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## Wi-Fi

### **Wi-Fi, Once a Lifeline for Mobile Carriers, Is Now a Threat**

**F**or most of President Obama's time in office, the Federal Communications Commission has worked aggressively to promote the creation of a fifth nationwide competitor in the wireless industry, one that could challenge the virtual duopoly of Verizon Wireless and AT&T Inc., which together claim 210 million customers, more than the next six carriers combined.

But so far, every effort has failed.

Verizon and AT&T still dominate the market for wireless services. Sprint Corp. and T-Mobile US Inc. are still the No. 3 and No. 4 carriers, respectively, and still scramble to undercut their much bigger rivals on price, with varying degrees of success. And that fifth nationwide carrier is still, much to the FCC's chagrin, nonexistent.

Or is it? Could that elusive fifth carrier not actually be a carrier, but a technology?

A confluence of forces—the Institute of Electrical and Electronics Engineers' (IEEE) approval of a new Wi-Fi standard, 802.11ac; the FCC's release of an additional 100 megahertz of spectrum in the 5 gigahertz band for Wi-Fi use; the proliferation of Wi-Fi devices with 5 GHz-enabled chips; the activation of hundreds of thousands of Wi-Fi hotspots by the nation's largest cable operators; and the first large-scale deployment of Wi-Fi-to-cellular roaming technology—have come together in recent months to make Wi-Fi the most formidable competitive threat to the Big Four to date.

**Wi-Fi: From Savior to Saboteur.** “The wireless carriers have completely changed their tune about Wi-Fi—because they have to,” said David Callisch, vice president of corporate marketing for Ruckus Wireless, a Sunnyvale, Calif.-based maker of Wi-Fi hardware, whose customers include Verizon, AT&T, Time Warner Cable Inc., Deutsche Telekom AG, and China Telecom.

“Wi-Fi for them [the carriers] is like a train going down the track,” Callisch told Bloomberg BNA in an interview. “You could get hit by it or you could jump on the train. They're jumping on the train.”

Though Wi-Fi networks operate exclusively over unlicensed frequencies (anyone can use them, making signals vulnerable to interference), wireless carriers continue to rely heavily on Wi-Fi to divert traffic off of their 3G and 4G networks and eliminate congestion caused by bandwidth-hungry users.

In 2013, according to Cisco Systems Inc.'s Visual Networking Index, wireless carriers offloaded 45 percent of

all mobile data traffic onto a fixed network using Wi-Fi or femtocell technology. By 2018, Cisco predicts that there will be more data traffic offloaded from cellular networks via Wi-Fi than remain on cellular networks.

These trend lines notwithstanding, the nation's wireless carriers still prefer *licensed* spectrum. The FCC is slated to hold two major spectrum auctions in the next two years, during which Verizon, AT&T, Sprint, and T-Mobile are expected to bid tens of billions of dollars for exclusive rights to the nation's airwaves.

“Carriers have historically hated Wi-Fi, because they can't control it,” Callisch said. “They've always liked the licensed band, because they can buy it and they can control it and they can deliver a quality of service to customers over it. With Wi-Fi, you can't do that.”

At least not yet. In the interim, as Callisch noted, the carriers have been busy attaching Wi-Fi antennas to their cell sites and installing Wi-Fi hot spots and routers in and around sports stadiums, train stations, and on building rooftops—all to redirect traffic to Wi-Fi.

For the carriers, it's a simple matter of cost-benefit analysis. They know all too well that a Wi-Fi access point is significantly cheaper to activate and maintain than a cell site—and does not require any licensed spectrum.

**For the Carriers, a Mixed Bag of Wi-Fi Strategies.** But this is how the Big Four see Wi-Fi: A helping hand with offload and some extra capacity here and there, little more.

Among wireless carriers, AT&T has deployed the most Wi-Fi hotspots in the United States—30,000—but mainly to bolster its 3G and 4G networks' capacity in the largest metropolitan markets.

Sprint and T-Mobile have offered voice-over-Wi-Fi calling plans to customers, but mainly to compensate for poor indoor cellular reception.

Verizon's view of Wi-Fi was stated clearly recently by the company's chief financial officer, Fran Shammo, at the Jefferies Global Technology, Media, and Telecom Conference.

“Wi-Fi technology can't replace wireless,” Shammo said at the conference, held May 6. “It's not a mobile technology, but it is complementary.”

“Wi-Fi's primary value to the telco is an offload and backhaul technology,” he continued. “You can't build enough capacity to handle that [4G data traffic] so you need that Wi-Fi offload. . . . If you look at Wi-Fi growth and LTE growth, they're both going in the same direction. They're complementary. We don't believe Wi-Fi is a replacement for wireless; it can't 'hand off.' It's complementary, not replacement.”

