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

Framework for NGN support of multicast-based services

Recommendation ITU-T Y.2236

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Framework for NGN support of multicast-based services

Summary

Recommendation ITU-T Y.2236 provides a framework for NGN support of multicast-based services. In particular, it provides general descriptions of NGN multicast capabilities and functional requirements for each functional group of the NGN architecture.

FOREWORD

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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CONTENTS

Recommendation ITU-T Y.2236

Framework for NGN support of multicast-based services

1 Scope

This Recommendation describes a framework for NGN support of multicast-based services. It provides a general description of NGN multicast capabilities and the functional requirements for each functional group of the NGN architecture (i.e., transport stratum functions, service stratum functions, end-user functions and management functions).

Specific multicast-based services, as well as the actual implementation of NGN multicast capabilities for different network technologies, are out of scope of this Recommendation.

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.601]   Recommendation ITU-T X.601 (2000), *Multi-peer communications framework*.

[ITU-T X.603]   Recommendation ITU-T X.603 (2004) | ISO/IEC 16512-1:2005, *Information technology – Relayed multicast protocol: Framework*.

[ITU-T Y.2011]   Recommendation ITU-T Y.2011 (2004), *General principles and general reference model for next generation networks*.

[ITU-T Y.2012]   Recommendation ITU-T Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.

[ITU-T Y.2201]   Recommendation ITU-T Y.2201 (2007), *NGN release 1 requirements*.

[ITU-T Y.2233]   Recommendation ITU-T Y.2233 (2008), *Requirements and framework allowing accounting and charging capabilities in NGN*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 active group [ITU-T X.601]: A set of enrolled group members that has entered the multicast data transfer phase; satisfying the group-characteristics requirements.

3.1.2 multicast [ITU-T X.603]: A data delivery scheme where the same data unit is transmitted from a single source to multiple destinations in a single invocation of service.

3.1.3 multicast group [ITU-T X.601]: A set of service users that abide by appropriate group-membership criteria, or a set of rules belonging to a group that enables multicast-based services and applications.

3.1.4 **nomadism** [b-ITU-T Q.1706]: The ability of the users to change their network access point on moving. When changing the network access point, the user's service session is completely stopped and then started again, i.e., there is no service continuity or hand-over used. It is assumed that normal usage pattern is that users shut down their service session before attaching to a different access point.

3.1.5 **personal mobility** [b-ITU-T Q.1706]: This is the mobility for those scenarios where the user changes the terminal used for network access at different locations. The ability of a user to access telecommunication services at any terminal on the basis of a personal identifier, and the capability of the network to provide those services delineated in the user's service profile.

3.1.6 **service continuity** [ITU-T Y.2201]: The ability for a moving object to maintain ongoing service over including current states, such as user's network environment and session for a service.

3.1.7 **terminal mobility** [b-ITU-T Q.1706]: This is the mobility for those scenarios where the same terminal equipment is moving or is used at different locations. The ability of a terminal to access telecommunication services from different locations and while in motion, and the capability of the network to identify and locate that terminal.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 **group**: A set of service users using a particular service.

NOTE – The concept of group allows defining a set of entities as a virtual single entity. One of the main reasons to create a group is the possibility to name and address all group members with a single name, a single address, or unified characteristics of group communications, called group-name, group-address, or group-characteristics respectively.

3.2.2 **multicast connection**: A transmission path used for data transfer among members of a multicast group.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ANI	Applications to Network Interface
DMB	Digital Multimedia Broadcasting
EPG	Electronic Program Guide
FTP	File Transfer Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPTV	Internet Protocol Television
MPLS	MultiProtocol Label Switching
NGN	Next Generation Network
NNI	Network to Network Interface
PON	Passive Optical Network
QoS	Quality of Service
SDR	Session Directory
TTL	Time to Live
VoD	Video on Demand

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 prohibited from" 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 need not be present to claim conformance.

The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation can still be claimed even if this requirement is present.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is 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 this Recommendation.

6   Introduction

As shown in Figure 6-1 below, various services − multimedia conference, linear TV, file distribution and entertainment applications such as games being representative examples – may require that NGN supports multicast capabilities.
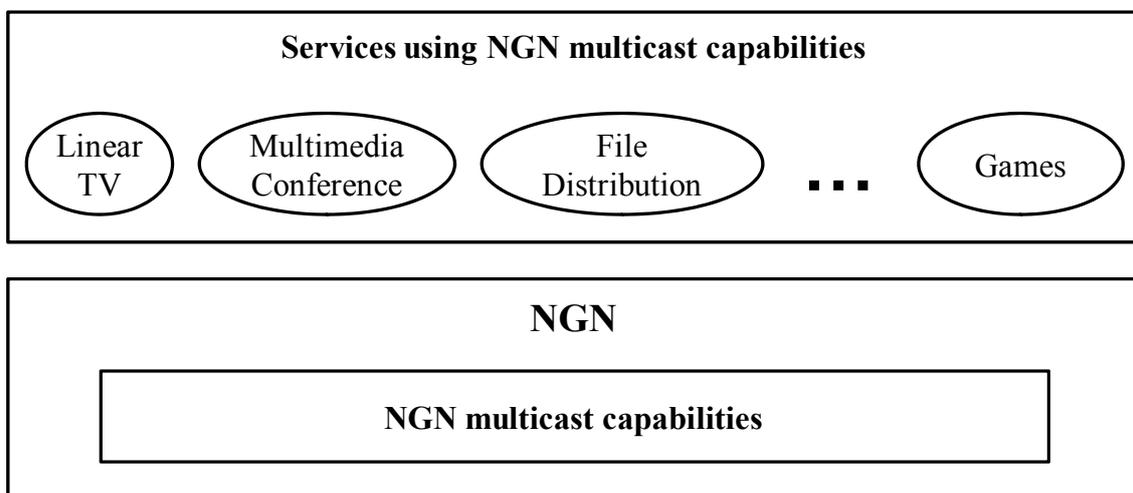
Figure 6-1 – Examples of services using NGN multicast capabilities

NGN may provide multicast capabilities based on different network technologies (e.g., IP, MPLS, Ethernet and PON); these different network technologies do not necessarily provide identical multicast related functionalities.

