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Rural Broadband and the TV White Space

How Unlicensed Access to Vacant Television Channels Can Bring Affordable Wireless Broadband to Rural America

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In 2004, the FCC initiated a proceeding to determine rules to allow the unlicensed operation of wireless communication devices in unused television band spectrum between channels 2 and 51. These vacant and unassigned television channels, known as the TV "white spaces," would help make affordable wireless broadband in rural America a reality.

Although wireless is seen as critical to bringing high-speed and affordable broadband access to rural America, build-out and adoption of this service has been slow. Larger wireless providers have focused exclusively on mobile broadband and have not deployed a residential or business wireless broadband service that can serve as a substitute to DSL or cable access in rural areas. If wireless access is available, it is likely provided by local commercial wireless internet service providers (WISPs), rural local exchange telephone carriers (RLECs) or by local communities and governments, utilizing unlicensed spectrum. However, the current availability of unlicensed spectrum that spurs these networks is largely inadequate. Local providers and communities will need access to additional higher quality, low-frequency spectrum in order to expand coverage areas and improve the quality of service for both fixed and mobile access.

Unlicensed access to the TV "white spaces" would fill the need by WISPs and RLECs for additional and better spectrum, while also creating additional opportunities for local governments and entrepreneurs to bring affordable wireless broadband to underserved communities. Open and free access to the airwaves would lower barriers to entry, facilitate innovation and enable what Google co-founder Larry Page recently called "WiFi on steroids."[1] Signals in the TV band travel far greater distances at lower power and are far less susceptible to physical obstructions by trees, hills and buildings. These unique propagation characteristics can reduce network build-out costs and improve service both outdoors and indoors. The vast majority of white spaces are in rural areas, providing an enormous opportunity for local communities, governments and service providers to transform unused TV channels into rocket-fuel for wireless broadband.

The rural broadband divide

According to a 2007 survey by the Pew Internet and American Life Project, just 31 percent of rural residents had access to broadband at home, compared to 49 percent in suburban areas and 51 percent in urban areas.[2] Although reasons for the rural broadband divide are many, prohibitive costs and limited access appear to be clear obstacles to increasing broadband adoption in rural America. A 2006 survey by Local Development Districts (LDDs) of the Appalachian Regional Commission in Pennsylvania found that half of the 60 percent of rural residents that relied on dial-up for Internet access indicated that cost was the primary factor limiting their purchase of broadband services. Another 40 percent of these dial-up users indicated that broadband service was not available.[3] The survey also found that over 30 percent of rural businesses still used dial-up and almost half indicated their Internet bandwidth was inadequate.[4] Half of dial-up users cited the cost of higher speed access as the reason for their continued use of dial-up, with another 42 percent indicating higher speeds were not available.[5]

What are the TV "White Spaces" and how will they impact rural broadband?

The TV "white spaces" are vacant television channels that were set aside a half-century ago to prevent analog broadcasts in the same market or nearby markets from interfering with each other. For example, if channel 9 is licensed to a TV broadcaster in a market, channel 8 and 10 cannot be used in that market, and channel 9 cannot be used in neighboring markets. White spaces will be available in channels 2 through 51 (except 37,

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reserved for radio astronomy and medical telemetry) beginning next February when full-power TV stations in every market become digital-only and stop broadcasting analog signals. The portion of the TV band that is white space in each community ranges from 20 to 30 percent in congested urban markets such as Trenton, New Jersey, to 70 percent or more in small city and rural markets such as Columbia, South Carolina.[6]

Instead of allowing these unused TV channels to lie fallow, local service providers, community groups, and governments seeking to provide critical broadband access to rural areas could put them to good use. Thousands of locally-operated WISPs, RLECs, and community and municipal wireless networks currently rely on unlicensed spectrum in the higher frequency bands, primarily at 2.4 GHz and 5 GHz, to provide wireless broadband to rural areas. Although some of these wireless signals can travel up to 60 miles with point-to-point directional antennas, they generally work well only over very short distances or with a line of sight connection, making them vulnerable to physical obstructions such as dense foliage and hilly terrain.[7] As a result, the networks are unable to reach certain areas or require a larger number of cell towers or wireless transmitters to carry the signal, adding substantially to network build-out costs.

However, the unique propagation characteristics of signals in television spectrum allow WiFi-type devices to cover far larger areas and cut through tree lines to reach more remote areas, increasing the range of the wireless network. [8] An Intel study estimates that a rural wireless network transmitting in the TV band can cover four times the area, and at a higher quality of service, than a network transmitting in current unlicensed bands.[9] Thus, build-out costs for a wireless network incorporating the low-frequency spectrum in the white spaces would be 75 percent less than current unlicensed networks.[10]

Why unlicensed access?

