APPLICATION WHITEPAPER

UN MISSIONS ADOPT CODAN'S RELIABLE HF ASSURE TECHNOLOGY

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SUMMARY

In July 2014, Codan Communications released its 2nd Generation Digital Voice solution. This offered affordable, encrypted (optional), clear and 'better than analogue' performance with their Envoy™ series of Software Defined Radios (SDR's), and HF Assure was born. Since its introduction, several organisations and agencies have begun upgrading their entire fleet of analogue High Frequency (HF) radios. This paper gives an introduction into HF Assure; how it can help the UN communicate (the UN in Mali have been used as an example) and how to design and deploy reliable HF communications mitigating the challenge with skip zone.

The UN who have suffered with unreliable HF communications while operating within the HF skip zone reached out to Codan to help provide them with a reliable and easy to use HF network that eliminated HF skip zones. Codan engineers provided a proposal to incorporate HF Assure technology into their current HF network.

By following Codan's recommendations, additional base stations were deployed throughout Mali with their respected remote control points installed in the UN operation rooms and connected via Internet Protocol (IP). All mobile radios were upgraded with 2nd Generation ALE (2G ALE) to benefit from 'Best in Group Calls.'

The HF Assure system is now deployed in Mali and the UN no longer worry about unreliable HF communications and can carry out their mission, safe in the knowledge that they can communicate from anywhere in Mali.

INTRODUCTION

Commercial High Frequency (HF) radio communications have been used in Mexico since the 1960's and gained an immediate following as a means to communicate with lone or remote workers over vast distances. Every decade or so, HF radio manufacturers release unique features that re-invigorate the market interests in the communications medium. Whilst the 1970's were reasonably subdued for HF radio, the 1980's brought about multi-channel 'computer controlled' radios; the 1980's brought Automatic Tuning antennas; and the 1990's Automatic Link Establishment (ALE) where users no longer needed to perform channel tests or have an in-depth knowledge of HF propagation. Unfortunately for HF radio, the current millennium also introduced inexpensive satellite communications which in turn has reduced the uptake of HF radio terminals.

In 2013, Codan Communications, began working on the next evolution for commercial HF radio – Long Range Digital Radio (HF Assure). Although Codan had developed and was already selling an early generation of Digital Voice for its NGT™ HF radio series, the cost, performance and voice quality limited it's uptake to certain 'secretive' organisations and para-military groups. Since the introduction of HF Assure in July 2014, several organisations and agencies have begun upgrading their entire fleet of analogue HF radios to Codan's Envoy X2 radio.

It needs to be highlighted that reliable remote-area communications are only as good as the infrastructure that supports them. Without a properly designed, implemented and maintained network, the maximum benefits of an HF Assure network will never be realised.

WHAT IS HF ASSURE?

HF Assure is a voting style system which represents the evolution of HF long distance communications, from legacy based signaling, to state-of-the-art digital for voice, messaging and data communications. The system offers easy to use multilingual user interface, integrating the capability for encryption, smart-phone application control, Internet Protocol (IP) and Ethernet connectivity along with advanced HF capabilities. HF Assure systems can have up to four radios linked together via IP. This forms the backbone of the voting style system.

HF Assure uses 2nd Generation ALE (Automatic Link Establishment) technology. This 2nd Generation (2G) network vastly simplifies HF, making communications no more complicated than a push of a button.

Using Codan's advanced ALE calling technology with redundant "Best-in-Group" calling capability (e.g. the mobile user establishes communications with a group of stations on the HF Assure network, chosen by the operator via the pre-programmed address book in the radio) the mobile radio evaluates the responses received from each of the radios and establishes a link with the best radio. Radios on the network are connected to the UN operations room via IP links. All the radios are

monitored using the Codan Virtual Control Point (VCP) or console. The mobile is able to speak to the operations room and report in.

HOW CAN HF ASSURE HELP THE UN COMMUNICATE?

The UN throughout the world are experiencing challenges when trying to communicate with HF radios in the skip zone. A skip zone (also known as a silent zone or zone of silence) is a region where a radio transmission cannot be received. The skip zone is located between regions both closer and further from the transmitter where reception is possible.

