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Ethernet and Computing needs from DAQ

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1 Introduction

In this document, we summarize and precise the needs and constraints concerning the Ethernet network and the computing machines for the DAQ that were presented in different presentations [1, 2, 4, 6].

The "DAQ view" of the Ethernet network is shown in figure 1.

Most of the AdV fast data are exchanged and collected through the TOLM network inside the interferometer (ITF) area. They are finally formatted by the real-time PCs (RTPC's) located mainly in the Computing Room, and possibly for some of them in the different AdV buildings[1]. The data are then collected via Ethernet for processing in the DAQ farm (machines called *olserver* in Virgo).

The slow monitoring data are collected via the Ethernet network. Typical sources of slow monitoring data configuration and monitoring information for the DAQ-Boxes, picomotors, slow environmental sensors, vacuum devices and camera configuration.

The images from the cameras are collected via the Ethernet network to the RTPC's. The DAQ flow on the Ethernet network in the ITF area will be dominated by these images.

Most of the PC's for DAQ (RTPC, video, olserver and ctrl) will be located in the central building, in the computing room and in the control room. It induces other constraints on the Ethernet network in this area.

Different types of farms are illustrated on the figure.

The real-time PC's collect the online TOLM data from the TOLM network, process the fast loop computations and format the data into frames for data collection.

The DAQ farm (olserver) is used for the data collection and detector characterization processes. It receives data through Ethernet from the RTPC's and from the slow monitoring devices. The frame data are processed and merged. The output frames are on one hand available for online display and on the other hand sent to the storage farm for storage on disk.

A machine dedicated for the video display of the camera images on the screens of the control room is also shown.

The ctrl farm in the control rooom is used for commissioning purpose, with a fast access to the online data directly from the olservers and to the offline data from the storage area. They are connected to screens, keyboards, mouses on desktops for people in the control room. Other machines called ctrl are also located in the different Virgo labs for people doing commissioning on the sub-systems.

The olnode/farmn farm is used for the online processes more related to data analysis and for remote access to the Virgo network.

Typical number of machines (olserver, ctrl, olnode/farmn) are also given in the figure. Their characteristics will be more detailed in section 3. In general, a large number of core and a large amount of memory is needed. Such a configuration will allow to share the data available in

[1] An option in the future is to install all the RTPC's in the Computing Room.

shared memory between a lot of processes and therefore reduce the copy of the online data to a lot of machines via the Ethernet network.

A list of DAQ devices planned to be installed in Virgo and which need Ethernet connections has been done in [1]. This list describes the network end-points needed for each device as well as the expected data flow.

2 Ethernet network

The main constraints given by the "DAQ" on the Ethernet network are listed in this section. The corresponding "DAQ view" of the Ethernet network is shown in figure 1.

2.0.1 "DAQ network" [2]

- *Ctrl* **machines in the AdV labs (CEB, NEB, WEB, MCB).**
  These machines, called *ctrl* in Virgo, will be used for people working on the detector in the different labs. They must have a fast access to the online data. If they are to be installed in the labs, as in Virgo, the same mecanism as during Virgo+ will be used: only a user selected subset of the raw data will be sent from the Computing Room to these machines when requested, via processes called FdIOServers.
  Instead, the proposal of EGO Computing Service to install these machines in the Computing Room with a direct access to all the data, with remote screen/keyboard/mouse via Ethernet is a good idea to have a faster data access from these machines.

- **Collection of data from gigE cameras to RTPC's.**
  The raw images represent a flow of $\sim$ 12 MB/s per camera[2] and up to 50 cameras will be installed in AdV. Assuming that a RTPC can collect the data at least 4 cameras, it represents an input flow of $\sim$ 40 MB/s per RTPC.

- **Configuration and collection of data from devices in the AdV labs.**
  The end devices in the different labs are cameras, DAQ-Boxes, picomotors, controllers, environmental sensors, vacuum devices, lab PC (ctrl), ... The flow will be dominated by the collection of the camera images.

