The Scimitar family of combat net radios

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Summary Recent technological advances have contributed significantly to the increasing electronic warfare threat against combat net radios but also make it possible to render such radios considerably more resistant to that threat and, at the same time, make possible the incorporation into manpack equipments of facilities previously available only in vehicular installations.

The article discusses these techniques and their application to the Scimitar family – a new and complete generation of cost-effective, ECM-resistant combat net radio designed to meet, world wide, all aspects of the battlefield requirement. Scimitar M is a highly flexible, cryptographically protected, pocket radio. Scimitar H (in the h.f band) and Scimitar V (in the v.h.f band) can be used both in the manpack role and as part of a higher-powered vehicle fit. They provide the options of full cryptographic protection and advanced frequency hopping in addition to the full range of facilities normally associated with such equipments.

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Introduction

The armies of the world have long used methods of communication for tactical purposes which have become known as combat net radio. These methods enable groups of nets or users to employ multiple address methods of exchanging information and orders. Various technical developments in recent years have made it possible for the different techniques used in some civil applications to become relevant in the military tactical environment also.

It was with these factors in mind that The Marconi Company started, a few years ago, the development of a new family of radios which would have wide applications in both civil and military fields. This article concentrates on the military applications of this family but there will be many occasions on which the designs described will also have applications outside the defence context.

The company has long experience in mobile communications from the earliest developments of Guglielmo Marconi himself. The most recent tactical military equipment is the VRC353. It is, of course, the vehicle and tank v.h.f set of the Clansman range, still being delivered to the British army and many others overseas, which has established itself both in training and in combat as an effective and reliable equipment. The company continues research and development to up-date and improve it and spares and technical support will continue to be available probably until the end of this century. However, the increasing threat of electronic warfare attack on tactical communications has led to a requirement for electronic countermeasures resistance and also the avoidance of the electronic support measures capabilities of potential enemies.

At the same time new developments and large scale integration have offered opportunities for more economical and yet more capable equipments. It was, therefore, against the background of technological developments, the need for economy and the needs of customers in the military and other fields that The Marconi Company began the development of its new family of radios. This family has been named the Scimitar range.

Principle

The expertise of the electronic warfare teams of Marconi Space and Defence Systems was used to project ahead into all possible threats to communications in various parts of the world. All the studies and evaluation that the company has carried out in the context of the new United States Army ground and air communications system, SINCGARS, were of major advantage in achieving an insight into a wide range of technical and tactical circumstances. The world-wide marketing expertise of the Marconi group of companies was also used to evaluate conditions and requirements which would not be relevant to the United States, United Kingdom or the broader NATO environment. Technical innovations were examined to ensure that the equipments which were ultimately developed would not quickly date as technology advanced. The key principle in the development of this new family was that costs should be kept to a minimum. None of the well-known Marconi quality standards were to be prejudiced but nevertheless all of the

The Scimitar M pocket radio

engineers involved in the development had to keep down not only the initial costs but also the maintenance and whole life-cycle costs. One aspect of this policy was an insistence on having standard modules and maintenance arrangements that would be relevant to as many of the radios in the family as possible.

Personal radio

The first equipment in the family is a body-worn radio variously known as a pocket radio or squad set. It has been dubbed Scimitar M for mini or micro. It will be available in ½W and 1½W variations and can be offered in a variety of frequency bands. 68–88MHz is normally used for combat purposes and there will be other options in the 150 and 450MHz regions. Scimitar M has ten preselected frequencies which the operator can access quite simply with a single control. These frequencies are not set into the equipment permanently during manufacture but can be readily reprogrammed in the field with a pocket 'fill' device. The preselected frequencies are arranged in ten pairs which means that they can be used either as single frequency switched simplex, for combat net radio purposes, or for double frequency using a talk-through as is used in an urban environment and police systems. The radio can be fitted easily into a single breast pocket in the ½W version and the 1½W version can be in two similar small packages or in one slightly larger. The efficiency of this new radio means that there will be many instances where it can be used instead of the conventional manpack.

The major breakthrough, however, is that this very small radio, without any increase in size, can include a communication security device giving very high-grade security protection to the user. In addition a facility exists for selective calling of users employing the same channel.

Scimitar V

V.H.F is the most flexible frequency band for mobile communications and consequently the Scimitar V is the workhorse of the family. The significant factor here is that modern technology and components have made it possible for the first time to make an RT module which is small and light enough to be carried on a man's back, yet rugged enough and with a good enough performance to be used in the demanding multi-set installations of a vehicle. Attempts hitherto to turn a manpack radio into a vehicle radio have always resulted in poor vehicular performance expecially on the move, compared with sets designed for the purpose, but this can now be overcome. It has been designed for easy assembly and simple maintenance with particular emphasis on modular construction. The RT module, which operates over the full 30–88MHz combat range, radiates up to 5W when incorporated in a manpack. It weighs only 6·5kg, has a low profile antenna and the operator's control set provides access to all the important controls without having to dismount the equipment. There is a wide range of options in the design of control and display facilities. It was concluded that no one solution meets all possible requirements, and versions with either conventional knobs or push button controls will be available to suit the customer's preference.

