Business Oriented OSS for NGN

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Abstract— The Operations Support Systems (OSS) of Telco service providers have proven to be a critical success factor for businesses as well as a key differentiator between competitive systems providers. Currently, several standards bodies, initiatives and projects attempt to deal with OSS issues concerning Next Generation Network (NGN). Unfortunately there is no coordinated view and actions in the Telco community that can influence these players in terms of participation, liaisons or partnerships issues- Moreover no common understanding exists amongst the Telco service providers of technological issues involved in NGN-OSS. This paper provides a comprehensive discussion and reports on the analysis of key topics that are crucial to meet the OSS requirements in order to address the challenges offered by NGN. These challenges include the use of Commercial off the Shelf components for process automation and systems development and a business view of operational issues.

Index Terms— Next Generation of Network, Operation Support System,

1. INTRODUCTION

The Operations Support Systems of Telco service providers have proven to be a critical success factor for individual businesses as well as a key differentiator between competitive OSS providers. OSS provides support for managing network infrastructure, billing systems, quality assurance, customer care, troubleshooting and provisioning system [1, 2].

A crucial challenge for establishment of NGNs is to build an appropriate service based architecture for their operation, administration and maintenance. The realisation of such a service based architecture involves a large number of different network elements. Currently, several bodies, initiatives and projects propose standards and technologies to deal with OSS issues in NGN [3, 4, 5, 6, and 15]. It is clearly stated in The Eurescom study P1445 [7] that there are no coordinated views and actions in the Telco community to influence standards bodies in terms of participation, liaisons or partnerships issues.

The technical issues and critical operational factors of NG-OSS can be explained in terms of:

- Creating service orchestration frameworks for support of customisable and dynamic business processes in the organisational value chain and value networks.
- Technological convergence and associated issues in terms of resources, business functionality and new capabilities (e.g. introduction of new technology and / or components).
- Satisfying ever increasing demands for cost reduction and value proposition through utilisation of service based process automation.
- Industry consolidation and potential network services integration (e.g. in case of merger and acquisition).

It is, therefore, important to create a roadmap of understanding for NG-OSS within Telco network value systems.

This paper is organised as follows. Section 2 discusses NGN. Section 3 discusses the need for services loose coupling and their operational convergence. Section 4 briefly discusses functional grouping. Section 5 provides the discussion of dynamic issues of OSS. Section 6 presents various standards and end to end vision of the system. Finally section 7 provides the conclusion of the paper and outlines some points for future research, which includes the proposed use of intelligent technology for modelling and implementing of NG-OSS.

2. Next Generation Network

There is no universally accepted definition of NGN. However in context of our discussion; Next-Generation-Network is defined by ITU-T as “a packet-based network able to provide telecommunication services through the use of multiple broadband quality of service (QoS) enabled transport technologies” [3]. The service-related functions of NGN are independent of underlying transport-related technologies. This separation of service related functions enables unfettered users’ access to networks and to the services of their choice. It supports generalised mobility which allows consistent and ubiquitous provision of services to users.

NGN is a new service and network architecture that allows network and services operators to address some of the main business requirements in Information and Communication Technologies (ICT) area.

It intends to incorporate the flexibility and dynamics of the Internet service creation model in an operator business model. This model makes it easier to improve the number of telecom services

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and the user experience, while keeping their OPEX under control. Figure 1 shows a four layer generic architecture of an NGN. These layers are known as access, transport, control, service/application layer.

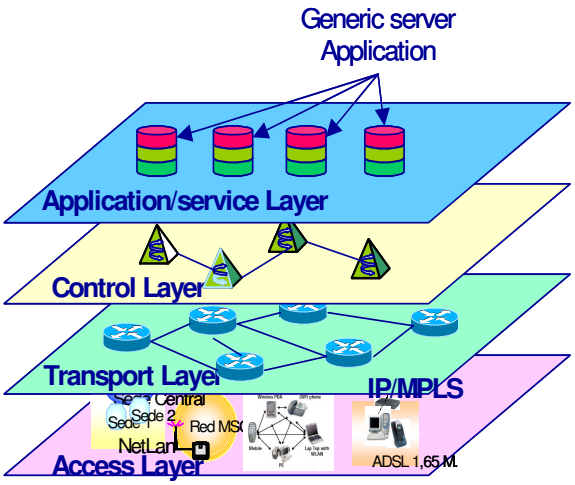

Figure 1: NGN Generic Architecture

NGN is an emerging industry capability that encompasses a number of operational and technical characteristics:

- Customer centric in terms of self service and customer definition of services;
- Service based (e.g. supports multimedia) services such as voice, video and unified/instant messaging;
- Agile in changing services offered to customers;
- Ability to add in new networking and communications applications;
- Predominately packet based with intelligence at the edge;
- Networking technology can be plugged and played;
- Radical reduction in CAPEX and OPEX costs.

3 Loose Coupled Sernices

An effective OSS is critical in order to address the emerging NGN business challenges. An OSS should help to accommodate flexible service integration framework, introduction of new technologies at a faster pace and lower cost; and reduction in cost base through process automation. One of the main trends in industry is the adoption of loose coupling of traditional services towards horizontally layered structures.

The use of commercial off the shelf components enables seamless integration of systems. In the past telecom operators were used to cover all the roles from network resources to customers. Recently, this model has changed considerably, and the value chain has been broken into parts corresponding to the following roles as shown in Figure 2:

- Infrastructure Provider
- Network Provider
- Service Provider
- Content Provider

Figure 2: Value Chain Corresponding Roles

Due to high cost of deployment and maintenance of infrastructure, incoming actors usually play the service provider role whereas the telecom operator may act both as the network provider as well as the service provider.

The network provider is responsible for providing network services to the service provider. The operation and management of these services is made via the OSSs. Due to the re-configured value chain operation it is mandatory to deliver not only network services but also operation services to third party providers.

From an architectural point of view, one of the main characteristics of the NGN is to decouple network and services functionalities. NGN tries to make services independent of underlying technologies and also make it available through different networks. This fact makes NGN suitable to provide fixed-mobile convergence (FMC). Furthermore, FMC is one of the main drivers behind NGN standardisation and adoption from networks manufacturers and service providers. Operators that do not embrace convergence to enable the delivery of third party content will reduce the value of their network.

The goal of NGN is to provide the capabilities to enable the creation, deployment, and management of all kinds of services. In order to achieve this goal, service creation/deployment infrastructure must be decoupled from transport infrastructure. Such decoupling is reflected in NGN architecture as separation of transport and service strata as shown in Figure 3.

This horizontal approach implies to formalise the separation (e.g. through standard protocols or APIs) between:

- Transport layer: various access networks (UTRAN, WLAN, xDSL) connected to a single backbone.
- Control layer: control functions designed to be common to these various access networks (e.g. network attachment control, resource and admission control, session establishment control, service triggering control)
- Application layer: access-independent session-based services (i.e. that are triggered during a session)

NGN operations should facilitate this decoupling or separation. Importantly, OSS should offer operational services taking into account the layers defined by NGN.

Legacy management systems for NGN infrastructure should also accomplish the same NGN layer separation as shown in Figure 4.

