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2020 30th International Telecommunication Networks and Applications Conference (ITNAC)

	Tuesday, November 24	Wednesday, November 25	Thursday, November 26
8:00 - 8:40		R1: *Registration*	
8:40 - 10:40		S1: *Session 1:* S2: *Session 2:*	S5: *Session 5:* S6: *Session 6:*
10:40 - 11:00		MT1: *Morning Tea*	MT2: *Morning Tea*
11:00 - 12:00			W3: *Software Defined Networking*
12:00 - 12:30		W1: *Women in Technology Workshop*	K4: *Keynote*
12:30 - 13:00			L2: *Lunch*
13:00 - 13:30		L1: *Lunch*	
13:30 - 14:30		K1: *Keynote*	
14:30 - 15:00		K2: *Keynote*	S7: *Session 7:* S8: *Session 8:*
15:00 - 15:20		AT1: *Afternoon Tea*	
15:20 - 15:30			
15:30 - 16:30			W2: *Juniper Contrail / Linux Tungsten Cloud Workshop*
16:30 - 16:50		S3: *Session 3:* S4: *Session 4:*	CR: *Closing Remarks and Prizes*
16:50 - 17:00			
17:00 - 17:20	WR: *Welcome Reception*		
17:20 - 20:00			

Tuesday, November 24

Tuesday, November 24 17:00 - 20:00

WR: Welcome Reception

Mark Gregory

Room: Welcome Reception Room

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

Welcome, an opportunity to meet and talk with other authors and attendees. Check Internet connectivity and applications are working ok.

Wednesday, November 25

Wednesday, November 25 8:00 - 8:40

R1: Registration

Room 1

Chair: Shuo Li (RMIT University, Australia)

Wednesday, November 25 8:40 - 10:40

S1: Session 1:

Room 1

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

8:40 *Performance Evaluation of UAV-Aided Mobile Networks by Means of Ray Launching Generated REMs*

Silvia Mignardi, Maximilian James Arpaio, Chiara Buratti, Enrico M. Vitucci, Franco Fuschini and Roberto Verdone (University of Bologna, Italy)

Unmanned Aerial Vehicles (UAV), also known as drones, are receiving increasing attention as enablers for many emerging technologies and applications, a trend likely to continue in the next future. In this regard, using Unmanned Aerial Base Stations (UABSs), i.e. base stations carried by UAVs, is one of the most promising means to offer coverage and capacity in 5G applications to those users that are not being served by terrestrial base stations. In this paper, we propose a novel approach for trajectory design and Radio Resource Management (RRM) in UAV-aided networks using information retrieved from precise Radio Environmental Map (REM) based on Ray Launching (RL) simulations for RF propagation and narrow band estimations. Furthermore, we consider different possible models for antennas to be installed on multiple UABSs as well as proper RRM strategies which are able to take advantage of REM inputs. Simulation results will show the performance achieved by the system for the different approaches and it will compare them with the previous use of statistical models.

pp. 1-6

9:10 *An End-to-End Medical Emergency Response System to Support Elderly People*

Akbar Hossain and Sayan Kumar Ray (Manukau Institute of Technology, New Zealand); Seyed Reza Shahamiri (Manuka Institute of Technology, New Zealand); M. Daud Ahmed and Garry Singh (Manukau Institute of Technology, New Zealand); Rose Arts (School of Health and Counselling, Manukau Institute of Technology, New Zealand)

This paper proposes the concept and preliminary design of an end-to-end medical emergency response system (EEMERS) to support and help elderly people in the community who live alone. The system integrates the informal caregivers, like the neighbors, friends, and family, with the traditional formal caregivers, such as the paramedics, ambulance and medical professionals. The informal caregivers act as the first responders to attend a patient in case of a medical emergency situation before the arrival of an ambulance or other medical services. An overview of the different modules of the EEMERS, the technological details and the end-to-end process flow of the system are discussed in this work. Moreover, the selection of the most appropriate informal caregiver to attend a medical emergency situation depends on a list of pre-defined contexts and is an important part of EEMERS. This work also discusses the preliminary validation results of the informal caregiver selection based on three machine learning algorithms, namely, Logistic Regression, Support Vector Machine, Nave Bayes. Finally, the paper provides a brief overview of the basic proof-of-concept implementation of the system.

pp. 7-12

9:40 ***Indigenous Big Data Implications in New Zealand***

Marianne Cherrington (University of Huddersfield, United Kingdom (Great Britain))

Our world is dynamic and digital. It is irrefutable; big data are reshaping commerce, healthcare and governmental decisions. Individuals forgo awareness or even desire to uncover or appreciate how big data are affecting our society. This raises distinct data issues of huge effect, especially for indigenous communities. The novel proposition of this research, is that by considering advances in big data optimisation and issues from an indigenous perspective, a broad appreciation of decision-making significances will result. The microcosm in Aotearoa, New Zealand is relatively simple. It permits both a clear and leading view, especially of complex indigenous effects, due to its foundations in Māoridom. As big data advancements impact the quality of life for us all, there is an enormous responsibility, opportunity and incentive to focus research and awareness into nascent data design fields. Through an indigenous lens, unique perspectives and insights are shaped and presented in this paper, implicating feature selection in high-dimensional data.

pp. 13-18

10:10 ***Software-Defined Vehicular Networks: A Cooperative Approach for Computational Offloading***

Syed Danial Ali Shah, Mark A. Gregory and Shuo Li (RMIT University, Australia)

