Has ‘‘unlicensed’’ in Part 15 worked? A case study

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Abstract

Purpose – *This paper aims to review a case study of a project to provide broadband to city-run housing developments in San Francisco, California.*

Design/methodology/approach – *The paper provides a first-person account of a broadband solution implemented by the Bay Area Wireless Research Network.*

Findings – *It was found that the Bay Area Wireless Network implemented an unlicensed 5.8 GHz wireless point-to-point link.*

Research limitations/implications – *The case study provides a first-person account.*

Practical implications – *Creation of an unlicensed band through Part 15 and the development of open protocols such as 802.11 spawned low cost devices through efficiencies of scale, ease of use through competition of feature sets of the devices such as the user interface.*

Originality/value – *Digital inclusion projects such as Alice Griffith might not have been economically viable without the unlicensed bands and the open protocols. Broadband would have been at least one or two magnitudes more expensive in capital costs.*

Keywords *Broadband networks, Case Studies, Communication technologies, Internet, Wireless*

Paper type *Research paper*

1. Introduction

The Federal Communications Commission established the provisions for unlicensed operations of intentional radiators or transmitters for commutations in what was called the industrial scientific and medical bands. This was a significant change in mindset for the FCC and this case study is meant to show an example of how unlicensed devices have contributed to the community ‘‘good’’.

2. Background

The internet became a major economic entity and an essential tool for commerce in the mid to late 1990s. With that, the digital divide was identified as a significant issue by 1996[1]. Typically the digital divide has been the result of cost of the equipment to use the internet, such as computers, as well as the cost or lack of access in connecting to the Internet. Many efforts by local community groups and governments have been made to attack the issue but one problem that they all encountered was addressing the ‘‘last mile’’ to connect the disenfranchised.

Two groups of companies were prepared to jump in and address the need for broadband to the home. These were companies that already had built out wired infrastructure such as voice grade copper that the incumbent Regional Bell Operating Company (RBOC) had installed and maintained for the last 100 years under a guaranteed profit of the AT&T

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monopoly or so or the guaranteed profit of a local franchise cable company that had deployed uni-directional coaxial cable for television distribution.

Each of these companies had technical hurdles to overcome in order to have a product that could satisfy business and residential consumers. The RBOC had to find technology that could deliver one or more Megabit per second (Mb/s) of bandwidth over various grades and conditions of copper pairs of which the installations can date back to nearly 100 years. A number of ITU standards[2] such as various grades of DSL were developed to support services that could work for the incumbent telephone companies in working with this older infrastructure.

Cable companies adopted technologies like Date Over Cable Service Interface Specification (DOCSIS)[3] and had to upgrade the current cable system to one that provided bi-directional bandwidth as almost all cable deployments had amplifiers that only sent the signal towards the customer and not back which was required for supplying broadband.

With the RBOC and cable company deployments, there were significant costs in upgrading and providing broadband services. Besides the last mile capitol expenses, there were core network equipment design and deployments that can easily run into the millions of dollars. Just ten years before, this deployment, the monopoly of AT&T was broken up through the case *United States* v. *AT&T*, and opened up competition in the form of competitive local exchange carriers (CLEC). The local RBOC had to not only address the costs of a broadband offering and compete like they never had to do before. Broadband offerings were rolled out over a decade and in many locations of the US, it still is not offered. Typically these are areas that do not support the customer density to see a return on investment (ROI) in short term to cover the capitol costs.

Customer density can occur in a couple of ways; either the population is so sparse, that it may be several miles between customers or that the population may not be able to afford it. The later was true for many low-income areas of city populations. In San Francisco, the southeast corner of the city has a significant low-income population. According to the 2000 US census, many neighborhoods of this area of San Francisco will have more than 50 percent of the families that are classified as under the poverty level[4]. The local San Francisco RBOC (then SBC) understood this as being an area where the ROI was not as great and in 2004 it was one of the last areas that they had not built out DSL offerings.

