2024 34th International Telecommunication Networks and Applications Conference (ITNAC)

Time (Sydney)	Building G17, Foyer 102	Building G17, Room G22	Building G17, Room G23	Building G17, Room G03
Tuesday, November 26				
16:00-18:00				WR: Welcome Reception

Time (Sydney)	Building G17, Foyer 102	Building G17, Room G22	Building G17, Room G23	Building G17, Room G03
Wednesday, November 27				
08:30-09:00	R1: Registration			
09:00-10:30		S1: Session 1: Wireless	S2: Session 2: Peer-to-Peer Network	
10:30-11:00	MT1: Morning Tea			
11:00-11:45		K1: Opening Keynote - Leveraging Machine Learning and Explainable AI for Enhanced Cybersecurity		
11:45-12:30		K2: Keynote - The Network is dead, long live the network		
12:30-13:30	L1: Lunch			
13:30-15:30		S3: Session 3: Internet of Things (IoT)	S4: Session 4: Cybersecurity	
15:30-16:00	AT1: Afternoon Tea			
16:00-17:30		S5: Session 5:Wireless	S6: Session 6: Networking and General	

Time (Sydney)	Building G17, Foyer 102	Building G17, Room G22	Building G17, Room G23	Building G17, Room G03
Thursday, November 28				
09:00-11:00		S7: Session 7: Network Security	S8: Session 8: Networking and General	
11:00-11:30	MT2: Morning Tea			
11:30-12:15		K3: Keynote - Toward Internet of Things with Endogenous Intelligence		
12:30-13:30	L2: Lunch			
13:30-17:30	T1: Conference Tour			
18:30-22:00	D1: Conference Dinner			

Time (Sydney)	Building G17, Foyer 102	Building G17, Room G22	Building G17, Room G23	Building G17, Room G03
Friday, November 29				
09:00-10:30		S9: Session 9: UAV	S10: Session 10: LoRa Networks	
10:30-11:00	MT3: Morning Tea			
11:00-11:45		K4: Keynote session: Explainable AI-Enabled Haptic Feedback Prediction for Human-to-Machine Applications		
11:45-12:30		T: Tutorial		
12:30-13:30	L3: Lunch			
13:30-15:30		S11: Session 11: Smart Cities, Intelligent Transportation, and Network Optimization	S12: Session 12: Wireless Communications and Networking	
15:30-16:00	AT3: Afternoon Tea			
16:00-16:15	CR: Closing Remarks			

Tuesday, November 26

Tuesday, November 26 16:00 - 18:00 (Australia/Sydney)

WR: Welcome Reception

Building G17, Room G03
Chair: Himanshu Agrawal (Curtin University, Australia)

Wednesday, November 27

Wednesday, November 27 8:30 - 9:00 (Australia/Sydney)

R1: Registration

Room: Building G17, Foyer 102
Venue:

Wednesday, November 27 9:00 - 10:30 (Australia/Sydney)

S1: Session 1: Wireless

Building G17, Room G22
Chair: Philip Branch (Swinburne University of Technology, Australia)

9:00 ***Optimizing Channel Availability in WLAN 6GHz Networks Using Automatic Frequency Coordination(AFC) System***

Ashish Sheikh (Cisco Systems, USA)

The Federal Communications Commission (FCC) has authorized the use of 1200 MHz in the 6 GHz (5.925 - 7.125 GHz) band by Wi-Fi devices in the US, while ensuring the protection of fixed services and microwave links through Automated Frequency Coordination (AFC). As per the FCC rules, the Wi- Fi 6E/7 Access Points (APs) in the local area networks query the AFC to obtain a list of permitted 6 GHz channels for APs to operate in standard power mode (indoor APs) and allowed power levels (for outdoor deployments).The existing system operates under the assumption that the incumbents transmit continuously, which results in reduced channel availability for WLAN networks. This paper proposes improvements to the AFC system by validating the presence of incumbents in the area using an off-channel radio to monitor the spectral characteristics of incumbents. This approach enables 6 GHz WLAN networks to access an increased numbe

9:30 ***Fuzzy Logic Based Broadcasting Scheme for Mobile Ad Hoc Network***

Ismatov Akobir (Chungnam National Unviersity, Korea (South)); Beomkyu Suh and Ki-Il Kim (Chungnam National University, Korea (South))

Broadcast is generally used to disseminate specific information to whole nodes in mobile ad hoc networks. However, the broadcast storm problem, characterized by excessive packet collisions and redundancy, severely impairs network performance. To address this, researchers have developed enhanced broadcasting techniques, including fuzzy logic-based schemes. However, many existing fuzzy-based approaches lead to a large number of redundant packets by considering too general parameters. To overcome the mentioned problem, in this paper, we propose a new fuzzy logic-based broadcast scheme to reduce the duplicated number of packets. In the proposed scheme, fuzzy logic is designed with connection time, the number of neighboring nodes, and signal strength to decide to forward in a receiverbased approach. Finally,

our scheme outperforms previous work in the aspects of the number of redundant messages and network overhead.

10:00 ***Comparative Performance Evaluation of Real-Time Traffic on Wi-Fi Standards: 802.11ax vs. 802.11ac***

Abdussalam A A Salama (Lecturer, United Kingdom (Great Britain) & Sheffield Hallam University, United Kingdom (Great Britain)); Maryam Bagheri and Emmanuel Onyilo Peter (Sheffield Hallam University, United Kingdom (Great Britain))

This paper presents a comparative analysis of Wi-Fi 6 (IEEE 802.11ax) and Wi-Fi 5 (IEEE 802.11ac) standards, focusing on their performance in supporting Voice over IP (VoIP) applications. The study is conducted using a controlled laboratory environment, where key performance metrics such as delay, jitter, and packet loss ratio are measured. The results indicate that Wi-Fi 6 significantly outperforms Wi-Fi 5 in terms of all evaluated metrics, making it a superior choice for real-time communication applications. However, while these results confirm the expected advantages of Wi-Fi 6, this study also explores the challenges associated with its implementation in practical scenarios. The findings are compared with existing literature to provide a comprehensive understanding of the implications of adopting Wi-Fi 6 for VoIP services.

Wednesday, November 27 9:00 - 10:30 (Australia/Sydney)

S2: Session 2: Peer-to-Peer Network

Building G17, Room G23
Chair: Leith H. Campbell (RMIT University, Australia)

9:00 ***Data Compliance in P2P Energy Sharing: A Blockchain-Based Platform for PIPEDA***

Farhad Rahmanifard and Masoud Barati (Carleton University, Canada)

Compliance with the Personal Information Protection and Electronic Documents Act (PIPEDA) is essential for managing personal data in Canadian peer-to-peer (P2P) energy sharing systems. However, achieving robust privacy protection in such decentralized energy networks presents significant challenges due to the distributed nature of data and the need for effective consent mechanisms. PIPEDA's rigorous data protection and consent requirements are necessary for ensuring user trust and securing sensitive information within these networks. This paper introduces a new design pattern for a compliance- supported platform that adheres to PIPEDA standards within P2P energy networks. The platform incorporates key components that implement PIPEDA's core principles and their verification through blockchain and smart contract technologies. We formally present a detailed description of these principles and the algorithms that convert them into executable codes. Furthermore, we deploy the smart contracts containing such codes on available blockchain test networks and assess the costs and mining time involved in their deployment and execution.

9:30 ***Towards Optimized Peer Connectivity in Blockchain Networks using Digital Twin***

Prashanth Pvn (Visvesvaraya National Institute of Technology, Nagpur, India); Satish Kumar Yellaveni (Visvesvaraya National Institute of Technology, India); Sudhamsu Mouli and Veeraiah Talagondapati (Mahindra University, India)

Optimized peer connectivity is crucial for reducing network latency in peer-to-peer (P2P) blockchain networks which in-turn contributes to achieve higher transaction rates. A new peer joins the P2P network by connecting to a random set of existing peers making these networks inherently random, resulting in increased network latency. Connecting peers that are geographically proximal (nearest neighbor connectivity (NNC) approach) helps to reduce the network latency, however, it creates network imbalance and leads to formation of hub nodes. Therefore, having a global view of the entire network is essential for making informed decisions about peer connectivity while balancing the network. This paper introduces 'Digital Twin for blockchain P2P Network' (DTPN) that stores the real time information of the peers including their geo-location, connectivity and latencies. Further, this work proposes "Proximal and Degree Balanced Connectivity Algorithm (PDBCA)" which leverages DTPN to strategically identify peers based on their geographical proximity and existing connection load for every new peer joining the P2P network. Experimental evaluations demonstrate that PDBCA improves overall network latency while balancing the P2P network compared to Random and NNC approaches.

