Security Sublayer: A Required Evolution of Wireless Security IEEE 802.16j

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Abstract—This paper investigates the fundamental and security issues of security sublayer reside at MAC layer of Wimax networks. Initially healthy overview of Wimax technology is documented followed by the weakness to the MAC layer and problems associated to the Wimax 802.16j .The risks and impacts are assessed according to a systematic approach. Several articles have been published to address the flaws in IEEE 802.16j Security even then enhanced version of this protocol cannot settle all the problems and additional flaws emerge. Here in particular vulnerabilities leading to the denial of service attacks on standard like regarding Reset-Command message, key sharing mechanism, water torture attacks, black hat threat etc are discussed in a precise and concise manner.

Keywords— Security Sublayer, Wimax, Dos Attacks, IEEE 802.16j, Authentication, Encryption

I. INTRODUCTION

In Wimax, The base station and subscriber station face most of the same security threats and attacks as their wired counterparts, including eavesdropping, masquerading session, hijacking, middle in man attacks, replay attacks etc. Moreover wireless network regardless of whether they belong to which family are inherently less secure then wired networks because they lack the physical infrastructure. [1]. Wireless networks represent an important example of such scenarios where capturing and forging packets are relatively easy .Attacks against networked systems are becoming more complex and powerful. IEEE 802.16j task group works on incorporating multihop relay capabilities into mobile Wimax ,the change mode is highly agree with 802.16e mobile and subscriber stations , but a base station specific to 802.16j will be required for relays to operate . Standard launched a new product called Relay stations which is high cost efficient and less complex then base station with relay capabilities .RS is used to collect all traffics from different sources and relay it to a base station, there is no processing at relay station. As it's easy to install, cheaper and less complex nature, chances of introducing Rogue RS or hijacking of the session, or any sorts of attacks are much easier.

IEEE 802.16j security specifications can mainly be found within the MAC layer, security parameters within the MAC layer can be embedded in a separate layer called security sublayer .The goal is to provide access control and confidentiality of the authentication, secure key exchange and encryption so when two parties establish a link, they are protected via a set of protocol that ensure confidentiality and unique access of the authorized parties. The unique hand shaking between the two entities, namely base stations and subscriber station is done at the MAC layer through security sublayer. [1]. MAC layer consists of three sub-layer, the first sub-layer is the service specific convergence sub-layer for mapping services to and from 802.16 Mse connections, the synchronous transfer mode (ATM) convergence layer is dedicated to ATM facilities whereas the packet convergence layer is accountable of for mapping conventions and protocols[2].the second sublayer is common part sub-layer which is the core of the standard and is tightly integrated with security sub-layer .the last sublayer is security sub-layer which lies between the MAC CPS and the PHY layer, addressing the authentication ,key establishment and exchange etc between the MAC and PHY layer.[3].This paper will address the security issues, vulnerabilities ,threats and risks of IEEE 802.16j standard in a very precise and sequential manner.

II. SECURITY SUBLAYER THREATS AND SOLUTIONS

Most of the experts and professionals claiming that broadband data delivered over 3G cellular networks will choke the hope of the WiMAX industry for the standard to become worldwide significant. There are too many factors involved in weakening WiMax security, stability, Quality of service etc. A WiMax wireless access network consists of base stations and mobile stations (MSs). The base stations provide network add-on to the mobile stations. As a serving base station, a mobile station selects the one which offers the strongest signal. At this point, the subscriber plays the role of the user while a base station and a collection of served mobile stations play the role of system.in wimax most of the security issues are addressed and handled in the MAC security sub-layer as described in the figure below: After MAC common part sublayer ,security sublayer starts,in common part sublayer MAC protocol data units (PDUs) are constructed,connections are establised and bandwidth is managed.the common part exchanges MAC serivice data units(SDUs) with the convergence layer.The common part is tightly integrated with the security sublayer.the security sublayer addresses

