SwaCom: A Swarm Computing framework for connected devices

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1 INTRODUCTION

No longer simply for making calls, most smartphones now have microprocessors which allow for increased computing power in a small space. For example, ARM [1] chips efficiently feed instructions to the circuits on the microprocessor, providing lots of computing power for relatively little energy. However, this computing power could be used most efficiently not only by advances in network technology that make messaging more robust, but also by further connections to the application layer. Technologies such as Bluetooth Mesh[1] and Low Power WAN[2] are making advances in connecting small sensors and machines that are typically less power constrained on the Internet.

The first generation of the internet germinated with connecting the computers. The next generation of the internet will see a transformation where there exist smart networks of the sensors and machines around us. Machines will be able to generate data and share it with other machines of concern. Based on the data they gather, they further build collective intelligence about the world. All of that requires designing the infrastructure facilitating the networking of the machines.

We require a framework that allows efficient collection of data from the low power compute sensors, performing tasks in a distributed fashion utilizing another set of devices in proximity with higher compute resources. This not only means localizing the communication within a network leading to the overall reduction in latency but also faster completion of the analytical tasks for actionable insights.

2 RELATED WORK

- *The Atos Approach* [3]: In this approach, authors combined the network and cloud capabilities to create an on-demand, autonomous and decentralized computing system which we call a computing swarm. The processing required for immediate action and extremely low latency happens at the edge of the network, while other processes will run in a range of cloud models. This shall all be executed in an automated, self-organized and self-managed model called swarm computing. The resources here can be any IoT[2] device.
- *Swing Approach* [4] [5]: In this approach, the authors studied the source of performance slowdown of the sensing applications on a single device and designed and implemented the Swing framework. Swing manages parallelism in stream processing, dynamism from mobile users and heterogeneity from the swarm devices. Swing provides a distributed resource management framework that aims to minimize processing latency while reducing resource usage and energy consumption. It also provides mechanisms for automatic device discovery, dynamic application deployment, and mobility handling.

3 EVALUATION

We intend to study the various compute nodes needed in that network and understand the performance and their capacity. Understanding and exploring the performance of sensor devices like their capacity, computational information will be a major focus of our research.

Once the infrastructure is in place, the next action plan is to build different layers of software, such as the Distributed Infrastructure Resource Manager. Dissemination of applications such as intelligent traffic management control, efficient distribution and storage of electricity generated from renewable resources, and resource sharing at the hyper-local level. For instance, sharing the status of the washing machine on your network to efficiently distribute the load to minimize idle time. Since anonymity is inherently safe for people, peer-to-peer networks for anonymously verifying the work of politicians and local administrators in a democratic setup is another exciting application.

To evaluate the system we develop, we would mainly be focusing on:

- Survey the bandwidth and compute capacity of the devices in the network. Networks would have devices with varying compute resources.
- Resource management for the devices considering heterogeneity and dynamics.
- Routing hierarchy with focus on edge computing.

4 CONCLUSION

In this project, we shall design, implement and evaluate a distributed mobile computing framework, targeting continuous sensing applications that are *compute-intensive* and *delay-sensitive*. Motivated by the immense applications which can be built in the new internet world, we shall continue the research on the current state of the infrastructure today as the immediate next step in the research. We conclude with a demonstration of a proof of concept by building one of the aforementioned applications.

[1] Advanced Risc Machines
[2] Internet of Things

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