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International application number:	PCT/US2019/065750
International filing date:	11 December 2019 (11.12.2019)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 62/782,110
	Filing date: 19 December 2018 (19.12.2018)
Date of receipt at the International Bureau:	06 January 2020 (06.01.2020)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

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Document details: Country/Office: US

Filing date: 19 Dec 2018 (19.12.2018)

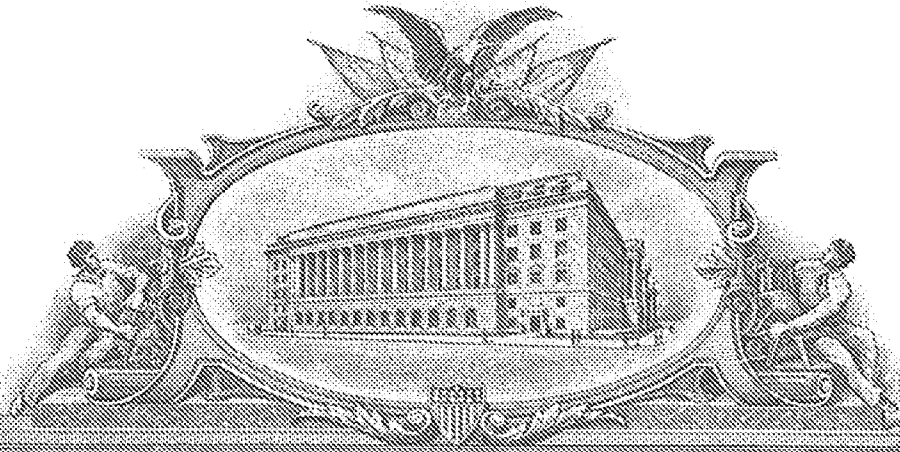
Application number: 62782110

Date of availability of document: 08 Jan 2019 (08.01.2019)

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THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

February 25, 2020

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: *62/782,110*
FILING DATE: *December 19, 2018*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US62/782,110*



Certified by

Anders Iversen

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	December 19, 2018
First Named Inventor	Kevin Ross
Title	METHODS FOR BUILDING WIRELESS MESH NETWORK
Art Unit	TBA
Examiner Name	TBA
Attorney Docket Number	Naim-00020

SIGNATURE of Applicant or Patent Practitioner

Signature	/Rory P. Shea/	Date (Optional)	2018-12-19
Name	Rory P. Shea	Registration Number	60529
Title (if Applicant is a juristic entity)	Attorney of Record		
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.



*Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

130085

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

- ☒ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature

Date (Optional)

Name

Kevin Ross

Title

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

130085

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

--

- ☒ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Ahsan Naim	Date (Optional)	12/05/2016
Name	Muhammad Ahsan Naim		
Title			

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	34642564
Application Number:	62782110
International Application Number:	
Confirmation Number:	9762
Title of Invention:	METHODS FOR BUILDING WIRELESS MESH NETWORK
First Named Inventor/Applicant Name:	Kevin Ross
Customer Number:	130085
Filer:	Rory Patrick Shea
Filer Authorized By:	
Attorney Docket Number:	Naim-00020
Receipt Date:	19-DEC-2018
Filing Date:	
Time Stamp:	17:25:41
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 140
RAM confirmation Number	122018INTEFSW17261200
Deposit Account	506632
Authorized User	Rory Shea
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	Naim-00020_ADS.pdf	1255805	no	8
			874e88931178531e5f1f16392c36952cd2b bd4d7		

Warnings:**Information:**

2	Provisional Cover Sheet (SB16)	Naim-00020_ProvCoverSheet. pdf	2032314	no	3
			eede92341a1ee1d78df09c424581047cdb bbc7b		

Warnings:**Information:**

3		Naim-00020_Spec.pdf	181792	yes	28
			c5383228022d90d88e5f819b9c5d6111ee9 f42c3		

Multipart Description/PDF files in .zip description

	Document Description		Start	End
	Abstract		28	28
	Specification		1	27

Warnings:**Information:**

4	Drawings-only black and white line drawings	Naim-00020_Figs.pdf	382952	no	14
			48d703202397bb42a47426cc791cbc3235f 975fd		

Warnings:**Information:**

5	Power of Attorney	Naim-00020_POA_for_filing. pdf	891639	no	3
			b5225a77eb5f024ad81b067a0d5247d7470 2c0ec		

Warnings:**Information:**

6	Fee Worksheet (SB06)	fee-info.pdf	29530 cc5eb4266b23421209236e59ccb66e6578792568	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			4774032		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Kevin		Ross			
Residence Information (Select One) • US Residency Non US Residency Active US Military Service						
City	Lehi	State/Province	UT	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	4186 N Red Maple Ct					
Address 2						
City	Lehi	State/Province	UT			
Postal Code	84043	Country i	US			
Inventor	2				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Muhammad	Ahsan	Naim			
Residence Information (Select One) • US Residency Non US Residency Active US Military Service						
City	South Jordan	State/Province	UT	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	2676 West Constance Way					
Address 2						
City	South Jordan	State/Province	UT			
Postal Code	84095	Country i	US			
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.						

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).
--

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

☐ An Address is being provided for the correspondence information of this application.

Customer Number	130085		
Email Address	ls3_docketing@cardinal-ip.com	Add Email	Remove Email

Application Information:

Title of the Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		
Attorney Docket Number	Naim-00020	Small Entity Status Claimed ☒	
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	14	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:
☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	130085		

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Remove
Application Number	Continuity Type	Prior Application Number
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.		Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Remove
			Access Code ⁱ (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

- ☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
- NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1 Remove			
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section. Clear				
Assignee	Legal Representative under 35 U.S.C. 117		Joint Inventor	
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest		
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:				
Name of the Deceased or Legally Incapacitated Inventor:				
If the Applicant is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Applicant:				
Address 1				
Address 2				
City		State/Province		
Country		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Applicant Data may be generated within this form by selecting the Add button.				Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

Assignee	1
-----------------	---

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Rory P. Shea/		Date (YYYY-MM-DD)	2018-12-19
First Name	Rory P.	Last Name	Shea	Registration Number
				60,529

Additional Signature may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	Naim-00020
		Application Number	
Title of Invention	METHODS FOR BUILDING WIRELESS MESH NETWORK		

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Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

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Title of Invention

METHODS FOR BUILDING WIRELESS MESH NETWORK

Attorney Docket Number (if applicable)

Naim-00020

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

130085

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

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Entity Status**Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29**

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Signature	Rory P. Shea/		Date (YYYY-MM-DD)	2018-12-19
First Name	Rory P.	Last Name	Shea	Registration Number (If appropriate)
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ABSTRACT:

[00044] Methods, and systems relating to narrow beam wireless mesh network planning and deployment are disclosed. Example methods for wireless network planning and deployment include identification of an AOI either through consideration of various factors or as a result of pre-marketing which is followed by door to door marketing that provides a list of candidate sites to the network planning engine. Network Planning engine filters out some candidate sites and design a wireless mesh network based on the remaining candidate sites. The design is handed over to a scheduling entity for scheduling of installation team to complete the network installation and deployment phase in an optimal manner from time and cost perspectives.

Provisional Application for United States Patent

TITLE: METHODS FOR BUILDING WIRELESS MESH NETWORK

INVENTOR(S): Kevin Ross, Lehi, UT 84043
Muhammad A. Naim, South Jordan, UT 84095

[0001] BACKGROUND

[0002] The present disclosure, for example, relates to wireless networks and communications including, but not limited to, broadband internet services to end user, security and/or automation systems, and more particularly to narrow beam mesh networking and related operations and techniques.

[0003] Wired and wireless networking and communications systems are widely deployed to provide various types of communication and functional features, including but not limited to those for security and automation, and/or others. These systems may be capable of supporting communication with a user through a communication connection or a system management action.

[0004] Contemporary wireless mesh network rollout approaches for fixed wireless access especially in those networks where ptp/ptmp millimeter wave link length is very short (50~300 meters) involve fiber PoP site/node development, establishing multiple long ptp/ptmp links from the fiber PoP site(s) to seed homes sites i.e. seed home sites development. This is followed by making a line-of-sight (LOS) analysis from seed homes for the potential anchor homes (high speed internet fixed wireless customers) to identify potential customers and finally followed by marketing including door-to-door sales for a small area to build a ring or multiple rings of anchor homes of wireless mesh network. Once, the sales and/or installation of anchor homes that form a partial ring, a complete ring, or multiple rings is completed, next round of sales starts targeting potential customers (LoS

availability to the existing nodes) to extend the mesh network by adding additional anchor homes or rings to the newly created portion of the mesh network. This process slows down the building of wireless mesh network especially the one that is spread over a large geographical area for example 10~20 sq. miles to due inherently sequential methodology of intermediary steps especially marketing using door-to-door (direct-to-home) sales that is done at mesh ring or cluster level rather than over a large portion of the intended coverage area of the wireless mesh network. Thus, there exists need in the art for improved methods and planning approaches relating to wireless communication network planning process and design to make the wireless mesh communication network rollout swift and cost efficient.

[0005] BRIEF SUMMARY OF THE DISCLOSURE

[0006] Contemporary wireless mesh network rollout approaches for fixed wireless access especially in those networks where ptp/ptmp millimeter wave link length is very short (50~300 meters) involve fiber PoP site/node development, establishing multiple long ptp/ptmp links from the fiber PoP site(s) to seed homes sites i.e. seed home sites development. This is followed by making a line-of-sight (LOS) analysis from seed homes for the potential anchor homes (high speed internet fixed wireless customers) to identify potential customers and finally followed by marketing including door-to-door sales for a small area to build a ring or multiple rings of anchor homes of wireless mesh network. Once, the sales and/or installation of anchor homes that form a partial ring, a complete ring, or multiple rings is completed, next round of sales start targeting potential customers (LoS availability to the existing nodes) to extend the mesh network by adding additional anchor homes or rings to the newly created portion of the mesh network. This process slows down the building of wireless mesh network especially the one that is spread over a large

geographical area for example 10~20 sq. miles to due inherently sequential methodology of intermediary steps especially marketing using door-to-door (direct-to-home) sales that is done at mesh ring or cluster level rather than over a large portion of the intended coverage area of the wireless mesh network.

