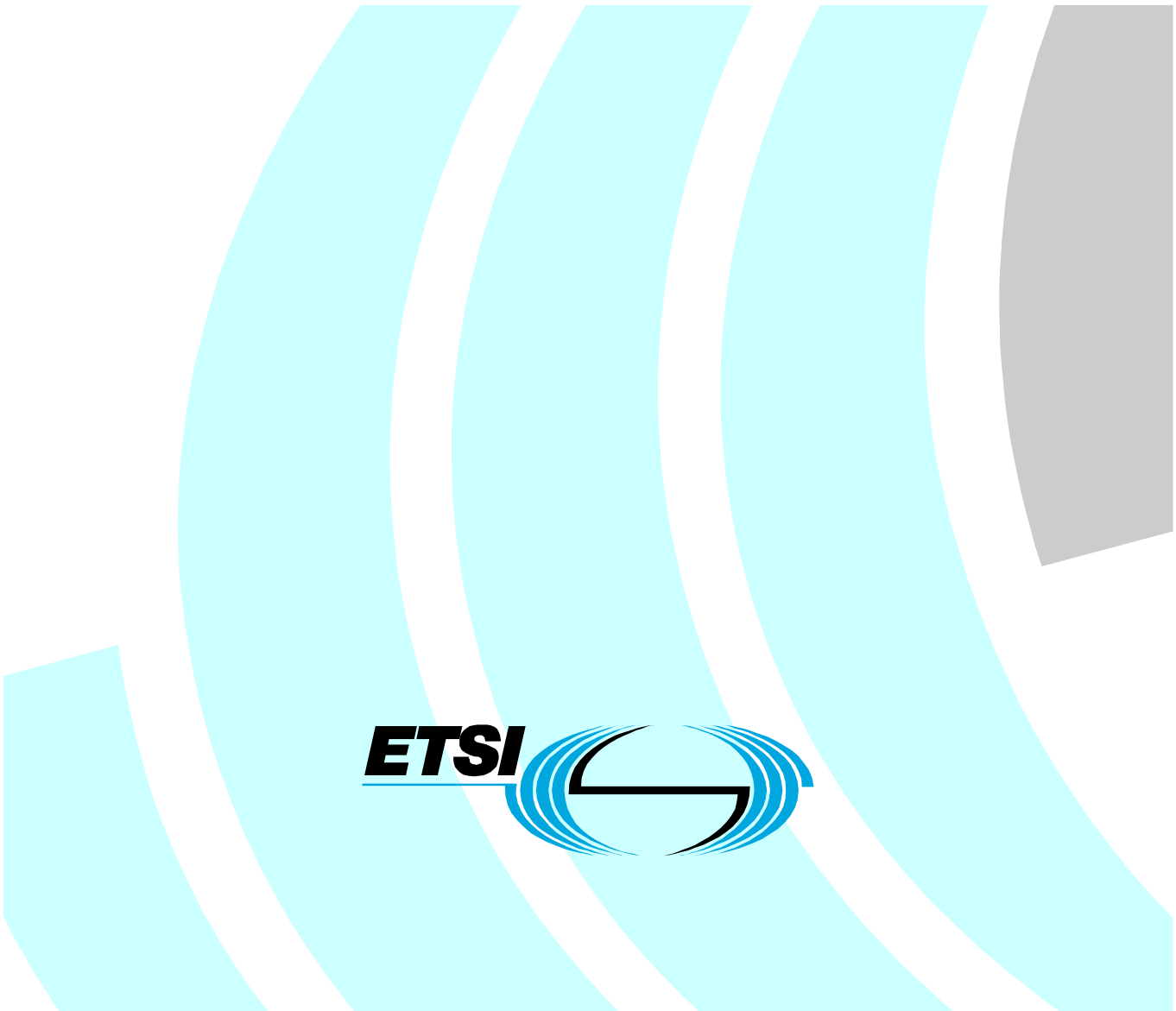
ETSI TS 102 024-3 V4.1.1 (2003-01)

Technical Specification

Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; End-to-end Quality of Service in TIPHON Systems; Part 3: Signalling and Control of end-to-end Quality of Service



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Foreword

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

The present document is part 3 of a multi-part deliverable covering the end-to-end Quality of Service in TIPHON Systems, as identified below:

TR 102 024-1: "General aspects of Quality of Service (QoS)";

TS 102 024-2: "Definition of Speech Quality of Service (QoS) Classes";

TS 102 024-3: "Signalling and Control of end-to-end Quality of Service (QoS) in a multi-media environment";

TS 102 024-4: "Quality of Service Management";

TS 102 024-5: "Quality of Service (QoS) measurement methodologies";

TR 102 024-6: "Actual measurements of network and terminal characteristics and Performance parameters in TIPHON networks and their influence on voice quality";

TR 102 024-7: "Design Guide for elements of a TIPHON connection from an end-to-end speech transmission performance point of view";

TS 102 024-9: "Call performance Classification (Voice)";

TS 102 024-10: "QoS Requirements for TIPHON Terminals".

1 Scope

The present document, "TIPHON signalling and control of end-to-end Quality of Service (QoS)", specifies procedures for the control of end-to-end QoS within and between domains. TS 101 882 (see bibliography) specifies the TIPHON meta-protocols and object definitions required by these control procedures.

Additional annexes to the present document define profiles for mapping a number of existing candidates protocols to the specified TIPHON meta-protocols.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

[1] ETSI TS 101 321: "Telecommunications and Internet Protocol; Harmonization Over Networks (TIPHON); Open Settlement Protocol (OSP) for Inter-Domain pricing, authorization, and usage exchange".

[2] ETSI TS 101 329-3: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; End-to-end Quality of Service in TIPHON systems; Part 3: Signalling and control of end-to-end Quality of Service (QoS)".

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

[4] ETSI TS 102 024-2: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; End-to-end Quality of Service in TIPHON Systems; Part 2: Definition of Speech Quality of Service (QoS) Classes".

[5] ITU-T Recommendation E.164 (1997): "The international public telecommunication numbering plan".

[6] ITU-T Recommendation Z.100 (1996): "Specification and description language (SDL) with corrigendum 1".

[7] ITU-T Recommendation X.680: "Information technology; Open Systems Interconnection; Abstract Syntax Notation One (ASN.1): Specification of basic notation".

[8] ITU-T Recommendation H.323 (2000): "Audiovisual and multimedia systems; Infrastructure of audiovisual services; Services and terminal equipment for audiovisual services; Packet-based multimedia communications systems".

[9] ITU-T Recommendation H.225.0 (2000): "Audiovisual and multimedia systems; Infrastructure of audiovisual services; Transmission multiplexing and synchronization; Call signalling protocols and media stream packetization for packet-based multimedia communication systems".

[10] ITU-T Recommendation H.245 (2001): "Audiovisual and multimedia systems; Infrastructure of audiovisual services - Communication procedures; Control protocol for multimedia communication".

[11] IETF RFC 1890: "RTP Profile for Audio and Video Conferences with Minimal Control".

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

[13] IETF RFC 2748: "The COPS (Common Open Policy Service) Protocol".

[14] IETF RFC 2806: "URLs for Telephone Calls".

[15] IETF RFC 3261: "SIP: Session Initiation Protocol".

3 Definitions and abbreviations

3.1 Definitions

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

name: unique identifier by which a user, access or terminal is known within a TIPHON system

TIPHON system: system that complies with the mandatory requirements identified in the TIPHON specifications

3.2 Abbreviations

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

ASN.1	Abstract Syntax Notation 1
COPS	Common Open Policy Service
OSP	Open Settlement Protocol
QFE	QoS Functional Entity
QoS	Quality of Service
RSVP	resource ReSerVation Protocol
RTP/AVP	Real-Time Protocol Audio-Video Profile
SCN	Switched Circuit Network
SDL	Specification and Description Language
SDP	Session Description Protocol
SIP	Session Initiation Protocol

4 End-to-end QoS Signalling functional requirements

4.1 Description

4.1.1 General description

End-to-end QoS Signalling is used within a TIPHON network to ensure that a caller is provided with an end-to-end connection having at least the QoS class subscribed to or a lower QoS class if this is acceptable to the user. A QoS level may either be requested explicitly by the user on a call-by-call basis or may be predefined as part of the user's subscription. Additionally, the caller may be able to take specific actions if the QoS moves outside the accepted level during an established call.

The user may use any of the following methods to request a specific end-to-end QoS at call establishment:

1) By subscription:

   The agreement between the user and the user's service provider identifies the QoS level to be requested for any call. The QoS level may be fixed or variable based upon such parameters as time-of-day and call destination. This method requires no signalling between the user and the service provider at call setup time.

2) By the use of a standardized TIPHON QoS Class:

The user indicates at each call establishment which of the TIPHON QoS Classes (standardized in TS 102 024-2 [4]) is to be requested for the call. The TIPHON QoS Classes are identified as:

- Class 1 Best effort;
- Class 2A Acceptable;
- Class 2M Medium;
- Class 2H High;
- Class 3 Best (broadband);

3) By the use of a non-standardized QoS Class:

The user indicates at each call establishment which non-standardized QoS class is to be requested for the call. The QoS class may represent any combination of QoS parameters previously agreed between the user and the service provider.

4.2 Procedures

4.2.1 Provision and withdrawal

End-to-end QoS Signalling shall be provided on a per-name, per application basis to all subscribers to the simple call within a TIPHON system.

When establishing a call, a user shall be able to select at least one of the options identified in table 1.

Table 1: QoS option

Option	Value
QoS class	- Predefined by user and service provider (TIPHON or non-TIPHON class) - TIPHON Best - QoS Class 3 (see note 1) - TIPHON High - QoS Class 2H (see note 1) - TIPHON Medium - QoS Class 2M (see note 1) - TIPHON Acceptable - QoS Class 2A (see note 1) - TIPHON Best effort - QoS Class 1 (see note 1) - Non-TIPHON QoS Class (see note 2)
NOTE 1: This value shall be as defined in TS 102 024-2 [4]. NOTE 2: This may be any value agreed between the user and the service provider to indicate a specific QoS	

4.2.2 Normal procedures

4.2.2.1 Activation, deactivation and interrogation

QoS Signalling shall be permanently activated.

4.2.2.2 Invocation and operation

When establishing a simple call, the calling user (or an agent within the user's network) may request a TIPHON standardized QoS class or a non-standardized QoS class, to be applied to the call in order to achieve a required end-to-end QoS.

If the end-to-end QoS requested by the calling user is available, communication using that QoS shall be established following the simple call procedures specified in TS 101 878 [3].

4.2.3 Exceptional procedures

4.2.3.1 Invocation and operation

If it is not possible to offer the requested end-to-end QoS at call establishment, the calling user shall be informed and may take one of the following actions:

- terminate the call attempt;
- request a lower QoS;
- proceed with the call at the QoS available between the caller and the called user.

If, during an established call, the end-to-end QoS perceived by the calling user falls below an acceptable level the following practical options are available:

- terminate the call;
- continue with the call at the inferior QoS level.

4.3 Interactions with other TIPHON service capabilities

This clause specifies interactions with other TIPHON services for which standards were available at the time of publication of the present document.

4.3.1 Registration service capabilities

4.3.1.1 Terminal transport service registration

No interaction.

4.3.1.2 User service registration

No interaction.

NOTE: The QOS to be used for subsequent calls by the registered user may form part of the information supplied at registration.

4.3.2 Call connectivity service capabilities

4.3.2.1 Simple call establishment

No interactions.

4.3.2.2 Calling user identity generation

No interactions.

4.3.2.3 Calling user identity conveyance

No interactions.

4.3.2.4 Calling user identity delivery

No interactions.

4.3.2.5 Call rejection

No interactions.

4.3.2.6 Number portability

4.3.2.6.1 Number portability - All call query

No interactions.

4.3.2.6.2 Number portability - Query on release

No interactions.

4.3.2.6.3 Number portability - Pivot routing (Drop back)

QoS Signalling shall be terminated prior to the invocation of the pivot routing service capability and then re-invoked after the drop back has occurred.

4.3.2.7 Emergency calls

4.3.2.7.1 Emergency Calling Service (ECS)

No interactions.

4.3.2.7.2 Authorized emergency priority calls

Insufficient QoS availability shall not cause the rejection of an authorized emergency priority call.

4.3.2.8 Bearer connectivity

4.3.2.8.1 Bearer creation

No interactions.

4.3.2.8.2 Bearer negotiation

The user's requested QoS should be one of the parameters used in bearer negotiation.

4.3.2.8.3 Bearer re-negotiation

The user's requested QoS should be one of the parameters used in bearer re-negotiation.

4.3.2.8.4 Media path optimization

The selection of an optimum path which is different from that selected at call establishment shall not cause an adverse effect on the perceived QoS of the call.

4.3.2.9 Event recording

No interactions.

4.3.2.10 Third party authorization

When a call is established using third party authorization, the requested QoS shall be that of the original calling user, not that of the third party.

4.3.2.11 Overlap sending

No interactions.

4.4 Interworking considerations

When interworking with a Switched Circuit Network (SCN) where the only variable affecting QoS is the choice of bearer service, fixed QoS parameters shall be assumed based on the bearer service selected.

4.5 Overall behaviour

Figure 1 contains the dynamic description of end-to-end QoS Signalling using a Unified Modeling Language (UML) activity diagram. The activity diagram represents the behaviour of a TIPHON system in providing end-to-end QoS Signalling.

NOTE: The syntax and semantics of UML diagrams are defined by the Object Management Group (OMG).

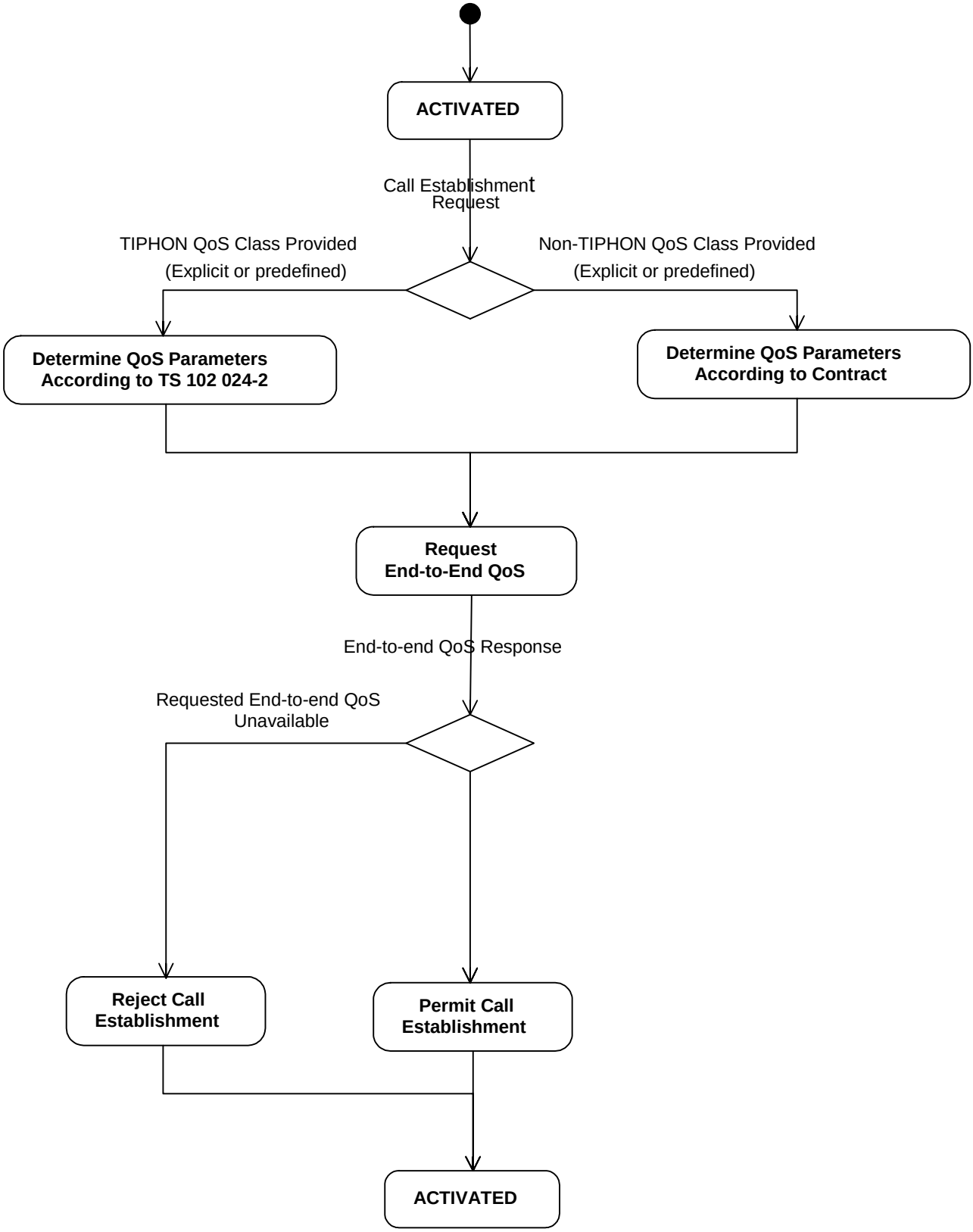

Figure 1: Overall behaviour of end-to-end QoS Signalling at call establishment

5 Functional entity model and information flows

5.1 Functional entity model

5.1.1 Description of model

The functional model shall comprise the following QoS Functional Entities (QFE):

Calling User	The application at the calling user's terminal which instigates the service request.
QFE1	The service agent that processes the calling user's request for end-to-end QoS signalling.
QFE2	The originating QoS coordination function. This QFE is responsible for negotiating and establishing a particular QoS on behalf of the calling user.
QFE3	The terminating QoS coordination function. This QFE is responsible for establishing a particular QoS on behalf of the called user.
QFE4	The service agent that processes an incoming call to the called user.
QFE5	The QoS policy control function associated with the calling user's service provider.
QFE6	The transport coordination function serving the calling user.
QFE7	The transport coordination function serving the called user.
QFE8	An intervening QoS coordination function. This QFE is responsible for establishing a particular QoS within an intervening domain.
QFE9	An intervening transport coordination function.
Called User	The application in the called user's terminal at which the service request is terminated.

The following functional relationships shall exist between these QFEs:

ra	between the Calling User and the Calling User's service agent (QFE1).
rb	between the Calling User's service agent (QFE1) and the Calling User's QoS coordination function (QFE2).
rc	between QoS coordination functions in the originating side (QFE2) and an intervening QoS coordination function (QFE8).
rd	between an intervening QoS coordination function (QFE8) and the Called User's QoS coordination function (QFE3).
re	between the Called User's QoS coordination function (QFE3) and the Called User's service agent (QFE4).
rf	between the Called User's service agent (QFE4) and the Called User.
rg	between the Calling User's service agent (QFE1) and the QoS Policy Control function associated with the Calling User (QFE5).
rh	between the originating QoS coordination function (QFE2) and the originating transport coordination function (QFE6).
ri	between an intervening QoS coordination function (QFE8) and the transport coordination function associated with it (QFE9).
rj	between the terminating QoS coordination function (QFE3) and the terminating transport coordination function (QFE7).

Figure 2 shows the Functional Entities (QFE) and the relationships between them.

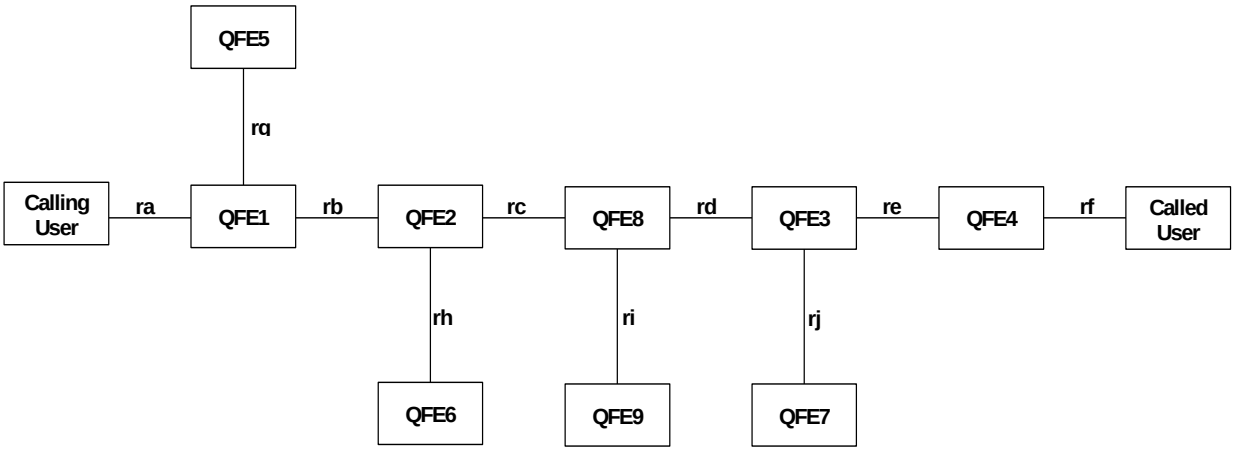

Figure 2: End-to-end QoS signalling functional entity model

5.1.2 Description of functional entities

5.1.2.1 Calling User

The Calling User functional entity acts on behalf of the human user to request the establishment of an end-to-end call with a specific QoS.

5.1.2.2 Calling User's service agent, QFE1

On receipt of a QoS establishment request from the Calling User, QFE1 determines whether current policy permits the requested QoS to be used with the call and either initiates a simple call establishment request towards the destination address or rejects the call request back to the calling user.

5.1.2.3 The originating QoS coordination function, QFE2

This QFE requests the provision of a bearer capable of supporting the desired end-to-end QoS and passes on the simple call request towards QFE3.

5.1.2.4 The terminating QoS coordination function, QFE3

QFE3 requests the provision of a bearer capable of supporting the desired end-to-end QoS and passes on the simple call request to QFE4.

5.1.2.5 The called user's incoming call service agent, QFE4

This QFE informs the called user that the requested QoS is required with the associated incoming simple call.

5.1.2.6 The QoS policy control function associated with the calling user's service provider, QFE5

This QFE consults its current service database to determine whether the calling user is permitted to make a call with the requested end-to-end QoS to the indicated called user.

5.1.2.7 The transport coordination function serving the calling user, QFE6

This QFE attempts to establish a bearer connection between the indicated incoming user access point and an appropriate outgoing network access point capable of providing the requested end-to-end QoS.

