



**NORTH WILTSHIRE and GWENT RAYNET GROUPS**

# **Communications Exercise**

**in conjunction with Wiltshire Fire & Rescue Service and Network Rail**

**Sunday, 26 November 2006  
Box Railway Tunnel, Wiltshire**



## **EXERCISE REPORT**

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(This document is designed for back-to-back printing.)

**RAYNET – The Radio Amateur's Emergency Network**

RAYNET is the United Kingdom's national voluntary communications network provided for the community by Radio Amateurs. RAYNET was formed in 1953 following the floods on the East Coast when Radio Amateurs provided emergency communications which, at the time, were not permitted by their licence conditions. However, soon after the floods, Government officials recognised how important and useful these Radio Amateurs had been, and amended the licence conditions accordingly, to allow such emergency communications.

RAYNET groups exist all over the UK, and you are likely to find a Group in just about every County. Members train themselves to be as professional as possible, with a lot of Groups also participating in joint training events and exercises with their local Emergency Services and Emergency Planning Units. There are laid down procedures for "message handling" to ensure that any information given to a RAYNET operator to be passed to another location, will be sent accurately.

As well as making use of traditional voice communications, RAYNET operators also have access to data transmission facilities, Position Reporting Systems and television transmission, though not all Groups utilise all of these facilities.

As well as being able to assist in times of emergency, RAYNET operators also provide communications assistance for all sorts of public events including: marathons, long-distance walks, orienteering exercises (with the Scouts, for example), charity cycle rides, Air Tattoo's and horse-riding events.

RAYNET members' licensing conditions allow them to provide communications on behalf of:

- Any UK Police Force, Fire & Rescue Service or Ambulance Trust;
- HM Coastguard/MCA;
- Local Authority Emergency Planning Officers;
- Health Authorities;
- Government Departments;
- British Red Cross;
- St John Ambulance Brigade, St Andrews Ambulance Association (Scotland);
- WRVS;
- The Utility Services (Gas, Electricity, Water, Transportation, etc.)

Normally, RAYNET assistance would be requested through the local Emergency Planning Unit, though any of the above may contact their local RAYNET Group directly.

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\* covering Blaenau Gwent, Caerphilly,  
Newport, Monmouthshire and Torfaen

## **Event Overview**

This exercise was a live communications test involving members of the North Wiltshire and Gwent RAYNET Groups together with staff from the Wiltshire Fire & Rescue Service, which took place in and around the Box Railway Tunnel, Wiltshire, under the control of Network Rail. The exercise also provided an opportunity for "Tunnel Familiarisation" for the Wiltshire Fire & Rescue Service.

The aim of the exercise was to test the viability of providing Network Rail (and other interested parties) with useable two-way communications between radio operators located at each Tunnel portal and between RAYNET operators who were walking through the Tunnel (from West Portal to East Portal). At the same time, Wiltshire F&RS tested communications using their UHF handsets. The RAYNET operators located at the West Portal were also provided with a Fire Service radio to assist with tests.

The exercise took place during the morning of Sunday 26th November 2006, with RAYNET operators deployed on the A4 road overbridge adjacent to the Tunnel West Portal (NGR: ST828688) and lineside at the bottom of the access steps at the East Portal (NGR: ST857694). Additionally, five RAYNET members joined a team of around 30 personnel who walked the length of the Tunnel. The RAYNET teams at each Tunnel portal included observers from/members of other RAYNET Groups who were interested in the testing and its results. It is not known if observers from other services joined the teams from Wiltshire F&RS and Network Rail.

The Exercise commenced at around 10:45hrs after the "walking party" had been given a safety brief and Visitors Track Access Permits.

## **Radio Operations**

RAYNET members used radio equipment operating on frequencies of 144MHz (2-metre band), 433MHz (70-centimetre band) and 1297MHz (23-centimetre band), all of which are frequencies allocated for Amateur Radio use. The main frequencies used for testing in the Tunnel were 433MHz and 1297MHz. The frequency used by the Fire Service handheld radios during this exercise is believed to be close to 460MHz. The RAYNET equipment used was a combination of handheld/portable radio transceivers, mobile (car-based) transceivers and a "base station" transceiver. Commercially-available "PMR446" (leisure) radios were also tested but, due to their limited power and high squelch threshold, these radios did not perform well.

The RAYNET operators located at both Tunnel portals set up their equipment utilising "Yagi\*" beam aerials pointing directly at each Tunnel portal for tests on 433MHz and 1297MHz, though the RAYNET operators on the A4 overbridge used a car-based vertical "whip" aerial for the 433MHz tests. The RAYNET operators walking through the Tunnel identified their locations by means of the "miles & chains" markers throughout the Tunnel. RAYNET are grateful for the permission given to operate from the lineside position at the East Portal.

Communication with the RAYNET members in the Tunnel was maintained throughout on 1297MHz, with the operators on the A4 overbridge also able to establish and maintain direct contact with the operators at the East Portal on the same frequency.