Please refer to Figure 1 in the diagram below.

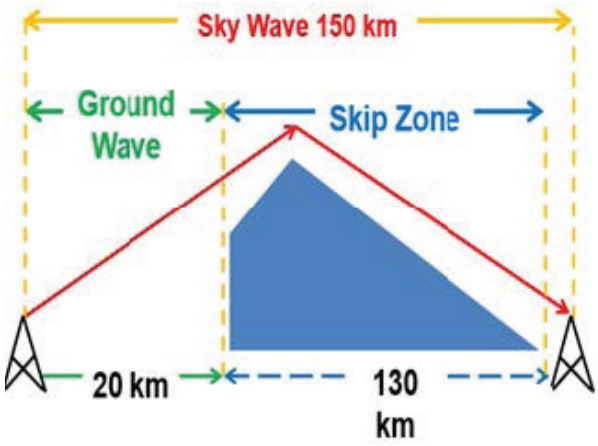

Figure 1: Skip Zone with ground and sky wave

THE UN SCENARIO?

With typical UN operations, the mobile units depart from their base locations and report their movements using either Very High Frequency (VHF) or Ultra High Frequency (UHF) radio networks up to a distance of approximately 20 to 30 kilometers (depending on repeater infrastructure, radio power and the terrain). Once beyond the VHF/ UHF coverage area, communications become difficult or unworkable. The mobile user turns to the HF radio to report their position back to base. In most cases, communication fails because the mobile is trying to communicate within the skip zone.

The industry standard method to reduce the skip zone is to install NVIS antennas on the mobile vehicles. (Please refer to Figure 2) While this configuration improves the performance within the skip zone, it does not completely remove skip zone or guarantee communications. Codan developed the HF Assure solution to mitigate skip zone completely.

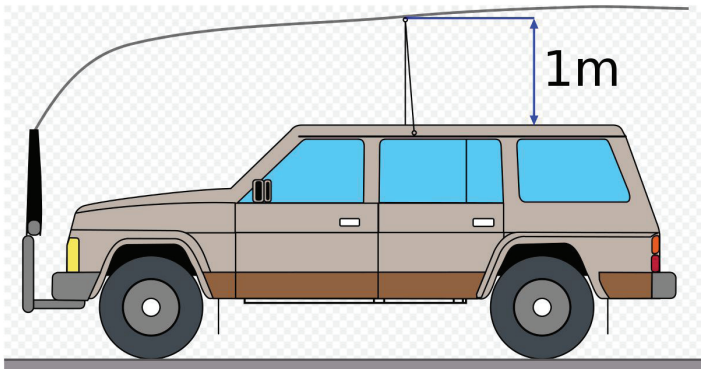

Figure 2: Mobile with NVIS atenna fitted

Codan's HF Assure technology will help defeat the skip zone and provide reliable communications from 0 to 500 kilometers, enabling the mobile user to safely carry out their duties in helping the United Nations to honor its mandate (and essentially protect the lives of the UN staff and the people they are there to protect).

DESIGN CONSIDERATIONS WHEN ESTABLISHING AN HF ASSURE RADIO SYSTEM

LOCATION

Site location for any analogue HF or HF Assure system is critical. Having a suitably located 'RF quiet' environment with enough real-estate to deploy an appropriate base antenna is the first step to a high performing network. HF Assure systems work best in locations where essential services such as mains power and IP connectivity are readily available (typically located on the outskirts of a remote or rural township). The HF Assure site should not be placed near noisy Single Wire Earth Return (SWER) lines or feed through the HF Assure site with AC Mains from a SWER line. The chosen site should ensure access is possible in all circumstances and is physically unaffected during times of natural disaster (e.g. floods and bushfires.)

THE BASE ANTENNA

Antennas are a critical system component that are quite often overlooked in favor of cost, reducing the overall system performance. HF suppliers agree that a properly selected antenna is at times favorable over a high power transmitter. Obviously the combination of both a high power transmitter and a high performance antenna will provide the ultimate in Quality of Service (QoS) for any long distance communications system.

