

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TWITTER, INC.,
Petitioner,

v.

PALO ALTO RESEARCH CENTER LLC,
Patent Owner.

IPR2021-01430
Patent 9,208,439 B2

Before KARL D. EASTHOM, SHEILA F. McSHANE, and
CHRISTOPHER L. OGDEN, *Administrative Patent Judges*.

OGDEN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Denying Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

In response to a Petition (Paper 2, “Pet.”) filed by Petitioner Twitter, Inc. (“Twitter”), the Board instituted an *inter partes* review of claims 1–5, 7–11, 13–17, 19, and 20 of U.S. Patent No. 9,208,439 B2 (Ex. 1001, “the ’439 patent”). Paper 12, (“Dec.”). Patent Owner Palo Alto Research Center Inc. (now Palo Alto Research Center LLC) (“PARC”) filed a Patent Owner Response (Paper 20, “PO Resp.”), Twitter filed a Reply to the Patent Owner Response (Paper 27, “Pet. Reply”), and PARC filed a Sur-reply (Paper 31, “PO Sur-reply”).

PARC also filed a Contingent Motion to Amend proposing substitute claims 21–40 if we find the original claims unpatentable. Paper 19 (“MTA”). Twitter filed an Opposition to this Motion to Amend (Paper 28, “Pet. Opp. MTA”). After we issued Preliminary Guidance on the Motion to Amend under the Board’s Motion to Amend Pilot Program (Paper 29), PARC filed a stipulation withdrawing proposed substitute claims 26, 32, and 38. Paper 24. Then PARC filed a Reply (Paper 30, “PO Reply MTA”) and Twitter filed a Sur-reply. Paper 39 (“Pet. Sur-reply MTA”).

We held an oral hearing on December 14, 2022, and the transcript is entered on the record. Paper 49 (“Tr.”).

This is a final written decision under 35 U.S.C. § 318(a) as to whether the claims challenged in the *inter partes* review are unpatentable.¹ For the reasons below, we conclude that Twitter has shown that all the challenged

¹ On November 7, 2022, the Chief Administrative Patent Judge issued a good-cause extension to the one-year period for issuing this decision. *See* Paper 36.

claims are unpatentable on at least one ground of the Petition. Twitter has also shown, by a preponderance of the evidence, that all pending proposed substitute claims are unpatentable and PARC has failed to show that the substitute claims do not contain new matter, so we also deny PARC's Motion to Amend.

II. BACKGROUND

A. RELATED PROCEEDINGS

Both parties are involved in the following related U.S. district court case: *Palo Alto Research Center Inc. v. Twitter, Inc.*, No. 2:20-cv-10754-AB (C.D. Cal. filed Nov. 25, 2020). Pet. 12; Paper 5, 2. According to Twitter, the court granted a stipulated stay of the district court proceeding. Pet. 82 (citing Ex. 1021 (granting joint request to stay proceedings)). The parties also identify the following two related matters: *Palo Alto Research Center Inc. v. Snap Inc.*, No. 2:20-cv-10755-AB (C.D. Cal. filed Nov. 25, 2020); *Palo Alto Research Center Inc. v. Facebook, Inc.*, No. 2:20-cv-10753-AB (C.D. Cal. filed Nov. 25, 2020). Pet. 12; Paper 5, 2–3.

As PARC notes, the '439 patent is also the subject of *inter partes* reviews IPR2021-00986 (instituted November 23, 2021) and IPR2021-01461 (instituted March 24, 2022). Paper 5, 3.

B. THE '439 PATENT (EX. 1001)

The '439 patent issued on December 8, 2015 from an application filed on April 29, 2013. Ex. 1001, codes (22), (45). It relates to “a method and system for collecting mobile device contextual information and facilitating efficient adaptation of a generic contextual intelligence system for

customized applications.” Ex. 1001, 1:8–12. A context-aware system on a mobile device detects the computing environment, and the system may recommend activities, such as leisure activities, based on a user model. *Id.* at 1:22–23, 1:30–31.

Figure 6, reproduced below, is a flowchart illustrating the steps of processing an event. Ex. 1001, 2:23–25.

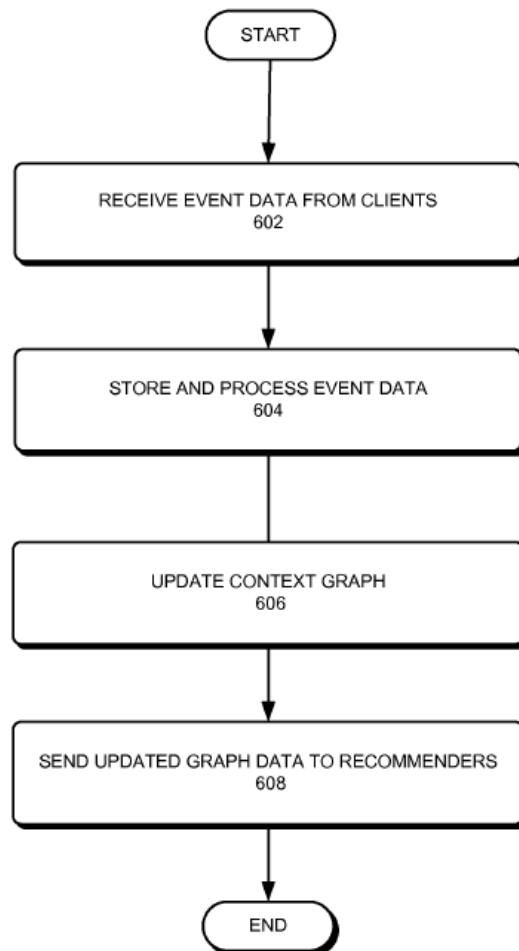


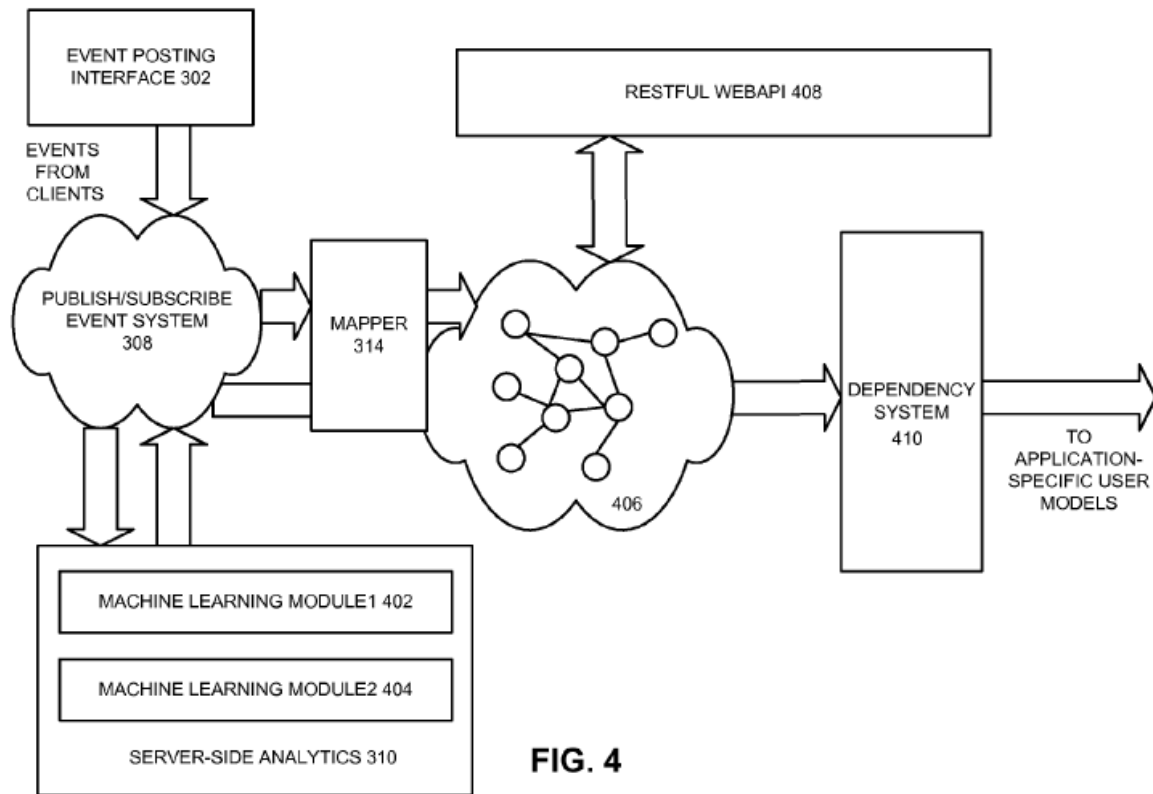
FIG. 6

In the steps shown in Figure 6 above, a server receives event data from clients (operation 602), and then stores and processes the event data (operation 604). *Id.* at 9:13–19. The server then analyzes the event data and

uses it to update a “context graph” (operation 606). *Id.* at 9:19–24. Next, the server sends the context graph data, and changed graph data, to relevant “recommenders” (operation 608). *Id.* at 9:26–29.

According to the ’439 patent, “[a] context graph is an in-memory model that stores facts and assertions about a user’s behavior and interests.” Ex. 1001, 3:20–22. “A recommender is an application that recommends items or activities for a user.” *Id.* at 3:23–25.

Figure 4, reproduced below, is a block diagram relating events, a mapper, and a context graph. Ex. 1001, 6:59–61.



As shown in Figure 4, event posting interface 302 sends events received from clients to publish/subscribe event system 308. *Id.* at 7:7–9. Based on subscriptions to publish/subscribe event system 308, mapper 314 uses the event data to modify context graph 406. *Id.* at 7:7–9, 7:44–47. “Context

graph 406 functions as a storage component of a generalized user model. A user model describes predicted current and future activities and interests for a user.” *Id.* at 7:34–36.

C. CHALLENGED CLAIMS AND GROUNDS

Claims 1, 7, and 13 of the ’439 patent are independent. Claims 13, representative of the challenged claims and the primary focus of Twitter’s arguments in the Petition, reads as follows:

13. A computing system comprising:
- [a] one or more processors,
 - [b] a non-transitory computer-readable medium coupled to the one or more processors having instructions stored thereon that, when executed by the one or more processors, cause the one or more processors to perform operations comprising:
 - [c] receiving, from a mobile device, event data derived from contextual data collected using detectors that detect a physical context surrounding the mobile device;
 - [d] modifying a context graph that stores facts and assertions about a user's behavior and interests using the event data;
 - [e] in response to determining that there exists a registration for notification of changes that matches the modification to the context graph, sending a notification of context graph change to a recommender.

Ex. 1001, 11:47–12:7 (Twitter’s reference letters added in brackets).

Twitter argues six grounds for *inter partes* review, as summarized in the following table:

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1	1–4, 7–10, 13–16	103 ²	Huomo ³
2	1–4, 7–10, 13–16, 20	103	Huomo, Cheng ⁴
3	5, 11, 17	103	Huomo, Lawson ⁵
4	5, 11, 17	103	Huomo, Cheng, Lawson
5	19	103	Huomo, Chauhan ⁶
6	19	103	Huomo, Cheng, Chauhan

Pet. 13–14.

D. DECLARATORY TESTIMONY

Twitter relies on two declarations by Dr. Don Turnbull. Exs. 1003, 1035. PARC relies on two declarations by Dr. David Martin. Exs. 2016, 2022.

III. PARC’S OBJECTIONS TO DEMONSTRATIVES

PARC objects to certain demonstratives that Twitter submitted for the oral hearing. *See* Paper 45 (objecting to at least portions of Exhibit 1037, slides 42, 43, 44, 48, 53, 54, 57, 67, 79, 82, 84, 93, 101, 104, 113, 116, and 118). We noted these objections at the oral hearing. *See* Tr. 28:18–29:2.

We do not rely on any statement by Twitter in the oral hearing that is based on material from the challenged demonstratives. Moreover, the slides

² 35 U.S.C. § 103 (2018).

³ Huomo et al., US 7,603,112 B2 (issued Oct. 13, 2009) (Ex. 1004).

⁴ Cheng, US 2013/0018954 A1 (published Jan. 17, 2013) (Ex. 1005).

⁵ Lawson et al., US 2011/0320550 A1 (published Dec. 29, 2011) (Ex. 1006).

⁶ Chauhan et al., US 2010/0262650 A1 (published Oct. 14, 2010) (Ex. 1007).

in question are non-evidentiary. *See* Ex. 1037 *passim* (“Demonstrative Exhibit – Not Evidence”).

