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TeleManagement Matters

The demand for faster, more interesting telecommunication services seems never ending. But these can only be delivered if there is an underlying network that has the resilience, performance and flexibility to provide them. And this means that network management needs to be an integral part of the design and operation of any major network. This paper examines the basis for a sound telecommunications management strategy and introduces a few of the practical issues that need to be addressed in its implementation.

The problem

It is one thing to build a network, another to get the most from the time and money that you have invested in it. To paraphrase Winston Churchill, the design of a network is not the end or even the beginning of the end. It is the merely the end of the beginning.

The real effectiveness of a network depends on how well it performs - day after day, month after month, year after year. An expensive resource that is central to an organisation's efficient operation needs to be taken good care of and that means both maintaining the equipment and ensuring its continued relevance to its users. The former is usually called network management; the latter is the essence of service management.

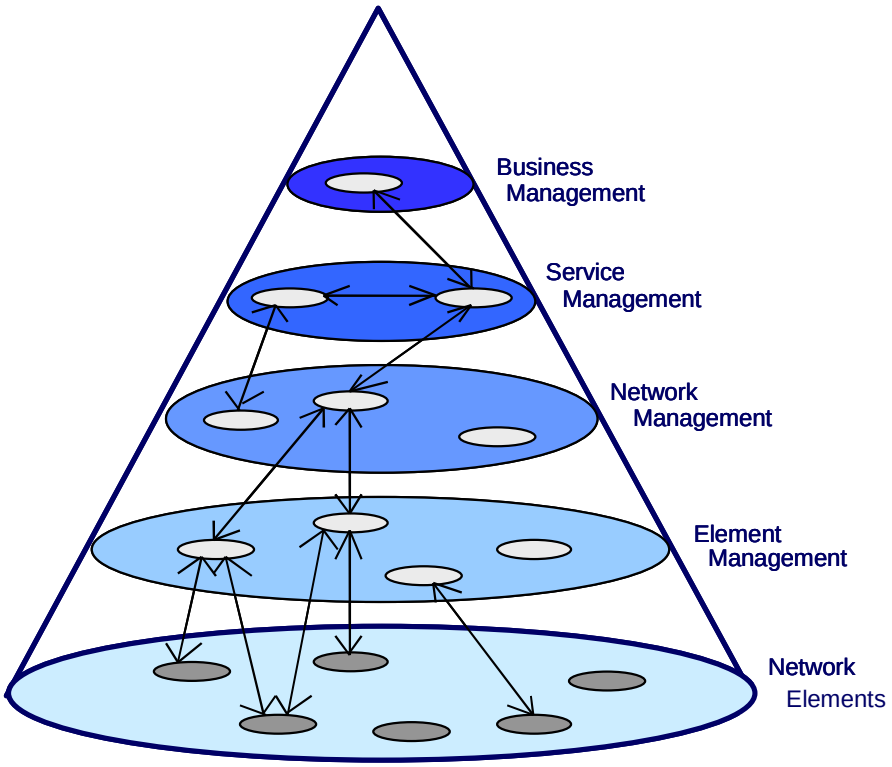
The real problem that is being addressed in both instances is the control of complexity. Modern networks are simply too diverse and disparate to be designed using anything other than well thought out principles and supported by powerful tools. The end user's information may be delivered as IP carried over ATM on an SDH ring, but it must be managed as an integrated, end to end service.

This is not something to be tackled as an afterthought - management capability has to be built in as an integral part of the network design.

