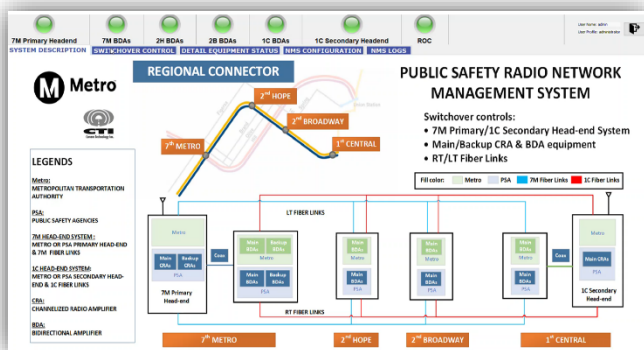
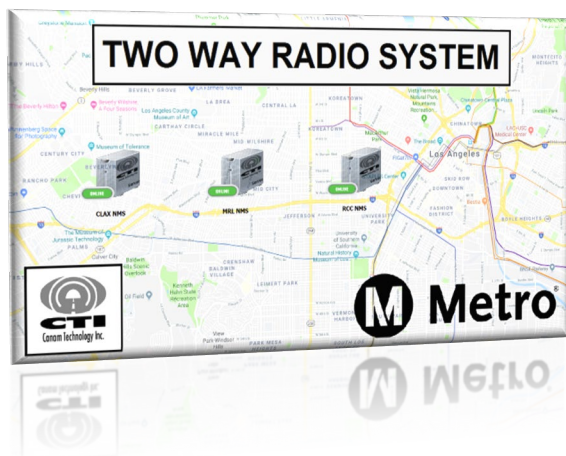


The Network Management System monitors the health and controls the operation of active DAS radio equipment elements; such as Channelized & Broadband RF Signal Boosters, RF-over-Fiber links, RF switches, Radio transceivers, RF Power Sensors, analog/digital Data Acquisition devices, other equipment. The NMS client Graphical User Interfaces (GUI) shows detailed information including alarm indicators, equipment controls, and other management information.

## Standard Features

- Monitor the operation and status of radio equipment, using standard network protocols.
- Alarm conditions can trigger automatic actions, responses, or notifications.
- Control equipment parameters from an integrated Graphical User Interface (GUI).
- Alarm levels of severity: Critical, Non-Critical, and Warning.
- Provide detailed information about every piece of equipment, including description, location, status, and serial number.
- Control operational parameters of individual pieces of equipment.
- Standard protocols: SNMP v1 - v2c - v3, Modbus, TCP/IP.
- Email notifications upon equipment alarms or events.
- System events logging.
- User profiles-based access control.
- Full configurable to match radio system architecture.
- NMS Server Application runs on Linux®.
- NMS Client GUI application runs on Windows® and Linux®.
- Single or dual server cluster configuration.
- NMS supports new systems sites, zones, or equipment, subject to software/hardware upgrades.
- Expandable network I/O modules





## Main Dashboard Multi-Site View

- Multiple sites are accessed using icons on a map-based login screen of the graphical user interface.
- Independent sites could be monitored using the same GUI (Graphical User Interface).
- Web browser links allow access to all network devices from the main dashboard, providing detailed equipment information to visualize operation and status, independently of network size.
- User logging access for each NMS Multi-Site location

## Detailed Equipment Information

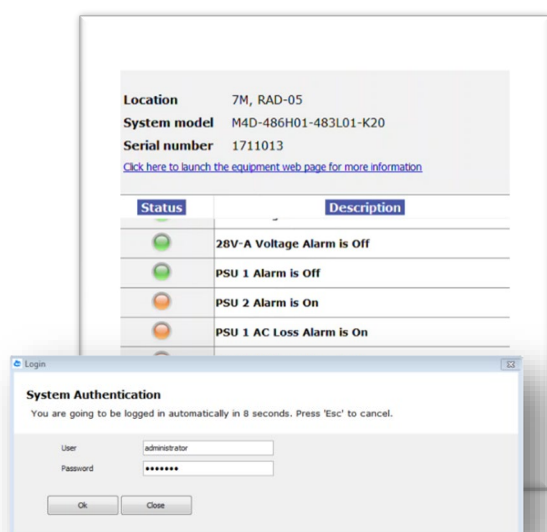
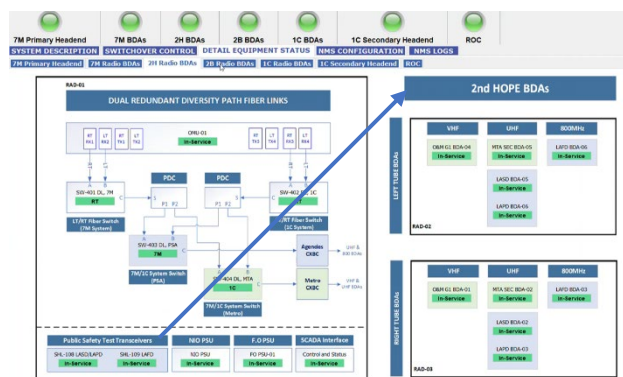
- The NMS grants access to equipment description, location, model, and serial number.
- The Equipment Detail Info window, generates detailed status information and allows control over main function commands for specific equipment.

