A Quantitative Study on the Influence of ASON/GMPLS on OPEX

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Abstract

ASON/GMPLS is promoted as one of the key technologies to reduce operational expenditures (OPEX) of network operators, since it provides the tools for automating the network operations. This paper gives a detailed model and qualitative analysis of the major OPEX-affecting operation processes. Moreover, a first quantitative evaluation of the changes in the operational efforts induced by ASON/GMPLS is described. The evaluation shows a significant potential to reduce OPEX, which is to some extend independent of the type of operator.

1 Introduction

Often, the automation of network operations using ASON/GMPLS is promoted as a major technology to reduce Operational Expenditures (OPEX) of network providers. However, detailed analysis and quantitative evaluation of the changes induced by such technologies is very rare. In this paper we quantify the cost reduction potential of ASON/GMPLS. We start with a detailed analysis and modeling of the five most technology dependent and OPEX affecting processes within the traditional structure of operators: the offer, provisioning, cease, move/change, and repair of services. Then, we describe the process changes to be expected by the introduction of ASON/GMPLS [1]. Based on a survey using questionnaire techniques with several operators, these process models are verified and parameterized regarding the costs and efforts involved. This allows a quantitative evaluation of the OPEX changes by ASON/GMPLS.

The results show that depending on the exact structure of a network operator's processes, different impact can be expected: Although there were some differences between individual operators, more than 40% savings per service showed up via the use of ASON/GMPLS technologies, but always under the prerequisite that the operators' processes have to be re-engineered accordingly.

2 Approach

The total expenditures of a company can be split in two parts: The capital expenditures and the operational expenditures. Capital expenditures (CAPEX) are related to the fixed infrastructure of the company and how they are depreciated over time. Operational expenditures (OPEX) do not contribute to the infrastructure itself and consequently are not subject to depreciation [2]. They represent the cost to keep the company operational and include costs for technical and commercial aspects of operations, maintenance, administration, etc.

This paper focuses on the impact of ASON/GMPLS on the OPEX in an operational network, i.e. one that is up and running [3]. We therefore don't consider the costs of the initial installation and those of network extensions. All infrastructures are counted as CAPEX in our model, as suggested in [4].

For the traditional network, we assume that it provides end-to-end services. The ASON/GMPLS network additionally offers dynamic services.

Network operation comprises all the processes and functions needed to operate a network and deliver services to customers. That includes the sales and marketing processes, the various support functions, as well as provisioning and monitoring, maintenance of the network and the corporate processes in general. By far, labor costs associated with all of these items account for the majority of a service provider's annual operating expenditures budget (besides other costs of infrastructure, such as energy, floor space etc). The significance that a reduction in operating expenditures may have cannot be played down, as it has become one of the key challenges for the operators in recent years.

In this study, we will perform a process-based qualitative and quantitative analysis of the reductions in operational costs to be expected for network operators

