Module3-Simulation scenarios
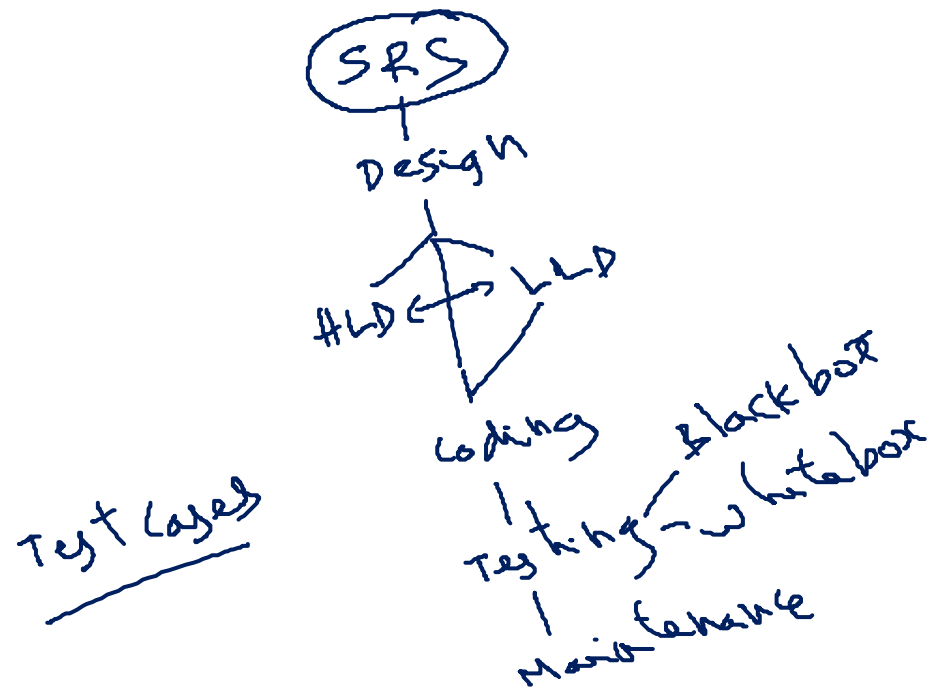
Models to simulate real world scenarios

Simulation →

- A simulation imitates **the operation of real world processes or systems with the use of models**. The model represents the key behaviors and characteristics of the selected process or system while the simulation represents how the model evolves under different conditions over time. → Validate

- Simulation modeling **solves real-world problems safely and efficiently**. It provides an important method of analysis which is easily verified, communicated, and understood.
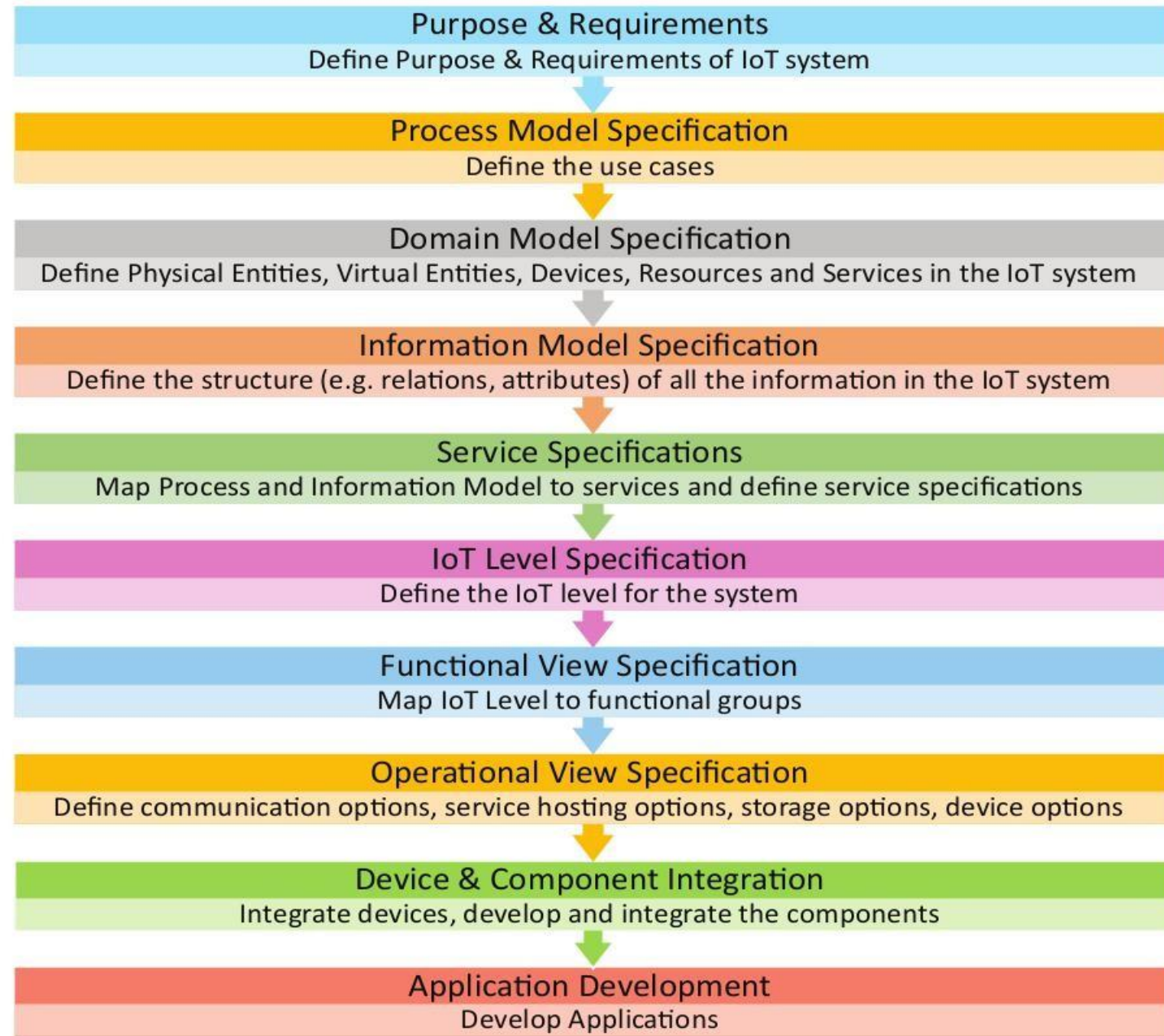
Developing Simulation Models