5.1.2.8 The transport coordination function serving the called user, QFE7

This QFE attempts to establish a bearer connection between the indicated incoming network access point and an appropriate outgoing user access point capable of providing the requested end-to-end QoS.

5.1.2.9 An intervening QoS coordination function, QFE8

If present, this QFE requests the provision of a bearer capable of supporting the desired end-to-end QoS and passes on the simple call request towards QFE3.

5.1.2.10 An intervening transport coordination function, QFE9

If present, this QFE attempts to establish a bearer connection between the indicated incoming network access point and an appropriate outgoing network access point capable of providing the requested end-to-end QoS.

5.1.2.11 Called User

The Called User functional entity acts on behalf of the human user to accept the establishment of an end-to-end call with a specific QoS.

5.2 Information flows

5.2.1 Definition of information flows

NOTE: In the tables within this clause, the following convention is used in the "Value" columns. Un-bulleted lists of values indicate that all items in the list are included in the associated information element; bulleted lists of values indicate that only one item in the list is included in the information element.

5.2.1.1 Relationship ra

5.2.1.1.1 OrigQoSEstab

`OrigQoSEstab` is a confirmed information flow that shall be sent across relationship ra from the calling user to QFE1 to indicate a request for a new call establishment with a specific end-to-end QoS. Table 2 lists the elements within the `OrigQoSEstab` information flow.

Table 2: Content of OrigQoSEstab

OrigQoSEstab			
Information element	**Value**	**Request**	**Response**
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	M	
Called user ID	TIPHON user name	M	
Codec	- List of possible codecs - Codec type - Frames per packet	M	O (see notes 1 and 2)
Result	- End-to-End QoS Established - with requested QoS - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available - Policy Rejection		M
NOTE 1: The list of codecs shall be limited to a single entry in the response. NOTE 2: This element shall be included if the Result element is set to "end-to-end QoS Established".			

5.2.1.2 Relationships rb, rc, rd and re

5.2.1.2.1 QoSEstab

`QoSEstab` is a confirmed information flow that shall be sent across relationships rb, rc, rd and re to indicate a request for the provision of a guaranteed end-to-end QoS for the associated TIPHON simple call. Table 3 lists the elements within the `QoSEstab` information flow.

Table 3: Contents of QoSEstab

QoSEstab			
Information element	**Value**	**Request**	**Response**
Calling user ID	TIPHON user name	M	
Called user ID	TIPHON user name	M	
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	M	
Transport parameters qualifier	- Transport QoS parameters indicate total remaining budget - Transport QoS parameters indicate budget available per domain	M	
Traffic descriptor	Media peak rate, Maximum media frame size,	M	
Codec	List of possible codecs - Codec type - Frames per packet	M	O (see notes 1 and 2)
Destination service domain	Network specific address	O	
Result	- Requested QoS available - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available		M
NOTE 1: The list of codecs shall be limited to a single entry in the response. NOTE 2: This element shall be included if the result of the request is "Requested QoS available".			

5.2.1.3 Relationship rf

5.2.1.3.1 DestQoSEstab

`DestQoSEstab` is a confirmed information flow that shall be sent across relationship rf from QFE4 to the called user to indicate a request for a new call establishment with a specific end-to-end QoS. Table 4 lists the elements within the `DestQoSEstab` information flow.

Table 4: Contents of DestQoSEstab

DestQoSEstab			
Information element	**Value**	**Request**	**Response**
Calling user ID	TIPHON user name	M	
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	M	
Codec	List of possible codecs - Codec type - Frames per packet	M	O (see notes 1 and 2)
Result	- Indicated codec selected - Rejection cause: - Codecs not supported		M
NOTE 1: The list of codecs shall be limited to a single entry in the response. NOTE 2: This element shall be included if the result of the request is "Indicated codec selected".			

5.2.1.4 Relationship rg

5.2.1.4.1 QoSPolicy

`QoSPolicy` is a confirmed information flow that shall be sent across relationship rg from QFE1 to QFE5 to request permission for a new call establishment with a specific end-to-end QoS. Table 5 lists the elements within the `QoSPolicy` information flow.

Table 5: Contents of QoSPolicy

QoSPolicy			
Information element	**Value**	**Request**	**Response**
Calling user ID	TIPHON user name	M	
Called user ID	TIPHON user name	M	
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	O (see note)	
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	O (see note)	
Result	- Call permitted - Rejection cause - Service not subscribed to - Service currently not available		M
NOTE: One of these information elements shall be provided.			

5.2.1.5 Relationships rh, ri and rj

5.2.1.5.1 TRMReserve

`TRMReserve` is a confirmed information flow that shall be sent across relationships rh, ri and rj to request the reservation of a media transport path with a specific end-to-end QoS towards the called user's address. Table 6 lists the elements within the `TRMReserve` information flow.

Table 6: Contents of TRMReserve

TRMReserve			
Information element	**Value**	**Request**	**Response**
Traffic identifier	Alphanumeric "handle"	M	
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	M	O (see note)
Transport parameters qualifier	- Transport QoS parameters indicate total remaining budget - Transport QoS parameters indicate budget available per domain	M	
Traffic descriptor	Media peak rate, Maximum media frame size	M	
Source transport domain	Network specific address	M	
Destination transport domain	Network specific address	M	
Result	- Requested resources reserved - Rejection cause - Requested resources not available - Destination unknown		M
NOTE: This information element shall be included if the value of the transport parameters qualifier in the request is "Transport QoS parameters indicate total remaining budget".			

5.2.1.5.2 TRMConnect

`TRMConnect` is a confirmed information flow that shall be sent across relationships rh, ri and rj to request the establishment of a previously reserved media transport path call with a specific end-to-end QoS towards the called user's address. Table 7 lists the elements within the `TRMConnect` information flow.

Table 7: Contents of TRMConnect

TRMConnect			
Information element	**Value**	**Request**	**Response**
Traffic identifier	Alphanumeric "handle"	M	
Result	- Reserved connection completed - Rejection cause - Unable to complete connection		M

5.2.1.5.3 TRMRelease

`TRMRelease` is an unconfirmed information flow that shall be sent across relationships rh, ri and rj to request that a previously reserved media transport path is released as it is no longer required. Table 8 lists the elements within the `TRMRelease` information flow.

Table 8: Contents of TRMRelease

TRMRelease		
Information element	**Value**	**Request**
Traffic identifier	Alphanumeric "handle"	M

5.2.2 Relationship of information flows to TIPHON simple call

Table 9 specifies the relationships of the end-to-end QoS information flows with those of the TIPHON Simple Call (see TS 101 882-3 in bibliography).

Table 9: Relationship of the End to End QoS information flows with the TIPHON Simple Call

Information flow			Independent of simple call flow	With simple call flow	Simple call flows
ra	OrigQoSEstab	request	no	yes	TCC_OrigCallSetup (req)
		response	no	yes	TCC_OrigCallSetup (resp)
rb	QoSEstab	request	no	yes	CallSetup (req)
		response	no	yes	CallSetup (resp)
rc	QoSEstab	request	no	yes	NWCallSetup (req)
		response	no	yes	NWCallSetup (resp)
rd	QoSEstab	request	no	yes	NWCallSetup (req)
		response	no	yes	NWCallSetup (resp)
re	QoSEstab	request	no	yes	DestCallSetup (req)
		response	no	yes	DestCallSetup (req)
rf	DestQoSEstab	request	no	yes	TCC_DestCallSetup (req)
		response	no	yes	TCC_DestCallSetup (resp)
rg	QoSPolicy	request	no	yes	QoSPolicy (req)
		response	no	yes	QoSPolicy (resp)
rh	TRMReserve	request	no	yes	TRMReserve (req)
		response	no	yes	TRMReserve (resp)
	TRMConnect	request	no	yes	TRMConnect (req)
		response	no	yes	TRMConnect (resp)
	TRMRelease	request	no	yes	TRMRelease (req)
ri	TRMReserve	request	no	yes	TRMReserve (req)
		response	no	yes	TRMReserve (resp)
	TRMConnect	request	no	yes	TRMConnect (req)
		response	no	yes	TRMConnect (resp)
	TRMRelease	request	no	yes	TRMRelease (req)
rj	TRMReserve	request	no	yes	TRMReserve (req)
		response	no	yes	TRMReserve (resp)
	TRMConnect	request	no	yes	TRMConnect (req)
		response	no	yes	TRMConnect (resp)
	TRMRelease	request	no	yes	TRMRelease (req)

5.2.3 Timers

5.2.3.1 Reservation Hold Timers

Within each of QFE6, QFE7 and QFE9, a Reservation Hold Timer is used to ensure that resources reserved with a `TRMReserve` information flow are not held indefinitely if a subsequent `TRMConnect` information flow is not received. The period of a Reservation Hold Timer is implementation dependent but shall be in the range of 8 seconds to 15 seconds.

5.2.4 Information flow sequences

A standard specifying TIPHON meta-protocols for end-to-end QoS Signalling shall provide signalling procedures in support of the information flow sequences specified below. In addition, signalling procedures should be provided to cover other sequences arising from error situations, interactions with simple call and interactions with other service capabilities.

In the figures, end-to-end QoS Signalling information flows are represented by solid arrows. Within a column representing a QoS Signalling functional entity, the numbers refer to functional entity actions listed in clause 5.3.

The following abbreviations are used:

req	request;
resp	response.

5.2.4.1 Normal operation

Figure 3 shows the information flows for the successful establishment of end-to-end QoS.

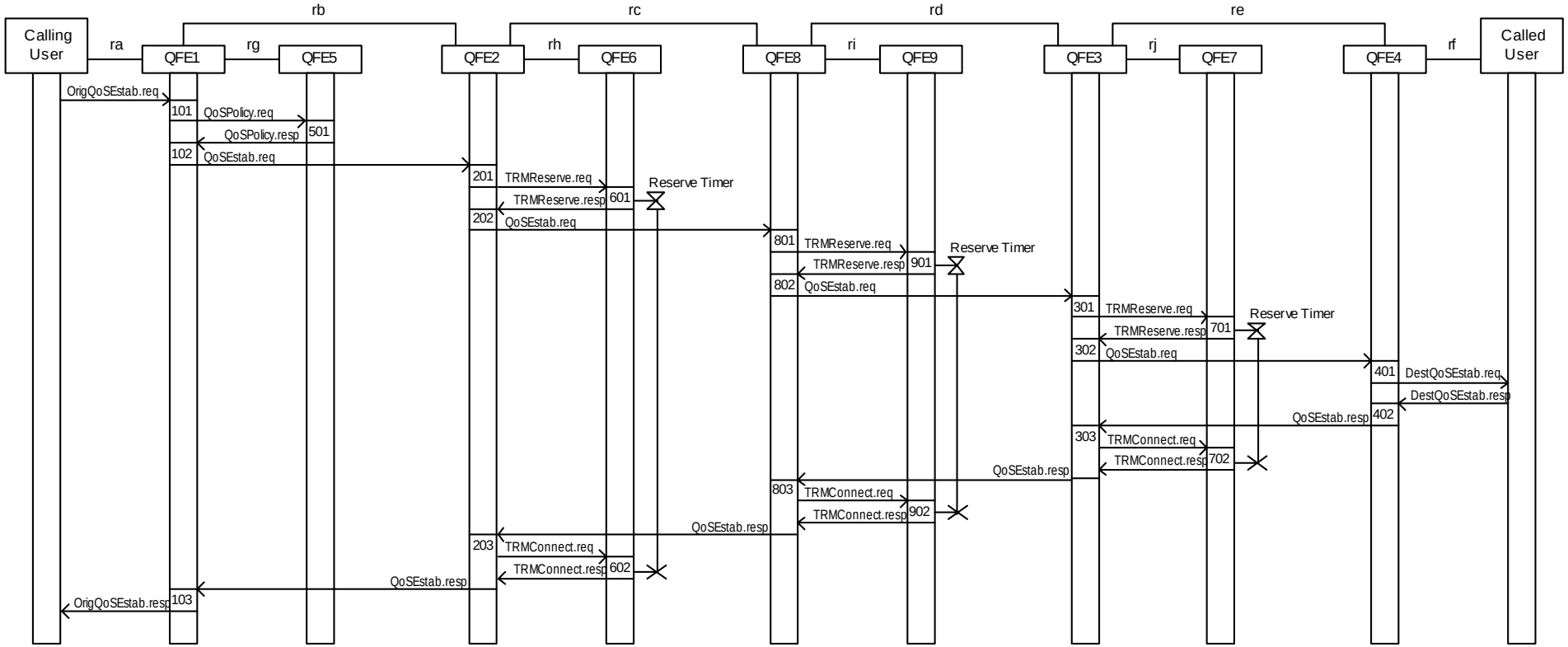

Figure 3: Information flows for successful QoS establishment

The information flows in figure 3 for successful QoS establishment can also be expressed in the form of a UML collaboration diagram as shown in figure 4.

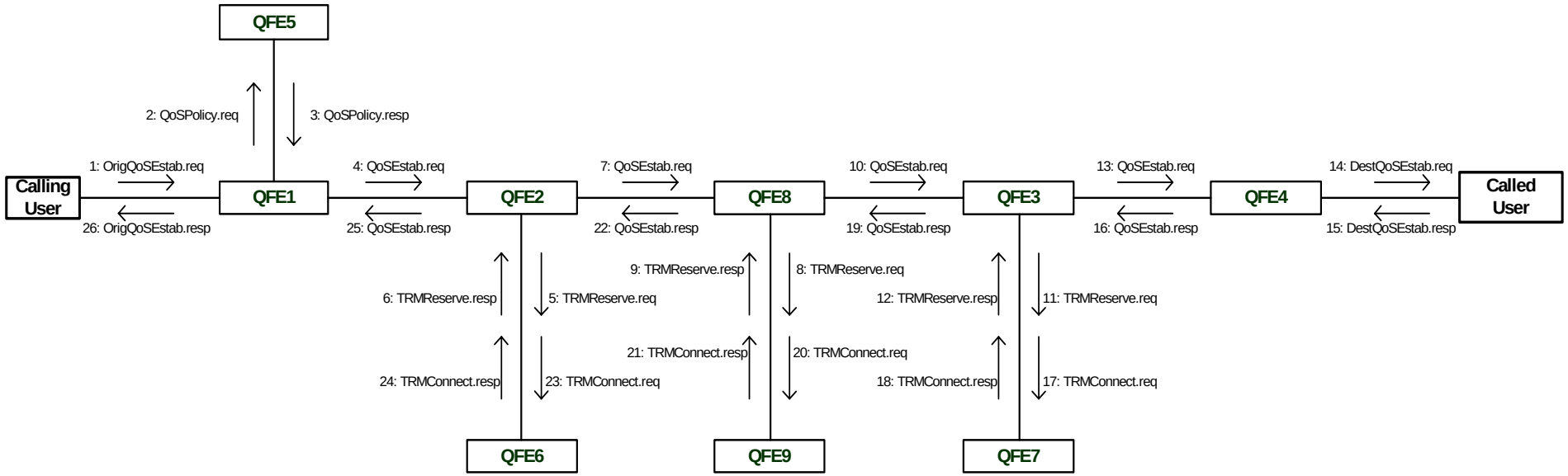

Figure 4: Successful QoS establishment shown in a collaboration diagram

5.2.4.2 Exceptional behaviour

Figure 5 shows the information flows for the rejection of QoS establishment due to the requested end-to-end QoS being unavailable.

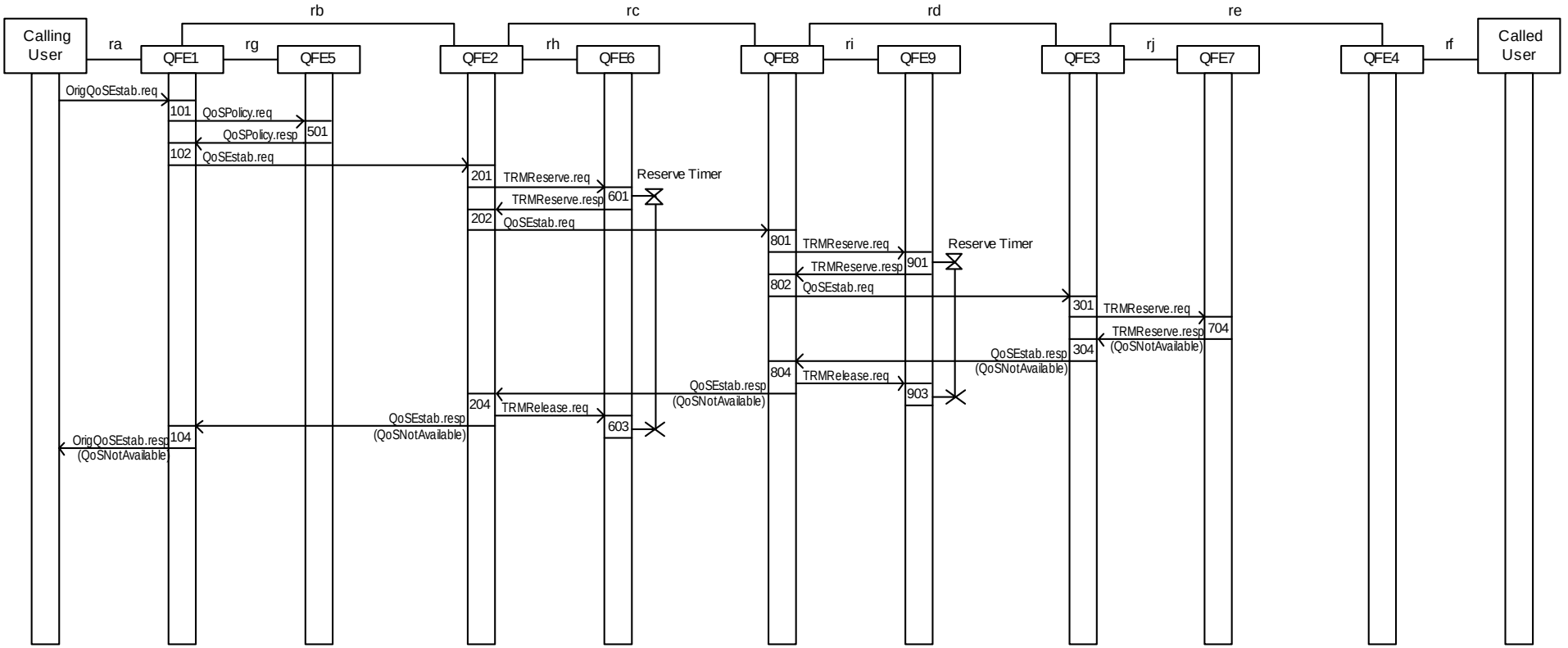

Figure 5: Information flows for unsuccessful establishment due to QoS not available

Figure 6 shows the information flows for the rejection of a QoS establishment due to policy conflict.

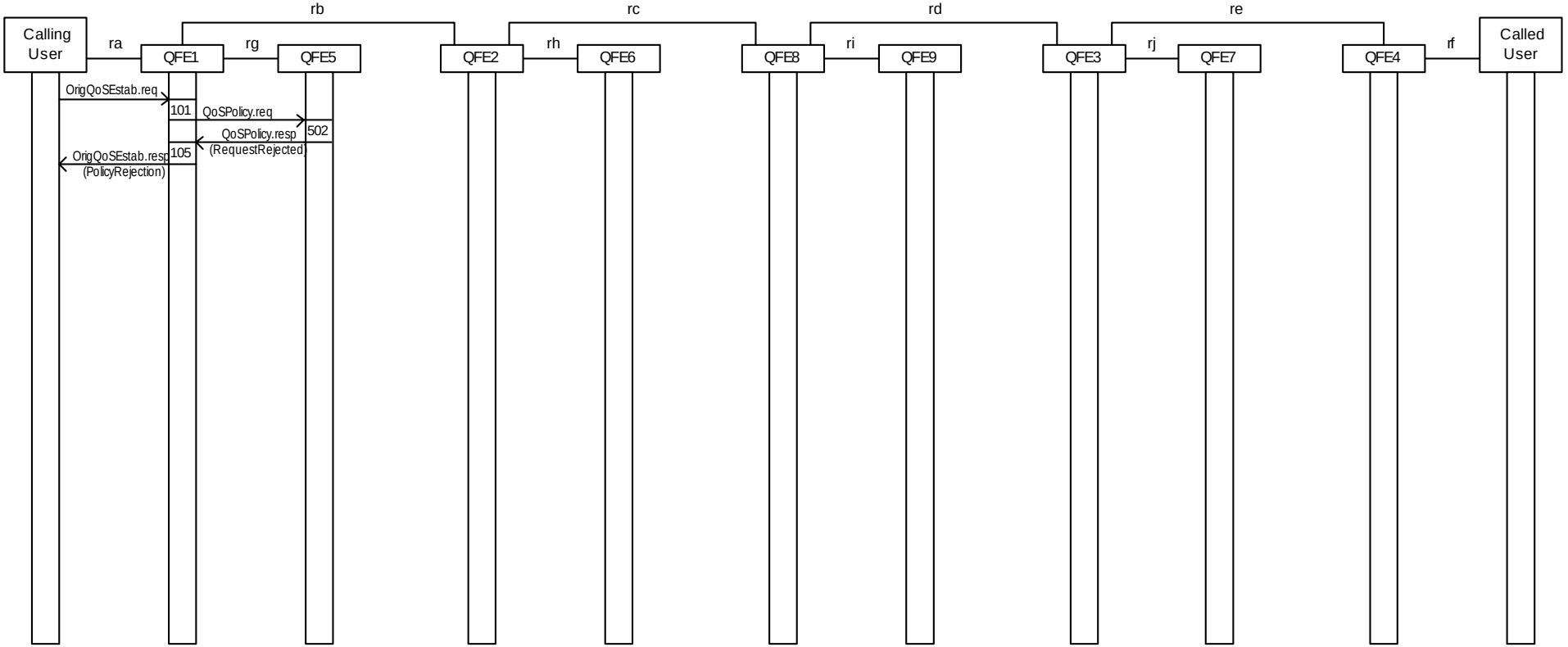

Figure 6: Information flows for the rejection of QoS establishment due to a policy decision

Figure 7 shows the information flows for the rejection of a QoS establishment because a compatible codec is not available at the called user.