Scimitar V is, therefore, an up-to-date rugged and economical radio and as such will meet many of the customers' requirements. But the impressive aspects of the design are that within the same weight and size and at a very economical price, the manpack radio can include a number of valuable tactical features, built-in security and resistance to electronic countermeasures.

These features are optional and have been included only as a result of a great deal of thought. It is not certain that frequency hopping, for example, is the most effective means of combating enemy intercept, direction finding or jamming. So Scimitar is not just a frequency-hopping radio because, paradoxically, those who first introduce frequency hoppers into their most

important nets may well draw attention to those nets.

However, provision is made for frequency-hopping, should the customer wish to use it. The tactical features are positive methods to improve the flexibility of operations. For example, selective calling for individuals or groups is provided and a very special feature of this facility is that a pair, or group, of stations can have a private conversation while the rest of the net can continue to operate separately and simultaneously. In addition to manual access to all of the 2320 frequencies, a total of 18 pre-set modes can be stored in the equipment, six fixed clear frequencies, six secure fixed frequencies each associated with a different crypto set if necessary and six hopping schedules also associated if necessary with different crypto settings.

Some of this information can be manually filled from the front panel. But the filling of hundreds of frequencies into each of six different hop-sets would be extremely laborious and prone to error. These are, therefore, injected with a 'fill gun' but, with what are known as orthogonal hop-sets, the schedule can be altered manually on the front panel of the radio.

The inclusion of these features is neither expensive nor complicated so that the soldiers who operate or repair the equipment need not be highly skilled and costs will not be significantly more than for fixed-frequency radios.

In the hopping mode the hop-rate, like the security system, will be a secret between individual customers and the manufacturer. Indeed, the filling of informatioon to the internal microprocessors is entirely under the control of the user, giving total confidence in the security of his system. A comprehensive and very flexible frequency management system is available for all Scimitar equipment.

A major technical breakthrough is that the radio hops over the complete range of 30–88MHz. This is absolutely vital to achieve resistance against broadband jammers and also improves resistance to follower jammers. Although it is much easier technically to provide a radio which hops over a limited band of, say, only 6 or 7MHz, techniques have been developed to cover the whole band in a single hop-set, and these have been incorporated in the design without increase in cost.

By simply unclipping the r.f module from the manpack antenna tuning unit (ATU) and battery, it can be plugged into an appliqué unit to form a vehicle station. This has been designed so that it can use the mountings of the VRC353 and can also fit into any known wheeled or tracked vehicle. A selection of powers is available up to 50W; the ATU, like that on the manpack, is entirely automatic. Single-set harness facilities are built into the vehicle unit so that for simple installations no additional harness boxes are needed.

All the tactical security and ECM resistance features of the manpack version remain available in the vehicle set.

The Scimitar V manpack

Scimitar H

Scimitar V is the workhorse of the family and for this reason it has been used as a standard in deciding the physical dimensions of the other members. But the high-frequency radio is of equal importance in a tactical setting and the combination of h.f and v.h.f radios provides excellent assurance of achieving communications in the face of enemy countermeasures.

The development of the h.f members of the family has been undertaken by Marconi Communication Systems Limited using the same dimensions and electrical characteristics as those in Scimitar V.

The manpack set operates over the full 2–30MHz range. A fully automatic ATU obviously makes this slightly larger than the v.h.f set, but it remains light and easily carried. It contains facilities for built-in pre-set frequencies and has simple controls. A final decision on the extent of frequency agility or security that is built in to the manpack h.f radio has not yet been taken.

The Scimitar H manpack

Scimitar H (left) and Scimitar V (right) each mounted in a vehicle appliqué unit fitted inside a Chieftain main battle tank

However, these features are included in the vehicle h.f radio which is based on the same appliqué unit with a 100W h.f amplifier. A separate unit provides security and frequency agility facilities. This is a high-grade digital system offering full security. Because of the need to select the best propagation characteristics at any one time, h.f hoppers do not cover such a wide frequency band in one hop-set but can include just as many frequencies since these can be closer together. In the main, the same facilities can be offered at h.f as described for v.h.f.