[0007] One embodiment of wireless mesh planning and construction method described in the current disclosure involves a pre-marketing phase that includes sub-phases social media/online marketing, radio/television-based marketing and mailer-based marketing that can generate leads of potential customer locations that expressed interest in subscription of the internet service based on wireless mesh network. Based on these leads, cluster of interest (area) is identified that is used for subsequent door to door marketing and sales. The door to door marketing/sales agent upload potential customers information that signed the agreement to a server or shared drive or can use a software application (or mobile application) to provide real time potential mesh network customer information to the network planning engine. The software application can also get potential wireless mesh customer information from pre-marketing phase leads and pass on to network planning engine. Network planning engine based on various criteria defined the current disclosure disqualify some potential customer locations and select remaining customer location for wireless mesh network installation/development. Through a feedback loop, network planning engine can convert a potential customer location from disqualified status to selected status and also from selected status to disqualified status. In addition, network planning engine can also select among those potential customer location that are not selected for wireless mesh network construction for a different tier of service that is built at a later stage in near future. The different tier can be due to different technology, service level agreement and or equipment pricing. Network planning engine also interacts with

door to door marketing phase of the proposed wireless mesh network planning and construction method in the event where there is requirement to find additional customer locations to complete the mesh network due to missing sites. Network planning engine interacts with network installation/deployment phase where based on the list of customer locations and mesh network layout, scheduling entity with the help of optimization engine plans on hourly/daily/weekly bases the schedules of various installer teams working on different phases of network installation/deployment including electrical installation, line run, antenna mounting, ptp/ptmp node installation, alignment, provisioning and customer service activation at a cluster level. In a different embodiment, some of the above mentioned phases can be omitted or can interact with other phases in a different way or can take place in a different order.

[0008] Another embodiment of wireless mesh planning and construction method described in the current disclosure starts with the identification of an area of interest that is selected based on multiple factors that are defined in detail in this current disclosure. Based on the AOI, a pre-marketing phase that includes sub-phases social media/online marketing, radio/television-based marketing and mailer-based marketing is executed that can generate leads of potential customer locations that expressed interest in subscription of the internet service based on wireless mesh network. This is followed by door to door marketing phase where door to door marketing/sales agent upload potential customers information that signed the agreement to a server or shared drive or can use a software application (or mobile application) to provide real time potential mesh network customer information to the network planning engine. The software application can also get potential wireless mesh customer information from pre-marketing phase leads and pass on to network planning engine. Network planning engine based on various criteria defined the current disclosure

disqualify some potential customer locations and select remaining customer location for wireless mesh network installation/development. Through a feedback loop, network planning engine can convert a potential customer location from disqualified status to selected status and also from selected status to disqualified status. In addition, network planning engine can also select among those potential customer locations that are not selected for wireless mesh network construction for a different tier of service that is built at a later stage in near future. The different tier can be due to different technology, service level agreement and/or equipment pricing. Network planning engine also interacts with door to door marketing phase of the proposed wireless mesh network planning and construction method in the event where there is requirement to find additional customer locations to complete the mesh network due to missing sites. Network planning engine interacts with network installation/deployment phase where based on the list of customer locations and mesh network layout, scheduling entity with the help of optimization engine plans on hourly/daily/weekly bases the schedules of various installer teams working on different phases of network installation/deployment including electrical installation, line run, antenna mounting, ptp/ptmp node installation, alignment, provisioning and customer service activation at a cluster level. In a different embodiment, some of the phases described above can be omitted or can interact with other phases in a different way or can take place in a different order.

[0009] The foregoing has outlined rather broadly the features and technical advantages of examples according to this disclosure so that the following detailed description may be better understood. Additional features and advantages will be described below. The conception and specific examples disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same procedures of the present disclosure.

Characteristics of the concepts disclosed herein including their organization and method of operation together with associated advantages will be better understood from the following description when considered in connection with the accompanying figures. Each of the figures is provided for the purpose of illustration and description only, and not as a definition of the limits of the claims.

[00010] BRIEF DESCRIPTION OF THE DRAWINGS

[00011] A further understanding of the nature and advantages the present disclosure may be realized by reference to the following drawings.

[00012] Figure 1(A). Figure 1(A) shows a diagram relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00013] Figure 1(B). Figure 1(B) shows a diagram relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00014] Figure 2(A). Figure 2(A) shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00015] Figure 2(B). Figure 2(B) shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00016] Figure 3(A). Figure 3(A) shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00017] Figure 3(B). Figure 3B shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00018] Figure 4. Figure 4 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00019] Figure 5. Figure 5 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00020] Figure 6. Figure 6 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00021] Figure 7(A). Figure 7 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00022] Figure 7(B). Figure 7 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00023] Figure 8. Figure 8 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure;

[00024] Figure 9. Figure 9 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure; and

[00025] **Figure 10.** Figure 10 shows designs illustrating example methods relating to wireless networking and communication systems, in accordance with various aspects of this disclosure.

[00026] **DETAILED DESCRIPTION**

[00027] Contemporary wireless mesh network rollout approaches for fixed wireless access especially in those networks where ptp/ptmp millimeter wave link length is very short (50~300 meters) involve fiber PoP site/node development, establishing multiple long ptp/ptmp links from the fiber PoP site(s) to seed homes sites i.e. seed home sites development. This is followed by making a line-of-sight (LOS) analysis from seed homes for the potential anchor homes (high speed internet fix wireless customers) to identify potential customers and finally followed by marketing including door-to-door sales for a small area to build a ring or multiple rings of anchor homes of wireless mesh network. Once, the sales and/or installation of anchor homes that form a partial ring, a complete ring, or multiple rings is completed, next round of sales start targeting potential customers (LoS availability to the existing nodes) to extend the mesh network by adding additional anchor homes or rings to the newly created portion of the mesh network. This process slows down the building of wireless mesh network especially the one that is spread over a large geographical area for example 10~20 sq. miles to due inherently sequential methodology of intermediary steps especially marketing using door-to-door (direct-to-home) sales that is done at mesh ring or cluster level rather than over a large portion of the intended coverage area of the wireless mesh network. Thus, there exists need in the art for improved methods

and planning approaches relating to wireless communication network planning process and design to make the wireless mesh communication network rollout swift and cost efficient.

[00028] Referring to figure 1(a), a planning method for constructing a wireless mesh network based on ptp/ptmp (point-to-point/ point-to-multi-point) links is described. In one embodiment, as shown in Figure 1(a), planning method involves pre-marketing block 101. Pre-marketing block can include multiple approaches including but not limited to marketing techniques that do not require a sales person to physically visit the potential customer's home for marketing. Pre-marketing step 101 is followed by the area of interest (AOI) block 102. In 102, based on the pre-marketing 101 leads (list of potential customers that expressed interest in subscribing to the wireless services), an area or multiple areas of interest are defined for building a wireless mesh network. Next, step in the wireless mesh network construction process is door to door marketing 103 or door to door sales where sales person physically visits customer's home to sell the wireless service. Next, based on the leads from pre-marketing 101 and contracted customers in the door to door marketing step 103, a subset of customers (mesh network nodes) are selected for building the wireless mesh network in the planning 104 step of the method. Lastly, based on output from planning 104 step of figure 1(a), actual network node installation on selected locations is started for wireless mesh network deployment. The planning method shown in figure 1(a) can also be altered. For example, in another embodiment, one or multiple steps among 101 to 105 in figure 1(a) can be omitted or occur in a different order.

[00029] Referring to figure 1(b), another approach to wireless mesh network planning is shown. In figure 1(b), the planning process starts with consideration of multiple factors 100 that ultimately lead to the selection of AOI. In one embodiment, multiple considerations can include availability of building with fiber connectivity at reasonable

cost, level of vegetation in the area, population density, demographics, average annual house hold income, etc. In another embodiment, a subset of the above factors can be included in the multiple factors 100 step of figure 1(b). Next, based on the analysis performed on the basis of multiple factors 100, AOI for wireless mesh network construction is selected in phase 101 as shown in figure 1(b). This is followed by pre-marketing 102 in the selected AOI from step 101. Next, step in the wireless mesh network construction process shown in figure 1(b) is door to door marketing 103 or door to door sales where sales person physically visits customer's home to sell the wireless service. Next, based on the leads from pre-marketing 102 and contracted customers in the door to door marketing step 103, a subset of customers (mesh network nodes) are selected for building the wireless mesh network in the planning 104 phase of the method. Lastly, based on output from planning 104 step in figure 1(b), actual network node installation on selected locations is started for wireless mesh network deployment. The planning method shown in figure 1(b) can also be altered. For example, in another embodiment, one or multiple steps among 100 to 105 in figure 1(a) can be omitted or occur in a different order.

[00030] Referring to figure 2(a), the pre-marketing phase 200 is defined that leads to the geo specific door to door marketing 205. The pre-marketing phase 200 is similar to pre-marketing phase 101 described in the context of figure 1(a). Pre-marketing phase 200 consists of social media/online marketing phase 201, radio/television marketing phase 202, mailers phase 203. Moreover, pre-marketing phase also contains a phase 204 where clusters of interest is defined. Social Media/online marketing phase 201 in figure 2(a) can contain techniques including but not limited to search engine optimization where mobile internet users and internet users at in-building locations are approached based on certain specific criteria. In one embodiment, the criteria can include but not limit to regions with

certain population density, demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket social media/online marketing can be used. Block 202 in figure 2(a) defines the phase where radio/television marketing is used. Radio/television marketing phase 202 can be performed in specific regions based on certain criteria. In one embodiment, the criteria can include but not limit to regions with certain population density, demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket radio/television marketing can be used. Block 203 in figure 2(a) defines the phase where mailer-based marketing is used. Mailer based marketing phase 203 can be performed in specific regions based on certain criteria. In one embodiment, the criteria can include but not limit to regions with certain population density, demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket mailer-based marketing can be used. In figure 2(a), phases 201, 202 and 203 are shown to take place in parallel. However, in a different embodiment, two or all three phases can take place sequentially and can take any order. In a different embodiment, some of these blocks can be omitted. The pre-marketing phase that consists of social media/online marketing 201, radio/television marketing 202 and mail-based marketing 203 can generate leads to potential customers with interests in subscription to the internet service. Based on those leads, some cluster of interest 204 or area(s) of interest can be generated. This cluster of

interest can later be used for subsequent geo specific door to door marketing 205 as shown in figure 2(a).

