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Draft for Development

Open Systems Interconnection: definition of common application service elements: commitment, concurrency and recovery (ISO DIS 8649/3)

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It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is in the progress of ongoing development within the International Standards Committee (ISO/TC 97/SC 21 Information Retrieval, Transfer and Management for Open Systems Interconnection).

It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification

of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.



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National foreword

This Draft for Development has been prepared under the direction of the Office and Information Standards Committee. The primary objective of this Draft for Development is to give advance guidance to product and systems designers concerned with the Application Layer of the Basic Reference Model for Open Systems Interconnection (OSI).

The text of the Draft for Development is identical with that submitted to the International Organization for Standardization (ISO) for issue as ISO DIS 8649/3.

For ease of reproduction the ISO text has been reproduced unchanged.

The UK has actively participated through BSI Technical Committee OSI/121 in the development of the Draft International Standard. The Technical Committee will review any agreed amendments or addenda to the ISO text and will, where appropriate, update the text of this Draft for Development via an amendment or revision. When the ISO Draft reaches an appropriate level of agreement and stability, this Draft for Development may then be converted to a British Standard.

ISO DIS 8649/3 is intended to form Part of an eventual multi-Part International Standard defining the Common Application Service Elements:

Part 1 Introduction

Part 2 Connection-based basic kernel subset

Part 3 Commitment, concurrency and recovery

Part 1 has recently failed a ballot at the Draft Proposal stage and is not available as a Draft for Development. Part 2 is at the Draft Proposal stage and will be published as DD 131. It is intended that additional Parts will be prepared when the need for further Common Application Service Elements has been identified.

The protocols providing the Common Application Service Elements in the Parts of the International Standard will be specified in the corresponding Parts of ISO 8650. In particular, the closely related DD 110 (ISO DIS 8650/3), specifies the protocol providing the Common Application Service Elements defined in this Draft for Development.

For information, a list of published British Standards and Drafts for Development (together with those scheduled for publication at the time of publication of this Draft for Development) for OSI, data communications and computer graphics is attached as national appendix A. Press Releases for new OSI, data communications and computer graphics British Standard publications will be issued to the computing press, and details of all new publications will be recorded in full in *BSI News*.

Terminology and conventions. The text of the Draft International Standard has been approved as suitable for publication as a Draft for Development without deviation. Some terminology and certain conventions are not identical with those used in Drafts for Development; attention is drawn especially to the following.

Wherever the words 'International Standard' appear, referring to this Draft for Development, they should be read as 'Draft for Development'.

Wherever page numbers are quoted, they are ISO page numbers.

Cross-references

International Standards	Corresponding British Standards
ISO 7498-1984	BS 6568 : 1984 Description of basic reference model for open systems interconnection (Identical)
ISO/DP 8509	DD 108* : Open Systems Interconnection: service conventions (ISO/DP 8509) (Identical)
ISO/DIS 8650/3	DD 110 : 1985 Open Systems Interconnection: specification of protocols for common application service elements: commitment, concurrency and recovery (ISO/DIS 8650/3) (Identical)
ISO/DP 8822	DD 101* : Open Systems Interconnection: connection-oriented presentation service definition (ISO/DP 8822) (Identical)
ISO/DP 8831	DD 105 : 1985 Open systems interconnection: job transfer and manipulation concepts and services (ISO/DP 8831) (Identical)

The Technical Committee has reviewed the provisions of ISO 2375, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

At the time of publication of this Draft for Development, the references in the text to TR xxxx, ISO 8650, ISO 8822 and ISO 8831 are at the Draft Proposal stage and the reference to AD 2 to ISO 7498 has not yet reached Draft Proposal stage, nor has it been issued as a Draft for Development.

*In preparation

Ø INTRODUCTION

This part of ISO 8649 defines the services of the commitment control, concurrency control, and recovery control (CCR) Service Element. This Service Element is architecturally part of the set of Service Elements called "Common Application Service Elements" which are available for use by all Open Systems Interconnection applications.

