UNDERSEA MARKET TRENDS:WHAT'S NEW AND WHAT'S NEXT?

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Abstract: Today's market demand is increasingly driven by non-traditional players and applications rather than new technology. Many developing areas have, or will soon have, their first undersea fiber cables. Non-traditional markets (e.g. oil platforms and sensor systems) are on the rise. Growth in these sectors is driven by the increased dependency of national economies and global businesses on reliable, economical communication, enabled by recent undersea network cost improvements.

These new and growing market sectors involve parties who may do business in a different way from traditional owners – stimulating increased interest in alternative ownership models and solutions.

This paper provides a synopsis of new trends in the market from a variety of perspectives and suggests what might be next.

1. TODAY'S MARKET

The drivers of today's undersea cable market are more varied than ever before.

The world's largest carriers have stimulated the resurgence of very large consortium projects (TPE, AAG, I-ME-WE, SEA-ME-WE 5) and the continued expansion of large private global networks (FLAG, VSNL).

Just as great in significance, however, is the fact that many smaller and more unique markets, which were often ignored in the past, have become significant in size and market influence. The most obvious example is the number of large regional networks proposed to serve East and West Africa. Yet equally important is the growing number of smaller regional networks-offshore oil platform networks and undersea sensor systems. And, of course, with the large amount of unlit capacity across the oceans, the upgrade market remains especially important.

From a structure and finance perspective, large consortium systems remain largely unchanged, while large private networks have seen a resurgence of equity capital or funding via new share listings, but also remain fundamentally unchanged. From a technology standpoint, these large networks can take advantage of recent incremental product improvements that make network provisioning, operations, and maintenance simpler, or make systems slightly more cost-effective. In sum, the large-system markets are primarily "more of the same".

The smaller regional and niche markets, on the other hand, serve much more varied needs. Cables in these newer markets are often the first of their kind for their purchasers, as the cost of an undersea cable solution has historically been prohibitive compared to the alternatives. The price reductions that made cables affordable were initially attributable to inventory-based pricing and severe competition. In the current market, purchasers and suppliers alike remain interested in seeing these niche markets thrive, which will only be possible if cables remain affordable. Some trends that preserve affordability are described below.

2. NEW NICHE MARKET TRENDS

Several changes that are currently underway should help sustain the niche markets. They include new funding sources, new ownership structures, and new network solutions.

3. NEW FUNDING SOURCES

For many years, members of this industry (including the authors of this paper) worked to establish the concept that connection to global markets should be a basic economic development priority, critical to the growth and sustenance in every economy. On the other side of this argument were those who maintained that participation in the information age is a luxury to be considered only after development renders it commercially feasible. The debate is finally over. It is now a generally accepted fact by governments and international funding institutions that connectivity is a key to economic development. This has been a breakthrough for many of the smaller economies of the world, as it opens up the opportunity for them to secure low-rate financing for new undersea commercial cable networks. The World Bank, as well as numerous regional and national funding institutions, are now eager to support new networks that bring connectivity to developing regions. Private equity is also starting to return to the undersea telecommunications cable market, especially in regions where a lack of communications facilities hampers economic development.

Similarly, funds are becoming available for undersea sensor systems for a variety of applications, as governments and other institutions recognize the potential of these systems to help avert tragedy, monitor the environment or manage resources. The Indonesia tsunami, the world's increasing dependency on energy extracted from ocean environments, and the interest in understanding global climate changes have all led to

increased funding for new types of undersea sensor systems.

4. NEW OWNERSHIP STRUCTURES

Various ownership structures have proved efficacious over the years: The carrier consortium is still going strong after decades of use; the privately-owned (especially carrier-owned) network has proved workable in the right environment; and various hybrid structures are being used in special situations. Two types of commercial structures are proving especially beneficial in today's environment; these structures are particularly interesting because they may be used with consortium, private, or hybrid ownership models. In each case, they do the same thing – they allow for win-win opportunities in which all participants save on capital and operating costs.

- The first structure is the "system within a system" structure, in which two or more independently-operated systems are incorporated within the same cable sheath. Fiber routing via branching units enabled such a many years ago. More recent advances in Dense Wavelength Division Multiplexing (DWDM), Optical Add Drop Multiplexing (OADM), and improved terminal transmission technology have allowed for independently- owned and operated systems at wavelength level.

- The second is the re-emergence of integrated networks, this time, with cross cable ownership structures.

Both of these structures minimize initial capital requirements of the network owners and yet provide a means of retaining the control individual owners demand. They are valuable approaches in traditional markets but are especially useful in very capital-sensitive emerging markets.

Today's "system within a system" structure is analogous to the real-estate market's condominium structure. A single cable owner/developer builds, owns and maintains the cable as a whole, and sells portions of the cable transport capability to others ("tenants"). The tenant may exclusively own the entire capacity on one portion of the network; may own a portion of capacity over the entire network; or may simply own a portion of the capacity over only a portion of the network. Capacity may be one or more fiber pairs, or a fraction of a fiber pair.

