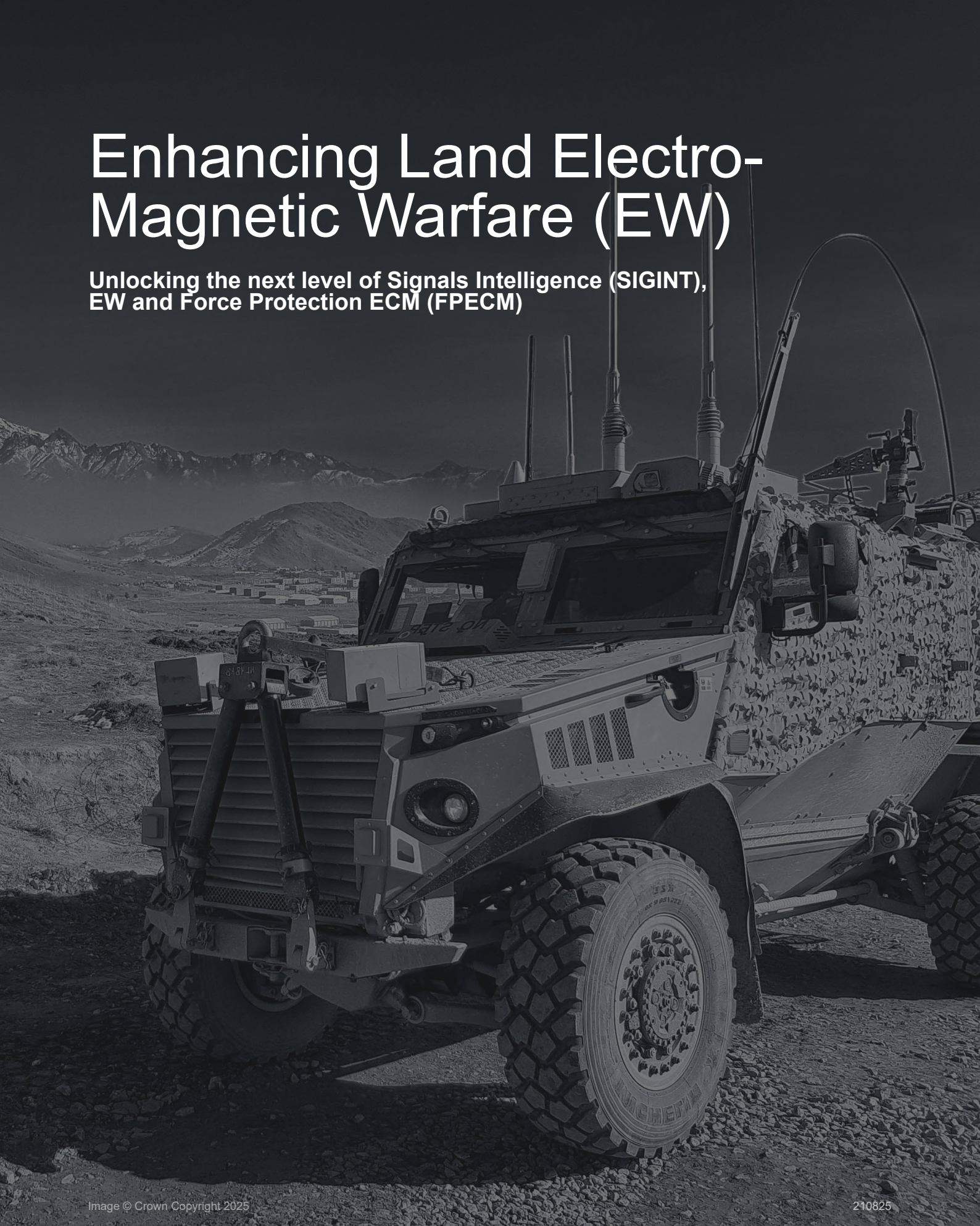
Enhancing Land Electro-Magnetic Warfare (EW)

Unlocking the next level of Signals Intelligence (SIGINT), EW and Force Protection ECM (FPECM)



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The challenges of a coaxial-based CEMA VIK

A land EW or CEMA system will typically consist of one or more antennas linked to one or more radios. This enables RF Signals of Interest (SoIs) to be captured and analysed for Signals Intelligence (SIGINT); or RF signals to be generated and transmitted to disrupt, deny or defeat threats.

