

Emergency **M**easures **R**adio **G**roup

Emergency & Disaster Communications 5 Year Plan

Strategy and Requirements

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1 INTRODUCTION

1.1 PURPOSE

This plan describes a series of projects, which define EMRG's communications infrastructure development for the next 5 years.

1.2 EMRG Mission

To be an effective & respected, volunteer communications solution, that when required, can and will add value in the event of an emergency or disaster.

1.3 Five Year Plan Guiding Principles

The EMRG Communications Infrastructure 5 year plan is built on key values and direction, laid out in the City of Ottawa Official Five Year Emergency Response Program Action Plan. The following components from the City's five year plan form the foundation for the EMRG plan;

"The Five Year Action Plan aims at heightening the combined level of response throughout the City of Ottawa's emergency response community."

Converging Goal

"Provide an integrated and effective emergency response ensuring a comprehensive coverage of the disaster victims needs while promoting appropriate contribution of all."

Project Principles

- Budget should be expended on multi-agency initiatives
- Projects or equipment will continue after the 5 years within a unit's normal operating budget
- Budget should maximize matching fund opportunities

1.4 EMRG's Role In An Emergency

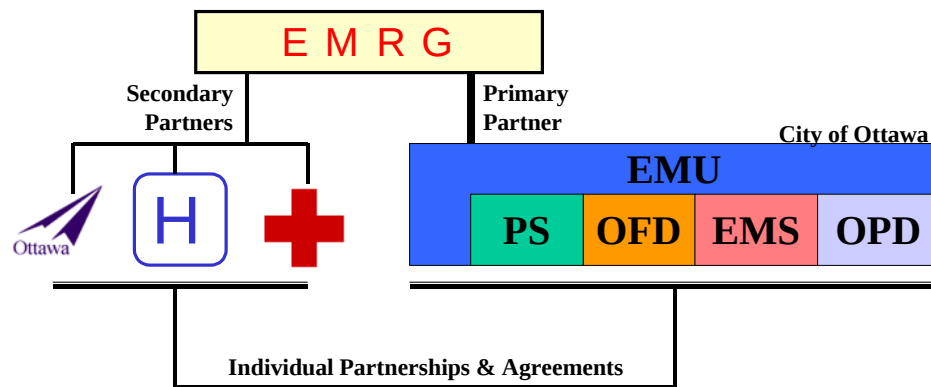
1.4.1 Service

Provide **radios** and **radio operators**, as part of a flexible, **City wide**, emergency radio communications infrastructure. Key services provided includes;

- Implement a dedicated emergency communications infrastructure where none normally exists (i.e. People Services for evacuation centres)
- Communicate between agencies or organizations who are on different communications systems (i.e. Red Cross, Salvation Army, People Services)
- Provide a backup solution (i.e. Hospitals)
- Augment existing communications capabilities to provide additional capacity in an emergency (EMU, OFD, EMS, OPD)
- Provide communications in the event that primary communications systems are degraded or disabled by the emergency or disaster

1.4.2 Partners

EMRG's primary partner is the City of Ottawa Emergency Measures Unit (EMU). In an emergency, where more than one EMRG partner requires assistance, EMRG resources would be allocated on a priority basis, through discussion with EMU. EMU & EMRG have a signed support agreement.



1.5 Ottawa Communications Challenges

1.5.1 Sealed Buildings

Radio communications from inside most buildings, especially from the core of the building, is difficult with hand held radios or cell phones. There are few entrances in most buildings so it is difficult to step outside to use the radio and there is typically no way to run cables outside to an antenna.

- This includes buildings used for shelters, the EOC and most dispatch centres
- Hospitals are most challenging due to limits on radio power inside the building

1.5.2 Distance

Radio signal clarity and data speed, diminish as distance increases. The City of Ottawa covers 2,760 square kilometres, with 250 square kilometres of urban area, 2,510 square kilometres of rural area and a total distance from East to West of over 110 kilometres.

- The problem is compounded by the terrain issues
- It is not possible to provide efficient, clear communications across Ottawa, without having a radio repeater infrastructure.

1.5.3 Terrain

The type of radio systems used for local communications, require nearly line of sight between the two radios in order to communicate. Communities that are below or behind a major hill, makes communications within the area, and from the area back to the core of the City difficult.

