

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

PARTEC AG and BF EXAQC AG,

Plaintiffs,

v.

MICROSOFT CORPORATION,

Defendant.

Case No. 2:24-cv-00433-JRG

JURY TRIAL DEMANDED

DEFENDANT MICROSOFT'S INVALIDITY CONTENTIONS

Pursuant to the Court’s Docket Control Order and the Local Patent Rules, Microsoft Corp. (“Microsoft” or “Defendant”) provides these Invalidity Contentions to ParTec AG (“ParTec”) and BF exaQC AG (“BFX”) (collectively “Plaintiffs”) for the claims (collectively, “Asserted Claims”) identified as asserted in Plaintiffs’ Infringement Contentions served on September 4, 2024 (“Infringement Contentions”).

Defendant’s Invalidity Contentions include the accompanying claim charts concerning U.S. Patent No. 10,142,156 (the “’156 Patent”); U.S. Patent No. 11,934,883 (the “’883 Patent”); U.S. Patent No. 11,537,442 (the “’442 Patent”) (collectively, the “Asserted Patents”).

I. INTRODUCTION

As disclosed in its Infringement Contentions served on September 4, 2024 (“Infringement Contentions”) served on Defendant, Plaintiffs assert the following patents and claims:

Patent	Asserted Claims	Plaintiffs’ Alleged Priority Date	Chart Prefix
’156 Patent	1-15	June 19, 2010	156
’883 Patent	1-16	June 19, 2010	883
’442 Patent	1-5, 7-9	January 23, 2018	442

The claims identified above are referenced as “the Asserted Claims” unless reference is made specifically with respect to particularly identified one or more of the Asserted Patents and/or one or more of the Asserted Claims. By identifying Plaintiffs’ alleged priority date for the Asserted Claims of each patent above, Microsoft does not concede that Plaintiffs’ claims of priority are correct. Further, the citation of prior art herein and the accompanying exhibits are not intended to reflect Defendant’s claim construction contentions, which will be disclosed in due course in accordance with the Docket Control Order (Dkt. No. 23). Instead, Microsoft’s Invalidity Contentions as set forth herein and in the accompanying exhibits may reflect Plaintiffs’ apparent claim constructions based on its Infringement Contentions.

As further detailed in and supported by these Invalidity Contentions, Defendant contends that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112.¹ Defendant reserves the right to prove the invalidity of the Asserted Claims on bases other than those required to be disclosed in these disclosures pursuant to the current Scheduling Order and the Patent Local Rules.

II. RESERVATION OF RIGHTS

Based on this disclosure of the Asserted Claims, Microsoft does not provide any contentions regarding any claims not asserted in Plaintiffs' Infringement Contentions. To the extent that the Court permits Plaintiffs to assert additional claims against Microsoft to amend its infringement contentions and/or assert one more claims other than the Asserted Claims, Microsoft reserves the right to further modify, amend, or supplement these invalidity contentions accordingly—for example, to show the invalidity and/or ineligibility of any such newly Asserted Claims.

This Court's Docket Control Order and Local Patent Rules requires that these invalidity contentions be served after Plaintiffs' Infringement Contentions, which must be "in the form of a chart setting forth where in the accused product(s) each element of the asserted claim(s) are found." Plaintiffs' infringement contentions fail to put Microsoft on notice of Plaintiffs' theories for why Microsoft's products are purportedly infringing, or how Plaintiffs interprets the limitations of its asserted patent claims as covering Microsoft's products.

These Invalidity Contentions do not constitute an admission that any accused products infringe the Asserted Patents. In other words, these Invalidity Contentions should not be deemed

¹ References to Title 35 of the United States Code are to statutes prior to amendment under the America Invents Act ("AIA"), to the extent that the Asserted Patents have effective filing dates prior to applicable AIA effective dates, and to the current statutory provisions with respect to Asserted Patents having effective filing dates after the applicable AIA effective dates.

to be related to the non-infringement positions that Microsoft may advance in this action. In particular, Microsoft's Invalidity Contentions are made in addition to, and/or in the alternative to, Microsoft's non-infringement positions, and should not be interpreted to rely upon, or in any way affect, the non-infringement arguments Microsoft makes in this case.

Microsoft provides these disclosures consistent with the schedule currently in place, but do so without waiving any right to receive from Plaintiffs such full and complete specific infringement disclosures as should have been provided within Plaintiffs' Infringement Contentions. Microsoft's compliance with the current schedule should not be viewed as a waiver of any right to seek relief regarding the deficiencies in Plaintiffs' Infringement Contentions or to further amend or supplement its Invalidity Contentions once Plaintiffs comply with the Court's requirements.

Microsoft further reserves the right to revise these Invalidity Contentions in view of the Court's construction of terms and phrases recited in one or more of the Asserted Claims, additional information obtained during discovery, additional infringement theories put forth by Plaintiffs during fact and/or expert discovery, any findings as to the priority date(s) of the Asserted Claims, and/or positions that Plaintiffs, their fact witnesses, or their expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues, as permitted by the Court. Microsoft further reserves the right to supplement their accompanying document productions should they later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware code, including information provided by third parties after the date of service of these Invalidity Contentions.

Additionally, Plaintiffs have not identified its contentions regarding the level of ordinary skill in the art for any of the Asserted Patents. Thus, Microsoft has based its Invalidity on the level

of skill in the art apparent from the face of the asserted patents. For the avoidance of doubt, Microsoft contends that the asserted claims are invalid for the reasons set forth in their Invalidity Contentions under any plausible definition of the level of ordinary skill for each of the Asserted Patents. Nevertheless, Microsoft reserves the right to revise these Invalidity Contentions in response to any position taken by Plaintiffs on the level of ordinary skill in the art applicable to a given Asserted Patent.

Microsoft may further rely on inventor admissions concerning the scope or state of the prior art relevant to the Asserted Claims, the patent prosecution histories of the Asserted Patents, related patents and/or patent applications, any deposition or trial testimony of the named inventors on the Asserted Patents, and the papers filed and any evidence produced or submitted by Plaintiffs in connection with these cases or other related litigation.

Prior art not included in these Invalidity Contentions, whether known or not known to Microsoft, may become relevant. In particular, Microsoft is currently unaware of the extent, if any, to which Plaintiffs will contend that limitations of the Asserted Claims are not disclosed in the prior art identified in these Invalidity Contentions. Accordingly, Microsoft reserves the right to identify other references that would disclose the allegedly missing limitation(s) of the claimed method, device, or system.

The references identified in these Invalidity Contentions, which include the attached claim charts, may disclose the elements of the Asserted Claims explicitly and/or inherently, render those elements alone or in combination obvious to those of ordinary skill in the art even absent an explicit or inherent disclosure, and/or they may be relied upon to show the state of the art in the relevant time frame. References identified in these Invalidity Contentions, as well as the “References Cited” on the face of the Asserted Patents and the patents cited within the body of the Asserted

Patents, may be used to illustrate, but not limit the scope of, the state of the art to which the Asserted Patents pertain (i.e., at a time prior to the date of alleged inventions of the Asserted Claims of the Asserted Patents). Moreover, Microsoft reserves the ability to rely on later-identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Because discovery is ongoing, Microsoft anticipates that additional prior art and invalidity bases may be found. Microsoft's investigation and analysis of the prior art is continuing, and thus Microsoft reserves the right to supplement, amend, and/or revise the information provided herein as Microsoft conducts further investigation and/or analysis, including identifying, charting, and relying on additional references.

Additionally, in view of likely third-party discovery that will be taken, Microsoft reserves the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and/or § 103 located during discovery or further investigation, and to assert contentions of invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, Microsoft expects to issue subpoenas to third parties believed to have knowledge, documents, and/or other evidence concerning invalidity of one or more of the Asserted Claims.

In addition to the positions and prior art identified in these Invalidity Contentions (including the accompanying claim charts), Microsoft also incorporates by reference all invalidity contentions and subject matter eligibility contentions, prior art, and invalidity claim charts (including, without limitation, all anticipation positions, obviousness positions [including all prior art combinations and motivations to combine], indefiniteness positions, written description positions, and non-enablement positions) concerning one or more of the Asserted Patents, as disclosed at any time. This includes without limitation disclosures in previous or related litigation,

in United States Patent & Trademark Office (“USPTO”) proceedings, by the Plaintiff, by any other parties accused of patent infringement by the Plaintiff, or by the named inventors or any individuals associated with the prosecution and/or any form of post-grant review or reexamination of the Asserted Patents.

Specifically, for example, Microsoft identifies, as prior art upon which they may rely to show the invalidity of the Asserted Claims, the prior art references disclosed by parties in any other litigation (including *inter partes* review and/or reexamination proceedings) involving one or more of the Asserted Patents, any patent related to any of the Asserted Patents, and/or any other patent allegedly assigned to Plaintiffs claiming priority to the Asserted Patents (collectively, “Other Plaintiffs Proceedings”). To the extent Microsoft has stipulated or stipulates in the future that it will not pursue certain invalidity grounds in these actions concerning patent claims subject to instituted *inter partes* review proceedings, Microsoft will abide by those stipulation(s), and nothing in these contentions should be read as suggesting otherwise. Rather, these contentions are intended to put Plaintiffs on notice of the grounds of invalidity that Microsoft may assert in these actions, including because the conditions of any relevant stipulation are not met (*e.g.*, if the corresponding *inter partes* review is not instituted) or because the grounds fall outside the scope of such stipulation(s).

Plaintiffs have a present and ongoing duty to produce to Microsoft all relevant documents from any other Plaintiffs Proceedings, including but not limited to all prior art, invalidity contentions, and expert reports on invalidity (among other relevant items).

Microsoft reserves the right to supplement or otherwise amend these Invalidity Contentions in response to any relevant discovery provided by third parties, Plaintiffs, opening or rebuttal expert reports, fact or expert depositions, or in response to any claim construction ruling(s) issued

by this Court (regardless of how and when such ruling is made). Microsoft also reserves the right to supplement or otherwise amend these Invalidity Contentions in response to any rebuttal evidence disclosed by Plaintiffs or as otherwise may be necessary or appropriate under the circumstances.

III. TECHNICAL BACKGROUND

A. Background of Cluster Computing

High-performance computing traces back to the early development of computers in the mid-20th century, with the Electronic Numerical Integrator and Computer (ENIAC) developed in 1943 as the world's first stored-program electronic computer.² In the 1960s, the world's very first supercomputers were introduced, starting with the Control Data Corporation (CDC)'s CDC 6600 supercomputer in 1964, which could compute floating point calculations at a rate of 500 KFLOP/s to 1 MFLOP/s.³ By 1980s, to increase processing speed, engineers started experimenting with building supercomputer with more, but smaller, processors with shared memory configured in a pipeline architecture to achieve uninterrupted streams of floating point computations.⁴

By the 1990s, many supercomputers were built as a system of clusters of distributed memory computers, allowing for parallel computing. These systems—often referred to as “cluster” supercomputers or “cluster” computing—could be used to process heavy computational workloads based on their parallel processing capabilities.⁵ Cluster computer systems could also also be scalable, with the ability to expand by adding more nodes and adjusting resource

² See *Computer History: All About the ENIAC*, <https://www.hp.com/ca-en/shop/offer.aspx?p=computer-history-all-about-the-eniac>

³ See *The Evolution of HPC* (August 24, 2016), <https://insidehpc.com/2016/08/the-evolution-of-hpc/>

⁴ See *id.*

⁵ See *id.*

utilization.⁶ In 1994, for example, NASA built the “Beowulf” clusters, made up of 16 interconnected Intel 486DX computers and could compute at a rate of 1 GFLOP/s.⁷

By the 2000s, multi-core supercomputers arrived on the scene, allowing for computers with increased performance through the use of multiple cores in a single chip and multiple chips on a single processor board.⁸ In addition to adding CPU cores, supercomputers could increase processing power through the inclusion of special purpose processors, such as graphics processors (GPUs), field-programmable gate arrays (FPGAs), and application-specific integrated circuits (ASICs), allowing for so-called heterogeneous computing.⁹

B. Microsoft’s Early Work in Cluster Computing

Microsoft was one of the players involved in the development of cluster computing, and specifically cloud cluster computing, well before Plaintiffs’ earliest priority date for any of its Asserted Patents.¹⁰

For example, in 1997, Microsoft introduced the Microsoft Cluster Server (MSCS) software architecture.¹¹ MSCS was designed to manage clusters consisting of loosely coupled, independent computer nodes.¹² MSCS included a “shared nothing” cluster model, in which each node is assigned a set of the cluster resources at any one time but can migrate resource to other nodes upon detection of node failure, thereby improving resource availability.¹³

⁶ See *id.*

⁷ See *The Evolution of HPC* (August 24, 2016), <https://insidehpc.com/2016/08/the-evolution-of-hpc/>; *Beowulf Clusters Make Supercomputing Accessible* (2020), https://spinoff.nasa.gov/Spinoff2020/it_1.html

⁸ See *The Evolution of HPC* (August 24, 2016), <https://insidehpc.com/2016/08/the-evolution-of-hpc/>

⁹ See *id.*

¹⁰ See Vogels et al., *The Design and Architecture of the Microsoft Cluster Service: A Practical Approach to High-Availability and Scalability* (June 1998), https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/mscs_ftcs98.doc; Bell et al., *High Performance Computing: Crays, Clusters, and Centers. What Next?* (August 2011), <https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/tr-2001-76.pdf>

¹¹ See Vogels et al., *The Design and Architecture of the Microsoft Cluster Service: A Practical Approach to High-Availability and Scalability* (June 1998), https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/mscs_ftcs98.doc;

¹² See *id.*

¹³ See *id.*

Table 1: components of the Cluster Service	
Component	Functionality
Event processor	Provides intra-component event delivery service
Object manager	A simple object management system for the object collections in the Cluster Service
Node manager	Controls the quorum <i>Form</i> and <i>Join</i> process, generates node failure notifications, and manages network and node objects
Membership manager	Handles the dynamic cluster membership changes
Global Update manager	A distributed atomic update service for the volatile global cluster state variables.
Database manager	Implements the Cluster Configuration Database
Checkpoint manager	Stores the current state of a resource (in general its registry entries) on persistent storage.
Log manager	Provides structured logging to persistent storage and a light-weight transaction mechanism
Resource manager	Controls the configuration and state of resources and resource dependency trees. It monitors active resources to see if they are still online
Failover manager	Controls the placement of resource groups at cluster nodes. Responds to configuration changes and failure notifications by migrating resource groups
Network manger	Provides inter-node communication among cluster members

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By 2006, Microsoft released its Windows Compute Cluster Server 2003, a publicly available high-performance computing cluster software for running parallel applications for solving complex computations.¹⁵ Windows Compute Cluster Server 2003 could be used, for instance, with Dell's high performance cluster computing solutions, such as Dell computer, connectivity, and storage technology.¹⁶ A Dell cluster configuration (shown below) could include a head node, which is the point for cluster management, deployment and job scheduling, including controlling and mediating access to available cluster resources pooled from one or more compute nodes.¹⁷ Windows Compute Cluster Server 2003 was able to provide monitoring tools, policy-based scheduling and scalable management for node and cluster configuration deployments.¹⁸

¹⁴ See *id.*

¹⁵ See *Microsoft Launches Windows Compute Cluster Server 2003* (June 9, 2006), <https://www.informationweek.com/software-services/microsoft-launches-windows-compute-cluster-server-2003;> *Microsoft Releases Windows Compute Cluster Server 2003, Bringing High-Performance Computing to the Mainstream* (June 9, 2006), <https://news.microsoft.com/2006/06/09/microsoft-releases-windows-compute-cluster-server-2003-bringing-high-performance-computing-to-the-mainstream/>

¹⁶ See *Deploying Microsoft Windows Compute Cluster Server 2003* (November 2006), https://i.dell.com/sites/csdocuments/Business_solutions_power_Documents/de/de/ps4q06-20070153-Pepper_de.pdf

¹⁷ See *Dell Enterprise Systems InfoBrief: Microsoft Windows Compute Cluster Server 2003*, <https://download.microsoft.com/download/8/6/1/86149563-03ec-427e-80f1-d683bd715b2b/Dell%20HPC%20InfoBrief.pdf>