The connectivity between antennas and radios is typically via coaxial cabling, which has a number of challenges:

Reducing Detection Range in Electronic Surveillance (ES) Applications

Coaxial cabling attenuates the received signals with an increasing magnitude of attenuation as the frequency and or cable length increases.

As the cable run to the radio equipment is often relatively long due to needing to pass through set Through Armour Connections (TACs), even some high stregth signals received at the antenna will drop into the noise floor by the time they reach the radio, effectively hiding the threat, and reducing detection range for the ES capability.

Reduces Scope of Effective Coverage for Force Protection ECM (FPECM) Applications

In FPECM systems, the reduced detection range from the coaxial cable attenuation will likely drive an FPECM system to administer more barrage type techniques, which is a less efficient use of the limited amount of power available in vehicles due to space constraints and adoption by other mission systems such as tactical communications.

Consequently, this could lead to a reduction in inhibition range, or a reduction in the number of simultaneous threats that can be defeated.

Fixed Point-To-Point (P2P) Network Topologies

Given a typical EW system uses coaxial cabling in a fixed point-to-point network topology, this often links antennas in sub-optimal positions to wideband radios / SDRs.

The often very capable SDRs are linked to banded antenna, effectively limiting the scope of the SDR to that of the antenna.

Moving to a star or hub type network topology will enable reconfiguration to optimise coverage to theatre - or even location-specific threats and targets. This will maximise performance for each platform's individual constraints, e.g. electrical power available and shape.

Reducing Engagement Range of Offensive CEMA (OC) or Electronic Attack (EA) Effect

Coaxial VIKs typically use power amplification that is co-located with, or a part of, the signal generation equipment that generates the OC or EA effect.

This equipment is typically inside the vehicle, which leads to reduced RF transmit power at the antenna through the coaxial VIK cable losses, which in turn reduces the engagement range for the OC or EA effect.

Benefits of an RFoF CEMA VIK

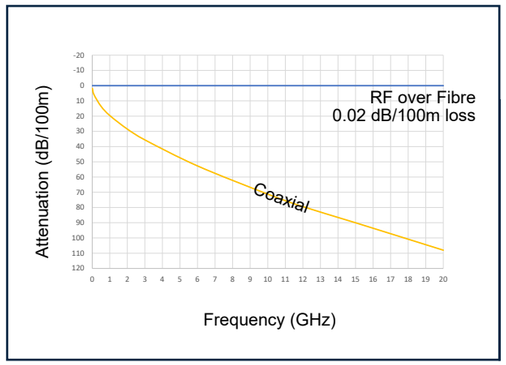
When compared to a traditional coaxial VIK, the benefits of PPM Systems' RFoF CEMA VIK manifest as a 5x increase in detection range (compared to a 10 m coaxial based antenna at 18 GHz), and a 7x increase in engagement range (compared to a 4 m coaxial based antenna system at 6GHz with equivalent amplification).

These benefits, as well as the dynamic configuration benefits are primarily driven by following two features of the VIKs:

Lossless Single Mode Fibre Optic Cabling

Losing only 0.02 dB over 10 m compared to a loss of 3.6 dB over 10 m for coaxial (LMR-400-DB coaxial cable at 6 GHz and fibre optic at 1550 nm).

It also supports high capacity data rates and the coexistence of both analogue RF and digital RF formats, providing future flexibility.



Optical Distribution (Hub / Star Network Topology)

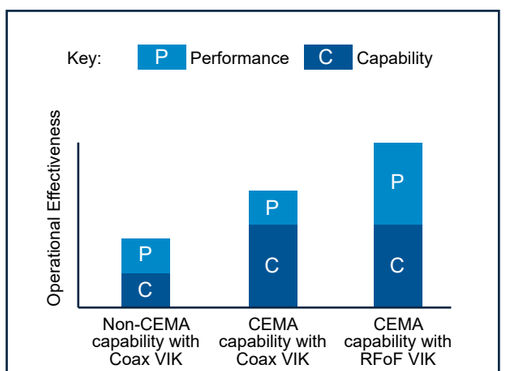
Enables the dynamic routing of signals.

Any SDR can be mapped and routed to any antenna on the platform, thus optimising the platform mounted CEMA capability to the operational threat and theatre environment almost instantly (less than a second).

The lossless feature of the RFoF VIK is especially pertinent above about 1 GHz, where many commercial and defence technologies of interest such as Wi-Fi, cellular, and SatCom sit.

Therefore, without this key feature, traditional coaxial VIKs effectively 'hamstring' the advanced CEMA capability.

