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SERIES Y: GLOBAL INFORMATION
INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS
AND NEXT-GENERATION NETWORKS

Next Generation Networks – Service aspects: Service
capabilities and service architecture

Requirements and capabilities for next generation network service integration and delivery environment

Recommendation ITU-T Y.2240



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Recommendation ITU-T Y.2240

Requirements and capabilities for next generation network service integration and delivery environment

Summary

Recommendation ITU-T Y.2240 provides requirements and capabilities for a service integration and delivery environment in NGN (NGN-SIDE) in order to support the following main functionalities in the NGN-SIDE ecosystem:

- integration of resources from different domains (e.g., telecommunication domain (fixed and mobile networks), broadcasting domain, internet domain or content provider domain) over NGN;
- adaptation and abstraction of resources from different domains;
- resource brokering for mediation among applications and resources;
- support of application development environment for application developers;
- support of different service interfaces across ANI, UNI, SNI and NNI for exposure of NGN-SIDE capabilities and access to resources in different domains;
- provision of mechanisms for the support of diverse applications including cloud services, machine to machine, and ubiquitous sensor network applications;
- provision of mechanisms for the support of applications making usage of context based information;
- provision of mechanisms for content management.

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Edition	Recommendation	Approval	Study Group
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Introduction

NGN-SIDE main objectives, characteristics and features are as follows:

- NGN-SIDE supports a multi-fold telecommunication business model and is paving the way for a comprehensive eco-system for all the stakeholders in the NGN value chain;
- NGN-SIDE puts NGN providers in the centre to control the whole NGN value chain and provides numerous opportunities for NGN providers to enhance NGN end-users access to applications;
- NGN-SIDE provides an environment that enables the development of applications that fully leverage underlying NGN and non-NGN resources such as:
 - enabling developers to create compelling applications that take full advantage of a variety of resources such as service enablers, network capabilities, device enablers, content, other applications;
 - providing access to a wide range of tools and technologies that can be used to develop rich applications.

NGN-SIDE can be viewed as the next generation service delivery platform (SDP), which is, in the context of this Recommendation, targeted for NGN, but whose framework can conceptually be applicable to other telecommunication environments (e.g., mobile networks).

Recommendation ITU-T Y.2240

Requirements and capabilities for next generation network service integration and delivery environment

1 Scope

The objective of this Recommendation is to provide requirements and capabilities for a service integration and delivery environment (SIDE) in NGN (NGN-SIDE) in order to support the following main functionalities in the NGN-SIDE ecosystem:

- integration of resources from different domains (e.g., telecommunication domain (fixed and mobile networks), broadcasting domain, internet domain or content provider domain) over NGN;
- adaptation, including abstraction and virtualization, of resources from different domains;
- resource brokering for mediation among applications and resources;
- support of the application development environment for application developers;
- support of different service interfaces across ANI, UNI, SNI and NNI for exposure of NGN-SIDE capabilities and access to resources in different domains;
- provision of mechanisms for the support of diverse applications including cloud services, machine-to-machine, and ubiquitous sensor network (USN) applications;
- provision of mechanisms for the support of applications making usage of context based information;
- provision of mechanisms for content management.

In this Recommendation, clause 6 provides an overview of the NGN-SIDE ecosystem, clause 7 describes the NGN-SIDE functional framework, clause 8 identifies NGN-SIDE requirements, clause 9 describes NGN-SIDE capabilities, clause 10 provides NGN-SIDE interface requirements, clause 11 provides security considerations and Annex A provides relationship between capabilities of NGN-SIDE and [ITU-T Y.2234].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T X.805] Recommendation ITU-T X.805 (2003), *Security architecture for systems providing end-to-end communications*.
- [ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.
- [ITU-T Y.2201] Recommendation ITU-T Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*.
- [ITU-T Y.2221] Recommendation ITU-T Y.2221 (2010), *Requirements for support of ubiquitous sensor network (USN) applications and services in the NGN environment*.

