

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands)	WT Docket No. 06-150
)	
Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band)	PS Docket No. 06-229
)	

SECOND FURTHER NOTICE OF PROPOSED RULEMAKING

COMMENTS BY PETER G. COOK CONSULTANCY, INC.

The PETER G. COOK CONSULTANCY, Inc. (PGCC) is submitting these comments in response to the **SECOND FURTHER NOTICE OF PROPOSED RULE MAKING (NPRM)**, FCC 08-128, Released May 14, 2008.

PGCC is a Mesa, Arizona-based consultancy offering consulting services in wireless communications systems, with emphasis on Public Safety. Hypres, Inc. of Elmsford, NY, a manufacturer of high-performance electronic equipment using Superconductor MicroElectronic (SME) technology, is a client of PGCC. PGCC is active in the Software Defined Radio Forum, with support from Hypres.

Introduction

The FCC Second Further Notice of Proposed Rulemaking (NPRM) at Paragraph 38 mentions a project to install WiFi broadband access on a thirty-

mile corridor of I-19 in Arizona¹. PGCC has done considerable investigation of that project and others, including interviews with a number of the participants. This submission is intended to provide information on the I-19 project, and similar projects in the State of Arizona, and comment on the lessons learned.

The referenced section of Interstate stretches due north from the Mexican border through Santa Cruz County into Pima County. Although sparsely populated, this road is the scene of intense Public Safety (Public Safety) activity, dealing with illegal immigrants headed north and stolen cars driving south. Under a grant from the Information Technology and Evaluation Program (ITEP) of the Department of Homeland Security (DHS) a network of 20 IEEE 802.11 access points (AP) were installed, in 2004-2006, and their performance in supporting Public Safety and commercial applications was evaluated.

Although installation and initiation of the system proved more difficult than anticipated, the total scope of the system was accomplished. It delivered data transfer rates of 2-4 Mbps to mobile units throughout the corridor, but, at high vehicle speeds (75 MPH) and high data rates, was prone to drop the connection during handover.

Funding for the program terminated in 2006, but it is continuing in operation as a commercial network. With the wireless connectivity in place, a number of applications have emerged. Although there are many differences, the close parallel between this project and the proposed 700 MHz network have potential to illuminate both difficulties and opportunities attending such a system.

¹ See also: WIFI SECURITY for First Responders U.S. Department of Homeland Security Award #2004-GR-T4-K002, ATIC DHS WiFi Security Project, ITEP Final Report, June 28, 2006

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In addition to the ITEP I-19 project, there are several similar installations in Arizona. The Graham County Sheriff's Department is on its second generation of equipment for a WiFi system. The City of Tucson has a Tropos Networks 2.4 GHz system supporting real-time data between en-route ambulances and hospital emergency facilities. WI-VOD², the system architect for the I-19 project has several similar installations in other parts of rural Arizona, and supports roaming between them.

Overview

The Public Safety market is characterized by tens of thousands of independent decision making buyer organizations, many of which operate under severe financial constraints, and lack in-depth expertise in communications system architectures. The supplier side has a relatively few participants, but is faced with the arduous task of selling to the individual perceived needs of a large number of small customers. The result is, from a systems perspective, chaotic, and limits the economies of scale by a factor of two to three orders of magnitude from that enjoyed by the commercial wireless community..

The availability of 700 MHz spectrum offers an unusual opportunity. It is a chance to put in place a nationwide system with a single architecture, substantially reducing arbitrary and costly minor differences as now exist. It has promise of supporting commercial traffic that can fill in between the highly variable fluctuations of Public Safety traffic, and provide a revenue stream from spectrum that would otherwise be fallow. It also delivers highly professional system management, with trained professionals working to optimize a visible and measurable objective function.

The intent for this new spectrum is to provide wideband mobile access. Such access is an incremental enhancement; it provides capabilities not previously

² www.wi-vod.com

available to personnel in the field. In particular, it is not intended initially to replace the currently installed voice systems that are the backbone of Public Safety communications.