The concept is illustrated in the chart, where, in the context of performance vs. capability, operational effectiveness is greatly improved with the introduction of an RFoF CEMA VIK.



Tactical land EW

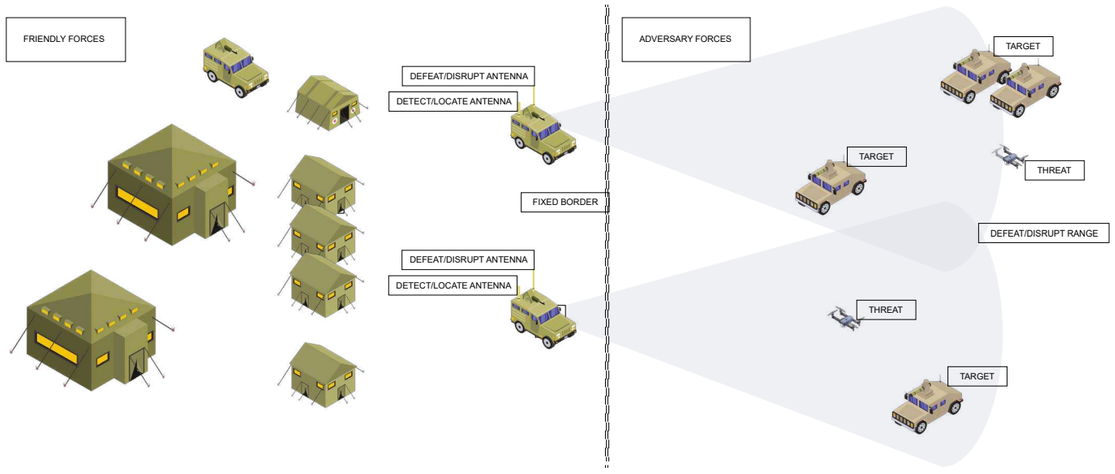
In a tactical or operational land environment Electronic Warfare (EW) consists of both Electronic Surveillance (ES) and Electronic Attack (EA). The ES capability enables the DETECT of Signals of Interest (SoI's), so that they can be analysed to evaluate whether they constitute targets or threats.

Once these targets or threats have been identified, the ES capability enables the LOCATE of them as part of Signals Intelligence (SIGINT), providing the commander with a better understanding of the battlefield to make more informed and more timely decisions.

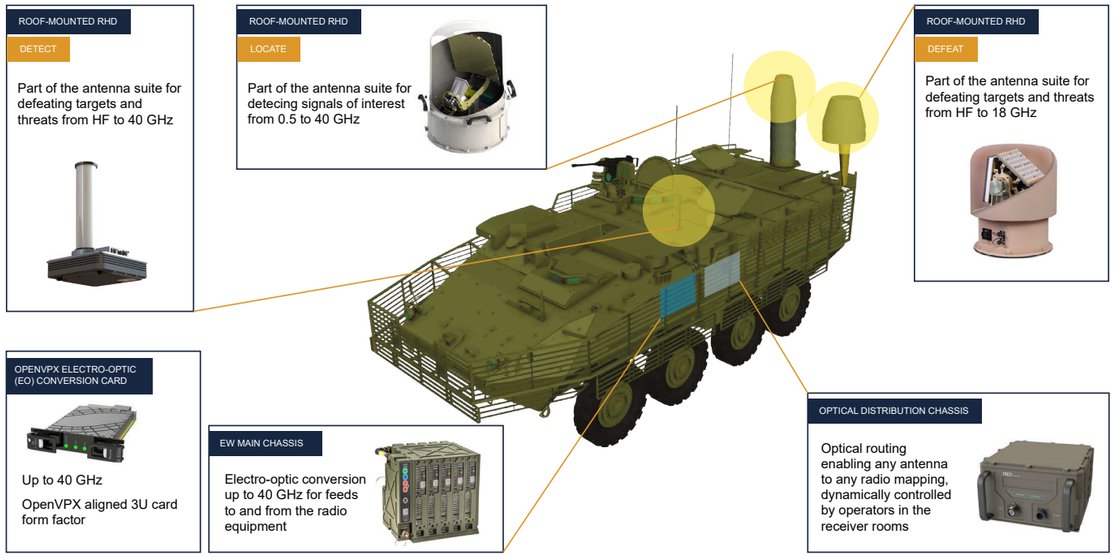
Knowing the position of the threats or targets, which could be communication or positioning signals, the EA capability can be used to DEFEAT, DISRUPT or DENY them. These effects will hinder the ability of adversaries to efficiently operate, reducing their operational effectiveness.