## User Level-Controlled Access

- Different User Security Levels for controlled system access.
- Password encryption storage

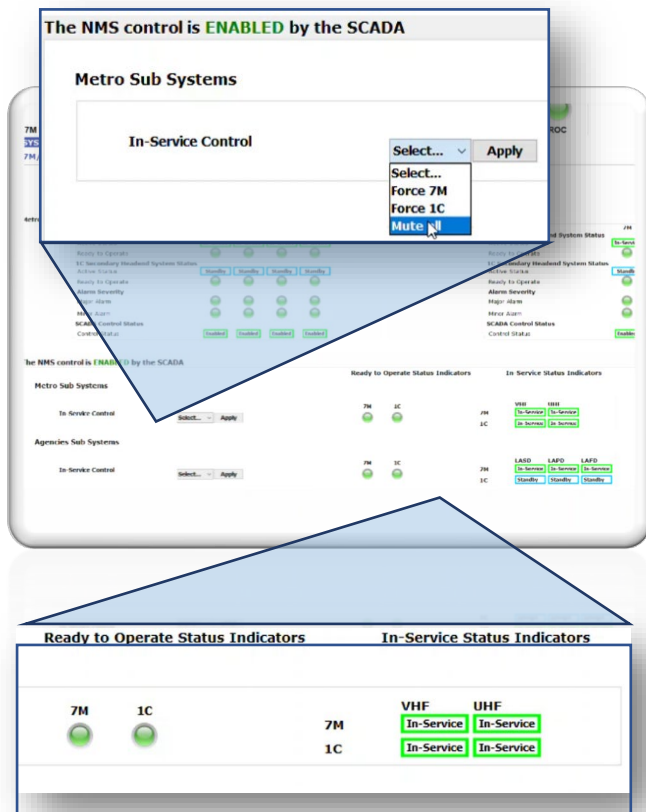
## General System Control NMS Switch Control Dashboard

- Define transmitting equipment per site and/or equipment.
- Enable manual redundancy control between sites and/or equipment.
- Show current system status, if main or backup equipment is ready to operate.
- Show the current in-service status of the Main/Backup system.
- Operate fail-over switching between main/backup RF systems.
- Failover control validated by user/password
- Configuration of equipment manual or automatic failback.
- Set all sites/equipment to standby if required.





# NETWORK MANAGEMENT SYSTEM



## Radio System, Equipment, or Fiber Path Diversity Switchover

NMS is able to perform a manual or automatic switchover

Radio Switchover could be executed at different levels.

1) System level: Implemented with two or more head-ends, where the main head-end is in-service and backup is on standby, or vice versa.

2) Equipment level: redundant equipment installed as main/backup sets 2 x CRAs or 2 x BDAs.

3) Fiber Path Diversity: two or more fiber links are installed as redundant elements in the RF transmission between CRAs and remote BDAs.

## NMS Analog and Discrete Digital I/O

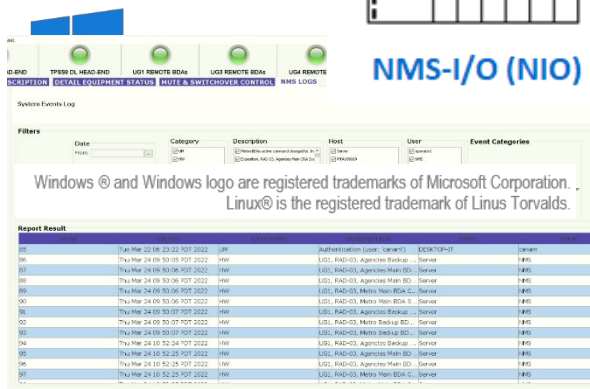
- The NMS can drive NMS-I/O (NIO) interfaces, which are based on industry-standard PLCs. The NMS can drive the NIO to control RF switches and control/monitor other devices via discrete I/O digital signals.
- The NMS can check the status of other external devices (Radio transceivers, RF Power/VSWR monitors) via discrete I/O wiring and networking protocols.
- NMS can also monitor multiple radio sites and generate discrete digital summary alarms for integration with external third-party SCADA systems.

