2020s vision: New tactical command systems begin to take shape

As the existing generation of systems approaches obsolescence, France, Germany, and the United Kingdom are all replacing their land forces C3 elements, while the United States continues its spiral development path. **Giles Ebbutt** examines the replacement projects

Land force command, control and communications (C3) systems do not have the visual impact and headline-grabbing quality of a new armoured vehicle or artillery system, but like logistics they are fundamental to effective operational capability, particularly at the tactical level at brigade and below. There are large projects to renew C3 systems in various stages of gestation in three major NATO countries as well as other developments.

These will replace systems based essentially on 1990s technology and are therefore in a position to reap the benefit of the advances in information technology in the last decade.

The United Kingdom is in the early stages of its programme to replace the Bowman tactical communications system and associated battle management system (BMS), although the MORPHEUS programme, as it is known, has a broader embrace than a straightforward one-for-one Bowman replacement. It will also include the dismounted situational awareness (DSA) element of the future soldier system programme, and plans include incorporation of the successor to the Falcon area communications system, Project TRINITY.

MORPHEUS is the major part of the Land Environment Tactical Communications and Information System (LE TacCIS) programme, with approximately GBP3 billion (USD4 billion) out of the total LE TacCIS GBP4 billion funding over 10 years, according to Brigadier Richard Spencer, head of the UK Ministry of Defence's (MoD's) Battlefield and Tactical Communications and Information Systems (BATCIS) delivery team. This funding is split about 66/33 between Joint Forces Command (JFC) and Army Command, with the army responsible for funding the dismounted capability, although Brig Spencer said that funds could be moved between the two to reflect needs.

HQ ARRC: 1448761

An early entry small form factor palletised version of the Falcon area communications system, shown here on exercise with HQ Allied Rapid Reaction Corps (ARRC), has been developed to provide a rapidly deployable capability. It is expected to be introduced by the end of 2017.

Three possible strategies were originally studied for replacing Bowman: Sustain, Evolve, or Replace. Replace, the 'big bang' approach adopted for Bowman, was discarded as being too disruptive and likely to be expensive. While Sustain – maintaining the existing system and updating where necessary – remains a fall back option. Evolve is the strategy that has been adopted.

Brig Spencer said that his team is working on three different timeframes: Now, Next, and Future. The Now timeframe includes improvement to existing systems. The final upgrade to the Bowman Common Battlefield Application Toolset (ComBAT), Infrastructure and Platform (BCIP) Battlefield Information System Application (BISA) is BCIP 5.6, developed by prime contractor General Dynamics and being trialled in late 2017. The main element of this is a significantly improved version of the ComBAT BMS. Brig Spencer told *Jane's* that this has a much more intuitive front end and has been almost universally welcomed by users who have been exposed to it, a phenomenon that has not been universally true of Bowman developments. BCIP 5.6 is planned to be fielded over two years, starting in late 2018.

Also part of the Now element is an early entry small form factor palletised version of Falcon, which has been developed by BAE Systems to provide a rapidly deployable capability. This was trialled in late 2017 and is expected to be introduced by the end of the year. Brig Spencer said that the existing palletised version of Falcon is too large and is over-capable for the early entry task, so a balanced risk has been taken on the capability required and the size, weight, and power (SWaP) has been squeezed. The result is a much-reduced Falcon node, two of which can fit on a single aircraft pallet, which could provide the necessary connectivity and switching capability for a deployed operating base.

The Next element of the BATCIS agenda is the provision of the Joint Common Remote

Viewing Terminal (JCRVT) for which L3 Communications was awarded a five-year USD23 million contract in July 2016. The JCRVT is based on L3's Remotely Operated Video Enhanced Receiver (ROVER) family and will enable the exchange of Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR) data including full-motion video (FMV) across the battlespace. A version of the ROVER 6i transceiver will be supplied to the navy and the army will get a version of the Tactical Network Rover (TNR), itself a pocket version of the ROVER 5i transceiver.

The meat of the BATCIS agenda is Future, which is principally MORPHEUS, the intended outcome of which is "delivery of the tactical edge of the Single Information Environment, enabling decision support and information superiority for commanders in the LE tactical battlespace".

