Instituto Superior Técnico - UL

Enterprise Integration

IoT Project

Home Security and Automation

Authors:
Diogo Moura
Pedro Pereira

IST ID:
86976
90766

---

19 of March of 2021

Contents

1 Introduction **2**

2 Company name and Logo **2**

3 Services Provided **2**

4 Target Customers **2**

5 Value proposition **2**

6 Business Drivers **3**

7 Operational Model **3**

8 Information Flow **4**

9 Business Processes **4**
- 9.1 Subscribe to Service 4
- 9.2 Unsubscribe to Service 5
- 9.3 Add/Remove IoT device 5
- 9.4 Change configuration 5
- 9.5 Raise Alarm 6
- 9.6 House Inventory Management 6

10 Regulatory Compliance **6**

1 Introduction

This project aims to develop business processes and integrating them into an IoT company.

2 Company name and Logo

The proposed company name is "SafeHomeIoT". The proposed company logo is represented on figure 1.

Figure 1: "SafeHomeIoT" logo

3 Services Provided

The company provides services in Home Security and Automation.

Our company area is the IoT. The services are provided through IoT devices and a central server, connected through a Wi-Fi/5G Internet connection.

4 Target Customers

Final consumers that rely on our channel and infrastructure to connect their IoT devices.

Companies that need a platform to connect their devices and reach the final consumer.

5 Value proposition

Our value proposition relies on two fundamental components, which can be used either by final consumers or companies:

1. Services: Up to Date Functional and valuable software for home automation that reduces energy costs and increases utility and security for customers.

2. Infrastructure: Highly reliable, secure, and easy to install channel/API to communicate with IoT devices over a Wi-Fi/5G Internet connection.

6 Business Drivers

There are two fundamental business drivers, each with different KPIs.

1. **Increasing customer satisfaction**
   This is related to improving customers' experience through the functionalities of the automation and security provided by our services.

   KPIs:

   - Average delay time between an order's scheduled date and the date it arrives and the average amount of products missing from an order.
     Measurement: Messages exchanged with supermarkets and customers who make orders allow to compute these statistics.
   - Energy efficiency.
     Measurement: Messages from the outside and inside temperature sensors and the IoT heating devices allow to compute the ratio internal temperature divided by external temperature per energy unity spent.
   - Average raise alarm precision (positive predicted value), this is, the fraction of alarms raised that represent real dangerous situations. Average raise alarm recall (true positive rate), this is, the the fraction of dangerous situations reported by customers that are captured by the raise alarm.
     Measurement: Messages exchanged with customers related to the real danger of the situations flagged by the alarms allow to compute these statistics.

2. **Increasing Business Efficiency**
   The service is provided directly through the internet available central server, which communicates with the IoT devices, by opposition to a home installed central, which allows to decrease the company costs.

   KPIs:

   - Number of dislocations to the users' house. Reduced number of dislocations indicates the central server solution is working well, as opposed to a home installed central, allowing the company to reduce costs with installment and technical support.
     Measurement: Messages exchanged with customers and technicians related with technical help allow to compute this statistic.
   - Ln IoT devices companies' time and cost needed to deploy a secure, highly reliable communication channel to IoT devices and get a fully functional app, increasing margins.
     Messages: Number of messages exchanged with other IoT devices' companies.

7 Operational Model

The company operational model is divided into the following components:

1. **Discover Service** Users discover the product through several channels: online marketing/physical stores/online stores where the IoT devices are sold. IoT devices documentation also describes the offered service and model.

2. **Select Service** Final Customers select the type of automation/security services on our website/app and choose the IoT devices on physical/online stores.
3. **Contract Service** Customers pay a monthly/annually fee for the service with online payments through our website/app.
4. **Consume Service** The service is consumed by final consumers through a Mobile/Web App/SMS that send the relevant information to the customer and provide interaction and authentication

8 Information Flow

The information flow is comprised of messages exchanged in the context of the Business Processes, described in the next section.

The entities involved in the message exchanges are the Central Server, Banking Entity, Technicians, Supermarket and Customer.

