

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ADEMCO INC.,

Petitioner,

v.

ECOFACOR, INC.,

Patent Owner.

Case: IPR2023-0040

U.S. Patent No. 10,584,890

DECLARATION OF EDWARD KOCH

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LIST OF EXHIBITS

Exhibit	Short Name	Description
EX1001	“’890 Patent”	U.S. Patent No. 10,584,890
EX1002	“Koch Decl.”	Declaration of Edward Koch
EX1003		C.V. of Edward Koch
EX1004	“’246 Application”	File History of U.S. Patent Application No. 16/374,246
EX1005	“’719 Application”	File History of U.S. Patent Application No. 15/616,719
EX1006	“’554 Application”	File History of U.S. Patent Application No. 14/491,554
EX1007	“2012 ’246 Application”	File History of U.S. Patent Application No. 12/788,246
EX1008	“Leen”	U.S. Patent Publication No. 2009/0140056
EX1009	“Trundle”	U.S. Patent Publication No. 2010/0289643
EX1010	“Ehlers”	U.S. Patent No. 6,216,956
EX1011	“Wedekind”	U.S. Patent No. 5,197,666
EX1012		’890 Patent Infringement Contentions, <i>EcoFactor, Inc. v. Resideo Techs., Inc.</i> , Civ. No. 6:22-cv-00069 (W.D. Tex.)
EX1013	“Rosenblatt”	U.S. Patent Publication No. 2010/0081375
EX1014	“Imes”	U.S. Patent No. 8,457,797
EX1015	“Imes Prov.”	Provisional Application No. 61/255,678

Exhibit	Short Name	Description
EX1016	“Young”	U.S. Patent No. 6,196,468
EX1017	“Gupta”	Gupta, M., Intille S., Larson, K., Adding GPS-Control to Traditional Thermostats: An Exploration of Potential Energy Savings and Design Challenges, International Conference on Pervasive Computing (2009)
EX1018	“Shah”	Shah, N., Tsai, C., Chao, K., Monitoring Appliances Sensor Data in Home Environment: Issues and Challenges, IEEE Conference on Commerce and Enterprise Computing (2009)
EX1019	“Leslie”	Leslie, P., et al., The Application of Smartphone Technology to Economic and Environmental Analysis of Building Energy Conservation Strategies, Intl J of Sustainable Energy (2011)
EX. 1020		Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation, Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office, Katherine Vidal (issued June 21, 2022).
EX. 1021		Claim Construction Order, Civ. No. 6:22-cv-00069-ADA, Dkt. 43 (W.D. Tex. Oct. 11, 2022)
EX. 1022		Reserved
EX. 1023		Reserved
EX. 1024		Reserved

Exhibit	Short Name	Description
EX. 1025		<i>EcoFactor, Inc. v. Resideo Techs., Inc.</i> , Civ. No. 6:22-cv-00069-ADA, Dkt. 29 (W.D. Tex. Aug. 1, 2022)

DECLARATION OF EDWARD KOCH

I, Edward Koch, hereby declare under penalty of perjury that the following statements are made based on my personal knowledge and are true and correct.

I. Professional Background

1. I am currently the Founder and an officer of several companies involved in the fields of unmanned robotics systems, healthcare device data management, and distributed control.

2. I received a M.S. in Electrical Engineering, with Honors, from the University of Florida. Before that, I received a B.S. in Electrical Engineering, with Honors, from the same institution.

3. My industry experience has spanned several different fields of technology, including smart grid development, automated demand response programs, and energy management. For example, from 1992 to 2002 I was the CTO and Founder of Coactive Networks, an industry leader in the field of remote telemetry and control applications, especially in the market of residential energy management. At Coactive Networks, I oversaw the development of gateways and routers for use in utility companies' energy management services.

4. Additionally, from 2002 to 2014, I was the CTO and Founder of Akuacom, where I was responsible for managing the company's engineering resources and research and development activities. In that role, I oversaw the

development of software used by utility companies in automated demand response programs. As an example, the automated demand response software developed by Akuacom would allow a server to send out signals to control devices such as thermostats in residential and commercial buildings in order to reduce energy consumption at times of peak demand.

5. In 2010, Akuacom was acquired by Honeywell to add to Honeywell's energy management and smart grid portfolio. From 2010 to 2014, I served as a Senior Fellow at Honeywell to manage the integration of Akuacom's technology and product offerings into Honeywell's smart grid operations and offerings. In that role, I provided Honeywell thermostat engineers with specifications and requirements for various features of connected thermostats, such as the use of automated demand response.

6. I also worked as a manager and project leader at Navigation Technologies from 1988 to 1991, developing the earliest incarnations of vehicle navigation software that utilized the geographic information database being developed by Navigation Technologies. Navigation Technologies' digital map database was used in leading navigation systems in North America.

7. I have authored or co-authored over 30 articles in peer-reviewed journals, conference proceedings, texts, and monographs in fields such as automated demand response for buildings.

8. I served on several standards-setting bodies related to smart grid standards for over a decade. For example, I served as co-chair of the Utility Communications Architecture International Users Group OpenADR Taskforce, and I was an active participant in the OASIS Energy Interoperation Technical Committee and Web Services Calendar Technical Committee. I have further served on other standards-setting bodies such as IEEE, HL7, IHE, CEA, and LonMark, including as a chair. I have drafted various standards related to device communications. I was the chair of the committee that drafted the Demand Response Automation Server Open Interface Standard. This work was performed within an industry consortium that is sponsored and managed by the California Energy Commission and the Demand Response Research Center of the Lawrence Berkeley National Laboratory.

9. I am a named inventor on 31 U.S. Patents. These patents are generally related to distributed control systems, geographic information systems, and demand response.

10. I attach as Exhibit 1003 my curriculum vitae, which includes a more detailed list of my qualifications.

II. Scope of the Engagement

11. I have been retained by Alston & Bird, LLP on behalf of Ademco Inc. (“Ademco” or “Petitioner”) to provide analysis and opinion testimony. I have also

been asked to evaluate whether a POSITA would have considered certain technologies and prior art to be relevant or material to determining the validity of the claims at issue of U.S. Patent No. 10,584,890 (the “’890 Patent”).

12. All of the opinions I express in this Declaration have been made from the standpoint of a person of ordinary skill. I believe that a POSITA at the time of the alleged invention of the ’890 Patent would have had (1) an undergraduate degree in electrical engineering, computer engineering, computer science, or a comparable field of study and (2) at least two years of experience with (i) process control, (ii) automation systems, (iii) or a comparable field of work. I believe that education can substitute for experience and vice versa. Under this definition, I was a POSITA as of at least the earliest priority date of the ’890 Patent.

13. My opinions are based on my experience and knowledge and the information I have reviewed as of the date of this Declaration. In connection with my analysis, I have reviewed the exhibits listed in the above list of exhibits as well as each of the items referenced herein.

14. I am being compensated at my standard hourly rate of \$450 per hour for my time. My compensation is not in any way contingent on my performance, the result of this proceeding, or any of the issues involved therein. I am also being reimbursed for expenses incurred as a result of activities performed as an expert.

III. Legal Understandings

A. Claim Interpretation

15. My opinions concern what I believe a POSITA would have understood the meaning of certain claim terms to be based on the patent documents. I use the legal principles below, of which I have been informed by counsel as a guide in formulating my opinions.

16. I understand that it is a basic principle of patent law that assessing the validity of a patent claim involves a two-step analysis. In the first step, the claim language must be properly construed to determine its scope and meaning. In the second step, the claim as properly construed must be compared to the alleged prior art to determine whether the claim is valid.

17. My methodology for determining the meaning of claim phrases was first to study the patent. In particular, I studied the claims themselves, followed by the specification, figures, and other patent content. Next, I reviewed the prosecution history looking for any clarifications or limitations that might be attached to claim terms.

18. I understand that in an *inter partes* review, claim terms are to be given their ordinary and customary meaning as understood by POSITA in the context of the specification and prosecution history at the time of the invention. I understand that one must be careful not to read a specific embodiment appearing in the written

description into the claim if the claim language is broader than the embodiment. I further understand that any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision.

19. I understand that this standard is the same as that used in United States district courts, in which claim terms are given their ordinary and customary meaning, as would be understood by a POSITA at the time of the invention having taken into consideration the language of the claims, the specification, and the prosecution history of record under the *Phillips* claim construction standard.

B. Prior Art

20. It is my understanding that information which satisfies one of the categories of prior art set forth in 35 U.S.C. § 102 may be used in an invalidity analysis under §§ 102 or 103. If information is not properly classified as prior art under one of the subsections of § 102 of the Patent Code, then it may not form the basis of an anticipation or obviousness determination. It is also my understanding that, for *inter partes* review, applicable prior art is limited to patents and printed publications.

C. Anticipation

21. I understand that to anticipate a patent claim under 35 U.S.C. § 102, a single asserted prior art reference must disclose each and every element of the claimed invention, either explicitly or inherently, to a POSITA. I understand that a

disclosure of an asserted prior art reference can be “inherent” if the missing element is necessarily present or is the inevitable outcome of the process and/or thing that is explicitly described in the asserted prior art reference.

D. Obviousness

22. I am also informed and understand that a patent claim is invalid under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a POSITA to which the subject matter pertains. Obviousness, as I understand, is determined based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and secondary indications of non-obviousness to the extent they exist.

23. I understand that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the view of a POSITA at the time of the invention. A POSITA is a hypothetical person who is presumed to be aware of all of the relevant art at the time of the invention. The person of ordinary skill is not an automaton and may be able to fit together the teachings of multiple patents employing ordinary creativity and the common sense that familiar items may have obvious uses in another context or beyond their primary purposes.

24. In analyzing the relevance of the differences between the claimed invention and the prior art, I understand that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person of ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

25. I understand that an invention would have been obvious if a POSITA, facing the wide range of needs created by developments in the field, would have seen an obvious benefit to the solutions tried by the applicant. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, it would be obvious to a POSITA to try the known options. If a technique has been used to improve one device, and a POSITA would have recognized that it would improve similar devices in the same way, using the technique would have been obvious.

26. I understand that I do not need to look for precise teaching in the prior art directed to the subject matter of the claimed invention. I understand that I may take into account the inferences and creative steps that a POSITA would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combined elements known in the prior art and the combination yielded results that were predictable to a POSITA at the time of the invention, then

this evidence would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yielded unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this evidence would make it more likely that the claim that successfully combined those elements was not obvious. I understand that hindsight must not be used when comparing the prior art to the invention for obviousness.

i. Motivation to Combine

27. I understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I understand that a claimed invention may be obvious if some teaching suggestion or motivation exists that would have led a POSITA to combine the invalidating references. I also understand that this suggestion or motivation may come from sources such as explicit statements in the prior art, or from the knowledge of a POSITA. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. I also understand that when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of

ordinary skill may be motivated to apply both his skill and common sense in trying to combine the known options in order to solve the problem.

28. In determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a POSITA, the following are examples of approaches and rationales that may be considered:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices, methods, or products in the same way;
- Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;
- Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA; or
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

IV. Technical Background

29. To better understand my opinions on the validity of the claims of the '890 Patent, in this section I provide some background and history about thermostats with a particular focus on modern programmable thermostats.

30. Within the context of this report, a POSITA would have understood that a “thermostat” is a device designed to control the air temperature within a facility. A thermostat uses a closed loop control system to maintain a desired temperature. In a closed loop system, the controller performs a control action depending on the feedback from the process in the form of the value of the process variable (PV). Using a thermostat as an example, a thermostat compares the building temperature (PV) with the temperature setpoint, which generates a controller output to maintain the building at the desired temperature by switching a heating/cooling unit on or off until the air temperature matches the desired setpoint. The thermostat monitors the air temperature within the building using continuously updated measurements from a temperature sensor.

31. While many residential and commercial buildings now use modern programmable thermostats, thermostats have long been used to maintain a desired temperature. For example, older mechanical versions of thermostats used components such as coiled bi-metallic springs to measure actual temperature, and a mercury switch that opens or completes a circuit when the spring coils or uncoils

with temperature changes. EX1001 at 1:35-39. A user was able to set a desired temperature by turning a dial, for example, which rotated the coiled bi-metal spring along with the mercury switch so that the switch would be activated at different temperatures depending upon the position spring apparatus is rotated to. Thus, different positions manually set by the user represent different temperature setpoints. These basic thermostats allowed a user to set a desired temperature but lacked the processing components to store heating and cooling schedules, to be controlled remotely, and to be controlled based on geo-location.

32. More recently, electronic digital thermostats have become prevalent. *Id.* at 1:39-40. These modern thermostats use solid-state devices such as thermistors or thermal diodes to measure temperature, and microprocessor-based circuitry to control the switch and to store and operate based upon user-determined protocols for temperature versus time. *Id.* at 1:40-44. Modern thermostats can shift between multiple temperature setpoints at different times without real-time involvement of a human being. *Id.* at 2:1-4. In order to accomplish this, the thermostat also contains a “clock” that provides the actual date, including day of the week, and time. With this capability it is possible to create schedules such that between some start date and time and some end date and time, the user can specify what the setpoint of the thermostat will be. From a user interface perspective, how schedules are specified can be done in a number of different ways, but it always

results in the creation of date/time periods with a corresponding setpoint for that period.

33. Additionally, at least by the earliest potential filing date of the '890 Patent, modern thermostats were able to be controlled remotely, such as by mobile devices. For example, U.S. Patent Application No. 2010/0081375 (“Rosenblatt”) contemplates the use of a handheld device such as an iPhone to control a “networkable thermostat 986.” EX1013 at [0314].

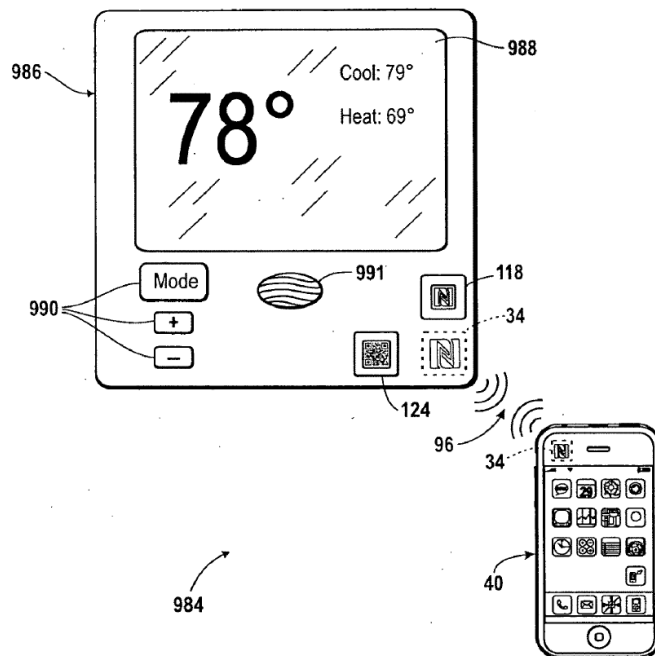
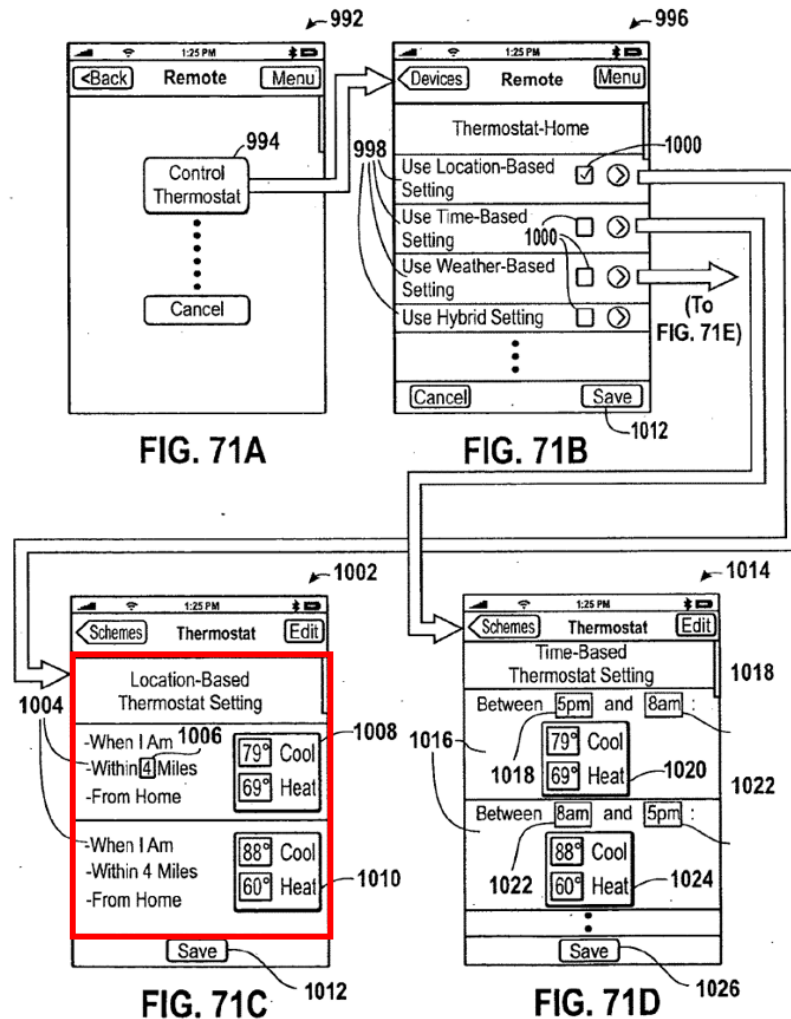


FIG. 70

EX1013, Fig. 70.

34. Further, modern thermostats were able to be controlled automatically based on a detected distance of a remote controller from the thermostat itself. For example, Rosenblatt describes that a user could choose to use a location-based

setting, which allows a user to “control[]the thermostat 986 based on the location of the handheld device 40.” EX1013 at [0318], FIGs. 71A-71D (annotated, below). “For example, when the handheld device 40 is located within a certain distance of the location of the thermostat 986, as determined by the location sensing circuitry 22, the thermostat 986 may select the temperature settings 1008; otherwise, the thermostat 986 may select the temperature settings 1010.” *Id.* at [0318].



EX1013, Figs. 71A-71D (annotated).

35. As another example, some modern thermostats were controlled specifically by a mobile device's GPS to adjust the thermostat to a more comfortable setting as the device user's location was detected to be moving toward the premise. *See, e.g.*, EX1009 at [0065].

36. And in general, by the time of the '890 Patent's earliest potential filing date, location-based services were ubiquitous, including as part of navigation systems, health and fitness trackers, and location-based advertising systems. As GPS capabilities became more prevalent in cell phones, more and more location-based services emerged.

37. As of the earliest potential filing date of the '890 Patent, a POSITA would also have understood that there were well-known techniques that allowed a thermostat to achieve greater energy efficiency and user comfort at the same time. For example, ramping involves changing the temperature of a space by automatically changing the thermostat setpoint in small increments between the ultimate setpoint and current temperature. Ramping of the setpoint value provides a gradual heating or cooling which uses less energy without sacrificing the user's comfort. There are other techniques such as "precooling" wherein the thermodynamic properties of the building are exploited by cooling the building down during times when the cost of electricity is low and then shutting off the system during times when the cost of electricity is high. The precooling energy is

stored in the building which will maintain a comfortable temperature for the user even when the cooling system is not operating. These precooling strategies could be implemented by automatically controlling the setpoint and changing it at opportune times corresponding to price changes in the cost of electricity or scheduled demand response events.

V. Summary of Opinions

38. Based on my review of the '890 Patent and its prosecution history, the materials I have considered, and my knowledge and experience, my opinions are as follows:

- Ground 1A: Claims 1-8 are obvious in view of the combination of Leen, Trundle, and Ehlers;
- Ground 1B: Claims 9-17 are obvious in view of the combination of Trundle, Leen, Wedekind, and/or Ehlers;
- Ground 2A: Claims 1-8 are obvious in view of the combination of Imes, Young, and Ehlers;
- Ground 2B: Claim 9-17 are obvious in view of the combination of Imes, Young, Ehlers, and Wedekind.

VI. Overview of the '890 Patent

39. The '890 Patent describes a thermostat system capable of adjusting temperature setpoints for an HVAC system that uses the geographic position of a

mobile device to determine whether a building is occupied and adjusts the temperature accordingly. EX1001 at 4:13-26. Specifically, the sole independent claim of the '890 Patent claims a “thermostat system” comprising a housing, electrical contacts; a display; a wireless radio; a temperature sensor; “one or more processors” configured with electronic circuitry to receive and determine various signals, data, and parameters; additional “electronic circuitry” configured to allow adjustment, analysis of parameters, and communication of certain metrics; and a compressor delay circuit. *Id.* at cl. 1.

40. The '890 Patent discloses that prior to the earliest potential filing date, the hotel industry employed several techniques to reduce energy consumption in individual hotel rooms based on the room's occupancy. For example, some hotels employed HVAC systems controlled by the presence of a keycard in a wall-mounted slot to indicate occupancy. *See* EX1001 at 2:47-53. Others employed motion sensors connected to the control circuitry of the HVAC system so that when no motion is detected for a predetermined interval, the system would conclude that the room is unoccupied and would alter the temperature setpoint to a more economical level. *Id.* at 2:56-64.

41. Additionally, the '890 Patent discloses that prior to the earliest potential filing date “tremendous technological change ha[d] come to the tools used for personal communication,” such that a user could control an HVAC system

remotely or away from the home. *Id.* at 3:21-32. Moreover, “[m]any new mobile devices now incorporate another significant new technology—the ability to geolocate the device (and thus, presumably, the user of the device),” including through the use of GPS. *Id.* at 3:37-39.

42. The ’890 Patent discloses “a thermostat attached to an HVAC system, a local network connecting the thermostat to a larger network such as the Internet, and one or more location-enabled mobile devices attached to the network, and a server in bi-directional communication with a plurality of such thermostats and devices.” *Id.* at 3:61-67. In one embodiment of the disclosure, the server is able to predict the rate of change in inside temperature in a given house under varying conditions. *Id.* at 12:56-13:4. Using this prediction ability, the server can determine when the HVAC system must be turned on in order to reach the desired temperature at the desired time, with minimum energy use, called just-in-time (JIT) optimization. *Id.* The target time when preconditioning of the building is intended to have been completed is called the target time (TT). *Id.* at 13:25-29. In calculating the appropriate start time, the server relies on input parameters such as historic readings from the thermostat, and associated weather data (e.g., outside temperature, solar radiation, humidity, wind speed and direction, etc.). *Id.* at 13:33-41.

A. Challenged Claims of the '890 Patent

43. The challenged claims of the '890 Patent are Claims 1-17. I have reproduced the challenged claims below.

1. A thermostat system comprising:
a housing;
electrical contacts configured to connect the thermostat with wires
that allow for at least two electrical connections from a building's
HVAC system to the contacts;
a display configured to present information to a user;
a wireless radio compatible with a wireless radio frequency protocol
and configured to communicate bi-directionally with a location-aware
mobile device;
a temperature sensor;
one or more processors configured with electronic circuitry to:
receive HVAC data parameters, including a first data parameter from
the temperature sensor comprising an interior temperature inside the
building; and
a second data parameter from a network connected to the thermostat,
wherein the second data parameter comprises an outside weather
condition collected from a source external to the building;

determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value;

determine a second temperature setpoint data parameter for the building, wherein the second setpoint data parameter includes a second temperature value and a second time value;

receive radio frequency signals from the location-aware mobile device;

receive geo-positioning data from the location-aware mobile device and automatically adjust a temperature value based on the geo-positioning data, including initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user;

electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system;

electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times; and

electronic circuitry configured to generate and communicate usage metrics pertaining to the HVAC system over time; and

a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling.

2. The thermostat system of claim 1, wherein the one or more processors is further configured to determine whether the building is occupied or unoccupied.

3. The thermostat system of claim 2, further comprising an interface configured to allow the user to input that the building is currently unoccupied.

4. The thermostat system of claim 3, wherein the determination of whether the building is occupied or unoccupied by the one or more processors is based at least in part on a fourth data parameter received from a motion sensor.

5. The thermostat system of claim 1, wherein the one or more processors is further configured to receive a third data parameter from a first sensor, wherein the third data parameter from the first sensor includes a measurement of at least one characteristic of a building within which the thermostat is located.

6. The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of the humidity of the building.
7. The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of sunlight.
8. The thermostat system of claim 7, wherein the second data parameter from the network connected to the thermostat further comprises a measurement of the outdoor humidity.
9. The thermostat system of claim 1, further comprising a memory configured to store historical values of the first data parameter and second data parameter.
10. The thermostat system of claim 1, wherein the one or more processors is further configured to predict, based at least on the first data parameter, the second data parameter, and the first temperature setpoint data parameter, the time necessary for the HVAC system to operate in order for the building to reach the first temperature value by the first time value.
11. The thermostat system of claim 10, wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time

value is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.

12. The thermostat system of claim 11, wherein the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value.

13. The thermostat system of claim 10, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

14. The thermostat system of claim 10, further comprising a memory configured to store historical values of the first data parameter and second data parameter; wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on historical values of the first data parameter and second data parameter.

15. The thermostat system of claim 14 wherein the one or more processors determines one or more intermediate temperature setpoints

that have a temperature value between a current temperature of the building and the first temperature setpoint.

16. The thermostat system of claim 14, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

17. The thermostat system of claim 1, wherein the one or more processors is further configured to receive a fifth data parameter generated based at least in part on a previous operation of the HVAC system, wherein the fifth data parameter includes at least one performance characteristic of the HVAC system.

B. Priority Date of the '890 Patent

44. I am informed and understand that the earliest possible priority date (or earliest potential filing date) of the claims of the '890 Patent is May 26, 2010—the filing date of U.S. Patent Application No. 12/788,246, to which the '890 Patent claims priority. *See* EX1001. For the purposes of this proceeding only, I adopt May 26, 2010 as the earliest possible priority date of the claims of the '890 Patent.

VII. Prosecution History

A. The '890 Patent

45. U.S. Patent Application No. 16/374,246 (the “'246 Application”) was filed on April 3, 2019 and resulted in the '890 Patent. *See* EX1004.

46. The claims of the '246 Application were rejected by the Examiner on the basis that the disclosure of the prior-filed applications failed to provide adequate support or enablement as required by 35 U.S.C. § 112(a). The Examiner explained:

These parent applications fail to specifically disclose first, second, and third setpoints, receiving the outdoor temperature from a network, the remote interface being configured to adjust temperature setpoints for the HVAC system; sending user-specific data through the internet; 'user-specific information' about the building and HVAC system; or adjusting the temperature setpoint 'without user intervention.'

EX1004 at 115.

47. As a result, the Examiner determined that the application was entitled to an effective filing date of no earlier than April 3, 2019, and all claims were deemed unpatentable as obvious. *Id.* at 116. In addition, claims 1-19 were rejected as indefinite because they included a recitation that the claimed system was "compatible with IEEE 802.11 wireless protocol," which is an industry protocol and thus subject to change or modification. *Id.* at 117.

48. In response, the Applicant amended its claims to remove the "IEEE 802.11 wireless protocol" limitation. In addition, the Applicant's response included a table that purported "to show support for the limitations that were indicated in the Office Action as allegedly having insufficient support under 35 U.S.C. § 112." *Id.* at 58, 63-95.

49. The Examiner accepted Applicant's assertion that this table properly established priority to May 26, 2010, and determined that "the previously applied Adamek and Sloo references no longer qualify as prior art." *Id.* at 38. A Notice of Allowance was mailed on November 1, 2019. *Id.* at 35.

B. Appl. No. 15/616,719

50. U.S. Patent Application No. 15/616,719 (the "'719 Application") was filed on June 7, 2017. *See* EX1005.

51. Although now abandoned, Appl. No. 15/616,719 was rejected by the Examiner on the ground of nonstatutory double patenting as being unpatentable over the patented claims of parent Patent Nos. 9,709,292 (the "'292 Patent"), 8,556,188 (the "'188 Patent"), and 8,840,033 (the "'033 Patent"). *See id.* at 163-66, 194. Because the Applicant failed to timely file a proper reply to an Office action, the application was abandoned.

C. Appl. No. 14/491,554

52. U.S. Patent Application No. 14/491,554 (the "'554 Application") was filed on September 19, 2014 and resulted in U.S. Patent No. 9,709,292 (the "'292 Patent"). *See* EX1006.

