

Nunavut Broadband Development Corporation

Wireless Issues for Municipalities

NBDC's planned network will connect every building and home in every Nunavut community to affordable, reliable broadband service. Two different wireless connection systems are proposed, both of which will work to connect buildings within communities. However, one system, (2.5 GHz), may be capable of linking people on the land around a community. This has never been tested in an Arctic environment, but many people are excited by the possibility. Please read this document to learn more about the technical, land-use, and financial issues involved.

Background

In the spring of 2003, the Nunavut Broadband Development Corporation asked satellite and last-mile vendors to propose solutions to connect all of the buildings in every Nunavut community to broadband services. We evaluated the various bids submitted, looking for reliable, cost-effective solutions. The winning vendor, SSI Micro, and its partners Polarnet, Sakku and Nunanet, proposed a wireless solution, 2.5 GHz, to connect the buildings in larger communities. In the smaller communities, they proposed 802.11b, a different wireless system, because it would effectively provide the same level of connectivity to all of the buildings and homes in smaller communities, at less cost than the 2.5 GHz. NBDC built all of these costs into the overall business plan in June of 2003, and has since secured financing to roll out broadband to every community.

Since the initial plan was developed, the 2.5 GHz wireless service was launched in Yellowknife, and a trial (using a small version of the proper antenna) was held here in Iqaluit.

People in Nunavut are intrigued by the possibility that the 2.5 service can actually service more than buildings in the community – and this has really sparked people's imaginations. People want to see the day when they can spend more time on the land, and be connected to the Internet for work, school, etc purposes.

So in order to provide everyone with more information on the technical, financial, and land-use issues involved in the two wireless systems, we have prepared a brief summary of the issues for municipalities to consider below.

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Technical Issues

Broadband services will be provided in every community by first linking communities to the Internet through satellite connections through a satellite dish located in every community.

Then, the signal from the satellite dish has to be distributed to every building in every community. To connect all the buildings (called “last mile”), wireless technology was selected for every Nunavut community for the following reasons:

- Wireless technology allows most of the work to install the delivery system to occur up front as a capital expenditure with minimal (or no) additional cost to install each new customer over time. This allows NBDC to install the infrastructure by March of 2005, and if there are any new buildings in a community, wireless will be able to serve those new buildings without additional infrastructure upgrade costs;
- Wireless technology allows us to cover virtually all homes and buildings that exist now and that will be built in the future using the initial capital investment. Other technologies would require new broadband investment for all future homes and buildings;
- Wireless technology allows customers to move within a community and between communities without any administrative or operational action or cost;
- Wireless technology can be administered remotely if the local Community Service Provider is not available.

How Wireless Works

Wireless community distribution involves a base station (transmitter and receiver) and an antenna in a central location in a community communicating with many wireless modems located in the various customer premises (homes and offices).

In a small community with no intervening tall buildings or mountains, a single antenna for the base station will cover every current and future customer site. At the other end of the spectrum, in Iqaluit at least three base stations and antennas will be required to accommodate all the buildings and the terrain.

Wireless Options

Two wireless options were proposed by the vendor for use in Nunavut:

Licensed 2.5 Ghz Wireless (Nextnet)

This wireless option uses a licensed frequency in the 2.5Ghz range. Because the hardware operates in a licensed frequency, it is able to use more power and therefore can reach further and makes it a more cost effective solution for large communities. The trade off is that the equipment is relatively expensive and therefore the vendor only included it in communities of over 1,000 people.

Un-licensed 802.11b (WiFi)

This technology, generally called WiFi, operates in the unlicensed 2.4Ghz frequency range. Because it is operating in a public frequency range there are limitations on how much power can be used which in turn limits the distance and penetration that can be achieved. As described below, this equipment is very economical (both the base station and the customer modem portion). This is the technology which the vendor proposed for the smaller non-decentralized communities.

Choice of Options

Our choice of the wireless option for each community was selected simply to ensure that every home and building was adequately covered at the lowest possible cost.

In the largest community (Iqaluit), 3 of the licensed base stations will likely be required. To cover Iqaluit with WiFi would likely take a dozen or more transmitters and the complexity of installing and maintaining them would be unreasonable. In the smallest community, one WiFi transmitter will clearly cover the entire community.

Pros and Cons

No matter what wireless service communities receive, broadband services will be available to every building in every community, with the same price, and same level of service – the same speed at the same price.

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The specifications for 2.5 GHz say that the antenna can reach 20 miles – assuming a perfectly flat terrain, with the modem in view of the antenna. This has not been tested in Nunavut – as this was never our intention in the initial design.

The 802.11b system requires a wireless access card for end users to access the service and this is much less expensive – (and in some cases will be free) than the modems required for the 2.5 GHz service, which will require a \$150 deposit from users.

The 802.11b system, due to the abundance of makes and models, may be more complex to install for the user, which will require more support from the local CSP to get set up. In some cases, the customer may require an external antenna for connectivity. The 2.5 GHz system will get through walls without any trouble and because there is only one make of modem the technical support is expected to be lower.

