Underwater Wireless Networks

Principles, Protocols and Implementations

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Underwater Wireless Networks / Underwater Acoustic Communications, Box Set Jun-Hong Cui,Shengli Zhou,2013-01-18
Energy-Efficient Underwater Wireless Communications and Networking Nitin Goyal,Luxmi Sapra,Jasminder Kaur Sandhu,2020 This book covers existing and future possibilities of the area as well as the current challenges presented in the implementation of underwater sensor networks   Adaptive RTT-driven Transport-layer Flow and Error Control Protocol for QoS Guaranteed Image Transmission Over Multi-hop Underwater Wireless Networks Jiahao Li,2014 With the rapid advances in data transmission over various advanced underwater acoustic networks it is important to develop the efficient protocol to obtain a high data rate with Quality of Service QoS guarantee requirements for acoustic wireless communications Because of the harsh underwater acoustic environments such as time varying network topology and channel conditions limited bandwidth and constrained underwater signal propagation we develop and implement a protocol called multi hop adaptive RTT driven transport layer flow and error control protocol ARTFEC for QoS guaranteed image transmission in underwater wireless networks ARTFEC is based on the congestion window size control and the Q learning optimal timeout selection with QoS provisioning For the congestion window size control we propose an RTT based data flow control policy to adapt to the varying acoustic channel environments aiming to guarantee the reliability and high data rate of data transmission In addition we develop a Q learning based optimal timeout selection algorithm to improve the channel utilization efficiency which can increase the end to end throughput while decreasing the packet loss rate We implement ARTFEC using our lab testbed which consists of the Aqua Net protocol stack and the acoustic OFDM modems The testbed results obtained show that our developed ARTFEC transport layer protocol outperforms the other existing reliable data transmission schemes in terms of end to end throughput and packet loss rate The electronic version of this dissertation is accessible from http hdl handle net 1969 1 151662   *The Underwater World for Digital Data Transmission* Parikshit N. Mahalle,Pooja A. Shelar,Gitanjali R. Shinde,Nilanjan Dey,2021-05-06 This book covers all small details about Underwater Sensor Networks UWSN Researchers can use this book as a prerequisite before starting any research on underwater networks or underwater applications This book covers the introduction challenges different architectural models for UWSN various attacks on UWSN underwater applications and networking layers The target audience includes professors and students in engineering and researchers and engineers working on marine applications In academic level the book is helpful for students having Networking and Information Security as elective subject and doing projects in Wireless Networks It is also helpful for spostgraduates and Ph D researchers to learn basics of Underwater Sensor Networks   On the Impacts and Benefits of Implementing Full-Duplex Communications Links in an Underwater Acoustic Network ,2002 Acoustic signals offer a means of establishing wireless networks in shallow water regions These networks may provide command and control for autonomous underwater vehicles forward reporting by arrays of sensor grids ad hoc communications links to covert forces or positive control of unmanned

forward deployed weapons systems However the capacity limitations and extreme propagation delays of acoustic communications must be addressed to ensure timely predictable message delivery This paper presents the status of current experimentation at the Naval Postgraduate School regarding the viability of full duplex underwater acoustic communications As implementation of full duplex links requires partitioning the total capacity into distinct sub channels the paper presents a top level description and specification of a capacity allocation protocol to mitigate the adverse impacts of such a partitioning when system load is light *Enabling High Throughput and Secure Underwater Wireless Networks Through Advanced Signal Processing Techniques* Hovannes Kulhandjian,2014 Underwater communication and networks will play a major role in many future commercial environmental and military applications including disaster prevention tactical surveillance offshore exploration pollution monitoring tsunami detection sunken airplane or vessel localization and oceanographic data collection Acoustic wireless communication is the transmission technology of choice for underwater networked systems However underwater acoustic signals propagating in water suffer from significant path loss time varying multipath propagation Doppler spread and high propagation delay These formidable challenges limit the available bandwidth for underwater acoustic communications while the rapidly varying channel results in communication links that are highly unreliable ultimately hindering advancements in underwater networked communications As a consequence the field of underwater communication and networking is still in its infancy The objective of this research work is to further push the boundaries in underwater communication and networking by developing a versatile reconfigurable underwater networking platform analyzing the statistical channel properties of short range shallow water communication environments and exploring advanced signal processing techniques to improve the network throughput provide a secure communication means and offer a low cost distributed networked localization and time synchronization framework for underwater acoustic networks Specifically in this dissertation we first present the development of a software defined underwater networking testbed we developed at the University at Buffalo In the second part of this work we investigate underwater acoustic channel characteristics in short range shallow water environments In the third part we propose CDMA based analog network coding for underwater acoustic sensor networks with the objective to improve the network throughput In the forth part we explore CDMA based analog network coding to provide a secure underwater acoustic communications means Finally in the fifth part of this work we propose a low cost distributed networked localization and time synchronization framework for underwater acoustic testbeds **Underwater Acoustic Sensor Networks** Yang Xiao,2010-05-19 A detailed review of underwater channel characteristics Underwater Acoustic Sensor Networks investigates the fundamental aspects of underwater communication Prominent researchers from around the world consider contemporary challenges in the development of underwater acoustic sensor networks UW ASNs and introduce a cross layer approach for effec **Localization in Underwater Sensor Networks** Jing Yan,Haiyan Zhao,Yuan Meng,Xinping Guan,2021-10-27 Ocean covers 70 8% of the

