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TECHNICAL REPORT

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LBT AO System Network Topology

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ABSTRACT

This report contains a brief discussion of the network topology needed for the LBT AO System.

1 Introduction

Due to some limitations in the BCU implementation of the TCP/IP stack, and to the required throughput on the network connections, there are a few constraints on the network topology which may be used for the LBT-AO System.

In the following pages we discuss these constraints and suggest a possible network configuration which ensure proper functioning of the AO System.

2 AO System Architecture

From the point of view of the network topology the AO System can be subdivided in three subsystems:

1. The **AO Workstations** which are the computers which run the AO Supervisor. They must communicate between them and, respectively, the first with the WFS and the second with the AdSec assemblies.
2. The **Wavefront sensor** (WFS) which includes a few network nodes all contained in the AGW crate at the focal station.
3. The **Adaptive Secondary Mirror** (AdSec), which includes a small number of network nodes all located in the electronics boxes on the secondary swing arm.

All the following discussion will refer to a schematic diagram of the network topology shown in figure 1.

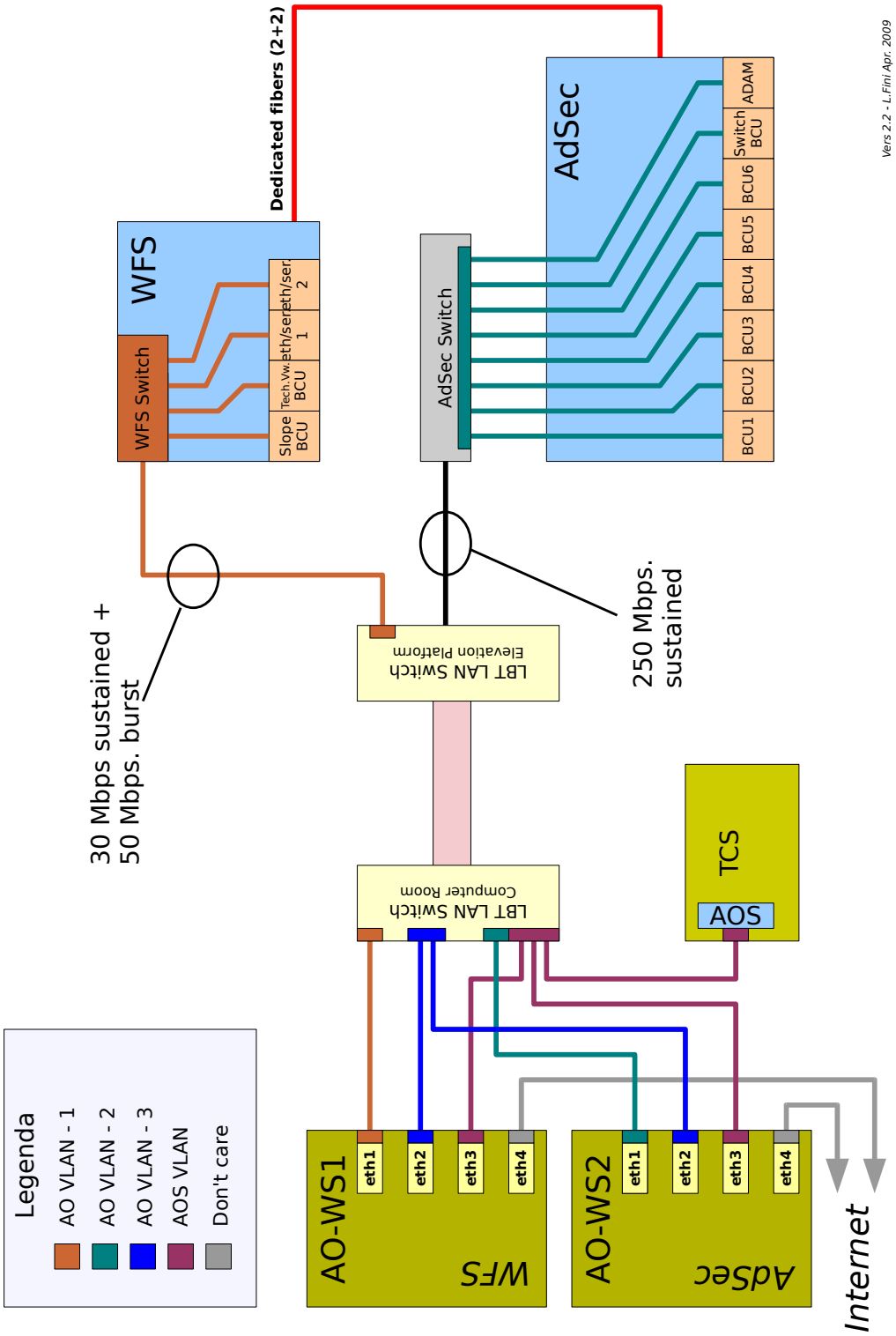

Figure 1: LBT-AO Network Topology

3 BCUs Limitations

The Basic Control Unit (BCU) is the main building block for all the electronics used within the AO System. Notably BCUs are used as frame grabbers for the WFS CCDs, as controllers of the Adaptive Mirror actuators, and so on [1, 2].

They are provided with an Ethernet interface for all the housekeeping tasks, including diagnostics, and their internal firmware implements a subset of the TCP/IP stack.

