MODS

Network Infrastructure Requirements

THE OHIO STATE
UNIVERSITY

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Contents

1 Introduction

1.1 Scope

This document describes the basic network requirements for the MODS1 and MODS2 instruments (hereafter collectively referred to as "MODS") at the Large Binocular Telescope Observatory.

This document was requested as part of the documentation required prior to mountain reassembly of MODS2 at the Laboratory Acceptance Review for that instrument in August 2013.

1.2 Reference Documents

1. *MODS1 Instrument Commissioning Report,* OSU-MODS-2011-001, Version 1.1 (2013 May 16 - final submitted version)

2. *MODS2 Laboratory Acceptance Test Report,* OSU-MODS-2013-001, Version 1.2 (2013 Sept 24 - final submitted version)

3. *MODS LBTO Network IP Addresses*, OSU-MODS-2010-0008, update of 2013 Sept 6

4. *MODS1 AGw Commissioning Report*, 2011 August 18.

5. *ICIMACS Messaging Protocol Version 2.5 (IMPv2.5)*, OSU-MODS-2008-002, Version 1.0.2 (2008 Nov 26).

6. *MODS Observing Script Manual*, OSU-MODS-2011-002 Version 1.3.2 (2013 Jan 20).

7. *MODS Instrument Manual*, OSU-MODS-2011-003 Version 1.4.5 (2013 Jan 20).

1.3 List of Abbreviations and Acronyms

AGw	Acquisition, Guide, and Wavefront unit
ARC	Astronomical Research Cameras (aka Leach/SDSU)
Cat5e	Category 5e twisted pair cable (TIA/EIA-586-B standard)
CCD	Charge Coupled Device
CGA	Color Graphics Adapter
CRA	Computer Room A on LBT Level 2
CRB	Computer Room B on LBT Level 2
GCS	Guider Control System (LBTO subsystem)
GUI	Graphical User Interface
HEB	Head Electronics Box – MODS CCD controller
IEB	Instrument Electronics Box (MODS subsystem)
IIF	LBT Instrument InterFace Library
IMCS	Image Motion Compensation System (MODS subsystem)
ISIS	Integrated Science Instrument Server
ISS	Instrument Support Structure (LBT focal station rotator component)
ITL	University of Arizona Imaging Technology Laboratory
IUB	Instrument Utility Box (MODS subsystem)
LBT	Large Binocular Telescope
LBTO	Large Binocular Telescope Observatory (operations arm)
LLB	Lamp/Laser Box – MODS calibration and laser control box
MODS	Multi-Object Double Spectrograph
MODS1	First MODS spectrograph
MODS2	Second MODS spectrograph
MOS	Multi-Object Spectroscopy
NEMA	U.S. National Electrical Manufacturers Association
OSU	The Ohio State University
TCS	Telescope Control System
WFS	Wave Front Sensor

2   MODS System Overview

To motivate the network infrastructure requirements for MODS, we describe the MODS system and its associated computer systems and network-attached components.

2.1   MODS Spectrographs

The Multi-Object Double Spectrographs (MODS) are seeing-limited low- to medium-dispersion spectrographs working in the 3200 to 10000Å range with a 6×6-arcminute field of view. There are two identical MODS spectrographs: MODS1 is on the LBT and began science operations in September 2011; MODS2 will arrive during 2013.

MODS1 is mounted on the LBT Left Direct Gregorian (LDG) focal station, and MODS2 will be mounted on the Right Direct Gregorian (RDG) focal station. They receive power, Ethernet, glycol, and dedicated fiber optic data connections through the focal station cable wraps. All connections to the MODS instruments are via an Instrument Utility Box (IUB) mounted on the instrument. These distribute AC power, glycol coolant, and Ethernet to all on-board systems, and provide the single point of connection for dedicated fiber optic lines for the two science CCD controllers and the LBTO facility AGw guide and off-axis wavefront sensor camera controllers.

