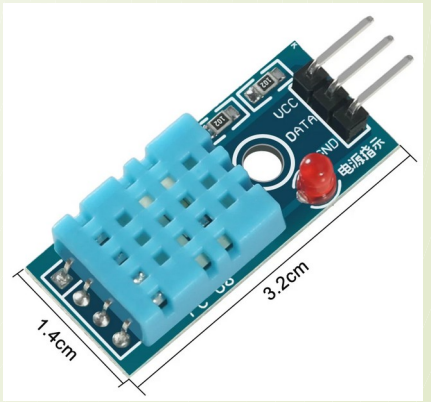
POLITECNICO DI TORINO

SMART STUDY ROOM

SMART STUDY ROOM IS A PROPOSAL TO MAKE A STUDY ENVIRONMENT WELCOMING AND COMFORTABLE IN A SMART WAY.

THE ROOM IS CONTROLLED IN A SMART WAY THOUGH SENSORS AND EQUIPMENTS.

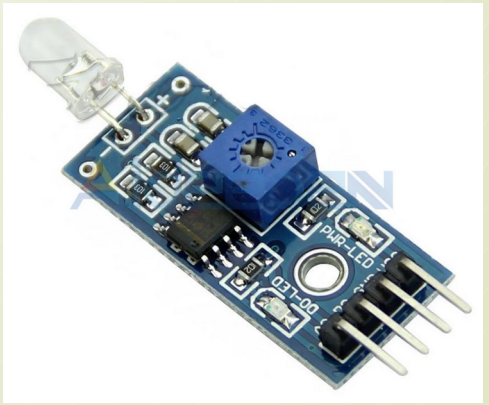
NOISE



TEMPERATURE AND HUMDITY

LCD

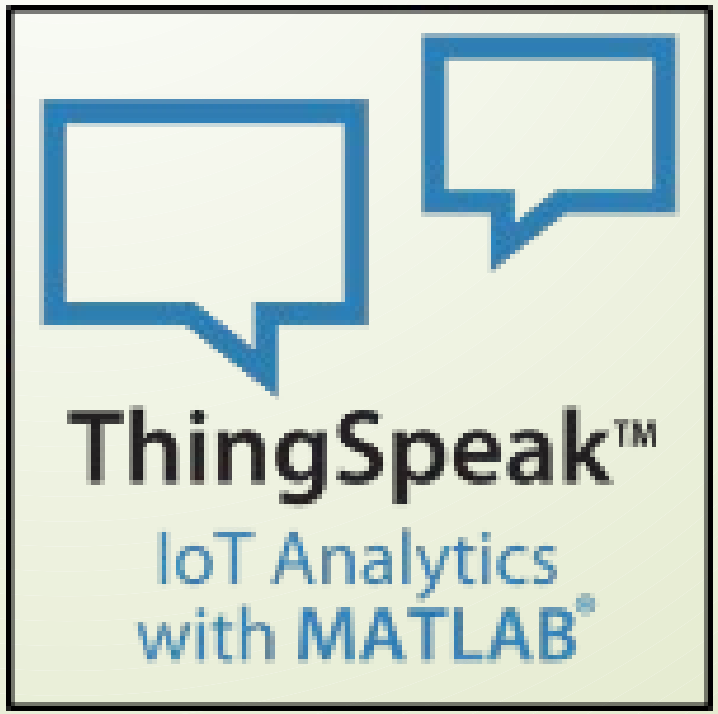
SPEAKER



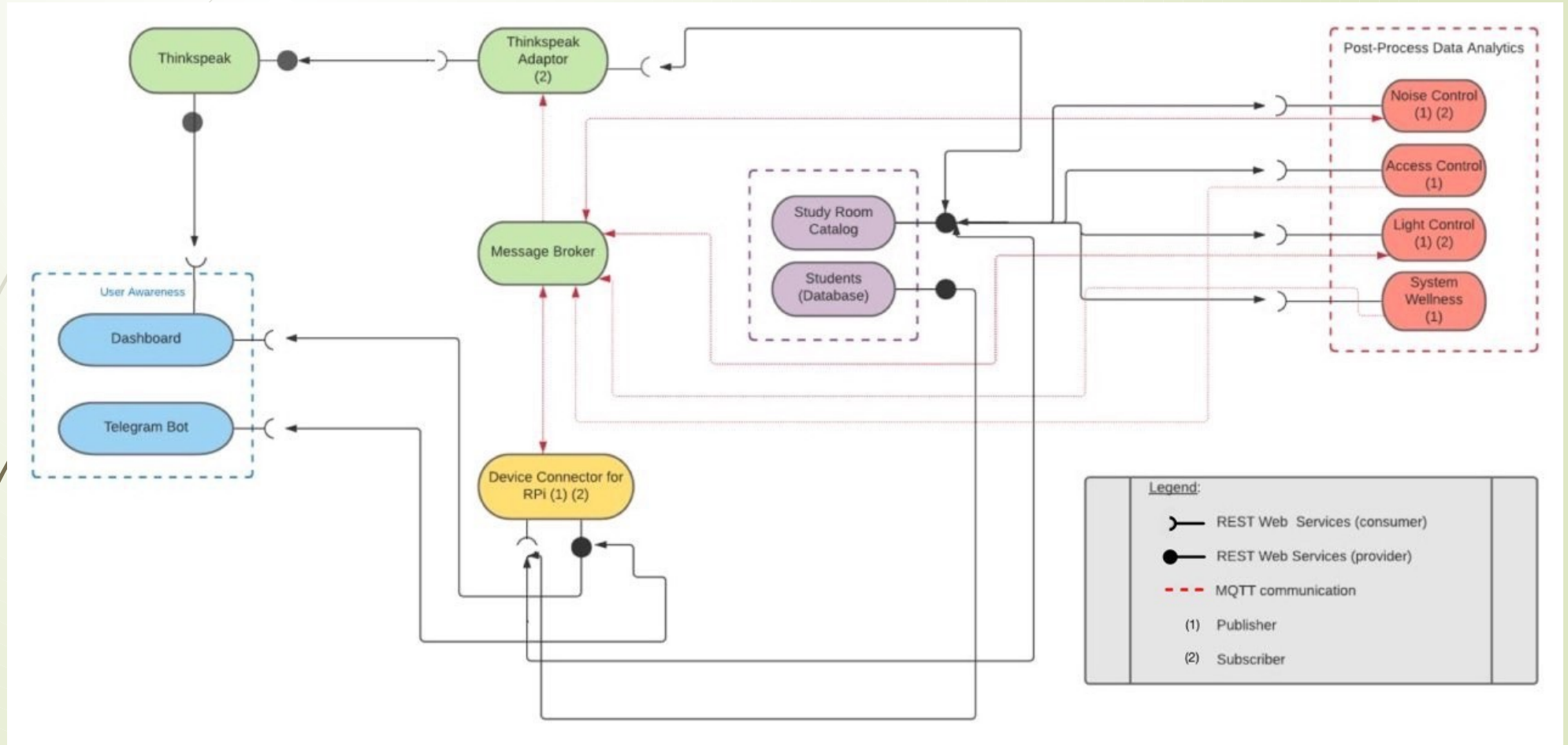
BRIGHTNESS

CONTROL OFFICER

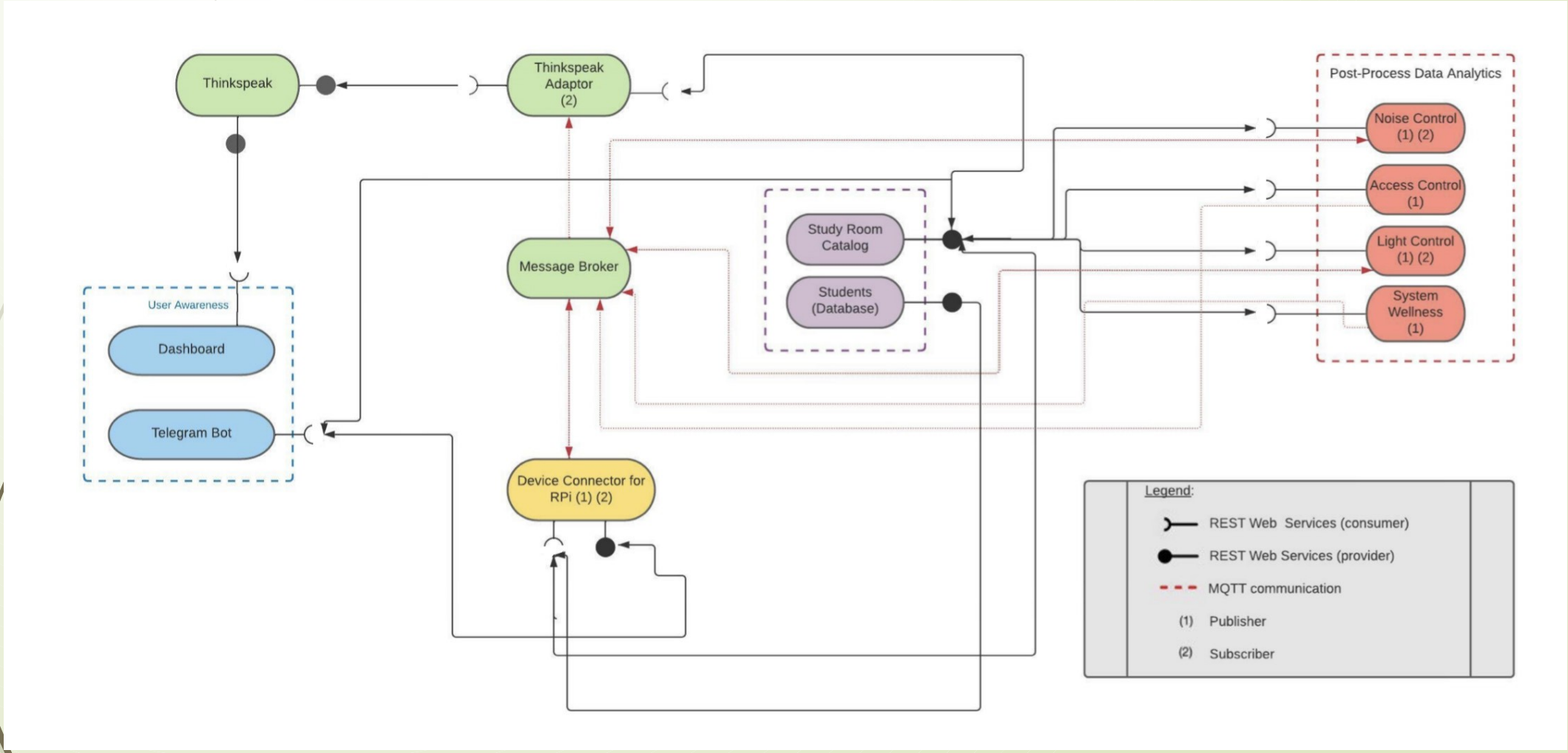
- THE CONTROL OFFICER MANAGES AND MONITORS THE STUDY ENVIRONMENT CONDITIONS DEPLOYING THIRD PART SOFTWARE SUCH AS TELEGRAM BOT AND THINGSPEAK.