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Network Security Empowered by Artificial Intelligence Yingying Chen,Jie Wu,Paul Yu,Xiaogang Wang,2024-06-25 This book introduces cutting edge methods on security in spectrum management mobile networks and next generation wireless networks in the era of artificial intelligence AI and machine learning ML This book includes four parts a Architecture Innovations and Security in 5G Networks b Security in Artificial Intelligence enabled Intrusion Detection Systems c Attack and Defense in Artificial Intelligence enabled Wireless Systems d Security in Network enabled Applications The first part discusses the architectural innovations and security challenges of 5G networks highlighting novel network structures and strategies to counter vulnerabilities The second part provides a comprehensive analysis of intrusion detection systems and the pivotal role of AI and machine learning in defense and vulnerability assessment The third part focuses on wireless systems where deep learning is explored to enhance wireless communication security The final part broadens the scope examining the applications of these emerging technologies in network enabled fields The advancement of AI ML has led to new opportunities for efficient tactical communication and network systems but also new vulnerabilities Along this direction innovative AI driven solutions such as game theoretic frameworks and zero trust architectures are developed to strengthen defenses against sophisticated cyber threats Adversarial training methods are adopted to augment this security further Simultaneously deep learning techniques are emerging as effective tools for securing wireless communications and improving intrusion detection systems Additionally distributed machine learning exemplified by federated learning is revolutionizing security model training Moreover the integration of AI into network security especially in cyber physical systems demands careful consideration to ensure it aligns with the dynamics of these systems This book is valuable for academics researchers and students in AI ML network security and related fields It serves as a resource for those in computer networks AI ML and data science and can be used as a reference or secondary textbook   **Network Security** Christos Douligeris,Dimitrios N. Serpanos,2007-06-02 A unique overview of network security issues solutions and methodologies at an architectural and research level Network Security provides the latest research and addresses likely future developments in network security protocols architectures policy and implementations It covers a wide range of topics dealing with network security including secure routing designing firewalls mobile agent security Bluetooth security wireless sensor networks securing digital content and much more Leading authorities in the field provide reliable information on the current state of security protocols architectures implementations and policies Contributors analyze research activities proposals trends and state of the art aspects of security and provide expert insights into the future of the industry Complete with strategies for implementing security mechanisms and techniques Network Security features State of the art technologies not covered in other books such as Denial of Service DoS and Distributed Denial of Service DDoS attacks and countermeasures Problems and solutions for a wide range of network technologies from fixed point to mobile Methodologies

for real time and non real time applications and protocols   <u>Wireless Network Security</u> Lei Chen,Jiahuang Ji,Zihong Zhang,2013-08-23 Wireless Network Security Theories and Applications discusses the relevant security technologies vulnerabilities and potential threats and introduces the corresponding security standards and protocols as well as provides solutions to security concerns Authors of each chapter in this book mostly top researchers in relevant research fields in the U S and China presented their research findings and results about the security of the following types of wireless networks Wireless Cellular Networks Wireless Local Area Networks WLANs Wireless Metropolitan Area Networks WMANs Bluetooth Networks and Communications Vehicular Ad Hoc Networks VANETs Wireless Sensor Networks WSNs Wireless Mesh Networks WMNs and Radio Frequency Identification RFID The audience of this book may include professors researchers graduate students and professionals in the areas of Wireless Networks Network Security and Information Security Information Privacy and Assurance as well as Digital Forensics Lei Chen is an Assistant Professor at Sam Houston State University USA Jiahuang Ji is an Associate Professor at Sam Houston State University USA Zihong Zhang is a Sr software engineer at Jacobs Technology USA under NASA contract   <u>Handbook of Research on Threat Detection and Countermeasures in Network Security</u> Al-Hamami, Alaa Hussein,Waleed al-Saadoon, Ghossoon M.,2014-10-31 Cyber attacks are rapidly becoming one of the most prevalent issues in the world As cyber crime continues to escalate it is imperative to explore new approaches and technologies that help ensure the security of the online community The Handbook of Research on Threat Detection and Countermeasures in Network Security presents the latest methodologies and trends in detecting and preventing network threats Investigating the potential of current and emerging security technologies this publication is an all inclusive reference source for academicians researchers students professionals practitioners network analysts and technology specialists interested in the simulation and application of computer network protection   **Cryptology and Network Security with Machine Learning** Atul Chaturvedi,Sartaj Ul Hasan,Bimal Kumar Roy,Boaz Tsaban,2024-04-22 The book features original papers from International Conference on Cryptology Network Security with Machine Learning ICCNSML 2023 organized by PSIT Kanpur India during 27 29 October 2023 This conference proceeding provides the understanding of core concepts of Cryptology and Network Security with ML in data communication The book covers research papers in public key cryptography elliptic curve cryptography post quantum cryptography lattice based cryptography non commutative ring based cryptography cryptocurrency authentication key agreement Hash functions block stream ciphers polynomial based cryptography code based cryptography NTRU cryptosystems security and privacy in machine learning blockchain IoT security wireless security protocols cryptanalysis number theory quantum computing cryptographic aspects of network security complexity theory and cryptography with machine learning   *Computer and Network Security Essentials* Kevin Daimi,2017-08-12 This book introduces readers to the tools needed to protect IT resources and communicate with security specialists when there is a security problem The book covers a wide range of