- [ITU-T Y.2233] Recommendation ITU-T Y.2233 (2010), *Requirements and framework allowing accounting and charging capabilities in NGN*.
- [ITU-T Y.2234] Recommendation ITU-T Y.2234 (2008), *Open service environment capabilities for NGN*.
- [ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.
- [ITU-T Y.2702] Recommendation ITU-T Y.2702 (2008), *Authentication and authorization requirements for NGN release 1*.
- [ITU-T Y.2704] Recommendation ITU-T Y.2704 (2010), *Security mechanisms and procedures for NGN*.
- [ITU-T Y.2720] Recommendation ITU-T Y.2720 (2009), *NGN identity management framework*.
- [ITU-T Y.2721] Recommendation ITU-T Y.2721 (2010), *NGN identity management requirements and use cases*.
- [ITU-T Y.2722] Recommendation ITU-T Y.2722 (2011), *NGN identity management mechanisms*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.101]: A structured set of capabilities, which provide value-added functionality supported by one or more services.

3.1.2 application network interface (ANI) [ITU-T Y.2012]: An interface which provides a channel for interactions and exchanges between applications and NGN elements. The ANI offers capabilities and resources needed for the realization of applications.

3.1.3 application programming interface (API) [b-ITU-T I.312]: An API provides a set of interfaces from an application environment to an execution environment. The execution environment provides services to the application environment.

3.1.4 functional architecture [ITU-T Y.2012]: A set of functional entities and the reference points between them used to describe the structure of an NGN. These functional entities are separated by reference points, and thus, they define the distribution of functions.

3.1.5 functional entity [ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.6 next generation network (NGN) [b-ITU-T Y.2001]: A packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

3.1.7 NGN service stratum [b-ITU-T Y.2011]: This refers to that part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications.

3.1.8 NGN transport stratum [b-ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities.

3.1.9 ubiquitous sensor network [ITU-T Y.2221]: A conceptual network built over existing physical networks which make use of sensed data and provide knowledge services to anyone, anywhere and at anytime, and where the information is generated by using context awareness.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 machine-to-machine applications: Applications enabled by the communications between two or more machines that need limited or no direct human intervention.

3.2.2 NGN service integration and delivery environment (NGN-SIDE): An open environment in NGN integrating resources from different domains and delivering integrated services to applications over NGN.

NOTE – These domains include, but are not limited to, telecommunication domain (e.g., fixed and mobile networks), Internet domain, broadcasting domain and content provider domain.

3.2.3 service enabler: A function or closely related set of functions made available over one or more well-defined interfaces to other consuming software applications.

NOTE 1 – A service enabler may support end-user services, provide operations functionality, or be used directly by other service enablers. Service enablers generally utilize underlying resources to perform their tasks and have interfaces for their own lifecycle management.

NOTE 2 – An example of functionality that a service enabler may provide is a location service or a fault management service.

NOTE 3 – In the context of NGN-SIDE, a service enabler is made available over well-defined interfaces to be used by NGN-SIDE users (e.g., application providers), including its usage as resource abstracted by NGN-SIDE (e.g., an underlying NGN service enabler [ITU-T Y.2201]).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ANI	Application Network Interface
API	Application Programming Interface
BCAST	Broadcasting
BPEL	Business Process Execution Language
CaaS	Communications as a Service
CAMEL	Customized Applications for Mobile networks Enhanced Logic
CP	Content Provider
CPU	Central Processing Unit
CRBT	Customized Ring Back Tone
DM	Device Management
DRM	Digital Rights Management
DVB	Digital Video Broadcasting
IaaS	Infrastructure as a Service
ID	Identifier

IdM	Identity Management
IMS	IP Multimedia Subsystem
IN	Intelligent Network
INAP	Intelligent Network Application Part
IP	Internet Protocol
IPTV	IP Television
ISDN	Integrated Services Digital Network
IT	Information Technology
J2EE	Java2 Enterprise Edition
J2SE	Java2 Standard Edition
JAIN	Java APIs for Integrated Networks
JDBC	Java Data Base Connectivity
JMS	Java Message Service
JTAPI	Java Telephony Application Program Interface
LCS	Location Service
M2M	Machine-to-Machine
MBMS	Multimedia Broadcast and Multicast Service
MMS	Multimedia Messaging Service
NaaS	Network as a Service
NGN	Next Generation Network
NGN-SIDE	NGN Service Integration and Delivery Environment
NGSI	Next Generation Service Interface
NNI	Network to Network Interface
OSA	Open Service Access
OSE	Open Service Environment
PaaS	Platform as a Service
PIM	Personal Information Management
PLMN	Public Land Mobile Network
PSA	Parlay Service Access
PSTN	Public Switched Telephone Network
QoS	Quality of Service
REST	Representational State Transfer
RSS	Really Simple Syndication
SaaS	Software as a Service
SDK	Software Development Kit
SDP	Service Delivery Platform
SDPaaS	Service Delivery Platform as a Service

