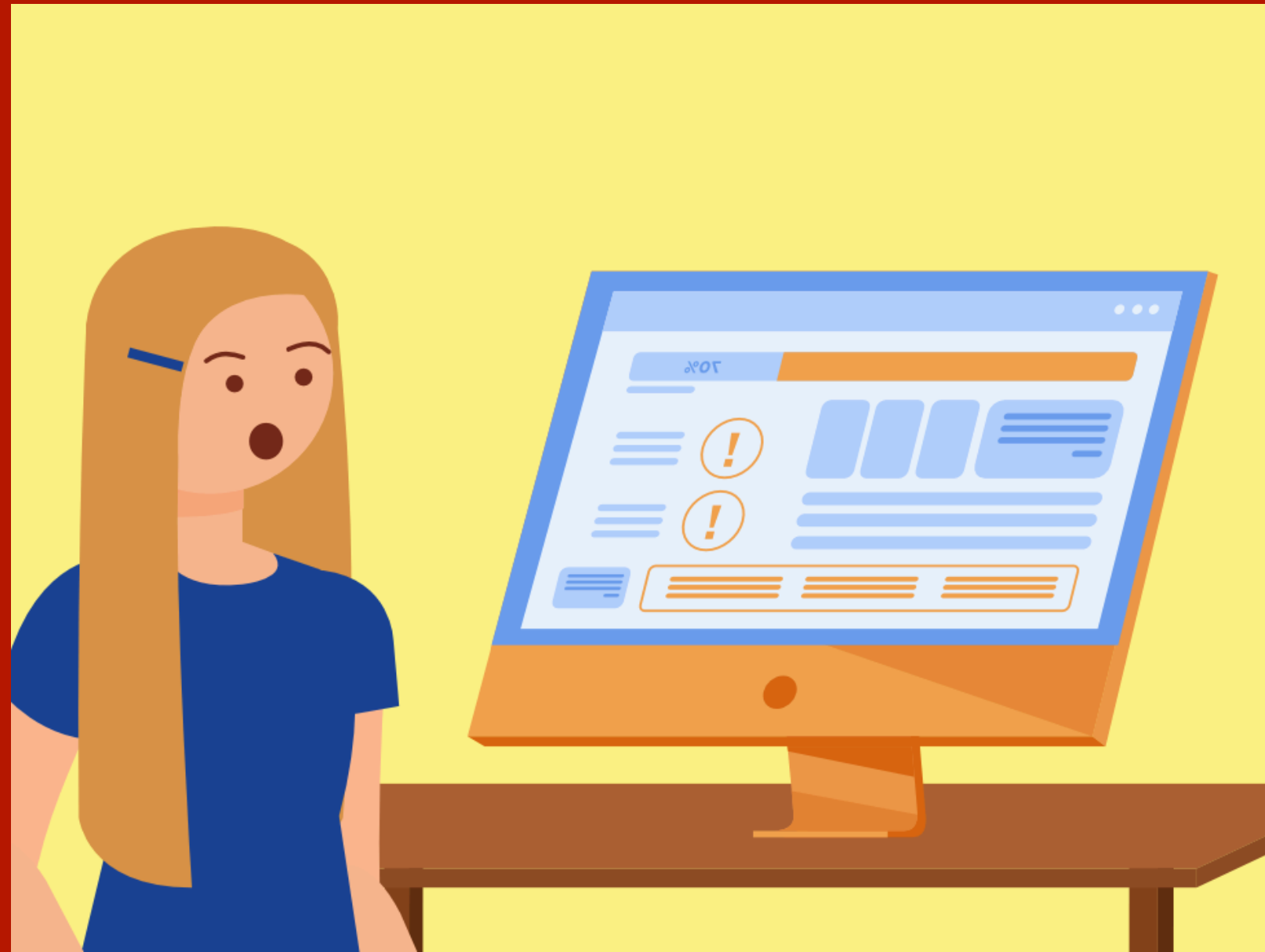


# iMuseum

**IOT Course 2020**

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# The problem



- As a curator I want to optimize the organization of the pieces inside my museum.
- I also want to make the best of the space available and be sure that all the pieces are seen by all visitors.\*
- As a curator, I don't want crowded areas in my museum because large amount of people can ruin the experience for everybody else and also be a security/health risk.

