Bringing Broadband to Remote, Rural Alaska

A great engineering and construction feat is being undertaken to bring high-speed broadband telecommunications to one of the most remote parts of the United States, laying the groundwork to connect southwest Alaska to the rest of the world for the first time, creating new economic opportunities, improving access to education and health care and increasing public safety.

By Erik Fredeen, PMP

Dark clouds start moving in on the Caribou Ridge site, one of four remote mountaintop sites and 13 new towers on UUI/GCI's TERRA-Southwest Project.

Southwest Alaska is remote. There are no highways or, for that matter, roads between most communities. Transportation is via snowmobile, boat or aircraft. Jet aircraft service is only available in hub communities such as Dillingham or Bethel. A hub community is typically a larger community of several thousand people that supports several smaller villages in proximity whose population may only be a few hundred or less. Telecommunications in these remote hub and village communities is therefore critical in many ways, and these communities have historically relied on expensive satellite backhaul and limited bandwidth (256 kbps to 1.544 Mbps), but that is about to change.

United Utilities Inc (UUI), a wholly owned subsidiary of GCI, is completing the $88 million TERRA-Southwest Project, a middle-mile project that will connect 65 individual communities (two hubs and 63 villages), including more than 9,000 households, with terrestrial broadband. For the first time, nonsatellite, 100 Mbps+ broadband will be made available to the Bristol Bay and Yukon-Kuskokwim regions of southwest Alaska, a service area about the size of North Dakota.

Nearly 470 miles of new hybrid fiber-microwave backbone will be constructed using existing broadband infrastructure in Homer, Alaska, to

Quinhagak, Alaska, where it will connect to UUI/GCI's DeltaNet. This distance does not include additional miles to spur communities not on the backbone. The DeltaNet system, constructed through the use of a U.S. Department of Agriculture Rural Utilities Service (RUS) loan in the mid-2000s, currently serves 43 communities in the Yukon-Kuskokwim region with OC-3 or DS-3 capacity and carries voice, data and Internet traffic. Although the DeltaNet project greatly improved telecommunication services in the region, the system still relied on expensive satellite backhaul from Bethel. The TERRA-Southwest Project will remove the entire DeltaNet from satellite service and ensure 100 Mbps of service.

The project's statistics are impressive. There will be 11 new separate fiber segments totaling 400 miles of both submarine and terrestrial cable, seven cable landing stations and 13 new microwave towers, including four on remote mountaintops. Tower heights will range from 60 feet to 250 feet. The hybrid fiber-microwave network will be configured into synchronous optical network (SONET) rings for resiliency and restoration with spurs to nonbackbone communities. The microwave backbone will be initially configured at 7xOC-3 (1.08 Gbps) and all sites will be capable of upgrading to 14xOC-3 (2.17 Gbps). There are nearly 70 partner companies providing goods and services listed on the project's website (*http://terra.gci.com*). The website has project photos, videos and maps.

TERRA is an acronym for "terrestrial for every region of rural Alaska" and, as with most rural broadband projects, its purpose is to improve economic and educational opportunities in unserved and underserved areas. Although southwest Alaska is a vast region of scenic beauty, including colossal lakes, wild rivers and significant fish and wildlife resources, it is considered economically depressed. Coupled with a lack of year-round private sector jobs, the region also has a high cost of living. The TERRA-Southwest Project will create opportunities to improve the well-being of these communities.

Another key goal of the TERRA-Southwest Project is improving telemedicine services for the region. Village clinics rely on connectivity to regional hospitals in the hub communities, and the hub communities are connected to state-of-the-art hospitals in Anchorage. Connecting these health care clinics and hospitals via terrestrial broadband will mitigate the problems of latency that are inherent with current satellite service.

