2022 32nd International Telecommunication Networks and Applications Conference (ITNAC)

Time	CO431	COLT122 (Cotton Building)	MCLT103 (Maclaurin Building)
Tuesday, November 29			
16:00-18:00	WR: *Welcome Reception*		

Wednesday, November 30

08:00-08:30	R1: *Registration*		
08:30-10:40		S2: *Session 2: Wireless*	S1: *Session 1: Mobile*
10:40-10:45	*Conference Opening*		
10:45-11:00	MT1: *Morning Tea*		
11:00-12:00			K1: *Keynote - Computer Network Automation*
12:00-12:45			K2: *Keynote - Intelligent surfaces and fluid antenna systems - new technologies for 6G?*
12:45-13:30	L1: *Lunch*		
13:30-15:30			W1: *Workshop: Online interactive workshop*
15:30-16:00	AT1: *Afternoon Tea*		
16:00-16:30	W2K: *Workshop: ICT4C3 Keynote Leading the global frontiers of*	S4: *Session 4: online networking*	S3: *Session 3: online wireless*

	technology-driven Humanitarian engineering programs for delivering sustainable innovations		
16:30-18:00	W2A: *Workshop 2: ICT4C3 Papers*		
18:00-18:45			

Thursday, December 1

08:30-10:30		S6: *Session 6: IoT*	S5: *Session 5: Optical networking*
10:30-10:40			
10:40-11:00	MT2: *Morning Tea*		
11:00-12:00			K3: *Keynote - Integrated Silicon Photonics Signal Processing and Sensing*
12:00-13:00			K4: *Keynote - At the Core of Internet Timing*
13:00-13:45	L2: *Lunch*		
14:00-17:30	T1: *Conference Tour*		
18:00-22:00	D1: *Conference Dinner*		

Friday, December 2

08:30-10:30		S7: *Session 7: General*	S8: *Session 8: Networks and Security*
10:30-11:00	MT3: *Morning Tea*		
11:00-12:00			K5: *Keynote - Tips and tactics for successful PhD research*
12:00-13:00	L3: *Lunch*		
13:00-15:30		S10: *Session 10: Wireless and Security*	S9: *Session 9: Networks and Design*
15:30-16:00	AT3: *Afternoon Tea*		
16:00-18:00		S12: *Session 12: Networks*	S11: *Session 11: General*
18:00-18:10	CR: *Closing Remarks*		

Tuesday, November 29

Tuesday, November 29 16:00 - 18:00 (Pacific/Auckland)

WR: Welcome Reception

Ian Welch

Chair: Harith Al-Sahaf (Victoria University of Wellington, New Zealand)

Venue: Milk and Honey (https://goo.gl/maps/ZTBUVpvT9pSNdZ1p8) 21 Kelburn Parade, Kelburn, Wellington 6012 Welcome, an opportunity to meet and talk with other authors and attendees. For online participants it is an opportunity to check Internet connectivity and applications are working ok.

Wednesday, November 30

Wednesday, November 30 8:00 - 8:30 (Pacific/Auckland)

R1: Registration

Venue: Cotton Building Foyer (COB151)

Wednesday, November 30 8:30 - 10:40 (Pacific/Auckland)

S2: Session 2: Wireless zoom

Room: COLT122 (Cotton Building)

Chairs: Abdullah Al Mamun (Victoria University of Wellington, New Zealand), Arman Khouzani (Victoria University of Wellington, New Zealand)

zoom password: 493593

8:30 ***Performance of OTFS Modulation over Rician Channels in Airborne Communication Networks***

Thi My Chinh Chu and Hans-Juergen Zepernick (Blekinge Institute of Technology, Sweden); Anders Höök (SAAB AB, Sweden); Alexander Westerhagen (Saabgroup, Sweden); Bo Granbom (Saab AB, Sweden)

In this paper, we consider airborne communication networks with directed air data links between high-mobility airborne platforms. Orthogonal time frequency space (OTFS) modulation is used to overcome the effects of the high Doppler shifts induced by the high relative speeds among airborne platforms which can be in excess of 1200 m/s. The performance of the considered system is assessed using the Rician channel to model the directed air data links accounting for the ratio of the signal power in the line-of-sight path to the signal power in the scattered paths. The numerical results reveal significant bit error rate (BER) improvements with increased Rician K-factor, illustrate the trade-offs between BER and bits per symbol offered by different modulation schemes, and show the independence of the BER from the relative speeds among airborne platforms. Further, it is shown that the BER of a

single path directed air data link approaches that of a two-ray channel for a sufficiently large Rician K-factor.

8:56 *Comparison of Contention-Based vs Timeslotted Channel Hopping Medium Access in Wireless Sensor Networks Under Noisy Environment*

Yevhenii Shudrenko (Hamburg University of Technology, Germany); Koojana Kuladinithi (Hamburg University of Technology & Institute of Communication Networks, Germany); Andreas Timm-Giel (Hamburg University of Technology, Germany)

Wireless communication is one of the key enabling factors for Internet of Things (IoT) and its many applications in industry, medicine, smart cities, etc. Tiny sensors with a radio transmitter offer ubiquitous connectivity and ease of maintenance, vital for covering areas with Wireless Sensor Networks (WSNs). Most WSNs utilize IEEE 802.15.4 standard for communication, which describes physical and Medium Access Control (MAC) layers architecture. Two most prominent IEEE 802.15.4 MAC modes are unslotted Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) and Time Slotted Channel Hopping (TSCH), which represent a randomized and scheduled solution, respectively. While CSMA/CA offers low latency with small management overhead, TSCH scheduling policies might grow complex to achieve high reliability under low duty cycle. Considering diverse use-case requirements, choosing and configuring a suitable MAC is not

straightforward. This work directly compares unslotted CSMA/CA with TSCH in several scenarios using simulations. The performance is evaluated based on the end-to-end delay and Packet Delivery Ratio (PDR) in a 100-node network with uplink and downlink communication under external interference. The results highlight key strengths and weaknesses of each MAC protocol alongside relevant aspects to be considered for the MAC selection.

9:22 *Analysis of the IEEE 802.11 DCF for Wireless Seismic Data Acquisition Networks*

Aliyu Makama (Hamurg University of Technology, Germany); Koojana Kuladinithi (Hamburg University of Technology & Institute of Communication Networks, Germany); Andreas Timm-Giel (Hamburg University of Technology, Germany)

Due to drawbacks accompanying conventional cable-based acquisition systems like survey downtime, complexities in survey logistics e.t.c., wireless seismic data acquisition (WSDA) has recently gained much attention from contractors, exploration companies, and researchers. Proposals for IEEE 802.11-based standards as viable technologies have been put forward in literature and practice to be employed in WSDA networks, also referred to as wireless geophone networks (WGNs), in connection with the large-scale deployment of geophones and high data rate requirements. Owing to the nature of WGN traffic and architecture presented in [21], our proposed model analytically investigates the performance

of IEEE 802.11 protocol for single-hop ad hoc WGNs under unsaturated traffic and non-ideal channel conditions. Although several IEEE 802.11 models have been presented in literature, some inaccuracies exist with respect to modeling IEEE 802.11-based WGNs. Our model focuses primarily on singling out the inaccuracies in modeling the backoff procedure and packet drop probability as some of the deviance with the existing literature.

Expressions for MAC delay, throughput, collision probability, and average duration a node spends during the backoff procedure before decrementing its counter were proposed. Furthermore, the model investigates an optimal number of geophones that could be supported within a subnetwork based on the proposed WGN architecture in [21].

The model was evaluated analytically in MATLAB and validated using simulation in OMNeT++ discrete event simulator.

9:48 *Energy efficient Firmware Over The Air Update for TinyML models in LoRaWAN agricultural networks*

Nicolas Chollet (ECE Paris & LISV - Université de Paris Saclay, France); Naila Bouchemal (ECE Paris, France); Amar Ramdane-Cherif (Université de Versailles St.-Quentin en Yvelines & LISV Laboratory, France)

The world population is rising, and so is humankind's standard of living. However, current agricultural practices already fail to feed everyone correctly while being harmful to the environment and highly sensitive to climate change. Therefore, new and modern agriculture

needs to be developed and overcome numerous challenges to increase its productivity and sustainability to produce more food with fewer resources. Artificial Intelligence (AI) is one of the tools widely used in this new type of Agriculture called Precision Agriculture (PA) or Smart Farming (SF). Thanks to the Internet of Things (IoT) technologies, AI algorithms are fed with a vast amount of data to provide valuable insights for farmers, such as weather prediction, pest development detection, irrigation management, etc. AI algorithms are often executed in cloud servers, thus requiring IoT devices to offload their data to process. This creates privacy, latency, and security issues, but mostly, it requires a large quantity of energy for transmission. To overcome those issues, recent research brought new tools like Tiny Machine Learning (TinyML) to perform AI directly on the IoT devices and break free from the cloud. Despite promising results, such Smart devices cannot train new models on their constrained hardware and therefore need frequent updating to increase the model's accuracy over time, regarding the specific environment where the sensor is deployed. In the Agricultural domain, sensor devices are numerous and usually spread over vast geographical areas while running on battery. For this reason, Farms Wireless Sensor Network (WSN) use mostly Low Power Wide Area Network like LoRaWAN to communicate. Therefore Firmware Update Over the Air (FUOTA) is required. In this context, this paper proposes a study of the FUOTA process for a TinyML model using LoRaWAN in a specific agricultural scenario. A TinyML sensor prototype was built to evaluate the feasibility of FUOTA for tinyML devices using LoRaWAN. The system's energy consumption and Packet delivery ratio are then analyzed in a simulator with different network scenarios.

10:14 ***SDN Intrusion Detection: An Ensemble Approach to Reducing False Negative Rate for Novel Attacks***

John W O'Meara (University College Dublin & SFI Centre for Research Training in Machine Learning, Ireland); Mahmoud Elsayed (University College Dublin, Ireland); Takfarinas Saber (National University of Ireland Galway, Ireland); Anca Delia Jurcut (University College Dublin, Ireland)

Machine Learning (ML) based Intrusion Detection Systems (IDSs) have rapidly overtaken other solutions for securing networks and as a result, robust and varied datasets are required to train ML models to perform this role. The separation of the control plane from the forwarding plane within Software Defined Networks (SDNs) results in differences in network traffic patterns and potential intrusion vectors when compared to traditional networks. Consequently, SDN-specific ML models need to be trained on datasets captured from SDNs and have the potential to recognise SDN specific attacks in addition to the standard cadre of exploits. When assessing the performance of an ML based IDS, reduction of the incidences of attacks that have been misclassified as normal traffic is of key importance. Therefore, measuring the False Negative Rate (FNR) of a trained model is of significantly more value than the standard metrics used in ML model assessment.