2.2   MODS Instrument Computers

Figure 1 shows a schematic of the MODS instrument control system.
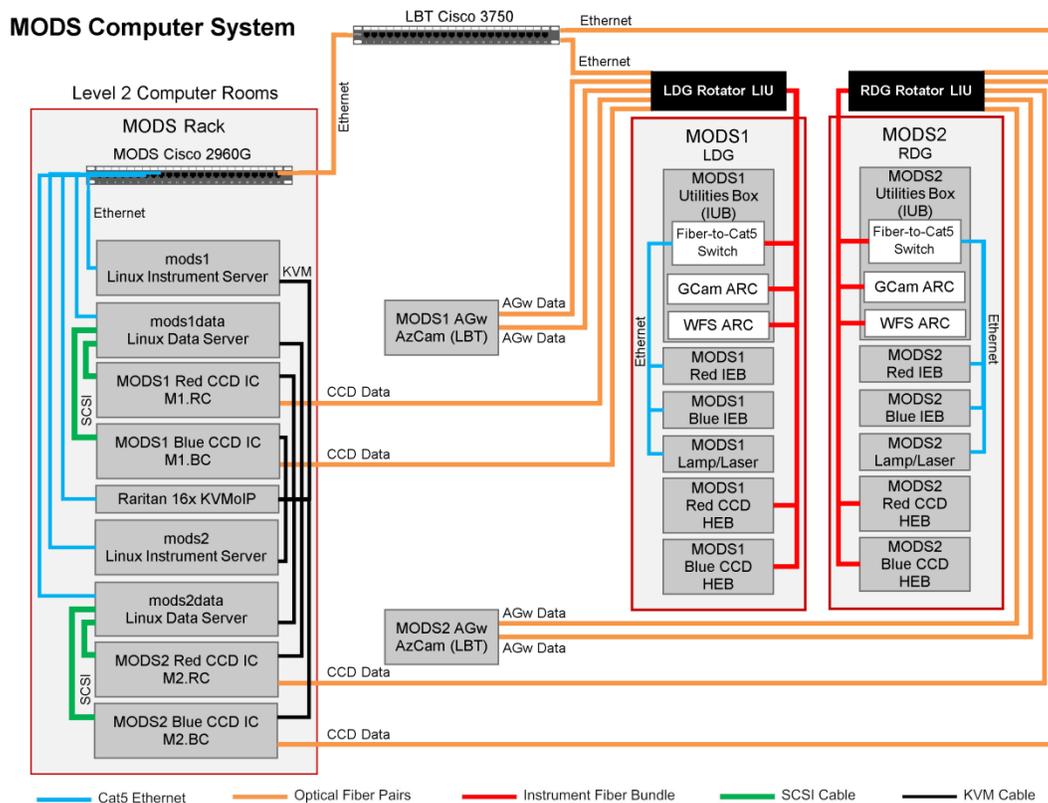
Figure 1: MODS instrument control and data-acquisition computer system.

A single MODS instance requires 4 computers to operate it (#=1 or 2):

> `mods#` = MODS# instrument server computer (Linux CentOS 5.3)
> `mods#data` = MODS# data server computer (Linux FC3)
> `M#.BC` = MODS# Blue CCD instrument computer or "IC" (DOS 6.3)
> `M#.RC` = MODS# Red CCD "IC" (DOS 6.3)

Autonomous programs running on each of these computers communicate using a common ASCII-based protocol developed at OSU (IMPv2.5), via network sockets or RS232 serial communication links. A central message-passing server (ISIS) links all of the different IMPv2 data-taking system nodes and records low-level communications traffic for debugging.

The computers for the MODS instrument control and data acquisition system are located in Computer Room B near the Level 2 control room. A single dedicated VLAN, assigned the entire 192.168.139 IP address block, is used for all MODS instrument network operations.

The functions performed by each of these computers are described in the following sections:

2.2.1   MODS Instrument Servers (`mods1` and `mods2`)

This is a Dell PowerEdge R510 2U workstation running CentOS 5.3 Linux that runs the main instrument control software for a single MODS instance. The main programs running on the instrument server are as follows:

1. Instrument Electronics Server (`IE`) that operates the instrument mechanisms, environmental sensors, voltage and current sensors, calibration lamps, IMCS lasers, and power control systems located in the IUB, IEBs, and LLB.

2. AGw Server (`AGW`) that operates the internal MODS AGw system XY stage, focusing mechanism and guide camera filter wheel. Provides the external command interface for the LBTO Guider Control System (GCS) used to operate the AGw cameras and stage during normal observing operations.

3. Environmental Monitor (`modsenv`) that regularly query the environmental sensors (temperature and pressure) and stores the data in the running environmental sensor logs.

4. LBT Telescope Interface Agent (`lbttcs`) which is an LBT IIF client instance that provides the primary interface between a MODS instance and the LBT telescope control system.

5. IMCS agents (`blueIMCS` and `redIMCS`) that readout the IMCS quad cell sensors in each science camera and runs the closed-loop image motion compensation system.

6. MODS Graphical User Interface (`modsUI`) that is the main observing interface for a unit MODS instrument. Observers work with the GUI directly or by executing scripts.

In addition to running these programs, the main instrument configuration tables are stored on this server, and the following runtime logs are kept on this system:

1. IE and AGw server logs, the latter of which records all communications between the AGw interface and the LBT GCS instance, stored in */home/mods/Logs/*.