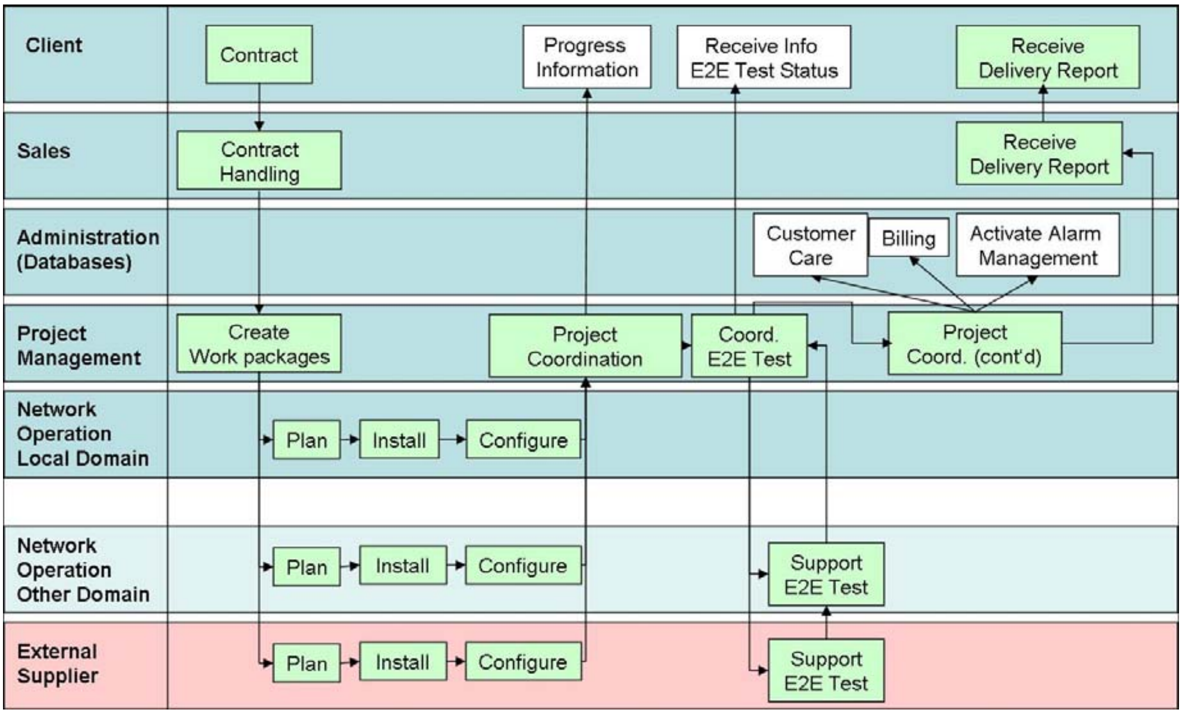


Figure 1: Typical service delivery process

using ASON/GMPLS. The idea is to evaluate which operations become more or less expensive and which operations become less expensive, when the traditional static transport network gets enabled with ASON/GMPLS technology. In extreme cases, some operations can even disappear or new operations appear. Based on the initial qualitative modeling, quantitative results can be calculated. The normal cost of each operational step is the one assumed in the basic OPEX model, for the traditional approach. Combining these costs and the qualitative variation, the new costs can be extrapolated. In this way the incremental costs/ benefits from using ASON/GMPLS can be obtained.

3 Considered Processes

Due to the automation capabilities of ASON/GMPLS, the service management will be affected to the greatest extent within the process structure of a network operator. Thus, for our study we investigated the five most technology dependent processes within the traditional structure of network operators considering the interactions and operations of sales department (SD), administration (AM), project management (PM), network operation (NO) and external suppliers (ES).

Service Offer

The sales department negotiates the terms and conditions of the offer with the customer and does an inquiry whether the connection request can be handled by the standard mechanisms and infrastructure. In case of non-standard connection inquiries, a separate individual projecting (PM) is triggered for the various domains (local, internal, external), and missing equipment (cards, fibers, etc.) is ordered, causing additional effort and delay. The projecting results then define the price calculation (SD), as well as the delay necessary to set up the service. Then the offer is sent to the customer.

Service Delivery

After the contract has been accepted, the service delivery process starts (see Fig. 1). The sales department handles the contract administration and forwards it to the project management that splits it into work packages according to the network domains involved. After providing the connection, an end-to-end test is conducted (PM) and customer care, billing and alarm management are activated (AM). Finally, a delivery report is issued by the sales department to the customer.

Service Cease

At the end of a contract or on cessation request by the customer the cease process (Fig. 2) triggers (via PM) the deactivation of the circuits (NO), followed by the recovery of equipment by field technicians (NO). SD is informed about the expected cessation and the final bill is sent out (AM).

Service Move or Change

Moving or changing a connection is the most complex task since it involves all three previous processes: Contract update, new connection setup, and release of

