**Transcript: Nebraska**

♪ [music] ♪ - [Tom] It's just when you walk off campus is where our challenges lie. And that's the whole nature of the homework gap over and over again throughout our state and other rural states, is how do you bridge that gap and how do you find solutions that are technically feasible and sustainable to get straight to the home.

- [Christopher] Welcome to the "Sustainable Wireless Strategies for Keeping Students Connected and Learning" podcast series. This series explores off-campus wireless solutions that school districts are deploying as a sustainable solution to provide home connectivity to students and educators. The podcasts are brought to you by the U.S. Department of Education's Office of Educational Technology, and accompany the recently released wireless network brief that is now available at tech.ed.gov/wireless-brief. I'm Christopher Mitchell with the Institute for Local Self-Reliance. I'll be hosting these with my co-host, Lisa Palacios. Welcome back, Lisa.

- [Lisa] Hi, thanks for having me.

- [Christopher] Thanks for being the co-host. We also have Tom Rolfes, the education IT manager for the Nebraska state office of the CIO. Welcome to the show.

- [Tom] Thanks for inviting me.

- [Christopher] And we also have Michael Oltrogge, the president of Nebraska Indian Community College. Welcome to the show.

- [Michael] Wonderful. Thanks for having me on.

- [Christopher] We're going to be talking about the northwest Nebraska tribal education broadband service. This podcast may contain the opinions, views, and recommendations of non-federal participants. The U.S. Department of Education does not control or guarantee the accuracy, relevance, timeliness, or completeness of any outside information included in this podcast, and the opinions expressed do not necessarily reflect the positions or policies of the U.S. Department of Education. So with that, let me start with you, Mike, and ask you to tell me a little bit about this part of Nebraska. I understand it's not as flat as perhaps some people have led us to believe.

- [Michael] No, it's definitely not as flat. Northeast Nebraska has a bunch of rolling hills, almost like the Loess Hills bluffs. So it's fairly hilly in most spots. Some spots, yeah, when you start getting a little further west, you know, out by Santee, that gets a little more dry. It's almost like a transition to the sand hills when you start getting that far out.

- [Christopher] What do people do around there? And tell me [inaudible], you're partially or entirely Indian country? What's the situation out there?

- [Michael] Well, actually, there are three different reservations, land-based reservations, in northeast Nebraska. The Omaha and the Winnebago are on the eastern side of the state, and then the Santee location is about 120 miles due west and a little north. And then otherwise, it's just open ground, you know, lots of agriculture, lots of rural development, lots of just small-town living type of things.

- [Christopher] Tom, the Nebraska Indian Community College is, I think, one of five different educational entities that use the network we're about to talk about. Tell us a little bit more about how this all fits together.

- [Tom] Very good. We actually have both the tribal community colleges in Nebraska part of Network Nebraska, which is our statewide network. And back in March of 2020, Michael along with five school districts, public school districts on tribal ground, envisioned this project that we'll be discussing, the ability to self-deploy and bring wireless internet to student homes.

[Tom] I work on a statewide basis, so the homework gap for the entire student population in Nebraska is of interest and concern to our agency and Nebraska Department of Ed as well, and so we were excited by this envisioning of this project in the northeast. We credit Michael with helping make that happen.

- [Lisa] So, Tom, tell us exactly what it is that you're doing. Tell us about how you started and built this network.

- [Tom] In 2018, we had several agencies in the state coming to grips with the homework gap. So this is all pre-pandemic planning. Our agency, Nebraska Department of Ed, and Nebraska Educational Television submitted joint comments to the FCC as they were beginning to reexamine the 2.5 gigahertz or what they call the EBS, educational broadband spectrum, area of the electromagnetic spectrum, which had been in use by education entities since the mid-'60s.

[Tom] We had envisioned or perceived that this spectrum had been fallow, meaning not fully utilized, and it was technically feasible to take the entire spectrum statewide and be able to serve every single student in every home that had not been previously served.

[Tom] As you can imagine, in Nebraska, we have very large expanses of rural, very low population density, and our telecommunications providers obviously will build areas where there's profit. And in some of our areas of the state, it's such high sparsity or low population density, it's just very difficult to build out with the capital that they have in order to serve.

[Tom] So that's where projects like the EBS spectrum and self-deployment can help fill the gap, at least on an interim basis, and that's the project we'll be talking about today. So the northeast Nebraska environment that Michael described is not alone, but they differentiate themselves by actually acting on the high need of their rural area in taking responsibility. So we're very excited by that project.

