



**Smart cards;
UICC-Terminal interface;
Internet Protocol connectivity between UICC and terminal
(Release 12)**

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Content

Intellectual Property Rights	4
Foreword.....	4
Modal verbs terminology.....	4
Introduction	5
1 Scope	6
2 References	6
2.1 Normative references	6
2.2 Informative references.....	7
3 Definition of terms, symbols and abbreviations.....	8
3.1 Terms.....	8
3.2 Symbols.....	8
3.3 Abbreviations	8
4 Terminal-UICC IP configuration	9
4.0 General	9
4.1 Local client on UICC	9
4.2 Local server on UICC.....	10
4.3 Remote client UICC	10
4.4 Remote server on UICC	11
5 Protocol Stack	12
6 UICC and Terminal components requirements.....	13
6.0 Introduction	13
6.1 UICC IP layer.....	13
6.1.0 General.....	13
6.1.1 IPv4 / IPv6 interworking.....	13
6.1.2 Address allocation	13
6.1.2.0 General	13
6.1.2.1 Local Connection	13
6.1.2.2 Remote Connection.....	14
6.1.2.2.0 General	14
6.1.2.2.1 IPv4 address allocation.....	14
6.1.2.2.2 IPv6 address allocation.....	14
6.2 Local naming.....	15
6.2.0 General.....	15
6.2.1 Predefined names.....	15
6.2.2 Names provided by the UICC.....	15
6.3 Summary of terminal and UICC configuration	16
6.3.1 UICC Configuration	16
6.3.1.1 IP v4.....	16
6.3.1.2 IP v6.....	16
6.3.2 Terminal Configuration	16
6.3.2.1 IP v4.....	16
6.3.2.2 IP v6.....	16
6.4 Terminal IP Components.....	16
6.4.1 Connection setting	16
6.4.2 Routing, Network Address Translation and port forwarding.....	17
Annex A (informative): Connection of a local equipment to the terminal and UICC.....	18
Annex B (informative): Example of activation parameters.....	19
Annex C (informative): Bibliography.....	20
Annex D (informative): Change history	21
History	22

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Introduction

The present document defines how an Internet Protocol connection may be established between a UICC and a terminal connected through a UICC-Terminal Interface able to carry Internet Protocol packets, and how the UICC resources defined in ETSI TS 102 221 [11] may be accessed over this connection. Most telecommunication infrastructures rely on the Internet Protocol and therefore telecommunication terminals commonly implement the IP layers as standardized by the IETF RFC 791 [1] and by the new version in IETF RFC 2460 [7]. Connecting the UICC and the terminal at this level is expected to bring the following advantages:

- Leverage on existing standardization efforts: Applicative protocols relying on IP, e.g. running over TCP or UDP, have already been standardized for a wide variety of applications and may be used by UICC applications.
- Minimize UICC-specific developments on the terminals; reuse what is already available on terminals rather than forcing specific developments.
- Facilitate connectivity of the UICC with standard network elements such as remote servers, etc.

The present document focuses on the establishment and configuration of a generic IP connection between the UICC and terminal, without addressing specific applications that may use this connection capability.

1 Scope

The present document specifies the establishment and configuration of an Internet Protocol connection between a UICC and a terminal interfaced through a protocol that supports the transport of Internet Protocol packets.

The way the Internet Protocol packets (or similar packets such as ARP) are transported over the UICC-Terminal interface is part of the UICC-Terminal interface specification and not within the scope of the present document. The present document focuses on the configuration and establishment of the Internet Protocol connection between the UICC and the terminal.

The Internet Protocol connectivity defined in the present document may be used by applications such as the Smartcard Web Server [i.7].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- In the case of a reference to a TC SCP document, a non specific reference implicitly refers to the latest version of that document in the same Release as the present document.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] IETF RFC 791: "Internet Protocol".

NOTE: Available from <http://www.ietf.org/rfc/rfc791.txt>.

[2] IETF RFC 826: "An Ethernet Address Resolution Protocol".

NOTE: Available from <http://www.ietf.org/rfc/rfc826.txt>.

[3] IETF RFC 792: "Internet Control Message Protocol".

NOTE: Available from <http://www.ietf.org/rfc/rfc792.txt>.

[4] IETF RFC 793: "Transmission Control Protocol".

NOTE: Available from <http://www.ietf.org/rfc/rfc793.txt>.

[5] IETF RFC 2449: "POP3 Extension Mechanism".

NOTE: Available from <http://www.ietf.org/rfc/rfc2449.txt>.

[6] IETF RFC 1122: "Requirements for Internet Hosts - Communication Layers".

NOTE: Available from <http://www.ietf.org/rfc/rfc1122.txt>.

[7] IETF RFC 2460: "Internet Protocol, Version 6 (IPv6)Specification".

NOTE: Available from <http://www.ietf.org/rfc/rfc2460.txt>.

[8] IETF RFC 2463: "Internet Control Message Protocol (ICMPv6)for the Internet Protocol Version 6 (IPv6) Specification".

NOTE: Available from <http://www.ietf.org/rfc/rfc2463.txt>.

