

ALARM AND CONTROL SUBSYSTEM DESCRIPTION

7.0 Alarm and Control Subsystem Description

7.1 OVERVIEW

Motorola will provide the Commonwealth of Virginia a Network Fault Management (NFM) system to the Statewide Agencies Radio System (STARS) for managing site alarms and controlling various site functions. The NFM system collects data automatically, processes that data, and then presents it to the appropriate personnel. The data will be used to operate the network, analyze the flow of site alarm and system control data, offer system solutions and handle pre-defined alarm situations automatically. The system provides reports to the engineers and the operators that will help in administering the network, and alarm history logs with query capabilities.

7.2 SYSTEM DESIGN

The Fault Management system in the ASTRO 25 VHF Integrated Voice and Data (IV&D) trunking system is based on the Host Computer Fault Monitoring system called FullVision. FullVision is a fault management tool (software application) that provides a single interface for monitoring alarms and alerts generated by the radio system infrastructure. The FullVision integrated network manager (INM) is based on HP OpenView Network Node Manager (NNM) software application. HP's OpenView is a standard network management software application that uses Simple Network Management Protocol (SNMP) over IP to communicate with the field sites and displays information obtained from SNMP-capable field devices. One FullVision server is provided at each master site and it resides in the same cPCI chassis as the Zone Database Server (ZDS). The system design includes non-IP sites and equipment that are not SNMP capable. The Motorola MOSCAD product provides the interface to FullVision for the conversion to SNMP over IP for non-SNMP and non-IP equipment. The non-SNMP-capable devices that exist at the Master, remote, and dispatch sites are as follows:

- Central Electronic Banks
- Microwave radio equipment
- Conventional Quantar base stations
- Zone TeNSr channel banks
- Trak GPS equipment
- UPS and backup power generators
- Site security and HVAC environmental equipment
- Shelter alarms

The Commonwealth will review and approve alarm assignments, operations and functionality prior to implementation.

7.2.1 MOSCAD SNMP Gateway

The MOSCAD SNMP Gateway provides the capability to forward SNMP traps to the Motorola FullVision Customer View Network Manager. These traps consist of alarms from the equipment listed in the previous paragraph.

All detailed remote site alarming information for each device is also provided via the MOSCAD Graphic Master Central (GMC).

7.2.2 Site Alarms and Controls

All discrete alarm point reporting and control functions are accomplished through the MOSCAD Remote Terminal Units (RTUs) and Front End Processor as described below.

7.2.3 MOSCAD Remote Terminal Unit (RTU)

Each of the STARS LMR sites, the Microwave-only sites, the Dispatch Centers, and the two Master Sites are equipped with RTUs to read and report faults and to provide control at the site. An RTU is a hardware interface for the alarms; specifications are shown in Appendix 5.

The MOSCAD RTU is a universal microprocessor controlled device that may serve as an RTU, or as the system Front-end Processor Unit (FEP). An RTU's functionality depends on its memory and its software. The configuration and programming for the RTU will be specific for each site. At the master site, the RTU's serve as an FEP.

The RTUs will serve as the equipment interface at the sites for the Alarm and Control Subsystem. The RTUs will read faults and send them to the FEPs at the two Master Sites. The RTU will receive control commands from the Graphic Master Central via the FEP and provide contact closure to carry out commands.

7.2.3.1 The ToolBox

- The MOSCAD Programming ToolBox is a collection of software tools that resides on the SPHQ Graphic Master Central (GMC) and is used to create configuration and application files, and to download those files into the MOSCAD RTU. A set of utility programs is provided to read/set the RTU's date & time, upload error logger files, and view the results of diagnostic tasks within the RTU. The toolbox contains software application utilities for the following:
 - Application programmer
 - Site configurator
 - Network configurator

- Downloader
- Communication setup
- Hardware test
- MDLC Links configurator
- MDLS monitor
- Protocol analyzer
- Software diagnostics, loggers and time tags
- Site date and time
- Dial up
- Phone book

RTUs will be installed at each of the STARS LMR sites, the Microwave only sites, the Dispatch Center equipment rooms, and the two Master Sites.

The maximum number of RTUs per site is four (4), which allows for 192 digital inputs, 64 digital outputs, and 32 analog inputs. Each type of RTU function is described below.