In all cases, a proper base antenna such as a Full Delta, Tandem Delta or a Bi-Conical antenna will always out perform any building mounted vertical antenna with tuner or broadband travelling wave horizontally mounted antenna.

The Full Delta example as seen below in Figure 3, has been specifically designed to promote short to medium communications distances, help reject overseas interference due to its radiating angles and provide a reasonable amount of gain.

Figure 3: Full Delta Antenna

When we analyse HF propagation, there is a clear link between higher transmit powers and successful communication between stations. This is particularly noticeable when the communication is between a base station and a mobile station. A base station usually consists of a large antenna that is often placed in an RF quiet environment. These antenna types offer good efficiency due to the physical size of the radiating element.

In comparison, a mobile station is a naturally noisy RF environment due to the internal electronics of the vehicle itself (alternators, engine management systems, etc) plus its frequent proximity to manmade RF noise such as high voltage power lines. The relatively small size of the mobile radiating element (compared to the base antenna) also introduces a high degree of inefficiency to the transmitters and receivers performance.

In essence, we could say this is an asymmetrical transmission path with the odds heavily stacked against the mobile installation. We can however re-balance it by increasing the transmit power of the base station to significantly improve the receive signal level at the vehicle. This approach also counters fluctuating RF conditions which are inherent to HF propagation and provide a more stable platform for reliable voice communications.

Where emergency service organisations are deployed during times of natural disasters, we not only need to deal with the vehicle's natural noise, but the noise and less-than-ideal conditions that are presented by the disaster itself.

In these circumstances, if we are to assume the worst, high-power base transmitters overcome the majority of these interference conditions to the point where an excellent QoS can be maintained, reliable communications can be attained and lives can be saved.

Figure 4: High Power Amplifier

MULTIPLE HF ASSURE SITES

For communications over large areas, one site can be established with the correct selection of frequencies, permitting wide-area communications. However in this situation, the single site would only permit one conversation to occur at any one time and would be prone to overseas interference due to frequency selection and antenna design. HF propagation (i.e. the communications distance) is generally based on the time of day, frequency selection and antenna design (where the lower the operational frequency, the shorter the communications distance, and the higher the frequency, the longer communications range possible).

Please refer to Figure 5 below.

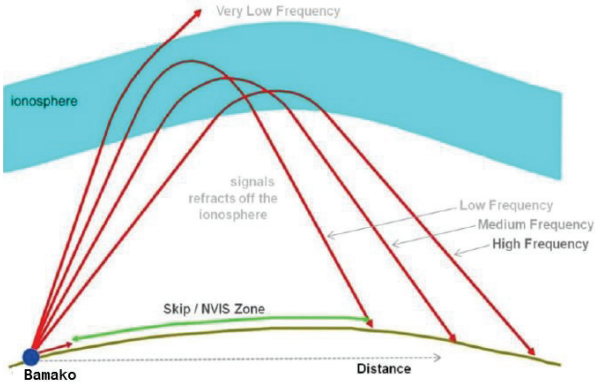

Figure 5: HF Propagation

MALI HF ASSURE DEPLOYMENT

Codan supported the UN by providing them with an HF Assure proposal. The proposal outlined a technical solution, frequency predictions, HF Assure site locations for both the 1000W and 125W trans-receivers, specifications to include quantities and the deployment plan. This was to resolve the skip zone challenges they were encountering.

The UN opted to deploy seven HF Assure systems. Each system incorporated two base stations (a primary and a secondary) which were geographically located in separate locations beyond each others skip zone (a minimum of 300km). They were located at existing sites where the UN already had established infrastructure such as power, networking capability and real-estate.

Refer to the Figure 6 below.