IV. GROUNDS OF THE PETITION

For the reasons below, we determine that Twitter has shown, by a preponderance of the evidence, that claims 1–4, 7–10, 13–16, and 20 of the ’439 patent are unpatentable under Ground 2 based on Huomo and Cheng; that claims 5, 11, and 17 are unpatentable under Ground 4 based on Huomo, Cheng, and Lawson; and that claim 19 is unpatentable under Ground 6 based on Huomo, Cheng, and Chauhan. In light of these determinations, which cover all the challenged claims, we do not address grounds 1, 3, or 5. Before analyzing these grounds in detail, we address two matters that underlie our analysis: the level of ordinary skill in the art and the construction we will apply to the claim terms.

A. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the pertinent art at the time of the invention is a factor in how we construe patent claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). It is also one of the factors we consider when determining whether a patent claim is obvious over the prior art. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

To assess the level of ordinary skill, we construct a hypothetical “person of ordinary skill in the art,” from whose vantage point we assess obviousness and claim interpretation. *See In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). This legal construct “presumes that all prior art references

in the field of the invention are available to this hypothetical skilled artisan.” *Id.* (citing *In re Carlson*, 983 F.2d 1032, 1038 (Fed. Cir. 1993)).

Relying on Dr. Turnbull’s testimony, Twitter argues that a person of ordinary skill in the art “would at minimum have a bachelor’s in software, computer, or electrical engineering or computer science with at least two years’ experience in software development, including with respect to context-aware devices and systems, or the equivalent.” Pet. 16 (citing Ex. 1003 ¶ 24). Also, “[a]dditional graduate education could substitute for professional experience, or significant experience in electronic messaging could substitute for formal education.” *Id.* (citing Ex. 1003 ¶ 24).

For this proceeding, PARC does not dispute this proposed level of ordinary skill. PO Resp. 21. Because Twitter’s uncontroverted articulation of the level of ordinary skill in the art is supported by testimonial evidence and appears consistent with the types of problems and solutions in the ’439 patent, we adopt it for this decision. *See, e.g.*, Ex. 1001, 1:4–33 (“Background” section of the ’439 patent, describing the field and related art as relating to the use of contextual data in computer systems).

B. CLAIM CONSTRUCTION

In an *inter partes* review, we construe a patent claim “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b) (2021). This generally includes “construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.* The ordinary and customary meaning of a claim term “is its meaning to the ordinary

artisan after reading the entire patent,” and “as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1313, 1321. There are only two circumstances in which a construction departs from the ordinary and customary meaning: “1) when a patentee sets out a definition and acts as [their] own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). Any such special meaning of a term “must be sufficiently clear in the specification that any departure from common usage would be so understood by a person of experience in the field of the invention.” *Multiform Desiccants Inc. v. Medzam Ltd.*, 133 F.3d 1473, 1477 (Fed. Cir. 1998).

To construe the claim terms, “we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006).

Twitter proposes explicit constructions for three terms: “context graph,” “recommender,” and “application event data and/or operating system event data.” Pet. 15–16. Of these, PARC only contests the construction of “context graph.” See PO Resp. 22–28.

Twitter argues that we should construe the term “context graph” to mean “a model that stores facts and assertions about a user’s behavior and interests.” Pet. 15 (citing Ex. 1001, 3:20–22 (“A context graph is an in-memory model that stores facts and assertions about a user’s behavior and interests.”); Ex. 1002, 108).

In contrast, PARC argues that we should construe the term “context graph” to mean a “per-user, in-memory, graph-based model.” PO Resp. 23

(emphasis omitted). According to PARC, “the claim language itself explicitly states that the facts and assertions are stored in a graph.” *Id.* PARC also points to dependent claim 20, which refers to “topological changes in the context graph” and to “properties of nodes and edges in the context graph.” *Id.* at 24 (emphasis omitted) (quoting Ex. 1001, 12:53–55); *see also* PO Sur-reply 2–3 (arguing that Twitter improperly reads out the word *graph* in its analysis of the term “context graph”).

PARC also points to supporting disclosures in the ’439 patent specification, including Figure 4 which, according to PARC, describe context graph 406 as having nodes and edges that, through their topology, store facts and assertions about user behavior and actions. PO Resp. 24–25 (citing Ex. 1001, 2:17–19, 7:26–28, 7:58–60, Fig. 4; Ex. 2016 ¶ 88); *see also* PO Sur-reply 3–5. PARC acknowledges that the ’439 patent discloses a number of ways to store the context graph in memory, for example using a “type-less approach to data storage” or storing the data as “entity-relationship data and unstructured data.” PO Resp. 26 (quoting Ex. 1001, 7:36–40) (citing Ex. 2016 ¶¶ 85–92). But no matter the underlying representation, PARC contends that the data is ultimately stored as a graph-based model. *Id.* PARC also contends that, during prosecution of the ’439 patent, the applicant “distinguished the prior art on the basis of the context graph’s nodes.” PO Resp. 26–27 (citing Ex. 1002, 107–08).

In its Reply, Twitter contends that PARC’s proposed construction improperly imports a “graph-based” limitation from the specification, despite a definitional statement in the ’439 patent defining a context graph without reference to it being graph-based. Pet. Reply 1–7. Moreover, Twitter contends that “[e]ven under [PARC’s] construction, Cheng discloses this

limitation, and Huomo in view of Cheng renders this limitation obvious.” *Id.* at 7 (citing Ex. 1003 ¶¶ 150–163).

We agree as to Twitter’s last point, as we discuss below, that Cheng teaches a graph-based model that stores data in memory on a per-user basis. *See infra* Section IV.C.4(a); Ex. 1005, Fig. 7. Moreover, this decision does not address grounds of the Petition that omit Cheng as a reference, Cheng discloses a “context graph” under either party’s construction. Thus, we need not construe the term for this decision. *See Nidec*, 868 F.3d at 1017.

Because the terms “recommender” and “application event data and/or operating system data” are not contested and are not material to our decision, we do not construe these two terms. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). To the extent that other claim terms are significant, we discuss them below in the context of the asserted prior art.

C. CLAIM 13

Turning to the grounds of the Petition, we begin with the challenge to claim 13 under Ground 2, which asserts that claim 13 is unpatentable under 35 U.S.C. § 103 as obvious over Huomo in view of Cheng. *See* Pet. 14, 26–58. For this challenge, Twitter relies on Huomo for the preamble and limitations 13[a]–[c]. Pet. 26–42. For limitation 13[d], Twitter relies (alternatively) on the teachings of Huomo, in addition to a combination with

the teachings of Cheng. *See* Pet. 42–55. For limitation 13[e], Twitter relies on both Huomo and Cheng. *See* Pet. 56–58.

A claim is unpatentable under § 103 for obviousness “if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains.” 35 U.S.C. § 103; *see also KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). When a ground in a petition is based on a combination of references, we consider “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *Id.* at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

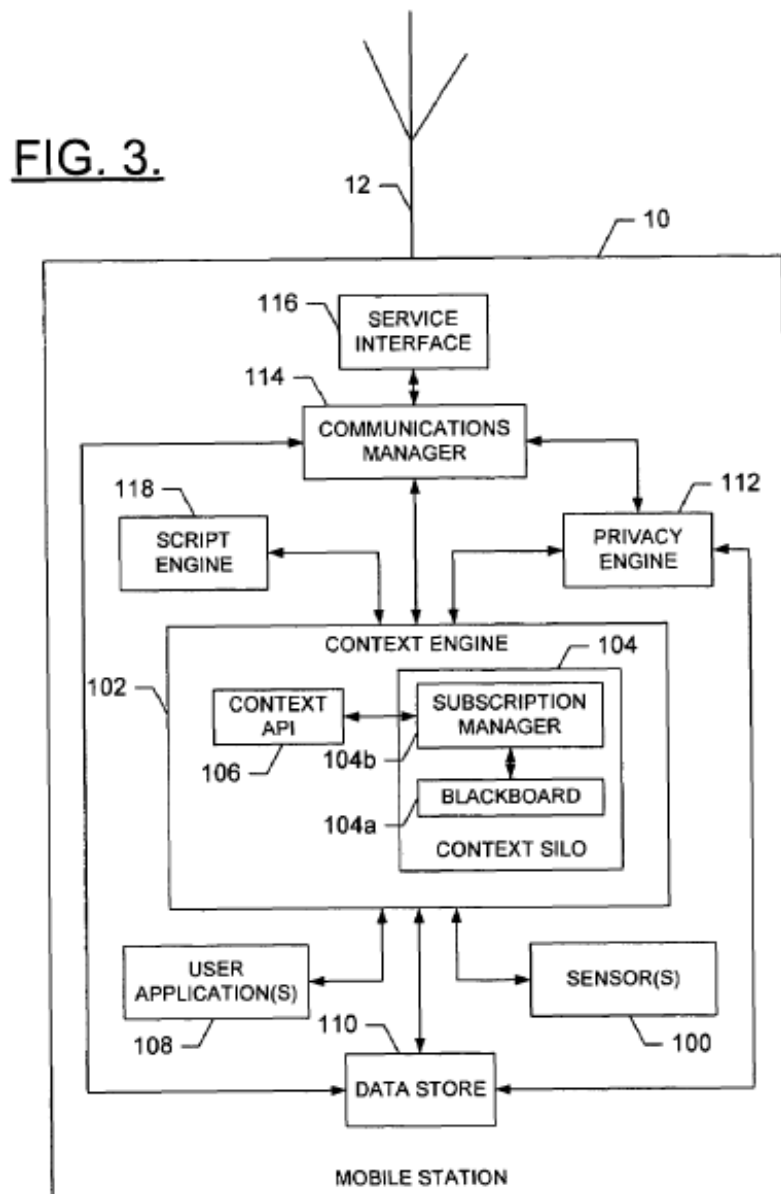
We base our obviousness inquiry on factual considerations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) any objective indicia of obviousness or non-obviousness that may be in evidence. *See Graham*, 383 U.S. at 17–18.

Considering these factors,⁷ we determine that Twitter has shown, by a preponderance of the evidence, that claim 13 is unpatentable under § 103 as obvious over Huomo in view of Cheng. We begin our analysis with a brief overview of Huomo and Cheng, and then we address the parties’ contentions with respect to the limitations of claim 13.

⁷ Neither party presents evidence of objective indicia of obvious or non-obviousness, so no such evidence factors into our decision.

1. *Overview of Huomo*

Huomo describes a system and method for “managing context-related information” that can “facilitat[e] the exchange and sharing of context-related information” by “provid[ing] application program interfaces (API’s) for applications that can then use, publish, and subscribe to context-related information” over a network. Ex. 1004, 2:28–37. This system includes a mobile station as depicted in Figure 3, which is reproduced below:



As shown above, Huomo's Figure 3 is "a schematic block diagram of a context exchange architecture within a mobile station." Ex. 1004, 3:31–32. Mobile station 10 can be, for example, a mobile phone, a portable digital assistant, or pager. *Id.* at 3:56–65. It includes sensors 100, which measure data and preprocess it to form a "context atom," which is "a specific piece of context-related information." *Id.* at 7:22–28. "For example, a temperature sensor can measure the ambient temperature of the environment around the mobile station 10, and thereafter process the temperature into a context atom." *Id.* at 7:35–38.

Within mobile station 10, context engine 102 "is capable of receiving, and thereafter storing, the context atoms, as well as providing access to the context atoms." Ex. 1004, 7:50–52. Context 102 engine includes blackboard 104a and subscription manager 104b. *Id.* at 7:54–56. Blackboard 104a is "a storage unit for context-related information and, as such, typically stores the context atoms received from the sensors or other context sources (such as other electronic devices . . .)." *Id.* at 7:56–60. Subscription manager 104b "provide[s] subscriptions to various of the context atoms and/or notifications when such context atoms change." *Id.* at 7:62–64.

