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Information technology — Future Network — Problem statement and requirements —

Part 2: Naming and addressing

Technologies de l'information — Réseaux du futur — Énoncé du problème et exigences —
Partie 2: Dénomination et adressage

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 6, *Telecommunication and information exchange between systems*.

ISO/IEC TR 29181 consists of the following parts, under the general title *Information technology — Future Network — Problem statement and requirements*:

— *Part 1: Overall aspects*

— *Part 2: Naming and addressing*

— *Part 3: Switching and routing*

— *Part 4: Mobility*

— *Part 5: Security*

— *Part 6: Media transport*

— *Part 7: Service composition*

Introduction

This part of ISO/IEC TR 29181 is the second part of this Technical Report on Future Network — Problem statement and requirements developed by ISO/IEC JTC1 SC6. As ISO/IEC TR 29181-1 provides an overall perspective of the missions and requirements of the FN project, this part of ISO/IEC TR 29181 focuses on the issue of naming and addressing. The objective of this part of ISO/IEC TR 29181 is to discuss how to develop a clean slate designed new naming and addressing schemes (NAS) to help FN project achieve its lofty ambitions.

Naming and addressing schemes are the cornerstones of telecommunication networks and information systems. NAS designs not only provide fundamental building blocks for network designs, but can also influence network characteristics, performance, and capabilities. Therefore, NAS needs to be among the top priorities of network design projects.

NAS plays an even more important role in FN. As a project aimed at designing a totally new network with a clean slate design approach, FN has to produce a clean slate designed naming and addressing scheme. The need for new naming and addressing systems were based from the gaps between the existing NAS systems and the rising future demands of new applications which produces many technical challenges the existing NAS systems cannot provide satisfactory solutions. This Technical Report summarizes some of the challenges and also offers some new directions for future research on NAS standardization.

However, as the new network has to produce a network structure which would allow information to flow more smoothly, fast, and securely among various networks with various kinds of naming and addressing structures, designing a new NAS which would not only function within the new system, but also interoperate with other naming and addressing systems (such as old systems like DNS or telecom networks and new systems such as RFID and sensor networks) is a very challenging task.

Considering evolutionary approaches which seek to engage gradual improvement with available technologies while protecting the integrity of overall structure of old networks, a new scheme will produce a totally new naming and addressing scheme. A clean slate design needs thorough analysis, full understanding of the demand, careful planning, and collective work. In order to achieve the maximum benefits and find the best solution, a strategic planning document is needed before specific schemes are standardized.

Information technology — Future Network — Problem statement and requirements —

Part 2: Naming and addressing

1 Scope

This part of ISO/IEC TR 29181 describes the general characteristics of Future Network naming and addressing schemes, including problem statements, requirements, design objectives, gap analysis, and development directions.

— Problem Statements: The characteristics and problems of existing NAS in existing network will be discussed.

— Technical Challenges: A list of major technical challenges to assure that the FN-NAS will be able to provide solid technical support from the base level to meet the objectives of FN.

— Requirements: The general characteristics of Future Network are discussed and their impact on NAS design.

— Gap analysis: Examines the gap between existing network NAS and future network performance expectations.

In Annex A, FN-NAS Standardization Plan, design objectives, gap analysis, development guidance, chronological scenarios for future network naming, and addressing guidance are described in detail.

Though this part of ISO/IEC TR 29181 mainly presents a list of up-to-date surveyed problems, requirements, and plausible techniques for Future Network, it does not mean that all of those would be applied to a single Future Network in common, since the naming and addressing scheme can be applied to the various networks, such as global networks, local networks, access networks, mobile networks, etc. If a specific Future Network is designed and implemented, some appropriate parts of ISO/IEC TR 29181 would be considered depending on its network usage and its characteristics.

2 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

2.1
Future Network naming and addressing schemes
system of mechanisms to provide identify and locate for information exchange in Future Network

Note 1 to entry: The system may design new naming schemes, new addressing schemes or an integrated scheme that combines identification and location.

2.2
naming
scheme which gives identity to every computer or object connected with the network or the party who is going to send or receive information from the network

2.3
addressing
scheme which provides information on the point, where sender or receiver is located in the networks

Note 1 to entry: It contains two mechanisms, one is to define the location (address format) and another is to specify how to find the addresses.

2.4
naming authority pointer
NAPTR
type of DNS resource record, used in particular (but not only) which is used for E.164 telephone number to URI resolution

[SOURCE: IETF RFC 3403(NAPTR)]

2.5
routing locator
RLOC
sddress of an ETR

Note 1 to entry: Typically, RLOCs are numbered from topologically- aggregatable blocks that are assigned to a site at each point to which it attaches to the global Internet.