It should end in tiers

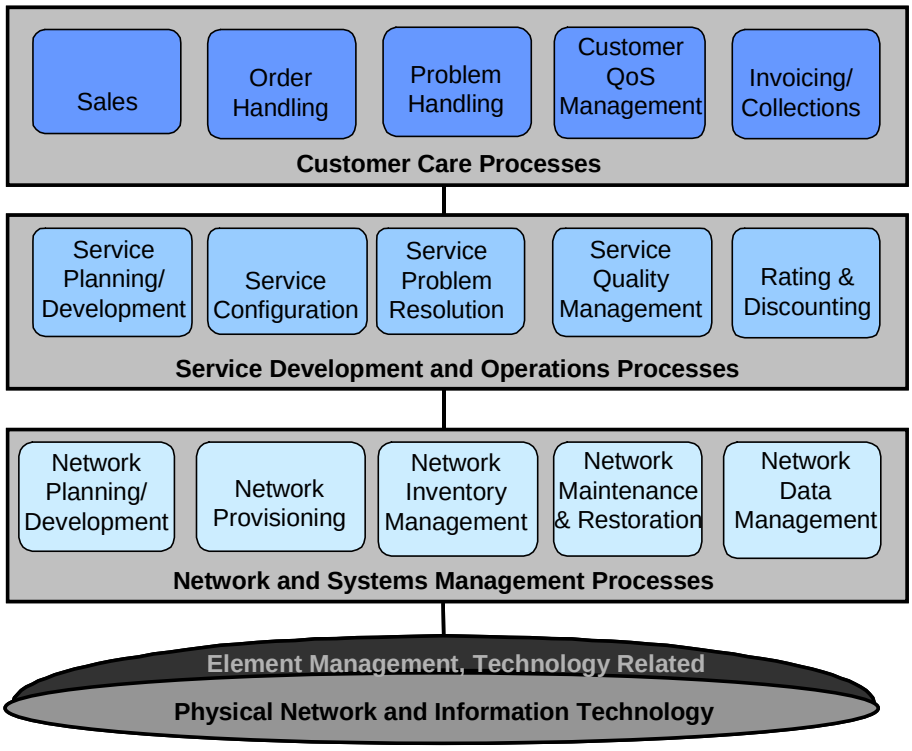
The best way to deal with any complex problem is to break it down. The first step in separating the key concerns in managing a telecommunications network is to look at the links in the end to end chain that link the user to the routers, circuits and switches.

The diagram shows an established management hierarchy for telecommunication networks, with the user need at the top and the management systems



and network elements that fulfil that need in support. Although simple, the figure does carry important messages – that management design doesn't have to follow the specific layout of the network itself and that it is necessary to correlate inputs from several sources in order to relate the user view to the underlying network.

Of course, a lot more detail is needed to make the layering notion practicable and this is where the definitions in the Telecommunication Operations Map (TOM) come into play. The TOM defines the specific activities that lie within the service and network management layers. The exact definition of these activities and how they link with each other is the first step in the management design for any network.



The structure of the TOM is shown below. It can certainly help to structure the management design but there is a lot more that needs to be done before a viable solution is ready. Issues such as quality of service and system performance need to be addressed so that appropriate measures of availability, target response times etc can be established.

Having a framework for network management along with some operational targets is a good start and provides something solid to design from and to check against. A good plan is the basis for subsequent work, and it is at this stage that we need to have one eye on any design dragons that need to be slain.

What goes wrong?

Surely a well designed network, once installed, just keeps going! In truth a trouble-free and future-proof network just doesn't exist – which should be no surprise when you consider that it is comprised of many components, from many suppliers that all need to cooperate to meet stringent availability, reliability and performance targets. On top of this, the uses to which the network is put inevitably change.

Even in stable operation there are plenty of situations that a management system must be capable of meeting. Here are a few of the main ones:

Chain reaction failures

You need to know how a failure in one part of the network might affect the total operation. Suppose there is a bug in the database software that keeps track of network addresses. It could block access to critical services and at the same time could hide this problem from the monitoring system. Correlation and consistency checks need to be built in to detect this kind of problem.

Traffic congestion

Any network can suffer from traffic jams. If several network elements fail simultaneously, the load of blocked and diverted traffic can overload queues or block switches and bring the entire system to a halt. Often overlooked (and adding to the congestion) are the messages the network generates to report the problems.

The unexpected

A network hit by unexpected events must be able to help itself. It should manage and reroute traffic to avoid trouble spots. The low level design must ensure that the network reacts properly to duplicate messages or verifies messages from questionable sources. Most systems use timeouts and retransmissions to deal with these problems. Another approach is to display a status flag that warns of impending problems. Good management design has a lot in common with 'defensive programming'.

Packages and Bundles

Management is not just about dealing with problems – it also covers provision of service and billing. If a

product or service being offered to an end user relies on separate network elements, there should be some way of relating reports from those separate elements to the product or service they support.

In dealing with these operational issues, there are a number of design choices that need to be made:

Centralized or decentralized management
Central management can ease correlation of information from network elements but it also creates a central point of failure. Decentralized management can be a source of inconsistency but can be a more resilient option. In a large network, it is usual to have elements of both, with their combined drawbacks! This means that issues such as who should be responsible for managing database consistency, standby systems, and database updates need to be clearly resolved. Another decision: who should receive status information and error messages? Often, a local group can take care of problems in its own system. There are other times when central management is more effective.