Bowman was delivered and is being sustained by General Dynamics as the prime contractor, owning all the intellectual property, acting as the design authority, and being responsible for the test and reference centre. The MoD's intention with MORPHEUS is to "take back control", unlocking ownership so that it becomes a "quasi prime", managing the project, returning the design authority in-house and moving to a multivendor, multicontract relationship. Brig Spencer acknowledged that it will be a challenge to establish the necessary expertise to manage the project. "We are still defining how much of this we will buy in and how much we develop ourselves," he said.

The first stage of this is through a solution called "Evolve to Open" (EvO), which remains the responsibility of General Dynamics as the transition partner through a GBP330 million contract awarded in April 2017. This will evolve Bowman from its current closed, proprietary, vendor locked-in status to what Brig Spencer described as an open, delaminated agile system. This will enable the MoD in future to procure different aspects of the system separately with different contracts; these could include systems integration, the provision of network-managed services, infrastructure, applications, a logistic wrapper, and fielding support. "At the end of EvO we will own the architecture and have unfettered intellectual property [IP] rights to the system solution and products," said Brig Spencer.

The EvO contract is for 45 months, with a Main Gate decision currently anticipated in around 2021. The aim by that stage is to have achieved a large-scale laboratory-tested capability. This would be followed by a demonstration period leading over two years to the equipping of a complete brigade. Initial Operating Capability (IOC) will be achieved when a brigade is equipped at EvO baseline, and this will be followed by large-scale manufacture and general fielding. Brig Spencer considered that in the worst case Bowman will remain in service until 2028.

Giles Ebbutt: 1529878

A screenshot of a BCIP 5.6 tactical picture in the new version of ComBAT overlain on satellite imagery, shown in September 2016 at the DVD exhibition.

EvO will consist of three layers: network, infrastructure, and applications. Part of the EvO process is to establish a defined architecture and standards, showing how a module will operate within a layer and interact across the layers. This will be fundamental to the whole principle of being able to develop different elements of the system separately; providing a new module meets these standards there should be greater confidence that it will work properly, reduce the need for testing, and allow more frequent updates.

The MoD is establishing a Tactical Architecture Forum that will bring together the project office, the user, and industry to share this architectural approach and the most suitable standards. The important element is interaction: IP within a module will be irrelevant providing it meets the necessary standards for integration. These standards will allow capability delivery on an evolutionary basis, with development in different layers at different times.

Brig Spencer said that the project would always look for open and industry-accepted standards, but would draw on the work done to develop standards for NATO's operational-level Federated Mission Network (FMN) if they were relevant.

He also said that he was keen on small- and medium-sized enterprise (SME) involvement in the project and noted that General Dynamics had targets for this in EvO. There is also a desire to draw on the widest possible pool of ideas. "We want to move away from it being a defence industry game to it being a wider ICT industry game," observed Brig Spencer.

In due course a Joint Project Office (JPO) will also be established, which will include representation from all involved once contracts have been awarded. "We want to get proper user feedback really early in the project," said Brig Spencer, observing that "we have the challenge of a vertical range of users from the dismounted infantryman to the brigade commander who wants to do full spectrum effects planning, as well as the breadth encompassing combat support and combat service support, as well as air and maritime users".

For EvO General Dynamics is working on three distinct products: Conductor, Manage, and the Modular Platform Processing System (MPPS). Conductor is a tactical internet framework that will provide the brokering capability between the different layers. It will manage the interaction between multiple different bearers and multiple battle

Giles Ebbutt: 1642661

A large screen display showing the French SICS dismounted soldier touchscreen interface.

management applications (BMAs). Manage will provide the network planning and monitoring tool, replacing the current Bowman communications management system (CMS) with a much simpler system. The MPPS is the replacement for the Vehicle Internal Distribution System (VIDS), which distributes data around a platform.

EvO will also include the development of a new BMA. "We'll either take an existing BMA and develop it or develop a new one from scratch," said Brig Spencer. The key requirement is that it does not come with vendor lock-in; it must be possible to adapt it and have control over that adaptation process.

The Invitation to Negotiate (ITN) for the new BMA was issued in late August 2017. The requirement includes the provision of geospatial services; a Local Operating Picture (LOP) to the user, relevant to their area of responsibility; a mission planning tool that can conduct and assist with wargaming and Rehearsal of Concept (ROC); an order of battle/task organisation (ORBAT/TaskOrg) editor; and some services as part of the Tactical Integration Framework (TIF) including a GIS interface and a symbology service interface.