This Recommendation provides the description of requirements for NGN multicast capabilities. Detailed requirements for specific network technologies are out of scope of this Recommendation. Appendix I describes an example scenario of multicast-based services.

7 Multicast communication modes

This clause describes multicast communication modes. Three types of multicast communication modes are required to be supported by NGN multicast capabilities [ITU-T Y.2201].

NOTE – The actual mechanisms to provide each multicast communication mode may vary according to the network environment, and their usage may be implementation dependent.

7.1 One-to-many multicast communication mode

This mode can be applied to deliver data to multiple recipients. It assumes one sender and a receiving group consisting of multiple recipients.
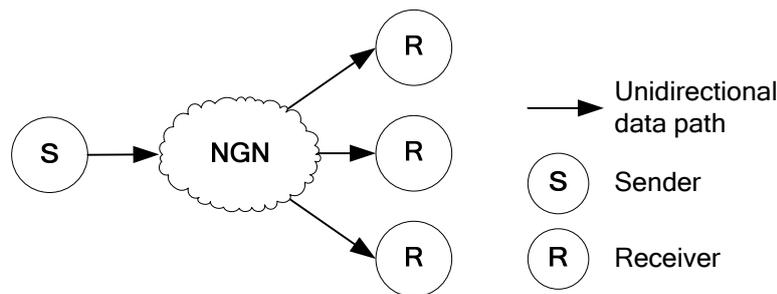
Figure 7-1 – One-to-many multicast communication mode

Examples of services that may use the one-to-many multicast communication mode include:

– Real-time services such as linear TV and digital multimedia broadcasting (DMB);
– Reliable services such as file distribution, software update and e-learning.

7.2 Many-to-many multicast communication mode

This mode can be applied to deliver data from multiple senders to multiple recipients. It assumes a group consisting of multiple senders and multiple recipients.
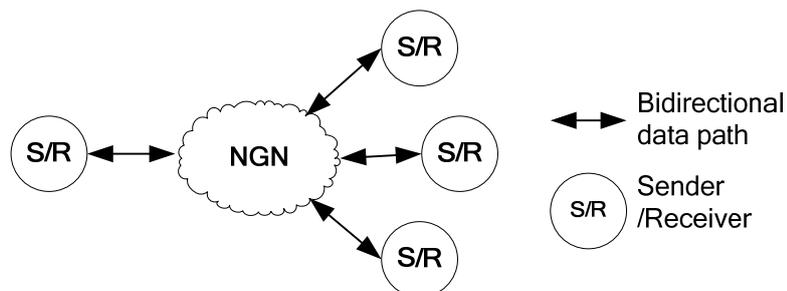
Figure 7-2 – Many-to-many multicast communication mode

For the many-to-many multicast communication mode, according to specific service requirements, data may be required to be aggregated, either within the NGN or at the recipient side.

Examples of services that may use the many-to-many multicast communication mode include:

– Real-time services such as teleconference;
– Reliable services such as whiteboard, application-sharing and network gaming.

7.3 Many-to-one multicast communication mode

This mode can be applied to deliver data from multiple sources to one recipient. It assumes a group consisting of multiple senders and one recipient.
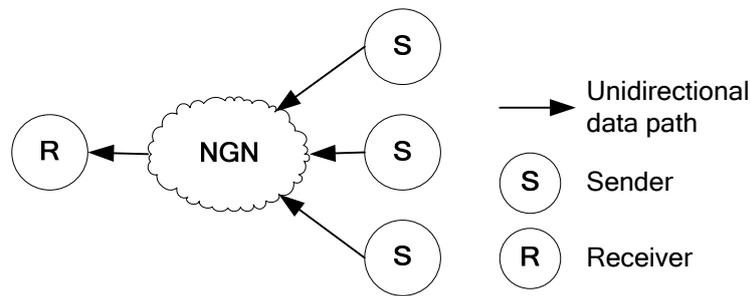
Figure 7-3 – Many-to-one multicast communication mode

For the many-to-one multicast communication mode, according to specific service requirements, data may be required to be aggregated, either within the NGN or at the recipient side.

Examples of services that may use the many-to-one multicast communication mode include:

– Real-time services such as vehicle traffic monitoring;

– Reliable services such as centralized data collection.

8 General description of NGN multicast capabilities

This clause describes the NGN multicast capabilities which may be used to provide the multicast communication modes, as required by multicast-based services.

The provision of NGN multicast capabilities is a deployment decision of service and network providers.

8.1 Multicast data delivery

This capability deals with the delivery of data to the multicast group members.

NOTE – Usually, as defined in [ITU-T X.603], multicast data delivery is associated with an 1:N data delivery scheme. However, more generally, it is not restricted only to an 1:N data delivery scheme, but it may cover other data delivery schemes such as N:1 and M:N. The real meaning of "multicast" is then dependent on its effective usage.

