APPLICATION WHITE PAPER

VULNERABILITY OF CIVILIAN COMMUNICATIONS IN ASYMMETRIC CONFLICT ZONES - AN IONOSPHERIC SOLUTION

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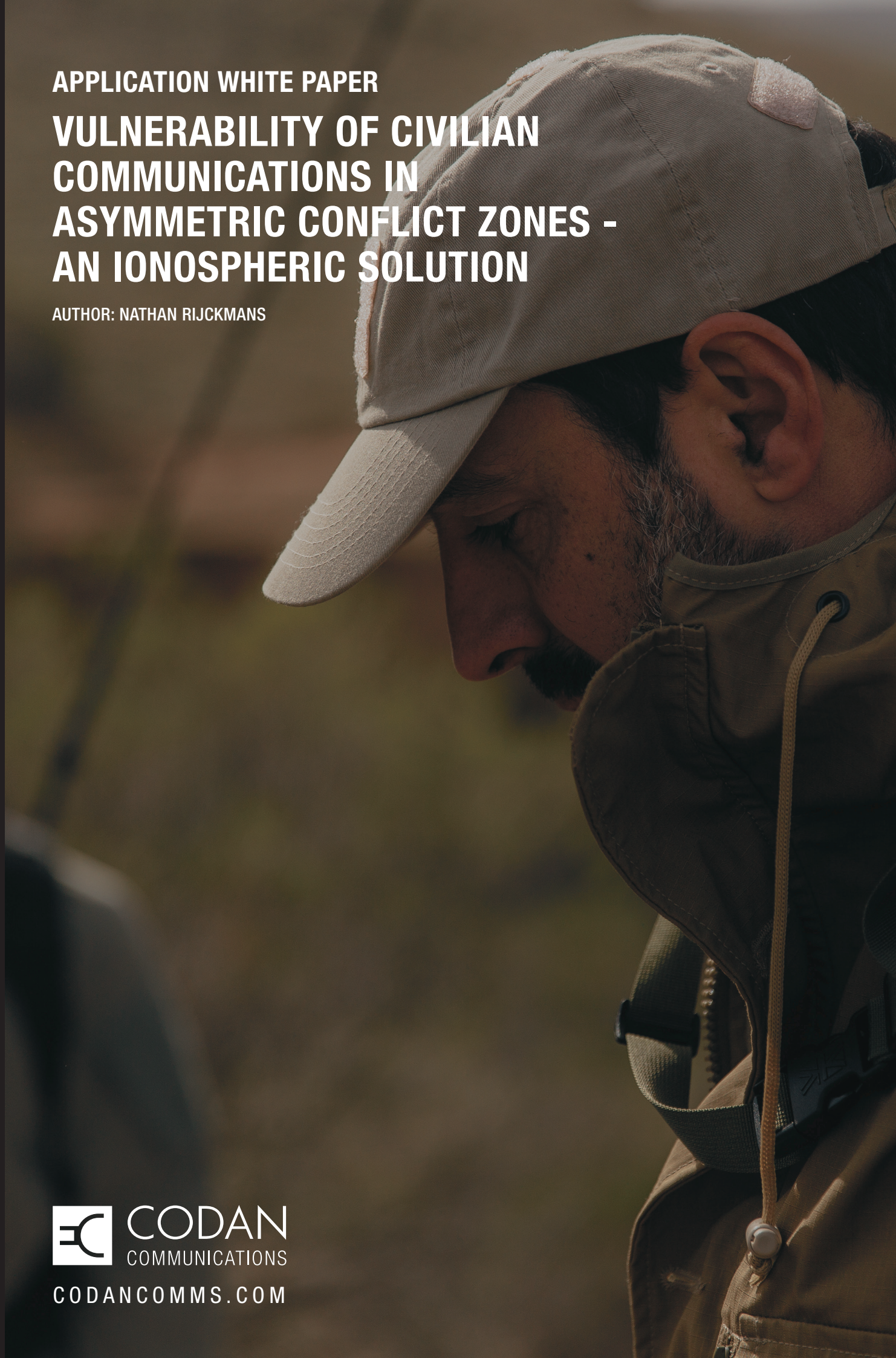

CODAN COMMUNICATIONS

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SUMMARY

Cellular, or cell, telephone systems are the primary means of voice and data communications for the vast majority of the world's population. Low costs, global availability, flexible price plans and ease of use all contribute as to why this form of communication is used on a daily basis in almost every walk of life. In isolated areas among private citizens or even branches of government, cellphones are often the only means of communication with the outside world.