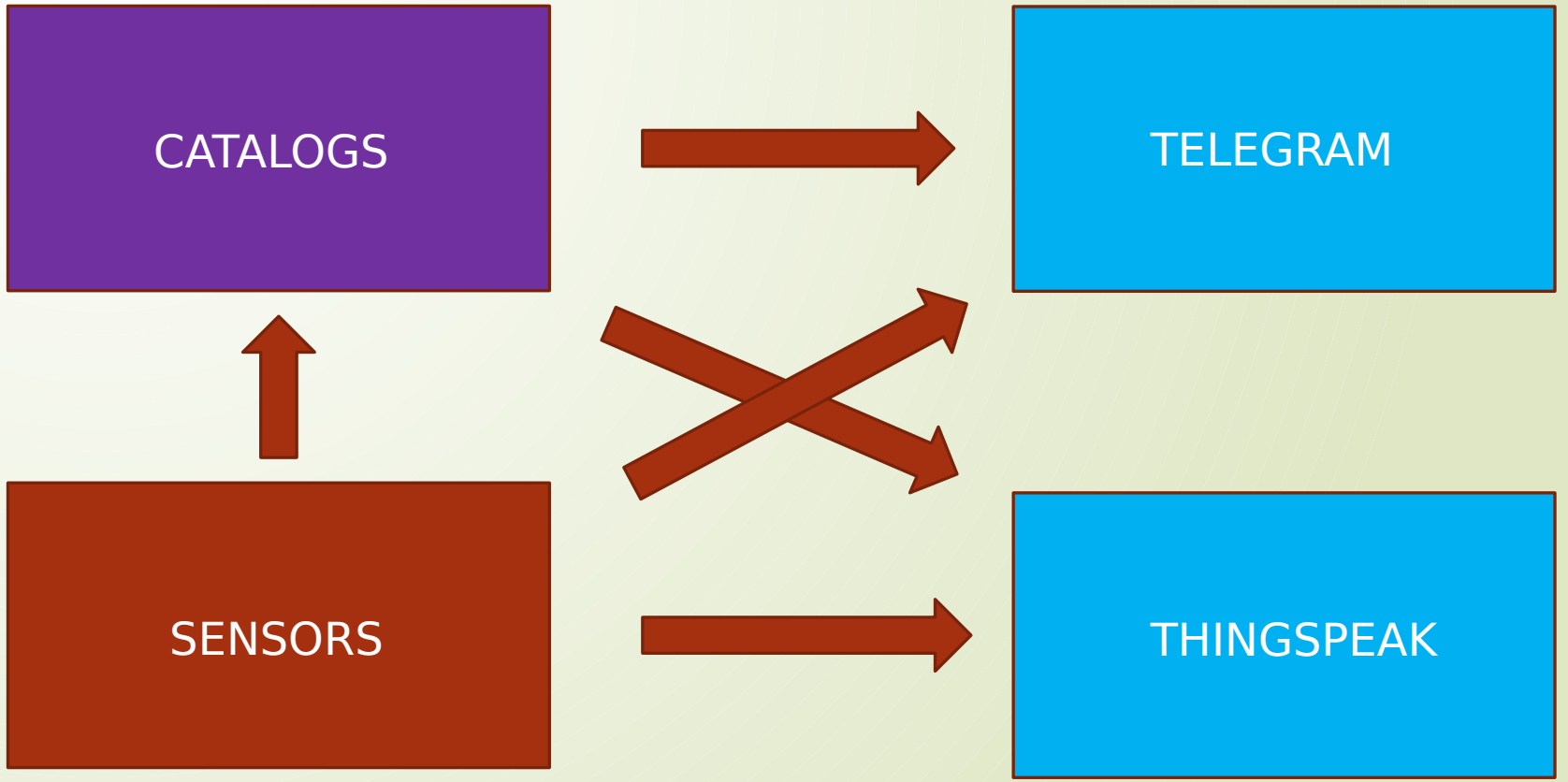
PROJECT PROPOSAL - BEFORE



PROJECT PROPOSAL - AFTER



MICROSERVICES APPROACH

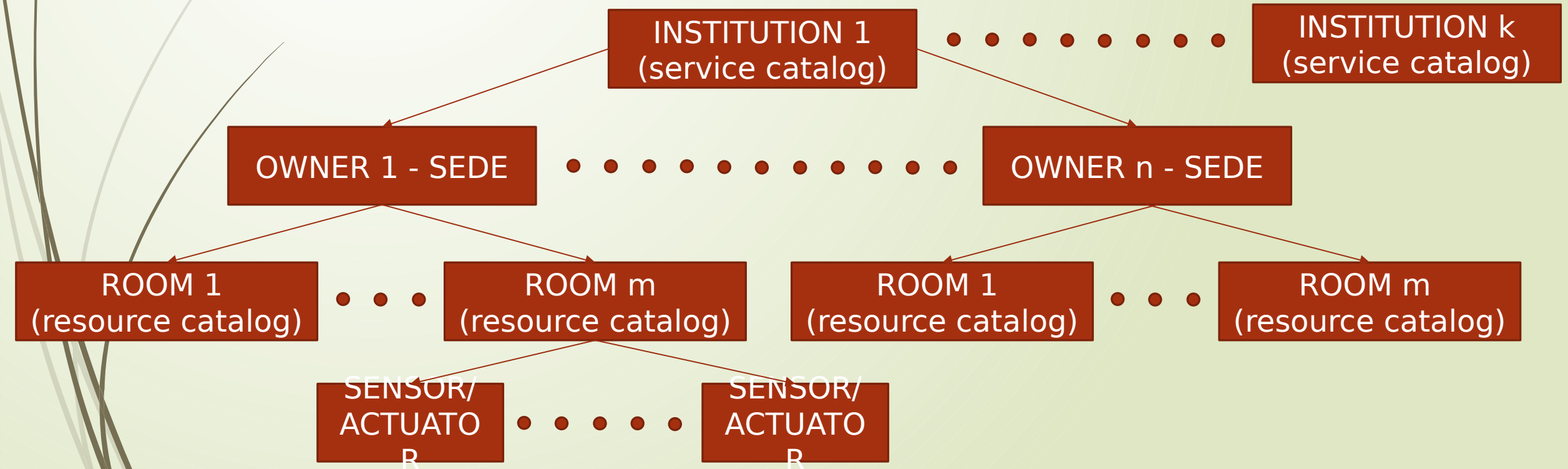


STUDY ROOM CATALOG

THE STUDY ROOM CATALOG IS COMPOSED BY:

- SERVICE CATALOG
- RESOURCE CATALOG

SCALABILITY IDEA



SERVICE CATALOG

- SERVICE REGISTRY SYSTEM
- USED TO DISCOVER REGISTERED SERVICES IN THE NETWORK
- CONTAINS THE ROOMS OF EACH OWNER
- INTERACTS WITH RESOURCE CATALOG, DEVICE CONNECTOR AND APPLICATIONS
- SERVICE CATALOG SETTINGS PROVIDES THE INFORMATION NECESSARY FOR COMMUNICATION VIA REST ACTING AS A REST WEB SERVER. REST IS USED AS PROVIDES INTEROPERABILITY BETWEEN DIFFERENT SYSTEMS BASING ON EXPOSED SERVICES ADDRESSABLE THROUGH A UNIQUE URI.
- THE SYNCHRONOUS COMMUNICATION IS BASED ON JSON FILE FORMAT
- THOSE FUNCTIONS ARE IMPLEMENTED THROUGH THE *CHERRYPY* AND *REQUESTS* PYTHON LIBRARIES

SET UP PHASE

SERVICE CATALOG
(study room politecnico)

ACT AS:
- REST server

```
{
    "resource_catalogs": [
    ],
    "ip_address": "192.168.1.208",
    "ip_port": 8095,
    "broker_port": 1883,
    "broker": "test.mosquitto.org",
