TELECOMMUNICATIONS HISTORY GROUP

# CONNECTIONS news

www.telcomhistory.org (303) 296-1221
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## A Message from Our Director

As I write this, our facilities are closed to guard against the spread of the COVID-19 virus We apologize for any inconvenience this may cause, but know you'll agree that the continued good health of our communities is of the utmost importance.

We have sad news: our founder Herb Hackenburg passed away on March 2, 2020. Thirty years ago, he saved historical company documents that were being thrown away and started The Telecommunications History Group. He was a wonderful storyteller and enjoyed talking to many different groups, telling of events and people in the telecommunications industry. He wrote the history of Mountain Bell, "Muttering Machines to Laser Beams," which ensured his place in the history of the industry. We plan to keep his legacy alive through our work at THG. He was a great guy and we miss him.

Warm regards,

Renee Lang

Acting Executive Director

**A Letter from the THG Board President**

March 19, 2020

As I write this I have been officially serving as the Telecommunications History Group's president for just two days, since our board meeting of March 17.

To begin, I want to personally thank Jack Shea for his more-than-a-decade of dedicated service as THG's previous president. Jack joined the board in 2007 and was elevated to the president position in 2008. He has provided a steady hand of leadership ever since, and while I understand Jack's decision to retire from the board to focus on his other activities, I will miss my interactions with him. I would also like to thank Pam Laird, Lisa Hensley Ekert and John Darrow for their long service to THG—it has been my pleasure to serve on the board with them since I joined the group in 2016.

I believe that I am the first person to serve as THG president who does not have a background in the Bell System or even in the telecommunications industry. My own career has taken me through some of the other well-known names in technology (and some less well-known ones as too). I began my working days at the National Weather Service, where I helped to develop the computerized workstations which the Weather Service uses to forecast tornados and other severe weather. I have also worked at the movie company Pixar, and I eventually retired from Microsoft where among other things, I led the development team for *Microsoft Word* (which of course I am using to write this letter to you). My joke was always that I enjoyed working on a product that almost everyone has heard of because I didn't have to explain what it was for. But the downside was that as they found out what I did, people would inevitably ask me for technical support!


Despite my lack of direct experience in the Bell System, my passion for and interest in the history of telecommunications is robust. So much of my own career was spent in industries founded on Bell System innovations. These innovations include technologies that would be unthinkable without a global communications system based on the research and development of the telephone industry and of Bell Labs in particular.

As I write this, COVID-19 concerns have already required us to close both of our museums and the THG archives—and not just to the public but to our dedicated and hardworking volunteers as well. The building which contains our archives is managed by AT&T, and to protect the folks who keep things running there they have restricted access to essential personnel only. That is the right thing for them to do at this time.

I cannot help but think of the famous paintings (there are more than one) depicting the *Spirit of Service*. The current situation reminds us that telephone people have always stepped up to help in times of crisis. We now find ourselves in another time where this spirit of service is as relevant as it ever was. I live in Seattle, currently one of the epicenters of the COVID-19 epidemic in the United States. Here we are doing everything we can to slow and try to prevent the person-to-person transmission of the virus so as not to overwhelm our local health-care providers and so as to conserve vital medical supplies and services.

That means we try to work from home… and we try to support our local businesses by ordering things from them by phone (or online) and picking up or having items delivered. It also means talking to our doctors by telephone or video chat instead of going to a clinic in person. I think you can see that all of this requires our telecommunications infrastructure to be ready to function in the face of extraordinary additional demand.

I'm happy to report that so far, both internet and telephone service in my building and neighborhood have been up to the task. We held the THG board meeting earlier this week purely by teleconference and that worked very well—the conference-call system we use seems to be holding up under the strain. I think this is all to the credit of the many dedicated workers both at our host company CenturyLink and, more broadly, at all of the telecommunications providers.

I know these workers take their jobs very seriously. For example, the central office technician who works in the building where the Seattle museum is housed is an extremely dedicated and hardworking person as well as an extremely nice one. Every one of my interactions with a CenturyLink employee reinforces my belief that these folks are stepping up to the task and will continue to keep our telephone and Internet service running smoothly for the duration.

