TERRESTRIAL AND SUBMARINE PLANT SIMILARITIES AND DIFFERENCES IN ALASKA

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Abstract: The great geographical distances presented by Alaska both on land and coastwise present unique challenges different from those found in the contiguous 48 states of America or that of Europe. Through the perspective of a single communications company grappling with these challenges in addition to an extremely limited population base to support these facility builds, this paper will examine the differences between terrestrial and submarine construction. The differences in regulatory compliance, land rights and obligations will be highlighted, along with an analysis of how these affect permitting timeframes and ultimately how they dictate construction activities. This paper will also demonstrate how these imposed conditions can have a negative effect on cable security as well as create added costs and reduced financial feasibility of a project. The intent is to highlight approaches that ensure both the terrestrial and marine cables can be designed to have the highest physical security while abiding by today's regulatory conditions.

1. INTRODUCTION

Slowing down the digital divide to allow remote rural communities to survive in the 21st century is challenging in Alaska's vast landscape. These Alaskan communities are sparsely populated and sometimes far from a road system connecting them to existing infrastructure. This digital gap widens as software industry further burdens internet users in these communities by developing applications that demand ever higher speed and bandwidth to function properly. Fiber connectivity to these communities is the only currently viable technology to bridge this gap adequately. However, the installation of fiber optic cables in these remote settings presents a wide range of issues that need to be resolved to provide sustainable and highly available connections to residents and to allow them to remain viable into the future.

Alaska has more shoreline than any other state by a wide margin (33,904 miles/54,563 km) and is home to several large inland lakes and rivers systems, allowing the option to use both submarine fiber and terrestrial based fiber to reach many of these communities. This offers direct comparisons of these methods when considering the best approach to interconnect various communities in Alaska.

Alaska is comprised of 663,300 mi^2 with a population of 739,795 residents of which 400,888 reside in the greater Anchorage area (Anchorage & Matanuska-Susitna Borough). This leaves a population density of approximately 1 person per 2 mi^2 outside the greater Anchorage area. Besides the obvious challenge of distance, very low populations in large areas also leads to limited resources in these areas to support construction, including very limited financial resources. In addition to these challenges, the state of Alaska has incredibly diverse geography, extreme weather, active volcanoes, frequent earthquakes, and is rapidly experiencing the effects of Climate Change, all of which pose concerns during the construction and life of a cable installation.

2. TERRESTRIAL VS SUBMARINE CABLE INSTALLATIONS

2a. Authorization: When contemplating a cable project, one of the early considerations is the ability to obtain the proper authorizations to install the cable. The differences between terrestrial permitting and marine permitting are significant. The initial investigation of land ownership can be extremely labor intensive for terrestrial routes especially in rural Alaska where plat research is hindered by poor records and complicated land exchanges between various Federal and State agencies. In comparison to submerged lands, which are all held by the State near shore and are federally controlled offshore with very few exceptions. The permitting regime varies with land ownership except for environmental permits, which vary in accordance to the types of terrain and wildlife in the area of construction. Both landownership related permits and environmental related permits vary to a much greater degree for terrestrial based construction projects due to the greater variety of land ownership and classified environments on land. In the past few years the requirement to have Storm Water Pollution Protection Plans (SWPPP) for any project disturbing more than an acre of land has significantly added to the rigors of terrestrial permits. For the reasons identified above, the permitting effort and complexity in Alaska is significantly less for submarine installations, although both are demanding exercises.

2b. Supply: The differences between terrestrial and submarine cables is most apparent in the supply and installation phase of a cable system. The supply of submarine cable requires a detailed marine survey to be conducted to allow the cable to be engineered prior to manufacturing. This includes determining a cable armoring plan, lengths with installed slack calculations, any planned splice or BU positions and if the system requires any ROPA or other in-line amplification. Once the cable engineering is complete there is approximately a 6 to 9-month lead-time prior to the cable being delivered to Alaska. Depending on the type and length of the system, the cable will be delivered via a large reel, in 40 ft ISO containers, barge or ship. Terrestrial cable orders do not require as detailed engineering and are generally ordered in 20,000 ft reels of identical cable that can be easily transported via truck. The lead-time for terrestrial cable delivery ranges from 4 to 10 weeks. However, terrestrial cable systems also need additional materials such as vaults, conduits, splice cases and possibly aerial hardware depending on type of construction.

2c. Contractors and mobilization: Securing contractors is another aspect where differences in terrestrial and submarine cable installation can be experienced. There are numerous US based contractors who are qualified to install terrestrial cable systems, in comparison to a very limited number of contractors worldwide with the equipment and expertise to install submarine cables properly. The initial cost to mobilize marine installation assets to Alaskan waters can be particularly expensive since these vessels do not reside in Alaska, but once the vessel is in Alaskan waters it is relatively simple to transit to the construction site. Once on site, all materials, installation equipment and support facilities to house, transport & feed crews are contained aboard the self-sufficient vessel(s). In contrast, the mobilization of equipment and crews to remote terrestrial sites and then sustaining them for any period of time can be a very complex logistical undertaking. Alaskan rural communities do not have the facilities to accommodate crews or support services to supply the construction efforts. Because of these factors, once installation commences terrestrial construction production is generally measured in 2 to 4 km per day while a vessel burying cable can complete 20 or more km per day and surface lay can complete 8 times that. The slow production and expensive logistics propel the cost per km to average in the range of $ 84 per km.