[SOURCE: IETF RFC 6830 (LISP)]

2.6
end point identification
EID
address used in the source and destination fields of the most inner LISP header of a packet

Note 1 to entry: The host obtains a destination EID the same way it obtains a destination address today. The source EID is obtained via existing mechanisms used to set a host's "local" IP address.

[SOURCE: IETF RFC 6830 (LISP)]

2.7
ingress tunnel router
ITR
router that resides in a LISP site

Note 1 to entry: Packets sent by sources inside of the LISP site to destinations outside of the site are candidates for encapsulation by the ITR. The ITR treats the IP destination address as an EID and performs an EID-to-RLOC mapping lookup.

[SOURCE: IETF RFC 6830 (LISP)]

2.8
egress tunnel router
ETR
router that accepts an IP packet where the destination address in the "outer" IP header is one of its own RLOCs

Note 1 to entry: In general, an ETR receives LISP-encapsulated IP packets from the Internet on one side and sends de-capsulated IP packets to site end-systems on the other side. ETR functionality does not have to be limited to a router device. A server host can be the endpoint of a LISP tunnel as well.

[SOURCE: IETF RFC 6830 (LISP)]

2.9
EID-to-RLOC database
global distributed database that contains all known EID-prefix to RLOC mappings

Note 1 to entry: Each potential ETR typically contains a small piece of the database: the EID-to-RLOC mappings for the EID prefixes "behind" the router.

[SOURCE: IETF RFC 6830 (LISP)]

2.10
locator
LOC
network layer topological name for an interface or a set of interfaces

Note 1 to entry: LOCs are carried in the IP address fields as packets that traverse the network

[SOURCE: ITU-T Y.2015 (2011)]

2.11
node ID
identifier used at the transport and higher layers to identify the node as well as the endpoint of a communication session

Note 1 to entry: A node ID is independent of the node location as well as the network to which the node is attached so that the node ID is not required to change even when the node changes its network connectivity by physically moving or simply activating another interface.

[SOURCE: ITU-T Y.2015 (2011)]

2.12
ID/LOC mapping storage function
stores the mapping of NGN identifiers, node IDs, and LOCs

[SOURCE: ITU-T Y.2015 (2011)]

2.13
address
identifier for a specific termination point and is used for routing to this termination point

[SOURCE: ITU-T Y.2091 (2011)]

2.14
identifier
series of digits, characters, and symbols or any other form of data used to identify subscriber(s), user(s), network element(s), function(s), network entity(ies) providing services/applications, or other entities (e.g. physical or logical objects)

[SOURCE: ITU-T Y.2091 (2011)]

2.15
name
identifier of any entity (e.g. subscriber, network element) that may be resolved/translated into an address

[SOURCE: ITU-T Y.2091 (2011)]

3 Abbreviations

DNS Domain Name Service

EID Endpoint ID

ENUM	E.164 NUmber Mapping
ID	Identifier
LER	Locator Edge Router
LOC	Locator
NAPTR	Naming Authority Pointer
NAS	Naming and Addressing Scheme
NID	Node ID
RLOR	Routing Locator

4 Problem statements

4.1 Naming and Addressing in Network Operation

Naming and addressing are an engineering approach to computer networking, and are two closely related core schemes in any network designs. Both names and addresses uniquely identify a host (or an interface on the host) Naming is a scheme which gives identity to every computer or object connected with the network or the party who is going to send or receive information from the network. -.

Addressing is a scheme which provides information on the point where receiver node is located in the networks. It contains two mechanisms in a single address field; one is to define the location and another is to specify how to find the addresses

At present, due the explosive growth of devices (especially mobile devices) and sites, scalability and mobility become hot issues to the future network.

Communication networks (composed of telecom networks and computer networks) are designed to deliver information from one point to another remote point or from one person to another person. In order to conduct the delivery, the sender must know the other party's name and where the other party is located. Therefore, a network system must contain the naming and addressing schemes as the most fundamental protocols so that the telecommunication networks and information systems know whom and where to send the information effectively and efficiently.

4.2 NAS Types

4.2.1 Telecom Network Naming and Addressing Schemes — addressing mode

The first generation of network is the traditional telecom network which is typically known for telephone system sending analogue signals through circuit switches and copper lines (or modernized fiber optical lines). The phone network connects people at two ends of the communication line. Typically, E.164 numbering system has been being used. The phone numbers have two different characteristics. One is a pure object identifier (a name), the other is function as an address.

For fixed line communication in first generation telecom networks, the fixed line telephone number is a simply address mode. A phone number actually contains information about the location and path. Fixed line telephone number is a system that mostly relies on addressing schemes. Furthermore, the E.164 is regarded as an easy-to-remember well organized addressing scheme.

Note: For example, when people dial number 861088888888,the telecom switch instantly know the identification of the party been called, but also knows which country (86) which city (10) and which location (88888888) the party is located. The telephone address is fixed, but the person who was called is unsure or not a requirement for communication.