    "base_topic": "study_room_politecnico"
}
```

```
{
    "ip_address_service":"192.168.1.208",
    "ip_port_service":"8095",
    "base_topic": "study_room_politecnico"
}
```

RESOURCE CATALOG

- DEVICE REGISTRY SYSTEM
- USED TO REGISTER AND PROVIDE AVAILABLE IoT DEVICES IN THE NETWORK
- CONTAINS THE DEVICES IN EACH ROOM
- INTERACTS WITH SERVICE CATALOG, DEVICE CONNECTOR AND APPLICATIONS
- RESOURCE CATALOG SETTINGS PROVIDES THE INFORMATION NECESSARY FOR COMMUNICATION VIA REST
- EACH RESOURCE CATALOG ACTS BOTH AS REST SERVER AND AS REST CLIENT

SET UP PHASE

Resource catalog registration

SERVICE CATALOG
(study room politecnico)

ACT AS:
- REST server

RESOURCE CATALOG
(sede centrale- room 1)

ACT AS:
- REST server
- REST client

RESOURCE CATALOG
(sede centrale- room 2)

ACT AS:
- REST server
- REST client

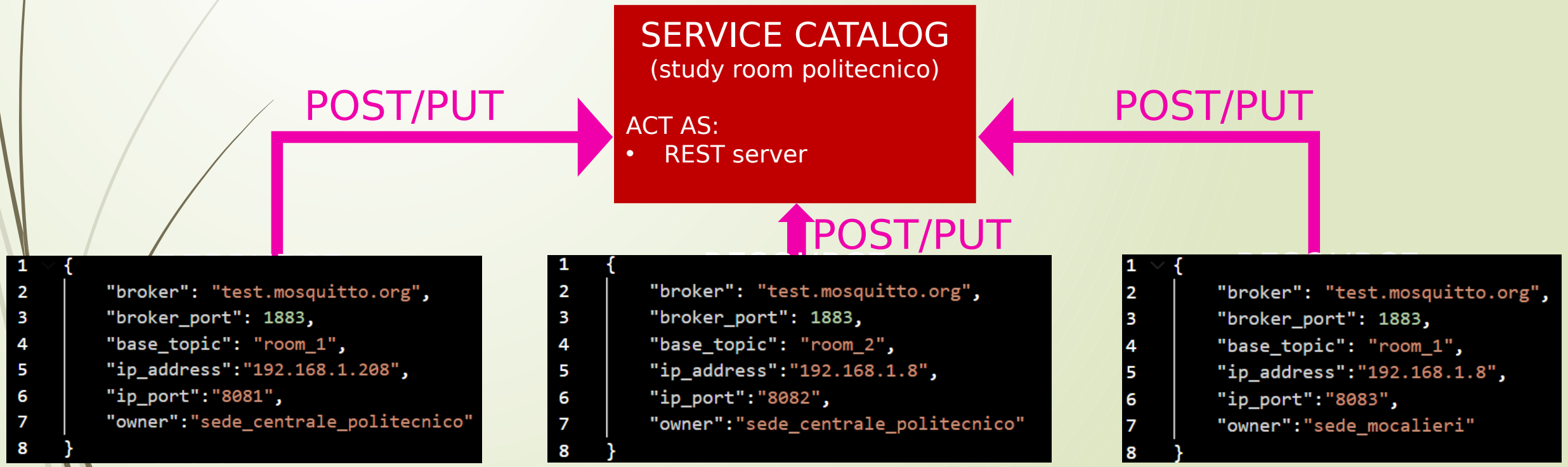
RESOURCE CATALOG
(mocalieri – room 1)

ACT AS:
- REST server
- REST client

```
{
    "broker": "test.mosquitto.org",
    "broker_port": 1883,
    "base_topic": "room_1",
    "ip_address":"192.168.1.208",
    "ip_port":"8081",
    "owner":"sede_centrale_politecnico"
}
```