- **Configuration and collection of data from devices in the minitowers.**
  The end devices inside the minitower air-tank will be cameras, DAQ-Boxes and picomotors. Again, the flow will be dominated by the camera data. All the devices will be connected to a switch inside the air-tank. The switch will then be connected via monomode optical fibers to the main network outside the minitower. A possible type of switch to be installed inside the air-tank is DLink DGS-1210-16.

[2] for cameras triggered at 50 Hz.

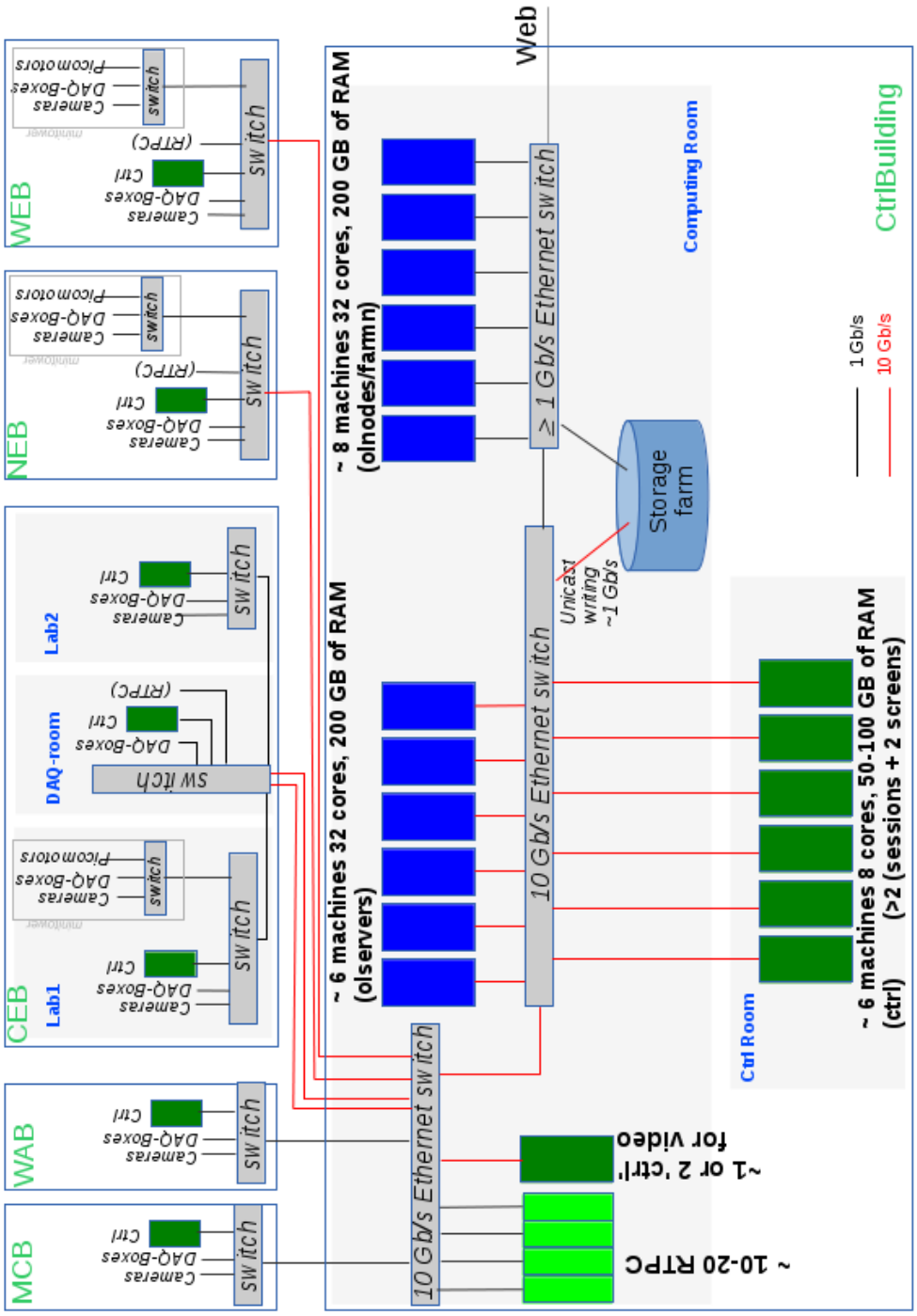

Figure 1: Sketch of the Ethernet network as seen by the "DAQ".