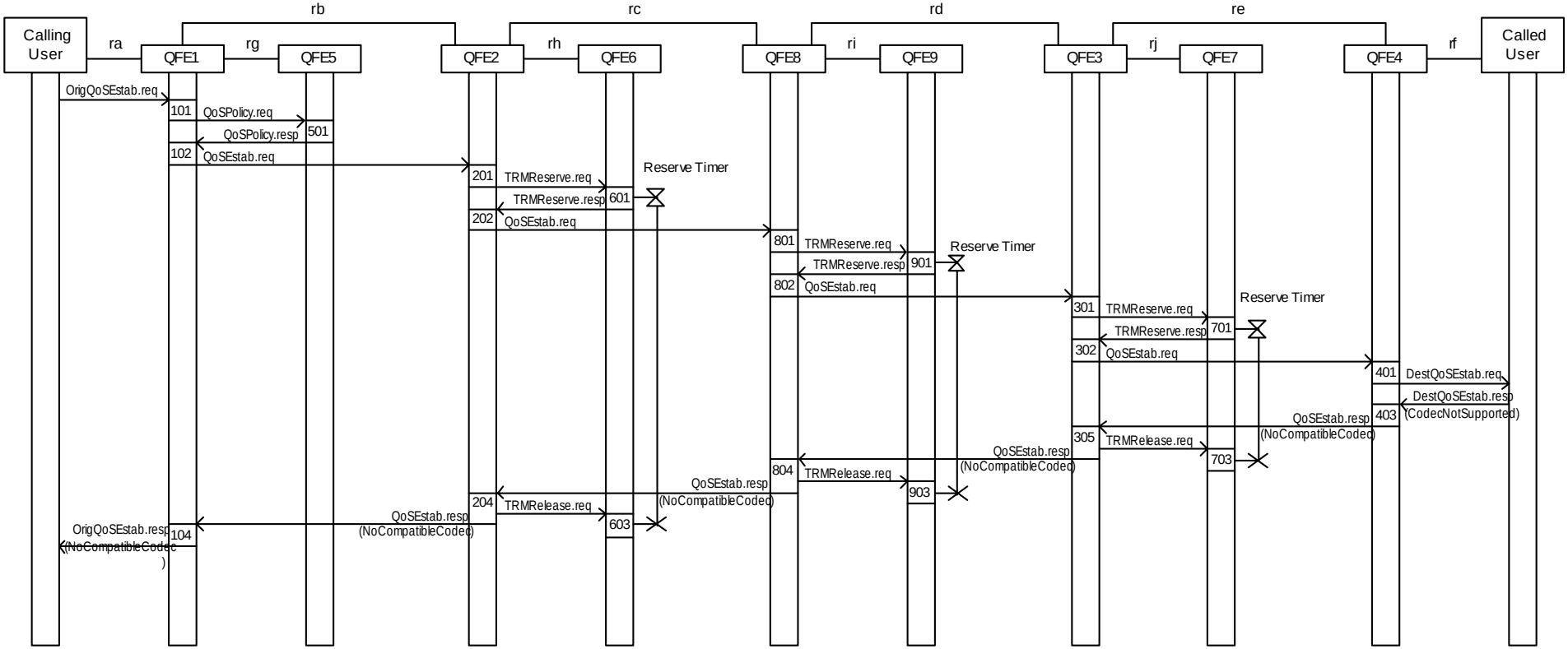

Figure 7: Information flows for the rejection of QoS establishment because a compatible codec is not available

Figure 8 shows the information flows for the rejection of a QoS establishment because a the resources reserved with a `TRMReserve` are no longer available when the `TRMConnect` is sent even though the Hold Reservation Timer has not expired.

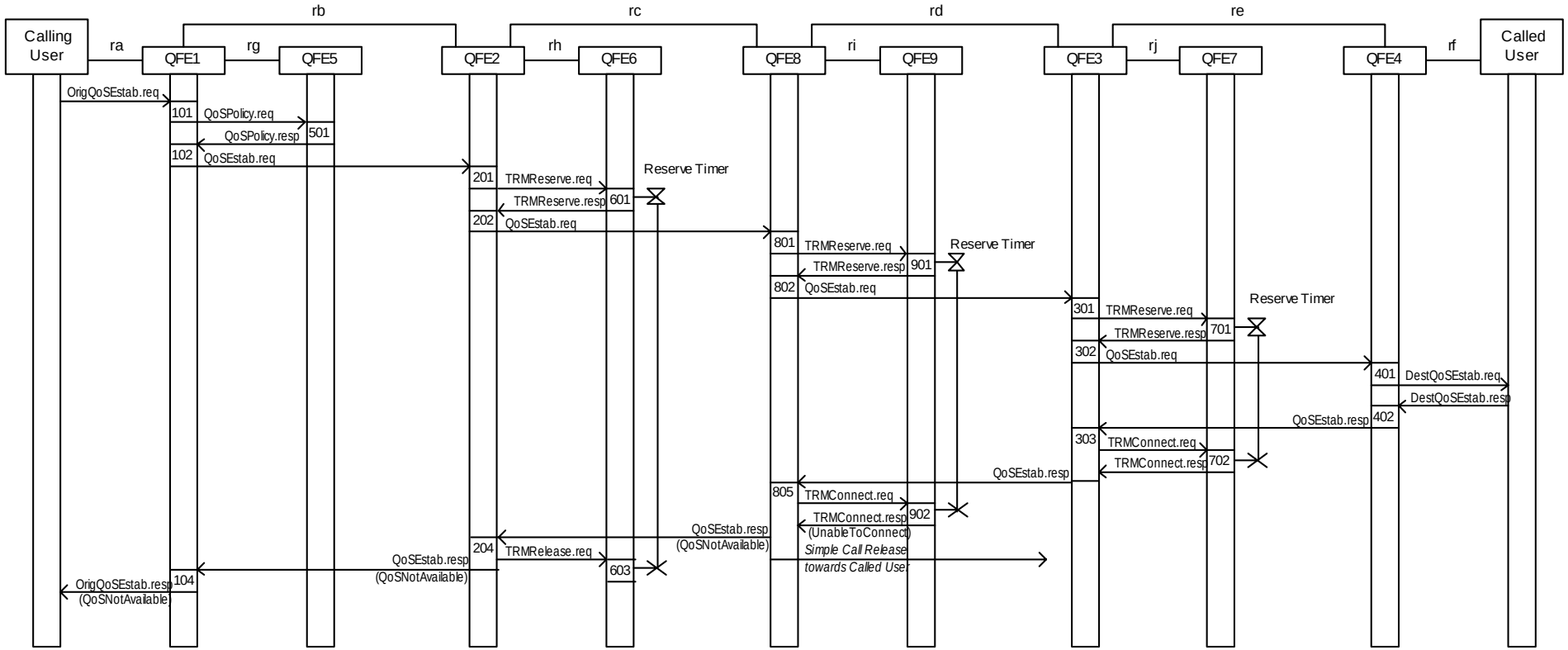

Figure 8: Information flows for the rejection of QoS establishment due to unavailability of previously reserved media transport resources

Figure 9 shows the information flows for the rejection of a QoS establishment because a the resources reserved with a `TRMReserve` are no longer available when the `TRMConnect` is sent because the Hold Reservation Timer has expired.

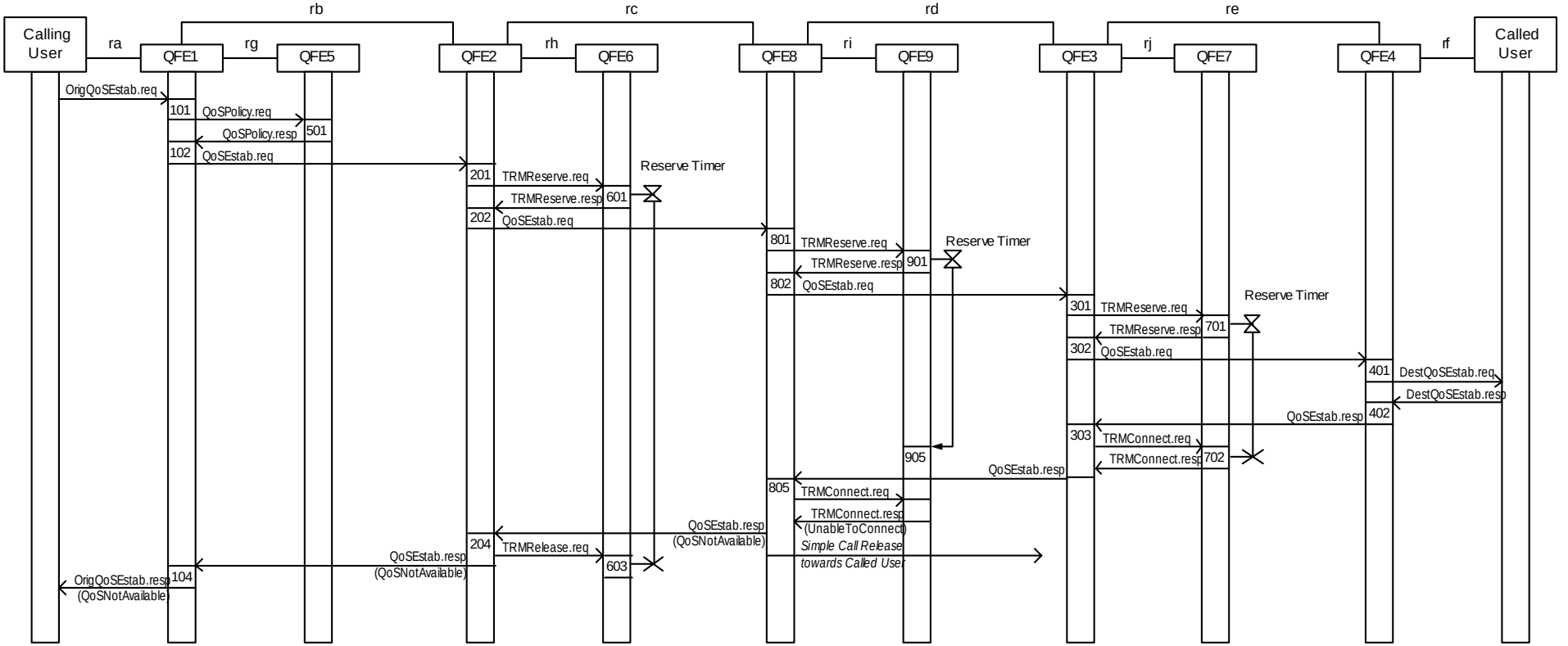

Figure 9: Information flows for the rejection of QoS establishment due to a resource time-out

5.3 QoS Functional entity actions

Throughout the descriptions of QFE actions, the following conventions are used to identify information flows:

- An information flow is referred to as a "request" at the QFE that sends it and as an "indication" at the QFE that receives it.
- The corresponding confirmation is referred to as a "response" at the QFE that sends it and as a "confirmation" at the QFE that receives it.

The following QFE actions shall occur at the points indicated in the figures of clause 5.2.4.

5.3.1 Actions of QFE1

101: On request from the Calling User (OrigQoSEstab indication), determine transport parameters to be used, formulate a QoSPolicy request and send it to QFE5.

102: Receive a positive QoSPolicy confirmation indicating that the call is permitted with the requested QoS, formulate a QoSEstab request and send it to QFE2.

103: Receive a positive QoSEstab confirmation, formulate a positive OrigQoSEstab response and send it to the Calling User.

104: Receive a negative QoSEstab confirmation, formulate a corresponding negative OrigQoSEstab response and send it to the Calling User.

105: Receive a negative QoSPolicy confirmation, formulate a corresponding negative OrigQoSEstab response and send it to the Calling User.

106: Receive a positive QoSPolicy confirmation indicating that the call is permitted but with an alternative QoS to that requested by the Calling User, formulate a QoSEstab request and send it to QFE2.

107: Receive a positive QoSEstab confirmation, formulate a positive OrigQoSEstab response indicating that an alternative QoS to that requested has been used and send it to the Calling User.

5.3.2 Actions of QFE2

201: Receive a QoSEstab indication, formulate a TRMReserve request and send it to QFE6.

202: Receive a positive TRMReserve confirmation, formulate a QoSEstab request and send it to QFE8.

203: Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE6. On receipt of a positive TRMConnect confirmation, send a positive QoSEstab response to QFE1.

204: Receive a negative QoSEstab confirmation, send a TRMRelease request to QFE6 and send a negative QoSEstab response to QFE1.

205 (not shown): Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE6. On receipt of a negative TRMConnect confirmation, formulate a negative QoSEstab response, send it to QFE1 and stimulate the release of the TIPHON Simple Call towards the Called User.

5.3.3 Actions of QFE3

301: Receive a QoSEstab indication, formulate a TRMReserve request and send it to QFE7.

302: Receive a positive TRMReserve confirmation, formulate a QoSEstab request and send it to QFE4.

303: Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE7. On receipt of a positive TRMConnect confirmation, send a positive QoSEstab response to QFE8.

304: Receive a negative TRMReserve confirmation, formulate a negative QoSEstab response and send it to QFE8.

305: Receive a negative QoSEstab confirmation, send a TRMRelease request to QFE7 and send a negative QoSEstab response to QFE8.

306 (not shown): Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE9. On receipt of a negative TRMConnect confirmation, formulate a negative QoSEstab response, send it to QFE2 and stimulate the release of the TIPHON Simple Call towards the Called User.

5.3.4 Actions of QFE4

401: Receive a QoSEstab indication, formulate a DestQoSEstab request and send it to the Calling User.
402: On request from the Calling User (positive DestQoSEstab confirmation), formulate a positive QoSEstab response and send it to QFE3.
403: On request from the Calling User (negative DestQoSEstab confirmation), formulate a negative QoSEstab response and send it to QFE3.

5.3.5 Actions of QFE5

501: Receive a QoSPolicy indication. If the established policy permits the call to proceed with the requested QoS, formulate a positive QoSPolicy response and send it to QFE1.
502: Receive a QoSPolicy indication. If the established policy does not permit the call to proceed with the requested or an alternative QoS, formulate a negative QoSPolicy response and send it to QFE1.
503: Receive a QoSPolicy indication. If the established policy does not permit the call to proceed with the requested QoS but would allow it to proceed with an alternative QoS, formulate a positive QoSPolicy response indicating the alternative QoS parameters and send it to QFE1.

5.3.6 Actions of QFE6

601: Receive a TRMReserve indication. If it is possible to meet the requested QoS demands, formulate a positive TRMReserve response, send it to QFE2 and start the QFE6 Reservation Hold Timer.
602: Receive a TRMConnect indication. If the reserved resources are still available, finalize the allocation of the resources and formulate a positive TRMConnect response and send it to QFE2.
603: Receive a TRMConnect indication. If the reserved resources are no longer available, formulate a negative TRMConnect response and send it to QFE2.
604 (not shown): Receive a TRMReserve indication. If it is not possible to meet the requested QoS demands, formulate a negative TRMReserve response and send it to QFE2.
605 (not shown): When the Reservation Hold Timer expires, release the reserved resources and set an indication that they are no longer available.

5.3.7 Actions of QFE7

701: Receive a TRMReserve indication. If it is possible to meet the requested QoS demands, formulate a positive TRMReserve response, send it to QFE3 and start the QFE7 Reservation Hold Timer.
702: Receive a TRMConnect indication. If the reserved resources are still available, finalize the allocation of the resources and formulate a positive TRMConnect response and send it to QFE3.
703: Receive a TRMConnect indication. If the reserved resources are no longer available, formulate a negative TRMConnect response and send it to QFE3.
704: Receive a TRMReserve indication. If it is not possible to meet the requested QoS demands, formulate a negative TRMReserve response and send it to QFE3.
705 (not shown): When the Reservation Hold Timer expires, release the reserved resources and set an indication that they are no longer available.

5.3.8 Actions of QFE8

801: Receive a QoSEstab indication, formulate a TRMReserve request and send it to QFE9.
802: Receive positive TRMReserve confirmation, formulate a QoSEstab request and send it to QFE3.
803: Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE9. On receipt of a positive TRMConnect confirmation, send a positive QoSEstab response to QFE2.
804: Receive a negative QoSEstab confirmation, send a TRMRelease request to QFE9 and send a negative QoSEstab response to QFE2.
805: Receive a positive QoSEstab confirmation, formulate a TRMConnect request and send it to QFE9. On receipt of a negative TRMConnect confirmation, formulate a negative QoSEstab response, send it to QFE2 and stimulate the release of the TIPHON Simple Call towards the Called User.

5.3.9 Actions of QFE9

901: Receive a TRMReserve indication. If it is possible to meet the requested QoS demands, formulate a positive TRMReserve response, send it to QFE8 and start the QFE9 Reservation Hold Timer.

902: Receive a TRMConnect indication. If the reserved resources are still available, finalize the allocation of the resources and formulate a positive TRMConnect response and send it to QFE8.

903: Receive a TRMConnect indication. If the reserved resources are no longer available, formulate a negative TRMConnect response and send it to QFE8.

904 (not shown): Receive a TRMReserve indication. If it is not possible to meet the requested QoS demands, formulate a negative TRMReserve response and send it to QFE8.

905: When the Reservation Hold Timer expires, release the reserved resources and set an indication that they are no longer available.

5.4 QoS Functional entity behaviour

The behaviour specified in this clause is intended to illustrate typical QFE behaviour in terms of information flows sent and received.

The behaviour of each QFE is shown using the Specification and Description Language (SDL) defined in ITU-T Recommendation Z.100 [6].

NOTE: The complete SDL model which was used for validation purposes (and from which the following process diagrams were extracted) is available separately in electronic form.

5.4.1 Information flows specified as ASN.1 operations

For the purposes of modelling end-to-end QOS signalling in SDL, the information flows defined in subclause 5.2 have been specified using the Abstract Syntax Notation 1 (ASN.1) defined in ITU-T Recommendation X.680 [7]. The ASN.1 is shown in table 10.

Table 10: End-to-end QoS information flows specified as ASN.1

```
TIPHON-QoS-Types DEFINITIONS ::=

BEGIN

-- Data structures for the OrigQoSEstab signals --

 CallReqType ::= SEQUENCE
 { qoSServiceClass QoSClass,
 calledUserID TiphonUserName,
 codec CodecList }

 CallRespType ::= SEQUENCE
 { codec CodecList OPTIONAL,
 result OrigResult }

 origResultOnly CallRespType ::= { result qoSNotAvailable }

 QoSClass ::= INTEGER(0..maxQoSClass)

 maxQoSClass INTEGER ::= 255

 predefinedQoS QoSClass ::= 0

 tiphonQoSClass-1 QoSClass ::= 1
 tiphonQoSClass-2A QoSClass ::= 2
 tiphonQoSClass-2M QoSClass ::= 3
 tiphonQoSClass-2H QoSClass ::= 4
 tiphonQoSClass-3 QoSClass ::= 5

 NonStandardQoSClass ::= QoSClass(16..maxQoSClass)

 TiphonUserName ::= E164Number

 E164Number ::= NumericString (SIZE (1..15))

 CodecList ::= SEQUENCE (SIZE (1..8)) OF CodecType
```

```
CodecType ::= SEQUENCE
{ codecID CodecID,
framesperPacket FrameCount }

CodecID ::= VisibleString (SIZE (1..15))

FrameCount ::= INTEGER (1..maxFrameCount)

maxFrameCount INTEGER ::= 256


OrigResult ::= ENUMERATED
{ requestedQoSEstablished,
qoSNotAvailable,
unknownUser,
noCompatibleCodec,
policyRejection }


-- Data structures for the QoSEstab Signals --

QoSReqType ::= SEQUENCE
{ callingUserID TiphonUserName,
calledUserID TiphonUserName,
transportQoSParams TransportParams,
paramQualifier ParamQualifier,
codec CodecList,
destServiceDomain NWspecificAddr OPTIONAL }

QoSRespType ::= SEQUENCE
{ codec CodecList OPTIONAL,
result QoSEstabResult }

qosResultOnly QoSRespType ::= { result qoSNotAvailable }

TransportParams ::= SEQUENCE
{ maximumDelay MicroSeconds,
maxDelayVariation MicroSeconds,
maxMeanPacketLoss PercentX1000
-- Packet loss is specified as % x 1000 to avoid --
-- the need for REAL numbers when loss is less --
-- than one percent -- }

MicroSeconds ::= INTEGER(0..10000000) -- Allows up to 10s to be expressed in micro-sec --

PercentX1000 ::= INTEGER(0..100000) -- Allows up to 100% to be expressed in --
-- increments of 0.001% --

ParamQualifier ::= ENUMERATED
{ totalRemainingBudget,
budgetAvailableForDomain }

NWspecificAddr ::= CHOICE
{ e164Number [0] E164Number,
e212Number [1] E212Number,
ipAddress [2] IPAddress }

E212Number ::= NumericString (SIZE (15))

IPAddress ::= CHOICE
{ ipv4Address [0] IPv4Address,
ipv6Address [1] IPv6Address }

IPv4Address ::= SEQUENCE
{ addr FourOctets,
port OneOctet }

IPv6Address ::= SEQUENCE
{ addr SixteenOctets,
port SixteenOctets }

OneOctet ::= OCTET STRING (SIZE (1))
FourOctets ::= OCTET STRING (SIZE (4))
SixteenOctets ::= OCTET STRING (SIZE (16))

QoSEstabResult ::= ENUMERATED
```

```
 { qoSAvailable,
 qoSNotAvailable,
 unknownUser,
 noCompatibleCodec }


-- Data structures for the DestQoSEstab signals --

 CalledReqType ::= SEQUENCE
 { callingUserID TiphonUserName,
 transportQoSParams TransportParams,
 codec CodecList }

 CalledRespType ::= SEQUENCE
 { codec CodecList OPTIONAL,
 result DestResult }

 DestResult ::= ENUMERATED
 { indicatedCodecSelected,
 codecsNotSupported }


-- Data structures for the QoSPolicyReq signals --

 PolicyReqType ::= SEQUENCE
 { callingUserID TiphonUserName,
 calledUserID TiphonUserName,
 requestedQoS RequestedQoS }

 PolicyRespType ::= PolicyResult

 RequestedQoS ::= CHOICE
 { transportQoSParams TransportParams,
 qoSServiceClass QoSClass }

 PolicyResult ::= ENUMERATED
 { callAllowed,
 serviceNotSubscribedTo,
 serviceCurrentlyNotAvailable }


-- Data structures for the TRMReserve signals --

 TRMResType ::= SEQUENCE
 { requestHandle Handle,
 transportQoSParams TransportParams,
 paramQualifier ParamQualifier,
 trafficDescriptor TrafficDesc,
 ingressAddress NWspecificAddr,
 destTranspDomain NWspecificAddr }

 TRMRespType ::= SEQUENCE
 { transportQoSParams TransportParams OPTIONAL,
 trmResResult TRMResResult }

 resultOnly TRMRespType ::= { trmResResult bandwidthReserved }

 Handle ::= VisibleString (SIZE (0..16))

 TrafficDesc ::= SEQUENCE
 { peakFrameRate FrameRate,
 maxFrameLength FrameLength }

 FrameRate ::= INTEGER (1..255)

 FrameLength ::= INTEGER (1..65535)

 TRMResResult ::= ENUMERATED
 { bandwidthReserved,
 bandwidthUnavailable,
 destinationUnknown }



-- Data structures for TRMConnect signals --

 TRMConnectType ::= Handle
```

```
 TRMConnRespType ::= TRMConnResult

 TRMConnResult ::= ENUMERATED
 { connectionMade,
 unableToConnect }


-- Data structures for TRMRelease signal --

 TRMReleaseType ::= Handle

END
```

5.4.2 Behaviour of QFE1

The behaviour of QFE1 is shown in the SDL process diagram in figures 10 to 13.

