Intellectual Property Office

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15 September 2023

PATENTS ACT 1977

APPLICANT	Amazon Technologies, Inc.
ISSUE	Whether patent application GB2106687.3 is excluded under section 1(2)(c)
HEARING OFFICER	H Jones

DECISION

Background

1 This decision relates to the issue of whether patent application GB2106687.3 ("the application") meets the requirements of section 1(2)(c) of the Patent Act 1977 ("the Act"), in particular to whether the claimed invention consists of a program for a computer as such.

2 The application is the GB national phase application of PCT/US2019/063058, published as WO2020/112664 by the International Bureau and republished as GB2593097 by the IPO. The prescribed period for putting the application in order, referred to in section 20 of the Act and defined by rule 30 of the Patents Rules 2007 (as amended), ended on 27 May 2023. The period was extended under section 108(2) of the Act to 27 July 2023.

3 The PCT application was searched in the international phase and an International Preliminary Report on Patentability (IPRP) was issued by the International Bureau in May 2021. This report identified five documents of prior art as being highly relevant for the assessment of novelty and/or inventive step, and concluded that none of the application's fifteen claims appeared to meet these requirements.

4 The first examination report in the national phase (dated 27 May 2022) acknowledged the IPRP issued by the International Bureau and adopted its findings. The examiner noted that since the invention appears to be limited to a computer program and that the prior art cited in the IPRP anticipate all present claims, the "*actual contribution of the invention is in question and a full assessment of excluded matter cannot be carried out*". The examiner says that the issue of patentability will be reassessed following amendments to resolve the novelty and inventive step issues.

5 The applicant amended the claims in September 2022. The second examination report (dated 13 October 2022) raises a novelty objection against all claims based on the disclosure in US2018/089041 A1 (D1), one of the five prior art documents listed in the IPRP. The only other objection raised in this report concerns the need to acknowledge the use of registered trade marks in the specification; the issue of

whether the invention is excluded as being a program for a computer is not mentioned.

6 The applicant amended the claims in February 2023. The third examination report (dated 22 February 2023) informs the applicant that the prior art search remains incomplete for section 2(3) art and that this search will be deferred until all remaining objections have been overcome. The examiner sets out his objections under two main headings, namely the lack of novelty of all claims over D1 and exclusion of the invention under section 1(2). Under the second heading of patentability, the examiner explains that "*due to the anticipation of the claims by the available prior art, the actual contribution of the claims is in question*". The examiner adds that *"I am of the opinion that any contribution of the claims would appear prima facie to fall into the excluded category of computer programs under section 1(2)*" and says that if the applicant "*is able to overcome the novelty objection then the issue of exclusion under section 1(2) would be reconsidered"*.

7 The applicant amended the claims in April 2023. The fourth examination report (dated 24 May 2023) states that the prior art search has been updated and that a new piece of prior art has been found (D2: IETF RFC6962, "Certificate Transparency", Laurie et al, June 2013). The report sets out novelty and inventive step objections against all thirteen claims based on the disclosure in D2 and sets out detailed reasoning why the invention defined by the claims is considered to relate to a program for a computer. At paragraphs 12 and 13 of the report, the examiner says that *"as the claims have been shown to be anticipated by the prior art, the actual contribution is unclear. For the purpose of the present objection, I will disregard the above novelty and inventive step objections. In your agent's most recent letter, the inventive difference of the present invention [of claim 1] from former citation D1 is set out"*. The examiner then sets out that stated difference before saying that this will be taken to be the alleged contribution of the invention. The examiner's conclusion is that the claim in its entirety relates to the processing of data by a computer and that no technical contribution has been identified.

8 The applicant amended the claims in June 2023. In the covering letter accompanying these amendments, the attorney requested a hearing should the examiner consider there to be any outstanding issues. The examiner issued a pre-hearing report (dated 27 July 2023) setting out the outstanding issues and the case was referred to me for a hearing. The pre-hearing report is effectively a fifth examination report on this application, which makes clear that the sole matter to be decided is whether the application is excluded from patent protection because it relates to a program for a computer "as such" under section 1(2)(c) of the Act.

