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

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

Requirements for distributed service networking capabilities

Recommendation ITU-T Y.2206

ITU-T Y-SERIES RECOMMENDATIONS

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

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	**Y.2200–Y.2249**
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Numbering, naming and addressing	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Future networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Y.2206

Requirements for distributed service networking capabilities

Summary

Recommendation ITU-T Y.2206 specifies requirements for distributed service networking (DSN) capabilities.

The main objective of this Recommendation is to provide guidance regarding the design of networks, services and applications making use of DSN.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Y.2206	2010-04-30	13

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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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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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

Recommendation ITU-T Y.2206

Requirements for distributed service networking capabilities

1 Scope

This Recommendation specifies requirements for distributed service networking (DSN) capabilities necessary to guide the design of networks, services and applications supported through the use of DSN.

The specific mapping of requirements for DSN capabilities into requirements for existing and extended NGN capabilities is 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 Q.1706] Recommendation ITU-T Q.1706/Y.2801 (2006), *Mobility management requirements for NGN*.

3 Terms and 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 control plane [b-ITU-T Y.2011]: The set of functions that controls the operation of entities in the stratum or layer under consideration, plus the functions required to support this control.

3.1.3 data plane [b-ITU-T Y.2011]: The set of functions used to transfer data in the stratum or layer under consideration.

3.1.4 overlay network [b-ITU-T Y-Sup.10]: A network of nodes and logical links that is built on top of the underlying, e.g., transport, network with the purpose of providing network service that is not available in the underlying network.

3.1.5 personal mobility [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 [b-ITU-T Y.101]: A structure set of capabilities intended to support applications.

3.1.7 service provider [b-ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider. See 1.4.6/M.3320.

3.1.8 terminal mobility [b-ITU-T Q.1703]: 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. Terminal mobility can be further classified into: continuous terminal mobility (handover) and discrete terminal mobility (roam).

3.1.9 trust [b-ITU-T Y.2701]: Entity X is said to trust entity Y for a set of activities if and only if entity X relies upon entity Y behaving in a particular way with respect to the activities.

3.1.10 user [b-ITU-T Y.2091]: A user includes end user, person, subscriber, system, equipment, terminal (e.g., FAX, PC), (functional) entity, process, application, provider, or corporate network.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 core DSN node: A DSN node deployed in the service provider domain.

3.2.2 distributed service networking (DSN): An overlay networking which provides distributed and manageable capabilities to support various multimedia services and applications.

3.2.3 DSN node: A node used in DSN providing distributed functionalities, including distributed routing and distributed storage.

NOTE – The node can be seen as a set of functions grouped together.

3.2.4 peer-to-peer (P2P): A system is considered to be P2P if the nodes of the system share their resources in order to provide the service the system supports. The nodes in the system both provide services to other nodes and request services from other nodes.

3.2.5 user DSN node: A DSN node in the user domain, e.g., a PC, mobile terminal, etc.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API	Application Programming Interface
DSN	Distributed Service Networking
IMS	IP Multimedia Subsystem
IP	Internet Protocol
NAT	Network Address Translation
NGN	Next Generation Network
OAM	Operation, Administration and Maintenance
P2P	Peer-to-Peer
PSTN	Public Switched Telecommunications Network
QoS	Quality of Service
SLA	Service Level Agreement
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

5 Conventions

In this Recommendation:

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

The phrase "is prohibited from" indicates a prohibition which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The phrase "is recommended" indicates a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be satisfied to claim conformance.

The phrase "is not recommended" indicates 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 satisfied.

The phrase "can optionally" indicates 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 the Recommendation.

A DSN service provider is to be understood as a service provider that makes use of DSN in order to provide services and applications to its users.

6 High level requirements for DSN capabilities

DSN is based upon the use of a collection of nodes organized in a peer-to-peer (P2P) or other distributed fashion and the links between the nodes for the purpose of enabling multimedia services and applications. It is assumed that DSN is an overlay above IP. Collectively, the nodes provide a distributed mechanism. DSN also provides capabilities for application layer QoS support.

The high level requirements for DSN capabilities are provided in the following clauses.

6.1 Routing

6.1.1 DSN is required to support routing in the control plane using distributed mechanisms, such as those based upon P2P techniques.

NOTE – P2P-based routing mechanisms are used for node searching: locating the called parties, requested contents, etc.

6.1.2 DSN is required to offer data-plane routing optimization using distributed mechanisms, such as those based upon P2P techniques.

NOTE 1 – Different applications have different data-plane routing requirements; e.g., VoIP requires low latency and jitter; downloading needs high throughput and high QoS and video conferencing needs both.

NOTE 2 – To meet these different requirements, P2P technology can offer better-than-best-effort routing, which is hard to realize in the native IP network, by the use of application layer routing optimization. For example, sometimes the routing path selected may be congested and one DSN node will be selected to perform a relay function to establish a new path, so as to improve the QoS.

6.1.3 DSN is required to support NAT traversal between DSN nodes separated by one or more NATs.

6.1.4 DSN is recommended to support multicasting of content.

NOTE – Multicasting capability efficiently utilizes the network resources in delivering content to multiple receivers.

