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Yunhao Liu, ACM Fellow and IEEE Fellow, Editor in Chief of ACM Transactions on Sensor Networks, Chang Jiang Professor and Dean of GIX at Tsinghua University.

Yunhao Liu

《AIOT: Artificial Intelligence in the Edge》
Dr. Jun Xu, Deputy Chief Designer, CASIC

Dr Xu received his PhD from University of Waterloo. His expertise covers satellite and wireless communication protocols and standardization with focus on DVB S2/S2X, 3GPP, IETF, etc. As a designer of several world most popular GEO and LEO satellite systems, he was an inventor of 25 US patents as well as many international patents. He is vice Chief Designer of CASIC and Chair of Satellite Networking Technical Committee of CCSA.

《Wideband Mobile Satellite Communication Protocols and Networking》

We proposed a novel wideband mobile satellite communication system, including physical and upper layer protocols for space-ground integrated wireless transmission. With advancing DVB S2/S2X to support mobility, we developed a complete solution for hybrid GEO/LEO networks. The system supports both bent-pipe and regenerative satellites.
With the fast deployment and wide coverage of networks, software systems play the increasingly important role to interconnect the information space, physical space, and human society. The advanced machine learning techniques have been increasingly important core components in modern software systems and them more adaptive and intelligent. It leaves huge space for system researchers and practitioners to invent new architectures, abstractions, and technologies. Currently, such systems are typically “centralized”, i.e., collecting a large volume of data from millions or billions of client devices onto the cloud and performing the analytics. However, we argue that the centralized fashion may not be always adequate for all application scenarios, given the increasing capability of mobile/IoT devices, wide deployment of edge appliances, and especially concerns of data privacy. In this talk, we envision some recent trends of making intelligence more “ubiquitous” out of only the cloud. We will talk about the key technologies that can drive the trend, including the programming model, containers, collaborative learning, and so on.
To facilitate monitoring and management, modern Implantable Medical Devices (IMDs) are often equipped with wireless capabilities, which raise the risk of malicious access to IMDs. Although schemes are proposed to secure the IMD access, some issues are still open. First, pre-sharing a long-term key between a patient’s IMD and a doctor’s programmer is vulnerable since once the doctor’s programmer is compromised, all of her patients suffer; establishing a temporary key by leveraging proximity gets rid of pre-shared keys, but as the approach lacks real authentication, it can be exploited by nearby adversaries or through man-in-the-middle attacks. Second, while prolonging the lifetime of IMDs is one of the most important design goals, few schemes explore to lower the communication and computation overhead all at once. Finally, how to safely record the commands issued by doctors for the purpose of forensics, which can be the last measure to protect the patients’ rights, is commonly omitted in the existing literature. Motivated by these important yet open problems, we propose an innovative scheme e-SAFE, which significantly improves security and safety, reduces the communication overhead and enables IMD-access forensics. We present a novel lightweight compressive sensing based encryption algorithm to encrypt and compress the IMD data simultaneously, reducing the data transmission overhead by over 50% while ensuring high data confidentiality and usability. Furthermore, we provide a suite of protocols regarding device pairing, dual-factor authentication, and accountability-enabled access. The security analysis and performance evaluation show the validity and efficiency of the proposed scheme.
Aerial Access Networks for 6G: From UAV, HAP, to Satellite Communication Networks

