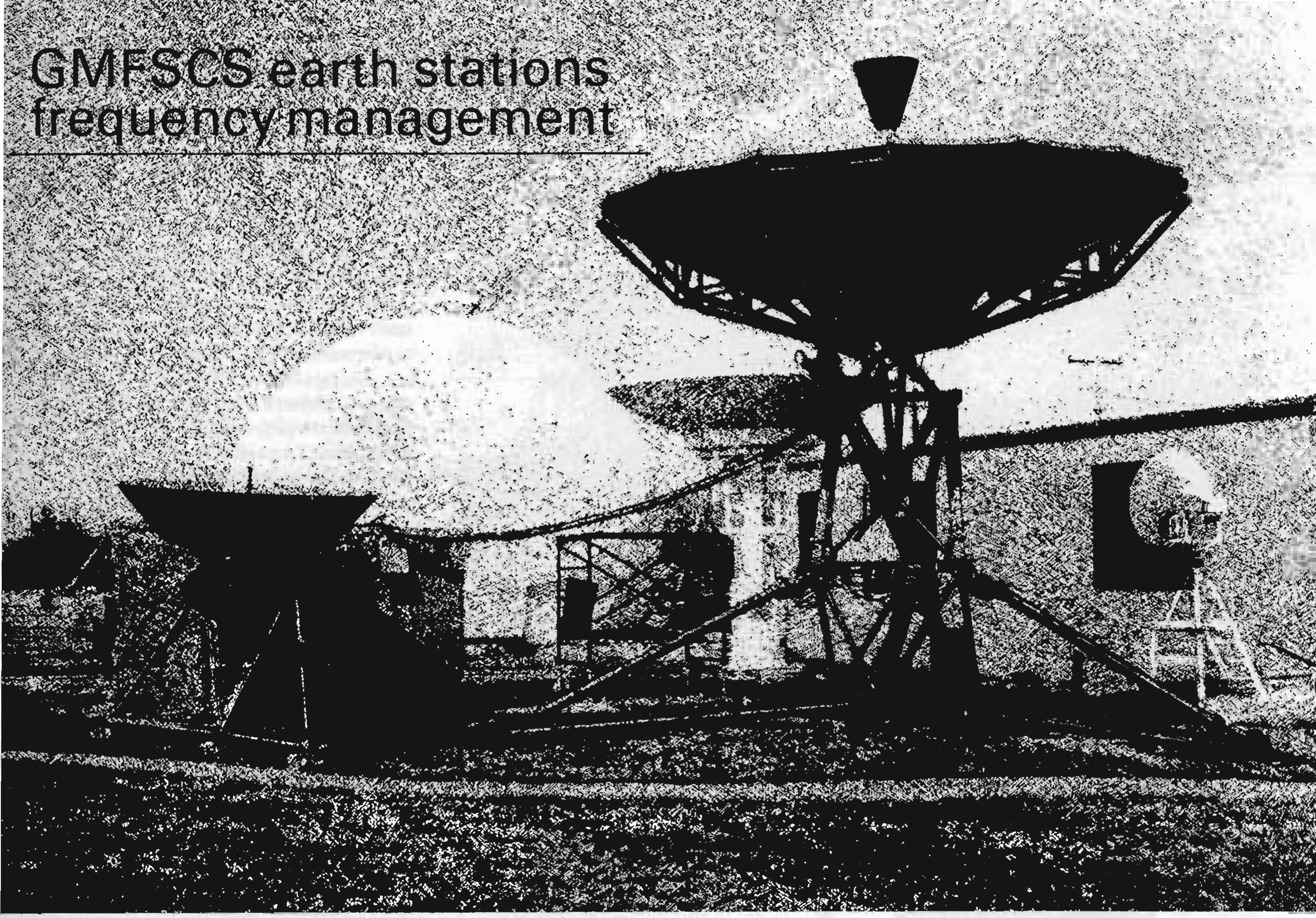

The resolution to a classic problem

by Paul J. Phillips and Thomas Sullivan

The GMFSCS was created to fulfill critical command and control communications requirements. Its full implementation is now possible because WARC-79 provided the frequency allocation and analysis techniques needed.

In August 1978, military communicators gained a long-needed and much sought-after communications capability when the first production model of a small, super-high frequency (SHF) tactical satellite communications terminal was delivered to the US Army. The SHF terminals were developed to satisfy critical command and control multichannel transmission requirements of the Ground Mobile Forces (GMF). The GMF are those components of the Army, Marine Corps and Air Force engaged in land combat operations.

Realization of the GMF Satellite Communications System (GMFSCS) required the development of transportable earth stations (TES) that could meet the demands of tactical operations. Terminal characteristics developed were: ease of setup for quick reaction; a high degree of transportability for a large population of mobile users; and flexibility of communications links during localized, though often shifting, scenes of action.

