DOES "COST CAUSER EQUAL COST PAYER"? ENSURING THE METHODS OF SHARING SYSTEM COSTS KEEP PACE WITH SYSTEM TECHNICAL DEVELOPMENT

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Abstract: Submarine cable consortium rules on sharing costs aim to do so on an equitable basis, using the principle "cost causer equals cost payer". Upgrades of a system can lead to distortions in how the costs are allocated. Cost sharing rules need to keep pace with system expansion and development, as different suppliers and/or technology are used and as existing wavelengths get replaced to allow further system growth. This paper considers issues with cost sharing rules that arise from implementing system upgrades and recommends alternative principles by which systems should apportion their costs.

1. INTRODUCTION

The construction of a new submarine cable system is usually only the first step in its life. Through system upgrades, owners are able to increase the capacity carried by the system and take advantage of new developments in transmission technology. Upgrading a submarine cable system prolongs the system's competitive commercial life and delays the need for new cables on its route. [1] [2]

The benefits are straightforward and easily enjoyed by private cable systems. It is not always so simple for common carrier consortium cables: each owner of a consortium cable has its own agenda and may not necessarily want to participate in an upgrade at a time when other owners of the same cable do. Consortia develop rules to ensure that all purchasers are treated fairly, and include them in the consortium Construction and Maintenance Agreement (C&MA). Such rules not only include constraints on how much capacity each party is able to obtain during an upgrade, but also the rights of parties who were purchasers of the original cable system but are not participating in the upgrade in question. The general concept is summarised by the phrase "cost causer equals cost payer", but it is not always clear who is causing the cost, and whether or not only they are benefitting.

2. TYPES OF UPGRADE

Upgrades come in many different varieties: as well as the familiar "dry" upgrades of terminal equipment, reconfigurations of wet plant are also now starting to be considered [3]. For simplicity, this paper will consider upgrades of dry plant only, as illustrated in Figure 1:

- Lighting of unused dim/dark fibres
- Overlay of new wavelengths in parallel with existing wavelengths on a fibre pair

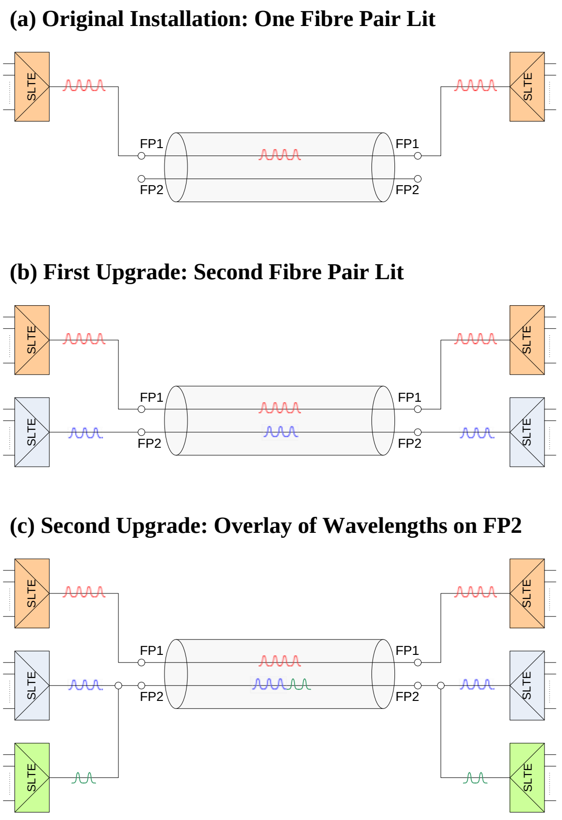


Figure 1: Upgrade Illustration

Because of the large number of possibilities and their relationship with future technical developments, it is impossible for C&MA rules to foresee all upgrade scenarios. Upgrades can be quantum leaps in the development of a cable system, at which the supplier or technology type is changed, or existing equipment needs to be replaced to allow further expansion. Conversely, an upgrade may involve the removal of system complexity and/or functionality if, for example, a SDH/SONET layer is replaced with Direct Wavelength Access (DWA). Thus it is not sufficient for C&MAs to create upgrade rules which assume that upgrades will simply be more equipment of the same type used in the original system implementation.

3. CASE STUDY

The authors have studied a sample regional cable system which has undergone several phases of upgrades. This system has undergone the stages of construction and expansion explained below. For the avoidance of doubt, these stages are different from the illustration in Figure 1.