[00031] Referring to figure 2(b), the pre-marketing phase 200 is defined that leads to the geo specific door to door marketing 206 based on leads 205 and is preceded by area of interest (AOI) 201 determination based on multiple factors. The multiple factors used for the determination of AOI 201 include but not limited to availability of fiber PoP building at a reasonable cost, line-of-sight profile of the building (e.g. roof) to the nearby surrounding area, population density, residential home density, demographics, vegetation. In one embodiment, all the above mention factors are considered. In another embodiment, a subset of these multiple factors can be considered for determination of AOI in phase 201 shown in figure 2(b). The pre-marketing phase 200 in figure 2(b) is similar to pre-marketing phase 102 described in the context of figure 1(b). Pre-marketing phase 200 consists of social media/online marketing phase 202, radio/television marketing phase 203, mailers phase 204. Social media/online marketing phase 202 in figure 2(b) can contain techniques including but not limited to search engine optimization where mobile internet users and internet users at in-building locations are approached based on certain specific criteria. In one embodiment, the criteria can include but not limit to internet users with certain demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket social media/online marketing can be used in the AOI defined in phase 201 of the figure 2(b). Block 203 in figure 2(b) defines the phase where radio/television marketing is be used. Radio/television marketing phase 202 can be performed in specific regions based on AOI defined in 201. In one embodiment, the criteria can include but not

limit to regions with demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket radio/television marketing can be used in the AOI defined in 201 phase. Block 204 in figure 2(b) defines the phase where mailer-based marketing is used. Mailer based marketing phase 204 can be performed in AOI 201 based on certain criteria. In one embodiment, the criteria can include but not limit to area with certain population density, demographics, age group, income group, ownership or residence in a certain type of housing, etc. In another embodiment, a subset of these criteria can be used. In yet another embodiment, certain different criteria other than the criteria defined above can be used or blanket mailer-based marketing can be used. In figure 2(b), phases 202, 203 and 204 are shown to take place in parallel. However, in a different embodiment, two or all three phases can take place sequentially and can take any order. In a different embodiment, some of these blocks can be omitted. The pre-marketing phase that consists of social media/online marketing 202, radio/television marketing 203 and mail-based marketing 204 can generate leads 205 to potential customers with interests in subscription to the internet service. Those leads can later be used for subsequent geo specific door to door marketing 206 as shown in figure 2(b).

[00032] Referring to figure 3(a), another alternate view of the wireless mesh network planning and construction is described. Figure 3(a) shows pre-marketing block 301 that has a sub-block leads, block AOI 302 that leads to door-to door marketing/sales phase 303 that has been described previously in this disclosure. In phase 303, sales personals physically visit the potential customer's home for marketing and sales of internet services. Figure 3(a) also contains planning block 304. Planning block 304 carries an up-

to-date list of all potential customers that have shown interest in subscribing to the internet service. Planning block 304 gets this information from pre-marketing block 301 that contains a sub-block leads. In addition, planning phase 304 also gets potential customer information from the door to door marketing phase 303 as shown in figure 3(a). Based on the comprehensive list of potential customers, their locations, line-of-sight profile (e.g. number of surrounding homes a particular home has line of sight path with), vegetation profile, number of hops, length of link, target market penetration rate, number of service tiers, number of technology tiers, etc. a wireless mesh network is designed which involves rejection of certain homes among the comprehensive list of customer homes provided to planning phase 304 by blocks 303 and 301 and selecting remaining homes for mesh network construction. This is followed by planning for actual network installation/development phase 305 as shown in the figure 3(a).

[00033] Referring to figure 3(b), another alternate view of the wireless mesh network planning and construction is described. Figure 3(b) shows AOI phase 301 that is based on multiple factors. The multiple factors used for the determination of AOI 301 include but not limited to availability of fiber PoP building at a reasonable cost, line-of-sight profile of the building (e.g. roof) to the nearby surrounding area, population density, residential home density, demographics, vegetation. In one embodiment, all the above mention factors are considered. In another embodiment, a subset of these multiple factors can be considered for determination of AOI in phase 301 shown in figure 3(b). Figure 3(b) also contains a pre-marketing block 302 that has a sub-block leads that leads to door-to door marketing/sales phase 303 that has been described previously in this disclosure. In phase 303, sales personals physically visit the potential customer's home for marketing and sales of internet services. Figure 3(b) also contains planning block 304. Planning block 304

carries an up-to-date list of all potential customers that have shown interest in subscribing to the internet service. Planning block 304 gets this information from pre-marketing block 302 that contains a sub-block leads. In addition, planning phase 304 also gets potential customer information from the door to door marketing phase 303 as shown in figure 3(b). Based on the comprehensive list of potential customers, their locations, line-of-sight profile (e.g. number of surrounding homes a particular home has line of sight path with), vegetation profile, number of hops, length of link, target market penetration rate, number of service tiers, number of technology tiers, etc. a wireless mesh network is designed which involves rejection of certain homes among the comprehensive list of customer homes provided to planning phase 304 by blocks 303 and 302 and selecting remaining homes for mesh network construction. This is followed by planning for actual network installation/development phase 305 as shown in the figure 3(b).

[00034] Referring to figure 4, another alternate view of the wireless mesh network planning and construction is described. Figure 4 shows door to door marketing phase 401 that can be limited to selected homes in a certain AOI in one embodiment and can also be a blanket door to door marketing in another embodiment. The output of door to door marketing phase is potential list of customers that show interest in subscription of the internet service by signing the contract agreements. This contract signing documents can be uploaded in some shared storage or server to make the penitential customer information and location information available in real time as shown in by the block 402 of the figure 4. In addition, a software application 403 (including mobile application) can be used to get the potential customer locations based on door to door marketing phase 401 in real time by instructing the door to door sales agents/personals to directly upload the signed contract information using the software application 403. The software application 403 is the central

part of the potential customer information gathering. The software application 403 also takes inputs from leads that resulted due to pre-marketing phase 404 of the wireless mesh planning method described in this disclosure and shown in figure 4. Figure 4 also contains wireless mesh network planning engine block 405. Network planning engine block 405 utilizes an up-to-date list of all potential customers that have shown interest in subscribing to the internet service by interacting with software application 403. Based on the comprehensive list of potential customers, their locations, line-of-sight profile (e.g. number of surrounding homes a particular home has line of sight path with), vegetation profile, number of hops, length of link, target market penetration rate, number of service tiers, number of technology tiers, etc. a wireless mesh network is designed which involves rejection of certain homes among the comprehensive list of customer homes provided to planning phase 304 by blocks 303 and 302 and selecting remaining homes for mesh network construction. In one embodiment, all the above-mentioned factors are considered by the network planning engine 405 to accept or reject a particular customer for the construction of wireless mesh network. In another embodiment, a sub set of these factors or a combination of subset of these factors and some other factors can be used for the selection and rejection of the potential customers that have expressed interest in subscription to the wireless mesh network-based internet service by the network planning engine 405 of figure 4. Moreover, network planning engine 405 can also select some customer (homes) for a lower or different tier of internet service if these are found to be not suitable or ideal candidate for the primary wireless mesh network based on criteria described above in this disclosure as shown by the block 408 of the figure 4. These candidate customers in 408 can be used to build another tier of network using a different technology, different SLA (service level agreement) and/or different pricing model at a

later stage in the near future. In addition, network planning engine can also identify certain areas where customers are need to complete/evolve/expand the wireless mesh network but not provided by the door to door marketing phase 401 and pre-marketing phase 404 of the wireless mesh planning method shown in figure 4. This can result in an additional phase 407 where goal of identification of missing targets for mesh network completion triggers a fresh round of door to door marketing focusing on the specific areas. This is shown by arrow originating from block 407 and terminating at door-to-door marketing block 401 in figure 4. Network planning engine 405 identifies the customer locations for wireless mesh network construction and this is followed by planning for actual network installation/development phase 406 as shown in the figure 4.

[00035] Referring to figure 5, detailed description of the network installation/development phase 500 of the wireless mesh network planning methods described in the current disclosure is shown. Figure 5 shows connectivity @ fiber PoP 501 phase that involves the construction of site (usually a tall building) that has fiber connectivity that ultimately connects the wireless mesh network to CORE network and data center. This is followed by actual network installation/deployment 500 of the nodes of the wireless mesh network that involves installing wireless mesh network equipment on the rooftop of the customer homes that were selected by the network planning engine described in the previous paragraphs of this current disclosure. Network installation/deployment phase 500 of the figure 5 consists of several phases including electrical installation 502 that can include among other things the installation of power box on the side of the customer home along the exterior wall to provide power (or any other appropriate location) to the telecommunication equipment of the wireless mesh network. Network installation/deployment phase also includes phase which involves line run and

antenna mast installation 503 along with actual mounting of ptp/ptmp equipment followed by alignment and provisioning 504 where antennas of wireless mesh network equipment are aligned to ensure line-of sight connectivity between a node of one customer homes with the node of near by customer home to establish line-of-sight based point-to-point or point-to-multipoint link and configuration/ network setting of these ptp/ptmp nodes to ensure end-to-end connectivity from the customer home via multiple wireless mesh network nodes to the CORE network or data center. Phases 502 to 504 of figure 5 may not involve any installation inside the customer home and can be performed even without the requirement of the presence of people living the particular dwelling. Last phase of the network installation/deployment 500 of figure 5 is the customer service activation at cluster level 505 that involves the installation of routers inside customer home to connect the wireless mesh network node installed at the customer roof-top to the devices of the customer to provide internet connectivity. Step 505 usually require customer to be present at in the house unlike steps 502 to 504 that usually do not involve resident's presence and can be performed from outside the customer home. The step 505 is usually performed after building and testing a complete ring or several rings forming a cluster of nodes of the wireless mesh network. Figure 5 shows steps 502 to 505 of network installation/deployment phase 500 taking place in sequential manner in one embodiment of this wireless mesh planning method described in the current disclosure. In another embodiment, some or all of these phase/steps of network installation/deployment phase 500 can take place in parallel. In another embodiment, some of the phases such as alignment & provisioning 504 can be automated.