The best way to ensure that the TV "white spaces" boost rural broadband is free, shared, unlicensed access. Unlicensed access would provide local users, governments, commercial WISPs and RLECs with the ability to determine the best uses for the spectrum resources in their geographic area. By allowing free access to prime airwaves, unlicensed spectrum spurs competition by promoting the entry of a multitude of service providers. Today's WiFi networks and home routers all operate on unlicensed spectrum shared with hundreds of millions of cordless phones, baby monitors and microwave ovens. Unlicensed access to the TV "white spaces" would operate the same way. Wi-Fi devices in the white spaces would operate at very low power, allowing hundreds of users to efficiently share the same frequency in a community.

How Much White Space?

Market	Post-DTV Transition	
	No. of Vacant Channels Between 2-51	**Percent of TV Band Spectrum Vacant**
Juneau, Alaska	37	74%
Honolulu, Hawaii	31	62%
Phoenix, Ariz.	22	44%
Charleston, W.V.	36	72%
Helena, Mont.	31	62%
Boston, Mass.	19	38%
Jackson, Miss.	30	60%
Fargo, N.D.	41	82%
Dallas-Ft. Worth, Tex.	20	40%
San Francisco, Calif.	19	37%
Portland, Maine	33	66%
Tallahassee, Fla.	31	62%
Portland, Ore.	29	58%
Seattle, Wash.	26	52%
Las Vegas, Nev.	26	52%
Trenton, N.J.	15	30%
Richmond, Va.	32	64%
Omaha, Neb.	26	52%
Manchester, N.H.	23	46%
Little Rock, Ark.	30	60%
Columbia, S.C.	35	70%
Baton Rouge, La.	22	44%

Source: "Measuring the TV 'White Space' Available for Unlicensed Wireless Broadband," New America Foundation and FreePress, January 5, 2006. Available at http://www.newamerica.net/files/whitespace%20summary.pdf.

The FCC assigns most licensed spectrum for wireless communications via an auction. Auctions represent an impossible barrier to entry for smaller operators, local governments, and individual users. There are large up front costs associated with purchasing exclusive licenses, which typically sell for millions and even billions of dollars since they cover larger geographic areas that rarely fit the budget or business model of start-up WISPs or RLECs seeking to cover very localized areas. Thus, unlicensed access is critical to ensuring that local users, from commercial WISPs to local governments, can utilize the unique spectrum in the white spaces to bring wireless broadband access to their local communities.

Unlicensed access would also allow for new and innovative uses of the spectrum that would benefit rural communities. For example, farmers and ranchers in some areas already utilize Wi-Fi networks on unlicensed spectrum to remotely monitor crops and control irrigation. Remote sensing and reporting can boost productivity in areas that are time-consuming and

costly to monitor. Local governments could also utilize the spectrum to build public safety and municipal wireless networks to connect emergency responders and government services. Such uses would simply not exist if the white spaces are auctioned to the highest bidder.

Examples of rural wireless networks

From a WISP providing underserved residential and business customers with broadband access, to a municipal wireless network keeping employers from relocating, the following examples offer a glimpse of the types of already-existing wireless networks utilizing unlicensed spectrum that would substantially benefit from free and open access to TV "white spaces." Such networks could utilize the unique propagation characteristics of the white spaces to reduce network build-out costs and create more robust wireless networks with better coverage and a higher quality of service.

Roadstar Internet

According to the Wireless Internet Service Provider Association (WISPA), as of early 2007 there were at least 3,000 Wireless Internet Service Providers (WISPS) in the U.S. serving about one million customers.[11] Roadstar Internet, an independently owned WISP, provides high-speed, affordable wireless broadband service to 2,000 business and residential customers in rural Loudon County, Virginia.[12] Started in 2002, the network utilizes a combination of unlicensed spectrum including 2.4 GHz, 5 GHz and 18 GHz to provide a DSL-like residential service. The first leg of the network travels 18 miles from a mountaintop transceiver using 5 GHz and makes final, last-mile (2 to 3 mile) connections by using modified 2.4 GHz Wi-Fi wireless access points mounted on customer's silos, barns and rooftops. Roadstar has also rolled out a wireless fiber alternative utilizing free and open spectrum in 80GHz for narrow-beam point-to-point high-speed connections.[13] Businesses on Roadstar's OnNet™ buildings can subscribe to 10 mbps services for the price of comparable T1 line services, or can choose 50 mbps services for $4,000 per month, a substantial savings over the incumbent telephone provider's $15,000 - $18,000 for 45 mbps service.[14]

