

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TERADATA CORPORATION,
Petitioner,

v.

SAP SE,
Patent Owner.

IPR2020-00943
Patent 7,617,179 B2

Before NEIL T. POWELL, KARA L. SZPONDOWSKI, and
STACY B. MARGOLIES, *Administrative Patent Judges*.

SZPONDOWSKI, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Teradata Corporation (“Petitioner”) filed a Petition (Paper 2, “Pet.”) to institute an *inter partes* review of claims 1–8, 10, 13–26, 28, and 31–37 of U.S. Patent No. 7,617,179 B2, issued on November 10, 2009 (Ex. 1001, “the ’179 patent”). SAP SE (“Patent Owner”) filed a Preliminary Response (Paper 9, “Prelim. Resp.”) to the Petition. With our authorization, Petitioner filed a Reply to the Preliminary Response (Paper 10, “Reply”) and Patent Owner filed a Sur-Reply (Paper 11, “Sur-Reply”). After consideration of the parties’ contentions and supporting evidence, we instituted *inter partes* review pursuant to 35 U.S.C. § 314. Paper 12 (“Inst. Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 19, “PO Resp.”); Petitioner filed a Reply (Paper 26, “Pet. Reply”); and Patent Owner filed a Sur-Reply (Paper 30, “PO Sur-Reply”). An oral hearing was conducted on August 25, 2021 and a transcript of the hearing has been entered into the record as Paper 33 (“Tr.”).

We have jurisdiction pursuant to 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has not demonstrated by a preponderance of the evidence that claims 1–8, 10, 13–26, 28, and 31–37 of the ’179 patent are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies itself, Teradata US, Inc., and Teradata Operations, Inc. as the real parties in interest. Pet. 76. Patent Owner identifies itself as the sole real party in interest. Paper 4, 1.

B. Related Matters

The parties advise that the '179 patent is the subject of the following parallel litigation in the Northern District of California: *Teradata Corp. v. SAP SE*, 3:18-cv-03670 (N.D. Cal.). Pet. 76; Paper 4, 1.

C. The '179 Patent (Ex. 1001)

The '179 patent issued from Application No. 10/835,230 filed April 28, 2004. Ex. 1001, codes (21), (22). The '179 patent is titled “System and Methodology for Cost-based Subquery Optimization Using a Left-deep Tree Join Enumeration Algorithm” and is generally directed to optimizing a database query. *Id.* at code (54), Abstr., 1:51–55.

The '179 patent explains that a database query “is a logical expression over the data and the data relationships set forth in the database, and results in the identification of a subset of the database.” *Id.* at 2:41–44. Such a query request is typically issued as an SQL query for retrieving particular data from database tables on a server. *Id.* at 2:45–50. However, “SQL queries express what results are requested but do not state how the results should be obtained.” *Id.* at 2:59–60.

A query optimizer is used to “determine[] the ‘plan’ or the best method of accessing the data to return the result required by the SQL query.” *Id.* at 2:62–65. The query optimizer, therefore, transforms the SQL request into an access plan in order to “find an adequate execution plan from a search space of many semantically equivalent alternatives.” *Id.* at 2:65–3:4. It does so “by generating different join strategies and, based on cost, choosing the best strategy.” *Id.* at 3:5–7. “The process of generating a subspace of the space of all the join strategies is called join enumeration.” *Id.* at 3:7–9. To optimize a query, the query optimizer must solve several problems, such as choosing the access method, choosing the order in which

to join the tables, and choosing the join method to be used for each join operation. *Id.* at 3:16–21. The '179 patent discloses that its query optimizer combines join enumeration, plan generation, and cost estimation into a single unified methodology. *Id.* at 12:9–16.

The Summary of the Invention describes this as follows:

The methodology of the present invention includes defining, for each qualifying subquery, a set of access methods (or execution methods), and a set of join methods to be used to join such subqueries with the rest of the query's tables. The access methods are defined based on the subquery execution strategies which could be employed for a subquery given its type and the semantic properties of the query the subquery is used in.

Ex. 1001, 5:53–60.

Figure 4 of the '179 patent, reproduced below, depicts the overall process of query optimization in the database system of the preferred embodiment. *Id.* at 6:61–62, 12:1–2.

