Université de Liège

Faculté des Sciences Appliquées

Systèmes et Automatique

Institut d'Electricité Montefiore, B28
Université de Liège au Sart Tilman
B-4000 Liège 1 (Belgique)

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The OSI95 Transport Service with Multimedia support

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The Connection Release Facilities in the OSI95 Transport Service

Y. Baguette and G. Leduc

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The Connection Release Facilities in the OSI95 Transport Service

Yves Baguette[1] and Guy Leduc[2]
[1] Research Assistant of the Belgian National Fund for Scientific Research (F.N.R.S.)
[2] Research Associate of the F.N.R.S.
Université de Liège, Institut d'Electricité Montefiore B28, B-4000 Liège 1, Belgium
Email: baguette@montefiore.ulg.ac.be

We explain in detail how the work carried out on the transport connection release aspects in the framework of the OSI95 Connection-Mode Transport Service has led to the introduction of a graceful transport connection release facility and, later on, to an enhancement of the existing ISO/IEC abrupt transport connection release facility.

Keywords: OSI95, Transport Service, Connection-Mode, Graceful Release, Abrupt Release.

1 Introduction

The sole Transport Connection (TC) release facility provided by the current ISO/IEC Connection-Mode Transport Service [ISO 8072] is an abrupt (and thereby possibly destructive) one. At present, in the OSI Reference Model [ISO 7498], the concept of orderly (or graceful) release is introduced at the session service level. So it is up to the peer session entities to make sure that there are no more in-transit data on the TC to which is assigned the session connection that is to be gracefully released before requesting the abrupt termination of this TC.

Some people even think that there is no objective reason for providing an orderly connection release in any layer except the application layer (cf. Question 6 in [ISO SD9]). They argue that peer application entities could ensure, by way of an exchange of application protocol control information, that there are no more data in transit on the presentation connection and could then safely perform an abrupt termination of this presentation connection. This, of course, suggests that an orderly release facility be provided in the Common Application Service Element (CASE) and that all other layers below implement an abrupt connection termination only.

We do not share this opinion, neither do we agree with the ideas that the existing orderly connection release facility is the most appropriate one and that the session layer is the best place to introduce it. We have therefore defined a graceful connection release facility *significantly different from what exists for the moment in the ISO/IEC standards*, and we have provided this facility in the connection-mode part of the OSI95 Transport Service (OSI95 TS) [BLL 93]. This decision has been based on several arguments which we deem of sufficient weight in favour of such a new facility at the transport level.

First, from a functional point of view, we think that the orderly release of a connection may be considered as a concern of the transport layer. In fact, the transport layer deals with most of the OSI aspects relating to the provision of a reliable data transfer service and, in our opinion, the graceful connection release may be regarded as a way to achieve reliability (unlike the abrupt connection release which is not reliable by itself in the sense that it may cause the loss of all data possibly still in transit on the connection).

Second, if a graceful TC release facility is introduced, the invocation of the orderly connection release facility at any upper service interface will merely result in the invocation of the same facility at the underlying service interface down to the transport service interface. The end-to-end PDU exchanges required to complete an orderly presentation connection release will thus be accomplished in the transport layer. No PDU processing will be needed above the transport layer, relieving the upper layers of that burden.

Third but not least, it is clear that today we have mainly two different network infrastructures, the one based on OSI and the one based on DoD Internet. From an essentially political point of view, an interesting issue is whether an enhanced transport service has to be strictly aimed at the OSI stack or instead has to be designed also to allow a rather smooth migration from the TCP and UDP transport services to this enhanced transport service. TCP offers a graceful connection release facility. One major reason for this is probably that there exists no session service on top of TCP, so that a graceful connection release, if required and not provided directly at the application level, can only be provided at the transport level. A graceful TC release facility does not appear as essential within the strict OSI framework, but its introduction would obviously ease the migration from the TCP world.

Of course, in the OSI95 TS, the graceful TC release facility is intended to be a complement to the abrupt TC release facility which is already defined in the ISO/IEC standard, and not a substitute for this abrupt TC release facility.

The remainder of the paper is organized as follows. Section 2 discusses the successive steps of the rationale that has led us to the definition of the graceful connection release facility we have ultimately adopted in the OSI95 TS. Section 3 examines the possible interferences that may occur between the graceful TC release facility and the abrupt TC release facility in the OSI95 TS, and proposes an enhancement of the standard ISO/IEC abrupt TC release facility to cope properly with these interferences. Section 4 describes this enhancement in a more detailed manner. The conclusions of the paper are drawn in the last section.

2 What Kind of Graceful TC Release Facility for OSI95 ?

2.1 Discussion of the ISO/IEC Orderly Session Connection Release Facility

The starting point of our study has been the orderly connection release facility currently in use at the ISO/IEC Basic Connection-Oriented Session Service level [ISO 8326]. This facility is always based on the classical 4-primitive (i.e. request, indication, response and confirm) scheme. However, there are two variants to release

a session connection in an orderly manner, depending upon the availability of the release token as negotiated during the session connection establishment.