[00036] Referring to figure 6, details of the network installation/development phase of the wireless mesh network planning and construction method is described. Figure 6

shows a scheduling entity 602 that can be a software program running on a general-purpose processor or on a dedicated processor/machine. This scheduling entity 602 gets its task from planning phase 601 that has been described earlier in the current disclosure. Planning phase 601 provides the scheduling unit 602 with list of customer location and also provides mesh network design information that defines how the ptp/ptmp node should be connected to ptp/ptmp nodes of the other customer locations (for antenna alignment and selection of the region of the roof for antenna mounting). Based on planning 601 information, scheduling unit 602 schedules different teams of network installers for various different phases of the network installation/development 600 including electrical installation 604, line run and mast installation 605, alignment and provisioning 607 and cluster service activation 608 that has been described in the previous paragraph and also in the context of figure 5. Lastly, scheduling entity 602 also interacts with optimization engine 603 for optimization of the scheduling of different phases of the network installation/deployment to make the phase 600 efficient. For example, in one embodiment, optimization engine 603 can run artificial intelligence-based algorithms such as simulated annealing etc., to device daily/weekly plan for network installer teams that results are least or near optimal amount of drive between wireless mesh network customer locations. Moreover, based on the real time feedback information from steps 604 to 608 of the network installation phase 600, optimization engine 603 can instruct the scheduling entity to change the schedules of installation teams working on various phases of the network installation/deployment to optimize the process.

[00037] Referring to figure 7(a), a summary of one embodiment of wireless mesh planning and construction method is explained with the help of building blocks defined earlier in the current disclosure. Figure 7(a) shows a pre-marketing phase that includes sub-

phases social media/online marketing, radio/television-based marketing and mailer-based marketing that can generate leads of potential customer locations that expressed interest in subscription of the internet service based on wireless mesh network. Based on these leads, cluster of interest (area) is identified that is used for subsequent door to door marketing and sales. The door to door marketing/sales agent upload potential customers information that sign the agreement to a server or shared drive or can use a software application (or mobile application) to provide real time potential mesh network customer information to the network planning engine. The software application can also get potential wireless mesh customer information from pre-marketing phase leads and pass on to network planning engine. Network planning engine based on various criteria defined the current disclosure disqualify some potential customer locations and select remaining customer location for wireless mesh network installation/development. Through a feedback loop, network planning engine can convert a potential customer location from disqualified status to selected status and also from selected status to disqualified status. In addition, network planning engine can also select among those potential customer location that are not selected for wireless mesh network construction for a different tier of service that is built at a later stage in near future. The different tier can be due to different technology, service level agreement and or equipment pricing. Network planning engine also interacts with door to door marketing phase of the proposed wireless mesh network planning and construction method in the event where there is requirement to find additional customer locations to complete the mesh network due to missing sites. Network planning engine interacts with network installation/deployment phase where based on the list of customer locations and mesh network layout, scheduling entity with the help of optimization engine plans on hourly/daily/weekly bases the schedules of various installer teams working on

different phases of network installation/deployment including electrical installation, line run, antenna mounting, ptp/ptmp node installation, alignment, provisioning and customer service activation at a cluster level as shown in figure 7(a). Figure 7(a) shows one embodiment of this method. In a different embodiment, some of the phases shown in figure 7(a) can be omitted or can interact with other phases in a different way or can take place in a different order.

[00038] Referring to figure 7(b), a summary of another embodiment of wireless mesh planning and construction method is explained with the help of building blocks defined earlier in the current disclosure. Figure 7(b) shows that the process start with the identification of an area of interest that is selected based on multiple factors that are defined in detail in this disclosure. Based on the AOI, a pre-marketing phase that includes sub-phases social media/online marketing, radio/television-based marketing and mailer-based marketing is executed that can generate leads of potential customer locations that expressed interest in subscription of the internet service based on wireless mesh network. This is followed by door to door marketing phase where door to door marketing/sales agent upload potential customers information that sign the agreement to a server or shared drive or can use a software application (or mobile application) to provide real time potential mesh network customer information to the network planning engine. The software application can also get potential wireless mesh customer information from pre-marketing phase leads and pass on to network planning engine. Network planning engine based on various criteria defined the current disclosure disqualify some potential customer locations and select remaining customer location for wireless mesh network installation/development. Through a feedback loop, network planning engine can convert a potential customer location from disqualified status to selected status and also from selected status to disqualified status. In

addition, network planning engine can also select among those potential customer locations that are not selected for wireless mesh network construction for a different tier of service that is built at a later stage in near future. The different tier can be due to different technology, service level agreement and/or equipment pricing. Network planning engine also interacts with door to door marketing phase of the proposed wireless mesh network planning and construction method in the event where there is requirement to find additional customer locations to complete the mesh network due to missing sites. Network planning engine interacts with network installation/deployment phase where based on the list of customer locations and mesh network layout, scheduling entity with the help of optimization engine plans on hourly/daily/weekly bases the schedules of various installer teams working on different phases of network installation/deployment including electrical installation, line run, antenna mounting, ptp/ptmp node installation, alignment, provisioning and customer service activation at a cluster level as shown in figure 7(b). Figure 7(b) shows one embodiment of this method. In a different embodiment, some of the phases shown in figure 7(b) can be omitted or can interact with other phases in a different way or can take place in a different order.

[00039] Referring to figure 8, a different aspect of wireless mesh network planning and constructed is discussed. Figure 8 shows a block called internet package. This block represents a phase where a generic internet service package is described that contains details of among other things the uplink and downlink speed ranges, pricing, contract term, options for bundling of multiple service, etc. These details are then used in all kinds of marketing as described earlier in the current disclosure including pre-marketing and door to door marketing for potential wireless mesh network customer list. This list is provided to the network planning engine as shown in figure 8. The details of this network planning

engine have been discussed in the context of figure 1(a) to 7(b). Based on network planning engine only a small group of potential customers is selected for wireless mesh network construction and network installation and deployment phase is carried out as shown in the figure 8 where solid black circles represent sites belonging to customers selected for wireless mesh network node and white circles represent potential customer locations that are not selected for wireless mesh network. This is called phase 1 as shown in figure 8. The SLA and pricing model for these selected mesh wireless node customers in one embodiment is different than the advertised internet package details in the internet package block phase of the wireless mesh network planning. For example, these selected wireless mesh node customers can be offered a higher uplink and downlink speeds at a lower monthly fee. In another embodiment, these selected wireless mesh node customers can be offered a higher uplink and downlink speeds with no monthly fee. In another embodiment, internet service fee is waived or lowered only if these customers select the bundle package that include other services such smart home security service or solar energy service. In other embodiments, internet package details for these selected wireless mesh network customers remains unchanged. In the next phase, additional hardware can be added to those customer sites selected for wireless mesh network in phase 1 and represented by solid black circles to build a wireless network that has the capability to provides a different tier of services than the wireless mesh network that is constructed in phase 1 as shown in figure 8. This additional hardware in one embodiment provides an omni directional coverage area for different tier of wireless internet service as shown in figure 8. In a different embodiment, the additional hardware provides a directional e.g. (45-degree, 90-degree, 120-degree sector) coverage area for different tier of wireless internet service not shown in figure 8. Based on the coverage area, some of those potential customers that are not selected in the

phase 1 as wireless mesh network node and represented by white circles can be offered 2nd tier wireless internet service by installing wireless network equipment on their location that are compatible with 2nd tier wireless network technology such as 4G LTE or LTE-Advanced or Wi-Fi Aps. In one embodiment, SLA and pricing of these 2nd phase customers represented by white circles can be same as the internet package details defined in the internet package phase and used in the marketing phase to generate the potential customer list. In another embodiment, SLA and pricing of these 2nd phase customers represented by white circles can be different than the internet package details defined in the internet package phase and used in the marketing phase to generate the potential customer list. These 2nd tier network customers can be included to wireless mesh network by adding wireless mesh network node equipment and creating ptp/ptmp links to connect them to existing nodes of the wireless mesh network. This can be triggered to you a variety of reasons as shown in figure 9. In one embodiment, reason can be un-subscription of an existing wireless mesh network customer node. In a different embodiment, reason can be the goal of increasing the coverage area of the 2nd tier technology network and add more 2nd tier network customers to wireless network. In a different embodiment, reason can be the goal of increasing wireless mesh network customers. In other embodiment, trigger to this conversion can be due to a different reason or multiple reasons.

[00040] In the wireless mesh communication network discussed in this current disclosure, private infrastructure such as single-family home rooftop is used for the deployment of wireless mesh communication network equipment including antennas, antenna mounts, radios, cables, etc. for ptp/ptmp mmWave links and wireless/cellular communication network small cells and CPE, etc. The location on the roof where the above communication network equipment is mounted is very important. Although the field

technicians and installers working for the wireless mesh communication network operator do their best to ensure no damage to the roof area/section where equipment is placed and antenna mounts are installed, due to possible drilling and other causes, there can be a possibility of roof damage in the longer run. If the roof area selected for wireless network equipment is above a living area including but not limited to living room, bedroom, attic or any covered area in general, the liability of the wireless network operator is greatly increased in case of any damage caused to roof due to the installation of wireless network (ptp/ptmp mesh and cellular) equipment.

[00041] Hence, by choosing an area or section of roof for the installation of above equipment that is not above any living space and/or covered area can greatly reduce the liability of the wireless network operator that uses private infrastructure for the network deployment. For example, one such area can be the roof overhangs or eaves overhangs as shown in the figure 10. Figure 10 shows that all the wireless network equipment is installed on roof overhangs and hence any potential roof damage due to this install is likely to not impact the roof over a living area. This can significantly reduce the wireless operator's liability in the event of roof damage as impact is likely to be outside the covered area of the private infrastructure.

