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COMMUNICATING IN TUNNELS AND THE SUBTERRANEAN ENVIRONMENT

THE SCENARIO:
Your team has to execute a mission that involves entering a complex remote tunnel system, entering an urban subterranean environment or perhaps a collapsed infrastructure. You're confident that your team members who are in relative proximity will be able to maintain communications with your existing radio equipment, though you need to maintain communications connectivity between the team and the above-surface, mission command area.

You establish communications at the entrance to the objective and proceed into the mission area. As you progress, there are multiple turns, switchbacks, and chokepoints that are stable and unstable. Your team proceeds and your last man drops relay points for your communications system to ensure you are connected back to the surface. You know that each relay point you place is a possible point of failure and you're not sure you have enough relays.

Let's imagine in this scenario one of two things might happen:

1 – Your last man runs out of repeaters. Your mission is called off because you can't maintain connectivity to the surface in this high-risk environment.

2 – One of your repeaters malfunctions or you incur an infrastructure collapse along your relay chain where a barrier now exists blocking your communications or destroying your equipment.

There is a solution you should be significantly considering.

Radio technology available today has a great array of capabilities. Connectivity, high data rates, encryption, and video streaming are all common features.

Unfortunately, as per the scenario, all this goes away when we enter tunnels, collapsed buildings, or any other environment in which line of sight is blocked or severely restricted. Traditional Radio Frequency (RF) signaling cannot get through solid objects or even around significant obstacles like curves and elevation changes.

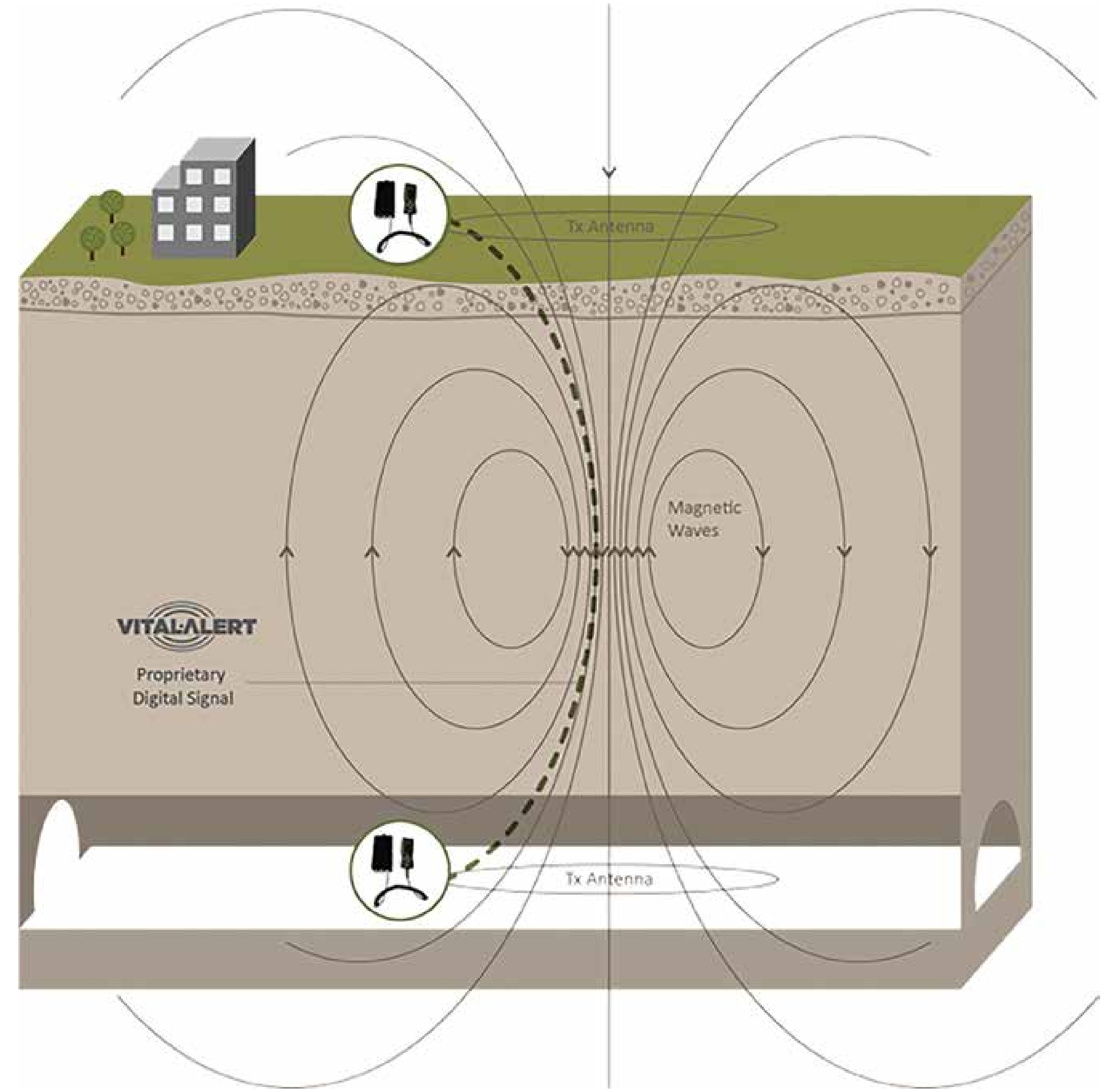

ILLUSTRATION 1. Magnetic induction communication.

