The Logical Evolution of RF Integration in the Battlespace

CEMA

Digital Intelligence

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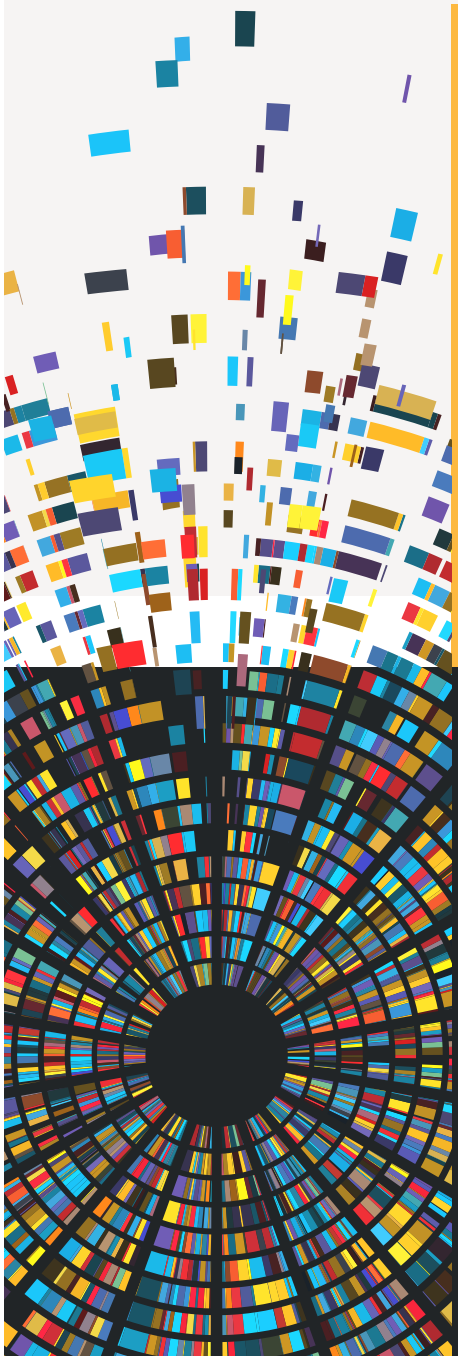
There has always been concern over the coexistence of ECM and communications at a tactical level. The more observant might highlight the incident in the Falklands campaign where a ship turned off its missile defence system in favour of communications with disastrous results. Today, the CEMA landscape is much more advanced and complex, and the problems have only got worse.

There us now a need for an ever expanding list of critical capabilities based on CEMA; Communications, Platform Protection, Sensing, Surveillance, Electronic Attack, Position Navigation & Timing and Cyber operations. Similar to the internet, the truth is no-one knows how far this will go. What we do know is the need to move data and information between platforms makes CEMA the single biggest dependency in military operations.

If this journey is to be successful, then in addition to solving the technology challenges, the integration and evolution aspects of CEMA also need to be addressed. There needs to be a consistent, converging and evolutionary approach for CEMA's future.



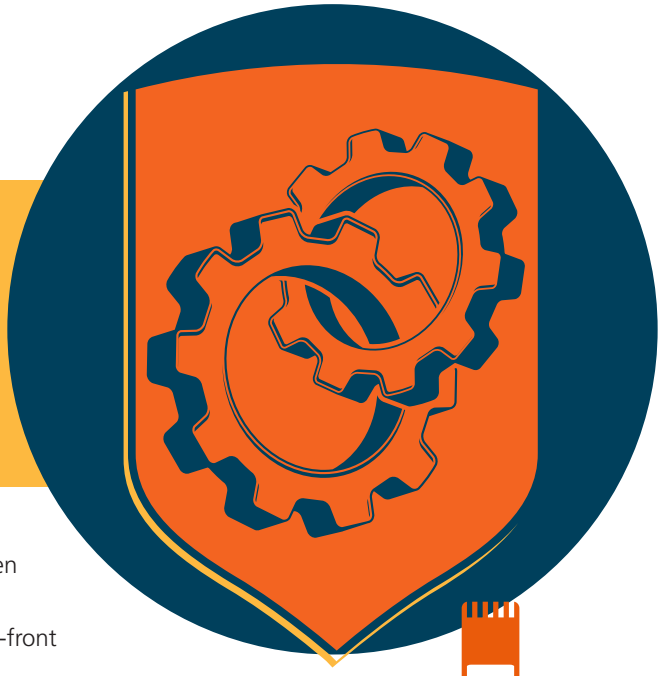
The defence open architecture journey began because there were separate platform electronics, C4I networks and ECM networks and there was a need to integrate. Three independent and expensive open architectures have been achieved for each domain.. It is not practical, affordable or viable for this to be the future of CEMA in the battlespace.