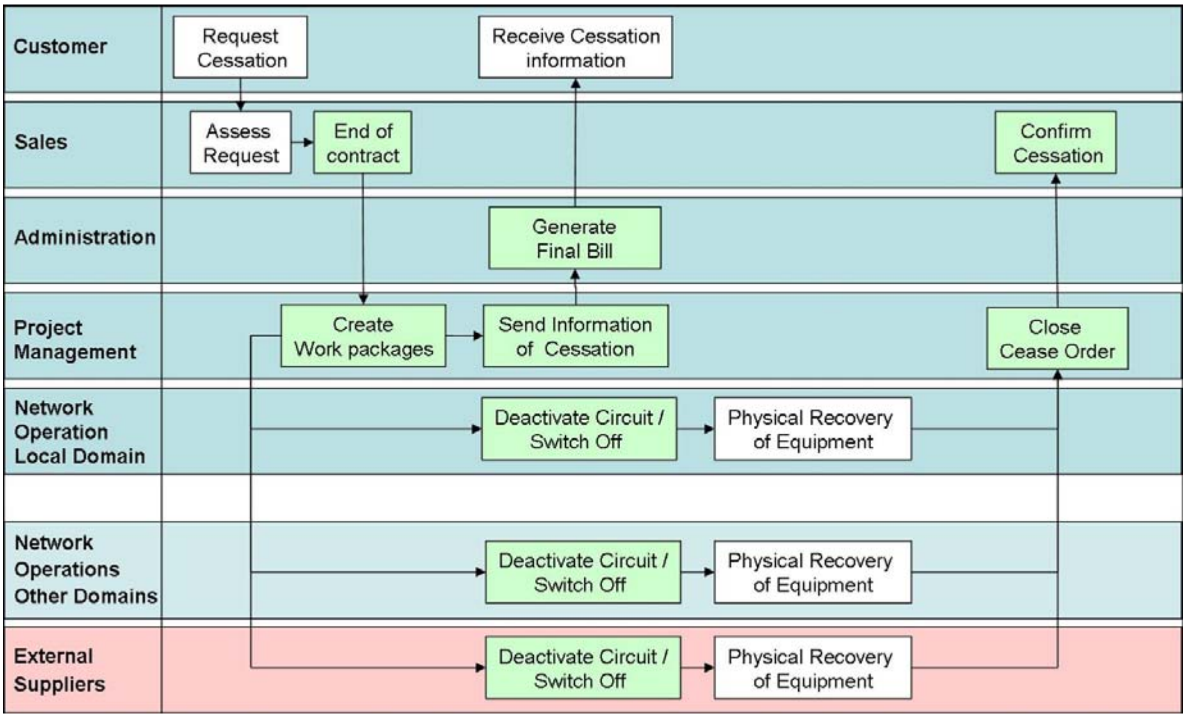


Figure 2: Typical service cessation process

the previous connection. The customer's request for change is handled by the sales department as a service offer process, checking again for the availability of resources. The sales department then generates orders for the service provisioning and cease process that are implemented through coordination from the Project Management department. At the same time the client is receiving updates on the new installation.

Repair

Repair means actually repairing the failure in the network, if this cannot happen in routine operation. Reparation may lead to real service interrupts, depending on the protection scheme used. The actions involved in the repair process are diagnosis and analysis, the technicians traveling to the place of the failure, the actual fixing of the failure and performing the tests required to verify that the failure has been successfully repaired.

4 Impact of ASON/GMPLS

Technologies automating some of the network operations allow to significantly reduce the costs for service provisioning, because network data, configuration commands and confirmations are automatically created and exchanged by signaling and routing protocols. The signaling can be done via standardized interfaces (User Network Interface UNI and Network to Network Interface NNI) and the amount of required manual intervention will be reduced. This means that the costs for setting up a new connection significantly decrease.

In this case, the service offer process and the provisioning process will change fundamentally [5]. Since the service delivery now will be automated and executed to a higher extent on a pure machine level, correct agreements and regulations have to be negotiated by the sales department, and implemented well before. Detailed Service Level Agreements (SLAs) are even more important compared to the traditional approach. The use of ASON/GMPLS technologies and the possibility to offer dynamic services are strongly interconnected issues. The strongest impact of the dynamic services is on the pricing and billing process. Fixed price services, e.g. leased lines, will definitely be cheaper in pricing and billing than dynamic services. For dynamic services it is more difficult (and thus more expensive) to correctly assign costs to customer accounts. Calculating a new price for a new service is more expensive than just applying a traditional pricing scheme. This is elaborated below as "negotiations" in the service provisioning process.

SLA Negotiations

The process chain therefore starts with the SLA negotiation process. Before services are ordered and delivered, a contract framework specifies in detail all sections of a generic service template. Technical aspects like bandwidth (minimum, burst) and its granularity, service availability, quality of service are specified as well as legal and organizational items (penalties for requirements not met, compensation, tracking, and reporting, etc.). Within the network operator, this is

