

Ham Radio and the Pony Express

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Abstract—The Pony Express (1860-61) used horse-back relays to carry the mail between St. Joseph, Missouri to Sacramento, California (USA) in 10-days, providing high-speed communication at the time. The Pony Express is re-enacted annually, with riders galloping day and night to carry the mail across the country. Ham radio operators provide emergency communication for this event across the remotest sections of the 1966-mile (3,164 km) route, using a variety of base and repeater stations, handheld and vehicle-supported radios, UHF, VHF, and HF bands, and a variety of deployed antennas, described in this article.

Index Terms—Pony Express, ham radio

I. INTRODUCTION

THE Pony Express provided mail service between Sacramento, California and St. Joseph, Missouri (USA) using relays of horse-mounted riders from April 3, 1860, to October 1861. The route, shown in Fig. 1, was roughly 1,966 miles (3,164 km) long, through country inhabited mainly by Native Americans with a few scattered white settlements in the

western United States. It crossed both the rugged Rocky Mountains and the Sierra Nevada range, through two states (Missouri and California) and six territories (Kansas, Nebraska, Colorado, Wyoming, Utah, and Nevada). Running both day and night, in all weather, riders galloped five miles (80 km) to 20 miles (320 km), depending upon the terrain, between stations, swapped to a fresh horse in two minutes or less, and continued on to the next station, covering a total of 100 miles (1600 km) before switching riders. All the same, the 10-day transcontinental delivery time was a breakthrough in communication speed, cutting the time required for mail delivery by stagecoach (21 days) in half. This feat required 80 riders, over 400 horses, 184 stations, and several hundred support personnel. In a whirl-wind delivery, the Pony Express brought news of President Abraham Lincoln's election to the west coast in a record-setting seven days and 17 hours.

The riders were often young, teen-age boys. A famous advertisement allegedly read, "Wanted: Young, skinny, wiry fellows not over eighteen. Must be expert riders, willing to risk death daily. Orphans preferred," however the ad has never been found, and many historians question its veracity. "Buffalo" Bill

