Shore station procedure

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Abstract

This note goes over the procedure to follow when installing the PPM-DU acquisition system, i.e. the shore station. It is mainly meant for when moving the PPM-DU from one test facility to another. The PPM-DU is the second prototype of the KM3NeT experiment. It is supposed to be deployed before spring 2014 and will therefore be extensively tested in several places. This note should help the user when receiving the full package.
Introduction

Optical modules are commonly used in experiments dedicated to Astroparticle Physics. Since the light emission in such environments is usually faint, their main purpose is to collect a maximum of photons, i.e. to maximize the product surface of collection times detection efficiency. A new type of optical module (Digital Optical Module), based on the segmentation of the sensitive area of detection, has been elaborated by the KM3NeT collaboration. The first prototype (PPM-DOM) has been deployed in April 2013. The analysis of the first data of such a detector has shown a large improvement in fields such as background suppression, light collection and arrival direction sensitivity.

The second prototype (PPM-DU) is supposed to be deployed before spring 2014. This prototype consists in a short line of 3 DOMs. The main point of the PPM-DU is the validation of the time tagging and of the communication system. Therefore the acquisition system of the PPM-DU is an assembly of 3 PPM-DOM acquisition systems with some modifications. This note is dedicated to the presentation of the procedure to follow when installing the acquisition system (hardware and software) of the PPM-DU from scratch.

1 Hardware Set-up

1.1 Equipment list

The PPM-DU acquisition system is meant for distributing the same GPS clock in 3 different crates in order to make coincidence between events with the same time flag. The general scheme of such a set up is shown in figure 1 for one crate.

![Figure 1: Scheme of the set up for one crate. A RJ45 cable is needed to connect the 1Gb switch to the PC.](image)

The list of needed devices is the following:

- 3 PPM-DOMs
- 3 crates
- 1 GPS receiver
- 1 GPS antenna
- 1 scientific Linux PC
- 3 BNC-SMA female cables (GPS-PPS)
• 3 BNC-SMA male cables (GPS-10 MHz)
• 1 multiplexer RS232-3×RS232 (GPS-crate)
• 7 RJ45 cables (Ethernet)
• 1 Ethernet switch (1 Gb.s\(^{-1}\))
• 1 12 V generator (for CLBs only)
• 4 SMA-SMB cables (for CLBs only)

A local network has to be established on the Linux PC allowing it to act as a dhcp server and a boot server for the disk-less PCs: the ML507s and the CLBs. A 1 Gb switch with \(2 \times n + 1\) ports (where \(n\) is the number of crates) is always mandatory for such a local network.

1.2 GPS

The GPS receiver, EC20S epsilon GPS clock - spectracom [1] (see top of figure 2), has been sent by the Catania group (INFN-LNS). Both the PPS (pulse per second) and the clock have BNC outputs which have to be connected to the crate. Up to 7 devices can be plugged to the receiver. A multiplexer is connected to the RS232 output in order to provide one RS232 cable to each crate. The GPS receiver must be connected to an antenna (standard GPS antenna connector). Note that the reception of the satellite signals can take up to several minutes when connecting the antenna to the receiver. The accuracy of the 10 MHz clock is supposed to be below 200 ps over a day. The GPS can be tested with the PC and the minicom software. This has been done just after installation at APC. It is worth mentioning that the GPS must be connected in order to start the acquisition since the CLB can not boot without the 10 MHz clock and since the acquisition start needs the PPS (start time is extracted from the UTC time).

1.3 Crates

The crate is a metallic box that contains the electronic cards: ML507 (control board), ML605 (communication board), Timing and, optionally, TDC. Its front panel provides an interface between the cards and the different devices (CLB, DOM, GPS, PC· · ·) as can be seen in figure 2. The main purpose of the crate is to handle the information provided by the CLB and to mark them in time. The information are then send to a PC where the trigger between the different DOMs can be processed in a quasi online mode. In the example of figure 2, we may find from left to right the CLB connectors (1), the control board RJ45 (2), the communication board RJ45 (3) and the GPS plugs (4): from top to bottom the 10 MHz, the PPS and the RS232.

