BUILDING INTEGRATED TMN SOLUTIONS USING MULTIPLE TECHNOLOGIES—AN INTRODUCTION

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Abstract—**This paper addresses one of the important issues facing today's telco industry, integrated management solutions based on multiple management technologies. It provides an analysis of the current industry requirements for such an integrated solution, the trends and the future directions. It proposes an integrated architecture framework based on the OSI, CORBA and Java/Web technology.**
An integration strategy and a proof of concept is presented here which examines the value of different management technologies and the strategies to integrate them in the management solutions. The view expressed here has been strongly endorsed by the recent Network Management Forum (NMF) in its management technology strategic round-table discussions.

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1 INTRODUCTION

The world wide competition and deregulation in the Telco industry has increased the need for building a service management system, where the service offering, service creation, service provisioning, service management and service implementation based on the network management functions are all integrated in a single architecture. This architecture enables the management of the element environment, network environment and service environment to be all focused on the management of customers and quality of services. It is also imperative that such an architecture be able to survive the migration and progression of the management technology.

In the past decade, the open standards movement has promised the telco management industry an open management architecture where more standard products can be produced and plugged into this architecture to provide the users with management solutions. Also in the past decade, we have seen the emergence of multiple management technologies, protocols, frameworks and object paradigms each of which has showed or promised the great value they can add to the management solutions.

So far, however, the industry still has no integrated management solutions. The plug and play goal has not been realised and the emergence of multiple technologies has not added great value to the solution due to the fact that integration of these technologies is very difficult. The open standards movement may have achieved some level of interoperability, but still no inter-working solutions have emerged. A great deal of standards effort has no direct benefit to Telcos business. Worse still, many standards efforts have become persistent religious wars, thus reducing their significance in helping the Telco industry's management of business.

The vendors are busy producing more platforms, tools, frameworks, languages and supporting more object paradigms. Very little effort, however, has been made in producing management solutions and component solutions to go with the platforms. We have frameworks enabling objects to interwork but we do not have objects; we have tools to build solutions from components but we do not have components; we have object paradigms enabling us to specify objects but we do not have the objects specified. The industry still has no component solution to manage SDH/SONET connections, faults and performance. The industry still has no standard GDMO objects implemented to manage ATM connections, or cross ATM and SDH/SONET connections.

Today, the industry is still looking for management solutions. Two major changes, however, have been witnessed in this pursuit for solutions: the requirements for integrated solutions with multiple technologies, and the solutions to management functions. Similar to other industries, the Telco industry cannot take an approach to break with its past and invent a *holy grail* solution. Instead, it must take a direction which protects and leverages the existing investment in the management technology to re-engineer, reuse and integrate the existing processes, solutions and technologies.

This paper addresses the issues of building such an integrated system. We propose an integrated service management environment with a Java-based user environment, a CORBA-based distributed service management environment and a TMN-based network management environment. We also report on CiTR's research and development effort to build a proof of concept for such an integrated system.

2 REQUIREMENTS

Two big challenges are facing the telco service management solutions: the integration of service management functions with network management functions, and the integration of service management activities. Figure 1 depicts a typical process flow from a customer request to the network elements.