10:00 ***Reputation-Driven Peer-to-Peer Live Streaming Architecture for Preventing Free-Riding***

Rashmi Kushwaha and Rahul Bhattacharyya (IIT Kanpur, India); Yatindra Nath Singh (Indian Institute of Technology Kanpur, India & YRRNA Systems Lab, India)

We present the design of an architecture for a peer-to-peer (P2P) live streaming system integrated with a reputation mechanism. The proposed system aims to address the challenges posed by free riders and malicious peers in P2P networks. By incorporating a reputation system, the architecture incentivizes active participation and discourages opportunistic behaviors, fostering a more collaborative and sustainable streaming environment. The design outlines key structural components, including peer roles, content sharing protocols, and reputation assessment mechanisms. The algorithm also tackles issues such as churn, and flash crowds through adaptive strategies and a request-to-join mechanism that forms a hybrid mesh or interconnected tree structure. This approach not only enhances the overall performance and reliability of the P2P live streaming system but also promotes its long-term sustainability by aligning individual peer incentives with the collective goals of the network.

Wednesday, November 27 10:30 - 11:00 (Australia/Sydney)

MT1: Morning Tea

Room: Building G17, Foyer 102

Wednesday, November 27 11:00 - 11:45 (Australia/Sydney)

K1: Opening Keynote - Leveraging Machine Learning and Explainable AI for Enhanced Cybersecurity

Professor Sanjay K. Jha
Building G17, Room G22
Chair: Himanshu Agrawal (Curtin University, Australia)

This presentation examines how machine learning can enhance cybersecurity. By integrating machine learning with methods that promote model interpretability and privacy protection, more robust cybersecurity solutions can be developed. Several key examples are highlighted: machine learning has long been applied to network traffic classification, but this discussion focuses on a novel approach using neural networks to accurately detect malicious traffic on the Tor network. To ensure the model's decisions are understandable and trustworthy, techniques that clarify model behavior are employed. Additionally, recent large language models used for network traffic classification bring forth questions around transparency, particularly when dealing with encrypted traffic. The risks of misinterpretation when using these models in such contexts are considered. Given the critical role of telecommunication infrastructure, companies in this sector face stringent regulatory requirements. The presentation introduces CompliNet, a security assistant powered by large language models, which aids network security professionals in efficiently retrieving compliance information through conversational queries.

Wednesday, November 27 11:45 - 12:30 (Australia/Sydney)

K2: Keynote - The Network is dead, long live the network

Adam Radford
Distinguished Solutions Engineer, Cisco
Building G17, Room G22
Chair: Himanshu Agrawal (Curtin University, Australia)
Enterprise networking has undergone significant transformations, evolving from 10Base5 Ethernet to multi-hundred Gigabit connections, and from 2Mbps wireless to Wi-Fi 7. Despite recurring predictions that innovation in networking has reached its peak, the field continues to evolve, driven by emerging technologies and increasing demands. This session will explore the ongoing evolution of enterprise networks, focusing on the latest advancements and future directions. We will examine how AI is revolutionizing control planes, enabling predictive networking technologies that enhance performance and reliability. The role of Ethernet is also evolving to meet the increasing demands of backend AI networks, as evidenced by initiatives like the Ultra Ethernet Consortium. Additionally, we will delve into the transformative potential of quantum networks. These networks enable quantum communication by allowing the exchange of quantum bits (qubits) through the distribution of entanglement between nodes, facilitating qubit exchange via quantum teleportation. By examining the past, present, and future of enterprise networking, we aim to inspire new research directions and technological advancements in this ever-evolving field.

Wednesday, November 27 12:30 - 13:30 (Australia/Sydney)

L1: Lunch

Room: Building G17, Foyer 102
Venue: Level 6 Building 16 Green Brain, Swanston St

Wednesday, November 27 13:30 - 15:30 (Australia/Sydney)

S3: Session 3: Internet of Things (IoT)

Building G17, Room G22
Chair: Leith H. Campbell (RMIT University, Australia)

13:30 ***A Novel Q-Learning Approach for Next Hop Selection in Source Routing for IoT Environments***

Mohammad M. Kadhum (Algonquin College & Queen's University, Canada)

The rapid proliferation of the Internet of Things (IoT) demands the development of robust and adaptive routing protocols capable of addressing the dynamic and resource-constrained nature of IoT environments. Traditional protocols like AODV and DSR struggle with frequent topology changes and energy limitations inherent to IoT networks. In this paper, we propose a novel Q-Learning-based routing protocol designed to enhance route discovery by enabling nodes to dynamically learn and adapt to network conditions. Leveraging Q-Learning, a reinforcement learning technique, the protocol optimizes routing decisions based on real-time network state information. Theoretical analysis and empirical simulations in ns-3 demonstrate the protocol's superiority in Packet Delivery Ratio (PDR), end-to-end delay, and control overhead compared to conventional routing protocols. The proposed method significantly advances intelligent and efficient routing in IoT networks.

14:00 ***A Comparative Analysis of IoT Device Fingerprinting Methods***

Mariam Munsif Mir (Griffith University, Nathan Campus, Australia); Wee Lum Tan (Griffith University, Australia); Mohammad Awrangjeb (School of Information and Communication Technology (ICT) Griffith University, Australia); Ali Zia (Machine Learning & Artificial Intelligence-Future Science Platforms, CSIRO, Australia)

In the Internet of Things (IoT) era where billions of connected devices interact within smart environments, ensuring secure and accurate identification of these devices is paramount. Device fingerprinting has emerged as a crucial technique to uniquely identify and monitor devices without relying on traditional authentication methods. Given the proliferation of resource-constrained IoT devices, non-intrusive and scalable security solutions are essential. Unlike conventional identification mechanisms, device fingerprinting leverages unique device characteristics to provide a robust security layer. Over the past few years, machine learning (ML) techniques have increasingly been integrated into device fingerprinting methods. These approaches can detect subtle variations in device behaviour and attributes, making them indispensable for device recognition in dynamic IoT environments. In this paper, we conduct a comparative analysis of six representative ML-based device fingerprinting methods using publicly available benchmark datasets. The performance of these methods is evaluated using several metrics, including identification accuracy, time overhead, CPU consumption, and memory usage. Our analysis shows that IoTPROFILE outperforms other methods in performance effectiveness, while IoTDevID and IoT SENTINEL excel in computational efficiency. This provides insights into the strengths and weaknesses of each method, offering a clear understanding of their applicability in different contexts and environments.

14:30 ***FedXAI for Detecting DDoS on IoT Edge Networks in Federated Learning***

Ahmed Asiri, Weiqi Wang, Feng Wu, Hiep K Vo and Shui Yu (University of Technology Sydney, Australia)

Federated Learning has emerged as an approach to distributed learning that utilizes artificial intelligence (AI) to protect data privacy on edge networks and devices. However, Federated Learning-based Internet of Things (IoT) edge networks can still be vulnerable to distributed denial of service (DDoS) attacks which can negatively influence the operations of Federated Learning models running on these networks. Current methods for detecting DDoS primarily focus on securing devices and data, overlooking model protection. In this paper, we utilize and adapt Federated Explainable AI (FedXAI), a Federated Learning designed with SHapley Additive exPlanations (SHAP) to enhance DDoS detection and interpretation within Federated Learning on IoT networks. FedXAI provides interpretable insights into the models that can be crucial for identifying anomalies indicative of DDoS. Our results show that FedXAI improves DDoS detection, contributing to data and model security with higher accuracy, precision, recall, and F-score than the selected baseline models.