Huomo's Figure 4 is reproduced below:

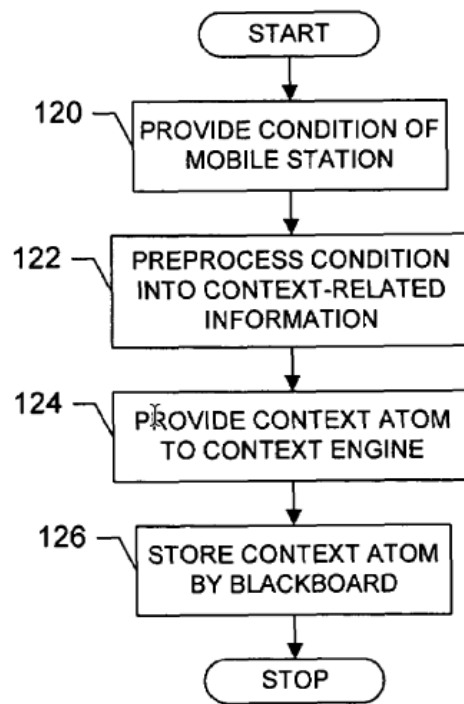


FIG. 4.

Huomo's Figure 4, above, is a "flowchart illustrating the steps in a method of creating context-related information and thereafter making the context-related information available to context consumers." Ex. 1004, 3:34–37. In this method, mobile station 10 measures or senses data about its condition (step 120). Ex. 1004, 11:27–30. The system then preprocesses this condition data to create context-related information (step 122) and packages the context-related information into a "context atom" (step 124) which the mobile station 10 then stores in its blackboard 104a (step 126). *Id.* at 11:30–41.

2. *Overview of Cheng*

Cheng describes "situation-aware user sentiment social interest models," particularly in the context of social networking services. Ex. 1005

¶¶ 3, 5–9. In discussing the background art, Cheng notes that other companies had been developing analytics to extract a user’s interest and sentiments from social networking data, but these efforts were “blind[] about the user’s situation” at any particular moment, which a system might use to make contextually appropriate suggestions to the user. *Id.* ¶ 10. “For example, even though a user may like good wine, suggesting going to a wine tasting nearby may not be a good idea when his friends with him at the time do not like wine.” *Id.*

Thus, Cheng describes “[a] method for constructing user models from user usage and context data . . . where a personal interest graph for a user is construct[ed] from interests of the user derived from usage data and situational data derived from one or more sensors of [an] electronic device.” Ex. 1005, code (57). “The personal interest graph can be modified by annotating one or more nodes of the personal interest graph with influence information.” *Id.*

Figure 2 of Cheng, reproduced below, illustrates the high-level architecture of this system (Ex. 1005 ¶ 19):

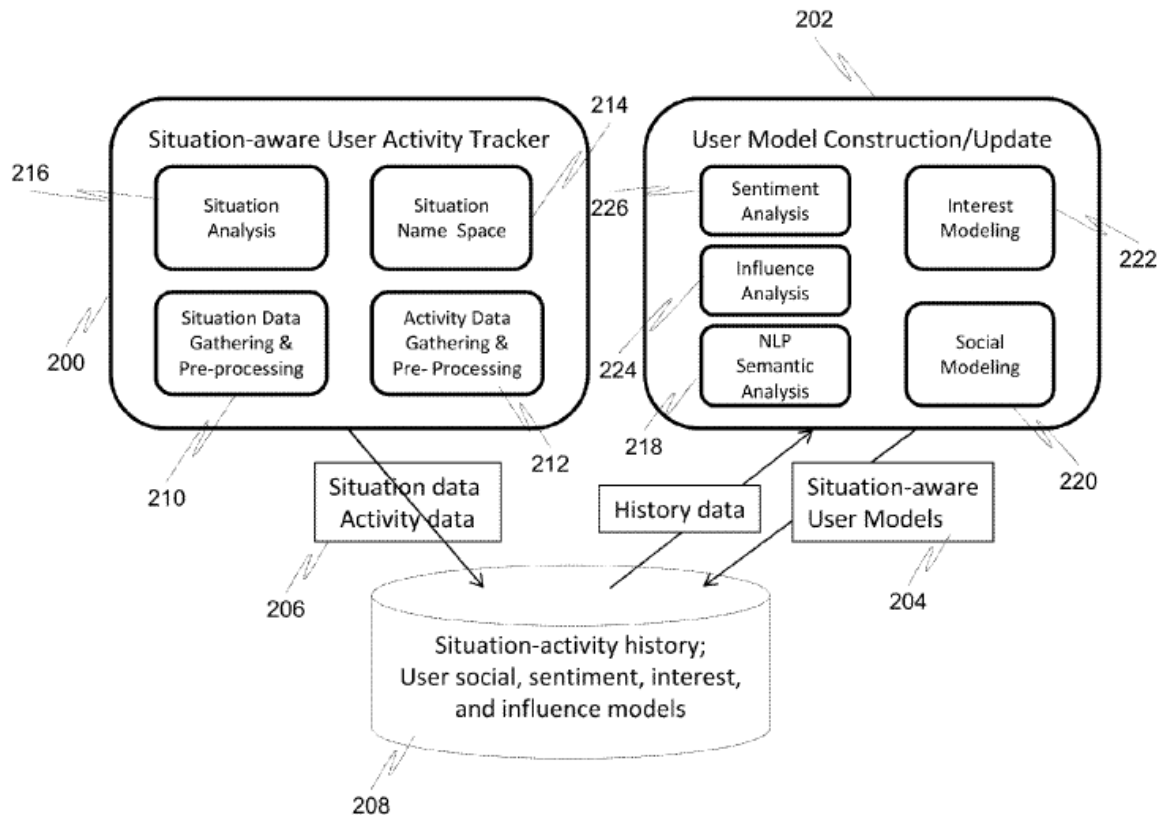


FIG. 2

As shown above in Figure 2, Cheng's system has two main parts:

(1) situation-aware user activity tracker 200, which logs user activity data within a device and application, and corresponding situation data at the time of usage; and (2) user model construction/update module 202, which “builds and updates user models.” Ex. 1005 ¶ 37. Storage 208 stores the user's annotated “relations, interests, influence, and sentiments.” *Id.* “[T]he output of the system is a set of models 204 about the user's relationship, interests, who influences the user about a topic, whom the user influences about a topic, and the user's sentiments towards a topic/concept or person.” *Id.*

As part of construction/update module 202, sentiment analysis module 226 “can compute the user's sentiments about people and concepts in various situations” (Ex. 1005 ¶ 48), as illustrated below in Figure 7:

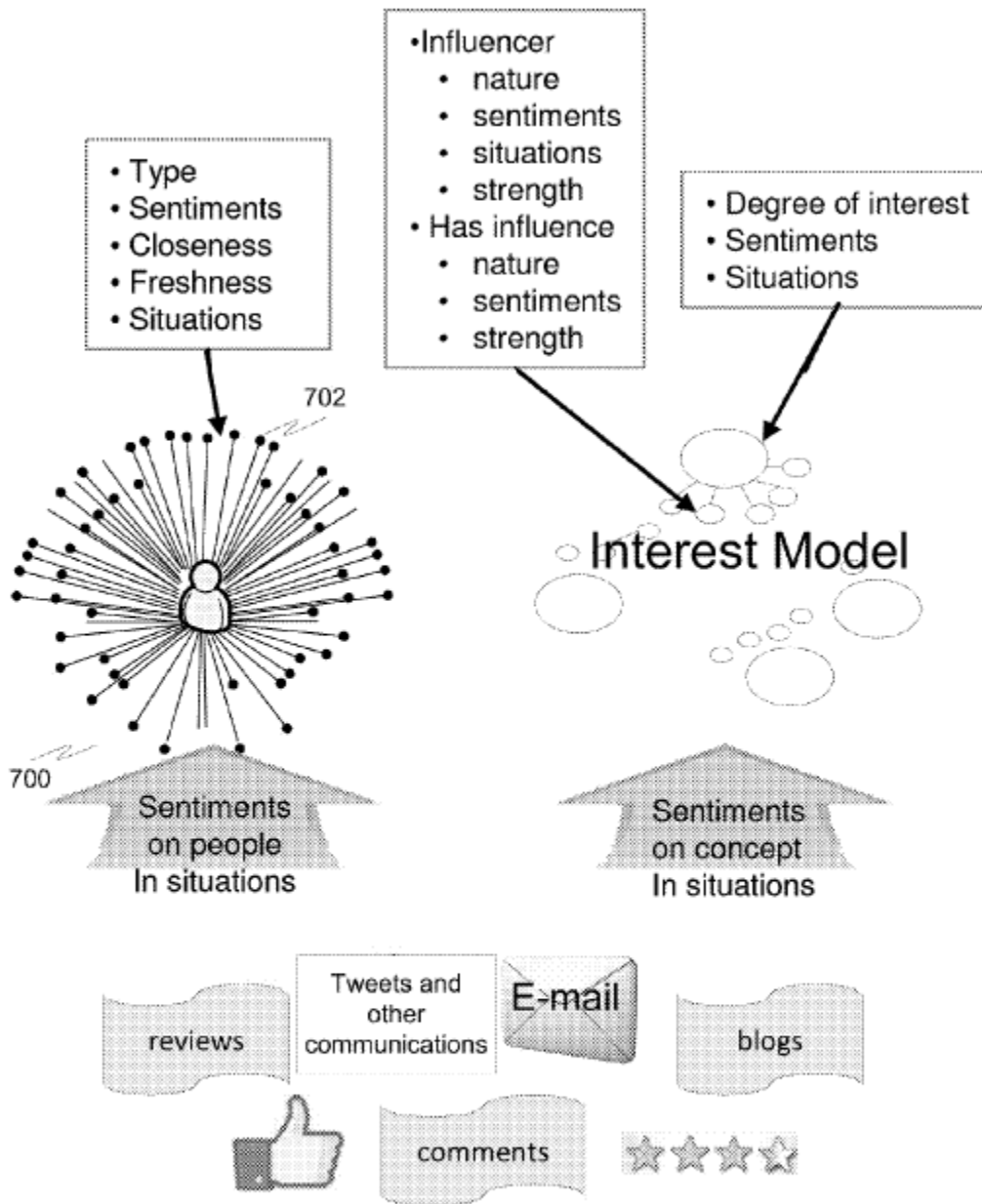


FIG. 7

Figure 7, above, depicts “the output of sentiment analysis.” Ex. 1005 ¶ 48. The lower part of Figure 7 illustrates how module 226 may obtain user sentiments “by tracking user actions such as clicks of a like, share, or recommend button,” or “by analyzing the texts associated with user online

activities such as blogs, emails, tweets, reviews, comments, etc.” *Id.* Using this information, module 226 constructs personal interest graph 700, a tree-like structure that includes a number of edges and nodes such as node 702. *Id.* ¶ 48. Node 702 “can be annotated with the sentiment information about the concept represented by the node,” as illustrated in the box above personal interest graph 700. *Id.* These annotations may include “the types and the strengths of users’ sentiments and the situation in which such sentiments are expressed.” *Id.*

For example, an “edge” may link the user to a node representing another person. *See* Ex. 1005 ¶ 48. “When the user expresse[s] sentiments toward a person, the sentiment information can be recorded in the personal social graph, for example by annotating the edge linking the user to the person.” *See id.*

Once constructed, the personal interest graphs “can then be directly used by applications, such as for predicting user needs, for making recommendations, and for decision making.” Ex. 1005 ¶ 52. In one embodiment, “a client device runs the situation-aware user activity tracker and sends the data to be stored on a server or in a cloud.” *Id.* ¶ 55. Then, “[a]t recommendation time, the client device identifies the current situation, and asks the server/cloud to identify the items for recommendation.” *Id.*

3. *Preamble and Limitations 13[a]–[c]*

The preamble of claim 13 recites “[a] computing system.” Ex. 1001, 11:47. Twitter argues that, “[t]o the extent deemed limiting,” *Huomo* discloses this preamble. Pet. 26–28 & n. 5 (citing Ex. 1003 ¶¶ 86–92; Ex. 1004, 1:18–21, 2:27–37, 2:57–67, 4:6–19, Figs. 1–3).

Limitation 13[a] recites “one or more processors” and limitation 13[b] recites “a non-transitory computer-readable medium coupled to the one or more processors having instructions stored thereon that, when executed by the one or more processors, cause the one or more processors to perform operations.” Ex. 1001, 11:53–56. Twitter contends that Huomo discloses these limitations. *See* Pet. 28–34 (citing Ex. 1003 ¶¶ 93–116, Ex. 1004, 2:27–30, 2:57–67, 3:53–4:19, 4:55–5:7, 5:10–14, 5:31–62, 6:2–19, 6:23–29, 7:12–48, 9:8–15, 10:56–11:9, 15:28–41, 15:45–49, 16:42–17:20, 24:1–27, Figs. 1–3).

