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Datasheet for the decision of 19 October 2022

Case Number: T 1376/20 - 3.5.05

Application Number: 10151411.5

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Language of the proceedings: EN

Title of invention:
Method for performing storage virtualization in a storage system architecture

Applicant:
Infortrend Technology, Inc.

Headword:
Storage virtualization/Infortrend

Relevant legal provisions:
EPC Art. 56, 84
RPBA 2020 Art. 11, 13(2)

Keyword:
Amendment after summons - exercise of discretion
Claims - clarity after amendment (yes)
Inventive step - (no)
Remittal to the department of first instance - (no)

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Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1376/20 - 3.5.05

D E C I S I O N
of Technical Board of Appeal 3.5.05
of 19 October 2022

Appellant: (Applicant)	Infortrend Technology, Inc. 6F, 7F, 8F 102 Chung-Shan Road Sec.3 Chung-Ho City Taipei Hsien (TW)
Representative:	Becker, Eberhard Becker Kurig & Partner Patentanwälte mbB Bavariastraße 7 80336 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 18 December 2019 refusing European patent application No. 10151411.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	A. Ritzka
Members:	P. Tabery
	E. Mille

Summary of Facts and Submissions

I. The appeal is directed against the examining division's decision to refuse the European patent application.

II. The examining division decided that the main request did not meet the requirements of Article 84 or 56 EPC and that the first to third auxiliary requests did not meet the requirements of Article 123(2), 84 or 56 EPC.

III. The documents referred to by the examining division included:

D2 US 2002/112113 A1

IV. In its statement of grounds of appeal, the appellant requested that a patent be granted on the basis of the claims in accordance with either the main request or one of the first to seventh auxiliary requests, all of which were submitted with the statement of grounds of appeal. The claims of the main request and of the first and second auxiliary requests are identical to those of the corresponding requests underlying the decision under appeal. In the event that none of the requests are found to be allowable, oral proceedings were requested.

V. The board issued a summons to oral proceedings. It also set out its preliminary opinion on the case (Article 15(1) RPBA 2020).

The board concurred with the findings of the examining division that neither the main request nor the first or second auxiliary request met the requirements of Article 84 or 56 EPC. Moreover, the board was inclined not to admit the third to seventh auxiliary requests into the proceedings.

VI. In a reply dated 15 September 2022, the appellant amended both the main request and the first and second auxiliary requests and provided arguments regarding these requests.

VII. Oral proceedings were held on 19 October 2022. 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 amended main request or of the first or second auxiliary request. As an alternative, it requested that the case be remitted to the department of first instance.

VIII. The sole independent claim of the **main request**, i.e. **claim 1**, reads as follows:

"A method for generating a virtual volume in a storage system architecture (30), the storage system architecture (30) comprising a host (10) and at least one disk array subsystem (20), the at least one disk array subsystem (20) comprising a disk array controller (200) and a physical storage device array (400), the method characterized by comprising:

mapping the physical storage device array (400) into one or more media extents;

providing a virtualization module (202) in one of the at least one disk array subsystem (20) between the at least one disk array subsystem (20) and the host (10), wherein said one disk array subsystem (20) provided with the virtualization module (202) is defined as a master disk array subsystem (20);

selecting, by the virtualization module (202), at least one of the one or more media extents to form a virtual pool;

forming, by the virtualization module (202), at least one virtual volume and managing the at least one virtual volume according to a section allocation system

(211), wherein the section allocation system (211) provides virtual section indices_to [sic] manage the at least one virtual volume by using a physical-section-versus-virtual-section cross-referencing mechanism; and

providing, by the virtualization module (202), the at least one virtual volume to the host (10)."

IX. **Claim 1** of the **first auxiliary request** reads as follows:

"A method for generating a virtual volume in a storage system architecture (30), the storage system architecture (30) comprising a host (10) and at least one disk array subsystem (20), the at least one disk array subsystem (20) comprising a disk array controller (200) and a physical storage device array (400) having a plurality of physical storage devices (410), the method characterized by comprising:

mapping the physical storage device array (400) into one or more physical volumes having a redundant array of independent disks (RAID) protection mechanism;

mapping each of the one or more physical volumes into one or more media extents;

providing a virtualization module (202) in one of the at least one disk array subsystem (20) in order to present storage space of the at least one disk array subsystem (20) to the host (10), wherein said one disk array subsystem (20) provided with the virtualization module (202) is defined as a master disk array subsystem (20);

