Comments on

The Delhi Government's Public Wi-Fi Initiative

Introduction

Delhi wishes to provide "public Wi-Fi" which ideally means blanket coverage free-of-cost broadband wireless Internet service for all Delhi residents and visitors. Case studies for related efforts abound around the globe in various sizes and configurations. For example, notable attempts at public broadband in the United States (often with some Wi-Fi component) include Corpus Christi Texas, Minneapolis Minnesota, Philadelphia Pennsylvania, New York City, Santa Monica California, Seattle Washington Bristol Virginia and St. Cloud Florida. Experiments with small and wide area mesh networks run by volunteer or community groups are also common. While there is much that can be learned from the success and failures of these cities and communities and the many cities and communities like them, it is important to understand that they have each had their own collection of goals, challenges, and resources to navigate.

High-Level Consideration

The ideal level of public Internet access is ubiquitous high-speed connection, in all places, at all times, for all purposes and for all people. However, network bandwidth is not a limitless good and ubiquitous service is a costly and challenging proposition especially in large dense urban areas. In order to implement its desired program, the municipality of Delhi will need to address two separate types of challenges. The first type of challenges generally falls within the sphere of "last mile" connectivity. In other words, the challenges associated with providing network access to specific locations within Delhi. The second type of challenges is associated with network "backhaul" or, in other words, the challenge of securing a sufficiently high capacity link or links from municipal networks to the Internet.

According to the Aam Aadmi Party, "India has some of the slowest and most expensive and unreliable Internet connectivity among the advanced nations." Among the most important steps for developing a plan for providing universal high-speed public Internet access in Delhi is obtaining a full understanding of the factors which are responsible for both the high cost and low quality of private ISP service in Delhi and in the nation of India as a whole. Relative to other cities around the globe, are Internet costs high and services poor because of insufficient competition amongst ISPs? Are costs and service levels simply a reflection of a scarce supply of backhaul bandwidth in the area? Most likely the explanation is a complex combination factors. Only with a thorough understanding of why the private sector has failed to satisfactorily provide Internet service to Delhi can a Government plan to correct this failure truly succeed. This problem may, in part, require action on a national level to address.

In order to assess the availability of city-level network backhaul, the Delhi Government must know how much bandwidth is reasonably available to Delhi and by what means and at what cost and in what time-frame the government would be able to obtain access to it. It is reasonable to assume that

backhaul bandwidth sufficient to support broadband Internet access for approximately 18 million individuals will either be cost-prohibitive to obtain from the owners/operators of regional infrastructure or simply in excess of that infrastructure's current operational capacity.

Broad Strokes Proposal

We propose, however, that even without short-term access to the desired amount of backhaul bandwidth, a municipal network initiative can nonetheless succeed. The network initiative we propose focuses initially on building a network to interconnect the people and institutions of Delhi with one another over high-speed city-area connections within Delhi. This network, the Delhi Metropolitan Area Network (MAN), could provide many of the same benefits as a broadband public Internet access service with a drastically lower need for backhaul Internet bandwidth. As additional Internet backhaul bandwidth becomes available to the network, its ability to provide Internet access to its users can expand accordingly.

We envision the roll-out of this city-wide network in three distinct phases:

- **Phase #1 – Serve Government Offices & Lay Foundation:** A Delhi MAN should reflect the social and cultural networks of Delhi itself. For example, a network might initially link together the civic centers of the community: Government offices, police and public safety stations, schools, etc. Each node in the Delhi MAN could be linked with a high-speed connection appropriate to the circumstances: e.g. fiber-optic cabling, high-bandwidth mid-range point-to-point wireless equipment or whitespace "super Wi-Fi" technologies. Innovative uses for a municipal network abound. Through these links government offices could communicate with one another through high-speed connections without the need for a 3rd party ISP. Many municipalities have offset some of the cost of municipal network infrastructure through the savings and efficiencies such networks provide to government budgets. The municipal broadband network of Santa Monica is such an example.

