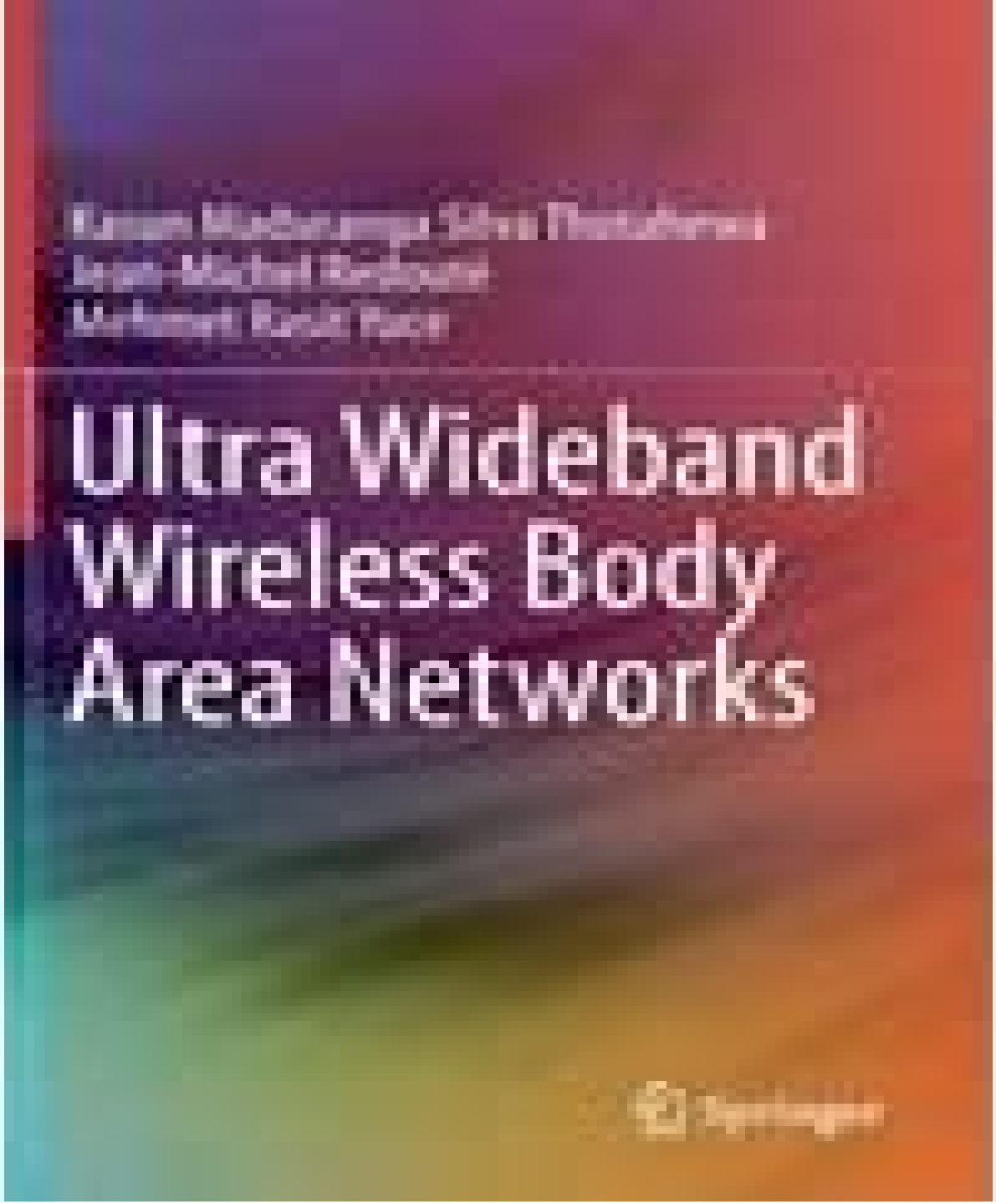
Ultra Wideband
Wireless Body
Area Networks

Ultra Wideband Wireless Body Area Networks

Léo Pomar

Ultra Wideband Wireless Body Area Networks:

Ultra Wideband Wireless Body Area Networks Kasun Maduranga Silva Thotahewa,Jean-Michel Redouté,Mehmet Rasit Yuce,2014-04-17 This book explores the design of ultra wideband UWB technology for wireless body area networks WBAN The authors describe a novel implementation of WBAN sensor nodes that use UWB for data transmission and narrow band for data reception enabling low power sensor nodes with high data rate capability The discussion also includes power efficient medium access control MAC protocol design for UWB based WBAN applications and the authors present a MAC protocol in which a guaranteed delivery mechanism is utilized to transfer data with high priority Readers will also benefit from this book s feasibility analysis of the UWB technology for human implant applications through the study of electromagnetic and thermal power absorption of human tissue that is exposed to UWB signals **Wireless Body Area Networks** Mehmet R. Yuce,Jamil Khan,2011-12-06 The book provides a comprehensive overview for the latest WBAN systems technologies and applications The chapters of the book have been written by various specialists who are experts in their areas of research and practice The book starts with the basic techniques involved in designing and building WBAN systems It explains the deployment issue Power Efficient Ultra-wideband Based Wireless Communication for Wireless Body Area Network Applications Kasun Thotahewa,2014 Ultra wideband UWB is a lucrative wireless technology for Wireless Body Area Network WBAN applications requiring a power restricted operation high data rate and high level of miniaturisation An Impulse Radio UWB IR UWB system transmits data by means of short duration pulses Because of the pulse based nature of this data transmission less complex modulation schemes such as Pulse Position Modulation PPM and On Off Keying OOK can be used in IR UWB based systems resulting in significant power savings Because of the simplicity of pulse generation IR UWB transmitters require a reduced hardware complexity compared to other candidates such as Orthogonal Frequency Division Multiplexing OFDM based UWB enabling a low form factor and improved power efficiency This dissertation contributes to the state of the art in the IR UWB technology for WBAN applications in three major areas namely Power efficient Medium Access Control MAC protocol design for IR UWB based WBAN applications Development of a low power sensor platform and evaluation for on body communication Feasibility analysis of the IR UWB technology for human implant applications through study of the electromagnetic and thermal effects caused by UWB signals Although IR UWB transmitters provide excellent benefits such as high data rate transmission low power consumption and simple hardware implementation IR UWB receivers remain a bottleneck for the use of IR UWB technology in WBAN applications because of the following reasons Firstly IR UWB receivers are complex in design and consume excessive amount of power Secondly the synchronisation of IR UWB pulses at the receive stage using low power front end circuitry is a major difficulty that restricts the use of IR UWB receivers in WBAN applications An IR UWB based communication system has to be designed in a manner such that it enhances the advantages provided by IR UWB transmitters while avoiding the complexities

introduced by IR UWB receivers In order to achieve this objective this dissertation presents a dual band communication system that uses IR UWB for data transmission from sensor nodes while using narrow band technology for data reception The MAC protocol plays a vital role in determining the data transmission efficiency of IR UWB based WBAN applications Unlike in wireless narrow band applications MAC protocols for IR UWB applications should be designed in a manner so as to incorporate the unique advantages provided by the physical layer properties of IR UWB signals This dissertation presents the design and evaluation of a new dual band MAC protocol for WBAN sensor nodes This MAC protocol improves the advantages provided by IR UWB signals such as high data rate transmission and low power operation while avoiding the complexities introduced by IR UWB reception at the sensor node end In addition data priority is taken into consideration during the design of the MAC protocol and a guaranteed delivery mechanism is utilised to transfer high priority data The performance of the suggested MAC protocol is analysed extensively using simulations in terms of critical parameters such as packet error rate throughput packet delay and power consumption These simulation studies have provided optimised design parameters for hardware implementation of sensor nodes that use the proposed MAC protocol for WBAN applications Although IR UWB has been identified as a viable wireless technology for WBAN applications there are no full implementations of low power and small size IR UWB sensor platforms for healthcare monitoring applications in both commercial domain and research domain This dissertation presents the implementation and evaluation of a complete communication platform for WBAN applications that includes sensor nodes coordinator nodes and interfacing computer software In order to overcome the limitations created by the use of IR UWB receivers in IR UWB based sensor platforms this dissertation presents an implementation method for WBAN sensor nodes that uses IR UWB for data transmission from sensor nodes to coordinator nodes up link and a narrow band link to receive control messages from coordinator nodes to sensor nodes down link This unique technique provides the means of achieving low power consuming sensor nodes with high data rate capability Wireless communication for implantable devices is another potential area for the use of the IR UWB technology in WBAN applications Implantable systems such as neural recording systems and wireless endoscopy devices require high data rates low power consumption and small form factor These requirements can be fulfilled by the use of IR UWB technology This dissertation demonstrates the feasibility of the IR UWB technology for implant applications through the study of electromagnetic and thermal power absorption of human tissue that is exposed to IR UWB signals These studies are conducted through finite element simulations using human body models In addition the path loss of UWB signals for various implant applications such as neural recording units and capsule endoscopy systems are studied using numerical modelling techniques and provides a predictive model that can be used as a guide in designing IR UWB systems for implant applications The findings of this research contribute to the improvement of wireless healthcare monitoring systems by introducing a high data rate low power and efficient communication mechanism The dual band sensor nodes that are developed as the final product of this research are capable

