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Change Record

Issue	Date	Section(s) Affected	Description of Change/Change Request Reference/Remarks
1.0	2004-09-01	All	First issue
2.0	2005-03-18	Several	Major rewrite. Details added on equipment and cabling. and layout modified. Analysis of bandwidth requirements included.
3.0	2006-08-21	Several	Details of physical connections and core netword added. IRACE connected to switch in Enclosure. M1 LCU only through az cable wrap. Different configuration for commissioning removed. Generally updated to reflect current ESO standards. User workstation removed, offline workstation added to some sections.

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Tables

Figures

1 Scope

This document describes the network configuration that is planned for VISTA. Equipment that will be connected to the networks is listed with node name and IP address. Also included are details of the connections within the VISTA Enclosure and between the VISTA Enclosure and the Control Building.

Connections for LAN, Time Bus and detector controllers are detailed. Connections for other systems such as fire alarms, telephones, video, and intruder detection system are only covered generically.

The equipment and configurations are all understood to be completely ESO compliant; any discrepancies will be accommodated by modifying details in this document.

2 References

2.1 Applicable Documents

[AD01] *VLT Electronic Design Specifications*, VLT-SPE-ESO-10000-0015, Issue 5, 2001-03-06.

[AD02] *Telescope to IR Camera Services Interface Control Document*, VIS-ICD-ATC-01000-04020, Issue 4.0, 2004-11-23.

[AD03] *LCU Location and Cable Wrap Schedules*, VIS-SPE-ATC-01000-0011, Issue 5.0, 2004-07-08.

2.2 Reference Documents

[RD01] *VLT Paranal Network/ Computers/ Consoles Design Description*, VLT-SPE-ESO-17100-3439, Issue 2, 2006-06-26.

[RD02] *TRS Time Bus Chain Technical Manual*, VLT-MAN-ESO-17300-1324, Issue 1, 1997-04-25.

[RD03] *ICD for Power and Services between Enclosure Buildings Work Package and All Users*, VIS-SPE-ATC-10000-0018, Issue 2.0.

3 Abbreviations and Acronyms

AG	Auto-guider
DFE	Detector Front End Electronics (part of IRACE)
IR	Infra red
IRACE	Infra Red Array Controller Electronics
LAN	Local Area Network
LCU	Local Control Unit
TBC	To be confirmed

TCCD	Technical CCD controller
TCS	Telescope Control System
WFS	Wave Front Sensor

4 General Requirements

The basic requirement is to host telescope and instrument equipment in a manner compatible with the VLT control architecture and standards [RD01] and [AD01]. Two features of VISTA are particular drivers *viz.* the data rate generated by the instrument and the distance between the VISTA Enclosure and the VLT Control Building.

The data rate from the VISTA IR Camera is 54 MBytes/s peak and 27 MBytes/s sustained. (If a Visible Camera is subsequently added to VISTA, its data rate will be no higher.) These data rates are significantly higher that those generated from the current generation of VLT instruments. The VISTA Enclosure is approximately 3 km from the Paranal Control Building. These factors mean that Gigabit Ethernet will be used extensively and mono-mode fibres will be used between the VISTA Enclosure and the VLT Control Building.

5 Assumptions

The following assumptions are made:

(a) Gigabit Ethernet, rather than ATM, will be used within the VISTA subnets.
(b) Provision is made for installing 'X-terminals' (e.g. PCs or workstations) in the various areas that engineers may work within the VISTAS Enclosure. These will not be used operationally.
(c) VISTA will use the Paranal site-wide Archive Workstation.
(d) The offline workstation used with VISTA will be on the site-wide General Services LAN.
(e) The Data Handling, User, and Pipeline Workstations are usually on a User Station LAN specific to the telescope, e.g. u1 for UT1. VISTA does not have any allocated User Station subnet and so these nodes will be on the Instrument LAN i.e. the *vc* subnet.
(f) Details of equipment in the VISTA Console area of the Paranal Control Room are described in [RD01].
(g) Details of backbone equipment are not described here; further information is contained in [RD01].

6 Equipment and Subnets

Two subnets have been assigned [RD01] to VISTA, the telescope subnet *vt* and the instrument subnet *vc* assigned to the IR Camera. (If and when the Visible Camera is approved, an additional subnet may be assigned.)

Table 1 lists the equipment that is planned to be connected to these two subnets. Hostnames and IP addresses follow the conventions described in [AD01]. Most connections will be to a switch port on either the *vt* or *vc* subnet, which will communicate with each other via gateway/router modules in the Control Building. IP and Ethernet protocols will be used for all communications within the VISTA areas.

