From the early current loop to today's fiber optics and wireless, system designers must weigh many variables.

Getting From Here to There: Serial Communications Systems

What do you do when you need to make a dedicated low speed data connection between two places? Need to monitor a PLC on the factory floor from an office area, connect a host PC to a timeclock or alarm system, or make a connection between buildings?

The asynchronous serial connection has been the workhorse of low bandwidth communications for decades. For control, monitoring and low volume data transfer asynchronous serial provides a low cost, low development solution. The RS-232 serial port is prevalent on PC's as well as scores of industrial, scientific and consumer devices making it a convenient starting point for communications. Since RS-232 itself is only suited to short connections, many applications require that it be adapted to fit requirements. This article summarizes the choices a system designer has when selecting a serial communications system.

RS-232 or, more currently, EIA-232 uses a single ended, bipolar voltage signal. Voltages typically swing from –12V to +12V with respect to signal ground. Suitable for low noise environments and distances below 30.5 meters (100 feet), RS-232 is commonly used for the desktop modem and mouse. An increase in modem speeds has spurred an effort to increase RS-232 data rates by chip vendors. Transceivers capable of 460k baud and higher are now available, although the actual throughput gains of running higher data rates than 115.2k baud on interrupt based systems is questionable at best.

RS-422 is suited to longer distance communications, up to 1200 meters (4000 feet) without repeaters. Using a balanced differential pair results in higher noise immunity than EIA-232. The differential voltage provides a valid signal down to 200 mV. Two wires are required for each signal in addition to a signal ground conductor. RS-422 is most commonly used for point-to-point communications, although up to 10 receivers may be connected to a single transmitter.

RS-485 is also suited to longer distance communications, up to 1200 meters (4000 feet) without repeaters. Again, a balanced differential pair is used for higher noise immunity than EIA-232. Voltage levels are identical to RS-422. In addition, RS-485 offers a multidrop capability, up to 32 nodes can be connected. The multidrop feature also allows "two-wire" (in addition to signal ground) half-duplex data connection to be made.

Current Loop is the oldest method of connecting serial devices, dating back to Teletype machines. Typically a loop current of 20 mA indicates a marking condition and 0 mA represents a space. Unfortunately, there is no true standard for current loop, so switching thresholds, voltage requirements and connections vary widely. A well designed current loop system has high noise immunity, and is inherently optically isolated. However, speeds are generally low and the lack of a standard makes connectivity between manufacturers spotty.

Fiber Optic communications is growing in popularity as another low bandwidth serial solution. While costs are still higher than copper solutions, fiber optic links benefit from optimum isolation, noise immunity, and distances up to several miles. Installation of fiber optic cabling requires more care than copper, and repairing damaged cabling is difficult.

RF wireless has become more affordable in recent years and the adoption of spread spectrum technology has further improved performance. Modules to convert RS-232 signals to RF can be used for low to medium data rates. Range is limited, typically several hundred feet, although units are available that reach several miles with appropriate antennas. Higher power units are also available but require an FCC site license to operate. The range and performance of RF wireless is highly dependent on the physical and electrical environment and costs are high. If mobility is required or wire isn't possible, wireless has become a viable solution.

Com Type	Pros	Cons
RS-232	Low cost Widely available	Limited distance Poor noise immunity
RS-422	Good noise immunity Long distance	May require additional isolation to prevent ground loops
RS-485	Good noise immunity Long distance Multidrop capability	May require additional isolation to prevent ground loops
Current Loop	High noise immunity Built-in isolation	Low speed Compatibility problems Rarely used in new designs
Fiber Optics	Ideal noise immunity Long distance	More care required in installation Higher initial cost
RF Wireless	High mobility	High cost Sensitive to environmental variables

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