- West Carleton is an extreme example, with Fitzroy Harbour, Constance Bay and Carp all on different sides of hills, plus significant distance back to central Ottawa.

1.6 Surplus Equipment

1.6.1 Identification

There are radio system components within the City that have low resale value as used equipment, but which are useful for EMRG and have a high purchase price to obtain new.

Most of the equipment is within the control of the Ottawa Fire Dept, but some very useful surplus equipment is spread out across different locations and different departments within the City.

There is a limited time window to identify these components and tag them for EMRG use, before the City disposes of them.

1.6.2 Removal

Some equipment must be removed by professionals, due to its' location, co-located equipment, or because of support agreements the City has.

EMRG volunteers can remove equipment where professionals are not required, or where professionals can remove equipment in large pieces, so EMRG volunteers can do the detailed equipment removal.

Co-ordination is important, because Professionals must often treat part of what they remove as "junk", to reduce removal time (costs), but critical or costly components are lost. There are components such as connectors, which are expensive to buy new, or brackets and cables which were part of specific systems and are either expensive or no longer available.

1.6.3 Inventory

Regardless of its intended purpose or value, all equipment must be inventoried. The inventory list will be maintained over time, to track equipment. Once the equipment is ready for EMRG use, it will be marked with a serialized inventory tag.

1.6.4 Storage

EMRG requires storage space from the City, in which to store and sort the equipment. The space will be required for up to 5 years, while EMRG processes equipment as part of various projects.

It would be advantageous if there was sufficient space for working on equipment as part of the project implementation phases.

1.6.5 Project Implementation

Equipment will be used as is, modified or integrated with other new or used components, to build the solutions defined as the EMRG projects. Standard connectors, inventory tags and testing will be required for all equipment.

2 PROJECTS

2.1 EMRG Direction

The Emergency Measures Radio Group (EMRG) must improve its radio communications network over the next couple years to ensure that the solutions we provide meet the needs and expectations of the agencies we serve. Improvements are required in order for EMRG to provide reliable, effective communications across the entire City of Ottawa, in both Urban and Rural environments.

As City of Ottawa radio users migrate to the EDACS radio system, the City is decommissioning a variety of VHF & UHF radio equipment that could be used by EMRG. We are not looking for truckloads of equipment, but rather selective allocation from the wide range of systems and equipment being decommissioned, based on usefulness for EMRG and its value to the City of Ottawa.

2.1.1 Funding

No matter how much work EMRG volunteers do for free using donated equipment, there are costs. Connecting cavities requires N connectors which cost up to \$20 each, amateur repeaters need controllers, which can be built as a kit to reduce cost and gain experience, but they still cost about \$250 USD. Old GE radios can be re-tuned and duplexed as repeaters or full duplex base phone/fax extensions (we have 2 Zetron phone interface units), but crystals cost upwards of \$50 with installation, calibration and shipping.

Some things can be acquired unofficially, as donations, etc, however other items must be purchased through normal channels and regular budgets cannot support the cost. Financial support is required from the City of Ottawa to fund these activities. (based on proper project proposals with detailed designs and costs).

2.1.2 Alternate Funding & Equipment Sources

While most of the solutions are based on City of Ottawa equipment, EMRG has tapped 3 other sources so far, which have provided some interesting additional equipment;

- Ottawa Red Cross - They were donated several radios, power supplies, phone interface units and remote consoles
- Ottawa Citizen - They donated about 10 UHF radios
- Insurance Company - Donated the components from an audio conference room, which includes 26 microphones, 7 mixers and some miscellaneous equipment

There are additional sources which EMRG can and will pursue, for direct donations of matching funding. For example some Amateur equipment vendors provide equipment at significantly reduced prices for Amateur emergency communications activities.

2.2 Project List

The EMRG 5 year plan is defined in a set of 16 projects, within four key areas of development;

1. Communications Across Ottawa
2. Operations Control & Management Sites
3. Speciality Radio Kits & Inventory
4. Communications Outside Ottawa

Most projects are independent and can be implemented without dependencies.