Interoperability

Each item in the new range of radios will be backwards interoperable – that is to say that a user will be able to interoperate between his existing radio and the right choice of Scimitar. Of course the full advantages of the Scimitar range can be obtained only with complete Scimitar nets. This backwards interoperability will be ensured throughout any subsequent development of the range.

Consideration has been given in the design of Scimitar to make it adaptable to any existing vehicle or manpack mounting frame. It has also been arranged that any existing harness can be used with Scimitar, although a special-to-type harness is available which will enable selection of the full range of Scimitar facilities from any harness position.

Conclusion

Scimitar is a comprehensive family of radios from the smallest and simplest to the most demanding in security and jam-resistant requirements. Every set bears the hall-mark of Marconi excellence and can be provided in a wide range of packages to meet specific requirements at economical prices.

A firm order for Scimitar V has already been received from the United Kingdom Ministry of Defence.

RÉSUMÉ

De récents progrès technologiques ont eu pour conséquence d'accroître de façon significative la menace de plus en plus importante de guerre électronique contre les radios de réseau de combat, ces progrès ont toutefois permis d'augmenter considérablement la résistance de ces radios à de telles menaces; en même temps, il sera possible, grâce à ces innovations, d'incorporer dans des équipements portatifs des facilités qui n'existaient précédemment que dans des installations montées sur véhicles.

L'article discute ces techniques ainsi que leur application à la famille des Scimitar – une génération entièrement nouvelle de radios de réseau de combat résistant aux contre-mesures électroniques (ECM), et ayant un excellent rapport coût-efficacité: elle a d'ailleurs été étudiée de manière à répondre, dans le monde entier, aux divers aspects des exigences sur le champ des opérations. La Scimitar M est une radio de poche polyvalente qui possède une protection contre le décodage. La Scimitar H (dans la bande d'ondes décamétriques) et la Scimitar V (dans la bande d'ondes métriques) peuvent à la fois être utilisées comme équipement portatif et comme partie intégrante d'un montage sur véhicule grande puissance; elles présentent à ce titre les options d'une protection intégrale contre le décodage et d'un système de saut de fréquence avancé en plus de toutes les autres facilités que l'on normalement en droit d'attendre de ce type d'équipements.

ZUSAMMENFASSUNG

Durch kürzliche technologische Fortschritte hat sich die Gefahr einer verstärkten elektronischen Kriegführung gegen Radio-Gefechtsnetze beträchtlich erhöht, andererseits wurde dadurch jedoch ermöglicht, solche Radios dieser Gefahr gegenüber weitaus widerstandsfähiger zu machen und sie zur gleichen Zeit in tragbare Geräte einzugliedern, die Möglichkeiten bieten, die zuvor nur in Fahrzeugausrüstungen vorhanden waren.

In dem Artikel werden diese Techniken und ihre Anwendung auf die Scimitar-Geräte beschrieben, einer neuen und in sich abgeschlossenen Reihe von kostenwirksamen, ECM Widerstand bietenden Gefechtnetz-Radios, die dazu ausgelegt wurden, allen Aspekten der Schlachtfeld-Gegebenheiten weltweit Rechnung zu tragen. Scimitar M ist ein weitgehend flexibles, durch Chiffre geschütztes Taschenradio. Scimitar H (im HF-Bereich) und Scimitar V (im VHF-Bereich) lassen sich beide sowohl als tragbare Geräte als auch als Teil einer stärkeren Fahrzeugausrüstung einsetzen. Ausserdem bieten sie wahlweise vollständigen Verschlüsselungsschutz und verbesserten Frequenzsprung sowie die gesamte Palette von Eigenschaften, die man normalerweise mit solchen Geräten in Verbindung bringt.

RESUMEN

Los últimos adelantos tecnológicos han contribuido significantemente a la creciente amenaza bélica electrónica contra los radios de red de combate, pero también hacen posible la producción de estos radios considerablemente más resistentes a esa amenaza y, al mismo tiempo, hacen posible la incorporación en equipos portátiles de fácil funcionamiento todas los medios previamente disponibles solamente en instalaciones de vehículos.

Este artículo discute estas técnicas y su aplicación a la familia Scimitar – una nueva generación completa de radio de red de combate de gran eficacia y bajo costo resistente a las ECM, diseñado para satisfacer mundialmente todos los aspectos de las necesidades y exigencias imprescindibles del campo de batalla. El Scimitar M es un radio de bolsillo sumamente flexible y protegido criptográficamente. El Scimitar H (en la banda de alta frecuencia) y el Scimitar V (en la banda de muy alta frecuencia) pueden operarse cuando se llevan consigo y como parte de un montaje de vehículo de mayor potencia, y suministra las opciones de protección criptográfica completa y variación por salto de frecuencias avanzadas además de la gama completa de los medios normalmente asociados con estos equipos.