Figure 1 — Addressing Mode NAS (Telecom network)

4.2.2 Telecom Network Naming and Addressing Schemes — naming mode

Other than the fixed line telecom networks, there is another type of network which sends communication signals not through wire but through the air, mobile telecom network, in which E.164 numbering system is also being used. In these kinds of networks, the same E.164 addressing does not provide the location (or device name) and path at the same time. The address is just a device name only, while mobile telecom network provides the path to the point where the device name is located using location management.

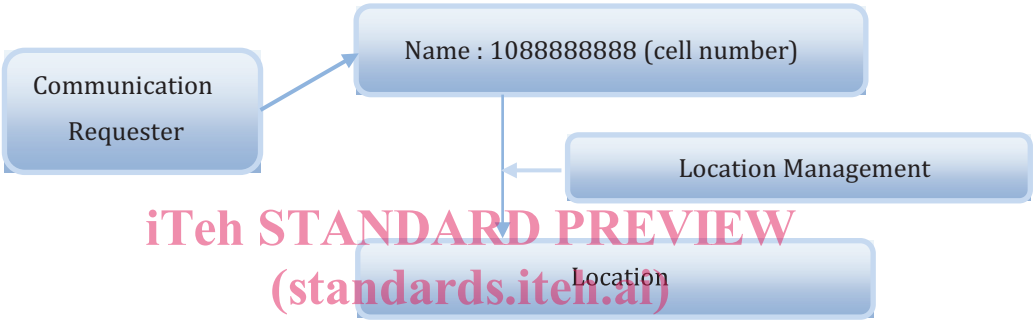

Figure 2 — Naming Mode NAS (Mobile Telecom network)

4.2.3 Computer Network Naming and Addressing Schemes — dual mode

Another generation of network is represented by Internet which mostly sending digital signals through routers and fibre optical backbones to connect computer hosts. In computer networks (Internet), there is also an address only communication mode. Internet address is composed of subnet prefix and host Identification, where host identification is to locate the host, while subnet prefix is advertised to the routers for routing path.

Since the internet address itself identifies a host or subnet, it faces some serious problems: (1) it does not scale well due to the finite address size limitation, (2) due to the renumbering, occurring whenever the network topologies change, more addresses are required, (3) the increased size of address field comes to be heavy especially in the short data payload packet, and (4) the size-increased address is worse human understandable.

Since even though the size of IPv4 address is 32 bits (relatively shorter than that of IPv6), it is not still human friendly, the name is used and translated via DNS server. It means two or more names can be assigned to the same host or site.

There is a dual mode NAS in telecommunication and information networks, in which both name and address are required for information exchange. IP based computer networks are typical dual mode NAS. IP network communication relies on domain name and IP addresses which are two different structures. Most of the computer communication involves a process inputting a domain name, finding matches involving a DNS server and converting into registered IP address.

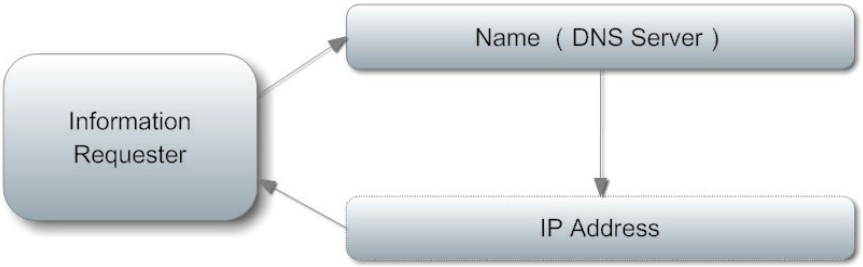

Figure 3 — Dual Mode NAS (IP network)

4.2.4 .Computer Network Naming and Addressing Schemes — naming mode

While the current internet address identifies a subnet and a host in a same address field, the other alternative is to separate host identification and subnet routing path. A same address format is separated into two new numbering spaces: an host identifier (or name) and routing locator. Each host has a globally unique ID(or EID) or name. Packet with EID is sent to the default locator router(Routing Locator, or ITR) which then map EID to destination RLOC using EID-to-RLOC database. The packet will be traversed from sending ITR to destination ETR using conventional routing mechanism. Finally the destination ETR will deliver the packet to the destination host.

While Tunnel Routers manage and maintain the routing path among them using the conventional routing mechanisms, the user only keeps the unique EID's for communication. From user's perspective, the internet access network behaves like telecom network, while the internet core itself performs in a conventional way.

