DeltaIoT: A Real World Exemplar for Self-Adaptive Internet of Things (Artifact)*

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Abstract

The DeltaIoT exemplar enables researchers to evaluate and compare new methods, techniques and tools for self-adaptation in Internet of Things (IoT). The exemplar applies multi-hop communication, where each IoT mote must have a path towards the gateway along other motes. Our motes use LoRa radio technology supporting long range communication. The focus is on dynamically adapting the network settings of the IoT motes (e.g., transmission power and spreading factor) to reduce the energy consumption of the motes and guaranteeing high packet delivery performance, regardless of uncertainties such as sudden changes in traffic load and communication interference. Traditionally, to deal with uncertainties the network settings are either hand-tuned or over-provisioned, resulting in continuous network maintenance. Self-adaptation can automate these tasks. The exemplar provides several reference scenarios for experimentation. DeltaIoT comprises a simulator for offline experimentation and a physical setup of 25 motes that can be accessed remotely for experimentation in the field. This IoT system is deployed at the Computer Science Department Campus of KU Leuven.

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1 Scope

The DeltaIoT exemplar promotes research through enabling the comparison of different self-adaptation solutions in the domain of Internet of Things (IoT). The central problem targeted

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by the exemplar is to *reduce the energy consumption* of the IoT motes, while *guaranteeing high packet delivery performance*, regardless of uncertainties in the IoT system and its environment, such as sudden changes in traffic load and interference of communication links. To that end, the user needs to design a feedback loop and deploy that on top of the network to monitor and assess the motes and the environment to autonomously adapt the IoT system. For reliable and efficient communication, this feedback loop needs to optimise the network settings of the IoT motes. The exemplar offers different adaptation scenarios, which are organised by type of uncertainty that makes self-adaptation necessary, type(s) of adaptation required, and type(s) of goals that these adaptations aim to meet. Within these scenarios, the exemplar defines quality attributes and metrics for the evaluation and comparison of different self-adaptation solutions.

The exemplar provides a simulator and a physical set up for experimentation, the latter can be accessed remotely. For both settings, the user can use a Java client comprising Probe and Effector classes to connect the self-adaptation solution (feedback loop) with the IoT network. The accompanying paper provides a simple example of a feedback loop realisation with test results.

2 Content

The artifact package includes:

- The sources and executables of the client to interact with the DeltaIoT network.
- The sources and executables of the simulator.
- A set of predefined configuration files for the simulator.
- The sources and executables of a simple self-adaptation solution.
- An installation manual.
- Documentation for designing a self-adaptation solution and running experiments.

Test results of previous self-adaptation solutions that can be used as benchmarks for comparing a newly developed solution are available at the exemplar website.

3 Getting the artifact

The artifact endorsed by the Artifact Evaluation Committee is available free of charge on the Dagstuhl Research Online Publication Server (DROPS). In addition, the exemplar is also available at: `https://people.cs.kuleuven.be/danny.weyns/software/DeltaIoT/`.

4 Tested platforms

Running the DeltaIoT exemplar requires the latest version of the Java Virtual Machine.

5 License

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6 MD5 sum of the artifact

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7 Size of the artifact

129.6 MB