British Trident dependence on the US

Submarine Communications

Very Low Frequency (VLF) and Low Frequency (LF)

VLF/LF has been described as "the backbone of the submarine broadcast system".[1] Signals on these frequencies can be received by a submarine without it having to raise an antenna above the surface ~~of the water~~. VLF/LF radio messages can be sent to British submarines using British, NATO or US transmitters.

Britain has for decades operated VLF transmitters at Rugby and Criggion. In 2001 a contract was awarded to the Alert Consortium for future VLF communications with submarines. Under this contract the facilities at Rugby and Criggion have been closed down and replaced by a new VLF transmitter at Skelton, near Penrith. Skelton is operated by Merlin Communications, part of the Alert Consortium. Other transmitters at Skelton are used for commercial High Frequency broadcasts, including the BBC World Service. VLF signals from Rugby and Criggion ended on 31st March 2003. The new transmitter at Skelton may now be the primary means of communicating with British Trident submarines.

As part of the 2001 contract Merlin Communications will also provide new VLF receivers for British submarines.

NATO operates a network of VLF transmitters. The NATO submarine commander based at Northwood has control over the VLF transmitter at Anthorn in Cumbria. He also coordinates three other transmitters in Norway, Germany and Italy. These transmitters were working in a mode which provided four channels from each, although this may have changed. Anthorn is now operated by Merlin Communications and is being upgraded as part of the contract awarded in 2001.

The US also has a network of VLF/LF transmitters covering the North Atlantic. The main VLF transmitter is at Culter in the USA. There are also LF transmitters in Iceland, Puerto Rico and Italy. These provide the main line of communications with US Navy Trident submarines in the Atlantic.

In 1988 the US initiated the NATO Interoperable Submarine Broadcast System (NISBS). NISBS enables NATO to use VLF/LF transmitters operated by the US around the Atlantic and in Australia. So a message from Britain could be transmitted to a British submarine using US transmitters in America, Puerto Rico or Iceland. or Aust

NISBS also enables the US to use NATO's four VLF transmitters. A message from the US Submarine Commander can be broadcast to a British submarine either using the American transmitters or any of the NATO transmitters in Europe.

The US transmitters were modified so that one of the four channels used by each transmitter was compatible with NATO. There is ongoing development of NISBS - the US issued a contract in 2002 for a further upgrade of the system.

In the early days morse code was used in VHF/LF broadcasts to submarine. Later a method of transmitting data over VHF/LF was devised. This is called the VHF Digital Information Network (VERDIN) and is used by both British and American Navies. VERDIN has been modified to provide compatibility with NATO and has been upgraded to the Enhanced Verdin System (EVS).

Satellites

The volume of information that can be transferred by radio is related to the frequency used. At one end of the range Extremely Low Frequency (ELF) can only transmit very basic messages. The US uses ELF to send simple messages to missile submarines. This ELF system is not used on British submarines. At the other end of the frequency range, Ultra High Frequency (UHF) and Extremely High Frequency (EHF) can be used to transfer large amounts of data. These highest frequencies are used for satellite communications.

A Cruise Missiles require a large amount of targeting data. The increasing deployment of Cruise Missiles on US and British submarines has led to a need for improved communications with these vessels. In addition, changes in Trident targeting methods have also created a demand for improved data transfer capability to ballistic missile submarines.

Fixed nuclear plans are preloaded onto a submarine when it leaves port. The target data is held on magnetic disk. A relatively simple message is sent to order the submarine to fire its missiles in accordance with one of a number of prearranged options. Today, in addition to implementing the prepared firing plan, American Trident submarines are expected to be able to respond to "Adaptive Planning". This means rapidly targeting Trident missiles as required. This new arrangement is called the Strategic Retargeting System (SRS). Both British and American submarines have been modified for SRS. For retargeting it is not just a simple message, but detailed targeting data that has to be sent from the command centre to the submarine.

Submarines can raise an antenna to communicate with satellites. To avoid detection the antenna is raised for only a few minutes. Data transfer to submarines, even by satellite, has in the past been slow. Since 1995 the US has been increasing the bandwith available for satellite communications with submarines. This reduces the time needed to transfer data and so allows substantial volumes of information to be exchanged without raising the antenna for long. In 2001 it was clear that British submarine communications were still limited by the low bandwith available.[2]

British submarines have access to US, NATO and British satellite communications systems. Britain deploys three satellites to provide military communications. The initial batch of Skynet 4 satellites (A, B and C) were deployed between 1988 and 1990 at 326 degrees West, 53 degrees East and 1 degree West. These were replaced between 1998 and 2001 by the second batch of Skynet 4 (D, E and F) that are currently in service. These each have three SHF transponders with a power of 50 watts and a frequency range of 60 – 125 MHz plus two UHF transponders. France and Germany are also involved in current Skynet system. In addition there is also a NATO satellite, NATO IV. This is based on Skynet 4 and provides communications over the Atlantic and Europe.[3]

The MoD has awarded a £2.5 billion Private Finance Initiative contract to replace Skynet 4 with Skynet 5. There will be two satellites, one over the Atlantic and one over the Indian Ocean. These are due to be launched in 2006 and 2007 and would provide SHF and UHF communications.