Open systems users require that applications initiate activities, in conjunction with a number of other open systems applications, which will complete successfully despite application failures; this requires coordination of the activities across all the open systems involved, and demands freedom from interference by other activities.

A distributed application is represented by a cooperation of application-entities. Where more than two application-entities participate, there will in general be more than one open systems interconnection involved. This part of ISO 8649 provides a means of coordinating the activities on the separate interconnections; it defines service primitives for commencing and concluding protocol exchanges and related activity on each interconnection so that the entire sequence appears to other applications as atomic.

The use of this part of ISO 8649 requires that the cooperating application-entities organise their activity into a tree structure. This tree may be statically predefined, or may be dynamically constructed using CCR services by the inclusion of new branches as the atomic action develops. The terminating exchanges will normally involve the entire tree. The identification of the application-entities involved and the construction of the tree of activity is not specified by this part of ISO 8649.

The CCR services can be used with presentation services, or with other application layer services subject to the restrictions specified in section three. This use enables an application standard to specify activity using many interconnections, possibly with different protocols on each interconnection, as an atomic action. This part of ISO 8649 is referenced by such an application standard, in order to apply CCR to the single application which it defines.

[ISO page 1]

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The application of CCR without such a coordinating standard is outside the scope of the current work.

Annex A, which does not form part of this International Standard, provides tutorial material to aid the understanding of commitment, concurrency, and recovery control.

Annex B, which does not form part of this International Standard, provides a glossary of terms. It is identical to clause 3, except that the terms are placed in alphabetical order. In clause 3, the order is chosen so that later definitions only use terms defined in earlier definitions.

[ISO page 2]

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1 SCOPE AND FIELD OF APPLICATION

This part of ISO 8649 defines the services of the Common Application Service Element (CASE) for commitment, concurrency, and recovery control.

These definitions can be referenced by an application standard when the functionality of the commitment, concurrency, and recovery protocol is required. The circumstances in which the commitment, concurrency and recovery control procedures are to be applied are specified when this part of ISO 8649 is referenced.

Where a reference to this part of ISO 8649 specifies, directly or indirectly, that a real event should cause a CCR service request or response to be issued, the occurrence of that event invokes the procedures and requirements of ISO 8650/3.

Where ISO 8650/3 requires that a CCR service indication or confirm primitive be issued, that is to be interpreted as invoking the procedures or specifying the events identified directly or indirectly in the reference to this part of ISO 8649.

This part of ISO 8649 can be applied only if the reference specifies the use of CCR service primitives in the sequence defined in clause 7 with the parameters defined in clause 8.

This part of ISO 8649 applies whenever the processing of two or more application-entities in a distributed application needs to be organised into an atomic action. The identification of the application-entities involved in the total activity and the establishment of the tree structure of this activity is not within the scope of this part of ISO 8649.

CCR services are used with the Presentation Service or with other application layer services, subject only to the restrictions given in clause 9.

This part of ISO 8649 is only applicable to a single distributed application whose operation is specified by the application standard referencing this part of ISO 8649. Its use to coordinate different forms of activity always requires the existence of such an application standard.

[ISO page 3]

2 REFERENCES

- ISO 7498 - Information processing systems -
Open systems interconnection -
Basic reference model.
- ISO 8650 - Information processing -
Open systems interconnection -
Specification of protocols for Common
Application Service Elements.
- ISO 8822 - Information processing systems -
Open systems interconnection -
Basic connection-oriented presentation
service definition.
- TR xxxx - Information processing systems -
Open systems interconnection -
Service conventions.
- ISO 2375 - Data processing - Procedures for
the registration of escape sequences.
- AD2 to ISO 7498
- Addendum on Naming and Addressing.
- ISO 8831 - Information processing systems -
Open systems interconnection -
JTM Concepts and Services
(Referenced only in the Tutorial Annex).

3 DEFINITIONS

3.1 This part of ISO 8649 uses the definitions in ISO 7498 and in ISO 8823. It also uses the definitions given below.

NOTE - An alphabetical list appears as annex B.

3.2 application failure: the failure of an application-entity to meet its normal specification.