In the end, the carriers' main commodity is minutes and megabytes. Wi-Fi service providers' main commod-

## 'Wi-Fi First' Business Models Proving Successful

"The trends are all lining up to favor a Wi-Fi-centric mobile experience," said David Morken, co-founder and chief executive of Raleigh, N.C.-based Bandwidth.com, the parent of company of Republic Wireless, which provides a \$5- to \$40-per-month "Wi-Fi First" mobile service.

The way Republic's service works is that the customer's mobile device automatically searches for and connects to a free public Wi-Fi hotspot—or a customer's home or work Wi-Fi network—to support voice and data transmissions. When Wi-Fi is unavailable, the device switches to Sprint's 3G network for the customer's same voice and data needs. To avoid dropped calls when the customer moves out of Wi-Fi signal range, each of the devices that Republic offers—the Moto G and Moto X—uses a software protocol to "anchor" the call in the cloud.

According to Morken, since the service's official launch in 2013, Republic has won over not just lower-income and budget-conscious consumers, but also those with the means to afford a \$100-plus 3G or 4G plan. One likely reason for this is that Republic's monthly service is premised on a growing but little acknowledged trend: Consumers are using their mobile devices most when they're not actually mobile. They're using their mobile devices while they're at work or at home, where Wi-Fi is almost always available. And they're using Wi-Fi even though the quality of 3G or 4G may be the superior connection option.

"When we see 90 percent [of subscribers] using Wi-Fi for data, what that tells us is that they're having a good enough experience the vast majority of the time on Wi-Fi not to cut over to cellular," Morken told Bloomberg BNA in an interview. "They can. Particularly with our \$25 or \$40 plan. They can use [Sprint's 3G network]. There's no downside to them doing so, but they're not." He added: "The cellular network plays an important backup role, but it's no longer the primary role."

Yet despite Republic's early success in market, the company has barely made a dent in Verizon's and AT&T's collective market share. (Verizon and AT&T together boast 210 million customers nationwide; Republic's subscriber base is believed to be about 100,000).

That said, Republic's business model could soon be replicated by a much bigger incumbent. Leveraging its "homespot" dual-login gateway hotspots, Comcast could theoretically do as Republic did and pay Sprint to provide "cellular backup" to a multi-million-site Wi-Fi First network.

On C-SPAN's *The Communicators* this month, Jot Carpenter, vice president of government affairs for CTIA—The Wireless Association, was asked whether wireless carriers were concerned about competition from CableWiFi. He responded, "This is an open and vibrantly competitive market and if there is somebody out there who's got a new idea they want to bring to market, come on in, the water's fine. We would welcome them."

ity is a *session* of Internet access, irrespective of quality.

Thus the resistance by mobile carriers to embrace Wi-Fi may have more to do with protecting a legacy revenue model than about the overall quality of Wi-Fi as a mobile technology. With the carriers increasingly diverting their 3G and 4G customers' data traffic onto Wi-Fi networks whenever and wherever possible, Wi-Fi may not be so inferior after all.

"Companies that have made these enormous investments like Verizon and AT&T have in nationwide cellular networks want to believe that those investments are secure," said Richard Bennett, a visiting fellow at the American Enterprise Institute who contributed engineering expertise to create the world's first Wi-Fi wireless networking standard, 802.11-1997, nearly 20 years ago.

"There's no major shortcoming in the design of Wi-Fi that can't be overcome by improving the standard or by making more spectrum available," Bennett told Bloomberg BNA in an interview. "Wi-Fi is still less efficient than the cellular protocols, but if you have a gigahertz of spectrum available to Wi-Fi—in the 5 GHz band, for example—you can get a lot of throughput, even with inefficient protocols."

**5 GHz, 802.11ac Seen as Game-Changers.** With new regulations already being implemented by the FCC, Wi-Fi's future home will be in 5 GHz. This is important because Wi-Fi networks have historically only operated over frequencies in the 2.4 GHz band, in which signals travel farther but are more susceptible to interference from other Wi-Fi hotspots (in coffee shops, airports, and parks) and common household appliances (like microwave ovens, garage-door openers, and baby monitors). Less competition for frequencies in 5 GHz means less congestion, ultimately translating into stronger signals and better performance. And because signals in the 5 GHz band do not travel as far as those in 2.4 GHz, there will be less interference among users of Wi-Fi device over distances, therefore allowing higher data rates.

And speed is the key. The latest Wi-Fi standard, 802.11ac—known as "Gigabit Wi-Fi" or "5G Wi-Fi," which will use 5 GHz airwaves exclusively—will allow connection speeds of up to 1.3 gigabits per second per access point for laptops, smartphones, and tablets, more than enough in most cases to handle data-intensive tasks like sharing files and streaming high-definition video.

