

# Design of a Parlay Network Application Programming Interface and Associated Architecture

P.V. Moodley and H.E. Hanrahan

Centre for Telecommunication Access and Services<sup>1</sup>

University of the Witwatersrand, Johannesburg, South Africa

e-mail: {prathaban.moodley@eskom.co.za, h.hanrahan@ee.wits.ac.za}

**Abstract**— The Parlay Architecture provides a way for applications to access network services using an open API to generic Service Control functions (SCF). No interface has been defined to the underlying transport network nor has an architecture been defined for this network. As Parlay gains acceptance for developing applications, the network interface becomes critical for delivering services to the end user. This paper addresses the design of an open, standard, technology independent API for the gateway-to-network interface. The interface definition must be platform independent and is therefore defined in UML for categories of network and network element: circuit switched packet switched, media gateways and interactive voice response units. The RM-ODP Enterprise Viewpoint for the architecture is presented.

**Index Terms**— OSA/Parlay, Network Interface, API.

## I. INTRODUCTION

THE telecommunications industry is changing rapidly due to market factors and technology changes. Telcos experience continued downward pressure on tariffs for voice and data bearer services, at a time when demand for data services increases rapidly [1]. Operators therefore look to value-added services that attract both premium charges and more bearer traffic to the network to increase revenue. In circuit switched networks, the Intelligent Network (IN) provides a means for provisioning advanced network services to consumers that attract traffic or premium charges [2]. Information Technology applications rely increasingly on telecommunications capabilities, providing a further potential revenue stream for telcos.

The OSA/Parlay architecture has been developed to facilitate convergence between IT-type applications and telecommunications services. The OSA/Parlay architecture is shown in figure 1. The Service Control Layer contains generic Service Capability Functions (SCF) such as call control, data connections, control of user interactions, messaging, mailboxes, charging and data functions such as user status, location and context [3, 4]. Applications, which may be located in a different business domain, invoke

network services through a secure, open standard Applications Programming Interface (API) [3, 4].

The OSA/Parlay Gateway provides a point of integration between Next Generation Network (NGN) application services and the underlying Transport Network infrastructure. OSA/Parlay allows 3<sup>rd</sup> Party intelligent application developers to develop services without detailed knowledge of the underlying transport network, using a level of abstraction provided by the Application Programming Interface (API) mechanism [4].

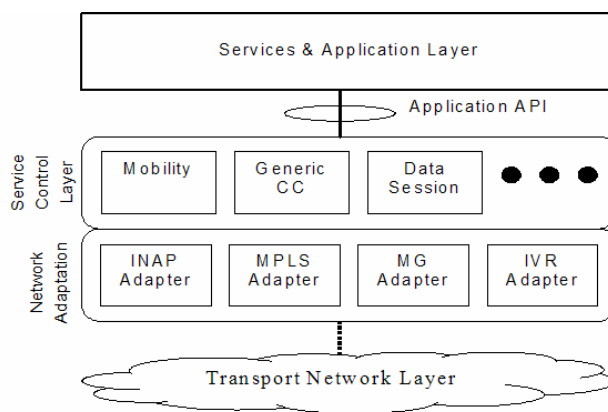


Figure 1: OSA/Parlay Architecture

The underlying network may be a legacy fixed or mobile circuit switched network or may be a packet network. Because of their ability to support multiple services and cost benefits of packet switched technology, many network operators are deploying Packet Switched Networks (PSNs) for data, voice and multimedia services [4]. Two specific network elements are necessary at the network level. Media gateways support interworking between circuit- and packet-switched networks as well as connections to Interactive Voice Response Units.

Service control functions allow applications to perform network functions, for example connect a party to a call or play an announcement to a call party. An interface is needed between the SCFs and the networks and specialised elements as shown in figure 1. The Parlay standard regards this interface as an implementation detail that could be handled by means of network adaptors for various protocols as shown in figure 1.

In this paper, we examine the design of the OSA/Parlay Network Interface (NI). We propose a standard, open API-based interface that has characteristics of technology independence and hence future proofing the interface.

<sup>1</sup> The Centre is supported by Telkom SA Limited, Siemens Telecommunication and the THRIP Programme of the Department of Trade and Industry

Similar to the definition of the Application Interface, the NI will be Object Oriented (OO) using UML. The interface should accommodate a broad range of transport networks and special resources (see figure 2). As with all new telecommunication technologies, the new technology must be able to interwork with the vast existing legacy networks [3]. Thus the NI and associated architecture will be defined for circuit switched networks (CSN), packet switched networks (PSN) and accommodate nodes such as media gateways (MG) and Interactive Voice Response Units (IVR).

