The North-East Shetland basin communications system for the oil industry

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Summary Gas and oil exploration and production demand a wide range of reliable telecommunication systems for efficient operation.

In the United Kingdom sector of the North Sea, platform constructions are linked to the British Telecom switched telephone network by means of tropospheric scatter microwave radio systems, providing a reliable and economical multi-channel communication medium for leased telephone, telex and data circuits to the operators' onshore communications centres.

This article describes the North East Shetlands Basin Area Communications System (NESBACS), which is the largest and most complex telecommunications system so far completed in Britain's North Sea oil fields, providing a communications lifeline to shore for eight oil platforms lying north-east of the Shetland Islands, and spanning 800 square miles. Each of the two tropospheric links operates in the 1·7–2·35GHz frequency band, configured on a quadruple (space/polarization) diversity basis to achieve four independent signal paths, presently carrying 132 voice channels. The complex inter-platform communications network is described, together with details of the network supervisory and control systems.

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Introduction

The North-East Shetland Basin Communications System (NESBACS) was installed to service all the oil production and pumping platforms in the Brent, Thistle, Cormorant, Dunlin and Murchison Fields. Future expansion will include the Magnus, Hutton, North Cormorant and Tern Fields.

Basic services

Most of the platforms need the following basic circuits to ensure efficient working:

a) An emergency voice circuit linking all platforms to Operations Control in Aberdeen to ensure that, in the event of an emergency, instructions can be passed to all parties on a shared basis.

b) A low-speed data circuit to and from all platforms to update pipeline input/output records at Operations Control.

c) A low-speed data circuit to and from most platforms to update equipment parameters monitored on the platforms and displayed/processed at Operations Control.

d) A telegraphy link to Production and Management Shore Offices.

e) A telephone link to Production and Management Shore Offices, usually in the form of an extension of the Shore Office private exchange.

f) A telephone link to the British Telecom UK public network, usually in the form of an extension of the Aberdeen exchange.

g) Inter-platform and platform-shore telephone lines, usually in the form of inter-PBX tie lines.

Multi-channel radio bearers had to be used to carry this traffic between platforms and shore and so the choice of bearer was limited to two, namely, satellite or tropospheric scatter communication. At the planning stage some five years ago the tropospheric scatter bearer mode was the more attractive choice on price and national control and was chosen.

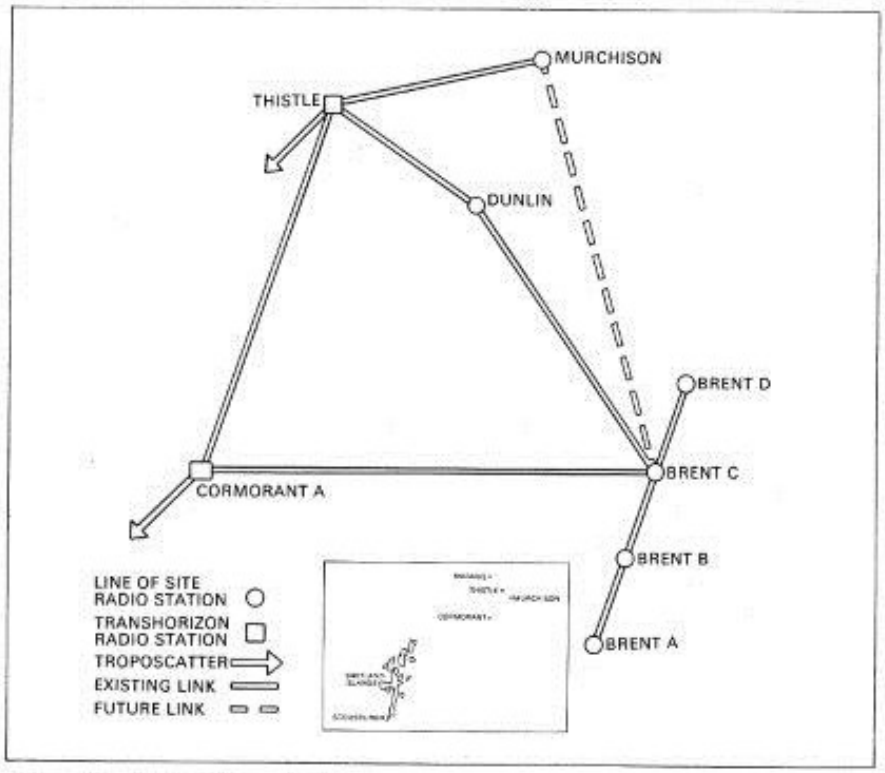
Tropospheric-scatter links

British Telecom awarded The Marconi Company a contract to establish a tropospheric scatter radio link between mainland Scotland and the Shetland Islands. This link is arranged in a quadruple (space/diversity) configuration and carries 132 4kHz standard audio channels in eleven 12-channel groups. The system is engineered to give a worst-month channel availability of 99·98% of time. The tropospheric scatter link out to the NESBACS complex has a shore station on Shetland and two sea stations, one working at a time, on the Cormorant 'A' and Thistle platforms. The reason for having two receiving/transmitting platforms is not primarily for reliability, but to allow a platform to have its high-powered electrical equipment shut off during the placing and exploding of charges in the oil-wells.

