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An Approach to Statewide Wireless Networks

Several states have initiated programs “for the purpose of implementing a statewide wireless broadband network”. These statewide programs exhibit a number of different priorities, but connectivity in under-served rural areas is the practical number one priority for most. Despite the recent wide swings of the hyperbole pendulum, many believe that thorough planning and a balanced approach will move to these projects forward and help the "community" broadband market develop.

The fundamental underlying concept in these initiatives is that computer and communication networks form an important societal infrastructure. They are vital and integral to the operations of many sectors of our society - from government, healthcare, and educational institutions to financial and manufacturing businesses. They are engines for economic growth. However, traditional networks and business models seem to have reached limitations that hinder the social, cultural, and economic growth in many of our rural regions. State initiatives want to provide these communities with improved, affordable access to broadband telecommunications infrastructure so that they can compete on a level playing field with their more urbanized neighbors.

The statewide wireless networks envisioned encompass large geographies with very diverse requirements and challenges. There are often obvious topological differences, going from the coastal lowlands to the hills and mountains often found further inland. In addition, states contain hundreds of governmental jurisdictions and communities with distinct urban, suburban, exurban, and rural flavors. Community demographics often vary significantly, with only a few large urban areas, and some moderately-sized communities. However, many states contain expanses of sparsely populated rural countryside – dotted with relatively small towns and villages. These communities may have well-formed centers around which some people and commerce are centered, but much of the population is spread along country roads, or located around relatively isolated features of local natural beauty. Within states, regions and communities each have unique qualities, which need to be reflected in designing the network, its business model, and it governance. The biggest challenge for these statewide initiatives often is how to effectively utilize the state’s collective power and resources, while fully incorporating, and even leveraging the unique character and spirit of each community. While this white paper was originally developed for a specific southern state, and may not be totally applicable to another state’s program, it is intended to contribute the author’s experience helping several states and communities implement similar wireless broadband networks.

Introduction

Our society and economy is increasingly reliant on information and correspondingly, depends on the technology and communications networks connecting people and organizations to the information they need on a daily basis. Today's complex world demands efficient delivery systems capable of quickly delivering large volumes of products and services – in both public and private sectors. Increasingly, wireless communications networks accomplish this by extending delivery systems into the "field," close to the ultimate consumer, patient, client, or constituent.

In addition, many rural and/or low-income communities are isolated from recent technological advances. They do not have access to personal computers, the Internet, or the interactions and opportunities these technologies provide. This experience defines the "digital divide" – the separation between those who do and those who do not have access to information technology. In many cases, traditional service providers, governed by commercial business models, have failed to provide ubiquitous low-cost broadband access. This is particularly so in the densely populated, but relatively low-income markets, or sparsely populated rural geographies of many states. At the same time, economists have long acknowledged that ubiquitous broadband communications networks stimulate the economic growth and prosperity so badly needed in these communities.

Wireless broadband technology platforms have developed to the point that public-private partnerships can implement networks capable of delivering economical, reliable, and secure wide area coverage with universal access across an entire community – even if that community goes beyond one city to encompass a county, a region, or even entire states. The public's growing acceptance and adoption of wireless-enabled mobile devices, such as laptops and PDA's, combined with the enormous growth of content transported over the Internet, has resulted in significant increases in demand and the ability to effectively use high-speed bandwidth over a wide area.

The growing digital divide and the availability of new low-cost wireless communications technology increasingly drives communities to adopt innovative approaches to investing in broadband communications infrastructure they require to provide truly mobile and interoperable voice, video and data applications for institutional users, residents, businesses and increasingly for public safety purposes. New business models that value returns on "social capital" as well as financial capital, and aggregate demand across disparate community groups enable the implementation of wireless networks with the broadest access, deepest market penetrations, and lowest possible costs that make such networks sustainable into the future.

Such business models often require building a governance model based upon public-private partnerships that can be made quite attractive to private companies and local service providers. Building partnerships that include local service providers often enables the "public" part of the partnership to focus its efforts and investments in incrementally expanding network infrastructure and services to specific portions of the community with

special needs. Public support can come in the form of anchor tenancy for services used, low-cost capital, or subsidies to promote digital inclusion.

The Market Context

The telecommunications services industry is a huge business in the US, with wired communications worth over $299 billion per year and wireless communications adding another $240 billion. Much of this revenue comes from voice communications, but with the growing convergence of voice into data, broadband data communications is increasingly important. Application requirements determine users' preferences for fixed wired or mobile wireless access. Over the past decade, broadband data network deployment has grown rapidly, with U.S. broadband penetration standing at approximately 45% of households nationwide. The rising popularity of Wireless Fidelity, or WiFi, with more than 400 million client devices in existence today (more than 100 million in the US), has created a consumer, business, and institutional demand for anytime/anywhere broadband data access.