S1: Session 1: Mobile zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Harith Al-Sahaf (Victoria University of Wellington, New Zealand), Niraj Gandhi (Victoria University of Wellington, New Zealand)

zoom password: 183518

8:30 *5G Vertical Use Cases and Trials of Transportation*

Haesik Kim and Jarno E. Pinola (VTT Technical Research Centre of Finland, Finland); Olli Apilo (VTT, Finland)

The 5G networks are still being deployed in many countries creating new business opportunities. 5G networks allow us to include new features and deliver new levels of system capacity and efficiency such as higher speed connectivity, ultra low latency connectivity, improved security, distributed networks, virtualized networks and so on. They enable us to have new use cases and scenarios such as automated vehicles, smart city, eHealth, and so on. In this paper, 5G vertical use cases and large scale trials of transportation undertaken at the EU 5G-HEART project trial sites across Europe are introduced. Four representative transport use cases are validated in the 5G-HEART project. They are as follows: (1) Platooning that drives a group of vehicles together, (2) Autonomous driving that avoids collision and achieves safer driving and better traffic efficiency, (3) Remote driving support that allows an user or cloud software to control vehicles remotely, and (4) Vehicle data services

that provides us with a better vehicle services by interconnecting various third-party data to autonomous vehicles using 5G networks. User requirements and KPIs are analyzed for 5G transportation use cases. The selected results of 5G-HEART transportation vertical trials are presented.

8:56 *Advanced Persistent Threat Detection: A Particle Swarm Optimization Approach*

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

Advanced Persistent Threat (APT) is one of the most sophisticated cyber threats aiming to gain access to a system and remain there for a long time utilizing continuous, covert, and sophisticated evasion techniques. As a result, detecting such an attack is still very challenging. A successful APT attack can cause significant financial and valuable information loss for a large company or a government organization. The importance of APT detection has attracted many researchers, and various machine learning methods have been proposed in the literature to improve APT detection performance. This paper utilizes Particle Swarm Optimization (PSO) to automatically evolve a classification model for APT attack detection and classification. The proposed method optimizes a set of weights, each corresponding to a feature in the dataset. These weights are then used to predict the class label, for instance, by calculating the weighted sum of the features based on the weights evolved by PSO. One of the main advantages of the proposed method is

that it does not require human intervention. The experimental results on a publicly available dataset, i.e., DAPT-2020, show that the proposed method significantly outperformed the state-of-the-art method and other commonly used machine learning methods for APT detection and multi-class classification. Furthermore, a detailed investigation of the proposed method's inner mechanism is discussed to highlight various aspects, e.g., convergence and some of the detected patterns.

9:22 *Cybersecurity of a Fact Certification Network*

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

A system of protocols is defined which enables suitably equipped systems or devices to record validated "facts" in a network of servers in such a way that only facts which are genuinely true can be validated by the network. The servers or devices using this network make use of remote attestation to provide this secure and integrated network, which is called, henceforth, Certnet (Certification Network). Certnet of this paper can be envisaged, for example, as providing rigorous factchecking for a news service. Currently any individual trying to capture media evidence (photo or video) has no way to certify their evidence. Certnet will provide this missing certification of evidence, for suitable equipment.

9:48 *TDMA Slot Allocation for UAV Formations: Minimum Superframe Lengths for Two-Dimensional Equidistant Deployments*

Amelia Samandari and Andreas Willig (University of Canterbury, New Zealand)

This paper looks at the case of mitigating collisions between UAVs in a formation through the use of safety beacons to relay information about UAVs that are at risk of collision due to their geographic proximity to one another. The UAVs send these safety beacons using time division multiple access (TDMA). With TDMA, UAVs can achieve collision-free transmission, thereby reducing the uncertainty of the UAVs in the formation receiving the necessary safety information. In this paper, we provide a system model for a specific regular deployment and a spatial reuse scheme for allocating UAVs to a TDMA slot that operates as follows: the regular, two-dimensional UAV deployment is partitioned into a hexagonal tiling, where all UAVs in the same tile are allocated to different TDMA slots and all UAVs in the same position in their respective tiles are allocated to the same TDMA slot. Through spatial reuse of TDMA slots, our scheme can support large formations with a bounded transmission period (i.e. a bounded superframe length). We also ascertain a safety margin factor for the transmit power that can be applied to moderate the effects of interference from multiple UAVs transmitting in the same time slot.

10:14 *Solutions for Traffic Isolation in 5G Infrastructures Using Network Slicing*

Techniques

Zaloa Fernández and Alvaro Gabilondo (Vicomtech, Spain); Álvaro Vázquez-Rodríguez and Carlos Giraldo-Rodríguez (Gradiant, Spain); J. Joaquín Escudero-Garzás (Centro Tecnolóxico de Telecomunicacións de Galicia - Gradiant, Spain); Sergio Giménez Antón (Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain); Andrés Cárdenas and Carlos Herranz-Claveras (i2CAT Foundation, Spain)

Network slicing techniques are paramount for the operation of commercial networks, as the 5G networks community widely accepts them. These techniques allow the creation of multiple virtual networks on top of a physical network with the aim of isolating the traffic and guarantee the requirements of the applications. These will allow the deployment of more tailored use cases, such as disaggregated services and specific highly consuming multimedia services. Therefore, several network slicing techniques are proposed in this paper to obtain traffic isolation in a 5G infrastructure. Specifically, edge and cloud architectures and alternatives to traditional network stack protocols are considered in the proposed solutions when slicing their virtual networks. Moreover, this paper describes which use cases are the most suitable for each proposed network slicing technique.

Wednesday, November 30 10:40 - 10:45 (Pacific/Auckland)

Conference Opening zoom

Ian Welch

Chair: Ian Welch (Victoria University of Wellington, New Zealand)

Venue: MCLT103 (Maclaurin Building), zoom password: 183518

Wednesday, November 30 10:45 - 11:00 (Pacific/Auckland)

MT1: Morning Tea

Venue: Cotton Building Foyer (COB151)

Wednesday, November 30 11:00 - 12:00 (Pacific/Auckland)

K1: Keynote - Computer Network Automation zoom

Emeritus Professor David Cheriton, Chief Data Centre Scientist, Juniper Networks

Room: MCLT103 (Maclaurin Building)

Chairs: Andrew B J Lensen (Victoria University of Wellington, New Zealand), Ian Welch (Victoria University of Wellington, New Zealand)

Computer networks are conceptually very simple. Cables connect switches and routers and packets are forwarded over this links to reach their destination.

However, the reality is far more complicated. The dynamic behavior of network traffic can be complicated and produced "grey" failures from congestion and convoying. Moreover, the control mechanisms such as access control filters, rate policers virtual networks, overlays, policy based routing, EVPN, routing protocols, etc add additional complexity. This complexity is colliding with human limitations to manage networks with the reliability and agility required by modern organizations. The consequences of misconfiguration and failures can be severe. Operator error is the primary source of network failure and personnel costs are the dominant overhead of running a computer network. The solution is automation of network management, assuming it can be done right. This talk discusses a wholistic approach to automated network management taking an "operating system" perspective. The network automation configures, monitors and identifies faults in the network, reducing the burden on the network operator. The challenge is making the system highly scalable, fault-tolerant and extensible to meet new network requirements and support new network features.

Wednesday, November 30 12:00 - 12:45 (Pacific/Auckland)

K2: Keynote - Intelligent surfaces and fluid antenna systems - new technologies for 6G? zoom

Professor Peter Smith, Victoria University of Wellington

Room: MCLT103 (Maclaurin Building)

Chairs: Andrew B J Lensen (Victoria University of Wellington, New Zealand), Ian Welch (Victoria University of Wellington, New Zealand)

Two novel technologies being investigated for 6G are reconfigurable intelligent surfaces (RIS) and fluid antenna systems (FAS). RIS: Essentially a panel of intelligent reflective elements, a RIS modifies the channel between transmitter and receiver without the need for extra RF chains. This makes it attractive as a low power performance enhancer. Despite its promise, there are serious challenges for RIS systems in terms of low complexity channel estimation and design. FAS: Imagine a device where antenna element(s) are mobile, being located in a fluid and able to be moved around a defined region, powered by a pump. In the simplest case, a single antenna is moved along a tube replicating antenna selection across a linear array. Such a system has enhanced spatial selectivity, but again, channel estimation is problematic and the mechanical design is likely to be challenging. Although very different techniques, both take advantage of spatial diversity in small volumes and it can be useful to consider the limits of both approaches in the limit as the number of elements grows large. For the RIS, this means filling the surface with more and more closely spaced reflective elements. For the FAS, this means continuous control of the antenna location over the whole region. This talk will outline the potential benefits and design challenges implicit in the RIS and FAS paradigms.

Wednesday, November 30 12:45 - 13:30 (Pacific/Auckland)

L1: Lunch

Venue: Cotton Building Foyer (COB151)

Wednesday, November 30 13:30 - 15:30 (Pacific/Auckland)

W1: Workshop: Online interactive workshop zoom

Wataru Nakamae, Juniper Networks

Room: MCLT103 (Maclaurin Building)

Chair: Mark A. Gregory (RMIT University, Australia)

zoom password: 183518

Wednesday, November 30 15:30 - 16:00 (Pacific/Auckland)

AT1: Afternoon Tea

Venue: Cotton Building Foyer (COB151)

Wednesday, November 30 16:00 - 16:30 (Pacific/Auckland)

W2K: Workshop: ICT4C3 Keynote Leading the global frontiers of technology-driven Humanitarian engineering programs for delivering sustainable innovations zoom

Sampathkumar Veeraraghavan, Global Chair, 2021-2022 IEEE HAC and 2023 Global President, IEEE Eta Kappa Nu

Room: CO431

Chair: William Liu (Auckland University of Technology, New Zealand)

16:00 ***Analysis of Lightweight Cryptographic Algorithms on IoT Hardware Platforms***

Mohammed Ibrahim El-hajj (Twente University, The Netherlands)

Highly constrained devices that are interconnected and interact to complete a task are being used in a diverse range of new fields. The Internet of Things (IoT), cyber- physical systems, distributed control systems, vehicular systems, wireless sensor networks, tele-medicine, and smart grid are a few examples of these fields. In any of these contexts, security and privacy might be essential aspects. Research on secure communi- cation in Internet of Things (IoT) networks is a highly contested topic. One method for ensuring secure data transmission is cryptography. Since IoT devices have limited resources, such as power, memory, and batteries, IoT networks have boosted the term "lightweight cryptography". Algorithms for

lightweight cryptography are designed to efficiently protect data while using minimal resources. In this research we evaluated and bench- marked lightweight symmetric ciphers for resource-constrained devices. The evaluation is performed using two widely used platform: Arduino and Raspberry PI. In the first part, we implemented 39 block ciphers on an ATMEGA328p micro- controller and analyzed in the terms of speed, cost, and energy efficiency during encryption and decryption for different block and key sizes. In the second part, the 2nd round NIST candidate (80 stream and block cipher algorithms) were added to the first part ciphers in a comprehensive analysis for equivalent block and key sizes in the terms of latency and energy efficiency.