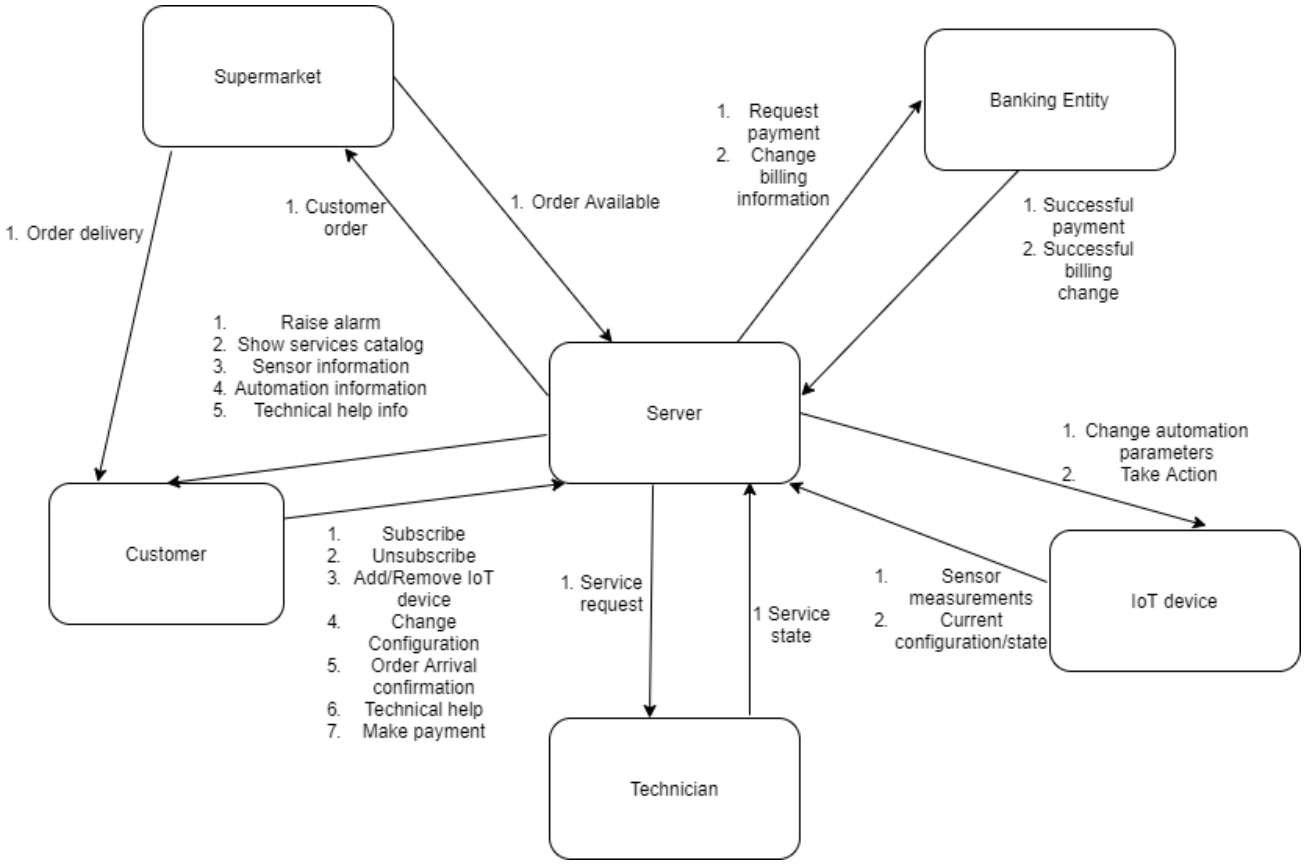

Figure 2: Information Flow

9 Business Processes

9.1 Subscribe to Service

The user accesses the web site and requests the available services (Catalog). The server retrieves them from a database and returns them to the user. The user then chooses the services he is interested in. If the user is already logged in, he sends the services he chose

to the server. Otherwise, the user will have to fill a form with personal information, send it to the server, which then registers the new user. If the server waits more than 5 minutes to receive the chosen services from the user the process finishes. The server then initiates the payment process by contacting the bank services. The bank service provides the payment details which then, the server forwards to the user. If the user does not pay the process finishes. If he pays, he sends the data to server and the server forwards it to the bank services. The bank services sends the payment confirmation to the server and the server sends it to the user. Finally the server associates the services with the user on a database.

The business process diagram is represented on the Appendix, figure 3 and also on an external file named *subscribe_to_service.bpmn.*

9.2 Unsubscribe to Service

The user requests the server to unsubscribe to services. The server cancels the bank billing by connecting to its services and waits for a confirmation from the bank. Then dissociates the user from the services and confirms the unsubscription by sending him a message.

The business process diagram is represented on the Appendix, figure 4 and also on an external file named *unsubscribe_to_service.bpmn*

9.3 Add/Remove IoT device

The client intends to register a new IoT device in the network. So he makes a request to the server with the device information (e.g. serial number, type, brand, model). The server then registers the device and associates it with the customer. The server ends encryption keys for communicating in the network. The use then decides if he needs help. If he does, he sends an help request to the server, with the desired date for the installation. The server schedules a installation. A technician goes to the customer's house at the scheduled date and hour to perform the installation and marks it as complete. If the client does not need help he will perform the installation on his own and inform the server that the installation was successfully completed. If, for some reason, during the installation the user has problems he will ask the server for help.

