Introduction to the ITU-T NGN Focus Group Release 1: Target Environment, Services, and Capabilities

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ABSTRACT

This article starts by introducing some interesting use cases of services and capabilities to be supported in next-generation networks. The target environment, relevant services, and some critical capabilities identified by the ITU-T Focus Group on NGN for the first phase of NGN deployments — NGN Release 1 — are then described. Finally, some examples of services to capabilities mapping are provided.

USE CASES FOR NEXT-GENERATION NETWORKS

Suppose you are the project coordinator for the upcoming release of a new product. You want to have a coordination call with the product designers at the research and development facility, the supervisor of the manufacturing facility, and the account manager of one of the sales teams in the field. Voice conference calls are easily set up, but you need more: sales wants to propose some design changes, and manufacturing is having problems on the assembly line. Now you need video channels as well as audio. Remember that you have four locations to manage and four types of networks: Ethernet for R&D, wireless LAN (WLAN) for manufacturing, cellular for sales, and digital subscriber line (DSL) for you. How can this all be managed as one conference call? The next-generation netowrk (NGN), using a common core IP multimedia subsystem (IMS), enables you to setup both audio and video calls to each of these types of access networks (Ethernet, WLAN, cellular, DSL) with a common control point for all of the parties involved. With the multimedia (audio and video) conference call set up, the sales team can propose their design changes, and product design can make sure the changes are appropriate, while manufacturing can estimate the impact on production costs. The conference gets everyone involved, decisions are made, and you get the new product delivered on schedule. Figure 1 shows what conference call connections through an NGN might look like.

That is very good for business, but what can NGN do for you personally? Suppose you are the proud parent of a new baby and want to relay the news to grandparents, aunts, and uncles. Using the same core IMS component, you can now create a multimedia conference from your cell phone (with camera) to both sets of grandparents, one set with a DSL connection and the other with a high-speed Internet cable connection, and an aunt and uncle at a coffee shop WLAN hotspot. The voice and pictures of the new baby can be shared with all parties. If you also want to add a niece to the call who has only audio on her cell phone, you can do that too Figure 1 shows how the capabilities within the NGN might be applicable for both personal and business services.

Multimedia conferencing is just one example of the use cases reviewed by the International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) Focus Group on NGN (FGNGN). In order to more clearly identify the scope and services NGNs will support, it is important to refer to use cases that require the new capabilities customers want, and then understand how the capabilities are used to provide new services. Multimedia conferencing highlights some key aspects of NGN: access to common services across multiple types of access networks (users from differing types of access networks can be included in a common call); and coordination of multiple types of communications from common control points in the network (a single call session control function [CSCF] can be used to connect multiple legs of a conference call, possibly having differing capabilities, to easily create a single call regardless of the network attachments of the other call parties).

Another use case that illustrates the NGN mobility capabilities involves *mobile telemedicine*. Suppose you are critically injured and arrive at a

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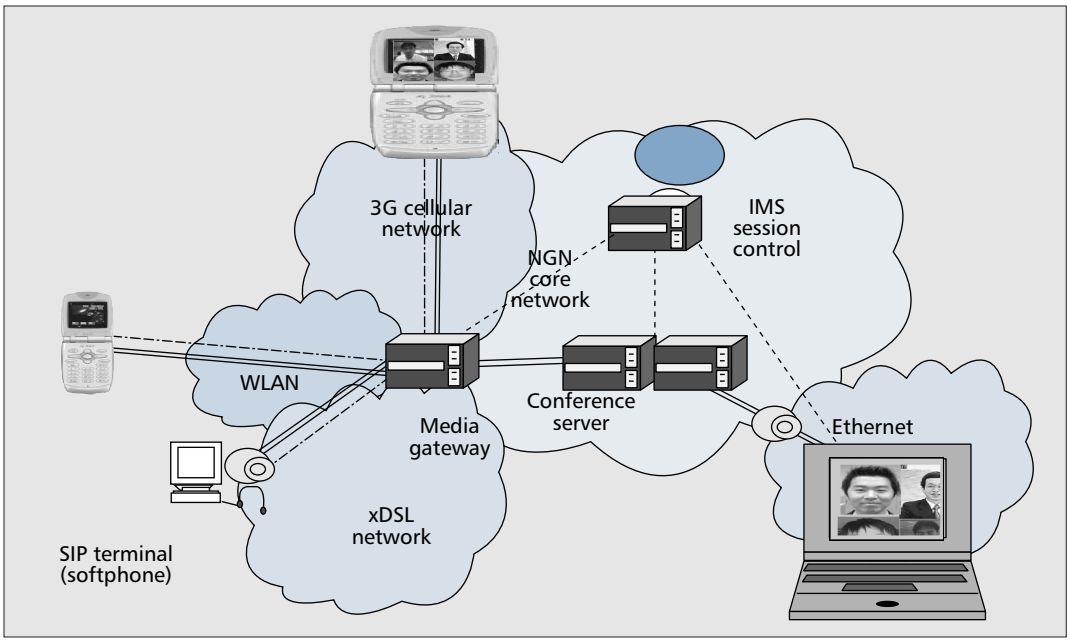