Limitation 13[c] requires that one of the operations that a processor will perform is “receiving, from a mobile device, event data derived from contextual data collected using detectors that detect a physical context surrounding the mobile device” Ex. 1001, 11:54–56. Twitter contends that Huomo discloses this limitation. Pet. 35–42 (citing Ex. 1003 ¶¶ 117–135; Ex. 1004, code (57), 2:57–67, 3:1–17, 3:53–4:19, 4:55–5:7, 5:13–15, 5:63–6:2, 6:23–29, 6:47–7:3, 7:12–60, 8:46–64, 9:8–15, 10:56–11:53, 12:9–20, 13:61–14:6, 15:28–41, 15:42–49, 16:42–53, Figs. 1–2, 4).

PARC does not contest Twitter’s arguments regarding the preamble⁸ or limitations 13[a]–[c]. *See generally* PO Resp. We find those arguments persuasive, and we credit Dr. Turnbull’s supporting testimony. *See* Ex. 1003 ¶¶ 86–135.

⁸ We need not resolve whether the preamble is limiting because neither party raises the issue and Twitter shows sufficiently that Huomo discloses a computing system as recited in the preamble.

4. *Limitation 13[d]*

Limitation 13[d] recites “modifying a context graph that stores facts and assertions about a user's behavior and interests using the event data.” Ex. 1001, 12:1–3. To the extent the recited “context graph” does not read on Huomo’s “context atoms,”⁹ Twitter argues that Cheng discloses a context graph in the form of its “personal interest graph.” Pet. 45–54 (citing Ex. 1003 ¶¶ 149–163; Ex. 1005 ¶¶ 3–15, 30, 37, 38, 40, 42, 44, 45, 53, 55, Figs. 2, 4–10); *see also* Ex. 1003 ¶ 151 (“A node of the personal interest graph 500 represents a concept and an edge connecting two concept nodes represents an ontological relationship between the concepts.”); Dec. 19 (acknowledging Dr. Turnbull’s explanation of how Cheng’s personal interest graph is a context graph). According to Twitter, Cheng’s personal interest graph reflects “interests of the user derived from usage data and situational data derived from one or more sensors.” Pet. 53–54 (quoting Ex. 1005, code (57)). Twitter also argues that Cheng’s personal interest graph is an in-memory model as per its proposed construction of the term “context graph.” *Id.*

Twitter contends that a person of ordinary skill in the art would have had reason “to implement Huomo’s context engine, which stores context atoms in a blackboard that is modified when context atoms change, using Cheng’s beneficial teachings of a context graph as the model for formally

⁹ In its Response, PARC raises a number of arguments contesting Twitter’s identification of Huomo’s context atoms as the recited “context graph.” *See* PO Resp. 29–34. We do not need to reach these issues because, as we discuss in this section, we find sufficiently persuasive Twitter’s arguments based on the combination of Huomo and Cheng.

organizing Huomo’s blackboard information.” Pet. 54; *see also* Pet. Reply 19–20. According to Twitter, “Cheng discloses that using a context graph beneficially and better facilitates taking into account users’ shared interests and how a user may influence other users in various domains (such as when shopping with a friend, as Huomo discloses).” Pet. 54 (citing Ex. 1005 ¶ 30). Twitter also argues that according to Cheng, “use of a context graph allows for better tracking of social relationships through the annotation of nodes and edges,” and this would have “allow[ed] for more facile manipulation and modeling of the data stored [in Huomo’s blackboard], including with respect to the ability to provide recommendations to the system.” Pet. 54–55 (citing Ex. 1005 ¶¶ 11, 30, 44). Twitter contends that for a person of ordinary skill in the art, “it would have been routine to make such an implementation choice, and (particularly given Cheng’s express teachings) [it would have been] clear [that] it would work and provide the expected functionality to yield predictable results with [a reasonable expectation of success].” Pet. 55 (citing Ex. 1003 ¶¶ 156–161).

(a) Whether Cheng Teaches Storing “Facts and Assertions” or Modifying a Context Graph Using “Event Data”

In its Response, PARC argues that “Twitter does not suggest that Cheng discloses a context graph that ‘stores facts and assertions’ or is modified ‘using the event data’ as required by this claim element.” PO Resp. 34.

In its Reply, Twitter contends that its Petition showed that Cheng discloses modifying its personal interest graph (the alleged context graph containing facts and assertions) using event data: “a personal interest graph

for a user is construct[ed] from interests of the user derived from usage data and *situational data derived from one or more sensors of the electronic device.*” Pet. Reply 17 (alteration in original) (quoting Ex. 1005, code (57)) (citing Ex. 1005 ¶¶ 14, 31, 32; Pet. 53–54; Ex. 1004 ¶¶ 33, 37, 150–155; Ex. 1003 ¶ 151 (“A node of the personal interest graph 500 represents a concept and an edge connecting two concept nodes represents an ontological relationship between the concepts.”)).

Belatedly in its Sur-reply, PARC argues that Twitter’s arguments about Cheng containing “facts and assertions” and whether there are separate “event data” rely on Dr. Turnbull’s testimony, not the Petition, and thus the Petition was deficient. PO Sur-reply 10 (citing 37 C.F.R. §§ 42.6(a)(3), 42.22(a)(2)). PARC also argues that “the terms ‘facts,’ ‘assertions,’ and ‘event data’ each have separate meanings, and thus a single piece of Cheng’s ‘situational data’ cannot render each of them obvious.” *Id.* at 11; *see also id.* at 6–7 (arguing that terms listed separately in a claim are presumed to have different meanings (citing *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010); *HTC Corp. v. Cellular Commc’ns Equip., LLC*, 701 F. App’x 978, 982 (Fed. Cir. 2017))).

At oral argument, Twitter challenged the timeliness of PARC’s Sur-reply arguments on the distinction between “facts,” “assertions,” and “event data,” including the sufficiency of the Petition on these issues. *See* Tr. 10:7–12:25. PARC argued that these issues were not waived, in part because PARC raised them in its Preliminary Response. *See id.* at 31:3–11, 32:16–33:7, 71:9–73:25. The Scheduling Order for this proceeding cautioned PARC that “any arguments not raised in the response may be deemed

waived.” Paper 13, 9. Based on our review of the Petition and Preliminary Response, we find that PARC waived its arguments on this issue, and their inclusion in the Sur-reply is untimely. *See In re Nuvasive, Inc.*, 842 F.3d 1376, 1380 (Fed. Cir. 2016) (holding that a patent owner waived its arguments from a preliminary response after failing to include them in its patent owner response, despite the Board’s warning in the scheduling order). However, we express our view on PARC’s Sur-reply arguments on this issue below for completeness, as PARC’s arguments would not change the outcome of our decision.

PARC contends that “[f]acts and assertions are . . . different from event data, which the ’439 Patent describes as ‘derived from contextual data collected using detectors that detect a physical context surrounding the mobile device.’” PO Sur-reply 8 (citing Ex. 1001, 3:9–11, 3:55–58, 9:7–9, 10:30–40; Ex. 2016 ¶¶ 97–109; Ex. 2018, 68:19–69:12; Ex. 2019, 37:19–38:15). PARC also distinguishes “facts” from “assertions.” According to PARC, an “assertion” is “to say that a user *tends* to do something at a certain time,” whereas “[t]hat the user *is* actually a coffee drinker, has a job, who his/her employer is, and where that employer is located, are facts. Facts and assertions are therefore different from one another.” PO Sur-reply 7–8 (citing Ex. 1001, 7:29–33; Ex. 2016 ¶¶ 39–43, 97–100; Ex. 2018, 77:21–78:10; Ex. 2019, 40:14–41:18 (cross-examination testimony of Christopher M. Schmandt, expert for petitioner Facebook, Inc. in related case IPR2021-01461)). Thus, PARC argues that ‘each of ‘event data,’ ‘facts,’ and ‘assertions’ are not the same.” *Id.*

Based on its proposed distinction between “facts” and “assertions,” PARC contends that Cheng’s “situational data” can only be facts, not

assertions, and that Twitter has not explained how the “ontological relationships” defined by the edges linking nodes in Cheng’s personal interest graph would include “assertions” as opposed to just “facts.” *See* Sur-reply 11–13.

We agree with PARC that the terms “facts,” “assertions,” and “event data” have different meanings in claim 13. However, we disagree that Twitter has failed to show that Huomo, in view of Cheng, teaches each of the three elements. In particular, Twitter identifies Huomo’s context atoms as the recited “event data” and (in the alternative in combination with Cheng) identifies the nodes and edges in Cheng’s personal interest graph as embodying the recited “facts and assertions.” *See* Pet. 43 n.11 (“Huomo’s context atoms, *inter alia*, represent event data”), 53–54 (explaining how Cheng’s nodes and edges embody facts and assertions). Twitter also identifies the “event data” as Cheng’s usage data and situational data derived from sensors of an electronic device. *See* Pet. Reply 16–17 (citing Pet. 53–54; Ex. 1005, code (57), ¶¶ 14, 31, 32; Ex. 1003 ¶¶ 33, 37, 150–155). Thus, Twitter’s arguments based on the combination of Huomo and Cheng clearly distinguish between “event data” and “facts and assertions.” We find these arguments persuasive, and credit Dr. Turnbull’s supporting testimony.

As to “facts” and “assertions,” we agree that the terms have different shades of meaning, as one would presume because both terms separately appear in claim 13. *See Becton, Dickinson*, 616 F.3d at 1254. However, we disagree with PARC’s implication that the terms are mutually exclusive. PARC’s argument that statements, for example, that a “user *is* actually a coffee drinker, has a job, who his/her employer is, and where that employer is located” (PO Sur-reply 7–8) would be “facts” and would also be

statements of facts believed to be true, that is, assertions. The '439 patent categorizes these examples as simply “facts and assertions” without saying they are one or the other. *See* Ex. 1001, 7:29–33. And, as a whole, the '439 patent refers to “facts and assertions” without distinguishing between the two in any way, including how the two are stored or handled. *See, e.g.*, Ex. 1001, 3:20–22, 7:26–33. Facts and assertions are treated as a single category of data or information about a user’s behavior and interests.

In any event, Twitter has identified examples in Cheng not just of what a user *is* doing (a “fact,” according to PARC), but also indications of what a user *tends* to do (an “assertion,” according to PARC). *See* Pet. Reply 21 (citing Ex. 1005 ¶¶ 10, 31, 44–46); *see also* Ex. 1005 ¶ 46 (a node may indicate the degree of a user’s interest in a concept, as extracted from user activity). PARC does not dispute that Cheng discloses “facts.” *See* PO Sur-reply 11 (arguing that “Cheng’s ‘situational data’ is derived from sensors and refers to facts, not assertions.”). But Twitter has also identified other items in Cheng, such as whether a user may enjoy going to theaters, that would apparently be assertions under PARC’s proposed distinction between the two terms.

We also determine that Cheng teaches a “context graph” under either party’s proposed constructions of that term. It is, for example, “per-user” (Ex. 1003 ¶ 153; Ex. 1005 ¶¶ 48–49, Figs. 7, 8), “in-memory” (Ex. 1003 ¶¶ 154, 159; Ex. 1005 ¶ 40), and “graph-based” (Ex. 1003 ¶¶ 151, 158; Ex. 1005 ¶ 45, Figs. 4, 5, 7) according to PARC’s proposed construction.

Thus, we find that Twitter has shown that the combination of Huomo and Cheng teaches a context graph that stores facts and assertions about a

user's behavior and interests, and teaches modifying the context graph using "event data."

(b) Motivation to Combine

In its Response, PARC argues that Twitter fails to identify evidence supporting its proposed motivation to combine Huomo with Cheng. PO Resp. 34. According to PARC, Huomo's context atoms represent "event data like temperature, location, last call data, etc., in a 'blackboard.' In contrast, in Cheng, '[a] node of the personal interest graph 500 represents a concept and an edge connecting two concept nodes represents the ontological relationship between the concepts.'" *Id.* (alteration in original) (quoting Ex. 1005 ¶ 45). But "Twitter does not explain how a [person of ordinary skill in the art] would find it 'straightforward' to transform Huomo's storage of a temperature reading in its blackboard into a Cheng 'concept' in which 'an edge connecting two concept nodes represents the ontological relationship between the concepts.'" *Id.* at 35 (quoting Ex. 2016 ¶ 107).

