Building Maintenance System

Documentation

In this part of the architecture of the Building Maintenance System we have to draw Decomposition View, Component Connectior View and Sequence diagram with additional use cases which are going to help current and future users and stakeholders to understand the system better and to see all implementation units of the system.

For the starters, system should work independently without relying on other parts of the bigger system meaning, Building Maintenance System shouldn't be depentend on the overall Smart Hospital System. It needs to have its' own database and services working continuously and independently. Additionally, the system needs to have a client application (Web, Mobile, etc...) where all the data and functionalities will be available to the end user. The only part the system doesn't need to have is the Authentication Server (a.k.a. Identity Management System, Authority, Token Issuer, etc...). Users of the system authenticate with their credentials and in response get tokens which describe their roles and the levels of authority over the system functionalities (Admin, Regular User, etc...).

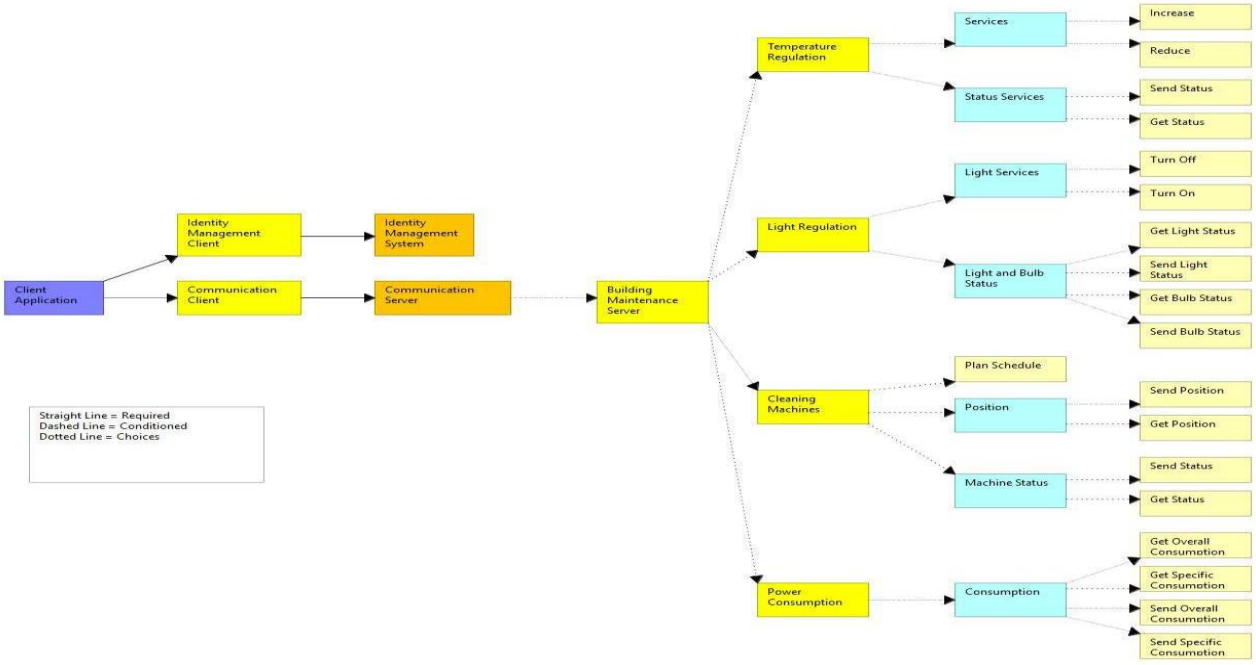
Building Maintenanace System is responsible for monitoring several buildings which are divided into sections. The only part of the building which is not responsibility of this system are patient and doctor rooms. The system functionalities include: Temperature Regulation, Light and Bulp Status Regulation, Cleaning Machines Control and Energy Consumption.

