

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Mercedes-Benz USA, LLC,
Petitioner,

v.

Daedalus Prime LLC,
Patent Owner.

Case No. IPR2023-01343
Patent 8,898,494

**PETITIONER'S REPLY TO
PATENT OWNER'S RESPONSE**

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PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 8,898,494 (“ ’494 Patent ”)
1002	File History for the ’494 Patent
1003	Declaration of David Wyatt
1004	Curriculum Vitae of David Wyatt
1005	U.S. Patent No. 7,421,601 to Bose (“ Bose ”)
1006	U.S. Patent No. 7,263,457 to White (“ White ”)
1007	U.S. Patent No. 8,601,300 to Anderson (“ Anderson ”)
1008	U.S. Patent Application No. 2009/0150689 (“ Simeral ”)
1009	U.S. Patent No. 8,510,582 to Naffziger (“ Naffziger ”)
1010	Deposition Transcript of Dr. Micheal C. Brogioli

I. Introduction

The Patent Owner's Response ("POR") attempts to rewrite, and read additional limitations into, the challenged claims so as to avoid the prior art. It should not be allowed to do so. As explained below and in the Petition, when the '494 Patent and its claims are properly considered, it is clear the prior art references invalidate the challenged claims and Patent Owner's arguments should be dismissed.

II. Independent Claim 1 (Bose)

A. Bose Anticipates or Renders Obvious Independent Claim 1.

Regarding independent claim 1, Patent Owner argues only that that Bose does not disclose Claim 1[g], i.e. "balancing control adapted to receive the bus workload from the bus workload monitor and to dynamically tune power allocation between the first core and the communication bus based on a power limit for the integrated circuit and a comparison between the bus workload and a bus workload threshold." (POR, 23-24.) Specifically, Patent Owner argues that (1) Bose does not disclose a "workload threshold" because the claimed threshold allegedly must be a fixed value (*id.*, 25); and (2) Bose does not disclose comparing the bus workload with a bus workload threshold. (*Id.*, 25-28.) Both arguments lack merit.

First, Patent Owner's assertion that the "workload threshold" must be a singular fixed value has no basis in the claims or the '494 Specification. (*Id.*, 25.) Instead, the claims, and the '494 Patent, generally describe use of any workload

“threshold,” which includes thresholds that vary or are dynamically updated over time as disclosed in Bose. (Petition, 25-26; Declaration of David Wyatt (EX1003), ¶¶53-56.) As explained in the Petition, Bose’s predicted power and performance in the Power/Performance Trade-off Table 206 represents a workload threshold. (*Id.*) Patent Owner points to the disclosure in Bose that the global PMCU controller 216 updates the Power/Performance Trade-off Table 206 and argues that “[d]ynamically changing data of this kind ... does not represent a threshold, a single value against which a measured quantity is evaluated.” (POR, 25.) However, this narrow interpretation of “workload threshold” is unsupported, and is simply an attempt to rewrite or read additional limitations into the claim that do not exist. While Bose discloses that the Power/Performance Trade-off Table 206 may be updated, this in no way precludes the information contained therein being used as a threshold. (Petition, 25-26; EX1003, ¶¶53-56.)

Moreover, Patent Owner argues that because the Phase Prediction Table includes a structure with update semantics and control, it is not to be used a threshold. (POR, 25.) But this is irrelevant. Patent Owner appears to be confused by the numerous tables disclosed in Bose. The Petition says nothing about using the Phase Prediction Table as a threshold. Again, the Petition explains the predicted power and performance represents a workload threshold for a given component,

which is used by the global PMCU to select and adjust the power mode of a component. (Petition, 25-26; EX1003, ¶¶53-56.)