The ITN requires the delivery of a fully functional EvO baseline software drop by mid-2020, with three earlier developmental software drops, and also includes an optional requirement for an enhanced dismounted user capability. A system acceptance test (SAT) by late 2020 will determine acceptance, prior to the Main Gate decision in 2021. Full operational capability will be across 17–24,000 devices, ranging from desktop computers to tablets.

As part of the EvO contract, General Dynamics will provide the middleware hosting environment and core services such as messaging and chat. Specific applications will then provide the necessary functionality. These will all interact and share data through the middleware, so that, for example, situational awareness information from the BMA is available to all apps.

The five existing BISAs in BCIP that cover fire support, combat engineering, ground-based air defence, NBC defence and support to the Watchkeeper unmanned aircraft system will initially be hosted on the EvO baseline. The army is currently developing its future strategy for applications. One possibility is to move away from single applications covering every aspect of a tactical function and use a number of small applications, each addressing a particular function and which can be accessed by any user via the middleware. This will contribute to the modularity of the system and make upgrading easier.

A critical part of MORPHEUS is the provision of DSA, the integration of the soldier with the network, and the ability to smoothly transition from the mounted to the dismounted state, with an immediate GPS fix and an accurate tactical picture. Brig Spencer said considerable effort is being made to ensure the wider dismounted soldier system programme, which covers the whole range of weaponry and personal equipment, is synchronised with the DSA element of MORPHEUS as the two are inextricably linked.

Interoperability is a constant mantra for coalition operations. At the tactical level, the British Army seeks to achieve interoperability in secure voice, the COP, digital fires and ISR sharing, with 'Five Eyes' and NATO partners, and MORPHEUS will seek to do this through common waveforms and its standard-based architecture. Brig Spencer noted that it is important to distinguish between technical and procedural interoperability and that the latter can be more of a challenge. Planning processes may differ between countries, and language differences can cause confusion, particularly where the same terminology can mean different things.

As a consequence of "taking back control" the MoD will have to establish its own MORPHEUS test and reference capability (MTRC) to replace that currently provided by General Dynamics at its Oakdale facility. Brig Spencer said he envisaged that initially there would be a small test facility established at the Land Systems Reference Centre, but this would expand in due course, possibly to a location in the Salisbury Plain area. He observed that there could be opportunities in the future for a cloud-hosting arrangement, which would make it easier for developers to test apps.

There is also the requirement to establish a reference centre for physical integration. The ITN for MORPHEUS Installation Design and Certification (MIDAC) was issued in August 2017.

The initial test centre will be responsible for testing and certifying vehicle installations. The plan is to design 10 first-of-type demonstrators, ranging from a simple platform to "something like AJAX", which will then be tested. Potentially, the EvO baseline will also be integrated at the land-based maritime reference centre at Portsdown to test its naval integration, with the hope that as much as possible can be hosted on existing ships' processors so that they only have to recognise a datastream coming into the platform. Integration with helicopters will also be explored, probably using virtual platforms to start with.

Renewing the network element of MORPHEUS does not all have to happen at once. HF, VHF, and UHF radios, LTE and SATCOM could all be run as separate projects, observed Brig Spencer, which will spread the cost. Eventually, radio providers will be able to write the interface with the middleware themselves with the support of a developer's guide. This will allow change to take place in a modular manner, making the system much

more adaptable over time.

Project TRINITY will provide the future WAN, replacing Falcon, but not the latter's LAN and switching functionality, which will be provided by MORPHEUS and the new style of IT deployed (NSoIT[D]). TRINITY's Initial Gate decision is due in late 2017 with the aim of achieving an early fielded capability by 2021.

The French Army's new BMS, the Systeme d'Information du Combat Scorpion (SICS) (Scorpion Combat Information System), being developed by Atos Technologies, is a key element of the SCORPION (Synergie du COntact Renforcé par la Polyvalence et l'InfovalorisatiON) programme to modernise the combined-arms capabilities of the French Army at battlegroup level and below. It has been developed using an agile methodology with continual user input.

SICS will replace five separate low-level BMS from three manufacturers: Système d'Information Terminal (SIT); Système d'Information Régimentaire (SIR); MAESTRO, the special forces system; SIT COMDÉ (Combattant Débarqué) for dismounted personnel; and SITEL (Elementaire or generic).