9 The hearing took place by videoconference on 13 September 2023. The applicant was represented by their attorney Dr Terence Broderick and Ms Kate Harkness of Murgitroyd and Company, who submitted skeleton arguments in advance.

10 The specification, including the amended claims, the objections raised by the examiner and the applicant's arguments and observations can all be viewed at the IPO's online file inspection service: Intellectual Property Office - Patent document and information service (Ipsum) (ipo.gov.uk).

The invention

11 Section 125(1) of the Act states that an invention shall be taken to be "*that specified in a claim of the specification of the application…, as interpreted by the description and any drawings contained in the specification*". As is evident from the background explanation set out above, the claims have been amended four times in order to better distinguish the invention from the prior art, although it is fair to say that the scope of the claims have not changed significantly.

12 Independent claims 1 and 7 are set out in fairly broad terms, with claim 1 being to a computer-implemented method comprising various steps and claim 7 being to a "non-transitory computer-readable storage medium" having stored thereon executable instructions that cause a computer to perform broadly the same method steps as set out in claim 1. The independent claims relate to the same embodiment of the invention and will stand or fall together. Claim 1 reads as follows:

> 1. A computer-implemented method, comprising:
>
> committing a transaction on a collection of data maintained by a database;
>
> storing, based at least in part on commitment of the transaction, a first node in a leaf region of a tree, the first node comprising a signature generated based at least in part on the transaction;
>
> providing, in response to a request to verify the transaction, one or more signatures corresponding to signatures retrieved by traversing between the first node and a second node of the tree;
>
> publishing signatures of nodes from at least some of the nodes on a path to the node corresponding to the transaction which is to be verified, wherein the signatures which are published include signatures from both stable and unstable root nodes; and
>
> providing access to the one or more signatures based at least in part on a query of a journal table.

13 The specification describes the invention as relating to cryptographic verification of ledger-based database management systems. A ledger is described as comprising a journal and summary data structures, the journal providing an immutable history of transactions on a document managed by the system and the summary data structure providing a synopsis of the document's current state. A cryptographic hash tree (or signature tree) structure provides independent verification that the history of a transaction is unaltered, and is said to be adapted to sustain high throughput and large transaction volumes.

14 In operation, the database management system receives a request to perform a transaction. The system performs (or commits) the transaction, and in response to committing the transaction, generates a cryptographic hash based on an attribute of the transaction. The cryptographic hash is stored in a leaf-region of a hash tree. In response to a request to verify the transaction, signatures are retrieved from the tree based on a traversal of the tree to locate the node corresponding to the transaction. The retrieved signatures are used to verify the transaction.

15 The invention can be understood from figures 5 and 10 of the specification, copied below.

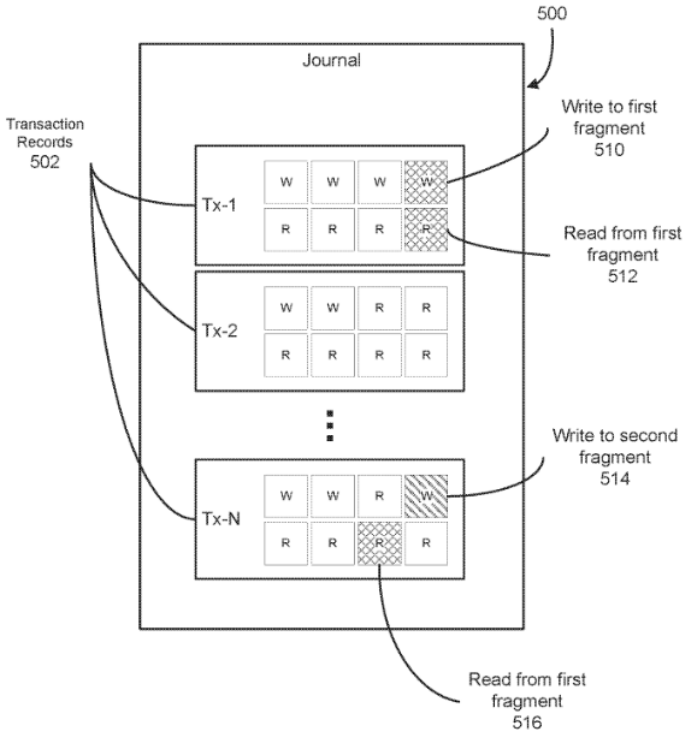

FIG. 5

16 Figure 5 illustrates the journal used to keep an immutable history of transaction records. Each transaction record 502 comprises data indicative of read or write operations on a document, and there is at least one sequence of transactions (Tx-1, …, Tx-N) for every document represented in the journal.

