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**Datasheet for the decision
of 18 June 2014**

Case Number: T 2251/09 - 3.5.07

Application Number: 05010671.5

Publication Number: 1605453

IPC: G11B19/00

Language of the proceedings: EN

Title of invention:

Adaptive storage system

Applicant:

Marvell World Trade Ltd.

Headword:

Adaptive storage/MARVELL

Relevant legal provisions:

EPC Art. 84, 123(2), 56

Keyword:

Claims - clarity after amendment (yes)
Amendments - added subject-matter (no)
Inventive step - (yes)

Decisions cited:

Catchword:



**Beschwerdekammern
Boards of Appeal
Chambres de recours**

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Case Number: T 2251/09 - 3.5.07

D E C I S I O N
of Technical Board of Appeal 3.5.07
of 18 June 2014

Appellant: Marvell World Trade Ltd.
(Applicant) Parker House, Wildey Business Park, Wildey Road
St. Michael (BB)

Representative: Grünecker, Kinkeldey,
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 8 July 2009
refusing European patent application No.
05010671.5 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 applicant (appellant) appealed against the decision of the Examining Division to refuse European patent application no. 05010671.5.
- II. The contested decision was based on the auxiliary requests 1 to 5 submitted with letter dated 27 April 2009 and an amended auxiliary request 3 submitted at the oral proceedings since, as noted by the Examining Division, the applicant had withdrawn the main request.

According to the Examining Division, the auxiliary request 1 did not comply with the provisions of Articles 84 and 56 EPC, the auxiliary request 2 did not comply with Article 56 EPC and claim 1 of the auxiliary request 3 was not clear within the meaning of Article 84 EPC. The amended auxiliary request 3 was refused because it did not comply with Article 56 EPC. Claim 1 of the auxiliary request 4 did not comply with Article 56 EPC. The auxiliary request 5 did not comply with Articles 84 and 56 EPC.

In the contested decision, the Examining Division relied on the following prior art:

D1: US-B1-6 628 469

D2: EP-A-0 666 539.

- III. In the statement of grounds of appeal, the appellant requested to set aside the decision of the Examining Division and to grant a patent on the basis of claims 1 to 29, submitted on 27 April 2009 as "AUXILIARY REQUEST No. 1" (main request). As a first auxiliary request, the appellant requested to grant a patent on the basis

of claims 1 to 29 submitted with letter of 27 April 2009 as "AUXILIARY REQUEST No. 2". Furthermore, the appellant maintained the auxiliary requests refused under sections 6 to 8 of the contested decision.

IV. In a communication dated 20 December 2013, the Board raised objections under Article 84 EPC with respect to claim 1 of the appellant's main request and expressed the preliminary opinion that neither claim 1 of the main request nor claim 1 of the auxiliary request appeared to fulfill the requirements of Article 56 EPC. As to the further auxiliary requests, the Board saw no reason to allow any of them as the appellant had not submitted any argument in their support. Furthermore, the Board drew the appellant's attention to the following prior art documents:

D3: US-A-2003/0196031

D4: US-A-5 142 684.

V. In reply to the Board's communication, the appellant filed new auxiliary requests 1 to 6 and declared that the auxiliary requests 1 to 5 referred to in the statement of grounds of appeal were not maintained in view of the new prior art cited and objections raised by the Board.

VI. Oral proceedings before the Board were held as scheduled on 18 June 2014. During these proceedings, the appellant replaced all its requests by a single new request filed at 17:00 hours.

VII. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis

of the claims filed during the oral proceedings at 17:00 hours.

VIII. Claim 1 according to the appellant's sole request reads as follows:

"A data storage system for a computer with high power and low power modes, comprising:

low power, LP, nonvolatile memory comprising a low power disk drive, LPDD (424, 424');

high power, HP, nonvolatile memory comprising a high power disk drive, HPDD (426, 426'); and

an adaptive storage control module (414) that communicates with said LP and HP nonvolatile memory;

wherein when write data is to be written to one of said LP and HP nonvolatile memory, said adaptive storage control module generates an adaptive storage decision that selects one of said LP and HP nonvolatile memory, the generating comprising determining whether data is likely to be used in the low-power mode,

wherein said adaptive storage decision is based at least on power modes of the computer associated with prior uses of said write data, the power modes comprising said high power mode and said low power mode,

wherein said high power mode refers to an active operation of a host processor and/or a primary graphics processor, and

wherein said low power mode refers to at least one of: a low-power hibernating mode, an off mode, and a non-responsive mode of said host processor and/or primary graphics processor when a secondary processor and/or a secondary graphics processor are operable."