[9] IETF RFC 3022: "Traditional IP Network Address Translator (Traditional NAT)".

NOTE: Available from <http://www.ietf.org/rfc/rfc3022.txt>.

[10] IETF RFC 3314: "Recommendations for IPv6 in Third Generation Partnership Project (3GPP) Standards".

NOTE: Available from <http://www.ietf.org/rfc/rfc3314.txt>.

[11] ETSI TS 102 221: "Smart Cards; UICC-Terminal interface; Physical and logical characteristics (Release 7)".

[12] IETF RFC 4861: "Neighbor Discovery for IP Version 6 (IPv6)".

NOTE: Available from <http://www.ietf.org/rfc/rfc4861.txt>.

[13] IETF RFC 4862: "IPv6 Stateless Address Autoconfiguration".

NOTE: Available from <http://www.ietf.org/rfc/rfc4862.txt>.

[14] IETF RFC 4294: "IPv6 Node Requirements".

NOTE: Available from <http://www.ietf.org/rfc/rfc4294.txt>.

[15] IETF RFC 4291: "IP Version 6 Addressing Architecture".

NOTE: Available from <http://www.ietf.org/rfc/rfc4291.txt>.

[16] IETF RFC 2136: "Dynamic Updates in the Domain Name System (DNS UPDATE)".

NOTE: Available from <http://www.ietf.org/rfc/rfc2136.txt>

[17] IETF RFC 1035: "Domain names - Implementation and Specification".

NOTE: Available from <http://www.ietf.org/rfc/rfc1035.txt>

[18] IETF RFC 3490: "Internationalizing Domain Names in Applications (IDNA)".

NOTE: Available from <http://www.ietf.org/rfc/rfc3490.txt>

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

NOTE: Available from <http://www.ietf.org/rfc/rfc2131.txt>.

[20] ETSI TS 102 600: "Smart Cards; UICC-Terminal Interface; Characteristics of the USB interface".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IETF RFC 2060: "Internet Message Access Protocol", version 4rev1.

NOTE: Available from <http://www.ietf.org/rfc/rfc2060.txt>.

- [i.2] IETF RFC 2246: "The TLS Protocol", version 1.0.
NOTE: Available from <http://www.ietf.org/rfc/rfc2246.txt>.
- [i.3] IETF RFC 2616: "Hypertext Transfer Protocol - HTTP/1.1".
NOTE: Available from <http://www.ietf.org/rfc/rfc2616.txt>.
- [i.4] IETF RFC 959: "File Transfer Protocol (FTP)".
NOTE: Available from <http://www.ietf.org/rfc/rfc959.txt>.
- [i.5] IETF RFC 821: "Simple Mail Transfer Protocol".
NOTE: Available from <http://www.ietf.org/rfc/rfc821.txt>.
- [i.6] IETF RFC 1034: "Domain Names - concepts and facilities".
NOTE: Available from <http://www.ietf.org/rfc/rfc1034.txt>.
- [i.7] OMA-TS-Smartcard-Web-Server-V1-0.
NOTE: Available from <http://www.openmobilealliance.org>.
- [i.8] IETF RFC 768: "User Datagram Protocol".
NOTE: Available from <http://www.ietf.org/rfc/rfc768.txt>.
- [i.9] ETSI TS 102 223: "Smart Cards; Card Application Toolkit (CAT)".
- [i.10] IETF RFC 4632: "Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

application: computer program that defines and implements a useful functionality on a smart card or in a terminal

NOTE: The term may apply to the functionality itself, to the representation of the functionality in a programming language, or to the realization of the functionality as executable code.

file: directory or an organized set of bytes or records in the UICC

3.2 Symbols

Void.

3.3 Abbreviations

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

ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
DHCP	Dynamic Host Configuration Protocol
FTP	File Transfer Protocol
HTTP	HyperText Transport Protocol
HTTPS	Secure HyperText Transport Protocol
ICMP	Internet Control Message Protocol

IMAP	Internet Message Access Protocol
IP	Internet Protocol
NAT	Network Address Translation
POP	Post Office Protocol
SMTP	Simple Mail Transfer Protocol
TCP	Transmission Control Protocol
TLS	Transport Layer Security
UDP	User Datagram Protocol
URI	Universal Resource Identifier

4 Terminal-UICC IP configuration

4.0 General

This clause is an introduction to the various configurations and uses of the IP UICC. A UICC supporting IP will be deployed with at least a local address. This address relates to a private network established between the UICC and the terminal, independently from other networks to which the terminal may be connected.

The UICC shall be able to act as a combination of the following basic configurations:

- A TCP/IP or UDP/IP client of a server located on the terminal.
- A TCP/IP or UDP/IP server for a client located on the terminal.
- A TCP/IP or UDP/IP client of a server located in a network reachable through the terminal.
- A TCP/IP or UDP/IP server for a client located in a network reachable through the terminal.

Depending on the final applications, the actual configuration may be a combination of these basic configurations.

In the present document, the wording TCP/IP or UDP/IP protocol includes any application protocol such as HTTP, FTP, POP, SMTP that may be enabled by TCP or UDP, i.e. the configuration targeted is not restricted to having a web server and web client on the card.