- Identify the problem with an existing system or set requirements of a proposed system.

- Design the problem while taking care of the existing system factors and limitations.

- Collect and start processing the system data, observing its performance and result.

IoT Design Methodology steps

SRS

Design

HLD ↔ LLD

coding

Testing ~ Black box / white box

Test cases

Maintenance

Home automation.

Purpose & Requirements
Define Purpose & Requirements of IoT system

Process Model Specification
Define the use cases

Domain Model Specification
Define Physical Entities, Virtual Entities, Devices, Resources and Services in the IoT system

Information Model Specification
Define the structure (e.g. relations, attributes) of all the information in the IoT system

Service Specifications
Map Process and Information Model to services and define service specifications

IoT Level Specification
Define the IoT level for the system

Functional View Specification
Map IoT Level to functional groups

Operational View Specification
Define communication options, service hosting options, storage options, device options

Device & Component Integration
Integrate devices, develop and integrate the components

Application Development
Develop Applications

# Purpose & Requirements Specification- Home automation

- To identify the system purpose, behavior and requirements. The requirements can be like data collection requirements, data analysis requirements, system management requirements, data privacy and security requirements, user interface requirements.
    - **Purpose:** A home automation system that allows controlling of the lights in a home remotely using a web application.
    - **Behavior:** The home automation system should have auto and manual modes. In auto mode, the system measures the light level in the room and switches on the light when it gets dark. In manual mode, the system provides the option of manually and remotely switching on/off the light.
    - **System Management Requirement:** The system should provide remote monitoring and control functions.
    - **Data Analysis Requirement:** The system should perform local analysis of the data.
    - **Application Deployment Requirement:** The application should be deployed locally on the device, but should be accessible remotely.
    - **Security Requirement:** The system should have basic user authentication capability. Ex: Identify theft, Password, Location tracking

Data collection methods and requirement for home automation

- Methods: Questionnaires and surveys, Observations, Documents and records, Focus groups, Oral histories.

- **Requirement:** smart device, a hub, and a connected application.

- A home automation system will monitor and/or control home attributes such as **lighting, climate, entertainment systems,** HVAC **systems and appliances** using IoT devices . It may also include home security such as access control and alarm systems.