This cooperative ownership structure is enabled, in part, by improvements technology, which help support the independence of capacity ownership and operation. Examples include upgrade technology improvements, which are simpler, more automated, and less intrusive to existing traffic than in the past; new OADM technology, which enables the sharing of fiber capacity across multiple landing points; and terminal transmission equipment, which can be diversely located in separate stations or Point of Presence (PoP) facilities.

Cable developers in emerging markets have cooperated with tenants to reduce capital requirements from the outset. The cable owner/developer grants sufficient rights to the tenants to satisfy their need for independence. Such rights include influence over the network design, options to expand the network, and perhaps most importantly - the right to individually own, operate, *and upgrade* their own capacity. Apart from the capital cost advantages, parties may share operating expenses. Because of reduced capital requirements on individual parties, time to raise financing may be greatly reduced.

Perhaps a more surprising development in ownership approaches is the planned construction of new networks with undersea stubs, designed apriori to specifically connect to other, separately-owned, separately-constructed networks. Multi-vendor integration of a single cable network, owned by one entity, is not new. It was characteristic of the first transoceanic fiber cable systems in the 1980s. Now, however, we're seeing a willingness of the owners of separate cables to cooperate during the planning stage, and agree to join their networks for common benefit. In this approach, owners and suppliers must manage the integration responsibility across networks via carefully-crafted commercial agreements and supply contracts. Network owners may sell fiber pairs to each other; they may sell wavelengths; they may sell their integrated capacity jointly to third parties. The major undersea network suppliers have begun to cooperate on almost all major projects these days, out of the necessity to manage production capacity. Hence, the suppliers are equipped to manage the technical integration of networks. The trick is to structure the supply contracts to assure technical integration is completed flawlessly, and commercial/ contractual terms and conditions (such as performance warrantees) are completely clear and sufficient.

5. NEW NETWORK SOLUTIONS AND TECHNOLOGY

Many advances in technology over the years have been introduced first to solve unique problems in niche markets. High-power amplifiers, low-loss fiber, and Raman amplification are a few examples. Today, technologies being stimulated wholly or in part by niche sectors and emerging markets include: (a) network recovery and redeployment; (b) new OADMs; (c) underwater nodes incorporating complex power distribution and routing capability; (d) cheaper, better transmission terminals.

The most resourceful new approach to minimizing capital of a new network is one discussed in a paper by Stafford, et. al. at the last SubOptic, concerning cable re-deployment. Mr. John Hibbard is presenting a paper at this conference discussing a successful effort in

support of Papua New Guinea to install a new cable from there to Australia, by recovering and redeploying a portion of the older, retired PacRimEast cable. The resultant system cost Papua New Guinea a small fraction of the cost of a new cable. Another such recovery and redeployment project, HUGO, has been put into service reusing the Gemini cable to the Guernsey Islands in northern Europe. There are considerations for other projects of this type being made elsewhere, as well. For an application that requires a very low-cost network, and is able to live with the capacities afforded by a prior-generation cable, this "undersea cable recycling" approach may indeed prove to be very attractive.

The most unique new network architecture may be the multipoint architecture now being installed for the oil industry, connecting many drilling platforms together. This network solution is enabled by new OADM technology, which allows the capacity of a relatively small number of fiber pairs along the main cable route to share their capacity with many separate platforms. This OADM technology is distinctly different from the OADM technology deployed previously, in that it does not predetermine (or limit) the amount of bandwidth each node is able to utilize. Rather, the OADM broadcasts a fiber's bandwidth to all nodes. Compared to past OADM networks, the net result is a simpler, less expensive, and more robust network design, that evolves more flexibly to unpredictable levels of demand between nodes. These new OADM structures are being currently deployed and are also under active consideration in some commercial undersea long-haul networks.

The most complex new undersea systems are the undersea sensor systems being developed to serve as scientific research platforms for studying a wide range of ocean phenomena, such as turbidity, seismic activity, or salinity- for research, security or commercial purposes. Perhaps the most sophisticated project underway is the Neptune project on the west coast of the Americas. Neptune's unique requirements to measure a vast array of oceanographic phenomena, beyond those cited above, impose real technical challenges to the undersea system network design. The product solutions to be developed by the system supplier(s) will require: (a) distribution of large amounts of power (current) undersea, (b) collection and distribution of information among numerous nodes, (c) new dynamic riser cables enabling connectivity to floating platforms and enabling sustained, adaptable observations at any ocean depth, (d) robustness in inherently unstable ocean bottom conditions which are of particular interest to the scientists (volcanoes, submarine earthquakes zones), and (e) the capability to dynamically reconfigure network topology. These and other developing capabilities are likely to lead to new technologies and products that may have broader applicability in commercial networks of the future.