Subnet	LAN	Hostname	Address	Notes
Telescope LAN vt 134.171.236.x	TCS workstation	`w vt tcs`	134.171.236.1	
	WFS1 image analyser	`w vt ia1`	134.171.236.2	
	WFS2 image analyser	`w vt ia2`	134.171.236.3	
	Altitude	`l vt alt`	134.171.236.16	
	Azimuth	`l vt az`	134.171.236.17	
	Rotator	`l vt rot`	134.171.236.18	
	M1	`l vt m1`	134.171.236.19	
	M2	`l vt m2`	134.171.236.20	
	Enclosure	`l vt enc`	134.171.236.21	
	Autoguider 1	`l vt ag1`	134.171.236.22	
	Autoguider 2	`l vt ag2`	134.171.236.23	
	WFS 1	`l vt wfs1`	134.171.236.24	
	WFS 2	`l vt wfs2`	134.171.236.25	
	Switch (Enclosure)	`s vt 1`	134.171.236.251	TBC
	Switch (Control Building)	`s vt 2`	134.171.236.250	TBC
	Gateway	`r vt 1`	134.171.236.254	TBC
Instrument LAN vc 134.171.237.x	Instrument workstation	`w vc am`	134.171.237.1	
	User workstation	`w vc uws`	134.171.237.2	
	Data handling workstation	`w vc dhs`	134.171.237.3	
	Pipeline workstation	`w vc pl`	134.171.237.4	
	Instrument control LCU	`l vc ics1`	134.171.237.16	
	IRACE 1	`w vc irc1`	134.171.237.17	
	IRACE 2	`w vc irc2`	134.171.237.18	.
	Switch (Enclosure)	`s vc 1`	134.171.237.251	TBC
	Switch (Control Building)	`s vc 2`	134.171.237.250	TBC
	Gateway	`r vc 1`	134.171.237.254	TBC
General Services LAN gs 134.171.224.x	'X-terminals', e.g. PC or workstation	`x gs x - x gs x`	134.171.224.x - 134.171.224.x	TBC
	Offline workstation	`w gs offx`	134.171.224.x	TBC

Table 1: List of network hosts and IP addresses.

It is assumed that hubs are no longer used, switches being used in their place. Equipment conforming to [RD01], extended to cover newer hardware and protocols as agreed with ESO, will be used i.e. Cisco Catalyst 3750. One system installed in the Enclosure will use switch modules equipped with multi-mode or copper ports for communications within the Enclosure and switch modules equipped with mono-mode ports for communications to the Control Building. The equipment in this unit will comprise two logical switches, one for each LAN. An analysis of its bandwidth requirement is given in Section 7.

Both these systems will connect to the backbone LAN, providing access to:

- each other,
- the VISTA User Workstation on the General Services LAN
- the Paranal Archive Workstation
- external links

7 Bandwidth Requirements and Solutions

7.1 Enclosure Equipment

The only equipment in the Enclosure that generates a high data rate is the two IRACE Number Crunchers.

7.2 Control Room Equipment

VISTA generates high data rates, in excess of those generated by the current generation of VLT instruments. The network topology is designed to minimise bottlenecks, e.g. the IRACE Number Crunchers are connected to the Instrument Workstation with a minimum of network hops.

The bandwidth requirements on the Cisco 3750 that connects the Number Crunchers and the Instrument Workstation are listed in Table 2 and compared below to the quoted performance of the Catalyst 3750. To estimate the bandwidth the following assumptions are made:

- Image size = 263 MB
- Transfer time from IRACE to Instrument WS = 4s
- Interval between successive exposures = 20s
- Network performance does not cause increasing backlog of data at any point in the system.
- (This implies 663 GB of data per night. The nominal requirement of one exposure every 10s throughout a 14 hour night would cause a backlog of data on the Instrument WS, unless the bandwidth performance is greater than indicated above.)

Bandwidth is estimated for the two situations when the IRACE is transmitting data and when it is not.

Table 2 Bandwidth of connections to Cisco 3750 switch.

Device	Peak Bandwidth Requirement MBytes/s	
	During Exposure Transmission	Otherwise
VISTA Enclosure Link	-	-
IRACE NC 1	31	-
IRACE NC 2	31	-
Telescope WS	-	-
Instrument WS	61	33
Data Handling WS	-	33
Pipeline WS	-	33
User WS	-	-
General Services LAN	-	33
Total	**123**	**132**

The Cisco switch model 3750G-24TS-S, as recently procured by ESO, has 24 10/100/1000 copper ports and 4 SFP GBE ports, adequate for the requirements. Performance is quoted by Cisco as:

- Bandwidth aggregation up to 8 Gbps through Gigabit EtherChannel technology
- Forwarding rate: 6.5 mpps (i.e. 416 MB/s if packets are 64 bytes and ignoring overheads)

These figures are significantly more than the VISTA requirement (132 MB/s).

8 Network Lay-out

The physical lay-out of the VISTA equipment connected to the network is shown in Figure 2. All equipment in the Enclosure is connected directly to a system comprising two logical switches, one for each subnet. All network connections within the Enclosure will be multi-mode. Each device will be connected to a switch port; hubs and shared media will not be used. Similarly all VISTA equipment within the Control Building will be connected to a switch port via multi-mode fibre.

Because of the distance to the Control Building (approximately 3 km) the connections between the Control Building and the Enclosure will be mono-mode. Each subnet will have its own physical connection. The network equipment is such that interface cards can be installed with the appropriate multi- or mono-mode connectors, without the need for media converters except to connect to 10 Mbps fibre as required by [AD01] for the LCU connections.