4.1 Local client on UICC

In this configuration the UICC is a client for TCP/IP servers located on the terminal. This configuration is the simplest and does not require any routing or address translation. It requires however naming resolution inside the UICC, so that the UICC applications can resolve the server IP address from the terminal name (localterminal).

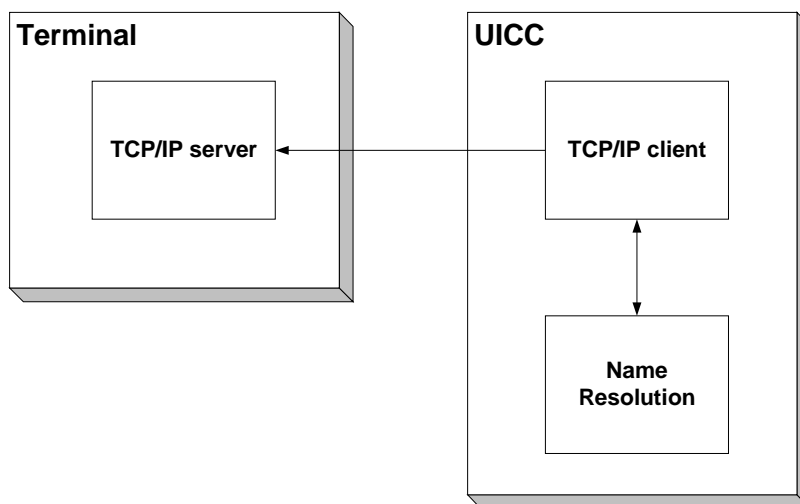


Figure 1: Local TCP/IP Client on UICC

4.2 Local server on UICC

In this configuration the UICC is a local server for a TCP/IP protocol, e.g. HTTP. The server is accessed only from the terminal. This configuration requires proper configuration of the terminal naming services, so that the terminal can resolve the UICC name (localuicc) to the UICC IP address.

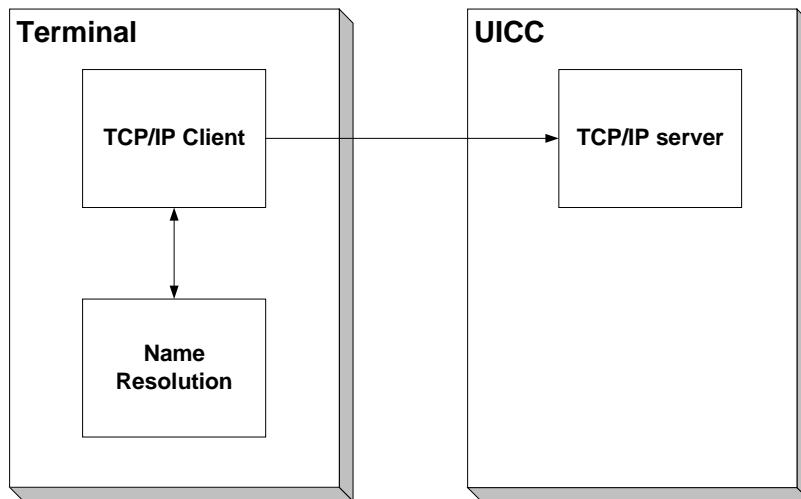


Figure 2: Local TCP/IP server on UICC

4.3 Remote client UICC

This configuration allows the UICC to act as a client for TCP/IP servers located on the internet. The network configuration requires the following:

- naming services, so that the UICC can resolve the internet server name to the internet server IP address;
- routing services on the terminal, so that the card can send/receive IP packets to/from the internet server through the terminal;
- address translation when configured with an IPv4 address, so that on the internet, packets to and from the UICC have the IP address of the UICC replaced by the IP address of the terminal.

