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Estimation of AdV rack needs and locations

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1 Introduction

A preliminary estimation of the needs of racks in Advanced Virgo had been done for the Technical Design Report [1] beginning of 2012. The latest estimation of the needs of racks in the different AdV locations are given in this note. It is based on discussions with the different AdV sub-system managers and on the presentation [**?**] from March 2013.

The needs are not summarized for each sub-system, but for each location. The latest building maps were provided by the EGO Infrastructure group.

The AdV sub-systems that need electronics to be installed are given here, with an idea of their main goals:

- PSL: electronics for the main laser generation and pre-stabilization,
- INJ: electronics for the main laser modulation and injection to the ITF,
- DET: electronics to control the OMC, the longitudinal and quadrant photodiodes, the phase cameras and mirror mount picomotors. Most of the DET electronics will be put in the air-tank below the benches suspended inside the mini-towers (thus not in external racks).
- TCS: electronics for the 2 TCS (around NI and WI mirrors) and the 5 Hartmann beams.
- SAT: electronics for the control of the 10 long suspensions (LVDT, coil drivers, ...).
- SBE: electronics for the control of the 5 multiSAS suspensions and of the EIB-SAS suspension (LVDT actuator conditioners, stepper motor controlers, LVDT/actuator drivers for local controls, DC power supplies: $\pm$18 V and +48 V).
- ISC: electronics for the 2 auxiliary lasers (CALVA).
- VAC: electronics for the vacuum control.
- DAQ: digital electronics to synchronize all the AdV electronics, DACs and ADCs channels to collect the data and provide digital loops, control and acquisitioni of the digital cameras, It also includes the front-end electronics for the environmental monitoring.
- EGO Computing group: electronics for the Ethernet network: space for Ethernet switches and optical fibers patch panels is needed in each location.

The goal of the electronics architecture is to limit the copper connections between different locations of the detector. It implies to have the front-end electronics close to the sensors and actuators, as well as the front-end digital electronics (ADCs and DACs). The timing data, Ethernet data and digital detector data are then collected through networks of optical fibers between the different systems.

No general DC power distribution is planned in AdV. However, a local DC power distribution is planned for the injection labs.

2 Racks

3 Central Building

Sketches of the central building, level 1 (ground) and level 2 (platform and DAQ-room), with the foreseen racks are given in figures 1 and 2.

3.1 Injection laboratories

Most of the electronics of the injection lab and injection electronics lab will be plugged on a DC distribution provided from DC power supplies in the DAQ-room. The PSL and INJ analog electronics will be located in the injection electronics lab: **four racks** are needed there. No rack is needed in the injection labs itself, close to the benches.
The network will use 16 U inside the racks for Ethernet switches and optical fibers patch panels.

3.2 EE-room

The EE-room will contain the digital electronics of the systems installed in the INJ labs (PSL, INJ, EIB-SAS, Hartmann sensor, environmental monitoring). Racks for VAC will also be added in this room.

In the EE-room, the electronics will be installed in **three racks for electronics and three racks for VAC**:

- One rack dedicated to the network that will use 25 U to 30 U.
- One rack dedicated to the control of the EIB-SAS.
- One rack dedicated to the DAQ
  - the DAQ environmental electronics: 11 U (4 U for 2 slow monitoring modules, 3 U for 2 Nexus amplifiers and 2 U for 1 custom board).
  - the DAQ collection electronics of the INJ labs data: 25 U (2 U for 1 CameraBox, 6 U for 3 DAQ-boxes, 12 U for a 2 crates with 3 ADC7674 and their DC supply, 1 U for 1 TDBox).
- there should be some space left in the previous racks for the electronics of the Hartmann sensor (10 U) (most probably in the EIB-SAS rack).
- Three racks dedicated to the VAC sub-system: tower vacuum, IB cryotrap and link pumps. No additional rack should be needed for the vacuum of the SPRB minitower since it will be separated from the ITF by a viewport.

- a (possibly short) rack might be needed for the SPRB minitower[1]:
  - ∼20 U for the phase camera of the bench EPRB and associated DAQ data collection.
  - it must be possible to add the DAQ environmental electronics (1 slow monitoring module and 1 Nexus amplifier) to the other environmental electronics (possibly adding 2 U more).

