Project NavyStar

Commander David Price discusses the Navy's progress in implementing the new communication system…

The original NavyStar system – based upon the OASIS 11 design – comprised a ring backbone of fibre optic cable with nodes to form a single Fibre Distributed Data Interface (FDDI). The nodes formed the link between the backbone and the local cabling down to the peripherals. The servers were enclosed in a server cabinet with an Uninterruptible Power Supply for resilience, and the system included provision for communication between the ship and the shore by a physical connection when alongside, and a brouter connection to a satellite communication link (Satlink) when deployed.

The system was to be installed in ships through the Alteration & Addition (A&A) process during refits and other major upkeep periods. Those with experience or knowledge of ship upkeep cycles will be aware that planning for ship refits can be a long and arduous task beset by many pitfalls. Of most importance to infrastructure installation was the need to initiate the LAN specification and topology early enough to ensure that this was included in the refit work packages. Planning for refits can take anything from eight months for a minor war vessel, and as long as four years for nuclear submarines, before the upkeep period commences. The project had initiated A&A action throughout the fleet, and a programme was drawn up to cover all the ship refits as they occurred. The programme initially showed 10 years of elapsed time from first fitting to the final installation – the tail being driven by the difficulty in matching the nuclear submarine programmes. The surface fleet was less complex, and each ship was taken in turn during the normal rotation of units to meet force deployments.

The programme commenced with HMS Cardiff in April 1997, and early completion of the major surface units was achieved by the Fleet Time installation of two frigates, HM Ships Cornwall and Cumberland, in late 2002. Fleet Time fitting was proven to be cost-effective and resource efficient, and greater use of Fleet Time fitting will become possible, as previously N* fitted ships are refreshed.

As at February 2004, all operational major surface units and RFAs will have N* fitted. Excluding new build vessels, only three nuclear and six minor war vessels will be outstanding this year. The 100th installation overall is planned to take place this April.

Environmental standards

The installation of equipments in a maritime platform can be a complex and demanding process. The ship floats, moves, fights and provides accommodation for the crew and is expected to survive enemy action, hostile environments ranging from the physical elements of storm force winds and waves, and through the maze of electronic emissions from a variety of sources.

Fig.1: Maritime equipments

Maritime equipments are expected to meet these challenges, and the IT hardware selected by N* for installation on-board is no exception. From experience gained over many years from involvement in Project OASIS and other similar projects, N* now sets the trend in the provision of Commercial Off-the-Shelf (COTS) IT hardware for use afloat. The latest equipments entering the fleet today are tested to ensure they comply with shock levels of up to 200G and can survive cyclical vibration movements. They are required to operate and survive within external electronic emissions and power surges without themselves causing a disruption to the Electronic Warfare (EW) signature of the vessel. Equipments in submarines are also required to withstand significant air pressure changes, high temperatures and humidity, have fire resistant qualities, and have a low level of substances considered hazardous to health (COSHH). Finding and providing IT equipment to meet these standards does not come without a cost in both financial and management terms. But in real terms, the use of financially competitive COTS equipment is the only acceptable methodology to provide generalised IT capability throughout the fleet vessels, covering mission-critical systems down to administrative deskstations.

Shock

The ability of vessels and equipment to survive shock is taken seriously in the Royal Navy. As a requirement, all classes of warships undergo shock tests where underwater explosions are detonated under controlled conditions to sim-

Fig. 2: HMS Pembrokeshire – underwater charge has been detonated, shock has been transmitted

Fig. 3: HMS Pembrokeshire – final cascade of displaced water, just like the movies

ulate as far as possible a non-contact underwater explosion, such as a mine or a near miss bomb, which are considered to be the worst case scenarios for shock.

N* provides equipment to be installed on-board, so the equipment has to be designed to withstand those shock levels without causing injury to ship staff – either users or adjacent personnel – or damage to other equipments by disintegration. Thus, the IT HW is provided with mountings to restrain the equipment under shock, but also to provide the means to secure the equipment properly to the desktops or workbenches.

Fig. 4: This is what happens when the shock mount or equipment fails

N* ensures that the best ergonomic solution for restricted areas can be achieved by combining both smaller equipment and adjustable mount designs.

Although the Display Screen Equipment Regulations (DSER) do not apply to forms of maritime transport – including warships – we are required by the Secretary of State for Defence to provide solutions as good as, if not better than, that dictated by legislation as far as is reasonably practicable. This is achieved by tiltable flat panel displays secured directly in front of the user.

Recent shock tests at QinetiQ have proven that the latest design of N* deskstations not only meets the safety requirements of shock protection of the user, but also remains operational through the shock boundaries up to 200G.

EMC

A modern warship is a mobile weapon platform with expensive, sophisticated and technologically up-to-date weapon and sensor arrangements. They have electronic warfare systems, communication systems, sonar and radar. They also have internal power generation systems with a multitude of pumps and motors, and even degaussing systems, running at will. All of these equipments can potentially transmit electromagnetic waves of varying intensity that can interfere with each other significantly. They operate throughout the oceans of the world in a complex and ever more frenetic external radio frequency environment.

