

Wireless Community Networks: Evolution and Technical Challenges

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The widespread success of the IEEE 802.11 family of standards for wireless local area networks gave rise to a grass-roots level effort that envisions using this technology to realize the goal of unlimited, inexpensive bandwidth and Internet access to mobile or nomadic users, in what we call *wireless community networks (WCNs)*. These kinds of networks have emerged, with variable scope, in some urban and suburban areas in a number of countries in North America, Europe and Oceania. Common characteristics of such networks include:

- Spontaneous deployment: in industrialized countries, WCNs often appear through grass-roots efforts driven by hobbyists, who share their own resources (access bandwidth, primarily) with others by setting up WLANs with open access (no authentication) and extended range through the use of external antennas. These independent groups often informally organize to exchange ideas, map hotzones within some geographical area and provide technical support to novices. Local governments are also starting to set up free hotzones that blanket an entire town; these efforts take more deliberate planning and funding.
- Low cost equipment, ubiquitous technology: virtually all WCNs make use of IEEE 802.11 technology, due to its immense popularity and low cost of equipment. As mentioned before, increased range is achieved through the use of external antennas (sometimes home-made). Access technologies currently in use include cable modems, Digital Subscriber Line (DSL), and leased lines (T1). We believe that as IEEE 802.16 systems and service become available, we will start to see this technology deployed to provide access in 802.11-based WCNs.
- Not for profit: most WCNs share the goal of *free* Internet access for all. Participants often make available their resources and time without financial compensation. In some cases, individual participants charge small sums for use of their access point, acting as micro-WISPs (wireless Internet Service Providers) for their neighbors. When WCNs are set up by local governments, public funding is used to provide what is viewed as a service for the community.

Applications of WCNs go beyond general access to the Internet, to include e-governance, telemedicine, radio broadcast within a community, IP telephony, support of non-governmental organizations (NGOs), etc. Although the types of wireless technologies that make WCNs viable (IEEE 802.11, in particular) are still not pervasive in some developing countries, we expect this to happen soon. Wireless communications are an especially promising solution for broader network access in such countries due to the lack of infrastructure (fiber, cable, twisted pair) requirements and rapidly decreasing costs. There is significant potential for adapting the WCN model to bring wideband access to under-privileged communities. Some of the relevant issues include:

- Access to broadband “last mile” links: community networks can make broadband access available to a larger portion of the population, by creating a multiplicative effect. Broadband access can be supplied to a few points, and then distributed within a limited geographic area by forming overlapping wireless local area networks.
- WISP model for very small-scale entrepreneurs: this model may enable the establishment of a large number of small scale ISPs, each providing Internet connectivity to a neighborhood.

- Role of government and NGOs: in some countries, it is not realistic to expect the private sector to take the lead in the deployment of WCNs. Local governments, international donors, and NGOs may need to play an active role in the funding and viability of these projects.
- Coverage planning: in developed countries, WCNs have evolved in a mostly un-coordinated fashion. If the objective is to provide uniform coverage to a community, some planning for the location of access points is desirable. Techniques in cellular network dimensioning and planning may be adapted for this purpose.
- Regulatory issues: in most countries, IEEE 802.11 technology works in unlicensed bands of the spectrum. Licensing and regulation can limit the rapid spread of this technology. For instance, China imposes limits on the use of WiFi technology, mandating a Chinese version of the WLAN specifications (foreign vendors can manufacture and market products following that standard only when partnered with a Chinese company). Variations in licensing and regulation in different regions of the globe would also tend to increase the cost of equipment.
- Rate of penetration of the technology: the rate of penetration of IEEE 802.11 access points and network interface cards (and, related, laptops and palmtops) is lower in developing countries. As previously mentioned, rapidly falling prices make it likely that this will change in the near future.

Although wireless community networks may not have been envisioned in the original development of the IEEE 802.11 specification, this is the technology that gave rise to the WCN movement. There are still technical hurdles to overcome: the standardization of inter-access point protocols will enable more seamless movement between coverage areas of different access points; stronger encryption will address privacy concerns; and quality of service support will enable real-time applications with acceptable performance. Other wireless technologies currently in development, including the IEEE 802.16 wireless metropolitan area networking specification and integration of IEEE 802.11 and third generation mobile wireless systems (3G), will also play an important role in how wireless community networks evolve.

Nationwide access to the Internet in Bangladesh seems to be hampered in various degrees by insufficient fiber infrastructure, non-uniform access to the power grid, illiteracy, and lack of software and web content in Bengali. Wireless community networks certainly do not address all these problems. However, they can provide an effective solution for wider broadband access in Dhaka and other urban areas in the near future, at a relatively low investment cost. WCNs can also serve as a component of current and future efforts funded by UNESCO, USAID and UNDP, among others, to use Internet access to foster literacy and job training in rural areas and remote villages.