



***A Communications
Industry Whitepaper***

**Driving Service Innovation
and Profitability**
Adoption of TM Forum Standards in OSS

An Independent analysis published on behalf of:



April, 2008

Executive Summary

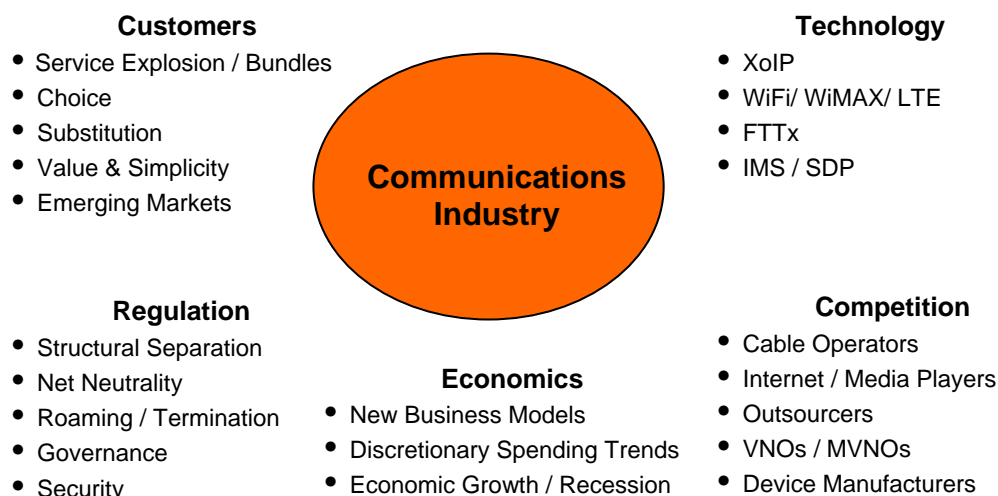
Today's communications industry is characterized by unprecedented complexity and dynamic forces of change in virtually every aspect of its environment, as illustrated in Figure 1 below. Faced with increasing customer demand, pressure on operating margins and increasing competition, Communications Service Providers are now adopting a top-down, end-to-end Service Management approach, managing their infrastructure in the context of the services delivered and ultimately the customer's experience.

While leading Communications Service Providers now recognize that few areas offer broader potential for enabling transformative change than Operational Support Systems, standardization has come slowly to the industry. Accordingly, the benefits that other industries have realized from information technology have eluded some CSPs

The rise of the Telemangement Forum as a leading authority on OSS standardization is evidence of the need for transformation in the industry. The TMF has driven the creation of a series of programs critical to the advancement of OSS, especially in the emerging area of Service Management. A number of CSPs and their technology partners have achieved early success in implementation of standards compliant capabilities.

The objective of this paper is to discuss industry efforts to move toward a more efficient, flexible OSS infrastructure, and the early adoption success and market driven approach of a leading service and resource management company, EMC.

Figure 1: Challenges Facing the Communications Industry



Source: Rich Media & Communications Consulting, 2008

1.0 Introduction

Communications Service Providers (CSPs) today are experiencing tremendous change in their environment. Challenged by reduced pricing power for core services, an explosion of new applications, market entry by competitors from all directions, the emergence of new business models, dynamic change in infrastructure technology and the specter of an impending recession, CSPs are driven to innovate with new services that increase revenues while lowering operating costs for existing services. In addition, the imperative to retain and upsell customers, and speed the introduction of new services is fundamental to success in today's communications industry. Accordingly, CSPs are striving to deploy new services and supporting management infrastructure with a top-down, Service Management approach, managing the end-to-end infrastructure in the context of the service and the user's experience with it.

One of the key areas of focus in addressing these challenges is the CSP's Operational Support systems (OSS). Historically OSS investment has been seen primarily as a cost of doing business, but more recently it has gained recognition for its potential as a strategic weapon. In order to achieve this status, OSS is undergoing a transformation, both functionally and architecturally, and new OSS-related technologies and standards promise significant improvements in achieving end-to-end management and control over services, reductions in cost of ownership, and increasing capabilities for rapid service creation and delivery. The work of the TeleManagement Forum (TMF) in defining and promulgating standards is particularly important to this transformation.

The goal of this paper is to discuss industry efforts to move toward a more efficient, flexible OSS infrastructure, and the EMC's approach to adoption of these standards.