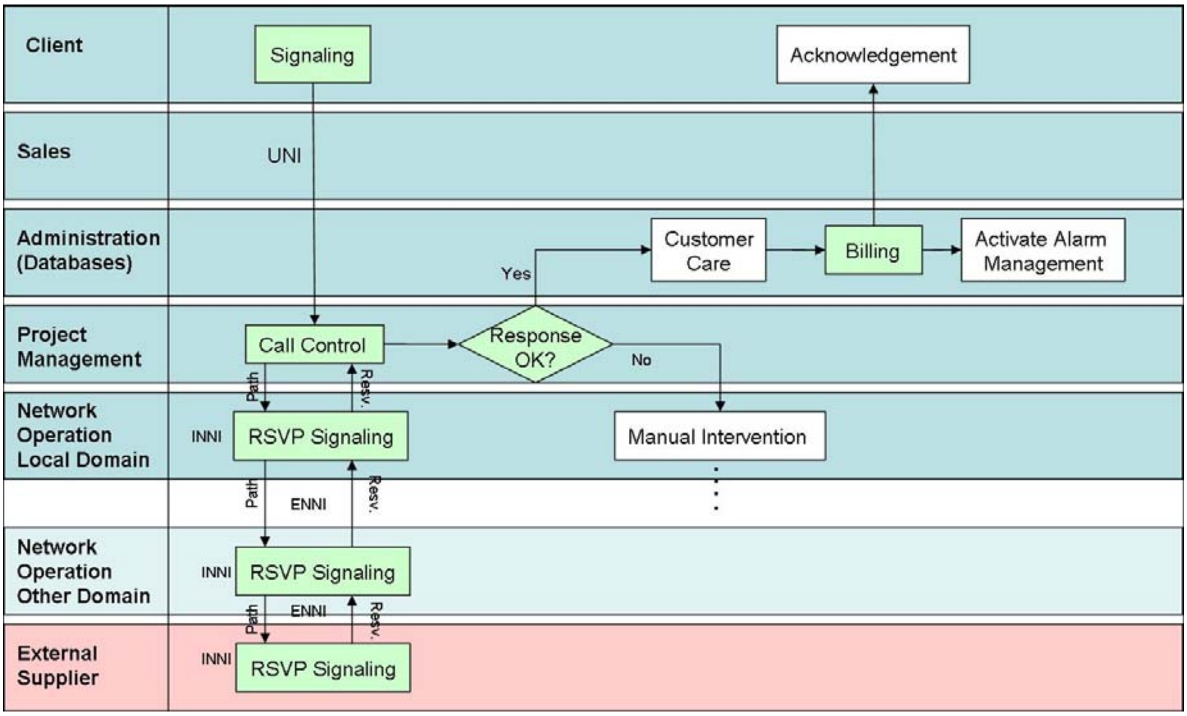


Figure 3: Automated service delivery process

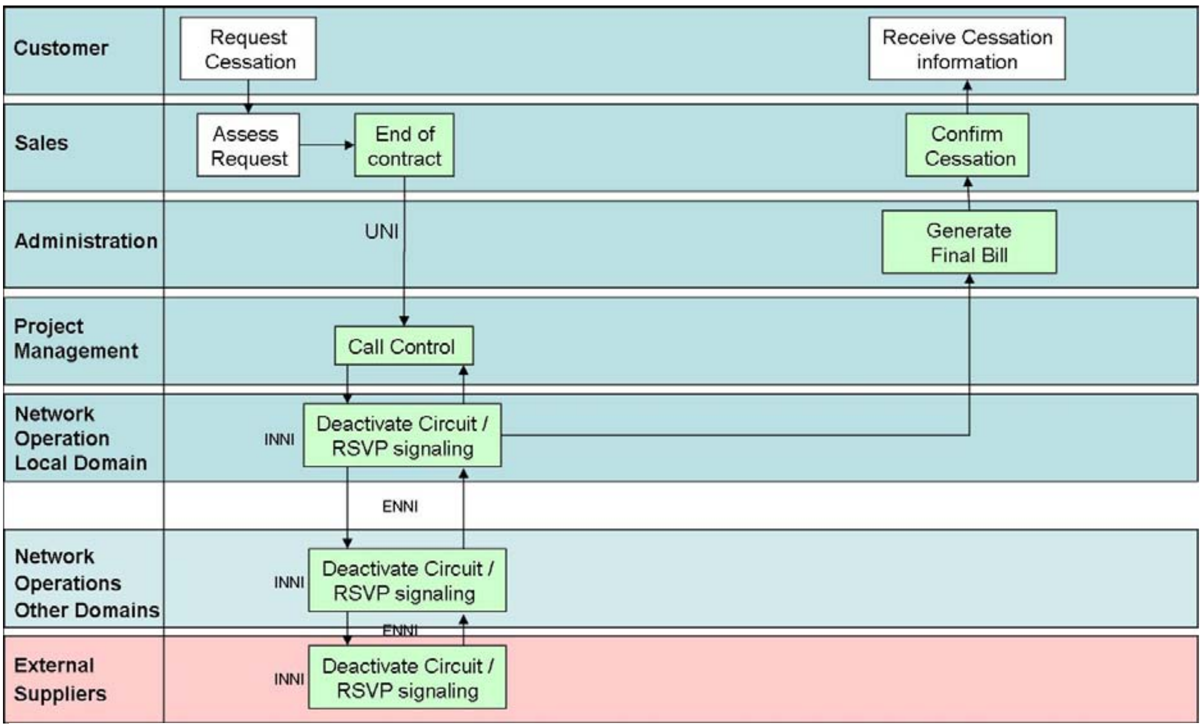
accompanied by forecasts (SD), planning (PM), and adaptation of the infrastructure (NO).