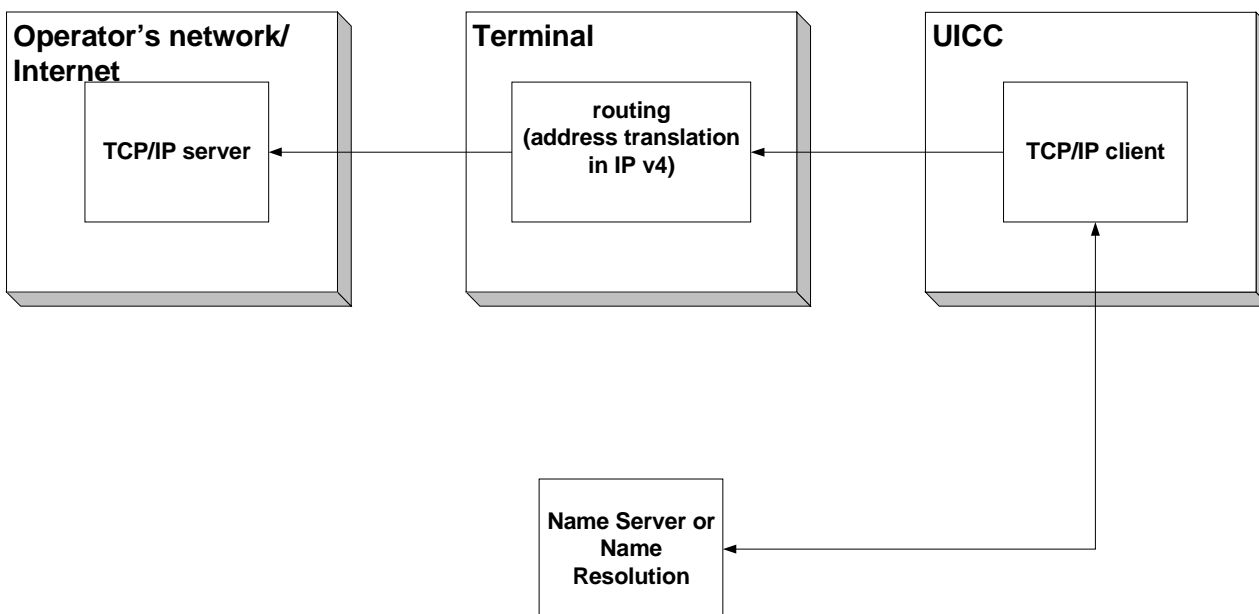


Figure 3: Remote TCP/IP client on UICC

4.4 Remote server on UICC

This configuration allows the UICC to act as a server for TCP/IP client located on a remote network (subject to limitations that may be set by the operator). The network configuration requires the following:

- Naming services, so that the internet client can resolve the UICC server name to the UICC server IP address. The way address resolution is performed in the network is out of the scope of the present document.
- Routing services on the terminal, so that the UICC can send/receive IP packets to/from the internet client through the terminal.
- Address translation when configured with an IPv4 address, so that on the internet, packets to and from the UICC have the IP address of the UICC replaced by the IP address of the terminal.
- Port forwarding when configured with an IPv4 address, so that the incoming connection request on some given port numbers will be rerouted to the UICC. For IPv4, two port numbers are defined by the IETF to be used by smart cards. The terminal shall route all the incoming traffic to these port numbers to the UICC.

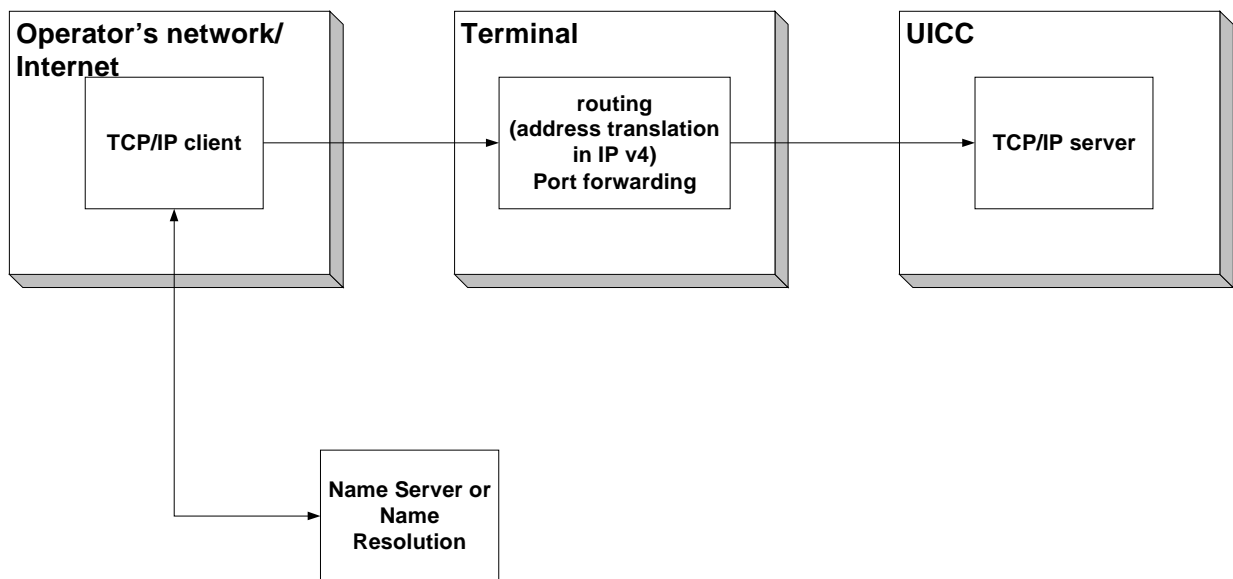


Figure 4: Remote TCP/IP server on UICC

5 Protocol Stack

The protocol layers that are considered in the present document are represented in figure 5.

