

Is Amateur Radio Communication Relevant to Fairmount Fire?

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Certification Statement

I hereby certify that this submission constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

A handwritten signature in black ink, appearing to read "Ed Lyndall". The signature is written in a cursive style with a large, prominent initial "E".

Sign name: \_\_\_\_\_

### Abstract

The problem was that Fairmount Fire Protection District (FFPD) had not identified how amateur radio communication can support fire service operations. The purpose of the research was to identify how amateur radio communication can support operations at the FFPD. A descriptive method of research was utilized to answer the following four research questions: (a) To what planned, forecasted, or unplanned events can the amateur radio community support FFPD? (b) In what capacity can amateur radio communication support FFPD? (c) How much time and money is required to implement and sustain amateur radio communication in support of the FFPD? (d) What equipment, training, and infrastructure does FFPD need to provide for the successful support of amateur radio communications? The procedures included: (a) survey of Colorado fire officers, (b) survey of Colorado Amateur Radio Emergency Service (ARES) team leaders, and (c) interviews with fire officers from the Denver Front Range area. The results of the Colorado fire officer and ARES team leader surveys indicated that fire service command staff did not understand amateur radio's capabilities and that numerous situations existed where amateur radio could serve as a resource to support fire operations. The recommendations were: (a) FFPD should develop relationships with ARES personnel, (b) identify, document, and track situations where FFPD can utilize ARES resources, (c) conduct quarterly training between ARES and FFPD, (d) FFPD should support its members in the obtainment of an amateur radio license, and (e) FFPD should facilitate an event that serves as a platform for ARES to demonstrate their communication capabilities to command staff.

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### Is Amateur Radio Communication Relevant to Fairmount Fire?

Members of the fire service are highly trained, motivated, and effective at their craft. Introduce communication deficits to emergency situations and those same skilled firefighters can become significantly less capable. The sharing of information, ideas, or communication, is a critical component of effective fire service operations. As compared to years past, the fire service relies on sophisticated technology to facilitate voice and data communications. What if that technology was interrupted or a catastrophic event destroyed components of the communication infrastructure? What would be the backup plan for this type of disruption to primary communication methods? Specifically, what capabilities can amateur radio operators provide in support of fire service operations at the Fairmount Fire Protection District (FFPD)?

Hurricanes in Florida, tornadoes in Oklahoma, and flooding along the Mississippi are examples of natural disasters where amateur radio operations provided assistance when primary routes of emergency communication were damaged or destroyed. Amateur radio operators have a demonstrated track record of supporting their communities during times of need. As a part of the accreditation process, FFPD has identified risk factors to its community such as flooding, snow storms, and hazardous materials events (Joel Hager, personal communication, December 18, 2018). Identifying how FFPD can capitalize on the capabilities of local amateur radio operators for such anticipated events could reduce the potential impact to life and property during similar types of incidents.

The problem was that FFPD had not identified how amateur radio communication can support fire service operations. The purpose of the research was to identify how amateur radio communication can support operations at the FFPD. A descriptive method of research was

utilized to answer the following four research questions: (a) To what planned, forecasted, or unplanned events can the amateur radio community support FFPD? (b) In what capacity can amateur radio communication support FFPD? (c) How much time and money is required to implement and sustain amateur radio communication in support of the FFPD? (d) What equipment, training, and infrastructure does FFPD need to provide for the successful support of amateur radio communications?

### Background and Significance

FFPD is a combination of volunteer and career members providing an all-hazard response. These hazards include structural fire response, Emergency Medical Services (EMS), hazardous materials response, vehicle accidents, technical rescue, and wildland firefighting incidents. Additional non-operational services delivered by FFPD include fire inspections, plans review, fire-related safety presentations, and first aid training.

FFPD is organized into four divisions comprised of operations, life safety, support services, and administration. There is 76 total personnel in the organization. Of this, 73 members are uniformed personnel and three are civilians. Uniformed personnel can be further subdivided into 27 paid firefighters and 46 volunteer firefighters.

Service delivery is provided to the community utilizing three shifts, working a 48-hour shift schedule, responding from three stations. Station 31 houses the on-duty Battalion Chief, Type-1 Engine, Type-6 Brush Truck, administrative staff, and reserve equipment. Station 32 houses a Type-1 Engine, Type-2 Tender, Type-6 Brush Truck, and a Type-3 Engine used primarily for wildland deployments. Station 33 is home to a reserve Type-1 Engine and Type-6

Brush Truck. Both Station 31 and Station 32 maintain a minimum staffing of three personnel assigned to an engine company, 24-hours a day, 365 days a year.

FFPD is surrounded by five fire service agencies ranging from large career fire districts, small combination fire districts, to a small volunteer fire district. Automatic aid, enhanced mutual aid, or mutual aid agreements are in place with these neighboring agencies. The District is dispatched through Jefferson County Communications Center Authority (JeffCom), a regional fire, police, and emergency medical service 911-dispatch center. FFPD is a participating member of regional resources such as the Adams-Jefferson County Hazardous Materials Team and the West Area Strike Team. In 2018, FFPD achieved an Insurance Services Office class 2 rating.

FFPD is located at the foothills of the Colorado Rocky Mountains, just west of the Denver metropolitan area. The fire district serves portions of the cities of Golden and Arvada, along with a portion of unincorporated Jefferson County. FFPD is comprised of 25 square miles, consisting primarily of single-family homes, commercial buildings, light industry, and a large industrial complex.

The landscape is a mix of suburban, wildland-urban interface, and open space. The district has a full-time resident population of approximately 19,000 and during regular business hours this number increases to approximately 35,000 (American Fact Finder, 2010). FFPD is home to MillerCoors, the largest single-site brewery in the world (MillerCoors, 2017). Several Fortune 500 companies, such as International Paper and Ball Metal, operate facilities within FFPD's borders (Fortune, 2016). The District has hosted portions of the U.S. Pro Cycle Challenge and outdoor recreation seekers frequent the area for its quick access to hiking,

mountain biking, and fly-fishing. In 2018, the District responded to 777 incidents (Emergency Reporting).

From FFPD's establishment in 1962, through the submission of this paper, the District has contracted dispatch services with external agencies (Joel Hager, personal communication, December 18, 2018). Chief Hager explained that FFPD originally was dispatched by the Jefferson County Sheriff's Office (JCSO) until the late 1980's and at that time the District made the decision to contract with West Metro Fire Dispatch for all dispatch services (personal communication, December 18, 2018). FFPD's dispatch services remained with West Metro until a regional consolidation of Jefferson County dispatch entities took place (Joel Hager, personal communication, December 18, 2018). In 2018, all fire, police, and EMS dispatching for Jefferson county agencies was combined at JeffCom.

Progression of technology also changed how FFPD communicated by radio. In the early 1960's when FFPD first began as a volunteer fire department, JCSO dispatching took place on Very High Frequency (VHF) radio channels (Joel Hager, personal communication, December 18, 2018). Chief Hager stated that in 2002, FFPD transitioned to Ultra High Frequency (UHF) communication systems utilizing the Colorado State 800-Megahertz (MHz) equipment (personal communication, December 18, 2018). While primary communications moved to the Colorado 800-MHz system, a backup VHF repeater remained in service to distribute radio signals to volunteers carrying pagers as a mechanism for incident notification. The backup VHF system remained functional until 2016 when the repeater site was dismantled. The VHF repeater system served as an effective backup system to the 800-MHz equipment.

At the time of this applied research papers (ARP) writing, there were limited backup communication options between JeffCom and the emergency service agencies it served. Chief

Hager explained that should a failure of the communication system occur at JeffCom, that dispatch center could transfer dispatching services to South Metro Fire Rescue Authority's dispatch center known as "Metcom" (personal communication, December 18, 2018). Metcom also operates on the Colorado State 800 MHz system and in the event that the state 800 MHz system became inoperable, the alternatives for FFPD are limited (Mark Hall, personal communication, Fall, 2018).

Mark Hall, communication coordinator for the Jefferson County IMT, explained that dispatchers could use landline telephone service, cellular service, VHF radio channels in the event of a primary radio communication failure (Mark Hall, personal communication, Fall, 2018). Use of the non-repeated VHF channels would not reach a significant portion of the area served by JeffCom because of topographical and distance challenges. During 2002, a damaged phone line severed the communication link to a VHF repeater site resulting in an area of FFPD that was unable to communicate by radio with West Metro Dispatch (Joel Hager, personal communication, December 18, 2018). In 2013, flooding destroyed fiber optic infrastructure that linked radio repeaters along Colorado's foothills (Mark Hall, personal communication, Fall, 2018). While both examples are specific to Colorado, they serve as a reminder that every year catastrophic natural and manmade events occur that negatively impact the communication infrastructure relied upon by the fire service.

When the author of this research was brainstorming ideas for an ARP topic, conversations were had with a number of Colorado fire service officers. One theme that came to light was that very few of those officers knew what their agency's backup communication system was in the event of a primary communication system failure. Those same officers were able to explain how they would each develop an impromptu solution to a

primary communication system failure, however only a few were able to articulate their agency's preplanned backup communication procedure. In fact, most of the officers interviewed were unsure if a backup communication system was in place or how to access such a system if it existed. While those fire officers were adept at developing a solution to a primary communication failure, none of them voiced amateur radio as a potential solution.

The author of this research is an amateur radio operator with a General Class license and belongs to the regional Amateur Radio Emergency Service (ARES) team in Jefferson County, Colorado. ARES teams are comprised of ham radio operators that have an interest in donating their time, expertise, and equipment in support of others. Hams are technically competent with regards to communication modalities and many are highly educated professionals in career fields directly related to communication technologies. ARES volunteers participate in frequent training and are eager to contribute their knowledge, skills, time, and equipment to support real world events. It has been the authors experience that amateur radio has typically been used to support an Emergency Operations Center (EOC), or Incident Management Team (IMT), but that ham radio has largely been an untapped resource when it came to working with individual fire agencies.

The 2013 Colorado flooding in the foothills northwest of Denver demonstrated how a natural disaster could disrupt responder communication infrastructure. Colorado ARES teams solved this disruption by providing support personnel that quickly implemented repeater systems and relayed information between the Denver Front Range and cut off mountain locations (Marco Vasquez, personal communication, December 15, 2018). This example highlighted how amateur radio could be utilized as a timely and cost-effective solution to emergency communication

challenges. ARES personnel have a demonstrated track record of helping their communities and have been eager to provide their talents at real-world events.

Technology can and does fail. Communication systems have failed because of weather related events such as snowstorms, or from malicious acts such as a computer virus (Marco Vasquez, personal communication, December 15, 2018). The belief that such an event “could never happen here” is planning for failure. This belief was observed with hurricane Katrina. The levies and pumps protecting New Orleans were not expected to fail, until they did (Baker & Hsu, 2006). Over the past few years the author of this ARP has heard other professional emergency responders make comments to the effect that “our radio system will not fail.” It is the authors belief that this perspective is essentially “planning to fail.”

Identifying mechanisms for redundant communications is important for emergency service organizations such as the FFPD. While amateur radio has been used in a range of capacities to support FFPD’s county EOC and IMT, the role of ham radio has the potential to be expanded upon. Emit Hurdelbrink, of the Colorado Division of Homeland Security and Emergency Management - Public Safety Department, explained that creating training opportunities for ham radio operators to demonstrate their capabilities could help fire service leaders better understand how amateur radio can be a helpful and capable resource rather than an inconvenience to fire service operations (personal communication, January 29, 2019).

The research conducted in this ARP related to several content areas addressed in the Executive Analysis of Fire Service Operations in Emergency Management course. The ARP specifically related to the following content areas, “developing partnerships with the community to implement programs” and “assesses a community risk” (United States Fire Administration [USFA], 2015, p. 8). Completion of this ARP supported two of the United States Fire

Administration goals. The first goal was (a) “promote response, local planning and preparedness for all hazards” and the second goal was (b) “advance the professional development of fire service personnel and of other people engaged in fire prevention and control activities” (United States Fire Administration, 2014-2018, p. 9). Both goals were achieved by identifying the capabilities of amateur radio and how such communication support could benefit FFPD.