The Integration Challenge

It is important to recognise the challenges are not technology challenges, principally they stem from a lack of logical cohesion across Defence. One topical example, of which there are many within the CEMA space, is that whilst ECM and communications could be provided by a single combined system, they are procured independently with different architectures and different rules and often at different times. Whilst there are open architecture initiatives such as GVA, MOSA and Pyramid to address this, there are still barriers to prevent cohesion. This is no longer feasible for two principal reasons:

- Physical, integration and RF space is limited, with overburdened platforms that can no longer afford the size, weight and power implications.
- Independent systems cost more and as the CEMA environments mature we may not be able to afford the capability investment.

Much more can be done within Defence to create coherence across programmes and domains in this area.



So is this not what open architectures are there to address? The answer is yes, open architectures aim to bring the following benefits to the user community.

First of all there is a 'spend to save approach' - by spending a little more on the up-front procurement we reduce the cost of through life enhancements.

Second we have the agility aspects, in that new capability can be integrated faster and more flexibly increasing the ability to react to the changing battlespace.

Finally it is the SWAP reductions afforded by the common components, allowing the benefits of an integrated common system with the flexibility of independent modular procurement.

It is not the technical approach that is lacking. More that these benefits will only be gained when, and if future systems exploit these architectures. This can only be enabled if CEMA is viewed holistically and the procurement strategy doesn't compartmentalise the range of capabilities that depend on it.

Examples from the commercial world

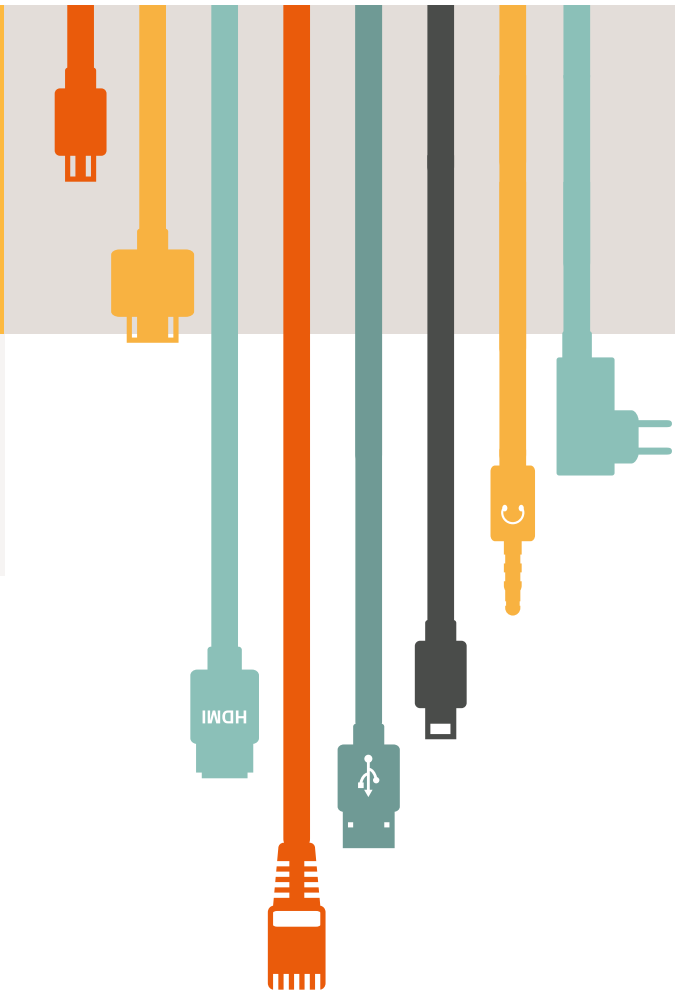
Let us examine USB, working similarly to other standards such as HDMI. Surprisingly USB is a proprietary standard, however it is open in that it allows equal access to all. 12 companies control the standard, with a non-profit, equal opportunities ethos. Any company can use the standard for a modest fee, and will need to be certified as compliant. All parties benefit from a managed standard that will be maintained, and there is control to ensure fair compliance, and all devices must be tested fairly. The standard is backwards and forwards compatible, and any USB device can work with any other regardless of version. Later standards do introduce performance advantages and features, but these are not required as minimum functionality.

