QoS-Aware Fog Resource Provisioning and Mobile Device Power Control in IoT Networks

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ABSTRACT

Fog-aided Internet of Things (IoT) addresses the resource limitations of IoT devices in terms of computing and energy capacities, and enables computational intensive and delaysensitive tasks to be offloaded to the fog nodes attached to the IoT gateways. A fog node, utilizing the cloud technologies, can lease and release virtual machines (VMs) in an on-demand fashion. For the power-limited mobile IoT devices (e.g., wearable devices and smart phones), their quality of service may be degraded owing to the varying wireless channel conditions. Power control helps maintain the wireless transmission rate and hence the quality of service (QoS). The QoS (i.e., task completion time) is affected by both the fog processing and wireless transmission; it is thus important to jointly optimize fog resource provisioning (i.e., decisions on the number of VMs to rent) and power control. This paper addresses this joint optimization problem to minimize the system cost (VM rentals) while guaranteeing QoS requirements, formulated as a mixed integer nonlinear programming problem. An approximation algorithm is then proposed to solve the problem. Simulation results demonstrate the performance of our proposed algorithm. In this as extension we will add advance CHA CHA light weight encryption algorithm to secure iot data.

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1. Introduction

Internet of Things (IoT) connects billions of physical objects, including sensors, smart meters, smart cars and actuators, to collect and exchange data to facilitate various applications, such as smart city, smart grid, e-healthcare and home automation [1], [2]. The fundamental application of IoT is the sensing service which deploys several sensors to detect the ambient environment and send the sensed datato the users for monitoring purposes [3]. The sensed data are usually collected by the IoT gateway and then transmitted to the users[4]. Many IoT devices have severely limited resources[5], [6]. However, many IoT applications require real-time processing and event response[7]. In fog computing, fog nodes, equipped with computing, storage and networking resources, are attached to an IoT gateway (GW) to assume a substantial amount of computing tasks instead of performing all tasks in the remote cloud, thus enabling immediate service response [8].

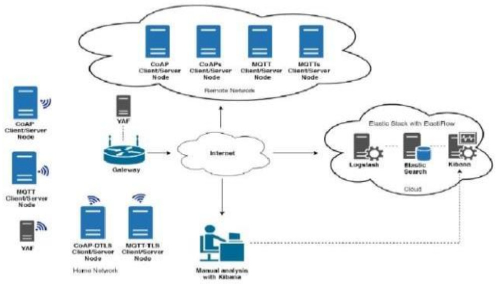

Fig.1: Example Figure

2. Literature Review

Resource provisioning for IoT application services in smart cities:

In the last years, traffic over wireless networks has been increasing exponentially, due to the impact of Internet of Things (IoT) and Smart Cities. Current networks must adapt to and cope with the specific requirements of IoT applications since resources can be requested on-demand simultaneously by multiple devices on different locations. One of these requirements is low latency, since even a small delay for an IoT application such as health monitoring or emergency service can drastically impact their performance. To deal with this limitation, the Fog computing paradigm has been introduced, placing cloud resources on the edges of the network to decrease the latency. However, deciding which edge cloud location and which physical hardware will be used to allocate a specific resource related to an IoT application is not an easy task. Therefore, in this paper, an Integer Linear Programming (ILP) formulation for the IoT application service placement problem is proposed, which considers multiple optimization objectives such as low latency and energy efficiency. Solutions for the resource provisioning of IoT applications within the scope of Antwerp's City of Things testbed have been obtained. The result of this work can serve as a benchmark in future research related to placement issues of IoT application services in Fog Computing environments since the model approach is generic and applies to a wide range of IoT use cases.

Managed edge computing on Internet-of-Things devices for smart city applications:

We demonstrate a managed edge computing platform for Internet-of-Things (IoT) devices, which supports dynamic deployment of virtualized containers running distributed analytics. We build a model city, and install multiple Raspberry Pis as minions, and a mini PC as the master. Through the web dashboard on the master, we show how users can remotely monitor, manage, and upgrade the IoT analytics and devices. Multiple concrete IoT analytics, namely: (i) air quality monitor, (ii) sound classifier, and (iii) image recognizer are demonstrated. Several sample measurements on deployment speed, Quality-ofService (QoS) achievements, and event-driven mechanisms are also carried out on the testbed.