Figure 1. *Multimedia conferencing in NGN.*

The FGNGN NGN Release 1 Scope deliverable provides a high-level overview of the current status of FGNGN Release 1. The document is organized in terms of target environment, services, and capabilities to be addressed in the near term.

remote clinic with limited staff. Mobile telemedicine enables communication of information that could save your life. The remote clinic may have its own WLAN internal communication system and connection via DSL/broadband to the main hospital. Early examination can report your vital information to the main hospital and receive any medical information from your records stored in the main hospital system. More experienced physicians at the main hospital could make evaluations based on more complete X-ray or video information sent as the examination continues. In the ambulance your vital data can continue to be relayed using cellular networks. Such communication requires high-priority service and appropriate quality of service (QoS) during the entire travel time. Upon arrival at the main hospital all arrangements for additional treatment could already be prepared based on the continuing communication with the ambulance. Once again, multiple access networks (WLAN at the remote clinic, cellular in the ambulance, and DSL/broadband at the hospital) have coordinated to provide continuous communication. Various forms of multimedia communication (audio, video, imaging, high-speed data) have been coordinated to provide the communication bandwidth needed to monitor your vital data. Figure 2 shows a high-level view of the NGN connections and requirements for mobile telemedicine.

This article obviously does not allow for all the use cases evaluated by the FGNGN to be discussed, but is meant to introduce some of the capabilities in NGN. More of the use cases are provided in the FGNGN NGN Release 1 Scope deliverable itself.

NGN Release 1

The ITU-T FGNGN has adopted a release-based approach for the production of NGN recommendations, with the scope of each release clearly defined and with precise deadlines for completion.

Release 1 is the first step toward a comprehensive framework of services, capabilities, and network functions that constitute an NGN, as described in Recommendation Y.2001 [1]. Ensuring architectural flexibility to support future enhancements and releases with minimum impact is an essential characteristic of the NGN framework.

The FGNGN NGN Release 1 Scope deliverable provides a high-level overview of the current status of FGNGN Release 1. The document is organized in terms of target environment, services, and capabilities to be addressed in the near term. It should be noted that the final status may change according to further discussions and agreements.

The NGN framework is expected to deliver services tailored to all users' and service providers' requirements so that they satisfy a wide range of needs and human capabilities. It is recognized that specific realizations of NGN Release 1 may extend beyond the services and capabilities described in the FGNGN NGN Release 1 Scope document, and service provider requirements may drive a particular set of services and capabilities to be supported in a particular network.

It is important to mention that some relevant areas have not been included in the Terms of Reference of the FGNGN and consequently have not been addressed (at least in a direct way) in the FGNGN Release 1 work. These areas include naming, numbering, addressing and routing, signaling, charging and billing; management aspects, transmission aspects, and QoS for network performance.

Target Environment

This section introduces some key aspects of the NGN Release 1 environment.