Remote conflict zones have limited infrastructure and therefore have increased vulnerability. Increasingly, armed insurgent groups are exploiting this vulnerability by destroying or disabling cellular infrastructure, benefiting from the resulting communication blackout to carry out devastating attacks, restrict a nation's security and intelligence capabilities and exert control over a civilian population.

Different solutions exist to counter this increasingly dangerous problem, both technical and strategic. However, the majority of these means are unfeasible for the remote, typically underfunded regions at risk. With systems simpler to use than ever before, zero ongoing costs and a lifespan counted in decades, High-Frequency (HF) radio communication continues to be the only suitable solution.

WHAT IS ASYMMETRIC WARFARE?

Asymmetric warfare is an ambiguous concept, but has been cited by the Association of the United States Army as:

"…..war by guerrillas, subversives, insurgents, assassins, war by ambush instead of by combat; by infiltration, instead of aggression, seeking victory by eroding and exhausting the enemy instead of engaging him….."

This description was made by President J.F. Kennedy to a West Point graduating class in 1962. Despite the time passed, this definition is still relevant today regarding new and emerging methods of warfare seen increasingly in the deep isolation of African, Middle-Eastern and Central Asian theatres – specifically, low-tech (destructive) communications denial attacks conducted by insurgents against civilian infrastructure in isolated positions.

In developing nations, cellular (cell phone) telephone communications are far more common than older, wired (PSTN) telephone communications, and in many areas are the local population's only connection with the wider world. To place a figure on this, a count of 400,000 rural settlements on the continent found that less than 3% had PSTN access – while a 2006 survey found that over 45% had cellular access. 'Cellular was introduced in Nigeria in August 2001. Before then, only about 500,000 telephone lines were provided by the national telecoms monopoly (NITEL) in a country of about 120 million people.'[1] Comparatively the Nigerian Communications Commission estimated at the same time that >92% of the population were cellular subscribers. [2]

CELLULAR SYSTEMS

In cellular systems, a cell tower or mast serves as a 'hotspot' for any user with a cell phone to connect to wirelessly. National connections will be made mostly by point to point microwave, and internationally via international transit services. This connection can be made over subterranean fibre optic cables, or through point to point microwave links. In developing nations, microwave links are by far the more common solution, owing to the high initial expense and logistical demands of fibre optic cabling – this makes cellular connectivity far more vulnerable, as cellular towers become single points of failure for entire geographical regions.

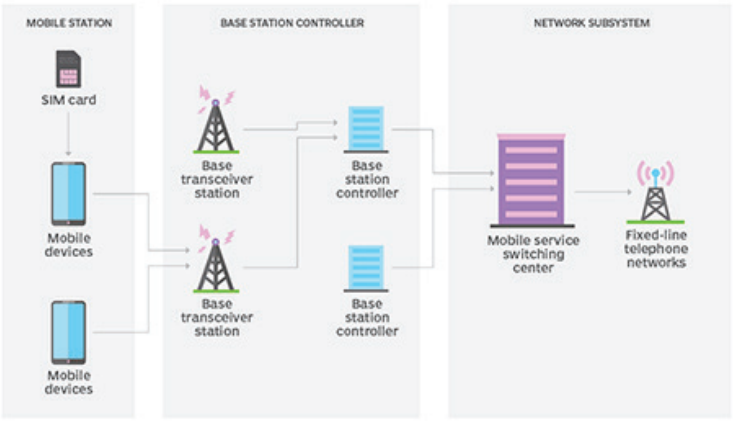


Diagram of a Cellular system

Beginning roughly from the late-2000s, the height of the point at which both Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom in Iraq began to evolve into asymmetric, counter-insurgent engagements, a specific mode of attack began to emerge in which insurgents operating in extremely isolated zones would deliberately destroy or disable cellular phone networks.