2.0 Operational Support Systems: a Brief History

Operational Support Systems are computer systems and software used by CSPs. This paper will use the term OSS broadly, including network and customer facing systems.

For the majority of the century of telephone service as we know it, most OSS activities were performed by manual processes. In the 1970s, leading service providers created a number of applications which automated much of this activity. The Bell Systems in North America were leaders in the development of OSS, as was British Telecom and a handful of other larger operators. Some of these systems (e.g. TIRKS) are actually still in use today.

Reflecting the state of most large scale software implementations at the time, most OSS systems were initially not linked to each other and often required manual, or "swivel chair" integration in order to accomplish tasks such as service fulfillment. Recognizing the inefficiency in this approach, service providers worked to integrate the systems, but generally these integrations were proprietary and specific to the systems being linked. In fact, the integration of a complex new system into a service provider's environment could run to several times the cost of the application software itself. Inexpensive, rapid, and simple OSS integration remains an important but elusive goal of service providers.

Recognizing the proprietary and closed nature of early OSS, the explosion of new systems and technologies, and given the dynamic changes taking place in the communications industry, an

increasing number of service providers, systems integrators and technology vendors have focused on standards for the integration and interoperability within OSS. These companies are working towards more standardized and flexible approaches to enable rapid service creation and delivery, and to automate the entire service ecosystem – how the user experiences a service, and the business processes involved in creating and delivering the service - across the complex infrastructure components which enable that user experience.

3.0 The TeleManagement Forum

The TeleManagement Forum (TMF) is an international membership organization of communications service providers and suppliers to the communications industry, as well as related industries, such as media and entertainment, which are increasingly intertwined with the communications sector. The TMF has been active in providing a framework and discussion forum for advancements in OSS and BSS, and is generally regarded as the most authoritative source for standards and frameworks in OSS.

The TeleManagement Forum was founded as the Network Management Forum in 1988 with 8 members, including service providers AT&T and British Telecom. The forum's original vision was of "accelerated availability of interoperable network management products".

Since then the TMF has expanded to more than 600 members globally. Its scope has expanded beyond network management to broadly address many of the processes and technical specifications across the end-to-end business ecosystem for a CSP's creation and delivery of services. The TMF's NGOSS framework and its components are increasingly accepted as de facto standards for analyzing telecom business processes and for building easy-to-use systems to automate those processes.

3.1 TMF Programs

TMF programs are broad and wide ranging in scope. Some of the pertinent programs for this paper include:

3.1.1 New Generation Operations Systems and Software (NGOSS)

The NGOSS program is TMF's attempt to create a comprehensive, integrated framework for developing, procuring and deploying operational and business support systems and software. It is driven by 5 key principles:

- Separation of Business Process from Component Implementation
- Loosely Coupled Distributed Systems
- A Shared Information Model
- Common Communications Infrastructure
- Contract defined interfaces

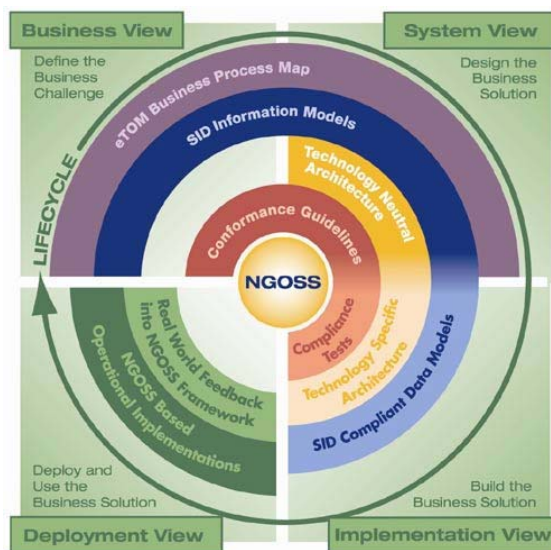
Figure 2 shows the key aspects of the NGOSS program

NGOSS is available from the TMF as a toolkit of industry-agreed specifications and guidelines that cover key business and technical areas including:

- Business Process Automation delivered in the enhanced Telecom Operations Map (eTOM™)
- Systems Analysis & Design delivered in the Shared Information/Data Model (SID)
- Solution Design & Integration delivered in the Contract Interface and Technology Neutral Architecture (TNA)
- Conformance Testing delivered in the NGOSS Compliance Tests
- Procurement & Implementation delivered in ROI Model, RFI Template, and Implementation Guide documents

This approach is intended to allow all participants in the OSS/BSS supply chain to use the elements appropriate for their business with the confidence that they all fit together with a reduced level of “integration tax”.

