



(51) International Patent Classification:

|                      |                       |
|----------------------|-----------------------|
| H04W 24/10 (2009.01) | H04W 24/04 (2009.01)  |
| H04W 24/02 (2009.01) | H04B 7/0413 (2017.01) |
| H04W 28/08 (2009.01) | G06F 1/20 (2006.01)   |
| H04W 52/42 (2009.01) | H04W 52/38 (2009.01)  |
| H04W 84/12 (2009.01) | G01K 13/00 (2006.01)  |

(21) International Application Number:

PCT/US2018/063233

(22) International Filing Date:

30 November 2018 (30.11.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

|            |                               |    |
|------------|-------------------------------|----|
| 15/832,816 | 06 December 2017 (06.12.2017) | US |
| 15/832,822 | 06 December 2017 (06.12.2017) | US |
| 15/832,878 | 06 December 2017 (06.12.2017) | US |

(71) Applicant: **PLUME DESIGN, INC.** [US/US]; 290 S. California Ave., Suite 200, Palo Alto, CA 94306 (US).

(72) Inventors: **MCFARLAND, William**; 290 S. California Ave., Suite 200, Palo Alto, CA 94306 (US). **MALKIN, Yoseph**; 290 S. California Ave., Suite 200, Palo Alto, CA 94306 (US). **CHANG, Richard**; 290 S. California Ave.,

Suite 200, Palo Alto, CA 94306 (US). **HANLEY, Patrick**; 290 S. California Ave., Suite 200, Palo Alto, CA 94306 (US).

(74) Agent: **BARATTA, Lawrence A., Jr.**; Clements Bernard Walker, 4500 Cameron Valley Parkway, Suite 350, Charlotte, NC 28211 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: THERMAL MANAGEMENT OF WIRELESS ACCESS POINTS

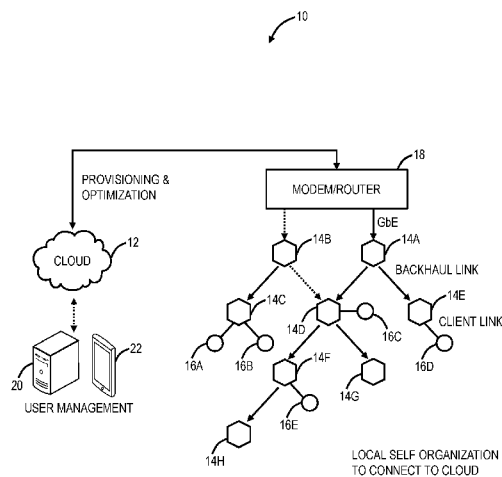


FIG. 1

(57) Abstract: The present disclosure relates to thermal management of wireless access points including local thermal management, cloud-based thermal management, and thermal management based on optimization and operation such as in a distributed Wi-Fi network. The objective of the present disclosure is for thermal management in access points allowing small form-factors and aesthetic designs, preventing overheating and without requiring reduced performance or reduced hardware. Generally, the systems and methods detect when access points are nearing overheating and alter their operation so as to minimize the reduction of performance in the network while reducing power consumption.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

**Published:**

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**(88) Date of publication of the international search report:**

30 January 2020 (30.01.2020)

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2018/063233****A. CLASSIFICATION OF SUBJECT MATTER****H04W 24/10(2009.01)i, H04W 24/02(2009.01)i, H04W 28/08(2009.01)i, H04W 52/42(2009.01)i, H04W 84/12(2009.01)i, H04W 24/04(2009.01)i, H04B 7/0413(2017.01)i, G06F 1/20(2006.01)i, H04W 52/38(2009.01)i, G01K 13/00(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

H04W 24/10; G05B 19/418; G06F 17/18; G08C 17/00; H04M 1/02; H04W 24/04; H04W 52/00; H05K 7/20; H04W 24/02; H04W 28/08; H04W 52/42; H04W 84/12; H04B 7/0413; G06F 1/20; H04W 52/38; G01K 13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) &amp; Keywords: Wi-Fi, access point, thermal mitigation, radio chips, threshold, cloud-based controller

