

A photograph of network equipment with blue and yellow cables plugged into ports. The cables have labels like '01171-M2' and 'M2-5'. The background is a teal gradient.

GARR STRATEGY

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INTRODUCTION

In the meeting of 16 December 2020, GARR Technical and Scientific Committee (SCT) approved this document about the strategy that GARR should adopt in relation to the ninth framework program of the European Commission, called Horizon Europe (HE).

This document takes up the lines drawn in the discussions held during the SCT Workshop of September 2019 in the Elba Island and also described in the document approved by the SCT on November 13, 2019 (and then approved by the Board of Directors on November 14, 2019), and provides the necessary updates in relation to the evolution occurred in 2020 and to changes in the Horizon Europe program scenario.

GARR MISSION AND UNIQUENESS

GARR's main mission aims now and in the future to continue developing and improving the national network for universities, research, education and cultural activities, ensuring its reliability, sustainability and efficiency.

Maintaining the uniqueness of GARR remains a fundamental objective.

These characteristics are divided into multiple technical, strategic and policy aspects and, in addition to the network itself, they concern the GARR community and the organisational structure chosen by GARR with the establishment as a legal entity. In particular:

- Access to GARR network and services is guaranteed continuously over time (maximum reliability) and by proactively responding to the constantly evolving needs of the institutions connected to GARR.
- The evolution of the network infrastructure is not conditioned by market considerations and the pursuit for profit, as in the case of commercial operators, but it is based both on needs and requirements of the community and on the principle of sustainability.
- GARR network provides a transparent data transport service responding to the principle of neutrality.
- The network infrastructure meets the requirements of the communication symmetry with guaranteed access capacity at each point of the network, thanks to an over-provisioned backbone, as opposed to commercial networks which apply overbooking.
- GARR network is part of a worldwide system of National Research and Education Networks (NRENs), adopting practices and use policies which are shared within the national and international community.
- In the configuration of the routing mechanisms, latency minimization is privileged even at the supranational level.
- Ownership and direct control of the infrastructure are enabling elements to make innovation laboratories accessible by the community.
- Solidarity development and overcoming the digital divide are the founding principles of the first GARR national network and its evolution over time.

The national network

The network infrastructure is and will remain GARR top priority. Therefore, the network needs to evolve and be maintained at the cutting edge of technology in terms of capacity, reliability, security and latency. Particular attention and emphasis is given to increasing the coverage and reducing or eliminating the digital divide in the research and university community.

For these reasons, it is necessary to maintain internal skills at the highest levels and ensure the necessary funding for the implementation of the network.

The strategic development plan has to be clear regardless of the available funds, however the temporal implementation will have to respect the limits of available resources.

Direct control and knowledge of the elements composing the network are the founding pillars of the GARR network and at the same time the leading principles of the evolution of the physical and technological infrastructure. At the moment the evolution project GARR-T, where T is for Terabit, is currently underway.

The necessity to acquire dark optical fibre for long terms (15 years or more) is therefore confirmed, as it has been done since 2009 with the GARR-X project. The goal is to continue to expand the coverage by favouring fibre connections and by creating closed topologies with multiple points of presence in order to increase the resilience and reliability of the network. It is necessary to guarantee the technological and functional innovation of the infrastructure, with characteristics of flexibility and dynamism on which multiple networks, physical or virtual, can coexist (for example with the spectrum-sharing on valuable resources such as submarine cables), which respond to different needs in terms of capacity, latency, resilience, functions and services.

The monitoring and control of the network infrastructure and services have necessarily to be strengthened through automation tools, which will facilitate the management and configuration process of the equipment, the implementation and release of connections and services, as well as the management of faults and malfunctions. GARR computing and storage infrastructure, together with cloud technology, are essential elements for the development of the new network and the evolution of services to manage, monitor and operate it through mini-data centres distributed nationwide at GARR network PoPs.

The international network

GARR is an important component of the global system of international Research and Education Networks and needs therefore to have an active part in the related European and international initiatives, maintaining and increasing the collaboration for the development of the European GÉANT backbone (currently GN4-3 and GN4 -3N).

It is therefore necessary to increase the direct participation of GARR members in the Work Packages of GNx projects (with particular reference to the harmonisation of services of common interest) and other large-scale international projects.

