

## LOW COST INNOVATION IN DATA TRANSMISSION

The geomagnetic field is a dynamic entity. It is on a move and constantly changes on timescales of a few seconds to millennia. These changes are in response to dynamical processes occurring within the Earth and on the Sun. The primal nature of cosmos can be understood by continuously monitoring and recording these changes. The data thus obtained gives an effective platform to launch many important and seminal scientific investigations.

Indian Institute of Geomagnetism (IIG) has been given this mandate and is involved in recording magnetic field changes across India for about 175 years. It earlier did the recording in analogue form, but now does it digitally. However, these records became available to users only after some time lag, because of which real-time data availability became the need of the hour. The technocrats of the Institute came forward and took up this challenge. They developed innovative ways to connect together all the scattered magnetic observatories to provide real-time data to the global scientific community.

IIG has 12 magnetic observatories (MOs) that are widely spread apart from one another, as well as from headquarter situated at Navi Mumbai. There were delays in recording and disseminating magnetic data. This was in stark contrast to the prevalent international practice of making available data in real-time to all the stakeholders. The analogue data was acquired and sent to headquarter in a conventional manner. This led to occasional postal delays, loss of precious data and impediments in analyses and scientific interpretation of natural processes.

IIG technocrats initiated digital acquisition of data by implementing latest information technology to overcome all the conventional hindrances. Earlier, huge recurring costs drained precious national financial resources to international companies giving them total control over the maintenance and upkeep of the expensive instruments. Repairs, though rare, took time and money to bring the instruments on track. These lacunae inspired IIG technocrats towards self reliance. The technocrats developed a system that allowed central acquisition of magnetic data from all the 12 MOs in real-time. The system, built in-house, involved installation of data loggers at all the MOs. The data recorded is transmitted via cost effective mobile data network using secure IPSec tunnel monitored by software developed at and by the Institute. This technology ensures zero loss of data even when the mobile network is down. The system also simultaneously plots all the magnetic parameters in real-time which makes it easy to spot anomalies, if any.

The technology was adapted from Cisco, Cradlepoint, Advantech and NI Labview involving firewall, routers and switches from Cisco; router from Cradlepoint; single board computer from Advantech; system design and switches from Labview. The operating system used was from Windows and Linux. IIG is the first Government research institute to use IPsec VPN tunnel technology of GPRS mobile network (2G/3G) for secure real-time data transfer. Also, Windows data logger module was developed to collect data from imported fluxgate magnetometer (DFM)

instrument. It is also the first Indian science research institute to develop in-house real-time plots of magnetic data of all the 12 MOs. A robust estimate puts the revenue savings of more than 10 lakh per observatory per year. This is huge a saving and 'earning' which can be used for some other research purpose.

Because of this technology innovation, IIG has benefited on several fronts. The recurring expenses which run into lakhs of rupees are saved, dependency on foreign instrument makers has reduced, innovative ability of in-house technocrats has come to the fore and the possibility of increasing the magnetic instrumentation coverage all over India, even in remote locations, has become a reality.

This technology can also be marketed to generate precious revenue. VPN tunnel technology has put an end to technocrats running to all the 12 MOs to resolve configuration issues. Technocrats at the IIG headquarter can virtually 'repair' from the comfort of their offices any problems that crop up anywhere in India. The main stakeholders, the world scientific community, can now use data as soon as any magnetic 'event' has taken place without time lag. The scientific productivity of the Institute has grown tremendously and is now in the position to compete with its international counterparts.

The expenses for installing, maintaining and repairing of magnetic instruments have come down drastically. Some of the strategically important tectonomagnetic locations in India have been kept out of the purview of installing permanent MOs due to lack of financial resources. Such places can now be covered by unmanned MOs that will require only a fraction of what is expended on such initiatives.

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# NETWORK DIAGRAM OF CENTRAL DATA ACQUISITION SYSTEM