¹⁸ See *id.*

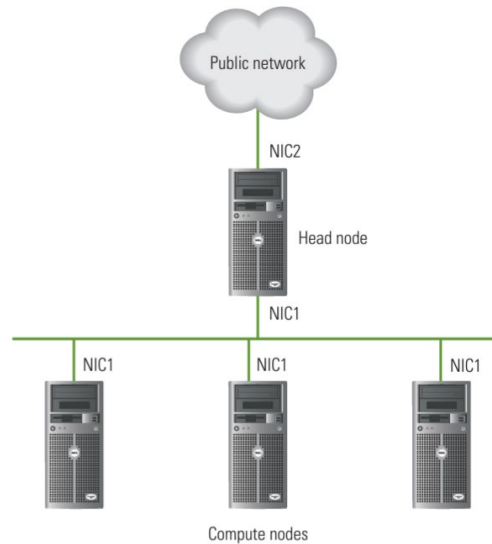


Figure 1. Example Microsoft Windows Compute Cluster Server 2003-based cluster configuration

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By early 2010, Microsoft had announced its Microsoft Azure cloud computing platform.²⁰ At that time (in 2010), Microsoft publications on Azure described the use of “virtualized storage, network and computer resources deployed on demand by the provisioning policies set at deployment time.”²¹ According to MSDN Magazine, at that time, “Azure provide[d] a hosted application server and the necessary storage, networking and integration infrastructure for building and running Windows applications.”²² The same article described the use of a “Fabric Controller” that “is the brain of the entire ecosystem” and “spawns additional instances to meet contractual service-level agreements” (aka “SLAs”), allowing for virtualized pools of computers.²³

¹⁹ See *Deploying Microsoft Windows Compute Cluster Server 2003* (November 2006), https://i.dell.com/sites/csdocuments/Business_solutions_power_Documents/de/de/ps4q06-20070153-Pepper_de.pdf

²⁰ See *Cloud Computing - Microsoft Azure for Enterprises* (February 2010), <https://learn.microsoft.com/en-us/archive/msdn-magazine/2010/february/cloud-computing-microsoft-azure-for-enterprises>

²¹ See *id.*

²² See *id.*

²³ See *id.*

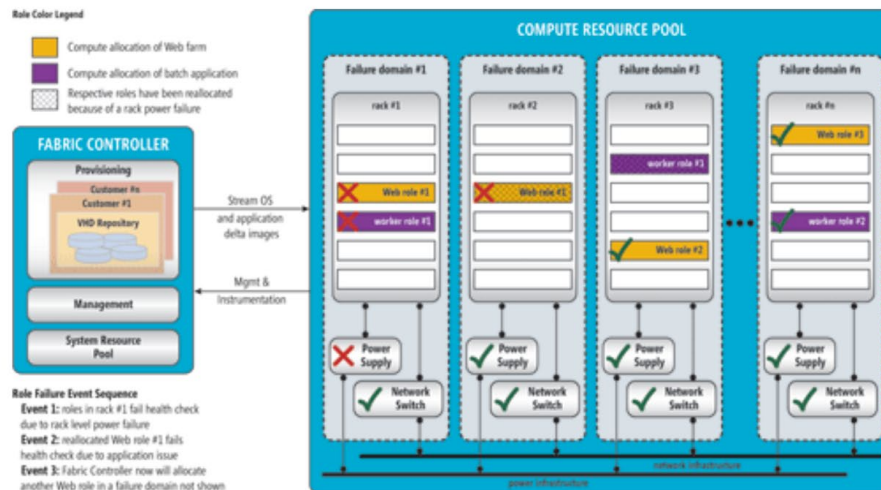


Figure 2 Conceptual View of Compute Infrastructure (Azure Setup May Be Different) 24

Microsoft also worked with arrays of servers accelerated with FPGAs in the early 2000s, as part of a program named “Project Catapult.”²⁵ FPGAs can be capable of post-deployment reconfigurability, allowing for the optimization of workloads in cloud computing platforms—they provide more flexibility than accelerators using fixed-functionality ASICs.²⁶ Positioning FPGAs between a top-of-rack network switch and a server’s network interface can accelerate communication and distributed computation by better handling network traffic.²⁷ By 2012, Microsoft had developed the first prototype of Project Catapult’s programmable hardware fabric, incorporated it in Microsoft Bing’s IndexServe engine, and deployed a pilot of 1,632 FPGA-enabled servers at a Microsoft production datacenter.²⁸

²⁴ See *id.*

²⁵ See *Project Catapult*, <https://www.microsoft.com/en-us/research/project/project-catapult/>

²⁶ See *Microsoft Supercharges Bing Search With Programmable Chips* (June 16, 2014), <https://www.wired.com/2014/06/microsoft-fpga/>

²⁷ See *Project Catapult*, <https://www.microsoft.com/en-us/research/project/project-catapult/>

²⁸ See *id.*; Putnam et al., *A Reconfigurable Fabric for Accelerating Large-Scale Datacenter Services* (June 2014), <https://www.microsoft.com/en-us/research/publication/a-reconfigurable-fabric-for-accelerating-large-scale-datacenter-services/>; *Catapult: Moving Beyond CPUs in the Cloud* (June 16, 2014), https://www.microsoft.com/en-us/research/wp-content/uploads/2016/02/Catapult_ISCA_2014.pdf

Microsoft's work on cluster and cloud computing has often repeatedly broken new ground, resulting in numerous patents in field, including, but not limited to: U.S. Patent No. 4,588,074; 5,708,814; 5,752,031; 5,758,184; 6,223,207; 6,460,178; 6,481,008; 6,493,810; 6,546,443; 6,609,248; 6,662,356; 6,748,585; 6,748,588; 6,757,900; 6,792,607; 6,802,056; 6,907,516; 6,915,454; 6,944,797; 6,961,750; 6,990,653; 6,996,599; 7,013,340; 7,028,290; 7,076,786; 7,096,456; 7,096,462; 7,111,283; 7,117,504; 7,120,897; 7,155,515; 7,162,723; 7,171,464; 7,191,364; 7,197,702; 7,197,748; 7,213,245; 7,228,540; 7,305,541; 7,321,918; 7,389,471; 7,395,312; 7,395,335; 7,398,276; 7,412,686; 7,415,524; 7,434,228; 7,441,234; 7,447,896; 7,451,176; 7,451,352; 7,464,368; 7,469,362; 7,493,397; 7,496,576; 7,496,904; 7,512,957; 7,516,209; 7,568,205; 7,581,231; 7,581,232; 7,584,458; 7,594,001; 7,603,676; 7,606,814; 7,607,142; 7,624,114; 7,624,126; 7,634,778; 7,644,305; 7,644,414; 7,665,061; 7,694,188; 7,698,397; 7,756,821; 7,765,374; 7,769,779; 7,783,718; 7,784,044; 7,809,985; 7,821,930; 7,861,118; 7,904,508; 7,930,705; 7,958,512; 7,984,155; 7,996,719; 7,996,841; 8,010,648; 8,024,546; 8,065,600; 8,086,882; 8,112,771; 8,151,337; 8,169,894; 8,245,035; 8,250,576; 8,255,373; 8,255,742; 8,266,290; 8,280,908; 8,312,459; 8,359,604; 8,369,208; 8,375,383; 8,407,206; 8,407,434; 8,434,079; 8,438,635; 8,458,287; 8,473,778; 8,477,610; 8,490,093; 8,495,036; 8,516,137; 8,533,701; 8,539,481; 8,543,863; 8,554,919; 8,589,481; 8,589,535; 8,620,884; 8,631,279; 8,635,152; 8,635,341; 8,713,378; 8,719,473; 8,719,803; 8,751,863; 8,755,283; 8,762,336; 8,769,134; 8,776,093; 8,799,629; 8,804,523; 8,806,426; 8,806,494; 8,812,687; 8,850,007; 8,850,018; 8,856,917; 8,862,914; 8,868,624; 8,868,711; 8,875,157; 8,886,796; 8,893,141; 8,904,008; 8,918,362; 8,918,478; 8,958,325; 8,959,503; 8,990,562; 8,990,907; 9,026,837; 9,038,071; 9,069,467; 9,086,922; 9,098,470; 9,098,609; 9,110,762; 9,141,422; 9,170,849; 9,218,497; 9,229,788; 9,231,869; 9,244,761; 9,253,293; 9,262,366;

9,274,906; 9,276,860; 9,286,001; 9,300,532; 9,317,482; 9,361,080; 9,372,735; 9,378,084;
9,412,466; 9,419,859; 9,432,472; 9,438,520; 9,465,602; 9,471,348; 9,473,944; 9,507,066;
9,507,577; 9,513,806; 9,519,555; 9,537,773; 9,547,496; 9,560,055; 9,565,250; 9,575,539;
9,575,864; 9,590,655; 9,606,836; 9,609,054; 9,639,299; 9,641,614; 9,652,327; 9,665,432;
9,674,090; 9,736,243; 9,749,208; 9,760,159; 9,760,401; 9,781,128; 9,792,154; 9,792,252;
9,807,153; 9,819,542; 9,832,267; 9,842,228; 9,846,628; 9,847,918; 9,847,980; 9,851,991;
9,852,010; 9,871,857; 9,875,115; 9,888,095; 9,922,200; 9,928,105; 9,946,548; 9,983,938;
9,996,572; 10,027,543; 10,061,652; 10,069,941; 10,108,528; 10,127,295; 10,129,153;
10,140,252; 10,153,941; 10,167,800; 10,169,097; 10,177,994; 10,180,840; 10,187,083;
10,198,294; 10,216,555; 10,230,529; 10,235,077; 10,241,812; 10,241,970; 10,242,026;
10,257,342; 10,270,709; 10,296,392; 10,318,279; 10,320,677; 10,326,696; 10,331,445;
10,332,008; 10,338,925; 10,372,456; 10,423,451; 10,425,472; 10,437,506; 10,445,097;
10,447,594; 10,452,399; 10,452,971; 10,452,995; 10,455,061; 10,467,324; 10,503,419;
10,511,478; 10,528,119; 10,536,523; 10,540,588; 10,545,831; 10,565,182; 10,566,076;
10,585,627; 10,601,596; 10,606,651; 10,606,672; 10,609,159; 10,628,086; 10,630,765;
10,635,500; 10,652,321; 10,656,868; 10,664,348; 10,691,413; 10,733,020; 10,768,920;
10,768,936; 10,776,115; 10,789,223; 10,791,054; 10,795,678; 10,819,657; 10,831,913;
10,838,775; 10,860,384; 10,860,924; 10,875,525; 10,877,787; 10,915,314; 10,924,525;
10,929,272; 10,936,316; 10,944,640; 10,958,717; 10,963,379; 10,965,457; 10,977,104;
11,010,198; 11,016,770; 11,032,359; 11,048,517; 11,089,088; 11,099,906; 11,099,910;
11,103,780; 11,126,433; 11,132,599; 11,138,029; 11,144,820; 11,157,801; 11,163,887;
11,194,604; 11,200,486; 11,228,510; 11,288,245; 11,290,524; 11,314,459; 11,329,889;
11,366,769; 11,386,061; 11,470,118; 11,494,614; 11,526,761; 11,531,552; 11,556,456;

11,556,762; 11,561,841; 11,562,247; 11,574,239; 11,586,594; 11,586,883; 11,593,138;
11,604,960; 11,625,505; 11,641,397; 11,645,493; 11,663,450; 11,676,003; 11,681,531;
11,720,594; 11,726,912; 11,741,362; 11,755,484; 11,762,980; 11,790,212; 11,803,389;
11,853,897; 11,882,011; 11,886,833; 11,886,925; 11,886,929; 11,899,518; 11,922,198;
11,934,327; 11,973,758; 12,045,724; 12,056,229; 12,067,495; 12,093,433; 12,107,674.

C. Known Technologies in Cluster Computing and Related Fields

In addition to the high-level overview described above, by the time of the Asserted Patents, many of the technologies described and recited in the asserted claims of the Asserted Patents were commonly used and well-known, as demonstrated by their presence in the prior art. Accordingly, Microsoft describes the following known technologies and identifies prior art references in which they are described. The known technologies listed below are not, of course, exhaustive—many other technologies and subject matter were well-known as of the dates of the purported inventions—and Microsoft reserves the right to identify additional categories and additional art demonstrating such categories at a later date as appropriate and permitted by law and the rules of this Court, including during expert discovery. The absence of a particular reference from a group is not an admission or suggestion that the reference does not disclose any particular claim limitations.

1. Heterogeneous Computing

Multiple prior art publications and references refer to systems and methods of accelerating compute nodes with GPUs or other general purpose hardware accelerators such as FPGAs, i.e., heterogenous (“mixed”) computing. Heterogenous computing is high-performing and involves parallel computing by using processors at multiple nodes to perform a computational task at the same time. Accordingly, a person of ordinary skill in the art of designing a cluster computer system would naturally consider adding accelerators to the system for any number of reasons,

including but not limited to, for enhancing processing of complex computational tasks and reducing the time to perform such computations. The following references either explicitly or implicitly relate to such systems and methods of accelerating compute nodes with hardware accelerators, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: Gupta; Dillenburger; Roadrunner; NSCA Lincoln; CBEA; Chen; Fong; Lippert; Kasahara; Burger; Belviranli; Budenske; Kwok '99; Kwok '00; Crutchfield; Jang; '771 Krishnamurthy; Cho; Scantlen; Hayavadana; Barik; Newburn; Phull; Majumdar.

2. Resource Management and Job Scheduling

Multiple prior art publications and references refer to systems and methods of resource management and job scheduling. Accordingly, a person of ordinary skill in the art of designing a cluster computer system would look to systems and methods of resource management and job scheduling, including but not limited to, for managing utilization of resources and task allocation in a heterogenous computing system. For example, in a heterogenous computing system, resource and/or task allocation are employed to load balance among overload and idle nodes as a means for optimized utilization or fault tolerance and recovery. Such redistribution of resources and tasks on a dynamic basis, such as based on runtime conditions observed in individual nodes, is known in the art. The following references either explicitly or implicitly relate to such resource management and job scheduling methods, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: Terascale Open-source Resource and Queue (TORQUE) Resource Manager, MOAB Cluster Manager, MOAB Workload Manager, or Maui Cluster Scheduler as described in Roadrunner and NCSA Lincoln; SLURM Workload Manager, as described in SLURM; Apache Hadoop YARN, as described in YARN, Bhandarkar, Kambatla; Heterogeneous

Dynamic Self-Scheduler (HDSS), as described in Belviranli; the assignment manager, as described in Dillenberger; a hypervisor or partition manager as described in Gupta, CBEA, Branda; and Quality of Service (QoS) monitoring, as described in Lee; Liu; Davidson.

3. Performance Monitoring

Multiple prior art publications and references refer to systems and methods of monitoring processing performance. Accordingly, a person of ordinary skill in the art of designing a cluster computer system would look to known systems and methods of monitoring processing performance, including but not limited to, for dynamically updating resource and job allocation. The following references either explicitly or implicitly relate to such systems and methods of monitoring processing performance, and a person of ordinary skill in the art would have reason to combine their disclosures with cluster computer systems with a reasonable expectation of success: SLURM Workload Manager, as described in SLURM; Apache Hadoop YARN, as described in YARN, Bhandarkar, Kambatla; Jang.

4. Service Level Agreements (SLAs)

Multiple prior art publications and references refer to systems and methods of maintaining service level agreements in cluster and cloud computing. Accordingly, a person of ordinary skill in the art of designing a cluster computer system would look to known references for maintain service level agreements in designing any cluster or cloud computer system needed for running multiple jobs.. The following references either explicitly or implicitly relate to such service level agreements, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: '771 Krishnamurthy.

5. Iterative Processing

Multiple prior art publications and references refer to iterative applications and/or systems and methods of iterative processing—it was a well-known technique for processing complicated computing problems that required more computational power or memory than could be addressed by a single system at a given time. Accordingly, a person of ordinary skill in the art of designing a cluster computer system would look to iterative processing systems and methods, including but not limited to, for use in complex computations or simulations with changing, instead of fixed, variables. The following references either explicitly or implicitly relate to such iterative processing systems and methods, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: Iterative Monte-Carlo Algorithm, as described in Burger²⁹; Iterative K-Means Clustering Algorithm³⁰; Iterative automatic target recognition (ATR) tasks, as described in Budenske, Kwok '99, Kwok '00; Apache Spark's support for iterative processing, as described in Chen³¹; Fong; Lippert; Kasahara; Burger; Phull.