Growth in broadband access for households is being dramatically echoed by growth in municipal and county-wide broadband networks. The September 2007 MuniWireless list of U.S. wireless broadband deployments still shows a significant 39% growth in community wireless activity for 2008, and more than 400 community wireless networks operating or being developed by cities of various sizes around the country. Normally, communities would expect demand for community wireless access to be easily satisfied by traditional service providers participating in such a large and dynamic industry. Yet, evidence shows that this is not the case. The MIT Internet and Telephony Consortium Group (http://itel.mit.edu/) has identified a number of forces driving the implementation of municipal broadband access networks:

- Local broadband needs have not been met by many private sector providers in an adequate manner.
- The current economic environment, especially in regards to telecommunications, makes such deployment highly unlikely in the near future.
- Regulatory and legal delays caused by the 1996 Telecommunications Act and initiated by incumbent service providers have resulted in institutional stalemates and excessive cost factors to create an inefficient path to broadband deployment.
- The over 400 community broadband deployments in some phase of development are proof that establishing city-wide broadband networks can be extremely effective.

Even though the press has highlighted some notable growing pains among community wireless network projects, the empirical facts show, quite simply, that these community networks provide citizens and businesses the low-cost broadband access they want, save lives, make first responders more productive, improve the efficiency of government workers, and much more. States and local government usually have largest number of

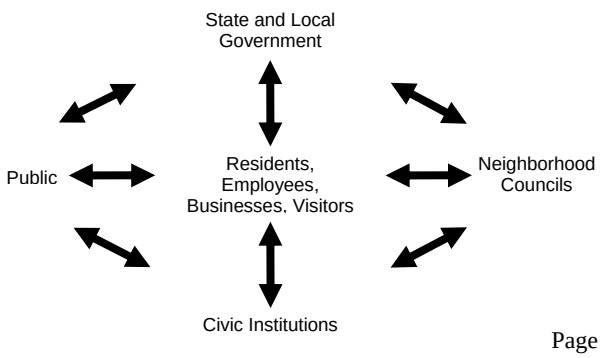
workers employed within the network coverage area, so the long term savings provided through the delivery of more cost-effective public services contributes significantly to the financial sustainability of these networks. Realistic and successful community wireless models do exist and work. Regardless of whether community broadband wireless networks are provisioned by a city or a carrier and whether their purpose is improved public safety, stronger economic development, or more broadband Internet access, they are working.

Developing the Local Market for Wireless Broadband Applications

Successful networks and network business models are based upon applications and services that solve real problems and deliver real value to people and organizations in the community. Sometimes these networks appropriately start focused tightly on specific applications, such as public safety or government services, but with broader projects such as envisioned by statewide programs, many high-value applications can, and should, be identified. However, the remoteness and lack of broadband connectivity in many under-served regions often stifles general market understanding and appreciation of today's broadband services and their benefits. Similarly, these geographies often lack the software infrastructure necessary to implement the most useful applications on broadband wireless networks. A significant effort is required to educate the market and to foster the cross-sector collaboration that focuses resources on building the applications necessary for the community broadband network to deliver its full potential.

For this reason, communities should endeavor to use their networks and associated marketing programs to completely reflect the unique character of their "community". This strategy supports local self-expression and entrepreneurship of network users and customers, while promoting a "local community" branding opportunity for the network and its partners (as with RI-WINs, Neighbor Net, and Adirondack Lifestyle from some of the author's projects). The objective is to have local markets identify their networks as closely as possible with their local community – as its indigenous communications network. In the best outcome, residents come to view the network as a community resource that they prefer using as an expression of civic duty and a source of pride in the region. Customers need to identify with and adopt their community network and its service provider partners as their very own "community" network. This maximizes network traffic by aggregating community usage on the network and insures significant revenue and cash flow. Ideally, the entire community becomes stakeholders, vested in the idea, supporting the community broadband project as if it were the "home town team". This makes a broad public-private partnership possible, and is usually the key to a successful community broadband network marketing effort.

Following a strategy of civic or community collaboration can often be the catalyst for renewed cohesiveness within communities, their regions and states. It can provide civic benefits far beyond the advantages for the individual



residents and organizations that use the network, and can be the key to a community wireless network's overall success because it will:

1. Clearly differentiate the community wireless service offering from any other and provide significant civic-minded motivation for people and organizations to support and use the network.