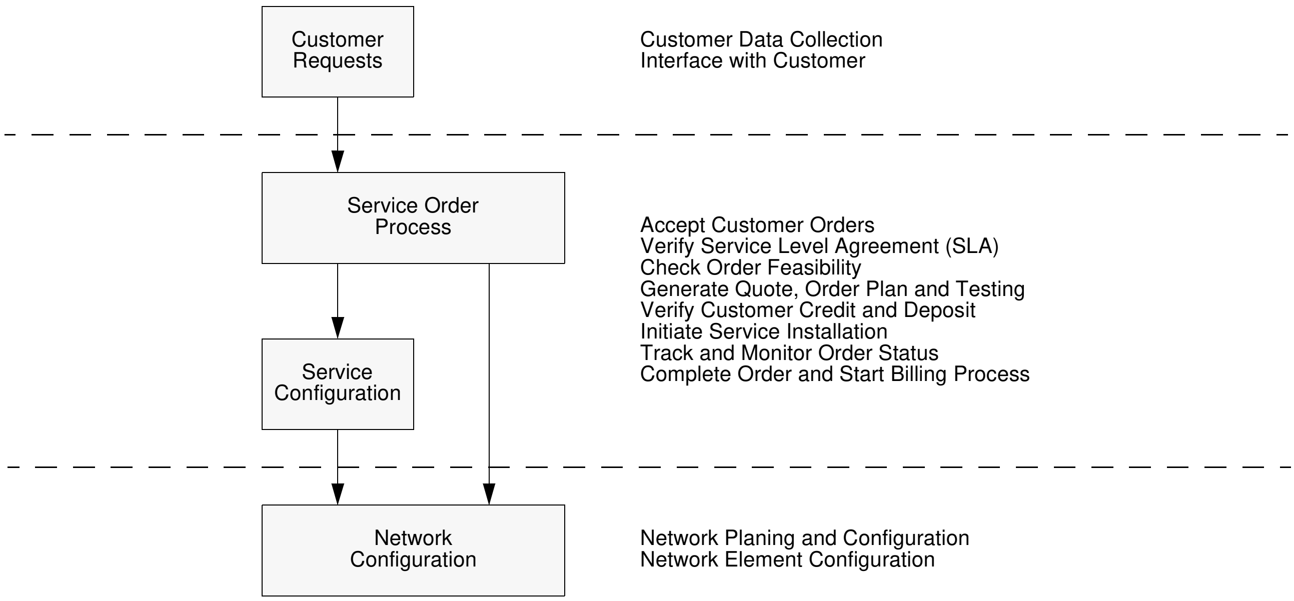

Figure 1: Service Management Life-cycle Scenario

In this scenario, a technology framework is required which will enable the customer requests to be decomposed into a set of network management processes, and which will also allow the information both from customer and from the network to flow consistently with the process flow-through.

Figure 2 depicts a different scenario, where different service management functions such as fault, performance, billing, ordering, etc. can be integrated to represent and manage the customer services and the quality of the services.

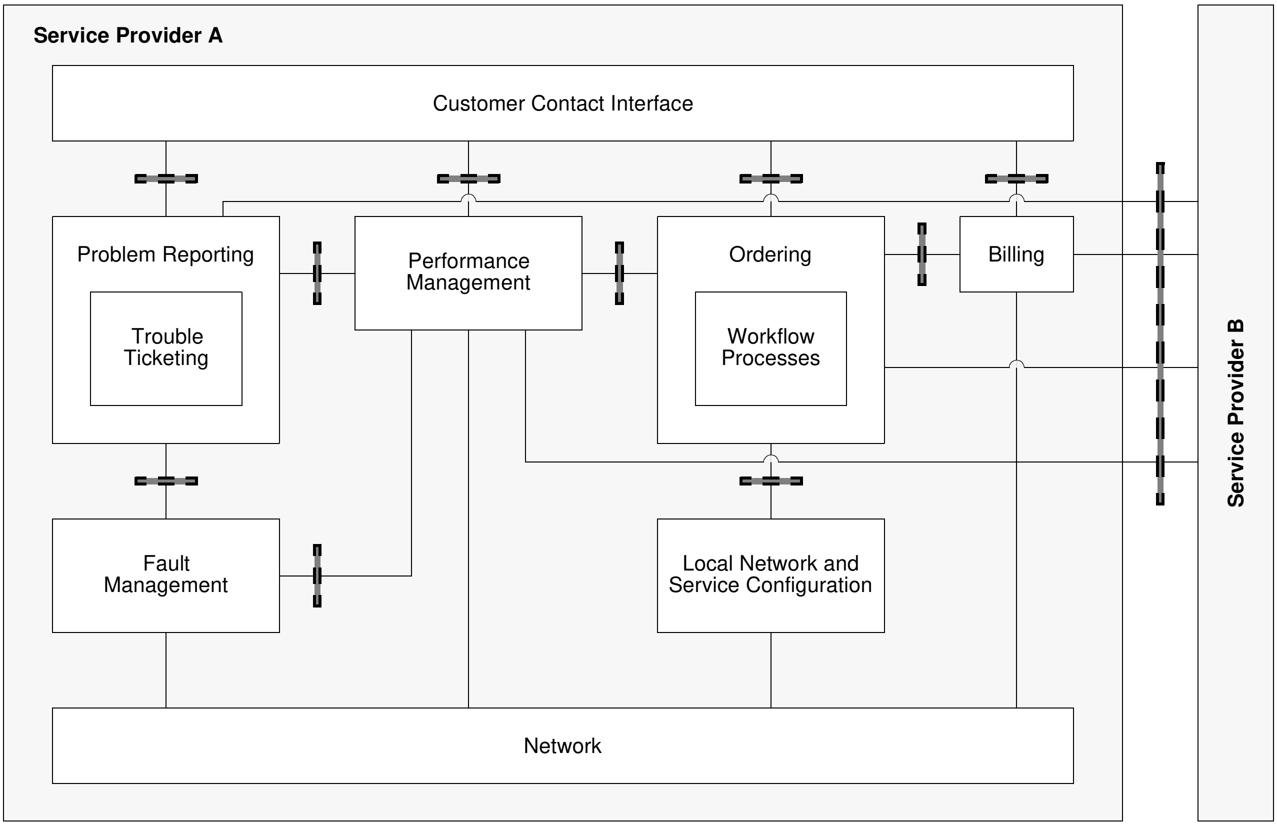

Figure 2: Service Management Integration Scenario

In this scenario, not only do the service management processes within a service provider interact between themselves, they also interact with the processes in peer service providers' environments.