### Literature Review

Radio and technology related communication issues have often been a critique point during an after action review (AAR). Whether the incident was a structure fire, hazardous materials incident, or wildland fire, AAR’s for those events frequently address communication shortcomings and failures (Joe Snyder, personal communication, January 24, 2019).

Communication is defined as “a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior” (“Communication,” 2014, p. 251). The process of communicating requires a “message, sender, medium, receiver, and feedback” (Ward, 2015, p. 62). Interruption or removal of any part of such a process can negatively impact the ability to send and receive information.

The communication systems used by fire service agencies have become much more sophisticated as compared to 10, 20 or 50 years ago. Emergency service dispatch centers rely on technology dependent computer aided dispatch systems to collect information from members of the public reporting an incident. This information is distributed to responders via fiber optic cables, telephone lines, data cable, and radio frequencies. Firefighters receive dispatch information as texts on phones or pagers, information on apparatus mobile data terminals, station alerting systems, and on their radios. Those systems for communicating dispatch information are

generally reliable, however, Chief Hager, Operations Chief for FFPD, recalled several instances that radio communication systems had failed at FFPD (personal communication, December 18, 2018). While dispatch radio systems are reliable, emergency radio communication systems are similar to any machine in that there is always a risk of breakage.

Members of the fire service identified that a communication “black hole” existed inside many commercial buildings. High-rise structures were often constructed from reinforced concrete to provide strength and stability as resistive properties to a potential fire, however the unintended consequence of such construction was poor radio signal propagation for emergency responders (Segal, 2015). In 2009, changes were introduced to the International Fire code (IFC) that would improve responder communication in such buildings by providing the authority having jurisdiction (AHJ) the ability to enforce fire code requirements for “In-building emergency radio communication enhancement systems” (Johnson & Shudak, 2018, para. 3). Subsequent enforcement of this IFC communication enhancement has allowed fire officials to reduce responder exposure to a communication failure within potential problem buildings.

The commercial building communication problem was an example that illustrated the identification of a risk to emergency response operations and the subsequent development and implementation of a solution to address that problem. A more neglectful approach to the identification of a risk was observed with government officials during the developing days of hurricane Katrina. Officials from the federal government made public statements that the levees and pumps surrounding New Orleans would never fail (Baker & Hsu, 2006). In fact, over 50 levee locations did fail which resulted in substantial flood damage to the city (The University of North Carolina at Charlotte [UNCC], n.d.).

During discussions with fire officers from Colorado fire agencies, a recognition of the need for redundant emergency service communications occurred during each conversation. The recognition that a backup communication shortcoming existed and that options were available to address this risk was similar to the proactive approach taken by the aforementioned building communication challenge. Chief Joel Hager said that until 2017, there was a fully operational backup VHF radio system that could be used in the event that primary communications failed on the state 800 MHz system (personal communication, December 18, 2018). Chief Hager explained that the decision was made to move solely to the state 800 MHz system because of bandwidth efficiencies and communication enhancements found with a digitally trunked radio system, however the result of switching to the state 800 MHz setup was a reliance on a single radio system (personal communication, December 18, 2018). While apparatus and stations still have VHF radio capability, the VHF repeater infrastructure was eliminated. Removal of the VHF repeater effectively meant that topographical blind spots would not allow areas served by JeffCom to receive a VHF radio signal when transmit directly from the JeffCom dispatch center in Lakewood, Colorado.

It has been the authors experience that firefighters and Marines are both particularly talented at developing solutions to problems on the fly. This situation was made apparent during interviews with Colorado fire officers as a component of the research for this ARP. When fire officers were asked what the backup communication plan was should the 800 MHz state radio system fail, a range of answers were provided. However, the answers given by each fire officer were based on “in the moment” problem solving and not from a preplanned document that directed the steps to be followed for alternate modes of communication. West Metro Fire Rescue’s Chief Johnson explained that cell phones would likely be the backup communication

system used if primary radio communications failed with JeffCom (personal communication, Fall, 2018). Special Operations Chief Joe Snyder shared a similar answer. Chief Snyder articulated a solution that included the use of cell phones for communication beyond line of site and VHF resources for radio-to-radio communications (personal communication, January 24, 2019). Conversations with both Chief Snyder and Chief Johnson identified the need to consider an agreed upon preplanned alternative backup system in the event of a primary radio system failure. Additionally, neither Chief Snyder nor Chief Johnson voiced amateur radio as a solution. When prompted to consider ham radio, neither Chief was familiar with the specific process for activating their local ARES team.

On the south side of the Denver Metro area, the Douglas County Sheriff's Office (DCSO) dispatch center serves both police and fire. The primary radio system used by DCSO dispatch is the Colorado State 800 MHz system (Matt Rettmer, personal communication, Fall, 2018). In the event of a problem with the primary radio system, radio traffic can be switched to a redundant VHF radio system (Matt Rettmer, personal communication, Fall, 2018). DCSO operated a VHF radio system before purchasing and implementing 800 MHz digitally trunked equipment. The DCSO dispatch center, and agencies operating through their center, have maintained all VHF equipment in order to have a readily available backup system in the event of a primary communication failure (Matt Rettmer, personal communication, Fall, 2018). Utilizing old equipment was a cost effective solution because the equipment and infrastructure was already in place. Marco Vasquez, a district team leader for a Colorado ARES team, explained that implementing a new backup radio system that is permanently installed can be cost prohibitive as the cost associated with initial equipment purchase, installation, training, and maintenance, can all add up quickly (personal communication, December 15, 2018). Considering such factors,

what if there was a way to assure redundancy of communication systems and do so in a fiscally responsible fashion?

An alternative to a permanent backup communication system required looking for a solution that could be used on-demand, had low associated costs, was flexible, and had a demonstrated track record of being able to integrate into emergency responders operations. Amateur radio operators had the unique ability to fulfill that role. Amateur radio has been shown to be reliable, cost effective, offered a range of communication capability, and had highly trained individuals and teams interested in sharing their talent and resources in a community service role. Amateur radio has been around since the Amateur Radio Relay League (ARRL) was established in 1914 (Silver, 2017, p. 1.1) and ARES was established in 1935 (Aberle, 2017, para. 3).

Amateur radio operators, also known as a “ham” radio operators or “hams”, were individuals that have obtained a license to operate as an amateur radio operator at one of three levels. The three licensing levels from lowest to highest were “Technician,” “General Class,” and “Amateur Extra” (*Amateur radio service*, 2017, para. 6).” The author of this ARP has been a ham radio operator since 2008 and holds a General Class license as issued by the Federal Communications Commission.

Ham radio is diverse hobby with over 750,000 members in the US (American Radio Relay League [ARRL], 2017). In the US, the ARRL has developed a communication plan that voluntarily designates what types of transmissions may occur within the frequency spectrum designated for use by ham radio operators. The types of transmission include voice, radio teletype, data, Morse code, and low power modes (Wilson, 2016).

Amateur radio has several goals, two of which related to the fire service and emergency responders in general. The first goal was for ham radio enthusiasts to serve “as a source of trained operators, technicians, and electronic experts,” and the second relevant goal was that hams had a public service value in that they were capable of “providing emergency communication support” (ARRL, 2017, p. 1.3). Charlie Gilbert, of the Jefferson County ARES team, explained that participation in an emergency communications role is a highly rewarding aspect for many folks involved in ham radio (personal communication, Fall, 2018). Amateur radio operators also regularly train with alternative power sources such as generators and solar power all of which gives the amateur radio operator more flexibility to move equipment as needed without being anchored to the power grid (McCamey & Yaeger, 2018).

Ham radio operators have developed knowledge of radio communication a number of ways. Progression through the three amateur radio license certifications which required studying course material to pass each certification test. Building and operating a radio station also assisted in the development of practical skills. Radio competitions, such as long distance communication contests, were a way for ham radio operators to practice their skills. Contests can include radio signal tracking, contacting all 50 states, or competing to see how many contacts can be made in a defined number of hours using alternative energy to power their amateur radio equipment (Wilson, 2016). All of those aspects of ham radio promote knowledge and experience with amateur radio communication techniques and modes of communication, the result of which is a pool of skilled communicators that can be called upon to support emergency communications.

Participation in amateur radio also requires a range of equipment based on the communication mode being used. The equipment needed to setup an amateur radio station

includes power supply, transceiver, antenna, and a range of cables to connect the equipment (Charlie Gilbert, personal communication, Fall, 2018). Gilbert explained that the cost for a radio transceiver could range from a \$50 used VHF single band unit to \$900 for a multi-band radio that provides more flexibility of communication modes along with greater power (Charlie Gilbert, personal communication, Fall, 2018). Costs can be in excess of \$4,000 for a base station High Frequency (HF) radio that has all the bells and whistles (Charlie Gilbert, personal communication, Fall, 2018). Current pricing on a new all-band Yaesu FT-857D is approximately \$840 on the universal radio website (<https://www.universal-radio.com/catalog/index2.html>). A device designed to serve as a power supply for a ham radio currently costs between \$70 and \$160 at that same website (<https://www.universal-radio.com/catalog/index2.html>). Ham radio equipment is designed to work on a 12 volt power supply system which allows amateur radio equipment to be powered by a vehicles electrical system (Wilson, 2016).

Antennas for ham radio equipment come in many shapes and sizes. Antenna selection for a given communication mode and frequency determine the type of antenna to be utilized (ARRL, 2017). Commonly used for local and regional amateur radio communication, particularly during emergency communications, is the two-meter and 70-centimeter band (Clayton Strong, personal communication, Fall, 2018). Those two bands work well for line of sight communication up to 30 miles, further if a repeater system was used (Charlie Gilbert, personal communication, Fall, 2018). Pricing on the Universal Radio website indicated that VHF/UHF antennas currently cost approximately \$30 to \$300 for a base station unit (<https://www.universal-radio.com/catalog/index2.html>). Clayton Strong, manager of the Denver Ham Radio Outlet store, explained that connections, fittings, cables and an antenna feedline to

connect all of the ham radio station equipment would cost between \$100-\$200 (personal communication, Fall, 2018). Clayton stated that the cost for those connecting items could potentially be purchased for less if bought used on websites like eBay and Craigslist.

Installation of a radio station does not require a substantial amount of space. A mobile station can be installed in a vehicle, radio operators construct “go-kits” in pelican cases to be setup on a desk or truck tailgate, and small base stations can be built in a closet or left in place on a desk (Clayton Strong, personal communication, Fall, 2018). One Florida teenager completed his Eagle Scout project by collecting donated amateur radio equipment and then building a ham station at his local fire department so that firefighters had a backup communication platform (Bay News 9, 2014). The ham station built by that Florida Eagle Scout only required about an 8 inch by 10 inch footprint on a desk that was already located at the fire station (Bay News 9, 2014).

A similar sized ham radio station was installed as a redundant communication system at a hospital. Members of the Clark County ARES team in Nevada approached a local hospital to install a ham radio station inside their building (Drake, 2008). The installed ham station had antenna cables, access to outlets supplied with power from a hospital backup generator, work station for writing messages, and all of the equipment was installed in lockable cabinets (Drake, 2008). The ARES radio equipment installed at the Nevada hospital remained secure, out of sight, but easily activated and operable when needed.

The capabilities of amateur radio are diverse and afford a wide range of communication coverage. Amateur radio operations take place on HF, VHF, and UHF bands (Wilson, 2016, p. 1.14). “VHF and UHF operations typically reaches around 30 miles by using antennas that are practical for emergency deployment” (Cid, Mitz, & Arnesen, 2017, p. 262). “HF radio can use

the ionosphere to send signals to receivers hundreds of miles away.” (Cid et al., 2017, p. 262). Frequency selection on the amateur bands is based factors such as topography, solar activity, distance between sender and receiver, and type of transmission to be conducted (Wolfgang, 2005). The communication requirements dictate which frequency is selected and how much power is required to effectively transmit a signal.