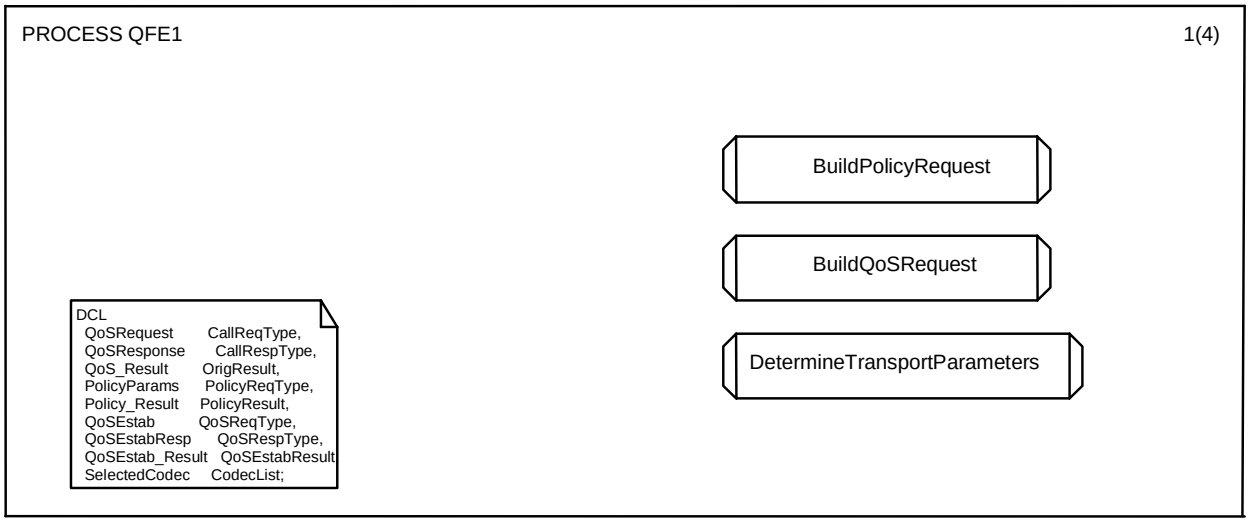

Figure 10: SDL process diagram for functional entity QFE1 (1 of 4)

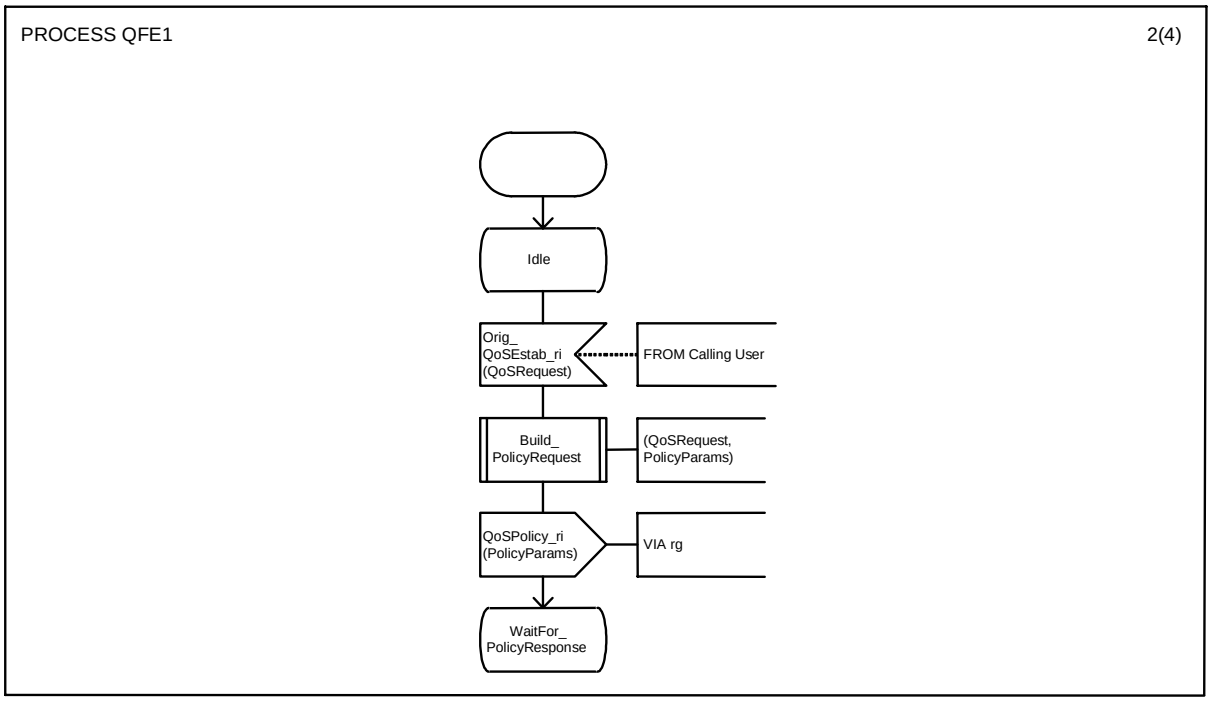

Figure 11: SDL process diagram for functional entity QFE1 (2 of 4)

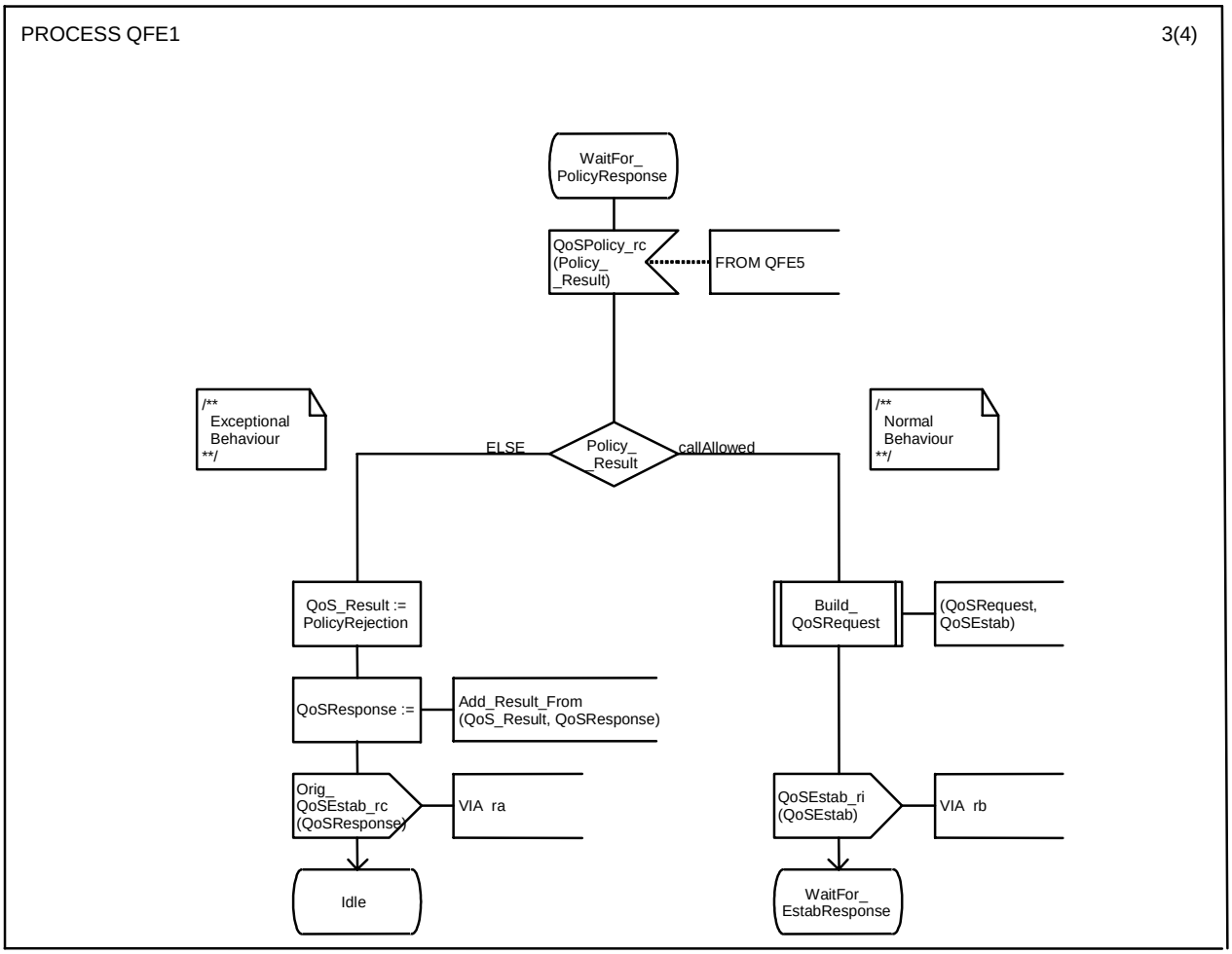

Figure 12: SDL process diagram for functional entity QFE1 (3 of 4)

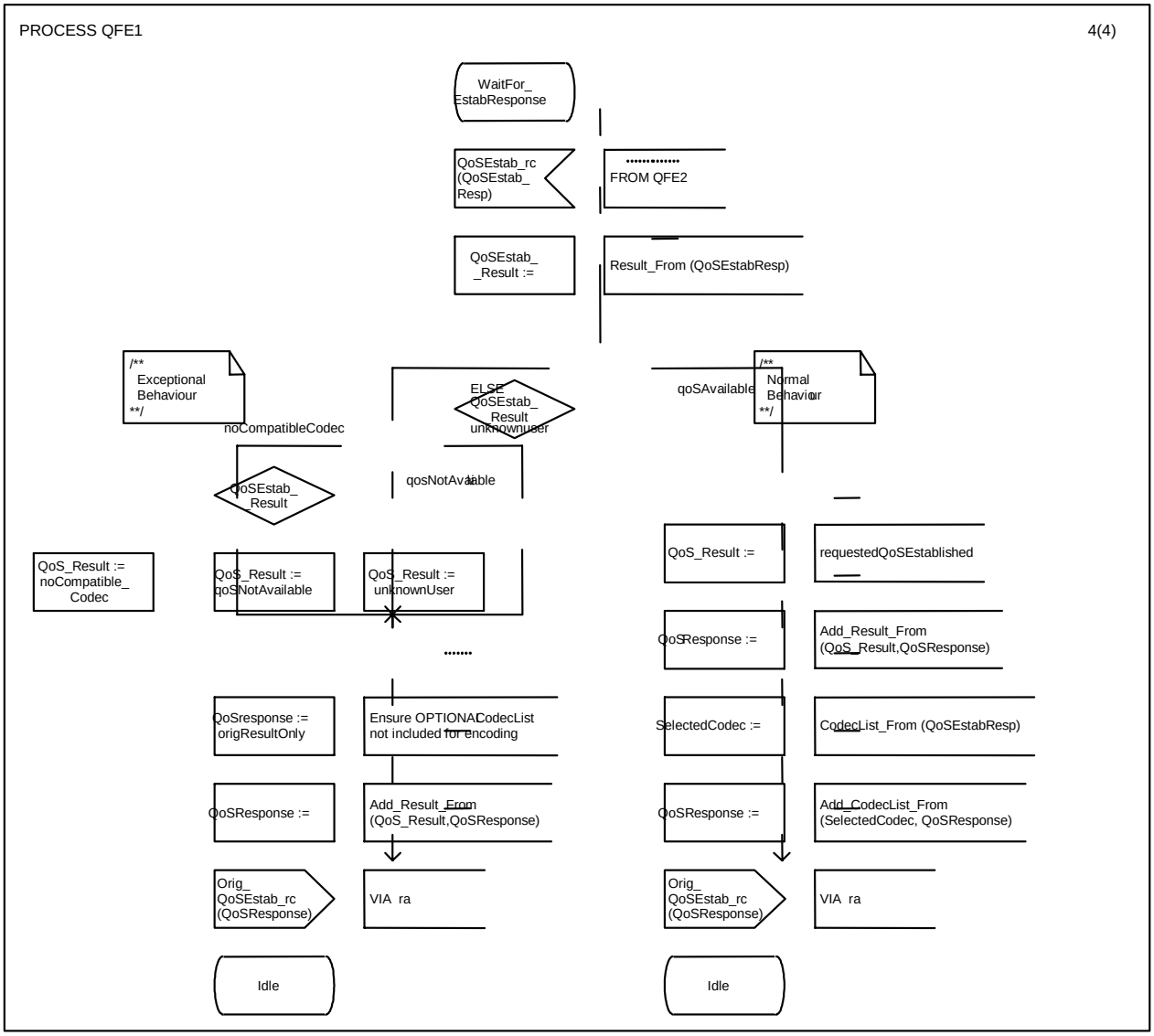

Figure 13: SDL process diagram for functional entity QFE1 (4 of 4)

5.4.3 Behaviour of QFE2, QFE3 and QFE8

The behaviour specifications of functional entities QFE2, QFE3 and QFE8 are, for the purposes of the present document, identical. This behaviour is shown in the SDL process type diagram in figures 14 to 20.

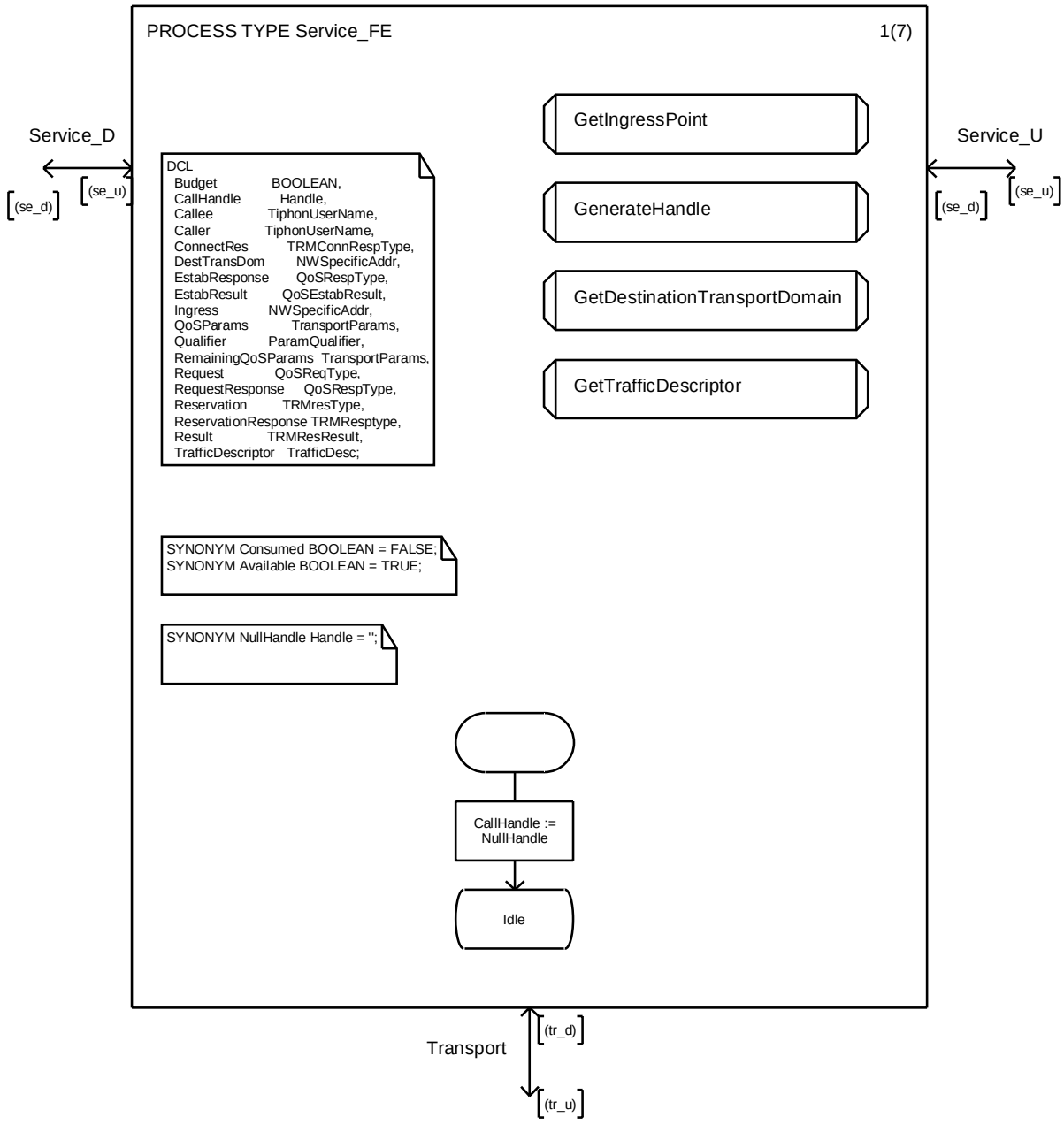

Figure 14: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (1 of 7)

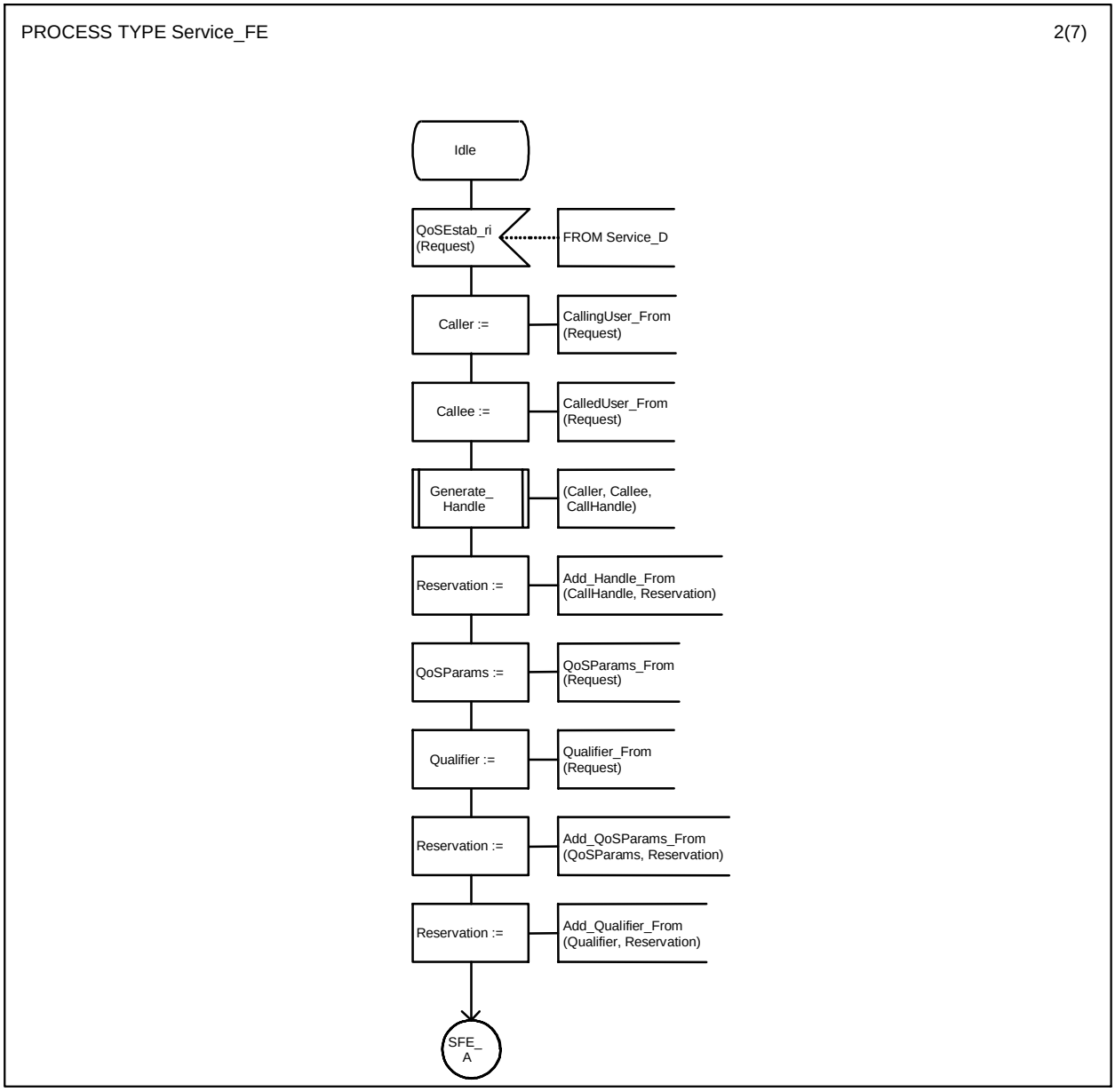

Figure 15: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (2 of 7)