Prof. Zhu Han, IEEE Fellow, University of Houston, USA

5-Dec. 9:10-9:50

Zhu Han received the B.S. degree in electronic engineering from Tsinghua University, in 1997, and the M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park, in 1999 and 2003, respectively. From 2000 to 2002, he was an R&D Engineer of JDSU, Germantown, Maryland. From 2003 to 2006, he was a Research Associate at the University of Maryland. From 2006 to 2008, he was an assistant professor in Boise State University, Idaho. Currently, he is a John and Rebecca Moores Professor in Electrical and Computer Engineering Department as well as Computer Science Department at University of Houston, Texas. His research interests include security, wireless resource allocation and management, wireless communication and networking, game theory, and wireless multimedia. Dr. Han is an NSF CAREER award recipient 2010. Dr. Han has several IEEE conference best paper awards, and winner of 2011 IEEE Fred W. Ellersick Prize, 2015 EURASIP Best Paper Award for the Journal on Advances in Signal Processing and 2016 IEEE Leonard G. Abraham Prize in the field of Communication Systems (Best Paper Award for IEEE Journal on Selected Areas on Communications). Dr. Han is the winner 2021 IEEE Kiyo Tomiyasu Award. He has been IEEE fellow since 2014, AAAS fellow since 2020 and IEEE Distinguished Lecturer from 2015 to 2018. Dr. Han is 1% highly cited researcher according to Web of Science since 2017.

Providing “connectivity from the sky” is one new innovative trend in wireless communications for beyond 5G or coming 6G communication systems. Satellites, high and low altitude platforms, drones, aircrafts, and airships are being considered as candidates for deploying wireless communications complementing the terrestrial communication infrastructure. Utilizing modern information network technologies and interconnecting space, air, and ground network segments, the aerial access network (AAN) has attracted many attentions from both academia and industry, which has been recognized as a potential solution for the 6G systems. AANs are subject to heterogeneous networks that are engineered to utilize satellites, high-altitude platforms (HAPs), and low-altitude platforms (LAPs) to build network access platforms. Compared to terrestrial wireless networks, AANs are characterized by frequently changed network topologies and more vulnerable communication connections. Furthermore, AANs have the demand for the seamless integration of heterogeneous networks such that the network quality-of-service (QoS) can be improved. Thus, designing mechanisms and protocols for AANs poses many challenges. To solve these challenges, extensive research has been conducted. Notice that AANs are not intended to replace the above existing technologies, but instead to work with them in a complementary and integrated fashion. However, design, analysis, and optimization of AANs require multidisciplinary knowledge, namely, knowledge of wireless communications and networking, signal processing, artificial intelligence (e.g., for learning), decision theory, optimization, and economic theory. Therefore, this talk first provides a general introduction to AANs integrated networks based on physical, MAC, and networking layer requirements, followed by some state-of-the-art of AANs along with possible applications.
High-reliability and low-latency LEO satellite backbone with directed percolation routing

Prof. Lin Cai, IEEE Fellow, University of Victoria, Canada

6-Dec. 8:30-9:10

Lin Cai received her M.A.Sc. and PhD degrees (awarded Outstanding Achievement in Graduate Studies) in electrical and computer engineering from the University of Waterloo, Waterloo, Canada, in 2002 and 2005, respectively. Since 2005, she has been with the Department of Electrical & Computer Engineering at the University of Victoria, and she is currently a Professor. She is an NSERC E.W.R. Steacie Memorial Fellow and an IEEE Fellow. In 2020, she was elected as a Member of the Royal Society of Canada’s College of New Scholars, Artists and Scientists. Her research interests span several areas in communications and networking, with a focus on network protocol and architecture design supporting emerging multimedia traffic and Internet of Things.

She was a recipient of the NSERC Discovery Accelerator Supplement (DAS) Grants in 2010 and 2015, respectively, and the Best Paper Awards of IEEE ICC 2008 and IEEE WCNC 2011. She has founded and chaired IEEE Victoria Section Vehicular Technology and Communications Joint Societies Chapter. She has been elected to serve the IEEE Vehicular Technology Society Board of Governors, 2019-2021. She has served as an area editor for IEEE Transactions on Vehicular Technology, a member of the Steering Committee of the IEEE Transactions on Big Data (TBD) and IEEE Transactions on Cloud Computing (TCC), an Associate Editor of the IEEE Internet of Things Journal, IEEE Transactions on Wireless Communications, IEEE Transactions on Vehicular Technology, IEEE Transactions on Communications, EURASIP Journal on Wireless Communications and Networking, International Journal of Sensor Networks, and Journal of Communications and Networks (JCN), and as the Distinguished Lecturer of the IEEE VTS Society. She has served as a TPC co-chair for IEEE VTC2020-Fall, and a TPC symposium co-chair for IEEE Globecom’10 and Globecom’13. She is a registered professional engineer in British Columbia, Canada.