Details of equipment lay-out and fibre connections within the VISTA Enclosure are shown in Figure 3 and the tables below. These show not only the network connections, but other fibre connections i.e. the Time Bus and the fibres that link the IRACE DFEs to the Number Crunchers.

Location	Equipment
Plant Room	Altitude LCU
	Azimuth LCU
	Rotator LCU
	Maintenance 'x-terminals' (4 max.)
Local Control Room	Network equipment comprising two switches
	IRACE Number Crunchers (2 off)
	Autoguider LCUs (2 off)
	WFS LCUs (2 off)
	WFS Image Analyser Workstations (2 off)
	Maintenance 'x-terminals' (4 max.)
	Time Bus Distribution
Instrument Prep Room	Any equipment normally in telescope area
	Maintenance 'x-terminals' (4 max.)
Static Azimuth Floor	Enclosure LCU
Telescope Centre Section	M1 LCU
	M2 LCU
Rotator	IRACE DFEs
	TCCD front end (SDSU)
	Instrument Control LCU
Paranal Control Building (Computer Room and Control Room)	Network equipment (ESO specified)
	Telescope Workstation
	Instrument Workstation
	Data Handling Workstation
	Offline Workstation
	Pipeline Workstation
	X terminals (see [RD01])

Table 3 Location of VISTA's network and computing equipment.

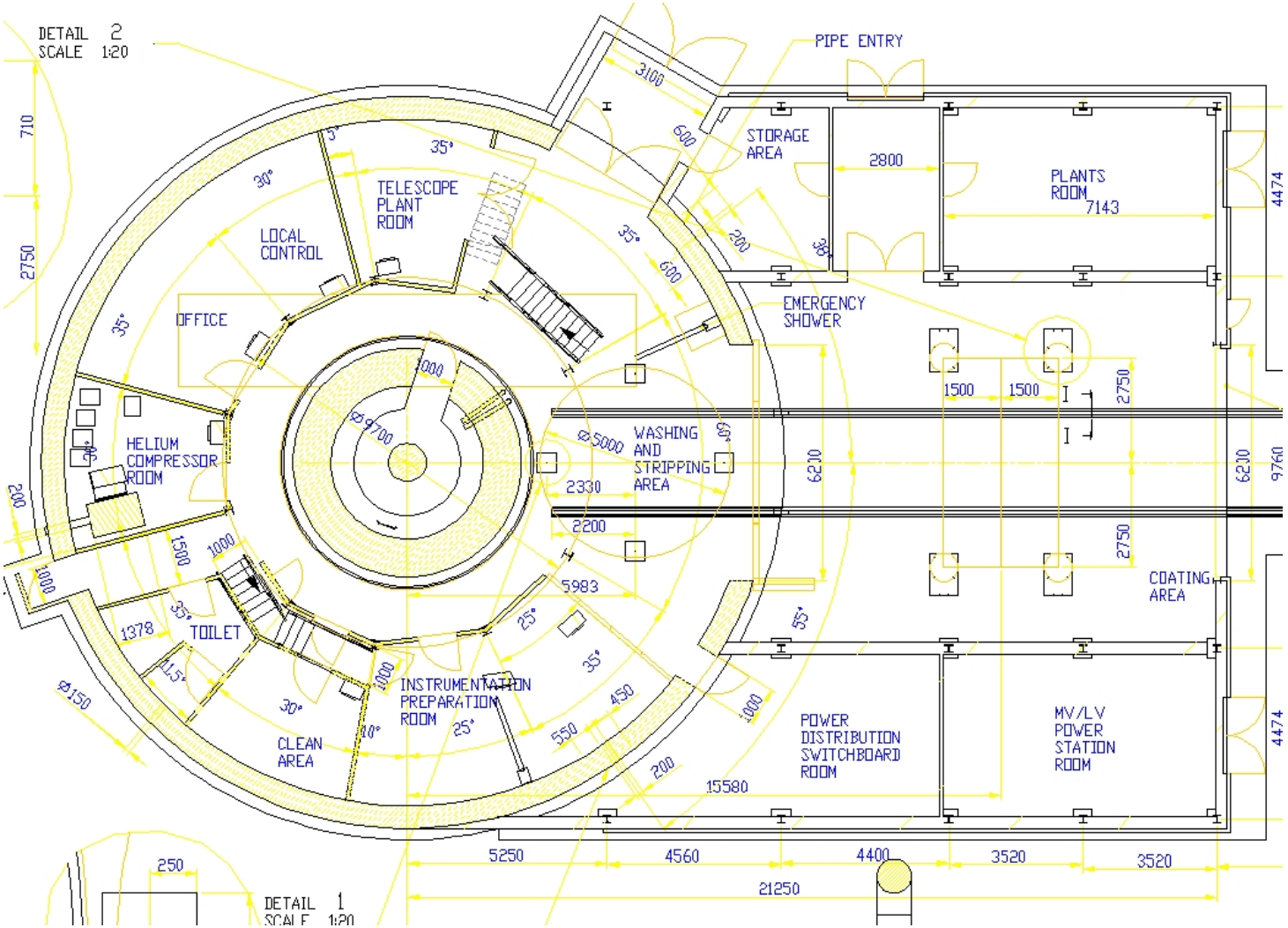

Figure 1. Plan of theVISTA Enclosure.