1 https://www.e-ir.info/2013/11/03/the-costs-of-boko-haram-attacks-on-critical-telecommunication-infrastructure-in-nigeria/?_sm_au_=iVVQ0jS4t5SrRtqHF23vvK3kcC4N6#_edn13
2 https://www.concise.ng/2019/03/02/ncc-reveals-number-of-cellular-subscribers-in-nigeria/

In 2008, Afghanistan's Communications Minister Amir Zai Sangin stated that over 40 cellular towers had been disabled by the Taliban in that year alone.[3] Diverse reasons were given for these attacks, ranging from the deliberate disruption of elections (a vital element in the path to peace), to cut off isolated positions before an attack and to prevent coalition intelligence services from tracking and monitoring insurgent communications.

Referring to a particularly catastrophic action costing the lives of 27 Nigerien security force members in 2019, insurgents had deliberately destroyed several cellular towers in the region as part of a complex planned attack, completely cutting off the security force's only means of communication.

Alarmingly, the past 18 months have seen a surge of attacks on telephone infrastructure in Somalia border regions carried out by foreign security forces, with cellular providers themselves allegedly sponsoring initial and retaliatory attacks. 'The telco wants to have complete monopoly in Somalia along the border and 50 kilometres across in order to shut out foreign telcos', [4] according to an international security report from 2019.

In these escalating incidents, sources with security forces state that these attacks are to prevent Al Shabaab militants from using cellular signals to detonate IEDs; whilst Al Shabaab is believed to destroy telephone masts to prevent participation in elections.

Destroyed Cellular base stations in Kenya, Somalia and Afghanistan

National security in these regions can often be dependent on regional cellular infrastructures. Public services such as medical facilities are similarly dependent on the same, and similarly vulnerable. The tactic of disabling cellular communications facilities prior to an attack not only allows the insurgent actor to inflict devastating civilian casualties but also destroy a region's security and health capabilities.

It is clear that cellular infrastructure is a vulnerable element of local and national security, being actively targeted by insurgent forces.

WHAT SOLUTIONS EXIST TO REMOVE THIS VULNERABILITY?

Satellite communications, e.g. BGAN or INMARSAT portable devices are routinely suggested, as they would be easily relocatable and easy to protect from insurgent action. However, the permanent operating costs of such systems are entirely unfeasible for these regions of the world.

Local government authorities lack the means, willingness and organization to maintain the ongoing costs of a satellite subscriber unit. Apart from being very expensive, satellite communications are not sufficiently rugged to survive the difficult conditions of isolated Africa and Middle Eastern conflict zones. The lifespan of devices can also drop significantly if kept in difficult conditions such as being regularly moved, being charged from fluctuating power supplies, or stored in high heat, dust and humid environments.

Satellite communications are also reliant upon third party infrastructure which is typically owned and controlled by foreign commercial entities and / or government bodies.

3. (Wall Street Journal, https://www.wsj.com/articles/SB10001424052748704117304575137541465235972)
4. https://www.business-humanrights.org/en/somalia-based-telecom-company-allegedly-financing-terror-group-to-destroy-communication-masts-in-kenya-to-increase-its-market-share?_sm_au_=iVVQ0jS4t5SrRtqHF23vvK3kcC4N6

Such infrastructure cannot always be relied upon during times of conflict or natural disaster.

WHAT CODAN CAN PROVIDE?

HF radio and extreme conditions go hand in hand. Modern HF radios are built to military standards of environmental protection, with some models having a **lifespan of over decades even in the most difficult of conditions**. With zero ongoing costs, HF communications are ideal for regions unable to manage the reoccuring billing of a satellite systems.

