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Harmonizacija telekomunikacij in internetnega protokola prek omreģij (TIPHON) - Postopki za dolol̨anje naslovov IP za usmerjanje paketov po medsebojno povezanih omreģjih IP za podporo javne telefonije

Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); The procedure for determining IP addresses for routeing packets on interconnected IP networks that support public telephony

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Technical Report

Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); The procedure for determining IP addresses for routeing packets on interconnected IP networks that support public telephony

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Foreword

This Technical Report (TR) has been produced by ETSI Project Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON).

Introduction

The present document explains the procedures for *routeing* of public telephony calls to an IP network. Starting point are the existing requirements in TS 101 324 [2] on numbering, and the numbering options for users on IP terminals as identified in TR 101 327 [3]. Additional general requirements for E.164/IP resolution are identified. These requirements may form the basis for a **service capability description** for call routeing.

The present document is based on the architecture developed in Tiphon WG2.

1 Scope

The present document provides a collection of information and guidance relating to:

- the choice of naming schemes;
- the relationship of names to services;
- the role of the proposed ENUM system; and
- the resolution of names in the process of routing

for the routing of public telephone calls (i.e. calls where the called party is identified by an E.164 number) to a terminating IP network or an IP network that supports a gateway back to an SCN. The calls may originate from or transit public IP based or SCN based networks.

NOTE: This is intended to be approximately equivalent to the public telephone service defined in ITU-T Recommendation E.105.

The present document is applicable to all networks that support the public telephony service and is therefore written on the basis that the E.164 numbering scheme is used for calling and called party identification. Nevertheless the underlying principles could also be applied with minor adaptation to private network numbering schemes.

The present document applies to calls to most types of number structures within E.164 [13], and includes the support of carrier selection and number portability. It does not specifically address the support of mobility or roaming, although it would apply to the routeing of a call to the home mobile network.

The types of IP network considered include but are not limited to TIPHON Release 3. Because the routing aspects of the present document focus mainly on routing between networks for the support of a common service (public telephony), the report has a different emphasis from the main emphasis of TIPHON Release 3, which is focused on the provision of customized services to the customers of a single service provider.

The present document covers only the routeing between networks. It does not include the routeing inside a terminating network.

2 References

For the purposes of this Technical Report (TR), the following references apply:

[1] ETSI TS 101 314: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Network architecture and reference configurations; TIPHON Release 2".

[2] ETSI TS 101 324: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Numbering; Scenarios 1, 2, 3 and 4".

[3] ETSI TR 101 327: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Guide to numbering options for public networks based on VoIP technology".

[4] ETSI TR 101 287: "Services and Protocols for Advanced Networks (SPAN); Terms and Definitions".

[5] ETSI TR 102 081: "Network Aspects (NA); Number Portability Task Force (NPTF); Signalling requirements to support number portability".

[6] ETSI TR 101 697: "Number Portability Task Force (NPTF); Guidance on choice of network solutions for service provider portability for geographic and non-geographic numbers".

[7] ETSI TR 101 119: "Network Aspects (NA); High level description of number portability".

[8] ETSI TR 101 118: "Network Aspects (NA); High Level Network Architecture and Solutions to support Number Portability".

[9] ETSI TR 101 122: "Network Aspects (NA); Numbering and addressing for Number Portability".

[10] ETSI EG 201 367: "Intelligent Network (IN); Number Portability Task Force (NPTF); IN and Intelligence Support for Service Provider Number Portability".

[11] ITU-T Recommendation H.225.0: "Call signalling protocols and media stream packetization for packet-based multimedia communication systems".

NOTE: See annex G: "Communication between Administrative Domains".

[12] ITU-T Recommendation Q.769.1: "Signalling system No. 7 - ISDN user part enhancements for the support of number portability".

[13] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".

[14] ITU-T Recommendation E.105: "International Telephone Service".

[15] ISO 3166: "Codes for the representation of names of countries and their subdivisions".

[16] ITU-T Recommendation E.191: "B-ISDN addressing".

