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Datasheet for the decision
of 23 February 2016

Case Number: T 2343/10 - 3.5.07
Application Number: 03729000.4
Publication Number: 1506501
IPC: G06F17/30
Language of the proceedings: EN

Title of invention:
Associative database searching using FPGA devices

Applicant:
IP Reservoir, LLC

Headword:
Data matching using FPGA/IP RESERVOIR

Relevant legal provisions:
EPC Art. 123(2), 56
RPBA Art. 13(1)

Keyword:
Amendments - added subject-matter (yes) main request and auxiliary requests 1-9
Inventive step - (no) auxiliary requests 10 and 11
Decisions cited:

Catchword:
Case Number: T 2343/10 - 3.5.07

DECISION of Technical Board of Appeal 3.5.07 of 23 February 2016

Appellant: IP Reservoir, LLC
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted on 12 July 2010 refusing European patent application No. 03729000.4 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman R. Moufang
Members: M. Rognoni
R. de Man
Summary of Facts and Submissions

I. The former applicant (appellant), Washington University, appealed against the decision of the Examining Division to refuse European patent application no. 03729000.4, filed as international application PCT/US03/15638 and published as WO 03/100662.

II. The Examining Division based its decision essentially on the following objections against all requests filed with telefax dated 10 May 2010:

- the subject-matter of claim 1 according to the main request extended beyond the content of the application as originally filed (Article 123(2) EPC);
- claim 1 of the main request was neither clear nor supported by the description as required by Article 84 EPC;
- claims 1 according to auxiliary requests 1 to 7 did not comply with Articles 123(2) and 84 EPC.

As an Obiter Dictum, the Examining Division noted that the subject-matter of a claim amended to overcome the objections of clarity and added subject-matter would not be new over the following prior-art document:


Furthermore, in the Examining Division's opinion, the subject-matter of this hypothetical claim would not
involve an inventive step in view of the common knowledge generally available in the art.

III. With the statement of grounds of appeal the appellant filed new claim sets according to a main request and auxiliary requests 1 to 9.

IV. Registration of the transfer of the present application to IP Reservoir, LLC (current appellant) took effect on 13 January 2014.

V. With a communication dated 9 September 2015, the appellant was summoned to oral proceedings scheduled to take place on 23 February 2016.

VI. In a communication pursuant to Article 15(1) EPC, dated 11 December 2015, the Board expressed, inter alia, the preliminary opinion that claim 1 according to the main request and to auxiliary requests 1 to 9 did not appear to comply with Article 123(2) EPC. The Board expressed also doubts as to the inventive step of the claimed invention and, in this respect, drew the appellant's attention to the following prior art document:


VII. With letter dated 8 February 2016, the appellant submitted new auxiliary requests 10 and 11.

VIII. Oral proceedings before the Board were held as scheduled on 23 February 2016. At the end of these proceedings, the Chairman pronounced the Board's decision.
IX. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the claims of the main request filed with the statement of grounds of appeal or, in the alternative, on the basis of the claims of one of auxiliary requests 1 to 9 filed with the statement of grounds of appeal or one of auxiliary requests 10 and 11 filed with the letter dated 8 February 2016.

X. Claim 1 according to the appellant's main request reads as follows:

"A system for performing data reduction, the system comprising:

at least one re-configurable logic device (21) that is configured to (i) store a data key, (ii) receive a stream of target data, the target data comprising a plurality of data fields, (iii) match the stream of target data against the data key to find matched data within the stream of target data with respect to a first field of the target data, and (iv) summarize the matched data in aggregate form according to a second field of the target data."

Claims 2 to 18 are dependent on claim 1. Claim 19 is directed to a method essentially comprising the steps which the system of claim 1 is configured to perform. Claims 20 to 36 are dependent on claim 19.

Claim 1 according to auxiliary request 1 reads as follows:

"A system for performing data reduction, the system comprising:

at least one re-configurable logic device (21) that is configured to (i) store a data key, (ii) receive a
stream of target data, the target data comprising a plurality of portions, (iii) match the stream of target data against the data key to find matched data within the stream of target data, and (iv) summarize the matched data in aggregate form such that the matching operation and the aggregate summarization operation are performed on different portions of the target data."

Claim 1 according to **auxiliary request 2** reads as follows:

"A system for performing data reduction, the system comprising:
   at least one re-configurable logic device (21) that is configured to (i) store a data key, (ii) receive a stream of financial information, (iii) match the stream of financial information against the data key to find matched data within the stream of financial information, the matched data comprising data representative of a plurality of prices for a stock, and (iv) summarize the matched data in aggregate form according to the prices for the stock."