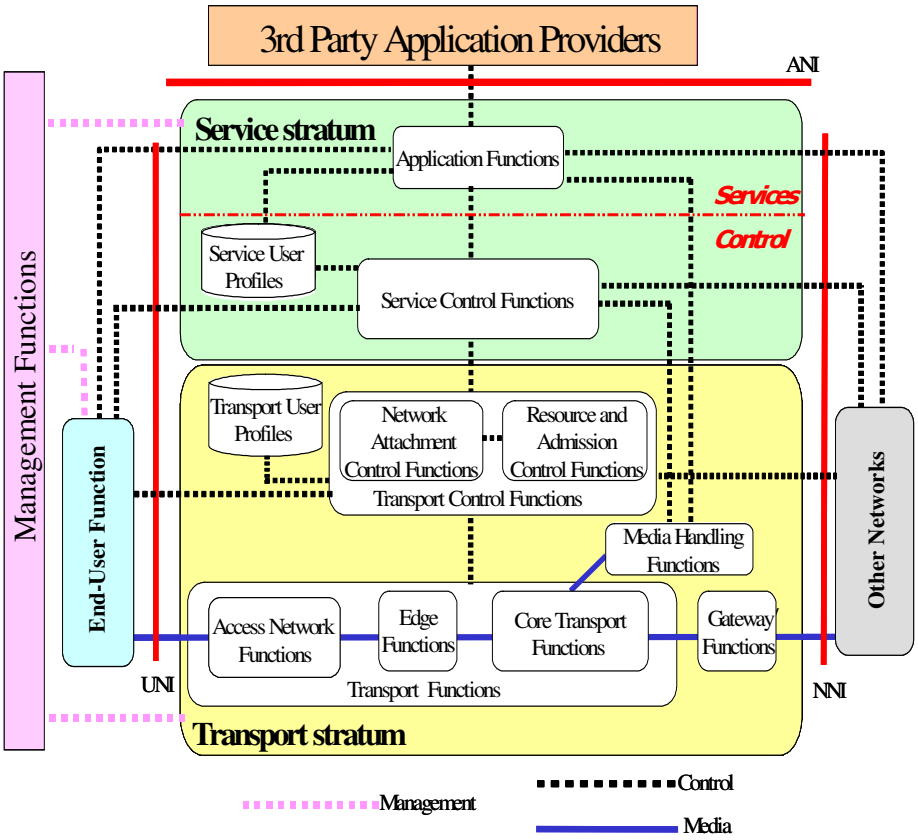

Figure 3: Transport and Service Stratum View of NGN Architecture [7]

Legacy management systems are called NGN EMS. At the NGN OSS stratum operation services are decoupled to allow seamless integration of Commercial Off the Shelf Systems(COTS). OSS/J [9] may be used for this purpose.

The service decoupling as described above follows the business process model of a generic telecom operator, called enhanced Telecom Operation Map (eTOM) [10]. This functional grouping will be further analysed taking into account an operational point of view as well as networking point of view like Telecommunication Management Network, fault configuration, accounting, performance, and security (TMN FCAPS).

Both views are necessary. OSS are best analysed and developed starting from an operational point of view. TMN FCAPS will stay supporting this operational view from the services and network layers.

A great level of loose coupling enables the use of COTS modules, thereby reducing OSS development costs. Eventually, the operators should only be concerned with business process and customisation of different items. Figure 5 depicts the process involved in implementation of OSS using COTS components. Decoupling network management functions from the OSS itself would facilitate the use of modules or components such as APIs of OSS through Java (OSS/J).