Given the importance of the Italian component in international scientific collaborations, GARR shall also play an important role, in agreeing on the methods of interconnection of advanced network infrastructures (see user-to-user) with particular attention to capacity and latency.

It is important to promote, among other things, the shift of the centre of gravity of European initiatives towards Southern Europe and the Mediterranean, with the aim of reducing or

eliminating the digital divide within the European and non-European research and academic community and beyond.

To this end, GARR shall establish bi-and multilateral relations both with other European and extra-European NRENs and with the European Commission, interacting with various Directorates General of the European Commission to propose initiatives for interconnection of the European network with the Research networks other continents (Africa, Antarctica, Latin America, etc.).

Skills development

To achieve the mentioned objectives, GARR Network has also to be configured as a laboratory for experimentation activities available to the community, where new interconnection infrastructures are tested (with particular attention to capacity and latency) and networks (including virtual ones) are implemented for direct user-to-user collaborations.

Although basic research is not among GARR aims, as it pertains to the Academic and Research organisations connected to GARR, testing of new technologies in the field of networking can be seen as a form of support for research in the field of technologies such as Photonics, Time / Frequency distribution, Quantum key distribution, etc.

These support activities also have the aim of consolidating collaboration with Research Bodies and Universities and focusing on the developments of the network based on peak requests.

To achieve these objectives, GARR must equip itself with the necessary advanced skills, both by updating the knowledge of internal staff, and by making use of external technicians with the necessary design skills in the field of optical transmission and packet networks.

It is therefore desirable to increase collaborations for the development of the network, by collaborating with the technical skills available among universities and research institutes.

It is also necessary to proceed with training programmes to develop and expand technical skills within the institutions connected to GARR, in order to improve local networks configurations and make them more efficient.

In general, importance must be given to continuously taking care of the technical training of internal and external personnel via webinars, e-learning and, when possible, in presential classes.

Relations with GARR user community

The process of evolution of the national and international network infrastructure has been integrated over time with many services to: facilitate the development of applications, facilitate access to data and online resources, support user mobility and make access to network and services safer. These collaborative services and activities are elements that characterise the GARR user community.

Services such as IDEM, eduroam, GARRbox, VCONF, WebMeeting / eduMeet / OpenMeet, BlueMeet, Filesender, Mirror, SCARR (vulnerability scans to be carried out on local networks), e-mails, calendars, agendas, shared editing, messaging, etc. have become essential to-

¹La lista e la descrizione completa dei servizi è disponibile sul portale: www.servizi.garr.it

ols for the community and therefore must be updated and maintained continuously. Network security remains a key objective in the design and management of the infrastructure, by strengthening and, where possible, automating its monitoring, control and mitigation functions. In this evolution process of the tools, software systems and procedures for GARR network control and management, the activities of the CERT will be even more essential and complementary to the activities of the NOC and of the groups engaged in the design and development of software, applications (and microservices) and systems integration. The idea is to strive towards a functional objective of "Security as a Service".

It is therefore appropriate and necessary to develop and maintain high-availability and low-latency services and applications through redundant mini-datacentres distributed on a national scale at GARR PoPs or at the offices of GARR members organisations.

The "Orio Carlini" scholarships are and will remain a contribution to strengthen GARR user community,, an important training opportunity for young graduates to take place within institutions connected to GARR. A greater adherence of the Scholarships Projects to GARR core activities is however desirable and the call proposed by the SCT starting from 2021 goes in this direction.

Maintaining the current high quality level of GARR News remains a priority, as an important instrument for the dissemination of GARR brand, as well as of GARR Conferences and Workshops. Another primary objective is to produce, at least on a monthly basis, information bulletins on the network and network services both at the national and international level, aimed at APA and APM of research bodies, universities and schools, in order to involve them more and more in the life of GARR.

It is also necessary to take care of the clarity and usability of GARR website for its immediate use and to improve the dissemination and promotion of GARR services, following the best practices of other NRENs.

Schools

GARR has produced a "School Plan" which maintains all its relevance and validity.

The objectives of GARR need to focus on the following points:

- to continue to advocate the connection of schools through synergies with other subjects (aggregators);
- to privilege access to the backbone of school infrastructures which are already organised at the regional level;
- to focus on the students of the last three years of high school, who are interested not only in having resources for their education, but also for their orientation towards university studies.