6. Virtualization

Multiple prior art publications and references refer to virtualization—it was a well-known technique for allocating virtual resources that could be shared across hardware infrastructure. As a result, virtualization enables the performance of complex tasks to be performed by specific hardware elements that provide specialized processing capabilities. Accordingly, a person of ordinary skill in the art would look to virtualization as a known technique for implementing and developing cluster computing and other high performance computing systems, including but not limited to, for use in distributed super computers and cloud computing. By early 2010,

²⁹ See *What is Monte Carlo Simulation?*, <https://www.ibm.com/topics/monte-carlo-simulation>

³⁰ See *What is k-means clustering?*, <https://www.ibm.com/topics/k-means-clustering>

³¹ See also Zaharia et al., *Spark: Cluster Computing with Working Sets* (June 22, 2010), https://people.csail.mit.edu/matei/papers/2010/hotcloud_spark.pdf

virtualization services in the form of software were known to implement virtual computing environments that could leverage these specialized processing capabilities.³² Different virtualization techniques have been contemplated throughout the prior art. One example of virtualization involves separating physical and virtual administrative domains by forming Virtual Organization Clusters (VOCs).³³ VOCs increase computing capacities by leveraging hardware resources across multiple locations.³⁴ Advantageously, VOCs overlay hardware networks to create virtual environments that allow users to dynamically provision resources based on increasing workloads.³⁵ The following references either explicitly or implicitly relate to such iterative processing systems and methods, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: Abraham; Giunta; Grouzdev; Fu; Branda; Richoux; and Archer.

7. Resource Management and Cloud Computing

Multiple prior art publications and references refer to resource management in connection with cloud computing—managing cloud resources and decentralized hardware infrastructure was a well-known technique used in cloud computing systems. For example, heterogeneous cloud computing environments were well known and often included hardware appliances, like CPUs and GPUs, that were provisioned based on software applications.³⁶ Further, by 2010, virtualization techniques and software as a service models contemplated managing resources, for example, by using accelerators that were allocable across a cloud computing environment to accelerate

³² See Abraham et al., *Self-Provisioned Hybrid Clouds*, ICAC 2010: Proceedings of the 7th Int'l Conf. on Autonomic Computing (June 7, 2010),

³³ See Giunta et al., *A GPGPU Transparent Virtualization Component for High Performance Computing Clouds*, P. D'Ambra, M. Guarracino, and D. Talia (Eds.): Euro-Par 2010, Part I, LNCS 6271, at 379–391 (2010),

³⁴ *Id.*

³⁵ See Abraham et al., *Self-Provisioned Hybrid Clouds*, ICAC 2010: Proceedings of the 7th Int'l Conf. on Autonomic Computing (June 7, 2010),

³⁶ See Giunta et al., *A GPGPU Transparent Virtualization Component for High Performance Computing Clouds*, P. D'Ambra, M. Guarracino, and D. Talia (Eds.): Euro-Par 2010, Part I, LNCS 6271, at 379,

computations.³⁷ In some cases, VOCs can be used to leverage generic cloud computing resources.³⁸ For example, some prior art systems describe using a resource manager called a hypervisor to manage virtualized environments having accelerators, such as GPUs, by assigning groups of GPU cores to virtual machines (VMs).³⁹ In this way, accelerators can allocate accelerator resources for real CPU and GPU cores according to VM applications for host and guest machines.⁴⁰ Consequently, performance improvements were achieved by implementing VMs of multiple GPUs or GPU virtualization stacks.⁴¹ In some prior art examples, high performance computing used parallel computing applications, like CUDA and OpenCL, to leverage the performance capabilities of specialized accelerator hardware (e.g., GPUs).⁴² Specifically, software was developed to use CPUs to control groups of general purpose graphics processing units (GPGPUs).⁴³ In addition to specialized GPUs, other coprocessors were known in heterogeneous computing environments, including Cell Broadband Engine Architecture (CBEA) and Field Programmable Gate Arrays (FPGAs).⁴⁴ The following references either explicitly or implicitly relate to such iterative processing systems and methods, and a person of ordinary skill in the art would have reason to combine their disclosures with other cluster computer systems with a reasonable expectation of success: Giunta; Abraham; Guevara; and the CBEA.

³⁷ *Id.* at 379–380,

³⁸ See Abraham et al., *Self-Provisioned Hybrid Clouds*, ICAC 2010: Proceedings of the 7th Int’l Conf. on Autonomic Computing (June 7, 2010),

³⁹ See Giunta et al., *A GPGPU Transparent Virtualization Component for High Performance Computing Clouds*, P. D’Ambra, M. Guarracino, and D. Talia (Eds.): Euro-Par 2010, Part I, LNCS 6271, at 379,

⁴⁰ *Id.* at 380,

⁴¹ *Id.* at 383–389,

⁴² See Guevara et al., *Enabling Task Parallelism in the CUDA Scheduler*, in Programming Models and Emerging Architectures Workshop (Parallel Architectures and Compilation Techniques Conference (2009),

⁴³ *Id.*

⁴⁴ *Id.*

IV. IDENTIFICATION OF PRIOR ART

Subject to Microsoft's reservations of rights, Microsoft identifies each item of prior art that anticipates or renders obvious the Asserted Claims below.

A. U.S. Patent No. 10,142,156

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '156 Patent are provided in attached Exhibits 156-1 through 156-6.

Table 1-A: Prior Art Patents and Printed Publications for the '156 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2011/0010721 A1 ("Gupta")	6/30/2011	12/24/2009
US 2011/0161972 A1 ("Dillenberger")	6/30/2011	12/24/2009
US 2007/0283358 A1 ("Kasahara")	12/6/2007	1/23/2007
US 2011/0270986 A1 ("Archer")	11/3/2011	4/29/2010
US 2010/0205619 A1 ("Barsness")	8/12/2010	2/10/2009
US 2009/0178049 ("Branda")	7/9/2009	1/9/2008
US 2008/0244126 A1 ("Hundley")	10/2/2008	6/9/2008
US 2008/0320489 A1 ("Grouzdev")	12/25/2008	6/19/2008
US 2008/0100629 A1 ("Bakalesh")	5/1/2008	9/26/2007
US 7,065,764 B1 ("Prael")	6/20/2006	7/20/2001
US 2006/0106931 A1 ("Richoux")	5/18/2006	11/17/2004
US 2010/0223618 A1 ("Fu")	9/2/2010	2/26/2010
US 2005/0251567 A1 ("Ballew")	11/10/2005	4/15/2004
US 2004/0136241 A1 ("Rapp")	7/15/2004	10/9/2003
US 8,249,904 B1 ("DeSantis")	8/21/2012	12/12/2008
US 2009/0256855 A1 ("Tran")	10/15/2009	6/16/2009
US 2009/0213127 A1 ("Krishnamurthy")	5/31/2011	8/27/2009
US 2010/0122199 A1 ("Darrington")	5/13/2010	11/13/2008
US 2004/0244006 A1 ("Kaufman")	12/2/2004	5/29/2003
US 5,031,089 A ("Liu")	7/9/1991	12/30/1988
US 2006/0112297 A1 ("Davidson")	5/25/2006	11/17/2004
US 2009/0213866 A1 ("Eicker")	8/27/2009	6/9/2006
US 2011/0131425 A1 ("Banerjee")	6/2/2011	11/30/2009
US 2011/0067030 A1 ("Isard")	3/17/2011	9/16/2009
US 8,332,862 B2 ("Isard 2")	12/11/2012	9/16/2009
US 2003/0140179 A1 ("Wilt")	7/24/2003	1/4/2002
US 2005/0278680 A1 ("Mukherjee")	12/15/2005	6/15/2005
US 2007/0174290 A1 ("Narang")	7/26/2007	1/19/2006

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2011/0035736 A1 (“Stefansson”)	2/10/2011	9/30/2010
US 2011/0161943 A1 (“Bellows”)	6/30/2011	12/30/2009
US 2010/0058036 (“Degenaro”)	03/04/2010	08/29/2008

Table 2-A: Prior Art Systems and Inventions for the ’156 Patent

Name of System or Invention⁴⁵	Date of Sale / Offer for Sale / Public Use / Known by Others
Roadrunner	June 2008
National Center for Supercomputing Applications (NCSA) Lincoln	February 2009
Cell Broadband Engine Architecture (CBEA)	November 2006
SLURM	2003

Table 3-A: Charts for the ’156 Patent

Exhibit No.	Primary Prior Art Reference/System
156-1	Gupta
156-2	Dillenberger
156-3	Kasahara
156-4	Roadrunner
156-5	NCSA Lincoln
156-6	CBEA
156-7	Isard
156-8	103 References
156-9	Krishnamurthy
156-10	Degenaro
156-12	SLURM

For each of the prior art devices identified above, Microsoft has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Microsoft has obtained or is in the process of attempting

⁴⁵ “System” includes any relevant combination of hardware and/or software including, without limitation, computers, mobile phones and tablets, biometric scanners, smartcards, RFID systems, location trackers, etc.

to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.⁴⁶

Further, Microsoft is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-A.

Discovery is ongoing, and Microsoft may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Microsoft reserves the right to supplement these contentions accordingly. Microsoft continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Microsoft's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '156 Patent. Microsoft's investigation of such prior art systems is still ongoing and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example,

⁴⁶ U.S. Patent No. 10,142,156 (the "'156 Patent'") is subject to the laws under pre-AIA 35 U.S.C. § 100 *et seq.*

subsequent discovery may provide additional information regarding whether or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '156 Patent. As such, Microsoft reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '156 Patent. Microsoft has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which Microsoft reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. Microsoft reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Microsoft will make all such devices, software programs, or other products in Microsoft's possession, custody, or control available for inspection by Plaintiffs.

Consequently, Microsoft reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Microsoft identifies, responsive to Plaintiffs' Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-A and 2-A as evidence of the state of the art as it relates to.

Each of these references show that the concept of is not novel and was well-known for many years before the alleged priority date of the '156 Patent, as discussed in more detail in Section

VI.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '156 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '156 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Microsoft has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiffs and third parties, Microsoft reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

B. U.S. Patent No. 11,934,883

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '883 Patent are provided in attached Exhibits 883-1 through 883-6.

Table 1-B: Prior Art Patents and Printed Publications for the '883 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2011/0010721 A1 ("Gupta")	6/30/2011	12/24/2009
US 2011/0161972 A1 ("Dillenberger")	6/30/2011	12/24/2009
US 2007/0283358 A1 ("Kasahara")	12/6/2007	1/23/2007
US 2011/0270986 A1 ("Archer")	11/3/2011	4/29/2010
US 2010/0205619 A1 ("Barsness")	8/12/2010	2/10/2009
US 2011/0270986 A1 ("Archer")	11/3/2011	4/29/2010

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2009/0178049 (“Branda”)	7/9/2009	1/9/2008
US 2008/0244126 A1 (“Hundley”)	10/2/2008	6/9/2008
US 2008/0320489 A1 (“Grouzdev”)	12/25/2008	6/19/2008
US 2008/0100629 A1 (“Bakalesh”)	5/1/2008	9/26/2007
US 7,065,764 B1 (“Prael”)	6/20/2006	7/20/2001
US 2006/0106931 A1 (“Richoux”)	5/18/2006	11/17/2004
US 2010/0223618 A1 (“Fu”)	9/2/2010	2/26/2010
US 2005/0251567 A1 (“Ballew”)	11/10/2005	4/15/2004
US 2004/0136241 A1 (“Rapp”)	7/15/2004	10/9/2003
US 8,249,904 B1 (“DeSantis”)	8/21/2012	12/12/2008
US 2009/0256855 A1 (“Tran”)	10/15/2009	6/16/2009
US 2009/0213127 A1 (“127 Krishnamurthy”)	5/31/2011	8/27/2009
US 2010/0122199 A1 (“Darrington”)	5/13/2010	11/13/2008
US 2004/0244006 A1 (“Kaufman”)	12/2/2004	5/29/2003
US 5,031,089 A (“Lu”)	7/9/1991	12/30/1988
US 2006/0112297 A1 (“Davidson”)	5/25/2006	11/17/2004
US 2009/0213866 A1 (“Eicker”)	8/27/2009	6/9/2006
US 2011/0131425 A1 (“Banerjee”)	6/2/2011	11/30/2009
US 2011/0067030 A1 (“Isard”)	3/17/2011	9/16/2009
US 8,332,862 B2 (“Isard 2”)	12/11/2012	9/16/2009
US 2003/0140179 A1 (“Wilt”)	7/24/2003	1/4/2002
US 2005/0278680 A1 (“Mukherjee”)	12/15/2005	6/15/2005
US 2007/0174290 A1 (“Narang”)	7/26/2007	1/19/2006
US 2011/0035736 A1 (“Stefansson”)	2/10/2011	9/30/2010
US 2011/0161943 A1 (“Bellows”)	6/30/2011	12/30/2009
US 2010/0058036 (“Degenaro”)	03/04/2010	08/29/2008

Table 2-B: Prior Art Systems and Inventions for the ’883 Patent

Name of System or Invention⁴⁷	Date of Sale / Offer for Sale / Public Use / Known by Others
Roadrunner	June 2008
National Center for Supercomputing Applications (NCSA) Lincoln	February 2009
Cell Broadband Engine Architecture (CBEA)	November 2006
SLURM	2003

⁴⁷ “System” includes any relevant combination of hardware and/or software including, without limitation, computers, mobile phones and tablets, biometric scanners, smartcards, RFID systems, location trackers, etc

Table 3-B: Charts for the '883 Patent

Exhibit No.	Primary Prior Art Reference/System
883-1	Gupta
883-2	Dillenberger
883-3	Kasahara
883-4	Roadrunner
883-5	NCSA Lincoln
883-6	CBEA
883-7	Isard
883-8	103 References
883-9	Krishnamurthy
883-10	Degenaro
883-12	SLURM

For each of the prior art devices identified above, Microsoft has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Microsoft has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.⁴⁸

Further, Microsoft is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-B.

Discovery is ongoing, and Microsoft may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and

⁴⁸ U.S. Patent No. 11,934,883 (the“'883 Patent”) is subject to the laws under pre-AIA 35 U.S.C. § 100 *et seq.*

Microsoft reserves the right to supplement these contentions accordingly. Microsoft continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Microsoft's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '883 Patent. Microsoft's investigation of such prior art systems is still ongoing and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '883 Patent. As such, Microsoft reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '883 Patent. Microsoft has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery

during this lawsuit, which Microsoft reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. Microsoft reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Microsoft will make all such devices, software programs, or other products in Microsoft's possession, custody, or control available for inspection by Plaintiffs.

Consequently, Microsoft reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Microsoft identifies, responsive to Plaintiffs' Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-B and 2-B as evidence of the state of the art as it relates to user authentication, including but not limited to.

Each of these references show that the concept of is not novel and was well-known for many years before the alleged priority date of the '883 Patent, as discussed in more detail in Section VI.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '883 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '883 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Microsoft has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiffs and third parties, Microsoft reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

C. U.S. Patent No. 11,537,442

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '442 Patent are provided in attached Exhibits 442-1 through 442-7.