mapping, by the virtualization module (202), at least one of the one or more media extents to form a virtual pool;

forming, by the virtualization module (202), at least one virtual volume from the virtual pool and managing

the at least one virtual volume according to a section allocation system (211), wherein the section allocation system (211) for managing the at least one virtual volume provides virtual section indices which are mapped, by using a physical-section-versus-virtual-section cross-referencing mechanism, to location information about physical sections located in the one or more media extents, so that the disk array controller (200) updates the mapping relationships between the virtual section indices and the location information when performing a data section migration procedure that is induced by adding a media extent into the virtual pool or by removing one of the media extents from the virtual pool, to migrate a first set of data in a first media extent of the media extents, into a second media extent of the media extents, wherein the first media extent is the removed media extent in case of removing and wherein the second media extent is the added media extent or other media extent of the virtual pool in case of adding; and

providing, by the virtualization module (202), the at least one virtual volume to the host (10);

wherein the host (10) accesses the first set of data from the first media extent by issuing host IO requests having the same virtual section index before and after the data section migration procedure is performed; and

wherein the volume capacity of each of the at least one virtual volume presented to the host is a virtual capacity."

X. **Claim 1** of the **second auxiliary request** reads as follows:

"A method for generating a virtual volume in a storage system architecture (30), the storage system architecture (30) comprising a host (10) and at least

one disk array subsystem (20), the at least one disk array subsystem (20) comprising a disk array controller (200) and a physical storage device array (400) having a plurality of physical storage devices (410), the method characterized by comprising:

mapping the physical storage device array (400) into one or more physical volumes having a redundant array of independent disks (RAID) protection mechanism;

mapping each of the one or more physical volumes into one or more media extents;

providing a virtualization module (202) in one of the at least one disk array subsystem (20) in order to present storage space of the at least one disk array subsystem (20) to the host (10), wherein said one disk array subsystem (20) provided with the virtualization module (202) is defined as a master disk array subsystem (20);

mapping, by the virtualization module (202), at least one of the one or more media extents to form a virtual pool;

forming, by the virtualization module (202), at least one virtual volume from the virtual pool and managing the at least one virtual volume according to a section allocation system (211), wherein the section allocation system (211) for managing the at least one virtual volume provides virtual section indices which are mapped, by using a physical-section-versus-virtual-section cross-referencing mechanism, to location information about physical sections located in the one or more media extents, so that the disk array controller (200) updates the mapping relationships between the virtual section indices and the location information when performing a data section migration procedure that is induced by adding a media extent into

the virtual pool or by removing one of the media extents from the virtual pool, to migrate a first set of data in a first media extent of the media extents, into a second media extent of the media extents, wherein the first media extent is the removed media extent in case of removing and wherein the second media extent is the added media extent or other media extent of the virtual pool in case of adding; and

providing, by the virtualization module (202), the at least one virtual volume to the host (10);

wherein the host (10) accesses the first set of data from the first media extent by issuing host IO requests having the same virtual section index before and after the data section migration procedure is performed;

wherein the volume capacity of each of the at least one virtual volume presented to the host is a virtual capacity; and

wherein the section allocation system (211) comprises at least one block association sets section allocation list (BAS SAL) (213) representing a data structure of the at least one virtual volume for recording information about the virtual section indices on the section allocation system (211) and an inode table (215) for recording information about the at least one block association sets section allocation list (213)."

Reasons for the Decision

1. The present application concerns a virtualization layer for a storage array which allows for rendering data migration - e.g. in case a disk is added or removed - transparent to IO access commands.

2. Main request

The main request differs from the main request considered in the decision under appeal in that one of the dependencies of claim 9 has been deleted.

2.1 Admissibility (Article 13(2) RPBA)

The straightforward amendment remedies the lack of clarity identified in the board's preliminary opinion. The board has therefore exercised its discretion to admit the main request into the proceedings.

2.2 Clarity (Article 84 EPC)

In the impugned decision, the examining division considered claims 1 and 6 to 11 to lack clarity due to the terms "*media extents*", "*section allocation system*", "*data location query command*", "***latest*** *validity check sequence number*" and "***special*** *validity check sequence number*" [emphases added by the board] lacking an unambiguous meaning in the art.