Claim 1 according to **auxiliary request 3** differs from claim 1 of auxiliary request 2 in that features (iii) and (iv) read as follows:

"(iii) match the stream of financial information against the data key to find matched data within the stream of financial information, the matched data comprising data representative of a plurality of prices and times for a stock, and (iv) summarize the matched data in aggregate form according to the prices for the stock by computing in parallel paths a minimum price, a maximum price, and a latest price for the stock prices within the matched data as the matched data streams through a data shift
register (102) resident on the at least one reconfigurable logic device."

Claim 1 of auxiliary request 4 reads as follows:

"An apparatus comprising:
   at least one re-configurable logic device (21) for performing data reduction searching on financial information, the at least one re-configurable logic device configured to (i) store a data key, (ii) receive a stream of financial information, the financial information comprising a plurality of stock prices and associated times, (iii) match the stream of financial information against the data key to find a stock within the stream of financial information, (iv) return a plurality of stock prices and times for the found stock, (v) stream the stock prices and times for the found stock through a data shift register (102) resident on the at least one re-configurable logic device, and (vi) summarize the stock prices and times for the found stock in an aggregate form by identifying a minimum price, a maximum price, and a latest price of the found stock using decision logic resident on the at least one re-configurable logic device as the stock prices and times for the found stock stream through the data shift register, the decision logic comprising parallel paths for identifying the minimum price, maximum price, and latest price of the found stock."

Claim 1 according to auxiliary request 5 differs from claim 1 of auxiliary request 4 in that the last feature of the latter ("the decision logic comprising parallel paths for identifying the minimum price, maximum price, and latest price of the found stock") has been replaced by the following wording:
"wherein the decision logic comprises:

a first data register (104) configured to store a most recent minimum stock price;

a second data register (106) configured to store a most recent maximum stock price;

a third data register (108) configured to store a most recent latest stock price;

a fourth data register (116) configured to store a most recent time;

a first comparator (110);

a second comparator (112); and

a third comparator (114);

wherein the first, second and third comparators are configured to operate in parallel with each other;

wherein the first comparator is configured to compare the current stock price in the data shift register with the stored most recent minimum stock price to determine which is lower; and

wherein the decision logic is further configured to update the stored most recent minimum stock price in the first data register with the current stock price in response to a determination by the first comparator that the current stock price is lower;

wherein the second comparator is configured to compare the current stock price in the data shift register with the stored most recent maximum stock price to determine which is higher;

wherein the decision logic is further configured to update the stored most recent maximum stock price in the second data register with the current stock price in response to a determination by the second comparator that the current stock price is higher;

wherein the third comparator is configured to compare the current time in the data shift register with the stored most recent time to determine which is later; and
wherein the decision logic is further configured to update the stored most recent latest stock price in the third data register with the current stock price in the data shift register in response to a determination by the third comparator that the current time is later."

Claim 1 according to **auxiliary request 6** differs from claim 1 according to auxiliary request 3 in that feature (iv) reads as follows:

"(iv) summarize the matched data in aggregate form, wherein the at least one re-configurable logic device comprises:

- a data shift register (102);
- a first data register (104) configured to store a most recent minimum stock price;
- a second data register (106) configured to store a most recent maximum stock price, the second data register configured to operate in parallel with the first data register;
- a third data register (108) configured to store a most recent latest stock price, the third data register configured to operate in parallel with the first data register and the second data register;
- a fourth data register (116) configured to store a most recent time, the third data register configured to operate in parallel with the first data register and the second data register [sic];
- a first comparator (110);
- a second comparator (112) configured to operate in parallel with the first comparator; and
- a third comparator (114) configured to operate in parallel with the first comparator and the second comparator;

wherein the at least one re-configurable logic device is further configured to stream the data
representative of the stock prices and times within the matched data through the data shift register;

wherein the first comparator is configured to compare the current stock price in the data shift register with the stored most recent minimum stock price to determine which is lower; and

wherein the at least one re-configurable logic device is further configured to update the stored most recent minimum stock price in the first data register with the current stock price in response to a determination by the first comparator that the current stock price is lower;

wherein the second comparator is configured to compare the current stock price in the data shift register with the stored most recent maximum stock price to determine which is higher;

wherein the at least one re-configurable logic device is further configured to update the stored most recent maximum stock price in the second data register with the current stock price in response to a determination by the second comparator that the current stock price is higher;

wherein the third comparator is configured to compare the current time in the data shift register with the stored most recent time to determine which is later; and

wherein the at least one re-configurable logic device is further configured to update the stored most recent latest stock price in the third data register with the current stock price in the data shift register in response to a determination by the third comparator that the current time is later."

