LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Technical Note	**LIGO-T1400268-v2**	2014/04/23

LLO Camera Status

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1 Overview

At LLO we have 23 GigE cameras on hand, and 6 more being delivered next week, putting us at 29 out of 31. We have 32 analog cameras (7 new for PSL and the rest from iLIGO) on hand and we only require 31 for the initial plan.

New camera cans have been delivered by Caltech, so between the old and new cans we have enough to cover our needs.

We have 3 camera server computers and 2 camera network switches in the corner which can handle the 32 digital cameras. Each end station has 2 available GigE ports with 2 PoE power injectors

2 Cameras

Table 1: Table of cameras per area, table or chamber

Location	GigE	Analog	Camera Mounted Lenses
PSL Table	1	7	None
ISCT 1	2	3	3.6mm lens (looking at PDs)
ISCT2R	2	1	75mm lens (looking at PD)
ISCT2L	3	1	75mm lens (looking at PD)
ISCT6	2	2	2x 75mm lens(looking at PDs)
ISCTEX	1		None
ISCTEY	1		None
HAM 2	6	6	Large Angles (4x 13mm lens) Small Angles (2x varible 100-300mm lens) Faraday Isolator (2x 12.5-75mm vari-focus lens) General views (2x 6mm lens)
HAM 3	6		Large Angles (2x 13mm lens) Small Angles (4x variable 100-300mm lens)
BSC 2	1		12.5mm lens
BSC 1	2	1	Chamber (6mm lens) Small Angle (12.5-75mm variable lens) or (55-250mm variable lens) Looking into IR blocking options
BSC 3	2	1	Chamber (6mm lens) Small Angle (12.5-75mm variable lens) or (55-250mm variable lens) Looking into IR blocking options
BSC 4	1	1	Chamber (12.5mm lens) Small Angle (12.5-75mm variable lens)
BSC 5	1	1	Chamber (12.5mm lens) Small Angle (12.5-75mm variable lens)
HAM 4		1	Small Angle (variable 100-300mm lens)
HAM 5		3	Small Angle (2x variable 100-300mm lens) Output Faraday (variable 12.5-75mm)
HAM 6		5	Looking at PDs (2x variable 12.5-75mm) Looking down in chamber and at splitters and PDs (2x 6mm/12.5mm)
TCS	2*		
Total	**32 + 2 TCS**	**31**	

2.1 PSL: 1 Digital Camera, 7 Analog cameras

Installed:

- 7 analog cameras on the PSL table as specified in the PSL Layout document. Installed. No camera mounted lenses.
- 1 digital camera on the PSL table for IOO looking at trans-periscope beam. Installed. No camera mounted lens.

2.2 ISCT1: 2 Digital cameras, 3 Analog cameras

Installed:

- 2 Digital camera looking at the green X and Y arm transmission. No camera mounted lenses.
- Analog camera looking at a pickoff of the POP beam. No camera mounted lenses.
- Analog camera looking at a pickoff of the REFL beam. No camera mounted lenses.
- Analog camera looking at the REFL Photodetectors. 3.6mm computar lens looking at both PDs.

2.3 ISCT2R: 2 Digital cameras, 1 Analog Camera

Installed:

- 2 Digital cameras looking at MC_REFL and MC_Trans. No camera mounted lenses
- 1 Analog camera looking at the MC REFL photodetector. 75mm computar lens.

2.4 ISCT2L: 3 Digital cameras, 1 Analog Camera

Not installed at the moment:

- 3 Digital cameras looking at IM4_TRANS, PRM_REFL_90, and PRM_REFL_180. No camera mounted lenses.
- 1 Analog camera looking at the PRM REFL PD. 75mm computar lens.

2.5 ISCT6: 2 Digital cameras, 2 Analog cameras

Not installed at the moment:

- A digital camera looking directly at a pickoff of the OMC REFL beam. No camera mounted lenses.
- A digital camera looking directly at a pickoff of the OMC TRANS beam. No camera mounted lenses.

