

## 21<sup>st</sup> Century Equipment Technical Summary

In today's day in age of agriculture, producers are faced with the overwhelming task of having to adapt to all the challenges thrown at them on a daily basis. Volatilities in markets, weather, and pests all weigh in on them while trying to find a way to supply food, fiber, and fuel to our world's growing population. Overcoming these challenges means producers need to be proactive in making management decisions. Historical knowledge of the land and industry can only do so much. Today's producers must use the immense amount of data they have at their fingertips along with that historical knowledge for managing their farms and ranches to stay profitable and productive for current and future generations.

Data driven decisions come with their own challenges for these producers. One of the major challenges that our rural Nebraska producers face is the ability to collect the data needed to make these decisions with the urgency that's required. Starting in the late 1990's, John Deere released the ability to collect field data with farm machinery with combines, tractors, and other farm machinery. With the exponential growth of producers utilizing precision agriculture technology in Western Nebraska, 21<sup>st</sup> Century Equipment developed a precision agriculture team in 2005. This team's mission was centered around supporting evolving on-farm technology as well as being trusted advisors for producers making data driven farm management decisions.

Up until 2010, all data transmission had to be done manually. This meant exporting data from the precision ag hardware mounted in the farm equipment onto a data stick and uploading it into farm management software on the producer's computer. In 2010, John Deere farm machinery started to come equipped with the ability to not only collect this crucial data but also wirelessly send it to the cloud-based farm management systems. This cell-based data transmission unlocked the much-needed ability to start making farm management decisions with the urgency they required. Embedded cellular modems also unlocked several critical remote support features for producers as well as John Deere dealers. Connected support allows 21<sup>st</sup> Century Equipment the ability to monitor alerts from a producer's machine and remotely connect to them for real-time diagnostics. Maintaining the machinery's uptime is critical to our producer's livelihood.

While this technology worked great for several areas across the United States, thousands of producers and agricultural companies faced the challenge of adequate cell coverage and quality to get this data in the time frame they needed. Unfortunately, several of these same individuals continue to struggle with this same adversity today. The image below in figure 1 details a coverage map of 4G wireless coverage across the United States. This is the same technology and services that John Deere equipment uses today. Over the course of the last 14 years with farm machinery with embedded cellular modems, John Deere has continued to enhance the hardware built into these machines in keeping up with the increased amount of data collected from these machines for decision-making.

Unfortunately, many machines our producers currently use on their operations in Western Nebraska are equipped with obsolete technology. Machines built from 2010 to 2018 came with 2G or 3G cellular modems installed from the factory. This was the result of continued evolution of cellular technology across the United States. Many producers across this region experienced poor data transmission due to the limitations with this early cellular technology. This poor performance meant they either continued

to move data manually with data sticks or just gave up on data collection all together as they couldn't make the timely management decisions they needed. This also meant limitations for 21<sup>st</sup> Century equipment in our mission to assist these customers with data driven decisions and remote support.

The overarching mission for 21<sup>st</sup> Century Equipment is to get these producers the support they need. At a conference in January 2024, John Deere released a map of cellular call quality from machines equipped with 4G modems across the United States as shown in figure 2. The green polygons covering the map means producers are getting the high volume of data collected with every pass across their fields in near real time with fewer issues with latency. The yellow and red polygons show areas where customers still face obstacles. As we zoom in on Nebraska (Figure 3), and specifically Western Nebraska, we observe green polygons of favorable data transmission. We also can see a lot of white zones across that area. Those areas were where producers faced poor performance early on with the 2G and 3G technology. They are apprehensive about investing money in technology that didn't give them the return they needed in the past. This reluctance obstructs them from the advantages mentioned before with data transmission, remote support and other technology advancements John Deere and partnering companies developed dependent on wireless data flow.

Enhancements in cellular infrastructures across rural America coupled with 4G cellular modems and high-performance antennas embedded in John Deere machinery have greatly improved the viability of these Western Nebraska producers getting the data flow they need. John Deere's current 4G modem technology offers producers up to 150 Mbps and 50 Mbps for download and upload respectively. As mentioned before, the data speed and coverage across much of the U.S. and specifically Nebraska has proven to be adequate to meet and exceed the demands of information flow from the farm machinery vital to these producers as the John Deere communication maps showed minimal disruption in data transmission to and from the cloud based farm management programs they rely on.

These producers can add cellular modems to non-Deere powered equipment across their fleet. This helps reduce some of the chaos in stressful times like planting and harvesting as producers can know where all connected machines are and can coordinate logistics in a much more efficient manner.

Overall, the implementation of connected machines for 21<sup>st</sup> Century Equipment and the producers we serve is imperative. Helping these producers overcome the challenges they face currently and help them make better use of the data they are collecting helps make their operations perform the way they need to remain successful.