2. The environmental logs for the instrument optomechanical systems (CCD environmental logs are stored separately) stored in `/home/mods/Logs/Env/`

The configuration of the MODS instrument server includes a custom share memory (shmem) sector that provides an additional layer of interprocess data storage, primarily for low-level engineering and environmental sensor data used by particular programs.

Because the instrument server is the primary command and control node outside the data server computers, we are looking at running a lightweight Apache webserver to more easily provide access to the low-level logging functions. This will be explored during MODS2 commissioning, and should be completely setup by the time we begin binocular MODS commissioning where the full range of logging needs to be integrated.

2.2.2 MODS Data Servers (`mods1data` and `mods2data`)

These are Linux workstations running a legacy Fedora Core 3 operating system that serve as the primary data transfer interface with the CCD control computers and the rest of the MODS data-acquisition system. We use FC3 operating system because it supports the legacy AdvanSys ABP-940 dual-ported SCSI controller cards essential for operation of our DOS-to-Linux data-transfer hardware (subsequent version of Linux dropped AdvanSys support, at least for the so-called "target mode" of operation that allows dual-ported use). Two AdvanSys SCSI cards are mounted in each data server machine.

The two DOS IC computers that operate the red and blue science CCD cameras are connected to the data server workstation via a SCSI cable (for FITS image transfer via the Caliban program) and RS232 serial for command and control communications with the rest of the system via the ISIS server.

The data server workstation runs the following programs

1. ISIS Server (`isis`), the message passing server that mediates all interprocess communications between all MODS instrument subsystems via the IMPv2.5 messaging protocol. It also records all command and control messaging traffic in runtime communications log stored on this machine.

2. Data Transfer Agents (`caliban`), the programs that mediate the transfer of raw images from the DOS CCD control computers to the Linux disk via the shared SCSI disk data transfer hardware. The two Caliban instances (red and blue) are responsible for creating FITS format images from the raw image data, copying these images to the LBT data archive machine and logging all raw data.

3. The CCD environmental sensor monitor (`ccdMon`). This queries the DOS CCD control computers to record the CCD and dewar temperature and vacuum pressure, and the internal temperature in the CCD head electronics boxes. This program is new to the system with the MODS2 delivery, and will be qualified and released for MODS1 use during MODS2 commissioning.

In addition to these programs, the following runtime logs are maintained on these systems:

1. ISIS communications logs recording all command traffic among the interactive instrument control and image acquisition system nodes. The log files are stored by UTC data in `/Logs/ISIS/`.

2. Caliban debug logs in `/Logs/Caliban/`

3. Raw FITS image header data logs in `/Logs/Data/`. These are generated using the `autolog` program triggered by each Caliban instance after writing a raw FITS image to disk.

4. CCD environmental monitor logs in `/Logs/CCD/`.

Raw data from the CCD computers is stored on the `/lhome/data/` directory as an intermediate cache and copied to the LBT data archive machines by the Caliban agents. This acts as a live backup of data in case of problems with the archive machines. We auto mount the `/newdata/` disk on the archive machine as `/archive/data/` on `modsNdata`.

2.2.3 CCD Control Computers (ICs)

These are custom-built computers running the DOS 6.3 operating system and containing the custom OSU Sequencer Card. The "sequencer" controls the CCD head electronics box (HEB) for a detector and operates the high-speed dedicated 850nm fiber link for command communication and data download from the detectors. All MODS sequence cards use the same SFP optical adapters (4GBps Multi-Rate Fiber Channel PLRXPL-VE-SG4-62-N) purchased from JDSU and PicoLight, both of which we have used interchangeably without problems.

These computers also include an AdvanSys ABP-940 dual-ported SCSI card and a pair of SCSI disks that constitutes the raw data transfer hardware. The second port of the SCSI bus is connected to an identical AdvanSys card in the MODS Data Server Linux workstation to complete the data transfer system.

No data other than runtime configuration files and some very low-level engineering logs are stored on the DOS IC computers.

2.2.4 AGw Camera Control Computers

These are Windows 7 computers owned and configured by LBTO. They use the same ARC PCI fiber interface cards and AzCam server software that operates all LBTO facility AGw system guide and off-axis wavefront sensor cameras. We mention them here because they are required to operate MODS, but the MODS instrument itself does not interact with these computers directly: we only provide fiber optic connections to the ARC GenIII controllers mounted in the MODS IUBs to run the cameras mounted on the MODS AGw XY stages.

2.3 Internal Network Devices

Each MODS instrument deploys a number of internal networked appliances as part of its instrument control system. Fiber Ethernet from the LBTO network is routed through the direct Gregorian cable wrap and connected to the instrument's IUB. There an unmanaged network switch mounted inside the IUB converts fiber Ethernet to Cat5 copper connections that are then distributed to the individual on-board systems. This means each instrument only has a single point of connection to the LBTO network.