2. Enable the community wireless network to develop the role of a "trusted neutral third party," not driven by profit motives, partnering and working with all of a state's diverse entities and interest groups. This provides an inclusive umbrella theme under which different communities and factions can come together, resolve differences in direction or priorities, and develop common solutions to overall broadband needs. Most importantly, the community wireless network can be positioned to aggregate commercial and non-commercial demand, which is crucial to capital funding and the on-going financial model.

3. Enlist partner organizations in marketing the wireless services that support their programs and natural constituencies, lowering the network's cost and increasing its revenues. Partnering with such civic groups gives the community wireless network a natural "hook" to these constituencies as users.

4. Provide a smoother, lower cost path and programs toward "digital inclusion" by providing venues for public access kiosks, as well as the computer skills, training, and education programs needed.

5. Help fill the application infrastructure deficit referred to above by providing local content and collectively developing the collaborative applications these networks need to maximize success.

While the overall universe of potential applications is very large (see examples in the table below), the diversity of each state's topology and communities will drive very specific requirements for each locale. Understanding individual communities and assessing their specific requirements are important steps early in network planning, and can establish the foundation of local cooperation and support from the entire community. The data collection process itself can be used to educate people, local institutions, and businesses about what is realistically possible and to build consensus around what network services each community needs. The process identifies key local stakeholders and service providers that can participate and contribute to the network.

Potential Applications

Building inspection-permitting:

- Easy sharing of complaint, licensing, and permitting information
- Automated dispatch, tracking, and accountability
- Acceleration of the inspection, permitting and development processes

Housing inspection-permitting:

- Housing authorities provide ISP services to tenants
- Improved security and crime prevention
- Collaboration tools
- Easy access to images of properties
- Automated dispatch and tracking of maintenance crews

Law enforcement-emergency response:

- Site data availability when responding to fires and chemical spills
- Automated fire inspection record keeping
- Availability of integrated GIS/incident records
- Multi-departmental response coordination and data sharing
- Wireless fire alarms
- Distribution of video to responders in field

Education:

- Public access wireless in all local libraries and schools
- Virtual library branches with public kiosks
- Remote registration for library cards
- Student schedule tracking to help different agencies coordinate after-school programs
- Support for practical education and mentor programs
- Data access for student achievement tracking programs
- Homework assistance
- Access for homebound and home educated students
- Attendance officer tracking
- International curriculum availability
- Student use on long school bus rides
- Coordination of curriculum development

Consumer:

- Internet: high speed access, email, and web hosting
- Primary line VoIP telephone services with consumer feature packages and E911
- IP radio and music
- IP Television: multicasts and video on demand
- Time-slipped media distribution
- Home security services: video and alarms
- Home health and medical support
- Energy management

Elder care:

- Dedicated information websites for elder care
- Field use by social service agencies for senior
- Medicare prescription drug education and sign-up
- Streamlined administration of federally subsidized programs
- Health & wellness programs

Job skills training and placement:

- Coordinated programs across multiple facilities
- Coop and internship programs with colleges and employers
- Job and candidate matching

Culture and the Arts

- Simulcast performances/audio & video streaming
- Virtual exhibits
- Culture experts on-line
- Satellite or virtual performance venues

Commercial:

- Internet: high speed access, company email, and company applications/ web hosting
- Primary line VoIP telephone services with common business lines, IP PBX, and IP Centrex service with commercial feature packages and E911
- Broadband data: high speed Internet and private line
- Unified messaging
- Video broadcast and multicast
- Background music
- Security: video and alarms
- Energy management

Business Models and Governance

Because the states need to create cost-effective, coordinated, and interoperable statewide networks that flexibly incorporate the diverse requirements of local communities; they will need a central statewide organization to establish standards and key processes. Such a resource can guide communities in the planning and development of local networks, as well as providing a central location for resources to help network implementation and operations.

While it important to accommodate and plan for diverse community interests and significantly different broadband requirements, it is important for a large-scale statewide initiative to avoid small independent and disjointed local projects. Differing technical approaches and incompatibilities in localized networks might ultimately make it difficult to integrate them into a larger statewide network, or to take advantage of scale economies and regional application solutions. Dealing with local projects on an individual, first-come-first-served basis, might also generate inequities, resentment, and political problems – especially if there are potential funding constraints.

