FIRST PERSON

That Radio Network Sound

A Long-Time Engineer and Announcer Recalls Working With His Friends at Toll

by Fred Krock

Back in the days before satellites, radio network broadcasts had a certain characteristic sound.

Every rookie announcer's dream was to work for a network some day. Most despaired of ever developing that network sound in their voice. What they didn't realize was that, given the limitations of transmission, it's amazing that it sounded as good as it did.

The amount of degradation was a function of distance. On the West Coast, programs from Chicago sounded better than those originating in New York.

Even a relatively short transmission distance would impart noticeable network tures as well as sound. Later the television duties were split off to what was known as TOC for television operations center. Audio circuits were handled by what was renamed AOC, the A standing for audio. We still called it toll.

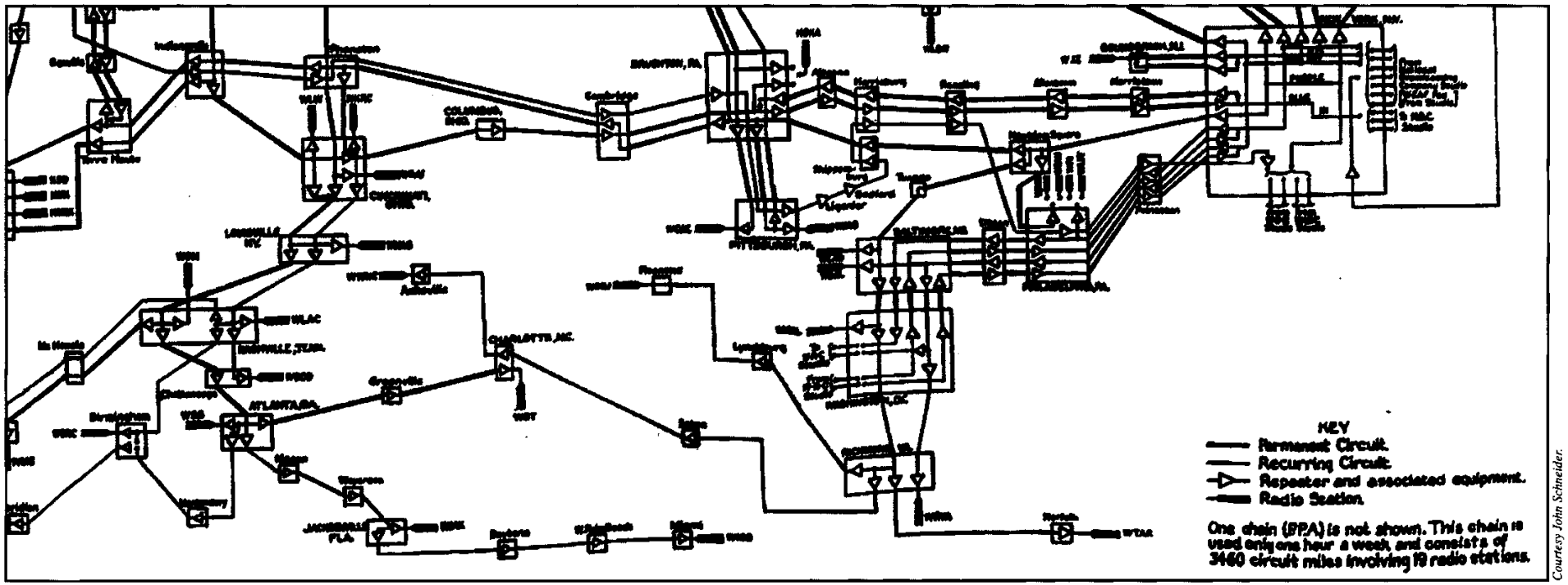
Most telephone company employees belong to the Communication Workers of America union. In San Francisco broadcast toll employees belonged to the International Brotherhood of Electrical Workers.

was to time-shift commercials in network newscasts, insert regional commercials in newscasts and to supply all service to the West Coast until 11 p.m. Pacific Time after the eastern network went goodnight at 9 p.m.

Please, not over dinner

Laxative spots always were shifted. Laxative spots at mealtime brought listener complaints. A spot fed at 9 p.m. Eastern Time, a prime time for a laxative account, arrived on the west coast at 6 p.m., dinnertime. Other accounts paid a premium for spots to run in drive time. They were delayed three hours.

Some spots were tape-delayed from their



Part of a graphic from the Bell System Technical Journal, January 1930, showing NBC's network connections. John Schneider, the radio history buff who provided this image, notes that 'NBC and AT&T had created a very elaborate hookup system just three years after the formation of the network' and that NBC's choices of locations for its network programming centers were based upon AT&T's program line connections. Only Chicago, New York and Washington feed the entire system; San Francisco could feed only West Coast stations, and Los Angeles could not originate programs of the line. AT&T's line repeaters were

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sound in their voice. What they didn't realize was that the network announcers didn't have that characteristic mellow sound in their voices, either. It was a product of the telephone company transmission, not the network announcer's throat.

