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Part 8: RINA general delimiting procedures

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Partie 8: Procédures générales de délimitation RINA

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
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Telecommunications and information exchange between systems — Recursive inter-network architecture —

Part 8: RINA general delimiting procedures

1 Scope

This document provides a delimiting module that defines a mechanism for encoding Service Data Units (SDUs), the amount of data passed across the layer boundary within Protocol Data Units (PDUs), the amount of data sent to its peer. It is not necessary to use this document if each PDU carries precisely one SDU.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4396-1, *Telecommunications and information exchange between systems — Recursive Inter-Network Architecture — Part 1: Reference Model*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4396-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Detailed specification of the procedure

4.1 General

The delimiting module produces on input, one or more User-Data fields for the error and flow control protocol (EFCP) to create PDUs; and on output, depending on quality of service (QoS) parameters, complete, incomplete, or partial SDUs for the user of the flow. Partial delivery refers to whole SDUs that are delivered incrementally, while incomplete delivery refers to an SDU that can have pieces missing. This implies that partial delivery of incomplete SDUs is possible. The described mechanism covers a range of policy options, allowing fragmentation of SDUs, concatenation of SDUs, and both fragmentation and concatenation of SDUs simultaneously. It also provides additional information needed for delivery despite gaps in the SDU stream, if delivery across a gap is permitted by the QoS-cube for the flow. The delimiting policy may be different between QoS-cubes. This module can be used with several QoS-cubes with different constraints on which flags can appear.

4.2 Syntax

The User Data field of an EFCP Transfer PDU may contain SDU fragments, entire SDUs, or prescribed combinations of the two. The User Data Field syntax is:

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<Data> ::= <lastFragment> | <midFragment> | <firstFragment> | <SDUData>

<PDUdata> ::= <Data> | [<Length>< lastFragment >] (<Length> <SDUdata>)* [< Length >< firstFragment >]

<UserDataField> ::= <SDUDelimiterFlags> [<SDUSequenceNumber >] [<PDUdata>]

This syntax has the following properties:

- The SDUSequenceNumber may or may not be present in the PDU.
- The syntax of PDUdata permits the Length field to be omitted if the PDU contains a single SDU or fragment. The SDUDelimiterFlags field described below determines the type of the Data content in this case.
- If more than one SDU or fragment is present, the Length fields in conjunction with the SDUDelimiterFlags field described below shall be used to parse the PDUdata into its component fragments or SDUs.

SDUDelimiterFlags: 1 Byte

'08'X – SDUSequenceNumberPresent, when set(1) in the SDUDelimiterFlags indicates that a SDUSequenceNumber immediately follows the SDUDelimiterFlags field, preceding any fragment or SDU data.

The following flags in the SDUDelimiterFlags field define the PDUData syntax used to encode the remainder of the PDU Data field.

'04'X – noLength, indicates whether the PDU contains exactly one fragment or SDU and that the length delimiter is omitted on the single fragment or SDU. If noLength is set (1), the entire remainder of the PDU Data field is the Data, and the two low-order flags ('02'X and '01'X) are interpreted as follows:

'00'B – The PDU data contains a continuation (midFragment), that is, an SDU neither begins nor ends in this PDU.

'01'B – The PDU data contains the first fragment (firstFragment) of the next SDU in sequence.

'10'B – The PDU data contains the final fragment (lastFragment) of an SDU, completing it.

'11'B – The PDU data contains one complete SDU.

If the noLength flag is clear (0), a Length precedes each Data fragment or SDU in the PDU Data field, and the two low-order flags are interpreted as follows:

'00'B – The PDU data contains zero or more complete SDUs.

'01'B – The PDU data contains zero or more complete SDUs, followed by a firstFragment.

'10'B – The PDU data contains a lastFragment, followed by zero or more complete SDUs.

'11'B – The PDU data contains a lastFragment, followed by zero or more complete SDUs, followed by a firstFragment.

The high order 4 bits of the SDUDelimiterFlags field shall be 0.

Data: a variable number of data bytes: The content portion of an SDU or fragment of an SDU.

Length: SDUFragLen – This field contains the length of the Data (SDU or fragment of an SDU) following it that is being delimited. It is an error if the PDU data field contains an incomplete Length field. It is an error if the PDU Data field is not exactly consumed by the delimited SDUs and/or fragments.