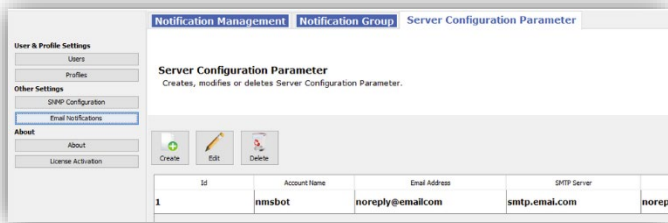


NMS-I/O (NIO)

## Configurable and Platform Independent

- The NMS is configurable to monitor a variety of equipment via standard TCP/IP network protocols and/or via physical contacts. Using the industrial protocols SNMPv2, v3 and MODBUS TCP/IP devices like Cisco® routers, Moxa® data acquisition modules, PLC and others can be controlled and monitored. NMS multi-clients are platform independent, running on.
- Microsoft Windows® and GNU/Linux® based systems.





## Events and Alarms Information

- The NMS keeps track of Radio System events and alarms. Supports filtering of logged information by date, time, device, location, IP address, alarm, and status to display only relevant data.
- Log information could be exported to an excel file.

## Email Notifications

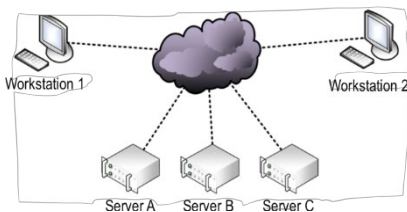
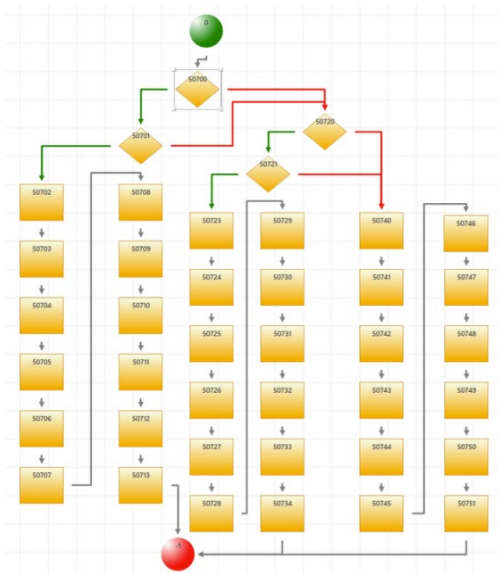
Receive notifications from NMS according to your needs, anywhere, anytime

NMS has built-in email notifications for both alarms and events; just configure the email contact lists or groups, SMTP server, and event triggers to receive email notifications of the Radio system status at the first moment.

## Decision Flowchart Function

NMS could perform a system automatic response or generate a summary system status

The radio manager system is able to analyze different statuses from radio equipment and create an automatic response upon abnormal conditions or provide a system summary status from several components or pieces of equipment. These automatic responses or summary system statuses could be accessed by GUI, Modbus or mapped into an NIO (Radio Input/Output PLC or RTU) for 3rd party system integration (SCADA). Factory configuration is required.