\*As highlighted in this report:

[https://books.google.it/books?id=jqxult73sAEC&pg=PA604&lpg=PA604&dq=musei+organizzazione+pezzi&source=bl&ots=SD1ZhOJpGh&sig=ACfU3U3nAO\\_OUy3mU8hSHAYZQgP7IDxwPg&hl=it&sa=X&ved=2ahUKEwiXhpDIrs3qAhX9isMKHTleCKQQ6AEwBnoECAwQAQ#v=onepage&q=musei%20organizzazione%20pezzi&f=false](https://books.google.it/books?id=jqxult73sAEC&pg=PA604&lpg=PA604&dq=musei+organizzazione+pezzi&source=bl&ots=SD1ZhOJpGh&sig=ACfU3U3nAO_OUy3mU8hSHAYZQgP7IDxwPg&hl=it&sa=X&ved=2ahUKEwiXhpDIrs3qAhX9isMKHTleCKQQ6AEwBnoECAwQAQ#v=onepage&q=musei%20organizzazione%20pezzi&f=false)

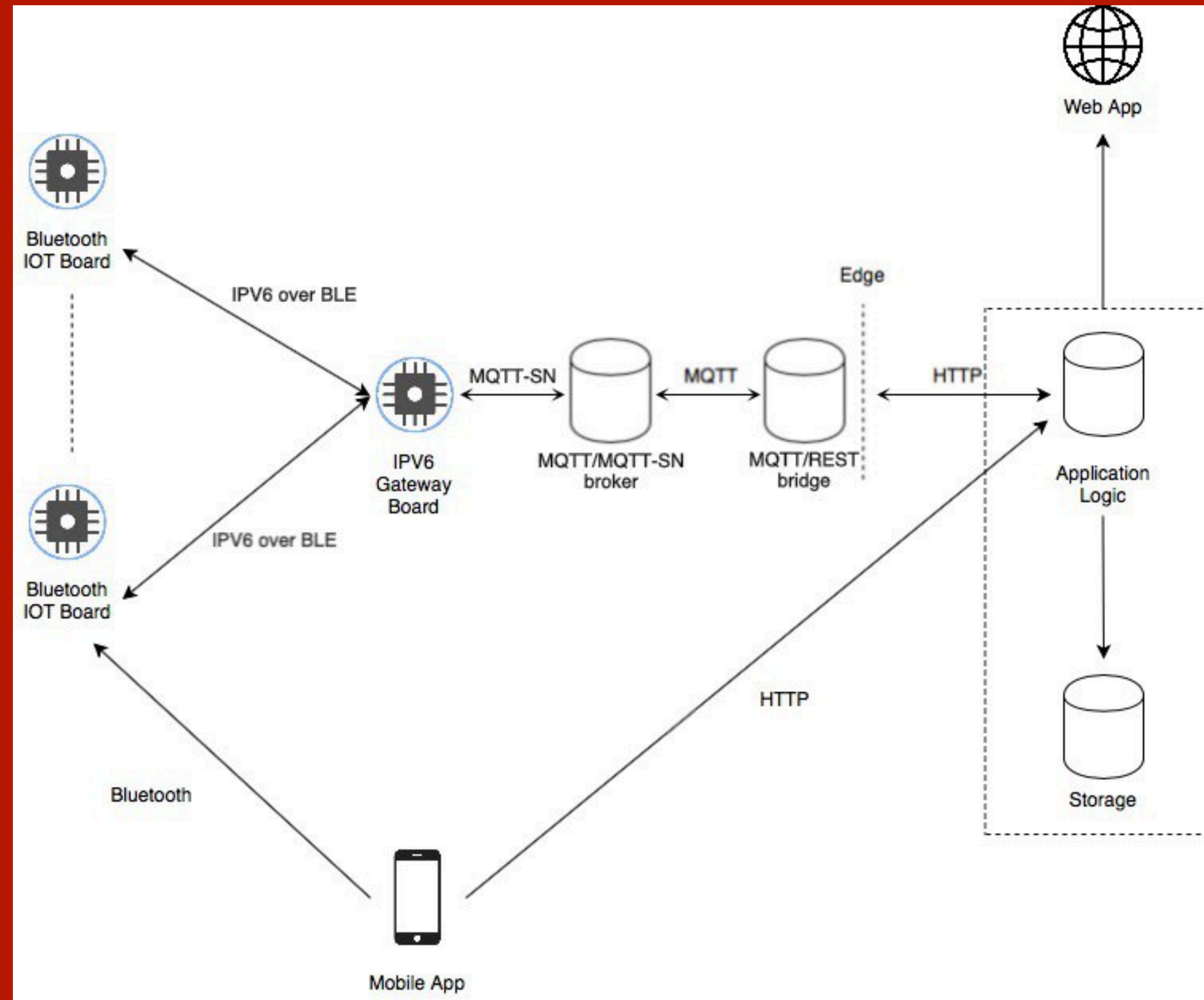
# Existing Approaches

- [http://www.diid.unipa.it/networks/ocities2015/ppt/s1\\_2\\_1.pdf](http://www.diid.unipa.it/networks/ocities2015/ppt/s1_2_1.pdf) (University project about smart museum)
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6470879/> (Report about the benefits and opportunities of IOT for museums)