• Multicast data forwarding support

It provides the capability of data forwarding of multicast packets. Various mechanisms of data forwarding can be used to support each multicast communication mode. The detailed mechanisms are implementation dependent.

• Multicast data delivery support across multiple NGNs

It enables multicast-based services to be provided across multiple NGN domains. An example scenario for end-to-end multicast data delivery across multiple NGN domains is described in Appendix II.

NOTE – The impact on other NGN multicast capabilities of the provisioning of multicast-based services across multiple NGN domains is for further study.

- Reliable multicast data delivery support

    It provides the capability to deliver multicast data with reliability. Some services such as file distribution, software-updates, and application-sharing need reliable data delivery support. Senders and receivers need to support reliable data delivery mechanisms to ensure that multicast data are correctly delivered.

    Usually, reliable data delivery is required at the end-to-end level. If the NGN transport stratum supports a reliable data delivery capability, this capability can be used by NGN end-user functions and/or NGN service stratum functions to support efficient reliable data delivery. However, it may happen that the NGN transport stratum cannot support a reliable data delivery capability: in this case, reliable data delivery may be ensured by functions at the service stratum (e.g., service level multicast functions).

- Load sharing for multicast data delivery support

    It provides the capability for multicast-based services to share the load (including load balancing) while delivering multicast traffic. This capability may maintain service resilience as the size of the group grows.

8.2 Multicast group management

This capability deals with membership management of a group involved in a multicast-based service. Appendix III describes the concepts of group and phases of a multicast communication.

- Group identification and group member identification support

    It provides the capability to identify group/group member. Examples of group identifiers include IP multicast address, e-mail address, alphanumeric name, etc.

- Group advertisement and discovery support

    It provides the capability to announce and discover multicast groups. By using multicast group identifiers, it is possible to perform service discovery.

- Group creation/release support

    It provides the capability to create and release groups.

- Group monitoring support

    It provides the capability to monitor relevant information of groups. Group monitoring parameters depend on the deployment decisions made by each service provider (e.g., group members' status, group size).

- Membership change notification support

    It provides the capability to inform the service provider and/or service users of group membership changes. This capability allows multicast-based services to easily manage group member changes for frequent joins and/or leaves.

- Membership management support

    It provides the capability to manage group membership. Examples of membership management operations include inviting specific members to the group, expelling specific members from the group, and examining the status of active members.

8.3 Multicast service control

This capability deals with service control for multicast data delivery.

- Multicast connection management support

    It provides the capability to initiate and release a multicast connection. Also, it provides the capability to identify a multicast connection for group members to join and leave multicast-based services.

- Service admission control support

    It provides the capability to determine whether to accept new members into an already established multicast connection. NGN needs to judge whether it has enough resources available to accept new members into an already established multicast connection. Typical resources include bandwidth, storage capacity and processing capacity.

- Service advertisement and discovery support

    It provides the capability to enable advertisement and discovery of relevant information of multicast connections. Service providers (users) may have specific methods of advertising (discovering) relevant information of multicast connections. Relevant information of multicast connections can be provided to multicast group members by offline or online mechanisms.

- Service scope control support

    It provides the capability of constraining the scope of packet delivery for multicast-based services. This scope can be controlled to not overload the entire network. Most popular methods of scoping include TTL scoping and administrative scoping. The TTL scoping is used to scope services by limiting the packet forwarding hop counts. The administrative scoping is used to scope services by configuring boundaries which limit forwarding of specified ranges of multicast addresses.

8.4   QoS control

This capability deals with QoS control support for multicast-based services.

The QoS parameter value set for a given multicast group (group-wide QoS) is a single value set applicable for all group members. The single QoS value set is predefined before the establishment of the multicast connection.

Participation into the multicast connection by multicast group members who cannot support the single predefined QoS value set depends on the specific policies of each multicast group member.

QoS negotiation among the group members (located in the NGN or in the end user functions) is for further study.

- Support of predefinition of a QoS parameter value set

    The QoS parameter value set is defined before the establishment of the multicast connection.

- Support of advertisement of predefined QoS parameter value set

    The group members need to be aware of the predefined QoS parameter value set in order to determine their participation in the related multicast connection. The advertisement of the predefined QoS parameter value set can be provided to end-users by online or offline mechanisms.

- Group-wide QoS support

    Every group member uses a single QoS parameter value set for the multicast connection.

Appendix IV provides some details on QoS aspects of multicast communications.

8.5   Security

This capability deals with security support for multicast-based services.

- Authentication support

    It provides the capability to authenticate users of a multicast group.

- Authorization support

   It provides the capability to authorize a user once authenticated to behave as sender and/or receiver.

   Being a sender gives the rights to "send" to specific receivers while being a receiver gives the rights to "receive" from specific senders. After being successfully authorized, the senders can send multicast data to the group members, while the receivers can receive multicast data addressed to the multicast group. Authorization support protects from non-authorized members' participation in a particular multicast connection.

- Confidentiality support

   It provides the capability that enables multicast-based services to secure multicast data delivery through encryption/decryption of multicast data. This capability can protect multicast-based services from eavesdroppers. A group key is used to encrypt/decrypt multicast data.

- Data integrity support

   It provides the capability to ensure that multicast data have not been altered or destroyed in an unauthorized manner.

- Group key management support

   The group members of a multicast-based service may share a group key to encrypt and decrypt the exchanged multicast data. A group key management capability is needed to control the sharing of group keys among group members.

