New Chip Makes Free P2P Mesh Internet Available To Everyone On Earth. The End of ISP's?

Columbia Engineers develop the first on-chip RF circulator that doubles WiFi speeds with a single antenna -- could transform telecommunications

Columbia University School of Engineering and Applied Science

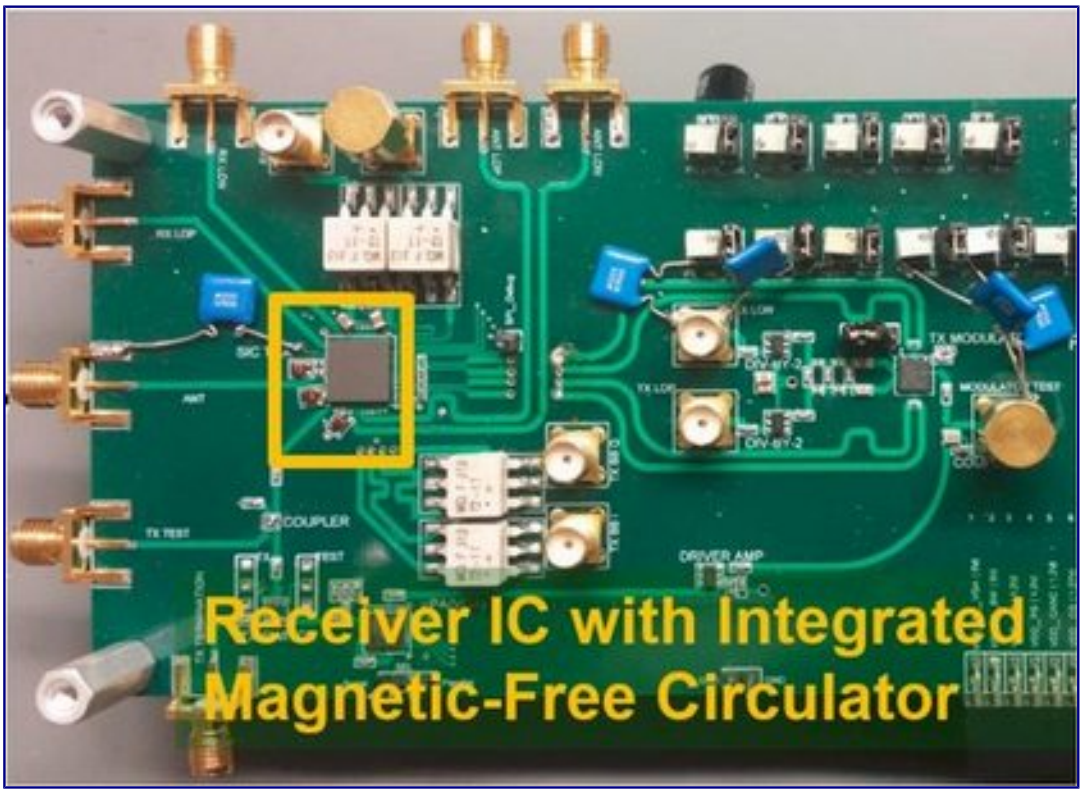

IMAGE: This is the first CMOS full duplex receiver IC with integrated magnetic-free circulator. view more

Credit: Negar Reiskarimian, Columbia Engineering

New York, NY--April 15, 2016--Last year, Columbia Engineering researchers were the first to invent a technology--full-duplex radio integrated circuits (ICs)--that can be implemented in nanoscale CMOS to enable simultaneous transmission and reception at the same frequency in a wireless radio. That system required two antennas, one for the transmitter and one for the receiver. And now the team, led by Electrical Engineering Associate Professor Harish Krishnaswamy, has developed a breakthrough technology that needs only one antenna, thus enabling an even smaller overall system. This is the first time researchers have integrated a non-reciprocal circulator and a full-duplex radio on a nanoscale

silicon chip. The circulator research is published online April 15 in *Nature Communications* (DOI is 10.1038/NCOMMS11217) and the paper detailing the single-chip full-duplex radio with the circulator and additional echo cancellation was presented at the 2016 IEEE International Solid-State Circuits Conference on February 2.