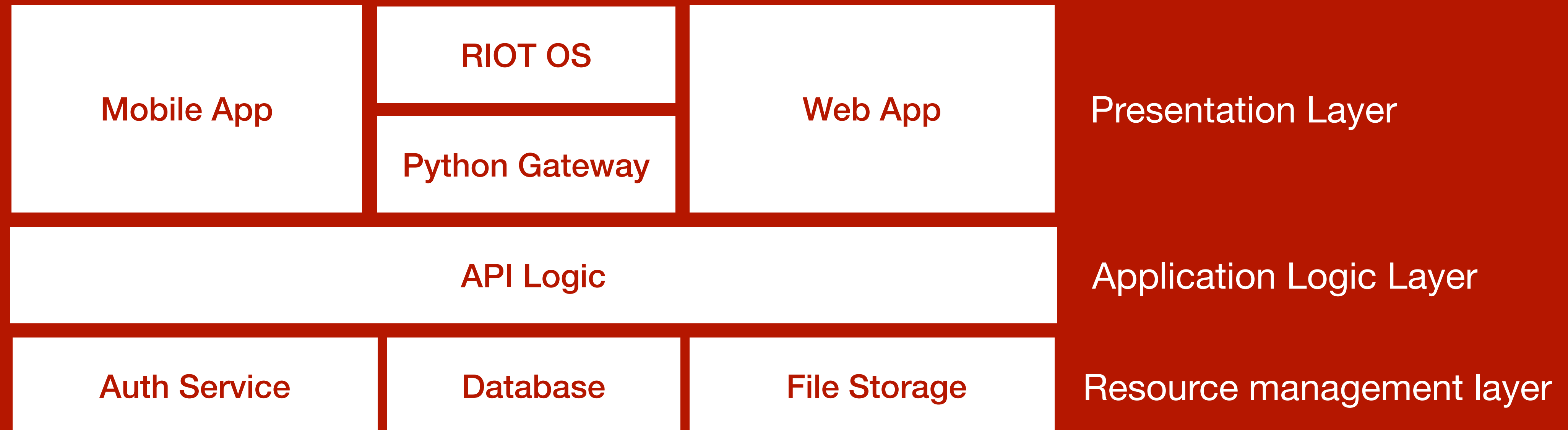
# The solution

- iMuseum is an all-in-one IOT solution that provide both interesting informations to the visitors, while collecting important data about the path took inside the museum, along with the most viewed pieces inside the exhibition.
- For the curator, iMuseum provide a way to know all the important statistics of the museum (all the visits that took place, what are more crowded parts of the museum ecc..) and a managing tool, to check and manage the status of all the sensors and the placement of all the pieces inside the museum.

# Network Diagram



# Software Architecture



- The software architecture rely on the API Logic server to handle the database, auth service and file storage, making them completely transparent to the other clients.
- The clients comunicate with the api using the HTTP protocol.
- The gateway sends data to the boards subscribed using MQTT.

# Evaluation(1)

## Communication Latency

- No precise performance evaluation
- Some delays experienced in the HTTP communication via REST, still acceptable
- Good expectations, would like to test on a real-world environment (with many communicating boards)
- Possibility of compared evaluation adding 1+ bridges (avoid MQTT congestion)

## Cloud Infrastructure Costs

- Realtime database: < \$5/year
- 72m function invocations, ca \$30/year
- Acceptable costs for storage service (highly depending by museum specifics)
- Negligible costs for dashboard hosting and authentication



# Evaluation(2)

## Beacons Efficiency

- Scope: 3-4 meters range action, acceptable for Sapienza Museum
- Cost: around \$30, acceptable depending by the number of pieces and the disposition choice for the boards

## User Feedback

We had some people (friends, relatives) trying our prototype of the application and extracted some notes and future guidelines from their comments:

- The user interface was really appreciated, as simple and user-friendly;
- Some users questioned the need of giving their position, maybe could be removed in a next review;
- From the web app side, some users noticed it may be difficult using some of the statistics without a guide; a caption explaining the usage and meaning could be added aside each one in a next review.



# Missing functions and Evolutions

- Introduce the battery level in the alive message sent by the boards to the backend: right now, the only information received by the backend is the timestamp, used to check whether the board has been recently alive or much time has passed and therefore it has probably gone down. It may be useful to monitor the battery level of the boards, in order to check the energy consumption and be ready to replace it.
- Study and implement a ML model to compute the attendance level of a statue (opposed to the current one based upon thresholds).