Master Thesis : Distributed Resiliency for IoT Edge Compute Nodes

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Diplôme : Master : ingénieur civil en informatique, à finalité spécialisée en "computer systems security"
Année académique : 2020-2021
URI/URL : http://hdl.handle.net/2268.2/11660

Distributed Resiliency for IoT Edge Compute Nodes

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Cloud computing is the practice of using a set of remote servers hosted on the internet to process, store and manage data, instead of doing it locally. This practice, widely used nowadays, has many advantages but also quite a few downsides, such as high latency, low bandwidth... To face these issues, cloud computing can be combined with another paradigm called edge computing (see figure 1) which brings computation at the edge of the network. Edge computing has quite a few challenges, among which service management. Edge nodes are exposed to suffering from diverse type of failures, such a degradation, loss of connectivity... It is important to make sure that they offer highly available services, and are extremely resilient.

This work explores the feasibility of grouping the edge nodes in order to offer high availability and resiliency, and does so by focusing on searching a solution that fits the constraints of a particular environment : the manufacturing sector. After having defined these constraints, an exploration of potential solutions and mechanisms is conducted. This explorations leads to the use of a leader-driven distributed system approach (see figure 2). The idea of this system is to always have a leader and a successor. The leader edge node can be seen as a directly available edge node, which receives data that needs to be processed, while the successor can be seen as hot standby edge node. The rest of the edge nodes in the system participate in elections in order to become successor. The elections take place when either the leader or the successor fails.

In order to prove the feasibility and the interest of this solution, a small proof-of-concept has been implemented, using GNS3 (a network simulator) and Lubuntu virtual machines (see figure 3). This proof-of-concept, even though relatively simple, allows to simulate and test different failure scenarios. Those tests have proven that the approach used by the system is viable. However, it remains to be seen what the impact of such a system would be in a real-life environment, and how it would scale. Furthermore, the approach of grouping the edge nodes in a cluster is of interest and could potentially be used in other applications.