1.4 CLBs

In the frame of APC tests, the CLBs were still not integrated in the DOMs and were therefore still easily accessible. To connect one CLB to a crate, the only things needed were a 12 V
Figure 2: Picture of the front panel of one crate and of the GPS receiver (above). The numbers refer to the text

generator\(^1\) and 4 SMA-SMB cables. While the generator supplies power to the CLB, the communication with the crate is done via the SMA-SMB cables. It is worth mentioning that CLB actually means power board, CLB and mini-module together and that the power supply cable between the 12 V generator and the CLB is supposed to be provided.

\section{Software Set-up}

Once every pieces are connected, one need to configure the PC. For this purpose, several steps are needed.

\subsection{DHCP}

IP addresses of the ML507s and CLBs are allocated via the dhcpd.conf file

\begin{verbatim}
> vi /etc/dhcp/dhcpd.conf
\end{verbatim}

An example is given in the left screen-shot of figure 3 for a 2 DOM configuration. For a 3 DOM configuration, one has to add 2 hosts in the group, one for the ML507 (ctrlboard3) and one for the CLB (clb3). In order to allocate the IP addresses to their corresponding device, the mac-addresses of each device has to be known. Mac-addresses of the ML507 cards and the mini-modules are not permanent and can be changed when flashing. Therefore, one

\(^1\)Current consumption is about 0.75 A when power is turned on and about 0.85 A when mini-module is booting
should make sure that all the mac addresses are different (if not, the flashing should be done with new mac addresses by some professional). The DHCP service has to be started or restarted in order to take into account the latest saved configuration

> sudo service dhcpd.conf start

![Dhcpd.conf example](image)

**Figure 3:** On the left, example of dhcpd.conf file for a 2 DOM configuration. On the right, List of commands to get the run control working from scratch.

### 2.2 Icegrid

Meantime, the icegrid application has to be enable. Icegrid is a software allowing to assign servers to specific nodes. The so-called registry maintains a persistent record of this information, while the nodes are responsible for starting and monitoring their assigned server processes. For this purpose, registry and node services have to be started.

> sudo service icegridregistry start

> sudo service icegridnode start

The graphical interface software can then be executed

> icegridgui &

and the application PPM-DOM uploaded (see figure 4 and left plot of figure 5).

From time to time it may happen that run control crashes. In this case scenario, one way to solve the problem is to stop the servers as in the right plot of figure 5. If servers do not restart auto-magically (a small red square appears on the icon), one has to kill them as in the left plot of figure 6.
Figure 4: Graphical interface of the icegrid software. On the left, the mouse is pointing towards the registry opening icon. On the right, the corresponding pop up window is shown.

Figure 5: On the left, the icegrid graphical interface as it appears after application loading. On the right, one server is stopped. It should be restarted. If not then it has to be killed.

Figure 6: In the right, one server is being killed. In the left, sample of the configuration file of the run control. This configuration file corresponds to a 2 crates scenario. 2 control boards and 2 CLBs have been defined. Their IP addresses match the ones defined in the dhcpd.conf file.
2.3 Run control configuration

Before to launch the run control, it can be needed to modified its configuration, more especially when moving from a one crate acquisition to a 2 or 3 crate acquisition. It can be done in the xml file: `ppm-dom_site_2.1.xcfg`. This file allows to connect the ice nodes to the IP addresses defined in the dhcpd.conf. A sample of the file is shown in the right plot of figure 6. In this example, 2 crates have been defined and the IP addresses of the control boards and CLBs are matching the ones of the dhcpd.conf file of the left plot of figure 3.

2.4 Run control

Once the servers are assigned to the nodes, the graphical interface of the run control can be launched

```
> kdaq.sh
```

This bash script can be find in the `$KDAQ_HOME` directory. One example of the graphical interface of the run control can be seen in figure 7. More information can be find in the PPM-DOM procedure [2].

![Graphical interface of the run control.](image)

**Figure 7:** Graphical interface of the run control.

**Conclusion**

The acquisition system of the PPM-DU consists in one run control handling 3 crates, one for each DOM. Time is given to the crates by an external 10MHz clock which has been fully calibrated. From a hardware point of view, all the connexions should be made before switching on any device. In case a connexion inside the crate looks lost or broken, please contact the corresponding author. From a software point of view, the 2 major actions to perform are the upgrade of dhcpd and run control configuration files. In a near future, all instruments (crates, DOMs, GPS receiver · · ·) should be gathered at Nikhef for the first tests after assembly. Next step is supposed to happen in Marseille for further tests. Then the shore station should be send to Capo Passero while the PPM-DOM line to Malta.
References