Amateur radio offers a range of communication options. Ham radio operators are commonly pictured using a radio for Morse code or voice communications on VHF, UHF, and HF bands (Clayton Strong, personal communication, Fall, 2018). These communication methods are conducted from a handheld radio, vehicle based mobile setup, or base station (Wilson, 2016). Hams also regularly implement and operate their own repeater systems which extend the communication coverage area (Wilson, 2016).

Many of the commonly used modes of amateur radio communication have applicability to the fire service. Types of communication beneficial to the fire service include voice, ability to send photos and video, share global positioning system (GPS) coordinates, or send and receive email using amateur radio specific systems such as Winlink 2000 (Marco Vasquez, personal communication, December 15, 2018). These systems can be implemented locally, such as in support of an isolated incident in the community, or could be used for global communications (Wilson, 2016). Ham radio communications do not rely on the extensive established infrastructure found in cell phone communications and ham radio more resilient to damage (McCamey & Yaeger, 2018). Amateur radio capabilities are critical because as telecommunication infrastructure is damaged from an event such as a storm, ham radio is one of the few resources that will remain operable and available to keep incident command teams informed (Solomon, 2016).

Less commonly considered modes of ham radio communication include techniques that combine computers and radio transceivers to share a range of information. Amateur Television (ATV) transmits video across a radio frequency which can provide remote eyes and ears to an EOC or command post (Wolfgang, 2005, p. 1.70). Slow-scan television (SSTV) can be used in a similar fashion to transmit photos using a “computer, software, sound card, and a transmitter” (Wolfgang, 2005, p. 1.72). SSTV can allow for remote viewing of an area, clearly a potential benefit to an EOC or incident commander (Wolfgang, 2005).

Several terms have been used to describe amateur radio emergency communications. These terms include “EmComm,” “public service communications,” and “auxiliary communications” (Corey & Rodia Schoenfeld, 2016, p. 8). Ham radio enthusiasts have long been interested in combining their radio hobby with service to their community (Marco Vasquez, personal communication, December 15, 2018). To address this interest in serving the public during times of need, the ARRL created a range of training programs designed to improve the skills and knowledge of ham radio operators so that they might better provide emergency communications support (Corey & Rodia Schoenfeld, 2016). Two such courses were “Introduction to Emergency Communications (EC-001)” and “Public Service and Emergency Communications Management for Radio Amateurs (EC-016)” (Corey & Rodia Schoenfeld, 2016, p. 16). Additionally, many amateur radio clubs specialized in public service and emergency communications. Those amateur radio clubs focused their efforts not only on teaching entry level classes to persons interested in becoming hams, but they have also have programs that teach ham radio operators how to conduct public safety communications (Wilson, 2016).

In 2007, the ARRL developed an “Emergency Preparedness Program (EPP)” to be able to assist government organizations as well as national and regional humanitarian organizations (Corey & Rodia Schoenfeld, 2016, p. 8). This program allowed amateur radio operators the opportunity to “work side by side with disaster relief officials from the Red Cross, Salvation Army, government emergency management and other entities, supplementing their communication” (Wilson, 2016, p. 2.18). Wilson stated that in the U.S., the “ARRL’s Amateur Radio Emergency Service program is the primary platform upon which amateur radio disaster response and emergency communication is conducted.” (Wilson, 2016, p. 2.18). The ARRL has developed many training materials, courses, and provided organizational support to the ARES program so that it can remain an effective alternative communication resource during times of need (Charlie Gilbert, personal communication, Fall, 2018). Communication systems must be developed and tested to make sure they will work when needed “across the disaster cycle of preparedness, response, recovery, and mitigation” (DeMers & Jacoby, 2016, p. 275).

In order to effectively work with emergency service entities, ARES team members are required to complete FEMA courses such as “ICS-100, Introduction to Incident Command Systems” (Wilson, 2016, p. 2.23). Use of common terminology and communication practices, such as that found in NIMS, is critical for ARES operators to effectively integrate into an incident support role (DeMers & Jacoby, 2016). ARES members providing support to IMT’s and EOC’s are required to participate in monthly or quarterly training (Charlie Gilbert, personal communication, Fall, 2018). Additional requirements of ARES team members vary based on the emergency service partner organization. These additional requirements can include background checks through local, state, and federal law enforcement agencies, as well as medical evaluations and drug screenings (Charlie Gilbert, personal communication, Fall, 2018).

Typically, ARES membership is comprised of individuals that originally just had an interest in radio communication, but after dabbling in the hobby their interest expanded to more technical aspects of amateur radio communications (Emit Hurdelbrink, personal communication, January 29, 2019). Most of those operators take the licensing exam to increase their operating privileges and upgrade their ham radio license. Many ham operators become interested in combining their radio hobby with an opportunity to help their community and eventually join their local ARES team (Charlie Gilbert, personal communication, Fall, 2018). Aberle described ARES personnel as “licensed amateur radio operators who have voluntarily registered their qualifications and equipment with local ARES leadership for communications duty when disaster strikes” (Aberle, 2017, para. 2).

A unique benefit of ARES personnel is that they not only come with their own equipment and technical expertise, they understand the challenges associated with the topography and climate of the area because they are in fact locals. As radio hobbyists, they have developed unique regional knowledge because of the time they spend operating their radio equipment (Corey & Rodia Schoenfeld, 2016). Additionally, ARES organizations conduct weekly meetings either in person or over the air. Participation in weekly “nets” provides members a format to remain engaged with their ARES team and do so in a way that simulates how an ARES network will operate when requested to support an incident (Charlie Gilbert, personal communication, Fall, 2018).

The ARRL ARES section distributes an annual report highlighting the statistics and activity of all ARES operations. In 2017, ARES had over 31,000 members in the U.S. which was over a 12% increase from the previous year (ARRL Section Emergency Coordinators, 2018). The 2017 data indicated that the ARES organization participated in “5,730 public service

events” and “1,930 operational events” (ARRL Section Emergency Coordinators, 2018, p. 3). The total number of volunteer hours contributed by ARES members in 2017 exceeded 700,000 (ARRL Section Emergency Coordinators, 2018). Considering the hourly cost of a firefighter, or paid employee at an EOC, the amount of money saved by utilizing volunteer ARES members was significant.

With regard to an organizational structure, ARES is comprised of four tiers. The ARES organization has a “national, section, district, and local” level (Corey & Rodia Schoenfeld, 2016, p. 8). This creates a hierarchy to expand ARES capabilities and to facilitate amateur radio emergency communications at a local level or across the country. ARES has used this structure to provide organized amateur radio communication capabilities to such events as hurricanes, wildfires, and the 2017 solar eclipse (ARRL Section Emergency Coordinators, 2018, p. 1).

Ham radio has had a range of involvement assisting at public events and emergencies. The individual ham radio operator has used their equipment to report weather events and car accidents. More formally, amateur radio enthusiasts have joined ARES teams, Radio Amateur Civil Emergency Services (RACES), or as a qualified amateur radio operator providing support to an EOC or IMT (Charlie Gilbert, personal communication, Fall, 2018). McKenna explained the difference between ARES and RACES quite succinctly, “ARES operates prior to a disaster declaration and RACES can only be activated once a disaster declaration has been made” (McKenna, 2010, para. 6). Jacobsmeyer’s observation that “Hams are among the unsung heroes of hurricanes, earthquakes, fires and floods” (Jacobsmeyer, 2011, p. 30) appears a genuinely accurate description ARES personnel.

In 2016, the Colorado state legislature officially designated qualified hams as members of Colorado’s new Auxiliary Emergency Communications Unit (Auxcomm), under the authority of

the state's Division of Homeland Security and Emergency Management (Careless, 2017, para. 13). As a result of this new law, Colorado ARES personnel that become Auxcomm members would be part of the state's emergency management team (Careless, 2017). Emit Hurdelbrink explained that the primary advantages of Auxcomm over ARES were the increased training requirements, mandatory background checks, and validated experience and skill set of Auxcomm team members (personal communication, January 29, 2019).

Amateur radio has also provided emergency communications support to several non-governmental organizations. Examples of those organizations include "American Red Cross and Salvation Army" (Corey & Rodia Schoenfeld, 2016, p. 8). The Salvation Army has come to rely on ham radio support so much so that they created a "Salvation Army Team Emergency Radio Network" (SATERN) (Corey & Rodia Schoenfeld, 2016, p. 25). SATERN has recruited amateur radio operators to conduct communication training for Salvation Army personnel and to facilitate emergency communications when that organization has been activated for a significant event such as a hurricane or tornado (Corey & Rodia Schoenfeld, 2016). Local, regional, national, and international SATERN nets are conducted to develop and maintain communication capabilities (Corey & Rodia Schoenfeld, 2016). SATERN administrators believe that this team can be the organizations "eyes and ears" at disasters (Corey & Rodia Schoenfeld, 2016, p. 29).

The American Red Cross (ARC) has conducted disaster research and identified that incidents will occur "in concentric rings of severity - nothing will be heard from the very center of the damaged area, with increasing reports coming in as one moves away from the center" (Corey & Rodia Schoenfeld, 2016, p. 23). Emergency responders and managers can expect that areas most affected by disaster will either have no communication due to infrastructure damage or because communication systems have been overwhelmed by

users (Corey & Rodia Schoenfeld, 2016). Based on expected communication infrastructure damage, the ARC maintains partnerships with ham radio operators that have received training and background checks (Corey & Rodia Schoenfeld, 2016). ARC is comprised of local and national levels, and has amateur radio operators at all levels so that their organization can expand and contract to meet the requirements of the incident (Corey & Rodia Schoenfeld, 2016).

A number of success stories were found that illustrated real-world incidents, or training evolutions, at which ARES was an asset to emergency management leaders. After the 2010 earthquake in Haiti, that killed and injured approximately a half million people, the only communication platform that worked reliably was amateur radio (McKenna, 2010). Satellite communications were lost between disaster response resources, but amateur radio was able to fill the void and distribute information both on the island and externally to locations like Miami (McKenna, 2010).

In Tucson Arizona, emergency management officials partnered with amateur radio operators to develop a network that served as a redundant communication platform (Tucson News Now, 2015). This backup network used computers and a “special antenna system” to transmit information (Tucson News Now, 2015, para. 5). An amateur radio “mesh network” allowed ham radio operators to populate an area with network nodes, all of which were interconnected, and transmit “phone calls, send emails, files, even video and photos” (Tucson News Now, 2015, para. 10). It can be cost prohibitive to purchase and maintain a fully functional and permanently installed backup communication equipment, so partnering with amateur radio enthusiasts to develop a system that is amateur owned and can be used as needed was a cost-effective solution.

Three Bethesda area hospitals partnered with amateur radio operators to implement backup communications which included intranet, email, and voice communications. (Cid et al., 2017). The system developed by amateur radio operators was “developed to complement and augment the emergency communications resources of medical facilities” and did not require permanent installation of transceivers and antenna systems (Cid et al., 2017, p. 263). ARES personnel were able to establish an inexpensive intranet that could be installed on the fly and was “cost-effective, easy-to-use, and adaptable” (Cid et al., 2017, p. 258). Amateur radio operators also used ham radio data communication modalities to provide a format of messaging communication at the Bethesda area hospitals. The data communication format used radio frequencies to relay emails and attached information (“Winlink,” 2019). Prior to disaster drills, “email accounts were created on the Winlink system” for the various positions of the Bethesda hospitals incident command system. (Cid et al., 2017, p. 258).

Tarleton State University conducted simulated disaster exercises to evaluate the capabilities and effectiveness of ham radio communications when normal modes of communication failed (McCamey & Yaeger, 2018). The goals of the exercise were to build relationships between hospital staff and ham radio personnel, rapidly implement amateur radio operations between hospital facilities, and conduct accurate communications between those locations (McCamey & Yaeger, 2018). Participating ham radio operators were able to accomplish those goals and also demonstrate an ability to adapt on the fly to changing needs and conditions (McCamey & Yaeger, 2018). One observation noted during a review of the exercise was the need for permanently installed amateur radio communication equipment at strategically identified locations (McCamey & Yaeger, 2018). This would allow permanent antennas and cable that would allow the receive and transmit features of ham radio equipment to be optimized

in comparison to on they fly implementation of amateur radio stations (McCamey & Yaeger, 2018).