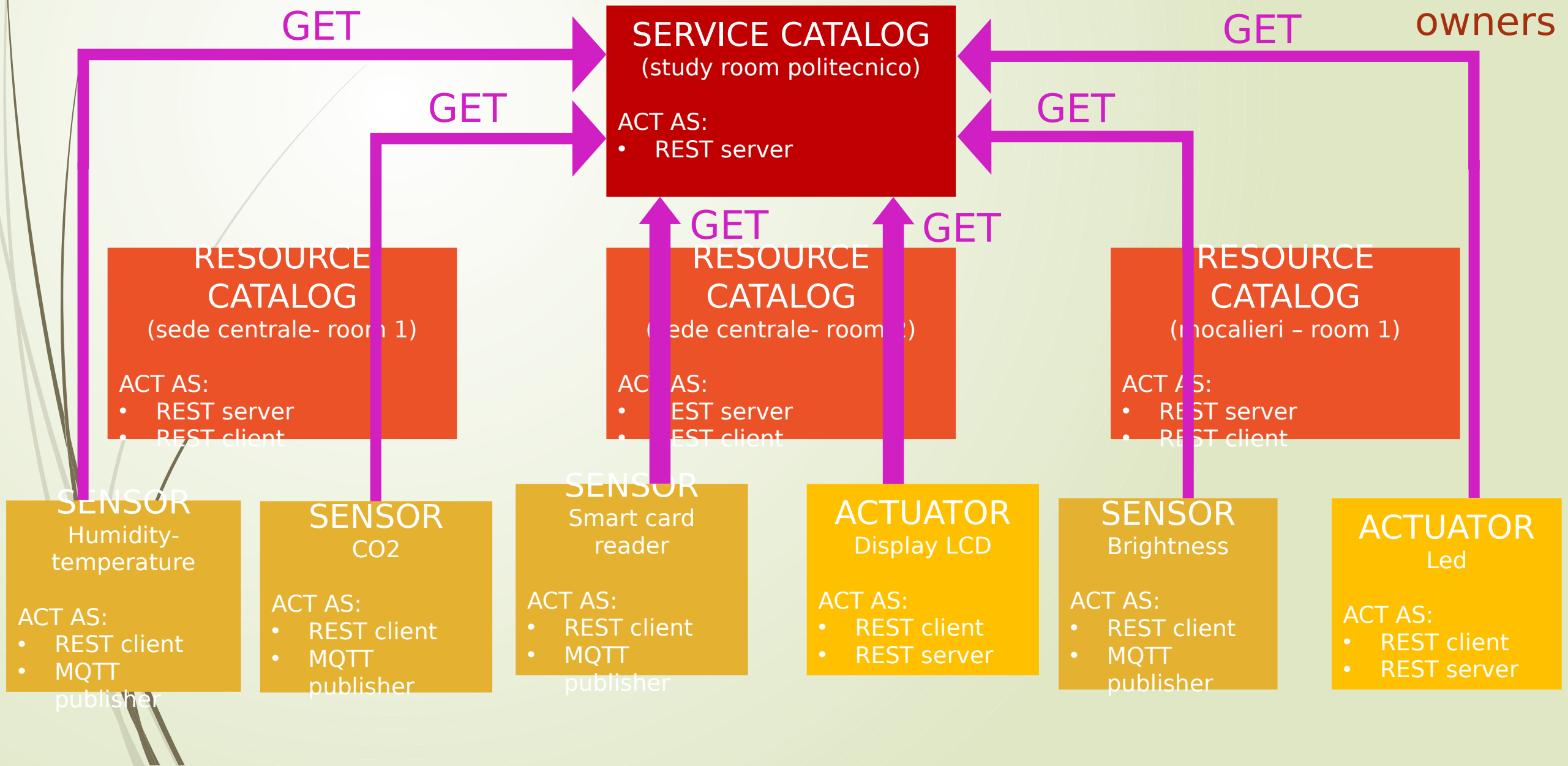
SET UP PHASE

Resource catalog registration



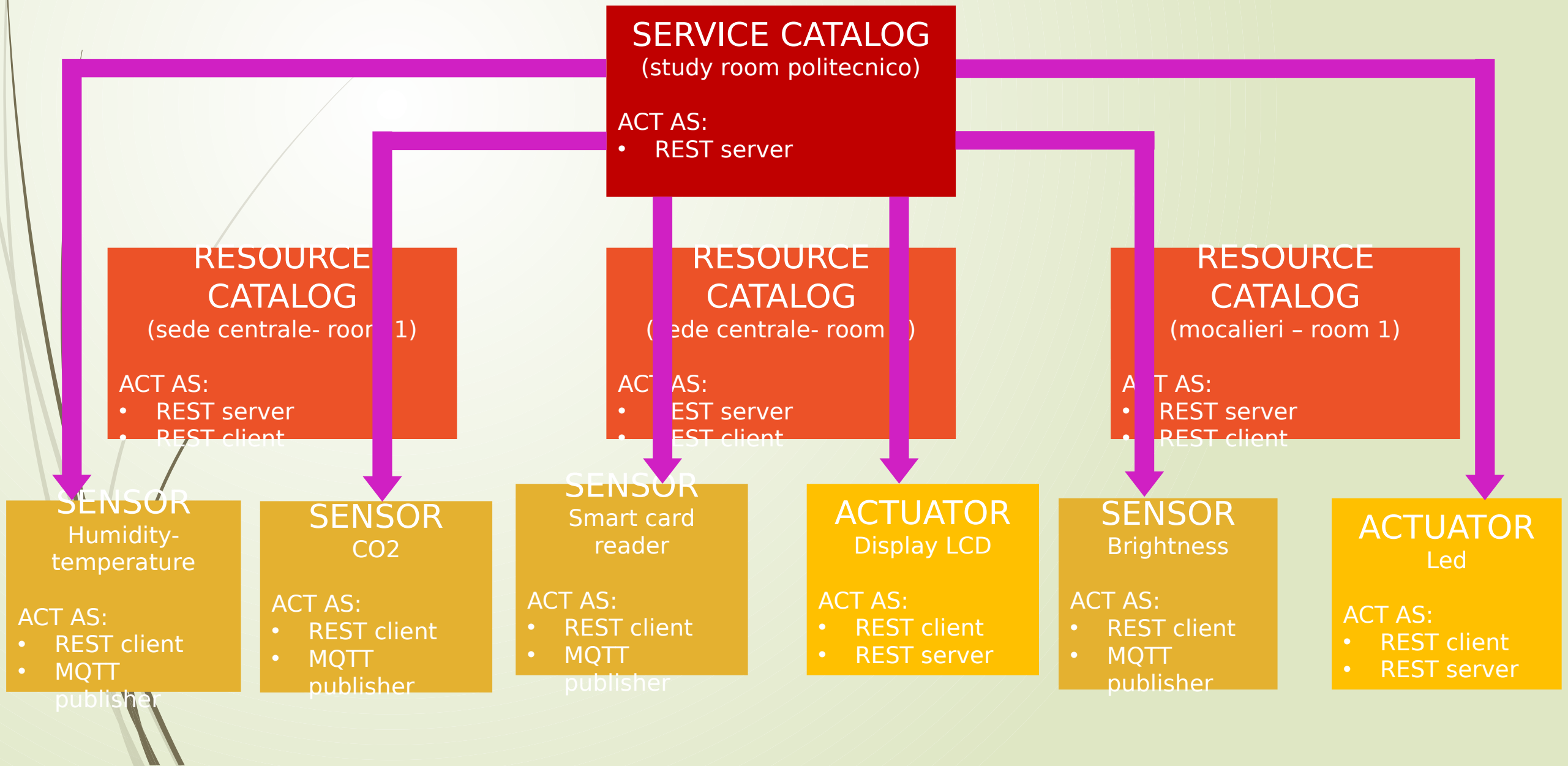
SET UP PHASE

Sensor/actuator request for list of owners



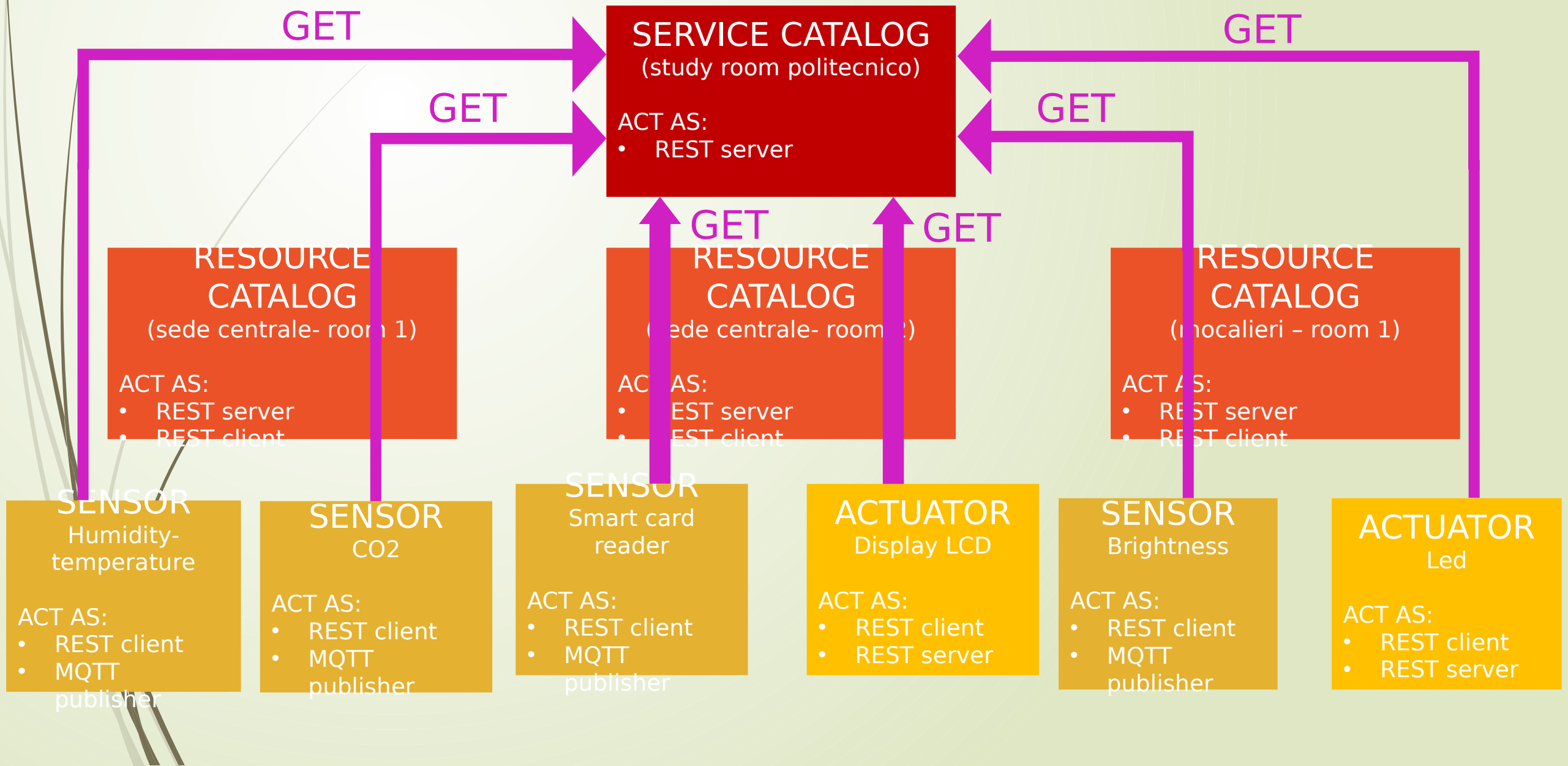
SET UP PHASE

Service catalog response



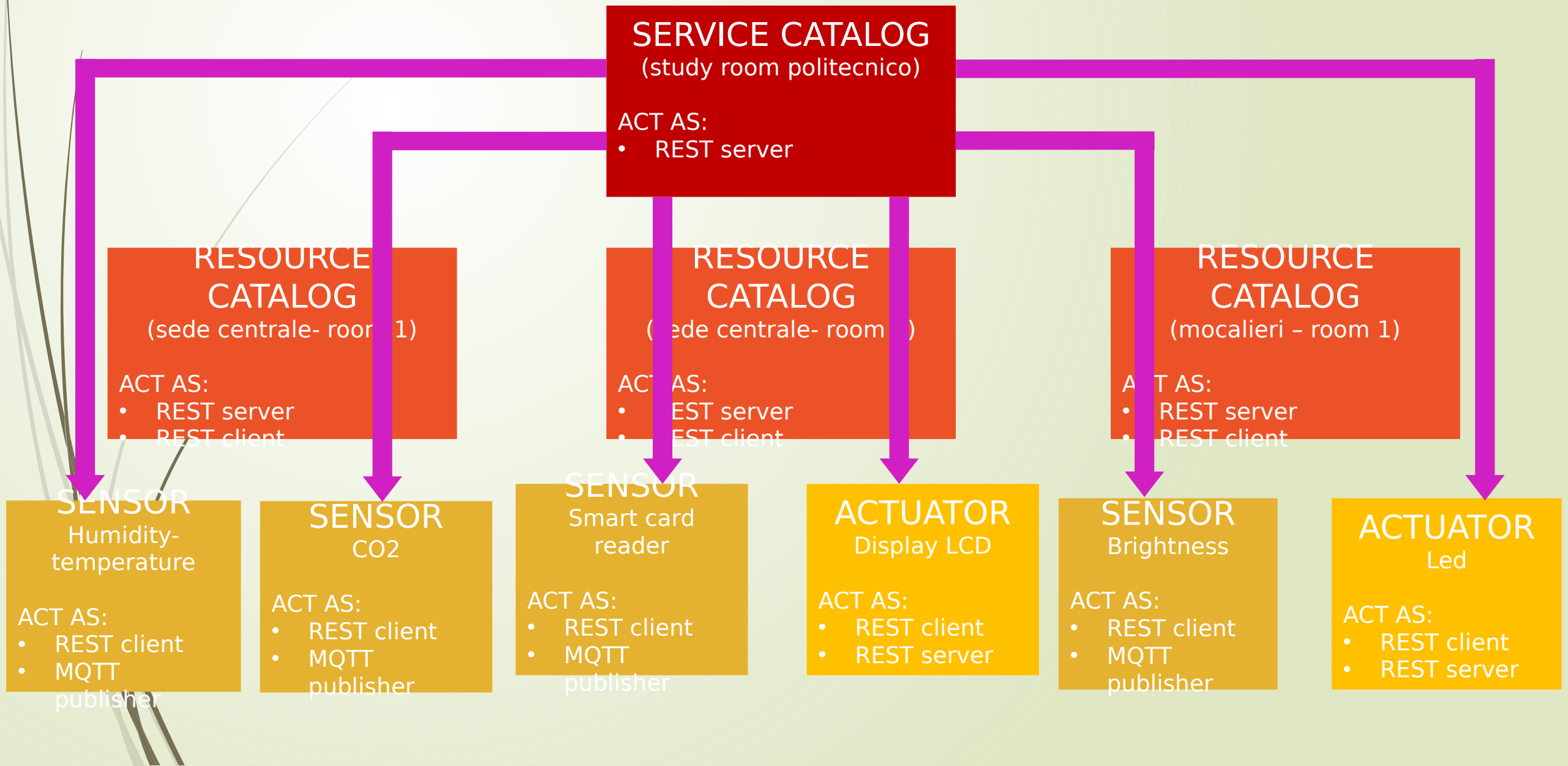
SET UP PHASE

Sensor/actuator request for list of resource catalogs



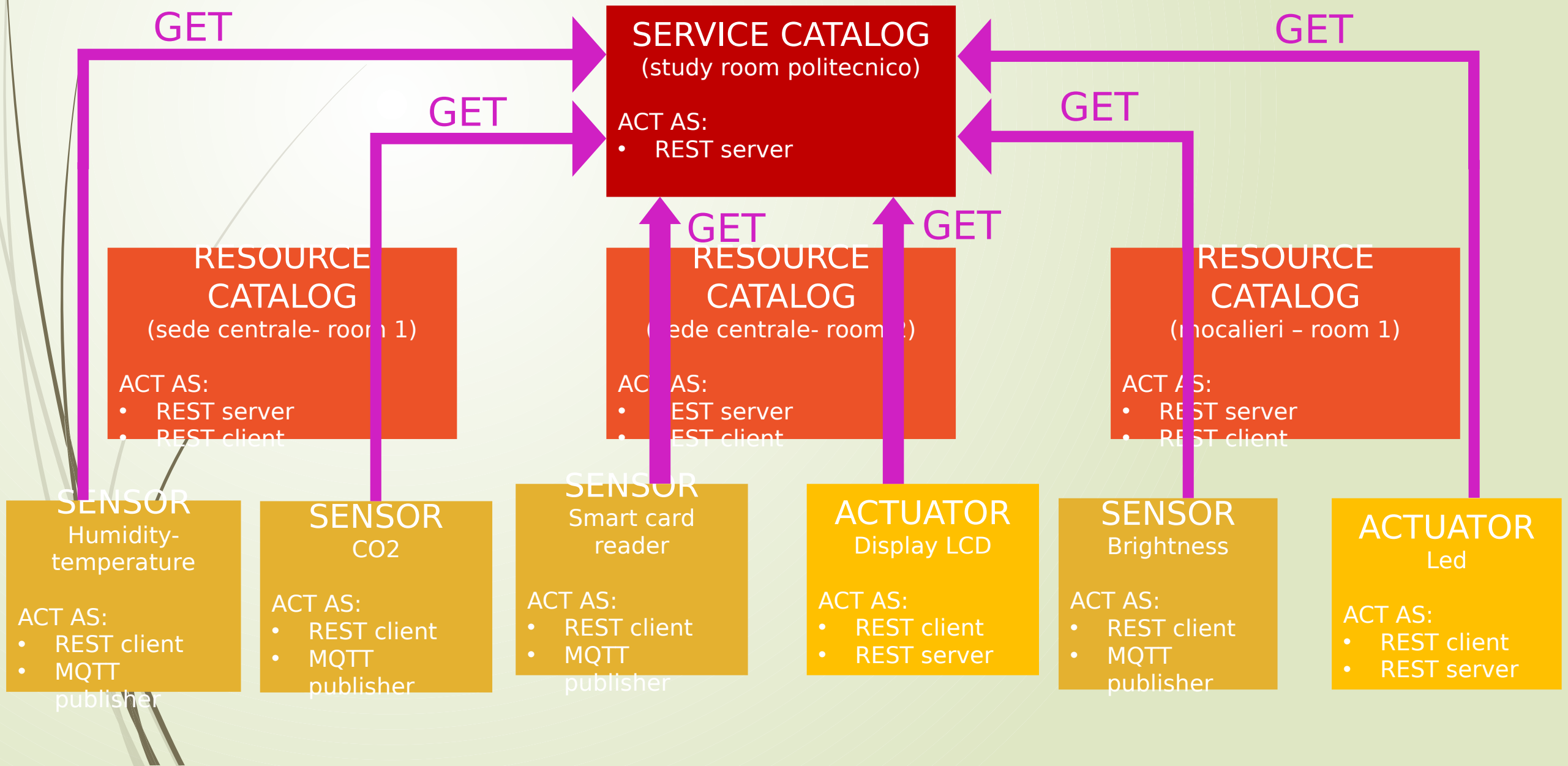
SET UP PHASE

Service catalog response



SET UP PHASE

Sensor/actuator request for the resource catalog's info



SET UP PHASE

Service catalog response

```
{ "isFound":1,
  "result":
      {
          "broker": "test.mosquitto.org",
          "broker_port": 1883,
          "base_topic": "room_1",
          "ip_address": "192.168.1.208",
          "ip_port": "8081",