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SDUSequenceNumber: SeqNumLen – If present, this field is used to indicate the SDU sequence number of the SDU that contains the first byte of fragment Data or SDU Data present in the PDU. The sequence numbers of any additional SDUs or fragments in the PDU, if any, can be trivially deduced. It is an error if the provided SDUSequenceNumber does not match the expected value based on the content of the PDU with the previous PDU sequence number.

4.3 Procedure

If the QoS-cube for this flow implements fragmentation, concatenation, or both, the EFCP PCI is immediately followed by an SDUDelimiterFlags field describing how fragment(s) and/or SDU(s) are encoded in the PDU Data field. The SDUDelimiterFlags describe the syntax of the encoding.

— noLength flag set: When the SDUDelimiterFlags field indicates that no Length is present in the PDU Data field, the SDUDelimiterFlags provides the additional information needed to properly identify the single Data block occupying the remainder of the PDU as an SDU or fragment, and if a fragment, how to associate it with the proper SDU.

— noLength flag clear: When any Length is present in the PDU Data field, any such Length is an integer of length “SDUFragLen” bytes, immediately preceding a sequence of data bytes of the indicated length. Note that it is necessary to examine in turn each <Length><Data> pair present in the PDU Data field to properly parse the content of the PDU Data field into its component fragment(s) and/or SDU(s) and verify that the PDU is correctly encoded. The SDUDelimiterFlags then provides the additional information needed to identify each Data block as a fragment or complete SDU, and if a fragment, how to associate it with the proper SDU.

— SDU sequence number: When set (1), the SDUSequenceNumberPresent flag in the SDUDelimiterFlags field indicates that the SDU sequence number of the SDU containing the first byte of Data in the UserData field is present immediately following the SDUDelimiterFlags field, in a field of length sequenceNumberLength bytes. The remainder of the UserData is encoded according to the SDUDelimiterFlags as specified above.

If the QoS cube enables fragmentation, concatenation, or both, then the SDU sequence number and the PDU sequence number may be unequal. They will only be equal when 1 SDU is always mapped to 1 PDU. In such cases, the SDU sequence number shall be explicitly encoded into the PDU if it is important to know the SDU sequence number(s) of the SDU(s) in the PDU. In the case where the QoS cube specifies a non-zero, non-infinite SDU gap, it is necessary to know the SDU sequence number of an SDU starting (and possibly completing) in a PDU in order to determine whether delivery of the SDU to the application is appropriate. When the application has indicated that partial or incomplete delivery is allowed, a partial or incomplete SDU may be delivered.

— Minimum and maximum SDU length: The length and contents of an SDU are set when it is created by the user of the flow, and both are preserved through delivery to the destination application. The maximum length of an SDU permitted on a flow is determined by policy as a parameter of the DIF, and if fragmentation is enabled for the flow, may be larger than a single maximum-length PDU can carry. The minimum length of an SDU is zero data bytes. The only maximum-SDU-length restriction made by this Delimiting Specification is that the length of an SDU or fragment shall be able to be encoded in the Length field encoded as defined above.

Implementation note 1: The suggested parsing approach of a PDU data field with Lengths present is to validate that all <Length><Data> pairs are validly encoded and exactly fit the PDU data portion, saving their starting points and lengths in a list/array as a side-effect of the validation. Then, the SDUDelimiterFlags can be easily consulted to identify any first fragment, SDUs, and last fragment in the array. This order helps avoid committing any action before the validity of the PDU has been established and simplifies SDUDelimiterFlags processing.

Implementation note 2: By convention in some operating systems, including UNIX-derived operating systems, a zero-length data return from a read operation is often interpreted as an end-of-file indication. Receiving a zero-length SDU will be interpreted as an end-of-file indication by many applications on those systems, which may not be the intended consequence of sending one. However, that interpretation is an application choice – the network makes no such assumption. Provided that the applications at both

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ends agree to adopt the convention, a zero-length SDU can be treated as “end-of-session” (implying that deallocation of the flow is forthcoming) for maximum compatibility with legacy programs. Alternately, the applications can exchange application-level protocol information within the flow to indicate when the data transfer is complete and the flow can be deallocated, opening the possibility of exchanging zero-length SDUs on the flow if that is deemed useful.

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