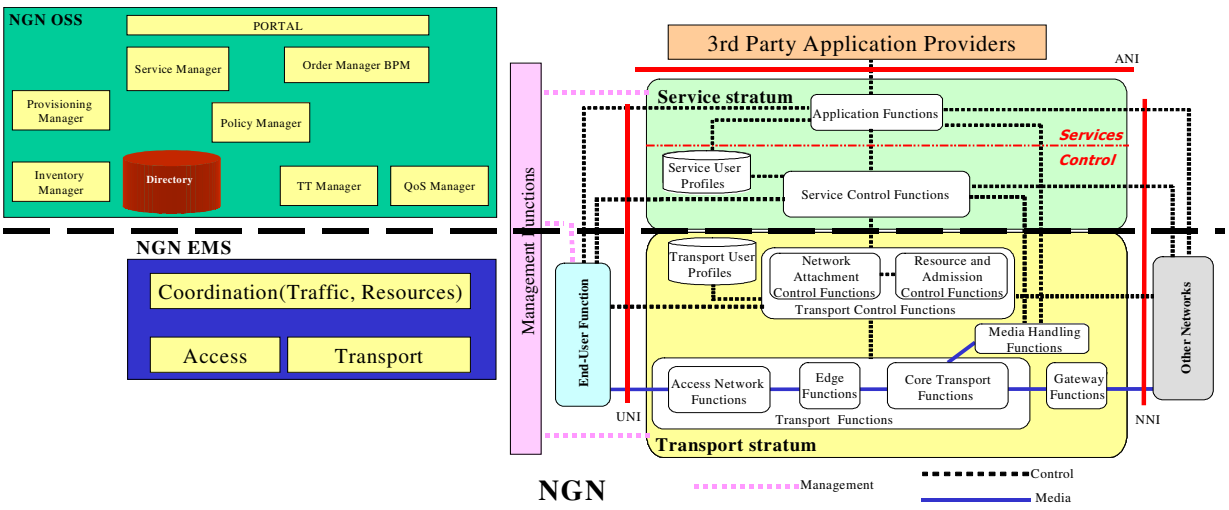

Figure 4: NGN EMS Model

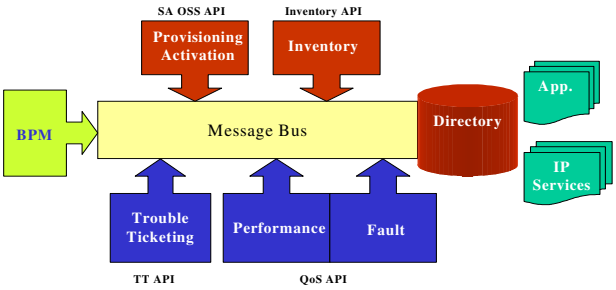

Figure 5: Implementation of OSS Using COTS

Such decoupling helps in building OSS systems in a modular way. TeleManagement Forum initiative known as CO-OP [11] is working to standardise NMS. The goal of this decoupling is to improve OSS interoperability and to reduce the complexity of integrating network equipments and managements systems from multiple vendors.

In order to achieve this goal, telco operators will build their OSSs by combining and customising COTS components, and most importantly by focusing on business needs and their orchestration. A business framework should be used in order to standardize OSSs. It also provides basic mappings between business processes and management function sets. One of the main reasons for this large diversity of activities is lack of a universally agreed set of management requirements for NGN. To date only a few high-level requirements have been expressed by the newly established ITU-T NGN[12] focus group. The structuring of general management requirements will eventually be done on the basis of management functional areas of the eTOM's Fulfillment, Assurance and Billing (FABs) instead of TMN's Fault, Configuration, Accounting, Performance, Security (FCAPS).

4. *Functional Coupling*

We believe that the interaction between actors, information objects, business services and their orchestration needs to be well elaborated for the NGN from the business requirements viewpoint. These information objects and business services derive from the multilevel descriptions in Enhanced Telecom Operations Map (eTOM). Therefore, the business services have to be organised according to eTOM guideline.

The eTOM organises business processes, in form of a multi-level matrix, such as; a process areas, a horizontal (functional) process

In order to allow service providers to deliver, control, and monitor and bill services in a timely and accurate manner it is necessary to take into account the following areas. These areas are further described in the eTOM framework for successful operation of the system.

Provisioning: Each customer's subscription to a service requires its translation into network data and their provisioning on appropriate network functionalities.

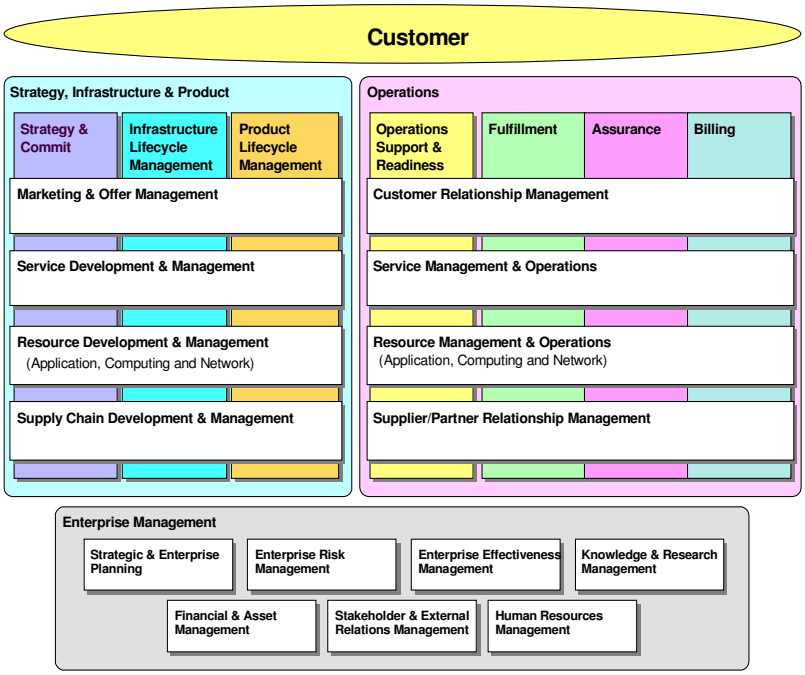

Figure 6: Overview of eTOM

This framework is a part of service delivery mechanism used by service providers to deliver services to customers. Moreover, the data that is provisioned can also be used in other mechanisms such as monitoring and billing, etc.