Joint content placement and storage allocation in C-RANs for IoT sensing service:The Internet of Things (IoT) sensing service allows systems and users to monitor environment states by transmitting the content sensed by a variety of sensors. Owing to billions of sensors and devices deployed in the IoT system, a huge amount of data (big data) are generated, thus injecting tremendous traffic into the network. Cloud radio access network (C-RAN) is a promising wireless network architecture to accommodate the fast growing IoT traffic and improve the performance of IoT services. Caching in C-RAN, which brings content to the edges, not only alleviates the network traffic, thus improving the end-to-end user quality of service (QoS), but also avoids activating the sensors too frequently, thus reducing their energy consumption. The content placement problem determines what and where to cache in C-RAN. However, the caching performance is highly related to the caching storages. The storage allocation problem determines the storage capacities of network entities. In this paper, we jointly optimize the storage allocation problem and content placement problem in a hierarchical cache-enabled C-RAN architecture for IoT sensing service. We formulate the joint problem as an integer linear programming (ILP) model with the objective to minimize the total network traffic cost. The storage allocation problem and content placement problem are constrained by caching storage budgets and cache capacities, respectively. Two heuristic algorithms are proposed in order to reduce the computational complexity of ILP. Extensive simulations have been conducted to demonstrate that the performances of our proposed algorithms approximate the optimal solutions.

Distributed online scheduling and routing of multicast-oriented tasks for profit-driven cloud computing: It is known that to support a few common applications well, e.g., datacenter (DC) backup, multicast-oriented tasks need to be handled in inter-DC networks. In this letter, we propose an approach to schedule and route multicast-oriented tasks in inter-DC networks with arbitrary topologies. Specifically, we leverage Lyapunov optimization to develop a distributed online approach that can maximize the time-average profit with only local information. Besides, we also design a destination grouping scheme to address the scalability issue of our proposed approach and demonstrate that the number of queues in the system can be reduced significantly. Extensive simulations verify the performance of the proposed approaches.

On fast and coordinated data backup in geo-distributed optical inter-datacenternetworks: In an optical inter-datacenter (inter-DC) network, for preventing data loss, a cloud system usually leverages multiple DCs for obtaining sufficient data redundancy. In order to improve the data-transfer efficiency of the regular DC backup, this paper investigates fast and coordinated data backup in geographically distributed (geo-distributed) optical inter-DC networks. By considering a mutual backup model, in which DCs can serve as the backup sites of each other, we study how to finish the regular DC backup within the shortest time duration (i.e., DC backup window (DCB-Wnd)). Specifically, we try to minimize DC-B-Wnd with joint optimization of the backup site selection and the data-transfer paths. An integer linear programming (ILP) model is first formulated, and then we propose several heuristics to reduce the time complexity. Moreover, in order to explore the tradeoff between DCB-Wnd and operational complexity, we propose heuristics based on adaptive reconfiguration (AR). Extensive simulations indicate that among all the proposed heuristics, AR-TwoStep-ILP achieves the best tradeoff between DC-B-Wnd and operational complexity and it is also the most time-efficient one.

3.Methodology

The fundamental issue of fog computing in IoT is resource provisioning, which addresses how to allocate computing resources and how to process service requests over a set of computing resources. These computing resources usually include virtual machines (VMs), which are scheduled to process different tasks. Fog computing adopts the virtualization and cloud technologies, and hence can lease and release computing resources in an on-demand utility-like fashion. As renting VMs incurs rentals (i.e., system cost), the service provider should determine how many VMs to rent to minimize its system cost (i.e., fog resource provisioning problem), and at the same time ensure that the service completion time does not surpass tasks' expected deadlines.