of operating at scalable data rates up to 5 Mbps with a power consumption as low as 11 nJ bit The unique features of the MAC protocol suggested in this dissertation enable the dual band communication system to operate in varying channel conditions with a controllable BER around 10 4 Simulation based analysis carried out in order to investigate the feasibility of IR UWB for implant communication shows that it is possible to set the IR UWB transmit power in the in body channel at a higher level than the FCC spectral mask such that tissue power absorption levels fall within the regulatory levels while outdoor power levels meet the FCC spectral requirements These peak transmit power levels depend on the position of the implant within the human body The path loss analysis carried out for UWB based Wireless Capsule Endoscopy WCE devices shows an average path loss of 80 dB for an in body propagation distance of 80mm *A System Concept for Ultra Wideband (UWB) Body Area Networks* Thomas Zasowski,2007 Wireless body area networks have recently gained a lot of interest due to multiple possible applications such as wireless health monitoring or wearable computing Because of the rather simple hardware realizations and the energy efficiency ultra wideband UWB communication has become one promising technology for the use in wireless body area networks BAN After pointing out the motivation of this work and highlighting its contribution a definition of body area networks is presented as well as a brief introduction on UWB There the main promises of UWB communications are presented as well as the principles of some typical receiver structures for UWB Since UWB communication at the human body is a brand new topic channel measurements at the human body are performed The frequency range for these measurements is chosen from 2 to 8 GHz Based on 1100 channel measurements a channel model for the UWB BAN is derived Using the Akaike information criterion AIC it is shown that the channel decays over the time and that the channel taps are log normal distributed The channel at the head is of particular interest as most human communication organs such as mouth ears and eyes are located there Therefore the ear to ear link which can be regarded as a worst case scenario at the head due to the missing line of sight component is considered to specify the impact of the channel on the system design When considering the ear to ear link it is shown by means of theory simulations and measurements that the direct transmission through the head is attenuated so much that it is negligible Therefore antennas should be designed in a way that they do not radiate into the body but away from it or along its surface Moreover it is shown that the channel is robust against distance variations between the antenna and the skin and that reflections and absorptions are caused by the body For the ear to ear link the antennas should be placed behind the ears to get the smallest channel attenuations From the measurements it can also be observed that the main energy of the channel impulse response is contained in a very small time window Thus non coherent receivers with a short integration duration can capture almost the whole energy of the channel Since UWB systems are a secondary spectrum user the impact of existing wireless services on UWB is investigated as well Due to the low transmit power not only the in band but also the out of band interferers are harmful for UWB transmission Based on frequency domain and time domain measurements it is shown that interference not