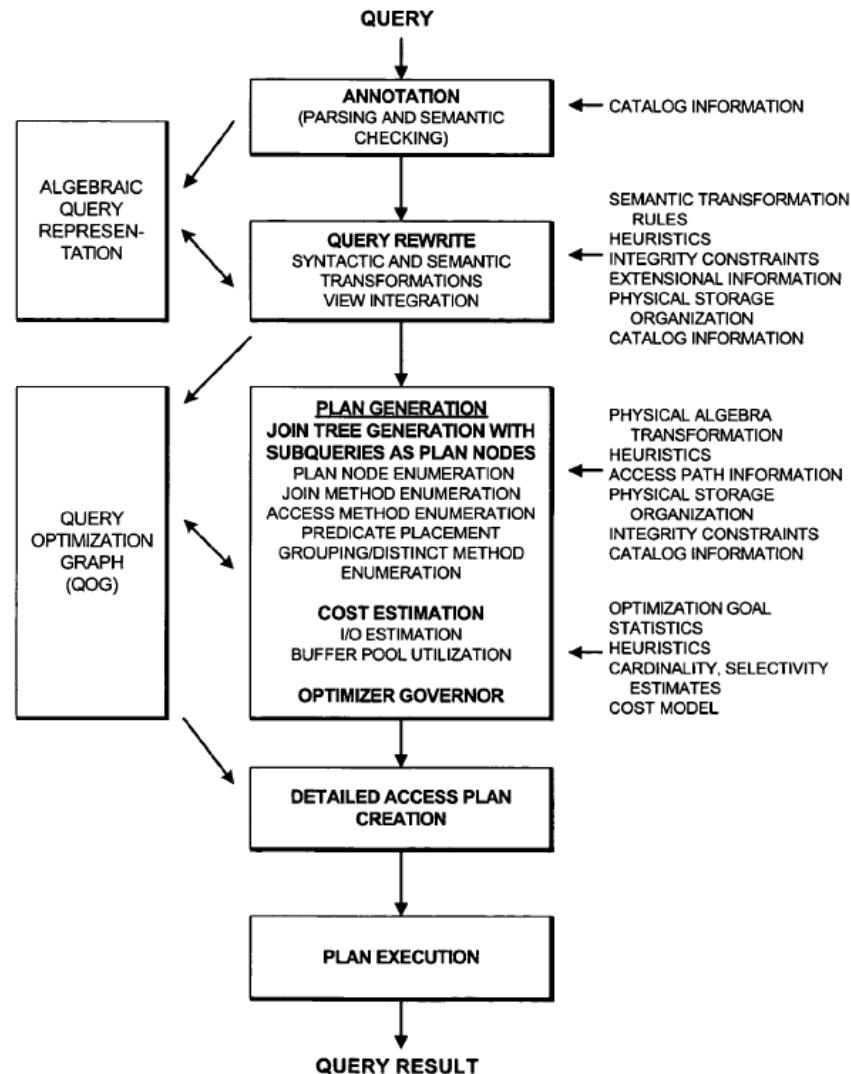


FIG. 4

Figure 4 depicts “the input to the plan generation phase of the query optimizer is a Query Optimization Graph (QOG),” which is “the internal representation of a query block or Derived Table Block (DTB).” *Id.* at 12:3–7. “Each query block is optimized independently in a bottom-up fashion.” *Id.* at 12:7–8. The optimization of a query block consists of four phases: (1) in phase one, “rewrite optimizations are applied and a semantically equivalent rewritten query is generated”; (2) in phase two, the QOG for each query block is built; (3) in phase three, “a left-deep join enumeration

algorithm is applied, in a bottom-up fashion, to each subplan”; and (4) in phase four, “the best plan is rebuilt and a Data Flow Operator (DFO) tree is built corresponding to this best plan.” *Id.* at 12:44–13:5.

The ’179 patent explains that the claimed invention does not transform “the subquery participating in the enumeration process . . . during optimization to reflect different subquery execution strategies.” *Id.* at 6:19–22. Instead, the transformation is applied “after the optimization is completed.” *Id.* at 6:22–26. According to the ’179 patent, this approach is advantageous in that it “uses far less memory than other transformation-based subquery optimization techniques where a SQL query is rewritten to reflect a certain subquery evaluation strategy, and, for each rewritten query, the optimization process is applied.” *Id.* at 6:26–30.

D. Illustrative Claim

Among the challenged claims, claims 1 and 23 are independent. Independent claim 1, reproduced below with brackets noting Petitioner’s identifiers and emphasis on the dispositive claim limitation, is illustrative of the claimed subject matter.

1. [1.pre] In a database system, a method for optimizing a database query for execution by a processor, the method comprising:

[1.a] receiving a database query including at least one subquery;

[1.b] building a query optimization graph for each query block of the database query, the query optimization graph including plan nodes representing subqueries of each query block;

[1.c] *prior to optimization of a query block, identifying alternative strategies for evaluation of a subquery plan node of the query block based on subquery type and semantic properties of the database query;*

[1.d] for each alternative strategy, pre-computing a subquery access method and subquery join method for use during optimization of the query block, wherein the subquery access method includes an estimate of execution costs;

[1.e] generating a set of access methods and join methods for other plan nodes of the query block;

[1.f] optimizing each query block to determine an optimal access plan for the query block based upon selecting pre-computed subquery access methods and join methods for subquery plan nodes of the query block as well as access methods, join methods, and join order for other plan nodes of the query block having favorable execution costs,

[1.g] wherein each query block is optimized without transformation of the subqueries using the pre-computed access methods and join methods; and

[1.h] constructing a detailed access plan for execution of the database query based upon the optimal access plan determined for each query block.

E. Asserted Grounds of Unpatentability and Evidence

Petitioner asserts that claims 1–8, 10, 13–26, 28, and 31–37 are unpatentable on the following grounds. Pet. 19. Trial was instituted on these grounds. Inst. Dec. 70.