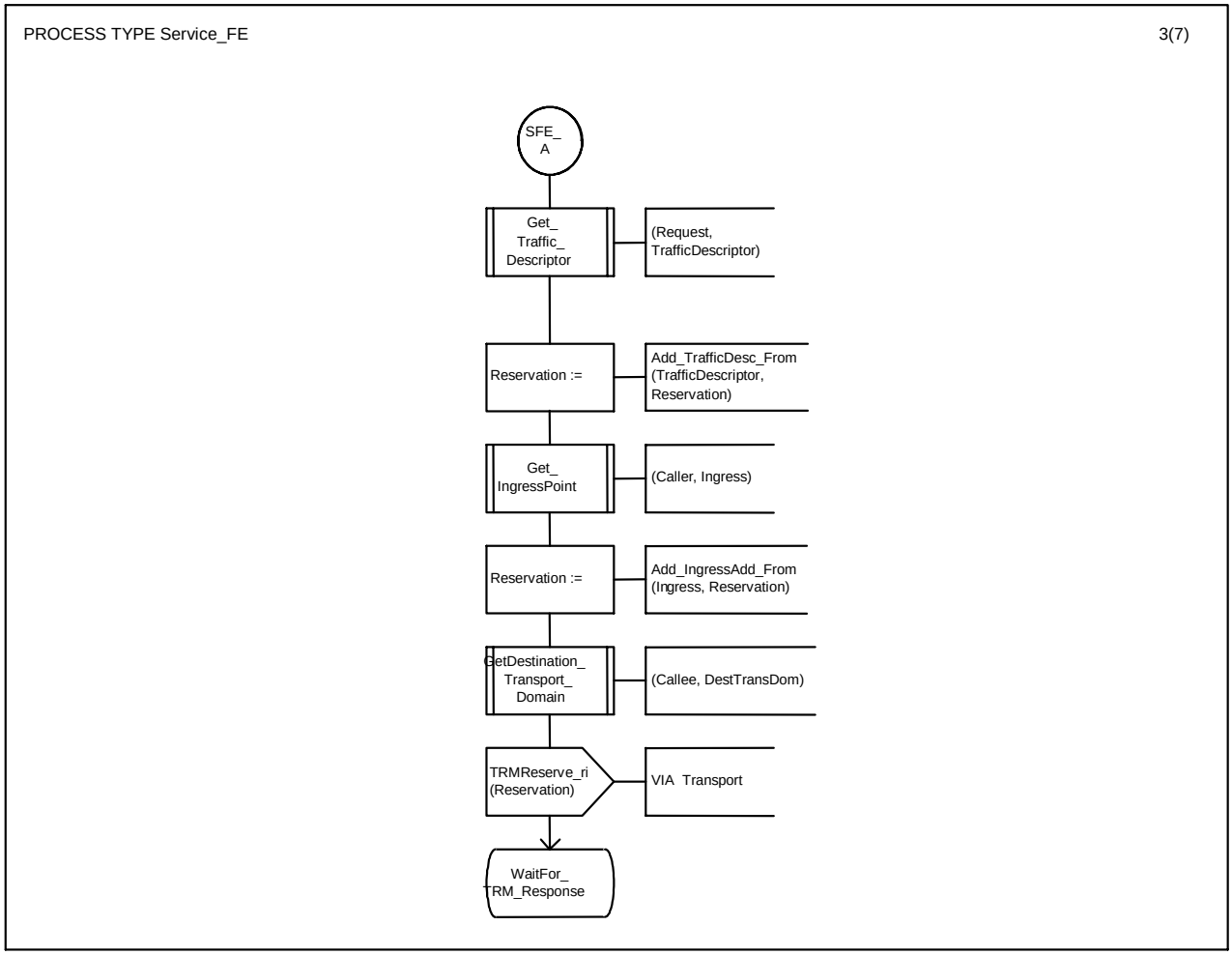

Figure 16: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (3 of 7)

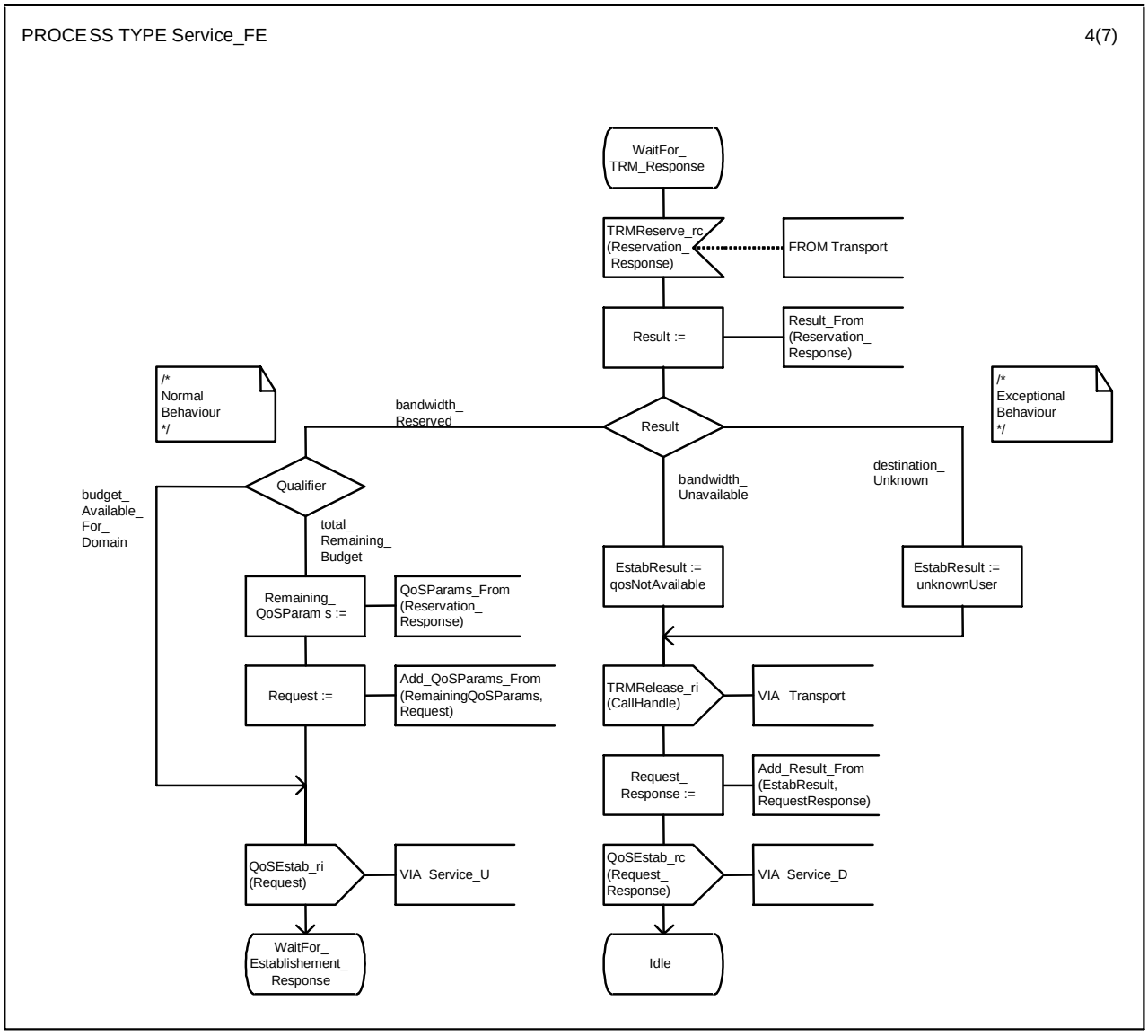

Figure 17: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (4 of 7)

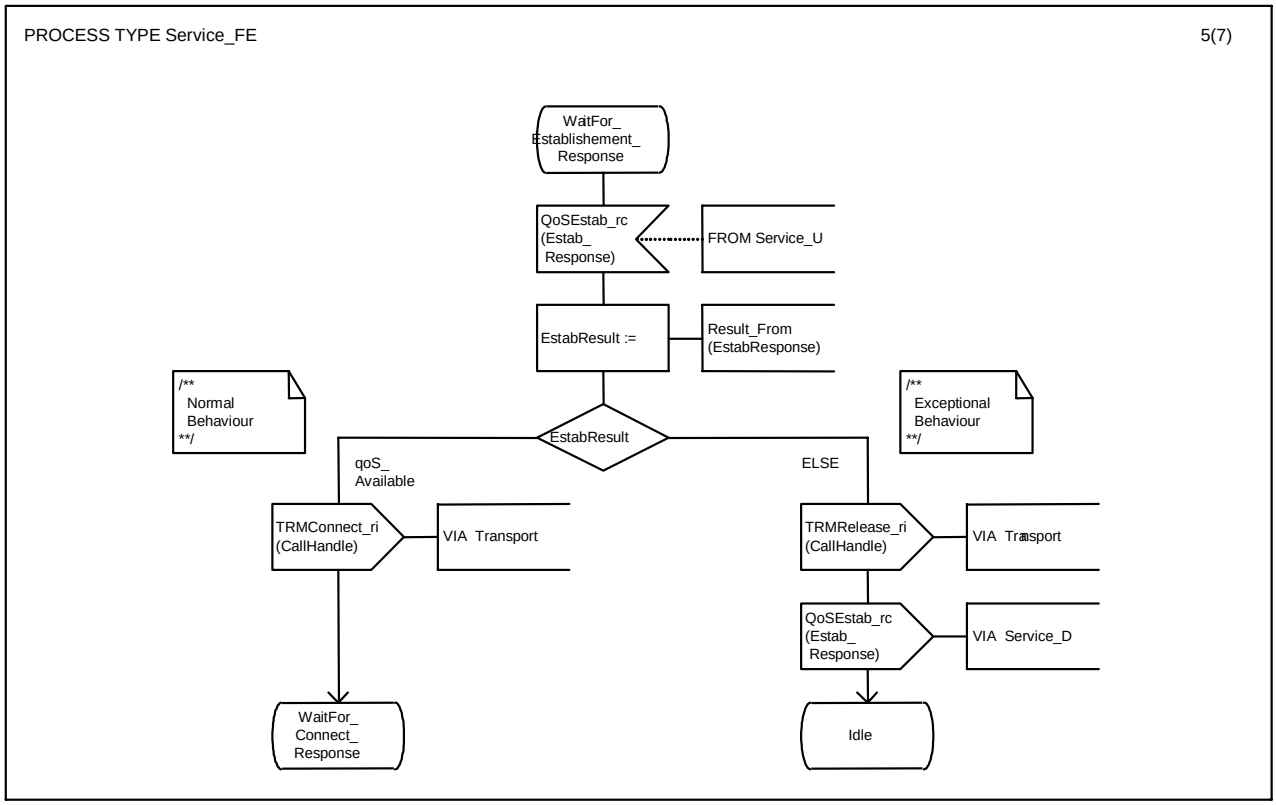

Figure 18: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (5 of 7)

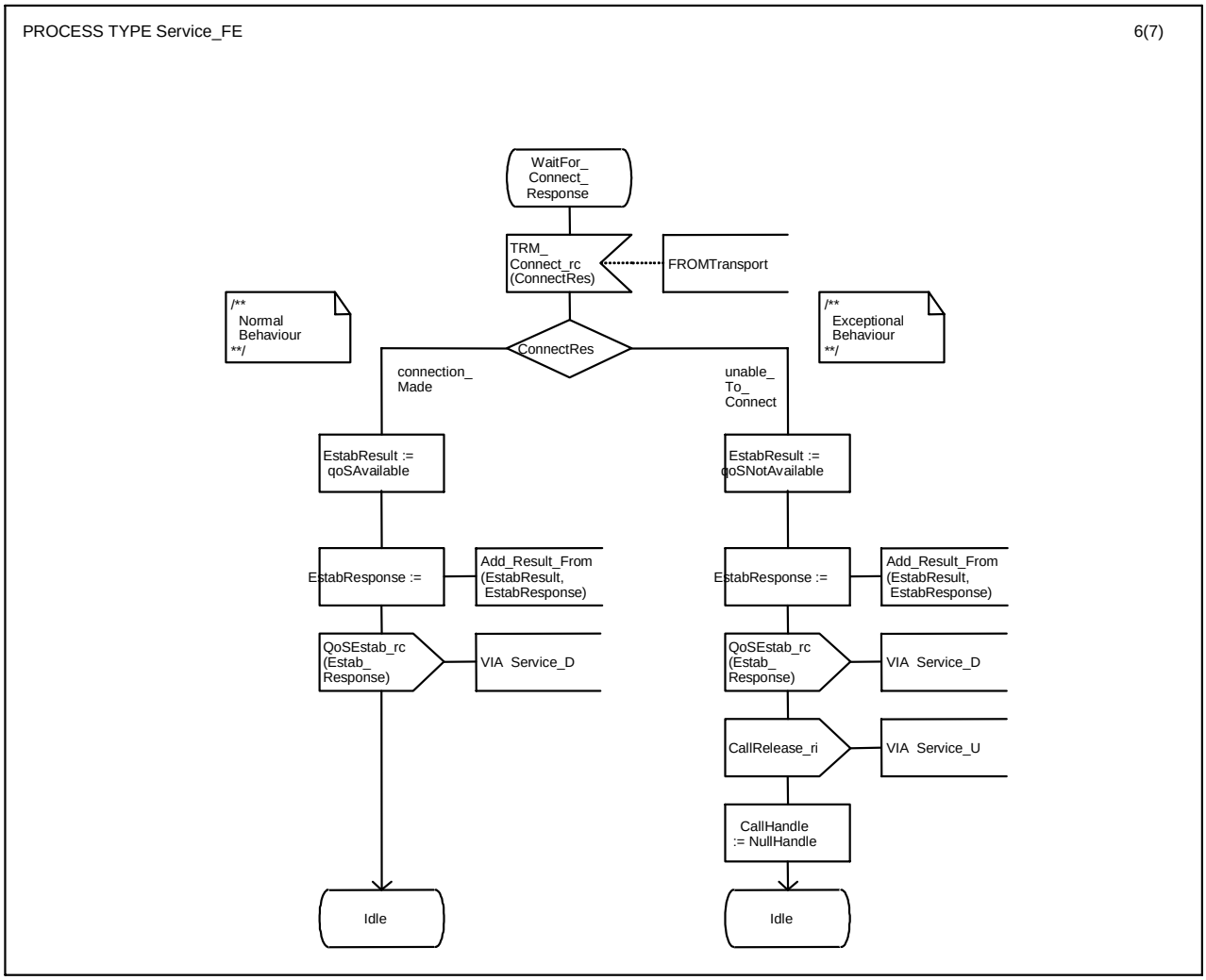

Figure 19: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (6 of 7)

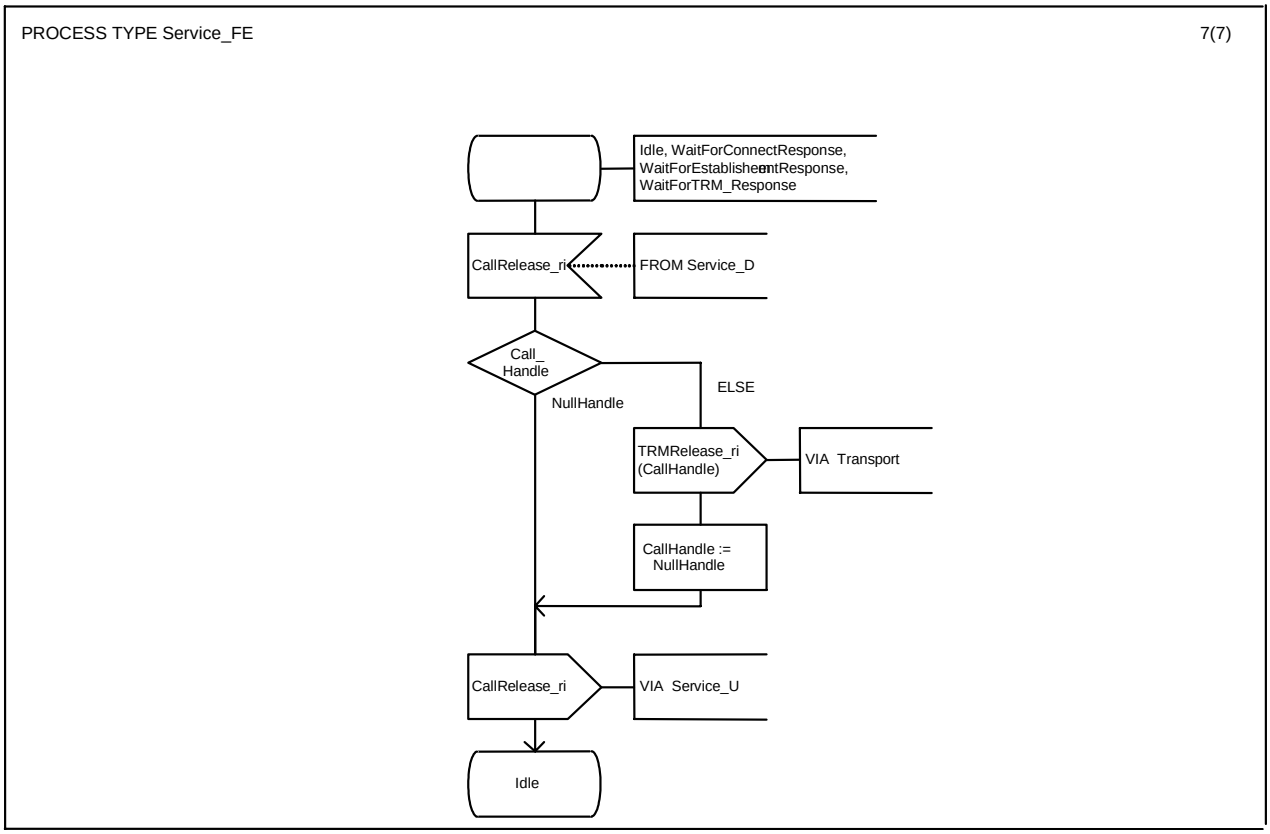

Figure 20: SDL process type diagram for functional entities QFE2, QFE3 and QFE8 (7 of 7)

5.4.4 Behaviour of QFE6, QFE7 and QFE9

The behaviour specifications of functional entities QFE6, QFE7 and QFE9 are, for the purposes of the present document, identical. This behaviour is shown in the SDL process type diagram in figures 20 to 24.

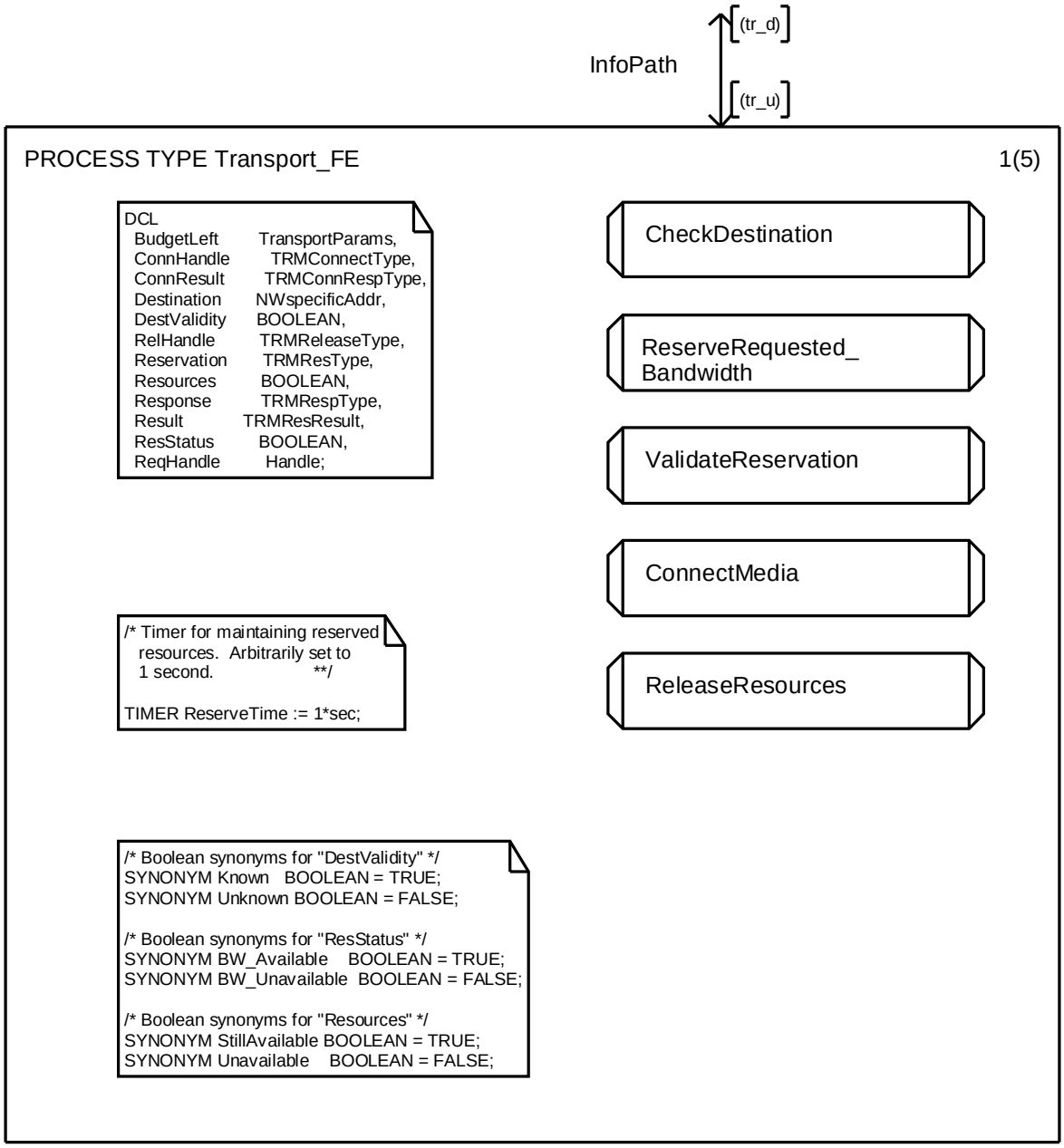

Figure 21: SDL process type diagram for functional entities QFE6, QFE7 and QFE9 (1 of 5)