Fig.2: System architecture

4.Implementation

Now-a-days millions of mobile devices such as sensors, healthcare devices and smart phones are connected to internet with the help of IoT, using IoT they can exchange data between each other, all IoT mobile devices operates on limited battery power and cannot perform heavy task

execution, to run heavy task all IoT devices were using cloud services but due to mobile mobility (changing location) huge latency will occur in cloud response time.Above technique of choosing close FOG terminal not concentrating on needed Resource Provisioning (which means to faster mobile request how many VM's need to assign to complete request processing in order to reduce response time) and Mobile Power Control (need to control mobile transfer rate so mobile power consumption will be drop.

In this project as input we are uploading images to fog terminals to recognize faces from images. This application will choose less cost and high power VM.I design two application two implement above concept. 1.Fog Gateway: This is a fog terminal with threads and the task of this gateway to accept image and then recognize face from images and send back to mobile.2.Simulation: This is mobile simulator which will choose optimize FOG terminal and send uploaded image to that terminal which will detect faces from image and send result back to simulator.

EXTENSION:

In this project introduced resource provisioning concept by offloading task to nearest fog but not provided any technique to secure data which is offloading to fog so we are employing CHACHA algorithm to encrypt all data offload to fog and then fog will process data and send result back to mobile user. While processing fog will not know any data of offloaded task so security will be applied.