Tests in many environment conditions have shown that the BCUs are very sensitive to broadcast traffic: whenever BCU based electronic devices are connected to a general purpose network, the usual broadcast traffic (e.g.: ARP requests) is likely to fill up the input data buffers of the Ethernet port and block the communication. After that, only a complete reset of the board can bring the Ethernet communication back to work.

The safest way to avoid the above problem consists in the set up of a dedicated LAN (or better VLAN) so that no broadcast traffic from the outside world is received.

This peculiarity is the main constraint which leads to the proposed network topology.

4 Network Architecture Detailed Discussion

All the following sections provide details o various aspects of the network topology, with reference to figure 1.

We have identified four VLANs and some interfaces which have no special requirements:

1. **AO VLAN-1** is dedicated to the Wavefront Sensor assembly.
2. **AO VLAN-2** is dedicated to the Adaptive Secondary assembly.
3. **AO VLAN-3** is dedicated to the communications between the two AO Workstations.
4. **AOS VLAN** supports the communication between the AOS[1] and the AO Supervisor.
5. **Don't care I/F** indicate switch ports or Ethernet interfaces with no special needs; i.e.: they do not affect network communications in the AO System.

Note: there is no need of routing between the VLANs as defined here to support the communication paths used by the AO System.

4.1 AO VLAN 1

AO VLAN 1 is dedicated to the Wavefront Sensor subsystem. It includes the first Ethernet interface of the WFS AO Workstation and, through the WFS switch, the networked devices within the WFS (which include two BCUs). As shown in figure, all the ports of the WFS switch located within the WFS assembly belong to this VLAN, so it is not necessary that this particular switch supports VLANs.

[1]The AOS is the TCS subsystem dedicated to the communication between the TCS and the AO Supervisor.

4.2 AO VLAN 2

AO VLAN 2 is dedicated to the Adaptive Secondary subsystem. It includes the first Ethernet interface of the AdSec AO Workstation and, through the AdSec switch, the networked devices into the AdSec assembly. Here 8 BCUs are used.

4.3 AO VLAN 3

AO VLAN 3 is used for communication between the two workstations. The WFS and AdSec workstations must exchange a huge amount of diagnostic data during the AO operation; moreover the efficiency of data exchange is critical for the Adaptive Secondary safety because it is needed to detect possibly dangerous conditions.

We have reserved a specific VLAN for this data stream in order to ensure that it is not affected by traffic generated by other network devices.

4.4 AOS VLAN

AOS VLAN includes the third Ethernet interface of the AO Workstation and any other devices as needed, provided that AOS can establish a TCP/IP communication with the AO Workstation.

Currently this is the "Command subnet" of the LBT.

4.5 Don't care I/F

Don't care I/F indicate switch ports or Ethernet interfaces with no special needs; i.e.: they do not affect network communications in the AO System. E.g.: the fourth Ethernet interface of the AO Workstations may be used to allow remote access from the Internet, and will be part of any VLAN defined for this purpose.

5 Ethernet Switches

The required network architecture has some impact on the communication equipment used.

In figure 1 the **LBT LAN Switches** identify network devices of the telescope network: they could possibly be more than two. The drawing includes also two switches which are integrated into the AO subsystems.

5.1 The WFS Switch

The WFS switch is embedded in the AGW electronics box, but it only requires basic capabilities[2].

The current selection (D-Link DGS 1005D) does not provide management capabilities.

[2]The only selection criteria are the physical dimensions and the environmental specs (see [3, 4])

5.2 The AdSec Switch

The Adaptive Secondary assembly Ethernet switch is placed in the electronics rack hosted at the base of the swing arm. It has no special requirements, except for the performances[3].

The selected device is D-Link DGS-3312SR [5].

6 The AO Workstations

The AO Workstations are the computers hosting the AO Supervisor.

From the network point of view, they are both equipped with four Ethernet interfaces:

- **eth1**. To support communication with the hardware
- **eth2**. To support communication with the Other AO Workstation.
- **eth3**. To communicate with the AOS
- **eth4**. To support remote connections.

Note: it can be noted that AO VLAN-1 and AO VLAN-2 have special requirements deriving from the connection to BCUs as detailed in a previous section. For this reason the eth1 interfaces on both workstations, will be configured with static ARP tables to avoid the ARP broadcast traffic.

The other two interfaces have no particular requirements and will be configured as usual. Moreover, although we have indicated two different interfaces to separate the communication with the AOS from the communication from the external world (e.g.: for remote access), this is not a requirement: the two functions can share the same interface, if this is most suitable to the actual network layout in the LBT.

[3]Due to bandwidth limitations in the implementation of the TCP/IP stack of BCUs, any Gigabit Ethernet switch should provide the required performances.

References

[1] Microgate S.r.l, "Adaptive Secondary Control System. Design Report", LBT CAN N. 640a006.

[2] Microgate S.r.l, "Adaptive Secondary Basic Computational Unit. Design Report", LBT CAN N. 640a009.

[3] Joar Brynnel,"LBT672 On-axis Wavefront sensor #1. Lab Acceptance Test Report", LBT CAN N. 687s001, July 2008.

[4] Joar Brynnel,"LBT672 On-axis Wavefront sensor #2. Lab Acceptance Test Report", LBT CAN N. 687s002, February 2009.

[5] Simone Esposito, Andrea Tozzi, Armando Riccardi, Roberto Biasi, Daniele Gallieni "FLAO Interface Control Document", LBT CAN 485f004e, March 2009.

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