EMERGENCY MEASURES RADIO GROUP	**EMERGENCY MEASURES RADIO GROUP**
AMATEUR RADIO RAC EMERGENCY SERVICE	**OTTAWA ARES**

Two Names - One Group - One Purpose

Packet Network Plan Phase I
EMRG-615

Version: 1.0

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1 REVISION SUMMARY

Date of Change	Revision Number	Summary of Changes (Section #, type of change)
July 17, 2003	0.1	Initial document -DRAFT
October 25, 2003	1.0	Document Standardization to Template • Correct frequency for Barrhaven • Correct CTCSS for Stittsville • Correct Randall future packet frequency

2 PURPOSE OF THIS DOCUMENT

This document is the phase I project description for building a Packet Radio Network to provide digital communications across the City of Ottawa, as part of the Emergency Measures Radio Group (EMRG) commitment to volunteer emergency communications in time of disaster.

3 INTRODUCTION

3.1 OVERVIEW

3.1.1 Data Vs Voice

In an emergency, voice communications is excellent for short tactical messages, especially if the sender or recipient is mobile or portable. For moving blocks of information such as lists of names or supplies, text messages using a computer and radio link are more efficient. In fact voice links become overloaded with this type of message.

3.1.2 The Death Of Packet Radio

Many amateurs view Packet Radio as a historical part of Amateur radio, which died in the nineties. The main failure of packet radio was the requirement for multiple hops to link locations and the low speed of these backbone links. With the Internet growth in the late nineties, packet radio could not compete.

3.1.3 Packet Radio For Emergency Communications

Packet radio is still a viable emergency communications solution as a 1200 & 9600 bps wireless local loop, providing communications between end sites and the nearest node. Nodes can then be interconnected using wired or wireless high speed links.

By using 9600bps radio links and TCP/IP, the packet radio links become transparent to the user, allowing use of applications that support TCP/IP and interconnection with wired networks such as the Internet.

3.2 NETWORK USE

The EMRG packet network is being built to support emergency communications, but the network will be open to all local amateurs when it is not in use for an emergency or EMRG exercise. Local amateurs are encouraged to use the network, to promote interest and skill in using the packet network.

3.3 DATA RATES

3.3.1 1200

The EMRG emergency packet network will support 1200 bps as implemented in Phase I, this project. Operation at 1200 bps is important because this is the speed that most amateur's TNCs support and because as the distance increases from the central node to the remote site, supporting higher speeds may not be possible.

3.3.2 9600

Phase II, a future project, will add operation at 9600 bps. Supporting 9600 bps will allow higher speed transmission and the potential to support TCP/IP. With TCP/IP, Internet type routing can be used, allowing the separation of the user and the packet gateway. This allows a person with a text email application to send messages which travel over a wired or wireless LAN connection to a packet radio gateway node. The gateway node sends the data across the packet network to its destination. Using TCP/IP on 1200bps links is not effective because most of the bandwidth is consumed by the TCP/IP overhead.

3.4 NODES & STATIONS

There are three key types of network stations required for the EMRG Packet Radio Network;

3.4.1 Central Node

This is a single site, supporting 1200 packet + Node packet routing protocols. This site would support 9600bps operation in the future as well as the possibility of POCSAG paging, a paging protocol that would allow directed messages to text based pagers.

3.4.2 Core Stations

There are four central sites which are key to supporting any emergency in Ottawa;

- EMRG Communications Centre (Fire Dispatch)
- City of Ottawa Emergency Operations Centre (EOC)
- City of Ottawa People Services Control Centre
- Ottawa Red Cross HQ

3.4.3 Portable Stations

Seven portable packet radio kits with laptop computers, for deployment to shelters or other locations in an emergency.

3.5 RADIO - COMPUTER INTERFACE

The original packet radio networks required a Terminal Node Controller (TNC) to interface between a computer serial port and the radio. In recent years, sound cards have become standard in computers and software has been written which can encode and decode packets through the sound card.

3.5.1 Sound Card Interface

Several manufacturers produce a Sound Card Interface to simplify the use of a computer sound card with a radio. The Sound Card Interface provides PTT from the computers serial port or in some cases a built in VOX, plus they provide electrical isolation between the radio and computer. Most of these sound card interfaces support multiple communications modes and can include additional connections for microphones and other equipment, so the installation does not need to be dismantled in order to use the radio for other purposes. West Mountain Radio is a well known Sound Card Interface company, with their RIGBlaster product line.

The EMRG packet network will use Sound Card Interfaces for all fixed and portable end user sites.

