

**Attachment A**  
**To Defendant Kia's Invalidity and Subject Matter Eligibility Contentions**

**'958 Patent Subject Matter Eligibility**

**1. Exceptions to Eligibility**

In the chart below, Kia identifies each exception to eligibility to which each Asserted Claim of the '958 patent is directed and the factual and legal basis therefor. The chart also identifies whether one or more of the Asserted Claims are representative of any other Asserted Claim.

| <b>Claim</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Exceptions to Eligibility</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[1] A method comprising:</p> <p>detecting loss of lockstep for a lockstep pair of processors;</p> <p>using firmware to trigger an operating system to idle the lockstep pair of processors, recover lockstep for the lockstep pair of processors, and trigger the operating system to recognize the lockstep pair of processors having recovered lockstep; and</p> <p>responsive to said detecting loss of lockstep, using said firmware to determine if lockstep is recoverable for the lockstep pair of processors, wherein said using said firmware to determine if lockstep is recoverable further comprises determining if a lockstep mismatch has occurred between the lockstep pair of processors.</p> | <p>This claim is directed to ineligible subject matter because it is directed to the abstract idea of detecting an error, pausing to determine if the error is correctable, and if so correcting the error. The claims do not claim any improved functionality of the generic components used to implement the abstract idea. For example, idling and resetting processors, using firmware to trigger an operating system, detecting loss of lockstep, and recovering lockstep were well-known, routine, and conventional activities commonly used in the industry.</p> <p>Applying this abstract idea in a particular technological environment, involving generic processors, firmware, and operating systems operating according to their ordinary functions, does not make it patent eligible.</p> <p>Claim 1 is representative of asserted claims 2-3, 6, and 8, which all depend from claim 1 and are directed to the same abstract idea. The dependent claims simply add additional limitations</p> |

|                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                 | that are routine and conventional. The individual limitations are addressed below in Section B.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>[2] The method of claim 1 wherein said using firmware to trigger an operating system to idle the lockstep pair of processors further comprises:</p> <p>using the firmware to trigger the operating system to idle a master processor of the lockstep pair of processors.</p> | <p><i>See</i> Claim 1, <i>supra</i>.</p> <p>Claim 2 depends from claim 1 and further limits that a “master processor of the “lockstep pair of processors” is idled by the operating system. The claim 2 lacks any inventive concept and instead involves only the use of unspecified, generic computer components functioning in their routine and conventional manner to carry out the claimed abstract idea without providing any improvement to the preexisting technology.</p> <p>Idling a master processor of a lockstep pair of processors was well-known, routine and conventional. <i>See, e.g.</i>, U.S. Patent Application Publication No. US 2003/0126498 (“Bigbee”) at ¶ 0035 (“The illustrated process begins (block 402) and thereafter hardware (e.g FRC logic) detects an error within a first processor core of a plurality of processor cores operating in an FRC mode as a single logical processor, disables the first processor core, and generates a system-transparent machine check exception (block 404) which in turn causes firmware (e.g. SAL program code) to generate a system-visible system control interrupt (SCI) to operating system (OS) software and return control of at least a second, error-free processor core of the plurality of processor cores to the OS (block 406).”); Andrew Grover, <i>Modern System Power Management</i>, <a href="https://queue.acm.org/detail.cfm?id=957774">https://queue.acm.org/detail.cfm?id=957774</a> (Dec. 5, 2003) (“CPU—use processor power and performance states to save power while maintaining good performance”).</p> |
| <p>[3] The method of claim 2 wherein said using firmware to trigger the operating system to recognize the lockstep pair of processors having recovered lockstep further comprises:</p>                                                                                          | <p><i>See</i> Claims 1-2, <i>supra</i>.</p> <p>Claim 3 depends from claim 2 and further limits that the operating system recognizes the master core of the lockstep</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>using the firmware to trigger the operating system to recognize the master of the lockstep pair of processors.</p>                                                                                                   | <p>processor. Claim 3 lacks any inventive concept and instead involves only the use of unspecified, generic computer components functioning in their routine and conventional manner to carry out the claimed abstract idea without providing any improvement to the preexisting technology.</p> <p>Using an operating system to recognize a recovered master core of a lockstep pair of processors was well-known, routine and conventional. <i>See, e.g.</i>, U.S. Patent Application Publication No. US 2003/0126498 (“Bigbee”) at ¶ 0037 (“In response to the operating system ejection request, firmware virtually ejects the processor from the system, resets the processor, re-enables FRC operation of at least the first and second processor cores and generates an SCI to the Operating System...”).</p> |