The business process diagram is represented on the Appendix, figure 5 and also on an external file named *add_remove_iot_device.bpmn*

9.4 Change configuration

The client accesses the web-app (Self-Service CRM) where he can: add/remove an IoT device from the network, change an IoT device or service configurations, read an IoT device config/state, control IoT device actions or leave the webapp.

Requesting to add/remove a IoT device from the network will start the Add/remove IoT device process. This action initiates the IoT device state and configuration on the server.

Requesting to change a device automation configuration will result on a message sent to the device, which will rewrite its configuration. After completing it, the IoT Device informs the server, which informs the client that the parameter change was successful. The server then updates the device current configuration on a database. This action updates the IoT device configuration on the server.

Requesting for an IoT to take an action will result in a message sent to the server which forwards that command to the IoT device. The device does the action, updates its state

and informs the server that the action has been taken, which then informs the client. This action updates the IoT device state on the server.

Reading the IoT Device will send a request to the server which forwards the request to the IoT device. The IoT device sends back the configuration and the server sends it to the user. This action updates the IoT device state on the server.

The business process diagram is represented on the Appendix, figure 6 and also on an external file named *change_ configuration.bpmn*

9.5 Raise Alarm

Sensors installed at the customer's house are constantly scanning the environment, whether it is measuring temperature or collecting images or measuring humidity or motion detection and heat signatures. These sensors are constantly sending the data they collect to a server. The servers logs the data from the sensors and analyzes it in an attempt to detect a potential occurrences. If the data doesn't display any evidence of occurrences, the process terminates. If the suspicion level is very high or confirmed, the server informs the client that a occurrence has been detected and calls the emergency services. The emergency services then go to the customer's house to see to the situation. If the suspicion level is medium or undetermined, the server asks the client to confirm if it is a real occurrence by sending him some information details. If the client does not detect any anomaly, the process terminates. Otherwise, if the client detects a danger situation, the client informs the server, which calls the emergency services. In the end, the occurrence is registered in a database table, even if it is a false positive (i.e. the server detected a possible occurrence, but it was not considered one by the client), in order to measure the system performance.

The business process diagram is represented on the Appendix, figure 7 and also on an external file named *raise_ alarm.bpmn*

9.6 House Inventory Management

There are sensors placed in fridges and shelves on the customer's house. Every time a product is added or removed the sensor sends a message to a server which keeps track of each user's inventory. Whenever a product is removed the server check for any inventory shortages of that product. If there are any the it updates the customer's shopping list. When a product is added it only updates the user's inventory. Periodically some time before a certain day/hour of the week, defined by the customer the server makes an order to a shop shop/supermarket of the products in the shopping list. If the shop is unable to fulfill the delivery it informs the server, which informs the client. If it's able, it also informs the server which informs the client. The client will wait for the shop to deliver the products. If the products aren't there on time, the client will inform the server of the delay. The server then asks the shop for the delivery state and the server forwards it to the client. The shop eventually delivers the products to the customer's house, which then are stored in the shelves/fridge.

The business process diagram is on the Appendix, figure 8 and also on an external file named *house_ inventory_ management.bpmn*

10 Regulatory Compliance

There are already some standards for IoT communication, namely IEEE standards such as:

1. Infrastructure (ex: 6LowPAN, IPv4/IPv6, RPL)
2. Identification (ex: EPC, uCode, IPv6, URIs)
3. Comms / Transport (ex: Wifi, Bluetooth, LPWAN)
4. Discovery (ex: Physical Web, mDNS, DNS-SD)
5. Data Protocols (ex: MQTT, CoAP, AMQP, Websocket, Node)
6. Device Management (ex: TR-069, OMA-DM)
7. Semantic (ex: JSON-LD, Web Thing Model)
8. Multi-layer Frameworks (ex: Alljoyn, IoTivity, Weave, Homekit)

Our plataform will rely on some of these standards.

There is generally a lack of IoT regulation.

However, in some places, there is some regulation in place related to the security of the IoT communication channel. Namely devices must be patchable, rely on industry standard protocols, and be built without hard-coded passwords and known security vulnerabilities (https://innovationatwork.ieee.org/should-government-regulate-iot/).

Our platform aims at complying with these regulations, through providing a secure communication channel for IoT devices.