#	Name	1	2	3	4
1	Voted Amateur VHF Repeater	X			X
2	Central Amateur UHF repeater	X			
3	Main Communications - Operations Centre	X	X		X
4	HF - Auxiliary Communications Centre	X	X		X
5	Mobile command vehicle operator position		X		
6	Community VHF &/or UHF Amateur repeaters	X			X
7	Digital Repeaters (Data Communications)	X			
8	Cross-band & In-Band VHF/UHF Repeaters			X	
9	Phone extension (Remote phone patch) kits			X	
10	Remote Radio Console Kits			X	
11	Remote base kits (Shelter Kits)			X	
12	Data communications kits			X	
13	Radio Equipment Inventory			X	
14	Remote Communications Sites		X		
15	Replace local Amateur radio club VHF repeater	X			X
16	Commercial VHF Repeater	X			

3 PROJECT DESCRIPTIONS

3.1 Central Voted Amateur VHF Repeater

3.1.1 Description

The repeater would include a central transmitter with 3 to 5 remote receiver sites, located East, Central, South, West and North West. The receiver sites would be connected back to a voter at the central transmitter site.

This repeater would provide portable radio coverage in most of the City, urban and rural areas and would ensure mobile radio or remote base coverage City wide, making this repeater a backbone system capable of providing radio communications between sites anywhere in Ottawa.

3.1.2 Considerations

How to extend the remote receivers back to the transmitter site.

- Currently using phone lines (ongoing cost).
- Alternative is to use radio links (Amateur spectrum = no license costs), but the voter may not work with radio links and the initial equipment and installation would cost money (JEPP Grant?).

3.1.3 Overview

Central dispatch and repeater sites have higher power transmitters and greater antenna height than the portable and mobile radios they communicate with in the field. As a radio user moves away from the central radio site, there is a point where the radio user can hear the central radio site, but the central radio site can no longer hear the users radio. By installing remote receivers, the transmit distance and the receive distance will be equal.

3.2 Central UHF repeater

3.2.1 Description

The repeater would include a central UHF transmitter and receiver at one site, Randall Dispatch, connected together with a duplexer. UHF provides good building penetration and the location at Randall provides good coverage of the City core. This repeater would provide portable radio coverage from the core, including from within many buildings. For example a hand held radio can communicate from the Ottawa Police HQ on Elgin St to the existing PARC UHF repeater on Bank St (Just below Randall).

3.2.2 Considerations

1. 4 bay Sinclair UHF antenna
 - Could a 4 bay Sinclair UHF antenna be installed on the tower at Randall? EMRG has an antenna donated.
2. UHF Equipment
 - Most of the UHF radio equipment in the City cannot be moved into the amateur radio frequency band. Used equipment may need to be purchased to build the repeater.

3.3 Main Operations Centre

3.3.1 Description

The City of Ottawa Fire Department is making space available at the Randall dispatch centre, for EMRG to create its' Main Operations Centre. In a disaster, the main operations centre acts as the central control for all EMRG communications. The communications room will be equipped with several radio operator positions as well as having space for operations planning and resource allocation. One or more Net Control Station (NCS) operators and at least one operations leader would be there if EMRG is active.

3.3.2 Overview

Each frequency used by EMRG has a NCS assigned, who is the Amateur equivalent of the Fire or EMS dispatcher. All radio operations on the assigned frequency are controlled by the NCS. With a dedicated, central location for all EMRG net control operators, information can move quickly within the centre, because all activity in the room is dedicated to EMRG communications support.

The preferred option is a dedicated room for EMRG operations, however the communications room could be used for other purposes normally, so long as in an emergency, it can be dedicated to EMRG use.

3.4 HF - Auxiliary Operations Centre

3.4.1 Description

The primary use for the HF - Auxiliary operations centre is to operate HF (High Frequency) communications, which is similar to short wave radio. Communications on HF provides long range, such as to the Toronto EMO HQ, across the country or across North America.

There would be several antennas required, to ensure use on multiple bands, over different conditions and survivability should an antenna fail (i.e. ice storm).