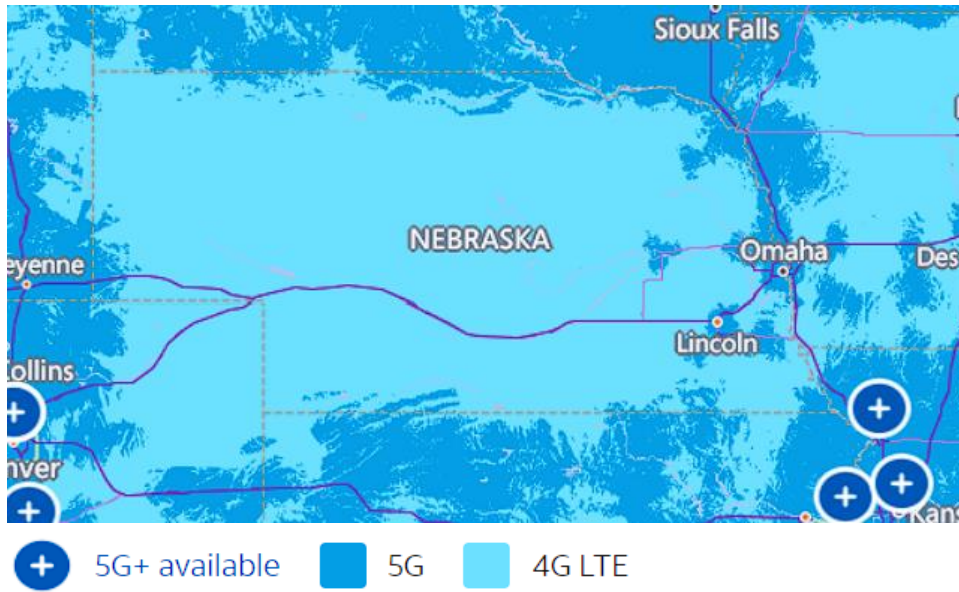


Figure 1.

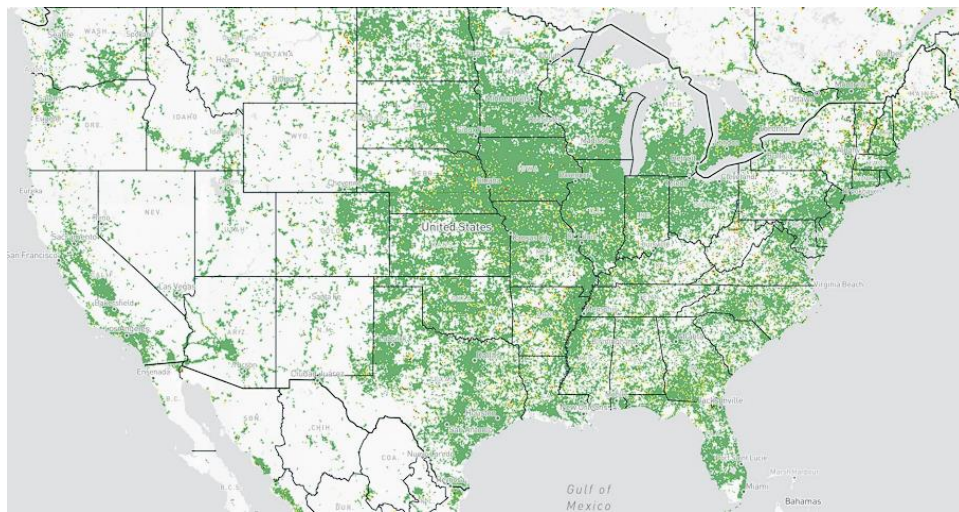


Figure 2.

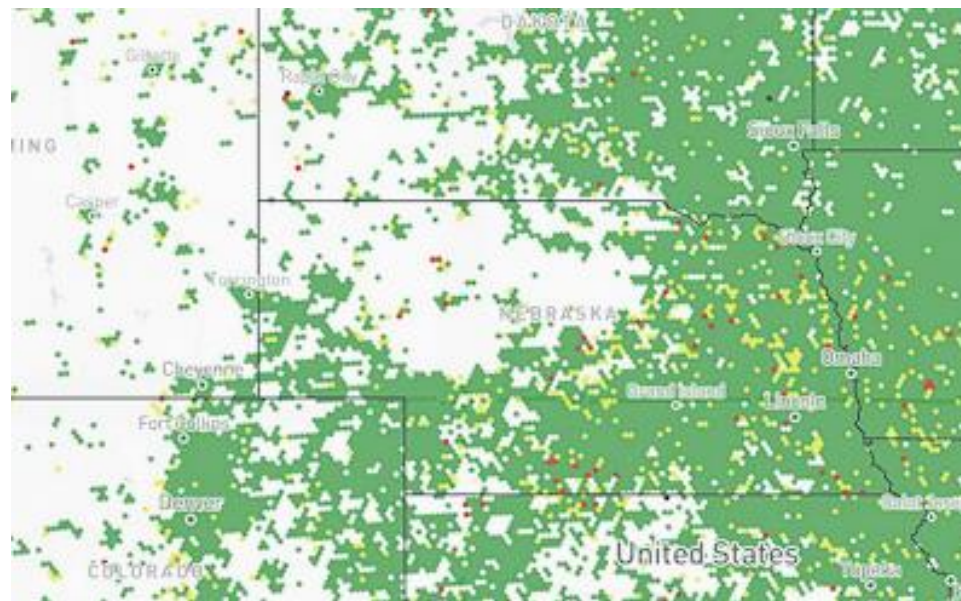


Figure 3.