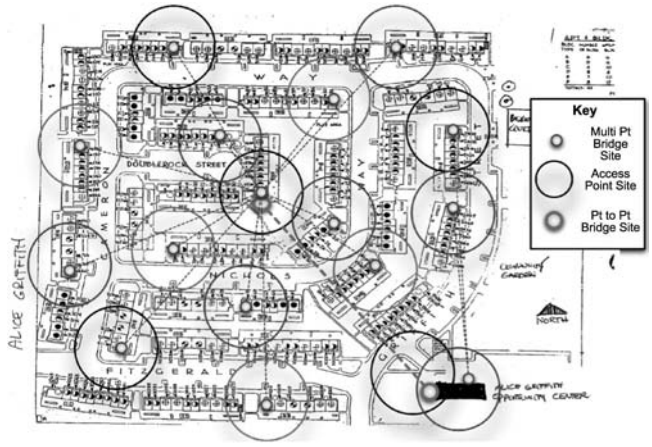
3. Alice Griffith – design and deployment

In 2005, the City of San Francisco's San Francisco Housing Authority (SFHA), with prompting from organizations like One Economy, started a project to provide broadband to city run housing developments. The first development was the Double Rock or Alice Griffith Housing Development in the extreme southeast corner of the city. Alice Griffith/Double Rock is a gated community that consists of 254 housing units, clustered in double-deck barracks originally built for navy shipyard workers.

The city of San Francisco understood that delivering broadband to the residents meant that infrastructure was needed to provide the last ''100 feet''. Installing Ethernet to each unit was going to be a problem. As the Alice Griffith buildings were built in 1962, they have only basic copper wiring supporting telephone service. Plumbing in new Category 5 or better cabling would be cost prohibited. Additionally there were plans on the table to tear down the current buildings and replace them with more modern structures within a number of years.

Working with One Economy, SeaKay and commercial companies like cisco, the city was able to design and deploy an 802.11b network to the end user with a backbone at 5.8 GHz within the development. Access points for the end user were placed at multiple points in each of the two story buildings in order to provide enough signal into each unit. Each of these access points were connected to multiple 5.8 GHz radio links that ''shot'' back to the a two story building known as the ''opportunity center''. Figure 1 shows a map of the distribution of

Figure 1 Alice Griffith LAN topography



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access points and backbone links in the complex. The opportunity center is in the lower right corner of this map.

The city of San Francisco faced another problem with this project. They were able to address the last 100 feet within the complex but delivery of broadband for the last mile was blocked by the incumbents. Alice Griffith has been in effect ''red lined'' by broadband providers with SBC (now AT&T) not providing DSL service in the area and the city of San Francisco not being able to come to an agreement with the local cable company to provide broadband to the development. The only ''solution'' the city could find would be to bring in two bonded DS1 circuits that would provide 3 Mb/s at the cost of $1,300 a month.

The ''last mile'' was even closer than a mile. About a half a mile away is a major hub for the internet, commonly known as ''200 Paul''. The data center at 200 Paul contains a majority of the carriers for the Bay Area such as XO, MFN, CENIC, Level3 and AT&T. Thousands of gigabits flow through this building. It is considered one of the more well connected locations in the Bay Area and the USA.

The city of San Francisco contacted myself as founder of the Bay Area Wireless Research Network (BAWRN), to look for a solution. The timing worked well as at that point in time I was a co-owner of an ISP at 200 Paul and could provide the expertise to design and deploy the link and could provide the bandwidth to the internet.

An unlicensed 5.8 GHz wireless point-to-point link was quickly decided on. A direct link was determined as not feasible but ''bouncing'' it through and existing AM radio transmission site just south of the 200 Paul and Alice Griffith sites was studied and found to work. Agreements and Memos of Understanding (MOU) were established between my company, the building owner at 200 Paul, the City of San Francisco and Bonneville International who was the AM tower owner at the time. The only recurring cost was $1 a year for the lease of the AM transmitter building. This was a significant savings over the $15,600 a year for the DS1 lines.

Figure 2 shows the paths from 200 Paul to the AM site (KOIT) and then to Alice Griffith.

Radios were purchased and deployed within weeks of the start of project. Most of the schedule was taken up with the legal paperwork that was needed between all of the parties. Capitol costs were under $20,000 for link to Alice Griffith.

Figure 2 Microwave path between 200 Paul, KOIT-AM and Alice Griffith

© Google 2009 - Map Data; 2009 TerraMetrics

Figure 3 shows co-worker Otto Grajeda on top of the Opportunity Center, next to one of the 5.8 GHz antennas that links to each of buildings. ''Candlestick Park'' can be seen in the background. Otto is installing one of two (main and backup) 5.8 GHz radios that will be providing transit into the complex. These links can provide up to 50 Mb/s of bandwidth into Alice Griffith.

By developing the AM radio site, the city has been able to add additional radios to supply bandwidth to other housing development locations. Figure 4 shows a schematic of the links going between 200 Paul, Alice Griffith, a couple of proposed Hunters Point links and Mount San Bruno.