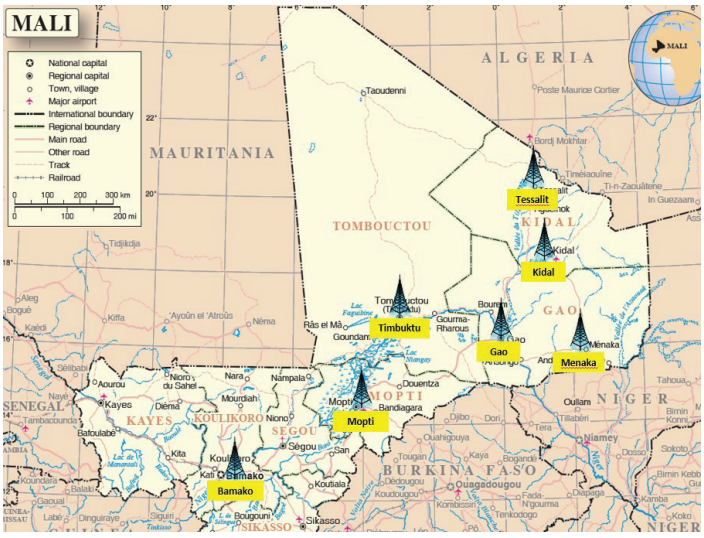

Figure 6: HF Assure sites for primary and secondary base stations

The primary and secondary radio sites were deployed according to the table below in Figure 7. As an example, Bamako itself had the primary radio at its location with the secondary base located in Mopti.

Refer to Figure 7.1 above right.

HF ASSURE Base station site allocation table							
	Bamako	Mopti	Timbuktu	Gao	Kidal	Menaka	Tessalit
Bamako	Primary						
Mopti	Secondary	Primary		Secondary			
Timbuktu			Primary		Secondary	Secondary	
Gao		Secondary		Primary			Secondary
Kidal			Secondary		Primary		
Menaka						Primary	
Tessalit							Primary

Figure 7: HF Assure sites allocation table

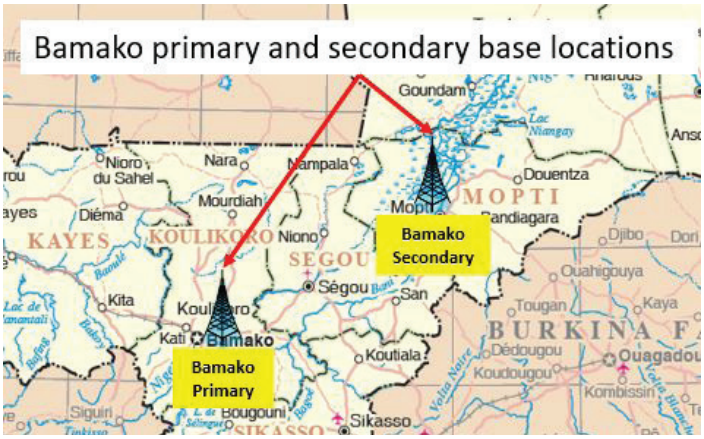

Figure 7.1: Bamako primary and secondary sites

Primary sites were configured with the High Power Amplifier (HPA) transceiver using the equipment in Figure 8 below. The HF Assure console is linked to the secondary site via an IP connection.

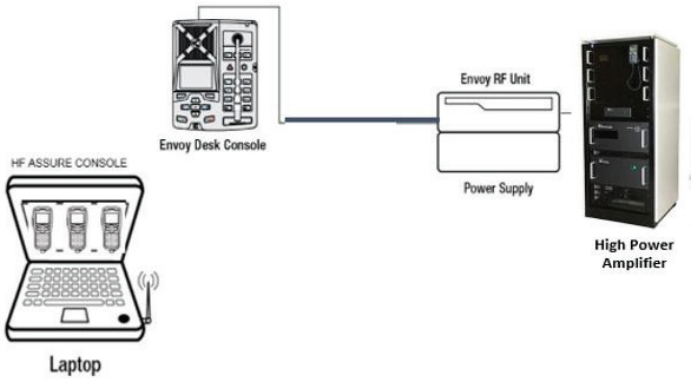

Figure 8: Primary HPA Transceiver equipment

Codan's 1kW C411 Terminated Folded Dipole Antenna was installed at the primary sites. This provides excellent performance for short to medium distance HF communications. This particular antenna is offered in a range of lengths to suit installation requirements and can be optimised for propagation by utilising the inverted 'V 'configuration or adjusting the installed height above ground.