Citizen's Communications Corporation

Over the past few years, hundreds of city and county governments have built municipal wireless networks, providing broadband access while also connecting city services and emergency first responders. Scottsburg, Indiana (pop. 6,000), is located near the Kentucky border, 29 miles north of Louisville. With an unemployment rate already exceeding 20 percent, a Chrysler auto parts plant and a prominent plastics manufacturer threatened to leave town due to the lack of advanced communications infrastructure. The city first talked to the phone company, but they were not making the capital expenditures necessary to support DSL or other high-speed technology.[15] In response, the city decided the most cost-effective solution was to build a municipal wireless network using unlicensed spectrum.

The city formed the Citizen's Communication Corp. (C3bb) to build and manage the network and used the municipal utility's water and electric towers to create a wireless coverage footprint. The network was built over a four-month period, in which 45 wireless transmitters were mounted on 15 towers, covering Scott County at a total cost of $385,000 (far less than the $5-to-$6 million cost of a fiber network). In the first year of operation, more than 350 households and 50 local businesses subscribed to the city's broadband service. The network utilizes a mix of unlicensed 5 GHz, 2.4 GHz and 900 MHz radio transmitters to reach customers not only in Scott County, but also in neighboring Jackson, Washington, Jefferson, and Clark Counties.[16]

Morrow County Emergency Management

In rural Oregon, Morrow County Emergency Management Department built a 700-square-mile wireless broadband network to monitor the region surrounding the Umatilla Chemical Depot, a U.S. Army storehouse for the destruction of chemical weapons, in case of a disaster. Utilizing unlicensed spectrum in 2.4 GHz, the wireless network helps to coordinate evacuation and emergency responses in case of a major incident, allowing local fire and police departments in seven cities, parts of three counties, and two states to communicate with each other and the emergency operations center on a common interoperable format. First responders have access to a mobile Wi-Fi device called a "recon," allowing them to view a chemical cloud's "risk envelope" in relation to their location via global positioning systems (GPS) and to retrieve, collect and send data from the field.[17] The network is also open free to the public and for a moderate fee to businesses, providing much-needed connectivity in the sparsely populated northeastern Oregon.[18]

Columbia Rural Electric Association

In the past century, rural and agricultural regions throughout America's heartland have banded together to form cooperative utilities. These cooperatives along with regional utility companies around the country are beginning to offer wireless services, leveraging existing towers and customer bases. The Columbia Rural Electric Association (REA), located in the agricultural southeastern part of Washington State was established in 1939 by a group of farmers who did not have elec-

trical distribution service and found it too expensive to connect to the existing power grid. Columbia REA chose Wi-Fi technology, operating on unlicensed spectrum in the 2.4GHz band to blanket its expansive 3,700 square mile service area in wireless connectivity, due to its low cost in comparison with other wireless technologies. The utility installed six long range "phased array" antennas that serve about 1,500 customers each and shorter-range access points in areas with obstructions or interference. In addition to providing broadband access, the ubiquitous wireless networks allow local farmers to remotely monitor crops and control pivots, irrigation pumps, sprinkler systems and other farm technology to reduce costs.[19]

Broadband Education Network

The Broadband Education Network of Somerset County and the Broadband Rural Area Information Network (BRAIN) of Cambria and Clearfield Counties have connected rural schools and areas in mountainous Western Pennsylvania, where high-speed Internet access was limited or costly. The schools' existing dial-up accounts were expensive and rendered connection speeds barely surpassing 14 kbps. With grant money awarded from the Individuals with Disabilities Act and E-Rate discounts, wireless access points were installed on the roofs of Rockwood High School and the Kingwood Elementary School using 5.8 GHz and 2.4 GHz unlicensed spectrum. Another $360,000 in grant money awarded by the Pennsylvania Department of Economic and Community Development allowed for the creation of a larger network that was soon expanded to include the Moshannon Valley School District and Philipsburg-Osceola School District and surrounding communities.

Subsequently named the Broadband Rural Area Information Network (BRAIN), it now provides wireless Internet service to school districts in Cambria and Clearfield counties, and has grown to cover over 10 school districts and over 70 different communities. In addition to connecting the schools, by utilizing excess bandwidth these networks also connect the rural surrounding communities, where broadband service had previously been unavailable or too expensive.[20]

Endnotes

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