3.3 secure data: data which survives an application failure and is available to the application-entity after local recovery procedures have restored it to normal operation.

3.4 communication failure: the failure of a communication path to meet its normal specification.

NOTE - Loss of data or of an application association which is visible to the application is a communication failure.

3.5 CCR relationship: a relationship between two or more application-entities which survives both communications failure and an application failure, and which is established and terminated using CCR service primitives.

3.6 atomic action data: secure data used for the duration of a CCR relationship to maintain that relationship and the state of the relationship.

3.7 bound data: secure data which exists beyond the CCR relationship, but whose state is bound by the rules of CCR to the state of the CCR relationship for the duration of that CCR relationship.

3.8 atomic action: a sequence of operations performed by a distributed application with the following properties:

- a) the atomic action is directly or indirectly controlled by a unique application-entity;
- b) the atomic action progresses without interference from external actions;
- c) the parts of the atomic action being undertaken by different application-entities (possibly in different open systems) either
 - (i) all complete successfully; or
 - (ii) all terminate with no change to bound data, and with the controlling application-entity having available one or more diagnostic messages supplied by

[ISO page 5]

the other application-entities involved in this atomic action.

3.9 master: the unique application-entity within the distributed application which directly or indirectly controls the entire activity for this atomic action.

3.10 subordinate: an application-entity controlled directly (by protocol exchanges) by a superior.

3.11 superior: an application-entity which directly controls (by protocol exchanges) one or more subordinates.

3.12 initial state: the state of bound data at the time of first use by an atomic action.

3.13 final state: the state of bound data produced as a result of the operations of the atomic action.

3.14 commitment (of an atomic action): termination of an atomic action with termination of bound data in the final state, and with termination of the CCR relationship.

3.15 rollback (of an atomic action): termination of an atomic action with release of bound data after returning it to the initial state, and with termination of the CCR relationship.

3.16 an offer of commitment: a statement by a subordinate to a superior that the subordinate is ready for either commitment or rollback.

3.17 period of use (of a datum used by an atomic action): the time from first use of the datum by any branch of the atomic action to the last use of that datum by the atomic action.

3.18 concurrency control: ensuring that an atomic action is not committed unless

- a) all atomic actions which have changed the value of a datum prior to its period of use by this atomic action have committed; and
- b) no change has been made to the value of a datum during its period of use, except by branches of this atomic action.

NOTE - Locking is one technique which can be applied by an implementation to obtain concurrency control. Other techniques can be used which involve less serialisation of atomic actions, but a higher incidence of rollback. The application of appropriate techniques is an implementation matter.

3.19 recovery control: ensuring the correct progress of an atomic action in the presence of application or communications failures.

3.20 marks: a numbered sequence of interactions, provided by the Session Service and made available through the Presentation Service, which can be transferred on an association.

3.21 resynchronisation: a facility, provided by the Session Service and made available through the Presentation Service, to reset to a selected mark.

NOTE - The Session and Presentation Layers do not define any application semantics when resynchronisation occurs, nor is the earlier state of the association necessarily restored by the action of resynchronisation to a number used earlier in the association.

3.22 restart: a facility by which the state of an application and the state of the communications are associated with resynchronisation so as to return the state of the application (including its bound data) and the state of the communication to an earlier state associated with a previously communicated mark.

NOTE - This version of this part of ISO 8649 provides only those restart facilities which are necessary for recovery control and rollback. More extensive facilities have been proposed for future standardisation.

3.23 service element access point: the point at which the services of an application service element are provided by an application service element to its users.

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4 ABBREVIATIONS

CCR	Commitment, concurrency, and recovery control.
CASE	Common Application Service Element
JTM	Job Transfer and Manipulation (used in the Tutorial Annex only).

[ISO page 8]

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SECTION ONE - GENERAL

5 INTRODUCTION TO CCR5.1 The atomic action tree

The model used for the definition of CCR consists of two or more cooperating application-entities communicating by means of a set of pair-wise associations. An application-entity (instance) which is a part of an atomic action introduces new application-entity instances into the atomic action as a result of the requirements of the application, as expressed in the application protocol used on the existing associations. This adds a new branch to the atomic action tree.