Claim 1 according to auxiliary request 7 reads as follows:
"A system for performing data reduction, the system comprising:

at least one re-configurable logic device (21) that is configured to (i) store a data key, (ii) receive a stream of financial information, the financial information comprising a plurality of stock symbols, a plurality of stock prices associated with the stock symbols, and a plurality of times associated with the stock prices, (iii) match the stream of financial information against the data key to find matched data within the stream of financial information with respect to a stock symbol, the matched data comprising a plurality of stock prices and times for the stock symbol, and (iv) summarize the matched data in aggregate form according to price, wherein the at least one re-configurable logic device comprises:

- a data shift register (102);
- a first data register (104) configured to store a most recent minimum stock price;
- a second data register (106) configured to store a most recent maximum stock price;
- a third data register (108) configured to store a most recent latest stock price;
- a fourth data register (116) configured to store a most recent time;
- a first comparator (110);
- a second comparator (112); and
- a third comparator (114);

wherein the at least one re-configurable logic device is further configured to stream the stock prices and times within the matched data through the data shift register;

wherein the first comparator is configured to compare the current stock price in the data shift register with the stored most recent minimum stock price to determine which is lower; and
wherein the at least one re-configurable logic device is further configured to update the stored most recent minimum stock price in the first data register with the current stock price in response to a determination by the first comparator that the current stock price is lower;

wherein the second comparator is configured to compare the current stock price in the data shift register with the stored most recent maximum stock price to determine which is higher:

wherein the at least one re-configurable logic device is further configured to update the stored most recent maximum stock price in the second data register with the current stock price in response to a determination by the second comparator that the current stock price is higher;

wherein the third comparator is configured to compare the current time in the data shift register with the stored most recent time to determine which is later; and

wherein the at least one re-configurable logic device is further configured to update the stored most recent latest stock price in the third data register with the current stock price in the data shift register in response to a determination by the third comparator that the current time is later."

Claim 1 according to auxiliary request 8 reads as follows:

"A system for performing data reduction, the system comprising:

at least one re-configurable logic device (21) that is configured to (i) store a data key, (ii) receive a stream of target data, the target data comprising a plurality of data fields, (iii) match the stream of
target data against the data key to find a plurality of matched data occurrences within the stream of target data, wherein the matched data occurrences comprise the target data deemed a match against the data key as well as other target data within a bounding field, and (iv) summarize the matched data occurrences in aggregate form such that the matching operation and the aggregate summarization operation are performed on different data fields of the target data."

Claim 1 according to auxiliary request 9 differs from claim 1 of auxiliary request 8 in that the expression "data fields" in features (ii), (iii) and (iv) has been replaced with "data portions" or "portion", to read as follows:

"(ii) receive a stream of target data, the target data comprising a plurality of portions, (iii) .... wherein the matched data occurrences comprise the target data deemed a match against the data key as well as other target data portions within a bounding field, and (iv) ... such that the matching operation and the aggregate summarization operation are performed on different portions of the target data."

Claim 1 according to auxiliary request 10 reads as follows:

"A method for performing data reduction searching, the method comprising:

streaming financial information through reconfigurable logic that is configured to perform a matching operation on data according to a data key;

matching, via the reconfigurable logic configured to perform the matching operation, the streaming financial information against the data key to find matched data
within the streaming financial information, the matched
data comprising a plurality of prices and times for a
stock;

storing the matched data in a memory;

streaming the matched data from the memory through
reconfigurable logic that is configured to perform an
aggregate summarization operation via a plurality of
parallel paths; and

summarizing, via the reconfigurable logic
configured to perform the aggregate summarization
operation, the streaming matched data according to the
prices for the stock by computing in the parallel paths
a maximum, minimum, and latest price for the stock as
the matched data streams through the reconfigurable
logic configured to perform the aggregate summarization
operation."

Claim 1 according to auxiliary request 11 reads as
follows:

"A method for performing data reduction searching,
the method comprising:

streaming financial information through
reconfigurable logic that is configured to perform a
matching operation on data according to a data key;

matching, via the reconfigurable logic configured to
perform the matching operation, the streaming financial
information against the data key to find a plurality of
matched data occurrences within the streaming financial
information, wherein the matched data occurrences
comprise a plurality of prices and times for a stock
within a bounding field of the streaming financial
information;

storing the matched data occurrences in a memory;

streaming the stock prices and times within the
matched data occurrences from the memory through
reconfigurable logic that is configured to perform an aggregate summarization operation via a plurality of parallel paths; and

summarizing, via the reconfigurable logic configured to perform the aggregate summarization operation, the matched data occurrences according to the prices for the stock by computing in the parallel paths a maximum, minimum, and latest price for the stock as the stock prices and times stream through the reconfigurable logic configured to perform the aggregate summarization operation."

XI. The appellant's arguments relevant to the present decision may be summarised as follows:

The content of a patent application encompassed all the subject-matter that the skilled person, using common general knowledge, would directly and unambiguously derive from the original application documents. Where features were disclosed in different embodiments within the application, as in the present case, the relevant question was whether the skilled person would seriously contemplate combining the different features.