Several examples were found regarding the use of amateur radio to support events and disasters in Colorado. Colorado ARES teams have supported numerous bike races such as the Golden Gran Fondo and Elephant Rock. (Charlie Gilbert, personal communication, Fall, 2018). At the Golden Gran Fondo bike race, ARES team members staged throughout the race course and provided updates on rider locations, investigated and reported injuries, and informed the EOC of changing weather conditions (Charlie Gilbert, personal communication, Fall, 2018). ARES members supporting the Golden bike race were able to provide such information on radio equipment purchased and brought to the event by each member. Additionally, unlike cellphone service and the 800 MHz state radio system, ham radio was the only reliable communication platform throughout the mountainous race course (Charlie Gilbert, personal communication, Fall, 2018).

During the Colorado flooding of 2013, ham radio operators provided support between evacuation shelters and county EOC's (Marco Vasquez, personal communication, December 15, 2018). Amateur radio operators were able to use ham frequencies to relay shelter head counts and resource needs, which kept such logistical radio traffic off of primary emergency communication channels (Emit Hurdelbrink, personal communication, January 29, 2019). Not only were radio channels kept free, but professional emergency response personnel were not assigned to such activities which made them available for other critical assignments (Emit Hurdelbrink, personal communication, January 29, 2019). Similar situations have occurred across the U.S. ARES teams in Delaware were used to report weather and road conditions after a major snowstorm, which kept police and fire resources available for more

urgent assignments (McKenna, 2010). Butte County ARES team members supported their EOC with voice communications at evacuation shelters and to report flood levels (The ARRL Letter, 2017). Hurdelbrink believed that this aspect of amateur radio should be marketed more effectively to emergency response leaders (personal communication, January 29, 2019). Hurdelbrink explained that amateur radio operators are eager to assist, respond with their own equipment, and they are able to successfully work within a predefined operational framework that allow them to accomplish assignments with minimal or no experience (personal communication, January 29, 2019). Furthermore, Hurdelbrink explained that ham radio operators that come from Colorado Auxcomm have completed required ICS and NIMS course work, passed criminal background checks, and have experience integrating into the operations of an incident command structures (personal communication, January 29, 2019). James Careless described ham radio operators as “legendary for their willingness to aid public safety during emergencies” (Careless, 2008, p. 57). The description Careless provided summarized the authors experience of ARES participation at incidents in Colorado.

Marco Vasquez, team leader for the Jefferson county ARES team, explained that the next step ARES teams should be taking is to develop a Memorandum of Understanding (MOU) between ARES teams and local response agencies and actively participate in training with those agencies (personal communication, December 15, 2018). Development of an MOU would allow ARES teams to support local response agencies by establishing predetermined expectations of ARES members. A challenge associated with the use of ham radio operators at real-world events has been the perception of hams being “jolly-volley’s”. It has been the authors experience that ham radio operators have at times lacked the social skills needed for effective team operations and that hams were often quite arrogant with regard to their technical

knowledge. That perspective was reiterated during conversations with Colorado fire officers. Marco Vasquez felt that if training opportunities were coordinated between ARES operators and professional responders, relationships would develop, preconceived notions would disperse, and the technical capabilities of amateur radio could be demonstrated (personal communication, December 15, 2018).

Amateur radio has been integrated into dispatch centers and fire stations across the country by several fire chiefs. Fire Chief, Craig Maciuba, wanted ham radio equipment because of the communication redundancy it provided (Bay News 9, 2014). Chief Maciuba stated that “It does provide us with those additional means of communication to the county EOC and other Ham radio operators that can give us information from the public should the 911 system fail” (Bay News 9, 2014, para. 6). The author has had personnel experience using a ham radio to request help where cell phone reception is unavailable in the backcountry of Colorado. Whether out of range of a cell phone signal in the backcountry, or after a windstorm has damaged cell towers eliminating service, ham radio communication will still be available and largely unaffected.

Ham radio is robust, consistent, reliable resource that can fill a primary communication void when needed. The Lamoille County Sheriff’s Department incorporated an amateur radio station in the build out of their new dispatch center (McCain, 2011). Sheriff Roger Marcoux was quoted as making the statements “I want to get everyone trained on how to use the ham rework” and “We need that backup and need to be comfortable using it.” (McCain, 2011, p. 51). Marcoux recognized the value amateur radio communications provided to both his citizens and response personnel. Walton County Public Information Officer, T.H. Merritt, had similar high regard for the robust reliability of ham radio. Merritt was quoted as saying “When all else fails,

ham radio always works” (Solomon, 2016, para. 2). As a long time licensed amateur radio operator, this is a mantra the author has heard and witnessed many times.

The literature review revealed that amateur radio offers talented personnel and a broad spectrum of technical capabilities. Numerous examples of training evolutions, natural disasters, and planned public events highlight situations that ARES has supported emergency service organizations and specifically fire operations. The fire service’s use of the resource ARES did not appear to be limited by financial or time constraints, the limiting factor to the expanded use of amateur radio is a lack of knowledge and interagency training.

### Procedures

Descriptive research methodology was conducted to identify factors related to the use of amateur radio communication in direct support of fire service operational activities. The intent of these procedures was to obtain data from a variety of stakeholders involved in emergency communications. The two populations targeted for participation in research surveys were officers belonging to Colorado fire service agencies and Colorado ARES team leaders. The decision was made to only target Colorado survey participants because of the distinct difference in hazards experienced by the Rocky Mountain region. Including survey participants from areas prone to disasters such as hurricanes and earthquakes would not provide data relevant to FFPD’s risks. Surveys were developed, distributed, and data was collected using the website SurveyMonkey ([www.surveymonkey.com](http://www.surveymonkey.com)).

Two surveys were developed in order to obtain data for this ARP. The first survey titled “Ham Radio in Support of Fire Service Operations - Fire Agency,” (Appendix A) was administered to fire officers affiliated with Colorado fire service agencies. Individual officers at

20 different fire departments were sent an email requesting their participation in the survey. A link to the survey was included in the email with specific directions not to forward the survey invitation to other individuals. The survey remained open for 7 days before the online data collector was closed. Selection of those 20 agency leaders was done with the intent of including a range of organizations that represented the spectrum of Colorado all-hazard fire service agencies. That group of agencies included volunteer, combination, and career fire organizations. Additional diversity factors included fire protection district versus fire department, rural versus metropolitan, and single fire station entity vs. the largest fire department in Colorado which was comprised of 36 stations. Of the 20 fire service leaders solicited for participation in the survey, 90% submitted complete surveys. The survey for fire agency personnel contained 13 questions. Two questions were open-ended providing the participant with the ability to answer without restriction. The remaining 11 questions were multiple choice.

A second survey titled “Ham Radio in Support of Fire Service Operations - ARES Team Leads,” (Appendix B) was administered to Colorado ARES regional leaders. The Colorado ARES regional leaders were each sent an email requesting their participation in the survey. A link to the survey was included in the email directing each participant to the online survey platform. The survey remained open for 7 days before it was closed. The selection of these ARES district leaders was done with the intent of receiving survey input from every ARES region in the state of Colorado. Colorado is comprised of 9 all-hazard regions. Of the 9 Colorado ARES districts solicited for participation in the survey, 100% completed surveys. The survey for ARES team leads contained 15 questions. Four questions were open-ended providing the participant with the ability to answer without restriction. The remaining 11 questions were multiple choice.

Interviews were conducted with members of fire service agencies and ARES organizations. The interviews began with the researcher identifying himself and the ARP's intent, documenting the name of the person being interviewed. Then a focused discussion took place surrounding the topic of amateur radio's ability to support fire service operations. Specific questions were asked regarding the interviewees experience with ham radio's ability to support the fire service, however the interview was largely unstructured.

There were certain assumptions and limitations noted. The first assumption was that the individuals solicited for input in each survey had insight into their respective agency's involvement, or potential involvement, with fire service organizations and ARES teams. The second assumption was that the participants understood each survey question and provided truthful responses to each question. Lastly, it was assumed that the individuals solicited for participation in the research surveys were in fact the same person answering the online survey questions.

Limitations included a lack of full participation from officers invited to participate in the fire agency survey. A lack of incentive to participate, busy work and personal schedule, and the increased frequency of requests for participation in ARP surveys might have contributed to the lack of full participation by fire agency leaders. Additional limitation included isolating the survey populations to include only participants from Colorado. Expansion of the both survey groups to have included all 50 states could have resulted in different information being collected.

## Results

In order to complete this ARP two surveys were conducted. One survey titled "Ham Radio in Support of Fire Service Operations - Fire Agency" (Appendix B) solicited input from

leaders associated with 20 different Colorado fire service agencies. The fire agency survey invitation was emailed individually to each of the 20 fire agency representatives. Out of the 20 officers invited to participate in the survey, 18 completed the survey for a response rate of 90%. The fire agency survey solicited insight from Colorado fire service leaders as it pertained to each of the leader's experience surrounding the topic of amateur radio supporting fire operations. The fire agency leaders were asked 13 survey questions. Of those 13 questions, 11 were multiple choice and two were open-ended. The results of the fire agency survey can be found in Appendix D.

A second survey, titled, "Ham Radio in Support of Fire Service Operations - ARES Team Leads" (Appendix B), solicited input from individuals fulfilling regional leadership roles for the Colorado ARES organization. The state of Colorado is comprised of 9 all-hazard regions and the Colorado ARES organization utilized the same boundaries to define ARES team regions. Representation in the Colorado ARES team lead survey was received from all 9 regions for a response rate of 100%. Participants for both surveys received a link that directed them to their respective survey using the website SurveyMonkey ([www.SurveyMonkey.com](http://www.SurveyMonkey.com)). The ARES team lead survey solicited insight from participants regarding their experience on the topic of amateur radio in support of fire service operations. The 9 individuals representing ARES regions were asked 15 survey questions. Of those 15 questions, 11 were multiple choice and 4 were open-ended. Results of the ARES team leader survey can be found in Appendix C.

The first research question asked in this ARP was "In what capacity can amateur radio communication support FFPD?" This question was addressed through several questions in both populations surveyed. ARES leaders offered many examples of how their organization could

support fire service operations. ARES teams can assist fire service operations by offering the following capabilities:

- Provide technically competent radio and computer operators
- Provide NWCG qualified ham radio operators
- Establish communication links providing digital video
- Deliver communications support at shelters, logistic sites, and staging areas
- Conduct radio direction finding

Several survey questions were asked that related to ARES capacity to support FFPD. Question two (Appendix C) identified that 67% of ARES respondents provided support to an IMT and question three (Appendix C) identified that 100% of ARES respondents provided support to an EOC. Fire agency leaders indicated that there was a role for ARES to support operations within an EOC and IMT. Question 9 (Appendix D) identified that 94% of fire agency respondents believed there was a role for ARES to support an EOC. Question 10 (Appendix D) identified that 89% of fire agency respondents believed there was a role for ARES to support an IMT. Question 11 (Appendix D) indicated 72% of fire agency survey participants believed there was a role for ARES personnel to support fire operations. Team leaders from ARES organizations indicated that only 44% of respondents provided support to fire department operations at the time the survey was conducted. Question 13 (Appendix D) indicated that several fire agency survey respondents did not have experience working with ARES, were not educated on ARES capabilities, and were not familiar with amateur radio capabilities. Question two (Appendix D) showed that only 22% of fire agency survey participants had interacted with ARES personnel and question three (Appendix D) identified that only 6% had participated in training with ARES resources. Fire agency survey question 7

(Appendix D) indicated that 100% of respondents believed their agency's command staff did not understand the capabilities ARES could offer their organization. Question 10 (Appendix C) showed 89% of ARES respondents believed most fire department leaders in their region did not understand the capabilities amateur radio could provide.