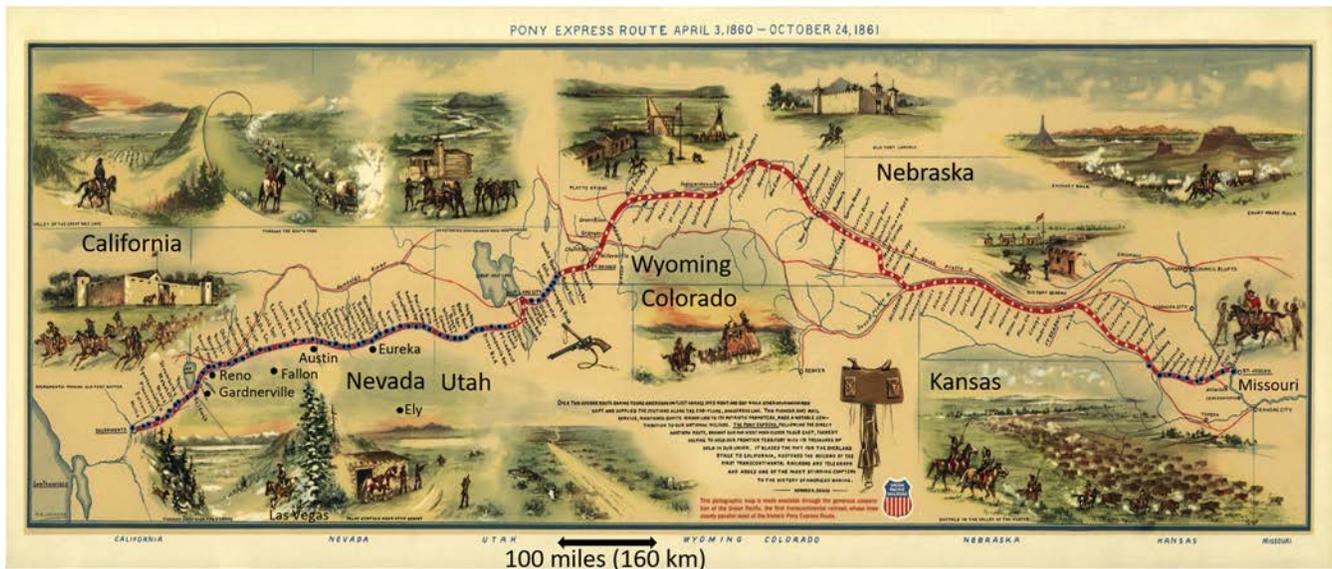


Fig. 1. The Pony Express (1860-1861) carried the mail between St. Joseph, Missouri and Sacramento, California (USA), a distance of about 1900 miles (3,100 km) in 10 days, running day and night in all weather. [Illustrated Map of Pony Express Route in 1860 by William Henry Jackson. Courtesy the Library of Congress. Reproduction 1960 by the Union Pacific Railroad Company.] The annual Pony Express Re-Ride closely follows most of the original routes. Some areas are as remote as they were in the mid-19th century. Blue dots indicate portions of the re-ride through Utah and Nevada supported by HAM operators.

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Cody claimed to have been a Pony Express rider, and he later glamorized the Pony Express in his "Buffalo Bill's Wild West Show," capturing imaginations and turning its young riders into national heroes. The horses were outfitted with special lightweight saddles, and the mail was carried in a leather mail bag, called a mochila -- four locked pouches, called canteens, attached to a leather saddle cover that fit over the saddle, held in place by the weight of the rider sitting on it. When the rider would pull up to a station, he would exchange the mochila from his tired horse to a fresh mount, swing up, and gallop off.

The Pony Express was never intended to be long-term nor the only system of delivery. Mail was still carried overland with wagons and stagecoaches. Ponies only carried express mail, at \$5 a half-ounce (14 g), equivalent to over \$140 USD today. The transcontinental telegraph, already well on its way to linking the frontier when the Pony Express began operating, merely sealed the doom of the operation, which was already collapsing due to conflicts with Native American, harsh winter conditions, and financial mismanagement. The riders of the Pony Express made a last gallop across the country in November, 1861, soon to be replaced by the transcontinental telegraph, depicted in Fig. 3.

But the romance of the Pony Express never really faded away. In 1923 a Re-Ride from St. Joseph to Sacramento (not necessarily following the original Pony Express trail) was kicked off by a signal from President Calvin Coolidge. In 1935, 300 Boy Scouts carried the mail from west to east, more or less following the original trail. In 1960, for the Pony Express Centennial, the mail was carried simultaneously both east and west. Following this ride, the National Pony Express Association (NPEA) was organized, and a Re-Ride of the famous journey between St. Joseph, Missouri and Sacramento, California has been an annual event since 1985. Each state organizes mounted relay teams, with rides between 2 and 10 miles (3.2 – 16 km) each, before passing off the mochila to the next rider. Riders are sworn in as temporary mail carriers taking the same oath as the original riders, and the fifty pound (23 kg) mochila contains actual U.S. mail (souvenir letters from the Pony Express, which cost \$5 USD (the same as in 1860) to send).

The Pony Express was originally running through a remote frontier, typically following stage coach routes with vast empty expanses between small urban areas. Stage stations served as "home stations" where riders stopped, and smaller stations between them provided stations just to exchange horses. Today much of the trail remains remote and rugged with majestic mountains to scale, primitive roads to follow, long distances between water, and miles and miles of nothing but miles. Imagine galloping a strong horse under a full moon through a desert remoteness where it can be forty miles (64 km) or more to a telephone, 125 miles (200 km) between gas stations, and the only traffic are wild mustangs, antelope, and coyote. Often the only domestic thing that is seen is a range cow.