SIDE	Service Integration and Delivery Environment
SLA	Service Level Agreement
SMS	Short Message Service
SNI	Service Network Interface
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
STB	Set-Top-Box
UDH	User-Data Header
UDP	User Datagram Protocol
UE	User Equipment
UNI	User Network Interface
URL	Uniform Resource Locator
USN	Ubiquitous Sensor Network
WAP	Wireless Application Protocol
WIN	Wireless Intelligent Network
XaaS	Everything as a Service
XML	Extensible Markup Language

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement needs not be present to claim conformance.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

The keywords "application(s)", "service enabler(s)", "computing", "storage", "connectivity", "network capability(ies)", and "content" refer to specific types of resource as described in clause 7.1.

6 NGN-SIDE ecosystem

The NGN service integration and delivery environment (NGN-SIDE) aims to support an ecosystem for all the stakeholders in the NGN value chain.

Figure 6-1 shows the key business roles involved in the NGN-SIDE ecosystem and the business relationships among them.

NOTE 1 – Some business deployment scenarios of the NGN-SIDE ecosystem, including description of relevant actors, are described in Appendix I.

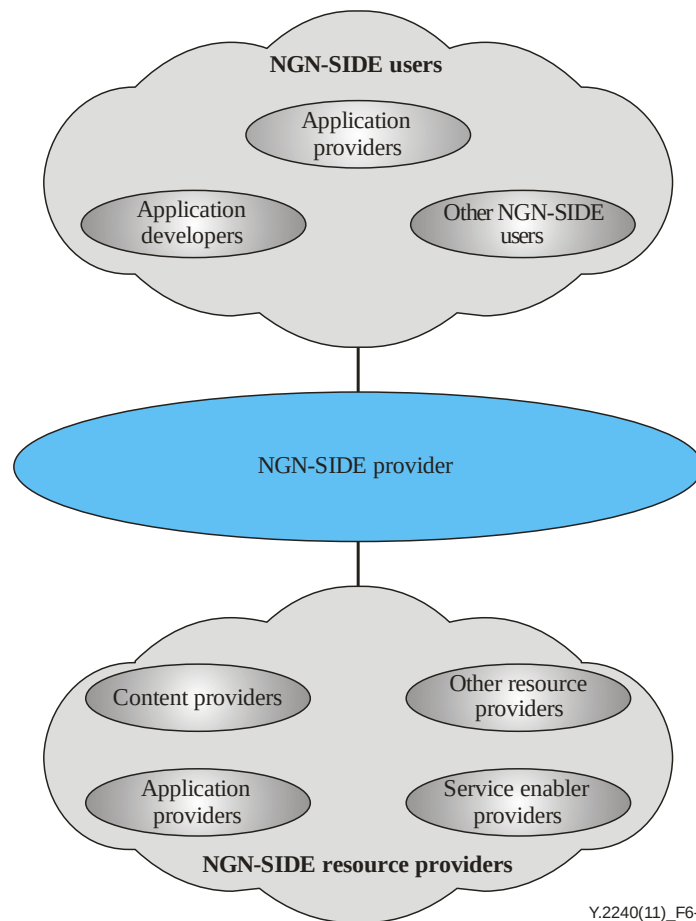


Figure 6-1 – Business role relationships in the NGN-SIDE ecosystem

NOTE 2 – Although NGN-SIDE resource providers and NGN-SIDE users are part of the NGN-SIDE ecosystem, they are external to NGN-SIDE itself. The following clauses describe the different key business roles involved in the NGN-SIDE ecosystem, i.e., NGN-SIDE users, NGN-SIDE provider, and NGN-SIDE resource providers.