- A digital camera looking at the high gain AS port RFPD. Planning on using a 75mm lens.
- A digital camera looking at the low gain AS port FRPD. Planning on using a 75mm lens.

2.6 ISCEX: 1 Digital camera

Installed:

- A digital camera looking directly at a pickoff of the transmission beam of ETMX. No camera mounted lenses.

2.7 ISCEY: 1 Digital camera

Installed:

- A digital camera looking directly at a pickoff of the transmission beam of ETMY. No camera mounted lenses.

2.8 HAM2: 6 Digital cameras, 6 Analog cameras

Installed:

- 2 digital cameras on the tube going to HAM3 looking at MC2 (WAMCA1/LAMCA1,port VP9) and PR2 (WAMCA1/LAMCA1, port VP3). 2x Tamron Tele-macro 100-300mm variable focal length lenses.
- 2 digital camera looking at large angle view of MC1 (HAM2, port A1F3). Lens attached to camera is a 13mm focal length, 1" diameter lens with lens tube (15cm), PRM (HAM2,port A2F5)

To be installed:

- 2 analog cameras looking at the Faraday isolator, one on input (HAM2, port A2F1) and one on output (HAM2, port C1). Planning on using 12.5-75mm variable focus lenses.
- 2 digital cameras looking at MC3 (HAM2, port D7), PRM (HAM2, port A2F5). Planning on using 13mm focal length, 1" diameter lenses with lens tube kits.
- 2 analog cameras looking at IM1 (aka SM1) (HAM2, port C1) and IM4 (aka SM2) (HAM2, port C1). Planning on using 12.5-75mm variable focus lenses.
- 2 analog cameras with general views of the chamber, Left General View (HAM2, port A1F2) and Right General View (HAM2, port A2F2). Planning on using 6mm lenses.

2.9 HAM3: 6 Digital cameras

Installed:

- 1 digital camera on the tube going to HAM2 looking at MC1 (WAMCB1/LAMCB1, port VP10). Tamron 100-300mm variable focus lens.
- 1 digital camera on the tube going to HAM2 looking at MC3 (WAMCB1/LAMCB1, port VP3). Tamron 100-300mm variable focus lens.
- 1 digital camera on the tube going to HAM2 looking at PRM (WAMCB1/LAMCB1, port VP9). Tamron 100-300mm variable focus lens.
- 1 digital camera on the tube going to HAM2 looking at PR3 (WAMCB1/LAMCB1, port VP12). Tamron 100-300mm variable focus lens.
- 1 digital camera on the chamber looking at the large angle view of MC2 (HAM2, VPA1F5). 13 mm focal length lens, 1" diameter with lens tube kit.

To be installed:

- 1 digital camera on the chamber looking at the large angle view of PR2 (HAM2, VPA2F3). 13mm focal length lens, 1" diameter with lens tube kit.

2.10 BSC2: 1 Digital

Installed:

- Digital camera looking at the BS from 45 degrees - to be used by ASC for the Beam Centering Servo. (BS2, port G8). 12.5 mm computar lens.

2.11 BSC1: 2 Digital camera, 1 Analog camera

Installed:

- A digital camera at close to normal incidence on ITMY (A1-F, Port VP2). Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch). Also tried a Canon EF-S 55-250mm lens with EzFoto Canon EOS EF lens to C-mount adapter (left over from contamination mobility experiment).

To be installed:

- An analog camera looking at the input side of the compensation plate and ITMY (BSC1, Port G11). Computar 6mm lens.
- 1 digital camera at close to normal incidence on ITMY (A1-F, Port VP2) for the Green light. Corey G. is looking into IR blocking filter/lens combinations.

2.12 BSC3: 2 Digital camera, 1 Analog camera

Installed:

- A digital camera at close to normal incidence on ITMX (A1-C, Port VP5). Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch). Also tried a Canon EF-S 55-250mm lens with EzFoto Canon EOS EF lens to C-mount adapter (left over from contamination mobility experiment).
- An analog camera looking at the input side of the compensation plate and ITMX (BSC3, Port G1). Computar 6mm lens.