16:30 *A Novel Story Plots Extraction Based Rapid Reading Comprehension System to Assist the Education for Low-income Families*

Xinchun Zhang and Weihua Li (Auckland University of Technology, New Zealand); Quan Bai (University of Tasmania, Australia); William Liu (Auckland University of Technology, New Zealand); Huan Wang (Jilin Agricultural University, China)

The study of information extraction has been growing in prominence with the advent of big data. Given such a huge volume of stories and novels, it is difficult for parents and educators to identify suitable ones for their children and students within a short time. In this paper, we aim to assist people with rapidly understanding the story content by proposing a novel

framework that is capable of generating and visualising story plots from literature narratives. Meanwhile, The visualised story plots are represented as a sequenced knowledge graph, helping people grasp the story's linguistic meanings and flow. Furthermore, two well-known works of fiction, i.e., "Alice in Wonderland" and "Through the Looking Glass," are utilised as case studies to validate the proposed framework. The experimental results reveal that story plot extraction can provide explicit information for presenting storylines chapter by chapter.

17:00 *Autonomous Driving Simulation for Hybrid Traffic*

Zhong Wen (Beijing Institute of Technology, China); Biao Yang (Space Engineering Development Co. Ltd, China); Haoxing Zhang (Beijing Institute of Technology, China)

In hybrid traffic where autonomous vehicles share roads with human-driven vehicles, mismatch between estimated and actual behaviors of human-driven vehicles leads to inefficient control, and results collisions in the worst case. The paper aims to propose a method to reduce the risks generated by human-driven vehicles. We uses the widespread internet of things and the number of the connected devices in intelligent transportation for safety, energy saving and comfort. We also address the emerging technologies in intelligent transportation environments. A simulation platform for hybrid traffic is proposed and designed to simulate various scenarios that are difficult to study in the real

world. Simulation results demonstrate that our method can improve driving efficiency.

17:30 *Unmanned Aerial Vehicle Assisted Healthcare Resource Allocation in Disasters*

Vincent Diao, Yue Liu and William Liu (Auckland University of Technology, New Zealand); Luca Chiaraviglio (University of Rome Tor Vergata, Italy)

The fast response to a disaster is a key factor in rescuing victims who are trapped in the affected areas. The high amount of casualties as well as life and medical resource allocation cause the complexity of the disaster rescuing. This paper concentrates on developing a multi-objective (MO) optimization model and adopts an algorithm named Probabilistic Solution Discovery Algorithm (PSDA) to generate a set of Pareto solutions on account of (i) the affected location, (ii) the amount of victims in the affected location, (iii) the amount of resource, including food, water and medicine, (iv) the location of the resource, (v) the deployment of UAVs. PSDA is used to solve the MO model, and each of the Pareto solutions is an emergency rescuing strategy. A study case is provided to validate the perspectives. The results of resource allocation is generated with the five aforementioned factors have confirmed the effectiveness of the proposed solution.

18:00 *TIDS: Trust Value-Based IDS Framework for Wireless Body Area Network*

Mohammad Yaghoubi, Khandakar E Ahmed and Yuan Miao (Victoria University, Australia)

This study aims to develop a Trust Value Based Intrusion Detection System (TIDS) to identify and prevent Denial of Sleep attacks (DoSL) in Wireless Body Sensor Networks (WBAN). To detect and deter DoSL attacks, this IDS employs pre-distributed random keys, random passwords, the trust value of each node, node energy consumption, and an agent database. Since sending and receiving information packets within the network consumes the energy of the sensors, adopting an appropriate and optimal method to reduce energy consumption and efficient routing selection is necessary. The proposed framework uses Genetic Algorithm (GA) to select the optimal Cluster Head (CH) and the Ad-hoc On-demand Distance Vector (AODV) routing protocol for intra-cluster routing. This work simulates two attack scenarios: one in the presence of IDS and one in its absence, to understand the efficiency and effectiveness of IDS. In both scenarios, we measure and compare various network parameters such as throughput, network lifetime, Packet Delivery Rate (PDR), and node residual energy. We also benchmark TIDS against one of the recent highly cited works, "Secure and energy-efficient framework using Internet of Medical Things (IoMT) for e-healthcare (SEF-IoMT)", against all network parameters listed above. The simulation results and their comparison with the benchmark study show that the proposed method could significantly improve the network parameters in deterring DoSL attacks. This study uses NS2 for running all tests and experiments.

18:30 ***Minimizing Energy Loss Decisions for Green Driving Platoon***

Zhiru Gu and Zhongwei Liu (Hunan University of Technology, China); Ziji Ma, Feilong Wang and Xiaogang Zhang (Hunan University, China)

This paper presents the application of reinforcement learning (RL) in the vehicle communication simulation framework (Veins). Reinforcement learning methods for energy saving and greening in the field of autonomous driving have rarely been studied. Under a CACC platoon of green environmental protection, we investigate the use of reinforcement learning algorithms to train the behavior of member vehicles in the event of a serious collision in the front vehicle, so that platoon members can minimize collision damage and energy consumption from behavior which is not in line with the green theme. In terms of energy consumption metrics, the gradient policy algorithm has good convergence in computing the energy consumption problem. It is a feasible training decision planning algorithm for solving the minimization of energy consumption caused by decision behavior in platoon avoidance behavior.

19:00 ***Adaptive Client Model Update with Reinforcement Learning in Synchronous Federated Learning***

Zirou Pan and Huan Geng (Anhui University of Technology, China); Wei Zhao (Anhui University of Technology (Xiushan), China & Anhui Engineering Laboratory for Intelligent Applications

and Security of Industrial Internet, China); Linna Wei (Anhui University of Technology, China)

Federated learning enables collaborative training of globally optimal models in scenarios where multiple data sources are aggregated.It is widely applied in daily life, and green wireless and mobile technologies.In practical applications, federated learning requires frequent communication between the client and the server.This results in significant communication overhead.In response to the communication bottleneck of federated learning, this paper adopts the method of reducing the communication frequency.The method of deep reinforcement learning(DRL) is used to adaptively select the number of local self-learning of the client and analyze the optimal trade-off between local training and global aggregation.With guaranteed accuracy of the model, our proposed method reduces the communication overhead, especially from perspective of green initiatives.

Wednesday, November 30 16:00 - 18:00 (Pacific/Auckland)

S4: Session 4: online networking zoom

Room: COLT122 (Cotton Building)

Chairs: Abdullah Al Mamun (Victoria University of Wellington, New Zealand), Arman Khouzani (Victoria University of Wellington, New Zealand)

zoom password: 493593

16:00 ***Internet Routing with Auto-Assigned Addresses***

Nirmala Shenoy, Shreyas Chandraiah and Peter Willis (Rochester Institute of Technology, USA)

Key challenges faced in the Internet today can be enumerated as follows: (1) complex route discovery mechanisms (2) latency and instability during link or device failure recovery (3) inadequacy in extending routing and addressing to limited domains, (4) complex interworking of multiple routing protocols at border routers. Routing table sizes increase with increasing number of networks indicating a scalability issue. One approach to address this spiraling complexity and performance challenges is to start fresh and re-think Internet routing and addressing. The Expedited Internet Bypass protocol (EIBP) is such a clean slate approach. In the interim, EIBP works in parallel with IP and has no dependency on layer 3 protocols. We demonstrated EIBP for routing and forwarding in an Autonomous system (AS) in our earlier work. In this article, we demonstrate EIBP for inter-AS routing. We compare EIBP's inter-AS operations and performance to Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP) deployed in an intra-AS, inter-AS communications scenario with two AS.

16:30 ***Auxiliary Factor Method for Nyquist Filters with Reduced Complexity and Delay***

Zijian Zhou, Dongsheng Zheng, Lifeng Lin and Bingli Jiao (Peking University,

China)

The Nyquist first condition promises data transmission without intersymbol interference (ISI). However, the implementation using any finite impulse response (FIR) filter cannot get rid of the ISI completely because the window's length truncates the Fourier transform, thus, preventing calculations from reaching the intended approximation in the frequency domain. Our previous work introduced an auxiliary factor (AF) method that uses the AFs to compensate the truncated Fourier transform and eliminates the ISI in practice. In this paper, we propose a decomposition solution to further reduce the computational complexity and system delay caused by the AF method. In consequence, an efficient algorithm is exploited to calculate the AFs and numerical results confirm the effectiveness of the proposed solution.

17:00 ***Effect of Construction Materials on Indoor Positioning System using Bluetooth Low Energy***

Fei Gao (Intellectual Property Office of New Zealand, New Zealand); Xue Jun Li (Auckland University of Technology, New Zealand)

Indoor positioning system (IPS) has become increasingly important due to its wide applications in indoor navigation, location-based services (LBS), and disaster relief / recovery. Among the technology candidates, Bluetooth Low Energy (BLE) provides low cost and low power consumption. This paper studies the effect of construction materials on the localisation accuracy of an IPS based on

trilateration using received signal strength indicators (RSSI) from BLE beacon nodes. Through experiments, we found that plasterboard walls and glass walls provide better localisation accuracy as compared to wooden walls. Furthermore, knowledge about the room-level location of BLE beacon nodes can help improve the localisation accuracy.

