

IEEE P1903™/D1 Draft White Paper for Next Generation Service Overlay Network

Prepared by the NGSON Working Group of the

IEEE Standards Committee

Copyright © 2008 by the Institute of Electrical and Electronics Engineers, Inc.
Three Park Avenue
New York, New York 10016-5997, USA
All rights reserved.

This document is an unapproved draft of a proposed White Paper. This document is subject to change. USE AT YOUR OWN RISK! Because this is an unapproved draft, this document must not be utilized for any conformance/compliance purposes. Permission is hereby granted for IEEE Standards Committee participants to reproduce this document for purposes of IEEE standardization activities only. Prior to submitting this document to another standards development organization for standardization activities, permission must first be obtained from the Manager, Standards Licensing and Contracts, IEEE Standards Activities Department. Other entities seeking permission to reproduce this document, in whole or in part, must obtain permission from the Manager, Standards Licensing and Contracts, IEEE Standards Activities Department.

IEEE Standards Activities Department
Standards Licensing and Contracts
445 Hoes Lane, P.O. Box 1331
Piscataway, NJ 08855-1331, USA

Abstract:

NGSON framework describes the capabilities and issues that form the basic consideration for the need of service overlay network standardization. The NGSON Framework is a networking framework for collaborative service plane, network plane, operations and management plane capabilities.

The readers of this document will be able to identify their domain related issues and can use this document as reference to illustrate specific functions for standardization. The IEEE NGSON standards to be described in a detailed standard specification will deal with few of the capabilities and issues concerned with the NGSON framework.

Keywords: NGSON, service-oriented networks, context aware, dynamically adaptive, self organizing, framework

Patents

Attention is called to the possibility that implementation of this <gde./rec. prac./std.> may require use of subject matter covered by patent rights. By publication of this <gde./rec. prac./std.>, no position is taken with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying patents or patent applications for which a license may be required to implement an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

Participants

The following individuals contributed to the authoring of this white paper:

Rick Townsend, *Chair*
Wu Bin, *Vice-chair*
Jinkyung Hwang, *Vice-chair*

China Mobile	Wu Bin, Vice-chair
	Chen Gang
China Unicom	Liao Jun
ETRI	Sangjin Jeong
	Myung-Ki Shin
	Hyun Kyung Yoo
	Jong Hwa Yi
Fraunhofer FOKUS	David Linner
	Stephan Steglich
Hankuk University of Foreign Studies	Ilyoung Chong
Hewlett Packard	Marc Brandt
Huawei	Rick Townsend, Chair
	Li Yan
	Pan Qiuling
	Li Yizhou
	Li Li
	Liu Feng
	Zong Ning
	Ma Qifeng
	Tang Jie
	Yang Peilin
	Johnson
	Chen Shan
	Niranth Amogh
	Jiang Xingfeng
	Mehmet Ulema
IBM	Gordon Kerr
Korea Telecom	Moon Suk Kang
	Jinkyung Hwang, Vice-chair
	Sungcheol Park
	Seungjoo Back
	Eun Kyoung Paik

RITT

Telcordia

ZTE Corporation

Jungmin Seo
Young Sook Choi
Zhou Yi
Cui Yuanyuan
Ming Lai
Fuchun Joseph Lin (Joe)
Subir Das
Ken Kerpez
Tao Zhang
Xing Xiaojiang
Jia Xia
Lu Jie (Alex)
Lin Zhaojin
Hu Jie

CONTENTS

1. Introduction	2
1.1 Scope and Purpose	3
2. References	3
3. Acronyms	3
4. Motivations.....	4
4.1 Business Needs	4
4.2 State of the Art.....	4
4.3 Need for NGSON	12
5. NGSON Framework.....	12
6. Service Overlay Network Functions.....	15
6.1 Service-Related Functions	15
6.2 Transport-Related Functions	17
6.3 Service Provisioning, Operation and Management Network Related Functions	19
7. Considerations for Standardization.....	20
8. Scenarios	21
8.1 The IPTV and Mobility Scenario in NGSON.....	21
8.2 Dynamic Service Composition in a Seamless Mobility Environment.....	25

DISCLAIMER: This version of the NGSON White Paper gives the current view of the direction of the IEEE P1903 (NGSON) Working Group and is a work in progress; it's contents may change.

Comments on the White Paper are invited and may be sent to Rick Townsend, Chair IEEE P1903 at ricktownsend@comcast.net

Draft White Paper for Next Generation Service Overlay Network

1. Introduction

This document is a White Paper that provides an overview of a Next Generation Service Overlay Network (NGSON) framework. The focus is to describe the capabilities and issues that allow this framework to be used in the basic considerations of service overlay network standardization. The readers of this document will be able to identify their domain related issues and can use this document as reference to illustrate specific functions for standardization. It is expected that the IEEE NGSON Working Group will directly pursue the standardization of only some of the capabilities described in this White Paper and will utilize specifications from other standards developing organizations whenever possible.

Traditionally the various networks like NGN or the IT/Web have provided services that are offered to consumers through usage of highly specialized technologies. As users consumed services offered through various networks, their lifestyles have evolved and users have pushed for blending the service offerings of these various networks for a richer experience. Changing lifestyles and requirements of rich experiences should now be supported by collaboration amongst various provider entities of these networks. Telco/Network operators are usually providers of NGN services/applications and Internet Service Providers, Content Providers offer services over the web or similar IT architectures. We cannot minimize the fact that there might be new networks offering services to the end user.

With such an evolution foreseen, it is important to organize the services/applications offered by various networks on an overlay and provide access to stakeholders like end users and providers. Such an overlay network, called NGSON in this document, would help the providers to organize and improve their business by offering rich services to their users not only through composing services dynamically from their networks but also collaborate with other providers and provide a much rich service to the end users which can support the growing lifestyle of the users. End users will be able to use NGSON to demand/create services of their choices too.

NGSON solves many challenges with respect to providing a very reliable service which are blended for rich experience from a wide range of services offered through different networks over different devices. With this in focus, the NGSON basically targets solving and standardizing issues primarily differentiated at two levels; Service and Transport.

Services are usually provided over resources which have computing, storage and IP networking capabilities. To reliably serve the users, the services offered by different networks should provide standardized access to utilize them. Today different networks might only have a pool of services, but with service blending across networks, there will be a multitude of services managed under different administrative domains. To offer services through such a network, more automated service delivery capabilities should be provided with the

keys being the self organization of the service overlay network, service awareness and network awareness or broadly classified to be NGSON contexts.

To support high quality of service delivery over heterogeneous network elements and devices, it is important to optimize the usage of the heterogeneous transport network. For wireless technologies, high quality delivery could involve more optimized organization of network structures for optimal energy utilization and ubiquitous connectivity.

Section 1 gives the overview of NGSON and also briefly illustrates the scope and purpose of NGSON standards. Section 4 provides the motivations for NGSON providing a brief analysis based on business needs and state-of-the-art technologies. Section 5 provides a detailed description of the NGSON framework and Section 6 describes the various service -related, transport-related and operations and management functions in NGSON. Section 7 provides considerations for NGSON architectural standardization. Section 8 details scenarios enabled through NGSON.

1.1 Scope and Purpose

This White Paper describes a framework of Internet Protocol (IP)-based service overlay networks and specifies context-aware, (e.g., such as required Quality of Service (QoS) level, type of service such as real-time vs. data, nature of data stream such as I-frame vs. B-frame, and type of terminal such as TV monitor vs. personal digital assistant), dynamically adaptive (e.g., using locally derived information to discover, organize, and maintain traffic flows in the network within a local area network), and self-organizing networking capabilities (e.g., developing network structures based on the needs of the customers and the capabilities of existing network structures), including advanced service level routing and forwarding schemes, and that are independent of underlying transport networks.

This standard benefits network operators, service/content providers, and end-users to provide and consume collaborative services by the deployment of context-aware, dynamically adaptive, and self-organizing networking capabilities. [B1]

2. References

- [B1] NGSON Approved PAR <http://grouper.ieee.org/groups/ngson/PAR>
- [B2] http://telephonyonline.com/iptv/technology/ip_service_awareness_071706/
- [B3] Y.2012 – Functional Requirements and architecture of the NGN release 1.
- [B4] <http://en.wikipedia.org/wiki/Peer-to-peer>
- [B5] Figure from the P2P System Tutorial by Keith Ross and Dan Rubenstein
- [B6] Open Mobile Alliance, <http://www.openmobilealliance.com/>.
- [B7] The PARLAY Group, <http://www.parlay.org/en/index.asp>.

3. Acronyms

For the purposes of this draft , the following terms apply. *The Authoritative Dictionary of IEEE Standards, Seventh Edition*, should be referenced for terms not defined in this clause.

CSF – Call Session Control Function
 CT -Computer Technology
 IEEE – Institute of Electrical and Electronics Engineers
 IP – Internet Protocol

IT – Information Technology
 NGN – Next Generation Network
 OPEX – Operating Expenses
 QoS – Quality of Service
 SIP – Session Initiation Protocol
 SOA – Service Oriented Architecture
 TMF – TeleManagement Forum
 XML – eXtensible Markup Language

4. Motivations

The motivations for realizing IEEE NGSON are typically driven by business needs of the service providers/operators and from the limitation of the state of the art in delivering the business needs through existing standards.

4.1 Business Needs

Operators/network providers have clear motivations to be more than just pipe providers. The rapidly falling Average Revenue Per User (ARPU) over the years with connectivity services has further strengthened the motive to move to the services and application spaces. The over the top providers have exploited the access and network infrastructure and built a framework where non-voice services can be sold to large scale users. Additionally, stacking services, using a current architecture, also risks diluting the value of IP convergence by creating multiple independent application layers on top of a single IP infrastructure.

The question arises as to how to make full value of existing and future investment and expand into services and applications spaces while dynamically collaborating and co-operating with all forms of service providers.