"This technology could revolutionize the field of telecommunications," says Krishnaswamy, director of the Columbia High-Speed and Mm-wave IC (CoSMIC) Lab. "Our circulator is the first to be put on a silicon chip, and we get literally orders of magnitude better performance than prior work. Full-duplex communications, where the transmitter and the receiver operate at the same time and at the same frequency, has become a critical research area and now we've shown that WiFi capacity can be doubled on a nanoscale silicon chip with a single antenna. This has enormous implications for devices like smartphones and tablets."

Krishnaswamy's group has been working on silicon radio chips for full duplex communications for several years and became particularly interested in the role of the circulator, a component that enables full-duplex communications where the transmitter and the receiver share the same antenna. In order to do this, the circulator has to "break" Lorentz Reciprocity, a fundamental physical characteristic of most electronic structures that requires electromagnetic waves travel in the same manner in forward and reverse directions.

"Reciprocal circuits and systems are quite restrictive because you can't control the signal freely," says PhD student Negar Reiskarimian, who developed the circulator and is lead author of the *Nature Communications* paper. "We wanted to create a simple and efficient way, using conventional materials, to break Lorentz Reciprocity and build a low-cost nanoscale circulator that would fit on a chip. This could open up the door to all kinds of exciting new applications."

The traditional way of breaking Lorentz Reciprocity and building radio-frequency circulators has been to use magnetic materials such as ferrites, which lose reciprocity when an external magnetic field is applied. But these materials are not compatible with silicon chip technology, and ferrite circulators are bulky and expensive. Krishnaswamy and his team were able to design a highly miniaturized circulator that uses switches to rotate the signal across a set of capacitors to emulate the non-reciprocal "twist" of the signal that is seen in ferrite materials. Aside from the circulator, they also built a prototype of their full-duplex system--a silicon IC that included both their circulator and an echo-cancelling receiver--and demonstrated its capability at the 2016 IEEE International Solid- State Circuits Conference this past February.

"Being able to put the circulator on the same chip as the rest of the radio has the potential to significantly reduce the size of the system, enhance its performance, and introduce new functionalities critical to full duplex," says PhD student Jin Zhou, who integrated the circulator with the full-duplex receiver that featured additional echo cancellation.

Non-reciprocal circuits and components have applications in many different scenarios, from radio-frequency full-duplex communications and radar to building isolators that prevent high-power transmitters from being damaged by back-reflections from the antenna. The ability to break reciprocity

also opens up new possibilities in radio-frequency signal processing that are yet to be discovered. Full-duplex communications is of particular interest to researchers because of its potential to double network capacity, compared to half-duplex communications that current cell phones and WiFi radios use. The Krishnaswamy group is already working on further improving the performance of their circulator, and exploring "beyond-circulator" applications of non-reciprocity.

"What really excites me about this research is that we were able to make a contribution at a theoretically fundamental level, which led to the publication in *Nature Communications*, and also able to demonstrate a practical RF circulator integrated with a full-duplex receiver that exhibited a factor of nearly a billion in echo cancellation, making it the first practical full-duplex receiver chip and which led to the publication in the 2016 IEEE ISSCC," Krishnaswamy adds. "It is rare for a single piece of research, or even a research group, to bridge fundamental theoretical contributions with implementations of practical relevance. It is extremely rewarding to supervise graduate students who were able to do that!"

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The work has been funded by DARPA MTO (Microsystems Technology Office) under the ACT (Arrays at Commercial Timescales) and the RF-FPGA programs, and by the National Science Foundation (ECCS-1547406).

LINKS

PAPER: http://www.. DOI is 10.1038/NCOMMS11217.