close to the UWB device can be handled by using filters However this is not sufficient enough if an interferer is in close vicinity of the UWB device Therefore the temporal cognitive medium access is presented to avoid the interference from burst wise transmitting devices There the UWB system listens if the channel is occupied by an interferer and it transmits only in case that no other system is active at the same time For such a temporal cognitive MAC an expression is given to calculate the optimum UWB packet length Assuming different interference scenarios the packet lengths are evaluated Moreover it is shown that reasonable usable idle times can be achieved which the UWB device can use for transmission and strict latency time requirements can be met ALOHA 1 persistent CSMA and non persistent CSMA are considered as access schemes for the performance evaluation of the temporal cognitive MAC For evaluation two different cases are distinguished with and without bandpass filter at the UWB receiver It is shown that a UWB device with bandpass filter that uses the temporal cognitive MAC in conjunction with non persistent CSMA has low packet error rates below 102 for up to about 15 active UWB links Due to complexity reasons non coherent receivers are the most promising solution for the use in UWB devices Hence the focus in this thesis lies on the energy detector and the transmitted reference receiver which have both the same performance Furthermore the maximum likelihood receivers in the presence of inter symbol interference are derived for binary pulse position modulation and transmitted reference pulse amplitude modulation assuming partial channel state information The maximum likelihood receivers in the presence of a co channel interference are calculated for the transmitted reference PAM as well A family of maximum likelihood receivers is also derived for the transmitted reference pulse interval amplitude modulation which is a combination of pulse position modulation and transmitted reference pulse amplitude modulation The performance of all these receiver structures is evaluated by means of bit error rate simulations The simulations are performed by using channels with independent and identically distributed channel taps and exponential decaying channels as well as by using the BAN channel model For all these receiver families a trade off between performance and complexity is observed Assuming a higher level of channel state information the performance improves while the complexity increases The receiver structures with knowledge of the average power delay profile are recommended for the use in wireless BAN These receiver structures exhibit for most channels better performance than the ones without channel state information however they require only moderately higher complexity Furthermore the receivers with knowledge of the average power delay profiler are less sensitive to the chosen integration duration since the weighting can be regarded as choosing a variable integration duration Finally recommendations for a UWB BAN system are given and conclusions are presented *Academic Press Library in Biomedical Applications of Mobile and Wireless Communications: Wireless UWB Body Area Networks* Matti Hamalainen,2014-03-05 Wireless sensor and body area networks WSN and WBAN respectively have been seen as a future way to monitor humans psycho physiological signs remotely There are a number of standards that could be used for building WBAN sytems However wireless UWB networks based on IEEE 802 15 4a offer the advantages of a large frequency range

and low power spectral density making it suitable for both WSNs and WBANs used for medical applications The technology has matured sufficiently that it can be used to develop products for the marketplace This book presents how the IEEE802 15 4 2011 former IEEE802 15 4a can be used in wireless body area networks WBAN for healthcare and welfare related applications It gives a short overview on the IEEE802 15 4 family and then gives details of IEEE802 15 4 2011 based solutions Presents how the IEEE802 15 4 2011 former IEEE802 15 4a can be used in wireless body area networks WBAN for healthcare and welfare related applications Gives a short overview on the IEEE802 15 4 family Gives details of IEEE802 15 4 2011 based solutions **A Comparative Study on Ultra-wideband and Ultrasonic Technologies for Wireless Body Area Networks and Healthcare** ,2016 With the advent of MEMS and integrated circuits size of device reduced to the order of mm with micro sensors and microprocessors and other components on it This low power miniature sensor device placed on the human body or inside the human body can collect the information or symptoms of the body that can be used for diagnosis and in some cases for cure or relief This information can also be sent to the medical center for the remote monitoring For networking of these devices an appropriate choice of radio technology and communication methodology has to be made that is suitable for requirements of such networks like heat dissipation transducer size QoS provisioning propagation inside body interference transmission power etc UWB has been identified as a solution for WBAN in IEEE802 15 6 but there are issues to be addressed such as attenuation inside body for implantable devices energy efficient networking with low heat dissipation Ultrasonic communication although an emerging without much well established standard or protocols promises better propagation inside body in which water content is high and hence well suited for implantable devices It is known to be used without much health hazard in Medical applications This thesis compares and evaluates two technologies for Wireless Body Area Networks compares their applications There is a initial discussion on existing technologies for Body Area Networks This thesis provides an extensive survey of existing work on UWB and ultrasonic for body area networks that helps in making the radio choice for different medical applications design choices for WBAN protocols and highlights the unaddressed research challenges in using UWB and Ultrasonic for WBAN applications **Body Area Networks using IEEE 802.15.6** Marco Hernandez,Ryu Miura,2014-03-21 The market of wearable wireless medical sensors is experiencing a rapid growth and the associated telecommunications services for the healthcare sector are forecast to further increase in the next years Medical body area networks MBANs allow the mobility of patients and medical personnel by facilitating the remote monitoring of patients suffering from chronic or risky diseases Currently MBANs are being introduced in unlicensed frequency bands where the risk of mutual interference with other electronic devices radiating in the same band can be high Thus coexistence is an issue on which the research scientists have dedicated much effort Ultra wideband UWB signals offer many advantages to MBANs and some features of this technology can be exploited for effective implementation of services UWB can help in several aspects like spectrum efficiency energy consumption and coexistence This book discusses the main aspects and in