Optimizing revenue means optimizing ARPU, and clearly that cannot be done effectively without an ecosystem view of services. A service set targeting a customer population has to be created by not only a single infrastructure but also a single set of application and signaling facilities, allowing service features to be composed from a set of tools available to any service, wire line or wireless, and targeting any customer need.

4.2 State of the Art

4.2.1 Service Delivery Platform

The concept of a Service Delivery Platform (SDP) provides businesses with powerful, high-quality, integrated software solutions. Wikipedia describes the SDP as following: “The term **Service Delivery Platform (SDP)** usually refers to a set of components that provide a service’s delivery architecture (such as service creation, session control & protocols) for a type of service.” SDP is intended to enable rapid development and deployment of the new convergent multimedia services, from basic POTS phone services to complex audio/video conferencing for multiplayer games (MPGs). SDPs typically provide a service control environment, a service creation environment, a service orchestration and execution environment, and abstractions for media control, presence/location, integration, and other low-level communications capabilities. Often, they will feature a unified directory of customers that provides a metadata model for all existing customer databases, including business, consumer, broadband or mobile. SDPs are applied to both consumer and business applications with the latter set often focused on the integration of telecom and IT capabilities.

People believe that SDP resolves the problems of “silo” mode service offering. The core idea is to have the SDP provide an infrastructure for service management and operation by aggregating the network capabilities and service management functions in a common platform. Since we consider the future when services grow rapidly while millions of service deployed in SDP platform, the issue was: is it still easy and cost-effective to create, to deploy services under SDP? The following diagrams show the evolution of service layer that finally align with NGSON’s proposal.

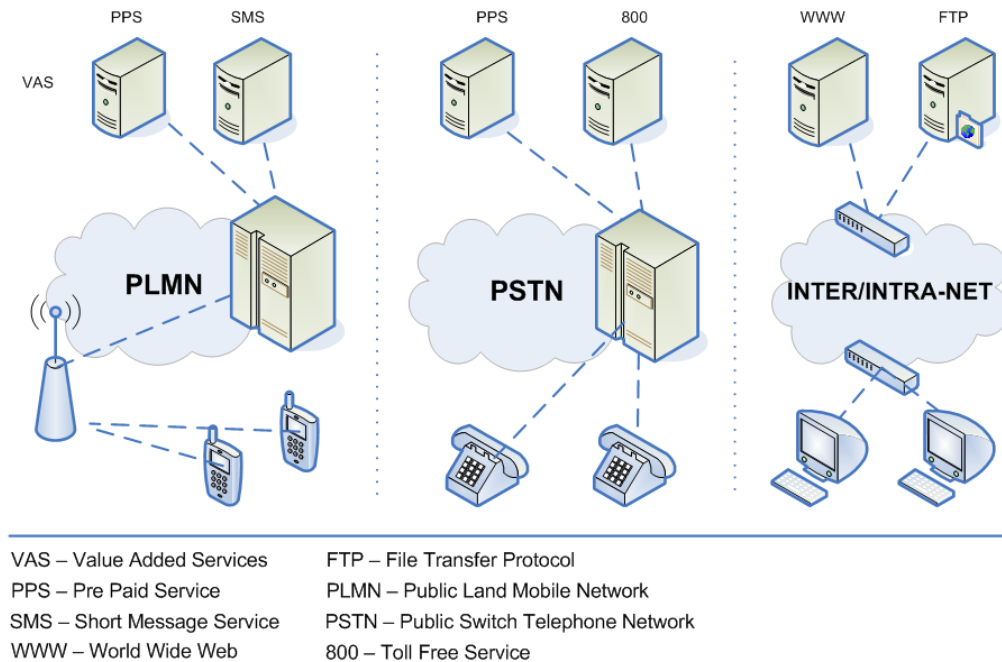


Figure 1 Traditional “silo” structure of the telecom network

The silo architecture limits the resource reusability, especially among different service providers. In a silo environment, every single service provider/network must deploy its own service platform and the services will only run within this proprietary environment. The operator who wants to provide a new service across different networks will face difficulty and incur the obvious cost factor.

With the evolution of service management and operation, SDPs enable the operator to enhance the reusability of existing resources and void the integration problems of proprietary environments.

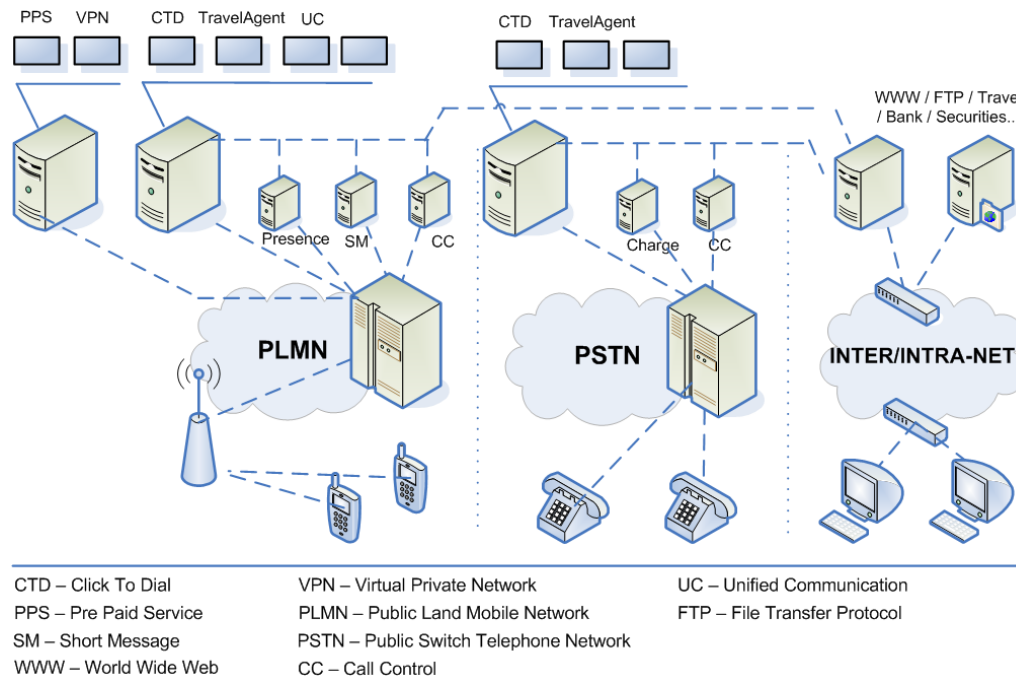


Figure 2 SDP based service layer structure

An example of SDP is the Service Delivery Architecture (SDA) introduced by China Mobile (CMCC). SDA, as the name implies, is created to deliver value-added services to the end user by designating in today's mobile operator's service network, a service layer divided into 3 sub-layers, i.e., the service enabler layer, the service access layer and the application layer. These 3 sub-layers are defined for the purpose of service provisioning, service control and service operation.

The service enabler sub-layer is composed by some service capabilities such as presence, group list, location and messaging etc. These service enablers are being standardized in the Open Mobile Alliance (OMA) [B6] organization.

The service access sub-layer is to provide protocol translating, QoS Control, authentication execution, encapsulating API functions to the application layer. An example service element in service access layer is the PARLAY **Error! Reference source not found.** gateway.

New services can be generated in the application layer by combining or calling the service capabilities provided by the service enabler layer. For example, sending weather forecast message via SMS is a type of such an application.

Besides the 3 layers that were defined for the purpose of service provisioning, the additional functions of service portal, service control, and service operating are also included in the SDA architecture.

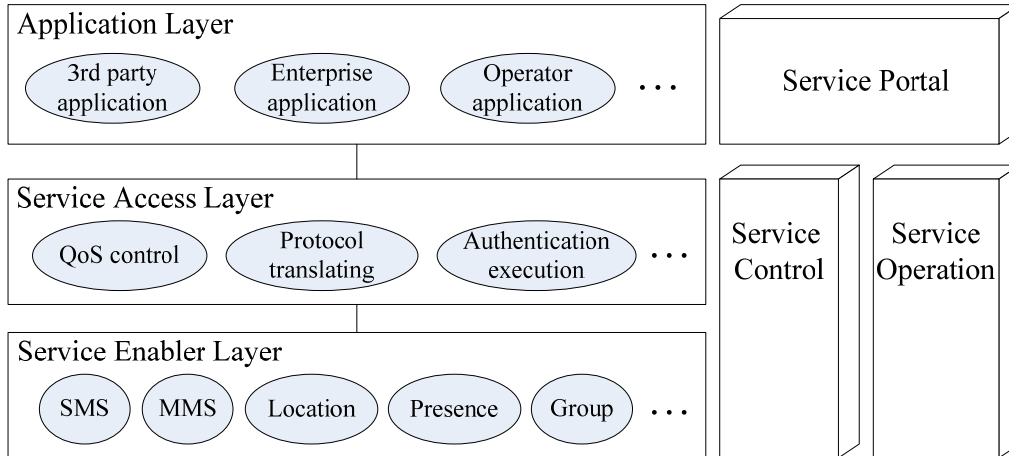


Figure 3 CMCC Example of Service Delivery Architecture (SDA)

4.2.2 IP Multimedia Subsystem

The IP Multimedia Subsystem (IMS) is an architectural framework for providing multimedia services to the users. IMS focus areas have been standardized by 3GPP, IETF, OMA, TISPAN. The 3GPP and 3GPP2 defined the overall structure and their related requirements; the Open Mobile Alliance (OMA) is mainly targeted on the definition of services and applications on top of the IMS infrastructure, commonly understood as service enablers; the Internet Engineering Task Force (IETF) focuses on network level protocols; TISPAN supports IMS for wire-line networks and, hence, specializes in Fixed Mobile Convergence (FMC) issues. IMS uses SIP (Session Initiation Protocol) and CSCF (Call Session Control Function) through which it is able to bind the users and the services over an Internet infrastructure.

