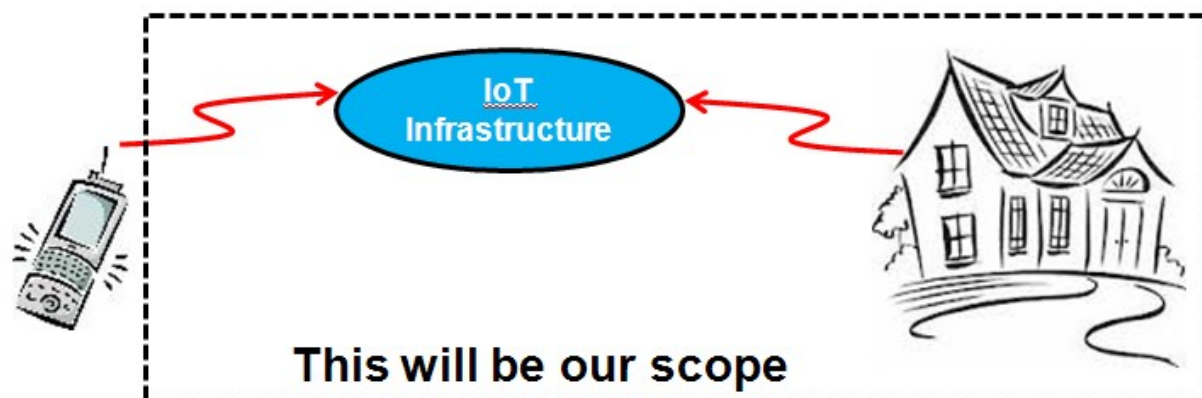


Architectural Driver Specification

1. Introduction

The key business goals is to enter the IoT market successfully by providing following features.

1. a system/infrastructure that enables users to communicate with sensors and actuators installed in a building via any mobile device or desktop system connected to the Internet
2. an infrastructure to support an open ecosystem of hardware device and software application developers, service providers, and installers and maintainers
3. a basic data centric infrastructure that will support the collection of data for future analytic operations and services



2. System context

2.1 Market context

Customer/Stake holders	<ul style="list-style-type: none">• Product Manager• Team members• Sensor/Actuator producers.• Third party service providers – packaging, installing, maintaining, providing data services, etc.• Consumers.• Homebuilders.• Smart appliance producers.• Utilities companies.
Functional expectations	To build an IoT infrastructure that will support access to home sensors and actuators.
How quickly you must design and deliver new products(Time to market)	The target date is 26/06/2015. (to be considered)
Notions of quality	The infrastructure should support Do-It-Yourself (DIY) customers, or contractors enabling them to procure easily install IoT products for use in homes or businesses.
Price of products and services	<p>The competitors have their own price policies. Refer to following texts and the web-site.</p> <ul style="list-style-type: none">• Apple App Store : 30% of the App price• https://blog.profitbricks.com/top-49-tools-internet-of-things/• Dragino V2 MS14-S with M32 IoT Module : \$65.90
Product packaging	The package comprises SA nodes, Sensors, SDK for 3rd party vendors, user manual and the home server. These products will be available at DIY stores such as Lowes, Home Depot, and so forth.

2.2 Organizational context

Structure	This team comprises following experts in their own fields. YUMI KIM(Leader), YONG JAE JANG, SEUNG CHAN KWON, WOO JUHYUNG, YONGBONG CHOE, SANG WON LIM And, Phil Bianco(Product Manager)
Culture	Our culture can be explained by one word, "Laon" means just "pleasure".