If it has been negotiated not to use the release token, either of the two session service users may invoke a S-RELEASE request, and the other session service user cannot refuse the release. A S-RELEASE request means that the requestor asks for the orderly release of the session connection (which implies that it has no more data to send in the context of the session and thus will not invoke any S-DATA request any more). The S-RELEASE request gives rise to a S-RELEASE indication at the peer SSAP. The acceptor of the S-RELEASE indication knows that it will not receive any S-DATA indication any more, but may still invoke S-DATA requests. When it has no more data to send, the acceptor of the S-RELEASE indication will respond positively with a positive S-RELEASE response, which gives rise to a positive S-RELEASE confirm at the peer SSAP. When a positive S-RELEASE confirm comes back, the requestor of the release knows that the other session service user has been correctly informed of its request and also that the session connection orderly release is successfull. Moreover, a specific solution has been developed to deal with the possible problem of a collision between S-RELEASE requests.

If it has been negotiated to use the release token, only the session service user that owns the token may invoke a S-RELEASE request, but the other session service user may refuse the release and continue the session connection without loss of data. In this case, the acceptor of the S-RELEASE indication issues a negative S-RELEASE response and remains in the data transfer phase. The negative S-RELEASE response gives rise to a negative S-RELEASE confirm at the peer SSAP, which causes the requestor of the orderly session connection release to go back to the data transfer phase. The acceptor of the S-RELEASE indication may also behave as in the case where no release token is available, i.e. may wait until it has no more data to send before responding with a positive S-RELEASE response.

We think that either of the two variants of the orderly session connection release presents a certain drawback. In the first variant, the requestor may not get a confirmation of the orderly release of its output direction of data transfer until the acceptor of the T-RELEASE indication decides to also release the reverse direction by issuing a positive T-RELEASE response. This means that if the acceptor is not ready to perform the orderly release immediately and if something wrong happens before it becomes ready, the requestor will not have any chance to know whether the orderly release of its output direction of data transfer has been successful. In the second variant, we do not see the interest of putting the requestor back in the data transfer phase when the acceptor of the T-RELEASE indication responds negatively. In fact, the requestor has clearly no more data to send since it has invoked a T-RELEASE request. Putting the requestor back in the data transfer phase will therefore have as sole effect to force it to try and try again (until success or until the release token is passed to the other session service user) the orderly session connection release.

The aforementioned drawbacks come from the fact that the positive S-RELEASE confirm has a double role: it confirms the orderly release of the requestor's output direction of data transfer and indicates the orderly release of the reverse direction as well. There is no way for the acceptor of the S-RELEASE indication to confirm the orderly release of the requestor's output direction of data transfer without closing the reverse direction. So, if the acceptor is not willing to perform the orderly release of its

output direction immediately, it has to either delay the confirmation of the orderly release of the requestor's output direction (first variant) or refuse the orderly release of the requestor's output direction (second variant). We judge both alternatives unacceptable.

2.2 Graceful Release of Either Direction Separately from the Other One

This explains why we have chosen to define a new graceful connection release facility which relies on an idea previously exploited at the transport level by some well-known non-OSI protocols, e.g. TCP [RFC 793] and more recently XTP [PEI 3.6].

This idea is that either of the directions of data transfer of a connection should be treated quite separately from the other one as for its graceful release. Such an idea conforms perfectly to our view of a TC in OSI95. Indeed, in OSI95, the building block for the concept of TC is the simplex virtual circuit (corresponding to one direction of data transfer). Thus, a TC may be uni-directional, in which case it is made up of a single simplex virtual circuit, or bi-directional, in which case it has to be regarded as two simplex virtual circuits rather than as a single duplex virtual circuit. The new graceful connection release facility we have designed applies to a single direction of data transfer, without any consideration for the current state of the reverse direction if the connection is bi-directional.

2.3 Design of the OSI95 Graceful TC Release Facility

The sequence of OSI95 TS primitives we have first envisaged to gracefully release a single direction of data transfer on a TC is the following one: a T-RELEASE request generated by one of the two users of a TC gives rise to a T-RELEASE indication issued to the peer OSI95 TS user [DBL 92]. The invocation of a T-RELEASE request by one of the two users of a TC means that it *wants to gracefully release* its output direction on this TC (which implies that the requestor has no more data to send and thus will not invoke any T-DATA request any more). The reception of a T-RELEASE indication by one of the two users of a TC means that its input direction on this TC *has been released gracefully* owing to the invocation of a T-RELEASE request by the remote OSI95 TS user.