Second, Patent Owner claims that the Petition improperly relies on Mr. Wyatt's declaration rather than the teachings of Bose itself to show that Bose discloses the claimed "comparison" of the bus workload to the bus workload threshold. (POR, 26.) But this is not true. As explained in the Petition, Bose's system decreases or increases power level of a component based on both the monitored power and performance levels of the component (*i.e.*, the "workload") and the predicted power and performance level (*i.e.*, the "workload threshold"). (Petition, 26.) Mr. Wyatt simply explained these teachings of Bose in more detail, including that Bose discloses when the actual total power exceeds the total power budget, the system "assigns a lower power mode" to a component "if the power budget assigned to the [component] is **insufficient** and increases to higher power modes if the [components] are **exceeding** the power budget, such that the sum of power usage for all components fits into the overall power budget" based on the monitored activity level ("workload") and the predicted power/performance trade-off stored in the Power/Performance Trade-off Table ("workload threshold"). (Bose, 8:35-39. 9:14-30; EX1003, ¶¶55-56.)

Patent Owner further argues that it is not necessary for the Bose system to compare bus workload to a bus workload threshold "because direct information

concerning actual power level decreases or increases for different power modes is available from the power-performance tradeoff table.” (POR, 27.) This argument is also unavailing. As explained in the Petition, the global PMCU adjusts the power mode of a component based on real time statistics stored in the Phase History Table 213 (i.e., the monitored power and performance levels) and the predicted power and performance for each power mode stored in the Power/Performance Trade-off Table 206 (i.e., the “workload threshold”). (Petition, 25-26; EX1003, ¶¶53-56; Bose, 7:8-17, 7:50-53, 8:35-39, 9:3-24, 12:30-41.) By comparing the monitored power and performance level (i.e., “workload”) with the predicted power and performance level (i.e., “workload threshold”), the global PMCU determines whether the power budget assigned to the component is sufficient and assigns a power mode accordingly. (Petition, 25-26; EX1003, ¶¶53-56; Bose, 9:25-35 (“With these considerations, the state 311 assigns a lower power mode for a core if the power budget assigned to the core is insufficient and increases to higher power modes if the cores are exceeding the power budget.”)) While each power mode will result in a decreased or increased power level and the amount of such change in power is available, the global PMCU still needs to determine when a higher or lower power mode is required, which is done via comparing the monitored power and performance level to the predicted power and performance as indicated in Bose. (Petition, 25-26; EX1003, ¶¶53-56; Bose, 9:14-30.)

Moreover, the object of Bose's system is not only to ensure that the total power usage is within the maximum power limit, but also to achieve performance goals, such as to maximize the chip (or system) level throughput performance. (Petition, 27; EX1003, ¶59; Bose, 2:43-51, 4:21-29, 4:42-45, 8:15-18.) To achieve the performance goals, in adjusting the power mode, Bose system considers both the predicted performance and the monitored "performance statistics such as ... instructions per cycle (IPCs)" (Bose, 6:60-62), which Patent Owner's own expert conceded is workload. (Deposition Transcript of Dr. Michael Brogioli (EX1010), 50:12-20.) Therefore, Patent Owner is wrong that it is not necessary for there to be any comparison of bus workload to a bus workload threshold in the Bose system. And, as explained, Bose in fact makes such a comparison as it uses both the monitored performance and the predicted performance when determining when to assign new power budget and new power mode. (Petition, 25-26; EX1003, ¶¶53-56)

Furthermore, Claim 1 only requires balancing control to dynamically tune power allocation based on "a comparison between the bus workload and a bus workload threshold," but does not limit it to any particular type of comparison. Only in Claim 3 does the '494 Patent specifically require adjusting frequency of the communication bus based on the monitored bus workload being more or less than a bus workload threshold. To the extent that the Board determines that Claim 1 requires the same type of comparison as recited in Claim 3, Bose in view of Simeral

discloses this, as explained in the Petition with respect to dependent claim 3. (Petition, 29-33; EX1003, ¶¶62-69.) In particular, Simeral discloses comparing the activity level of a bus with a fixed threshold. (Petition, 29-30.) For example, Simeral discloses “data path controller 100 can manage power for a computing device by first monitoring the activity level of the bus (e.g., the data transfer rate of the bus)” and:

if the data rate is below some threshold (i.e., low amounts of data are passing over the bus), then data path controller 100 can either decrease (i.e., “throttle down”) the bus width or shut down one or more bus controllers, thereby conserving power that would otherwise be expended by maintaining a higher bandwidth.

