

# 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 weaknesses 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 than 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 than 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 Mac 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 established and bandwidth is managed, the common part exchanges MAC service 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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**TD Snyder**



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*Wireless Systems and Network Architectures in Next Generation Internet* Matteo Cesana, 2006-05-12 This book constitutes the refereed post proceedings of the second international joint workshops on Wireless and Mobility and on New Trends in Network Architectures and Services organized by the European Network of Excellence on Next Generation Internet EURO NGI 2005 The 19 revised full research papers presented together with 1 invited talk are organized in topical sections on wireless solutions QoS support in next generation networks and peer to peer architectures and algorithms

### **TELECOMMUNICATION SYSTEMS AND TECHNOLOGIES-Volume I** Paolo Bellavista ,2009-10-17

Telecommunication Systems and Technologies theme is a component of Encyclopedia of Physical Sciences Engineering and Technology Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias Telecommunication systems are emerging as the most important infrastructure asset to enable business economic opportunities information distribution culture dissemination and cross fertilization and social relationships As any crucial infrastructure its design exploitation maintenance and evolution require multi faceted know how and multi disciplinary vision skills The theme is structured in four main topics Fundamentals of Communication and Telecommunication Networks Telecommunication Technologies Management of Telecommunication Systems Services Cross Layer Organizational Aspects of Telecommunications which are then expanded into multiple subtopics each as a chapter These two volumes are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers and NGOs

**Neutrosophic Systems with Applications (NSWA), Vol. 8, 2023** Florentin Smarandache, Mohamed Abdel-Basset, Said Broumi, **Issues in Electronics Research and Application: 2011 Edition** ,2012-01-09 Issues in Electronics Research and Application 2011 Edition is a ScholarlyEditions eBook that delivers timely authoritative and comprehensive information about Electronics Research and Application The editors have built Issues in Electronics Research and Application 2011 Edition on the vast information databases of ScholarlyNews You can expect the information about Electronics Research and Application in this eBook to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Issues in Electronics Research and Application 2011 Edition has been produced by the world s leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com> Adaptive PHY-MAC Design for Broadband Wireless Systems Ramjee Prasad, Suvra Sekhar Das, Muhammad Imadur Rahman, 2022-09-01 The next generation mobile communication networks 4G have the challenging target of The next generation mobile communication networks 4G have the challenging target of providing a peak data rate

of 1 Gigabit per second local area and 100 Megabit per second wide area The ability to offer such high data rates in 100MHz bandwidth requires overall a very high spectral efficiency and hence the need for multi antenna techniques MIMO with spatial multiplexing fast dynamic link adaptation and packet scheduling wideband access techniques and most likely non contention based spectrum sharing among multiple operators Many of these required technology components and techniques are well researched and established Adaptive PHY MAC Design for Broadband Wireless Systems explains how one can integrate and optimise their use in providing the target cell data rates with high availability The authors address the ability to cope with interference and enhanced physical layer processing and simultaneously the multifaceted system level design Focus is also on the selection of technology components and techniques which leads to the highest spectral efficiency and peak data rate availability with reasonable Quality of Service QoS support such as improved outage scenario reduced delay guaranteed bit rate etc In short this book will answer questions such as how individual techniques relate to each other how can we benefit the gains by suitable combinations of different technologies and how to choose different technological solutions in different scenarios etc The next generation mobile communication networks 4G have the challenging target of 1 Gigabit per second local area and 100 Megabit per second wide area

**Advances in Computational Intelligence and Its Applications** Sheikh Fahad Ahmad, Shadab Siddiqui, Rajib Debnath, Kakali Das, Figlu Mohanty, Sumit Hazra, 2024-06-07 It is with great pleasure and enthusiasm that we welcome you to the International Conference on Advances in Computational Intelligence and its Applications ICACIA 2023 In the ever evolving landscape of technology computational intelligence stands as a cornerstone shaping the future of diverse fields and industries This conference serves as a nexus for researchers academicians and industry experts to converge exchange ideas and explore the latest advancements in the realm of computational intelligence

**Radio Technologies and Concepts for IMT-Advanced** Martin Döttling, Werner Mohr, Afif Osseiran, 2009-10-01 Radio Technologies and Concepts for IMT Advanced presents the findings of the Wireless World Initiative New Radio WINNER project in Framework Program 6 of the European Commission It provides an insight into the key concepts and technologies for the IMT Advanced radio interface based on the collaborative research of manufacturers network operators research centres and universities within WINNER The book covers the fundamental radio characteristics of a typical 4G wireless communication system focusing on the transceiver s chain from the physical layer to layers 2 and 3 Starting by defining realistic and futuristic usage scenarios the authors provide in depth discussion of key technologies including modulation and coding link level procedures spatial temporal processing multiple access schemes and inter cell interference mitigation channel estimation and newly developed channel models Finally a cost assessment and optimisation methodology is developed for different deployment concepts in order to assess a wireless system in a condition close to reality The book provides an important system level approach to the latest radio technologies in the field and evaluates IMT