5.EXPERMENTAL RESULTS

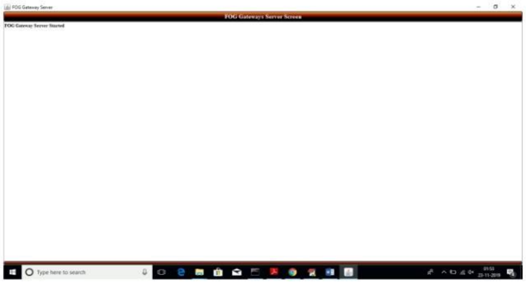

Fig.3: Fog gateway server

Fig.4: Simulation configuration screen

Fig.5: Calculate cost

Fig.6: View simulation

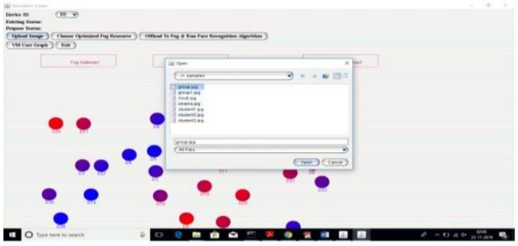

Fig.7: Upload image

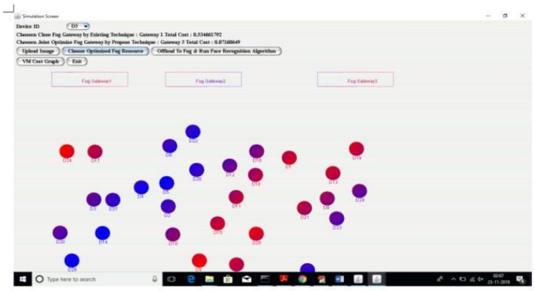

Fig.8: Choose optimized for resource

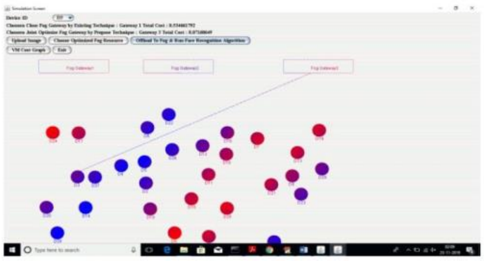

Fig.9: Offload To Fog & Run Face Recognition Algorithm

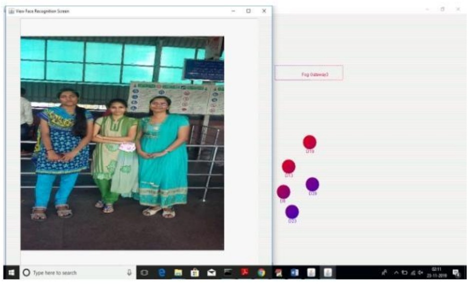

Fig.10: Detected faces

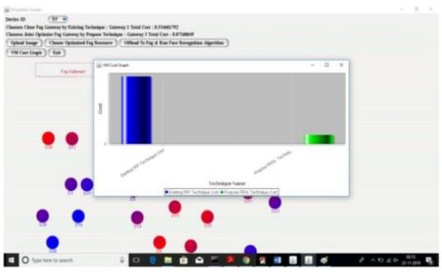

Fig.11: View cost graph

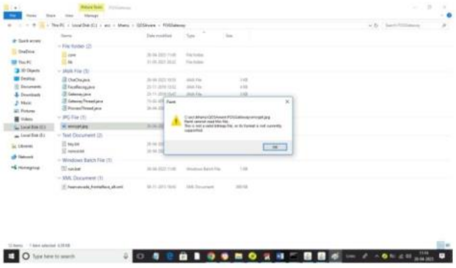

Fig.12: Encrypted image

6.Conclusion

In this paper, we have investigated joint fog provisioning and power control problem to minimize the system cost incurred by renting VMs while satisfying the QoS requirement. We have modeled our QoS requirement as the sum of delays of two tandem queues, including the wireless transmission queue and the fog processing queue.As an extension in this project secure data which is offloading to fog so we are employing CHACHA algorithm to encrypt all data offload to fog.We have further designed the integer recovery algorithm to obtain the feasible solution of the MINLP. Simulation results have demonstrated that our proposed algorithm FRPA performs very close to the lower bound of the relaxed MINLP and much better than the existing work, FPP, which only considers the fog provisioning problem.

7.References

1. J. Santos, T. Wauters, B. Volckaert, and F. D. Turck, “Resource provisioning for IoT application services in smart cities,” in Proc. 13th Int. Conf. Netw. Service Manag. (CNSM), Nov. 2017, pp. 1–9.
2. Y.-C. Hsieh et al., “Managed edge computing on Internet-of-Things devices for smart city applications,” in Proc. NOMS IEEE/IFIP Netw. Oper. Manag. Symp., Apr. 2018, pp. 1–2.
3. Venu, S., Kotti, J., Pankajam, A., Dhabliya, D., Rao, G. N., Bansal, R., . . . Sammy, F. (2022). Secure big data processing in multihoming networks with AI-enabled IoT. Wireless Communications and Mobile Computing, 2022 doi:10.1155/2022/3893875
4. Agrawal, S. A., Umbarkar, A. M., Sherie, N. P., Dharme, A. M., & Dhabliya, D. (2021). Statistical study of mechanical properties for corn fiber with reinforced of polypropylene fiber matrix composite. Materials Today: Proceedings, doi:10.1016/j.matpr.2020.12.1072
5. Anupong, W., Azhagumurugan, R., Sahay, K. B., Dhabliya, D., Kumar, R., & Vijendra Babu, D. (2022). Towards a high precision in AMI-based smart meters and new technologies in the smart grid. Sustainable Computing: Informatics and Systems, 35 doi:10.1016/j.suscom.2022.100690
6. Anupong, W., Yi-Chia, L., Jagdish, M., Kumar, R., Selvam, P. D., Saravanakumar, R., & Dhabliya, D. (2022). Hybrid distributed energy sources providing climate security to the agriculture environment and enhancing the yield. Sustainable Energy Technologies and Assessments, 52 doi:10.1016/j.seta.2022.102142