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No. |
|-----------|---|-----------------------|
| X         | US 2010-0091691 A1 (JOHN G. DORSEY et al.) 15 April 2010<br>See paragraphs [0016], [0024]-[0035], [0094], [0114], [0131]-[0143], [0150]-[0163], [0180]-[0181]; and figures 1, 2B. | 1-14, 16-20           |
| A         |   | 15                    |
| X         | US 2016-0283443 A1 (ROCKWELL AUTOMATION TECHNOLOGIES, INC.)<br>29 September 2016<br>See paragraphs [0003]-[0095]; and figures 1-6.  | 1-14, 16-20           |
| A         | US 2010-0285828 A1 (JAMES L. PANIAN et al.) 11 November 2010<br>See paragraphs [0005], [0013], [0039], [0050], [0069], [0089]; and figures 1-2.                                   | 1-20                  |
| A         | US 2014-0247729 A1 (QUALCOMM INCORPORATED) 04 September 2014<br>See paragraphs [0001], [0031]-[0047]; and figure 2.   | 1-20                  |
| A         | KR 10-2016-0085640 A (LG ELECTRONICS INC.) 18 July 2016<br>See paragraphs [0047]-[0048], [0146]-[0151]; and figure 1.   | 1-20                  |

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

17 December 2019 (17.12.2019)

Date of mailing of the international search report

**17 December 2019 (17.12.2019)**

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

YANG, Jeong Rok

Telephone No. +82-42-481-5709



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2018/063233**

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|--|------------------|-------------------------|------------------|
| US 2010-0091691 A1                     | 15/04/2010       | US 8244296 B2           | 14/08/2012       |
| US 2016-0283443 A1                     | 29/09/2016       | EP 3076253 A1           | 05/10/2016       |
|  |                  | EP 3076256 A1           | 05/10/2016       |
|  |                  | EP 3076257 A1           | 05/10/2016       |
|  |                  | US 10025300 B2          | 17/07/2018       |
|  |                  | US 10054934 B2          | 21/08/2018       |
|  |                  | US 10185309 B2          | 22/01/2019       |
|  |                  | US 10185310 B2          | 22/01/2019       |
|  |                  | US 10254749 B2          | 09/04/2019       |
|  |                  | US 10394227 B2          | 27/08/2019       |
|  |                  | US 2016-0282828 A1      | 29/09/2016       |
|  |                  | US 2016-0282843 A1      | 29/09/2016       |
|  |                  | US 2016-0282853 A1      | 29/09/2016       |
|  |                  | US 2016-0282854 A1      | 29/09/2016       |
|  |                  | US 2016-0282858 A1      | 29/09/2016       |
|  |                  | US 2016-0282859 A1      | 29/09/2016       |
|  |                  | US 2016-0284073 A1      | 29/09/2016       |
|  |                  | US 2016-0284128 A1      | 29/09/2016       |
|  |                  | US 2016-0284144 A1      | 29/09/2016       |
|  |                  | US 2016-0285274 A1      | 29/09/2016       |
|  |                  | US 2016-0285959 A1      | 29/09/2016       |
|  |                  | US 2018-059653 A1       | 01/03/2018       |
|  |                  | US 2018-321661 A1       | 08/11/2018       |
|  |                  | US 2019-219991 A1       | 18/07/2019       |
|  |                  | US 9665091 B2           | 30/05/2017       |
|  |                  | US 9804590 B2           | 31/10/2017       |
|  |                  | US 9805460 B2           | 31/10/2017       |
|  |                  | US 9898001 B2           | 20/02/2018       |
|  |                  | US 9971344 B2           | 15/05/2018       |
| US 2010-0285828 A1                     | 11/11/2010       | CN 102422682 A          | 18/04/2012       |
|  |                  | CN 102422682 B          | 03/12/2014       |
|  |                  | EP 2430862 A2           | 21/03/2012       |
|  |                  | EP 2894907 A1           | 15/07/2015       |
|  |                  | JP 2012-526478 A        | 25/10/2012       |
|  |                  | JP 2014-014088 A        | 23/01/2014       |
|  |                  | JP 2016-040927 A        | 24/03/2016       |
|  |                  | JP 6073198 B2           | 01/02/2017       |
|  |                  | KR 10-1354061 B1        | 23/01/2014       |
|  |                  | KR 10-2012-0007076 A    | 19/01/2012       |
|  |                  | TW 201127137 A          | 01/08/2011       |
|  |                  | US 8229492 B2           | 24/07/2012       |
|  |                  | WO 2010-129667 A2       | 11/11/2010       |
|  |                  | WO 2010-129667 A3       | 29/12/2010       |
| US 2014-0247729 A1                     | 04/09/2014       | TW 201438455 A          | 01/10/2014       |
|  |                  | TW I573431 B            | 01/03/2017       |
|  |                  | US 9055470 B2           | 09/06/2015       |

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2018/063233**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
|   |                     | WO 2014-134315 A2          | 04/09/2014          |
|   |                     | WO 2014-134315 A3          | 23/10/2014          |
| KR 10-2016-0085640 A                      | 18/07/2016          | None                       |                     |