(Simeral at [0021] (emphasis added).) Simeral also discloses activity level thresholds can be “upper limits, lower limits and/or one or more ranges.” (*Id.* at [0026].) Thus, even if the Board determines that a threshold must be a fixed value as contended by Patent Owner, Simeral discloses such fixed threshold, and as explained in the Petition (such as with respect to claim 3), it would have been obvious to modify Bose in view of Simeral to include a comparison to a fixed threshold in order to, for example, adjust power allocation in a more timely and efficient manner. (Petition, 32.)

B. Claim 1 Does Not Preclude the Hierarchical Control System Described in Bose.

Patent Owner also contends that claim 1 is not obvious in view of Bose, largely regurgitating the same arguments that Bose does not disclose a fixed threshold and that Bose makes it unnecessary to perform any comparison of bus workload to a bus workload threshold. (POR., 28-33.) As discussed above, neither argument has merits. Additionally, Patent Owner asserts that claim 1 is not obvious over Bose because “the claimed invention does not resemble the hierarchical and distributed control system described by Bose.” (*Id.*, 29.) This is a red herring. Nothing in the claims or specification of the ’494 Patent precludes an implementation of power control in a hierarchical manner, *i.e.*, with a global control unit to determine the power mode for each component and with a local control unit to execute the power allocation decision. (EX1010, 108:14-110:13.)

Patent Owner does not dispute that Bose discloses a processor comprising a processor that has an integrated circuit which includes (1) a first core, (2) a cache memory, (3) a communication bus coupled to the first core, the communication bus to connect the first core and the cache memory; (4) a core workload monitor configured to determine a core workload for the first core; and (5) a bus workload monitor configured to determine a bus workload for the communication bus as recited in claim 1. With respect to the balancing control element that is the focus of Patent Owner’s arguments, claim 1 does not contain any limitations as to its structure, such as whether it is limited to a single control unit. (’494 Patent, Cl. 1.)

Nor does anything in the claim recite or indicate it cannot be a hierarchical and distributed control system. (*Id.*) This is because the '494 Patent does not limit its scope in such a manner—the specification explicitly discloses that “[i]t will be apparent ... to one skilled in the art that these specific details [such as examples of “specific hardware structures”, “specific architectural and micro architectural details”, “specific structures of determining workloads”, “specific modules to determine and set performance/power limits”] ***need not be employed to practice the present invention.***” ('494 Patent, 2:32-45.) Patent Owner’s expert admitted as much, confirming that it is not “explicitly called out one way or the other” in claim 1 (and claim 4) whether a single power control module is required or whether a system with hierarchical power management is excluded. (EX1010, 108:14-110:13; *see also* EX2001, ¶52.).

Therefore, Patent Owner’s arguments that Bose cannot render claim 1 obvious because it is directed to a hierarchical control system are irrelevant. As explained above, in the Petition, and by Mr. Wyatt, Bose discloses to a POSITA a “balancing control adapted to receive the bus workload from the bus workload monitor and to dynamically tune power allocation between the first core and the communication bus based on a power limit for the integrated circuit and a comparison between the bus workload and a bus workload threshold.” (Petition, 23-26; EX1003, ¶¶50-56.)

III. Dependent Claims 2-3 and 13-15 (Bose)

Patent Owner argues that dependent claims 2-3, and 13-15 are not obvious in view of Bose in combination with additional references because of their dependency on claim 1. (POR, 33-34.) Patent Owner offers no separate arguments with respect to these claims. (*Id.*) Because Patent Owner's arguments regarding Bose with respect to claim 1 fail, its arguments regarding dependent claims 2-3, and 13-15 also fail.