The present invention was capable of performing data reduction searching. According to page 26, lines 29 to 34 of the application, reduction searching involved both matching data and summarising the matched data in some aggregate form. This was an explicitly clear and unambiguous disclosure of a data reduction embodiment which included both matching and aggregate summarisation. Indeed, the very general nature of the statement made it clear that this embodiment was not limited to one of the examples of matching previously described in the application, but rather could be implemented using any of the disclosed examples.
Claim 1 of the main request combined the disclosure in the application relating to the use of reconfigurable logic to perform data matching with the disclosure relating to the use of reconfigurable logic to perform aggregate summarisation.

Figure 27 disclosed a specific embodiment for the use of reconfigurable logic to perform aggregate summarisation of financial information. Many of the application's preceding figures disclosed embodiments for using reconfigurable logic to perform matching operations. Given that the patent application already set out extensive descriptions of how matching data against a key could be performed in reconfigurable logic, the description at pages 26 and 27 for the data reduction searching embodiment focused on the aggregate summarisation operation and did not explicitly referred to matching operations again.

Although Figure 27 disclosed a specific application of aggregate summarisation of financial information, the patent application made it clear that the scope of the disclosure for the data reduction searching embodiment was not to be limited solely to the processing of financial information. Furthermore, the application clearly implied that all embodiments of the invention could be deployed on at least one logic device. The person skilled in the art would therefore understand these disclosures to mean that if a particular implementation required more logic resources than were available on a given reconfigurable logic chip, then multiple reconfigurable logic chips could be used together.
It was furthermore well understood within the financial industry that stock market information was distributed as streaming feeds of stock prices for various stocks, and that these feeds were comprised of various fields such as stock symbol, stock price, and a time associated with each stock price. This basic elemental understanding was so well-known in the art that it needed not be elaborated upon in the patent application. Figure 27 expressly showed that the aggregate summarisation logic for the data reduction searching embodiment operated on the price and time fields of streaming financial information of a stock. Hence, financial information was disclosed as having multiple fields.

Consequently, for the skilled person the present application taught that key-based matching was operated on streaming financial information comprised of multiple fields in order to find the price data of a stock, where the stock price data included at least a stock price field and an associated time field, and furthermore that the stock prices and time were processed by the aggregate summarisation logic to compute the desired aggregated price summarisation, namely its minimum, maximum and latest prices. Accordingly, a skilled person would understand that the matching operation and the aggregate summarisation operation operated in different fields of the financial information.

Claim 1 according to the main request and according to the auxiliary requests 1 to 9 did not specify whether the streamed target data was a live data stream or read from a mass storage. Although the description explicitly referred to target data streamed from a mass storage, it was implicit to the skilled reader that the present invention was not limited to the explicit embodiments
and, in particular, could be applied to live data streams.

As to the question of inventive step, it was worth reviewing the context in which the present invention had been conceived back in 2002. Whilst the invention was originally aimed primarily at the use of FPGAs for text mining purposes, as discussed in the context of the "matching alone" embodiments, the inventors also realised that such methods could be applied alongside data reduction searching in respect of financial market data. This embodiment satisfied a substantial need in the financial technology sector for a lower latency "ticker plant" system, designed to handle the collection and throughput of massive data streams, as generated by financial markets, to allow the display of "real time" prices and, more particularly, to feed computerised trading systems. The data reduction searching functionality according to the present invention could provide trading applications with updated information because of the speed with which the relevant information could be extracted from the financial data stream. This could translate into the effective advantage of placing such trading applications "ahead of the market" in relation to other applications which relied on the output from conventional (slower) ticker plant systems.

The use of FPGAs in the processing of streamed financial data allowed the appellant's ticker plant appliances to operate over ten times faster than commodity servers running software.

None of the cited prior art taught the combination of steps recited in claim 1 of any of the requests. In particular, document D9 merely described a generalised
capability for using FPGAs to perform "stream oriented, signal processing type applications". No teachings were found that related to using FPGA logic to perform matching operations followed by aggregate summarisation operations, much less the specific aggregate summarisation operations recited in claim 1 according to the auxiliary requests 10 and 11. Instead, the focus of document D9 was on how to compute processing times for various operations so that a decision could be made as to whether such operations should be deployed in reconfigurable logic or on a host processor. Document D9 was completely lacking in any specific teachings that would guide the skilled person to the present invention.

Reasons for the Decision

1. The appeal is admissible.

2. The present application relates, inter alia, to the use of a reconfigurable logic device, such as a field programmable gate array (FPGA), in the context of data matching and data aggregation.