With no cell phone coverage, and long distances without access to emergency care, amateur radio (ham) operators provide tactical and emergency communications for various events in these areas such as races, bike events, and the Pony Express Re-Ride. In Utah and parts of California, they follow in a truck behind the riders. In Nevada and most of California, they are posted along the trail. Either way, they provide

information on the location of the pony and rider, and are there in case of an emergency. Fig. 1 shows a map of the ham radio support (marked by blue dots) along the trail, as well as the locations of repeater stations, etc. used along the way.

Ham reports, plus a satellite tracker in the locked mail pouch, track the mochila as it traverses the country. The tracking is updated continuously on the National Pony Express Association (NPEA) website and is followed by people all over the world [1]. This helps riders saddle up and be ready when the mail is coming near, reports, locations of rider exchanges, so people who want to see and cheer on the riders as they come through, and their reports from the trail are uploaded to the NPEA website. But the most important communication the ham operators can provide is for emergency assistance – injuries, medical issues, run-away horses, flat tires and truck problems, lost riders, etc.

This article is about the details of the ham radio support for the Pony Express Re-Ride and the challenges of providing communication for long distances in remote areas with rugged mountains and deserts, through quite literally rain, hail, sleet, snow, mud, and the dark of night. The trail and terrain through each state is a little different, requiring different ham radio support, which is described below for each state.



Fig. 3. The romance of the Pony Express, of a young rider galloping headlong across the desert, continues to capture imaginations to this day. Wire-line communication – the telegraph – brought a quick end to the Pony Express. (from the Utah Historical Society, all rights reserved)

II. CALIFORNIA HAM SUPPORT

California (CA) hams cover the whole stretch of the Re-Ride from Old Sacramento, CA to the Nevada border or close to



Fig. 2 Volunteer ham radio operators provide logistical and emergency communication for the annual Pony Express Re-Ride. Here Utah ham operators in "The Rover" follow rider, Cindy Furse, on her horse, Tesla, through Utah's West Desert where cell phone coverage is non-existent. Note the leather mochila mail pouches (carrying a GPS transponder locked in with the mail) on either side of the horse, and the antennas protruding from either side of the Rover.

it. There are 43 exchanges (covering 143 miles in 23 hours), 42 of which are accessible for ham coverage to report to net control the rider in/out times. Ham support is particularly necessary in the High Sierra mountains, where cell phone coverage is spotty. There are two different trails used for the Re-Ride, depending on if the ride is from east-to-west (when the mochila and amateur reporting is handed off to Nevada XP and the S.I.E.R.A. hams at Woodfords, CA) or west-to-east (when they pick up the mochila from Nevada at the border in South Lake Tahoe). The terrain varies from the high Sierras where the rider and the hams are far from the road to the great Sacramento Valley and Old Sacramento with traffic and potentially irritated motorists irritable for any delay in their travel. In these urban areas, the ham pickup truck travels close behind the horse and rider, protecting them from cars.

California has 23 hours to get the mail through the state, with ham coverage all the way. Two net controllers split the shift, and an operation officer manages the whole route, with two ride captain ham shadows, who stay with the captain and relay information that is pertinent to the smooth operation of the ride. There is also shadow following the ride lieutenants. The exchanges are usually 5 miles apart. Usually there are 20 hams taking part in the Re-Ride leap frogging from one place to the other.

Repeater 146.805 in Pollock Pines, CA covers 95% of the trail. The other 5% is covered by linking into the S.I.E.R.A.'s repeater in Minden, CA. Even though there are areas where cell phone communication is readily available, the repeater is used for the whole trip, so all the information goes through the net control and keeps the hams on the route in the link as to what is happening. The hams do not follow the pony like in other states, especially in the Sierras, because a jeep cannot get though.

III. NEVADA HAM SUPPORT

Amateur radio is a hobby that encompasses many different interests. Some like contests. Some like using low power. Some like building equipment. Others like serving their communities by providing public service communications support, of which the Pony Express ham radio support is one activity. The Sierra Intermountain Emergency Radio Association (SIERA) solicits volunteers to help with the National Pony Express Association (NPEA) Pony Express Re-Ride each year, and ham radio operators throughout the state of Nevada (NV) step up to provide communication support for this annual event.