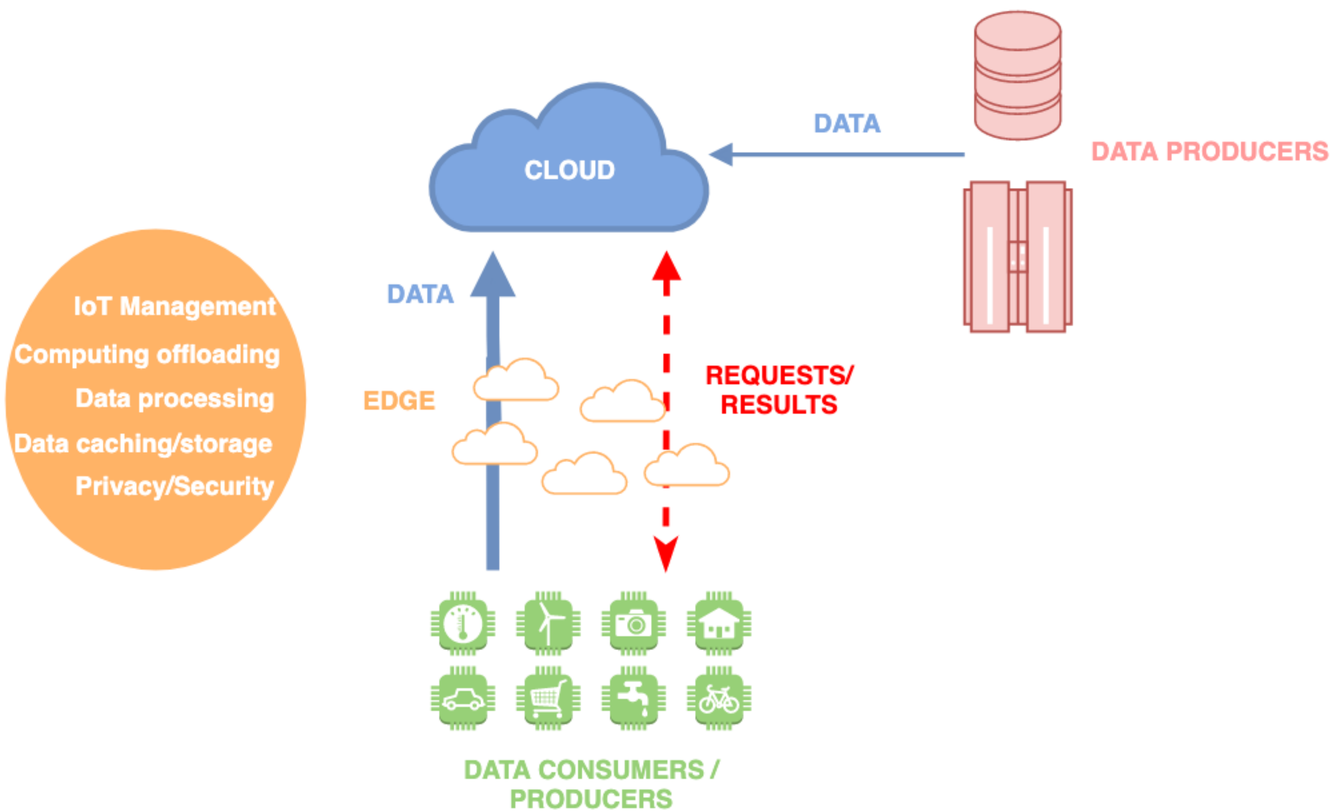

Figure 1: The edge computing paradigm

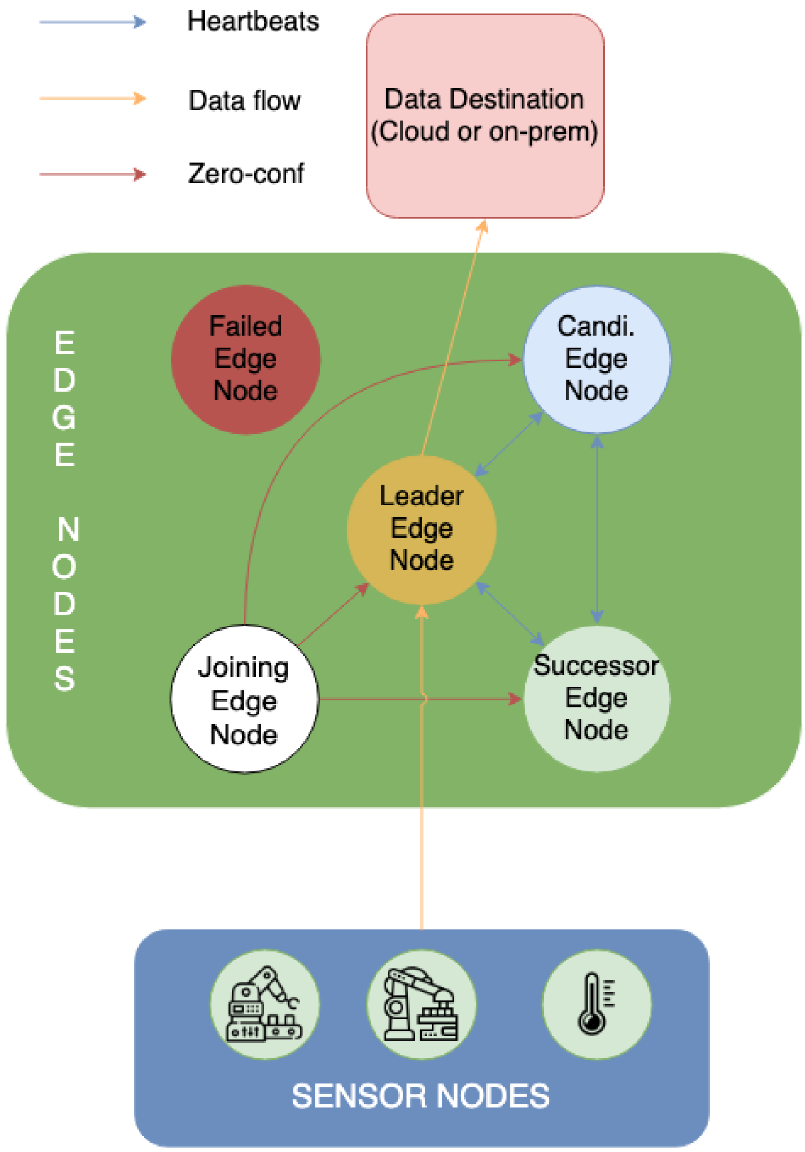