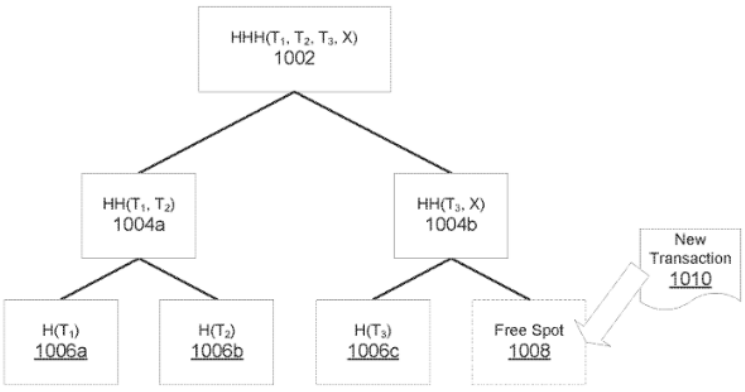

FIG. 10

17 Figure 10 shows an example of a cryptographic hash tree. The tree comprises a plurality of nodes (1002, 1004a-b, 1006a-c) that may be categorised as leaf nodes or non-leaf nodes, the leaf nodes being those without descendant (or child) nodes (e.g. 1006a and 1006b), and the non-leaf nodes being those higher up the tree having descendant nodes (e.g. 1002 and 1004a). Each leaf node comprises a cryptographic hash value computed from one or more attributes of a transaction ($H(T_1)$, $H(T_2)$, etc.). Non-leaf nodes comprise a cryptographic hash value computed from hash values in the descendant nodes, e.g. $H(H(T_1), H(T_2))$ for non-leaf node 1004a. Node 1002 at the top of the tree is referred to as a root node. The hash tree in figure 10 is described as a binary hash tree because each node is limited to having two child nodes.

18 As new transactions are committed in the database management system, a hash value for each new transaction is added as a new leaf node to the rightmost side of the tree (called the free spot, 1008). The leaf level of the hash tree is filled from the rightmost position and moves outwards, such that the rightmost edge or region of the tree is considered an active or unstable zone that is subject to change when a new transaction is added. A node in the tree can be described as a stable root if it is a non-leaf node whose hash value will no longer change. In figure 10, node 1004a is stable because its child nodes have been filled and its stored hash value will not change.

19 A traversal from one node representing a transaction to a stable root can provide information sufficient to verify the ordering of a transaction and indicate whether it has been altered since it was originally recorded. For example, inserting or deleting records of a transaction could constitute tampering with the order, but this can be detected based on nodes retrieved during traversal between a leaf node representing the transaction in question and a stable node: a traversal from leaf node 1006b to stable node 1004a can provide information sufficient to verify the ordering of transaction T_2.

20 The hash values are published so third parties can verify that a transaction has not been modified. The hash values can be published once a region has been made stable or even prior to a region of the tree being finalised, i.e. it is in an unstable state. For example, the hash values are published even though they are computed with values representing “null” or “empty” transactions. The specification says that the use of an unstable node can permit verification of the ordering of a transaction in cases where an insufficient number of subsequent transactions have been received. This is because as the tree structure grows, there may be an increasing interval of time between the addition and finalisation of a root node.

The law

21 The relevant provision is section 1(2)(c) of the Act, which says that certain things cannot be protected by a patent:

> *1(2) It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of—*
>
> *(a) a discovery, scientific theory or mathematical method;*
>
> *(b) a literary, dramatic, musical or artistic work or any other aesthetic creation;*
>
> ***(c) a scheme, rule or method for performing a mental act, playing a game or doing business, or a program for a computer;***

(d) the presentation of information;

but the foregoing provision shall prevent anything from being treated as an invention for the purposes of this Act only to the extent that a patent or application for a patent relates to that thing as such.