Protocol standards
The choice of network management standards (and none at all is sometimes a valid option) can either improve management or make it harder. If the design is based on recognised standards, it is important to be sure that the entire system follows the same version. Otherwise, it might interpret some messages in strange ways. Standards often make it easier to integrate network management with the network as a whole but, where standards are immature or not widely implemented, proprietary solutions can be a better option.

Testing
Testability is one of the fundamental requirements in systems theory, yet is often overlooked in network design. A good network management system should include test points and should have inbuilt trace and audit capability.

Whatever approach is taken in the management design, some allowance needs to be made for change. A reasonable test of this is to check how the following will be accommodated:

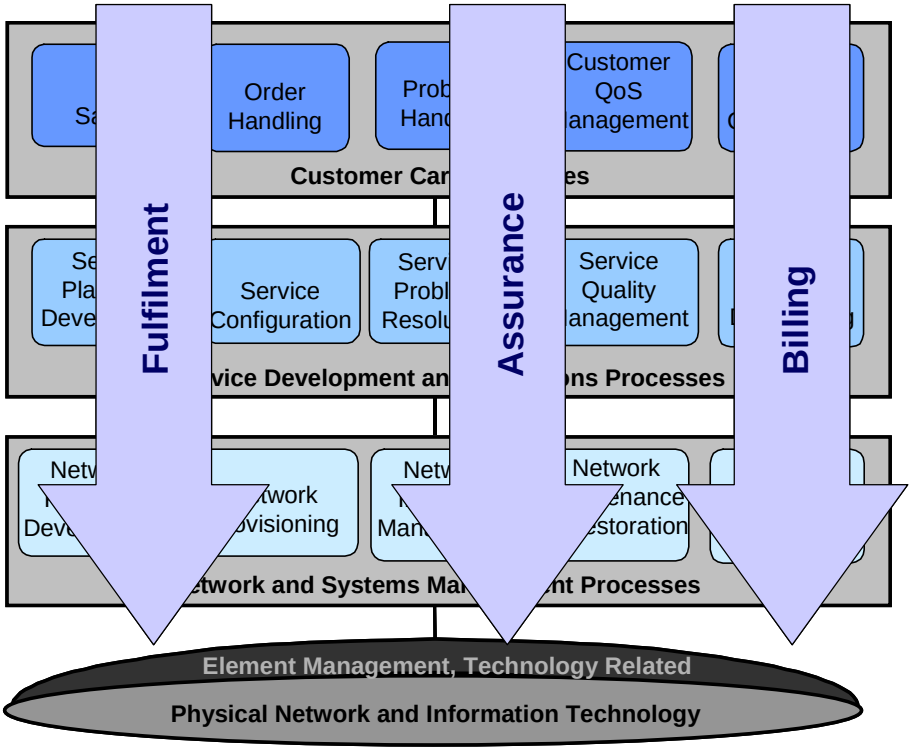
Growth
The management system should be able to cope with traffic growth and the addition of new nodes and networks. It should also be structured so that new technology can be incorporated – an attribute that the layering approach outlined above helps with.

Adaptability
The network management system should adapt to system changes and allow the relationships between network elements to be redefined.

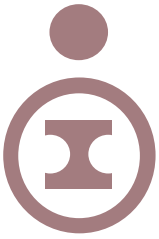
This list could be extended but these are the essential (and inevitable) issues that have to be addressed. Knowing what the likely problems are and having the TOM as a framework for designing a solution, we can now start to look at the options that can be deployed in a management solution.

What needs to be done

From an operational point of view, management is all about Fulfilment (taking orders and providing service), Assurance (locating, tracking and fixing faults) and Billing (allocating costs and issuing bills) – the 'FAB' paths though the activities defined in the TOM.



To be able to carry out these tasks effectively, there are a host of practical issues that need to be attended to. Perhaps the most important are to know exactly what is in the network, to know when there is a problem with it (and to fix it), to be able to manage its configuration



and to have some mechanism for correlating alarms. Taking these in turn:

Inventory
Invariably, several pieces of management software need to be deployed to cover all of the required activities. Each will hold some information about the network or its users – for instance, a billing system needs to know who has used the network, for how long and for what purpose. Together, the data used by a complete suite of management software covers the network users, services, products, configuration and physical components. So all of the information needed for an inventory is there. The commonly encountered pitfall is that the required information is not accessible or, because the same data is usually used in more than one place, it is not clear which is the master source.