15:00 ***Performance Analysis of Single-Carrier and Multi-Carrier Schemes in a Non-Linear Terahertz Communication System***

Safa Yahia Alghadi and Shuo Li (RMIT University, Australia); Withawat Withayachumnankul (The University of Adelaide, Australia); Ke Wang (RMIT University, Australia)

This study presents a systematic comparison of single-carrier modulation schemes versus multi-carrier scheme, i.e., Orthogonal Frequency Division Multiplexing (OFDM), for indoor terahertz communications in the 300 GHz band. The analysis incorporates real-world measurement data, accounting for practical channel conditions and system non-linearities. Our findings show that OFDM without clipping performs worse than single-carrier schemes, as it is more affected by the system nonlinearities. However, with the application of amplitude clipping techniques, OFDM demonstrates enhanced resilience to terahertz channel characteristics and system non-linearity, particularly at higher signal-to-noise ratios (SNR). Results show that OFDM with a clipping ratio of 0.5 achieves a BER improvement of up to 20% compared to single-carrier schemes under the same conditions. These results provide valuable insights into the tradeoffs between single-carrier and multi-carrier modulation schemes for terahertz communications, guiding the design of future wireless systems.

Wednesday, November 27 13:30 - 15:30 (Australia/Sydney)

S4: Session 4: Cybersecurity

Building G17, Room G23

Chair: Shuo Li (RMIT University, Australia)

13:30 ***Limitations of Advanced Persistent Threat Datasets: Insights for Cybersecurity Research***

Abdullah Al Mamun, Harith Al-Sahaf and Ian Welch (Victoria University of Wellington, New Zealand); Marinho Barcellos (University of Waikato, New Zealand); Seyit Camtepe (DATA61 - CSIRO, Australia)

Advanced Persistent Threats (APTs) pose a significant and ever-evolving challenge to cybersecurity, necessitating the development of robust and effective detection mechanisms. Central to this endeavor is the availability of high-quality datasets that accurately capture the complexities and nuances of APT activities. This paper presents a comprehensive analysis of four publicly available APT datasets, focusing on their strengths, limitations, and implications for cybersecurity research. A meticulous examination shows that none of these datasets can be used directly without extensive preprocessing. The strengths and limitations of each dataset are explained, enabling researchers to make informed decisions regarding their selection and application. Additionally, common challenges encountered in APT dataset analysis are identified, and data preprocessing techniques tailored to effectively apply machine learning algorithms are proposed. Leveraging these datasets, initial results demonstrating balanced accuracy across various standard machine learning classifiers are provided. By shedding light on the intricacies of APT dataset management and utilization, this study contributes to the broader discourse on enhancing the detection and mitigation of these sophisticated threats.

14:00 ***The Cybersecurity Management of Incontrovertible Information***

Kaled Aljebur and Ron Addie (University of Southern Queensland, Australia)

Incontrovertible facts (statements whose truth is certain and can't be subverted) can be transferred securely to a trusted server which can then be used by a network of clients to independently and conveniently validate them, without access to their original source. Certnet (Fact Certification Network) provides such a service. The proposed protocol is based on securely capturing the media (photo or video) in a client's mobile device using the mobile device's security hardware as a remote attestation mechanism which ensures the certainty of the fact. The protocol utilises hardware security features like Apple's SEP to provide the remote attestation concerning the client to the server.

14:30 ***Topology- and resource-based distribution scheme for collaborative security-focused design space exploration in large-scale static WSNs***

Benjamin Förster (IHP - Innovations for High Performance Microelectronics, Germany & Brandenburg University of Technology, Germany); Thomas Hinze (Friedrich Schiller University Jena, Germany); Peter Langendoerfer (IHP Microelectronics, Germany)

Security is a crucial aspect in wireless sensor networks (WSNs), ensuring protection of the network and its data against attackers. The resource-constrained nature of sensor nodes, however, poses a challenge for the implementation of security means. Instead of perfect security a trade-off between security, longevity and functional requirements is necessary. The problem of designing optimal security configurations for large-scale static WSNs, becomes even more complex when we intend to take advantage of the distributed nature. On the model of a neighbourhood watch, the advantage of distributed collaborative security is displayed, in which security coverage increases, while the individually induced workload for security tasks is reduced. Ensemble security frameworks provide similar solutions for WSNs by combining multiple security means. While they are capable of optimally utilising available resources to maximise security, they are highly specialised, hence not well adaptable to new applications and requirements. We propose a topology- and resource-based distribution scheme for the design of distributed collaborative security configurations in large-scale static WSNs. Further, we elaborate the application of our scheme and its suitability to be integrated into a design space exploration (DSE) concept. Moreover, we propose a DSE concept that combines exhaustive and heuristic

exploration techniques and is able to integrate analytical and simulation models for evaluation. The computational efficiency of our distribution scheme is evaluated on lambda-precision unit disk graphs as models for WSNs with up to 300 nodes.

15:00 ***Hybrid Deep Learning-based Ensemble Model for detecting network-based cyber-attacks of Industrial Internet of Services***

Ghazia Qaiser (Swinburne University of Technology, Australia); Siva Chandrasekaran (Swinburne University of Technology & Melbourne, Australia); Rifai Chai and Jinchuan Zheng (Swinburne University of Technology, Australia)

The Industrial Internet of Things (IIoT) and Industrial Internet of Services (IIoS) have been positioned as crucial pillars of Industry 4.0 and are continuously accelerating in the digital era. Moreover, in the recent era, the focus has shifted from simply connecting systems and smart devices to offering a more evolved and service-oriented architecture that allows the effective utilization of industrial resources. However, the dynamic complexity introduced by IIoS and IIoT opens the door for cyber-attacks and reveals the industrial architecture of malware and cyber threats. Recent studies have shown that hybrid deep-learning models can potentially mitigate sophisticated cyber-attacks. However, existing models suffer from some concerns, such as low detection rates, false alarms, and resilience to predefined signatures and rules, making them ineffective in detecting sophisticated cyber-attacks. Considering this, this study proposes a deep-learning-based ensemble model (DLEM) that is optimized using ensemble-based models. In DLEM, the hybrid model, which is optimized using ensemble algorithms, is useful for detecting network-based attacks because it utilizes spatial and temporal features to analyze complex and sophisticated patterns. In this DLEM, MLP captures complex features, whereas BiLSTM uncovers correlations and trends that make this model practical for detecting network attacks that evolve gradually. Moreover, the ensemble model in this DLEM improves the final accuracy by integrating decisions from multiple models, which makes the model more robust against a wide range of attacks and prevents false-negative results. The proposed DLEM with 97 % accuracy is valuable for both practitioners and researchers because it offers a robust framework for industrial defense.

Wednesday, November 27 15:30 - 16:00 (Australia/Sydney)

AT1: Afternoon Tea

Room: Building G17, Foyer 102

Wednesday, November 27 16:00 - 17:30 (Australia/Sydney)

S5: Session 5:Wireless

Building G17, Room G22
Chair: Philip Branch (Swinburne University of Technology, Australia)

16:00 ***A study on Transmission Selection for Credit-Based Shaper in IEEE 802.1TSN***

Kaori Iwata and Yoshihiro Ito (Nagoya Institute of Technology, Japan)

This paper proposes a novel method of Transmission Selection (TS) for Credit-Based Shaper (CBS) in IEEE 802.1TSN. To realize Smart Factory, Ethernet is increasingly being adopted for industrial networks. However, QoS control is essential since various data are transmitted on Ethernet. Consequently, the adoption of IEEE 802.1TSN to industrial networks is being considered. CBS is the most considered among many controls defined in IEEE 802.1TSN because of its lightweight implementation. On the other hand, CBS requires TS since it is a shaper. In general, CBS is combined with Strict Priority (SP) as TS. SP transmits frames according to priority. As a result, the maximum transmission delay of middle- or low-priority frames can be significant. This study proposed transmitting frames according to the queue length instead of priority to improve the above issue. From the experimental results, this paper confirmed the effectiveness of the proposal method.

