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Datasheet for the decision
of 19 September 2018

Case Number:	T 0732/15 - 3.5.07
Application Number:	02791409.2
Publication Number:	1488529
IPC:	H03M13/00, H03M13/09, H04L1/00, H04L29/06, H03M13/11
Language of the proceedings:	EN

Title of invention:
Separable cyclic redundancy check

Applicant:
Adaptec, Inc.

Headword:
Separable CRC/ADAPTEC

Relevant legal provisions:
EPC Art. 54(1), 54(2), 56

Keyword:
Novelty - main request (no)
Inventive step - first and second auxiliary requests (no)

Case Number: **T 0732/15 - 3.5.07**

D E C I S I O N
of Technical Board of Appeal 3.5.07
of 19 September 2018

Appellant: (Applicant)	Adaptec, Inc. 691 South Milpitas Boulevard Milpitas, California 95035 (US)
Representative:	Dilg, Haeusler, Schindelmann Patentanwaltsgesellschaft mbH Leonrodstrasse 58 80636 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 4 August 2014 refusing European patent application No. 02791409.2 pursuant to Article 97(2) EPC**

Composition of the Board:

Chairman	R. Moufang
Members:	R. de Man
	M. Jaedicke

Summary of Facts and Submissions

I.   The applicant (appellant) appealed against the decision
        of the Examining Division refusing European patent
        application No. 02791409.2, published as international
        application WO 03/084078.

II.   The Examining Division decided that the subject-matter
        of claim 1 of both the then main request and the then
        auxiliary request infringed Article 123(2) EPC and that
        the subject-matter of claim 1 of the main request
        lacked inventive step over the following document:

        D1: US 5 410 546, published on 25 April 1995.

III.   With its statement of grounds of appeal, the appellant
        submitted a main request and first to third auxiliary
        requests, the main request and the second auxiliary
        request corresponding to the main request and the
        auxiliary request considered in the contested decision.

IV.   In a communication accompanying a summons to oral
        proceedings, the Board also referred to the following
        documents:

        D2: US 5 951 707, published on 14 September 1999; and
        D4: V. Cavanna, "iSCSI Digests - CRC or Checksum?",
            draft-cavanna-iscsi-crc-vs-cksum-01.txt, Internet
            Engineering Task Force (IETF) Internet Draft,
            2 March 2001.

        The Board questioned the compliance of all requests
        with Articles 84 and 123(2) EPC and expressed the
        preliminary view that the subject-matter of claim 1 of
        all requests lacked either novelty or inventive step
        over any of documents D1, D2 and D4.

V.   In a letter dated 17 August 2018, the appellant
        replaced its requests with a new main request and new
        first and second auxiliary requests.

VI.   In a letter dated 14 September 2018, the appellant
        informed the Board that it would not participate in the
        oral proceedings and requested a decision on the state
        of the file.

VII.   Oral proceedings were held on 19 September 2018 in the
        appellant's absence. At the end of the oral
        proceedings, the chairman pronounced the Board's
        decision.

VIII.   The appellant requested that the decision under appeal
        be set aside and that a patent be granted on the basis
        of the claims of the main request or on the basis of
        the claims of either of the first and second auxiliary
        requests.

IX.   Claim 1 of the main request reads as follows:

        "A method for computing a cyclic redundancy check (CRC)
        for a transmitted data stream, the method comprising:
            performing a CRC process on a first segment of the
        data stream, the CRC process generating a first CRC
        remainder;
            projecting the first CRC remainder for the first
        segment by mathematically moving the first CRC
        remainder to the end of the data stream;
            performing the CRC process on a second segment of
        the data stream, the CRC process generating a second
        CRC remainder;

projecting the second CRC remainder for the second segment by mathematically moving the second CRC remainder to the end of the data stream; and
combining the projected first CRC remainder and the projected second CRC remainder to calculate a complete CRC remainder for the data stream."

X.   Claim 1 of the first auxiliary request differs from claim 1 of the main request in that the part of the claim before "performing a CRC process" reads as follows:

"A method for computing a cyclic redundancy check (CRC) for a transmitted data stream comprising at least two segments, the method comprising:
       determining the order in which the segments are received based on a respective location or order number in a header information of each segment;"

XI.   Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the following text has been added at the end of the claim:

"wherein for projecting the first and second CRC remainders there is calculated a distance between the first segment and the end of the data stream and the second segment and the end of the data stream, respectively."

XII.   The appellant's arguments, where relevant to the decision, are discussed in detail below.

Reasons for the Decision

1.   The appeal complies with the provisions referred to in
        Rule 101 EPC and is therefore admissible.

2.   The duly summoned appellant having been absent at the
        oral proceedings, it is treated - in accordance with
        its request for a decision on the state of the file -
        as relying only on its written case (Article 15(3)
        RPBA).