          "owner": "sede_centrale_politecnico"
      }
}
```

RESOURCE CATALOG
(sede centrale- roo 1)

ACT AS:
- REST server
- REST client

RESOURCE CATALOG
(ede centrale- room)

AC AS:
- EST server
- EST client

RESOURCE CATALOG
(mocalieri – room 1)

A T AS:
- REST server
- REST client

SENSOR
Humidity-temperature

ACT AS:
- REST client
- MQTT publisher

SENSOR
CO2

ACT AS:
- REST client
- MQTT publisher

SENSOR
Smart card reader

ACT AS:
- REST client
- MQTT publisher

ACTUATOR
Display LCD

ACT AS:
- REST client
- REST server

SENSOR
Brightness

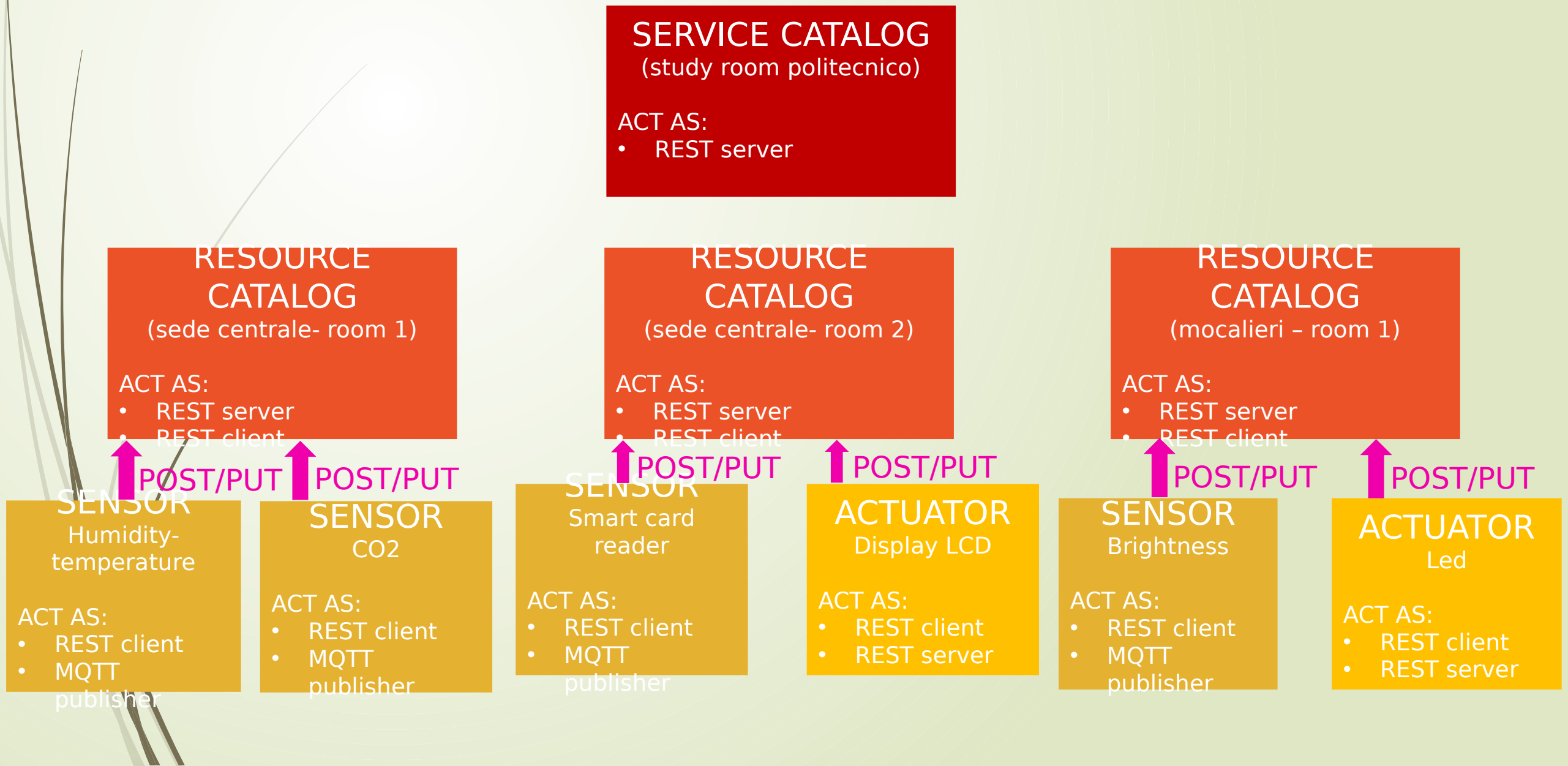
ACT AS:
- REST client
- MQTT publisher

ACTUATOR
Led

ACT AS:
- REST client
- REST server

SET UP PHASE

Sensor/actuator registration



SENSORS

- REGISTRATION PHASE:
  - RETRIEVE INFORMATION FROM SERVICE CATALOG