5.2 Two-phase commitment

The CCR commitment control enables the master of an atomic action to determine in Phase I whether subordinates are prepared to carry out, that is, to commit to, the action. It is only following offers of commitment (or refusal) from all subordinates that the master decides whether to proceed or not. In Phase II, all subordinates are ordered to commit or to rollback.

5.3 Failure

The application-entities may fail at any time, but secure data is not lost.

NOTE - Loss of secure data can cause a breakdown of the CCR service.

Following an application failure, local recovery mechanisms (possibly some considerable time later, and possibly involving human interaction) restore the operation of an application-entity. The secure data and CCR service primitives then enable the atomic action to be successfully restarted. Any loss of transferred information as the result of an application or communications failure is recovered by the CCR restart mechanisms.

5.4 Concurrency control

Each application-entity accesses resources within its own open system and makes changes to these resources as part of the operation of an atomic action. Local mechanisms, such as locking, are used to provide concurrency control.

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5.5 Restart and rollback

All bound data used during an atomic action is capable, by local mechanisms, of being restored to its initial state at any time up to commitment. This is done in response to CCR requirements for restart and for rollback. It may be possible to restart at a point part way through an atomic action, but this depends on the application services in use.

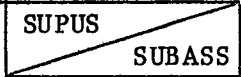
NOTE - Other secure data, such as charges incurred, may be affected by the operation of an atomic action. In general, this is not bound data, and is neither visible to CCR nor subject to rollback.

5.6 Architecture

The CCR Service is placed within the Basic Reference Model as the service provided (at service element access points) by Common Application Service Elements within the application-entities using CCR in their communication with other application-entities.

An application-entity using CCR in its communication with other application-entities makes use of the CCR Common Application Service Element for each association on which CCR is to be applied. There is a single service element access point to the CCR CASE for each such association. The other Elements in the application-entities form the users of the CCR Service.

Each CCR service element access point supports the operations of the CCR user as either a superior or as a subordinate in relation to a single application association. Viewed by the CCR user, each CCR service element access point supports communication with either a subordinate or a superior. The following relation and notation is used for describing the functions performed by the CCR CASE in relation to a single service element access point:

	<u>Option 1</u>	<u>Option 2</u>
<u>View of the CCR user as seen by the CCR CASE</u>	Superior	Subordinate
<u>View of the association as seen by the CCR user</u>	Access to a subordinate	Access to a superior
<u>Notation:</u>		

Each CCR user either

- a) acts as a superior in relation to one or more subordinates; or

- b) acts as a subordinate in relation to a single superior; or
- c) acts simultaneously as a subordinate to one superior and as a superior to one or more subordinates.

The following notation is used for describing the CCR user:

<u>CCR user type</u> (defined above)	<u>Notation</u>
(a)	SUP
(b)	SUB
(c)	SUB SUP

Using this notation, the CCR tree can be refined to show the detail in figure 1.

NOTE - The CCR user may have an internal substructure of superior and subordinate parts. These may communicate using services which are defined to carry the CCR semantics. This is not visible to the CCR CASE, but is shown in figure 1 for illustration.

The operation of the CCR user is not constrained by this part of ISO 8649 nor by ISO 8650/3 except in relation to the sequence of service primitives which are issued at a CCR service element access point. (The behaviour of the CCR user may, however, be constrained by some specific application standard.)

This part of ISO 8649 and ISO 8650/3 define the services provided by the CCR CASE and the protocol to support the operation of CCR CASEs.