GARR Cloud

GARR Cloud, which is GARR's computing and storage infrastructure based on IaC technology (Infrastructure as Code), is an important element in two ways. As a service in itself, the cloud supports the evolution of the network infrastructure through the introduction of au-

tomation in the management, monitoring and analysis of the network status and network services. As a tool, the cloud is used for the construction of other services for GARR users (virtualised and collaborative network services and applications).

For this reason, GARR Cloud must be kept at the cutting edge technological level in terms of functionality, reliability and safety, following the needs of the national network.

However, the legal implications associated with the storage of third parties data will have to be addressed, through explicit agreements for the control and responsibilities of access to the data and their possible encryption. As an example, self-managed backup space and long-term storage of scientific data services could be made available. GARR, with its competences, can assist universities and research Institutions who would like to require them. As a manager of one of the Italian research clouds, GARR will promote the creation of a national federated cloud platform through the interaction of the existing clouds among research bodies and universities, thus contributing to the support of the Italian scientific research for the development of Open Science.

However, because cloud technologies are constantly and rapidly evolving, it is necessary for the GARR approach to be based on criteria of flexibility and openness, and that GARR strategy be adapted to the actual needs of the Community.

The role that GARR will be able to assume in this process, whether of participation, coordination and/or management, will depend on the evolution of the national and international context and on the actual needs of the GARR community. The SCT will be called to periodically evaluate the initiatives and needs of both GARRmembers and community in the national and international context, in order to identify the most effective and sustainable collaboration options over time.

Final recommendations

It is important to continue to work for the acknowledgement at the ministerial level of GARR as an institution that can be financed for special projects and as an institution which is equivalent to universities and research bodies in relation to the participation in the PON and POR calls (National and Regional Operational Programmes) launched by the Ministry and the Regions. This follows the example of what already happens at the European level, for projects aimed at the construction and maintenance of e-Infrastructures supporting research.

In this context, it is desirable for GARR to increase its contribution to international projects relating to tenders on subjects that fall within the primary purposes of GARR, enhancing the skills of GARR personnel or of the personnel of Italian universities and research bodies.

Competitiveness of GARR as an employer

We must not forget that being able to attract capable and passionate people is a precondition for implementing the strategic lines set out in this document. Having been able to do it in a proper way in the past is not a sufficient guarantee for the future, because the ICT market is in tension especially in large cities and the perception of living in an impoverished country makes young people rightly cautious. Administrative constraints on wages and

bonuses are not easily overcome, but we can try to build together with private companies some initiatives to make internships and positions at GARR more attractive. The Orio Carlini Scholarships are also important for this purpose. GARR's effective presence in schools and universities is also strategic to create a "GARR" brand recognised and appreciated by young people.

Glossary

APA: Access Port Administrator

APM: Access Port Manager

BoD: Board of Directors

CERT: Computer Emergency Response Team

STC: Scientific and Technical Committee

GÉANT: is the name of the European backbone network connecting all national research and education networks (NREN). The management of the European network is entrusted to the GÉANT Association, the non-profit association having all European NRENs as members, as national representatives of the research and education community

GN4-3: GN4 Phase 3 is the project co-funded by the European Commission and the national research networks (NREN), now in its seventh edition in over 15 years of activity. It is responsible for the management and evolution of the European research backbone GÉANT and for network services, digital identity and applications connected to it

GN4-3N: GN4 Phase 3 Network is the 48-month project aiming to enhance and extend the European backbone of GÉANT research by improving access to the network and to digital services and infrastructures by European users, regardless of the place they are. The goal is to improve the capacity, resilience, reliability and flexibility of the GÉANT network and to offer access to the 100Gbps network (possibly with fibre optic links) to many more GÉANT partner countries, thus helping to reduce the digital divide

IaC: Infrastructure as a code (IaC) is the process of managing and provisioning data centre computers using machine-readable definition files, rather than physical hardware configuration or interactive configuration tools. The IT infrastructure managed by this process includes both physical equipment, such as bare metal servers, as well as virtual machines and associated configuration resources. The definitions can be in a version control system. Declarative scripts or definitions can be used, rather than manual processes, but the term is more often used to promote declarative approaches.

ICT: Information Communication Technology

PON: National Operational Program (Ministry of University and Research)

POR: Regional Operational Programs

NOC: Network Operation Centre

NREN: National Research and Education Network

PoP: Point of Presence - These are the points of presence (or nodes) of GARR Network distributed throughout the national territory