Intellectual Property Office

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13 December 2016

PATENTS ACT 1977

APPLICANT	The Boeing Company
ISSUE	Whether patent application GB 1203690.1 complies with Section 1(1)(b) and Section 76(2)
HEARING OFFICER	Peter Mason

DECISION

Introduction

1. This decision concerns patent application GB1203690.1 entitled “Methods and systems for evaluation of signal propagation across disparate time domains” in the name of The Boeing Company, and whether the invention, as defined by the claims, comprises added subject matter in accordance with section 76(2) of the Patents Act 1977 and an inventive step as required by section 1(1)(b) of the Patents Act 1977 (herein after the “Act”). The application was filed on 1 March 2012 claiming priority of 3 March 2011 and was published on 5 September 2012. The extended compliance period ended on 4 May 2016 and I indicated at the hearing that a further extension to the compliance would be required by 4 July 2016.

2. Throughout the examination process the examiner has maintained his view that the invention defined in the claims as filed, and subsequently amended, does not meet the requirements of section 1(1)(b) of the Act because it does not comprise an inventive step over the cited prior art and following several rounds of correspondence the applicant has been unable to convince the examiner otherwise. In his final examination report dated 29 March 2016, the examiner stated that he remained of the view that the invention, as defined by the amended claims filed on 4 March 2016, does not meet the requirements under section 1(1)(b) of the Act and, as such, refusal of the application under section 18(3) was being considered. In his examination report the examiner also raised the issue of added matter under section 76(2) of the Act regarding the feature of active aircraft control.

3. In response to the agent’s request of 4 March 2016 the examiner referred the application for a hearing on the outstanding issues raised within the examination report dated 29 March 2016. Amended claims were filed on 20 June 2016

intended to address the outstanding issues of added subject matter and inventive step. A hearing considering the outstanding issues outlined above was held on 27 June 2016. The applicant was represented by Mr Jonathan Morrall of Kilburn & Strode. Also present at the hearing were hearing assistant Dr Natalie Cole and observer Mr Andrew Isgrove.

The invention

4. The application, as filed, describes methods and systems for evaluating signal propagation delay in an avionic system. Aircraft are configured with a number of systems including navigation, fuel monitoring, altitude sensors, communications, radar, autopilot etc. These systems communicate to one another via communications buses. The system receives data from a first bus and then passes the information through to a second bus that is “time dependent” from the first bus. The first system and second system operate using independent clocking and as such there is an inherent uncertainty regarding the timing of events as the data being transmitted onto the first bus is not identifiable when the data is processed by the system and output onto the second bus. The components of such aircraft systems are known as “line-replaceable units” (LRU) that operate together as a system and are programmed to provide the flight crew with one or more displays that provide status, and allow flight crew input. LRUs generate output signals which can be monitored to determine if the LRU and/or component with which it is associated is operating correctly. In modern aircraft LRUs communicate on multiple communication buses each having a disparate time domain. This leads to an inability to precisely determine the timing of events with respect to a second bus since the event timing is first bus dependent. The application seeks to address the above problems by providing a common time reference for multiple buses.

5. In the method of the invention a referencing unit receives messages that are transmitted between various LRUs of an aircraft across a plurality of disparate communications busses; each LRU including a module incorporating one or more processors to control one or more components or subassemblies of the aircraft. The referencing unit includes a receiver for each disparate communications bus that the referencing unit is required to monitor. The referencing unit references the content of a first selected received message using a master clock within the referencing unit. The master clock then references the content of a second selected received message, where the second selected received message is related to the first selected message and occurs on a communications bus disparate from the communications bus upon which the first received message occurred. A common time reference for the content of both the first and second received messages is provided and instances of a parameter occurring in the first and second selected received messages are synchronized to determine the propagation delay across the disparate communications busses.