The NGN framework supports advanced

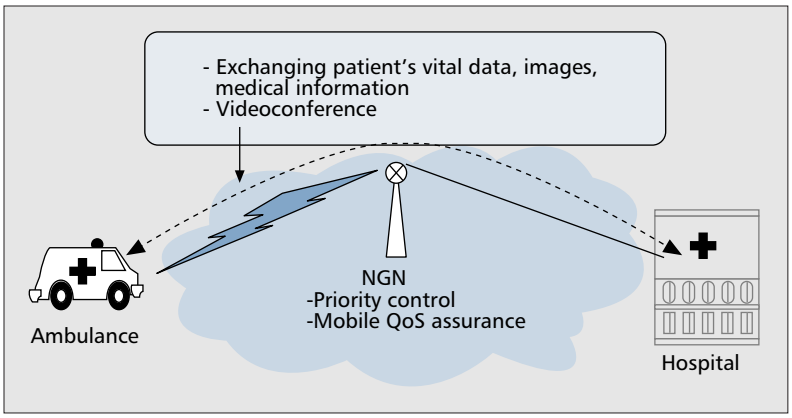

Figure 2. *Mobile telemedicine use case.*

architecture objectives for the offer of a comprehensive set of services over a unifying IP layer network. The transport stratum has to support a multiplicity of access networks, and a variety of mobile and fixed terminal types. Services are separable from the transport stratum into a service stratum and are not limited to those provided by the "home network," but may be obtained from multiple service providers and third parties. In Release 1 all services are carried over IP, although IP itself may in turn be carried over a number of underlying technologies, such as asynchronous transfer mode (ATM), Ethernet, and so on. IPv4 or IPv6 networking is assumed at packet interconnection points and packet network interfaces, so the focus is on the definition of IP packet interfaces.

As far as the QoS objectives are concerned, QoS coordination across the transport stratum (access and core segments), in cooperation with application resource requirements, will lead to an end-to-end QoS environment for the services offered to end users. Within that perspective, NGN Release 1 will provide an initial set of requirements, architectures, mechanisms, and guidelines to enable end-to-end QoS, including resource and admission control, coordination between access and core networks, and inter-core network aspects.

In an open IP environment, security for end users and the network itself is a critical aspect. NGN Release 1 will contain a security requirements specification based on the application of ITU-T Recommendation X.805 [3] to NGN and thus addressing the following dimensions of NGN security: access control, authentication, nonrepudiation, data confidentiality, communication security, data integrity, availability, and privacy. The specification will also address the incremental security considerations resulting from the interconnection of existing networks to NGN.

Coordination of all the various network components within the NGN and across network boundaries is needed to provide a robust, efficient, manageable system. NGN management supports the monitoring and control of NGN services and service/transport components via the communication of management information across interfaces between NGN components and management systems, between NGN-supportive management systems, and between NGN components and personnel of service providers and network operators. As far as the management objectives of NGN Release 1 are concerned, another ITU-T specialized group — the NGN Management Focus Group — is working, in cooperation with ITU-T FGNGN and Study Group 4, toward the definition of realistic objectives and corresponding solutions. This work includes, for example, provisioning of capabilities for management of NGN service components independent from the underlying NGN transport components, personalization of end-user services and creation of new services from service capabilities, and end-user service improvements such as customer self-service, enabling service providers to reduce the timeframe for the design, creation, and delivery of new services.

Generalized mobility is a key aspect of the NGN framework. Mobile users require seamless and transparent mechanisms for roaming between network operators and continual access to tailored services from a variety of environments while using a variety of terminals with varying capabilities. In addition, NGN communications and services have to be available to all qualified users requesting those services, regardless of the type of access network technology, as long as the services can be tailored for the specific terminal type and are compatible with the QoS of the access network. In describing the mobility within an NGN network, no major new interfaces for mobility are proposed for Release 1. Existing interfaces will be used, as well as existing signaling capabilities for all types of mobility as currently defined.

Personal mobility is based on a personal identifier and the capability of the network to provide those services delineated in the user's service profile. For NGN Release 1, personal mobility will continue to be used where users can register themselves with the services. Similarly, terminal mobility will exist within and among networks where the terminal can register to the access network. *Nomadism*, defined as personal or terminal mobility without maintaining an active service session during mobility, shall be supported between networks and within a network. This does not exclude support for mobility with an active service session. Where such continuity exists, such support is expected to also be used for NGN Release 1.

Applications and end-user services offered as part of the NGN are designed to be easily created in an open environment for both operators and third parties. A flexible service framework will enable implementation of value added services making usage of core network capabilities in an agnostic fashion. These core capabilities will be accessed via published application interfaces and features providing consistent access methods to the capabilities. Application developers will rely on this consistency when designing new applications. NGN Release 1 aims to support interfaces to the following classes of services (where applicable): intelligent network-based services, Session Initiation Protocol (SIP)-based services, and open service environment (OSA/Parlay [4], OMA [5], etc.)-based services.

Additional open service environment capabilities include end-user support, for compatibility among various services, of subscription from differing service providers and access from different access network environments.

Some Basic Components

Among the basic components of NGN Release 1, it is essential to mention the IP multimedia component: positioned within the service and control functions of the NGN architecture, this service component is based on the Third Generation Partnership Project (3GPP)/3GPP2 IMS [6, 7]. It has been a starting point for the definition of NGN Release 1 to leverage the capabilities of the 3GPP/3GPP2 IMS (for SIP-based call/session control of real-time conversational communications), with consideration of the appropriate extensions, required, for example, to support the heterogeneous access network environment of Release 1. Full compatibility with 3GPP/3GPP2 IP connectivity access networks (e.g., IP-CAN) and terminals will be maintained.