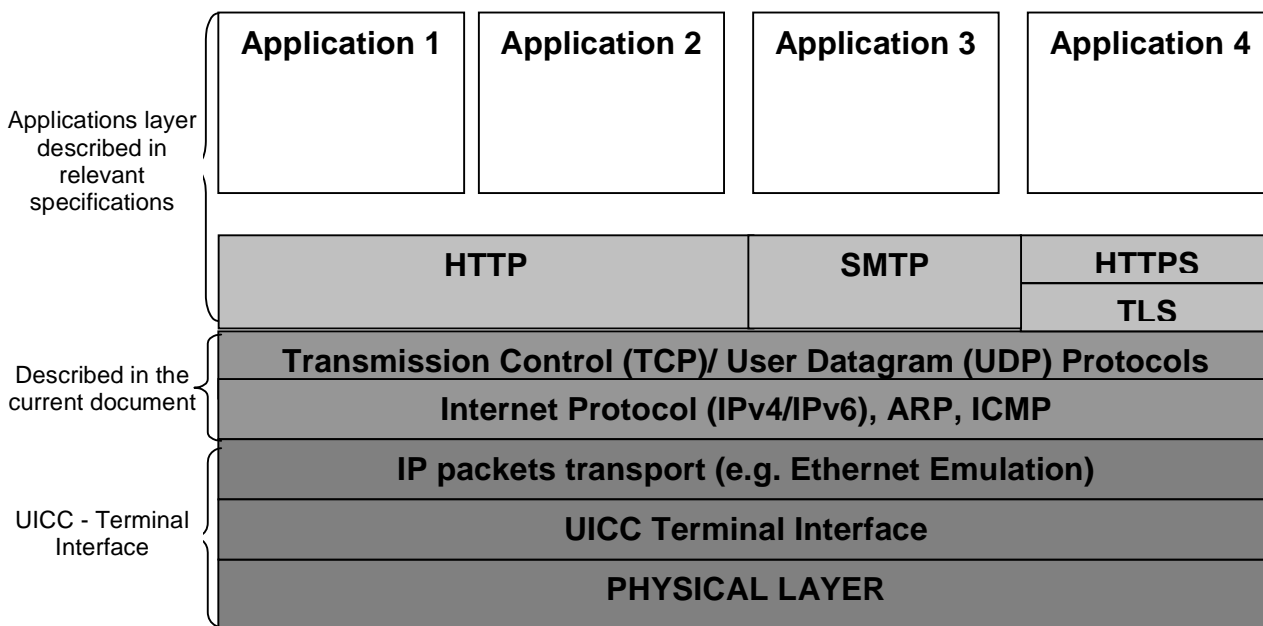


Figure 5: TCP/IP over UICC-Terminal Interface protocol stack

In figure 5, the IP, ARP, ICMP, TCP, UDP, TLS, HTTP and HTTPS layers are as standardized by the Internet Engineering Task Force (IETF) in references indicated below.

A UICC and a terminal supporting the present specification shall support the following protocols:

- IP V6 (Internet Protocol Version 6) [7], Neighbour discovery [12] and ICMPv6 (Internet Control Message Protocol) [8].
- IP V4 (Internet Protocol Version 4) [1] and ICMPv4 (Internet Control Message Protocol) [3].
- TCP (Transport Control Protocol) [4].
- UDP (User Datagram Protocol) [i.8].
- ARP (Address Resolution Protocol) [2] which is used to retrieve the MAC address when the UICC-Terminal interface only carries Ethernet frames.
- DHCP (Dynamic Host Configuration Protocol) [5] in client mode for the UICC.

Optionally, the following additional protocols may be supported:

- DHCP (Dynamic Host Configuration Protocol) [5] in server mode for the terminal
- TLS (Transport Layer security,[i.2]) or other Security protocols as profiled in relevant ETSI specifications.
- DNS (Domain Name System) [i.6].

NOTE: The requirements for the terminal how to resolve a request from the UICC for a non-local domain name (e.g. parameters to activate a connection to a remote DNS server) are not defined.

As an example applicative protocols could include HTTP (Hypertext Transport Protocol) [i.3] and HTTP Over TLS [i.2]. Other applicative protocols such as FTP (File Transfer Protocol) [i.4], SMTP (Simple Mail Transfer Protocol) [i.5], POP [5] and IMAP [i.1] may additionally be supported.

Applications needing to access information stored in the UICC file structure defined in ETSI TS 102 221 [11] may define how this is performed using the applicative layer they rely on. For example, some applications may use HTTP URI requests while others may rely on FTP.

6 UICC and Terminal components requirements

6.0 Introduction

In the IETF terminology, an Internet communication system consists of interconnected packet networks supporting communication among host computers using the Internet protocols. The networks are interconnected using IP routers or gateways. A host computer is the ultimate consumer of communication services.

The Requirements for Internet Hosts as defined in IETF RFC 1122 [6] for IPv4 and IETF RFC 4294 [14] for IPv6 have been used to build the present document.

6.1 UICC IP layer

6.1.0 General

Both IPv6 and IPv4 shall be supported, but support of IP fragmentation is not mandatory in IPv4.

6.1.1 IPv4 / IPv6 interworking

To ensure a smooth transition and deployments, it is important to provide the capability to support IPv4 in addition to IPv6 for the foreseeable future.

Depending on the destination address, the UICC will use the IP layer that matches this IP address. However, local communication between the terminal and the UICC shall use the IPv6 protocol, while the IPv4 layer is present to provide support for remote connection in the case of a legacy IPv4-only infrastructure.

6.1.2 Address allocation

6.1.2.0 General

The main difference between IPv6 and IPv4 is the address allocation mechanism. Due to the large amount of addresses available, there is no NAT mechanism for IPv6, every node connected on the network shall have its own address.

