Andy Pelling, Steve McNickle and John Hooper

Network Management in the 21st Century

The story so far....

Chapter 1—The Quest.
On a small blue planet in the outer reaches of the Milky Way a rapidly developing civilisation is becoming increasingly hungry for information.

The dawn of the age has arrived where it's people have recognised that 'Knowledge is Power' and global telecommunications is the key to unlocking that power.

Back on Earth, most of the leading telcos have now embraced the concept that superior operational support systems (OSS) help to keep them ahead of the pack by permitting optimal network utilisation, reduced cost, improved lead times, greater efficiency and flexibility. Many operators now have state of the art 20th century systems in place such as network infrastructure management and process automation tools, others are in the process of developing or deploying them now.

Challenges addressed to date have included:

- reducing the need for detailed equipment configuration knowledge in the planning community, and
- automating the planning processes.

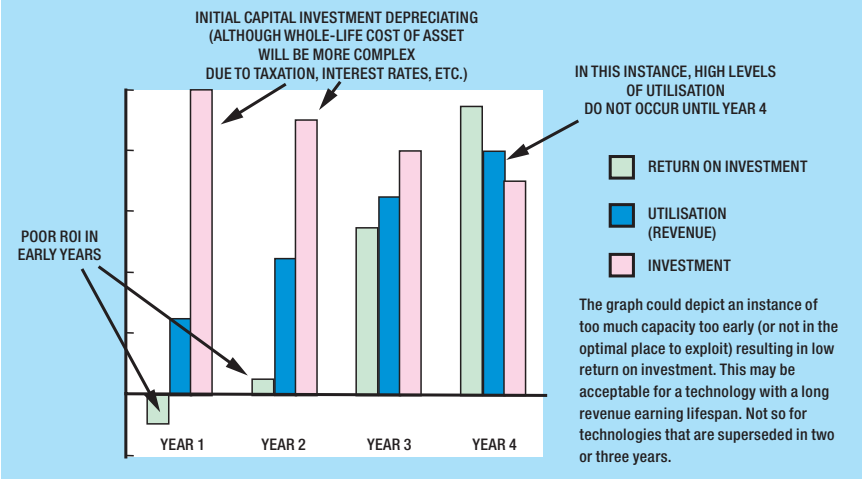
The combination of these can dramatically increase productivity and asset utilisation, facilitate multi-skilling and planning transportability as well as enforcing best practice and ensuring the adherence to minimum standards.

This paper now poses the intriguing questions of what are the next giant steps for mankind in the telecommunications industry; where do we boldly go beyond the OSS of this century? As we all know, standing still means the competition will draw ahead and the race will quickly be lost. It is therefore not an option. Axarté is working with customers to try and anticipate the operational support systems requirements for the next millennium. In such a rapidly developing industry it is not practical to plan too far ahead as technology advances and changing customer expectations are likely to revolutionise many sectors of the market beyond recognition in just a few years. For example it was not so long ago that many access providers believed that they would have to bear the incredible cost of replacing their copper networks with fibre. This strategy has now been radically changed by the development of technologies such as asynchronous digital subscriber line (ADSL), which will give many access networks a new lease of life, enabling them to support the products of the next few years.

One area worthy of significant development is capacity management. This in essence means a move from reactive to **proactive** planning. Some operators have networks with inherent values in billions of pounds and annual investments of hundreds of millions. If these are not optimally managed then the increased cost can be huge. A saving of 1% may seem small but in this context can be worth several millions and is likely to pay for the OSS many times over. Good capacity management, in simple terms, means having the right amount of capacity in the right place and at the right time. Put too much in too early and return on investment (ROI) is low. Provide too little, too late and potentially huge costs are incurred in reactive provision (fire fighting) of short-term, poorly planned network growth. In the worst cases of course, customer orders are lost and thus revenue reduces.

Figure 1 shows the first of these shortcomings (that is, over capacity, too early).

Figure 1—Over capacity, too early



Andy Pelling, Steve McNickle and John Hooper:
Axarté (formerly Accunet),
Votec House,
Hambridge Lane,
Newbury, Berkshire,
RG14 5TN
United Kingdom
Tel: +44 (0)1635 528001
Fax: +44 (0)1635 528085
E-mail: smcnickle@axarte.com

How Do We Get There?

To be able to manage a network efficiently, the starting point is accurate records. Many have trodden the expensive path of data cleanse and the list is long and distinguished of those that have spent vast sums cleansing data but have failed to put the systems and processes in place to maintain that accuracy.

