PRACTICAL IMPLEMENTATION OF SPREAD SPECTRUM TECHNOLOGY – PART II

Point to Multipoint 2-Way Communications

Continued from the January/February *IMSA Journal*, page 40

by Ken Szgatti

Wireless Solutions today are having an immense influence in shaping the way traffic monitoring and control systems are designed, providing a degree of flexibility not available with hardwired systems (cable or fiber). In part I of this series we introduced the concept of Appropriate Technology Wireless Solutions for traffic control applications that are non-serial data based; applications with no RS232 interface available to connect to the standard radiomodems that are all so common today. In situations requiring the reliable transfer of status (ON/OFF) information to or from a remote device or location, we outlined technologies that are specifically designed to directly accept and transfer contact closures in one direction, providing cost-effective, easy to implement wireless monitoring or control functionality. Taking the concept a step further, the logical progression, then, is to two-way (bidirectional) communications. Implementing radiocontrollers that feature direct contact-closure (status) inputs and outputs, providing the direct ability to both monitor and control.

Point-to-Point Monitoring and Control Systems

In its simplest variation, a Master radiocontroller communicates with one Slave only. This configuration is referred to as Point-to-Point, as there is only one end node; all communications takes place between two points (the Master and its dedicated Slave). A minimum of intelligence need be built into such systems, as the destination of the Input commands at either end of the RF link is known (its' corresponding companion radiocontroller). The Master and Slave radiocontrollers are in constant communication with each other at all times, regardless of changes in any I/O lines.

Fig. 1 shows a practical configuration for a simple Point-to-Point control application. In this example, a Master radiocontroller issues one command (ON/OFF) to a single Slave. The single output at the Slave controls the load through the first set of contacts on an interposing relay. Load relay status from the Slave output is fed back into the Slave input, via the second set of contacts on the load relay, providing a confirmation of load status at the output of the Master radiocontroller.

Fig. 2 shows an expanded version of the simple system outlined above. Still operating in Point-to-Point mode, multiple Inputs and Outputs are now available for use by the application. The Master and Slave radiocontrollers know the final physical destination of their status commands (their companion radio-

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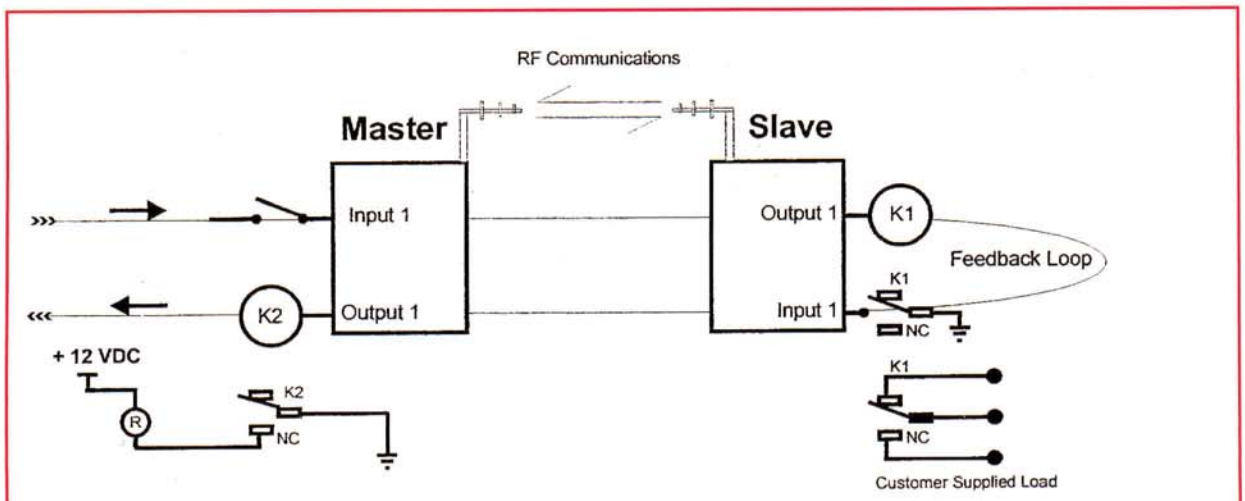

