

Fred-eZone
A City of Fredericton Free WiFi Zone

By
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The City of Fredericton

The City of Fredericton is the capital city of New Brunswick, located in the Atlantic Provinces of Eastern Canada. The province of New Brunswick borders the State of Maine and is a six-hour drive from Boston. The greater Fredericton area has a population of 85,000. Fredericton is a very scenic City, heavily treed with the Saint John River running through it. There is no industry or manufacturing to speak of in Fredericton. The economic base is primarily the IT sector, e learning, Research and Development, GIS, two University campuses and government. The student population expands the population in Fredericton during the school year by approximately 12,000.

The City of Fredericton is a “Smart Community” and as such the municipality has recognized the importance of high-speed low cost broadband. The broadband market in Fredericton tended to be a duopoly, which resulted in relatively high prices, compared to other near by major centers such as Halifax, Montreal or Boston. The municipality therefore decided to become it’s own non-dominate carrier and created a not-for-profit company called “e-Novations”. E-Novations mandate is to bring high-speed (minimum 100 Megs) low cost network to the City for government, business and Institutional use. The result has been to bring the price of bandwidth from the highest in Eastern Canada to the same or lower the all major Cities along the Atlantic Seaboard.

Fiber Optic Network:

The City of Fredericton, through it’s municipally owned carrier e-Novations, deployed a Fiber optic (Dark Fiber) network to connect a number of City sites, and a number of partner sites from the local academic and business community. All sites are connected to a core layer 2/3, CISCO 3750 switch, which assures preferred routing at full 100 Megs within the Community Network. All site switches are automatically updated using RIP protocol. The fiber network is managed and lit using single mode single-fiber transceivers. The use of this new technology, which transmits and receives data on a single strand of fiber on separate light frequencies, has doubled e-Novations fiber count capacity. Single-mode fiber is used throughout the network because of its longer distance qualities. So far, the fiber network extends over a 22 km ring. All fiber is connected to the head-end on a *Metrobility* chassis platform. This allows for remote management and troubleshooting of fiber optic transceivers and signal quality throughout the network.

Point to Multi Point Wireless Network:

A high capacity wireless network was required to extend the fiber optic network's coverage area. *Motorola Canopy* was selected because of its superior capabilities, ease of implementation and affordable cost. Seven tower sites were constructed to host the *Motorola Canopy* access points thus extending the Community Network's broadband footprint throughout the entire City. All sites are synchronized using a unique approach. Broadcast and receive cycles are synchronized using G.P.S.

Tower sites are built or located on existing City properties or on partner sites. As an example; a 100-foot water tower was used to install an omni directional set of Canopy access points. Canopy backhaul at the water tower is consolidated by the use of a *CISCO 2940* series switch and re-broadcasts Ethernet over the fiber optic network to the head-end network switch. Seeking out a qualified Motorola dealer versed in both radio and networking was identified as a critical success factor in the deployment and maintenance of the wireless network. *Eastern Wireless*, a local Motorola dealer was selected to supply, install and maintain the network. In return, *Eastern Wireless* is invited to use the over capacity to offer ISP services to the community. *BrunNet*, another local ISP, also re-sells the City's network to small business and to homes. In this way, e-Novations acts as a wholesale ISP to the community.

Fred-e-Zone WiFi Network:

Fred-eZone is comprised of a unique combination of leading edge technologies. The recent 802.11g wireless technology standard has allowed for low cost, reliable equipment that is now interoperable. Deploying isolated access points to create a "Hot-Spot" has become relatively easy and is now quite common. Deploying a larger metropolitan Wi-Fi "zone", however, has unique and difficult challenges, which include:

- antenna type determination, configuration and site selection;
- city-wide backhaul network;
- traffic management using ISP core network technology;
- high speed Internet access.