Federal funding

Funding for the $88 million TERRA-Southwest Project came from a $44 million grant and a $44 million loan from the RUS. This funding is part of the $2.5 billion Broadband Initiatives Program (BIP) funded by the American Recovery and Reinvestment Act of 2009. The TERRA-Southwest Project was Alaska's largest project, and one of 320 projects awarded nationwide under the BIP program.

Under RUS's BIP program, specific administrative requirements must be met. Some are straightforward, such as ensuring compliance with Equal Employment Opportunity and Davis-Bacon Act provisions. Other administrative approvals must be obtained *prior* to receiving reimbursement under the program, including approval of a programmatic agreement that addresses historic preservation, approval of FCC licenses and approval of each individual contract.

Route planning and permitting

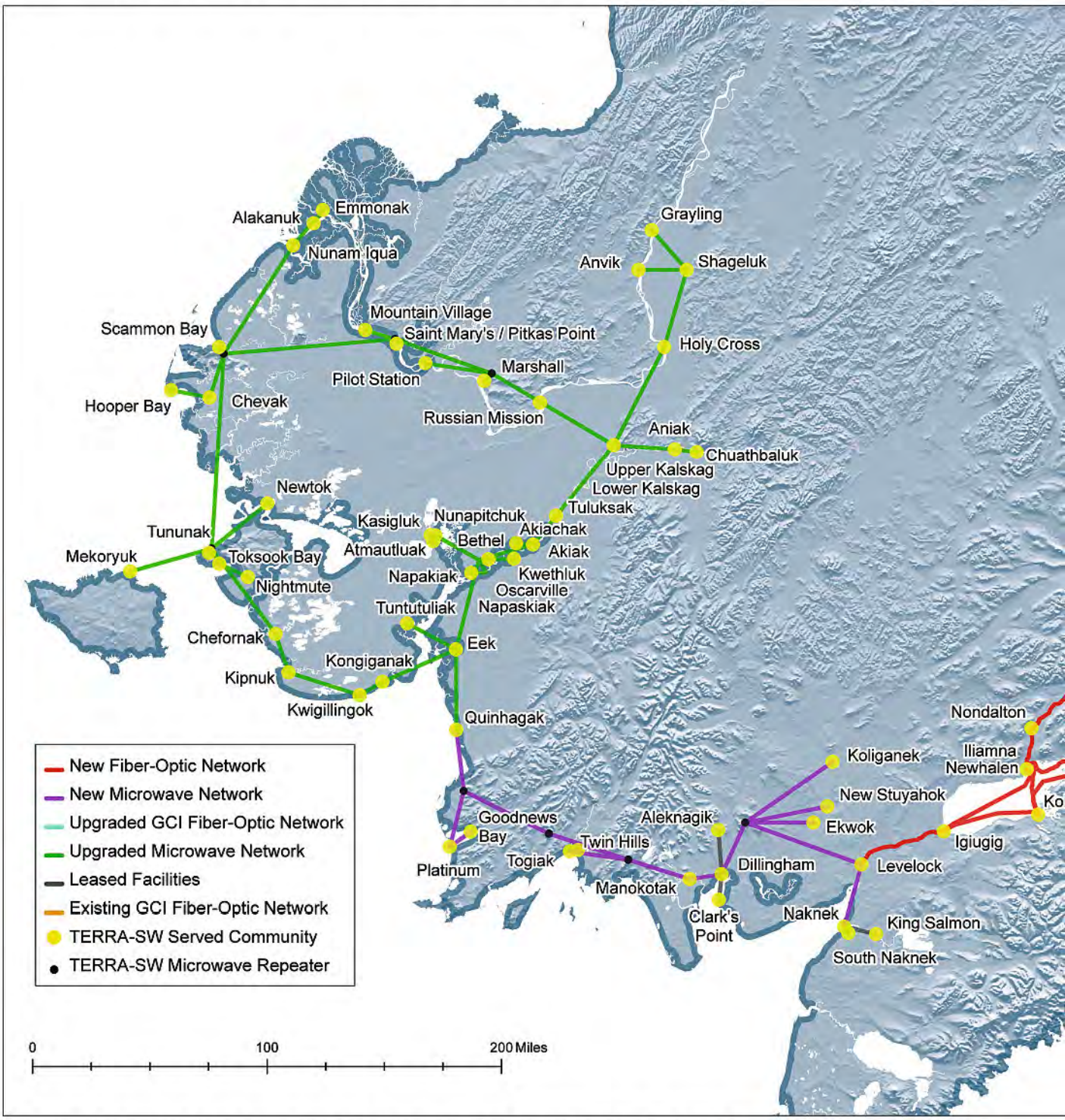
In Alaska, less than one percent of the land is in private ownership, not including Alaska Native land. The largest landowner is the federal government with about 60 percent ownership, followed by state land at 28 percent and Alaska Native land at 12 percent. When planning routes for projects such as the TERRA-Southwest Project, it is nearly impossible to not encounter a combination of federal, state and Alaska Native land. When faced with time constraints on funding availability, which is typical for programs like the BIP program, route selection, subsequent permitting and right of way efforts had to begin in earnest. Dryden & LaRue of Anchorage was hired to assist in this effort. Ultimately, among the submarine fiber, terrestrial fiber and microwave towers, a combination of 120 permits, leases, easements and licenses was required from federal, state and Alaska Native entities. This could not have been accomplished without a professional, proactive and