Appendix

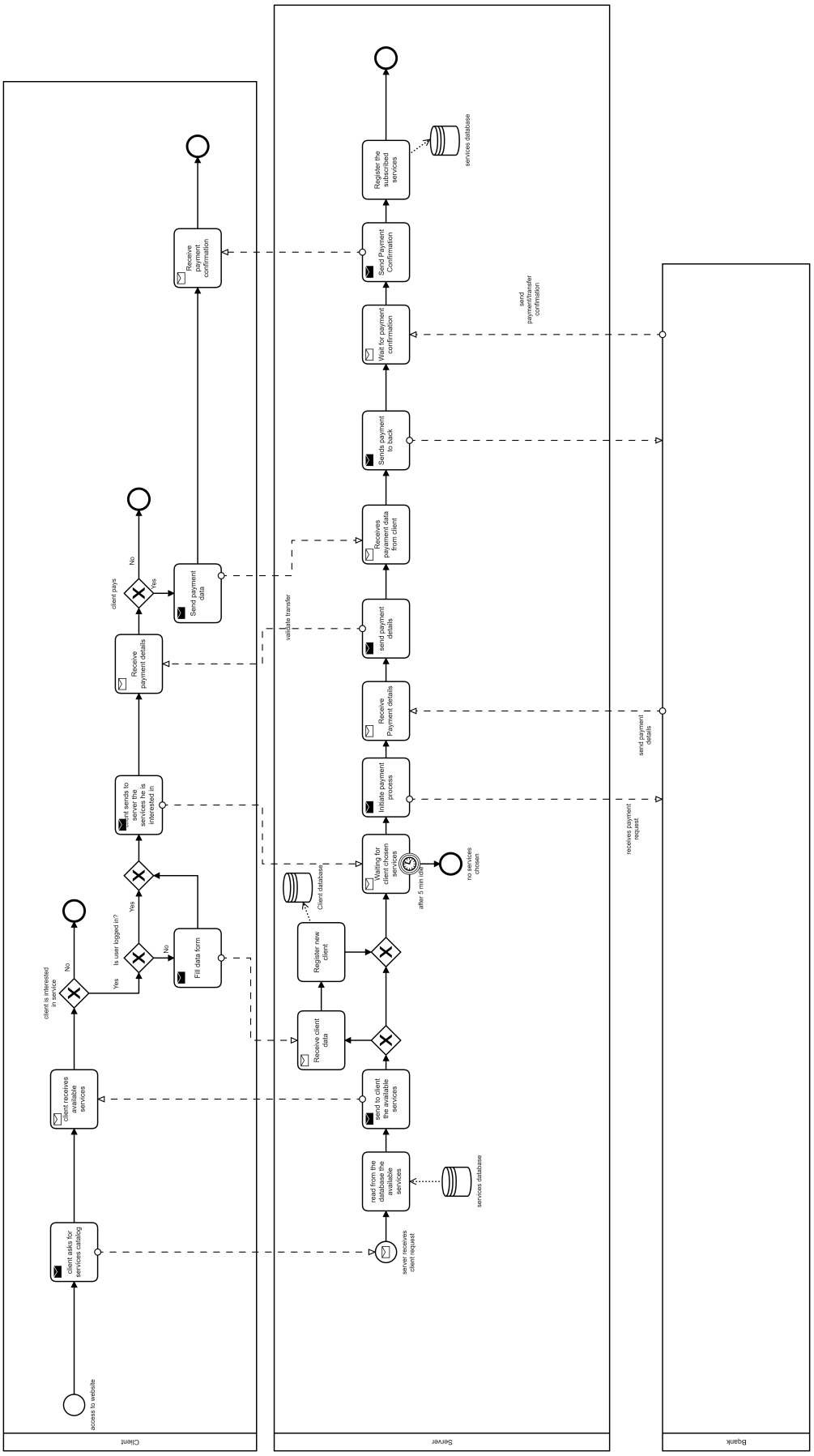

Figure 3: Subscribe to Service