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The international public internet group (IPIG) http://p2p-internet.weebly.com wants developers to know that internet is free, unlimited and you can reach it anywhere on Earth. Finding a cell phone tower or cable box is not required in order to reach the web.

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Peer-to-Peer Internet and “Neighbor-Networked Web” just made ISP's obsolete overnight

FREE UNLIMITED INTERNET FROM PUBLIC P2P MESH NETWORKS IS HERE, NOW!

Per The P2P Alliances at http://p2p-internet.weebly.com

NYC Mesh is trying to get around the big ISPs — one node at a time. Between them and the Red Hook Initiative, here's the state of mesh networks in Brooklyn.

Brian Hall gets on his laptop and types “ev.mesh/” in the address bar. A splash page opens. “This is the Mesh. This is not the internet.”

From this page, Hall chats with other people connected to “the Mesh.” Soon, he hopes to create a social network, where people will find local events and special deals advertised by local businesses. Maybe they’ll even be able to access Netflix, Hall said, admitting that this last wish is “just a wacky idea for the future.”

Brian Hall is a member of NYC Mesh, an organization that tries to build a decentralized network of devices, or “nodes,” which are connected between them. This network is called “the Mesh,” or meshnet, and is independent from the internet: If the internet is down, people who have access to a node can still be connected to each other. And unlike the internet, access to a mesh network is free, once you’ve bought the hardware to set up the network.

The goal of NYC Mesh is to connect all New Yorkers, provide free internet and “be an alternative to Time Warner,” Hall said.

Eight people faced their computers in a room on 3rd Avenue in Brooklyn, during one of NYC Mesh’s recent meetings. In Spain, a meshnet group, Guifi.net, managed to create a 20,000-node network, Hall said — actually the network has close to 30,000 nodes, according to Guifi’s website. One person at the table asked how many NYC Mesh nodes exist. “About 17, I think,” Hall answered with a smile, as he looked down on the table.

The Community-Owned ISPs Building an Alternative to Big Telecom in New York City

Written by Jason Koebler Staff Writer

If you want high speed internet in most any spot in New York City, you’re stuck with Time Warner Cable. Or at least, that’s how it usually works. But increasingly around the city, citizens and small community groups are setting up their own locally owned and operated free wifi networks.

This week on Radio Motherboard, we take a trip to a meetup where two nascent but potentially disruptive groups

were discussing how to collaborate in order to provide new connection options to people around the city. Since 2012, the nonprofit Red Hook Wifi network has been providing totally free internet to people in the small Brooklyn neighborhood. For weeks after Hurricane Sandy struck the neighborhood, the Red Hook Wifi network was the only way many in the community could get on the internet or make phone calls. On any given day, Red Hook Wifi has about 500 users.

Meanwhile, NYC Mesh is little more than a meetup group at the moment, but its organizers have big plans. Its network currently has about 40 “nodes,” or routers that connect to each other to form a larger wireless network. Organizer Brian Hall is currently working to set up two “super nodes” that are jacked into a large internet exchange will allow anyone in lower Manhattan and large swaths of Brooklyn to bypass traditional internet service providers and connect directly to the NYC Mesh network.

Finally, a brand new fiber project is about to give the masses a new option, at least when they’re out on the streets of New York. Link NYC is a $200 million project to replace 7,500 payphones in the city with a free, gigabit fiber-connected wifi hotspot. We took a trip to Link NYC’s headquarters to check out the new “links” and learn about how the project hopes to protect privacy, become a profitable enterprise, and provide connections that people will actually want to use.

Topics: Radio Motherboard, podcasts, new york city, Red Hook Wifi, Broadband competition, Municipal Networks, NYC Mesh, mesh networks

“The challenge is to scale up to a size where it becomes a reliable internet source,” Hall said.

Programmers and people with a tech background “all get the idea immediately,” Hall said. They like the idea of having a community-run network that doesn’t need the big internet providers. But it’s hard to sustain without getting more people onboard. “The average person is just looking for internet, really,” Hall said. “Non-technical people just want to watch Netflix so it’s hard to explain to them.”