The below illustration shows an example land EW scenario, where EW platforms are being used to DEFEAT and DISRUPT targets. This EW effect will significantly hinder (or even stop) the adversary's ability to coordinate an effective incursion across the border.

The DEFEAT and DISRUPT effect shown below is used after the same EW vehicles have been used to DETECT and LOCATE the targets.



Example customer solution: RFoF VIK for EW



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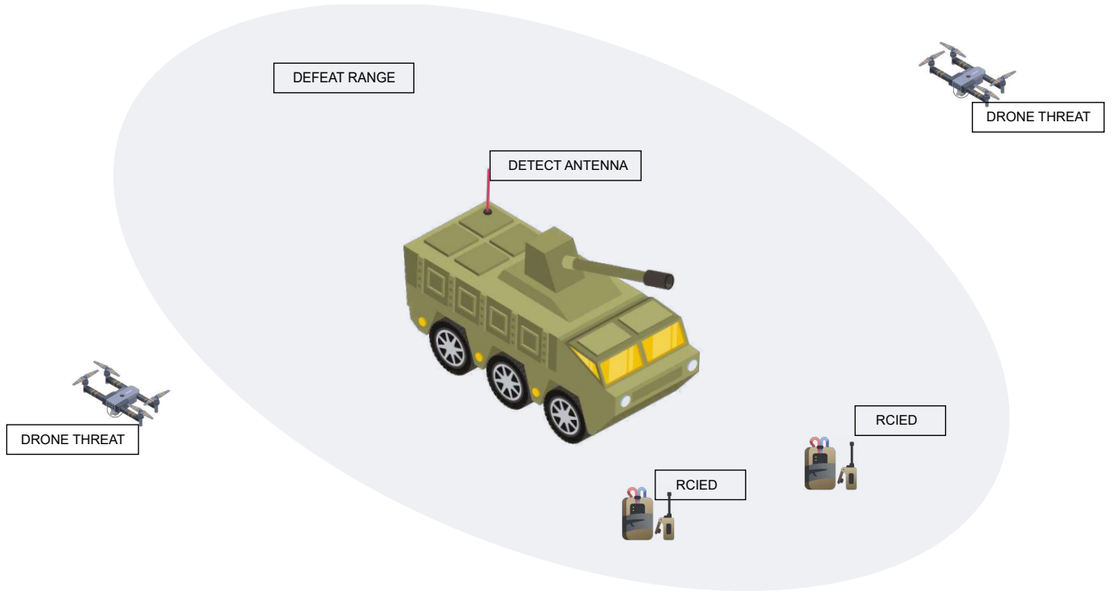
Frequency range	3 MHz to 40 GHz for DETECT functionality, with LOCATE from 0.5 to 40 GHz, and DEFEAT up to 18 GHz.
RF performance	NF of 3 to 17 dB frequency dependent, P1dB of -20 to -30 dBm, IIP3 of -20 to -10 dBm, and SFDR of 97 to 106 dB/Hz2/3. Performance can be further tuned to customer requirements. Transmit ERP from 50 to 120 W dependent on frequency. Optimised for Barrage jamming, but compatible with complex / modulated DEFEAT signals.
Modular architecture	Easily swap radioheads (without any other changes to the system) to keep the system current with the operational environment.
Azimuth & elevation control	For DEFEAT, +/-120° azimuth and +/- 60° elevation with a beam width of 30° to enable fast moving targets in the air or on land to be efficiently defeated.
Environmental	IP67 rated with operating temperature -40°C to +55°C for all external equipment, corrosive salt environment protected. Designed for operation in harsh maritime and land environments as per DefStan 00-035.
Ease of installation	Up to 3 km cable run between antenna CCU and radio equipment enabling optimised positioning for maximum effect. Ruggedised fibre cable that can use existing coaxial cable runs.

Force Protection ECM

FPECM is traditionally centred on providing a Counted-IED (C-IED) capability by jamming the remote control signals used to trigger IED's, but this same capability can also be easily used to jam other remote control signals such as for UAS's to provide a C-UAS capability.

To provide these capabilities, the FPECM system needs to be able to DETECT the threat signals and then select the most appropriate jamming signal to DEFEAT them. Therefore, an effective solution needs complete coverage of the platform using a mixture of roof mounted and side (inc. front / rear) mounted antennas, and the ability to dynamically configure the antennas used to DETECT and DEFEAT for a more power efficient capability.