53. During prosecution of the '554 Application, the Examiner rejected claims 2-10 and 12-20 as anticipated by U.S. Patent No. 8,428,782 to Imes ("Imes '782") (a relative to the prior art patent asserted here), and claims 11 and 21 were

rejected as obvious over the same patent. *See id.* at 395, 397. Further, claims 2-21 were rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-22 of U.S. Patent No. 8,556,188. *Id.* at 399.

54. The Examiner stated:

“Imes discloses a method/system for adjusting at least one temperature setpoint of an HVAC system associated with a structure, the method comprising: associating the at least one mobile electronic device with the structure . . . ; receiving with one or more computer processors, the geographic location of the at least one mobile electronic device . . . ; and adjusting with one or more computer processors, at least one temperature setpoint of an HVAC system associated with the structure based upon the predicted length of time for a user of the mobile electronic device to reach the structure”

Id. at 395-96.

55. Additional claims of Imes ’782 “disclose[] using geospatial data associated with the mobile electronic device to control (i.e., increase or decrease) the predicted length of time to reach the structure based on characteristics of a location (i.e., distance from the structure) the user has stopped at before reaching the structure.” *Id.* at 396.

56. In response, Patent Owner amended independent claims 2 and 12 to add limitations that the one or more computer processors receive at least a measurement of a temperature obtained from within the structure and predict a length of time to reach a desired temperature, and that the temperature setpoint is

adjusted “at least in part upon the predicted length of time to reach the desired temperature.” *Id.* at 461-63.

57. Patent Owner explained in its Applicant Remarks that “Imes does not predict a length of time that is needed for a structure to reach a desired temperature.” Patent Owner further explained that “Imes does not adjust the temperature setpoint of an HVAC system based on a) the predicted length of time that is needed for a structure to reach a desired temperature and b) upon the predicted length of time for a user of a mobile device to reach the structure.” EX1006 at 454. Finally, Patent Owner submitted a terminal disclaimer to address the obviousness-type double patenting rejection. *Id.* at 416-17. The Examiner subsequently issued a notice of allowance on March 13, 2017. *Id.* at 466-470.

D. Appl. No. 12/788,246

58. U.S. Patent Application No. 12/788,246 (the “2012 ’246 Application”) was filed on May 26, 2010, and resulted in U.S. Patent No. 8,556,188 (the “’188 Patent”). *See* EX1007.

59. The claims of the ’246 Application were initially rejected as obvious over U.S. Patent Pub. No. 2001/0202181 (“Lee”) in view of U.S. Patent No. 8,386,082 (“Oswald”). *Id.* at 197. The Examiner explained that Lee taught “controlling the HVAC system based on user proximity,” including with the use of a mobile device such as an Internet-connected, GPS-enabled phone, and that

Oswald taught “control of an HVAC system based on determined occupancy.” *Id.* at 198. Additionally, while Lee did not specifically prompt the user to confirm occupancy, “user confirmation for automatic controls is considered a common routine control expedient that would have been obvious to one of ordinary skill in the art to apply to the system of Lee et al. for the general purpose of assuring the sensed conditions are accurate before changing the control settings.” *Id.* at 199.

60. In response, Applicant amended independent claims 1 and 12, in addition to dependent claims 19-22. *Id.* at 215-18. Applicant argued that amended claim 1 purportedly differed from Lee and Oswald because it claimed the use of historical route data to determine whether a mobile device user is using a known route to go home; the use of current traffic data to predict a length of time for said user to reach his home from the location of the mobile device; and the adjustment of a temperature setpoint of the home based on the predicted length of time and predicted rate of change of inside temperatures. *Id.* at 220.

61. Applicant argued that amended claim 12 purportedly differed from the cited references because it is directed to “a system that comprises at least a database of stored data comprising a plurality of internal temperature measurements taken within a structure and a plurality of outside temperature measurements relating to temperatures outside the temperature,” and because the claimed computer processors are configured to adjust at least one setpoint based on

“whether or not said structure is deemed to be occupied based upon the geographic location of said electronic device,” in addition to the predicted length of time for the user to reach the structure, and the predicted rate of change of temperatures inside the structure. *Id.* at 221-22.

62. The Examiner allowed the claims, explaining that the prior art did not teach the limitations regarding the use of historical route data; the use of current traffic data; and processors adjusting the at least one setpoint based on occupancy, the length of time to reach the structure, and predicted rate of change of temperatures inside the structure. *Id.* at 296. A Notice of Allowance was mailed on August 5, 2013. *Id.* at 290-94.

VIII. Claim Construction

63. I understand that claims in *inter partes* review proceedings are construed using the same claim construction standard that would be used to construe the claim in a civil action. For the purposes of this IPR and in my opinion, the claims of the '890 Patent do not include any terms that require specific construction. Instead, each of the claims includes terms that an ordinary artisan would understand according to their plain and ordinary meaning.

64. I understand that the Petitioner has asserted that the preamble of the sole independent claim (claim 1), which reads “A thermostat system,” is limiting, Petitioner advocated for such a position in the co-pending district court case, and

the Court adopted this position. *See, e.g.*, EX1025 at 5; EX1021 at 2. While I agree with Petitioner’s position, I have adopted Patent Owner’s assertion that the preamble is not limiting for the purposes of this IPR. Regardless, and as I demonstrate below, it is my opinion that at least Grounds 1 and 2 render the claims unpatentable under either construction.

IX. Overview of the Prior Art

A. Leen

65. U.S. Patent Publication No. 2009/0140056 A1 to Leen (“Leen”) was filed on November 25, 2008 and published on June 4, 2009. *See* EX1008. I understand that Leen was not cited and was not considered by the Patent Office during the prosecution of the ’890 Patent.

66. Leen discloses a thermostat. Specifically, Leen discloses “simplified interfaces for controllers having programming capabilities,” such as an HVAC controller that enables users to create and edit a cooling and heating schedule based on occupancy, including “when the user is away from the house.” EX1008 at [0010], [0024], [0092]-[0093], [0171]; *see generally id.* at Figs. 18-26.

B. Trundle

67. U.S. Patent Publication No. 2010/0289643 A1 to Trundle et al. (“Trundle”) was filed on May 18, 2010, published on November 18, 2010, and claims priority to Provisional Application No. 61/179,224, filed on May 18, 2009. *See* EX1009.

68. I understand that while Trundle was cited in the '890 Patent, it was not relied upon in an action and is used here in combination with references never before considered.

69. Trundle discloses techniques for remotely monitoring and controlling devices such as thermostats. EX1009 at [0036]. In addition to disclosing an application operating on a mobile device for scheduling a thermostat system, Trundle discloses the use of a mobile device application to track a device's physical location, and the use of the "location tracking to automatically set thermostat, lights, and appliances accordingly." *Id.* at [0037], [0072], [0116].

70. In particular, Trundle teaches the monitoring and use of a user's geolocation through, for example, GPS data or cell tower triangulation, to infer a time when future occupancy is expected. *See, e.g., id.* at [0131]-[0136].

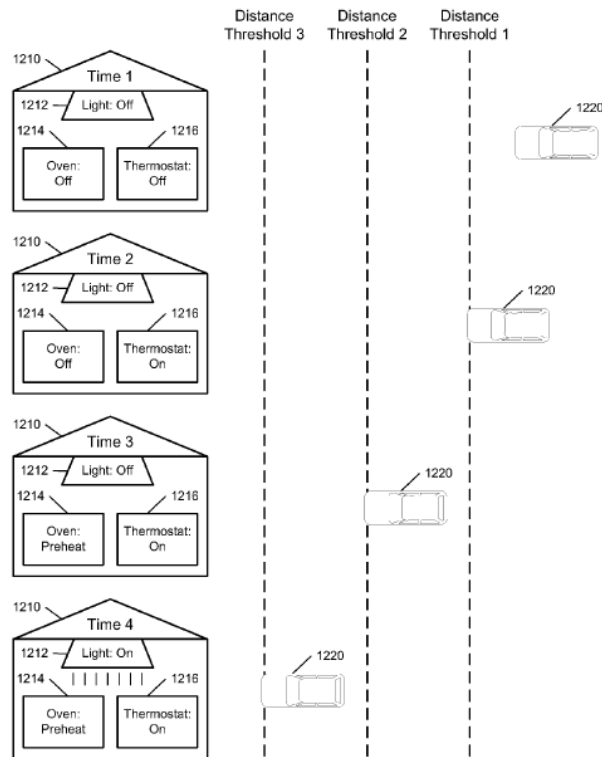


FIG. 12

EX1009, Fig. 12.

C. Ehlers

71. U.S. Patent No. 6,216,956 to Ehlers et al. (“Ehlers”) was filed on December 23, 1998 and issued on April 17, 2001. EX1010. I understand that while Ehlers was cited during the prosecution of the ’890 Patent, it was not relied upon in an action and is used here in combination with references never before considered.

72. Ehlers, which is directed to a thermostat, discloses an environmental condition sensing and control system in which “the processor controls the heating and cooling system to ramp up or down indoor temperature during certain time periods to reduce energy consumption costs.” EX1010 at 2:42-45, 4:43-46. Ehlers

also teaches pre-heating (or pre-cooling) a building by a number of degrees selected by a user prior to an energy rate increase. *Id.* at 29:25-36.

D. Wedekind

73. U.S. Patent No. 5,197,666 to Wedekind (“Wedekind”) was filed on January 2, 1992 and issued on March 30, 1993. I understand that Wedekind was not cited or relied upon in an action and is used here in combination with references never before considered. *See* EX1004 at 389.

74. Wedekind discloses the use of inputs such as indoor and outdoor air temperatures to “more accurately achieve predetermined temperatures at predetermined times in addition to achieving these conditions while optimizing energy consumption.” EX1011 at 2:45-63. Specifically, Wedekind teaches an energy prediction system involving a non-linear efficiency model of three coupled differential equations governing the thermal characteristics of an enclosure. *Id.* at 18:65-19:4.

E. Young

75. U.S. Patent No. 6,196,468 to Young (“Young”) was filed on July 23, 1999 and issued on March 6, 2001. Young is prior art under at least 35 U.S.C. §102(a) and §102 (b). Young was not considered during prosecution.

76. Young discloses the use of an apparatus or method for controlling HVAC systems “that avoids unnecessary wear upon the compressor unit in an air

conditioner.” EX1016 at 2:22-23. Specifically, Young discloses “a compressor timer that delays reactivation of the compressor for a startup delay after the compressor relay has been deactivated and that overrides the system timer when the door and windows have been closed for less than that startup delay.” *Id.* at 2:57-61.

F. Imes

77. U.S. Patent No. 8,457,797 to Imes et al. (“Imes”) was filed on September 29, 2010, published on February 24, 2011, and claims priority under 35 U.S.C. §119(e) through a number of continuation applications to provisional application Nos. 61/255,678 and 61/235,798, filed on October 28, 2009 and August 21, 2009, respectively.

78. At least provisional application No. 61/255,678 (“Imes Prov.”) (EX1015) was filed before the effective filing date of the ’890 Patent, and the teachings of the provisional application were carried forward into Imes. EX1014 at 1:1-25. Imes is therefore prior art under at least 35 U.S.C. §102(e) (pre-AIA).

79. Imes Prov. provides support for at least one claim of Imes. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). For instance, with respect to claim 12 of Imes, support for all of the claimed limitations is found throughout both Imes and Imes Prov., as shown below.

Claim	Imes	Imes Prov.
12. A method comprising: detecting a network device at a first site;	EX1014 at 4:65-5:13, 5:65-6:2, 6:48-50, 6:53-57, 7:66-8:4, 12:32-34, 39:4-15, 45:28-45, 45:46-57, 54:63-55:1	EX1015 at 7 at § 1.2; 8-9 at § 1.4; 18-19 at § 2.1.17
detecting a first reporting device associated with the first site;	<i>Id.</i> at 6:53-59, 7:40-52, 8:62-9:14, FIG. 2, 5A	<i>Id.</i> at 7 at § 1.2; 7-8 at § 1.3; 8-9 at § 1.4; 18-19 at § 2.1.17
detecting a network device at a second site;	<i>Id.</i> at 4:65-5:13, 5:65-6:2, 6:48-50, 12:32-34, 39:4-15, 45:28-45, 45:46-57, 54:63-55:1	<i>Id.</i> at 7 at § 1.2; 8-9 at § 1.4; 18-19 at § 2.1.17
detecting a second reporting device associated with the second site;	<i>Id.</i> at 7:40-52, 8:62-9:14, 54:63-55:4	<i>Id.</i> at 7 at § 1.2; 7-8 at § 1.3; 8-9 at § 1.4; 18-19 at § 2.1.17
detecting a first relative location between the first location reporting device and the first site;	<i>Id.</i> at 8:62-9:14, 12:35-58, 35:63-36:7	<i>Id.</i> at 7 at § 1.2; 8-9 at § 1.4; 11-12 at § 2.1.6; 12-14 at § 2.1.7; 18-19 at § 2.1.17
detecting a second relative location between the second location reporting device and the second site;	<i>Id.</i> at 8:62-9:14, 34:57-64, 35:63-36:7	<i>Id.</i> at 7 at § 1.2; 8-9 at § 1.4; 11-12 at § 2.1.6; 12-14 at § 2.1.7; 18-19 at § 2.1.17
altering a first operating condition of the network device disposed at the first site in response to the first relative location of the first location reporting device; and	<i>Id.</i> at 8:62-9:14, 12:35-58, 35:63-36:7	<i>Id.</i> at 7 at § 1.2; 8-9 at § 1.4; 11-12 at § 2.1.6; 12-14 at § 2.1.7; 18-19 at § 2.1.17

altering a second operating condition of the network device disposed at the second site in response to the second relative location of the second location reporting device.	<i>Id.</i> at 8:62-9:14, 34:57-64, 35:63-36:7	<i>Id.</i> at 7 at § 1.2; 8-9 at § 1.4; 11-12 at § 2.1.6; 12-14 at § 2.1.7; 18-19 at § 2.1.17
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80. While Imes was cited in the '890 Patent, it was not relied upon in an action and is used here in combination with references never before considered. Additionally, a relative of Imes, Imes '782, was cited in the file history of the '554 Application. However, Patent Owner did not traverse Imes '782 based on any of the limitations at issue in at least Claim 1. Instead, Patent Owner explained in its Applicant Remarks that “Imes does not predict a length of time that is needed for a structure to reach a desired temperature.” EX1006 at 454. Patent Owner further explained that “Imes does not adjust the temperature setpoint of an HVAC system based on a) the predicted length of time that is needed for a structure to reach a desired temperature and b) upon the predicted length of time for a user of a mobile device to reach the structure.” EX1006 at 454. I understand Patent Owner did not traverse any of the remaining limitations or the fact that Imes is indeed prior art.

81. Imes discloses an energy management system capable of receiving site report data received from a plurality of residential sites, each of which can include a thermostat accessible to the wireless home energy network. EX1014 at 4:65-5:4; EX1015 at 7 at § 1.2; 8-9 at § 1.4; 18-19 at § 2.1.17. Imes further

discloses a proximity detection module that can be deployed to detect a location of a mobile device relative to a site and modify operating conditions of the site based on the proximity of a location-aware mobile device to the site. EX1014 at 7:66-8:4; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

X. Invalidity of the Challenged Claims of the '890 Patent in Light of the Prior Art

A. Count 1A: Claims 1-8 are rendered obvious by Leen, Trundle, and Ehlers

i. Motivation to combine Leen, Trundle, and Ehlers

82. Leen discloses a standard thermostat. Specifically, Leen discloses “simplified interfaces for controllers having programming capabilities,” such as an HVAC controller that allows a user to create and edit a cooling and heating schedule. EX1008 at [0010], [0024], [0171]; *see generally id.* at Figs. 18-26.

83. Leen discloses a schedule that allows a user to set a temperature “when the user is away from the house.” EX1008 at [0092] – [0093]. Moreover, Leen discloses that “HVAC controller 20 may instead include or be in communication with one or more sensors that register whether someone is in the house, and thus may operate in accordance with an unoccupied setting when the house is sensed to be empty.” EX1008 at [0171].

84. Trundle represents an advancement brought about by “smart” devices and “smart” phones, such as the iPhone and other mobile devices with touch screens, GPS capabilities, and the like. Specifically, Trundle is a smart system that

enables a thermostat to be controlled by a mobile device. Trundle discloses an application for “controlling wake-up and turn-down schemes” such as “chang[ing] a thermostat setting to a day setting.” EX1009 at [0072], [0116].

85. In addition to scheduling, Trundle discloses techniques for remotely monitoring and controlling devices, such as thermostats, to increase convenience to the user and to improve energy efficiency. EX1009 at [0036]. Specifically, Trundle discloses the use of a mobile device application to track a device’s physical location, and the use of the “location tracking to automatically set thermostat, lights, and appliances accordingly.” *Id.* at [0037]. Indeed, Trundle discloses reliance on a specific geo-location for the automatic control of a thermostat. *See, e.g., id.* at [0131].

86. It would have been obvious to a POSITA to combine Leen with Trundle for several reasons.

87. First, Leen teaches that there is a need for HVAC controllers that are more intuitive and user friendly to program and operate. EX1008 at [0003]-[0004]. A POSITA would have recognized that the complexity of programming thermostats and other programmable devices, such as thermostats and VCRs, prevented many users from obtaining the benefits of their programmable functionalities, such as automated schedules, set to the user’s preferences.

88. A POSITA would have further understood that most end users, especially novice and/or non-technical users, would have found programming and/or operating modern HVAC controllers to be “difficult and/or confusing.” *Id.* at [0003]. In fact, Leen even suggests a solution that envisions the ability to upload or download information such as previously-created thermostat configurations and values of operating parameters to the HVAC controller, “thereby hastening the programming process” and avoiding the complexities of programming the thermostat. EX1008 at [0028].

89. In addition to identifying a need to make programming and scheduling more user friendly, Leen also recognizes a need to automate control of a thermostat so as to save energy. Specifically, Leen suggests that there is a need in the art to control HVAC systems in an energy-efficient manner. *See id.* at [0170].

90. Leen suggests that one way to operate in a more efficient manner is to rely on sensors to determine whether a property or space is occupied. *See id.* at [0171]. Even though Leen suggests sensors as a mechanism to automate HVAC control, a POSITA would have understood that sensors were expensive and difficult to install and maintain, and required regular replacement of the batteries on which they ran.

91. Other than suggesting the ability to upload schedules and the use of automated occupancy detection for energy efficiency, Leen does not provide any

additional implementation details for occupancy detection. A POSITA would have identified those details in other related literature given the ubiquitous nature of location aware mobile devices at the time and the increased desire to optimize energy consumption across the United States. *See, e.g.*, EX1013 at [0318], FIGs. 71A-D; EX1017 at 1 (“We propose a system for augmenting these thermostats using just-in-time heating and cooling based on travel-to-home distance obtained from location-aware mobile phones.”); EX1018 at 2 (proposing energy management system in which “[u]sers may interact with the system anytime via PC, or mobile phone in order to see their energy consumption in real-time and seek advice from system on efficient use of energy”); EX1019 at 8 (explaining that features of an energy audit could “be enhanced by the location-aware capabilities of the smartphone including GPS mapping”).

92. A POSITA would have been motivated to implement the mobile device-based occupancy detection of Trundle to improve both user-friendliness and energy efficiency of modern programmable thermostats, such as the one disclosed in Leen. Specifically, a POSITA would have been motivated to combine the teachings of Leen with those of Trundle because Trundle teaches techniques that “provid[e] an enhanced level of convenience to users” that would reduce or eliminate the well-known difficulties with respect to schedules. EX1009 at [0036].

93. Trundle provides the ability to rely on occupancy detection and its associated benefits by relying on a phone or other proxy device and, thus, eliminating the need for complicated schedules and/or expensive sensors. *See, e.g.*, EX1009 at [0037]. By eliminating the need for schedules and by instead relying on location as a proxy for occupancy, the resultant system becomes significantly more energy efficient. That is, the resulting system only heats/cools when a user is occupying the property or within a predefined distance of the property and, importantly, at least reduces (or even turns off) heating/cooling when the user is not occupying the property or within a predefined distance of the property.

94. Second, a POSITA would have been further motivated to combine Trundle with Leen because Trundle further enhances convenience and energy efficiency by preparing a property for a user's arrival based on a precise geo-location. EX1009 at [0133]-[0136], [0144].

95. A POSITA would have understood that the automatic adjustment of heating or cooling while a user is away from the controlled building conserves energy when the energy conservation would not compromise the comfort of the occupant. *See, e.g.*, EX1009 at [0101]-[0103]. That is, by using the location of the user and a desired setpoint as a mechanism to determine when to start

heating/cooling, a user can enhance efficiency while still enjoying continued comfort.

96. As a result, a POSITA would have been motivated to rely on automated systems, such as those taught by Trundle, to determine arrival times and occupancy without user interaction. *See* EX1009 at [0101], [0131]. In this way, Trundle relies on precise geolocation to not only allow for efficiency gains but to also ensure that a home will be sufficiently heated / cooled to a desired comfort level prior to a user's arrival.

97. Third, in addition to location-based services and occupancy, a POSITA would have understood the benefit of remotely controlling a thermostat generally. A POSITA would have understood the benefits of leveraging user interfaces and displays on existing "smart" devices, such as mobile devices, for the remote control of thermostats. The use of existing displays and interfaces, such as those on a mobile device, prevents the need for a complex user interface on every controlled device.

98. A POSITA would have understood that a further benefit of remotely controlling a thermostat is the ease and convenience of altering a temperature setpoint from a remote location. A POSITA thus would have been motivated to rely on wireless networks configured to facilitate communications between a monitoring system control unit and one or more mobile devices, as taught by

Trundle, to further provide enhanced convenience to users in the form of remote device control, energy monitoring, and/or automated control based on the wireless device's location. EX1009 at [0036], [0043]. Indeed, Trundle specifically discloses user interfaces, such as interfaces for controlling a thermostat from a remote location. EX1009 at [0114]. Such interfaces provide enhanced convenience and ease of use for users.

99. The POSITA would have had a reasonable expectation of success in the combination of Leen and Trundle given that both references rely on occupancy-dependent protocols to control heating and cooling devices.

100. For similar reasons, a POSITA would have been motivated to combine the teachings of Leen and Trundle with those of Ehlers. Trundle teaches the importance of automated temperature control systems, and the enhanced convenience of having a property ready for the user at a time when the user arrives home. EX1009 at [0144]. However, Trundle does not provide specific implementation details regarding how its system would calculate the time needed for a property to be pre-heated or cooled for arriving users.

101. In a similar field, Ehlers teaches an environmental control system that “controls internal environmental conditions to optimize comfort and minimize energy consumption and/or energy cost” through features such as ramping, preheating, and precooling. EX1010 at 1:11-14, 12:55-56. Specifically, Ehlers

teaches gradual ramping up or down of temperature over a period of time in order to “reduce[] energy usage.” *Id.* at 19:27-34, 19:40-43, 29:1-2. Ramping rates may be set based on one degree of change in a 30 or 60 minute interval, or based on learning modes that measure, for example, the natural thermal rate of change for the premise by measuring the time it takes for a one-degree change in temperature. *Id.* at 29:2-10.

102. Separately, Ehlers teaches pre-heating (or pre-cooling) a premise by a number of degrees selected by a user prior to an energy rate increase. *Id.* at 29:25-36.

103. A POSITA would have been further motivated to combine the teachings of Trundle with those of Ehlers, because Ehlers teaches specific implementation details regarding automatic environmental condition control based on sensed external environmental conditions. EX1010 at 2:14-18, 2:35-39. While Leen and Trundle disclose the monitoring of external environmental conditions, Ehlers discloses that outside weather conditions can be tracked along with setpoint changes by a user to “develop a correlation to these factors” and “achieve a balance of comfort and energy consumption efficiency.” *Id.* at 22:23-46.

104. A POSITA would have further been motivated to rely on the use of historical data to automatically determine the optimum settings for the thermostat

system based on an analysis of consumption data based on several factors, as taught by Ehlers. *See id.* at 17:56-64.

105. Additionally, while Leen discloses a thermostat, Leen does not specifically disclose what a POSITA would have readily understood to be well known and necessary elements of a thermostat, such as relays (or contacts). Indeed, relays were the standard and well known to a POSITA and were necessary for powering the thermostat and controlling the HVAC. A POSITA would have been motivated to turn to an analogous reference for further implementation details. Ehlers provides such details.

106. Indeed, Ehlers describes controlling an HVAC in the same way as Leen and Trundle and explicitly discloses the use of electrical contacts to control the HVAC system. *See EX1010* at 30:37-44. The POSITA would have had a reasonable expectation of success in the combination given that each of the references disclose thermostats to control heating and cooling devices.

107. Accordingly, it is my opinion that a POSITA would have combined the teachings of Leen, Trundle, and Ehlers as described herein. Indeed, combining their teachings would have been routine to a POSITA due to this overlap and the simple software and system modifications to adjust Leen so it includes the teachings of Trundle and Ehlers.

ii. Claim [1Pre]: A thermostat system comprising:

108. If limiting, the preamble is disclosed by Leen. Leen discloses an HVAC controller 10 (*thermostat system*), such as a thermostat, that includes a processor or controller and a user interface. EX1008 at [0025]; *see also* Fig. 1. Leen further discloses that an algorithm operating on the thermostat may control “one or more components of an HVAC system.” *Id.*

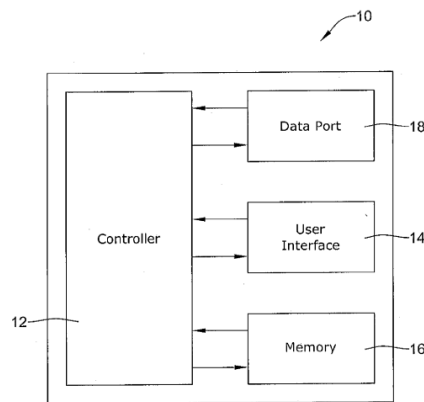


Figure 1

EX1008, Fig. 1.

iii. Claim 1[A]: a housing

109. Leen discloses an HVAC controller that “includes a display 22 that is disposed within a housing 24.” EX1008 at [0030]. “[H]ousing 24” (*housing*) is illustrated in Leen’s Figure 2, reproduced below:

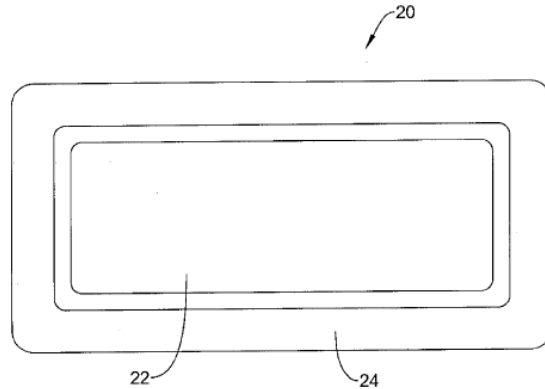


Figure 2

EX1008, Fig. 2.

- iv. Claim [1B]: electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building's HVAC system to the contacts;*

110. The '890 Patent itself discloses that contacts connect a relay to the wires that are connected to the HVAC system. Specifically, the '890 Patent describes:

Thermostat 108 includes temperature sensing means 252, which may be a thermistor, thermal diode or other means commonly used in the design of electronic thermostats. It includes a microprocessor 254, memory 256, a display 258, a power source 260, a relay 262, which turns the HVAC system on and off in response to a signal from the microprocessor, and contacts by which the relay is connected to the wires that lead to the HVAC system.

EX1001 at 8:52-61.

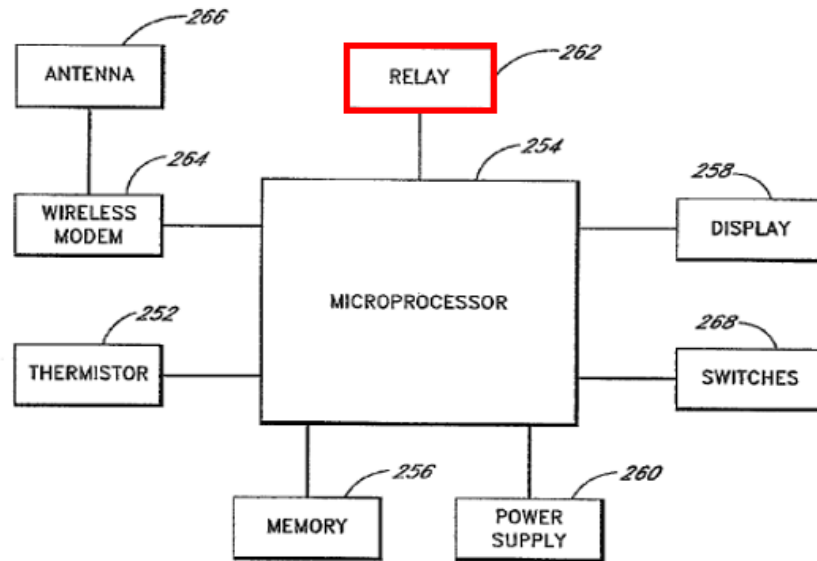


FIG. 4

EX1001, Fig. 4.