- automation sensors include **temperature sensors, humidity sensors, light sensors, and gas sensors.**
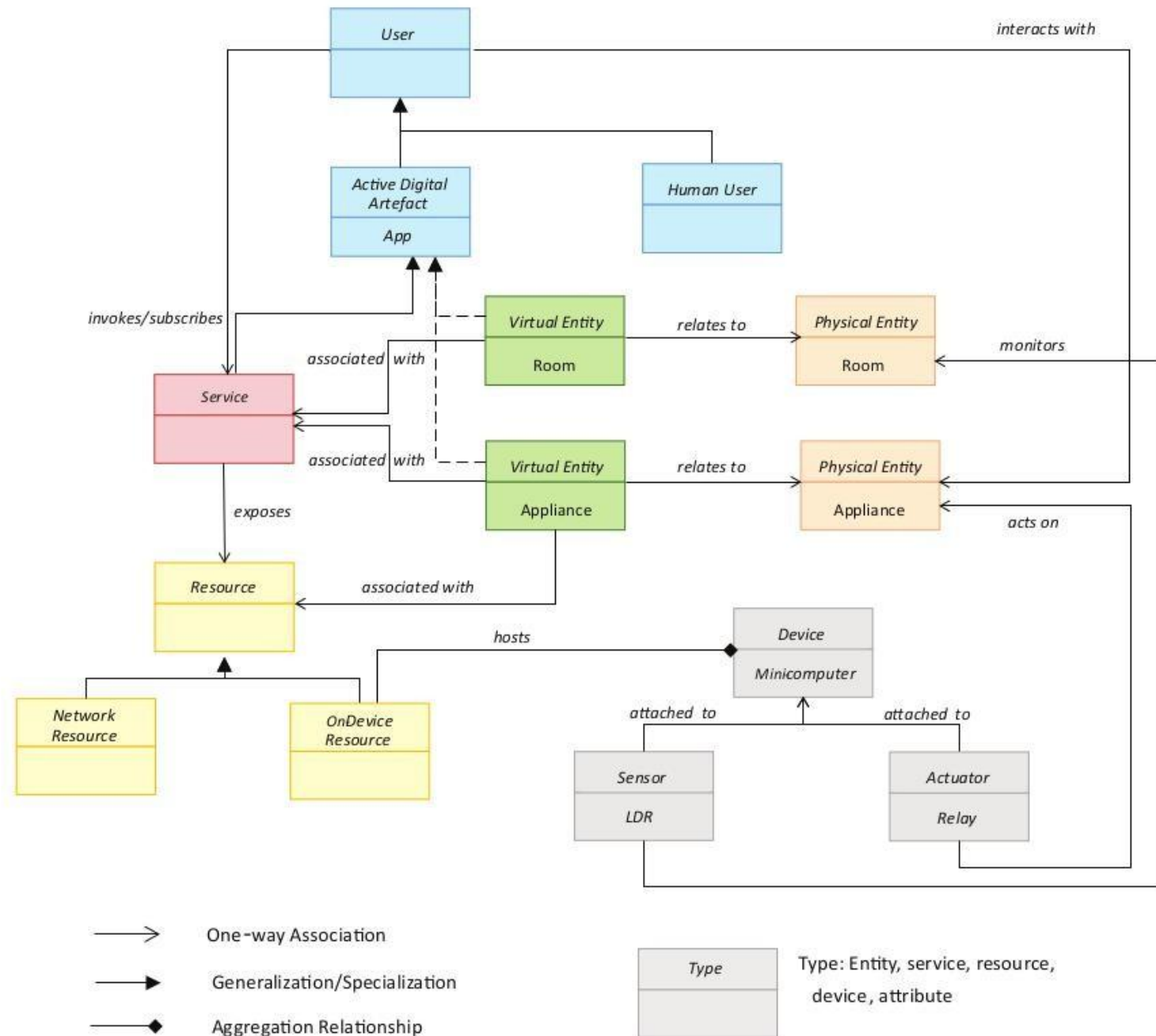
Process Specification-home automation

- It formally described the use cases of the IoT system are based on the purpose and requirement specifications.
- Example for home automation given below:
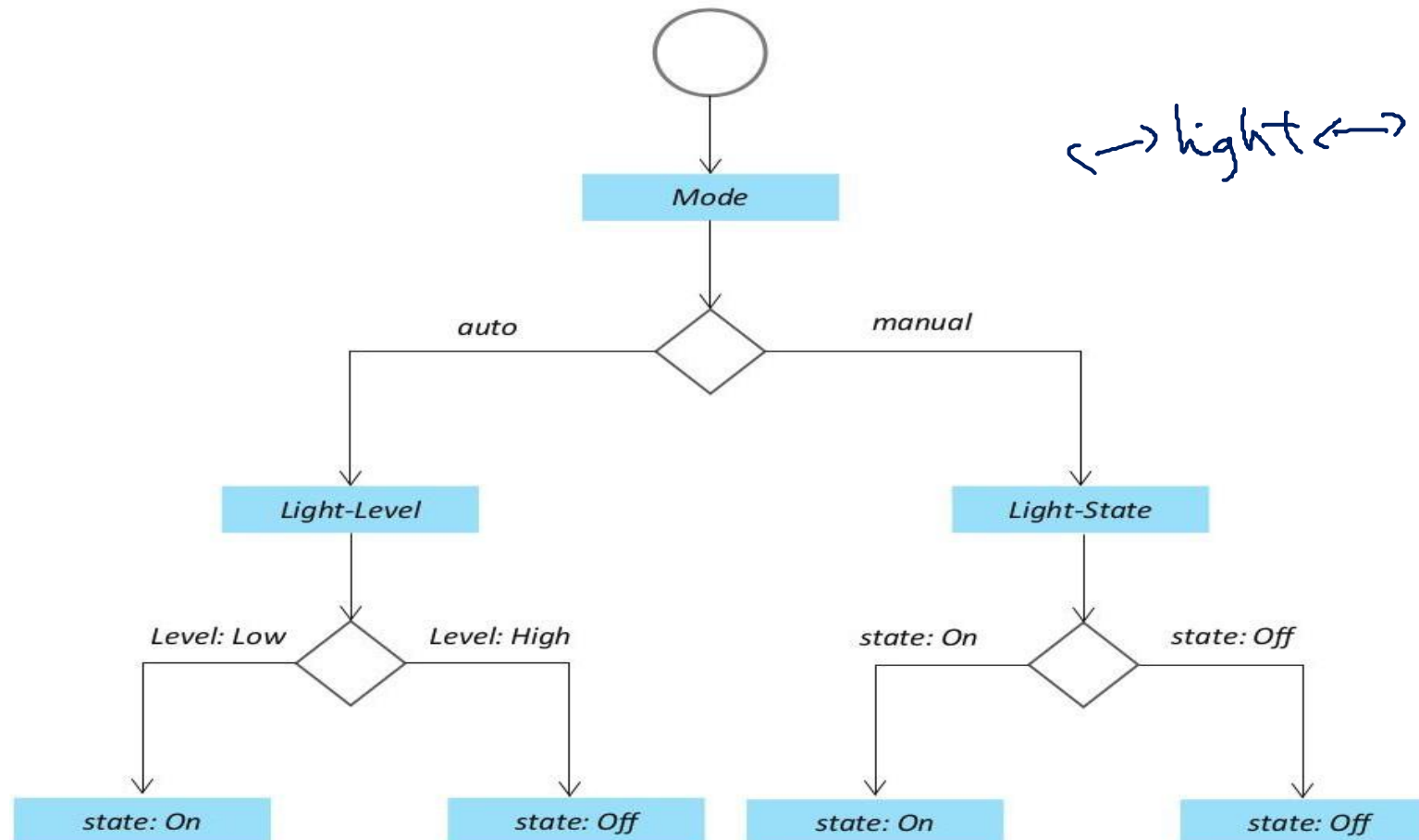
Domain Model Specification