7.2.3.2 Sixteen Digital Outputs (DO)

This will be used for control purposes, such as remote backup generator start and stop as required by the Commonwealth. A single 16-DO module will be included within the RTU chassis at the remote sites. The DO's contain Form A relays.

The following are DO's that are required:

- Remote generator start
- Remote door lock activation (Certain sites)
- Main/ Standby base station transfer (Certain sites)
- Remote light activation (Certain sites)
- Spares

The Control capability will be available from the GMC but not the Full Vision system.

7.2.3.3 Digital Inputs (DI)

These are used for environmental fault reporting purposes, such as low generator fuel level, building intrusion, building smoke or tower lights out, etc. as required by the Commonwealth. A single 48-DI module will be included within the RTU chassis at the remote sites. Table 7-1 shows the alarms available in the buildings to be provided:

MOSCAD ALARM POINT #	POINT DESCRIPTION
	Building
1	Equipment Room Door
2	Building Smoke Alarm
3	Temperature Hi/Lo
4	Main AC Fail
5	AC Arrestor
6	HVAC Fail
7	RF Line Dehydrator
8	Tower Light Fail
9	Spare
10	Spare
11	Spare
12	Spare
13	Spare
14	Spare
	UPS
15	Power Fail UPS 1
16	Power Fail UPS 2
17	UPS 1 Run
18	UPS 2 Run
19	UPS 1 Fail
20	UPS 2 Fail
21	Bypass UPS 1
22	Bypass UPS 2
23	Low Battery UPS 1
24	Low Battery UPS 2
25	Summary Alarm UPS 1
26	Summary Alarm UPS 2
27	Spare
28	Spare
29	Spare
30	Spare

GENERATOR	
31	Generator Run
32	Generator Fail
33	Generator Disable
34	Generator Low Coolant Level
35	High Battery Voltage Warning
36	Low Battery Voltage Warning
37	Low Fuel
38	Spare
39	Spare
40	Spare
41	Spare
42	Spare
ATS (Automatic Transfer Switch)	
43	ATS Normal
44	ATS Standby
45	Spare
46	Spare
47	Spare
48	Spare

Table 7-1 - Alarms Available in the Buildings to be Provided

Additionally, an analog input module will be provided at each site accommodating eight (8) inputs. The following are some of the analog inputs which can be monitored. The inputs are $\pm 5Vdc$.

- RF Forward and Reflected power
- Shelter Temperature
- DC power on batteries
- Commercial Power
- Spares
- TX Combiner port High Reflected Power

7.2.4 Front-end Processor Unit

Front-End Processor (FEP) units will be installed at the Master Sites.

The FEP is the interface between the GMC and the RTUs. The MOSCAD FEP has the appropriate memory (1MB RAM and 262K flash memory) and software to independently manage the communication tasks with all the RTUs linked to the FEP.

The FEP uses the Motorola Data Link Control (MDLC) which is Motorola's seven layer communication protocol designed according to the Open System Interconnection (OSI) reference model.

The RTUs at the remote sites, the Dispatch Centers, and the Master Sites will communicate alarms to the FEPs. The FEP will communicate this alarm information to the Graphic Master Central. If the FEP fails, the Graphic Master Central will sound an alarm.

7.2.5 CPU Serial Alarm Diagnostic Interface

MOSCAD CPU modules are part of the RTUs at STARS IV&D sites, the Microwave only sites, the Dispatch Center equipment rooms, and Master Sites. These modules provide RS-232 or USB, if available, serial alarm diagnostic interfaces to various processor based RF communication devices for the purpose of receiving and reporting faults from these devices. The serial interface can allow remote troubleshooting and remote software updates to processor based equipment.