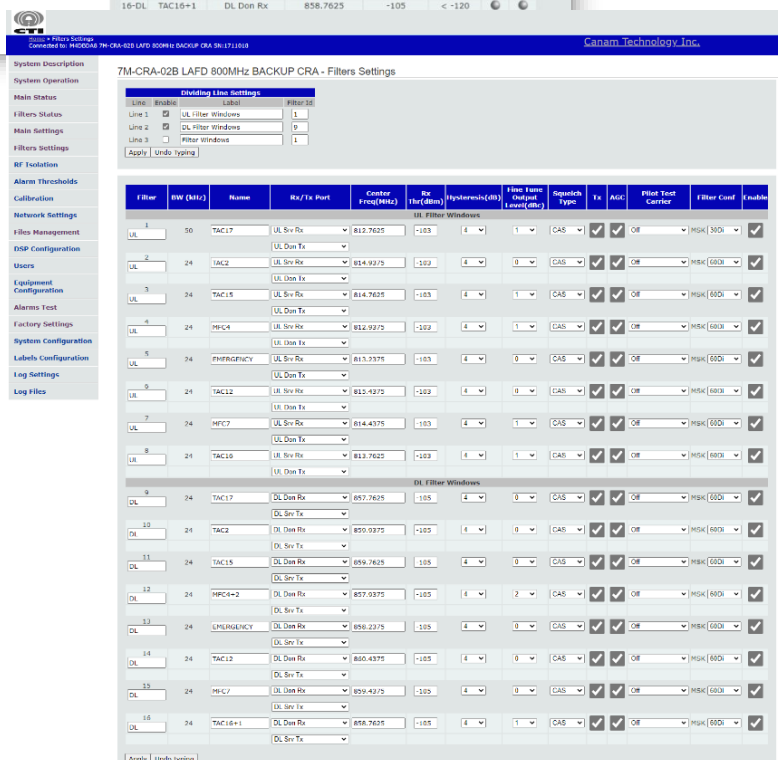
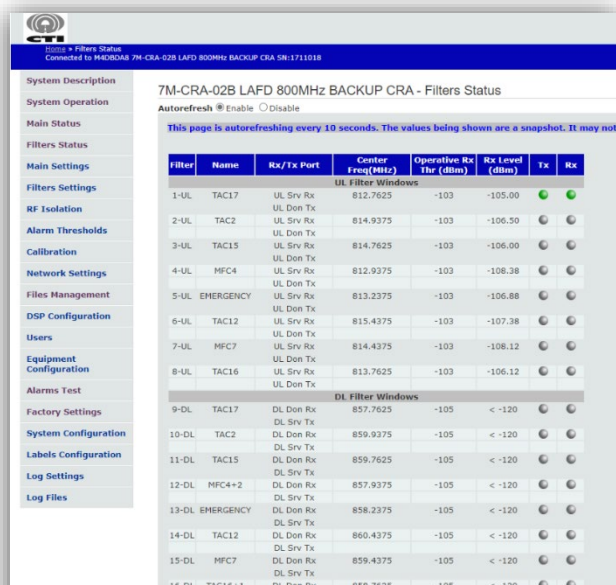
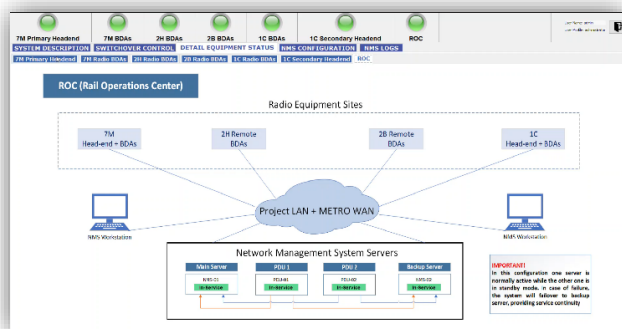


## NMS Servers Architecture

The NMS can be deployed in two modes:

- Single Server  
Single computer (server) running server applications. In case of failure, the system will be unavailable until the computer is repaired or replaced.

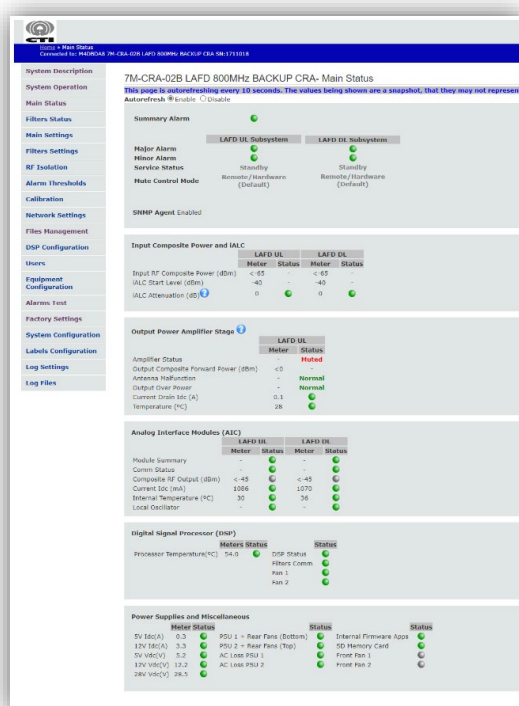




- **High Availability Cluster**  
Two or more servers that support the server applications. These are deployed in an active/standby architecture, providing continued service when a failure occurs. In this configuration, one computer is normally active while the other(s) are in standby mode and, in case of a crash, the system will failover to one of the backup computers and continue providing the service seamlessly.

## Radio Equipment Web Browser Interface

- Hyperlink to control, configure and monitor the operational parameters of each RF device to access the web interface. Typical operational parameters are frequency, gain, amplifiers control, alarm thresholds, settings files, log files, general meters, and RF meters.
- User-level-controlled access is also implemented on each Radio device. Users profiles like: controller, supervisor, service, and administrator as different levels.