PARC contends that "Twitter resorts to merely implying that it would be beneficial if Huomo were more like Cheng and/or the '439 Patent." PO Resp. 35. For example, according to PARC, Dr. Turnbull testified that the Cheng–Huomo combination "would provide 'more facile manipulation and modeling of the data stored therein' and would 'increase the accuracy and reliability of the information provided to recommenders,'" but "Twitter never asserts that Huomo's blackboard is not sufficiently 'facile' or is lacking in terms of 'accuracy and reliability.'" *Id.* at 35–36 (quoting Ex. 1003 ¶¶ 160–163). PARC argues that this rationale for the combination relies on improper hindsight. *Id.* at 36.

PARC also argues that, “[t]o the extent Twitter contends that individual Huomo context atoms would become free-standing, disconnected nodes in a Cheng ‘personal interest graph,’ Twitter neglects to consider Cheng’s ‘variables for storage of such information,’ which, according to PARC, would be stored separately from Cheng’s personal interest graph. PO Resp. 35 (citing Ex. 2016 ¶ 107).

Twitter disagrees that Cheng’s “variables” would be stored outside of the personal interest graph, because Cheng teaches that these variables “can be used to define a ‘situation,’” and the personal interest graph “may carry the information that indicates *the situations* in which the user has expressed interests in the concept.” Pet. Reply 17–19 (quoting Ex. 1005 ¶¶ 31, 46) (citing Ex. 1005, code (57), ¶¶ 14, 32, Fig. 5; Ex. 1035 ¶ 47; Ex. 1003 ¶¶ 33, 37, 150).

Twitter also disagrees that its obviousness argument needs to show a deficiency in Huomo, such as that it is insufficiently facile or is lacking in accuracy or reliability. Pet. Reply 20. Twitter reiterates that its argument for combining Huomo with Cheng is that Cheng’s personal interest graph serves as the “model for formally organizing Huomo’s information.” *Id.* at 19–20 (emphasis omitted) (citing Ex. 1003 ¶ 160; Ex. 1035 ¶ 49).

In Sur-reply, PARC argues that Twitter’s assertion that a person of ordinary skill in the art would have used Cheng’s personal interest graph as a model for organizing Huomo’s information is insufficiently specific to establish a motivation to combine. According to PARC, “Twitter has failed to point to any disclosures in Cheng indicating that a [person of ordinary skill in the art] would recognize that the system in Huomo could be improved by applying teachings disclosed in Cheng.” PO Sur-reply 14.

PARC also argues that “Twitter has also not identified any disclosures in Cheng indicating that its personal interest graph would be viewed as advantageous or as an improvement to the system disclosed in Huomo.” *Id.*

We determine that Twitter has persuasively, and with sufficient specificity, shown that the combination of Huomo and Cheng teaches all aspects of limitation 13[d], and that it would have been obvious to modify Huomo by using Cheng’s personal interest graph as the model for how facts and assertions are stored in Huomo’s “blackboard.” This modification would have been compatible with Huomo and would simply affect the form of the information, or types of information, that are stored in Huomo’s blackboard. *See Intel Corp., v. PACT XPP Schweiz AG*, No. 2022-1037 at 10–13 (Fed. Cir. Mar. 13, 2023) (there is motivation to combine where one reference addresses a problem in one way, and another reference addresses the same problem in an alternative way that would be a suitable option).

We agree with Twitter that this modification would have been within the ordinary skill in the art, that there would have been a reasonable expectation of success, and that an ordinarily skilled artisan would have recognized benefits to using Cheng’s graph-based structure such as the ability to better track social relationships through annotating the nodes and edges, and the ability to more easily track users’ shared interests and the influences that users may have on each other. *See* Pet. 53–55; Ex. 1003 ¶¶ 156–161.

5. *Limitation 13[e]*

Limitation 13[e] recites, “in response to determining that there exists a registration for notification of changes that matches the modification to the context graph, sending a notification of context graph change to a

recommender.” Ex. 1001, 12:4–7. Twitter relies on either Huomo or the combination of Huomo and Cheng as teaching this limitation. *See* Pet. 56 (citing Pet. 42–55; Ex. 1003 ¶¶ 164–180; Ex. 1004, 7:60–8:11, 9:27–34, 10:3–17, 10:23–50, 11:63–12:8, 12:21–25, 13:18–41, 14:50–15:2, claims 1–2, 7).

Twitter argues that a person of ordinary skill in the art “would have understood that Huomo’s disclosure of ‘context consumers’ is disclosure of ‘a recommender’ as claimed,” and Twitter points to the example of a “supermarket loyalty club” that “can subscribe to receive a notification of changes to the content graph,” such as a trigger indicating that a user’s location is a particular store. Pet. 57 (citing Ex. 1004, 14:50–57). Twitter also contends that a person of ordinary skill in the art “would have understood that Huomo’s teachings, employed in [the Huomo–Cheng] combined system, include sending notification of a change to a recommender.” Pet. 58 (citing Ex. 1003 ¶ 179). Also, according to Twitter, “it would have been obvious, straightforward, and advantageous to implement Huomo’s disclosed connected personal/server computers using . . . Huomo and Cheng’s combined teachings[] of sending a notification of changes to the context graph (blackboard) to a recommender.” *Id.* (citing Ex. 1003 ¶¶ 177–178, 180).

In its Response, PARC argues that the combination of Huomo and Cheng does not teach limitation 13[e] “[b]ecause the asserted prior art does not teach the claimed ‘context graph.’” PO Resp. 37 (citing Ex. 2016 ¶ 111). Similarly, PARC contends that “[w]ithout an understanding of what is stored within the personal interest graph, Twitter cannot assert—without evidence—that the resulting system would necessarily send a notification of

context graph change to a recommender” as recited in limitation 13[e]. *Id.* at 37–38 (citing Ex. 2016 ¶ 113).¹⁰

As Twitter notes in its Reply, these arguments reiterate PARC’s arguments about limitation 13[d]. *See* Pet. Reply 22. As we discuss above, we disagree with the premise that the Huomo–Cheng combination does not teach a context graph that stores facts and assertions as recited in limitation 13[d]. *See supra* Section IV.C.4. Thus, we disagree with PARC’s arguments.

We find Twitter’s arguments persuasive that the combination of Huomo and Cheng teaches all aspects of limitation 13[e], and that it would have been obvious to modify Huomo as Twitter proposes. Apart from its arguments about limitation 13[d], PARC raises no other issue relating to limitation 13[e] that would rebut Twitter’s contentions.

6. *Conclusion as to Claim 13*

For all reasons discussed in the sections above, we determine that Twitter has shown by a preponderance of the evidence that claim 13 is unpatentable as obvious over Huomo in view of Cheng.

D. CLAIMS 1–4, 7–10, 14–16, AND 20

Claims 14–16 depend from claim 13 and add further limitations. Ex. 1001, 12:8–38. Twitter provides claim charts for these dependent claims, relying on Huomo’s teachings and Chang’s user interest model for providing

¹⁰ PARC also makes a third argument that the same entity in Huomo cannot be both a context consumer and a receiver of notifications. *See* PO Resp. 38–39; PO Sur-reply 15–16. This argument relates solely to the grounds based on Huomo without Cheng, which we do not address in this decision. As such, we need not address this argument.

the added limitations. *See* Pet. 58–75 (citing Ex. 1003 ¶¶ 181–257, 278–279, 282; Ex. 1004, 3:1–17, 7:3–6, 7:12–48, 7:53–8:4, 8:11–20, 8:46–64, 9:16–34, 9:50–65, 10:3–50, 11:7–9, 11:18–49, 12:9–63, 13:18–22, 13:24–30, 13:61–14:17, 14:50–15:19, 15:42–65, Fig. 3).

Independent claim 1 is a method claim with limitations that are essentially a subset of the limitations of claim 13. *Compare* Ex. 1001, 10:30–40, *with id.* at 11:47–12:7. Independent claim 7 is directed to “[a] non-transitory computer-readable storage medium” and is likewise essentially a subset of the limitations of claim 13. *Compare id.* at 11:1–13, *with id.* at 11:47–12:7. Twitter contends that “[c]laims 13–1[6] are the system claim analogs of claims 7–1[0] and 1–[4], respectively.” Pet. 75 (footnote omitted). Thus, Twitter relies on the same evidence and arguments for claims 1–4 and 7–10 as those provided for claim 13–16. Pet. 75–76 (citing Ex. 1003 ¶¶ 85, 286–328, 361–403).

Claim 20 depends from claim 1 and further recites “wherein sending the notification comprises notifying the recommender of topological changes in the context graph and/or changes to individual properties of nodes and edges in the context graph.” Ex. 1001, 12:52–55. Twitter relies on its arguments for claim 13, along with additional teachings from Cheng. Pet. 79–82 (citing Ex. 1003 ¶¶ 350–360; Ex. 1005 code (57), ¶¶ 14, 43–50, 52, 53, 54, 55, Figs. 2, 5, 7–10).

PARC does not contest Twitter’s specific showing for claims 1–4, 7–10, 14–16, or 20. *See generally* PO Resp. We find those arguments persuasive, and credit Dr. Turnbull’s supporting testimony. For all the reasons above, we find Twitter’s arguments persuasive that Huomo, in view of Cheng and Larson, teaches all the limitations in these claims and that a

person of ordinary skill in the art would have had reason to combine *Huomo* with the teachings of *Cheng*. Thus, we determine that Twitter has shown by a preponderance of the evidence that claims 1–4, 7–10, 14–16, and 20 are unpatentable as obvious over *Huomo* in view of *Cheng*.

E. CLAIMS 5, 11, AND 17

Claims 5, 11, and 17 depend from claims 1, 7, and 13, respectively, and further recite “receiving real-time event data through a RESTful WebAPI; and modifying the context graph based on the received real-time event data.” Ex. 1001, 10:58–62; *accord id.* at 11:35–40; *id.* at 12:31–38.

Lawson discloses “[a] method and system for real-time eventing including interacting with at least one configuration attribute according to instructions specified through an application programming interface (API),” and which involves subscribers. Ex. 1006, code (57). As preferable configuration attributes, Lawson discloses the use of “a representational state transfer (REST) application protocol interface (API).” *Id.* ¶ 29. Twitter relies on teachings from Lawson to motivate using a RESTful WebAPI to receive real-time event data. Pet. 72–75 (citing Ex. 1003 ¶¶ 265–268, 280, 281, 283–285; Ex. 1006 code (57), ¶¶ 2, 15, 18, 19, 26, 27, 29, 30, 33). According to Twitter, a person of ordinary skill in the art “would have understood that it would be beneficial to implement *Huomo* using Lawson’s receiving of real-time event data using REST architecture to allow *Huomo* to timely push to subscribers notifications of changes to such data in the blackboard.” Pet. 73–74.

PARC argues that Lawson only disclosed the use of a RESTful API to configure an “event router” device, and not “to receive, process, or distribute

events or collect data from sensors.” PO Resp. 40 (citing Ex. 1006 ¶¶ 19, 29–30, Fig. 8; Ex. 2016 ¶ 118); *see also id.* (citing Ex. 2016 ¶ 119) (arguing that a person of ordinary skill would appreciate Lawson’s limited use of REST and would consider the proposed combination to “do something completely different than what either Huomo or Lawson teaches”); *see also* PO Sur-reply 16–17 (arguing that “Lawson’s RESTful WebAPI only relates to configuring an ‘event router’ device.”). PARC also contends that modifying Huomo to use Larson’s REST architecture “would be onerous and would require adding hardware to Huomo’s system,” in part because “Lawson relies on an ‘event router,’ which is a discrete hardware component, to distribute events.” PO Resp. 41–42 (citing Ex. 1006, Fig. 2; Ex. 2016 ¶¶ 69–78, 117); *see also* PO Sur-reply 17–19.

Twitter disagrees with PARC that Lawson does not disclose using a RESTful API for events, as Lawson’s configuration attributes are accessed as part of processing events, disclosing that “a routing configuration attribute is preferably retrieved, and the event message is routed to the specified event(s) in the routing configuration attribute.” Pet. Reply 23 (quoting Ex. 1006 ¶ 32) (citing Ex. 1006 ¶¶ 19, 24, 29, 30; Ex. 1035 ¶¶ 56–59; Ex. 1003 ¶¶ 80, 268); *see also id.* at 23–24 (citing Ex. 1003 ¶ 257, 259–260, 274–275; Ex. 1035 ¶¶ 60–61) (arguing that because Lawson processes events, a person of ordinary skill in the art would consider the use of a RESTful WebAPI a way to add flexibility and reduce bandwidth).

