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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Next Generation Networks – Packet-based Networks

T interface for the public packet telecommunication data network

Recommendation ITU-T Y.2620

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Recommendation ITU-T Y.2620

T interface for the public packet telecommunication data network

Summary

Public packet telecommunication data network (PTDN) is one of the hierarchical data networks needed to meet the requirements of future packet-based networks whose reference interfaces are defined in ITU-T Y.2613.

Recommendation ITU-T Y.2620 identifies the T interface and its functions between PTDN edge devices and address translators (ADT). The functions, procedures for the two interface types, i.e., T1 interface and T2 interface, are described. Appendix I gives an example of encapsulation for T interface messages, and Appendix II gives a candidate message format for address resolution in the T1 interface.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.2620	2019-04-29	13	11.1002/1000/13889

Keywords

Address resolution, address update, public packet telecommunication data network, PTDN, registration.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Recommendation ITU-T Y.2620

T interface for the public packet telecommunication data network

1 Scope

This Recommendation specifies the T interface of the public packet telecommunication data network (PTDN), including general description, functions and procedures.

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 Y.2613] Recommendation ITU-T Y.2613 (2010), *General technical architecture for public packet telecommunication data network.*

3 Terms and Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 public packet telecommunication data network (PTDN) [ITU-T Y.2613]: A packet data network designed for the NGN transport stratum, which should be secure, trustworthy, controllable, and manageable, can meet all the requirements described in [b-ITU-T Y.2601]. PTDN is a hierarchical network, which can be subdivided into several network layers.

3.1.2 address [b-ITU-T Y.2601]: An address is the identifier for a specific termination point and is used for routing to this termination point.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 T interface: The interface that public packet telecommunication data network (PTDN) address translator (ADT) uses to communicate with PTDN edge device (ED) and/or other ADTs to provide address translation service.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACK Acknowledge

ADT Address Translator

ED Edge Device

IP Internet Protocol

NM Network Manager

PTDN Public packet Telecommunication Data Network

SR Service Router

VPN Virtual Private Network

5 Conventions

None.

6 Architecture

PTDN is a hierarchical network that consists of an access network, an aggregation network and a core network, which are also hierarchical networks that can be subdivided into several network layers.