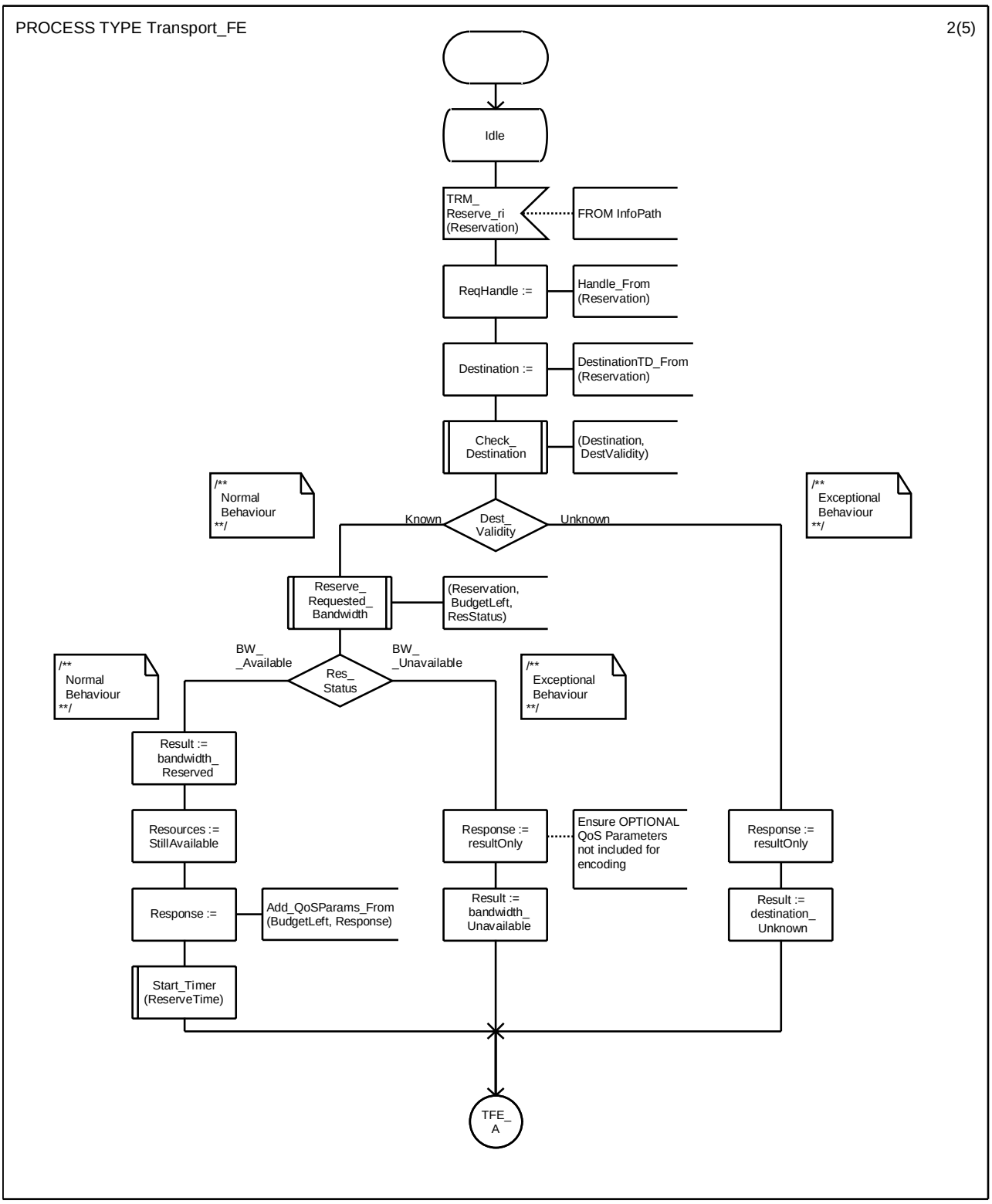

Figure 22: SDL process type diagram for functional entities QFE6, QFE7 and QFE9 (2 of 5)

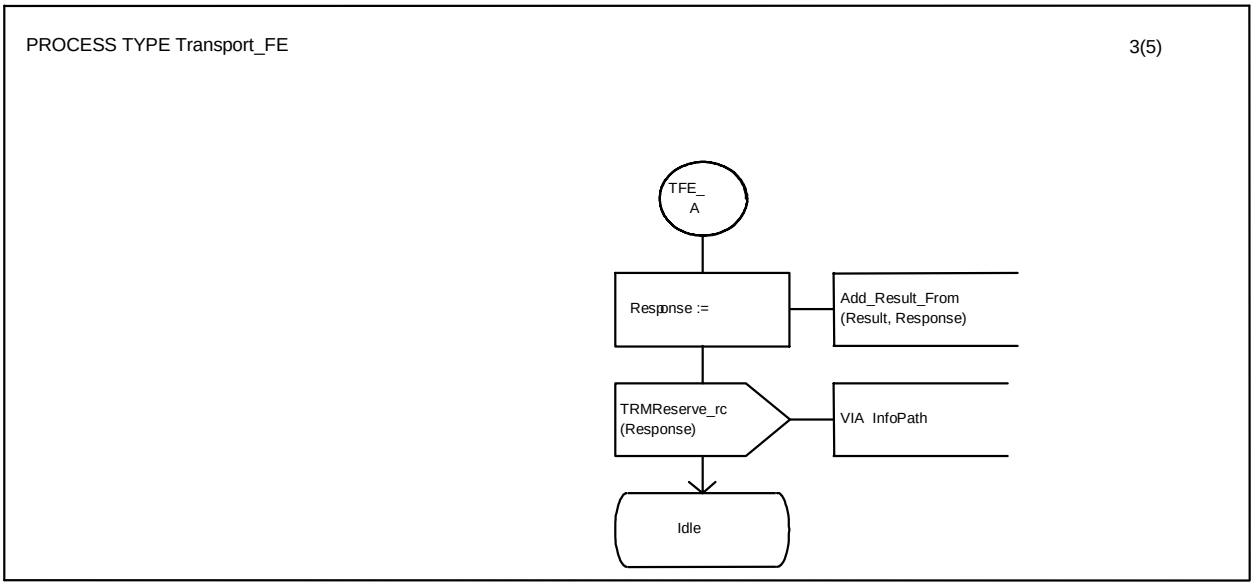

Figure 23: SDL process type diagram for functional entities QFE6, QFE7 and QFE9 (3 of 5)

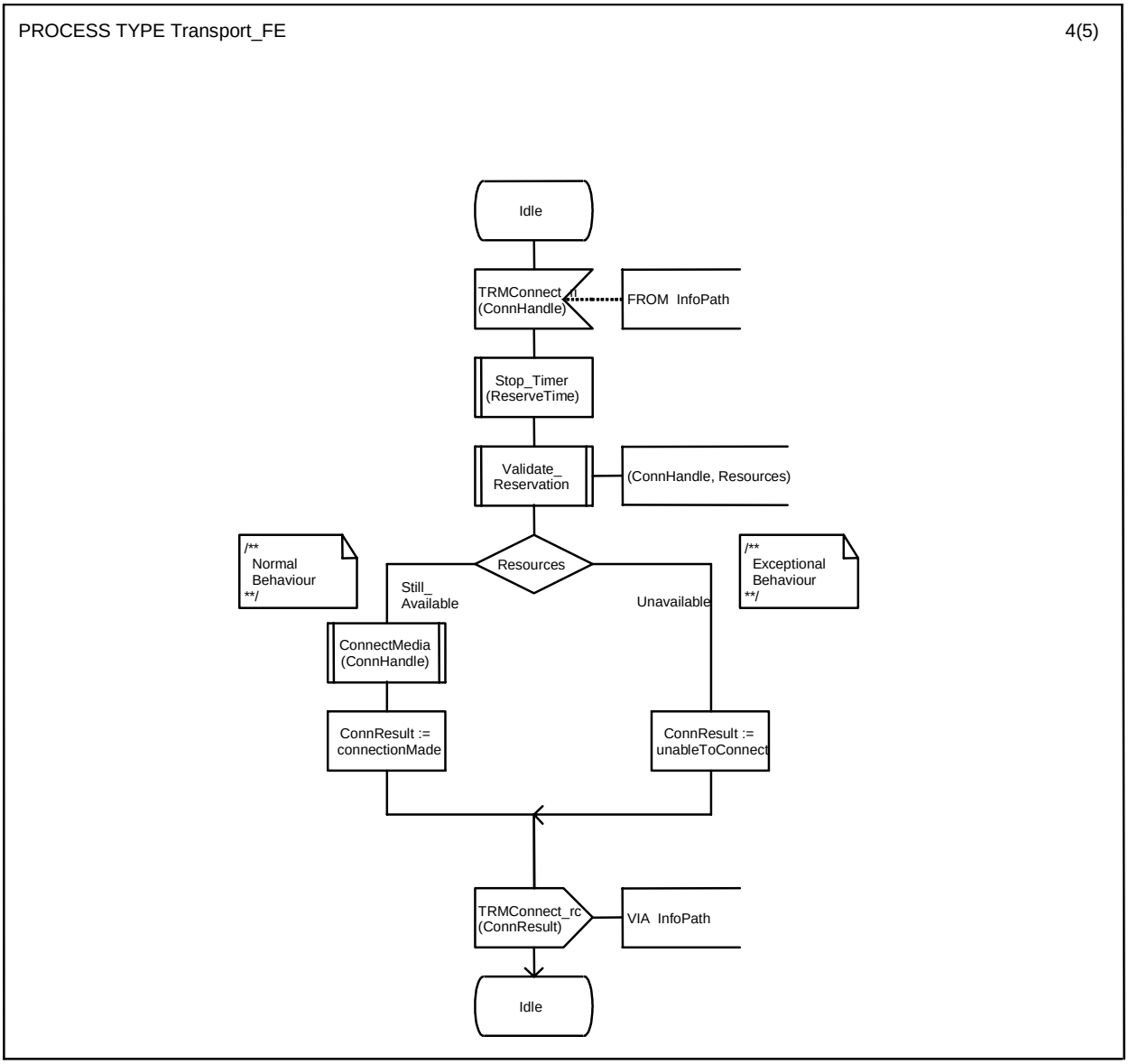

Figure 24: SDL process type diagram for functional entities QFE6, QFE7 and QFE9 (4 of 5)

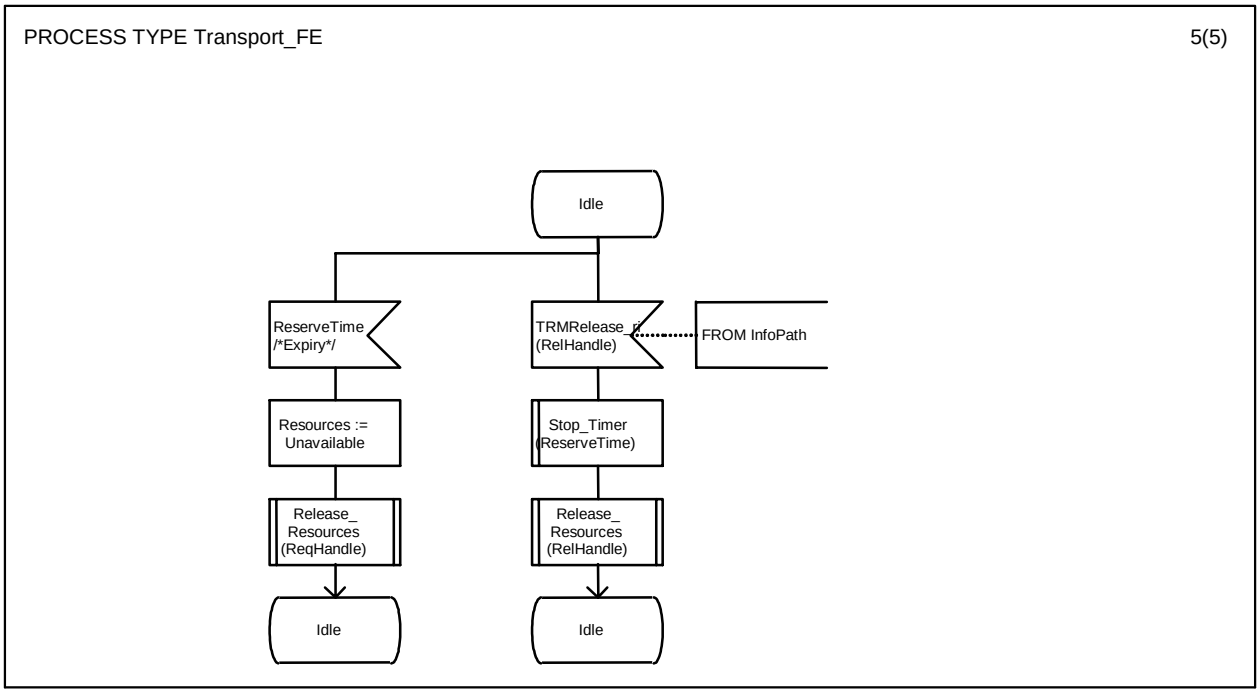

Figure 25: SDL process type diagram for functional entities QFE6, QFE7 and QFE9 (5 of 5)

5.4.5 Behaviour of QFE4

The behaviour of QFE4 is shown in the SDL process diagram in figures 26 to 29.

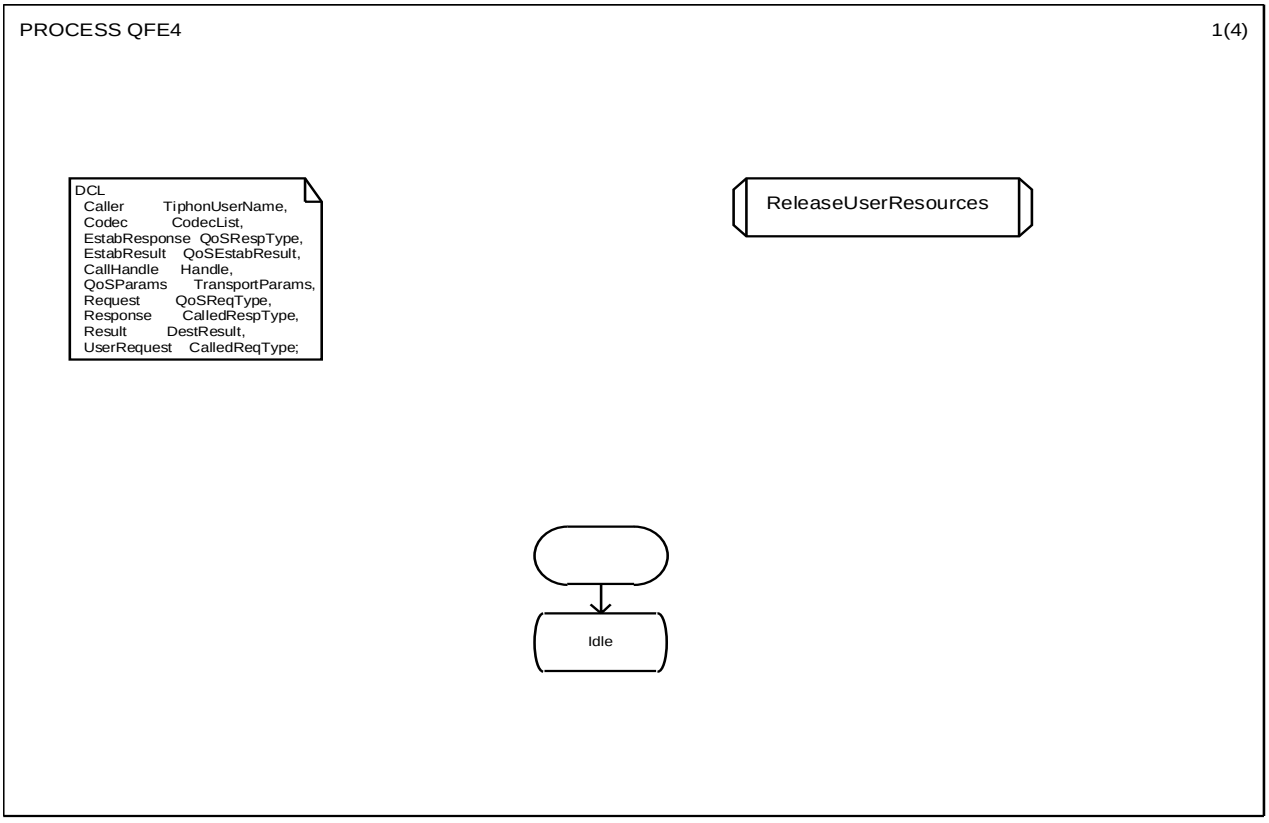

Figure 26: SDL process diagram for functional entity QFE4 (1 of 4)

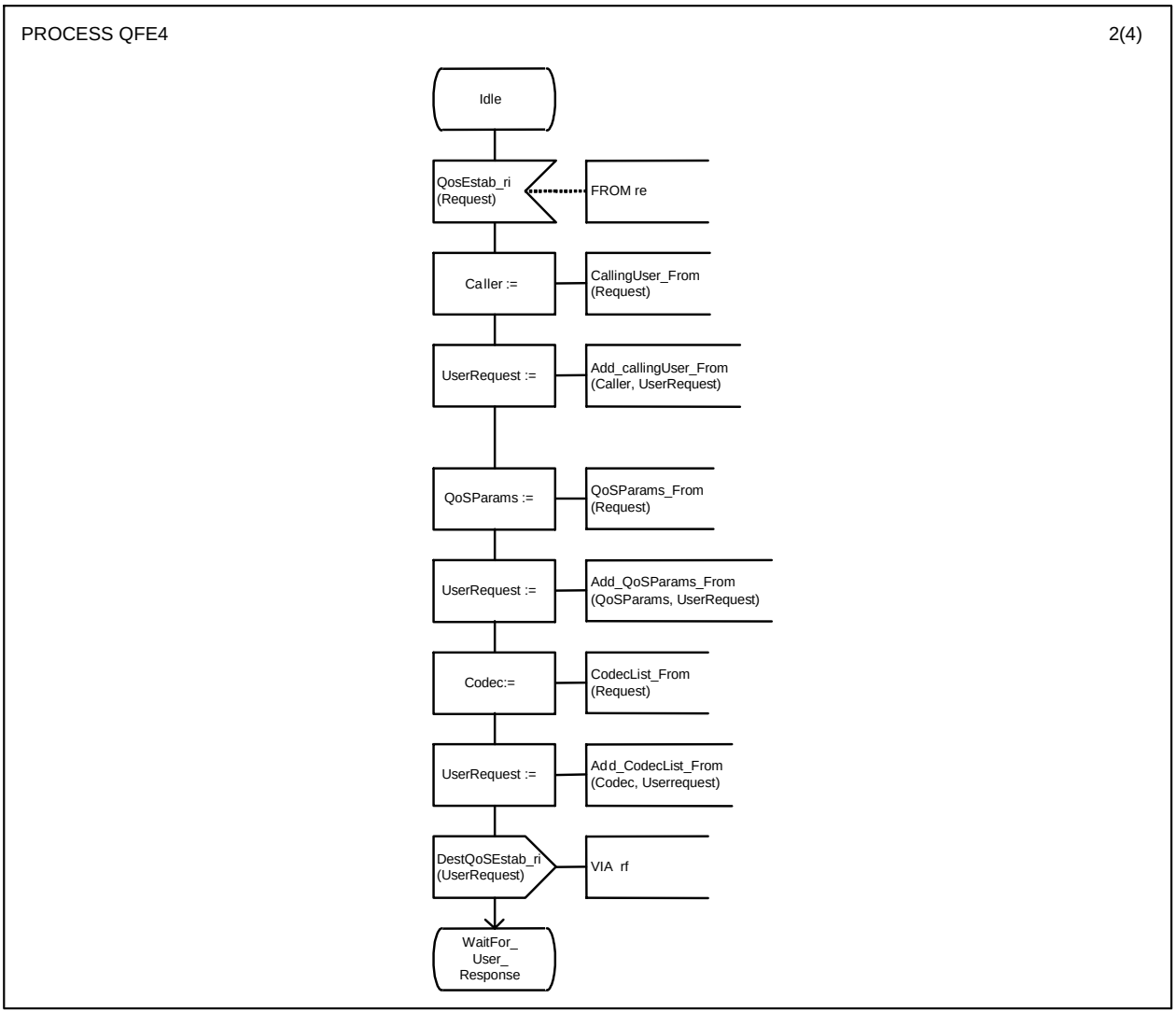

Figure 27: SDL process diagram for functional entity QFE4 (2 of 4)

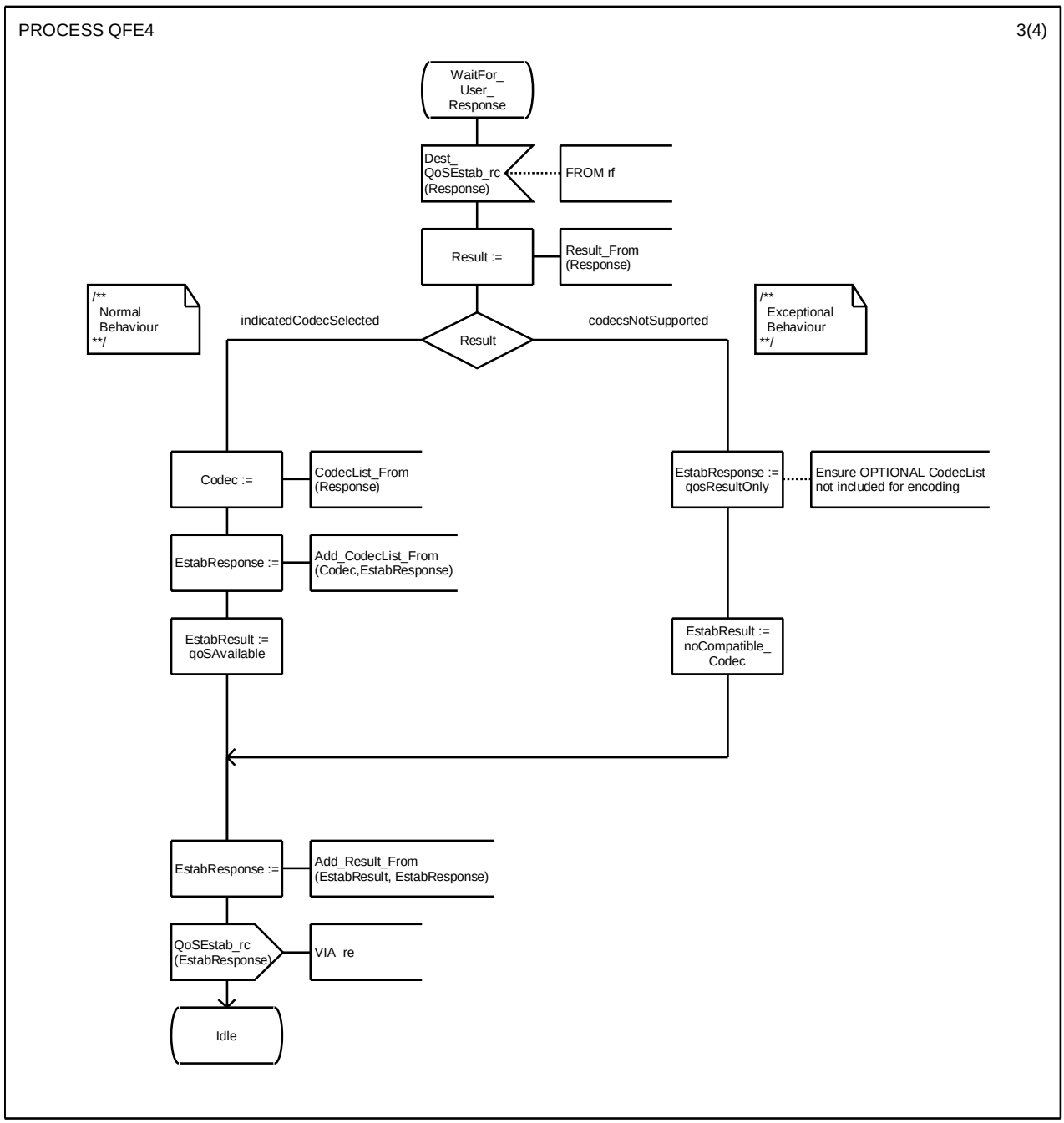

Figure 28: SDL process diagram for functional entity QFE4 (3 of 4)