Replace with the following sentence, "The below illustration shows a dual threat scenario where the same FPECM system is being used to defeat both RCIED's and UASs.



Example customer solution: RFoF CEMA VIK for FPECM

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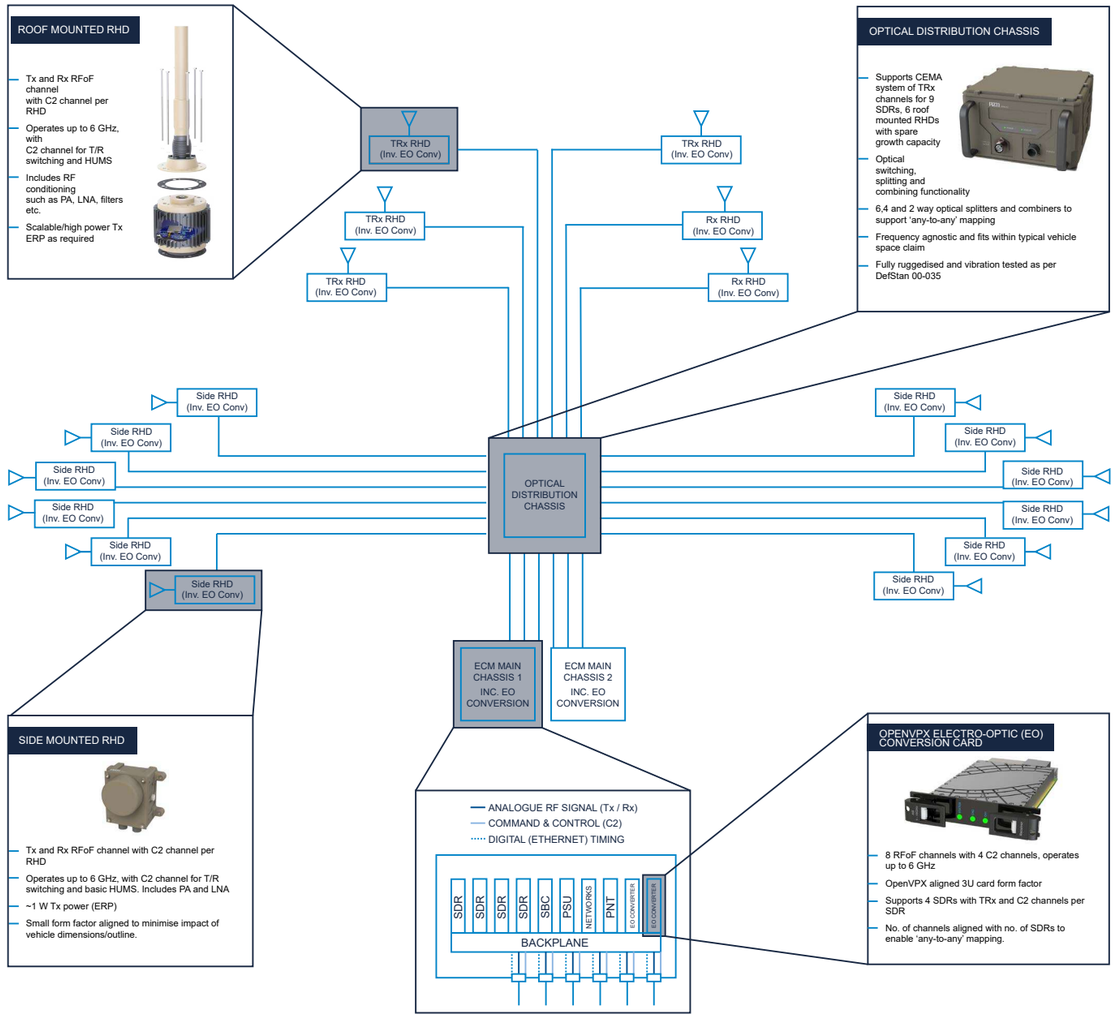
This example solution enables a switching schema to be used to minimise interference between side mounted RHDs to improve performance

It also allows an SDR producing basic/simple technique (e.g. jamming) to be optically split to all roof mounted RHDs, and then optically combined with a threat specific technique from a dedicated SDR per RHD - generating a hybrid/ complex DEFEAT effect.



PPM Systems

ppmsystems.com
+44 (0)1793 784389
sales@ppmsystems.com

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