"802.11ac's goal was to provide another multiplicative increase in throughput," said Adrian Stephens, chair of the IEEE 802.11 working group and its technical editor, whose views represented that of the working group and not IEEE or Intel Corp. UK, where he is principal engineer.

Stephens and the IEEE 802.11 working group spent two years—from 2011 through 2013—developing the new standard, which offers five times the point-to-point throughput than the previous standard, 802.11n, did.

"To be cynical, bigger numbers enable marketing, because people will want to buy the bigger number," Stephens told Bloomberg BNA. "But to be less cynical, bigger numbers enable usage models."

As Stephens explained, 802.11ac makes "moving large amounts of data around" much easier.

“The operators have got huge challenges,” Stephens added, commenting on the demands that will be placed on cellular data networks over the next five years. “Operators want to use the unlicensed bands as much as they can; they want to offload that data from their networks to the unlicensed bands, which pushes them into the direction of deploying hotspots.”

**Could Comcast Become the Fifth Carrier?** As it stands today, Comcast Corp. is in the most advantageous position to turn Wi-Fi hotspots into a true nationwide wireless network that could compete for customers against the likes of Verizon, AT&T, Sprint, and T-Mobile.

How? By converting all of its residential customers’ home Wi-Fi routers into *public* hotspots. The company has already begun hooking up new gateways in peoples’ homes that transmit two Wi-Fi signals—one for the family and one for the public—capable of supporting data speeds of 15 megabits per second (Mbps) to 20 Mbps. And, if the company obtains regulatory clearance to acquire Time Warner Cable, Comcast will have a combined 29 million residential and small business high-speed data customers, each of which would be a potential new dual-mode hotspot.

On top of that, Comcast, together with Time Warner, Cox Communications, Bright House Networks, and Cablevision Systems Corp., have created a “collective” network for their hotspots called “CableWiFi,” and made them available to each other’s home broadband subscribers—in many cases for free.

But what Comcast seems to want, perhaps more than anything else, is for Wi-Fi to feel as ubiquitous as any nationwide cellular network.

**Passpoint Solves ‘Hand Off’ Problem.** Enter Passpoint 2.0, a technology that allows mobile device users to roam freely from one Wi-Fi hotspot to another, to cellular networks, and back again without having to “re-authenticate” each session. In essence, if a company like Comcast has deployed hotspots with overlapping Wi-Fi signals, end-user customers will be able to maintain one session as they move between access points, much like they would on a cellular network, and not have to key in a password over and over again.

As of early 2014, the Wi-Fi Alliance had certified more than 400 distinct devices for Passpoint 2.0—350 mobile handsets and 50 tablets. (The Wi-Fi Alliance’s 600 industry members include Comcast and Time Warner).

In an interview with Bloomberg BNA, Sarah Morris, senior marketing manager for the Wi-Fi Alliance, said she sees Passpoint going a long way toward replicating the “cellular experience.”

Earlier this month, Comcast revealed that it has entered into trial partnerships with Taiwan Mobile and Japan’s KDDI to allow their subscribers to use Comcast’s Wi-Fi hotspot network when traveling to the United States, reducing the international roaming charges that they would otherwise have to pay to the cellular carriers.

Morris also said that Passpoint could enable more “second screen” business models, in which Wi-Fi hotspot owners, like Comcast, would sell access directly to users of tablets, whose primary Internet connectivity option is Wi-Fi.

But asked whether Passpoint will turn Wi-Fi, as a technology, into a more head-to-head competitor with cellular, Morris said: “It’s a compelling alternative or

complement in some very high-volume situations. It’s not going to be a substitute for someone who’s driving cross-country at highway speeds through the middle of America having a phone conversation, but considering how the majority of consumers use their mobile devices today—for data, and nomadically—it’s a great opportunity.”

**Replacement? Or Just Substitute?** But how many Wi-Fi hotspots must there be across the country—and how much enhancement must be made to the 802.11 networking standard—before Wi-Fi can truly match cellular’s nationwide reach?

“It cannot,” said Peter Rysavy, president of Rysavy Research and a wireless engineer who works as a consultant to the carriers. “Wi-Fi can augment cellular coverage; it can substitute for it in certain scenarios. But the two are fundamentally different.”

To Rysavy, the Wi-Fi-versus-Cellular argument is a specious one. To approximate a cellular carrier’s nationwide footprint, he said, a company like Comcast would have to deploy more than 150 million access points to cover the continental United States. (That is assuming a 100-meter Wi-Fi operating radius.)

When you compare the carriers’ coverage to that of CableWiFi, the carriers have a 100-to-1 advantage.