This first scenario raises a few questions. For instance, may an OSI95 TS user assume a TC to be closed (so that no OSI95 TS primitive pertaining to this TC is allowed at the local TSAP any more) immediately after both the issuance of a T-RELEASE request and the reception of a T-RELEASE indication, in any order ? The questions that arise are due to the fact that a T-RELEASE request just means that the graceful release of the output direction *is requested* and not that it *is completed*. When completed, there is no confirmation of the graceful release to the requestor. Let us remember here that the impossibility to confirm the orderly release of one direction of data transfer as long as the reverse direction is not also closed in an orderly manner has been identified as a main drawback of the ISO/IEC orderly session connection release facility. By choosing to apply our graceful release facility to a direction of data transfer rather than to a connection, we have paved the way for a solution to the problem of confirmation but we have not actually solved the problem yet.

The obvious solution to this problem is to use a confirmed service facility, i.e. to introduce a form of confirmation at the OSI95 TS level by means of an additional T-RELEASE confirm primitive. A T-RELEASE confirm simply confirms to the requestor the graceful release of its output direction, i.e. confirms the delivery of a T-RELEASE indication to the remote OSI95 TS user. Figure 2.1 illustrates the sequences of OSI95 TS primitives finally elected for the graceful release of a single direction or both directions of data transfer of a TC [DBL 92]. With this new graceful TC release scenario, an OSI95 TS user may consider a TC to be completely closed (i.e. closed in both directions) immediately after the receipt of both a T-RELEASE indication and a T-RELEASE confirm, in any order.

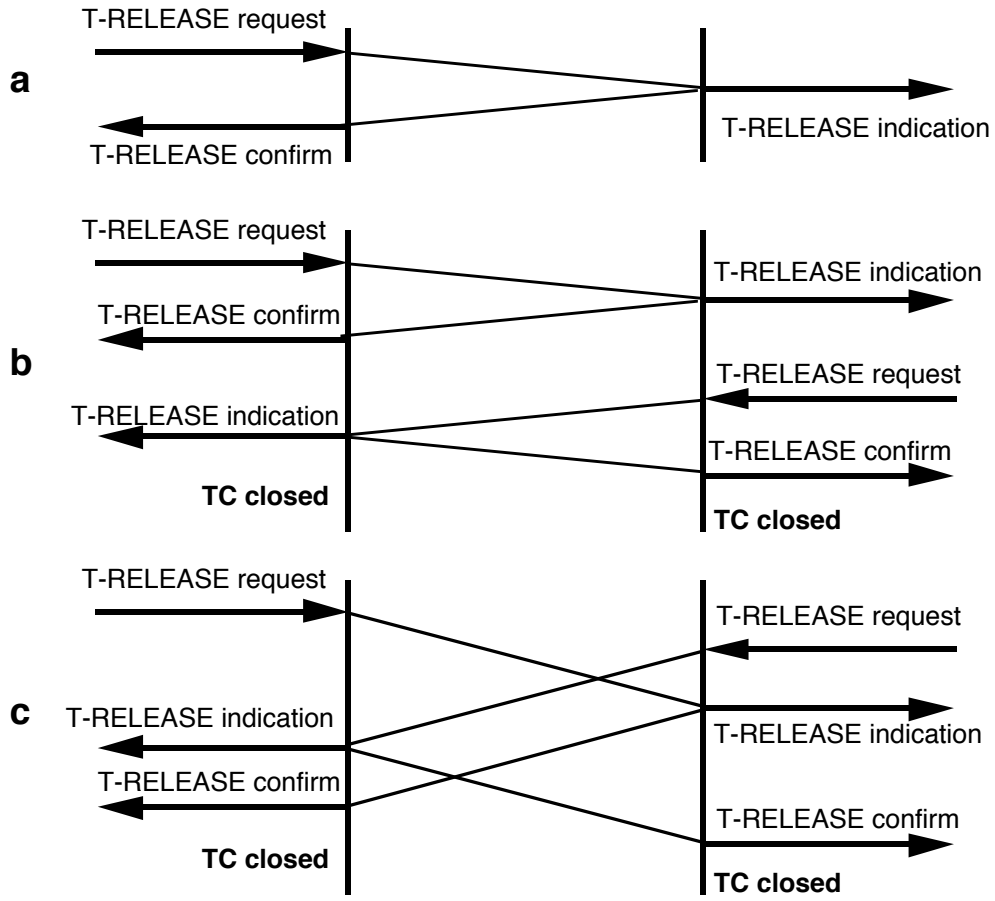

Fig. 2.1 Graceful TC release facility:
a. release of a single direction of data transfer of a TC;
b. successive releases of both directions of a TC;
c. interleaved releases of both directions of a TC

2.4 Parameters of the T-RELEASE Primitives

The T-RELEASE request may have a TSDU parameter. The T-RELEASE indication may have a TSDU parameter and transfer status parameters used for error control purposes. The T-RELEASE confirm has never any parameter. The relations which

have to be verified between the parameters of the T-RELEASE request and indication primitives are summarized in table 2.1.

