Profs bring free "Super WiFi" to working-class Houston

By Nate Anderson | 10-11-2010

A couple dozen residents of the working-class Pecan Park neighborhood in Houston are about to do something few Americans have yet tried—access the Internet through a wireless connection that uses the empty TV-band "white spaces." And the federal government is picking up the tab.

Rice University professors Edward Knightly, Robert Stein, Lin Zhong, and William Reed won a $1.8 million grant this summer from the National Science Foundation. Their goal: expand Rice's free-to-use testbed network in east Houston from Wifi to white spaces.

Since 2004, the university has partnered with local nonprofit Technology for All (TFA) to build and maintain a three square kilometer wireless network that serves 3,000 local users, free of charge. The network currently uses WiFi to deliver signal, but it's no off-the-shelf WiFi; Knightly and his graduate students have built custom WiFi nodes that run Rice-developed software. The TFA network is a free ISP for local residents, but it's also a testbed to work on issues related to urban WiFi, fair bandwidth distribution, capacity planning, and multi-antenna systems.


Dr. Edward Knightly

To its users, though, the TFA network just looks like free wireless broadband—and they don't care how well a "multi-antenna system" works if it can't deliver a reliable signal into the home. WiFi, which generally operates in unlicensed spectrum at 2.4GHz or 5GHz, doesn't penetrate walls well (or leafy trees, for that matter); in fact, Knightly told Ars when we spoke to him this week, signal strength was a major complaint among users.

Enter white spaces. Operating in empty TV channels, these much lower frequency 500-700MHz signals easily penetrate walls, and the FCC last month approved final rules governing white space wireless devices. Knightly's new $1.8 million grant will allow his team to upgrade the TFA network to use new white space hardware—all of it custom, of course.

"We'll be designing custom nodes," he says, because commercial products aren't yet available, and the software will also be heavily customized. TFA already has a 60 foot high tower that can handle the new white spaces nodes, and the team also has the use of several tall buildings. This part of Houston also has five empty TV channels available, or about 30MHz of spectrum.

This won't be a simple deployment, though. Not only will the team need to build its own custom nodes, but it plans to build custom white space receivers, too—otherwise, residents can't take advantage of the new signal.

Getting to "standards"

Initially, the FCC had called for both a geolocation database and spectrum-sensing to keep white space transmitters from interfering with wireless mics or TV stations. Last month's rules dropped the spectrum-sensing requirement, which Knightly says were "extremely restrictive" because devices had to "defer to even the slightest noise." Without the need for spectrum sensing, the hardware should stay much cheaper.

As for how much hardware will be needed, that's part of the experiment. The team can't build thousands of custom devices for users, so only a few dozen people will test the new network until

commercial hardware is available. But there's some question about how many nodes will be needed to blanket the community; while white space signals should have terrific propagation, each node still has only limited capacity.

Knightly says the team will have to deploy numerous nodes to handle capacity issues, but it will experiment with things like energy efficiency. For instance, when traffic drops in the middle of the night, can the network simply switch off most of its nodes to save power and yet still provide adequate capacity?

The research is funded in part by the government, but Knightly and his team also work closely with companies like Microsoft, Cisco, Intel, and Bell Labs on white spaces hardware and software (Microsoft Research has long been working on what it calls "WhiteFi" transmission protocols, for instance.)

One of the goals is to do the basic white space research needed to develop comprehensive standards, like the 802.11 standards that have helped to make WiFi ubiquitous. We want to "provide early experiences to industry and IEEE standards [bodies] and ISPs," says Knightly, who predicts that basic IEEE standards will appear soon.

For Rice students, who are "deeply involved" in the TFA network, this should be an incredible opportunity to help guide the development of a promising new tech. That's because the research team gets to do so much; as the grant application puts it, "the project team will serve as researchers, the wireless network service provider, the network equipment and protocol designers, and community-technology educators and advocates." To say nothing of the *really* fun part—students driving around Houston in cars with prototype hardware, doing "mobility experiments."