Figure 1. Point to Point Bi-Directional Contact Closure Transfer

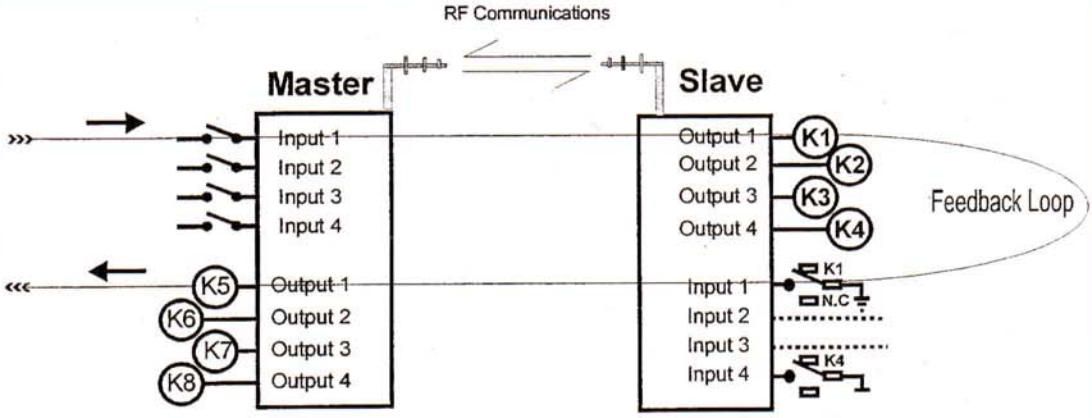

Figure 2. Point to Point Example of I/O Mapping

controller), but with the availability of multiple Input lines at each end of the link a method of identifying and routing the individual lines is necessary. This is accomplished internally, by assigning a data "tag" to each input line. This tag information is sent along with the Input line status every time the inputs are scanned, allowing the receiver at the far end of the RF link to decode and route the Input status value to the proper Output. This process of assigning which Master status Input is "connected" to which Slave status output is called "I/O Mapping", and in simple Point-to-Point systems is typically configured straight through (Master Input 1 mapped to Slave Output 1, etc.)

Although useful, Point-to-Point system configurations are limited in their flexibilities. Suppose your application calls for monitoring and control of remote devices at more than one geographical location? In this case a dedicated radiocontroller would be installed at each remote location, picking up status information from the monitored device, as well as providing control outputs. It is usually impractical, both from a cost and a technical point of view, to install a number of dedicated Point-to-Point links to remote sites. The alternative is to design the system using Point-to-Multipoint architecture, where one Master radiocontroller communicates with multiple remotes within its radio coverage area.

Point-to-Multipoint Monitoring and Control Systems

In a Multipoint network, the Master radiocontroller is tasked with the operation and control of the entire data collection network. As there may be a large number of Slave units in the field, each Slave is assigned an address, and as the Master can only communicate with one Slave at a time, the Master is configured to interrogate, or Poll, each Slave in a preset sequence. As opposed to the continuous communications nature of Point-to-Point networks, Slaves in a Multipoint network only speak when spoken to by the Master. This reduces unnecessary system radio traffic, prevents Slaves from interfering with the operation of others and allows efficient loading of the available RF spectrum (maximizes the number of Slaves per channel).

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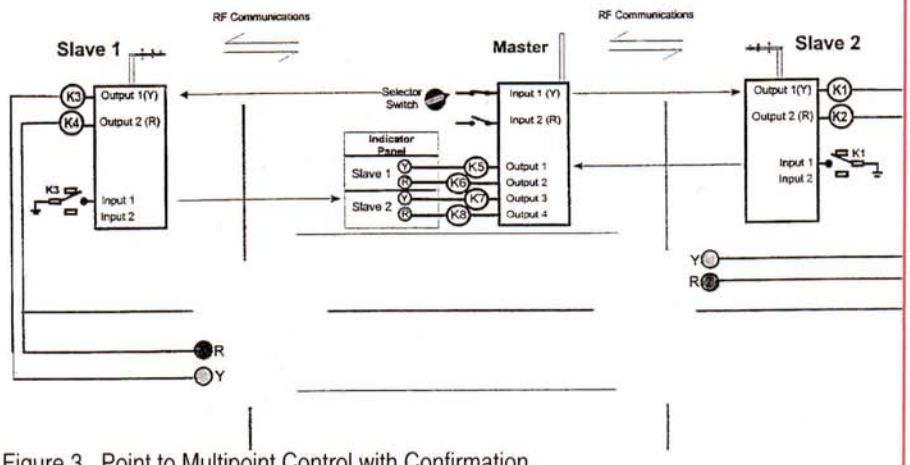

Figure 3. Point to Multipoint Control with Confirmation.

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As system complexity grows, specifically moving up into Multipoint systems, the amount of intelligence required by the Master radiocontroller increases dramatically. A specific status Input at the Master not only needs to be mapped to the Slave Output, it now also needs to be addressed to a specific Slave radiocontroller. Communication from Master to Slave typically consists of an originating address (Master), the destination address (Slave), the Map location (where the output is directed) and finally, the actual Status value. On the return transmission from the Slave to the Master this same sequence is repeated. With more than two Slaves in a network, each with multiple I/O lines, the possible configuration options and resulting system functionality can seem overly complex and difficult to implement. With currently available technology, however, even the most demanding status monitoring and control system is achievable easily, without modifications to the end-users existing system software or hardware.

Configuration of all system addressing and I/O mapping takes place at the Master radiocontroller, and is handled by easily managed PC based software. When properly installed and configured, these systems operate transparently, as though cabled. Any switched input anywhere within the network can be routed to force an output, or outputs, anywhere within the network.

Figure 3 shows a typical Point-to-Multipoint control and monitoring system. Two Slaves are installed, one at either approach to an Emergency Vehicle exit onto a busy corridor. Yellow warning flashers at each Slave location warn motorists of the Emergency Vehicle exit ahead, the operation of which are monitored by the Master radiocontroller continuously, with visual confirmation of proper operation available at the Master monitoring panel. A manual switch, activated by the Emergency Vehicle crew before leaving the station, forces the yellow flashers off and forces Red Flashers on. Positive confirmation (feedback) of the status change of both Slaves from Yellow to Red is displayed on the Master indicator panel as soon as the commands are responded to.

Appropriate technology wireless solutions permit the rapid design, deployment and commissioning of a wide range of Monitoring and Control systems. Being easily end-user configurable, and field reconfigurable on the fly. This technology allows for easy site additions and expansions. Frequency-Hopping Spread-Spectrum technology provides a robust and secure RF platform. Robustness and flexibility combined provide system integrity with built-in longevity for the demanding traffic monitoring and control industry. ■

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