6.1 NGN-SIDE users

The NGN-SIDE users use the services offered by the NGN-SIDE provider, including resource exposure. Resources exposed by the NGN-SIDE provider to a NGN-SIDE user include NGN-SIDE provider's and NGN-SIDE resource providers' exposed resources. NGN-SIDE users include the following specific roles:

- application provider: in the perspective of NGN-SIDE user, the role which uses capabilities and resources exposed by the NGN-SIDE provider for offering application(s) to customers;
- application developer: the role which uses capabilities and resources exposed by the NGN-SIDE provider for developing applications;
- other NGN-SIDE users: other roles (e.g., other service providers) which use capabilities and resources exposed by the NGN-SIDE provider.

NOTE – An NGN-SIDE user can also be an NGN-SIDE resource provider. For example, this can be the case for an application provider (see clause 6.3).

6.2 NGN-SIDE provider

The NGN-SIDE provider manages the NGN-SIDE ecosystem. In particular, the NGN-SIDE provider performs the following main functions:

- access and integration of resources provided by NGN-SIDE resource providers;

- support and control of the service integration and delivery infrastructure;
- offering of services, including resource exposure, to NGN-SIDE users.

6.3 NGN-SIDE resource providers

The NGN-SIDE resource providers provide resources to the NGN-SIDE provider. NGN-SIDE resource providers include the following specific roles:

- content provider: the role that is responsible for providing content to the NGN-SIDE provider according to commercial agreements;
- application provider: the role that is responsible for providing application(s) as resource(s) to the NGN-SIDE provider;
- service enabler provider: the role that is responsible for providing service enabler(s) to the NGN-SIDE provider;
- other NGN-SIDE resource providers: other roles that provide resources to the NGN-SIDE provider (e.g., providers of network capabilities, providers of computing, connectivity, storage resources).

NOTE – A NGN-SIDE resource provider can also be a NGN-SIDE user. For example, this can be the case for an application provider (see clause 6.1).

7 NGN-SIDE functional framework

7.1 NGN-SIDE layered view

Figure 7-1 shows the layered view of NGN-SIDE.

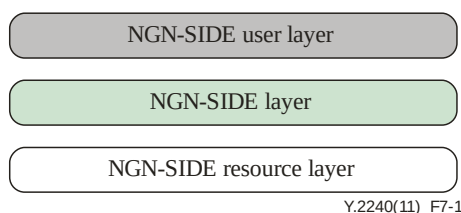


Figure 7-1 – NGN-SIDE layered view

The layered view of NGN-SIDE includes the following layers:

- the NGN-SIDE user layer, which uses the services offered by the NGN-SIDE layer, including resource exposure. It includes users accessing the NGN-SIDE, such as applications and other users. Applications include the following: a) NGN UE hosted applications, hosted in the NGN end user domain; b) Third-party applications, hosted by NGN-SIDE users (e.g., application providers); and c) NGN-SIDE in-house applications, hosted by the NGN-SIDE provider. Application scenarios involving NGN-SIDE are described in Appendix II;
- the NGN Service Integration and Delivery Environment layer (NGN-SIDE), which corresponds to NGN-SIDE;
- the NGN-SIDE resource layer, which includes resources accessible by NGN-SIDE, such as applications, service enablers, network capabilities, connectivity, computing, storage, and content.

7.2 NGN-SIDE functional view

Figure 7-2 shows a functional view of NGN-SIDE according to the layers in Figure 7-1.