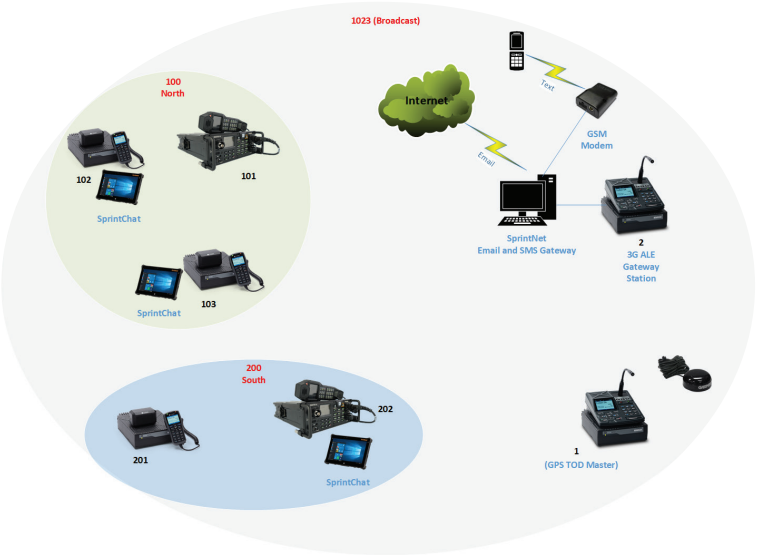
With a multitude of available antennas, HF radio does not present anything like the highly visible, highly vulnerable mast required by cellular communications. Small, discreet HF antennas may be simple horizontal wires, less than 3m from the ground, or vertical fibreglass whips only 3m high. These antennas can be rapidly installed and dismantled. and are extremely simple to fix in case of breakage using only the most basic of tools.

Collapsable Whip Antenna and Tape Whip Antenna

The broadcast ability of HF radio allows for greater and faster sharing of information than satellite or even cellular communications. This capacity can be vital in situations in which groups of isolated settlements or positions in the same region are under threat. This can be seen in the example of Invisible Children - a US Aid sponsored NGO supporting community-based protection solutions in Democratic Republic of the Congo (DRC) and Central African Republic (CAR). Invisible Children has installed and maintains a network of Codan HF radios in extremely isolated communities, far out of the reach of cellular communications. These isolated communities regularly come under threat of attack from armed militias and The Lord's Resistance Army (LRA). Their Codan HF network allows the first community under threat to immediately send out broadcast communications to all other communities in the vicinity, allowing them to take rapid action.

The example of Invisible Children is based on simple voice communications alone. A Codan HF radio network is based on simple fixed frequency voice communications.

For example, a Codan network could be set up using 3rd Generation ALE (Automatic Link Establishment). This 3rd Generation (3G) network vastly simplifies HF, making communications no more complicated than the push of a button.

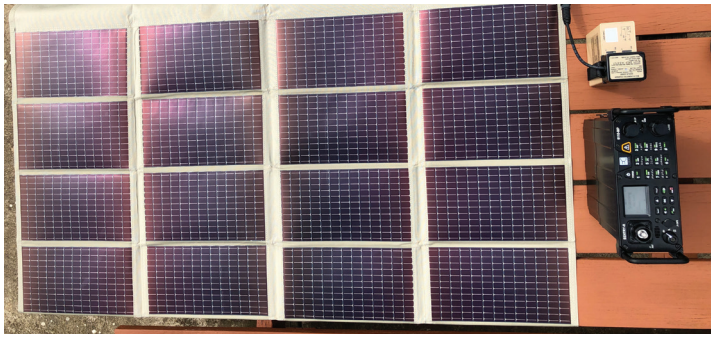


Codan network using 3rd Gen 3G ALE

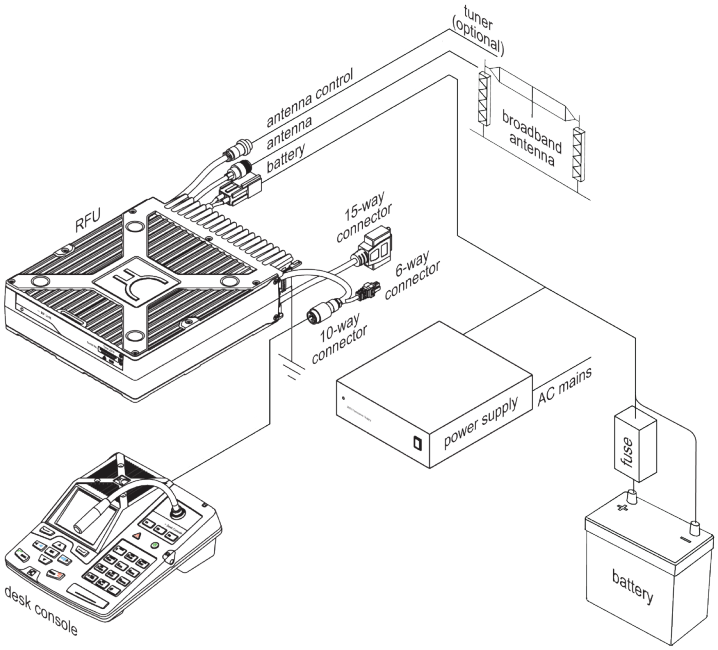
A sequential examination of this functionality, using a mix of portable and fixed communications systems is outlined above.

