Editorial: Fourth Quarter 2019 IEEE COMMUNICATIONS SURVEYS AND TUTORIALS

I WELCOME you to the fourth issue of the IEEE COMMUNICATIONS SURVEYS AND TUTORIALS in 2019. This issue includes 25 papers covering different aspects of communication networks. In particular, these articles survey and tutor various issues in "Wireless and Cellular Communications," "5G Communications," "Vehicular and Sensor Communications," "IoT and M2M," "Internet Technologies," and "Network Security." A brief account for each of these papers is given below.

I. WIRELESS AND CELLULAR COMMUNICATIONS

Low latency applications such as massive sending, holographic teleportation, and autonomous vehicles have gained much attention as the futuristic applications. To investigate the performance of the above mentioned low-latency applications, the existing physical layer channel models are not sufficient. They do not consider the quality-of-service (QoS) related metrics to investigate the QoS-aware applications. For this purpose, effective capacity (EC), which is a link-layer channel model, has been proposed to investigate the performance of the futuristic low-latency applications. EC is considered as the dual concept of effective bandwidth, which is used to find the maximum arrival/source rate for a given service rate while satisfying a certain delay constraint. In this context, the paper titled "Effective Capacity in Wireless Networks: A Comprehensive Survey" by Muhammad Amjad, Leila Musavian, and Mubashir Husain Rehmani provides a detailed survey on state-of-the-art work on the topic of EC framework. This work presents five different case studies, various applications, and fading models that encompass the concept of the EC. The achievable EC of various wireless networks such as cognitive radio networks, cellular networks, full-duplex communications, and cooperative networks is also surveyed with its higher level insights and future research direction.

To effectively provide ultra-reliable low latency communications and pervasive connectivity for Internet of Things devices, next-generation wireless networks can leverage intelligent, data-driven functions enabled by the integration of machine learning notions across the wireless core and edge infrastructure. In particular, in wireless networks, machine learning has two key functions: 1) Intelligent and predictive data analytics, the ability of the wireless network to intelligently process large volumes of data, gathered from its devices, to analyze and predict the context of the wireless users and the wireless network's environmental states thus enabling data-driven network-wide operational decisions, and 2) intelligent/self-organizing network control and optimization, the ability of the wireless network to dynamically learn the wireless environment and intelligently control the wireless network and optimize its resources according to information smartly learned about the wireless environment and users' states. In this context, the paper titled "Artificial Neural Networks-Based Machine Learning for Wireless Networks: A Tutorial" by Mingzhe Chen, Ursula Challita, Walid Saad, Changchuan Yin, and Merouane Debbah presents a comprehensive overview on how artificial neural networks (ANNs)-based machine learning algorithms can be employed for solving various wireless networking problems. For this purpose, a detailed overview of a number of key types of ANNs that include recurrent, spiking, and deep neural networks, that are pertinent to wireless networking applications, is presented. Furthermore, this tutorial provides an in-depth overview on the variety of wireless communication problems that can be addressed using ANNs, ranging from unmanned aerial vehicle based communication to wireless virtual reality and edge computing and caching. In a nutshell, this tutorial sheds light on the development of ANN-based machine learning techniques tailored to the needs of future wireless networks.

In recent years, machine learning has become a hot topic in various areas, which facilitates the development of recommendation systems, speech and image recognition, unmanned autonomous vehicles and so on. With machine learning, things, such as computers, robots or cars, are endowed with intelligence of different levels. Although machine learning is reshaping our daily lives, its application in mobile wireless networks is still an open problem. Specifically, current mobile operators mainly use machine learning for promoting business sales via analyzing customer profiles. However, if machine learning is directly applied to network configuration and optimization, mobile wireless networks will be capable of self-evolving and self-tuning, making it possible for more efficient provisioning of high quality of service and quality of experience. In this context, the paper titled "Application of Machine Learning in Wireless Networks: Key Techniques and Open Issues" by Yaohua Sun, Mugen Peng, Yangcheng Zhou, Yuzhe Huang, and Shuwen Mao presents a survey that comprehensively

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summarizes advances in machine learning driven resource management, networking, mobility management, and localization. Particularly, considerations when applying machine learning, advantages over traditional approaches, motivations to adopt machine learning and open issues are elaborated, which would be very useful for readers interested in working in related fields.