As for THG itself, I am confident about our future. There will be a temporary interruption in our ability to deliver our mission through in-person interactions. But there is an opportunity for us to use our time at home and to use the technology whose history we celebrate to "up our game" online. We will see a dip in THG revenue because people can't visit our museums or archives at the moment. But I am optimistic that once the crisis has passed, we will be able to get back to delivering THG's mission more effectively than ever.

I want to thank the rest of the THG board for their confidence in me in asking me to take this role. I look forward to serving the organization in as many ways as I can in the future.

By the time this issue of *Connections News* is printed and mailed to you, the COVID-19 situation in the United States may have changed in any number of ways. But I remain optimistic. I urge everyone to stay safe, to follow all of the recommendations to protect your health and that of your neighbors and loved ones, and to remain optimistic yourselves.

All of my best.

Peter Amstein

TELECOMMUNICATIONS HISTORY GROUP

## Board of Directors

THG's Board provides voluntary service in the form of oversight and management of the organization. (Several of our Board members are also active volunteers at the Archives and the Seattle and Denver museums.) They are instrumental in the planning, development and fundraising that supports our efforts to preserve the history of the telecommunications industry.

Valued member and long-time President Jack Shea and Vice President John Darrow have retired from the Board. We will greatly miss their leadership. Lisa Hensley Ekert and Pam Laird have also left. We're sad to see them go but thank them for their service and wish them continued success.

**Officers**

President –**Peter Amstein**, Software Industry Executive (ret.)
Vice President - **Michael W. Nearing**, Senior Engineer, CenturyLink
Secretary - **Jody L. Georgeson**, U S West (ret.), THG Executive Director (ret.)
Treasurer - **John W. Kure**, Executive Director Public Policy (ret.) Qwest