particular the coexistence of MBANs based on the IEEE 802 15 6 Standard using UWB physical layer A exhaustive description of body area networks using IEEE802 15 4 technologies providing an in depth understanding of how the overall system works Provides understanding and insight on the use of ultra wide band technologies for the physical layer of body area networks low power consumption and coexistence are investigated Includes services methodologies and results related to link level and system level evaluations of body area networks **Ultra-Wideband and 60 GHz Communications for Biomedical Applications** Mehmet R. Yuce,2013-10-16 This book investigates the design of devices systems and circuits for medical applications using the two recently established frequency bands ultra wideband 3 1 10 6 GHz and 60 GHz ISM band These two bands provide the largest bandwidths available for communication technologies and present many attractive opportunities for medical applications The applications of these bands in healthcare are wireless body area network WBAN medical imaging biomedical sensing wearable and implantable devices fast medical device connectivity video data transmission and vital signs monitoring The recent technological advances and developments proposed or used in medicine based on these two bands are covered The book introduces possible solutions and design techniques to efficiently implement these systems in medical environment All individual chapters are written by leading experts in their fields Contributions by authors are on various applications of ultra wideband and the 60 GHz ISM band including circuit implementation UWB and 60 GHz signal transmission around and in body antenna design solution hardware implementation of body sensors UWB transceiver design 60 GHz transceiver design UWB radar for contactless respiratory monitoring and ultra wideband based medical Imaging The book will be a key resource for medical professionals bio medical engineers and graduate and senior undergraduate students in computer electrical electronic and biomedical engineering disciplines Design and Characterization of Textile Ultra Wideband (UWB) Antenna for Wireless Body Area Networks (WBAN) Javier Higuera Oro,Guy Van Den Bosch,Katholieke Universiteit Leuven,2011 **13th EAI International Conference on Body Area Networks** Chika Sugimoto,Hamed Farhadi,Matti Hämäläinen,2020-03-03 The papers in this proceeding discuss current and future trends in wearable communications and personal health management through the use of wireless body area networks WBAN The authors posit new technologies that can provide trustworthy communications mechanisms from the user to medical health databases The authors discuss not only on body devices but also technologies providing information in body Also discussed are dependable communications combined with accurate localization and behavior analysis which will benefit WBAN technology and make the healthcare processes more effective The papers were presented at the 13th EAI International Conference on Body Area Networks BODYNETS 2018 Oulu Finland 02 03 October 2018 **An Introduction to Ultra Wideband Communication Systems** Jeffrey Hugh Reed,2005 Breaks down the fundamentals of UWB equipping engineers with the understanding of this newly approved communication standard *Ultra-Wideband Radio Propagation Channels* Pascal Pagani,2008 Ultra Wideband UWB technolog is based on the transmission of radio signals over frequency

bandwidths from 500 MHz to several GHz Its unique charateristics can be exploited for the design of high data rate wireless ccommunication systems as well as location based and imaging applications the development and optimization of swuch systems require a precise knwoldge o the radio transmission medium This book examines all aspects of the propagation channel for UWB systems starting with a presentation of UWB technology with a particular emphasis being placed on applications spectrum regulation issues and different communication techniques Next the author s introduce the theoretical foundations of electromagnetic wave or signal propagation and give an overview of channel sounding techniques adapted for UWB signals Finally the two main principles of UWB channel modeling are described and illustrated first deterministic channel modeling based on simulation of the propagation phenomena in a given environment and second statistical channel modeling which relies on experimental analysis of the main channel characteristics Ultra Wideband Mohammad Abdul Matin,2012-10-03 Ultra wideband UWB has advanced and merged as a technology and many more people are aware of the potential for this exciting technology The current UWB field is changing rapidly with new techniques and ideas where several issues are involved in developing the systems Among UWB system design the UWB RF transceiver and UWB antenna are the key components Recently a considerable amount of researches has been devoted to the development of the UWB RF transceiver and antenna for its enabling high data transmission rates and low power consumption Our book attempts to present current and emerging trends in research and development of UWB systems as well as future expectations