3.3 Detection laboratories

No rack is planned in the DET lab itself. Only front-end electronics and drivers might be installed below the external detection bench (EDB).

The electronics will be installed in **five racks** in the Elec. DET lab:

- One rack will be dedicated to the network that will use 20 U.
- One rack will be dedicated to the control of the SDB2 multiSAS.
- Two racks will be dedicated to the DET sub-system.
  - Linked to SDB1, the control of the OMCs implies piezo drivers and Peltier drivers, the control of different mirrors implies picomotor drivers, some electronics to control the two quadrant photodiodes used to align SDB1 on the ITF, and electronics is needed for SDB1 local controls.
  - The SDB2 electronics will be installed in the air-tank below the bench. All the SDB2 electronics will be powered in DC: the DC power supply will be installed in a rack of the Elec. DET lab.
  - Some electronics will be needed to control and readout the phase camera and the scanning Fabry-Perot installed on EDB.
- A rack will be used for
  - the TCS electronics of the EDB Hartmann sensor: 10 U,
  - the DAQ environmental electronics: 11 U (4 U for 2 slow monitoring modules, 3 U for 2 Nexus amplifiers and 2 U for 1 custom board).
  - the DAQ collection electronics: 17 U (2 U for 1 CameraBox, 4 U for 2 DAQ-boxes, 6 U for a crate with 3 ADC7674 and their DC supply, 1 U for 1 TDBox).
- It is not expected that VAC will need any rack in the DET labs. If necessary, one rack could be added later to improve the vacuum in the SDB2 minitower.

At longer term, another minitower could be installed to add the squeezing technique to AdV. It is estimated that two additional racks would then be needed.

[1] If this short rack cannot be installed close to the EPRB bench

3.4 TCS room

The TCS room will contain the electronics for the TCS. **Five racks** are needed:

- One rack will be dedicated to the network and DAQ:
  - Netowrk: 10 U.
  - DAQ environmental eletronics: 9 U (2 U for 1 slow monitoring modules, 3 U for 1 Nexus amplifier and 2 U for 1 custom board).
  - DAQ collection electronics: 17 U (2 U for 1 CameraBox, 4 U for 2 DAQ-boxes, 6 U for a crate with 1 ADC7674 and their DC supply, 1 U for 1 TDBox).
- Four racks will be dedicated for the TCS electronics.

3.5 Central Building platform (level 2)

The electronics to control the super-attenuators will be put close to each tower, along with the corresponding needs for Ethernet and DAQ. A sketch of the central building platform and racks is given in figure 2.

3.5.1 Need for one suspension

Two racks are needed for each tower:

- 6 U for the network
- 24 U for the SAT electronics (3 or 4 crates of 6 U).
- 3 U for the DAQ environmental eletronics (2 U for 1 slow monitoring module).
- 11 U for the DAQ collection electronics (2 U for 1 CameraBox, 6 U for a crate with 2 ADC7674 and their DC supply, 1 U for 1 TDBox).

3.5.2 Racks on the platform

A total of **14 racks are needed for the 7 suspensions** of the Central Building.

Additionally, **7 racks are needed for the vacuum** sub-system. The VAC racks will be attached to the walls in order to limit the seismic noise transmitted to the platform.

3.6 DAQ-room

Since the front-end electronics and front-end DAQ electronics will be moved close to the actuators and sensors, there will be less racks in the DAQ-room for AdV than for Virgo.

Of the order of 7 racks are needed in the DAQ-room:

- Two racks dedicated to the network **??????**
- One rack dedicated to the DC power supply of the INJ labs.
- Tow racks dedicated to the control of SIB2 and SPRB multiSAS (including DAQ collection electronics) and their DC power supplies.
- Two racks dedicated to the DAQ:
  - DAQ environmental eletronics: 4 U (3 U for 1 Nexus amplifier)
  - DAQ: GPS receiver, master TDBoxes and Mux/Demux
- One rack for the DAQ/network common rack, with the common optical fiber patch panels (Ethernet, Timing and TOLM networks). **??????**

Number of racks and internal organisation of the racks still to be discussed between DAQ and EGO Computing Service. **??????**

3.7 Racks in the Central Area (level 1)

One (possibly short) rack is needed for the environmental monitoring and the phase camera around the SPRB minitower. If this rack does not fit below the bench EPRB, it can be installed in the EE-room.