The claims

6. At the hearing Mr Morrall confirmed that the amended claims filed on 20 June 2016 were the working copy of the claims to form the basis of the hearing and decision. These claims comprise two independent claims. Claim 1 is reproduced below:

> *A method of correlating, in time, selected events that are memorialized as data within messages transmitted across disparate communications buses of an avionics system, said method comprising:*
>
> *receiving, with a referencing unit, the messages that are transmitted across the disparate communications busses;*
>
> *referencing, with the referencing unit, the content of a first selected received message to a master clock within the referencing unit;*
>
> *referencing, with the referencing unit, the content of a second selected received message to the master clock within the referencing unit, the second selected received message related to the first selected message, the second selected received message occurring on a communications bus disparate from the communications bus upon which the first received message occurred;*
>
> *providing, based on operation of the master clock, a common time reference for the content of both the first selected received message and the second selected received message;*
>
> *and syncing instances of a parameter occurring in the first selected received message and the second selected received message to determine a true propagation delay across the disparate communications busses across disparate time domains;*
>
> *wherein the messages that are transmitted across the disparate communications busses comprise messages transmitted between various line replaceable units of an aircraft across a plurality of disparate communications busses and each line replaceable unit includes a module incorporating one or more processors to control one or more components or subassemblies of the aircraft;*
>
> *and wherein the referencing unit includes a receiver for each disparate communications bus that the referencing unit is to monitor*

Independent claim 6 relates to an avionics system to perform the method of claim 1.

The law

Added subject matter

7. Section 76(2) of the Patents Act states:

> *No amendment of an application for a patent shall be allowed under section 15A(6), 18(3) or 19(1) if it results in the application disclosing matter beyond that disclosed in the application as filed.*

Inventive step

8. Section 1(1) of the Act sets out the requirements which need to be met for an invention to be granted:

> *A patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say –*
>
> *(a) the invention is new*
>
> ***(b) it involves an inventive step***
>
> (c) is capable of industrial application
>
> (d) the grant of a patent for it is not excluded by subsections (2) and (3) or section 4A below; and references in this Act to a patentable invention shall be construed accordingly.

9. Section 3 of the Act sets out how inventive step is determined:

> *An invention shall be taken to involve an inventive if it is not obvious to a person skilled in the art, having regard to any matter which forms part of the state of the art by virtue only of section 2(2) above (and disregarding section 2(3) above)*

10. Matter which "forms part of the state of the art by virtue only of section 2(2)" is all matter which was made available to the public before the priority date of the application in question. In this case all matter published before 3 March 2011.

11. It is well-established that the approach to adopt when assessing whether an invention involves an inventive step or not is to follow the steps originally set out by the Court of Appeal and reformulated by the Court in Windsurfing[1]/Pozzoli[2]

> *(1) (a) Identify the notional "person skilled in the art"*
>
> *(b) Identify the relevant common general knowledge of that person;*
>
> *(2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;*
>
> *(3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed;*
>
> *(4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?*

Arguments and analysis

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[1] *Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd,* [1985] RPC 59

[2] *Pozzoli SPA v BDMO SA* [2007] EWCA Civ 588

Added Matter

12. At the hearing Mr Morrall stated that the added subject matter objection raised in the examination report dated 29 March 2016 had been addressed by the amendments made to the claims filed on 20 June 2016. The opening lines of claim 1 have been amended to that as originally filed so that it no longer defines active aircraft control and I am satisfied that this amendment removes the added subject matter raised by the examiner in his examination report dated 29 March 2016. Mr Morrall went on to state that the basis for the additional feature of *"wherein the referencing unit includes a receiver for each disparate communications bus that the referencing unit is to monitor"*, in claim 1, is at page 12 lines 3-4 of the application as filed and I am in agreement that there is adequate basis for this feature within the application as filed.

13. As stated at the hearing I am satisfied that the amended claims filed on 20 June 2016 do not comprise added subject matter as required by section 76(2) of the Act. The issue I must now consider is whether the invention as defined by the claims comprise an inventive step as required by section 1(1)(b) of the Act.

Inventive step

14. To decide whether the invention as defined by the amended claims filed on 20 June 2016 involve an inventive step within the meaning of the Act I will follow the *Windsurfing/Pozzoli* steps set out above.

Step 1 – Identify the notional person skilled in the art and their common general knowledge

15. It was common ground between the examiner and Mr Morrall regarding the identity of the skilled worker. In his examination report dated 29 March 2016 the examiner stated *"In this case the skilled person will be a designer of avionics networks and/or avionics network monitoring systems. They will be familiar with the equipment and protocols used in avionics networks"* and I am in agreement with this analysis.