| <p>[6] The method of claim 1 wherein said detecting loss of lockstep comprises:</p> <p>detecting lockstep mismatch between the lockstep pair of processors.</p>                                                         | <p><i>See</i> Claim 1, <i>supra</i>.</p> <p>Detecting lockstep mismatch between the lockstep pair of processors was well-known, routine and conventional. <i>See, e.g.</i>, U.S. Patent Application Publication No. US 2003/0126498 (“Bigbee”) at ¶ 0002 (“The processor cores are operated in a functional redundancy check (FRC) mode in which identical instructions are provided to each core and concurrently executed on identical data so that any error occurring within a single core will produce an inconsistent result as compared to the remaining cores associated with a given processor.”).</p>                                                                                                                                                                                                      |
| <p>[8] The method of claim 1 further comprising:</p> <p>if determined that a lockstep mismatch has occurred between the lockstep pair of processors, then determining that the loss of lockstep is not recoverable.</p> | <p><i>See</i> Claim 1, <i>supra</i>.</p> <p>Determining that the loss of lockstep is not recoverable was well-known, routine and conventional. <i>See, e.g.</i>, U.S. Patent Application Publication No. 2004/0123201 (“Nguyen”) at ¶ 0022 (“Since FRC errors are not recoverable, reset module 160</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | resets the system, if FRC checker 130 signals an FRC error before the underlying parity/ECC error is detected.”).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p>[19] A system comprising a pair of lockstep processors and computer-executable firmware code stored to a computer-readable medium, the computer-executable firmware code comprising:</p> <p>firmware code, responsive to detection of loss of lockstep between the pair of lockstep processors, for determining if the lockstep is recoverable for the pair of lockstep processors, wherein said firmware code for determining if the lockstep is recoverable further comprises firmware code for determining if a lockstep mismatch has occurred between the pair of lockstep processors; and</p> <p>firmware code, responsive to determining that the lockstep is recoverable, for triggering an operating system to idle the processors, attempting to recover lockstep between the pair of processors, and if lockstep is successfully recovered between the pair of processors, triggering said operating system to recognize the processors as being available for receiving instructions.</p> | <p>This claim is directed to ineligible subject matter because it is directed to the abstract idea of detecting an error, pausing to determine if the error is correctable, and if so correcting the error. The claims do not claim any improved functionality of the generic components used to implement the abstract idea. For example, idling and resetting processors, using firmware to trigger an operating system, detecting loss of lockstep, and recovering lockstep were well-known, routine, and conventional activities commonly used in the industry.</p> <p>Applying this abstract idea in a particular technological environment, involving generic processors, firmware, and operating systems operating according to their ordinary functions, does not make it patent eligible.</p> <p>Claim 19 is representative of claim 20, which depend from claim 19 and are directed to the same idea. The dependent claims simply add additional limitations that are routine and conventional. The individual limitations are addressed below in Section 2.</p> |
| <p>[20] The system of claim 19 wherein the code for attempting to recover lockstep further comprises:</p> <p>code for resetting the pair of processors.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><i>See Claim 19, supra.</i></p> <p>Providing code for resetting a pair of lockstep processors was well-known, routine and conventional. <i>See, e.g.</i>, U.S. Patent Application Publication No. US 2003/0126498 (“Bigbee”) at ¶ 0037 and Fig. 4B (“In one embodiment, the operating system may request insertion of the processor using a _PS0 control method which puts a device into its D0 or “active” state.”);</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|  |                                                                                 |
|--|---------------------------------------------------------------------------------|
|  | Ohguro at Abstract (“the processors are re-synchronized by a processor reset”). |
|--|---------------------------------------------------------------------------------|

## 2. Description of the Industry/Well Understood, Routine, and Conventional Limitations

The chart below describes the industry, at the relevant time, in which the Asserted Claims are alleged to be well understood, routine, and conventional, as well as a description of how each element of each Asserted Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and conventional, and the factual and legal basis therefor. Kia may also rely on percipient and/or expert testimony to supplement, summarize, and/or explain the state of the industry at the time the earliest application to which the '958 patent claims priority was filed. Any such witnesses will be disclosed pursuant to the Federal Rules of Civil Procedure and any Docket Control Order that is entered in this case for initial, additional, and expert disclosures.