Private service providers are motivated to implement networks in the most densely populated and economically well-off communities. Grants, subsidies, and incentives can motivate service providers to incrementally extend their networks, but it is difficult to motivate them to implement networks in the areas that need it most. If only one private, for-profit, service provider is helped in this way, some in the community may complain of preferential treatment or that private entities should not profit from use of public monies.

Broadband implementations in the most unserved or underserved communities are usually left to governments, community groups, and non-profit entities. Unfortunately, as mentioned above, their very "unconnected-ness" often makes the institutions and people in these areas least aware of broadband technologies, potential applications, and the benefits to them and their communities. While these community projects are generally supported by the population at large, local communities usually lack experience and expertise about how to implement community broadband networks. Community broadband projects must aggregate local traffic onto their networks in order be economically feasible and successful long term. Most communities will require outside assistance in assessing requirements and building local consensus on needs and priorities. When sufficient and sustainable market demand is finally identified, most communities will then need outside help in developing a local business plan to design, implement, operate (or outsource), finance, and market the community broadband network's services.

Statewide entities need to think about the following:

- A statewide plan that identifies, sets priorities, and targets specific unserved and underserved geographies and application requirements.
- A detailed framework for assessing community needs and requests within the context of the entire state.
- The state's goals and objectives in relation to those of individual communities, and how to make them most compatible.
- Using state government's mobile/field communications requirements to strengthen local community network efforts.
- Developing tools and programs to help individual communities through the entire implementation cycle – from market education and consensus-building, network design, technology selection, through business planning, to implementation and operation.
- Developing a statewide or regional group that could provide cost effective operational services (service activation, customer support, network management, billing, etc.) for individual communities, while still providing local control and enabling each local network to reflect the unique character of that community.

The bylaws and board of directors governing a state's community wireless network should be designed to represent the broadest possible cross-section of stakeholders from the state's population and various communities. Operational procedures and reporting

practices should be open and visible to the public to invite broad community participation.

The objectives of this entity are to satisfy the community's data access and communications needs (to support economic growth and innovation, enable more cost-effective public services, and ensure more broadly available and affordable broadband services) that are not currently being satisfied by existing service providers. The state's business model can creatively provide appropriate incentives (cost and risk reduction, upside revenue potential) to attract private entities into public-private partnerships designed specifically to satisfy community needs. Such a business and operating model needs to:

- Be a trusted third party, able to resolve diverse community interests and aggregate demand from multiple entities and sectors within communities across the state.
- Be a non-profit corporation that is not profit driven, but values the return on social capital invested by the state and communities to solve local problems and reinvests surplus funds back into programs that support community access.
- Focus on working with multiple entities to provide complete solutions within communities.
- Use public infrastructure, as well as state and local government's demand for cost-effective services to minimize incremental investment in building the network.
- Enable communities to maintain control and the flexibility to solve long-term community access issues, while also maintaining an open and competitive retail market that assures maximum penetration and the lowest cost.

Given these requirements, the formation of independent, non-profit (501-3C) corporations are often the best governance solution. Such an entity can be formed at a statewide level, for the purpose of central planning and resource allocation, and coordinated with similar affiliated organizations formed by local entities (individual communities, counties, or regions, etc.) to explicitly assess local need, manage network implementation, and own assets. This governance structure would enable states to:

- Form broad-based partnerships among government, civic institutions, businesses, and Internet service providers statewide.
- Secure project funding from a variety of public and private sources.
- Manage a statewide network implementation and its on-going evolution.
- Provide for local ownership and control of network assets.
- Negotiate contracts with vendors and providers to achieve scale economies, while also providing flexibility, in dealing with partners and customers concerning the local operations and outsourcing of service on a community-by-community basis.
- Provide responsible and transparent governance representative for the diverse interests of community and statewide stakeholders.

Operating a statewide wireless infrastructure with an open wholesale business model enables multiple "retail" ISPs to offer a broader range of services to a state's population. This model helps states control costs through standards and centralized purchasing, while enabling a statewide "franchised" approach to marketing the network's overall functionality, a statewide brand, local community benefits, and also promoting proactive work with selected community groups and partners to satisfy specific unsatisfied community requirements.

Retail service providers buy bulk connectivity and bandwidth, and repackage access for individual users. ISPs are intended to provide first-level customer support, any end-to-end security, host applications, unique customer functionality, and issue retail billing for services rendered. A variety of partners and suppliers can be engaged to outsource as much of a given community's network's implementation, wholesale operations and management, and retail service as appropriate to the locale.

