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Connecting to the IaRTN

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Introduction

Starting on February 2nd the Iowa Department of Transportation (DOT) sponsored state-wide RTK network (IaRTN) is now fully functional and open for public use. The potential uses of this technology in agriculture are wide spread and will complement the strong recent growth in precision agriculture and machinery automation. Questions still remain though regarding exactly what equipment will be compatible with the IaRTN and how producers should navigate the decision making process when evaluating equipment purchases.

Identifying the necessary components

The IaRTN is a very different form of RTK service in that it uses cellular phone communication to transmit the high accuracy correction signal rather than the point-to-point radio system used by traditional RTK networks. This does make connecting to the IaRTN more challenging for agricultural users because only a limited set of GPS equipment options currently exist for this type of application. Producers need to understand the three key components necessary to connect to the IaRTN before you begin to work with your local dealers to configure a system that is suitable for your operation.

1. RTK ready GPS receiver: Your GPS receiver must be able to accept an RTK correction message. Most low cost WAAS receivers will not have this capability. If you are already using a subscription based differential correction then it is likely that your receiver is able to receive the RTK correction provided by the IaRTN, although you may need to purchase an activation code from your dealer.
2. Cellular Modem: The cellular modem in an IaRTN system is a direct replacement of a radio in a traditional RTK system. This is the key component that facilitates communication between the GPS receiver and the GPS base station. The cellular modem can come in many forms ranging from a standard cell phone to a hardened cell modem that is permanently mounted in your vehicle.
3. Network Connection Software: The network connection software is key difference between the traditional radio based RTK service and the IaRTN system. When using a standard RTK radio you are able to receive the RTK correction directly from the broadcast tower. In the IaRTN system, like any statewide cellular based RTK network, you will need a piece of software that can manage the cellular modem's communication with the IaRTN network server and then relay the correction response to the GPS receiver. This software is a crucial component for enabling your GPS receiver to connect to the IaRTN. Currently, this is the area with the largest gap in available technology. Some companies offer a third-party software solution to work with your current GPS products (InTime Connections) while others offer software that is integrated directly into the GPS receivers (Leica, Trimble, Topcon, among others). Look for more software solutions to come available as the adoption and market for agricultural use of the IaRTN grows.

Selecting a cellular modem and service provider

Many users may be tempted to upgrade their personal cell phone to a data plan and utilize it for connecting to the IaRTN. This is not the best solution for several reasons. First, voice calling has priority over data transfer, so if you are connected to the IaRTN and a call comes into your phone then you will instantly loose connection to the IaRTN server. This will immediately drop your RTK correction signal and leave you at a standstill until you're able to reconnect. Secondly, commercial cell phones are limited to ¼ watt of power. A dedicated cellular modem will have power levels ranging from 1 – 3 watts, similar in power to the now extinct bag phones. This increased power level will help maintain communication in areas where cell phone service is limited.

When selecting a service provider make sure to research their coverage around the areas that you are farming. If you can't get cell coverage in your field then you won't be able to utilize the IaRTN service. Connecting to the IaRTN requires only a data service plan, not a voice plan. On average while operating with an IaRTN connection you'll be using 1 Megabyte of data per hour of transmission time. By estimating your monthly working hours you can determine what size of data plan is needed. You should also discuss with your cell phone vendor if there are any

costs associated with changing your plan during the year. Your overall costs can decrease significantly if you are able to drop your data plan during the winter months when you're not out in the field.

Additionally, it is important to select a data plan that is compatible with the GPS hardware that you plan to use. For example, if you plan to run a free software package on a small netbook computer then you are free to choose any service provider that provides a suitable data plan. If you plan to use a GPS product that includes an internal cell modem then you need to determine whether the modem is GSM or CDMA compatible. GSM and CDMA are essentially two different types of cellular technology. GSM is a worldwide cellular standard and is the most common modem used internally in GPS equipment. Providers of GSM coverage in Iowa are AT&T as well as Sprint. CDMA is a common type of cellular technology within the US and is provided through many companies including US Cellular and Verizon. In general Iowa has much better CDMA coverage than GSM coverage.

Today's cellular networks are designed to handle large amounts of data transfer and the IaRTN correction data usage is quite low compared to other data applications. With that said there can still be instances when you may lose connection to the server because of limited capacity at your local cellular tower. These will be rare and will most likely be in conjunction with spikes in local usage like when a local school lets out and a high number of users are making voice calls simultaneously.

Recent accuracy results

A long term GPS accuracy test is ongoing at Iowa State University to quantify the stability and performance of the IaRTN service. This test is based on a Trimble AG25 antenna which is permanently mounted on the roof of Davidson Hall, home of the Agricultural and Biosystems Engineering Department. The antenna is connected to a Trimble Ez-Guide 500 with an active RTK activation. RTK corrections are streamed to the receiver from a desktop computer running NTRIP software available from www.lefebure.com. GPS data is collected at 0.2 second intervals and down sampled to one minute intervals for analysis.

Results from the recent early harvest period from September 19, 2009 through October 29, 2009 are summarized below. This data is quite representative of the consistent long-term accuracy that should be expected from the IaRTN system.

- Total GPS Events Recorded: 24,789
- Total Number of RTK GPS Events: 23,342
- Percentage of Time with RTK Fix: 94%
- 2DRMS (95%) Accuracy during RTK Test Period: 1.3 inches

The vast majority of lost RTK service occurred during the first two days of October. It should be noted that the Iowa DOT was quick to announce this downed service due to a technical issue with the IaRTN server and also kept all users informed as hardware repairs were made. Outside of this single event the test GPS receiver was able to achieve an RTK fix 99% of the time over this 40 day test period. The remaining RTK outages were a combination of lost server connection as well as low satellite visibility. Low satellite visibility in particular can be a problem with the current test configuration as the GPS antenna is slightly shaded by adjacent buildings.

The conclusion from this test experience is that the IaRTN service is highly reliable and robust for agricultural applications. Although server outages will continue to occur, they should reduce in frequency as the network and associated hardware and software matures. Additionally, the Iowa DOT has demonstrated a high level of professionalism and support by notifying users of potential problems immediately.