The networked devices located inside each MODS instrument proper are as follows:

2.3.1   N-Tron 105FX-ST Industrial Ethernet Switch

Located in the IUB, the N-Tron 105FX-ST is a 5-port unmanaged Ethernet switch converts the 100BaseFX fiber Ethernet connection from the instrument rotator cable wrap into four 10/100BaseTX copper connections that distribute Ethernet services to all on-board instrument electronics boxes. The N-Tron switch uses an industrial standard 1310nm fiber link, and is rated for operation at temperatures between −40 and +70°C.

On the LBT network side, the fiber Ethernet to this switch is connected to a GLC-GE-100FX SFP module mounted in an instrument network CISCO 3750 switch in Control Room A.

2.3.2   N-Tron 104TX Industrial Ethernet Switch

Inside each of the 4 electronics boxes (IEBs, IUB, and LLB) we use N-Tron 104TX 4-port 10/100BaseTX industrial Ethernet switches to distribute Ethernet to all networked devices in that box (e.g., Comtrol and WAGO units). The primary Ethernet connection is a single Cat5 cable from the IUB's N-Tron 105FX switch to the box. The 104TX switches are rated for operation at temperatures between −40 and +80°C.

2.3.3   Comtrol DeviceMaster RTS Serial Port Servers

All devices requiring serial communications lines are operated using Comtrol DeviceMaster RTS 8-port and 2-port Ethernet device servers (configured for RS232 serial). These units are rated for operating temperatures of −37 to +74°C. Low level configuration is performed via their native web administration interface or using the PortVision Plus software running on a Windows laptop connected to the MODS VLAN.

There are 6 Comtrol units in each MODS, 3 in each of the Instrument Electronics Box (IEB), blue and red, as follows:

1. Two Comtrol DeviceMaster RTS-8 8-port device servers (for 16 ports total) that are used to communicate with the MicroLYNX 7 programmable stepper motor controllers that operate all of the MODS mechanisms.

2. One Comtrol DeviceMaster RTS-2 2-port device ports server that is used to acquire data from the IMCS Germanium quad cell sensor in each CCD Head Electronics Box.

All of the Comtrol units use TCP/IP protocol sockets for communications with host programs.

2.3.4   WAGO FieldBus Controllers

MODS internal instrument control automation and sensor telemetry uses systems based on the WAGO-I/O-System 750 fieldbus controllers manufactured by WAGO Kontakttecknik GmbH. These use TCP/IP sockets for command and control communications with the various automation modules (e.g., temperature sensors, control relays, etc.). A WAGO fieldbus controller and its DIN-rail of associated automation modules are located in each of the IEBs, the IUB, and the LLB. The fieldbus controller and associated modules are rated for operation at temperatures from −25 to +80°C.

The WAGO units operate all of the switched AC and DC power distribution systems, readout all temperature, pressure, voltage, and current sensors, and are used to control the calibration lamps and the IMCS laser systems.

2.4   Common Infrastructure Components

In addition to the instrument control and data-acquisition computers, both MODS share the following common infrastructure components, located in the MODS computer rack in CRB:

2.4.1   Cisco Catalyst 2960G Switch

This is a managed 48-port 10/100/1000 network switch for the MODS instrument VLAN, located at the top of the MODS computer rack. It is configured and managed by LBTO personnel. All computers with fixed IP addresses on the 192.168.139 MODS subnet must be connected through this switch.

This switch was purchased at LBTO instruction at MODS Project expense. We note that since it was purchased and deployed, Cisco has issued an End-of-Life notice for this product.

2.4.2   Raritan Dominion KX II KVMoIP Switch

The keyboard, video, and mouse interface for all computers in the MODS rack are controlled with a Dell 1U fold-out keyboard/LCD panel through a Raritan Dominion KX II secure KVM-over-IP switch. Custom dongles convert the KVM connections on each computer to Cat5 cables that plug into the back of the Raritan unit.

The Raritan unit provides us with secure BIOS-level access and control of all the machines, as well as providing the primary keyboard/video/mouse interface for setup and servicing by LBTO observing support personnel.

We deployed an 8-port version of the Raritan unit with MODS1 and will replace it with a 16-port unit when MODS2 is delivered to LBT in Fall 2013. The old 8-port Raritan unit will be returned to OSU (both were purchased by the MODS Project).