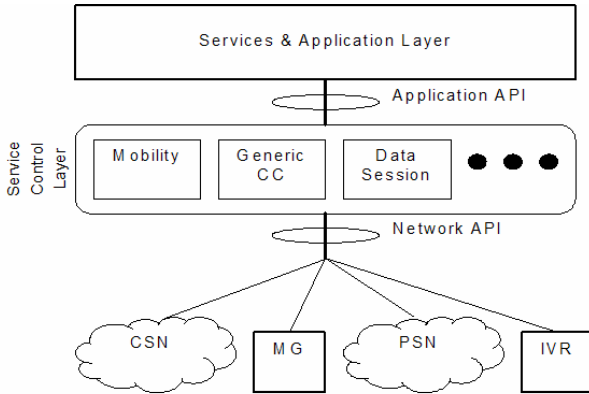


Figure 2: Proposed OSA/Parlay Network Interface

Section II presents the design requirements for the network interface. Section III builds the Enterprise Viewpoint specification of the transport network architecture. Section IV outlines aspects of the Information Viewpoint. Section V describes the methodology for completing the definition of the network interface.

## II. DESIGN CONSIDERATIONS

No standards exist for the interface between the Parlay gateway and the transport network. Two 3GPP reports give an indication on how network interfaces may be realised for a circuit switched network using the INAP or CAP protocols and for an IP Multimedia system using SIP session signalling [5, 6]. In both cases, there is one point of contact between the Parlay gateway and the network. The Gateway does not co-ordinate connections, for example by orchestrating a media gateway and the circuit and packet mode signalling in the adjacent networks. Rather, the gateway exchanges requests and responses with one element and call/session signalling completes the connection.

The Network Interface (NI) envisaged in this work operates on the same principle, that is, there is a single point of communication between the gateway and the network. The underlying network architecture (NA) however does not rely on call/session signalling. More powerful call admission, connection co-ordination, network federation and end-to-end Quality of Service mechanisms are incorporated.

The following subsections present the requirements for the Network Interface, the Network Architecture and a number of constituents of the architecture.

### A. Network Interface

The requirements on the Network Interface are as follows. The network interface must:

- be defined in a *technology-independent* form;
- be suitable for adoption as an *open API*;
- support end-to-end connections as well as those to IVRs while hiding the detail of the actual network;
- support *quality of service*;

The network interface is envisaged as an API rather than a network protocol because the API mechanism easily addresses the requirements for openness, simplicity and technology independence.

### B. Network Architecture

The Network Architecture is not a detailed definition. Rather it provides the concepts and principles for connections involving the constituent networks (packet and circuit-switched) and single elements (media gateways and IVRS). Within the network architecture there are also functional entities for connection admission, routing, federation and QoS. The network architecture must

- provide *connection admission control* as part of a QoS assurance system;
- support connections in *layer networks*;
- support *routing of connections*;
- support *federation* between network operators to provide QoS-assured end-to-end connections.

### C. Circuit Switched Network

Circuit Switched Networks (CSNs) are the most commonly deployed telecommunication networks. CSNs have been used for the deployment of PSTN's worldwide. Due to the development of Intelligent Networks for the PSTN, the INAP protocol has been defined as a standard for utilising Intelligent Network services. The INAP protocol provides a means for adaptation to the Parlay Gateway as both first and third-party calls can be controlled. An exercise to compare the various methods of Parlay to INAP confirmed that a close correlation exists, making the adaptation to the Parlay NI simplistic.

### D. Packet Switched Network

Packet Switched Networks (PSNs) are being rapidly deployed in telecommunication networks due to performance, cost and flexibility benefits. However, addressing real-time traffic requirements require an integrated QoS approach. Connection-oriented packet networks are assumed. Thus the network architecture must provide mechanisms for setting up paths in MPLS networks.

The QoS mechanism will ensure that the network will be able to service the real-time traffic requirements and will also serve to inform the Admission Control entity whether an admit or reject decision is made for the specific connection request.

### E. Media Gateway

Telecommunication networks are large and financial restrictions force new technologies to interwork with existing legacy systems and need to provide a migratory approach. Therefore, the Parlay NI must be designed to interwork with existing Circuit Switched Networks (CSNs),

Packet Switched Networks (PSNs). The network interface and underlying architecture must therefore support interworking between circuit and packet networks.

Media Gateways (MGs) provide for translation between CSNs and PSNs. This special resource in an integral part of the communication setup over networks of differing technologies and therefore QoS and resource availability issues need to be addressed by the Parlay NI. This entity will inform the Admission Control entity whether an admit or reject decision is made for the specific connection request.