This approach allows suppliers to invest in common, supported standards that will endure and be reflected in complementary products. Testing and integration is reduced due to independent verification. A supplier is independently tested against USB and a certification assures all parties that it will work correctly with all other USB devices.

This allows consumers and integration platforms to adopt USB, confident that they are long term supported standards that will have an enduring product line. It enables an open supplier market, there are multiple competing products and adoption of USB allows the freedom of choice.

USB is a proprietary maintained and managed standard that opens up the supply chain for suppliers and consumers.

If the USB standard became truly open then this would reduce its effectiveness. Maintenance may not be done, and there would be no control over who declared conformance. This would ultimately lead to its demise when products that claimed compliance did not interact with others.



How does this relate to the Defence Industry?

The defence industry is implementing measures to improve but right now there remains little commonality between procurement areas, domains and architectures. Certainly there is no centralised approach for procuring CEMA capability. Therefore there is little in regards to a common approach that suppliers can invest against. This is compounded by UK specific approaches and bespoke developments. For a supplier, a single funded delivery project for a given architecture may require significant investment. With the risk of not winning that leaves some expensive shelf wear. Directly or indirectly these risks are passed on and this results in many of the benefits of the open architecture being lost. If the architectural approaches increase cost there is a compounded risk that we invest for a saving that can never be realised.

Let us follow a thread to bring the issue to life.

If we took an example of tactical communications radio replacement, these would most likely focus on the lowest price functionally compliant radio device compatible to the Morpheus architecture. Capabilities in the CEMA space are not required and if present may not be useable for lack of alignment to CEMA architectures.

We then provide Land ECM equipment, completely independently to the Morpheus architecture. This equipment is focused on a different single function, and whilst it may be able to do a wider CEMA function instead we procure the lowest price LCA compliant ECM function. The inclusion of wider CEMA capabilities have no value to the procurement, and likely the successful product will be purely ECM focused.

We include network functions such as JICD, however due to security and interfaces it will not be able to connect to a bearer since it is not aligned with Morpheus. It is not that there is no desire to use Morpheus, more that neither the Morpheus nor LCA architectures are compatible with each other. We have added network functions but there is no network because it is out of scope of the procurement.

There is then the growing need for EW, ES and cyber capabilities that are planned to align to the LCA approach. Whilst LCA may allow these components to be added, the re-use of components is not required. To save cost, components may be selected purely for the ECM function, and therefore any wider CEMA function will not be included. Yet there are elements of common architecture meaning unfortunately there will likely be two sets of CEMA functionality in the same box. Due to the cost and integration implications this will be unaffordable resulting in a lack of EWSI capability.

It is not that we cannot purchase a CEMA capability that can provide communications, ECM and ES. It is that these projects are independent stovepipe procurements that purchase these capabilities as individual units against a price sensitive completion without recourse to other functions.

There is then the SWAP aspects, in that if these functions are procured as independent projects they will all require their own systems, something that will no longer fit on many platforms. Antenna fit and de-conflicting becomes an increasingly futile task and it is this challenge that physically demonstrates the disparate way CEMA capabilities are currently procured.

Looking at the maritime and air sector, there is bespoke architecture selection for land that is different for their environments. Therefore it is likely suppliers investing in the CEMA space will need to provide differing products and solutions for these respective environments. This is also the case for other nations, as the LCA is a tailored adoption of US standards adapted to bespoke UK approaches such as GVA.

The result is UK industry will need to make price sensitive bespoke equipment for individual programmes . Should a supplier not win this capability this will be a wasted investment. It is unlikely that UK industry will maintain these products should they not win. The concept of 'spend to save' will not be realised due to the one-off bespoke development. Instead we will end up with 'spend and not realise the benefits of investment.

A Better Approach?

