The MEUST Infrastructure for Neutrino Astronomy

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Abstract

We present the infrastructure of the MEUST observatory (Mediterranean Eurocentre for Underwater Sciences and Technologies) being developed offshore of Toulon in the context of the KM3NeT and EMSO European consortiums, with emphasis on the submarine network and its use for neutrino astronomy.

1) Context

The MEUST project builds on the experience acquired with the ANTARES detector [1] and the developments ongoing within the European KM3NeT Consortium [2]. It aims at deploying a second generation (vs. ANTARES) submarine infrastructure for neutrino astronomy and environmental sciences. Together with similar projects developed at Capo Passero (Italy) and Pylos (Greece), MEUST will act as one KM3NeT site in a multisite approach of KM3NeT. It will also be part of the French Liguria node of the future European network of deep sea observatories EMSO [3].

2) Onshore infrastructure

The MEUST project benefits from the ongoing renovation of the Toulon Bay infrastructures within the “Grand Project Rade” (figure 1). On the Brégaillon site, the “Technopole de la Mer” will gather all local economic, institutional and scientific actors in marine activities. A new building will be built to host the MEUST activities, including a control room of the infrastructure and the neutrino telescope, as well as marine science instruments and workshops. The Toulon-based marine logistics (intervention ships and ROVs), which was a key ingredient of the ANTARES success, will be further strengthened with e.g. the ongoing development of a new ROV by IFREMER.

3) Offshore infrastructure

The investigations for the MEUST submarine site are ongoing. The final choice will be a compromise between the site intrinsic qualities (landslides, bioluminescence, …), proximity to shore (which governs the operation costs) and external constraints like existing cables. Three autonomous instrumented lines have been built. Two of them have already been deployed on two potential sites. Autonomous optical modules are under construction and will be added soon to the autonomous lines, with the goal to monitor bioluminescence of the candidate sites on a full yearly cycle, and decide about the site by end 2012 latest.

The Main Electro Optical Cable (MEOC) will land at the Sablettes Beach, where an extension of the existing ANTARES power hut will be required. The offshore components are designed for a modular and scalable deployment of up to one hundred neutrino Detection Units (DU), corresponding to one KM3NeT Building Block. In the baseline option, two MEOCs similar to the present ANTARES MEOC will feed a ring of 6 Junction Boxes (nodes) connecting up to 16 DUs each (figure 2). The optimal procedures for deployment and possible recovery of a node are under definition in collaboration with industry.

4) Submarine network functionalities

The submarine network must transfer electrical power and control parameters to the DUs and ship their data to shore in real time.

The moderate distance to shore (30 to 50 km) allows performing the energy transport in single phase AC current. The voltage will be raised up to 6500V in the shore source for transport, and then decreased to 400 V and converted to DC current in the nodes. The ring topology provides redundancy for the power transfer in case of failure of a node (figure 3). A quantitative simulation of the overall network has confirmed that losses stay at an acceptable level in this configuration.

The DU control and data transfer is based on an optical network and complies with the KM3NeT standards. Dense Wave Length Multiplexing (DWDM) will be used with 80 wavelengths per fiber. Servicing a complete KM3NeT building block requires of the order of 70 optical fibers, to be shared between the two MEOCs (figure 4).

5) Planning and outlook

The MEUST observatory deployment has started and will proceed gradually. The first phase will deploy one MEOC and one submarine node together with up to 10 neutrino DUs in the coming 3 years. This phase will act as an “engineering phase” for the overall KM3NeT project. Around 2015 it is expected to start completing the submarine infrastructure up to the size of a full KM3NeT building block.