Twitter also contends that Huomo “already discloses a REST-like API with sufficient hardware to receive and distribute real-time event data.” Pet. Reply 24 (citing Ex. 1003 ¶¶ 257–264, 274). And according to Twitter, REST was known to be lightweight, so no additional hardware would have

been necessary, including Larson’s event router. *Id.* (citing Ex. 1003 ¶¶ 257–259, 275; Ex. 1035 ¶ 63). Twitter states that it relies only on Lawson’s RESTful API teachings, not its event data teachings. *Id.*

We find Twitter’s arguments persuasive, and in particular, we disagree with PARC that the proposed combination would require incorporating Larson’s event router into Huomo’s system, or is only applicable to Larson’s own hardware. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art.”). The evidence of record suggests that applying a RESTful API would have been within the ordinary skill in the art, and Petitioner’s showing involves applying it without necessarily adding other hardware to Huomo’s system.

Thus, we determine that Twitter has shown by a preponderance of the evidence that claims 5, 11, and 17 are unpatentable as obvious over Huomo in view of Cheng and Larson.

F. CLAIM 19

Claim 19 depends from claim 1 and further recites “sending a second notification to the recommender by pushing events into the recommender’s publish/subscribe system asynchronously using a long-pull persistent push connection.” Ex. 1001, 12:47–51. Twitter relies on the arguments for claim 13, and also relies on Chauhan for teaching that such a system may push data asynchronously. *See* Pet. 76–79 (citing Ex. 1003 ¶¶ 329–349; Ex. 1004,

7:60–8:4, 9:27–34, 10:3–17, 10:23–50, 11:63–12:8, 12:21–25, 13:24–30, 14:50–65, 15:42–64; Ex. 1007 ¶¶ 2–5, 12, 13, 15, 274, 284).

Chauhan describes “methods and systems for managing the connections between a client, an intermediary appliance and a server, so that asynchronous messages can be transmitted over HTTP from the server to a client.” Ex. 1007, code (57). According to Twitter, Chauhan teaches that “long-polling advantageously allows a system to ‘achieve low latency and low bandwidth because an open connection with the client is always available to the server.’” Pet. 78 (citing Ex. 1007 ¶ 5).

Twitter argues that a person of ordinary skill in the art would have been motivated “implement Huomo’s disclosure of sending a notification to a recommender’s publish/subscribe system (particularly given Huomo’s express disclosures of push notifications) using Chauhan’s advantageous teachings of sending data asynchronously using a long-poll persistent push connection.” Pet. 78. Twitter also contends that the combination “achieve[s] low latency and low bandwidth” as “an open connection with the client is always available to the server.” Pet. 79 (citing Ex. 1007 ¶¶ 4, 5). According to Twitter, “it would have been routine to make such an implementation choice, and clear it would work and provide the expected functionality to yield predictable results with [a reasonable expectation of success].” *Id.* (citing Ex. 1003 ¶¶ 342–348).

In its Response, PARC first argues that “combining Chauhan with Huomo would require the addition of intermediary hardware between the context consumers and event sources, and a [person of ordinary skill in the art] would not be motivated to make this burdensome change to Huomo’s system.” PO Resp. 42–44 (citing Ex. 2016 ¶¶ 120–123).

To this argument, Twitter responds that its proposed combination of Huomo, Cheng, and Chuahan does not require the addition of intermediary hardware between the context consumer and the event source because “the combined Huomo–Chauhan system draws on Chauhan only for its ‘advantageous teachings of sending data asynchronously using a long-poll persistent push connection.’” Pet. Reply 25–26 (quoting Ex. 1003 ¶ 342). In its Sur-reply, PARC contends that Twitter’s argument is conclusory and relies on impermissible hindsight. PO Sur-reply 19.

We disagree with PARC that Twitter’s proposed combination is conclusory or relies on impermissible hindsight. To establish obviousness, Twitter need not bodily incorporate Chuahan’s system into that of Huomo, and may rely only on individual teachings that Chuahan contributes to the art, such as its teachings about the use of a long-poll persistent connection. *See Keller*, 642 F.2d at 425. This is not an impermissible hindsight reconstruction because “it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure.” *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971).

PARC also contends that Twitter’s proposed combination “requires that the alleged recommender (Huomo’s ‘context consumer’) be a web browser that creates the long-poll persistent connection,” and Twitter has not explained what the motivation would have been to modify Huomo’s “context consumers” into a web browser, as opposed to simply using a server. PO Resp. 44–45 (citing Ex. 2016 ¶¶ 124–125).

Twitter replies that PARC “is incorrect that Huomo’s context consumer must be a web browser: before ’439’s priority date it was common

for *mobile applications* to be web applications with only a mobile [operating system] web client within a wrapper.” Pet. Reply 26 (citing Ex. 1031, 6–7; Ex. 1035 ¶¶ 70–71). Twitter also argues that Huomo teaches that a context consumer could be “any of a number of different internal or external systems, devices and/or elements capable of retrieving a context atom,” which would include a web browser. *Id.* (quoting Ex. 1004, 12:24–25) (citing Ex. 1016 ¶ 125). In particular, Twitter argues that Huomo refers to HTTP as a protocol for transmitting and receiving context atoms, which a person of ordinary skill in the art would have understood to mean that context consumers may include web browsers. *Id.* at 27 (citing Ex. 1004, 9:51–55; Ex. 1035 ¶ 72).

We find Twitter’s arguments persuasive, including that Huomo, in view of Cheng and Chauhan, teaches all aspects of claim 19, that there would have been reason to modify Huomo’s system by using an asynchronous long-poll persistent push connection as recited in claim 19, and that doing so would not have required intermediary hardware between the context consumers and event sources.

For all reasons discussed above, we determine that Twitter has shown by a preponderance of the evidence that claim 19 is unpatentable as obvious over Huomo in view of Cheng and Chauhan.

V. PARC’S CONTINGENT MOTION TO AMEND

Because we conclude that all of the challenged claims are unpatentable based on the grounds of the Petition, we consider PARC’s Contingent Motion to Amend. *See* MTA(Paper 19) 1 (stating that the Motion to Amend is contingent on if “the Board finds any of the original

claims 1–20 unpatentable”). Although PARC originally submitted proposed substitute claims 21–40 to replace original claims 1–20, PARC has withdrawn proposed substitute claims 26, 32, and 38. *See* Paper 24, 3.

For the reasons below, we find that each of pending proposed substitute claims 21–25, 27–31, 33–37, 39, 40 would introduce new matter and are unpatentable under § 103. Therefore, we deny the Contingent Motion to Amend.

A. PROPOSED SUBSTITUTE CLAIMS

PARC proposes claims 21–25, 27–31, 33–37, 39, 40 as substitutes for original claims 1–5, 7–11, 13–17, 19, and 20 of the ’439 patent, respectively. *See* MTAApp’x A. Proposed substitute claim 21 is reproduced below, with underlining to indicate the text proposed to be added to original claim 1:

21. (Proposed substitute for claim 1, if found unpatentable) A method, comprising:

- [a] receiving, from a mobile device, event data derived from contextual data collected using detectors that detect a physical context surrounding the mobile device;
- [b] aggregating the event data from multiple mobile device clients for analysis, at a server-side architecture, regarding co-location events;
- [c] modifying a context graph that stores facts and assertions about a user’s behavior and interests using the event data, wherein the context graph includes nodes shared between two or more users;
- [d] in response to determining, at the server-side architecture, that there exists a registration for notification of changes that matches the modification to the context graph, sending, by the server-side architecture, a notification of context graph change to a recommender.

MTA App'x 1 (PARC's reference letters added, and formatting added for consistency with the original claims). PARC proposes similar amendments to independent claims 27, corresponding to original claim 7 (*id.* at 3–4) and 33, corresponding to original claim 13 (*id.* at 5–6).

B. PARC'S BURDEN TO SHOW COMPLIANCE WITH STATUTORY AND REGULATORY REQUIREMENTS

We first consider whether PARC has met its burden to show that it has met the statutory and regulatory requirements for a motion to amend.

“Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4 (PTAB Feb. 25, 2019) (precedential). Accordingly, a patent owner must make a claim listing reproducing each proposed substitute claim (which it has, *see* MTA App'x A), and must make an initial showing to demonstrate the following: (1) the amendment proposes a reasonable number of substitute claims; (2) the amendment responds to a ground of unpatentability involved in the trial; (3) the amendment does not seek to enlarge the scope of the claims of the patent; and (4) the proposed claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of filing date is sought) without introducing new subject matter. *See* 35 U.S.C. § 326(d); 37 C.F.R. § 42.121.

1. *Whether There Is a Reasonable Number of Substitute Claims and Whether the Proposed Amendment Responds to a Ground of Unpatentability Involved in the Trial*

PARC contends that it has proposed a reasonable number of substitute claims and that the proposed amendments respond to the patentability grounds involved in this trial. *See* MTA2–3. Because proposed substitute claims 26, 32, and 38 corresponded to original claims that were not challenged in this proceeding, PARC withdrew these claims from its Contingent Motion to Amend. *See* Paper 23; Paper 24, 3.

In light of this withdrawal, Twitter does not challenge the number of proposed claims or whether the proposed amendments respond to issues involved in the trial. *See generally* Pet. Opp. MTA. Because PARC now only proposes one substitute claim per original claim challenged in the Petition, we determine that the number of claims is reasonable. We also determine the pending proposed substitute claims only include amendments that respond to issues raised in the Petition.

2. *Whether the Proposed Amendment Seeks to Enlarge the Scope of the Original Claims*

PARC alleges that its “proposed substitute claims retain all of their original features and add narrowing elements.” MTA4. Twitter does not contest this. *See generally* Pet. Opp. MTA.

We agree with PARC that the proposed amendment does not seek to enlarge the scope of the original claims.

3. *Whether the Proposed Amendment Introduces New Matter*

We next consider whether the proposed substitute claims (including material found in the original claims) are supported in the original disclosure and whether the proposed amendment introduces new matter in violation of 35 U.S.C. § 316(d)(3). New subject matter is any addition to the claims that lacks sufficient support in the subject patent's original disclosure. *See TurboCare Div. of Demag Delaval Turbomach. v. Gen. Elec. Co.*, 264 F.3d 1111, 1118 (Fed. Cir. 2001) ("When [an] applicant adds a claim . . . , the new claim[] must find support in the original specification."). The Board requires that a patent owner show in a motion to amend that there is written-description support in the originally filed disclosure of the subject patent for each proposed substitute claim, and also set forth support in an earlier-filed disclosure for each claim for which the patent owner seeks the benefit of the earlier-filed disclosure's filing date. *See* 37 C.F.R. §§ 42.121(b)(1), 42.121(b)(2).

The test for determining whether an amendment lacks written description support in the original disclosure is not simply the presence or absence of literal support in the disclosure for the claim language, but rather, whether the disclosure as originally filed reasonably conveys to a person of ordinary skill in the art that the inventor had possession of the claimed subject matter at the time of filing. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc); *Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 1563 (Fed. Cir. 1991); *In re Kaslow*, 707 F.2d 1366, 1375 (Fed. Cir. 1983).

In its Motion to Amend, PARC contends that “the proposed substitute claims are supported in the original non-provisional application and thus do not introduce new subject matter.” MTA4. As support, PARC provides the testimony of Dr. Martin including a table that purportedly shows where support for each limitation may be found in the non-provisional parent application, App. No. 13/873,061 (“the ’061 application”). MTA5 (citing Ex. 2016 ¶¶ 49–60). PARC also provides an outline of this support in its Contingent Motion to Amend. MTA5–8.

Twitter contends that the proposed substitute claims lack support for the limitation “wherein the context graph includes nodes shared between two or more users” in proposed independent claims 21, 27, and 33 and in the other proposed substitute claims through dependency. *See* Pet. Opp. MTA2–4. According to Twitter, term “nodes” is only mentioned in paragraphs 49 and 51 of the ’061 application. *Id.* at 2. Twitter argues that paragraph 49 only discloses that the *context graphs* can be shared between users, but conveys to an ordinarily skilled artisan “nothing about the sharing of nodes or any other individual components of the user’s context graph.” *Id.* (citing Ex. 1035 ¶ 81). As to paragraph 51, Twitter argues that it only discloses that changes to a context graph can include changes to properties of the nodes and edges, and does not suggest any sharing of nodes between users. *See id.* at 3 (citing Ex. 1035 ¶ 85). Twitter also points to testimony by Dr. Martin discussing paragraph 48 of the ’061 application and allegedly admitting that the example being discussed (which is also the subject of paragraph 49) “does not directly call for storage of a node shared between two or more users.” *Id.* at 3–4 (emphasis omitted) (quoting Ex. 2016 ¶ 143) (citing Ex. 1035 ¶ 86).