8.6 Mobility

This capability deals with mobility support for multicast-based services. It is important to note that both receivers and senders can be mobile. The movement of a user equipment may cause changes in the multicast connection.

- Nomadism support

   It provides the capability for a user equipment to access multicast-based services when connecting to a new access network after disconnection from another access network. The user equipment needs to "leave" the multicast-based service(s) in this last access network and "join" the multicast-based service(s) in the new one.

8.7 Accounting and charging

This capability deals with the charging and accounting of multicast-based services. For further information, see [ITU-T Y.2233].

9 Functional requirements for multicast-based services

The functional requirements described in this clause are expected to be supported by the NGN architecture, extended so as to support multicast-based services. While details on the NGN architecture are presented in [ITU-T Y.2012], this clause provides considerations with respect to multicast-based services. The functional requirements are identified for the NGN multicast capabilities provided in clause 8 and structured according to the NGN multicast framework architecture described in clause 9.1.

9.1 NGN multicast framework architecture

The NGN multicast capabilities identified in clause 8 may be supported by the different functional groups of the NGN architecture, i.e., transport stratum functions, service stratum functions, end-user functions, and management functions.

It is recognized that, according to different possible functional implementations for the support of the identified NGN multicast capability requirements, the functions required for each specific NGN multicast capability may be provided by more than one of the functional groups of the NGN architecture.
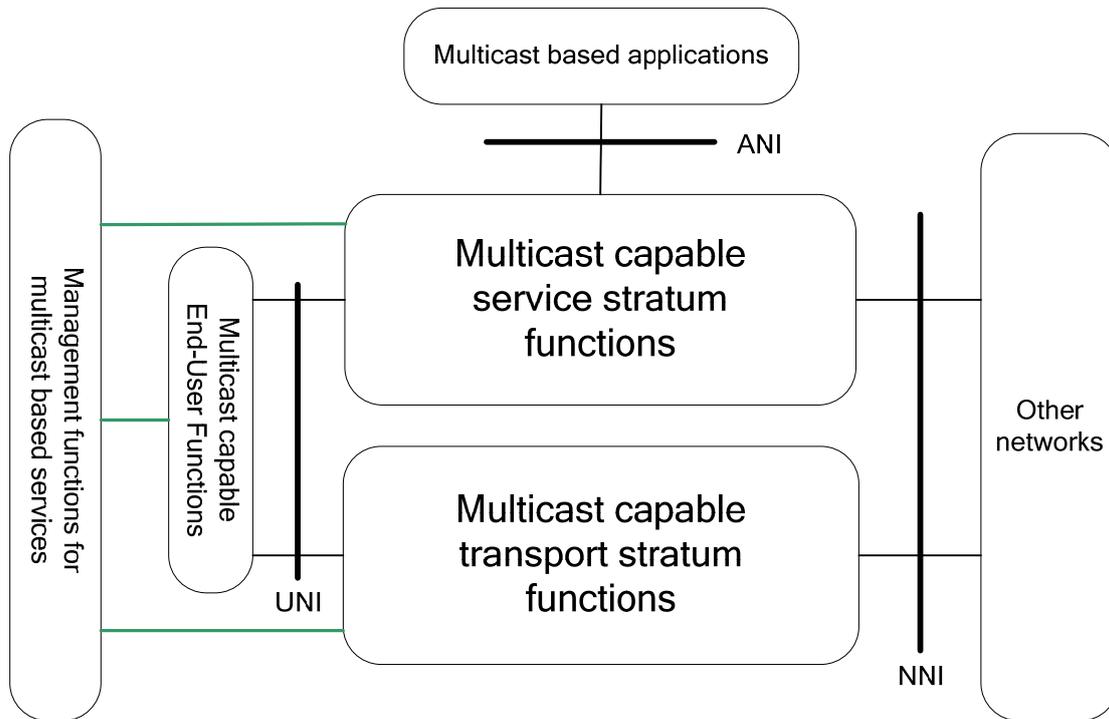
Figure 9-1 – High level illustration of the NGN multicast framework architecture

Figure 9-1 is a high level illustration of the NGN multicast framework architecture. This figure shows the following functions:

• Multicast capable service stratum functions

The NGN service stratum [ITU-T Y.2011] is the 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. User services may be implemented by a recursion of multiple service layers within the service stratum. The NGN service stratum is concerned with the application and its services to be operated between peer entities.

The functions of the NGN service stratum need to be extended to support multicast-based services. These extensions include support of multicast service control and multicast data delivery capabilities.

• Multicast capable transport stratum functions

The NGN transport stratum [ITU-T Y.2011] is the 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.

The functions of the NGN transport stratum need to be extended to support multicast-based services. These extensions include support of multicast data delivery and multicast QoS control capabilities.

- Multicast capable end-user functions

The end-user functions need to be extended to support multicast-based services, including functions for the end-user participation in multicast-based services as a sender and/or receiver.

NOTE – No assumptions are made about the diverse end-user interfaces and end-user networks that may be connected to an NGN access network. End-user equipment may be either mobile or fixed [ITU-T Y.2012].

- Management functions for multicast-based services

Support for management is fundamental to the operation of the NGN. These functions provide the ability to manage the NGN in order to provide NGN services with the expected quality, security and reliability [ITU-T Y.2012].

The management functions need to be extended to support multicast-based services. These extensions include support of group membership management capability.

9.2 Service stratum functional requirements

This clause describes the functional requirements of the NGN service stratum in support of the identified NGN multicast capabilities.