	Primitives:	
Parameters:	T-RELEASE request	T-RELEASE indication
TSDU	U	C*(E)*
Transfer status {…}		C'

Keys: {…} : generic denomination gathering several parameters;
U : inclusion of this parameter or of this group of parameters in the request or response primitive is a choice made by the OSI95 TS user;
C : presence of this parameter or of this group of parameters in the indication or confirm primitive is conditional, depending upon its inclusion in the preceding request or response primitive;
C' : presence of this parameter or of this group of parameters in the indication or confirm primitive is conditional, depending upon the inclusion of another parameter (here, the TSDU parameter) in the preceding request or response primitive;
(E) : the contents of this parameter may differ from that of the corresponding parameter in the preceding primitive only within the limits authorized by the error control policy;
Blank : the parameter is absent.

Table 2.1 Relations between the parameters of the T-RELEASE request and indication primitives

When they convey a TSDU parameter, the T-RELEASE request and indication primitives may be considered as classical T-DATA request and indication primitives in regard to the transfer of the TSDU, but they carry additional information that concerns the graceful release of the corresponding direction of data transfer of the TC. In practice, all happens as if a T-RELEASE request or indication primitive conveying a TSDU were split up conceptually into a classical T-DATA request or indication primitive instantaneously followed by a T-RELEASE request or indication primitive without any parameter.

3 Interferences Between the T-RELEASE and T-DISCONNECT Primitives

3.1 Examples of Encountered Problems

Since the OSI95 TS is intended to provide the graceful TC release facility in complement to the abrupt TC release facility which is already defined in the ISO/IEC standard, it is important to see how the two facilities may interfere with one another.

Let us remind that the abrupt TC release facility currently offered by the ISO/IEC Connection-Mode Transport Service [ISO 8072] always closes both directions of data transfer of a TC together. Therefrom comes an interesting question: if an OSI95 TS user invokes a T-RELEASE request to gracefully release its output direction on a TC and then decides to abruptly release its input direction on this TC via a classical T-DISCONNECT request, when may the T-DISCONNECT request be issued without

taking the risk of releasing both directions abruptly ? Since the OSI95 TS user is assured that its output direction on the TC has been closed gracefully as soon as it receives the T-RELEASE confirm, waiting for this primitive is a firm guarantee. By contrast, there cannot be any guarantee on the graceful release of the output direction if the T-DISCONNECT request is invoked prior to the receipt of the T-RELEASE confirm. In this latter case, as shown in figure 3.1, depending upon which one of the remote T-RELEASE indication and the remote T-DISCONNECT indication (prompted respectively by the T-RELEASE request and the T-DISCONNECT request) is issued first, the requestor's output direction is closed gracefully or abruptly. However, even when the output direction is closed gracefully, the graceful release cannot be confirmed.

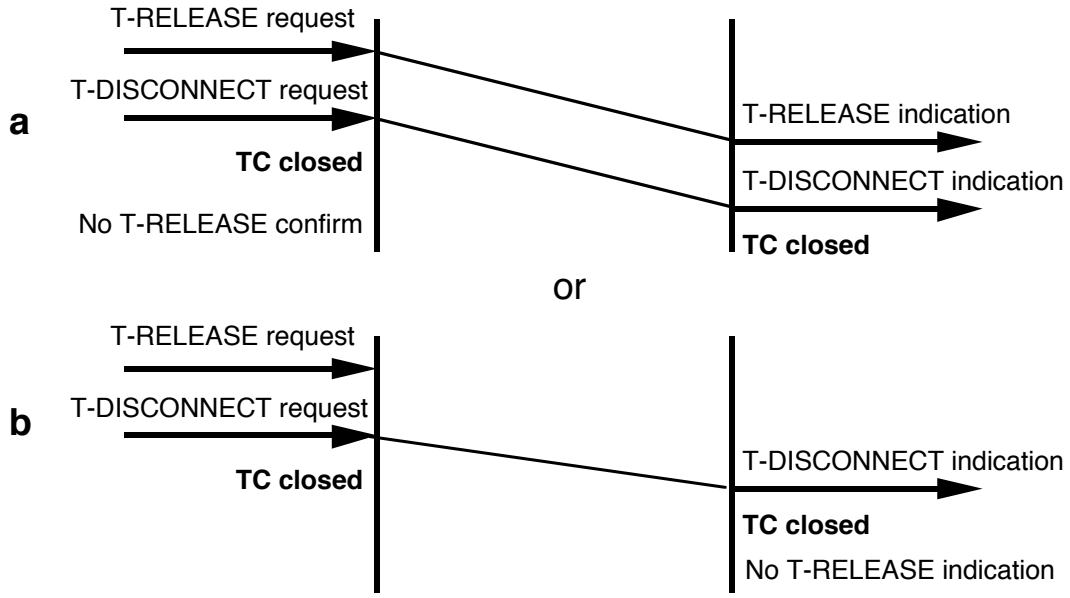

Fig. 3.1 Condition of competition for issuance between a T-RELEASE indication and a T-DISCONNECT indication:
a. left user's output direction released gracefully (without confirmation to the requestor), left user's input direction released abruptly;
b. both directions released abruptly

