KANTRONICS COMMERCIAL MODEM PROTOCOLS

Making the Right Choice

Kantronics modems are available with several off-the-shelf protocols, which can be used with many applications. However, if your application requires a special data protocol or a non-standard modem operation, Kantronics can, in some cases, modify the programming in the radio modems for volume applications. This is done on a case-by-case basis for a fee.

The available protocols in Kantronics Commercial Wireless Modems are:

- **AX.25 (Packet)**
- **Transparent Unproto Packet (TUP)**
- **Poll Mode**
- **Line Substitution (LSUB)**
- **Modem Mode**

AX.25 (Packet)

AX.25 is a radio networking standard, based on the X.25 protocol, adapted for radio use. AX.25 provides for the exchange of essentially error-free computer data between two modems via a RF link. AX.25 is a highly structured, positive acknowledgment protocol using advanced algorithms to insure that data exchanged between two modems (7 or 8 bits) is correct. This protocol also allows each modem in a network to function as a digital repeater in order to extend the effective range of the system.

AX.25's prime advantage is the robustness of the protocol, providing error-free communication between the modems. The protocol uses a CRC-l6 error check of each data packet and frame check sequences to guard against receiving data frames out of order when multiple packets are received.

The highly structured format of AX.25 also presents the primary difficulty of implementing the protocol for most applications. More often than not, the Data Terminal Equipment (DTE) connected to the modem's RS-232 port does not know how to communicate with the modem, requiring software to be written for the DTE in order to work smoothly and provide a suitable interface for the application. If data integrity is of paramount importance and the inherent response delays, overhead, and control of the modem are tolerable, AX.25 is the best protocol choice for the application.

Transparent Unproto Packet (TUP)

TUP provides essentially error-free reception of computer data via a RF link. Using the Unproto feature of the AX.25 packet protocol, TUP allows the modem to operate as an automatic data switch, ready to accept data (7 or 8 bits) from either the radio or the associated DTE without the necessity of first establishing a packet session.

The receiving modem decodes monitored data, strips any addressing information or modem control characters from the data stream and sends only the data portion of the AX.25 packet to the serial port of the DTE if, and only if, the packet contains no detectable data errors. The transmitting modem buffers data sent to it by the DTE and transmits packets based on a serial port activity time-out.

TUP's prime advantage is the reception of error-free data since the AX.25 CRC-l6 error check is used, without the complexity of having to first establish a packet session.

As with AX.25, each modem in a network using TUP can operate as a digital repeater in order to extend the effective range of the system. If digipeaters must be used to extend the range of the system, the information frame sent by any modems in the system will be output to the serial ports of the receiving modems only once, regardless of how many times it was received correctly. Also, data sent by any modem will not be decoded by itself when the data is digipeated. The TUP mode protocol also provides an automatic "Time to Live" timer that inhibits any modem from transmitting or receiving additional data until sufficient time has expired to allow in-progress data to travel through all the digipeaters specified by the originating modem. Since the time for a given packet to travel the entire UNPROTO path may vary due to the presence of other signals or noise, an additional delay time, if needed, may be imposed during which each modem will be inhibited from decoding or transmitting new data.

The disadvantage of this protocol is that there is not an end-to-end handshake automatically performed by the modems to confirm that the data was, in fact, received at the intended destination. Usually, successful implementation of this protocol requires that the data sent to the modem by the DTE already contains addressing information and that the system can tolerate or retransmit occasional missed data frames.

If the DTE used in your application already implements a method of addressing (if needed) and can determine that data has been received by the remote location (if necessary), the TUP protocol may provide an elegant solution to your application problem.

Poll Mode

The Poll Mode is generally used in system applications that implement a polled-response protocol between a central site and one or more remote locations. The Poll Mode is similar to the TUP mode since it uses a data transparent broadcast mode, and a packet protocol with CRC-16 error checking to insure the integrity of the received data.

All ASCII characters (hex 00 through FF) can be transmitted and received. The Poll Mode differs from TUP by allowing an application program to address specific locations without changing any modem parameters. All data sent by the application program at the central site must begin with the address (POLLID) of the intended remote modem.

When any remote modem receives data from the radio, the data is checked for errors and the received POLLID is compared with its own POLLID. If a match exists, the POLLID is stripped and the data that follows is sent to the serial port. If a match does not exist, the data that follows is discarded and nothing is output to the serial port. All data received by the central site from the remote location will arrive with the POLLID of the remote automatically attached to the beginning of the data.