111. A thermostat system regulates temperature by turning heating and cooling subsystems on and off so that temperature is maintained near a desired setpoint. In many residential and commercial buildings, the thermostat system(s) are wall-mounted and are in a physical location separate from a heating, ventilation and cooling (HVAC) unit. For these systems in which the thermostat and HVAC system are detached, a POSITA would have known that a simple and obvious way to provide control signals to the cooling and heating subsystems is to use a wired communication link between the HVAC and thermostat. The electrical contacts of the thermostat act as an electrical switch to the heating and cooling subsystems that the thermostat controls. A POSITA would have known that this simple solution of a wired communications link would work on a broad range of heating and cooling

subsystems, and is in fact what thermostat manufactures have been doing for many decades.

112. A person of ordinary skill would understand that Leen inherently discloses the claimed electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building's HVAC system to the contacts. In particular, Leen discloses that the HVAC controller operates the HVAC equipment. EX1008 at [0057] ("First region 36 may include one or more selection buttons that can be pressed to instruct HVAC controller 20 how to operate the HVAC equipment."). A POSITA would have understood that electrical contacts are the standard and necessary mechanism for connecting an HVAC controller such as a thermostat to the HVAC equipment. Thus, Leen inherently discloses this element.

113. Regardless, Ehlers explicitly discloses "electrical contacts." Ehlers discloses an environmental condition control system "contained within a thermostat-like unit." EX1010 at 30:44-46. These contact closures (electrical contacts), "similar to standard thermostats, may be used to control the heating or cooling of the premise." *Id.* at 14:12-13. This system may contain "contact closures for controlling the HVAC unit in a home." *Id.* at 30:37-44. Thus, Ehlers also discloses electrical contacts configured to connect the thermostat with wires that

allow for at least two electrical connections from a building's HVAC system to the contacts.

114. As depicted below in Figure 2 (annotated), “[d]ry contact closures 51 will be used to provide control to devices outside the system from functions 41, 42, 44 and 45. These contacts will be rated for controlling relays and low voltage circuits. The contacts may, for example, control the external load devices for energy consumption management and environmental condition control” (*electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building's HVAC system to the contacts*). *Id.* at 14:42-47.

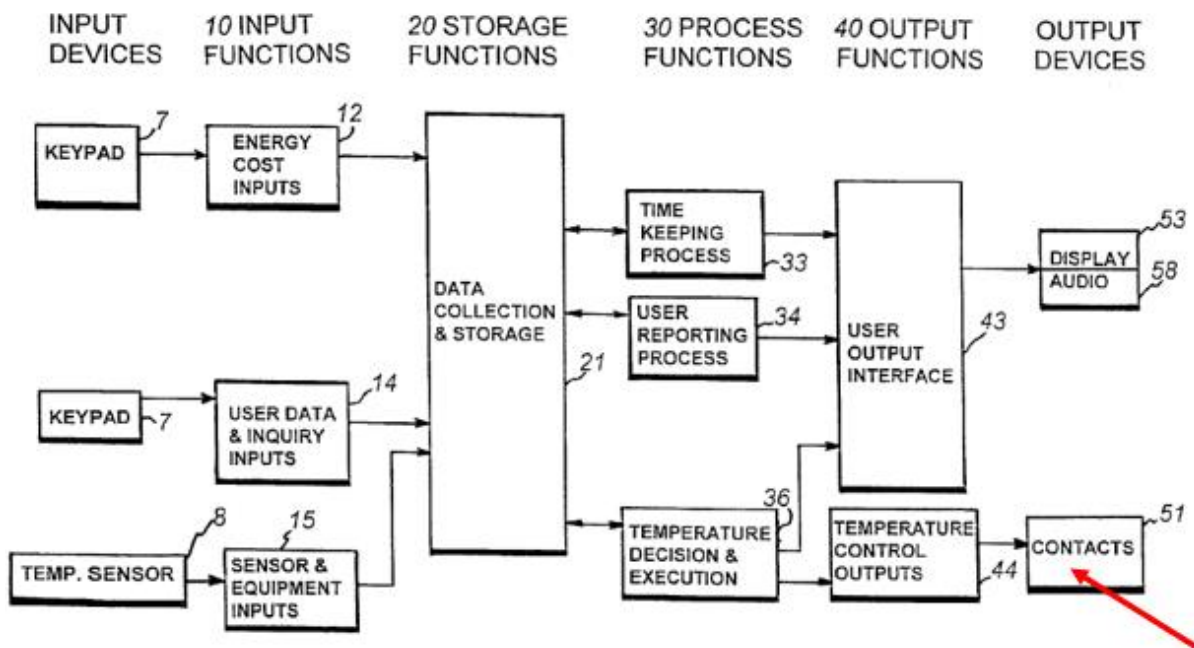


Fig. 2

EX1010, Fig. 2 (annotated).

115. The POSITA would have been motivated to combine Ehlers with Leen for at least the reasons disclosed in Section X.A.i (Motivation to Combine Leen, Trundle, and Ehlers), *supra*.

v. *Claim [1C]: a display configured to present information to a user;*

116. Leen discloses a user interface that may be “any suitable interface that permits controller 12 to display and/or solicit information as well as permitting a user to enter data such as temperature set points” EX1008 at [0026]. Such interface may include “a display and a distinct keypad” (*display configured to present information to a user*). *Id.* For example, Leen discloses one such display in Figure 3:

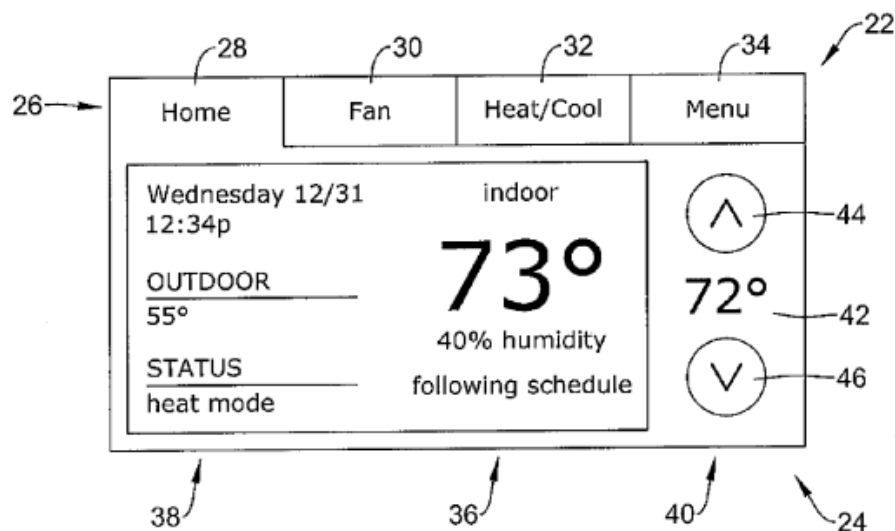


Figure 3

EX1008, Fig. 3.

- vi. ***Claim [1D]: a wireless radio compatible with a wireless radio frequency protocol and configured to communicate bi-directionally with a location-aware mobile device;***

117. Leen discloses a data port (which may be a wireless or wired port) configured to communicate with controller 12 to upload or download information such as previously-created thermostat configurations and values of operating parameters to the HVAC controller, “thereby hastening the programming process.” EX1008 at [0028]. Leen, however, does not explicitly disclose communication with “a location-aware mobile device.”

118. I understand that in a parallel district court proceeding, Patent Owner asserted that this limitation may be met by a location-aware mobile device that communicates indirectly through a network to include one or more servers. EX1012 at 25-33. I rely on Patent Owner’s interpretation only for the purposes of this IPR.

119. According to the Patent Owner’s interpretation of this limitation, it is not necessary for the mobile device to communicate directly with the thermostat system using the wireless radio frequency protocol. Thus, according to Patent Owner’s interpretation, either a mobile device communicating ***directly*** via wireless radio frequency protocol with the thermostat, or ***indirectly*** through a network satisfies the limitations of this claim.

120. Regardless, Trundle discloses that its mobile devices can communicate directly with one or more components. EX1009 at [0059]. Trundle discloses a monitor control unit that is in communication with a thermostat and one or more mobile devices. The network 205 disclosed in Trundle may “facilitate[] communications between the monitoring system control unit 210, ***the one or more mobile devices 240, 250*** . . . and the monitoring application server 260,” and may include one or more of a “Local Area Network[]” (LAN); “wireless telephone networks;” “radio;” and “any other delivery or tunneling mechanism for carrying data.” *Id.* at [0043], [0051]. The network “may be configured to enable exchange of electronic communications between the monitoring system control unit 210, [and] the one or more mobile devices 240, 250, the one or more client devices 270, 280, and the monitoring application server 260.” *Id.* at [0044].

121. The mobile devices 240, 250 (*a location-aware mobile device*) disclosed in Trundle may be cellular phones such as a smart phone, a personal digital assistant, a “Blackberry-type device[],” or an “iPhone-type device[].” *Id.* at [0054]. A POSITA would have understood that such cellular phones are location-aware mobile devices. Specifically, in some embodiments, “the system leverages GPS information from the one or more mobile devices 240, 250.” *Id.* at [0061]. “The one or more mobile devices 240, 250 receive data directly from the modules

220, 222, and 230 and sends data directly to the modules 220, 222, and 230.” *Id.* at [0060].

122. As shown in the annotated figure below, module 230 refers to a thermostat. Trundle discloses that “the one or more mobile devices 240, 250 may communicate directly with the sensors and other devices controlled by the monitoring system control unit 210.” *Id.* at [0056]. A POSITA would have understood that one such device controlled by the monitoring system control unit 210 is the thermostat 230.

123. As Trundle further explains, “[t]he one or more mobile devices 240, 250 communicate with and receive monitoring system data from the monitoring system control unit 210 using the communication link 238” (*communicate bi-directionally*). *Id.* at [0055]. The communication between the monitoring system control unit 210 and the mobile devices may be carried out “using various local wireless protocols such as wifi, Bluetooth, zwave, zigbee . . . to connect the one or more mobile devices 240, 250 to local security and automation equipment” (*a wireless radio compatible with a wireless radio frequency protocol*). *Id.*

124. Thus, Trundle discloses a wireless radio compatible with a wireless radio frequency protocol and configured to communicate bi-directionally with a location-aware mobile device.

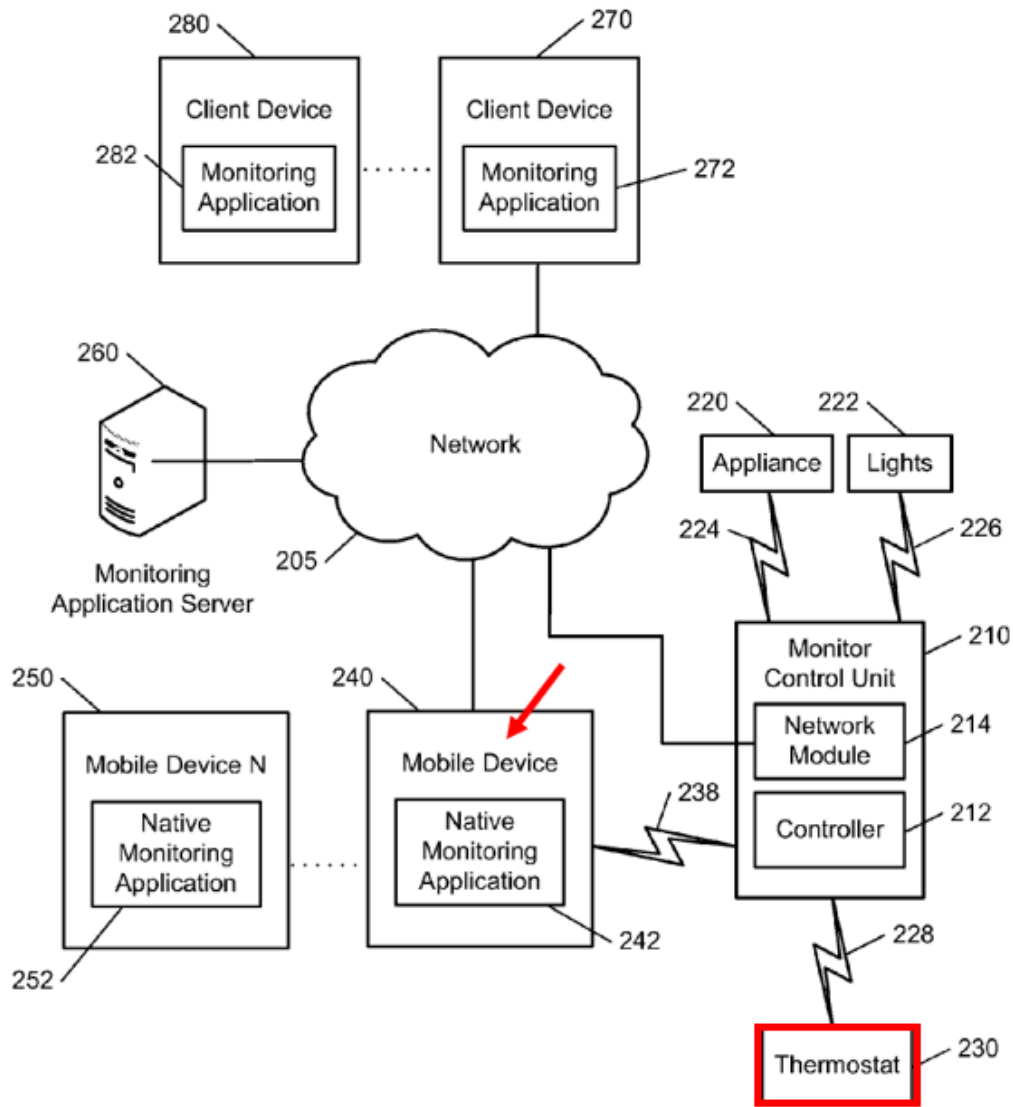


FIG. 2

EX1009, Fig. 2 (annotated).

125. The POSITA would have been motivated to combine the wireless radio with the Leen thermostat for at least the reasons described in Section X.A.i.

vii. Claim [1E]: a temperature sensor;

126. Leen discloses an HVAC controller that may be “configured to either sense ambient temperature at HVAC controller 20 using an internal thermal sensor [a temperature sensor] and/or to use a temperature reading from a thermal sensor that may be present within the remote control.” EX1008 at [0041]; *see also id.* at [0042] (“internal thermal sensor”).

viii. Claim [1F]: one or more processors configured with electronic circuitry to;

127. Leen discloses an HVAC controller 10 which includes “a processor or controller 12,” as illustrated in Figure 1 (annotated) (*one or more processors configured with electronic circuitry*). EX1008 at [0025].

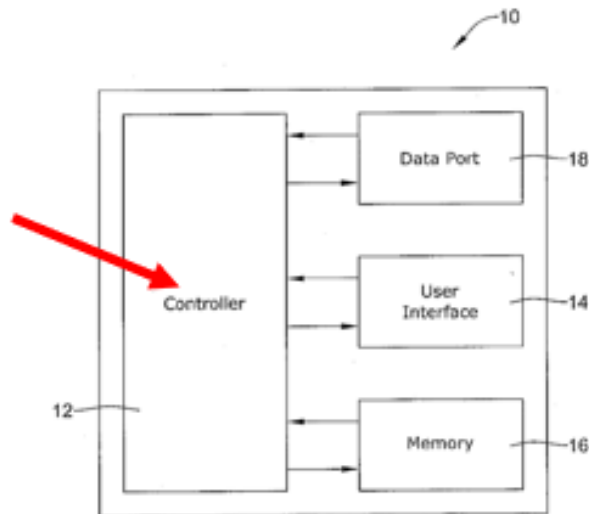


Figure 1

EX1008, Fig. 1 (annotated).

128. Similarly, Trundle discloses “one or more processors included in one or more electronic devices.” EX1009 at [0078]. As is further disclosed below, the POSITA would understand that the processor of Leen in combination with at least Trundle, teach or suggest the recites this limitation.

ix. Claim [1G]: receive HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building; and

129. Leen teaches an HVAC controller that includes “a processor or controller 12” that receives HVAC data parameters. EX1008 at [0025]. Said HVAC controller “may be configured to either sense ambient temperature at HVAC controller 20 using an internal thermal sensor [*HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building*] and/or to use a temperature reading from a thermal sensor that may be present within the remote control.” *Id.* at [0041]; *see id.* at [0042] (“An individual may instead wish to instruct HVAC controller to use the internal thermal sensor (or a remote sensor located near HVAC controller 20 and communicating wirelessly therewith).”). Leen illustrates the first data parameter at least in Figure 10:

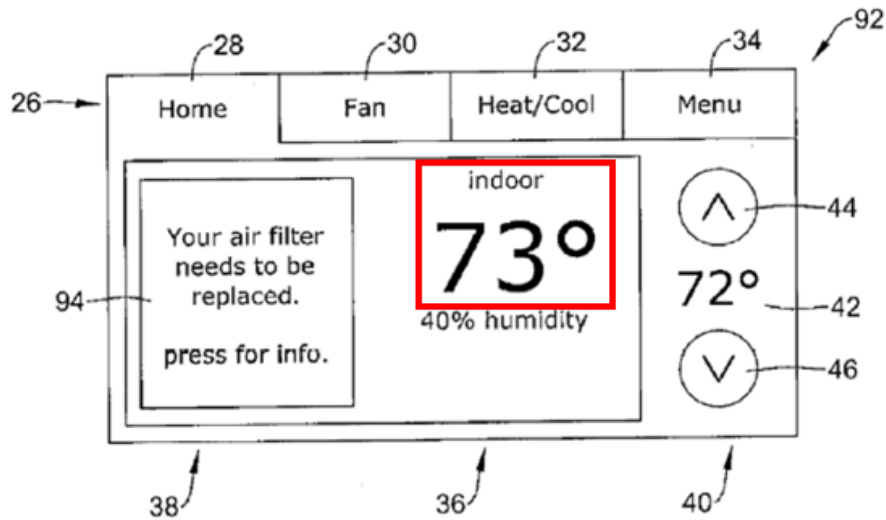


Figure 10

EX1008, Fig. 10 (annotated).

130. Thus, Leen discloses the receipt of HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building.

- x. ***Claim [1H]: a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building;***

131. As an initial matter, it would have been unclear to a POSITA how an “outside weather condition” could be collected from any source other than one “external to the building.” For example, outside weather conditions such as outdoor temperature, outdoor humidity, wind, etc. can only be measured or sourced by an apparatus that is necessarily located outside the building. A POSITA would have understood that outdoor weather conditions that require sensors outside of the

monitored property for detection are necessarily collected from a source external to the building. Additionally, it was well known to receive weather data via network connections such as phone lines, and a POSITA would have appreciated receiving weather data from a network because it saves the cost and time associated with installing outdoor temperature sensors at the monitored property, which is sometimes difficult or impossible to do. A POSITA also would have understood that temperature sensors installed at the monitored property, directly outside the building, may be faulty or unreliable depending on their placement (e.g., temperatures measured by a sensor at the property may be affected by the amount of sunlight or shade provided by nearby buildings or trees). And a POSITA would have recognized that by the time of the '890 Patent's earliest potential filing date, it was common for weather service providers to provide outside temperature data over a network connection. *See, e.g.*, EX1010 at 9:50-58. For example, Ehlers discloses an “[i]nput function 13 [that] provides weather information,” which can be provided by “decoding DTMF from a phone input or through a communications link.” EX1010 at 9:50-58. “The data can come from either an energy provider or a weather service provider.” *Id.*; *see also infra* at ¶ 268.

132. Leen teaches that “[w]ireless devices” such as “exterior temperature sensors, exterior humidity sensors, [and] exterior wind sensors” may communicate with an HVAC controller and provide outside weather conditions (*a second data*

parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building). EX1008 at [0173]. Such exterior measurements would have been collected from an internal network and from a network source external to the building. Leen also specifies that information received by the data port 18 of its HVAC controller 10 could be received from a Bluetooth network connection, or in the alternative a wired network connection. EX1008 at [0029]. Specifically, Leen states that “[d]ata port 18 may be a wireless port such as a Bluetooth™ port or any other wireless protocol. In some cases, data port 18 may be a wired port.” *Id.* Leen explains that “[i]f wireless communication between HVAC controller 20 and the remote device was successfully established,” the HVAC controller may display a screen with text informing the user that the remote device was successfully added. *Id.* at [0176]. A POSITA would have understood that the wireless communication between HVAC controller 20 and the remote device to rely on a network connected to the thermostat.

133. To the extent it is argued that Leen does not disclose this limitation, Trundle also is configured to receive weather information from a remote source, such as a broadcast system or the Internet. The POSITA would have understood that a broadcast system and the Internet are examples of networks.

134. Specifically, Trundle discloses a system that “receives current weather data from a weather feed provided by a weather broadcasting system” (*a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building*). EX1009 at [0119]; *see also id.* at [0090] (“The weather data used to evaluate conditions set in the weather column 405 may be received from a weather feed and may include any number of relevant weather parameters.”).

135. Thus, Leen, Ehlers, and/or Trundle disclose a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building.

xi. Claim [11]: determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value;

136. I understand that Patent Owner has asserted that this limitation may be met by setpoint schedules. *See* EX1012 at 46-50. Leen teaches allowing a user to set “time and/or temperature set point information” in a schedule. EX1008 at [0062]. For example, Leen allows a user to determine “heating and cooling temperature set points for the Wake period, the Leave period, the Return period

and the sleep period for weekdays Monday through Friday.” *Id.* An example schedule is illustrated in Figure 19 (annotated):

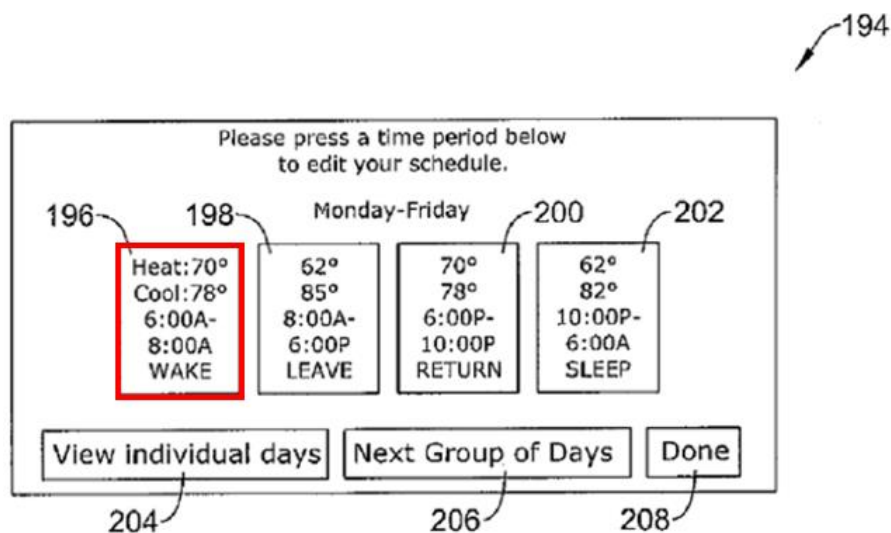


Figure 19

EX1008, Fig. 19 (annotated).

137. As is shown in Figure 19, Leen discloses a first heat setpoint of 70 degrees and a cool setpoint of 78 degrees at 6:00A (determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value). To the extent that Patent Owner argues that this limitation requires the thermostat to determine a first temperature setpoint data parameter without user involvement, Leen discloses that setpoints may be changed based on a sensor-based determination of occupancy. EX. 1008, [0171]. Further, Trundle discloses different setpoints for different schedules set by the user, *see, e.g., id.* at [0116], FIGs. 6, 16B, 17, and determining

setpoints without user involvement, *see, e.g., id.* at [0152] (“[T]he system 200 may automatically, without user intervention, control the one or more energy consuming devices based on the determined user identity for the one or more users.”). In particular, Trundle describes a learning thermostat that manages energy consumption based on an energy management profile. *See, e.g., id.* at [0206] (“[T]he system 200 may dynamically and without user driven inputs, run tests (usually with no occupants) to maximize its understanding of the property.”), [0168] (“Based on the derived relative presence pattern and the detection of all people leaving the office property 1610, the monitoring system 1650 determines to . . . control devices at the office property 1610 to conserve energy overnight.”), [0169]-[0170], [0171]-[0176] (“The system 200 analyzes the monitored energy usage, sensor data, and device status with respect to the energy management profile (1750) and performs operations related to managing energy consumption based on the analysis (1760).”). Thus, the system disclosed in Leen is able to determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value.

- xii. Claim [1J]: determine a second temperature setpoint data parameter for the building, wherein the second setpoint data parameter includes a second temperature value and a second time value;***

138. For the same reasons as described above for element [1I], Leen and Trundle disclose multiple scheduled setpoints, and Trundle contemplates an ongoing analysis of energy consumption and changing setpoints. See, e.g., EX. 1009, [0116], [0152], [0206], [0168]-[0170], [0171]-[0176].

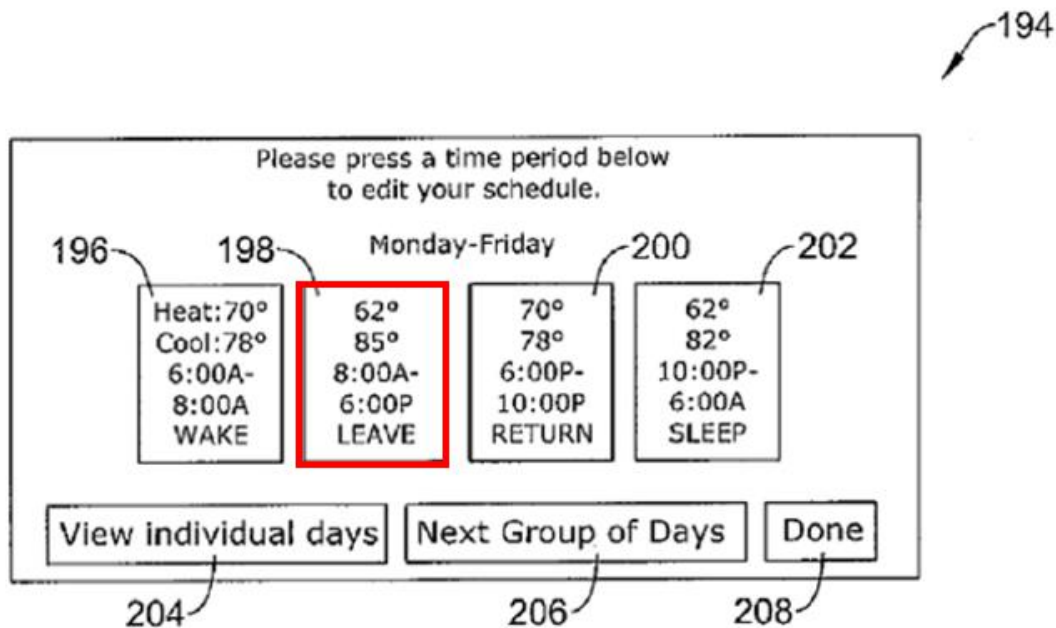


Figure 19

EX1008, Fig. 19 (annotated).

139. For example, as is shown in Figure 19 (annotated), Leen discloses a second heat setpoint of 62 degrees and a cool setpoint of 85 degrees at 8:00A (determine a second temperature setpoint data parameter for the building, wherein

the second setpoint data parameter includes a second temperature value and a second time value).

xiii. Claim [1K]: receive radio frequency signals from the location-aware mobile device;

140. While Leen discloses several important features of a programmable thermostat system, including a data port (which may be a wireless or wired port) configured to communicate with controller 12, Leen does not, however, explicitly disclose “receiv[ing] radio frequency signals from the location-aware mobile device.” EX1008 at [0028]. As described herein with respect to the motivation to combine section, the POSITA would have been motivated to combine Trundle with the teachings of Leen.

141. Trundle discloses an HVAC controller that communicates with location-aware mobile devices. Trundle discloses that “the system leverages GPS information from the one or more mobile devices 240, 250 to determine whether the one or more mobile devices 240, 250 are close enough to the modules 220, 222, and 230 to use the direct local pathway or whether the one or more mobile devices 240, 250 are far enough from the modules 220, 222, and 230 that the pathway over network 205 is required” (*location-aware mobile device*). EX1009 at [0061].