6) References

[1] http://antares.in2p3.fr
[2] http://www.km3net.org
[3] http://www.emso-eu.fr

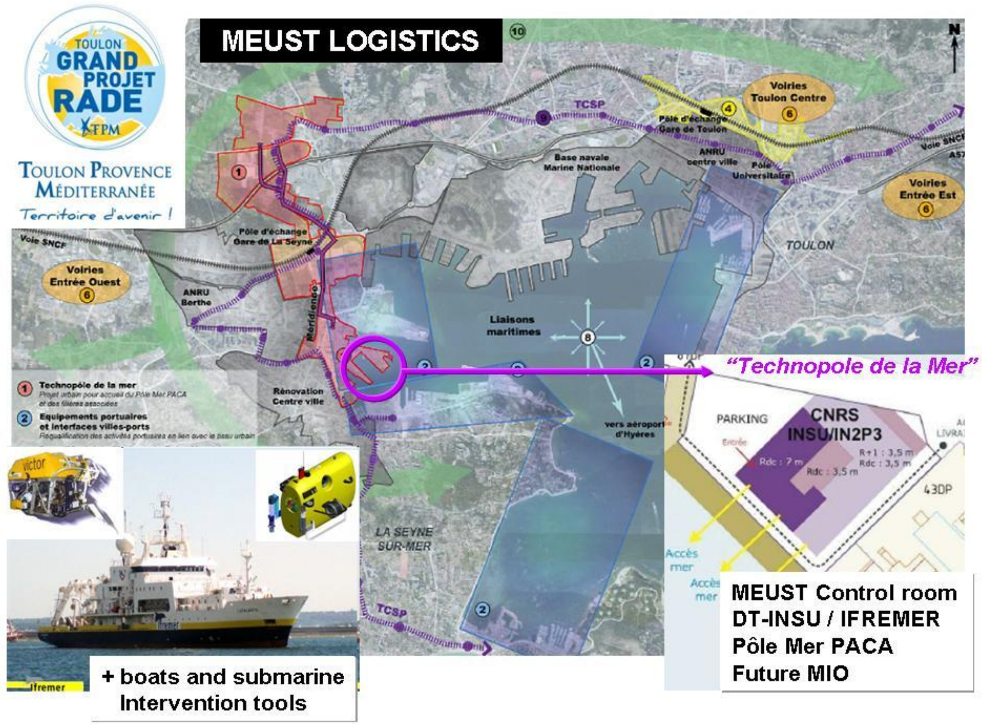

Figure 1: the Toulon Bay developments within the "Grand Project Rade".

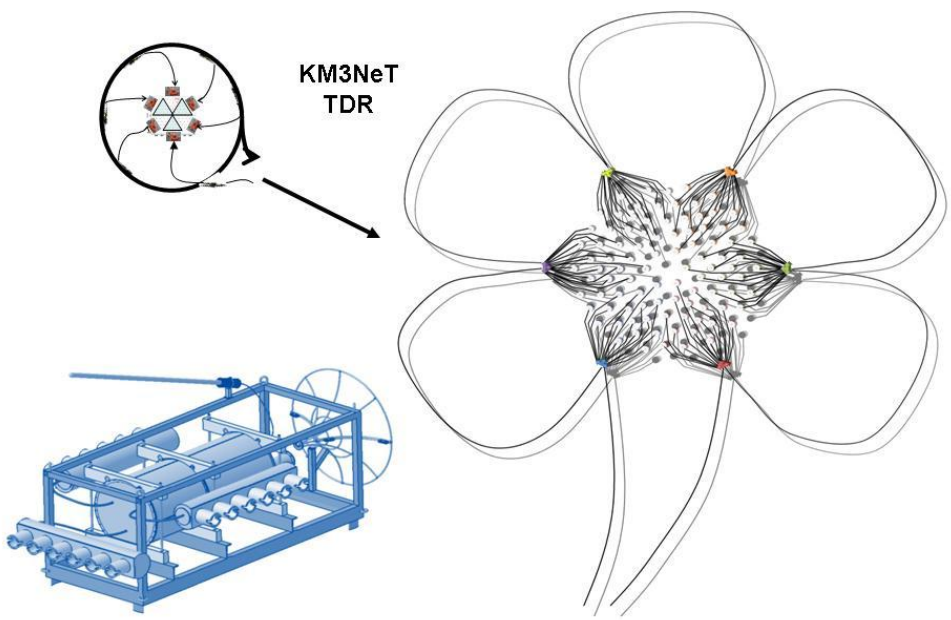

Figure 2: Foreseen submarine network of the MEUST infrastructure (right, after full deployment of a KM3NeT Building Bock) and sketch of a network node (left).