2.3 Business context

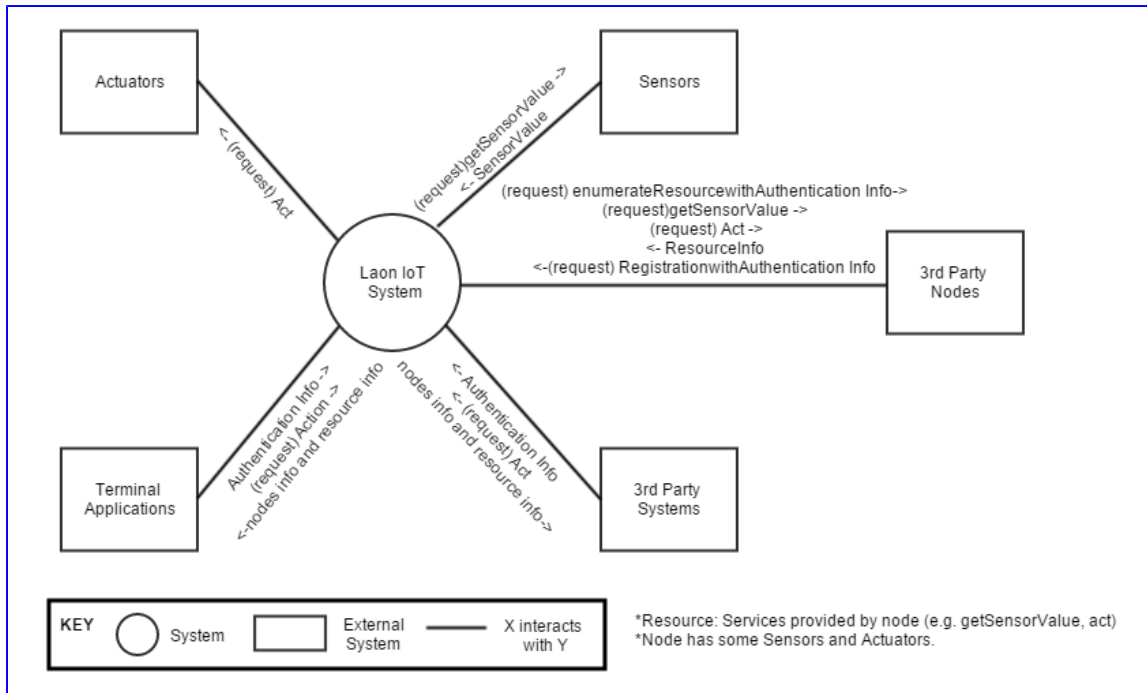
The strategies for serving our markets	We focuses the premium village in which high salary people stay.
Profit model	The incomming occurs on selling & installing the infrastructure package and nodes, compatibility certification fee from the apps on the app market.
Competition and competitive positions	Other teams.

2.4 Technological context

Languages and language paradigm	JAVA, Python, Arduino programming language(C, C++).
Tools	Eclipse, Arduino development tool.
Operating systems and hardware platform	<ul style="list-style-type: none"> Linux on Arduino Router – standard Wi-Fi router connected to the CMU network as described above 1 SA node that includes the following sensors/actuators on an Arduino board: (sensors) <ul style="list-style-type: none"> 1 temp and humidity sensor 1 presence/proximity sensor 1 door open-close sensor (actuators) <ul style="list-style-type: none"> 1 each indoor and outdoor light (LEDs) 1 door open-close actuator 1 alarm (LED: lit=secured, unlit=unsecured)
Implementation frameworks	Arduino
Industry standard/best practices and software engineering techniques	IEEE 802.11, IEEE 802.15 Modbus, HTTP (TBD)

3. System boundary

This system we create comprises SA nodes and a server. This is shown on the following context diagram.



<Context Diagram of Laon IoT System>

4. High-level functionality

4.1 Requirements analysis

Following functional requirements are recognized from the requirements document.

ID	Title	Description	Note
FR-01	Install	Shall allow users to query the home to find out both 1) how many nodes are installed 2) what sensors/actuators are installed on each node	performance
FR-02	Control	Shall allow users to control 1) turn on and off lights 2) open and close the door 3) turn on and off the alarm	actuator계열 availability
FR-03	Monitor	Shall allow users to determine 1) temperature 2) humidity 3) presence	sensor계열, door 상태는 몰라도 되나?
FR-04	Writing log	Shall store sensor values every xxx(configurable) seconds for yyy (configurable) hours.	e.g. a configurable sliding window of data with 72 hours as the default value TODO: What value of xxx should be? Does the store means log? availability
FR-14	Writing log	Shall log all user commands for yyy (configurable) hours.	
FR-05	Reading log	Shall allow user applications to review their sensor and command history.	security format
FR-06	Security	Shall not allow unauthorized persons to access 1) the home sensors/actuators 2) any data generated by sensors/actuators 3) any data stored	
FR-07	Install	Shall not allow unauthorized persons to register a sensor that they do not own	TODO: Is this "sensor" a node? of just sensors?
FR-08	Watching	Shall send an emergency message when the door is manually opened while alarmed	TODO: How the message should be sent to? (Celluar network? E-mail?) How about the format? TODO: Who is supposed to receive the message? (Security agency? Police? House residence?)
FR-15	Watching	Shall send an emergency message when the house is suddenly occupied while alarmed	