22 The Court of Appeal in *Symbian*[1] stated that the question of whether a computer-implemented invention is patentable has to be resolved by answering the question whether it reveals a technical contribution to the state of the art. The Court proceeded to answer the question with the aid of the four-step test set out in its earlier judgment in *Aerotel*[2], namely:

1) construe the claim;
2) identify the actual (or alleged) contribution;
3) ask whether it falls solely within the excluded subject-matter;
4) check whether the actual or alleged contribution is actually technical in nature.

23 Paragraph 43 of *Aerotel* provides some guidance regarding the second step:

43. The second step – identify the contribution - is said to be more problematical. How do you assess the contribution? Mr Birss submits the test is workable – it is an exercise in judgment probably involving the problem said to be solved, how the invention works, what its advantages are. What has the inventor really added to human knowledge perhaps best sums up the exercise. The formulation involves looking at substance not form – which is surely what the legislator intended.

24 The question of what has been added to human knowledge is helpfully addressed at paragraphs 1.21-1.21.2 of the Office's Manual of Patent Practice (MPP):

1.21 As Jacob LJ stated in Aerotel/Macrossan, this is the summation of what the contribution is, and all of the other factors (see 1.21.2-1.21.4) weigh in to making this determination. The starting point for that assessment is the claims. It may be helpful to consider what makes the invention novel (see 1.20.1); however, it is then necessary to place that in its proper context and ensure that the effects of the invention are taken into account. It is not correct to eliminate everything in the claim that is known to arrive at that which is unknown, and then to conclude that the unknown part must be the contribution; i.e., as the Court of Appeal in Genentech [1989] RPC 205 put it, it is not the case that "an invention is unpatentable if the inventiveness was contributed only by matters excluded under section 1(2)". This approach – which is sometimes referred to as "Falconer reasoning", from its originator; or, less formally, "salami-slicing" – was expressly rejected by the Court of Appeal in that decision. Birss J, in Lenovo (Singapore) PTE Ltd v Comptroller General of Patents [2020] EWHC 1706 (Pat) at paragraph 16, summarised matters thus; "invention can lie in a new combination of old features and so, while identifying an individual feature as disclosed in prior art is a relevant thing to do, it will always be necessary to consider it in the context of the invention as a whole before reaching a conclusion." In Lantana v Comptroller-General of Patents [2014] EWCA Civ 1463 paragraph 64, Kitchin LJ set out the importance of considering the proper context of an invention when assessing the contribution, accepting "[a] submission that it is the claim as a whole which must be considered when assessing the contribution which the invention has made, and that it is not permissible simply to cut the claim into pieces and then consider those pieces separately and without regard to the way they interact with each other". However, at paragraph 65, Kitchin LJ qualified this by observing: "[n]evertheless, I also have no doubt that, approached in this way, it is the actual contribution to the art which the invention has made which must be considered.

[1] Symbian Ltd. V Comptroller -General or Patents [2008] EWCA Civ 1066
[2] Aerotel Ltd v Telco Holdings Ltd and Macrossan's Application [2006] EWCA Civ 1371

1.21.1 The courts have consistently found that, where claims recite standard hardware, such conventional apparatus does not form part of the contribution. This is often the case in computer program inventions – an application relating to a computer program cannot be saved simply by claiming conventional computer hardware programmed in a particular way. Jacob LJ remarked on this in paragraph 44 of Aerotel/Macrossan, and specifically rejected the use of standard hardware when determining the contribution of the Macrossan application in paragraph 73.

1.21.2 What constitutes a technical contribution can change over time. Therefore the view that, once a technical contribution is made, that same contribution will always be technical may not apply. In paragraph 16 of Lantana v Comptroller-General of Patents [2013] EWHC 2673 (Pat), Birss J addressed this point, noting that "[t]he fact that in the IBM case [T6/83] the method of communication between programs and files [...] was held patentable in 1988 does not mean that any method of communicating between programs and files [...] necessarily involves a technical contribution today". This was endorsed by Arden LJ in paragraph 43 of the Court of Appeal judgment Lantana v Comptroller-General of Patents [2014] EWCA Civ 1463.