7.2.5.1 Dispatch Centers and Master Sites

At the Dispatch Centers and Master Sites, multiple MOSCAD CPU modules with RS-232 serial or USB, if available, interfaces will receive faults and alarms from system components and forward them to the Graphic Master Central:

- Zone TeNSr Channel Bank
- Trak 9100 GPS-Disciplined Rubidium Standard
- Central Electronics Bank
- UPS's, if available
- Generators, if available

7.2.5.2 STARS Remote RF Sites

At the STARS IV&D sites and the Microwave-only sites, multiple MOSCAD CPU modules with RS-232 serial interfaces will receive faults and alarms from the following system components and forward them to the Graphic Master Central:

- Zone TeNSr Channel Bank
- Microwave Radio
- Quantar Repeaters
- UPS's, if available
- Generators, if available

7.2.6 Graphic Master Central

The Graphic Master Central interfaces with the FEP and provides a graphical interface for monitoring and controlling devices in each subsystem. The Graphic Master Central will run In-Touch™ by Wonderware software. In-Touch™ by Wonderware is an object-oriented, graphical interface software application for industrial automation, process control and supervisory monitoring applications. It will present a graphical representation of the physical devices used to monitor equipment at remote sites. The graphical representation of device monitoring is based on information received from the FEP. There will be one GMC located at Zone 1 Master Site (State Police Headquarters NOC in Richmond) and one GMC located at Zone 2 Master Site 2 (VSP 6th Division Headquarters in Salem). See Figure 7-3.

7.3 INTERCONNECTION

The Alarm and Control Subsystem uses site RTUs to receive discrete alarms and faults from alarm capable equipment (equipment that will give discrete contact closures) at the STARS IV&D sites, the Microwave-only sites, the Dispatch Centers, and Master Sites.

The interconnections to some of the alarm capable site equipment are described below.

7.3.1 Site RTUs

The Digital Microwave Network that serves as the backbone for the ASTRO Digital Integrated Voice and Data System will be used to interconnect the remote site RTUs throughout the STARS communications networks including alarm, telephone, and future VSP LAN/WAN. All the RTUs are connected to the FEPs at Zone 1 Master Site or Zone 2 Master Site via the Digital Microwave Network. See Figure 7-1 at end of this section for an example of what the site RTU displays at the GMC terminal.

7.4 GMC OPERATOR INTERFACE

The GMC operator interface will utilize a Graphical User Interface (GUI) and text messages to present information to the user. The GUI will run in the current Microsoft environment with an icon for the Alarm and Control Subsystem located at the SPHQ NOC. Upon selecting the Alarm and Control Subsystem icon, the user will login to the system by entering a User Name and Password. If the User Name and Password are valid, a map of the Commonwealth of Virginia displaying the remote RF sites, Dispatch Centers, and Master Sites will be presented to the user.

If a critical alarm (as defined by the Commonwealth) is detected at any of the sites, an audible tone will sound at the GMC and the site icon will flash red. Simultaneously, a text window will be displayed to the operator indicating the reason for the alarm. An operator must manually reset the audible alarm at the workstation. An operator can then select that site to investigate further.

Information provided in the alarm information window will include the following fields:

- Date/Time
- Alarm Text
- Site
- Fault I/O
- Priority – Critical, Major & Minor Alarm

Any alarm requiring correction at any site will be displayed in the alarm information window in red text. The alarm will remain in red text until the alarm has been corrected. The alarm and acknowledgment will be journalized to a log for later reference.

7.5 RELIABILITY

The Alarm and Control Subsystem provides reliability through back-up power systems, through redundancy of the microwave backbone communication paths, and through redundancy of the GMCs.

7.5.1 Back-up Power Systems

The primary communications path for the remote RF site alarms is the Digital Microwave Network. All Digital Microwave Network electronics are provided with battery back-up power to maintain communications in the event of commercial power loss. All RTUs and FEPs are provided with battery back-up power to maintain communications in the event of commercial power loss. The Graphic Master Central will be backed-up by Uninterruptible Power Supply (UPS) system in the event of commercial power loss.

7.5.2 GMC Redundancy

The STARS MOSCAD subsystem will have a fully redundant GMC at the Zone 2 Master Site. This fully redundant GMC will be physically located at the Zone 1 Master Site until Zone 2 connectivity is established. This GMC will assume all the duties of the Zone 1 Master Site GMC in the event of its failure. Should the GMC fail at Zone 1 Master Site, all the alarms will still be received at the Zone 2 Master Site GMC. This redundancy ensures that alarms from the remote sites and the Zone 2 Master Site are still available at the redundant GMC. An audible alarm will be produced from the Zone 1 Master Site GMC to the redundant site in the event of its failure.

