Computer Standards & Interfaces 77 (2021) 103521

Contents lists available at ScienceDirect

Computer Standards & Interfaces

journal homepage: www.elsevier.com/locate/csi

6G-enabled Edge Intelligence for Ultra -Reliable Low Latency Applications: Vision and Mission

Rajesh Gupta, Dakshita Reebadiya, Sudeep Tanwar *

Department of Computer Science and Engineering, Institute of Technology, Nirma University, Ahmedabad, Gujarat, India

ARTICLE INFO

Keywords:
Edge intelligence
6G
Ultra-reliable low-latency
COVID-19
Internet of drones
Holographic communication

ABSTRACT

The increasing demand for automation and instant solution leads the technological world towards massive applications such as the Internet of drones, Autonomous Vehicles (AVs), border surveillance, telesurgery, and Augmented Reality (AR), which requires a vast upgrade in technology with improved processing and computation capabilities. The Centralized Cloud Server (CCS) provides the facility to compute critical tasks at the central data server, but it consumes more time due to the distance between CSS and edge device. In this article, we discuss the advantages of edge computing over cloud computing to overcome latency and reliability issues in critical applications. Moreover, the idea of processing and analyzing massive applications at the edge comes up with the requirement of building intelligence at the edge to compute complex tasks within a negligible time. Edge intelligence offers intelligence at the edge to process large datasets for critical computations and to overcome storage issues. Also, the performance tolerant connectivity and low-speed rate issues with 4G and 5G can be solved using a 6G wireless network. The 6G connected edge intelligence application offers ultra-low-latency, security, and reliability mechanisms that could be helpful in COVID-19 pandemic situations. We have also discussed the demonstration of aforementioned massive application in the form of a case study on combating COVID-19 situations using 6G-based edge intelligence. The case study depicts the benefits of using 6G (latency: $10-100\mu s$) over 4G (latency: $< 10ms$) and 5G (latency: $< 5ms$) communication networks. The proposed 6G-enabled scheme is compared against the traditional 4G and 5G networks to designate its efficiency in terms of communication latency and network mobility. Eventually, we then analyzed various open issues and research challenges in this emerging research area for future gains and insights.

1. Introduction

In the era of data science and high-performance computation, rapid and reliable access to the data is highly required. This aspect can be fulfilled with centralized cloud computing, where high-end servers and massive storage systems are installed for scalable computing [1]. Cloud computing suffers from security and latency issues that are not suitable for mission-critical applications (i.e., do not tolerate even a millisecond of delay) such as Autonomous Vehicles (AVs), Internet of drones, border surveillance, augmented reality, telesurgery, and live video streaming [2]. The viable solution for the same is to introduce edge computing, which can offer low-latency by performing computation either at the mobile device or in the proximity of the data source without relying on the CCS [3,4].

The performance of edge computing majorly relies on two factors such as (i) the amount of data transfer for communication between the edge device and edge server and (ii) time for data processing at the edge server [5]. However, the edge servers are in the proximity of the source of data, the data transfer is done in a fraction of seconds which ensures low-latency for time-sensitive applications [6]. Edge computing also guarantees the Quality-of-Service (QoS) even in case of a massive amount of data [7]. As, the data is stored near the device, which reduces the network bandwidth requirements as well as computation cost. Except for these benefits, edge computing also minimizes the data redundancy at some level [8], because initially the data is stored locally for a while (for local processing) and then stored into the CCS. The other gem feature of edge computing is data security, i.e., despite sending data for processing to the central location, the data processing, and execution is being held within the devices themselves or transferring data to the local edge server in close proximity. Also, Edge computing offers high scalability, i.e., more number of devices can be added to the network without influencing other devices [9]. Edge computing is deficient to

* Corresponding author.
E-mail addresses: 18ftvphde31@nirmauni.ac.in (R. Gupta), 19mcec12@nirmauni.ac.in (D. Reebadiya), sudeep.tanwar@nirmauni.ac.in (S. Tanwar).

https://doi.org/10.1016/j.csi.2021.103521
Received 29 August 2020; Received in revised form 24 December 2020; Accepted 4 February 2021
Available online 6 February 2021