Figure 2: NGOSS Program Components

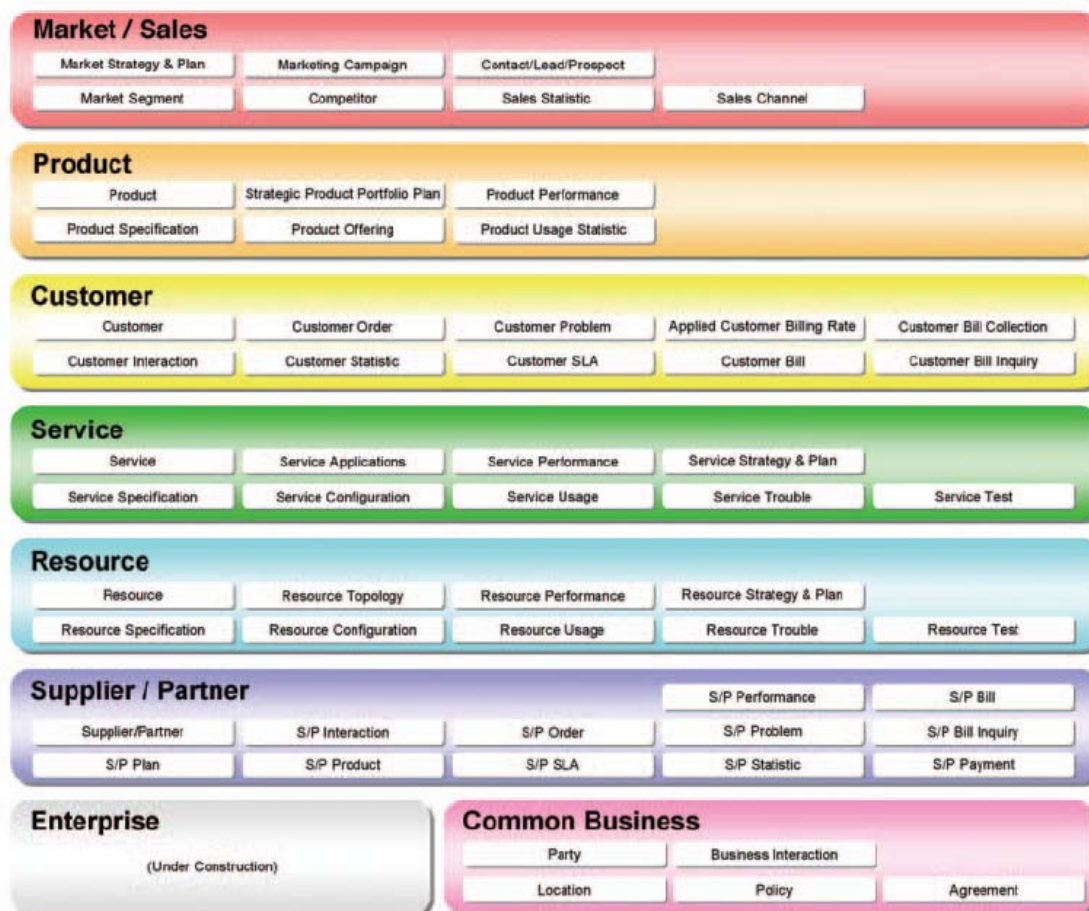


Source: TeleManagement Forum, 2007

One NGOSS area of particular interest to this paper is the SID. The SID is intended to deliver standardized data definitions and structure to support the complete information needs of a CSP. The notion of a single set of data definitions shared by a portfolio of systems is a powerful one. This promises lower development, implementation and operation costs, faster implementation of new systems and services, and the ability to manage a service – including the end to end elements and the relationships and dependencies which exist among them. Figure 3 shows the eight domains of the SID and the associated Aggregate Business Entities of each domain.

Notably, the TMF is collaborating with the Distributed Management Task Force (DMTF) to enhance the DMTF's Common Information Model (CIM) and the SID. This is a particularly powerful idea as it links the information models used to manage the enterprise infrastructure (the CIM) with that intended to manage the CSP infrastructure (the SID). This should also serve CSPs well as their infrastructure evolves to look more like a very large scale enterprise, and as they look to provide more services to enterprises and small/medium businesses.