#### F. Interactive Voice Response

The interactive voice response (IVR) special resource is a common unit deployed in telecommunication networks. An essential part of services such as prepayment and call center services. Due to the essential nature, the Parlay NI needs to cater for interworking with the resource.

#### G. Quality of Service

Presently envisaged implementations of Parlay based systems rely on network-level mechanisms to negotiate and agree on parameters affecting quality of service, for example using the session description carried in SIP messages. Application-related quality of service is however an ultimate goal. The following steps are required. The application requests the required QoS using parameters that are suitably abstracted from the underlying infrastructure. The service provider specifies the maximum QoS that it offers. This level may be specified in policies and may depend on the state of the network. The service provider and application agree on a quality. At the network level, end-to-end interactions may be necessary to determine the QoS available. If the requested quality cannot be provided, the request may be refused, for example a call request is not admitted. The underlying network mechanism must record the QoS achieved for billing and management purposes.

The NI will encapsulate capabilities to query the state of the Transport Network and send connection control requests to the Transport Network. The capabilities of the NI will include QoS and network-level federation queries and requests. The NI will be designed, built and demonstrated through a proof of concept case study. This study will highlight the advantages and disadvantages of the API based NI according to criteria for connection setup, maintenance and teardown in CSNs and PSNs. Other criteria will include communication with special resources, FCAPS management, federation and QoS.

#### H. Federation

Telecommunication operators are often required to federate networks in order to provide an effective service to their users. This would include the federation of local networks for consumers to contract each other notwithstanding the separate networks. Similarly, international calls require an interworking of operators networks. Due to the trend of rapidly evolving technologies, it is not uncommon to have interconnection requirements for a call with varying technologies along the path. This requirement needs to ensure that the QoS required for the service can be guaranteed for the entire duration of the call.

Added to the complexity, some operators would

implement a OSA/Parlay type architecture while others would operate SIP or H.323 call control without advanced services. These cases need to be addressed separately.

#### I. Simplicity

The network interface and architecture should be designed in a manner that will ensure:

- Minimise the number of architectural layers;
- Decisions to be made at the lowest layer possible (efficiency);
- Tree structured architecture.

These characteristics influence the amount of data and processing required by each layer in the architecture. Minimising the information requirements reduces the overhead and additional processing demands of the entire network architecture.

#### J. Design Methodology

The Reference Model for Open Distributed Processing (RM-ODP) methodology is being used for completing the viewpoints in designing the NI. A framework is developed for the NI and related architecture. The framework ensures that the interface will consist of the following characteristics: *openness, simplicity, future-proof, QoS mechanisms* and supporting *federation* between telcos. This methodology ensures that the NI to be specified will be independent of systems and technology. Various tools are being used within the RM-ODP methodology to complete the RM-ODP views, these will include SDL, ICONIX and UML amongst others.

### III. ENTERPRISE VIEWPOINT

The objective is to develop a Parlay Network API and associated Transport Network Architecture. The purpose, scope and responsibilities of the architecture need to be defined in a technology and distribution transparent manner. To achieve this, the RM-ODP enterprise viewpoint is used. This viewpoint answers the following questions [7]:

1. What is the **purpose, scope** or **objectives** of the Architecture?
2. What abstract **objects** combine to form the Architecture?
3. What **environment, community** and **domain** does the Architecture operate in?
4. What are the **roles, relationships** and **interactions** between the objects?
5. What are the **contracts**, expressed as **policies**, which define object interactions?
6. Does **federations** exist between different domains?

#### A. Purpose of the Architecture

The architecture will enable the use of advanced Parlay application services by consumers within the transport network. A network API is required in order to facilitate the use of services developed in the application domain by consumers in the network domain. An adaptation of the ideas in the TINA [8, 9] and MSF [10] architecture ensures various aspects can be used in the new architecture such as, inter alia, the QoS within the transport network, federation

between networks and reporting on the instantaneous state of the network. These new elements in the architecture can be used for traffic engineering and the planning of the expansion of the network as this statistical information will be available.