With tens of thousands Low Earth Orbit (LEO) satellites covering Earth, LEO satellite networks can provide coverage and services that are otherwise not possible using terrestrial communication systems. The regular and dense LEO satellite constellation also provides new opportunities and challenges for network architecture and protocol design. In this talk, we introduce a new routing strategy named Directed Percolation Routing (DPR), aiming to provide Ultra-Reliable and Low-Latency Communication (URLLC) services over long distances. Given the long propagation delay and uncertainty of LEO communication links, using DPR, each satellite routes a packet over several Inter-Satellite-Links (ISLs) towards the destination, without relying on link-layer retransmissions. Considering the link redundancy overhead and delay/reliability tradeoff, DPR can control the size of percolation. Using the Starlink constellation as an example, we demonstrate that with DPR, the inter-continent propagation delay can be reduced by about 4 to 21 ms, while the reliability can be several orders higher than single-path optimal routing.
Stephen S. Yau is Professor of Computer Science and Engineering at Arizona State University (ASU), Tempe, Arizona, USA. He served as the chair of the Department of Computer Science and Engineering, and later as the director of Information Assurance Center at ASU. Previously, he was on the faculties of Northwestern University, Evanston, Illinois, and University of Florida, Gainesville.

Dr. Yau served as the president of the IEEE Computer Society and the editor-in-chief of IEEE COMPUTER magazine. He organized many major conferences. He served as the chair of the Organizing Committee of the 1989 World Computer Congress sponsored by the International Federation for Information Processing, and the general chair of the 2018 IEEE World Congress on Services. His current research includes services computing, cybersecurity, software engineering, distributed computing systems, IoT, and blockchain. He has received many awards and recognitions, including the Tsutomu Kanai Award and Richard E. Merwin Award of the IEEE Computer Society, and the Outstanding Contributions Award of the Chinese Computer Federation. He is a Fellow of the IEEE and the American Association for the Advancement of Science. He received the Ph.D. degree from the University of Illinois, Urbana, in electrical engineering.