security topics including Cryptographic Technologies Network Security Security Management Information Assurance Security Applications Computer Security Hardware Security and Biometrics and Forensics It introduces the concepts techniques methods approaches and trends needed by security specialists to improve their security skills and capabilities Further it provides a glimpse into future directions where security techniques policies applications and theories are headed The book represents a collection of carefully selected and reviewed chapters written by diverse security experts in the listed fields and edited by prominent security researchers Complementary slides are available for download on the book s website at Springer com   Space-Air-Ground Integrated Network Security Jianwei Liu,Lin Bai,Chunxiao Jiang,Wei Zhang,2023-06-19 This book focuses on security science and technology data and information security and mobile and network security for space air ground integrated networks SAGINs SAGIN are expected to play an increasingly important role in providing real time flexible and integrated communication and data transmission services in an efficient manner Today SAGINs have been widely developed for a range of applications in navigation environmental monitoring traffic management counter terrorism etc However security becomes a major concern since the satellites spacecrafts and aircrafts are susceptible to a variety of traditional specific network based attacks including eavesdropping session hijacking and illegal access In this book we review the theoretical foundations of SAGIN security We also address a range of related security threats and provide cutting edge solutions in the aspect of ground network security airborne network security space network security and provide future trends in SAGIN security The book goes from an introduction to the topic s background to a description of the basic theory and then to cutting edge technologies making it suitable for readers at all levels including professional researchers and beginners To gain the most from the book readers should have taken prior courses in information theory cryptography network security etc   Wireless Sensor Network Security Javier Lopez,2008-04-15 Wireless sensor networks WSN are quickly gaining popularity in both military and civilian applications However WSN is especially vulnerable against external and internal attacks due to its particular characteristics It is necessary to provide WSN with basic security mechanisms and protocols that can guarantee a minimal protection to the services and the information flow This means the hardware layer needs to be protected against node compromise the communication channels should meet certain security goals like confidentiality integrity and authentication and the protocols and services of the network must be robust against any possible interference This book provides a deep overview of the major security issues that any WSN designers have to face and also gives a comprehensive guide of existing solutions and open problems The book is targeted for the semi technical readers technical managers graduate students engineers as well as the specialists They will get a clear picture regarding what security challenges they will face and what solutions they could use in the context of wireless sensor networks They will also benefit from the cutting edge research topics being presented   Machine Learning, Image Processing, Network Security and Data Sciences Rajesh Doriya,Badal Soni,Anupam Shukla,Xiao-Zhi Gao,2023-01-01

This book constitutes the refereed proceedings of the Third International Conference on Machine Learning Image Processing Network Security and Data Sciences MIND 2021 The papers are organized according to the following topical sections data science and big data image processing and computer vision machine learning and computational intelligence network and cybersecurity This book aims to develop an understanding of image processing networks and data modeling by using various machine learning algorithms for a wide range of real world applications In addition to providing basic principles of data processing this book teaches standard models and algorithms for data and image analysis   Accountability and Privacy in Network Security Yuxiang Ma,Yulei Wu,Jingguo Ge,2020-09-15 This book discusses accountability and privacy in network security from a technical perspective providing a comprehensive overview of the latest research as well as the current challenges and open issues Further it proposes a set of new and innovative solutions to balance privacy and accountability in networks in terms of their content flow and service using practical deep learning techniques for encrypted traffic analysis and focusing on the application of new technologies and concepts These solutions take into account various key components e g the in network cache in network architectures and adopt the emerging blockchain technique to ensure the security and scalability of the proposed architectures In addition the book examines in detail related studies on accountability and privacy and validates the architectures using real world datasets Presenting secure and scalable solutions that can detect malicious behaviors in the network in a timely manner without compromising user privacy the book offers a valuable resource for undergraduate and graduate students researchers and engineers working in the fields of network architecture and cybersecurity   **5G Wireless Network Security and Privacy** DongFeng Fang,Yi Qian,Rose Qingyang Hu,2023-11-02 5G WIRELESS NETWORK An expert presentation of 5G security privacy and network performance In 5G Wireless Network Security and Privacy a team of veteran engineers delivers a robust and accessible discussion of 5G security solutions including physical layer security authentication and mobility management In the book the authors expertly cover the requirements of 5G wireless network security and privacy with explorations of existing solutions and vulnerabilities from security architecture and mechanism perspectives Readers will learn how to enhance the security and network performance of 5G wireless networks in contexts like vehicle to vehicle and vehicle to infrastructure communications industrial automation health services smart cities and smart homes They will develop a comprehensive understanding of 5G wireless network security as they move through the book s 11 insightful chapters developing in depth knowledge on the current state of 5G security and coming developments in the field Readers will also find A thorough introduction to legacy cellular network security including network performance development from 1G to 4G In depth treatments of 5G network security including the motivation and objectives of 5G wireless network security Comprehensive explorations of wireless security solutions including cryptographic approaches and physical layer security Fulsome discussions of the security architecture of cellular networks including 3G and 4G security Perfect for researchers and professionals working in the field of cybersecurity and 5G