To install safely and correctly yet another electronic equipment within this array requires careful consideration and a test regime designed to ensure that all possible variations of emission and susceptibility are measured and quantified. N* achieves this by following the procedures set out in the appropriate Defence Standard publications and ensuring, by testing, that the equipments can match those standards to achieve EMC Certificates of Conformity. Most equipment tested to date has required some form of power-input filter and choke to reduce unwanted conducted emissions.

EMC conformity through a batch of equipments is assured by testing quantities of equipments selected at random through the batch, and the monitoring of component parts. The selection and monitoring of the individual component parts is based upon the professional assessment of the degree of impact that the components will have on the EMC signature. When it is discovered that components have been changed, for example by a change of manufacturer for that part, then the batch process of testing is again undertaken to ensure that, as far as is reasonably practical, EMC conformity is maintained.

Design

Deskstations. Since those early days in the late Nineties the significant advances in technology have been embraced by N* to improve the standard and quality of fit.

Figs. 5 & 5A: Original PCs were large and bulky – filling the desktop completely

Flat panel displays were introduced as the norm for deskstations in 2000 to reduce the footprint of the equipment on the desk – leading to more desk space for the user – and the panel mounting can be tilted to best suit the user's preference.

Figs. 6 & 6A: The latest versions of PCs with a smaller footprint and separate flat panels can easily fit onto desktops

In parallel, the reduction in PC processor size has also reduced the footprint, and by de-coupling the processor and screen, the flexibility provided allows most positions to be fitted well within DSER and safety criteria.

Server cabinets – It became obvious within the first year of the project that the old style cabinet with a maximum of four servers per cabinet would not be sufficient to meet the ever increasing demand for IS services and the growing numbers of administrative software applications. The new style 1.8m high server cabinet, capable of housing up to seven servers, was introduced in 1999. Further flexibility, damage resilience and increased capacity was achieved in major units by installing additional cabinets.

The latest server cabinets provided by Fujitsu Services, our industry partner, are manufactured from stainless

Figs. 7 & 7A: Original and latest in server cabinet design – the latter allows for more capable contents

steel and are fully compliant with the commercial 19 inch rack dimension. The stainless steel fabrication assists in the reduction of ship magnetic signatures. The cabinets are mounted on X-mounts to protect the internal configurations from shock, and they are tested to the full 200G requirement. EMC conformity of full cabinets is proven through laboratory tests conducted at QinetiQ, and internal cable looms are designed from the outset to allow flexibility of future upgrades – changes in the number of servers, for example – as demands increase through the life of the equipment.

Equipment selection

The experience of previous projects had shown that the normal practice of buying IT hardware up-front and rolling them out to the vessels would not be appropriate for a project of this size. The N* decision was to ensure the continuity of equipments for batches of ship work covering periods of approximately six months. By constantly reviewing equipment roadmaps and proactive planning for change, the project was able to keep up with technology whilst minimising the need for and the cost of repetitive EMC and shock testing, and containment re-design.

The frequency of equipment obsolescence and change over the life of the project has resulted in many iterations of IT hardware, including 11 PCs, five laptops, eight printers and six servers.

In the early days across the MOD (N) projects, there was a considered and measured belief that COTS IT equipment would not be able to survive in the maritime climate. In order to achieve 'success' projects reduced the contractual environmental parameters required of equipments, particularly in the areas of shock. N* has proven that this need not be the case, and has not only demanded that all equipments meet the criteria but has also proven that they can exceed them.

Another factor which initially had a marked influence on early project progress was the high rate of 'dead on arrival' HW deliveries in the Nineties. To overcome this, and to provide some assurance of success, N* initiated a Factory Acceptance Test regime of every complete vessel system prior to despatch to the waterfront for installation. This allows the full system build and applications to be pre-loaded onto servers and individual deskstations to prove the complete system prior to installation, whilst leaving all the equipments powered up over a 48 hour period to reduce the failure rate through the first part of the empirical 'bath tub curve'.

Summary

Project N* has delivered nearly 100 installations across the fleet. There are currently over 60 certified software applications capable of running on the system. They range across the logistic, engineering, medical and personnel functions. Now that NavyLink has been successfully connected to the system, access is available from the N* desktop for both internet and email connectivity ('blueys').

The imminent arrival of DII to supply infrastructure in the deployed Maritime Estate (the fleet) will provide an opportunity to rationalise the whole ship installation of mission and business-critical systems. A standard approach for the provision of desktop IT hardware will provide equipment cost savings and increased user efficiency.

As the author had cause to remind the Defence Minister on his visit to Ensleigh, N* was the only IT project in the 20th (and latterly, so far, in the 21st) Century that completed installations on time, to cost, that worked the way the users wanted it to work – and the users actually wanted more.

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The views expressed in this article are those of the author and are not necessarily those of the MOD.

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