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LoraWan Test Results

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ABSTRACT

Low power, long range (LoRa) Wi-Fi systems are seeing increased use in creating large scale networks. FPInnovations performed initial tests of a LoRa system in a lightly wooded area in suburban Montreal to test the feasibility of this system in a forest environment.

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INTRODUCTION

Establishing communication infrastructure for internet or telephone access in remote locations is a difficult and expensive process. The forest industry lacks the level of capital that other resource sectors such as oil and gas have to construct cell phone towers or to establish satellite connections. As well, forest operations are constantly on the move which demands more extensive traditional networks. A potential solution to this issue is Low-Power Wide-Area Network (LPWAN) communications, which is exactly what the name suggests, a low power long range wireless network solution. LoRaWAN networks are a type of LPWAN developed for the Internet of Things. There are solutions available which can reach between a range of 12 km to 15 km[1], which consume only 100 mW of power (Semtech, 2016). The LoRa system usually takes on a star-of-stars topology, where a long range WiFi router called a gateway backhauls an internet connection to endpoints which are called LoRa modules as shown in Figure 1. These modules can be integrated into circuits for a multitude of uses such as GPS and data sharing. The modules are capable of transmitting and receiving data to and from the gateway (Poole). While this system consumes very little power and can create a long range network, the trade-off is the low data rate. Typical Wi-Fi routers used in the average household has a data rate between 11 to 53 Mbps, while the LoRaWAN data rates are between 0.3 to 50 kbps (LoRa Alliance, 2016).

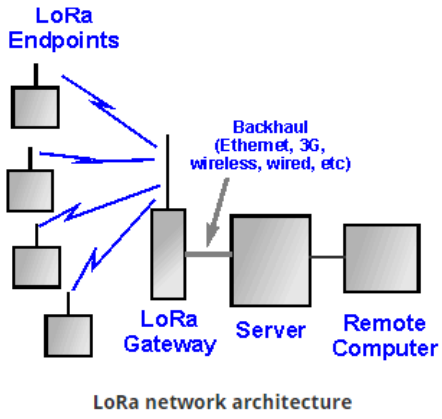

Figure 1: LoRaWAN Configuration

The system chosen to be tested was the Symphony® Link Development kit from LinkLabs. This kit comes with a LoRa gateway, 2 modules and an evaluation board which has a GPS function to accurately test the range of the gateway[2]. This system was chosen because it can integrate up to 250,000 end points, transmit up to 12 km and transmits data at 915 MHz.

[1]"Embedded Wireless: LowP-Power Wide-Area Network." *Microchip*. http://www.microchip.com/design-centers/wireless-connectivity/embedded-wireless/lora-technology#utm_medium=Press-Release&utm_term=LoRa%20Certification%20&utm_content=WPD&utm_campaign=LoRa.

[2]"Symphony Link Development Kit." *LinkLabs*. http://www.link-labs.com/product/m2m-development-kit/

OBJECTIVE

To test viability of using the LinkLabs LoRaWAN system to create a wireless long range network for Forest Operations.

METHODOLOGY

To test this system for its viability to be used in forest operations, we needed to determine how well the connection would work in lightly wooded areas and across fairly large fields. It was felt that an initial test near the FPInnovations Pointe Claire office should be done prior to undertaking more expensive tests in more remote areas. Figure 2 shows the location in Montreal which we decided provided us with the best location for testing this system in a rural and wooded environment. The area encompasses the Morgan Arboretum, three City of Montreal nature reserves as well as the McGill's Experimental Farm. It thus resembles a more rural environment than an urban one.

