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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

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

Recommendation ITU-T Y.2240

ITU-T Y-SERIES RECOMMENDATIONS

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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.

#### History

Edition	Recommendation	Approval	Study Group
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#### Keywords

Adaptation, API, brokering, NGN, NGN-SIDE, resources, resource adaptation, SDP, service creation, service delivery, service delivery management, service enablers, service execution, service integration.

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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.

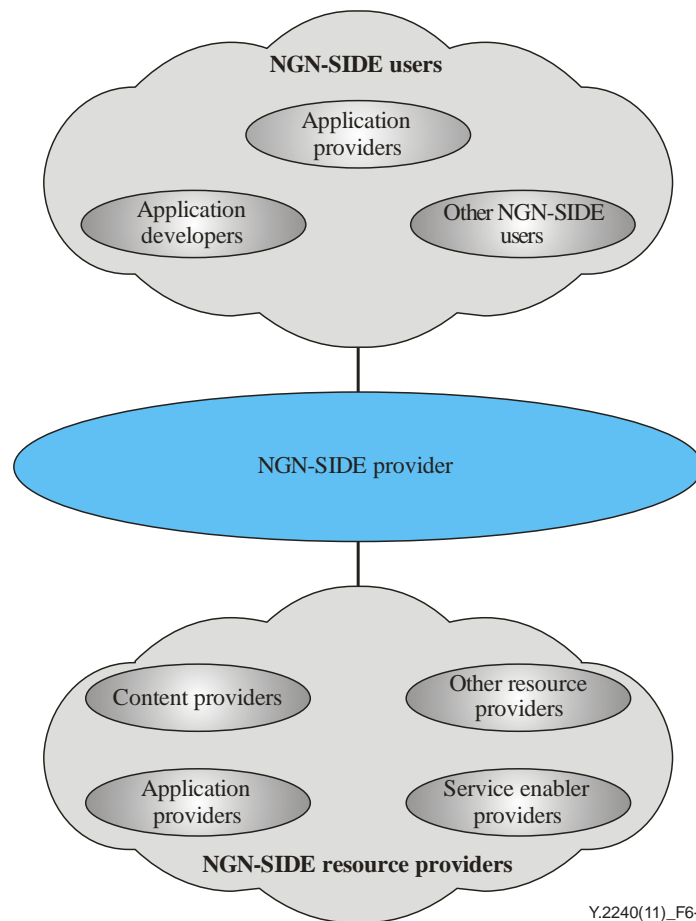
The keywords "application(s)", "service enabler(s)", "computing", "storage", "connectivity", "network capability(ies)", and "content" refer to specific types of resource as described in clause 7.1.

## 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:

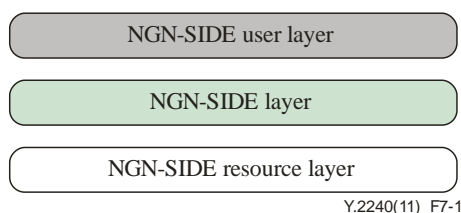
- content provider: the role that is responsible for providing content to the NGN-SIDE provider according to commercial agreements;
- application provider: the role that is responsible for providing application(s) as resource(s) to the NGN-SIDE provider;
- service enabler provider: the role that is responsible 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.



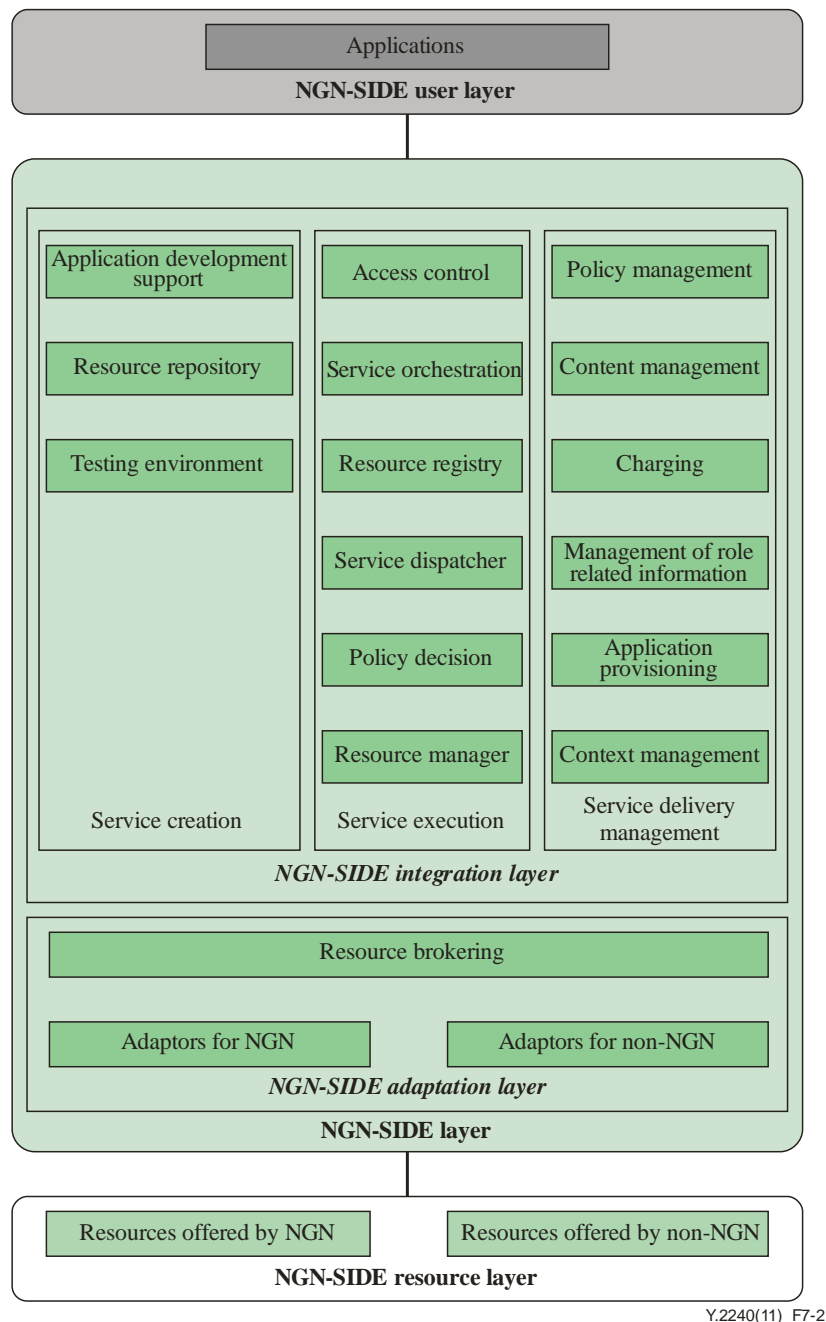
**Figure 7-1 – NGN-SIDE layered view**

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.

## **8.4 NGN-SIDE security related requirements**

A. NGN-SIDE is required to support the following:

- 1) NGN-SIDE is required to fulfill the NGN security requirements according to [ITU-T Y.2201], [ITU-T Y.2701] and [ITU-T Y.2702];
- 2) NGN-SIDE is required to support security mechanisms according to [ITU-T Y.2704] for the following dimensions: access control, authentication, authorization, non-repudiation, data confidentiality, communication security, data integrity, availability and privacy;
- 3) When NGN-SIDE is not supported by the NGN provider, NGN-SIDE is required to fulfill general security requirements according to [ITU-T X.805] dimensions;
- 4) NGN-SIDE is required to provide a security environment for the NGN-SIDE user, so that the NGN-SIDE user can set up a trust domain for context aware applications;
- 5) NGN-SIDE is required to provide a privacy schema to enable the NGN-SIDE user's protection for access and selection of NGN-SIDE user related context information;
- 6) NGN-SIDE is required to have mechanisms to manage, control and distribute context related information, according to the NGN-SIDE provider's privacy policies and related agreements with NGN-SIDE users and the NGN-SIDE resource providers supplying context information;
- 7) NGN-SIDE is recommended to provide identity management support to NGN-SIDE users via integration of NGN identity management network based capabilities according to [ITU-T Y.2201], [ITU-T Y.2720], [ITU-T Y.2721] and [ITU-T Y.2722] with Identity Management capabilities provided by applications and/or other resources.

## **9 NGN-SIDE capabilities**

This clause describes the capabilities of NGN-SIDE according to the NGN-SIDE layered view.

Part of the functionalities provided by NGN-SIDE is supported via the capabilities identified in [ITU-T Y.2234]. Specific relationships between the capabilities defined in this Recommendation and the capabilities defined in [ITU-T Y.2234] are provided in Annex A.

### **9.1 NGN-SIDE capabilities related to the NGN-SIDE integration layer**

#### **9.1.1 Application development support**

This capability enables application developers to develop applications using resources exposed by NGN-SIDE.

An application developer can develop applications using online or offline design tools.

In the online application development mode, the application developer interacts with the application development support and develops applications using online tools accessible via the application development support.

In the offline application development mode, the application developer uses offline tools (e.g., software development kits (SDKs), plug-ins) via the application development support and develops applications.

NOTE – SDKs are used to facilitate the development of applications by application developers.

The following types of SDK are considered:

- device SDK, which provides a set of development tools for the creation of UE hosted applications residing on UEs;

- network SDK, which provides a set of development tools for the creation of applications (third-party applications or NGN-SIDE in-house applications).

The application development support capability is required to:

- provide an easy and secure access to resource repository;
- provide developers' applications with customer and contextual data to deliver an enhanced user experience;
- support integrated development management tools;
- provide access to the application developers' community;
- support access to the testing environment;
- support purchasing and payment mechanisms as well as revenue sharing models;
- provide support functionality for secure storage of developers' applications;
- provide rules, guidelines, sample applications and API definitions for rapid application development;
- support the collection and exposure of customer's feedback and ratings about applications;
- support security mechanisms to assure protection of intellectual property.

### **9.1.2 Resource repository**

The resource repository capability is required to provide functionalities for the storage of information related to the registered resources. Information related to the registered resources includes various suitable packaging tools (e.g., Java SDK, .NET SDK and Eclipse) for application developers.

The resource repository capability is recommended to:

- provide a version management mechanism to allow registered resource automatic upgrade;
- provide a common mechanism to interact with the resource registry capability for cooperation on resource related information retrieval and storage.

### **9.1.3 Testing environment**

This capability provides a testing environment to application developers to allow testing of application operation (e.g., support of application tracing, debugging).

The testing environment capability:

- can optionally support tools and capabilities for simulation of NGN-SIDE capabilities as appropriate for testing;
- is recommended to not impact the operations of NGN-SIDE;
- is recommended to support resource simulation by NGN-SIDE itself within the testing environment.

### **9.1.4 Access control**

The access control capability provides translation of APIs and protocols across different NGN-SIDE service interfaces as well as access from applications to functionalities or resources exposed by NGN-SIDE.

The access control capability is required to support the following functionalities:

- API and protocol translation between different service interfaces and NGN-SIDE;
- authentication of NGN-SIDE users requesting usage of exposed functionalities or resources;

- policy-based authorization of NGN-SIDE users requesting usage of exposed functionalities or resources;
- handling and relaying of service requests or events from applications or resources towards NGN-SIDE;
- handling and relaying of responses from applications or resources;
- triggering of charging events for applications accessing functionalities or resources exposed by NGN-SIDE.

### **9.1.5 Service orchestration**

This capability is required to provide mechanisms for:

- composing resources (resources provided by the NGN-SIDE provider as well as registered resources from other domains) to create new composite resources;
- executing composite resources.

Composing resources is the process of generation of the service logic (i.e., the logic of the service to be provided by NGN-SIDE) taking into account the requirements from the end-user (user of the application), including the consideration of context information, and dynamic changes of resources.

Executing composite resources includes parsing and running the service logic.

NOTE – The execution process also includes ensuring reliability and continuity of the service to be provided by NGN-SIDE, when a resource to be composed is not available (e.g., the resource hosting device is powered off or its connection to NGN-SIDE is broken).

### **9.1.6 Resource registry**

This capability provides the functionalities related to the registration, deregistration, discovery, and governance of resources offered by NGN-SIDE resource providers. Registration-oriented resource descriptions, including unique resource identification and resource addressing, are published in resource registry.

This capability defines a mechanism for a resource of an NGN-SIDE resource provider to be registered within NGN-SIDE, so that this resource can be located and accessed by applications.

The resource registry capability provides the following functionalities:

- The resources offered to NGN-SIDE by NGN-SIDE resource providers are required to be registered in the resource registry. The resource registry is required to support resource update as well as resource deregistration.
- When there is a resource deregistration request (e.g., if a resource is not needed anymore), the resource registry capability is required to ensure the application running instances' reliability.
- The resource registry capability is required to provide a resource discovery mechanism which allows NGN-SIDE users (e.g., applications) to choose an appropriate resource. Resources are discovered based on static configuration and dynamic information.

NOTE – The static information used for selection may include user identity information (e.g., user name or binding address) which is generally invariable; the dynamic information used for selection may include other user information, such as user's presence and location, user's access network bandwidth, which is subject to change.

- The resource registry capability is required to provide resource governance in terms of the management of all registered resources, including resource life cycle management, resource portfolio management, resource performance monitoring. For example, when a resource is updated, the resource registry capability is responsible for updating the resource repository and the application running instances about this update.

### **9.1.7 Service dispatcher**

This capability provides unified message routing and message exchange mechanisms within NGN-SIDE.

The message routing mechanisms provide route calculation for requests and responses between NGN-SIDE users and NGN-SIDE resource providers. Message routing can be based on various criteria, e.g., context, policies.

The message exchange mechanisms control the message flow between NGN-SIDE users and NGN-SIDE resource providers.

The service dispatcher interacts with policy decision to enforce policies for service level monitoring such as QoS control.

The service dispatcher also provides API and protocol transformation from applications to common message structure and business event handling and vice versa.

The service dispatcher capability is required to:

- support the exchange and routing of messages between NGN-SIDE users and NGN-SIDE resource providers. This includes support of message flows involving multiple application providers;
- interact with policy decision to enforce policies for service level monitoring such as QoS control;
- support API and protocol transformation from applications to common message structure, and handling of business events, and vice versa.

### **9.1.8 Policy decision**

The policy decision provides the policy decision making function and interacts with other capabilities to provide the policy decision results for policy enforcement. The policy decision capability is required to:

- synchronize policy related information with the policy management capability;
- interpret policy rules provided by the policy management capability;
- interact with other capabilities (e.g., service dispatcher, resource brokering) for policy decisions, according to policy related information.