Now, what happens when an OSI95 TS user receives a T-RELEASE indication, indicating that its input direction on the TC has been released gracefully, and then decides to abruptly close its output direction ? The only way for the OSI95 TS user to close its output direction abruptly is to issue a T-DISCONNECT request. However, in this case, nothing prevents the corresponding T-DISCONNECT indication to occur at the remote TSAP before the expected T-RELEASE confirm (see figure 3.2). Clearly, it would be preferable for the remote OSI95 TS user to definitely get the confirmation of the graceful release of its output direction before receiving the T-DISCONNECT indication (Figure 3.2(a)). On the other hand, if the OSI95 TS provider was forced to always deliver the T-RELEASE confirm before delivering the T-DISCONNECT indication, we would no more strictly conform to the semantics of the T-

DISCONNECT primitives as specified in the current ISO/IEC Connection-Mode Transport Service (which we call the "pre-emptive right" semantics in the sequel).

This "pre-emptive right" semantics states indeed that once a T-DISCONNECT request has been invoked by a TS user, the TS provider should be in a position to issue the corresponding T-DISCONNECT indication to the peer TS user without any consideration for the pending actions, whatever they are. In the queue model describing in an abstract way the operation of a TC, this statement is formalized by the property that a Disconnect object takes precedence over any other object (see section 9 of [ISO 8072] for more details). Obviously, if we want the competition for issuance illustrated by figure 3.2, i.e. the competition for issuance between a T-RELEASE confirm prompted by a remote T-RELEASE indication on the one hand and a T-DISCONNECT indication prompted by a remote T-DISCONNECT request on the other hand, to always lead to the sequence of primitives (a), the Disconnect object must not keep precedence over the new ReleaseConfirm object in the queue model.

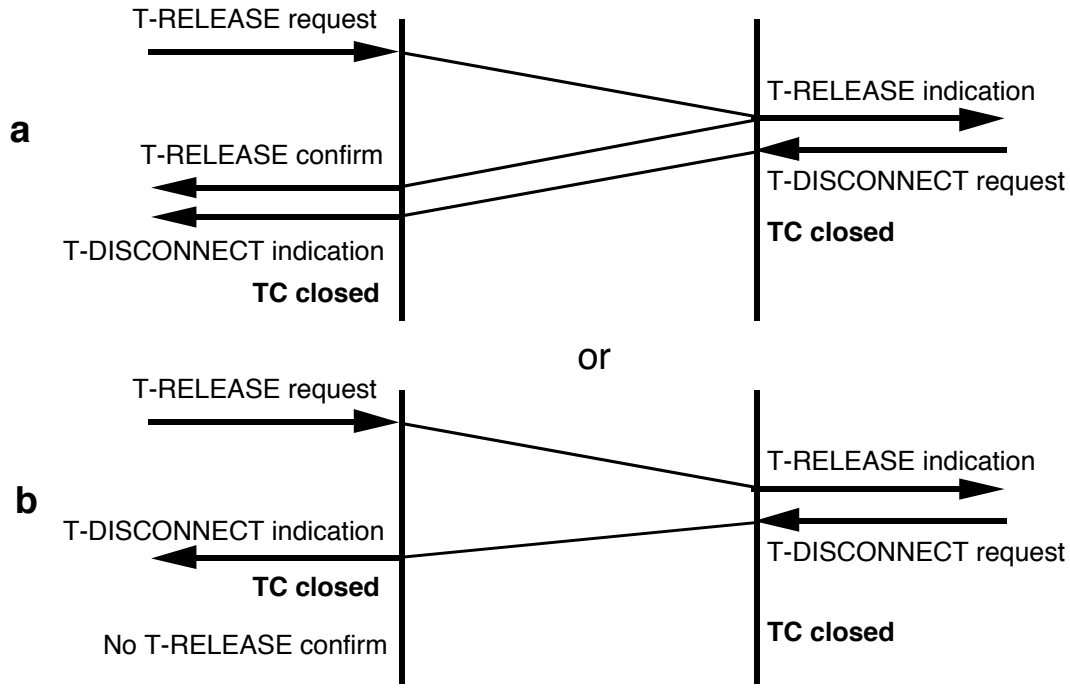

Fig. 3.2 Condition of competition for issuance between a T-RELEASE confirm and a T-DISCONNECT indication:
a. left user's output direction released gracefully (WITH confirmation to the requestor), left user's input direction released abruptly;
b. left user's output direction released gracefully (WITHOUT confirmation to the requestor), left user's input direction released abruptly

3.2 Investigation of an Attractive Solution

It is acceptable to modify the property of the Disconnect object in the queue model, by stating that a Disconnect object takes precedence over any other object *except the ReleaseConfirm object*, since this modification concerns a new object that does not

exist in [ISO 8072] where no graceful TC release facility has been defined. However, for the OSI95 TS, we have preferred to investigate another solution to this problem of condition of competition for issuance between TC release primitives [BLL 92]. We find our solution more promising because we think it is elegant and because it does not require any change in the "pre-emptive right" semantics of the T-DISCONNECT primitives (in other words, it allows the Disconnect objet to keep precedence over any other object, without any exception, in the queue model).

