Classification of Fog Computing Applications

A Technical Report by Sepehr Sabour

***Abstract*— Reducing delay in IoT applications is the most important goal of using Fog Computing. "How to share the processes between processors" is a question with no concluded answer. Many papers try to find a solution. In my opinion, they all have a common weakness: they don't pay attention to the different applications. I think for finding the best solution is necessary to classify the applications later can decide on offloading algorithms.**

I. INTRODUCTION

I arrange the applications in 3 different groups: 1) Sensor & Actuator Network-based Applications, 2) Applications Needed Heavy Processing and 3) Wide Area Applications.

II. CLASSIFICATION

A. Sensor & Actuator Network-based Applications

This application includes sensors and actuators, connected by a low power network, send data and receive commands. The network might be a Low Power Local Area Network (like Bluetooth or Zigbee) or a Low Power Wide Area Network (like Sigfox or LoRaWan). A gateway could be edge processor. The other characteristics can be summarized as follows.

- Data: The communicate data, sensed data and commands, is usually light. so the data processing needs few CPU cycles.
- Process: Although process time for each task is small the queuing delay is very large because the quantity of tasks is enormous. one task should process in a single processor.
- Priority: Sensors send data to a processor, the processor makes a decision and finally sends commands to actuators, that's usual scenario. In some cases, the processor must make decisions quickly, for example in smart health applications, means, some task is more important than the others so a fog processor must prioritize the tasks.
- Challenges: When a sensor sends data in LoRaWAN, more than one gateway may receive the data. if two or more processors process the data and make different decisions, will be a bad situation so controlling the redundant process is so important and challenging.

B. Applications Needed Heavy Processing

This application includes huge processing tasks, for example, image processing, natural language processing and augmented reality and user devices are more than a simple sensor, like a surveillance camera or smart phone. Following items establish The other characteristics.

- Data: The produced data is large like a video that sends by security camera for face detection applications.
- Process: Tasks need further CPU cycles for processing than other applications. User equipment produces data can process the data, for example, a smartphone can process the taken video or send it to the other processors. If fog nodes cooperate with each other, the processing delay will be reduced significantly.
- Priority: Third-party companies may provide the edge processors so the users should pay for the services so if a user pay more money privileged to use more processing power.
- Challenges: Applications like Augmented Reality don't tolerant large delay. The jitter must be constant in applications like video stream analysis. These processing tasks should be shared between processors optimally.

C. Wide Area Applications

Wide area applications like the smart city or smart vehicles, in this applications users equipment usually have mobility. the features of the application are listed as follows:

- Data: In these applications, the data collected from distributed sensors for example for controlling the traffic it's required to get the status of other streets. The obtained data are heterogeneous. For example in a smart car, the cameras find the distance from other cars, the speed sensor determines the pace and GPS shows the location, all data used for considering a safe speed.
- Process: The tasks need less CPU power than the second class of applications. The collected data should be weighted and make a decision, in some cases it's required to use old data stored in databases.
- Priority: Applications like speed control in smart vehicles must be processed with a small delay and prioritize over others because a large delay may make a catastrophe.
- Challenges: Mobility is the most important difficulty. the processes have to migrate from one processor to the another with an infinitesimal delay also as explained before, the previous data used in processing the new ones so the databases must update after processing

III. CONCLUSIONS

In this report, I classified fog computing applications to 3 different groups. At the next step, I will find a model for each of the groups and I'll try to optimize them.