16:30 ***Parameter Estimation-Aided Conditional Handover***

Zolzaya Kherlenchimeg (Univerisity, Mongolia); Telmuun Tumnee, Ugtakhbayar Naidansuren and Nanzadragchaa Dambasuren (National University of Mongolia, Mongolia); Di Zhang (School of Electrical and Information, Zhangzhou University, Mongolia); Battulga D (National University of Mongolia & SITE, Mongolia)

This paper introduces a parameter optimization mechanism tailored for Conditional Handover (CHO) in 5G networks. CHO, a state-of-the-art handover technique designed exclusively for 5G, decouples the preparation and execution phases of the traditional handover process, aiming to reduce incorrect cell selection by employing a list of potential target cells. Despite its advantages, static parameter configurations often compromise CHO performance. We propose a dynamic and automated method for estimating and optimizing CHO parameters to overcome this limitation. Our mechanism adjusts key parameters in fine-tuning the conditions that trigger the execution stage of the handover process. We demonstrate that our approach significantly reduces the incidence of Ping-Pong handovers and radio link errors, enhancing signal stability and more reliable handover performance.

17:00 ***Resource Allocation Optimization with Cluster-Based Auction in Wireless Virtual Reality Networks***

Xinyu Wan, Feiran You and Abbas Jamalipour (University of Sydney, Australia)

Virtual reality (VR) has shown great potential in various fields to provide novel experiences and enhance industrial working efficiencies. The characteristics of high resolution for VR streaming lead to the high requirement of bandwidth during VR streaming, while the proactive streaming in wireless VR communication provides users with an immersive experience under strict latency constraints through viewport prediction. As a large amount of user data is required to train a

strong-applicable prediction model and these data are collected in a distributed manner, the federated learning (FL) framework can be utilized to gather local training weights into global weights without occupying limited bandwidth for data transmission. While users may obtain different individual requirements when participating in the global FL training, an auction-based user clustering algorithm is proposed in this paper to group users based on their preferences for user utility. The simulated annealing (SA) scheme is utilized to select the number of users in each cluster for FL participation and a cluster-based resource allocation approach is presented to allocate resources to users based on characteristics of clusters. By considering the utility of both the small base station (SBS) and users, the proposed approach can provide users with enhanced utility and SBS with sustainable bandwidth usage.

Wednesday, November 27 16:00 - 17:30 (Australia/Sydney)

S6: Session 6: Networking and General

Building G17, Room G23
Chair: Himanshu Agrawal (Curtin University, Australia)

16:00 ***ABACUS: A Joint Optimal Dynamic RMLSA in Elastic Optical Networks***

M Jyothi Kiran (Indian Institute of Technology Kharagpur, India); Venkatesh Chebolu (University of Cyprus, Cyprus); Goutam Das (Indian Institute of Technology, Kharagpur, India); Raja Datta (Indian Institute of Technology Kharagpur, India)

The optimal Routing and Spectrum Assignment (RSA) presents a significant challenge in the Elastic Optical Networks (EONs). Integrating adaptive modulation formats into the RSA problem, i.e. Routing, Modulation Level and Spectrum Assignment (RMLSA), increases allocation options and heightens complexity. The conventional RSA approach involves pre-determining fixed paths and then allocate spectrum within them separately. However, expansion of path set for optimality may not be advisable due to the substantial increase in paths with network size expansion. This paper explores a novel RMLSA, proposing a comprehensive solution addressing route determination and spectrum assignment concurrently. The necessity of concurrent resolution arises from the mutual interdependence between route determination and spectrum allocation. The optimization of overall performance is bolstered by the combination of mutual dependence and the formulation of an objective function that considers both spectrum utilization and fragmentation. So, an objective function has been developed and designated as ABACUS, Adaptive Balance of Average Clustering and Utilization of Spectrum. This nomenclature highlights the objective function's capability to adjust and assign significance to both "average clustering" (lower fragmentation) and "spectrum utilization". Our approach involves formulating an Integer Linear Programming (ILP) model with a simple relationship between path and spectrum constraints. The simulation results shows the reduction in the resources utilized and the fragmentation along with the lowered bandwidth blocking probability at different arrival rates.

16:30 ***Evolution of Data Center Design to Handle AI Workloads***

Tushar Gupta (Senior IEEE Member, USA)

Large Language Model (LLM) training differs significantly from traditional computing tasks, presenting unique challenges for data center design. This computationally intensive workload demands low-latency, high-throughput, and lossless network operations. We present an analysis

of networking solutions designed to address these challenges in AI-focused data centers. Our approach leverages High Performance Computing tools and protocols, including Remote Direct Memory Access (RDMA), InfiniBand (IB), and Priority-based Flow Control (PFC). We examine high-performance networking solutions such as RoCEv2, GPU Cluster Design, and Rail-Optimized Design. These solutions effectively mitigate issues of packet loss and congestion, crucial for LLM training environments. Our analysis reveals potential challenges in implementing these solutions, providing valuable insights for optimizing data center operations in LLM training. This work contributes to the evolving field of AI infrastructure, offering a roadmap for researchers and practitioners developing next-generation data centers for advanced AI applications.

17:00 ***Explainable Artificial Intelligence for Computation Offloading Optimization***

Samarakoon Mudiyanselage Rasini Pamoda Amarasooriya (RMIT, Australia); Mark A. Gregory and Shuo Li (RMIT University, Australia)

Computation offloading has proven effective as a technology that enables mobile devices to run resource-intensive applications. Multi-access Edge Computing facilitates computation offloading for mobile devices. Compute-heavy tasks can be transferred from a mobile device to a nearby cloudlet to reduce computation time and to conserve the battery life of the mobile device. However, due to fluctuating network conditions and the limited computational capacity of the MEC nodes, the offloading decisions made by mobile devices might not always result in the lowest cost. This paper introduces a dynamic offloading framework for mobile users, taking into account the local overhead on the mobile device and the restricted communication and computation resources available on the network. We frame the offloading decision problem as a multi-label classification challenge and employ the eXtreme Gradient Boosting algorithm incorporated with Explainable Artificial Intelligence to minimize computation and offloading overhead. With this research, we show how to exploit Shapley Additive Explanations for feature selection, resulting in an optimal set of features leading to improved accuracy. Furthermore, the simulation results indicate that our approach can reduce system costs by up to 66.67% and 81.09% compared to the random offloading scheme and total offloading scheme, respectively.

Thursday, November 28

Thursday, November 28 9:00 - 11:00 (Australia/Sydney)

S7: Session 7: Network Security

Building G17, Room G22

9:00 ***Enhancing IDS with Ensemble LSTM Networks Using Real and GAN Data***

Roberto Saia, Salvatore Carta, Gianni Fenu, A. Sebastian Podda and Livio Pompianu (University of Cagliari, Italy)

Today's computer system security is critical at every operational level and device, as the compromise of a single element can propagate through connected other network elements, causing unpredictable and dangerous effects. To face unauthorized access and evolving malicious strategies, researchers have intensified efforts to develop effective Intrusion Detection Systems (IDSs) that monitor and analyze network traffic to detect illegitimate activities. This is a difficult challenge given the growing sophistication of malicious tactics that often mimic legitimate behavior. In such a context, this work proposes the HYDRA-LNNE (Hybrid Data Real

and Artificial LSTM Neural Network Ensemble) approach, which involves feature selection and data quantization to reduce data complexity, and an ensemble of three Long Short-Term Memory (LSTM) neural networks trained on real data, GAN-generated synthetic data, and a combination of both, with the aim to maximize the strengths of each data type, effectively discriminating normal from malicious network activities. The validation process performed on the UNSW-NB15 dataset, well known for its comprehensive representation of modern cyber threats, shows that our approach outperforms state-of-the-art solutions across multiple metrics.