Provisioning frameworks must provide specifications that define the management information and interfaces between subscription activation, subscription to network information, and network information to network configuration.

Maintenance: This framework is responsible for managing incidents, identifying problems and investigating underlying causes of these problems. The core OSS system for this purpose is Trouble Ticketing system, Commercial off the Shelf modules, may be used. However a precise definition of the interfaces and information is essential. As stated in the eTOM framework the objective is to maintain the service-timely response and resolution of customer or network triggered problems, tracking, reporting, managing and taking actions to improve performance of all aspects of a service.

QoS: Network data management is core information in relation to QoS. Due to the nature of this data it can be separated between Fault and Performance Management. For each of this management disciplines, TMN FCAPS defines its scope. This information should be analysed in order to consider QoS from a customer's perspective.

Billing: Billing is concerned with timely and accurate bills, knowledgeable and responsive billing inquiry support, including timely adjustment handling and payment collections.

5. NGN-M: DYNAMIC OSS

The main characteristic of NGN architecture is that of being a Service Oriented Architecture (SOA). Figure 7 shows the generic SOA architectural model [13, 14]. This model is decomposed into four distinct aspects and two cross cutting concerns. The four distinct aspects are briefly discussed below:

Service Description: Metadata that articulates the interface of a service in order for a service consumer to understand service's externally accessible functionality.

Policy: A set of assertions that must be adhered to when a service is invoked. A policy represents some form of constraints or conditions on the use, deployment or description of an owned entity. Policies may apply to many aspects of SOAs, such as security, privacy, manageability, quality of service and so on.

Contract: It is implied when a service consumer makes an invocation request to a service, in accordance with the policy declaration. A contract can refer to everything from detailed description of a service interface to a legal contract entered into when two or more parties agree to use a given service.

Data Model: It is the abstract paradigm used in invocation and consumption of a service. A data model manifests itself within a concrete architecture as a set of concrete messages.

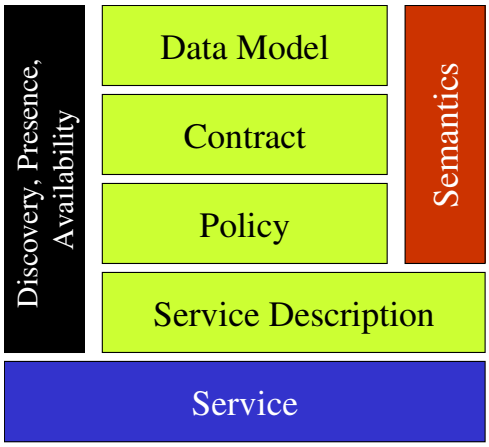

Figure 7: SOA Model

In the subsequent subsection we describe the cross cutting concepts of semantics and discovery within the object model.

5.1 Semantics

Semantic agreement on what entities mean with respect to their roles in a system is necessary for realisation of service oriented architecture. Many of the components (Service Descriptions, Policies, Contracts and Data Models) need to be available for discovery by potential service consumers to determine both the suitability of a service and their ability to invoke and/or consume the service.

A service represents an action boundary between the infrastructure that the service is deployed over and the business context in which it is deployed. In principle, the semantics of a service reflects many of its aspects, from the format and structure of any data communicated between participants of a service interaction to the expected effects of successful interactions.

5.2 Discovery

The concept of discovery is to provide awareness of the presence of a service. Moreover auto discovery is an act of self detecting, identifying, understanding and selecting a service within the constraints and boundary conditions specified within SOA model.

An SOA follows the "find, bind and execute" paradigm as depicted in Figure 8. The service consumer queries a registry for a service that matches its criteria. Once such a service is discovered, the consumer will bind to the provided SOA.