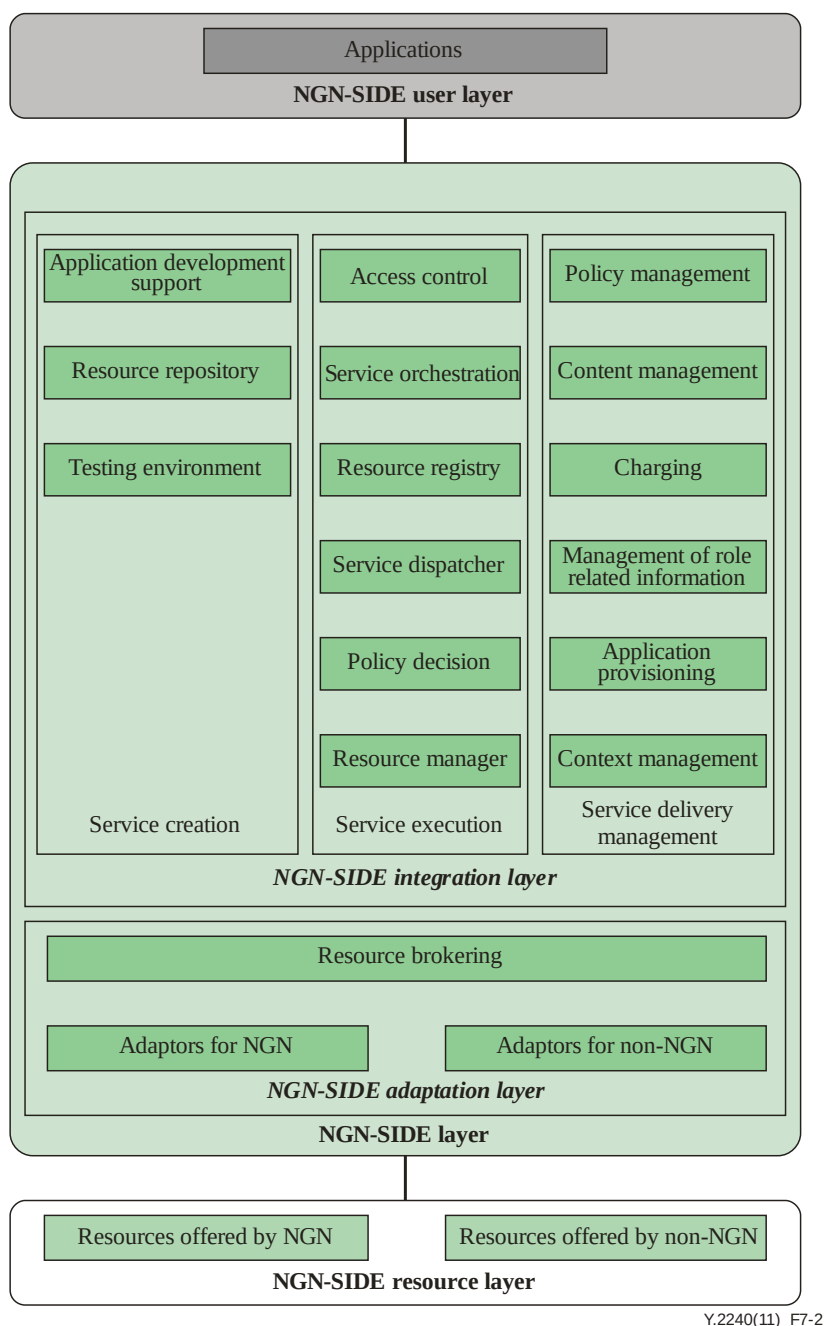


Figure 7-2 – NGN-SIDE functional view

As shown in Figure 7-2 the NGN-SIDE layer is comprised of the following two layers:

- NGN-SIDE integration layer;
- NGN-SIDE adaptation layer.

7.2.1 NGN-SIDE integration layer

In order to reduce the complexity of integrating resources, the NGN-SIDE integration layer provides a unified way for the NGN-SIDE users to access the resources offered by NGN and non-NGN.

As shown in Figure 7-2, the NGN-SIDE integration layer supports the following functional groups:

- service creation functional group;
- service execution functional group;
- service delivery management functional group.

The following clauses provide a description of the functional groups supported by the NGN-SIDE integration layer.

7.2.1.1 Service creation functional group

The service creation functional group provides capabilities to realize an application development environment for application developers. This functional group includes the following capabilities:

- the application development support which is responsible for providing secure access to NGN-SIDE capabilities and resources from NGN-SIDE resource providers, secure storage of developers' applications, access to the testing environment and various application developer's support functions and mechanisms such as development management tools or API definitions. The application development support capability also provides design tools which are responsible for service creation according to application requirements;
- the resource repository which is responsible for providing resource information reusable to develop new applications;
- the testing environment which is responsible for providing an application simulation environment to verify if a new application can work correctly.

7.2.1.2 Service execution functional group

The service execution functional group provides capabilities to support the service execution environment. The service execution functional group processes service requests received from the NGN-SIDE user layer and as a result, sends back responses to the NGN-SIDE user layer. While processing the service requests, service execution invokes the NGN-SIDE adaptation layer for requested resources. This functional group includes the following capabilities:

- The access control which provides functions related to control and manage access to NGN-SIDE by applications and translates standardized or proprietary APIs and protocols across different NGN-SIDE service interfaces.

NOTE 1 – NGN-SIDE service interfaces are described in clause 10.2.