This restriction is important for two reasons. The first is that, as an incremental enhancement, failure of the system to function due to low signal strength results in a condition that is no worse than the current state of affairs. During a traffic stop, for instance, the officer would not have a picture of individuals associated with the offered registration and license.

The second reason deals with the inherent differences between voice and graphic stimuli. Voice is ideal as the primary means of communication because it can be used while driving or in the midst of other physical activity. Think of the difference between a radio transmission of a “Suspect is armed” warning and being handed a written warning. Assimilation of graphic material, while very useful in making an identification, takes longer and demands more attention than voice. So, although the packet-based digital systems can certainly provide voice through VoIP, it is not economically feasible to initially engineer the new systems up to the level of voice capability provided by existing trunked LMR systems.

In light of these observations, we can consider how the lessons of the Arizona wide-band systems can be of value in moving forward with 700 MHz deliberations and set the grounds for development of the Public/Private Partnership (PPP).

Perspectives

We suggest five perspectives to aid in understanding accomplishments and problems in orthogonal dimensions. Those perspectives are:

1. Demographic
2. Technical
3. Economic
4. Operational
5. Political

Parsing the information available with this structure provides a number of different views of the lessons learned by the experience.

Demographic

The new system is intended to provide the same capability nation-wide. But distribution of people, resources, and funding vary widely between densely and lightly populated areas. In a major city a very few Public Safety organizations control communications, have significant internal expertise, and obtain substantial funding. High demand levels justify installation of equipment to support specific applications and to overcome local coverage issues.

In an area such as the I-19 corridor, not only is the population density low, but there are a dozen or more Public Safety stakeholders and other government organizations needing communication system access. The proliferation of small government entities also complicates the process of making system architecture decisions, obtaining necessary permissions, finding appropriate vertical sites with power available, and physically installing system access points (AP).

Low population density reduces potential dollars per unit area to support commercial use of the system, but also reduces contention for bandwidth. More multi-purpose equipment is needed to economically support a variety of applications, and emergency situations are more likely to need portable or deployable equipment rather than using permanently installed infrastructure.

Technical

The I-19 project, as well as others in Arizona made use of commercially available WiFi (IEEE 802.11) equipment in order to reduce costs. The most common configuration was an infrastructure Access Point (AP) linked to a mobile access point (MAP) in a vehicle with a Vehicle Local Area Network (VLAN) connection to a laptop computer.

The problem of finding appropriate AP sites at 3 kilometer intervals was more difficult than originally anticipated. Line-of-sight and seasonal foliage variation needed to be taken into account. Antennas were placed on existing towers, buildings, electrical poles, and even tall signs. Some units were deployed with solar panels as an energy source, a power source that proved viable.

The system operates as a mesh network, with four transceivers at each node. Backhaul requires special consideration. Wireless backhaul reduces effective system capacity, but serves when wideband landlines are not readily available in remote areas. Once area coverage was in place, it was adequate to reliably support a number of applications.

Once the system was installed, good coverage was obtained for stationary terminals. For vehicular terminals moving at 75 miles per hour, the handoff between APs, occurring slightly less than once a minute, was not dependable. An unexpected problem was equipment performance variation due to extremes of temperature found in the Arizona desert.

Connection setup while moving was problematic, both because of conflicts between handover and the connection process and because of potential for driver distraction. Even with an external antenna, the initial connection was best accomplished while stationary.

Security was an initial concern. Perceived risks hampered early efforts to obtain commitment to use the system, and were used by some skeptics as a substantial question. In order to provide a reasonable degree of security, the project took on a “whitelisting” protocol, under which ability to connect to the system was limited to registered and approved users. In commercial practice, encryption methods have been introduced to overcome the weaknesses of the original WEP.

The intent of this project was to explore the potential for Public Safety use of broadband wireless. The number of different applications that emerged indicate that not only Public Safety, but number of other organizations, businesses, and individuals found adequate connectivity. In the proposed 700 MHz system two significant needed enhancements are longer range and ability to operate reliably at normal highway speeds.