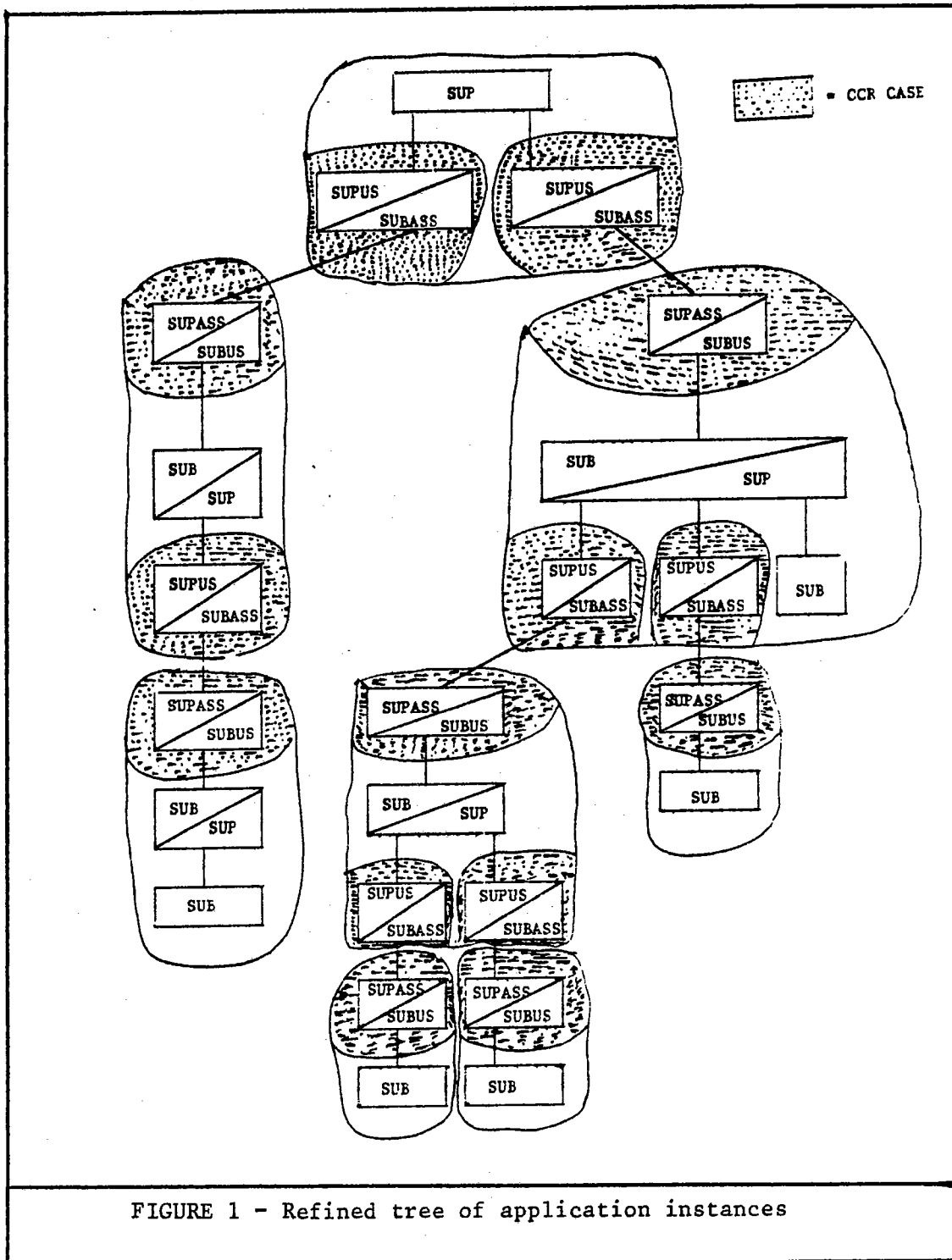


FIGURE 1 - Refined tree of application instances

6 OVERVIEW OF THE CCR SERVICE

The CCR service primitives provide an initiating and terminating exchange for each atomic action, and are used within the pair-wise associations between application-entities. They ensure correct operation and termination of atomic actions no matter when application failures occur.

The essential feature of commitment, supported by this part of ISO 8649, is that a superior can obtain offers or refusals of commitment from all of its subordinates, and can then decide to commit or to rollback.