9:30 ***WNetMon: An ML Approach for Real-time DoS Attack Detection in Wireless Networks***

Fahim Faisal and Birupaxha Mondal (Independent University Bangladesh, Bangladesh); Md Fahad Monir (Virginia Polytechnic Institute and State University, USA); Tarem Ahmed (Independent University, Bangladesh (IUB), Bangladesh); Md Zahangir Alam (Independent University, Bangladesh)

Denial of Service (DoS) attacks have emerged as sophisticated threats that exploit the known vulnerabilities of wireless communication, potentially sabotaging their operations and causing extensive downtime. Among these, de-authentication, disassociation and beacon flooding are particularly concerning due to their efficiency in disrupting network services. This paper delves into different types of Denial of Service (DoS) attacks and proposes a state-of-the-art detection mechanism. Most of the current state-of-the-art ML and DL-based IDSs are evaluated on the training dataset, which needs more variation in real-time attack data and requires substantial computational resources. In the following work, we propose a lightweight software solution named WNetMon, developed using the AWID2 dataset and evaluated using a new dataset generated using our custom testbed. Moreover, it can perform real-time Denial of Service (DoS) flooding attack detection on edge devices in wireless networks. Our results show that, while being small and effective, WNetMon achieves an overall accuracy of 99% for attack detection, benchmarked in real-time network traffic generated in our testbed. Therefore, it demonstrates the potential for using extensible ML solutions for Denial of Service (DoS) attack detection on edge systems that cannot execute industrial network monitoring tools due to resource constraints.

10:00 ***A Novel AI approach for Privacy Preserving In biomedical Using Federated Learning***

Nhung Hong Nguyen (Gachon University & Viet Tri Industry University, Korea (South)); Duc Hong Thi Phan (RMIT University, Australia & Knowledge Bridge Research Institute (KBERI), Australia)

One of the pivotal applications of artificial intelligence (AI) in the healthcare sector is to reduce dependency on human physicians, or at least diminish the frequency of their necessity. While AI cannot yet entirely replace doctors, it functions as an indispensable tool that significantly enhances their capabilities. This research summarizes various technologies that facilitate the integration of AI into healthcare applications. In particular, the development of effective AI systems necessitates the accumulation of vast datasets. Centralizing this data is imperative, which requires establishing a robust platform capable of storing and providing seamless access to this data for future use. Federated learning, a type of distributed and decentralized machine learning, is particularly useful when users cannot or do not wish to share their data with a central server due to privacy and security concerns. This paper also summarizes general solutions to the statistical, system, and privacy challenges in federated learning, highlighting some results of machine learning techniques applied to healthcare. Ultimately, this paper can serve as a

foundation for guiding future research in AI based on federated learning for healthcare challenges.

10:30 ***ExpIDS: A Drift-adaptable Network Intrusion Detection System With Improved Explainability***

Ayush Kumar, Kar Wai Fok and Vrizlynn L. L. Thing (ST Engineering, Singapore)

Despite all the advantages associated with Network Intrusion Detection Systems (NIDSs) which use machine learning (ML) models, there is a noticeable hesitance among security practitioners when it comes to deploying those models in real-world production environments due to their black-box nature, i.e., how and why the underlying models make their decisions. In this work, we design a NIDS, ExpIDS to have high decision tree explanation fidelity, i.e., the predictions of decision tree explanation corresponding to ExpIDS should be as close to ExpIDS's predictions as possible. ExpIDS can also adapt to changes in network traffic distribution (drift). With the help of extensive experiments, we verify that ExpIDS achieves higher decision tree explanation fidelity and a malicious traffic detection performance comparable to state-of-the-art NIDSs for common attacks with varying levels of real-world drift

Thursday, November 28 9:00 - 11:00 (Australia/Sydney)

S8: Session 8: Networking and General

Building G17, Room G23

Chair: Philip Branch (Swinburne University of Technology, Australia)

9:00 ***A Machine Learning Approach to Estimating Queuing Delay on Routers: The Multiple-Hop Case***

Khondaker M Salehin (University of Portland, USA); Travis Ricker, Yi Wang and Alex Chen (California State University, Dominguez Hills, USA); Eiji Oki (Kyoto University, Japan)

Compression and Decompression (CoDe) is an active, state-of-the-art scheme for measuring queuing delay on Internet routers that utilizes an unsupervised learning algorithm for data processing. In this paper, we present a comparative evaluation of CoDe over a multiple-hop path under demanding traffic conditions using ns-3 simulation. This is the first evaluation of this kind because prior study of the scheme only considered a single-hop path, reflecting a limited performance evaluation. Our simulation data shows that CoDe measures queuing delay on intermediate routers along a multiple-hop path with high accuracy. It also outlines some measurement challenges prevalent in other existing schemes.

9:30 ***A Specialised Synthetic Mobility Model Based on Real-World Traces***

Max Amiri, David Eyers and Zhiyi Huang (University of Otago, New Zealand)

The rapid expansion of the Internet of Things presents new opportunities for network optimisation, especially with the rise of connected vehicles and IoT devices in industrial areas. In these settings, service vehicles can act as data sinks for battery-powered IoT devices, improving cloud communication, extending battery life, and reducing costs.

Existing mobility models, like VANET, focus on urban or rural areas and do not capture the unique movement patterns of service vehicles in industrial environments. This gap motivates the

development of specialised models tailored for such vehicles in bounded industrial areas.

This paper introduces a synthetic mobility model for service vehicles in industrial areas based on thousands of real-world traces. Our contribution includes insights into mobility patterns, along with the probability distributions and their best-fitting mathematical models.

Our Markovian memory-based model predicts future speed and direction using past speed ranges and provides the best-fitting mathematical model for each extracted distribution. The novelty of this work lies in our new dataset and the model's accuracy, which achieves an 86% to 98% match with our mobility dataset.

10:00 ***StackSpecter: Detecting Stack Buffer Overflows for the Xtensa Architecture***

Kai Lehniger and Peter Langendoerfer (IHP Microelectronics, Germany)

This paper presents a new approach, StackSpecter, for stack buffer overflow detection, specifically for architectures with register windows. It uses a combination of plausibility checks for stack pointers and obfuscation using a secret XOR key. This combination allows it to give similar security guarantees as stack canaries but without the need of adjustments to the stack frame layout. StackSpecter was implemented by modifying the FreeRTOS operating system of a ESP32 microcontroller. The performance overhead was evaluated using BEEBS, showing an average overhead of only 0.114%, a large improvement compared to stack canaries, and a worst-case overhead of 64.854% compared to an unprotected application.

10:30 ***Radio Propagation Model Adjusted to Mountainous Topography for TVWS Coverage Study***

Jherson F Caceres Chanaga, Efren D Acevedo Cardenas and Julian Rodriguez-Ferreira (Universidad Industrial de Santander, Colombia)

The Internet brings significant technological innovations, but not all sectors of the population have access to this service, especially in rural areas due to the digital divide. This necessitates the deployment of emerging technologies like TVWS to help rural communities enter the digital age. Nevertheless, accurate radiopropagation models are required to effectively plan their implementation. Currently, adjustments to these models are being developed for specific areas to improve their performance in targeted applications. However, there has been limited development of these models for mountainous terrains, mainly due to the focus on cellular networks in urban areas, leaving less attention for case studies in rural zones. This paper proposes an enhanced radiopropagation model through parameter adjustment, based on data obtained from a measurement campaign conducted in a mountainous rural area, focusing on TVWS characteristics. The model is validated by simulating the coverage of a TVWS base station, achieving a root mean square error of 6 dB when comparing measured and simulated data. Furthermore, it demonstrates greater accuracy compared to other models used with the same approach. This suggests that the proposed model is suitable for predicting propagation losses in irregular terrains, thus facilitating the optimal deployment of TVWS technology.