All NGN access network types are required to offer IP connectivity. As previously mentioned, NGN will support access networks of diverse technologies and capabilities. The following provides a nonexhaustive set of candidate technologies for Release 1 (the required technologies will be those capable of providing IP connectivity within the Release 1 timeframe):

- Wireline domain: xDSL (asymmetrical, ADSL; symmetrical, SHDSL, and very high data rate, VDSL, transport systems and supporting connection/multiplexing technologies), plesiochronous/syncrhonous digital hierarchy (PDH/SDH) dedicated bandwidth access, optical access — point-to-point and passive optical network (xPON) transport systems (e.g., BPON, EPON, GPON, GEPON) — cable networks, LANs, and power line carrier (PLC) networks
- Wireless domain: IEEE 802.x wireless networks (e.g., WLAN, broadband wireless access [BWA]), 3GPP/3GPP2 packet-switched (PS) domain (circuit-switched domain is not supported), broadcast networks

As far as interconnection between multiple NGN network administrative domains or between NGN domains and other networks is concerned, the NGN is required to support access to and from other networks that provide communications, services, and content. NGN Release 1 will provide support for services across multiple NGN network administrative domains. Direct interconnection with the public service telephone network (PSTN)/integrated services digital network (ISDN) will be supported by means of interworking functions implemented within the NGN. The following lists the network-to-network interconnection capabilities supported in Release 1 (also applicable to enterprise networks as private network-to-network interconnection):

- Circuit-based legacy networks: PSTN/ISDN, public land mobile network (PLMN)
- Other IP-based networks: public Internet, cable networks, broadcast networks, other multimedia networks (3GPP/3GPP2 IMS)

NGN customers may deploy a variety of network configurations, both wired and wireless, behind the network termination function. It is also recognized that many customer and termination functions deploy firewalls and private IP addresses in combination with network address port translation (NAPT). NGN Release 1 will support simultaneous access to NGN through a single network termination function from multiple terminals connected via a customer network. The support for customer and termination functions will be limited to controlling (part of) the gateway functions between customer-owned equipment and the access transport function. Management of customer networks, as well as implications of specific architectures of customer networks (e.g., home networks) on the NGN network, is beyond the scope of Release 1.

As far as NGN end-user equipment is concerned, the NGN shall support a huge variety of end-user equipment, from those with intrinsic capability to support a simple service set to others supporting programmable service sets.

However, it is important to note that the NGN framework does not intend to specify or mandate a particular NGN end-user equipment type or capability beyond compatibility with NGN authentication, control, and transport protocol stacks.

User equipment uses its network termination function to access services. This function being access network technology specific, the network termination function types supported in Release 1 will be determined by the Release 1 access network types. The simultaneous use of multiple access networks by single equipment shall be allowed; however, there is no requirement to coordinate the communication in such scenarios.

Services

FGNGN Working Group 1 is leading the work on services and associated requirements for NGN Release 1. The following are examples of the types of services supported by NGN Release 1. It has to be noted that compliance of a given network environment to NGN Release 1 does not mean support of all possible combinations of services (as well as capabilities and network configurations) described in the FGNGN NGN Release 1 Scope document.

Multimedia services: NGN Release 1 will support both real-time conversational communications (beyond voice) and non-real-time communications. This includes, but is not limited to, the end-to-end delivery of communications using more than one media. Examples include:

- Messaging services: instant messaging (IM), short messaging service (SMS), multimedia messaging service (MMS), and so on
- Push to talk over NGN
- Point-to-point interactive multimedia services (e.g., video telephony, whiteboarding, total conversation), collaborative interactive communication services (multimedia conferencing with file sharing and application sharing, e-learning, gaming)

It is important to note that the NGN framework does not intend to specify or mandate a particular NGN end user equipment type or capability, beyond the compatibility with NGN authentication, control and transport protocol stacks.

An NGN network should not inhibit user access to the Internet through existing mechanisms. Support for Internet access through the NGN core that includes end to end transparency, peer to peer interactions and some other Internet services is in the scope of NGN, but not required in Release 1.