[00042] Hence the network planning and network planning engine discussed in this current disclosure earlier and in the context of figures 1 to 8 can use the above criterion for the wireless mesh node home selection for building the wireless mesh network infrastructure. Line of sight criterion is one the key aspect of the wireless mesh network planning where it is ensured that every wireless mesh node (equipment on the roof top) has direct line of sight with its existing and future wireless mesh node neighbor sites as wireless signals suffer very high level of attenuation if encountered with vegetation and/or buildings

and ptp/ptmp links can drop due to weak received signals. Line of sight profile is dependent on the area of roof selected for line of sight analysis. For example, one node can have a perfect line of sight to its existing or future neighbor node equipment from the highest point of the roof (which is above a living area) and may not have the line of sight to the very same existing or future neighbor if the equipment is moved to a different section of the roof such as the roof overhangs discussed above and in the context of figure 10. Such home if picked for wireless mesh network node by installing equipment on the top of the roof for setting up the ptp/ptmp links can later cause large liability issues for the wireless mesh operator in case of future damages to the roof due to this equipment installation. Hence, in one embodiment, the network planning phase and network planning engine discussed in the current disclosure can only select homes for wireless mesh network nodes if they show good line-of-sight profile (connectivity to other mesh network nodes) from the area or section of the roof that is not above any covered or living area and drop those potential candidate customer sites that do not have good line-of-sight profile with other mesh network nodes (including existing and future/planned) from the area or section of the roof that is not above any covered or living area. In a different embodiment, both these types of homes can be picked as wireless mesh network node. In one embodiment, the area or section of the roof that is not above any covered or living area can be eaves overhang or roof overhang. In a different embodiment, the area or section of the roof that is not above any covered or living area can be other than eaves overhang or roof overhang.

[00043] The concepts disclosed herein have been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Obviously, many modifications and variations of the disclosed concepts are possible in light of the above teachings. It is,

therefore, to be understood that within the scope of the claims (to be added later), the disclosed concepts may be practiced otherwise than as specifically described.

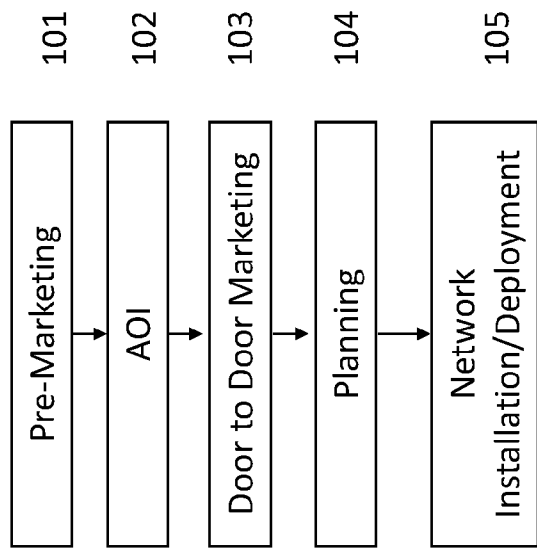


Figure 1(A)

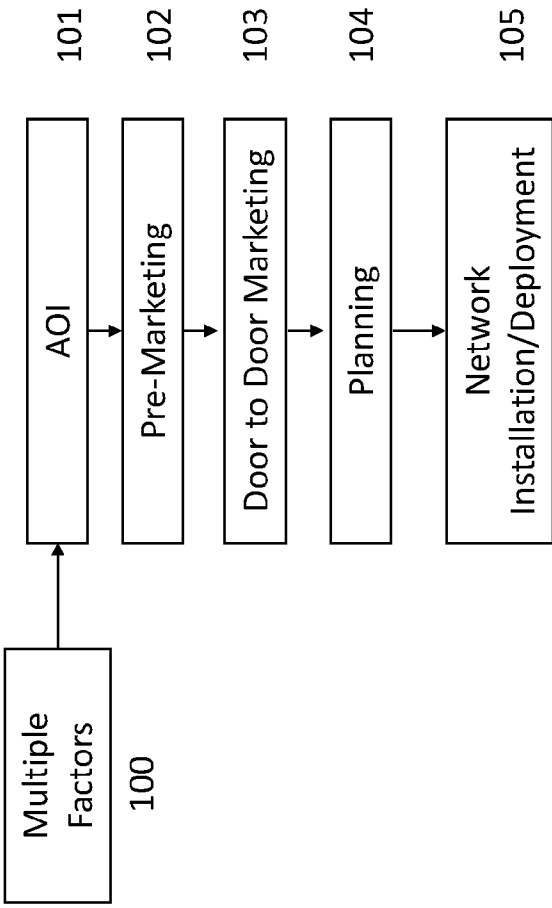


Figure 1(B)

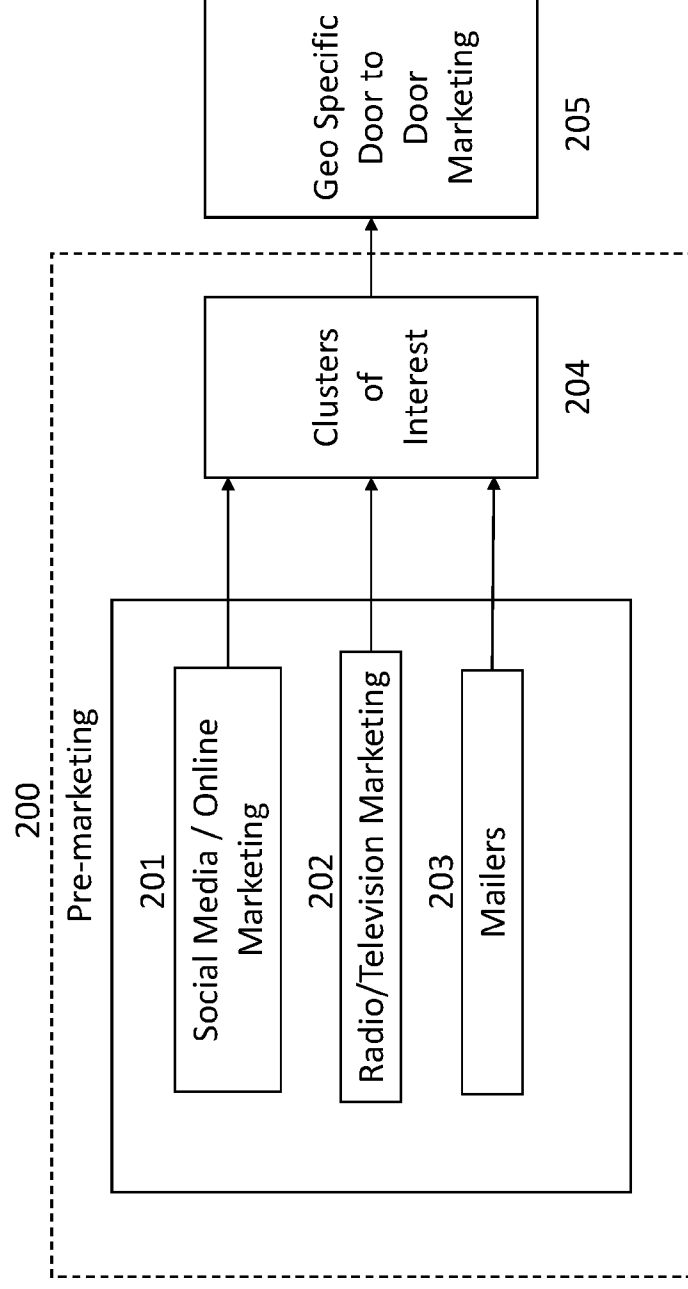


Figure 2(A)

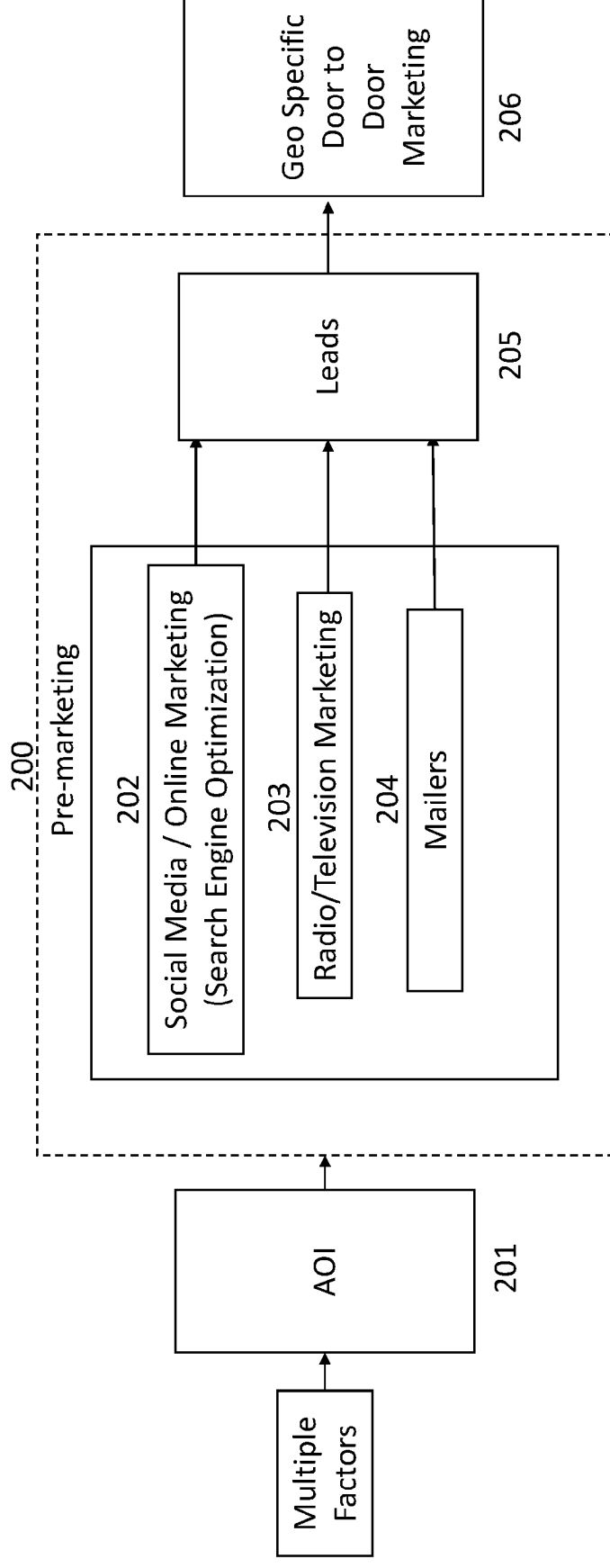


Figure 2(B)