Table 1-C: Prior Art Patents and Printed Publications for the '442 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2018/0107524 A1 ("Fong")	4/19/2018	10/13/2016
WO 2012/049247 A1 ("Lippert")	4/19/2012	10/13/2011
US 2007/0283358 A1 ("Kasahara")	12/6/2007	1/23/2007
US 2017/0255877 A1 ("Cho")	9/7/2017	5/27/2016
WO 2015/127667 A1 ("Bhandarkar")	9/3/2015	2/28/2014
US 2017/0078373 A1 ("Hayavadana")	3/16/2017	9/9/2016
US 2016/0055612 A1 ("Barik")	2/25/2016	12/26/2014
US 2012/0079298 A1 ("Majumdar")	3/29/2012	4/4/2011
US 2012/0233486 A1 ("Phull")	9/13/2012	3/1/2012
US 2012/0054771 A1 ("771 Krishnamurthy")	3/1/2012	8/31/2010
US 2013/0219405 A1 ("Lee")	8/22/2013	8/14/2012
US 2017/0153920 A1 ("Scantlen")	6/1/2017	9/8/2016
US 2011/0161978 A1 ("Jang")	6/30/2011	7/23/2010
US 10,452,995 B2 ("Burger")	10/22/2019	6/29/2015
US 2018/0074855 A1 ("Kambatla")	3/15/2018	5/15/2017
US 2017/0262319 A1 ("Newburn")	9/14/2017	3/11/2016
US 2007/0294512 A1 ("Crutchfield")	12/20/2007	3/5/2007
Budenske et al. ("Budenske"), "A Method for the On-Line Use of Off-Line Derived Remappings of Iterative Automatic Target Recognition Tasks onto a Particular Class of Heterogeneous Parallel Platforms"	10/1/1998	
Kwok et al. ("Kwok '00"), "Implementation and Performance Study of a Semi-Static Approach to Mapping Dynamic Iterative Tasks onto Heterogeneous Computing Systems"	1/25/2000	

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
Kwok et al. (“Kwok ’99”), “Evaluation of a Semi-Static Approach to Mapping Dynamic Iterative Tasks onto Heterogeneous Computing Systems”	6/23/1999	
Chen et al. (“Chen”), “Task Scheduling For Multi-Core And Parallel Architectures: Challenges, Solutions And Perspectives”	11/23/2017	
Belviranli et al. (“Belviranli”), “A Dynamic Self-Scheduling Scheme for Heterogeneous Multiprocessor Architectures”	1/20/2013	

Table 2-C: Prior Art Systems and Inventions for the ’442 Patent

Name of System or Invention⁴⁹	Date of Sale / Offer for Sale / Public Use / Known by Others
YARN	2012
SLURM	2003
Roadrunner	June 2008
National Center for Supercomputing Applications (NCSA) Lincoln	February 2009
Cell Broadband Engine Architecture (CBEA)	November 2006
Keeneland Project or Keenland Initial Delivery System (KIDS) or Keenland Full Scale (KFS) (KEENELAND)	2010

Table 3-C: Charts for the ’442 Patent

Exhibit No.	Primary Prior Art Reference/System
442-1	Chen
442-2	Fong
442-3	Lippert
442-4	Kasahara
442-5	YARN
442-6	SLURM
442-7	Burger
442-8	103 References
442-9	KEENELAND

⁴⁹ “System” includes any relevant combination of hardware and/or software including, without limitation, computers, mobile phones and tablets, biometric scanners, smartcards, RFID systems, location trackers, etc

Exhibit No.	Primary Prior Art Reference/System
442-10	Roadrunner
442-11	NCSA Lincoln
442-12	CBEA

For each of the prior art devices identified above, Microsoft has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Microsoft has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.⁵⁰

Further, Microsoft is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-C.

Discovery is ongoing, and Microsoft may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and Microsoft reserves the right to supplement these contentions accordingly. Microsoft continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

⁵⁰ U.S. Patent No. 11,537,442 (the“442 Patent”) is subject to the laws under AIA 35 U.S.C. § 100 *et seq.*

Microsoft's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '442 Patent. Microsoft's investigation of such prior art systems is still ongoing and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '442 Patent. As such, Microsoft reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '442 Patent. Microsoft has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third party discovery during this lawsuit, which Microsoft reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. Microsoft reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this

lawsuit. Furthermore, Microsoft will make all such devices, software programs, or other products in Microsoft's possession, custody, or control available for inspection by Plaintiffs.

Consequently, Microsoft reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, Microsoft identifies, responsive to Plaintiffs' Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-C and 2-C as evidence of the state of the art as it relates to user authentication, including but not limited to.

Each of these references show that the concept of is not novel and was well-known for many years before the alleged priority date of the '442 Patent, as discussed in more detail in Section VI.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '442 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '442 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because Microsoft has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiffs and third parties, Microsoft reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

V. PRIORITY DATE

A. U.S. Patent No. 10,142,156

In its Infringement Contentions, Plaintiffs argue that the asserted claims of the '156 Patent are entitled to a "priority date no later than October 13, 2010, based on European Patent Application No. 10187436,"⁵¹ which is the foreign parent patent application to the continuation U.S. Patent Application No. 13/861,429 that became the '156 Patent. Plaintiffs further contend that the asserted claims of the '156 Patent "were conceived and/or reduced to practice on or before the filing of European Patent Application No. 10187436, followed by diligence in the preparation and filing of that application."⁵²

Additionally, during prosecution of the '156 Patent, Applicant attempted to overcome a prior art rejection, in part, based on an inventor declaration filed under C.F.R. 1.131 (the "Declaration") along with a Request for Continued Examination (RCE).⁵³ In this declaration, inventor Thomas Lippert swore that he was the sole inventor of the '156 Patent and that he had conceived of the claimed invention before the filing date of the foreign European Patent Application No. 10187436.⁵⁴ As supporting evidence, Applicant filed 6 exhibits with the declaration, including: Exhibit A allegedly dated July 12, 2010, Exhibit B allegedly dated June 19, 2010, Exhibit C allegedly dated July 19, 2010, Exhibit D allegedly dated September 16, 2010, Exhibit E allegedly dated September 2, 2010, and Exhibit F allegedly dated September 24, 2010.⁵⁵

Defendants do not agree, and therefore dispute, that the '156 Patent's asserted claims are entitled to either the priority date asserted by Plaintiffs (*e.g.*, October 13, 2010) or any of the earlier conception dates argued during prosecution. At best, and solely for the purposes of prior art

⁵¹ Plaintiffs' Infringement Contentions at 5.

⁵² *Id.*

⁵³ '156 File History, pre-AIA Rule 1.131 Affidavit (February 19, 2018).

⁵⁴ *Id.*

⁵⁵ *Id.*

references that only qualify as prior art under pre-AIA 35 U.S.C. §§ 102(a) or (e), the priority date of the '156 Patent is the filing date of its parent the foreign European Patent Application No. 10187436, filed October 13, 2010. However, the priority date of the '156 Patent for prior art that qualifies under pre-AIA 35 U.S.C. § 102(b)⁵⁶ is instead the filing date of its parent PCT Application No. PCT/EP2011/067888 filed October 13, 2011.⁵⁷

Further, contrary to the assertions made by Thomas Lippert in his sworn declaration, it appears that there are several unnamed authors that contributed to the '156 Patent. For example, the Declaration contends that “Exhibits B-D are different versions of a concept paper describing the key aspects of the claimed invention. The original version 0.1 (Exhibit B) is dated June 19, 2010, a subsequent version 0.2 (Exhibit C) is dated July 19, 2010, and a final version (Exhibit D) is dated September 16, 2010.”⁵⁸ Notably, and despite being self-described as “describing the key aspects of the claimed invention,”⁵⁹ Exhibits C and D list two authors: Thomas Lippert and Norbert Eicker.⁶⁰ Norbert Eicker is not a named inventor of the '156 Patent. Similarly, the Declaration describes that “Exhibit F is an additional description of the claimed invention, which was created on September 24, 2010.”⁶¹ Exhibit F list three completely different authors: Sebastian Rinke, Daniel Becker, and Felix Wolf, and does not mention either Thomas Lippert or Norbert Eicker.⁶²

⁵⁶ Pre-AIA 35 U.S.C. § 102(b) provides a statutory bar if “the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.” Pre-AIA 35 U.S.C. § 363 further provides that “[a]n international application designating the United States shall have the effect, from its international filing date under article 11 of the treaty, of a national application for patent regularly filed in the Patent and Trademark Office except as otherwise provided in section 102(e).”

⁵⁷ Thus, the critical date for any reference that qualifies as prior art under pre-AIA 35 U.S.C. § 102(b) is October 13, 2010. Further, Microsoft notes that Plaintiffs have not produced or submitted copies of EP Patent Application No. 10187436.0, filed October 13, 2010 to which PCT Application No. PCT/EP2011/067888 claims priority.

⁵⁸ '156 File History, pre-AIA Rule 1.131 Affidavit ¶ 5 (February 19, 2018).

⁵⁹ *Id.*

⁶⁰ *See* '156 File History, pre-AIA Rule 1.131 Affidavit, Exs. C-D (February 19, 2018).

⁶¹ '156 File History, pre-AIA Rule 1.131 Affidavit ¶ 7 (February 19, 2018).

⁶² *See* '156 File History, pre-AIA Rule 1.131 Affidavit, Exs. F (February 19, 2018).

Accordingly, the Asserted Claims of the '156 Patent are invalid for improper inventorship which is not able to be corrected.

B. U.S. Patent No. 11,934,883

In its Infringement Contentions, Plaintiffs argues that the asserted claims of the '883 Patent are entitled to a “priority date no later than October 13, 2010, based on European Patent Application No. 10187436,”⁶³ which is the foreign parent to a PCT patent application, a subsequent continuation of which (U.S. Patent Application No. 17/196,665) became the '883 Patent. Plaintiffs further contend that the asserted claims of the '883 Patent “were conceived and/or reduced to practice on or before the filing of European Patent Application No. 10187436, followed by diligence in the preparation and filing of that application.”⁶⁴

Defendants do not agree, and therefore dispute, that the '883 Patent's asserted claims are entitled to either the priority date asserted by Plaintiffs (*e.g.*, October 13, 2010) or any of the earlier conception dates argued during prosecution. At best, and solely for the purposes of prior art references that only qualify as prior art under pre-AIA 35 U.S.C. §§ 102(a) or (e), the priority date of the '883 Patent is the filing date of its parent the foreign European Patent Application No. 10187436, filed October 13, 2010. However, the priority date of the '883 Patent for prior art that qualifies under pre-AIA 35 U.S.C. § 102(b)⁶⁵ is instead the filing date of its parent PCT Application No. PCT/EP2011/067888 filed October 13, 2011.⁶⁶

⁶³ Plaintiffs' Infringement Contentions at 5.

⁶⁴ *Id.*

⁶⁵ Pre-AIA 35 U.S.C. § 102(b) provides a statutory bar if “the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.” Pre-AIA 35 U.S.C. § 363 further provides that “[a]n international application designating the United States shall have the effect, from its international filing date under article 11 of the treaty, of a national application for patent regularly filed in the Patent and Trademark Office except as otherwise provided in section 102(e).”

⁶⁶ Thus, the critical date for any reference that qualifies as prior art under pre-AIA 35 U.S.C. § 102(b) is October 13, 2010. Further, Microsoft notes that Plaintiffs have not produced or submitted copies of EP Patent Application No. 10187436.0, filed October 13, 2010 to which PCT Application No. PCT/EP2011/067888 claims priority.

Further, contrary to the assertions made by Thomas Lippert in his sworn declaration in connection with the applications of the '156 Patent, it appears that there are several unnamed authors that contributed to the concepts claimed in the '883 Patent for the same reasons described above with regard to the '156 Patent, including Norbert Eicker, Sebastian Rinke, Daniel Becker, and Felix Wolf. Accordingly, the Asserted Claims of the '883 Patent are invalid for improper inventorship which is not able to be corrected.

C. U.S. Patent No. 11,537,442

In its Infringement Contentions, Plaintiffs argues that the asserted claims of the '442 Patent are entitled to a priority date of at least the filing date of its foreign application, EP Patent Application No. 18152903, which was filed January 23, 2018.

Defendant does not agree, and therefore disputes, that the '442 Patent's asserted claims are entitled to the priority date asserted by Plaintiffs. The priority date of the '442 Patent is instead the filing date of its PCT Application No. PCT/EP2019/051615, January 23, 2019.

Furthermore, for the reasons described with regard to the '156 and '883 Patents above, the it appears that there are at least one or more unnamed authors that contributed to the concepts claimed in the '442 Patent, including Norbert Eicker, Sebastian Rinke, Daniel Becker, and Felix Wolf. Accordingly, the Asserted Claims of the '442 Patent are invalid for improper inventorship which is not able to be corrected.

VI. INVALIDITY UNDER 35 U.S.C. §§ 102 AND 103

Microsoft contends that certain prior art references below anticipate one or more Asserted Claims and that to the extent the identified prior art references do not anticipate the Asserted Claims, those claims are invalid as obvious under 35 U.S.C. §103. Each anticipatory prior art reference, either alone or in combination with other prior art, also renders the Asserted Claims invalid as obvious. In particular, each anticipatory prior art reference may be combined with (1)

information generally known to persons skilled in the art at the time of the alleged invention, and/or (2) any of the other identified prior art references. To the extent that Plaintiffs contend that any of the anticipatory prior art fails to disclose one or more limitations of the Asserted Claims, Microsoft contends that any difference between the reference and the corresponding patent claims would have been obvious to one of ordinary skill in the art. Thus, all charts should be interpreted as both reflecting anticipation by the reference, as well as invalidity due to single reference obviousness, to the extent that Plaintiffs contend that any limitation is missing, and obviousness when combined with other references disclosed herein.

As stated above, Microsoft incorporates by reference all other invalidity contentions related to the Asserted Patents served on or otherwise provided to Plaintiffs, whether past or future. Prior art references anticipating the Asserted Claims are provided below. The prior art listed below anticipates the Asserted Claims under the proper construction of the claims and/or under Plaintiffs' apparent interpretation of the claims reflected by Plaintiffs' Complaint and Infringement Contentions.

Microsoft's reference to a particular system, system, software program, device, or product in the provided claim charts should be interpreted alternatively as both a reference to the product itself and to any corresponding patents, publications, or product literature cited in the charts that relate to the cited system, system, software program, device, or product. In addition, Microsoft may rely on other documents or things that have not yet been located to support its contentions regarding such prior art system(s), system(s) software program(s), device(s) or product(s) that are referenced in the charts. Additionally, where Microsoft identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an

identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Microsoft's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiffs on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Microsoft therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

Microsoft also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references.

A. U.S. Patent No. 10,142,156

The Asserted Claims of the '156 Patent are anticipated and/or rendered obvious by prior art. Microsoft identifies the prior art references that anticipate or render obvious the '156 Patent's asserted claims in the claim charts of Exhibits 156-1 through 156-8 (collectively, the "'156 Claim Charts") which are hereby incorporated by reference as if fully set forth herein. The claim charts of the '156 Claim Charts show how these prior art references teach or suggest each and every element of the '156 Patent's asserted claims. For each reference or combination of references suggested by each chart and/or herein, Microsoft indicates whether the prior art renders the claim

anticipated and/or obvious. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in the '156 Claim Charts. To the extent a finder of fact determines that a limitation of any of the '156 Patent's asserted claims is not disclosed by one of the references identified above, the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '156 Patent's asserted claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

In addition to contending that the '156 Patent's asserted claims are invalid in view of the prior art references cited in the claim charts of the '156 Claim Charts, Microsoft further contends that the '156 Patent's asserted claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Microsoft continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '156 Patent's asserted claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of the '156 Claim Charts, Microsoft further contends that the knowledge of skill evidenced by those references render those claims invalid. Microsoft further contends that, even if a prior art reference does not expressly

disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. See, e.g., *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Furthermore, Microsoft incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '156 Patent, all prior art cited during reexamination proceedings of the '156 Patent, all prior art as described in any future *inter partes* review proceedings of the '156 Patent, and all prior art disclosed during previous litigation proceedings. Microsoft further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any other Plaintiffs Proceedings wherein invalidity contentions have been, or will be, provided regarding the '156 Patent, its foreign counterparts, or any parent or child patent of the '156 Patent. Microsoft reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

1. Specific Combinations

For at least the reasons described below, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '156 Claim Charts with any other reference or references listed in Section IV along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '156 Patent.⁶⁷ For example, and without limitation,

⁶⁷ Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-A. It would have been obvious to one of ordinary skill in the art to combine each of the prior art references listed in the '156 Claim Charts with any of the systems identified in Table 2-A. Defendants reserve the right to supplement or amend these contentions as discovery progresses, to the extent permitted by the Court.

the Asserted Claims of the '156 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

Prior Art	In Combination with One or More of:
Gupta	Dillenger; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Dillenger	Gupta; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Kasahara	Gupta; Dillenger; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Roadrunner	Gupta; Dillenger; Kasahara; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
NCSA Lincoln	Gupta; Dillenger; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
CBEA	Gupta; Dillenger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Isard	Gupta; Dillenger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson;

Prior Art	In Combination with One or More of:
	Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Krishnamurthy	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Degenero	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; SLURM; and the knowledge of a person of ordinary skill in the art.
SLURM	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero;; and the knowledge of a person of ordinary skill in the art.

