

STRATEGIC INTELLIGENCE
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Mission Critical Seismic Network CQ Net: Republic of Cyprus



Cyprus GSD Seismology Team

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With an average of one catastrophic earthquake every century and one destructive/damaging earthquake every decade, the Republic of Cyprus, Geological Survey Department (GSD), have a mandate to monitor seismic activity for Cyprus and the Eastern Mediterranean in real-time on a daily basis. The last time the Republic of Cyprus updated their seismic network was in 1997, in the pre-broadband, pre-digital technology era, so an upgrade was long overdue. The GSD faced some serious challenges in order to accomplish this feat. Not only were there the usual fiscal barriers when embarking on this project, but also a key objective for this network was to remain self-sufficient. At the time, the GSD consisted of only 2 people in the Geophysics and Seismology department; one seismologist/geophysicist and one engineer. They did not have the budget to install a state-of-the-art seismic system as well as increase the number of staff that has traditionally been required in order to run such an endeavor.

Today, the Republic of Cyprus Geological Survey Department boasts one of the most advanced real-time seismic networks on the globe. The GSD seismology team is completely self-sufficient with two seismologists and one engineer. The new seismic network consists of a private satellite network with real-time earthquake detection and processing, including data management software with 24/7 high availability network monitoring.

How did they do it?

In 2008, the GSD seismology team turned to the leading earthquake-monitoring companies, including Nanometrics, to help them with their challenge and explore the available options. In 2011 the GSD director managed to secure a budget and gave the team the green light to prepare and proclaim an international tender in early 2012. Nanometrics, the tender winner, took the time to thoroughly understand the GSD's requirements and worked closely with the GSD team to design a self-sufficient network that would meet their needs.

During 2012-2013 the GSD team finalized the 9 station locations (8 stations and one provisional) and carried out all the necessary civil works at the sites. The locations were chosen based on a number of criteria, such as geographical coverage, geological setting (bedrock) of the site, accessibility, land

The Republic of Cyprus has independent ownership and operation of a Nanometrics turn-key seismic network.

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ownership, level of natural or cultural seismic noise, and level of security of the station. The most challenging and crucial part of the site preparation were the seismometer vaults. The team, adopting the basic standards of the seismological community for broadband seismometer vaults, designed and built their own vault, which was more than endorsed by Nanometrics.

During 2013, Nanometrics deployed and commissioned the network, which consists of eight seismological stations, two seismological centres, a satellite communication network and a backup GPRS/DSL network. The remote seismological stations are equipped with: 3-component low noise broadband seismometers, digitizers, and autonomous solar powering systems. All stations transmit continuous data in real-time, through a private satellite network ([Libra II VSAT System](#)), to two seismological data processing centres to ensure redundancy: one at Lefkosia (main centre) and one at Mathiatis village (backup centre). A second level of data transmission (backup), is functional at four stations. The data communication between stations and seismological centres is two-way, enabling the remote monitoring and maintenance of the remote stations.