### **9.1.9 Resource manager**

The resource manager performs the controlling functions for all resources in order to satisfy the application's requirements. During the deployment of NGN-SIDE in-house applications, the application provisioning capability communicates with the resource manager which assigns the resources (including computing, connectivity, and storage) internal to NGN-SIDE according to the application's requirements (SLAs) and the NGN-SIDE provider's policies. The resource manager capability is required to assign the resources (including computing, connectivity, and storage) internal to NGN-SIDE according to the application's requirements (SLAs) and the NGN-SIDE provider's policies.

### **9.1.10 Policy management**

The policy management capability provides the management of policies [ITU-T Y.2201], used for access, provisioning, logging and management of resources. The policy management capability is required to provide policy management functionalities, including storing policy related information such as SLAs between NGN-SIDE users and NGN-SIDE resources and end-user's preferences provided by end users at subscription time.

### **9.1.11 Content management**

Content can be provided as resources to NGN-SIDE by different NGN-SIDE resource providers (e.g., content providers and end users). The content management capability is required to provide the following functionalities:

- extraction of appropriate information (including size, type, publisher, location) from content, enabling the NGN-SIDE provider to ensure the integrity of the content itself;
- profiling of content as appropriate to enable its delivery to different NGN-SIDE users' environments, such as content for specific applications (e.g., WAP applications, CRBT applications, web applications), content for specific end-user equipment, content for specific end-user locations;
- dispatching of content to content storage resources in order to expose content to applications.

NOTE – Content storage resources can be supported within NGN-SIDE or outside of NGN-SIDE.

### **9.1.12 Charging**

This capability coordinates charging for NGN-SIDE, interacting as appropriate with the NGN accounting and charging capabilities [ITU-T Y.2201]. The charging capability is required to support charging modes and mechanisms as specified in [ITU-T Y.2233], including:

- support of revenue sharing among the various actors involved in the NGN-SIDE ecosystem (e.g., support of individual application developers);
- support of event-based online or offline charging in the NGN-SIDE ecosystem.

### **9.1.13 Management of role-related information**

The management of role-related information capability makes role-related information available to other NGN-SIDE capabilities (e.g., to access control for role authentication and authorization).

Role-related information includes basic information for all roles (e.g., NGN-SIDE user – resource provider relationship), role specific information (e.g., preference profiles), subscription related information (e.g., end user-application provider subscription relationship information for in-house applications). The management of role related information capability:

- is required to provide policy-based access and centralized management (i.e., add, modify or delete operations) of role-related information, including information on role inter-relationship, concerning the different roles involved in the NGN-SIDE ecosystems;
- can optionally support storage of role-related information.

### **9.1.14 Application provisioning**

The application provisioning capability is used for the deployment of applications in a secure way by the NGN-SIDE provider when they are available for deployment.

NOTE – This capability is used for NGN-SIDE in-house applications. This capability provides application packaging, publishing, deployment, lifecycle management and monitoring functions. The application provisioning capability is required to provide:

- a standard format for application packaging, including directory structure, compression format, configuration format;
- a standard schema for application provisioning;
- a publishing mechanism to make an application accessible in different domains, e.g., assigning a domain name to the application for Internet user access, assigning an SMS access code for PLMN user access;
- a deployment mechanism which allows the assignment of an application server in the NGN-SIDE provider domain for application hosting;

- access means for control of application lifecycle, including application setup, revocation, update, version management and tracing log.

### **9.1.15 Context management**

The context management capability collects, aggregates and manages context information related to different context sources, exposing context information, including to other NGN-SIDE entities, according to the NGN-SIDE provider's policies.

Context information includes different types of context related information such as service, end-user, device and network context:

- the service context may include service availability, service QoS, service performance;
- the end-user context may include the end-user's identity, end-user's presence, end-user's end location, end-user's preferences and end-user's social status;
- the device context may include device status (e.g., device's presence, device's capabilities) and device's runtime parameters (e.g., CPU, memory, load, performance);
- the network context may include network conditions (e.g., bandwidth, traffic, topology) and network performance.

The context management capability is required to:

- collect and aggregate context information related to different context sources;
- expose context information, including to other NGN-SIDE capabilities, according to the NGN-SIDE provider's policies.

## **9.2 NGN-SIDE capabilities related to the NGN-SIDE adaptation layer**

### **9.2.1 Resource brokering**

This capability provides the interaction between applications and resources for the downward invocation of resources and the upward triggering of applications. It also interacts with the NGN-SIDE integration layer capabilities (e.g., policy decision) to enforce the resource related policies such as scheduling of resources. The resource brokering capability provides the following functionalities:

- For the downward request from the application side, the resource brokering is required to interact with policy decision in order to decide which resources should be invoked among the candidate resources and to mediate among the resources according to the context information (e.g., end-user's preferences, resource conditions, device status).
- For the upward request from the resource side, the resource brokering is required to control the application's trigger sequence and mediate among the applications and resources according to policies (including the NGN-SIDE provider's policies, context information, and application provider's policies).
- The resource brokering is recommended to provide brokering of cloud resources from a single or multiple domains.

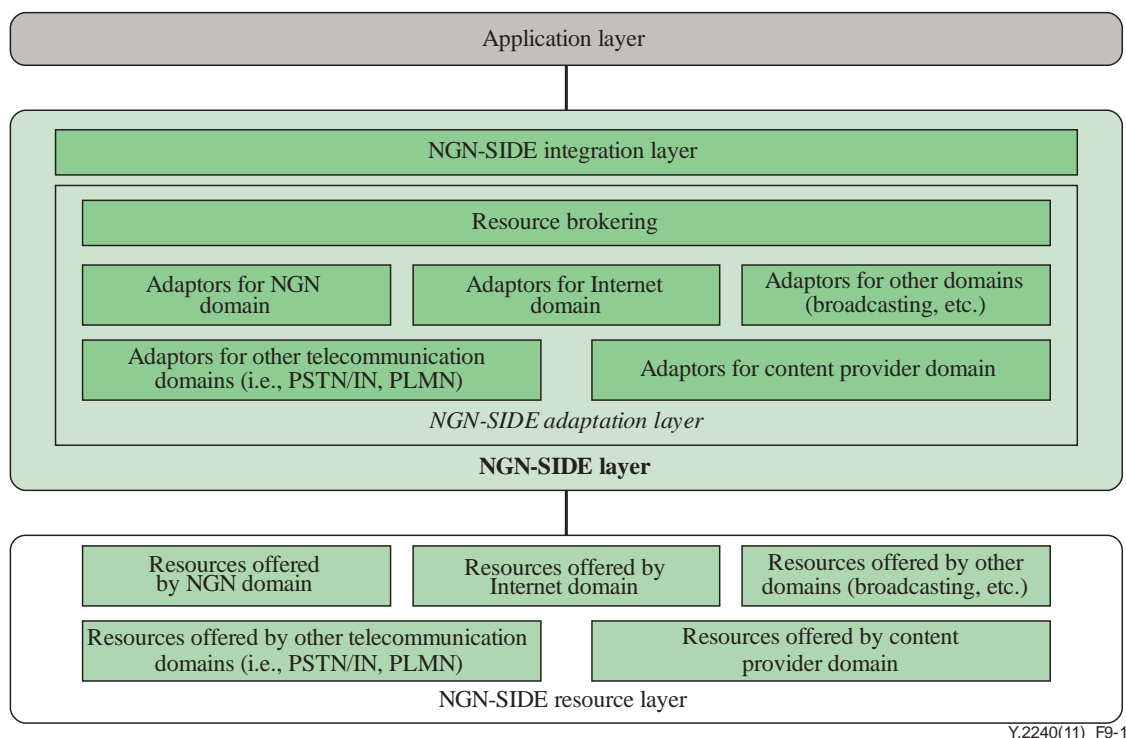
NOTE – Details about requirements for support by the resource brokering of cloud resources are out of scope of this Recommendation.

### **9.2.2 Adaptors**

The resources offered by NGN-SIDE resource providers may vary, based on the underlying resource technology used by the NGN-SIDE resource providers. This makes it difficult for application developers to develop new applications based on direct usage of such diverse and complex underlying resources.

The NGN-SIDE adaptation layer adapts resources offered by NGN-SIDE resource providers such as their own service logic and service control, and related protocols, in order to provide uniformly adapted resources (e.g., control and media format) for interaction with the NGN-SIDE integration layer. NGN-SIDE resource providers use standardized or proprietary interfaces called "NGN-SIDE resource interfaces" (clause 10.2) to offer resources to NGN-SIDE. These interfaces are adapted by NGN-SIDE.

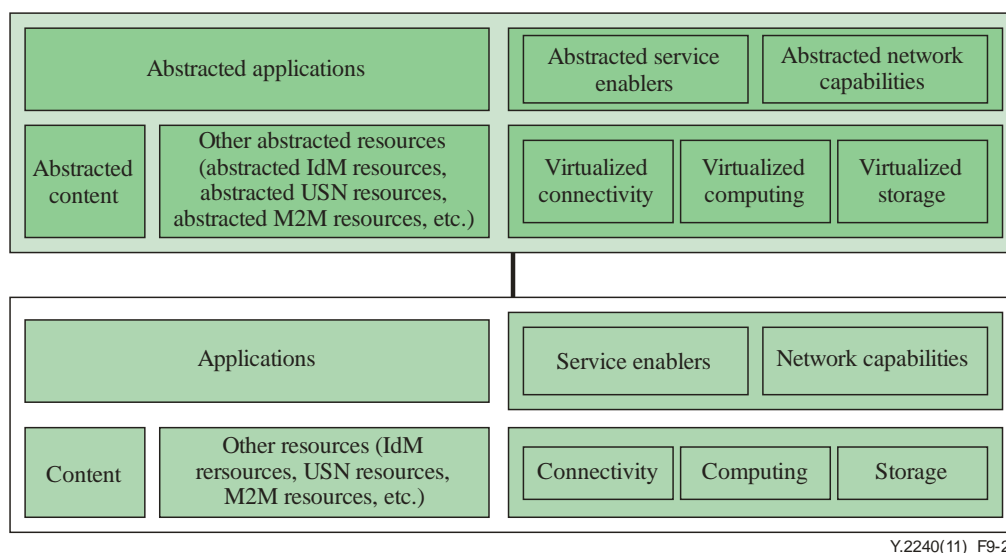
The NGN-SIDE adaptation layer provides adaptation capabilities, called adaptors, hiding the details of the resources in the NGN-SIDE resource layer as shown in Figure 9-1.



**Figure 9-1 – Adaptation of resources in NGN-SIDE**

The NGN-SIDE adaptation layer includes adaptors for resources available in the NGN-SIDE resource layer. The adaptors perform adaptation at both control plane and media plane level.

Figure 9-2 shows the approach for adaptation of resources offered by the NGN-SIDE resource layer.



**Figure 9-2 – Resource adaptation in NGN-SIDE**

Resources shown in Figure 9-2 such as service enablers, network capabilities, applications, connectivity, computing, storage, content and other resources (including USN resources and M2M resources), can be offered by NGN or non-NGN.

NGN-SIDE is required to abstract connectivity, computing and storage resources by using virtualization mechanisms.

NGN-SIDE is required to abstract network capabilities, service enablers, applications, content and other resources by using a standardized description mechanism, i.e., common message structure, common media format, unique mapping scheme between resources and common message structure.

NGN-SIDE is recommended to support the adaptation of resources to support M2M applications, including:

- support of M2M adaptors for accessing M2M devices (e.g., directly or via M2M gateways) [b-ETSI-102.689].

NOTE 1 – NGN-SIDE acts in this approach as middleware for M2M (resources for support of M2M applications are abstracted in NGN-SIDE);

- support of M2M adaptors for accessing M2M related resources.

NOTE 2 – NGN-SIDE acts in this approach as a mediator between M2M applications and M2M middleware.

NGN-SIDE is recommended to support the adaptation of resources to support USN applications [ITU-T Y.2221], including:

- support of USN adaptors for accessing sensor networks (e.g., directly or via USN gateways).

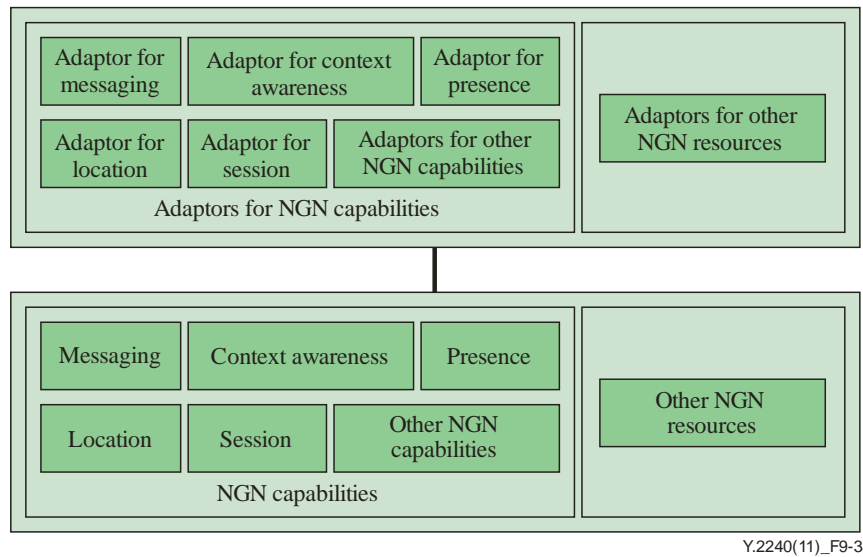
NOTE 3 – NGN-SIDE acts in this approach as USN middleware (NGN capabilities for support of USN applications [ITU-T Y.2221] are abstracted in NGN-SIDE);

- support of USN adaptors to USN middleware as described in [ITU-T Y.2221].

NOTE 4 – NGN-SIDE acts in this approach as a mediator between USN applications and USN middleware. NGN-SIDE is recommended to support adaptation of resources to support the various cloud service categories, including support of adaptors for accessing cloud resources (including connectivity, computing, and storage). The following clauses provide details about adaptors for resources offered by NGN and Non-NGN.

### 9.2.2.1 Adaptors for resources offered by NGN

Figure 9-3 shows the approach for adaptation of resources specifically offered by NGN.



**Figure 9-3 – Adaptation examples of resources offered by NGN**

NOTE – NGN resources include NGN capabilities, as described in [ITU-T Y.2201], and other NGN resources.