2.4.3   Dell 1U KMM Rack Console

The administrator keyboard, monitor, and mouse (KMM) console for all computers in the MODS rack is a Dell 1U KVM/KMM Console. This unit has a 17-inch height-adjustable LCD monitor, standard keyboard, and touchpad mouse in a 1U height fold-out slide mount. It is connected to the computers in the MODS rack via the Raritan KVMoIP switch.

2.4.4   Spare Computers

There are at least three spare computers on the mountain at any given time, either mounted in the MODS rack, or on the shelf, as follows:

1.   Spare MODS instrument server (§2.2.1) Linux computer

2.   Spare MODS data server (§2.2.2) Linux computer

3.   Spare DOS IC detector controller computer (§2.2.3)

Since the AGw control (aka "AzCam") computers are not the responsibility of the MODS project, we do not maintain a spare for that system.

If rack space is available, it is desirable to have these installed in the rack and powered on so that we can keep them synchronized with the active computers and be ready to switch these over as "hot spares" as needed to reduce loss of observing time in case of failure or the primary units. If space is not available, other arrangements will need to be made.

2.4.5 Additional Components

During instrument testing or engineering operations, a small LCD monochrome (CGA) monitor and 4-port CGA DE-9 connector switch is setup on a shelf in the MODS rack to allow direct operation of the DOS computers via an old engineering interface. With MODS2 deployment this unit will be kept in the on-site MODS storage cabinets and only used when required rather than being kept full time in the MODS rack.

We also occasionally connect laptops to the MODS VLAN via Cat5 cables. Two particular laptops are used: a Dell laptop running Windows XP laptop used to run the PortVision Plus and WAGO configuration applications, and a Dell Precision M6400 workstation-class laptop running CentOS Linux used as a portable instrument control and data analysis workstation. When they are connected to the MODS VLAN, they are assigned one of the fixed IP addresses in the common network resources IP address block (see §4.3).

2.5 MODS Computer Rack

All MODS computers and associated common infrastructure equipment (CISCO switch, Raritan KVMoIP switch, Dell KMM console, and other auxiliary equipment) are housed in a full-height (but not full-depth) 19-inch wide APC equipment rack on Level 2 in Computer Room B (CRB). A schematic of the rack population is given in Figure 2.
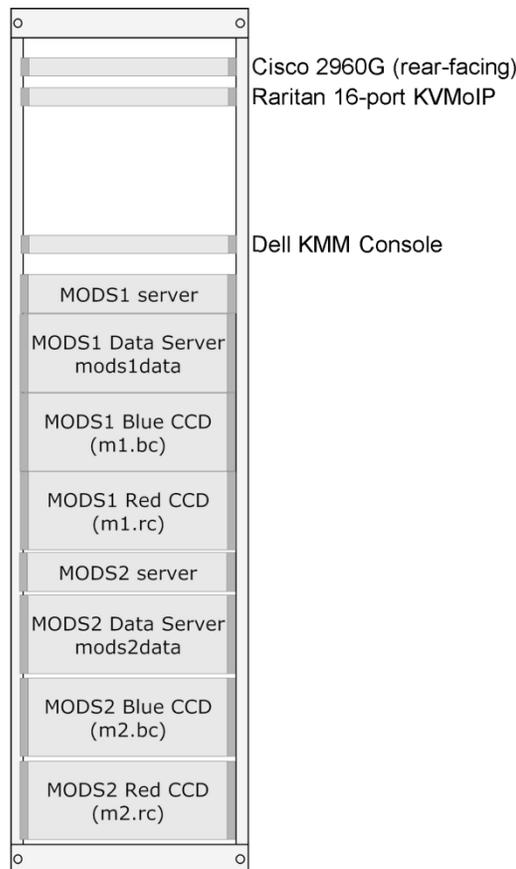
Figure 2: MODS Rack Schematic. This shows only the volume of the rack occupied by MODS computers and network equipment, but not their actual placement in the rack:

modules are grouped logically with no consideration of physical obstructions, cable runs, ergonomic location of the monitor/keyboard console, etc. Not shown are spare computers (4U and 2U) that may be mounted or not in this rack as space allows.

The DOS ICs and `modsNdata` Linux data servers are in 4U rack-mountable enclosures, while the `modsN` Linux instrument servers are Dell PowerEdge R510 computers in 2U enclosures. The Raritan KVMoIP and Dell KMM console are in 1U height packages. The CISCO switch is also in a 1U package, but following LBTO standard practice it is mounted rear-facing for easier access.

For the MODS1 deployment we have added a rack shelf and drawer, but these will likely be removed to fit all the MODS2 computers.

2.5.1   Computer Rack Mounting Issues

One of the challenges to using the APC computer racks purchased by LBT is that the MODS computer infrastructure uses heterogeneous computer depths; the data taking system uses 26-inch depth (industrial computer standard), while the instrument servers require a 30-inch depth (server computer standard). This makes necessary a third vertical rail on each side of the rack, which interferes with the envelope required by the standard Dell server rails we originally intended to use.