3.   *The invention*

3.1   The background section of the application describes the
        known cyclic-redundancy-check (CRC) method for
        detecting errors in transmitted data. In this method,
        the transmitting device calculates a CRC for the
        message to be transmitted and appends the CRC to the
        end of the message. The receiving device recalculates
        the CRC of the received data and compares the result
        with the received CRC.

3.2   The CRC of a message is normally calculated by
        processing the data words contained in the message in
        sequential order. This means that if the message has
        been split into smaller segments during transmission,
        the message must first be reassembled at the receiving
        side before its CRC can be calculated.

3.3   The invention essentially proposes calculating the CRC
        of a message that has been broken up into smaller
        segments by calculating the CRC of the individual
        segments and combining the CRCs to obtain the CRC of
        the full message.

Main request

4.   *Claim 1 of the main request*

4.1   Claim 1 of the main request specifies a step of
         performing a CRC process on a first segment of a data
         stream to generate a first "CRC remainder" and a step
         of "projecting the first CRC remainder for the first
         segment by mathematically moving the first CRC
         remainder to the end of the data stream". In the same
         way, a second CRC remainder is generated for a second
         segment of the data stream and then "projected" by
         being "mathematically moved to the end of the data
         stream". The two projected remainders are then
         "combined" to calculate a complete CRC remainder for
         the data stream.

         The Board notes that the application uses the term
         "data stream" to refer to a protocol data unit that is
         made up of a number of segments which are individually
         transmitted to a receiving destination (see page 6,
         lines 11 to 14, of the published application). The term
         "remainder" is used because the calculation of the CRC
         of a data segment involves the computation of the
         remainder polynomial obtained when dividing a
         polynomial with binary coefficients representing the
         data segment by a fixed generator polynomial.

4.2   As explained in the description on page 10, line 26, to
         page 11, line 14, the formula describing the
         calculation of a complete CRC remainder from partial
         CRC remainders is as follows:

$$R(M_k) = R(mr_{kr} + \ldots + x^{k3+\ldots+kr}m2_{k2} + x^{k2+\ldots+kr}.m1_{k1} + x^{k1+\ldots+kr}.m0_{k0})$$

$$= R(mr_{kr}) + \ldots + R(x^{k3+\ldots+kr}).R(m2_{k2}) + R(x^{k2+\ldots+kr}).R(m1_{k1}) + R(x^{k1+\ldots+kr}).R(m0_{k0})$$

Here, $R(M_k)$ is the CRC remainder of the message M_k represented as a polynomial. The polynomials mr_{kr}, $m2_{k2}$, $m1_{k1}$ and $m0_{k0}$ represent segments of the message M_k of length kr, $k2$, $k1$ and $k0$, respectively. Their partial CRC remainders are $R(mr_{kr})$, $R(m2_{k2})$, $R(m1_{k1})$ and $R(m0_{k0})$. The factors $R(x^{k3+\cdots+kr})$, $R(x^{k2+\cdots+kr})$ and $R(x^{k1+\cdots+kr})$ are referred to as "projection multipliers". The exponents $(k3+...+kr)$, $(k2+...+kr)$ and $(k1+...+kr)$ represent the distance between the respective segment and the end of the message.

The description states that "the product of each of the CRC remainders of each of the respective packets or segments and the respective projection multiplier yields a projected CRC remainder", and so the formula "allows for the mathematical movement of the CRC remainders to the end of the PDU". It also states that "the addition of the projected CRC remainders represent[s] the bit-wise exclusive-OR of the projected CRC remainders" (page 11, lines 7 to 12).

In other words, the claimed step of "projecting" by "mathematically moving" a partial CRC remainder "to the end of the data stream" is to be understood as multiplying the partial CRC remainder by the appropriate projection multiplier, where the projection multiplier is related to the distance from the corresponding segment to the end of the data stream.

The claimed step of "combining" refers to the addition (by means of bitwise exclusive-OR operations) of the resulting "projected" CRC remainders.

4.3   The Board notes that the process of calculating the complete CRC remainder from partial CRC remainders is

essentially determined by the underlying mathematics of CRC calculations.

5.   *Novelty*

5.1   Document D2 discloses a method of calculating the CRC of an ATM packet partitioned into ATM cells by calculating a partial CRC for each ATM cell and combining the partial CRCs to obtain the complete CRC of the ATM packet (column 1, lines 39 to 48; column 3, lines 30 to 42; column 4, lines 24 to 31).