Free internet might be a selling point for Hall. If one node has access to the internet, it can provide internet to the other nodes of the mesh network for free.

That echoes the project another Brooklyn-based organization is also currently developing.

Building a free internet network that bypasses the big providers was on the mind of workers at Red Hook Initiative (RHI) for a while, but “Hurricane Sandy kind of pushed the development,” said Robert Smith, the assistant administrator for RHI’s free WiFi project. During Hurricane Sandy, the internet was down, and RHI started to set up internet access points so people could get information and contact their families, Smith said.

FOR TECHNICAL DETAILS ON ONE SOLUTION SEE:

http://www.tranzeo.com/products/docs/EnRoute500-Mesh-sample-design-report.pdf

RHI pays its internet subscription to Brooklyn Fiber, and redistributes this coverage for free to a dozen parts of Red Hook. “We still have a lot of work to do,” Smith said. There are 13 routers operating now, and Smith said he thinks they need about 40 to 50 to cover the entire neighborhood.

Back in the 3rd Avenue room, Brian Hall said he’s planning to offer similar services via NYC Mesh. As his organization installs more nodes, he hopes to connect network with others in New York City, including the one RHI has set up. Before his meshnet reaches Red Hook, though, Hall will have to convince a lot of Netflix lovers to set up a node.

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Gregoire Molle is a recent graduate of the Columbia University Graduate School of Journalism who has covered Brooklyn for The Brooklyn Ink. The native of France is a former radio intern for Parisian radio station Vivre FM, where he reported and produced daily stories for its news show.

Profile / @GregoireMolle

The internet may feel free, but it certainly isn't. The only way for most people to get it is through a giant corporation like Comcast or Time Warner Cable, companies that choke your access and charge exorbitant prices.

In New York City, a group of activists and volunteers called NYC Mesh are trying to take back the internet. They're building something called a mesh network — a makeshift system that provides internet access. Their goal is to make TWC totally irrelevant.

How it works: Mesh networks start with one internet connection, which broadcasts that connection to another router and then jumps from router to router until it builds a whole web of "nodes." Each node is its own access point where you can log onto the internet like any other Wi-Fi connection.

In New York, NYC Mesh has about 40 of these nodes installed, and for the cost of the router (about $30), volunteers will come by and climb trees or rooftops to wire up a new node for anyone who wants to host one.

Mesh networks aren't just a makeshift version of a mainstream internet provider — they're an opportunity to create something more free and resilient. Mesh networks like the one in Red Hook, Brooklyn, are built so that if Time Warner broadband goes down in the area, mesh users still have internet access. What mesh networks need are new nodes that can daisy-chain out to existing nodes to reach places where traditional Wi-Fi hasn't gotten to. And in some parts of the world, this is already happening.

A global revolution: Mesh networks caught fire during Hong Kong's Umbrella Revolution, a student-led protest movement in 2014. During the protests, the open internet wasn't safe: Chinese government was deleting mentions of the sit-ins online, wiping posts from Chinese sites and blacking out CNN's news coverage of the movement.

So the protesters used an app called Firechat, which turns every phone into a node by linking them all together over Wi-Fi and Bluetooth to communicate. Tens of thousands of protesters at a time were organizing anonymously, without the use of an established cellular network where they could face censorship.

Mesh networks aren't just used for subverting government censors and telecom giants. They can also bring the internet to those who don't have a national broadband infrastructure.

To bring the internet to Spanish farmland and blow past telecommunications giant Telefónica, a Spanish NGO created guifi.net, the world's largest mesh network with over 30,000 nodes. In Germany, the Freifunk initiative helps people create free local networks where there are few public Wi-Fi access points.

If a storm or flood wipes out existing cable infrastructure, or knocks out the broadband in an area, a mesh network of rooftop nodes and home routers could bounce the signal along through the air, unhindered.