Claims Challenged	35 U.S.C. §	References
1–8, 10, 21–26, 28	103(a)	Paulley ¹ , Lucent '144 ²
13–20, 31–37	103(a)	Paulley, Lucent '144, Young-Lai ³
1–8, 10, 21–26, 28	103(a)	Paulley, Lucent '144, Galindo-Legaria ⁴
13–20, 31–37	103(a)	Paulley, Lucent '144, Galindo-Legaria, Young-Lai

Pet. 19.

In support of its asserted grounds of unpatentability, Petitioner relies on the Declaration and Supplemental Declaration of Dr. Jaideep Srivastava, Ph.D. Exs. 1002, 1017. Patent Owner deposed and cross-examined Dr. Srivastava, and provides transcripts of these depositions (Exs. 2030, 2031). Patent Owner proffers a Declaration of Professor David Maier. Ex. 2024. Petitioner deposed and cross-examined Dr. Maier, and provides a transcript of this deposition. Ex. 1015.

¹ U.S. Patent Pub. No. 2002/0116357 A1 to Paulley, published Aug. 22, 2002 (Ex. 1003).

² U.S. Patent No. 6,032,144 to Srivastava et al., issued Feb. 29, 2000 (Ex. 1006). The parties refer to this reference as Lucent '144 so as to avoid confusion with Petitioner's expert, who has the same last name as the lead inventor. *See* Pet. 23. There is no relation. Ex. 1002 ¶ 72.

³ U.S. Patent Pub. No. 2004/0030677 A1 to Young-Lai, published Feb. 12, 2004 (Ex. 1004).

⁴ César Galindo-Legaria et al., "Fast, Randomized Join-Order Selection — Why Use Transformations?", Proceedings of the 20th VLDB Conference, Santiago, Chile, 85–95 (1994) (Ex. 1007).

III. ANALYSIS

A. Legal Standards

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must demonstrate obviousness by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d); *see also Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016 (citing 35 U.S.C. § 312(a)(3) (requiring inter partes review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”))).

B. Level of Ordinary Skill in the Art

Petitioner asserts a person of ordinary skill in the art “would have at least a master’s degree in computer science and would have studied database implementation [and] at least two years’ experience working on database optimizer internals.” Pet. 14–15 (citing Ex. 1002 ¶¶ 59–60). Patent Owner

asserts that a person of ordinary skill in the art “would have had a master’s degree in computer science, would have studied database implementation, and would have had two years’ experience working on database optimizer internals.” PO Resp. 27.

In our Institution Decision, we found that Petitioner’s proposal was consistent with the level of ordinary skill in the art reflected by the prior art of record and preliminarily adopted Petitioner’s unopposed position. Inst. Dec. 27 (citing *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001)). However, we found that the phrase “at least” in Petitioner’s proposal created a vague, open-ended upper bound for the level of ordinary skill in the art, so we did not adopt that aspect of the proposal. *Id.* Patent Owner’s proposal reflects this finding.

As neither party challenges our preliminary finding regarding the level of ordinary skill in the art, and Patent Owner has adopted our finding, we see no reason to disturb that finding. Accordingly, we maintain and reaffirm that one of ordinary skill in the art at the time of the invention would have had “a master’s degree in computer science, would have studied database implementation, and would have had two years’ experience working on database optimizer internals.”

C. Claim Construction

We apply the same claim construction standard used to construe the claim in a civil action under 35 U.S.C. § 282(b), as articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). See 37 C.F.R. § 42.100(b) (2019). In this context, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips*, 415 F.3d at 1312–13 (citations omitted). “In determining the meaning of the disputed

claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 131.

We determine that the dispositive issue turns on claim construction. Independent claims 1 and 23 each recite “prior to optimization of a query block, identifying alternative strategies for evaluation of a subquery plan node of the query block based on the subquery type *and semantic properties of the database query*.” Ex. 1001, 38:54–57, 40:41–43 (emphasis added) (limitation [1.c]). The Parties dispute whether the “semantic properties of the database query” is satisfied by showing only semantic properties of the subquery itself, as Petitioner contends, or whether the term also requires semantic properties of the database query of which the subquery is part, as Patent Owner contends. PO Resp. 40–41; Pet. Reply 13–15; PO Sur-Reply 13–19. As explained below, we agree with Patent Owner that the claim requires more than the semantic properties of the subquery itself.

We start with the language of the claims. *See, e.g., Phillips*, 415 F.3d at 1314 (“[T]he context in which a term is used in the [claim at issue] can be highly instructive.”). The claims recite “a database query including at least one subquery,” and further recite a “subquery type” and “semantic properties of the database query.” Ex. 1001, 38:49, 38:56–57 (claim 1), 40:31–32, 40:42–43 (claim 23). We agree with Patent Owner that this language, which separately recites a “subquery” and a “database query,” indicates a difference between the two terms. *See* PO Sur-Reply 14–15; *e.g., Symantec*

Corp. v. Comput. Assoc. Int'l, Inc., 522 F.3d 1279, 1289 (Fed. Cir. 2008) (“the general assumption is that different terms have different meanings.”). Indeed, the plain language of the claim recites the “semantic properties of the database query,” not the “semantic properties of the subquery.”