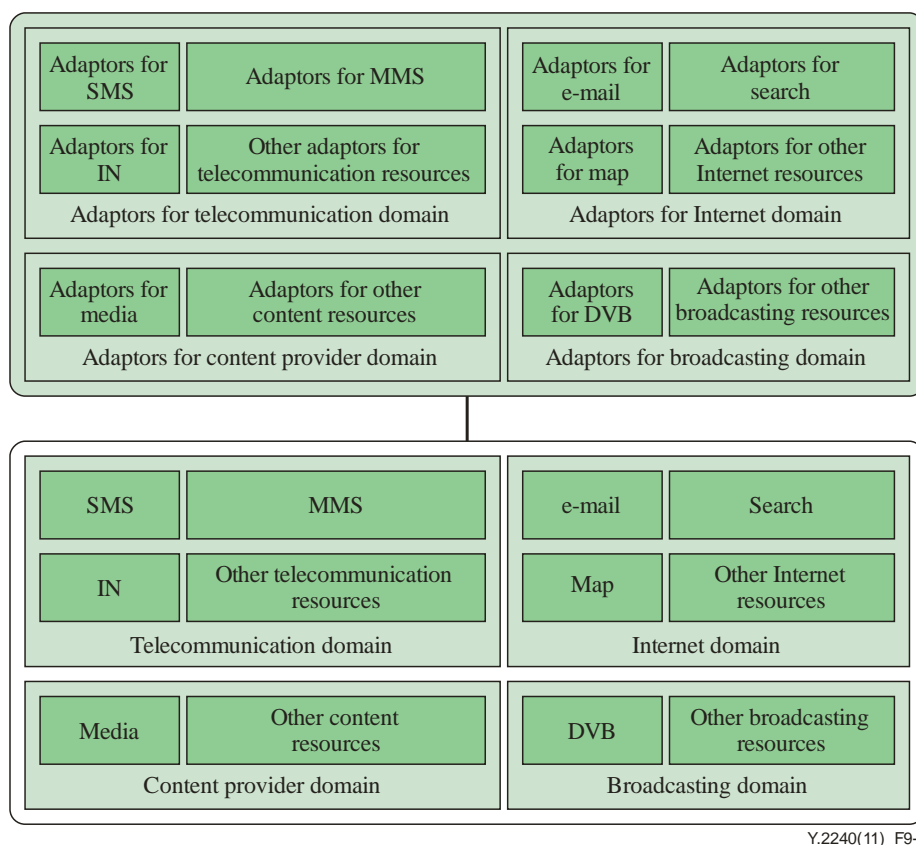
Figure 9-3 shows only some examples of NGN capability adaptors. The actual scope of adaptation depends on the NGN-SIDE provider's policies and, in case the NGN-SIDE provider and the NGN provider are distinct, on the agreements with the NGN provider.

NGN-SIDE is recommended to provide adaptors for at least the following service enablers [ITU-T Y.2201]:

- message handling;
- presence;
- location management;
- session handling;
- accounting and charging.

### 9.2.2.2 Adaptors for resources offered by non-NGN

Figure 9-4 shows the approach for adaptation of resources specifically offered by non-NGN.



**Figure 9-4 – Adaptation examples of resources offered by Non-NGN**

NGN-SIDE supports the adaptation of telecommunication domain resources, Internet domain resources, broadcasting domain resources and content provider domain resources.

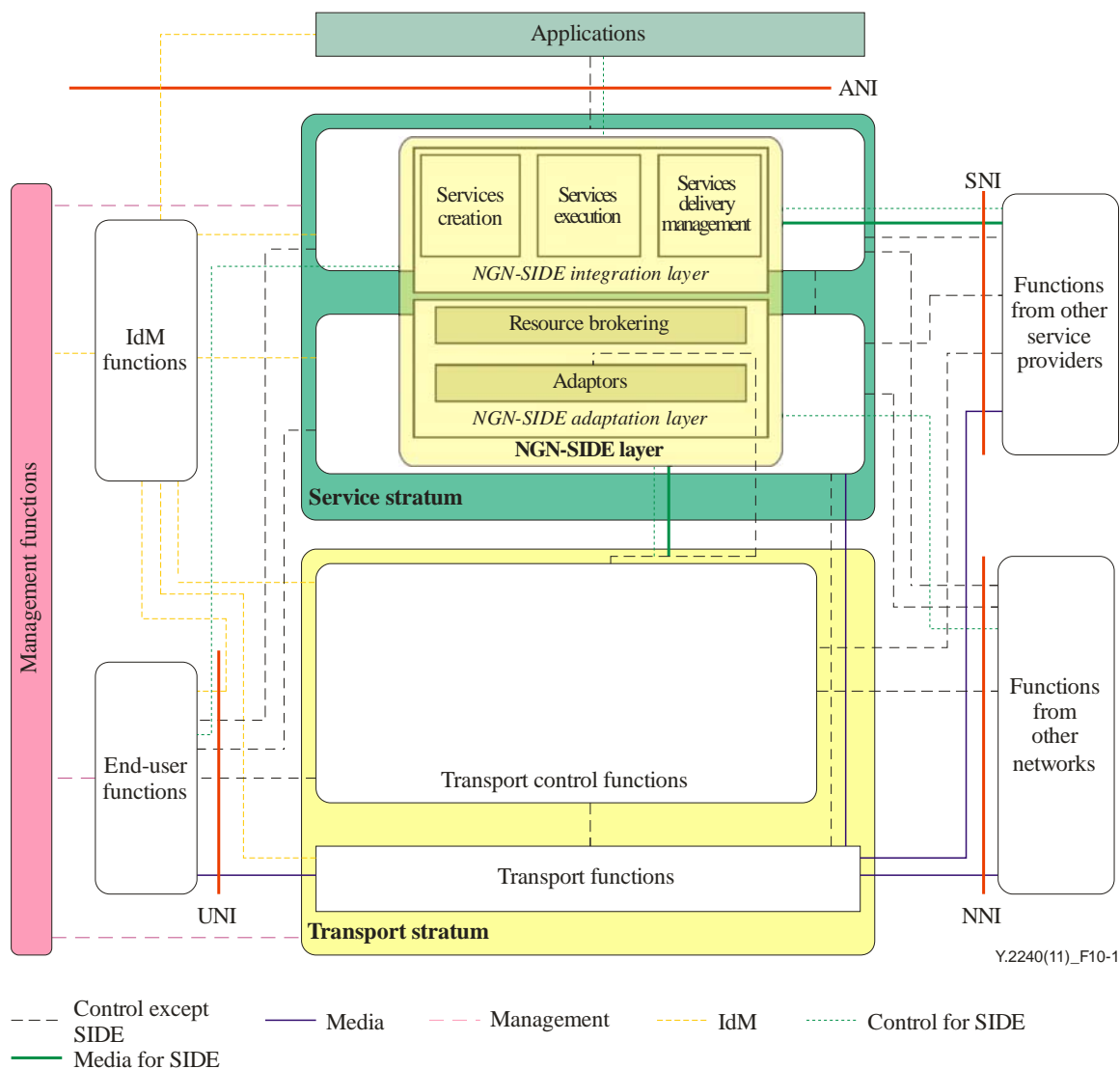
- A. In order to access resources from the telecommunication domain, NGN-SIDE is:
- i) required to provide adaptors for the following resources:
    - SMS resources;
    - MMS resources;
    - LCS resources;
    - WAP gateway resources.
  - ii) recommended to provide adaptors for the following resources:
    - intelligent network resources (e.g., adaptation for INAP, WIN, CAMEL based interfaces);
    - IMS based network resources.
- B. In order to access resources from the Internet domain, NGN-SIDE is recommended to provide adaptors for at least the following Internet resources:
- Internet e-mail resources;
  - file transfer resources;
  - search resources;
  - RSS resources
  - map resources;
  - web services resources;
  - social network services resources.

- C. In order to support adaptation for content provider domain, NGN-SIDE is recommended to provide content adaptation for different content types, and support of format adaptation, codec adaptation, and code and packaging adaptation according to the corresponding standards:
- format adaptation provides data conversion from one coding format to another one as per context (e.g., binary coding to text coding);
  - codec adaptation provides media translation from one codec format to another one (e.g., ITU-T G.711 codec format to ITU-T G.729 codec format);
  - code and packaging adaptation provides file and packaging format adaptation (e.g., bitmap to gif, rar to zip).
- NOTE – Content can be adapted from different sources, such as directly from a content provider or indirectly from a content delivery service provider.
- D. In order to access resources from broadcasting domain, NGN-SIDE is recommended to provide adaptors for the corresponding resources, including adaptation for enablers from DVB, OMA and 3GPP (e.g., OMA BCAST [b-OMA-BCAST] or 3GPP MBMS [b-3GPP-MBMS]).
- E. NGN-SIDE is recommended to provide adaptors for streaming resources from different domains.
- F. In order to access cloud resources, NGN-SIDE is recommended to provide adaptors for the cloud resources.

## **10 NGN-SIDE interfaces requirements**

### **10.1 NGN-SIDE positioning within the NGN reference architecture**

Figure 10-1 shows the NGN-SIDE positioning within the NGN reference architecture [ITU-T Y.2012].



**Figure 10-1 – NGN-SIDE positioning within the NGN reference architecture**

The NGN-SIDE functional components are positioned inside the NGN service stratum. The NGN-SIDE adaptation layer enables the abstraction of resources, including the resources of the NGN transport stratum (e.g., transport control functions and transport functions related resources) and the NGN service stratum (e.g., service control functions and content delivery functions related resources).

NOTE 1 – This Recommendation assumes one single NGN-SIDE per NGN domain.

"Control for SIDE" in Figure 10-1 represents the control level interfaces between NGN-SIDE and relevant entities outside the NGN service stratum. In particular:

- "Control for SIDE" at the ANI between applications and NGN-SIDE represents the interface to third-party applications.
- "Control for SIDE" at the NNI between other networks and NGN-SIDE represents the interface to other networks (e.g., to access NGN-SIDE in another NGN, resources in other networks).
- "Control for SIDE" at the UNI between end-user functions and NGN-SIDE, represents the interface to end-user functions (e.g., to access resources located in the end-user side, to expose NGN-SIDE capabilities to applications in the end-user side).

- "Control for SIDE" at the SNI between other service providers and NGN-SIDE represents the interface to other service providers (e.g., content providers).

"Media for SIDE" in Figure 10-1 represents the media level interfaces between NGN-SIDE and relevant entities outside the NGN service stratum.

NOTE 2 – "Control for SIDE" and "Media for SIDE" interfaces between NGN-SIDE and NGN service stratum are implicit but not shown in Figure 10-1. In line with [ITU-T Y.2012], it is possible for identity management (IdM) functions to reside in different planes (e.g., user, control and management) and different strata of the architecture (e.g., service stratum and transport stratum). Although IdM functions are shown in Figure 10-1 as a stand-alone group of functions, this is not intended to impose any implementation design or restrictions for IdM functions.

NGN-SIDE may provide support for IdM (e.g., IdM related to NGN-SIDE users, NGN-SIDE resource providers and NGN-SIDE provider). In particular, NGN-SIDE capabilities such as resource registry, resource repository, access control, management of role-related information may provide support for IdM mechanisms [ITU-T Y.2722].

In addition, NGN-SIDE may also provide adaptation of IdM resources (via appropriate adaptors), including NGN IdM resources, and may also expose IdM resources to NGN-SIDE users. Although management functions are shown in Figure 10-1 as a stand-alone group of functions, this is not intended to impose any implementation design or restrictions for management functions. In particular, NGN-SIDE supports some management functions in the service delivery management functional group.

## **10.2 NGN-SIDE interfaces**

The NGN-SIDE interfaces extend the NGN interfaces [ITU-T Y.2012], i.e., ANI, UNI, SNI, and NNI, for its interaction with NGN-SIDE users and NGN-SIDE resource providers.

The NGN-SIDE interfaces can be categorized as follows:

- NGN-SIDE resource interfaces;
- NGN-SIDE service interfaces.

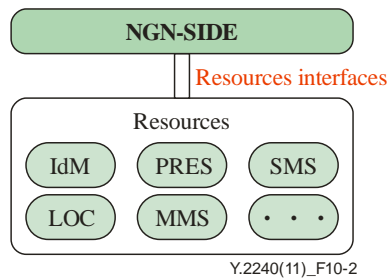
As far as the interfaces among NGN-SIDE internal capabilities, this Recommendation does not identify reference points among NGN-SIDE internal capabilities. However, it is not precluded that NGN-SIDE uses standard interfaces among NGN-SIDE internal capabilities, in order to facilitate NGN-SIDE internal capabilities' reusability, portability, accessibility.

### **10.2.1 NGN-SIDE resource interfaces**

Figure 10-2 shows interaction between NGN-SIDE and resources from NGN-SIDE resource providers. In this perspective, NGN-SIDE consumes resources offered by NGN-SIDE resource providers.

NGN-SIDE resource interfaces refer to the standardized or proprietary interfaces exposed by NGN-SIDE resource providers. NGN-SIDE adapts these interfaces to access resources as described in clause 9.2.2.

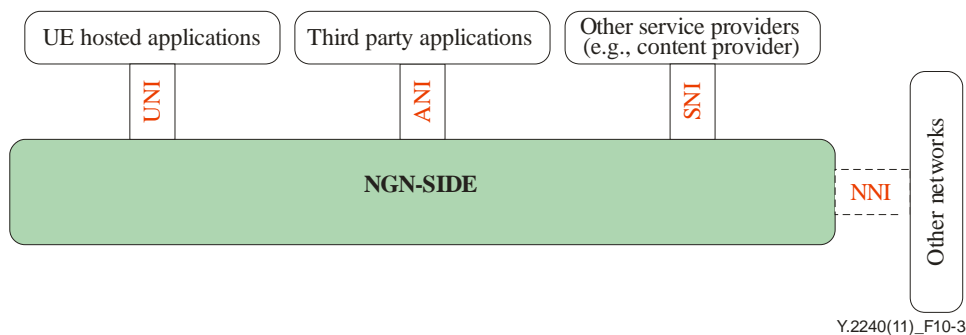
NOTE – This Recommendation assumes that NGN-SIDE accesses resources via standardized or proprietary interfaces. Mapping between resource interfaces and NGN interfaces [ITU-T Y.2012] is not provided in this Recommendation.



**Figure 10-2 – Interaction between NGN-SIDE and resources**

### 10.2.2 NGN-SIDE service interfaces

This section identifies the NGN-SIDE service interface requirements in terms of APIs, related protocols and technologies across NGN ANI, UNI, SNI, and NNI. Figure 10-3 shows a high level view of the relationship of NGN-SIDE with NGN ANI, UNI, SNI, and NNI.



**Figure 10-3 – Service interfaces supported by NGN-SIDE**

NGN-SIDE service interfaces support:

- NGN UE hosted applications, which access NGN-SIDE via UNI [ITU-T Y.2012];
- Third-party applications, which access NGN-SIDE via ANI [ITU-T Y.2012];
- NGN-SIDE in-house applications, which may access NGN-SIDE via ANI [ITU-T Y.2012], but access via proprietary interfaces is not precluded.