17:30 *SQBRP: A Switch Quality-Based Routing Protocol for Software-Defined Networks*

Nabila Bouziane (USTHB University, Algeria); Doukha Zouina (USTHB, Algeria)

Nowadays, networks are facing new challenges due to the proliferation of network devices, the excessive use of bandwidth-intensive network applications, as well as the increasing demand for network quality of service. To satisfy these growing user expectations and improve network performance, an efficient network routing is needed. In order to overcome these challenges, Software Defined Networking (SDN) was designed to manage data flow and network maintenance. However, the standard SDN short-path first routing protocol (SPF) degrades network performance because it ignores the dynamic nature of the network in terms of traffic flow. In addition, there is no SDN routing solution that exploits switch states like CPU usage in the routing process. In this context, this paper proposes an SDN Routing protocol based on switch quality and residual bandwidth (SQBRP). To evaluate the performance of our protocol, we carried out several simulations. The results show that SQBRP reduces packet drop ratio as well as delays and improves throughput

compared to SPF, particularly in an overloaded network.

S3: Session 3: online wireless zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Ramón J. Durán Barroso (Universidad de Valladolid, Spain), Niraj Gandhi (Victoria University of Wellington, New Zealand)

zoom password: 183518

16:00 ***Channel Sounding Measurements for 5G Campus Networks in Industrial Environments***

Michael Knitter (University of Dortmund, Germany); Ruediger Kays (TU Dortmund University, Germany)

To allow 5G deployments in challenging environments and for special use cases like 5G radio positioning, authorities reserve a part of the radio spectrum for privately owned campus networks. Such deployments require a characterization of the communication channel in the specific environment to fit to application requirements. This paper presents results on a channel sounding measurement series in an industrial environment. The sounding approach, based on 5G wideband downlink test signal channel estimation, only uses widely available equipment and may serve as a template for easy but efficient channel sounding in such environments. The arriving measurement results give some insights on special challenges regarding network coverage and radio positioning in industrial environments.

16:30 ***Energy-Efficient and QoS Assurance Link Adaptation Scheme for Wireless Body Area Networks***

Da-Ren Chen and Nai-Xin Liang (National Taichung University of Science and Technology, Taiwan)

Due to limited power supply and long-life service requirements for wireless sensor nodes, energy and timeefficient methods are critical to in the wireless body area networks (WBAN). Link adaptation (LA) technique, in which modulation and coding are applied to change per channel conditions to maximize link throughput are widely investigated in the field of mobile communications. On the basis of LA and transmit power control (TPC) techniques, we propose a modelbased calibration scheme to maintain a transmit power threshold table WBAN which satisfies the target quality of service (QoS) while minimizing transmission power of sensor nodes. Rather than existing methods that compare the SNR threshold with instantaneous channel SNR, we contrast the target bit error rate (BER) with instantaneous received BER, and calibrate the path loss and shadowing model, and receiver sensitivity. The proposed method lower bounds the transmit power given a pair of prescribed data rate and BER for a set of feasible combinations of modulation and coding schemes (MCSs). The performance evaluation show that the proposed method outperforms previous link adaptation methods in execution overheads and energy efficiency.

17:00 ***Interference Mitigation for Device-to-Device based Cellular***

Communications

Suleyman Onur Acar (Izmir Institute of Technology); Berna Özbek (Izmir Institute of Technology, Turkey)

Device-to-device (D2D) communication underlaying cellular networks can improve the performance of cellular systems and it provides an effective way to meet growing mobile traffic and capacity demand. When user equipment is located in close proximity, they can communicate through direct links. In this case, D2D links can increase both energy and spectrum efficiency by reusing uplink (UL) cellular resources while satisfying the users' quality-of-service requirements. However, integrating D2D links into the cellular infrastructure causes an interference situation since D2D communication can increase co-channel interference and degrade cellular users' transmission link quality. In this paper, the interference mitigation techniques including power control, multiple antenna and resource allocation based on graph coloring technique are proposed for D2D communications underlaying cellular systems to increase the data rate of both the cellular users and D2D pairs. Compared to the prior works, in the proposed algorithm, D2D and cellular users have same priority for resource allocation. Finally, the proposed algorithm improves the overall system capacity significantly.

17:30 ***Outage Performance of Satellite-Terrestrial MISO Downlink Transmission***

Xinghan Lin (Beijing Technology and Business University, China); Haoxing Zhang, Gaofeng Pan, Shuai Wang and

Jianping An (Beijing Institute of Technology, China)

The satellite-terrestrial communication system is considered to be a necessary way to provide global broad coverage. Particularly, as the low Earth orbit (LEO) constellation system develops rapidly and LEO satellites operate low orbits with heights lower than 2000 km, short serving time and frequently handovers are necessary for LEO satellite-terrestrial communications. Thus, diversity gain via multiple satellites needs to be considered. In this work, code-division multiple access scheme is adopted for the downlink delivery while there are multiple satellites trying to simultaneously deliver information bits to a terrestrial terminal. Moreover, an aerial platform generates interference signals to interfere with the information delivered from the satellites to the terrestrial terminal. Then, we derive an outage performance analysis model by derive the closed-form analysis expression for outage probability. Finally, Monte Carlo simulation is presented to show how the system parameters, e.g., the synchronization of the clock and the frequency drifts among the multiple terrestrial users, influence the downlink transmission performance of target satellite-terrestrial systems.

Wednesday, November 30 16:30 - 18:45 (Pacific/Auckland)

W2A: Workshop 2: ICT4C3 Papers

Room: CO431

Chair: William Liu (Auckland University of Technology, New Zealand)

https://vuw.zoom.us/j/92899190064

Thursday, December 1

Thursday, December 1 8:30 - 10:40 (Pacific/Auckland)

S6: Session 6: IoT zoom

Room: COLT122 (Cotton Building)

Chairs: Abdullah Al Mamun (Victoria University of Wellington, New Zealand), Arman Khouzani (Victoria University of Wellington, New Zealand)

8:30 ***Detecting Approaching Objects at Intersection Using on-Vehicle 3D-LiDAR for Automated Driving Vehicle***

Yuki Komatsu (National Institute of Advanced Industrial Science and Technology & Tokyo University of Science, Japan); Shin Kato (The National Institute of Advanced Industrial Science and Technology,

Japan); Makoto Itami (Tokyo University of Science, Japan)

In our research, we developed a method for detecting approaching objects at intersection by focusing on geometric features of point cloud obtained from 3D-LiDAR, without using pre-generated maps to understand the environment. This method can be applied to intersection with diagonal crossings, and can detect approaching vehicles and pedestrians at distances of up to 49 m and 38 m, respectively. The results also showed that the detection was robust and continuous. Furthermore, This process can be used in 50 ms per a frame, so that can be used in real time. This will lead to collision prediction and judgment of starting for automated vehicles.

8:56 *Smart Agriculture IoT Network Communications Security Improvement*

Brian Cusack (AUT, New Zealand); Paula Lutui (Auckland University of Technology, New Zealand)

The technologies for low powered wide area networks (LPWAN) are readily available and utilized for performance advantages in a range of industries. The challenge for research is to identify capable radio signals that propagate over the required geographic regions and physical obstacles. Also, to design and standardize protocols with sufficient load and performance capability. The Internet of Things (IoT) is motivating the search for capable network solutions as industries, such as agriculture, seek working control solutions for their supply chain and production requirements. Critical for network performances are security features that protect communications and

assure the intended message. In this research we evaluated the security features of one common LPWAN protocol for performance against alternative cryptographic security mechanisms. Performance differences are found between the default algorithm and others suggesting model design trade-offs and areas for further research. The contribution of this paper is awareness of the potential scope for improvements to IoT LPWAN communications security, and the cost trade-offs between different wireless network cryptographic solutions.

9:22 *A Comparative Study to Evaluate the Performance of Communication Protocols for Process Industry*

Xinyu Wang, İlhan Mutlu, Fatima Rani, Lucas Drowatzky and Leon Urbas (Technische Universität Dresden, Germany)

With the boom of Industry 4.0 for industrial automation, the data exchange between the different industrial devices has tremendously increased through local (edge) and cloud computing. Nowadays, several communication protocols are available to realize data acquisition in the industry. As a result, understanding the practical capabilities of each communication protocol arises as an essential issue in optimizing the data acquisition and storage in industrial plants. This study aims to develop a software-based test environment to evaluate the performance of two widely used communication protocols within the scope of the Industrial Internet of Things (IIoT). These contemplated protocols are Open Platform Communications Unified Architecture (OPC UA)

and Message Queuing Telemetry Transport (MQTT). With the help of the developed test environment, several performance metrics, like packet overhead, latency, packet loss ratio, and CPU utilization, are evaluated for different application scenarios where the varying number of clients and subscribers are considered. Derived results indicate the stronger parts of each protocol under varying communication configurations.

9:48 *A proposal of DoH-based domain name resolution architecture including authoritative DNS servers*

Satoru Sunahara (Chitose Institute of Science and Technology, Japan); Yong Jin (Tokyo Institute of Technology, Japan); Katsuyoshi Iida (Hokkaido University, Japan)

In addition to cache poisoning attacks, the privacy leakage has become a critical issue in DNS nowadays. Especially, the communication between the DNS full-service resolver and the authoritative DNS servers may go through multiple ISP networks. Thus, if the communication path contains areas with different privacy policies, the security and privacy in DNS domain name resolution cannot be guaranteed. To mitigate cache poisoning attacks and protect the privacy of the Internet users, we propose an architecture that encrypts all DNS communications with DoH. In the proposed architecture, in addition to the communication between the end clients and the DNS full-service resolver, that between the DNS full-service resolver and the authoritative DNS server is also covered by DoH. As a result,

not only the risk of cache poisoning attacks can be dramatically mitigated on DNS full-service resolver but also the risk of eavesdropping on DNS traffic can be reduced. Moreover, the architecture is the first approach to pure DoH-based domain name resolution including DNS authoritative DNS servers.