Our current strategy for installing the Dell servers in the rack without rails uses a 1U rack slide manufactured by StarCase (see www.starcase.com). We have successfully used their shorter rack slides in our lab computer racks. But it is unknown whether three of these rails will fit in the available space in the APC rack until we attempt it on-site. We are purchasing three of these rail sets and will attempt to install them in the MODS rack in CRB during MODS2 assembly visits in mid-November.

If this racking scheme does not work out, we will explore alternatives with LBTO personnel.

3 MODS Network Infrastructure Requirements

Both MODS instruments require a single, dedicated VLAN to meet all current and extended network addressing needs. At present, each MODS instrument uses 14 fixed IP addresses for computers and network appliances, for a total of 28 dedicated addresses for both instruments. Another 8 IP addresses assignments are given to equipment common to both MODS. This leaves plenty of capacity for future expansion, and allows "intuitive" assignment of IP addresses so that the same base pattern is repeated between the two MODS instances (this is evident from reading the current IP assignments in §4).

The breakdown in network infrastructure required for the full MODS system on the telescope and in the lab is as follows:

1. Each MODS requires 10 dedicated fiber optical connections to their respective direct Gregorian focal stations, organized into 5 pairs as follows:

   a. One (1) pair for 100BaseFX Ethernet for instrument network connectivity.
   b. Two (2) pairs of data fibers for the blue and red science CCD controllers.
   c. Two (2) pairs of data fibers for the AGw unit guide and wavefront sensor camera controllers.

2. Dedicated Ethernet into the Cisco switch in the MODS compute rack on Level 2 for all MODS instrument computers.

3. At least one (1) Ethernet connection on the MODS VLAN into the Instrument Clean Lab on Level 1. This allows us to connect a MODS instrument located in the instrument lab for servicing to the MODS VLAN, either directly or through an unmanaged switch/hub, including provision for connecting laptops, portable mechanism controllers (e.g., the MODS 4-wide MicroLYNX controller box) or other computers to the MODS VLAN from the instrument lab.

4. At least one (1) Ethernet connect available from the Auxiliary Control Room on Level 5, to allow connecting either MODS instrument into the MODS VLAN when it is on its cart on Level 5 dismounted from the telescope. It is impractical to connect a dismounted MODS instrument to the rotator services while on the floor.

In practice, this covers most of our needs.

4   MODS VLAN IP Address Assignments

This document shows the MODS VLAN IP Addressing scheme as of the date of this document. Note that this document replaces an earlier document used during MODS assembly and testing that was changing regularly. Except for occasional changes for new equipment in future MODS upgrades, we expect it to be stable as of the MODS2 deployment at LBTO in late 2013.

4.1   Basic Configuration

Subnet:	192.168.139
Starting IP:	.011
Ending IP:	.254
VLAN:	.239
Subnet:	255.255.255.000
Gateway:	192.168.139.001
DNS-Prime:	010.144.000.005
DNS-Backup:	010.144.000.101

The MODS network switch (CISCO Catalyst 2960G) has been assigned an IP address by LBTO. Configuration and on-going management of the switching is the responsibility of LBTO personnel. The switch is used by both MODS1 and MODS2, and is located in the MODS computer rack in Computer Room 2B (CRB) on Level 2 at the LBT.

4.2   IP Address Mapping

We divide the MODS VLAN up into three blocks:

1. Common Resources are given addresses in the 192.168.139.0xx range

2. MODS1 network resources are given addresses in the 192.168.139.1xx range.

3. MODS2 network resources are given addresses in the 192.168.139.2xx range.

Within the MODS1 and MODS2 blocks, we use the same last 2 digits for the analogous devices in both instruments, for example, the mods1data server is given IP 192.168.139.131, while the analogous mods2data server is given IP 192.168.139.231.

Base IP Address: **192.168.139.xyz**

```
x =0: Common Network Resources
   1: MODS1 Specific
   2: MODS2 Specific
  y=0: MODSx Red Channel Instrument Electronics Box (IEB-R)
    1: MODSx Blue Channel Instrument Electronics Box (IEB-B)
   z=0: WAGO Field-Bus Controller
     1: Comtrol RTS-8P Serial Port Server #1 (MicroLYNX 1-8)
     2: Comtrol RTS-8P Serial Port Server #2 (MicroLYNX 9-16)
     3: Comtrol RTS-2P Serial Port Server (HEB Quad Cell)
     4-9: Future expansion
  y=2: MODSx Lamp/Laser Box (LLB) & Utility Box (IUB)
    z=0: LLB WAGO FieldBus Controller
      1: LLB Comtrol RTS-2P Serial Port Server (decommissioned)
```

```
      2: IUB WAGO FieldBus Controller
      3-9: Future expansion LLB or IUB
  y=3: MODSx Instrument Computers
    z=0: MODSx instrument server
    ..1: MODSx data server
    ..2: MODSx Red IC
    ..3: MODSx Blue IC
    ..4: MODSx instrument server, second Ethernet port
  y=4: MODSx KVM console appliances
    z=0: KVM for computer xyz=x40
      1: KVM for computer xyz=x41
      n: KVM for computer xzy=x4n
  y=5: Future Expansion (z=0..3)
```