The following chart contains a complete listing of the pros and cons for each of the two wireless technologies:

	<u>802.11b (WiFi)</u>	<u>2.5 GHz Licensed Band (Nextnet)</u>
PROS	<p>Commodity hardware available from many sources.</p> <p>Low prices for customer premises modem (less than \$100).</p> <p>Customers may be able to use built in wireless capabilities of their notebooks.</p>	<p>No possibility of Radio Frequency interference.</p> <p>One base station will cover a much larger area (in some cases outside the community up to 20 miles in perfect conditions).</p> <p>Non Line Of Sight (signals may reach inside buildings and may bounce off buildings and rocks to reach more customers).</p> <p>Technical support is simpler, as all customer modems are identical, vs. 802.11b where customers may try to install their own customer modems.</p>
CONS	<p>Possibility of interference with other WiFi transmitters (support calls may be necessary).</p> <p>Poor indoor penetration: Clients may require external antennas to achieve acceptable signal strength (a small book-size antenna may need to be installed on the outside of the customer building with a</p>	<p>More expensive base station (about \$45,000 capital more than WiFi) plus annual fees of \$3,000 per year).</p> <p>The customer modem will cost NBDC approximately \$450 and the customer will be required to put down a deposit of \$150.</p>

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	<p>wire leading to the customer's computer).</p> <p>Line of Sight is recommended although because of the size of the communities will not always be required.</p>	
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Land-based Issues

Since our initial design, it has become apparent that the 2.5 GHz system (NextNet) planned for larger communities can be used in some circumstances up to a maximum of 20 miles from the base station.

Many people have shown interest in attempting to be connected while on the land, using a portable power supply.

Please note that this on-the-land access is entirely dependent on the terrain, and has not been tested for this type of application in the Arctic.

In Iqaluit for example, a customer modem may work toward the west along the river but will certainly not work to the north and will only work to the east if the on-the-land location can “see” the Iqaluit harbour. In Pangnirtung, the Nextnet solution will probably not work very far up the trail by the river and probably will not work on the land up and down the fiord. It probably would work on the water and directly across the fiord.

In the Kivalliq, as long as the computer modem is on a gravel esker, in view of the antenna, it will likely work – but we are not sure of the exact range in a “real life” setting. However, in Grise Fiord, the signal can't get through the hilly/mountainous terrain surrounding the antenna, but if someone wanted to connect from the ice in view of the antenna, it will likely reach – but again, we don't know how far in a “real life” setting. It all has to be tested to see how far, and under what circumstances the 2.5 GHz service will reach outside of communities.

It is important to note that NBDC and SSI Micro cannot guarantee any particular level of service beyond the homes and buildings in a community.

Questions to Consider

In deciding if 2.5 GHz is truly useful for people on the land, here are some questions that Municipalities may want to consider. If these questions can be answered, it will help determine if there is a need that can actually be met by 2.5 GHz service.

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1. What uses do you see for connecting to locations OUTSIDE of your community, within a 15-20 mile range? (or less)
2. What kind of terrain surrounds your community – flat, hilly, mountainous?
3. What is the distance from the community, and the terrain where people traditionally camp? Please indicate the numbers of people (roughly), the distance they traditionally camp, and the terrain. Please estimate if their camp could “see” an antenna located in the community.
4. Understanding that the 2.5 GHz service has not been tested as a service for providing connectivity on the land, are you interested in attempting to make this available to ALL 25 communities for the purposes of testing its capacity for connectivity on the land?
5. Do you see uses beyond connecting outpost camps with wireless services?

Financial Issues

In order to upgrade all 15 communities to 2.5 GHz originally slated for 802.11b, it will cost an additional \$650,000, on top of the \$9 million we have raised in contributions and debt financing to put in the entire satellite/last mile infrastructure.

NBDC will NOT be approaching smaller communities to pay funds toward this service, when larger communities do not pay extra for 2.5 GHz, if it is determined that all must have this service. If one community pays into an “Upgrade fund” of some kind, all communities would need to participate.

If NBDC was to attempt to obtain the remaining \$650,000 to upgrade all communities (before the installation), we will need to obtain the funds before the end of June, 2004 in order to install this year.

If there is a huge desire from all 25 Municipalities to help ensure 2.5 GHz gets installed into all communities, there may be a way to raise the necessary funds. There is no guarantee that all the funding could be raised, nor is there a guarantee that even if funding were raised, that the 2.5 GHz system could be installed this year due to equipment supply time lines. If the funding was secured this year, there still may be some communities would initially get 802.11b, and then be upgraded in 2005.

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NBDC would require substantial interest and support from Municipalities in order to upgrade to 2.5 GHz in all communities.

Any comments or questions about any of the issues raised here are very welcome. Please contact Lorraine Thomas at lorraine@nunanet.com, phone (867) 979-0575, or fax (867) 979-4622.