This site would also act as an auxiliary or backup site for the Main Operations Centre. In a disaster, the number of frequencies in use may exceed the space and radios available for NCS operators in the main operations centre and the RF loading of the main operations centre may cause interference between operators. The main operations centre may also not be operational due to the disaster

3.4.2 Site Selection Criteria

- 1) Not near high voltage transmission lines due to HF interference. (this rules out some work centres, EMS dispatch)
- 2) In an area where antennas would not be close to residential areas. (Some fire stations are surrounded by homes, so it would be best to avoid community complaints and have as much freedom as possible for antenna installations)
- 3) In flat or slightly higher ground for VHF/UHF coverage.
- 4) South or West, to provide VHF/UHF coverage in those areas of the City or with neighbouring Municipalities. (Randall covers well to the East, but not as well West and South)
- 5) Secure, but accessible for EMRG, so it can be tested regularly.
- 6) Providing a dedicated room for the equipment. There would need to be additional space available in an emergency, so operators are not permanently confined to the one room.
- 7) Robust building, not in the Rideau river flood plane, not beside railroad level crossings, not beside a tank farm or under a flight path,
- 8) It should have reliable (redundant) power.

3.4.3 Considerations

- a) The City owns enough equipment today to establish an HF station. The equipment is not the best, but it will work.
- b) Environment Canada built an extensive HF station in their building in Ottawa as part of the Y2K preparation and for their Canwarn weather spotting program. The station has been dismantled, amateurs are not allowed unescorted access to the building and the weather office is moving. They are looking for a partner to continue to operate the station so it is available for weather spotting if required.

3.4.4 Overview

HF communications, requires large antennas due to the low frequencies and variability of communications conditions at these low frequencies. To ensure consistent capabilities over varying conditions, beam antennas are used to focus the signal in a specific direction. The beam antenna is usually located on top of a tower and has a motor which allows the user inside to change the direction of the antenna.

3.5 Mobile command vehicle operator position

3.5.1 Description

Installing an Amateur radio in the mobile command vehicle allows the City to deploy EMRG quickly in an emergency and establishes an EMRG presence. The equipment would include a dual-band Amateur radio, wired for voice & computer interface, with a roof mount antenna.

The mobile command vehicle is a multi use vehicle, so the EMRG installation would not provide a permanent operator position. The EMRG operator position would only be used when a requirement was identified for EMRG assistance.

The ability to provide emergency services personnel direct access to the EMRG radio operator, reduces the time required for transferring information and limits the potential for error.

3.5.2 Considerations

The antenna and radio would need to be purchased new.

3.6 Community VHF &/or UHF Amateur repeaters

3.6.1 Description

Community Repeaters are simple VHF &/or UHF stand alone repeaters, located in about 6 locations across the City of Ottawa. VHF repeaters would all share the same frequency, but use different CTCSS tones and/or a remote on/off capability. The repeaters can be commercial repeaters or base stations modified for repeater operation.

Communications across the City is important for co-ordination of emergency response, but local communications is important within the affected area. Community repeaters provide portable and mobile radio coverage within their respective areas. The base station at Randall should be able to communicate with each of the community repeaters so they are not isolated in the overall co-ordination.

3.6.2 Considerations

1. Some sites have antennas on towers owned by cellular companies.
 - Is the City interested in continuing to keep the antennas in place?
 - Where does the cable terminate (City Property)?
 - Could a UHF antenna be added?
2. Building repeaters from base stations should provide plenty of repeaters, but getting enough duplexers may be an issue.
3. While EMRG can build repeaters from the base stations, there may need to be some financial assistance at some point for components such as repeater controllers.
4. Tone boards will be required for the repeaters, so mobile radios with after market tone boards will be required to remove the tone boards.

3.7 Distributed Digital Repeater (Data Communications)

3.7.1 Description

Three distributed digital repeaters (digipeaters), East, West and South, to provide coverage across the City and provide diversity, for transmission of data between computers. Critical operating locations such as the main operations centre, EOC and Red Cross, should be able to reach two of the three digipeaters directly or through another location, ensuring network survivability in a disaster.

The three digipeaters will be VHF or UHF based due to the availability of equipment. Key centres such as the EMRG main operations centre, EOC, and Ottawa Red Cross will be equipped to support the VHF or UHF standard as well as VHF 220 MHz for direct, more secure communications. (VHF 220 MHz is not frequently monitored (many scanners don't support it), so greater security, but 220 MHz radios are not very common in the amateur community.

Initial installations would support 1200 Baud communications using terminal programs on the computers. This will evolve to support 9600 baud communications for user links and higher speed backbone trunks using 56kb amateur radio solutions or high speed off the shelf LAN equipment.