There are two possibilities to allocate the address of an IPv6 node - stateless and stateful auto configuration. The stateful address allocation mechanism needs a DHCPv6 server to allocate the address. Following the IETF recommendations for IPv6 [10], the UICC will implement stateless address configuration. In this case, the network gateway assigns a prefix which is unique in the scope of a network activation (e.g. PDP context), the different nodes are in charge of self assigning a unique interface identifier.

6.1.2.1 Local Connection

The allocation of the local IPv6 address of the UICC shall follow these steps:

- The UICC calculates its own local IPv6 address [13] from a unique value in the UICC (e.g. MD5 or SHA of the ICCID) with the universal bit of the interface identifier set to 1 as defined in IETF RFC 4291 [15]. This calculation can be done both in the network gateway and the UICC, avoiding creating a field in the subscriber database.
- The UICC sends a multicast Neighbor Solicitation message to the terminal. This message will be used by the terminal to discover the UICC's address suffix.

- The Terminal sends a Neighbor Advertisement message to the UICC using the previously discovered UICC address. This message will be used by the UICC to get the terminal's address suffix. The present document makes no assumption on the way to allocate the terminal address suffix. Support of duplicate address detection is not required.

At this stage, the terminal and the UICC have established a local connection and resolved their respective addresses. It should be noted that the stateless configuration is used for the local network configuration. The same procedure can be used for a locally connected equipment.

6.1.2.2 Remote Connection

6.1.2.2.0 General

The establishment of a remote connection to the network gateway for the UICC is triggered by any packet sent by the UICC with an address out of the scope of the local network. In IPv6, the first message sent by the UICC shall be a router solicitation message.

6.1.2.2.1 IPv4 address allocation

The present version relies on either a fixed address allocation, statically allocated by the terminal and the UICC or address allocation by a DHCP server in the terminal as follows:

- UICC IP address: 192.168.0.1.
- Terminal IP address: 192.168.0.2.

In case a DHCP server is present in the terminal, the UICC shall use this DHCP. The DHCP client and server shall behave as follows:

DHCP Discover:

To minimize traffic between the DHCP client and server, the DHCP client shall not include any option in the request.

DHCP Offer:

To avoid a situation where the UICC is replaced and the IP address never comes back to the DHCP server, the DHCP client shall always start in INIT state (see IETF RFC 2131 [19]) whenever the layer transporting the IP packets enters operational mode. The DHCP server shall reassign the UICC IP address when receiving a DHCP discover and shall probe the UICC IP address before reassigning it.

It is recommended to reduce the network load from the renewal request traffic. Therefore the DHCP server shall use infinite lease. In addition, and to reduce the amount of data transmitted between the DHCP client and server, the DHCP server shall only use the "Server Identifier" and the "IP address lease time" options.

NOTE: When the layer transporting the IP packets leaves operational mode, the DHCP server may release all IP addresses allocated on the UICC interface.

For an underlying layer according to ETSI TS 102 600 [20], entering operational mode happens when the UICC is configured and leaving operational mode happens when the UICC leaves Configured state - except for Suspended state.

6.1.2.2.2 IPv6 address allocation

The UICC sends a router solicitation message to the terminal.

If the terminal needs some network activation parameters, they should be retrieved as described in clause 6.4. The terminal does the network activation if no appropriate connection is available.

The terminal sends back a router advertisement message to the UICC. This message may be generated by the terminal itself or be a forwarded from the network.

Based on the previously received message, the UICC set its address prefix according to the prefix received in the router advertisement. The UICC is now ready to send messages over the network.

6.2 Local naming

6.2.0 General

To resolve the local name of the UICC / the terminal, the following mechanisms shall be implemented in the terminal/the UICC.

6.2.1 Predefined names

In order to facilitate application development and interoperability, the ME shall be referenced by **localterminal** and the UICC by **localuicc**.

6.2.2 Names provided by the UICC

If applications on the UICC require the use of customized names for their access from the terminal side, the following mechanism shall be used by the UICC to provide names to the terminal. Requests by applications on the terminal using these names shall be resolved to the UICC.

A subset of the DNS UPDATE message encapsulation according to IETF RFC 2136 [16] shall be implemented on the terminal.

After resolution of its IP address, a UICC requiring customized name(s) shall send a DNS update message to the terminal. The message shall have the following settings:

- transport protocol: UDP;
- server port on the terminal: 53;
- ZOCOUNT, PRCOUNT and ADCOUNT are all zero (no zone, prerequisite and additional data);
- the update section contains one or more RRs (resource records).

The RRs shall have the following settings:

- NAME: domain name to be associated to the IP address.
- TYPE: A for IPv4, AAAA for IPv6.
- CLASS: IN (internet).
- TTL: 'FF FF FF FF' (unlimited time to live).
- RDATA: IP address.

Thus each message will consist of the header section and one resource record per name as specified in IETF RFC 2136 [16] and IETF RFC 1035 [17].

The domain names shall be coded as defined in IETF RFC 1035 [17], i.e. using ASCII characters, or as defined in IETF RFC 3490 [18] for internationalized domain names.