| Claim                                                                                                                                                                                                                                                                    | Description of the Industry                                                                                                                                                                                                                                                                                                                                                                                                                            | Well Understood, Routine, and Conventional                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[1] A method comprising:</p> <p>detecting loss of lockstep for a lockstep pair of processors;</p> <p>using firmware to trigger an operating system to idle the lockstep pair of processors, recover lockstep for the lockstep pair of processors, and trigger the</p> | <p>The '958 Patent was filed on October 25, 2004 without claiming an earlier priority date. The asserted claims in the '958 Patent generally recite unspecified, generic computer components to perform the following well-understood, routine, and conventional activities previously known to the industry.</p> <ul style="list-style-type: none"> <li>⌚ Lockstep Processors or FRC Processors</li> <li>⌚ Determining Whether Lockstep Is</li> </ul> | <p>The subject matter of this claim was well understood, routine, and conventional.</p> <p>Using redundant computer components to verify and double-check data processing was routine and conventional, as discussed in the description of the industry portion of this chart.</p> <p>A method for recovery from loss of lock step is well-understood, routine and conventional. <i>See, e.g.,</i> Safford, 2:13-25; Akai, [0006], [0008]; Bigbee, at Abstract.</p> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>operating system to recognize the lockstep pair of processors having recovered lockstep; and</p> <p>responsive to said detecting loss of lockstep, using said firmware to determine if lockstep is recoverable for the lockstep pair of processors, wherein said using said firmware to determine if lockstep is recoverable further comprises determining if a lockstep mismatch has occurred between the lockstep pair of processors.</p> | <p>Recoverable</p> <ul style="list-style-type: none"> <li>⌚ Handling Recoverable or Non-Recoverable Errors</li> <li>⌚ Using Firmware to Detect and Handle Processor Errors</li> <li>⌚ Switching Role of One Processor to Another Processor</li> </ul> <p><b>A. Lockstep Processors or FRC Processors Was Known</b></p> <p>Before the time of the '958 Patent, a typical approach to improve fault tolerance of a computer system is to use lockstep processing. The use of fault tolerant data processing architecture was well-known for decades. <i>See, e.g.,</i> Jan G. Oblonsky, <i>Eloge: Antonin Svoboda, 1907-1980</i>, <a href="https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4639397">https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4639397</a> at 288 (“SAPO was ... the first fault-tolerant computer ever built” from 1950 to 1956.). Since the early days of fault tolerant computing, multiple processors were used to operate concurrently on identical data to check for errors, and multiple methods were available to recover from an error. <i>Id.</i> at 288 (“[SAPO] had three CPUs operating concurrently on identical data, two voting units to select the correct result, immediate reread and compare to check the memory-write operations, parity for checking the memory-read operations, and single-instruction restart if any of the</p> | <p>Detecting loss of lockstep for a lockstep pair of processors is well-understood, routine and conventional. <i>See, e.g.,</i> Safford, 1:32-43, 1:51-55, Fig. 1B; Bigbee, [0033]; Akai; [0018]-[0023]; Wardrop, 13:23-14:6, 6:13-20, 20:19-25 and Fig. 6.</p> <p>Using firmware to cause operating system to idle, recover and recognize the recovered lockstep processors is well-understood, routine and conventional. <i>See, e.g.,</i> Bigbee, [0025], [0034]-[0037]; Andrew Grover, <i>Modern System Power Management</i>, <a href="https://queue.acm.org/detail.cfm?id=957774">https://queue.acm.org/detail.cfm?id=957774</a> (Dec. 5, 2003). Using firmware to send instructions to the operating system to access functionality provided by computer components such as processors were routine and conventional. <i>See</i> '958 patent at col. 5:5-15 (describing common types of processors), 5:20-45 (describing “well-known functions provided by the supporting firmware (SAL, EFI)”).