6.1.5 DSN is recommended to support multipath distributed routing, which includes delivery of the same traffic from one DSN node to another DSN node via different paths.

NOTE – This support includes routing based on user DSN node information that provides optimized delivery according to the location and heterogeneity (such as in terms of supported access technologies) of DSN nodes.

6.2 Numbering, naming and addressing

6.2.1 DSN is required to provide numbering, naming and addressing capability of DSN nodes.

6.2.2 DSN is required to support the separation of the DSN node network address and the DSN node identifier.

6.2.3 DSN is recommended to provide mapping between a DSN node network address and a DSN node identifier.

6.2.4 The DSN node identifier is required to be unique and consistent.

6.3 Load balancing

6.3.1 DSN is required to dynamically balance the traffic to DSN nodes, based on the status and/or capabilities of DSN nodes, operator's policy, etc.

6.4 Scalability

6.4.1 DSN is required to offer scalability by using P2P and other distributed mechanisms, so that the DSN capacity of providing service to users is proportional, or nearly proportional, to the number of the DSN nodes.

6.5 Fault tolerance

6.5.1 DSN is required to be fault tolerant to ensure reliability and availability of DSN in order to handle abnormal events, such as a single DSN node failure and multiple DSN node failures located in the same region.

In the case of these failures, other DSN nodes are required to dynamically replace the capabilities of the failed DSN node(s) to provide consistent service to end users.

6.6 Mobility support and service continuity

6.6.1 DSN is recommended to support service continuity in case of terminal and personal mobility.

6.6.2 DSN is required to continue the service provision when the DSN node moves or roams.

6.7 Quality of service

6.7.1 DSN is recommended to support end-to-end QoS to ensure the required service level quality for users or applications, especially end-to-end high bandwidth assurance for high quality video services and low delay assurance for video conferencing in the IP network environment.

6.7.2 DSN is required to support application layer QoS.

NOTE – Application layer QoS means the QoS specific to certain services like VoIP, P2P streaming, etc.

6.7.3 DSN is recommended to support DSN node selection to match the service level quality requirements for users, based on DSN nodes' capability.

6.7.4 DSN is recommended to support service capability negotiation mechanisms between users. That is, the DSN user is able to interact with the DSN to obtain a list of DSN nodes and their capabilities, so that it can select those nodes with service capabilities matching the service requirements.

NOTE – The service capabilities of a DSN node can include, but are not limited to, the following capabilities:

– available uplink bandwidth;

– the number of concurrent served users and the maximum number of supported served users;

– the number of concurrent data connections and the maximum number of supported data connections.

6.8 Interworking

6.8.1 Networks supporting DSN capabilities are recommended to interwork with networks that do not natively support DSN capabilities (e.g., PSTN, ISDN, etc.).

6.9 Accounting in the distributed environment

6.9.1 DSN is required to provide accounting on DSN service usage.

NOTE – Accounting information includes records of the service activity of users. This information can be used for billing and/or providing incentives to contributing user DSN nodes.

6.10 OAM in the distributed environment

6.10.1 DSN is required to support mechanisms for the service and network provider to perform operation, administration and maintenance (OAM) in trusted DSN nodes.

NOTE – DSN nodes deployed by the operators can be considered to be trusted, and also some user DSN nodes can be considered to be trusted if they can satisfy certain security requirements.

6.11 Traffic and topology awareness

6.11.1 To realize traffic optimization, DSN is required to support the following topology-aware features:

a) DSN is required to provide topology related information for the DSN nodes located within its network;

NOTE – The granularity of topology information can vary.

b) DSN is required to identify the preferred path between any pair of DSN nodes. The path information can be based on historical data or on real-time data to reflect the traffic congestion situation between those DSN nodes;

c) DSN is required to prevent the network's topology from leaking to applications.

6.11.2 It is recommended that DSN uses its topology information including geographic information and path measurement information in order to support services and applications.

6.12 Traffic optimization

6.12.1 DSN is recommended to provide control over its traffic optimization according to optimization objectives.

NOTE – Optimized traffic may come from content delivery application, or from real-time applications, such as voice and multimedia telephony. The optimization objectives include: traffic localization, inter-operator traffic minimization, use of cache to improve DSN performance, improvement of voice performance, etc.

6.12.2 DSN is recommended to provide traffic localization support for content delivery.

NOTE – Content delivery may cause the traffic to unnecessarily traverse inter-domain routing paths, which results in large amounts of inter-domain transit traffic.

6.12.3 DSN is recommended to minimize traffic that traverses inter-operator links, thus reducing operating costs and improving resource usage.

6.12.4 DSN is recommended to provide optimized routing of voice, multimedia telephony and other real time services, in order to enhance the performance of these services.

6.12.5 DSN is required to support cache capability for content and content location to realize traffic control and optimization.

6.13 Bandwidth management

6.13.1 DSN is required to support management of bandwidth for DSN services.

NOTE – In services like content delivery, a DSN node can set the bandwidth limitation of the uploading and downloading traffic.