Refer to Figure 9 below.

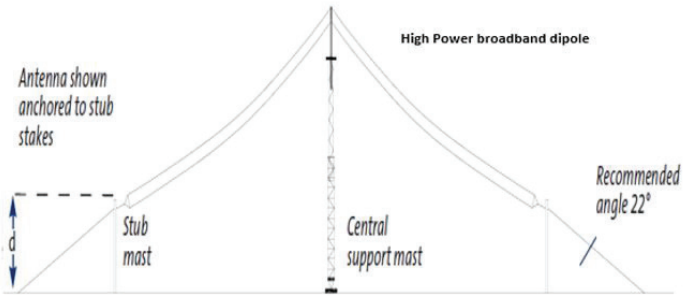

Figure 9: Primary 1kW C411 broadband antenna

In addition to equipment located at the primary site, is the control point from the secondary site. This can be either a console or Codan's VCP. The control point is connected using IP. This in turn means the operator located at the primary site now has the ability to receive audio from either the primary or secondary radio sites.

Refer to Figure 10 below.

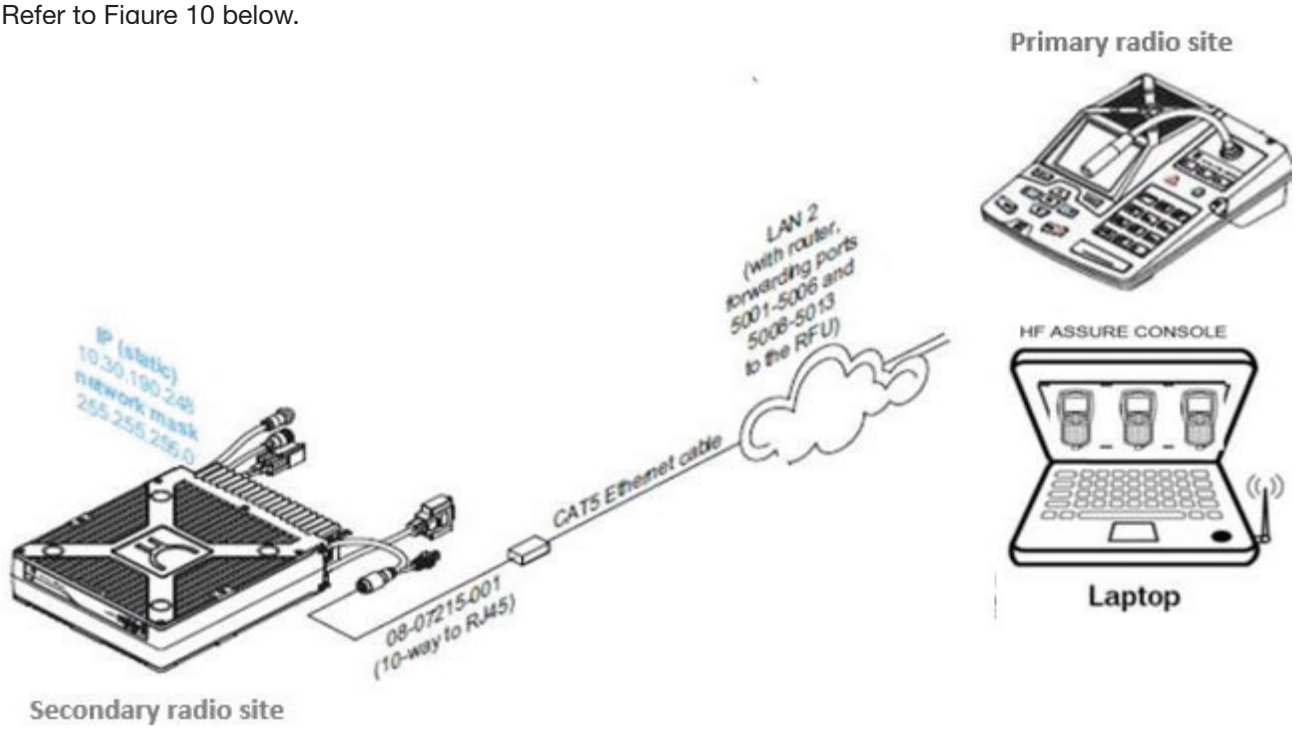

Figure 10: IP connectivity illustrating the VCP or control point from the secondary radio site to the primary radio room

The secondary sites were configured using Codan's Envoy X2 transceiver with 125W power. This is connected to Codan's Full Delta antenna in figure 11 below. The console or VCP is located at the primary radio room via an IP connection.