FR-09	Policy	Shall not allow automatic door opening while the house is alarmed.	* The alarm must be disabled prior to opening the door
FR-10	Watching	Shall send a message to the user to inform them when the house is vacant and not alarmed. It should ask them if they want to alarm the home. Shall lock the house, if they do not respond within 5 minutes. If a door is open, it will close the door before alarming the house.	TODO: How the message should be sent to? (Celluar network? E-mail?) How about the format? TODO: How many users should receive the messages? TODO: What does "lock" mean? TODO: What is the expected behavior if the users request to turn the alarm on when door is open? configurable, 5 minutes is the default value
FR-11	Policy	Shall turn off the lights when no one is home and 10 minutes elapses.	configurable, 5 minutes is the default value
FR-12	registration	Shall add and remove nodes to and from the system without having to restart the system or other nodes. This includes registration and recognition of the type of sensors and actuators provided by the node.	
FR-13	ecosystem	Should support to build custom apps, services, and/or make mashups from existing available services.	you should describe how the design supports this TODO: What kind of things should be supported? (API set & document? Service agency? and so forth.)

4.2 Use cases

UC-01 'Shall allow users to query the home to find out'

Use case ID	UC-01
Use case title	FR-01 - 'Shall allow users to query the home to find out '
Stakeholders	User
Description	1) The user would starts the application on own devices such as a laptop and a mobile phone. Then the node lists are shown on the screen. 2) The user selects a node to see what sensors/actuators are installed on the selected node. 3) Then the information which sensors/actuators are installed would be displayed.

UC-02 'Shall allow users to control'

Use case ID	UC-02
Use case title	FR-02 - 'Shall allow users to control '
Stakeholders	User
Description	After the information which sensors/actuators are installed would be displayed, its icon would indicate the current status(on/off, open/closed). Then, 1) The user would select the lights or the alarm to turn on/off it. 2) The user would select the door to open/close it. After the user selection, each actuator would work well and the icon on the user's screen would be toggled.

UC-03 'Shall allow users to determine 1) temperature 2) humidity 3) presence'

Use case ID	UC-03
Use case title	FR-03 - 'Shall allow users to determine 1) temperature 2) humidity 3) presence'
Stakeholders	User
Description	1) The user starts the application. 2) Login screen will be displayed and then the user inputs ID and password If it is correct, application display status of sensors and actuators on screen.

UC-04 'Shall store sensor values every xxx(configurable) seconds for yyy (configurable) hours.'

Use case ID	UC-04
Use case title	FR-04 - 'Shall store sensor values every xxx(configurable) seconds for yyy (configurable) hours.'
Stakeholders	Server
Description	<ol style="list-style-type: none"> 1) Server request status of sensors and actuators every xxx seconds 2) SA node reply with status. 3) Server update this information in the repository. 4) Server check that the information has passed for yyy hours in the repository. If there are, Server will remove that information.

UC-14 'Shall log all user commands for yyy (configurable) hours.'

Use case ID	UC-14
Use case title	FR-14 - 'Shall log all user commands for yyy (configurable) hours.'
Stakeholders	User
Description	<ol style="list-style-type: none"> 1) The user change status of actuators on screen 2) The application send control message to the Server 3) Server update this information in repository. 4) Server check that the information has passed for yyy hours in repository. If there are, Server will remove that information. 5) Server send control message to the SA node

UC-05 -'System shall allow user applications to review their sensor and command history'.

Use case ID	UC-05
Use case title	FR-05 -'System shall allow user applications to review their sensor and command history'.
Stakeholders	User
Description	<ol style="list-style-type: none"> 1) The application starts and main menu is displayed. 2) The user login to the system through the application. 3) The user can review their sensor value history on the application. 4) The user can review their command history on the application. 5) The user elect to exit the application.

UC-06 'System Shall not allow unauthorized persons to access'

Use case ID	UC-06
Use case title	FR-06 System Shall not allow unauthorized persons to access
Stakeholders	Malicious user
Description	<ol style="list-style-type: none"> 1) The application starts and main menu is displayed. 2) The user attempt to login to the system through the application but user fail to login. 3) The user attempt to access home sensors or actuators but the attempt failed. 4) The user attempt to generate data by sensors or actuators but the attempt failed. 5) The user attempt to store some data but the attempt failed. 6) The user elects to exit the application.