Economic

Total funding for the project was \$500K, of which \$34K was for equipment. The DHS grant served to kick-start the project and demonstrate its viability. It is still functioning under the aegis of WI-VOD serving as an Internet Service Provider³.

There was considerable resistance to the project from various stakeholders who saw it as either competitive or simply “not invented here”. All of the serious objections were overcome, and the system became economically viable as numerous organizations found ways to take advantage of its capabilities.

One of the unexpected obstacles was the difficulty of obtaining all of the needed permissions and right-of-ways. In some cases substantial payments were suggested for rights of way. In some cases in-kind arrangements were made where reduced price services were granted in return for needed

³ Current pricing for the system can be found at <http://www.wi-vod.com/pricing.php>.

antenna placement. In other cases the cost was prohibitive, and alternate placements were found. One of the lessons learned was to tackle this problem early, and to make sure written agreements were in place to avoid later disagreement (and cost of resolving disputes or relocating).

The project started with a focus on area security and Public Safety operations. It quickly became clear that there was a strong motivation for commercial use of the facility which, in turn, provided a very helpful revenue stream. Careful evaluation of application potential, development of an economic model, and precise construction of the business case for mixed use was another of the lessons learned.

In the case of the PPP, timing is a critical issue. Prior to negotiation of the network sharing agreement (NSA), a high degree of uncertainty about the cost structure exists, but the auction is prior to the NSA to identify who the D-Block licensee will be. . Reserves to cover contingencies associated with that uncertainty will inhibit bidding for the D-Block spectrum. Provision for federal funding to remove uncertainty is one solution.

Operational

In reading the reports of the wideband data projects in Arizona one gets the impression that applications emerge in significant numbers from unexpected places. Graham county emphasized that Sheriff's Deputies could complete the paperwork for their shift from a vehicle located out in the community rather than back in the office. This had the desirable effect of having them closer to potential call destinations and providing the traffic calming effect of a Police presence at key intersections.

Although voice communications are key to operational communications, graphic material has important supplemental value. An officer making a traffic stop can enter the license plate of the stopped vehicle and scan the driver's license. Then information from the Criminal Justice Information

System (CJIS), including photographs of the real license holder, and a picture of the vehicle model and color, help the officer decide if they consistent, or if there is something suspicious.

Mobile cameras played a role in several applications. One was a camera mounted on a bridge taking pictures of cars passing below. Acquiring pictures at a rate up to four cars per second, picture recognition software can locate and recognize the license plate. An adaptation of face recognition software can identify the car type and color. A mismatch is possible evidence of a stolen car being driven to Mexico, and can provide an alert to patrol units.

Another camera use was to monitor places where illegal dumping was taking place. Hidden cameras and motion detection software can alert dispatchers of a potential violation.

The University of Arizona Telemedicine has a trailer that serves as a mobile clinic. Using a broadband connection, it can be in with a Doctor in Tucson to assist in diagnosis.

Using GPS tracking, vehicle locations are available to both dispatchers and other units in the field as locations on a map.

Fire departments can transmit building plans, hazmat information, pictures, and maps to units on the way to a fire.

Warehouses handling about 40% of the US supply of winter produce from Mexico are located in the coverage area. This connectivity supports sensor technology to protect against chemical and biological threats to the food.

Political

This initiative, funded by the Federal Government, was supported by the Governor of Arizona, the state Government Information Technology Agency

(GITA)⁴ and a number of other state agencies. The following quote from the final report is indicative of the local climate:

The involvement in and affirmation of the project by state agency directors increased the likelihood of political subdivisions such as counties, cities, towns and school districts to support and participate in the project. This acceptance was important, because only with local help and support would the project succeed.

However, such high level influence did not make success automatic. For example, local government prerogatives had to be respected in their use of permits and rights-of-way as a source of revenue. Indeed, such constraints, along with similar issues from the private sector, led to major project delays and to the constant need to re-engineer the network. Until near the end of the project, key antenna node sites were being changed or eliminated because right-of-way or permitting issues either prohibitively increased costs or pushed time limits beyond viability.