NGN-SIDE is recommended to implement standardized APIs, protocols, and technologies to realize the service exposure towards applications.

NOTE – Appendix IV provides an overview of API related efforts in the standardization arena.

#### 10.2.2.1 General requirements of NGN-SIDE service interfaces

NGN-SIDE is required to provide NGN-SIDE users with access to NGN-SIDE via the NGN-SIDE service interfaces (i.e., ANI, UNI, NNI, SNI) for usage of the services offered by the NGN-SIDE provider.

The NGN-SIDE integration layer processes the service request received from the invoked NGN-SIDE service interface according to the service request's communication needs. The NGN-SIDE adaptation layer is invoked according to the service request's processing results in order to provide adaptation for the requested resource and then the service response is sent to the NGN-SIDE service interface.

NGN-SIDE is recommended to expose standardized APIs to enable support of the different cloud service categories, including:

- application services (SaaS);
- platform services (PaaS);

- communication services (CaaS);
- resource services (IaaS);
- network services (NaaS).

NOTE 1 – Support of the different cloud service categories through exposure of standardized APIs at the different NGN-SIDE service interfaces is for further study.

NOTE 2 – In order to support the different cloud service categories, NGN-SIDE can offer, but is not limited to, cloud APIs as specified in [b-OGF-OCCHI], [b-DMTF-OVF] and [b-SNIA-CDMI].

NOTE 3 – Support of APIs listed in the following subclauses across other NGN-SIDE service interfaces is not precluded.

#### **10.2.2.2 Service interface requirements across ANI**

NGN-SIDE ANI service interface is required to provide the interaction between applications and NGN-SIDE. The service requests initiated by applications are sent to the NGN-SIDE integration layer via ANI.

NGN-SIDE is recommended to support standardized APIs at the ANI for exposing NGN-SIDE resources to applications.

NOTE – NGN-SIDE can support, but is not limited to, the following APIs across ANI:

- Parlay service access (PSA) APIs [b-OMA-PSA] [b-3GPP 29.199];
- Parlay APIs [b-3GPP 29.198];
- next generation service interfaces (NGSI) APIs [b-OMA-NGSI];
- RESTful bindings for Parlay X web services (ParlayREST) APIs (See [b-OMA-ParlayREST1.0] and [b-OMA-ParlayREST2.0]);
- GSMA One APIs [b-GSMA-OneAPI] [b-OMA-PXPROF];
- J2SE APIs, J2EE APIs, JAIN APIs, JTAPI, JDBC APIs, JMS APIs, IMS services APIs, IMS communication enablers (ICE)) [b-JCP-JSR];
- social networks service APIs [b-Twitter], [b-Facebook].

#### **10.2.2.3 Service interface requirements across UNI**

NGN-SIDE is recommended to support standardized APIs at the UNI for exposing NGN-SIDE resources and functions to applications whose application logic is located in the NGN end user functions (e.g., NGN UE hosted applications).

NOTE – NGN-SIDE can support, but is not limited to, the following APIs across UNI:

- WAC/OMTP (Wholesale Application Community/Open Mobile Terminal Platform)'s BONDI APIs [b-OMTP-BONDI];
- WAC/JIL (Wholesale Application Community/Joint Innovation Lab) Widget System Handset APIs [b-JIL-API];
- W3C's WebApps (web applications) APIs and widgets [b-W3C-WebApps];
- W3C's DAP (device API and policy) [b-W3C-DAP];
- W3C's UWA (ubiquitous web applications) [b-W3C-UWA];
- OMA CSEA(client-side enabler API) [b-OMA-CSEA];
- HTML5 and Xhtml5 [b-W3C-HTML5];
- Java Micro Edition JSRs [b-Java ME-JSR].

#### **10.2.2.4 Service interface requirements across NNI**

NGN-SIDE NNI service interface is used to provide interaction with other NGN-SIDEs, NGNs and non-NGNs.

The following service interfaces are relevant for the interaction of NGN-SIDE with other domains at NNI level:

- service interface between two distinct NGN-SIDEs (that is, located in two distinct NGN domains);
- service interface between NGN-SIDE and other NGNs which have no NGN-SIDE support;
- service interface between NGN-SIDE and Non-NGNs.

NGN-SIDE is recommended to support standardized protocols and APIs at the NNI for exposing NGN-SIDE resources and functions to other networks.

NOTE – NNI Interworking with other (non-NGN) telecommunication domain networks (PSTN, PLMN) follows the existing NGN related NNI specifications (NGN-SIDE is not directly involved in this interworking scenario).

#### **10.2.2.5 Service interface requirements across SNI**

NGN-SIDE is recommended to support standardized protocols and APIs at the SNI for exposing NGN-SIDE resources to other service providers (e.g., such as content providers, data information providers and application service providers).

NOTE – NGN-SIDE can support, but is not limited to, the following protocols, APIs and technologies across SNI:

- some parlay service access (PSA) APIs (for both control and media), including "Multimedia streaming control", "Multimedia multicast session management", "Content management" [b-OMA-PSA] and [b-3GPP 29.199];
- Protocols and APIs for IPTV service support [b-ITU-T Y.1910].

## **11 Security considerations**

The security requirements of NGN-SIDE are provided in clause 8.

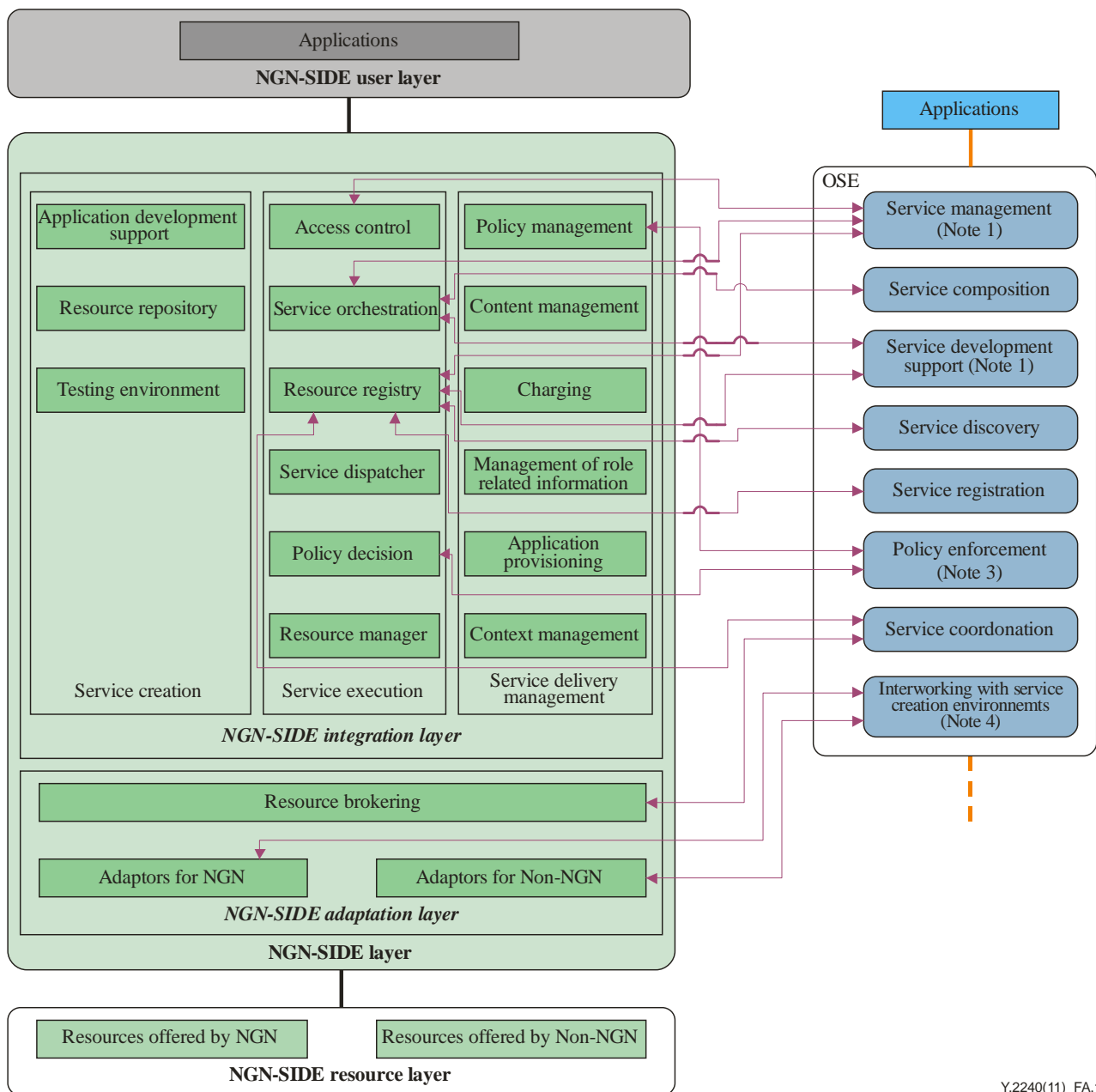
## **Annex A**

### **Relationship between capabilities of NGN-SIDE and [ITU-T Y.2234] capabilities**

(This annex forms an integral part of this Recommendation.)

Figure A.1 shows the relationship between the OSE capabilities defined in [ITU-T Y.2234] and the NGN-SIDE capabilities defined in this Recommendation.

NOTE – In Figure A.1, relationships between OSE [ITU-T Y.2234] and NGN-SIDE capabilities are highlighted using arrows.



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NOTE 1 – It is for further study whether the OSE [ITU-T Y.2234] service management capability relates to other NGN-SIDE capabilities.

NOTE 2 – It is for further study whether the OSE [ITU-T Y.2234] service development support capability relates to other NGN-SIDE capabilities.

NOTE 3 – The OSE policy enforcement capability as described in [ITU-T Y.2234] relates to the NGN-SIDE policy decision and policy management capabilities. It is for further study whether the OSE [ITU-T Y.2234] policy enforcement capability also relates to the policy enforcement in NGN-SIDE as realized by the NGN-SIDE service dispatcher and resource brokering capabilities.

NOTE 4 – The OSE [ITU-T Y.2234] capability for "Interworking with service creation environments" can be conceptually realized by using NGN or non-NGN adaptors with the collaboration of other capabilities in NGN-SIDE. With such adaptors, resources created in other service environments such as IN resources, IMS resources can be made available to NGN-SIDE. Once adapted, these resources can be used in the same way as any other resources in NGN-SIDE, i.e., be used by service creation, service execution and service delivery management functional groups. Therefore although not shown in Figure A.1, the OSE [ITU-T Y.2234] capability for "Interworking with service creation environments" also relates to other NGN-SIDE capabilities.

**Figure A.1 – Relationship between ITU-T Y.2240 and ITU-T Y.2234 capabilities**

Table A.1 provides details about the mapping between the NGN-SIDE capabilities and the capabilities defined in [ITU-T Y.2234]. It is worth to note this mapping is a capability level mapping, in line with the scope of this Recommendation.

**Table A.1 – Details about the mapping between ITU-T Y.2240 and ITU-T Y.2234 capabilities**

<b>ITU-T Y.2240 capabilities</b>	<b>ITU-T Y.2234 capabilities</b>	<b>Main additional functions in ITU-T Y.2240 not covered in [ITU-T Y.2234]</b>
Access control	Part of "Service management"	Access control additionally provides other functionalities including: <ul style="list-style-type: none"> <li>– access control for resources offered by non-NGN;</li> <li>– API and protocol translation between different service interfaces and NGN-SIDE.</li> </ul>
Service orchestration	Service composition	Service orchestration additionally covers: <ul style="list-style-type: none"> <li>– service logic composition for resources offered by non-NGN</li> </ul>
Resource registry	Service discovery, Service registration, part of "Service coordination", part of "Service development support", and part of "Service management"	Resource registry additionally covers: <ul style="list-style-type: none"> <li>– registration of resources offered by non-NGN</li> </ul>
Application provisioning	No equivalent capability	As specified in clause 9
Resource brokering	Part of "Service coordination"	Resource brokering additionally supports: <ul style="list-style-type: none"> <li>– brokering for Non-NGN resources and cloud resources;</li> <li>– brokering for applications triggering based on events from underlying resources</li> </ul>
Policy decision	Part of "Policy enforcement"	Policy decision additionally supports: <ul style="list-style-type: none"> <li>– synchronization of policy related information with other capabilities</li> </ul>
Service dispatcher	No equivalent capability	As specified in clause 9
Application development support	No equivalent capability	As specified in clause 9
Resource repository	No equivalent capability	As specified in clause 9
Testing environment	No equivalent capability	As specified in clause 9
Policy management	Part of "Policy enforcement"	Policy management additionally supports: <ul style="list-style-type: none"> <li>– management and storing of policy rules</li> </ul>
Content management	No equivalent capability	As specified in clause 9
Charging	No equivalent capability	As specified in clause 9
Management of role-related information	No equivalent capability	As specified in clause 9
Context management	No equivalent capability	As specified in clause 9
Resource manager	No equivalent capability	As specified in clause 9

**Table A.1 – Details about the mapping between ITU-T Y.2240 and  
ITU-T Y.2234 capabilities**

<b>ITU-T Y.2240 capabilities</b>	<b>ITU-T Y.2234 capabilities</b>	<b>Main additional functions in ITU-T Y.2240 not covered in [ITU-T Y.2234]</b>
Adaptors for NGN	No equivalent capability (Note)	As specified in clause 9
Adaptors for non-NGN	No equivalent capability (Note)	As specified in clause 9
NOTE – See also Figure A.1 and its Note 4.		

## Appendix I

### Business deployment scenarios in the NGN-SIDE ecosystem

(This appendix does not form an integral part of this Recommendation.)

This appendix identifies business deployment scenarios in the NGN-SIDE eco-system. Firstly, identification of typical actors (not an exhaustive set) is provided based upon business roles identified in clause 6 of this Recommendation. Secondly, business deployment scenarios are provided.

#### I.1 Actors mapping to business roles

The following identifies different actors of the NGN-SIDE ecosystem and the business roles that they can play:

- The "NGN provider" actor. In the context of NGN-SIDE, the "NGN provider" actor plays the role of NGN-SIDE resource provider (e.g., for resources such as NGN capabilities, NGN service enablers). Depending on the business scenario, the "NGN provider" actor can also play the role of NGN-SIDE provider. If playing the role of NGN-SIDE provider, the "NGN provider" actor can also play the roles of application developer and application provider for NGN-SIDE in-house applications.
- The "integration provider" actor. The "Integration provider" actor plays the role of NGN-SIDE provider; Depending on the business scenario, the "integration provider" can also play the role of application provider.
- The "third-party application provider" actor. The "third-party application provider" actor plays the role of application provider but is distinct from the NGN provider (although it may be a different NGN provider). Examples of third-party application providers include end-users, web-based application providers.