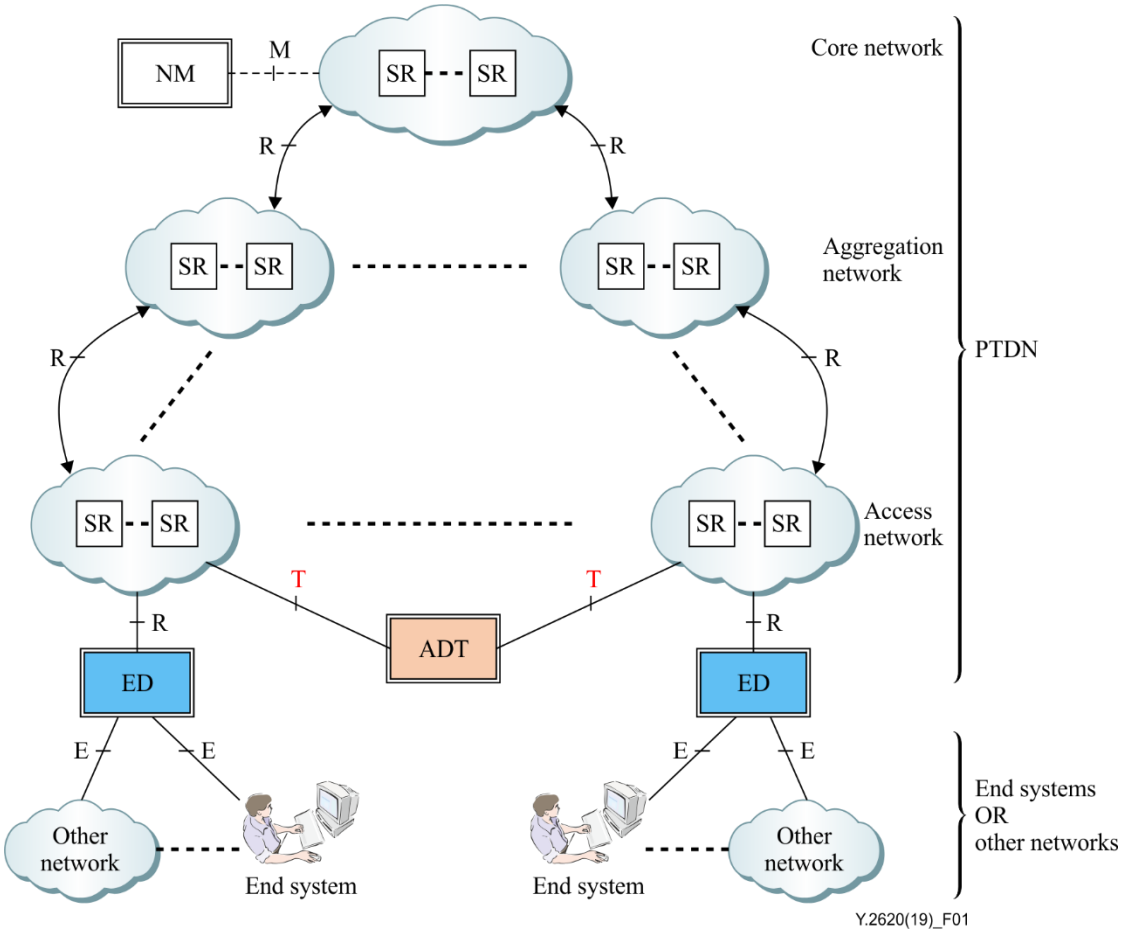


Figure 1 – T interface in PTDN

In the PTDN, address translators (ADTs) are responsible for mapping or translating Internet protocol (IP) addresses (or other networks addresses) to PTDN addresses. ADTs cooperate with edge devices (EDs) to achieve the activities of address mapping/translation by the T interface.

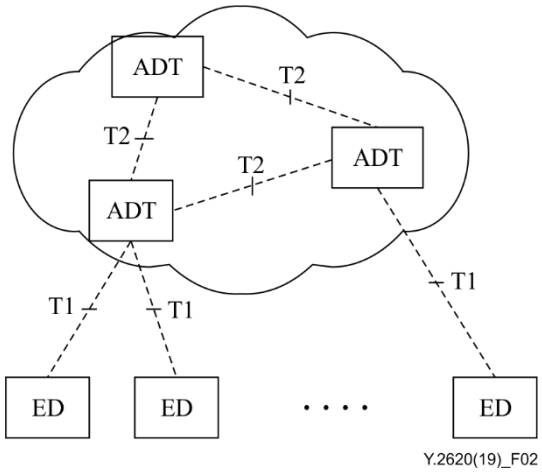


Figure 2 – T interface category

T interface includes the interface between ADTs and EDs, and the interface among ADTs, to provide address mapping and translation. T interface can be classified into:

– T1：Interface between ADTs and EDs.

Through T1 interface, EDs can register their access customer network addresses to ADTs and resolve customer network addresses to PTDN addresses from ADTs.

– T2：Interface among ADTs.

Through T2 interface, ADTs register, advertise and query address mapping information to/from other ADTs.

ADTs form a logical network, which uses underlying network transmission facilities. Figure 2 illustrates a mesh ADT network topology including both a T1 interface and a T2 interface. ADT network topology is not limited to mesh topology, but it can also be other topologies, such as ring, star, etc.

The ADT network should be designed to avoid the risk that a single fault may cause address translation failures.

7 Transmission

Messages on T interface are carried in the control plane of the PTDN or in a specific virtual private network (VPN).

If T interface messages are transformed in control plane, the messages encapsulation shall follow the definitions defined in [ITU-T Y.2613]. The message type in control packet header is used to determinate T interface messages. An example is given in Appendix I.

If T interface messages are transformed in a specific VPN, this specific VPN ID is used to determine T interface messages.

8 T1 interface

T1 interface includes three functions:

– ED registration function is used to register EDs to ADTs. ADTs have the capability to authorize the registration of EDs;

– the address resolution function is to provide the ED with the mapping information between the customer network address and the destination ED address;

– the address update function is used to modify the mapping information.

An ED can get address translation service from more than one ADT using primary and/or secondary ADT addresses, which can be assigned by the network operator or be implemented through any cast mechanism.

8.1 ED registration

As soon as an ED boots up successfully and is ready to work, it shall send a registration request message to its assigned ADT. The registration request message contains the ED identification information as well as authentication information.

