QINETIQ

Enabling future maritime operating concepts

Introduction

As the cost of conventional warships has increased dramatically over the years, many nations have been experimenting with Uncrewed Autonomous Vehicles (UxVs). These are seen by naval force developers as critical enablers for the future operating concepts, where the aspiration is to use UxVs together with manned platforms to create mass, reduce force vulnerability to new missile threats, as well as enabling the wider dispersal of naval forces andgreater lethality. Navies aspire to use UxVs not only singly, but also in collaborative swarms to deliver more comprehensive Intelligence, Surveillance and Reconnaissance (ISR) at range, in the surface, sub surface, and air environments.

Whilst UxV technologies have developed apace in recent years, these still tend to be proprietary Commercial or Military Off-The-Shelf (COTS or MOTS) solutions encompassing not only the UXV asset and the sensors on it, but also its Ground Control Station (GCS) and the communications bearers between the two. Effectively these are closed, “black box” solutions as far as naval procurement authorities are concerned. Given that one UxV provider’s GCS is typically unable to control another provider’s assets, if UxVs from different vendors are to be deployed on the same warship, then rack-space will potentially need to be found for multiple GCSs and their communications fits. Mast space will potentially also need to be found for multiple aerials, raising a realistic prospect of mutual Radio Frequency (RF) interference.

System of Systems

While "black box solutions" undoubtedly have their place in modern naval inventories and are easier for defence authorities to procure, navies seeking to create a more flexible, modular, interoperable, and interchangeable UxV ecosystem would benefit from considering an alternative "white box" approach.

This effectively puts responsibility for system of systems design, architecting and integration firmly in the hands of the military customer. However, to do this client authorities need to have sufficient numbers of Suitably Qualified and Experienced People (SQEP) with the right skills to define these architectures, and organisational commitment to invest in the medium to long term – as architecting is not a one-off activity.

Architecting for Success

QinetiQ's point of view is that four distinct architectures and associated standards are needed to ensure integration, interoperability and interchangeability by design.

Optimally UxV GCSs are integrated with the warship's Combat Systems (CS) so that the ship's Warfare Officer can assign tasks and receive information from UxVs through a single screen. However, considering the many different CS and potential diversity of UxVs, without intervention each GCS and each CS will require a bespoke interface, creating a complex many-to-many integration problem for naval procurement authorities. To solve this, for one client QinetiQ developed an UxV C2 Abstraction Architecture, which effectively creates a standard mission/C2 information architecture for GCSs, CSs and UXVs and has been proven in NATO experiments.

However, this alone is not sufficient to solve the problem if one vendor's GCS is still unable to control another vendor's UxV. A Common Control System Architecture also needs to define a set of control standards for military UxV assets, and associated weapons and sensors.

Furthermore, as drones become more central to the conduct of naval operations, the need for secure reliable communications with UxVs becomes paramount. A Maritime Communications for Autonomy Architecture defines a set of standardised multi-bearer and multi-constellation communications services, including gateways, to guide the procurement of communications equipment for ships and UxVs, while minimising the need for rack and mast space on warships.

Lastly, a Modular Autonomy and Payload Architecture defines the key modules deployed at the edge, in the UxVs themselves. This architecture specifies not only the Size, Weight and Power (SWAP) needs for a family of modules, but also the nature of their interfaces to the extended system of systems.

QinetiQ has over 20 years' experience in testing and integrating complex maritime systems of systems, including physical integration to the ship, a deep expertise in developing architectural approaches to enable C2 and flexible control of UxVs, as well as their integration into a distributed highly networked system of systems.

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