Listeners sometimes were amazed when visiting Los Angeles or New York how different some of their favorite network personalities sounded when the program originated locally. Even today a quick listen to a recording from the golden age of radio reveals whether that recording was made where the show originated or whether it was recorded on the end of a network line.

That sound

Frequency response was not a major problem in those days of AM broadcasting. Radio network lines had frequency response up to 8 kHz. After World War II the networks cut back to 5 kHz lines to save money. Telephone company customers paid according to the bandwidth used.

Frequency response was essentially flat to 5 kHz. At 5,100 Hz it was 30-50 dB down.

A few stations in extremely small markets used 3.5 kHz circuits. Networks paid for delivering programs to most affiliates. If the market were too small to be worth the expense, the station had to pay for the circuit from the nearest network access point. The cheapest circuit was 3.5 kHz. In a few other cases, that was all the telephone company could provide into remote areas.

Considering all the things that were happening to the sound during network transsound. I was surprised to hear it on a network newscast I read in San Francisco rebroadcast from Chico, Calif., a distance of 183 miles by road. It was audible even on a car radio.

At one time the telephone company played a major role in radio broadcasting. (The "telephone company" meant the Bell System, "Ma Bell." AT&T and its wholly owned local telephone companies provided almost all telephone service in the United States. In a few scattered locations, General Telephone or a small independent local company provided service. In the earliest days of broadcasting AT&T even owned a few radio stations.)

The FCC would not license radio links for broadcast use unless the station could demonstrate that the telephone company could not provide service. It provided virtually all studio-to-transmitter circuits and most remote lines.

Only in larger cities did the telephone company provide a facility dedicated to broadcast circuits. In small markets, you were lucky if you could find a test board man who even knew where the broadcast circuits were located. Often the radio station engineer would have to show a circuit installer how to equalize the line.

The operative word is man. In those days I never heard a female voice while talking to any telephone company technicians.

Broadcasters referred to the telephone company broadcast circuit test board as "toll."

When television broadcasting began, the same telephone company crew handled pic-

Stations usually bought one full-time circuit from toll to the station for incoming remote broadcasts. Then a circuit would be bought from the remote site to toll. Circuits between telephone company central offices (COs) could be bought by the quarter-hour as needed. The crew at toll would patch the various circuits as scheduled, which saved stations a lot of money. The telephone company did not charge extra for this service at that time.

A lot of remote lines were routed via toll, even though a shorter path might have existed. This allowed quick access by trained personnel in case of trouble.

Circuits were bought either as transmit or receive. Since passive equalizers were used, if no amplifiers were in the circuit, audio could be fed in either direction. Equalization was not perfect when audio was fed in the wrong direction, but it was better than no audio at all in case of a line failure. After the telephone company switched to active equalizers, this emergency backup capability was lost.

In 1958 the station where I worked became the Mutual affiliate in San Francisco. In addition to the network audio circuit, the telephone company installed a ring-down telephone to toll. Pick up that telephone twenty-four hours a day and someone answered at toll.

Ring-down telephones were supplied free to all major-market network affiliates. About 10 years later the ring-down was disconnected after a telephone company budget cut.

In 1960 the station became the West Coast hub for the Mutual network. Our job

earlier network broadcast. Most were played from transcription discs supplied by advertising agencies.

Radio network circuits between New York and Chicago were called the "round robin." They made a big loop from New York to Chicago and then back to New York. Any station within the round robin could feed the net.

Switching from one point on the round robin to another was instantaneous. The loop must be opened at the station that begins feeding. Occasionally an operator would forget to open the loop when starting a feed. The result sounded like a tape echo as the sound went around and around the loop until the operator woke up.

From Chicago to the West Coast the network was one-way westbound. The telephone company could reverse the circuit during a silent period so a West Coast station could feed the nation. Networks allowed 30 seconds for the telephone company to reverse the circuit.

Reversing the network was a major operation. All amplifiers in the circuit had to have their input and output connections reversed.

Starting in 1936 the telephone company would supply, at extra cost, customer-controlled reversing equipment. Reversing the line between the West Coast and Chicago caused about three seconds of dead air. Literally thousands of relays would throw.

On-air reversals usually were done only during newscasts. The East Coast newscaster would say something like, "Now, with a

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pause for switching, we go to Los Angeles for a report from (name of newscaster)." Three seconds later the Los Angeles announcer would begin talking.