STAGE 1

The HF radio is installed in the isolated community. A high capacity radio with a large antenna, such as an Envoy X2 base radio, may take a few hours to install with a minimum of training and understanding. A 6110MP, a man-portable radio using a simple verticle whip antenna, can be installed in less than a minute by following a basic diagram, requiring zero training. The Sentry 6110-MP can support operation for up to 50 hours on a single battery charge. Batteries may be recharged using chargers that can connect to wide range DC input, solar panels, or AC mains source.



Codan Sentry-H 6110-MP battery charging on solar power



Codan Envoy with 411 on float charge kit with car battery

alternatively communications can be established simply by holding the radio's prominently visible emergency key.

Like most providers, Codan radio systems require a GPS signal in order to synchronise the calling system and establish communications. In the event of a GPS denied environment, the Codan Software Defined Radio (SDR) platform is able to operate entirely without synchronisation if required, automatically switching to an asynchronous mode and continuing to operate.

Close up of the chain call process beginning

STAGE 2

The radio is simply left to operate unattended. The radio scans channels pre-set into it prior to its deployment. All settings in the radio are locked by an administrator PIN code, ensuring that the radio cannot be tampered with and misconfigured by an unqualified end user. In case the radio does require reconfiguration (for example if the end user's requirements change), it can be reprogrammed and new radio plans issues and implemented via files from a USB stick or Thumbdrive.

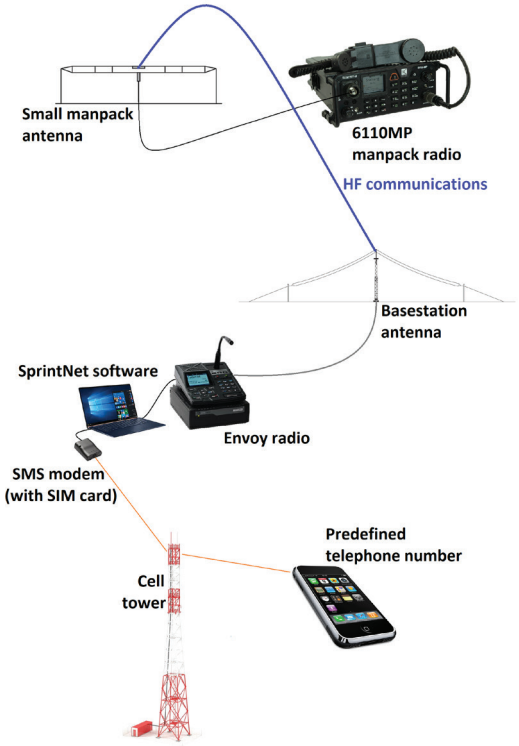
Sentry-H 6110-MP being programmed

STAGE 3

An attack is imminent – a confident operator may choose to contact a specific station or group of stations and make a voice call, send a text message or data file; or

