WHAT IF A CABLE SYSTEM WAS LIKE A CAR?

Norma Spruce, Stéphanie Rousseau, Laurent du Mouza (Alcatel-Lucent Submarine Networks)

Email: <norma.spruce@alcatel-lucent.com>

Alcatel-Lucent Submarine Networks, Route de Villejust, 91620 Nozay, France

Abstract: In 2009 governments worldwide introduced financial incentives to consumers to trade in cars aged ten years or older for new models. The car scrappage schemes introduced in many countries were designed to stimulate sales of new vehicles. Applying the same rule to submarine cable systems around a quarter of the submarine cable systems in service today would eligible for scrapping. This paper looks at the deployment and utilisation of submarine cables over the last two decades and whether a 10th birthday is a mid-life crisis or a coming of age for submarine cables.

1 INTRODUCTION

Now that for many countries the global recession appears to be over, there are many reviews of the actions taken to reduce the period and the impact of recession and whether they were successful. In 2008-9 the global recession lead many governments to look for ways to encourage spending and save national industries, especially manufacturing.

The scrappage incentive scheme for cars over 10 years old was introduced by several countries to stimulate the car industry and to promote the environmental benefit of removing older inefficient polluting vehicles and reducing carbon emissions. For example, in France, the “scrapping bonus” was offered on the condition that new car CO_2 emission was ≤160 grams of CO_2/km). Schemes in other countries such as the car scrappage scheme in the UK had no environmental pre-requisites but most new cars are designed with reduced emission rates. In North America, the Canadian Vehicle Efficiency plan and the Car Allowance Rebate Scheme (CARS) in the USA – commonly known as the ‘cash for clunkers’ scheme – linked the exchange to improved fuel efficiency cars.

According to CNN [1], at the end of the scheme in the USA in September 2009 (when the $3B fund had been used), around 690,000 new cars had been sold under the scrappage scheme and we assume that 690,000 cars were scrapped. Whilst some of the cars were not in good shape, there is a view that many of the cars scrapped were still serviceable and could have been driven for several more years.

The submarine cable industry does not appear to have suffered directly from the recent global recession and has not needed economic stimulus for its survival in the last two years. However, as the submarine cable business addresses global markets, it depends to some degree on macro-economic and global trends. The current global economic crisis coincides with the maturity of 10 Gb/s technology in submarine systems. This led us to examine some potential comparisons between the automobile industry stimulus schemes and the submarine cable industry, focusing on the age of systems and the maturity or obsolescence of the technology used in their construction.

As a simple starting point, it is interesting to assess the effect of applying a similar rule to submarine cables, i.e. scrapping systems over 10 years old.

2 TODAY'S INSTALLED SYSTEMS

Based on Telegeography Bandwidth Research [2], at the end of 2009 there were around 180 submarine optical fibre cable systems in service in the world (Figure 1). Almost two thirds of these cables are over 10 years old. Also only a few cables have been taken out of service in the past five years. These include 2 transatlantic systems (TAT-12/13 and Gemini North/South), the PacRim East/West systems in the Pacific, and some older regional cables (e.g. T-V-H).

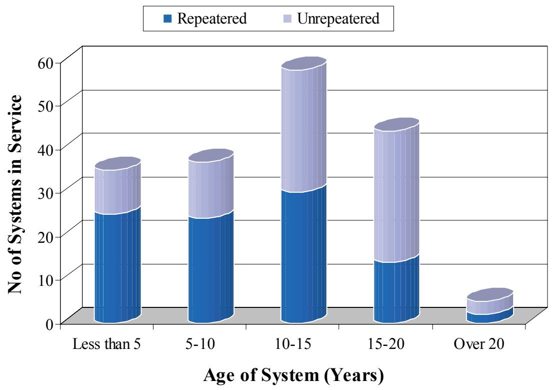

Figure 1 : Submarine Cables in Service in 2009

Of the total number of systems there were around 100 repeatered systems in service at the end of 2009. Of these cables nearly half are over 10 years old and one fifth over 15 years old (see Figure 2 below). Included in the systems that are under 10 years old are 5 cable systems that went into service less than 3 years ago but are made up of components of older systems that were taken out of service.

A few systems are now in the last seven years of their 25 year design life and continue to meet the technical performance for the submerged plant, cable and terminal equipment.

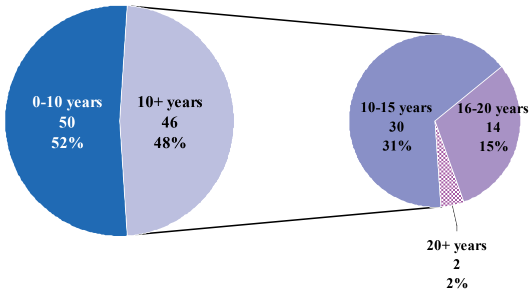

Figure 2 : Number of Repeatered Systems in Service Over 10 Years Old

The age profile of unrepeatered optical fibre cable systems is similar to that of repeatered systems, and around three quarters of the unrepeatered systems in service are over 10 years old.