Massive multiple-input multiple-output (MIMO) is a scale up version of the conventional small scale MIMO systems which has been deployed since the third generations (3G) wireless communication system. Detection is at the very heart of any modern receiver. Although the maximum likelihood (ML) attains the optimal performance, it is prohibited in realization due to a high computational complexity. Alternative linear and nonlinear detectors have been proposed to obtain a satisfactory balance between the performance and the complexity. In this context, the paper titled "Massive MIMO Detection Techniques: A Survey" by Mahmoud A. Albreem, Markku Juntti, and Shahriar Shahabuddin presents a survey, where the paper overviews the detection techniques and classifies the researchers' efforts. First, the paper starts by providing an overview of the definition of massive MIMO, why it is needed, and challenges. Then, the paper presents the linear and nonlinear massive MIMO detection such as detectors based on the approximate matrix inversion, local search, belief propagation and box detection. Furthermore, the paper presents the machine learning and sparsity based algorithms in the context of massive MIMO detectors. Finally, the impact of channel estimation and precoding on massive MIMO detection techniques has been discussed. The survey concludes with a comparative discussion that highlights the key challenges and potential future directions.

Modern networks such as Internet of Things (IoT), Unmanned Aerial Vehicle (UAV), 5G, and cognitive radio have become more decentralized, autonomous, and ad-hoc in nature. In such networks, the network entities such as IoT devices, mobile users, and UAVs need to make local and autonomous decisions, e.g., spectrum access, data rate selection, transmit power control, and base station association, to achieve desirable goals. Under the dynamics, uncertainty, and unpredictability of the network environments, learning algorithms such as reinforcement learning and deep reinforcement learning have been recently used that enable the network entities to make their optimal decisions. In this context, the paper titled "Applications of Deep Reinforcement Learning in Communications and Networking: A Survey" by Nguyen Cong Luong, Dinh Thai Hoang, Shimin Gong, Dusit Niyato, Ping Wang, Ying-Chang Liang, and Dong In Kim provides a comprehensive survey on applications of the deep reinforcement learning for emerging issues, e.g., dynamic network access and network security, in the modern networks. The paper also provides a tutorial of deep reinforcement learning and advanced deep reinforcement learning models. The paper concludes with a discussion that highlights key challenges, open issues, and future directions of applications of deep reinforcement learning in the modern networks.

Multiplexing schemes incorporating time, polarization, and wavelength have been used to satisfy the increasing need for higher transmission capacity in wireless and optical communication networks. However, it might not be possible to meet the continuously growing global capacity demand for a bandwidth-hungry world in the near future. One potential solution to efficiently cope with the upcoming "capacity crunch" is spatial mode multiplexing, where independent data streams can be carried over orthogonal modes. A particular mode of choice for multiplexing is the orbital angular momentum (OAM). In this context, the paper titled "Communicating Using Spatial Mode Multiplexing: Potentials, Challenges and Perspectives," by Abderrahmen Trichili, Ki-Hong Park, Mourad Zghal, Boon S. Ooi, and Mohamed-Slim Alouini reviews the potentials of the use of space as an additional degree of freedom in various communication applications, with particular focus on OAM modes. Then, the paper analyzes the main challenges of OAM multiplexing. The article further identifies a range of open problems and proposes future research directions. Finally, the paper provides a discussion on the practical deployment and cost of multi-OAM communication.

In the past decade, an exponential growth in the usage of wireless resources is been faced, following the popularization of wireless devices such as smartphones, tablets and IoT devices. This phenomenon brought the need to review traditional wireless technologies such as Wi-Fi and cellular networks, and along with that, increased the popularity of alternative wireless technologies among academic and industrial areas. In that sense, Visible Light Communication (VLC) has gathered a lot of attention in the last years, especially due to its advantages when compared to traditional standards, such as usage of an unlicensed spectrum, higher data rates and enhanced security. In this context, the paper titled "Visible Light Communication: Concepts, Applications and Challenges" by Luiz E. M. Matheus, Alex B. Vieira, Luiz F. M. Vieira, Marcos A. M. Vieira, and Omprakash Gnawali presents a comprehensive survey about Visible Light Communication, where the approach taken covers the main aspects of VLC, from Physical and MAC layer characteristics to possible applications and challenges of the area. In addition, the survey offers a comparative analysis of research platforms in literature and concludes with a discussion of future perspective of the technology.