Guifi

The people's provider: NYC Mesh has the potential to be the internet provider of the people, but there's one problem: If you trace back the internet connections through the nodes to their root, you'll eventually reach the source of the network, which is — guess what — a Time Warner Cable connection.

"Everyone seems to hate Time Warner; that's the thing that unifies the city," NYC Mesh organizer Brian Hall told Motherboard. "It's going to be a while before we replace Time Warner, but there's some hope of it happening."

FREE UN-CAPPED, UN-THROTTLED, ULTRA-HIGH-SPEED INTERNET WITHOUT CENSORING HAS ARRIVED AND THERE IS NO POSSIBLE WAY TO STOP IT

The founder of Aereo is promising to bring gigabit internet to every home

- By Ben Popper, Jacob Kastrenakes, and Jordan Golson

At a launch event in New York City today, Chaitanya "Chet" Kanojia, the founder of the now-deceased startup Aereo, launched an ambitious new wireless hub called Starry. Starry is supposed to offer gigabit internet to the home, but delivered over a wireless network rather than a traditional wired one. The technology was built by the same antenna experts who made Aereo, and may run into its own regulatory troubles as it attempts to leverage

unlicensed bands of spectrum.

"It’s a little bit like witchcraft."

Like Aereo, Starry is a questionably ambitious idea. Kanojia wants to deliver extremely high-speed internet over the air using millimeter waves, which don't travel very far and aren't very good at penetrating obstacles — not even water in the air. That means Starry will have a lot of technical hurdles to overcome. The company is only presenting a sleek wireless hub at its event today, but it seems like more hardware — perhaps something outside the home — will be needed to fully connect to Starry's gigabit wireless network. It also means that Starry will need to set up broadcast points in very close proximity to its customers or use some sort of mesh technology to improve its reach. Doing that would likely make it harder for Starry to reach its goal of gigabit speeds. So, to be very clear, there's a lot to be skeptical about here.

Starry hasn't provided details on how it'll get around the many technical limitations in its way. "What are millimeter waves you ask? It’s a little bit like witchcraft," Kanojia says. The company keeps repeating a dense list of technologies — OFDM modulation, MU-MIMO, active phased array — which apparently add up to a solution. Kanojia acknowledges that no one has attempted internet delivery over millimeter waves before because it's difficult to get a connection from outside to inside of a house. But Starry has supposedly figured out a way to "steer" the signal using a bank of tiny antennas that increase the connection's power and accuracy. "People historically assumed fiber was the answer at all times," Kanojia says. Starry's approach, he claims, is "the most meaningful, scalable architecture anyone has proposed to this point."

Kanojia says that he wanted to launch Starry to give consumers an option about how they get internet. Most people are stuck with only one choice of internet provider — two if they're lucky — and it's difficult for new competitors to enter the space. Laying wires is expensive, as is launching a more traditional wireless network, so Kanojia is once again in charge of a company taking an unconventional approach in an attempt to quickly enter and disrupt an established market.

The company's hub, called Starry Station, doubles as a Wi-Fi router that can be controlled through a small touchscreen. The Station is supposed to include a built-in "internet health monitoring system," which will break down how much bandwidth different devices are using throughout the home and can suggest creating new networks to better suit specific devices.

"Did he say what the solution was?"

Starry still has a lot to prove. "A phased array is the worst possible choice for millimeter wave antenna. It’s terrible. I don’t understand it. The feed structure is very lossy, and it’s not cost-effective compared to a reflector or lens antenna," says Spencer Webb, an antenna consultant and President of AntennaSys. "[Kanojia] said it’s hard to go from the outside to the inside, but did he say what the solution was? Millimeter wave won’t go through a window."

Starry will launch its service first in Boston, with its hub selling for $349.99. It hasn't said yet how much it'll cost to get internet service delivered to that hub, but it has said that there will be no contracts or data caps. Sales will start on February 5th, with deliveries beginning in March. Starry plans to launch in additional cities throughout the year.

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