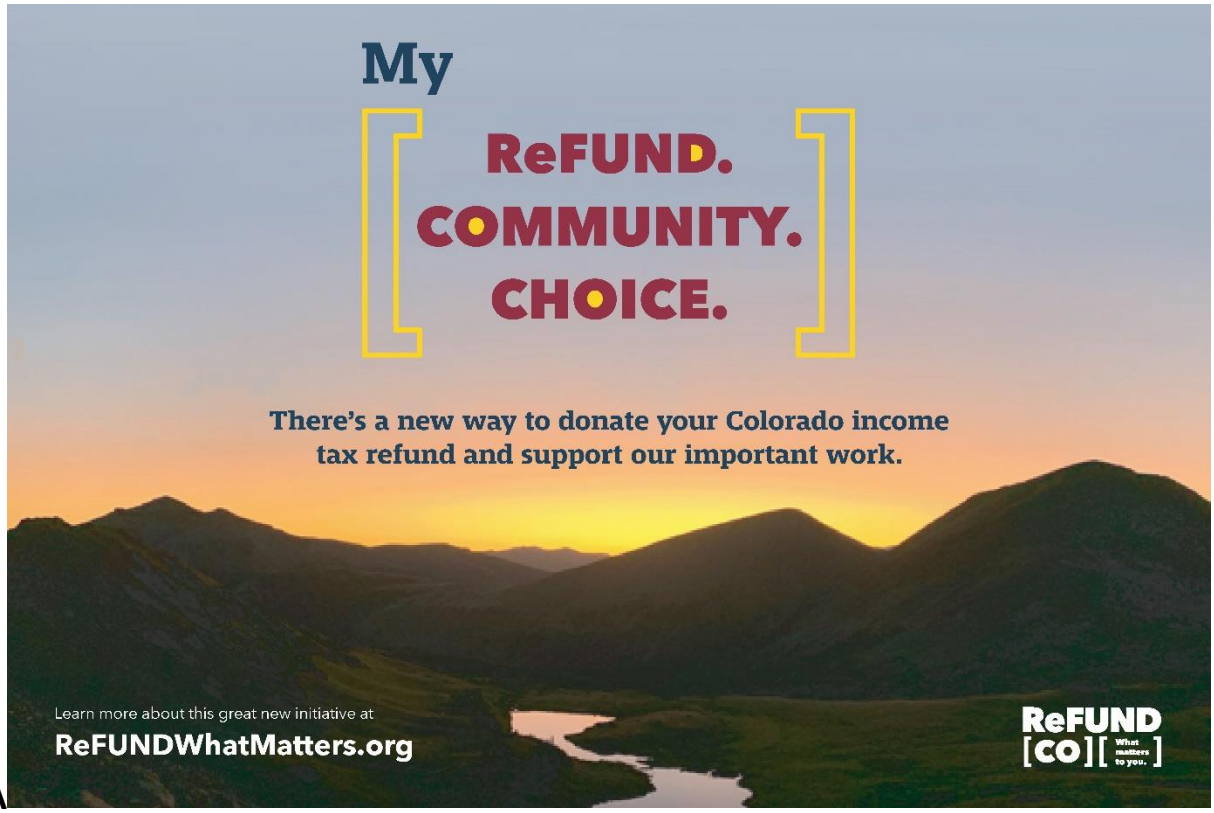
**Members**

**Roger Christensen**, EVP & Chief Administrative Officer (ret.) Media One
**Laurence W. DeMuth, Jr**., EVP General Counsel & Secretary (ret.) U S WEST
**David Dintenfass**, Full-Track Productions Owner/Operator
**John J. Herbolich**, Telecommunications Director Network (ret.) US West, Inc.
**Philip A. Linse**, CenturyLink
**Ed Mattson**, Medical Director (ret.)
**Scott McClellan**, VP Washington (ret.) - U S WEST/Qwest
**Mary Retka**, Director, Network Policy - CenturyLink

### In Memory of George A. Ek

December 15, 2019-January 23, 1930

George was a valuable volunteer at THG for many years. His breadth of interests and knowledge contributed greatly to our organization. After a long and notable career as an educator (with a focus on educating young people on the importance and need for conserving our Natural Resources) George served on many boards and volunteered for many programs, and remained active at his passions for trains, telephones, the environment and of course his beloved dogs. We miss you, George.




**A**

## As Tax Day looms, please remember to help us with your refund

Tax Day could be a big day for THG.

This year there's a new Colorado program that allows you to support our work when you're completing your state income tax return.

This new state initiative, promoted through the ReFUND CO awareness campaign, will give you an opportunity to directly support a local nonprofit like us that is doing important work in your community. If you get a state income tax refund, it puts you in control of deciding if you want to donate some or all of it and choosing exactly which Colorado-registered charity will directly benefit.

For our organization, this provides a new way to fund important work in the community. The new ReFUND CO campaign shows how you can choose where your donation goes.

Decide how much of your state income tax refund to donate (all or any portion of it).

Enter The Telecommunications History Group and our registration number 20083005673 in the Donate to a Colorado Nonprofit Fund line on your return or tax software – or just give this info to your tax preparer when you share your tax documents.

You can learn more details about the program at RefundWhatMatters.org.

When you choose to donate from your state income tax refund, your contribution will go directly to us.

This is one deadline you don't want to miss. Thank you in advance for sharing your tax refund with us so we can re-energize our important work.

# A Telegraph, Telephone, and "Citizen's Key"

By James Collier

*This article originally appeared in the Denver Police Museum Newsletter and is used with the author's permission.*

Police call boxes were part of Denver policing since the latter part of the eighteenth century. Without the benefit of radios or the ready availability of telephones, the call box served the early communications needs of foot beats, horse patrols, and the earliest motorized patrols. The call boxes in Denver were all manufactured by the Gamewell Company of Newton, MA and later New York City. Gamewell also supplied the fire alarm boxes utilized by the Denver Fire Department. Both the police call boxes and fire alarm boxes used the same telegraph system. In fact, the Denver Fire Department maintained the police call boxes. The early police call boxes utilized two technologies: the telegraph and telephone.