Submarine communications using UHF on Skynet and NATO IV are compatible with the US FLTSATCOM satellite system using a Demand Assigned Multiple Access (DAMA) antenna. SHF communications on Skynet and NATO IV are compatible with the US Defence Satellite Communications System (DSCS).

Control of Skynet 4 and NATO IV is from RAF Oakhanger (NATO designation F4). The other NATO satellite ground stations in Britain are at Balado Bridge (F17) near Kinross and at Saxa Vord (F29) in Shetland. Skynet 5 will be controlled from RAF Colerne, in Wiltshire.

The MoD was considering adding an Extremely High Frequency (EHF) facility onto Skynet 5 but is now advocating that Britain join in the US Advanced EHF (AEHF) MILSATCOM satellite programme.[4] New shore-based terminals will be set up as part of this Naval EHF/SHF SATCOM Terminal (NEST) project. NEST will provide "robust, high data rate satellite communications to UK submarines".[5]

The addition of an EHF capability and the ability to handle large volumes of data are seen as priorities in the modification of US submarine communications systems for SSBN.[6] For British Trident submarines this new EHF capability will be dependent on the use of an American satellite.

There is a current British project to replace existing UHF DAMA antenna on submarines with a new Sub DAMA Satellite Communications System (SDSCS). As part of this new mini-DAMA are being bought from the US. These will probably be able to handle data at higher rates of transmission. There is also a program to develop a new Universal Modem System (UMS) for handling satellite data on a submarine. UMS should provide compatibility between US, British, French and NATO systems.

Data handling protocols

Until recently communications to US submarines used a system called the Submarine Satellite Information eXchange Sub-system (SSIXS). SSIXS prepared messages for both VLF and satellite broadcast. The Royal Navy was also using SSIXS and the British and American systems were compatible. In 2003 the US Navy moved from SSIXS to an Internet Protocol (IP) system. A briefing given to a joint maritime communications group by a British official in 2001 shows that this loss of compatibility was a major issue for Britain.[7]

In 2001 two joint working groups were established to look into how to provide compatibility with the new IP system. The first was a US/UK working group. Following requests from Australia and Canada, an additional Allied working group was also set up.

The MoD set up the Submarine Command and Control (SMC2) project to enable British submarines communications to continue to be compatible with the US. The SMC2 programme is "responsible for maintaining UK/US interoperability capability by migrating the Royal Naval Submarine Satellite Information Exchange System to an Internet Protocol environment".[8]

High Frequency (HF)

British and American submarines can release a Submarine Emergency Communications Buoy that can transmit information to the shore on HF. There is a network of three stations around the Atlantic to receive and retransmit these messages. This is called the Clarinet Merlin Receiver System (CMRS). The station in the UK is at RAF Croughton.

Emergency Action Messages

The American submarine broadcast system over all frequencies can be completely taken over at any time by STRATCOM in order to send Emergency Action Messages. These are messages telling Trident submarines to launch their missiles. There is a similar arrangement in Britain – "SSBN operations pre-empt UK communications".[9]

Command and Control

British Trident submarines are controlled through Command Task Force (CTF) 345 which is based at Northwood in London. AMS were awarded a contract for the CTF 345 command centre and also to develop a Submarine Broadcast Processing System (SMBPS) to provide headquarters communications to the British submarine fleet and to allied submarines.

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[1] SCMP Appendix B
[2] Submarine issues for future networking in the maritime battlespace, AD Sutherland, AUSCANNZUKUS paper.
[3] Information from Federation of American Scientists www.fas.org
[4] Satellite Communications Acquisition IPT www.mod.uk
[5] Satellite Communications Acquisition IPT www.mod.uk
[6] SCMP
[7] Submarine issues for future networking in the maritime battlespace, AD Sutherland, AUSCANNZUKUS paper.
[8] Satellite Communications Acquisition IPT www.mod.uk
[9] Submarine issues for future networking in the maritime battlespace, AD Sutherland, AUSCANNZUKUS paper.