- Phase 1a: original installation by supplier “X” (original system supplier)
- Phase 1b: upgrade by supplier “X” based on the same technology as original installation
- Phase 2a: upgrade by supplier “Y” (different supplier than original system supplier)
- Phase 2b: further upgrade by supplier “Y” based on same technology as Phase 2a

The example system can be considered to have undergone two broad phases, each provided by a different supplier. Each phase was made up of 2 steps: the original implementation followed by a further upgrade where “more of the same” equipment was added. This terminology of “phase” and “step” will be used in the discussions below.

4. CAPITAL EXPENDITURE CONSIDERATIONS

Consideration of the allocation of Upgrade costs tends to focus on the equipment capital cost. On the “cost causer equals cost payer” principle, parties wanting to participate in an upgrade need to pay the capex for the new equipment plus associated services (increase in space and power, Purchaser QA, etc.). These simple capex costs are sometimes adjusted according to the principles described below.

Equalised costs. Some systems require the steps within each phase of development to have equalised costs. That is, for a given series of upgrades based on the same technology and same supplier, the unit cost of each upgrade should be the same. In our example system, the unit costs of Phase 2a and Phase 2b would be the same, for instance. Given that the cost of equipment generally decreases with time, equalisation is achieved by adding a surcharge to later upgrade steps which is paid to partially reimburse the earlier steps. This concept is motivated by fairness but it is questionable whether the extra complexity entailed is worthwhile or even whether it is beneficial to try to manipulate market forces in this way. Artificially increasing the cost of upgrades could reduce the economic life of a system.

Right to use. For upgrades where not all owners participate, some systems have developed a "right to use" (RTU) concept whereby upgrade parties have to compensate the original owners for making use of the wet plant that they originally built. This means an increase in the upgrade capital budget to accommodate the RTU payment. In such cases it is argued that the upgrade parties are enjoying the benefit of the submerged plant and under-cutting the capacity costs of the original owners, while at the same time preventing the non-participants from upgrading in future. Such arguments are avoided by systems whose C&MAs include the concept of "upgrade rights", where each party has a guaranteed share of any upgrade in proportion to its original capital investment.

The RTU model is simplistic in that it ignores the following factors:

- It ignores the increasing operation and maintenance (O&M) costs of old terminal equipment as it ages. When the equipment reaches the edge of the bathtub curve, increased failure rates mean that more effort is expended by station staff in maintaining the equipment.
- Sharing fixed O&M costs (e.g. manpower, cable maintenance agreement costs, etc.) between an original system and upgrades reduces the costs for all. Simplistic rules based on capex and ignoring opex are insufficient.
- The effect of increasing the cost of the upgrades or acting to block upgrades, which limits the economic life of a system.
- Investments made when the system was originally built were approved without necessarily expecting or relying on upgrades, so the non-participants have not "lost" anything when an upgrade is constructed.

Common costs. For a given phase of a system's development, some of the equipment will be specific to a particular upgrade step, while other equipment will be common to all steps in that phase. The common costs will generally have been incurred at the first step in an upgrade phase, with subsequent steps benefitting from this. Some systems therefore require the later steps to reimburse the earlier steps for the use of the common equipment. The separate treatment of common costs recognises the responsibilities of parties for the ongoing development of the system and encourages responsible planning of equipment procurement.

Replacement costs. Sometimes it is necessary to replace existing equipment in order to allow future expansion of a system, for instance to replace existing 2.5G wavelengths with higher bit rate wavelengths. In such cases, a proportion of the upgrade capacity is allocated to replace the retired equipment of the owners not participating in the upgrade. The cost of this capacity is often allocated to the upgrade parties on the "cost causer equals cost payer" principle; if there was no upgrade, then no replacement would be needed. This however ignores the finite lifetime of terminal equipment and the fact that the non-participants are effectively having their equipment renewed free of charge. The industry standard lifetime for submerged plant is 25 years; by contrast, terminal equipment has a realistic lifetime of 15 years and its economic lifetime is often less. Therefore cable system owners should not assume that their original investment is their only investment: even if they do not wish to participate in upgrades, they should expect to have to replace terminal equipment during the system life to maintain their original capacity. This is a further argument against the RTU concept discussed above. Owners need to consider the total cost of ownership and accept the need to bear a proportion of replacement costs.