3.5.2 Terminal Node Controller (TNC)

One of the leading manufacturers of TNCs for many years, is Kantronics. The Kantronics KPC-9612+ TNC will be used at the central node. The central node will use a TNC due to the TNCs built in support for 1200 and 9600 bps, plus mail boxes, packet routing and better packet decoding from poorer quality signals.

The Kantronics TNC also supports Post Office Code Standardization Advisory Group (POCSAG) code, which has been used successfully by amateurs to build a paging network. This could be used for distributing short messages to selected personnel or sites, for people on the move.

3.6 FUTURE OPPORTUNITIES

The network created by this project, will provide basic data communications capabilities. The system will be a closed network (no gateways) and will only support text based messaging, point to point. From the experience of building and operating the network, amateurs can become more knowledgeable and look for opportunities to improve.

3.6.1 Printers

There are a couple printers available, but including a printer as part of the portable kits, would greatly enhance the communications capability by providing a printed copy of the message.

3.6.2 Additional Nodes

The central node will not be reachable from all locations in the City, without digital repeaters. Initially this function will be done by portable systems and through the use of beam antennas. By installing additional nodes across the City, the distance from the end site (shelter) to a node will be shorter allowing higher speed and less end user equipment.

3.6.3 High Speed Backbone

Adding more nodes will lead to congestion if the links between nodes are not larger than the links to end users. Wired and wireless links can be used to ensure that there is sufficient speed between nodes. The wired solution could be using dial up modems or piggybacking on City owned facilities. Wireless solutions include amateur radio high speed modems or using unlicensed wireless 802.11 LAN/WAN equipment which is now readily available.

3.6.4 High Speed Portable Systems

Amateur radio has an allocation within the wireless LAN/WAN spectrum and the LAN/WAN spectrum is unlicensed anyway, so there are opportunities to enhance the network by integrating high speed LAN/WAN links into the network.

The West Carleton Amateur Radio club and numerous other groups across North America, are experimenting with the use of 802.11 wireless equipment for amateur radio communications. It may be possible to provide much higher speed remote links at end sites, allowing non text data transfers and information exchange.

3.6.5 Post Office Code Standardization Advisory Group (POCSAG) Paging

The POCSAG code is a synchronous paging format that allows pages to be transmitted to a text based pager or a computer with decoding software. Pagers are available that can operate in the Amateur bands, so it would be possible to use paging for delivery of one way messages to users who are mobile, such as within a shelter.

There are limits on paging due to the power transmitted, so coverage would not include the entire City of Ottawa, but should cover the most densely populated portion.

4 PACKET NETWORK REQUIREMENTS

4.1 RADIOS

The radios for the portable stations are Motorola Radius model M120 or Motorola Maxar 80. These are 2 channel VHF radios, allowing one channel for 1200 bps and one for 9600 bps. The Radius M120 radios are software programmable, while the Maxar 80 use crystals. Modification information has been obtained for both radios, for supporting 9600 bps operation.

The fixed sites will use a mix of surplus radios from the City of Ottawa, including the Motorola Radius M120 and Maxar 80.

The duty cycle of the radios must be considered to ensure that under load, the radio will not fail. Lower transmit power, improved heat sink capacity and fans for better airflow will be incorporated to ensure continuous system operation. The central site will require a commercial continuous duty transceiver because all stations will be routed through this node, making it active almost continuously.

4.2 ANTENNAS

The fixed sites have commercial VHF antennas or VHF antennas are being installed as part of site changes, such as the Ottawa Red Cross move to a new building.

Portable systems will use a mix of home brew 1/4 wave and 5/8 J-Pole antennas as well as a few commercial 210C antennas. There will be a pool of antennas with the antenna selection made based on where the system will be deployed.

The antenna for the central node is a Sinclair 210C-4, currently installed on the tower at Randall Dispatch.

4.3 COAX

Seven sections of RG8x coax, fifty feet long, with PL259 connectors on each end, are required for the portable kits. The coax provides the connection from the radio to the antenna.

4.4 COMPUTERS

The fixed sites have a mix of computers, from Pentium 133 MHz up. The computer does not need to be state of the art to run the windows packet program.

The portable systems are made up of laptop computers donated by a local corporation. The systems are in excellent shape and will provide plenty of performance.

4.5 PACKET SOFTWARE APPLICATIONS

There are several software applications for packet radio. Many were written many years ago for DOS, but there are a few written for windows, such as WINPACK and FNPack. The windows based packet software will be used because it allows cut and paste of text information from other applications, support for APRS and the ability to use other windows based applications.