Conventional vehicular systems are gradually evolving into intelligent transportation systems. Multi-access Edge Computing (MEC) has become an important component of the software-defined vehicular networks that benefit from the introduction of reliable and low latency 5G networks and Wi-Fi. MEC offers a variety of smart services closer to the access networks leveraged by vehicles. The intelligent and connected vehicles demand access to compute-intensive applications that require compute and storage resources in addition to what is available in vehicles today. The computational burden on the connected vehicles can be significantly reduced by offloading to the MEC nodes and to the cloud. However, existing computational offloading schemes are challenged by the fast-moving vehicles, frequent handovers and subtle differences to the scenarios designed to support mobile phone handovers. The paper presents a software-defined vehicular edge computing architecture that copes with the mobility challenges by utilising the Software Defined Networking paradigm to perform traffic flow management for information collection and intelligent management of connected vehicles and networks.

pp. 19-21

S2: Session 2:

Room 2

Chair: Shuo Li (RMIT University, Australia)

8:40 *Framework for a Decentralized Web*

Raman Singh (Trinity College Dublin Ireland & Thapar Institute of Engineering and Technology Patiala, Ireland); Andrew Donegan (Trinity College Dublin Ireland, Ireland); Hitesh Tewari (Trinity College Dublin, Ireland)

Over the past decade, we have witnessed the Internet becoming increasingly centralized in the hands of a small number of giant technology firms, that control many of the most popular applications and the content they host on their platforms. In addition, in the majority of instances today, access to the Internet is usually provided through local internet service providers (ISPs) in each country. Governments in different jurisdictions can exert pressure on these technology firms and ISPs to enforce restrictions on Internet usage by their citizens, such as the blocking access to certain sites and/or content. In this paper, we present a promising new approach to circumventing some of these issues. Our decentralized web (DWeb) proposal makes use of a mesh network to connect community based routers. In addition, objects on the DWeb are indexed using Bblockchain technology, which allows for secure storage of immutable object references, and integrity checking of the data being served to users. Our DWeb design is also capable of operating during network partitions, and is able to quickly re-synchronize with the larger network once connectivity has been restored.

pp. 22-28

9:10 *Constraint-Based Rerouting mechanism to address Congestion in Software Defined Networks*

Vijaya Durga Chemalamarri (University of Technology Sydney, Australia); Robin Michael Braun (University of Technology, Sydney, Australia); Mehran Abolhasan (University of Technology Sydney, Australia)

In this paper, we propose a traffic rerouting mechanism to address congestion in Software-Defined networks. We employ back-tracking and constraint propagation techniques to find alternate paths to reroute multiple active flows simultaneously. Cost function is based on standard deviation of link-loads. We then compare traffic distribution and link utilisation with and without rerouting active flows. We measure and compare network performance using parameters such as total rate of transfer, jitter, and packet loss with that of Shortest Path First with no rerouting. Our proposed solution produces lower jitter, packet drops, and higher transfer rate. We finally conclude the paper by making observations and discussing the scope of the future work.

pp. 29-34

9:40 *Joint Resource Allocation and Computation Offloading Strategy for D2D-assisted and NOMA-based MEC Systems*

Umar Ajaib Khan and Rong Chai (Chongqing University of Posts and Telecommunications, China); Muhammad Junaid Tahir (Chongqing University of Posts and Telecommunication, China); Waleed Almughalles (Chongqing University of Posts and Telecommunications, China)

Mobile edge computing (MEC) emerged as a promising network paradigm that provides computation, storage and networking features within the edge of the pervasive mobile radio access network. This paper jointly considers resource allocation and computation offloading problem in device-to-device (D2D)-assisted and non-orthogonal multiple access (NOMA)-based MEC systems, where each computing user (CU) is allowed to execute its task in one of the three ways, i.e., local computing, MEC offloading or D2D offloading. The original problem is formulated as an overall cost minimization problem, which proves to be NP-Hard, making it intractable to solve optimally. So, we transform the original problem into two sub-problems, i.e., resource allocation sub-problem and computation offloading sub-problem and propose two heuristic algorithms to obtain the sub-optimal solutions of both sub-problems. Finally, simulation results demonstrate the efficiency of proposed scheme when compared with related scheme.

pp. 35-41

10:10 *Quintuple Band Antenna Design Using Stacked Series Array For Millimeter Wave*

Rauful Nibir (IIUM, Malaysia); Md Rafiqul Islam (International Islamic University Malaysia, Malaysia); Nazmus Shaker Nafi (MIT, Australia); Mark A. Gregory (RMIT University, Australia)

Millimeter wave applications require efficient array antenna designs to fully utilize the spectrum. A quintuple band antenna is proposed for millimeter wave applications. Dual-layer substrate technology is utilized to achieve multiple resonances at higher frequencies ranging from 26GHz-40GHz. Twenty-five antenna array configurations were simulated and analyzed to develop the model. The resonances achieved correspond to the number of radiating patches. The operating frequencies of this design correspond with single band 27.64 GHz, dual band 24.18, 28.77 GHz, triple band resonances 23.18, 25.63, 35.79 GHz, quadruple band resonances 24.58, 26.77, 29.33, 34.43 GHz and quintuple band resonances 23.79, 25.37, 28.29, 31.69, 33.53 GHz. The proposed quintuple band antenna can be used for millimeter wave applications in all bands.

pp. 42-47

Wednesday, November 25 10:40 - 11:00

MT1: Morning Tea

Room 1

Wednesday, November 25 11:00 - 13:00

W1: Women in Technology Workshop

Room 1

Chair: Jahan Hassan (Central Queensland University, Australia)

Wednesday, November 25 13:00 - 13:30

L1: Lunch

Room 1

Wednesday, November 25 13:30 - 14:30

K1: Keynote

Mr. Matt Fowler, Juniper Networks

Room 1

Chair: Leith H. Campbell (RMIT University, Australia)