In Nevada, ham support is provided for the entire Re-Ride from east to west. Throughout the route, cell phone coverage is sparse. Nevada is one of the longest remote stretches in the Pony Express Re-Ride. Ham operators provide communication support from repeaters on mountain summits to areas that are flat, harsh desert. Stations can be sweltering during the day and icy cold, sometimes snowing, at night. Jeff (K7BCV) and Susan (KI7CTT) Cauhape spent the first 15 years on Overlook Pass West (see Fig. 4) north of Eureka, NV, where they strung out an 80-m (covering 3.5-4.0 MHz, roughly 130 feet long) antenna up the hillside and also hoisted a mast for a 40-m (covering 7.0-7.3 MHz, roughly 65 feet long) antenna. Huddling over VHF and HF radios powered by a deep-cycle battery in the back of a Jeep, they helped cover the state. Now they use a mobile



Fig. 4 Ham radio support on Overlook Pass West includes dipole antennas, VHF and HF radio links and shelter from the weather.

antenna system that was made by MFJ. It consists of two pairs of verticals that can be mounted on the back bumper of the Jeep on separate 12-foot (3.6 m) masts to form dipoles. In addition



Fig. 5 On wet and soggy years, ham stations sometimes also provide shelter from the weather for both ham operators and Pony Express riders. The horse, Patriot Commander, is making it clear he'd like to come all the way into the tiny tent.

to providing communication support, they also shelter the riders as they wait, often hours, for the mail.

Austin, NV, is a very small community located very near the center of Nevada on US Route 50 very close to the path that the original Pony Express riders used. The 2010 Census listed the population of Austin as 192. Nearby Austin Summit is about 8500 feet (2600 m) above sea level and has a view of a major part of the state. The dirt forest road from Route 50 to the summit is poorly maintained and difficult to climb. In 2018, Bob Nelson made it to the summit in a pickup truck pulling a small utility trailer (shown in Fig. 6) and set up communications with the mobile operators who track the progress of the Pony Express riders both along the roads that are used and at check

points in areas where the riders are cross country. He used a VHF simplex frequency (146.55 MHz) to communicate with the mobile and check point operators and a repeater (KC5ARS) near Fallon, NV, to communicate with the base stations which were all in the Reno to Gardnerville, NV area. That repeater was 117 miles (188 km) away, and the operators were somewhat surprised at how good the signal was in both directions throughout the 2 ½ days of the Nevada Pony Express transit. Dipole antennas on two HF frequencies (3.965 MHz and 7.230 MHz) were set up as a backup but were not used. The Pony Express runs 24/7, and the ham support does as well. Originally expecting to support only a 4-hour shift near the Austin transit, the unexpectedly good coverage led Nelson to work a full eighteen hours without a break as the Pony ran across the state.

Nelson's station is made up of equipment that is built into a camper shell on the back of a pickup truck (shown in Fig. 6) and a linear amplifier that is stationed at his home. In the camper are fifteen two way radios, several modems, two laptop computers, and three 50 amp-hr 12 volt batteries. Everything in the truck runs on 12 volts DC except the air conditioner. The utility trailer contains all the camping gear and two small Honda generators. The radios are mostly commercial Motorola radios and cover the 1.8 MHz to 900 MHz radio bands. Nelson operates four HF radios with three of them in the truck and one in a very low noise area just at the north end of Las Vegas. He operates this from wherever he is using an internet device to link the control head to the radio. The camper was custom built for Nelson by Alaskan Campers of Winlock Washington. The top rises and lowers using a hydraulic system so that when up as in the photos it has a full 6-foot tall interior but when lowered it is slightly above the pickup cab which makes driving much easier.