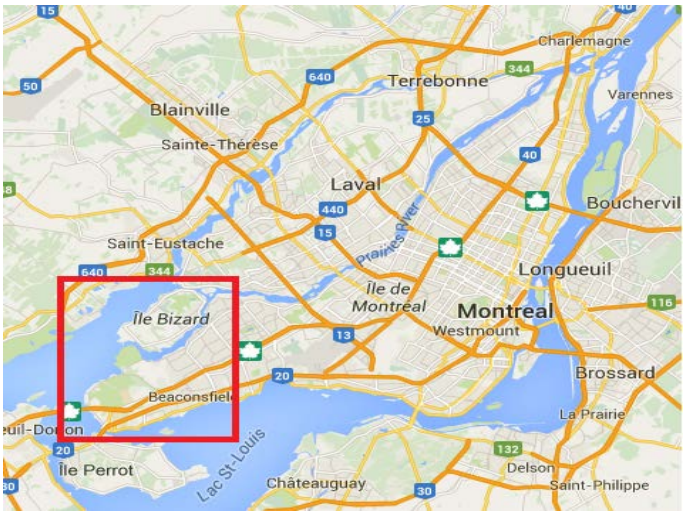

Figure 2: Geographical Area for Initial Testing

LinkLabs© claims that their systems can reach a range of up to 11 km, so our ultimate goal was to reach the distance shown in figure 3. The first test did not produce the expected range result shown in figure 3, so two more tests starting at different locations were performed in the hope of reaching this range. A two person team was used to perform the tests: Tester 1 stayed at a fixed point with the gateway while Tester 2 drove around with the evaluation board. The evaluation board communicates with the gateway every 10 seconds and shows a message that it has acknowledged its connection with the gateway so it can be very quickly ascertained when a connection has been lost.

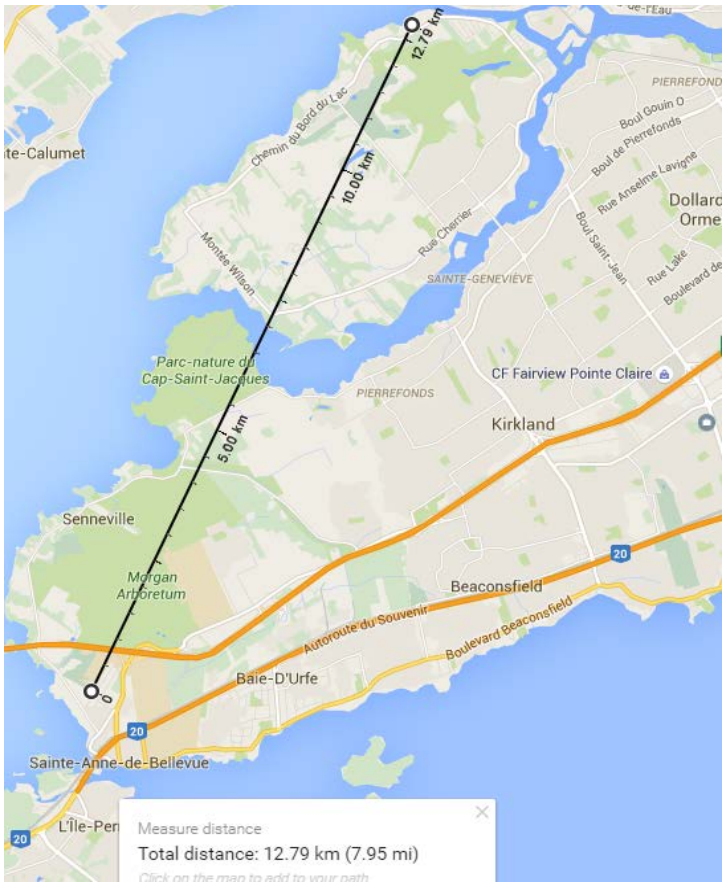

Figure 3: Product Estimated Coverage

The procedure followed for all three tests was as follows:

1. Establish a connection between gateway and evaluation board while parked at the gateway test location.
2. Once a connection is established, Tester 1 remains at the connection point with the gateway, while Tester 2 drives away with the evaluation board.
3. Once the connection is broken, Tester 2 will park the car on the side of the road and call Tester 1 to inform him of his location.
4. If a connection is re-established in less than 1 minute, then Tester 2 will continue on the same path until the connection is lost once again.
5. If the connection is never regained, then Tester 2 returns to the gateway location.

For Test 1, the gateway vehicle was parked on Morningside Drive in Senneville, Quebec and Tester 2 drove away north on Chemin Senneville. For Test 2, the gateway stayed at the entrance of the Morgan Arboretum in Sainte-Anne de Bellevue, Quebec while Tester 2 drove away west on Highway 40 towards Chemin Senneville. For Test 3, Tester and the gateway were at the south end of Chemin de l'Anse à l'Orme road in Kirkland, Quebec while Tester 2 drove north with the evaluation board on Chemin de l'Anse à l'Orme road.

RESULTS

The first test started with the connection being established on Morningside Dr. in Senneville, QC. Tester 2 then drove with the evaluation board north along Ch. Senneville towards Highway 40. There was a connection up until Tester 2 crossed underneath the highway at a distance of 1.03 km.