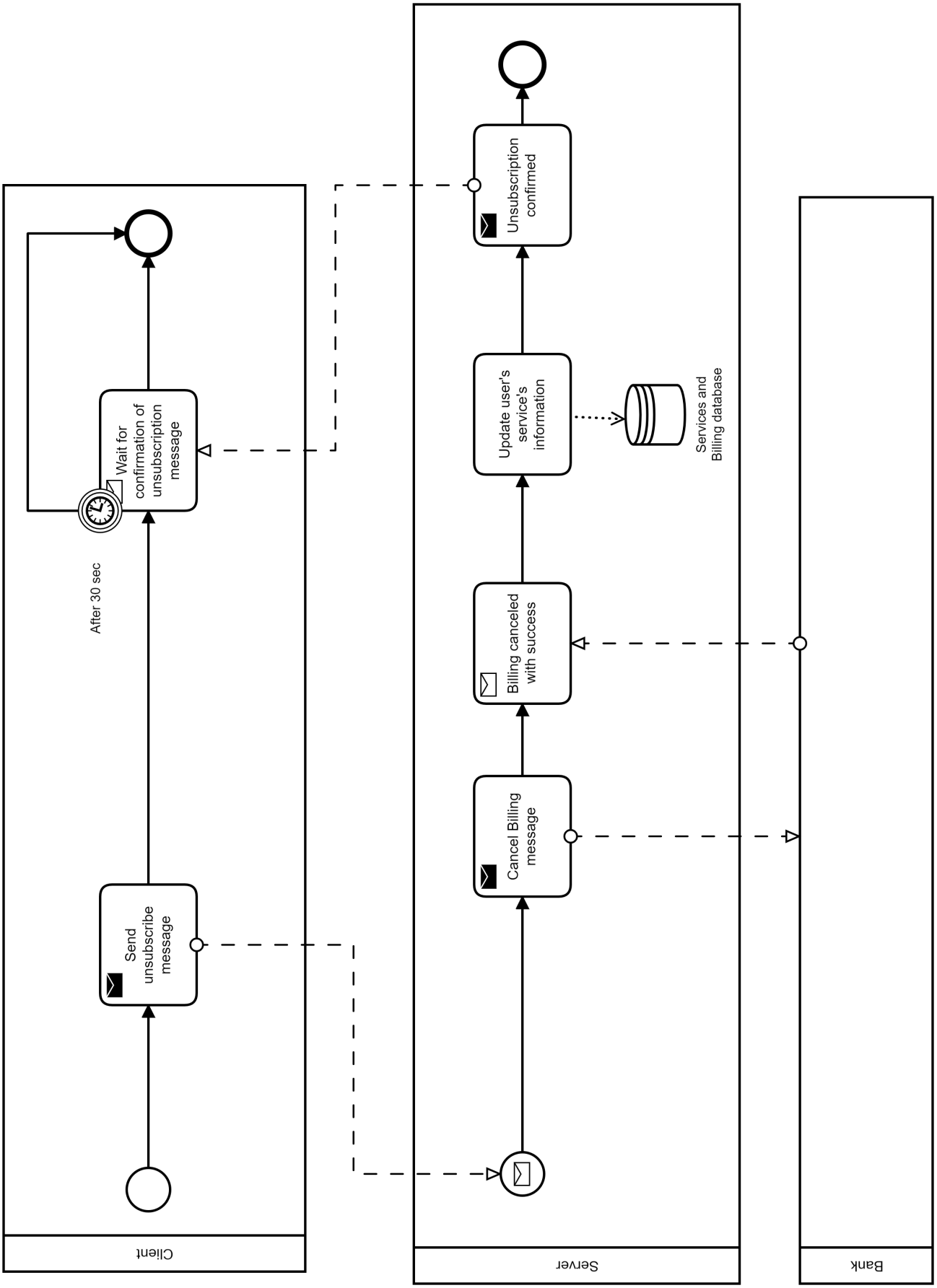

Figure 4: Unsubscribe to Service

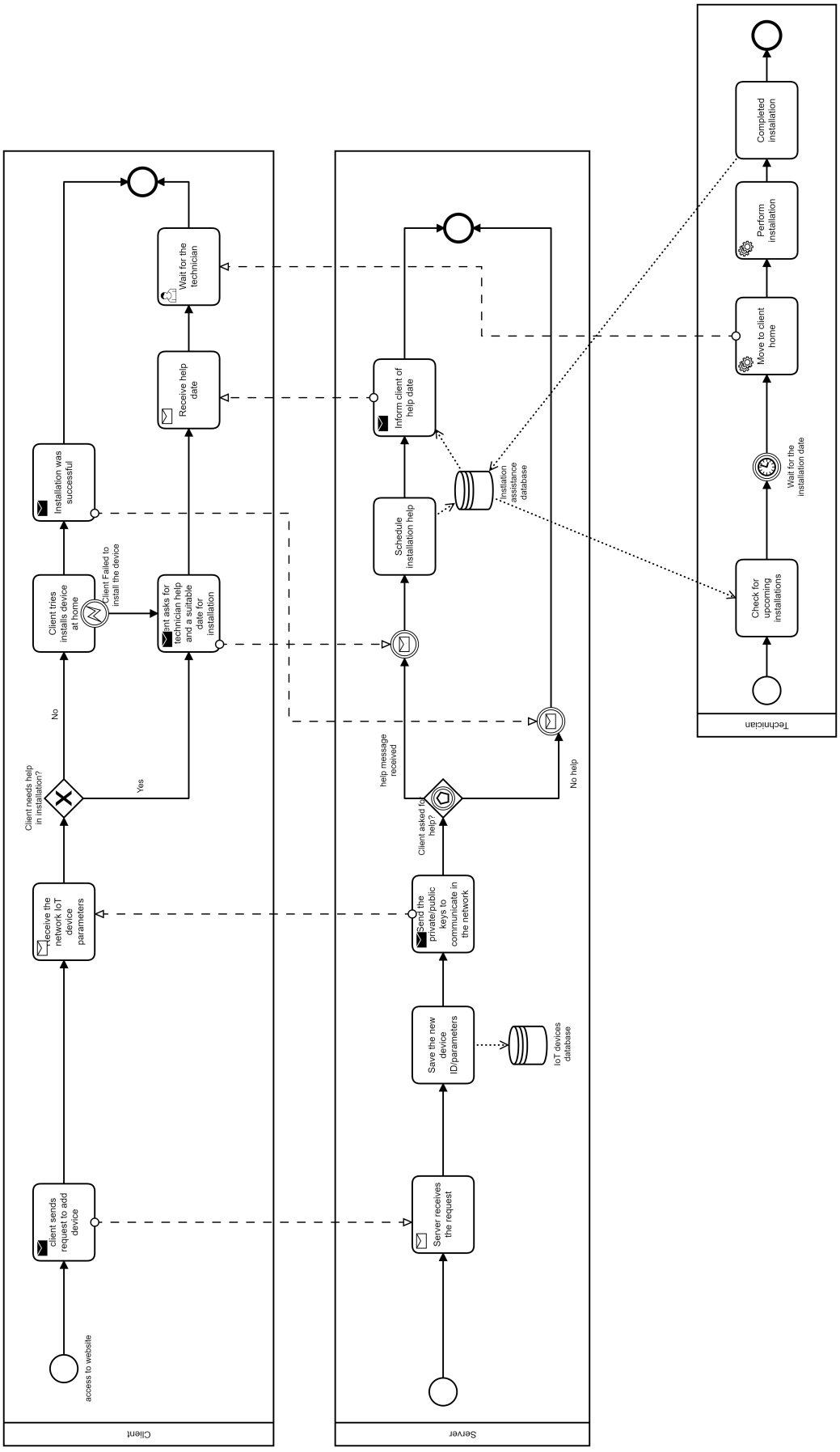