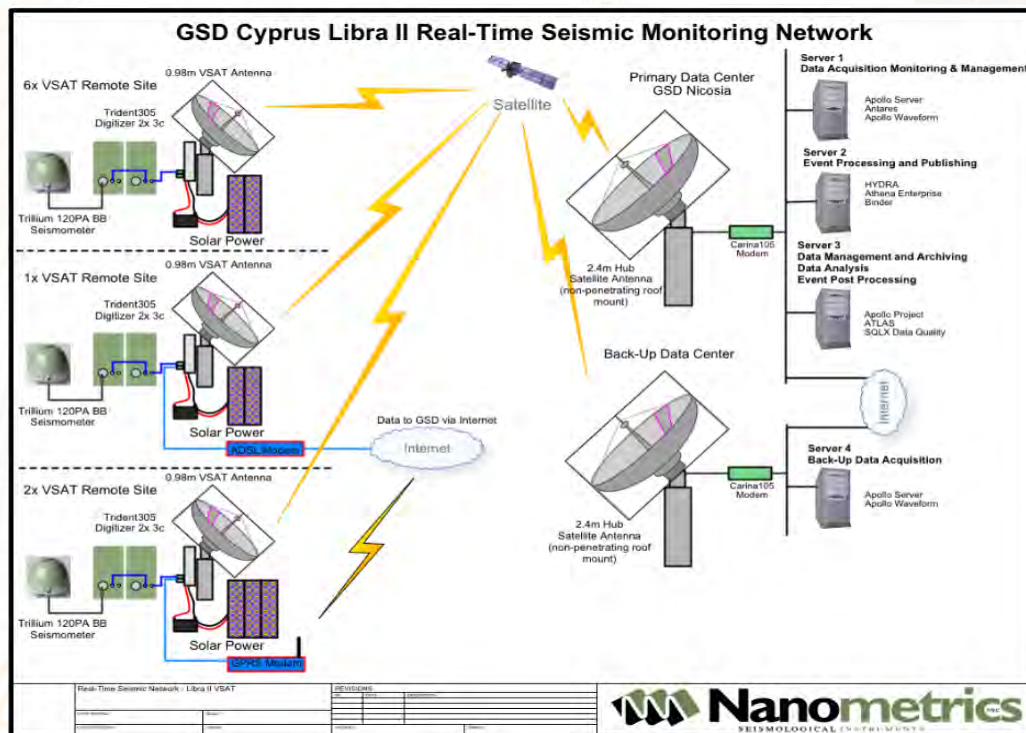


Primary Seismological Centre (Lefkosia): supports all functionalities with computing resources redundancy (primary and secondary servers for all basic operations)

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GSD's prototype station in the capital city of Lefkosia. It utilizes dual data-streaming via VSAT and DSL.



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Additionally the network includes the permanent station of Mathiatis, which has been operational since 1998 in the [GEOFON](#) network of [GFZ](#) (Potsdam, Germany) and 2 ocean-bottom-seismometers in the south of Cyprus, which have been operational since mid-2013 by [CSnet International Inc.](#) The GSD seismological centres receive additionally in real-time broadband data from another 50 regional and international seismological stations.

NMX Data Centre, real-time automatic data processing, Nanometrics Athena Catalog and Notification System and Antares Integrated Network Management are the keystones of this seismic network. NMX Data Centre includes elements from the USGS, (Hydra - an open source software platform that is in use today at NEIC and other institutions) and original Nanometrics software capabilities that include:

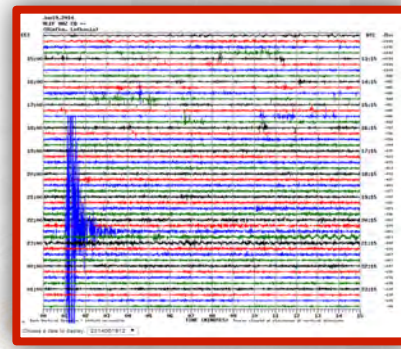
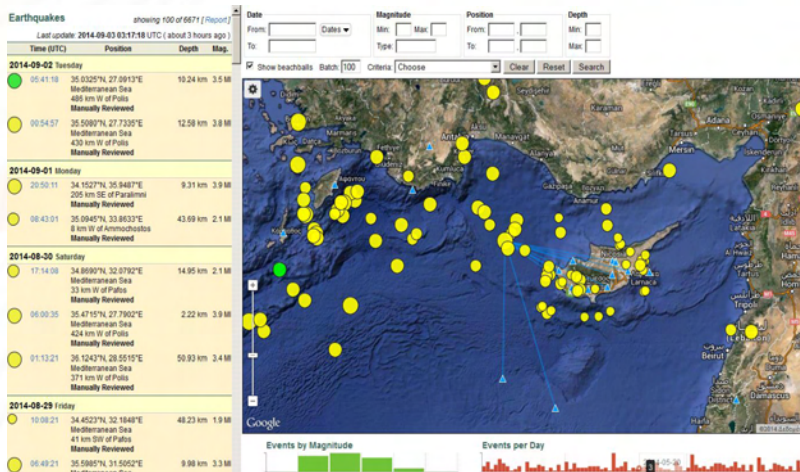
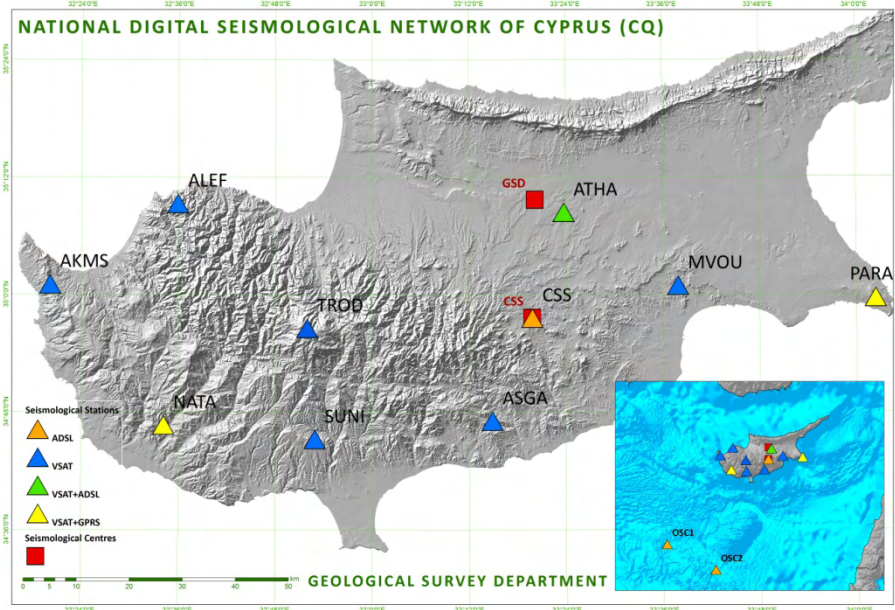
- ▶ installation modules
- ▶ local & teleseismic analysis package
- ▶ support documentation
- ▶ training