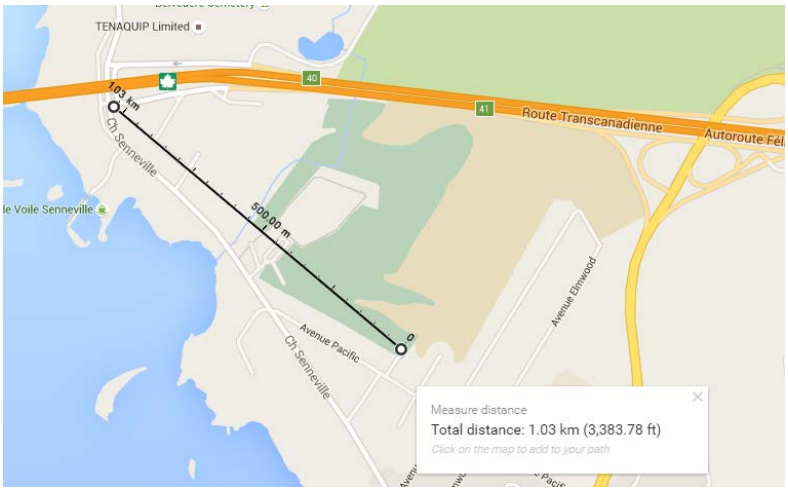

Figure 4: Actual Coverage for Test 1

The area encountered in this first test had a mixture of houses and wooded areas which the connection remained throughout. The connection was unable to stay active through the overpass on highway 40, as shown in figure 4, despite multiple efforts of keeping the connection.

Figure 5: Actual Coverage for Test 2

The second test, with the gateway at the entrance to the Morgan Arboretum attained a range of about 800 m. The connection was lost right before entering highway 40, as shown in Figure 5.

This initial location was chosen because it was on the top of a hill and it was assumed that greater range could have been reached. It is also of note that when Tester 2 drove along Chemin Senneville north of the highway the connection was never re-established.

For the third test, the gateway was placed at the south end of Chemin de l'Anse à l'Orme road. This test attained a range of 1.04 km before the connection was lost. This area only consisted of trees and open fields, but was still unable to produce a larger range that the first test as shown in figure 6.

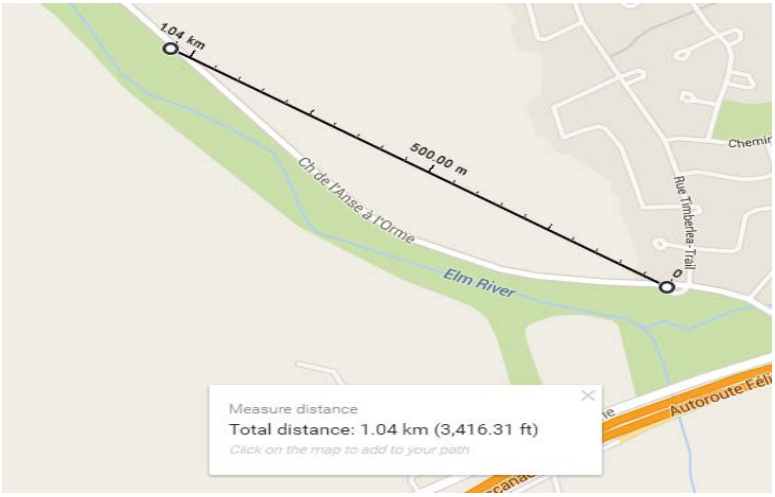

Figure 6: Actual Coverage for Test 3

CONCLUSION

The LinkLabs system claims to be able to attain a network range of up to 12 km. This would seem like an ideal range with perfect conditions, which would not apply for forest operations. The initial tests only yielded a range of roughly 1 km for each test before the network disconnected, but there is a belief that the range can be extended for this gateway and module configuration. The system was tested by Tester 1 with the gateway set-up at his home. He was able to attain a range of roughly 4 km by setting up the gateway on the second floor of his house and by keeping the evaluation board on the outside of his vehicle. This indicates that it is possible to reach larger ranges of coverage with better antenna placement and possibly with higher gain antennas. FPInnovations will do undertake further testing to establish how much range can be achieved with the LoRaWan system in better conditions.

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