IV. Independent Claim 1 (White in Combination of Simeral)

Patent Owner argues that the White-Simeral combination does not render claim 1 obvious because White allegedly fails to teach Claim 1[e], i.e. a core workload monitor configured to determine a core workload for the first core. (POR, 42-45.) Particularly, Patent Owner argues that monitoring the operating voltages and frequencies of a component as disclosed in White is not the same as monitoring the workload of the component. (*Id.*, 42, 44.) However, the sole basis for this is Patent Owner's improper attempt to narrow the scope of the claimed determination of "workload" through argument in a manner not supported by the '494 Patent. *CUPP Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1383 (Fed. Cir. 2022) (Precedential) ("A rule permitting a patentee to tailor its claims in an IPR through argument alone would substantially undermine the IPR process. ... If patentees could shapeshift their claims through argument in an IPR, they would frustrate the Patent Office's power to 'revisit' the claims it granted, and require focus on claims the patentee now wishes it had secured.") This is just what Patent Owner is trying to

do here—change the scope of its claims to exclude determinations of workload found in the prior art.

Contrary to Patent Owner’s argument, nothing in the ’494 Patent indicates that determining a “workload” cannot be done by monitoring operating frequencies and voltages, which provide indications of activity or use of a processing element. (Petition, 53-54, 72; EX1003, ¶¶102-103, 134.) Notably, the ’494 Patent explicitly discloses:

Determining *a workload includes any known method for determining activity of hardware, a workload of software, a number of instructions executed or to execute, or any other metric for determining use of a processing element.* As one example, a workload for core 505 includes an amount time core 505 is active during a period of time. Activity may be determined as when core 505 is in an active performance state versus a sleep or low power state or a number of cycles executing or performing operations. (’494 Patent, 9:47-57; *see also* 16:19-23.) Thus, it is clear the ’494 Patent considers any metric for determining use of a processing element counts as a way to determine “workload.” Indeed, the ’494 Patent indicates that frequency can be monitored as an indication of “workload.” *See e.g.*, ’494 Patent at 10:65-11:2 (“**[I]f workload module 520 determines the GPU 505’s frequency is below a threshold ...**, then any CPU 505’s frequency cap or limit is increased to cause more production, such that GPU cores 510 workload increases accordingly.”)

As explained in the Petition, White discloses the power management logic 200 monitors and adjusts the operating frequency and/or voltage of various

components to increase or decrease their power consumption. (Petition, 53-54.) And it is well understood by a POSITA that the operating frequency and voltage of a component reflect the activity and use, or workload, of that component. (EX1003, ¶103.) Patent Owner contends that monitoring operating voltage/frequency is not the same as monitoring workload because “performance metrics such as frequency *can* be altered independently of workload.” (POR, 44.) However, that performance metrics such as frequency can be altered independent from workload does not mean they do not provide an indication of the use of a component (*i.e.*, a determination of “workload.”) As discussed above, the ’494 Patent broadly defines any metric for determining use of a component as a determination of “workload,” and White’s monitored performance metrics or operating characteristics of voltage or do this. (EX1003, ¶80.)

V. Dependent Claims 2-3 and 13-15 (White in Combination of Simeral)

Patent Owner argues that dependent claims 2-3, and 13-15 are patentable over White and Simeral in combination with additional references because of their dependency on claim 1. (POR, 45-46.) Patent Owner offers no separate arguments with respect to these claims. (*Id.*) Because Patent Owner’s arguments regarding White in combination with Simeral with respect to claim 1 fail, its argument regarding dependent claims 2-3, and 13-15 also fail.

VI. Independent Claim 4

Regarding independent claim 4, Patent Owner argues only that White does not disclose part of Claim 4a, i.e., “receiving a bus workload for a communication bus and a first processing element workload for a first processing element based on an integrated circuit reaching a limit.” (POR, 46.)

First, Patent Owner similarly argues that operating voltage/frequency cannot reflect workload. (POR, 46-49.) As discussed above, this argument should fail.

Second, Patent Owner argues that Claim 4[a] recites “receiving” workload, and asserts that this requires receiving the actual “activity level,” and cannot be receiving anything that reflects the activity and use, or workload of a component. (POR, 48-49.) As discussed above, Patent Owner’s narrow read that workload can only be measured as activity over a period of time is inconsistent with the broad language of the claim and the ’494 Patent, which indicates determining workload can be done using any known method for determining use of a processing element. *See Supra* Section IV. Moreover, to support its argument, Patent Owner selectively quotes from the Specification to make it *appear* that “workload” was defined as being “measured as a number of active cycles over a period of time.” (POR, 48-49 (citing to, for example, ’494 Patent, 9:61-63.) However, reading these sections of the ’494 Patent in context, it is immediately apparent that “activity level” is simply one of “***the multitude of potential workload measurements,***” that “***the components to measure such workload may also vary,***” and that the example of workload being

activity cycles over time was simply provided to “further discussion of the ***potential components*** for workload measurement.” (’494 Patent, 9:47-63.)