Whether or not the refinements described above are desirable seems to come down to a simple question: should upgrades be seen as taking a "free ride" on the back of the original investment by the parties who built the wet plant or previous upgrade steps, or, considering the total cost of ownership, should they seen as developments which benefit all system owners, regardless of whether they participate in an upgrade?

5. OPERATION AND MAINTENANCE CONSIDERATIONS

Whilst considerable effort and thought has been expended addressing cost allocation for upgrade construction, as yet the industry has given little consideration to the allocation of O&M costs following upgrades.

O&M charges come under one of the following broad headings:

- **Cable maintenance agreement costs.** These are usually fixed by the cable length, and as such are not affected by upgrades. Other marine costs such as cable protection are also fixed.
- **Maintenance Authority costs**, such as land cable maintenance, cable protection and wayleaves. These costs are also fixed regardless of the capacity of the system.
- **Station staff.** The number of staff in cable landing stations rarely increases following an upgrade. Moreover, the nature of operations has migrated towards lower levels of maintenance activity as systems have trended away from SDH aggregation and services towards DWA services. The optical transport system is becoming the main focus and not the low level services in what is the reversal of the operations paradigm. As a result, the effort involved in maintaining new upgrade equipment is less than maintaining the legacy equipment from previous phases.
- **Space/power.** The footprint of new equipment is generally smaller on a per-capacity basis than earlier equipment.

At present there are two schools of thought for allocating O&M costs: charging by ownership or by capacity. Neither method was developed in an era of system upgrades and the interaction of O&M and upgrades was not considered. The shortcomings of the methods have led to distortions in the allocations of costs and hence discontentment from both sides of the upgrade debate, resulting in conflict between upgrade parties and non-upgrade parties. Some parties have been known to simultaneously advocate contrary positions in different cable system consortia, depending on whether or not they are upgrade participants, to suit their own interests. This inconsistency exposes the weaknesses of the models.

Allocation by ownership. Figure 2 shows the division of ownership (based on capital investment) for the example system studied by the authors. Note that this system neither employs RTU, Equalisation or Common Costs rules, so the data is purely based on the capital expenditure at each stage. Figure 2 shows that the original system cost dominates, making up >80% of the total cost of the system.

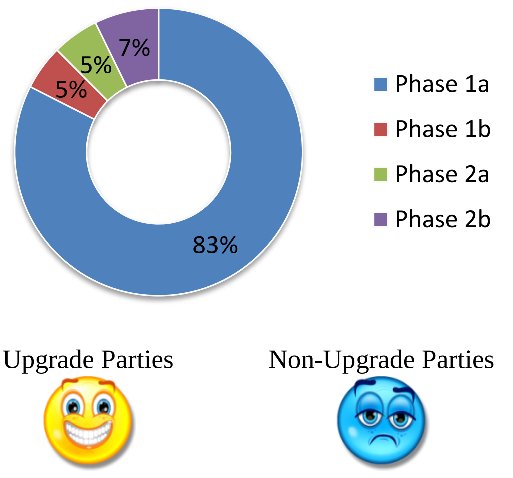


Figure 2: System Ownership (Capital Cost) by Phase

Given that a large proportion of the Phase 1a costs was used to build the submerged plant, which is needed to support the subsequent phases, this model seems to unfairly penalise the original owners and favour the upgrade parties.

Allocation by capacity. Dividing O&M costs by activated capacity is more common. Figure 3 shows that, for our example system, the original build (Phase 1a) only constitutes 10% of the capacity, while the subsequent upgrades (which were able to exploit more modern transmission equipment) together make up 90% of the system capacity. Dividing costs in this way favours the non-upgrade parties.

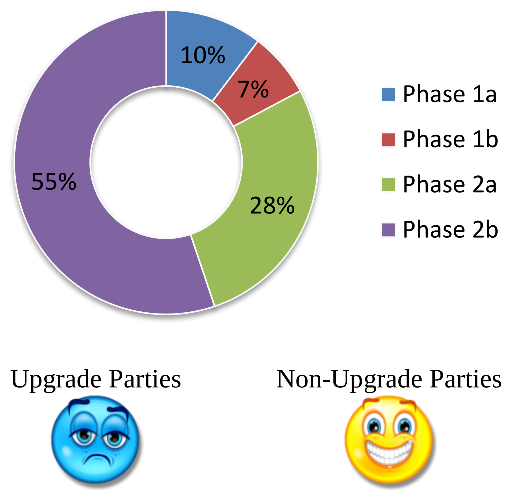


Figure 3: System Capacity by Phase

Neither method seems a satisfactory basis for dividing up the O&M costs.