25 The fourth step of the test is to check whether the contribution is technical in nature. According to paragraph 46 of *Aerotel*, applying the fourth step may not be necessary because the third step should have covered the question. This is because a contribution which consists solely of excluded matter will not count as being a "technical contribution" and thus will not, as the fourth step puts it, be "technical in nature".

26 In *AT&T/CVON*[3]*,* Lewison J (as he then was) set out five signposts that he considered helpful when considering whether a computer program makes a technical contribution. In *HTC/Apple*[4]*,* the signposts were reformulated slightly considering the decision in *Gemstar*[5]. The signposts are:

> i) whether the claimed technical effect has a technical effect on a process which is carried on outside the computer
> ii) whether the claimed technical effect operates at the level of the architecture of the computer; that is to say whether the effect is produced irrespective of the data being processed or the applications being run
> iii) whether the claimed technical effect results in the computer being made to operate in a new way
> iv) whether the program makes the computer a better computer in the sense of running more efficiently and effectively as a computer
> v) whether the perceived problem is overcome by the claimed invention as opposed to merely being circumvented.

Application of the *Aerotel* test

Step (1): construe the claim

27 The applicant agrees with the examiner's construction of claim 1 set out in the pre-hearing report. In this report, the examiner says that the database and tree data structure of claim 1 generally operate in a standard way according to principles well understood in the art. The journal table comprises a log of the transactions of the

[3] AT&T Knowledge Ventures/Cvon Innovations v Comptroller General of Patents [2009] EWHC 343 (Pat)
[4] HTC Europe Co Ltd v Apple Inc [2013] RPC 30
[5] Gemstar-TV Guide International Inc v Virgin Media Ltd [2010] RPC 10

database, the journal is immutable and the tree, such as the well-known Merkle tree, is used to ensure the validity of the transactions.

Step (2): identify the actual (or alleged) contribution

28 The applicant says that the examiner's assessment of the contribution has been overly simplified.

29 In his fourth examination report, the examiner takes the stated difference between claim 1 and document D1 set out in the applicant's letter of 26 April 2023 as being the alleged contribution of the invention. He sets this out as follows:

> "*the claimed subject matter enables the order of transactions which led to a subject transaction to be verified, even if insufficient transactions have been completed to make a node stable. The time between a node being started and stabilising could be a vulnerability which may be exploited by those who want to manipulate the database in a malicious way. The claimed subject matter, by publishing all signatures, exposes all nodes of the tree and would enable a malicious actor's actions to be identified.*"

He adds that there is no dispute that the fundamental functionality of the Merkle tree structure is known in the art, before concluding that i) the alleged contribution lies in which data is published during the continuing growth of the Merkle tree, ii) that "*the nodes are published for the purpose of verification*" and iii) that by "*publishing unstable nodes, verification can be initiated at an earlier stage, leaving a smaller window of time for errors or malicious actions to occur.*"

30 In his fifth examination report (i.e. the pre-hearing report), the examiner says that the features of document D2 should also be considered when assessing the actual contribution. He says that when he objected to excluded matter in the previous examination report (the fourth report), it was expedient to use the applicant's own assessment of the contribution without reference to D2. Given the subsequent amendment of the claim in response to the fourth report, the examiner says that he will consider the contribution of the newly amended claim, as set out at paragraph 12 above, in view of both documents. Before considering the differences between the claimed invention and the prior art, the examiner notes that the database and cryptographic hashing mechanism are independent of one another, that transactions of the database are not affected by the Merkle tree functionality, and that the database transactions do not fundamentally change the mechanism of the hash tree. He says that the only effect of the transactions on the hash tree is to provide a dataset to be hashed, adding that hash trees are known to be suited to datasets which are continually updated and that the database transactions disclosed in the application are just one example of this type of dataset.

31 The examiner says he agrees with the general summary of the contribution set out in the applicant's letter dated 26 April, namely "*to provide access to signatures, in response to a request to verify a transaction and based at least in part on a query of a journal table.*" I note that the applicant's letter adds that "*the signatures correspond to signatures based on transactions, retrieved by traversing between nodes of a tree. Additionally, some signatures from both stable and unstable root nodes are published. The whole process allows for transactions to be verified, thus improving the integrity of the ledger. Without this process, a third party would not be able to request verification that a transaction has not been modified"*.