One of the call boxes in the Denver Police Museum's collection is the earliest model—one that utilized the telegraph, telephone, and a "Citizen's Key." In the early days of telephone communication, phones were rare and frequently unreliable, hence the need for a means for citizens to summon the police. This was accomplished by the Citizen's Key. Shopkeepers and prominent citizens were given a key that, when inserted into the outer door of the call box and turned, activated a telegraph signal to police headquarters alerting them that a citizen needed an officer at that particular box location. The key was locked in the box and could only be released by the responding officer when they opened the outer door.


These older boxes were equipped with a seven-position brass plate that, when lined up with the pointer and the lever pulled, would send an appropriate message to police headquarters. The messages could be a request for a wagon, to activate and answer the telephone, or to request an ambulance. Four additional positions were used during the shift to report that the officer was well and on their beat. This is what old timers meant when they would speak of "making a pull" or "pulling the box."


Another call box in the Museum's collection has a similar telegraph/telephone system, but instead of a Citizen's Key, it has a key slot in the front door for a "Wagon Call."

These call boxes served the police well and were a part of the urban scene for many years. While the telegraph units were removed with the advent of radios and more commonplace telephones, the boxes continued to soldier on as a communications device with police headquarters until sometime into the 1950s or perhaps the early 1960s. I understand that any remaining boxes were taken down and sold to a Pueblo scarp dealer sometime in the latter 1960s for $0.05 per pound. A complete and functional box with its complete telegraph unit is selling today for several thousand dollars.

I was fortunate to have located the last of the call boxes still tucked away and mounted on an old building in 1973. The folks at Fire Alarm Headquarters graciously retrieved it for me, and even supplied an original pedestal and mounting collar. These photos are of the restored and complete box that is in my home. The call box is stamped 1889 in
Roman numerals on the bottom of the outer box. I'm certain that it is the only complete unit in Colorado, and it has taken me over twenty years to locate the telegraph works, pointer, lever, and Citizen's Key lock to make it functional. My family has agreed that this entire unit will go to the Denver Police Museum as part of my estate wishes.

# Restoring THG's Historic Electronic Switching System

In addition to its key role in the development of telephony, the Bell System has had a tremendous impact on society and the world through its fundamental contributions to the field of computer science. The widely used C programming language and the UNIX operating system, to name just two well-known examples, are outgrowths of research and development work in computer systems done at Bell Laboratories.

Because this aspect of Bell System history appeals strongly to many of the current generation of technology workers who visit our museums, THG is happy to be able to show our visitors in Seattle an example of an early Western Electric computer-controlled telephone switch—a Number 3 Electronic Switching System (No. 3 ESS). This switch once served the community of Crosby, a small town located on the Kitsap Peninsula across the water from Seattle here in Washington State. The No. 3 ESS was a good choice for that location when it was installed there in 1980, but it would soon become obsolete.

Let's start with some background. While many of the basic concepts of central control for telephone switches go back as far as the 1920s and the Western Electric Panel switch, AT&T began working on computer-controlled systems in earnest in 1955 at the suggestion of W. Keister and W.A. Budlong of Bell Laboratories. By 1960 they had deployed the first prototype ESS in Morris, Illinois. The Morris system design was not carried forward into future machines, but Bell Labs learned a great deal from the effort.

By 1965, Western Electric was ready with a true production system, the No. 1 ESS which was first put into service in May of that year in Succasunna, New Jersey. While the first of the type was installed in a suburb, No. 1 and 1A ESS machines would eventually replace most of the large electromechanical urban telephone exchanges.

Western Electric introduced the No. 2 ESS switch in 1970 as a smaller and more cost-effective system for central offices with a maximum of 16,000 lines and a call volume of up to 19,000 calls per hour. It was intended for rapidly developing suburban areas.

The operating companies also needed to replace aging Step-by-Step systems in rural offices serving just a few thousand lines. This resulted in the 1976 introduction of the No. 3 ESS (also known simply as the 3ESS). The 3ESS used a new central processor, known as the 3A Central Control unit or 3ACC. This processor was also incorporated into several other systems, including later revisions of the No. 2 ESS and even as an add-on to the No. 5 Crossbar switch.