Thus, it is clear that activity level is only one of many potential workload measurements contemplated by the ’494 Patent, and there is no basis to limit Claim 4[a] to receiving only activity level as workload. As explained in the Petition, White discloses Claim 4[a] because it discloses the power management logic 200 receives the operating frequency and/or voltage of a component in order to adjust its power consumption, and the operating frequency and voltage of the component reflects the activity and use, or workload, of that component. (Petition, 53-54; EX1003, ¶103.)

Third, Patent Owner argues that White does not disclose receiving workload based on an integrated circuit reaching a limit because (1) White does not mention battery power limit; and (2) only the temperature control logic is configured to request changes in operating characteristics of the cores based on reading from temperature sensors, not the power management loci. (POR, 50.) Both arguments lack merits. First, as explained in the Petition, White discloses that its system will adjust operating characteristics of the components so as to reduce overall power consumption when the system is on battery power. (Petition, 53; White, 15:54-64; *see also* 18:25-39, 20:6-12, 24:7-29.) A POSITA would have understood that battery power indicates a power supply limit, and when the system is on battery power, it is reaching a power limit. (EX1003, ¶104.) Second, as explained in Mr. Wyatt’s

declaration, White makes it clear that “temperature control logic 210 and power management logic 200 may both be part of a single set of logic ... that is configured to monitor and adjust the operating frequency and/or voltage of various portions of integrated circuit 100, such as the logic cores 120 and common bridge logic 110.” (EX1003, ¶104; White, 14:32-38.) White also generally discloses that an integrated circuit may have a predetermined maximum operating temperature, and the operating characteristics of components on the integrated circuit may be adjusted to lower the operating temperature. (Petition, 54; White, 2:34-44.) Thus, a POSITA would have understood White discloses that the power management logic 200 receives workload information based on the integrated circuit reaching a thermal design power limit. (EX1003, ¶105.)

Further, to the extent that Patent Owner interprets the claim element to mean that the workload is received ***only when the system reaches a limit*** (POR, 50), there is no support for such a narrow interpretation, and indeed this is inconsistent with the disclosure in the ’494 Patent. For example, in the flow chart as shown in Fig. 10 for a method of balancing power between cores and a communication bus, the first step is to determine workloads of elements of interest and then the power service routine determines if the integrated circuit is operating within limits. (’494 Patent, Fig. 10, 18:35-62; *see also* 13:31-38, 14:25-36, Figs. 7-8.) Throughout its specification, the ’494 Patent consistently teaches balancing performance and power

among components based on measured workloads without limiting when the monitored workload can be received, and White discloses the same. (Petition, 53-54; EX1003, ¶¶102-105.)

VII. Dependent Claims 5-7 and 17-18

Patent Owner argues that dependent claims 5-7 and 17-18 are patentable over White and Simeral in combination with additional references because of their dependency on claim 4. (POR, 52.) Patent Owner offers no separate arguments with respect to these claims. (*Id.*) Because Patent Owner's arguments regarding White in combination with Simeral with respect to claim 4 fail, its argument regarding dependent claims 5-7 and 17-18 also fail.

VIII. Conclusion

For the reasons above and in the Petition, the Board should cancel the challenged claims as unpatentable.

Dated: August 15, 2024

Respectfully submitted,

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Certificate of Word Count

The undersigned certifies, in accordance with 37 C.F.R. § 42.24(d), that the foregoing **PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE** complies with the type-volume limitation of 5,600 words, comprising 3514 words, excluding the parts exempted by § 42.24(c).

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Certificate of Service

The undersigned certifies that, in accordance with 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, the foregoing **PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE** was served on August 15, 2024, electronically via e-mail upon the following parties:

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