NOTE 1 – The "third-party application provider" actor can also play the role of application developer or NGN-SIDE resource provider.

- The "third-party resource provider" actor. The "third-party resource provider" actor plays the role of NGN-SIDE resource provider but is distinct from the NGN provider (although it may be a different NGN provider). Examples of third-party resource providers include PLMN providers, PSTN and ISDN providers, application providers, other NGN providers, end-users.

NOTE 2 – The "third-party resource provider" actor can also play the role of application provider.

- The "content provider" actor. The "content provider" actor plays the role of content provider, but is distinct from the NGN provider. Examples of such providers include IPTV content providers, end users.
- The "Third-party application developer" actor. The "third-party application developer" actor plays the role of application developer, but is distinct from the NGN provider. Examples of third-party application developers include end users.

NOTE 3 – The "third-party application developer" actor can also play the role of application provider.

NOTE 4 – End-users may include NGN end users and end users from other domains.

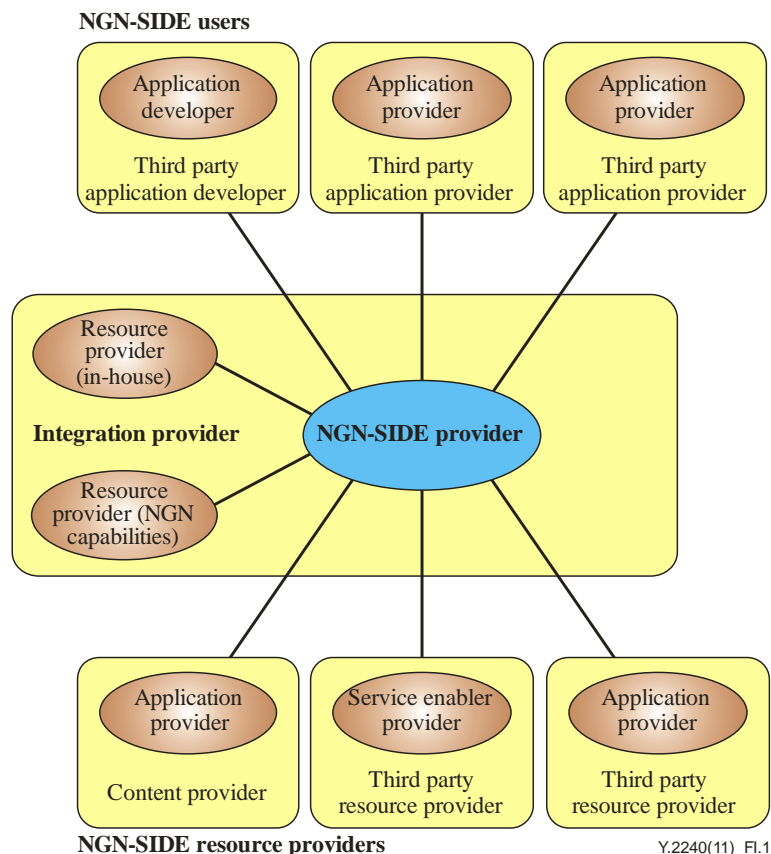
## I.2 Business deployment scenarios

This clause identifies business deployment scenarios where the NGN-SIDE provider role is played by either the "NGN provider" actor or the "integration provider" actor as described in clause I.1.

NOTE – In the following figures:

- actors are represented using yellow coloured rounded boxes;
- the NGN-SIDE provider role is represented using blue coloured ovals;
- roles other than the NGN-SIDE provider role are represented using grey coloured ovals.

Figure I.1 illustrates an example of business deployment scenario where the NGN provider plays the role of NGN-SIDE provider.

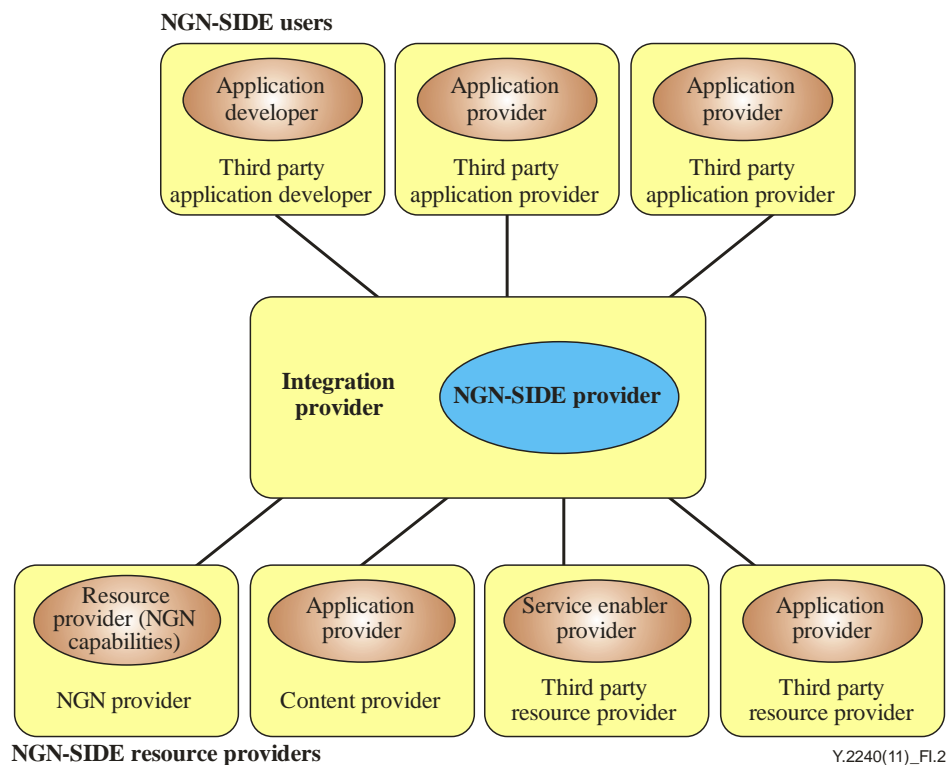


**Figure I.1 – NGN provider as NGN-SIDE provider**

In the scenario shown in Figure I.1, in addition to the NGN-SIDE provider role, the "NGN Provider" actor is also playing the role of NGN-SIDE resource provider for the resources it owns as well as the role of an application provider since providing so-called "NGN-SIDE in-house applications". In addition, since playing the role of NGN-SIDE provider, the "NGN provider" actor can:

- access and integrate resources of actors such as "content provider" and "third-party resource provider";
- expose NGN-SIDE capabilities and resources to actors such as "third-party application developer" and "third-party application provider".

Figure I.2 illustrates an example of business deployment scenario where an "integration provider" actor (distinct from the "NGN provider") plays the role of NGN-SIDE provider.

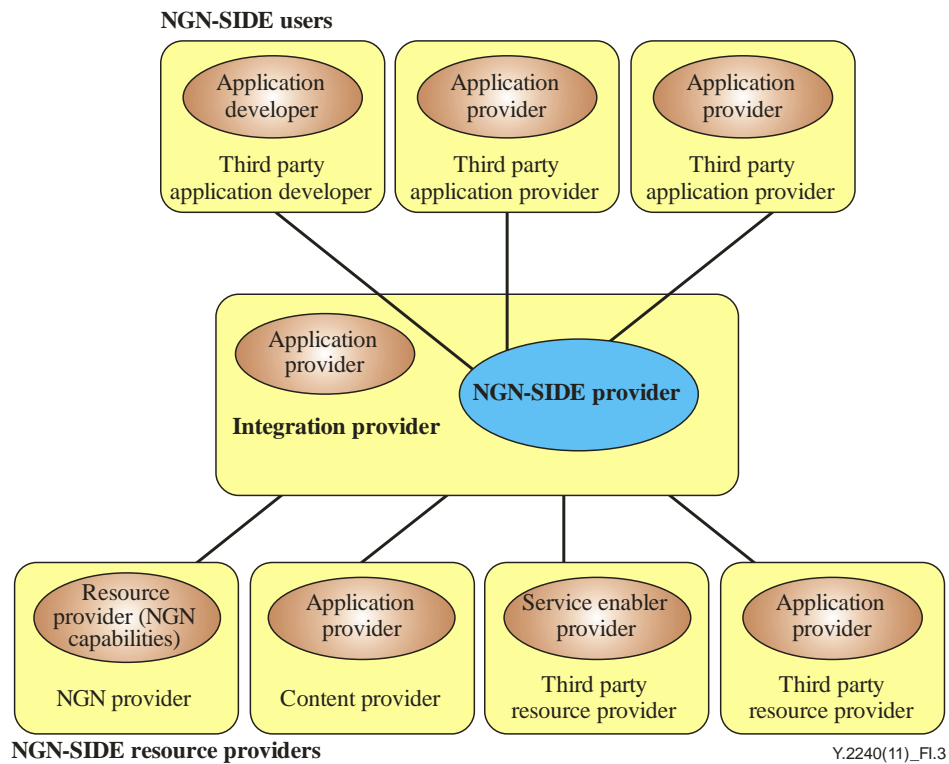


**Figure I.2 – NGN-SIDE provider as an integration provider  
(distinct from NGN provider)**

In the scenario shown in Figure I.2, since playing the role of NGN-SIDE provider, the "integration provider" actor can:

- access and integrate resources of actors such as "NGN provider", "content provider" and "third-party resource provider";
- expose NGN-SIDE capabilities and resources to actors such as "third-party application developer" and "third-party application provider".

Figure I.3 illustrates an example of business deployment scenario where the "integration provider" actor also plays the role of application provider. This scenario is similar to the scenario shown in Figure I.2 but allows the "integration provider" to be an application provider.



**Figure I.3 – NGN-SIDE provider as an integration provider and application provider**

## Appendix II

### Application scenarios involving NGN-SIDE

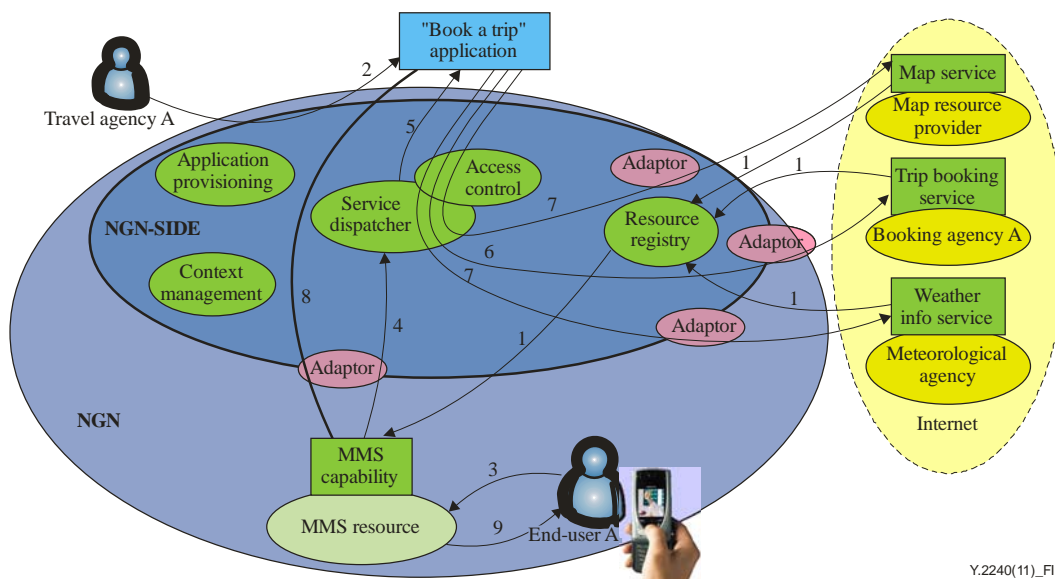
(This appendix does not form an integral part of this Recommendation.)

This appendix provides application scenarios involving NGN-SIDE.

#### II.1 Third-party application scenario "Book a trip"

NGN-SIDE users	1) Application called "Book a trip" provided by a "third-party application provider" actor named 'Travel Agency A'.
NGN-SIDE resources	1) MMS resources provided by an NGN provider called 'Network Operator A'. 2) Application called "Booking & Info" provided by a "third-party resource provider" actor named 'Booking Agency A'. This application returns the flight and the hotel reservation reference number, related tourist information. 3) Application called "Weather Info" provided by a "third-party resource provider" actor referred as 'Meteorological agency'. This application provides the weather report associated with a specific location. 4) Application called "Map" provided by a "third-party resource provider" actor named 'Map Resource Provider'. This application returns the map data.
Actors	1) 'End-user A': the end-user of the Application called "Travel agency"; 2) 'Network Operator A': the NGN provider who provides the MMS service to end-user A; 3) 'Booking Agency A': the NGN-SIDE resource provider who registers the exposed application "Booking & Info" to NGN-SIDE; 4) 'Map resource provider': the NGN-SIDE resource provider who registers the exposed application "Map" to NGN-SIDE; 5) 'Meteorological Institute': the NGN-SIDE resource provider who registers the application "Weather Info" as a resource in NGN-SIDE; 6) 'Travel Agency A': the third-party application provider who provides the application named "Book a trip".
<b>Analysis of the usage model</b>	
Main objective of the scenario in terms of usage model	This scenario shows how NGN-SIDE can support third-party applications.
NGN-SIDE key features	1) Third-party deploys an application over NGN-SIDE which is accessed by the end-user using MMS resources. 2) NGN-SIDE provides a way for third-party applications to access the resources registered in NGN-SIDE.

