

How to feed data-hungry mobile devices? Use more antennas (w/ Video)

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Researchers from Rice University unveiled a new multi-antenna technology that could help wireless providers keep pace with the voracious demands of data-hungry smartphones and tablets. The technology aims to dramatically increase network capacity by allowing cell towers to simultaneously beam signals to more than a dozen customers on the same frequency.

Details about the new technology, dubbed Argos, were presented at the Association for Computing Machinery's MobiCom 2012 [wireless](#) research conference in Istanbul. Argos is under development by researchers from Rice, Bell Labs and Yale University. A prototype built at Rice this year uses 64 antennas to allow a single wireless base station to communicate directly to 15 users simultaneously with narrowly focused directional beams.

Thanks to the growing popularity of smartphones and other data-hungry devices, the demand for [mobile data](#) is expected to grow 18-fold within the next five years. To meet demand, wireless carriers are scrambling to boost network capacity by installing more wireless base stations and shelling out billions of dollars for the rights to broadcast on additional frequencies.

In tests at Rice, Argos allowed a single base station to track and send highly directional beams to more than a dozen users on the same frequency at the same time. The upshot is that Argos could allow carriers to increase network capacity without acquiring more spectrum.

"The technical term for this is multi-user beamforming," said Argos project co-leader Lin Zhong, associate professor of electrical and computer engineering and of computer science at Rice. "The key is to have many antennas, because the more antennas you have, the more users you can serve."

Zhong said the theory for multi-user beamforming has been around for quite some time, but implementing technology has proven extremely difficult. Prior to Argos, labs struggled to roll out prototype test beds with a handful of antennas.

"There are all kinds of technical challenges related to synchronization, computational requirements, scaling up and wireless standards," he said. "People have really questioned whether this is practical, so it's significant that we've been able to create a prototype that actually demonstrates that this works."

Argos presents new techniques that allow the number of antennas on base stations to grow to unprecedented scales. The Argos prototype, which was built by Rice graduate student Clayton Shepard, uses an array of 64 antennas and off-the-shelf hardware—including several dozen open-access test devices called WARP boards that were invented at Rice's Center for Multimedia Communications. In tests, Argos was able to simultaneously beam signals to as many as 15 users on the same frequency. For [wireless carriers](#), that performance would translate to more than a six-fold increase in network capacity. Zhong said the base-station design can be scaled up to work with hundreds of antennas and several dozen concurrent users, which would result in much higher capacity gains.

"There's also a big payoff in energy savings," Shepard said. "The amount of power you need for transmission goes down in proportion to the number of antennas you have. So in Argos' case, we need only about one-

sixty-fourth as much energy to serve those 15 users as you would need with a traditional [antenna](#)."

Zhong and Shepard said Argos is at least five years away from being available on the commercial market. It would require new network hardware and a new generation of smartphones and tablets. It might also require changes in wireless standards. Those are big hurdles, but Zhong said the potential benefits of multi-user beamforming technology make it a very likely next big step for the wireless industry.

"The bandwidth crunch is here, and carriers need options," Zhong said. "They're going to pay close attention to any new technologies that may allow them to serve more customers with fewer resources."

Provided by Rice University

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