Mutual had discontinued customer control reversing between Chicago and the West Coast long before we became the West Coast hub. We did have customer reversing between Los Angeles and San Francisco. Some newscasts were fed to the West Coast from KHJ in Los Angeles.

The reverse

Network reversing control equipment at the station occupied two rack units. It had a small two-position rotary switch and red, white and green lights. The same type of lights and switch were used on telephone switchboards built by Western Electric.

The switch turned on a phantom voltage on the network line. This control voltage was repeated from each amplifier to the next all the way to the far end of the network line. If neither end was feeding control voltage, a white light was displayed on both ends. This indicated that the network was unlocked and could be switched to feed from either end. The network audio path did not change until the former receiving end began to send control voltage. If one end had control, the transmitting end displayed a green light while the receiving end displayed a red light.

The network could be reversed only when the white light was on. If the receiving end turned on the switch, nothing would happen while the red light was on.

A few seconds before a hot switch, the transmitting end would turn off the control voltage. Ideally the white light would come on at the receiving end at same instant the switching cue ended. Half of the switching time was required for the white light to come on at the receiving end.

Photo provided by John Schneider, courtesy of Rich Kolm, from the collection of Lee Kolm.

Master Control Room at NBC's Radio City in San Francisco, December, 1944. Standing: George Greaves, engineer-in-charge of NBC San Francisco. Seated: Lee Kolm, control room supervisor. The operator determined which studio program was fed to which broadcast phone line on the network. Fourteen circuits could be fed simultaneously. All programs fed to KPO, KGO and the two networks originated here. Audio patch panels could be used to substitute a failed studio amplifier in case of emergency. A telegraph sounder on the desk was used to communicate with the KPO transmitter in Belmont.

You didn't want to drop the control voltage too soon because a lightning strike or other disturbance along the line could cause a premature reversal. When the receiving end heard the cue and saw the white light, the operator would turn on the control switch and cue the announcer after waiting for the network to finish reversing.

We would experience line trouble on the incoming feed from the east between once and twice a week on average. Sometimes the network would operate for a few weeks with no problems and then be followed by a dozen outages in a single week.

Much of the circuit was underground cable. It was subject to backhoe fade. A backhoe has been described as the perfect tool to find a buried cable.

The telephone company maintained spare circuits for use in case of trouble on the regular network circuits. These spares also were available for occasional-use customers.

Service

Our friends at toll took pride in restoring service very rapidly in case of trouble.

Sometimes they had to reroute circuits half way across the country to make good service. Once after a major line failure somewhere in Nebraska, our network service was routed from Chicago to Dallas to

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How They Got That Sound

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What did Mother Bell do to make radio networks sound that way? Network sound was degraded in five major ways:

1. Harmonic and intermodulation distortion

[illegible]

The distortion was not [illegible]

[illegible] frequency response [illegible] from [illegible]

The [illegible] of a twisted pair, such as used by the telephone company, is a large number of extremely small-value inductors wired in series shunted by a large number of extremely small-value capacitors. The result is a low-pass filter. The telephone company would compensate for the high-frequency loss by connecting a passive equalizer consisting of series capacitance shunted by inductance. The result is relative phase shift. When a large number of these circuits are connected in series, group delay will reach a very high value.

You might also recognize these equivalent circuits as similar to those used in delay lines. As a result network radio signals traveled across country well below the speed of light. Attempts by the telephone company to use existing radio network circuits to transmit audio for early network television programs resulted in loss of lip-synch in as short a distance as between New York and Washington.

All that reactance in network circuits would cause a number of resonant frequencies in the circuit. A transient near the frequency of one of these resonances could excite the circuit into producing a damped wave at the resonant frequency. This was called ringing. The effect was audible on program material.