## Scenario description



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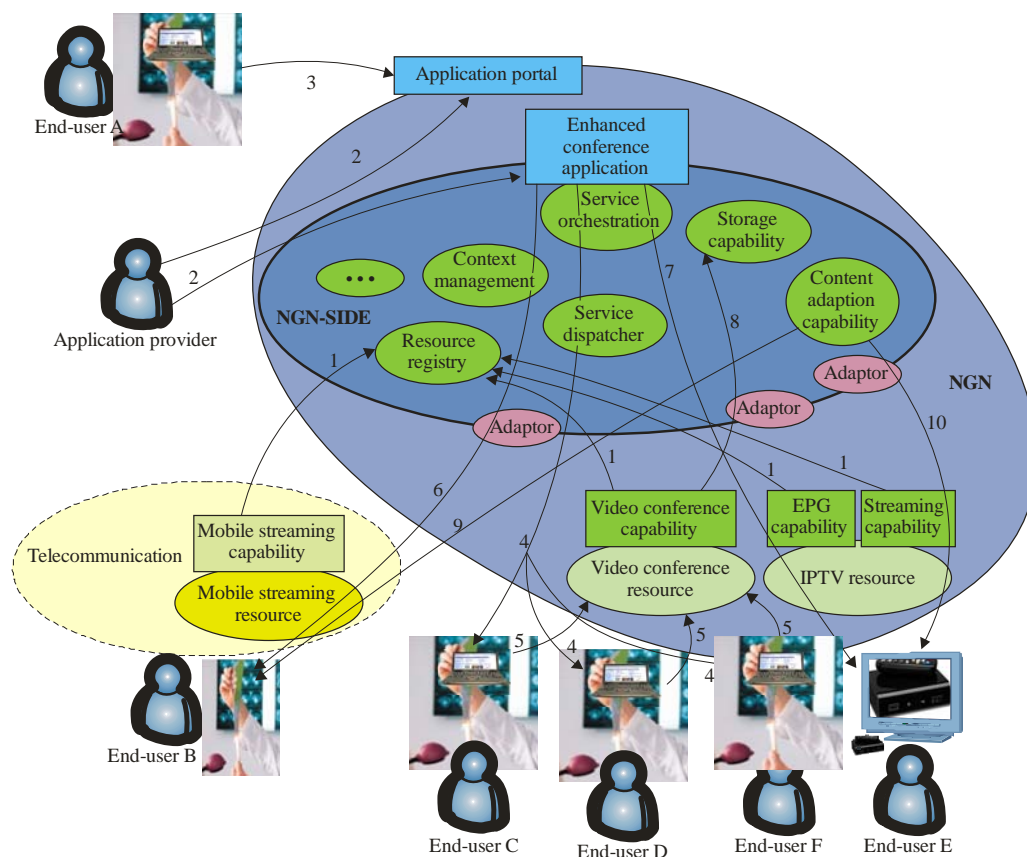
**Figure II.1 – Third-party application scenario in NGN-SIDE**

- 1) The following operations are performed:
  - i) The 'map service provider' registers the "Map" application in NGN-SIDE;
  - ii) 'Network operator A' registers the MMS service enabler in NGN-SIDE;
  - iii) 'Booking agency A' registers the "Trip booking service" application in NGN-SIDE;
  - iv) 'Meteorological agency' registers the "Weather info" application in NGN-SIDE.
- 2) The 'Travel Agency A' (application provider) deploys "Book a trip" application over NGN-SIDE.
- 3) The 'end-user A' is reading a newspaper, which contains an advertisement from 'Travel agency A' with some travel with a related service code. The 'end-user A' decides to make a travel booking, so 'end-user A' uses his or her mobile phone to send the service code via MMS.
- 4) When the MMS receives the message with service code, there is always a pre-configured identifier to forward this message to NGN-SIDE.
- 5) NGN-SIDE finds that the application is 'Book a trip' offered by 'Travel agency A', then routes the message with service code to the related application server.
- 6) The application "Book a trip" calls another application 'Trip booking service' provided by 'Booking agency A' to book the flights, the hotels and to get the related tourist information. NGN-SIDE routes this request to 'Trip booking service' application.
- 7) If the result of the 'Trip booking service' request is successful, the application "Book a trip" calls other applications i.e., 'Map service' and 'Weather info service', and generates a service code including the booking ID.
- 8) The application "Book a trip" composes a response message (MMS) and sends it via the MMS service.
- 9) The 'end-user A' receives the MMS with the response on his or her mobile phone.

Benefits for relevant business roles	<ol style="list-style-type: none"> <li>1) NGN-SIDE benefits the third-party resource providers providing controlled, managed and secure means to access to their own resources and thus generating revenues related to the use of these resources.</li> <li>2) NGN-SIDE benefits the application providers providing single access means to discover NGN-SIDE exposed resources that can be used for developing applications and also providing a flexible and simple way to deploy an application which makes usage of resources from different domains.</li> <li>3) NGN-SIDE benefits the NGN provider providing a service integration and delivery environment in an efficient and economical way.</li> </ol>
Derived NGN-SIDE requirements	The NGN-SIDE requirements which can be derived from this application scenario are described in clause 8.1 (requirements A.2 and A.3) and clause 8.2 (requirements F.1 and F.2).

## II.2 NGN-SIDE in-house application scenario "Enhanced Conference"

NGN-SIDE user(s)	1) NGN-SIDE in-house application.
NGN-SIDE resources	<ol style="list-style-type: none"> <li>1) Video conference resources which provide the video conference related capabilities including initiating a video conference, inviting a user to join a conference, and recording a conference.</li> <li>2) IPTV resources which provide IPTV related capabilities including EPG capability and streaming capability.</li> <li>3) Mobile streaming resources which provide mobile streaming related capabilities including streaming capability and management capability.</li> </ol>
Actors	<ol style="list-style-type: none"> <li>1) 'End-user A': end-user who pays a 4 persons' video conference and invite his or her team to join the video-conference.</li> <li>2) 'End-user B': end-user who is a member of End-user A's team but not involved in the video-conference.</li> <li>3) 'End-user C': end-user who is a member of End-user A's team, and who is participating to the video-conference.</li> <li>4) 'End-user D': end-user who is a member of End-user A's team, and who is participating to the video-conference.</li> <li>5) 'End-user E': end-user who is a member of End-user A's team, and who is participating to the video-conference.</li> <li>6) 'End-user F': end-user who is a member of End-user A's team, and who is participating to the video-conference.</li> <li>7) 'Network operator A': the resource provider providing IPTV, video-conference and mobile streaming resources.</li> <li>8) 'Application developer A': the application developer accessing NGN-SIDE resources (from 'Network operator A') to build a new NGN-SIDE in-house application.</li> </ol>
<b>Analysis of the usage model</b>	
Main objective of the scenario in terms of usage model	NGN-SIDE supports a convergent application which uses resources from multiple domains (IPTV resources, Video conference resources, Mobile streaming resources).
NGN-SIDE key features	<p>NGN-SIDE provides the following content handling mechanisms:</p> <ul style="list-style-type: none"> <li>– NGN-SIDE provides real-time content recording, and processing.</li> <li>– NGN-SIDE provides content delivery mechanisms.</li> <li>– NGN-SIDE provides content storage and adaptation (including codec conversion, format conversion).</li> </ul>



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**Figure II.2 – NGN-SIDE in-house application scenario "Enhanced Conference"**

- 1) The resources (mobile streaming resource, video conference resource, EPG and streaming resources) are registered in the NGN-SIDE by 'Network operator A'.
- 2) A NGN-SIDE in-house application called "Enhanced Conference" is published on the Application portal making use of the resources offered by NGN-SIDE, e.g., mobile streaming resource, EPG resource, IPTV streaming resource, video conference resource, storage resource, content adaptation resource and context management resource.
- 3) 'End-user A' orders a video conference through the application portal facilities. 'End-user A' invites his or her team including 'End-user C', 'End-user D', and 'End-user F' to join the conference and invites 'End-user B' and 'End-user E' to watch the live conference.
- 4) When the conference is successfully created, the "Enhanced Conference" application sends a conference notification to the different end-users invited to participate in the conference. NGN-SIDE then selects the method used for notification (e.g., SMS, IM, E-mail or the initiation of a call) according to the end-users' presence and preference using the NGN-SIDE "management of role related information" capability and the context management capability.
- 5) 'End-user C', 'End-user D' and 'End-user F' receive the invitation and join the conference.
- 6) 'End-user B', using a mobile phone, receives the invitation from "Enhanced Conference" application, which notifies whether 'End-user B' wants to watch the live meeting.
- 7) 'End-user E', using a set top box (STB) to watch TV, receives the invitation from "Enhanced Conference" application, which notifies whether 'End-user E' wants to watch the live meeting.

	<p>8) When 'End-user B' and 'End-user E' select 'Yes', the "Enhanced Conference" application uses the storage capability offered by NGN-SIDE to record the meeting.</p> <p>9) The "Enhanced Conference" application requests NGN-SIDE to convert the real-time media from the format used in the video conference to a mobile streaming format to 'End-user B'. Once done, the Mobile streaming system then streams the video meeting to 'End-user B'.</p> <p>10) The "Enhanced Conference" application requests NGN-SIDE to convert the real-time media from the video conference format to an IPTV streaming format compatible with 'End-user E' terminal capabilities. 'End-user E' receives a notification, and a new channel related to the conference appears on his or her STB's service guide (EPG). 'End-user E' then selects the live meeting.</p>
Benefits for relevant business roles	<p>Without NGN-SIDE, the deployment of this application would be very complex and the video conference would have to connect to each system (e.g., mobile streaming system, IPTV system).</p> <p>1) NGN-SIDE acts for access control and service integration.</p> <p>2) NGN-SIDE also provides application specific capabilities, including media control, storage and content adaptation functions.</p>
Derived NGN-SIDE requirements	The NGN-SIDE requirements which can be derived from this application scenario are described in clause 8.2 (requirements G.1, G.2 and G.3).

### II.3 M2M/USN application scenarios

NGN-SIDE users	1) M2M/USN NGN-SIDE in-house application
NGN-SIDE Resources	<p>1) USN resources including USN gateways and USN middleware.</p> <p>2) M2M resources including M2M gateways and M2M core.</p>
Actors	<p>1) 'Customer A': end user of the M2M/USN in-house application.</p> <p>2) 'Operator A': actor playing the role of NGN-SIDE provider;</p> <p>3) 'Application developer': actor developing the new NGN-SIDE in-house application;</p> <p>4) 'M2M Provider': actor providing M2M resources to NGN-SIDE;</p> <p>5) 'USN Provider': actor providing M2M resources to NGN-SIDE.</p>
<b>Analysis of the usage model</b>	
Main objective of the scenario in terms of usage model	NGN-SIDE supports M2M and USN applications which use resources from multiple domains (including M2M and USN resources).
NGN-SIDE key features	NGN-SIDE provides a set of capabilities to support different M2M and USN applications; NGN-SIDE supports adaptation of M2M and USN resources.

<p>Scenario description</p>	<p>Y.2240(11)_FII-3</p>
	<p><b>Figure II.3 – M2M/USN application scenario in NGN-SIDE</b></p> <ol style="list-style-type: none"> <li>1) NGN-SIDE registers M2M resources from the 'M2M provider' and USN resources from the 'USN provider'.</li> <li>2) 'Application developer' develops a new NGN-SIDE in-house application using the NGN-SIDE service creation environment and the registered M2M resources, USN resources and other NGN-SIDE resources.</li> <li>3) 'Customer A' signs a contract with the NGN-SIDE provider to purchase this new M2M/USN in-house application.</li> <li>4) The application invokes M2M provider's resources through M2M gateways or M2M core, USN provider's resources through USN gateways or USN middleware.</li> </ol>
<p>Benefits for relevant business roles</p>	<ol style="list-style-type: none"> <li>1) NGN-SIDE can make use of M2M/USN resources which can be combined with other NGN-SIDE resources to support different M2M and USN applications.</li> </ol>
<p>Derived NGN-SIDE requirements</p>	<p>The NGN-SIDE requirement which can be derived from this application scenario is described in clause 8.1 (requirement 'B').</p>

## **Appendix III**

### **Cloud services and supporting role played by NGN-SIDE**

(This appendix does not form an integral part of this Recommendation.)

Cloud computing characteristics and models are currently under study in the ITU-T Study Groups.

Everything as a service (XaaS), broad term that embraces all the cloud computing based service categories, is a concept of resource outsourcing at different levels.

The main objective of this appendix is to provide an overview about how NGN-SIDE can support different cloud service categories.

Further studies and developments are required to specify the details of cloud services support by NGN-SIDE as well as the possible roles of NGN-SIDE in a cloud ecosystem.

XaaS includes the following major cloud service categories:

- software as a service (SaaS);
- platform as a service (PaaS);
- infrastructure as a service (IaaS);
- communications as a service (CaaS);
- network as a service (NaaS).

#### **III.1 NGN-SIDE support of cloud software as a service**

Cloud software as a service (SaaS) is the capability provided to the cloud service user to use the cloud service provider's applications running on a cloud infrastructure.

NOTE – All applications have the common characteristic to be non real time and may be of different kinds, including multimedia telephony services, IT applications and may be accessible from different user devices. The cloud service user does not manage or control the underlying cloud infrastructure with the possible exception of limited user-specific application configuration settings.

The NGN-SIDE application provisioning capability allows publication of NGN-SIDE in-house applications. Applications can be offered by NGN-SIDE as SaaS, and NGN-SIDE users can invoke these applications through the NGN-SIDE platform.

#### **III.2 NGN-SIDE support of cloud platform as a service**

Cloud platform as a service (PaaS) is the capability provided to the cloud service user to deploy onto the cloud infrastructure user-created or acquired applications developed using platform tools supported by the cloud service provider.

NOTE – Platform tools may include programming languages and tools for application development, interface development, database development, storage and testing. The cloud service user does not manage or control the underlying cloud infrastructure, but has control over the deployed applications and possibly application hosting environment configurations.

The NGN-SIDE integration layer's functionalities (e.g., service creation functional group, service execution functional group and service delivery management functional group) can be offered by NGN-SIDE as PaaS.

The PaaS service offered by NGN-SIDE allows developers to develop their applications and upload them via the NGN-SIDE application development support capability to NGN-SIDE, which provides an execution environment for the applications.

### **III.3 NGN-SIDE support of cloud infrastructure as a service**

Cloud infrastructure as a service (IaaS) is the capability provided by the cloud service provider to the cloud service user to provision processing, storage, intra-cloud network connectivity services (e.g., VLAN, firewall, load balancer, application acceleration), and other fundamental computing resources of the cloud infrastructure where the cloud service user is able to deploy and run arbitrary application.

NOTE 1 – The cloud service user does not manage or control the resources of the underlying cloud infrastructure but has control over operating systems, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

The IaaS service can be provided to NGN-SIDE users by usage of NGN-SIDE provider's resources and/or NGN-SIDE resource providers' resources from NGN and other domains.

NOTE 2 – A cloud computing compatible approach (e.g., virtualization, distributed file system, distributed dispatch, distributed cache, distributed database, search engine) can be used to manage NGN-SIDE provider's resources;

NOTE 3 – The NGN-SIDE resource brokering capability can be used to manage NGN-SIDE resource providers' resources (e.g., connections, computing, storage) in a cloud computing compatible approach.

### **III.4 NGN-SIDE support of communications as a service**

Cloud communications as a service (CaaS) is the capability provided to the cloud service user to use communication and collaboration services.

NOTE – Communication and collaboration services include IMS based services, voice over IP, instant messaging, video conferencing, for both fixed and mobile devices. CaaS may be seen as a specific type of SaaS.

The NGN-SIDE application provisioning capability allows publication of NGN-SIDE in-house applications.