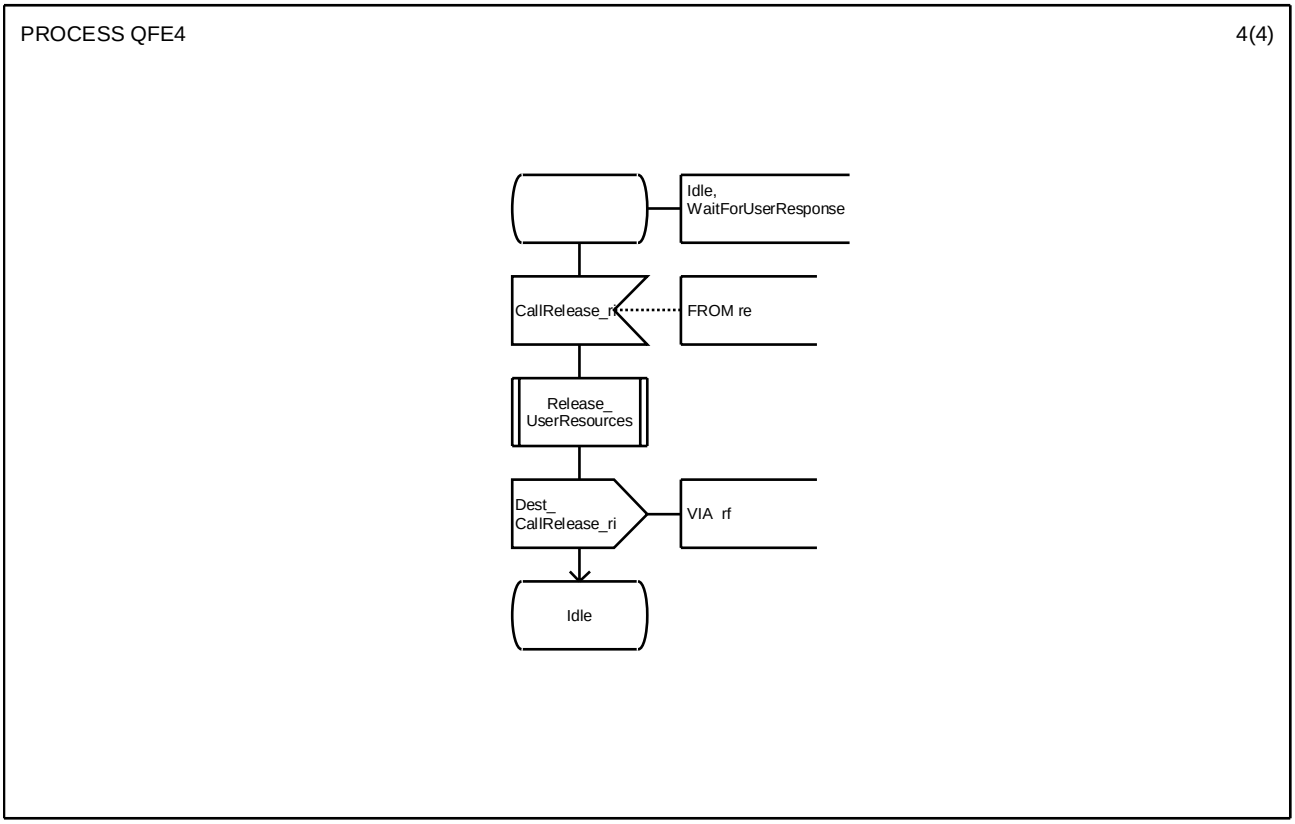

Figure 29: SDL process diagram for functional entity QFE4 (4 of 4)

5.4.6 Behaviour of QFE5

The behaviour of QFE5 is shown in the SDL process diagram in figure 30.

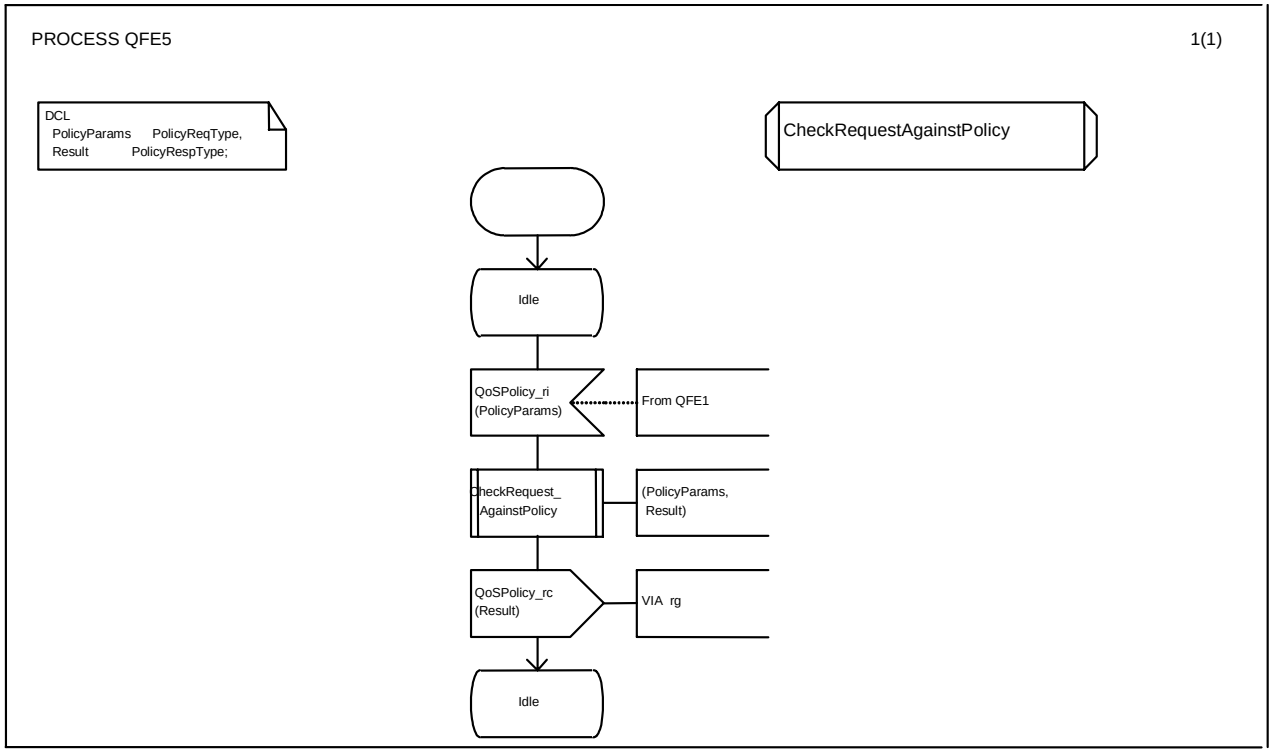

Figure 30: SDL process diagram for functional entity QFE5

5.5 Allocation of functional entities to domains

The possible allocation of QFEs to TIPHON domains is shown in table 11 where:

TE	indicates Terminal Equipment;
OSD	indicates the Originating user's Service Domain;
OTD	indicates the Transport Domain associated with the Originating user;
DSD	indicates the Destination user's Service Domain;
DTD	indicates the Transport Domain associated with the Destination user;
IVSD	indicates an Intervening Service Domain; and
IVTD	indicates an Intervening Transport Domain.

Table 11: Allocation of QFEs to TIPHON domains

Scenario	QFE1	QFE2	QFE3	QFE4	QFE5	QFE6	QFE7	QFE8	QFE9
a	TE	OSD	DSD	TE	OSD	OTD	DTD	IVSD	IVTD
b	OSD	OSD	DSD	DSD	OSD	OTD	DTD	IVSD	IVTD
c	OSD	OSD	DSD	DSD	OSD	OTD	DTD	IVSD	IVTD
d	TE	OSD	DSD	DSD	OSD	OTD	DTD	IVSD	IVTD
e	OSD	OSD	DSD	DSD	OSD	OTD	DTD	OSD	IVTD
f	OSD	OSD	DSD	DSD	OSD	OTD	DTD	OSD	OTD
g	OSD	OSD	DSD	DSD	OSD	OTD	OTD	OSD	OTD

This table is not exclusive and other allocation scenarios may also legitimately exist. However, the following limitations shall apply:

QFE1	shall only be allocated to either TE or OSD;
QFE2	shall only be allocated to OSD;
QFE3	shall only be allocated to DSD;
QFE4	shall only be allocated to either TE or DSD;
QFE5	shall always be allocated to OSD;
QFE6	shall always be allocated to OTD;
QFE7	shall only be allocated to either DTD or OTD;
QFE8	shall be allocated to either IVSD or OSD; and
QFE9	shall only be allocated to either IVTD or OTD.

The allocations specified in table 11 are shown graphically in annex A.

Annex A (informative): Graphical representation of QFE allocation scenarios

The diagrams shown in figures A.1 to A.7 illustrate graphically the legitimate allocation of QFEs to TIPHON domains as specified in table 11.