4.3   Common Network Resource IP Addresses

These are devices that are common to MODS1 and MODS2, assigned IP addresses in the 192.168.139.0xx range. Addresses marked with an asterisk (*) are reserved for future expansion.

  .011 – unassigned
  .012 – Ethernet Power Controller (lab only)
  .013 – Future NAS*
  .014 – Four-wide IE controller box Comtrol RTS-4P
  .015 – MODS Linux Laptop computer (when connected as a static IP device)
  .016 – Webcam***** (lab only)
  .017 – Spare MODS Linux data server
  .018 – Spare IC*****
  .019 – Raritan KVMoIP Switch
  .020 – Spare MODS Linux instrument server
  .021 – Spare MODS Linux instrument server iDRAC
  [.022 – .099] – unassigned

4.4   MODS1 IP Addresses

4.4.1   MODS1 Red Instrument Electronics Box (IEB_R):

  .100 – MODS1 IEB_R WAGO
  .101 – MODS1 IEB_R Comtrol RTS-8P (#1) Ports 1-8 (8001 – 8008)
  .102 – MODS1 IEB_R Comtrol RTS-8P (#2) Ports 1-8 (8009 – 8016)
  .103 – MODS1 IEB_R Comtrol RTS-2P HEB Ports (8017 – 8018)
  [.104 – .109] – MODS1 IEB_R Extra IP's

4.4.2   MODS1 Blue Instrument Electronics Box (IEB_B):

  .110 – MODS1 IEB_B WAGO
  .111 – MODS1 IEB_B Comtrol RTS-8P (#1) Ports (8001 – 8008)
  .112 – MODS1 IEB_B Comtrol RTS-8P (#2) Ports (8009 – 8016)
  .113 – MODS1 IEB_B Comtrol RTS-2P HEB Ports (8017 – 8018)
  [.114 – .119] – MODS1 IEB_B Extra IP's

4.4.3   MODS1 Calibration Lamp and IMCS Laser Box (LLB):

.120 – MODS1 LLB WAGO
.121 – MODS1 LLB Comtrol RTS-2P Ports (8001 – 8002)

4.4.4   MODS1 Instrument Utility Box (IUB):

.122 – MODS1 IUB WAGO
[.123 – .129] – unassigned

4.4.5   MODS1 Data Acquisition Computers and Appliances:

.130 – MODS1 instrument server (mods1)
.131 – MODS1 data server (mods1data)
.132 – MODS1 Red IC (M1.RC)*****
.133 – MODS1 Blue IC (M1.BC)*****
.134 – MODS1 instrument server iDRAC
[.135 – .199] – future expansion

Within the 13x address block, the two ICs marked with an asterisk (*****) are reserved for future internet-connected MODS ICs or equivalent function machines. Note that the current DOS IC computers are not network attached.

4.5   MODS2 IP Addresses

4.5.1   MODS2 Red Instrument Electronics Box (IEB_R):

.200 – MODS2 IEB_R WAGO
.201 – MODS2 IEB_R Comtrol RTS-8P (#1) Ports 1-8 (8001 – 8008)
.202 – MODS2 IEB_R Comtrol RTS-8P (#2) Ports 1-8 (8009 – 8016)
.203 – MODS2 IEB_R Comtrol RTS-2P HEB Ports (8017 – 8018)
[.204 - .209] – MODS2 IEB_R Extra IP's

4.5.2   MODS2 Blue Instrument Electronics Box (IEB_B):

.210 – MODS2 IEB_B WAGO
.211 – MODS2 IEB_B Comtrol RTS-8P (#1) Ports (8001 – 8008)
.212 – MODS2 IEB_B Comtrol RTS-8P (#2) Ports (8009 – 8016)
.213 – MODS2 IEB_B Comtrol RTS-2P HEB Ports (8017 – 8018)
[.214 – .219] – MODS2 IEB_B Extra IP's)