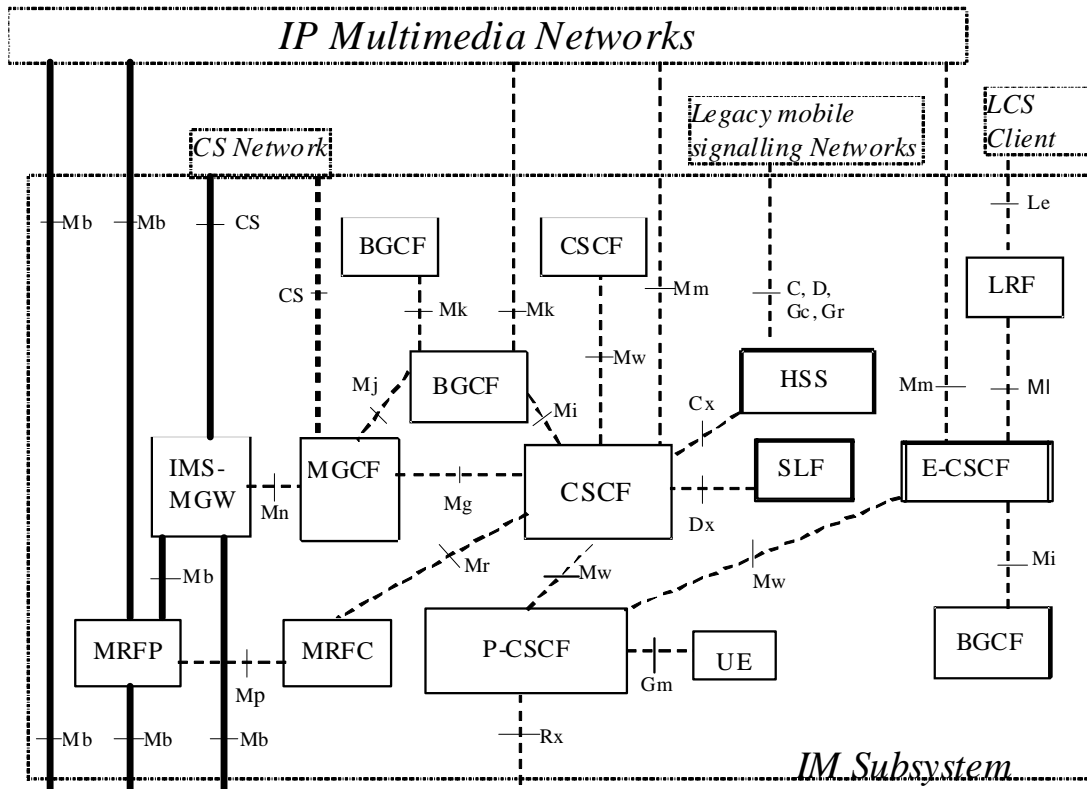


Figure 4 3GPP IMS Architecture

Legend:

Bold lines: interfaces supporting user traffic;

Dashed lines: interfaces supporting only signaling.

NOTE: The reference point CS (Circuit Switched) is not specified.

The figure above depicts an overall view of the functional architecture for services.

AS - Application Server

BGCF - Breakout Gateway Control Function

CN - Core Network

CSCF - Call Session Control Function

I CSCF - Interrogating CSCF

P CSCF - Proxy CSCF

S CSCF - Serving CSCF

MGCF - Media Gateway Control Function

MRFC - Multimedia Resource Function Controller

MRFP - Multimedia Resource Function Processor

HSS - Home Subscriber Server

IM-MGW IM - Media Gateway Function

SLF - Subscription Locator Function

UE - User Equipment

A description of the functional entities can be found in TS 23.002.

4.2.3 Next Generation Networks

Next Generation Network (NGN) is a packet-based network able to provide services including multimedia transport and telecommunication services by making use of multiple broadband, QoS-enabled transport

technologies in which service-related functions are independent from underlying transport-related technologies. NGN offers unrestricted access by users to different service providers and supports generalized mobility that will allow consistent and ubiquitous provision of services to users. [B3] Figure below shows a high level view of the NGN architecture.

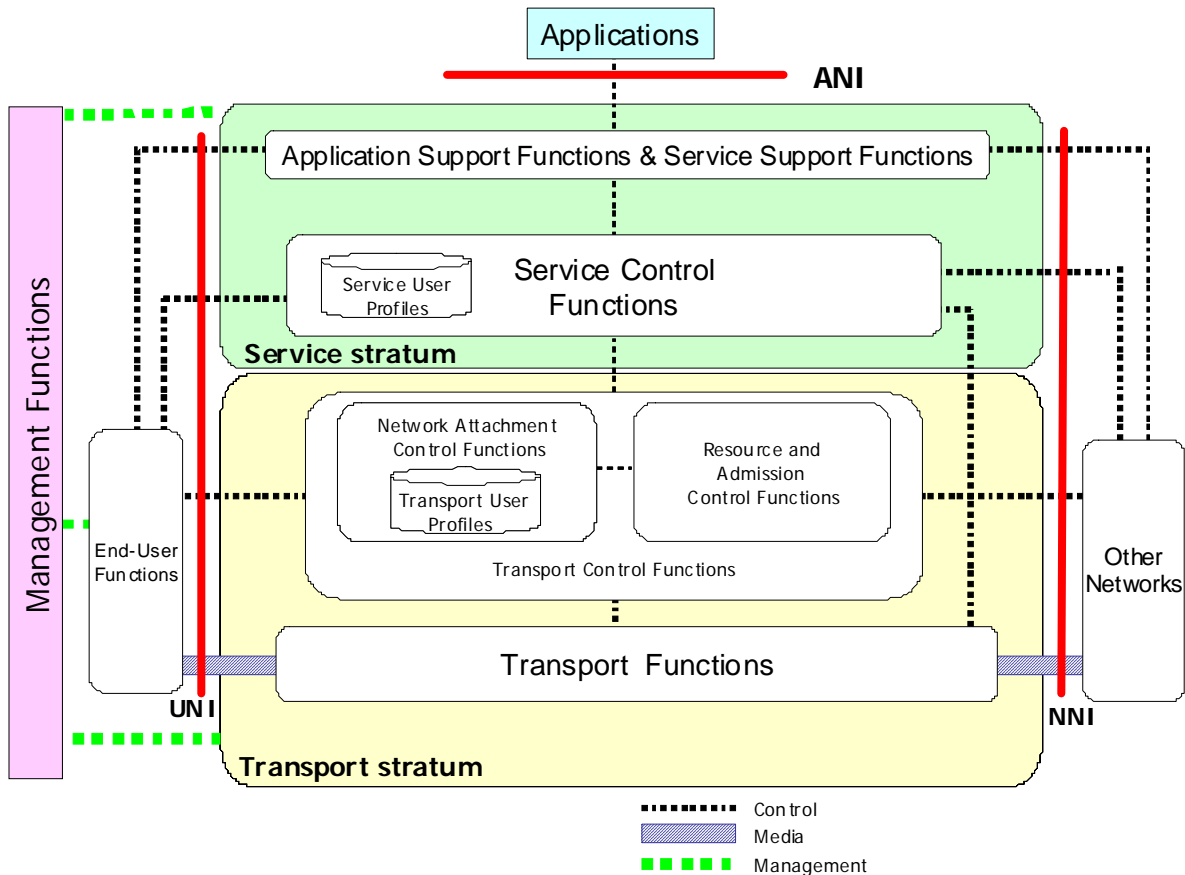


Figure 5 NGN Architecture

4.2.4 Service Oriented Architecture

Service Oriented Architecture (SOA) provides an application framework that defines concept architecture for loose coupled service collaboration. OASIS (the Organization for the Advancement of Structured Information Standards) defines SOA as the following: "A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains." SOA provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations. Figure below shows a simplified SOA architecture.

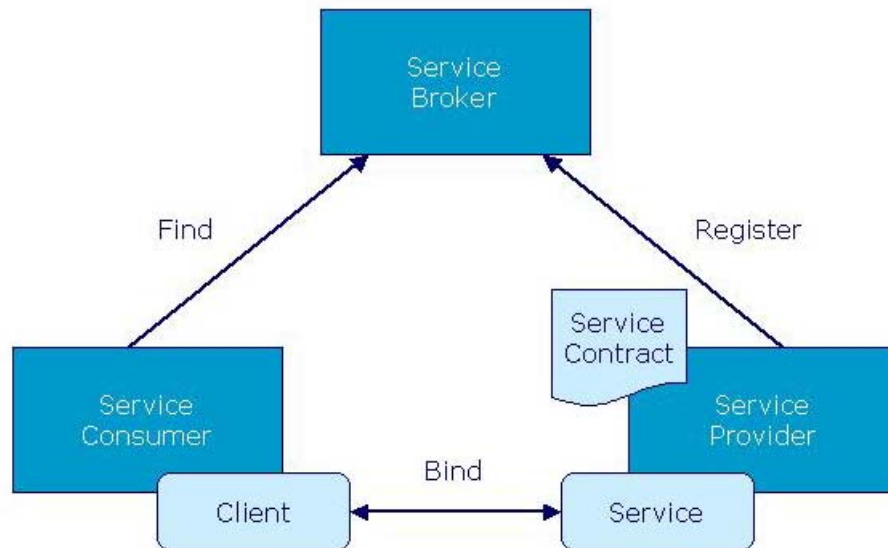


Figure 6 Service Oriented Architecture

4.2.5 Peer-to-Peer Networks

A peer-to-peer (P2P) computer network uses diverse connectivity between participants in a network and the cumulative bandwidth of network participants rather than conventional centralized resources where a relatively low number of servers provide the core value to a service or application. P2P networks are typically used for connecting nodes via largely ad hoc connections. Such networks are useful for many purposes. Sharing content files (see file sharing) containing audio, video, data or anything in digital format is very common. Real-time data, such as telephony traffic, is also transported using P2P technology. [B4] Figure below shows a general P2P network structure.