AIOps (artificial intelligence and operations) is staring to gain traction across the industry and for good reason. AIOps solutions use the same kind of machine learning and advanced analytics technologies behind Google Maps or Uber's predictive ride pricing models to help IT departments anticipate and fix problems before users even realise they've happened. Juniper is leading this transition, driven by Mist AI, which is being adopted by IT operations to address the growing data and complexity in networking and, at the same time, the continuing pressure on IT budgets. AIOps holds especially exciting promise in assuring speed and reliability of wireless networks. Wi-Fi has taken its place alongside water, power and light as a must-have technology on which businesses are building mission-critical services for consumers and employees in today's highly mobile, app-driven world. Thus, it must be more predictable, measurable and easily managed than ever. In this session you will learn and experience how AI and ML concepts are being applied to solve real-world problems in wired and wireless networks that are being built by businesses today.

Wednesday, November 25 14:30 - 15:00

K2: Keynote

Professor Shui Yu

Room 1

Chair: Leith H. Campbell (RMIT University, Australia)

Wednesday, November 25 15:00 - 15:20

AT1: Afternoon Tea

Room 1

Wednesday, November 25 15:20 - 17:20

S3: Session 3:

Room 1

Chair: Hadi Alasti (Purdue University Fort Wayne, USA)

15:20 *Energy-Efficient and QoS-aware UAV Communication using Reactive RF Band Allocation*

Marjan Moradi (UNSW, unknown); Ayub Bokani and Jahan Hassan (Central Queensland University, Australia)

Next generation mobile communication systems propose the use of Unmanned Aerial Vehicles (UAVs)in providing wireless communication services. Emerging bandwidth-demanding applications such as real-time video streaming could also be satisfied by the next generation UAVs while exploiting the unoccupied bandwidth available at millimetre wave (mmWave) frequency ranging from 30 to 300 GHz. However, mmWave UAVs suffer from high attenuation loss and Line Of Sight (LOS) communication. To combat the attenuation, UAVs must transmit using higher transmission power which results in higher energy consumption. MmWave, however, incurs shorter communication sessions implying shorter flight duration and less energy consumption than Long-Term Evolution (LTE) band for delivering the same service. Furthermore, a wide range of applications are delay sensitive and unable to be served by LTE. Since mmWave UAVs require continuous LOS and are unable to serve concurrent multiple nodes, we explore the concept of dual-mode UAV-assisted service delivery in which the UAV switches to mmWave band for serving bandwidth-hungry applications, and back toLTE for all other applications. The aim is to achieve a trade-off between Quality of Service (QoS) and energy consumption for Air2Ground (A2G) service delivery. Our evaluation results show the feasibility of such dual-mode system for next generation UAVs while achieving higher QoS compared to the current mono-band UAVs.

pp. 48-53

15:40 *MLIDS: Handling Raw High-Dimensional CAN Bus Data using Long Short-Term Memory Networks for Intrusion Detection in In-Vehicle Networks*

Kibrom Desta Araya, Shuji Ohira, Ismail Arai and Kazutoshi Fujikawa (Nara Institute of Science and Technology, Japan)

CAN uses no authentication and encryption mechanisms for secure communication. To solve the security issues of the CAN bus, a deep learning-based intrusion detection systems have been proposed. But due to the high dimensional property of the CAN bus data, it was not possible to create an effective Intrusion Detection System (IDS) in the CAN bus that can take the property of the CAN data into consideration. In this paper, we are proposing a Long Short-Term Memory Networks (LSTM) based IDS that can handle the high dimensional property of the CAN bus data. Unlike the conventional methods which required a single network architecture for each unique arbitration ID, our method gives a single overall anomaly signal over a certain detection window without the need for reverse-engineering the CAN bus data. Using this anomaly signal we have managed to achieve 100% detection precision for insertion, fuzzy and targeted attacks in our data and in a public data that is prepared for this specific purpose.

pp. 54-60

16:00 *A Spatiotemporal Analysis of a Group-based Access Solution for Massive MTC Networks and the Stability-Scalability Trade-off*

Rasha Al Khansa and Hassan A. Artail (American University of Beirut, Lebanon); Mohamad Assaad (CentraleSupelec, France); Karim Y. Kabalan (American University of Beirut, Lebanon)

Machine-Type Communication (MTC) Systems play a critical role in providing ubiquitous Internet of Things within the emerging 5G technologies. We consider an MTC system with a massive number of devices and provide a hybrid scheduled and group-based random access solution for accommodating the massive traffic. We study the proposed solution through a spatiotemporal analytical framework, where we use stochastic geometry, probability theory, and iterative algorithms to derive the frequency of successful transmissions and the expected queue status at the devices. The analytical model is then used to study the stability-scalability trade-off in the proposed scheme.

pp. 61-68

16:20 *Integrated Game Theoretic-Grey Relational Analysis Handover Method for Heterogeneous Networks*

Mohanad Alhabo and Naveed Nawaz (University of Leeds, United Kingdom (Great Britain)); Omer Waqar (Thompson Rivers University (TRU), Canada)

In this paper, an integrated game theoretic and grey relational analysis handover method for dense small cells heterogeneous networks is proposed. The game theory is deployed to optimize the transmission power of the base stations before applying the grey relational analysis technique. The payoff function of the game contains utility and cost functions. The game is solved by reaching the Nash equilibrium where we mathematically proved the existing of it. The grey relational analysis is then used to rank the small cells prior to handover. Results show that the proposed method outperformed the conventional method in terms of unnecessary handover, handover failure, average SC throughput and average SC load.

pp. 69-74

16:40 *A Design of Military Mobile Networks Converged with mHealth, IoT and Low Power Wide Area Network*

