

CONNECTIVITY OPTIONS FOR RANCH MANAGEMENT TECHNOLOGIES



Sustainable Southwest Beef
Knowledge and tools for ranch and rangeland resilience

Introduction to Precision Ranching Technologies:

Precision ranching is the use of smart sensors and technology to increase production, reduce labor time, and streamline operational efficiency. Some precision systems use automated monitoring of livestock, stock tanks and drinkers, and rainfall to provide accurate and timely information to producers. Other precision systems can automate some tasks such as opening gates, measuring animal weight, and/or containing and moving livestock using virtual fencing collars. Precision systems are fairly common in intensive animal agriculture (e.g., dairy industry), but their use in ranching operations is still in its infancy. As ranch management technologies that use wireless data transmission networks become more common and less expensive, new and exciting opportunities to develop robust precision ranching systems are rapidly emerging. Of course, there is no “one size fits all”, and this is true even of the wireless network options available for device connectivity. Here we discuss the main features of the most common options for getting connected to the smart-device(s) you’re using.

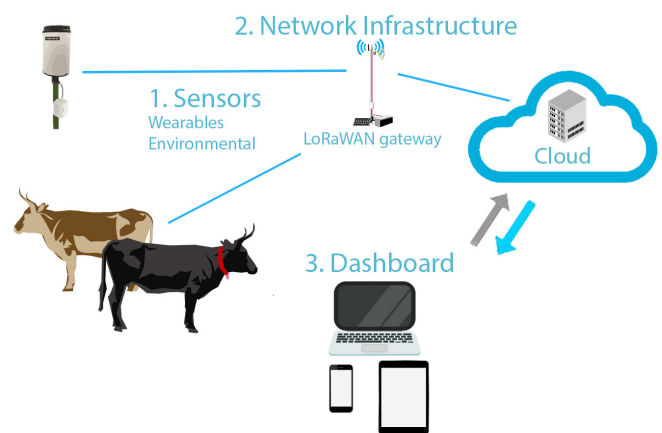
Cellular (4G/5G):

The cellular 4G/5G network is a nationwide system already put in place by cellular companies that allows transfer of data from one place to another. It’s the same system your cell phone or tablet uses every time you make a call, send a message, or go online. Harnessing the power of existing cellular 4G/5G networks can be an easy strategy for getting ranch management devices online as there is often minimal additional infrastructure needed to install or maintain to use the network. However, if you only have patchy cellular 4G/5G coverage this may not be the best option, as there will be places the device(s) may not operate properly when they can’t communicate with the network. There are some systems where intermittent cellular communication is acceptable. An example is virtual fence collars that communicate directly with cellular networks to upload cattle movement data and download virtual boundary data, but will continue to function using GPS and the last established boundary even without a cellular connection. Once the collars come into contact with cellular networks, they can be updated with a new boundary and will also upload any cattle movement data.



LoRaWAN:

Long-range wide area networks (LoRaWAN) are systems that use long-range radio frequencies to transmit information from a precision ranching device to a tower (also called a base station or gateway), and then either a cellular or Wi-Fi connection to transmit the data from the base station to your computer or smartphone. A LoRaWAN system is customizable to your ranch and its unique topography. You can place the base stations with the transmitters strategically to communicate with all the devices you have throughout your operation, even those in remote locations. Think of LoRaWAN as setting up your own personal network that is contained within your ranch.



LoRaWAN relies on line of sight between base stations and devices in use, so high points with good cellular connectivity are required. In general, the rougher the terrain the more base stations will be needed, which can drive up costs. If the coverage area is very steep with many canyons and mountains, then numerous LoRaWAN towers or gateways are required to provide sufficient coverage. Even with several gateways, LoRaWAN communication likely will not reach canyon bottoms or mountain faces opposite of the gateway.

Getting set up with LoRaWAN requires a significant initial investment, however it enables collection and transmitting of data across large areas of rangeland in remote locations where other network options might be limited.

Satellite:

There are companies with networks of satellites (e.g., Starlink, Kuiper, OneWeb, etc.) that work together to create virtually uninterrupted internet coverage across most parts of the world. Depending on the terrain of your ranch, using satellites for internet connectivity can be either more or less expensive than other connectivity options. In areas with relatively level terrain there are other connectivity options that may cost less over time, but in areas with steep terrain satellites may be able to reach areas other connectivity methods can't. Some advantages to using satellites to connect to the internet include a minimal investment in additional equipment (when compared to some other options) and the potential connectivity access to large areas of rugged terrain, however, the subscription to the service is not an insignificant investment.



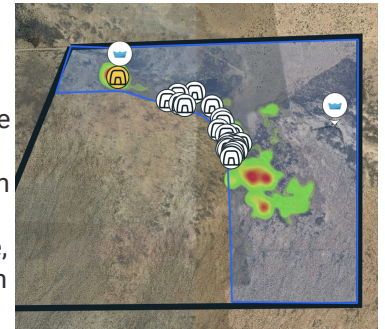
Wi-Fi:

Wi-Fi uses routers connected to a central wired internet source from a cable company to spread wireless internet coverage across distance. Most public buildings and many homes utilize Wi-Fi routers to provide a wireless internet network that's easily accessible by phones, tablets, computers, and other devices. A Wi-Fi network can also be used to support precision ranching technology on a ranch. The required infrastructure is minimal compared to some other methods, and the network coverage is customizable to the needs of your ranch. With strategic router, extender, and repeater placement you may be able to extend your network into remote portions of your ranch, though the more expansive the area or steep the terrain, the more routers, extenders, and repeaters will be required.



GPS and Virtual Fencing:

All virtual fence collars use GPS technology to establish virtual boundaries and identify when cattle approach those boundaries. Thus, the virtual fence boundaries should work in any location that satellite signal is received. To program virtual fence collars or to track the cattle location, the collars require communication with cellular signal or LoRaWAN, but once the virtual fence boundaries are programmed into the collars, they will work on GPS alone. This is an important aspect to understand in extensive systems because no communication network will be 100% in large pastures with deep canyons, mountains, etc. However, strategically placing communication systems can overcome these challenges. For example, water tanks can be utilized using either cellular or LoRaWAN as established communication points allowing virtual fence collars to be updated and virtual fencing objectives achieved.



Comparing Selected Features of Different Options:

Cellular Type	Can Work in Rough Terrain	May Have Restricted Range	Customizable Network	Infrastructure Investment Required	Subscription Service Needed
Cellular [4G]		✓			✓
LoRaWAN	✓	✓	✓	✓	✓
Satellite	✓			✓	✓
Wi-Fi		✓	✓	✓	✓

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For more information, visit:

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Or contact

Santiago Utsumi
sutsumi@nmsu.edu