OSS following SOA architecture are intrinsically dynamic, and services have mechanisms for self-provisioning, registering its capabilities, availability and status.

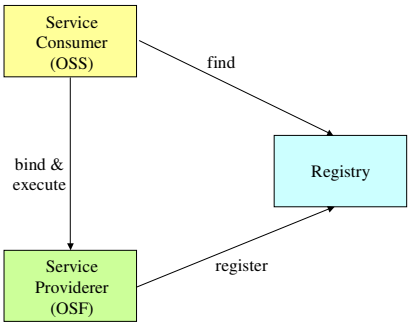

Figure 8: Find, Bind and Invoke Model of SOA

6. Standardisation of an End to End Vision

We believe that a standardisation framework is of paramount important in order to realise the end to end vision. Figure 9 depicts how this vision can be accomplished at several levels.

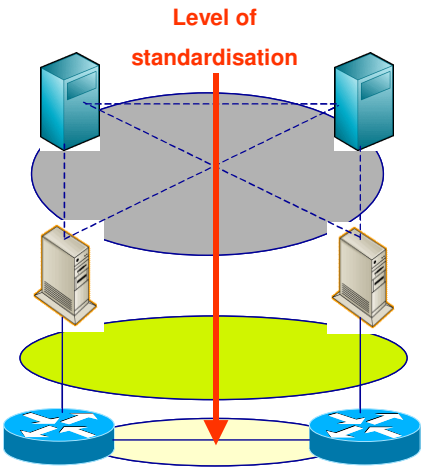

Figure 9: Standardisation Levels

At the lowest level standards play a main role in the service automation as they allow network equipment interconnection. At this level specified standards are PDH, SONET, IP, etc.

Towards this direction, telecommunication industry has also made a great effort to standardise the interconnection between NE's and the OSS that manages them. This effort has been conducted by operators with a varying degree of success.

Currently a number of initiatives exit in this area. For example, the CO-OP project defines a common peer-to-peer architecture, and introduces horizontal interfaces between operation support systems.

Its technical specification consists of interface specification, solution set and reference implementation as discussed below [9]:

- Interface Specification (IS) is an unambiguous syntactical technology independent definition of a CO-OP Interface.
- Solution Set (SS) is an unambiguous syntactical technology specific definition of a CO-OP Interface.
- Reference Implementation (RI) is a prototype or "proof of concept" implementation of the respective IS and SS that exercises all aspects of the CO-OP interface but may be limited in reliability, scalability, and availability.

The major difference between standardised network elements and standardised management systems is that management systems depend on an operator's business process a highly dynamic environment. However, this does not mean that standards for OSS interconnection are not needed. In fact, their requirements imply a dynamic factor that business models help to achieve.

To standardise an NGN management system, it is necessary to identify which standards would be necessary to realise end-to-end vision. It is rather difficult to find end-to-end services in a complex NGN environment as shown in Figure 10.

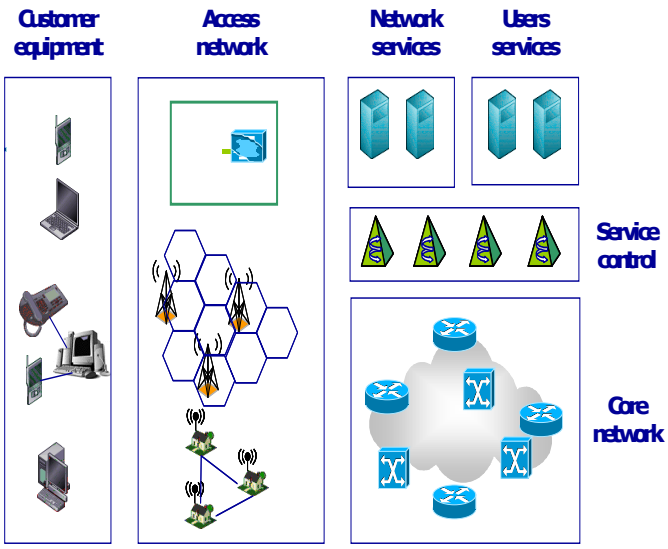

Figure 10: NGN Environment

The responsibility of standardisation organisations is to define standards. However, the existing literature shows that none of them provide standards to realise this end to end vision that allows operators to build more efficient management system.