Local governmental agencies, businesses, and individuals all have vested interests, often overlapping, sometimes conflicting, in the geographic area covered by the I-19 project. The final report indicates that dealing with the diverse individual interests was the source of considerable delay and incremental cost for the system. Local organizations, accustomed to a high degree of autonomy, did not feel any strong compulsion to expedite installation of the system, or even to make extensive use of it.

Local control of community attributes is derived from the tenth amendment to the constitution, and ingrained in the American political system. Communities can adopt local laws, enforce them through police action, and determine what emergency response resources to maintain. Mechanisms to coordinate consistency between jurisdictions are generally weak. As a result, standardized adoption of new technology is most effective when externally supplied. The external source may be from commercial organizations, such

⁴ Much of the detailed information in this report was furnished by Galen Updike of GITA, gupdike@azgita.gov

as 1,435mm for railroad track gauge or 60 Hz for power generation. Or it may be generated by the Federal government, such as currency design to deter counterfeiting.

Conclusions

This project was intended to demonstrate the viability and effectiveness of wireless broadband for Public Safety, other agency, and commercial users in an area of strategic importance but sparse *demographics*. It was effectively managed, and a significant technical success. It serves as a successful proof of the concept.

The project was successful from an *economic* perspective. Although it did not originate as an entrepreneurial opportunity, the DHS funding provided the starting impetus for the system. Once installed, a number of applications emerged, and it is now being operated as an Internet Service Provider. The same model is being used in several other parts of the state.

Operational aspects of the project were disappointing. It should have received more use than was actually experienced, but lack of enthusiasm of some area participants was noticeable. This response is in contrast to that experienced in Graham County, where a substantial part of system funding justification is based on the cost-benefits of added police presence in the community for a given level of sworn officer staffing.

A very positive aspect of system operation is the number and variety of supplemental applications arising from bandwidth availability.

Political aspects of the system are a major source of concern. Some local organizations did not demonstrate motivation to support the system, and no mechanism was found to compel them. It was a case of small (perceived) carrot and no stick. A major nationwide initiative supported by the federal government would probably see a more positive reception than a state pilot

project. It is important to have the program offered to local jurisdictions with a very limited range of options. Having to negotiate many thousands of individualized agreements would be prohibitive.

There is a significant lesson to be learned from this political situation: Spontaneous and voluntary participation and support cannot be assumed. Implementation provisions for this concern must be an integral part of initial planning and may even have an impact on system architecture.

The *technical* experiences from the I-19 project are probably less relevant. Propagation at 700 MHz is quite different than at 2.4 GHz, and newer air interfaces than 802.11b/g available. With a nationwide buildout, the D-Block licensee will have more resources and relevant experience to deal with siting problems. The key requirement is availability of reliable wideband wireless access; given that, the rest of the lessons derived from the project are relevant.

This experience supports the FCC position proposing to use D-Block and the adjacent Public Safety spectrum for nationwide broadband connectivity with commercial ownership subject to Public Safety constraints. Working under guidelines established by the Commission, the D-Band and Public Safety licensees, possibly aided by others, define how the system is to be implemented and used. They agree on an architectural approach based on commercial standards with a very small option set to be implemented nationwide. Commercial use pays for the system, with Public Safety usage given priority under specific conditions. Local decision-makers basically have two choices: sign up or don't sign up. Those signing up receive service at a rate lower than commercial users, and have access to equipment that benefits from commercial economies of scale and government subsidies (the carrot). System coverage and other Public Safety reliability requirements apply only to the territorial boundaries of organizations subscribing to the service.

Commercial coverage in the areas of rejecting organizations is optional, and will not include a Public Safety priority scheme (the stick).

PGCC submits this information with the intent of making the results of the DHS funded I-19 Corridor and related projects available to the Commission and others considering Public Safety needs and commercial opportunities in the subject spectrum.

Respectfully submitted:

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