Applications can be offered by NGN-SIDE as CaaS, and NGN-SIDE users can invoke these applications through the NGN-SIDE platform.

### **III.5 NGN-SIDE support of network as a service**

Cloud network as a service (NaaS) is the capability provided to the cloud service user to use transport connectivity services or inter-cloud network connectivity services.

NOTE 1 – NaaS services include flexible and extended VPN, bandwidth on demand, end-to-end SLA/QoS, cloud backup. NaaS can be seen as a specific type of IaaS.

The NaaS service can be provided to NGN-SIDE users by usage of NGN-SIDE provider's resources or NGN-SIDE resource providers' resources from NGN and other domains.

NOTE 2 – A cloud computing compatible approach (e.g., virtualization, distributed file system, distributed dispatch, distributed cache, distributed database, search engine) can be used to manage NGN-SIDE provider's resources.

NOTE 3 – The NGN-SIDE resource brokering capability can be used to manage NGN-SIDE resource providers' resources (e.g., connections, computing, storage) in a cloud computing compatible approach.

## Appendix IV

### Survey of API related standardization efforts

(This appendix does not form an integral part of this Recommendation.)

This appendix provides a survey of API related standardization efforts.

NOTE – The content of this appendix is derived from publicly available documents from relevant standards development organizations (SDOs).

#### IV.1 Open mobile alliance (OMA)

This clause identifies the open mobile alliance (OMA) initiatives in the area of APIs.

##### IV.1.1 OMA NGSI

The main objective of the OMA next generation service interface (NGSI) enabler is to define a set of new services for deployment across individual, corporate and general societal user communities. NGSI stimulates the usage of various service enablers into new services and applications.

OMA NGSI key features include call enhancements, identity control, preferences, enhanced conference experience, multimedia list handling, access to service provider data, service recommendations, and context management. The NGSI V1\_0 APIs include:

- NGSI-1 – Generic Data Management Interface
- NGSI-2 – Generic Data Change Notification Interface
- NGSI-3 – Address List Change Notification Interface
- NGSI-4 – Call Control Extension Interface
- NGSI-5 – Call Notification Extension Interface
- NGSI-6 – Call Handling Extension Interface
- NGSI-7 – Multimedia Conference Extension Interface
- NGSI-8 – Multimedia List Handling Interface
- NGSI-9 – Context Entity Discovery Interface
- NGSI-10 – Context Information Interface
- NGSI-11 – Service Registration Interface
- NGSI-12 – Service Discovery Interface
- NGSI-13 – Identity Resolution Interface
- NGSI-14 – Identity Management Interface

For details, the latest OMA NGSI drafts are available at:

[<http://member.openmobilealliance.org/ftp/Public\\_documents/ARCH/Permanent\\_documents/>](http://member.openmobilealliance.org/ftp/Public_documents/ARCH/Permanent_documents/)

##### IV.1.2 OMA Parlay REST

The OMA Parlay REST API specifications under development are intended to define RESTful bindings for Parlay X web services. Until now, the work has progressed on the following APIs:

- ThirdPartyCall [b-OMA- ParlayREST2.0]
- TerminalStatus [b-OMA- ParlayREST2.0]
- TerminalLocation [b-OMA- ParlayREST2.0]
- ShortMessaging [b-OMA- ParlayREST2.0]
- Payment [b-OMA- ParlayREST2.0]

- MultiMediaMessaging [b-OMA- ParlayREST2.0]
- CallNotification [b-OMA- ParlayREST2.0]
- AudioCall [b-OMA- ParlayREST2.0]
- DeviceCapabilities [b-OMA- ParlayREST2.0]
- Presence [b-OMA- ParlayREST2.0]
- AddressListManagement [b-OMA- ParlayREST2.0]

For details, the latest OMA REST drafts are available at:

<[http://member.openmobilealliance.org/ftp/Public\\_documents/ARCH/Permanent\\_documents/](http://member.openmobilealliance.org/ftp/Public_documents/ARCH/Permanent_documents/)>

#### **IV.1.3 OMA CSEA**

OMA Client-Side Enabler API (CSEA) defines the enabler requirements for Javascript-callable API's for web applications to access a set of OMA enablers in the following two work areas:

- OMA enablers focused on access to content, as a typical web application need, initially limited to DCD (Dynamic Content Delivery) and Push);
- OMA enablers supplementing the web application experience with key capabilities enabling application personalization and contextualization (initially limited to DPE (Device Profile Evolution)).

The scope of this work is being limited to requirements specification in order to allow OMA to define the requirements and determine a roadmap for realization of the requirements through specific API's.

For details, the latest OMA CSEA Candidates are available at:

<[http://member.openmobilealliance.org/ftp/Public\\_documents/CD/Permanent\\_documents/](http://member.openmobilealliance.org/ftp/Public_documents/CD/Permanent_documents/)>

#### **IV.1.4 OMA PSA**

3GPP, jointly with the Parlay Group and ETSI, developed application programming interfaces (APIs) for open service access (OSA). 3GPP CT5 closed on June 2008 and the work was transferred to open mobile alliance (OMA), Architecture (ARC) parlay service access (PSA) group. The OMA ARC PSA group is now responsible for the completion of the Parlay/Parlay X Release 8 work.

The Parlay API specification ([b-3GPP TS 29.198]) is structured in the following Parts:

29.198-1	Part 1:	Overview
29.198-2	Part 2:	Common Data Definitions
29.198-3	Part 3:	Framework
29.198-4	Part 4:	Call Control Service Capability Feature (SCF)
29.198-5	Part 5:	User Interaction Service Capability Feature (SCF)
29.198-6	Part 6:	Mobility Service Capability Feature (SCF)
29.198-7	Part 7:	Terminal Capabilities Service Capability Feature (SCF)
29.198-8	Part 8:	Data Session Control Service Capability Feature (SCF)
29.198-9	Part 9:	Generic Messaging SCF, NOTE- specification withdrawn
29.198-10	Part 10:	Connectivity Manager Service Capability Feature (SCF)
29.198-11	Part 11:	Account Management Service Capability Feature (SCF)

29.198-12	Part 12:	Charging Service Capability Feature (SCF)
29.198-13	Part 13:	Policy Management Service Capability Feature (SCF)
29.198-14	Part 14:	Presence and Availability Management (PAM) Service Capability Feature (SCF)
29.198-15	Part 15:	Multi-media Messaging (MM) Service Capability Feature (SCF)
29.198-16	Part 16:	Service Broker Service Capability Feature (SCF)

The Parlay X API specification (PSA 1.0, [b-3GPP TS 29.199]) is structured in the following Parts:

29.199-1	Part 1:	"Common"
29.199-2	Part 2:	"Third party call"
29.199-3	Part 3:	"Call Notification"
29.199-4	Part 4:	"Short Messaging"
29.199-5	Part 5:	"Multimedia Messaging"
29.199-6	Part 6:	"Payment"
29.199-7	Part 7:	"Account management"
29.199-8	Part 8:	"Terminal Status"
29.199-9	Part 9:	"Terminal location"
29.199-10	Part 10:	"Call handling"
29.199-11	Part 11:	"Audio call"
29.199-12	Part 12:	"Multimedia conference"
29.199-13	Part 13:	"Address list management"
29.199-14	Part 14:	"Presence"
29.199-15	Part 15:	"Message Broadcast"
29.199-16	Part 16:	"Geocoding"
29.199-17	Part 17:	"Application driven Quality of Service (QoS)"
29.199-18	Part 18:	"Device Capabilities and Configuration"
29.199-19	Part 19:	"Multimedia streaming control"
29.199-20	Part 20:	"Multimedia multicast session management"
29.199-21	Part 21:	"Content management"
29.199-22	Part 22:	"Policy"

For details, specifications are available at: <<http://www.3gpp.org/ftp/Specs/html-info/29-series.htm>>

## IV.2 GSM association (GSMA)

The GSM association (GSMA) OneAPI is an initiative to define a commonly supported API to allow mobile (and other network) operators to expose useful network information and capabilities to Web application developers. It aims to reduce the effort and time needed to create applications and content that is portable across mobile operators. The project aims to reuse existing standards (or a proper subset thereof) as well as advise standards bodies as to what web developers expect from

network operator APIs, so that such standards can evolve accordingly. The project is a work in progress.

For details, the latest drafts are available at:

<<https://gsma.securespsite.com/access/Access%20API%20Wiki/Home.aspx>>

#### **IV.2.1 Version 1.0 APIs/ OMA PXPROF**

The following APIs are OMA candidate releases (PXPROF: OneAPI Profile of the Parlay X SOAP Web Services V1.0). GSMA will reuse the following OMA candidate release APIs for the GSMA version 1.0 APIs:

- SMS RESTful API – send and receive SMS via your application;
- MMS RESTful API – send and receive MMS via your application;
- Location RESTful API – get the location of one or more mobile network users;
- Payment RESTful API – charge mobile network users for your services.

NOTE – A minor change from the original OMA API is implemented in GSMA version 1.0.

#### **IV.2.2 Version 0.91 beta APIs**

##### **a) RESTful APIs:**

- SMS RESTful API v0.91
- MMS RESTful API v0.91
- Location RESTful API v0.91
- Payment RESTful API v0.91

##### **b) Web Services APIs:**

- SMS Web Service API
- MMS Web Service API
- Location Web Service API
- Payment Web Service API

#### **IV.2.3 Phase 2 APIs**

OneAPI 2.0:

- APIs to make delivery of video content to user equipment (UE). This includes functions for:
  - Data Connection profile to identify bearer and network;
  - Remaining Credits Look-Up to see if the user can afford the stream;
  - Determining the supported video codecs on the handset.
- In-app billing;
- Click-to-call to set up calls between two or more people;
- Call notification where a web application can be informed of events in a phone call (caller busy, diverts).

#### **IV.2.4 Phase 3 APIs**

OneAPI 3.0:

- SMS triggering via user-data header (UDH) and other triggering or provisioning technologies such as USSD;
- QoS to ensure a good quality, jitter-free video stream between a web server and handset.

### IV.3 Java Community Process

The Java Community Process (JCP) is the mechanism for developing standard technical specifications for Java technology [b-JCP-JSR].

JSRs by Platform are JSRs relate to one or more of the Java platforms, including Java Enterprise Edition, Java Standard Edition and Java Micro Edition:

- The Java Enterprise Edition offers APIs and tools for developing multitier enterprise applications. The JSRs in this list are part of the Java EE platform as component or umbrella JSRs.
- The Java Standard Edition offers APIs and tools for developing desktop and server-side enterprise applications. The JSRs in this list are part of the Java SE platform as component or umbrella JSRs.
- The Java Micro Edition specifically addresses the vast consumer space, which covers the range of extremely tiny commodities such as smart cards or a pager all the way up to the set-top box, an appliance almost as powerful as a computer.

JSRs by Technology:

- OSS/J (Operations Support System through Java) is providing a set of APIs focused on operations and business support systems for service provider networks.
- JAIN (Java APIs for Integrated Networks) is providing a set of APIs focused on emerging network protocols and architectures driven by convergence of traditional telecommunications and IP networks.
- XML(Extensible Markup Language) is a universal syntax for describing and structuring data independent from the application logic. Several JSRs focus on developing Java technology APIs specifically targeted at building XML-based applications.

For details, the latest JSRs are available at: <<http://jcp.org/en/jsr/all>>

### IV.4 Wholesale Applications Community (WAC)

#### IV.4.1 WAC/OMTP

The wholesale applications community (WAC)/open mobile terminal platform (OMTP) BOND initiative is addressing the way in which the existing Web 2.0 environment is moved onto mobile devices. Mobile devices offer new capabilities to Web service developers which make them very desirable, but present new security issues. BOND uses Web technologies and builds upon them to provide new APIs to key mobile phone functionalities like contacts, calendar, messaging location.

BOND API Specification version 1.1 approved Release defines the composite specifications to allow Web applications (widget and Web pages) to interoperate over BOND defined execution environment (widget runtime and Web user agent). BOND API Features v1.1:

1. The BOND module
2. The Application Launcher module: applauncher
3. The Messaging module: messaging
4. The User Interaction module: ui
5. The File System module: filesystem
6. The Gallery module: gallery
7. The Device Status module: devicestatus
8. The Application Configuration module: appconfig
9. The Geolocation module: geolocation
10. The Camera module: camera

11. The Telephony module: telephony
12. The PIM module: pim
13. The Contact module: contact
14. The Calendar module: calendar
15. The Task module: task

For details, the latest APIs are available at: <<http://bondi.omtp.org/1.1/apis/index.html>>.

#### **IV.4.2 WAC/JIL**

The WAC/JIL (Joint Innovation Lab) API provides a mechanism to access services available on the handset. Access to these services is via a semi-object-oriented paradigm in which functions and parameters are accessed via objects that correspond to the handset.

The WAC/JIL API provides access to handset services in the following categories:

- Telephony: for initiating phone calls and accessing call records
- PIM: for accessing contacts and calendar information
- Multimedia: for accessing multi-media capabilities such as the camera
- Device: for accessing information about the phone, including the file system
- Messaging: for sending SMS, MMS, and email messages and accessing messages on the phone

Access to these categorized services is via a JavaScript object-containment name spacing mechanism. In this mechanism, all services are accessed via a hierarchical identification scheme in which the widget object is the top-level entry point. For details, the latest APIs are available at: <http://www.jil.org/web/jil/develop>.

### **IV.5 World Wide Web Consortium (W3C)**

#### **IV.5.1 W3C Web Applications**

The mission of the Web Applications Working Group [b-W3C-WebApps], part of the Rich Web Client Activity, is to provide specifications that enable improved client-side application development on the Web, including specifications both for application programming interfaces (APIs) for client-side development and for markup vocabularies for describing and controlling client-side application behaviour.

The target environments for the Web Applications Working Group's deliverables include desktop and mobile browsers as well as non-browser environments that make use of Web technologies. The group seeks to promote universal access to Web applications across a wide range of devices and among a diversity of users, including users with particular accessibility needs. The APIs must provide generic and consistent interoperability and integration among all target formats, such as HTML, XHTML, and SVG.

The working group is focusing on the following deliverables:

- A. Asynchronous DOM Mutation Notification (ADMN):  
a performance-sensitive asynchronous mechanism to provide script notifications of changes to the DOM, such as the addition, removal, or alteration of elements, attributes, and text content, to replace DOM Mutation Events.
- B. Clipboard Operations for the Web 1.0: Copy, Paste, Drag and Drop (ClipOps):  
a detailed model for rich clipboard operations in User Agents, with consideration for different environments; this may be developed as part of the HTML5 specification.