The following are the main features of an atomic action defined by this part of ISO 8649:

- a) commitment implies that the results produced by the atomic action have become permanent; no recovery capability exists at this level of operation for undoing the results produced once commitment has occurred;
- b) a superior may order rollback to the initial state at any time prior to ordering commitment;
- c) a superior may not order a subordinate to commit unless it has received an offer of commitment from it;
- d) if a subordinate has offered commitment, it may not refuse an order to commit;
- e) a subordinate may refuse commitment at any time up to making an offer to commit;
- f) the superior orders rollback for any subordinate which has refused commitment.

The master of an atomic action is the ultimate recipient of diagnostics generated by subordinates, and has the ultimate responsibility for ordering commitment or rollback. The master's name is used in the identification of the atomic action for the purpose of concurrency control.

The nature of the atomic action is determined by the application protocol used between the initiating and terminating CCR exchange. The nature of the atomic action may vary according to whether some or all subordinates have refused to offer commitment.

At the end of the atomic action, all resources used by the action are released. This includes the release of all bound data, the release of any concurrency controls, and the deletion of all atomic action data. The recovery mechanisms in CCR ensure that the termination procedures are correctly applied throughout the atomic action tree.

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The CCR service primitives are used on each of the pair-wise communications between a superior and one of its subordinates.

6.1 Service primitives

6.1.1 Initiation

C-BEGIN request : issued by a superior
C-BEGIN indication : issued to a subordinate

This service initiates an atomic action, or includes a new subordinate in an existing atomic action. It establishes a CCR relationship. It is followed by use of application service primitives which are not part of CCR, and which serve to define and to progress the atomic action.

NOTE - A signal by the subordinate that the action can proceed is not provided by the CCR service primitives; it is considered to be a part of the application service (if it is needed). Refusal can be signalled by C-REFUSE (see 6.1.4) at any time; absence of such refusal, and the non-use of flow control on the association, can be taken as an indication to proceed.

6.1.2 Indication of termination

C-PREPARE request : issued by a superior
C-PREPARE indication : issued to a subordinate

This optional service is used by a superior to indicate the end of this branch of the atomic action, and to request the subordinate to issue a C-READY or a C-REFUSE. The superior issues no further application service primitives to this subordinate (within this atomic action), unless there is a restart.

NOTE - Where a priori knowledge, or the application service in use, provides an indication of the end of the action, C-PREPARE need not be issued.

6.1.3 Offer of commitment

C-READY request : issued by a subordinate
C-READY indication : issued to its superior

This service is used at the end of an action to inform the superior that the subordinate is offering commitment. The subordinate issues no further application service primitives (within this atomic action) unless there is a restart.

NOTE - The subordinate does not issue a C-READY unless it knows, by receipt of a C-PREPARE or otherwise, that this part of the atomic action is completed.

6.1.4 Refusal of commitment

C-REFUSE request : issued by a subordinate
C-REFUSE indication : issued to its superior

This service is used at any time during the action (prior to an offer of commitment) to inform the superior that the subordinate is refusing commitment. Diagnostic information that distinguishes between refusal due to transient conditions and other refusals can be carried in the user data parameter of these primitives.

NOTES

- 1 A subordinate either refuses or offers commitment, but not both.
- 2 This service can cause loss of data which is in transit.

6.1.5 Commitment

C-COMMIT request : issued by a superior
C-COMMIT indication : issued to a subordinate
C-COMMIT response : issued by a subordinate
C-COMMIT confirm : issued to a superior

This confirmed service is used by the superior to order commitment. The response is issued by the subordinate as the last event in the termination of the atomic action, following the release of all resources, and following local termination of the CCR relationship. The request is issued only to subordinates who have offered commitment.

6.1.6 Rollback

C-ROLLBACK request : issued by a superior
C-ROLLBACK indication : issued to a subordinate
C-ROLLBACK response : issued by a subordinate
C-ROLLBACK confirm : issued to a superior

This confirmed service is used by the superior, at any time prior to use of C-COMMIT, to order rollback. The response is issued by the subordinate as the last event in the rollback process, following the release of all resources, and following local termination of the CCR relationship.

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