6. ALTERNATIVE MODEL FOR OPERATION AND MAINTENANCE COSTS

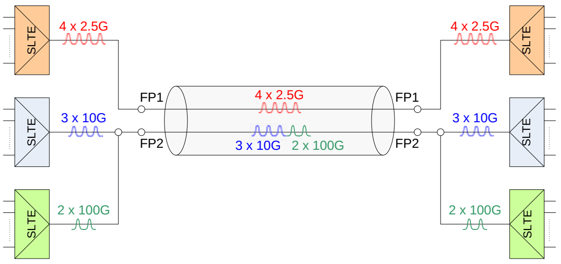
The authors propose an alternative method for allocating O&M costs based on "real estate" usage, which we believe provides a more equitable picture, in keeping with the "cost causer equals cost payer" principle.

Cable maintenance agreement and Maintenance Authority costs. The authors propose that the cable maintenance agreement costs and other marine fixed costs be normalised by fibre pair and wavelength.

- Cost allocation should in the first instance be weighted by fibre pair. That is, each fibre pair in the system should contribute an equal share of the overall O&M budget. This concept should mean equitable contributions towards the submerged plant maintenance, e.g. Maintenance Agreement km.
- Within each fibre pair, the costs should be weighted by wavelength. On this basis, n x 2.5G wavelengths would incur the same amount of cost of n x

10G or n x 100G wavelengths. This concept should mean equitable contributions towards terminal equipment, based on the amount of effort needed by staff in the station.

To demonstrate this model, Figure 4 shows an illustration based on Figure 1(c).



Phase	FP	Number of Wavelengths	Share of Maintenance Agreement Cost
Original installation	1	4	50%
First upgrade	2	3	30%
Second upgrade		2	20%

Figure 4: Allocation of Maintenance Agreement Costs Based on Alternative Method

Station Staff and Space and Power. For simplicity, the authors suggest that these costs be allocated based on equipment footprint, as a crude measure of the amount of equipment and therefore work and power incurred.

Figure 5 shows the case study system divided up according to the "real estate" model. The O&M costs are divided more equally than in the existing models.

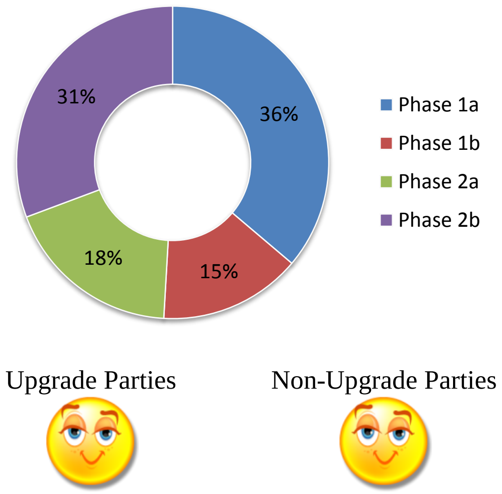


Figure 5: System O&M Costs by Real Estate Model

Different answers may be needed for different systems. Figure 4 shows a point-to-point system, the simplest possible configuration. With appropriate refinements, it should be possible to apply the "real estate" model to more complex network topologies For instance, on a trunk and branch system, the normalisation by fibre pair can be applied to each segment or digital line section. Further complexity may be needed where a mixture of DWA and SDH/SONET is carried.

7. CONCLUSIONS

Rules for allocating Upgrade costs often overlook the fact that Upgrades are beneficial to all parties, whether participating in the upgrade or not, when the total cost of ownership is considered. With largely fixed O&M costs, an Owner's share will always reduce if the capacity of a system is expanded. Moreover, upgrades allow non-participants to update obsolescent equipment carrying their traffic and thereby benefit from technical developments.

Given the fast pace of technical change in the submarine cable industry, attempts to second-guess the future or artificially equalise capex costs are unlikely to succeed. Rules for the division of capex should not create unnecessary obstacles to discourage upgrades of a cable system. Such rules should consider the total cost of ownership and facilitate responsible management of the system.

Until now, the division of opex costs has been neglected and still requires more study. The proposed "real estate" model for O&M costs is a possible first step towards a fairer allocation of costs.

8. ACKNOWLEDGEMENTS

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9. REFERENCES

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