James Jin Kang (Edith Cowan University, Australia)

Networks for military applications have unique characteristics when compared with other applications, and are usually composed of unstructured networks due to the nature of the network environment being required to adapt to unexpected geographic locations. Ad-hoc networks are unstructured and increasing in prevalence with such examples being Low Power Wide Area Networks (LPWAN) and

Wireless Body Area Networks (WBAN). These are emerging alongside various applications such as health monitoring and emergency user location identification, which can be further adapted with alarm detection through the inference of a user's situation via the use of sensors and personal devices within an LPWAN. During a military operation, injured personnel or those at emergent health risks can be identified and located from an automatic alarm activation. This paper discusses the design and construction of a framework for secure automated messaging and data fusion which could be applicable to a battlefield.

pp. 75-77

S4: Session 4:

Room 2

Chair: Leith H. Campbell (RMIT University, Australia)

15:20 *On-Demand Blind Packet Forwarding*

Irfan Simsek (University of Duisburg-Essen, Germany)

Network Address Confidentiality (NAC) classifies all third parties and network nodes as adversaries and limits access to the network packet addresses in cleartext exclusively to the communicating endpoints. NAC implies certain anonymity properties, namely sender/recipient and relationship unlinkabilities. Blind Packet Forwarding (BPF) realizes NAC and its unlinkability properties by redesigning the packet forwarding and its associated network functions to blind ones transferring and processing packet addresses in end-to-end encrypted form. BPF defines two modes. In the semi-blind mode, NAC and its unlinkability properties apply only to communicating endpoints, while the fully blind mode provides these security properties for communicating endpoints as well as domains and local networks. However, the full blindness in a domain requires to set up and maintain masked routing tables within the entire domain, which is a costly process. This paper proposes multiple approaches for different cases to selectively set up masked routing table entries and to perform the full blindness on demand. Moreover, we present our prototype implementation and its evaluation by means of an adjusted OpenFlow version and multiple scenarios respectively.

pp. 78-85

15:40 *An Investigation on Core Network Latency*

Uwe Bauknecht and Tobias Enderle (University of Stuttgart, Germany)

The growing adoption of 5G and cloud services places an increasing importance on the attainable point-to-point latency in Internet service provider networks. It directly impacts whether latency-critical services can be offered as well as the number and location of the corresponding data centers. In order to investigate the limits and variability of latency values in an actual core network, we collected round-trip time values published by a large North American Internet service provider spanning the duration of more than one year. We present a statistical analysis of this data set from which we infer a potential fiber topology. We use this topology to hypothesize on the efficacy of different means of reducing latency and determine their effect on the viability of low-latency services.

pp. 86-91

16:00 *OFDM-IM Performance Evaluation Under Jamming Attack*

Ahmet Kaplan, İbrahim Altunbaş and Gunes Karabulut Kurt (Istanbul Technical University, Turkey); Mustafa Kesal (ASELSAN, Inc., Turkey); Defne Kucukyavuz (Aselsan Inc., Turkey)

Orthogonal frequency division multiplexing (OFDM) with index modulation (OFDM-IM) conveys extra information bits by the active subcarrier indices that are selected according to input bits. OFDM-IM is a strong transmission technology candidate for the next-generation networks, due to its performance gain over OFDM. In this paper, we analyze the performance of OFDM-IM under jamming attack and propose a new jamming model called arbitrary jamming to adjust jamming power over each subcarrier. We show the superior performance of OFDM-IM in comparison to the classical OFDM, at high signal to jamming power ratios under a jamming attack. We also compare the OFDM-IM system performance in the presence of the barrage jamming and partial band jamming. To support our results, an upper bound on the average bit error probability that is relatively tight at high signal-to-noise and signal-to-jamming power ratio regions is derived under the jamming attack.

pp. 92-97

16:20 *Link Scheduling in Rechargeable Wireless Sensor Networks with Battery Memory Effects*

Tony Tony (Curtin University, Australia & Tarumanagara University, Indonesia); Sieteng Soh (Curtin University, Australia); Kwan-Wu Chin (University of Wollongong, Australia); Mihai M Lazarescu (Curtin University, Australia)

This paper considers deriving a link schedule for rechargeable WSNs. Unlike past works, it considers: (i) the time required by nodes to harvest energy, and (ii) deterioration in battery lifetime due to memory effects. It presents a greedy heuristic that schedules links according to the earliest time in which the batteries at each link's end nodes are fully discharged. Our results show that considering memory effects via a battery cycle constraint and energy harvesting time increases the link schedule by up to 30.43% and reduces the number of charge/discharge cycles of battery by up to 84.05%. Hence, it helps to increase a battery's lifetime. On the other hand, an increase in energy harvesting time linearly increases link schedules but it does not affect the number of charge/discharge cycles. Finally, increasing a battery's depth of discharge reduces its number of charge/discharge cycles by up to 399.84%, while lengthening the link schedule by up to 7.03% only.

pp. 98-105

16:40 *Reference-free Detection of LSB Steganography Using Histogram Analysis*

Natiq Abdali (University of Babylon, Iraq); Zahir M. Hussain (University of Kufa & Edith Cowan University, Iraq)

Due to the difficulty of obtaining a database of original images that are required in the classification process to detect tampering, this paper presents a technique for detecting image tampering such as image steganography in the spatial domain. The system depends on deriving the auto-correlation function of the image histogram, then applying a high-pass filter with a threshold. This technique can be used to decide which image is cover or a stego image, without adopting the original image. The results have eventually revealed the validity of this system. Although this study has focused on LSB steganography, we expect that it could be extended to other types of image tapering.