Step 2 – Identify the inventive concept of the claim in question, or if that cannot readily be done construe it

16. In his examination report dated 29 March 2016, the examiner construed claim 1 as:

    A network monitor for a heterogeneous aircraft control avionics (here after avionics) network that takes copies of network traffic, timestamps the copies using a common clock, identifies related traffic copied from different points in the network and determines propagation delays in the traffic.

17. However, I do not agree with this construction. Claim 1 requires a referencing unit comprising a master clock and that the referencing unit receives the (at least two) messages that are transmitted across the disparate communications busses.

Neither of these features appear in the examiner's construction of claim 1. Furthermore, claim 1 as amended includes the additional feature of *"and wherein the referencing unit includes a receiver for each disparate communications bus that the referencing unit is to monitor"*.

18. In my view the construction of claim 1 is as follows:

A method of correlating, in time, selected events that are copied as data within messages transmitted across disparate communications buses of an avionics system, the method comprising:

receiving, within a referencing unit, messages that are transmitted across disparate communications busses;

referencing, the content of a first selected received message by a master clock within the referencing unit;

referencing, the content of a second selected received message by the master clock within the referencing unit, wherein the second selected received message is related to the first selected received message, and the second selected received message occurs on a communications bus disparate from the communications bus upon which the first selected received message occurred;

providing, based on the master clock, a common time reference for the content of both the first and second selected received messages;

and synchronising the first selected received message and the second received message to determine a propagation delay across the disparate communications buses;

wherein the messages that are transmitted across the disparate communications busses comprise messages transmitted between various line replaceable units of an aircraft across a plurality of disparate communications busses and each line replaceable unit includes a module incorporating one or more processors to control one or more components or subassemblies of the aircraft;

and wherein the referencing unit includes a receiver for each disparate communications bus that the referencing unit is to monitor.

Step 3 – Identify the differences between the state of the art and the inventive concept

19. The state of the art has been maintained by the examiner to be represented by the three patent documents: US2002/093917 A1 (D1), US2008/049633 A1 (D2) and EP0726664 A2 (D3).

20. D1 ('917) discloses a method for measuring the performance of devices on a network where the device passively monitors arriving and departing data packets on one or more networks, correlates the arriving data packets with the departing data packets, and calculates latency estimates based on the confidence of the

correlation. In particular, D1 relates to passively calculating the time required to transverse a network device, i.e. routers, firewalls and servers.

21. As argued by Mr Morrall at the hearing, and as acknowledged by the examiner, D1 does not make any reference to avionics monitoring systems. Mr Morrall also argued that D1 does not make reference to a master clock. This was also acknowledged by the examiner in his examination report dated 29 March 2016 *"D1 is the closest physical match to the claimed system with timestamping within a single device connected to two network points (see Fig. 10 for instance). D1 does not explicitly state that it has a single clock…"*. I am in agreement that neither the feature of an avionics monitoring system nor a master clock are suggested in D1.

22. Furthermore, in relation to the added feature of *"wherein the referencing unit includes a receiver for each disparate communications bus that the referencing unit is to monitor"* within claim 1, Mr Morrall argued that "any units in D1 that could be considered referencing units as defined in claim 1 do not have a receiver for each disparate communications bus". Whilst the latency measurement device (LMD 100) disclosed in figure 10 of D1 could be considered as a referencing unit, I do not consider that there is any disclosure of a receiver for each disparate communications bus as defined by claim 1, as there is no disclosure of separate receivers and a common master clock.

23. D2 ('633) discloses a system and method for obtaining synchronized timestamps to measure latency in a network environment. D2 discloses that a monitor node is used to measure latency in a computer network or in a computing device by timestamping signal messages sent from nodes in the computer network and/or tasks in a particular node or device. The time stamps are generated using a system clock of the monitor node to reduce any discrepancies in timing.

24. As argued by Mr Morrall at the hearing, and as acknowledged by the examiner, D2 does not make any reference to avionics monitoring systems.