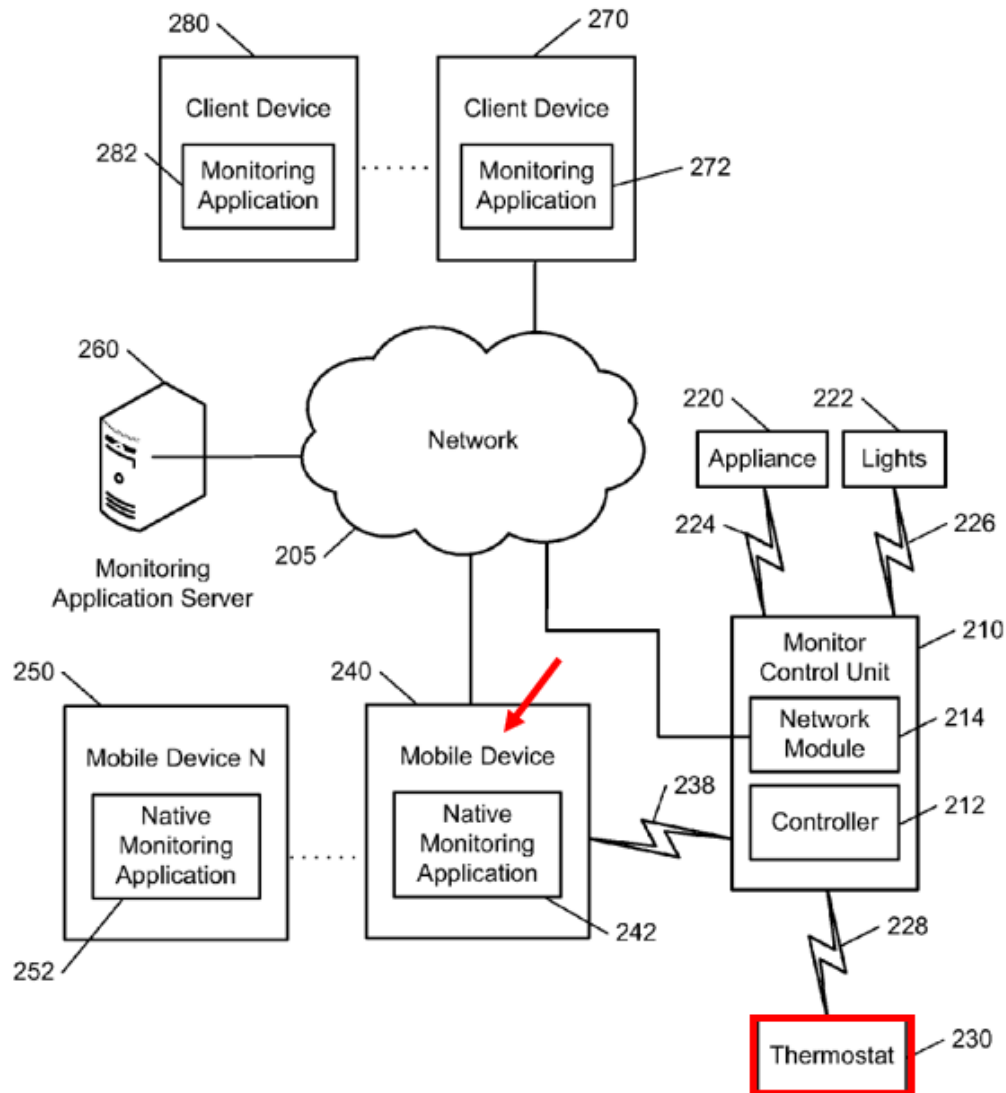


FIG. 2

EX1009, Fig. 2 (annotated).

142. As Trundle describes and as shown above in Figure 2 (annotated), the location-aware mobile devices “may connect locally to the monitoring system and its sensors and other devices.” *Id.* at [0055]. And while “the one or more mobile devices 240, 250 are shown as communicating with the monitoring system control unit 210, the one or more mobile devices 240, 250 may communicate directly with

the sensors and other devices controlled by the monitoring system control unit 210.” *Id.* at [0056]. A POSITA would have understood that one such device controlled by the monitoring system control unit 210 is a thermostat 230.

143. As Trundle further explains, “[t]he one or more mobile devices 240, 250 communicate with and receive monitoring system data from the monitoring system control unit 210 using the communication link 238.” *Id.* at [0055]. The communication between the monitoring system control unit 210 and the mobile devices may be carried out “using various local wireless protocols such as wifi, Bluetooth, zwave, zigbee . . . to connect the one or more mobile devices 240, 250 to local security and automation equipment” (*receive radio frequency signals*). *Id.*

xiv. Claim [1L]: receive geo-positioning data from the location-aware mobile device and automatically adjust a temperature value based on the geo-positioning data, including initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user;

144. As described with respect to Limitation [1K], the combination of Leen and Trundle disclose receiving radio frequency signals from the location-aware mobile device. Further, Trundle discloses the control of devices in a property based on geographic proximity of a user to the property. EX1009 at [0031].

145. For example, as illustrated in Figure 11 below, the control system may receive geographic location by “using any type of mechanism for determining a geographic location of a user” such as “GPS data” and “cell tower triangulation”

(receive geo-positioning data from the location-aware mobile device). *Id.* at [0131]. “The system 200 may determine and monitor a geographic location of one or more users relative to a geographic location of a monitored property (e.g., within a particular number of miles).” *Id.* Based on the received geographic location data, the system “infers future occupancy” of the user. *Id.* at [0133]. “The system 200 determines an operation related to controlling the one or more energy consuming devices based on the inferred future occupancy (1130)” and “may include automatically setting a thermostat to an energy conserve mode” (automatically adjust a temperature value based on the geo-positioning data) when the property will not be occupied for a relatively long period of time. *Id.* at [0136], [0138]. A POSITA would have understood that a building is unoccupied by the user of a location-aware mobile device when the user is not in the same geographic location as the monitored building (and the system would be required to “infer future occupancy”).

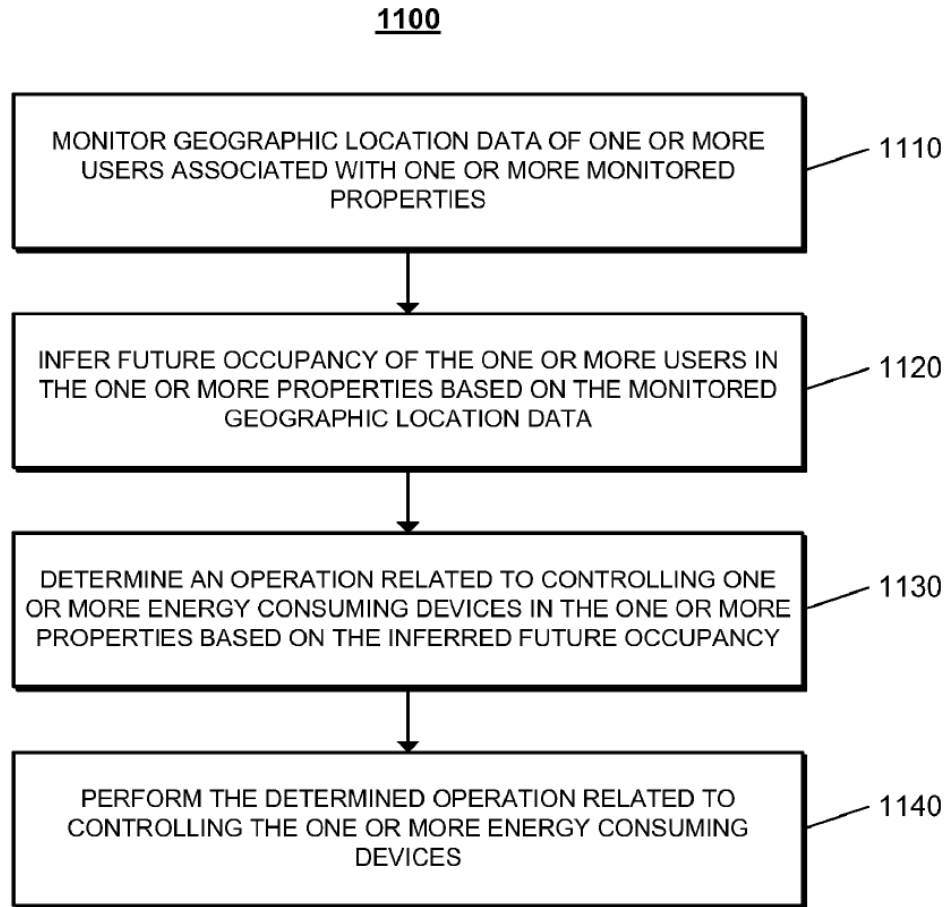


FIG. 11

EX1009, Fig. 11.

146. I understand that in the parallel district court case, Patent Owner interprets switching to Away temperature settings as satisfying “initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user.” EX1012 at 69. I am relying on Patent Owner’s interpretation only for the purposes of this IPR. As is disclosed by Trundle, the native monitoring application also may switch

between the modes (e.g., home or away) “based on factors, such as location of the mobile device and status of an alarm system at one or more locations” (*initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user*). EX1009 at [0073].

147. In addition, as illustrated in Figure 12 (annotated) below, the system disclosed in Trundle initiates at least one cooling or heating cycle for the HVAC system when it determines that the building is unoccupied by the user but that the user is approaching. When the monitoring system determines that the user has crossed a first distance threshold outside of the property but remains outside of a second distance threshold that is closer to the property than the first threshold, the monitoring system “turns the thermostat 1216 to an on state to begin controlling a heating and/or cooling system of the property 1210 to cool or heat the property 1210 to a suitable temperature for the user 1220.” *Id.* at [0141].

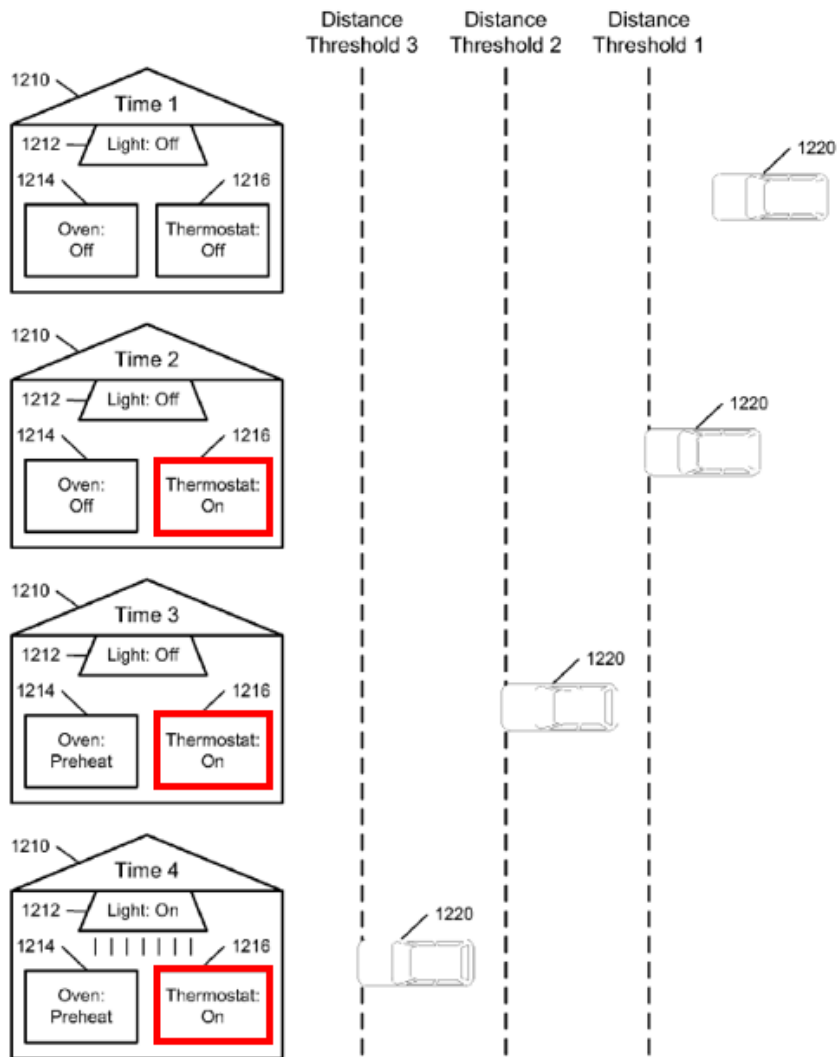


FIG. 12

EX1009, Fig. 12 (annotated).

xv. Claim [1M]: electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system;

148. As illustrated in Figure 4 (annotated) below, Leen discloses electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC

system.¹ Specifically, a third region of an HVAC controller may display a heating temperature set point and a cooling temperature set point that may be manipulated by one or more arrow buttons, such as is shown in Figure 4 (*electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system*). EX1008 at [0036].

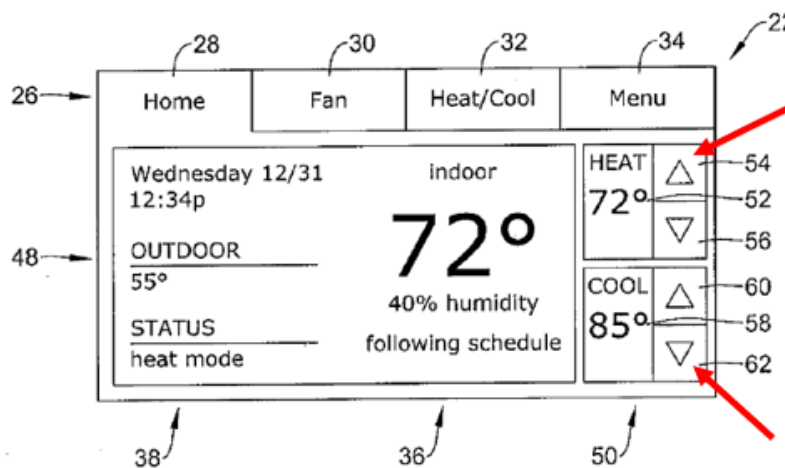


Figure 4

EX1008, Fig. 4 (annotated).

149. As Leen describes:

¹ The claims suggest that “electronic circuitry” in limitations [1M] – 1[O] is different circuitry than the processor. That said, Patent Owner appears to be relying on the processor as being the same as the claimed electronic circuitry in the contentions. EX1012 at 70-81. As such, and for the purposes of this IPR only, Petitioner has adopted this position.

Third region 50 may include a first parameter 52, a first up arrow 54 and a first down arrow 56. Third region 50 may include a second parameter 58, a second up arrow 60 and a second down arrow 62. First parameter 52 may be adjusted up or down using first up arrow 54 and/or first down arrow 56, as appropriate. Second parameter 58 may be adjusted up or down using second up arrow 60 and/or second down arrow 62, as desired.

EX1008 at [0036].

150. I understand that even though the claims at issue are directed to a thermostat, Patent Owner identifies a mobile application in some instances in its infringement contentions. I am relying on Patent Owner's interpretation only for the purposes of this IPR.

151. To the extent Patent Owner argues that the electronic circuitry is referring to a mobile device, Trundle teaches that a mobile device may be used to allow a user to adjust a desired temperature for the HVAC system. Specifically, Trundle describes a user "tak[ing] the user's mobile device on a business trip out of town," and "us[ing] native monitoring application 242, 252 to control the thermostat(s) in the user's home to turn the air conditioning system on or adjust a temperature of the home to a desired level." EX1009 at [0064]. The mobile device described in Trundle has electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system. The systems, methods, and techniques described in Trundle "may be implemented in digital electronic circuitry, computer hardware, firmware, software, or in combinations of these elements." *Id.* at [0200].

xvi. Claim [1N]: electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times; and

152. Claim limitation [1N] is directed to “a plurality of data parameters *specific to the user*, including at least one data parameter relating to usage of the HVAC system at various times.” EX1001 at cl. 1 (emphasis added). That is, the claim is limited to user level data parameters. In contrast, Claim 17 is directed to “at least one performance characteristic of the HVAC system.” However, I understand that in a parallel district court proceeding, Patent Owner appears to interpret “data parameters specific to the user” as encompassing data parameters specific to a *monitored property*. See EX1012 at 81-83 (showing home energy usage reports). I rely on Patent Owner’s broad interpretation for the purposes of this IPR.

153. In view of Patent Owner’s interpretation, Leen suggests monitoring various usage statistics for a user, such as run time of the furnace filter.² EX1008 at [0308].

² The claims suggest that “electronic circuitry” in limitations [1M] – 1[O] is different circuitry than the processor. That said, Patent Owner appears to be relying on the processor as being the same as the claimed electronic circuitry in the

154. In addition, Trundle discloses a system that “monitors energy usage” at a monitored property. EX1009 at [0173]. The system performs operations related to managing energy consumption based on an energy management profile, and “uses the one or more energy management goals or rules to define **a profile for the user**, which is used to control energy management at one or more properties associated with the user” (*electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times*). *Id.* at [0171]. The system “may measure energy consumed by a single device (e.g., a heating and cooling system controlled by a thermostat),” including by measuring energy consumption directly by “using output from an energy meter.” *Id.* at [0173].

155. Additionally, Trundle teaches data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times. For example, “[t]he system 200 determines a user-specific operation related to controlling the one or more energy consuming devices based on the detected event and the determined user identity for the one or more users (1330) and performs the user-specific operation related to controlling the one or more

contentions. EX1012 at 81-83. As such, and for the purposes of this IPR only, Petitioner has adopted this position.

energy consuming devices (1340).” *Id.* at [0152]. As a further example, Trundle also teaches that “when a first user is detected as being present in a property, a thermostat for the property may be set to a first temperature preferred by the first user.” *Id.* at [0153].

156. Trundle further describes that a user identity associated with an event can impact evaluation of a rule. “The user identity associated with an event may be determined using any type of mechanism (e.g., biometric recognition techniques, user specific alarm entry codes, etc.) and allows the rules to apply user-specific device control preferences of specific users.” *Id.* at [0091]. The systems, methods, and techniques described in Trundle “may be implemented in digital electronic circuitry, computer hardware, firmware, software, or in combinations of these elements.” *Id.* at [0200].

157. Additionally, Ehlers teaches that a storage function may collect and storage data types including “user preferences and limits,” and “consumption profiles.” EX1010 at 10:43-62. “Other optional data includes the HVAC consumption.” *Id.* at 28:24-29. For example, the system disclosed in Ehlers can “track patterns of set point change as they relate to times of day, days of the week and, at a minimum, track changes in these patterns for exceptions such as holidays,” which allows the system to track set point patterns or routines. *Id.* As another example, the system can analyze another parameter specific to the user,

including by “tracking [] set point changes by the occupant in relationship to the outside weather conditions” (*electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times*). *Id.* By tracking these patterns, the system can maintain the indoor air temperature to achieve the desired comfort conditions of the occupant. *Id.* at 22:39-46.

xvii. Claim [1O]: electronic circuitry configured to generate and communicate usage metrics pertaining to the HVAC system over time; and

158. The combination of Leen, Trundle, and Ehlers suggests generating and communicating usage metrics pertaining to the HVAC system over time.³ For example, Trundle discloses a system that generates and communicates usage metrics pertaining to the HVAC system over time. Specifically, Trundle teaches that “[t]he system 200 analyzes the monitored energy usage, sensor data, and device status with respect to the energy management profile (1750) and performs

³ The claims suggest that “electronic circuitry” in limitations [1M] – 1[O] is different circuitry than the processor. That said, Patent Owner appears to be relying on the processor as being the same as the claimed electronic circuitry in the contentions. EX1012 at 83-84. As such, and for the purposes of this IPR only, Petitioner has adopted this position.

operations related to managing energy consumption based on the analysis (1760).” EX1009 at [0176]. Trundle discloses at least one data parameter relating to usage of the HVAC system over time because it teaches that the “system 200 also may analyze ***patterns of the energy usage***, sensor data, and device status.” *Id.* at [0177]. Additionally, Trundle states that in addition to analyzing monitored energy usage, the system described “may send alerts or display suggested changes to a user based on the analysis of the monitored ***energy usage***, the monitored sensor data, and the monitored device status” (*electronic circuitry configured to generate and communicate usage metrics pertaining to the HVAC system over time*). *Id.* at [0178]. Further, Trundle discloses “providing energy usage suggestions based on determined energy usage profiles for efficient energy users.” EX1009, [0035]. As shown below in Figure 20, Trundle’s system may monitor energy consumption levels to determine a user’s energy profile, and suggests to inefficient users “the efficient energy usage profile determined for” a more efficient user. *Id.* at [0196]. “The monitoring system also aggregates in storage 2050 efficient profiles for display and analysis.” *Id.* at [0199]. Ehlers also discloses generating and communicating usage metrics pertaining to the HVAC system. EX. 1010, 10:43-62, 28:24-29. “With sufficient historical data collected, function 31 can provide historical consumption analysis by ***providing graphs and summary data*** of the average consumption of a premise as a function of time, temperature, or user set

point changes.” *Id.* at 36:17-22.

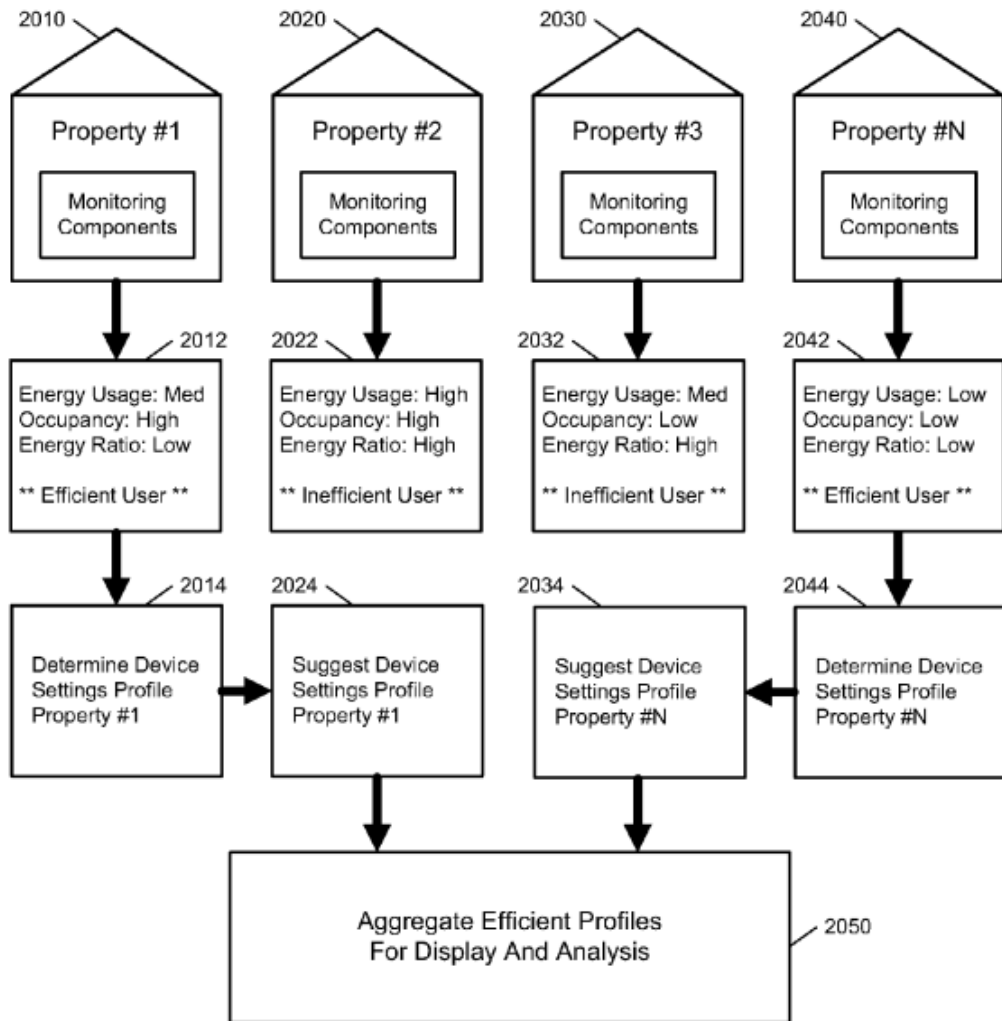


FIG. 20

EX1009, Fig. 20.

xviii. Claim [1P]: a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling.

159. Claim Limitation [1P] is directed to a particular compressor delay circuit, which suggests to a POSITA that the compressor delay circuit is a physical

circuit. I understand, however, that in a parallel district court proceeding, Patent Owner appears to interpret the compressor delay circuit as software capable of keeping the compressor off before restarting. See EX1012 at 85 (“[T]he Accused Products include Compressor Protection to prevent equipment damage.”). I will rely on Patent Owner’s interpretation for the purposes of this IPR.

160. It was well known to a POSITA that if a compressor is cycled on and off too quickly it can be damaged. Since fundamentally, a thermostat can turn compressors on and off, there should be means built into the thermostat to prevent rapid cycling from happening. A compressor delay circuit creates a limitation on how frequently a compressor can be cycled and is a means for limiting rapid cycling of the compressor.

161. Leen specifically discloses a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling. Leen teaches that a compressor may be programmed to remain off for a minimum time period, as illustrated below in Figure 161 (annotated). Specifically, Leen teaches that “[a] second setup parameter may be a compressor minimum off time” (*a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling*). EX1008 at [0317]. This minimum off time value “can be increased or decreased, as desired, using Up arrow 1250 and/or Down

arrow 1252.” *Id.* at [0316]. A POSITA would have understood that a minimum compressor off time would delay the start of a compressor to protect it from rapid cycling.

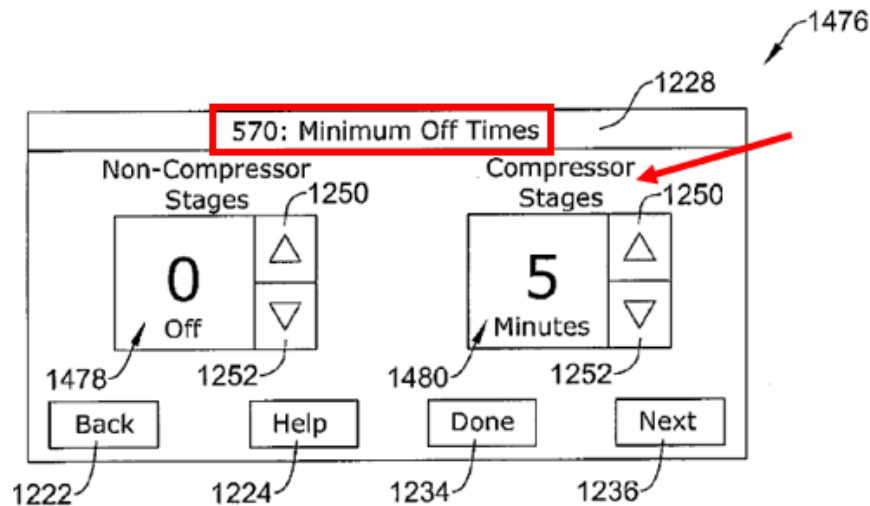


Figure 161

EX1008, Fig. 161 (annotated).

162. Further, Leen teaches a method of delaying the start or stop of a compressor for the HVAC system. Specifically, and as illustrated below in Figure 142 (annotated), the HVAC controller described in Leen permits a user to increase or decrease a “dead band value” representing the minimum difference between a heating temperature set point and a cooling temperature set point. EX1008 at [0270]. The HVAC controller may be programmed to automatically switch between heating and cooling. *Id.* at [0269]. A POSITA would have understood that the programming of a dead band value protects the compressor from rapid cycling.

Specifically, a POSITA would have understood that by programming a larger dead band value, a user can prevent the HVAC system from rapid cycling between a cooling mode and a heating mode.