Network Design and Technology Candidates

As mentioned above, the size, complexity and diversity of statewide, community-based wireless networks make it unlikely that any single network design or technology will be appropriate for all requirements. A hybrid design that includes multiple wireless technologies in combination with a high-capacity fiber optic backbone for transport – within and beyond state borders – is more likely. In reality, this design will be driven by overall state funding and requirements, as well as the requirements for specific locations and communities. With this in mind, let's take a look at the wireless technologies that can be potentially utilized.

There are basically three core wireless technologies available — Cellular, WiFi, and WiMAX—that can meet the needs of most state wireless networks. These technologies can be evaluated based on cost, operational efficiencies, and availability. Design models for each technology alternative can be developed based on the total square mileage and the population of each coverage area (unincorporated rural geography, villages, towns, cities, etc.) and categorized into an appropriate usage (urban, suburban, exurban, rural) model. These usage patterns can then be used to establish cost models for each technology and for each area. The availability of wireless spectrum availability, which has a big impact on network cost and performance, should also be assessed. Unless an existing cellular provider participates in a state network, the cost of cellular technology and radio spectrum, with its limited availability and bandwidth, makes it an impractical alternative for most states.

WiFi is a fixed wireless local area network (WLA N) technology that operates primarily in free, but unlicensed radio spectrum. It is the lowest cost (network infrastructure and end-user devices) and most pervasive wireless technology for implementing wireless networks for large user populations in relative small coverage areas. Utilizing WiFi enables a network to include the most popular low-cost end-user devices, reduces costs associated with major technology upgrades, and enables more users to access the network. However, operating in unlicensed radio bands leaves a network susceptible to

capacity and performance limiting interference, and ultimately increases the cost required to achieve any given throughput. A WiFi-only network also requires the installation, operation and maintenance of tens of thousands of WiFi access points to cover a state. The associated capital and operational costs would also make a statewide WiFi implementation impractical.

The WiMax standard incorporates mobility and operates in both unlicensed, as well as FCC licensed radio spectrum bands (such as the 2.5GHz ITFS/EBS bands in the US). Licensed spectrum significantly eliminates interference, enabling network transmissions at higher power levels over longer distances, ultimately reducing the number of, and expense for, transmission sites and associated equipment required to cover a particular geography.

Given the relative benefits and signal propagation characteristics associated with WiFi and WiMAX technologies the most cost-effective network would likely use WiMAX to achieve statewide coverage, and both WiMax and WiFi technology implementations for end-user interfaces, depending on the user's application requirement (cost, throughput, mobility, etc.) – especially if licensed spectrum is available. In addition to providing better coverage with far fewer transmission sites than WiFi, a WiMAX distribution network exhibits greater reliability and lower operating costs. If licensed radio spectrum is not available for WiMax, a state would have to evaluate the trade-offs concerning the cost, flexibility, and performance of using WiMAX in unlicensed radio spectrum, particularly in rural settings where interference is less of an issue.

Existing communications infrastructure, such as access to conduits and rooftops, tower locations, fiber networks, etc. can be used to greatly reduce the time and costs associated with constructing a state-wide network. Public and private assets may be made available as part of a state's initiative – providing a stronger foundation in creating a statewide wireless network.

Potential Early Actions

A key objective is usually to implement the network as quickly as possible. The importance of doing the right kind of front-end market assessment, consensus building, and business model planning cannot be underestimated. It is necessary to achieve local community and service provider support – and it usually helps have experts, experienced in implementing community wireless networks on-board.

It is important to get local service providers involved in network design and implementation. The key to attracting local service providers is to show them that the public contribution to the public-private partnership helps reduce their risk and helps them make more money by aggregating community traffic, especially in rural areas.

Finally, the project needs to secure sufficient funding. The right business plan and statewide consensus will contribute, but the entity implementing and operating the wireless network has to prove itself early in the project to gain the credibility to get

funding. Implementing a successful pilot network is a crucial early step. The pilot network requires careful analysis to select a good site(s), with the right scale and objectives: to prove the project operationally, secure additional funding for the full network roll-out (until positive cash flow is achieved), and provide a foundation for market expansion across the state.

About the author

Bob Panoff is the principal of RPM, which he founded ten years ago, after twenty successful years starting and growing companies in the computer and telecommunications industry. RPM specializes in helping clients develop successful business and marketing strategies for new and changing markets across the entire telecommunications value chain – from components to service providers, and eventually to the end-user. After conceiving and developing the groundbreaking Rhode Island Wireless Innovation Network (RI-WINs) three years ago, Bob has successfully helped numerous communities develop wireless broadband projects. For more information, please see RPM's website: www.rpm-strategy.com.