Communication Systems for Gas Measurement Data
Class # 3080.1

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Introduction

Communications systems for gathering gas measurement data may require the use of several technologies for reliable communications back to the host computer. Commonly used wireless technologies are licensed radio, non-licensed spread-spectrum radio, and cellular because they allow for two-way poll response messages to be passed between the host computer and the end devices such as flow computers and gas chromatographs. Deployment and maintenance of licensed and non-licensed radio systems usually require a fair amount of engineering. Cellular modems are much easier to deploy as they work off of existing cellular infrastructure. Other technical considerations include saturation points, host protocol versatility, and solar power.

Communications Technologies

Licensed Radios

- Require an FCC license
- Stationary Master location
- Restricted transmit and receive frequencies i.e. 928/952 MHZ, 931/942 MHZ, etc.
- Up to 5 watts of transmit power for extended coverage
- Power consumption typically 2 Amp Transmit current at 5 watts, 125 mA Receive current
- Has Serial and Ethernet versions

Non-Licensed Radios

- Do not require an FCC license
- Master can be located anywhere within the network
- Use frequency hopping spread-spectrum technology usually over 901-928 MHZ
- Up to 1 watt of transmit power
- In most cases the radios can be configured as masters, repeaters, or slaves
- Power consumption typically 380 mA transmit at 1 watt, 55 mA Receive current
- Ability to block/unblock frequencies to avoid interference
- Ability to apply unique network addresses
- Has Serial and Ethernet versions

Cellular Modems

- Requires a data plan through cellular provider i.e. ATT, Verizon, etc.
- Can be placed anywhere within cellular coverage area
- Operates on 850 MHZ, 900 MHZ, 1800 MHZ, 1900 MHZ, and 2100 MHZ
- Provides static/dynamic wireless Internet Protocol addresses to access
- Common platforms are GPRS (General Packet Radio Service) and CDMA (Code Division Multiple Access)
- Power consumption is typically 350 mA Transmit/Receive current and 40 mA idle
- Most modems have the ability to restrict access to known host IP addresses for added security
- Has Serial and Ethernet versions

Serial and Ethernet options are available in the radios and modems listed above. Serial technology was developed in 1960 and was intended for use with communications equipment like phone modems. As advances were made in communications technology and software the need for more advanced networking capabilities produced Ethernet in 1974. In the 1990's Ethernet became the most frequently used of all LAN types due to its speed, cost, versatility, dependability, and ability to connect a variety of networks according to a white paper written by B&B Electronics.

Serial Communications

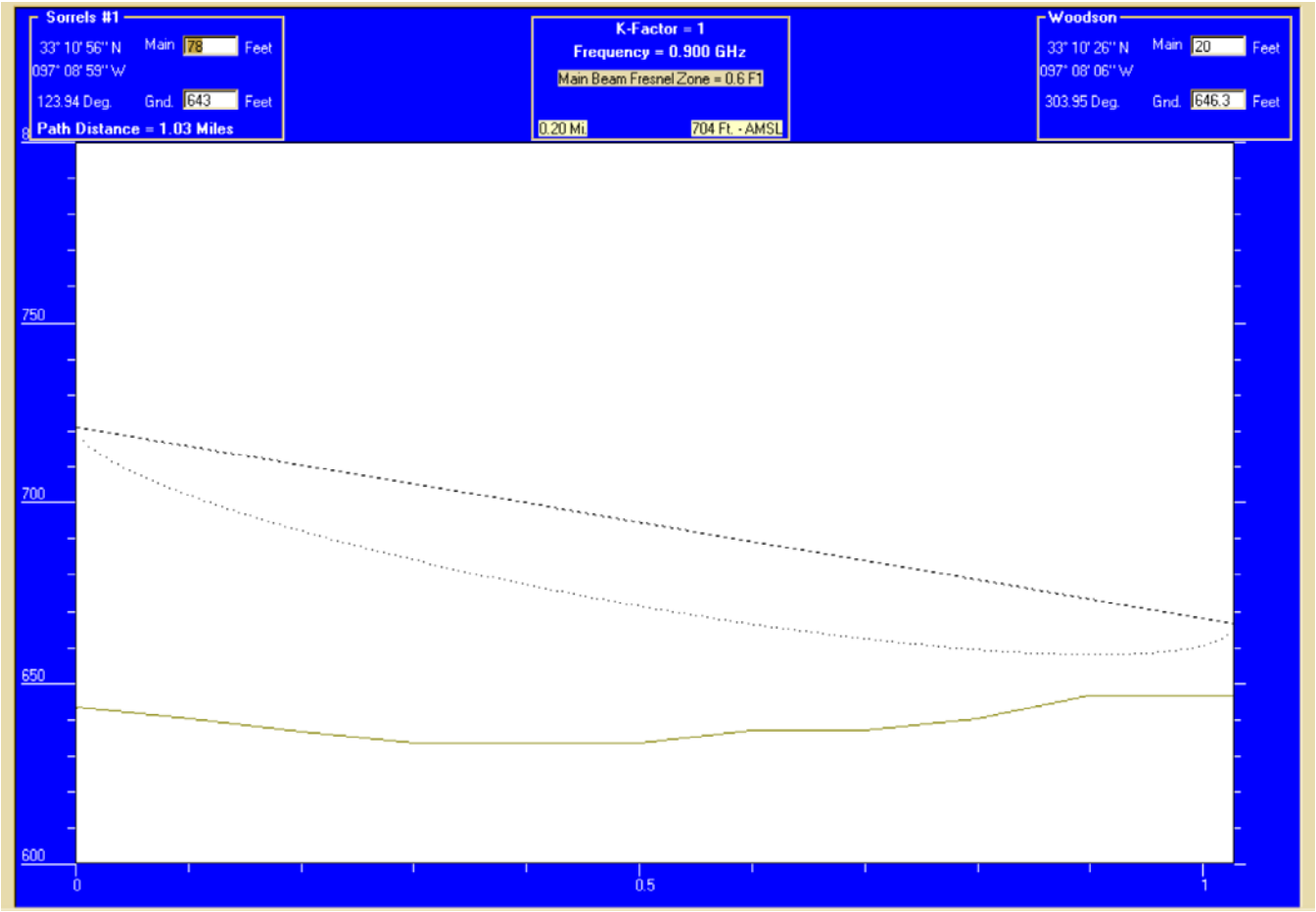
- Maximum distance for RS232 is limited to 50’ unless repeaters are installed; RS485 can go up to 4000’ without adding repeaters.
- The top number of devices for a serial LAN with repeaters is usually 256.
- Monitoring and control of remote equipment is more difficult.
- Upgrading software and firmware must be handled locally.
- Various types of networks can’t talk to each other.