STAGE 4

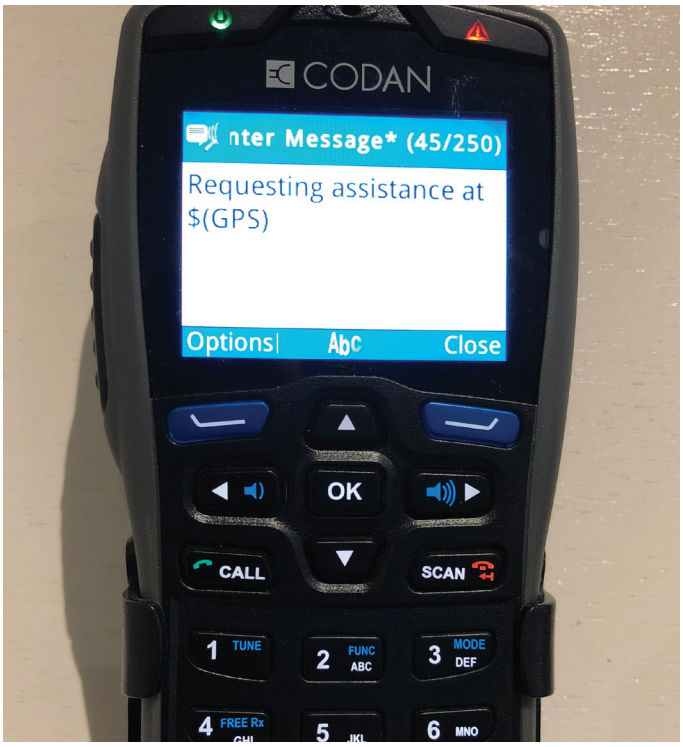
Once the emergency button is pressed, the radio's advanced calling system interrogates the network to locate the station with the best possible link conditions, and establishes a link with the best radio alone.



A simple schematic of the SprintNet SMS routing process, from HF radio to SMS receiver

STAGE 5

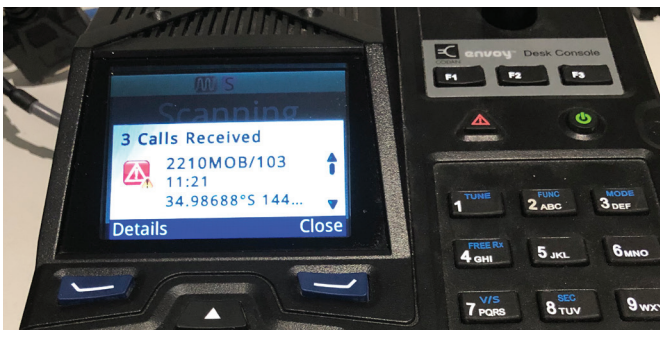
The radio in the isolated community displays an automatic confirmation that the message has been sent: (visible on screen). The radio will automatically send a GPS position out.



A close-up of a pre-defined text message with GPS syntax, shown on radio

STAGE 6

Finally, the radio initiates a broadcast emergency voice call to all, or a group of, HF stations in the network. All receiving radios emit an alert tone, showing the GPS position of the calling radio. Open voice communications enable the initiating operator to speak to the other stations, warning them of the impending attack.



Envoy receiving an emergency call as chain call 3 of 3, showing the GPS position

The calling system described in stage 6 requires no more intervention from the operator than the simple push of a button. Once the chained calling system is initiated the radio conducts the automated chain call procedure. The message will be successfully delivered to all reachable users on the network.

The system can easily be relocated if the community must rapidly evacuate from the area, with the HF radio able to communicate with other stations in range even while moving.