PARC replies that the '061 application “explains that (1) “[e]ach user is associated with a context graph,” (2) “context graphs can also be shared between users[,]” and (3) “context graphs with greater numbers of nodes [can be managed] using cross module interconnections.” PO Reply MTA 1 (alterations in original) (quoting Ex. 1002 ¶¶ 48–49) (citing Ex. 2022 ¶¶ 79–86). Based on these disclosures, PARC contends that a person of ordinary skill in the art would have understood “that each user has his/her own context graph and nodes may be shared to minimize storage space.” *Id.* (citing Ex. 2022 ¶¶ 79–94, 107–111). According to PARC, this is because duplicate nodes for different users would be stored once, rather than multiple times, and using cross-module interconnections, the system would distribute nodes for large graphs across multiple software modules on different devices. *See id.* (citing Ex. 1002 ¶ 49). PARC contends that such a shared context graph would still be “per-user” under its proposed construction because “[e]ach user’s graph simply points to the same memory location of the data contained in the shared node,” thus each user “retains his or her own graph while sharing nodes.” *Id.* at 2 (citing Ex. 2022 ¶¶ 89–94, 107–111). PARC disagrees that Dr. Martin’s testimony is an admission that the '061 application fails to disclose the sharing of nodes, because the cited testimony “explains how an example in the specification could apply to multiple users and involve shared nodes,” and “supports a finding of sufficient written description.” *Id.* (citing Ex. 2016 ¶ 143; Ex. 2022 ¶ 79).

Twitter counters that the disclosure of sharing of an entire context graph tells a person of ordinary skill in the art nothing about sharing individual components of that graph. Pet. Sur-reply MTA 1 (citing Ex. 1035 ¶ 81; *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351–52 (Fed.

Cir. 2010)). Twitter also argues that the '061 application's reference to "cross-module interconnections" involves the sharing of system components, not nodes. *Id.* at 2 (citing Ex. 1035 ¶ 81–83; Ex. 2022 ¶ 93).

We agree with Twitter. At best, PARC's arguments go to whether the sharing of nodes would have been obvious in view of the disclosure in the '061 application. Although "the description requirement does not demand any particular form of disclosure, . . . a description that merely renders the invention obvious does not satisfy the requirement." *Ariad*, 598 F.3d at 1352 (citing *Carnegie Mellon Univ. v. Hoffmann–La Roche Inc.*, 541 F.3d 1115, 1122 (Fed. Cir. 2008); *Lockwood v. Am. Airlines*, 107 F.3d 1565, 1571–72 (Fed. Cir. 1997)).

Thus, we find that PARC has failed to show support in the original disclosure for the added phrase "wherein the context graph includes nodes shared between two or more users." Consequently, we find that each of the proposed substitute claims would introduce new matter, and the amendments are disallowed under 35 U.S.C. § 316(d)(3).¹¹

¹¹ Twitter also contends that PARC has failed to show written description support for the "recommender's publish/subscribe system" recited in proposed substitute claim 39, which also appears in original claim 19. Pet. Opp. MTA4–5. Because we find that proposed substitute claim 39 lacks written description support in the '061 application through its dependency from proposed substitute claim 21, we need not address this separate question.

C. PATENTABILITY OF THE PROPOSED SUBSTITUTE CLAIMS

Having considered whether PARC has met its statutory and regulatory burden for a motion to amend, we next consider whether the record as a whole shows that the proposed substitute claims are patentable.

“A petitioner bears the burden of persuasion to show, by a preponderance of the evidence, that any proposed substitute claims are unpatentable.” 37 C.F.R. § 42.121(d)(2); *see also Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d 1027, 1040 (Fed. Cir. 2017), *amended by Bosch Automotive Service Solutions, LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018). To determine whether a petitioner has proven the substitute claims are unpatentable, the Board focuses on “arguments and theories raised by the petitioner in its petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020). The Board itself also may justify any finding of unpatentability by referring to evidence of record in the proceeding. *Lectrosonics*, Paper 15 at 4 (citing *Aqua Products v. Matal*, 872 F.3d 1290, 1311 (Fed. Cir. 2017) (O’Malley, J.)).

Twitter contends that each of the proposed substitute claims is unpatentable under 35 U.S.C. §§ 101 and 103. Pet. Opp. MTA3–25. The table below is a summary of the unpatentability grounds Twitter advances in its Opposition to the Contingent Motion to Amend:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
21–24, 27–30, 33–36, 40 ¹²	103	Huomo, Cheng
25, 31, 37	103	Huomo, Cheng, Lawson

¹² Proposed substitute claims 26, 32, and 38 have been withdrawn, and we do not consider them in our analysis. See PO Reply MTA 1.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
39	103	Huomo, Cheng, Chauhan
21–24, 27–30, 33–36, 40	103	Huomo, Cheng, Li ¹³
25, 31, 37	103	Huomo, Cheng, Lawson, Li
39	103	Huomo, Cheng, Chauhan, Li
21–24, 27–30, 33–36, 40	103	Huomo, Cheng, Tseng ¹⁴
25, 31, 37	103	Huomo, Cheng, Lawson, Tseng
39	103	Huomo, Cheng, Chauhan, Tseng
21–25, 27–31, 33–37, 39, 40	101	Eligibility

Pet. Opp. MTA6, 21. Of the above grounds, we only address the three grounds under § 103 involving Li, which are sufficient to show unpatentability of all the proposed substitute claims.¹⁵

1. Obviousness of Proposed Substitute Claims 21, 27, and 33 over Huomo, Cheng, and Li

In addition to its prior arguments regarding original claims 1, 7, and 13, Twitter contends that corresponding proposed substitute claims 21, 27, and 33 are unpatentable under § 103 as obvious over Huomo, Cheng, and Li. Pet. Opp. MTA5–21. We address Twitter’s arguments below.

¹³ Quannan Li et al., *Mining User Similarity Based on Location History*, Proc. 16th ACM SIGSPATIAL Int’l Conf. on Advances Geographic Info. Sys. 34:1 (2008) (Ex. 1034).

¹⁴ Tseng et al., US 2012/0166432 A1 (published June 28, 2012) (Ex. 1025).

¹⁵ Twitter states that, “[t]he Petition’s analysis and Dr. Turnbull’s prior opinions . . . remain applicable to the independent claim’s unamended limitations, . . . and a [person of ordinary skill in the art] would have been motivated and found it obvious to incorporate Li’s . . . teachings in the Petition’s grounds.” Pet. Opp. MTA13. We incorporate our analysis above with respect to these limitations. *See supra* Section IV.

(a) Overview of Li

Li describes a framework “to geographically mine the similarity between users based on their location histories.” Ex. 1034, 1. The framework clusters users’ travel information into a hierarchical location graph for modeling a users’ location history “in which a graph node is the cluster containing the user’s stay points and a graph edge stands for the sequence of the clusters (geographic regions) being visited by this user.” *Id.* at 4. Two users can “share the same nodes,” and “[t]o better measure the similarity between two users, on each layer of their hierarchical graphs we first find the same graph nodes the users shared, and then formulate a sequence based on these graph nodes.” *Id.* at 5.

(b) Amendments Regarding “Aggregating” Step

Proposed amended claims 21, 27, and 33 include a new limitation reciting the step of “aggregating the event data from multiple mobile device clients for analysis, at a server-side architecture, regarding co-location events.” MTAApp’x A, 1, 3, 6. PARC argues that both Huomo and Cheng disclose “a single-user, rather than a multi-user focused environment,” and thus do not teach aggregating data regarding co-location events as required in the proposed substitute claims. MTA 11–13.

Twitter contends that PARC ignores Huomo’s disclosure that its “blackboard” receives context data not only from the user’s mobile device but from other electronic devices, including other mobile device clients. Pet. Opp. MTA 6–7 (citing Ex. 1004, 7:56–60, 15:29–30). Twitter also argues that Huomo discloses determining whether the user is near another user, such as when they are shopping together. *Id.* at 8–9 (citing Ex. 1004, 13:52–

60, 13:66–14:13, 14:36–49; Ex. 1003 ¶¶ 125, 141, 278, 281; Ex. 1035 ¶¶ 118–119, 122–123). Twitter also contends that this aggregation regarding co-location events occurs at a server-side architecture. *Id.* at 9–10 (citing Ex. 1004, 4:6–9, 4:64–5:7, 11:3–7; Ex. 1003 ¶¶ 75, 95–96, 98, 109–112, 132; Ex. 1035 ¶¶ 125–129).

PARC counters that, “although Huomo’s blackboard receives one user’s information from ‘a variety of different sources’” such as sensors in wireless accessories like speakers and microphones, “they are all under that one user’s control.” PO Reply MTA 7–8 (quoting Ex. 1004, 2:57–59) (citing Ex. 1004, 2:9–13, 6:66–7:1, 6:47–58, 14:36–49; Ex. 2022 ¶¶ 117–122). PARC also argues that Huomo’s aggregation is not related to co-location events because they involve only one particular user. *Id.* at 8 (citing Ex. 1004, 17:31–54, Figs. 1, 3; Ex. 2022 ¶¶ 118–127). As to Huomo’s disclosure about users who are shopping together, PARC contends that “Huomo determines users are together through that one user’s ‘instant messaging contacts, email contacts,’ or calendar meetings.” *Id.* at 7 (quoting Ex. 1004, 14:36–49) (citing Ex. 1004, 2:9–13).

Twitter replies that PARC’s argument focusing on sensors associated with a single mobile station under a single user’s control ignores what Twitter relied on in its Opposition, which is “the multitude of other mobile devices/clients (including ‘other user terminals’) from which Huomo’s server receives and aggregates event data.” Pet. Sur-reply 3–4 (citing Ex. 1004, 6:47–51). Twitter also argues that the aggregation of dating relating to co-location is “based upon the people, or more particularly *the electronic devices of the people*, around the user of the mobile station.” *Id.*

at 4 (quoting Ex. 1004, 14:40–45) (citing Ex. 1004, 2:9–13, 14:36–40; Ex. 1035 ¶ 119).

We agree with Twitter that Huomo’s disclosure is not limited to wireless accessories of a single user’s device. For example, Huomo discloses aggregating data from “other mobile stations” (Ex. 1004, 6:27), “other user terminals” (*id.* at 7:60), “a neighborhood of mobile stations (e.g., for peer-to-peer communication)” (*id.* at 2:63–64), “a cellular network” (*id.* at 2:66), and “sensors located on other mobile stations that are capable of communicating with the mobile station” (*id.* at 15:30–32). Thus, for the above reasons, we find Twitter’s arguments persuasive that Huomo discloses “aggregating the event data from multiple mobile device clients for analysis, at a server-side architecture, regarding co-location events.”

(c) Amendments Regarding Sharing Nodes Between Two or More Users

Proposed amended claims 21, 27, and 33 include the new limitation “wherein the context graph includes nodes shared between two or more users.” MTA App’x A, 1, 3, 6. PARC argues that “neither Huomo nor Cheng disclose[s] a context graph with nodes shared between two or more users.” MTA 14 (citing Ex. 2016 ¶¶ 143–148).

Twitter argues that Li discloses a hierarchical context graph with nodes representing geographical regions and edges representing the locations a user has visited. Pet. Opp. MTA 12 (citing Ex. 1034, 1–2; Ex. 1035 ¶ 151, 153). According to Twitter, Li teaches that nodes are shared between users and that user similarity is determined by searching for the same graph nodes that users shared, which would indicate that users have visited the same locations. *See id.* at 12–13 (citing Ex. 1034, 4–5; Ex. 1035

¶¶ 161–163); *see also id.* at 14 (arguing that Li’s system “stores only *one* copy of the shared node that can be referenced by each user’s per-user context graph” (citing Ex. 1035 ¶ 176)). Twitter argues that using Li’s teaching of shared nodes in the Huomo–Cheng combination “would advantageously increase the combined system’s ability to provide highly-relevant recommendations by, *e.g.*, leveraging additional information about users’ common interests based on their shared location histories.” *Id.* at 13–14 (citing Ex. 1035 ¶ 175). Twitter also argues that the combination “would advantageously reduce the number of nodes the system stores, reducing memory requirements and increasing context graph data storage efficiency,” and would allow the system to “quickly recognize overlaps,” and “alter the node data once in a single location (rather than multiple times in each individual graph).” *Id.* at 14–15 (citing Ex. 1035 ¶ 176).