Figure 3 On the roof of the AG Opportunity Center installing the link back to the internet

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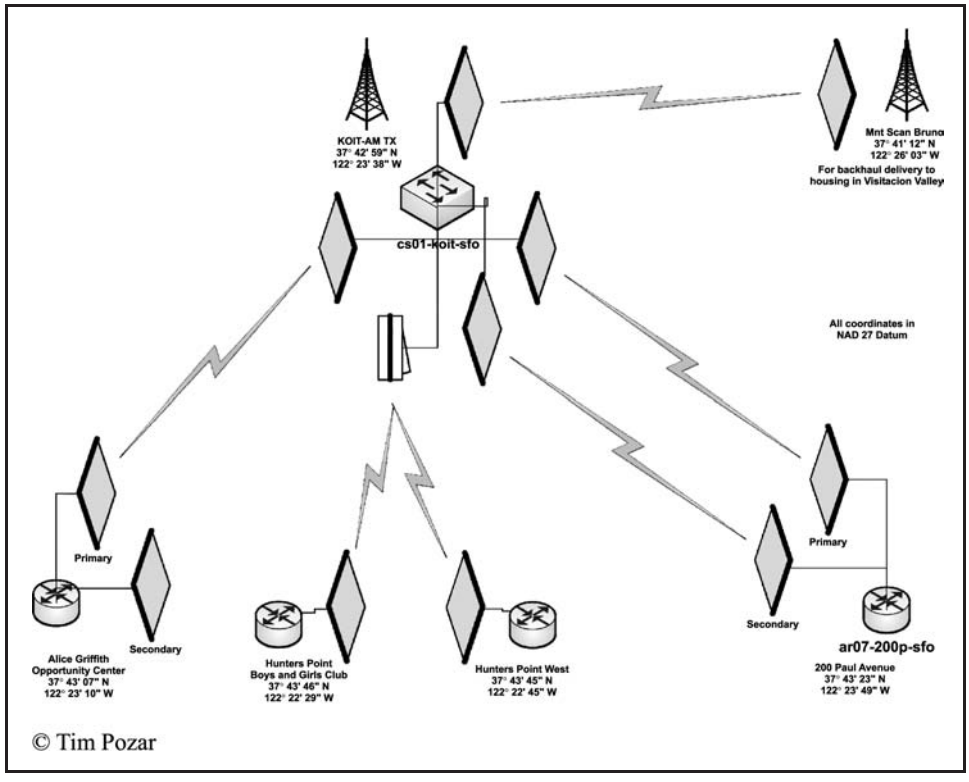
Figure 4 Housing development network schematic



The Alice Griffith deployment was considered a success in the deployment of broadband. So much so that, other housing developments have followed such as the Sunnydale development in 2008/2009 that can support up to 1,600 residents. Where developments can accommodate wired infrastructure, the city is still deploying wireless access points typically on top of the development's buildings in order to supply access to outside users and the city residents near the development.

4. Conclusion

Creation of an unlicensed band though Part 15 and the development of open protocols such as 802.11, created low cost devices through efficiencies of scale, ease of use through competition of feature sets of the devices such as the user interface.

Without these bands and the open protocols broadband would have been at least one or two magnitudes more expensive in capitol costs. Certainly there would be a recurring cost in licensing and maintenance of the equipment we do not see with unlicensed radios. It is likely that digital inclusion projects such as Alice Griffith would not be economically viable.

Notes

1. William J. Clinton, ''Remarks of the President and VP in Knoxville TN'', (http://archives.clintonpresidentialcenter.org/?u = 101096-remarks-by-president-and-vp-in-knoxville-tn.htm).
2. InterOperability Laboratory ''UNH-IOL DSL Knowledgebase'' (www.iol.unh.edu/services/testing/dsl/training).
3. Cable Television Laboratories, Inc. ''DOCSIS Specifications Archive'' (www.cablelabs.com/specifications/archives/docsis.html).
4. Year 2000 United States Census data for 94124 zip code, ''Families below poverty level'' (http://factfinder.census.gov).

About the author

Tim Pozar is a telecommunications consultant specializing in microwave engineering for government and commercial applications. He was an early entrepreneur and developer in the internet start-up area, co-founding companies including TLGnet, San Francisco's first ISP, Brightmail, an early anti-spam company, and others. He is active in community wireless networking, and is a co-founder of the Bay Area Wireless User Group. He is also leading the Bay Area Research Wireless Network's (BARWN) effort to study the scalability and sustainability of deploying wireless high speed internet access for urban and rural settings to address the digital divide. BARWN is working with the city of San Francisco to deploy back-bone and last mile to the city's housing developments. He has also published a number of papers covering the regulatory issues in the USA and engineering of high-speed wireless networks. Tim Pozar can be contacted at: pozar@lns.com