**Through-The-Earth OFDM Magneto Static Communication**

Recent years have introduced an ever-growing need for a high-rate reliable Through-The-Earth (TTE) communication: two-way link between ground surface and underground devices separated by 10’s to 100’s of meters of soil. That necessity has emerged in the military as well as in the Homeland Security (HLS) sectors as asymmetric warfare is slowly migrating to the underground medium, but TTE could also be useful in pure civilian applications such as the mining industry.

The Electro-Magnetic (EM) fields’ characteristics in such medium, considered conducting, show superior performance in the Very Low Frequency (VLF) spectral band, which corresponds to the Quasi Static regime, namely the Magnetic one.

Although several industrial TTE devices have been developed, they all assume fixed deployment, use relatively old communication technology and present humble performance.

We propose a novel approach of a TTE communication system integrating highly efficient and sensitive Magneto-Inductive analog hardware, together with state-of-the-art Digital Signal Processing communication formats and algorithms, namely the Orthogonal Frequency Division Multiplexing (OFDM) technique. To our knowledge, such an approach has not been pursued so far. The main achievement was the establishment in field tests of an actual full TTE communication link capable of real-time transmission of voice across several floors of a building with relatively lightweight analog equipment (comparing to the commercial devices). In that system were combined many high-end communication concepts, namely the Software Defined Radio (SDR) architecture:

* PAPR reduction
* MIMO equalization
* Frequency & phase combined improved estimation
* Channel enhanced estimation

The whole design was preceded by a thorough phase of system engineering that set goals and predicted the performance.