The terminal shall respond with a message as defined in IETF RFC 2136 [16] section 3.8 with ZOCOUNT, UPCOUNT, PRCOUNT and ADCOUNT set to zero.

A new message shall completely replace previous information. If the update section is empty, no customized names shall be associated to the UICC.

NOTE: Terminal behaviour in case of collisions between names in the internet and names requested by the UICC is undefined. So name collisions should be avoided.

6.3 Summary of terminal and UICC configuration

6.3.1 UICC Configuration

6.3.1.1 IP v4

If there is no DHCP server in the terminal, the IP address is: 192.168.0.1.

If there is a DHCP server in the terminal, the IP address is allocated by this DHCP server.

Network mask: 255.255.255.0.

Operator's name server.

In case there is no DHCP server in the terminal, the UICC network routing table shall be the following:

Network Destination	Gateway	Netmask	Interface
192.168.0.0	*	255.255.255.0	UICC-Terminal interface
127.0.0.1	*	255.0.0.0	Loopback interface

6.3.1.2 IP v6

In IP v6, the UICC address shall be dynamically configured according to stateless configuration mode [13].

6.3.2 Terminal Configuration

6.3.2.1 IP v4

If there is no DHCP server in the terminal, the terminal shall use: IP address 192.168.0.2, network mask: 255.255.255.0.

If there is a DHCP server in the terminal, the IP address is allocated by this DHCP server.

In case there is no DHCP server in the terminal, the terminal network routing table shall be the following:

Network Destination	Gateway	Netmask	Interface
192.168.0.0	*	255.255.255.0	UICC-Terminal interface
127.0.0.1	*	255.0.0.0	Loopback interface

The network routing table shall be completed according to the activation parameters provided by the currently active Network Access Application.

6.3.2.2 IP v6

In IP v6, the terminal address shall be dynamically configured according to stateless configuration mode [13]. The network routing table shall be completed according to the activation parameters provided by the currently active Network Access Application.

6.4 Terminal IP Components

6.4.1 Connection setting

The network activation by the terminal for the UICC is triggered by an IPv6 router solicitation message sent by the UICC, or by any message sent by the UICC to a non local address when using IPv4. The terminal may use an already existing network activation context provided that its parameters are compatible with those requested by the UICC. Otherwise a new network activation shall be done.

The way to retrieve the network activation parameters to be used by the terminal for the UICC shall be specified by the Network Access Application. Network activation parameters shall be retrieved each time the Network Access Application providing network connectivity is initialized or if the NAA indicates to the terminal that an update has occurred (e.g. by means of a REFRESH proactive command, see ETSI TS 102 223 [i.9]).

6.4.2 Routing, Network Address Translation and port forwarding

The terminal shall forward incoming IP packets from the UICC to the Internet interface using the UICC APN, and responses from the network to the UICC.

When IPv4 addresses are used, the terminal shall perform Network Address Translation (NAT) as per IETF RFC 3022 [9], so that the UICC can perform IP sessions with external servers.

The incoming remote IPv4 connections to the following TCP / UDP ports shall also be forwarded to the UICC:

smartcard-port	3516/tcp	Smartcard Port
smartcard-port	3516/udp	Smartcard Port
smartcard-tls	4116/tcp	smartcard-TLS
smartcard-tls	4116/udp	smartcard-TLS

In IPv6 since the UICC has its own public address no port forwarding or NAT mechanism is necessary.

Annex A (informative): Connection of a local equipment to the terminal and UICC

It is assumed that configurations similar to those described in the present document may also be available for an equipment locally connected to the terminal. Such connections are device dependent and should therefore be specified on an application basis. Depending on the terminal configuration, NAT and port forwarding may not be necessary in the terminal.