❑ The domain model describes the main concepts, entities and objects in the domain of IoT system to be designed.

❑ It defines the attributes of the objects and relationships between objects.

❑ It provides an abstract representation of the concepts, objects and entities in the IoT domain, independent of any specific technology or platform.

❑ The entities, objects and concepts include:
  ❑ Physical entity-room, light
  ❑ Virtual entity- representation
  ❑ Device-medium for interaction, sensors, cameras, motion sensors
  ❑ Resource- network, IoT cloud, Database, on-device
  ❑ Service-interface

Information Model Specification-home automation

- The Information Model defines the structure of all the information in the IoT system and adds more details to the Virtual Entities by defining their attributes and relations.

- But it does not describe the specifics of how the information is represented or stored.
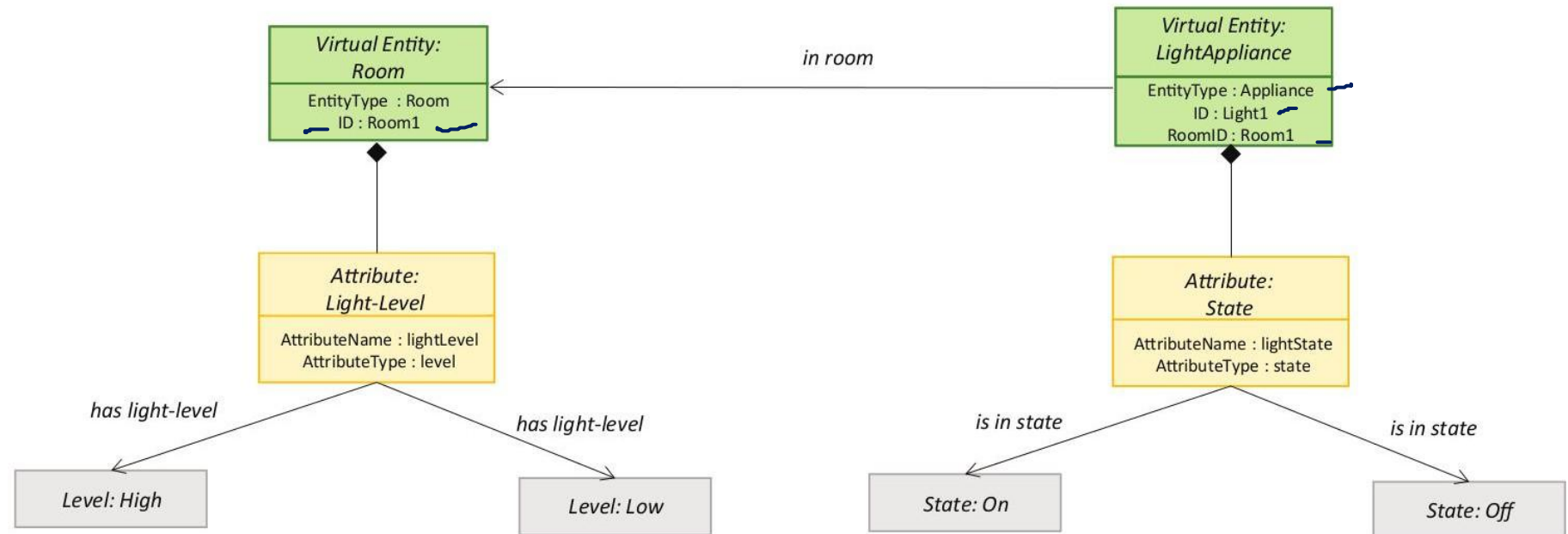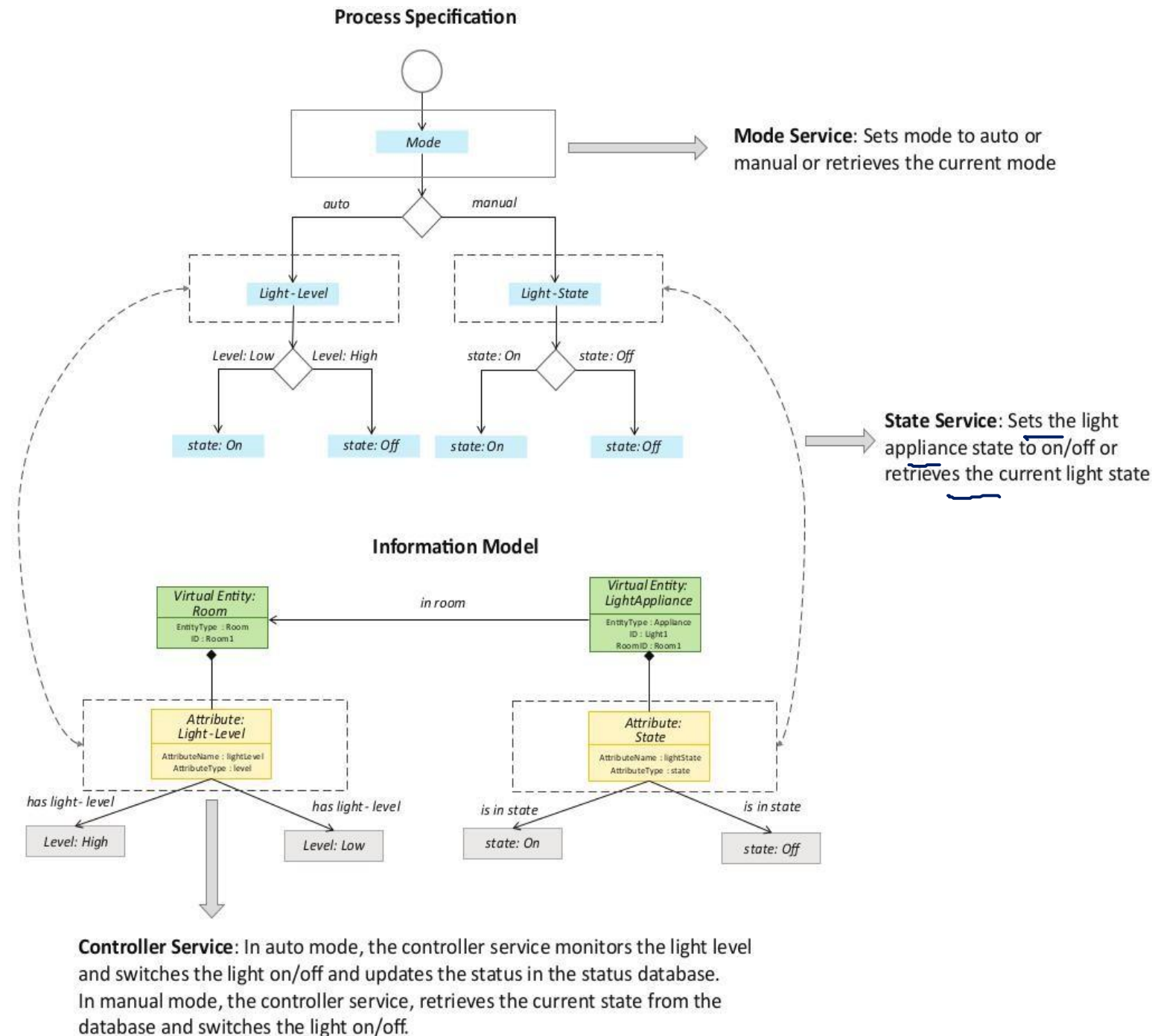
Service Specifications