2.1 As explained at page 5, lines 3 to 11 of the published application, an advantage offered by FPGAs is the speed of reconfiguration. In fact, FPGAs "may be quickly programmed in the field to optimize the search methodology using a template, the template having been prepared in advance and merely communicated to the FPGA's over a connecting bus. Should it then be desired to search using a different methodology, the FPGA's may then be quickly and conveniently re-programmed with another prepared template in a minimal number of clock cycles and the second search started immediately".
Main request

3. Claim 1 according to the main request relates to a "system for performing data reduction" and comprises the following features:

- at least one re-configurable logic device that is configured to

  (i) store a data key,

  (ii) receive a stream of target data,

  - the target data comprising a plurality of data fields,

  (iii) match the stream of target data against the data key to find matched data within the stream of target data with respect to a first field of the target data, and

  (iv) summarize the matched data in aggregate form according to a second field of the target data.

Claim 1 of the main request differs from the corresponding claim of the main request considered by the Examining Division only by the deletion of the term "continuously" in feature (iii) and of the expression "to thereby achieve a data reduction for the matched data" in feature (iv), as shown in the following:

(iii) continuously match the stream of target data against the data key to find matched data within the stream of target data with respect to a first field of the target data, and
(iv) summarize the matched data in aggregate form according to a second field of the target data to thereby achieve a data reduction for the matched data.

4. In paragraph 12 of the contested decision, the Examining Division pointed out that the features "to find matched data [...] with respect to a first field" and "summarize the matched data [...] according to a second field" had no basis in the application as filed (Article 123(2) EPC).

4.1.1 In particular, the Examining Division noted in paragraph 13.1 of the contested decision that the sole example of the claimed "data reduction" given in the description (see published application page 26, line 32 to page 27, line 16) merely related to calculating/searching the minimum, maximum and latest price of a stock using a couple of shift registers and processors. It did not disclose matching a data field against a data key or using such matched data in any way. In fact, said example of "aggregate data reduction" operated on "raw" data read from a mass storage medium, not on matched data fields.

4.1.2 Furthermore, the Examining Division considered that the different embodiments of the invention disclosed in the application related either to "matching" or to "data reduction" and did not suggest a system combining both operations.

4.2 The appellant essentially argued that the application conveyed the following unambiguous information:
- the data reduction embodiment shown at pages 26, lines 32 to page 27, line 16 of the description comprised a matching operation and a downstream aggregate summarisation operation that was undoubtedly performed on the matched data;

- the financial information example of the data reduction embodiment operated to find the minimum, maximum and latest price for a stock.

4.2.1 In the appellant's view, the only reasonable conclusion that could be derived from the interplay of the above aspects of the invention was that the matching operation was directed to finding a stock within the financial information, while the downstream aggregate summarisation operation computed the min/max/latest price of the matching stock. This necessarily implied that the matching operation and the aggregate summarisation operation were performed on different data fields.

5. In view of the reasons given by the Examining Division for refusing the then main request, the first question to be considered in the present appeal is whether the subject-matter according to claim 1 of the main request can be directly and unambiguously derived from the application as originally filed.

5.1 The application deals primarily with various forms of data matching (i.e. exact, approximate, analogue and digital).

For instance, it is specified at page 5, line 36 to page 6, line 13 of the published application that, "[g]enerally, the invention may be described as a technique for data retrieval through approximate
matching of a data key with a continuous reading of data as stored on a mass storage medium, using FPGA's to contain the template for the search and do the comparison, all in hardware and at essentially line speed. By utilizing FPGA's, the many advantages and features commonly known are made available. These include the ability to arrange the FPGA's in a "pipeline" orientation, in a "parallel" orientation, or even in an array incorporating a complex web overlay of interconnecting data paths allowing for complex searching algorithms. In its broadest, and perhaps most powerful, embodiment, the data key may be an analog signal and it is matched with an analog signal generated by a typical read/write device as it slews across the mass storage medium. In other words, the steps taught to be required in the prior art of not only reading the analog representation of digital data stored on the mass storage medium but also the conversion of that signal to its digital format prior to being compared are eliminated" (underlining added).

5.1.1 A second aspect of the invention, "data reduction", apart from being mentioned in a statement at page 4, lines 8 to 12 ("... given the vast amount of information available to be searched, data reduction operations (i.e., the ability to summarize data in some aggregate form) has [sic] become critical. Oftentimes, the ability to quickly perform data reduction functions can provide a company with a significant competitive advantage"), is more extensively treated in relation to the embodiment shown in Figure 27.

