SUBMARINE UPGRADES; ARE THEY JUST A DROP IN THE OCEAN?

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Abstract: Cloud cover is gathering; the move to cloud based services is driving significant bandwidth growth on the global submarine network. It's no secret that submarine cables require careful planning and crucially involves significant startup cost to construct. To solve for near term capacity requirements, submarine upgrades are taking more of a central stage. The good news is that technology is rapidly advancing and enabling a scalable network to transport cloud based services and large content objects such as video, images and web content. But with these opportunities also come decisions for network owners as they evolve their networks in support of the explosive traffic demand they generate.

This paper explores whether we can be solely reliant on upgrades or whether a more holistic approach is required to some age old problems.

1 INTRODUCTION

Life has a habit of repeating itself. Think back to the dawn of the railway age. From circa 1830 to circa 1914, the upstart railway battled with existing proven transport techniques to demonstrate its worth and efficiency, against an extensive waterway network.

The dilemma of large capital investments "build it and they will come" and uncertain and unproven financial returns made many look on the railway with uncertain eyes. The reverberating themes of that bygone age are equally true now. The requirement for fast, efficient transport links which were scalable and easily adaptable to transport valuable cargo to support economic growth and prosperity resonates today. Speed was of the essence; with alarming similarity to today's clamour for latency in every inch of the globe for all kinds of applications, and not just those used by a niche corner of the market and those high frequency trades.

The way to solve this appetite for more efficient transport links is vital.

2 FROM COAL TO CONTENT

Just like coal, the valuable cargo of the 19th century, today large content objects transported over the web will continue to challenge legacy networks and business models. To meet this challenge, network owners must deliver flexible network solutions on both terrestrial and submarine networks that scale seamlessly, ensure resiliency and perform flawlessly, all while maintaining a cost structure that is consistent with ever declining average rate per user, or "ARPU".

As the world goes ever more global this will put greater emphasis on the inventory and availability of submarine networks. To achieve this availability, network owners must successfully combine effective strategy, network assets, core competencies, and operational excellence to future proof submarine networks to meet these challenges.

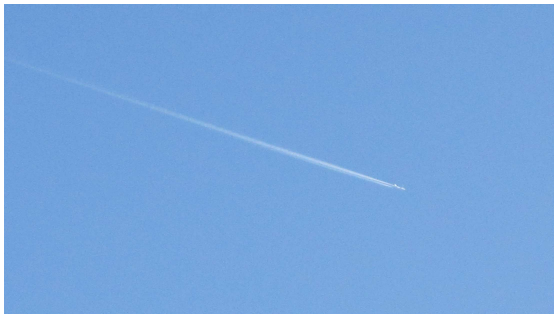

Figure 1 Before the Cloud

3 THE ATLANTIC REVOLUTION

Never has this been more relevant than in the Atlantic Subsea market, the equivalent of the "yo-yo" dieter of the international communications world.

1999 saw a skinny transatlantic market with legacy and traditional consortium cables nearing their fill capacity, but the old adage of "never go shopping on an empty stomach" proved prophetic. The market then gorged on a fast food diet of easy finance and both traditional and new market entrants raced to deploy multiple new, high capacity capable Atlantic systems, and it only took until the end of 2001 for it to become apparent that the market was saturated. Traditionally the huge capital investment involved in deploying an Atlantic system necessitates trying to recover these sunk costs in the early life of the system by holding firm on unit capacity price. However at that time the vast over supply in the Atlantic market coupled with weak demand would not support this traditional payback model and unit price went into free fall – a boom time for the customers, not so for the system Operators.

Since 2002, this over-indulgent "super-size me" Atlantic capacity market has been on a period of forced abstinence, with systems relying on the original lit capacity to satisfy customer demand. However the Atlantic market is now in a more slim-line and athletic form with much of the lit capacity now either in use or allocated; essentially all of the major Atlantic Operators are now considering upgrade options.

4 CHANGING PICTURE

The submarine transmission equipment industry has changed dramatically with the emergence of new equipment providers who were initially focused solely on the upgrade market. These, together with vendors both traditional and those who have emerged from the terrestrial space are offering technical solutions which are doubling and tripling the original design capacity with competitive pricing.

It's certainly true that with choice now come decisions; whether to select vendors who have specialized in subsea upgrades, those with a terrestrial background or the more traditional options.

During the relatively quiet years following the build boom, progressive network operators closely monitored Atlantic market demand whilst continually evaluating technology roadmaps for innovation windows to exploit. There have been examples where these forward looking operators with headroom in their own network saw increasing evidence that the capacity glut could be bottoming out, and proactively reached out and secured significant quantities of leased capacity while it was still available at compelling price points. Although such historical moves could have been perceived as a highly speculative, they have proved to be a shrewd investment and have secured the required backbone growth.

But will this be enough as surely such deals won't be found in abundance? With today's modern living and an ever increasing appetite for instantaneous connectivity via social media portals this will correspondingly drive a similar requirement for the associated submarine bandwidth.

5 BACK TO BLACK

Submarine upgrades have driven an insatiable need for efficiency, requiring the use of Ethernet, that suite of transport protocols with its origins in University of Hawaii and the development of ALOHAnet; a pioneering computer networking system which demonstrated the first application of wireless packet data delivery back in 1971.

Just like that first network, Ethernet waves, the "new black" in the transport product portfolio, was a simple way of getting computers to communicate with each other in a more efficient manner and hence became the must have transmission flavor of choice for upgrades. The result was a business case that was not simply tested by the ARPU requirements and financial parameter check lists alone; but a real requirement to differentiate from the crowd. If you had it, you could sell it.