7.6 FAULT REPORTING

The NFM RTU incorporates self-diagnostic software routines, error-reporting capabilities, and local LEDs, help maintenance personnel identify and correct operational problems.

7.7 SYSTEM TESTING

MOSCAD will also use that communication link to connect, for example, a technician at Site A, who is using the TeNSr channel bank configuration tools to reconfigure the channel bank equipment at Site B. Remote configuration capability is available to the technician without the time expenditure required traveling to the equipment site.

7.7.1 Internal Alarm and Control Subsystem Faults

Each RTU is periodically and automatically polled by the FEP to verify the RTU's functional status. Any RTU faults that are detected during polling tests are immediately reported to, and alarmed by, the Graphic Master Central. Similarly the Graphic Master Central periodically and automatically checks its associated FEP to confirm its functional status. Any FEP failure is alarmed by the Graphic Master Central.

7.8 Diagrams

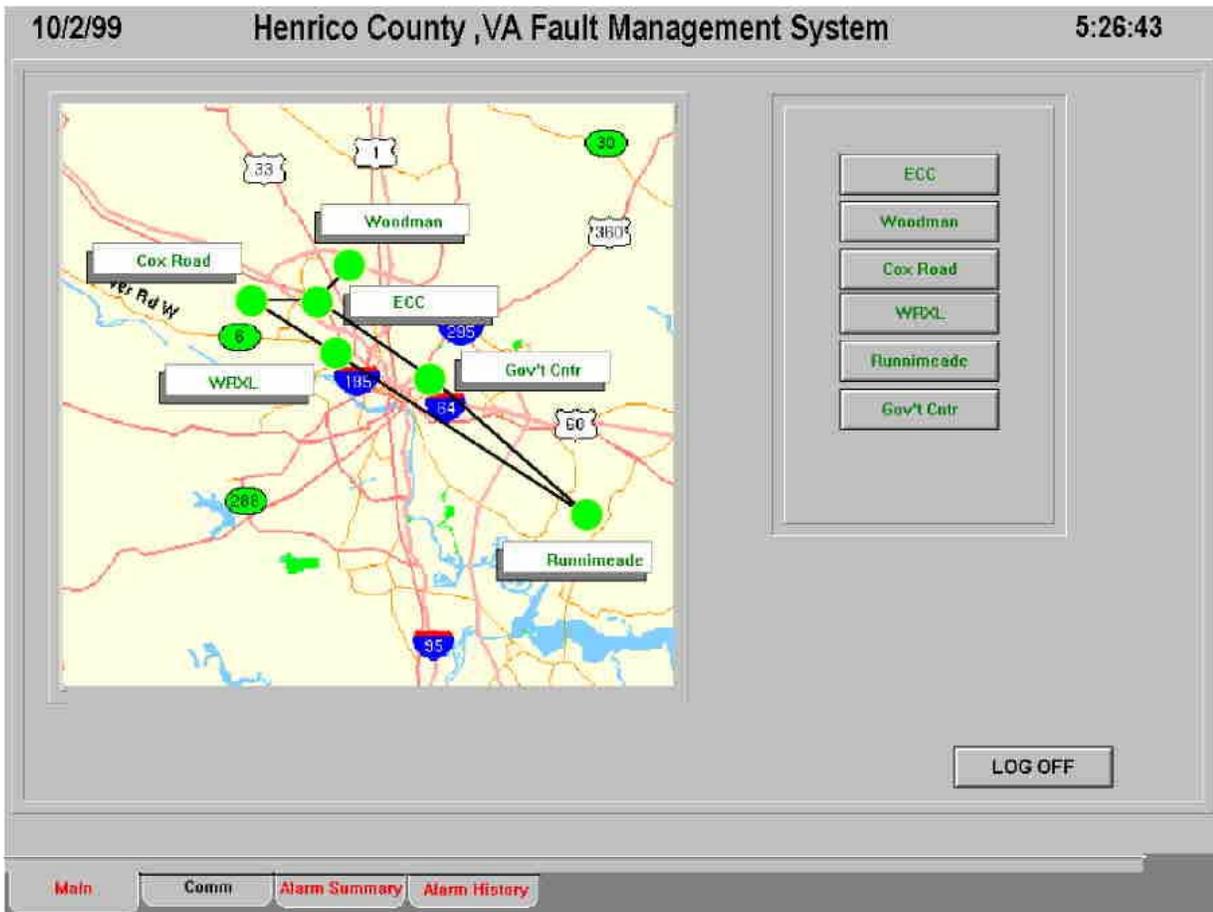


Figure 7-1 - Example of GMC GUI Interface Screen

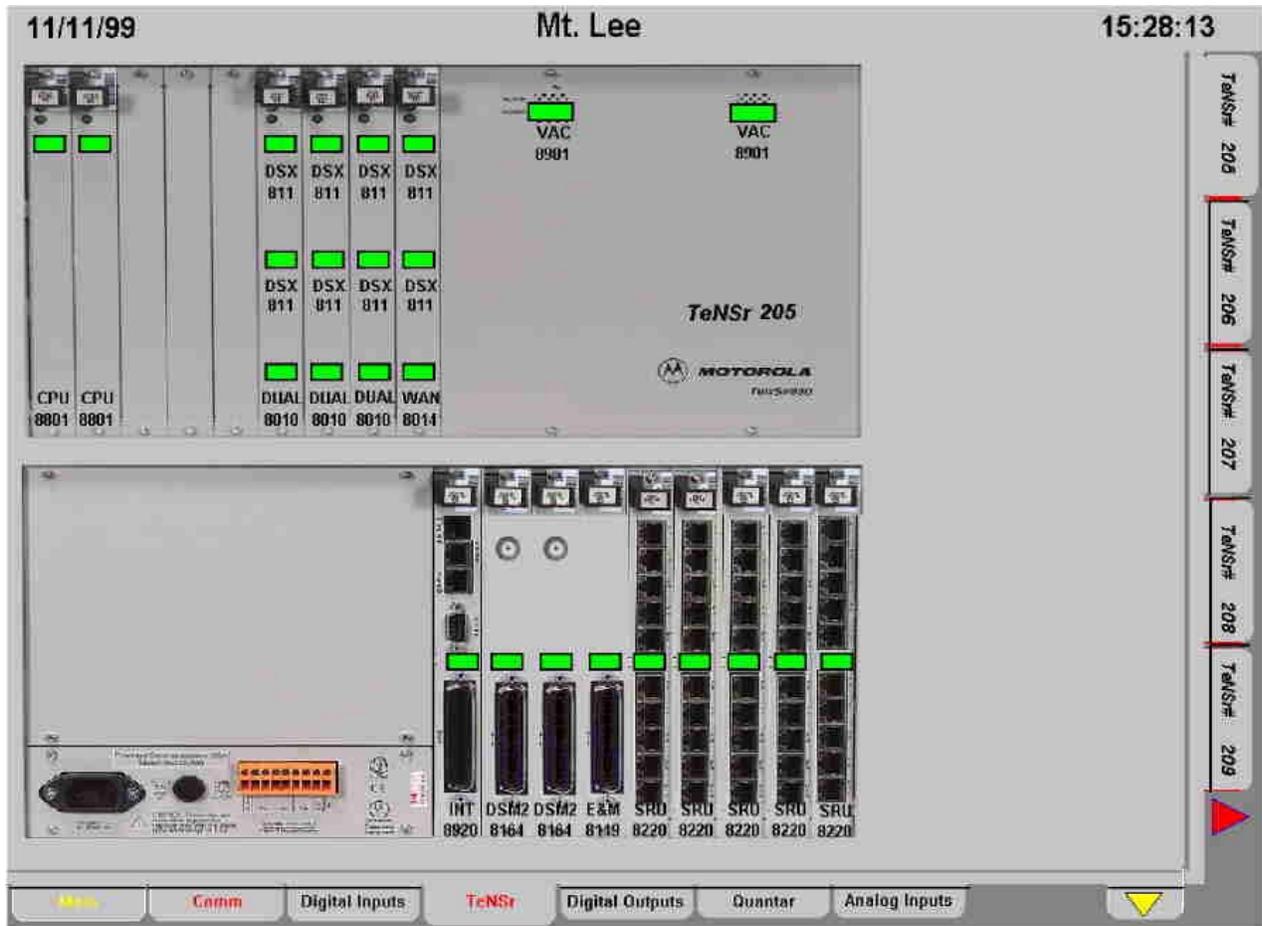


Figure 7-2 - An Example of GMC Remote Site Monitor Screen

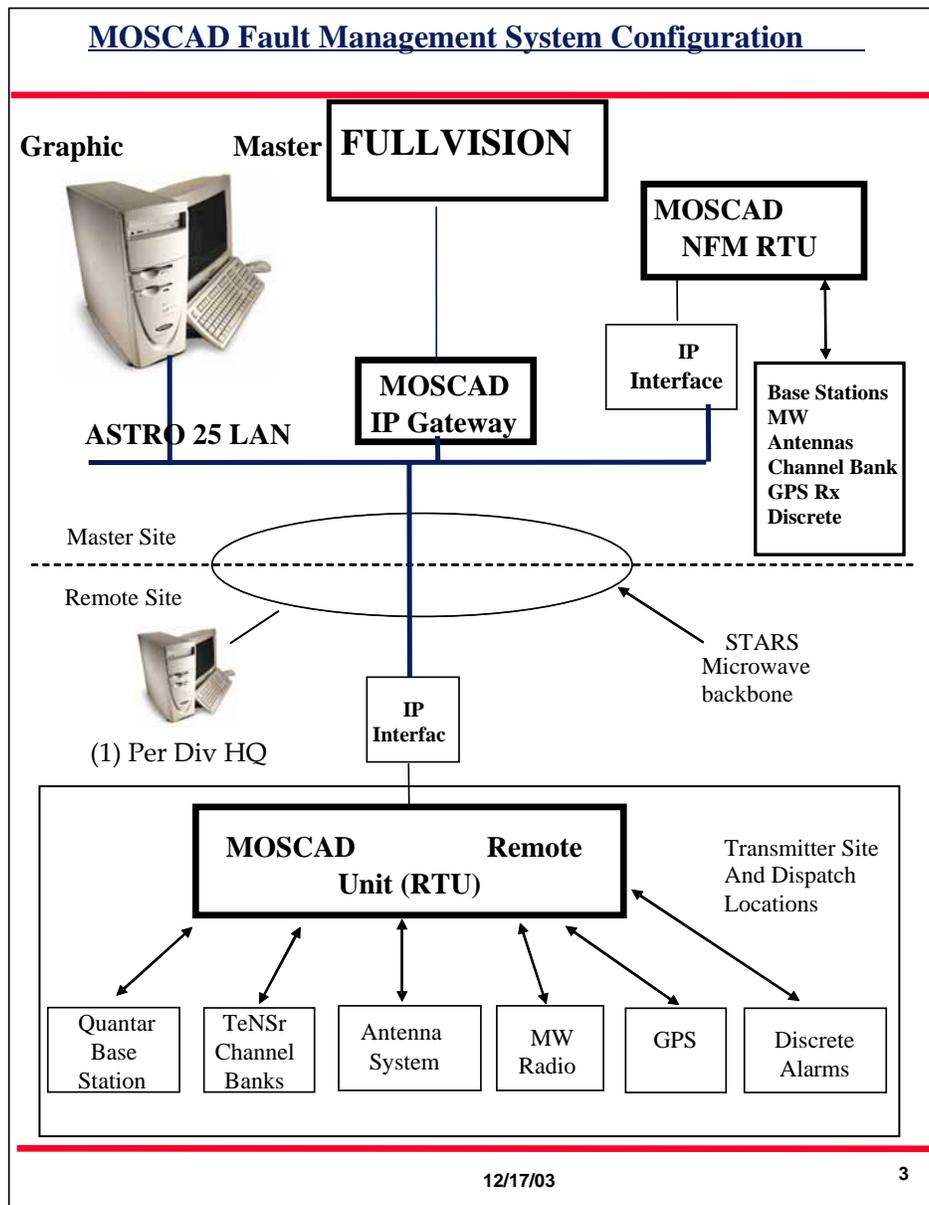


Figure 7-3 - This is representative of each master site (Richmond SPHQ NOC and Salem).