25. At the hearing Mr Morrall made particular reference to paragraphs [0025] and [0026] of D2; paragraph [0025] outlines *"…In step 400, a monitor device or monitor node (e.g., node device 205) may initially measure the latency associated with the network links between the monitor node and each of the nodes in the transmission path. The latencies may be measured by determining a round trip time corresponding to the transmission and receipt of an echo request transmitted to each of the nodes. For example, in a network including a head node, an intermediate path node (e.g., 207) and an end node (e.g., node 208), the monitor node may initially determine latency between the monitor node and each of the three nodes…"*; and paragraph [0026] outlines *"…In response to the signal message from the head node, the monitor node may generate and store a time stamp according to an internal clock in step 410. In generating the time stamp, the monitor node may adjust the time stamp to compensate for any latency between the monitor node and the head node measured in step 400.*

Such a process may be performed to normalize potential delays or time differences caused by network connections between the head node, or any path node and the monitor node…".

26. Mr Morrall argued that *"the monitor node 205 receives the message from a head node 206 and an end node 208 and it's in response to these received messages that the time stamp is generated within monitor node 205"* he went on to say that *"there isn't any tap to snoop on the bus…D2 relies on both the head node and end node forwarding the message which in itself will add latency along that particular network connection…so you are initially monitoring the delay of the network connection as well rather than tapping off a receiver".* Mr Morrall argued that the system of D2 not only adds extra infrastructure to the network, but the device also requires additional knowledge, because it needs to know the latency of whichever of the network links from the head node or end node, for any latency calculation. Claim 1 defines *"…the second selected received message related to the first selected message, the second selected received message occurring on a communications bus disparate from the communications bus upon which the first received message occurred…"*. In his examination report the examiner considered that *"The detection of receipt of a message at a node is synonymous with the message being "on" the communication link"*, however I do not share this view. As disclosed in D2 and as argued by Mr Morrall the system of D2 requires initial monitoring of the delay of the network link which is not required by the present invention. I therefore do not consider that the detection of receipt of a message at a node is synonymous with the message being "on" the communications link. Thus D2 does not disclose referencing of messages occurring on a communications bus as defined by claim 1.

27. Furthermore, D2 does not disclose a single referencing unit comprising a receiver for each communications bus to be monitored.

28. D3 ('664) discloses a plurality of digital transmission network analysers arranged to analyse and compare a data packet on a plurality of ports on a network.

29. As argued by Mr Morrall and as acknowledged by the examiner, D3 does not make any reference to avionics monitoring systems.

30. At the hearing Mr Morrall argued that D3 discloses many analysers which individually have a single tap on the network. At the hearing Mr Morrall made reference to column 2 lines 14-26 of D3 which discloses *"One way of clock synchronization and counter coordination is to put two analyzers in the same cabinet with the controller computer and use the controller computer's clock to run both analyzers and also to synchronize the counts by using both analyzers…"*. Mr Morrall argued that *"The same analyser isn't receiving and syncing the first and second message as required in our claim…having additional analysers and additional computers in an avionic system wouldn't be a desired outcome… you are adding multiple additional infrastructure"*. However I do not agree with this view. In his examination report the examiner stated *"Whilst the*

main embodiment shows network taps with individual clocks, it is pointed out (column 2 lines 14-26) that multiple analysers can be co-located with a controller computer whose clock is used for the analysers where physical constraints permit". I am of the opinion that whilst the teaching of D3 centres on a plurality of analysers each having an individual clock this document also suggests that two analysers (receivers), can be co-located with a controller computer wherein the controller computer's clock (master clock) is used to run and synchronise both analysers.

Step 4 – Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention.

31. In relation to D1 do the differences outlined above constitute steps which would have been obvious to the person skilled in the art?