wireless networks 5G Wireless Network Security and Privacy will also earn a place in the libraries of engineers computer scientists and graduate students studying 5G network security and privacy **Network Security and Communication Engineering** Kennis Chan,2015-07-06 The conference on network security and communication engineering is meant to serve as a forum for exchanging new developments and research progresss between scholars scientists and engineers all over the world and providing a unique opportunity to exchange information to present the latest results as well as to review the relevant issues on **Smart and Sustainable Approaches for Optimizing Performance of Wireless Networks** Sherin Zafar,Mohd Abdul Ahad,Syed Imran Ali,Deepa Mehta,M. Afshar Alam,2022-01-28 SMART AND SUSTAINABLE APPROACHES FOR OPTIMIZING PERFORMANCE OF WIRELESS NETWORK Explores the intersection of sustainable growth green computing and automation and performance optimization of 5G wireless networks Smart and Sustainable Approaches for Optimizing Performance of Wireless Networks explores how wireless sensing applications green computing and Big Data analytics can increase the energy efficiency and environmental sustainability of real time applications across areas such as healthcare agriculture construction and manufacturing Bringing together an international team of expert contributors this authoritative volume highlights the limitations of conventional technologies and provides methodologies and approaches for addressing Quality of Service QOS issues and optimizing network performance In depth chapters cover topics including blockchain assisted secure data sharing smart 5G Internet of Things IoT scenarios intelligent management of ad hoc networks and the use of Artificial Intelligence AI Machine Learning ML and Deep Learning DL techniques in smart healthcare smart manufacturing and smart agriculture Covers design implementation optimization and sustainability of wireless and sensor based networks Discusses concepts of sustainability and green computing as well as their relevance to society and the environment Addresses green automation applications in various disciplines such as computer science nanoscience information technology IT and biochemistry Explores various smart and sustainable approaches for current wireless and sensor based networks Includes detailed case studies of current methodologies applications and implementations Smart and Sustainable Approaches for Optimizing Performance of Wireless Networks Real time Applications is an essential resource for academic researchers and industry professionals working to integrate sustainable development and Information and Communications Technology ICT *Computer Network Security* Vladimir Gorodetsky,Leonard Popyack,Victor Skormin,2003-12-01 This book constitutes the refereed proceedings of the Second International Workshop on Mathematical Methods Models and Architectures for Computer Network Security MMM ACNS 2003 held in St Petersburg Russia in September 2003 The 29 revised full papers and 12 revised short papers presented together with 6 invited papers were carefully reviewed and selected from a total of 62 submissions The papers are organized in topical sections on mathematical models and architectures for computer network security intrusion detection public key distribution authentication and access control cryptography and stenography Wireless Network Security Yang Xiao,Xuemin

Shen,Ding-Zhu Du,2007-12-29 This book identifies vulnerabilities in the physical layer the MAC layer the IP layer the transport layer and the application layer of wireless networks and discusses ways to strengthen security mechanisms and services Topics covered include intrusion detection secure PHY MAC routing protocols attacks and prevention immunization key management secure group communications and multicast secure location services monitoring and surveillance anonymity privacy trust establishment management redundancy and security and dependable wireless networking