We do have technology that is really good at switching frequencies to maximize penetration and persistence; however, the laws of physics do not allow for traditional open-air communications to function in these environments. This type of environment requires assistance and alternatives.

Instead we have to look at a different approach making use of what physics gives us. By using Magnetic Induction (MI), communicating Through-The-Earth (TTE) and through barriers is possible. MI works by creating a magnetic field and using that as a carrier for a signal. The magnetic field penetrates earth, concrete, and solid rock. ILLUSTRATION 1 shows this.

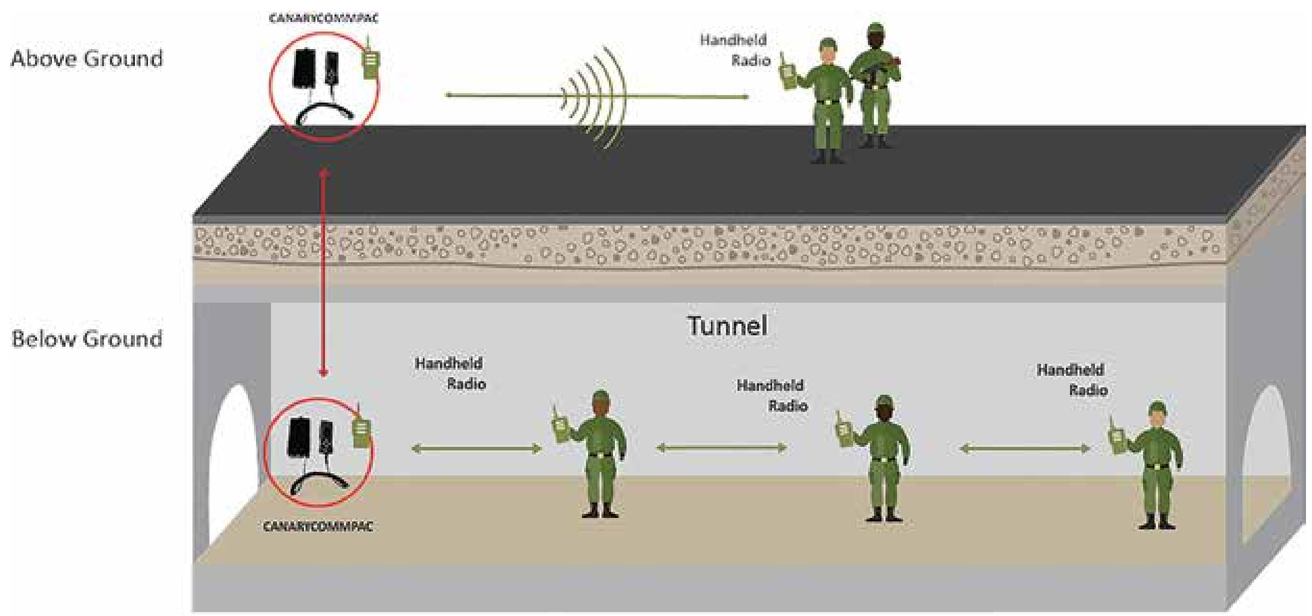

ILLUSTRATION 2. Communication between CanaryCommPac and multiple personnel vertically and horizontally below ground.

In the illustration, two TTE devices—in this case Vital Alert Communication's "CanaryCommPacs"—are used. As long as they are within each other's magnetic field (using regular communications terminology, "within range"), communication can be established and maintained.

This technology has limitations compared to traditional systems with which you might be familiar. Distance is about 1,000′ for voice and 2,000′ for text or data. This is due to the size of the field that can be generated by the equipment easily. It is Very Low Frequency (VLF); consequently, it has a very low bandwidth. In other words, it cannot support things like streaming video. There is work being done to potentially allow video, but it is not quite there yet. As mentioned above, it requires antennas for sending, "transmitting," and receiving. The receive antenna can be quite small; however, the transmit antenna is a loop of wire. The larger the loop, the further the distance. At a certain size, making the loop bigger doesn't get you more distance because the resistance in the antenna limits the field size. The wire gauge can be thin, 18–24, so it's easy to carry and deploy from a small reel. The loop does not have to be perfect. As long as there is some separation and the magnetic field can be established, it will work. A perfect loop may get you longer distance.

The technology itself is not new to the Army. Any operator familiar with the Army's Magneto Inductive Remote Activation Munition System (MI-RAMS) has used it. This equipment is utilized to remotely initiate demolition charges, munitions, and other defense systems in RF-denied areas and in underground environments such as tunnels and into infrastructures. The only difference is that the technology also can be utilized for voice and data communications.