Claims 2 to 9 are directly or indirectly dependent on claim 1.

- IX. In support of its sole request, the appellant essentially argued that none of the available prior art documents disclosed or suggested a data storage system having the combination of features recited in claim 1. In particular, none of the prior art documents D1 to D4 taught using an adaptive storage module which generated a respective adaptive decision selecting either the low power or the high power nonvolatile memory based on the power modes associated with prior uses of the write data to be written into the nonvolative memories.

Reasons for the Decision

1. The appeal is admissible.
2. The present application relates to a data storage system which comprises low power and high power disk drives and is to be connected to a computer with low power and high power modes.

The gist of the invention consists essentially in making the decision to store data in the low power disk drive or in the high power disk drive dependent on whether the data to be stored has been previously used in the computer's low power or high power mode.

In other words, if the write data were previously associated with the low power mode of the computer, they are considered likely to be used again in the computer's low power mode and thus are stored in the low power disk drive. Similarly, if they were previously associated with the computer's high power mode, they are stored in the high power disk drive.

- 2.1 In particular, according to the embodiment of the invention described in paragraphs [0094] to [0096] of the published application, a counter is incremented when a particular program or file is used during the low-power or the high-power mode in order to determine whether a data block (associated with said program or file) is likely to be used in the low power (or in the high power) mode.

3. In the exercise of its discretion under Article 13(1) RPBA the Board admits the appellant's request filed at 17:00 hours during the oral proceedings since it overcomes objections raised by the Board in its communication dated 20 December 2013 and in the oral proceedings. Claim 1 of this request is directed to a *"data storage system for a computer with high power and low power modes"*. For convenience, its features are itemised and highlighted as follows:
 - (a) low power, LP, nonvolatile memory

 - (b) comprising a low power disk drive, LPDD (424, 424');

 - (c) high power, HP, nonvolatile memory

 - (d) comprising a high power disk drive, HPDD (426, 426'); and

- (e) an adaptive storage control module (414) that communicates with said LP and HP nonvolatile memory;
- (f) wherein when write data is to be written to one of said LP and HP nonvolatile memory, said adaptive storage control module generates an adaptive storage decision that selects one of said LP and HP nonvolatile memory,
- (g) the generating comprising determining whether data is likely to be used in the low-power mode,
- (h) wherein said adaptive storage decision is based at least on power modes of the computer associated with prior uses of said write data, the power modes comprising said high power mode and said low power mode,
- (i) wherein said high power mode refers to an active operation of a host processor and/or a primary graphics processor, and
- (j) wherein said low power mode refers to at least one of:
 - a low-power hibernating mode,
 - an off mode, and
 - a non-responsive mode of said host processor and/or primary graphics processorwhen a secondary processor and/or a secondary graphics processor are operable.

Articles 84 and 123(2) EPC

4. Features (a), (c), (e) and (f) of claim 1 correspond to the features recited in the original claim 21 which relates to a data storage system for a computer including low power and high power modes.

4.1 As to features (b) and (d), the description leaves no doubt that the low power nonvolatile memory and the high power nonvolatile memory comprise a low power disk drive and a high power disk drive, respectively (see for instance paragraph [0017] of the published application).

4.2 In paragraph [0092], column 15, lines 1 to 15, the application as published specifies that the *"adaptive control module 414 monitors usage of files and/or programs to determine whether they are likely to be used in the low power mode or the high power mode"*. As shown in Figure 9 of the application and explained in paragraph [0094], this information is required to generate a decision that selects either the low power or the high power nonvolatile memory for data storage (cf. feature (g)).