5.1.2 In particular, the description (page 26, line 29 to page 27, line 16) specifies in connection with Figure 27 the following:
"The present invention is also capable of performing data reduction searching. Such searching involves matching as previously described herein, but includes summarizing the matched data in some aggregate form. For example, in the financial industry, one might want to search financial information to identify a minimum, maximum, and latest price of a stock. A re-configurable logic device for computing such aggregate data reductions is illustrated as 100 in Figure 27. Here, a data shift register 102 reads target data from a mass storage medium containing stock price information. In the example shown, three data reduction searches are shown, namely calculating the minimum price, the maximum price, and the latest price. As target data is fed into the data shift register 102, decision logic computes the desired data reduction operation. In particular, the stock price is fed to a minimum price comparator 110 and maximum price comparator 112 and stored therein. Each time a stock price is fed to comparator 110, it compares the last stored stock price to the stock price currently being fed to it and whichever is lower is stored in data register 104. Likewise, each time a stock price is fed to comparator 112, it compares the last stored stock price to the stock price currently being fed to it and whichever is higher is stored in data register 106. In order to compute the latest price, the stock price is fed into a data register 108 and the current time is fed into a comparator 114. Each time a time value is fed into comparator 114, it compares the last stored time with the current time and which ever is greater is stored in data register 116. Then, at the end of the desired time interval for which a calculation is being made, the latest price is determined" (underlining added).
5.1.3 In other words, the data reduction referred to in the description relates to "target data" read from a "mass storage medium containing stock price information" and is aimed at determining the minimum price, the maximum price and the latest price. It is further noted at page 27, lines 17 to 23 that the present invention can perform data reduction searching for a variety of different applications of varying complexity requiring such functionality.

5.1.4 According to the disclosure at page 11, lines 3 to 13, a re-configurable logic device "may itself include a plurality of functional logic elements including a data shift register and possibly a microprocessor, or they could be on separate chips, or the individual logic elements could be configured in a pipeline or parallel orientation as shown in some of the other figures herein. In any event, re-configurable logic refers to any logic technology whose form and function can be significantly altered (i.e., reconfigured) in the field post-manufacture. Examples of re-configurable logic devices include without limitation programmable logic devices (PLDs)" (underlining added).

5.2 In general, the Board agrees with the appellant that the application as originally filed at least implicitly discloses that a re-configurable logic device may perform more than one logical function and that a system according to the invention can be configured to perform both data matching and data reduction on the previously matched data.

5.3 All independent claims 1, 10, 14, 28, 32 and 33 of the original application specify that the data to be matched or otherwise processed is stored in a mass storage device, in particular a magnetic storage device. In the
appellant's opinion, this limitation of the claimed subject-matter was unnecessary, because the skilled reader understood from the disclosure that the present invention could be applied to a live data stream.

5.3.1 According to page 13, lines 5 to 11, of the published application, "the present invention may be used to perform a variety of different types of matching or data reduction operations on the target data. [...] For all operations, however, it will be assumed that the target data is written onto the magnetic mass storage medium 26 with sufficient formatting information attached so that the logical structure of the target data can be extracted" (underlining added).

5.3.2 In particular, the present invention can be "implemented in a stand-alone computer or computer system" and comprises "at least one re-configurable logic device 21 coupled to at least one magnetic mass storage medium 26, with that re-configurable logic device being an FPGA" (published application, page 10, line 37 to page 11, line 3 and Figure 1 - underlining added).

5.3.3 Thus, the mass storage medium provides storage for the large amount of data, referred to as "target data", which is fed to the re-programmable logic device (see description, page 12, lines 3 to 5). In fact, it is reiterated throughout the application that the target data, on which the data matching or the data reduction operation is performed, is streamed from a mass storage device (cf. for instance page 15, lines 7 to 8 and lines 22 to 24, page 19, lines 33 to 36, page 20, lines 27 to 31, page 22, lines 30 to 31, page 23, lines 20 to 23).

5.3.4 As pointed out by the appellant, claim 1 of the main request does not exclude the possibility that between
the matching operation and the data reduction operation matched data is stored. However, even if it may make technical sense to buffer the matched data before data reduction, the skilled person need not implement the invention as claimed using a mass storage medium as a buffer. In other words, the mass storage medium referred to in the application cannot be regarded as an implicit feature of the claimed subject-matter.

5.3.5 In the Board's view, claim 1 clearly encompasses embodiments of a system which may perform both data matching and data reduction "on the fly", i.e. without data buffering between the two operations.

These embodiments are neither explicitly nor implicitly disclosed in the original application which, as shown above, consistently specifies that the "target data" is data streamed from a mass storage and, in particular, that "a shift register 102 reads target data from a mass storage medium containing stock price information" (page 26, lines 36 to 37).

5.3.6 Hence, as far as the claim covers the above embodiments, it generalizes and extends the teaching contained in the application as originally filed. It does therefore not comply with Article 123(2) EPC.

5.4 As to the Examining Division's objection that claim 1 then on file defined data matching and data summarisation with respect to undisclosed first and second data "fields" (see features (iii) and (iv)), the Board notes that the application as filed does not specify any format for the target data, although, in the case of financial information relating to stock prices, it may be assumed that target data would comprise different data "types", such as company identifiers and
corresponding stock prices at given times, and that data
matching would be performed on the basis of a company
identifier, while corresponding stock prices would be
the object of summarisation. However, this does not
necessarily imply that the target data comprises "a
plurality of data fields" and that the data processing
is performed on the basis of a first field and a second
field, as recited in claim 1 of the present main
request.