Working through the Defense Satellite Communications System (DSCS), the GMF terminals were to

GMFSCS earth stations frequency management

The AN/TSC-86, currently being produced, will fill the need for SHF single-carrier in places where communications are not readily available and where users require the advantages of higher frequencies (the AN/TSC-86 operates in 7/8 GHz range) and can tolerate reasonably sized antennas.

replace selected links now serviced by conventional radio equipment. Planned for use from Army headquarters down to brigade level, or equivalent command echelons, they significantly increased combat effectiveness through improved command and control.

A significant GMFSCS implementation obstacle was its dependency on the availability of frequency support. The international and national frequency allocation tables did not clearly accomodate the TES type of operation. An Army assessment of the frequency support problem revealed another obstacle. In the 7/8 GHz frequency range, there were no

regulatory provisions or analytical procedures that could assure electromagnetic compatibility between TES and the other terrestrial radio services.

When the GMFSCS was first developed, the DSCS ground segment consisted of large earth stations at permanent sites. These were fixed earth stations (FES) operating in the FIXED-SATELLITE service. The GMF terminal operates in motion or at a halt while deployed as shipborne, airborne or transportable earth station. Thus, the GMF did not fit the classic international definitions of either FIXED or MOBILE satellite service. Since each frequency band is allocated to a particular telecommunication service, conformance of the TES operations with the allocations tables was questionable.

Electromagnetic compatibility (EMC) is an important factor which must be considered when fielding a new telecommunications system. It is essential that a new system accomplish its intended function without experiencing degradation caused by other systems. Likewise, a new system should not degrade the performance of other systems already in operation. These two conditions basically describe EMC.

The AN/TSC-85(V)2 is the only terminal which can serve as the hub of a multi-point network. It can also function as a nodal destination terminal or in point-to-point operation.

Power limits and antenna pointing restrictions were enacted to achieve EMC between radio-relay and fixed satellite operations in the 7/8 GHz bands. These regulatory measures were designed to instill EMC in a priority manner and prevent over-consumption of the spectrum resources by any one system. Administrative and analytical procedures established for assessing and preventing interference between satellite networks were implemented on a case-by-case basis. However, no such procedures were available for treating the potential problems of EMC between TES and radio-relay stations.

The issue in securing frequency support for the GMFSCS was threefold: a new analytical procedure was needed for evaluating and preventing interference between TES and radio-relay; this procedure needed to be accepted as a viable means for ensuring EMC; and the procedure needed to be internationally and nationally administered.

The TES was capable of being deployed worldwide. Therefore, only a general area could be known in advance. The problem was to calculate, where to designate within this general area, a service area which would allow the TES to operate without causing or experiencing interference.

The US preparation for and later participation in the 1979 World Administrative Radio Conference (WARC-79), provided the avenue for the resolution of the TES issue. WARC-79 met in Geneva, Switzerland, for about three months in late 1979 under the auspices of the International Telecommunication Union (ITU) to revise the regulations governing the use of the electromagnetic spectrum.

The US developed a definition of TES, taking into account the GMFSCS needs, as well as the technical

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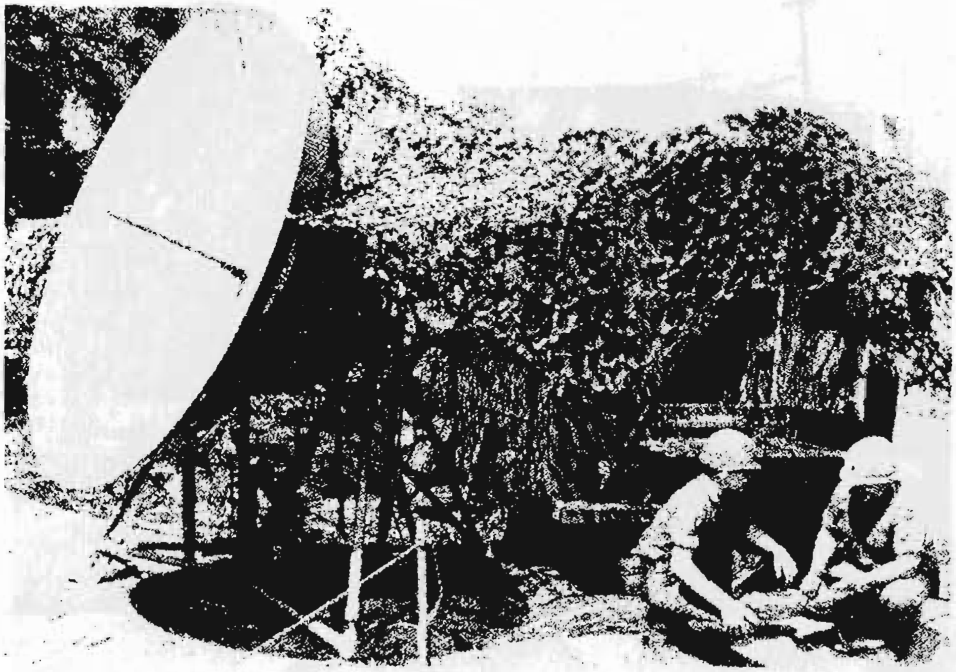