- Push-based services (e.g., IP multimedia services and new services including public safety, government, and corporate information technology)
- Content delivery services (radio and video streaming, music/video on demand, TV channel distribution, financial information distribution, professional and medical image distribution, electronic publishing)
- Broadcast/multicast services
- Hosted and transit services for enterprises (IP Centrex, etc.)
- Information services (e.g., cinema ticket information, motorway traffic status)
- Presence and general notification services
- Location-based services
- 3GPP/3GPP2 OSA-based services

PSTN/ISDN emulation services: enabling legacy terminals to continue to use existing telecommunication services while connected to an NGN network. The user should have the identical experience as provided by the legacy PSTN/ISDN services. Not all service capabilities and interfaces have to be present to provide an emulation of a particular PSTN/ISDN network.

PSTN/ISDN emulation will provide PSTN/ISDN service capabilities and interfaces using adaptation to an IP infrastructure. The supported PSTN/ISDN service set may be only applicable to certain terminal types (i.e., legacy terminals or user equipment behaving like legacy terminals).

PSTN/ISDN simulation services: enabling NGN terminals in an NGN network to use telecommunication services similar to legacy PSTN/ISDN services (legacy terminals with terminal adaptations may also use these simulation services). Simulated services may not necessarily have the full functionality defined for PSTN/ISDN, and may not necessarily use PSTN/ISDN call models or signaling protocols. PSTN/ISDN simulation will provide PSTN/ISDN-like service capabilities using session control over IP interfaces and infrastructure.

Other services: This category primarily addresses various data services common to packet data networks. Examples include virtual private network (VPN) services, data tetrieval applications, data communication services (e.g., data file transfer, email, and Web browsing), Online applications (online sales for consumers, e-commerce, online procurement for commerce), sensor network services, remote control/teleaction services (e.g., home applications control, telemetry, alarms), over-the-network device management.

Internet access: An NGN network should not inhibit user access to the Internet through existing mechanisms. Support for Internet access through the NGN core that includes end-to-end transparency, peer-to-peer interactions, and some other Internet services is in the scope of NGN, but not required in Release 1. Examples of Internet services can be found in the list of multimedia and other services provided in this section.

Public service aspects: These services may be applicable to NGN networks required to support public services. The NGN network should provide these services in compliance with national and regional regulations and international treaties. Precise network realizations of these services are beyond the scope of FGNGN Release 1:

- Lawful interception
- Malicious call trace
- User identity presentation and privacy
- Emergency communications
- Users with disabilities
- Service provider selection

Capabilities for NGN Release 1

In today's networks, vertical integration is the typical service construct, requiring specific infrastructure components for service delivery. This will not be the usual case within a converged NGN infrastructure. In order to support multiple innovative and evolving services, allowing flexible service design, creation, and development, as well as third-party development and support, the concept of *capabilities* as a set of basic building blocks for the provisioning of NGN service features is essential. NGN shall provide such a standard set of capabilities.

One possible way to characterize these capabilities is to distinguish them in two groups, one constituting the *basic capabilities*, the other the *service support capabilities*. With respect to the NGN architecture layering, the basic capabilities mainly relate to the transport stratum (underlying capabilities), while the service support capabilities mainly relate to the service stratum (and are basically accessible directly by NGN applications).

Examples of basic capabilities include network management, routing, network authentication and authorization, accounting, traffic class and priority management, and media resource management.

Service support capabilities are generally combined with other capabilities or services to provide enhanced functionality, although some may be also used as standalone services in specific cases. The capabilities identified for NGN Release 1 are derived from functionalities already developed in various technical bodies that are considered ready for use in the Release 1 time frame.

Service Support Capabilities

Within the set of (more or less service- or environment-specific) service support capabilities, those supporting critical features of NGN Release 1 services include presence, location, group management, message handling, broadcast/multicast, push, session handling, and device management. Below we provide some details of this subset of capabilities.

Presence concerns information describing the status of each user or device connected to NGN. Presence includes information such as location (longitude and latitude), place (office, home, or outside), type of access (dialup, DSL, fiber, or wireless), type of terminal (cellular or PC), availability (busy or free), access condition (congestion or resource availability), and so on.

In order to support presence, the following capabilities are required:

- Collecting capability: collects presence information and sends it to the management capability in realtime. While presence information is watched by this capability, all updates of presence information should be detected.
- Management capability: stores the collected presence information and sends it to requesting users through the distribution capability.
- Distribution capability: distributes the collected presence information to requesting users. If the user requests, he/she should be notified of all updates of presence information.