The appellant argued as follows:
Media extent: The "*skilled person has no difficulty to come to a reasonable interpretation of the term 'media extent', that is 'an area of storage reserved for a file in a system of storage media' which is basically consistent with the broad interpretation set forth in item 15.1 of the decision.*"
Section allocation system: "*The remaining features of claim 1, e.g. 'the section allocation system (211) provides virtual section indices to manage the at least one virtual volume by using a physical-section-versus-virtual-section cross-referencing mechanism' defines the section allocation system such that the skilled person comes to a general but sufficiently clear*

meaning of the section allocation system."
Data location query command: "...*may be understood as defined by its purpose...*"
Finally, the appellant noted that in the present case, defining a command or value/number through its purpose was not only reasonable but also the only efficient way of clearly distinguishing the subject-matter from other entities and data.

The board notes that terms which do not have a well-recognised meaning in the art do not *per se* give rise to a lack of clarity. In the present case, the board considers that these terms allow for interpretation using their literal (descriptive) meaning. The board therefore concurs with the appellant that the terms "*media extents*", "*section allocation system*", "*data location query command*" and "*latest validity check sequence number*" do not give rise to doubts about the claimed subject-matter.

In view of the above, the board has decided that the requirements of Article 84 EPC are met.

2.3 Novelty (Article 54(1) EPC)

In the decision under appeal, the examining division held that the subject-matter of claim 1 differed from the disclosure of document **D2** in that

> "the virtualization module is provided in one of the at least one disk array subsystem which is defined as a master disk array subsystem".

The appellant argued that document **D2** did not disclose that the section allocation system (211) provided virtual section indices to manage the at least one virtual volume by using a physical-section-versus-virtual-section cross-referencing mechanism. Paragraphs [0050] and [0051] of document **D2** merely disclosed the

intended use of the "*virtual blocks*" and "*physical blocks*".

The board notes that paragraph [0050] of document **D2** mentions a "*virtual SCSI block number*" and that paragraph [0051] discloses a "*physical SCSI block number*" as well as that a physical block is translated. The board considers that the claimed "*virtual section indices*" may comprise the disclosed "*virtual SCSI block number*" and that the claimed "*physical section*" may comprise the disclosed "*physical SCSI block*". Furthermore, the "*translating*" of a physical block disclosed in paragraph [0051] of document **D2** refers to the translating of a virtual address to a physical address as mentioned in paragraph [0009] of document **D2**. The board thus considers that said "*translating*" implies "*using a physical-section-versus-virtual-section cross-referencing mechanism*". Consequently, the board asserts that the feature under scrutiny is disclosed in document **D2**.

Hence, the board considers that the difference between the subject-matter of **claim 1** and that of document **D2** resides in the distinguishing feature identified by the examining division in the decision under appeal.

2.4 Inventive step (Article 56 EPC)

In the impugned decision, the examining division determined that the technical effect achieved by the distinguishing feature was "*to reduce the number of components in the system of D2*". The objective technical problem could thus be formulated as "*how to integrate the system of D2.*" The examining division came to the conclusion that the distinguishing feature was a mere design choice which the skilled person would

adopt without the need for inventive skill and thus the subject-matter of claim 1 was not inventive.

The appellant argued that the objective technical problem could be considered to be "*how to increase efficiency in data reference between the host and the physical layer?*"

The board is not convinced by the appellant's argument, since it is not apparent that the appellant's problem is actually solved by the distinguishing feature. In particular, the board cannot perceive a link between the virtualization module being in the disk array subsystem and an increase in efficiency. Moreover, the board concurs with the examining division in that where the virtualization module should be implemented appears to be a mere design choice. Since there is a limited number of choices, the skilled person would select, depending on the circumstances, the same location as the invention without exercising any inventive skill. Consequently, the board considers that the subject-matter of claim 1 is not inventive over the disclosure of document **D2**.

2.5 In view of the above, the **main request** is not allowable.

3. First auxiliary request

The first auxiliary request is based on the first auxiliary request considered in the decision under appeal.