Communications in the Tunnel were also tested using the 433MHz frequency. The results were surprisingly good, with the Tunnel operator able to communicate with operators at the West Portal for a considerable distance through the Tunnel. Communications between the "walkers" and the East Portal were maintained from start to finish.

\* A "Yagi" aerial is very similar in appearance to a domestic TV aerial, though its length depends on the frequency in use.

### **Communications during the Exercise**

Please refer to the "Communications Network Diagram" on page 6 for an overview of RAYNET's operation.

The RAYNET operators walking through the Tunnel used handheld radios with the standard, rubber helical aerial, and a power output of around 5-watts on 433MHz and 1-watt on 1297MHz. A separate earpiece and microphone were also used. We understand that the Fire Service communications were maintained within the Tunnel, although communications to each portal were "lost" at a point roughly half-way through the Tunnel.

The RAYNET operators at the East Portal mainly used handheld radios, again with 5-watts power on 433MHz and 1-watt on 1297MHz. Larger radio transceivers were used occasionally, but the majority of tests were performed with the handheld radios as these would more likely be the first radios to be deployed in a real incident.

RAYNET operators located at the A4 overbridge (West Portal) used an Icom "Base Station" radio feeding a 36-element Yagi beam aerial with around 10-watts power output for the tests on 1297MHz. Communications on 433MHz from this location were made using a Kenwood handheld radio and standard helical aerial with an output power of 2.5-watts, and a Yaesu car-based mobile radio, set at 5-watts output feeding a typical vertical whip on the roof of the car. We would also note that the same Kenwood handheld radio used for the 433MHz tests was capable of receiving (but not transmitting) on 1297MHz, and was receiving all transmissions on the 1297MHz frequency from the Tunnel operator.

As this was purely a communications testing exercise, neither Wiltshire F&RS or Network Rail were asked to provide any exercise-specific message traffic for RAYNET operators to deal with, though there were a few requests from the Fire Service for calls to be attempted from the West Portal station. We concluded that if RAYNET had been asked to pass messages, the communication links were of a more than adequate quality to have been able to do so.

General radio communications during the exercise took place on 433MHz and 1297MHz, with an "Engineering Net" active on 144MHz for most of the other, non-exercise message traffic. A member of the Bath & North East Somerset RAYNET Group operated a "Monitoring Station" from the Avon F&RS Command Centre at Lansdown, Bath.

The radio links on 433MHz and 1297MHz were maintained with good signal quality (R5) between all locations, with the Lansdown station able to communicate, without difficulty, with the Box Tunnel area operators on 144MHz and 433MHz.

### **Conclusions**

As a follow-on to Exercise "Avon Express" at the Severn Railway Tunnel in 2005, this exercise at Box Tunnel was arranged to allow the Wiltshire RAYNET Group to gain experience with a major Tunnel in their area. RAYNET's participation was based on one aim with three specific objectives:

The aim:

- to establish a two-way, end-to-end communications link through the Tunnel.

The objectives were:

- attempt to establish and operate a two-way radio communications link between each end of the Tunnel utilising the 1297MHz frequency;
- attempt to establish and operate a two-way radio communications link between each end of the Tunnel utilising the 433MHz frequency;

- attempt to establish and operate a two-way communications link, using 433MHz and 1297MHz, between RAYNET operators walking through the Tunnel, and the RAYNET operators located at each Tunnel portal.

It is very pleasing to note that the overall aim was met. Whilst we cannot claim 100% success with the third objective, this has been identified as being due to the incorrect aerial being used at the West Portal. Had a "Yagi" aerial for 433MHz been in use here, then we are certain that all of the objectives would have been met, without difficulty. (Gwent RAYNET members, operating at the West portal, apologise for not having the usual, full range of equipment available for this exercise.)

One minor difficulty was encountered by the RAYNET staff at the East Portal, though this did not impact on the exercise or its results. The activity around the East Portal led to the MoD Police being made aware (presumably by members of the public) of "suspicious activity" in the area. MoD Officers were appraised of the situation when they arrived at the Portal, but were concerned that they had not previously been made aware of the activity, as it was "their domain".

### **Further Objectives resulting from this Exercise**

- *To carry out a communications exercise in the Box Tunnel area to establish and test a communications link to and from the Network Rail Local Control office at Temple Point(?) and/or Swindon(?) and/or Cardiff(?);*
- *To carry out communication exercises with the Police, MoD Police, Fire and Ambulance Services, whereby RAYNET would operate from key Tunnel locations, passing message traffic during a simulated communications failure with the Emergency Service concerned;*
- *To carry out similar radio communications testing at the Chipping Sodbury Railway Tunnel to provide experience for, and test the capabilities of, members of the South Gloucestershire RAYNET Group.*

