



WI-FI APPLICATIONS IN SEISMIC AND GEODETIC MONITORING SYSTEM

V. CARDINALE, C. D'AMBROSIO, F. MINICHELLO, L. FALCO, A. MEMMOLO, A. CASTAGNOZZI, R. MOSCHILLO
ISTITUTO NAZIONALE di Geofisica e Vulcanologia - Sede Irpinia

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) uses different transmission systems for the seismic and GPS data from remote sites. Those different types of transmission makes the Italian seismic monitoring reliable and redundant. An IP link is now possible using the already existing and dense phone networks (adsl, cdn), through the creation of ad-hoc data networks: the Rete Unificata per la Pubblica Amministrazione (RUPA); the evolution of the mobile phone signal (/EDGE/UMTS/HSDPA); the recent satellite links provided by SatLink, (<http://www.satlink.it/en>) Astra2Connect, (<http://www.astra2connect.com/1870167/en>), Tooway, (<http://www.open-sky.it/tooway/>);



Fig. 1 - Example of a remote station.



Fig. 2 - Example of a remote cabled site.

finally, a satellite hub Nanometrics Libra Vsat, (<http://www.nanometrics.ca/>). The first applications of the Wi-fi technology based on Mikrotik routerboard were created to connect our remote seismic stations to the closest cabled networks.



Fig. 3 - The Montefusco site (AV, Southern Italy)

This connection was needed because most of the recording stations have been installed where the antropic noise is very low. On one side, this aspect is



Fig. 4 - Example of our acquisition structure

important to obtain a very high data quality. On the other hand, those sites are often very far from the closest cabled connections.

The Mikrotik devices experienced robustness and reliability also in extreme conditions. Thus, we decided to connect some remote stations of the Italian national seismic network to the acquisition centers with Wi-Fi technology, instead of the previously installed satellite telemetry connection, to have a redundancy in the acquisition systems.

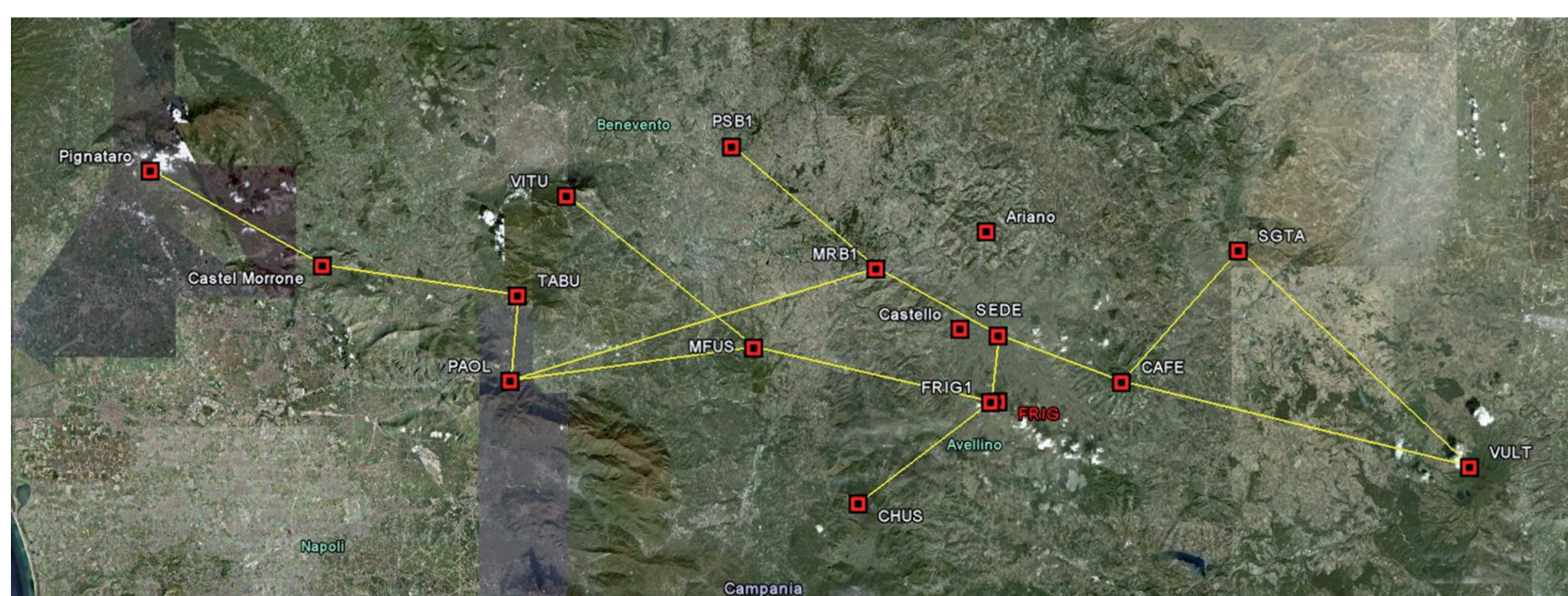


Fig. 5 - The network (Data source Google Earth)

This connection change provided us a bandwidth increase in the data transmission, allowing an increasing of the sampling frequency of the recording stations and a reduction of the maintenance costs.