Moreover, the Parties agree that the subquery is part of the database query. *See* Pet. Reply 13 (“the semantic properties of a subquery are part of the semantic properties of the database query” because “a subquery is part of a database query”); Ex. 1015, 16:22 (Dr. Maier providing testimony that a “[d]atabase query can include a subquery”). This acknowledgement that the subquery is *part of* the database query also supports that the database query is something more than the subquery itself. *See also* Ex. 1001, 3:26–28 (“The SQL language allows the usage of queries using nested subqueries. In general, a subquery is embedded in the WHERE clause of a query to further restrict data returned by the query.”). In fact, the Parties do not dispute that the semantic properties of the database query can *include* semantic properties of the subquery. *See, e.g.*, Pet. Reply 14 (“the semantic properties of a database query include the semantic properties of each and every subquery contained within the query”); Ex. 1017 ¶¶ 11–12; Tr. 23:7–17, 48:10–49:4; PO Sur-Reply 13 (the claim language “does not *preclude* consideration of the subquery semantic properties[, b]ut consideration of *only* the subquery semantic properties does not meet the claimed requirement that the subquery strategies be based on the ‘semantic properties of the database query.’”). Yet, in advancing its position that the semantic properties of the “database query” may solely include the “subquery,” Petitioner essentially reads out the claimed “database query.”

We next turn to the specification. “[T]he specification is always highly relevant to the claim construction analysis. Usually, it is dispositive;

it is the single best guide to the meaning of a disputed term.” *Phillips*, 415 F.2d at 1315 (internal quotes and citation omitted). Petitioner argues that nothing in the specification or prosecution history precludes consideration of the “semantic property of the subquery” for the “semantic property of the database query.” *See* Pet. Reply 13–15; Tr. 20:11–21:8, 23:7–17. However, as discussed above, Patent Owner’s argument is not that the semantic properties of the subquery should be excluded; only that they cannot be considered on their own. *See* PO Sur-Reply 17 (“[t]he question is not whether the claim allows consideration of subquery semantic properties, but rather whether the claim *requires* considering the semantic properties of the enclosing database query”). Patent Owner’s contentions are based upon the premise that the specification supports an integrated approach, whereby the *context* of the subquery, i.e., the semantic properties of the database query enclosing the subquery, as opposed to just the characteristics of the subquery itself, must be considered. PO Sur-Reply 13.

Both Petitioner and Patent Owner rely on the same portion of the Summary of the Invention in the specification:

The methodology of the present invention includes defining, for each qualifying subquery, a set of access methods (or execution methods), and a set of join methods to be used to join such subqueries with the rest of the query’s tables. The access methods are defined based on the subquery execution strategies which could be employed for a subquery given its type *and the semantic properties of the query the subquery is used in*.

Ex. 1001, 5:53–60 (emphasis added); *see* Tr. 20:11–22; PO Sur-Reply 15–16. Dr. Srivastava testifies that a person of ordinary skill in the art “would not interpret this passage as precluding consideration of semantic properties

of the subquery, because the passage reflects the fact that the subquery is part of the query.” Ex. 1017 ¶ 12.

Petitioner’s argument that this disclosure from the specification supports its interpretation is simply not persuasive. Rather, this disclosure better supports Patent Owner’s position that the context of the subquery must also be considered. Moreover, although the location of a statement in the specification is not determinative, we note that this portion of the specification is in the Summary of the Invention. *See, e.g., C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 864 (Fed. Cir. 2004) (“Statements that describe the invention as a whole are more likely to be found in certain sections of the specification, such as the Summary of the Invention”); *Microsoft Corp. v. Multi-Tech Sys., Inc.*, 357 F.3d 1340, 1348 (Fed. Cir. 2004) (“Those statements, some of which are found in the ‘Summary of the Invention’ portion of the specification, are not limited to describing a preferred embodiment, but more broadly describe the overall inventions of all three patents.”). This portion of the specification refers to “[t]he methodology of the present invention,” i.e., the invention as a whole, and clearly describes “*the semantic properties of the query the subquery is used in.*” Ex. 1001, 5:53–60 (emphasis added).

Petitioner further argues that “given the different embodiments described in the specification including those discussed with respect to [Figures] 8A–8C of the ’179 patent, a person of skill in the art would not find that considering the semantic properties of the subquery itself when forming alternative strategies for the subquery should be excluded.” Pet. Reply at 15 (citing Ex. 1017 ¶¶ 10–12). However, Petitioner does not explain why this is the case, and does not assert that these embodiments consider the semantic properties of the subquery alone. *Id.* In other words,

Petitioner does not identify any embodiments, support, or examples in the specification where the semantic properties of the subquery *alone* are considered. *See* Tr. 23:18–24:7. Nor does Petitioner or Dr. Srivastava provide any other evidence supporting Dr. Srivastava’s conclusion.

