AI-Enabled Spectrum Technology: What's Next?

DARPA challenge reveals that AI-managed spectrum sharing still has obstacles to overcome

"You've graduated from the school of spectral hard knocks," Paul Tilghman, a U.S. Defense Advanced Research Projects Agency program manager, told the teams competing in DARPA's Spectrum Collaboration Challenge (SC2) finale on 23 October. The three-year competition had just concluded. ¶ "Hard knocks" wasn't an exaggeration—the 10 teams that made it to the finale, as well as others who were eliminated in earlier rounds of the competition, had been tasked with doing something that had never been done before. Their challenge was to see if AI-managed radio systems could work together to share wireless spectrum more effectively than static, preallocated bands. They had spent three years battling it out in matchups in Colosseum, an RF emulator that DARPA built specially for the competition. ¶ By the end, the top teams had demonstrated that their systems could transmit more data over less spectrum than is possible using existing standards like LTE; they also showed an impressive ability to reuse spectrum over multiple radios. In some matchups, the radio systems of five teams were transmitting 200 or 300 percent more data than is possible with today's rigid spectrum band allocations. And that's important, given that we're facing a looming wireless-spectrum crunch. ¶ But, as Tilghman also stressed during SC2, when a DARPA Grand Challenge ends, it doesn't mean the technology is ready to go to market. These challenges are more about proving that a new technological idea is possible. So the contest showed that AI-controlled radios can work together to share spectrum among themselves, and pack more data into a given amount of spectrum. But where does the technology go from here, now that the DARPA challenge is finished?

At MWC Los Angeles, the mobile-industry convention at which the final competition took place, a group made up of industry experts, employees of the U.S. Department of Defense and the U.S. Federal Communications Commission, and members of the top three teams all weighed in. They agreed that there's still room for more collaboration.

"Now that the competition is over," Tilghman said, "I know many of the teams are looking forward to working together with their competitors."

The competitive nature of the challenge meant that teams didn't necessarily build their systems to be as truly collaborative and altruistic as they may need to be in the real world. GatorWings' and third-place team Zylinium's systems both had modes that selfishly hoarded spectrum from other well-performing teams.

There are also larger technical questions that must be resolved. Members of the GatorWings team talked about how they spent two years building the custom software-defined radios for their system—and these team members each have 20 years of experience in RF engineering. The winning teams agreed that there's still plenty of work to be done in refining the radios, including improving the systems' "brawn"—a measure of how well their signals can resist interference and still get their own data through.

Julius Knapp, chief of the FCC's Office of Engineering and Technology, said it could be tricky to get competing service providers to share spectrum in the real world, as collaborative radio efforts require sharing information about customers that companies might not be keen to disclose.

For at least one opportunity, though, the final competition of SC2 seems well timed: the deployment of 5G networks. Several bands of spectrum are being developed for this next generation of wireless—including, for the first time, millimeter-wave spectrum. But 5G also relies on immensely valuable midband spectrum, which remains coveted and in short supply. Developing collaborative spectrum technologies alongside 5G could make the wireless generation more successful. —MICHAEL KOZIOL

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