[17] ETSI ETR 316: "Broadband Integrated Services Digital Network (B-ISDN); Numbering and addressing in B-ISDN".

[18] IETF RFC 2543: "SIP: Session Initiation Protocol".

[19] IETF RFC 2131: "Dynamic Host Configuration Protocol".

[20] IETF RFC 1715: "The H Ratio for Address Assignment Efficiency".

[21] IETF RFC 1035: "Domain names - implementation and specification".

[22] ITU-T Recommendation H.323: "Framework and wire-protocol for multiplexed call signalling transport".

[23] ITU-T Recommendation H.248: "Gateway control protocol".

[24] IETF RFC 2871: "A Framework for Telephony Routing over IP".

[25] IETF RFC 2327: "SDP: Session Description Protocol".

[26] ITU-T Recommendation Q.931: "ISDN user-network interface layer 3 specification for basic call control".

[27] ETSI TS 101 878: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Service Capability Definition; Service Capabilities for a simple call".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

address: string or combination of digits and symbols which identifies the specific termination points of a connection/session and is used for routeing

called number: normally, name written as a numerical string identifying the called party or called terminal

contact ID: intermediate identifier for the destination of the next point of resolution, i.e. the destination of the next hop for the signalling messages

NOTE: The form of the Contact ID may vary and may or may not depend on the protocol and the technology used in the transport plane.

destination network: network to which a call is currently being routed

NOTE: For service resolutions that take place before the home network is reached, the destination network is the home network. For service resolutions performed by the home network (e.g. call forwarding or the support of roaming) this is the visited network.

E.164 number: number conforming to the numbering plan and structure specified in ITU-T Recommendation E.164

NOTE: See ITU-T Recommendation E.164 [13].

ENUM: telephone number mapping

NOTE: IETF working group.

home network name: network on which the customer's service application is provided whether by the network operator or a separate service provider, e.g. the network on which the customer has a subscription

NOTE: This is in most cases the network through which the customer is assigned its E.164 number.

internet named telephony: service that supports conversational voice and uses Internet names for the identification of the called party

name: combination of alpha, numeric or symbols that is used to identify end-users

NOTE: A name may be portable between Service Providers.

public telephony: service that conforms to ITU-T Recommendation E.105, i.e. it supports conversational voice and uses E.164 numbers for the identification of the called party

NOTE: From the perspective of the present document, the only point of significance is the use of E.164 numbers. The issue of whether any quality requirements should be applied to public telephony or whether E.164 numbers should be allocated only to services that achieve a certain threshold of quality is outside the scope of the present document. See ITU-T Recommendation E.105 [14].

Routeing Number (RN): within TIPHON, specific number that is used by the networks to route the call

NOTE: The Routeing Number conveys information in a form more readily usable by the network (e.g. to route calls to a ported number).

routeing: set of instructions on how to reach a destination

Second Level Domain name (SLD): part of the names in the DNS below the TLD

NOTE: Under the country code TLDs, there is a wide variation in the structure, in some countries the structure is very flat, in others there is substantial structural organization. In some country domains the second levels are generic categories (such as, AC, CO, GO, and RE), in others they are based on political geography, and in still others, organization names are listed directly under the country code.

Top Level Domain name (TLD): part of name structure in the Domain Name System (DNS) under the control of the Internet Corporation for Assigned Names and Number (ICANN)

NOTE: In the DNS naming of hosts (computers) there is a hierarchy of names. The root of system is unnamed. Below the root, there is a set of what are called "top-level domain names" (TLDs). They include the generic TLDs (EDU, COM, NET, ORG, GOV, MIL, and INT and new ones that are under creation), and the two letter country codes such as .UK, .DE and .JP from ISO-3166 [15].

transit network: network between two networks, e.g. between the originating network and the terminating network

