Wireless mesh network of seismic sensors, new perspectives for seismic early warning, earthquake task force mission, and monitoring of civil infrastructure.

M. Picozzi, C. Milkereit, S. Parolai, K. Fleming, J. Zschau, J. Fischer, F. Kühnlenz, B. Lichtblau, I. Eveslage.

A crucial point of several seismological applications as, for example, early warning systems, task force missions and state-of-the-health monitoring of civil infrastructures is that a large number of stations to be deployed in the field is required. This opens some main issues: the costs of the standard seismological equipment to be used is generally very high; the dimension, weight and function of the standard seismological equipment make it not suitable for rapid installation of sensors within structures, especially the damaged ones, in the post-event timeframe; and the analysis of data is generally performed only in a post-survey timeframe, which represents a severe drawback for some applications, as for example the early warning and earthquake task force missions.

A promising solution to these issues is provided by the rapid improvement in telemetry and computer technology, which is literally driving a revolution in seismology and earthquake engineering.

Earliest application of wireless communication technology started in the late 90s, when wireless sensors were connected together with embedded pc for structural monitoring purposes.
These earlier applications first showed that real-time processing of data can be performed locally, and that wireless monitoring systems are feasible, reliable and cost-effective. Over the last few years, prototype structural wireless monitoring systems have been validated by tests performed on bridges and other structures, where they have been found to be a highly cost-competitive, completely autonomous and very reliable alternative to traditional wired systems.

At the present time, the *Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum* (GFZ) and the *Humboldt University of Berlin* (HU-Berlin) are developing an innovative, self-organizing wireless mesh information networks made up of low cost sensors, with the aim of setting up a new earthquake early warning system for the mega city.
This innovative system, named the Self-Organizing Seismic Early Warning Information Network (SOSEWIN) is developed within the framework of the European projects Seismic eArly warning For EuRope (SAFER) and Earthquake Disaster Information systems for the Marmara Sea region, Turkey (EDIM), and a first test version has been deployed since July, 2008, in Istanbul, Turkey.

This innovative system employs advances in various technologies to incorporate off-the-shelf sensor, processing and communications components into low-cost accelerometric seismic sensing units that are linked by advanced, robust and rapid communications routing and network organizational protocols appropriate for wireless mesh networks.

The reduced cost of the instruments (less than one tenth of a standard instrument) and the possibility of creating dense, self-organizing and decentralized seismic monitoring networks are key aspects for new approaches to both seismic early warning, structural engineering monitoring, ambient noise monitoring.

Furthermore, the decentralized, self-organizing character guarantees the functionality of the network during a disastrous event, even when some of the sensing units are damaged. These novel accelerometric stations are easy to install (and therefore very suitable for rapid deployment during emergencies) and are able to collect, store and undertake preliminary analysis of data. Additionally, at the same time the stations also create a wireless mesh network by which raw data and computed parameters can be communicated to a user's laptop connected to any node that belongs to the network.

With this contribution we aim to report some example and preliminary results of SOSEWIN applications. In particular, we present here the SOSEWIN system operating in Istanbul, and the results of an experimental monitoring of the gravity-anchored Fatih Sultan Mehmet Suspension Bridge spanning the Bosphorus Strait. Finally, we report about the monitoring activities of some strategic infrastructures carried out with SOSEWIN accelerometric sensing units during the Earthquake Task Force mission following up the recent moment magnitude (Mw) 6.3 Central Italy Earthquake of the 6th April 2009.