  In addition to providing wired connections city workers, each connected node in the Delhi MAN should also make wireless service available in indoor areas open to the public and in immediate surrounding outdoor areas. Through virtual network tagging, these wireless hot-spots or hot-zones can provide both secure managed access to government resources for government employees and open access to a public network for anyone and everyone with a Wi-Fi compatible device in range of a wireless access point (AP).

  Wireless access to managed Government IT resources from outdoor locations throughout Delhi could allow Government employees who work in the field such as police, emergency workers and inspectors to receive up to the moment information and records without the need to travel back to their individual offices or rely on expensive private cellular wireless services.

  Wireless access to the parallel public networks could provide the foundation for a new system of collaboration and communication for the people and institutions of Delhi. While this public network could offer users some limited upstream Internet access, its initial utility for the public should rest primarily on electronic/mobile government content and services.

The government should investigate the development of one or more government data centers which could offer hosted content and services for government offices and other institutions as appropriate.

Amongst these services could be locally hosted mirrors of not-for-profit public interest educational websites such a Wikipedia or Kahn Academy. A Delhi government data center could be designed to serve electronic government resources over not only the Delhi MAN but also to serve some of those same resources over a connection to the Internet. A data center configured in this way would likely be an obvious point in the network topology of the Delhi MAN to position a gateway through which varying degrees of Internet traffic can be permitted to flow from the Delhi MAN to the Internet and vice-versa.

- **Phase #2 – Civic Expansion:** Once a foundation network is in place and is in use by the public the development of the Delhi MAN should begin to focus on expanding to include new areas of the city and institutions of civic importance. New nodes should be developed in the public parks, universities, and hospitals of Delhi. As the Delhi MAN expands to these locations, its utility will be poised to grow exponentially connecting more people to more valuable resources in more places across Delhi.

   Public access to the network will be served by establishing nodes and Wi-Fi hot-zones throughout public parks and similar public meeting places. Connecting public universities and hospitals with each other, with the government, and with the people of Delhi will provide more opportunities collaborate and share which in turn enables improved research, tele-medicine, and public access to health, safety and educational materials.

- **Phase #3 – Expansion to Commercial Actors:** As Delhi MAN expands and proves its utility in Delhi, it is likely that commercial entities will see value in the municipal network. Some commercial entities may be interested in access to a Delhi MAN backbone node at their offices in order to serve commercial services over the network or gain the benefits of collaborating with other Delhi institutions over the network. It is also possible that as Delhi's network infrastructure matures it will be in a position to offer preferential Internet service to those who can afford it at a better price to service ratio than its commercial competitors.

   Whenever such opportunities develop, Delhi should seek to secure concessions from and negotiate terms with commercial actors which will ultimately benefit the public's interest in the network, including its long term financial viability, resiliency, capacity and availability.

Technology Required

The appropriate link technologies, routers and other network management/operation infrastructure equipment is best determined after close study and initial modeling/design.

Wi-Fi communication technology is likely the most appropriate choice for the primary access layer of the network due to its widespread availability in modern consumer devices. As a general matter, we encourage the use of commodity hardware, open standards and free and open source software (FOSS) wherever possible and with a particular emphasis on the network's edges. A preference for these kinds of technologies is motivated by factors such as security, flexibility, longevity, cost, and

lock-in risk. The openness of these tools provides an opportunity for Delhi to involve students, businesses, and community groups in developing innovative new tools and valuable experience in the area of network and computer technology.

One potential use for these technologies is that it allows for innovations such as ad-hoc extension of the Delhi MAN. Community wireless networks based on mesh or other wireless network technologies can be surprisingly effective. The Freifunk project, based on the OpenWrt router firmware and using open mesh wireless standards such as OSLR and B.A.T.M.A.N., is an example of a community mesh wireless initiative with multiple network deployments.

Delhi may want to consider encouraging community involvement and open innovation by enabling, supporting, and facilitate community-driven initiatives whereby the businesses and residents in the neighborhoods surrounding Delhi MAN backbone nodes can work together to coordinate their own wireless-to-wireless network coverage in the broader area. While an ad-hoc collaborative community network may not be able to offer the same degree of service as a well designed and well operated municipal network they can be a path to efficient expansion of service to suit local knowledge. A full study should be undertaken to identify extensible and affordable hardware, software, and operational methods to enable these kinds of networks to develop and meaningfully connect to the Delhi MAN.

