

# A TeRABIT network for the Einstein Telescope in Italy

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TeRABIT (Terabit Network for Research and Academic Big Data in ITaly) is a project funded within the initiative for realization of an integrated system of research and innovation infrastructures of the Italian National Recovery Plan. TeRABIT aims at creating a distributed, hyper-networked, hybrid Cloud-HPC computing environment offering tailored services to address the diverse requirements of research communities. This will be done by networking, integrating and upgrading three leading digital Research Infrastructures inserted in the National Plan for Strategic Research Infrastructures: GARR-T (the national network infrastructure dedicated to Research and Education), PRACE-Italy (the Italian node of PRACE, the Partnership for Advanced Computing in Europe), HPC-BD-AI (the National HUB for HPC for Big Data and Artificial Intelligence). The project will seamlessly integrate state-of-the-art High-Performance and High-Throughput computing elements into an innovative distributed platform, leveraging heterogeneous hardware and offering a portfolio of computing solutions for data-intensive research and industry applications, from edge computing to connectivity and workflows to central HPC Exascale systems. The extensive portfolio and a computing power in the order of Petaflops will enable TeRABIT to handle parallel requests from many scientific domains and industrial applications, where and when needed and act as a fast lane to prototype innovative research. The project, funded with a budget of 41 M€ in three years, is coordinated by INFN (the National Institute of Nuclear Physics) in partnership with OGS (the National Institute of Oceanography and Experimental Geophysics - OGS), GARR Consortium (the Italian Education and Research Network) and CINECA (a Consortium dedicated to advanced computing which includes 117 Institutions, Universities, the Ministry of Research, the Ministry of Education and several Research Institutions and public bodies).

TeRABIT will consider high performance computing and distributed cloud services within the framework of the edge-computing paradigm, developing a mid-size HPC service instances (HPC Bubbles) which are deployed closer to the users and data sources. The project is developed in strict synergy with the supercomputing services of ICSC, the National Research Centre for High Performance Computing, Big Data and Quantum Computing, as well as the national Tier-1s.

The TeRABIT network related activity, which represents 40% of the total budget, is focused on providing the necessary technology and capacity upgrades and the geographical extension of the ultra-broadband network layer in order to bring Terabit-grade connectivity and composable services to Universities and Research centers in the Sardinia Region and upgrade the fiber network in Sicily where the KM3net project is located.

This substantial connectivity upgrade will become an essential asset for the Italian proposal to host in Sardinia the Einstein Telescope, the future European Laboratory for gravitational waves. Italy already hosts the VIRGO detector and brings a consolidated scientific expertise developed within the LIGO-VIRGO collaboration (now LIGO-VIRGO-KAGRA Collaboration) which achieved the first direct detection of a gravitational waves signal (leading to the Nobel prize in 2017) and opened the era of multi-messenger astronomy. Presently LIGO and VIRGO are still the only detectors worldwide capable of observing gravitational waves.

Sardinia has unique characteristics in terms of extremely low seismic and anthropic noise, making the region an ideal site for the future European observatory.

Einstein Telescope is part the program for the future large research infrastructures within ESFRI, the European Strategy Forum for Research Infrastructures. Presently two sites are under study, one in Sardinia, supported by the Italian Government and one in the Euregio Meuse-Rhine (the border area of the Netherlands, Belgium and Germany) with the support of the Dutch Government. The project started with the idea of a single site, but recent scientific results show that the most promising solution should be a configuration based on a twin system, located at a large distance, like the present LIGO detector.

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