- **Real-time PCs in the Computing Room and possibly in the other buildings.** The RTPC's from Virgo+ will be used for the start of AdV. They will be replaced when the PCIe boards to interface the RTPC's with the timing and TOLM networks will be available. The replacement of the machines is planned in 2015. The RTPC's receiving camera raw data will have an input flow of $\sim$ 40 MB/s and generate an output flow lower than 1 MB/s. The other RTPC's receives the fast data via the TOLM network and generate an Ethernet output flow of 5 to 20 MB/s towards the DAQ farm (olservers).

2.0.2 Fast online data acess in the control room

In order to increase the speed of the online raw data access for the people working in the control room, it is planned to distribute online the raw data to all the ctrl machines (in the computing room but with remote desktop or in the control room). The data will then be available in the ctrl shared memory for local access (via dataDisplay in particular).
If the remote desktop mechanism can be used for desktop in the Virgo labs, it could be extended to all the ctrl machines of Virgo.

- the data distribution from the DAQ machines (olserver) to the ctrl machines will be done using point-to-point connection or multicast (broadcast is not planned since the data must not be sent to all the other devices of the network).

- the ctrl machines should have multiple sessions in order to limit the amount of data in the network, sent from the DAQ machines to the ctrl machines.

2.0.3 Video data

Dedicated machines will be needed to provide the multiplexed images to the screens in the control room, a video archive and a playback functionnality. The machines will received a compressed video flux[3] from the RTPC. The flow is $\sim$ 100 kB/s per camera.

Assuming a single machine is used, the input flow will be $\sim$ 5 MB/s.

2.0.4 Data access on disk

Fast write access from the DAQ machines to the storage farm is mandatory. The data flow will be $\sim$ 1 Gb/s.

Fast read/write access to the storage farm is needed from all the machines, online and offline.

[3] RTSP flow compressed in H264.

2.0.5 Possibility to work on laptops

Laptops will be used by people working on the ITF during the installation and commissioning phases. Ethernet plugs must be available for laptops in the labs.

Additionnaly, wireless connection in the buildings will allow to work on laptops around the towers, without cable. Of course, the wireless will be switched off during Science Runs if it turns out that it induces some noise in AdV.

3 Computing

3.1 Desktops in the control room

- the ctrl machines should have multiple sessions in order to limit the amount of data in the network, sent from the DAQ machines to the ctrl machines. The number of desktops in the control room is kept to be 10 as in Virgo, but a single machine machine will be shared between different (2 to 4) desktops. Each desktop will have two screens, as in Virgo.

- the ctrl machines need enough memory to store the online data and to do complex display or data processing. A buffer of a few minutes seems reasonable, which is converted in a memory of a few tenth of GB per machine.

In conclusion, ~ 5 ctrl machines with 8 cores, 50 GB to 100 GB memory and at least four graphical outputs are needed.

3.2 Desktops in the Virgo ITF laboratories

The ctrl machines with desktops in the AdV labs (CEB, NEB, WEB, MCB) will be used for people working on the detector in the different labs. They must access the online data. ~ 10 desktops are needed (1 per lab). If the machines are installed in the labs, the same mecanism as during Virgo+ will be used: only the raw data asked by the user will be sent from the Computing Room to the machine. If the machines are installed in the Computing Room with remote desktop, ~ 5 of them can be added to the machines described in previous section.

Additionnaly, as already stated, laptops can be connected in the ITF labs.