- less than ∼20 U for the phase camera of the bench EPRB and associated DAQ data collection.
- 6 U for the DAQ environmental electronics (2 U for 1 slow monitoring module and 3 U for 1 Nexus amplifier).

The other racks in the central area and at the input of the arms are for the vacuum control. XX**??????** racks are needed by VAC. There positions in the area are shown in figure 1.

4 Mode-Cleaner Building

1?????? rack for vacuum and three racks for electronics are needed in the MC building. They will be installed on the ground (no more on the platform as the SAT rack during Virgo):

- One rack dedicated to the network (10 U).

- One rack dedicated to the SAT electronics.
- One rack dedicated to INJ and DAQ:
  - INJ: few U for photodiode, camera **??????**
  - DAQ environmental eletronics: 10 U (4 U for 2 slow monitoring modules, 3 U for 1 Nexus amplifier and 2 U for 1 custom board).
  - DAQ collection electronics: 11 U (2 U for 1 CameraBox, 2 U for 1 DAQ-Box, 6 U for a crate with 2 ADC7674 and their DC supply, 1 U for 1 TDBox).
- VAC: 1 rack**??????**

5 End Buildings

XX?????? racks for vacuum and six racks for electronics are needed in each end building. They will be installed on the ground, all on the same side of the vacuuum tubes if possible in order to ease the cabling and maintenance.

- One rack dedicated to the network.
- Two racks dedicated to the SAT electronics.
- One rack dedicated to control the SNEB/SWEB multiSAS.
- 40 U for DAQ electronics, possibly installed in two blocks:
  - DAQ environmental eletronics: 10 U (4 U for 2 slow monitoring modules, 3 U for 2 Nexus amplifier and 2 U for 1 custom board).
  - DAQ collection electronics: 30 U (2 U for 1 CameraBox, 4 U for 2 DAQ-Box, 12 U for two crates with 5 ADC7674 and their DC supply, 2 U for 2 TDBox).
- less than 20 U for DET electronics (SNEB/SWEB minitower DC power supply, SNEB/SWEB alignment control to follow the end mirror)
- 10 U for the Hartmann sensor (TCS)
- VAC: XX **??????** racks..

The electronics of the auxiliary laser (ISC) will be installed below the bench ENEB/EWEB, so no specific rack is needed.