With a state of the art citywide network as a foundation, a metropolitan Wi-Fi project became possible. In Fredericton, Wi-Fi installations are comprised of the integration of all levels of it's existing network technology. A typical configuration consists of one or more *CISCO 1200 g* radios (Wi-Fi access points) consolidated on a single *CISCO 2940* (8 port) switch . In general, 110-degree panel antennas are deployed outdoors for WiFi coverage. Ceiling omni antennas are used for indoor coverage. Antennas are connected to *Cisco* radios using *LMR 400* cabling. The consolidated signal is then backhauled to the core network via *Motorola Canopy*. The *Canopy* equipment is also consolidated on the same 2940 switch.

CISCO 's Wireless LAN Solution Engine is used to manage over 120 *CISCO 1200* Wi-Fi radios. This allows for remote management, automatic firmware updates, power and load balancing and rogue access point detection. Trouble areas are logged using SNMP and network administrators are automatically advised of faulty equipment and many other potential issues the system has been configured to detect.

Fred-eZone is made up of over 120 access points deployed in over forty geographical locations. All Wi-Fi 2940 switches are identically configured and tag all Fred-eZone traffic on a dedicated VLAN. When Fred-eZone traffic is consolidated at the core, the VLAN is redirected to a "*Solutions Inc.*" proxy server.

When a user launches a browser, all DNS requests are redirected to the proxy server forcing the user to the Fred-eZone portal. At this point users learn more about Fred-eZone and are asked to agree to an acceptable use policy (AUP) and enter account information. Future use of Fred-eZone is then managed by the *Solutions Inc.* server by login account and password. User information and MAC addresses are managed and stored on a central database. In this way the *Solutions Inc.* proxy server also acts as a Radius server.

The City of Fredericton as its own ISP:

Fred-eZone traffic is passed to the Community Network *Cisco 3750* router. The Community Network destined traffic remains on the core network at maximum speeds and minimum network hops. This creates a truly low latency, high-speed network. For example, users with an 802.11a card can theoretically realize full 54 Mbps within the network. Internet bound traffic is directed to a dedicated port on the Community Network Internet gateway switch. Again this is accomplished using VLAN tagging. Bandwidth is shaped on this port to a 4 Mbps maximum of full symmetrical bandwidth. This approach minimizes the impact of possible denial of service attacks or inequitable use of the full Community Network Internet pipe by Wi-Fi users.

Users on the network can receive and send mail through the Community Network mail relay. Users can also allow the *Solutions Inc.* proxy server to automatically relay their sent items without requiring a change of SMTP settings.

A large number of routable IP addresses are required to facilitate a project of this size. The Community Network has peering agreements with two ISPs using BGP. The large IP requirement along with the peering agreements and number of users, qualified the Community Network to apply for and receive its own IP allocation from ARIN.

Conclusion:

A unique combination of City infrastructure and leading edge technology has been combined with superior network engineering to accomplish a City wide WiFi zone. This has been realized through the partnership of City staff, local expert resources and the vendor community. It has taken four years from start to finish to form a non-dominate carrier company, construct the fiber optic network, deploy the point to multi point wireless network, and finally, to deploy over 120 Cisco WiFi access points in the field. All this has been done using existing budgeted dollars by re-investing the City's telecom savings back into the network and by accepting commercial subscribers on the City's network. The private sector has also contributed cash and in-kind services representing a total value in excess of \$250,000.

The resulting infrastructure has made Fredericton stand out as a truly "Smart City" and has built an "Intellectual Infrastructure" that is seen by many as leading edge and visionary.

About the author:

Mike Richard is a City of Fredericton employee in the Information and Communication Technology Division. He is responsible for technology infrastructure and support. Mr. Richard is also one of the founding staff members of e-Novations, a municipally owned carrier company, occupying the position of V.P. of Operations. Mr. Richard has been with the City of Fredericton since 1985, first serving as a police officer. Leaving the police department as a Sergeant for his current management position, Mr. Richard has been involved in the implementation of a public safety mobile data network, a City wide Trunked Mobile Radio network and the current fiber optic and wireless networks.