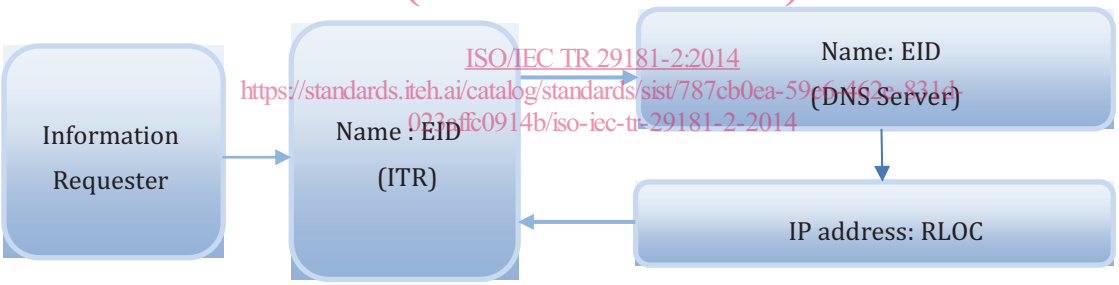

Figure 4 — Naming Mode NAS (IP network)

4.2.5 Hybrid Network Naming and Addressing Schemes — Addressing mode

Even though internet is widely deployed network and popular to users, (mobile) telecom network is another powerful and popular network as well. As long as two types of networks exist, it is natural to combine them. There are two ways to implement combined networks: Access network can be either telecom network or internet.

Since E.164 numbering is more user friendly and telecom network is more widely deployed up to date, a telephone number can be used to identify a host, while the telephone number is translated to the IP address,

Note that the use of any/multicasting changes the one-to-one association of an address with a physical endpoint

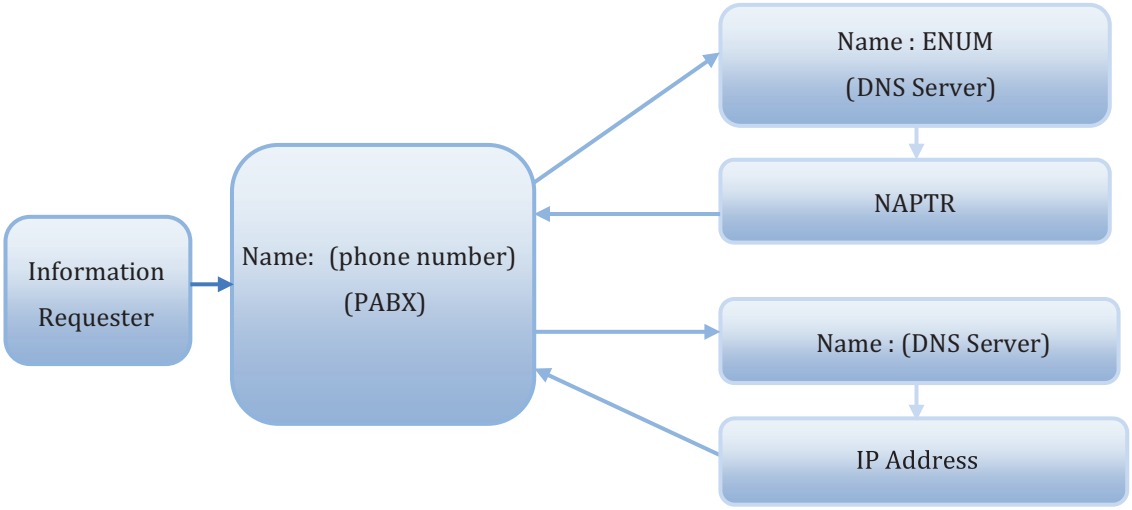

Figure 5 — Addressing Mode NAS (Telecom network + IP network)

4.3 Problems in Network Integration

The brief reviews of network naming and addressing schemes indicate some problems for any attempt to integrate existing networks.

— Telecom networks and computer networks have different addressing formats.

— Telecom networks and computer networks have different naming formats and different method in addressing searching, transporting and forwarding.

— Many forms of naming and addressing in old networks make the network integration very complicated, if not impossible. Even though technicians can find technologies to allow information shared among the networks, it would be a huge effort to overhaul the existing network infrastructures.

— In order to avoid duplicating construction, sharing network resources, providing more and better services, there is a tendency to integrate various kinds of networks into one system to allow information seamlessly transmitted among networks. This is one of the objectives for Future Network.

— Considering the fact that IP networks have the potential to be a platform for future network integration, its own problems should be fundamentally resolved. Otherwise, if they are spread into other networks, it would bring more broad and severe problems.

4.4 NAS and Network Performance

In network designs, naming and addressing are not only essential and indispensable, but should also occupy top priority in design schedules. Reasons are:

— Only after naming and addressing schemes are set, the whole architecture and other subsystems such as router designs and application services can have a base to start work on.

— NAS structures may affect network performances

— NAS format influences network security

— NAS format influences accuracy for information delivery, etc.