6 Summary

7 Figures: building plans with rack locations

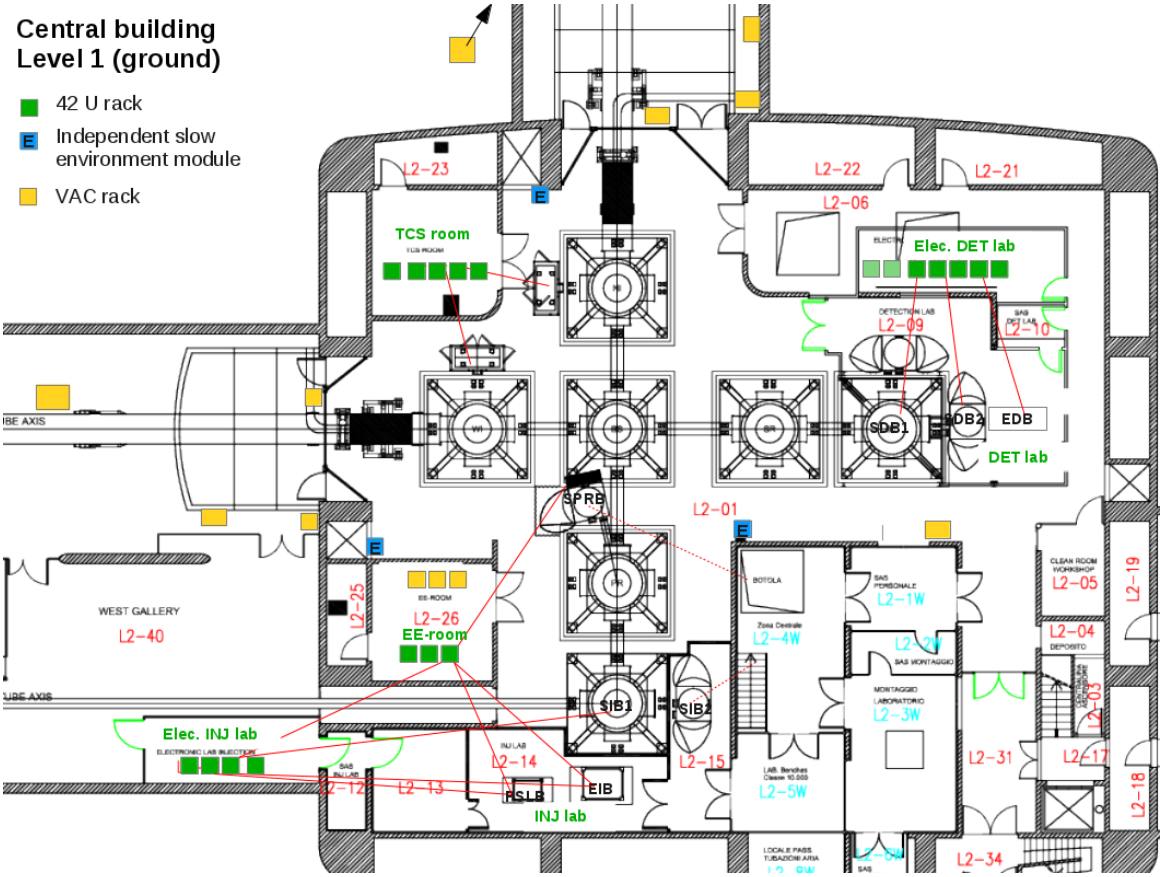

Figure 1: Central building, level 1 (ground). (One VAC rack is in the north tube outside the figure, as indicated by an arrow).