7. J. Yao and N. Ansari, “Joint content placement and storage allocation in C-RANs for IoT sensing service,” IEEE Internet Things J., to be published, doi: 10.1109/JIOT.2018.2866947.
8. J. Camhi, Former Cisco CEO John Chambers Predicts 500 Billion Connected Devices by 2025, Business Insider, New York, NY, USA, 2015.
9. K. Wu, P. Lu, and Z. Zhu, “Distributed online scheduling and routing of multicast-oriented tasks for profit-driven cloud computing,” IEEE Commun. Lett., vol. 20, no. 4, pp. 684–687, Apr. 2016.
10. J. Yao, P. Lu, L. Gong, and Z. Zhu, “On fast and coordinated data backup in geo-distributed optical inter-datacenter networks,” J. Lightw. Technol., vol. 33, no. 14, pp. 3005–3015, Jul. 15, 2015.
11. Z. Zhu, P. Lu, J. J. P. C. Rodrigues, and Y. Wen, “Energy-efficient wideband cable access networks in future smart cities,” IEEE Commun. Mag., vol. 51, no. 6, pp. 94–100, Jun. 2013.
12. F. Bonomi, R. Milito, P. Natarajan, and J. Zhu, “Fog computing: A platform for Internet of Things and analytics,” in Big Data and Internet of Things: A Roadmap for Smart Environments, N. Bessis and C. Dobre, Eds. Cham, Switzerland: Springer Int., 2014, pp. 169–186.
13. X. Sun and N. Ansari, “EdgeIoT: Mobile edge computing for the Internet of Things,” IEEE Commun. Mag., vol. 54, no. 12, pp. 22–29, Dec. 2016.
14. K. Han et al., “Application-driven end-to-end slicing: When wireless network virtualization orchestrates with NFV-based mobile edge computing,” IEEE Access, vol. 6, pp. 26567–26577, 2018.
15. J. Yao and N. Ansari, “QoS-aware joint BBU-RRH mapping and user association in cloud-RANs,” IEEE Trans. Green Commun. Netw., vol. 2, no. 4, pp. 881–889, Dec. 2018.
16. M. Armbrust et al., “A view of cloud computing,” Commun. ACM, vol. 53, no. 4, pp. 50–58, Apr. 2010.
17. P. Lu, Q. Sun, K. Wu, and Z. Zhu, “Distributed online hybrid cloud management for profit-driven multimedia cloud computing,” IEEE Trans. Multimedia, vol. 17, no. 8, pp. 1297–1308, Aug. 2015.
18. L. Chen, J. Hoey, C. D. Nugent, D. J. Cook, and Z. Yu, “Sensor-based activity recognition,” IEEE Trans. Syst., Man, Cybern. C, Appl. Rev., vol. 42, no. 6, pp. 790–808, Nov. 2012.
19. K. Ha et al., “Towards wearable cognitive assistance,” in Proc. 12th Annu. Int. Conf. Mobile Syst. Appl. Services, 2014, pp. 68–81.
20. Mr. Pathan Ahmed Khan, Dr. M.A Bari,:Impact Of Emergence With Robotics At Educational Institution And Emerging Challenges”, International Journal of Multidisciplinary Engineering in Current Research(IJMEC), ISSN: 2456-4265, Volume 6, Issue 12, December 2021,Page 43-46.
21. Mohammed Abdul Bari, Shahanawaj Ahamad, Mohammed Rahmat Ali,” Smartphone Security and Protection Practices”, International Journal of Engineering and Applied

Computer Science (IJEACS) ; ISBN: 9798799755577 Volume: 03, Issue: 01, December 2021.

22. Shahanawaj Ahamad, Mohammed Abdul Bari, Big Data Processing Model for Smart City Design: A Systematic Review ", VOL 2021: ISSUE 08 IS SN : 0011-9342 ;Design Engineering (Toronto) Elsevier SCI Oct.
23. Mohammed Abdul Bari, Shahanawaj Ahamad, Mohammed Rahmat Ali," Smartphone Security and Protection Practices", International Journal of Engineering and Applied Computer Science (IJEACS) ; ISBN: 9798799755577 Volume: 03, Issue: 01, December 2021(International Journal,U K) Pages 1-6.
24. Dr.M.A.Bari, "EffectiveIDS To Mitigate The Packet Dropping Nodes From Manet ", JACE, Vol-6,Issue -6,June 2019.
25. M.A.Bari&Shahanawaj Ahamad," Process of Reverse Engineering of Enterprise InformationSystem Architecture" in International Journal of Computer Science Issues (IJCSI), Vol 8, Issue 5, ISSN: 1694-0814, pp:359-365,Mahebourg ,Republic of Mauritius ,September 2011.
26. M.A.Bari&Shahanawaj Ahamad, "Code Cloning: The Analysis, Detection and Removal", in International Journal of Computer Applications(IJCA),ISSN:0975-887, ISBN:978-93-80749-18-3,Vol:20,No:7,pp:34-38,NewYork,U.S.A.,April 2011.