Service Delivery

After this contract framework has been set up, the service delivery process can be simplified due to the introduction of standardized interfaces (Fig. 3). Manual intervention is necessary if no positive responses were received. After a database update (AM), customer care is informed, and billing and alarm management are activated. At the end of this process, the client receives the delivery report. It is important to note that no end-to-end testing is assumed in this process, thus the pure cost comparison with the standard service delivery process might not be completely fair since the quality of the service may decrease here.

Service Cease

In the ASON/GMPLS case, the cessation request is also received via the UNI. The cease process (Fig. 4) then triggers the sales department to assess the cessation request and trigger the billing and confirmation of



cessation to the client. On the network side, the network operation centre is requested to cease the physical connection. Once the connection is released, this is confirmed to the project management and the order is closed.

Service Move or Change

The ASON/GMPLS-modified move and change process is initiated by the customer requesting a move or change. The availability of resources and the conformity of this request within the SLA contract are checked automatically. If both have been answered positively the corresponding cease and provisioning steps are handled directly via the control plane. Manual intervention is only necessary if additional resources have to be deployed in the network or if the request exceeds the SLA framework. Finally, the customer is informed about the results.

Repair

As a result of using ASON/GMPLS it is expected that more failures can be fixed from the network operation center, which could have a beneficial impact on the repair costs. On the other hand, ASON/GMPLS leads to more complex network operation processes, which might be an additional source of failures. Rerouting of traffic happens faster: ASON/GMPLS allows for enhanced restoration and protection schemes. Isolating a fault gets cheaper when LMP's fault management procedure is available (however, the link management protocol LMP is optional in ASON/GMPLS, [1]). Overall, we expect the costs for the reparation process to decrease in case of ASON/GMPLS. [3] gives an overview of the repair process.

5 Quantitative Results

For each of the processes, costs have been assigned to the process steps (boxes in the figures above) and a probability to the branches. We focused on labour costs, expressed in terms of hours required to carry out the task described in the box. Then we calculated the hourly costs[1] of each kind of employee[2], and multiplied it by the number of hours. Summing up costs for all steps gives then an upper bound estimate of the overall costs of a given process.

The figures on which we based our calculations were obtained by means of interviews and surveys of several network operators[3]. A first analysis of these figures revealed two main types of operators. As a matter of fact, some operators had high number of hours for the sales, administration and project management departments. On the other hand, another group of operators presented lower figures for these departments, whereas the figures for the other departments remained in the same range. We denote the first type of operators as incumbent since they have usually heavier administrative procedures involving a bigger number of employees. By contrast, the second type is denoted as new entrant, having less administrative overhead and simpler project management procedures.

Incumbent

In case of a typical incumbent operator (Fig. 5, costs normalized to total costs of the most expensive process), the service offer process involves expensive sales and availability check operations. In the end this is nearly as expensive as the service provisioning itself. The cease process involves nearly no work from project management and network operations centre, which explains why it is much cheaper. The move and change process is the combination of service offer, provisioning and cease (in principle, it is a little more expensive since it requires some more coordination).

