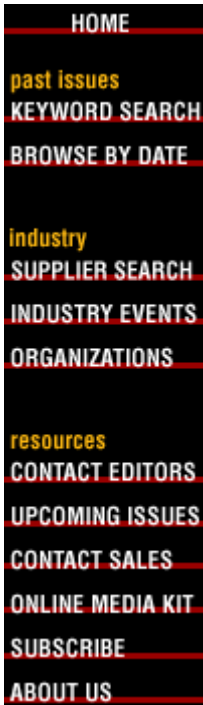




September 15,
1997



The river ran through it

Premises jacks and demarcation blocks filled with sewage, salt, solvents, rotting food, and cattle feed. Only one jack consistently produced dial tone.

[Rick Muscoplat](#)

When the 500-year flood hit Grand Forks, N.D., in early 1997, it was not just about river water invading a section of town. It was about an angry river that took on the entire city, suburbs and surrounding communities, refusing to be held in place by something as trivial as a wall of sandbags.

The river claimed victory over homes, businesses and city offices. But there's one thing the river didn't get: its chance to declare victory over the telecommunications network. Vital communications stayed up and running during the entire flood, enabling fire, rescue, public safety, and disaster officials to do the jobs they had to do.



After the floodwaters receded many phones had dial tone, while others didn't.

This is the story of how some very smart long-term planning, including the installation of gel-filled premises jacks and demarcation boxes, crystal-clear communications for thousands of homes and businesses.

Although the floodwaters were bad enough, far worse was what this river brought with it. The Red River floodwater arrived in Grand Forks before the spring rains had a chance to cleanse the landscape. When the water swept across roads, it soaked up excessive road salt from three years worth of brutal winter weather. Water swirled around farmers' vacant fields, absorbing herbicides, insecticides and animal manure. It swallowed bulging stores of fertilizer and feed. It ruptured sanitary sewer lines and popped oil and gasoline tanks from their cozy underground nests, its force breaking the cement slabs above them. Meanwhile, home refrigerators, without power, turned meat, chicken, and fish into award-winning science experiments. As the floodwaters reached stove height, the refrigerators floated like fishing bobbers, eventually rolling around and dumping their furry innards into the nightmare. There the river sat for two weeks, soaking into telephone jacks in the basement, first floor and second floors of homes and businesses.



U S West struggled day and night to keep its central office switch dry

and operable. Loren Fritz, U S West director of service assurance, tells the story: "The basement of our building in Grand Forks was filling with water. Denny Braaten, U S West central office manager in Grand Forks, and his staff performed miracles. They welded shut the door that goes to the basement and then inserted two 4-inch diameter hoses through them and down into the water. The bilge pumps couldn't keep up. So they called the U.S. Air Force base just outside of Grand Forks and borrowed its 6-inch diameter pump. All three pumps ran 24 hours a day throughout the entire event. The switch remained dry.

While the waters may have receded, more problems were about to appear. It was as though the whole town had been "slimed," ready for the filming of the next "Ghostbusters" sequel. Unfortunately, this wasn't Hollywood make-believe. Officials worried about the effects of flood waste on public health. And it threatened to stop telecommunications in the entire region.

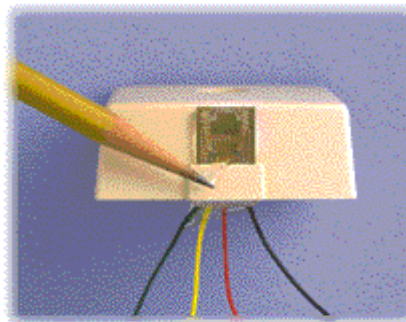
Years earlier, U S West had instituted a "sealed-plant" policy, requiring watertight connections at every point of entry. That was fine for overhead and underground cabling, but what about premises connections such as wall jacks and demarcation boxes? U S West had no control over the connections customers had made past the demarcation point. Unfortunately, many customers had purchased the least expensive jack they

could find--without even checking to see if the jack met FCC Part 68--an action that would prove to be a costly mistake.