9.2.1 Multicast group management

- NGN is required to support group and group member identification management capability.
- NGN is required to support group advertisement and discovery capability.
- NGN is recommended to support group membership change notification to multicast-based services' providers and/or users.
- NGN is recommended to support group membership management capabilities such as addition and deletion of group membership.

9.2.2 Multicast service control

- NGN is required to support multicast connection management capability.
- NGN is required to support service admission control capability.
- NGN is required to support service advertisement and discovery capability.

9.2.3 Multicast data delivery

- NGN is recommended to support load sharing capability for multicast data delivery support.

  NOTE 1 – Load sharing at the service stratum is recommended in case multicast data delivery is performed at the service stratum.

- NGN can optionally support multicast data forwarding capability for providing service level multicast mechanisms.
- NGN can optionally support multicast data forwarding capability to support the one-to-many communication mode.
- NGN can optionally support multicast data forwarding capability to support the many-to-many communication mode.
- NGN can optionally support multicast data forwarding capability to support the many-to-one communication mode.

NOTE 2 – Multicast data forwarding at the service stratum may be used in case it is not supported by the transport stratum.

- NGN can optionally support reliable multicast data delivery capability for providing service level multicast mechanisms.

9.2.4 QoS control

- NGN is required to support group-wide QoS.

- NGN is required to support predefinition of a QoS parameter value set before the establishment of a multicast connection.

    NOTE – QoS control at the service stratum is required in case multicast data forwarding is performed at the service stratum.

- NGN is recommended to support advertisement of a pre-defined QoS parameter value set to multicast group members.

9.2.5 Mobility

- NGN is required to support nomadism for terminal mobility in case of multicast communications.

- NGN is required to support nomadism for personal mobility in case of multicast communications.

- NGN is prohibited from precluding support of service continuity for terminal mobility.

9.2.6 Security

- NGN is recommended to support sender/receiver authentication capability.

- NGN is required to support sender/receiver authorization capability.

- NGN is recommended to support data confidentiality capability.

- NGN is recommended to support data integrity capability.

- NGN is recommended to support group key management capability.

    NOTE – These security capabilities are provided at the service stratum in case multicast data delivery is performed at the service stratum.

9.3 Transport stratum functional requirements

This clause describes the functional requirements of the NGN transport stratum in support of the identified NGN multicast capabilities.

9.3.1 Multicast group management

- NGN is required to support group and group member identification management capability.

9.3.2 Multicast service control

- NGN is required to support multicast connection management capability.

- NGN is required to support service admission control capability.

- NGN is required to support management of the multicast-based services' scope.

9.3.3 Multicast data delivery

- NGN is required to support multicast data forwarding capability to support the one-to-many multicast communication mode.

    NOTE 1 – Multicast data forwarding capability to support the one-to-many multicast communication mode can be provided efficiently when the transport stratum supports one-to-many multicast mechanisms (e.g., IP multicast).

- NGN is required to support multicast data delivery across multiple NGN domains.

- NGN is prohibited from precluding support of reliable multicast data delivery mechanisms in the transport stratum.

- NGN can optionally support multicast data forwarding capability to support the many-to-many multicast communication mode.

- NGN can optionally support multicast data forwarding capability to support the many-to-one multicast communication mode.

  NOTE 2 – Multicast data forwarding capability for, respectively, the many-to-many and many-to-one multicast communication modes can be provided efficiently when the transport stratum supports, respectively, many-to-many and many-to-one multicast mechanisms. Many-to-one and many-to-many multicast mechanisms at the transport stratum are for further study.

9.3.4 QoS control

- NGN is required to support group-wide QoS.

- NGN is required to support predefinition of a QoS parameter value set before the establishment of a multicast connection.

- NGN is recommended to support advertisement of a predefined QoS parameter value set to multicast group members.

9.3.5 Mobility

- NGN is required to support nomadism for terminal mobility in case of multicast communications.

- NGN is required to support nomadism for personal mobility in case of multicast communications.

- NGN is prohibited from precluding support of service continuity for terminal mobility.

9.3.6 Security

- NGN is recommended to support sender/receiver authentication capability.

- NGN is required to support sender/receiver authorization capability.

- NGN is recommended to support data confidentiality capability.

- NGN is recommended to support data integrity capability.

9.4 End-user functional requirements

This clause describes the functional requirements of the NGN end-user functions in support of the identified NGN multicast capabilities.

9.4.1 Multicast group management

- End user functions are required to support group and group member identification management capability.

- End user functions are required to support group advertisement and discovery capability.

- End user functions are required to support reliable multicast data delivery mechanisms for support of multicast-based services requiring multicast reliable data delivery.

- End user functions are recommended to support group membership change notification.

9.4.2 Multicast service control

- End user functions are required to support multicast connection management capability.

- End user functions are required to support service advertisement and discovery capability.

9.4.3 QoS control

• End user functions are required to support group-wide QoS.

• End user functions are required to support predefinition of a QoS parameter value set before the establishment of a multicast connection.

• End user functions are recommended to support advertisement of a predefined QoS parameter value set from the NGN.

9.4.4 Mobility

• End user functions are required to support nomadism for terminal mobility for multicast communications.

• End user functions are required to support nomadism for personal mobility for multicast communications.

• End user functions are prohibited from precluding support of service continuity for terminal mobility.

9.4.5 Security

• End user functions are recommended to support sender/receiver authentication capability.