II. 5G Communications

Full dimension (FD) multiple-input multiple-output (MIMO) was introduced in the 3rd Generation Partnership Project (3GPP) Release 13 as a promising technology for the next-generation of wireless communication networks. By utilizing a planar 2D active antenna array (AAA), FD-MIMO not only allows a large number of antennas to be placed within feasible base station (BS) form factors, but also provides the ability of adaptive electronic beamforming in both the elevation and the traditional azimuth dimensions. Several research papers addressing this subject through system-level simulations and measurement campaigns have appeared, with focus on identifying the key areas in the LTE-Advanced standard

that need enhancement to support up to 64 antennas in a 2D array. Most of these works do not provide mathematical models and analysis. In this context, a tutorial paper titled "Elevation Beamforming with Full Dimension MIMO Architectures in 5G Systems: A Tutorial" by Qurrat-Ul-Ain Nadeem, Abla Kammoun, and Slim Alouini is distinguished in being the preliminary one on FD-MIMO technology and in its objective of equipping the readers with the necessary information on the underlying array structures, the TXRU virtualization models and the 3D channel modeling approaches to allow them to analyze the performance of FD-MIMO systems. In an attempt to bridge the gap between industry and theory, this tutorial introduces the relevant array and transceiver architecture designs and two different 3D channel modeling approaches that enable elevation beamforming. The spatial correlation functions (SCF)s are characterized based on both approaches and the antenna element approach is shown to be more practical. All these aspects are put together to provide a mathematical framework for the design of elevation beamforming schemes in single-cell and multi-cell scenarios.

The vision of Future Internet is strongly related to achieving seamless mobility among multiple heterogeneous networks comprising the 5G and beyond ecosystem. This requires the consideration of a Vertical Handover (VHO) management framework that will be based on a unified approach to consider all available connectivity opportunities and to integrate diverse networking technologies, in order to properly address different service requirements. In that respect, Autonomic Network Management (ANM) elements such as context awareness, self-management and cognitive functionalities become highly relevant as they play a critical role in ensuring service continuity and robustness against link and network load dynamics. In this context, the paper titled "Autonomic Handover Management for Heterogeneous Networks in a Future Internet Context: A Survey," by Adamantia Stamou, Nikos Dimitriou, Kimon Kontovasilis and Symeon Papavassiliou, presents a survey that analyzes VHO operations from an ANM standpoint, with a focus on mechanisms involving context-awareness and self-management considering the implications of Future Internet and 5G network heterogeneity. The paper proposes a taxonomy of the autonomic VHO management phases and of the associated architectural components, considering also key autonomic features, towards the overall enhancement of the VHO operations. The paper identifies also robustness criteria that are related to the ability of a system to achieve stable decisions, under conditions of partial and possibly imprecise knowledge. Related state-of-the-art handover management solutions are presented, analyzed and correlated according to the proposed taxonomy and criteria, leading to conclusions that provide useful insights towards future, further enhanced VHO solutions.

Mobile data traffic has grown enormously in past few years due to the evolution of smart devices and different multimedia applications, which according to Cisco, will reach 48.3 Exabytes per month in 2021. This continuous growth in the global mobile data traffic has placed a huge burden on the existing cellular infrastructure and hence 5G cellular networks are being investigated for such huge data traffics. The 5G networks would not only provide better data rate but also overcome the existing limitations of cellular network in terms of spectrum efficiency, capacity, reliability, latency, coverage, and energy efficiency. However, there would be different stakeholders with different objectives involved in the 5G networks and this would make the resource management a challenge in the 5G networks. While considering the low efficiency of traditional solutions to resource management, economic and pricing models have been adopted as tools to obtain these objectives. In this context, the paper titled "Applications of Economic and Pricing Models for Resource Management in 5G Wireless Networks: A Survey" by Nguyen Cong Luong, Ping Wang, Dusit Niyato, Ying-Chang Liang, Fen Hou, and Zhu Han reviews economic and pricing approaches for the solution of resource management challenges in 5G networks. They also discuss the applications of these models for mobile data offloading and wireless caching. The paper concludes with open issues and challenges, and future research directions in the domain.