5.4.1 Indeed, according to the description (page 27, lines 17
to 23), data reduction is not limited to financial
information, but it can be performed for a variety of
different applications of varying complexity requiring
such functionality. Furthermore, the application
provides several examples of data matching with
reference to different kinds of target data, such as
text data, image data etc. (cf. published application,
page 4, lines 13 to 20, page 5, lines 21 to 28, page 7,
lines 1 to 26).

5.4.2 If data matching consists essentially in detecting
certain binary patterns in a data stream, data reduction
involves also the extraction of data somehow linked with
the matched patterns.

In the case of financial information, data matching is
related to the recognition of a company or stock
identifier and data reduction to the extraction of other
data associated with the matched pattern.

On the other hand, the general statement at page 27,
lines 17 to 23, could be interpreted as hinting at the
possibility of performing data matching and reduction
on, for instance, image data so as to identify images
with a certain pattern (e.g. a face) and discarding from
the identified image all the pixels which do not belong to the matched pattern. In this case, the data matching and reduction would be performed on target data which could not be divided into predefined "fields" or "portions".

5.5 In the Board's opinion, defining the target data in claim 1 as comprising a plurality of data fields and specifying data matching and summarisation with respect to first and second fields constitute an undisclosed intermediate generalisation of the invention lying between the specific embodiment shown in Figure 27 and the general hint at other possible applications given, for instance, at page 27, lines 17 to 23.

5.6 Hence, the Board comes to the conclusion that claim 1 according to the main request does not comply with Article 123(2) EPC.

Auxiliary requests 1 to 9

6. Claims 1 according to the auxiliary requests 1 to 9 encompass embodiments of a system which processes a stream of data "on the fly" to match the data to a stored data key and summarise the matched data.

6.1 However, as pointed out above, the application as filed specifies, in particular, that the "target data" to be "summarized" in some aggregate form according to the embodiment described at page 26, line 29 to page 27, line 16, is read "from a mass storage medium".

6.2 Thus, for the reasons given above, auxiliary requests 1 to 9 relate to subject-matter extending beyond the content of the application as originally filed (Article 123(2) EPC).
Admission of auxiliary requests 10 and 11

7. In reply to the Board's preliminary opinion, the appellant filed auxiliary requests 10 and 11 with letter dated 8 February 2016. Although these requests were submitted late in the appeal proceedings, the Board considered that they constituted a promising attempt on the part of the appellant to overcome at least some of the Board's concerns.

7.1 Hence, the Board, exercising it discretion under Article 13(1) RPBA, decided to admit these late-filed requests into the proceedings.

Auxiliary request 10

8. Claim 1 according to auxiliary request 10 relates to a "method for performing data reduction searching", which comprises the following features itemised by the Board:

(a) streaming financial information through reconfigurable logic that is configured to perform a matching operation on data according to a data key;

(b) matching, via the reconfigurable logic configured to perform the matching operation, the streaming financial information against the data key to find matched data within the streaming financial information,
   (i) the matched data comprising a plurality of prices and times for a stock;

(c) storing the matched data in a memory;
(d) streaming the matched data from the memory through reconfigurable logic that is configured to perform an aggregate summarization operation via a plurality of parallel paths; and

(e) summarizing, via the reconfigurable logic configured to perform the aggregate summarization operation, the streaming matched data according to the prices for the stock by computing in the parallel paths a maximum, minimum, and latest price for the stock as the matched data streams through the reconfigurable logic configured to perform the aggregate summarization operation.

9. Steps (d) and (e) are directly supported by the embodiment shown in Figure 27 and described at page 26, line 29 to page 27, line 16. The description also specifies that "reduction searching" involves data matching and summarising the matched data, and that the data to be summarised are read from a mass storage medium. This implies that a method for performing the data reduction searching disclosed in the application also comprises steps (a), and (b) recited in claim 1.

As to step (c), the Board notes that the term "memory" does not define exclusively a "mass storage device", but may also apply to a data buffer. It is therefore broader than the terms used throughout the application, i.e. "mass storage medium" and "magnetic storage medium".

9.1 It may therefore be questionable whether claim 1 according to auxiliary request 10 complies with Article 123(2) EPC. However, in view of the fact that a possible objection under Article 123(2) EPC could be easily overcome and thus would not prejudice the grant of a
patent, the Board has decided not to pursue this issue further, but to direct its attention to the question of inventive step of the claimed subject-matter.

10. According to the appellant, none of the available prior art documents disclosed a method for performing data reduction searching which combined data matching with data summarising performed on the matched data. There was also no suggestion in the prior art that it might be advantageous to provide a method based on the combination of these two operations. In particular, there was no disclosure hinting at the possibility of performing these operations on financial information for computing a maximum, minimum and latest price for a stock.