UC-07 'Shall not allow unauthorized persons to register a sensor that they do not own'

Use case ID	UC-07
Use case title	FR-07 - 'Shall not allow unauthorized person to register a sensor that they do not own'
Stakeholders	User
Description	<ol style="list-style-type: none"> 1) The user would search a node that can be registered. 2) The user could not see a sensor if he is not unauthorized.

UC-08 'Shall send an emergency message'

Use case ID	UC-08
Use case title	FR-08 - 'Shall send an emergency message when the door is manually opened while alarmed'
Stakeholders	User
Description	1) The door is manually opened while alarmed. 2) The user will see emergency message.

UC-15 'Shall send an emergency message'

Use case ID	UC-15
Use case title	FR-15 - 'Shall send an emergency message when the house is suddenly occupied while alarmed'
Stakeholders	User
Description	1) The house is suddenly occupied while alarmed. 2) The user will see emergency message.

UC-09 'Shall not allow automatic door opening while the house is alarmed.'

Use case ID	UC-09
Use case title	FR-09 Shall not allow automatic door opening while the house is alarmed.
Stakeholders	User
Description	1) The user would like to open door from remote terminal such as smartphone or desktop via the system while alarmed. 2) The system should inform the user that house is alarmed. 3) The user disables alarm. 4) The user requests the door open again. 5) The system opens the door.

UC-10 'Shall not allow automatic door opening while the house is alarmed.'

Use case ID	UC-10
Use case title	FR-10 Shall send a message to the user to inform them when the house is vacant and not alarmed.
Stakeholders	User
Description	1) The user goes out not enabling alarm. 2) The system checks vacant and alarm status. 3) If house is vacant and not alarmed, the system will send a message such as SMS or email to user(s) registered on the system. 4) The user can login the system and enable alarm of house after receiving the message. 5) If the user(s) don't respond within 5 minutes, the system shall close the door if it is open and will enable the alarm.

UC-11 'Shall turn off the lights when no one is home and 10 minutes elapses.'

Use case ID	UC-11
Use case title	FR-11 - 'Shall turn off the lights when no one is home and 10 minutes elapses.'
Stakeholders	Server
Description	1) Server checks the status of presence or proximity sensor. 2) If no one is at home during 10 minutes, the server shall turn off the lights.

UC-12 'Shall add and remove nodes to and from the system'

Use case ID	UC-12
Use case title	FR-12 - 'Shall add and remove nodes to and from the system'
Stakeholders	User
Description	1) The user would search nodes. 2) The user would select nodes to add or remove to or from the searched lists. 3) The user could get the result from the system when nodes are added or removed to or from the node lists.

UC-13 'Should support to build custom apps, services, and/or make mashups from existing available services.'

Use case ID	UC-13
Use case title	FR-13 - 'Should support to build custom apps, services, and/or make mashups from existing available services.'
Stakeholders	Server
Description	1) Application/node developer request the API documents to us. 2) Application/node developer make application or mashup service with the API documents provided by us. 3) The application/node works well with our system.

5. Constraints

5.1 Business constraints

ID	Description
BC-01	You may use 3rd party open source SW but please check with the project manager and business developer(course instructor).
BC-02	The system should be delivered in 5 weeks and the team is consist of 6 members.

5.2 Technical constraints

ID	Description
TC-01	Permissible languages for this system (excluding the nodes) include Java and Python.
TC-02	The node should be implemented on Arduino.

6. Quality attributes

6.1 Prioritization

Score is calculated by Priority + Difficulty.

ID	Quality Attribute	Attribute Refinement	Description	Priority	Difficulty	Score
QA01	Security	Confidentiality integrity Availability	The system shall allow user applications to review their sensor and command history in a secure and private way.	H	M	5
QA02	Security	Authorization	The system shall provide secure registration of the type of sensors and actuators provided by the node. The system shall not allow unauthorized persons to register a sensor that they do not own	H	H	4
QA09	Security	Authentication	The system shall provide some authentication method for user.	H	H	4
QA03	Security	Authorization	The system shall not allow unauthorized persons to access 1) the home sensors/actuators 2) any data generated by sensors/actuators 3) any data stored	H	M	5

QA04	Usability	Number of tasks accomplished	The system shall provide easy ways to add and remove nodes to and from the system within 5 step tasks.	M	M	4
QA05	Availability	No downtime	The system shall provide to add and remove nodes to and from the system without having to restart the system or other nodes.	M	L	5
QA06	Scalability	Number of nodes	Assume that a home can have one or more nodes up to 100.	L	H	2
QA07	Interoperability	Discover service	The system shall be easy for application developers to build custom apps, services, and/or make mashups from existing available services.	M	H	3
QA08	Modifiability	Coupling	SA nodes currently utilize 802.11 the system should make it easy to add emerging protocols with modifying only 1 element. (e.g. it is expected that we will add Bluetooth 802.15 products in the future)	L	M	3

QA Prioritization:

The QA prioritization order is in the condition of Score ≥ 5 or High priority marked items.