2. General Motivations to Combine

For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Exhibits 156-1 to 156-12 (collectively, the '156 Claim Charts) along with the knowledge of one of ordinary skill in the art to meet the limitations of the '156 Patent's Asserted Claims. *See generally* Ex. 156-1–156-12. As a result, the references identified herein render one or more Asserted Claims of the '156 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Plaintiffs' Asserted Claims. Defendant may rely upon a subset of the identified references or all

of the references identified herein, including all references in the '156 Claim Charts, for purposes of obviousness depending on the Court's claim construction, positions taken by Plaintiffs during this litigation, and further investigation and discovery.

To the extent not anticipated, the '156 Patent's asserted claims represent no more than the result of ordinary variations of the prior art. Defendant further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendant identifies motivation and reason to combine the cited art.

Any of the combinations of the prior art references identified in the '156 Claim Charts would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of

predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in the '156 Claim Charts would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '156 Patent's Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

The motivation to combine the teachings of the prior art references disclosed in the '156 Claim Charts is thus found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in the '156 Claim Charts because all of these references relate to the same area of technology and/or are from analogous art. The '156 Patent's asserted claims are directed to the use of a computer cluster-booster system for processing a computation task using a resource manager to assign a hardware booster to a hardware computation node. '156 Patent at Abstract. The '156 Patent's asserted claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '156 Patent's asserted claims.

A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '156 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to a computer cluster-booster system and computation technology. For example, it was well-known around that time that users sought methods to perform processing of a computation task using assigned a hardware accelerators coupled to a hardware computation node. Resource management of computation tasks proved to be an important technique for increasing the speed and efficiency of hardware computation nodes in parallel processing applications.

Moreover, many of the claim elements were already known as admitted by the applicants in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '156 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '156 Patent, there are a finite number of approaches for arranging and configuring a heterogeneous cluster computing system that can dynamically assign computation tasks to different hardware nodes. For example, as of the priority date of the '156 Patent, a POSITA would have been very familiar with basic elements of the '156 Patent's claims such as hardware computation nodes, hardware boosters, a resource manager, an initial assignment, and a dynamic assignment. *See* '156 Claim Charts. Particularly, heterogeneous cluster computing systems were known to use dynamic assignments of computation tasks in order to complete tasks within a desired time period. Such systems were implemented for simulations, biological research, and financial transactions. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '156 Patent's claims does not render them novel or non-obvious.

Moreover, as mentioned above, Defendant has not yet completed their search or discovery concerning additional prior art. As such, Defendant's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendant reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

3. Exemplary Specific Motivations to Combine

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '156 Claim Charts with any other

reference or references listed in the '156 Claim Charts along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '156 Patent. For example, one of ordinary skill in the art would have had the motivation and ability to existing technologies, as described in Section III and the references listed therein, in combination with the prior art references in the '156 Claim Charts.

Additionally, various aspects of the Asserted Claims of the '156 Patent would have been obvious to one of ordinary skill in the art in view of combinations of the following specific art. For example:

- (1) “a resource manager being arranged to assign the at least one hardware booster to the at least one hardware computation node, including: at a start of processing of said computation task, establishing an initial assignment by using a predetermined assignment metric specified as a function of at least one of a group of assignment parameters”

Claim 1 of the '156 Patent recites limitations for “a resource manager being arranged to assign the at least one hardware booster to the at least one hardware computation node, including: at a start of processing of said computation task, establishing an initial assignment by using a predetermined assignment metric specified as a function of at least one of a group of assignment parameters.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 156-1–156-7, 156-9–156-12. A person of ordinary skill in the art would have found it obvious to combine or substitute disclosure of a resource manager arranged to establish an initial assignment of a hardware booster to a hardware computation node using a predetermined assignment metric data with the disclosures any of the other references because, for example, the substitute would be

simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because establishing an initial assignment, using a resource manager, according to an assignment metric was well known at the time the application leading to the '156 Patent was filed, and would not have required undue experimentation. *See, e.g.,* Section III.C; *see also* Ex. 156-8.

- (2) “a resource manager being arranged to assign the at least one hardware booster to the at least one hardware computation node, including: ... during said processing of said computation task: (i) updating the predetermined assignment metric, and (ii) establishing a dynamic assignment by using the predetermined assignment metric that was updated”

Claim 1 of the '156 Patent recites limitations for “a resource manager being arranged to assign the at least one hardware booster to the at least one hardware computation node, including: ... during said processing of said computation task: (i) updating the predetermined assignment metric, and (ii) establishing a dynamic assignment by using the predetermined assignment metric that was updated.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.,* 156-1–156-7, 156-9–156-12. A person of ordinary skill in the art would have found it obvious to combine or substitute disclosure of a resource manager arranged to update a predetermined assignment metric and establishing an dynamic assignment, according to an updated assignment metric with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution,

for example, because updating an assignment metric and establishing a dynamic assignment, using a resource manager, according to the updated assignment metric was well known at the time the application leading to the '156 Patent was filed. *See, e.g.*, Section III.C.2; *see also* Ex. 156-8.

- (3) “wherein said predetermined assignment metric is formed according to at least one of a group of metric specification techniques, said group of metric specification techniques comprising: a temporal logic, an assignment matrix, an assignment table, a probability function, and a cost function”

Claim 1 of the '156 Patent recites limitations for “wherein said predetermined assignment metric is formed according to at least one of a group of metric specification techniques, said group of metric specification techniques comprising: a temporal logic, an assignment matrix, an assignment table, a probability function, and a cost function.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 156-1–156-7, 156-9–156-12. A person of ordinary skill in the art would have found it obvious to combine or substitute disclosure of forming a predetermined assignment metric based on a temporal logic, an assignment matrix, an assignment table, a probability function, or a cost function with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because the use of a predetermined assignment metric, such as a temporal logic, an assignment matrix, an assignment table, a probability function, or a cost function was well known at the time the application leading to the '156 Patent was filed. *See, e.g.*, Section III.C.2; *see also* Ex. 156-8.

- (4) “wherein said group of assignment parameters comprise one or more of: resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, and a time stamp”

Claim 1 of the '156 Patent recites limitations for “wherein said group of assignment parameters comprise one or more of: resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, and a time stamp.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 156-1–156-7, 156-9–156-12. A person of ordinary skill in the art would have found it obvious to combine or substitute, disclosure of an assignment parameter that includes resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, or a time stamp with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because using a parameter (*e.g.*, an assignment parameter) to form a metric (*e.g.*, an assignment metric) was well known at the time the application leading to the '156 Patent was filed. *See, e.g.*, Section III.C.2; *see also* Ex. 156-8.

- (5) “wherein the resource manager assigning the at least one hardware booster to the at least one hardware computation node triggers at least one of a group of signals, said group of signals comprising: a remote procedure call, a parameter handover, and a data transmission”

Claim 1 of the ’156 Patent recites limitations for “wherein the resource manager assigning the at least one hardware booster to the at least one hardware computation node triggers at least one of a group of signals, said group of signals comprising: a remote procedure call, a parameter handover, and a data transmission.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 156-1–156-7, 156-9–156-12. A person of ordinary skill in the art would have found it obvious to combine or substitute, disclosure of the resource manager assigning the hardware booster to the hardware computation node by triggering a group of signals with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because assigning hardware by triggering a group of signals that includes a remote procedure call, parameter handover, or data transmission was well known at the time the application leading to the ’156 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 156-8.

- (6) Roadrunner, NCSA Lincoln, and CBEA System References combined with Archer and Barsness References

A POSITA would have had reason to combine Roadrunner, NCSA Lincoln, and CBEA Systems with the Archer and Barsness references, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of

Roadrunner, NCSA Lincoln, CBEA, Archer, and Barsness concern hardware and software used to optimize computing for parallel algorithms across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '156 Patent. Each of Roadrunner, NCSA Lincoln, and CBEA Systems provide means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks. A POSITA would have understood that resource management systems and methods (such as those taught in Archer and Barsness) were intended to be used in combination with certain resource allocation and parallel processing techniques. A POSITA would understand that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. A POSITA would further understand that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather forecasting simulations. Given that Archer and Barsness describe optimizing parallel processing techniques (including monitoring computing performance and resource usage for optimizing resource allocation, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to

combine the teachings of these references. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(7) Roadrunner, NCSA Lincoln, and CBEA System References combined with Branda Reference

A POSITA would have had reason to combine Roadrunner, NCSA Lincoln, and CBEA Systems with the Branda reference, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of Roadrunner, NCSA Lincoln, CBEA, and Branda concern hardware and software used to allocating resources for parallel computing across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '156 Patent. Each of Roadrunner, NCSA Lincoln, and CBEA Systems provide means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks. A POSITA would have understood that resource allocation and management systems and methods (such as those taught in Branda) were intended to be used in combination with certain resource allocation and parallel processing techniques. A POSITA would understand that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. A POSITA would

further understand that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather forecasting simulations. Given that Branda describes allocating resources across virtual partitions used for multi-element processing techniques (including monitoring computing performance of partitioned resources for improved resource allocation, load balancing, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

- (8) Roadrunner, NCSA Lincoln, CBEA, and SLURM System References combined with One or More of Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, Degenaro, and/or the knowledge of a person of ordinary skill in the art

POSITA would have had reason to combine Roadrunner, NCSA Lincoln, CBEA, SLURM Systems with one or more of Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, Degenaro, and/or the knowledge of a person of ordinary skill in the art, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of Roadrunner, NCSA Lincoln, CBEA, SLURM,

Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, and Degenaro, concerns hardware and software used to allocate resources for parallel computing across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '156 Patent. Each of Roadrunner, NCSA Lincoln, CBEA, SLURM, Systems provides means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks. A POSITA would have understood that resource allocation and management systems and methods (such as those taught in Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, and Degenaro) were intended to be used in combination with certain resource allocation and parallel processing techniques. A POSITA would understand that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. A POSITA would further understand that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather

forecasting simulations. For example, at the time of the invention, SLURM, “designed to operate in a heterogeneous cluster,”⁶⁸ was “one of the most popular job scheduling systems available and used on about 40 percent of the largest computers in the world,”⁶⁹ providing capabilities for reserving resources for job allocation and monitoring jobs at node level. SLURM is compatible with Moab and Maui cluster job schedulers,⁷⁰ which are also used in combination with TORQUE resource manager, the environment implemented in NCSA Lincoln. A POSITA thus would have found it obvious to combine or substitute resource management and job scheduling systems used in heterogeneous computing systems with SLURM to optimize resource usage and fault tolerance in case of node failure. Given that Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, and Degenaro describe allocating resources across cluster computing environments that are used for parallel processing techniques (including monitoring computing performance of cluster resources for improved resource allocation, load balancing, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

⁶⁸ LLNL SLURM Archive, https://web.archive.org/web/20100527193633mp_/https://computing.llnl.gov/linux/slurm/ (captured May 27, 2010)

⁶⁹ SchedMD LLC Archive, <https://web.archive.org/web/20100717130739/http://schedmd.com/> (captured July 17, 2010).

⁷⁰ Moab-SLURM Integration Guide Archive, <http://web.archive.org/web/20080908002114/http://www.clusterresources.com/products/mwm/docs/slurmintegration.shtml> (captured March 14, 2006).

B. U.S. Patent No. 11,934,883

The Asserted Claims of the '883 Patent are anticipated and/or rendered obvious by prior art. Microsoft identifies the prior art references that anticipate or render obvious the '883 Patent's asserted claims in the claim charts of Exhibits 883-1 through 883-8 (collectively, the "'883 Claim Charts") which are hereby incorporated by reference as if fully set forth herein. The claim charts of the '883 Claim Charts show how these prior art references teach or suggest each and every element of the '883 Patent's asserted claims. For each reference or combination of references suggested by each chart and/or herein, Microsoft indicates whether the prior art renders the claim anticipated and/or obvious. The claim charts of the '883 Claim Charts show how these prior art references teach or suggest each and every element of the '883 Patent's asserted claims. For each reference or combination of references suggested by each chart and/or herein, Microsoft indicates whether the prior art renders the claim anticipated and/or obvious. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in the '883 Claim Charts. To the extent a finder of fact determines that a limitation of any of the '883 Patent's asserted claims is not disclosed by one of the references identified above, the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '883 Patent's asserted claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve

predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

In addition to contending that the '883 Patent's asserted claims are invalid in view of the prior art references cited in the claim charts of the '883 Claim Charts, Microsoft further contends that the '883 Patent's asserted claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, Microsoft continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '883 Patent's asserted claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of the '883 Claim Charts, Microsoft further contends that the knowledge of skill evidenced by those references render those claims invalid. Microsoft further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. See, e.g., *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Furthermore, Microsoft incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '883 Patent, all prior art cited during reexamination proceedings of the '883 Patent, all prior art as described in any future *inter partes* review proceedings of the '883 Patent, and all prior art disclosed during previous litigation proceedings. Microsoft further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any other Plaintiffs Proceedings wherein invalidity contentions have been, or will be, provided regarding the '883 Patent, its foreign counterparts, or

any parent or child patent of the '883 Patent. Microsoft reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

1. Specific Combinations

For at least the reasons described below, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '883 Claim Charts with any other reference or references listed in the '883 Claim Charts along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '883 Patent.⁷¹ For example, and without limitation, the Asserted Claims of the '883 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

Prior Art	In Combination with One or More of:
Gupta	Dillenberger; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Dillenberger	Gupta; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Kasahara	Gupta; Dillenberger; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.

⁷¹ Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-B. It would have been obvious to one of ordinary skill in the art to combine each of the prior art references listed in the '883 Claim Charts with any of the systems identified in Table 2-B. Defendants reserve the right to supplement or amend these contentions as discovery progresses, to the extent permitted by the Court.

Prior Art	In Combination with One or More of:
Roadrunner	Gupta; Dillenberger; Kasahara; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
NCSA Lincoln	Gupta; Dillenberger; Kasahara; Archer; Barsness; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
CBEA	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Isard	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Krishnamurthy	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; SLURM; and the knowledge of a person of ordinary skill in the art.
Degenero	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; SLURM; and the knowledge of a person of ordinary skill in the art.
SLURM	Gupta; Dillenberger; Kasahara; Roadrunner; Archer; Barsness; CBEA; Branda; Hundley; Grouzdev; Bakalesh; Prael; Richoux; Fu; Ballew; Rapp; DeSantis; Tran; Krishnamurthy; Darrington; Kaufman; Lu; Davidson; Eicker; Banerjee; Roadrunner; NCSA Lincoln; Degenero; and the knowledge of a person of ordinary skill in the art.

2. General Motivations to Combine

For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Exhibits 883-1 to 883-12 (collectively, the '883 Claim Charts) along with the knowledge of one of ordinary skill in the art to meet the limitations of the '883 Patent's Asserted Claims. *See generally* Ex. 883-1–883-12. As a result, the references identified herein render one or more Asserted Claims of the '883 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Plaintiffs' Asserted Claims. Defendant may rely upon a subset of the identified references or all of the references identified herein, including all references in the '883 Claim Charts, for purposes of obviousness depending on the Court's claim construction, positions taken by Plaintiffs during this litigation, and further investigation and discovery.

To the extent not anticipated, the '883 Patent's asserted claims represent no more than the result of ordinary variations of the prior art. Defendant further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017).

Indeed, the Supreme Court held that a person of ordinary skill in the art is “a person of ordinary creativity, not an automaton” and “in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendant identifies motivation and reason to combine the cited art.

Any of the combinations of the prior art references identified in the '883 Claim Charts would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in the '883 Claim Charts would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '883 Patent's Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

The motivation to combine the teachings of the prior art references disclosed in the '883 Claim Charts is thus found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in the '883 Claim Charts because all of these references relate to the same area of technology and/or are from analogous art. The '883 Patent's asserted claims are directed to the use of a computer cluster-booster system for processing a computation task using a resource manager to assign a hardware booster to a hardware computation node. '883 Patent at Abstract. The '883 Patent's asserted claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '883 Patent's asserted claims.