- [Michael] Well, it was January 2020 when the FCC announced that they were going to do this 2.5 gigahertz spectrum for tribes, and I knew at that point that I wanted to do something. However, it flew to the top of the list when COVID came out and when the Fed started pushing some funding out to help with COVID.

- [Christopher] So, Mike, we want to set a little bit of context because a lot of places, a lot of times, schools already had this EBS spectrum, but in your case, it sounds like you got it because the FCC was actually, I think, in a very bold and really exciting, I'm trying to think of the right words, just exciting proposition made it available on indigenous lands to tribes, you know, first so that you didn't have to compete for it and you would just be able to take advantage of it. And so you were able to get there at the front of the line and just really jump into it. So that's a little bit different from some of the other folks we've talked to.

- [Michael] Yeah. And that was very, very helpful. Although, right now, we've had the Santee FCC license for almost a year now, and we're still waiting on getting the Omaha reservation FCC license. So we've been operating on STAs since. You know, and part of the Omaha reason is because we have an addendum, because we wanted to try to include the rest of the school district or one of our schools that was operating outside of the reservation, you know, just to try to help them. And hopefully, we'll still get that addendum included in our FCC application for the Omaha reservation.

- [Tom] Sure. So… - And STA, special temporary authorization.

- [Christopher] Thank you. So let's go back then. So it's where the pandemic is just starting and you have the opportunity with these licenses and some federal dollars.

- [Michael] Yeah. And then for the most part, I knew that none of my students…well, very, very few of my students actually have internet connections at home and actually have computers at home and things like that. My institution has about 250 students separate, you know, spread out across the Santee reservation, the Omaha reservation, and generally, the city of South Sioux. So the city of South Sioux students, they have more access to internet services.

[Michael] In March of 2020, for the most part, more than half of the Omaha reservation had one service provider. That single service provider, for the most part, told us to kind of kick rocks a little bit when we were, like, you know, "We need to have our students access to the internet." And they told us they might be able to do something in six to eight weeks.

[Michael] You know, and that really wasn't really acceptable, I mean, just because we were in the...yeah, we were starting to go into a pandemic, NICC was transitioning all of our coursework to online, remote learning, you know, just most of our coursework into the just remote meetings.

[Michael] For the most part, almost right away, I was able to reach out, and I was able to get in contact with the high schools and then Tom, you know, so that we could just start having some meetings because I knew if my students were having these issues and everybody was, you know, going to be forced to this online living environment, then I know my other students, my school district students, the K-12 kids, they were on the same boat as my adult learners.

[Michael] Yeah. So then we just kind of started pulling this together, NICC was able to get some CARES funding for the K-12 schools, so NICC helped to pay for the base stations. So we have a base station in, well, basically in Bancroft-Rosalie, we have one in Macy, Nebraska, we have one in Pender, we have one in Walthill, and then we also have one in Santee.

[Michael] With the partnerships with the K-12 schools, we were able to make this thing a little more sustainable for the long term as well because the K-12 schools were able to take advantage of the E-Rate program, so they were able to get internet access at a much cheaper rate. You know, and that's not saying that Network Nebraska hasn't been trying to help us with that either because, I mean, the partnership with Network Nebraska has been huge, that lead to the infrastructure to be able to do some of these things.

[Michael] It's still not a seamless process, or it's still not a seamless system. For example, this week, we're still working on getting some towers set up. One is Santee, and the one in Macy. After that, we'll work on getting taller cell towers set up in Walthill, because basically, what we've done is we've installed a lot of this base station equipment. We've tried to put at the highest points that are in close proximity to the K-12 schools.

[Michael] And then, like Pender, that worked out really well because we were able to shoot off the water tower. In Santee, the tallest place we could find was to shoot off of the college's radio tower, and that didn't work out so well. And Macy, we tried shooting off of an anemometer tower that we had, and that's why we've been replacing that one as well.

And I know Walthill, they just need some bigger towers because of the rolling hills and the topography makes getting signals to everybody a little more difficult.

- [Christopher] So you are using a few towers then and the 2.5 gigahertz to connect people in their homes, students in their homes. And when you're saying you're building new towers, does that mean that those students were kind of left unconnected in that area, or did you have to rig something temporary and now, you'll be able to go back and do something better? How did that come together?

- [Michael] For the most part, some of those students…we weren't able to rig anything temporary together, but we've been able to...at least for the college students, we've been able to find other internet service providers for them so then that way, we can make sure that those students still have internet access. At the high schools is that we're working a little bit more on now, especially with Walthill, to make sure that we're able to get to all of their students.