Claim 1 of the first auxiliary request mainly differs from claim 1 of the main request in the step of

> "mapping the physical storage device array (400) into one or more physical volumes having a

redundant array of independent disks (RAID) protection mechanism"

and in that the "*forming*" step reads as follows:

"forming, by the virtualization module (202), at least one virtual volume from the virtual pool and managing the at least one virtual volume according to a section allocation system (211), wherein the section allocation system (211) for managing the at least one virtual volume provides virtual section indices which are mapped, by using a physical-section-versus-virtual-section cross-referencing mechanism, to location information about physical sections located in the one or more media extents, so that the disk array controller (200) updates the mapping relationships between the virtual section indices and the location information when performing a data section migration procedure that is induced by adding a media extent into the virtual pool or by removing one of the media extents from the virtual pool, to migrate a first set of data in a first media extent of the media extents, into a second media extent of the media extents, wherein the first media extent is the removed media extent in case of removing and wherein the second media extent is the added media extent or other media extent of the virtual pool in case of adding" [emphases added by the board].

3.1 Admissibility (Article 13(2) RPBA)

The first auxiliary request differs from the first auxiliary request considered in the decision under appeal in that claim 1 further specifies that "*the first media extent is the removed media extent in case of removing and [that] the second media extent is the added media extent or other media extent of the virtual*

pool in case of adding". Furthermore, several dependent claims have been amended.

The amendments address the issues of the technical effect not being derivable from the wording of claim 1 and a lack of clarity, as raised in the board's preliminary opinion. Since the amendments overcome the board's objections, the board has exercised its discretion to admit the first auxiliary request into the proceedings.

3.2 Clarity (Article 84 EPC)

The board holds that the considerations for the main request also apply to the first auxiliary request. Therefore, the first auxiliary request also fulfils the requirements of Article 84 EPC.

3.3 Novelty (Article 54(1) EPC)

In the decision under appeal, the examining division held that the subject-matter of claim 1 of the first auxiliary request differed from the disclosure of document **D2** in that:

> "1. the virtualization module is provided in one of the at least one disk array subsystem which is defined as a master disk array subsystem;
>
> 2. the amended features of the forming step"

The appellant submitted that as opposed to document **D2**, the claimed solution possessed a "*physical-section-versus-virtual-section cross-referencing mechanism*". Furthermore, document **D2** merely disclosed a "*physical pool*" rather than the claimed "*virtual pool*".

The board is not convinced by the appellant's arguments. Regarding the "*physical-section-versus-*

virtual-section cross-referencing mechanism", the board considers that document **D2** discloses such a mechanism in paragraphs [0050] and [0051], see section 2.3 above. As to the "*virtual pool*", the board holds that the formulation of claim 1 does not define any particular properties of the "*virtual pool*" and thus allows for the broad interpretation that it is identical to the "*virtual volume*". It has not been contested that the latter may be anticipated by the "*virtual disk image*" of document **D2**.

The board thus holds that the subject-matter of claim 1 differs from document **D2** in that:

1. the virtualization module is provided in one of the at least one disk array subsystem;

2. the disk array controller updates the mapping relationships between the virtual section indices and the location information when performing a data section migration procedure that is induced by adding a media extent into the virtual pool or by removing one of the media extents from the virtual pool, to migrate a first set of data in a first media extent of the media extents, into a second media extent of the media extents.

3.4 Inventive step (Article 56 EPC)

3.4.1 As to distinguishing feature 2, the examining division considered that paragraph [0005] of document **D2** suggested such a migration, hence this could not contribute to an inventive step. As to distinguishing feature 1, the examining division provided the same considerations as for claim 1 of the main request. Therefore, the examining division concluded that the subject-matter of claim 1 of the first auxiliary request was not inventive.

3.4.2 The appellant argued that the difference of a "*physical-section-versus-virtual-section cross-referencing mechanism*" would mean that the data change taking place on the MEs was concealed and no change was detected from the point of view of the upper-layer application (i.e. the host). Furthermore, the virtual pools would allow for grouping of storage areas which are separately located and render migration of data more efficient. In particular, instead of regenerating the entire mapping table in case of a migration, it would be sufficient to update the mapping of the virtual section index. These technical effects were not obvious in view of document **D2**.

3.4.3 The board holds that the two distinguishing features identified by the board do not interact synergistically, since they may be implemented independently and do not produce an effect going beyond the sum of the separate effects. It is thus sufficient to show that each of the distinguishing features is obvious in order to show that the subject-matter of claim 1 is not inventive.

As to **difference 1**, reference is made to section 2.4 above.