Patent Owner, on the other hand, relies on additional disclosure in the specification, which further supports that consideration of the semantic properties of the subquery alone are not sufficient. *See* PO Sur-Reply 16 (citing Ex. 1001, 31:48–58 (“The present invention comprises a system [in which] . . . ‘[t]he access methods are defined based on the subquery execution strategies which could be employed for a subquery given its type and the *semantic properties of the query the subquery is used in.*’”), 35:62–64 (“The access methods are set during this pre-optimization phase by analyzing each subquery and *the context in which it is used.*”)); *see also* PO Resp. 20. We agree with Patent Owner that the specification supports that the semantic properties refer to those “of the query the subquery is used in” and “the context in which [the subquery] is used.” *See* PO Sur-Reply 15–16. Moreover, the integrated approach is also supported by the specification: “What is needed is a query optimization solution which integrates subquery optimization with an optimizer’s general enumeration methodology . . . [t]he present invention provides a solution for these and other needs.” Ex. 1001, 4:3–10; *see* Tr. 54:24–55:12.

Accordingly, based upon the claim language and disclosure in the specification, we do not find support in the intrinsic record for Petitioner’s interpretation. We agree with Patent Owner that the “semantic properties of the database query” cannot be met solely by the semantic properties of the subquery within that database query, without consideration of the database query. We, therefore, interpret the “semantic properties of the database

query” as the semantic properties of the database query in which the subquery is used. This does not exclude the semantic properties of the subquery, but cannot *only* include the semantic properties of the subquery.

D. Ground 1: Obviousness Over Paulley and Lucent '144

Petitioner contends claims 1–8, 10, 21–26, and 28 would have been obvious over the combination of Paulley and Lucent '144. Pet. 20–56. For the reasons explained below, we agree with Patent Owner that Petitioner has not shown by a preponderance of the evidence that claims 1–8, 10, 21–26, and 28 would have been obvious over the combined teachings of Paulley and Lucent '144.

1. Paulley (Ex. 1003)

Paulley was published on August 22, 2002, and is titled “System and Methodology for Join Enumeration in a Memory-constrained Environment.” Ex. 1003, codes (43), (54). Paulley relates to “access and processing of information in a data processing system” and describes “[a] small-footprint relational database system providing a deterministic join enumeration methodology for left-deep processing trees.” *Id.* ¶ 3, Abstr. According to Paulley, “[b]y providing a deterministic branch-and-bound join enumeration method for left-deep processing trees, the invention is able to efficiently optimize complex queries with high join degree by employing a novel approach to cost-based pruning of the search space.” *Id.* ¶ 18.

Paulley discloses that “Adaptive Server Anywhere (ASA) is the relational database system that forms the core module of Sybase SQL.” *Id.* ¶ 42. Figure 3 of Paulley, reproduced below, depicts the overall process of query optimization in ASA. *Id.* ¶ 50.

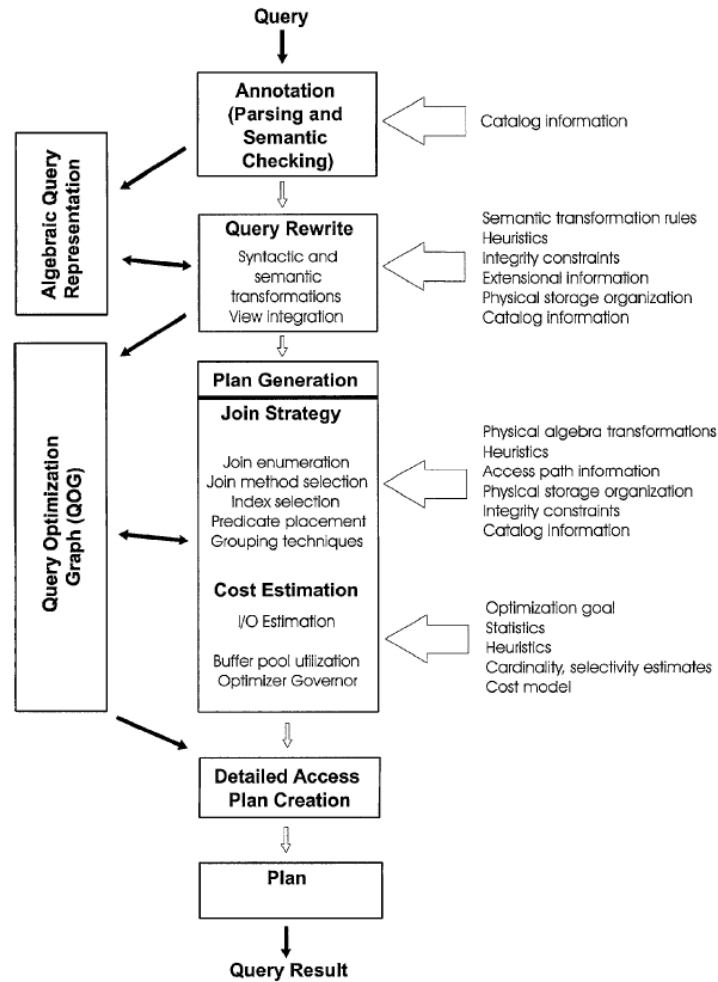


FIG. 3

As shown in Figure 3, the query optimization process steps include Annotation, Query Rewrite, Plan Generation, which includes Join Strategy and Cost Estimation, Detailed Access Plan Creation, and Plan. See Fig. 3.