problem-solving effort by the entire TERRA-Southwest Project team.

Additional requirements

Of the 13 new microwave tower sites, four were on remote mountaintops. One was on state land, and the three other sites were on federal land, including two in a federal conservation area. Given the geographic location of this project, it was nearly impossible to avoid the 4.7-million-acre Togiak National Wildlife Refuge, which is under the jurisdiction of the U.S. Fish and Wildlife Service. The refuge is about the size of Connecticut and Rhode Island combined.

Obtaining a right of way to construct two towers in the Togiak National Wildlife Refuge required an environmental assessment (EA), a



This map of southwest Alaska shows UUI/GCI's existing DeltaNet network and the new hybrid fiber and microwave network that will connect 65 communities to terrestrial broadband for the first time, thanks to the GCI/UUI TERRA-Southwest Project.

formal third-party evaluation of alternatives, ANILCA 810 determination (subsistence impacts), a compatibility determination by the refuge manager and amendment to the refuge's Comprehensive Conservation Plan. Third-party consultants were hired to draft the EA and the "Economically Feasible and Prudent Alternative Evaluation of Alternatives" study. The alternatives analysis determined that a technically feasible alternative existed (i.e., a submarine fiber link), but it was not economically feasible and prudent. As part of the EA process, UUI/GCI hosted public presentations with the federal agencies in affected communities, and there were public comment periods as well. The result of the EA was the issuing of a Finding of No Significant Impact (FONSI), which was issued on April 11. The ANILCA 810 determination was consistent with the EA findings, and the refuge manager, after considering the previous approvals, issued the compatibility determination. All of these combined actions allowed for subsequent issuance of the amendment to the refuge's Comprehensive Conservation Plan and issuance of a right of way.

Even with a FONSI issued, federal regulators placed restrictions on both the construction and operations of these facilities within the refuge. Prior to construction being allowed to start, refuge officials had to approve the limits of work areas on the mountaintop sites that were presurveyed, staked and approved again after the temporary camp facilities were constructed. Operational restrictions included fueling the sites outside of spring moose-calving periods and minimum altitudes for aviation access.

