INTERNET OF THINGS

PROJECT

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IDLAB

http://idlab.technology | *http://idlab.ugent.be*

1 SCOPE

The Internet of Things is a broad and ever evolving domain, with new technologies, frameworks, tools, Cloud services, etc. becoming available regularly. Hence, it is important that professional workers can quickly assess the relevance and potential of new solutions & technologies. This can be done by skimming through available material on the Internet, consulting a variety of sources to get an unbiased view, quickly setting up a prototype using open-source software, exploring the capabilities and features of a software platform, etc. Based on such assessment, you should be able to provide your boss or manager with a comprehensive report, based on which further decisions can be made.

Such an assignment will be the scope of this project. You are considered to be part of a team that has been asked to explore a given technology and quickly assess its strengths and weaknesses. **Two topics are being provided, out of which you need to select 1 topic**. The outcome of the assessment must be a **written report**. If problems have been encountered, things have failed, issues have been discovered, aspects were not considered due to time constraints, etc. you are expected to communicate about this. Finally, as time is money, there is a limit to the time you are allowed to spend on the execution of this task.

2 PRACTICAL INFORMATION

Group formation

- The project should be executed by a **team of 2 or 3 students**.
- Teams can be formed **using the group functionality of Ufora until November 20 08:00 pm**
    - Go to *Groups* → select *Project* group → subscribe to 1 of the teams

Timing

- The report must be handed in before the start of the Christmas recess, i.e**. latest by December 20.**
- Submission must be done by 1 of the team members **using the Assignment functionality in Ufora**
    - Go to *Ufora-tools* → *Assignments* → select your team
- In case of questions, please contact PabloEsteban.AvilaCampos@UGent.be, Jeroen.Hoebeke@ugent.be , Eli.Depoorter@ugent.be

Effort

- The effort foreseen for executing the project is targeted to be around 5 hours per person, excluding the writing of the report.

3 REPORT

The format of the report is free, apart from the following rules:

- The report is submitted in docx or PDF format
- The length of the report should not exceed 10 pages (font: Arial 10)
- Clearly mention the names of the team members in the report
- When appropriate, use figures and drawings to explain concepts, architectures, protocols, interactions, etc.
- If references are used, appropriate references should be added.
- The report must discuss the questions being asked and include a section containing the main conclusions or the lessons learned.

4 GRADING

The project is mandatory and part of the continuous assessment of the course. It counts for 10% of the overall score. Grading will be based on the content and quality of the report. Individual feedback will be provided to the teams.

5 POSSIBLE TOPICS

5.1 OMA LWM2M

OMA Lightweight M2M is a protocol from the Open Mobile Alliance for M2M or IoT device management. Conceptually, your team already has a high-level understanding of how LWM2M works, but wants to get some hands-on experience to better understand whether the protocol is suitable for their next-generation IoT devices. You are asked to make use of available open source software in order to quickly set up a working prototype: see e.g. https://projects.eclipse.org/projects/iot.leshan (https://github.com/eclipse/leshan) for the server side and e.g. https://github.com/AVSystem/Anjay or https://projects.eclipse.org/projects/iot.wakaama (https://github.com/eclipse/wakaama) for the device side. For the device side, a C implementation is preferred, as the target devices are embedded systems with limited memory. Once the prototype is up and running you explore the operation of the protocol (bootstrapping, registration/discovery, eventing, etc.) and illustrate it by capturing some packet traces. Your boss explicitly asked not to ignore security during the evaluation.

Finally, you should also try to come up with a well-motivated answer and discussion with respect to the following concerns:

- Our product line currently contains embedded Wi-Fi devices that operate in a home context. Devices can be located behind NAT. Will OMA LWM2M still work?

- To avoid the Wi-Fi infrastructure cost for our customers, a new product line will be launched making use of LoRaWAN. Can OMA LWM2M be used?
- OMA LWM2M claims to be able to run over SMS (as an alternative to UDP). Are there differences when running it over SMS compared to UDP?
- Can I update multiple parameter settings at once (i.e. update multiple parameters using only a single request)?
- Can you propose a commercial Cloud platform with support for LwM2M? Briefly discuss which functionalities are offered with respect to processing and storage, event notifications to users and firmware updates?
- Can I offer my customers a smartphone app to manage their devices remotely?

Both the LWM2M Core (https://www.openmobilealliance.org/release/LightweightM2M/V1_2_1-20221209-A/OMA-TS-LightweightM2M_Core-V1_2_1-20221209-A.pdf) and Transport (https://www.openmobilealliance.org/release/LightweightM2M/V1_2_1-20221209-A/OMA-TS-LightweightM2M_Transport-V1_2_1-20221209-A.pdf) specifications (and IoT syllabus) provide a good starting point to find a suitable answer to (some of) the provided questions.

The report is expected to contain a description of the setup of the prototype, illustration of the evaluation of the behaviour/functionalities and a discussion of the above concerns.

5.2 THINGSBOARD

ThingsBoard is an open-source IoT platform that enables rapid development, management, and scaling of IoT projects. Supporting both cloud and on-premises deployments, ThingsBoard allows you to create rich IoT Dashboards for data visualization and remote device control in real-time. In this case, your team is looking for an open-source Dashboard platform to show their hardware capabilities to customers. You are asked to do a quick assessment of ThingsBoard by deploying a local (on-premise) Community Edition server (see https://thingsboard.io/docs/user-guide/install/installation-options/). Then, by using one of the built-in available transport protocols (MQTT, CoAP, HTTP, LwM2M) inject telemetry to the platform and display it in a Dashboard. The telemetry generator might be any device, but ideally, telemetry should be real data such as CPU Temperature or Load.

To have a better understanding of the capabilities of this platform, the following questions need to be answered (Hint: use the Thingsboard online documentation as a reference):

- One of our products uses LoRaWAN technology, considering we have our own Gateways. Using a simple diagram, illustrate the network architecture required to display the product telemetry on a ThingsBoard dashboard. Briefly describe each element involved.
- Due to processing constraints, one of our end nodes cannot convert the measured voltage from a TMP36 sensor to temperature. Is it possible to accomplish this conversion at Thingsboard? How this could be done?

- We have a node monitoring pumps vibration on a water station. We need to predict when vibration will reach critical levels so we can schedule preventive maintenance for the pump and avoid unplanned downtime. Briefly describe how this could be accomplished with ThingsBoard.
- Alarms are an important part of telemetry monitoring. Describe how they work in ThingsBoard and what options are available to send notifications when an alarm is triggered.
- Thingsboard supports the most deployment architectures. The selected architecture heavily depends on both the number of messages produced by devices and the structure of those messages. Assuming 1000 NB-IoT smart meter devices send messages to ThingsBoard once per day, with 4 data points per message. Based on a rough calculation of the number of requests to the database per second and the daily needed space on disk, propose/draw a diagram with an architecture to support the load. Explain what you would change in your architecture (storage and load) if the number of meters were increased to 1,000,000. Additionally, describe how different available messaging/queueing systems could support this scaling.
- ThingsBoard IoT Gateway is an extra module that could help you to integrate devices that are connected to legacy and third-party systems. Assuming you want to include a Bluetooth Low Energy (BLE) end-device into your platform, explain what extra parts are required and how the data will travel to your platform.

The report is expected to contain a description of the setup of the prototype, an illustration of the injection of telemetry data in the Dashboard, and answers to the above questions.