4.6 COMPUTER TO RADIO INTERFACE

The packet network requires 11 Sound Card Interfaces and 1 TNC. These items must be purchased and represent the request to the OARC for funding.

4.6.1 TNC

The Terminal Node Controller (TNC) is a Kantronics KPC-9612+. This unit has two radio ports, one for 1200 bps and one for 9600 bps.

There are two options available for the KPC-9612+ and both of these are required. The two options are;

- 128K memory expansion for 512K total
- K-Net Node Firmware

4.6.2 Sound Card Interface

The Sound Card Interface is the West Mountain Radio RIGBlaster NOMIC. The NOMIC is the basic interface and has no microphone (NOMIC) interface, so once connected to the radio, it must be disconnected to use the radio for voice.

The portable packet systems are dedicated to packet radio only, so there is no requirement to have the microphone interface, which reduces the overall cost. There are 11 NOMIC Sound Card Interfaces required.

5 NETWORK DESIGN

5.1 BASIC NETWORK

The EMRG Emergency Packet Radio network is based on an initial 1200 bps configuration, which can be enhanced through a series of future projects, to provide an expanded backbone and to overlay TCP/IP on the network.

The network has one central node capable of simultaneous 1200 & 9600 bps (9600 is a future project) operation, four fixed sites at key emergency locations and seven portable stations for deployment as required in an emergency. The fixed and portable stations can operate at 1200 or 9600 bps.

The central node is capable of packet routing so with packet terminal software on each PC, text messages can be exchanged between stations. There is also an email option on the central node, allowing mail boxes to be established if required.

5.1.1 Short Term 220 MHz

The EMRG Communications Centre at Randall Dispatch and the EOC will use Tri-band (144,220,440 MHz) radios for packet, allowing a dedicated channel between these two sites if required. The 220 MHz band is not used by many amateurs and is not supported by many older scanners, making it less likely to be monitored in an emergency. The 220MHz option could be extended to the Red Cross in the future, making a dedicated core station network.

5.1.2 Network Drawing

The network shown in Figure 1, is the minimal network required to provide an adequate emergency data communications solution in Ottawa. The Central node is shown with 1200 & 9600 bps support, but support for 9600 is a future project.