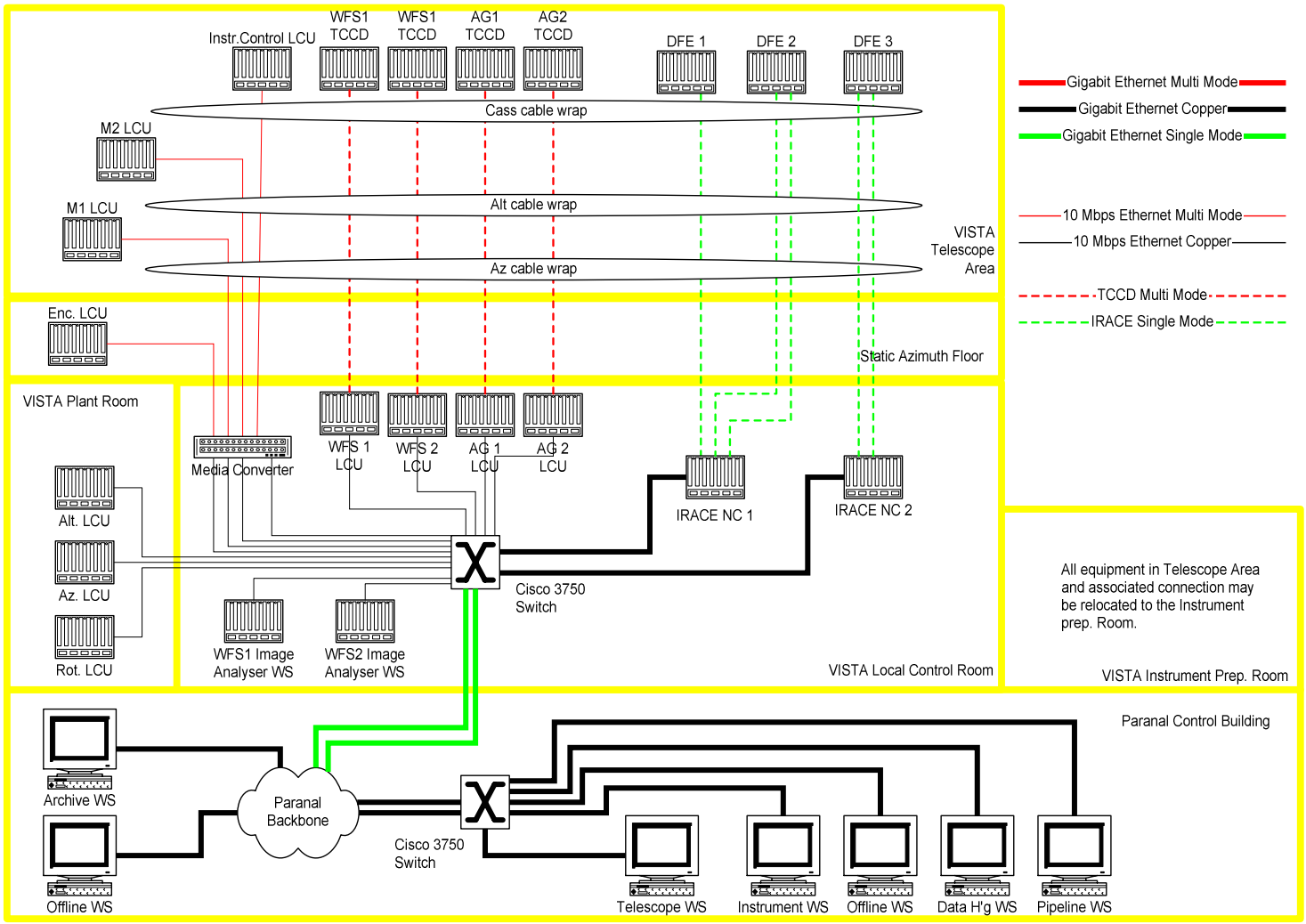

Figure 2: Lay-out of VISTA's control local area network.