### **Thanks**

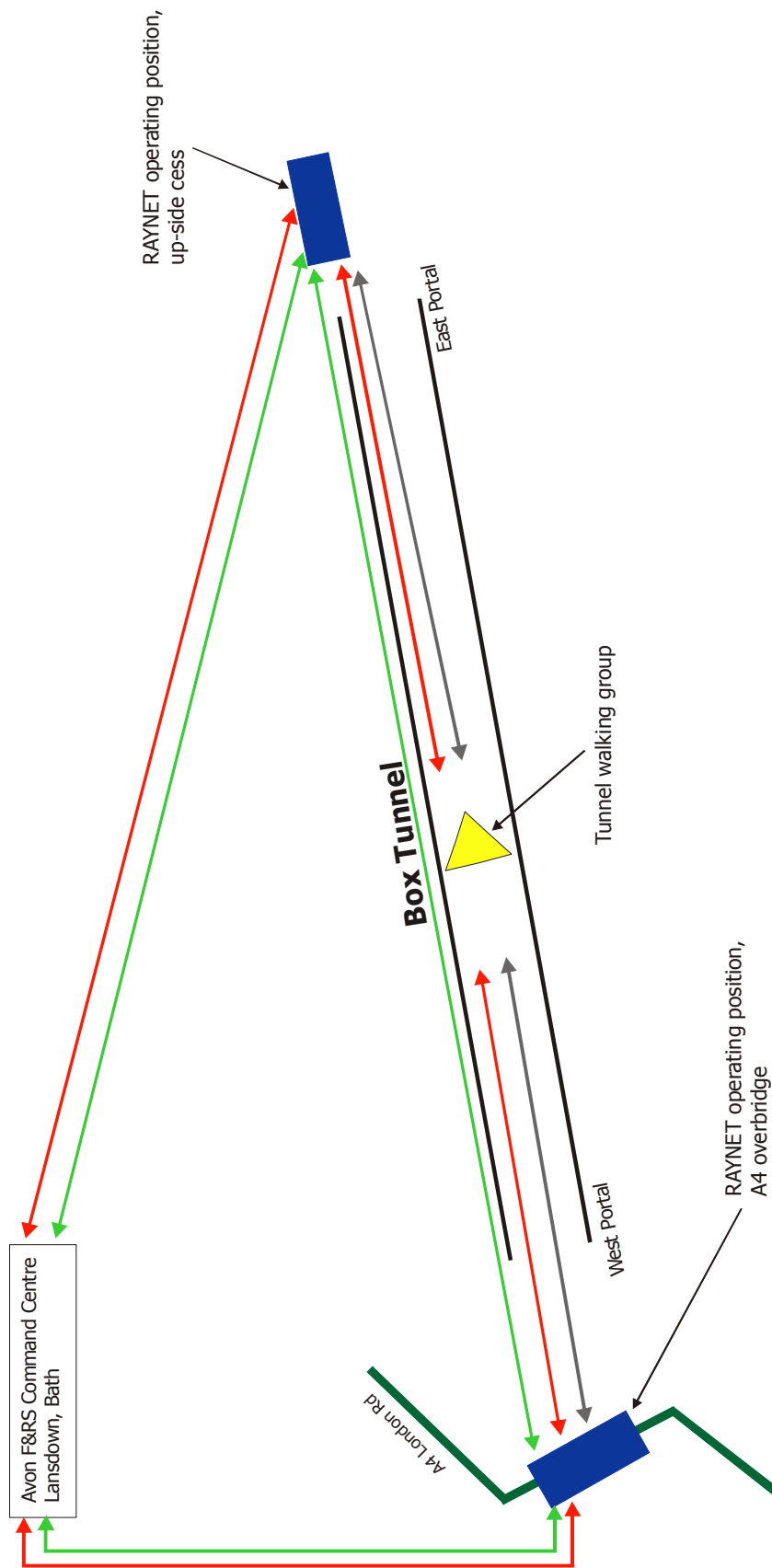
RAYNET members would like to thank Network Rail for allowing us to carry out this exercise, especially with the deployment of RAYNET operators lineside at the Tunnel East Portal and walking through the Box Tunnel.

Thanks also to Wiltshire F&RS for allowing us to operate one of their UHF Portable Radios, which we hope provided them with useful feedback during the tests.

Thanks to Phil Ashby (G6ZUG) for activating the radio station at Lansdown and providing useful feedback on signal quality to/from that location.

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**North Wilts and Gwent RAYNET Groups Communications Exercise  
Box Railway Tunnel, Sunday 26 November 2006.**

**LEGEND**

- 433MHz Link
- 1297MHz Link\*
- 144MHz Link

\* Direct, through-tunnel, portal-to-portal link also established on this frequency

**NOT TO SCALE** (GW7BSC 28/11/06)

**Exercise Photographs**

View of Box Tunnel, West Portal  
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Pre-exercise meeting point, Middlehill Yard  
© GW7BSC 2006



Walking group heading for Box Tunnel  
© GW7BSC 2006



Walking group exit the tunnel at the East Portal  
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North Wilts RAYNET station, East Portal  
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East Portal and Access Steps  
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