Figure 5: Add/Remove IoT device

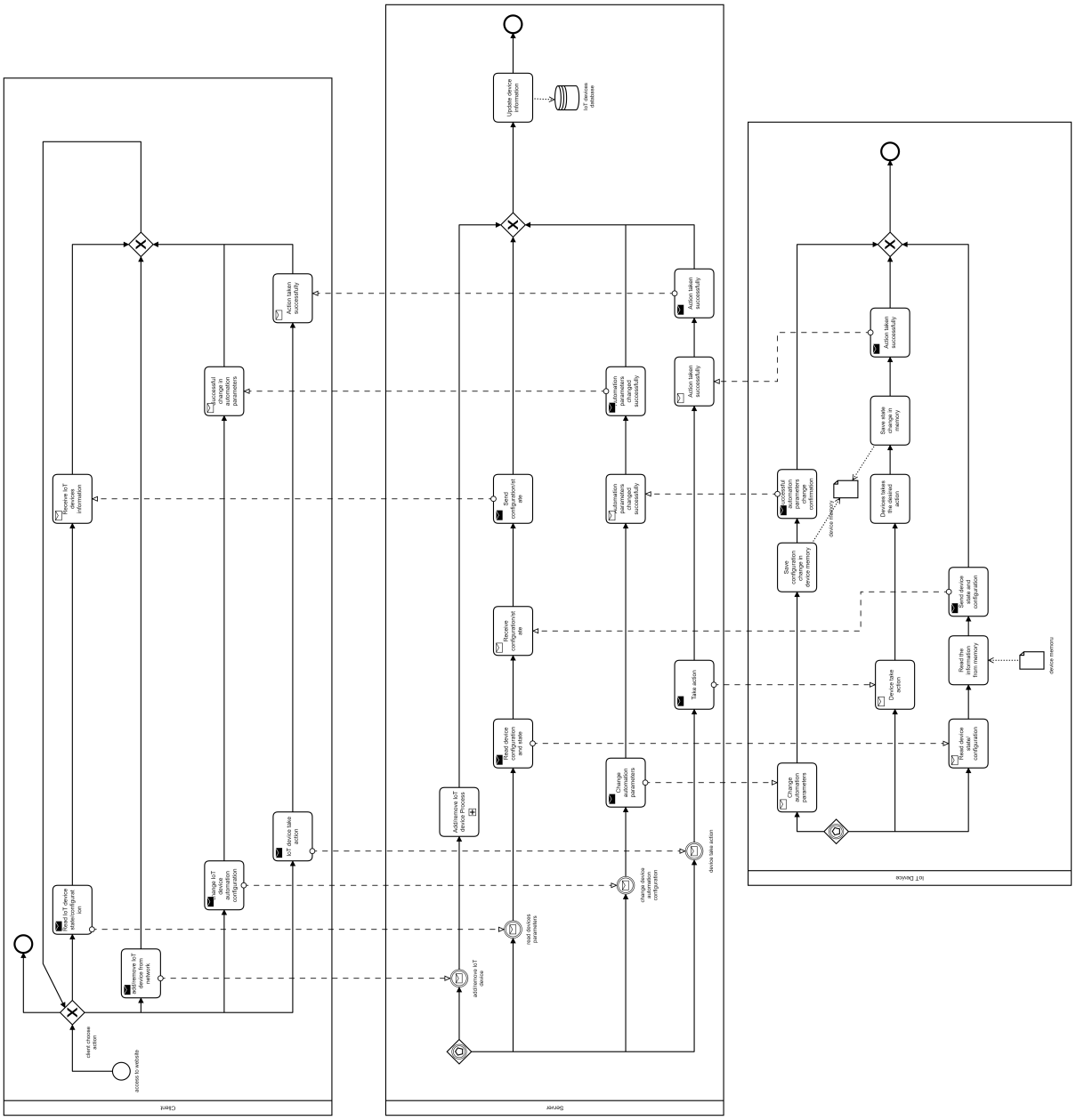