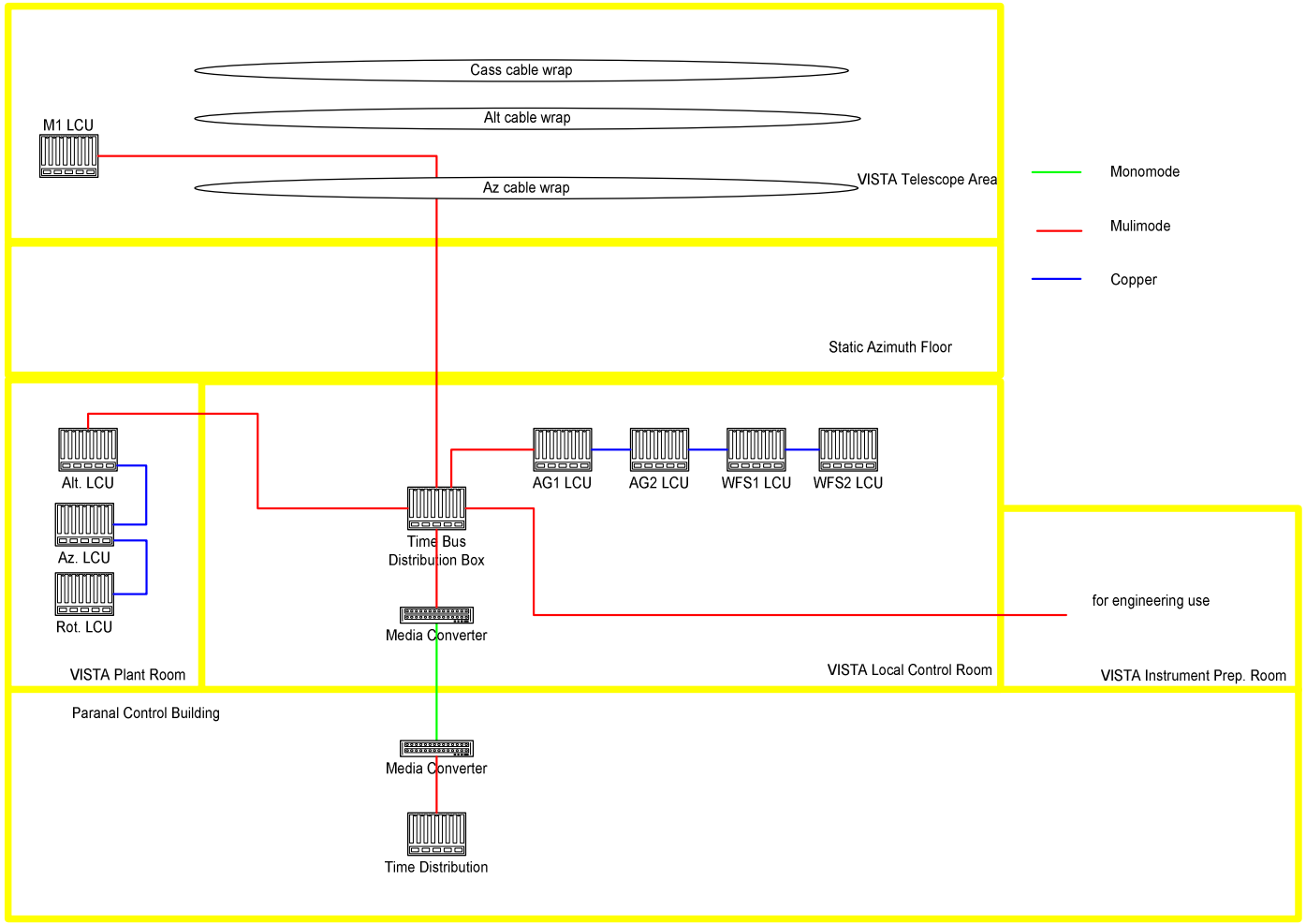

Figure 3: Time Reference System lay-out for VISTA.