pp. 106-112

Thursday, November 26 8:40 - 10:40

S5: Session 5:

Room 3

Chair: Marjan Moradi (UNSW, unknown)

8:40 *A distributed algorithm for range-based localization in sparse wireless networks*

Quentin Vey (IRIT - CNRS, France); Rejane Dalce (Institut de Recherche en Informatique de Toulouse UMR 5505 - CNRS, France); Adrien van den Bossche (IRIT, Université de Toulouse, Toulouse, France); Thierry Val (IRIT, Université de Toulouse, France)

Wireless nodes localization has become a major research theme in recent years. Distributed and collaborative solutions are particularly interesting since the nodes can compute their own localisation without depending on external computational resources. In this paper, we present the context of distributed and cooperative localisation and the principles of a distributed Force-Based localisation algorithm. We then present an original algorithm: UWL (Uncertainty Weighted Localization). A performance evaluation of UWL has been conducted by simulation and the results are compared to the well-known PPE algorithm. The results show that UWL performs better than PPE on a scenario where a comparison with PPE is possible. On two others scenarios where the number of anchors is limited, the localisation accuracy depends on the network density; With a medium connectivity, the localisation accuracy is below 1m for 99% of the nodes, even though none of them is within range of more than 1 anchor.

pp. 113-120

9:10 *MOBDroid: An Intelligent Malware Detection System for Improved Data Security in Mobile Cloud Computing Environments*

Noah Oghenefego Ogwara, Krassie Petrova and Mee Loong Yang (Auckland University of Technology, New Zealand)

We propose an intelligent malware detection system (MOBDroid) that aims to protect the end-user's mobile device (MD) in mobile cloud computing (MCC) environment. MOBDroid utilizes the Android Operating System (OS) permission-based security system. The APK files of 28,306 benign and malicious applications (apps) collected from the AndroZoo and RmvDroid malware repositories were used in the system development process. The apps were decompiled in order to extract their manifest files and construct a dataset comprising the permissions requested by each of the apps. We identified some unique permissions that could be used to distinguish between malicious and benign apps and performed a series of experiments using a machine learning (ML) model; the model drew on the ML.net library and was implemented in C#.net. In the experiments conducted, we obtained classification accuracy of 96.89%, a detection rate of 98.65%, and false negative rate of 1.35%. The results indicate that our model compares very favorably to other models reported in the extant literature.

pp. 121-126

9:40 *Cuckoo Prefix: A Compressed IP Blocklist Hash Set*

Donovan Allen and Navid Shaghaghi (Santa Clara University, USA)

IP blocking has become a vital task for all network attached devices. Every device from Internet of Things, to routers, to application servers requires the ability to filter certain IP addresses from delivering malicious information. Blocking IPs requires storing and checking lists of tens to hundreds of millions of IP addresses. Cuckoo hash sets provide strong performance by offering relatively low numbers of memory accesses per lookup. This makes them optimal for time sensitive applications like networking. Using cuckoo++ hash tables as a baseline, we propose a new data structure known as cuckoo prefix for the purpose of blocking IPs quickly with relatively little space. Leveraging IP subnets allows us to achieve similar throughput rates as implementations such as cuckoo++ with 8 times less memory usage. In addition, in this paper we offer a comparison of throughput and memory usage of several modern hash set and hash table implementations. In particular, we examine linear probing, robin hood hashing, bit sets (including EBVBL), and cuckoo hashing implementations to determine which provides the best throughput at the lowest memory cost.

pp. 127-134

10:10 *Feature-Based Adversarial Attacks Against Machine Learnt Mobile Malware Detectors*

Maryam Shahpasand and Leonard Hamey (Macquarie University, Australia); Mohamed Ali Kaafar (Macquarie University & Optus Macquarie University Cyber Security Hub, CSIRO Data61, Australia); Dinusha Vatsalan (Data61|CSIRO, Australia)

The success of Machine Learning (ML) techniques in security applications, such as malware detection, is highly criticized for their vulnerability to Adversarial Examples (AE): perturbed input samples (e.g. malware) can mislead ML to produce an adversary's desired output (e.g. benign class label). AEs against ML models are broadly studied in the computer vision domain where the adversary perturbs the pixel values of an image such that the change is not perceptible, but the resulting image is misclassified by the model. We investigate the effectiveness of attack techniques proposed in the image domain to attack ML classifiers in the context of mobile malware detection. Since the feature vector representation of samples is often used in ML, a simplified evaluation of ML classifiers' robustness to AEs is to study feature-based attack models, where the adversary perturbs the input features. We compare the methods, trade-offs, and gaps for such attack models and show that generative models (e.g. GANs) outperform a selection of existing attacks in terms of attack success rate but apply large distortion to the original sample. We also describe how we use the generated samples for increasing a classifier's robustness through adversarial training.

pp. 135-142

S6: Session 6:

Room 4

Chair: Navid Shaghaghi (Santa Clara University, USA)

8:40 *WP4: A P4 Programmable IEEE 802.11 Data Plane*

Paul Zanna, Pj Radcliffe and Dinesh Kumar (RMIT University, Australia)

IEEE 802.11 wireless networking is now one of the most common methods of connectivity, and with it, a new range of security and reliability issues. While a Software Defined Networking (SDN) approach has made significant inroads with these problems in wired networks, the impact has not been as notable in the wireless networking space. One reason for this is that the existing SDN approach, predominately OpenFlow, is restricted to the network interface level as their match-action pipelines are only capable of processing Ethernet frames and cannot, therefore, address the underlying wireless elements. The introduction of the P4 programming language allows developers to create custom data planes which can include definable packet parsers. This functionality enables the construction of data planes capable of parsing IEEE 802.11 wireless frames. In this paper, we develop a new P4 compiler extension called WP4 to enable the creation of a P4 data plane accessible by a Linux wireless driver. It allows the processing of previously inaccessible management frames such as beacons, probes and de-authentication. Finally, we provide example scenarios for this novel approach and a performance evaluation of the WP4 implementation.