1. **Temperature Regulation** needs to regulate the temperature of all rooms of the hospital excluding patient and doctor rooms. The system should automatically set the temperature of a room to a previously specified target temperature. Further the system should allow people to interact with it and specify a target temperature through the client application. Also, the status of the temperature should be available at any time.
2. **Light and Bulp Status Regulation** covers the topic of the illumination of the hospital, from checking if every lamp is operative to the adjustment of the brightness when needed. The system has the task to warn if some part is not working through messaging client but also to adjust the brightness for every place in the hospital according to the environment and other conditions and at the same time to allow authorized users to modify it.
3. **Cleaning Machines Control** and their schedule are controlled by the Building Maintenance System which is part of the Hospital System. When there is need to use the cleaning machines, staff which is assigned to control their usage, plan the schedule for them. First, they check whether machines are in position. If the wanted machine is not in the position, that machine cannot be used. If the machine is in position, system checks its' status. The status of the chosen machine tells the staff whether that machine can be used soon. If the machine is charging or currently working the system checks until it is available for the next usage. However, if the machine is going to another place, system notifies the staff that that machine cannot be used soon.
4. **Energy Consumption** for the Hospital is maintained using a combination of sensors, triggers, and a software with an UI for the administrators. Energy consumption is read continuously by the system using the sensors and the data is stored for later use. When the need comes, administrators can view the consumption for the type of consumption they specify, on some intervals they specify by using the software. Optionally, triggers can be set to notify the administrators if the consumption passes a threshold set by them. Optionally, sensors can communicate the status of an electricity socket (used/not-used, on/off) or a gas valve (on/off, used/not-used). Optionally, administrators can switch electricity sockets on/off or gas valves on/off.

The system deeply relies on smart devices (sensors, smart machines, etc...) which means relying on different types of gateways and protocols. Because of the possible change of devices in the future and to prevent the major change in the system, system itself needs to have custom gateway adapter, which will unify different types of device gateways and protocols into one layer. When device change happens, only one layer of the system needs to be changed (abstraction over protocols).

Decomposition View

Entity Relationship Diagram



Explanation

Building Maintenance System as the biggest module consists of smaller modules which are describing each functionality in more detail.

Client application as the concrete interface of the whole system is the web application that the end user is going to use to interact with the system.

Identity Management Client is the part of the system which deals with the authorization part and is closely connected to the Auth Sever itself. It relies on the proper fucntionality of the IMS and it stores the sessions inside a built in cache which is going to be used by the client application before interacting with the other part of the system.

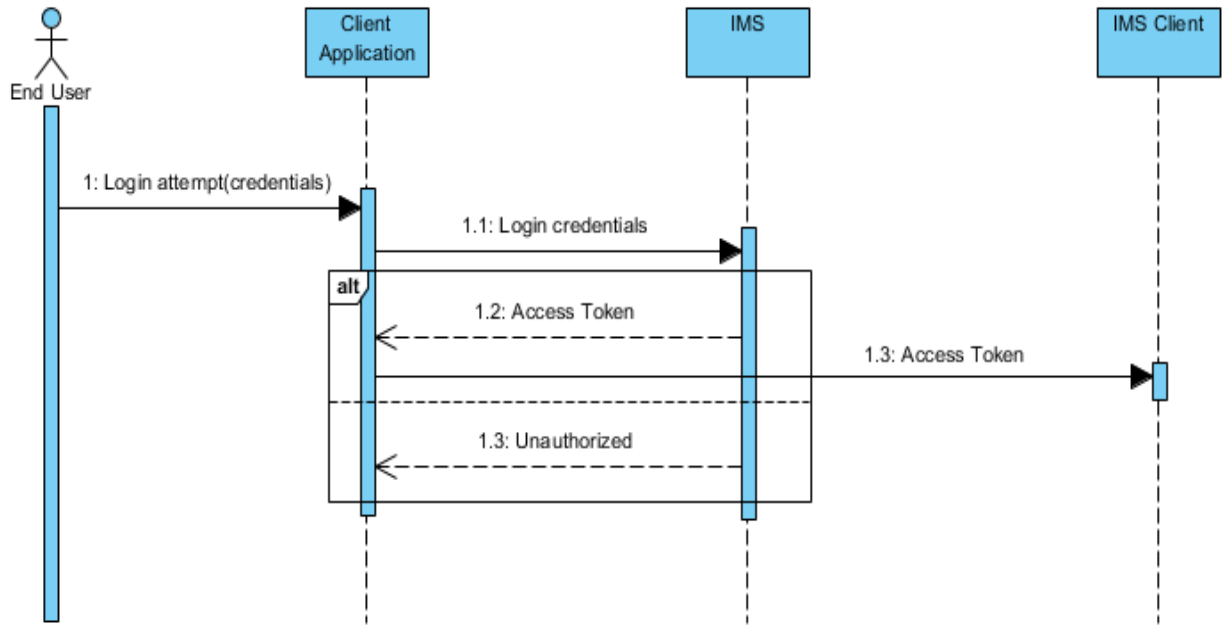
Communication Server and Communication Client are parts of the system which are integrated for the event and acknowledgement purpose. Each service after every performed action notifies other parts of the system that the action was performed so other services could use that information to adapt their actions or change their usual behavior. It is completely event based and each module is subscribed to every other modules events(actions).