The TTE transmitters/receivers have been designed to work with existing communications technology. Whatever handset used now can be used too with the TTE link. This is very useful because only one member of the underground team needs to carry the TTE unit. Once deployed, it links to the closest handset. The local group can freely communicate and the TTE link sends those communications to the surface. The line of sight/RF rules will still apply to the handhelds; however, by moving the TTE device along with you, local communications can be maintained.

Another feature of the technology is the ability to send data. This means that sensors can be deployed along the route. Sensors also can be buried along with the TTE unit allowing covert information to be relayed after the team has left. Sensors of any type can be deployed including vibration for intrusion alerting or geo-fencing, gases, temperature, etc. These sensors and the TTE device can be designed to run on very low power and send information only when there is something new to report.

TTE technology can be instrumental in support of military operations in dense urban and subterranean environments. The U.S. Army Maneuver Center of Excellence (MCoE), Capabilities Development and Integration Directorate, Concepts Development Division (CDD), has looked at the functional areas required for subterranean operations. Sustaining communications between elements above and below ground and through barriers during subterranean operation will be essential. TTE technology clearly will need to be in the operator's equipment set for effective task execution.

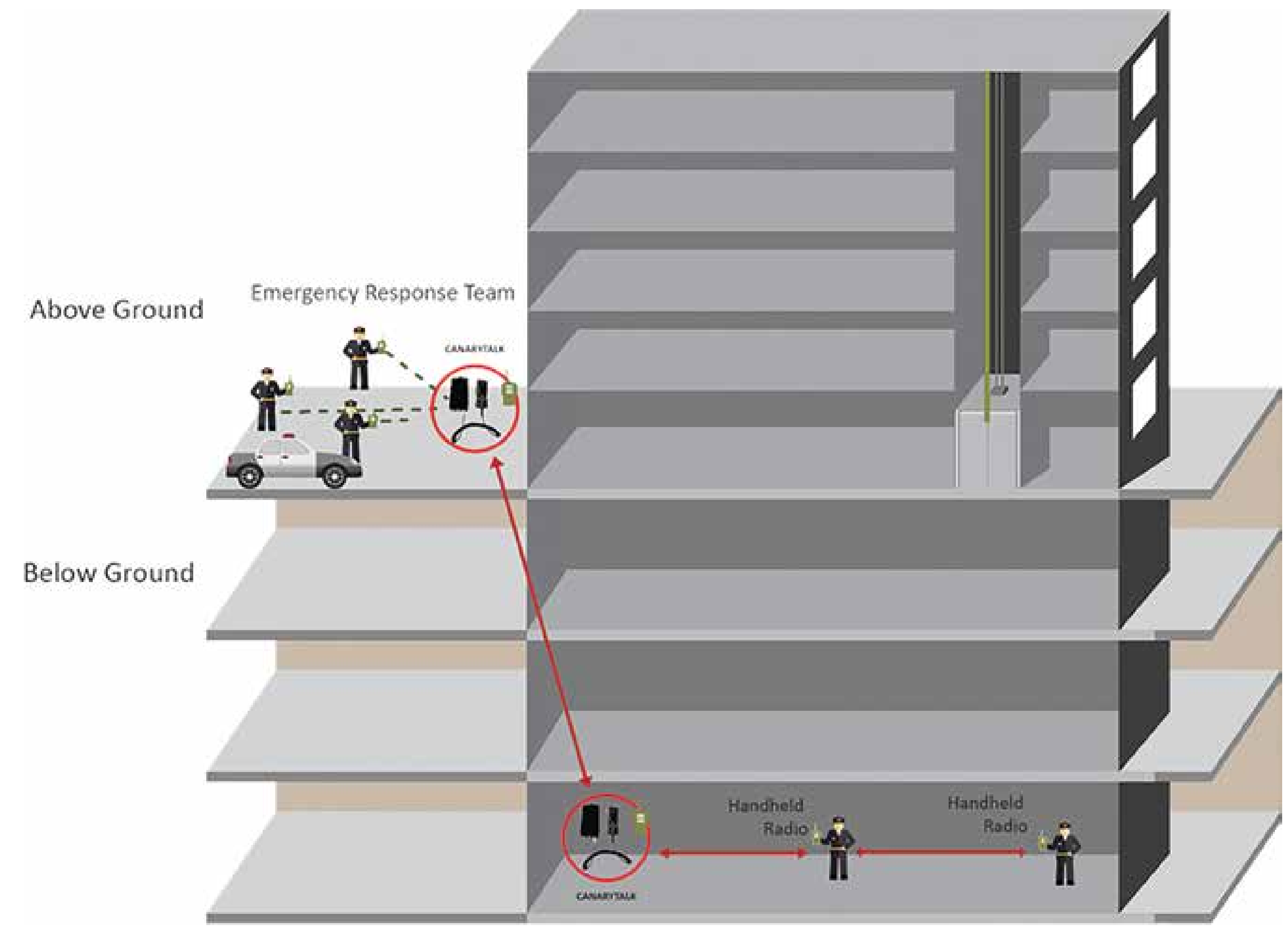

ILLUSTRATION 3. Communication between above-ground team and below-ground team through two CanaryTalk terminals.

More information on TTE and its various applications can be found at www.vitalalert.com