4.3 Feature (h) finds support in claim 22 of the original application.

Furthermore, paragraph [0095] and Figure 10 illustrate one way of determining whether a data block is likely to be used in the low power mode. In particular, it is specified in column 15, lines 39 to 50, that when *"a particular program or file is used during the low-power or high-power modes, the counter field 493 and/or 494 is incremented. When data storage of the program or file is required to nonvolatile memory, the table 492*

is accessed. A threshold percentage and/or count value may be used for evaluation. For example, if a file or program is used greater than 80 percent of the time in the low-power mode, the file may be stored in the low-power nonvolatile memory such as flash memory and/or the microdrive. If the threshold is not met, the file or program is stored in the high-power nonvolatile memory."

- 4.4 A definition of "low power mode" and "high power mode" corresponding to features (i) and (j) is given in paragraph [0062] of the application as published.

- 5. Claim 1 according to the auxiliary request 5 refused by the Examining Division related to subject-matter similar to claim 1 of the appellant's request, although it did not specify that the step of generating an adaptive storage decision (see feature (f)) included determining whether data was likely to be used in the low-power mode (feature(g)).
 - 5.1 With respect to auxiliary request 5, the Examining Division objected that it was clear from paragraphs [0010] and [0083] that "*the control module*" was essential since it included the "*adaptive storage module*" responsible for generating an adaptive storage decision. Deleting this feature thus offended against Article 123(2) EPC.

 - 5.2 In the Board's view, claim 1 of the appellant's request now appropriately specifies "*an adaptive storage control module*". This terminology is consistent with the embodiment shown in Figures 8A to 8C and described in paragraphs [0092] to [0096] of the description which provide support for the claimed data storage system.

6. Hence, claim 1 does not include subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC). The dependent claims 2 to 9 are also in compliance with Article 123(2) EPC.

6.1 The Board is furthermore satisfied that the claims of the appellant's request comply with the requirements of Article 84 EPC.

Novelty and inventive step

7. None of the available prior art documents discloses a data storage system comprising all the features recited in claim 1 of the appellant's request. Hence, the subject-matter of this claim is new within the meaning of Article 54 EPC.

8. In its refusal of the auxiliary request 5, the Examining Division considered that data needed in the low power mode would be found in the LPDD and that such data would always be written back to the LPDD. Similarly, data stored on the HPDD would always be written to the HPDD after use.

8.1 The data storage system according to claim 1 of the appellant's request differs from the disk drive system according to the auxiliary request 5 considered by the Examining Division in that the generating of an adaptive storage decision comprises the step of "*determining whether data is likely to be used in the low-power mode*". The determination of this likelihood involves the active monitoring of prior uses of the data to be written, so that data which were first stored on the HPDD may be subsequently stored on the LPDD, depending on the power modes associated with the actual uses of the data. Claim 1 of the auxiliary

request 5, as interpreted by the Examining Division, would however exclude any dynamic changes of the storage location (see paragraph 8.6 of the contested decision).

8.2 Hence, the Board considers that the objection of lack of inventive step raised by the Examining Division against claim 1 of the auxiliary request 5 does not apply to the subject-matter of claim 1 of the appellant's request.

9. Document D1 relates to a data storage system comprising features (a) to (d) recited in claim 1 of the appellant's request.

Document D1 (col. 2, lines 43 to 48) teaches "*that a low power consuming disk drive unit is effectuated by a disk drive unit having multiple HDDs and/or HDD subsystems of differing power consumption requirements and functioning as an integrated unit wherein only the more energy efficient HDD subsystem is selectively powered the majority of the disk drive unit's operating time*" (underlining added).

In order to operate the more efficient HDD subsystem in a disk drive unit without losing capacity and performance, "*the most frequently accessed information for the preferred embodiment of the present invention is read-written to the smaller/more efficient HDD subsystem 50, while the less frequently accessed information is read-written to the larger/less efficient HDD subsystem 55. Accordingly, only the more power efficient HDD subsystem 50 of the preferred embodiment is powered the majority of the time that the disk drive unit 100 is in operation. The less power efficient HDD subsystem 55 is instead selectively*

powered up for operation infrequently since the information accessed on the HDD subsystem 55 is required to be accessed less frequently" (D1, col. 5, lines 39 to 50 - Underlining added).