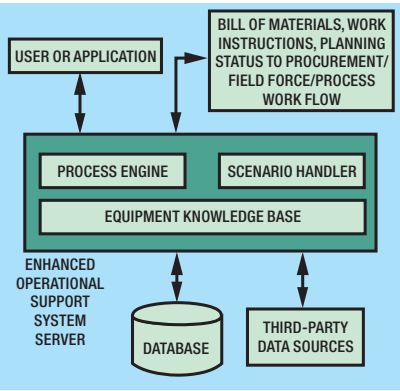
Emerging operators are faced with the pressures of quickly establishing new networks and being able to meet large volumes of customer orders. Starting with a 'clean sheet' of records, they often believe that data accuracy is only a problem for the incumbents, it will however, soon become their problem too and of course the sooner it is tackled the less the cost of data cleanse. Their options are:

1 Incorporate systems/processes to maintain data accuracy from day 1.
2 Wait until it becomes a significant problem then undertake data cleanse and option 1.
3 Undertake data cleanse every couple of years or so.
4 Ignore the problem and reap the consequences later.

To maintain accurate records, network operators and equipment suppliers require a process automation tool which can add to and make changes upon the record data automatically, removing the possibility of human error and not allowing the process to be completed without full databuild to predetermined standards; and which updates, and checks the integrity between, dependent systems via synchronisation. Figure 2 shows the key elements and operations.

Assuming that an operator has accurate records of all network assets and the varying status of each component, there are three main considerations for using that data.

Figure 2—Process automation tool



- Firstly, the investment needs to be exploited to the maximum; as much available capacity as possible must be utilised for revenue earning products, or leased to other operators or moved to a location where it can be better utilised.
- Secondly, the operator must be able to maintain the network at minimum cost, by being able to anticipate potential areas of deterioration in terms of loss of service or lower operational parameters. When components do fail they need to be located rapidly and alternative network solutions need presenting on-line.
- Thirdly, consideration needs to be given as to how this network will evolve. In many cases this will be growth although it must be recognised that some platforms are supporting dying or migrating product streams and planned downsizing can give gains in reduced operating cost. Alternatively networks may need to be enhanced to support future services. Individual platforms can no longer be looked at in isolation as most are linked by the service streams they support. A new generation switch network for instance will have significant impact upon the transmission network.

Within the third point above the current focus has tended to be on monitoring for exhaustion. Simply identifying redundant equipment and turning off the power (which in turn is loading vent plant) can reduce operating and maintenance costs.

If we look at network growth, which will account for a significant proportion of a telco's capital investment, the following factors need to be considered.

Initially there are some key business decisions to make, such as:

- What will be the ROI for this expenditure over its useful lifetime?
- Should I buy or should I lease?
- What are the trade-offs between incremental build (just-in-time) and the economies of scale from bulk build?

A good OSS will give vital information, on demand, to support these types of decisions. Various scenarios should be easily entered into the system, which will be able to return costs and resource requirements for each scenario along with the capacity profile that such a solution will deliver.

If the decision is made to add to a network for increased capacity, trending and projections based upon forecasts and weighting factors should be available to the OSS user. Armed with this information an optimum build can be planned in terms of topology and quantity. Where a scenario for incremental build or relatively small-scale bulk build is identified as a suitable option that will support projected demand, this allows deferment of the capital spend or redirection of it to other requirements. Alternatively, for certain types of networks where intrusion can be costly† and components are not; bulk capacity build may be desirable.

The enhanced operational support system (EOSS) developed by Axarté allows multiple scenarios to be built, tested against and costed. One scenario can have associated sub-scenarios. Once a scenario is promoted to the chosen option, a full history trail is maintained of what went before, and this history provides a very important source of actual time-based network changes.

Axarté is developing ways to manipulate the network data to give projections of capacity exhaustion, over-provision, under-utilisation, non-optimal topologies and opportunities for directing sales to areas of potential capacity exploitation. A user will be able to display the results of such network queries in a multiplicity of formats. Automated warnings can be applied or reports can be initiated and then represented as anything from a model of the network at some pre-determined future time to simple graphical displays, such as pie charts and line graphs or tables.

Thresholding, But Not As We Know It!

The ultimate step would be to trigger a build at defined thresholds using an automated plan-and-build process

† Intrusion is manual work within the network infrastructure with costs possibly due to faults caused by these interventions, or out-of-hours working to minimise disruptions, etc.