Thursday, November 28 11:00 - 11:30 (Australia/Sydney)

MT2: Morning Tea

Room: Building G17, Foyer 102

Thursday, November 28 11:30 - 12:15 (Australia/Sydney)

K3: Keynote - Toward Internet of Things with Endogenous Intelligence

Professor Huadong Ma
Building G17, Room G22
Chair: Himanshu Agrawal (Curtin University, Australia)
The Internet of Things (IoT) has been widely recognized as the kernel technology for sensing the physical environments and providing smart services further. At the same time, the rapid development of Artificial Intelligence (AI), from traditional Machine Learning and Deep Learning to Large Model Learning, brings many opportunities to IoT. In this talk, first, we will introduce the long-term challenges of the development of IoT. Combining AI theory, then we will present some explorations and recent research progress on intelligent sensing, intelligent transmission, and intelligent service in the IoT environment. In the future, endogenous intelligence will drive the revolution of IoT, we will discuss the open issues in the IoT area, such as the theories and key technologies of human-like sensing, concise and intelligent networking for heterogeneous wireless networks, and cognitive service. The breakthrough for solving the above problems will promote the innovative development of the Internet of Things.

Thursday, November 28 12:30 - 13:30 (Australia/Sydney)

L2: Lunch

Room: Building G17, Foyer 102
Venue:

Thursday, November 28 13:30 - 17:30 (Australia/Sydney)

T1: Conference Tour

meet outside Building for the bus departing at 1:40 PM at UNSW Gate 2 Avenue near the IGA store close to High Street.

Thursday, November 28 18:30 - 22:00 (Australia/Sydney)

D1: Conference Dinner

Venue: Coogee Pavilion Rooftop

Friday, November 29

Friday, November 29 9:00 - 10:30 (Australia/Sydney)

S9: Session 9: UAV

Building G17, Room G22
Chair: Leith H. Campbell (RMIT University, Australia)

9:00 ***A Deep Learning Algorithm for UAV Placement in 6G Cell-Free Massive MIMO Networks***

Hongyu Zhu and Abbas Jamalipour (University of Sydney, Australia)

Cell-Free massive MIMO (CF-mMIMO) represents a significant advancement in the sixth-generation communication systems (6G), characterized by numerous distributed access points managed collectively to enhance user service. This paper introduces a novel strategy employing Unmanned Aerial Vehicles (UAVs) as mobile base stations to capitalize on the inherent flexibility, ease of deployment, and extensive operational scope provided by CF-mMIMO. We develop a deep learning model that facilitates the rapid deployment of UAVs, ensuring dynamic and efficient communication coverage. This model not only predicts the aggregate data transmission rates but also enables UAVs to adapt swiftly to changes in user location, thereby optimizing overall network performance.

9:30 ***Meteorological and Topographical Big Data-Driven UAV Trajectory Planning***

Shuaijun Liu (Boston University, USA); Jiaying Yin (University of Cambridge, United Kingdom (Great Britain)); Jinqiu Du (University of Washington, USA); Yaxin Zheng, Yuhui Deng and Jingjin Wu (BNU-HKBU United International College, China)

We propose a comprehensive trajectory planning framework for quadcopter unmanned aerial vehicles (UAVs) assisting in edge computing, aiming to control their crash probability when deployed at the edge of the Internet of Things (IoT) across diverse meteorological and topographical environments. First, we collect hourly meteorological data from the National Oceanic and Atmospheric Administration's (NOAA) Integrated Surface Data (ISD), which includes 16 key metrics such as temperature, atmospheric pressure, wind speed, and solar radiation. We then use the Spark framework and a Long Short-Term Memory (LSTM) network, accounting for seasonal trends, to predict meteorological conditions based on the collected data. Subsequently, we combine a dynamic risk assessment model with the EndoH crash risk model to calculate the probability of crash. Finally, we design a three-dimensional ant colony system variant, referred as ACS-DS-R, to plan UAV trajectories, incorporating meteorological predictions and topographical information. Our proposed framework dynamically adjusts UAV paths based on terrain data and real-time meteorological predictions to avoid high-risk areas, significantly reducing crash rates. We present extensive numerical results using real data from across Japan-including cities, forests, lakes, coasts, and mountainous areas-demonstrating that our approach reduces crash probability by more than 33%, improves the task completion rate by about 2.58 times while increases total energy consumption by only 13% compared to existing mainstream approaches. Our work demonstrates the value of integrating real-time meteorological predictions and topographical data into UAV trajectory planning, offering a practical solution for safer and more efficient UAV deployments in diverse environments.

10:00 ***Joint Task-Trajectory and Location Sense Optimization for UAV-enabled Communication Computation and Sense System***

Siyu Ren and Mei Haibo (University of Electronic Science and Technology of China, China); Shuang Du (University of Electronic Science and Technology of China(UESTC), China); Fan Runzhi (University of Electronic Science and Technology of China, China); Qi Wang and Huan Ye (Chengdu Jiuzhou Electronic Information System Co., Ltd., China)

Integrated communication computation and sensing becomes a key technology for 6G system. With radio frequency (RF) sensing, mobile users can more easily receive communication and computation services from 6G providers, to support applications like VR, XR and Meta Universe. This paradigm shift will be particularly considered in 6G emergency scenarios, where UAVs are intensively applied. To this end, we consider the UAV-enabled Communication Computation and Sensing system, where multiple UAVs in the air provide communication and computation services to ground terminals (GTs), and each UAV has the RF sensing ability to sense the location of GTs with acceptable accuracy. We further formulate the joint optimization of UAV trajectory, task offloading and GT location sensing as a multi-constrained non-linear problem. A Successive Convex Approximation (SCA) method will be used to solve the problem to find the sub-optimal solution. With such solution, UAVs will provide communication and computation services with higher QoS on latency, and the UAV will work in a better energy efficient way. In the end, we provide numerical results to validate that the proposed solution does improve the performances of the considered system.

Friday, November 29 9:00 - 10:30 (Australia/Sydney)

S10: Session 10: LoRa Networks

Building G17, Room G23

Chair: Shuo Li (RMIT University, Australia)

9:00 ***DDFH: Dynamic Dual Frequency Hopping for LoRa Networks***

Ana Rita Ortigoso (CIIC - Polytechnic University of Leiria, Portugal); Gabriel Vieira (Polytechnic University of Leiria & CIIC, Portugal); Daniel Fuentes (CIIC - Polytechnic University of Leiria, Portugal); Luis Frazao (Polytechnic University of Leiria & CIIC Research Centre, Portugal); Nuno Costa and António Pereira (Polytechnic Institute of Leiria, Portugal)

This short paper introduces the Dynamic Dual Frequency Hopping (DDFH), a novel architectural approach for LoRa networks, designed to address the inherent limitations in existing LoRa implementations, including regulatory duty cycle restrictions and security vulnerabilities. The proposed solution employs two distinct frequency hopping mechanisms: LoRa Temporal Frequency Hopping (LTFH) for the management network and LoRa Software-Defined Frequency Hopping (LSFH) for the access network. By implementing a mesh topology based on controlled flooding, the architecture enhances both network scalability and security, making it more suitable for Internet of Things (IoT) applications in demanding environments. A prototype, utilising diverse Single-Board Computers (SBCs) and LoRa modules demonstrates the feasibility of the architecture with 94.66% average received message success rate. Preliminary results suggest significant improvements in network resilience and data transmission efficiency, validating the effectiveness of the DDFH approach. Future work will focus on optimising the system performance and scalability through extensive testing across various environments and deployments.

9:30 ***Power Saving in LoRa Linear Networks through Self Synchronization***

Philip Branch (Swinburne University of Technology, Australia); Jason But (Swinburne University, Australia)

This paper describes an implementation of reduced duty cycle power saving for lightly loaded, multi-hop, LoRa linear networks. Reduced duty cycle power saving requires nodes to be in a low power state until a scheduled message is expected whereupon they go into full power mode, process the message, reschedule the next time they expect another message and go back into low power mode. The challenge of synchronization frequently makes this approach infeasible. However, LoRa linear and near linear networks can be made self-synchronizing. We implemented a LoRa linear network with a single source generating data every ten seconds with four relays and a single destination. We carried out experiments with four different network topologies and took measurements of power consumption. Using reduced duty cycle reduced average power consumption of source nodes by 80%, relay nodes by 71% and destination nodes by 79%

10:00 ***Flooding in LoRa Mesh Networks***

MD Jannatul Rakib Joy and Philip Branch (Swinburne University of Technology, Australia)

Although LoRa is most well known for the substantial distances over which it can transmit it also has some characteristics that make it attractive as a mesh networking technology. In particular it overcomes one of the main objections to using flooding as a routing mechnanism in mesh networking. Flooding involves each node in the network forwarding a copy of every message it receives. Flooding is robust and simple but unfortunately, if multiple nodes in the mesh receive a message it typically results in many copies of the same message being received at the destination. However, a LoRa receiver synchronises with only one transmitter and treats other messages as noise. Because duplicate messages are ignored flooding can be designed to be much less wasteful of radio resources than mesh networks based on other wireless technologies. In this paper we demonstrate that LoRa's physical layer mechanism ensures only one copy of a message is forwarded by a node, regardless of how many copies it receives. We then present results from a simple LoRa mesh network to demonstrate that, for LoRa nodes, flooding is an efficient method of routing.