- C. Database and Offline Application APIs:  
a set of objects and interfaces for client-side database functionality. Currently, the following specifications comprise the WebApps Database APIs:
- Web Storage: an API for persistent data storage of key-value pair data in Web clients.
  - Indexed Database API: an API for a database of records holding simple values and hierarchical objects.
  - Programmable HTTP Caching and Serving: an API for off-line serving of requests to HTTP resources using static and dynamic responses.
  - Web SQL Database: an API for storing data in databases that can be queried using a variant of SQL.
- D. Document Object Model (DOM):  
a set of specifications defining objects and interfaces for interaction with a document's tree model. These deliverables include:
- DOM Level 3 Events: A generic platform- and language-neutral event system which allows registration of event handlers, describes event flow through a tree structure, and provides basic contextual information for each event.
  - DOM Level 4 Core: A platform- and language-neutral interface that allows programs and scripts to dynamically access and update the content, structure, and style of documents, with specific considerations for the browser-based Web platform.
- E. File API:  
an API for representing file objects in Web applications, as well as programmatically selecting them and accessing their data. This may include file writing and file system APIs. This replaces the File Upload specification.
- F. Progress Events:  
event types used for monitoring the progress of uploads and downloads.
- G. Selectors API, Level 1 and Level 2:  
an interface for matching and retrieving Element nodes in a DOM according to flexible criteria.
- H. Server-Sent Events:  
an API for opening an HTTP connection for receiving push notifications from a server in the form of DOM events. The API is designed such that it can be extended to work with other push notification schemes such as Push SMS.
- I. Secure Cross-Domain Resource Sharing:  
mechanisms for selective and secure cross-domain scripting. For more details, see the WebApps WG Comparison of CORS and UMP. Currently, there are two different specifications for defining proposed mechanisms:
- Cross-Origin Resource Sharing, extending the design of the Same Origin Policy.
  - Uniform Messaging Policy, describing a mechanism upon which a variety of access-control mechanisms can be implemented.
- J. Web Interface Definition Language (Web IDL):  
language bindings and types for Web interface descriptions.
- K. Web Messaging:  
a secure messaging system to allow discovery of and communication between cross-domain documents, including postMessage and MessageChannel.

- L. **Web Sockets API:**  
an API that enables Web pages to use the Web Sockets protocol for two-way communication with a remote host.
- M. **Web Workers:**  
an API that allows Web application authors to spawn background workers running scripts in parallel to their main page, allowing for thread-like operation with message-passing as the coordination mechanism.
- N. **Widgets:**  
a set of specifications that describe various aspects of widgets, interactive single purpose applications for displaying and/or updating local data or data on the Web, packaged in a way to allow a single download and installation on a user's machine or mobile device. Currently, the following specifications comprise Widgets:
- Widgets Packaging and Configuration: a packaging format and configuration format for widgets.
  - The Widget Interface: APIs to store preferences and access widget package metadata.
  - Widgets Digital Signature: a means for widget packages to be digitally signed using a custom profile of the XML-Signature Syntax and Processing Specification.
  - Widgets Updates: a version control model that allows widgets to be kept up-to-date over [HTTP].
  - Widgets Access Request Policy: a means to request access to URI-identifiable resources (e.g., resources on the Web).
  - Widgets URI Scheme: a URI scheme for use inside widgets or other such applications of Web technology that do not run on the Web.
  - Widgets View Mode: a media feature and API related to presentation mode.
  - Widgets Embedding: a mechanism to allow embedding of packaged applications within other Web content, such as referencing via the HTML object element.
- O. **XML Binding Language (XBL2):**  
a language and set of APIs to allow for rich real-time transformations of documents
- P. **XMLHttpRequest (XHR), Level 1 and 2:**  
an API for client-server data transfer to specify what is currently implemented and to extend its capabilities.

For details, the latest APIs are available at: <<http://www.w3.org/2008/webapps/wiki/PubStatus>>.

#### **IV.5.2 W3C DAP**

The mission of the Device APIs and Policy Working Group [b-W3C-DAP] is to create client-side APIs that enable the development of Web applications and Web widgets that interact with devices services such as calendar, contacts, or camera. Additionally, the group focuses on producing a framework for the expression of security policies that govern access to security-critical APIs.

The working group is focusing on the following specifications:

- A set of Personal Information Management (PIM) APIs that includes:
  - Calendar API, an API to access a calendar service (e.g., to add an entry, to edit an entry, to delete an entry)
  - Tasks API, an API to access a personal task management or organizer service (e.g., to add, edit, delete a task)

- Contacts API, an API to access a contacts or address book service (e.g., to add an entry, to edit an entry, to delete an entry)
- Camera API, an API to manage a device's camera (e.g., to take a picture);
- Messaging API, an API to access a message service (e.g., to create a message, to send a message, to delete a message). The API is agnostic to the underlying messaging service (e.g., e-mail, SMS, MMS);
- System Information and Events API, an API to access various system services (e.g., battery level, network status);
- FileSystem API, an API to access the file system and perform basic operations (Create, Read, Update, Delete) and more complex operations (e.g., mount, unmount) – this API is developed in coordination with the Web Applications Working Group File Upload specification;
- Application Launcher API, an API to discover, identify and launch the platform's native applications;
- Application Configuration API, an API to manage application settings and user preferences;
- User Interaction API, a set of APIs that gives a widget or website far better control of how it manifests itself on different platforms. This is intended to include minimize/maximize functions, window size, alerting mechanisms;
- Communication Log API, an API to access information about past communication events, such as sent emails, SMS, MMS, call events;
- Gallery API, an API to manage the local media file storage;
- Security Policy Framework, to express security policies that govern access of Web applications and widgets to security-critical APIs, including:
  - Identification of APIs;
  - Identification of Web Applications and Widgets;
  - Definition of a policy description language for security policies;
  - Expression of security policies that govern access of Web applications and widgets to security-critical APIs.

For details, the latest APIs are available at: <<http://www.w3.org/2009/dap/>>.

### IV.5.3 W3C UWA

The UWA Working Group [b-W3C-UWA] focuses on extending the Web to enable distributed applications of many kinds of devices including sensors and effectors. Application areas include home monitoring and control, home entertainment, office equipment, mobile and automotive.

The working group is focusing on the following specifications:

- Recommendations
  - Composite Capability/Preference Profiles (CC/PP): Structure and Vocabularies 1.0  
A CC/PP profile is a description of device capabilities and user preferences. This document describes the structure of a CC/PP profile and shows how vocabularies for these capabilities are used.
- Candidate Recommendations
  - Delivery Context Client Interfaces (DCCI)  
DCCI defines a framework for client-side access to a hierarchy of device properties together with a means to set event handlers for notifications of changes to property values. W3C Candidate Recommendation published in December 2007.

- Content Selection for Device Independence (DSelect) 1.0  
This document defines a markup for selecting between versions of content. W3C Candidate Recommendation published in July 2007.
- Delivery Context: XPath Access Functions 1.0  
This document defines a suite of XPath functions for access to the delivery context. W3C Candidate Recommendation published in July 2007.
- Composite Capability/Preference Profiles (CC/PP): Structure and Vocabularies 2.0 (CC/PP 2.0)  
This working draft updates the CC/PP 1.0 Recommendation by making it in line with the latest revision of RDF, and ensures its interoperability with OMA's UAProf2.
- Delivery Context Ontology  
It describes an OWL ontology for device properties as a basis for adaptation to the context in which an application is executed.
- Device Independent Authoring Language (DIAL)  
This working draft describes a markup language for the filtering and presentation of Web page content available across different delivery contexts.
- Content Selection (DSelect) Primer 1.0
- Core Presentation Characteristics: Requirements and Use Cases  
This working draft describes the requirements for core presentation characteristics and covers a number of use cases.
- Working Group Notes
  - Authoring Techniques for Device Independence  
This provides a summary of several techniques and best practices that website authors and solution providers may employ when creating and delivering content to a diverse set of access mechanisms.
  - Device Independence Principles  
This discusses the general principles associated with device independence.
  - Authoring Challenges for Device Independence  
This discusses the challenges associated with authoring materials that can be accessed by a wide range of device with very different capabilities. It includes a set of high level requirements for systems that support device independence.

For details, the latest APIs are available at: <<http://www.w3.org/2007/uwa/docs/>>.

#### **IV.5.4 HTML5 and XHTML5**

HTML5 is a standard for structuring and presenting content on the World Wide Web. The new standard incorporates features like video playback and drag-and-drop that have been previously dependent on third-party browser plug-ins such as Adobe Flash, Microsoft Silverlight, and Google Gears.

HTML5 specifies scripting application programming interfaces (APIs). There are also new APIs, such as:

- The canvas element for immediate mode 2D drawing. See Canvas 2D API Specification 1.0 specification <<http://dev.w3.org/html5/2dcontext/>>
- Timed media playback
- Offline storage database (offline Web applications). See Web Storage <<http://dev.w3.org/html5/webstorage/>>

- Document editing
- Drag-and-drop
- Cross-document messaging. See HTML5 Web Messaging <<http://dev.w3.org/html5/postmsg/>>
- Browser history management
- MIME type and protocol handler registration.
- Microdata. See HTML Microdata <<http://dev.w3.org/html5/md/>>

HTML5 has both a regular text/html serialization and an XML serialization, which is known as XHTML5. In addition to the markup language, the specification includes a number of application programming interfaces. The Document Object Model is extended with APIs for editing, drag-and-drop, data storage and network communication.

For details, the latest HTML5 specifications are available at: <<http://www.w3.org/TR/html5/>>.

#### **IV.6 Organization for the advancement of structured information standards (OASIS)**

Organization for the advancement of structured information standards (OASIS) standards [b-OASIS] are mostly related to basic service oriented architecture (SOA) and web services (WS) technologies. Although OASIS has no specific activities regarding the development of APIs, the text below is provided for general information.

OASIS produces web services standards along with standards for security, e-business and standardization efforts in the public sector and for application-specific markets.

OASIS continues to develop and enhance standards for some of the essential underpinnings of web services, such as managing distributed services, implementing service registry and security, and, at a higher level, for implementing business processes. The web services description language (WSDL) [b-W3C-WSDL] developed in OASIS is typically used to express the web services descriptions and interface syntax.

As well, some standard languages such as in particular business process execution language (BPEL) [b-OASIS-WS-BPEL] are developed by OASIS. BPEL can be used to compose web services although initial BPEL specification is not suitable for composing web services to be used in conjunction with telecommunication services, due to its poor real time and asynchronous support as well as lack of support of some important features such as availability, reliability, security. OASIS is defining (within its open composite services architecture (Open CSA) member section) a collection of standards and related items to allow for pre-defined building of services from sub components, including "on-the-fly" runtime assembly. The Open CSA member section advances open standards that simplify SOA application development. OASIS is defining (within its WS discovery and WS devices profile (WS-DD) Technical Committee):

- A lightweight dynamic discovery protocol to locate Web services that composes with other web service specifications.
- A binding of SOAP to user datagram protocol (UDP), including message patterns, addressing requirements, and security considerations.
- A profile of web services (WS) protocols consisting of a minimal set of implementation constraints to enable secure WS messaging, discovery, description, and eventing on resource-constrained end-user domain.

OASIS is considering (within its IDtrust Technical Committee) to address the issue related to the exchange of common reputation data for social networking and trust establishment. The aim is to focus on common data format for social networking.

OASIS is trying to realize the full advantages of SOA to the telecommunications industry (within its telecommunications services member section (OASIS Telecom)). OASIS Telecom was chartered with a clear focus on telecommunication services in a SOA framework. The specific telecommunications related issues that the OASIS Telecom is addressing include:

- security (incremental security in a telecommunication environment);
- SLAs, including mechanisms to predict the composite SLA associated with an aggregate service that may include multiple SOA components;
- service availability and reliability models for composed services, in particular for mission-critical telecommunication services.

## **IV.7 Open Grid Forum (OGF)**

### **IV.7.1 OGF OCCI**

The Open Grid Forum (OGF) open cloud computing interface (OCCI) working group will deliver an API specification for remote management of cloud computing infrastructure, allowing for the development of interoperable tools for common tasks including deployment, autonomic scaling and monitoring. The scope of the specification will be all high level functionality required for the life-cycle management of virtual machines (or workloads) running on virtualization technologies (or containers) supporting service elasticity.

The new API for "IaaS" is allowing:

- consumers to interact with cloud computing infrastructure on an ad-hoc basis (e.g., deploy, start, stop, restart);
- integrators to offer advanced management services;
- aggregators to offer a single common interface to multiple providers;
- providers to offer a standard interface that is compatible with available tools;
- vendors of grids and clouds to offer standard interfaces for dynamically scalable service delivery in their products.

## **IV.8 Distributed Management Task Force (DMTF)**

### **IV.8.1 DMTF VMAN**

The distributed management task force, virtualization management initiative (DMTF VMAN Initiative) includes a set of specifications that address the management lifecycle of a virtual environment. VMAN's open virtualization format (OVF) specification provides a standard format for packaging and describing virtual machines and applications for deployment across heterogeneous virtualization platforms. VMAN's profiles standardize many aspects of the operational management of a heterogeneous virtualized environment.

The key properties of the format are as follows:

- optimized for distribution;
- optimized for a simple, automated user experience;
- supports both single VM and multiple;
- portable VM packaging;
- vendor and platform independent;
- extensible – OVF is immediately useful and extensible;
- localizable – OVF supports user-visible descriptions in multiple locales.

The DMTF's Open Cloud Standards Incubator focuses on standardizing interactions between cloud environments by developing cloud resource management protocols, packaging formats and security mechanisms to facilitate interoperability.

The Open Cloud Standards Incubator addresses the following aspects of the lifecycle of a cloud service:

- description of the cloud service in a template;
- deployment of the cloud service into a cloud;
- offering of the service to consumers;
- consumer entrance into contracts for the offering;
- provider operation and management of instances of the service;
- removal of the service offering.

## **IV.9 Storage Networking Industry Association (SNIA)**

### **IV.9.1 SNIA CDMI**

Storage networking industry association (SNIA) leads the storage industry worldwide in developing and promoting standards, technologies, and educational services to empower organizations in the management of information.

The cloud storage initiative (CSI) is promoting the adoption of cloud storage as a new delivery model that provides elastic, on-demand storage billed only for what is used.

The cloud data management interface (CDMI) defines the functional interface that applications will use to create, retrieve, update and delete data elements from the cloud. As part of this interface the client will be able to discover the capabilities of the cloud storage offering and use this interface to manage containers and the data that is placed in them. In addition, metadata can be set on containers and their contained data elements through this interface. This interface is also used by administrative and management applications to manage containers, accounts, security access and monitoring and billing information, even for storage that is accessible by other protocols. The capabilities of the underlying storage and data services are exposed so that clients can understand the offering.

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