Plan generation involves the generation of alternative “join strategies” for each subquery block. *Id.* ¶¶ 19, 52. As shown in Figure 3, the input to the plan generation phase is a Query Optimization Graph (QOG). *Id.* at ¶ 52. A QOG is the internal representation of a complete SQL Statement, possibly composed of multiple “subquery blocks.” *Id.*

“The plan generation phase optimizes each subquery in the QOG independently.” *Id.* at ¶¶ 20, 53. Paulley describes that plan generation for each subquery involves the following steps:

1. adjust predicate selectivities to account for disjuncts, Between predicates, and user estimates of selectivities,
2. construct a join graph for the query that models inner and outer equijoin predicates, sargable single-variable predicates on single quantifiers, and Cartesian products,
3. enumerate join strategies and prune the search space using a branch-and-bound heuristic,
4. recall the cheapest strategy and construct the detailed access plan for that strategy.

Id. at ¶¶ 20–24, 53–57.

Paulley discloses that unlike IBM’s Starburst optimizer, which separates join enumeration from plan generation and cost estimation, the ASA optimizer combines these processes into a single unified methodology. *Id.* ¶¶ 19, 52. According to Paulley, cost estimation is an integral part of the enumeration method, because it is through comparing the costs of partial access plans that the ASA optimizer can quickly prune significant portions of the join strategy search space. *Id.*

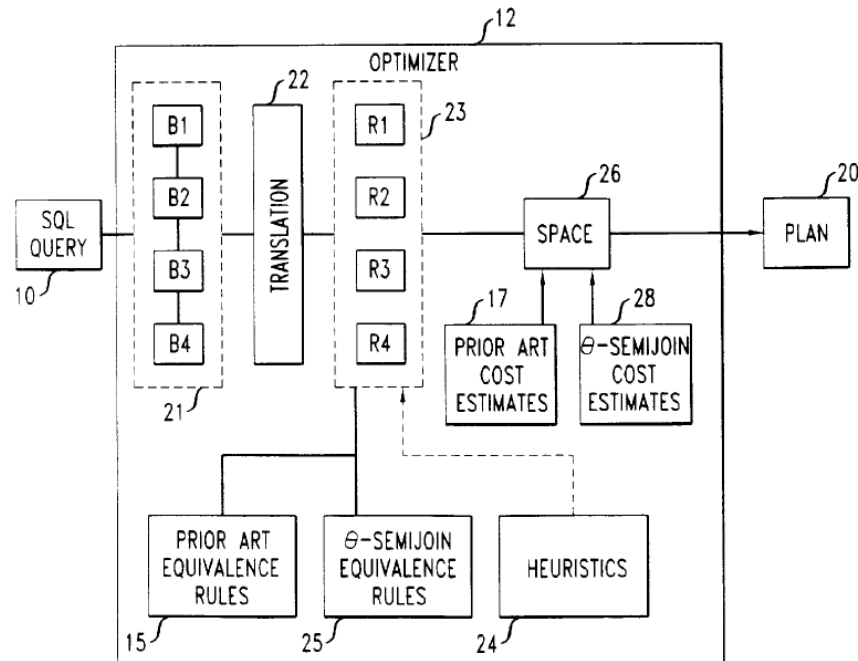
2. *Lucent ’144 (Ex. 1006)*

Lucent ’144 issued on February 29, 2000, and is titled “Optimization of Queries Using Relational Algebraic Theta-semijoin Operator.” Ex. 1006, codes [45], [54]. Lucent ’144 “relates generally to database management systems and in particular to the optimization of SQL queries.” *Id.* at 1:10–11. Lucent ’144 explains that “a complex SQL query is broken into smaller

blocks . . . [that are] translated to relational algebraic expressions to which the equivalence rules . . . are applied.” *Id.* at 2:40–45. Lucent ’144 states that “for each block, the ‘optimal’ alternative is determined.” *Id.* at 2:45–46.

Figure 2 of Lucent ’144, reproduced below, depicts an embodiment of the disclosed optimization technique:

FIG. 2



As shown in Figure 2, upon receiving SQL query 10, optimizer 12 breaks down the query into any number of “blocks” 21 indicated as B1–B4. *Id.* at 4:65–67. These blocks are then translated by a translation process 22 into relational algebraic expressions 23, indicated as R1–R4. *Id.* at 4:65–5:2–53. A set of equivalence rules consisting of prior art equivalence rules 15 and semijoin equivalence rules 25 that consider the “interrelationships” between blocks, are applied to each expression to generate search space 26. *Id.* at 5:2–8. Once each search space 26 is generated, cost estimates 17 for the various relational algebraic operators

and the theta-semijoin cost estimates 28 are utilized to determine the optimal method of evaluating the SQL query 10, the plan 20. *Id.* at 5:25–29.