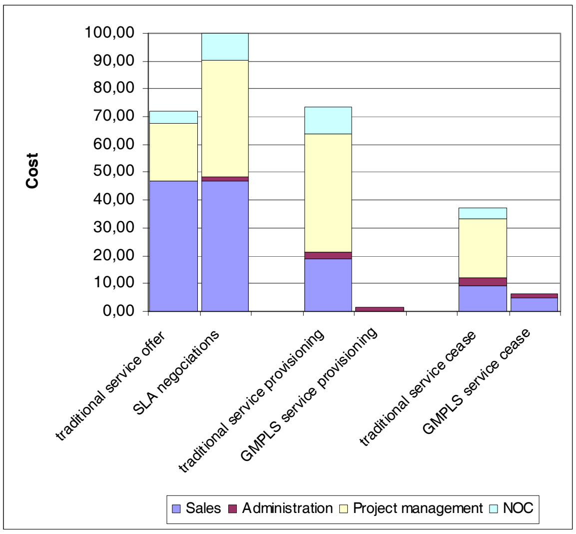


Figure 5. Cost comparison for incumbent

Looking at the ASON/GMPLS-modified processes, we first notice that SLA negotiations are more expensive than the typical service offer. This is not unusual since the former includes some operations that are usually carried out in the service provisioning process (plan, install and configure equipment boxes). For a fair comparison, one needs to compare the combination of service offer and provisioning. In the case where ASON/GMPLS is used, project management and sales are involved only once - when the SLA is setup - leading to substantial savings. Another advantage is the fact that the same SLA can serve for several

[1] Costs for the company, not only the wages, as suggested in [6].

[2] Each department involved in the processes is composed of one type of employee except the Network Operations Center, where engineers, technicians and field technicians have been considered [6].

[3] For confidentiality reasons the company names of these operators are not disclosed in this paper.

services. Once the SLA is in place, provisioning several services with ASON/GMPLS costs much less.

New Entrant

For new entrants (Fig. 6, costs again normalized with the same factor as in Fig. 5), we first see that typical processes are cheaper. This is not unusual since less administrative procedures and project management are involved. However, we should not forget that this type of operator certainly owns less equipment and infrastructure and thus probably doesn't provide as many different types of services as an incumbent. Moreover, outsourcing parts of a connection to an external supplier is more frequent, e.g. access lines from a city carrier. In Fig. 5 and 6, the costs displayed do not include the costs of having part of a service going through an external supplier, since this can vary widely and depends on many parameters. But one has to keep in mind that the additional costs it induces (renting, more testing required at interconnection points, etc.) will certainly reduce the cost difference between incumbents and new entrants. In any case, also for the latter ASON/GMPLS modified processes are cheaper and in the same proportion as for the incumbent.

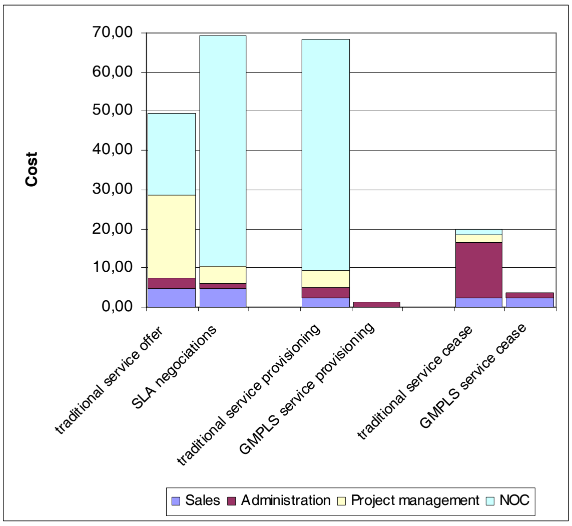


Figure 6: Cost comparison for new entrant

6 Conclusion

The investigations for this paper include a considerable high effort for surveys and interviews with multiple carriers. This allows going one step beyond the general claims of advantages of ASON/GMPLS. First quantitatively substantiated conclusions can be drawn, critically evaluating the real OPEX benefits of ASON/GMPLS.

Our studies show that most network operators' processes are similar and can be modelled quite generically. When looking at the typical efforts for these processes, there are major differences between incumbent operators and so called new entrants, which have much lighter business processes but also more complex technical processes since they have to resort to external partners more often. This is also the reason why new entrants are very often focusing on large customers and project business, where customized solutions with more technical efforts are required anyway. Incumbents in contrary have lean technical processes that allow providing standard services more easily. However, interestingly for both types of operators OPEX effort and cost reductions in the order of 50% compared to traditional operations can be identified when introducing ASON/GMPLS.

Based on these results the introduction of ASON/GMPLS can generally be recommended to significantly reduce OPEX. This advantage can even be improved, if all network domains and all network layers support interworking ASON/GMPLS control planes and hereby also reduce the operational costs for end-to-end connections across multiple operators' domains.

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