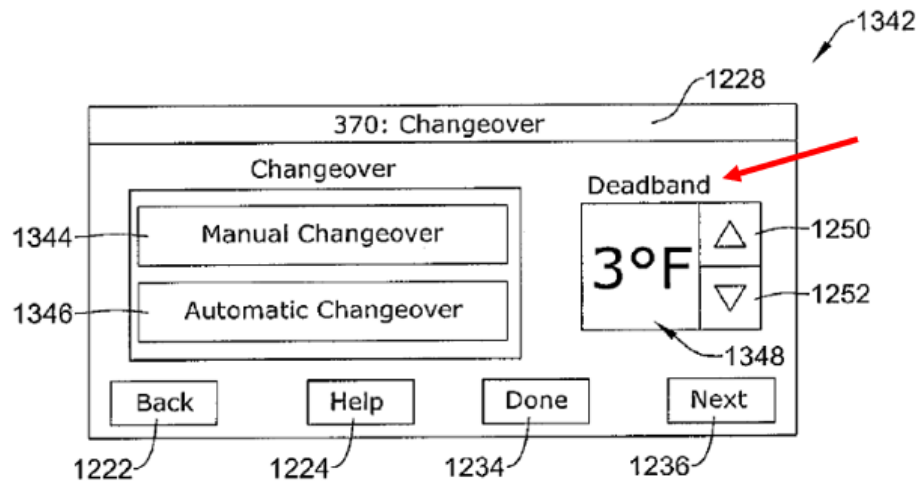


Figure 142

EX1008, Fig. 142 (annotated).

- xix. Claim 2: The thermostat system of claim 1, wherein the one or more processors is further configured to determine whether the building is occupied or unoccupied.***

163. Leen discloses an HVAC controller “configured to permit operation of the HVAC equipment in accordance with an unoccupied setting.” EX1008 at [0171]. The HVAC controller may be “instructed that the house will be temporarily vacant,” or it may “be in communication with one or more sensors that register whether someone is in the house, and thus may operate in accordance with an unoccupied setting when the house is sensed to be empty” (*wherein the one or*

more processors is further configured to determine whether the building is occupied or unoccupied). *Id.*

164. I understand that in a parallel district court proceeding, Patent Owner accused products that utilize geo-fence technology, or “location-based temperature control” that “use[s] your smartphone’s location” as meeting this claim limitation. EX1012 at 93. I will rely on Patent Owner’s interpretation for the purposes of this IPR. To the extent Claim 2 relates to determining whether the building is occupied or unoccupied based on the location of a mobile device, Trundle discloses geo-positioning data from the location-aware mobile device and automatically adjust a temperature value based on the geo-positioning data. *See* Section X.A.xiv (discussing limitation [1L]).

165. Moreover, Trundle teaches that the detection of the “presence (or lack thereof” of a user in a particular area within a property “impacts evaluation of a rule.” EX1009 at [0087]. “The presence within area number one may be detected by a motion sensor, a contact sensor, an image sensor or any other sensor that enables a system to determine whether area number one is occupied.” *Id.* As illustrated below in Figure 4 (annotated), the presence or lack thereof a user within an area affects the control of the building’s thermostat.

	401	402	403	404	405	406	407	408	409	410
	Presence Area #1	Presence Area #2	Window	Door	Weather	User	Temp	Energy Measure	Geographic Location	Action
411	No	No	Any	Any	Any	Any	Any	Any	Any	Turn off all lights; set all thermostats to conserve
412	No	Yes	Any	Any	Any	Any	Any	Any	Any	Turn off lights in Area #1; set thermostat for Area #1 to conserve
413	Yes	No	Any	Any	Any	Any	Any	Any	Any	Turn off lights in Area #2; set thermostat for Area #2 to conserve
414	Any	Any	Open	Any	Any	Any	Any	Any	Any	Send alert when thermostat is set to cooling or heating mode
415	Any	Any	Any	Open	Any	Any	Any	Any	Any	Stop thermostat from cooling or heating while door is open
416	Any	Any	Any	Any	Any	Any	> 85°	Any	Any	Control thermostat to cool mode
417	Any	Any	Any	Any	Any	Any	< 45°	Any	Any	Control thermostat to heat mode
418	No	No	Any	Any	Any	Any	Any	Any	< 1 Mile	Suggest light and appliance control
419	No	No	Any	Any	Any	Any	Any	Any	< 5 Miles	Control thermostat to scheduled heating or cooling mode
420	No	No	Any	Any	Any	Any	Any	Any	> 5 Miles	Control thermostat to conserve
421	Yes	No	Any	Any	Any	User1	Any	Any	Any	Set User1 control for Area #1
422	Yes	No	Any	Any	Any	User2	Any	Any	Any	Set User2 control for Area #1
423	Yes	Yes	Any	Any	50 to 80°	Any	Any	Low	Any	Control thermostat and lighting to scheduled mode
424	Yes	Yes	Any	Any	50 to 80°	Any	Any	High	Any	Control thermostat and lighting to conserve
425	Any	Any	Open	Open	Rain	Any	Any	Any	Any	Send alert to close window/door due to anticipated weather
426	Yes	Yes	Closed	Closed	> 90°	Pet	Off	High	> 20 Miles	Send alert to set thermostat to cool mode for pet

FIG. 4

EX1009, Fig. 4 (annotated).

166. For example, when a user is not present in area number one and not present in area number two, and that user is less than five miles away from the monitored property, the HVAC controller is directed to “[c]ontrol thermostat to scheduled heating or cooling mode.” *Id.* at Fig. 4; *see also id.* at [0101]. When a user is not present in area number one and not present in area number two, and that user is greater than five miles away from the monitored property, the HVAC controller is directed to “[c]ontrol thermostat to conserve.” *Id.* at Fig. 4; *see also id.*

at [0103]. Thus, Trundle discloses one or more processors further configured to determine whether the building is occupied or unoccupied.

xx. Claim 3: The thermostat system of claim 2, further comprising an interface configured to allow the user to input that the building is currently unoccupied.

167. As described with respect to Claim 1, both Leen and Trundle disclose determining occupancy and also disclose a user interface.

168. It would have been well known to a POSITA that users typically have the ability to enter schedules of setpoint temperatures through some user interface on the thermostat. The purpose of schedules is to modify the setpoint of the thermostat based on date and time so as to save energy and/or make it more comfortable for the user. An obvious example of the use of the schedule is to change the setpoint based upon time of day corresponding with work schedules when the user may not be home. A POSITA would have understood that it is a waste of energy to heat or cool the house if no one is present. Furthermore, a POSITA would have understood that thermostats were well-known to have interfaces configured to allow a user to input so called “vacation” or “away” time slots into said schedules, thus it was well known that users typically have the ability to input when the building is currently unoccupied during those time slots. Indeed, the '890 Patent teaches that users are allowed to establish programming

schedules, including an away setting, to indicate that the building is currently unoccupied. EX1001 at 10:1-16. Specifically, it describes:

If the user has previously specified (at the time that the program was initially set up or subsequently modified) that the user prefers that the system automatically change settings under such circumstances, the application then proceeds to step 1358, in which it changes the programmed setpoint for the thermostat to the setting intended for the house when unoccupied. If the user has previously specified that the application should not make such changes without further user input, then in step 1354 the application transmits a command to the location specified by the user (generally mobile device 105) directing the device display a message informing the user that the current setting assumes an unoccupied house and asking the user to choose whether to either keep the current settings or revert to the pre-selected setting for an occupied home. If the user selects to retain the current setting, then in step 1318 the application will write to database 300 the fact that the user has so elected and terminate.

Id. at 11:3-21.

169. Regardless, Leen discloses an interface configured to allow the user to input that the building is currently unoccupied. Leen teaches that an HVAC controller may display a screen to allow the user to create, edit, and/or view a vacation schedule. EX1008 at [0105]. The user may enter the date and time that they will be leaving on vacation, and a date and time that they will be returning from vacation. *Id.* at [0105]-[0111]; *see also id.* at [0184]. A POSITA would have understood that by indicating the date and time at which a user will be leaving a vacation, such as illustrated in Figure 28 (annotated), that user is inputting that the building is unoccupied.

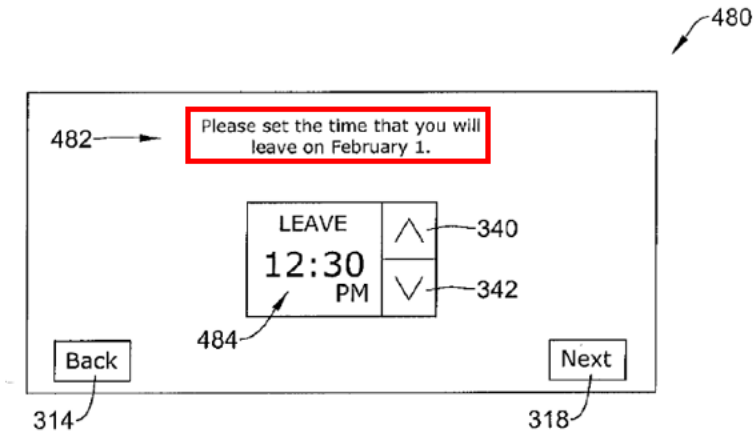


Figure 48

EX1008, Fig. 48 (annotated).

170. Further, Leen teaches:

HVAC controller 20 may be programmed or otherwise configured to permit operation of the HVAC equipment in accordance with an unoccupied setting, i.e., anytime the house is temporarily unoccupied. In some cases, this may correspond to the Leave period, or when **HVAC controller 20 has been instructed that the house will be temporarily vacant** as a result of vacation and the like.

Id. at [0171].

171. I understand that in a parallel district court proceeding, Patent Owner accused products that “connect to the internet via Wi-Fi and allows a mobile application to view data and adjust settings” as meeting this claim limitation.

EX1012 at 100. I will rely on Patent Owner’s interpretation for the purposes of this IPR. Adopting Patent Owner’s interpretation, Trundle specifically discloses a native monitoring application on one or more mobile devices that may operate in “**user defined modes** that control temperature, light, appliance behavior,” including

an Away-Work Mode and an Away-Vacation mode. EX1009 at [0073]. This native monitoring application “may define the modes and settings corresponding to the modes ***based on user input***,” and it “also may ***switch between the modes based on user input*** or may automatically switch between modes based on factors, such as location of the mobile device” *Id.*

172. In addition, Ehlers discloses the use of “[a]n equipment interface” to access a Security System, which “will be used to determine if the premise is occupied to provide cost control occupancy Sensing.” EX1010 at 31:59-65. “When the user arms the Security System, it is assumed the premise will be unoccupied and the temperature Set point will be changed to a user-defined or default level until the security system is disarmed” (*an interface configured to allow the user to input that the building is currently unoccupied*). *Id.* Thus, Ehlers describes an interface configured to allow the user to input that the building is currently unoccupied.

xxi. Claim 4: The thermostat system of claim 3, wherein the determination of whether the building is occupied or unoccupied by the one or more processors is based at least on a fourth data parameter received from a motion sensor.

173. As described above under claim 2, both Leen and Trundle teach a system wherein the determination of whether the building is occupied or unoccupied by the one or more processors is based at least on a fourth data parameter received from a motion sensor. Specifically, Leen teaches that the

“HVAC controller 20 may instead include or be in communication with one or more sensors that register whether someone is in the house, and thus may operate in accordance with an unoccupied setting when the house is sensed to be empty” (wherein the determination of whether the building is occupied or unoccupied by the one or more processors is based at least on a fourth data parameter received from a motion sensor). EX1008 at [0171]. And Trundle confirms that determining occupancy based on a sensor was well known as it teaches that the presence of a user within a particular area “may be sensed using a motion sensor.” EX1009 at [0087].

xxii. Claim 5: The thermostat system of claim 1, wherein the one or more processors is further configured to receive a third data parameter from a first sensor, wherein the third data parameter from the first sensor includes a measurement of at least one characteristic of a building within which the thermostat is located.

174. Leen discloses an HVAC controller that may communicate with “[w]ireless devices” such as “interior humidity sensors” (a third data parameter from a first sensor, wherein the third data parameter from the first sensor includes a measurement of at least one characteristic of a building within which the thermostat is located). EX1008 at [0173]. A POSITA would have understood that humidity is a characteristic of a building within which the thermostat is located.

175. In addition, Ehlers further discloses that an “[i]nput function 15 provides for interfacing with sensors and equipment as well as any other data

sources that may be appropriate such as . . . communication link 6,” as illustrated in Figure 3 (annotated) below. EX1010 at 10:14-17. In general, input functions condition and convert input device information to data useable by the system. *Id.* at 9:9-16. “Sensor types supported will sense internal and external environmental conditions including temperature and humidity.” *Id.* at 10:17-19.

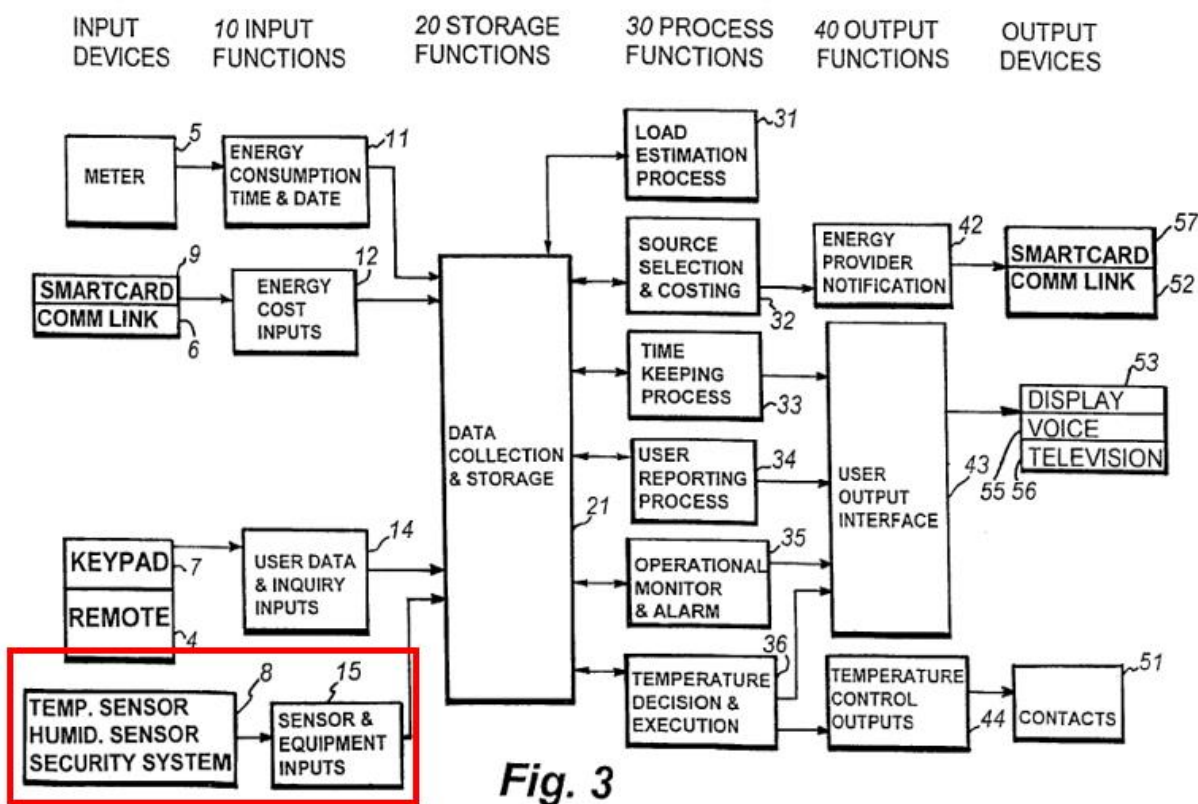


Fig. 3

EX1010, Fig. 3 (annotated).

176. A POSITA would have understood that the measurement of internal environmental conditions such as humidity is an example of a third data parameter that includes a measurement of at least one characteristic of a building within

which the thermostat is located. Ehlers further discloses that the thermostat system could sense “at least” “UV intensity.” EX1010 at 2:52-57.

177. A POSITA would have understood that measuring UV intensity is one way to measure the sunlight striking a sensor. While other lighting sources such as fluorescent lights provide illuminance, UV radiation is a key component to sunlight.

xxiii. Claim 6: The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of the humidity of the building.

178. As described above in Claim 5, Leen discloses an HVAC controller that may communicate with “[w]ireless devices” such as “interior humidity sensors” (*the third data parameter from the first sensor comprises a measurement of the humidity of the building*). EX1008 at [0173]. As described above, a POSITA would have understood that the measurement of the humidity of the building is an example of a third data parameter that includes a measurement of at least one characteristic of a building within which the thermostat is located.

xxiv. Claim 7: The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of sunlight.

179. As described above in Claim 5, Ehlers discloses that the thermostat system could sense “at least” “UV intensity” (*wherein the third data parameter from the first sensor comprises a measurement of sunlight*), which POSITA would

understand to be a measurement of sunlight. EX1010 at 2:52-57. As described above in paragraph 173, a first sensor receives a third data parameter which reflects a measurement of at least one characteristic of a building within which the thermostat is located.

180. As an initial matter, the specification does not define a “characteristic of a building.” However, the ’890 Patent does describe that the system can also “help compensate for anomalies such as measurement inaccuracies due to factors such as poor thermostat location,” thus distorting the temperature read by the temperature sensor. EX1001 at 24:57-25:15.

181. The ’890 Patent also states that “when the direct sunlight hits the thermostat, the thermostat and the surrounding area can heat up, causing the internal temperature as read by the thermostat to diverge significantly from the average temperature for the rest of the house. A conventional thermostat has no way of distinguishing this circumstance from a genuinely hot day, and will both over-cool the rest of the house and waste considerable energy when it cycles the air conditioner in order to reduce the temperature as sensed by the thermostat.” *Id.* at 25:4-15.

182. As described above and in view of the disclosure of the ’890 Patent, a POSITA would have understood that the UV intensity disclosed in Ehlers is a

measurement of the amount of sunlight and thus a characteristic of a building within which the thermostat is located.

xxv. Claim 8: The thermostat system of claim 7, wherein the second data parameter from the network connected to the thermostat further comprises a measurement of the outdoor humidity.

183. Claim limitation [1H] recited: “a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building.” As I discussed above in paragraphs 131-135 the second data parameter from the network connected to the thermostat comprises an outside weather condition collected from a source external to the building. Further, Leen discloses this second data parameter from the network connected to the thermostat that comprises a measurement of the outdoor humidity. Specifically, Leen discloses that “[w]ireless devices that may communicate with HVAC controller 20 include, for example, . . . exterior humidity sensors” (*wherein the second data parameter from the network connected to the thermostat further comprises a measurement of the outdoor humidity*). EX1008 at [0173].

184. To the extent that it is argued that the measurement of outdoor humidity must be transmitted from a source external to the building, which would be incorrect, Ehlers discloses an input function 13 that provides “weather information” that “can be provided by . . . a communications link.” EX1010 at

9:50-52. Said weather data “can be in the form of discrete parameters representing . . . humidity” “suitable for use in calculating the effect of weather on cooling or heating a premise.” *Id.* at 9:54-58. The system described in Ehlers could also “obtain, using a communications medium, weather information or indexes that it would use to maximize its efficiency.” *Id.* at 21:31-33. Information such as “humidity could all be received over the communication link . . . and used by the economic modeling tool to effectuate the optimal environment and energy unit cost consumption scheme.” *Id.* at 37-41.

B. Count 1B: Trundle, Leen, Wedekind, and Ehlers

i. Motivation to combine Trundle, Leen, Wedekind, and Ehlers

185. As was described in Ground 1A, the POSITA would have been motivated to combine Leen, Trundle, and Ehlers. The POSITA would have been motivated to combine the teachings of Wedekind with those of Leen, Trundle, and Ehlers for at least the following several reasons.

186. Trundle teaches the importance of automated temperature control systems, and the enhanced convenience of having a property ready for the user at a time when the user arrives home. EX1009 at [0144]. For example, “the system 200 may set the threshold distance to one mile when the current temperature is two degrees above the desired temperature, it typically takes the cooling system two minutes to cool the property two degrees, and it typically takes the user two

minutes to travel to the property from one mile away.” *Id.* at [0102]. Trundle further discloses that “[t]he system 200 then uses the calculated R value to more efficiently control the thermostat to minimize usage and maximize efficiency on behalf of the consumer.” EX1009 at [0202]. However, Trundle does not provide specific implementation details regarding how its system would calculate the time needed for a property to be pre-heated or cooled for arriving users.

187. Wedekind discloses additional details regarding a time needed to reach a desired heating or cooling setpoint. Wedekind recognizes that thermostat systems require different amounts of time to achieve a desired set-point temperature at a desired time, depending on the surrounding environment. EX1011 at 1:36-41.

188. A POSITA would have been motivated to combine the teachings of Trundle with those of Wedekind, because Wedekind discloses the use of inputs such as indoor and outdoor air temperatures to “more accurately achieve predetermined temperatures at predetermined times in addition to achieving these conditions while optimizing energy consumption.” EX1011 at 2:45-63. Indeed, Wedekind discloses specific formulas that describe a thermodynamic model of the monitored enclosure and its associated climate control system that utilize thermal and thermodynamic parameters. EX1011 at 17:53-63. More specifically, the differential equations utilized in the predictor system govern the average

temperature (T') of the conditioned space, the average temperature (T) of the thermal capacitance of the enclosure, and the rate at which energy is delivered to or removed from the conditioned space by the climate control system. *Id.* at 17:68-18:64. Thus, a POSITA would have been motivated to combine the teachings of Trundle with that of Wedekind to more accurately determine the proper start up times of a heating or cooling system to have an enclosure reach a desired set-point temperature when the user returns to the enclosure. *Id.* at 2:21-26. That is, the systems of Wedekind and Trundle enable the use of distance and time away from the enclosure when determining when to activate the heating or cooling system.

189. A POSITA would have been similarly motivated to combine the teachings of Ehlers with those of Wedekind. Ehlers emphasizes that the prior art does not “provide automatic environmental condition control based on sensed external environmental conditions, which external conditions may greatly effect [sic] internal conditions.” EX1010 at 2:14-18. Ehlers also aims to “optimize comfort and minimize energy consumption and/or energy cost, based on user-defined parameters.” *Id.* at 2:35-39. A POSITA would have turned to analogous art such as Wedekind for details to address the need for environmental condition control based on “external environmental conditions.” *See* EX1011 at 2:14-18.

190. Specifically, Wedekind teaches an energy prediction methodology which uses certain thermal and thermodynamic parameters, along with the

measured outdoor air temperature, to determine “the optimum thermostat setback schedule 80 which, while maintaining the user-specified occupancy comfort schedule 39, minimizes the input energy consumption of the climate control system 18.” EX1011 at 17:53-67. Wedekind further teaches a processing means that will “automatically change the setback temperature if it computes, using the non-linear efficiency model a more energy efficient setback temperature exists for the existing outside air temperature and occupancy comfort schedule 39.” *Id.* at 6:44-48. Thus, a POSITA would have been motivated to combine the teachings of Wedekind and Ehlers.

191. A POSITA would also have been motivated to combine the teachings of Wedekind with those of Leen. While Leen suggests that there is a need in the art to control HVAC systems in an energy-efficient manner (*see* EX1008 at [0170]), it provides no further implementation details. As described above, a POSITA would have turned to related literature to identify further implementation details, such as the energy prediction methodology and automatic setback change for greater energy efficiency as taught in Wedekind. *See, e.g.*, EX1011 at 17:53-67, 6:44-48.

192. The POSITA would have had a reasonable expectation of success in the combination given that each of the references disclose thermostats to control heating and cooling devices as well as specific mechanisms for controlling when to activate an HVAC system so as to achieve a particular setpoint at a particular time.

193. Accordingly, a POSITA would have combined the teachings of Leen, Trundle, Ehlers, Wedekind as described herein. Indeed, combining their teachings would have been routine to a POSITA due to this overlap and the simple software and system modifications to adjust Leen so it includes the teachings of Trundle, Ehlers, and Wedekind.

ii. Claim 9: The thermostat system of claim 1, further comprising a memory configured to store historical values of the first data parameter and second data parameter.

194. As discussed in element [1N], Leen suggests monitoring various usage statistics for a user, such as run time of the HVAC filter. EX1008 at [0308]. Moreover, Trundle discloses a system that generates and communicates usage metrics pertaining to the HVAC system over time. As described above in [1N], Trundle teaches a system that analyzes patterns of energy usage over time. See EX1009 at [0177]. And Ehlers teaches that a storage function may collect and store data types including “user preferences and limits,” and “consumption profiles.” EX. 1010, 10:43-62. “Other optional data includes the HVAC consumption.” *Id.* at 28:24-29.

195. While Leen and Trundle disclose monitoring and storing metrics, Wedekind specifically discloses storing inside and outside temperatures. Specifically, Wedekind discloses a thermostat system containing a “processing means 44” that “receives the temperatures of the inside and outside air as measured

by the inside 34 and outside 36 air temperature sensors.” EX1011 at 4:45-47. The processing means may comprise a computer “having data acquisition capabilities and sufficient memory capabilities to store all the data received by the data acquisition system,” (*a memory*) including data received from “the various sensors, i.e., the distribution air temperature sensors 58, and the inside 34 and outside 36 air temperature sensors” (*configured to store historical values of the first data parameter and second data parameter*). *Id.* at 4:55-63.

196. Ehlers further discloses that storing such data was well known in the art as it discloses a system that, “after being installed for a period of time, will have sufficient history data in its memory to provide the average consumption analysis data such as energy units used and cost of the energy units as a function of time, temperature, occupant changes in the set point and weather related factors for normalization.” EX1010 at 17:56-64. Ehlers’ system is also able to provide “weather correlated historical consumption analysis” and “weather correlated set point learning.” *Id.* at 35:4-7. Ehlers also teaches that a storage function may collect and storage data types including “user preferences and limits,” and “consumption profiles.” EX1010 at 10:43-62. “Other optional data includes the HVAC consumption.” *Id.* at 28:24-29. For example, the system disclosed in Ehlers can “track patterns of set point change as they relate to times of day, days of the week and, at a minimum, track changes in these patterns for exceptions such as

holidays,” which allows the system to track set point patterns or routines. *Id.* As another example, the system can analyze another parameter specific to the user, including by “tracking [] set point changes by the occupant in relationship to the outside weather conditions.” *Id.* By tracking these patterns, the system can maintain the indoor air temperature to achieve the desired comfort conditions of the occupant. *Id.* at 22:39-46.

iii. Claim 10: The thermostat system of claim 1, wherein the one or more processors is further configured to predict, based at least on the first data parameter, the second data parameter, and the first temperature setpoint data parameter, the time necessary for the HVAC system to operate in order for the building to reach the first temperature value by the first time value.

197. Leen discloses that “Adaptive Recovery may implement a control algorithm that initiates the HVAC equipment at an appropriate time before a step change in temperature set points (e.g. at a transition between programmable time periods) such that the temperature in the building reaches the new set point at or about the time that the temperature change is set to take place.” EX1008 at [0169].

198. Regardless, Trundle discloses setting a threshold distance for starting the heating or cooling process based on “how close the current temperature is to the desired temperature [(the first data parameter . . . and the first temperature setpoint data parameter)], how long it typically takes the system to adjust the temperature from the current temperature to the desired temperature [(the time necessary for the HVAC system to operate in order for the building to reach the

*first temperature value by the first time value)], and how long it typically takes the user to travel a particular distance.” EX1009 at [0102]. For example, “the system 200 may set the threshold distance to one mile when **the current temperature is two degrees above the desired temperature, it typically takes the cooling system two minutes to cool the property two degrees**, and it typically takes the user two minutes to travel to the property from one mile away.” *Id.* (emphasis added).*

199. Indeed, Trundle discloses that its system learns information about the heating and cooling systems to determine a time to heat or cool and to be more efficient. EX1009 at [0204]. For example, the system disclosed may be a “learning system” that “runs experiments” on heating or cooling a property.

“[G]iven a certain expected outdoor weather condition (e.g., weather, humidity, solar intensity) [(*the second data parameter*)] the system 200 may advise the property owner to close all window drapes one day before going to work and calculate a baseline for that day. The system 200 then, during periods of that day, experiments with different cooling intensity control process (e.g., gradual cooling versus intensive cooling) and measures the work required to create a certain amount of temperature change. Based on the results of the experiments, the system 200 learns how gradually or intensively to proceed with cooling the property to best achieve efficient operation. The system 200 may use this learned information to control future heating or cooling scenarios in a more efficient manner.

Id.