Figure 3: SID Domains and Aggregate Business Entities



Source: TeleManagement Forum, 2007

3.1.2 OSS/J

The OSS/J program enables participants from service providers, system integrators, independent software vendors, equipment manufacturers, consultants and academe to effectively deliver a

roadmap and suite of Java, XML and Web Services based APIs aligned with the NGOSS framework. OSS/J APIs apply the notion of Core Business Entities (CBEs), which are based upon the TMF SID data model, and are intended to link OSS applications together throughout their lifecycle,

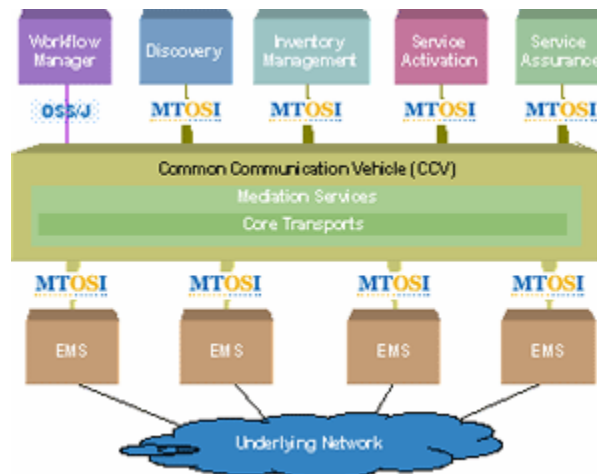
The OSS/J functional APIs currently available include Trouble Ticketing, Order Management, Fault Management, Inventory Management and Discovery.

The OSS/J Program leverages the work of other standards bodies as well, including Java Community Process (JCP), 3rd Generation Partnership Project (3GPP), Object Management Group (OMG), Workflow Management Coalition, International Telecommunications Union (ITU), and IPDR.

3.1.3 Multi-Technology Operations Systems Interface (MTOSI)

The MTOSI effort has the goal of defining a unified open interface to be used between OSSs for the purpose of network and service management. The goal is to cover all technologies from layer 1 (e.g., SONET/SDH) to high layer technologies such as VoIP or media services. Figure 4 shows an example of this drawn from the TMF Catalyst Program.

Figure 4: MTOSI Catalyst Project Architecture



Source: TeleManagement Forum, 2007

3.1.4 Prosspero

The Prosspero Program was conceived with the goal of facilitating faster and broader adoption of standards within the marketplace through the inclusion of appropriate support capabilities. Prosspero defines appropriate support components for new technical specifications, as well as a process to ensure their existence prior to approval.

Prosspero Solution Packages include:

- Case studies of existing implementations

- Implementation guides
- Request For Proposal (RFP) guidelines
- Online Support Community
- Training and Education
- Marketing plan and collateral
- Ecosystem of certified implementers, support tools and services

3.1.5 The Catalyst Program

The Catalyst Program is the TMF's OSS proving ground. It provides the industry players with the environment to work together to solve common, critical industry challenges through collaborative short term projects that culminate in live demonstrations. Solutions are based on TM Forum standards enabling integration across multiple Commercial off the Shelf products. Each project is sponsored by active service provider participants who define the project scope and business requirements. Typical projects include:

- Proof-of-Concept projects, which explore the feasibility of an idea or concept.
- Technology Exploration projects, which prove out technology as a basis for future solutions.
- Specification Validation projects which test specifications developed by TM Forum working teams or industry bodies to see if they are implementable based on real product development and integration.
- Supplier Proving Ground projects, which seek to demonstrate the interoperability of the off-the-self products, as well as the ability of a set of vendors to work together

In summary, TMF solutions are intended to use mainstream IT concepts and technologies to deliver a more productive development environment and efficient management infrastructure. The TMF is careful to maintain NGOSS as prescriptive for only those few 'cardinal points' where interoperability is key while enabling ease of customization across a wide range of functionality. The intent is to allow NGOSS-based systems to be tailored to provide a competitive advantage while also working with legacy systems.

Benefits of TMF programs work include faster, less expensive development cycles, lower long term implementation risk, increased operational efficiencies, greater speed and agility in the implementation of new services, and visibility and control over infrastructure based upon customer and service-centric views.