• End user functions are recommended to support sender/receiver authorization capability.

• End user functions are recommended to support data confidentiality capability.

• End user functions are recommended to support data integrity capability.

• End user functions are recommended to support group key management capability.

9.5 Management functional requirements

This clause describes the functional requirements of the NGN management functions in support of the identified NGN multicast capabilities.

9.5.1 Multicast group management

• NGN management functions are required to support group and group member identification management capability.

• NGN management functions are required to support group membership management capabilities such as addition and deletion of group membership (by default, these capabilities include support of group membership change notification).

• NGN management functions are required to support group creation and release management capability.

• NGN management functions are required to support group monitoring capability.

• NGN management functions are recommended to support group advertisement and discovery capability.

9.5.2 Multicast service control

• NGN management functions are required to support multicast connection management capability.

9.5.3 QoS control

• NGN management functions are recommended to support predefinition of a QoS parameter value set before the establishment of a multicast connection.

9.5.4 Security

• NGN management functions are recommended to support group key management capability.

9.6 Accounting and charging functional requirements

• NGN is required to support accounting and charging functionalities associated with the provision of multicast-based services.

 NOTE − These functionalities may reside in the NGN service stratum and/or NGN transport stratum.

Appendix I

Example scenario of multicast-based services

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

This appendix describes an example scenario of multicast-based services.
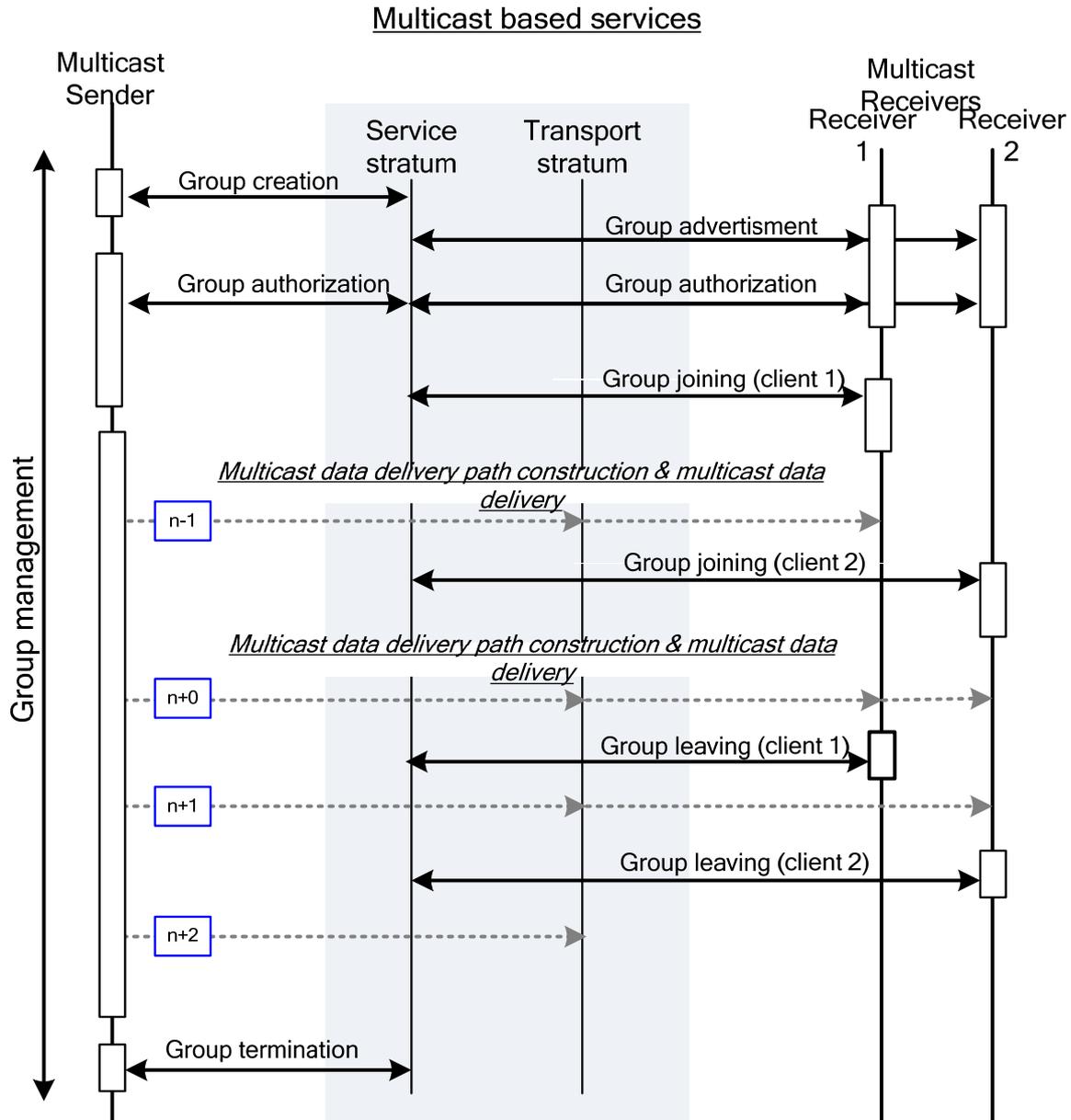
Figure I.1 – Scenario of multicast-based services (one-to-many communication mode)

- Group creation

    At the start of a multicast-based service, a multicast group is created in the service stratum. Various pieces of information of the multicast-based service such as group address and media types are defined in this phase.