3. *Independent Claims 1 and 23*

Limitation 1.c recites “prior to optimization of a query block, identifying alternative strategies for evaluation of a subquery plan node of the query block based on the subquery type and semantic properties of the database query.” Ex. 1001, 38:54–57. Independent claim 23 recites the same limitation. *See id.* at 40:41–43.

a) *The Parties’ Contentions*

Petitioner asserts that Paulley discloses this limitation. Pet. 31–34. Specifically, Petitioner contends that Paulley’s “plan generation” stage, which is the stage of the optimization process in which alternative strategies are considered, “occurs before the optimization of the query . . . (i.e., the detailed access plan creation stage).” *Id.* at 31 (citing Ex. 1003, Fig. 3; Ex. 1002 ¶ 93). Petitioner contends that in the “plan generation” stage, “the optimizer considers alternative ‘join strategies’ for each subquery block (i.e., subquery plan node).” *Id.* at 32 (citing Ex. 1003 ¶ 19; Ex. 1002 ¶ 94). Petitioner further contends that “Paulley discloses that the consideration of alternative strategies is based on subquery type and semantic properties of the database query.” *Id.* (citing Ex. 1002 ¶ 95). Petitioner asserts that the four steps of the “plan generation” phase disclosed in paragraphs 20–24 of Paulley are based upon subquery type and semantic properties of the database query. *Id.* at 32–33 (citing Ex. 1003 ¶¶ 20–24; Ex. 1002 ¶ 96). As one example, Petitioner asserts that step 3 (enumerating join strategies and pruning the search space using a branchy-and-bound heuristic) is based on the subquery type and semantic properties of the query. *Id.* at 33. Petitioner states that:

Both subquery type and semantic properties will influence what access methods and join methods will be pruned from a given search space because the semantic property and subquery type will ultimately have an influence over the cost of employing certain access methods and join methods and thus will influence which access methods and join methods will be pruned from the search space.

Id. (citing Ex. 1002 ¶¶ 96–101).

Patent Owner argues that Paulley does not teach “identifying alternative strategies for evaluation of a subquery plan node . . . based on . . . semantic properties of the database query.” PO Resp. 40. Specifically, Patent Owner argues that Paulley’s generation of alternative join strategies “is performed as part of the *independent* optimization of a subquery,” and is “not based on ‘semantic properties of the [enclosing] *database query*.’” *Id.* (citing Ex. 2024 ¶ 135). According to Patent Owner, Paulley “does not consider characteristics of the enclosing database query when optimizing a subquery” because it ‘optimizes each subquery in the QOG independently.’” *Id.* (citing Ex. 1003 ¶¶ 20, 53). Patent Owner argues this is supported by Dr. Srivastavas’ testimony, where he refers to the semantic properties of the subquery, not the semantic properties of the enclosing database query. *Id.* at 41 (citing Ex. 2030, 79:18–81:1, 81:21–82:3, 83:4–11; Ex. 1002 ¶¶ 92–101). Patent Owner further asserts that Dr. Srivastavas “agreed that Paulley’s ‘independent’ subquery optimization means that the optimizer ‘would not’ ‘consider other information of another query block, like a higher or a lower level query block.’” *Id.* (citing Ex. 2030, 88:12–89:22, 87:22–88:3). Patent Owner, therefore, contends because “the Petitioner relies only on the [semantic properties of the] subquery alone,” Petitioner has not shown that Paulley teaches limitation 1.c. PO Sur-Reply 19–20.

b) Analysis

It is undisputed, and we agree, that Paulley “optimizes each subquery of the QOG independently.” Ex. 1003 ¶ 20 (“[t]he plan generation phase optimizes each subquery in the QOG independently”); *e.g.*, Pet. 33; Pet. Reply 11, 19–20; PO Resp. 37, 39–40. Regarding this optimization, Petitioner’s expert, Dr. Srivastava, testifies that a person of ordinary skill in the art would understand that “in that optimization process for a particular subquery, you do not take the characteristics of other subqueries into account.” Ex. 2030, 88:22–89:3 (referring to Paulley ¶¶ 20–24) (cited in PO Resp. 41)). When asked whether Paulley “would consider other information of another query block, like a higher or lower level query block,” Dr. Srivastava testifies that “[f]rom the word ‘independently,’ no, there would – at least my sense is that they would not.” *Id.* at 89:16–22 (cited in PO Resp. 41). Dr. Srivastava’s understanding of Paulley’s disclosure is reflected in Petitioner’s analysis, and there is no dispute that Petitioner relies on semantic properties of the *subquery* to show that Paulley teaches the “semantic properties of the *database query*,” as recited in limitation 1.c. *See* Ex. 2030, 81:21–82:3, 83:4–11; Tr. 67:2–15; PO Resp. 41.