A recent project of development of the Italian national seismic network allowed the inter-connection of 25 sites through Wi-Fi technology. This technology allowed to acquire

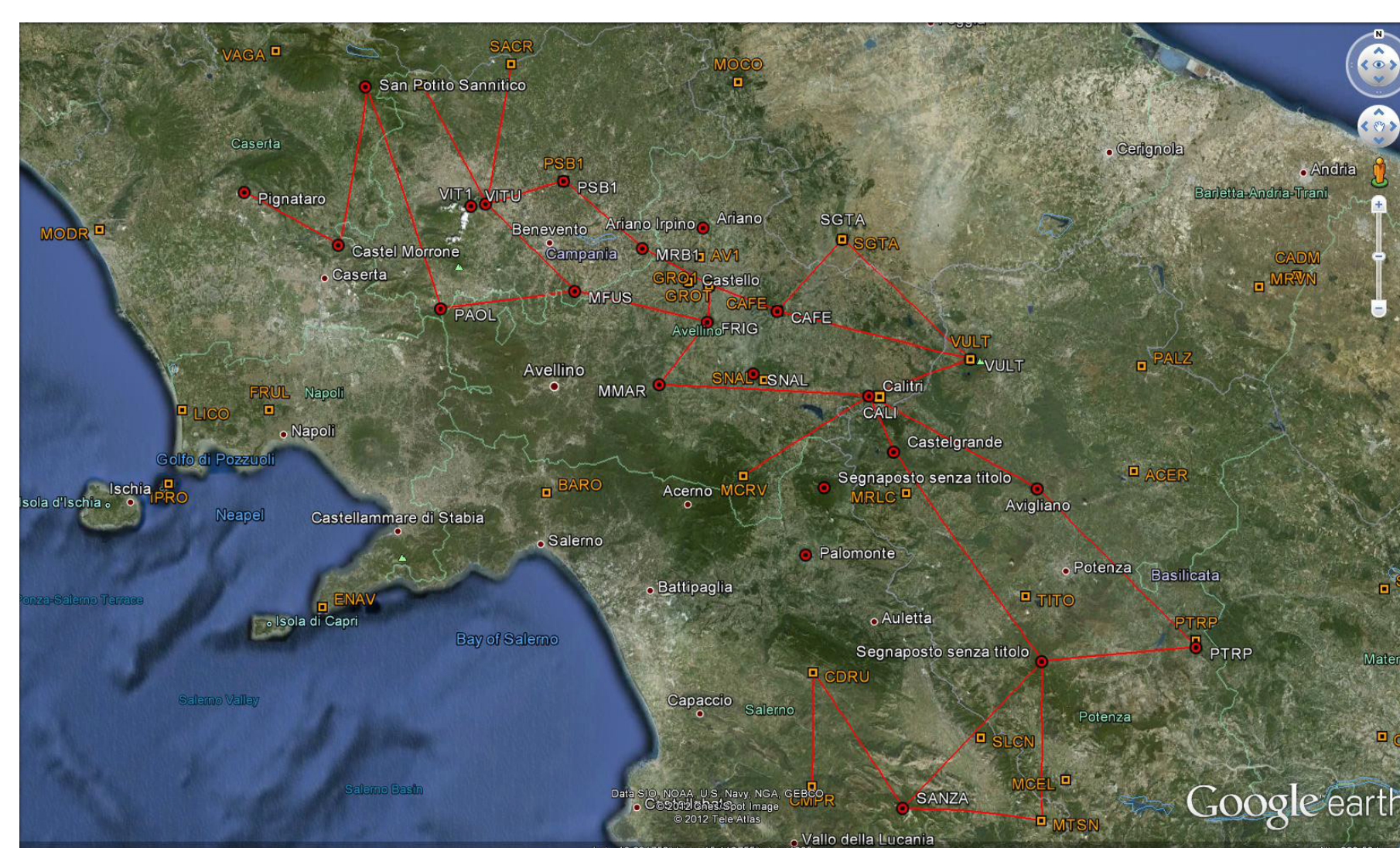


Fig. 6 - The Wi-Fi network project.

high-resolution seismic and geodetic data, i.e. with sampling frequencies of 200Hz and 20Hz, respectively. The Wi-Fi network design was based on the implementation of the "OSPF" routing protocol. Through this protocol, the wireless paths and data acquisition devices have been configured with different networks routes.