3.2 TMF Progress in Standards Adoption

TMF standards adoption momentum has been building over the last few years. We believe this has been driven by a cycle of awareness, education and implementation, the TMF's conscious and deliberate efforts to accelerate adoption and, in particular, the changing dynamics within the communications industry itself towards the accelerated delivery of new, compelling services.

The TMF has driven awareness through a variety of methods, but perhaps most effectively through its conferences around the world and its webcasts. Attendance at both the conferences and webcasts has grown steadily. As a result, membership has grown by more than 200 members over the past 3 years, despite the rapid consolidation of industry players.

This increase in awareness and membership has in turn driven an increase in education, with more than 4000 student training days delivered around the world in the last two years.

Finally, programs such as the Catalyst Program and most recently the Prosspero effort have begun to move TMF standards from simple inclusion in RFIs to more critical aspects of solution selection and more recently to implementation.

As proof of the value of TMF standards, there are a number of implementation case studies available through the TMF describing use of standards by service providers. Service providers range from large incumbent fixed operators, through mobile operators, new competitors, and video broadcast network operators. Projects include systems consolidation, new systems and network implementation, business process transformation and systems architecture evolution. Among the most interesting in our view is the implementation of a vendor independent mediation layer by Telecom Italia's NGN2 program. The mediation layer, called the Network Neutral Element Management (NNEM) layer, uses the SID model for Resource Domain and Service Domain, and was implemented in 2007 to provide network upload, service activation and trouble shooting functions for about 200 IP DSLAMs. Subsequent releases of the NNEM will target Fiber to the Building and Fiber to the Home in 2008. This is a clear demonstration of adoption of TMF standards for large scale, mission critical initiatives.

4.0 EMC's Approach to TMF Standards Adoption

EMC is an active member of numerous industry standards bodies. To better understand EMC's position and approach on adoption of TMF standards, it is important to understand the industry problems that EMC is addressing, as well as their strategy and architectural approach in addressing them. This section of the paper briefly describes these aspects of EMC's focus.

4.1 The NGN Management Problem

The creation and management of a Next Generation Network (NGN) and related services for CSPs portends a complex and dynamic environment. Services are continually activated and de-activated, and new services are frequently added to the network, impacting the performance of the network. Infrastructure platforms and elements – physical devices, logical links or virtualized services - are frequently introduced, removed or re-configured, changing the relationships among the

components of the network and service. Dealing with the nuances of these elements adds an additional level of complexity.

In this environment, operators are challenged to maintain end-to-end performance, and during times of service degradation to quickly collect the myriad alarms emanating from infrastructure elements, evaluate the threat that the alarms pose, determine the root cause of the service degradation, and respond accordingly.

In traditional, purpose built networks, this problem could be considered “straightforwardly complex”, as traditional networks deployed a limited set of devices and services. Accordingly, the management systems were specialized for a particular domain, with separate management systems for voice, data, transmission, etc. To deal with the stream of alarms, these systems generally deployed rules-based correlation engines. This approach does not adapt well in an NGN environment, as the sheer number of alarms generated from diverse devices, the additional complexity of the distribution of resource consumption for new services, and myriad inter-domain dependencies would quickly overwhelm these systems. Simply put, traditional management systems could not cope with the scale, complexity or rate of change. Ultimately, the failure of the management system to keep up would result in significant business issues, such as:

- Increased manual intervention, raising the cost of network and service management
- Decreased new service velocity, lowering revenues and potentially market share
- Lower customer satisfaction, reflecting the increase in time to resolve performance problems.

The desired state – the ‘holy grail’ for managing services – is ultimately where technology could automate how services are managed in real time, based on service objectives. In this approach, problems that cause variance from targeted service objectives are automatically identified and remediated, impacts on other services and users identified, and trend analysis applied to dynamically affect changes before future problems occur. This is the notion of “Service Management”, which takes a ‘top-down’ approach to OSS management by focusing on the customer experience first.

In order to address the NGN Management problem, EMC has taken a model-based approach, applying automated analysis to isolate problems that are service impacting. EMC’s vision, enabled over time via broader adoption of standards such as those of the TMF, is enabling an automated approach to Service Management across NGN services and infrastructure.