pp. 143-148

9:10 *An Efficient Machine Learning Algorithm For Spatial Tracking Of Correlated Signals In Wireless Sensor Field*

Hadi Alasti (Purdue University Fort Wayne, USA)

An efficient machine learning algorithm based on stochastic gradient is proposed and discussed for spatial tracking of correlated spatial signals from the sensor observations in wireless sensor field. The proposed algorithm can be used for environmental monitoring applications such as efficient temporal monitoring of temperature in hot island, or efficient monitoring of the distribution of pollutant gasses in wide areas for example terrain of large cities, etc. The proposed algorithm is computationally efficient and is low cost. In this paper the number of reporting sensors in tracking of signal is defined as cost. The spatial signal is compressed into a number of its iso-contours at specific levels and the sensors whose their sensor readings are in given margin of these contour levels, report their sensor readings to the fusion center (FC). The algorithm is done in two phases of spatial modeling and spatial tracking, where it uses the correlation between the spatial signal before and after variation of the spatial signal and updates the new set of contour levels for spatial tracking. The proposed machine learning algorithm finds the modeling parameters during the spatial modeling phase, and then updates them in spatial tracking phase. The performance analysis of the proposed algorithm shows that it successfully tracks the spatial variations of the signal at low cost with similar modeling performance to the spatial modeling.

pp. 149-154

9:40 *Multi-State Border Gateway Protocol for Multi-Domain Software Defined Networking-Based Gateways*

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

Border Gateway Protocol (BGP) is a path-vector routing protocol used to exchange routing and reachability information between autonomous system (AS) that offers flexibility and scalability. BGP is capable of handling scalability issues using classless inter-domain routing and is more efficient than alternatives. However, BGP related challenges have been encountered, including growing routing tables, load balancing issues, hijacking, and AS transit delays, leading to increased convergence delay. Convergence delay is the time gap between the commencement of the best-path selection process and when the router is updated. Convergence delay has become a significant issue for larger networks because frequent routing path updates can lead to network instability. Network instability causes packet loss, delayed packet delivery and occasional loss of network connectivity. The research aims to incorporate Software Defined Networking (SDN) technology with gateway operation to reduce the BGP convergence time.

pp. 155-160

10:10 *Features of Human-Centred Algorithm Design*

Marianne Cherrington (University of Huddersfield, United Kingdom (Great Britain)); David O. Airehrour (Unitec Institute of Technology & New Zealand, New Zealand); Joan Lu (Huddersfield University, United Kingdom (Great Britain)); Qiang Xu (University of Huddersfield, New Zealand)

Algorithms are pervasive, unseen influencers of decisions. Algorithmic features can fluctuate widely, depending on use, user or criteria applied. This paper considers the nascent field of human-centred algorithm design (HCAD), intersecting human-centred design and algorithmic systems. Human-centred, more-than-metric feature selection approaches, create fairer and deeper meaning. More value is created. The unique impact of this paper is to integrate feature selection within a technology HCAD strategy, for a novel, innovative HCAD approach to machine learning. This flexible and evaluative approach can support data advances with human-social nuance, designed for purpose with knowledge for data-driven decisions. The design of machine learning algorithms to the uses in which they will be employed is user-centric. This is important within environments utilising automated, semi-automated or high-performance analytics.

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Thursday, November 26 10:40 - 11:00

MT2: Morning Tea

Room 3

Thursday, November 26 11:00 - 12:00

W3: Software Defined Networking

Mr. James Kershaw / Mr. Ming Kai, Juniper Networks

Room 3

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

Thursday, November 26 12:00 - 12:30

K4: Keynote

Energy-Efficient Systems for Smart Sensor Communications

Professor Zahir Hussain

Room 3

Chair: Leith H. Campbell (RMIT University, Australia)

A wireless sensor network (WSN) is a communication network with ad hoc configuration consisting of tiny, low-power, low-cost sensors which are normally distributed in a decentralized fashion and have limited processing capability. WSNs have found a wide range of applications such as industrial process control, healthcare monitoring, surveillance, forest fire detection, natural disaster detection, target tracking, among many other applications. It is known that WSNs are resource-constrained, hence, energy efficiency is crucial for all applications of WSNs to extend the life span of the sensors' batteries. The most energy consuming operation in WSN is data communication, hence, it is important to reduce amount of data transmission through WSNs without significantly affecting the transferred information. In this presentation we will focus on two directions of data-efficient signal representations that are expected to provide WSNs with sufficient energy control. The first direction is the use of intelligent short word-length (SWL) systems via embedded sigma-delta modulation, and the second direction is to use compressive sensing (CS) with chaotic sequences. If security is a factor, then CS via chaos can support secure communication in addition to its main function as a technique for data compression.

