Ad-hoc Mesh Radio Over Satellite for First Responders

Cobham Technical Services
Antenna and Electronic Systems

The most important thing we build is trust
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CAMROSS is a new product development by Cobham Technical Services that provides a networked radio system with full-duplex capability and seamless ad-hoc networking, even indoors and underground.

Cobham’s Adhoc Mesh Radio Over Satellite System (CAMROSS)

Cobham Technical Services is developing a low cost custom Mobile Ad-hoc mesh NETwork (MANET) of handheld radios, data terminals and deployable repeater nodes connected to a custom IP-based satellite gateway unit that will interface to 3rd party satellite modems and antenna terminals.

This solution provides a satellite backhaul to an ad-hoc terrestrial radio system. This enables full duplex PMR voice and data services to be used in disaster situations, in areas without existing communications, with a link back via satellite to headquarters anywhere in the world. Several terrestrial ad-hoc networks can be linked together via satellite to co-ordinate operations in a number of areas, even where users are located in several groupings spread over a large geographical region.

Additionally, a data terminal interfaced to the MANET provides a touch-screen Graphical User Interface (GUI). This provides access to communications features such as messaging and contact information. Fully featured Graphical Information System (GIS) mapping software is also included, allowing user locations to be tracked on a map, plus a wealth of features such as labelling of hazards and finding optimum routes for users to converge.

The MANET technology works especially well in buildings or underground environments. The MANET handsets form a robust communications network, linking users to each other, their local commanders and their remote operation control centres, as well as tracking their locations. MANET repeater nodes can be dropped to further extend coverage and network reliability.

The portable, small and lightweight system can be easily transported on commercial flights and deployed in minutes. It is a self-contained and rapidly deployable system that can be used immediately anywhere. The 2.4GHz frequency band used is freely available everywhere in the world without a license. CAMROSS is fully compatible with other Cobham products, including equipment for wireless video streaming and range extension.

The main target markets for CAMROSS are first responders, including all rapid response emergency services, for humanitarian and disaster scenarios.

Key Features
- Rapidly deployable and independent of any terrestrial infrastructure
- Low cost, handheld, rugged, environmentally sealed, small & lightweight
- Simple hands free use
- Display of maps, messages & interactive situational awareness
- Portable IP gateway gives access to global satellite reach-back
- Concurrent data & full duplex voice with PTT
- Self healing ad-hoc network, allowing groups to seamlessly split and reform
- Excellent in-building coverage. Repeater nodes can be dropped to extend range
- 800m typical range single hop, but up to 5 times this coverage with multiple hops
- User location from internal GPS receiver with software showing user locations on a map
- Communication across command and control structure with group call prioritisation and pre-emption
- Audio interface to other radios, such as UHF/VHF, TETRA or P25
- Add-on equipment includes cameras with wireless video streaming & 20km range extenders
- Use of license-exempt terrestrial band (2.4GHz) for free worldwide use
- Encrypted frequency hopping radio

Full duplex voice and data radio
Unlike existing Combat Net Radios, Cobham’s networked radio system provides full-duplex voice communications within a group, and also supports a data capability for the distribution of situational awareness information. Within a group, up to 6 users can talk simultaneously, whilst the network also handles the transmission and reception of data at up to 61kb/s. There can be up to 28 users in a group and 64 groups, but additionally, each radio contains a second receiver so users can select...
a second group to monitor whilst working on the primary group. This provides plenty of capacity to handle the largest of missions. Full duplex voice eliminates the need for rigid voice procedure. In the VOX mode of operation, it emulates true command and control and allows users to pass instructions and orders as if they were standing next to each other.

**Ruggedised handset with GPS**
The MANET handsets are rugged, designed to be used in the harshest of conditions. The handsets are display-less so that they can be used even when visibility is impaired, for example in smoke. The simple menu system is accessed with a single push and turn selection button, accompanied by voice prompts, spoken through the headset, to guide users through the menu structure. English and the local language are provided as standard. In reality, once setup there are very few changes that a user would make other than altering volume and changing group.

**Display terminal for maps**
The MANET data terminal is a display device and handheld computer connected to the MANET handset and featuring customised software. A range of PDAs and smartphones have been approved for use, some of which are fully ruggedised. A lightweight harness secures both the handset and data terminal, leaving hands free. Full colour touch-screen displays enable situational awareness information to be provided. There are facilities for preparation and display of messages, web browsing and e-mail, plus all the voice communication facilities of a MANET handset are available.

**MANET technology**
The system uses mobile adhoc network technology which comprises a self-configuring network of mobile devices connected by wireless links. Each MANET terminal is free to move independently in any direction, and will therefore change its links to other MANET terminals frequently. A key advantage of an adhoc network is that it does not require any kind of base-station or existing infrastructure; it can be used anywhere and immediately.