III. Vehicular and Sensor Communications

Smart control system advances in the recent years have resulted in Unmanned Aerial Vehicles (UAVs) that are agile, efficient, precise and effortless in comparison to the traditional on-site methods. UAVs are widely used for observations and tactical planning in future smart applications including surveillance and remote sensing. In addition, Cyber-physical systems could innovatively combine the computational power and the physical movability of multi-UAV systems so as to constantly have an eye on the desired target. Approaching the highlighted goal requires a well-navigating and controlling mechanism that enables the drones to cooperatively work together towards the determined plan. However, the agility of such systems gives rise to several challenges that should be addressed in order to have an efficient and stable control system. In this context, the paper titled "Design Challenges of Multi-UAV Systems in Cyber-Physical Applications: A Comprehensive Survey, and Future Directions" by Reza Shakeri, Mohammed Ali Al-Garadi, Ahmed Badawy, Amr Mohamed, Tamer Khattab, Abdulla Al-Ali, Khaled A. Harras, and Mohsen Guizani, at the beginning discusses the design challenges of multi-UAV systems in cyber-physical applications and tries to cover the architectural design aspects of such systems. Then it addresses some of the main design challenges in different areas such as target coverage, trajectory planning, video-based analysis, networking and cross-layer design, and more, and highlights novel algorithms followed by comprehensive comparative studies for key techniques in these areas. Finally, it summarizes possible new directions and insights into forming more manageable and simpler to implement designs of these systems for the future.

Unmanned aerial vehicles (UAVs) are unmanned aircraft, which can be operated by radio remote control equipment and self-contained program control devices. It involves sensor technology, communication technology, information processing technology, intelligent control technology, and aerodynamic

propulsion technology. Therefore, UAVs are the product of high technology content in this age of information. As the development technology of UAVs has matured, the manufacturing costs are greatly reduced. Thus, there exist awfully broad applications of UAVs. For instance, communications relay, function extension of base station, forest fire prevention, environmental monitoring, logistics transportation, safety inspection, and agricultural planting. In this context, the paper titled "A Survey of Game Theory in Unmanned Aerial Vehicles Communications" authored by Mbazingwa E. Mkiramweni, Chungang Yang, Jiandong Li, and Wei Zhang presents a survey which overviews the latest research progress of game theory for UAV-aided wireless networks. First, the paper briefly introduces the wireless communications of UAVs, and presents the basic concept and classification of game theory for UAV-aided wireless communications. Then, the paper elaborates on game-theoretic techniques utilized in the UAV-based wireless networks to resolve difficulties. Moreover, the paper provides novel distributed schemes for interference management in large-scale UAV-aided networks. Ultimately, the paper summarizes the demands of the future UAV-aided networks, and looks forwards to the future research directions.

The integration of UAVs into cellular networks is becoming a developing opportunity in academia, industry, and standardization. Optimizing positioning and mobility of UAV-mounted flying relays and base stations are explored as a promising solution to improve the quality of services for the users and to enhance the network performance. The Third Generation Partnership Project has recently concluded a study item to explore the challenges and opportunities for cellular networks to serve the UAVs as a new type of user equipment. However, the practical aspects of cellular UAV communications are not covered completely in the recent activities. In this context, the article titled "Survey on UAV Cellular Communications: Practical Aspects, Standardization Advancements, Regulation, and Security Challenges," by Azade Fotouhi, Haoran Qiang, Ming Ding, Mahbub Hassan, Lorenzo Galati Giordano, Adrian Garcia-Rodriguez, and Jinhong Yuan provides a comprehensive survey by covering a variety of cellular-specific issues such as the relevant 3GPP developments, vendor prototypes of flying BSs, regulations as well as cyber-security and user privacy issues affecting cellular UAVs, and the potential impacts of UAV adoption on the cost and business models of cellular networks. The authors believe that UAV cellular communication is at a very early stage of development and it can be expected to see continued interest and progress in this exciting new direction of cellular networking research in the coming years.

IV. IoT AND M2M

Agricultural lands and the subsurface environment provide various natural resources, such as groundwater, fossil fuels, metal ores, and earth minerals. Internet of Underground Things (IoUT) technology allows the use of these resources efficiently. In different applications, IoUT devices require different communication technologies, networking protocols, and localization methods. Due to the heterogeneous nature of the soil consisting of sand, rock, and watersheds, communication through it is challenging. For example, electromagnetic waves based IoUT devices have low penetration depth in the soil and can only be useful in agricultural applications. Alternatively, the magnetic induction channel is more stable and can be the right solution for underground fossil fuel monitoring. Each of these technologies has its pros and cons with a specific application. In this context, the paper titled "Towards the Internet of Underground Things: A Systematic Survey" by Nasir Saeed, Mohamed-Slim Alouini, and Tareq Y. Al-naffouri presents a survey. The paper overviews various communication technologies, including Electromagnetic waves, acoustic waves, mud-pulse telemetry, magnetic induction, wired, and visible light, for IoUT networks. The paper also elaborates on corresponding networking and localization solutions. Moreover, the survey highlights critical challenges for the IoUT systems.