12:00 *Energy-Efficient Systems for Smart Sensor Communications*

Zahir M. Hussain (University of Kufa & Edith Cowan University, Iraq)

A wireless sensor network (WSN) is a communication network with ad hoc configuration consisting of a number of tiny, low-power, low-cost sensors which are normally distributed in a decentralized fashion and have limited processing capability. WSNs have found a wide range of applications such as industrial process control, healthcare monitoring, surveillance, forest fire detection, natural disaster detection, target tracking, among many other applications. It is known that WSNs are resource-constrained, hence, energy efficiency is crucial for all applications of WSNs to extend the life span of the sensors' batteries. The most energy consuming operation in WSN is data communication, hence, it is important to reduce amount of data transmission through WSNs without significantly affecting the transferred information. In this paper we will focus on two directions of data-efficient signal representations that are expected to provide WSNs with sufficient energy control. The first direction is the use of intelligent short word length (SWL) systems via embedded sigma-delta modulation, and the second direction is to use compressive sensing (CS) with chaotic sequences. If security is a factor, then CS via chaos can support secure communication in addition to its main function as a technique for data compression.

pp. 167-170

Thursday, November 26 12:30 - 13:00

L2: Lunch

Room 3

Thursday, November 26 13:00 - 15:30

S7: Session 7:

Room 3

Chair: Sayan Kumar Ray (Manukau Institute of Technology, New Zealand)

13:00 *Smart Attendance System in an Enterprise-Based Access Point Environment*

Temitope Adeyemi Odewole and Rajan Kadel (Melbourne Institute of Technology, Australia)

Attendance is of great importance in our daily activities as it determines performance, productivity and accountability in workplaces, classrooms, and other organizations but this has been an arduous task especially in a large enterprise. The relationship between Media Access Control (MAC) address of smart devices of users and the Received Signal Strength (RSS) from user device at Wireless Access Point (WAP) has been proven to be the way out. However, there are some factors such as the location of a WAP, type of Wi-Fi technology, security concerns, Angle of Arrival (AoA) of the received signal, etc. that were not considered for possible improvement on accuracy. This paper presents a smart attendance system for an organisation using enterprise AP. The proposed attendance system uses RSS and AoA for better accuracy and results. The paper also present comparison results on threshold RSS value and accuracy of attendance for IEEE802.11a and IEEE802.11g Wi-Fi standards.

pp. 171-176

13:30 *Detecting Network Intrusion through Anomalous Packet Identification*

Tanjim Dipon and Md Shohrab Hossain (Bangladesh University of Engineering and Technology, Bangladesh); Husnu S Narman (Marshall University, USA)

Rule based intrusion detection depends on the attack signature database which has to be constantly updated, requiring time and efforts. Anomaly based intrusion detection through unsupervised methods does not require comparing with attack signatures. However, detecting anomalous behaviour is a complex task. In this paper, we have proposed an unsupervised approach for anomalous network traffic identification by combining dimensionality reduction with sub-space clustering. Our approach takes the attribute values from network traffics as input, performs principal component analysis on them, and then applies densitybased clustering on each possible three dimensional sub-spaces to rank the outliers. Results show that our proposed approach detects a wide range of anomalous network session which included instances of intrusive sessions too. The evaluation of this approach showed significant accuracy and faster detection with a zero false negative rate, implying that no instance of the listed attacks went undetected.

pp. 177-182

14:00 *QNOC Isochronous Router with Efficient Dynamic Virtual channel and Error Termination*

Molom Lakshmi Prasad Reddy (PES University & Intel, India); Sumanth Sakkara (PES University, India)

The Quality-of-Service-Network-on-Chip (QNoC) architecture is used in complex System-on-Chip (Soc) for intercommunication. For high efficiency and throughput, Buffer Virtual-Channel (VC) input port NoC is utilized. In order to provide a good Quality-of-Service (QoS), input port buffer area optimization is important. Compared to traditional VC approaches, the current efficient dynamic VC (EDVC) organizes the buffers in an effective way to minimize area overhead for enhanced performance. In this paper, we propose an Isochronous Efficient Dynamic Virtual Channel (IEDVC) router architecture that aims to effectively organize the VC input port, prioritise packets, and provide good communication. To enhance the QoS, techniques such as frequency boosting and error termination have been introduced. Thus, with all modifications, the results of IEDVC showed that it utilizes the 14.19 % less hardware, with a 3.7% and 3.8% increase in frequency and throughput respectively.

pp. 183-188

14:30 *Road Crack Detection Using Gaussian Mixture Model for Diverse Illumination Images*

Da-Ren Chen and Wei-Min Chiu (National Taichung University of Science and Technology, Taiwan)

The studies on road crack detection using machine learning techniques have been conducted and derived significant accuracies. Most of the studies do not consider diverse illumination during daytime or nighttime, and only focus on the detection of category or presence of road crack. In this paper, we propose IlumiCrack, a novel road crack detection framework collaborating Gaussian mixture model (GMM) and object detection CNN models to address these issues. The contributions of this paper are: 1) For the first time, a large-scale road crack dataset with a variety of illumination such as the pictures at nighttime are prepared using a dashcam. 2) On the basis of GMM, experimental evaluations on 2 to 4 levels of brightness classification is conducted for optimal classification. Experimental results show that IlumiCrack outperforms the state-of-the-art R-CNN object detection framework.

pp. 189-194

15:00 *Dynamic Bandwidth Allocation (DBA) Algorithm for Passive Optical Networks*

Liwei Yang, Qi Zhang and Ziyi Huang (China Agricultural University, China); Wenjie Zhang (Minnan Normal University, China)

The emergence of Passive Optical Network (PON) technology, which is one of the important solutions for 5G bearer network enables the telecommunications industry to provide users with services with higher transmission rates and lower construction costs, compared with the traditional bandwidth access mode. This paper mainly analyses the dynamic bandwidth allocation (DBA) of the NG-PON, proposes a novel scheme based on traditional DBA algorithm and introduces a DBA algorithm supporting quality of services (QoS) and services hierarchy. This algorithm can divide the services into different priority. The results show that the improved DBA can effectively improve channel utilization and reduce average delay.

pp. 195-200

S8: Session 8:

Room 4

Chair: Lincy Elizebeth Jim (Melbourne Institute of Technology, Australia)