200. While both Leen and Trundle provide relevant disclosure and Trundle discloses reliance on a current indoor air temperature, outdoor weather condition, and a setpoint, Wedekind provides explicit detail with respect to outdoor

temperature. For example, Wedekind teaches a “**processing means** 44 [that] stores a non-linear efficiency model therein so it may be used to **predict**, in advance of implementation, the **time required** for air warm-up or cool-down . . . and to optimize the energy consumption **as a function of the inside and outside air temperatures**” (*predict, based at least on the first data parameter, the second data parameter, and the first temperature setpoint data parameter, the time necessary for the HVAC system to operate in order for the building to reach the first temperature value by the first time value*). EX1011 at 4:39-47. Specifically, the predictor system 14 incorporates “**the current outside air temperature 36**,” or second data parameter, to predict the **recovery time t_r** necessary to return the inside air from the setback temperature, T_i (*the first data parameter*), to the occupancy comfort temperature T_f (*first temperature setpoint data parameter*). *Id.* at 7:41-50, 19:59-20:2. Moreover, Wedekind explicitly describes that its system “us[es] the continuous measurement of various air temperatures.” EX1011 at Abstract.

201. Specifically, Wedekind describes that the thermostat assembly is capable of “predict[ing] in advance the time period, t_r , necessary for temperature recovery from the setback temperature, T_i , to the occupancy set-point or comfort temperature, T_f .” EX1011 at 7:19-23. The occupancy set-point or comfort temperature is the “first temperature value” claimed. The predicted recovery time, t_r , “is sent to the programmable thermostat so that the setback temperature, T_i , can

be raised to the set-point temperature, T_f , enough time in advance so that the air temperature reaches the comfort temperature T_f , at the beginning of the specified comfort time domain, t_4 .” *Id.* at 7:23-30. The specified comfort time domain, t_4 , is the “first time value” claimed. “The occupancy comfort time domains, t_0 - t_1 and t_4 - t_5 , represent the times in which the occupants of the enclosure 30 are using the enclosure 30 and want it comfortable.” *Id.* at 5:57-60.

202. Further, Ehlers confirms that it was well known that weather parameters or index may be used as “a load variable which would modify the *estimate* of the amount of energy required, [and] *time* . . . to heat or cool the premise from a specific temperature to *a new set point*,” or “as a predictor for user-desired temperature set point changes.” EX1010 at 35:17-28.

203. For example, Ehlers discloses an energy management system in which “[c]omputed thermal recovery time for heating and cooling [is] adjusted to compensate for the external temperature, wind speed, direction, UV index, humidity and cooling or heating degree day factors.” EX1010 at 39:44-51. “This computed factor is used to more accurately compute the recovery time for thermal gain or loss when combined with the average normalized thermal gain or loss for the premise.” *Id.*

204. Thus, it would have been obvious to a POSITA that the combination teaches this element.

- iv. Claim 11: The thermostat system of claim 10, wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.***

205. Leen discloses that “Adaptive Recovery may implement a control algorithm that initiates the HVAC equipment at an appropriate time before a step change in temperature set points (e.g. at a transition between programmable time periods) such that the temperature in the building reaches the new set point at or about the time that the temperature change is set to take place.” EX1008 at [0169].

206. Regardless, Trundle discloses setting a threshold distance based on “how long it typically takes the system to adjust the temperature from the current temperature to the desired temperature.” EX1009 at [0102]. Indeed, Trundle discloses it relies on an “R Value Rating for a monitored property.” EX1009 at [0202]. A POSITA would have understood that the R-Value reflects “the work of the heating and cooling system (e.g., the HVAC system) to raise/lower temperatures,” which would include an understanding of a rate of change. EX1009 at [0203]. Further, Trundle discloses the derivation of a “Home R Value Rating,” which is “[b]ased on the determined inside temperature of the monitored property and the outside weather information.” *Id.* at [0202].

207. As another example, Trundle discloses a “learning system” that runs heating/cooling experiments, and is able to take into account “a certain expected

outdoor weather condition (e.g., weather, humidity, solar intensity),” and “measure[] the work required to create a certain amount of temperature change.” *Id.* at [0204]. “Based on the results of the experiments, the system 200 learns how gradually or intensively to proceed with cooling the property to best achieve efficient operation.” *Id.* A POSITA would have understood that a consideration of “how gradually or intensively to proceed with cooling the property” inherently takes into account a rate of change value for the HVAC system to operate to achieve a desired temperature.

208. Moreover, a POSITA would have understood that any rate of change value necessary for the building to reach the first temperature value by the first time value necessarily includes an associated time, as a rate describes how one quantity changes in relation to another quantity. The '890 Patent describes how the prediction of time to reach the first temperature value is dependent on the rate of change value. Specifically, it describes how the server calculates an “effective thermal mass” for the monitored property, or “the rate at which the temperature inside a given building will change in response to changes in outside temperature.” EX1001 at 12:56-59. “Because the server will also log these inputs against other inputs including time of day, humidity, etc., the server will be able to predict, at any given time on any given day, the rate at which inside temperature should change for given inside and outside temperatures.” *Id.* at 12:60-64.

209. The system's ability to predict a rate of change is utilized by "holding the desired future inside temperature as a constraint and using the ability to predict the rate of change to determine ***when the HVAC system must be turned on in order to reach the desired temperature at the desired time.***" *Id.* at 12:65-13:6 (emphasis added).

210. While both Leen and Trundle provide relevant disclosure and Trundle discloses calculation of an R-value, both Wedekind and Ehlers disclose a thermostat system in which the processors' prediction is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.

211. For example, Wedekind teaches a non-linear efficiency model consisting of a series of three differential equations representing the major physical mechanisms governing the thermal and thermodynamic processes involved. EX1011 at 17:63-67. These three differential equations ((21), (22), and (23)) that govern the thermal characteristics of the enclosure and its associated climate control system can be solved by the non-linear efficiency model processor "using classic mathematical solution techniques for the five different time domains 40, 42 of the typical occupancy comfort 39 and thermostat setback 80 schedules depicted in FIG. 2." *Id.* at 18:65-19:4. One of the three differential equations, (23), "govern[s] the ***rate at which energy is delivered to (heating) or removed from***

(cooling) the conditioned space, E_s, by the climate control system 18,” and is utilized by the processor means 72. *Id.* at 18:26-35 (emphasis added). A POSITA would have understood that solving these three differential equations involves calculating the derivative, or rate of change value.

212. Likewise, Ehlers generally teaches a system that uses comfort preconditioning to “pre-cool or pre-heat the premise within the allowable ranges specified by the user to minimize cost of operation.” EX1010 at 19:14-19. “Preconditioning, which can be used with or without ramping, pre-cools (or preheats) the premise prior to a rate increase by the number of degrees selected by the user.” *Id.* at 29:25-27. The starting time prior to the rate increase is determined by multiplying the rate change for cooling (or heating) by the number of user-selected degrees. *Id.* at 29:30-32. The “rate change” is determined by “measuring the time it takes to cool the premise one full degree” (*prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value*). *Id.* at 29:28-30. Then, if ramping is in use, the system disclosed in Ehlers “will use this lower temperature to calculate the rate of change for its operation which lowers the overall temperature during the higher rate period.” *Id.* at 29:33-36.

213. Ehlers further discloses that the interface device of its energy management system may supply data such as “the average thermal degree gain or loss per unit of time for the premise for a rolling 30, 60 and 90 day period.” *Id.* at 26:53-55. A POSITA would have understood that a “rate” value is by definition a change in a value over time. Thus, Ehlers discloses a thermostat system in which the processors’ prediction is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.

v. Claim 12: The thermostat system of claim 11, wherein the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value.

214. As an initial matter, claim 12 ultimately depends from claim 1, which recites in limitation [1L]: receive geo-positioning data from the location-aware mobile device and automatically adjust a temperature value based on the geo-positioning data, including initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user.

215. Leen discloses that “Adaptive Recovery may implement a control algorithm that initiates the HVAC equipment at an appropriate time before a step change in temperature set points (e.g. at a transition between programmable time

periods) such that the temperature in the building reaches the new set point at or about the time that the temperature change is set to take place.” EX1008 at [0169].

216. Similarly, Trundle discloses a “learning system” that “runs experiments occasionally on cooling or heating a property” in order to “control future heating or cooling scenarios in a more efficient manner.” EX1009 at [0204]. Specifically, Trundle discloses that the learning system “experiments with different cooling intensity control process (e.g., gradual cooling versus intensive cooling) and measures the work required to create a certain amount of temperature change. Based on the results of the experiments, the system 200 learns how gradually or intensively to proceed with cooling the property to best achieve efficient operation. The system 20 may use this learned information to control future heating or cooling scenarios in a more efficient manner” (*the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value*). *Id.*

217. Wedekind generally teaches a method “to more accurately achieve predetermined temperatures at predetermined times.” EX1011 at 2:60-63. As explained above in relation to Claim 11, Wedekind discloses a rate of change value, including by solving a differential equation that “govern[s] the **rate at which energy is delivered to (heating) or removed from (cooling) the conditioned space**, E_s , by the climate control system 18,” and is utilized by the processor means 72. EX1011 at 18:26-35 (emphasis added). Wedekind also discloses automatically

adjusting a temperature setpoint based on a rate of change value. For example, Wedekind explains that even if a user has programmed a setback temperature, T_i , “the processing means 44 will ***automatically change the setback temperature*** if it computes, using the non-linear efficiency model a more energy efficient setback temperature exists for the existing outside air temperature and occupancy comfort schedule 39.” EX1011 at 6:41-48.

218. Ehlers discloses that weather information may include “any number of weather parameters or a simple weather index which can be used to modify temperature set point calculations.” EX1010 at 35:17-28. The weather parameters or index may be used as “a load variable which would modify the estimate of the amount of energy required, time and cost to heat or cool the premise from a specific temperature to a new set point,” or “as a predictor for user-desired temperature set point changes.” *Id.* For the same reasons as above in Claim 11, Ehlers discloses a thermostat system wherein the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value.

vi. Claim 13: The thermostat system of claim 10, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

219. Leen discloses that “Adaptive Recovery may implement a control algorithm that initiates the HVAC equipment at an appropriate time before a step

change in temperature set points (e.g. at a transition between programmable time periods) such that the temperature in the building reaches the new set point at or about the time that the temperature change is set to take place.” EX1008 at [0169].

220. Regardless, Trundle discloses setting a threshold distance based on “how long it typically takes the system to adjust the temperature from the current temperature to the desired temperature.” EX1009 at [0102]. In this way, “[t]he system 200 attempts to ***automatically start a heating or cooling process*** with sufficient time prior to the user’s expected arrival to adjust the temperature to a suitable level by the time the user arrives at the property.” *Id.* at [0101] (emphasis added).

221. Moreover, Wedekind discloses a non-linear efficiency model for predicting the advance time period, t_r , necessary “for temperature recovery from the setback temperature, T_i , to the occupancy set-point or comfort temperature, T_f .” EX1011 at 7:19-23. This recovery time, t_r , is then sent to the thermostat “so that the setback temperature, T_i , can be raised to the set-point temperature, T_f , enough time in advance so that the air temperature reaches the comfort temperature, T_f , at the beginning of the specified comfort time domain, t_4 ” (*the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value*). *Id.* at 7:26-30.

222. Thus, Wedekind discloses the automatic adjustment of the temperature setpoint that is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

vii. Claim 14: The thermostat system of claim 10, further comprising a memory configured to store historical values of the first data parameter and second data parameter; wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on historical values of the first data parameter and second data parameter.

223. A memory configured to store historical values of the first data parameter and second data parameter is disclosed for at least the reasons provided with respect to Claim 9.

224. Regardless, Trundle discloses setting a threshold distance based on “how long it typically takes the system to adjust the temperature from the current temperature to the desired temperature.” EX1009 at [0102]. As I discussed above in paragraphs 129-30 and 131-135 respectively, the first data parameter comprises an interior temperature inside the building, and the second data parameter comprises an outside weather condition collected from a source external to the building. Trundle discloses the calculation of a “Home R Value Rating” “[b]ased on the determined inside temperature of the monitored property and the outside weather information.” *Id.* at [0202].

225. Trundle also discloses a “learning system” that performs “experiments with different cooling intensity control process (e.g., gradual cooling versus intensive cooling) and measures the work required to create a certain amount of temperature change.” *Id.* at [0204]. Based on the results of these experiments, the learning system “may use this learned information to control **future** heating or cooling scenarios.” *Id.* (emphasis added). Additionally, Trundle teaches that the learning system “may constantly use its **archive of information to learn over time**, and the system 200 may dynamically and without user driven inputs, run tests (usually with no occupants) to maximize its understanding of the property” (*the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on historical values of the first data parameter and second data parameter*). *Id.* at [0206] (emphasis added).

226. Additionally, Ehlers discloses enhanced capabilities for providing automatic control of heating and cooling that are based on historical values of a first data parameter and second data parameter. Specifically, Ehlers describes two artificial intelligence systems to automatically adjust the internal temperature “to meet the occupant’s desired comfort factors.” EX1010 at 22:35-39. In the first system, “the system will track patterns of set point change as they relate to times of

day, days of the week and, at a minimum, track changes in these patterns for exceptions such as holidays.” *Id.* at 22:1-5.

227. In a second artificial intelligence system, the system tracks “set point changes by the occupant in relationship to the outside weather conditions.

Whenever the system detects a change in the set point, it would be capable of recording and tracking the weather conditions outside and develop a correlation to those factors” (*a memory configured to store historical values of the first data parameter and second data parameter*). *Id.* at 22:23-28. By recording these factors, the system can “automatically adjust the internal environmental conditions to meet the occupant’s desired comfort factors.” *Id.* at 22:35-39. Further, “[b]y utilizing these control and comfort patterns, the system will be able to maintain the indoor air . . . to achieve the desired comfort conditions of the occupant.” *Id.* at 22:39-43.

A POSITA would have understood that the system of Ehlers is able necessarily to adjust operation to maintain the indoor temperature by tracking the historical values of the first data parameter. Moreover, the weather parameters can be used “as a load variable which would modify the estimate of the amount of energy required, time and cost to heat or cool the premise from a specific temperature to a new set point and as a predictor for user-desired temperature set point changes.”

EX1010, 35:23-28

228. Moreover, Wedekind discloses the use of historical values of indoor temperature (first data parameter) and outdoor temperature (second data parameter) to predict the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value. Specifically, Wedekind teaches a method of determining the efficiency of a climate control system as a function of the operating level, or average input energy rate, of the climate control system.

EX1011 at 13:15-22. Wedekind's parameter estimation methodology

“determine[s] the various thermal and thermodynamic parameters...required by the non-linear efficient model to currently determine the most efficient way to maintain the occupancy comfort schedule 39 which was input by the operator.”

EX1011, 12:43-53, This requires “direct temperature measurements of the ***inside air 34 . . . as a function of time.***” *Id.* at 13:23-25. Additionally, the climate control system described in Wedekind also requires a “direct measurement” of “the ***outdoor air temperature as a function of time, $T_o(t)$.***” *Id.* at 14:60-62.

viii. Claim 15: The thermostat system of claim 14 wherein the one or more processors determines one or more intermediate temperature setpoints that have a temperature value between a current temperature of the building and the first temperature setpoint.

229. I understand that in the parallel district court litigation, Patent Owner accuses “Adaptive Intelligent Recovery” as a feature containing one or more processors that determines one or more intermediate temperature setpoints that

have a temperature value between a current temperature of the building and the first temperature setpoint. EX1012 at 129. However, “Adaptive Intelligent Recovery” was well known in the art prior to the purported invention of the ’890 Patent. For example, Leen discloses that “Adaptive Recovery may implement a control algorithm that initiates the HVAC equipment at an appropriate time before a step change in temperature set points (e.g. at a transition between programmable time periods) such that the temperature in the building reaches the new set point at or about the time that the temperature change is set to take place.” EX1008 at [0169].

230. Further, Trundle discloses that “the threshold distance at which the automatic start of the heating or cooling process begins may be dynamically set based on how close the current temperature is to the desired temperature, how long it typically takes the system to adjust the temperature from the current temperature to the desired temperature, and how long it typically takes the user to travel a particular distance.” EX1009 at [0102].

231. As previously described, a thermostat is a closed loop control system that turns the heating and cooling subsystems of a building on and off. Once the thermostat turns a subsystem on, the trajectory of the temperature changes over time as dictated by thermal characteristics of the building (such as thermal mass

and R-value) and the current state of the environment, which may not be known or may be difficult to determine.

232. A POSITA would have known that if a specific trajectory or profile of temperature changes are desired, such as ramping the temperature over time, then the thermostat must calculate a series of intermediate setpoints along the desired temperature trajectory.

233. Ehlers further discloses the concept of temperature ramping, which “will cause the system to gradually ramp the temperature up or down over a period of time (i.e. 1 degree/30 min or 1 degree/1 hour . . .) in response to energy price changes” (*one or more intermediate temperature setpoints that have a temperature value between a current temperature of the building and the first temperature setpoint*). EX1010 at 19:27-34. Conversely, if prices drop, the ramping algorithm “uses a reverse recovery ramp” to ramping back to a narrower dead-band. *Id.* at 19:43-45. Thus, the reverse recovery ramp disclosed in Ehlers teaches the intermediate temperature setpoints that have a temperature value between current temperature of the building and the first temperature setpoint.

- ix. Claim 16: The thermostat system of claim 14, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.***

234. Claim 16 is rendered obvious for at least the same reasons as I explained above for Claim 13 (the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value).

- x. Claim 17: The thermostat system of claim 1, wherein the one or more processors is further configured to receive a fifth data parameter generated based at least in part on a previous operation of the HVAC system, wherein the fifth data parameter includes at least one performance characteristic of the HVAC system.***

235. Leen discloses that a data port may be used to upload or download information from a controller. EX1008 at [0028]. The information transmitted may include “values of operating parameters.” *Id.* Further, the thermostat system may receive information such as values of operating parameters using a wireless protocol, or via USB or a serial port. *Id.* at [0029].

236. Further, Trundle discloses that the thermostat system “may analyze patterns of the energy usage, sensor data, and device status and take action according to the relative overlap in the patterns.” EX1009 at [0177]. The system disclosed in Trundle describes other performance characteristics such as “the

efficiency of a heating and cooling system (e.g., an HVAC system) at a property” *(configured to receive a fifth data parameter generated based at least in part on a previous operation of the HVAC system the fifth data parameter includes at least one performance characteristic of the HVAC system)*. *Id.* at [0203]. The efficiency of the property may be calculated in terms of a Home R Value Rating, obtained by the system “watch[ing] how quickly the internal temperature of the property rises.” *Id.* at [0202].

237. While the '890 Patent does not explicitly define the term “performance characteristic,” it does state that the server of the purported invention “contain[s] a history of the thermal performance” of the buildings, which “performance data will allow the server 106 to calculate an effective thermal mass for each such structure – that is, the speed with [sic] the temperature inside a given building will change in response to changes in outside temperature and differences between inside and outside temperatures.” EX1001 at 23:43-51.

238. Wedekind similarly discloses that its “predictor system” involves a mathematical model that “utilizes the measured thermal and thermodynamic parameters determined and stored in the registers 45 or database 45.” EX1011 at 17:53-57. A POSITA would have understood that thermal and thermodynamic parameters are performance characteristics of the HVAC system. Similarly, Wedekind also describes that the parameter estimation assembly “includes the

adaptive capability of indirectly learning . . . such thermal parameters as . . . the efficiency characteristics of the climate control system (18).” *Id.* at Abstract. For example, a change to the enclosure such as “new cracks in the structure or around windows and doors, of the enclosure 30, new insulation added to the enclosure 30, replacement of windows, changes in the furnace 20, the air distribution ducts 22, or the like” may alter the thermal parameters of a system. *Id.* at 7:50-61. Even further, Wedekind teaches that its predictor system determines the climate control efficiency η_s by “measuring the variables associated with the thermal energy consumption of the enclosure 30, i.e., inside temperature, outside temperature, flow rates, input energy rate, etc.” *Id.* at 12:10-26. Specifically, the predictor system uses the coefficient a_0 and an exponent n , which are parameters of the climate control system, to determine the efficiency η_s , such that $\eta_s = a_0 E_g^n$ where E_g equals the input energy rate of the climate control system 18. A POSITA would understand that the parameters a_0 and n are generated based at least in part on a previous operation of the HVAC system because they are “[b]ased on [] measurements of the climate control system 18,” *id.* at 12:6-7, such as the inside and outside temperature, temperature of the distributed air at the warm air ducts, flow rates, input energy rate, and cycle times, *id.* at 9:1-13, 12:20-25.

239. Further, Ehlers discloses a monitoring function that “entails extracting performance data from the collected data, tracking it over time and making

periodic comparisons.” EX1010 at 37:20-24. Specifically, Ehlers explains that “***the time to*** cool the premise one degree with known temperature and weather conditions can be determined as with comfort ramping. This value can be stored and a new value measured and stored monthly. The system then can calculate a trend in operation and determine if the cooling unit is operating at the same level as when the initial measurement was taken.” *Id.* at 37:24-28. The time to cool the premise one degree with known temperature and weather conditions is a performance characteristic of an HVAC system that indicates the level at which the cooling unit is operating.

C. Count 2A: Imes, Young, and Ehlers

i. Motivation to combine Imes, Young, and Ehlers

240. Ehlers discloses a well known thermostat along with the well known and necessary elements of the thermostat. For example, Ehlers describes a housing, electrical contacts, a display, processor, sensors (such as internal temperature and occupancy sensors), and setpoint control found in thermostats at the time. *See generally* Sections X.A.iii-xiv. Ehlers further discloses energy management systems that “provide automatic environmental condition control based on sensed external environmental conditions, which external conditions may greatly effect internal conditions.” EX1010 at 2:10-18.

241. Ehlers further discloses an energy management system that receives inputs from the user and from external sources “to provide an environmental condition control system that automatically controls internal environmental conditions to optimize comfort and minimize energy consumption . . . based on user-defined parameters.” *Id.* at 2:35-39. One of the inputs for the energy management systems could include an occupancy sensor that “would permit the system to generate greater savings by allowing greater use of the dead-band during periods when the premise is vacant without jeopardizing the comfort of the occupant.” *Id.* at 21:41-47.

242. Imes represents an advancement in thermostat technology brought about by mobile devices with location detection capabilities. In addition, Imes discloses an energy management system that uses a proximity detection module to automatically control the operation of an HVAC system. Specifically, “control data can be provided in response to a detection of a travel direction and a distance between mobile device 210 having location reporting device, and site 202.”

EX1014 at 11:10-21; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

243. It would have been obvious to a POSITA to combine Ehlers with Imes because Ehlers teaches that there is a need for automatic controls of HVAC systems that both “minimize[s] energy consumption” and “optimize[s] comfort.”

EX1010 at 2:35-39. Indeed, in the early 2000s, the functionality of mobile phones was expanding both in terms of the functionality of handsets and of the networks. One such improvement for handsets was the incorporation of a GPS for location tracking. *See, e.g.*, EX1001 at 3:21-50. As the incorporation of GPS became more ubiquitous, the POSITA would have looked for ways to incorporate GPS and location into thermostat solutions so as to automate and/or to more precisely control devices in a home or business. One such example of the use of location tracking to monitor and/or control devices within a home or business was disclosed by Imes.

244. A POSITA would have been motivated to implement the mobile device-based occupancy detection and control of Imes to improve the automatic control of heating and cooling systems taught in Ehlers. Specifically, a POSITA would have been motivated to combine the teachings of Ehlers with those of Imes because Imes teaches techniques such as automatically controlling a site “on a zone by zone basis as mobile device 632 moves away from, or towards, site 604” that eliminates the need for manual control of thermostats to minimize energy consumption. EX1014 at 36:4-7; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

245. Imes relies on occupancy detection and its associated benefits by relying on a location of a mobile device and, thus, eliminating or reducing the need

for manual control of thermostat settings. *See, e.g.*, EX1014 at 35:63-36:7; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. By eliminating or reducing the need for manual control and by instead relying on location as a proxy for occupancy, the resultant system becomes significantly more energy efficient. That is, the resulting system only heats/cooling when a user is occupying the property or within a predefined distance of the property and, importantly, at least reduces (or even turns off) heating/cooling when the user is not occupying the property or within a predefined distance of the property.

246. Moreover, a POSITA would have recognized that the complexity of programming thermostats prevented many users from obtaining the benefits of their programmable functionalities, such as automated schedules and energy conservation. Users of energy management systems often “lack energy awareness,” and displays of energy prices “take a passive role to conservation, and leaving it up to the consumer to manually curtail their use.” EX1014 at 1:35-46. Thus, the location-based control of thermostats as disclosed in Imes reduces the need for manual control of energy management systems, and thus increases energy efficiency.

247. The POSITA would be further motivated to combine Imes with Ehlers because the same location-based occupancy detection taught in Imes also optimizes a user’s comfort. For example, Imes teaches adjusting HVAC settings

“to detect when mobile device 632 may be moving away from site 604” and adjusting a percentage change in the thermostat setting. EX1014 at 36:25-36; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. A POSITA would have understood that altering a temperature setpoint based on user occupancy greatly enhances user comfort compared to other energy conservation methods. For example, by relying on occupancy detection, a home or business can be cooled or heated when imminent arrival is detected so as to make sure the home or business is comfortable on arrival.

248. The POSITA would have had a reasonable expectation of success in the combination of Ehlers and Imes given that both references rely on occupancy-dependent protocols to control heating and cooling devices. For the same reason, a POSITA would have been motivated to combine the teachings of Ehlers and Imes with those of Young. Young discloses that “an occupancy sensor can be provided to sense the presence of occupants in the room,” and said occupancy sensor can be a motion detector. EX1016 at 3:29-43.

249. A POSITA would have been further motivated to combine the teachings of Ehlers and Imes with those of Young, because Young teaches a necessary implementation detail that minimizes wear and tear on a heating and cooling system. EX1016 at 2:43-3:22. Specifically, Young teaches a compressor timer that prevents a compressor from reactivating after it has been turned off for a

preset time, thus “prevent[ing] wear and tear on the compressor and reduc[ing] the need for maintenance that would be caused if the compressor were turned on and off more frequently than allowed by the startup delay.” *Id.* at 3:12-22. A POSITA would have understood that minimizing maintenance of an HVAC system would enhance user comfort.

250. The POSITA would have had a reasonable expectation of success in the combination of Ehlers, Imes, and Young given that all references rely on thermostats and particular well known implementation details of the same, including the use of sensors to detect a room’s occupancy.

251. Accordingly, it is my opinion that a POSITA would have combined the teachings of Ehlers, Imes, and Young as described herein. Indeed, combining their teachings would have been routine to a POSITA due to this overlap and the simple software and system modifications to adjust Ehlers so it includes the teachings of Imes and Young.

ii. Claim [1Pre]: A thermostat system comprising:

252. To the extent the preamble is limiting, Ehlers discloses a thermostat system. Ehlers describes thermostat systems generally as “devices [] designed primarily to sense the temperature inside a premise and, based on an occupant-designated temperature setting, activate a heating and/or cooling system or systems to maintain the temperature at that setting” (*thermostat system*). EX1010 at 1:17-

24. Ehlers further describes the state of the art of thermostats, including describing a system called Smart Systems 1000™ that uses an infrared motion sensor to detect occupancy and “control[] the temperature differently when a person’s presence is detected than in the absence of such detection.” *Id.* at 1:64-2:3.

iii. Claim 1[A]: a housing

253. Ehlers discloses an HVAC control unit that “may be contained within a case similar to thermostats presently available” (*a housing*). EX1010 at 27:36-38.

iv. Claim [1B]: electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building’s HVAC system to the contacts;

254. As I explained with respect to limitation [1B] of Ground 1A in Section X.A.iv, the ’890 Patent itself discloses that contacts connect a relay to the wires that are connected to the HVAC system. Specifically, as depicted in Figure 4 (annotated) below, the ’890 Patent describes:

Thermostat 108 includes temperature sensing means 252, which may be a thermistor, thermal diode or other means commonly used in the design of electronic thermostats. It includes a microprocessor 254, memory 256, a display 258, a power source 260, a relay 262, which turns the HVAC system on and off in response to a signal from the microprocessor, and contacts by which the relay is connected to the wires that lead to the HVAC system.

EX1001 at 8:52-61.

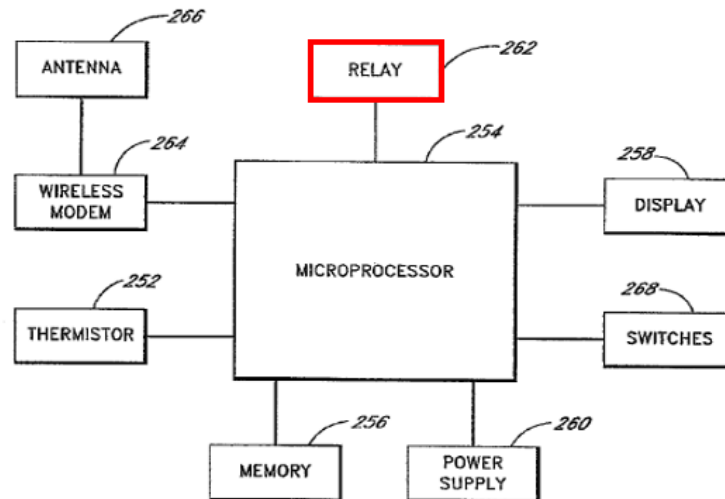


FIG. 4

EX1001, Fig. 4.