U S West, like most regional Bell operating companies (RBOCs), offers line-maintenance plans to its residential customers. Having a vested interest in keeping service calls to a minimum, U S West had been field testing a gel-filled jack for several years. The decision to install a gel-filled jack was left to the discretion of the individual installer.

FOR WHOM THE GEL TOLLS

The RJ-11 modular jack has an interesting history. First field-tested in 1968 in Chicago by the then-Bell Laboratories, the modular jack proliferated



Closeup of a gel-filled jack. Notice the gel completely fills the plug cavity to seal the gold-to-gold connection.

throughout the Bell System. However, in some areas, the jacks were costing a fortune to maintain. In those areas, the ratio of new jacks purchased to new lines installed was as high as 10:1. The problem? Corrosion, which was in some cases, causing failure in as little as one week. Bellcore re-examined the specifications for the gold spring-wire inside the jacks and eventually modified them slightly.

But it was time to think about factors other

than the gold-plating. After all, gold is inert--it can't corrode. But the base spring-wire material is not gold; it is a combination of nickel, brass or bronze which is gold-plated and then crimp-connected to a copper lead wire. When dissimilar metals come into contact with moisture, galvanic action and corrosion can occur. The corrosion causes the gold plating to rupture, which accelerates the corrosion process.

Bellcore scientists searched for a way to seal the jack from moisture. At the same time, BellSouth was approaching independent vendors to make a sealing agent that would remain in the jack. The sealant also had to be non-toxic, in case a customer removed the jack. Bellcore and BellSouth searched for a jack manufacturer to join the effort. The two companies found the right formula for the sealing gel and a manufacturer to build the jacks; Bellcore then wrote the TR-1334 specification.

MEANWHILE, BACK AT THE FORK

When it was safe to enter Grand Forks, Fritz, along with Jerry Begley, director of provisioning and network and technology services and 28 other managers from U S West's regional communications center in Plymouth, headed north. Fritz and Begley had seen their share of natural disasters--fires, tornadoes and floods--so they were expecting the worst. They had been warned about the conditions and came equipped with boots, orange vests, gloves

and plenty of disinfectant soap. One of the first team members to arrive at the scene stepped out of her vehicle and immediately lost her footing on the slimy pavement. The others were warned. This was the worst Fritz and Begley had ever seen. Everything that was once white, was now gray. The entire town needed a high-pressure (clear water) washdown.

U S West dubbed its team, "Feet on the Street." The team's immediate goal was to establish dial tone, house by house. One team member divided the city into quadrants, off they went, knocking on doors, asking the residents if they had telephone service.

"What we discovered was simply amazing," says Fritz. "In every case where the installer had used a gel-filled jack, we had crisp, clean dial tone." There were many instances where U S West personnel found dial tone at gel-filled demarcation jacks that were still filled with sewage. Some customers were tossing out their non-working phones and plugging new phones into old gel-filled jacks and getting instant dial tone.

The results from non-filled jacks were pretty dismal in comparison. "Either we had no dial tone, or static so bad you couldn't hold a conversation," says Begley.

Communications in the days after the flood was critical. Before the electric utility would restore power to a home, the resident had to have the home inspected by

a licensed electrician. How do you contact an electrician when your phone system has been underwater? It was no problem for those customers whose homes were wired with the gel-filled jacks. In fact, Fritz and Begley encountered line-maintenance contract customers who told them, "I don't need you. My phone's working fine. It's the electrician I can't get a hold of. Can you help me with that?" Those were the customers who had been wired with gel-filled jacks. Obviously, they were oblivious to that fact and had just taken their phone service for granted--the way it's supposed to be.

In a shopping center on the edge of town, U S West had recently upgraded all the businesses to sealed-plant status, including the installation of gel-filled jacks in every location. In every case, those businesses had static-free telecommunications. They were able to answer the phones, let customers know they were open and had inventory, and were ready for business.

