory for testing new wireless gadgets and new approaches to building wireless systems. We just started looking at WiFi-based Voice-Over-IP (VOIP) phones. We learn something new every week."

SIGCOMM 2007 Paper citation: " Automating Cross-Layer Diagnosis of Enterprise Wireless Networks," by Yu-Chung Cheng, Mikhail Afanasyev, Patrick Verkaik, Jennifer Chiang, Alex C. Snoeren, Stefan Savage, and Geoffrey M. Voelker from the Department of Computer Science and Engineering at UCSD's Jacobs School of Engineering; Péter Benkö from the Traffic Analysis and Network Performance Laboratory (TrafficLab) at Ericsson Research, Budapest, Hungary

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