NOTE: A transit network is not always present in a call, but in some calls there may be more than one transit network present.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACK	ACKnowledge
ALG	Application Layer Gateway
CR	Call Routing
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
ICANN	Internet Corporation for Assigned Names and Number
ID	IDentifier
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISUP	ISDN User Part
ITU	International Telecommunication Union
LAN	Local Area Network
NAT	Network Address Translators
NOA	Nature Of Address
PSTN	Public Switched Telephone Number
RN	Routeing Number
RTP	Real Time Protocol
SC	Service Control
SCN	Switched Circuit Network
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SLD	Second Level Domain
SMS	Short Message Service
TCP	Transmission Control Protocol
TLD	Top Level Domain
TRIP	Telephony Routing over IP Protocol
TSAP	Transport layer Service Access Point
UAC	User Agent Client
UAS	User Agent Server
UCI	Universal Communications Identifier
UDP	User Datagram Protocol
UPT	Universal Personal Telephony
URL	Uniform Resource Locator
VoIP	Voice over the Internet Protocol

4 The choice of naming system

4.1 Introduction to naming and addressing

4.1.1 Naming

A name is a "combination of characters and is used to identify end users (character may include numbers, letters and symbols)".

NOTE: According to ITU-T Recommendation E.191 [16].

An end user is "a logical concept which may refer to a person, a persona (e.g. work, home etc.), a piece of equipment (e.g. NTE, phone etc.), an interface, a service (e.g. freephone), an application (e.g. video on demand), or a location".

A name is distinct in function from an address, which " identifies the specific termination points of a connection and is used for routeing". Addresses are essential for communication as the end points always have to be identified in a way that can be used for routing, but names are not essential. Names are added for some services to make it easier for users to identify the distant end-point or to provide an identification system that is independent of the structure of the networks or the current location of the entity to be communicated with.

4.1.2 Addressing

An address is defined as "a string or combination of digits and symbols that identifies the specific termination points of a connection and is used for routeing". An address is a specification of the location of the entity in terms of network structure. It includes information about the location within the network and may also include the identity of the network itself and its location in the topology of interconnected networks. An address identifies the interface at which the connection is to be delivered without regard to whether the connection continues beyond that interface. It contains location information and in telecommunications this is expressed in terms of the network structure in order to achieve as high as possible a degree of aggregation that reduces the complexity of routing tables in switches or routers.

NOTE 1: According to ETR 316 [17].

Addresses differ from names in that addresses contain explicit network information and this information is what makes them usable for routing. In order to route a call or a packet, the called name must be translated into an address that identifies the location in network terms and so can be used in the routing process. When a name is ported from one location or one service provider to another, the address associated with the name changes.

Unfortunately the distinction between name and address is not followed consistently and entities that are names, or closer to names than addresses, are often spoken of as addresses. A Uniform Resource Locator (URL) pointing to a company's web page is often called an Internet address, but is actually based on a domain name.

NOTE 2: Often the word "address" is used to mean "containing location information" but this is not sufficient for the purposes of the distinction between names and address in telecommunications. Here the critical issue is whether the location information is specified in terms of network structure. For example, An E.164 number may contain location information if numbering is related to geographical areas, but such a number may be a name rather than an address if the structure that provides the location information does not relate explicitly to network structure. This would be the case for example if there is number portability between competing networks.

NOTE 3: Where a communications system is structured in terms of layers with each layer offering a service to the layer immediately above and using the services of the layer immediately below, the identities offered to the layers tend to have the properties of names. Yet when viewed from the layer above, the same identifiers have the properties of addresses. This difference in perspective may explain why the term "address" is used for email and SIP (see IETF RFC 2543, [18]) identifiers e.g. "email address" and SIP "address".

4.1.3 IP addresses

IP addresses are allocated to interfaces, but different communication streams using different protocols may share the same interface. These streams are differentiated using port numbers which are carried in the protocol (e.g. TCP, UDP or RTP) that runs on top of IP. The combination of an IP address and a port number uniquely identifies the source or destination of a stream of packets flowing between two end points. Each application protocol has a "well known" fixed port number assigned to it plus a range of port numbers for dynamic assignment to communication streams.