Friday, November 29 10:30 - 11:00 (Australia/Sydney)

MT3: Morning Tea

Room: Building G17, Foyer 102

Friday, November 29 11:00 - 11:45 (Australia/Sydney)

K4: Keynote session: Explainable AI-Enabled Haptic Feedback Prediction for Human-to-Machine Applications

Professor Elaine Wong

Building G17, Room G22

Chair: Himanshu Agrawal (Curtin University, Australia)

The immersive experience of humans through remote machines has a high potential for economic and societal impact - from enabling tactile robots for industrial applications to assistive technologies for

the elderly and those with additional needs. Nonetheless, the emergence of human-to-machine (H2M) applications poses significant challenges to communication networks that carry multi-modal information between humans and machines/robots. H2M communications require ultra-low latency, and high reliability to ensure seamless responsive interactions between humans and machines. As such, advanced network architectures, hardware, and bandwidth allocation algorithms have been investigated to provide quality-of-service guarantees for these latency-sensitive applications. Foremost, AI-enhanced servers located at the optical line terminals of optical access networks have been proposed to predict haptic feedback signals, thus reducing the round-trip time in control feedback loops. In this plenary talk, we will review our newly proposed explainable AI (XAI) framework for haptic feedback prediction. The framework harnesses a feature selection process based on Shapley additive explanations to reduce the number of features in the machine learning model such that training and inference times can be reduced. This reduction is important for supporting latency-sensitive H2M applications and improving the overall user experience. For future H2M communication networks, deploying XAI-enhanced servers is a promising solution to further reduce latency.

Friday, November 29 11:45 - 12:30 (Australia/Sydney)

T: Tutorial

Building G17, Room G22

Friday, November 29 12:30 - 13:30 (Australia/Sydney)

L3: Lunch

Venue: Level 6 Building 16 Green Brain Swanston St

Friday, November 29 13:30 - 15:30 (Australia/Sydney)

S11: Session 11: Smart Cities, Intelligent Transportation, and Network Optimization

Building G17, Room G22
Chair: Hassan Habibi Gharakheili (University of New South Wales, Sydney, Australia)

13:30 ***Innovative Message Routing for next Generation Transportation System using GA-based SVM***

Priyanka Singla (Ch. Ranbir Singh University, India); Himmat Rathore (DISYS Solutions Inc., USA)

In the past decade, the public's access to electric vehicles (EVs) and unmanned aerial vehicles (UAVs) has been made possible by ongoing technological breakthroughs in the recent past. However, intelligent models of transportation are still needed and for that purpose, there is a need to create suitable and improved protocols that empower these powered-by-battery devices to communicate predictably and quickly. In this research, the difficulties in signal routing within an integrated framework of electric and flying vehicles are a prime focus. A multifaceted message routing system for such vehicles is discussed in this paper that is based on a modified genetic algorithm (GA) with Support Vector Machine (SVM). The study presents an improved and intelligent approach that presents an optimal and potential solution. In addition, vehicles' dependability, data transfer speed, and remaining power are also considered substantial communication benefits. The proposed method surpasses the existing methods and provides

more packet delivery at 90%, the shortest average hop distance, and a longer connectivity time. To validate performance of the work, its accuracy was compared with the four existing works.

13:54 ***Improving the Convergence of a Data-Driven Factor Graph Model for UWB-Based Positioning in Challenging Indoor Scenarios***

Ana Moragrega (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC-CERCA), Spain); Carles Fernández-Prades (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Spain)

Indoor scenarios can pose challenges for localization. Effects such as multipath and non-line-of-sight propagation between devices can cause errors in positioning systems that utilize radio technologies, even in ultra-wideband (UWB) technology-based systems. Additionally, the geometrical location of the anchor nodes can also impact the positioning error with lateration. In the case of iterative algorithms such as those based on Machine Learning, these effects can affect algorithm convergence. This work presents a solution to enhance the convergence stage of a Data-driven Factor Graph (FG) Model for UWB-based positioning in these scenarios. The FG is represented as a tree, a connected and acyclic graph that ensures convergence of the Gaussian Belief Propagation (BP) algorithm. The new solution utilizes Gaussian Mixture Model fitting to estimate the covariance of distances between the target and anchor nodes. The presented solution is compared with the classical solution that estimates the covariance with a Gaussian fitting. The comparison is conducted using real-life data collected from sensor network nodes compliant with IEEE 802.15.4, featuring a physical layer based on UWB technology. The results show that in challenging scenarios, the presented solution improves the rate of the convergence phase of BP, although at the expense of increased complexity in the FG-based algorithm.

14:18 ***Congestion Prevention at Ingress Peering Links***

Yannick Carlinet, Eric Gourdin and Nancy Perrot (Orange Labs, France)

This paper focuses on the problem of congested ingress interfaces in the case of peering agreement. For various reasons, in this case, it is not possible to increase the interface capacity. Therefore, traffic engineering is a good candidate to better balance load in ingress interfaces. Traffic can be redirected from the congested interface to another one thanks to specific BGP mechanisms. However, the problem of selecting which traffic to redirect can become quite difficult due to its combinatorial structure. Nonetheless, the problem, that we show to be NP-hard, can be tackled by exact approaches. We propose an Integer Linear Program (ILP) formulation which can be used, together with a solver, to obtain, within very short computing times, exact optimal solutions. The benefit of this approach is assessed by comparing its optimal results with a natural greedy heuristic algorithm that serves as a baseline solution. The results of both approaches, applied on instances collected from a real tier-1 transit network, show that the optimal exact approach allows to reduce the number of interfaces to reconfigure by up to 19% on average. More importantly, this exact approach is much more efficient in finding feasible solutions, whereas the greedy sometimes fails, and hence does not provide useful solutions to the network administrators.

14:42 ***On the way to distribute Compute Continuum Urban applications by deploying Clusters of Drones***

Giuseppe Tricomi (Institute for High Performance Computing and Networking of ICAR, Italy & University of Messina, Italy); Luca D'Agati, Michele Arena and Francesco Longo (University of Messina, Italy); Giovanni Merlino (University of Messina & National Interuniversity Consortium for Informatics (CINI), Italy); Antonio Puliafito (University of Messina, Italy); Stefano Silvestri (Institute for High Performance Computing and Networking, ICAR-CNR, Italy)

Nowadays, Smart Cities leverage cutting-edge technologies to improve quality of life, optimize sustainability, and streamline urban infrastructure. Among the key technologies revolutionizing urban planning and infrastructure development, drones and the IoT have established themselves as true catalysts of change. The following steps in urban environment evolution go through the Computing Continuum paradigm adoption, where distributed applications seamlessly integrate into the urban fabric, extending computing power from the cloud to edge devices such as drones. These quickly deployable drones assist in traffic management, car parking, crowd monitoring and control, weather assessments, security, and emergency responses. This is possible thanks to the exploitation of drones' bird's-eye view, enabling urban planners and stakeholders to collect precise data, conduct inspections, and perform assessments with unprecedented efficiency. On the other hand, IoT sensors and devices provide real-time insights into various aspects of urban life, from traffic patterns and air quality to waste management and energy consumption. The use of drones in Smart Cities is not limited to simple data collection; they are versatile tools with numerous applications, particularly in the areas of surveying, mapping, and inspections, by the acquisition of data from their sensors that may be processed in near Fog devices belonging to Smart City Computing Continuum infrastructure. This work presents an all-encompassing study describing architectural insights, application deployment, and management of sensing elements (drones).