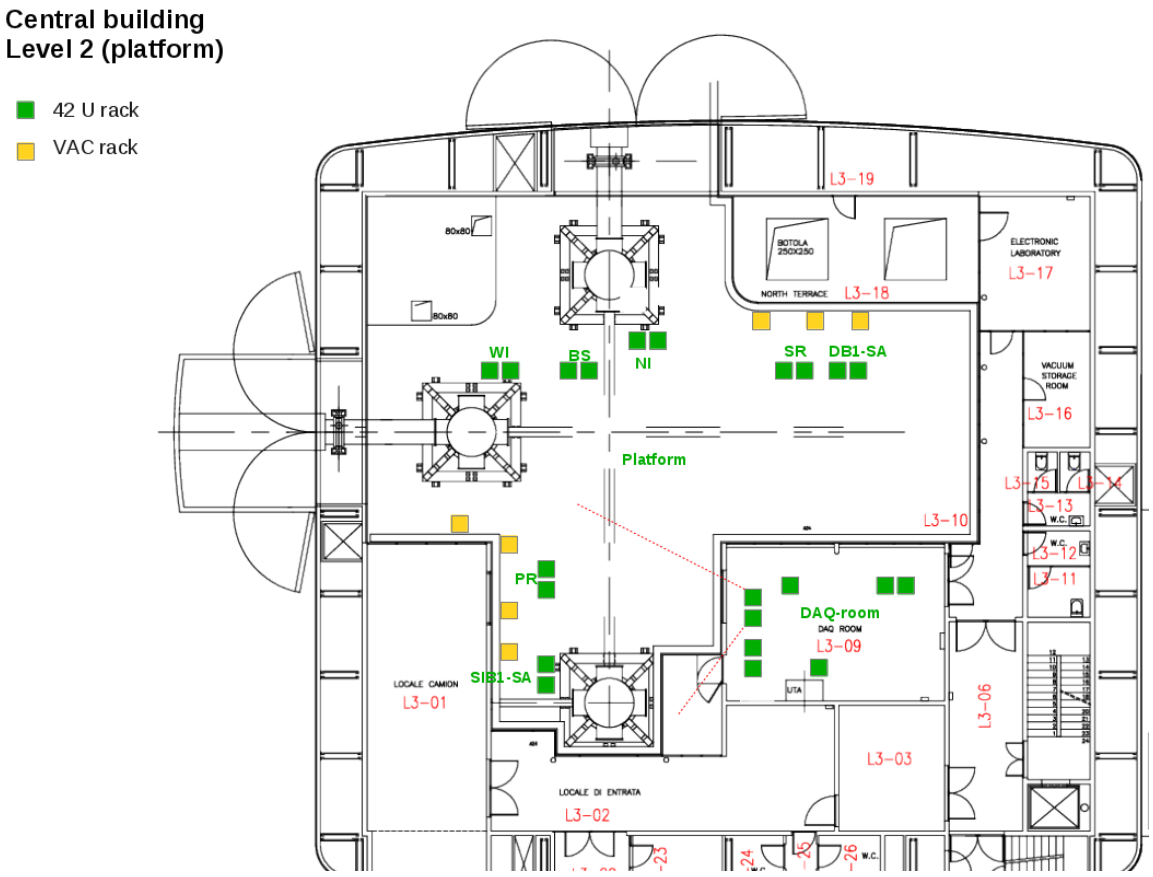

Figure 2: Central building, level 2 (platform).

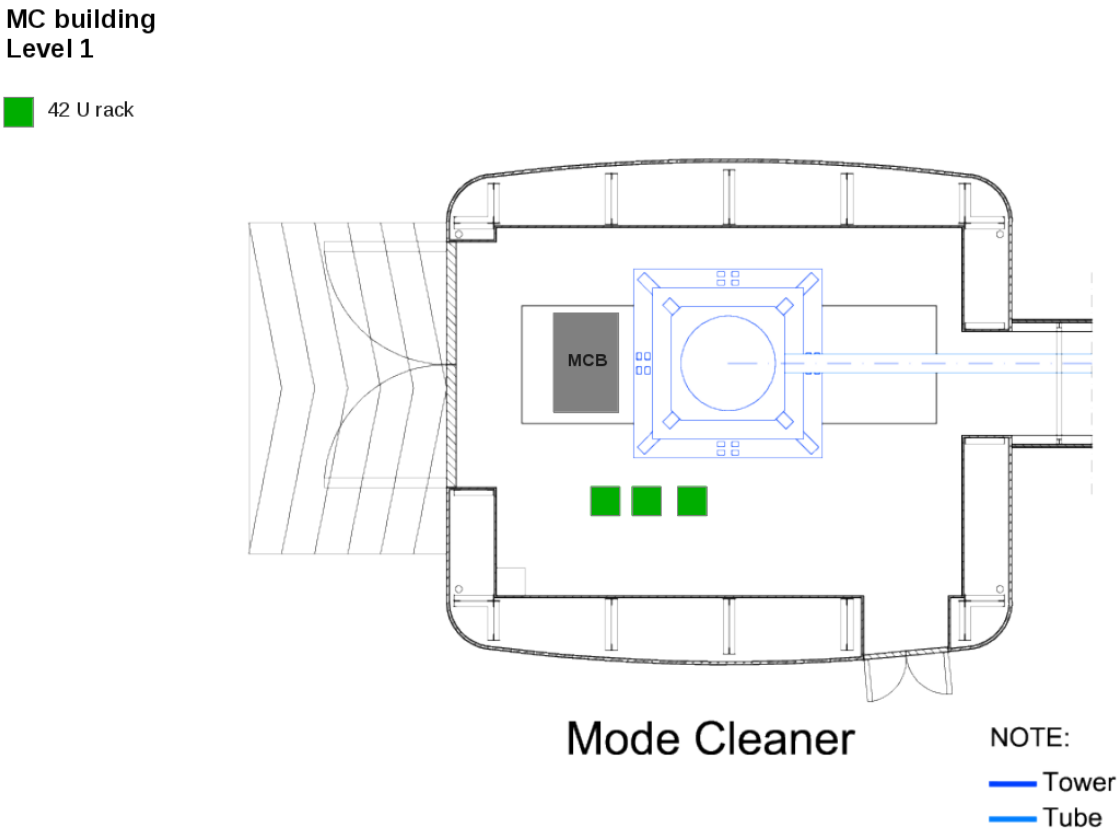

Figure 3: Mode-cleaner building, level 1 (ground).