Immediately after the occurrence of strong earthquakes in Italy, the INGV is now able to build up a temporary seismic network in a few hours to densify the already existing permanent seismic network.

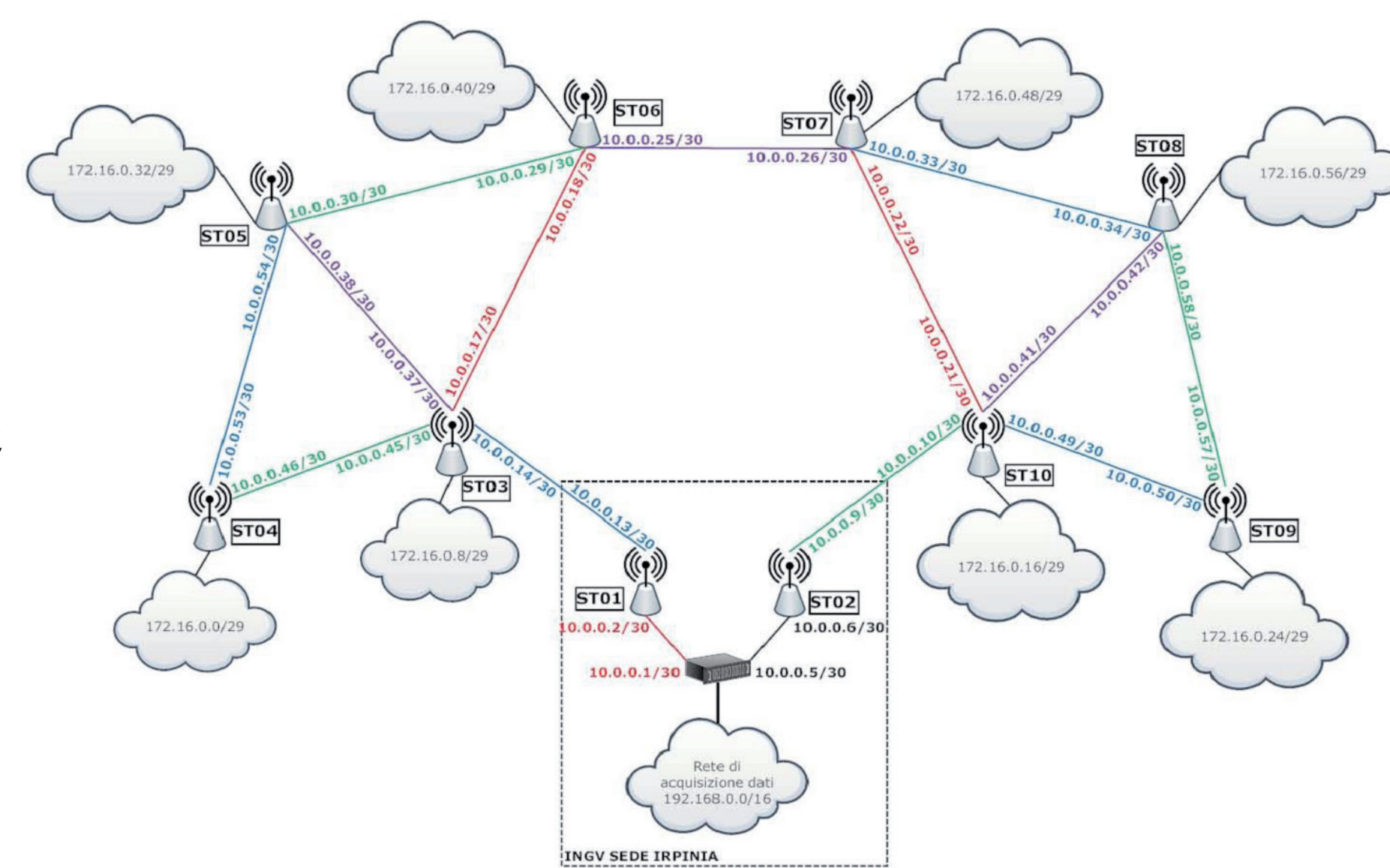


Fig. 7 - Sketch project of the Wi-Fi network project.

This temporary network is named "emergency network". This network consists in 12 recording stations transmitting data in real-time to the acquisition center in the seismic monitoring room in Rome.

This further densification will help INGV staff to monitor the evolution of the aftershocks after the main-shock. With this aim, the Mikrotik devices allow a very fast installation.