As the days went on and homes started to dry out, the problems worsened. "Corrosion," says Begley. "Salt, fertilizer, cattle feed, sewage--it went to work on those connections, and if we had originally wired the home with non-filled jacks, we just had to toss them."

The gel-filled jacks won the duel with the Red River by doing what they were designed to do--seal the modular plug-spring finger-copper wire to spring finger connection.

NOW WHAT?

What does this mean for service providers? You don't need to be located in a floodplain to be concerned about corrosion in modular jacks. RBOCs, interconnects, cabling contractors, network designers and supervisors alike need to be concerned about corrosion. Bellcore's technical support staff member Ken Moyers helps us understand the physics behind modular jack corrosion.

"If I take two little gold wires, place them .018 to .20 inches apart, put them into a slightly conductive solution, and put 50 volts across them, I can plate gold from one side to the other. The driving force is the 50 volts. So, you can't ever forget that you've always got 48 volts DC at that modular jack, where tip and ring are separated by only .018 to .020 inches. That movement of gold leaves the spring wire wide open for corrosion," he explains.

But electrolytic solution in an office or home environment? Absolutely; most jacks are mounted near the floor, resulting in a temperature difference that invites condensation.

"There is a tendency for moisture to form hydroxyl ions and acid when you have a gap between two electrodes," says Moyers. Think about the electrolytic and corrosive effects of the chemicals found in household cleaners, carpet shampoos, commercial cleaners for office surfaces, and off-gassing from plastics. They all act

as electrolytes, he adds.

Attaining sealed-plant status is important today with homes and businesses demanding higher data-transfer speeds and highly reliable voice communications. To achieve that level of reliability, the connection between premises wiring and the jack itself should also be of concern. Gel-filled jacks equipped with encapsulant-filled IDC connectors rather than screw terminals--keep moisture away from all connections and prevent it from wicking down the insulation and into the jack. Ordinary station cable can wick moisture at rates of up to 1-foot per day.

Wicking will be especially important to watch in the coming months and years as Grand Forks dries out. U S West anticipates many more service calls from those installations that are wired with non-gel-filled jacks. Here, extra cost of the gel-filled jack starts to turn into long-term savings. A gel-filled jack is a fraction of the price of a truck roll. Customers who wired their own jacks will have to toss the flood-damaged jack. Worse yet, they may experience continuing episodes of static if they contaminate the new jack with the old modular plug, or do not use encapsulant-filled IDC connectors.

The issue of retail store jacks not meeting FCC Part 68 standards and the Bellcore TR-1334 are recurring. Installers who are unaware of the critical need to seal premises wiring and the modular connection from future corrosion will

wonder why they are getting continued callbacks from the same address.

U S West purchased gel-filled jacks from Suttle Apparatus, a division of CSI Communications Systems Inc. (Hector, Minn). The Corro-Shield jack contains an anti-corrosive, memory-retaining gel called GelGuard, which is manufactured by Raychem (Menlo Park, Calif.). As the modular plug is inserted into the jack, the gel deforms and then reforms around the plug to seal. When the plug is removed, the gel actually peels off the plug and snaps into its original shape. The gel stays in the jack, not on the plug.

Although Suttle has performed rigorous accelerated lab tests on the Corro-Shield gel-filled jack, little did the company know that Grand Forks would be the field test to beat all field tests. No lab testing could have predicted the 100% performance rate they discovered after the Grand Forks floodwaters receded.

Roger Amundson, marketing manager for Suttle Apparatus, says, "Obviously, the Grand Forks flood was a worst-case scenario. The river water was filled with corrosive contaminants, and our gel-filled jacks stood the test and kept them out--even after 15 days under water. These were conditions we could never have duplicated in our laboratory."

Initial estimates show that hundreds of homes and businesses were equipped with the gel-filled jacks. The river had run

through them, and when it left, they still delivered crisp, clean dial tone.

Rick Muscoplat is a freelance telecommunications writer based in Minnesota.

[Back](#)

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