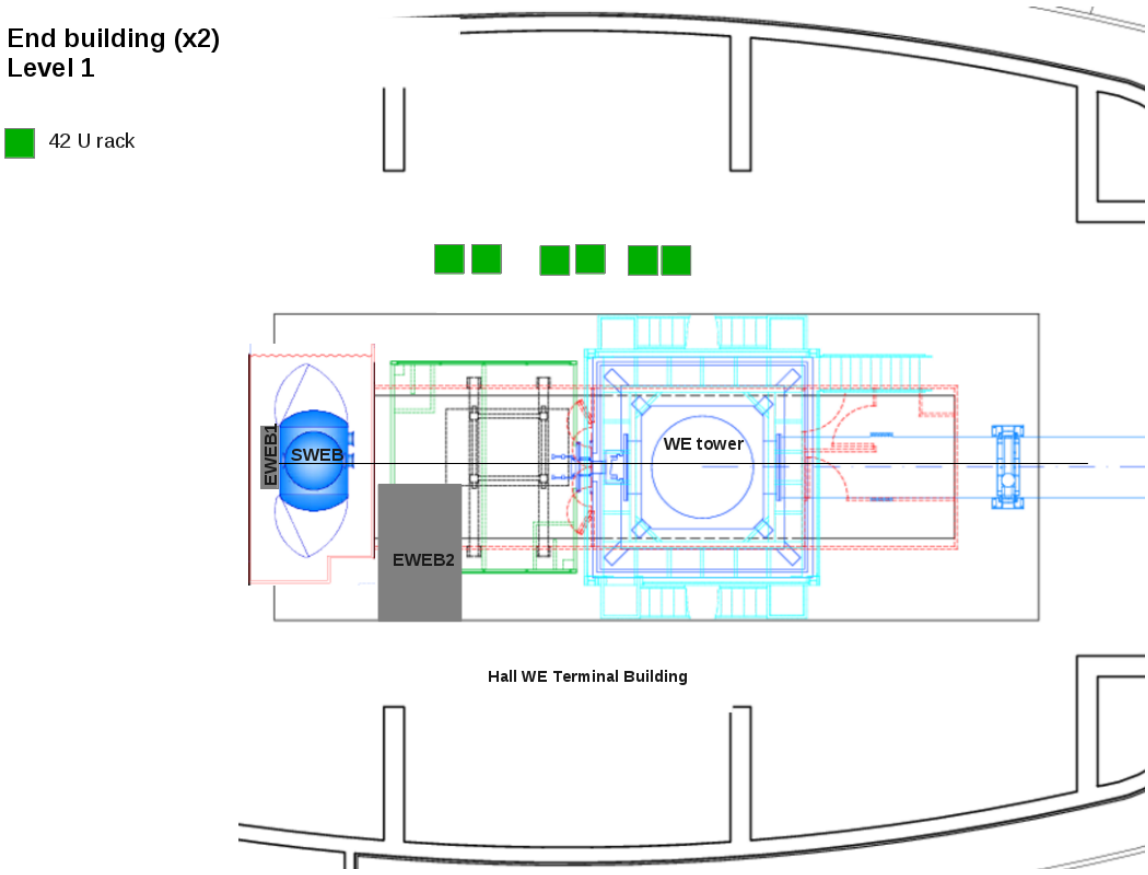

Figure 4: End buildings, level 1 (ground).

References

[1] The Virgo collaboration, *Advanced Virgo Technical Design Report* (2012) VIR-0128A-12.

[2] L. Rolland, *Estimation of AdV racks needs and location* (2013) VIR-0071A-13.