It is based on Atos' Bull BMS, which contains a number of elements all of which were core requirements for SICS. These include: compliance with low-bandwidth communication networks; communications agnostic; operating system independence; interoperable with NATO Friendly Forces Information (NFFI); provision of blue-force tracking (BFT), chat and situational awareness; and ease of deployment, use, maintenance, and training.

The system uses a standard layered open architecture and incorporates a multipurpose communication server that supports a range of tactical radios plus GSM, LTE, TETRA, TETRAPOL, and SATCOM. For the French Army, the emphasis has been on integration with the Thales PR4G using the TDMAI waveform, which was originally developed for use with the French aviation BMS SIT-ALAT, and with the Sagem RIF-NG for dismounted personnel. In future the system will use the Thales Contact software-defined radio, which is expected to be fielded in 2019. The BMS uses the Luciad GIS for mapping and Open Office for its core office functions.

SICS has three levels with the same software but different HMI: the dismounted soldier and vehicle-mounted commander variants have a touchscreen interface, while the variant intended for command posts (CP) has a conventional mouse and keyboard. The mechanics and the HMI have been inspired by social media, a reflection of the constant user input during development, so the system should be intuitive to use.

The interface between SICS and the new French higher level command system, Système d'Information des Armées C2 (SIA C2) will be at battalion level and it will be based on the same data formatting and messaging protocols. SICS tracks will be aggregated in SIA C2, but this will be configurable, enabling SIA C2 users at brigade or above to drill down to greater granularity if necessary.

SICS will be interfaced with Atlas, the French indirect fire-control system from Thales. There will be two levels of interface. The lower will provide for the automatic exchange of BFT and other track data while the higher will enable the exchange of fire plans and tactical plans. The call for fire function within SICS will be quick and based on automatic mechanisms. An interface with MARTHA, the French ground-based air-defence system from ThalesRaytheonSystems, will also be developed.

SICS Version 0.1 (V0.1), which was the third experimental

software release, was delivered in October 2016. Sylvain Gonnet, Atos project director for the Bull BMS told *Jane's* that for the CP version a collaborative working capability was added. The messaging tool and the chat facility were improved for the vehicle-mounted version, as was integration with vehicle vetronics.

The French Army has not adopted a standard vehicle electronic architecture like the Generic Vehicle Architecture (GVA), but each vehicle manufacturer has developed its own architecture and protocols.

Annual SICS software releases will take place every July, said Gonnet. The main feature of V0.1.1 in July 2017 was an improvement in the communications protocol, developed with Thales to overcome poor voice quality with the PR4G radio when used in conjunction with the system, which "had been a bit of a show-stopper but was now solved". He said a new protocol will be developed for the Contact radio, which will be included in the software release for 2019.

V1.0 in July 2018 will be the first version to be deployed widely in the French Army. This will add further simplifying improvements to the HMI for all versions plus additional capabilities to the CP version, and will include integration into the new Jaguar and Griffon vehicles. V1.1 will be issued in July 2019 and Gonnet said that it would be this version that will be used by the first operational SCORPION brigade by the time it achieves full operational capability, which is expected to be in 2021. Gonnet noted that Atos would "be working closely with the [first user unit] during the introduction of the system".

In French doctrine, interoperability is achieved above battalion level. However, SICS will be deployed on the Exercise 'Bold Quest' coalition interoperability test event in October/November 2017 to assess its capability in exchanging positional information with allied C2 systems and updating the operational picture using the NFFI protocol.

Synchronised with the SICS programme has been the development of the Bull BMS, which has a more generic character. It is designed for export releasability and to be flexible enough to meet a range of customer requirements. Gonnet noted in particular the need to be compliant with a range of data protocols, such as ADAT-P3; to accept different communication protocols; and to be integrated into different vehicles. Atos has a customer for the Bull BMS, but Gonnet was unable to identify them.

IHS Markit/Patrick Allen: 1475307

Rohde & Schwarz announced in July 2017 that it had been awarded a contract to equip an initial 50 Puma and Boxer (shown here) command vehicles with the Software Communications Architecture (SCA)-compliant Streitkräftegemeinsame Verbundfähige Funkgeräteausstattung (SVFuA) joint software-defined radio system, a first step in the MoTaKo programme.