[Michael] Otherwise, the students can use the MiFi devices, and if you were able to get within, for the most part, a mile of one of the transmission locations, you can use the MiFi device just like you would a normal MiFi device, and you're able to log in that way.

- [Lisa] So it sounds like this project is really unique compared to the other projects that we're covering on this podcast series in that we're including college students and their families, which is a fantastic thing because most of this has been focused on K-12. So hearing how you worked with kind of K-12 and using your tribal funds also to construct this is actually very fascinating. So, Tom, how did you fold in these college…

- [Christopher] Yeah, Tom, why do you get any credit for this anyway?

- [Tom] Like I said, I'm only a catalyst, and I've got a chemistry background, so you help speed up the reaction, but you don't take a material part in the reaction. It's all Michael and the five superintendents and all the technology coordinator staff and other staff that helped.

[Tom] I think you've drawn one distinction with this project among the others. You know, the technology is not unique, obviously, but I think what is unique, Michael was able to pull together these five other school districts and almost a sixth one that kind of withdrew early on.

[Tom] And so you're really talking about different political subdivisions pooling their money and collaborating and using existing staff time because there's never enough money to hire all the installation, all the support that you need. And I think that was also amazing that they made the project successful doing it within existing human resources along with the additional federal dollars.

[Tom] So multi-district, extreme rural area, challenging population and topography, and then stood up the project, made the technology happen during supply chain interruptions. They were able to get gear shipped here from, in this case, China ahead of a number of other batches from across the U.S. because there is high demand, not only on device but all radio technology at the time.

[Tom] So, you know, we would love for this type of project to be replicated in other high-need areas of the state. Unfortunately, EBS spectrum is not available but CBRS is. So yes, you can go up to 3.5 gigahertz but then we start having range issues because we need propagation probably in the 5 to 15-mile range.

[Tom] And this type of technology, unless you have multiple towers, really can't blanket the coverage area. So we are still looking, you know, on a statewide basis, we're not only…not one single solution is going to do everything we need to do.

- [Christopher] I'd like to ask a little bit of a technical question related to that. When we were speaking with Imperial County, Luis Wong there, he was talking about how with CBRS, you only get that power level of, like, half a watt, and he is on 5 channels and has 100 megahertz of spectrum.

[Christopher] I don't know how many channels, how much capacity you have in this project, but I am curious about that. Like, you said about a mile or two from the transmitter, that seems pretty decent for some of this stuff.

- [Michael] Like with our systems right now, you know, it's up to a mile or so away from the tower, you have to use a MiFi device. When you start getting, you know, out in the further ranges, like the, you know, two to five miles, you use a different set of antennas, and then five to seven miles is a different set of antennas.

- [Lisa] If you would like to go and view the network map of this, that's available at tech.ed.gov/wireless-brief, and you can just go down to the Network Nebraska example and take a look at their map so that you can get a sense of what we're talking about here in the visual.

- [Tom] Yeah. It's Model 2 in the brief. So talking with some of the technical support staff from the school districts, the download speed was almost better than they had expected. So students might be experiencing 20, maybe up to 35 megabits, it was the upload speed that caused challenges, which is really limited by whether they had a MiFi device or a low-band or mid-band antenna.

[Tom] And so I think, you know, consistently across all projects of this type, it's the return speed and power of those devices and how the antennas are mounted and tuned that really may limit a student's experience. And as we all know, during the entire pandemic, a lot of collaborative video conferencing going on, and that is not a 25 over 1 experience, you really need 5 Meg by 5.

[Tom] And so the upload speed is really critical unless you're doing, you know, textual student information system basic internet browsing as part of your education experience. As they had envisioned, multiple towers, multiple political subdivisions, a single network ID across the entire environment, I thought that was phenomenal.

[Tom] And the other neighboring tribe, Michael may be able to elaborate with the Winnebago that's bringing up their own system, and originally, it was envisioned that that could also join this network, but it may emerge independently. We'll have to see how that goes.

- [Christopher] And then how do you get out of northeast Nebraska because I've done a little bit of work with some economic development associations and I know that there are wide regions of Nebraska where it is very difficult to connect to the rest of the internet for a lack of that middle mile?

- [Tom] As part of the university grant, and Michael may remember, it was called NEURON, from the National Science Foundation, they actually helped pay for the connectivity and fiber to both of our Little Priest Tribal College and Nebraska Indian Community College.