Although the cost of submarine cable installation changes considerably depending on burial requirements and overall length of the system, they are normally notably less than terrestrial costs. The economies of scale play a large role in the cost per km determination, causing the difference in cost between terrestrial and submarine system to increase with the length of the proposed system.

2d. Mitigating human or environmental damage: Remote cable installations have the benefit of lower human aggression causing damage to the cable, but conversely if damage is caused by natural events the time to repair is extended due to time consuming mobilizations and limited access to equipment and resources on site. Natural forces at play in Alaska include earthquakes, volcanic eruptions, high winds, large temperature ranges, fourth largest tidal range and temperate rainforest to name a few. These have combined to cause cable system failures from floods, rock slides, seafloor slumps, abrasion, ice crush, tree falls, erosion, and forest fires. There is not clear evidence that terrestrial cables suffer more or less damage from these effects. The largest known difference appears in mean time to restore service. Even with the complexities of logistics to get to a remote terrestrial site, it can be done relatively fast as compared to mobilizing a vessel of opportunity or calling out the NAZ maintenance vessel from Victoria BC. On average, the transit from Victoria to Alaska is 4.5 days compared to the ability to have a crew on site in remote Alaska in less than 24 hours to complete a service restoration repair which is then followed by a final repair.

3. ENGINEERING COMPROMISES

There is a high prevalence of interference by agencies or underlying land owners to deter best practices in the design, schedule and installation methods of terrestrial cables in Alaska as compared to submarine cables.

3a. Land ownership: Terrestrial cable installations have a more complex and rigid permitting regime which has at times caused less than ideal design and construction changes to the cable system to meet or reduce permit stipulations. A prime example is in the different permitting requirements and fee structures that various land owner's use for utility easements. This difference is enough to warrant major re-routes to avoid certain land owners, which in several cases added length and/or forced the cable to be placed in higher risk locations. Native allotments and lands set aside for land grant institutions are notoriously difficult to work with and are best avoided whenever possible. This also applies to submarine cables since State waters which are within 3 nm of the shoreline require an easement with an annual rental fee, however outside of state waters in federal and international waters there is free passage of cable and no charge. This tends to direct the planned routing of cables away from state waters even if this means losing the best possible route engineering. This is problematic for the cable due to current rules that only allow pelagic mid-water trawling in state waters and allow hard bottom trawling in federal waters, making Alaskan state waters safer for cables but more expensive.

3b. Arctic considerations: A few permitting agencies use standards develop for other states and do not consider the possibility of permafrost or the effect of karsting in arctic environments causing long term maintenance issues for cable operators.

3c. Multiple utilities in one corridor: There was also consideration to force multiple utilities into shared corridors that would have created several areas where physical diversity between different networks would have been lost. Fortunately, these efforts did not come to fruition.

3d. Seasonal wilderness/environmental timelines: Construction schedules can be subject to windows between migratory bird activities, tundra access seasons, wetland stipulations and other seasonal concerns which may only leave either very short construction windows or force work into harsh wintertime as the only option. Submarine construction activities have had limited schedule restrictions applied to them in Alaska. Normally these pertain to salmon or other concentrated fishing activity and substance hunting times. Due to ice and poor weather, submarine cable installations in Alaska should be scheduled from May to October (Aug. to Oct. in higher latitudes). However, protected marine mammal restrictions have commonly been linked to maintaining a safe working distance away and/or temporarily halting installation activities until the protected mammal is clear, rather than a set calendar date restriction. Alaska currently does not have organized fishing agreements that impose other restrictions or requirements on the installation of submarine cables. The above circumstances may have delayed a few marine installations, but they have not forced any marine installations into any compromised lay plan or weather window in Alaska.

4. CONCLUSION

On first glance, this paper suggests that submarine cables in Alaska are subject to less permit scrutiny and cost less on a per km basis. However, the drawbacks of submarine cables include time needed to design & secure cable plant and the mobilization of a cable installation vessel to Alaska. The other limitation to using submarine cable installation as the primary method to add fiber connectivity to remote communities is that many are landlocked. Perhaps one possible solution is to deploy cable systems in the Alaska river systems to increase the ability to connect to more rural communities, even though river installations pose a whole different series of unique questions with ice scour, shifting stream beds, currents and large salmon stocks to name a few.

Using either terrestrial or submarine methods to provide connectivity to rural Alaska presents challenges from permitting to logistics and maintenance that drive up costs that most rural communities cannot support. Subsidies to aid construction can certainly improve the situation, but a complete solution will require the cooperation of agencies to allow more cost-effective installation methods and the telecom providers to develop and endorse new construction standards to bring fiber connectivity to communities being left behind in the ever-widening digital gap.