ITU-T has created a group known as NGNMFG whose role is to act as a coordinator and as an information broker among various bodies concerned with specification of NGN Management.

Figure11 presents the areas where various bodies' specifications have been agreed within the NGNMFG. It is divided into four categories depending on the origin of the standards. The categories are discussed below.

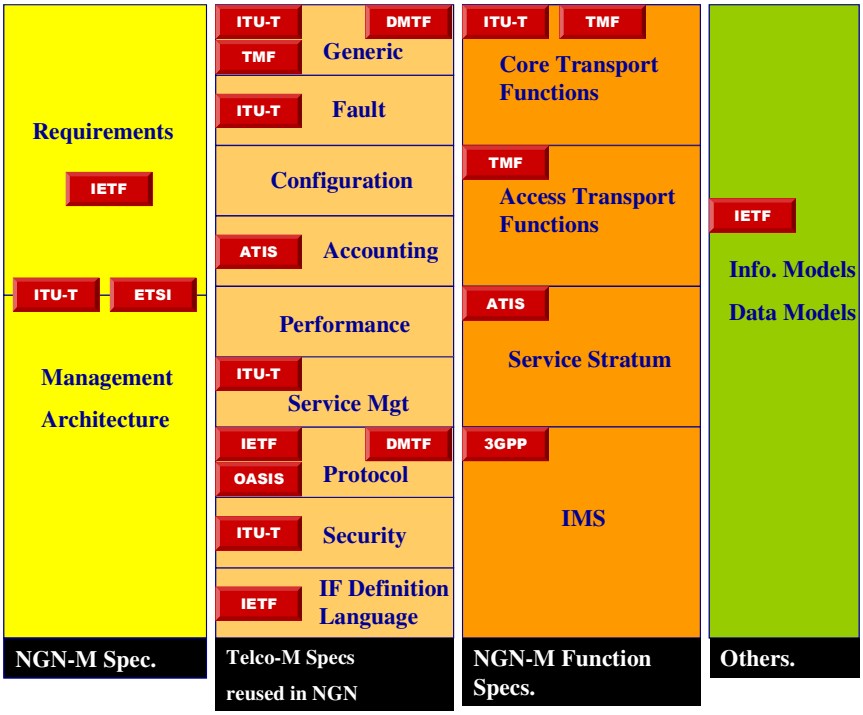

Figure 11: Specifications Areas of NGN

Specification for NGN Management: The specifications listed under this category are written specifically for NGN management and their scope is NGN as a whole, i.e. they are not related to a specific functional entity in the NGN. Within this category, specifications are grouped according to their role in specification architecture. (e.g. ETSI TS 188 003 OSS Requirements)

Generic Telecommunications Management Specifications: Specifications within this category are identified as generic or according to their relation with FCAPS and other functional areas (e.g. ITU-T M.3050 eTOM; TMF GB922 SID; IETF STD 62 SNMPv3).

Specifications for the management of NGN functions: This category includes specifications which have been written specifically for the management of NGN functions. It also includes specifications which have been written for the management of non-NGN functional entities which are reused in the NGN (e.g. TMF 513 MTNM Business Agreement, 3GPP TS 32.311.314 Generic IRP).

Other relevant specifications: It contains specifications considered relevant to the management of the NGN, which do not belong to another category (e.g. IETF RFC 3444 "On the difference between Information models and Data models").

In a complex environment where management standards arise, it is important to have well defined interfaces. It is worth noting that a group created by the TMF is committed to the development of a single and modular NGOSS-based interface specification for managing next generation networks and services, including element, inventory and control plane management. The TMF mTOP Interface as shown in Figure 12 describes specification for the implementation through NGOSS compliant OSS products.

7. *Conclusion and Future Work*

In this paper, we have discussed NGN OSS, a contract driven SOA for operational systems. This integrates business, services, resource management and more importantly the necessary orchestration required to deliver measurable business advantage.

We emphasise that the SOA environment is essential to help service provider to accomplish the key objectives in NGN, which include policy-based dynamic QoS provisioning. SOA supports dynamic infrastructure paradigm that is able to adapt its capabilities and services to the customer's demands. We have also elaborated that common information, relationship, abstraction, interface models and reference architecture that is needed to provide a roadmap for the realisation of an adaptive dynamic infrastructure.