Earth s surface and it plays an important role in supporting all life on Earth Nonetheless more than 80% of the ocean s volume remains unmapped unobserved and unexplored In this regard Underwater Sensor Networks USNs which offer ubiquitous computation efficient communication and reliable control are emerging as a promising solution to understand and explore the ocean In order to support the application of USNs accurate position information from sensor nodes is required to correctly analyze and interpret the data sampled However the openness and weak communication characteristics of USNs make underwater localization much more challenging in comparison to terrestrial sensor networks In this book we focus on the localization problem in USNs taking into account the unique characteristics of the underwater environment This problem is of considerable importance since fundamental guidance on the design and analysis of USN localization is very limited at present To this end we first introduce the network architecture of USNs and briefly review previous approaches to the localization of USNs Then the asynchronous clock node mobility stratification effect privacy preserving and attack detection are considered respectively and corresponding localization schemes are developed Lastly the book s rich implications provide guidance on the design of future USN localization schemes The results in this book reveal from a system perspective that underwater localization accuracy is closely related to the communication protocol and optimization estimator Researchers scientists and engineers in the field of USNs can benefit greatly from this book which provides a wealth of information useful methods and practical algorithms to help understand and explore the ocean **Information-Centric Design and Implementation for Underwater Acoustic Networks** Robert Martin,2018 Over the past decade Underwater Acoustic Networks UANs have received extensive attention due to their vast benefits in academia and industry alike However due to the overall magnitude and harsh characteristics of underwater environments standard wireless network techniques will fail because current technology and energy restrictions limit underwater devices due to delayed acoustic communications To help manage these limitations we utilize Information Centric Networking ICN More importantly we look at ICN s paradigm shift from traditional TCP IP architecture to improve data handling and enhance network efficiency By utilizing some of ICN s techniques such as data naming hierarchy we can reevaluate each component of the network s protocol stack given current underwater limitations to study the vast solutions and perspectives Information Centric architectures can provide to UANs First we propose a routing strategy used to manage and route large data files in a network prone to high mobility Therefore due to UANs limited transmitting capability we passively store sensed data and adaptively find the best path Furthermore we introduce adapted Named Data Networking NDN components to improve upon routing robustness and adaptiveness Beyond naming data we use tracers to assist in tracking stored data locations without using other excess means such as flooding By collaborating tracer consistency with routing path awareness our protocol can adaptively manage faulty or high mobility nodes Through this incorporation of varied NDN techniques we are able to see notable improvements in routing efficiency Second we analyze the effects of Denial of Service DoS attacks on upper layer protocols Since UANs are typically resource

restrained malicious users can advantageously create fake traffic to burden the already constrained network While ICN techniques only provide basic DoS restriction we must expand our detection and restriction technique to meet the unique demands of UANs To provide enhanced security against DoS we construct an algorithm to detect and restrict against these types of attacks while adapting to meet acoustic characteristics To better extend this work we incorporate three node behavior techniques using probabilistic adaptive and predictive approaches for detecting malicious traits Thirdly to depict and test protocols in UANs simulators are commonly used due to their accessibility and controlled testing aspects For this section we review Aqua Sim a discrete event driven open source underwater simulator To enhance the core aspect of this simulator we first rewrite the current architecture and transition Aqua Sim to the newest core simulator NS 3 Following this we clean up redundant features spread out between the various underwater layers Additionally we fully integrate the diverse NS 3 API within our simulator By revamping previous code layout we are able to improve architecture modularity and child class expandability New features are also introduced including localization and synchronization support busy terminal problem support multi channel support transmission range uncertainty modules external noise generators channel trace driven support security module and an adapted NDN module Additionally we provide extended documentation to assist in user development Simulation testing shows improved memory management and continuous validity in comparison to other underwater simulators and past iterations of Aqua Sim **Networking Support for Underwater Wireless Networks** Kurtis B. Kredo,2010 Underwater wireless networks provide many opportunities for exploration environmental monitoring and military applications However research and development in this field comes with unique challenges due to the new operating environment Our work addresses this issue by providing networking support to underwater wireless networks by exploiting the unique characteristics of the underwater environment through protocol design Limited energy resources and low data rates focus our attention at the MAC and routing layers as they have the greatest potential to improve network performance We begin our investigation of underwater networks by evaluating a hybrid MAC protocol that combines TDMA and unscheduled access to improve energy efficiency Our analysis and simulation work shows that a hybrid protocol improves energy efficiency in many cases and provides a higher throughput at a particular delay than either protocol individually Our work also shows that devices must share and use network state effectively to yield any benefit Our work continues as we formulate and investigate a novel channel scheduling scheme that exploits the underwater channel characteristics We formulate the new scheduling scheme named Staggered TDMA as an optimization problem and explore its performance through numerical evaluation We then develop a distributed MAC protocol the Staggered TDMA Underwater MAC Protocol STUMP When compared through numerical results STUMP yields higher throughput and lower latency than traditional TDMA and scales well with synchronization error We continue to expand upon STUMP by integrating it with a routing protocol which results in STUMP with routing STUMP WR Evaluation in a network simulator shows that STUMP WR