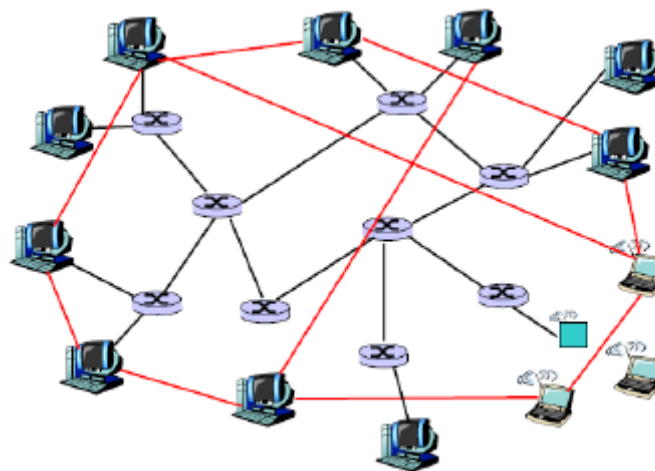


Figure 7 P2P Overlay [B5]

P2P networks are broadly classified as structured, unstructured, hierarchical, and semantic P2P overlays.

4.2.5.1 Structured P2P Overlay

Overlay networks create a structured virtual topology above the basic transport protocol level that facilitates deterministic search and guarantees convergence. The structure is based on one or more mathematical functions that determine how the nodes are connected. The network's structure contributes to the overlays' bound lookup times. When nodes fail, overlay network maintenance algorithms provide mechanisms that let the network recover and recreate or maintain an appropriate network structure. Lookup data are on the basis of identifiers derived from the content and, thus, don't directly support keyword-based searching. The methodologies employed offer efficient lookup hops (usually $O(\log N)$) and good churn handling properties. Examples are Chord, Plaxton, Pastry, Tapestry, CAN, Kademia, Bamboo, Koorde, Tourist, and Z-Ring.

4.2.5.2 Unstructured P2P Overlay

Overlay nodes attach to the network according to measures unrelated to content, such as join-order, connection speed, and even physical proximity, creating a random connection topology. Maintaining connections is simpler than other P2P structures. No guarantee on convergence and topology is non-deterministic. Unstructured P2P methodologies offer good topology management or membership management, load balancing, routing path maintenance and self healing. Examples are BitTorrent, eDonkey, Scamp, Kelips, and BISON.

4.2.5.3 Hierarchical P2P Overlays

In a hierarchical P2P structure, peers are organized into groups, and each group has its autonomous intra-group overlay network and lookup service. The groups themselves are organized in a top-level overlay network. To find a peer that is responsible for a key, the top-level overlay first determines the group responsible for the key; the responsible group then uses its intra-group overlay to determine the specific peer that is responsible for the key. This structure facilitates the large-scale deployment of a P2P lookup service by providing administrative autonomy to participating organizations. The methodologies of hierarchical P2P offer good fault isolation, security, caching, effective bandwidth utilization and adaptation to the underlying physical network. Examples are HiScamp, Canon, and Cyclone.

4.2.5.4 Semantic P2P Overlays

Overlays that offer networks based on intuitive reasoning (ontologies) or heuristics are usually termed as semantic P2P overlays. Within an overlay, broadcasting all queries to all information sources obviously doesn't scale efficiently. Hash-based queries scale, but provide no effective solution for complex queries such as approximate queries, range queries, and text queries. It's better to route queries only to peers that are more likely to have answers. Shared content often has pronounced ontological structure (e.g., music, movies, scientific papers). Examples are EZSearch, pSearch, and Google SON.

4.2.6 Web Service

The Web Service has been and will continue to be an important service paradigm over the Internet. It delivers many useful new services and has evolved to Web 2.0 for unlocking greater service capabilities.

A Web Service is defined by the W3C as "a software system designed to support interoperable machine-to-machine interaction over a network" using client-server communications based on the HTTP protocol. There are two camps of Web Services: Big Web Services and RESTful Web Services.

Big Web Services use XML over HTTP following the SOAP standard defined by the W3C. In such systems, machine-readable descriptions of the operations offered by the service are written in the Web Services Description Language (WSDL). The latter is not a requirement of a SOAP endpoint, but it is a prerequisite for automated client-side code generation in many programming (C++, Java and .NET SOAP)

frameworks. Some industry organizations, such as the WS-I (Interoperability), mandate both SOAP and WSDL in their definition of a Web service.

RESTful Web services are integrated with HTTP than SOAP-based services. They do not require XML messages or WSDL service-API definitions. The terms "representational state transfer" and "REST" strictly refers to a collection of network architecture principles which outline how resources are defined and addressed. The term is often used in a looser sense to describe any simple interface which transmits domain-specific data over HTTP without an additional messaging layer such as SOAP or session tracking via HTTP cookies. All Web Services that follow the REST principles are referred to as "RESTful" Web Services.

4.3 Need for NGSON

With the proliferation of services and the need to provide richer experience to the user offered by the blending of services from various networks and technology paradigms, the complexity of an individual architecture grows enormously. The operators/providers cannot find a suitable answer from a business perspective when they investigate the potential use of the current technology frameworks.

The state of the art technologies such as those surveyed in Section 4.2 (e.g., SDP, IMS, SOA, and P2P) all intend to offer the user richer broadband services under different paradigms. However, to enable service providers, content providers, and end-users to offer and consume collaborative services, none of these existing paradigms alone can support the required more customer-centric focus and an efficient way of delivering these services and applications. As a result, there is a need for another paradigm having context-aware, dynamically adaptive, and self-organizing networking capabilities dealing with services from consumer's perspective (richer service experience) and service providers perspective (more effective, less costly use of resources).

This new service-oriented overlay network is designated NGSON. NGSON aims to bridge the service layer and transport network over IP infrastructure to address the accommodation of highly integrated services. For the capabilities to this blending of services, NGSON takes the same role for services as IMS and NGN take for the transport of the services that run at the NGSON layer in supporting this blended service view based on context awareness, dynamic policy enforcement and self organization capabilities.

NGSON intends to accommodate the P2P services under a controlled environment so that the operators/providers can receive revenue from the P2P traffic through their networks. It also utilizes the P2P technologies to better achieve context awareness, dynamic adaptation, self-organizing of service networks. In particular, NGSON's focus is on composing new collaborative services by either using existing components from IMS, NGN, SOA, and P2P or defining new NGSON components and delivering them to the end users.

5. NGSON Framework

The motivations in Section 4 drive the vision of an NGSON Framework that binds the stakeholders in a collaborative environment as illustrated in the collaborative environment shown in Figure below.

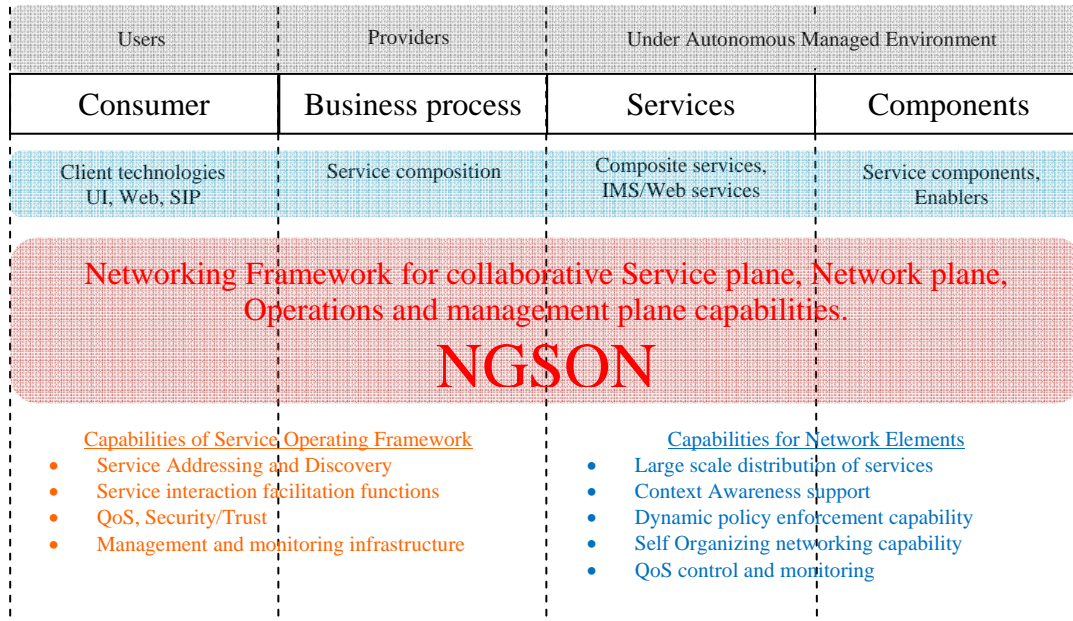


Figure 8 NGSON Collaborative Environment

The NGSON framework is described in the context of the following elements that are involved in the business of transporting information from provider to the consumer and of accounting for the usage of resources.

- Components are software programs provisioned in an autonomously managed environment, more simply a service provider environment that can be combined with each other using specific tools or mechanisms to offer a service. The service might range from software components like Java objects to specifically defined service components like IMS enablers.
- Services are composed of components and offered as entities to users or other services to carry out a function or functions. Higher level services can be formed that enact entities such as a workflow composed of services provided by various providers.
- Business processes a series of procedures that carry out some business function and that are usually modeled by the providers/operators using various service composition tools. The composed services are then executed in a service provider environment/collaborative environment.
- Consumers are clients that utilize various technologies to access services or business processes offered by service providers/operators.

It is important to address the issues arising in enabling a networked framework where two or more stakeholders will collaborate to utilize services of each other in a highly distributed environment. A stakeholder could be a service provider, an user, a service itself, or any combination. Figure below shows the NGSON Framework that illustrates how the various functions in NGSON relate to one another.