Refer to Figure 12 on the right.

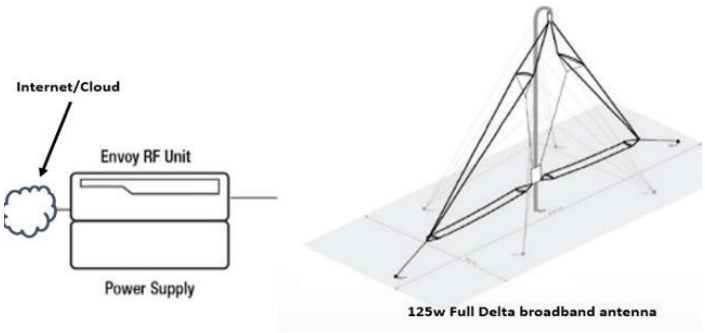

Figure 11: Secondary site radio and antenna configuration

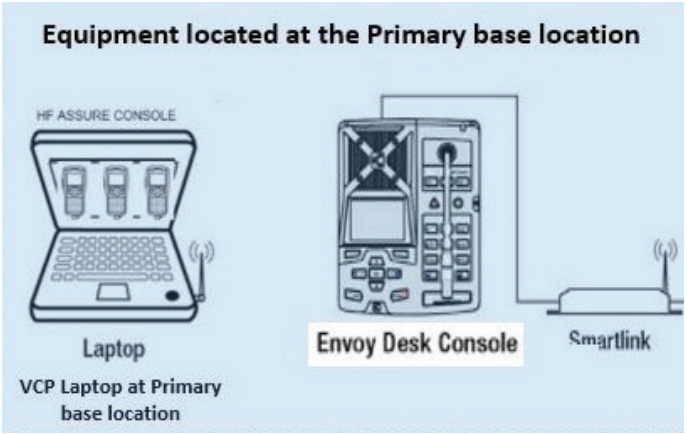

Figure 12: Secondary site control point at primary site

To date, skip zone proves the most difficult challenge to the UN in terms of HF communications. UN operations can be conducted beyond the VHF / UHF coverage area and within the skip zone. Codan has provided the UN in Mali with the technology to completely remove the skip zone challenges by providing the HF Assure solution. The UN are now able to communicate to it's operation rooms without the need to worry about skip zones or local interference.

Codan's HF Assure brings reliability to every HF call from the field to fixed stations. Figure 13 below is a concept diagram of a typical UN operation with three base stations linked with IP. The more base stations you add the more reliable the system becomes. The UN in Mali could improve their network further by adding additional base stations (four maximum).

HF communications has never been more reliable when HF Assure is incorporated into your HF network.