The Bundeswehr has two programmes, Mobile Taktische Kommunikation (MoTaKo – mobile tactical communication) and Mobiler Taktischer Informationsverbund (MoTIV – mobile tactical information network), which together will provide its future tactical C3 system. Taken together they aim to achieve something similar to much of the MORPHEUS programme. Quoted by *Jane's* in May 2017, the Inspector of the German Army, Lieutenant General Jorg Vollmer, described the main thrust of the MoTaKo and MoTIV programmes as being capable of creating a next-generation C3I suite that can support Bundeswehr ground forces conducting multinational and joint expeditionary operations.

The first MoTaKo/MoTIV-equipped task group is expected to be operational in 2023.

The leading contenders for the two programmes are probably the "home team" of Rohde & Schwarz (R&S) and Rheinmetall, which announced in March 2017 that they had formed a partnership and subsequently announced in September 2017 a formal joint venture to apply for the projects. Their position as front runners was reinforced when R&S announced in July 2017 that it had been awarded a contract to equip an initial 50 Puma and Boxer command vehicles with the Software Communications Architecture (SCA)-compliant Streitkräftegemeinsame Verbundfähige Funkgeräteausstattung (SVFuA) joint software-defined radio system, a first step in the MoTaKo programme.

The joint venture might offer a MoTaKo solution including the R&S vehicle-mounted software-defined tactical radio (SDTR) and handheld SDHR V/UHF radios; Telefunken's HRM 7000 (400W) HF radio; and RUAG's tactical vehicle switch router.

At the DSEI 2017 exhibition in September in London, Rheinmetall, R&S, and ESG Elektroniksystem showed a concept demonstration integrating Rheinmetall's Gladius dismounted soldier system, a version of which is in service with the Bundeswehr as the Infanterist der Zukunft – Erweitertes System (IdZ-ES; infantryman of the future – extended system); a Boxer armoured vehicle representing a mobile company CP; and a static HQ. The BMS being used was Rheinmetall's TacNet for dismounted and vehicle use, integrated with ESG's Taranis for the HQ. This was also linked to ESG's joint-fires command system, in service with the Bundeswehr as Adler II.

A company representative emphasised that this was merely a demonstration of existing capability. He suggested that in future the MoTIV solution might well consist of a software core with a number of applications for specific functions, noting that interoperability was a key requirement.

Another company eyeing the MoTIV/MoTaKo prize is likely to be Elbit Systems (of which Telefunken Racoms are a wholly owned subsidiary), which is the prime contractor for the Israeli Digital Army Programme and provides the IDF's radios and the TORC2H BMS, as well as the BMS element of the Australian Army's Land 200

digitisation programme and a number of similar unspecified projects elsewhere.

There are a number of other companies which can offer either communications or BMS solutions but which have not yet broken cover in formal partnerships and may not until the Request for Information (RFI) is issued sometime in 2018. Thales and Harris are among those probably eyeing MoTaKo. Atos confirmed to *Jane's* that it is keeping a watching brief on MoTIV, as did Danish software house Systematic whose SitaWare C2 software suite is in use in more than 15 countries including Denmark and New Zealand. It is the BMS in the recently awarded United Arab Emirates land forces C2 project with legacy Thales radios for which Harris is the system integrator, and provides the C2 software in Harris' rebadged hC2 offering.

Atos, Systematic, and Elbit Systems have also confirmed to *Jane's* their interest in the BMA element of MORPHEUS, and General Dynamics, as the incumbent, is also almost certain to be in the running.

In the United States, the issue of brigade and below C2 has a slightly different focus and is concentrated on achieving seamless interoperability between a number of stove-piped systems such as the Joint Battle Command-Platform (JBC-P) and the Advanced Field Artillery Tactical Data System (AFATDS).