Fig. 6. Nevada ham operators provide communication access in some of the remotest areas of the Pony Express Re-Ride. This photo shows the 2018 setup at the peak of the Austin Summit. The 2 tall poles have dual band J poles antennas; one set to communicate on the VHF simplex frequency (146.55MHz) and one set to communicate with the Fallon repeater (147.345MHz). There are two dipoles off to the right of the photo and the 19 foot whip on the camper shell was used for various HF frequencies through an autotuner.

After the communication success in 2018, Nelson and three other operators (Frank Kostelac (N7ZEV), Linda Kostelac

(KC7IIT) and Keith Gordon (K7KSG)) planned to support communication from Austin Summit, sharing the workload in shifts over the 2 ½ days the Pony was crossing Nevada. About a week before the event, they were told that the road to the summit was so bad that the maintenance crews for the microwave relay station on the summit were still using a tracked snow-cat to get to the top. Frank came up with the idea of building a cross band repeater that would operate on solar power with batteries for night time, and he proposed using his Jeep, outfitted for off road work, with which he was sure he could reach the summit. The remaining equipment would be set up at the Austin Airport, which was line of sight to Austin Peak. Keith, who is a corporate pilot, arranged access at the airport through the Austin Airport Authority, who were very supportive of the effort. They not only provided use of the airport grounds, but also gave the radio operators access to the lounge, bathroom, shower, and electric power. Frank and Keith took the equipment up to the summit and set it up while Bob set up the antennas and radio equipment at the airport. The cross band repeater operated on the VHF frequency (146.55 MHz) to the mobiles and on the UHF frequency (446.025 MHz) to the airport. They were not able to reach the Fallon, NV repeater from the airport so used the HF radios on 3.965 MHz and 7.230 MHz with dipoles cut for those frequencies. These dipole antennas are set up using some surplus Collins Radio antennas which have coils of wire and a simple mechanical computer that enable pulling out just the right amount of wire for the desired frequency. They also have a balun and work remarkably well. They also set up an 80-foot (24.4 m) wire about 10 feet (3 m) off the ground fed with a SGC auto-tuner. They used that radio for trying various frequencies and principally for Winlink transmission and reception as a backup to the HF voice communications. Nelson also used Winlink [2] (using the fast Pactor mode), which he has found to be a particularly effective tool in emergency and public service communications. Winlink gateways (from Nevada to Utah, California, Mexico, and sometimes Oregon) or a Winlink capable station can pass email or peer to peer traffic.

In all, four HF radios were used, one connected to each of the dipole antennas, one connected to the 80-foot wire, and the fourth was Nelson's remote radio in Las Vegas, NV operated through the internet using a Verizon hotspot for connection to LTE. That radio is connected to a terminated folded dipole for HF, so it covers the HF spectrum. The base stations were about 150 miles (240 km) from the airport and about 350 miles (560 km) from the Las Vegas radio. The propagation conditions worked out that either the local radio at the airport or the Las Vegas radio was in solid contact with the base stations every time they needed to communicate. They also had one VHF radio in the truck at the airport on the simplex 146.55 MHz frequency and one UHF radio on the cross band repeater UHF frequency (446.025MHz), that could have been used if needed.

During the 2019 Pony Express Re-Ride, the team began communicating with the mobiles to the east of the airport, north of Ely, NV, and were able to communicate most of the way to Fallon, NV, covering about 200 miles (320 km) of the Re-Ride route. The airport was on the Re-Ride route, so the ham operators stationed at the airport saw the riders as they passed. Numerous mobile and check point operators helped throughout

the 2 ½ day event. They used mobile and hand held VHF radios to contact the airport crew via the cross band repeater. They also manned several base stations in the Reno, NV to Gardnerville, NV region, posting information day and night on the riders' progress.

Plans for the 2020 Pony Express Re-Ride include three cross band repeaters. One will be set up as it was in 2019 to communicate with the mobiles and check points along the route. The second will communicate with one of the repeaters near Fallon, NV, as in 2018. And a third will communicate with a repeater near Ely, NV, which should have coverage most of the way to the Utah border. The support team hopes to set up again at the Austin Airport.