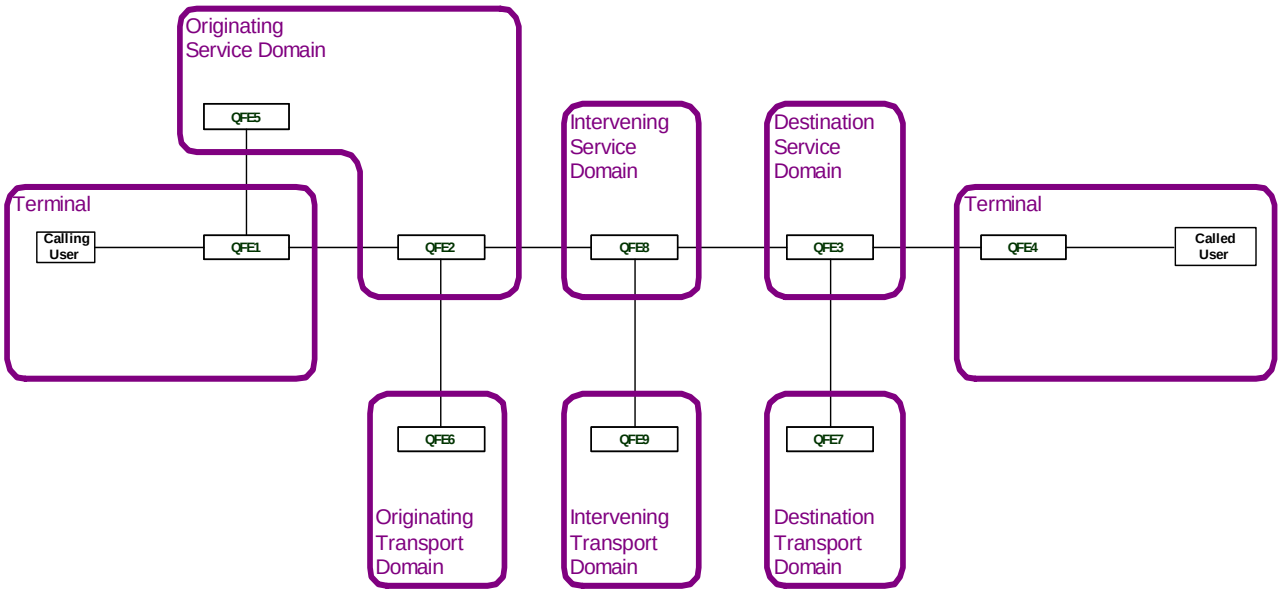

Figure A.1: QFE Allocation Scenario a

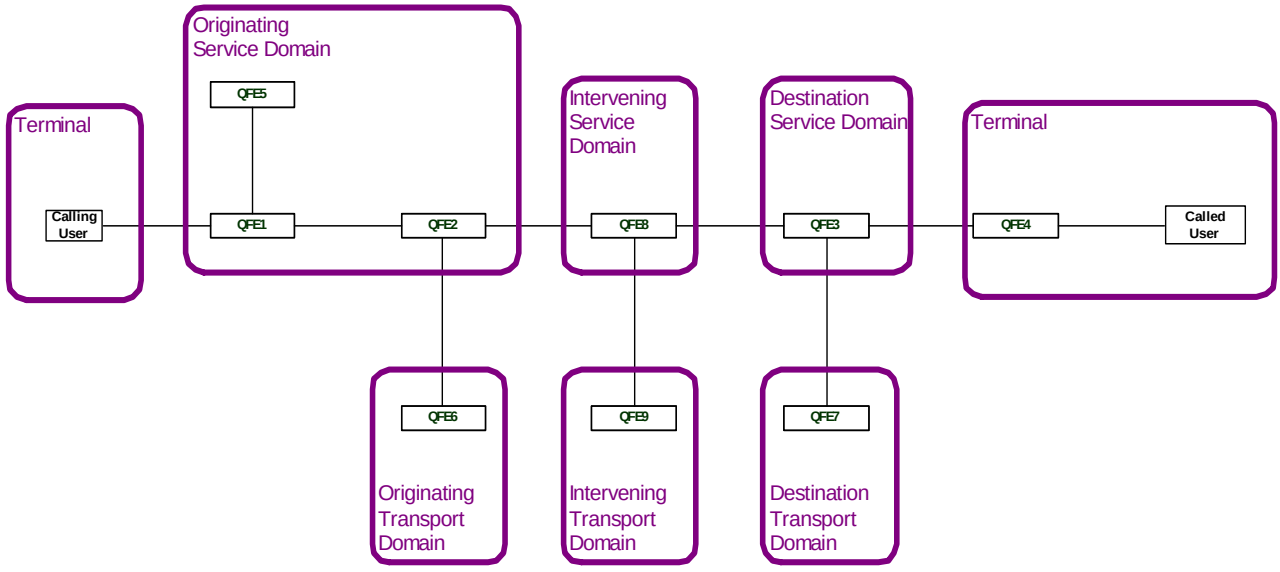

Figure A.2: QFE Allocation Scenario b

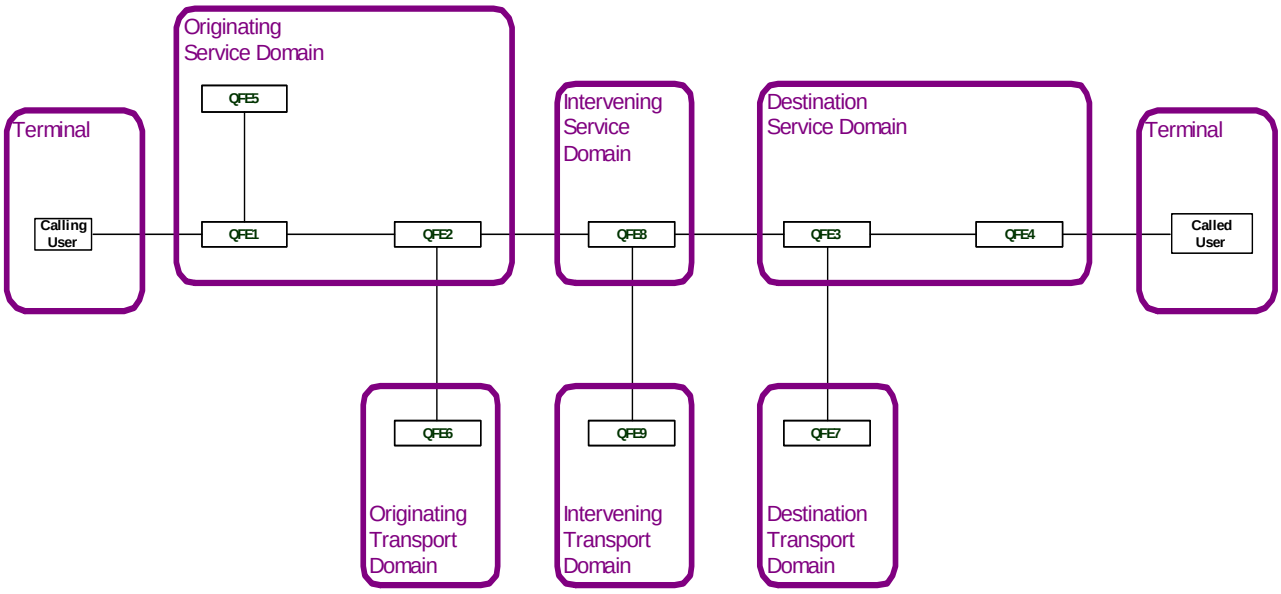

Figure A.3: QFE Allocation Scenario c

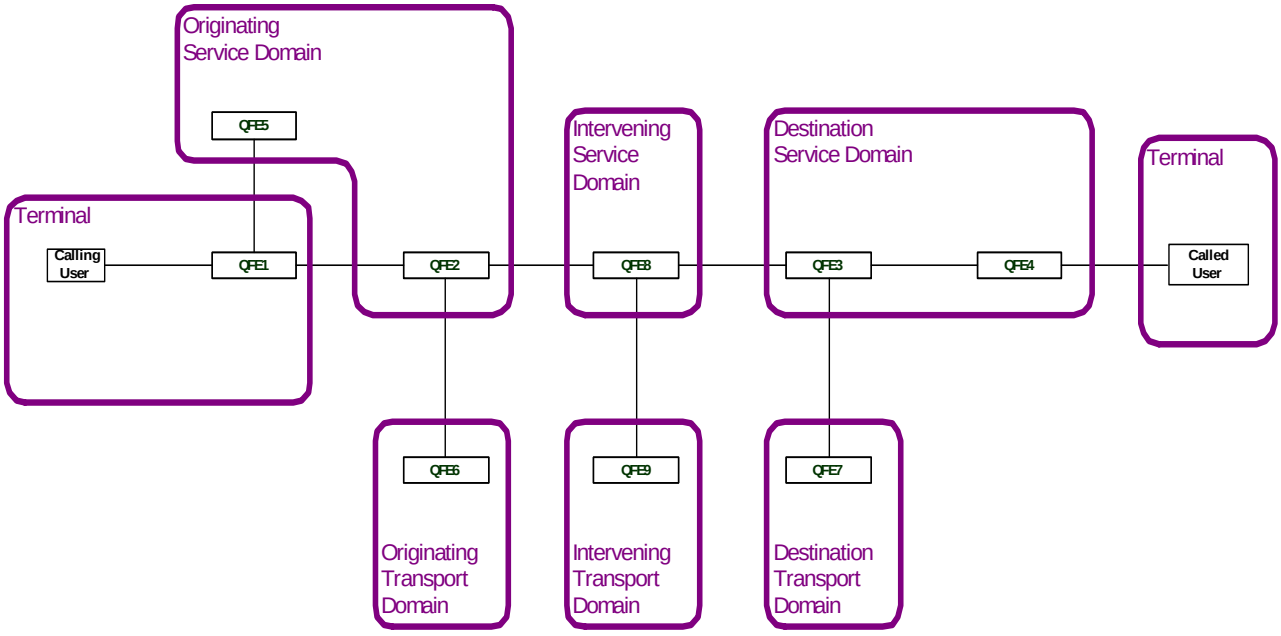

Figure A.4: QFE Allocation Scenario d

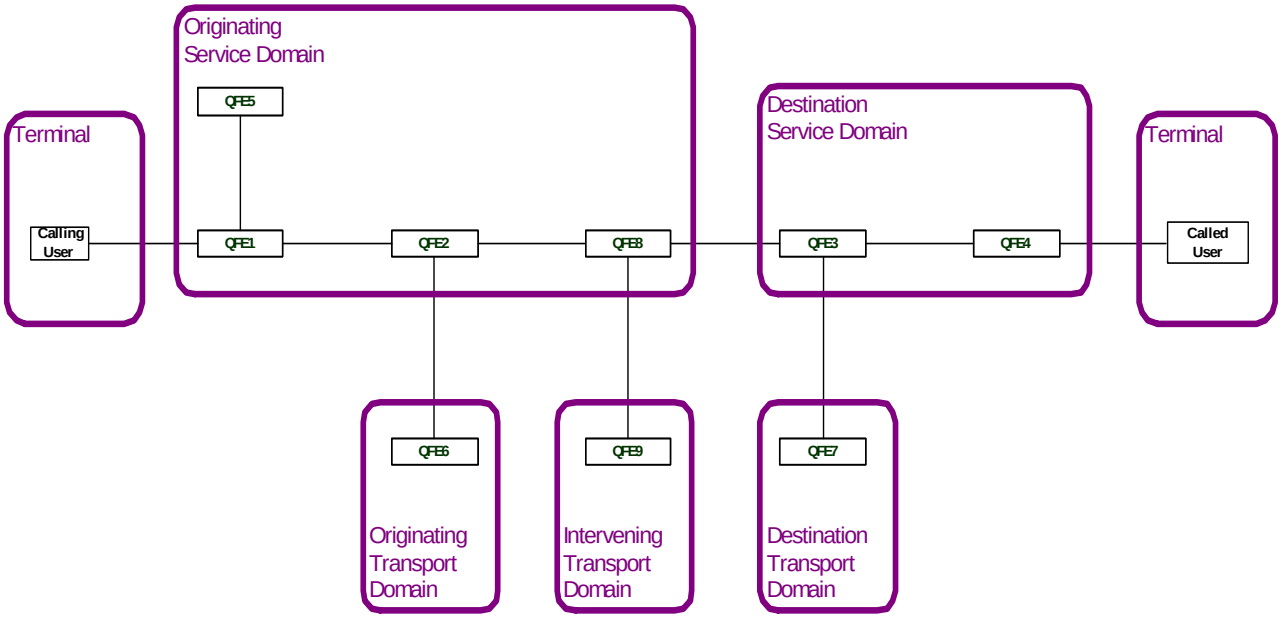

Figure A.5: QFE Allocation Scenario e

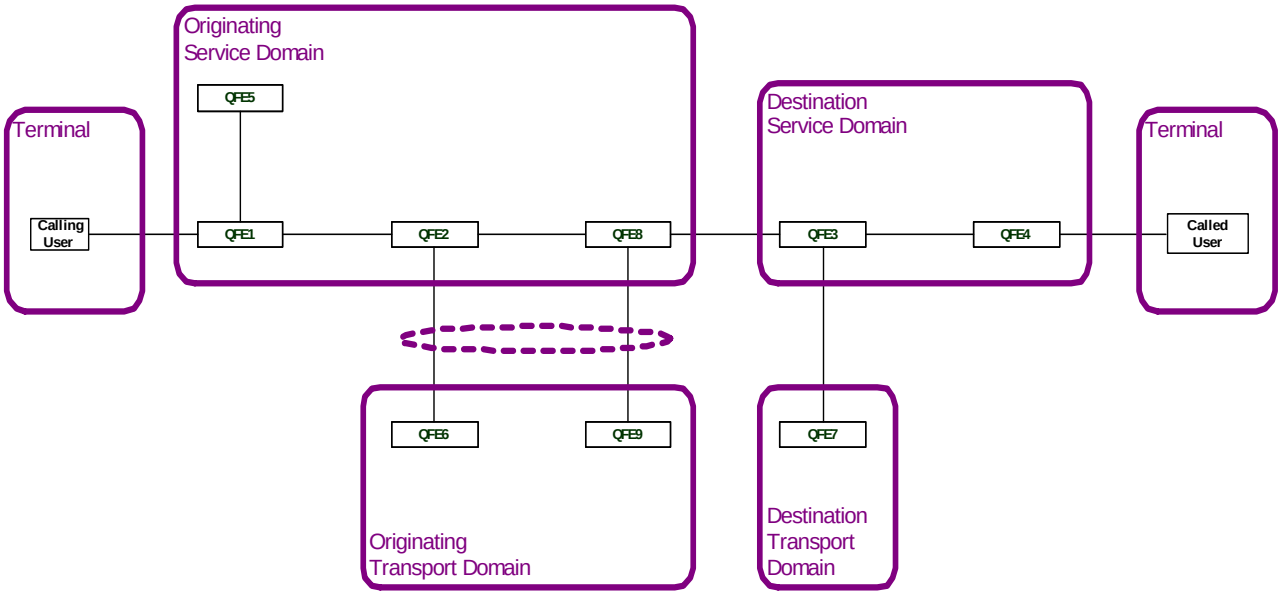

Figure A.6: QFE Allocation Scenario f

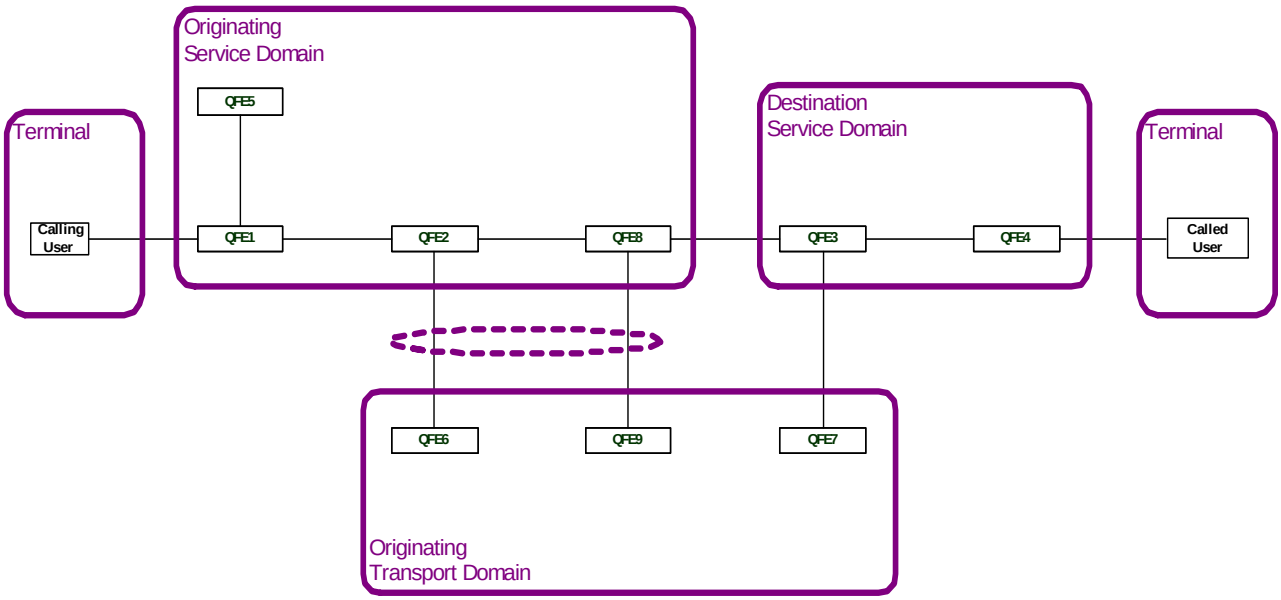

Figure A.7: QFE Allocation Scenario g

Annex B (informative): Mappings of QoS meta-protocol to H.323 series protocols

B.1 Introduction

For each element in each of the QoS Signalling information flows, the tables in this annex identify where and how the information can be obtained or sent in the H.323 [8] series of protocols (H.225.0 [9] and H.245 [10]). The underlying architectural model of H.323 is simpler than the TIPHON model as there is no provision for guaranteed QoS in H.323. This means that some of the mappings in this annex are tentative, speculative or non-existent. In each case, notes in the tables identify the status of the mappings.

B.2 OrigQoSEstab

Table B.1: Mapping of OrigQoSEstab request

OrigQoSEstab *request*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	No equivalent	Can be implied from the bearer capability IE in the Q.931 Setup message, particularly for voice-only calls. A Bearer capability of "speech" or "3,1kHz audio" maps to a QoS Service Class of "TIPHON 2H".
Called user ID	TIPHON user name	ARQ *destinationInfo* - a single entry as an E.164 number	TS 102 024-3 specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Codec	- List of possible codecs - Codec type - Frames per packet	No equivalent (H.245 uses its *TerminalCapabilitySet* message to communicate codec information. As this is an end-to-end signal, it does not provide a valid mapping with *OrigQoSEstab*)	Can be implied to some extent from the bearer capability IE in the Q.931 Setup message, particularly for voice-only calls. A bearer capability of "speech" or "3,1kHz audio" maps to a Codec type of " G.711". As a default, the Frames per packet should be set to the value 20 in this case (see note).
NOTE: The value of 20 G.711 samples per packet is not entirely arbitrary but is based on the common use of 20 or 30 in existing devices which packetize G.711 sample streams. However, there appears to be no published research on determining the optimum value.			

Table B.2: Mapping of OrigQoSEstab response

OrigQoSEstab *response*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Codec	- List of possible codecs - Codec type - Frames per packet	No equivalent	This information could be carried in the ACF *genericData* IE. The codec type can use the type "text" and the frames per packet can use the type "number8"
Result	- End-to-end QoS Established - with requested QoS - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available - Policy Rejection	 ACF ARJ *rejectReason* - resourceUnavailable - calledPartyNotRegistered - no direct mapping - invalidPermission	

B.2.1 Additional H.225.0 ARQ settings for OrigQoSEstab

The transportQOS information element in the H.225.0 ARQ message should be set to the value *gatekeeperControlled*.

B.3 QoSEstab

Table B.3: Mapping of QoSEstab request

QoSEstab *request*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	ARQ *srcInfo* - a single entry as an E.164 number	The present document specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Called user ID	TIPHON user name	ARQ *destinationInfo* - a single entry as an E.164 number	The present document specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in the ARQ *genericData* IE. Delay and delay variation can use the type "number16" and packet loss can use the type "number32"
Transport parameters qualifier	- Transport QoS parameters indicate total remaining budget - Transport QoS parameters indicate budget available per domain	No equivalent	This information could be carried in the ARQ *genericData* IE using the type "number8"
Traffic descriptor	Media peak rate, Maximum media frame size,	No equivalent	This information could be carried in the ARQ *genericData* IE. The peak rate can use the type "number8" and the maximum frame size can use the type "number16"
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent (H.245 uses its *TerminalCapabilitySet* message to communicate codec information. As this is an end-to-end signal, it does not provide a valid mapping with *QoSEstab*)	This information could be carried in the ARQ *genericData* IE. The codec type can use the type "text" and the frames per packet can use the type "number8"
Destination service domain	Network specific address	ARQ *destCallSignalAddress*	For both IPv4 and IPv6 addresses, there is an exact mapping of the address portion itself. However, the present document specifies the port as a 16 octet string while H.225.0 specifies it as a 16-bit integer

Table B.4: Mapping of QoSEstab response

QoSEstab *response*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent	This information could be carried in the ACF *genericData* IE. The codec type can use the type "text" and the frames per packet can use the type "number8"
Result	- Requested QoS available - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available	ACF ARJ *rejectReason* resourceUnavailable calledPartyNotRegistered no direct mapping	

B.3.1 Additional H.225.0 ARQ settings

transportQOS should be set to ***gatekeeperControlled***.

B.4 DestQoSEstab

Table B.5: Mapping of DestQoSEstab request

DestQoSEstab *request*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	ARQ *srcInfo* - a single entry as an E.164 number	The present document specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in the ARQ *genericData* IE. Delay and delay variation can use the type "number16" and packet loss can use the type "number32"
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent	This information could be carried in the ARQ *genericData* IE. The codec type can use the type "text" and the frames per packet can use the type "number8"

Table B.6: Mapping of DestQoSEstab response

DestQoSEstab *response*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent	This information could be carried in the ACF *genericData* IE. The codec type can use the type "text" and the frames per packet can use the type "number8"
Result	- Indicated codec selected - Rejection cause: - Codecs not supported	ACF ARJ *rejectReason* no direct mapping	

B.5 QoSPolicy

The H.323 model does not include a policy entity and so there is no equivalent to the QoSPolicy protocol messages. Consequently, it is not possible to make any definite mapping between the TIPHON meta-protocol and H.323 in this area. However, it may be useful to consider the Clearing House Border Element (BE_{CH}) described in annex G of ITU-T Recommendation H.225.0 [9] as performing this function.

Table B.7: Mapping of QoSPolicy request

QoSPolicy *request*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	ARQ *srcInfo* - a single entry as an E.164 number	The present document specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Called user ID	TIPHON user name	ARQ *destinationInfo* - a single entry as an E.164 number	The present document specifies an E.164 number as a 1 to 15 digit numeric string. H225.0 specifies it as a 1 to 128 character IA5 string
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in the ARQ *genericData* IE. Delay and delay variation can use the type "number16" and packet loss can use the type "number32"
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	No equivalent	This information could be carried in the ARQ *genericData* IE using the type "number8"

Table B.8: Mapping of QoSPolicy response

QoSPolicy *response*		**H.225**	
Information element	**Value**	**Mapping**	**Notes**
Result	- Call permitted - Rejection cause - Service not subscribed to - Service currently not available	ACF ARJ *rejectReason* invalidPermission neededFeatureNotSupported	

B.6 TRMReserve, TRMConnect, TRMRelease

The H.323 series of standards are explicitly intended for providing communications without a guarantee of QoS. As a consequence, the underlying model is different from the TIPHON model. H.323 assumes a direct, but uncontrolled media path to the destination whereas TIPHON assumes linked transport domains carefully controlled by service domains to ensure that sufficient resources are available that the desired QoS can be achieved. There is, therefore, no functional equivalence in H.323 to the messages that pass between a TIPHON service domain and the corresponding transport domain (TRMReserve, TRMConnect and TRMRelease) and, thus, no mapping of meta-protocol information elements to H.323 signals is possible.

B.7 Summary of mapping QoS meta-protocol to H.323 series

Although, with some assumptions, it is possible to show how H.225.0 can be mapped to the TIPHON QoS meta-protocol between users and service domains and between service domains and service domains, there is no provision in the current version of the H.323 series of standards for any signalling between service domains and transport domains. Since this signalling is fundamental to the provision of guaranteed QoS in the TIPHON model, there is a significant gap in the mappings. To achieve full mapping, there needs to be a revision of the H.323 architecture as well as considerable modifications to the protocols themselves. This should include:

1) the clear recognition that there are entities which can at least act as service domains between the calling user and the called user;

2) the modification of H.225.0 to provide communication between user and service domain as well as between service domain and service domain;

3) the addition within the H.323 architecture of transport domains distinct from the current administrative domains and a specific Policy Entity;

4) the addition of specific protocol within H.225.0 for making enquiries to the Policy Entity (possibly based on TIPHON OSP [1]);

5) the addition of a completely new protocol recommendation for signalling between service domains and transport domains;

6) the addition within the H.225.0 ARQ message of information elements to carry QoS class, Transport QoS Parameters, the Transport Parameters Qualifier, the Traffic descriptor and Codec lists;

7) the addition within the H.225.0 ACF message of an information element to carry a Codec descriptor.

Annex C (informative): Mappings of QoS meta-protocol to SIP and associated protocols

C.1 Introduction

For each element in each of the QoS Signalling information flows, the tables in this annex identify where and how the information can be obtained or sent in the Session Initiation Protocol (SIP) [15] and its associated protocols, the Session Description Protocol (SDP) [12], and the Real-Time Protocol Audio-Video Profile (RTP/AVP) [11]. As with H.323, the underlying architectural model of SIP is simpler than the TIPHON model as there is no provision for guaranteed QoS. This, again, means that some of the mappings in this annex are tentative, speculative or non-existent. In each case, notes in the tables identify the status of the mappings.

C.2 OrigQoSEstab

Table C.1: Mapping of OrigQoSEstab request

OrigQoSEstab *request*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	The suggested attribute for quality *(a=quality:<quality>)* in SDP offers an integer range of 0 to 10. These can be mapped thus: 0 TIPHON Class 1 1 TIPHON Class 2A 2 TIPHON Class 2M 3 TIPHON Class 2H 4 TIPHON Class 3 5 Predefined 6 - 10 Non-standardized QoS classes	The "quality" attribute is intended primarily for video media streams but there is nothing in RFC2327 [12] which would prevent it being used for voice QoS Although the range suggested for the SDP quality attribute is 0 to 10, there is no reason why this could not be extended to the TIPHON range of 0 to 255
Called user ID	TIPHON user name	SIP INVITE "*To*" header field using the tel URL format	For simple mapping to TIPHON user name, the To field should be formulated as a telephone-url as specified in RFC 2806 [14]
Codec	- List of possible codecs - Codec type - Frames per packet	SDP *media announcements* (m) sub-field, *media formats*. This can carry a list of RTP/AVP codes for available codec types. For example, to use G.711, it is necessary to select the µ-Law PCM code "0", as follows: *m=audio 49232 RTP/AVP 0* No equivalent to Frames per packet	As a default, the Frames per packet should be set to the value 20 in this case (see note)
NOTE: The value of 20 G.711 samples per packet is not entirely arbitrary but is based on the common use of 20 or 30 in existing devices which packetize G.711 sample streams. However, there appears to be no published research on determining the optimum value.			

Table C.2: Mapping of OrigQoSEstab response

OrigQoSEstab *response*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
Codec	- List of possible codecs - Codec type - Frames per packet	No equivalent response	Both the codec type an the Frames per packet information could be carried as a TIPHON-defined *attribute* (a) sub-fields in SDP
Result	- End-to-end QoS Established - with requested QoS - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available - Policy Rejection	 SIP INVITE response 200 SIP INVITE request failure - 415: Unsupported media type - 404: Not found - no direct mapping - 406: Not acceptable	

C.2 QoSEstab

Table C.3: Mapping of QoSEstab request

QoSEstab *request*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	SIP INVITE "*From*" header field using the tel URL format	For simple mapping to TIPHON user name, the To field should be formulated as a telephone-url as specified in RFC 2806 [14]
Called user ID	TIPHON user name	SIP INVITE "*To*" header field using the tel URL format	For simple mapping to TIPHON user name, the To field should be formulated as a telephone-url as specified in RFC 2806 [14]
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in a TIPHON-defined *attribute* (a) sub-field in SDP
Transport parameters qualifier	- Transport QoS parameters indicate total remaining budget - Transport QoS parameters indicate budget available per domain	No equivalent	This information could be carried in a TIPHON-defined *attribute* (a) sub-field in SDP
Traffic descriptor	Media peak rate, Maximum media frame size,	No equivalent	This information could be carried in a TIPHON-defined *attribute* (a) sub-field in SDP
Codec	List of possible codecs - Codec type - Frames per packet	SDP *media announcements* (m) sub-field, *media formats*. This can carry a list of RTP/AVP codes for available codec types. For example, to use G.711, it is necessary to select the µ-Law PCM code "0", as follows: *m=audio 49232 RTP/AVP 0* No equivalent to Frames per packet	The Frames per packet information could be carried as a TIPHON-defined *attribute* (a) sub-field in SDP
Destination service domain	Network specific address	Connection address sub-field in the SDP connection data (c) field	Current edition of SDP supports only IPV4 addresses

Table C.4: Mapping of QoSEstab response

QoSEstab *response*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent response	Both the codec type an the Frames per packet information could be carried as a TIPHON-defined *attribute* (a) sub-fields in SDP
Result	- Requested QoS available - Rejection cause - Requested QoS not available - Called user unknown - No compatible codec available	SIP INVITE response 200 SIP INVITE request failure - 415: Unsupported media type - 404: Not found - 406: Not acceptable	

C.3 DestQoSEstab

Table C.5: Mapping of DestQoSEstab request

DestQoSEstab *request*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	SIP INVITE "*From*" header field using the tel URL format	For simple mapping to TIPHON user name, the To field should be formulated as a telephone-url as specified in RFC 2806 [14].
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in a TIPHON-defined *attribute* (a) sub-field in SDP
Codec	List of possible codecs - Codec type - Frames per packet	SDP *media announcements* (m) sub-field, *media formats*. This can carry a list of RTP/AVP codes for available codec types. For example, to use G.711, it is necessary to select the µ-Law PCM code "0", as follows: *m=audio 49232 RTP/AVP 0* No equivalent to Frames per packet	The Frames per packet information could be carried as a TIPHON-defined *attribute* (a) sub-field in SDP

Table C.6: Mapping of DestQoSEstab response

DestQoSEstab *response*		**SIP/SDP/RTP/AVP**	
Information element	**Value**	**Mapping**	**Notes**
Codec	List of possible codecs - Codec type - Frames per packet	No equivalent	Both the codec type an the Frames per packet information could be carried as a TIPHON-defined *attribute* (a) sub-fields in SDP
Result	- Indicated codec selected - Rejection cause: - Codecs not supported	SIP INVITE response 200 SIP INVITE request failure - 406: Not acceptable	

C.4 QoSPolicy

The SIP model does not include a policy entity and so there is no equivalent to the QoSPolicy protocol messages. Consequently, it is not possible to make any mapping between the TIPHON meta-protocol and SIP in this area. However, the Common Open Policy Service (COPS) protocol [13] used by RSVP exists specifically for this purpose. Its underlying architectural model is similar to the TIPHON QoS model in that COPS provides communication between a network node and a policy entity referred to as the Policy Decision Point (PDP). Tables C.7 and C.8 show how the meta-protocol information flow, QoSPolicy, can be mapped to COPS.

Table C.7: Mapping of QoSPolicy request

QoSPolicy *request*		**COPS**	
Information element	**Value**	**Mapping**	**Notes**
Calling user ID	TIPHON user name	COPS REQ C-num = 3 *In Interface* C-type = 1 (IPv4) or 2 (IPv6)	COPS permits only an IPv4 or IPv6 address. The TIPHON user name would need to be converted from an E.164 number before use
Called user ID	TIPHON user name	COPS REQ C-num = 4 *Out Interface* C-type = 1 (IPv4) or 2 (IPv6)	COPS permits only an IPv4 or IPv6 address. The TIPHON user name would need to be converted from an E.164 number before use
Transport QoS parameters	Maximum delay, Maximum packet delay variation, Maximum mean packet loss	No equivalent	This information could be carried in the *ClientSI* object (C-num = 9, C-type = 1)
QoS Service Class	- Predefined - TIPHON QoS class - 3 Best - 2H High - 2M Medium - 2A Acceptable - 1 Best effort - Non-standardized QoS class	No equivalent	This information could be carried in the *ClientSI* object (C-num = 9, C-type = 2)

Table C.8: Mapping of QoSPolicy response

QoSPolicy *response*		**COPS**	
Information element	**Value**	**Mapping**	**Notes**
Result	- Call permitted - Rejection cause - Service not subscribed to - Service currently not available	COPS DEC C-num = 6, C-type = 1; 4 COPS DRQ C-num = 5 C-type = 1; 9 C-type = 1; 7	C-Type 1; 4 = Admit Request C-Type 1, 9 = Unsupported decision C-type 1, 7 = Insufficient resources

C.5 TRMReserve, TRMConnect, TRMRelease

SIP and its associated standards are intended for providing communications without a guarantee of QoS. As a consequence, the underlying model is different from the TIPHON model. SIP assumes a direct, but uncontrolled media path to the destination whereas TIPHON assumes linked transport domains carefully controlled by service domains to ensure that sufficient resources are available that the desired QoS can be achieved. There is, therefore, no functional equivalence in SIP or SDP to the messages that pass between a TIPHON service domain and the corresponding transport domain (TRMReserve, TRMConnect and TRMRelease) and, thus, no mapping of meta-protocol information elements to SIP, SDP or RTP/AVP signals is possible.

C.6 Summary of mapping of QoS meta-protocol to SIP, SDP, RTP/AVP and COPS

Although, with some assumptions, it is possible to show how SIP and SDP can be mapped to the TIPHON QoS meta-protocol between users and service domains and between service domains and service domains, there is no provision in the current version of the IETF series of standards for any signalling between service domains and transport domains. Since this signalling is fundamental to the provision of guaranteed QoS in the TIPHON model, there is a significant gap in the mappings. To achieve full mapping, there needs to be considerable modifications to the SIP-related protocols. This should include:

1) the clear recognition that there are entities which can at least act as service domains between the calling user and the called user;

2) the addition within the SIP/SDP architecture of transport domains;

3) the addition of a new protocol specification for signalling between service domains and transport domains;

4) the extension of COPS to include fields for carrying QoS Class or Transport QoS Parameters;

5) the extension of SDP to include fields for carrying QoS class, Transport QoS Parameters, the Transport Parameters Qualifier, the Traffic descriptor and Codec lists.

Annex D (informative): Bibliography

ETSI TS 101 882-3: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Protocol Framework Definition; Part 3; TIPHON Simple Call".

History

Document history		
V4.1.1	January 2003	Publication