Advanced research in relation to international standardisation Presents the research findings of IMT Advanced radio interface from the WINNER project Covers the latest concepts for relaying multiple access radio resource control flexible spectrum use and ITU R spectrum demand calculation Examines the most recent Multiple Input Multiple Output MIMO techniques and Distributed Antenna Systems Coordinated Multipoint Transmissions Describes a 4G system concept and all major building blocks Provides 4G propagation models and system level evaluation methodologies Information Technology Convergence James J. (Jong Hyuk) Park,Leonard Barolli,Fatos Xhafa,Hwa-Young Jeong,2013-07-14 Information technology and its convergence issue is emerging rapidly as an exciting new paradigm with user centric environment to provide computing and communication services This area will be the most comprehensive topics with various aspects of advances in information technology and its convergence services This book covers all topics as computational science and applications electronics engineering manufacturing technology services technical skill to control the robot automatic operation and application simulation and testing communication and many more **Advances in Hybrid Information Technology** Marcin S. Szczuka,Daniel Howard,Dominik Slezak,Haeng-kon Kim,Tai-hoon Kim,Il-seok Ko,Geuk Lee,Peter M.A. Sloot,2007-12-08 Complete with online files and updates this important new volume covers many of the areas in which hybrid information technology is advancing The book is the thoroughly refereed post proceedings of the First International Conference on Hybrid Information Technology held in Korea in 2006 More than 60 revised papers were carefully selected during a second round of reviewing from 235 reports given at the conference and are presented in extended version in the book **Unlicensed Mobile Access Technology** Yan Zhang,Laurence T. Yang,Jianhua Ma,2008-08-28 The goal of Unlicensed Mobile Access UMA is to provide seamless access to GSM and GPRS mobile service networks via unlicensed spectrum technologies including Bluetooth WiMAX and Wi Fi Expanding on the level of knowledge in this growing field Unlicensed Mobile Access Technology Protocols Architectures Security Standards and Applications **Advances in Computational Intelligence and Communication** Manolo Dulva Hina,Amar Ramdane-Cherif,Rafik Zitouni,Assia Soukane,2022-12-13 This book presents select papers from the 2nd EAI International Conference on Computational Intelligence and Communications CCom 2021 The papers reveal recent advances in the broader domains of Computational Intelligence including 1 automation control and intelligent transportation system 2 big data Internet of Things and smart cities 3 wireless communication systems and cyber security and 4 human brain computer interfaces and image and pattern recognition The book demonstrates complex real world problems in which mathematical or traditional modelling are not the preferred solution and posits alternative solutions This collection of applications demonstrates the important advances in computational intelligence The chapters present various ideas that will benefit researchers graduate students and engineers in this domain Information Networking. Towards Ubiquitous Networking and Services Teresa Vazão,Mário M. Freire,Ilyoung Chong,2008-11-20 This volume contains the set of revised selected papers presented at the 21st International

Conference on Information Networking ICOIN 2007 which was held in Estoril Portugal January 23 25 2007 The conference series started under the name of Joint Workshop on Computer Communications in 1986 At that time it constituted a technical meeting for researchers and engineers on network technologies in East Asian countries where several technical networking issues were discussed In 1993 the meeting was reorganized as an international conference known as ICOIN Recent conferences were held in Sendai Japan 2006 Jeju Korea 2005 Pusan Korea 2004 Jeju Korea 2003 Jeju Korea 2002 Beppu City Japan 2001 Hsin chu Taiwan 2000 and Tokyo Japan 1999 In 2007 for the first time since its creation ICOIN took place outside Asia and we were very pleased to host it in Portugal ICOIN 2007 was organized by INESC ID and IST Technical University of Lisbon Portugal with the technical co sponsorship of IEEE Communications Society and IEEE Portugal Section Computer Society Chapter in cooperation with the Order of Engineers College of Informatics Engineering Portugal IPSJ Information Processing Society of Japan KISS Korea Information Science Society and Lecture Notes in Computer Science LNCS Springer Germany The papers presented in this volume were selected in two stages 1 reviewing and selection for the ICOIN program and 2 on site presentation review by session chairs or by program committee chairs

**Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications** Management Association, Information Resources, 2015-09-30 We live in a wireless society one where convenience and accessibility determine the efficacy of the latest electronic gadgets and mobile devices Making the most of these technologies and ensuring their security against potential attackers requires increased diligence in mobile technology research and development Mobile Computing and Wireless Networks Concepts Methodologies Tools and Applications brings together a comprehensive range of voices and research in the area of mobile and wireless technologies exploring the successes and failures advantages and drawbacks and benefits and limitations of the technology With applications in a plethora of different research and topic areas this multi volume reference work benefits researchers service providers end users and information technology professionals This four volume reference work includes a diverse array of chapters and authors covering topics such as m commerce network ethics mobile agent systems mobile learning communications infrastructure and applications in fields such as business healthcare government tourism and more

*Handbook of Enterprise Integration* Mostafa Hashem Sherif, 2009-11-09 Maintaining compatibility among all affected network and application interfaces of modern enterprise systems can quickly become costly and overwhelming This handbook presents the knowledge and practical experience of a global group of experts from varying disciplines to help you plan and implement enterprise integration projects that respond to business needs