The CRC for the complete ATM packet is calculated by multiplying, for each ATM cell, the partial CRC by a corresponding "fixed remainder" and taking the sum of these products (column 5, lines 5 to 9).

The fixed remainder for an ATM cell relates to the position of the cell within the ATM packet (column 4, lines 55 to 58). More precisely, the fixed remainder for the first cell is "the remainder of $2^{384(L-1)}$ when divided by P, where L represents the maximum packet length in cells", and the fixed remainder for the second cell is "the corresponding remainder of $2^{384(L-2)}$" (column 4, line 64, to column 5, line 1). The fixed remainder for a particular ATM cell therefore relates to the distance from the cell to the end of the ATM packet.

The summation of the products involves a "64-bit add with no carry" (page 6, lines 42 and 43), which is well-known to be equivalent to an exclusive-OR operation.

5.2   The appellant argued that document D2 did not disclose a "target location" for the projected partial CRCs and

that this target location could be the end of the data
stream. Placing the partial CRCs at the end of the data
stream had the technical effect that "after the partial
CRC checking a final single one and compact data stream
will be produced".

The Board notes that, contrary to what the appellant
appears to argue, the claimed "projecting" and
"mathematically moving" steps cannot be understood as
actually placing the partial CRC at the end of the data
stream. The partial CRCs for the different segments of
the data stream are intermediate results, which neither
are nor become part of the data stream. As explained in
point 4.2 above, the claimed "projecting" steps merely
multiply these intermediate results by appropriate
factors ("projection multipliers"). The values of these
factors as determined by the mathematical formula
discussed above relate to the distance from the segment
to the end of the data stream. Since the same formula
necessarily underlies the calculation of the complete
CRC from partial CRCs disclosed in document D2, it is
no surprise that the "fixed remainders" in that
document likewise relate to the distance from the
segment (ATM cell) to the end of the data stream (ATM
packet).

5.3   Hence, the subject-matter of claim 1 of the main
        request is not new (Article 54(1) and (2) EPC).

First auxiliary request

6.   *Inventive step*

6.1   Claim 1 of the first auxiliary request adds to claim 1
        of the main request the step of "determining the order
        in which the segments are received based on a

respective location or order number in a header
information of each segment".

6.2   Document D2 relates to the calculation of the CRC of
        ATM packets. These packets are partitioned into ATM
        cells, which on transmission are interleaved with the
        cells of other ATM packets (column 1, lines 39 to 51).
        By calculating the partial CRC for each ATM cell in
        hardware and combining the partial CRCs of the
        individual cells, it becomes possible to calculate the
        complete CRC of an ATM packet in an efficient manner
        with relatively simple hardware (column 2, lines 3
        to 29).

6.3   Since the ATM protocol does not allow reordering of ATM
        cells during transmission, ATM cell headers need not
        and do not contain a "location or order number".
        Nevertheless, in the Board's judgment the skilled
        person, starting from document D2, would consider
        applying the same technique to obtain the same
        advantage to other network protocols, including
        protocols that do allow reordering of packet segments.
        Since the inclusion of a sequence number (i.e. a
        "location or order number") in each segment header is
        the standard technique for allowing the receiving side
        to reassemble packets from segments received out of
        order, the skilled person would arrive at the subject-
        matter of claim 1 without the exercise of inventive
        activity.

6.4   The subject-matter of claim 1 of the first auxiliary
        request therefore lacks inventive step (Articles 52(1)
        and 56 EPC).

6.5   In view of this finding, there is no need for the Board
        to assess novelty and inventive step with respect to

either document D1 (which also appears to disclose the mathematical process for calculating a complete CRC from partial CRCs) or document D4 (which suggests calculating a complete CRC from partial CRCs in the context of the iSCSI protocol, which is one of the protocols considered in the present application and uses sequence numbers; see page 8, lines 3 to 6).

Second auxiliary request

7.   *Inventive step*

7.1   Claim 1 of the second auxiliary requests adds to claim 1 of the first auxiliary request that "projecting" the partial CRC remainder of a segment involves calculating a distance from the segment to the end of the data stream.

7.2   In document D2, the "fixed remainder" to be used when "projecting" the partial CRC of an ATM cell depends on the number of cells between that cell and the end of the ATM packet, which number qualifies as "a distance" from the cell to the end of the ATM packet. It is therefore obvious to calculate this number, either explicitly or implicitly, as part of the process of "projecting" a partial CRC.

7.3   It follows that the subject-matter of claim 1 of the second auxiliary request likewise lacks inventive step (Articles 52(1) and 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

I. Aperribay   R. Moufang

Decision electronically authenticated