- Group advertisement

  Potential or candidate members of the multicast group are notified of the creation of a new multicast group through group advertisement. Examples of group advertisement are EPG (electronic program guide), SDR (session directory), web page, etc.

- Group authorization

  Group members are authorized to access the multicast-based service through multicast authorization procedures. When a group is not open to the public, a member is required to have access permission to use the multicast-based service. An example of group authorization is the use of ID and password.

- Group join

  The subscribed members join the multicast-based service. Since a multicast-based service can be implemented in several ways, each multicast member joins the multicast-based service by using the appropriate method such as IGMP, proxy IGMP, etc.

- Multicast data delivery path construction

  The multicast data delivery path is constructed from the multicast sender to multicast receivers. The method of constructing the multicast data delivery path depends on the underlying network technologies. For example, IP multicast uses multicast routing protocols, and other multicast technologies use multicast tree management protocol in the NGN service stratum.

- Multicast data delivery

  Multicast data are delivered from the multicast sender to multicast receivers along the constructed multicast data delivery path.

- Group leave

  Multicast group participants can leave a multicast-based service.

- Group termination

  Multicast-based services can be terminated. During the group termination phase, NGN needs to release the allocated network resources such as multicast address, network bandwidth, etc.

- Group management

  During the operation of a multicast-based service, the service provider may need to monitor the multicast-based service for management of multicast groups or for other administrative purposes. As some group participants may affect the operation of the multicast-based service, the service provider needs to control those participants to provide a robust multicast-based service.

  Group management is also needed to control and distribute a group key to provide a secure multicast-based service. If the service is being degraded due to the lack of resources or network fault, the service provider may take actions to solve such problems.

Appendix II

End-to-end multicast data delivery across multiple NGN domains

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

This appendix describes some aspects related to multicast data delivery across multiple NGN domains. Each NGN domain may be administrated by a different provider which may have different policies or different network capabilities. Due to the heterogeneity of NGN domains, multicast data delivery across multiple NGN domains can have some limitations.

The different policies of the different NGN domains should be associated for interworking. In order to provide successful multicast data delivery, the NGN domains need to interwork different NGN multicast capabilities such as multicast group management, multicast service control, multicast data delivery, QoS control, mobility, security, etc.
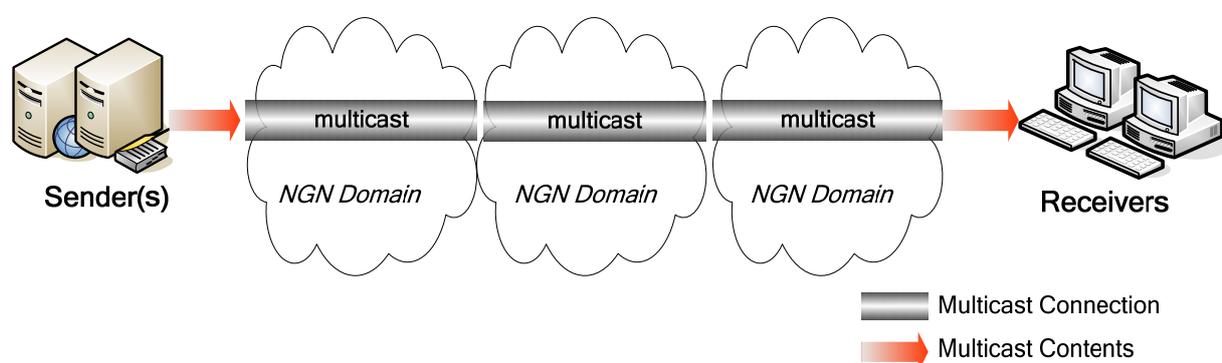
Figure II.1 – End-to-end multicast data delivery across multiple NGN domains

Figure II.1 shows the delivery of multicast contents through the multicast connections that are established by the various NGN domains. The NGN domains need to support interworking capabilities to achieve end-to-end multicast data delivery.

Appendix III

Concepts of group and phases of a multicast communication

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

This appendix describes various instances of multicast group and different phases of a multicast communication based on relevant terms contained in [ITU-T X.601].

III.1 Concepts of group

III.1.1 Multicast group

It is a set of service users that abide by appropriate group-membership criteria, or a set of rules for belonging to a group that enables multicast-based services and applications utilization.

NOTE – To each multicast group, a group name is assigned. The group name and the rule defining the multicast group are known, but it may not be feasible to determine all service users that satisfy the rule.

III.1.2 Registered group

It is a set of multicast group members that have indicated implicitly or explicitly to the group manager their intention to be a member of the enrolled group.

III.1.3 Enrolled group

It is a set of registered group members that is assigned with a group address. A member of an enrolled group can be reached by its individual address.

III.1.4 Active group

It is a set of enrolled group members that has entered the multicast data transfer phase, satisfying the requirements for participating in a group communication.