Document D1 specifies that the operating system of the host *"is required for partitioning the information stored on the disk drive unit such that the frequently accessed data is stored on the smaller/more efficient HDD subsystems, while the less frequently accessed information is stored on the larger/less efficient HDDs in accordance with the invention" (D1, column 8, lines 42 to 47).*

On the other hand, it is also *"contemplated that the controller 24 may contain sufficient logic for the transfer of information from one HDD subsystem to another HDD subsystem within a given disk drive unit. In certain instances, it is desirable to have the ability to transfer data between the multiple HDD subsystems comprising the disk drive unit, e.g., disk caching" (D1, col. 8, lines 9 to 19 - underlining added).*

Furthermore, document D1 teaches that, for partitioning the information between the more efficient and the less efficient disk drive units, *"any number of suitable algorithms could be used, such as placing all program files on the smaller/more efficient HDD subsystem 50 and all data files on the other HDD subsystems 55 and 60" (D1, col. 8, lines 47 to 50).*

However, document D1 does not give any information as to the kind of host system (and its operation) to which the disk drive unit can be connected.

- 9.1 Document D2 relates to a disk drive system comprising a low power storage medium ("cache"), a high power storage element and a control system to transfer "sectors" of data from the "cache" to the high power storage element in response to a read or write request.
- 9.2 D3 relates to a hybrid storage device comprising a RAM unit and a disk drive. As specified in paragraph [0016], this arrangement *"enhances and optimizes the performance of the traditional disk drive by integrating a high speed RAM unit into the interface. It also reduces the frequency of disk drive accesses that results in longer usage life, less power consumption and a more reliable disk drive"* (underlining added).

According to paragraph [0035], when *"the content of the data block in RAM Unit 104 is modified by the computer system, a modified flag 204 is set for that item in the list. Periodically, the controller 101 saves or backs up the changes in the RAM unit 104 to the disk drive 102. The modified flag 204 is reset once the change is saved in the disk drive."*

Furthermore, claim 12 of D3 specifies that the *"controller maintains a cross-reference list of RAM data block address and disk drive data block address with a [sic] access sequential number and a modified flag. The less frequently used data block is removed from said RAM unit if the capacity of said RAM units is less than the capacity of the disk drive and the RAM units have been fully loaded with data blocks"* (underlining added).

Hence, D3 teaches to operate a computer both with a low power storage medium and with a high power storage

medium in order to reduce the computer's power consumption.

It could be argued that the computer will be in a low power mode when only the RAM unit is operated and in a high power mode when both units are operated. However, these are not high power and low power modes as specified by features (i) and (j) of claim 1 of the appellant's request.

9.3 Document D4 deals with the problem of conserving power in microprocessor controlled devices (cf. column 2, lines 9 to 11) and suggests using two processors (cf. column 2, lines 23 to 30). As it is implicit that this teaching can also be applied to a computer, document D4 discloses features (i) and (j) of claim 1 of the appellant's request.

9.4 In summary, documents D1 to D3 relate to disk drive units comprising both low power and high power nonvolatile memories and disclose various schemes for partitioning the stored data, whereby data partitioning can be controlled by the operating system of the host or by an internal storage control module. However, none of these documents addresses the question of how to operate a disk drive unit connected to a computer having high power and low power modes as defined by features (i) and (j) of claim 1. As to document D4, it relates, at least implicitly, to a computer having high power and low power modes, but does not consider the possibility of operating it with a disk drive unit comprising low power and high power memories.

Hence none of the available prior art documents suggests linking the partitioning of data between low power and high power disk drive units to the computer's

power modes associated with the prior uses of the same (or similar) data.

10. In the light of the above, it would not have been obvious to a person skilled in the art to arrive at a data storage system according to claim 1.

Hence, the subject-matter of claim 1 of the appellant's request involves an inventive step within the meaning of Article 56 EPC.

- 10.1 Dependent claims 2 to 9 relate to different embodiments of the data storage system according to claim 1, and therefore also involve an inventive step.

11. In summary, the Board finds that claims 1 to 9 of the appellant's request satisfy the requirements of the EPC. However, as the claims have undergone substantial amendments, the description and the drawings may need to be adapted to the claimed subject-matter before a patent can be granted. In particular, the Board notes that the description contains embodiments which appear not to be covered by the independent claim.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the claims filed during the oral proceedings at 17:00 hours with a description and drawings still to be adapted.

The Registrar:

The Chairman:



I. Aperribay

R. Moufang

Decision electronically authenticated