Analysis of the how the repeatered systems aged 10 years and over are utilised shows a breakdown into three categories:

- Systems operated at original design capacity
- Systems that have been upgraded with later technology terminal equipment
- "Second life" cable systems.

These different categories are explored in more detail in the following sections.

2.1 Systems Operated at Original Design Capacity

Just under the half of the repeatered systems installed before 2000 continue to operate commercially in their original state, i.e. they have not been upgraded with new technology. These are the early generation of optical systems operating at 280 Mb/s up to 2.5 Mb/s. The age profile of these cables is shown in Figure 3 below.

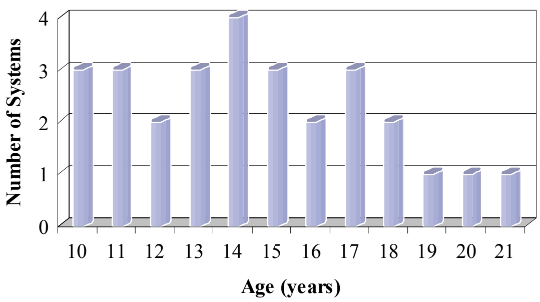

Figure 3 : Age Profile of Repeatered Systems Not Upgraded

Thirteen cable systems are over 15 years old, the oldest being now 20 years old. We assume that these systems remain in service as they continue to provide capacity at an economically viable rate due to low operations and maintenance costs and no market demand for higher capacity on the routes. Nevertheless it is expected that several of these systems will be taken out of service by the end of 2010 (e.g. CANTAT-3, Denmark-Russia, SAT-2) as it may become more economic to carry the relatively small amount of traffic on a newer cable in the region.

For some of the "younger" systems (less than 15 years old), there is still the potential to upgrade the terminal equipment without replacing the submerged part of the systems. Therefore by mid-2010 the number of systems operating at their original rate may be in single digits.

The technology developments that make this possible are discussed in the next section.

2.2 System Upgraded with Later Technology Terminal Equipment

Early generation optical systems often included conservative system design choices resulting in either additional margins or added potential bandwidth, or both. In addition, some of the key technologies and components available at the time of original system manufacture, (e.g. FEC, lasers, photo-diodes), had lower performance than today's equivalents. This has allowed telecoms suppliers to develop and offer new line terminal equipment based on more recent technologies and advanced modulation formats (e.g. DPSK) that can be installed on the older optical fibre systems whose original design capacity was based on 2.5 Gb/s technology. The replacement of the terminal equipment has increased the initial design capacity of the cable by a factor of 50 or more in some cases. This allows system owners to keep their systems in service longer. In 2009 several systems in the Latin American region which started service in 1994 were upgraded in this way and now have potential capacity of 320 Gb/s per fibre pair, having started life with an initial design capacity of typically 2.5 Gb/s per fibre pair, or less.

Introduction of DWDM technology in the late 90s, and the availability of higher performance components resulted in tighter designs with a significantly higher design capacity which meant that the initial installed capacity of newer systems is a fraction of the maximum capacity. For example the Apollo cable system started service in 2003 with initial loading of 80 Gb/s but has an ultimate capacity of more than 3.2 Tb/s per route. Additional 10 Gb/s wavelengths have been added through several upgrade contracts and incorporate latest features such as 10 GigE LAN-PHY Ethernet capability to meet demands for new services such as international Ethernet VPN services.

2.3 Second Life Cable Systems

In the last decade, system owners have become more innovative in optimising their submarine cable assets. A system that is no longer economically viable still has some residual value. For the old analogue systems, the cables were usually left on the seabed unless there was a legal requirement to remove them, and this requirement tended to be limited to the territorial waters of some countries. In the mid to late nineties when commodity prices rose, some cables were sold and subsequently recovered as the cable materials (copper and polythene) could be sold and a profit made even after paying for ship costs for the recovery. For optical cables, the recovery value is less as newer cable designs have reduced the amounts of the high value materials.

Another use for out of service cables is to hand them over to universities and other agencies for scientific research. The cable data published and updated the website of the International Cable Protection

Committee (ICPC) [3] includes records of several analogue cables in the Pacific Ocean that are retired from service but are marked as being in use by universities and government agencies for scientific use. For example in the Northern Pacific, the Oluhu (Japan-Philippines) and Okitai and Japan-Korea cables that were retired in 1997 after 17-20 years of service are now shown as being in scientific use with the maintenance authorities shown as ocean research institutes of universities in Japan, Korea, Taiwan and the Philippines. Earthquake research institutes along with other US universities are cited as the point of contact for several cables from Hawaii to the US mainland (e.g. HAW-1, HAW-4 and COMPAC).

If a cable is recovered, this obviously clears space on the seabed for a new cable on the same route. Shore-end cables of earlier systems are likely to be on the best and most secure route and the corresponding landing parties also have an operating license. Therefore it may be possible to re-use this shore-end route for a newer cable or re-use the actual shore-end cable as part of a new system.