4.2 Model Based Management: the EMC Smarts approach

EMC Smarts has developed a parallel approach to meeting the challenges of NGN as developed by TMF, by deploying a set of patented technologies underpinning an application architecture offering significantly greater scalability and flexibility than traditional NGN management approaches. While EMC refers to this approach as Model-based Management, there are in fact several key components of the architecture.

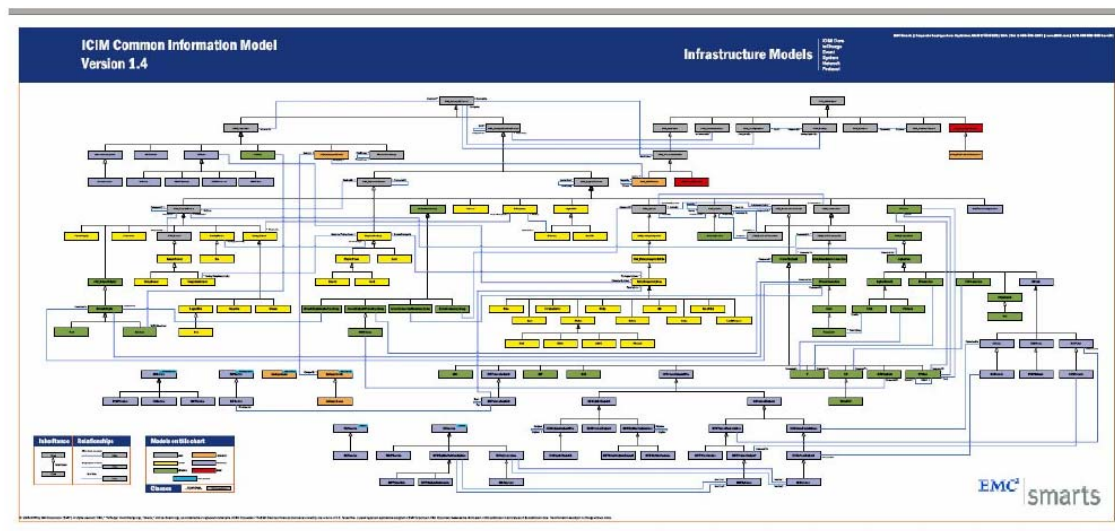
4.2.1 Unified Data Model

At the core of the architecture is a unified data model whose base classes are built on the Common Information Model (CIM) developed by the DMTF.

The EMC Common Information Model (ECIM) is a common context shared by all EMC Smarts applications, and extensible to support open data interchange between and among EMC and third party systems. ECIM provides an abstract description of the NGN environment and contains classes for standard management information for systems, networks, applications and services. The topology object classes span many technologies, management silos and infrastructures. There are physical, as well as logical and virtualized object classes.

This capability allows Smarts to describe an NGN and its related services in a single place. This is especially powerful, given the range of different vendor equipment and technologies in an NGN. Moreover, the ECIM has the ability to describe not only the components of the NGN but, via semantic extensions within the data model, also their constraints, dependencies, and propagation behaviors. This capability is extremely powerful in speeding root cause analysis. Figure 5 shows a graphical depiction of the ECIM infrastructure model.

Figure 5: EMC Smarts Common Information Model



Source: EMC, 2008

4.2.2 Mediation

Mediation is a critical function for EMC Smarts in two respects:

While the ECIM is a powerful tool for NGN management, it is only as good as the data that populates it. CSPs need the capability to rapidly and accurately populate the ECIM data model with the specific infrastructure components and configurations. This is accomplished by the use of an open discovery capability. EMC Smarts uses a variety of mediation protocols to accomplish this, including SNMP, TL1, TMF814, and other standard and proprietary interfaces

In addition, CSPs need to collect and correlate realtime state information from the network on an ongoing basis. Again EMC Smarts uses a variety of mediation protocols, including SNMP, TL1, TMF814, SysLog and other standard and proprietary interfaces to accomplish this.

4.2.3 Automated Root Cause Analysis

All Smarts applications use patented root cause analysis technology, leveraging the constraint, dependency and behavior information stored in the ECIM model. This provides operations staff with a realtime analysis of the source of failure, speeding problem resolution and improving service quality.

4.2.4 Impact Analysis

EMC Smarts has the ability to describe the layering of services over infrastructure end points; therefore, if the root cause analysis capability identifies an end point failure, it can link it to other impacts within the infrastructure, as well as a specific service being delivered (such as a corporate VPN service in the case of a Provider Edge device or card outage), saving the operator valuable time in problem resolution.