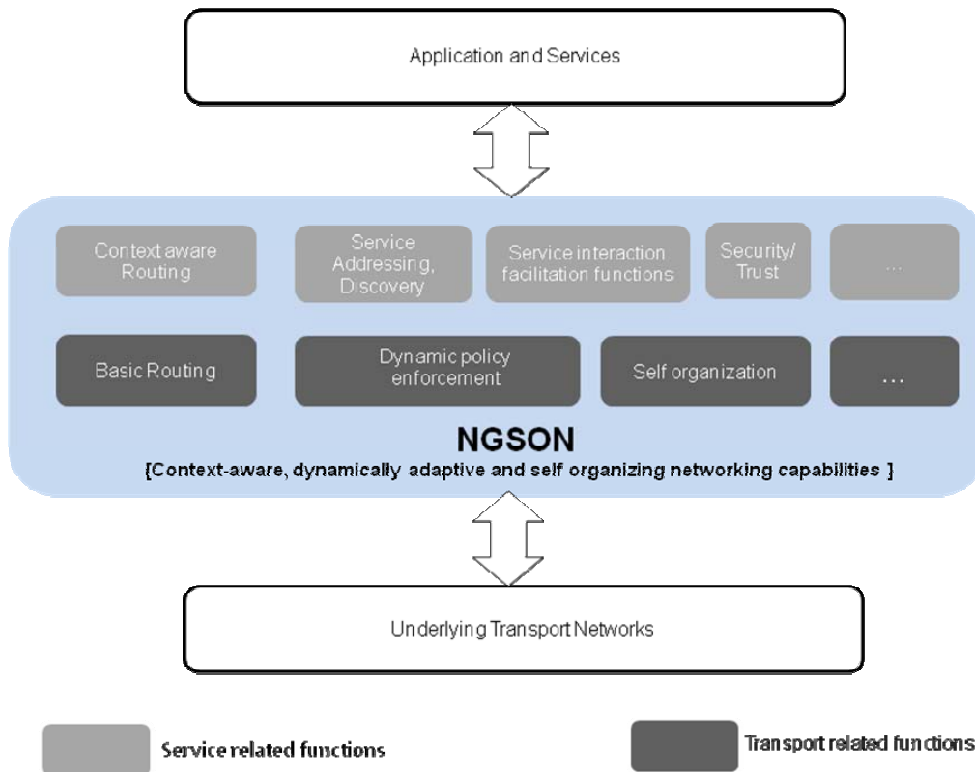


Figure 9 NGSON Framework

To understand the capabilities and issues that fall within the scope of the NGSON Framework, we will organize the functions as described in the sections below.

The service overlay network functions describe the capabilities and issues that are required for a carrier grade service oriented interaction paradigm like service addressing, service interaction facilitation functions, etc. The stakeholders will have access to the service overlay network functions through which services can be created and provisioned on the fly to the user, reducing the time to market. So the provisioning and operation of collaborating services can involve services solely within a particular environment or can encompass a broader inclusion of services such as those from a third party, other service provider, or an enterprise. An integration of IT and CT services in a highly distributed environment can be attained with capabilities that offer context aware routing, dynamic policy enforcement, and self organization in the network to provide the best service experience to the users. The service layer is organized into service-related and transport-related functions that depend on the focus of the interactions of each function.

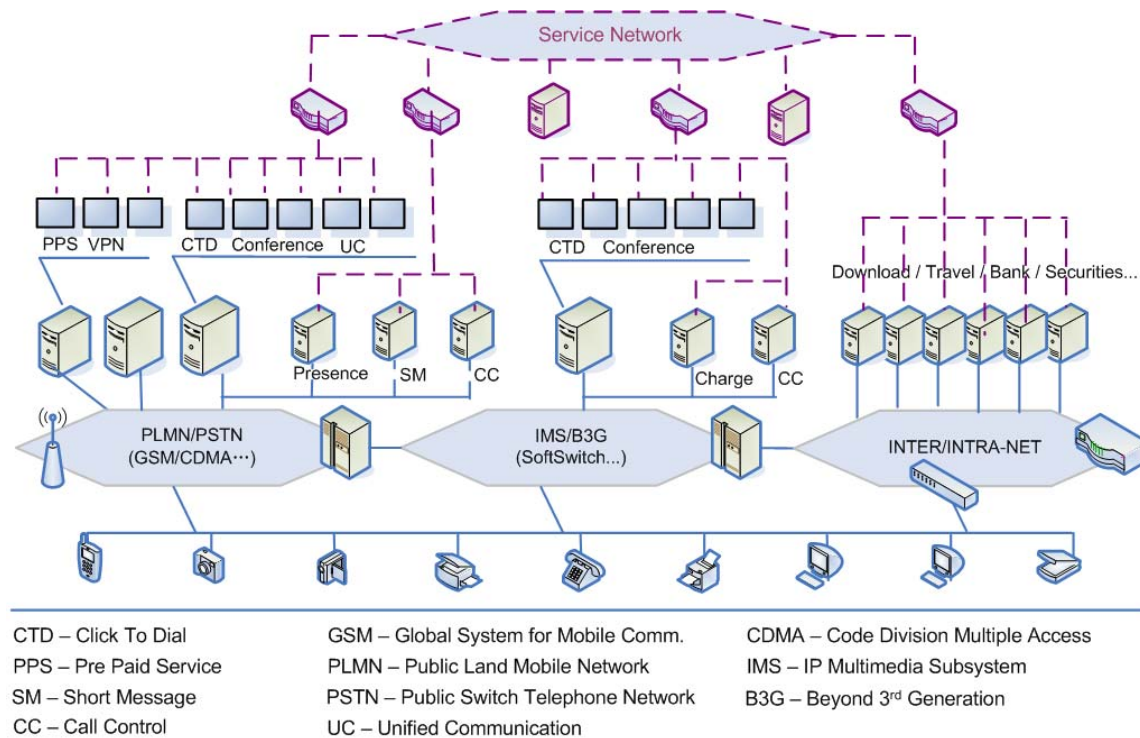


Figure 10 Position of Service Overlay Network

The service network represented in the above figure is NGSON. The services offered through various networks like PSTN, IMS, Mobile, Internet, etc are also part of NGSON. NGSON can integrate any service infrastructure operating in IT, CT and Web standards.

Every execution environment is managed by a network management (NM) function an operation and supported by operation and business support management systems (OSS/BSS). The interactions between the NM function and the service and transport layers are needed to provide for a reliable managed network. Interactions between the NM function and OSS/BSS carry out the required accounting functions. All of these interactions must work across the same collaborative environment as the service collaborations being managed and illustrate the need to extend collaboration to the NM-OSS/BSS operations to complete the business side of the NGSON framework. These functions can be seen as analogous with telecommunications management networks such as the TMF model.

6. Service Overlay Network Functions

The service overlay network deals with the issues in the service layer and functions that control optimizations in the network layer.

6.1 Service-Related Functions

Service-related functions are those in the Service Layer that interact primarily with other service oriented functions.

6.1.1 Service Addressing

Service identification mechanisms will be provided to address large scale services in heterogeneous networks and domains. The mechanisms deal with addressing issues across the Internet and, hence, addressing scheme is IP-based.

6.1.2 Service Interaction

NGSON will provide a common protocol to standardize the way of service interaction driven by Industry standards. This will effectively improve the service reusability when operators want to compose new services based on existing services.

6.1.3 Service Routing

Service routing is provided according to the operator's policy, context (e.g., such as required QoS level, type of service such as real-time vs. data, nature of data stream such as I-frame vs. B-frame, and type of terminal such as TV monitor vs. personal digital assistant) . For a large number of services and resources, especially those owned by users, distributed service routing without centralized directory/lookup servers will provide NGSON with improved scalability and autonomy in some ad-hoc scenarios.

NGSON's routing paradigm for service interaction will be based on the service addressing technologies since the service interaction protocol needs an entity to route the message from the source to a proper destination. It also provides intelligent service routing.

6.1.4 Service Registration/Discovery

To establish an SOA interaction paradigm, NGSON will provide service dynamic registration and discovery functions. The service registration/discovery function focuses not only on the interface of the services but also includes QoS, SLA, and policies governing the offered service.

6.1.5 Service Negotiation and Agreement

To establish the networking between services, NGSON will provide a negotiation and agreement platform upon which SLA and Policies can be framed, automatically negotiated and agreed. SLAs can be introduced dynamically in the overlay and the overlay is able to self-organize through service negotiation and agreement within and across managed environments. These dynamic principles are intended to lower OPEX for service providers.

6.1.6 Resource Meta-data Registration/Discovery

Along with service registration/discovery, the access protocol to various resources (video, documents, music, and web pages, etc.) is important for services to utilize heterogeneous resources. There is no common standard access protocol for services to access the resources in a standardized way. The NGSON will provide a common protocol to access these data. On the other hand, in order to improve the resource sharing among services, the unstructured data will be organized by NGSON infrastructures. This function decouples the relationships among services and resources through resource dynamic discovery.

6.1.7 Service QoS

End to End QoS is the core concept of NGSON. NGSON will act as a bridge between services and bearer networks when service interaction requests the bearer network to support QoS requirement. The concept of service network QoS is not the traditional network QoS but it includes the service layer quality of service (i.e., SLA). The service network QoS includes, but is not limited to, bandwidth, service response time, and media resolution and size, cost.

NGSON will support the service QoS negotiation in the service network and will translate the QoS requirement and forward it to proper enforcement entities (e.g., Policy Decision Function (PDF) or Gateway GPRS Support Node (GGSN)).

6.1.8 Security/Trust

NGSON will ensure each of the interactions within the NGSON overlay is secure and trusted. The service network infrastructure will support original verification and message integrity protection while confidentiality will ensure that a third party cannot decipher the contents of a message. NGSON will support distributed security with single sign-on feature that gives users access to services in NGSON.