255. In the same way, Ehlers discloses electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building’s HVAC system to the contacts. Specifically, Ehlers discloses an environmental condition control system “contained within a thermostat-like unit.” EX1010 at 30:44-46. This system may contain “contact closures for controlling the HVAC unit in a home.” *Id.* at 30:37-44. These contact closures (*electrical contacts configured to connect the thermostat with wires that allow for at least two electrical connections from a building’s HVAC system to the contacts*), “similar to standard thermostats, may be used to control the heating or cooling of the premise.” *Id.* at 14:12-13. Thus, Ehlers also discloses electrical contacts configured

to connect the thermostat with wires that allow for at least two electrical connections from a building's HVAC system to the contacts.

256. As depicted below in Figure 2 (annotated), “[d]ry contact closures 51 will be used to provide control to devices outside the system from functions 41, 42, 44 and 45. These contacts will be rated for controlling relays and low voltage circuits. The contacts may, for example, control the external load devices for energy consumption management and environmental condition control.” *Id.* at 14:42-47.

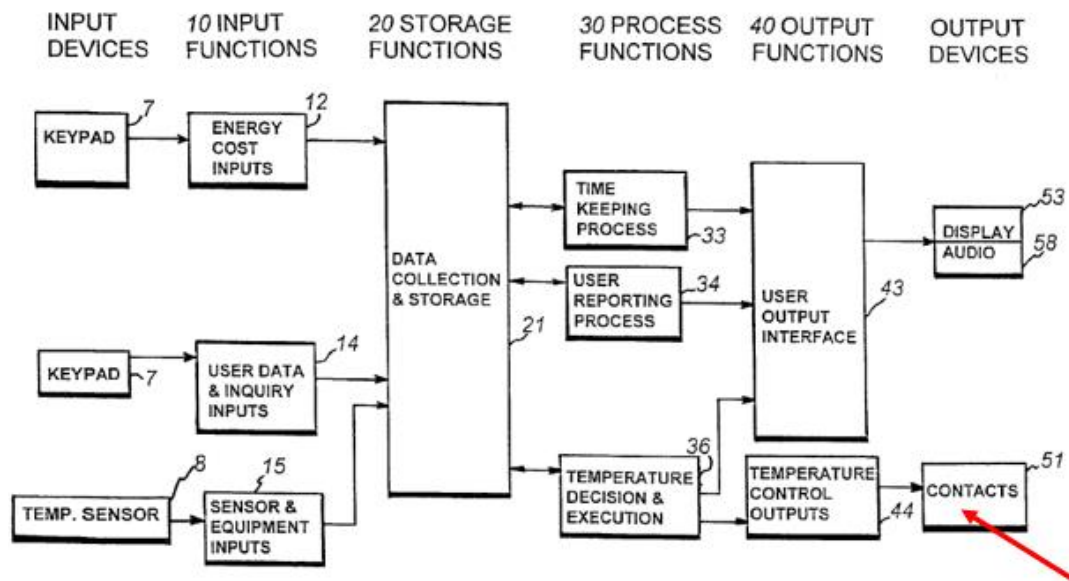


Fig. 2

EX1010, Fig. 2 (annotated).

v. Claim [1C]: a display configured to present information to a user;

257. Ehlers further discloses a user interface which may include a “display device, which displays information to a user” (*a display configured to present information to a user*). EX1010 at 7:37-44.

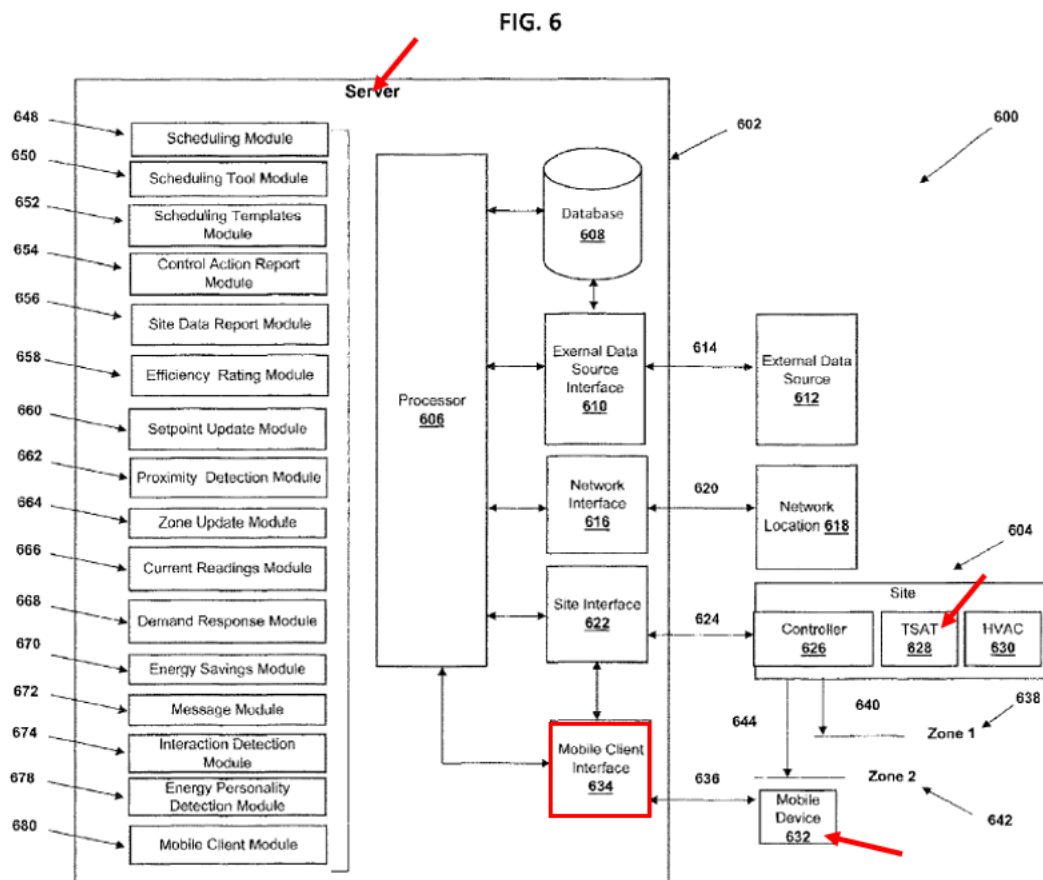
vi. Claim [1D]: a wireless radio compatible with a wireless radio frequency protocol and configured to communicate bi-directionally with a location-aware mobile device;

258. As I explained above with respect to limitation [1B] of Ground 1A in Section X.A.iv, I understand that in a parallel district court proceeding, Patent Owner asserted that this limitation may be met by a location-aware mobile device that communicates indirectly through a network to include one or more servers as meeting this limitation. EX1012 at 25-33. I rely on Patent Owner’s interpretation only for the purposes of this IPR.

259. According to the Patent Owner’s interpretation of this limitation, it is not necessary for the mobile device to communicate directly with the thermostat system using the wireless radio frequency protocol. Thus, according to Patent Owner’s interpretation, whether a mobile device communicates **directly** via wireless radio frequency protocol with the thermostat, or whether the mobile device communicates **indirectly** through a network, either satisfies the limitations of this claim.

260. Regardless, Imes discloses that its mobile devices can communicate at least indirectly with one or more components. For example, as illustrated below in Figure 6 (annotated), the energy management system disclosed by Imes “can include mobile client interface 634 operable to be coupled to mobile device 632 associated with site 604.” EX1014 at 39:59-64; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. “For example, mobile client interface 634 can include a WAP gateway or other mobile client gateway to enable server 602 access to mobile device 632.” EX1014 at 39:61-64; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. This mobile client interface can be provided as part of a server. EX1014 at 39:64-67; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. Imes teaches that the mobile client interface 634 “can receive a request from mobile device 632 to modify a current temperature set-point of HVAC system 630,” and communicate the control action to the site using site interface 622. EX1014 at 30:19-40; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 10 at § 2.1.1; 11 at § 2.1.4; 19 at § 2.1.9; 16 at § 2.1.12; 28; 30; 33-35; 43-45. Then, when the temperature set-point has been updated, “home controller 626 can communicate a control action confirmation data . . . to confirm the updated temperature set-point,” and the processor can output confirmation to the mobile client interface 634 and output an updated temperature set-point to mobile device 632 (*configured to communicate bi-directionally with a location-aware mobile*

device). EX1014 at 30:19-40; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 10 at § 2.1.1; 11 at § 2.1.4; 19 at § 2.1.9; 16 at §§ 2.1.12, 2.1.14; 28; 30; 33-35; 43-45. In a similar embodiment, the controller 216 “can initiate an outputting of new set-point values to TSTAT 208 and others using wireless energy network 242” (*a wireless radio compatible with a wireless radio frequency protocol*). EX1014 at 12:32-34; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 10 at § 2.1.1; 11 at § 2.1.4; 19 at § 2.1.9; 16 at § 2.1.12; 28; 30; 33-35; 43-45.



EX1014, Fig. 6 (annotated).

261. Further, Imes discloses that its mobile devices can communicate directly with the wireless radio of the thermostat system. For example, the controller 216, which is capable of connecting to both the mobile device 210 and TSTAT 208, “can establish a wireless energy network 242 using a wireless communication described herein.” EX1014 at 6:53-62; EX1015 at 8 at § 1.3; 30; 33-35; 43; 44. And “[a]ccording to a further aspect, mobile device 210 can communicate with controller 216 using a WIFI or 802.11 based communication, Bluetooth communication, Zigbee communication, or various other wireless communication, or any combination thereof” (*a wireless radio compatible with a wireless radio frequency protocol*). EX1014 at 6:63-67; EX1015 at 8 at § 1.3; 30; 33-35; 43; 44.

262. The POSITA would have been motivated to combine the wireless radio of Imes with the Ehlers thermostat for at least the reasons described in Section X.C.i (Motivation to Combine Imes, Young, and Ehlers).

vii. Claim [1E]: a temperature sensor;

263. Ehlers discloses that an “[i]nput function 15 provides for interfacing with sensors and equipment” such as those that “sense internal and external environmental conditions including temperature and humidity, as well as other conditions such as occupancy” (*a temperature sensor*). EX1010 at 14-19.

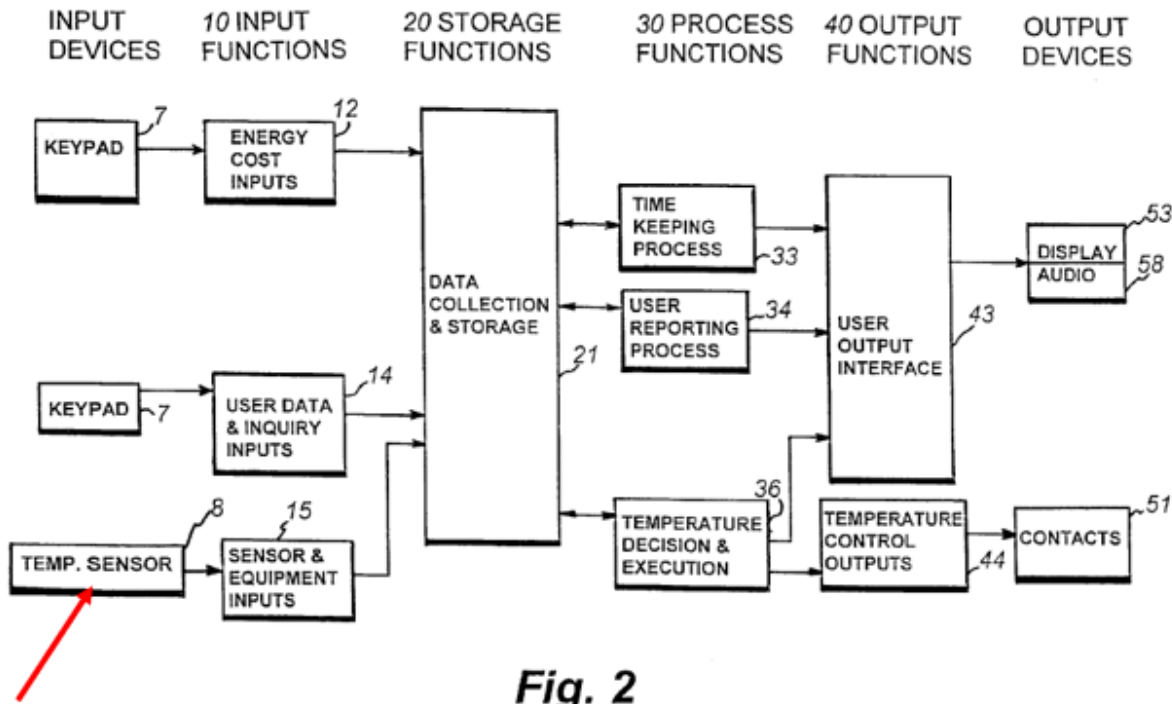


Fig. 2

EX1010, Fig. 2 (annotated).

viii. Claim [1F]: one or more processors configured with electronic circuitry to;

264. Ehlers discloses a system that includes “at least one input device 10, a memory 20, **a processor 30**, a user interface and device control block 40 and an external device 50” (*one or more processors configured with electronic circuitry*).

EX1010 at 6:66-7:3 (emphasis added).

ix. Claim [1G]: receive HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building; and

265. As I explained above, Ehlers discloses that its system supports sensor types including “internal and external environmental conditions including temperature and humidity.” EX1010 at 10:14-19. As another example, Ehlers

explains that “the system of the invention would have the ability to sense an indoor temperature,” which “sensed conditions and inputs are processed by a processor of the system” (*receive HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building*). *Id.* at 2:52-65.

266. Thus, Ehlers discloses the receipt of HVAC data parameters, including a first data parameter from the temperature sensor comprising an interior temperature inside the building.

x. Claim [1H]: a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building;

267. As an initial matter, it would have been unclear to a POSITA how an “outside weather condition” could be collected from any source other than one “external to the building.” For example, outside weather conditions such as outdoor temperature, outdoor humidity, wind, etc. can only be measured or sourced by an apparatus that is necessarily located outside the building. A POSITA would have understood that outdoor weather conditions that require sensors outside of the monitored property for detection are necessarily collected from a source external to the building. Additionally, it was well known to receive weather data via network connections such as phone lines, and a POSITA would have appreciated receiving weather data from a network because it saves the cost and time associated with

installing outdoor temperature sensors at the monitored property, which is sometimes difficult or impossible to do. A POSITA also would have understood that temperature sensors installed at the monitored property, directly outside the building, may be faulty or unreliable depending on their placement (e.g., temperatures measured by a sensor at the property may be affected by the amount of sunlight or shade provided by nearby buildings or trees). And a POSITA would have recognized that by the time of the '890 Patent's earliest potential filing date, it was common for weather service providers to provide outside temperature data over a network connection. *See, e.g.*, EX1010 at 9:50-58.

268. Regardless, Ehlers discloses an “[i]nput function 13 [that] provides weather information,” which can be provided by “decoding DTMF from a phone input or through a communications link.” EX1010 at 9:50-58. “The data can come from either an energy provider or a weather service provider.” *Id.* The weather data received “can be in the form of discrete parameters representing temperature, humidity, wind speed and direction or a weather index value suitable for use in calculating the effect of weather on cooling or heating a premise.” *Id.* at 54-58. “The data may be provided at regular intervals and be sufficiently localized for acceptable accuracy.” *Id.* at 58-60. Said communications link “may be available to communicate to equipment remote to the system.” *Id.* at 14:14-15. A POSITA would have understood that communicating with equipment remote to a given

system may utilize a network. In particular, a POSITA would have understood that Ehlers' phone input or communication link provides a connection to a telephone network and is therefore a network connection.

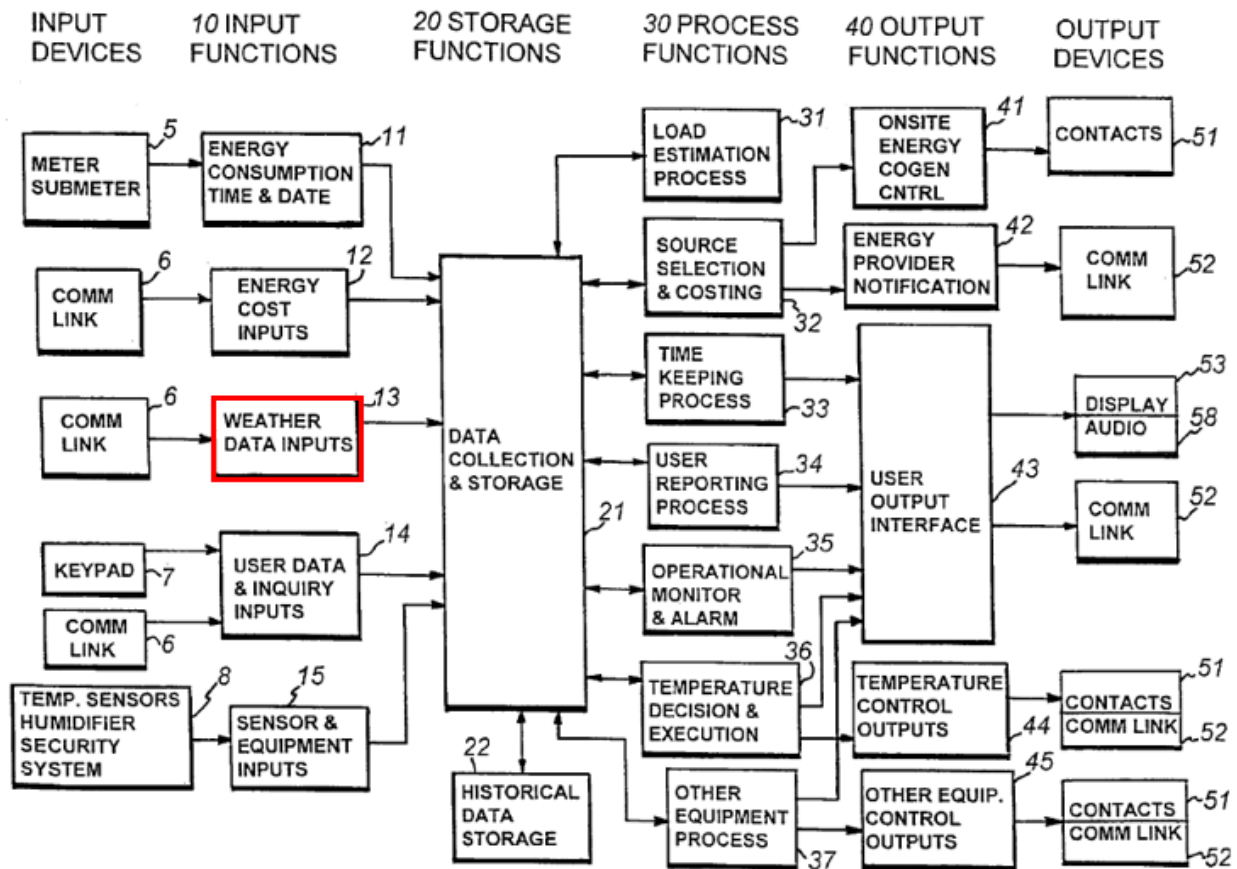


Fig. 4

EX1010, Fig. 4 (annotated).

269. Thus, Ehlers discloses a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building.

270. Moreover, Imes discloses an energy management system that obtains data from an external data source using a network connection. EX1014 at 34:18-

20; EX1015 at 8 at § 1.4; 15 at § 2.1.10. “For example, an external data source 612 can include subscription based, non-subscription based, or any combination thereof of data having weather conditions . . .” (*a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building*).

EX1014 at 34:24-27; see EX1015 at 8 at § 1.4; 15 at § 2.1.10. The wireless thermostat of Imes can include “a weather forecast display 1104.” EX1014 at 49:1-3; see EX1015 at 8 at § 1.4; 15 at § 2.1.10.

xi. Claim [1I]: determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value;

271. Ehlers teaches that determining a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value was well-known in the art. For example, Ehlers explains that temperature control systems “may be programmed by a user with **multiple desired temperature settings** for activating both heating systems and cooling systems **based on time-dependent user-programmed parameters**, such as time of day, day of week, month, etc.” (*determine a first temperature setpoint data parameter for the building, wherein the first setpoint data parameter includes a first temperature value and a first time value*). EX1010 at 1:57-64. I understand that Patent Owner may argue that the claimed determination must be made by the

“thermostat system” and without user involvement. In that case, this limitation is further disclosed by the artificial intelligence systems disclosed in Ehlers as described in Ground 1B with respect to claim 14, and by the location-based control disclosed in Imes as described in Ground 2A with respect to element [1L].

xii. Claim [1J]: determine a second temperature setpoint data parameter for the building, wherein the second setpoint data parameter includes a second temperature value and a second time value;

272. For the same reasons as described above for element [1I], Ehlers discloses multiple temperature setpoint parameters and associated time values (*determine a second temperature setpoint data parameter for the building, wherein the second setpoint data parameter includes a second temperature value and a second time value*).

xiii. Claim [1K]: receive radio frequency signals from the location-aware mobile device;

273. Imes discloses that its mobile devices can communicate at least indirectly with one or more components of the system with radio frequency signals. As I explained earlier with respect to limitation [1K] of Ground 1A in Section X.A.xiii, I understand that in a parallel district court proceeding, Patent Owner asserted that this limitation may be met by a location-aware mobile device that communicates indirectly through a network to include one or more servers as

meeting this limitation. EX1012 at 53-63. I rely on Patent Owner's interpretation only for the purposes of this IPR.

274. According to the Patent Owner's interpretation of this limitation, it is not necessary for the mobile device to communicate directly with the thermostat system using the wireless radio frequency protocol. Thus, according to Patent Owner's interpretation, whether a mobile device communicates *directly* via wireless radio frequency protocol with the thermostat, or whether the mobile device communicates *indirectly* through a network, either satisfies the limitations of this claim.

275. For example, as illustrated below in Figure 6 (annotated), the energy management system disclosed by Imes "can include mobile client interface 634 operable to be coupled to mobile device 632 associated with site 604." EX1014 at 39:59-64; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. "For example, mobile client interface 634 can include a WAP gateway or other mobile client gateway to enable server 602 access to mobile device 632." EX1014 at 39:61-64; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. This mobile client interface can be provided as part of a server. EX1014 at 39:64-67; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 11 at § 2.1.4; 28; 30; 33-35; 43-45. Imes teaches that the mobile client interface 634 "can receive a request from mobile device 632 to modify a current temperature set-point of HVAC system

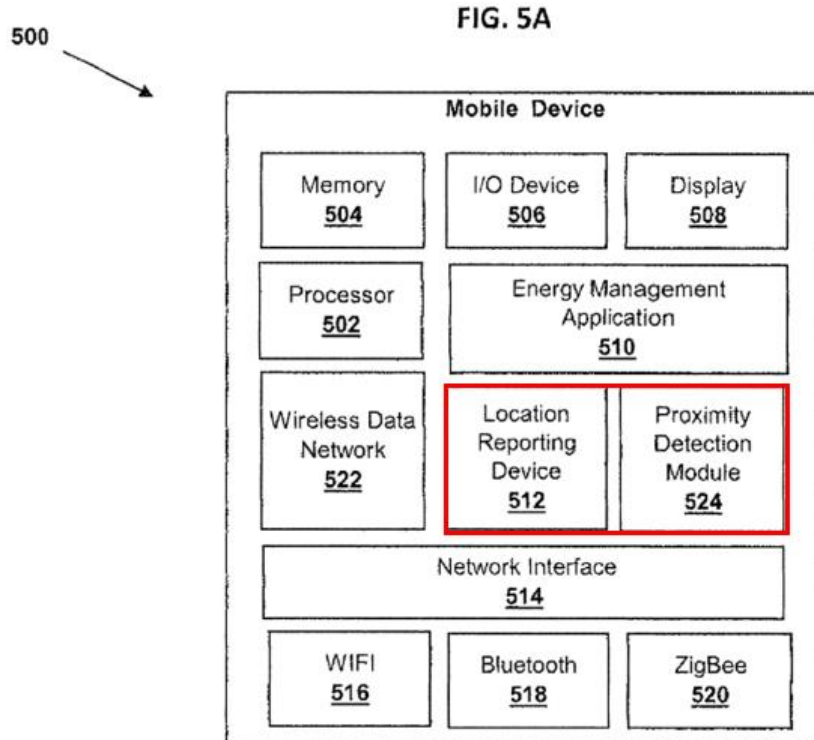
630,” and communicate the control action to the site using site interface 622 (receive radio frequency signals from the location-aware mobile device). EX1014 at 30:19-40; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 10 at § 2.1.1; 11 at § 2.1.4; 19 at § 2.1.9; 16 at § 2.1.12; 28; 30; 33-35; 43-45. Then, when the temperature set-point has been updated, “home controller 626 can communicate a control action confirmation data . . . to confirm the updated temperature set-point,” and the processor can output confirmation to the mobile client interface 634 and output an updated temperature set-point to mobile device 632. EX1014 at 30:19-40; EX1015 at 7-8 at § 1.3; 8-9 at § 1.4; 10 at § 2.1.1; 11 at § 2.1.4; 19 at § 2.1.9; 16 at §§ 2.1.12, 2.1.14; 28; 30; 33-35; 43-45.

xiv. Claim [1L]: receive geo-positioning data from the location-aware mobile device and automatically adjust a temperature value based on the geo-positioning data, including initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user;

276. As described with respect to Limitation [1K], Imes discloses receiving radio frequency signals from the location-aware mobile device. See EX1014 at 53:64-54:8 (“mobile device 1324 can be used to alter and [sic] operating condition of TSTAT 1320”); EX1015 at 7 at § 1.2; 7-8 at § 1.3; 10 at § 2.1.1. Further, Imes discloses the control of devices in a property based on geographic proximity of a user to the property. EX1014 at 7:66-8:4; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

277. For example, Imes describes that a mobile device 500 can be configured to enable a user to manage energy use of a site. EX1014 at 29:28-31; EX1015 at 7 at § 1.2; 7-8 at § 1.3; 10 at § 2.1.1. As illustrated in Figure 5A (annotated) below, “[m]obile device 500 can also include a **location reporting device 515, such as GPS technology**, cell tower location technology, triangulation technology or any combination thereof. Portions of location reporting device 515 can be located within mobile device 500” (*receive geo-positioning data from the location-aware mobile device*). EX1014 at 29:31-38 (emphasis added); EX1015 at 7-8 at § 1.3; 9 at § 1.4; 15 at § 2.1.8; 30; 37.

278. As another example, Imes describes that “proximity detection module 524 can be operated as a background process that periodically requests a location from location reporting device 512. Location reporting device 512 can use various location reporting methods (e.g. GPS, triangulation, etc.) to detect a current location.” EX1014 at 32:8-24; EX1015 at 7-8 at § 1.3; 9 at § 1.4; 15 at § 2.1.8; 30; 37. The “proximity mode” disclosed by Imes involves “**automatically controlling** a network device based on detecting a location the mobile device may be from the residential site.” EX1014 at 18:59-67; EX1015 at 10 at § 2.1.1.



EX1014, Fig. 5A (annotated).

279. As yet another example, Figure 6 (annotated) below depicts that a “[s]erver 602 can also include a site interface 622 that can be coupled to site 604 using a network connection 624 operable to be coupled to a home controller 626.” EX1014 at 34:45-48; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28; 30; 32. Imes describes the use of proximity zones to automatically adjust a temperature value based on the geo-positioning data, including initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user: “[S]ite 604 can also include a wireless thermostat, TSTAT 628, operably coupled to NVAC system, HVAC 630. Site 604 can further include

a mobile device 632 associated with site 604.” EX1014 at 34:51-64; EX1015 at 8 at § 1.3; 9 at § 1.4; § 2.1.8; 9 at § 2.1.9; 15 at § 2.1.10; 16 at § 2.1.11; 35.