NOTE 2 – Access control is only applicable during application execution.

- The service dispatcher which provides the following functionalities:
 - a) API and protocol transformation from applications to common message structure;
 - b) business event handling;
 - c) message routing and exchange to or from NGN-SIDE users;
 - d) coordination policy enforcement based on interaction with policy decision for service level monitoring such as QoS control.
- The service orchestration which is responsible for:
 - a) composing service logic in static and dynamic mode;
 - b) executing the service logic.
- The policy decision which provides policy decision making for access control, resource consumption, application schedule and traffic control functions according to the service level agreements (SLAs) between NGN-SIDE users and NGN-SIDE resources. Other capabilities interact with the policy decision capability to acquire policy decision results, and then enforce the policies accordingly.

- The resource registry which provides mechanisms to register or de-register, discover, and ensure governance of resources. Resource registry maintains a catalogue of the description of the resources available. At run-time, the resource registry is accessed to locate the resources.
- The resource manager which performs the controlling function for the pool of resources hosted by the NGN-SIDE provider. The resource manager also assigns the required resources to NGN-SIDE in-house applications.

NOTE 3 – The role of the resource manager in managing resources external to the NGN-SIDE provider is for further study.

7.2.1.3 Service delivery management functional group

The service delivery management functional group provides capabilities to realize the management of different aspects, provisioning of applications and charging for ensuring proper functioning of the service creation and service execution functional groups and providing associated delivery functionalities. This functional group includes the following capabilities:

- the policy management which provides support for managing, including storing of agreed policies. Policies include SLAs between NGN-SIDE users and NGN-SIDE resources and end-user's preferences. The policy management capability synchronizes policy related information with the policy decision capability;
- the management of role-related information which provides centralized access, and management of information related to the different NGN-SIDE roles;
- the content management which provides mechanisms to handle content for its appropriate access by NGN-SIDE users;
- the charging capability which coordinates charging for NGN-SIDE, including the triggering (online and offline) of all charging events during service delivery, interacting as appropriate with the NGN accounting and charging capabilities [ITU-T Y.2201];
- the application provisioning which provides deployment mechanisms for NGN-SIDE in-house applications in a secure way;
- the context management which collects context information and exposes context information to other entities in a secure way.

7.2.2 NGN-SIDE adaptation layer

NGN-SIDE adaptation layer includes resource brokering and resource adaptors.

The resource brokering mediates among resources and applications located in NGN-SIDE resource layer and NGN-SIDE user layer respectively.

Upon requests received from the NGN-SIDE integration layer, the resource brokering identifies the appropriate resource from the NGN-SIDE resource layer.

Upon requests received from the NGN-SIDE resource layer, the resource brokering identifies the appropriate application in the NGN-SIDE user layer.

The resource brokering also interacts with the NGN-SIDE integration layer (i.e., policy decision) to enforce the resource related policies such as scheduling of resources.

The resource adaptors include adaptors for NGN and adaptors for Non-NGN.

The resource adaptors perform adaptation of resources from the NGN-SIDE resource layer, i.e., resources from NGN and Non-NGN, based on NGN-SIDE integration layer's request as a result of its processing of the service request. The resource adaptors perform adaptation of control plane and media plane related resources.

8 NGN-SIDE requirements

This clause describes NGN-SIDE requirements.

8.1 Applications related requirements

A. NGN-SIDE is required to support mechanisms for application provisioning, addressing and routing:

- 1) NGN-SIDE is required to provide mechanisms to publish an NGN-SIDE in-house application so that it can be accessible from various domains.

NOTE 1 – This may include publishing a domain name for Internet domain, assigning a special access number (e.g., an ITU-T E.164 number) for telecommunication domain;

- 2) NGN-SIDE is required to support standard addressing mechanisms for applications (e.g., URL or ITU-T E.164 address);

- 3) NGN-SIDE is required to provide a mechanism to send requests originated from NGN-SIDE or resources to applications, and vice versa.

B. NGN-SIDE is required to provide mechanisms to support ubiquitous sensor network (USN) applications [ITU-T Y.2221] and machine-to-machine (M2M) applications as defined in clause 3.

C. NGN-SIDE is recommended to provide mechanisms to support the following cloud service categories:

- 1) application services (SaaS);
- 2) platform services (PaaS);
- 3) communication services (CaaS);
- 4) resource services (IaaS);
- 5) network services (NaaS).