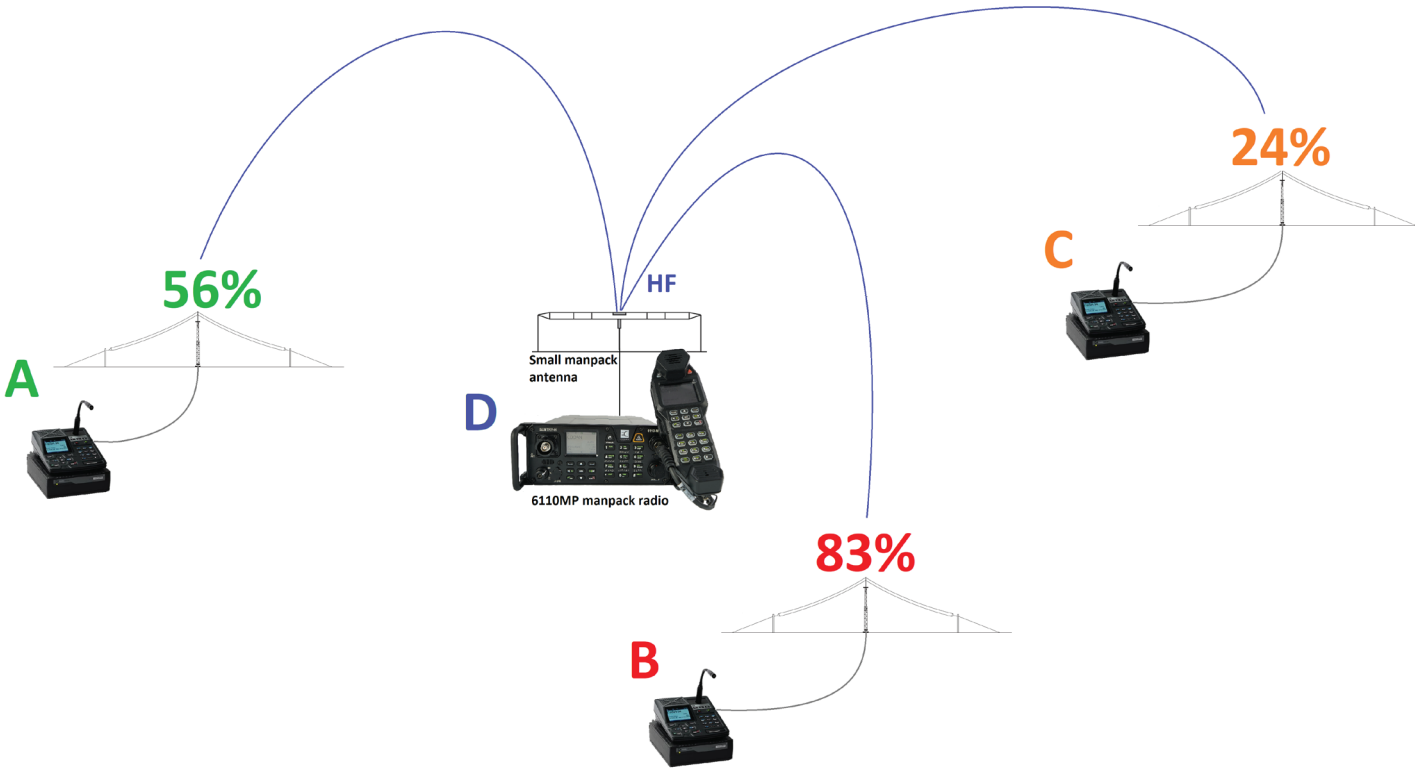
Beyond pre-programmed chain, group and broadcast calling, the SDR radio is able to cognitively interrogate a network to locate and select which stations are able to communicate. Using Codan's advanced ALE calling technology with redundant "best-in-list" calling capability, an isolated radio at risk of attack no longer establishes communications with a particular station, group of stations or network chosen by the operator, but instead interrogates the entire network to locate the station with the best possible link under current conditions. The calling radio evaluates the responses received from each radio on the network, and establishes a link with the best radio alone.

HOW THIS HELPS THE USER

Since the introduction of the NGT radio in the year 2000, Codan has shown itself to be the industry's leader in simplicity of HF communications. From physical installation to human operation, every effort is made to ensure that the platform is as easy and intuitive as possible. Codan's objective is to ensure that even in the most challenging of circumstances, operators with only the bare minimum of training are still able to communicate, simply at the push of a button.

Codan understands that even the most intuitive radio interface system is not fit for purpose if it cannot link and communicate reliably in challenging conditions. Beyond one of the highest levels of receive sensitivity in the industry, features such as chain calling, broadcast and group calling and even cognitive radio linking are implemented so that operators are safe in the knowledge that when it's most required, they will **be heard**.

By definition, asymmetric conflict will forever involve enemies with poor material means attempting to find and exploit vulnerabilities in their perceived target's defences. The exploitation of the vulnerability of cellular communications to low-tech destructive attacks in isolated environments has cost, and continues to cost, hundreds of lives. HF communications with Codan SDR radios provides the means to remove this vulnerability, continuing as has been the case for over 60 years to communicate where other means to fail.



In the above diagram, there are three basestation radios (A, B & C) active in the HF network. Instead of selecting a particular station, which may or may not be in communications range or available, the manpack radio (D) transmits a call to the entire network. The three radios (A, B & C) respond, with different levels of signal quality. The 'D' radio analyses their communications quality and links with the best signal in the network – radio 'B'.

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 100 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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