To be installed:

- 1 digital camera at close to normal incidence on ITMY (A1-F, Port VP2) for the Green light. Corey G. is looking into IR blocking filter/lens combinations.

2.13 BSC5 and End VEA: 1 Digital camera, 2 Analog camera

Installed:

- A digital camera at close to normal incidence on ETMY (A1-B, VP1) or (A1-B, Port VP4). Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch).

To be Installed:

- An analog camera looking at the transmission side of ETMY. 6mm lens planned.

2.14 BSC4 and End VEA: 1 Digital camera, 2 Analog camera

Installed:

- A digital camera at close to normal incidence on ETMX (A1-E, VP6). Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch).

To be Installed:

- An analog camera looking at the transmission side of ETMX (. 6mm lens planned.

2.15 HAM4: 1 Analog camera

To be installed:

- An analog camera looking at SR2 (MCA2,VP10). 100-300mm variable focal length lens planned.

2.16 HAM5: 3 Analog cameras

To be installed:

- 2 analog cameras looking at the SRM (MCB2, VP12) and SR3 (MCB2, VP9). 100-300mm variable focal length lens planned for each.
- 1 analog cameras looking at the Output Faraday Isolator (HAM5,VPA2F3). Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch) planned.

2.17 HAM6: 5 Analog cameras

To be installed

- 1 analog camera looking down on the output mode cleaner. 6mm lens planned.
- 2 analog cameras looking at the reflection and transmission from the output mode cleaner. Computar 12.5-75mm lens (M6Z12112-3S 2/3-inch) planned.
- 2 analog cameras looking at the Output mode cleaner PDs and splitters. 6mm/12.5 mm planned.

2.18 TCS

To be installed

- 2 GigE Far infrared cameras for TCS.

3 Network switches and computers

3.1 Switches and computers

The currently installed network and computer hardware at LLO includes the CDS core switch, a Brocade FGS48S, a Brocade FGS624P - PoE (Power over Ethernet) switch in the CER, a Brocade ICX6610 switch with 24 PoE ports in the CER, a Brocade FGS624P at each end, and three Supermicro computers with 2 ethernet ports each connected to both the camera network (VID) as well as the main CDS OPS network. There is a dedicated windows machine which will be used to handle the TCS camera images. The Brocade FGS48S is connected to the Brocade FGS624P - PoE via a 10 GigE fiber connection and to the Brocade ICX6610 via a second 10 GigE fiber connection, both of which are dedicated to only video camera traffic. The ends are connected by 1 GigE fiber, which share CDS and video traffic. All other connections use Cat 5e (or better) ethernet cables.