Figure 6: Change configuration

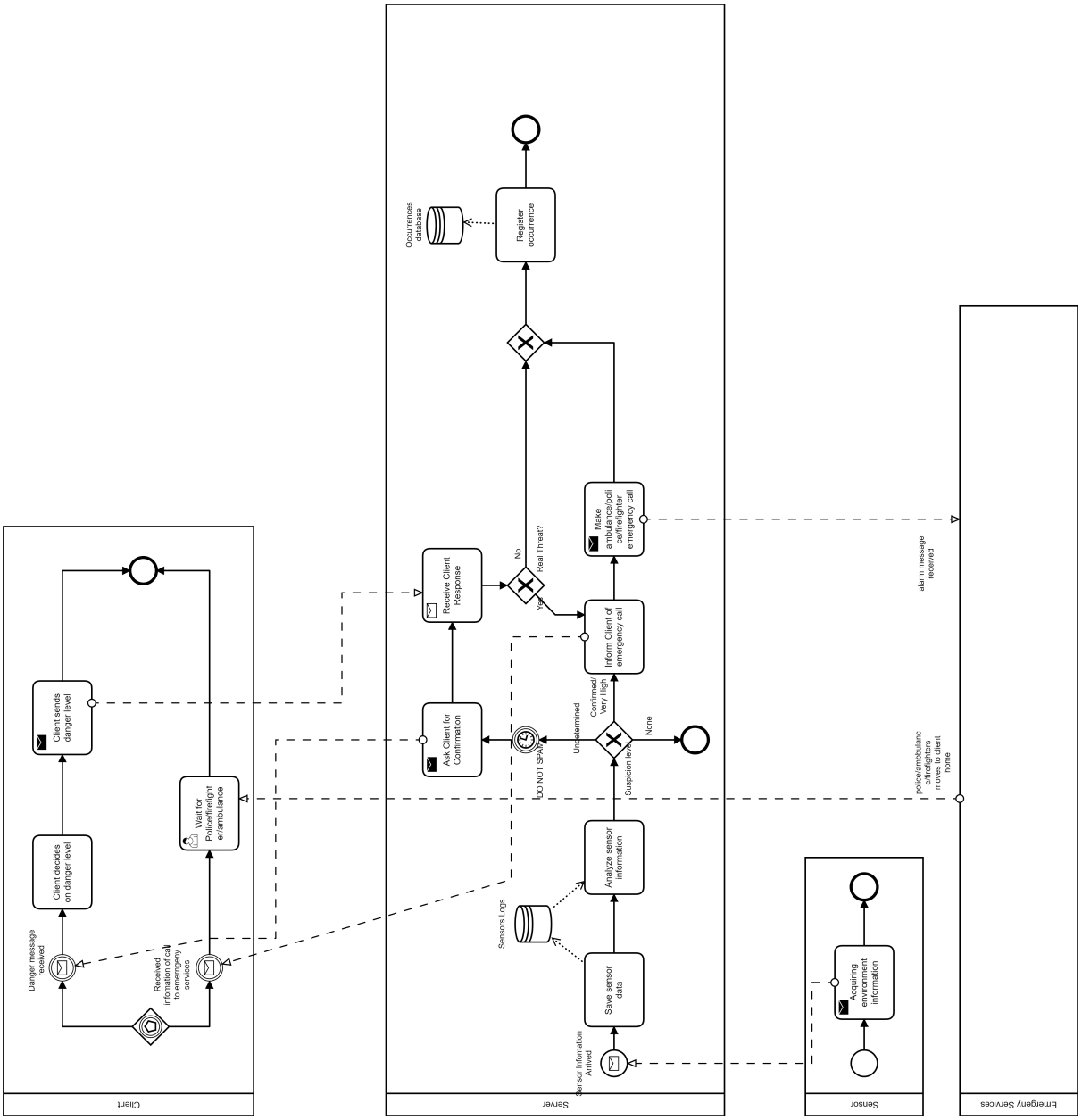