“There are far too many ways in which Wi-Fi and cellular are different for them to ever be equivalents,” Rysavy said. “For example, if you try to do larger, 5-to-10-mile-radius cells with Wi-Fi, all of a sudden you have a lot more people that can be interfering with your signal—competing providers trying to use the same radio channel on unlicensed spectrum bands. Right now, the percentage of the total Wi-Fi coverage area that has unacceptable interference is pretty small because the coverage areas themselves are so small. But once you expand these cells, you have a lot less control. Airports, hotel lobbies, and coffee shops are controlled environments for Wi-Fi. If you expand those cells, suddenly you have so many potential new users—and potential new interference.”

Another inherent problem, Rysavy said, is the Wi-Fi protocol itself.

“Wi-Fi protocols, especially the core listen-before-talk mechanism, were designed for operation in small areas and gracefully allow for overlapping networks to share spectrum,” he said. “In large coverage areas, however, where stations are much less likely to hear each other, these protocols break down, and can result in networks interfering with each other.”

In an interview with Bloomberg BNA, Rysavy also warned about the complexities involved with every Wi-Fi hotspot provider and cellular carrier in the country negotiating Passpoint 2.0 roaming arrangements.

“The technology is now there to do seamless roaming, but the business side is harder to figure out,” Rysavy.

**Wi-Fi Emerging, Consolidation Increasing.** Wi-Fi’s emergence comes at a time when the nation’s cable and telecommunications industries are becoming increasingly consolidated.

With Comcast’s proposed acquisition of Time Warner Cable, AT&T’s takeover bid for DirecTV, Dish Network Corp.’s continued search for a merger partner, and Sprint Corp. parent SoftBank Corp.’s reported plan to combine Sprint with T-Mobile US Inc., the FCC may

soon be regulating a market with fewer carriers—not more.

Faced with such a likelihood, the FCC appears to have decided to foster competition in the wireless sector by freeing up spectrum for Wi-Fi.

In March, the agency voted to make available some 100 megahertz of spectrum in the 5.1 gigahertz band for use by outdoor, high-powered Wi-Fi equipment, part of a broader plan to release more 5 GHz frequencies for shared Wi-Fi use over the next five years.

To realize Wi-Fi's full potential, however, the FCC will have to exploit the entire 5 GHz band, from top to bottom.

"It's really all about spectrum," said Rob Alderfer, principal strategic analyst for CableLabs, the cable industry's research consortium. "Until the FCC took action recently in 5 GHz, it really wasn't possible to do Gigabit Wi-Fi broadly."

For the FCC, the challenge now is to figure out how Wi-Fi can best share the 5 GHz band with incumbent users.

Now reserved mainly for federal radar and automotive intelligence systems, the 5 GHz band was among those spectrum bands targeted by Congress in the Middle Class Tax Relief and Job Creation Act of 2012 (Pub. L. No. 112-96) for potential sharing opportunities. Under the statute, the FCC can permit the use of unlicensed Wi-Fi devices in the 5350-5470 MHz band only if "licensed users will be protected by technical solutions, including use of existing, modified, or new spectrum sharing technologies and solutions, such as dynamic frequency selection" and "the primary mission of federal spectrum users in the 5350-5470 MHz band will not be compromised by the introduction of unlicensed devices."

"When you think about Wi-Fi spectrum bands, it's important to think of it as pieces to a puzzle," Alderfer

told Bloomberg BNA in an interview. "5 GHz is a big piece; 2.4 GHz will continue to be a big piece, because that's the core Wi-Fi bands, and there are other opportunities as well."

This month, the FCC approved an extensive and complex set of rules that will govern the agency's first-ever incentive auctions of spectrum, set for 2015. At stake in the incentive auctions is as much as 84 megahertz of 600 MHz low-band spectrum, which the FCC will try to reclaim from television broadcasters and then auction off to wireless carriers led by Verizon Wireless and AT&T Inc., with a portion of the proceeds paid to the broadcasters.

Under the rules, according to FCC staff, about 20 to 34 MHz will be set aside for unlicensed use, in addition to the TV "white spaces."

"That could be a pretty significant boost to unlicensed, low-frequency spectrum, relative to what we have today," Alderfer said. "[Signals] in the 600 MHz band are very good at travelling distances, going through walls, and will be well-suited to the less-stationary, more nomadic applications. The way I think about it is that I'd love to be able to make a Skype call when I'm walking down the street—and not have to worry about my call dropping because I walked out of the range of the Wi-Fi access point. That scenario will become less likely as you're able to incorporate low-frequency spectrum."

By PAUL BARBAGALLO AND TIM McELGUNN

To contact the reporters on this story: Paul Barbagallo in Washington at [pbarbagallo@bna.com](mailto:pbarbagallo@bna.com) and Tim McElgunn in Cherry Hill, NJ at [tmcelgunn@bna.com](mailto:tmcelgunn@bna.com)

To contact the editor responsible for this story: Bob Emeritz at [bemeritz@bna.com](mailto:bemeritz@bna.com)