NOTE 2 – Details about cloud service categories can be found in Appendix III.

D. NGN-SIDE is recommended to enable applications and functionalities supported by NGN-SIDE as a cloud service (SDPaaS).

NOTE 3 – SDPaaS can be viewed as the capability provided to the users of cloud services to use applications and functionalities supported by NGN-SIDE as well as the capability provided to a provider of cloud services to deploy, control and manage NGN-SIDE functionalities.

E. NGN-SIDE can optionally provide the following functionalities to support cloud services:

- 1) mediation functionalities between users of cloud services (as NGN-SIDE users) and providers of cloud services (as NGN-SIDE resource providers). These mediation functionalities include SLA negotiation, monitoring, security, screening, adaptation, provisioning and integration of cloud services;

F. NGN-SIDE can optionally be deployed, as internal resources and functionalities, in a distributed fashion using cloud computing mechanisms (e.g., virtualization, distributed file system, distributed cache or distributed database).

NOTE 4 – This deployment can provide IaaS support by the NGN-SIDE infrastructure itself.

NOTE 5 – An overview of characteristics and models of cloud computing technology and the relationship of these models with NGN-SIDE are described in Appendix III.

8.2 NGN-SIDE integration related requirements

- A. NGN-SIDE is required to provide an open environment for the integration of resources from different domains:
- 1) NGN-SIDE is required to support integration of resources supplied by the same NGN-SIDE resource provider and from different NGN-SIDE resource providers;
 - 2) NGN-SIDE is recommended to support the composition of resources offered by the NGN-SIDE provider as well as resources offered by different NGN-SIDE resource providers;
 - 3) NGN-SIDE is required to provide standardized mechanisms to access the resources located in different NGN-SIDE resource providers;
 - 4) NGN-SIDE is recommended to provide an abstract standardized description of resources located in different NGN-SIDE resource providers;
 - 5) NGN-SIDE is required to provide NGN-SIDE users with a physical location independent resource identification scheme for accessing the resources exposed by NGN-SIDE.
- B. NGN-SIDE is required to support features for a configurable, manageable, scalable and reliable service execution environment:
- 1) NGN-SIDE is required to provide mechanisms for SLA control according applications' SLAs;
 - 2) NGN-SIDE is required to support traffic control related functions based on applications' SLAs for the invocation of resources offered by NGN-SIDE resource providers;
 - 3) NGN-SIDE is required to support service level monitoring functions and resource monitoring functions (e.g., monitoring of resources' availability, devices' overload, network congestion level) for resources offered by NGN-SIDE resource providers;
 - 4) NGN-SIDE is required to provide functions for application execution's scalability and reliability;
 - 5) NGN-SIDE is required to support virtualization mechanisms to expose connectivity, computing and storage resources.
- C. NGN-SIDE is required to provide access control:
- 1) NGN-SIDE is required to support access from applications to NGN-SIDE functionalities and to exposed resources in a secure and controlled way.
- D. NGN-SIDE is required to support charging functionalities related to resource consumption and application usage.
- E. NGN-SIDE is required to support service orchestration features as follows:
- 1) NGN-SIDE is required to support static service orchestration according to the pre-defined service logic;
 - 2) NGN-SIDE is required to support a mechanism to select the appropriate resource responding to dynamic context information changes such as those of end user context, device context, network context;
 - 3) NGN-SIDE is required to support a mechanism to generate a service logic meeting the NGN-SIDE user's demand (e.g., cost and execution requirements);
 - 4) NGN-SIDE is required to support a mechanism for adaptive orchestration to ensure the application's reliability when some resources are not available.