performs well in underwater environments and yields high energy efficiency and throughput and low latency when compared to TDMA and other proposed random access protocols STUMP uses a specific technique for channel scheduling but the unique characteristics of the underwater channel allow for a spectrum of scheduling options We evaluate five scheduling methods for use in underwater networks and evaluate their performance through numerical and simulation studies Our work shows that scheduling links provides the best tradeoff between scheduling state overhead and protocol performance across several metrics of interest   Machine Learning Modeling for IoUT Networks Ahmad A. Aziz El-Banna,Kaishun Wu,2021-05-29 This book discusses how machine learning and the Internet of Things IoT are playing a part in smart control of underwater environments known as Internet of Underwater Things IoUT The authors first present seawater s key physical variables and go on to discuss opportunistic transmission localization and positioning machine learning modeling for underwater communication and ongoing challenges in the field In addition the authors present applications of machine learning techniques for opportunistic communication and underwater localization They also discuss the current challenges of machine learning modeling of underwater communication from two communication engineering and data science perspectives   Efficient and Robust Underwater Sensor Network Systems Zheng Peng,2012   **Design and Implementation of Dynamic Channelization for Next-generation Wireless Networks** ,2015   Underwater Wireless Communications M. Stojanovic,2014-05-30 Underwater acoustics is an important area of research and this is the first book to date that describes the signal processing aspects of the field Written by the pre eminent authority on underwater acoustic communications this text spans topics from acoustic channel modeling to signal processing and network solutions for channel sharing among different users This approach offers a self contained subject treatment to practicing engineers students and researchers with a basic background in digital communications   *Acoustic and Optical Communication for Underwater Wireless Sensor Networks* Dustin Gene Torres,2010   **A Selective Automatic Repeat Request Protocol for Undersea Acoustic Links** John M. Kalscheuer,2004-06-01 A recent improvement to the Seaweb underwater wireless network was the implementation of a Selective Automatic Repeat Request SRQ mechanism SRQ is a protocol implemented in the Seaweb link layer as a measure for mitigating unreliability inherent in the telesonar physical layer In January 2004 an experiment was performed in St Andrew s Bay Panama City Florida The goal was to transmit large data files through the network in accordance with a Naval Special Warfare need for imagery file telemetry For three point to point test geometries SRQ was tested with a noisy and variable physical layer Through the incorporation of SRQ the unreliability was overcome A link budget model calibrated with the sound channel data collected from the experiment establishes the benefit of a SRQ gain   A Wireless Underwater Sensor Networks Jimmi Grönkvist,Jan Nilsson,2009   **Underwater Wireless Sensor Network Localization** Majid Hosseini Abdul Samad,2009   **Wireless Underwater Sensor Networks** Jimmi Grönkvist,Totalförsvarets forskningsinstitut,2007   **Design, Optimization, and Applications of Underwater Acoustic**

Sensor Networks Bhumika Gupta,Kamal Kumar Gola,2023-02-24 The development of underwater sensor networks opens new possibilities for maritime exploration and data collection Underwater sensor networks have a variety of military and civilian applications that must be studied further to ensure they are utilized appropriately Design Optimization and Applications of Underwater Acoustic Sensor Networks serves as a premier interdisciplinary forum for researchers practitioners and educators to present the most recent innovations trends concerns and practical challenges encountered and solutions adopted in the fields of underwater acoustic communications and underwater wireless sensor networks The book also investigates underwater sensor network applications and challenges Covering key topics such as sensor devices acoustics and environmental processing this premier reference source is ideal for engineers computer scientists industry professionals researchers scholars academicians practitioners instructors and students

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