[Tom] So early on, both colleges were members of Network Nebraska and also were fiber interconnected with our network. So completely scalable, and on the head end, as the model brief will show, we have 115 gigabits for the entire state, serving 450,000 end users. So we're not limited in terms of internet or scalability to the campus or to any of the school districts, it's just when you walk off campus is where our challenges lie.

[Tom] And that's the whole nature of the homework gap over and over again throughout our state and other rural states, is how do you bridge that gap, and how do you find solutions that are technically feasible and sustainable to get straight to the home, and that still remains to be seen. We're not done with that problem or challenge.

[Tom] We have extraordinary infrastructure in the state, every college and every school district fiber connected, and we're only lacking about fewer than a dozen school buildings out of 1000 without fiber. So we're well positioned there, it's just where do we and how do we take the broadband beyond the school if need be.

- [Lisa] So Tom, I know that this is in the brief, and you've actually started down this path of answering the question, but how did you afford all this? I mean, it sounds like you've got NSF grants, you know, you've taken CARES money. How are you affording putting this network together and then maintaining it?

- [Tom] The statewide network, I can speak to, and then Michael can talk about the project between districts. Network Nebraska by statute is a fully voluntary enterprise. So it's completely self-funded. We have no state dollars involved whatsoever.

[Tom] And all we do is manage the amount of E-Rate eligibility that applies to the K-12 portion of the internet as well as each of their circuits. So we have 293 total entities involved in the statewide network, K-20. So we only have 1 school district out of 244 who has withdrawn.

[Tom] So we're at 99.6% participation at K-12, and then 100% participation in public higher ed as well as our two sovereign colleges. And that's the way it's been for the last six years or so.

- [Lisa] That's astounding.

- [Christopher] Well, and then you have this wireless investment that seems…honestly, I don't know how you've built so much EBS for $275,000, although I'll note that you've mentioned that you will use Baicells, and they seem to be a favorite of folks that are trying to build, you know, a quick network that's going to work well but will not break the bank.

- [Michael] The college's spend right now is right about 600,000, you know, and that includes all of our user equipment, with all the base stations, the towers, all of it. And the piece I can't remember for sure is if that counts in any other high school end user equipment because for the most part, usually, the high schools have their own end user equipment to give out their MiFi devices, to give out their antennas, and things like that.

[Michael] So that's where some of that is. Most of the funding, well, almost all of the funding for that came from one of the COVID pots, most likely the first pot, you know, the first pot or the second pot. There might be another second pot of money at this point, the CRRSSA maybe. Anyway, that really doesn't matter.

[Michael] If you just say COVID money, most people know. Yeah. So then, we're also trying to get a full time dedicated tribal...for the most part, like, a tribal broadband person just to be able to take care of this because we know in two years when the COVID money expires, you know, we're going to have to figure out some methods to fund some other things in different ways, you know, and that tribal broadband wireless person is one of those positions that will need to be funded in a different way if we're able to finally get somebody hired into that position.

[Michael] Because, you know, and I certainly agree with Tom, I can't take much of any credit for a lot of this, it's a lot of us, the IT people at the high schools, at the college, because I don't necessarily know enough about it to at times even speak intelligently about it. And then, also, we've also had some conversations and discussions with the K-12 supers about, you know, possibly splitting that broadband position up, being able to possibly split some other expenses and things up in the future, you know, if we need to.

[Michael] But as long as the college has, you know, some COVID funds that can be used towards this, I will keep using whatever COVID funding I can to make sure that we have a system set up, you know, during a pandemic so when we come out of it, which, you know, we slowly are, but I want to make sure that the college in northeast Nebraska is a little bit stronger than we were when we went into it.

- [Christopher] Usually when something is this successful, there's lots of people that want to take credit for it, but you all are like a bunch of teenagers after the parents get home after the weekend and, like, "Who threw the party?" "Me, I didn't do it."

- [Tom] Yeah. The nickname for Nebraska is the "no, show me" state.

- [Lisa] One of the things that we keep hearing from these other projects is how the success of this really comes in the fact that everyone involved in this has focused on the student and focused on really the instructional part of getting the broadband out.

[Lisa] It isn't about the broadband, it isn't about, you know, we're going to build this great network, and obviously, you guys aren't going to be the ones bragging about it, but it seems that the big successes come when you've got leadership that is really strong in terms of really focusing on student and even families being able to connect to the internet for their education. Can you talk about the superintendents of these districts and whether or not their leadership helped push this forward?