6.1.9 Autonomic or Self organization Capabilities

NGSON will provide its physical elements with self-organizing capabilities. A self-organizing system not only regulates or adapts its behavior; it creates its own organization. The organization is defined as structure with function. Structure means that the components of a system are arranged in a particular order, and requires both connections, that integrate the parts into a whole, and separations, that differentiate subsystems, so as to avoid interference. Function means that this structure is organized to fulfill a specific purpose.

Self organization capabilities increase the robustness of a network. Self organization at service level means adapting service parameters driven by the context (user, composition, network, etc) – service centric self organization – that effects the organization of the service overlay network.

6.2 Transport-Related Functions

Transport-related functions are those in the Service Layer that interact primarily with Transport Layer functions.

6.2.1 Network Traffic Optimization

Services and resources sharing amongst users/services would produce a large amount of end-to-end traffic in the transport network. Intelligent integration of these shared traffic effectively reduces redundant flow and, hence, preserves network layer resources, e.g., bandwidth. NGSON will provide intelligent bindings of network information to optimize the performance of transport layer.

6.2.2 Service Awareness

Customers want more service bundles and service choices. To satisfy this demand, carriers/providers will be able to combine all of the services into a single network with a per service QoS. Most carriers choose this approach, converging onto an IP network because the costs are lower. But that puts a QoS burden on the network. Different service types require different levels of QoS, so the converged IP network elements (access, core) must be service aware: NGSON must be able to detect the service type (voice, video or data) and apply the appropriate QoS level.

The IP network must be able to distinguish each service being delivered so carriers/providers can provide high service quality for their customers while maintaining high network efficiency and low costs. IP service awareness allows carriers/providers to save money with a converged network while offering QoS appropriate to each service type. [B2]

Service awareness stimulates service providers to offer a wide variety of added value services and guarantees their operation on the Internet broadband network. Deployments of service awareness on NGSON will enable the improvement of revenue and profitability for operators. NGSON offers mechanisms in order to identify the services in an efficient, flexible way and provide a better granular

control over the services. Supported by service awareness functionality on NGSON, service providers will be able to increase their revenue and lower their costs in the Internet broadband service value chain.

6.2.3 Context Awareness

Context awareness is applied to network elements that are aware about any information that can be used to characterize the situation of cooperating entities. These entities include users, services, environment conditions, etc. the data of which influence the service operation dynamically. NGSON will incorporate context (e.g., such as required QoS level, type of service such as real-time vs. data, nature of data stream such as I-frame vs. B-frame, and type of terminal such as TV monitor vs. personal digital assistant) function to support other functions like routing, messaging, adaptation, and self organization.

The context awareness function enables operators/providers to deploy a dynamic service strategy that aims at improving and broadening the experience of the user interaction with the network/service.

6.2.4 Security

Security in NGSON will provide the structure that defines and enforces the relationships between roles, content, and resources, particularly with respect to access. It includes the framework for definitions as well as the means to implement them. Several key means will be employed in the security process including authentication, authorization, and access (control). The basis for applying these means requires the definition of roles and their relationships to resources, processes and each other. High-level concepts like privacy, anonymity and verification are likely imbedded in the form of the role definitions and derive from policy. Successful security reliably supports and enforces roles and relationships.

Network security functions similar to IMS and enhanced for secure ubiquitous access will be utilized as part of NGSON and are transparent to the services/application.

6.2.5 Dynamic Policy Enforcement

NGSON will provide capabilities to dynamically compute, select and possibly optimize the (multiple) path(s) that will be used by the participating devices to forward the traffic towards the end-user according to the service-specific (if not end-user-specific) QoS, traffic engineering and security based policies that will have to be enforced at the scale of a domain (that is, a set of networking devices administered by a globally unique entity) or a region of domains (e.g. a metropolitan area).

6.2.6 Autonomic or Self Organization Capabilities

Self organization at network level means adapting networking parameters driven by the context (user, services, quality of experience, etc) – network centric self organization – that supports dynamic flow, routing decisions in the physical connected network. The self organization will impact the organization of the network driven by the context.

NGSON will support self-* (star) functionalities like:

- self-configuration: The system can automatically perform dynamic adjustments to itself in varying and unpredictable environments.
- self-optimization: The system monitors its constituent parts and adapts its behavior to achieve predetermined system goals.
- self-healing: The system is able to discover the causes of failures and then find alternative ways of using resources or reconfiguring the system to keep functioning smoothly.
- self-protection: The system detects, identifies, and protects itself against various types of attacks to maintain overall system security and integrity.
- self-adaptation: The system uses self-adaptation to find ways to best interact with neighboring systems, i.e., it can describe itself to other systems and discover those systems in the environment.

6.3 Service Provisioning, Operation and Management Network Related Functions

NM and OSS/BSS functions are those outside the Service and Transport Layers that interact with functions within the Service and Transport Layers to provide network management, service provisioning, operation and management network functions that are key to establishing and operating a successful business for the provider/operator.

6.3.1 Business Componentization

To offer the services as utilities to third parties or users, the following componentization aspects are considered.

6.3.1.1 Services Modeling

NGSON's service modeling is important so that businesses can easily manage the services built using networks, servers and other resources. Service modeling is a way of communication and collaboration between designers, implementers, operators, and users and produces information that can easily be shared, tracked, and revision controlled. This information is important because complex services are often built and maintained by a variety of people playing different roles.

Service modeling requires enabling increased automation of operation and management tasks. Automation facilities exposed by the majority of services/systems today need to be driven by software – not people – for reliable initial realization of a service/system as well as for ongoing lifecycle management.

Service modeling in NGSON will enable standard semantics for services that enhances its usability under various contexts in a dynamic manner.

6.3.1.2 Services Creation/Composition

In order to respond to the customer's demand quickly and shorten the service development lifecycle, the NGSON will offer an on-demand and flexible composition mechanism. NGSON focuses on dynamic service composition that bonds the related service components into a new service offering. Hence, it is the cost-effective way to meet the user's requirements. Service composition is part of NGSON scope but the logical entity that actually does the bonding may or may not reside on NGSON infrastructure layer.

6.3.1.3 Services Deployment

A service deployment function will enable optimize the deployment procedure of the service and hence making the service more readily and quickly available to users.

NGSON is envisioned as a large scale service network. Hence, autonomic service deployment function will be provided, particularly with the view of deploying across heterogeneous networks. An autonomic service deployment function will allow the distributed and complex capabilities present in network elements to be leveraged more efficiently when installing new services than is possible in traditional centralized network management-based approaches. Installation is faster and use of functional resources is optimized.

6.3.2 Services Run-Time Lifecycle Management

NGSON will provide services run-time lifecycle management function that details aspects of state associated with service operation such as active, passive, fault, running, provisioned, and start.

6.3.3 Service-to-Service Collaboration (SLAs, Policies)

NGSON will provide a platform for SLA and policies to be framed and dynamically provisioned to the elements of the network. These SLAs and policies are further used in the negotiation and agreement for dynamic organization of the service network within/between managed environments.

A workflow could represent a composite service that is basically driven around the usage of the description semantics of the service. To enhance the experience of the service to the user – user driven policies and operator level service agreements can be used to identify a potential collaboration between services. For example, if a workflow has a search service as one of its nodes, then the actual service to be invoked at run-time could be decided by the user cost. If the user is willing to pay an amount for the search service, a search service from a renowned service provider that matches within this cost can be invoked. Otherwise, a free search service can be utilized. The difference will appear to the user in terms of the experience delivered upon execution of this workflow.

6.3.4 Services Assurance

NGSON will provide service monitoring function to ensure whether the service is delivering quality per the specified QoS. This function is responsible for gathering and monitoring data during the execution of the service and then utilizing the data to improve the selection of services for composition and to improve service strategy decisions.

6.3.5 FCAPS

NGSON will incorporate the usual fundamental principles of management including the standard functions of:

Fault management, Configuration management, Accounting management, Performance management and Security management.

6.3.6 Service Provisioning Function

The service provisioning function plays the role as an application server, which provides service logic, service execution and service creation abilities. The stakeholders of service provisioning function will have access to the service delivery function through which services can be created and provisioned on the fly to the user, reducing the time to market.

NGSON provides the above functions for the elements in the service network.

7. Considerations for Standardization

NGSON framework caters to a higher level vision for future service network. The potential issues mentioned in this document that can be considered for standardization are noted below.

- Service-related functions: Service addressing, Service routing, Service network QoS and Self organization capabilities.
- Network-related functions: Service awareness, Context awareness, Dynamic policy enforcement and Self organization capabilities.
- Service provisioning, operation and management network related functions: Service run-time lifecycle management, service-to-service collaboration, services monitoring and FCAPS.

Some of these functions are likely being standardized (or have been standardized) in other standards developing organizations and, if so, NGSON will be adopting those specifications. NGSON Working Group intends to establish a vigorous liaison activity to sort what is being done (or has been done) elsewhere and to work with those other organizations as appropriate if NGSON has special requirements that need fulfilling. NGSON WG has no intention to re-do the work that others are doing or have done. The WG will be working directly on those functions that are not being done elsewhere.