The selection and switching of the off-shore tropospheric scatter platform is controlled automatically by a sub-baseband voice-frequency telegraph (v.f.t) tone system, with a discrete tone unique to each platform sent from the shore to the platform to indicate and switch between platforms, and a discrete tone per platform sent to the shore

for monitoring and automatic switching. Another feature of this system is that the feedhorns are moved physically to switch the beams between the Cormorant A and Thistle platforms, the movement being achieved automatically. This is necessary due to the angle between the directions from the shore station to the two platforms being greater than the 2dB lobes on the beams of the 18m billboard antennas at the shore station.

Thus the main bearer from Aberdeen to the North-East Shetland oil fields is a system of two tropospheric-scatter links in series each utilizing two 1kW 2GHz transmitters at each end, to two 18m billboards, spaced horizontally, on-shore and two 9m dishes offshore which are spaced vertically. There are four receivers utilizing predetection combining to give 132 4kHz audio channels with a worst-channel availability for 99·98% of time.



Map of North-East Shetlands Basin area

Line-of-sight links

The baseband traffic arriving or leaving either of the two tropospheric scatter platforms is demodulated down to group level and automatically distributed onwards to destination platforms via 1·7GHz, 132- or 72-channel line-of-sight radio links. The main platforms are looped in a ring system to avoid traffic loss on platform switch-down or failure, the direction of traffic flow being determined by a combination of sub-baseband v.f.t switching tones, supergroup pilot tone detection loops and 'E' and 'M' wire audio channel detection loops. The change-over systems are automated using co-axial switches to route each group of 12 channels.

The line-of-sight links use a vertically-spaced diversity arrangement of receive dishes to overcome the effect of fading due to sea reflections, with the baseband traffic selected by noise-switching or an optimally-combined baseband signal from both receivers. Special care is needed when engineering very short links to give the required signal-to-noise ratio in the presence of multiple reflections.

Audio channels

The audio channels are combined in standard frequency-division-modulated channels using Groups 1A and Supergroups 1 and 2. The audio channels are allocated to the various services as detailed from (a) to (g) with an extra fall-back situation for the first two. In the event of the failure of the line-of-sight radio/multiplex system two emergency voice channels are established by means of u.h.f single-channel radio links between a master station platform and the other platforms. The circuits are held on to the line-of-sight radio/multiplex routing by 'M' to 'E' wire audio-channel loops from the outstation platform to the master station and back. If the 'M' to 'E' wire loop fails, the emergency path is switched to the u.h.f single-channel radio link and the transmitter is switched on. Switching for the fall-back system is processor-controlled from the control centre with an automatic time check of the quality of the fall-back system.

A typical North Sea oil production platform

Data circuits

The low-speed data for circuit (b), on which Aberdeen Control Centre polls each platform in turn and receives a data update, and also for circuit (c), are running at 2·4kbit using an audio channel modem and splitter/combiner. The (c) 2·4kbit channels from each platform are time-division combined/split at two master platforms to a 9·6kbit/s rate to be sent to and from Aberdeen. These circuits are in the process of being evaluated and experience is being gained in the ability of two tropospheric-scatter links in series to carry multi-level, multi-phase audio signals which constitute 2·4, 4·8, 7·2 and 9·6kbit/s data streams in standard 4kHz audio channels.

Engineering order wire

The whole system is linked by a sub-baseband engineering order wire, alarm reporting system and switching system. All platforms can speak to one another and to the British Telecom station on Shetland using a common speech channel. There is another speech channel for the Shell platforms Cormorant 'A', Dunlin and Brents A, B, C and D. Alarms are remotely reported from each Shell platform to the master station on Cormorant 'A' and both tropospheric scatter platforms report alarms to the British Telecom station on Shetland. Selected alarms from all Shell stations are combined and reported to British Telecom.