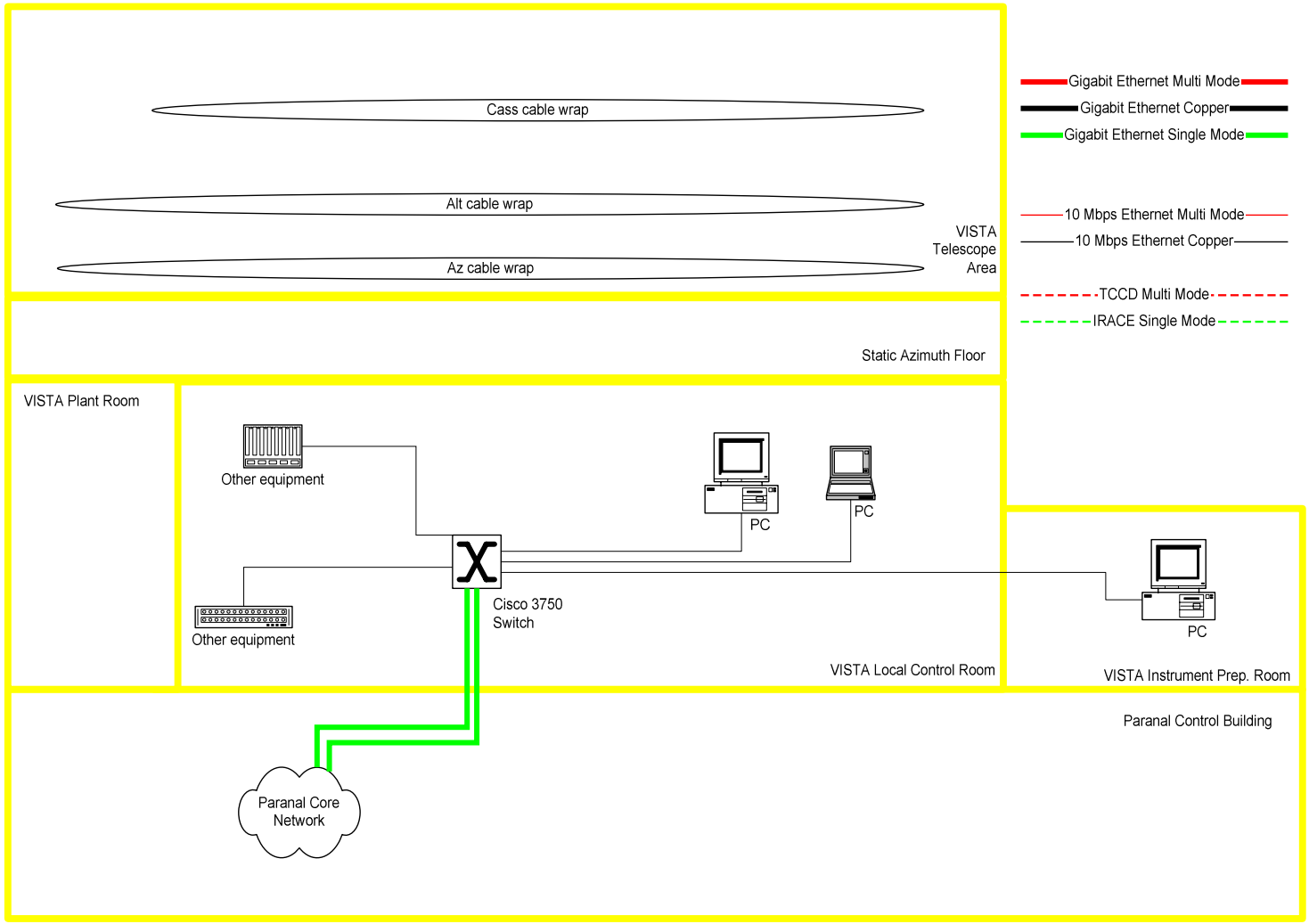

Figure 4 Layout of VISTA's Core Network.

9 Core Network

Networked equipment that is not part of the VISTA control system is connected to the Core Network, similar to but physically separate from the Control Network as required by ESO. This network, which could host items such as PCs, access control systems and webcams, is shown in outline form in Figure 4. A 3750 switch in the Comms Rack will connect to the networked equipment in the Enclosure via copper (10, 100 or 1000 Mbps Ethernet) and to the Paranal Core Network in the Control Building via mono-mode fibre (1000 Mbps Ethernet is probably the most convenient).

The equipment that will be connected to the Core Network is not yet defined, but is covered by the Comms rack spare connections in Table 4.

10 Time Reference

The VLT Time Reference will be transmitted from the Control Building along fibre to the VISTA Enclosure. Because of the distance media converters will be used to allow the use of mono-mode fibre between the Control Building and the Enclosure. A standard Time Bus Distribution Box incorporating a media converter will be installed in the Comms Rack to distribute the Time Reference to the various locations (see Figure 3). A copper daisy chain [RD02] will be used to distribute the Time Reference between adjacent LCUs, e.g. the three axis LCUs and and autoguiding and wavefront sensing LCUs.

11 Connections within the VISTA Enclosure

The location of VISTA's computing and network equipment in the VISTA Enclosure (Figure 1) is listed in Table 3. The hub of the VISTA Enclosure's communications will be the Comms Rack in the Local Control Room. This rack will connect to other locations within the Enclosure and to the Paranal Control Building as shown in Figure 5.

This layout is consistent with the description of cable wrap connections [AD03], although it should be noted that the M1 LCU connections (LAN and Time Reference) are not included in that document. They are also consistent with the specification of services between the Telescope and the IR Camera [AD02]. The description of services between the Enclosure Buildings Work Package and All Users has been superseded in some respects, since networking is not now part of that work package.