15:06 ***Three-Phase Handover Protocol Design for Multi-access Edge Computing***

Shaima Alkaabi, Mark A. Gregory and Shuo Li (RMIT University, Australia)

Multi-access Edge Computing (MEC) plays a crucial role in reducing latency and enhancing the Quality of Experience by bringing cloud services to the network edge. One of the primary challenges within MEC is ensuring seamless handovers between servers, specifically during end-user mobility, without disrupting active sessions. To address this challenge, we propose the Server Search and Select Algorithm Protocol (SSSAP), a standardized protocol designed to manage handovers across heterogeneous MEC networks. SSSAP leverages the User Datagram Protocol (UDP) to guarantee low latency and fast transmission. It gives a structured approach for handover decision-making, utilizing real-time network metrics to enhance session continuity, inspired by the architecture of Transmission Control Protocol (TCP). By establishing a scalable framework for seamless interoperability in MEC environments, SSSAP ensures uninterrupted service delivery, reduces handover latency, and improves network performance. SSSAP is particularly relevant as MEC evolves to support next-generation technologies.

Friday, November 29 13:30 - 15:30 (Australia/Sydney)

S12: Session 12: Wireless Communications and Networking

Building G17, Room G23

Chair: Shuo Li (RMIT University, Australia)

13:30 ***Improving Last-Mile Maritime Communication Using Intelligent Reflecting Surfaces***

Saurab Rauniyar (University of Oslo, Norway); Pål Orten (Kongsberg Maritime & University of Oslo, Norway); Stig Petersen (Sintef ICT, Norway)

Near-shore ship communication is vital to maritime operations, serving as the last-mile communication link between vessels and shore-based infrastructure. Despite its importance, this environment poses pressing challenges. The high density of ships, towering vessels, shore-based buildings, and natural obstacles like mountains obstruct communication paths, leading to degraded signal quality and reliability. Moreover, sea surface reflections and other obstructions create a complex propagation environment, often resulting in composite fading channels. These channels are modeled as a mixture of Nakagami-m multipath fading and log-normal shadowing, capturing both small-scale and large-scale fading effects. If these challenges are not adequately addressed, they can severely compromise the safety and efficiency of maritime operations. To address these issues, we propose to use Intelligent Reflecting Surfaces (IRS) to enhance last-mile communications in the maritime domain. IRS can dynamically manipulate electromagnetic waves to optimize signal propagation and improve communication performance. By smartly adjusting the phase shifts of IRS elements, our approach aims to enhance signal strength, extend coverage, and mitigate both composite fading effects. Our results demonstrate that the IRS-aided system can effectively outperform the traditional relaying systems by 6bps/Hz. Implementing IRS in near-shore communication networks further enhances maritime operations, providing more resilient and efficient communication channels.

13:54 ***Frame Error Rate of Turbo Coded Rotating Polarization Wave***

Muhammad Moazzam Ali (Universiti Putra Malaysia, Malaysia); Shaiful Hashim (UPM, Malaysia); Zaid Ahmad (Universiti Putra Malaysia, Malaysia & COMSATS University Islamabad, Pakistan); Guillaume Ferré (University of Bordeaux, France); Fakhrul Zaman Rokhani (University Putra Malaysia, Malaysia); Muhammad Akmal Chaudhary (Ajman University, Ajman, United Arab Emirates)

This study provides the performance of a turbo-coded rotating polarization wave in Additive White Gaussian Noise (AWGN) and Rayleigh fading wireless communication channels. To test the robustness of the system under changing channel circumstances we compute the Frame Error Rate (FER) over a range of Signal-to-Noise Ratios (SNRs) using MATLAB simulations. We show that, in comparison to uncoded systems, the turbo-coded system with rotating polarization wave greatly enhances error correcting capabilities. More precisely, for three polarization states (Np=3) and five polarization states (Np=5), a 2.2 dB improvement in FER is noted in the condition of Rayleigh fading. These results show that using several polarization states lessen the negative consequences of channel impairments. The better error correction performance emphasizes how Turbo-coded rotational polarization can be used in contemporary wireless communication systems to provide more dependability and robustness. The capabilities of the system are thoroughly analyzed in this work, which paves the way for further study and useful applications in the area of Low Power Wide Area Network (LPWAN).

14:18 ***Reliability-considered Multi-platoon's Groupcasting using the Resource Sharing Method***

Chung-Ming Huang and Yen-Hung Wu (National Cheng Kung University, Taiwan); Duy-Tuan Dao (University of Science and Technology Da Nang, Vietnam)

In the context of 5G platoon communications, the Platoon Leader Vehicle (PLV) employs groupcasting to transmit control messages to Platoon Member Vehicles (PMVs). Due to the

restricted transmission power for groupcasting, it may need to pick one PMV as the Platoon Relay Vehicle (PRV) to be responsible for re-groupcasting PLV's messages. To optimize the usage of limited spectrum resources, resource sharing can adopted to enhance spectrum efficiency within the platoon. This study proposes a resource allocation method, which is called Resource Sharing for Platoon Groupcasting (RSPG), for platoon's groupcasting based on transmission reliability. RSPG utilizes the tripartite matching to assign a subchannel to either a PLV or PRV that shares the assigned subchannel with the corresponding individual entity (IE), which does not belong to any platoon. The simulation results shown that the proposed method has the better performance in terms of IEs' QoS satisfaction rate, the number of allocated subchannels for platoons, and spectral efficiency.

14:42 ***Deep Learning-Based Automatic Modulation Classification for Composite Modulated Radar Signal Using Time-Frequency Image***

Geonho Song, Ganghyuk Jeon and Dongweon Yoon (Hanyang University, Korea (South))

Automatic modulation classification (AMC) of radar signals is a crucial technique in modern electromagnetic warfare. Recently, various AMC methods using deep learning (DL) have been proposed. This paper focuses on an DL-based AMC for composite modulated radar signals, leveraging the time-frequency image (TFI) of the received radar signals. We propose a novel TFI generation method that can reduce distortion to enhance classification performance. The proposed method first generates a grayscale TFI from the received radar signal and reduces its noise via temporal marginalization and the μ-law function. The resulting image is then standardized and clipped along the frequency axis for pattern enhancement. Through computer simulations on various DL models, we show that the proposed method outperforms the conventional ones in terms of classification accuracy.

15:06 ***Towards WRSN Security: Probabilistic Approach for Malicious Node Identification***

Ayush Verma and Tanuj Chandela (Netaji Subhas University of Technology, India)

The advancement of Wireless Power Transfer (WPT) has led to the widespread adoption of Wireless Rechargeable Sensor Nodes (WRSNs) for distributed reporting, making these networks attractive targets for adversaries seeking to disrupt their functionality. Numerous solutions have been proposed, such as machine learning, cryptography, and verification protocols. However, these methods are typically designed for Wireless Sensor Networks (WSNs) and may not be suitable for resource-constrained rechargeable sensor nodes. In this paper, we focus on preventing malicious nodes from establishing legitimate connections with normal nodes, which can severely disrupt the network. We propose a sensor node registration mechanism with multiple Cuckoo Filter-based verification and malicious node isolation. We also employ MinHashing, k-shingling, and Jaccard similarity techniques at the Mobile Charger for effectively detecting Replicated nodes and fake connections. We also perform a comprehensive performance analysis of our approach, demonstrating its efficiency in detecting and mitigating false nodes.

Friday, November 29 15:30 - 16:00 (Australia/Sydney)

AT3: Afternoon Tea

Room: Building G17, Foyer 102

Friday, November 29 16:00 - 16:15 (Australia/Sydney)

CR: Closing Remarks

ITNAC 2025 is in Christchurch, New Zealand
Himanshu Agrawal, General Co-Chair, Curtin University
Room: Building G17, Foyer 102