The equipment inside the camper is shown in Fig. 7 and Fig. 8. The Pelican case on the left contains the control head and speaker for the remotely operated radio at the north end of Las Vegas. One of the laptop computers is to the right of that unit and is the main operating position. There are two 110 watt Motorola MCS 2000 commercial VHF radios, one with dual control head so that it can be operated from the cab of the pickup. Below the VHF radio is a Motorola UHF Digital Mobile Radio (DMR). There are two Motorola Micom HF radios to the right of the VHF radios. One is a Micom 2 and the other is a Micom 3. These are 125 watt commercial HF radios. In the center is the controller for the three 100 watt solar panels that run all the equipment within the camper. Below the table top are stored the two cross band repeaters; one that operates VHF to HF connecting to the Micom radios and one that is VHF to UHF as well as some backup VHF and 900 MHz radios. The UHF radio covers both the amateur 70 cm band and the GMRS frequencies. To the right of those radios is telephone patch equipment that provides two means of providing phone patch capabilities, a direct hard wired line when at home and on the road either Voice over IP (VOIP) or a standard analog phone using a Verizon LTE hotspot. This hotspot also enables control of the Las Vegas radio from the camper. In Fig. 8 three of the modems are shown. These include the SCS Pactor 3/4 modem, the RapidM RM2 modem for the military M110A mode, and the Kantronics Packet Modem. There is also a modem for Winmor that is behind the computer. Antenna hardware (not shown) includes two dual band J Pole antennas, a UHF beam, a 900 MHz collinear antenna, and a dual band log periodic antenna, and two Collins Radio adjustable dipole antennas. Many feet of coaxial cable, fiberglass poles, and nylon guy ropes are used to set up the antennas.

IV. UTAH HAM SUPPORT

Ham operators provide support for the Utah (UT) segment of the Pony Express Re-Ride on both the east and west sides of the state where cell phone coverage is limited or non-existent. The ride through the central part of the state goes through Salt Lake City and surrounding urban areas, so ham coverage is not required there. The eastern ride from Barker Ranch on the Utah-Wyoming border to This Is The Place Monument on the eastern side of Salt Lake City is a steep (paved) mountain road with deep canyons that sometimes limit even ham coverage. West of Salt Lake City from Camp Floyd, UT to Ibapah on the Nevada border is on a gravel road through desolate desert. Wild horses



Fig. 7 Radios and control units inside the camper.

and coyote are often seen. The Re-Ride is generally scheduled on a weekend where a full moon lights the way through the desert at night.



Fig. 8. Three of the modems are shown. These include the SCS Pactor 3/4 modem, the RapidM RM2 modem for the military M110A mode, and the Kantronics Packet Modem. A modem for Winmor is behind the computer.



Fig. 9. Ham radio support for an event as remote, long, and challenging as the Pony Express Re-Ride requires the skill and cooperation of a huge team of ham radio operators. Operators that manned the Austin, NV relay site shown are Robert Nelson (WA3PAD), Frank Kostelac (N7ZEV), Linda Kostelac (KC7IIT), and in the camper Keith Gordon (K7KSG). Because of the late spring the dirt roads were mostly impassable so using two jeeps they setup a cross band radio on the summit instead of setting the relay station on the summit.

The eastern part of the state is covered by two repeaters,

K7HEN located on Lewis Peak and W7SP located on Farnsworth Peak. The route through Utah's western desert utilizes four linked repeaters provided by W7EO. The repeaters are located at Vernon, Wendover Peak, Black Mountain, and South Mountain in and around the Tooele, UT area. Typically, 15-20 amateur radio operators volunteer their time to provide communications along the roughly 36-hour route. One or more vehicles equipped with amateur radio equipment and operators accompany the horse and rider along each of the routes. A net control operator monitors the repeaters, relaying the position of the pony and being ready to handle emergency communications if required.