10:14 *UAV-based Smart Agriculture: a Review of UAV Sensing and Applications*

Salaheddin Moradi (Payame Noor University & Zeelamo Academy, Iran); Ayub Bokani and Jahan Hassan (Central Queensland University, Australia)

One of the main problems in agriculture is the lack of timely, accurate data. Farmers require real-time farm management that can reduce production costs while increasing production per unit area. Precision agriculture could be very helpful for farmers in many ways. One of the latest precision agriculture tools is unmanned aerial vehicles (UAVs). UAVs are used for a variety of purposes, including imaging, monitoring biotic and abiotic stresses, foliar spraying, pollination, livestock management, monitoring natural resources, and more. At a low cost, farmers can get the same results as with expensive treat- ments. The vast amounts of data collected by UAVs equipped with the on-board sensors can help improve agricultural production by providing accurate information about the fields and environment. This paper provides an overview of how agricultural production can be improved through the use of UAVs, including the various on-board sensors in use and their application areas in smart farming. Discussions on challenges and opportunities in

UAV- based smart farming that will guide subsequent research are provided

Thursday, December 1 8:30 - 10:30 (Pacific/Auckland)

S5: Session 5: Optical networking zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Harith Al-Sahaf (Victoria University of Wellington, New Zealand), Niraj Gandhi (Victoria University of Wellington, New Zealand)

zoom password: 183518

8:30 *Spatial Frequency Detection of Optical Signals Embedded in the Environment*

Don Barber, Vikram Kanth, Zachary White and John C. McEachen (Naval Postgraduate School, USA)

Preventing the exfiltration of critical data via out-of-band channels is one of the most difficult challenges in cybersecurity. This challenge notably includes communications utilizing optical channels. Numerous papers have suggested the modulation of indicator lights to transmit information out of otherwise secure networks. These means of optically embedding data are both challenging to detect and a threat to the security of confidential data. This paper presents a scalable, near-real-time process to detect and localize data hidden in optical channels amid other optical modulation, including electric network frequencies. Assumptions on the detectability of hidden optical channels are reviewed and a method of detecting and localizing transmissions based on

spectral artifacts of embedded data is developed. Proof-of-concept experiments demonstrate successful detection of potential optical data leaks in an office environment. This capability can allow for low-cost optical bug sweeping devices, arming information security teams with a tool to detect and mitigate the insidious threat of optical out-of-band channels.

9:00 ***Enabling Road Side Units with Optical Access Networks: Planning and Techno-Economic Analysis***

Camilo Anzola-Rojas, Ramón J. Durán Barroso, Ignacio de Miguel, Juan Carlos Aguado and Noemí Merayo (Universidad de Valladolid, Spain); Patricia Fernández, Rubén M. Lorenzo and Evaristo J. Abril (University of Valladolid, Spain)

The upcoming Connected and cooperative and automated mobility paradigm (CCAM) requires the deployment of road-side units (RSUs) beside the roads to provide wireless communication to connected-vehicle on board units. The deployment of RSUs along the highways provide low-latency communication, suitable for applications where high-speed response is needed, such as autonomous driving and crash avoidance. These RSUs must be connected to the Internet through a high-bandwidth and reliable access network being the optical fiber technologies the most convenient technology for that. In this paper, we propose a planning scheme for enabling RSUs with optical access networks. The method starts choosing the locations of the access

network headers (the connection points to the local service provider facilities), and then defines the connections between the headers and the RSUs in a convenient manner considering the road infrastructure. Then, two deployment technologies based on optical fibers are compared: Point to Point and Passive Optical Network (PON).

9:30 *Dispersion Compensating using Chirped Fiber Bragg Grating for Multiple Optical Bands*

Muhammad Towfiqur Rahman (University of Asia Pacific, Bangladesh & Computer Science and Engineering, Bangladesh)

Applications of fiber bragg gratings (FBG) in optical communication are a growing area. Recently, there has been a lot of interest in the creation and use of chirped FBGs, which are distinguished by a non-uniform modulation of the refractive index within an optical fiber core. Chromatic dispersion (CD) in pulse broadening and inter symbol interference (ISI) at the light detector significantly affect high-speed optical networks. The wavelength range where optical fibers have a low transmission loss is where fiber-optic communication is mostly carried out. Five wavelength bands make up this low-loss wavelength zone, which has a range of 1260 to 1625 nm. In this study we compared three different optical bands with different chirped FBG lengths to tackle the chromatic dispersion compensation containing 10 Gbps data speed. The single-mode fiber length and quality factor (Q) are minimally improved by the combination of four UFBG and CFBG design technique. By implementing quality factor (Q) of the available

SMF are improved by using the combination. The best results have been seen for correcting chromatic dispersion by implementing quality factor (Q) of the available SMF are improved by using the combination. We consider Q-factor, eye diagram, and BER as a performance indicator of the system.

10:00 *Migration Strategy from C-Band Elastic Optical Network to C+L Multiband Optical Network*

Soheil Hosseini, Ramón J. Durán Barroso and Ignacio de Miguel (Universidad de Valladolid, Spain); Oscar González de Dios (Telefonica I+D, Spain); Noemí Merayo and Juan Carlos Aguado (Universidad de Valladolid, Spain); Edward Echeverry (Telefónica SA, Spain); Patricia Fernández, Rubén M. Lorenzo and Evaristo J. Abril (University of Valladolid, Spain)

Multi-band elastic optical network (MB-EON) is a promising technology to extend the bandwidth of the current elastic optical networks in the middle term. The migration from current networks to MB-EONs should be made carefully taking into account both the required cost and the bandwidth requirements. This paper focuses on the necessity of looking for a trade-off between the links to be upgraded during the migration from the standard C-band to the L-band and the acceptable level of capacity increase. Therefore, it makes two contributions to efficiently upgrade current elastic optical networks: firstly,

a planning method to decide which fibers should be upgraded to exploit C+L band; and second, one heuristic for solving the routing, band, modulation level, and spectrum assignment (RBMLSA) problem during network operation. Simulation results demonstrate that, thanks to use of these proposals, the upgrade of a set of the fibers could be viewed as a fully convincing middle term solution by the network operators to get around the huge cost of the whole network migration to C+L line system.

Thursday, December 1 10:40 - 11:00 (Pacific/Auckland)

MT2: Morning Tea

Venue: Cotton Building Foyer (COB151)

Thursday, December 1 11:00 - 12:00 (Pacific/Auckland)

K3: Keynote - Integrated Silicon Photonics Signal Processing and Sensing zoom

Professor Robert Minasian, University of Sydney, IEEE Fellow

Room: MCLT103 (Maclaurin Building)

Chairs: Muhammad Shabbir Abbasi (Victoria University of Wellington New Zealand & University of Agriculture Faisalabad, New Zealand), Leith H. Campbell (RMIT University, Australia)

Integrated silicon photonics signal processing offers a new powerful paradigm that enables the realisation of functions that are difficult or not even possible to be achieved using electronic techniques. This exploits the inherent advantages of photonics including wide bandwidth and immunity to electromagnetic interference. Photonic signal processors are intrinsically compatible with optical-wireless systems, and can provide connectivity with in-built signal conditioning for overcoming a range of challenging problems. Recently, there has been a significant global drive to achieve integration of photonic signal processors on silicon platforms, especially since this leverages the CMOS fabrication technology to enable boosting the performance of future systems performing communications and sensing with the potential for implementing high bandwidth, fast and complex functionalities. Advances in silicon photonics integrated signal processing are presented. These include dense optical integration techniques for LIDAR on-a-chip systems, widely tunable microwave photonic filters, multifunction and programmable photonic signal processors, and high-resolution integrated sensors for IoT. These photonic processors herald new capabilities for achieving high-performance signal processing.

Thursday, December 1 12:00 - 13:00 (Pacific/Auckland)

K4: Keynote - At the Core of Internet Timing zoom

Professor Darryl Veitch, University of Technology Sydney, IEEE Fellow

Room: MCLT103 (Maclaurin Building)

Chairs: Muhammad Shabbir Abbasi (Victoria University of Wellington New Zealand & University of Agriculture Faisalabad, New Zealand), Leith H. Campbell (RMIT University, Australia)

Internet based synchronization of software clocks is a service relied upon by the global computer population. It is made possible by the existence of a forest of timeservers, the time distribution protocol NTP exchanging timestamps between hosts and their timeserver(s), and synchronization algorithms. At the roots of this forest are the Stratum-1 servers, those enjoying direct access to reference hardware such as an atomic clock, or a reliable GNSS receiver. The Stratum-1 servers act as independent systems, serving their respective trees. They are trusted, core infrastructure, but recent work has shown that many are inaccurate, creating timing errors that cannot be detected by client software, and that no-one is keeping track of. In this talk the fundamental difficulties in the Internet timing landscape will be described, and a new system design, the Network Timing Core (NTC), will be described to replace the independent Stratum-1 model, which addresses these fundamentals at their core.

Thursday, December 1 13:00 - 13:45 (Pacific/Auckland)

L2: Lunch

Venue: Cotton Building Foyer (COB151)

Thursday, December 1 14:00 - 17:30 (Pacific/Auckland)

T1: Conference Tour

meet outside MCLT103 and we will make our way down to Te Papa with opportunity to have coffee and cake at the cafe on the ground floor https://goo.gl/maps/xh7TY5rYhCPhbZKBA

Thursday, December 1 18:00 - 22:00 (Pacific/Auckland)

D1: Conference Dinner

Chair: Ian Welch (Victoria University of Wellington, New Zealand)

Te Puni room, Wharewaka Function Centre, Taranaki Wharf, 2 Taranaki Street, Waterfront (https://g.page/WellingtonFunctions?share)

Friday, December 2

Friday, December 2 8:30 - 10:30 (Pacific/Auckland)

S7: Session 7: General zoom

Room: COLT122 (Cotton Building)

Chairs: Abdullah Al Mamun (Victoria University of Wellington, New Zealand), Arman Khouzani (Victoria University of Wellington, New Zealand)

zoom password: 493593

8:30 ***The Impact of ICN/CCN Cache Decision Policies on Video and Audio Transmission QoE***

Keisuke Kobayashi and Toshiro Nunome (Nagoya Institute of Technology, Japan)

This paper considers video and audio transmission in ICN (Information-Centric Networking) / CCN (Content-Centric Networking), in which each intermediate node can cache contents. LCE (Leave Copy Everywhere) has been known as a generic cache decision policy. However, because LCE caches at all the intermediate nodes, the cache of intermediate nodes can be duplicated. Therefore, various cache decision policies that eliminate redundancy have been proposed. In this paper, we evaluate the effect of the cache decision policies on QoE of video and audio transmission in ICN/CCN. We assess application-level QoS using a computer simulation with a tree network and QoE by means of subjective experiment.

9:00 ***On Viable Statistical Metrics for Re-Embedding Network Steganalysis***

Jun O Seo (University of Auckland, New Zealand); Sathiamoorthy Manoharan (The University of Auckland, New Zealand); Ulrich Speidel (University of Auckland, New Zealand)

Network steganalyses attempt to uncover hidden messages (steganograms) in network flows. These techniques are binary in that they

classify if a flow contains steganograms or not. Moreover, most of these techniques assume the availability flows that do not contain any steganograms as baselines for comparison, an assumption that is hard to hold. A re-embedding steganalysis does not require any baseline, and moreover, it can not only detect the presence of steganograms but also estimate the amount of steganograms. Being able to estimate the amount of steganograms allows a network forensic expert to judge the damage caused by these hidden messages. This paper addresses the question of what statistical metrics might apply for effective re-embedding steganalysis of network traces. It presents an empirical comparison of several statistical metrics in the light of their effectiveness in re-embedding steganalysis.