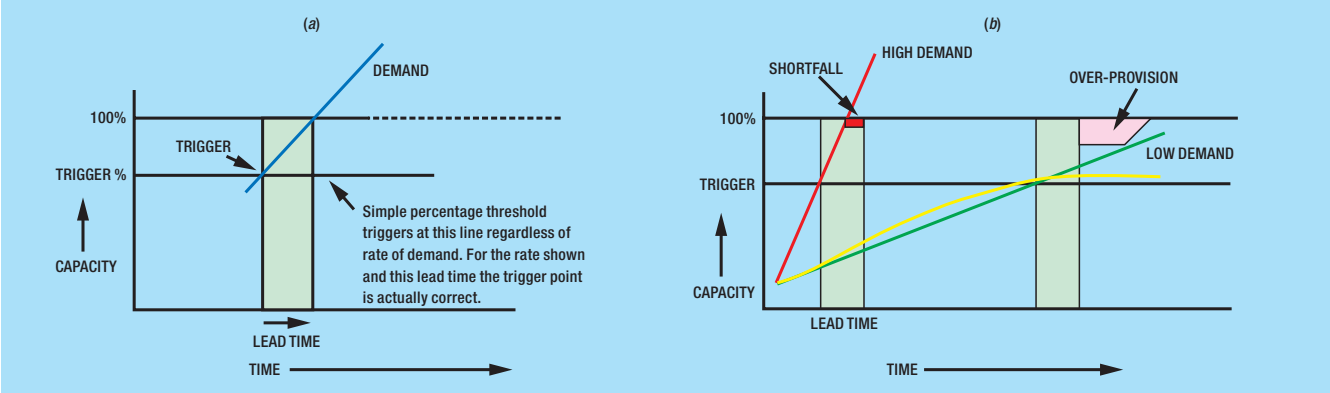


Figure 3—Thresholding the old way (before time travel)

manager with no manual intervention, and for some straightforward types of network build this may be appropriate. A threshold would not be a simple percentage remaining as this is incredibly inefficient (although widely used at present). Experience shows that this type of triggering will almost always get it wrong and as such lead planners to build in excess safety margins which results in under utilised networks with poor ROI. The graphs in Figure 3 show that only in the case of the medium demand (blue line) in graph (*a*), which also happens to be linear, does the trigger point lead to the optimum network build time. Figure 3(*b*) shows that a higher demand will lead to exhaustion in advance of the delivered capacity; a lower or tailing off demand means that capital has been invested far too early and in some cases there may never be a return on part of that investment.

The two graphs show four possible rates of growing assignments to a network segment, which in simple thresholding would not be trended. New build would simply be triggered when the set percentage utilisation was reached. Taking the lead time between planning/ordering and installed capacity being available for use as the green rectangles it can be seen that the optimum point for re-ordering will vary depending upon the demand profile.

Capacity planning tools need to be much smarter than just employing simple thresholding. An application must consider historic trending at an appropriate level of granularity, and take account of non-linear demand (that is, seasonal variances, market driven peaks, etc.). They must also allow the input of forecast data and weighting factors. Lead times and safety margins can be built in to remove the over-ordering of cautious planners. Where rules are breached

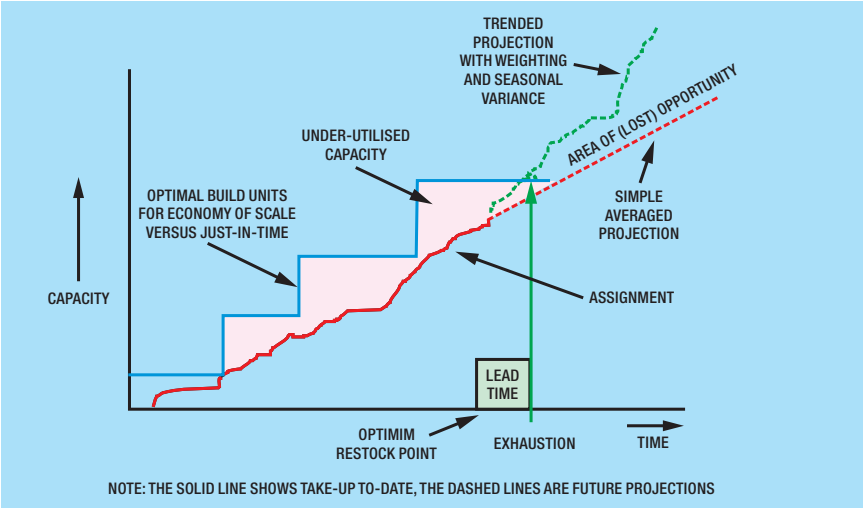


Figure 4—21st century thresholding

or overridden, flags or exception reports can be raised. Another requirement will be the ability to consider both the physical and logical/virtual components with regard to capacity management.