4.5.3   MODS2 Calibration Lamp and IMCS Laser Box (LLB):

.220 – MODS2 LLB WAGO
.221 – MODS2 LLB Comtrol RTS-2P Ports (8001 – 8002)

4.5.4   MODS2 Instrument Utility Box (IUB):

.222 – MODS2 IUB WAGO
[.223 – .229] – unassigned

4.5.5   MODS2 Data Acquisition Computers and Appliances:

.230 – MODS2 instrument server (mods2)

.231 – MODS2 data server (mods2data)

.232 – MODS2 Red IC (M2.RC)*****

.233 – MODS2 Blue IC (M2.BC)*****

.234 – MODS2 instrument server iDRAC

[.235 – .254] – future expansion (**NB** .239 is reserved for MODS VLAN)

As with the MODS1 assignments, we are reserving two IP addresses in the 230 range for future internet-connected MODS2 ICs or equivalent machines.

4.6 Comtrol DeviceMaster RTS Serial Port Assignments

These show the reserved TCP port mappings for the Comtrol DeviceMaster RTS serial ports located in each MODS instrument. We use the same port assignments for MODS1 and MODS2.

4.6.1   Red Channel Instrument Electronics Box (IEB_R)

These ports are all assigned for serial communication with MicroLYNX-7 stepper motor controllers for the named mechanisms controlled from the Red Channel IEB, and the serial connection to the IMCS quad cell readout electronics in the Red HEB.

MicroLYNX Controllers

8001	hatch	Instrument Dark Hatch
8002	dichroic	Dichroic Select
8003	rcolttfa	Red Collimator Tip/Tilt/Focus Actuator A
8004	rcolttfb	Red Collimator Tip/Tilt/Focus Actuator B
8005	rcolttfc	Red Collimator Tip/Tilt/Focus Actuator C
8006	rgrating	Red Grating Select
8007	rgrtilt1	Red Grating Tilt 1 (grating select position 2)
8008	rgrtilt2	Red Grating Tilt 2 (grating select position 4)
8009	rfilter	Red Camera Filter Wheel
8010	rcamfoc	Red Camera Primary Mirror Focus
8011	red11	Spare standard I/O MicroLYNX
8012	minsert	Slit Mask Insert/Retract

MicroLYNX Controller with Extra I/O

8013	mselect	Slit Mask Select
8014	red14	Spare extended-I/O MicroLYNX
8015	rshutter	Red Camera Shutter
8016	red16	Spare extended I/O MicroLYNX

2-Port Comtrol (Red HEB Quad Cell)

8017	rimcs	Red IMCS Quad Cell Readout
8018	red18	unassigned serial port (hot spare for 8017)

4.6.2   Blue Channel Instrument Electronics Box (IEB_B)

These ports are all assigned for serial communication with MicroLYNX-7 stepper motor controllers for the named mechanisms controlled from the Blue Channel IEB, and the serial connection to the IMCS quad cell readout electronics in the Blue HEB.

MicroLYNX Controllers:

8001	calib	Calibration Tower
8002	agwy	AGw Stage Y positioner
8003	agwx	AGw Stage X positioner
8004	agwfoc	AGw Stage Focus Actuator
8005	agwfilt	AGw Guide Camera Filter Wheel
8006	bcolttfa	Blue Collimator Tip/Tilt/Focus Actuator A
8007	bcolttfb	Blue Collimator Tip/Tilt/Focus Actuator B
8008	bcolttfc	Blue Collimator Tip/Tilt/Focus Actuator C
8009	bgrating	Blue Grating Select
8010	bgrtilt1	Blue Grating Tilt 1 (grating select position 2)
8011	bgrtilt2	Blue Grating Tilt 2 (grating select position 4)
8012	bfilter	Blue Camera Filter Wheel

MicroLYNX Controller with Extra I/O

8013	bcamfoc	Blue Camera Primary Mirror Focus
8014	blue14	Spare extended I/O MicroLYNX
8015	bshutter	Blue Camera Shutter
8016	blue16	Spare extended I/O MicroLYNX

2-Port Comtrol (Blue HEB Quad Cell)

8017	bimcs	Blue IMCS Quad Cell Readout
8018	blue18	unassigned serial port (hot spare for 8017)

4.6.3   MODS "4X" Lab MicroLYNX Mechanism Test Box

This is a 4-port Comtrol RTS-4 unit with 4 extended I/O MicroLYNX 7 controller and the standard MODS motor control board (4-port segment), used to operate mechanisms in the laboratory (e.g., to operate the camera shutter, focus, and filter wheel when doing camera alignment or testing).

Labels (e.g., ML1) correspond to the labeled mechanism cable connectors on the 4X box bulkhead.

8001	ML1
8002	ML2
8003	ML3
8004	ML4