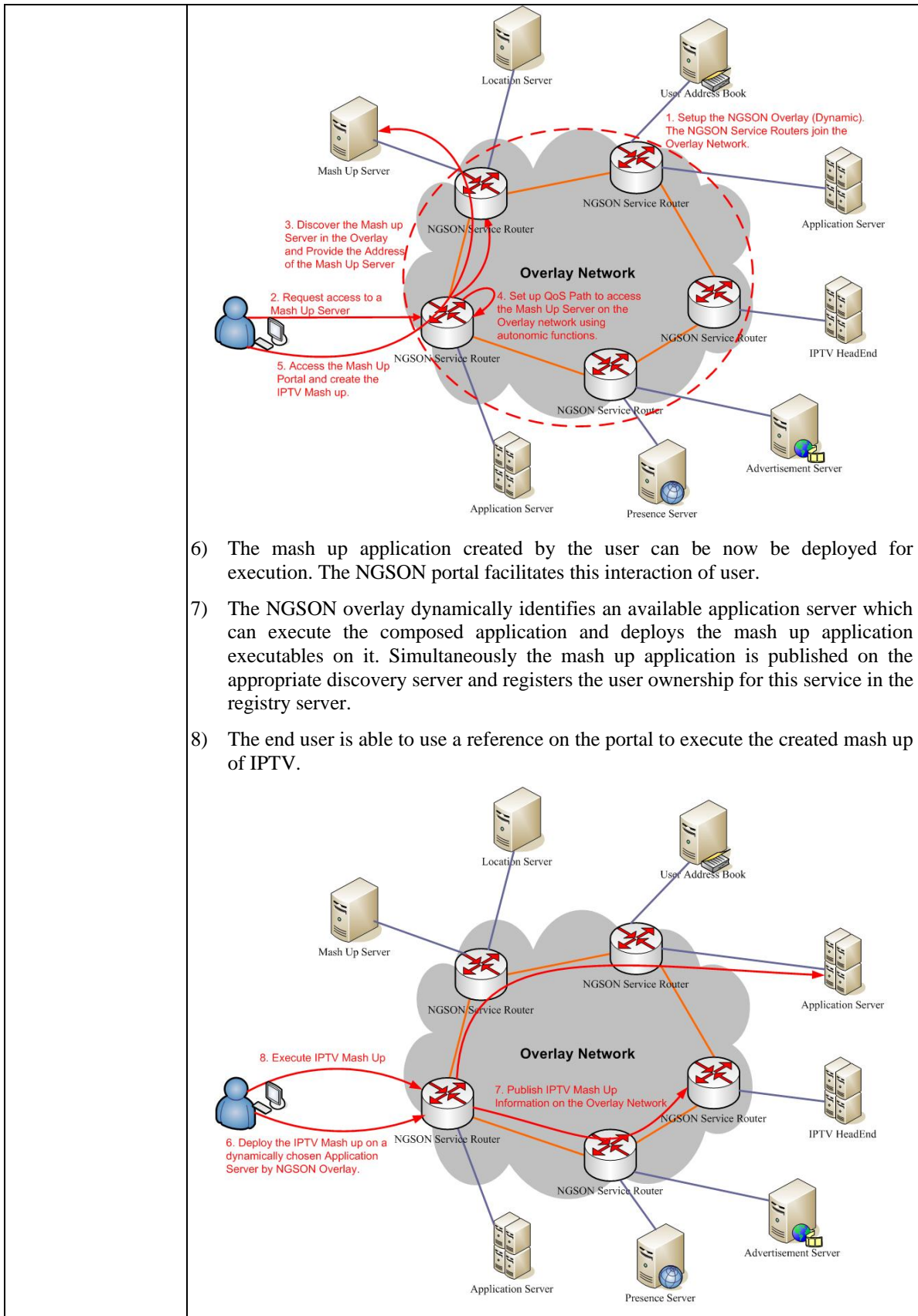
Other capabilities not noted above can be considered for standardization in a future PAR going forward with strengthening the vision of NGSON framework.

8. Scenarios

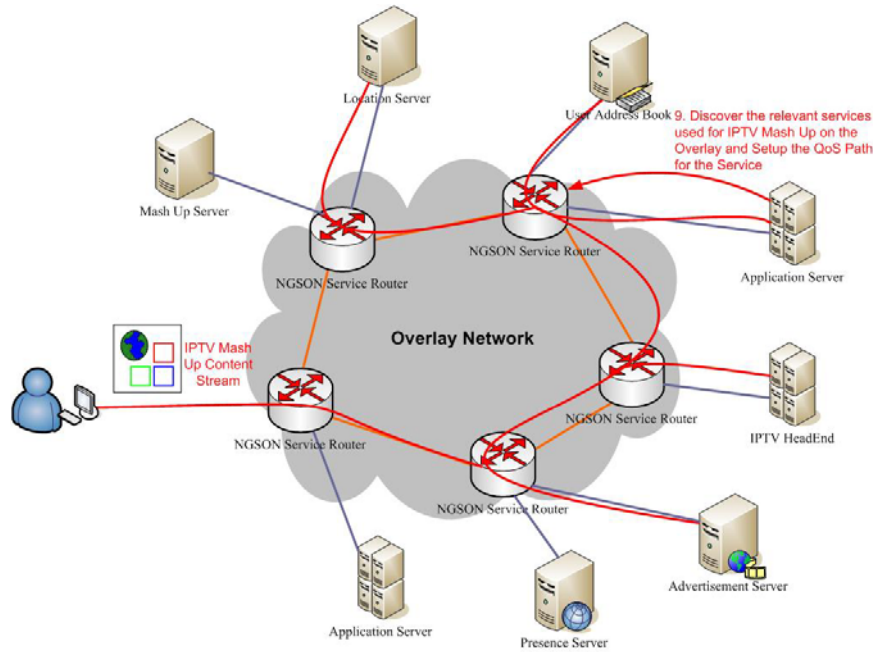
8.1 The IPTV and Mobility Scenario in NGSON

Environment Description	
NGSON Topology	<p>The diagram illustrates the NGSON Topology. At the center is the 'NGSON Overlay Network', represented by a cloud containing five 'NGSON Service Router' nodes. These routers are interconnected. Surrounding the overlay network are several servers: 'Mash Up Server', 'Location Server', 'User Address Book', 'Application Server', 'IPTV HeadEnd', 'Advertisement Server', 'Presence Server', and another 'Application Server'. An 'Access Network' cloud is connected to one of the NGSON Service Routers. A user icon is shown connected to the Access Network.</p>
Entities	<p>NGSON Service Router: It is an entity which hosts the procedures of sending a service request to a service node (either a peer node or a server) where this request can be satisfied.</p> <p>IPTV Server: It is an entity which provides the IPTV service.</p> <p>Advertisement Server: It is an entity which provides the Advertisement service.</p> <p>Presence server: It is an entity which provides presence information related to a user.</p> <p>User address book server: It is an entity which provides the list of user addresses. Eg. Buddy list.</p> <p>Discovery Server: It is an entity which provides the static information of services like description of service class, interface, provider, QoS, SLA, etc. It deals with service publication and discovery.</p> <p>Register Server: It is an entity which provides the dynamic information of services like service ID, service state, service home address, etc.</p> <p>Mash up Server: It is an entity which provides service composition capabilities.</p> <p>Application Server: It is an entity which hosts the services.</p>
Roles	
Primary Actor	End User (Customer pays to access the IPTV Service)
Stake holders	Operators, Service Providers, Content Providers
Analysis of the Scenario	
Intent/Objective	Enhancing the user experience by user integration of advertisements to the IPTV application based on user preferences.

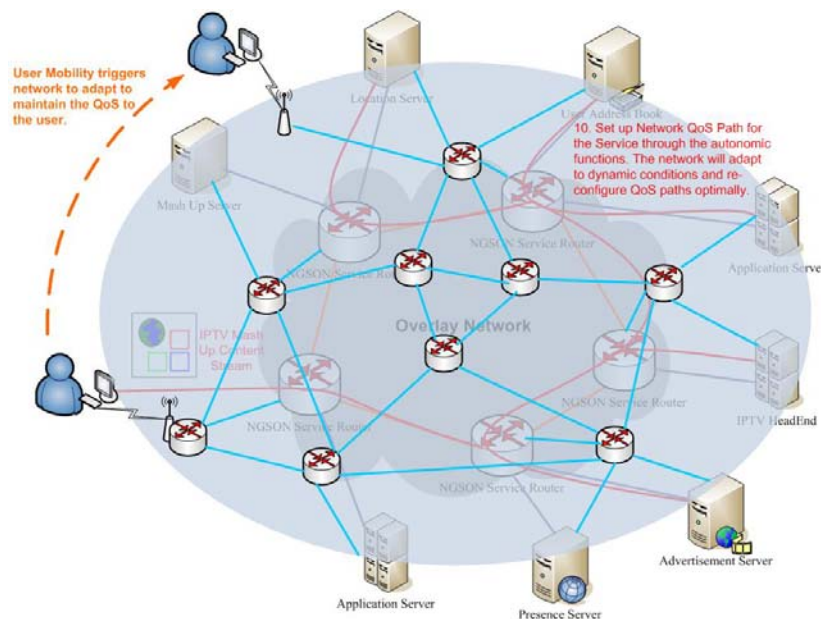
<p>Key features</p>	<p>The NGSON service routers are configured by the operators to dynamically join an overlay across operator domain.</p> <p>Key objectives of the NGSON standardization project are illustrated by points:</p> <ul style="list-style-type: none"> • Self configuration (SON) and context aware adaptation • Context aware resource selection and routing. • Dynamic Policy enforcement • Context aware routing and dynamic policy enforcement
<p>Main scenario</p>	<ol style="list-style-type: none"> 1) NGSON functional entities organize themselves into an Overlay Network. 2) The end user should be able to request access to a mash up service through NGSON portal facilities. 3) The NGSON overlay should discover the available mash up server and return access to it by validating the identity of the user. 4) Upon the resolution of access reference to the mash up server, the autonomic functions should be auto-configured to adapt to context, e.g.: user roaming, access conditions, QoS, etc. 5) The end user is provided with a user mash up (service composition) environment where the mash up specification for combining IPTV application with advertisements based on user preference attributes can be designed by the user.



9) The application server which provided the mash up application executes the application upon invocation from the end user. The mash up application requests the NGSON overlay for access to various services composed in it. The NGSON overlay discovers the relevant services and sets up the QoS path for the service access based on the policies governed by users, operators using the autonomic functions. Depending on the context of the end user, the service is made available by the NGSON overlay to a relevant device configured by the end user.