With respect to **difference 2**, the board holds that "*data section migration*" as such is disclosed in document **D2**, see paragraph [0005] which mentions "*changes in the physical location of storage blocks ... can be accommodated by a simple update of the virtual-to-real mappings*". Furthermore, the solution disclosed in document **D2** is also based on using "*RAID*" (Redundant Arrays of Independent Disks) sets, see paragraph [0022]. The board considers it to be common practice for disks to also be removed from a RAID set. Therefore, the problem of how to mitigate the removal of a disk is readily apparent to the skilled person. The skilled person would recognise that the solution

which document **D2** discloses for the failure of a disk is also applicable when a disk is removed. Document **D2** also discloses in paragraph [0005] that said update of the virtual-to-real mappings is also applicable in case of "*growth*", which includes a case in which "*[new] physical disks can be added to the system*", see paragraph [0010]. Hence, the skilled person would have arrived at the subject-matter of claim 1 without having to employ any inventive skill.

The board is not convinced by the appellant's arguments. Firstly, the board notes that the argument regarding the "*physical-section-versus-virtual-section cross-referencing mechanism*" is based on a feature which is already known from document **D2**, see section 2.3 above. Secondly, the alleged effect related to the "*virtual pools*" is not derivable from the wording of claim 1, since no properties of the "*virtual pools*" are defined therein. Finally, with respect to the "*virtual section index*", the board considers that document **D2** also discloses in paragraph [0005] a "*simple update of the virtual-to-real mappings*" and thus already provides this technical effect.

The board thus concludes that claim 1 is not inventive over the disclosure of document **D2**.

3.5 In view of the above, the first auxiliary request is not allowable.

4. Second auxiliary request

The second auxiliary request is based on the second auxiliary request considered in the decision under appeal.

Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in the additional feature that

"the section allocation system (211) comprises at least one block association sets section allocation list (BAS SAL) (213) representing a data structure of the at least one virtual volume for recording information about the virtual section indices on the section allocation system (211) and an inode table (215) for recording information about the at least one block association sets section allocation list (213)".

4.1 Admissibility (Article 13(2) RPBA)

The second auxiliary request has been amended in the same way as the first auxiliary request. Furthermore, amendments have been made to the additional feature.

The board notes that for the amendments that are identical to those of the first auxiliary request, the same considerations apply. As to the further amendments, the board holds that these overcome the objection pursuant to Article 84 EPC raised in the board's preliminary opinion. Therefore, the board has exercised its discretion to admit the second auxiliary request into the proceedings.

4.2 Clarity (Article 84 EPC)

The appellant submitted that the amendments overcome the objections regarding antecedences as raised by the board in its preliminary opinion.

The board asserts that the amendments indeed overcome these issues and has thus decided that the requirements of Article 84 EPC are fulfilled.

4.3 Inventive step (Article 56 EPC)

In the decision under appeal, the examining division considered that the additional feature was not used by any of the method steps of claim 1. Therefore, it was held that the additional feature was a "*non-functional*" feature which could not contribute to an inventive step.

The appellant argued that claim 1 specified that the additional feature related to the mapping of the virtual section indices using a physical-section-versus-virtual-section cross-referencing mechanism. Due to the use of two tables, it was possible to more reliably identify the locations of the data to be retrieved. This was not obvious in view of document **D2**, which disclosed a single table only.

The board is not convinced by the appellant's argument, since it is not apparent how the technical effect alleged by the appellant can be derived from the wording of the claim. In particular, the added feature concerns a data structure which records information about "*virtual section indices*" and another data structure ("*inode table*") which holds information about the former data structure. Since a record with "*virtual section indices*" was already contained in claim 1 according to the first auxiliary request, the board considers that the added feature merely adds a denomination without expanding or altering the functionality which was already present.

Therefore, the board holds that claim 1 of the second auxiliary request is not inventive over the disclosure of document **D2** for the reasons provided with respect to claim 1 of the first auxiliary request.

4.4 Consequently, the second auxiliary request is not allowable either.

5. Remittal (Article 11 RPBA)

As a further auxiliary request, the appellant requested remittal of the case to the department of first instance.

The board notes that pursuant to Article 11 RPBA, a case may only be remitted in case of special reasons for doing so. The board asserts that in the present case, no such reasons have been presented and thus it has decided to refuse the request for remittal.

6. In view of the above, the appeal is not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

K. Götz-Wein A. Ritzka

Decision electronically authenticated