Phase 2 will implement TCP/IP on the network, which will allow standard computer applications to access the digital network in the same way they would use a dial up internet connection. The amateur packet network can then interface to any Intranet through a firewall, allowing email to be generated at a shelter, then transmitted over the amateur data network, for delivery to a mailbox on the City of Ottawa or Red Cross computer network.

3.7.2 Overview

The digipeaters are made up of a base radio, Terminal Node Controller (TNC) and a computer, all permanently connected and turned on. Remote stations connect through the digipeater for computer to computer communications, in the same way that voice repeaters are used for people.

Computer communications is typically more secure, because it requires more than just a scanner to monitor. For moving lists of information, computers allow user verification (i.e. names) before sending and recipient printing or cut and paste forwarding, ensuring information accuracy and speed of data movement.

3.8 Portable Cross-band VHF/UHF Repeaters

3.8.1 Description

Establish an inventory of bi-directional VHF-to-VHF in band and VHF-to-UHF cross-band repeaters for deployment in an emergency. Cross-band VHF-UHF repeaters are used today by the Fire Dept for vehicle based onsite repeaters. The end user has a portable radio which communicates with the vehicle repeater and the vehicle repeater retransmits the users radio signal out on its other radio. Bi-directional repeaters also re-transmit incoming signals out to the portable radio.

3.8.2 Overview

EMRG's goal is to be flexible enough to operate from anywhere in the City of Ottawa. There are two situations that make that difficult;

1. Operation from buildings not pre-wired for radio communications
2. Operation from sites that are on the far side of a hill

Most buildings do not have windows, so in an emergency, it is impossible to install a temporary antenna. Portable radios do not have the power to produce a signal that will penetrate the building walls and reach the repeater. Cross-band repeaters can be deployed from a vehicle in a parking lot, so the portable radio signal now only needs to penetrate the building and reach the parking lot.

Radio communications is line of site, so communities that are on the far side of a hill may not be able to communicate with local repeaters. The West Carleton area is a prime example, where several communities are on different sides of hills, making communications difficult between them. Cross-band repeaters can be deployed on top of a hill, to link radio operators on the far side of the hill, with the repeaters.

3.9 Phone extension (Remote phone patch) kits

3.9.1 Description

Phone extensions provide a radio to telephone capability, so phone service can be extended to building(s) in an area without phone service. EMRG has several telephone to radio interfaces and a repeater with a telephone interface. This project would package these interfaces with a radio, antenna and any phones or cables required.

There are two types of phone extension. One allows a user with a radio equipped with a touch tone pad to make phone calls over the radio. The other provides a telephone interface at the remote end, so users place calls using a conventional telephone.

3.9.2 Overview

In an emergency, where people are in shelters, there is a requirement for people to contact family or friends, to let them know where they are. This is a stressful time, so making the user interface as "normal" as possible, makes the process easier for the user. The phone interfaces which use a conventional telephone will provide this transparency for the users.

3.10 Remote Radio Console Kits

3.10.1 Description

There is commercial radio equipment that allows the user console to be installed at a location remote from the radio. The connection between the user console and the radio is a 2 wire or 4 wire circuit directly from one to the other. EMRG has a couple of commercial radio remote consoles and there are a few within the Ottawa Fire Dept.

These remote consoles can be configured as kits, which can be deployed to buildings with a cable already installed, or using a temporary cable. The kits would be suitable for use in sites that have a higher probability of use in an emergency, but which cannot support a business case for a permanent antenna. They would also be useful in sites such as a large shelter, where the distance between the radio and the user is too great to run a direct temporary antenna.

3.10.2 Considerations

Most of the equipment exists or will exist from the surplus radio equipment. There will be a requirement for connectors, cable and cases to put the kits in.

3.11 Remote base kits (Shelter Kits)

3.11.1 Description

Remote base kits are predefined equipment packages, which contain all the components required to establish a radio base station, such as at a shelter. This would include a radio, power supply, coax cable, antenna and antenna mast. The kit can be permanently packaged together, or can be made up on the fly as required.

The actual equipment can be stored as individual pieces, radios, power supplies, coax etc, but the kit contents is predefined and the transport container is ready for the full kit.

The objective is to be able to provide 10 complete kits.