</p> <p>It was routine and conventional to detect loss of lockstep for a pair of processors by, for example, comparing the output of one processor to that of the other processor. <i>See</i> Klecka at Abstract (“Outputs of one of the processor units are compared to that of the other processor unit.”). Using firmware to determine if lockstep is recoverable based on the detected error and to determine if the detected error is a lockstep</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                               |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>previous measures failed.”); <i>see also</i> Bigbee, [0033]; Nguyen, [0006]; Kondo, [0004]; '958 Patent, 2:13-19. A discrepancy between the outputs of a pair of processors is a loss of lockstep. Safford, 1:51-55. Because lockstep processors execute redundant instructions in parallel, lockstep systems are said to perform a “functional redundancy check.” Safford, 1:51-55. Thus, processors operating in lockstep were also referred to as processors operating in functional redundancy check mode or FRC mode. A POSITA would have understood that both the terms FRC processor or a lockstep processor refer to a processor including two or more processor cores operating in FRC mode or in lockstep.</p> <p>If comparing the outputs of the pair of processors indicates that they have produced the same outputs, it is assumed that there is no error in processing. If the comparison indicates a difference or mismatch, it is assumed that at least one processor has an error. Safford, 3:10-20. An example of such an error is a data cache error or a soft error. <i>Id.</i>, 1:46-50; Nguyen, [0008]. A loss of lockstep, if not promptly corrected, may cause the computer system to crash. That is, a failure of one of the pair of processors may halt the entire computer system, even if the other processor does not encounter an error. <i>Id.</i>, 1:46-50. A POSITA would have understood that a “soft error” results when, for example, a high-energy particle switches the state of a memory element</p> | <p>mismatch is well-understood, routine and conventional. <i>See, e.g.</i>, Safford, 3:21-51; Nguyen, [0022] and [0046]; Kondo [0089], [0100] and [0102]; Bigbee, [0033].</p> |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>causing a parity or other error. Nguyen, [0004]; Kondo, [0006]. Soft errors are generally correctable by rewriting the effected memory location. Soft errors are distinct from so-called “hard” errors which indicate the actual failure of a hardware element.</p> <p>It was conventional and well known to a POSITA that a pair of lockstep processors are often differentiated by designating one as a master processor and the other as the slave processor, that these roles may change over time, and that processors have status registers for recording such designations. Goodrum, 1:32-41; Marshall, 1:11-16; Kondo, [0086]; Tu, [0031].</p> <p>It was also known that an error detected in an individual processor of a pair of lockstep processors signals an impending mismatch error. Safford, 3:5-34 (error detected in an single processor core of a lockstep processor signals an impending loss of lockstep); Kondo, [0101] (detecting an error in the processor provides early warning of a divergence), [0103] (“When utilizing lockstepped processors, a recoverable error on one processor ... will nevertheless result in a divergence, since it will take additional processing and some number of clock cycles on the part of the one processor to recover from the error.”), [0106] (divergence between the processor cores of an FRC processor can be predictively detected by detecting errors in the processor cores); Nguyen, [0008] (soft errors in</p> |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>FRC-enabled processors are likely to be manifested as FRC errors since they take the execution cores out of lockstep), [0022] (data corruption in a processor core of an FRC processor can trigger an FRC error).</p> <p><b>B. Determining Whether Lockstep Is Recoverable Was Known</b></p> <p>It was known that lockstep is recoverable from some errors in a lockstep processor, such as soft errors, but not recoverable from some other errors, such as some lockstep mismatch errors.</p> <p>For example, lockstep is recoverable from an error detected in an individual processor before a mismatch error is detected and signaled. A pair of lockstep processors can include error detection and signaling logic 112 and 114, respectively, to signal an impending loss of lockstep. Safford, 3:21-51.</p> <p>It was known that detecting and handling such error before signaling a mismatch error improves processor or system availability. Safford, 3:21-51 (using the error detected in the processors of a lockstep processor pair to signal an impending loss of lockstep and improve availability of the processor assets); Nguyen, [0046] (detecting an error in the processor core before triggering an FRC reset allows recovery from the error); Kondo, [0100] (a processor error indicating that a divergence will occur but will not compromise</p> |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>data integrity is a correctable memory error).