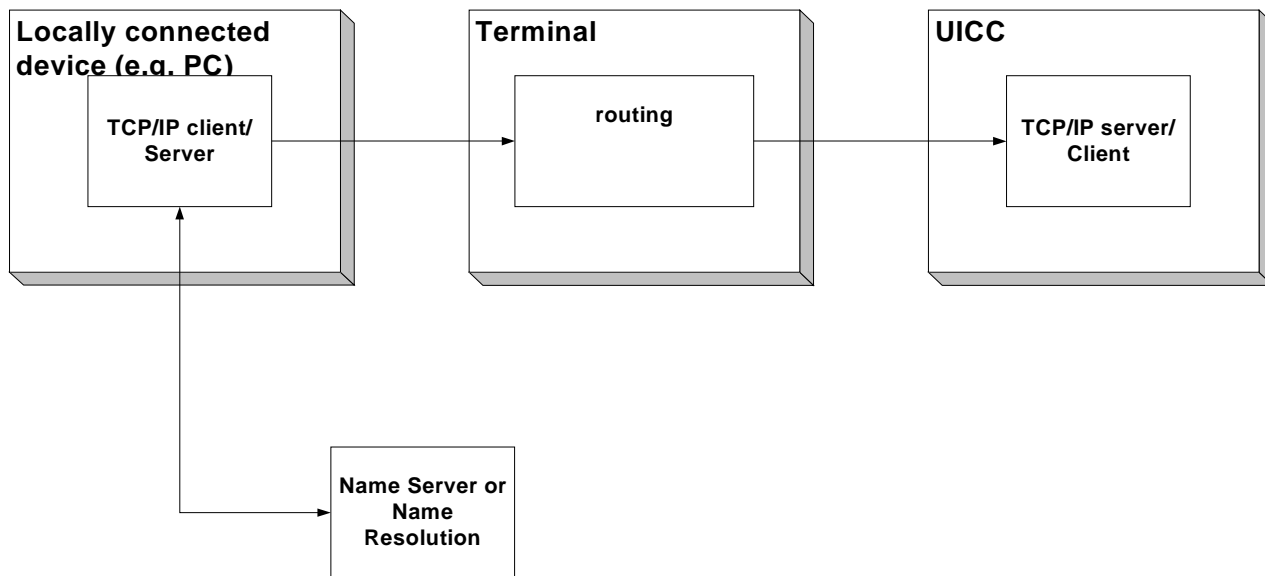


Figure A.1: Connection configuration between several devices

Annex B (informative): Example of activation parameters

The activation parameters that are necessary to initiate a connection depend on the network technologies. This annex provides an example of activation parameters that are provided by a NAA.

The NAA provides a list with a sequence of entries. Each entry contains the following data items:

- Address type (IPv4 or IPv6).
- Address range, defined as address prefix.
- Network Access Name (gateway to external packet network).
- Bearer Description.

Network Access Name and Bearer Description are described in ETSI TS 102 223 [i.9] under the description of the OPEN CHANNEL proactive command related to Packet Data service bearer. If these are missing, the terminal uses settings from the terminal configuration or the default subscription values.

The list is ordered according to the priority of the entries, i.e. entries with higher priority come first. When IP packets originating from the UICC are to be sent to an external destination, the terminal checks the list starting from the beginning. The parameters of first entry where address type matches and the destination address of the IP packet is within the given address range are taken to forward the IP packet.

It is recommended to end the list with "all addresses" entries (having a prefix length of zero) which are used if no other entry matches.

Example for a list of activation parameters:

Entry	Address type	Address prefix	Network Access Name	Bearer Description
1	IPv4	88.224.64.00/20	service.mno.net	packet data service
2	IPv6	2001:DB8:0:CD30::/60	special.net	packet data service
3	IPv4	0.0.0.0/0	web.mno.net	packet data service
4	IPv6	2001::/16	portal.mno.net	packet data service
5	IPv6	::/0	v6web.mno.net	packet data service

NOTE: For the notation of IPv4 address prefixes see IETF RFC 4632 [i.10]; For the notation of IPv6 address prefixes see IETF RFC 4291 [15]. The number after the slash defines the number of valid bits of the prefix. It is recommended to define a data format where trailing zeros can be omitted.

Explanation of the example:

IPv4 packets to addresses from 88.224.64.0 to 88.224.79.255 are routed via gateway "service.mno.net" (entry 1), all others are routed via gateway "web.mno.net" (entry 3).

IPv6 packets to addresses from 2001:DB8:0:CD30:: to 2001:DB8:0:CD3F:FFFF:FFFF:FFFF:FFFF are routed via gateway "special.net" (entry 2), other IPv6 packets from 2001:: to 2001:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF are routed via gateway "portal.mno.net" (entry 4), and all others are routed via gateway "v6web.mno.net" (entry 5).

Annex C (informative): Bibliography

- IETF RFC 4311: "IPv6 Host-to-Router Load Sharing".

NOTE: Available from <http://www.ietf.org/rfc/rfc4311.txt>.

Annex D (informative): Change history

The table below indicates all changes that have been incorporated into the present document since it was placed under change control.

Change history								
Date	Meeting	Plenary Doc	CR	Rev	Cat	Subject/Comment	Old	New
2007	SCP-33	SCP-040416	001		D	Editorial corrections and clarifications	7.0.0	7.1.0
	SCP-33	SCP-040417	002		C	Clarification of the use of terminal DHCP server according to action point 31/01 from SCP#31	7.0.0	7.1.0
2008	SCP-35	SCP-080020	003		B	Addition of a naming mechanism based on DNS UPDATE	7.1.0	7.2.0
2008	SCP-37	SCP-080211	004		F	Clarifications for UICC provided names	7.1.0	7.2.0
2008	SCP-39	SCP-080429	006		F	Clarifications on DHCP support	7.2.0	7.3.0
2008	SCP-39	SCP-080429	005		C	Alignment with 3GPP on External link control	7.3.0	8.0.0
2009	SCP-40	SCP-090027	007		D	Update of Annex B	8.0.0	8.1.0
2019	SCP-86					Updated to Release 9	8.1.0	9.0.0
2019	SCP-86					Updated to Release 10	9.0.0	10.0.0
2019	SCP-86					Updated to Release 11	10.0.0	11.0.0
2019	SCP-86	SCP(14)000212	008			Editor's note on DNS resolution	11.0.0	12.0.0

History

Document history		
V12.0.0	March 2019	Publication