In order to realise the benefits of common architectures and achieve the savings it is important to look at the CEMA and C4I space in an agnostic logical fashion before forcing a specific approach:

Antennas should be optimised and selected to cover a specific frequency and performance target, any system that needs to use this capability can use this common component. They should be selected to cover the range of current and future envisioned functions against a cost benefit case to cover future evolution.

RF and digital processing should look at the bigger picture, addressing current and future needs for capability. Processing should consider needs of overall platform CEMA, C4I and platform current and future needs. It is a lot cheaper to incorporate other features into a product at the outset than add this later at higher costs.

Architectures should be planned for cohesion and through life cost savings. The focus should be on alignment with other architectures, shared use and commonality. Components should be selected based on alignment with commercial standards and other platform systems therefore reducing integration and through life costs.

Mandating physical connectors such as GVA connectors and OpenVPX should be done with caution. Physical interfaces can be easily addressed through cables, connectors and adapters. Developing custom units to implement these physical interfaces can be complex and costly. Thought should be made on whether we are promoting a wide supply chain standard or forcing a bespoke implementation.

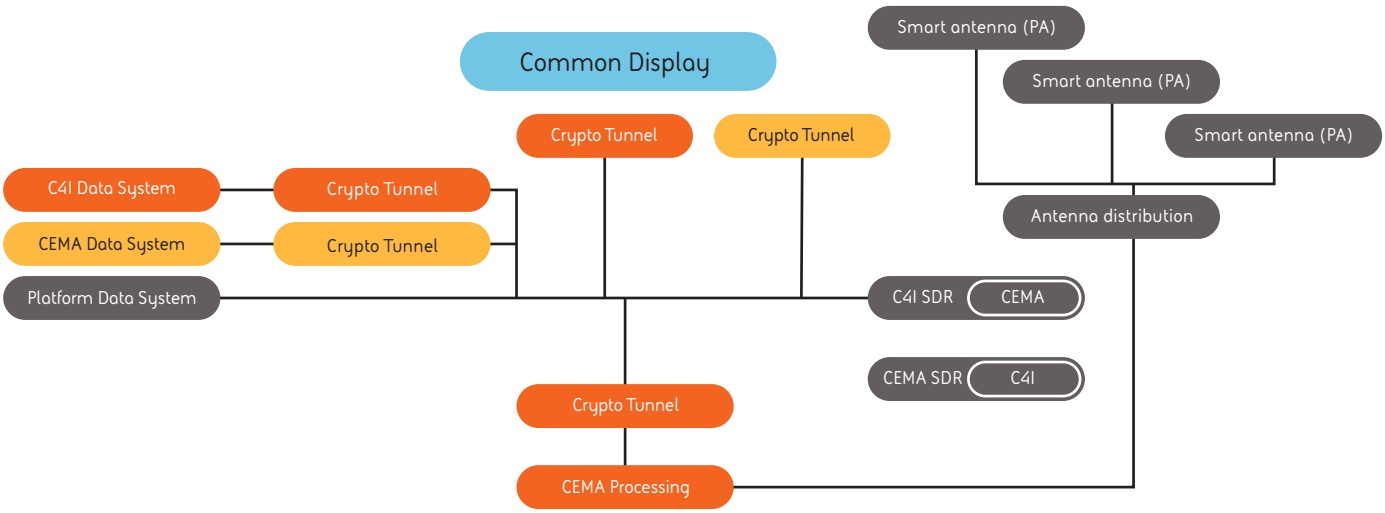
The need for improved Data Integration

For all platforms there is a desire for single points of user interaction, this saves through life cost and vastly improves the user interface. This is more than purely a data model, but the integration of data models and middleware approaches to work as a cohesive whole.

As an example, we can focus on separating each security domain into a single domain data store. These data stores can be connected both on and off vehicles via an encryption tunnel. This then requires a common official-sensitive network that can apply for all networked systems. Transmission devices focus on providing receive or transmit functions whether C4I, CEMA or otherwise. A main owner will control the primary function, and it can still be prioritised for a specific function, however it will not preclude the use of other functions. Data integration can be done at the display showing the user all combined domain security flows in a single place. The display is volatile and ensures all data remains separate. This approach largely removes the need for complex and costly data gateways.

