Wi-FM listens to FM signals to determine best times to send and receive data

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One minute your wireless Internet is working fine. The next minute, it takes an infuriatingly slow five seconds to load a single Web page. You paid for the fastest Internet speed available but during these all-too-frequent times, it seems like the connection barely works at all.

"Most people think it's a mystery," said Aleksandar Kuzmanovic, associate professor of electrical engineering and computer science at Northwestern University's McCormick School of Engineering. "They get upset at their routers. But what's really happening is that your neighbor is watching Netflix."

Most people don't realize how much their neighbors' Internet networks interfere with their own, heavily affecting speed and performance. Unless a home is located in the middle of nowhere, it is likely that neighboring homes' Wi-Fi networks will bump into each other and prevent data from getting through. This is particularly true in large, urban apartment buildings where many people reside within a smaller area.

Kuzmanovic and his PhD students Marcel Flores and Uri Klarman have found that problems caused by competing networks can be mitigated by using an already-existing, extremely cheap medium: FM radio. Flores will present this work Tuesday, November 10 at the 23rd annual IEEE International Conference on Network Protocols in San Francisco.

"Our wireless networks are completely separate from each other," said

Flores, the lead author of the study. "They don't have any way to talk to each other even though they are all approximately in the same place. We tried to think about ways in which devices in the same place could implicitly communicate. FM is everywhere."

Called "Wi-FM," the team's technique enables existing wireless networks to communicate through ambient FM radio signals. The team agreed that using FM was attractive for several reasons. For one, most smartphones and mobile devices are already manufactured with an FM chip hidden inside. FM is also able to pass through walls and buildings without being obstructed, so it's very reliable. Minor upgrades to software would allow devices to take advantage of Wi-FM.

Using Wi-FM prevents a person's network data from fighting with his or her neighbor's data. When network data are sent at the same time, they bump into each other. Then both data packets back off and stop moving toward their destinations. This is what causes those unexpectedly slow Internet speeds. Wi-FM works by allowing the device to "listen" to the network and select the quietest time slots according to FM radio signals.

"It will listen and send data when the network is quietest," Flores said. "It can send its data right away without running into someone else or spending any time backing off. That's where the penalty happens that wastes the most time."

This is a problem that Klarman knows all too well. Living in a large, urban apartment building with more than 30 different networks, he regularly experiences slow Internet speeds.

"Even if I configure my Internet to choose a channel that is least likely to overlap with my neighbors, the problem cannot be avoided," Klarman said. "You can't find a quiet channel when there are 30 other networks in the same building. My speed is 10 percent of what it should be."

Wi-FM identifies the usage patterns of other networks in order to detect times with lightest and heaviest traffic, helping to harmonize Wi-Fi signals that are transmitting on the same channel. And it can adapt as those patterns change with very little effort.

"Our system can solve these problems without involving real people," Kuzmanovic said. "Because are you going to knock on 30 doors to coordinate your wireless network with your neighbors? That is a huge management problem that we are able to bypass."

More information: Study: networks.cs.northwestern.edu/p …/icnp2015-flores.pdf

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