3 INTEGRATED ARCHITECTURE

Figure 3 shows a partitioning of management activities into three main environments. The integration of these environments provides an integrated solution for the service management industry.

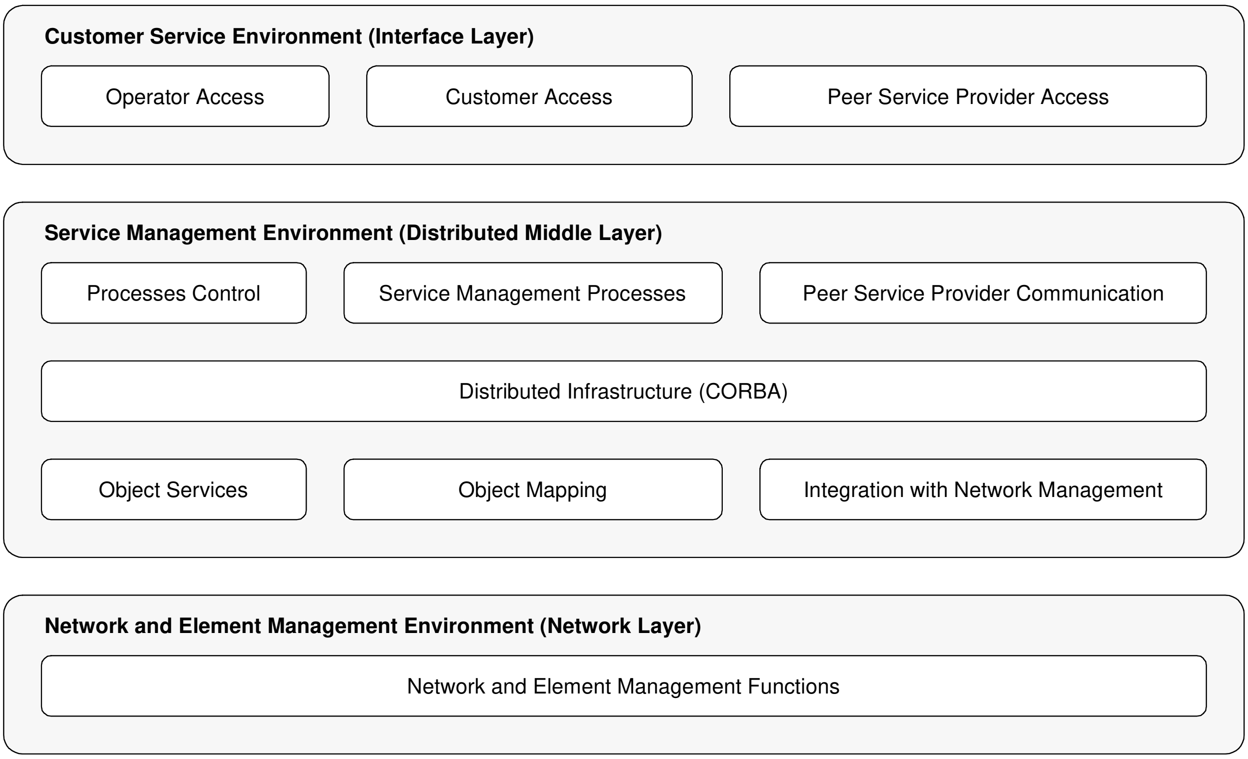

Figure 3: Integrated Management Architecture

Customer Service Environment supports different types of access to the system. In particular, it supports the concept of *Customer Service Management (CSM)*, where as in Customer Network Management (CNM), the customer will be able to interact with the service provider's environment through CSM with respect to the quality of customer services. It includes Java-based GUIs for both operators and customers.

Service Management Environment provides service management functions as defined in TMN. These functions include:

- ²service management components such as TMN FCAPS management
- provisioning process control and automation components
- ²distribution of application components by supporting distributed infrastructure and services

The distributed object paradigm has shown its merits in adding value to the management solutions. CORBA and its services have shown promise as an integration platform for management functions and applications, as well as a platform for supporting distribution, scalability and dynamic object modelling.