Service specifications define the services in the IoT system

☐ Service types

☐ Service inputs/output

☐ Service endpoints

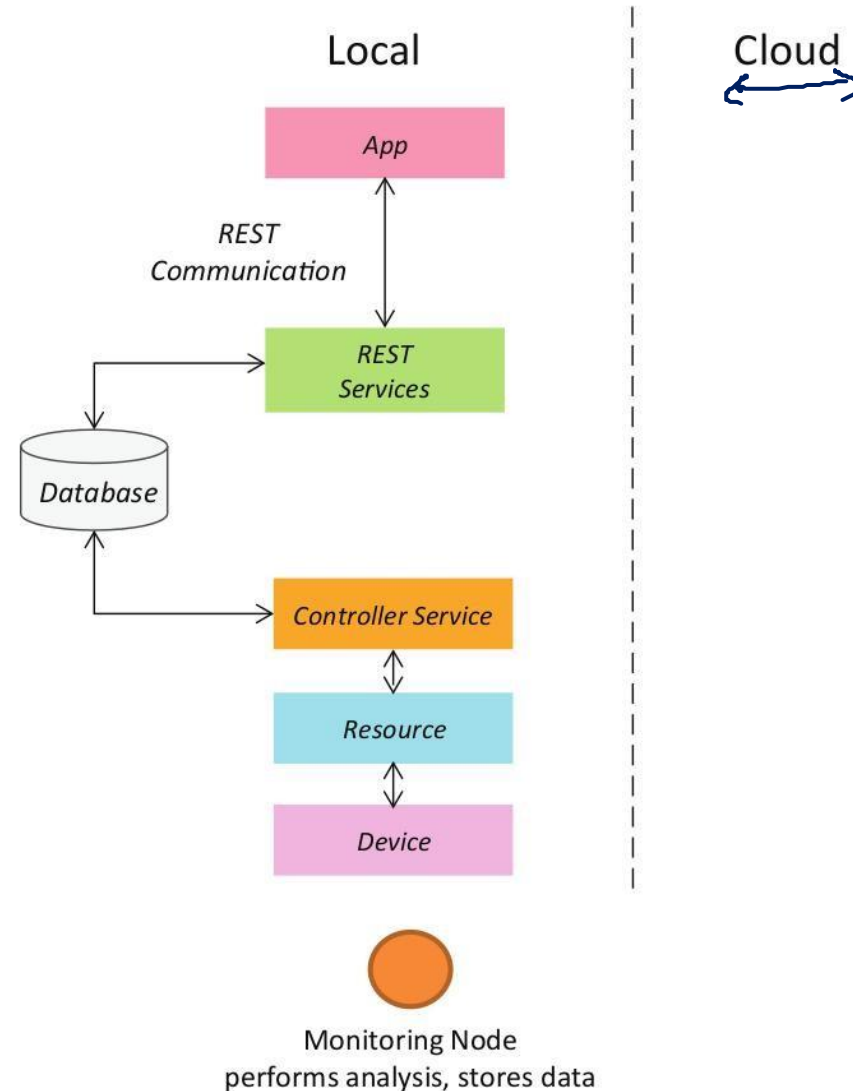☐ Service schedules

☐ Service preconditions

☐ Service effects

For each state and attribute service is specified.

Change or retrieve the values

Process Specification

Mode

Mode Service: Sets mode to auto or manual or retrieves the current mode

auto   manual

Light - Level   Light - State

Level: Low   Level: High   state: On   state: Off

state: On   state: Off   state: On   state: Off

State Service: Sets the light appliance state to on/off or retrieves the current light state

Information Model

Virtual Entity: Room
EntityType : Room