In the past five years another category of cable re-use has emerged – "Second Life" commercial cable systems. Certain operators and entrepreneurs re-use the wet plant and other parts of a retired cable system to create a "second life" cable system on a different cable route. One example of this is the private transatlantic cable system that was only in service for seven years before commercial operation ceased. The owner/operator of this cable had ownership in newer and higher capacity cables across the Atlantic and therefore we can assume that the reason for early retirement was economic. However, although retired, this cable has not been "scrapped" and that was the start of its second life. Parts of the system have been re-used together with new network elements to create new regional cable links.

In the Pacific region, two new cable systems – American Samoa-Hawaii and APNG-2 – are in operation. These 'new' systems were implemented using parts of the PacRim East and PacRim West cables which were taken out of service around 2005 after 10-12 years of service since the 560 Mb/s technology had long been overtaken by more modern WDM systems serving the same routes.

3 THE FUTURE FOR NEXT GENERATION OF 10 YEAR OLD CABLES

The improvements in DWDM technology in the last 10-12 years will probably see some systems not reaching full capacity till much later in life, particularly on regional routes. Even to meet very small initial capacity needs (e.g. Gondwana, Atlas Offshore, GCN/SCF/MCN, Greenland Connect) a minimum system design still yields significantly more design capacity than the initially installed capacity - possibly by a factor of 100 or more. Thus the probability of the submarine cable being filled and or replaced by something with larger capacity during its design lifetime is low based on current market assumptions, unless commercial or political factors are sufficiently strong to justify a competing system offering the same connectivity, e.g. the recent Australia-USA cables (Telstra Endeavour and PPC-1). Previous generations of "single channel" technology simply did not have this massive upgradability. Fortunately, the continuing growth of bandwidth consuming applications (e.g. video content) is helping to keep system suppliers in business despite selling highly upgradable DWDM systems.

In 2010 around 20 repeatered systems will be approaching their tenth birthday. Of the 11 systems in service across the Atlantic, ten would be eligible for "scrappage" by 2011 under a hypothetical 10 year scheme. However, there is no sign yet of new build of Atlantic cables and based on Telegeography's bandwidth research [1] the cables that came into service from 2000 to 2003 are still less than 50% lit. In the Pacific Ocean, 2 new transpacific cables – Trans Pacific Express (TPE) and Asia-America Gateway (AAG) - came in to service in 2009 but there is no sign of any of the existing cables coming out of service.

4 THE ENVIRONMENTAL EFFICIENCY ANALOGY

Coming back to the car comparison, the second reason for scrapping cars over ten years old was to promote the environmental benefit of removing older inefficient polluting vehicles from the automobile population to reduce carbon emissions. There is not much published research on the environmental impact of submarine cables. A recent Environment Update published by ICPC [3] referenced a recent graduate study that assessed the environmental impact of submarine cables and concluded that the largest impact was associated with the electrical power consumption at the cable stations and the operations of the installation and maintenance vessels during the life of the cable.

Current and future designs of telecommunications systems are already addressing reductions in power consumption and we assume ship design will also take this into consideration. As for the generation of carbon emissions by ship operations, this is another reason for not recovering and scrapping submarine cables too early. Once the cable system is retired, the power consumption can be reduced to zero and the cable is generally considered to be benign on the seabed. But to remove the cable from the seabed, ships must be deployed and system components disposed of safely – both activities generating CO_2 emissions.

Therefore, in line with recent analysis of the impact of car scrappage, the jury is still out on whether there is real benefit to the environment by removing and scrapping cables as they are not energy efficient compared to new models. However, this conclusion is based on the current business model for marine maintenance. Evolution of maintenance service structure (i.e. fewer ships or eco-sustainable 'green' ships) may revise this view. Also it is possible that energy cost increases or infrastructure needs with high eco-quality targets may stimulate some profitable "early dismantling schemes". It is worth noting that while these external parameters could drive some evolution of the market structure, the speed of such evolution is not expected to be very fast, based on available submarine market data.

5 SUMMARY AND CONCLUSION

With continued support from the system suppliers, owners/operators appear confident that most submarine cables will be economically and viable throughout their 25 year design life. For most upgraded optical fibre cable systems it is only the transmission equipment has been updated - the cable, submerged plant and power feeding equipment remain unchanged.

A 10 year old submarine cable system is in fact in its prime – having been in service for less than half of its design life. Today, there is no need to trade in such systems for new models, and the system owners have options to maximize the value of their initial investment.

However, for some cable owners a 'scrappage' incentive for a cable aged 15 years may look attractive as IRUs and/or building leases or even licenses expire, and, as a consequence, revenue is reduced and costs increased. So a financial contribution to a new cable build that delivers higher revenues could be appealing. But it would probably be market forces rather than government stimulus that would drive any such 'trade-in'.

Coming back to the original title of this paper – What if a cable system was like a car? – it is evident that the context in which the car scrapping schemes proved to be efficient does not fully match today's reality in the submarine cable industry. Let's assume that the automobile industry is probably relieved that the car is not like a submarine cable!

6 REFERENCES

[1] CNN Money.com October 29, 2009

[2] Telegeography Research Publication Global Bandwidth 2009

[3] International Cable Protection Committee – www.iscpc.org