1976 also saw the introduction of the No. 4 ESS, designed specifically for long-distance offices. Eventually Lucent would produce the all-digital 5ESS, which was designed to replace installations of the original No. 1 ESS series. The No. 4 and 5 ESS systems are still in widespread use today. In fact, the 931 14th Street building, where THG's Denver museum is located, has several 5ESS systems; and over one hundred 4ESS machines still make up the backbone of AT&T's long-distance network.

But back to our 3ESS. It had many features that made it ideal for small-town locations like Crosby, including the ability to run fully unattended for long periods. It provided modern calling features aimed at residential subscribers (such as call forwarding and three-way calling) which were not available on the older systems that it would replace. It also included extensive maintenance programs, as well as remote monitoring and maintenance capabilities via a Switching Control Center (SCC).

Unlike THG's Panel switch, which was in use for over 50 years, our 3ESS system did not enjoy a particularly long service life. After 1984, divestiture meant that new demands were placed on all central office switches, including the ability to use a different long-distance carrier for each subscriber (known as equal access). Furthermore, given the rapid advance of integrated circuit technology in the 1970s and 1980s, it was more cost-effective to replace the 3ESS systems with newer machines than to perform the major upgrades necessary to enable them to keep functioning in the post-divestiture telephone network. So this particular 3ESS switch was removed from Crosby in 1994, and it was subsequently moved to the Connections Museum in Seattle.


The drive emulator that Colin Slater built, and a faulty tape cartridge.

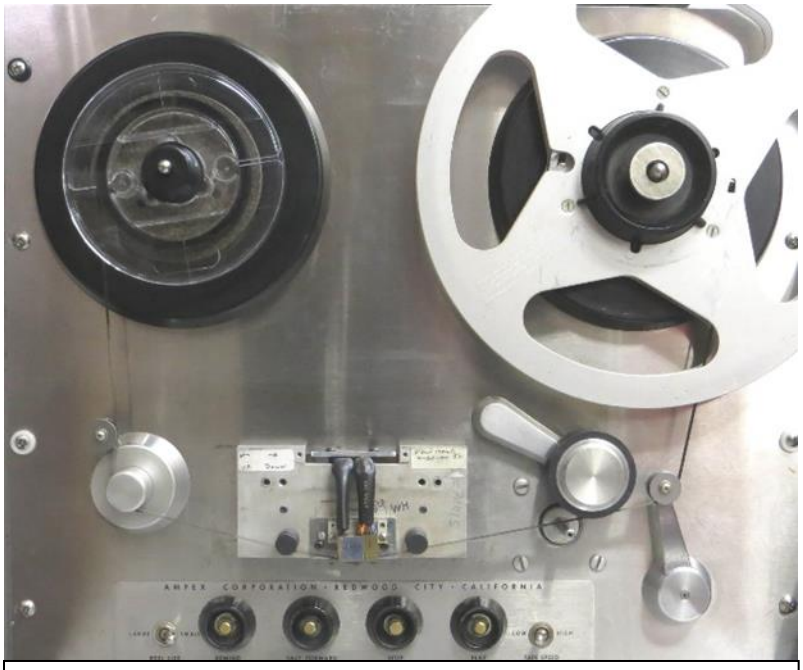
Once at the museum, it operated continuously for well over a decade. Originally it was maintained by the late Rich Barger, a long-time dedicated Seattle museum volunteer. The responsibility eventually passed into the hands of volunteer Astrid Smith. In 2009, the machine suffered a serious fault that caused it to halt. After multiple recovery attempts failed to get our 3ESS running again, the museum staff decided that it would be better to power it off than to leave it powered up in a nonworking state.