After the introduction of mechanization, electricity, and digitalization, the transition towards an ICT-backed, interconnected industry is seen as the fourth stage of industrialization. ICTs are expected to play key roles supporting global, economic, social, and environmentally sustainable industrialization, resulting in "Industry 4.0". In its broader meaning, Industry 4.0 can be seen as a governmental explicit commitment to foster and properly develop a set of technologies and cultural and legal framework necessary to harness their full potential. Horizontal, vertical, and end-to-end integration are key concepts, that together lead from a linear value chain to a highly dynamic value network, including production systems, infrastructures, and customers, ideally completing the automation of the whole production process. In this context, the paper titled "A survey on Information and Communication Technologies for Industry 4.0: State-of-the-Art, Taxonomies, Perspectives, and Challenges" by Giuseppe Aceto, Valerio Persico, and Antonio Pescapè focuses on the technological aspects of Industry 4.0 and considers in depth ten distinct ICT enablers including Big Data, Internet of Things, and Cloud Computing, together with the more rarely considered Fog and Mobile Computing, Artificial Intelligence, Human-Computer Interaction, and Robotics, down to the often overlooked, very recent, or taken for granted Open-Source Software, Blockchain, and the Internet. Relevant case studies from the scientific literature are discussed and the main challenges and future directions are drawn. The paper provides references for both experts and laymen about the applications, impact, and extension and of ICTs implied by I4.0.

End to end security has been a necessary tool for the development of e-commerce but turned into an indispensable technology in nowadays Internet communications. Despite protocols, as TLS, and authentication frameworks, as PKI, have been pervasively adopted and combined for this purpose, the development of this technology has not been calm, as many problems regarding protocol design and trust establishment have affected their use. Regarding PKI, the number of Trusted Third Parties and their misuse have triggered the development of side protocols for Certificate Pinning that allow participant entities to improve certificate verification. The deployment of new concepts as Internet of Things and Machine

to Machine requesting new services to be instantiated and securely accessed, sometimes in an ephemeral way, require revising the technology. In this context, the survey "TLS/PKI Challenges and Certificate Pinning Techniques for IoT and M2M Secure Communications," by Daniel Díaz-Sánchez, Andrés Marín-Lopez, Florina Almenarez, Patricia Arias, and R. Simon Sherratt overviews the past problems of TLS and PKI highlighting the key challenges to be faced as the detection of attacks, the robustness of the proposed solutions and how they would affect IoT/M2M ecosystem.

V. Internet Technologies

The ubiquitous sensing, communication and computing encourages the development of the smart world. The smart world will have features controlled significantly by location information often addressed as location-based services (LBS). Device-free passive localization is a significant part of these type of services which aims to localize or track targets without requiring them to carry any devices or to be actively involved with the localization process. Device-free localization schemes fall into a wide range of smart world application scenarios within the smart world ecosystem. A few notable examples are occupancy detection, gesture detection, activity monitoring, pedestrian and vehicle-traffic flow surveillance, security safeguarding, ambient intelligence-based systems, emergency rescue operations, and assistive healthcare system. In this context, the paper titled "Ubiquitous Localization (UbiLoc): A Survey and Taxonomy on Device Free Localization for Smart World" by Rathin Chandra Shit, Suraj Sharma, Deepak Puthal, Philip James, Biswajeet Pradhan, Aad van Moorsel, Albert Y. Zomaya, and Rajiv Ranjan presents a survey and taxonomy. First, the emergence of device-free localization technologies has been reviewed comprehensively. Then, an innovative taxonomy of existing device-free localization systems is presented alongside comparative analysis of the different approaches such as model-based, training based, and scattering are organized. Furthermore, the lessons learned from each approach of device-free localization in terms of accuracy and computational complexity is presented. Finally, the application ranges of device-free approach of localization is discussed, followed by challenges, and innovative future research is drawn and concluded.