ID : Room1

in room

Virtual Entity: LightAppliance
EntityType : Appliance
ID : Light1
RoomID : Room1

Attribute: Light-Level
AttributeName : lightLevel
AttributeType : level

Attribute: State
AttributeName : lightState
AttributeType : state

has light- level   has light- level   is in state   is in state

Level: High   Level: Low   state: On   state: Off

Controller Service: In auto mode, the controller service monitors the light level and switches the light on/off and updates the status in the status database. In manual mode, the controller service, retrieves the current state from the database and switches the light on/off.
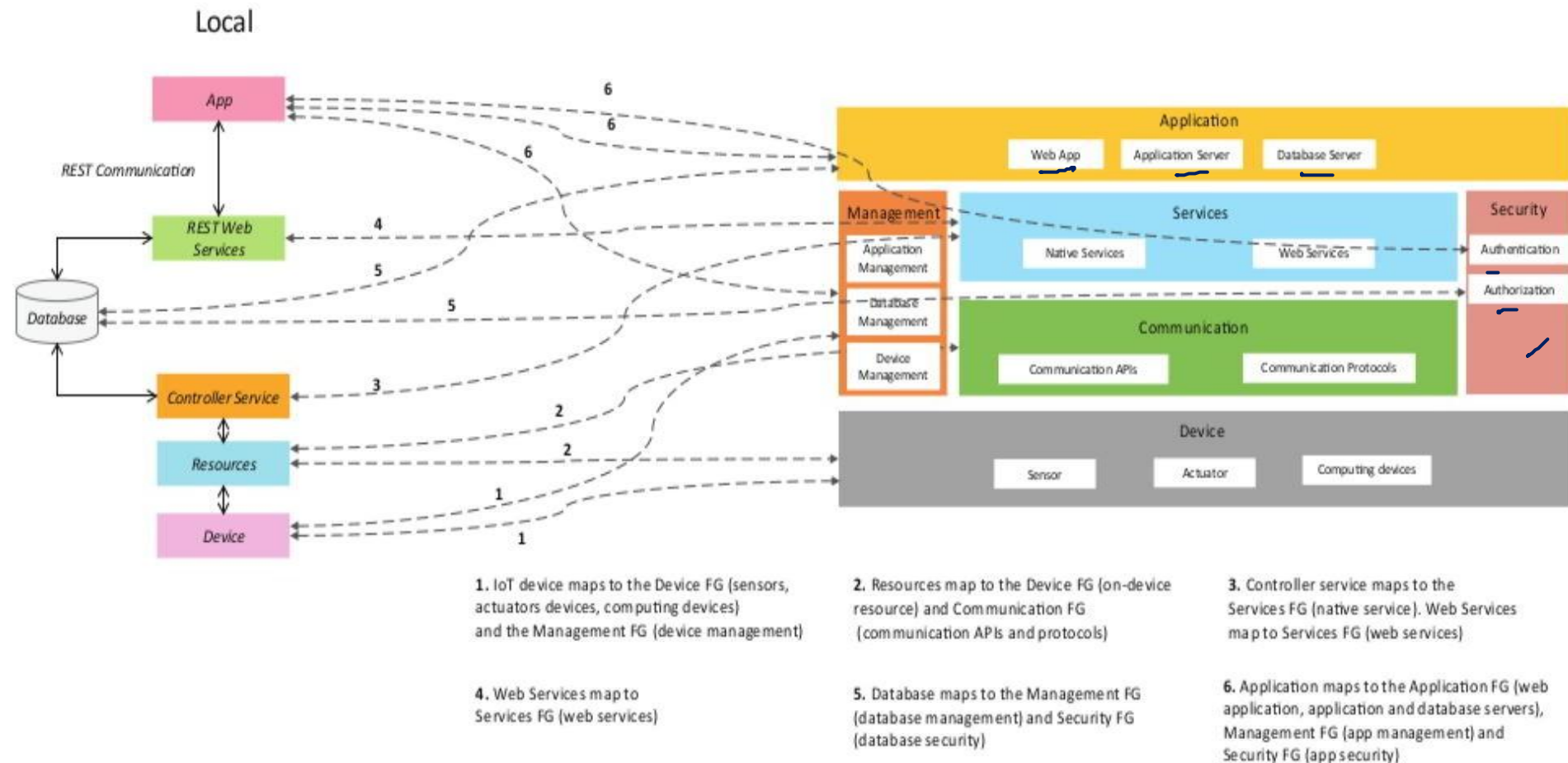
IoT Level Specification-home automation