Shooting Troubles
All but the smallest networks require automated procedures to report problems, raise trouble tickets and track progress against them. As well as creating a history file for each separate problem report, the systems should record the nature of the problem, its current status, how it was resolved, vendor contacts, and other information that might be helpful in the future or required for audit purposes.

Managing Configuration
A basic tenet of management is that you have to know what it is that you are managing! The dilemma that this introduces is that the interrogation of the network to assess what is there can be both time consuming and resource hungry. Hence a balance has to be struck between gathering information and generating management traffic.

Correlation
One problem deep within a network can manifest itself as a host of broken links and lost services. An effective management solution should be capable of identifying the root cause of a problem from the observed or measured effects.

In addition to the above capability requirements, there are several temporal issues to be considered in developing a management solution.

First is legacy, which represents not only a capital investment, but also a system which is often not totally unsatisfactory – keeping it or modifying it may reduce both costs and risk. Experience shows that just because a system offers colour graphics, object oriented design, and artificial intelligence; it may not necessarily do what you want it to. Slightly boring old systems often turn out to be more effective and reliable.

Second is that the cost of a management solution must be in proportion to the benefits it offers, and should normally be a fraction of the network cost. In truth, this fraction tends to average around 5%, a figure that is probably too low for today's complex and feature rich networks.

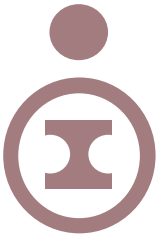
Tools of the Trade
There are plenty of management systems on the market, some that tackle the whole management space, others that cover a part of it. Some are optimised toward a particular vendor's product and come with proprietary interfaces, others are built for the open market and use standard interfaces and protocols.

IBM NetView is an example of the former. NetView has a strong orientation toward managing transaction monitor programs (CICS, IMS) used on host systems, as well as IBM or IBM-compatible network devices. Through NetView/PC, it can be provided with management links to virtually any type of product or service. NetView is the most pervasive integrated network management system on the market, installed in over half of all IBM mainframe sites. It is entirely based on IBM's own SNA protocols and relationships and is thus proprietary.

Nortel Network's Preside is an open system and is built as an integrated management system with a variety of platform-resident modules that support a range of management functions. These modules, which provide reporting, correlation and other capabilities, connect to a core set of storage, event logging, and display services through an application program interface (API). The core gets its raw information from the MIBs (see panel) installed on the network elements being managed using standard management protocols (such as CMIP and SNMP).

In addition to these integrated systems, there are a wide variety of management frameworks on the market. HP's OpenView Network Node Manager, NCR's StarSentry Manager, SunConnect's SunNet

MIB (Management Information Base)	**SNMP** (Simple Network Management Protocol)	**CMIP** (Common Management Information Protocol)
Network elements can be represented as a collection of objects. These objects are stored in the MIB and link to the network management systems via protocols such as SNMP and CMIP. Real MIBs can be very large.	A protocol, one of the Internet suite, used to communicate between the MIB that represents a network element and the network management systems. SNMP can get information from the MIB and can set parameters in it.	An international standard (ISO) protocol that carries out much the same function as SNMP. CMIP was originally a more feature-rich and complex protocol but it is now much closer to SNMP.



Manager and Novell's Network Management System (NMS) are all widely deployed examples. These all provide a framework, rather like the core of Netview or Preside, to which additional tools can be added.

The list of additional tools that can be used to support some part of the management space is extensive. For example, Clarify and Remedy/ARS are well known trouble ticketing systems (although both can be used to do more than just this); Arbor is a widely used billing system, Siebel a popular customer care system.

Summary

The power of modern networks can only be harnessed effectively if they are properly managed. This requires both a clear plan for management and an awareness of the practical problems that need to be addressed. In this short paper, we have outlined the logical structure for a management solution and introduced some of the actions that need to be taken in turning the plan into a practical implementation.

Networks are increasingly being assembled from a set of standard components. And so the way in which those components are assembled and operated becomes ever more important. From a purchaser's point of view, the management solution is now as important as the design of the network. Hence, from a supplier's perspective, the same level of detail and planning needs to be applied to both.

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