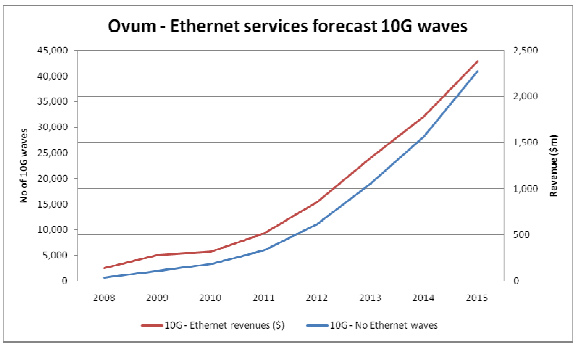

Figure 2 Ethernet Services Forecast

Upgrades therefore needed to be characterized by short cycle times, flexible and ready to adapt to this changing landscape. Software configurable cards, rapid deployment of transponders with corresponding light touch on the common equipment were not luxuries, they were essential and the new entrance vendors had the leading edge compared to their traditional counterparts which Operators were willing take advantage of .

In commercially challenged markets, you need a network that can adapt and change and ensure good margins and quick return on investments. Upgrades in the new submarine world do just that.

6 WHEN IS A GOOD TIME TO UPGRADE?

The technology evolution does not stop with the transport protocols. With careful thought to architect networks it is possible to deliver improved resiliency of existing infrastructure and extend the life and capacity of the existing systems by anticipating technology development and intelligently engineering technology evolutions. This when embedded into network planning cycles will enable migration paths from 10Gbit/s wavelengths to 100Gbit/s wavelengths reducing the number of interconnects, addressing the needs of those responsible for operating and maintaining the network.

But here's the thing, we don't live in a perfect world. Not every part of a network can be upgraded at the same amount, at the same time, and for the same cost. Reality means that even in a short horizon of time cables were initially built with differing fiber types, number of pairs, repeater spacing and not all optimized for 10Gbit/s let alone 40Gbit/s or 100Gbit/s.

Just as you can't put a high speed bullet train (or TSV) on the railway tracks of yesteryear, the new optical technologies are not optimized for the submarine "tracks" that were built a decade ago meaning trades offs are necessary.

Equally amidst all the evaluations, hybrid upgrades, alien waves and other ingenious techniques to cost optimize every last nanometer of the optical spectrum; it could be that the answer is to do nothing.

Bespoke upgrades with potentially complicated deployment phases may not only cost additional capital for the

equipment, but can also cost in operational manpower. Watching and observing the changing patterns of technology may not mean that every modulation innovation is appropriate for every network. 40Gbit/s networks have proved to be vital for some submarine cables, but not all. Simply waiting for a time when the next technology leap will occur could be the braver decision. Delaying deployments may on the face of it seem counter intuitive, but could be financially beneficial assuming the need for capacity is catered for in a different way.

Akin to turkeys voting for Christmas, each different business function will have a say of this. The sales force wants to meet its commission target; the operations team wants to demonstrate an efficient network and the finance team is looking to increase margins and cash balances.

Patience is a virtue and waiting on an upgrade could be the thing. But in waiting you of course need to ensure that you have the relative luxury of being able to wait and solve near term network needs via other methods.

Mesh topology has been around for a while and offers significant benefits but doesn't naturally scale well to a multi terabit network. Resource Reservation Protocol (RSVP-TE) routing algorithms and engineering for routers is required to make best use for these large multi terabit routes but comes with a cost that can made deployment highly challenging.

But if achieved re-using existing capacity could offer some short term flexibility. It could at first seem to be more hassle than it's worth, but re-using non optimized bandwidth is just as useful as modern recycling and can lead to a greater focus on better use of capacity and removal of more costly legacy equipment.

7 KEEPING THE CONTENT HAPPY

But how does the network planner now cope with the changing landscape due to the ever increasing presence of media rich content flowing over the internet and associated backbones? Traditional traffic flow patterns are being challenged with geographical expansions and the growing use of social network sites and mobile data.

Content Delivery Networks (CDN's) are designed with this very much in mind. Bringing content closer to the edge of networks and therefore the eyeballs is, as the theory goes, reducing the load on long-haul transport networks. As ever, only time will tell if that really is the case, or whether the inter-regional demand for bandwidth will continue to drive long-haul demands, or will it become far more regional in nature.

But today's high speed internet connectivity remains very much in demand fueled further by mobile data usage, a trend that isn't easily to see letting up with LTE and 4G deployments already operational. The humble submarine system can't be seen in isolation anymore. Integrated city to city offerings, integration to wide area terrestrial networks will all play their part in creating a seamless and scalable platform.

8 CONCLUSION

Just as we are benefiting from those early railway pioneers, we are now greatly benefitting from the deployment of those early optically amplified systems ten or so years ago. Then the idea of being able to replace the end terminals with essentially a vendor of your choice to increase the capacity to 2x, 3x or 4x or more seemed hugely desirable, but perhaps a little too much of science fiction. But it's a reality.

The world has changed; it has accelerated and today on many of the subsea routes;

across the Atlantic, Pacific into Latin America and Asia these fast, efficient upgrades are sucking up a lot, if not all, of the current upgrade demand. These upgrades will enable an extension of the commercial design life of submarine cables, and for the first time perhaps we will need to seriously consider impacts of approaching actual system design life of sub-plant than we ever did in the past.

But does this mean that all the growth can be served by upgrades? Unfortunately not. There remain key undeveloped routes that do require development of new cable systems. The key question is when and how. Financiers still recall the recent past and the steady procession to the Bankruptcy Courts and therefore private systems can be challenged to get the much-needed finance. Consortiums whilst sharing the capital risk perhaps don't offer the ability to develop a unique route not owned by other like-minded developers.

What is in no doubt however is the significance of the humble upgrade and that the ability to adapt and use it in current networks holds the key for growth and opportunity.