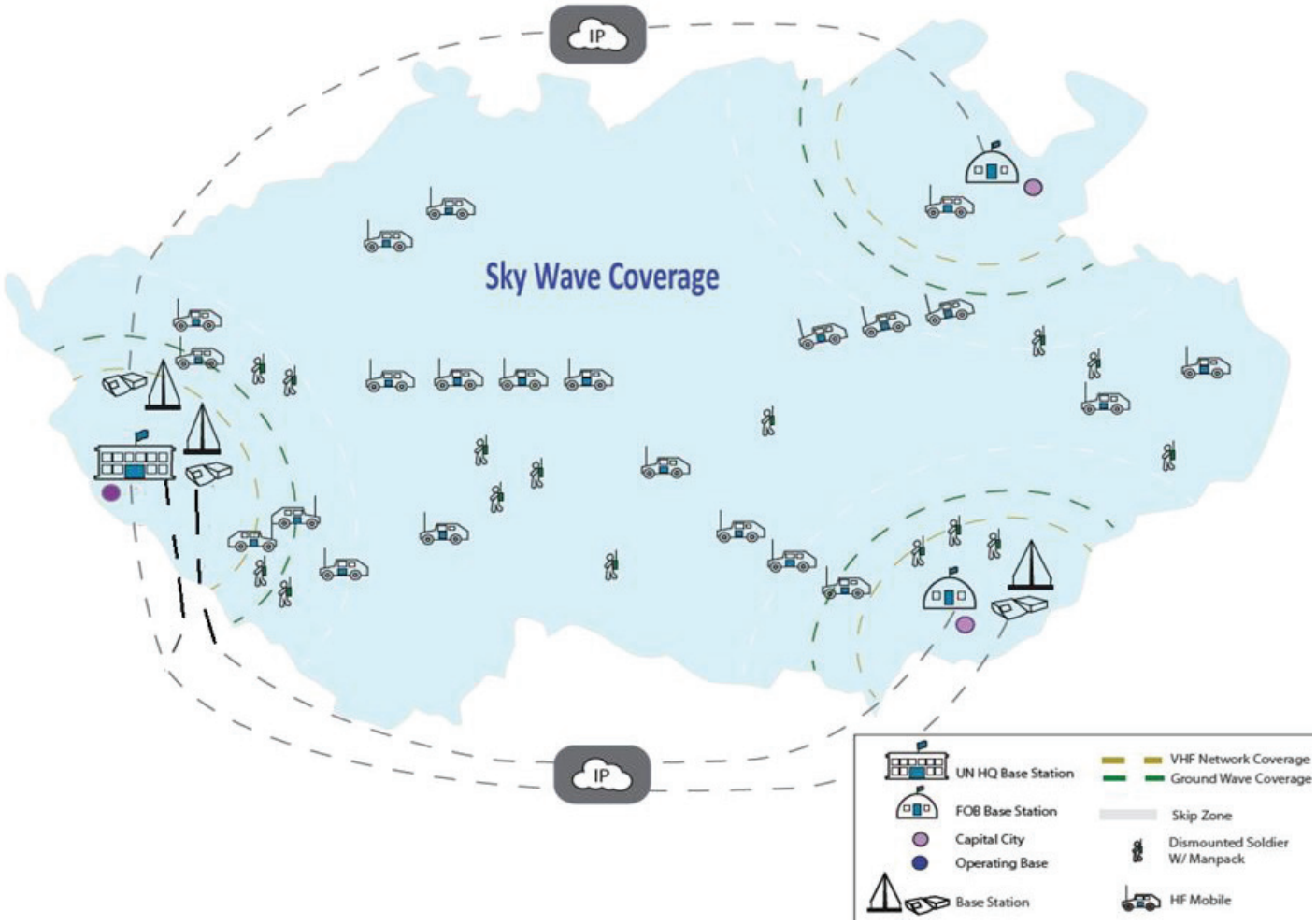

Figure 13: Concept deployment of HF Assure for a typical UN operation

ABOUT CODAN COMMUNICATIONS

Codan Communications is a leading international designer and manufacturer of premium communications solutions. We deliver our capability worldwide for the military, defence, humanitarian, peacekeeping, commercial, security and public safety markets.

Our mission is to provide communications solutions that enable our customers to **be heard** – to ultimately save lives, create security and support peacekeeping worldwide. With over 60 years in the business, Codan Communications has garnered a reputation for quality, reliability and customer satisfaction, producing innovative and industry-leading technology solutions.

We know that every deployment of a communications solution is different, having deployed our solutions in more than 150 countries. And when lives are on the line, it's critical that each deployment is right and that every stakeholder is heard. That's why it's important to truly understand your situation, your infrastructure, your environment and your stakeholders.

At Codan Communications, that's what we're best at. Not fitting your situation into our products, but really understanding what's at stake. So whenever you work with Codan, you know that right from the start you'll **be heard**.

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