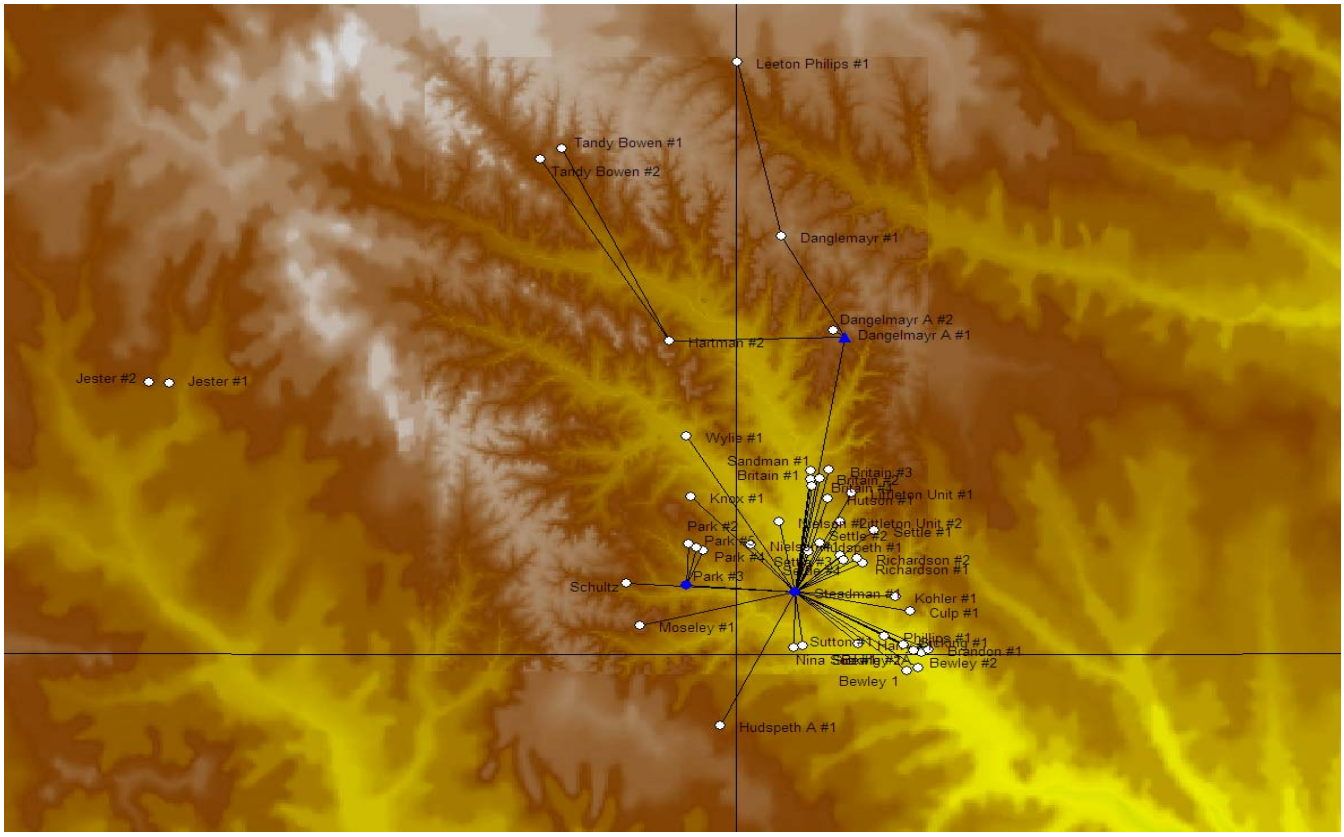
Ethernet Communications

- Improved Access – Connect to serial devices over great distances.
- Cost Effective – extend network out to field without having to replace existing radios.
- Remotely access communications networks.
- Enables more effective troubleshooting.
- Enables remote software upgrades from network.