III.2 Phases of a multicast communication

A multicast communication needs different phases of communication such as creation/release, registration/de-registration, enrolment/de-enrolment, activation/deactivation and data transfer. This clause describes the phases of a multicast communication and the relationship with the different instances of the group. Figure III.1 shows the life cycle state transition diagram of a group member and the phases of a multicast communication.
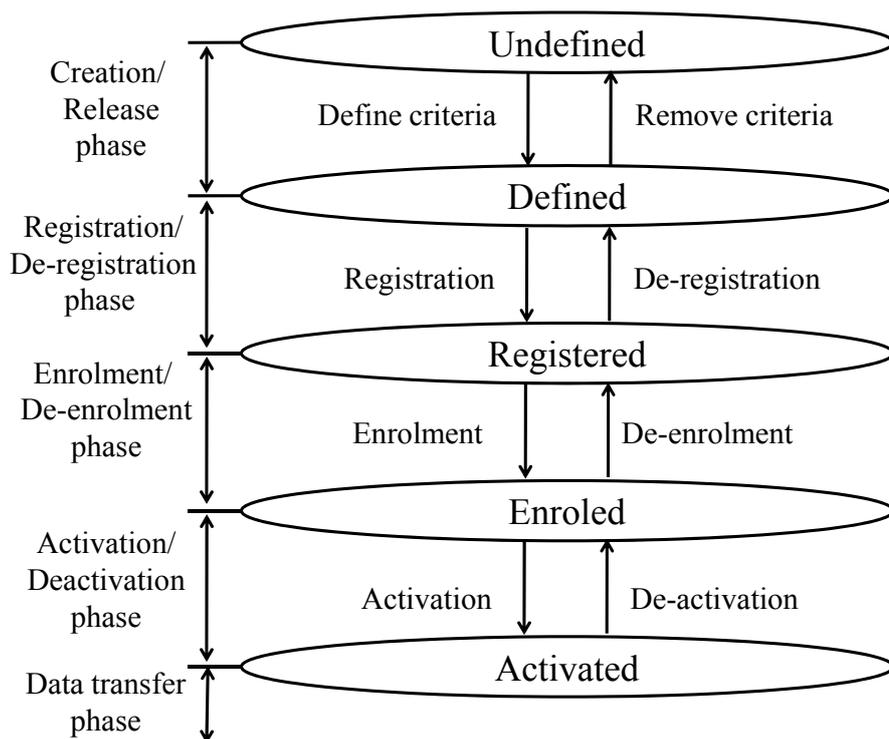
Figure III.1 – Lifecycle state transition diagram of a group member

- Creation/release phase

    The first phase associated with a multicast-based service is the creation of the multicast group. The multicast group may be created by specifying the set of rules that define the future enrolled group membership. A multicast group is created in this phase by the group management functions. In this phase, the service provider can announce service availability to multicast-based service users.

- Registration/de-registration phase

    After successful creation of a multicast group, a multicast-based service user is required to inform the group manager about his/her intention to become a member of the enrolled group. A registration phase can be understood as simply letting the group manager to know peer names and addresses of multicast group members. Thus, a registered group is composed of members of a multicast group that have successfully performed the registration phase. In this phase, a multicast-based service user can subscribe to the multicast-based service group and wait for the acknowledgement of the subscription and permission to enrol in a group.

- Enrolment/de-enrolment phase

    The enrolment phase allows the registered user to become a member of the enrolled group. An enrolled group is composed of members that have successfully performed the registration and the enrolment phase. This is the phase when a multicast-based service user waits for the multicast-based service to start.

- Activation/deactivation phase

   The activation phase establishes the shared state of a specific instance of the multicast-based service based on the information exchanged during the enrolment phase. The successful completion of the activation phase leaves the user in the data transfer phase. An active group is composed of enrolled group members that have completed the activation phase. In this phase, a multicast-based service user is ready to send or receive data.

- Data transfer phase

   The data transfer phase involves the actual transfer of data among the group participants who belong to the active group. Data transfers are allowed among the participants only if the integrity condition is satisfied.

Appendix IV

QoS aspects of multicast communications

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

Group members may have different QoS characteristics so that they need to agree on a QoS parameter value set before the initiation of a multicast communication. This appendix describes various QoS aspects of multicast communications based on [ITU-T X.601].

IV.1 Levels of QoS agreement

This term is used to describe the agreed actions, which are to be taken by the service provider and/or the service users to maintain the agreed levels of QoS.

Two levels of agreement are defined: best effort and guaranteed.

- Guaranteed QoS level

    In the guaranteed QoS level, the agreed QoS must be guaranteed so that the requested level will be met. This implies that the service will not be initiated unless there is the expectation that it can be maintained within the specified limits.

- Best-effort QoS level

    The weakest QoS level so that all parties do their best to meet the user requirements without compromising any services for which a guarantee QoS level is offered. In this case, there is no assurance that the requested QoS will be provided.

IV.2 QoS metrics

QoS metrics describe the performance parameters of networks, such as speed or reliability of multicast traffic, that need to be considered. The traditional parameters used to measure network QoS are bandwidth, delay, jitter and packet loss.

- Bandwidth

    The "bandwidth" of a link refers to the ability of the link to transfer data at a rate expressed commonly in bits per second. The bandwidth is an important factor in evaluating and provisioning QoS. There are several factors related to bandwidth, including maximum burst size, peak bandwidth, minimum guaranteed bandwidth, and average bandwidth.

- Delay

    Delay in packet transmission can significantly affect the quality of real-time traffic. Packets belonging to real-time traffic benefit when delay is minimized across the network.

- Jitter

    Jitter is defined as the variation in the delay introduced between different packets of a single transmission. Jitter may be caused by bandwidth constraints and network congestion.

- Packet loss

    Packet loss may be due to various factors such as low bandwidth and link congestion. Intelligent user equipments are capable of reconstructing data using various algorithms, but extreme packet losses may result in the inability to reconstruct data.

Bibliography

[b-ITU-T Q.1706]   Recommendation ITU-T Q.1706/Y.2801 (2006), *Mobility management requirements for NGN*.

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