- [Michael] You know, I know there's been a couple of superintendents who've been very strong about helping and pushing. Bancroft-Rosalie's Jon Cerny, Walthill, Kirk Ahrends, and then Stacie Hardy, to an extent as well, at Omaha Nation, have been fairly strong in the project, just making sure that they push, but Jon Cerny is probably one of the biggest pushers, just one of the biggest people that just trying to push to make sure that we get things done.

[Michael] One of Jon's big issues at the very beginning, and, you know, everybody agreed, is that we had to get this thing set up before August 2020, you know, because that's when school starts. So then we did everything that we could to make sure that we were getting things set up as close to August 2020 as we could. And for the most part, I believe we were fairly successful.

[Michael] I know we missed our…we had a target date, and I know we missed that by, like, two weeks, but in the middle of pandemic, getting everything set up, you know, having my IT guys curl up on water towers and install equipment, I think we did well making sure that we got everything set up, you know. And I mean, just some of the other things that I'd like to see out of the project is I wish there was some method where we could track some of the data better, like with the Baicells equipment and the MiFi units.

[Michael] You know, we don't have a lot of good, like, sent, received data, that kind of information. You know, I know that at the college, we have 90 operational antenna sites, you know. So I mean, we have 90 just families or students using antenna sites for internet. We've also checked out over 80 MiFi devices at the college. I know we have 30 antenna locations at the high schools surrounding, but I have no idea how many hundreds of other MiFi units have been checked out by all the participating high schools.

- [Lisa] You obviously are recognizing that you need to track these metrics, and so that seems to be something that is a future plan?

- [Michael] Yes, definitely. Because I mean, right now, we're using, for the most part, something like a Baicells software to track things, but it's pretty clunky, from what I've seen. And yeah, my IT guy kind of beats his head up against a pole with some of it because it doesn't track the MiFis, it doesn't, you know, say what's giving information back and forth.

[Michael] So I'm not sure how we're going to be able to correct that in the future, but I know each of the IT folks, you know, at the K-12 schools, you know, they're kind of doing the same thing because we've given everybody access, you know, so they can almost treat each location for, like, their MiFi units and their antenna sites, where they can turn them off and turn them on or turn them, like, turn them up or turn them down, if that makes sense.

- [Lisa] Yes, it does.

- [Michael] Yeah. So that way, you know, everybody kind of has some tracking. And then that also alleviated some concerns in the beginning about making sure that students weren't getting on inappropriate things because I know the high schools have much stricter…

- [Lisa] Yeah. K-12, you guys, you have to filter. Yeah.

- [Michael] Yeah. So I know that that's part of the reason why everybody is able to track their own stuff, too, but I know we need to get much more sophisticated in some of that, then making sure that we are much more sophisticated in data tracking, data analysis, making sure that we have somebody who's going to own the project, and it almost has to be a position just because, if you guys are familiar with TCUs or not, everybody at TCUs wears many, many different hats.

[Michael] So that's why we need to have, hopefully, a dedicated position that can take care of this because I can't keep asking my IT guy, well, not only to run around to my three rural locations but then to also hit five more high schools along the way. I think he'd probably throttle me.

- [Christopher] So it raises a question, though, if a person came in with sort of a devil's advocate point of view to say, "Well, how do you know that this is really working? Like, how do you know this has been worth the expense?" You know, how would you answer that?

- [Michael] Well, I know that our students are in class because we're currently…we haven't went back to complete in-person learning, and we actually won't ever go back to 100% in-person learning again. That's not to say that we won't have some 100% in-person classes, but, you know, just through the pandemic and everything else, we're able to tell that our students are still learning, our students are attending class, our students, you know, are using our systems. You know, especially those 90 antenna sites that we're able to track.

- [Tom] And one thing from one of the school districts, Bancroft-Rosalie, was Superintendent Jon Cerny that Michael mentioned, this was not new to them to do e-learning. So that district had had three years of pre-pandemic experience with Chromebooks, sending them home, and they no longer had snow days, no down days.

[Tom] In fact, they were featuring days when students could stay home and learn and not have to come to school, which would have even facilitated, like, a four-day week. But the weakening was when everybody's remote all the time and 15% to 20% of your learners or more have no connection at home.

[Tom] So he was terribly motivated to get involved in this project to bridge that gap and try to reach 100% of all learners, all connected all the time, which is our statewide goal that our agencies have identified, and we'd love to accomplish that by August 1, 2022 because it'll take that long, and we hope to achieve 100% connectivity by that date.