recommendations of the International Radio Consultative Committee (CCIR). This definition, proposed to WARC-79, included three points: 1) that TES may operate in either the FIXED or MOBILE satellite service, depending on the communications function; 2) that TES are portable; and 3) that TES will operate during halts at unspecified points and not while in motion. Although WARC-79 deliberations concluded that a TES definition was not essential to the new ITU Radio Regulations, agreement was reached on a two-step analytical procedure. The procedure determined the coordination area around the service area that included all radio-relay stations which might have affected or have been affected by the TES operations; and it determined the protection areas for each radio-relay station, outside of which the TES could

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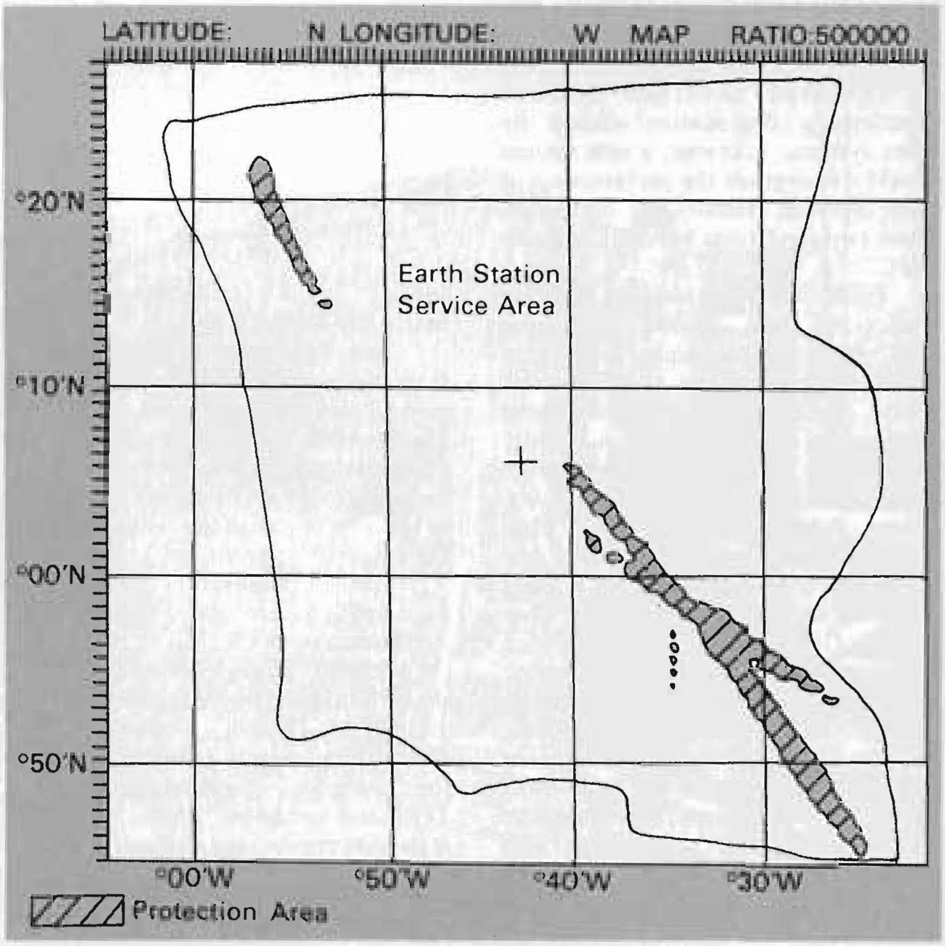
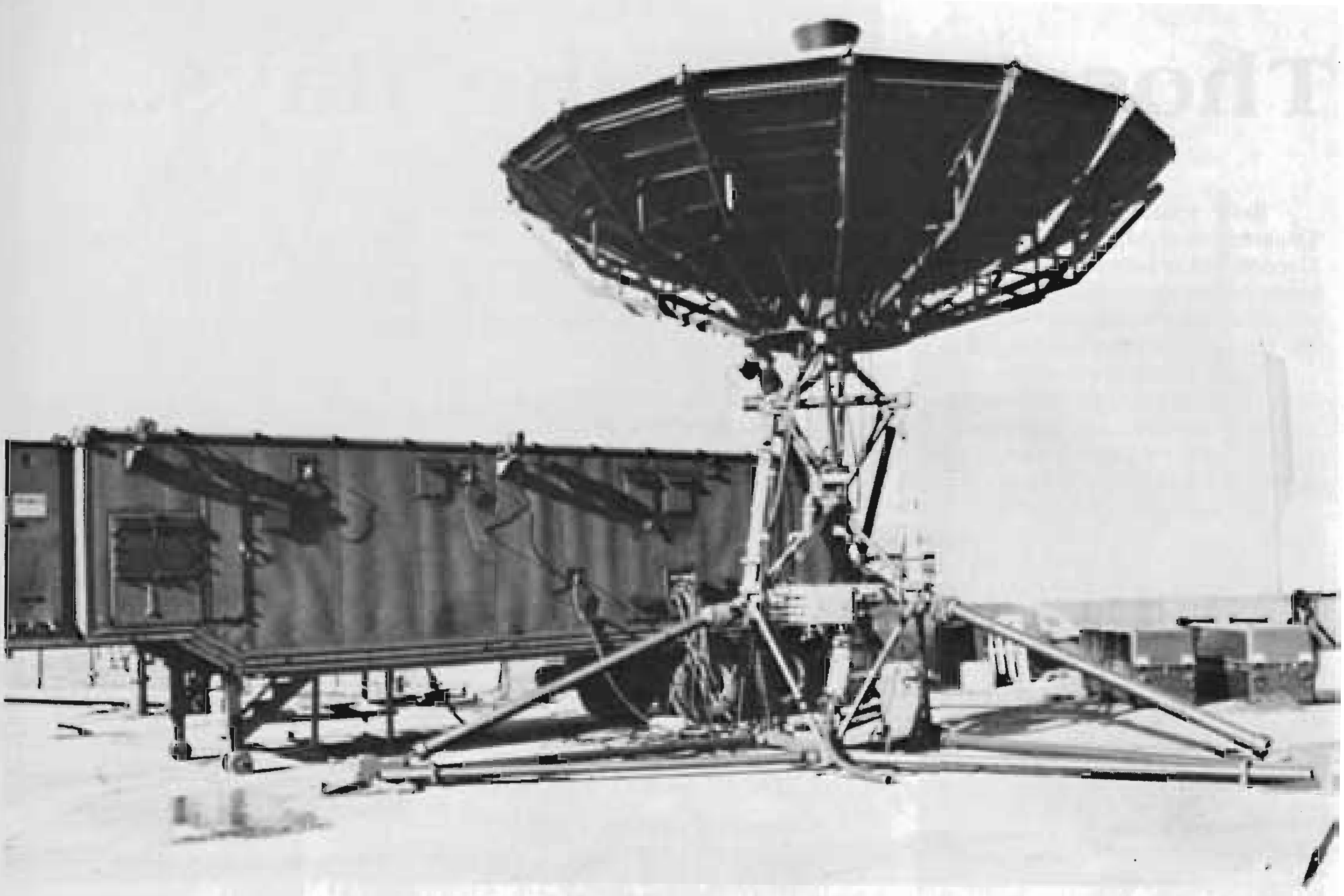