## • NMS Software Functionality & Components Specification

Parameter	Specification
Minimum NMS Server Computer Requirements	<ul style="list-style-type: none"> <li>Processor: <ul style="list-style-type: none"> <li>Clock speed 2.4 GHz or more.</li> <li>4 cores or more.</li> <li>x64-bit processor.</li> </ul> </li> <li>Disc drive: 250GB or more.</li> <li>Ram Memory: 8GB or more.</li> <li>Network: Dual redundant 10/100/1000 Ethernet RJ45 port.</li> <li>Power supply: Dual redundant AC/DC PSUs are recommended.</li> <li>Computer Operating System shall be Linux 16.04.</li> </ul>
Minimum NMS Remote Workstation Computer Requirements	<ul style="list-style-type: none"> <li>Processor: <ul style="list-style-type: none"> <li>Clock speed 2.4 GHz or more.</li> <li>4 cores or more.</li> <li>x64-bit processor.</li> </ul> </li> <li>Disc drive: 250GB or more.</li> <li>Ram Memory: 8GB or more.</li> <li>Network: 10/100/1000 Ethernet RJ45 port.</li> <li>Computer Operating System shall be Windows 10 / Linux 16.04.</li> </ul>
NMS Server Functionality	<ul style="list-style-type: none"> <li>The NMS can monitor and control CANAM Radio equipment plus specific 3rd party equipment, contact CANAM to confirm compatibility.</li> <li>Control and communication with NMS remote I/O extender modules (NIO) using standard protocols.</li> <li>Standard industrial Protocols supported: <ul style="list-style-type: none"> <li>SNMP v1, v2, v3.</li> <li>MODBUS-TCP/IP.</li> <li>MQTT.</li> </ul> </li> <li>Digital inputs readings from NMS remote I/O extender modules.</li> <li>Digital output activation from the NMS remote I/O extender modules.</li> <li>All managed devices monitoring provides Third Party Systems (SCADA) summary indicators to perform actions or take decisions over the radio system (failover operations).</li> <li>Detailed system alarm and event logging.</li> <li>Date and time are registered in logging information.</li> <li>Email notification upon event configurations.</li> <li>User accounts with password-protected login.</li> <li>NMS connectivity with sites, zones, or projects, subject to software upgrade provided by CTI.</li> </ul>
Remote NMS I/O extender modules	<ul style="list-style-type: none"> <li>Discrete digital input/output extensions to the NMS server at all radio locations.</li> <li>Network: 10/100 Ethernet RJ45 port.</li> <li>Relay Digital Outputs and digital inputs.</li> <li>Support for SNMP v2, v3 / Modbus-TCP / MQTT over the network.</li> <li>Dual-redundant AC/DC power supplies.</li> </ul>



## • NMS Software Functionality & Components Specification

Parameter	Specification
NMS Client software, Graphical User Interface (GUI)	<ul style="list-style-type: none"><li>• Operator access to all managed devices.</li><li>• Can be installed on system-designated PC workstations. These computers could be supplied by the customer or by CTI upon contract specification.</li><li>• GUI is compatible with Linux or MS-Windows7/10 Operating Systems.</li><li>• In case the workstations are provided by the customer CTI provides the corresponding licenses, one per machine.</li><li>• The summary status of all managed devices is displayed on the GUI screen, typically grouped in tabs by location or/and sub-system.</li><li>• Integrates direct access to web-browser interfaces to each managed device when supported.</li><li>• Display and generate reports for logs and events.</li></ul>

## • Ordering Part Number and Options

Part Number	Description
1. NMS-SRV-CORE	NMS Server software license, for a single server standard configuration. (Perpetual license)
2. NMS-RN	Redundant Server Cluster, dual is the basic configuration. One NMS Server software license is required per server. (Perpetual license)
3. NMS-CLIENT	NMS Client software license, single computer. (Perpetual license)
4. NMS-#IO	NMS Discrete Input/Output software module. PLC is not included. Contact Canam for project-specific requirements.
5. NMS-SUB-PLAN	NMS Paid Subscription Plan after the second year post radio system integrated test (Radio SIT). The first year after Radio SIT is covered by the standard warranty. The subscription plan includes software updates to the perpetual license.
Additional NMS Components (Contact CANAM)	<ol style="list-style-type: none"><li>1. 1 RU Server computer</li><li>2. LAN Ethernet Switch (ESW).</li><li>3. IP-switched AC Power Distribution Unit (PDU).</li><li>4. LCD Display and Keyboard, Video and Mouse switch (KVM).</li></ol>