The second research question of this ARP asked "To what planned, forecasted, or unplanned events can the amateur radio community support FFPD?" ARES survey respondents provided a range of examples in question eight (Appendix C). The following list were specific events ARES team leaders shared for question 8 (Appendix C):

- Wildland events
- EOC support
- IMT support
- OEM support
- Community events such as parades, fairs, and bike races
- Weather observation and reporting
- Incidents requiring staging and logistic sites
- Downed primary communication systems
- Regional power outage

Fire service leaders also provided a range of answers to the question "To what planned, forecasted, or unplanned events can the amateur radio community support fire operations?" Question 6 of the fire agency survey (Appendix D) provided an open-ended question for respondents to reply. The following list were specific events fire agency leaders shared in response to question 6 (Appendix D):

- Alternative lines of communication

- Incident communication plan development
- Weather observation and reporting
- Wildland events
- Community events such as firework shows, bike races, and large gatherings
- Natural disasters
- Solar weather event
- Communication infrastructure damage or failure
- Terrorism event
- Weather events such as hurricanes, tornadoes, wind storms, flooding, and blizzards

The third research question asked in this ARP was “How much time and money is required to implement and sustain amateur radio communication in support of FFPD?”

Participants in the fire agency survey indicated in question 5 (Appendix D) that an average of 10 hours of training should occur annually in order for fire personnel to work successfully with ARES team members at real-world events. ARES team leads indicated in question 6 (Appendix D) that at the time of survey completion an average of 11 training hours was taking place between represented ARES teams and the fire agencies they served. ARES team leaders participating in the survey indicated that on average, 23 hours of annual training needed to take place to help ensure effective operational relationships between ARES team members and fire personnel.

Regarding the question of cost, one ARES respondent stated in question 15 (Appendix C) that they did not have a dollar amount for a ham radio station as their team members were self-sufficient and no equipment was needed. Question 14 (Appendix C) indicated respondents believed that if amateur radio station equipment was to be installed at a fire station, on average

the cost would be \$1,000. ARES survey respondents selected \$0 as the lowest cost for equipment purchase and installation, and \$3,000 was identified as the highest amount required to implement a ham radio station. Question 8 (Appendix D) identified that 6% of survey fire participants believed if ARES was utilized there would be a financial cost to the fire agency.

The fourth research question in this ARP asked “What equipment, training, and infrastructure does FFPD need to provide for the successful support of amateur radio communications?” In question 15 of ARES survey (Appendix C) respondents stated that while radio equipment could be installed at a fire station, developing a memorandum of understanding to address equipment installation, training, and maintenance should be considered. Question 12 (Appendix C) identified that 67% of ARES respondents believed installing a ham shack at a fire station could result in improved backup communication capabilities. Question 15 (Appendix C) indicated that a demonstration of amateur radio capabilities, along with annual training drills could reinforce the capabilities and support ARES teams could provide. One ARES respondent stated in question 15 (Appendix C) that installation of amateur radio equipment and corresponding infrastructure was only appropriate at a fixed facility such as a fire station based rules and regulations surrounding how amateur radio equipment can be used. Installed ham radio equipment located at a fire station could then be used as a backup communication system with an EOC, IMT, or dispatch center, so long as it was operate by a licensed amateur radio operator.

Another ARES respondent indicated in question 15 (Appendix C) that demonstrating to fire service leaders that no equipment is required to be purchased by fire agencies, and that ARES members arrive ready to go with all of their own equipment, could be effective selling points. While installation of ham equipment at a fire station could be done, it is not a

requirement. Additionally, question 15 (Appendix C) indicated that including ARES operations into scheduled local agency fire trainings, could serve as source of motivation for ham radio operators to continue serving their local organizations.

### Discussion

The intent of this ARP was to utilize descriptive research methodology to identify how amateur radio communication can support operations at the FFPD. This objective was accomplished by a completing a detailed literature review and facilitation of focused surveys with two populations of survey participants. After evaluating the literature review and conducting both ARP surveys, the data suggests there is an opportunity for FFPD to expand its familiarity and application of amateur radio as an alternative communication resource.

Amateur radio has been around since the ARRL was established in 1914 (Silver, 2017, p. 1.1) and ARES was established in 1935 (Aberle, 2017, para. 3). Ham radio has been shown to be reliable, robust, and comprised of a dedicated and talented membership pool. Many of those skilled members have been eager to use their equipment and knowledge to support their community (Emit Hurdelbrink, personal communication, January 29, 2019). This enthusiasm for community support has been demonstrated across the country at a range of planned, forecasted, and unplanned events. Two Colorado examples of ARES support include; the Gran Fondo bike race in Golden, as well as the establishment and operation of a radio repeater system when the 2013 floods washed out state 800 MHz radio system fiber optic cable (Charlie Gilbert, personal communication, Fall, 2018).

The two Colorado examples of ham radio support were also representative of how amateur radio has typically served as a resource to support an IMT and EOC. This illustrated an

important point, at an operational level ham radio does not typically interact with individual fire agencies. Both surveys conducted in this ARP provided data that reinforced this perspective. Respondents to the ARES team member survey indicated that all of their teams supported a local EOC and 67% supported an IMT, while only about half of the survey participants indicated they supported a local fire jurisdiction (Appendix C). Discussions with Denver area fire chiefs, and results of the fire agency survey, support the perspective that there is less interaction between fire agencies and ARES. 95% of respondents to the fire agency survey (Appendix D) indicated that their agency does not participate in training with ARES personnel. However, when asked to list types of planned, forecasted, and unplanned events to which ARES could support a fire agency, both survey populations provided numerous overlapping examples. Across the country a number of successful examples could be found that demonstrated how ARES could be a valuable asset to emergency service organizations. During Hurricane Matthew, ARES operators successfully supported emergency managers by using ham frequencies and personnel to report weather and road conditions (Solomon, 2016). This example illustrated Emit Hurdelbrink's belief that qualified ham operators can be a competent and capable resource to use in roles that ultimately free up professional front line responders for other priority assignments (Emit Hurdelbrink, personal communication, January 29, 2019). A risk assessment should be conducted to determine if it makes sense to park a fully staffed ladder truck next to a bridge to monitor flood conditions when a ham operator with a radio in their vehicle or SSTV equipment could conduct the same task.

The capabilities ARES can provide a fire agency are extensive. Several examples illustrate this point. In Tucson Arizona, ARES team members implemented a backup communication network for a local hospital. The capabilities established included redundant

voice communications and a mesh network that provided email and messaging capability (Tucson News Now, 2015). In Maryland, a network of hospitals partnered with ARES personnel to implement backup communication processes and conduct drills with ARES personnel to evaluate the effectiveness of such a backup communication system (McCamey & Yaeger, 2018). In the author's home area, local ARES teams have the ability to implement repeater systems in order to distribute dispatch information to fire stations in the event of a failure of the primary state 800 MHz repeater system (Mark Hall, personal communication, Fall, 2018).

While amateur radio had a broad range of capabilities and a demonstrated track record of supporting communities, one challenge was identified during research conducted for this ARP. Respondents from both survey populations made it clear that it was their belief that fire agency command officers' roles did not understand the capabilities ham radio had to offer. 89% of ARES team leads (Appendix C) and 100% of fire agency respondents (Appendix D) indicated that fire agency command staff did not understand the services amateur radio could offer. Emit Hurdelbrink explained that this disconnect could be corrected with a combination of better marketing on the part of amateur radio to fire service agencies and by ARES and Auxcomm personnel demonstrating their capabilities during multi-agency training evolutions (Emit Hurdelbrink, personal communication, January 29, 2019). Demonstration of ARES capabilities at Bethesda area hospital drills increased the understanding and awareness of participating hospital personnel to the spectrum of amateur radio communication options (Cid et al., 2017). Marketing the capabilities of ham radio can also be done by sharing past successes. ARES ability to implement a repeater system as a solution to damaged repeater network needs to be communicated to fire agency leaders. Such an example, as well as the solutions ARES can offer in the event of other communication disconnects, could educate and

inform fire agency leaders as to the range of potential uses that extend beyond communicating with an EOC and IMT.

An additional marketing strategy ARES needs to communicate more clearly with fire agency command staff is the cost associated with using amateur radio. ARES provides all of its own equipment. An example of an exception to this would be if permanent installation of equipment or radio cables and antenna were to be installed in a fire station. ARES survey respondents indicated that on average the cost of such an installation would be \$1,000 (Appendix C). However, several examples were found where permanent installation of equipment occurred with no out of pocket expense to the fire agency. In Florida, a Boy Scout complete his Eagle project by soliciting donated radio equipment and installing a ham radio station at his local fire department (Bay News 9, 2014). As fire agency command staff become exposed to the capabilities of ARES, combined with the low out-of-pocket cost of such a partnership, there is an increased opportunity for such fire agencies to expand their use of ham radio.

Unlocking the potential of ARES support of fire operations could come through a better understanding of potential fire agency needs and ARES capabilities. Confidence in amateur radio as resource would be optimized through combined agency training and MOU's. The Jefferson County ARES team lead in Colorado stated that development of an MOU and increased frequency of interagency training would greatly improve the odds of both a partnership developing and successful interactions at real-world events (Marco Vasquez, personal communication, December 15, 2018). Creation of an MOU would allow both agencies to define and agree upon training requirements, certification levels, equipment provided, and specific roles and responsibilities of ARES team members at an incident. Drills, such as those conducted by Bethesda area hospitals, would allow strengths and weaknesses of such agreements to become

self evident (Cid et al., 2017). Comparing training or incident successes and shortcomings against such an MOU would allow improvements to be made. Survey results of ARES team leads indicated that interagency training would need to increase from the current average of 11 annual hours to an average of 23 hours annually (Appendix C). Respondents from the fire agency survey population indicated that the current average of 1 hour of annual training would need to increase to an average of 11 hours of training in order to optimize chances of successful interaction between fire agencies and ARES personnel (Appendix D). Special Operations Chief Joe Snyder believed that training, such as quarterly drills, is critical to the development of relationships between firefighters and ARES members (Joe Snyder, personal communication, January 24, 2019). Bethesda area hospitals facilitated integrated training between hospital staff and ARES members to help ensure success at a future real-world event (Cid et al., 2017).

The research indicated a need to enhance relationships and educate fire personnel on ARES capabilities, both of which can be accomplished through training. Amateur radio is a resource that FFPD can use in an expanded role. ARES ability to shore up primary communication failures, such as those witnessed during the 2013 Colorado flooding, are an obvious benefit (Marco Vasquez, personal communication, December 15, 2018). As a small fire service organization, FFPD could potentially increase its capacity to address multiple assignments through a more connected and clearly defined partnership with ARES.

### Recommendations

The intent of this ARP was to utilize descriptive research methodology to identify how amateur radio communication can support operations at the FFPD. This objective was accomplished by a completing a detailed literature review and facilitation of focused surveys

with two populations of survey participants. Based on conducted research, five recommendations have been made.

The first recommendation was that FFPD should develop a relationship with the local Jefferson County ARES team. This should be done by having the on duty Battalion Chief attend the monthly ARES meetings. Attendance at such a meeting would allow FFPD command staff to become familiar with the capabilities the ARES team can provide and would also connect names with faces prior to a real-world response. Interaction between decision makers of both organizations would allow stake holders from both sides to better understand each other's needs. Participants from both surveys indicated frequent interaction through increased training would improve the operational relationship between fire and ARES agencies.

The second recommendation is for FFPD to implement a procedure for documenting situations where amateur radio capabilities and personnel might have had an opportunity to be utilized. FFPD has not had a process for collecting this data in a format that is able to be documented, tracked, and searched. Development of a such a process would allow FFPD to ensure an isolated opportunity on a single shift could be discussed more broadly among the Operations Division and command staff. Additionally, sharing those documented situations with ARES team members would allow their organization to provide insight on how they felt they might be able to support FFPD at a similar situation.