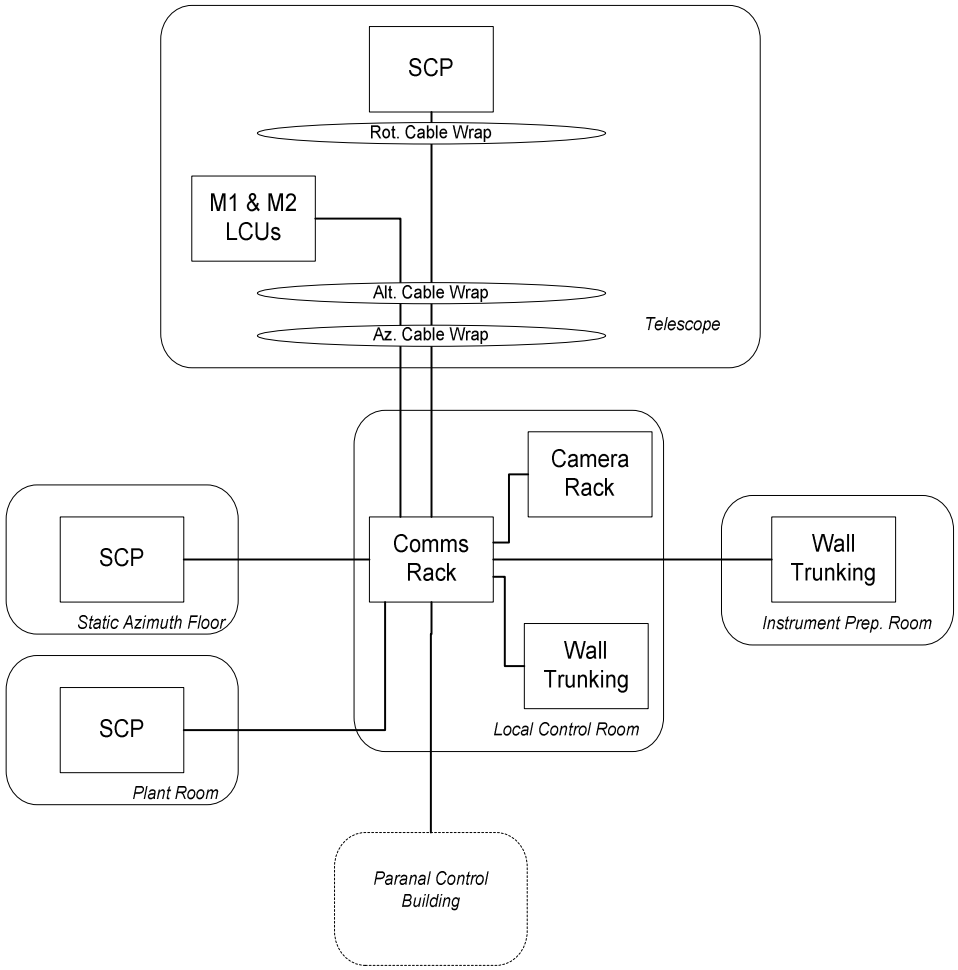

Figure 5 Network topology for the VISTA Enclosure.

This Comms Rack is envisaged as having a patch panel for each location, including the Local Control Room itself. These patch panels will host network connections, Time Reference connections and detector controller connections. For illustration, the communications and computing equipment within the Local Control Room is show in Figure 6.

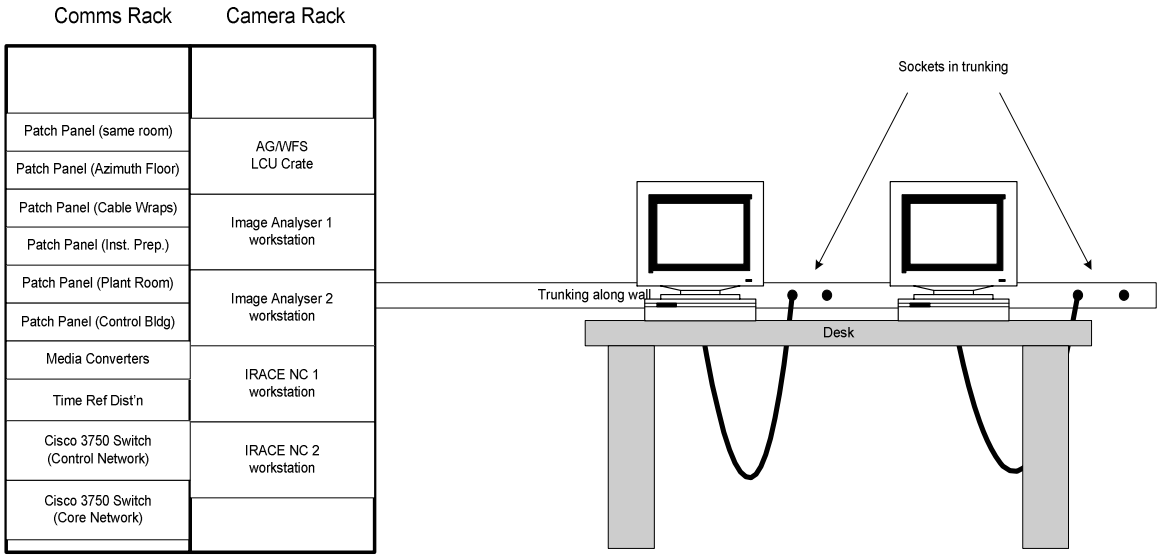

Figure 6. Typical layout of equipment within the VISTA Local Control Room.

Media will be:

- **mono-mode fibre**: connections to Paranal Control Building and IRACE connections
- **multimode fibre**: longer distance connections within the VISTA Enclosure and TCCD connections
- **copper (Cat 5)**: shorter distance connections within the VISTA Enclosure

The connections on the patch panels in the Comms Rack are listed in Table 4. From the rear of each patch panel fibre and cable bundles, spliced as necessary, will be routed to the other locations in the VISTA Enclosure and also to the Paranal Control Building. From the front of each patch panel, patch leads will be routed to the Cisco 3750 and the Time Reference Distribution Unit housed in the same rack. Media converters, e.g. to connect 10 Mbps fibre to the 3750, will also be housed in the Comms Rack. The connections to the Enclosure 3750 are listed in Table 7.