6.14 Terminal support

6.14.1 DSN is recommended to support all the terminals that can be used in the NGN environment, including the terminals roaming into networks supporting DSN capabilities that have no specific DSN software or functionalities.

NOTE – NGN terminals that need to be supported depend on network operators' requirements and/or national regulations.

6.15 Resource contribution and usage management

6.15.1 DSN is recommended to provide resource contribution and usage management capability in order to collect information on resource provision and consumption of user DSN nodes.

NOTE – DSN service providers can use this information to provide incentives to users such as rate discount and access right extension. It is also possible to use this information to give more resources to nodes that contribute to DSN during content distribution. The resources include application-related resources and DSN infrastructure resources. Application-related resources include content, subscription data, etc. DSN infrastructure resources include network bandwidth, storage, CPU usage, etc.

6.16 Heterogeneity support

6.16.1 DSN is required to provide mechanisms to support heterogeneous access networks and terminals.

NOTE – There are various types of heterogeneous networks and terminals (or peers) in terms of their resources and/or characteristics. For example, user DSN node in a WLAN can contribute 11~54 Mbit/s network bandwidth, but the user DSN node in a cellular network may have difficulty in contributing more than 1 Mbit/s of bandwidth in wide-spread 2G/3G access. If the same service is used for both user DSN nodes, DSN should support adaptation according to the different characteristics of the access networks, by providing different QoS or different contents through service policies.

6.17 Adaptability to service and network environment

6.17.1 DSN is recommended to provide mechanisms to adapt to changes of service and network environment (e.g., terminal capability, network status, user preference, service policy, overlay membership, terminal location, etc.).

NOTE – By adapting to service and network environmental changes, the quality of DSN services can be enhanced by extra DSN infrastructure resources (e.g., bandwidth), or can be preserved at similar level even with fewer DSN infrastructure resources (e.g., network bandwidth decreases at network congestion). The adaptation target may be delivery path, content type, quality of service, content source, etc.

6.18 Dynamic DSN infrastructure resource scheduling

6.18.1 DSN is recommended to support server consolidation, to allow different services to share a single DSN node.

NOTE – Server consolidation combines multiple workloads into a smaller number of powerful resilient servers, which helps increase DSN infrastructure resource utilization efficiency and reduces overall costs.

6.18.2 DSN is recommended to provide dynamic infrastructure resource scheduling among services within a single DSN node.

NOTE – Dynamic infrastructure resource scheduling refers to the scheduling of infrastructure resources for the support of different services, according to their dynamically changing infrastructure resource requirements.

6.18.3 DSN is recommended to provide unified infrastructure resource management and dynamic infrastructure resource scheduling (e.g., in the form of on-demand service migration) across different DSN nodes for one service or multiple services.

6.19 Open service interface

6.19.1 DSN is required to offer an open interface to provide network and service capabilities.

a) DSN is required to provide programming interfaces to services. In this case, the service and the DSN network are deployed in the same node. Different services can call different APIs to realize different functions and meet different requirements.

b) DSN is required to provide messages based upon open interfaces. In this case, the service node can request the use of DSN capabilities through messages.

6.19.2 DSN is recommended to support adding APIs with minimal configuration.

6.19.3 DSN is required to provide secure access to APIs in accordance with defined SLAs.

6.19.4 DSN is recommended to support reporting and analysis of the usage of APIs.

6.20 Content distribution management

6.20.1 DSN is required to support content distribution management capabilities for initiation, termination, pause and resumption of content distribution.

NOTE – The content distribution management capability can be used to control the illegal distribution of content. It can also be used to control distribution to specific users or closed groups. A service provider can control content distribution by use of policy management.

6.20.2 DSN is recommended to support a content distribution capability based on the policy of the service provider.

6.20.3 DSN is recommended to support content distribution acknowledgement mechanisms to provide reliable distribution of content.

NOTE – This can be used for applications that need immediate synchronization, such as whiteboard and teleconferencing.

6.21 Accumulation of transferred fragmented content

6.21.1 DSN is required to support the accumulation of fragmented content transferred from multiple DSN nodes to another DSN node.

NOTE – This capability enables higher end-to-end throughput and enhances the reliability of content transfer, those are applied in applications such as streaming, downloading and file sharing.

6.22 Distributed storage and lookup

6.22.1 DSN is required to provide distributed storage of content and user profile.

NOTE – The distributed storage capability is used mainly to support sharing of streamed content or web2.0 like applications.

6.22.2 DSN is required to support data redundancy and backup consistency.

6.22.3 DSN is required to support content segmentation and distributed storage of fragmented content in various locations.

6.22.4 DSN is required to support storage of content location information for content searching.

6.22.5 DSN is recommended to support storage of content related information (e.g., charging, resolution, content size, quality, licence involved, etc.) for content searching.

6.22.6 DSN is required to provide search for contents (including fragmented content) and user profiles that are distributed across DSN. The search result is required to be unique when there are different searching criteria for one specific target.

7 Security considerations

Security requirements of DSN are for further study.

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Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
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Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
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Series U	Telegraph switching
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