The third recommendation was for FFPD to conduct quarterly communication drills with dispatch that focused on the use of alternative communication methods. Conducting such drills would provide FFPD personnel with a forced opportunity for response personnel to communicate with dispatch using methods other than the 800 MHz state system. Such a quarterly event would identify what backup communication methods are effective and which are not. ARES personnel

should be invited to participate at these quarterly drills with the goal of providing ARES a platform to demonstrate how ARES can quickly implement a backup communication system that helps the firefighters communicate with dispatch. Conducting such drills would address survey data that indicated more interagency training was needed to improve operational relationship between ARES members and fire personnel.

The fourth recommendation was for the Operations Division to coordinate an ARES demonstration event. Both populations surveyed in this ARP indicated that it was their belief that fire command staff did not understand the capabilities amateur radio had to offer. Scheduling a session for ARES to demonstrate their range of communication capabilities would serve as an opportunity for ARES to sell their resource to FFPD command staff.

The fifth recommendation was for FFPD to support its members pursuing amateur radio licensing. Support could take the form of approved study time on shift, payment of license testing fee, and providing shift coverage in the event a member was scheduled to be on duty during a license testing session. Increasing FFPD's ranks of licensed amateur radio operators would help ensure a better understanding of the capabilities able to be offered by groups such as ARES.

Based on the result of the ARP's literature review and surveys of both fire officers and ARES team members, the above recommendations should be considered applicable to most fire service organizations. Future researchers and fire service leaders may find these recommendations relevant areas to investigate further. Depending on your agencies needs, additional research on this ARP topic may not require inclusion of all recommendations of this ARP.

## References

- Aberle, S. (2017). Ham radio in emergency operations. Retrieved from <https://www.domesticpreparedness.com/preparedness/ham-radio-in-emergency-operations/>
- Amateur radio service*. (2017). Retrieved from Federal Communications Commission website: <https://www.fcc.gov/wireless/bureau-divisions/mobility-division/amateur-radio-service>
- American Fact Finder. (2010). <https://factfinder.census.gov>
- American Radio Relay League. (2017). *Handbook for radio communications 2018* (95th ed.). USA: Author.
- ARRL Section Emergency Coordinators. (2018). The amateur radio emergency service 2017 annual report. Retrieved from <http://www.arrl.org/files/file/Public%20Service/ARES/ARES%202017%20Report.pdf>
- Baker, P., & Hsu, S. S. (2006). Katrina Video Refuels Debate Over Response. Retrieved from <http://www.washingtonpost.com/wp-dyn/content/article/2006/03/02/AR2006030202130.html?noredirect=on>
- Bay News 9. (2014). Everyday hero: Teen creates backup emergency communications system for local fire station. Retrieved from [https://www.baynews9.com/fl/tampa/news/2014/6/27/everyday\\_hero\\_ham\\_ra](https://www.baynews9.com/fl/tampa/news/2014/6/27/everyday_hero_ham_ra)
- Careless, J. (2008, September). Bargain bandwidth. *Fire Chief*.
- Careless, J. (2017). Emergency Communications Driving Increase in Amateur Radio Operators. Retrieved from <http://www.govtech.com/em/disaster/Emergency-Communications-Driving-Increase-in-Amateur-Radio-Operators.html>

- Cid, V. H., Mitz, A. R., & Arnesen, S. J. (2017, April). Keeping communications flowing during large-scale disasters: Leveraging amateur radio innovations for disaster medicine. *Society for Disaster Medicine and Public Health, 12*, 257-263.
- Communication. (2014). In F. C. Mesh (Ed.), *Merriam-Webster's collegiate dictionary* (11th, p. 251). United States of America: John M. Morse.
- Corey, M., & Rodia Schoenfeld, B. (Eds.). (2016). *The amateur radio public service handbook* (1st ed.). United States of America: The American Radio Relay League.
- DeMers, G., & Jacoby, I. (2016). Disaster communications. In G. R. Ciottone (Ed.), *Ciottone's disaster medicine* (2nd ed., pp. 275-279). Philadelphia, PA: Elsevier.
- Drake, F. (2008). EmComm can be fashionable. Retrieved from <https://www.eham.net/articles/19032>
- Fortune. (2016). [www.fortune.com](http://www.fortune.com)
- Jacobsmeier, J. M. (2011, August). Often overlooked, but vitally important. *Urgent Communications, 28-30*.
- Johnson, B., & Shudak, L. (2018, December 3). Emergency Responder Radio Coverage for New and Existing Buildings. *Fire Rescue*. Retrieved from <https://www.firerescuemagazine.com/articles/print/volume-13/issue-11/departments/technology-and-communications/emergency-responder-radio-coverage-for-new-and-existing-buildings.html>
- McCain, C. (2011, April). Everything old is new again. *Public Safety Communications, 50-51*.
- McCamey, R., & Yaeger, J. (2018, January/February). Amateur radio communications in a disaster preparedness simulation. *Journal of Emergency Management, 16*(1), 41-47.

McKenna, C. (2010). Amateur radio operators provide a critical communications link during emergencies. Retrieved from <http://www.govtech.com/em/safety/Amateur-Radio-Operators-Communications.html>

MillerCoors. (2017). [www.millercoors.com](http://www.millercoors.com)

Segal, Y. (2015). September 11th – The Challenges of Emergency Communications in High-Rise Buildings. Retrieved from <https://www.equities.com/news/september-11th-the-challenges-of-emergency-communications-in-high-rise-buildings>

Silver, W. (Ed.). (2017). *The ARRL handbook for radio communications* (95th ed.). United States of America: The American Radio Relay League.

Solomon, M. (2016). Walton county ARES assists in hurricane relief. Retrieved from <https://www.mypanhandle.com/news/walton-county-ares-assists-in-hurricane-relief/592422788>

The ARRL Letter. (2017). ARES volunteers support evacuation, shelters, in wake of Oroville dam crisis. Retrieved from <http://www.arrl.org/arrlletter?issue=2017-02-16>

The University of North Carolina at Charlotte. (n.d.). New Orleans Hurricane Katrina Levee Failures. Retrieved from <https://eng-resources.uncc.edu/failurecasestudies/dam-failure-cases/new-orleans-hurricane-katrina-levee-failures/>

Tucson News Now. (2015). Pima county plans ham radio network as communications backup. Retrieved from <http://www.tucsonnewsnow.com/story/29546041/pima-county-creating-ham-radio-network-to-back-up-emergency-system/>

United States Fire Administration. (2014-2018). *Strategic Plan*. Retrieved from: [https://www.usfa.fema.gov/downloads/pdf/publications/strategic\\_plan\\_2014-2018.pdf](https://www.usfa.fema.gov/downloads/pdf/publications/strategic_plan_2014-2018.pdf)

United States Fire Administration. (2015). Executive fire officer program handbook. In.

Retrieved from [https://www.usfa.fema.gov/downloads/pdf/efop\\_guidelines.pdf](https://www.usfa.fema.gov/downloads/pdf/efop_guidelines.pdf)

Ward, M. J. (2015). *Fire officer principles and practice* (3rd ed.). Burlington, MA: Jones & Bartlett.

Wilson, M. (Ed.). (2016). *The ARRL operating manual* (11th ed.). United States of America: The American Radio Relay League.

Winlink is... (2019). Retrieved from <https://www.winlink.org>

Wolfgang, L. (Ed.). (2005). *The ARRL general class license manual* (5th ed.). United States of America: The American Radio Relay League.

## Appendix A

## Ham Radio in Support of Fire Service Operations – Fire Agency

1. Are you a member of a fire service agency?
2. Does your fire service agency interact with Amateur Radio Emergency Service (ARES) personnel?
3. Does your fire service agency participate in training with Amateur Radio Emergency Service (ARES) personnel?
4. On an annual basis, how many hours of training were conducted between your fire service agency and Amateur Radio Emergency Service (ARES) personnel? (Drag sliding scale to number between 1-100 hours)
5. To enhance pre-event relationships and optimize operations at real world events, how many annual hours of training do you think should take place between your fire service agency and Amateur Radio Emergency Service (ARES) personnel? (Drag sliding scale to number between 1-100 hours)
6. To what planned, forecasted, or unplanned events can your ARES team support its local fire department/districts? List.
7. Do you believe the command staff within your organization understand the capabilities Amateur Radio Emergency Service (ARES) personnel can provide?
8. Do you believe there is a financial cost to your agency when utilizing the capabilities of Amateur Radio Emergency Service (ARES) personnel?
9. Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support an Emergency Operations Center (EOC)?

10. Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support an Incident Management Team (IMT)?
11. Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support local fire agency operations?
12. Consider the culture of your fire service agency. On a scale of 1-10, how receptive would the members of your organization be to working with Amateur Radio Emergency Service (ARES) personnel? (1 = not receptive, 10 = highly receptive)
13. The below space is available for you to provide any additional thoughts regarding this survey topic. Please explain.

## Appendix B

## Ham Radio in Support of Fire Service Operations – ARES Team Leads

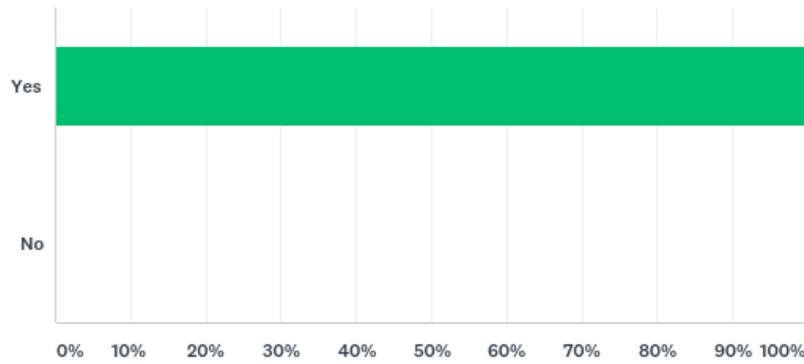
1. Is one of your ARES team goals to support emergency communications? Yes or No.
2. Does your ARES team support an Incident Management Team? Yes or No.
3. Does your ARES team support an Emergency Operations Center? Yes or No.
4. Does your ARES team support fire departments/districts in your area? Yes or No.
5. Does your ARES team conduct training with fire departments/districts in your area? Yes or No.
6. On an annual basis, how many hours of training were conducted between your ARES team and fire departments/districts in your area? (Drag sliding scale to number between 1-100 hours)
7. To enhance pre-event relationships and optimize operations at real world events, how many annual hours of training do you think should take place between your ARES team members and fire personnel? (Drag sliding scale to number between 1-100 hours)
8. To what planned, forecasted, or unplanned events can your ARES team support its local fire department/districts? List.
9. What capabilities can your ARES team provide in support of local fire department/district operations? List.
10. Do you believe that most fire department leaders, in the region served by your ARES team, understand the capabilities your group can provide?
11. What recommendations can you make to improve the understanding fire department leaders have with regard to your ARES team capabilities? Explain.

12. Do you believe that installing amateur radio equipment at strategically predetermined fire station locations, or apparatus, would optimize redundant emergency communication capabilities?
13. Do individual fire departments/districts need to purchase amateur radio equipment in order to work with your ARES team?