### B. Roles of the Enterprise objects:

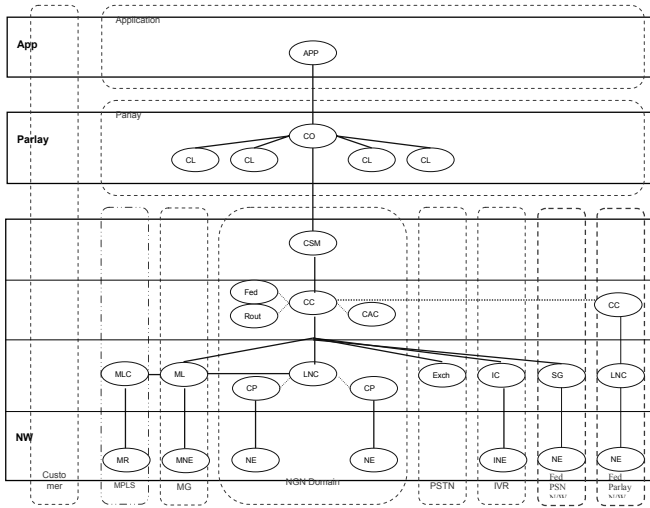


Figure 3: The Enterprise Viewpoint

The enterprise viewpoint is depicted in figure 3 above, the roles and responsibility of the enterprise objects are described below:

**App:** The Application (App) initiates calls between the various call parties within the network such as a PSTN or a MPLS user and possibly IVR's.

**CO and CL's:** The Call Object (CO) and Call Legs (CL's) are the objects used within the Parlay Gateway to represent the call and call parties within a call. The call properties including the QoS for the call are stored in these objects.

**CSM:** The Communication Session Manager (CSM) is responsible for the communication between the transport network and the Parlay Gateway. The CSM is also responsible for the Logical Connection Graph (LCG) for each instantiated call.

**CC, Rout, CAC, Fed:** The Connection Coordinator (CC) is responsible for the translating the LCG into physical connections. The Routing (Rout) object determines which layers are to be used for the call and selects the appropriate Layer Network Coordinator (LNC). The Call Admission Control (CAC) is responsible in determining whether the requested call properties (QoS) can be supplied by the transport network and on that basis, does a call admission control function. The Federation (Fed) object is responsible for managing the Administrative Federation on a call by call basis including authentication, etc.

**LNC and CP:** The Layer Network Coordinator (LNC) is responsible for the connection within the layer network. Its function is to set up the connections via the Connection Performer (CP) in sub-layer networks. The CP and LNC provide network state information back to the CC.

**NE:** The Network Element (NE) represents the actual physical network element in the network, providing information on its capabilities and the current state of the device.

### C. Other Domain specific objects

**ML and MNE:** The Media Gateway-LNC (ML) and Media Gateway-NE (MNE) are adaptations of the LNC (signaling) and NE (physical channels) specific to the Media Gateway.

**MLC and MR:** The MPLS-LNC (ML) and MPLS-NE (MR) are adaptations of the LNC (for signaling) and NE (MPLS routers) specific to the MPLS network.

**Exch:** The Gateway exchange into the PSTN network.

**IC and INE:** The IVR-LNC (IC) and IVR-NE (INE) are adaptations of the LNC (signaling) and NE (physical channels) specific to the IVR.

**SG and NE:** The Signaling Gateway (SG) and NE are adaptations of the LNC (signaling) and NE (physical channels) specific to the federated PSN network.

### D. Operational Community and Object Domains

The collection of enterprise objects constitutes a community, named the **Parlay Network Community**. The objects within this community interact to achieve a specific objective, which is to provide parlay based intelligent services to users in the Transport Network with the specified call parameters including QoS. Each enterprise object belongs to a specific administrative domain within the NGN service community.

In figure 3 above, the consumer, application, Parlay, NGN, PSTN, MPLS, Media Gateway, IVR, Parlay federated network and federated PSN domains are illustrated. The consumer domain represents the collection of users and associated terminal devices. The application domain represents a collection of intelligent applications that provide services to consumers. The Parlay domain represents the Parlay Gateway and its associated objects. The CO and CL objects represent the call and calling parties respectively.

The NGN domain represents the next generation network layers and its associated objects. These objects are responsible for interfacing to the Parlay Gateway, call control, managing the connections on a layer or sub-layer basis as well as representing the physical entities. The PSTN domain represents the legacy PSTN network. The MPLS domain represents the MPLS network layers and its associated objects for signaling and representing the physical routers. The Media Gateway domain represents the media translation gateway between networks of varying technology and its associated objects for signaling and representing the physical channels. The IVR domain represents the special resources and its associated objects for signaling and physical channels.

The Parlay federated network domain represents a federated network with a similar architecture to the Parlay NGN domain. The federated PSN network domain represents a federated network with a SIP or H.323 type architecture.

#### IV. INFORMATION VIEWPOINT

There are essentially two requirements for information objects. The first being, information objects required to contain the logical connection graph (LCG) and associated information per call instance. The specific call properties are distributed to the relevant objects in each layer within the architecture. This is essentially a push request down the architecture for a pending call instance.