As discussed above, our interpretation of the “semantic properties of the database query” is dispositive. Because Petitioner relies solely on the semantic properties of the subquery in Paulley to teach this limitation, we find that Petitioner has not shown by a preponderance of the evidence that Paulley teaches “the semantic properties of the database query,” as required in both independent claim 1 and independent claim 23.

Accordingly, Petitioner has not shown by a preponderance of the evidence that that any claim of the ’179 patent would have been obvious over the combination of Paulley and Lucent ’144.

E. Ground 2: Obviousness Over Paulley, Lucent '144, and Young-Lai

Petitioner contends claims 13–20 and 31–37 would have been obvious over the combination of Paulley, Lucent '144, and Young-Lai. Pet. 56–71; Pet. Reply 25–26. Claims 13–20 depend, directly or indirectly, from claim 1, and claims 31–37 depend, directly or indirectly, from claim 23. Ex. 1001, 39:46–40:22, 41:22–42:25. Petitioner does not rely on any additional evidence or analysis for disputed limitation 1.c in connection with its analysis of these claims. Accordingly, for the same reasons as in Ground 1, Petitioner has not shown by a preponderance of the evidence that any claim of the '179 patent would have been obvious over the combination of Paulley, Lucent '144, and Young-Lai.

F. Ground 3: Obviousness Over Pauley, Lucent '144, and Galindo-Legaria

Petitioner contends claims 1–8, 10, 21–26, and 28 would have been obvious over the combination of Paulley, Lucent '144, and Galindo-Legaria. Pet. 71–76; Pet. Reply 26. Petitioner states that “Ground 3 is identical to Ground 1 of the petition, except that, with respect to claim elements [1.g] and [23.f], rather than relying on the disclosure of Paulley to teach or suggest the recited negative limitation, Ground 3 instead relies on the disclosure of Galindo-Legaria.” Pet. 73. This ground suffers the same deficiencies as Ground 1. Accordingly, for the same reasons as for Ground 1, Petitioner has not shown by a preponderance of the evidence that that any claim of the '179 patent would have been obvious over the combination of Paulley, Lucent '144, and Galindo-Legaria.

G. Ground 4: Obviousness Over Paulley, Lucent '144, Galindo-Legaria, and Young-Lai

Petitioner contends claims 13–20 and 31–37 would have been obvious over the combination of Paulley, Lucent '144, Galindo-Legaria, and Young-Lai. Pet. 76; Pet. Reply 26. Petitioner states that “Ground 4 is identical to Ground 2 of the Petition except for its reliance on Galindo-Legaria to teach or suggest claim elements [1.g] and [23.f] of independent claims 1 and 23 respectively and as described above with respect to Ground 3.” *Id.* Accordingly, for the same reasons as for Grounds 1 and 2, Petitioner has not shown by a preponderance of the evidence that that any claim of the '179 patent would have been obvious over the combination of Paulley, Lucent '144, Galindo-Legaria, and Young-Lai.

IV. CONCLUSION

For the foregoing reasons, we are not persuaded that Petitioner established by a preponderance of the evidence that claims 1–8, 10, 13–26, 28, and 31–37 of the '179 patent are unpatentable. In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–8, 10, 21–26, 28	103(a)	Paulley, Lucent '144		1–8, 10, 21– 26, 28
13–20, 31–37	103(a)	Paulley, Lucent '144, Young-Lai		13–20, 31–37
1–8, 10, 21–26, 28	103(a)	Paulley, Lucent '144, Galindo- Legaria		1–8, 10, 21– 26, 28
13–20, 31–37	103(a)	Paulley, Lucent '144, Young-Lai, Galindo-Legaria		13–20, 31–37
Overall Outcome				1–8, 10, 13– 26, 28, 31–37

V. ORDER

In consideration of the foregoing, it is hereby
ORDERED that claims 1–8, 10, 13–26, 28, and 31–37 of the
'179 patent are not unpatentable; and
FURTHER ORDERED, that because this is a final written decision,
parties to the proceeding seeking judicial review of the decision must
comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2020-00943
Patent 7,617,179 B2

FOR PETITIONER:

David L. Fehrman
Shouvik Biswas
Roman A. Swoopes
MORRISON & FOERSTER LLP
dfehrman@mofo.com
sbiswas@mofo.com
rswoopes@mofo.com

FOR PATENT OWNER:

Andrew M. Mason
Derrick W. Toddy
Ryan Heck
Sarah E. Jelsema
John M. Lunsford
Tucker Mottl
KLARQUIST SPARKMAN, LLP
andrew.mason@klarquist.com
derrick.toddy@klarquist.com
ryan.heck@klarquist.com
sarah.jelsema@klarquist.com
john.lunsford@klarquist.com
tucker.mottl@klarquist.com

J. Steven Baughman
PAUL, WEISS, RIFKIND, WHARTON & GARRISON LLP
sbaughman@paulweiss.com

Joseph M. Beauchamp
JONES DAY
jbeauchamp@JonesDay.com