Wet-mate-able connectors, which allow various sensor devices to be added or replaced over the research network's lifetime could conceivably evolve to enable simplified repair technologies for commercial systems in years to come. Neptune's planned deployment of routers undersea may lead to development of sophisticated branching devices in commercial networks. While these may be remote possibilities, it is inevitable that some fraction of the technical achievements advanced for these applications will eventually have value to the commercial market. This, plus the revenue opportunity and prestige of these networks, makes system suppliers anxious to participate in such projects.

Perhaps the highest-value new product is the Submarine Line Terminal Equipment (SLTE) with higher performance, a greater degree of functional integration, smaller footprint, and lower price, and simplified installation and test procedures, now available from some of the traditional undersea system suppliers, as well as new vendors - some of whom are producing products with a strong resemblance to those used in the terrestrial market.

Lower price points for upgrades are especially important to those who struggle with how to cost-effectively equip their unlit capacity in installed systems, in markets where the capacity sale price is close to the price of the upgrade that enables it. Terminal performance improvements not only reduce the cost of new systems, by allowing repeater spacing to increase, but also extend the usefulness of older systems. The continued rise of new upgrade vendors in competition to the traditional suppliers has been a welcome relief to many operators, as they have fostered innovation, even as they have tended to keep upgrade prices in check throughout the market.

6. WHAT'S NEXT?

What comes next? We believe it will be a continuation of the evolution that is underway.

In terms of undersea network ownership structure, we suggest that "systems within systems" will become increasingly prevalent. For example, consortia may adopt the characteristics of the "system within a system" approach in order to expedite their plans, by: (a) keeping their member constituency to a very small number; (b) allocating ownership capacity on a fiber pair basis (or partial fiber pair basis) to retain independence in operation and upgrade; and (c) selling extensions to non-owner landing points and capacity on the network. Those landing parties who are unable to develop a cable on their own, might attain connectivity by funding a branch, and purchasing capacity on the whole.

In terms of financing, it is reasonable to assume that interest by the World Bank and other multilateral funding institutions in funding undersea networks, where needed, to foster regional development will

continue for some time. In addition, the world's attention to environmental and security concerns might be expected to stimulate new sources of funding for ocean monitoring systems, complementing the funds already committed for monitoring underwater seismic activity.

Transmission terminal technology will continue progress with incremental improvements in performance such as reduced size, reduced cost, and a higher degree of integration with terrestrial transport functionality. On a system level, we can expect to see continuing adaptation of this technology to meet the unique needs of emerging specialty and regional markets, perhaps with even greater degrees of commonality with terrestrial products.

One of the most interesting new developments in the market in years to come could be the convergence of some of these new developments for special applications. Niche technology houses, as well as some traditional suppliers, have begun to investigate the potential of incorporating sensor systems into commercial communication networks. Such dual-purpose networks clearly have technical challenges, to assure that each can be independently operated and maintained without interference to the other. Examples of possible advantages to ocean sensor communities include: remote tracking of tagged fish populations and their migration patterns along the continental shelf, early detection of cable failure modes that providing diagnostics for repair or future avoidance of similar problems, complementary tracking of tsunami generation and migration, documentation of pollution and or biofouling processes that might compromise a system or a benthic community, dual provision of information about the deep sea to a fiber-connected world audience along with more routine connectivity. Feasibility studies are underway, exploring the potential of coupling sensor technology into commercial networks. Such technology is not expected to be available tomorrow, and likely only the simplest of sensor technology will be compatible commercial systems in the foreseeable future. But, if multiple purposes can be served by one cable network, which potentially garner funding from multiple sources and are structured as separate "systems within a system", it is conceivable that the some of world's smaller and more remote economies may find connectivity affordable. To take it one step further, research networks have reused retired commercial systems for studying ocean phenomena for years. Imagine the ability to recover and redeploy a retired network and couple sensors into the network. Connectivity and increased security could perhaps be attained simultaneously, with one affordable network.

7. CONCLUSION

Current trends in the undersea system market hold promise for continued growth and stabilization of the industry. The continued development of regional and niche markets, specialized and cost-reduced technologies, and alternative sources of funding serve to broaden and diversify the base of the market, providing opportunities that either did not exist or were not exploited in years past. While supplier investment in these markets over the past several years was likely encouraged by the lull in traditional market demand, the profit-potential of these markets has grown to a level where suppliers find it increasingly difficult to ignore. Our industry's suppliers seem, like the purchasers, to be finding ways to cooperate through subcontracting relationships both with each other, and with niche technology providers, to serve the market's varied needs at large. It is significant that the niche opportunities are not linked temporally or financially to the cyclical nature of system replacement on major transport routes.

In addition, further adoption of co-operative and resource-conserving strategies such as systems-within-a-system, integrated systems, or "undersea cable recycling" of earlier systems, can further stabilize the market by reducing the amount of "overbuild" on popular routes.

Taken as a whole, these trends are exciting, because collectively they have the potential to dampen the boom and bust market cycles that have plagued the industry, by reducing the height of market peaks and the depth of market troughs. The authors are working with a number of parties promulgating each of these trends, and we look forward to seeing the outcome and discussing it with all of you at the Sub Optic Conference!