*Transportation Systems and Engineering: Concepts, Methodologies, Tools, and Applications* Management Association, Information Resources, 2015-06-30 From driverless cars to vehicular networks recent technological advances are being employed to increase road safety and improve driver satisfaction As with any newly developed technology researchers must take care to address all concerns limitations and dangers before widespread public adoption Transportation Systems and Engineering Concepts Methodologies

Tools and Applications addresses current trends in transportation technologies such as smart cars green technologies and infrastructure development This multivolume book is a critical reference source for engineers computer scientists transportation authorities students and practitioners in the field of transportation systems management *Green Networking and Communications* Shafiullah Khan,Jaime Lloret Mauri,2013-10-29 Although the information and communication technology ICT industry accounted for only 2 percent of global greenhouse gas emissions in 2007 the explosive increase in data traffic brought about by a rapidly growing user base of more than a billion wireless subscribers is expected to nearly double that number by 2020 It is clear that now is the ti *Intelligent Systems and Applications* W.C.-C. Chu,H.-C. Chao,S.J.-H. Yang,2015-04-14 This book presents the proceedings of the International Computer Symposium 2014 ICS 2014 held at Tunghai University Taichung Taiwan in December ICS is a biennial symposium founded in 1973 and offers a platform for researchers educators and professionals to exchange their discoveries and practices to share research experiences and to discuss potential new trends in the ICT industry Topics covered in the ICS 2014 workshops include algorithms and computation theory artificial intelligence and fuzzy systems computer architecture embedded systems SoC and VLSI EDA cryptography and information security databases data mining big data and information retrieval mobile computing wireless communications and vehicular technologies software engineering and programming languages healthcare and bioinformatics among others There was also a workshop on information technology innovation industrial application and the Internet of Things ICS is one of Taiwan s most prestigious international IT symposiums and this book will be of interest to all those involved in the world of information technology *5G and Beyond* Bharat Bhushan,Sudhir Kumar Sharma,Raghvendra Kumar,Ishaani Priyadarshini,2023-08-29 This open access book aims to highlight the coming surge of 5G network based applications and predicts that the centralized networks and their current capacity will be incapable of meeting the demands The book emphasizes the benefits and challenges associated with the integration of 5G networks with varied applications Further the book gathers and investigates the most recent 5G based research solutions that handle security and privacy threats while considering resource constrained wireless devices The information applications and recent advances discussed in this book will serve to be of immense help to practitioners database professionals and researchers

*Next Generation Mobile Networks and Ubiquitous Computing* Pierre, Samuel,2010-08-31 This book provides a comprehensive and unified view of the latest and most innovative research findings on the many existing interactions between mobile networking wireless communications and ubiquitous computing Provided by publisher *Electronic Commerce: Concepts, Methodologies, Tools, and Applications* Becker, Annie,2007-12-31 Compiles top research from the world s leading experts on many topics related to electronic commerce Covers topics including mobile commerce virtual enterprises business to business applications Web services and enterprise methodologies

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## **Table of Contents Ieee Base Paper On 4g Wireless System**

1. Understanding the eBook Ieee Base Paper On 4g Wireless System
  - The Rise of Digital Reading Ieee Base Paper On 4g Wireless System
  - Advantages of eBooks Over Traditional Books
2. Identifying Ieee Base Paper On 4g Wireless System
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Ieee Base Paper On 4g Wireless System
  - User-Friendly Interface
4. Exploring eBook Recommendations from Ieee Base Paper On 4g Wireless System



- Personalized Recommendations
- Ieee Base Paper On 4g Wireless System User Reviews and Ratings
- Ieee Base Paper On 4g Wireless System and Bestseller Lists
- 5. Accessing Ieee Base Paper On 4g Wireless System Free and Paid eBooks
  - Ieee Base Paper On 4g Wireless System Public Domain eBooks
  - Ieee Base Paper On 4g Wireless System eBook Subscription Services
  - Ieee Base Paper On 4g Wireless System Budget-Friendly Options
- 6. Navigating Ieee Base Paper On 4g Wireless System eBook Formats
  - ePub, PDF, MOBI, and More
  - Ieee Base Paper On 4g Wireless System Compatibility with Devices
  - Ieee Base Paper On 4g Wireless System Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Ieee Base Paper On 4g Wireless System
  - Highlighting and Note-Taking Ieee Base Paper On 4g Wireless System
  - Interactive Elements Ieee Base Paper On 4g Wireless System
- 8. Staying Engaged with Ieee Base Paper On 4g Wireless System
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Ieee Base Paper On 4g Wireless System
- 9. Balancing eBooks and Physical Books Ieee Base Paper On 4g Wireless System
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Ieee Base Paper On 4g Wireless System
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Ieee Base Paper On 4g Wireless System
  - Setting Reading Goals Ieee Base Paper On 4g Wireless System
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Ieee Base Paper On 4g Wireless System

- Fact-Checking eBook Content of Ieee Base Paper On 4g Wireless System
- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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