3.11.2 Considerations

Radios are an obvious part of the kits, but other equipment such as antennas, coax, power connectors, etc may not all be available as surplus from the City. Eventually, some parts may need to be built or purchased as part of a project.

3.12 Data communications kits

3.12.1 Description

Data communications kits contain all the equipment required for computer to computer communications, packed and ready for deployment. Some kits would include a laptop computer while others would have a CD and diskette with the software required. Kits would include the radio, TNC (computer to radio interface), cables, plus a CD and diskette.

Computer to computer communications over radio requires a special data modem that attaches to the radio called a Terminal Node Controller (TNC) and in some cases, internal connections to the radio for optimum performance.

Kits are important, because a limited number of amateurs have the equipment required for portable use.

3.12.2 Considerations

1. The TNCs are available in 9600 and 1200 baud rates. Either way it costs money to purchase the TNCs. The completion of the data communications kits may be a project that requires a JEPP grant or local partnership for the equipment.
2. The radios are standard mobile radios, but must be on the same band as the digipeaters

3.13 General Radio Inventory

3.13.1 Description

The general radio inventory is a catch all for a multitude of radios and radio related equipment that could be required in an emergency. The types of equipment includes

- CB radios & antennas
- FRS radios & FRS capable radios with external antennas
- Marine band radios & antennas
- 12 volt power supplies
- VHF & UHF base and mobile antennas
- Coax cable -various lengths and sizes
- Mobile VHF & UHF radios
 - Hand held VHF & UHF radios

3.13.2 Considerations

Some of this equipment exists today (i.e CB radio, 12 volt power supplies). The general inventory would ensure that all the components required to deploy a resource, are available. For example having a CB radio but no antenna is not a solution.

- This will require some funding over time to buy connectors, cable and hardware.

3.14 Remote Communications Sites

3.14.1 Description

Remote communications sites are a series of about 6 small centres across the City, that are equipped with a basic radio system for use in an emergency. The remote sites are required because communications from within a local area may be needed if repeaters are not operational or a portion of the disaster response is being co-ordinated from a local site.

The equipment would be installed in a location that does not interfere with daily operations, but which is secure and accessible in an emergency. Today there are several fire stations across the City which provide this function. The exact locations would depend on where the EMU would typically expect to establish a local portion of a disaster response.

The facilities required would be generator power, a permanent antenna and a radio with power supply.

3.14.2 Considerations

- There are three fire stations equipped with radios and antennas today.
- Additional radios and antennas should be available from surplus equipment so minimal cost would be involved with additional installations.

3.15 Replacement Amateur Radio Club VHF Repeater

3.15.1 Description

The Ottawa Amateur Radio Club (OARC) is the oldest Amateur radio club in Ottawa and has a strong affiliation with EMRG. The club operates a VHF repeater (VE2CRA) at Camp Fortune in Quebec, through the assistance of CFRA radio. The club is very generous with having others use their equipment and the location provides great coverage of Ottawa, from a diverse location, with a diverse power grid and backup power.

The VHF repeater used by the club, has been around for many years, is mostly home made and has been modified many times over the years. The result is a repeater that no longer operates up to expectation and which is difficult to maintain.

EMRG would like to assist the club, by arranging for the donation of a surplus VHF repeater from the City of Ottawa, to the club.

3.16 Commercial VHF Repeater

3.16.1 Description

Continue to operate the EMU VHF repeater and allow EMRG access to use the repeater. The City of Ottawa currently operates the EMU VHF repeater, which links Police, Fire, Ambulance and EMU.

There are several benefits in keeping the frequency assignment and repeater after the EDACS migration is complete and allowing EMRG use of the repeater.

- The City would maintain a communications resource that is non amateur (commercial radio rules apply). In an emergency, this could be used to augment the EDACS system or in a disaster which impacts EDACS, this would be an alternate system.
- Allowing EMRG to use the repeater, would give EMRG access to a commercial frequency which allows options such as signal scrambling, not allowed on amateur frequencies.
- By allowing EMRG to use the repeater, the repeater and radios would be used regularly, so the system operation is ensured in an emergency.

The repeater could be modified for dual CTCSS tones, so EMRG use would not be heard by any radios that the City may continue to operate on the repeater system.

3.16.2 Considerations

There is a yearly license charge based on the number of radios on the system. This cost would have to be retained in the EMU budget.