A Secure Hybrid Network Solution to Enhance the Resilience of the UK Government National Critical Infrastructure TETRA Deployment

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ABSTRACT

In developed economies, electronic communication infrastructures are crucial for daily public, private, and business interactions. Cellular systems are extensively used for business communications, private interaction, and in some cases, public information services, via such uses as mass SMS messaging. The Public Switched Telephone Network (PSTN) is at the core of all communications platforms. It was used primarily for voice communication purposes, but with current technological advances, this platform has been transformed from a voice to voice interface to a web enabled multimedia platform that provides commercial, business, and e-commerce services to the public. In response to the September 11, 2001, terrorist acts in New York City, the UK government introduced a policy of separating and transferring all emergency communication traffic from the PSTN to a digital public safety network based on the TETRA architecture. This paper extends the utilisation of the TETRA deployment by discussing a secure MANET hybrid solution for use in extreme situations as a short/mid-term EMS organisational communication platform for emergency and rescue operations.

Keywords: DSDV, DSR, Emergency Services, EPCIP, MANET, NCI, PSN, TETRA

1. INTRODUCTION

The ability for the emergency services to mobilise and organise efficient cross-communication platforms is critical in the delivery of a high quality service that is capable of coordinating the rescue effort in the most cost effective and efficient manner possible. This implies that the emergency services must be capable, under extreme circumstances, of quickly achieving
a high-level of inter-services communications without the assurance of a fully operational telecommunications platform.

Over the last few years we have seen a number of natural disasters, where such incidents as the devastating floods in Worcestershire, UK, in both 1998 and 2007, the Sichuan earthquake in China in 2008 and the recent earthquake in the Italian city of L’Aquila in 2009. These disasters not only severely tested the national and international telecommunication infrastructures, but in some cases completely destroyed the communication infrastructure in the affected areas. Resulting in the inability of the emergency services to react and organise themselves; whilst managing the sense of panic and anxiety, which is commonplace amongst the general population in the disaster zone.

In 2001 the American city of New York found itself under an alternative extreme situation - a man-made political terrorist attack where the public voice and data communication infrastructure was severely compromised on 9/11, by the extreme demands put on the New York’s PSTN. Research as clearly demonstrated that the inadequacies of the New York emergency radio communications infrastructure, was a major contributing factor to the loss of 120 New York fire-fighters (BWCS Consulting, 2002). Similar research both in the UK and Europe has found the old analogue radio networks demonstrated the same bandwidth inadequacies with congested airwaves, bad reception, and loss of signal (BBC News, 2002), during similar situations.

The governments of both Europe and the UK have taken these natural and man-made threats to their national communications infrastructure seriously and have developed systems to combat these types of threats; by the introduction of UK Critical National Infrastructure policy and the EU equivalent European Programme for Critical Infrastructure Protection (EPCIP). This was achieved by a policy of transferring all emergency communication from the PSTN services to a parallel digital TETRA based private mobile radio network and public access mobile radio network (ETSI, 2000).

The TETRA standard is a European wide standard for radio communications of the public safety and emergency services networks (ETSI, 1995), like GSM is the standard for mobile voice communication systems; TETRA is the equivalent standard and was developed by the European Telecommunications Standards Institute (ETSI, 2000).

2. TERRESTRIAL TRUNKED RADIO (TETRA) PUBLIC SAFETY NETWORKS

In the UK the TETRA system forms part of the UK government’s strategic Critical National Infrastructure policy; this was developed after the 2001 terrorist incidents to provide a comprehensive solution to combat terrorist attacks on the countries electronic communications infrastructure. These new emergency services communications platforms are generally called Public Safety Networks and their initial objective is to achieve signal coverage across a country, homogenising the regional communications of that country, between the ambulance services, police services and the fire brigade. These systems are digital radio systems that are a vast improvement on the old analogue radio networks previously used by the emergency services.

TETRA is a modern digital private mobile radio (PMR) and public access mobile radio (PAMR) technology used exclusively for the police, ambulance and fire service and other national and public safety organisations (ETSI, 2007). The service was first deployed in 1997, but it was not until 2006 that the PMR and PAMR systems took an increased share of the market, this increased share can be directly attributed to the UK Critical National Infrastructure policy and the EU equivalent European Programme for Critical Infrastructure Protection (EPCIP), which adopted the TETRA standard for the rollout of the emergency services private mobile radio network (PMR) for all police, fire and ambulance service communications. Now the TETRA standard and services have been ad-
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