Go/no-go decision

One of the biggest decisions UUI/GCI faced was whether to wait until all permits were in hand before bidding the materials and construction contracts, which would mean losing an entire construction season, or assume that permit approvals would be obtained prior to mobilizing labor, equipment and materials. This is not an uncommon scenario for major projects in Alaska where construction seasons are much shorter than they are elsewhere in the country. Material lead times and transportation commitments must be taken into account given the remote nature of such projects, and even a last-minute green light to mobilize may not allow enough time to complete the work before harsh winter weather sets in. Unfortunately, most federal construction grant programs do not accommodate the urgency for approvals for construction to commence in Alaska; nor do they provide additional time for completion. After careful analysis, UUI/GCI decided to proceed with ordering materials and bidding the construction components, but language was included in the bid documents that made bidders aware of potential cancellation or deferment, and bidders were required to include cancellation values in their bid forms as well. As was anticipated, the regulatory actions were favorable and allowed material procurement and construction to proceed on schedule.

Construction management

UUI/GCI hired Meridian Management of Anchorage to assist with project and construction management. Meridian worked on the planning, procurement and construction phases of both the microwave and fiber components of the project. The company developed an initial critical path methodology (CPM) schedule using Primavera software that was progressively elaborated throughout the project. As part of the administrative specifications that Meridian developed, scheduling specifications required contractors to submit schedule updates in a software format that could be imported into the master Primavera CPM schedule. This way, smaller components of the project could be integrated into the larger whole with owner activities and permitting approvals, upon which contractor notices to proceed (NTPs) were contingent. Having this master schedule also allowed for accurate cash flow projections by cost loading more than 40 contracts in the schedule to create the project's cash flow projection histogram, known as the S curve.

Meridian provided full-time, on-site representatives during the construction phase of the four remote mountain sites and for portions of the fiber plant construction. These owner representatives

Ice shields were being installed on the Kulukak Mountain site as clouds started to move in.

worked proactively with the contractors to resolve problems and also kept detailed daily reports and photo logs to document construction in case claims and subsequent litigation were to arise.

Meridian used Autodesk's Web-based Constructware program to track submittals, RFIs, cost events and in-house coordination meeting minutes. With multiple prime contracts, having a central repository of project information was especially beneficial.

Logistics and delivery methodologies

An analysis of the CPM schedule showed that long-lead items such as radios, integrated communications equipment and power shelters would need to be ordered quickly to be coordinated with installation by the contractor. Because not all of the engineering was completed at the time orders were placed, major material components were specified to be owner-furnished and contractor-installed. These major components were competitively bid and included towers from Valmont, radios from Ericsson, power module buildings from Precision Quincy, generators from Cummins and communications shelters from Reiff Manufacturing, which were integrated by KGP Logistics in Walla Walla, Washington. To save additional time, the power modules were procured through a design-build delivery.

All materials manufactured outside of Alaska required delivery within tight time frames to coordinate with the contractor's barge departure schedule in Seattle. The construction contractor that was awarded the contract, Marsh Creek, had teamed with a subcontractor, HEKO, that owned the barge that would be loaded in Seattle with the contractor's construction materials and equipment and then would dock in Seward, Alaska, to load additional owner-furnished materials manufactured in Alaska such as fuel tanks from Greer Tank and power modules from EPS. The barge would then sail to the rendezvous locations in southwest Alaska where materials and equipment were transported directly to the mountaintops with medium-lift helicopters or, for the heavier items such as fuel tanks and shelters, were staged onshore to wait for the heavy-lift helicopter. A smaller river barge was also mobilized.

Not only are short construction seasons a challenge in Alaska, but also in many locations where transportation of equipment is required via river barge, water levels in the rivers must be timed just right. If you miss the spring high-water window, you may be out of luck. A risk of a lower-than-average snowfall and spring runoff compounds this timing risk. There were three tower sites along the Nushagak River that were subject to these risks. With a bit of luck (and some project management), the contractor's river barge was able to make the schedule.

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Although a low snowfall may be a risk for river barges, a high snowfall could delay mobilization to the four remote mountaintop tower sites. It should be noted that even though the 13 tower sites were in the same geographic region, they had distinctly different local weather conditions; one site might have fair weather while the other sites might not be accessible by helicopter because of inclement weather. The mountaintop sites also saw varying wind exposures, which is important because of the potential of severe icing of the towers during winter months. Risk of ice damage was mitigated by installing ice shields over the antennas, and the towers were structurally designed for significant ice loading.