9:30 *DMB Video Quality Enhancement Using Header Syntax Repair*

Hans-Juergen Zepernick (Blekinge Institute of Technology, Sweden); Muhammad Imran Iqbal (Axis Communications AB, Sweden); Siamak Khatibi (Blekinge Institute of Technology, Sweden); Trung Q. Duong (Queen's University Belfast, United Kingdom (Great Britain)); Momin Jamil (Harman/Becker Automotive Systems GmbH, Germany); Rolf Esslinger (Harman Becker Automotive Systems GmbH, Sweden)

This paper studies a header syntax repair approach for quality enhancement of digital video broadcasting (DMB) videos. A sensitivity

analysis of the impact of transmission errors in different parts of the header of the underlying MPEG-2 transport stream packets on DMB video quality is provided. On this basis, a header syntax repair approach is presented using header masks and bounded minimum distance decoding of the headers of the received DMB packets. Objective and subjective quality assessment show a tremendous improvement in the quality of the header syntax repaired DMB video clips. The concepts of the header syntax repair approach proposed for packets of DMB video streams may also be adapted to the syntax of packet formats of other digital video standards.

10:00 *The Status Of IXPs In Africa: Failure Or Success?*

Yamba Daboné (Université Joseph Ki ZERBO, Burkina Faso)

The importance of the Internet imposes its exploitation in all regions of the world [1]. One of the main elements of the Internet is the Internet Exchange Point (IXP), which is [2]. All regions of the world have Internet exchange points. IXPs have shown their importance in Europe since the 2000s until today. Moreover, Europe has the largest IXP traffic in the world with a significant number (278 active IXPs) of IXPs 1. We make a comparative analysis of African IXPs with a giant IXP from Europe. This analysis has shown that most African IXPs have failed in their objective to maintain local traffic. Indeed, the success that Europe has had in operating IXPs is not the case for Africa. Thus, government policies and administrations of African IXPs need to adopt techniques for the success of the continent's IXPs.

S8: Session 8: Networks and Security

zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Muhammad Shabbir Abbasi (Victoria University of Wellington New Zealand & University of Agriculture Faisalabad, New Zealand), Harith Al-Sahaf (Victoria University of Wellington, New Zealand)

8:30 ***Dynamic Online VNF Placement with Different Protection Schemes in a MEC Environment***

Maryam Masoumi (University of Valladolid, Spain); Ignacio de Miguel, Ramón J. Durán Barroso and Lidia Ruiz (Universidad de Valladolid, Spain); Fabrizio Gabrio Brasca (Wind Tre); Gianluca Rizzi (Wind Tre, Italy); Noemí Merayo and Juan Carlos Aguado (Universidad de Valladolid, Spain); Patricia Fernández, Rubén M. Lorenzo and Evaristo J. Abril (University of Valladolid, Spain)

The Multi-access Edge Computing (MEC) architecture is made up of geographically distributed edge servers so that computing capabilities are provisioned at the network edge, close to the end users. Network Function Virtualization (NFV), when combined with MEC, provides network services in the form of Service

Function Chains (SFC) with low latency. In the design of NFV-based 5G networks, the trade-off between the cost of resource deployment and the effective provisioning of services must be considered. In this work, we analyze the impact of having different MEC locations when considering the provision of SFCs in a dynamic scenario (and thus also address VNF placement). In order to deal with infrastructure failures, it is of great importance to employ robust and resilient network strategies. To safeguard SFCs against failures, various protection techniques can be applied. We use two protection methods, namely, dedicated VNF protection and shared VNF protection, under the assumption of single network failures. The operational performances of different approaches are evaluated in terms of blocking ratio and end-to-end delay, both for the whole network and for different services, and we analyze whether it is better to distribute computing servers among a few MEC sites or among a higher number.

9:00 ***Partitioning and Placement of Deep Neural Networks on Distributed Edge Devices to Maximize Inference Throughput***

Arjun Parthasarathy (Crystal Springs Uplands School, USA); Bhaskar Krishnamachari (University of Southern California, USA)

Edge inference has become more widespread, as its diverse applications range from retail to wearable technology. Clusters of networked resource-constrained edge devices are becoming common, yet no system exists to split

a DNN across these clusters while maximizing the inference throughput of the system. We present an algorithm which partitions DNNs and distributes them across a set of edge devices with the goal of minimizing the bottleneck latency and therefore maximizing inference throughput. The system scales well to systems of different node memory capacities and numbers of nodes. We find that we can reduce the bottleneck latency by 40x over a random algorithm and 35% over a greedy joint partitioning-placement algorithm. Furthermore, we find empirically that for the set of representative models we tested, the algorithm produces results within 18.9% of the optimal bottleneck latency.

9:30 *Architectural Implementation of AES based 5G Security Protocol on FPGA*

Usva Rahim (COMSATS University Islamabad, Pakistan); Muhammad Faisal Siddiqui (COMSATS University, Pakistan); Muhammad Awais Javed (COMSATS University Islamabad, Pakistan); Nazmus Shaker Nafi (Boeing Defence Australia, Australia)

Confidentiality and integrity security are the key challenges in future 5G networks. To encounter these challenges, various signature and key agreement protocols are being implemented in 5G systems to secure high speed mobile to mobile communication. Many security ciphers such as SNOW3G, Advanced Encryption Standard (AES) and ZUC are used for 5G security. Among these protocols, AES algorithm has been shown to achieve higher hardware efficiency and throughput in the literature. In

this paper, we implement AES algorithm on Field Programmable Gate Array (FPGA) and real-time performance factors of AES algorithm were exploited to best fit the needs and requirements of 5G. In addition, several modifications such as partial pipelining and deep pipelining (partial pipelining with sub-module pipelining) is implemented on Virtex 6 FPGA ML605 board to improve the throughput of the proposed design.

10:00 *Evaluation of Managing MPTCP fairness via SDN versus Existing Congestion Control Techniques*

Farinaz Jowkarishasaltaneh (Swinburne University of Technology, Australia); Jason But (Swinburne University, Australia); Antonio L Cricenti (Swinburne University of Technology, Australia)

The MPTCP Transport Layer protocol allows applications to make use of multiple network interfaces simultaneously, allowing for improved throughput and resilience. MPTCP deploys a number of coupled congestion control algorithms that couple cwnd growth across multiple subflows. This restricts window growth to allow competing TCP flows to attain a fair bandwidth share. We examine the performance of existing algorithms across both shared and disjoint paths, finding that these function reasonably only when the bottleneck is shared and the paths exhibit a low bandwidth-delay product. We then pro- pose using uncoupled congestion control within MPTCP, instead managing fairness within the network using SDN. Experimental validation shows that

this approach results in fair sharing across shared and disjoint paths, including those with higher bandwidth- delay products.

Friday, December 2 10:30 - 11:00 (Pacific/Auckland)

MT3: Morning Tea

Venue: Cotton Building Foyer (COB151)

Friday, December 2 11:00 - 12:00 (Pacific/Auckland)

K5: Keynote - Tips and tactics for successful PhD research zoom

Associate Professor Nurul Sarkar, Auckland University of Technology

Room: MCLT103 (Maclaurin Building)

Chairs: Muhammad Shabbir Abbasi (Victoria University of Wellington New Zealand & University of Agriculture Faisalabad, New Zealand), Ian Welch (Victoria University of Wellington, New Zealand)

In this speech, Dr Sarkar will reflect upon his experience to discuss tips and tactics for successful PhD research. It draws information from several PhD supervisions to completions from the proposal to the oral examination (viva-voce). Dr Sarkar has successfully supervised over 35 research students and has examined about 30 PhD theses (mostly from Australian Universities). He is

currently a primary supervisor for six PhD students and has a wealth of experience to share with emerging researchers.

Friday, December 2 12:00 - 13:00 (Pacific/Auckland)

L3: Lunch

Venue: Cotton Building Foyer (COB151)

Friday, December 2 13:00 - 15:30 (Pacific/Auckland)

S10: Session 10: Wireless and Security

zoom

Room: COLT122 (Cotton Building)

Chairs: Qi Chen (Victoria University of Wellington, New Zealand), Lisa C Patterson (Victoria University of Wellington, New Zealand)

13:00 ***Comparison of classifiers for use case detection using onboard smartphone sensors***

Imran M Khan (Royal Melbourne Institute of Technology, Australia); Akram Al-Hourani (RMIT University, Australia); Andrew Thompson (Robert Bosch (Australia) Pty. Ltd., Australia); Shuai Sun (Dalian Maritime University, China); Sithamparanathan Kandeepan and Wayne Rowe (RMIT University, Australia)

Onboard smartphone sensors provide ample data modalities which can be used to determine the way a phone is being used. However, in order for use case detection systems to be unobtrusive to users, the classification algorithms and the number of sensors should be kept simple and at a minimum. In this paper light, accelerometer and orientation sensor measurements are recorded for 4 different phone use cases and results from 3 different classifiers (K-means, Naive-Bayes, Neural Network) are compared to identify the sensor modality and classification algorithm that provides the highest accuracy for use case detection. The onboard accelerometer is found to be the sensor modality with highest accuracy across all the classifiers, and the neural network is identified as being the best performing classifier. A discussion of the results linking back to theoretical aspects of the classifiers is also given.

13:25 *Cognitive Radio for Smart Grid: A Decentralized Emergency Management Approach*

Husam Rajab (Budapest University of Technology and Economics, Hungary); Mohammed B. M. Kamel (Furtwangen University, Germany & Eotvos Lorand University, Hungary); Alaa Khalaf Hamoud (Basrah University, Iraq); Hossam Farag (Aalborg University, Sweden); Tibor Cinkler (Budapest University of Technology and Economics, Hungary); Peter Ligeti (Eotvos Lorand University, Hungary)

With the remarkable advancements in wireless technology, the scarcity of the available spectrum has become more severe. Cognitive Radio (CR) technology is introduced as an emerging solution to alleviate the imbalance between spectrum under-utilization and high spectrum demands. CR enables unlicensed users to opportunistically transmit data through spectrum holes in licensed bands. In the context of smart grids, CR has become a key component to improve communication efficiency and spectrum usage. In particular emergency situations, some nodes are prone to failure, however the network must remain connected to the designated destination. In addition, the generated emergency communication and disaster relief cause high load of traffic that in turn will lead to congestion and affect the network coverage and capacity. In this paper, we introduced an efficient CR-based architecture for Smart Grid networks to enhance capacity coverage and scalability in the disaster and emergency case. The architecture is decentralized and consists of a set of clusters that communicate with each other in a secure way through number of gateways. CRT-based group key management has been used to manage the distribution of keys between gateways. In addition, the asymmetric encryption will assure the confidentiality of transmitted packets.