3.3 Machines for the video display in the control room

Assuming a single machine is used for the video display in the control room, the input data flow will be of the order of ~ 5 MB/s and it shall have: > 16 cores[4] and 50 GB to 100 GB memory. The needs are very similar as for the machines in the control room.

[4] 8 cores should be enough for basic use of the Telescreen software. More cores will be needed when the video flows will be re-encoded in order to be exported to visualize them on external/multiple web interfaces.

At least four graphical outputs will be needed to connect the four screens of the control room.

The video flows will be stored on a local circular buffer, which represents $\sim$ 500 GB of storage space assuming a buffer of 24 hours.

In conclusion, the video machine can be the same type as for the ctrl machine.

The machine can be located in the network room or the computing room, with cables going down to the screens in the control room, or in the control room directly.

3.4 Machines for the data collection and online detector characterization

Of the order of 6 machines with 32 cores and 200 GB of memory will be used for the data collection and online detector characterization processes.

(3 for data collection (2+1 spare), 3 for detector monitoring (omicron: 50 cores).)

Amount of memory needed to buffer the data in shared memory during 30 minutes -> $\sim$70 GB (for compressed data flow of 40 MB/s).

3.5 Machines for the other online processes and access from outside

A different farm is planned for the other online processes, offline processes and access from outside. However, the same type of machines as for the data collection machines can be used It will allow to pass a machine from this farm to the online farm easily in case of need (or the reverse) and to share the spares.

Can the mecanism used to export the desktops for the ctrl machines in AdV be used to export desktops to the external network for other laboratories ?

4 Conclusion

The different flows of data in the Ethernet network has been described in this note, with device per device details given in [1]. It gives constraints on the Ethernet network. The upgrade of the Ethernet network will be needed in 2014, to be ready for the start of AdV.

The machines will be replaced by machines with more cores and more memory. The estimation of the needs for DAQ for the different farms (mainly ctrl, olservers, video) have been carried out in this note. It is possible that all, or almost all, the machines are the same and are all installed in the computing room (including the olnode/farmn machines). This would ease the installation, maintenance and spare sharing.

The replacement of the machines can be staged in different steps. The priority is to upgrade the olserver machines and ctrl machines in 2014, so they are ready during the first stages of AdV installation, with final data collection configuration and an easier commissioning with the fast online data access in the control room.

The upgrade of the olnodes/farmn machines can be postponed to beginning of 2015. Meanwhile, since the olserver machines will not be used at 100% from the beginning, some processes could be configured on the olservers before being moved to the new olnodes machines when they will be ready.

	RTPC	video	olserver	ctrl		laptop	olnode/farmn
				ctrl room	other		
Input flow (MB/s)	40 (TOLM)	5	100	100	-	-	-
Output flow (MB/s)	< 20	-	100	-	-	-	-
Cores	4-8	≥ 16	32	≥ 8		-	32
Memory (GB)	~ 10	100	200	100		-	200
Number	~ 15	~ 1	~ 6	~ 5	~ 5	-	~ 10
Comments		output to multiple screens		multi desktops (2 to 4)		plugs and wireless	numbers to be updated by DA

Table 1: Summary of the estimation of machines needed in AdV

References

[1] L. Rolland, Living Excel file link in Working Area (since 2012) *Network requirements form.*

[2] L. Rolland, Virgo presentation VIR-0421A-12 (2012) *DAQ needs: Ethernet network (and Timing and TOLM).*

[3] S. Cortese, Virgo VDAS presentation link (2012) *Issues for on-line computing platforms.*

[4] L. Rolland, Virgo presentation VIR-0453A-13 (2013) *DAQ data streams, storage and computing needs at Cascina for AdV.*

[5] L. Salconi, Virgo presentation VIR-0459A-13 (2013) *Storage farm status and planning.*

[6] L. Rolland, Virgo presentation VIR-0464A-13 (2013) *Constraints for the AdV Ethernet network.*