There are many major challenges to achieving effective space-air-ground computing (SAGC). Due to the extensive, large-scale and complicated SGAC requirements and operations, the developments of an SABC services project usually involves many teams with specific expertise and different resources. These teams are often operating in a distributed environment, even if they are in the same organization. The success of such development heavily relies on the trusted coordination of all these teams during the entire development cycle. In this address, how to achieve trusted coordination among all the teams for developing a large-scale and complicated SAGC project, including the use of blockchain technology, will be discussed.
"How to face the threat of natural disasters" is always an important research topic. Currently, the mainstream research of disaster management is how to accurately and promptly forecast and notify such as earthquake early warning, but since complete disaster prevention is impossible, we still have to focus on the rapid response after disasters. In addition, to gain insight into the real-time situation of the affected area, we need the two-way communication between affected area and outside world. However, once the network infrastructure suffers from disasters, connections can be interrupted and support cannot reach affected area. Moreover, it is difficult to reconstruct the communication line from scratch. In order to achieve a set of post-disaster two-way communication solutions not relying on traditional network infrastructure, we design a next generation disaster response platform. There are mainly three problems to solve in this platform. First, the connections among users near to each other. Second, the connections between users and access points (APs). Third, the connections between APs and access network to outside world. To figure out first problem, we are going to make use of Device-to-Device (D2D) emergency communication in gathering users within the range of 100+m. Then for the second one, we take advantage of the high mobility of UAVs in fast building the emergency network with the range of 1000+m. For the third one, to realize the connection to outside world, we apply lower power wide area network (LPWAN) to expand the range to 10000+m.
A graph is one of the most common data models, which is widely used in databases (e.g., road traffic networks, social networks). However, in the real world, the structure of data is not static, but usually changes according to some specific factors (e.g., time). Therefore, the time-dependent graph was developed. Due to the different time model, time-dependent graphs can be divided into two categories: discrete time-dependent graphs (e.g., subway networks, railroad networks) and continuous time-dependent graphs (e.g., road networks). In this report, we will first introduce the background and characteristics of the time-dependent graphs and their impact on shortest path queries due to their practical applications. Secondly, we describe in detail the two types of time-dependent models, as well as the existing works on them. Finally, we introduce a more general model that can universally solve shortest path queries on time-dependent graphs.
Smart Internet of Things (IoT) includes numerous sensing nodes, sink nodes and heterogeneous devices. For the large scale networks, the conventional self-organization strategies are difficult to adapt the dynamic networking. Genetic algorithms are prone to falling into premature convergence owing to the lack of global search ability caused by the loss of population diversity during evolution. This talk combines the population state with the evolutionary process and proposes an Adaptive Robustness Evolution Algorithm (AREA) with self-competition for scale-free IoT topologies. In AREA, the crossover and mutation operations are dynamically adjusted according to population diversity to ensure global search ability. Moreover, a self-competitive mechanism is used to ensure convergence. Finally, the future trends for smart IoT will be discussed.
AI is becoming pervasive and ubiquitous, existing in every corner of our computing world. Traditional AI tasks, especially those driven by deep learning algorithm, are deployed in a cloud-centric fashion, which comes with the cost of user privacy and unstable network delay. Can we push the AI workloads into the network edge, with as little help from cloud as possible? In this talk, I will present our efforts towards this direction. We’ve built systems & software to address the performance and privacy issues of AI applications on various edge devices (smartphone, wearables, and cameras). Those systems combine the domain-specific knowledge of different workloads and platforms with the recent advances from AI community, thus provide significant benefits compared to prior work.