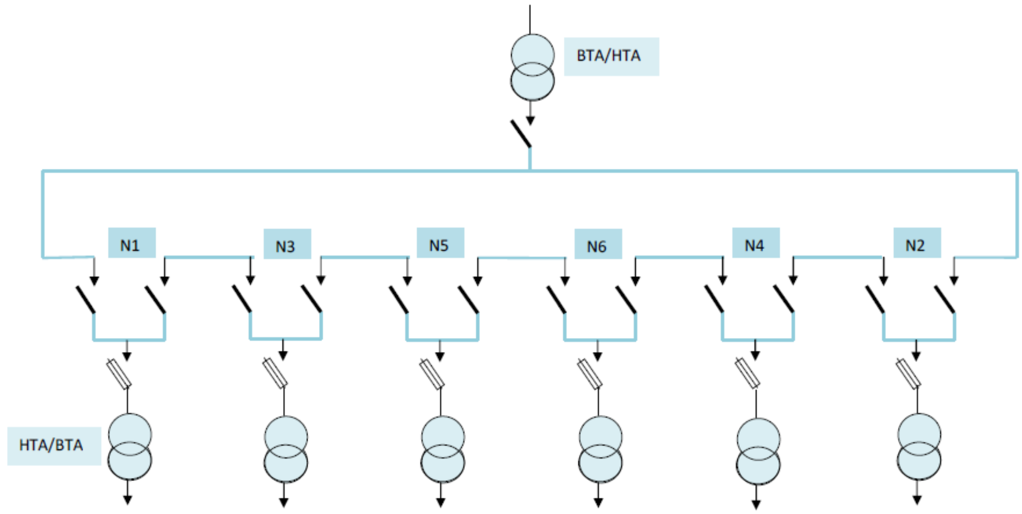

Figure 3: Submarine electrical power distribution network of MEUST.

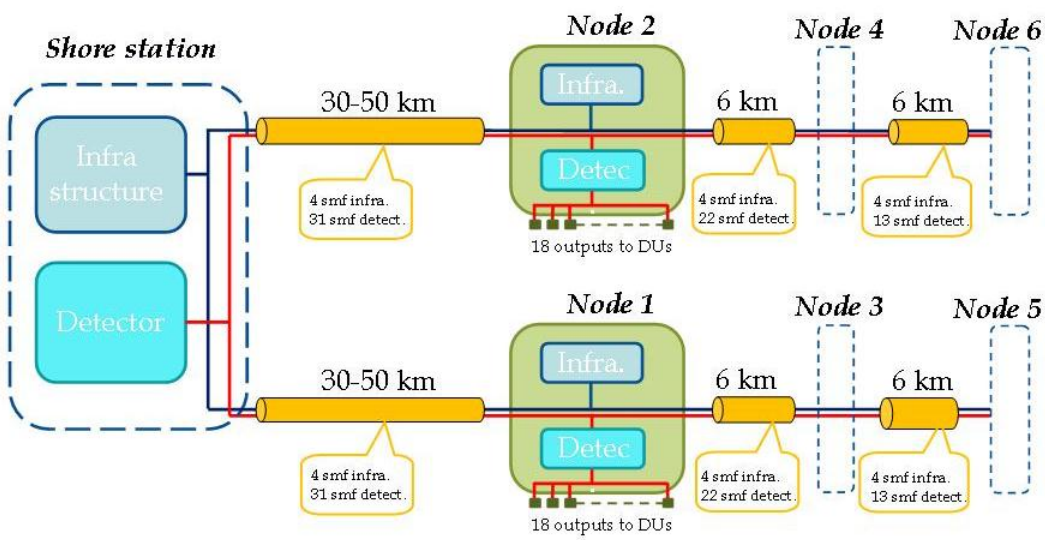

Figure 4: MEUST optical network for data transfers and detector control.