</p> <p>It was also known that lockstep is non-recoverable from a mismatch error in various situations. For example, lockstep is not recoverable from a hard error that caused the mismatch (e.g., partial or total hardware failure). Bigbee, [0033] (such inconsistencies can occur as a result of partial or total hardware failure; Bossen, 1:35-40 (no recovery is possible for hard errors). Also, lockstep is not recoverable if the processor or FRC logic does not know which processor core was responsible for the mismatch error. Nguyen, [0023] (“Not all FRC-errors are traceable to underlying parity/ECC or other correctible soft errors.”)</p> <p>As another example, lockstep is not recoverable if the mismatch error is triggered before the detection of the error in the individual processor. Nguyen, [0022] (triggering a non-recoverable FRC error before the underlying parity/ECC error in the processors is detected). And lockstep is not recoverable if the mismatch error is detected in the absence of detecting an error in the individual processor. Marshall, 2:17-34 (if an error is detected based on comparing outputs of the two processors, the system is stopped since comparison checks indicate only that there was a failure but not who failed). Such mismatch error typically would indicate a high risk of corrupt data or incorrect results about to propagate through the system. Kondo, [0089] (divergence</p> |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>detection is indicative of potential error or data corruption about to propagate); Kondo, [0102] (divergence detection in the absence of detecting errors in the processors typically would indicate a more serious error).</p> <p><b>C. Handling Recoverable or Non-Recoverable Errors Differently Was Known</b></p> <p>It was known that once an error was detected in FRC processors, the appropriate action responsive to the recoverability of the detected error should be taken to handle non-recoverable and recoverable errors to reduce impact of the errors on the system.</p> <p>With respect to non-recoverable errors, for example, it was known that when a non-recoverable error occurs, there is risk of corrupt data or results propagating through the system. An appropriate action for handling a non-recoverable error would have been immediately resetting or rebooting the system to return the system to a safe state or shut down the processor. Nguyen, [0007] (FRC errors are detectable but not recoverable; the FRC error handling routine typically resets the system, which is time consuming and reduces system availability); Marshall, 2:3-6 (the only recovery action responsive to an output mismatch is to reset the system); Kondo, [0039] (conducting a hard-reset of the lockstep computer processing system for handling a non-recoverable error), [0190] (shut down processor under conventional non-</p> |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>recoverable error handling, losing it as a resource, followed by repair/replacement); Schultz, [0030] (“When an error is not recoverable, the system may be rebooted to return it to a safe state”); Marisetty, 5:21-28 (For errors that cannot be corrected, the system will need a reboot and execution cannot continue.).</p> <p>Also, a mismatch error can be non-recoverable because it indicates a non-recoverable partial or hardware failure of the processor (Bigbee, [0033]), for which an appropriate action would have been replacing it with another processor. Klein, 1:19-66 (hot swapping a failed CPU while the system is running); Fox, Abstract, [0005]-[0014] (replacing a failing processor with a hot spare processor); Arai, 1:39-45, 2:23-41 (replacing a failed processor with a reserved processor).</p> <p>With respect to recoverable errors, various recovery routines have been used for handling such errors to reduce the impact of such errors on the system, such as those disclosed in Bigbee, Nguyen, Kondo, and Safford. Kondo, [0191] (structuring error recoveries to ensure data corruption will not leave the processor).</p> <p>Treating an otherwise recoverable error as a non-recoverable error would reduce system availability. Recovery of lockstep from a recoverable error can be implemented with a lower latency as compared to the reset or repair/replacement processes for handling a non-</p> |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>recoverable error, which can result in system performance loss over a longer latency. Nguyen, [0022]-[0023], [0040].</p> <p>Treating a non-recoverable error as a recoverable error would reduce system reliability. For example, it would create risks of having corrupt data or results propagating through the system. Kondo, [0101] (the detection and signaling of an error may be taken as an indicator of imminent divergence; the longer time that passes from error or divergence detection without remedial action, the more serious the impact of the error or divergence will be); Marisetty, 2:38-50 (other processors of a multiprocessor system may continue execution without knowledge of the error, propagating the error and causing further damage in the system), 2:51-52 (Multiprocessor systems may have to reboot or shut down for errors because of a lack of proper error handling).</p> <p><b>D. Using Firmware and Operating System to Detect and Handle Processor Errors Was Known</b></p> <p>It was known that firmware can be used for detecting lockstep errors and to cause operating system to virtually eject the lockstep pair of processors when lockstep error is detected and then virtually insert the lockstep pair when it is recovered. Bigbee, [0025], [0034]-[0037].