Gateways Adapter is the part of the system which interacts with the gateways in order to unify protocols from different devices in case the protocols differ. Every part of the system which interacts with devices uses this gateway. As said before, if device change occurs, other parts of the system won't be affected.

Concerning functionalities of the system, we have four parts which are divided into: Temperature Regulation, Light and Bulp Status Regulation, Cleaning Machines Control and Energy Consumption and they are explained earlier in this document.

Database as the last part is created outside of the system on purpose. The reason is that it could be easily integrated into some bigger system or at least accessed for information purposes.

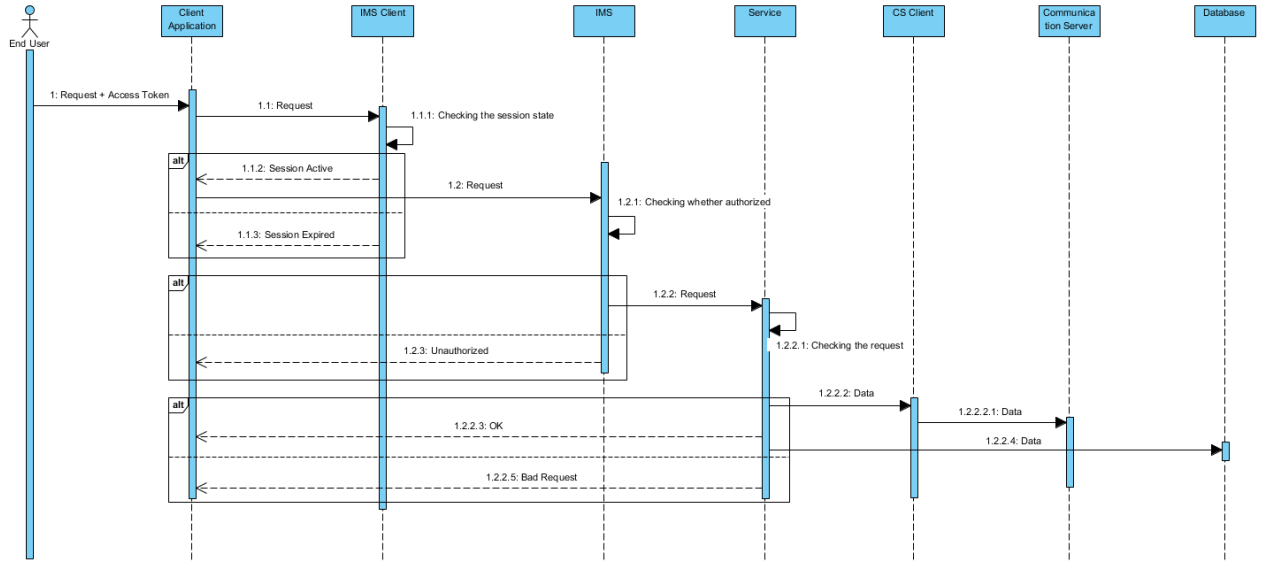
Login Process

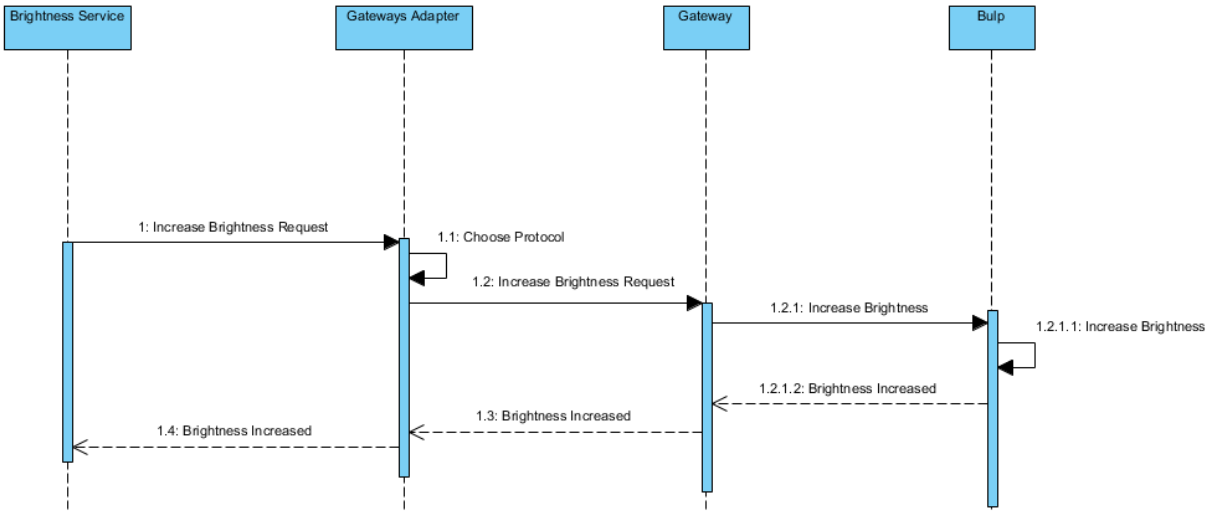


Explanation

In order to use the system, user needs to login to the application. In order to login, user needs to provide credentials which are sent directly from the client application to the Auth Server. If the credentials are correct and the user is successfully authenticated, IMS sends access token with other information (session, session expiration, etc) which are stored in the IMS client for later use. If the credentials are incorrect, IMS sends unauthorized status and the user is not able to use the services.

Service Flow





Explanation

After the user is successfully authenticated he is able to call service to perform some actions. Firstly, the user calls the service by sending a request which is passed to the IMS client. IMS client checks whether the session is

active and if it is not it asks the user to login again before even sending the request to the service. If the session is still active, request is then sent to IMS. IMS checks whether the user is authorized to perform this type of action and if not it returns unathorized status. If the user is authorized it passes the request to the service itself. The service checks whether the request is valid. If not, the service returns the bad request status and the user has to call the service again with modified request and whole previous process will be repeated. If the request is valid, then the service stores the information in the database and sends the information to the communication server through communication client that the action was performed in order to notify other modules.

In the second picture, concrete service is described. This is the process where the service interracts with the gateway adapter and the gateway in order to perform that action on the device. In this case, brigness service sends the request to the bulp adapter to increase the light. Thats signal is sent to the gateway which directly communicates with the device and the action is then finished.