Machine Learning and Cryptographic Solutions for Data Protection and Network Security Ruth, J. Anitha,Mahesh, Vijayalakshmi G. V.,Visalakshi, P.,Uma, R.,Meenakshi, A.,2024-05-31 In the relentless battle against escalating cyber threats data security faces a critical challenge the need for innovative solutions to fortify encryption and decryption processes The increasing frequency and complexity of cyber attacks demand a dynamic approach and this is where the intersection of cryptography and machine learning emerges as a powerful ally As hackers become more adept at exploiting vulnerabilities the book stands as a beacon of insight addressing the urgent need to leverage machine learning techniques in cryptography Machine Learning and Cryptographic Solutions for Data Protection and Network Security unveil the intricate relationship between data security and machine learning and provide a roadmap for implementing these cutting edge techniques in the field The book equips specialists academics and students in cryptography machine learning and network security with the tools to enhance encryption and decryption procedures by offering theoretical frameworks and the latest empirical research findings Its pages unfold a narrative of collaboration and cross pollination of ideas showcasing how machine learning can be harnessed to sift through vast datasets identify network weak points and predict future cyber threats   Computer Network Security Igor Kotenko,Victor Skormin,2012-10-10 This book constitutes the refereed proceedings of the 6th International Conference on Mathematical Methods Models and Architectures for Computer Network Security MMM ACNS 2012 held in St Petersburg Russia in October 2012 The 14 revised full papers and 8 revised short presentations were carefully reviewed and selected from a total of 44 submissions The papers are organized in topical sections on applied cryptography and security protocols access control and information protection security policies security event and information management instrusion prevention detection and response anti malware techniques security modeling and cloud security   Handbook of Research on Modern Cryptographic Solutions for Computer and Cyber Security Gupta, Brij,Agrawal, Dharma P.,Yamaguchi, Shingo,2016-05-16 Internet usage has become a facet of everyday life especially as more technological advances have made it easier to connect to the web from virtually anywhere in the developed world However with this increased usage comes heightened threats to security within digital environments The Handbook of Research on Modern Cryptographic Solutions for Computer and Cyber Security identifies emergent research and techniques being utilized in the field of cryptology and cyber threat prevention Featuring theoretical perspectives best practices and future research directions this handbook of research is a vital resource for professionals researchers faculty members

scientists graduate students scholars and software developers interested in threat identification and prevention

Advances in Malware and Data-Driven Network Security Gupta, Brij B.,2021-11-12 Every day approximately three hundred thousand to four hundred thousand new malware are registered many of them being adware and variants of previously known malware Anti virus companies and researchers cannot deal with such a deluge of malware to analyze and build patches The only way to scale the efforts is to build algorithms to enable machines to analyze malware and classify and cluster them to such a level of granularity that it will enable humans or machines to gain critical insights about them and build solutions that are specific enough to detect and thwart existing malware and generic enough to thwart future variants Advances in Malware and Data Driven Network Security comprehensively covers data driven malware security with an emphasis on using statistical machine learning and AI as well as the current trends in ML statistical approaches to detecting clustering and classification of cyber threats Providing information on advances in malware and data driven network security as well as future research directions it is ideal for graduate students academicians faculty members scientists software developers security analysts computer engineers programmers IT specialists and researchers who are seeking to learn and carry out research in the area of malware and data driven network security   Cyber Security: Issues and Current Trends Nitul Dutta,Nilesh Jadav,Sudeep Tanwar,Hiren Kumar Deva Sarma,Emil Pricop,2021-10-30 This book presents various areas related to cybersecurity Different techniques and tools used by cyberattackers to exploit a system are thoroughly discussed and analyzed in their respective chapters The content of the book provides an intuition of various issues and challenges of cybersecurity that can help readers to understand and have awareness about it It starts with a very basic introduction of security its varied domains and its implications in any working organization moreover it will talk about the risk factor of various attacks and threats The concept of privacy and anonymity has been taken into consideration in consecutive chapters Various topics including The Onion Router TOR and other anonymous services are precisely discussed with a practical approach Further chapters to learn the importance of preventive measures such as intrusion detection system IDS are also covered Due to the existence of severe cyberattacks digital forensics is a must for investigating the crime and to take precautionary measures for the future occurrence of such attacks A detailed description of cyberinvestigation is covered in a chapter to get readers acquainted with the need and demands This chapter deals with evidence collection from the victim s device and the system that has importance in the context of an investigation Content covered in all chapters is foremost and reported in the current trends in several journals and cybertalks The proposed book is helpful for any reader who is using a computer or any such electronic gadget in their daily routine The content of the book is prepared to work as a resource to any undergraduate and graduate level student to get aware about the concept of cybersecurity various cyberattacks and threats in the security In addition to that it aimed at assisting researchers and developers to build a strong foundation for security provisioning in any newer technology which they are developing

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