Since the presence information is part of a user's private information, it should be managed in compliance with user privacy and access rules.

NGN should have mechanisms to determine and report ***location*** information of the user's terminal, managing location information as a standard attribute of the terminal. This capability may be used by various services and is particularly important in emergency cases such as traffic accidents, natural disasters, and medical emergencies.

Location can be specified in various ways: for fixed terminals, the address assigned to the terminal can be used, while for mobile wireless terminals, the geographical position of the base station can be used. Moreover, in order to obtain more precise location information of mobile terminals, longitude-latitude information obtained by Global Positioning System (GPS) can be utilized.

Similar to presence, location information is part of the user's private information and, as such, should be handled adequately.

Group management deals with secure and efficient management of groups of network entities. VPN services provided by network operators constitute a typical case requiring this capability: a closed user group needs to be defined based on a membership list, and communications secured within that group. NGN should be able to manage such groups securely and efficiently.

Message handling deals with management of message-based data streams, also called *messaging*. Messaging types can be distinguished according to various criteria, including single and multimedia, real-time and non-real-time (3GPP has defined immediate, deferred delivery, and session-based messaging types). Examples of real-time messaging are IM and chat; email and SMS are examples of non-real-time messaging. NGN should support the various types of messaging.

The ***broadcast/multicast*** capability enables applications to deliver content to multiple users at the same time using broadcast or multicast content delivery mechanisms. In addition to standard point-to-point unicast, broadcast and multicast mechanisms should be supported for efficient network resource usage and scalable content delivery.

The ***push*** capability is used to transmit data from an initiator to a recipient without previous recipient action. This data transmission may trigger applications on the recipient's terminal. A typical example of push-based service is push to talk in cellular networks, but the push capability can be used in various other scenarios, such as message display or announcement generation on terminals like TVs, and emergency messaging in natural disaster situations like earthquakes or tsunamis.

Session handling deals with end-to-end session setup and termination, and related management coordination, such as finding destination users, controlling access rights, and controlling resource allocation.

The session management process increases in complexity when multimedia applications are launched among multiple users. For example, in a multimedia conferencing utilizing multiple media types (e.g., video, voice, IM, and whiteboard), the setup of multiple QoS-enabled connections may be required within a single session, as well as codec alignment for each medium. Multiparty session establishment requires session handling capability to manage users' join/leave operations.

Device management enables network management protocols and other mechanisms for robust management of user terminal devices and their applications over a variety of bearers during the entire life cycle of the terminals and applications. One aspect of this capability is device provisioning, by which a device is initially configured with a minimum of user interaction.

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Using Service Support Capabilities

Services deployed within NGN environments may be enhanced and new ones created by using capabilities. The following provides a few examples of service to capabilities mapping; for simplicity, we only refer to the subset of service support capabilities described earlier.

Going back to the multimedia conferencing example, it can be observed that the presence, group management, message handling, broadcast/multicast, and session handling capabilities can be used to enhance the features of this service. Presence may be used to find the address or determine the status of other conference members; group management may be used to manage the members; message handling enables message-based communications; broadcast/multicast enables appropriate communication methods among members; and session handling manages the conference sessions and join/leave member operations.

As far as the second example described earlier is concerned, the mobile telemedicine service may use, in addition to session handling support, the location capability in order to determine and report the exact position of the ambulance (such information will be especially useful to find the nearest hospital to be reached).

Content delivery services constitute a relevant use case (from use cases in the FGNGN NGN Release 1 Scope document) to show the possible usage of the other mentioned service support capabilities: the broadcast/multicast capability may be used there for resource efficiency and scalability purposes, and push may be used in real-time scenarios to forward contents immedi-

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ately after the terminals or applications are updated using device management.

As a conclusive remark, it is worthwhile to point out that the large spectrum of service scenarios within the various future network environments will actually use these and other capabilities in a number of different ways. Flexible service creation and deployment constitute a major requirement and major value of NGN environments.

CONCLUSION

NGN is beginning to provide the technology links to enable ubiquitous user access to a common set of services. Services are developed in an open environment, independent of the multiplicity of access networks and terminal types that will be supported by the NGN network. NGN Release 1, a first step toward a comprehensive NGN framework, identifies the basic services and capabilities readily available for use in this new converged environment. Future releases will enable additional services and capabilities that will enrich the user experience. Significant areas of work include seamless mobility, increased service enabler interaction, enhanced security, and the introduction of new multimedia services that have not yet even been considered.

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ADDITIONAL READING

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BIOGRAPHIES

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