  - RETRIEVE INFORMATION OF THE SPECIFIC RESOURCE CATALOG (ROOM)
  - REGISTRATION TO RESOURCE CATALOG (ROOM)

- SenML DATAFORMAT:

```
self.__message={
                'bn': self.topic,
                'e': [
                        {
                            'type':self.sensortype,
                            'unit':self.measure,
                            'timestamp':'',
                            'value':' ',
                            'owner':'',
                            'room':''
                        }
                    ]
}
```

SENSORS

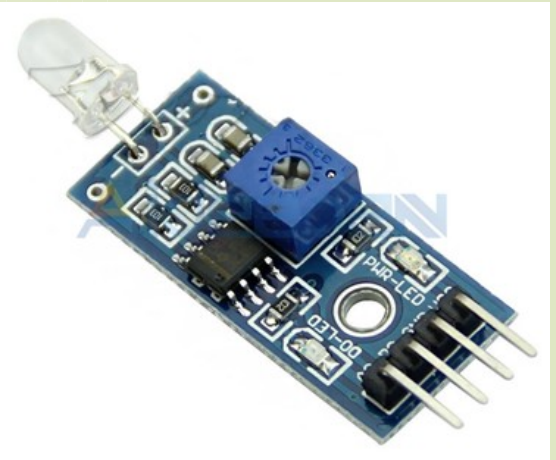
- EACH SENSOR HAS A CONFIGURATION FILE
- EX:

```
{
    "sensor_id":"sensor_th_1",
    "sensor_type":["temperature","humidity"],
    "measure":["celsius", "percentage"],
    "sensor_model":"DHT11",
    "pin":17
}
```