In conclusion a mention must be made of the major parties involved in implementation of this very complex system. Shell UK Exploration and Production as the main user of the system were responsible, together with Cable and Wireless, for the initial total planning of the system with British Telecom providing the on-shore circuits. Detail design and implementation was undertaken by The Marconi Company as the prime communications contractor to Shell.

RÉSUMÉ

L'exploration et la production de gaz et de pétrole exigent une gamme étendue de systèmes de télécommunications fiables pouvant être exploités de façon efficace.

Dans le secteur de la Mer du Nord appartenant au R.U., les structures de plates-formes sont reliées au réseau téléphonique commuté de British Telecom grâce à des systèmes en hyperfréquences à diffusion troposphérique. Ces systèmes représentent un moyen de communications multi-voies efficace et économique pour des circuits loués de téléphone, de télex et de transmission de données à destination des centres de communications à terre de l'opérateur.

Cet article décrit le système de communications du Bassin nord-est des Shetlands (NESBACS), qui est le système de télécommunications le plus important et le plus complexe qui ait été réalisé jusqu'à maintenant dans les champs pétrolifères de la Mer du Nord: il constitue un lien de communication vital avec la côte pour les huit plates-formes pétrolières situées au nord-est des Iles Shetland et couvrant environ 2000km². Chacune des deux liaisons troposphériques est exploitée dans la bande des fréquences 1,7–2,35GHz, selon un agencement basé sur une diversité quadruple (espace/polarisation), afin de pouvoir obtenir quatre trajets de signaux indépendants, portant à l'heure actuelle 132 voies téléphoniques. L'article donne également des détails sur le réseau de communications très complexe reliant les différentes plates-formes entre elles, ainsi que sur les systèmes de commande et de supervision du réseau.

ZUSAMMENFASSUNG

In der Gas- und Ölexploration und -förderung ist eine geraume Anzahl von zuverlässigen Fernmeldesystemen für einen wirksamen Betrieb Voraussetzung.

In dem Grossbritannien angehörenden Bereich der Nordsee sind Plattformkonstruktionen mit Hilfe von Mikrowellen-Rundfunksystemen troposphärischer Streuung mit dem Telefonwählernetz von British Telecom verbunden, wodurch eine zuverlässige und wirtschaftliche Mehrkanal-Fernmeldeverbindung über angemietete Telefon-, Telex- und Datenübertragungsleitungen zu den Küsten-Fernmeldezentren des Kunden gegeben ist.

Dieser Aufsatz befasst sich mit dem North East Shetlands Basin Area Communication System (NESBACS), welches das grösste und umfassendste Fernmeldesystem darstellt, das bisher in den britischen Nordsee-Ölfeldern fertiggestellt wurde. Es bietet acht nordöstlich der Shetlandinseln gelegenen Ölplattformen eine lebenswichtige Fernmeldeverbindung zur Küste und erstreckt sich über einen Bereich von 800 Quadratmeilen. Jede der beiden troposphärischen Verbindungen liegt im 1,7–2,35GHz-Frequenzband und ist auf einer vierfachen (Raum/Polarisation) Diversity-Grundlage angeordnet, um vier unabhängige Signalwege zu erlangen, die gegenwärtig 132 Sprechkanäle umfassen. Ausserdem wird das komplexe Fernmeldenetz zwischen den einzelnen Ölplattformen sowie Einzelheiten der Überwachungs-und Steuersysteme beschrieben.

RESUMEN

La exploración y producción del gas y del petróleo exige una amplia variedad de sistemas de telecomunicación fiables y seguros para el funcionamiento eficiente.

En el sector británico del Mar del Norte, las construcciones de plataformas están enlazadas a la red telefónica conmutada de la British Telecom por medio de sistemas de radio de microondas de dispersión troposférica, suministrando un medio de comunicación multicanálico fiable y económico (en lo que respecta a circuitos arrendados de teléfonos, télexes y datos) a los centros de comunicaciones costeros de los operadores.

Este artículo describe el North East Shetlands Basin Area Communications System (NESBACS), que es el sistema de telecomunicaciones mayor y más complejo hasta ahora completado en los campos petrolíferos del Mar del Norte de Gran Bretaña, suministrando una cuerda segura de comunicaciones a la costa para ocho plataformas de petróleo situadas al noreste de las Islas de Zetlandia, y extendiéndose sobre 800 millas cuadradas. Cada uno de los dos enlaces troposféricos opera en la banda de frecuencia de 1,7–2,35GHz, configurada en una base cuádruple de utilización (espacio/polarización) para lograr cuatro trayectorias de señales independientes, portando en la actualidad 132 canales acústicos. Se describe la red compleja de comunicaciones entre plataformas, junto con los detalles de los sistemas de vigilancia y control de la red.