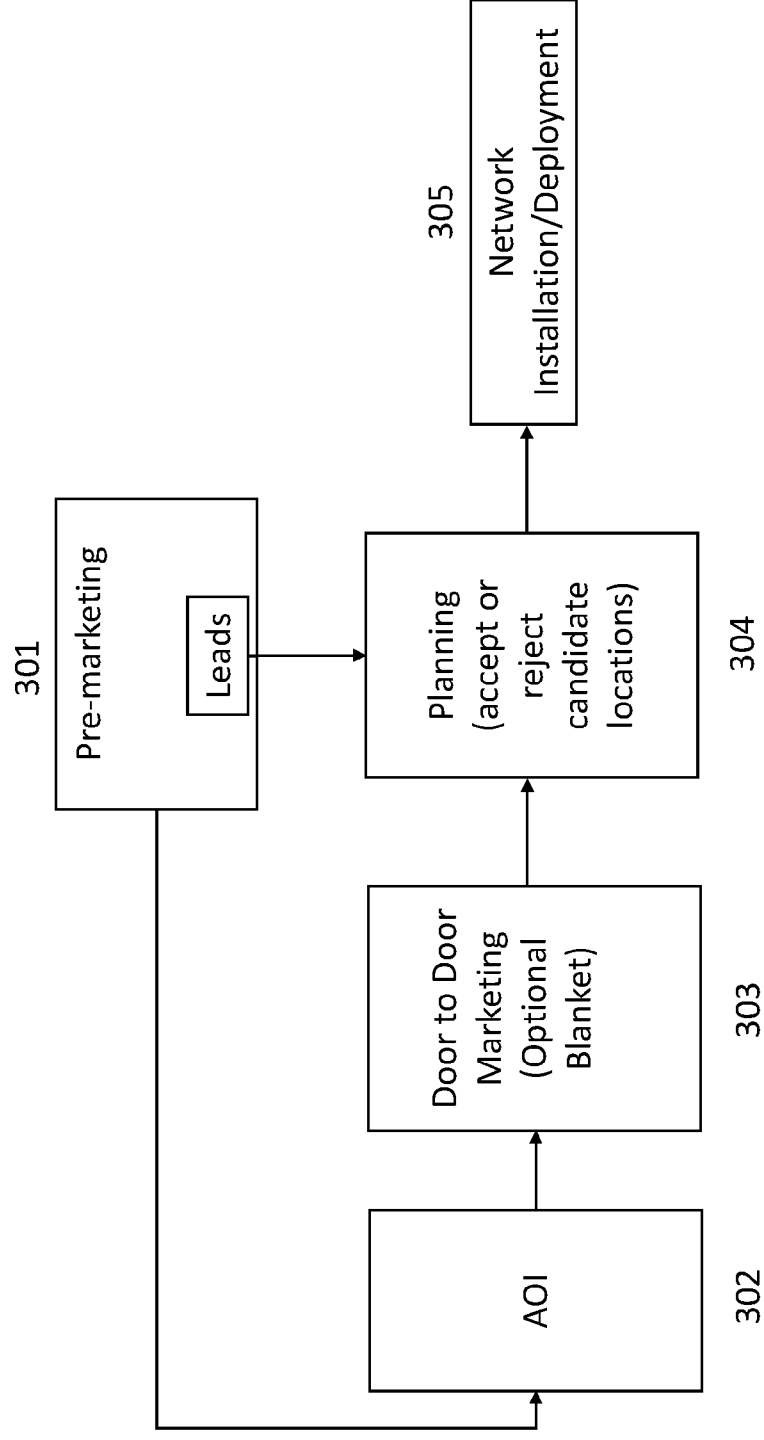


Figure 3(A)

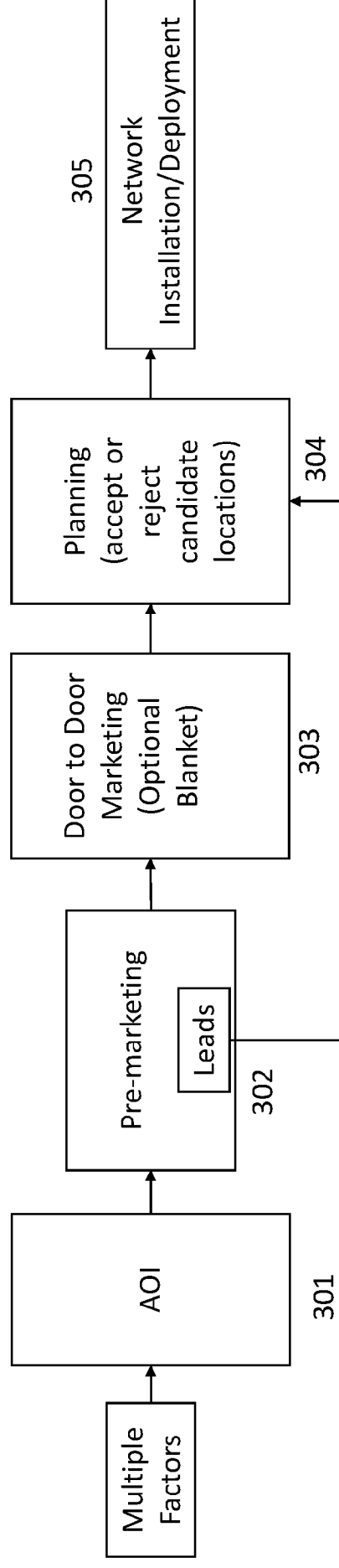


Figure 3(B)