[Tom] So that gives us a whole another year of reasonably normal instruction, more traditional. Nebraska got back into school in normal classrooms sooner than most states, but still, what we found, if you have 15% to 20% of your learners in traditional instruction going home without internet, an instructor will be very reluctant to make homework assignments for the whole class when only 1 out of 5 students cannot do those.

[Tom] So one of the points I like to make is, and it's probably not being talked about enough, is that the lack of connectivity for some students is affecting the education for all students. And we saw in a teacher homework gap survey in July of 2019, again, pre-pandemic, rural broadband task force of our agency sent that out to 23,000 teachers, the entire public school teaching staff of the state, in the month of July of 2019, they're not on contract, they're not supposed to be reading email, we got 7,000 responses.

[Tom] So 32%, and over and over again, because we were asking the question, what does the lack of home internet for some students do to your instructional environment? And they said over and over again, "I just don't make internet-based homework assignments because I can't know that all students can complete them." So if that was true then, it's got to be doubly true now.

- [Christopher] So I want to ask about lessons learned, and Tom, one of the things that is mentioned in the wireless brief is something I'll just throw out there, visit another network, I love that advice. One of the things that you threw out there, Tom, was that to see what's going on, but what are other lessons you wish you'd learned?

- [Tom] Let's just go with that one to start. We had talked early to Michael and the team, if we could have only gone to Northern Michigan University Education Access Network, the largest EBS installation in the country and the most mature, the oldest one, they have boots-on-the-ground experiences that would have really benefited us.

[Tom] The brief that's been written obviously is going to be very helpful for anyone who comes behind. But really, knowing about the technology upfront and what its capacity is and also possibly what its shortcomings are, right? So if we're reaching a goodly number of student households, and no mystery, but homes were built near sources of water 100 years ago, which normally means a valley, a ravine, a low spot, is not where you're going to get wireless connectivity in the year 2020, right?

[Tom] So what is it and how is it that we're going to reach using non-line of sight but yet we're using a line-of-sight technology? We knew that this project would probably not treat 100% of the students but it would narrow the gap. So we really need some fill-in technologies and then maybe low Earth satellite and things like that.

[Tom] Other things we wish we would have known, what is that total load for install and maintenance? You know, it's not like putting up a barn in the pioneer days, where all the neighbors just show up, at the end of the day, the barn is built, sided, and roofed.

[Tom] Here, you've got a situation where you're traveling to student homes, you've got to have a trust level, you might be drilling holes in the side of their house, you know, all for the sake of connectivity and a better learning environment. So is there a best practice to do that? Those are all questions I had, and Michael may be able to chime in as well.

- [Michael] No. I think you've probably nailed them, Tom. You know, just making sure that...I wish we would have been able to figure out some better mapping things just to make sure that we'd be able to hit some of the places that we're not able to hit now early on. You know, we wouldn't have had to...well, I guess we still would have done it anyway, I mean, we still would have stuck the stuff on the college radio antenna, we still would have stuck the stuff on the college anemometer tower, because that would have been the quickest way to get things able to turn on.

[Michael] But just, you know, taking out some of those questions is fantastic. You know, just like you've mentioned, eliminating the unknowns, that and also just being able to find qualified people who were willing and able to do some of these things, whether it's antenna installation, you know, whether it's running the entire program, has been difficult, you know, and that's even after we've trained our own number of people. I think we've had two or three different trainings where we've been training people to do these things, and we still can't keep people employed.

- [Christopher] Yes. Yeah. You're not alone in that.

- [Tom] There is a real shortage of, again, you're not just looking for a radio engineer, it's also somebody maybe making house calls, climbing towers, updating firmware and hardware, you know, diagnosing outages, and that's hard to come by in the first place, but you're also, in Michael's environment and non-population centers, so to speak, non-urbanized.

[Tom] So it takes a special, even possibly, a grow-your-own student with some aptitude that could be trained and then grow into the position. But I agree with Michael that that's got to be one of the very next things to do in order to make sure that the network is properly maintained and sustained and possibly growing as we go forward.

- [Christopher] Excellent. Thank you so much, Tom Rolfes and Michael Oltrogge. Thank you for your time today and for your work in connecting these students.

- [Michael] No, not a problem. Thank you very much for your time, and thank Chris, Lisa, and Shirley. And thank you again, Tom. It's always good to hear from you.

- [Tom] Yeah, likewise. Thanks for allowing us the opportunity to share information. ♪ [music] ♪