This solution consists in an enhancement of the abrupt TC release facility to allow the abrupt closing of a single direction of data transfer on a TC. With such an enhanced facility, an OSI95 TS user that receives a T-RELEASE indication may invoke a T-DISCONNECT request (my output) to request the abrupt release of its output direction on the TC without any risk. Indeed, even if the corresponding T-DISCONNECT indication (your input) is issued at the peer TSAP prior to the T-RELEASE confirm, the TC will not be considered to be closed until the receipt of the T-RELEASE confirm, which suppresses the problem of condition of competition for issuance between these primitives (Figure 3.3).

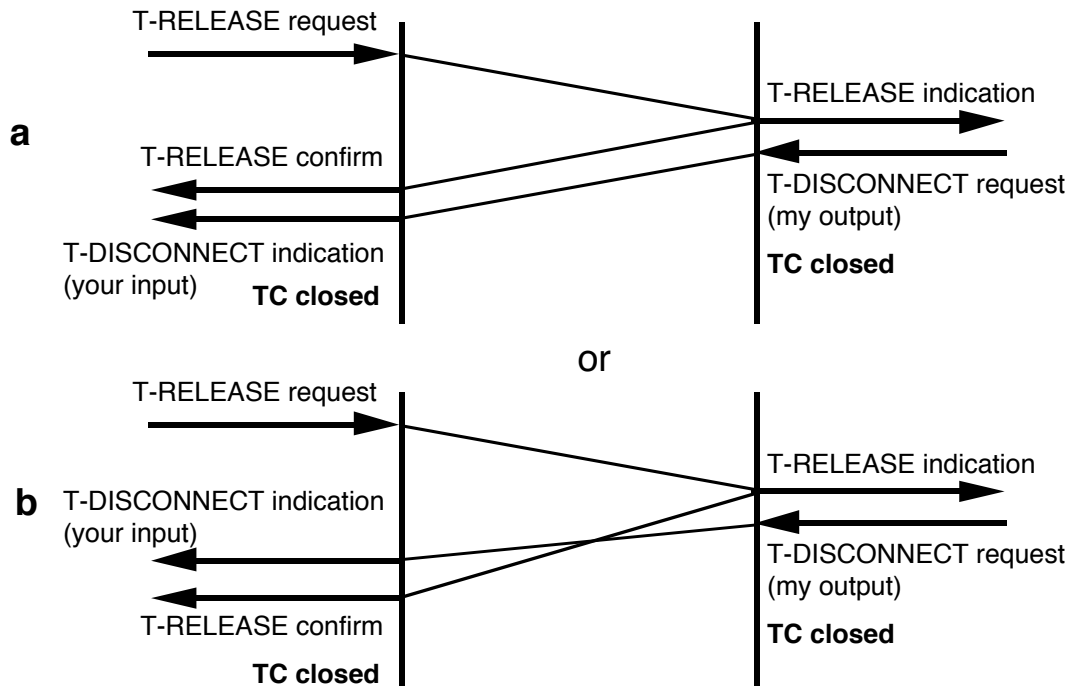

Fig. 3.3 Suppression of the problem of condition of competition for issuance shown in figure 3.2 thanks to the enhancement of the abrupt TC release facility: in both cases, the left user's output direction is released gracefully (WITH confirmation to the requestor) while its input direction is released abruptly

The enhancement of the abrupt TC release facility also presents an advantage in the situation shown in figure 3.1. The OSI95 TS user that decides to abruptly release its input direction on the TC, after the invocation of a T-RELEASE request to gracefully release its output direction on this TC, has to wait for the T-RELEASE confirm before issuing a usual bi-directional T-DISCONNECT request if it wants to be sure that its

output direction is actually closed gracefully. But if it uses a uni-directional T-DISCONNECT request (my input) instead, it may issue this primitive before the receipt of the T-RELEASE confirm without jeopardizing the graceful release of its output direction (Figure 3.4).