Accurate, real-time and reliable localization techniques are of prime importance for the future generation of wireless communication networks. Localization systems enable a user to find its location, and make use of the location for location-based services such as monitoring, tracking, and navigating, etc. GPS and GNSS work well for outdoor environments, but they fail to localize a user in an indoor or harsh environment. Indoor positioning systems have been developed based on various wireless communication technologies operating on different frequencies, all of which are based on a specific ranging technique. Multidimensional scaling is one of the most common network localization techniques which can work for both range-free and range based schemes. In this context, the paper titled "A State-of-the-Art Survey on Multidimensional Scaling Based Localization Techniques" by Nasir Saeed, Haewoon Nam, Tareq Y. Al-Naffouri, and Mohamed-Slim Alouini presents a comprehensive survey with a special focus on MDS technique and different variants of MDS based localization methods. The paper starts with an introduction of the fundamentals of different ranging techniques and covers the literature on different MDS based localization methods used for various wireless networks. In addition, the paper provides technical details of MDS techniques with its usage for localization systems and comparisons of the MDS based localization schemes along with the prospective applications of MDS based localization method.

The performance of the access technologies in wired and wireless networks has been steadily improving over the years, allowing the end users of the Internet to experience a number of new services and opportunities on the Web. However, the evolution at the physical and MAC layers needs to be matched by developments at the transport layer, which needs to evolve to reap the benefits in terms of high throughput, low latency and higher reliability offered by the lower layers. In this context, a paper titled "A Survey on Recent Advances in Transport Layer Protocols" by Michele Polese, Federico Chiariotti, Elia Bonetto, Filippo Rigotto, Andrea Zanella, and Michele Zorzi is a review of the evolutions of the algorithms and protocols designed for the transport layer over the last 15 years. In this survey, the authors highlight three different research directions. First, congestion control algorithms have evolved to address challenging scenarios, and some recent proposals also make use of machine learning techniques. Second, new transport protocols (such as QUIC) have been proposed to completely replace TCP. Finally, some transport protocol evolutions exploit the multipath capabilities of modern devices to improve the end-to-end performance.

Congestion Control (CC) has a significant influence on the performance of TCP connections. Over the last three decades, many researchers have extensively studied and proposed a multitude of enhancements to standard TCP CC. However, this topic still inspires both academic and industrial research communities due to the change in Internet application requirements and the evolution of Internet technologies. Standard TCP CC infers network congestion from packet loss events, this leads to long queuing delays when the bottleneck buffer size is large. Long queuing delays impact on the performance of flows sharing the bottleneck. A promising solution to this problem is to use the delay signal (RTT or one-way delay measurements) to infer congestion earlier and react to congestion before the queuing delay reaches a high value. A number of delay-based CC algorithms have been proposed. In this context, the paper titled "A Survey of Delay-Based and Hybrid TCP Congestion Control Algorithms" by Rasool Al-Saadi, Grenville Armitage, Jason But, and Philip Branch presents a survey. First, the paper provides an overview of TCP CC and congestion feedback signals. Then, the paper presents a novel taxonomy and reviews a range of key CC algorithms that utilise the delay signal to infer the existence of congestion and/or use the measured delay as part of their congestion response behaviour. Finally, the paper discusses the key challenges of using the delay signal and raises questions about the

impact of emerging Active Queue Management on delay-based approaches when they coexist.

VI. Network Security

The cybersecurity ecosystem continuously changes with the growth of cyber threats. Threat actors exploit different tactics, techniques, and procedures against the confidentiality, integrity, and availability of sensitive information. To protect the network perimeters, Intrusion Detection Systems (IDSs) allow taking defensive courses of actions by providing real-time, proactive and operational insights about cyber threat activities. They use different intrusion detection techniques to transform unbounded events into actionable information for counter-measures. These techniques are often limited when processing huge amounts of event streams. Event stream processing (ESP) approaches are potential solutions that leverage multiple event streams to provide a holistic view of network security postures and faster detection. In this context, the paper titled "Intrusion Detection Systems: A Cross-Domain Overview" by Lionel Tidjon, Marc Frappier, and Amel Mammar presents a tutorial and survey. First, the paper describes domains (including their vulnerabilities) on which recent work is based. The paper also surveys standards for vulnerability assessment and attack classification. Next, the paper provides a classification of IDSs, evaluation metrics, and datasets. The paper also presents the technical details of IDS and ESP approaches followed by an evaluation of recent work relying on these approaches. The evaluation covers different axes: domains, architectures, and local communication technologies. Finally, the paper discusses challenges and strategies to improve IDS in terms of accuracy, performance, and robustness.