</p> <p>It was also common and known that firmware</p> |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>can be used for handling processors errors. Nguyen, [0045] (using PAL or SAL layers of BIOS— firmware—for implementing error recovery mechanisms in Itanium® family processors); Marisetty, FIGS. 1-2, 5:48-8:64 (teaching using firmware including PAL and SAL to execute error handling routines); Schultz, FIGS. 1-3, [0017]- [0018] (teaching using firmware including PAL and SAL for correcting an error that is not correctable directly by hardware).</p> <p>By the time of the purported invention of the '958 patent, using firmware to trigger an operating system to manage the performance states of devices and processors (including idling) was well known and supported by many manufacturers and OS providers, such as Intel and Linux. <i>See, e.g.,</i> Andrew Grover, <i>Modern System Power Management</i>, <a href="https://queue.acm.org/detail.cfm?id=957774">https://queue.acm.org/detail.cfm?id=957774</a> (Dec. 5, 2003) (“The Advanced Power Management (APM) interface, created by Intel and Microsoft in 1992, marked the first time the firmware exposed power management interfaces to the operating system in a well-defined manner.”); Seh Kwa, Debra T. Cohen, <i>PCI Express Architecture Power Management</i>, <a href="https://www.intel.com.br/content/dam/doc/white-paper/pci-express-architecture-power-management-rev-1-1-paper.pdf">https://www.intel.com.br/content/dam/doc/white-paper/pci-express-architecture-power-management-rev-1-1-paper.pdf</a> (Nov. 8, 2002).</p> |  |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>By the time of the purported invention of the '958 patent, using firmware to determine if lockstep is recoverable and recovering lockstep was well known and widely used across the industry. <i>See, e.g.</i>, Shubhendu S. Mukherjee, Michael Kontz, and Steven K. Reinhardt, <i>Detailed Design and Evaluation of Redundant Multithreading Alternatives</i>, IEEE (2002) (“One fault-detection approach for microprocessor cores ... runs two identical copies of the same program as independent threads and compares their outputs. On a mismatch, the checker flags an error and initiates a hardware or software recovery sequence.”).</p> <p><b>E. Switching Role of One Processor to Another Processor Was Known</b></p> <p>It was known and common that the role of a lockstep pair of processors in which a lockstep error is detected can be switched to another lockstep pair of processors. Safford, 3:52-4:63; Akai, [0018]-[0023]; Wardop, 13:23-14:6.</p> <p>It was also common and known that one processor can be determined as a boot processor and another processor can be determined as a non-boot processor or non-primary processor in a fault tolerant multi-processor system. Goodrum, 2:14-23 (teaching a method of booting up a multiprocessor system including assigning a primary processor responsible for powering up the computer system).</p> |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|                                                                                                                                                                                                                                                                                                              |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>[2] The method of claim 1 wherein said using firmware to trigger an operating system to idle the lockstep pair of processors further comprises:</p> <p>using the firmware to trigger the operating system to idle a master processor of the lockstep pair of processors.</p>                              | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p><i>See</i> claim 1.</p> <p>Idling a master processor of a lockstep pair of processors is well-known, routine and conventional. <i>See, e.g.</i>, Bigbee, [0035]. It was conventional and well known to a POSITA that a pair of lockstep processors are often differentiated by designating one as a master processor and the other as the slave processor, and that these roles may change over time, and that processors have status registers for recording such designations. <i>See, e.g.</i>, Goodrum, 1:32-41; Akai, [0006], [0011]; Kondo, [0086].</p> |
| <p>[3] The method of claim 2 wherein said using firmware to trigger the operating system to recognize the lockstep pair of processors having recovered lockstep further comprises:</p> <p>using the firmware to trigger the operating system to recognize the master of the lockstep pair of processors.</p> | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p><i>See</i> claim 2.</p> <p>Using operating system to recognize as recovered the master of a lockstep pair of processors is well-known, routine and conventional. <i>See, e.g.</i>, Bigbee, [0025], [0034]-[0037].</p>                                                                                                                                                                                                                                                                                                                                         |