A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '883 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to a computer cluster-booster system and computation technology. For example, it was well-known around that time that users sought methods to perform processing of a computation task using assigned a hardware accelerators coupled to a hardware computation node. Resource management of computation tasks proved to be an important technique for increasing the speed and efficiency of hardware computation nodes in parallel processing applications.

Moreover, many of the claim elements were already known as admitted by the applicants in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '883 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '883 Patent, there are a finite number of approaches for arranging and configuring a heterogeneous cluster computing system that can dynamically assign computation tasks to different hardware nodes. For example, as of the priority date of the '883 Patent, a POSITA would have been very familiar with basic elements of the '883 Patent's claims such as hardware computation nodes, hardware boosters, a resource manager, an initial assignment, and a dynamic assignment. *See* '883 Claim Charts. Particularly, heterogeneous

cluster computing systems were known to use dynamic assignments of computation tasks in order to complete tasks within a desired time period. Such systems were implemented for simulations, biological research, and financial transactions. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '883 Patent's claims does not render them novel or non-obvious.

Moreover, as mentioned above, Defendant has not yet completed their search or discovery concerning additional prior art. As such, Defendant's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendant reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

3. Exemplary Specific Motivations To Combine

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '883 Claim Charts with any other reference or references listed in the '883 Claim Charts along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '883 Patent. For example, one of ordinary skill in the art would have had the motivation and ability to existing technologies, as described in Section III and the references listed therein, in combination with the prior art references in the '883 Claim Charts.

Additionally, various aspects of the Asserted Claims of the '883 Patent would have been obvious to one of ordinary skill in the art in view of combinations of the following specific art. For example:

- (1) “the resource manager being arranged to: assign a selected hardware booster of the plurality of hardware boosters to a first hardware computation node of the plurality of hardware computation nodes for computation of a part of the computation task”

Claims 1 and 5 of the '883 Patent recite limitations for “the resource manager being arranged to: assign a selected hardware booster of the plurality of hardware boosters to a first hardware computation node of the plurality of hardware computation nodes for computation of a part of the computation task.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Isard, Barsness, NCSA Lincoln, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager arranged to assign a selected hardware booster to a hardware compute node for computation of part of a computation task with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because assigning a selected booster to a compute node for computation of part of a computation task was well known at the time the application leading to the '883 Patent was filed, and assigning a selected booster to a compute node for computation of part of a computation task would not have required undue experimentation. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (2) “the resource manager being arranged to: ... provide assignment information to the first hardware computation node after the assignment of the selected hardware booster so as to enable the first hardware computation node to outsource the part of the computation task to the assigned selected hardware booster under control of the first hardware computation node”

Claims 1 and 1 of the '883 Patent recite limitations for “the resource manager being arranged to: ... provide assignment information to the first hardware computation node after the assignment of the selected hardware booster so as to enable the first hardware computation node to outsource the part of the computation task to the assigned selected hardware booster under control of the first hardware computation node.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager arranged to provide assignment information to a hardware computation node to enable the computation node to outsource a part of the computation task because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because providing assignment information to outsource part of the computation task was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (3) “the resource manager being arranged to: ... initialize a static assignment and further to establish a dynamic assignment during the processing of the computation task”

Claims 1 and 5 of the '883 Patent recite limitations for “the resource manager being arranged to: ... initialize a static assignment and further to establish a dynamic assignment during the processing of the computation task.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager arranged to initialize a static assignment and to establish a dynamic assignment during the processing of the computation task with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because initialize a static assignment and establishing a dynamic assignment during the processing of a computation task was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (4) “the resource manager being arranged to: ... accomplish the assignments as a function of a predetermined assignment metric: provide the static assignment at the start of the processing of the computation task by using the predetermined assignment metric”

Claims 1 and 5 of the '883 Patent recite limitations for “the resource manager being arranged to: ... accomplish the assignments as a function of a predetermined assignment metric:

provide the static assignment at the start of the processing of the computation task by using the predetermined assignment metric.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager arranged to accomplish the assignments with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because the use of a third party, such as a different entity, server, or other authentication module, to authenticate a user’s credentials was well known at the time the application leading to the ’883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (5) “the resource manager being arranged to: ... accomplish the assignments as a function of a predetermined assignment metric”

Claims 1 and 5 of the ’883 Patent recite limitations for “the resource manager being arranged to: ... accomplish the assignments as a function of a predetermined assignment metric.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta,

Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM's disclosure of a resource manager arranged to accomplish the assignments as a function of a predetermined assignment metric with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because the use of an assignment metric to accomplish an assignment was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (6) "the resource manager being arranged to: ... update the predetermined assignment metric during the processing of the computation task"

Claims 1 and 5 of the '883 Patent recite limitations for "the resource manager being arranged to: ... update the predetermined assignment metric during the processing of the computation task." It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM's disclosure of a resource manager that updates an assignment metric during the processing of a computation task with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because

updating an assignment metric during a computation task was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (7) “wherein the resource manager is arranged to perform said assignment of the selected hardware booster to the first hardware computation node as a function of the predetermined assignment metric, the assignment being static at a start of processing of the computation task and a dynamic assignment during processing of the computation task”

Claims 1 and 5 of the '883 Patent recite limitations for “wherein the resource manager is arranged to perform said assignment of the selected hardware booster to the first hardware computation node as a function of the predetermined assignment metric, the assignment being static at a start of processing of the computation task and a dynamic assignment during processing of the computation task.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager that performs an assignment based on a predetermined metric that is static at a start of processing of the computation task and is a dynamic assignment during processing of the computation task with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because initializing a static assignment at a start of a computation task and

dynamically updating the assignment during processing of the computation task was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (8) “wherein the resource manager is arranged to perform the dynamic assignment in response to specific computation task characteristics”

Claims 1 and 5 of the '883 Patent recite limitations for “wherein the resource manager is arranged to perform the dynamic assignment in response to specific computation task characteristics.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a resource manager that performs a dynamic assignment in response to computation task characteristics with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because dynamically assigning resources according to characteristics of a computation task was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (9) “wherein said predetermined assignment metric is formed according to at least one of a group of metric specification techniques, said group of metric specification techniques comprising: a temporal logic, an assignment matrix, an assignment table, a probability function, and a cost function”

Claims 1 and 5 of the '883 Patent recite limitations for “wherein said predetermined assignment metric is formed according to at least one of a group of metric specification techniques, said group of metric specification techniques comprising: a temporal logic, an assignment matrix, an assignment table, a probability function, and a cost function.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a predetermined assignment metric that is formed according to a group of metric specification techniques that include a temporal logic, assignment matrix, assignment table, probability function, or cost function with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because using a temporal logic, assignment matrix, assignment table, probability function, or cost function to form a predetermined assignment metric was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (10) “wherein said predetermined assignment metric is specified as a function of at least one of a group of assignment parameters, said group of assignment parameters comprising: resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, and a time stamp”

Claims 1 and 5 of the '883 Patent recite limitations for “wherein said predetermined assignment metric is specified as a function of at least one of a group of assignment parameters, said group of assignment parameters comprising: resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, and a time stamp.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of a predetermined assignment metric that is a function of an assignment parameter that includes resource information, cost information, complexity information, scalability information, a computation log record, compiler information, priority information, or a time stamp because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because using a parameter (*e.g.*, an assignment parameter) as a function of a metric (*e.g.*, an assignment metric) was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (11) “wherein said assignment of the selected hardware booster to the first hardware computation node triggers at least one of a group of signals, said group of signals comprising: a remote procedure call, a parameter handover, and a data transmission”

Claims 1 and 5 of the '883 Patent recite limitations for “wherein said assignment of the selected hardware booster to the first hardware computation node triggers at least one of a group of signals, said group of signals comprising: a remote procedure call, a parameter handover, and a data transmission.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of assigning the hardware booster to the hardware computation node by triggering a group of signals with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because assigning hardware by triggering a group of signals that includes a remote procedure call, parameter handover, or data transmission was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

- (12) “wherein the resource manager is arranged to detect computing capacities of the plurality of hardware boosters and computation task requirements of a hardware computation node of the plurality of hardware computation nodes, and to perform an assignment of a selected one or more hardware boosters of the plurality of hardware boosters to provide required capacities to the hardware computation node”

Claims 1 and 5 of the ’883 Patent recite limitations for “wherein the resource manager is arranged to detect computing capacities of the plurality of hardware boosters and computation task requirements of a hardware computation node of the plurality of hardware computation nodes, and to perform an assignment of a selected one or more hardware boosters of the plurality of hardware boosters to provide required capacities to the hardware computation node.” It would have been obvious to combine or modify each reference with another reference identified in Sections IV.A to render these claims invalid. By way of example only, Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM, among other references, teach these limitations. *See, e.g.*, 883-1–883-7, 883-9–883-12. A person of ordinary skill in the art would have found it obvious to combine or substitute Gupta, Dillenberger, Kasahara, Archer, Barsness, NCSA Lincoln, Isard, Branda, Krishnamurthy, Degenaro, and SLURM’s disclosure of the resource manager being arranged to detect computing capacities and computation requirements of hardware to perform an assignment of a selected hardware boosters in order to provide required capacities to the hardware with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because detecting computational capacities and requirements to assign hardware for providing required capabilities

was well known at the time the application leading to the '883 Patent was filed. *See, e.g.*, Sections III.A. and III.C.2.; *see also* Ex. 883-8.

(13) Roadrunner, NCSA Lincoln, and CBEA System References
combined with Archer and Barsness References

A POSITA would have had reason to combine Roadrunner, NCSA Lincoln, and CBEA Systems with the Archer and Barsness references, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of Roadrunner, NCSA Lincoln, CBEA, Archer, and Barsness concern hardware and software used to optimize computing for parallel algorithms across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '883 Patent. Each of Roadrunner, NCSA Lincoln, and CBEA Systems provide means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks. A POSITA would have understood that resource management systems and methods (such as those taught in Archer and Barsness) were intended to be used in combination with certain resource allocation and parallel processing techniques. A POSITA would understand that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. A POSITA would further understand that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating

biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather forecasting simulations. Given that Archer and Barsness describe optimizing parallel processing techniques (including monitoring computing performance and resource usage for optimizing resource allocation, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(14) Roadrunner, NCSA Lincoln, and CBEA System References combined with Branda Reference

A POSITA would have had reason to combine Roadrunner, NCSA Lincoln, and CBEA Systems with the Branda reference, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of Roadrunner, NCSA Lincoln, CBEA, and Branda concern hardware and software used to allocating resources for parallel computing across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '883 Patent. Each of Roadrunner, NCSA Lincoln, and CBEA Systems provide means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks.

A POSITA would have understood that resource allocation and management systems and methods (such as those taught in Branda) were intended to be used in combination with certain resource allocation and parallel processing techniques. For example, Branda describes multi-element architectures, such as CBEA, were known for having challenging architectures that were difficult for software application development. *See, e.g.,* Branda, [0003]-[0004]. A POSITA would have further understood that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. Indeed, Branda discloses such systems were known in the art, including virtualization systems that leverage a plurality of logical partitions, portioning algorithms specific to either general purposes processing elements or synergistic processing elements, and kernel management programming models. *See, e.g.,* Branda, [0004]-[0007].

A POSITA would further have understood that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather forecasting simulations. Given that Branda describes allocating resources across virtual partitions used for multi-element processing techniques (including monitoring computing performance of partitioned resources for improved resource allocation, load balancing, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to combine the teachings of these references.

Such a POSITA would have readily recognized that implementing Branda's technique for managing general purposes processing elements and synergistic processing elements would result in an increase in computational efficiencies, for example, by optimizing the specialized to generalized affinity ratio (SGAR). *See, e.g.*, Branda, [0053]. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

- (15) Roadrunner, NCSA Lincoln, CBEA and SLURM System
References combined with One or More of Gupta,
Dillenberger Kasahara, Isard, Hundley, Grouzdev,
Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis,
Tran, Krishnamurthy, Darrington, Kaufman, Liu,
Davidson, Eicker, Banerjee, Degenaro, and/or the
knowledge of a person of ordinary skill in the art

POSITA would have had reason to combine Roadrunner, NCSA Lincoln, CBEA, and SLURM Systems with one or more of Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, Degenaro, and/or the knowledge of a person of ordinary skill in the art, all of which relate to systems and methods for performing parallel computing tasks in a heterogeneous computing environment. Each of Roadrunner, NCSA Lincoln, CBEA, SLURM, Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, and Degenaro concerns hardware and software used to allocating resources for parallel computing across a heterogeneous computing environment. These references can be used for improved operating systems, efficient allocation of computational libraries, faster execution times, and improved overall computing performance. Systems and methods such as those

described in these references were conventional as of the time of the earliest alleged priority of the '883 Patent. Each of Roadrunner, NCSA Lincoln, CBEA, and SLURM Systems provides means—not necessarily expressly present in all other references—for parallel processing algorithms of larger computing tasks. A POSITA would have understood that resource allocation and management systems and methods (such as those taught in Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, Degenero) were intended to be used in combination with certain resource allocation and parallel processing techniques. A POSITA would have understood that these resource management systems and methods provide an improvement that can be used to optimize collective operations and resource usage across the heterogeneous cluster computing environment, and that improvements to those aspects of the process could be used in numerous different devices and applications that perform parallel computational tasks. A POSITA would further have understood that in order to implement a heterogeneous cluster computing architecture, systems and methods would commonly be combined with other traditional processing steps such as, but not limited to accelerating biomolecular modeling, quantifying intra- and inter-molecular interactions in quantum chemistry, simulating computational fluid dynamics, performing macromolecular modeling and bioinformatics simulations, and performing weather forecasting simulations. For example, at the time of the invention, SLURM, “designed to operate in a heterogeneous cluster,”⁷² was “one of the most popular job scheduling systems available and used on about 40 percent of the largest computers in the world,”⁷³ providing capabilities for reserving resources for job allocation and

⁷² LLNL SLURM Archive, https://web.archive.org/web/20100527193633mp_/https://computing.llnl.gov/linux/slurm/ (captured May 27, 2010)

⁷³ SchedMD LLC Archive, <https://web.archive.org/web/20100717130739/http://schedmd.com/> (captured July 17, 2010).

monitoring jobs at node level. SLURM is compatible with Moab and Maui cluster job schedulers,⁷⁴ which are also used in combination with TORQUE resource manager, the environment implemented in NCSA Lincoln. A POSITA thus would have found it obvious to combine or substitute resource management and job scheduling systems used in heterogeneous computing systems with SLURM to optimize resource usage and fault tolerance in case of node failure. Given that Gupta, Dillenberger Kasahara, Isard, Hundley, Grouzdev, Bakalesh, Prael, Richoux, Fu, Ballew, Rapp, DeSantis, Tran, Krishnamurthy, Darrington, Kaufman, Liu, Davidson, Eicker, Banerjee, and Degenerodescribe allocating resources across cluster computing environments that are used for parallel processing techniques (including monitoring computing performance of cluster resources for improved resource allocation, load balancing, usage, and execution times) used for executing parallel computing algorithms, a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for heterogeneous cluster computing systems and methods that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

C. U.S. Patent No. 11,537,442

The Asserted Claims of the '442 Patent are anticipated and/or rendered obvious by prior art. Microsoft identifies the prior art references that anticipate or render obvious the '442 Patent's asserted claims in the claim charts of Exhibits 442-1 through 442-8 (collectively, the “'442 Claim Charts”) which are hereby incorporated by reference as if fully set forth herein. The claim charts

⁷⁴ Moab-SLURM Integration Guide Archive, <http://web.archive.org/web/20080908002114/http://www.clusterresources.com/products/mwm/docs/slurmintegration.shtml> (captured March 14, 2006).

of the '442 Claim Charts show how these prior art references teach or suggest each and every element of the '442 Patent's asserted claims. For each reference or combination of references suggested by each chart and/or herein, Microsoft indicates whether the prior art renders the claim anticipated and/or obvious. The claim charts of the '442 Claim Charts show how these prior art references teach or suggest each and every element of the '442 Patent's asserted claims. For each reference or combination of references suggested by each chart and/or herein, Microsoft indicates whether the prior art renders the claim anticipated and/or obvious. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in the '442 Claim Charts. To the extent a finder of fact determines that a limitation of any of the '442 Patent's asserted claims is not disclosed by one of the references identified above, the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '442 Patent's asserted claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

In addition to contending that the '442 Patent's asserted claims are invalid in view of the prior art references cited in the claim charts of the '442 Claim Charts, Microsoft further contends that the '442 Patent's asserted claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products

and services related to the subject matter of the cited references. As discovery is ongoing, Microsoft continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '442 Patent's asserted claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of the '442 Claim Charts, Microsoft further contends that the knowledge of skill evidenced by those references render those claims invalid. Microsoft further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. See, e.g., *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

Furthermore, Microsoft incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '442 Patent, all prior art cited during reexamination proceedings of the '442 Patent, all prior art as described in any future *inter partes* review proceedings of the '442 Patent, and all prior art disclosed during previous litigation proceedings. Microsoft further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any other Plaintiffs Proceedings wherein invalidity contentions have been, or will be, provided regarding the '442 Patent, its foreign counterparts, or any parent or child patent of the '442 Patent. Microsoft reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

1. Specific Combinations

For at least the reasons described below, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '442 Claim Charts with any other

reference or references listed in the '442 Claim Charts along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '442 Patent.⁷⁵ For example, and without limitation, the Asserted Claims of the '442 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

Prior Art	In Combination with One or More of:
Chen	Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
Fong	Chen; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
Lippert	Chen; Fong; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
Kasahara	Chen; Fong; Lippert; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
YARN	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli;

⁷⁵ Further, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-C. It would have been obvious to one of ordinary skill in the art to combine each of the prior art references listed in the '442 Claim Charts with any of the systems identified in Table 2-C. Defendants reserve the right to supplement or amend these contentions as discovery progresses, to the extent permitted by the Court.