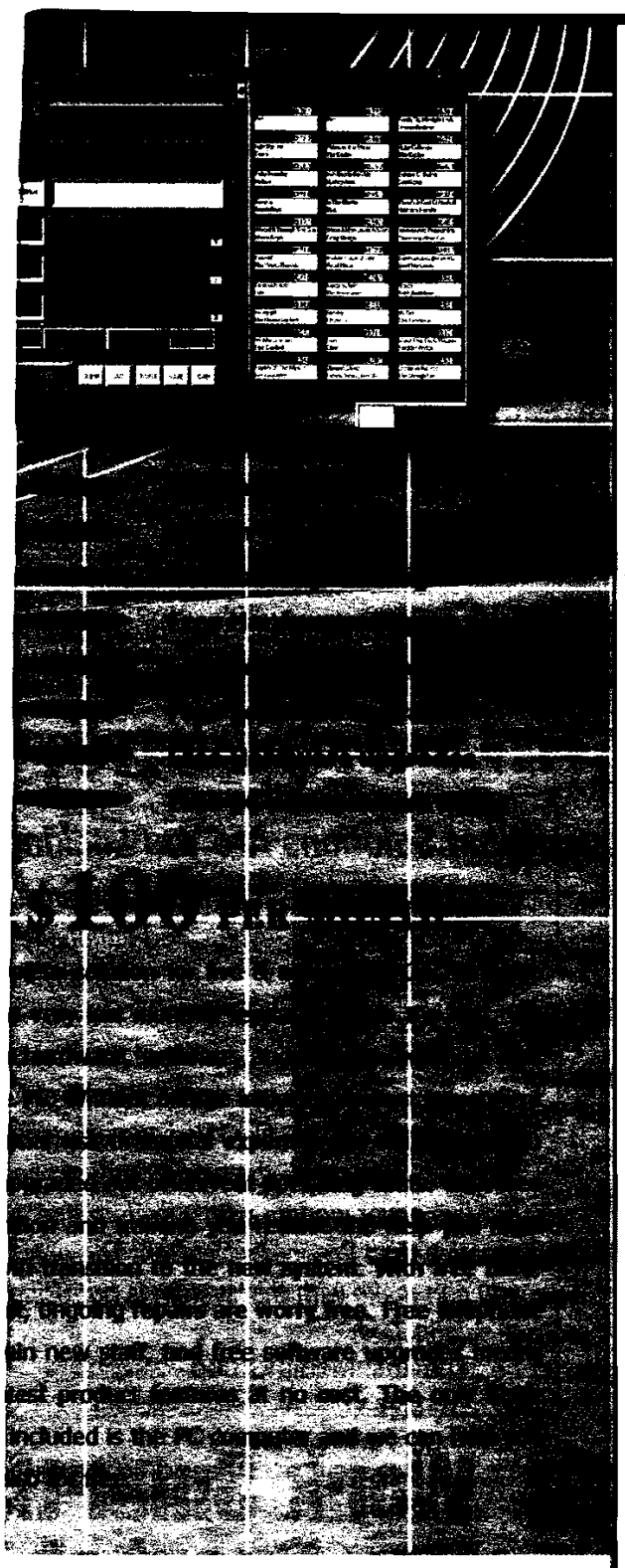
The telephone company frequently used companders (the word is a synthesis of "compressor" and "expander"). The signal dynamic range was compressed on the sending end and expanded at the far end. This increased the signal-to-noise ratio of the overall path. It also meant that the noise level went up and down as the signal level went up and down. The noise was not completely masked if the signal were primarily high frequency. A soprano voice or solo violin usually produced audible noise modulation. Even if the noise were masked, it caused the sound to become muddy.

The telephone company often used carrier circuits for long hauls. They allowed putting a number of different circuits on the same pair of wires. To allow the maximum number of circuits on a single pair, single sideband suppressed carrier signals were used. Carrier equipment was prone to all sorts of problems.

The most common problem with network radio feeds was what we called carrier whine. A continuous tone would appear between 30 and 40 dB below program level. Sometimes several of these tones would appear at the same time.

Even after the telephone company started using microwave transmission equipment, radio networks remained on the same old landlines they had been using for many years.

—Fred Krock



Skip Pizzi is contributing editor of Radio World.

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Los Angeles to San Francisco. From there it was routed east to Denver to serve the Mountain Time Zone stations.

If the line failure were west of Denver, San Francisco was responsible for restoring service. If the problem had happened east of Denver, it was given to the AT&T office in Chicago.

The first place San Francisco toll would call when the line failed was Denver. San Francisco was always happy to let someone else solve the problem. The ring-down telephone at the station would ring and the voice at the other end would say gleefully, "The problem's east of Denver."

This led to a lot of friendly teasing between the station and toll. If we had problems with one of our local remote lines, say from Oakland across the bay to San Francisco, the problem always kept getting described as east of Denver.

The telephone company employees kept a log of telephone calls involving trouble. At the end of the call they would ask, "How do you sign?" Your signature was your initials. Everyone used phonetics; I would reply "Fox King" for my initials, FK.

Imagination ran rampant. One telephone company employee with initials SJ would sign Stump Jumper. Calls between telephone company employees were logged in the same way. If any question ever arose about who said what and when, the log would tell.

Today we get our network programs from satellites. The sound is nearly identical with a local origination. Toll as we knew it is long gone.

Too bad that when Galaxy 4 failed several years ago, NPR stations couldn't pick up the ring-down telephone and let their friends at toll take care of the problem.

Fred Krock says he couldn't make up his mind whether he wanted to be an engineer or announcer, so he has major-market experience on both sides of the glass, mostly in San Francisco. His first professional job was at a predecessor to KKHI(AM) in 1953 while he was in college. He was chief engineer there for 15 years and at NPR affiliate KQED(FM) for 22 years; he retired in 2001 and still does occasional voice work.