

STUDENT COURSE FILE

Semester 1 Session 2018/2019

SCSP1513 TECHNOLOGY AND INFORMATION SYSTEM

Faculty of Computing

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***INTERNET OF THINGS***

Today we went to School of Electrical Engineering to attend the Internet-of-Things (IoT) Carnival 2018. Advanced Telecommunication Technology Research Group (ATT RG) in collaboration with ICONIX Consulting Sdn Bhd, JURUTEK, Kolej Tuanku Canselor (KTC), UTM, on behalf of the School of Electrical Engineering (SKE), Faculty of Engineering, Universiti Teknologi Malaysia (UTM), have organized the Internet-of-Things (IoT) Carnival 2018 for the second time, which was held on the 17th -18th November 2018. Activities during the IoT Carnival include project showcase, hackathon, hands-on training and workshop, open booths and industrial talks. There was participation from 30 secondary students in Johor Bahru area as part of their Corporate Social Responsibility (CSR) program to promote exposure and awareness to Science, Technology, Engineering and Mathematics (STEM) education which is in line with the Government’s National STEM Action Plan 2017 initiatives.

The first lecture of IOT was: **Predictive Maintenance Gets an Extreme Makeover**. The speech was delivered by Syahrul Hafidz Suid. He works in the industry in the name of Hewlett Packard Enterprise as an enterprise consultant in the commercial and public sector. You can contact him by the following ways:

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His main agenda for his talk today was about the followings:

1. Worldwide CIO Agenda 2019 Predictions by IDC
2. Industry 4.0 – Technology Trends
3. IOT – Predictive Maintenance

He told us about the three main sectors involving HPE digital transformation agenda:

* Technology: Intelligent, software-defined solutions, edge to cloud.
* People: Skills, processes and culture to keep pace with innovation.
* Economics: Investment strategies and business models to speed growth

About the topic of Worldwide CIO Agenda, he showed us some predictions

* **Prediction 1:** By 2021, driven by LOB needs, 70% of CIOs will deliver "agile connectivity" via APIs and architectures that interconnect digital solutions from cloud vendors, system developers, start-ups, and others.
* **Prediction 2:** Compelled to curtail IT spending, improve enterprise IT agility, and accelerate innovation, 70% of CIOs will aggressively apply data and AI to IT operations, tools, and processes by 2021.
* **Prediction 3:** By 2022, 65% of enterprises will task CIOs to transform and modernize governance policies to seize the opportunities and confront new risks posed by AI, ML, and data privacy and ethics.
* **Prediction 4:** Through 2022, 75% of successful digital strategies will be built by a transformed IT organization, with modernized and rationalized infrastructure, applications, and data architectures.
* **Prediction 5:** By 2020, 80% of IT executive leadership will be compensated based on business KPIs and metrics that measure IT's effectiveness in driving business performance and growth, not IT operational measures.
* **Prediction 6:** By 2020, 60% of CIOs will initiate a digital trust framework that goes beyond preventing cyberattacks and enables organizations to resiliently rebound from adverse situations, events, and effects.
* **Prediction 7:** By 2022, 75% of CIOs who do not shift their organizations to empowered IT product teams to enable digital innovation, disruption, and scale will fail in their roles.
* **Prediction 8:** Through 2022, the talent pool for emerging technologies will be inadequate to fill at least 30% of global demand and effective skills development and retention will become differentiating strategies.
* **Prediction 9:** By 2021, 65% of CIOs will expand agile/DevOps practices into the wider business to achieve the velocity necessary for innovation, execution, and change.
* **Prediction 10:** By 2023, 70% of CIOs who cannot manage the IT governance, strategy, and operations divides between LOB-dominated edge computing, operational technology, and IT will fail professionally.

He highlighted on the second prediction:

**Prediction 2:** Compelled to curtail IT spending, improve enterprise IT agility, and accelerate innovation, **70% of CIOs will aggressively apply data and AI to IT operations, tools, and processes by 2021.**

Then we had the talk about the **Industry Revolution**:

**Industry 1.0**

In the 1800s, water- and steam-powered machines were developed to aid workers. As production capabilities increased, business also grew from individual cottage owners taking care of their own — and maybe their neighbors’ — needs to organizations with owners, managers and employees serving customers.

**Industry 2.0**

By the beginning of the 20th century, electricity became the primary source of power. It was easier to use than water and steam and enabled businesses to concentrate power sources to individual machines. Eventually machines were designed with their own power sources, making them more portable.

This period also saw the development of a number of management programs that made it possible to increase the efficiency and effectiveness of manufacturing facilities. Division of labor, where each worker does a part of the total job, increased productivity. Mass production of goods using assembly lines became commonplace. American mechanical engineer Frederick Taylor introduced approaches of studying jobs to optimize worker and workplace methods. Lastly, just-in-time and lean manufacturing principles further refined the way in which manufacturing companies could improve their quality and output.