- F. NGN-SIDE is required to support mechanisms for resource registration, discovery and routing:
- 1) NGN-SIDE is required to provide mechanisms for resource registration, including a standard schema for registration-oriented resource description, including unique resource identification and resource addressing;
 - 2) NGN-SIDE is required to provide a routing mechanism to locate the required resources and establish a path to access the resources.
- G. NGN-SIDE is required to provide the following content handling mechanisms:
- 1) NGN-SIDE is required to provide real-time content recording, processing, including encryption, decryption, content protection and digital rights management (DRM);
 - 2) NGN-SIDE is required to provide content delivery mechanisms;
 - 3) NGN-SIDE is required to provide content storage, caching, adaptation (including codec conversion, format conversion).
- H. NGN-SIDE is required to support an agile service creation environment:
- 1) NGN-SIDE is required to use a standard schema for uniform service creation-oriented resource description within NGN-SIDE;
 - 2) NGN-SIDE is required to support at least one standardized description language for service logic (i.e., the logic of the services to be provided by NGN-SIDE);
 - 3) NGN-SIDE is required to support mechanisms to notify application developers about the availability of new or updated resources;
 - 4) NGN-SIDE is required to support the application testing environment for application developers;
 - 5) NGN-SIDE is required to support online and offline design tools for application developers;
 - 6) NGN-SIDE is required to support mechanisms for the creation of personalized applications based on the end-user's context information, including language, location, presence and other customized information;
 - 7) NGN-SIDE is required to support the protection of property rights in terms of ownership and usage for both application developer and NGN-SIDE.
- I. NGN-SIDE is required to support application developer related requirements:
- 1) NGN-SIDE is required to support the application developer's management including the developer's registration, auditing, authentication and authorization;
 - 2) NGN-SIDE is required to support various charging modes (e.g., revenue sharing or quota limitation) for application developers.
- J. NGN-SIDE is required to support service delivery management functionalities as follows:
- 1) NGN-SIDE is required to support mechanisms for context management as follows:
 - NGN-SIDE is recommended to support standardized data format and semantics of context information following [ITU-T Y.2201];
 - NGN-SIDE is recommended to manage context entities related information and access to context information (e.g., operations of registration, query, subscription, notification, update and availability discovery) in NGN and non-NGN;
 - NGN-SIDE is recommended to support security and reliability for context information following [ITU-T Y.2201];
 - NGN-SIDE is recommended to support charging function based on context information following [ITU-T Y.2201].

- 2) NGN-SIDE is required to support charging features as specified in [ITU-T Y.2233], including event-based online/offline charging.
- 3) NGN-SIDE is required to support mechanisms for the management of role-related information as follows:
 - NGN-SIDE is required to support the management (i.e., add, modify, delete, operations) of role-related information by the NGN-SIDE provider;
 - NGN-SIDE is required to support the management (i.e., add, modify, delete operations) of subscription related information between different roles by the NGN-SIDE provider;
 - NGN-SIDE is recommended to support the policy-based access of NGN-SIDE role related information;
 - NGN-SIDE is recommended to support policy based access of application end users' subscription related information.
- 4) NGN-SIDE is required to support mechanisms for content management as follows:
 - NGN-SIDE is required to support content profiling to handle content according to content usage in different NGN-SIDE users' environments;
 - NGN-SIDE is required to support the extraction of appropriate information (e.g., size, type or publisher) from content;
 - NGN-SIDE is required to support content dispatching to content storage resources.

8.3 NGN-SIDE adaptation related requirements

- A. NGN-SIDE is required to support adaptation for exposure of resources, including virtualized resources from different domains as follows:
 - 1) NGN-SIDE is required to support mechanisms to expose telecommunication domain resources. This includes mechanisms to expose NGN capabilities, including NGN service enablers, as specified in [ITU-T Y.2201];
 NOTE – NGN service enablers are a subset of the NGN capabilities specified in [ITU-T Y.2201].
 - 2) NGN-SIDE is required to support mechanisms to expose Internet domain resources;
 - 3) NGN-SIDE is required to support mechanisms to expose broadcasting domain resources;
 - 4) NGN-SIDE is required to support exposure of composite resources, such as composite applications and services, offered by a given NGN-SIDE resource provider;
 - 5) NGN-SIDE is required to support the exposure of legacy services (e.g., PSTN/IN based services);
 - 6) NGN-SIDE is recommended to support the exposure of contents offered by NGN-SIDE resource providers.
- B. NGN-SIDE is required to support brokering of NGN and non-NGN resources offered by different NGN SIDE resource providers in a secure and controllable way as follows:
 - 1) The resource brokering is required to manage interactions among all available resources, including cloud resources, offered by different NGN-SIDE resource providers;
 - 2) The resource brokering is required to take into account context information (including end user's context information) when selecting a resource to fulfill a request from the NGN-SIDE integration layer.