Furthermore, as the epicentral areas in Italy are localized in regions characterized by a variable topography (Apennines), we used the well-known MAC addresses propagation technique, instead of the "OSPF" routing protocol usually used by the National seismic network.

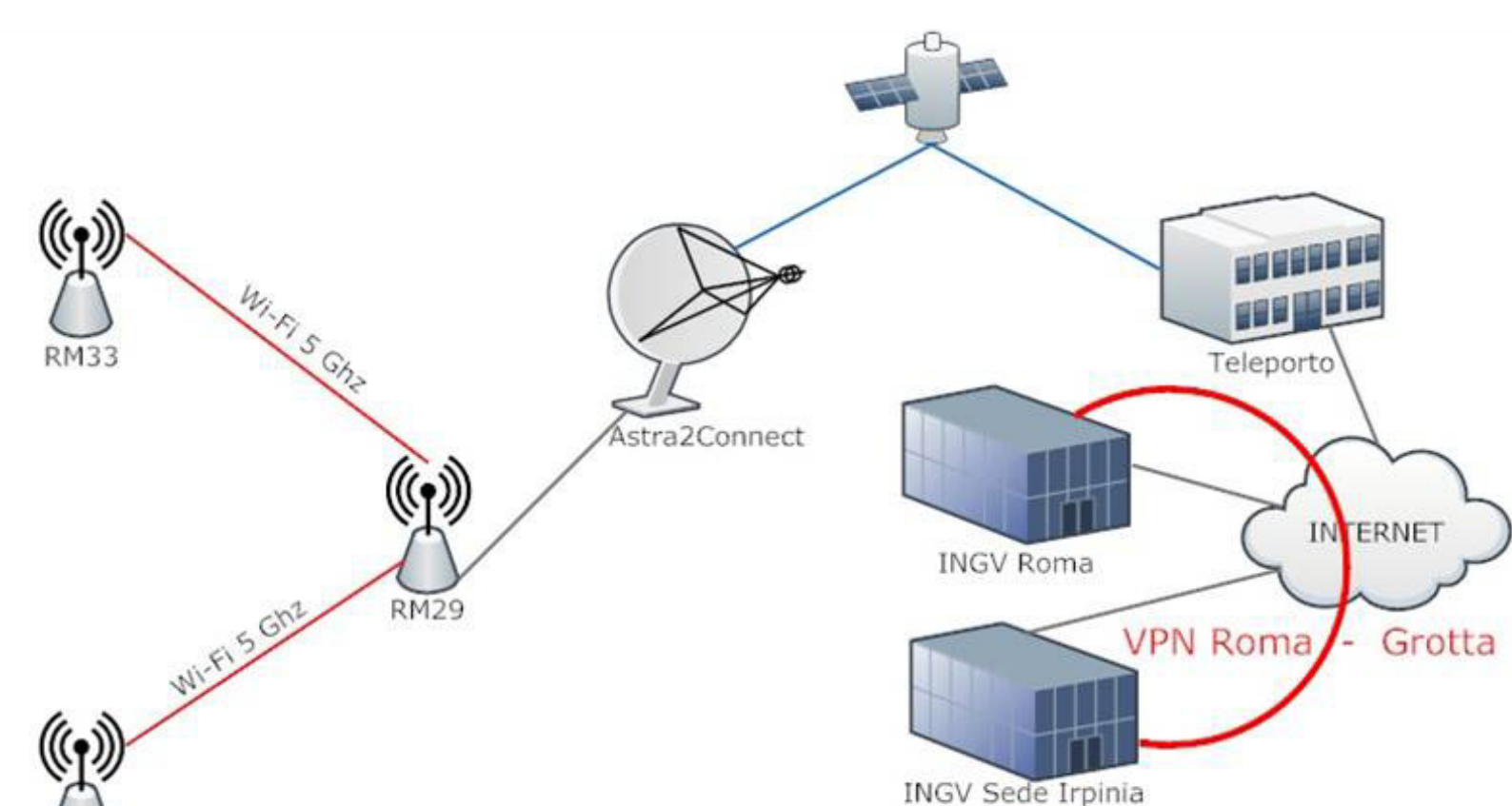


Fig. 8 - Sketch project WI-FI/Astra2Connect



Fig. 9 - Structure of mobile network station

Acknowledgements:

The authors thank Mr. Andrea Grittini and the Wi4Net society for the useful recommendations and the assistance provided for the creation of the WFN CPE device. This device was very helpful to build up emergency networks in regions devastated by a strong earthquake (L'Aquila, Central Italy, 2009) and to monitor micro-seismicity peaks (Montereale, Central Italy, 2009; Santa Sofia, Northern Italy, 2011). Finally, the authors thank INGV head staff for the confidence demonstrated in this project.