[High scored] QA1 = QA2 = QA3 = QA5 > QA4 = QA9 > QA7 = QA8 > QA6 [Low scored]

6.2 Scenario

Note: The measures are captured under same environment conditions only.

QA-01 Security - Data packet security

ID	QA-01 Security - Data packet security
Scenario (s)	The system shall allow user applications to review their sensor and command history in a secure and private way.
Stimulus	Request to review their sensor and command history
Stimulus Source	User application
Environmental Condition (s)	1. The user application and the system shall be on the network. 2. The user application shall be authorized.
Artifact (if known)	The system
Response	The system shall response the data packets which include information.
Response Measures	The data packet shall be encrypted. (The raw data packet shall be different from the originated data from sensors.)

QA-02 Security - Authorization

ID	QA02. Security - Authorization
Scenario (s)	The system shall provide secure registration and recognition of the type of sensors and actuators provided by the node. The system shall not allow unauthorized persons to register a sensor that they do not own
Stimulus	Pressing register button with secret number on the install screen.
Stimulus Source	User
Environmental Condition (s)	1. User node should be connected to the internet through Wifi. 2. It is working between server and SA node
Artifact (if known)	The system.
Response	message
Response Measures	If secret number is correct, SA node send information sensors and actuators But, in case of not correct, there is no response

QA-09 Security - Authorization

ID	QA09 Authorization
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Scenario (s)	The system shall not allow unauthorized persons to access 1) the home sensors/actuators 2) any data generated by sensors/actuators 3) any data stored
Stimulus	request to access
Source of Stimulus	unauthorized user
Environmental Condition (s)	The system is running on the network.
Artifact (if known)	The system.
Response	message
Response Measures	1) message means refusing. 2) message don't have any information about home sensors/actuators.

QA-03 Security - Authentication

ID	QA03 Authentication
Scenario (s)	The system shall not allow unauthorized persons to access 1) the home sensors/actuators 2) any data generated by sensors/actuators 3) any data stored
Stimulus	request to login with ID and password.
Source of Stimulus	User
Environmental Condition (s)	The system is running on the network.
Artifact (if known)	The system.
Response	message
Response Measures	1) If ID and password is wrong, message means login is refused. 2) If ID and password is right, message means login is permitted.

QA-04 Usability - Number of tasks accomplished

ID	QA04 Usability
Scenario (s)	The system shall provide easy ways to add and remove nodes to and from the system within 5 step tasks.
Stimulus	attempt to add or remove nodes
Source of Stimulus	User
Environmental Condition (s)	The system is running on the network.
Artifact (if known)	The system.
Response	Steps to complete the task.
Response Measures	The task is done within 5 steps.

QA-05 Availability

ID	QA05 Availability
Scenario (s)	The system shall provide to add and remove nodes to and from the system without having to restart the system or other nodes.
Stimulus	Install new nodes in house or remove nodes.
Source of Stimulus	User
Environmental Condition (s)	1. The system is already deployed and working well. 2. The network channel is working well.
Artifact (if known)	The system.

Response	Internal log
Response Measures	measure system downtime with system internal log (downtime/90 days is under 12 minutes)

QA-6 Scalability - Number of nodes

ID	QA06 Scalability
Scenario (s)	The system shall support more than 100 nodes.
Stimulus	Query a value of sensor
Stimulus Source	User
Environmental Condition (s)	More than 100 nodes are installed in the system.
Artifact (if known)	The system
Response	value of sensor
Response Measures	average response time is under 1 sec.