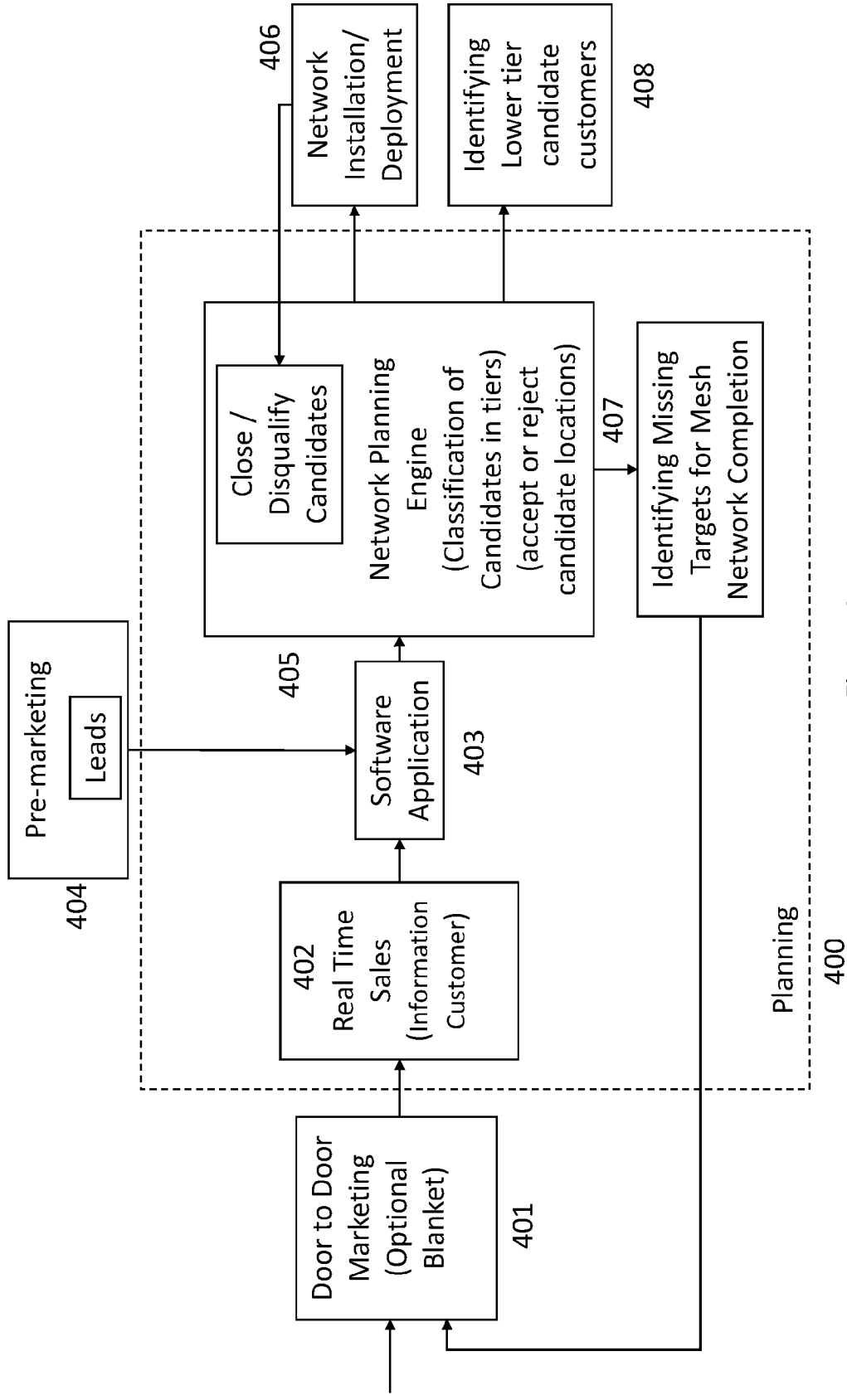


Figure 4

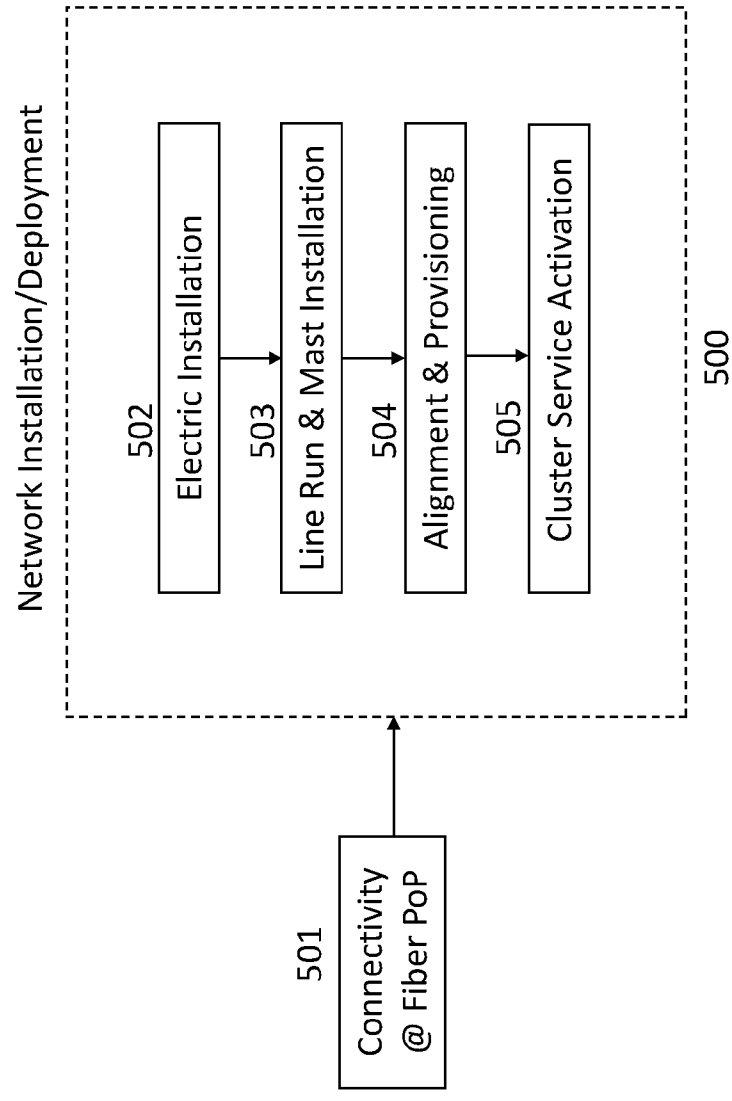


Figure 5

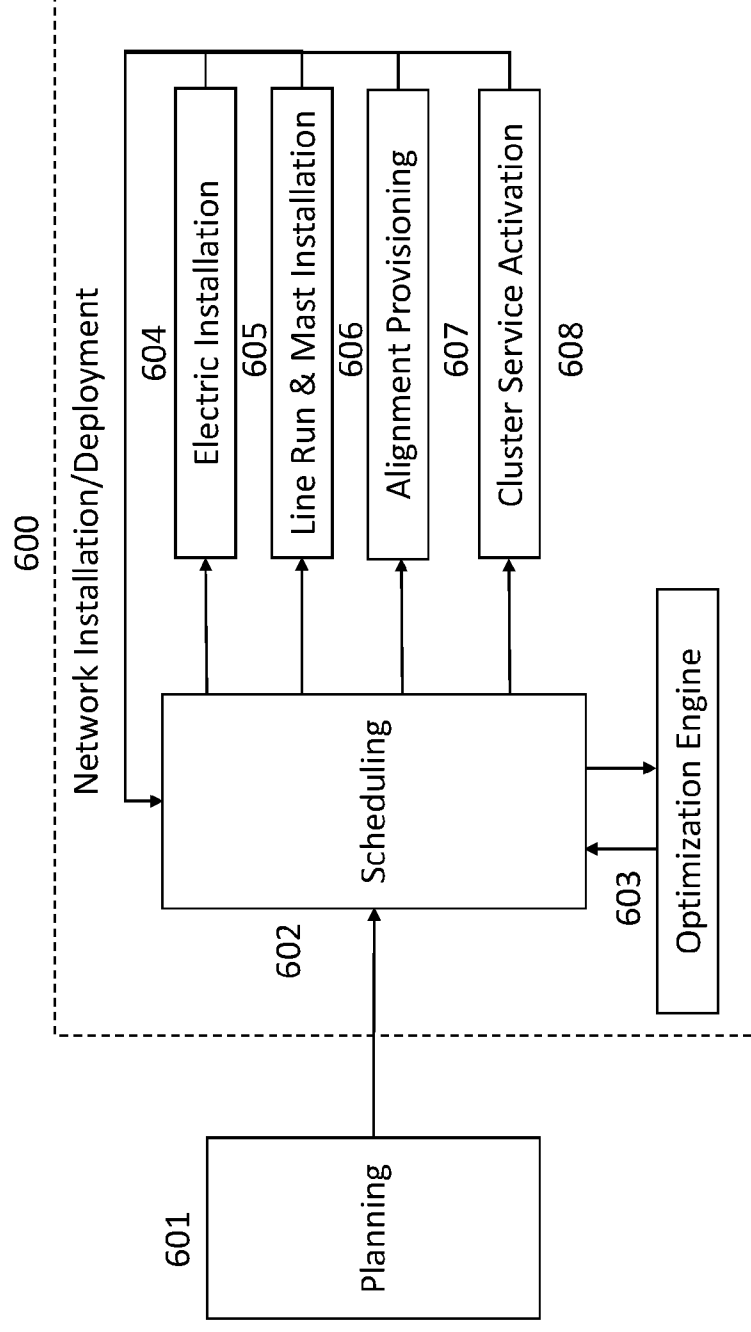


Figure 6

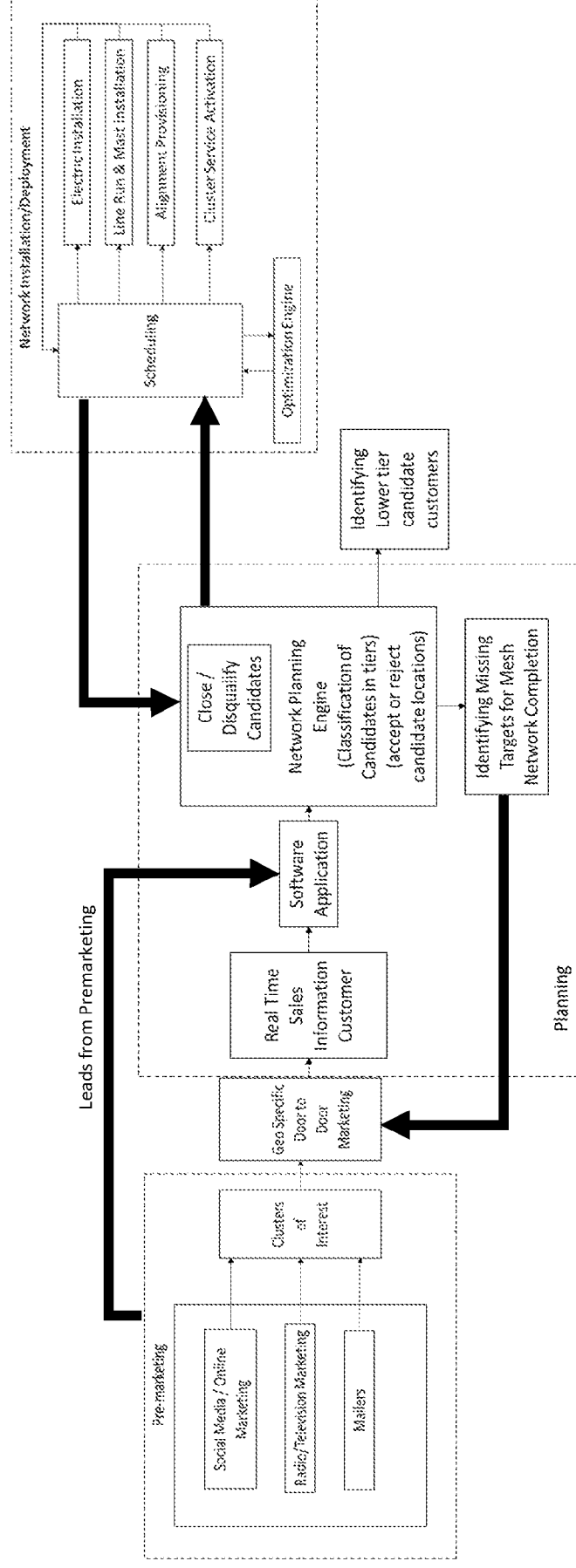


Figure 7(A)

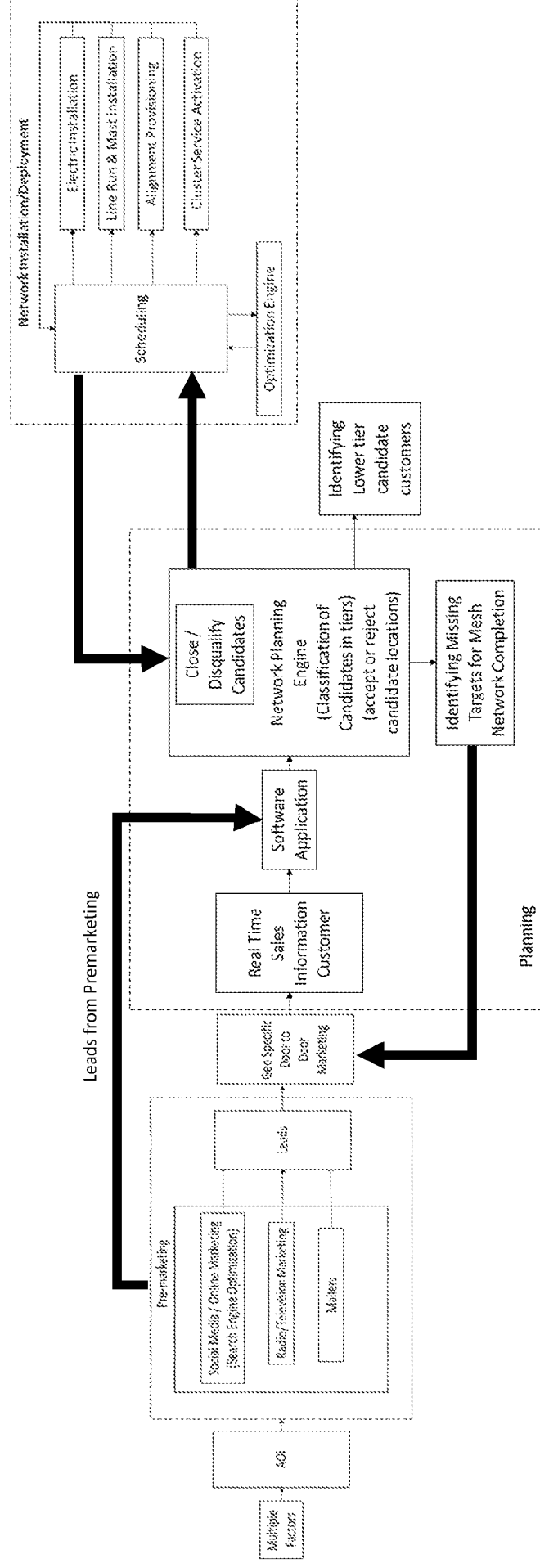


Figure 7(B)