10.1 Furthermore, in the appellant's opinion, it was particularly advantageous to perform these operations by means of reconfigurable logic which, in view of its flexibility and processing speed, provided up-to-date financial information and thus best satisfied the demands of today's financial world.

11. The claimed method is directed to the processing of streamed financial information relating to stock prices. The data stream is processed to identify a particular stock and the corresponding stock price at a given time in order to determine the maximum price, the minimum price and the latest price.

11.1 It is undisputed that financial information in the form of a report of the price for certain securities, updated continuously throughout the trading session by the various stock exchanges (i.e. "stock ticker"), was known and available before the filing date of the present application.
11.2 In the Board's opinion, it would be the task of a financial analyst to decide what kind of information should be extracted from a stock ticker and how it should be presented. In any case, even the lay investor should be interested in receiving regular updates on the maximum, minimum and latest prices reached by selected stocks during a particular trading session.

11.3 Starting from this general background, the claimed method addresses the problem of extracting information of general and obvious interest from stock price reports delivered as a data stream.

11.4 The skilled person confronted with the above problem will realise that it can be solved by performing a few basic logic operations. Firstly, in order to extract the price of a stock, the stock must be matched with a stock identifier. Secondly, the minimum and maximum prices are found by comparing the latest price with the stored maximum or minimum, respectively.

11.5 In the Board's opinion, the mere idea of combining simple logic operations, which are anyway necessary for extracting required information, cannot involve an inventive step.

11.6 A trivial way of performing the logic operations required to extract the minimum, maximum and latest stock prices from financial information would be by means of a software program running on a general purpose computer.

11.7 On the other hand, document D9, which is concerned with exploiting re-configurable FPGAs for query processing in computation intensive data mining application, points
out (see "Introduction") that General Purpose Processors (GPPs) do not provide enough computation power for processing and manipulating highly complex data. Specialized hardware (ASICs) provides considerable gains in performance. A further solution is provided by FPGAs based on static RAMs (SRAM-based FPGA) which "have bridged two extreme worlds (ASICs) and (GPPs) of computer architecture and provide not only the flexibility of binding the functionality of hardware dynamically, but also achieve a significant performance gain in certain applications" (sentence bridging columns 1 and 2).

11.7.1 Furthermore, according to section 2.1.2 (first paragraph), "[a]vailability of SRAM-based FPGA coprocessors creates a new design space and optimization problem for high performance parallel query processing."

In fact, "[t]he applications that have been reported to perform well on FPGAs are stream oriented, signal processing type applications. ... The data moves through the logic and the results are returned to users as a stream without having to wait for the completion of the evaluation of the entire task".

11.8 In the light of the known advantages that FPGAs provide when performing logic operations on a data stream, the Board considers that it would have been obvious to a skilled person, wishing to implement a system for extracting stock prices from a data stream of financial information and determining the minimum, maximum and latest prices of a certain stock, to consider the use of reconfigurable logic.

As the minimum, maximum and latest prices for a stock are determined on the basis of three independent
operations performed on the same data, it would have been obvious to exploit a further known advantage provided by FPGAs (see section 2.1.1 of D9) and perform the corresponding operations via parallel paths.

11.9 As to the step of storing the matched data in a memory prior to the summarising step (see feature (c) of claim 1), the Board considers that storing data in a buffer memory between two operations is a feature generally known in the art in order to avoid synchronisation problems between different data operations and data loss. On the other hand, if the term "memory" is interpreted as a mass storage medium, feature (c) would render the summarising operation time independent of the data matching and allow further data analysis, as the matched data would be permanently stored.

In the Board's opinion, a skilled person, in the light of the data operations to be performed and of general technical considerations, would have contemplated the possibility of storing the matched data in a data buffer or in a mass storage medium before the data summarising step (e). In doing so, the skilled person would have arrived at a system falling within the terms of claim 1 of the auxiliary request 10 (Article 56 EPC).

**Auxiliary request 11**

12. Claim 1 according to auxiliary request 11 differs from claim 1 of auxiliary request 10 essentially in the way it specifies the streamed financial information. In particular, claim 1 defines the matched data as "matched data occurrences" which "comprise a plurality of prices and times for a stock within a bounding field of the streaming financial information".
12.1 The above definitions aim at clarifying that the "matched data" comprise not only data which matches the data key (e.g. the stock ID), but also related data, such as stock prices and times, on which the aggregate summarisation operation is performed.

12.2 In the Board's opinion, the differences between claims 1 of the auxiliary requests 10 and 11 do not contain any technical features which might contribute to the inventive step of the claimed subject-matter. Hence, for the same reasons given above, the subject-matter of claim 1 does not satisfy the requirement of Article 56 EPC.

13. As none of the appellant's requests provides a basis for granting a patent, the appeal has to be dismissed.
Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

I. Aperribay R. Moufang

Decision electronically authenticated