Prior Art	In Combination with One or More of:
	KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
SLURM	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Burger; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
Burger	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
KEENELAND	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; Roadrunner; NCSA Lincoln; CBEA; and the knowledge of a person of ordinary skill in the art.
Roadrunner	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; NCSA Lincoln; CBEA; Archer, Barsness; and the knowledge of a person of ordinary skill in the art.
NCSA Lincoln	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; CBEA; and the knowledge of a person of ordinary skill in the art.
CBEA	Chen; Fong; Lippert; Kasahara; Cho; Bhandarkar; Hayavadana; Barik; Majumdar; Phull; '771 Krishnamurthy; Lee; Scantlen; Jang; Kambatla; Crutchfield; Newburn; Budenske; Kwok '00; Kwok '99; Belviranli; YARN; SLURM; KEENELAND; Roadrunner; NCSA Lincoln; and the knowledge of a person of ordinary skill in the art.

2. General Motivations to Combine

For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Exhibits 442-1 to 442-12 (collectively, the '442 Claim Charts) along with the knowledge of one of ordinary skill in the art to meet the limitations of the '442 Patent's Asserted Claims. *See generally* Ex. 442-1–442-12. As a result, the references identified herein render one or more Asserted Claims of the '442 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Plaintiffs' Asserted Claims. Defendant may rely upon a subset of the identified references or all of the references identified herein, including all references in the '442 Claim Charts, for purposes of obviousness depending on the Court's claim construction, positions taken by Plaintiffs during this litigation, and further investigation and discovery.

To the extent not anticipated, the '442 Patent's asserted claims represent no more than the result of ordinary variations of the prior art. Defendant further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017).

Indeed, the Supreme Court held that a person of ordinary skill in the art is “a person of ordinary creativity, not an automaton” and “in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, Defendant identifies motivation and reason to combine the cited art.

Any of the combinations of the prior art references identified in the '442 Claim Charts would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in the '442 Claim Charts would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '442 Patent's Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

The motivation to combine the teachings of the prior art references disclosed in the '442 Claim Charts is thus found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in the '442 Claim Charts because all of these references relate to the same area of technology and/or are from analogous art. The '442 Patent's asserted claims are directed to the dynamic allocation of multi-part tasks in a heterogeneous computing system. '442 Patent at Abstract. The '442 Patent's asserted claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '442 Patent's asserted claims.

A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '442 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to a dynamic task and resource allocation in heterogeneous computing system. For example, heterogeneous parallel computing system had emerged well before the time of the invention and parallel task processing framework, such as MapReduce, was well-known to optimize big data computing.⁷⁶ The use of a resource manager is a widely-used method for dynamic task and resource allocation.⁷⁷

Moreover, many of the claim elements were already known as admitted by the applicants in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '442 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '442 Patent, there are a finite number of approaches for dynamic task and resource allocation in a heterogeneous computing system. For example, as of the priority date of the '442 Patent, a POSITA would have been very familiar with basic elements of the '442 Patent's claims such as deploying a resource manager, an application manager and node managers to manage and allocate tasks and resources, partitioning tasks into multiple subparts, tracking of task and node health statuses, and updating task and resource

⁷⁶ Chen, at Ch. 7.

⁷⁷ Chen, at Ch. 2.

assignment during runtime. *See* '442 Claim Charts. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '442 Patent's claims does not render them novel or non-obvious.

Moreover, as mentioned above, Defendant has not yet completed their search or discovery concerning additional prior art. As such, Defendant's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendant reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

3. Exemplary Specific Motivations To Combine

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in the '442 Claim Charts with any other reference or references listed in the '442 Claim Charts along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '442 Patent. For example, one of ordinary skill in the art would have had the motivation and ability to existing technologies, as described in Section III and the references listed therein, in combination with the prior art references in the '442 Claim Charts.

Additionally, various aspects of the Asserted Claims of the '442 Patent would have been obvious to one of ordinary skill in the art in view of combinations of the following specific art. For example:

- (1) “heterogeneous computing system comprising a plurality of computation nodes and a plurality of booster nodes, at least one of the plurality of computation nodes and a plurality of booster nodes being arranged to compute a computation task, the computation task comprising a plurality of sub-tasks” / “heterogeneous computing system comprising . . . a plurality of computation nodes and a plurality of booster nodes for computing one or more tasks comprising multiple sub-tasks”

Claims 1 and 9 of the '442 Patent recite limitations for parallel processing of multi-part tasks in a heterogeneous computing system comprising compute nodes and accelerated “booster” nodes. It would have been obvious to combine or modify each reference with another reference identified in Sections IV.C to render these claims invalid. By way of example only, Chen, Fong, Lippert, Kasahara, Burger, KEENELAND, Roadrunner, NSCA Lincoln, and CBEA among other references, teach these limitations. *See, e.g.*, 442-1–442-4, 442-7, 442-9–442-12. *See also* Section III.C.1; Ex. 442-8. A person of ordinary skill in the art would have found it obvious to combine or substitute Chen, Fong, Lippert, Kasahara, Burger, KEENELAND, Roadrunner, NSCA Lincoln, and CBEA’s disclosure of processing multi-part tasks in a heterogeneous computing system with the disclosures of any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because operating a heterogenous computing system was well known at the time the application leading to the '442 Patent was filed, and implementing the parallel processing of divisible tasks on such heterogeneous computing system was standard practice and would not have required undue experimentation. For example, as described in *Chen*, MapReduce is one of most widely-used scheduling models for big data computing in heterogeneous environments: the

MapReduce framework divides jobs into granular tasks and distributes them across nodes for parallel processing.⁷⁸

- (2) “in a first computing iteration, assigning and processing the plurality of sub-tasks by at least a portion of the plurality of computation nodes and at least a portion of the plurality of booster nodes in a first distribution” / “a resource manager for assigning at least a portion of the plurality of booster nodes and at least a portion of the plurality of computation nodes to each other for the computing of the one or more tasks in a first computing iteration”

Claims 1 and 9 of the '442 Patent recite limitations for using a resource manager to assign sub-tasks for parallel processing in compute and accelerated nodes in each computing iteration. It would have been obvious to combine or modify each reference with another reference identified in Sections IV.C to render these claims invalid. By way of example only, Chen, Fong, Lippert, Kasahara, and Burger, among other references, teach these limitations. *See, e.g.*, 442-1, 442-2, 442-3, 442-4, 442-7. *See also* Sections III.C.3–4; Ex. 442-8. First, Chen, Fong, Lippert, Kasahara, and Burger, among other references, describe the parallel processing of multi-part tasks in a heterogeneous computing system. Additionally, Chen, Fong, Lippert, Kasahara, and Burger, among other references, describe assigning sub-tasks for parallel processing in scheduling cycles, or computing iterations. A person of ordinary skill in the art would have found it obvious to combine or substitute Chen, Fong, Lippert, Kasahara, SLURM, YARN and Burger's disclosure of assigning sub-tasks for parallel processing in each computing iteration in a heterogeneous computing system with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because the use of a resource manager to allocate sub-

⁷⁸ Chen, at Ch. 7.

tasks and iterative processing in a heterogeneous computing system were well known at the time the application leading to the '442 Patent was filed.

- (3) “using information relating to the processing of the plurality of sub-tasks by at least the portion of the plurality of computation nodes and at least the portion of the plurality of booster nodes” / “an application manager configured to receive information from daemons operating in at least the portion of the plurality of computation nodes and at least the portion of the plurality of booster nodes”

Claims 1 and 9 of the '442 Patent recite limitations for using per-node daemons to monitor application runtime processing information. It would have been obvious to combine or modify each reference with another reference identified in Sections IV.C to render these claims invalid. By way of example only, SLURM, YARN, Bhandarkar and Kambatla among other references, teach these limitations. *See, e.g.*, 442-5, 442-6. *See also* Section III.C.3; Ex. 442-8. A person of ordinary skill in the art would have found it obvious to combine or substitute SLURM and YARN's disclosure of using per-node daemons to monitor application runtime processing information with the disclosures any of the other references because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because deploying node managers to monitor the processing of sub-tasks in a heterogeneous computing system was well known at the time the application leading to the '442 Patent was filed.

- (4) “generating . . . a further distribution of the plurality of sub-tasks between the plurality of computation nodes and the plurality of booster nodes for processing thereby in a further computing iteration” / “an application manager configured . . . to update a distribution of the multiple sub-tasks between the plurality of computation nodes and the plurality of booster nodes in a further computing iteration”

Claims 1 and 9 of the '442 Patent recite limitations for using application runtime processing information to update allocation of sub-tasks to cluster resources. It would have been obvious to combine or modify each reference with another reference identified in Sections IV.C to render these claims invalid. By way of example only, SLURM, YARN, Bhandarkar and Kambatla among other references, teach these limitations. *See, e.g., 442-5, 442-6. See also* Section III.C.3; Ex. 442-8. A person of ordinary skill in the art would have found it obvious to combine or substitute SLURM and YARN's disclosure of using application runtime processing information to update allocation of sub-tasks to cluster resources because, for example, the substitute would be simple, requiring only a simple substitution of one known element for another. A person of ordinary skill in the art would have had a reasonable expectation of success for the combination or substitution, for example, because updating sub-task allocation during runtime based on runtime processing information in a heterogeneous computing system was well known at the time the application leading to the '442 Patent was filed.

- (5) Heterogeneous Computing System References combined with Resource and/or Task Allocation Architecture and Iterative Processing References

A POSITA would have had reason to combine Chen, Fong, Lippert, Kasahara, Burger, KEENELAND, Roadrunner, NSCA Lincoln, and CBEA, all of which relate to systems and methods for iteratively processing divisible tasks in parallel in compute and accelerated nodes. Each of Chen, Fong, Lippert, Kasahara, Burger, KEENELAND, Roadrunner, NSCA Lincoln, and CBEA concerns heterogeneous parallel computing systems and job allocation framework used to

distribute tasks and resources in a dynamic and optimized manager. These references can be used for improved processing performance and improved utilization of resources and scalability. Furthermore, high-performing heterogeneous computing systems are commonly deployed in the prior art for processing iterative simulations or algorithm.⁷⁹ *See, e.g.*, Ex. 442-8. Systems and methods such as those described in these references were conventional as of the time of the earliest alleged priority of the '442 Patent. Each of SLURM, YARN, Bhandarkar and Kambatla provides architecture or framework—not necessarily expressly present in all other references—for node-level monitoring and reporting application runtime processing information in order to improve dynamic task and resource allocation in systems taught by other references. A POSITA would have understood that heterogeneous parallel computing systems and methods (such as those taught in Chen, Fong, Lippert, Kasahara, Burger, KEENELAND, Roadrunner, NSCA Lincoln, and CBEA) were intended to be used in combination with resource management and job scheduling architecture or framework (such as those taught in SLURM, YARN, Bhandarkar and Kambatla). For example, Chen explicitly recites YARN as one of the “well-known parallel programming environments and task scheduling systems” used in a large amount of real-world large scale clusters/datacenters.⁸⁰ A POSITA would have understood that these resource management and job scheduling systems and methods provide an improvement that can be used to increase processing performance and resource utilization, and that improvements to those aspects of the process could be used in numerous different heterogeneous computing systems that must compute heavy workloads. As another example, at the time of the invention, SLURM, “designed to operate

⁷⁹ *See, e.g.*, Phull, [0005] (“Iterative methods are used in a wide variety of scientific and high performance computing (HPC) applications. An iterative method is essentially a computational procedure that generates a sequence of improving solutions for a problem. When the sequence converges to a final solution, the method is referred to as an iterative convergence method. Algorithms such as gradient descent, simulated annealing and numerous others are based on iterative convergence.”); Ex. 442-8.

⁸⁰ Chen, at 19-20.

in a heterogeneous cluster,”⁸¹ was “one of the most popular job scheduling systems available and used on about 40 percent of the largest computers in the world,”⁸² providing capabilities for reserving resources for job allocation and monitoring jobs at node level. SLURM is compatible with Moab and Maui cluster job schedulers,⁸³ which are also used in combination with TORQUE resource manager, the environment implemented in NCSA Lincoln. A POSITA thus would have found it obvious to combine or substitute resource management and job scheduling systems used in heterogeneous computing systems with SLURM to optimize resource usage and fault tolerance in case of node failure. Given that SLURM, YARN, Bhandarkar and Kambatla describe resource management and job scheduling techniques (including monitoring and reporting application runtime processing information) commonly used in the art for high performance computing systems, a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for resource management and job scheduling systems and methods in a heterogeneous computing system that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

VII. INVALIDITY UNDER 35 U.S.C. § 112

The grounds identified below both individually and collectively render certain of the Asserted Claims invalid under the statutory requirements of § 112. By identifying certain claim language below, Microsoft does not imply that such language is entitled to any patentable weight

⁸¹ LLNL SLURM Archive, https://web.archive.org/web/20100527193633mp_/https://computing.llnl.gov/linux/slurm/ (captured May 27, 2010)

⁸² SchedMD LLC Archive, <https://web.archive.org/web/20100717130739/http://schedmd.com/> (captured July 17, 2010).

⁸³ Moab-SLURM Integration Guide Archive, <http://web.archive.org/web/20080908002114/http://www.clusterresources.com/products/mwm/docs/slurmintegration.shtml> (captured March 14, 2006).

when comparing the claim as a whole to the prior art. Microsoft’s identifications are made based on Microsoft’s present understanding of the Asserted Claims and Plaintiffs’ apparent interpretation of these claims as reflected in its Infringement Contentions, and Microsoft reserves the right to amend these identifications, including in response to claim constructions and claim interpretations that would render claim limitations not enabled, lacking in written description, or indefinite. To the extent a claim element is contained within an element identified below or encompass an element identified below, that claim element also renders the claim invalid under 35 U.S.C. § 112.

A. Lack of Enablement and Written Description under 35 U.S.C. § 112 ¶ 1

35 U.S.C. § 112 includes an enablement requirement: “The specification shall contain a written description . . . of the manner and process of making and using [the invention] in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same.” 35 U.S.C. § 112, ¶ 1. To satisfy the enablement requirement, the disclosure “must teach those skilled in the art how to make and use the full scope of the claimed invention without ‘undue experimentation.’” *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997); *MagSil Corp. v. Hitachi Glob. Storage Techs., Inc.*, 687 F.3d 1377, 1381 (Fed. Cir. 2012); *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008). If a specification teaches away from a substantial portion of the claim or does not enable the full scope of the claim, there is no enablement. *AK Steel Corp. v. Sollac*, 344 F.3d 1234 (Fed. Cir. 2003); *see also MagSil Corp.*, 687 F.3d at 1383-84 (Fed. Cir. 2012).