Communications System Engineering

Engineering a new radio system starts with documenting the coordinates (latitude and longitude) for each location which will be used to do path analysis. Path analysis software takes into account tree height and elevation and will tell you where you need to install master, repeater, and end point towers as well as the height needed for each. Below you will see examples of an individual path profile and a system profile.





Note that the two wells farthest to the west are not connected to the radio system. Path analysis helped determine that those two points were either not in range or obstructions in the pathway.

Once the system infrastructure has been designed you will now have to determine the best way to backhaul data from the central points of presence i.e. master towers and isolated meter sites. In some cases the polling host is located within radio distance where a polling master can be installed. Other cases may require the use of a cellular modem with wireless IP to backhaul data to the polling server.

Technical Considerations

Saturation Point

As your network grows and more meters are added it may become necessary to:

- Add new masters.
- Increase number of repeaters.
- Upgade to an Ethernet backbone.
- Increase baud rate.

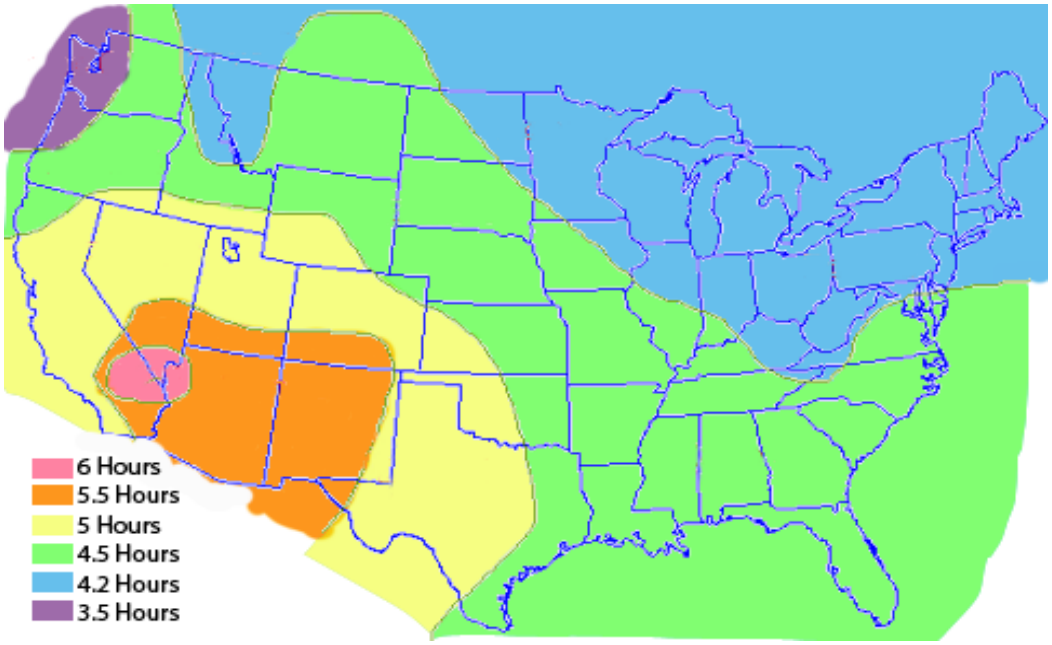
A general rule of thumb for determining the need to make adjustments is when the polling server is not able to complete its cyclical polling process before it reaches the end of the meter list, including archiving and poll retries.

Host Protocol Versatility

When considering a polling host it is critical that you determine what protocols are available and to what extent they have been developed. Most companies in our industry have many different makes and models of flow computers and protocols, which creates a need for a versatile polling server. Make sure that your meter makes and models are covered with fully featured protocols that capture measurement data as well as SCADA data.

Solar Power

Another consideration for optimum system performance is power. The chart below, provided by Solar Panels Plus shows the average daily sunlight hours available for solar panels in North America.



Most meters in the southern states survive using 20 watt panels, 26 amp hour batteries, and external charge controllers when polling every half hour collecting archives twice daily. A 30 watt panel and larger battery would be more beneficial when making use of expanded IO modules, near real-time polling, additional multivariable transmitters, etc. Obviously the less sun you have the more solar panel and battery you'll need.

Conclusion

As you look to install or maintain communications infrastructure for measurement systems it is extremely important to consider path engineering, communications technologies, host system and power requirements. A well engineered system will deliver reliable data.