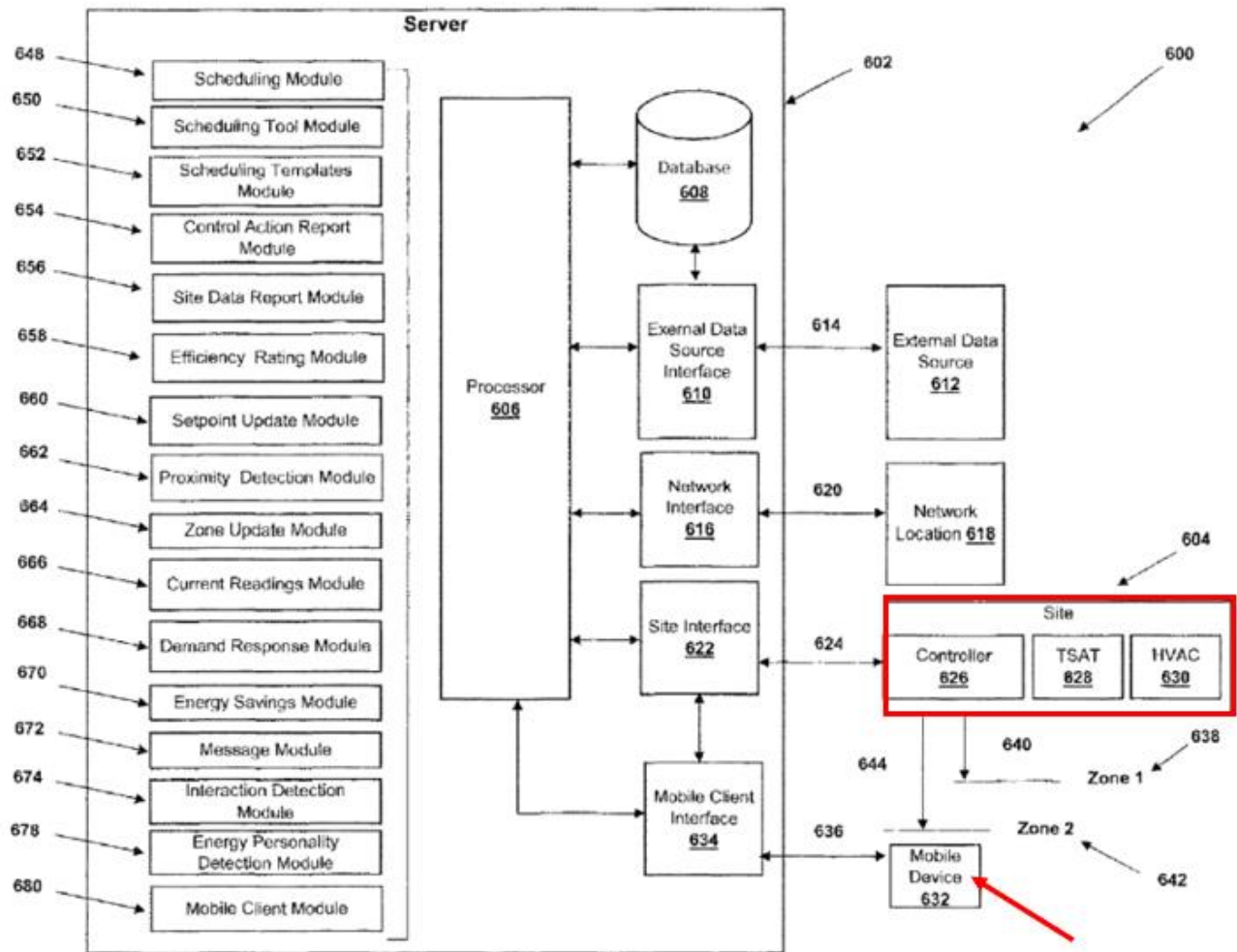
“According to an aspect energy management system 600 can be operably [sic] to provide a first zone 638 having a first distance 640, and a second zone 642 having a second distance 642. First zone 638 and second zone 642 can be used to control TSTAT 628 and HVAC 630.” EX1014 at 34:51-64; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

280. In another aspect of the energy management system disclosed in Imes, the server adjusts the set point of the thermostat by a certain percentage depending on the zone in which the mobile device is located in away from the home (*automatically adjust a temperature value based on the geo-positioning data*):

According to another aspect, server 602 can use proximity detection module 662 to detect when mobile device 632 may be moving away from site 604, and adjust HVAC 630 using thermostat 628. For example, processor 606 can detect mobile device 632 moving away from site 604. Processor 606 can further detect a percentage change value associated with a current zone, and further detect a base set-point of TSTAT 628. Processor 606 can further determine a difference between the base set-point, and a minimum seasonal set-point in response to a current operating mode of the HVAC 630. For example, if the HVAC 630 is in a heating mode a percentage change can be determined to adjust use of a heating unit.

EX1014 at 36:25-36; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28.

FIG. 6



EX1014, Fig. 6 (annotated).

281. I understand that in the parallel district court case, Patent Owner interprets switching to Away temperatures as satisfying “initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user.” EX1012 at 69. I am relying on Patent Owner’s interpretation only for the purposes of this IPR.

282. Imes discloses that “control data can be provided in response to a detection of a travel direction and a distance between mobile device 210 having location reporting device, and site 202.” EX1014 at 11:10-12; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. “For example, as mobile device 210 moves away from residential site 202, TSTAT 208 setting can be adjusted up during a warm or summer season (or down during a cold or winter season) to reduce energy consumption” (*initiating at least one cooling or heating cycle for the HVAC system when the geo-positioning data is determined to indicate that the building is unoccupied by the user*). EX1014 at 11:16-21; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. A POSITA would have understood that the detection of a mobile device moving away from a residential site would indicate that the residential site is unoccupied.

xv. Claim [1M]: electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system;

283. Ehlers discloses electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system.⁴ Ehlers discloses an indoor

⁴ The claims suggest that “electronic circuitry” in limitations [1M] – 1[O] is different circuitry than the processor. That said, Patent Owner appears to be relying on the processor as being the same as the claimed electronic circuitry in the

environmental condition control and energy management system that includes an input function 14 that “interfaces with the user to allow for data input and inquiries.” EX1010 at 9:65-66. The user may enter data using “any standard data input device such as keypad input” or “a handheld remote control device or a communication link when the user is not local to the system.” *Id.* at 9:66-10:3. The types of data a user is able to input includes temperature set points (*electronic circuitry configured to allow the user to adjust a desired temperature for the HVAC system*). *Id.* at 10:3-9.

284. I understand that even though the claims at issue are directed to a thermostat, Patent Owner identifies a mobile application in some instances in its infringement contentions. I am relying on Patent Owner’s interpretation only for the purposes of this IPR.

285. To the extent Patent Owner argues that the electronic circuitry is referring to a mobile device, Imes teaches that a mobile device may be used to allow a user to adjust a desired temperature for the HVAC system. Specifically, Imes teaches that an energy management user interface (EMUI) can be accessed from a mobile device, from which “a user can adjust a thermostat set-point up or

contentions. EX1012 at 70-81. As such, and for the purposes of this IPR only, Petitioner has adopted this position.

down.” EX1014 at 41:16-23, 41:64-67; EX1015 at 7 at § 1.2; 7-8 at § 1.3; 11 at § 2.1.4; 11 at § 2.1.5.

xvi. Claim [1N]: electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times; and

286. Claim limitation [1N] is directed to “a plurality of data parameters *specific to the user*, including at least one data parameter relating to usage of the HVAC system at various times.” EX1001 at cl. 1 (emphasis added). That is, the claim is limited to user level data parameters. In contrast, Claim 17 is directed to “at least one performance characteristic of the HVAC system.” However, I understand that in a parallel district court proceeding, Patent Owner appears to interpret “data parameters specific to the user” as encompassing data parameters specific to a *monitored property*. See EX1012 at 81-83 (showing home energy usage reports). I rely on Patent Owner’s broad interpretation for the purposes of this IPR.

287. In view of Patent Owner’s interpretation, Ehlers discloses analyzing a plurality of data parameters specific to the user, including the user’s usage of the

HVAC system at various times.⁵ EX1010 at 21:64-22:28. For example, the system disclosed in Ehlers can “track patterns of set point change as they relate to times of day, days of the week and, at a minimum, track changes in these patterns for exceptions such as holidays,” which allows the system to track set point patterns or routines. *Id.* As another example, the system can analyze another parameter specific to the user, including by “tracking [] set point changes by the occupant in relationship to the outside weather conditions” (*electronic circuitry configured to analyze a plurality of data parameters specific to the user, including at least one data parameter relating to usage of the HVAC system at various times*). *Id.* By tracking these patterns, the system can maintain the indoor air temperature to achieve the desired comfort conditions of the occupant. *Id.* at 22:39-46.

288. Ehlers teaches that a storage function may collect and storage data types including “user preferences and limits,” and “consumption profiles.” EX1010

⁵ The claims suggest that “electronic circuitry” in limitations [1M] – 1[O] is different circuitry than the processor. That said, Patent Owner appears to be relying on the processor as being the same as the claimed electronic circuitry in the contentions. EX1012 at 81-83. As such, and for the purposes of this IPR only, Petitioner has adopted this position.

at 10:43-62. “Other optional data includes the HVAC consumption.” *Id.* at 28:24-29.

xvii. Claim [10]: electronic circuitry configured to generate and communicate usage metrics pertaining to the HVAC system over time; and

289. Ehlers discloses that the energy management system may maintain data such as “[h]istorical totals of energy units usage and cost for this month, last 14 months and year to date” (*electronic circuit configured to generate and communicate usage metrics pertaining to the HVAC system over time*). EX1010 at 38:38-39:6. The system is able to “retrieve instantaneous and historical operational statistics and reports stored in the system’s memory either locally or remotely.” *Id.* at 26:23-28. Such statistics may include “a history of temperature set points for the day,” and “historical totals of energy units usage and cost for this month, last month and year to date.” *Id.* at 26:29-50. The system is able to “provide operational feedback to the premise occupant . . . and permit them to access information on system operation.” *Id.* at 26:15-28.

xviii. Claim [1P]: a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling.

290. Claim Limitation [1P] is directed to a particular compressor delay circuit, which suggests to a POSITA that the compressor delay circuit is a physical circuit. I understand, however, that in a parallel district court proceeding, Patent

Owner appears to interpret the compressor delay circuit as software capable of keeping the compressor off before restarting. See EX1012 at 85 (“[T]he Accused Products include Compressor Protection to prevent equipment damage.”).

291. Regardless, Young specifically discloses a compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling. Young teaches a system timer that deactivates the fan and compressor relays when a door or window is detected to be open, only after a “shutoff delay” has passed. EX1016 at 2:51-61. Young also teaches a compressor timer that prevents a compressor from reactivating until a “startup delay” after the compressor’s deactivation has passed. *Id.*

292. Young also describes an example of how a compressor delay circuit “prevents wear and tear on the compressor and reduces the need for maintenance that would be caused if the compressor were turned on and off more frequently than allowed by the startup delay.” *Id.* at 3:18-22. If a fan and compressor have been turned off because a door or window have been left open, “the compressor timer will prevent reactivation of the compressor until the expiration of the startup delay” (*compressor delay circuit configured to delay the start or stop of a compressor for the HVAC system and protect the compressor from rapid cycling*). *Id.* at 3:12-22.

xix. Claim 2: The thermostat system of claim 1, wherein the one or more processors is further configured to determine whether the building is occupied or unoccupied.

293. I understand that in a parallel district court proceeding, Patent Owner accused products that utilize geo-fence technology, or “location-based temperature control” that “use[s] your smartphone’s location” as meeting this claim limitation. EX1012 at 93. I will rely on Patent Owner’s interpretation for the purposes of this IPR.

294. Ehlers further discloses that in certain embodiments of a thermostat system, the system “includes a mechanism for receiving an indication of premise occupancy and wherein the processor computes a vacancy deadband range and an occupied deadband range.” EX1010 at 4:47-50. One function of the energy management system disclosed in Ehlers “will use a no occupancy temperature set point for use when the premise is empty.” *Id.* at 33:54-56. The occupancy sensor disclosed in Ehlers “would permit the system to generate greater savings by allowing greater use of the dead-band during periods when the premise is vacant without jeopardizing the comfort of the occupant.” *Id.* at 21:41-47.

295. Regardless, Young discloses that “an occupancy sensor can be provided to sense the presence of occupants in the room” (*one or more processors is further configured to determine whether the building is occupied or*

unoccupied). EX1016 at 3:29-43. “Preferably also, the occupancy sensor comprises a motion detector.” *Id.* at 3:47-48.

xx. Claim 3: The thermostat system of claim 2, further comprising an interface configured to allow the user to input that the building is currently unoccupied.

296. As I described above with respect to claim 3 of Ground 1A in Section X.A.xx, it would have been well known to a POSITA that users typically have the ability to enter schedules of setpoint temperatures through some user interface on the thermostat. Furthermore, a POSITA would have understood that thermostats were well-known to have interfaces configured to allow a user to input so called “vacation” or “away” time slots into said schedules, thus it was well known that users typically have the ability to input when the building is currently unoccupied during those time slots. Indeed, the ’890 Patent teaches that users are allowed to establish programming schedules, including an away setting, to indicate that the building is currently unoccupied. EX1001 at 10:1-16.

297. Regardless, Ehlers discloses the use of “[a]n equipment interface” to access a Security System, which “will be used to determine if the premise is occupied to provide cost control occupancy sensing.” EX1010 at 31:59-65. “When the user arms the Security System, it is assumed the premise will be unoccupied and the temperature Set point will be changed to a user-defined or default level until the security system is disarmed” (*an interface configured to allow the user to*

input that the building is currently unoccupied). *Id.* Thus, Ehlers describes an interface configured to allow the user to input that the building is currently unoccupied.

298. As another example, Ehlers discloses that “[t]o maximize energy efficiency while the premise is not occupied or is vacant, as might be the case for a vacation home or second residence, the system would support a minimum requirements function . . . which would be ***enabled by the premise owner, occupant or bill payer*** when conditions warrant.” *Id.* at 20:4-10.

299. Thus, Ehlers discloses an interface configured to allow the user to input that the building is currently unoccupied.

xxi. Claim 4: The thermostat system of claim 3, wherein the determination of whether the building is occupied or unoccupied by the one or more processors is based at least on a fourth data parameter received from a motion sensor.

300. Ehlers discloses that “[u]pon detection of occupancy by a motion sensing device,” the system could “adjust the heating and cooling systems to narrow the deadband range to an occupied state.” EX1010 at 21:49-56.

301. As I described above, Young discloses that “an occupancy sensor can be provided to sense the presence of occupants in the room.” EX1016 at 3:29-43. “Preferably also, the occupancy sensor comprises a motion detector” (*wherein the determination of whether the building is occupied or unoccupied by the one or*

more processors is based at least on a fourth data parameter received from a motion sensor). *Id.* at 3:47-48.

302. As another example, Young discloses that an “occupancy sensor 70 is preferably an infrared motion detector and is also preferably wireless. The signal from the occupancy sensor is sent to the receiver 14, which then sends a signal to an occupancy timer 75 which is connected to both the fan relay 20 and compressor relay 30.” *Id.* at 5:21-29.

xxii. Claim 5: The thermostat system of claim 1, wherein the one or more processors is further configured to receive a third data parameter from a first sensor, wherein the third data parameter from the first sensor includes a measurement of at least one characteristic of a building within which the thermostat is located.

303. Ehlers discloses that an “[i]nput function 15 provides for interfacing with sensors and equipment as well as any other data sources that may be appropriate such as . . . communication link 6,” as illustrated in Figure 3 (annotated) below (*a third data parameter from a first sensor, wherein the third data parameter from the first sensor includes a measurement of at least one characteristic of a building within which the thermostat is located*). EX1010 at 10:14-17. In general, input functions condition and convert input device information to data useable by the system. *Id.* at 9:9-16. “Sensor types supported will sense internal and external environmental conditions including temperature and humidity.” *Id.* at 10:17-19.

304. A POSITA would have understood that the measurement of internal environmental conditions such as humidity is an example of a third data parameter that includes a measurement of at least one characteristic of a building within which the thermostat is located. Ehlers further discloses that the thermostat system could sense “at least” “UV intensity.” EX1010 at 2:52-57.

305. A POSITA would have understood that measuring UV intensity is one way to measure the sunlight striking a sensor. While other lighting sources such as fluorescent lights provide illuminance, UV radiation is a key component to sunlight.

xxiii. Claim 6: The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of the humidity of the building.

306. As described above, Ehlers discloses that the third data parameter from the first sensor can include internal humidity (*wherein the third data parameter from the first sensor comprises a measurement of the humidity of the building*). EX1010 at 10:17-19.

xxiv. Claim 7: The thermostat system of claim 5, wherein the third data parameter from the first sensor comprises a measurement of sunlight.

307. Ehlers discloses that the thermostat system could sense “at least” “UV intensity” (*wherein the third data parameter from the first sensor comprises a measurement of sunlight*), which POSITA would understand to be a measurement

of sunlight. EX1010 at 2:52-57. As described above with respect to claim 7 of Ground 1A in Section X.A.xxiv, a first sensor receives a third data parameter which reflects a measurement of at least one characteristic of a building within which the thermostat is located.

308. As an initial matter, the specification does not define a “characteristic of a building.” However, the ’890 Patent does describe that the system can also “help compensate for anomalies such as measurement inaccuracies due to factors such as poor thermostat location,” thus distorting the temperature read by the temperature sensor. EX1001 at 24:57-25:15.

309. The ’890 Patent also states that “when the direct sunlight hits the thermostat, the thermostat and the surrounding area can heat up, causing the internal temperature as read by the thermostat to diverge significantly from the average temperature for the rest of the house. A conventional thermostat has no way of distinguishing this circumstance from a genuinely hot day, and will both over-cool the rest of the house and waste considerable energy when it cycles the air conditioner in order to reduce the temperature as sensed by the thermostat.” *Id.* at 25:4-15.

310. As described above, a POSITA would have understood that the UV intensity disclosed in Ehlers is a measurement of the amount of sunlight and thus a characteristic of a building within which the thermostat is located.

xxv. Claim 8: The thermostat system of claim 7, wherein the second data parameter from the network connected to the thermostat further comprises a measurement of the outdoor humidity.

311. Claim limitation [1H] recited: “a second data parameter from a network connected to the thermostat, wherein the second data parameter comprises an outside weather condition collected from a source external to the building.” As I discussed above in paragraphs 131-135 the second data parameter from the network connected to the thermostat comprises an outside weather condition collected from a source external to the building.

312. To the extent that it is argued that the measurement of outdoor humidity must be transmitted from a source external to the building, which would be incorrect, Ehlers discloses an input function 13 that provides “weather information” that “can be provided by . . . a communications link.” EX1010 at 9:50-52. Said weather data “can be in the form of discrete parameters representing . . . humidity” “suitable for use in calculating the effect of weather on cooling or heating a premise.” *Id.* at 9:54-58. The system described in Ehlers could also “obtain, using a communications medium, weather information or indexes that it would use to maximize its efficiency.” *Id.* at 21:31-33. Information such as “humidity could all be received over the communication link . . . and used by the economic modeling tool to effectuate the optimal environment and energy unit cost consumption scheme” (*the second data parameter from the network connected to*

the thermostat further comprises a measurement of the outdoor humidity). *Id.* at 21:37-41.

D. Count 2B: Imes, Ehlers, Young, and Wedekind

i. Motivation to combine Imes, Ehlers, Young, and Wedekind

313. As was described in Ground 1A, the POSITA would have been motivated to combine Ehlers, Young, and Imes. The POSITA would have been motivated to combine the teachings of Wedekind with those of Ehlers, Young, and Imes, for at least the following several reasons.

314. Ehlers emphasizes that the prior art does not “provide automatic environmental condition control based on sensed external environmental conditions, which external conditions may greatly effect [sic] internal conditions.” EX1010 at 2:14-18. Ehlers also aims to “optimize comfort and minimize energy consumption and/or energy cost, based on user-defined parameters.” *Id.* at 2:35-39.

315. Imes teaches the importance of automated temperature control systems, and the enhanced user comfort and energy savings associated with changing thermostat setpoints when the user is away from the building. See EX1014 at 34:51-64. For example, Imes describes that a processor can detect the location of a mobile device within a specific location zone that that “site 604 can be controlled on a zone by zone basis as mobile device 632 moves away from, or towards, site 604.” EX1014 at 35:63-36:7; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at §

2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. The processor “can further detect a percentage change value associated with a current zone” to adjust the set point of a thermostat. EX1014 at 36:25-36; EX1015 at 7-8 at §§ 1.2, 1.3; 10 at § 2.1.1; 11-12 at § 2.1.6; 13 at § 2.1.7; 28. However, Imes does not provide specific implementation details regarding how its system would calculate the percentage change value, or the distance to be used for the zones.

316. Wedekind discloses additional details regarding a time needed to reach a desired heating or cooling setpoint. Wedekind recognizes that thermostat systems require different amounts of time to achieve a desired set-point temperature at a desired time, depending on the surrounding environment. EX1011 at 1:36-41.

317. A POSITA would have been motivated to combine the teachings of Wedekind, because Wedekind discloses the use of inputs such as indoor and outdoor air temperatures to “more accurately achieve predetermined temperatures at predetermined times in addition to achieving these conditions while optimizing energy consumption.” EX1011 at 2:45-63. Indeed, Wedekind discloses specific formulas that describe a thermodynamic model of the monitored enclosure and its associated climate control system that utilize thermal and thermodynamic parameters. EX1011 at 17:53-63. More specifically, the differential equations utilized in the predictor system govern the average temperature (T') of the

conditioned space, the average temperature (T) of the thermal capacitance of the enclosure, and the rate at which energy is delivered to or removed from the conditioned space by the climate control system. *Id.* at 17:68-18:64. Thus, a POSITA would have been motivated to combine the teachings of the base references with those of Wedekind to more accurately determine the proper start up times or percentage change in setpoint of a heating or cooling system to have an enclosure reach a desired set-point temperature when the user returns to the enclosure. *Id.* at 2:21-26.

318. Moreover, Wedekind teaches an energy prediction methodology which uses certain thermal and thermodynamic parameters, along with the measured outdoor air temperature, to determine “the optimum thermostat setback schedule 80 which, while maintaining the user-specified occupancy comfort schedule 39, minimizes the input energy consumption of the climate control system 18.” EX1011 at 17:53-67. Wedekind further teaches a processing means that will “automatically change the setback temperature if it computes, using the non-linear efficiency model a more energy efficient setback temperature exists for the existing outside air temperature and occupancy comfort schedule 39.” *Id.* at 6:44-48. The POSITA would have been motivated to combine Wedekind so as to be able to automatically change the setback temperature so as to improve energy efficiency and enhance comfort.

319. The POSITA would have had a reasonable expectation of success in the combination given that each of the references disclose thermostats to control heating and cooling devices as well as specific mechanisms for controlling when to activate an HVAC system so as to achieve a particular setpoint at a particular time.

320. Accordingly, a POSITA would have combined the teachings of Ehlers, Young, Imes, and Wedekind as described herein. Indeed, combining their teachings would have been routine to a POSITA due to this overlap and the simple software and system modifications to adjust Ehlers so it includes the teachings of Imes, Young, and Wedekind.

ii. Claim 9: The thermostat system of claim 1, further comprising a memory configured to store historical values of the first data parameter and second data parameter.

321. As I explained above in paragraphs 129-30, the first data parameter is an indoor temperature. Ehlers further discloses that storing such data was well known in the art as it discloses a system that, “after being installed for a period of time, will have sufficient history data in its memory to provide the average consumption analysis data such as energy units used and cost of the energy units as a function of time, temperature, occupant changes in the set point and weather related factors for normalization” (*a memory configured to store*). EX1010 at 17:56-64.

322. Ehlers further discloses that the user interface device located on a premise can supply “a ***history of temperature set points*** for the day” (*historical values of the first data parameter*) and “***weather information and history data*** including outside temperature lows and highs, humidity, chance of precipitation, wind speed and direction and Ultra Violet [UV] indices” (*second data parameter*). *Id.* at 27:4-7 (emphasis added).

iii. Claim 10: The thermostat system of claim 1, wherein the one or more processors is further configured to predict, based at least on the first data parameter, the second data parameter, and the first temperature setpoint data parameter, the time necessary for the HVAC system to operate in order for the building to reach the first temperature value by the first time value.

323. For at least the reasons described above in Ground 1B with respect to Claim 10 in Section X.B.iii, Wedekind and Ehlers disclose one or more processors further configure to predict, based at least on the first data parameter (indoor temperature), the second data parameter (an outdoor weather condition), and the first temperature setpoint data parameter, the time necessary for the HVAC system to operate in order for the building to reach the first temperature value by the first time value.

- iv. Claim 11: The thermostat system of claim 10, wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.***

324. For at least the reasons described above in Ground 1B with respect to Claim 11 in Section X.B.iv, Wedekind and Ehlers disclose that the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on determining a rate of change value necessary for the building to reach the first temperature value by the first time value.

- v. Claim 12: The thermostat system of claim 11, wherein the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value.***

325. For at least the reasons described above in Ground 1B with respect to Claim 12 in Section X.B.v, Ehlers discloses that the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value. For the same reasons as above in Claim 11, Ehlers discloses a thermostat system wherein the automatic adjustment of the temperature setpoint is based at least in part on the rate of change value.

- vi. Claim 13: The thermostat system of claim 10, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.***

326. For at least the reasons described above in Ground 1B with respect to Claim 13 in Section X.B.vi, Wedekind discloses that the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

- vii. Claim 14: The thermostat system of claim 10, further comprising a memory configured to store historical values of the first data parameter and second data parameter; wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value is further based on historical values of the first data parameter and second data parameter.***

327. A memory configured to store historical values of the first data parameter and second data parameter is disclosed for at least the reasons provided with respect to Claim 9. And for at least the reasons described above in Ground 1B with respect to Claim 14 in Section X.B.vii, Wedekind and Ehlers disclose a memory configured to store historical values of the first data parameter and second data parameter; wherein the one or more processors' prediction of the time necessary for the HVAC system to operate in order to reach the first temperature

value by the first time value is further based on historical values of the first data parameter and second data parameter.

viii. Claim 15: The thermostat system of claim 14 wherein the one or more processors determines one or more intermediate temperature setpoints that have a temperature value between a current temperature of the building and the first temperature setpoint.

328. For at least the reasons described above in Ground 1B with respect to Claim 15 in Section X.B.viii, Ehlers discloses that the one or more processors determines one or more intermediate temperature setpoints that have a temperature value between a current temperature of the building and the first temperature setpoint.

ix. Claim 16: The thermostat system of claim 14, wherein the automatic adjustment of the temperature setpoint is based at least in part on the prediction of time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value.

329. Claim 16 is rendered obvious for at least the same reasons as I explained above for Claims 13 and 14. As I described above in Section X.B.vii (discussing claim 14 of Ground 1B), the artificial intelligence systems described in Ehlers not only predict the time necessary for the HVAC system to operate in order to reach the first temperature value by the first time value, but they also are able to “automatically adjust the internal environmental conditions to meet the occupant’s desired comfort factors.” EX1010 at 22:35-39.

- x. Claim 17: The thermostat system of claim 1, wherein the one or more processors is further configured to receive a fifth data parameter generated based at least in part on a previous operation of the HVAC system, wherein the fifth data parameter includes at least one performance characteristic of the HVAC system.*

330. For at least the reasons described above in Ground 1B with respect to Claim 17 in Section X.B.x, Wedekind and Ehlers disclose one or more processors further configured to receive a fifth data parameter generated based at least in part on a previous operation of the HVAC system, wherein the fifth data parameter includes at least one performance characteristic of the HVAC system.

331. Moreover, Imes discloses receiving performance characteristics of the HVAC system through the use of an “efficiency rating module 232” that can retrieve “EMI [energy management information] stored within database 224 or a remote data source to determine an efficiency rating, thermal response, . . . performance data, or various other [sic] of site 202.” EX1014 at 7:61-65; EX1015 at 9 at § 1.4.

XI. REVISION OR SUPPLEMENTATION

332. In this report, I have presented my opinions regarding the invalidity of the claims of the '890 Patent based on the information available to me. My opinions are subject to change in view of opinions provided by the Patent Owner or its expert, or any additional information that I may receive. I reserve the right to supplement my opinions accordingly.

I hereby declare that all statements made herein of my own knowledge are true and that all opinions expressed herein are my own; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

A handwritten signature in dark ink, appearing to be "Mr. Edward Koch", is written over a horizontal line.

Mr. Edward Koch

December 23, 2022