13:50 ***Fault-Tolerant Static Scheduling and Routing for In-vehicle Networks***

Ammad Ali Syed (Technical University of Chemnitz & Denso Automotive GmbH, Germany); Serkan Ayaz and Tim Leinmüller (DENSO Automotive

Deutschland GmbH, Germany); Madhu Chandra (Technical University of Chemnitz, Germany)

Reliability is considered the paramount requirement of the future vehicle which requires a huge amount of safety-critical data traversing through the in-vehicle network (IVN). To achieve reliability in Ethernet-based IVN, time-sensitive network (TSN) proposes a fault-tolerant mechanism called frame replication and elimination for reliability (FRER) in IEEE 802.1CB standard. In this paper, fault-tolerant joint scheduling and routing of static applications is developed which considers TSN's time-aware shaper (TAS) and FRER standards. The fault-tolerant scheduling and routing problem is formulated as a mixed-integer programming (MIP) model and solved with a CPLEX optimizer. Furthermore, a cuckoo search based meta-heuristic is developed to achieve scalable schedule solutions. Experimental results show that the cuckoo search takes 5.7 min to schedules 90 flows and utilizes 8% more bins as compared to the optimal solution.

14:15 *Optimum NN Algorithms Parameters on The UJIIndoorLoc for Wi-Fi Fingerprinting Indoor Positioning Systems*

Emad Ebaid and Keivan Navaie (Lancaster University, United Kingdom (Great Britain))

Wi-Fi fingerprinting techniques are commonly used in Indoor Positioning Systems (IPS) as Wi-Fi signal is available in most indoor settings. In such systems, the position is estimated based on a matching algorithm between the enquiry

points and the recorded fingerprint data. In this paper, our objective is to investigate and provide quantitative insight into the performance of various Nearest Neighbour (NN) algorithms. The NN algorithms such as KNN are also often employed in IPS. We extensively study the performance of several NN algorithms on a publicly available dataset, UJIIndoorLoc. Furthermore, we propose an improved version of the Weighted KNN algorithm. The proposed model greatly outperforms previous studies on the UJIIndoorLoc dataset and achieves better results for the success rate and the mean positioning error. The results of the success rate and the mean positioning error are 98.15 % and 7.39 (m) respectively.

14:40 *A Dynamic Vehicle-Ranking Approach for Online Virtual Network Embedding in Internet of Vehicles*

Khoa Nguyen, Wei Shi and Marc St-Hilaire (Carleton University, Canada)

Internet of Vehicles (IoV), which is a special domain of Internet of Things (IoT), has widely become an indispensable platform for the success of future intelligent transportation. Virtual Network Embedding (VNE), enabling flexible, cost-effective and on-demand deployments of multiple network service requests on a shared physical infrastructure, has become a technological breakthrough in IoV. Typical VNE problems have been well studied in the data center infrastructure where the physical topology is always static. Recently, various approaches have investigated the VNE problem in data center networks while considering IoV demands. However, the VNE

problem in IoV environments in which connected moving vehicles serve as substrate nodes to process service requests is still in its infancy. This paper proposes a novel heuristic algorithm for solving the online VNE problem in IoV by efficiently and rapidly ranking available vehicles based upon network attributes, and merely the knowledge of the preceding mappings. Extensive evaluation results indicate that the proposed solution not only outperforms several existing algorithms, but is also highly practical due to its fast execution time.

15:05 *Blockchain enhanced BGP4 Security for an SDN based Federation*

Mohammad Hassan, Mark A. Gregory and Shuo Li (RMIT University, Australia)

The Software Defined Networking (SDN) paradigm has the potential to improve the operation and efficiency of the global Internet and is now actively being implemented outside data centers and enterprise networks. As the complexity of the Internet increases, research is being carried out to overcome major challenges. Inter-networking challenges have increased due to complexity, security and increasing traffic loads. Transparency raises some intriguing questions. Mutual component authentication is required for distributed traffic management. This is still an unsolved challenge. Border Gateway Protocol Version 4 (BGP4) is the inter-domain routing protocol. Updates to BGP4, including a recent security update, have been issued by the IETF. To improve the transparency of BGP4 security transactions, this paper presents a proposed Blockchain-based

BGP4 Orchestration (BBO) framework that utilizes an Internet number resource authority and trustworthy management entity. BBO provided an origin advertisement source and was found to outperform Resource Public Key Infrastructure (RPKI) in terms of securing origin advertisement and establishing a required setting for the resource repository. It ensures sufficient deployment incentives for SDN based federations.

S9: Session 9: Networks and Design zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Muhammad Shabbir Abbasi (Victoria University of Wellington New Zealand & University of Agriculture Faisalabad, New Zealand), Ramón J. Durán Barroso (Universidad de Valladolid, Spain)

13:00 *A convolutional neural network based Android malware detection method with dynamic fine-tuning*

Zhen Liu (Guangdong University of Foreign Studies, China); Ruoyu Wang (South China University of Technology, China); Bitao Peng and Qingqing Gan (Guangdong University of Foreign Studies, China)

Android malware detection is an important foundation for guaranteeing the security of Android ecosystem. Deep learning techniques have been used in Android malware detection.

Deep learning usually requires a large amount of data for training an efficient model. However, collecting the benchmark datasets cost much time and work in malware detection field. The lack of training set may lead to overfitting problem. The model may become ineffective when the data distribution is significantly changed. To handle these problems, this paper proposes a new deep learning-based malware detection method. It firstly trains a model on the initial training set using convolutional neural network. During detecting the unknown malwares, the model is updated by fine-tuning the pre-trained model on the newly training set. So that the deep learning model could be dynamically updated. The experiments on the real data sets show that our method can further improve the accuracy and g-mean about 1.3% and 2.4% respectively on average.

13:30 *Artificial Neural Network (ANN)-Aided Signal Demodulation in a SiPM-Based VLC System*

Cuiwei He (Japan Advanced Institute of Science and Technology, Japan); Yuto Lim (Japan Advanced Institute of Science and Technology (JAIST) & School of Information Science, Japan)

This paper describes a new type of data-driven signal demodulation technique using an artificial neural network (ANN) in a silicon photomultiplier (SiPM) based visible light communication (VLC) system. SiPMs can potentially be used to create the most sensitive optical receiver in VLC since it contains a large array of microcells and each microcell is capable of detecting individual photons. However, after

each photon is detected, the associated microcell needs a period to recover. This means that the photon counting rate is not linearly related to the intensity of the light received by the SiPM and this effect causes a unique form of signal distortion when the transmission data rate becomes high. In this paper, an ANN aided data detection method is studied when the received signal is influenced by the SiPM nonlinearity. Both a single neuron based linear classifier and an ANN based non-linear classifier are introduced and explained in detail. The bit error rate (BER) results suggest that the ANN based receiver can significantly reduce the negative impacts caused by the SiPM nonlinearity for a wide range of irradiance levels.

14:00 *Implementation and experimental Evaluation of the rebalancing algorithm for folded Clos networks*

Satoru Ohta and Daichi Miyamoto
(Toyama Prefectural University, Japan)

Folded Clos network (FCN) is an important topology as it plays a significant role in building high-performance data center networks. To exchange packets over an FCN, traffic load must be uniformly diffused to fully utilize its high bandwidth. As a method to do this, the rebalancing algorithm was proposed. Previous studies have demonstrated the effectiveness of the method through theoretical analysis and computer simulation. However, its practical feasibility has not been elucidated. Moreover, its performance has not been confirmed on a physical experimental environment. This paper reports how the rebalancing algorithm is implemented on switches built on PCs using

software tools supported by the Linux OS. This confirms that it is relatively easy to practically implement the algorithm. In addition, the performance of the implemented algorithm was assessed and compared with that of a conventional method through an experiment. As a result, the rebalancing algorithm was found to be more advantageous in avoiding traffic congestion for heavy traffic and flows with different sizes.

14:30 *A Low-Complexity Approach for Constructing the Optimal Binary Finite-Length Block Code*

Dongsheng Zheng, Zijian Zhou, Wenyao Li and Bingli Jiao (Peking University, China)

Improving the bit error rate (BER) performance of finite-length block code is expected in the scenarios of ultra-reliable and low latency communications. Nonetheless, the complexity of algorithms to find such a high performance block code increases dramatically as the increment of blocklength. Towards this end, the paper proposes a low-complexity recursive algorithm to search the optimal binary block codes subject to the requirement of the minimum Hamming distance. As a result, two optimal code sets of code-length 16 and 32 are found with code rate of 1/2. The simulation results show that the constructed codes under binary phase shift keying (BPSK) modulation outperform the systematic polar codes in the same blocklength in terms of the BER performance.

15:00 ***Attribute Verifier for Internet of Things***

Mohammed B. M. Kamel (Furtwangen University, Germany & Eotvos Lorand University, Hungary); Yuping Yan and Peter Ligeti (Eotvos Lorand University, Hungary); Christoph Reich (HS Furtwangen, Germany)

Identity management, authentication, and attribute verification are among the main concerns in many Internet of Things (IoT) applications. Considering the privacy concerns, attribute verification became more important in many applications. Many of the proposed models in this field suffer from privacy and scalability issues as they depend on a centralized entity. In this paper, we proposed a decentralized attribute verifier based on a challenge-response approach. To address various IoT attribute verification requirements, the proposed model provides two modes of attribute verification, namely 1-out-of-n verification and n-out-of-n verification modes, in which the participants can prove the possession of one or all of the given target attributes.