**Industry 3.0**

In the last few decades of the 20th century, the invention and manufacture of electronic devices, such as the transistor and, later, integrated circuit chips, made it possible to more fully automate individual machines to supplement or replace operators. This period also spawned the development of software systems to capitalize on the electronic hardware. Integrated systems, such as material requirements planning, were superseded by enterprise resources planning tools that enabled humans to plan, schedule and track product flows through the factory. Pressure to reduce costs caused many manufacturers to move component and assembly operations to low-cost countries. The extended geographic dispersion resulted in the formalization of the concept of supply chain management.

**Industry 4.0**

In the 21st century, Industry 4.0 connects the internet of things (IOT) with manufacturing techniques to enable systems to share information, analyze it and use it to guide intelligent actions. It also incorporates cutting-edge technologies including additive manufacturing, robotics, artificial intelligence and other cognitive technologies, advanced materials, and augmented reality, according to the article “Industry 4.0 and Manufacturing Ecosystems” by Deloitte University Press.

The development of new technology has been a primary driver of the movement to Industry 4.0. Some of the programs first developed during the later stages of the 20th century, such as manufacturing execution systems, shop floor control and product life cycle management, were farsighted concepts that lacked the technology needed to make their complete implementation possible. Now, Industry 4.0 can help these programs reach their full potential.

**A Switch Migration-Based Decision-Making Scheme for Balancing Load in SDN:**

Elastic scaling and load balancing with efficient switch migration are critical to enable the elasticity of software-defined networking (SDN) controllers, but learning how to improve migration efficiency remains a difficult problem. To address this issue, a switch migration-based decision-making (SMDM) scheme is put forward that could be made aware of the load imbalance by a switch migration trigger metric; the migration efficiency model for this scheme is built to make a tradeoff between migration costs and the load balance rate. An efficiency-aware switch migration algorithm based on greedy method is designed to utilize the migration efficiency model and thus guide the choice of possible migration actions. We implement a proof of the scheme and present a numerical evaluation using Mininet emulator to demonstrate the effectiveness of their proposal.

As an emerging technology, SDN makes it easy to manage networks and enable innovation and evolution by decoupling the control plane from the data plane. The intelligence of SDN is shown by the fact that a logically centralized controller manages switches by providing them with rules that can dictate their packet handling behavior [1]. With the continuous extension of network scale, the scalability of the centralized controller becomes a key issue in SDN [2]. Deploying distributed controllers is a promising approach to solve the problem, and each controller manages part of the switches in the network. However, static switch-controller mapping results in load imbalances and sub-optimal performance in cases of uneven load distribution among controllers.

Dynamic switch migration is a promising approach to elastic scaling and load balancing. In practice, switch migration occurs in three cases. Firstly, if the aggregated traffic load goes beyond the capacity of all controllers, the new controllers should be added and the switches would be moved to them. Secondly, as a controller is shut down or to sleep for saving communication cost and power, its switches should be migrated away. Thirdly, even if there is no change in the number of deployed controllers, switch migration operation must be performed by migrating selected switch to other controllers when an individual controller load is beyond its capacity. We call this operation as load balancing.

 the primary objective is to make an efficiency switch migration scheme for load balancing in SDN Controllers. To this end, we first check the real-time controller load information collected by the monitoring module and decide whether to perform switch migration. Then, we built the migration efficiency model to tradeoff between the migration cost and the load balance rate. Finally, an efficiency-aware migration algorithm based on greedy method was designed to utilize the migration efficiency model and thus guide the choice of possible migration actions. In future work, we plan to implement the SMDM in a real large-scale wireless access network with more real-world traffic as well as evaluate the performance.

**Experimental Study on Low Power Wide Area Networks (LPWAN) for Mobile Internet of Things:**

In the past decade, we have witnessed explosive growth in the number of low-power embedded and Internet connected devices, reinforcing the new paradigm, Internet of Things (IoT). The low power wide area network (LPWAN), due to its long-range, low-power and low-cost communication capability, is actively considered by academia and industry as the future wireless communication standard for IoT. However, despite the increasing popularity of ‘mobile IoT’, little is known about the suitability of LPWAN for those mobile IoT applications in which nodes have varying degrees of mobility. To fill this knowledge gap, in this paper, we conduct an experimental study to evaluate, analyze, and characterize LPWAN in both indoor and outdoor mobile environments. Our experimental results indicate that the performance of LPWAN is surprisingly susceptible to mobility, even to minor human mobility, and the effect of mobility significantly escalates as the distance to the gateway increases. These results call for development. We have presented a real-world experimental study that revealed the relationship between the mobility and the performance of LPWAN to understand the suitability of LPWAN for mobile IoT. Consequently, we provided rather negative results: LPWAN is easily impacted by mobility, even by minor ones such as human mobility. The impact of mobility dramatically increased depending on the distance to the gateway, the vehicle speed, and whether the end node was placed in an indoor environment. As future work, based on these results, we will develop mobility-aware LPWAN protocols that address this mobility issue