Patch Panel To:	Remote Equipment	MM Pairs	MM Single	SM Pairs	SM Single	Cu
Paranal Control Building	LAN to IRACE NC 1			1		
	LAN to IRACE NC 2			1		
	Backbone to Control 3750			2		
	Backbone to Core 3750			2		
	Time Reference 1				1	
	Spares			5	1	
	Total	**0**	**0**	**11**	**2**	**0**
Local Control Room Camera Rack	WFS1 LCU (LAN)					1
	WFS2 LCU (LAN)					1
	AG1 LCU (LAN)					1
	AG2 LCU (LAN)					1
	WFS1 Analyser WS (LAN)					1
	WFS2 Analyser WS (LAN)					1
	IRACE NC1 WS (LAN)					1
	IRACE NC2 WS (LAN)					1
	Time Reference		1			
	Spares	2	1	0		4
	Total	**2**	**2**	**0**	**0**	**12**
Local Control Room “Trunking”	**Total**					**6**

Patch Panel To:	Remote Equipment	MM Pairs	MM Single	SM Pairs	SM Single	Cu
Plant Room "FOJB1"	Altitude LCU (LAN)	1				
	Azimuth LCU (LAN)	1				
	Rotator LCU (LAN)	1				
	Time Reference		1			
	Spares					0
	Total	**3**	**1**	**0**	**0**	**0**
Telescope through Az/Alt wraps "FOJB1"	M1 LCU (LAN)	1				
	M2 LCU (LAN)	1				
	Time reference		1			
	Spares					
	Total	**2**	**1**	**0**	**0**	**0**
Telescope through Az/Alt/Rot wraps "FOJB1"	WFS1 TCCD	1				
	WFS2 TCCD	1				
	AG1 TCCD	1				
	AG2 TCCD	1				
	IRACE DFE1			1		
	IRACE DFE2			2		
	IRACE DFE3			2		
	Instrument LCU (LAN)	1				
	Time Ref.		1			
	Spares to FOJB1	5	1	2		
	Total	**10**	**2**	**7**	**0**	**4**
	FOJB1 Grand Total	***15***	***4***	***7***	***0***	***4***
Power Dist'n Switchboard Room	Enclosure LCU (LAN)	1				
	Time Reference		1			
	Spares	2	1			2
	Total	**3**	**2**	**0**	**0**	**2**
Instrument Prep. Room "FOJB2" + SCPB3 multimode in SCPB3, rest in FOJB2	WFS1 TCCD	1				
	WFS2 TCCD	1				
	AG1 TCCD	1				
	AG2 TCCD	1				
	IRACE DFE1			1		
	IRACE DFE2			2		
	IRACE DFE3			2		
	Instrument LCU (LAN)	1				
	Time Reference		1			
	Spares	4	1	2		4
	Total	**9**	**2**	**7**	**0**	**4**

Patch Panel To:	Remote Equipment	MM Pairs	MM Single	SM Pairs	SM Single	Cu
Misc. Locations	He Compressor Room – SCP B1	3				
	Clean room – SCP B2	3				
	Coating Plant – SCP B4	3				
	Intermediate Floor – SCP B5	3				
	Fixed Azimuth Floor – SCP B6	3				
	Total	**15**	**0**	**0**	**0**	**0**
Phones	**Total**					**13**

Table 4. Connections on the patch panels of the Comms Rack in the Local Control Room.

Equipment	Supplied by	Height (mm)	Power (W)
Patch panels	Contractor	TBD	
Cisco C3750G-24TS (Control)	VPO	66	190
Cisco C3750G-24TS (Core)	VPO	66	190
Time Distribution (ESO)	VPO	100 TBC	200 TBC
Media converters (Allied Telesyn: 6 off MC115 XL in AT-MCR12 chassis)	VPO	132	300

Table 5. Equipment to be installed in the Communications Rack.

Application	Connector
Copper LAN	RJ45
Multi-mode LAN	ST
Gigabit fibre on Cisco	LC
TCCD LCU to front end multi-mode	ST
IRACE NC to front end mono-mode	SC
Time Reference	ST

Table 6. Connectors used with network equipment.

Device	Operations		
	MM Fibre	Copper	SM Fibre
Inst. Control LCU	1		
M1 LCU	1		
M2 LCU	1		
Enc. LCU	1		
Alt. LCU		1	
Az. LCU		1	
Rot. LCU		1	
WFS1 LCU		1	
WFS2 LCU		1	
AG1 LCU		1	
AG2 LCU		1	
Image Analyser WS 1		1	
Image Analyser WS 1		1	
IRACE NC1		1	
IRACE NC2		1	
Control Building Link			2
“X terminals”		4	
Total	**4**	**15**	**2**
	21		

Table 7 Connections to Control Network Cisco 3750 switch in VISTA Enclosure.

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