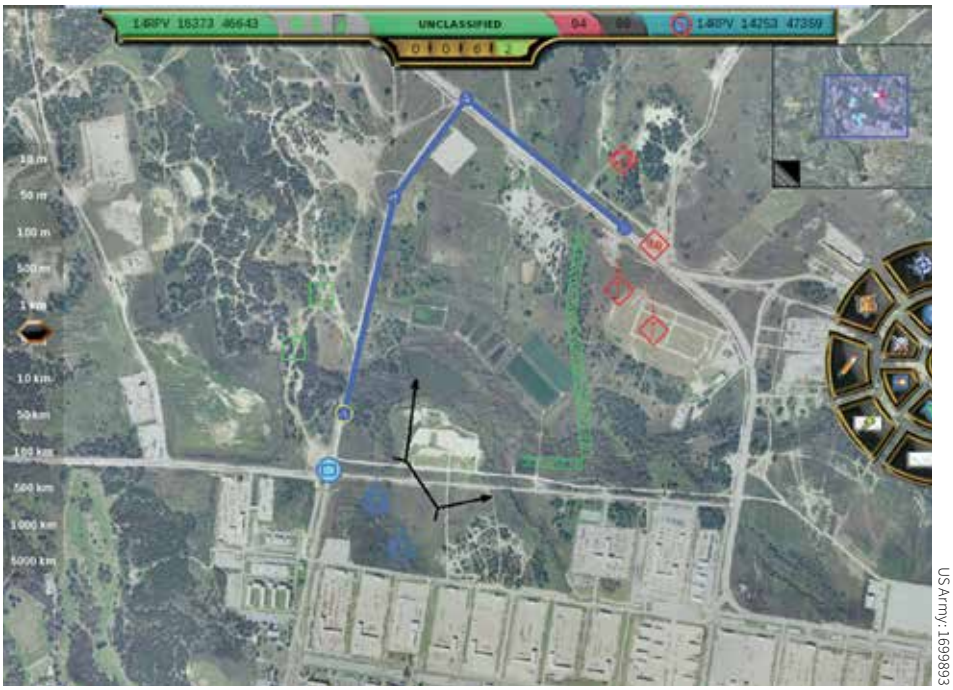
JBC-P is the vehicle-mounted C2 system that has been developed from Force XXI Battle Command Brigade and Below (FBCB2), the US Army's original tactical C2 system, and is currently being fielded. AFATDS, now in its sixth generation, provides C2 for fire support and has been in service since the mid-1990s. Both have had separate development paths, as have a number of other systems that support other tactical functions. As a result, they do not work seamlessly together despite efforts over a number of years to achieve data exchange.

Headway has finally been made with the development of the US Army's Common Operating Environment (COE), which encompasses six different computing environments (CE), including the dismounted, handheld CE, the vehicle-centred mounted CE (MCE), and the static command post CE (CPCE). The COE uses a common web service framework called Command Web and the ultimate aim is to render all the C2 systems as applications within the COE.

Much of the work has concentrated on the CPCE and MCE, these being the two areas where tactical C2 is concentrated. V2 of the COE has been completed, consisting mainly of consolidation of hardware within the tactical server infrastructure, reducing the server requirement in a headquarters to a single scalable server stack. The number of mapping engines in use has been reduced from 13 to six, with the ultimate aim of a single-mapping engine across the enterprise.

Development of V3 is still in progress and is expected to be fielded by 2019. This will provide a complete new architecture that will provide a common software baseline, a common map and other geospatial functions, and a common suite of hardware devices. It will share the geospatial environment to a common operating picture (COP). Applications for different tactical functions will be accessed through widgets in an ozone widget framework.

Subsequent versions are still at the planning stage, but V4 will probably concentrate on unified data, with a single data structure, common data standards and no translation mechanisms. It will also provide an enhanced COP and will address joint operability with navy and air force systems. V5 will concentrate on Mission Command on the Move and the associated latency issues as delays due to latency are not acceptable in a collaborative environment.



US Army: 1699893

A screenshot of the US Army's Joint Battle Command-Platform (JBC-P), which is the vehicle-mounted C2 system currently being fielded. It is developed from the Force XXI Battle Command Brigade and Below (FBCB2) system.

Unusually, in February 2017, Systematic was awarded a single-source contract worth potentially in excess of USD200 million to provide elements of SitaWare to support the synchronisation of mission command data across different levels of command. The Coalition Gateway embedded in the software will also provide interoperability with allies at the tactical level, a key and urgent requirement for US forces in Europe. ■

First published online: 27/09/2017

Comment

Open architectures, operating platform agnosticism, modularity, common services, flexible applications and intuitive, user-focused interfaces are all characteristics of the tactical C2 systems emerging to replace the systems designed in the 1990s, well before the era of the smartphone interface and application-based access to different functionality.

France is slightly ahead of the game, although SICS is a less wide-ranging project than MORPHEUS and MoTaKo/MoTIV, and the United States has a slightly different focus. But by the mid 2020s, while tactical situation displays may look much the same as they do now, the technology improvements behind them should bring a considerable increase in operational capability.