32 It seems to me that the examiner's assessment of the contribution has adopted an approach specifically cautioned against by the guidance set out at paragraph 1.21 of MPP. As the Manual says, it is not correct to eliminate everything in the claim that is known in order to arrive at that which is unknown, and then to conclude that the unknown part must be the contribution. The examiner very clearly adopted such an approach in his third, fourth and fifth examination reports. I will approach the assessment of contribution afresh.

33 In broad terms, claim 1 defines a computer-implemented method for providing hash signatures in response to a request to verify a transaction committed on data maintained by a database. The signatures are retrieved by traversing nodes in a hash tree. The signatures are published and can include stable and unstable nodes. The signatures provide verification of committed transactions stored in a journal table. The specification describes the benefits of using unstable nodes as permitting verification of a transaction in cases where an insufficient number of subsequent transactions have been received. As noted above, as the hash tree structure grows with more committed transactions being stored in the ledger, there may be an increasing interval of time between the stabilisation of a node. Also, the signatures are published to allow third party verification.

34 The applicant says in their skeleton arguments that in very large databases with many transactions, the waiting time necessary to verify a transaction can be reduced as there is no need to wait for an unstable node on a path to the node corresponding to the transaction to become a stable node. This means that the time to verify a transaction contained in the journal can be reduced. In other words, the time necessary for a third party to verify a transaction will be reduced due to the use of unstable root nodes. I accept this characterisation of the contribution.

35 The contribution is a method of verifying transactions in a ledger-based database management system, whereby stable and unstable nodes of a hash tree are published and used by third parties to verify transactions stored in a ledger, where the availability of unstable nodes allows quicker verification of the transactions.

Steps (3) and (4): ask whether it falls solely within the excluded subject-matter; check whether the actual or alleged contribution is actually technical in nature

36 The applicant argues that the contribution does not fall solely within the excluded subject-matter based on the first and fifth signposts set out in *AT&T/CVON* (as reformulated in *HTC/Apple*). The first signpost points towards allowability when a claimed technical effect has a technical effect on a process carried on outside the computer. The applicant submits that a client device seeking to verify a transaction stored in a networked database management system represents a process outside of a computer. However, the courts have consistently found that the term "computer" here should be read as a computer system or a system of computers. The client device in the application forms a part of the computer system and is not external to it, so the first signpost does not apply.

37 The fifth signpost addresses the technical character of an alleged invention by means of the problem addressed. When the problem is a technical one, the alleged invention can be considered to have a technical nature leading to it falling outside the exclusion if (but not only if) it solves the problem. In other words, the contribution can be technical if it directly solves a technical problem and not simply circumvents it. For example, the technical problem of how to improve transmission rate of data in a

narrow-band communication channel is not solved by reducing the amount of data transmitted through the channel.

38 The present application describes a need to speed up third-party verification of transactions stored in a ledger-based database management system. I regard this as being a technical problem. I agree with the applicant that this problem is solved (rather than circumvented) by publishing signatures from stable and unstable nodes in a hash tree. As a result, I find that the fifth signpost points to allowability of the computer-implemented invention in this case. I should note that despite Dr Broderick's view at the hearing that the first signpost provides a stronger basis for patentability than the fifth, I have found the opposite to be the case.

Other matters

39 The only issue before me is that of whether the invention is excluded under section 1(2)(c) of the Act. At the hearing, Dr Broderick addressed me on the suggestion made by the examiner in his pre-hearing report that the database and the cryptographic hashing mechanism are independent of one another (see paragraph 30 above), saying that if this influenced my view of the contribution as not being technical then it would be possible to amend the claim to make the link between the two clearer. It will be clear from my consideration above that I do not consider such an amendment is necessary.

40 The examiner has not presented any arguments on novelty and inventive step of the claims over D1 and D2, nor any concerns over the clarity and support of the amended claims. The search is complete for section 2(3) art, so it seems that substantive examination of the application has been completed.

Conclusion

41 I have found that the claimed invention is not excluded by section 1(2)(c) as a program for a computer as such. I therefore remit the application to the examiner to make the necessary arrangements for grant.

Huw Jones
Deputy Director, acting for the Comptroller