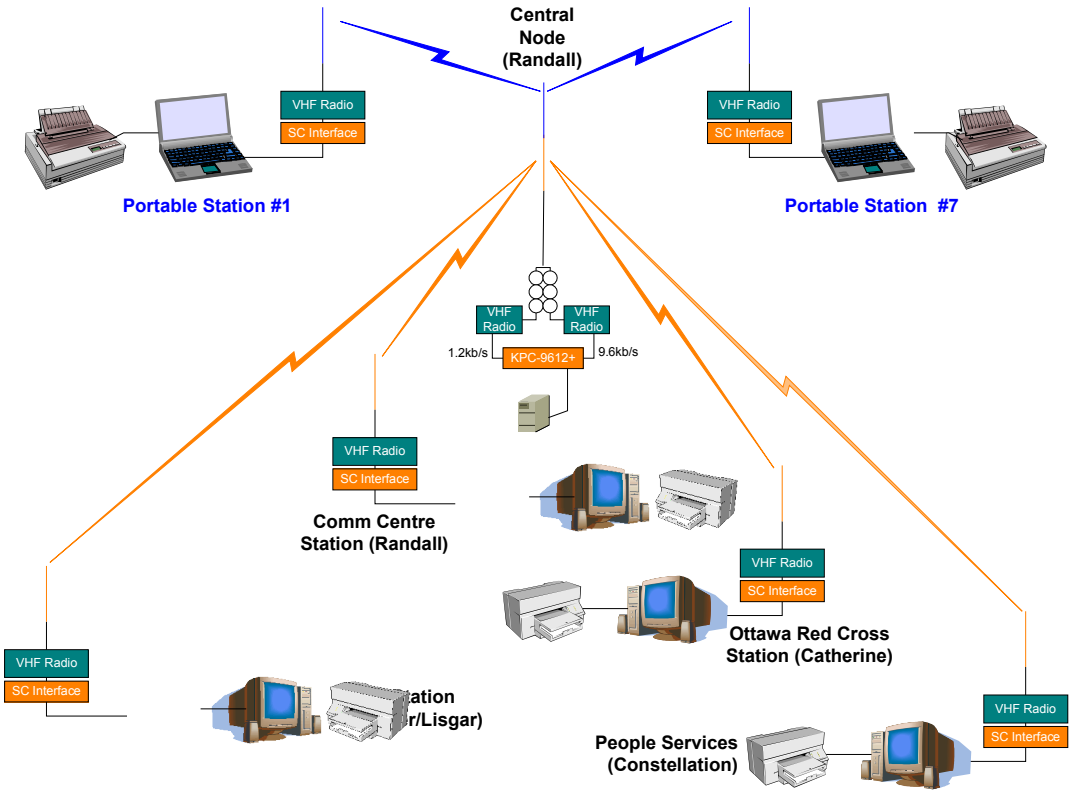

Figure 1 Initial Network Layout

5.2 FUTURE NETWORK OPTIONS

In future projects, options include moving the core fixed stations to 220MHz, adding a high speed backbone using wireless licensed or unlicensed spectrum or wired links and adding TCP/IP support for routing to the internet and within the EMRG network and POCSAG paging.

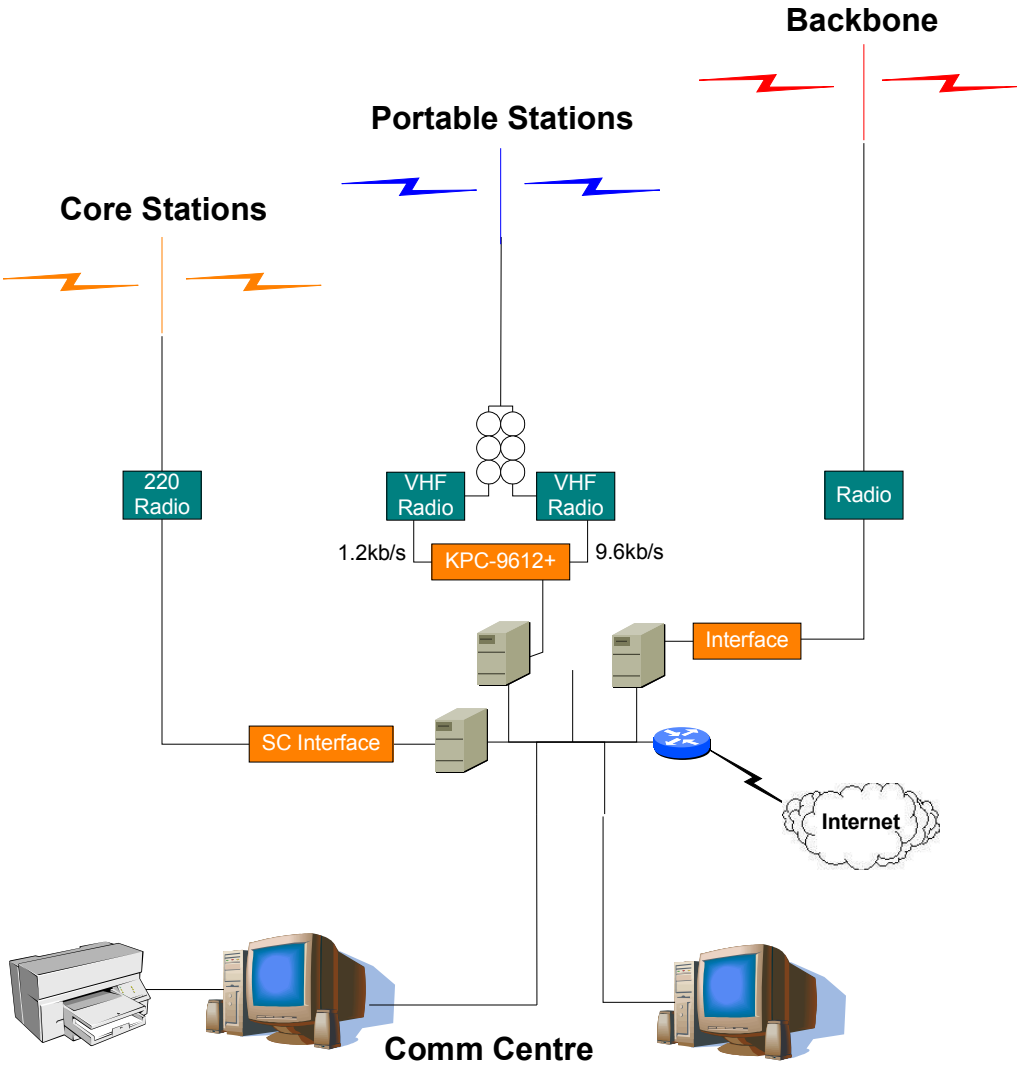

Figure 2 Central Node Possible Future Expansion