QA-07 Interoperability - Discover service

ID	QA07 Interoperability - Discover service
Scenario (s)	The system shall be easy for application developers to build custom apps, services, and/or make mashups from existing available services.
Stimulus	A request to exchange information among system
Stimulus Source	A system initiates a request to interoperate with the system
Environmental Condition (s)	The system services known prior to other systems.
Artifact (if known)	The system
Response	1) Unauthorized request is rejected. 2) Authorized request is accepted and information is exchanged successfully. 3) The request is logged by the systems.
Response Measures	1) Percentage of information exchanges correctly processed or rejected is over 99.99%

QA-08 Modifiability

ID	QA08 Modifiability
Scenario (s)	SA nodes currently utilize 802.11 the system should make it easy to add emerging protocols with modifying only 1 element. (e g. it is expected that we will add Bluetooth 802.15 products in the future)
Stimulus	the system should support emerging protocols such as Bluetooth 802.15
Stimulus Source	User
Artifact (if known)	The system
Environmental Condition (s)	1. the system has been developed to support 802.11 protocol 2. the software is already deployed.
Response	number of SW modules affected by adding new protocol
Response Measures	the modules less than five should be modified.

Planing 작성

- Risk 관리 계획
- WBS

99. Temp

UC-07 'Shall not allow unauthorized persons to register a sensor that they do not own' 아이디등은 개별 취합후 다시 정리

Use case ID	UC-07
Use case title	FR-07 - 'Shall not allow unauthorized person to register a sensor that they do not own'
Stakeholders	User
Description	1) 센서를 노드에 등록하는 것인지. 집에 노드를 등록하는 것인지 확인 필요. 2) 센서를 소유하고 있다는 것에 대한 의미 확인 필요. 노드에 센서가 등록되어있는데 따로 어떻게 소유하고 있다는 것인지. 3) 집하나에 여러사람이 등록되어 있고 등록된 노드도 다수 일수있다고 가정하고 집에 요청이 되었을때 등록된 사용자만 authorized로 판단 등록된 사용자가 아니면 unauthorized로 판단. 4) authorized인 사용자의 경우 노드 리스트중 어디에 센서를 등록할지 선택하는 형태로 작성필요.

UC-08 'Shall send an emergency message'

Use case ID	UC-08
Use case title	FR-08 - 'Shall send an emergency message when the door is manually opened while alarmed'
Stakeholders	User
Description	1) 메시지를 어떻게 보낼지 sms? email? 누구에게 보낼지 user? police? 2) The user open th door. 3) The system check the open mode. 4) If it is "manually" the system find the node which was mapped to the opened door. 문에는 노드하나 센서하나면 mapping되는 것인지 5) The system requests what sensors/actuators are installed on the selected node. 6) The system response with the information that sensors/actuators are installed. 7) The system check the status of alarm. 8) If it is "LED:lit=secured" send message who and how. ????

UC-15 'Shall send an emergency message'

Use case ID	UC-15
Use case title	FR-15 - 'Shall send an emergency message when the house is suddenly occupied while alarmed'
Stakeholders	User
Description	1) 메시지를 어떻게 보낼지 sms? email? 누구에게 보낼지 user? police? "suddenly occupied"는 어떻게 확인할 수 있는 것인지 문을 여는 것외에 집을 점유할 수 있는 경로가 어떤 것인지 2) The user open th door. 3) The system check the open mode. 4) If it is "manually" the system find the node which was mapped to the opened door. 문에는 노드하나 센서하나면 mapping되는 것인지 5) The system requests what sensors/actuators are installed on the selected node. 6) The system response with the information that sensors/actuators are installed. 7) The system check the status of alarm. 8) If it is "LED:lit=secured" send message who and how. ????

UC-12 'Shall add nodes to the system'

Use case ID	UC-08
Use case title	FR-08 - 'Shall add nodes to the system'
Stakeholders	User
Description	<p>1) The user request to add nodes to the system. (시스템 최초 접속시 authorized 여부 판단하여 add nodes등의 api호출시에는 이미 authorized된 것으로 가정함.)</p> <p>2) The system find house id which is mapped to this user id.</p> <p>3) The system add nodes to the installed node lists of this house id. (already installed node should not be added again)</p> <p>4) The system recognize the type of sensors and actuators about the added nodes.</p>

Use case ID	UC-08
Use case title	FR-08 - 'Shall remove nodes from the system'
Stakeholders	User
Description	<p>1) The user request to remove nodes from the system. (시스템 최초 접속시 authorized 여부 판단하여 add nodes등의 api호출시에는 이미 authorized된 것으로 가정함.)</p> <p>2) The system find house id which is mapped to this user id.</p> <p>3) The system remove nodes from the installed node lists of this house id.</p>