10) To manage dynamic situations of the end user like roaming, the NGSON overlay auto-reconfigures relevant enablers (in both overlay and underlay network) and dynamically composes relevant functions governed by the policies of operators to maintain the QoE to the end user. The overlay network is depicted in the below figure as interconnection of Service routers enabled by underlay network of IP routers.

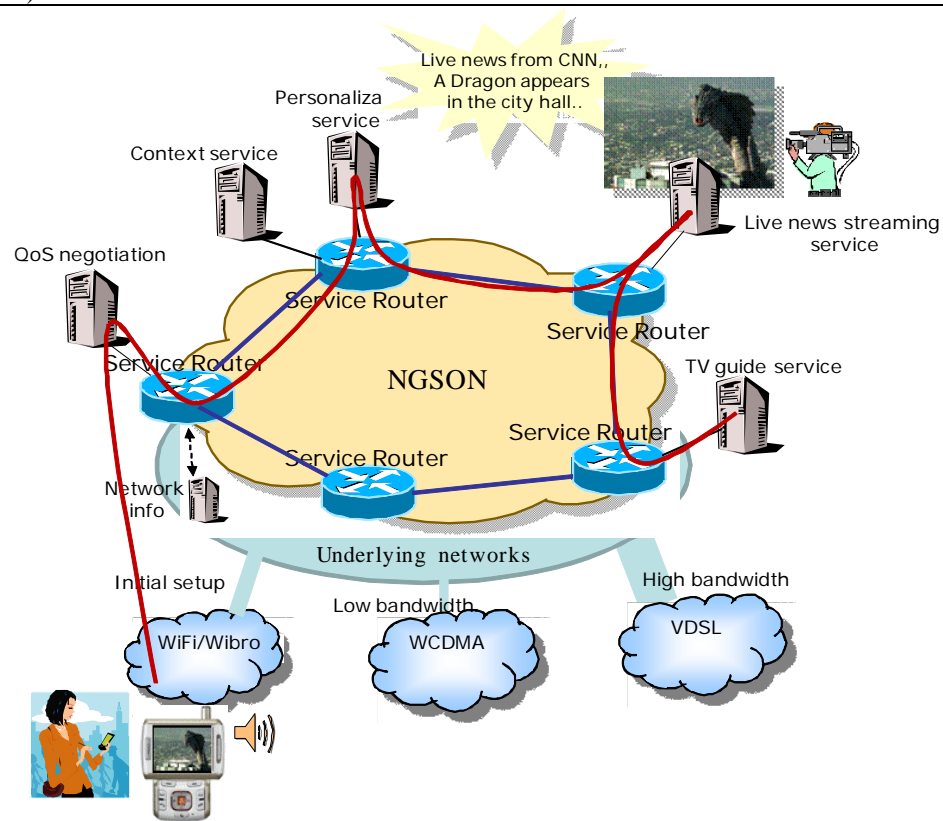


8.2 Dynamic Service Composition in a Seamless Mobility Environment

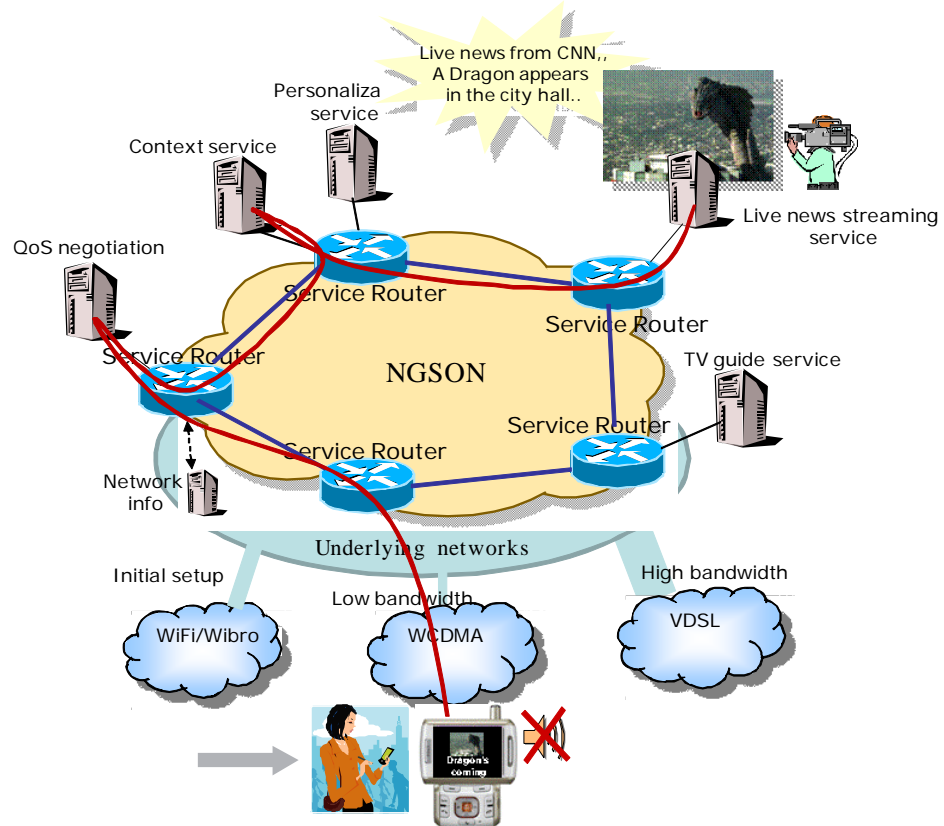
Environment Description	
NGSON Topology Used	<p>NGSON + WCDMA + Wireless Broadband + Fixed Broadband</p>
Entities	<p>NGSON Service routers Fixed/Wireless Access Gateways</p>
Roles	
Primary Actor	End User (Customer pays to access the Movie Service)
Stake holders	Operators, Service providers, Content providers
Analysis of the Scenario	
Intent/Objective	<p>The user roaming between differentiated bandwidth environments during access to movie service experiences no service outages and has access to acceptable level of QoE.</p>
Key features	Key objectives of the NGSON standardization project are illustrated by points:

3) context awareness and QoS inferred routing,
 4) and 6) location awareness and forwarding capabilities that dynamically adapt to environmental changes,
 5) context awareness.

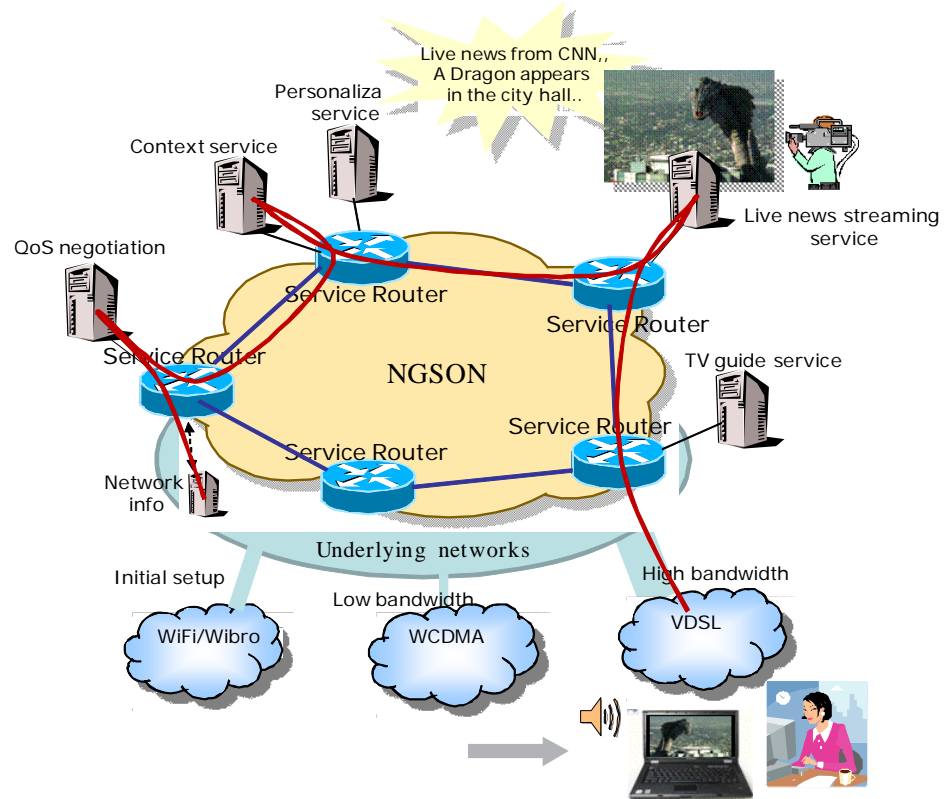
Main scenario



- 1) User watches live TV on her mobile phone. NGSON supports initial service composition of Live streaming service, personalization service, etc. It then performs the QoS negotiation as initiated by the application part.
- 2) A TV guide suggests specific channel on her preference. NGSON provides the application part to proactively provided suggestions based on User preferences.



- 3) She gets into a place with low bandwidth and requiring strict silence. NGSON supports the application part with Network sensing (context aware capability) and notification functions. It also supports bandwidth renegotiation request to maintain the QoS and QoE.
- 4) Her phone automatically gets reduced bit rate video stream and mutes and the news shows with text subtitles. NGSON nodes will accommodate new access conditions eg lower bit rate, and take into account the new location of the user to make their forwarding decisions.



- 5) When she comes home, she turns on her PC and connects the specific TV channel. At this point, NGSON supports the application part with network sensing and notification service.
- 6) The news continues from the point she stopped and she watches full screen news with high resolution/bandwidth. To support this scenario, NGSON processes application part request of dynamic service composition based on user and network situation, time shifted live streaming service, seamless service continuity service, etc. It also supports bandwidth renegotiation request to maintain the QoS and QoE.