We believe that business goals of OSS can better be achieved by employing a Multi-Agent System (MAS) [16, 17]. A MAS has the ability to cope with dynamics of telecom environment by making intelligent decision in real time and reacting to their environment changes. Therefore, we intend to realise OSS functionality in a set of intelligent agents in our future work. The collection of intelligent agents will achieve OSS business goals by interacting and negotiating with each other and system operators. The use of agent technology meets the SOA requirements discussed in section 5. MAS approach also helps in adding new service in a modular way in order

to enhance systems capability at faster pace and efficiently.

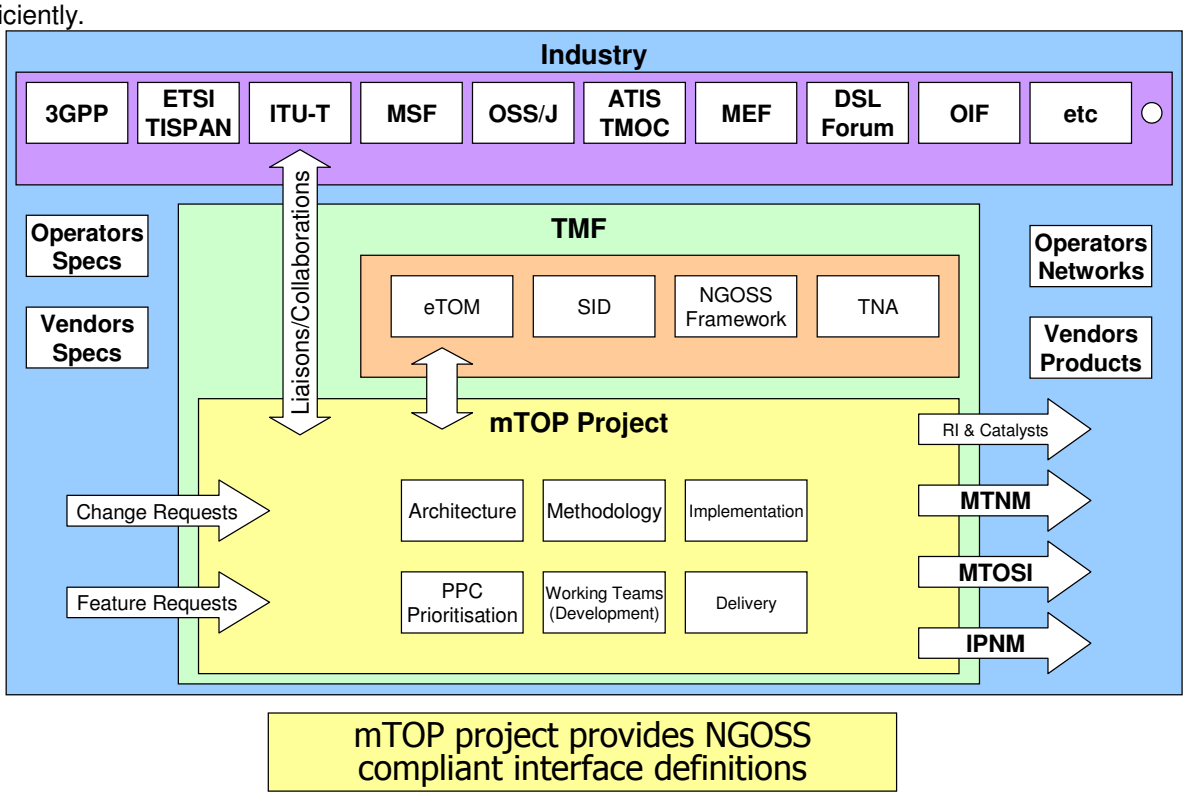

Figure 12: TMF mTOP Interface

Currently, we are working on several telecom projects in collaboration with various telecommunication organisations. We shall apply MAS approach for modelling and implementation of OSS to our ongoing projects. The proposed ITU-T standards for OSS stress the use of service oriented architecture. In fact, MAS is based on SOA and therefore, it is the most suitable candidate to be applied in such an environment.

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