The aim is not to enforce a particular architecture approach, the aim is to ensure re-use of common functions. A C4I radio should consider utilisation for CEMA and equally CEMA should consider C4I. Digital or analogue distribution is less important than remaining consistent on the platform, with new systems selecting how to upgrade the systems as a whole. A new system may choose to utilise the existing analogue distribution and supplement this, or it could replace the whole with digital. What it cannot do is a lack of integration with the current system or fail to consider the future use of other systems.

Some of the concerns with bearer integration are based on data usage on restricted bearers. There is a fear that by sharing bandwidth this will make them unable to perform their primary communication function. This is where edge processing comes into play, where processing is done at the tactical edge to ensure tight control over data usage and better QoS management.



We should develop displays to meet the overall platform needs rather than an individual system. C4I should provide overall communications needs not just C4I and systems should be designed to allow exploitation by other systems.

A converging Evolutionary Approach

One of the main challenges of multi-domain integration is how do we deal with non-compliant platforms. Any single supplier can propose a multi-domain system and ensure integration with all his platforms, however the reality is they are never going to have control over all platforms. There will always be legacy, other nations and other suppliers all who have a view on this integration. Equally even if this was not a barrier the UK simply cannot afford to upgrade 'all of anything at once' and must always work with a mixture of versions.

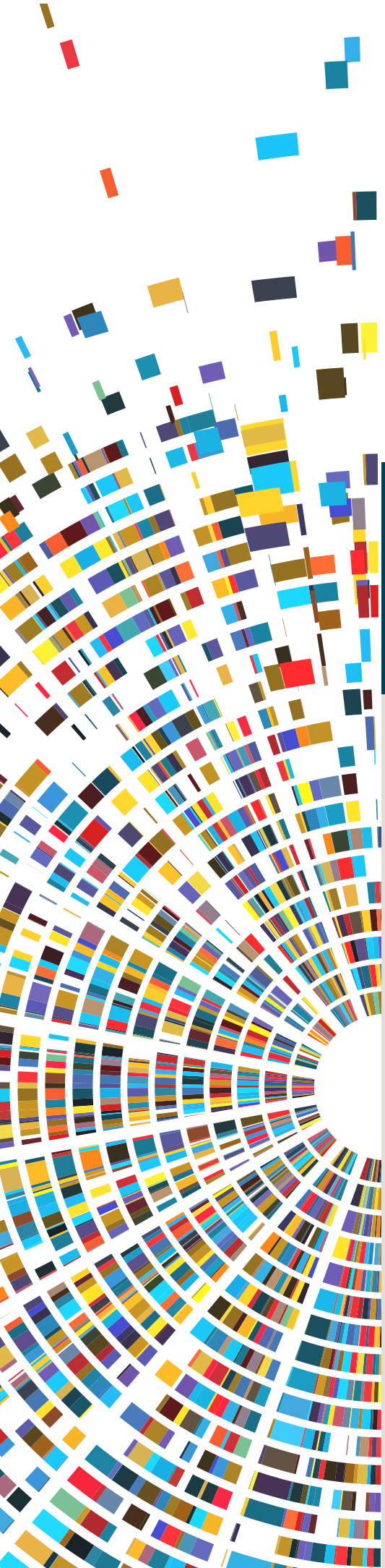
By aiming to converge rather than enforce an architecture we can deal with non-compliant platforms. By decomposing functions into modular building blocks each of these blocks can be used interchangeably, running some functions in parallel. For example an open software defined radio can run a link16 waveform, Morpheus waveform or any other waveform. A modular crypto can be provided separately to allow red data to be sent for each of the connecting systems. If we use open software frameworks then waveforms can be delivered through software applications to allow change of mission roles in a more agile manner.

Convergence cannot be achieved without a long term plan or road map that considers a series of stepping stones towards fuller compliance, taking into account a multi-domain approach.

We cannot continue with the current stove-piped CEMA and wider defence approach. BAE Systems is developing agile reconfigurable solutions to serve the converged vision identified. We ask to jointly discuss our ideas and investments in light of this vision, to mutual benefit, in enabling agile and high tempo multi-domain operations.

About the author

Chris McDonald is Lead CEMA system engineer working for BAE Systems Digital Intelligence. He is a member of the GVA and CTG Working Groups, a chartered engineer and has experience in advisory roles in to MOD over his 25 years in the defence industry.



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