The second being, information objects required to provide frequent network information pertaining to the state of the network back to the CAC entity. This is essentially a pull request up the architecture.

In order to avoid creating large complexities in the information requirements of the architecture, it is proposed that a simple model of configuration of the physical equipment from the sub-layered network be maintained throughout the network layers (see figure 4). The model would be configured up to the CAC object. It ensures that a single information structure be used throughout the architecture.

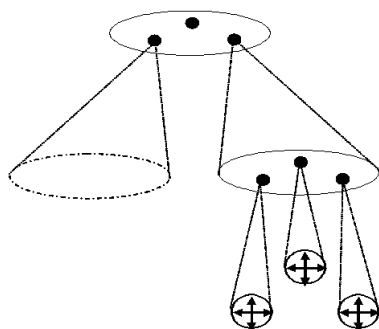


Figure 4: Configuration Model

#### V. FUTURE WORK

The Reference Model for Open Distributed Processing (RM-ODP) methodology is being used for completing the viewpoints in designing the NI. A framework has been developed for the NI and related architecture. The Information-, Computational-, Engineering- and Technology viewpoint is to be defined for the NI. Various tools are being used within the methodology to complete the RM-ODP views, these include SDL, ICONIX and UML amongst others.

The NI will be designed, built and illustrated through a proof of concept case study for the four broad categories: CSNs, PSNs, MGs and IVRs. The proof of concept environment will be UNIX based and implemented in a CORBA Distributed Processing Environment (DPE). The testing procedure will be based according to criteria for connection setup, maintenance and teardown in the CSNs and PSNs. Other criteria will include communication with special resources, FCAPS management, federation and QoS. The evaluation will highlight the advantages and disadvantages of the API based NI.

#### VI. CONCLUSION

The network interface is a critical part of the OSA/Parlay architecture for delivering services to the end user. Due to

the fast paced evolution of technologies it is essential that the interface needs to be future proof and therefore technology independent. The OSA/Parlay proposal for the use of technology-dependent protocol adaptors therefore can not meet this criteria. The network interface should be standards based and technologically independent. The interface will need to be defined in the OO paradigm, using APIs and in UML notation, similar to the approach adopted for the application interface.

The RM-ODP Enterprise Viewpoint for the architecture is presented. The viewpoint addresses the design of an open, standard, technology independent API for the gateway-to-network interface. The enterprise view is defined for categories of network and network element: circuit switched, packet switched, media gateways and interactive voice response units. The enterprise viewpoint provides a framework ensuring the following characteristics of the NI: *openness, simplicity, future-proof, QoS mechanisms* and supporting *federation* between telcos.

#### REFERENCES

- [1] Hanrahan HE, Advanced Telecommunication Service Architectures – Course Notes, University of the Witwatersrand, Johannesburg, 2003,.
- [2] Hanrahan HE, Intelligent Networks – Course Notes, University of the Witwatersrand, Johannesburg, 2003
- [3] Hanrahan HE, Advanced Telecommunication Service Architectures – Course Notes, University of the Witwatersrand, Johannesburg, 2003, pp 191-230
- [4] ETSI: "Open Service Access (OSA); Application Programming Interface (API); Part 1: Overview", 2003, [www.parlay.org](http://www.parlay.org)
- [5] 3GPP: "Universal Mobile Telecommunications System (UMTS); Open Service Access (OSA) Application Programming Interface (API) Mapping for Open Service Access; Part 4: Call Control Service Mapping; Sub-part 1: API to CAP Mapping" V6.0.0, December 2004, [www.3gpp.org](http://www.3gpp.org)
- [6] 3GPP: "Universal Mobile Telecommunications System (UMTS); Open Service Access (OSA) Application Programming Interface (API) Mapping for Open Service Access; Part 4: Call Control Service Mapping; Sub-part 4: Multiparty Call Control ISC", v6.0.4, December 2004, [www.3gpp.org](http://www.3gpp.org)
- [7] ITU-T, "Information technology — Open Distributed Processing — Reference model: Overview", First edition, 1998, [www.iso.org](http://www.iso.org)
- [8] TINA: "Service Architecture", Version 5, June 1997, [www.tinac.org](http://www.tinac.org)
- [9] TINA: "Network Resource Architecture", Version 3, February 1997, [www.tinac.org](http://www.tinac.org)
- [10] Gallon C, "Quality of Service for Next Generation Voice Over IP Networks", MultiService Switching Forum, February 2003, [www.msforum.org](http://www.msforum.org)