Timely Status Update in Wireless Uplinks: Analytical Solutions with Asymptotic Optimality

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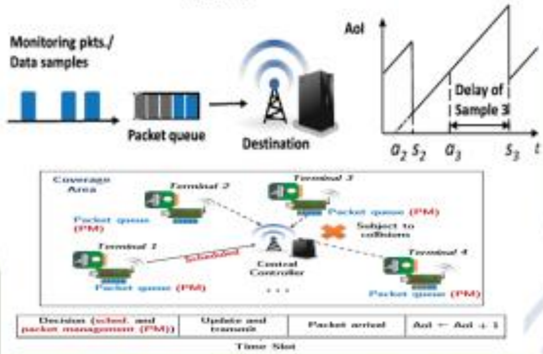
Abstract

In a typical Internet of Things (IoT) application where a central controller collects status updates from multiple terminals, e.g., sensors and monitors, through a wireless multiaccess uplink, an important problem is how to attain timely status updates autonomously. In this paper, the timeliness of the status is measured by the recently proposed age-of-information (AoI) metric; both the theoretical and practical aspects of the problem are investigated: we aim to obtain a scheduling policy with minimum AoI and, meanwhile, requires little signaling exchange overhead. Towards this end, we first consider the set of arrival-independent and renewal (AIR) policies; the optimal policy thereof to minimize the time-average AoI is proved to be a round-robin policy with one-packet (latest packet only and others are dropped) buffers (RR-ONE).

Introduction

(IoT) is becoming an increasingly growing topic of conversation both in the workplace and outside.
(IoT) is a system of interrelated computing devices and digital machines.The ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. it envisions to transform every physical object into an intelligent individual that is capable of sensing, communicating and computing. AoI is to solve the time Status update and to minimize the time An AoI optimization problem can be posed as minimizing the time-average AoI at the receiver by controlling the sampling rate at the terminal. This definition jointly accounts for the delay introduced by sampling the information source and data communication, which distinguishes AoI from the conventional end-to-end communication (queuing and transmission) delay metric.



My observation

To improve Scalability, Accuracy and Security I found about Microservice architecture that is very helpful to improve our System.The term "Microservice Architecture" has sprung up over the last few years to describe a particular way of designing software applications as suites of independently deployable services. While there is no precise definition of this architectural style, there are certain common characteristics around organization around business capability, automated deployment, intelligence in the endpoints, and decentralized control of languages and data.

Problem Statement

How To attain the timely Status Update in Wireless uplinks autonomously in both aspects of problem such as theoretical and practical. In this Paper, to solve the Problem is used the (AOI) Age of Information technology to maintain the timeliness of status and update.The aim to obtain a scheduling policy with minimum(AoI) consider the set of arrival-independent and renewal (AIR) policies.
To minimize the time-average (AoI) is proved to be a round-robin policy with one-packet (latest packet only and others are dropped) buffers (RR-ONE). The optimality is established based on a generalized Poisson-Arrival-See-Time-Average (PASTA) theorem.An AoI optimization problem can be posed as minimizing the time-average AoI at the receiver by controlling the sampling rate at the terminal. All the sampled data packets go through queue as shown in Fig. 1.

Results/Research

The main results of the paper include two aspects, i.e., scheduling policies for scenarios with and without packet management. For the former where in terminals apply packet management, the AoI performance of RR-ONE and optimality guarantees are analyzed as follows (Theorem 1 to 3).
Theorem1(Optimality among AIR Policies):RR-ONE is the optimal AIR policy to minimize the time-average of AoI. Theorem 2 (Asymptotic Optimality): RR-ONE is asymptotically optimal among all policies (including non-causal policies) in the massive IoT regime, i.e., it achieves the optimum asymptotic scaling factors.Theorem 3 (AoI Stationary Distributions under RR-ONE): The AoI evolution of terminal-n based on RR-ONE follows a Markov renewal process with a fixed renewal time of N time slots.

Conclusion

To solve the transmission failures whenever a collision happens. Through Microservices we can solve the transmission failures because in Microservices architecture we have technology to improve the fault Isolation.
To improve Scalability, Accuracy and Security of the System, I found about Microservice architecture that is very helpful to improve our System.

Refrences

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