This environment also serves as the integration bus between different functional layers, components and also between different service providers.

Network and Element Management Environment consists of a management platform and a set of management functions. This environment provides the support for FCAPS functions at the network management layer (NML) and element management layer (EML) to deliver services. It interacts with the service management layer (SML) to ensure that the service requests are mapped to network operations and the quality of service requirements are satisfied. We propose the OSI network management technology to be used in this environment.

In addition to identifying the management architecture and management framework for TMN solutions, it is important that the solutions include the implementation of management functions for different communication technologies. That is, the integrated solution must serve as an environment to define object class libraries, to implement object building blocks and to integrate building blocks as management solutions. Such building blocks include:

- Connection management for ATM and SDH/SONET networks
- Performance management
- Fault management

This layer of building blocks plays an important role as the integration gateways which offer the following functions:

- Bridging the gap between TMN network management functions and service management functions;
- Encapsulating the differences between different network technologies such as ATM and SDH;
- Acting as gateways between different management technologies to achieve a smooth integration, such as from OSI to CORBA

4 PROOF OF CONCEPT

To demonstrate the concept of the integrated architecture, CiTR's R&D team developed a proof of concept demonstration. Figure 4 shows the overall demonstration architecture:

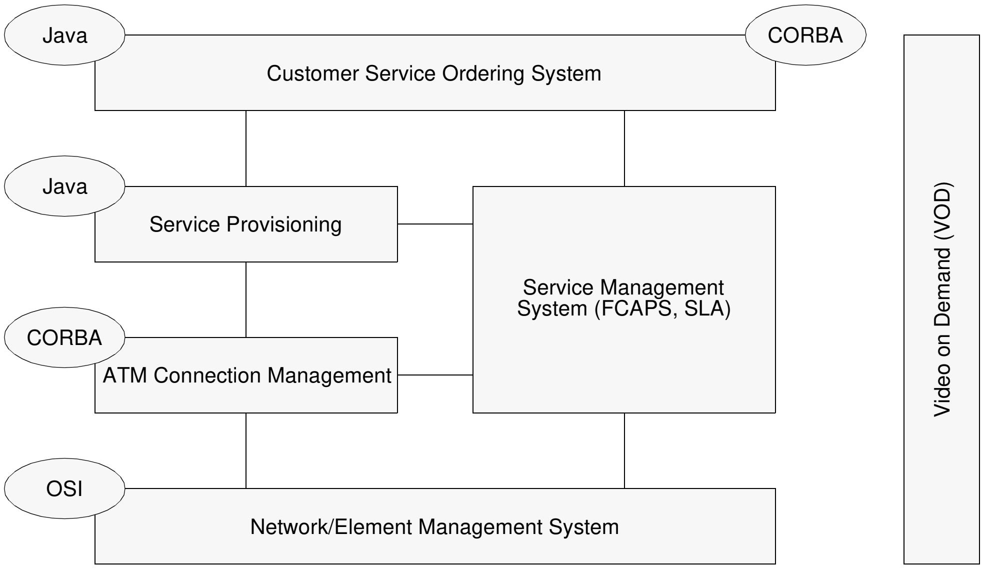

Figure 4: Demonstration Architecture

The demonstration provides:

- the customer management environment based on NMF SMART Ordering process and object modelling for which CiTR has contributed an initial specification,
- the service management environment based on the NMF SMART Configuration and Performance management, and
- the network management environment based on ATM connection management

The Video on Demand (VOD) service is used as an example to demonstrate the integrated management concepts.

The integrated demonstration has the following components:

- **NMF SMART Ordering process** supports ordering negotiation, pre-order, status tracking and firm ordering. It supports the NMF SMART Ordering interfaces at inter-SP level, and the interface is used at any level of nested sub-ordering. It follows the SMART Ordering object specification.
- **Service provisioning** is an ATM PVC provisioning system consisting of a Java front-end integrated with a CORBA-based provisioning system. The HP OpenView CORBA and its Topology Service is used to represent the logic view of the ATM connection management. This CORBA layer is well integrated with the lower level connection management of physical ATM virtual circuits.

  In addition to the Topology Service, other important CORBA services such as Transaction Service, Logging Service and Event Notification Service are also used. These services are supported by HP's newly announced OpenView CORBA platform.

- **ATM connection management** is an implementation of connection management based on ATM Forum's specification.
- **Service management system** provides the integrated management functions for NMF SMART processes and Service Level Agreements (SLAs).