Synchronization and (DE-) Modulation for Ultra-wideband Access Xiliang Luo,2006 Technologies for the Wireless Future Wireless World Research Forum,2005 See the future through the vision of the Wireless World Research Forum Technologies for the Wireless Future the result of pioneering cooperative work of many academic and industrial researchers from WWRF provides a wide picture of the research challenges for the future wireless world Despite much emphasis on hard technology the user is certainly not forgotten as this book provides an all encompassing treatment of future wireless technologies ranging from user centred design processes and I centric communications to end to end econfigurability and short range wireless networks The content will have a wide ranging appeal to engineers researchers managers and students with interest on future of wireless An important publication that highlights the significance of WWRF to the wireless industry Rarely has one publication covered the whole spectrum of future wireless technologies from human sciences to radio interface technologies highlighting the research work done both in academic and the business worlds Tero Ojanper Senior Vice President Head of Nokia Research Center Provides an excellent overview about the future development of mobile and wireless communication Starting from a user centric approach and the service infrastructure a reference model and roadmaps are being built up This book presents useful and necessary information to all who are involved in research and development strategy and standardisation activities towards future systems Anton Schaaf CTO and Member of the executive board Siemens COM The WWRF should be commended for taking an approach that defines technology

requirements from a user perspective This publication makes an important contribution to defining the technologies that will be most relevant to future wireless communications Padmasree Warrior Senior Vice President Chief Technology Officer Motorola Ultra-wideband Wireless Body Area Network Design and Optimisation Jie Ding,2015 In this thesis we will study the spectral efficiency and energy efficiency optimization problems in relay assisted UWB based WBANs under various practical transmission scenarios Antem 2005 ,2005 *Annales des télécommunications* ,2006 **Smart Environments** Diane J. Cook,Sajal Kumar Das,2005 Intelligent environments are revolutionizing the ways in which people live work and play Such an environment typically called a smart environment is a small specialized world where all kinds of devices work together to make inhabitants lives more comfortable These environments are as varied and individualized as the people who live there with technologies that range from safety and security systems to robotic lawn mowers to intelligent cars kitchens and more The interdisciplinary scope of the field integrates aspects of machine learning human machine interfacing wireless networking mobile communications sensor networks and pervasive computing Smart Environments explores the state of the art in this exploding field and shows the impact these environments are having in homes offices classrooms hospitals and automobiles It examines everything from design and architecture to health care issues and software engineering is explored and utilized in these far reaching applications With contributions from leading researchers in a wide array of disciplines Smart Environments covers such important topics as wireless sensor networks middleware home and office networking and appliances location and estimation techniques automated decision making privacy and security issues assisted environments for individuals with special needs future trends and much more **Ultra Wideband Signals and Systems in Communication Engineering** M. Ghavami,L. B. Michael,Ryuji Kohno,2007-02-27 The thoroughly revised and updated second edition of Ultra Wideband Signals and Systems in Communication Engineering features new standards developments and applications It addresses not only recent developments in UWB communication systems but also related IEEE standards such as IEEE 802 15 wireless personal area network WPAN Examples and problems are included in each chapter to aid understanding Enhanced with new chapters and several sections including Standardization advanced topics in UWB Communications and more applications this book is essential reading for senior undergraduates and postgraduate students interested in studying UWB The emphasis on UWB development for commercial consumer communications products means that any communication engineer or manager cannot afford to be without it New material included in the second edition Two new chapters covering new regulatory issues for UWB systems and new systems such as ad hoc and sensor networks MAC protocols and space time coding for UWB systems IEEE proposals for channel models and their specifications Interference and coexistence of UWB with other systems UWB antennas and arrays and new types of antennas for UWB systems such as printed bow tie antennas Coverage of new companies working on UWB such as Artimi and UBISense UWB potential for use in medicine including cardiology respiratory medicine obstetrics and gynaecology emergency room and acute care assistance

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web callum is the son of lorraine and one of the main characters of the park he is the hidden main antagonist of the park it is revealed during the game that callum was the child of both lorraine and her late husband don during that time lorraine tried to raise callum as good as any mother could however she found callum s presence to be an irritating

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