15:30 ***Evaluation of Graph Routing Single Objective Paths Using Pre-set Unequal Clustering***

Nouf H Alharbi (Taibah University, Saudi Arabia & University of Glasgow, United Kingdom (Great Britain)); Lewis M. Mackenzie and Dimitrios P Pezaros

(University of Glasgow, United Kingdom (Great Britain))

Multi-hop network paths and path redundancy enhance the reliability of communications in the Graph Routing of Industrial Wireless Sensor Networks (IWSNs). However, the centralised management of IWSNs creates unbalanced energy consumption between battery-powered wireless sensor nodes. This creates a hotspot challenge in Graph Routing. The inability to balance energy consumption with single-objective paths in mesh topologies was revealed in our previous work that used the Covariance-Matrix Adaptation Evolution Strategy (CMA-ES) to improve Graph Routing [1]. In this paper, we address this problem by combining the single-objective paths of the Graph Routing algorithm with a pre-set unequal clustering topology. First, this study detects isolated nodes within pre-set unequal clustering and then creates new clusters for these nodes. Second, the objective function of CMA-ES is used to select the best cluster head by considering node centrality between the nodes in the same cluster and the distance between other cluster heads or the gateway. Once the cluster heads are selected, single objective paths of Graph Routing that are minimum-distance (PODis), maximum residual energy (POEng), and minimum end-to-end transmission time (POE2E) can be effectively evaluated. Simulation experiments reveal that using the single objective paths of Graph Routing by the topology of pre-set unequal clustering results in more balanced energy consumption.

Friday, December 2 15:30 - 16:00 (Pacific/Auckland)

AT3: Afternoon Tea

Venue: Cotton Building Foyer (COB151)

Friday, December 2 16:00 - 18:00 (Pacific/Auckland)

S12: Session 12: Networks zoom

Room: COLT122 (Cotton Building)

Chairs: Abdullah Al Mamun (Victoria University of Wellington, New Zealand), Harith Al-Sahaf (Victoria University of Wellington, New Zealand)

16:00 ***A collaborative caching over PLC for remote areas***

Zunera Umar and Michela Meo (Politecnico di Torino, Italy)

Power line communication (PLC) technology has emerged to foster ease of reach for broadband access network in remote or developing areas at lower costs by making use of existing wired infrastructure for transmitting data signals. The increase in data demand, pushed by the popularity of communication services, poses an overwhelming burden on the underlying PLC technology, which has bandwidth limitations. To confront this issue, edge server deployed at the access network improves data processing and reduce network delays and also helps better provisioning of resources which are crucial for PLC networks. Moreover, data caching at specialized nodes such as edge server brings

forth efficient retrieving, storing and processing of data. In this work, we propose a distributed data caching scenario based on edge server (ES) and edge devices (EDs) that are equipped with caching facility and are communicating via PLC in a remote area. We develop a framework to test the mutual collaboration between ES and EDs for content fetching to minimize the use of cloud resources and relieve the load on possibly congested PLC backhaul links. Results reveal that a collaborative caching would boost effective utilization of low bandwidth PLC links and the shift of most popular content at user premises is crucial to improve socio-economic growth and digital learning platforms for unconnected part of the world.

16:30 ***On Sequential Dispatching Policies***

Esa Hyytiä (University of Iceland & Aalto University, Iceland); Rhonda Righter (University of California Berkeley, USA)

Job dispatching appears in many communication and computer systems. In this paper, we present a classification of dispatching policies according to their scalability, and introduce the class of sequential dispatching policies. These, highly scalable policies are a special case of index policies. By means of numerical examples, we show that efficient, practically optimal, dispatching may be achieved by a sequential policy, or a simple dynamic variant of such a policy, under heavy load. Performance is strong also under moderate loads. These numerical examples suggests that efficient and scalable load balancing can often be realized by simple

primitive dispatching elements amenable also for machine learning based approaches.

17:00 *Optimizing Adaptive Modulation for Symmetrically Clipped Band-Limited DCO-OFDM*

Alexander Frömming (University of Duisburg-Essen, Germany); Andreas Czylwik (Universität Duisburg-Essen, Germany); Lars Haering (University of Duisburg-Essen, Germany)

A multicarrier transmission system with clipping distortion on the transmitting side, additive white Gaussian noise on the receiving side and a frequency-selective channel is considered with respect to adaptive modulation. The investigations are made based on an optical intensity modulated band-limited DC-offset orthogonal frequency-division multiplexing (DCO-OFDM) system. Usually, the frequency-selective channel transfer function determines the bit allocation. In the present scenario, this approach must be adapted, because the clipping noise is distorted by the same channel as the information signal. Therefore, adaptive modulation can no longer achieve a gain when clipping becomes the dominating source of distortion. In this paper, the total signal-to-interference-and-noise power ratio (SINR), considering clipping noise at the transmitter and additive noise at the receiver, is calculated. Based on this result, the optimal bit allocation table (BAT) for each scenario, ranging from no clipping to very strong clipping, can be determined. It is shown that the error probability of a band-limited DCO-OFDM transmission can be approximately halved

based on this concept. Additionally, the optimal transmit power to achieve the lowest error probability in a given system can be theoretically calculated. The results are verified by simulations.

17:30 *SDN-Based Service Function Chaining Framework for Kubernetes Cluster Using OvS*

Amir Hoseein Ghorab (University of Carleton, Canada); Marc St-Hilaire (Carleton University, Canada)

The ongoing demand for deploying Virtual Network Functions (VNFs) in cloud environments is driving the motivation to also deploy end enable Service Function Chaining (SFC). However, deploying SFC in a cloud environment includes multiple subproblems such as implementing an SFC-compatible infrastructure, routing design, placement, and scaling. We believe the deployment of SFC-compatible infrastructures and the routing design issues need further attention as they are fundamental constituents of SFC-enabled cloud environments. In this paper, we present a new flexible service chain framework using a multi-nodes Kubernetes cluster, a Software-Defined Networking (SDN) controller, and an OpenFlow-enabled virtual switch known as Open vSwitch (OvS) to deploy and steer the user traffic to a distributed SFC. We demonstrate the correctness of the proposed SFC framework by monitoring the OvS flow table on Kubernetes worker nodes.

S11: Session 11: General zoom

Room: MCLT103 (Maclaurin Building)

Chairs: Niraj Gandhi (Victoria University of Wellington, New Zealand), Ian Welch (Victoria University of Wellington, New Zealand)

16:00 *Through the Window: On the exploitability of Xtensa's Register Window Overflow*

Kai Lehniger and Peter Langendoerfer (IHP Microelectronics, Germany)

While the name Xtensa is still mostly unknown to the public, the architecture plays a big role in the field of Internet of Things (IoT), be it in the form of custom designs or broadly used microcontrollers such as the ESP32 used inside millions of devices. This paper describes a newly discovered vulnerability that uses the window overflow exception handlers of an Xtensa LX processor to leak and manipulate data. To show its severity, an exploit is demonstrated that allows to disable Stack Canaries, a common protection against stack buffer overflows. Requirements and potential possibilities to escalate the vulnerability, including code-reuse attacks to completely compromise the attacked device. Finally, a countermeasure is introduced with a <0.5% runtime overhead in our worst-case scenario.

16:30 *Network Intrusion Detection System in a Light Bulb*

Liam Daly Manocchio and Siamak Layeghy (The University of

Queensland, Australia); Marius Portmann (University of Queensland, Australia)

Internet of Things (IoT) devices are progressively being utilised in a variety of edge applications to monitor and control home and industry infrastructure. Due to the limited compute and energy resources, active security protections are usually minimal in many IoT devices. This has created a critical security challenge that has attracted researchers' attention in the field of network security. Despite a large number of proposed Network Intrusion Detection Systems (NIDSs), there is limited research into practical IoT implementations, and to the best of our knowledge, no edge-based NIDS has been demonstrated to operate on common low-power chipsets found in the majority of IoT devices, such as the ESP8266. This research aims to address this gap by pushing the boundaries on low-power Machine Learning (ML) based NIDSs. We propose and develop an efficient and low-power ML-based NIDS, and demonstrate its applicability for IoT edge applications by running it on a typical smart light bulb. We also evaluate our system against other proposed edge-based NIDSs and show that our model has a higher detection performance, and is significantly faster and smaller, and therefore more applicable to a wider range of IoT edge devices.

17:00 *AAiBA: Attracting an Adversary for Increasing Base-Station Anonymity in Wireless Sensor Networks*

Sami Alsemairi (Institute of Public Administration, Saudi Arabia)

Wireless Sensor Networks (WSNs) have become one of the most interesting research areas in recent years. A WSN is comprised mainly of a set of homogeneous sensor nodes and an in-situ Base-Station (BS) that are randomly deployed within a delimited area of interest. These sensor nodes sense the area and transmit the sensed data to the BS through multiple wireless communication hops. In addition to data collection, the BS performs highly complex management functions and controls the whole network. The importance of the BS in the WSN represents a high-value target for an adversary that has a strong incentive to disable the network. Fundamentally, the adversary adopts to find the BS and launch a Denial-of-Service (DoS) attack on it by intercepting the data transmissions sent to the BS and using Evidence Theory (ET) as a technique of traffic analysis. In this paper, I propose a technique to counter the attack and increase the BS anonymity by creating cells and choosing HoneyCells from the created cells, which mimic the BS's cell and attract the adversary's attention. The simulation results demonstrate that the proposed technique offers superior anonymity results.

17:30 *MultiState-BGP Manager for Multi-Domain SDN*

Hamad Saud A Saud Alotaibi, Mark A. Gregory and Shuo Li (RMIT University, Australia)

The Border Gateway Protocol (BGP) is used between Autonomous Systems (AS) to enables and exchange routing information. AS are allocated an Autonomous System Number

(ASN). The ASN, which is utilized in BGP routing, represents the grouping of Internet Protocol (IP) routeing prefixes that have been allotted to a single administrative domain. Classless Interdomain-Routing (CIDR) is used to support hierarchical routing in the Internet backbone. As the Internet has grown, BGP has been updated to tackle challenges, including the growing routing tables, the need for improved load-balancing, BGPhijacking and security, and AS transit times. One major issue remaining is the BGP convergence delay, which is the time taken for a set of routers to agree on the network topology. Convergence delay has become an issue for large networks due to changing network topologies causing route updates and path failures that cause instability in the network. A network's instability might cause packet loss or delay, loss of connectivity and a delay in message transmission. We propose a novel technique named "MultiState-BGP Manager" in this research that is used to control and manage multi-domain SDN networks and to decrease the BGP convergence delay.

Friday, December 2 18:00 - 18:10 (Pacific/Auckland)

CR: Closing Remarks

ITNAC 2023 is in Melbourne, Australia

Mark Gregory

Chair: Mark A. Gregory (RMIT University, Australia)

Venue: Cotton Building Foyer (COB151)