MQTT

- ASYNCHRONOUS COMMUNICATION PARADIGM
- BASED ON TOPICS
- LIGHTWEIGHT

BRIGHTNESS



- MONITORS AND CONTROLS BRIGHTNESS OF THE ROOM
- TOPIC:
  - study_room_politecnico/sede_centrale_politecnico/room_1/brightness/#
- SENDS INFORMATION TO SERVER VIA REST
- SERVER RECEIVES INFORMATION AND SWITCHES ON/OFF THE LIGHTS
- ALSO THE SERVER REGISTERS ON RESOURCE CATALOG

NOISE

- MONITORS AND CONTROLS NOISE IN THE ROOM
- TOPIC:
  - study_room_politecnico/sede_centrale_politecnico/room_1/noise/#
- SENDS INFORMATION TO SERVER VIA REST
- SERVER RECEIVES INFORMATION AND MAKES THE SPEAKER TO ALERT THE STUDENTS
- ALSO THE SERVER REGISTERS ON RESOURCE CATALOG

ACCESS

- MONITORS AND CONTROLS THE ACCESS TO THE ROOM
- TOPIC:
  - study_room_politecnico/sede_centrale_politecnico/room_1/fiscal_code/#
- RECEIVES UPDATED LIST OF BOOKED STUDENTS VIA REST FROM SERVER
- SENDS INFORMATION VIA REST ABOUT APPROVAL/DENIAL OF STUDENTS TO SERVER
- SERVER RECEIVES INFORMATION AND PRINTS MESSAGE ON LCD SCREEN
- ALSO THE SERVER REGISTERS ON RESOURCE CATALOG

ACCESS

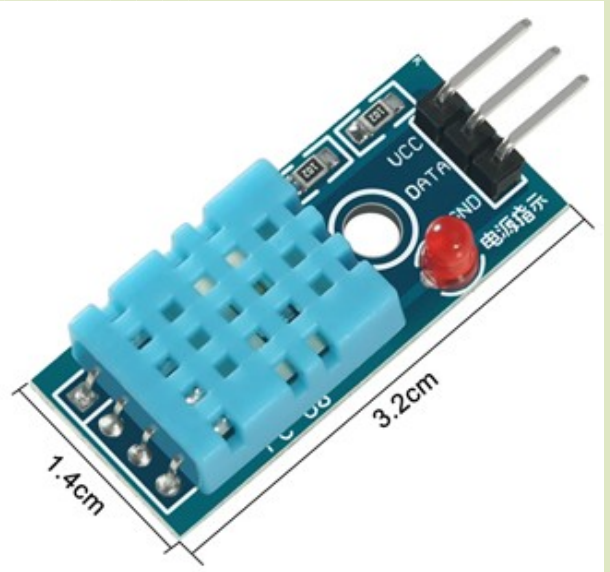
- SERVER RECEIVES INFORMATION AND PRINTS MESSAGE ON LCD SCREEN
- ALSO THE SERVER REGISTERS ON RESOURCE CATALOG

CO2

- MONITORS AIR QUALITY IN THE ROOM
- TOPIC:
  - study_room_politecnico/sede_centrale_politecnico/room_1/CO2/#
- SIMULATED SENSOR
- PROVIDES DATA TO TELEGRAM AND THINGSPEAK

TEMPERATURE AND HUMIDITY

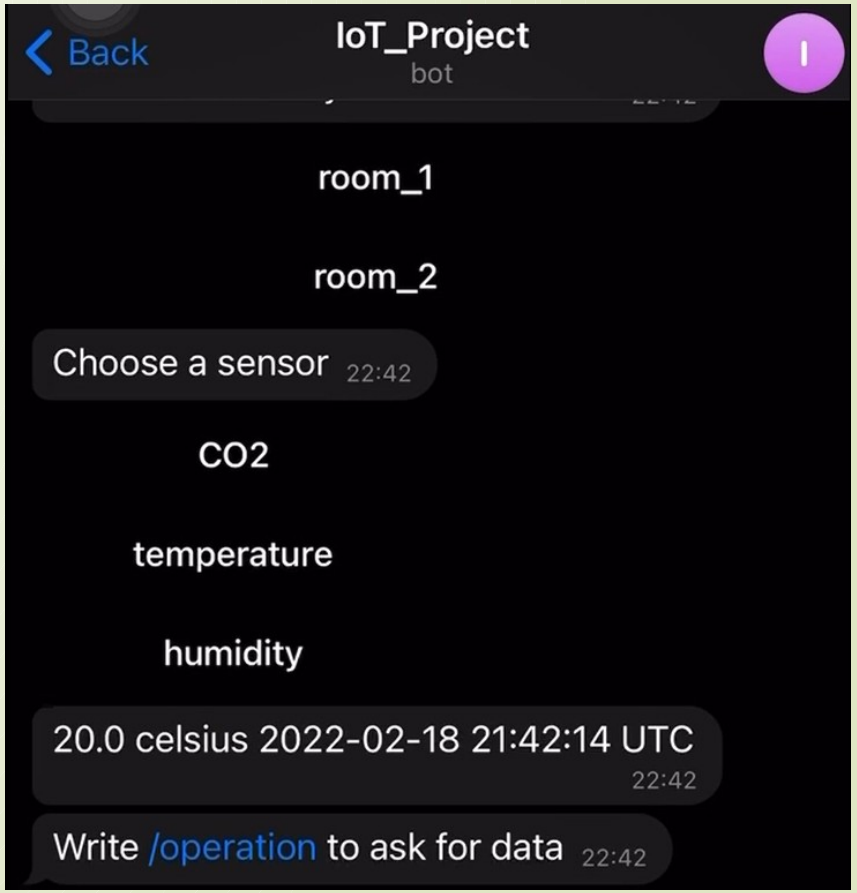
- MONITORS TEMPERATURE AND HUMIDITY IN THE ROOM
- TOPIC:
  - study_room_politecnico/sede_centrale_politecnico/room_1/temperature/#
  - study_room_politecnico/sede_centrale_politecnico/room_1/humidity/#
- PROVIDES DATA TO TELEGRAM AND THINGSPEAK



TELEGRAM BOT

HOW IT WORKS

- PROVIDES DATA RELATED TO THE STUDY ENVIRONMENT.
- SENDS A GET REQUEST TO RECEIVE DATA.
- PROVIDES A SCALABLE SERVICE ALLOWING THE CONTROL OFFICER TO CHOOSE:
  - THE OWNER
  - THE ROOM
  - THE SENSOR



TELEGRAM BOT

COMMUNICATION WITH

- SERVICE CATALOG TO RECEIVE INFORMATIONS ABOUT:
  - OWNERS
  - ROOMS
- RESOURCE CATALOG TO RECEIVE INFORMATIONS ABOUT:
  - DEVICES
- DEVICE CONNECTOR TO RECEIVE INFORMATIONS ABOUT:
  - SENSORS

```
service_get_string="http://"+self.service_catalog_info["ip_a
rooms_all=json.loads(requests.get(service_get_string).text)
self.rooms=[]
```

```
request_string="http://"+entry["ip_address"]+":"+entry["ip_port"]+"/alldevices"
devices=json.loads(requests.get(request_string).text)
```

```
value=requests.get("http://"+sys.argv[1]+"/?owner="+self.requested_owner+'
#GET REQUEST TO THE SENSOR SUBSCRIBER IN ORDER TO RECEIVE SENSOR DATA
```

TELEGRAM BOT - WARNING

HOW IT WORKS

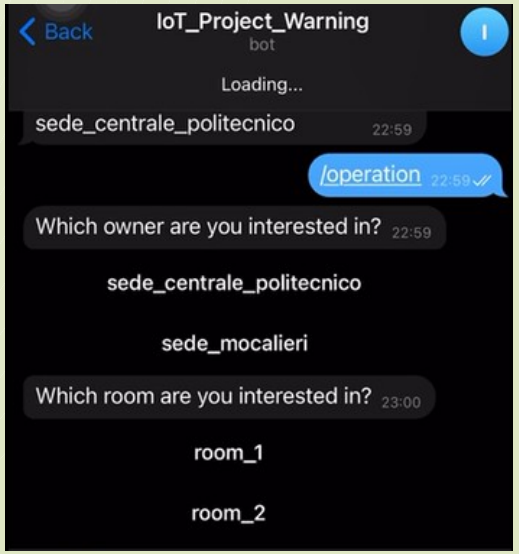
- SENDS A WANRING MESSAGE IF THE VALUE MEASURED BY THE SENSOR IS:
  - TOO HIGH
  - TOO LOW

  RESPECT TO AN ESTABLISHED LIMIT.

