Monitoring the State of Delaware's Communications Network

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The Challenge

The State of Delaware prides itself on being the first of the thirteen colonies to ratify the U.S. Constitution. It can also take pride in being one of the many sites for Motorola's communication network monitoring for its state-wide radio communications system.

The Delaware communications system, which supports the state's police, fire and emergency agencies, is an 800 MHz SmartZone™ Radio System. There are 20 sites, located strategically throughout the state, equipped with various I/O configurations and a large number of microwave radios, QUANTAR™ base stations, RF networks, and auxiliary equipment, each using its own specific alarm interface. The different equipment types and many system applications require a multitude of terminals, leaving the operator to search through a sea of computers and peripherals until a specific alarm can be located. In such a complex radio environment a system failure, even momentary, can be disastrous to a police officer or fireman in the field. State authorities wanted a monitoring solution that would use multiple computer workstations located throughout the state, with each workstation having the capability of monitoring the entire system. They also wanted the monitoring system to work transparently and at minimum cost for additional infrastructure. Since the state system is based on Motorola's 800 MHz SmartZone radio, Motorola was able to propose a network management solution to provide the monitoring, diagnostic and control of the communications equipment located at each of the state's 20 sites. The proposal was accepted and is being implemented using a three-phase plan. Each phase calls for the implementation of a set number of sites.

The MOSCAD Solution

The Delaware communication monitoring system consists of the following components:

- Graphic Master Central (GMC) computer
- Front End Processor (FEP)
- Communication media
- Protocol over the media
- MOSCAD RTUs
- Field devices to be monitored

The Graphic Master Central terminal features an industry standard SCADA package with full graphical, alarm and reporting capabilities and offers all the necessary flexibility for their monitoring needs.

The FEP (Front End Processor), consisting of a Series 300 MOSCAD CPU running a custom application program, communicates with the MOSCAD RTUs using the MOSCAD MDLC OSI/ISO 7-layer protocol via the microwave radio link installed for the ASTRO™ SmartZone system. In addition to the environmental alarms that are monitored in the field, several radio devices are monitored and controlled, including the QUANTAR base stations and the microwave radio itself.

Eight graphic central computers with friendly MMI are connected into the MOSCAD infrastructure via co-located MOSCAD front end processors. The Modbus™ protocol is used for the intercommunication between the FEP and the MMI. The customized screens, developed for the central computers, depict current system status allowing the operator easy access from a macroscopic system view to a detailed site view. The system also supports the remote dial-in function for remote alarm and control operation, as well as options for paging to an alpha numeric pager.

Both the microwave radio and the QUANTAR base station have a serial interface connection through a digital (RS-232) connection to the MOSCAD CPU. This interface supports all monitoring and control data exchange to/from the respective devices. The obvious benefits of this serial connection include decreased costs (no need for parallel I/O modules or alarm devices, such as the status control extender), little or no wiring, and decreased documentation efforts.

A dedicated digital (RS-232) service channel on the microwave radio serves as the intercommunication medium for the MOSCAD infrastructure. California Microwave's Telestar 2™, the microwave radios utilized for this system, provide an overhead (9600 bps) service channel for the MOSCAD communication monitoring system. The advantage of using this service channel is that the alarm system does not utilize any of the customer's communication payload – a feature of particular importance to the State of Delaware.

Microwave Diagnostic Interface

In a Telestar radio, the Alarm and Control Unit (ACU) which is a part of the Microwave equipment, provides the means to monitor performance and alarm information from the radio and also automatically corrects poor performance using methods such as switching transmitters and receivers. The ACU communicates to the outside world via a serial interface (RS-232) using a three-layer protocol. In a typical (non MOSCAD RTU) system, the ACU would connect to a California Microwave Status Control Extender (SCE) unit. The SCE would convert the ACU's RS-232 protocol to discrete digital outputs and accept discrete digital inputs to allow any RTU interconnection to the Microwave radio. For the MOSCAD, support for the ACU serial protocol has been developed in order to avoid the parallel interface and to provide the means to gather the radio alarm and performance information and to control the radio. The serial interface was developed as a flash file using the "C" programming interface available for the MOSCAD CPU.

QUANTAR Diagnostic Interface

The QUANTAR radio has two RS-232 ports that are used to communicate between the MOSCAD and the radio using the Radio Service Software (RSS). Front Panel Mode (FPM) is one of the options for using the RSS software to communicate with the QUANTAR. The FPM provides approximately 40 status information points in addition to configuration information, which includes such information as: number of channels configured, transmit and receive frequencies, serial number, firmware version, and whether or not the station is acting as the control channel (trunked systems).

The QUANTAR interface application in the MOSCAD RTU was also developed as a flash file using the "C" programming interface available for the MOSCAD CPU. Controls to the QUANTAR are also supported through the interface.

External (Environmental) Status Points

In addition to the Microwave and QUANTAR diagnostic information, the Motorola MOSCAD system supports local status indication from the site elements themselves. Status information such as waveguide pressure, trunking controller status, shelter ingress/egress, temperature and humidity, and fire and smoke alarms are transmitted to the central computer. Each site is capable of monitoring a maximum of 128 external digital inputs, controlling 16 external digital outputs, and monitoring 16 external analog inputs.

External analog inputs (0-5 volt input) are also used to connect to RF power sensors. The 15 QUANTARS at each of the remote sites are connected to a single antenna structure using a combiner. In addition to internal wattmeter information provided by the RS-232, diagnostic connection to the QUANTAR forward power output is measured at the input to the combiner using the RF power sensor and an analog input to the MOSCAD. Thus, all of the actual output power levels can be received from all the QUANTARS.

An additional power sensor is connected to the output of the combiner. Using all three reference points (internal power, external power, and combiner output power), a technician at the GMC can isolate a failure in the combiner network right up to, and including, the antenna itself.

Summary

The main advantage of Motorola's Network Management solution is its ability to display all the system alarm information, QUANTAR status, microwave status, as well as environmental alarms on a single operator interface.

The networking capabilities of the MDLC protocol handles the routing of alarm and control information transparently. This means that no external bridging equipment is necessary to route the information on the network, which results in cost savings to the customer.

Motorola's MOSCAD – Seamless Integration of Radio and Microwave Alarm Information into a Single Operator Interface.