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Editorial: Security and Privacy in Internet of Things

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1 Editorial

In our daily life, we interact with a large number of variety of technological devices for difference purposes, such as accessing documents stored in the cloud, viewing photos and videos, and remotely controlling devices in a smart home. Many of these devices are also Internet-connected, and hence they are also commonly referred to as Internet of Things (IoT).

There is a broad range of use cases for IoT, ranging from the healthcare sector (e.g. remote monitoring and collection of body and health-related information) to a smart city environment (e.g. vehicular ad hoc networks – VANETs, to facilitate safety-related, traffic management or infotainment services) to a more adversarial environment (e.g. battlefields)

There are, however, a number of challenges to be addressed in any IoT deployment, and two of these key challenges are security and privacy, particularly as the data from IoT devices are being sent and shared via some remote cloud services. The critical nature of some of these IoT applications (medical, battlefield, etc.) also call for development of tailored approaches.

Therefore, in this Special Issue, novel security and privacy approaches are presented in the six accepted articles.

The first article entitled 'Crowdsourcing analysis in 5G IoT: Cybersecurity Threats and Mitigation' by Ana Nieto, Antonio Acien and Gerardo Fernandez, studies security threats in IoT ecosystem, and seeks to mitigate such risks leveraging 5G technology [3]. In particular, the authors demonstrate how crowdsourcing techniques (i.e. cooperative approaches in which participants are rewarded for their participation) could be applied to this context. They identify several several use cases, such as information sharing among service providers and the implementation of digital witnesses in such an environment environment. They also propose a model to implement the presented approach and illustrate the effect of crowdsourcing in an attack to a VoIP system.

The second article, 'Identity-based user authenticated key agreement protocol for multi-server environment with anonymity', by Alzubair Hassan, Anyembe Andrew Omala, Mohamed Ali, Chunhua Jin and Fagen Li, focuses on IoT scenarios in which several servers co-exist and a single registration are desired [1]. Existing proposals are limited in that once credentials are stolen from one service, the remaining ones might be under the control of the attacker. To overcome this limitation, the authors propose an identity-based user authenticated key agreement scheme, which provides unconditional anonymity. Their ring signature-based approach is proven secure, and its performance evaluated on an Android device. Their results show that achieving this higher degree of privacy comes at the cost of increased computation and communication costs.

Another typical scenario for IoT devices, namely Mobile Ad-Hoc Networks (MANETs), is the context of the third contribution. In 'Determining the honesty of the accuser node in key revocation procedure for MANET', Maryam Zarezadeh and Hamid Mala focus on assessing the legitimacy of the nodes that cooperate in a key revocation

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process [6]. Once an IoT device is found to be compromised or misbehaving, it is important to evict it from the network. For this purpose, several existing schemes rely upon the opinion of other peer nodes. The proposal presented in their paper aims to determine how to set a statistical threshold to admit or reject accusations. Their performance results, based on simulations, show the time improvement as compared to previous schemes under different settings.

The fourth contribution, by Pradip Kumar Sharma, Jin Ho Park, Young-Sik Jeong and Jong Hyuk Park, focuses on a trending application of IoT – smart homes. In particular, authors explore how to apply Software-Defined Networks (SDNs) to achieve security in this scenario. In their paper, 'SHSec: SDN based Secure Smart Home Network Architecture for Internet of Things', the authors propose a flexible architecture that can deal with current and future security threats that may appear due to the interaction of IoT devices from different manufacturers [5]. Since their evolution pace may lead to threats that cannot be foreseen, it is important to count on an agile mechanism to mitigate their effects. Therefore, in a software-defined networking (SDN) approach, the data layer and control layers are detached. This results in a fast reaction against unexpected events. Different use cases are simulated to attest the accuracy and sensitivity of their system in detecting security events as well as the overhead incurred.

In the fifth paper, Sebastian Pape and Kai Rannenberg address privacy issues in a setting that is closely related to IoT – fog computing. In particular, their paper 'Applying Privacy Patterns to the Internet of Things' (IoT) Architecture' discusses how privacy patterns can be applied in this field [4]. Privacy patterns can be regarded as the means to turn the privacy-by-design principle in a real software implementation. Although many previous contributions have already addressed the problem of how to provide privacy in IoT, the aim of their paper is to identify which issues of this ecosystem can be leveraged to achieve privacy preservation. To show the application of their proposal, a smart vehicle scenario is analyzed.

Last but not least, the sixth paper, 'Decentralised functional signatures' by Bei Liang and Aikaterini Mitrokotsa, deals with the practical feasibility of digital signatures in the IoT ecosystem [2]. In particular, they focus on a particular type called functional signatures, which can be used to provide an intrinsic access control mechanism. Since they allow users to sign a given transformation of data, this mechanism prevents unauthorized access to the data itself. In order to make this mechanism suitable to the IoT context, they propose a multi-authority variant. Thus, different IoT devices (which may be issued or controlled by different authorities) can seamlessly cooperate. Their formal proofs show the theoretical validity of their proposal.

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