**Repeater nodes for range extension**
Each MANET terminal acts as a repeater, automatically rebroadcasting to all other users in range, so radios in the network talk with each other through other radios in the group. The point-to-point range is typically at least 800m, but by rebroadcasting over multiple hops, up to 5 times this range can be achieved. By rebroadcasting and multiple routing this allows coverage over a wide area and in demanding propagation environments, such as in urban areas, in buildings or underground. Part of the product offering is specially designed repeater devices that can be dropped to extend range and provide robust coverage. These devices are small and easily portable.

**Self-healing and dynamic ad-hoc networking**
The adhoc network provides a unique group self-healing capability. When a group intentionally, or unintentionally, splits into two or more sub-groups, which then move out of range of each other, separate autonomous networks are automatically formed with their own Dynamic Network Controller (DNC). This ensures that communications within each sub-group are maintained. Upon reforming, the system automatically re-connects the sub-groups seamlessly back together to form a single group again. This provides a high degree of flexibility for deployment in difficult terrain or in environments with poor RF propagation. In contrast to the fixed Master used in other full duplex systems, Cobham’s adhoc network uses a DNC. The DNC moves within the network automatically and is normally the

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CAMROSS is a low cost, rapidly deployable, robust, mesh networked radio system with satellite reach-back, which is self-contained and independent of terrestrial infrastructure.
radio judged to be in the RF centre of the mesh. High availability, reliability and system range is optimised at all times by this technique.

Group PTT calls
CAMROSS provides the advanced features of a Private Mobile Radio (PMR) system. This includes Push-To-Talk (PTT) group calls, private groups and sub-groups and prioritisation & pre-emption of calls. This allows users to talk to all or specific groups or individuals across the entire emergency services command and control structure.

Worldwide use in ISM band
The MANET handsets use the license exempt band at 2.4GHz, so they can be used for free, without a license, almost anywhere in the world.

Audio interface to other radios
The MANET handsets have a multi-function connector which provides an audio interface to UHF/VHF, TETRA, P25 or any other legacy voice radio. A second PTT is provided for keying external radios. Cobham’s solution can replace TETRA functionality, but also provides benefits to existing TETRA users, including satellite backhaul and improved in-building coverage. The port can also be used to for external DC power, RS232 serial data or an interface to a vehicle intercom system, such as Cobham’s VIS.

Satellite backhaul
A satellite backhaul is provided using a custom, portable IP gateway which can be linked to any 3rd party satellite modem. This enables the voice and data to be prioritised and routed over a chosen satellite to remote headquarters. This is an IP gateway so also provides access to any IP device, and applications such as WWW and email. A satellite backhaul has the advantage of being secure, covert, rapidly deployable and independent of terrestrial network infrastructure which can be disabled in disasters and combat scenarios. However, the gateway will provide an interface to any available IP backhaul network, such as 3G or Wifi.

CAMROSS is also integrated with Cobham's Duo IP radio which provides a wireless point-to-point bi-directional Ethernet link. This can be used to join two disparate MANETs separated in excess of 20km and allow users in both MANETs to communicate together and access the same satellite backhaul link.

Wireless video transmission
CAMROSS is integrated with Cobham’s state-of-the-art technology for wireless digital transmission of video. Using proprietary narrow bandwidth COFDM or standard DVB-T modulation, MPEG encoding and AES encryption, this provides a robust, configurable and spectrally efficient means of transmitting video captured by portable cameras back to the IP gateway and routed back over satellite. Supplied in a rugged, lightweight weather proof aluminium chassis, the video transmission kit can be used in body-worn applications, or prolonged outdoor deployments.

Cobham Technical Services
Cobham Technical Services works at the leading-edge of innovation by undertaking advanced design and development, producing high-performance custom components and sub-systems, delivering specialist technical consultancy services and by providing state-of-the-art electromagnetic and power system modelling software products.

Expert technical teams have extensive embedded programme management experience, which ensures efficient project planning, resource time management and on-time delivery.

These capabilities provide customers with high added-value and enhanced competitive advantage through reduced technical and commercial risk, faster time-to-market and improved performance of products, systems and engineering infrastructure assets.

Industry-leading technology is delivered to government departments and global companies across market sectors as diverse as communications, aerospace, defence, transport, electronics, medical and energy.

Cobham Technical Services is based across four sites located in Leatherhead, UK (ERA Technology), Abingdon, UK (Lightning Testing and Consultancy), Kidlington, UK (Vector Fields Software) and Aurora, USA (Vector Fields Software).

For further information please visit: www.cobham.com/technicalservices