Such a tool is effectively giving the user a glimpse of the predicted future based on the best information to hand and calculations using pre-determined logic rather than 'intuition'.

Figure 4 depicts both a simple averaged projection (which is better than percentage thresholding), based on actual time-based information, and a more sophisticated version where other factors are taken into account.

We Have the Power

Another key requirement for the OSS of the future must be to empower the customers to perform an appropriate amount of system configuration. It is not reasonable to expect that the users, or even in some cases the support/administrators, will have software programming skills for the application. They could however, be guided through reconfigurations by intuitive 'wizards'.

This is true today for many off-the-shelf home and office type products. Not many users would attempt to re-write their Internet software but to reconfigure a new modem for instance is a relatively simple task using a step-by-step wizard. Future systems will have such tools available to the user although full support will still be available for those that prefer to devolve such work to the experts.

Typical user or client configurable applications may be to facilitate process change, the introduction of new equipment types or redefining planning rules.

Management of the Fifth Dimension?

One of the limiting factors of some OSS products of the 1990s is their limitation of working with either the physical network components or at the logical circuit level; few are designed to manage both. Capacity

management tools and configuration systems usually operate at the logical level. Most planning systems can only consider equipment components and the connection between them, in other words, three-dimensional entities. We have already seen previously that EOSS will allow scenario planning and capacity projections which are effectively the fourth dimension (time). Beyond this there is the concept of virtual paths and virtual circuits which are common with today's technologies. These *logical entities* (the fifth dimension?) need to be managed in an entirely new way from their physically constrained bearers. If all of these 'dimensions' can be handled within one tool……..

Open Interfaces and Intelligent Message Handling

It is already the case that no one system can provide a complete solution for the many and complex requirements of the telecommunications industry. This requires a range of interface technologies being supported by the OSS applications and intelligence within the messaging sub-system.

In today's global market place these applications could be geographically remote and in countries of differing native languages. As telcos expand they may take on new partners around the globe, who must also be incorporated into the overall OSS environment.

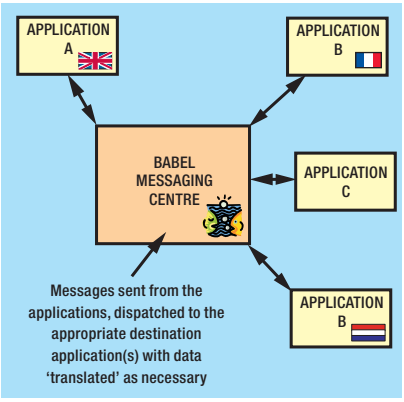
Ideally a platform independent messaging centre will handle this—the Babel messaging centre (Figure 5).

This message centre will automatically interrogate and direct messages between applications and guarantee delivery. But, what if this system actually translated in real time the appropriate data within a message to the native language of the receiving system (or indeed native languages of multiple receiving systems). How much more useful any instructions and information would become to the receiving party.

As an interim, applications comprising an OSS need to be capable of handling language issues, such as menus, tool tips, icons, but also including value translation.

Axarté is addressing these international issues today.

Figure 5—Babel messaging centre



Conclusion

Limited automatic planning is here today. The next millenium will bring automated proactive planning to achieve maximum ROI and efficiency, and integrated globalisation of telco OSSs.

For the 21st century, it looks as though there will be life out there, beyond the millennium, at least for those telcos that have been planning ahead and boldly going where no system has gone before.

Now as for the 22nd century, we can percieve networks on chips that intuitively plan and automatically reconfigure themselves in anticipation of the next second's capacity requirements in direct communication with satellites. These will provide access to a virtual datastore the size of a peanut containing all known data in the universe. The location of the end user chip—a cranial implant! Management of that we will discuss next millennium!

Biographies

Andy Pelling
Axarté

Andy Pelling is a telecommunications consultant for Axarté. He has 24 years experience working with one of the world's leading telcos, specialising in networks, systems and process improvements.

Steve McNickle
Axarté

Steve McNickle is the Technical Director for Axarté. He has some 20 years experience in the IT industry and is focusing now on flexible solutions to telco network, systems and process management challenges.

John Hooper
Axarté

John Hooper is the BT account manager for Axarté. He worked for 28 years within BT in various operational roles. Latterly he was seconded to the BT 'Breakout' initiative investigating process re-engineering within key operational areas.