It is the responsibility of the application program to address data to be sent to the remote sites, to determine if the data was received, and to recognize responses which contain the remote site's POLLID and data. *Digipeating is not allowed in Poll Mode.*

Line Substitution (LSUB)

The LSUB protocol is a raw ASCII broadcast mode (7 or 8 data bits) using no addressing or error detection by the modem. When the LSUB mode is enabled, the modem operates as an automatic data switch ready to accept data from either the radio or the associated DTE. This protocol has very little overhead and is best suited for use with systems that already provide error control and addressing within the transmitted data.

Since ANY audio received by the modem in a raw ASCII mode would normally generate ASCII characters, Kantronics has developed algorithms that inhibit the printing of random characters after data reception or during periods of received noise or static crashes. Advantages of the LSUB protocol include ease of set up and use. Although data errors are not detected and will be passed to the receiving DTE, LSUB is very straightforward and easily integrated into many applications.

Modem Mode

Modem mode allows operation as a true passive modem under DTE control. The RTS and CTS lines of the RS-232 port are used to control transmission times. Once the DTE asserts RTS, the modem will key the radio, transmitting a "mark hold" tone and return CTS to the DTE when the radio is ready to transmit data.

The data sent to the modem by the DTE can be of ANY format, since the output of the modem will directly mimic the speed (up to 1200 baud) and composition of the data stream presented to it. After the DTE sends its data to the modem and releases RTS, the modem returns to receive and drops CTS. Modem mode has no error detection, addressing, or bit dribble filtering, relying solely on the associated DTE for protocol assistance.

Protocol Summary

The following table summarizes the characteristic of the different protocols:

Protocol	AX.25	TUP	POLL MODE	LSUB	Modem Mode
Complexity	High	Moderate	Moderate	Low	Low
Error Checking	Yes	Yes	Yes	Discards noise between data transmissions	No
Receipt Confirmation	Yes	No	No	No	No
Supports Digipeating	Yes	Yes	No	No	No
Addressable	Yes	Yes	Yes	No	No
Intelligence Required in User Equipment (for non-critical applications)	High	Low to Moderate	Low to Very Low	None	None
Intelligence Required in User Equipment (for critical applications)	High	Moderate to High	Moderate to High	Very High	Very High

Making the Choice

By supporting a range of protocols with different characteristics, Kantronics allows you to choose the one that best suits your application.

At the low end, MODEM MODE and LSUB require very little from the connected equipment. But like a party-line phone, they lack addressing that would help distinguish the intended recipient(s). These two modes can enable you to get up and running quickly for very non-critical applications, but are not appropriate for other applications unless the application provides its own addressing and error detection capabilities. In the case of user equipment (for example, some SCADA equipment) that already incorporates addressing, error detection, and missing transmission handling, MODEM MODE and LSUB provide very transparent hookup and avoid the overhead of another layer of protocols.

TUP and POLL MODE both add error checking and address capabilities, as well as digipeating in the case of TUP. They are still simple enough to allow quick development of non-critical applications, but with the big advantage of error checking to prevent reception of erroneous data. While they don't provide the sending station with confirmation that the recipient received a sent message, this is not necessary in many applications. For periodic telemetry, for example, where data is transmitted at a (relatively) constant interval, the host end can simply issue a re-transmit reminder to the data collection instrument end if the host has not received data within the anticipated interval. These "lazy negative acknowledgements" can help conserve airtime, since they are only sent when the data is not received when expected. Obviously, this technique is not appropriate for applications where the data transmissions are triggered by non-periodic events.

POLL MODE is particularly appropriate for applications are already geared towards poll-response communication. It allows the remote site implementation to be very simple, with more of the complexity handled at the central site. It can also offer efficient use of the airtime for applications with a large number of nodes.

TUP protocol is well suited to peer-to-peer communications, and applications needing the digipeating capability to extend the range of the communications beyond a single station-to-station link.

The AX.25 protocol is appropriate where confirmed error-free delivery of messages is important. With digipeating, it allows communication over longer distances. Supervisory Control and Data Acquisition is an example of an application where the delivery confirmation is important. It may be inappropriate to command an action to a remote site (such as turning on a pump) if a prior command (to open a valve supplying fluid to the pump) was not successfully received.

While the AX.25 protocol requires more interaction between the application and the modem than other protocols, this can still be simpler than implementing complete addressing, error detection/correction, and receipt confirmation capabilities from scratch in the user application.

Implementation

Once you have chosen a protocol, you can refer to the KWM series user manuals for helpful information on configuring the KWM series modems for your chosen protocol. These manuals are available on-line in the support section of the Kantronics web site at www.kantronics.com. You can also contact Kantronics for further application assistance.

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