32. As identified by the examiner *"D1 is intended for use with pretty much any sort of network node (para 5) and any sort of network (para 104)"*. Paragraph [0005] discloses *"…latency measurements require a certain amount of interpretation and are therefore conventionally difficult to obtain without intrusive probes. This is particularly underscored when attempting to determine the amount of delay, in microseconds per byte, for data packets travelling across routers, firewalls, and servers"* and paragraph [0104] discloses *"Communications interface 374 preferably implements industry promulgated architecture standards, such as Ethernet IEEE 802 standards, Fibre Channel, digital subscriber line (DSL), asymmetric digital subscriber line (ASDL), frame relay, asynchronous transfer mode (ATM), integrated digital services network (ISDN), personal communications service (PCS), transmission control protocol/Internet protocol (TCP/IP), serial line Internet protocol/point to point protocol (SLIP/PPP), and so on…"*. However there is no teaching in D1 that the system may be applicable to avionics networks. In his final examination report the examiner outlined *"…Avionic control networks as you present them do not seem to differ markedly from other networks…Finally, avionics being complicated and having issues with legacy compatibility does not seem to materially distinguish it from networking in general…Whilst avionic control networks will be subject to some unique constraints, whether they be scale, size, power, reliability or similar that would preclude some terrestrial solutions, or at least require significant modification, it does not seem reasonable to conclude that the skilled person would dismiss terrestrial network disclosures out of hand when designing avionics monitoring systems"*. However I do not consider that the person skilled in the art would consider all types of network as being equally applicable to avionics networks. Claim 1 defines *"Wherein the messages that are transmitted across the disparate communications busses comprise messages transmitted between various line replaceable units of an aircraft across a plurality of disparate communications busses and each line replaceable unit includes a module incorporating one or more processors to control one or more components or subassemblies of an aircraft"* where page 1 lines 22-26 of the application outline *"…One type of LRU is*

a highly complex module often incorporating several processors for controlling and/or monitoring one or more components or subassemblies of an aircraft. Other LRUs are simple, such as a mechanical device that outputs a signal based on a position of an engine nozzle". The network monitoring system must therefore be equally applicable to simple and complex components or subassemblies of an aircraft where complex systems, such as navigation, fuel monitoring, altitude sensors, radar etc, would be subject to unique constraints such as reliability, power etc. Therefore one skilled in the art would consider that the constraints imposed on the network as disclosed in D1 would not be the same as those imposed on an avionics system. Thus when seeking to find a solution to the problem of designing an avionics network I do not believe that the skilled person would consider the system, as disclosed in D1, to be suitable to implement in an avionics monitoring system.

33. Furthermore, in his examination report the examiner states *"D1 does not explicitly state that it has a single clock, however in order to determine latency this is arguably necessary. Furthermore, within a single device a common master clock is the norm and would be an obvious option"*. However there is no teaching in D1 of a referencing unit comprising a receiver for each disparate communications bus being monitored and a master clock to reference the received messages as required by claim 1 and I do not consider that these features would be obvious in light of the teachings of D1. Whilst there are known systems which measure latency using a master clock the disclosure in D1 does not disclose or suggest a single referencing unit comprising a master clock which synchronizes messages from disparate communications busses received via receivers in the referencing unit.

34. I therefore conclude that the differences between the prior art as set out in D1 and claim 1 as construed would not be obvious to the person skilled in the art. I consider that Claim 1 comprises an inventive step over D1.

35. Similar arguments apply in relation to D2. D2 does not make any reference to avionics monitoring systems. Thus when seeking to find a solution to the problem of designing an avionics network I do not believe that the skilled person would consider the system, as disclosed in D2, to be suitable to implement in an avionics monitoring system.

36. As discussed above there is no teaching in D2 of a single referencing unit comprising a receiver for each communications bus to be monitored. Furthermore, I do not consider that the detection of receipt of a message at a node is synonymous with the message being "on" the communications link. In light of the teaching of D2 I do not believe that one skilled in the art would consider incorporating a single referencing unit comprising a receiver for each communications bus in the system disclosed.

37. I therefore conclude that the differences between the prior art as set out in D2 and claim 1 as construed would not be obvious to the person skilled in the art. I consider that Claim 1 comprises an inventive step over D2.

38. Similar arguments apply in relation to D3. D3 does not make any reference to avionics monitoring systems. Thus when seeking to find a solution to the problem of designing an avionics network I do not believe that the skilled person would consider the system, as disclosed in D3, to be suitable to implement in an avionics monitoring system.

39. I therefore conclude that the differences between the prior art as set out in D3 and claim 1 as construed would not be obvious to the person skilled in the art. I consider that Claim 1 comprises an inventive step over D3.

Conclusion

40. I find that the claims comprise an inventive step as required by section 1(1)(b) of the Act. I therefore remit the case back to the examiner so that the description may be amended to be bought into line with the claims as settled.

Appeal

41. Any appeal must be lodged within 28 days after the date of this decision.

Peter Mason

Deputy Director, acting for the Comptroller