| <p>[6] The method of claim 1 wherein said detecting loss of lockstep comprises:</p>                                                                                                                                                                                                                          | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p><i>See</i> claim 1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| detecting lockstep mismatch between the lockstep pair of processors.                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p>[8] The method of claim 1 further comprising:</p> <p>if determined that a lockstep mismatch has occurred between the lockstep pair of processors, then determining that the loss of lockstep is not recoverable.</p>                                                                                                                                                                                                                                                                                  | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p><i>See</i> claim 1.</p> <p>Determining that the loss of lockstep is not recoverable is well-known, routine and conventional. <i>See, e.g.</i>, Nguyen, [0022], [0023]; Bigbee, [0033].</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>[19] A system comprising a pair of lockstep processors and computer-executable firmware code stored to a computer-readable medium, the computer-executable firmware code comprising:</p> <p>firmware code, responsive to detection of loss of lockstep between the pair of lockstep processors, for determining if the lockstep is recoverable for the pair of lockstep processors, wherein said firmware code for determining if the lockstep is recoverable further comprises firmware code for</p> | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p>Providing a lockstep pair of processors is well-understood, routine and conventional. <i>See, e.g.</i>, Safford, 1:32-43, 1:51-55, Fig. 1B; Bigbee, [0033]; Akai; [0018]-[0023]; Wardrop, 13:23-14:6, 6:13-20, 20:19-25 and Fig. 6; Shubhendu S. Mukherjee, Michael Kontz, and Steven K. Reinhardt, <i>Detailed Design and Evaluation of Redundant Multithreading Alternatives</i>, IEEE (2002) at 11 (“Lockstepped dual processors—both on a single die and different dies—have long been used for fault detection.”). It is also well-understood, routine and conventional that a computer system comprises a computer-readable medium storing firmware code. <i>See, e.g.</i>, Bigbee, [0012]-[0014], [0016], [0019], [0026]-[0027], [0029], Fig. 2, Fig.3.</p> <p>Using firmware to determine if lockstep is recoverable based on the detected error and to determine if the detected error is a lockstep mismatch is well-understood, routine and</p> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>determining if a lockstep mismatch has occurred between the pair of lockstep processors; and</p> <p>firmware code, responsive to determining that the lockstep is recoverable, for triggering an operating system to idle the processors, attempting to recover lockstep between the pair of processors, and if lockstep is successfully recovered between the pair of processors, triggering said operating system to recognize the processors as being available for receiving instructions.</p> |                                                                                              | <p>conventional. <i>See, e.g.</i>, Safford, 3:21-51; Nguyen, [0022] and [0046]; Kondo [0089], [0100] and [0102]; Bigbee, [0033].</p> <p>It is well-understood, routine and conventional that firmware can be used trigger operating system to idle, recover and recognize a recovered lockstep pair if processors. <i>See, e.g.</i>, Safford, 3:52-4:63; Akai, [0018]-[0023]; Wardop, 13:23-14:6, 16:13-20, 20:19-25; Fig. 6; Bigbee, [0025], [0034]-[0037].</p> |
| <p>[20] The system of claim 19 wherein the code for attempting to recover lockstep further comprises:</p> <p>code for resetting the pair of processors.</p>                                                                                                                                                                                                                                                                                                                                           | <p>This claim relates to the same industry as claim 1. <i>See</i> claim 1, <i>supra</i>.</p> | <p><i>See</i> claim 19.</p> <p>Providing code for resetting a pair of lockstep processors was well-known, routine and conventional. <i>See, e.g.</i>, Bigbee, [0037], Fig. 4B.</p>                                                                                                                                                                                                                                                                               |