4.3 EMC's Approach to TMF Standards Adoption

EMC is a long time member of TMF and has already implemented some of the TMF standards. Its early adoption of a standards-based common information model, integration points with other systems, and support of a variety of mediation technologies is consistent with the overall objectives of TMF.

While many carriers are at the early stages of utilizing TMF standards in their actual production infrastructure, a number of EMC's service provider customers are already applying TMF standards in production through their use of EMC Smarts for NGN management. For example, one global Service Provider is using MTMN TMF 814 with EMC Smarts to instantiate ECIM with topology and events from Cisco Transport Manager managing 15454 devices, topology and events from Ciena ServiceOn managing CoreDirector devices, and topology update events from an inventory system. The early benefit for this customer in use of the standard has allowed extensive re-use across different applications. This element/system mediation is an early step toward a broader strategy to utilize EMC Smarts' shared data modeling and analysis across the service infrastructure, over time.

Given EMC's Model Based Management approach, the SID is particularly important, as it will drive the definitions contained in OSS systems. EMC, with its DMTF CIM-based model is supporting the TMF/DMTF efforts to align the SID and the CIM. In addition, the alignment work will help all players understand the contents of the SID in the context of the CIM, facilitating the information sharing between SID and CIM based systems and architectures

A second important area is mediation. As a result of its wide implementation in the CSP community, EMC already offers a very broad set of APIs and protocols for mediation, including TMF814 as mentioned above. EMC is following the development of the TMF's Multi-Technology

Operations System Interface (MTOSI), specifically TMF854, as an extension to their XML mediation services, on their product roadmap for EMC Smarts as well as the XML element management capability currently supported by their EMC Voyence configuration, change and compliance products.

Finally, EMC is focusing on the development of a common management architecture which leverages web services technologies and a common message bus for integration across all of EMC's management solutions, as well as external information sources or other management systems deployed by its service provider customers. This supports the OSS/J objectives as defined by the TMF, enabling open API mediation under the OSS/J definitions.

EMC views its adoption and delivery of specific TMF standards within its portfolio as market driven. EMC's current solutions support its customers' eTOM operational processes, primarily in the areas of Service and Resource Management and Operations. Today, EMC's solutions also integrate with external systems in support of its customers' Customer Relationship Management processes and business functions under eTOM. EMC sees opportunities in a number of areas to extend its solutions portfolio and, consistent with its support of TMF, intends to provide continued support of these standards.

As such, EMC has worked with both leaders and early adopters of TMF specifications in a number of areas, applying both the standards as well as the real-world experiences of deploying them into its forward-looking product roadmaps. It plans to maintain its support of the TMF SID via the ongoing effort between DMTF and TMF for interoperability between CIM and SID. EMC expects to support OSS/J APIs via its planned deployment of web services mediation in future releases of Smarts, and it continues its work with early adopters of MTOSI, planning for availability of MTOSI as a supported standard within EMC Smarts as the market develops. In the meantime, some of these mediation capabilities are supported on a custom basis during implementation.

5.0 Conclusion

Despite several decades of islands of automation connected through swivel chair integration, CSPs are making real progress toward increased agility and lower cost of ownership in their OSSs. The TMF and its members deserve substantial credit for their development, promulgation and support for adoption and implementation of OSS standards. In the end though, it is up to the CSPs and their technology partners to implement these standards in a complex, high transaction volume environment.

Companies like EMC, through thoughtful adoption strategies and early implementation experience in production environments, are leading the way to a more agile, efficient industry, better able to deliver the requirements of its customers.

We believe that given the industry maturity, the state of development of OSSs, and EMC's overall strategy and architecture, EMC's approach for compliance to TMF strategy is well conceived and practical, and will provide increasing benefit for its CSP customers as adoption progresses.

This independent analysis was sponsored by EMC

EMC is the world's leading developer and provider of information infrastructure technology and solutions that enable organizations of all sizes to transform the way they compete and create value from their most strategic asset—their information. EMC continues to innovate new ways for storing, protecting, optimizing, and leveraging information that enable organizations to solve their most-demanding business and IT challenges. Click on the following links for more information about [EMC](#) and its [network and telecommunications management solutions](#) mentioned in this report.

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