  ' /operation ' FUNCTION:
  THE CONTROL OFFICER CAN CHOOSE THE ROOMS OF INTERESTED.

  '/check' FUNCTION:
  THE CONTROL OFFICER MONITORS THE ROOMS CHOOSEN

- PROVIDES A SCALABLE SERVICE ALLOWING THE CONTROL OFFICER TO CHOOSE THE OWNER, AND ROOMS TO MONITOR.



TELEGRAM BOT - WARNING

COMMUNICATION WITH

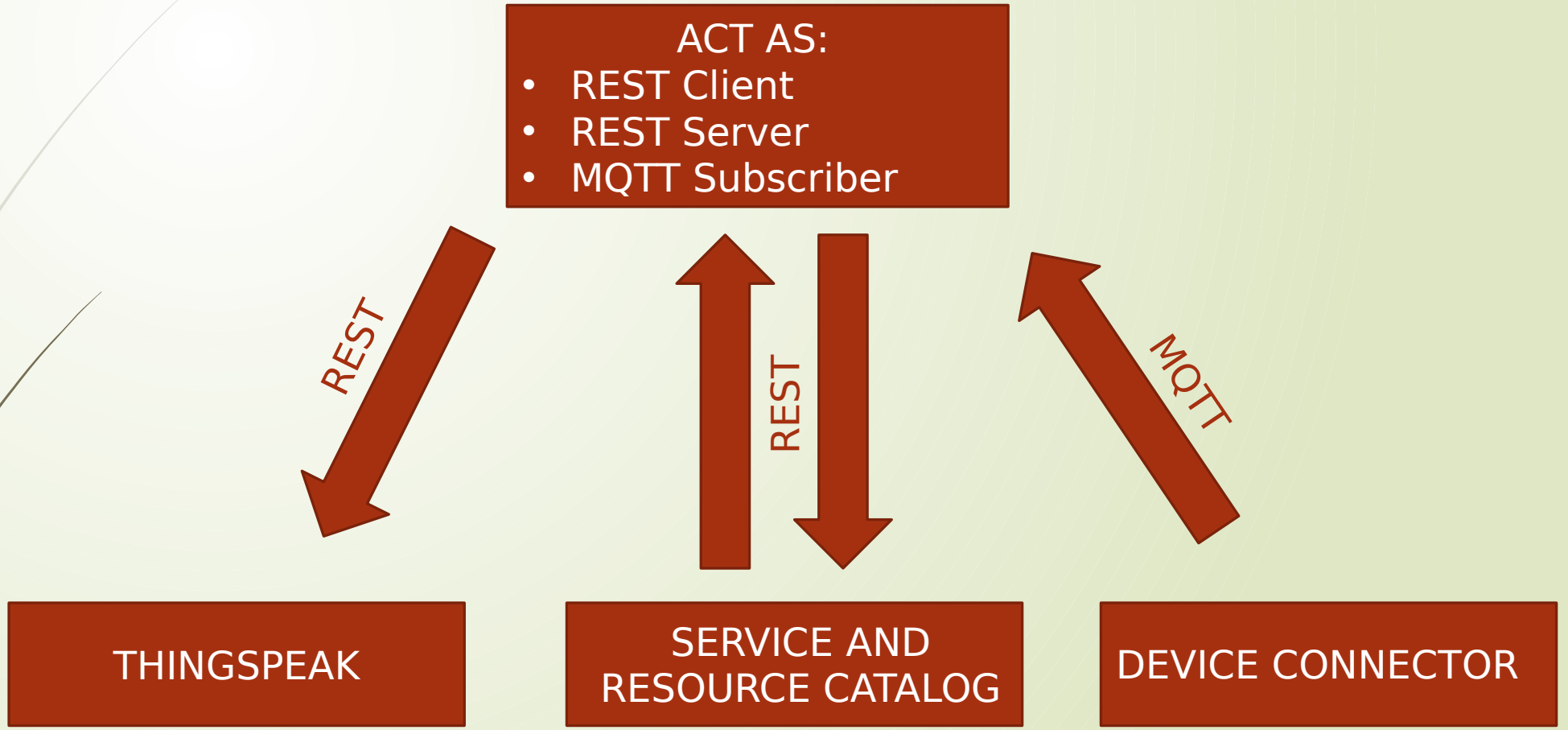
- SERVICE CATALOG TO RECEIVE INFORMATIONS ABOUT:
  - OWNERS
  - ROOMS
- RESOURCE CATALOG TO RECEIVE INFORMATIONS ABOUT:
  - DEVICES
- DEVICE CONNECTOR TO RECEIVE INFORMATIONS ABOUT:
  - SENSORS

```
service_get_string="http://"+self.service_catalog_info["ip_a
rooms_all=json.loads(requests.get(service_get_string).text)
self.rooms=[]
```

```
request_string="http://"+entry["ip_address"]+":"+entry["ip_port"]+"/alldevices"
devices=json.loads(requests.get(request_string).text)
```

```
value=requests.get("http://"+sys.argv[1]+"/?owner="+self.requested_owner+"
#GET REQUEST TO THE SENSOR SUBSCRIBER IN ORDER TO RECEIVE SENSOR DATA
```

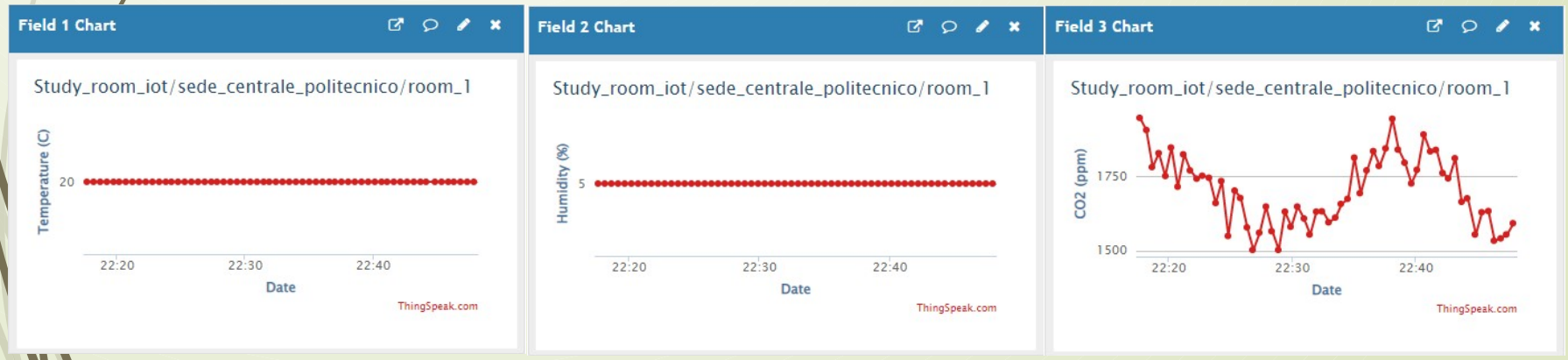
THINGSPEAK ADAPTOR



THINGSPEAK

HOW IT WORKS

- COLLECTS THE DATA SENT BY THE SENSORS.
- COMMUNICATES VIA REST WITH THINKGSPEAK ADAPTOR.
- ALLOWS TO HAVE A GRAPHICAL INTERFACE CONTAINING THE TRENDS OF THE DATA PROVIDED IN REAL TIME.



THINGVIEW

POLITECNICO DI TORINO

THANKS FOR WATCHING

PROFESSORS:
- EDOARDO PATTI
- MATTEO ORLANDO

STUDENTS:
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PROGRAMMING FOR IOT APPLICATIONS

ICT4SS
Information and Communications Technologies for Smart Societies