Figure 1. Example protection area map.



operate without causing or experiencing interference.

Established calculation techniques were utilized during the development of the new analytical procedure. This eased the international acceptance at both the 1978 CCIR Meetings and the Special Preparatory Meeting. WARC-79 accepted the coordination area calculation procedure and incorporated it into Section 7 of Appendix 28 to the ITU Radio Regulations. A computer program for calculating the coordination area was prepared by the US and given to the ITU. It is expected to ease the 1 January 1982 implementation of the new procedure.

The techniques used in coordinating terrestrial station frequency assignments, when the coordination area indicates that it is required, is not stipulated in the ITU Radio Regulations. This is a matter of agreement between administrations and they are free to use any methods for resolving national coordination problems. In anticipation of the need to deploy TES in the vicinity of radio-relay stations, a computer program has been devised to calculate protection areas. Protection areas are specified relative to terrestrial station sites and calculations use actual station equipment characteristics. Protection Contour Maps (PCMs) of the TES service area are prepared indicating the protection areas. An example PCM service area is shown in Figure 1. In order to obtain interference-free operations for the radio-relay stations and the TES, the TES must refrain from the shaded portions of the PCM.

The GMFSCS was created to fulfill critical command and control communications requirements. Its full implementation is now possible because WARC-79 provided the frequency allocation and analysis techniques needed.

The AN/MSQ-114 Satellite Communications Monitoring Center has 400 watts maximum power output, a 60 KW power generator, a 20-foot diameter antenna and a 24-hour setup time. It transmits at 7.9 to 8.4 GHz and receives at 7.25 to 7.75 GHz.

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