IP addresses are divided, in principle, into two parts:

- the identity of the network (the network part);
- the identity of the interface attached to the network (the host address, which is the destination of the IP packet).

IP address allocations are normally made through ISPs to end networks. The allocations to ISPs are made in blocks and are organized as far as practicable to be aggregatable so that traffic on a particular route is likely to have addresses in contiguous blocks. This is important to reduce the size of the routeing tables in routers where several contiguous blocks that share the same route require only one entry. The size of these routeing tables is a potential bottleneck in the growth of the Internet as router technology is only just keeping ahead of the traffic growth.

ISPs normally allocate blocks of addresses to end networks. Where the end networks have permanently connected terminals e.g. PCs connected to a LAN, the addresses may be allocated permanently to the terminals.

Conversely where terminals are likely to be disconnected frequently and where dial-up access is used, IP addresses are normally allocated dynamically, e.g. using the Dynamic Host Configuration Protocol (DHCP) (see RFC 2131 [19]). Addresses are allocated from a pool only while the customer is logged-on. After logging-off the same address will be allocated to another user.

There are two versions of IP protocols, whose address formats differ significantly:

- IPv4, a 32-bit address, which is used throughout the Internet but which is considered to be in increasingly short supply and whose allocations are being controlled carefully.

- IPv6, a 128-bit address, which is just starting to be used and should provide more than adequate capacity for the future if it is administered effectively.

IPv4 is the version of the IP protocol in general use. Use of IPv6 is only just beginning. Because the address lengths are different, the two addresses are not compatible and a long process of migration is beginning.

There are two main drivers for moving to IPv6:

- Avoiding problems when IPv4 addresses reach exhaustion.

- Obtaining benefits from features that IPv6 offers that are not available in IPv4.

There is however a disadvantage. The IPv4 header has a variable length with the minimum being 192 bits. The IPv6 header has a fixed length of 320 bits, with the possibility of additional extension headers that are normally used only by the end nodes. The fixed header length simplifies the packet handling in routers but the increased length reduces the efficiency of transmission unless header compression is applied.

UDP has a 64 bit header and TCP a 224 bit header. Therefore the maximum reduction in efficiency is 33 % (100 x (1 - ((192 + 64) / (320 + 64)))) for a zero length packet. However for speech for a 4 kbit/s speech codec with a packetization delay of 40 ms the speech packet would have a length of 4 000 x 0,04 = 160 bits and the efficiency reduction would be 24 %. For data using TCP the minimum reduction for a zero length packet would be 21 %. Thus the reduction in efficiency is greater for speech than data.

A significant uncertainty is the speed with which IPv6 will be introduced generally in the Internet world. Here there are two extremes and a continuum of possibilities between them.

- The first extreme is that ISPs will perceive some real operational advantage in using IPv6 and will introduce it as soon as possible in order to capitalize on these advantages.

- The other extreme is that ISPs will regard the introduction of IPv6 as an avoidable expense and will delay its introduction as long as possible, i.e. until the shortage in IPv4 addresses begins to be felt.

Although IPv4 has a theoretical capacity of some 4 billion (4×10^9) addresses, in practice a realistic maximum is probably some 200 million hosts. The lower practical limit is the result of the structuring of the address space and is a prediction based on observations of the points at which other numbering schemes reach saturation (see RFC 1715 [20] by Christian Huitema).

It is very difficult to obtain a well founded estimate of the current world-wide situation on allocations or when the effects of exhaustion will first be experienced. According to a paper on the IANA part of the web site (see http://www.iana.org/assignments/ipv4-address-space) of the Information Sciences Institute, there were in October 2000 some 102 unallocated/8 IP addresses out of the maximum total of 256. There were 23 allocations to the Regional Internet Registries who currently handle the allocations to ISPs and large users. The demand for allocations from these RIRs is doubling every year according to RIPE, suggesting that a further 2-3 years' growth can be accommodated without making other changes. However the remaining 131 values are allocated to organizations and large corporate and eventually some of this space could be released if necessary.