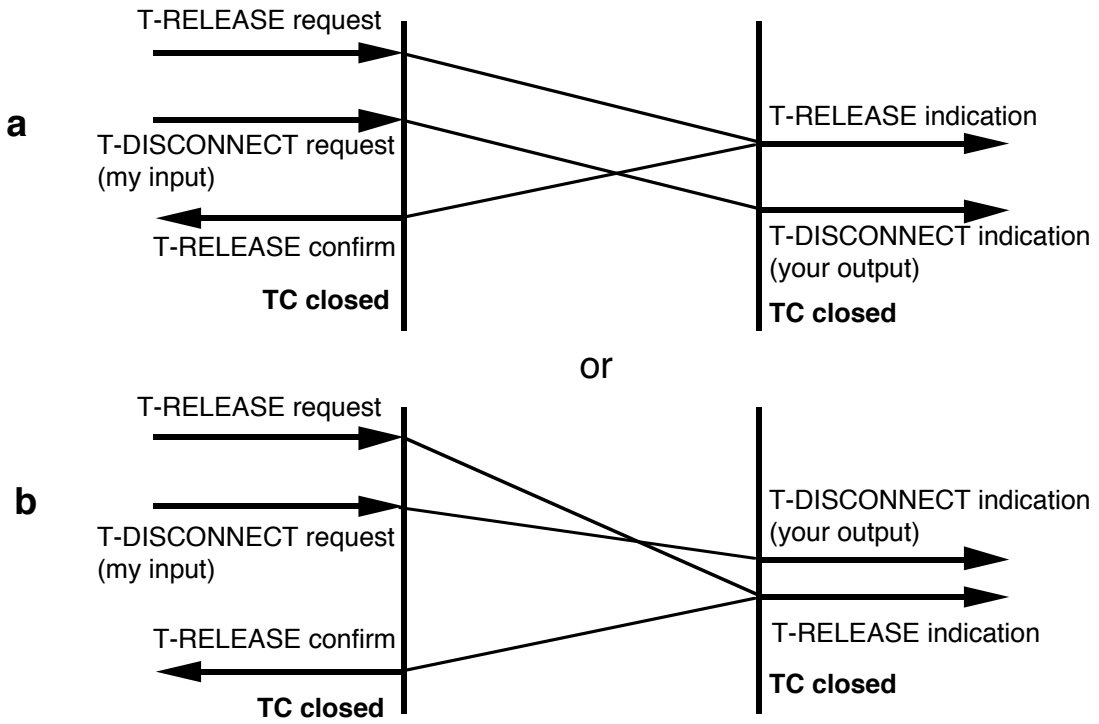

Fig. 3.4 Suppression of the problem of condition of competition for issuance shown in figure 3.1 thanks to the enhancement of the abrupt TC release facility: in both cases, the left user's output direction is released gracefully (WITH confirmation to the requestor) while its input direction is released abruptly

Additionally, the enhanced abrupt TC release facility gives the possibility to abruptly close one direction on a TC while still keeping the reverse direction open.

4 Enhancement of the Abrupt TC Release Facility for OSI95

As explained in the previous section, the proposed enhancement of the ISO/IEC abrupt TC release facility is the introduction of a new parameter for the T-DISCONNECT primitives: a "directions to close" parameter[1]. The enhanced abrupt

[1] In the OSI95 TS, another enhancement has been made to the ISO/IEC abrupt TC release facility in order to deal with the aspects relating to the semantics of the compulsory Quality of Service. This other enhancement is the introduction of special compulsory QOS report parameters in any T-DISCONNECT indication that is generated by the OSI95 TS provider to shut down the TC due to a compulsory QOS violation. The use of the compulsory QOS report parameters will not be detailed.

TC release facility may thus be used to release either or both direction(s) of data transfer of a TC abruptly. If an established TC is uni-directional, the release of its only open direction causes a complete TC release. If an established TC is bi-directional, the TC release completes when both open directions are released, together or separately.

Let us give some details about the new parameter. The parameters of the T-DISCONNECT primitives in the OSI95 TS, and the relations that have to be verified between them, are summarized in table 4.1.

	Primitives:	
Parameters:	T-DISCONNECT request	T-DISCONNECT indication
Disconnect reason		M
Directions to close	M	M
Compulsory QOS report {…}[2]		P
OSI95 TS user-data	U	C*(=)*

Keys: {…} : generic denomination gathering several parameters;
M : presence of this parameter or of this group of parameters in the primitive is mandatory;
U : inclusion of this parameter or of this group of parameters in the request or response primitive is a choice made by the OSI95 TS user;
C : presence of this parameter or of this group of parameters in the indication or confirm primitive is conditional, depending upon its inclusion in the preceding request or response primitive;
P : presence of this parameter or of this group of parameters in the OSI95 TS provider-initiated indication primitive is conditional, depending upon the reason why the OSI95 TS provider generates the primitive;
(=) : the value or option of the parameter in the primitive is identical to that of the corresponding parameter in the preceding primitive;
Blank : the parameter is absent.

Table 4.1 Relations between the parameters of the T-DISCONNECT request and indication primitives

The value of the "directions to close" parameter in a T-DISCONNECT primitive obeys the following rules:

1) When an OSI95 TS user invokes a T-DISCONNECT request primitive prior to the successful completion of the TC set-up on its side (in order to abandon the TC set-up attempt on the calling side or to reject the TC set-up attempt on the called side), every direction of data transfer whose opening has been requested shall appear in the "directions to close" parameter.
2) In a T-DISCONNECT indication primitive that is initiated by the remote OSI95 TS user and that occurs prior to the successful completion of the TC set-up, every direction of data transfer whose opening has been requested shall appear in the "directions to close" parameter.
3) When an OSI95 TS user invokes a T-DISCONNECT request primitive after the successful completion of the TC set-up on its side, a direction of data transfer may appear in the "directions to close" parameter only if this direction is not yet considered as closed by the OSI95 TS user.