Mobile ham support is provided by "The Rover" (shown in Fig. 11), a 1978 Dodge Kary Van that had once been a crime scene investigation (CSI) sheriff's vehicle, complete with running water and an on-board generator. Chuck Killian (WB6YOK) and Gerald Hasty (AD7QF) gutted the vehicle, fitting it out with two operator positions. They installed a high capacity battery stack, a rack with VHF (2 meter, 144-148 MHz) radios, internet and keyboard video mouse (KVM) switches, and seven Dell servers. Several crossed dipole antennas on masts that can be raised when the vehicle is stopped, as well as several field-deployable antennas are included. Today they have a single vmWare host that supports a number of guests. They can access Open Street Maps, an



Asterisk private branch exchange (PBX) to enable phone connections, computer systems for the two operators, radio location equipment, and more. The Rover is an ongoing project, and they are currently adding equipment that supports an

Fig. 10 Servers, VHF radios, and switches are rack-mounted behind the driver's seat. Operator stations are to the left, and the radios can be operated from the driver's seat as well.



Fig. 11 "The Rover" carries VHF mobile communication equipment, six crossed dipole antennas, and two operators. Here it is just about ready to start the night.



Fig. 12 Chuck Killian (right) and another ham operator, waiting for the rider to bring the mail. They will support the next team of riders running the mail across the desert overnight. Many ham operators also join the National Pony Express Association, as Chuck is shown wearing the official Pony Express uniform.

amateur radio emergency data network (AREDN) at the microwave frequencies of 2.4, 3 and 5 GHz to allow remotely sharing of the Rover capabilities with others in the line of sight.

The practical and logistical issues of providing continuous communication support day and night over long distances in challenging, remote locations stress the systems (mechanical, electrical, and human). A pickup truck and trailer (the "Rover Support Vehicle") provides a second large generator and enough gas, food, and water for 3 days, as well as more complex antenna systems, as needed. Quick snack food and freeze dried food with water heated on a propane stove are the norm. Cold water from the Rover's fridge is a luxury in the desert heat and dust.

V. WYOMING, NEBRASKA, COLORADO, KANSAS, MISSOURI

The route through Nebraska and Colorado mainly follows the Platte River Valley and I-80, and cell phone coverage is generally available. Ham radio support has been provided some years but not others.

Through Kansas and Missouri, the route follows both well-established roads (where the ham support may include marking rail road crossings), as well as more primitive dirt roads, rarely graded. Mud and washed out bridges have required re-routing riders, which the ham operators have helped communicate,



Figure 13 Kansas ham operators follow the rider in a mobile home, supporting the ride day and night.

collaborating with the local sheriff offices to ensure the safety of the Re-Ride. Severe weather warnings (rain, hail, and even one tornado warning) have also been shared, so riders could take cover. Ham operators have also helped with a couple of emergencies including a wheel coming off a trailer (it was found about 3 miles back down the road), and the loss of a rider's pocket Bible (carried by the riders, as in the original Pony Express; this was also found back down the trail). The challenges of covering the ride, which takes over 30 hours, requires the cooperation and collaboration of numerous dedicated volunteer ham operators plus local law enforcement, weather service, and the Pony Express captains who organize their teams of horses and riders. Each state-line crossing is cause for celebration, and bragging rights for the relays that keep the mail on time or make up time when it gets behind.

VI. CONCLUSION

The Pony Express, though short-lived, remains a romantic icon of the Old West frontier. The 1900 mile (3,100 km) mail run is re-run in 10 days each year (day and night, through all weather) by teams of dozens of horses and riders, carrying the mail between Sacramento, CA and St. Joseph, MO. Much of the Re-Ride closely follows the original trail, and much of this remains rugged and remote, even today, with little or no cell phone coverage. Volunteer ham radio operators provide communications support throughout these remote areas, helping organize the ride by sharing where the mail carrying rider is, and providing emergency communications as needed.

Perhaps it is poetic, in an engineering sort of way. The Pony Express was the high speed communication link of its time. It was soon outpaced by the transcontinental telegraph, only to ride again a century and a half later, supported by ham radio.