Figure 7: Raise alarm

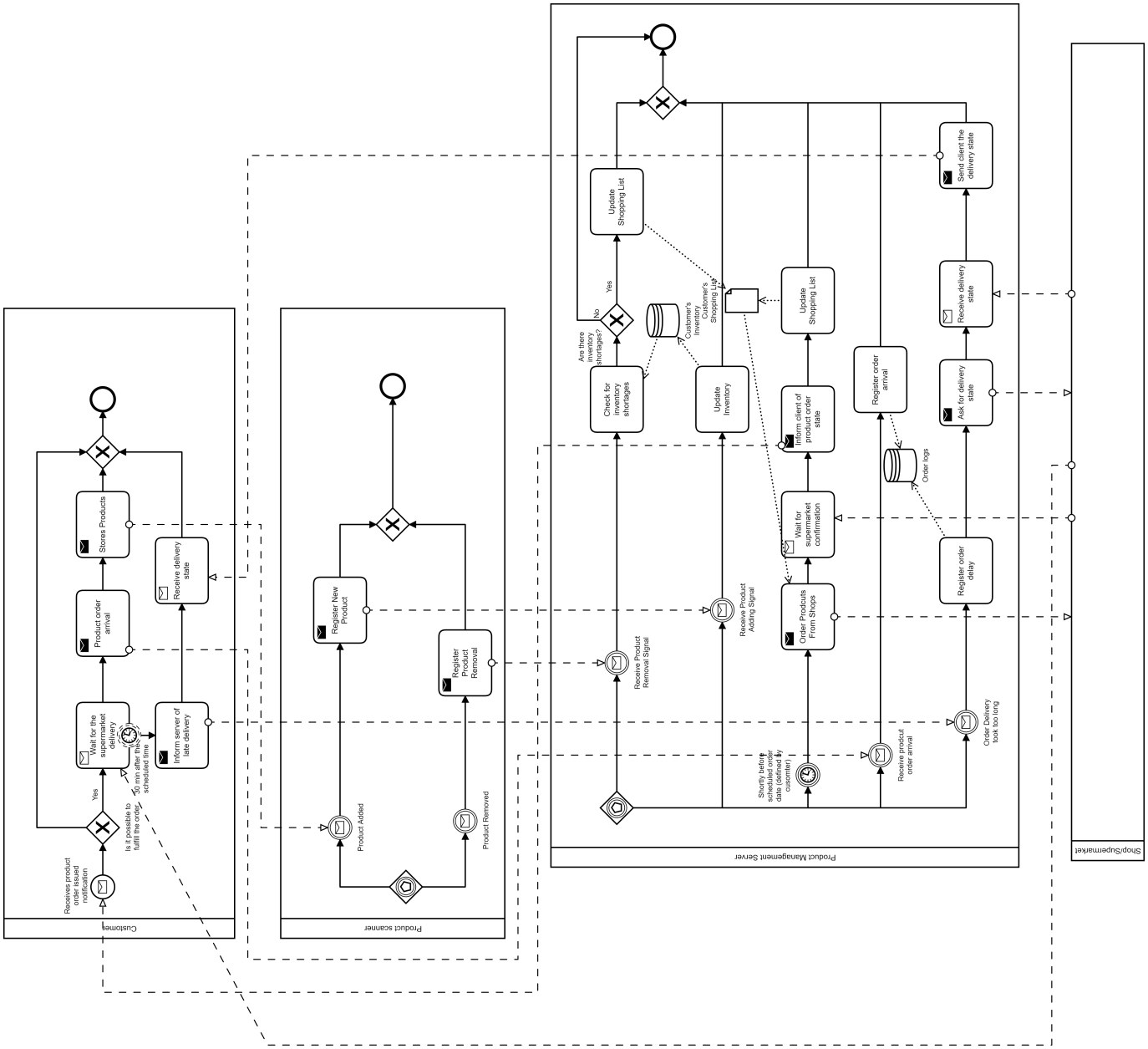

Figure 8: House inventory management