Powering-down the machine came at a price. Like a modern personal computer, the 3ACC processor needs to load software when it "boots up" after you turn it on. In the case of the 3ESS, this software is stored on a magnetic tape cartridge and not on a disk drive. But the old cartridges are prone to wear out and degrade over time. Back in 2002 when Rich Barger still maintained the machine the original data tapes were already becoming problematic. By 2009, there were no more working tape cartridges left and without a good one it was impossible to restart the machine.

Today, all the original tapes have further deteriorated to the point where even inserting one of them into the drive could destroy it. Some years ago, several volunteers tried to rebuild a few worn-out data cartridges (and even had a vendor make replacement pinch-rollers for both tape drives) but there were just too many problems associated with this approach. For one thing, the internal drive band (which moved the tape through the cartridge) was unique to these tapes and no replacements exist. Since there were other higher priority tasks for museum volunteers, the 3ESS project went to "back burner" status.

In 2019, a newly expanded team of volunteers decided it was time to "reboot" our 3ESS repair effort. While their work is not yet done, they have made a good amount of exciting progress. To start, museum volunteer Chuck Huffington took on an extensive examination of past restoration efforts and began doing comprehensive hardware maintenance, including identifying, tagging, and replacing faulty circuit cards in the machine's two processors. Fortunately, we had an adequate stock of spare cards for that task.

More recently, volunteer Colin Slater joined Astrid in spearheading the project. After considering many options, the restoration team decided the best approach would be to build a device to emulate the ESS's original tape drive. Colin designed and fabricated a printed-circuit board to serve as an interface between a modern processor and the original peripheral tape controllers of the 3ACC. When connected in place of a tape drive mechanism, the emulator can feed the 3ESS software program into the 3ACC processor at boot time. To build such an emulator one must know exactly how the original tape drive worked, but in this regard we had good luck. Western Electric had created extensive technical documentation back in 1976—and a complete set of this documentation was in THG's archives.




Tape removed from a cartridge and mounted on a AMPEX reel-to-reel machine with Dave Dintenfass's special head assembly.

Volunteers now actively work on the restoration every Sunday during our open hours. Many guests find it fascinating to watch them work and to ask questions about what they are doing. Of course, the restoration team also works at other times when the museum is closed to the public. Additionally, some of the work must be done elsewhere. For example, a huge challenge was recovering the software itself from the old degraded tapes so that it could be loaded onto the new tape-drive emulator.

The best option for data recovery was to remove the original 620 feet of quarter-inch wide magnetic tape from a faulty cartridge and load it onto a conventional open-reel audio recorder, allowing its content to be captured as a high-quality digital audio file. To that end, long-time volunteer Dave Dintenfass fabricated a custom head-mount assembly and a corresponding breakout box to connect a spare ESS cartridge-drive head

to four conventional XLR audio connectors. With this setup, Dave played the tape at 3.75 inches/second (a low speed) into a digital audio recorder using a 16-bit sample depth and 192 kHz sample rate. Museum volunteer Sarah Autumn helped with the data transfer process and file management and provided additional encouragement for what proved to be a much longer project than anyone anticipated. After a few weeks of effort, four tapes had been digitized and archived. Once that was done, the team could view and edit the file using modern audio waveform-editing software and digitally repair any problem areas on the original tape.

Capturing the data from the old magnetic tape as audio tracks was just the beginning. The audio files needed to be converted into useful digital bits that the 3ESS could understand. Volunteer Andrew Sentman wrote a data-recovery program to extract the bits from the audio. Matt Mullins contributed his math and signal processing skills to help Andrew improve the efficacy of the data recovery. Because the blocks of data on the original tapes had checksums, they did have a way to verify the integrity of the final result, and after many months of work the team is finally confident that it now has a complete and error free copy of the full software program for the 3ESS!

After all this work, the restoration team is not quite done. The processor is successfully loading and running software again but there are still a few more problems to be worked out. Still, we can see the light at the end of the tunnel, and we hope to be able to provide a 1980 style dial tone experience for museum visitors to try in the coming months.

We will provide an update on the team's progress in the next issue of the Connections News.


Colin Slater explains the 3ESSrestoration project to visitors at the museum.

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