Based on this registration request, the ADT should verify whether the ED is attached to it. If the ED is attached to the ADT, then the ADT sends acknowledge response message. When the ED receives the ADT acknowledge response message, the ED sends an address update message to register its address mapping information into the ADT. Figure 3 shows a basic procedure of ED registration.

If the ED is not attached to the ADT, then the ADT just drops this request silently.

This procedure can optionally include additional negotiation processes to decide if and how to apply relevant mechanisms, such as message retransmission mechanism, keep alive mechanism, and security mechanism. The security mechanism is used to authenticate the subsequent messages exchanged between the ED and the ADT.

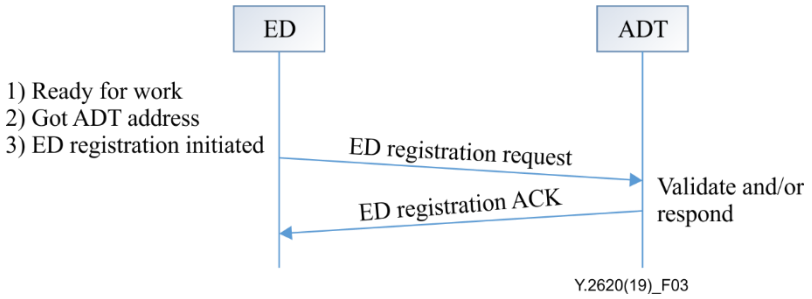


Figure 3 – ED registration procedure

8.2 Address resolution

Mapping information between customer network address and PTDN address are stored in ADTs. T1 address resolution function is used for the ED to get these mapping information from the ADT.

When an ED receives a customer's packet whose destination address is not a local customer network address, it needs to look for the corresponding PTDN ED address of the destination customer network address. When a cache mechanism is used, ED looks up within its cache to find the entry that meets the conditions. If it cannot find a suitable one, it sends an address resolution request message to the ADT (see Figure 4). This request message includes:

– a sequence number, that is used to correlate query and answer;

– the customer network address information including address type and address.

The ADT then looks up the customer-PTDN address mapping information. If it can obtain the corresponding entry, it returns the query result. Otherwise, it returns a query failure message. In query result, the following fields are included:

– sequence number;

– error code;

– address mapping, that includes queried PTDN address, optional properties such as expiry time;

– optional information.

Cache containing recently used customer-PTDN address mapping should be used in ED to reduce address queries. It is recommended to support other mechanisms such as aging mechanism.

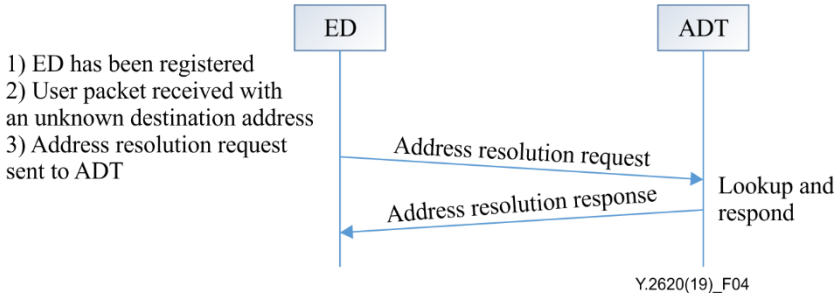


Figure 4 – Address resolution procedure

8.3 Address update

The address update function is used to guarantee that the address mapping information is up to date. Normally, only a small amount of customers addresses are changed, resulting in a small portion of changes on address mapping information. It is recommended to have an incremental mechanism to update this portion of changes instead of the entire address mapping information.

An ED obtains and keeps track of its attached customers network addresses information by interface E which is defined in [ITU-T Y.2613].

Once the changes of customer network reachability are detected, the ED will send an address update message to notify the ADT of these changes.

As the information is critical, the acknowledge mechanism and retransmission mechanism are recommended during the address update procedure to make sure that the information is notified to the ADT. Figure 5 shows a typical address update procedure.

Once the primary ADT out-of-service is detected, the ED is required to be able to interact with a secondary ADT.