The above architecture uses integration gateways to create the integration between different management technologies. The following figure demonstrates the integration gateway concepts:

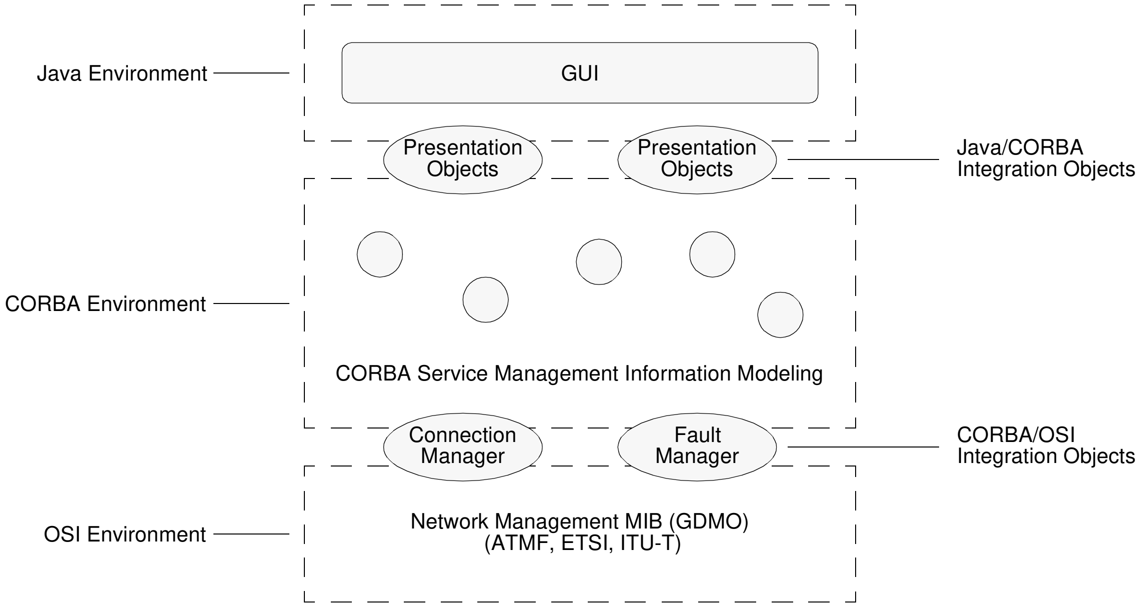

Figure 5: Integration Strategy

The integration object gateways are not direct translations of the objects from other object models, they are the abstract object implementation of the management functions in another object model. For instance, the Connection Manager is a CORBA representation of the lower level connection management functions. It abstracts the OSI management functions into a set of CORBA objects. This set of CORBA objects can be used to build higher order service management semantics.

The same is true for the integration of CORBA and Java. Not every CORBA object has visibility at the GUI level, instead, a set of presentation objects is defined to represent the presentation semantics existing in the CORBA objects and the GUI can be then built on top of these presentation objects.

5 EXPERIENCES

It is generally acceptable by the telco industry that we are in a multiple technology era, both in terms of management technology and transmission technology. Many management technologies have demonstrated their individual value to the management solutions and have been deployed in various different ways.

Our strategy focuses on integration which not only achieves interoperability but adds application value to the end solutions. For example, in the case of CORBA/OSI integration, we use the CORBA based system to model service management functions and the OSI system to model network management functions. We define a set of integration gateways which are CORBA objects (such as ATM connection manager) supported by the OSI function. This approach avoided the re-modelling of the OSI paradigm using CORBA, and reduced the overhead of translation between different object models. It also made the CORBA object layer more abstract (thus encapsulating the OSI functionality) and reduced the number of objects.

Our experience suggests that CORBA can add tremendous value to the Telco solutions. It offers a powerful distributed computing environment and rich object services. The recent NMF's strategic round-table on computing technologies has agreed the value of CORBA to the Telco industry.

It is better to use CORBA to model more dynamic environments such as SM functions. Try to have a stateless and coarse-grain object modelling with more abstract semantics to control the number of objects.

Location independence is a nice feature of CORBA, but don't use it un-necessarily, as the trading and naming services come at a performance price.

OSI-based TMN network management technology is a mature technology, both in terms of standards, object class definitions and commercial products. Compared to the CORBA object model, GDMO is a more optimised object model for representing stable networks and elements, and supports fine-grain object modelling. The existing commercial products, either in management platforms or agent development tools, can help users build large applications with millions of managed objects.

Java's attraction lies in its platform independence and integration with Web technology. It provides a GUI tool-kit and a light-weight, flexible user environment. Its object model, being close to CORBA, provides for easy integration. To benefit the telecom environment, an event driven approach, well integrated with CORBA event notification service is important. We found CORBA is still a better server technology when it comes to develop large management applications.