PARC disagrees that Li discloses shared nodes. PO Reply MTA9 (citing Ex. 2022 ¶¶ 135–159). According to PARC, Li’s reference to “sharing relates to clustering users into a specific geographic region based on location history.” *Id.* (citing Ex. 1034, 2, 4, Fig. 4). But “each user still maintains its separate location data (*i.e.*, Dallas and Houston), and are shown in the geographic ‘node’ as separate data points.” *Id.*

PARC also contends that Twitter has failed to offer a sufficient motivation to combine Huomo and Cheng with Li. PO Reply MTA11–12. According to PARC, “Twitter fails to explain *how* the cited statement from Li would motivate one to combine the references as suggested,” but “merely contends [that a person of ordinary skill in the art] would have combined the references because ‘[e]ach describes, *e.g.*, gathering information from sensors (including, *e.g.*, GPS data) and giving users recommendations based

on those data.” *Id.* at 11 (quoting Pet. Opp. MTA13). PARC characterizes this as “merely alleging that ‘the references came from the same field of study and address the same problem.’” *Id.* at 11–12 (quoting *Comcast Cable Commc’ns, LLC v. Promptu Sys. Corp.*, 838 F. App’x 555, 557 (Fed. Cir. 2019)). PARC also contends that the remainder of Twitter’s arguments as to the motivation to combine are conclusory. *Id.* at 12. And finally, PARC argues that “Li’s graphs are different from Huomo’s ‘blackboard’ and Cheng’s ‘personal interest graph’” because “Li’s graphs are temporary, and he does not describe modifying a graph or sending notifications.” *Id.* (citing Ex. 2022 ¶¶ 136–166).

Twitter replies that Li explicitly discloses that users “share the same graph nodes.” Pet. Sur-reply MTA6–7 (emphasis omitted) (quoting Ex. 1034, 5) (citing Ex. 1034, 2, 4, 9; Ex. 1035 ¶ 159). Twitter disagrees with PARC that nodes are different for each user, because “Li does not teach stay points [e.g., Dallas and Houston] are saved in the node; even if they were, these user’s stay points would all be the same.” *Id.* at 7. Also, according to Twitter, Dr. Martin admits in his declaration that “Li[] . . . giv[es] each unique cluster [has] *a unique ID*. When generating a user’s hierarchical graph layers . . . the system creates *nodes that refer to those geographical clusters via their cluster ID*.”” *Id.* (alterations in original) (quoting Ex. 2022 ¶ 143).

As to the motivation to combine, Twitter argues that PARC’s argument “ignores the detailed explanations as to how the modifications would improve the base reference provided in the Opposition and Dr. Turnbull’s declaration.” Pet. Sur-reply 9 (citing Ex. 1035 ¶¶ 146–148, 171–176, 195–197). As to PARC’s argument that Li’s user graphs are

temporary and that Li uses user similarity rather than location history for its recommendations, Twitter argues that it “relies on Li for its nodes shared between two or more users.” *Id.* (citing Ex. 1035 ¶ 150). Thus, “the process by which Li later provides recommendations is not relevant to whether Li discloses shared nodes or whether [a person of ordinary skill in the art] would have implemented the Huomo–Cheng–Li system using Li’s teachings of shared nodes.” *Id.* Twitter also contends that “Li expressly discloses stored user ‘location histories’ are used for recommendations.” *Id.* (citing Ex. 1034, 5, 10, Fig. 5).

We find Twitter’s arguments persuasive that Li teaches the sharing of nodes between two or more users as recited in claims 21, 27, and 33. Li expressly teaches that two users can share the “same nodes.” Ex. 1034, 4 (“[W]e search for the same graph nodes these two users shared on each layer of the framework.”), 5 (“[W]e first find the same graph nodes the users shared”; “User1 and User2 share the same nodes”). The evidence suggests that these shared nodes are, indeed, the same, as they represent the same geographical concept (e.g., “Texas” or, lower in the hierarchy, “Dallas” and “Houston”). This is consistent with Dr. Martin’s testimony cited by Twitter, that each node, representing a geographical region, is given “a unique ID,” and that the system “refer[s] to these geographical clusters via their cluster ID.” Ex. 2022 ¶ 143.¹⁶

¹⁶ Twitter argues that PARC has improperly incorporated by reference much of Dr. Martin’s testimony into its brief, including ¶ 143. *See* Pet. Sur-reply MTA 7 n.7. PARC, likewise, accuses Twitter of improperly incorporating expert testimony by reference. *See* PO Reply MTA 12. For both parties, we consider expert testimony in our decision only to the extent that it has been

The shared nodes in Li represent “hierarchical clusters,” each representing a different geographical area, and to obtain these clusters, the authors “put all users’ stay points into a dataset” and then assigned “similar stay points from various users . . . to the same clusters on different layers.” Ex. 1034, 4. Although the stay points assigned to each cluster may be distinct for each user, the clusters themselves (what Twitter identifies as the nodes) are clearly the same for all users because that is how users are compared with each other on the basis of geographical locations.

We also find Twitter’s proposed motivation to combine Li with the Huomo–Cheng combination sufficient and persuasive, as Twitter need only rely on Li’s teaching that nodes are shared between users in a context graph (which Cheng discloses, *see supra* Section IV.C.4). Thus, Twitter has shown that the combination of Huomo, in view of Cheng and Li, teaches the limitation “wherein the context graph includes nodes shared between two or more users.”¹⁷

discussed in the briefs. *See* 37 C.F.R. § 42.6(a)(3) (“Arguments must not be incorporated by reference from one document into another.”).

¹⁷ Alternatively, Twitter argues that Cheng teaches node sharing because multiple users have sub-graphs within the same global ontology, and nodes corresponding to the same concepts would be consistently named within each user’s sub-graph. Opp. 11–12 (citing Ex. 1005 ¶ 45; Ex. 1035 ¶ 145). We note that Cheng also discloses an embodiment (not mentioned by Twitter) in which personal interest graphs for multiple users can have links to the same nodes in a shared global ontology. *See* Ex. 1003 ¶¶ 46, 51; Ex. 1021 ¶ 92. Because we find Twitter’s arguments based on Li persuasive, we need not address Twitter’s alternative argument based on Cheng.

(d) Amendments Regarding “Server-Side Architecture”

Proposed substitute claims 21, 27, and 33 require that the “determining” and “sending” steps occur at or by “the server-side architecture.” MTA App’x 1, 3–4, 6. PARC argues that “[n]either Huomo nor Huomo + Cheng teach or render obvious the claimed *server-side architecture* in the proposed claims.” MTA 15–16. In particular, according to PARC, “there is no indication that the Huomo subscription manager would run at a server-side architecture.” *Id.* at 17.

Twitter argues that Cheng “discloses that its context graph and recommender can reside at a server-side architecture.” Pet. Opp. MTA 18–21 (citing Ex. 1005 ¶ 55). According to Twitter, a person of ordinary skill in the art would “have found it obvious, straightforward, and advantageous to implement Huomo’s disclosed connected server computer using the operations of the combined systems of Huomo–Cheng and Huomo–Cheng–Li.” *Id.* at 19 (citing Ex. 1003 ¶¶ 93–163; Ex. 1035 ¶¶ 125–138, 209). In particular, Twitter alleges that an ordinary skilled artisan “would have recognized the combined system would benefit from, *e.g.*, the additional memory and processing capability of a server computer that was not as readily, economically, or reliably available on mobile devices at the time.” *Id.* (citing Ex. 1003 ¶ 114; Ex. 1035 ¶ 208). Thus, Twitter contends that it would have been obvious that the “determining” and “sending” steps in the proposed combinations would take place at the server side. *Id.* at 19–21.

In Reply, PARC argues that Huomo itself does not teach performing the “determining” and “sending” steps on the server side. But PARC does not specifically address Twitter’s arguments about Cheng’s teaching that the

context graph and recommender can take place at a server and thus the “determining” and “sending” operations would take place on the server side. *See* PO Reply 10–12. According to PARC, Cheng and Li are not “alleged to overcome the deficiencies [that PARC identifies in Huomo alone]. Twitter simply relies on them to disclose the ‘server-side architecture,’ which is irrelevant as the registration/notification element is not disclosed.” *Id.* at 11.

We disagree that Twitter’s arguments about Cheng’s teachings are irrelevant to this issue because, as we discuss above, we determine that the combination of Huomo and Cheng teaches the registration/notification limitation. *See supra* Section IV.C.5. For the reasons discussed above, we determine that a person of ordinary skill in the art implementing the Huomo–Cheng or Huomo–Cheng–Li combination would have had reason to perform the “determining” and “sending” steps on the server side.

(e) Conclusion as to Proposed Substitute Claims 21, 27, and 33

For all reasons discussed in the sections above, we determine that Twitter has shown by a preponderance that proposed substitute claims 21, 27, and 33 are unpatentable as obvious over Huomo in view of Cheng and Li.

2. Obviousness of Proposed Substitute Claims 22–25, 28–31, 34–37, 39, 40

Twitter relies on its arguments in the Petition for the limitations found in the dependent proposed substitute claims. *See* Pet. Opp. MTA21. PARC does not separately challenge these arguments in its Contingent Motion to Amend. *See generally* MTA; PO Reply MTA.

Thus, for all the above reasons, we conclude that Twitter shows, by a preponderance of the evidence, that proposed substitute claims 22–24, 28–30, 33–36, and 40 are unpatentable as obvious over Huomo in view of Cheng and Li; that proposed substitute claims 25, 31, and 37 are unpatentable as obvious over Huomo in view of Cheng, Lawson, and Li; and that proposed substitute claim 39 is unpatentable as obvious over Huomo in view of Cheng, Chauhan, and Li.

VI. CONCLUSION¹⁸

For the reasons above, Twitter has shown by a preponderance of the evidence that claims 1–5, 7–11, 13–17, 19, and 20 of the '439 patent are unpatentable under § 103 as obvious over Huomo in view of Cheng (claims 1–4, 7–10, 13–16, 20), over the Huomo in view of Cheng and Lawson (claims 5, 11, and 17), and over Huomo in view of Cheng and Chuahan (claim 19).

Also, because PARC has failed to show, by a preponderance of the evidence, that proposed substitute claims 21–25, 27–31, 33–37, 39, and 40 do not contain new matter, and because Twitter has shown, by a

¹⁸ Should PARC wish to pursue amendment of claims in a reissue or reexamination proceeding after this decision, we draw PARC's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If PARC chooses to file a reissue application or a request for reexamination of the challenged patent, we remind PARC of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

preponderance of the evidence, that the claims are unpatentable under § 103, we deny PARC's Contingent Motion to Amend.

VII. ORDER

In consideration of the foregoing, it is

ORDERED that claims 1–5, 7–11, 13–17, 19, and 20 of the '439 patent are unpatentable;

FURTHER ORDERED that PARC's Contingent Motion to Amend is *denied*; and

FURTHER ORDERED that parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–4, 7–10, 13–16	103	Huomo ¹⁹		
1–4, 7–10, 13–16, 20	103	Huomo, Cheng	1–4, 7–10, 13–16, 20	
5, 11, 17	103	Huomo, Lawson		
5, 11, 17	103	Huomo, Cheng, Lawson	5, 11, 17	
19	103	Huomo, Chauhan		
19	103	Huomo, Cheng, Chauhan	19	
Overall Outcome			1–5, 7–11, 13–17, 19, 20	

¹⁹ Because our decision addresses grounds covering all the challenged claims, we need not, and do not, reach a separate determination on the grounds based on Huomo, Huomo and Lawson, or Huomo and Chuahan.

The table below summarizes our conclusions as to PARC's
Contingent Motion to Amend the claims:²⁰

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	21–25, 27–31, 33–37, 39, 40
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	21–25, 27–31, 33–37, 39, 40
Substitute Claims: Not Reached	26, 32, 38 ²¹

²⁰ Should PARC wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw PARC's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If PARC chooses to file a reissue application or a request for reexamination of the challenged patent, we remind PARC of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

²¹ PARC has withdrawn substitute claims 26, 32, and 38 from its Motion to Amend. See Paper 24, 3.

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