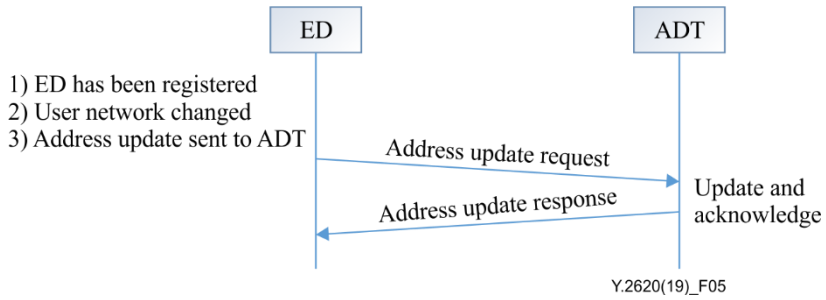


Figure 5 – Address update procedure

9 T2 interface

More than one ADT is deployed in a network to eliminate single points of failure. These ADTs work together to provide address translation services. The interface among these ADTs, i.e., T2 interface is further categorized into intra-domain interface and inter-domain interface.

9.1 Inter-domain interface

Peer-to-peer interaction between domains is required. The domain administrator deploys more than one ADT as domain border ADTs. When one customer from domain A wants to communicate to another customer in domain B, the information of both customers should be advertised to each other

through domain border ADTs. When domain border ADTs receive the customer information, they can advertise the information to other ADTs in the domain, but, in principle, will not advertise them to other domains.

The information to advertise includes, but is not limited to:

– customer identification information;

– customer network address type, (e.g., IP address);

– customer network address and network address prefix;

– PTDN address (i.e., border interworking gateway address).

The inter-domain T2 interface should also have the following properties:

– robustness to ensure reliable information delivery;

– efficiency to update information;

– flexibility and scalability to meet new requirements, such as new types of information and increasing number of network customers.

9.2 Intra-domain interface

According to the network scale, and the characteristics of customers and services, ADTs are deployed in either a centralized way, a distributed way, or an hybrid way. The ADTs form a logical network, which may be flat or hierarchical.

Intra-domain T2 interface should support one or both of the following two functions for different cases:

– address resolution function

This is required when an ADT does not maintain a whole set of address mapping information database for the domain. In this case, an ADT redirects the address resolution request received from the ED to other ADTs through the T2 interface when the requested customer address is not found in the local database (for detail, see clause 8.2).

– address advertise function

This is required when an ADT maintains the customer information received not only from local EDs but also from other ADTs. In this case, ADTs advertise the address mapping information learned from the local EDs to other ADTs and receive advertised information from other ADTs through the T2 interface. The intra-domain T2 interface has the same requirements as those listed in clause 9.1.

10 Security considerations

Address translation plays a crucial role in PTDN. Security must be considered on three levels: ADT, ED and communication between them.

– communication between ADT and ED:

  The security techniques are recommended to be applied in order to guarantee the safety of the information. For example:

  - Authentication between ED and ADT can be used, only authenticated ED and ADT can setup a connection between them, and can update address information.
  - Security mechanism such as encryption can be used in communication between ED and ADT.
  - Resources used to transmit T interface messages should be guaranteed either in control plane or in a specific VPN.

– ADT

  - Multiple ADTs in a PTDN should be deployed to remove a single point of failure and to balance load.
  - ADT may have a mechanism to detect malicious address resolution requests.

– ED

  Beside the normaj;l border security techniques and mechanisms to protect PTDN, EDs should have:

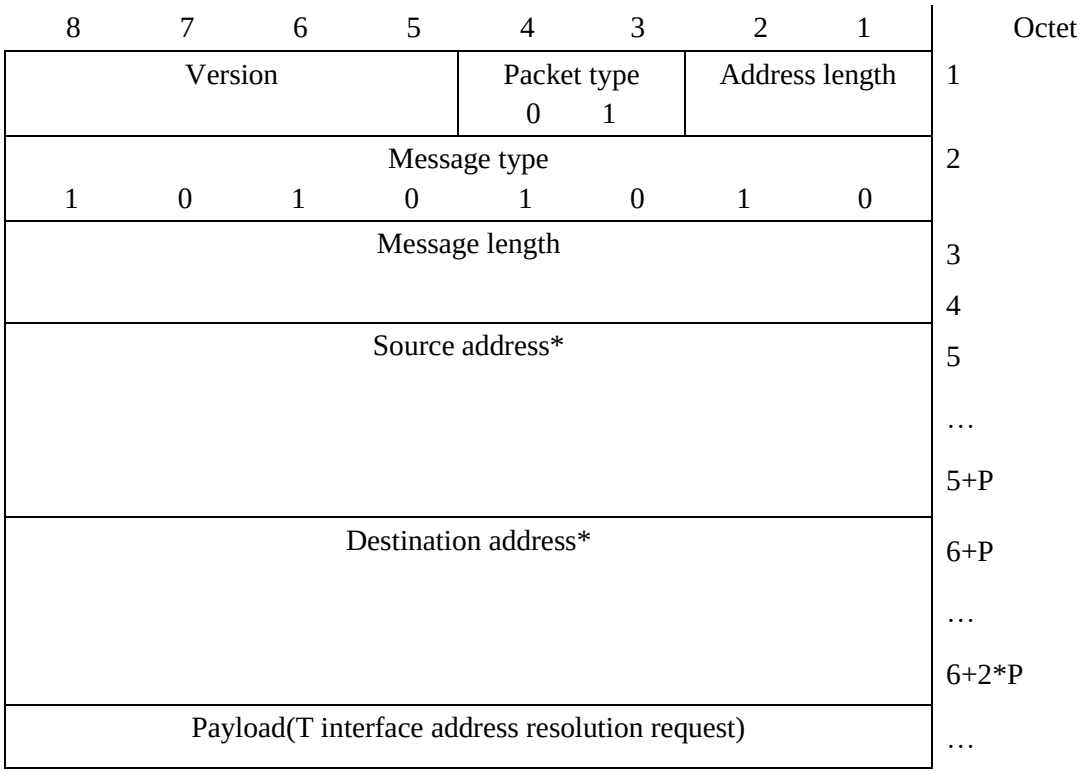
  - A mechanism to protect against denial-of-service attacks.
  - A mechanism to suppress address resolution requests by intentionally dropping new flows.

Appendix I

An example of encapsulation for the T interface message

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

Several values of message type in control packet header may be used to determine different types of T interface messages, for example, address resolution request, address resolution response, address update, etc. Figure I.1 shows the encapsulation of a T interface message in the control plane. In this example, control message with type value 0xAA is an address resolution request message.



* NOTE – This field length is determined by the field address length, and represented by P (octets)

Figure I.1 – An example of an encapsulation for a T interface message in the control plane

Appendix II

One candidate message format for address resolution

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

This appendix provides a candidate message format for address resolution based on clause 8.2. In this case the resolution request and response have the same format.

II.1 Resolution request

The field definitions of the resolution request message are defined in clause 8.2. The format of this message is depicted in Figure II.1.

8 7 6 5 4 3 2 1	Octet
Message Identifier (16)	1 2
Customer's protocol type (16)	3 4
PTDN address length (8)	5
Customer's address length (8)	6
00000000 00000000B	7 8
Source PTDN address *1	9 … 9+P
Source customer address *2	10+P … 10+P+C
Reserved(Destination PTDN address place holder) *1	11+P+C 11+2*P+C
Destination Customer address *2	12+2*P+C 12+2*P+2*C
Reserved (32)	13+2*P+2*C .. 16+2*P+2*C

NOTE 1 – This field length is determined by the field *PTDN address length*, and represented by P (octets).

NOTE 2 – This field length is determined by the field Customer's address length, and represented by C (octets).

Figure II.1 – The message format of resolution request

II.2 Resolution response

The field definitions of the resolution response message are defined in clause 8.2. The format of this message is depicted in Figure II.2.

8	7	6	5	4	3	2	1	Octet
Message Identifier (16)								1 2
Customer's protocol type (16)								3 4
PTDN address length (8)								5
Customer's address length (8)								6
Error code (16)								7 8
Source PTDN address*1								9 … 9+P
Source customer address *2								10+P … 10+P+C
Destination PTDN address *1								11+P+C 11+2*P+C
Destination Customer address *2								12+2*P+C 12+2*P+2*C
Reserved (32)								13+2*P+2*C .. 16+2*P+2*C

NOTE 1 – This field length is determined by the field *PTDN address length*, and represented by P (octets).

NOTE 2 – This field length is determined by the field *Customer's address length*, and represented by C (octets).

Figure II.2 –The message format of resolution response

Bibliography

[b-ITU-T Y.2601] Recommendation ITU-T 2601 (2006), *Fundamental characteristics and requirements of future packet based networks.*

[b-ITU-T Y.2611] Recommendation ITU-T 2611 (2006), *High-level architecture of future packet-based networks.*

[b-ITU-T Y.2612] Recommendation ITU-T 2612 (2009), *Generic requirements and framework of addressing, routing and forwarding in future, packet-based networks.*

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