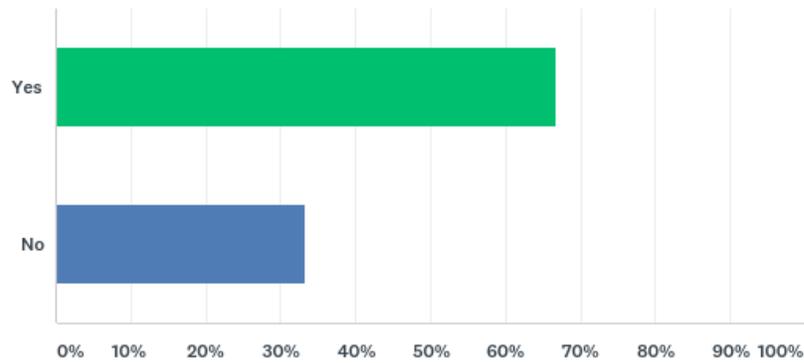
Appendix C

Ham Radio in Support of Fire Service Operations – ARES Team Leads Results

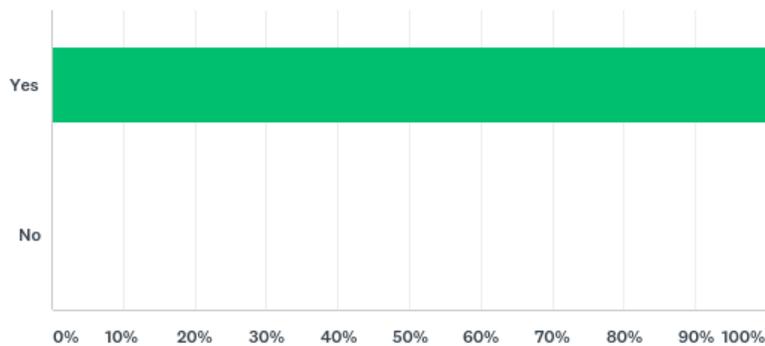
Q1 Is one your ARES team goals to support emergency communications?



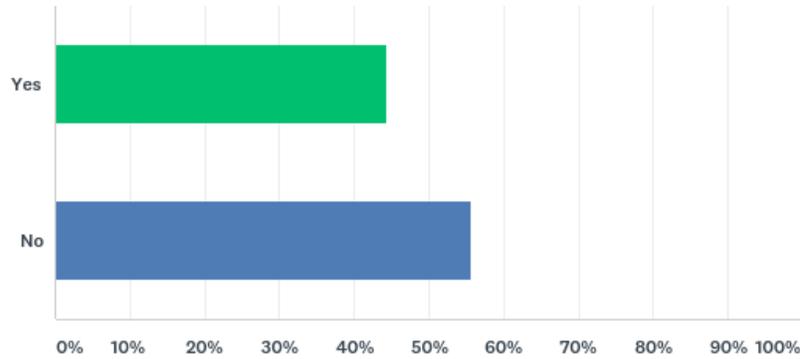
Q2 Does your ARES team support an Incident Management Team (IMT)?



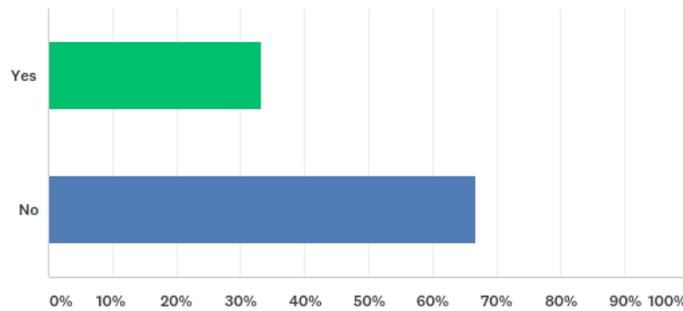
Q3 Does your ARES team support an Emergency Operations Center (EOC)?



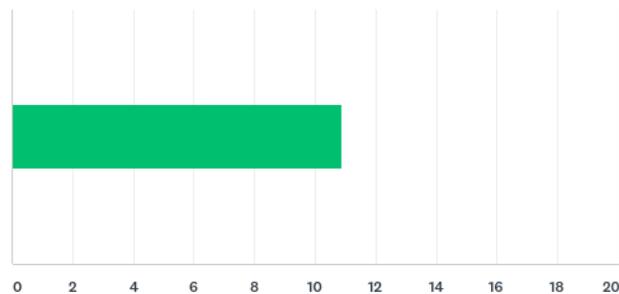
Q4 Does your ARES team support fire departments/districts in your area?



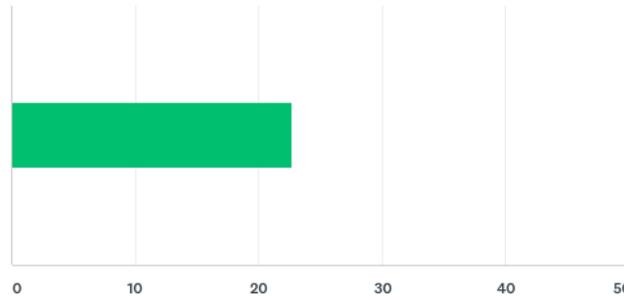
Q5 Does your ARES team conduct training with fire departments/districts in your area?



Q6 On an annual basis, how many hours of training were conducted between your ARES team and fire departments/districts in your area? (Drag sliding scale to number between 1-100 hours)



**Q7 To enhance pre-event relationships and optimize operations at real world events, how many annual hours of training do you think should take place between your ARES team members and fire personnel? (Drag sliding scale to number between 1-100 hours)**



**Q8 To what planned, forecasted, or unplanned events can your ARES team support its local fire departments/districts? List.**

Answered: 9 Skipped: 0

#

- 1 Outreach, radio training are the biggies. As a former Firefighter/EMT I recognize there is not a lot we can do in Urgent or Emergencies outside of wildfires and possibly large scale events. It's also difficult for the Fire Depts to understand how we can help so we need to work a little harder on educating them.
- 2 We work through the Director in the Boulder EOC
- 3 IDT support, incident dispatch (reserve) support, wildland fire staging/logistics communication support, RADO (NWCG Radio Operator) training
- 4 wildfires, floods, weather related downed communications
- 5 Planned events such as county fairs, parades, smoke detector hand-outs, CERT activities, community engagement
- 6 Joint participation in office of emergency management exercises
- 7 For the most part, this falls under OEM or IMTs
- 8 Wild fires, regional power outages, activation in unforeseen major events...your imagination is as good as mine
- 9 Weather Watch for County Fair, HF and VHF voice and digital comm links to county and state EOC's.

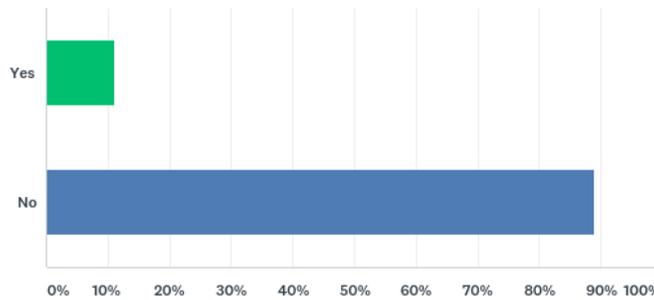
**Q9 What capabilities can your ARES team provide in support of local fire department/district operations? List.**

Answered: 9 Skipped: 0

#

- 1 Radio guys (and gals) are usually the ones that help with computer problems, VoIP, and other technical problems at and event or scene.
- 2 Auxiliary communications and Digital Video. Communication to ham in mountain communities.
- 3 NWCG red-carded radio operators, public-safety trained radio operators for non-direct operational communications (staging, logistics)
- 4 communications - various levels
- 5 Aux Communications, Support for longer-term fires and events. Assist with communications at shelters
- 6 Voice and data radio communication equipment and skilled operators
- 7 Communications, surveillance, EOC staffing, AuxComm actions
- 8 Early comms, CO-ordination of supportive radio services and activation of the Eastern Slopes considerable personnel and resources to provide manpower and additional expertise to our rural mountain districts
- 9 Back-up communications channels, direction finding, maintenance and testing of radio equipment, extra sets of eyes and ears with organic comms system. Amateur stations can provide digital/text(packet, pactor/winmor) communications. At present the 800 MHz DTRS does not do text.

**Q10 Do you believe that most fire department leaders, in the region served by your ARES team, understand the capabilities your group can provide?**



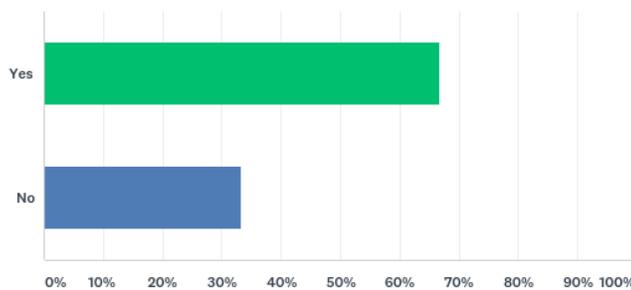
**Q11 What recommendations can you make to improve the understanding fire department leaders have with regard to your ARES team capabilities? Explain.**

Answered: 9 Skipped: 0

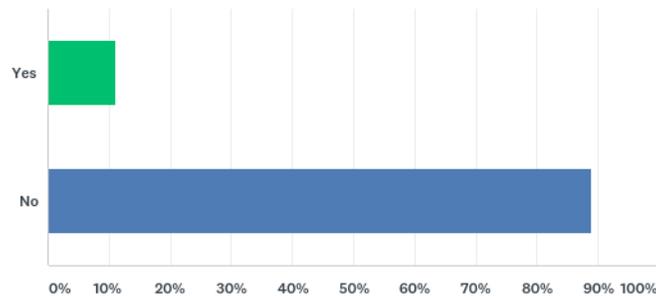
#

- 1 I think we, ARES, need to do more outreach to the Fire Dept leadership with demos, training opportunities, and relationship building.
- 2 We interface monthly at MACs (Multi Agency Committee) Meetings. 1/11/2019 5:44 PM
- 3 Invite to regional, county and district meetings and conferences to present capabilities and engage in Q&A with departments.
- 4 dialog
- 5 Fire Department leaders need to be receptive to what volunteers, such as ARES teams, can provide to their organizations. Allowing local ARES teams to provide overview to command staff of what ARES could bring to the table would be helpful.
- 6 Have an open mind and provide time to learn about ham resources
- 7 Direct interface, liaison.
- 8 Meet to create MOU. Consider local or regional exercises
- 9 Work to determine one or two types of incidents that would give ARES an opportunity to support the FD. Conduct a example demonstration/exercise.

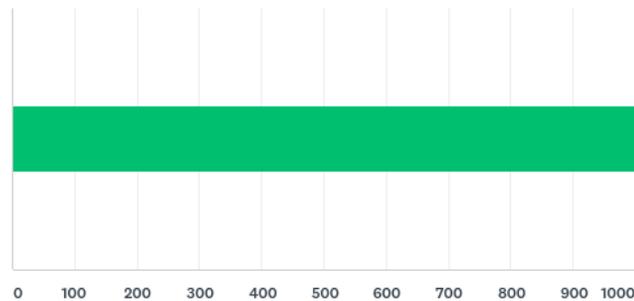
**Q12 Do you believe that installing amateur radio equipment at strategically predetermined fire station locations, or apparatus, would optimize redundant emergency communication capabilities?**



Q13 Do individual fire departments/districts need to purchase amateur radio equipment in order to work with your ARES team?



Q14 What do you estimate the dollar amount to be for a fire department to purchase and install a fire station "ham shack"? (Drag sliding scale to value between \$0-\$5000)



Q15 The below space is available for you to provide any additional thoughts regarding this survey topic. Please explain.

Answered: 9 Skipped: 0

#

1 ec@arapahoeares.org - I would welcome the opportunity to provide more feedback or offer my help and support in developing a plan and talking to the Fire Department Leadership.

2 We do many things to interface but I'm sure we could do more

3 Ref question 12: the challenge of installing equipment into stations is not the acquisition/installation cost, but rather the operational and maintenance cost. Radios and related equipment need maintenance. Trained (licensed) operators are needed to use the equipment. Far better to have an MOU with departments to deploy ARES operators to a station when needed.

4 none

5 ARES teams can be an asset to fire operations if allowed to volunteer for local fire departments. An MOU, which would outline responsibilities and roles, would help protect the fire department and ARES district. Annual training and 2-3 "missions" a year would help integrate ARES into the fire department organization.