35 U.S.C. § 112 further includes a written description requirement: “The specification shall contain a written description of the invention” 35 U.S.C. § 112, ¶ 1. “To satisfy the written description requirement, a patent applicant must convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention.” *ICU Medical Inc. v. Alaris Medical Systems, Inc.*, 558 F.3d 1368, 1377 (Fed. Cir. 2009) (internal

quotation marks and citations omitted); *see also Synthes USA, LLC v. Spinal Kinetics, Inc.*, 734 F.3d 1332, 1340 (Fed. Cir. 2013). “The test [for written description support] requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art. Based on that inquiry, the specification must describe an invention understandable to that skilled artisan and show that the inventor actually invented the invention claimed.” *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc).

The specification must describe the claimed invention in sufficient detail so that a POSITA can recognize what is claimed. “The appearance of mere indistinct words in a specification or a claim, even an original claim, does not necessarily satisfy that requirement.” *University of Rochester v. G.D. Searle & Co.*, 358 F.3d 916, 923 (Fed. Cir. 2004) (internal quotation marks and citations omitted).

Based on Microsoft’s present understanding of the Asserted Claims and Plaintiffs’ apparent interpretation of these claims as reflected in its Infringement Contentions, the following limitations of the Asserted Claims may fail to satisfy the requirements of § 112, ¶ 1 because the specifications and original patent applications fail to provide an enabling disclosure of and written description support for at least the following limitations:

1. U.S. Patent No. 10,142,156

Term	Relevant Claim(s)
“a plurality of hardware computation nodes, each of which interfaces with a communication infrastructure, at least two of the hardware computation nodes being arranged to jointly compute at least a first part of said computation task”	1
“computing, by at least two of the plurality of hardware computation nodes, at least a first part of a computation task, the at least two of the hardware computation nodes interfacing with a communication infrastructure”	14
“after having been assigned to at least one hardware computation node and under control of that at least one hardware computation	1

Term	Relevant Claim(s)
node, the at least one hardware booster interfacing with the communication infrastructure”	
“computing, by the at least one hardware booster assigned to the one hardware computation node, at least a second, specific part of said computation task, the at least one hardware booster interfacing with said communication infrastructure”	14
“a resource manager being arranged to assign the at least one hardware booster to the at least one hardware computation node”	1
“during said processing of said computation task . . . establishing a dynamic assignment”	1, 14
“at least one of the plurality of hardware computation nodes is assigned to and shared by more than one of the plurality of hardware computation nodes”	1, 14
“each of the hardware boosters is assignable to each of the hardware computation nodes”	1, 14
“initially assigning, by the resource manager, at least one hardware booster of the plurality of hardware boosters to one hardware computation node”	14
“virtual interface”	9

2. U.S. Patent No. 11,934,883

Term	Relevant Claim(s)
“the plurality of hardware computation nodes and the plurality of hardware boosters each interfacing a communication infrastructure”	1
“ each computation node of the plurality of computation nodes interfacing a communication infrastructure”	13
“assign a selected hardware booster of the plurality of hardware boosters to a first hardware computation node of the plurality of hardware computation nodes for computation of a part of the computation task”	1
“assigning a selected booster of a plurality of boosters to a first computation node of the plurality of computation nodes by a resource manager”	13
“initialize a static assignment and further to establish a dynamic assignment during the processing of the computation task”	1
“accomplish the assignments as a function of a predetermined assignment metric”	1
“assignment being accomplished”	13
“provide the static assignment at the start of the processing of the computation task by using the predetermined assignment metric”	1
“virtual interface”	8

3. U.S. Patent No. 11,537,442

Term	Relevant Claim(s)
“computation task”	1, 3, 4
“being arranged to compute a computation task”	1
“a first computing iteration”	1, 3, 7, 9
“at least a portion of the plurality of computation nodes”	1, 9
“at least a portion of the plurality of booster nodes”	1
“assigning and processing the plurality of sub-tasks by at least a portion of the plurality of computation nodes and at least a portion of the plurality of booster nodes in a first distribution”	1
“a communication interface connecting the plurality of computation nodes with each other and the plurality of booster nodes”	9
“a resource manager for assigning at least a portion of the plurality of booster nodes and at least a portion of the plurality of computation nodes to each other for the computing of the one or more tasks in a first computing iteration”	9
“to update a distribution of the multiple sub-tasks between the plurality of computation nodes and the plurality of booster nodes in a further computing iteration”	9
“first distribution”	1, 6
“generating ... a further distribution”	1
“further distribution”	1-3
“a further computing iteration”	1, 7, 9
“a function of the computation task”	3
“a grouping of sub-tasks”	7
“a measure of a loading”	8
“a loading”	8

B. Indefiniteness Under 35 U.S.C. § 112, ¶ 2

Section 112, ¶ 2 includes a definiteness requirement: “[T]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.” 35 U.S.C. § 112, ¶ 2. “[A] patent is invalid for indefiniteness if its claims, read in light of the patent’s specification and prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014).

The definiteness requirement requires that the claim must set forth what the applicant regards as the invention, and do so with sufficient particularity and definiteness. *Allen Eng'g Corp. v. Bartell Indus.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002). Where it would be apparent to one of skill in the art, based on the patent specification, that the “invention” set forth in a claim is not what the patent applicant regarded as the invention, the claim is invalid. *Id.*

Based on Microsoft’s present understanding of the Asserted Claims and Plaintiffs’ apparent interpretation of these claims as reflected in its Infringement Contentions, the following limitations of the Asserted Claims may fail to satisfy the requirements of § 112, ¶ 2 because the precise scope of at least the terms listed below cannot be determined with reasonable certainty by a POSITA when reading the claims in light of the specification and prosecution history.

1. U.S. Patent No. 10,142,156

Term	Relevant Claim(s)
“first interfacing unit”	8, 9
“second interfacing unit”	8, 9
“virtual interface”	9

2. U.S. Patent No. 11,934,883

Term	Relevant Claim(s)
“an interfacing unit”	8, 9
“virtual interface”	9

VIII. INVALIDITY UNDER 35 U.S.C. § 101

Microsoft further asserts that certain of the asserted patents are ineligible for patent protection under 35 U.S.C. § 101. To the extent that Microsoft identifies a defect that is also present in a claim of the asserted patents that is not at issue in this case (i.e., a claim that is not one of the Asserted Claims), Microsoft contends that such claim is also ineligible for patent protection.

Based on Microsoft's investigation to date and currently-available information, the following patents are ineligible for patent protection.

To be patentable subject matter under § 101, a claim must be directed to one of four eligible subject matter categories: “new and useful process, machine, manufacture, or composition of matter.” 35 U.S.C. § 101. “Claims that fall within one of the four subject matter categories may nevertheless be ineligible if they encompass laws of nature, physical phenomena, or abstract ideas.” *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344, 1350 (Fed. Cir. 2014) (citing *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980)). The Supreme Court established a two-step test for deciding the subject matter eligibility of claims under § 101. *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2355 (2014). First, the claims must be analyzed to determine whether they are drawn to one of the statutory exceptions. *Id.* Claims that invoke generic computer components instead of reciting specific improvements in computer capabilities are abstract under this first step. *See Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1335-36 (Fed. Cir. 2016). Second, the elements of the claims must be viewed both individually and as an ordered combination to see if there is an “inventive concept.” *Id.* The mere fact that a claim recites or implies that an abstract idea is implemented using a general-purpose computer does not supply an inventive concept necessary to satisfy § 101. *See Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1355 (Fed. Cir. 2016); *Alice*, 134 S. Ct. at 2357-59.

A. U.S. Patent Nos. 10,142,156 and 11,934,883 (“Task Assignment Patents”)

All of the Asserted Claims of the '156 and '883 Patents are directed to ineligible subject matter under 35 U.S.C. § 101 and applicable case law authority.⁸⁴

⁸⁴ See, e.g., *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347 (2014); *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S. Ct. 1289 (2012); *Trading Techs. Int'l, Inc. v. IBG, LLC*, 921 F.3d 1084 (Fed. Cir. 2019); *ChargePoint, Inc. v. SemaConnect, Inc.*, 920 F.3d 759 (Fed. Cir. 2019); *SAP America, Inc. v. InvestPic, LLC*,

The '156 and '883 Patents' Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g., Alice Corp. Pty. Ltd. v. CLS Bank Intern.*, 573 U.S. 208, 216 (2014). By way of example, the Asserted Claims of the '156 and '883 Patents are generally directed to the abstract ideas of assigning, processing, and updating information. Each of the asserted claims are directed to the abstract idea of assigning a part of a computation task based on a predetermined assignment metric, processing a portion of the part of the computation task, and updating the predetermined assignment metric. The '156 and '883 Patents discuss that the purported problem of a static assignment of accelerators to computing nodes that leads to over- or under-subscription of accelerators (e.g., potentially leading to either a lack of computing resources or an excess supply of computing resources). Yet, none of the asserted claims of any of the '156 and '883 Patents nor any the specifications of the '156 and '883 Patents disclose any technological improvement to any technological problem; instead the claimed features merely apply conventional, generic resource management technologies. It is unclear what the claimed advancement is over the prior art. Thus, under *Alice* Step 1, the '156 and '883 Patent's asserted claims are directed to one or more ineligible concepts.

898 F.3d 1161 (Fed. Cir. 2018); *Interval Licensing LLC v. AOL, Inc.*, 896 F.3d 1335 (Fed. Cir. 2018); *Aatrix Software, Inc. v. Green Shades Software, Inc.*, 882 F.3d 1121 (Fed. Cir. 2018); *Two-Way Media Ltd. v. Comcast Cable Commc'ns, LLC*, 874 F.3d 1329 (Fed. Cir. 2017), cert. denied, 139 S. Ct. 378 (2018); *Intellectual Ventures I LLC v. Capital One Fin. Corp.*, 850 F.3d 1332 (Fed. Cir. 2017); *Apple, Inc. v. Ameranth, Inc.*, 842 F.3d 1229 (Fed. Cir. 2016); *Affinity Labs of Texas, LLC v. DIRECTV, LLC*, 838 F.3d 1253 (Fed. Cir. 2016); *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350 (Fed. Cir. 2016); *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016); *Genetic Techs. Ltd. v. Merial L.L.C.*, 818 F.3d 1369 (Fed. Cir. 2016); *Intellectual Ventures I LLC v. Capital One Bank (USA)*, 792 F.3d 1363 (Fed. Cir. 2015); *Internet Patents Corp. v. Active Network, Inc.*, 790 F.3d 1343 (Fed. Cir. 2015); *OIP Techs., Inc. v. Amazon.com, Inc.*, 788 F.3d 1359 (Fed. Cir. 2015); *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat'l Ass'n*, 776 F.3d 1343 (Fed. Cir. 2014); *DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245 (Fed. Cir. 2014); *buySAFE, Inc. v. Google, Inc.*, 765 F.3d 1350 (Fed. Cir. 2014); *Digitech Image Techs., LLC v. Elecs. for Imaging, Inc.*, 758 F.3d 1344 (Fed. Cir. 2014); *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366 (Fed. Cir. 2011); *Automated Tracking Sols., LLC v. Coca-Cola Co.*, 723 F. App'x 989 (Fed. Cir. 2018); *EasyWeb Innovations, LLC v. Twitter, Inc.*, 689 F. App'x 969, 971 (Fed. Cir. 2017); *Yu v. Apple Inc.*, 1 F.4th 1040 (Fed. Cir. 2021).

Under *Alice* Step 2, the '156 and '883 Patents do not add an inventive step to the general abstract idea. The asserted claims of the '156 and '883 Patents recite a generic computer cluster arrangement that includes hardware computation nodes, hardware boosters, and resource manager technologies at the highest level of abstraction, which does not add anything particularly inventive to the asserted claims. *See, e.g., Yu v. Apple Inc.*, 1 F.4th 1040, 1043 (Fed. Cir. 2021) (“Only conventional camera components are recited to effectuate the resulting ‘enhanced’ image—two image sensors, two lenses, an analog-to-digital converting circuitry, an image memory, and a digital image processor. Indeed, it is undisputed that these components were well-known and conventional.”); *see also id.* at 1045 (“Because claim 1 is recited at a high level of generality and merely invokes well-understood, routine, conventional components to apply the abstract idea identified above ... claim 1 fails at step two, *see, e.g., Alice*, 573 U.S. at 225–26, 134 S.Ct. 2347; *Mayo*, 566 U.S. at 73, 132 S.Ct. 1289; *see also, e.g., In re TLI Commc’ns*, 823 F.3d at 615 (concluding patent claims ineligible at step two in part because ‘the recited physical components behave exactly as expected according to their ordinary use’).”). As described in the prior art disclosed in Section IV and in light of the known technologies and art described in Section III.C., these components were conventional, not novel, and even considered collectively, the limitations of the asserted claims of the '156 and '883 Patents amount to nothing more than assigning, processing, and updating information using conventional components.

B. U.S. Patent No. 11,537,442 (“Computing Iterations Patent”)

All of the Asserted Claims of the '442 Patent are directed to ineligible subject matter under 35 U.S.C. § 101 and applicable case law authority.⁸⁵

⁸⁵ *See* n.49, *supra*.

The '442 Patent's Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice Corp. Pty. Ltd. v. CLS Bank Intern.*, 573 U.S. 208, 216 (2014). By way of example, the Asserted Claims of the '442 Patent are generally directed to the abstract idea of assigning, processing, and generating information. Each of the asserted claims is directed to the abstract idea of assigning sub-tasks, processing the sub-tasks, and generating information based on the processing of the sub-tasks. The '442 Patent discusses that the purported problem of insufficient use of a computer hierarchy because of the inherent inflexibility and lack of adaptability of a static mapping and tailoring of computation tasks and sub-tasks to a computer architecture. Yet, none of the asserted claims of any of the '442 Patent nor the specification of the '442 Patent disclose any technological improvement to any technological problem; instead the claimed features merely apply conventional, generic resource management of computing tasks. It is unclear what the claimed advance is over the prior art. Thus, under *Alice* Step 1, the '042, '289, and '960 Patents Asserted Claims are directed to one or more ineligible concepts.

Under *Alice* Step 2, the '442 Patent does not add an inventive step to the general abstract idea. The asserted claims of the '442 Patent recite a generic heterogeneous computing system that includes generic computation nodes, generic booster nodes for generating information related to processing technologies at the highest level of abstraction, which does not add anything particularly inventive to the asserted claims. *See, e.g.*, *Yu v. Apple Inc.*, 1 F.4th 1040, 1043 (Fed. Cir. 2021) (“Only conventional camera components are recited to effectuate the resulting ‘enhanced’ image—two image sensors, two lenses, an analog-to-digital converting circuitry, an image memory, and a digital image processor. Indeed, it is undisputed that these components were well-known and conventional.”); *see also id.* at 1045 (“Because claim 1 is recited at a high level

of generality and merely invokes well-understood, routine, conventional components to apply the abstract idea identified above ... claim 1 fails at step two, *see, e.g., Alice*, 573 U.S. at 225–26, 134 S.Ct. 2347; *Mayo*, 566 U.S. at 73, 132 S.Ct. 1289; *see also, e.g., In re TLI Commc'ns*, 823 F.3d at 615 (concluding patent claims ineligible at step two in part because ‘the recited physical components behave exactly as expected according to their ordinary use’).”). As described in the prior art disclosed in Section IV and in light of the known technologies and art described in Section III.C., these components were conventional, not novel, and even considered collectively, the limitations of the asserted claims of the ’442 Patent amount to nothing more than assigning, processing, and generating information using conventional components.

IX. DOCUMENT PRODUCTION ACCOMPANYING INVALIDITY CONTENTIONS

Microsoft is producing and/or making available for inspection documents required under the Court’s Scheduling Order under a separate letter. Microsoft reserves the right to produce and rely on additional documents relating to its products in view of, for example, additional information revealed during discovery regarding Plaintiffs’ allegations and/or amendments to Plaintiffs’ Infringement Contentions as discovery processes, including the testimony of inventors, authors and publishers of the printed publications and prior art systems identified herein.

Date: March 6, 2025

Respectfully submitted,

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CERTIFICATE OF SERVICE

I certify that a true and correct copy of the above and foregoing document was served on counsel for Plaintiffs, via electronic delivery on March 6, 2025.

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