Figure 2: Architecture of the solution

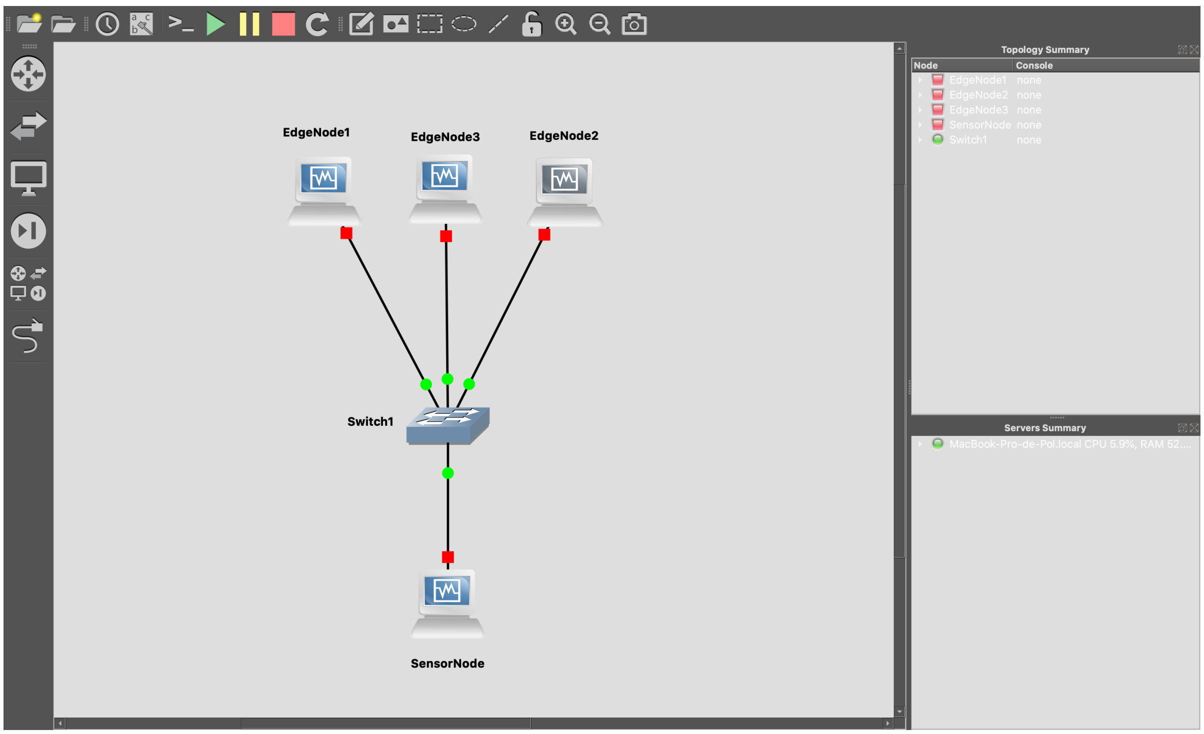

Figure 3: Screenshot of the GNS3 client graphical interface