❑ This highlights the deployment level for IoT system

❑ The figure shows the deployment design for the home automation IoT system

❑ monitor and control the attributes you want to manage.

❑ range of Wi-Fi devices collects and shares data via Internet protocols.

❑ computer intelligence into home devices to provide ways to measure home conditions and monitor home appliances' functionality.

Local | Cloud

App

REST Communication

REST Services

Database

Controller Service

Resource

Device

Monitoring Node
performs analysis, stores data

Functional View Specification-home automation

- It defines the functions of the IoT systems grouped into various functional groups.

- The functional groups included in a functional view are:
  - Device-computer, light
  - Communication-APIs
  - Services-monitoring, control
  - Management
  - Security-authentication
  - Application-interface

1. IoT device maps to the Device FG (sensors, actuators devices, computing devices) and the Management FG (device management)

2. Resources map to the Device FG (on-device resource) and Communication FG (communication APIs and protocols)

3. Controller service maps to the Services FG (native service). Web Services map to Services FG (web services)

4. Web Services map to Services FG (web services)

5. Database maps to the Management FG (database management) and Security FG (database security)

6. Application maps to the Application FG (web application, application and database servers), Management FG (app management) and Security FG (app security)

Operational View Specification-home automation

- In this step, various options pertaining to the IoT system deployment and operation are defined, such as, service hosting options, storage options, device options, application hosting options, etc
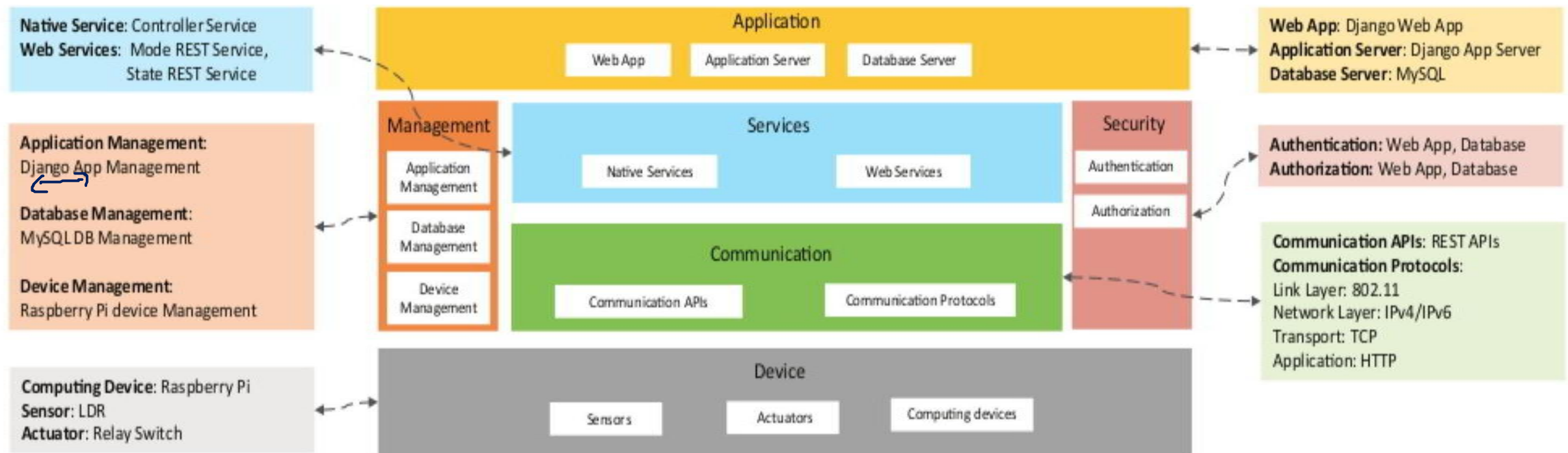
Device & Component Integration