6 Rural and metro departments have very different needs

7 In much of the North Central Region, ARES support is done through OEMs.

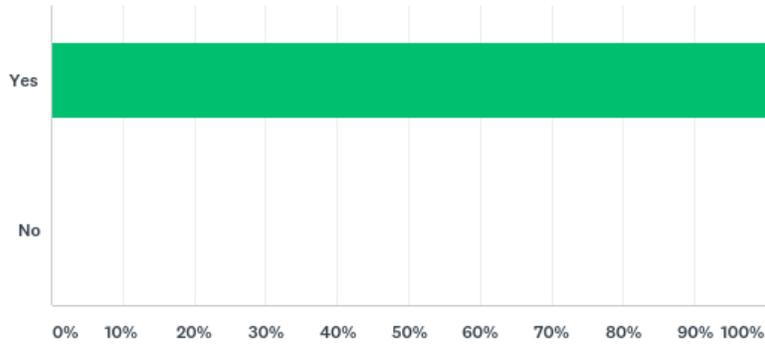
8 I didn't have a dollar amount as the stations need hams to operate equipment. We bring our own out here. I'd have a much more specific answer if you were asking about a regional EOC. Don't separate Fire from the rest of the integrated services.

9 For the purpose of providing accurate information in my county the county's AUXCOMM team is considered to be the ARES team in this survey. Re question 12: Amateur radio is not appropriate for tactical use on fire apparatus. Amateur stations at fire station for back up comms to county and state EOC's is appropriate support for emergency management incidents such as the 2013 floods. My fire district installed VHF - HF station with digital capability as a back up for the county EOC. Re question 13: Initially showing that ham operators bring their own equipment helps open the door to their being accepted. On the other hand amateur radio equipment gives less sticker shock that commercial LMR radio equipment. Re question nr 2: In my county the county's AUXCOMM team (not exactly ARES) would likely be called to support an IMT at a incident in the county. Re question 14: he estimate is based on experience of purchasing two ham radio stations, one for a fire district, the other for the county EOC.

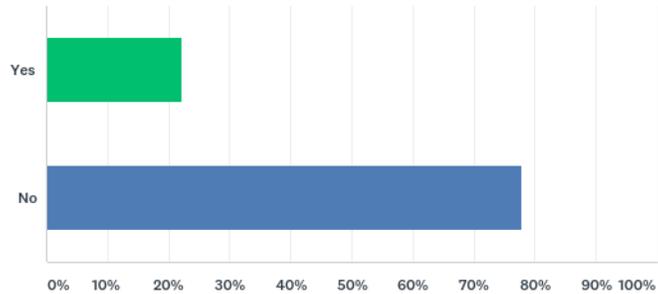
Appendix D

Ham Radio in Support of Fire Service Operations – ARES Fire Agency Results

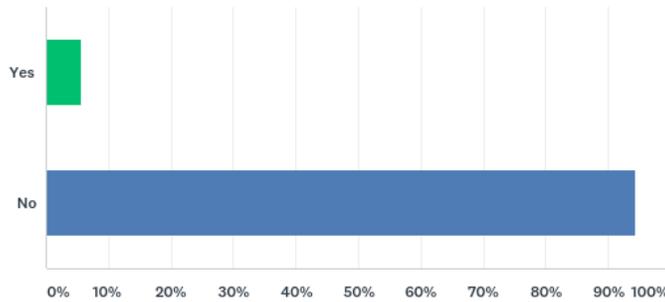
Q1 Are you a member of a fire service agency?



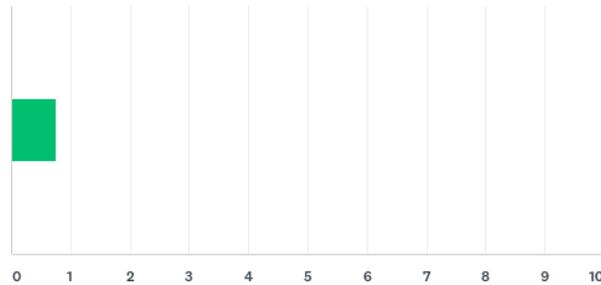
Q2 Does your fire service agency interact with Amateur Radio Emergency Service (ARES) personnel?



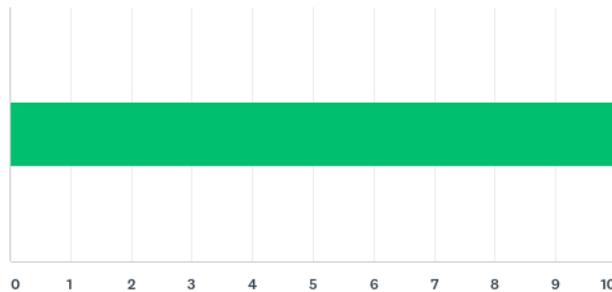
Q3 Does your fire service agency participate in training with Amateur Radio Emergency Service (ARES) personnel?



Q4 On an annual basis, how many hours of training were conducted between your fire service agency and Amateur Radio Emergency Service (ARES) personnel? (Drag sliding scale to number between 1-100 hours)



Q5 To enhance pre-event relationships and optimize operations at real-world events, how many annual hours of training do you think should take place between your fire service agency and Amateur Radio Emergency Service (ARES) personnel? (Drag sliding scale to number between 1-100 hours)

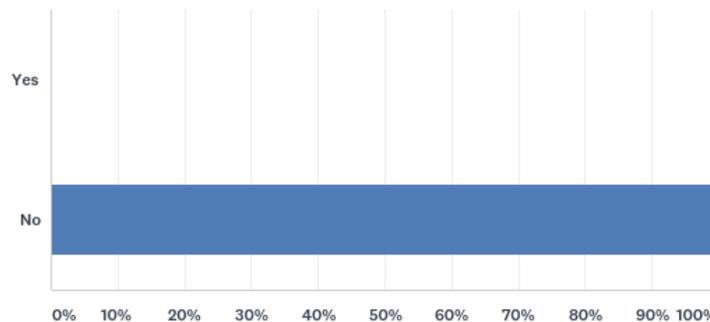


**Q6 To what planned, forecasted, or unplanned events can Amateur Radio Emergency Service (ARES) personnel support your fire service agency? List.**

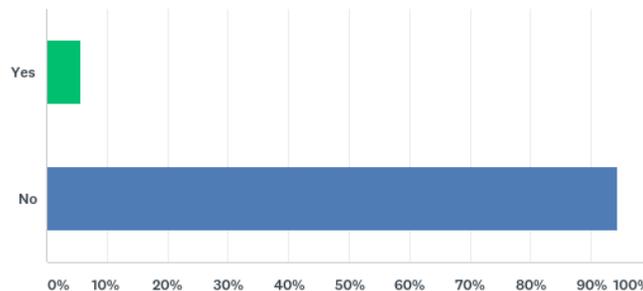
Answered: 18 Skipped: 0

- 1 alternative lines of communication with others
- 2 unknown
- 3 In large scale incidents this group is very valuable to assist with the communication plan and enhancing communications for the incident.
- 4 Large weather events.....Tornados, large hail storms, winter storms.....etc.
- 5 Wildfire, significant winter storms, 4th of July fireworks event
- 6 City / County wide catastrophe event or attack to current radio infrastructure.
- 7 Natural disasters, infrastructure failure, loss of communication capability
- 8 Not certain. Unaware of their presence in our service area or county.
- 9 Natural disasters, wildland fires
- 10 Unsure
- 11 Large gatherings or weather events
- 12 Weather events, Wildland, Special events
- 13 Wildland fires, large scale events
- 14 Communication
- 15 Weather, scanning for web apps
- 16 Radio outages, back country rescue, system overload, planned events, mci
- 17 Major events that occur within our district or within the county. For forecasted natural disasters (snow storms/blizzards/wildland fires).
- 18 Snow storms, wind events, terrorism, flooding, cyber attack, Solar event, large public events like bike races, woodland incidents, coordination with CERT teams

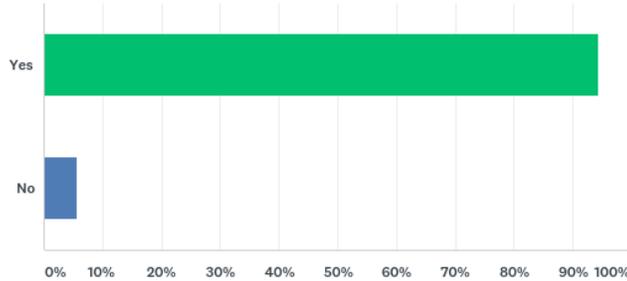
**Q7 Do you believe that the command staff within your organization understand the capabilities Amateur Radio Emergency Service (ARES) personnel can provide?**



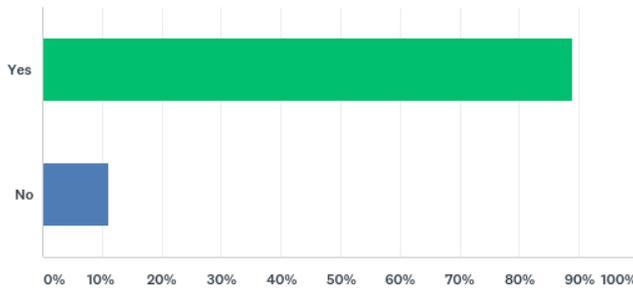
**Q8 Do you believe there is a financial cost to your agency when utilizing the capabilities of Amateur Radio Emergency Service (ARES) personnel?**



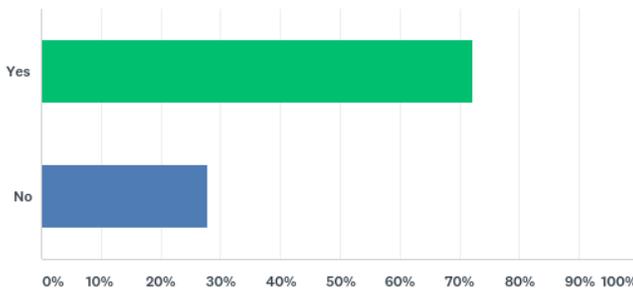
Q9 Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support to an Emergency Operations Center (EOC)?



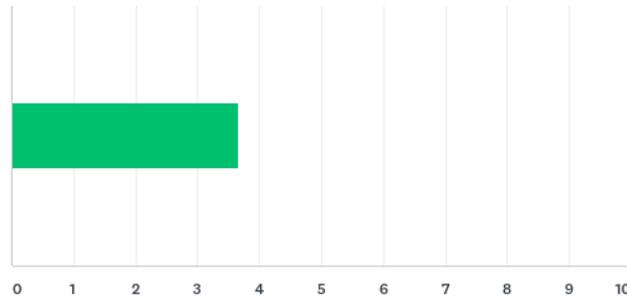
Q10 Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support an Incident Management Team (IMT)?



Q11 Do you believe there is a role for Amateur Radio Emergency Service (ARES) personnel to support local fire agency operations?



**Q12 Consider the culture of your fire service agency. On a scale of 1-10, how receptive would the members of your organization be to working with Amateur Radio Emergency Service (ARES) personnel? (1 = not receptive, 10 = highly receptive)**



**Q13 The below space is available for you to provide any additional thoughts regarding this survey topic. Please explain.**

Answered: 12 Skipped: 6

#

1 n/a

2 due to the current merger situation in our district I don't think command staff would be interested in implementing any new programs until early next year, then only in areas with extreme radio issues.

3 I do not believe ARES has been utilized by my organization or surrounding organizations in a beneficial manner.

4 From a 'City Fire Department' perspective this is not really discussed. I think this would be a very important role if in case of a very large incident, or failure of current radio infrastructure. Unfortunately, by the time these services would be needed it could be possibly too late if the City/Department is not informed or trained on ARES capabilities.

5 Not very well educated on capabilities of ARES. Would seem functional in the case of a complete communications failure. Possibly engage in planning at EOC level. Possibly helpful to notify remote occupancy or "fringe" citizens.

6 None

7 We don't have any experience working with Amateur Radio personnel. I think at least on our department it would take sometime to get used to the idea.

8 Have never really considered using ARES in our system

9 NA

10 I'm not familiar with ARES and hadn't considered it before this survey but can immediately see the value potential.

Addressing the cultural challenges would likely be our biggest barrier and perceptions of this role on our community. Good luck with your research.

11 None at this time. Might want to make "maybe" an option for # 10 and 11 with a box to explain the "maybe" answer.

12 na