[2] Refer to the footnote on the previous page.

4) In a T-DISCONNECT indication primitive that is initiated by the remote OSI95 TS user and that occurs after the successful completion of the TC set-up, every direction of data transfer that appeared in the corresponding T-DISCONNECT request primitive and that is also not yet considered as closed by the OSI95 TS user to which the indication primitive is issued shall appear in the "directions to close" parameter.
5) An OSI95 TS provider-initiated T-DISCONNECT indication primitive always releases the TC completely. If the OSI95 TS provider initiates the T-DISCONNECT indication primitive prior to the completion of the TC set-up, every direction of data transfer whose opening has been requested shall appear in the "directions to close" parameter. If the OSI95 TS provider initiates the T-DISCONNECT indication primitive after the completion of the TC set-up, every direction of data transfer that is not yet considered as closed by the OSI95 TS user to which the indication primitive is issued shall be indicated in the "directions to close" parameter.

5 Conclusions

In the framework of the Connection-Mode Transport Service developed within the OSI95 project, we have advocated important additions in the field of TC release.

The most important addition is the definition of a new graceful TC release facility. A bi-directional TC in OSI95 is viewed as made up of two simplex virtual circuits. In this line, our investigations have led us to a scenario of graceful TC release where each direction of data transfer on a TC is released quite independently of the reverse one. The graceful release of the requestor's ouput direction of data transfer is confirmed to this requestor, and is thus based on a 3-primitive sequence.

By examining how the new T-RELEASE primitives can interfere with the T-DISCONNECT primitive of the existing ISO/IEC abrupt TC release facility, we have highlighted some problems due to conditions of competition for issuance between these primitives.

We have proposed an elegant solution which respects the “pre-emptive right” semantics of the T-DISCONNECT primitives in the current ISO/IEC standard. This solution consists mainly in adding a parameter to the T-DISCONNECT primitives in order to allow the abrupt release of a single direction of data transfer on a TC.

We deem that the combination of the new graceful TC release facility with the enhanced abrupt TC release facility will be able to cover most of the needs of today's transport service users.

References

[BLL 92] Y. Baguette, L. Léonard, G. Leduc, A. Danthine, O. Bonaventure, "OSI95 Enhanced Transport Facilities and Functions", Technical report for ESPRIT II project 5341 (OSI95), Ref.: OSI95/Deliverable ULg-A/P/V1, Université de Liège, Institut Montefiore B28, B-4000 Liège, Belgium, Dec. 1992.

[BLL 93] Y. Baguette, L. Léonard, G. Leduc, A. Danthine, "The OSI95 Connection-Mode Transport Service", *The OSI95 Transport Service with Multimedia Support on HSLAN's and B-ISDN*, A. Danthine, ed., Springer Verlag, 181-198

[DBL 92] A. Danthine, Y. Baguette, G. Leduc, "Issues Surrounding the Specification of High-Speed Transport Service and Protocol", Technical report for ESPRIT II project 5341 (OSI95), Ref.: OSI95/ULg/A/15/TR/P/V2 (also submitted as ISO/IEC JTC1/SC6 N 7312 through the Belgian National Body at the SC6 interim meeting, Paris, France, Feb. 10-13, 1992), Université de Liège, Institut Montefiore B28, B-4000 Liège, Belgium, Jan. 1992.

[ISO 7498] ISO/IEC JTC1: "Information Processing Systems - Open Systems Interconnection - Basic Reference Model", ISO 7498-1, 1984.

[ISO 8072] ISO/IEC JTC1: "Information Processing Systems - Open Systems Interconnection - Transport Service Definition", ISO 8072, 1986.

[ISO 8073] ISO/IEC JTC1: "Information Processing Systems - Open Systems Interconnection - Connection-Oriented Transport Protocol Specification", ISO 8073, 1992.

[ISO 8326] ISO/IEC JTC1: "Information Processing Systems - Open Systems Interconnection - Basic Connection-Oriented Session Service Definition", ISO 8326, 1987.

[ISO SD9] ISO/IEC JTC1/SC21 (Information Retrieval, Transfer & Management for OSI): "Standing Document 9 - Approved Commentaries on the Basic Reference Model for Open Systems Interconnection", ISO/IEC JTC1/SC21 N 5217, June 19, 1990.

[RFC 793] Network Information Center: "Transmission Control Protocol", J.B. Postel, ed., NIC Standard RFC-793, Sept. 1981.

[PEI 3.6] Protocol Engines, Inc.: "XTP Protocol Definition - Revision 3.6", Ref.: PEI 92-10, Jan. 11, 1992.