Delhi may also want to consider providing FOSS-powered computer terminals in public areas to enable public access to select Delhi MAN resources.

Network Services

The first services that the Government should try to provide over this network are services geared at efficiently meeting its own internal needs. This early goal is a way to use the system to reduce government expenses while gaining further experience with the strengths and weaknesses of the network.

Through one or more FOSS data centers, government offices as well as other civic institutions such as museums, hospitals, libraries, schools, colleges, universities can also establish and maintain their own websites including blogs, forums, wikis. Educational resources and public health and safety information are just some of the content that should be locally hosted in the Delhi MAN.

While high bandwidth low-latency connections to the Internet may initially be cost-prohibitive to provide for everyone in the Delhi MAN, connections to locally hosted content and select educational and social resources such as *archive.org* or *wikipedia.com* might be strong and manageable first offerings.

Sustainable and Scalable Financial and Technical Model

The strategy of the model we propose is that while Delhi's public network should start small and grow gradually it should also anticipate and account for expansion from the outset.

Different technology and infrastructure configurations are likely to be useful for different tasks. The use of commodity equipment and free and open source software wherever possible is preferable. Where FOSS technology does not meet the needs of the municipality it should seek to support the development of new FOSS solutions. Maintaining flexibility and is key to allowing the network to

evolve and grow organically. For example where mesh equipment can be affordable obtained and configured the people of network may take it upon themselves to expand the network deeper into previously unserviced potions of their communities. Similarly, where citizens have access to the source code which runs the services they rely on those services may benefit from improvements developed by the people while giving birth to new services both public and commercial.

The Internet's greatest strength has been that it is open; that it is content agnostic. By connecting the institutions, organizations and spaces which form the backbone of the Delhi community you create a network for Delhi upon which the people of Delhi can build and expand in ways not planned for.

In addition to lowering some government expenses and stimulating education, business, and tourism in Delhi, funding offsets for the network's capital expenditure and operating expenditures may be available from a variety of sources. For example, as the municipality expands its network it may be able to utilize its resources, including rate or higher level of performance than commercial service providers. It could use that opportunity to expand Internet access in the city for businesses and reinvest any earnings in further expansion of its public network services. For-profit entities wishing to provide their services over the network could be charged fees. Users such as businesses or tourists who wish to obtain preferred access to special network resources or potentially the public Internet might pay for an hour or a day of this access.

Plan B: Self-Assembled Municipal Wireless

The preceding analysis would be the advice for any government planning to build a municipal wireless system in the developed world. It assumes large public capital investments and a significant continuing investment in managerial and administrative staff.

An alternative, perhaps more appropriate to Indian social circumstances, would attempt to provide network coverage – outside primary public spaces such as parks and public buildings – through self-assembly by civil society. Small, inexpensive wireless routers requiring no setup – pre-configured to provide free access using the Delhi Municipal Wi-Fi network IDs – could be sold in relevant quantities at a market price of Rs 500 or less. (Such devices are routinely available in the US, delivered to the customer's home, for less than Rs 750. Chinese-manufactured devices are available already at the stated price.) Using USB power, smaller than a cigarette package, requiring no maintenance in routine operation, such devices – making use of people's existing internet connections to provide wireless to the public near their router – could provide excellent network coverage if people had an incentive to install them. The municipality would arrange with the ISP suppliers of fixed-line Internet services to provide a monthly discount of approx. Rs 500 for installing such a router at each customer location. The user provides to the ISP the physical location and BSSID of the router, which can be verified by connecting wireless devices, in order to receive the discount. The customer's investment in buying and installing the router is recouped in the first month, and he has an incentive to keep the router in service to continue receiving the discount. The municipality receives pervasive wireless coverage in inhabited areas at the maximum cost of Rs 500 per router per month, constructed and installed, which is a very attractive price for government, and which can be shared to some extent by the telecom/ISP providers. Small businesses to make and distribute compliant routers will blossom in neighborhoods, and everyone will benefit.