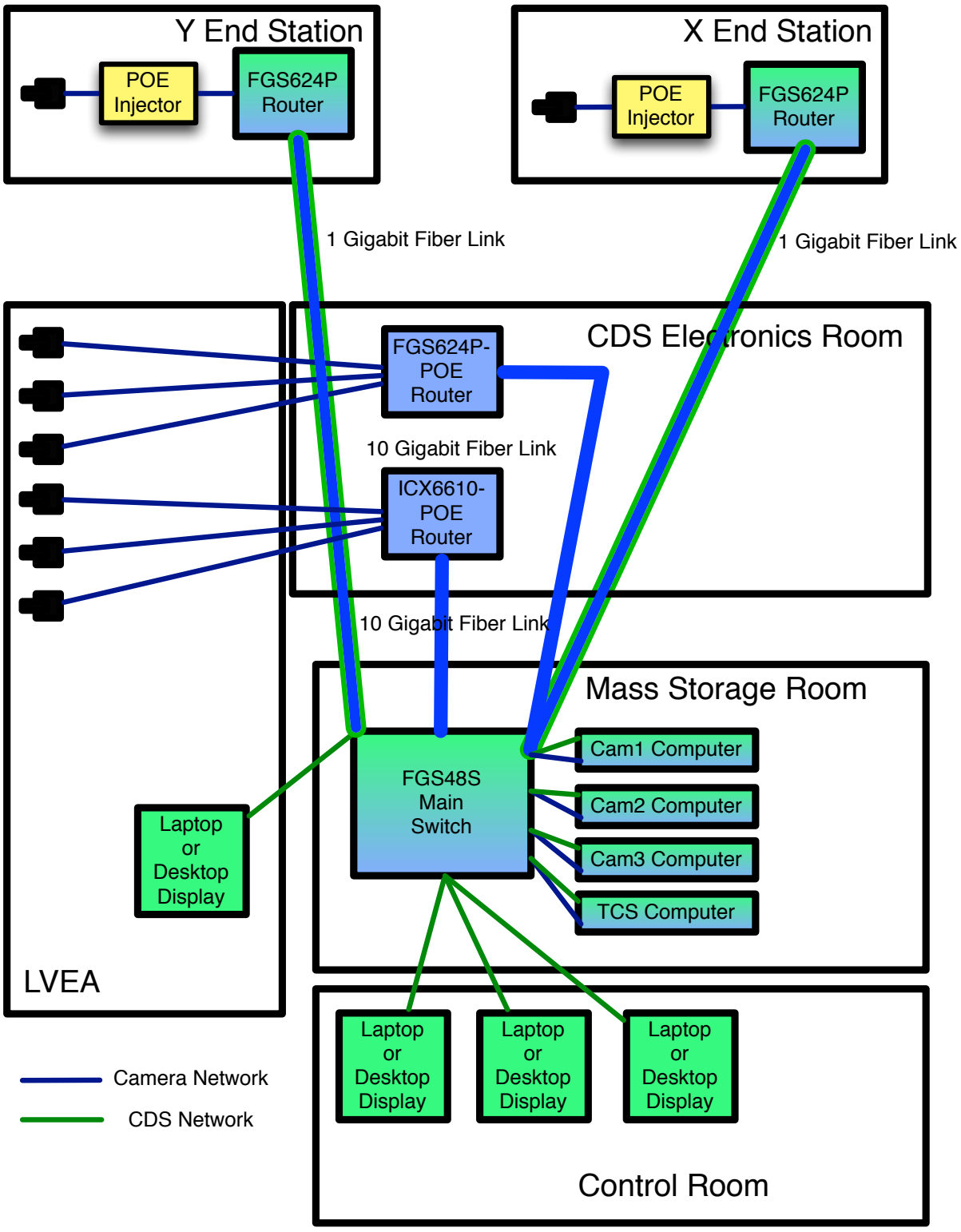

Figure 1: Diagramatic overview. Green indicates CDS network, blue Camera network, and blue-green indicates its on both. Not all cameras or control room computers shown.

Table 2: Table of network hardware and locations for L1

Hardware	**Purpose**	**Location**
Brocade FGS48S	Core Switch	MSR, L1-MSR-02
2x 10 Gb Fiber transceiver	Two 10 Gigabit connections	Brocade FGS48S
Brocade FGS624P - POE	PoE switch for Cameras	CER, L1-FAC-C1, row 24
10 Gb Fiber transceiver	10 Gigabit connection	Brocade FGS624P - PoE
Brocade ICX6610 24 PoE port	PoE switch for Cameras	CER, L1-FAC-C1, row 23
10 Gb Fiber transceiver	10 Gigabit connection	Brocade ICX6610 24 port PoE
Brocade FGS624P	CDS End station switch	CERX, L1-FAC-XC1
2x Trendnet TPE-113GI PoE Injector	Power over Ethernet Injectors	CERX, L1-FAC-XC1
Brocade FGS624P	CDS End station switch	CERY, L1-FAC-YC1
2x Trendnet TPE-113GI PoE Injector	Power over Ethernet Injectors	CERY, L1-FAC-YC1
Supermicro computer (Front End style /w 12 cores)	Camera server L1CAM1	MSR, L1-MSR-10, row 38
Supermicro computer (Front End style /w 12 cores)	Camera Server L1CAM2	MSR, L1-MSR-10, row 36
Supermicro computer (Front End style /w 12 cores)	Camera Server L1CAM3	MSR, L1-MSR-10, row 36