❑ The devices and components used here are:

 ❑ Raspberry   Pi mini computer
 ❑ LDR sensor
 ❑ Relay switch actuator

❑ The figure shows the device, sensor and actuator integrated

❑ Rasperry pi, minicomputer, LDR
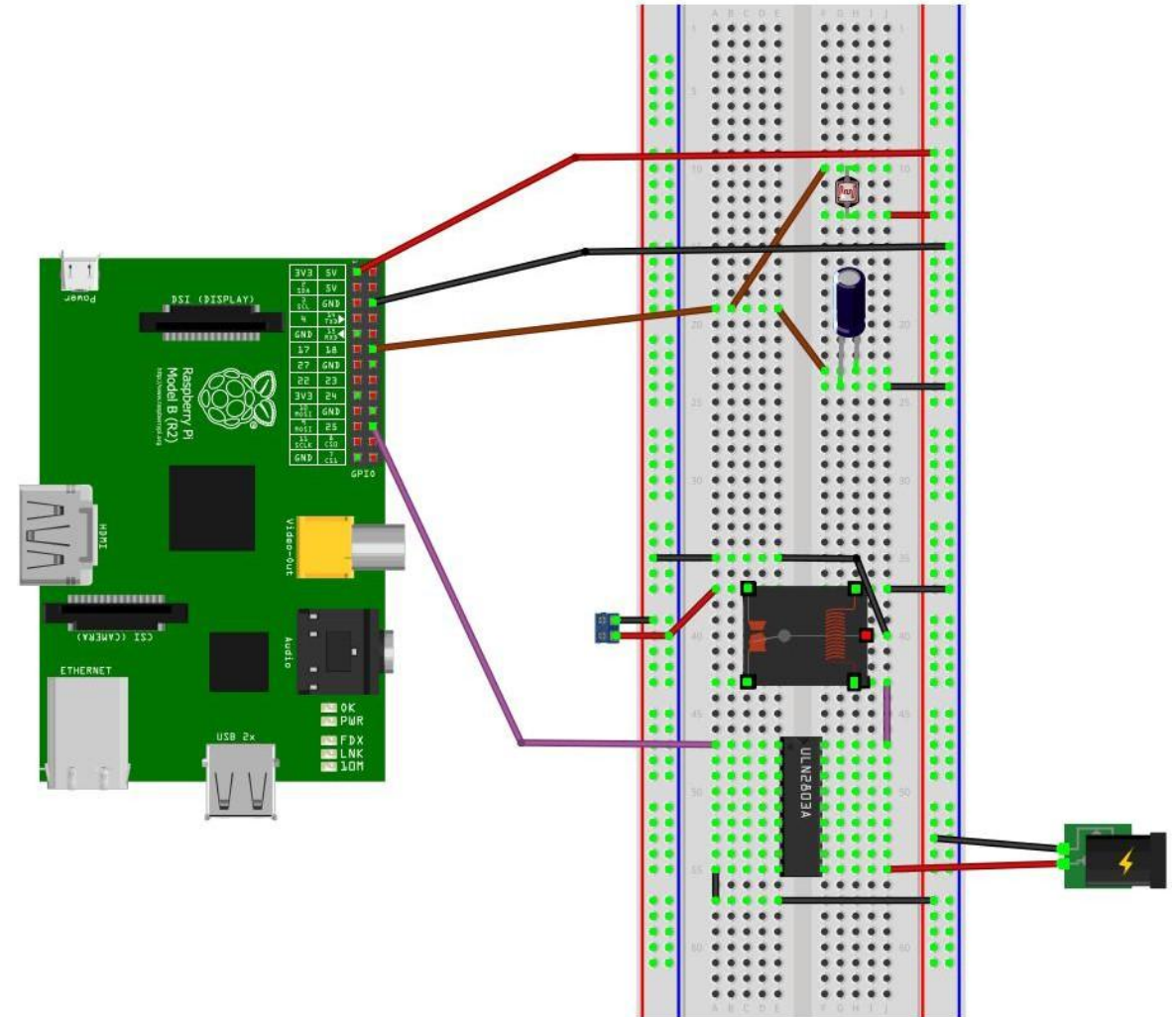
Application Development

❑ Auto

  ❑ Controls the light appliance automatically based on the lighting conditions in the room.

❑ Light

  ❑ When Auto mode is off, it is used for manually controlling the light appliance.

  ❑ When Auto mode is on, it reflects the current state of the light appliance.