13:00 *Mitigation of Fake Data Content Poisoning Attacks in NDN via Blockchain*

Stanislaw Baranski and Jerzy Konorski (Gdansk University of Technology, Poland)

Information-centric networks struggle with content poisoning attacks (CPAs), especially their stronger form called Fake Data CPA, in which an intruder publisher uploads content signed with stolen credentials. Following an existing graph-infection based approach leveraging the constrained time when stolen credentials are useful, we design a blockchain-based mitigation scheme for Named Data Networking architectures. We postulate Proof-of-Time verification to distinguish between intruder and legitimate publishers, and argue that blockchain solutions can implement it natively. The proposed scheme, using the Federated Byzantine Agreement protocol, is described in detail and found to be a valuable alternative to the graph-infection approach, superior with respect to outcome determinism, resiliency, and fault tolerance.

pp. 201-206

13:30 *A Study of Reference Node Placement based on 4-quadrant Node Selection in Ultra Wideband Indoor Positioning System*

Kriangkrai Maneerat, Krisada Chinda, Charuwalee Suwatthikul, Ladawan Klinkusoom, La-or Kovavisaruch and Kamol Kaemarungsi (National Electronics and Computer Technology Center, Thailand)

This paper investigated the impact of the reference node (RN) placement on the localization performance of Ultra wideband (UWB) indoor positioning system. Different RN-placement patterns based on 4-quadrant node selection strategy were experimented. The accuracy performance of UWB indoor positioning systems was evaluated with 3D trilateration algorithm. Experimental results showed that the RN placement with a crossing pattern (Pattern A) provided the highest location accuracy performance in which an average error distance was less than 0.24 m. Moreover, we found that the RN placement with a sloping pattern (Pattern B) could cause the accuracy performance degradation up to 66%. In particular, the positioning error of y- and z-coordinate of the tag placed in the middle for Pattern B was almost 1 m.

pp. 207-210

14:00 *Design of microstrip antenna and RF circuit for robust wireless communication of IoT devices under partial shield installation*

Bo Hu, Benjamin Fisher and Alirio Guerra (Rollease Acmeda Pty Ltd, Australia); John P.T. Mo (RMIT University, Australia)

In recent years, the IoT-enabled devices are popular in residents and commercial offices, which are often integrated into wireless local networks. To achieve it, those IoT devices often utilize microstrip antennas due to their low cost, low profile and ease of forming antenna arrays. However, they may be installed inside the steel truss walls for the beauty of the environment. The partial metal shield is observed to reduce the signal strength significantly and blocks the wireless data transmission among those IoT devices over a long distance. This paper's objective is to design and fabricate an inverted-U shape microstrip antenna and 433MHz radio frequency circuit, which has a good performance even under partial shield installation. The method is to optimize the impedance matching circuit with side and rear metal shields. The experiments confirm that this new design has robust wireless communication among multiple IoT devices over 40-meter indoors and 100-meter outdoors environment.

pp. 211-214

14:30 *Emulating Low Probability of Detection Algorithms*

James Yockey (US Army, Australia); Benjamin Campbell and Andrew Coyle (Defence Science and Technology Group, Australia); Robert Hunjet (DST Group, Australia)

Software Defined Radios (SDRs) can be used to create and modify radio waveforms in order to perform research into various wireless network problems. Defence Science and Technology Group (DSTG) has created the Experimental Framework of SDRs (EFOS) incorporating bespoke SDRs communicating with one another through an RF attenuation matrix. The Harlequin scenario planning software is used to create scenarios using a set of units, and then calculate the radio propagation matrix for this network. This matrix is fed into a Radio Frequency (RF) attenuator, which is used to modify the communications between the SDRs, creating a realistic radio environment. EFOS is described and then demonstrated using a Low Probability of Detection (LPD) power control problem on a simple network.

pp. 215-220

15:00 *Network Anomaly Detection Using LightGBM: A Gradient Boosting Classifier*

Md. Khairul Islam (Samsung R & D Institute Bangladesh, Bangladesh); Prithula Hridi and Md Shohrab Hossain (Bangladesh University of Engineering and Technology, Bangladesh); Husnu S Narman (Marshall University, USA)

Anomaly detection systems are significant in recognizing intruders or suspicious activities by detecting unseen and unknown attacks. In this paper, we have worked on a benchmark network anomaly detection dataset UNSW-NB15, that reflects modern-day network traffic. Previous works on this dataset either lacked a proper validation approach or followed only one evaluation setup which made it difficult to compare their contributions with others using the same dataset but with different validation steps. In this paper, we have used a machine learning classifier LightGBM to perform binary classification on this dataset. We have presented a thorough study of the dataset with feature engineering, preprocessing, feature selection. We have evaluated the performance of our model using different experimental setups (used in several previous works) to clearly evaluate and compare with others. Using ten-fold cross-validation on the train, test, and combined (training and test) dataset, our model has achieved 97.21%, 98.33%, and 96.21% f1 scores, respectively. Also, the model fitted

only on train data, achieved 92.96% f1 score on the separate test data. So our model also provides significant performance on unseen data. We have presented complete comparisons with the prior arts using all performance metrics available on them. And we have also shown that our model outperformed them in most metrics and thus can detect network anomalies better.

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Thursday, November 26 15:30 - 16:30

W2: Juniper Contrail / Linux Tungsten Cloud Workshop

Associate Professor Mark A Gregory

Room 3

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

A workshop on Cloud networks that includes a description and live example of how Juniper Contrail was installed and is being used at RMIT University.

Thursday, November 26 16:30 - 16:50

CR: Closing Remarks and Prizes

ITNAC 2021 is in Sydney, Australia

Mark Gregory

Room 3

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