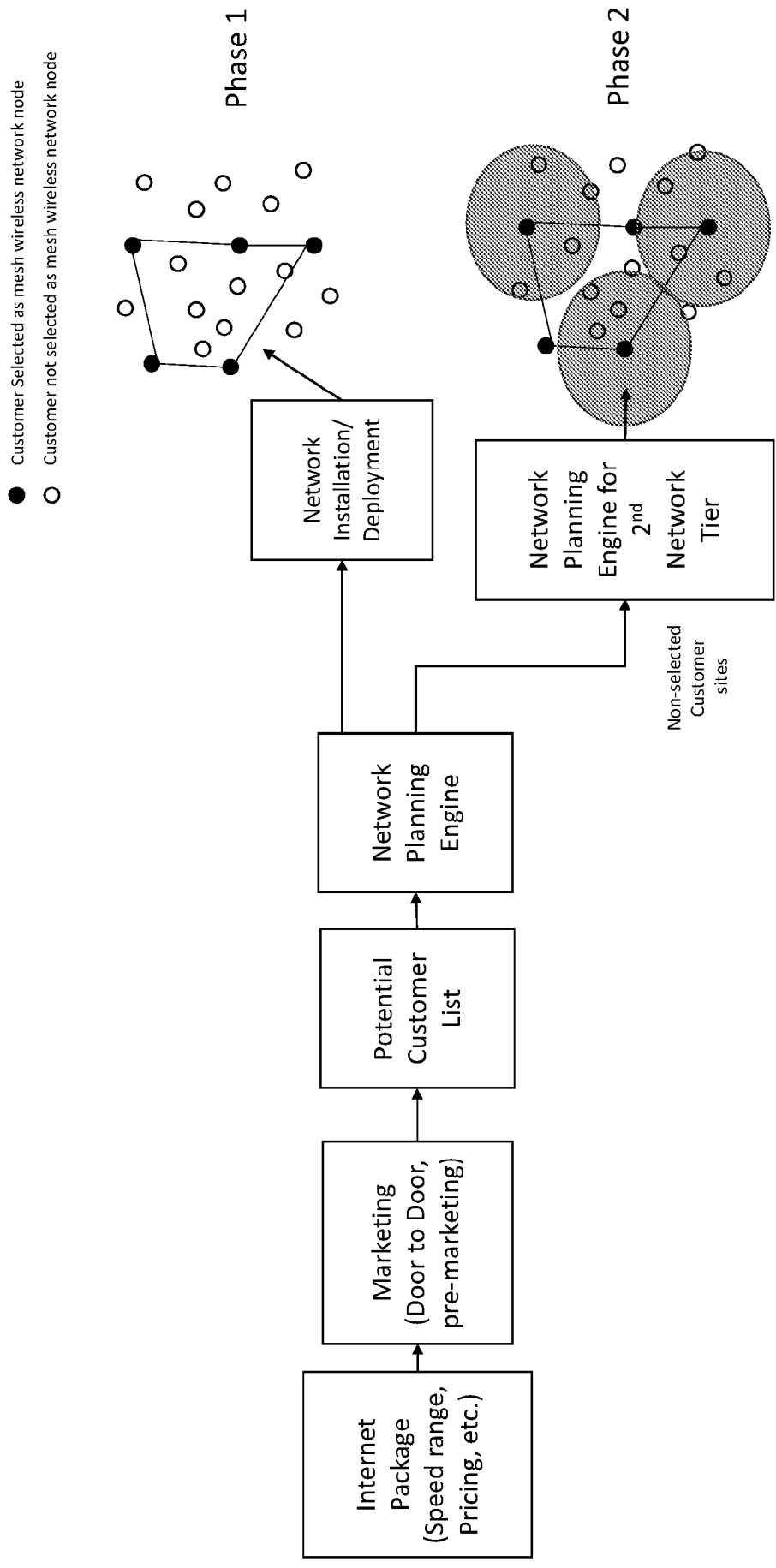


Figure 8

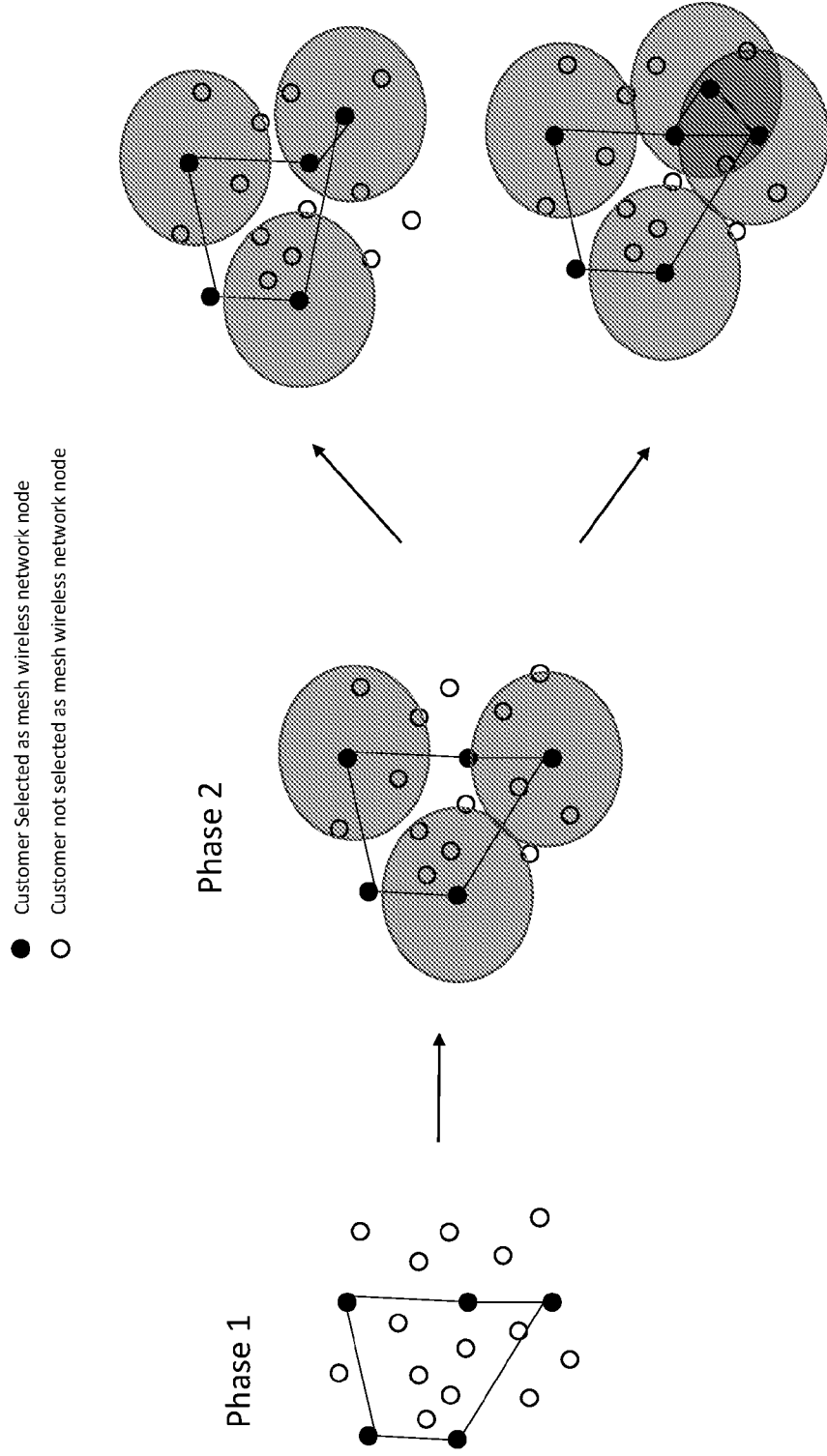


Figure 9

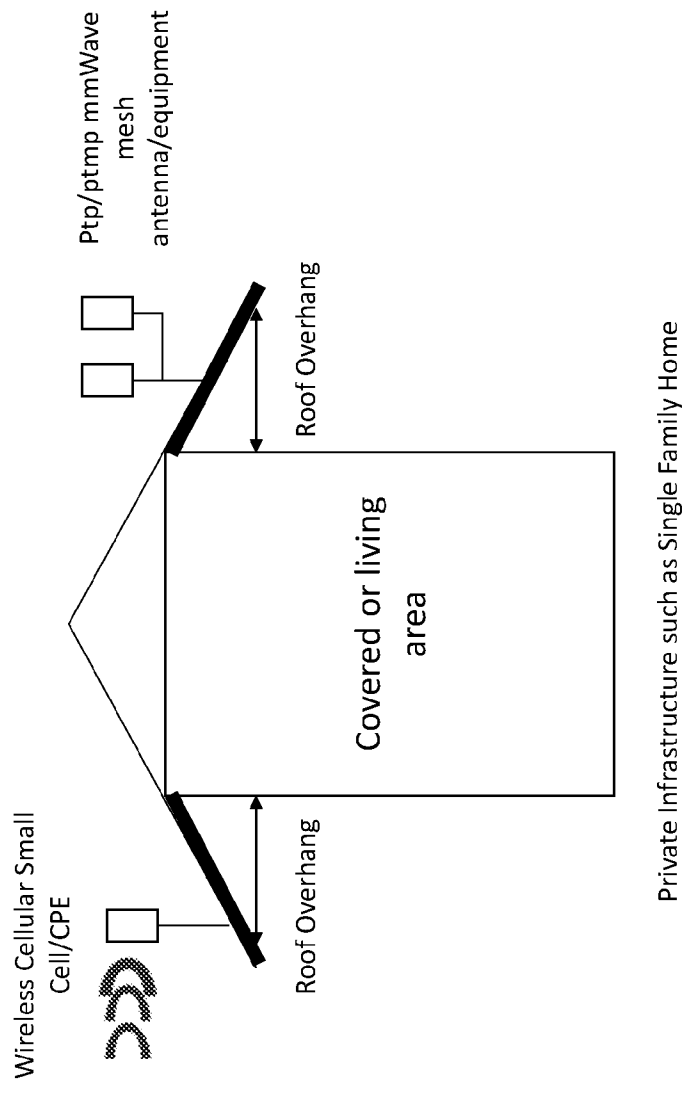


Figure 10