Pictured above left and right: Backup Seismological Centre (Mathiatis village). It is unmanned and supports all of the basic operations of the main seismological centre completely independently. An automatic backup scheme is setup between this and the Primary Seismological Centre. It hosts the primary web server.

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Digital Seismological Network of Cyprus (2014)
The new seismological network is comprised of 11 local seismological stations (9 in-land and 2 off-shore), 8 of which are fully owned and maintained by the Geological Survey Department of Cyprus.



GSD's new interactive website built on Athena Express.

Furthermore, Nanometrics offers a comprehensive configuration, tuning and training support package that enables smaller, resource constrained institutions to effectively and independently run a seismological network.

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When the network was established, Nanometrics helped the GSD with configuring and tuning the Data Centre location software. Once training and support was in place, the group at GSD was able to operate this new network effectively and efficiently. Data is streamed in real-time and Nanometrics now regularly monitors the network independent of the GSD as well as provide the GSD with troubleshooting and network optimization services.

Real-time data streaming coupled with Nanometrics seismic network support – monitoring, troubleshooting and network optimization – makes it possible for an institution with limited staffing resources to successfully own and operate a state of the art broadband network. The core engine of this network, the Nanometrics Apollo Suite, which comprises ApolloServer data acquisition and Apollo Project management software suite, coupled with monitoring services and support, ensures that it is extremely reliable. With Nanometrics support The Republic of Cyprus GSD advanced from an analogue network with only a couple of 3-component stations from the pre-digital/pre-broadband age to a state-of-the-art network with a modern digital system, with broadband seismometers and private VSAT. This new digital network has earned Cyprus a place for the first time in the [International Federation of Digital Seismograph Networks -- FDSN](#) under the national seismological network code "CQ".

The opening ceremony of the Nanometrics National Seismological Network of Cyprus was held in October 2014 in the presence of the Minister of Agriculture, Natural Resources and the Environment, who, being an engineer in profession, was highly impressed by this colossal achievement of GSD and Nanometrics.

The Republic of Cyprus GSD is now

- ▶ Monitoring closely the local seismicity of Cyprus (down to 0.8ML earthquakes), the regional seismicity of the eastern Mediterranean and the large teleseisms of the world.
- ▶ Estimating earthquake focal mechanisms in order to understand the seismotectonic setting of Cyprus.
- ▶ Offering to the seismological community high-quality broadband seismological data for crust and upper-mantle tomography studies of Cyprus and the broader area of Eastern Mediterranean Sea.
- ▶ Collaborating actively with neighboring networks and European and International seismological institutes.

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Cyprus GSD Director
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