Mengwei Xu is now an assistant professor, doctoral advisor in Beijing University of Posts and Telecommunications (BUPT). He hold both doctoral and bachelor degrees from Peking University. He was also a visiting scholar in Purdue University and Microsoft Research Asia. Dr. Xu has published 10+ papers on top venues including MobiCom/MobiSys/UbiComp/IEEE TMC, and served as TPC member or reviewer at ICDCS/UbiComp/ICWS/IEEE TMC. His research mainly centers around mobile and edge computing.
Nowadays, billions of resource-constrained IoT devices have been deployed into our lives. IoT has been applied to many industries around the world, including precision agriculture, healthcare, energy, transportation, building management etc. While IoT brings us a lot of conveniences, a number of serious concerns about dangers in the growth of IoT, especially in the areas of security and privacy. Public-key cryptography (PKC), especially Elliptic Curve Cryptography (ECC), is one of the major tools to defend data security and privacy. However, the IoT devices are usually resource-constrained and it's difficult to implement the complicated public-key cryptography on IoT devices. Massive efforts are required to carefully reduce the code size and offer memory-efficient implementation of ECC while maintaining high efficiency. In this presentation, I will present several memory-efficient techniques for Montgomery Curve on resource-constrained IoT devices.
Recently, Low Power Wide Area Networks (LPWANs) have shown its promising in connecting millions of devices in the age of Internet of Things, attracting much interest in both academia and industry. LPWANs act as an important communication technique for connecting IoT devices by providing long-distance and low-power communication under a low SNR. In this talk, I will introduce the background, current status of LPWANs as well as the opportunities for Internet of Things. Meanwhile, I will also discuss the challenges of LPWANs towards the vision of ubiquitously connecting devices in Internet of Things, and our approaches to address those challenges.
The main international standardization groups and specifications regarding the integration of satellite and 5G system is introduced. Then the progress of standardization of mainly 3GPP and ITU are elaborated. The work progress of SA group and RAN group of 3GPP including requirement, architecture and management are introduced respectively. Finally, the future directions of standardization in satellite and 5G integration are summarized.
Edge computing technologies are sparking innovation of satellite network. In the traditional satellite network, the massive data are delivered to ground data center for processing, causing the overload of satellite network and the long response time of users. In recent years, edge computing has been envisaged as a promising solution to these challenges. In satellite edge computing, satellites are equipped with sufficient computing resources and the intelligent control system to process the data collected from satellite payloads or ground IoT devices, and the processing result will be directly sent to the user by the satellite. Based on the support of satellite network technology, cross-satellite parallel and distributed computing can also be realized in smart satellite cluster, providing faster and better services for users. In this speech, we first introduce the motivation and challenges of satellite edge computing. Then, we focus on and analyze the key issues of satellite edge computing about space-based real-time services: computing architecture design, resource characterization, resource allocation, resource management and scheduling, computation offloading, and service migration. This paper provides potential solutions and new ideas for the future research in this field.
As a new type of network architecture, the Satellite-terrestrial Network integrates ground and satellite networks, which covers natural spaces such as space, aviation, land, and ocean, and ensures the information needs of various user activities such as space-based, land-based and sea-based. It provides a ubiquitous and reliable network, but also faces some new challenges, especially when it meets the growing demand of users for quality of service. With the rapid development of computation-intensive and latency-sensitive applications such as speech recognition, face recognition, intelligent transportation and 3D games, the Satellite-terrestrial Network is required to provide users with various computing services. In this case, people can offload part of or all computing tasks of the user terminal to the data center through computing offloading, and utilize the computing resources of the data center to complete these tasks. However, the data center is usually built in a ground area far away from the user terminal, which results in high transmission cost and service delay, and may not meet different requirements of various users for quality of service in the network. To process these computation-intensive and latency-sensitive tasks effectively and meet the requirements of users, mobile edge computing (MEC) has emerged as a new computing model. MEC refers to sinking some resources in the cloud center to the edge of the network, so that data can be processed at the edge of the network. We introduce the idea of MEC in the mobile network into the Satellite-terrestrial Network. The core idea is to extend the cloud computing platform to network edge or user terminal, providing users with multiple levels and heterogeneous computing resources, and enabling users to obtain computing services from anywhere in the world. And the network can improve user service experience and reduce redundant network traffic. As one of the key technologies of MEC, computation offloading refers to the technology that device terminals hand over part or all computing tasks to the cloud computing environment for processing. How to efficiently offload tasks and allocate resources reasonably is a hot issue in this field. Therefore, this talk first introduces the basic theory of MEC and computation offloading. Then, the architecture of MEC enabled the Satellite-terrestrial Network is proposed, and key technology is summarized and analyzed.
# PAPER SESSION

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| ID:6  | Distributed Task Offloading and Resource Allocation in Vehicular Edge Computing | Shichao Li, Hongbin Chen, Siyu Lin, Ning Zhang |
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<td>LDPC Code based Pseudonym Scheme for Vehicular Networks</td>
<td>Jin Zhou, Changsong Zheng, Yuedi Li, Hua Xu, Zhiguang Qin, Dajiang Chen</td>
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<td>20</td>
<td>A Lightweight and Efficient Key Generation Scheme for D2D Communication (Short Paper)</td>
<td>Rongchun Wu, Chunwei Lou, Hao Wang, Yuedi Li, Hua Xu</td>
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<td>29</td>
<td>Multi-Authority Attribute Based Encryption With Policy-hidden and Accountability (Short Paper)</td>
<td>Wei Zhang, ZhiShuo Zhang, Yi Wu</td>
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