The recent advances in wireless communication, specifically the emergence of new technologies and technological concepts in the Fifth Generation (5G) of wireless networks have brought new opportunities for new services. However, the technological advances have opened new doors for compromising the offered services through cyber security attacks. The attacks are more devastating due to the integration of communication technologies into our daily lives and critical infrastructures around us. Therefore, it is highly crucial and timely to understand the challenges, fingerprint the specific security weaknesses of existing technologies and new technological concepts that will be integrated into 5G. This article titled "Security for 5G and Beyond: A Survey," by Ijaz Ahmad, Shahriar Shahabbuddin, Tanesh Kumar, Jude Okwuibe, Andrei Gurtov, and Mika Ylianttila surveys the existing research output to look deep into the security challenges in important technologies used in 5G such as massive Multi Input Multi Output (MIMO) systems, Software Defined Networking (SDN), Network Function Virtualization (NFV), and the advances in cloud computing such as Multi-access Edge Computing (MEC) platforms. Then the potential security solutions for those challenges are described. Due to the emergence of new technological concepts such as blockchain, AI-based operations and network automation, the article looks into the security of futuristic network, termed as XG, serving new devices and services ubiquitously and autonomously. Thus, the article provides future research directions in wireless networks beyond 5G to spur research into the future of security of future networks beyond 5G.

With the advent and popularity of digitized healthcare telemetry, the number of networked medical devices has increased exponentially during the last two decades. Medical devices nowadays are compact and competent enough to ease human lives. However, such integration of networking in medical devices has brought serious security and safety issues. The devices are now vulnerable to lethal cyber-attacks and can put human lives in danger. To address such perilous impacts, researchers from around the globe have been striving hard to secure these connected medical devices. In this context, the paper titled "Security Vulnerabilities, Attacks, Countermeasures, and Regulations of Networked Medical Devices – A Review" by Tahreem Yaqoob, Haider Abbas, and Mohammed Atiquzzaman comprehensively studies and analyzes the security vulnerabilities present in medical devices along with the demonstrated cyber-attacks on more than a hundred devices. Furthermore, existing technical countermeasures and medical regulations have also been investigated. Finally, the identification of some open research areas has also been done for the security enhancement of these life-critical devices.

The salient features of cloud computing are being exploited by the attackers to launch the severe Distributed Denial of Service (DDoS) attack. Generally, the DDoS attacks in such an environment have been implemented by flooding a huge volume of malicious traffic to exhaust the victim servers' resources. Due to this huge volume of malicious traffic, the visibility of such attacks is high. Thus, the attackers are getting attracted towards the low-rate DDoS attacks, slowly. Low-rate DDoS attacks are difficult to detect due to their stealthy and low-rate attack traffic. In this context, the paper titled "Defense Mechanisms Against DDoS Attacks in a Cloud Computing Environment: State-of-the-Art and Research Challenges" by Neha Agrawal and Shashikala Tapaswi presents a survey. This paper starts with a discussion of security issues in cloud computing. The paper next discusses how the cloud computing salient features are exploited by the attackers to launch various DDoS attacks. This survey considers the high-rate and all the possible variants of low-rate DDoS attacks in a cloud environment. A new taxonomy of the DDoS attacks and the corresponding defense mechanisms is presented. The comparative analysis of the defense approaches and their behavior in cloud are also provided. Finally, the paper concludes by providing future research problems.

Blockchain is the distributed ledger which allows the transactions to be read, validated, and stored in the form of blocks that are chained together. In this context, the paper titled "A Vademecum on Blockchain Technologies: When, Which and How," by Marianna Belotti, Nikola Božic, Guy Pujolle, and Stefano Secc aims at providing a guideline to determine if it is worth thinking about the application of blockchain to a given application and use-case. If it is worthy, then which type of blockchain could be adopted and then how to implement it, identifying possible platforms among the existing ones. In the article, authors provide the community with

such a vademecum, while giving a general presentation of blockchain that goes beyond its usage in Bitcoin and surveying a selection of the vast literature that emerged in the last few years. Authors draw the key requirements and their evolution while passing from permissionless to permissioned blockchains, presenting the differences between proposed and experimented consensus mechanisms, and describing existing blockchain platforms.

I hope that you enjoy reading this issue and find the articles useful. Last but not the least, I highly encourage you to submit your work which fit within the scope of ComST. For detailed instructions on the preparation and submissions of manuscripts to ComST, please check the URL below: http://dl.comsoc.org/livepubs/surveys/. I will be happy to receive your comment and feedback on our journal.

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