In the cheer of the riders -- "Go! Pony!"

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She has taught electromagnetics, wireless communication, computational electromagnetics, microwave engineering, antenna design, and introductory electrical engineering and has been a leader in the development of the flipped classroom. She has applied her expertise in electromagnetics to sensing and communication in complex lossy scattering media such as the human body, geophysical prospecting, ionospheric plasma, and aircraft wiring networks. She has taught electromagnetics, wireless communication, computational electromagnetics, microwave engineering, antenna design, and introductory electrical engineering and has been a leader in the development of the flipped classroom.

Dr. Furse is a Fellow of the IEEE and the National Academy of Inventors. She is a past AdCom member for the IEEE AP society and past chair of the IEEE AP Education Committee. She has received numerous teaching and research awards including the 2009 IEEE Harriett B. Rigas Medal for Excellence in Teaching. She is a founder of LiveWire Innovation, Inc., a spin-off company commercializing devices to locate intermittent faults on live wires.



Charles Killian (M'18, WB6YOK'66) was born in Kakanak, AK, USA, a small fishing village in southwestern Alaska. He grew up in Seattle and then Southern California. After high school and attending the University California at Irvine he spent four years as an Air Force avionics technician working on F4 and C130 aircraft.

From 2004 to 2000 he spent a somewhat eclectic career as a field service technician repairing clinical and research laboratory instrumentation and programming control software for that equipment. From his discharge from the regular Air Force in 1974 until his retirement in 1992 he had a full career

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Currently he works at Dell EMC as a configuration administrator for systems that support the supply chain for products produced by Dell EMC.

He is a member of the ARRL and has been an amateur radio operator for over fifty years. His interests in amateur radio cover a wide range of communication modes including telegraphy, voice, and digital communications. His current focus is on emergency communications of all kinds, serving several agencies, and microwave digital communications utilizing mesh networks.



Gerald Hasty (AD7QF '92, VE7GLH, '96) was born in Ogden, UT, USA in 1946. He received the A.S. degree in Digital Electronics from the Clark County Community College, Las Vegas, in 1980 and the B.S. degree in Vocational Education from University of Nevada, Las Vegas, in 1981. Certified Microsoft Educator in 1997

From 1980 to 1993, he was the owner of the Gerald Hasty Company providing computer support in an industry that was just starting to find the desktop computer in small businesses. He is the author of two papers delivered at the West Coast Computer Fair. In 1993 was invited to work in Jeddah, Saudi Arabia on special projects. Upon completion of that assignment and coming back to the United States, he received an opportunity to work from Barnaby, British Columbia working with business radios in remote locations.

Currently when asked what he does for work, he gets to say, "whatever I want"; now having the time to explore his many different interests.



Bob Nelson (WA3PAD) received his BSEE in 1966 from the University of New Mexico. Mr. Nelson is an Episcopal Priest, and was a Registered Professional Electrical Engineer in several states prior to his retirement. He served in the Naval Nuclear Propulsion Program and the U.S. Nuclear Weapons Testing Program. Mr.

Nelson has been involved in public service communication activities since obtaining his amateur license over fifty years ago. He has organized and participated in many exercises and real world events as a volunteer operator. He is an American Radio Relay League (ARRL) Official Emergency Station, an operator in the Amateur Radio Emergency Service (ARES), the Radio Amateur Civil Emergency Service (RACES), the Military Auxiliary Radio System (MARS) a part of the Department of Defense, and the Shared Resources (SHARES) radio system for the Department of Homeland Security to provide emergency backup communications when other systems fail. He has been involved in communication support for real forest fires near Las Vegas, SKYWARN activations, many earthquake exercises, a Homeland Security pandemic exercise, and many smaller activation exercises in the community. His ARES organization normally provides a backup HF link (400 miles, 640 km) between the Clark County, NV, Emergency Operations Center (EOC) and the State of Nevada EOC in Carson City during exercises and activations