As an additional consideration to save time, a design-build delivery was used to construct the foundations for the microwave towers, waveguide supports, shelters and fuel tanks. This contractor would also erect the towers and install the antennas and waveguides. Marsh Creek, the contractor awarded the work, hired BBFM Engineers of Anchorage, which designed three typical foundation types: driven pile, rock anchor and helical anchor. Foundation designs were based on geotechnical reports created for each site for UUI/GCI by Golder & Associates through on-site core sampling the previous summer. Although permafrost (permanently frozen soil) is pervasive in many areas of Alaska, it was not a factor in 12 of the 13 tower sites. The site that was known to have frozen soils was designed as a driven-pile foundation and was also designed for an eventual thawing of the soils. An alternative design not used at this site, but which is common in Alaska, involves using thermosiphons that maintain the soils in a frozen condition.

Aviation challenges

Because the only means of access to the mountaintop sites was by helicopter, load limits played a significant role in the design of the site facilities. Weight limits had to be taken into account for every item on the site, especially the communications modules, power modules and fuel tanks. Although the bidders were allowed unlimited latitude in their approach, it was assumed that a heavy-lift helicopter would be required to transport the major components and set them on preconstructed foundations. Therefore, maximum weight limits were established for the major owner-furnished, contractor-installed materials. Other materials such as antennas, tower components and foundation steel could be mobilized by using medium-lift helicopters. Although medium-lift helicopters had some availability in

This view shows work under way at the Kulukak Mountain site.

southwest Alaska, the availability of private heavy-lift helicopters in Alaska was very limited. It was therefore assumed during project planning that a heavy-lift helicopter would have to be mobilized from the Pacific Northwest at significant expense, but bidders were allowed to propose alternative solutions. UUI/GCI included the material weights in the bidding documents and asked bidders to quantify mobilization of a heavy-lift helicopter, if applicable, as a line item on the bid form and elaborate on their approach in their proposal.

Another cost risk for the contractor was standby time for a heavy-lift helicopter during inclement weather in a region known for having aviation shut down for days on end. The contractor negotiated with UUI/GCI to share some of the risk of the heavy-lift helicopter for a limited number of no-fly days, past which the contractor would assume all liability.

The contractor ended up mobilizing a Chinook heavy-lift helicopter from Columbia Helicopters of Portland, Ore. They completed all lifts to the four remote mountaintop tower sites in only two days, and only one day of weather delay was incurred. The contractor was not as fortunate with the day-to-day construction support operations because it had to deal with multiple-day weather delays as weather system after weather system blew in from the Bering Sea.

Weather challenges

One of the most difficult challenges on the project was the weather condi-

This view shows a rare nice day at the Caribou Ridge site.

tions, especially at the four remote mountaintop tower sites. Summer weather in southwest Alaska can be rainy, windy and cold. On the mountaintops, storm winds can be sustained for days with poor visibility, and this means no helicopter access, which is the only means of getting materials, equipment and crew to the site. If the completion schedule was to be met, accessing the mountaintop sites only on good days was not feasible. Therefore, crews were mobilized to the sites with full camp provisions, and they worked through very challenging weather. Storms tested the limits of the field tents and their anchors and all materials had to be secured. Days of heavy fog without visibility, driving rain, constant wind and the inability to come and go as one would desire understandably had effects on production rates.

What's next

Once the TERRA-Southwest Project has been completed, UUI/GCI will be working to deploy last-mile services, including fixed wireless Internet, in the 65 communities that received middle-mile service. This scope of work was not included in the RUS loan/grant agreement.

GCI plans to expand this network north to Nome by 2013 through a new project called TERRA-Northwest. ■

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