

IEEE ComSoc Distinguished Lecture Tour – New Zealand, Aug. 15-28, 2015

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DLT Planning and Itinerary

This DLT (Distinguished Lecture Tour) was triggered by an invitation from IEEE Asia Pacific ComSoc office in Singapore on behalf of New Zealand ComSoc Chapter. Ms Ewell Tan in Singapore has helped to coordinate with three hosts, Prof. Harsha Sirisena in University of Canterbury, Christchurch, Dr Terrence Betlehem in Victoria University of Wellington, Wellington, and Prof. Nurul Sarkar in Auckland University of Technology, Auckland. Thus, the DLT planning was done with an itinerary quickly. First I flew to Christchurch in the South Island to give the lecture on Software Defined Networking (SDN): The 2nd Wave of Cloud Computing. Then I flew to Wellington in the North Island to give the 2nd lecture and drove to Auckland to give the 3rd lecture. Both lectures were on Research Roadmap Driven by Network Benchmarking Lab (NBL): Deep Packet Inspection, Traffic Forensics, WLAN/LTE, Embedded Benchmarking, Software Defined Networking, and Beyond. The reason they picked this topic is that New Zealand government is encouraging academia-industry cooperation with some incentive programs. Most hi-tech companies in New Zealand are small-medium enterprises. Thus, government funding is an important incentive to foster such cooperation. After the DLT, I was visited in my university by Prof. Winston Seah of Victoria University of Wellington, who missed my visit but was very interested in building cooperation with me. We planned to co-work on the topic of SDN modeling in the coming years. DLT creates chances for not only research sharing but also research cooperation.

Two topics in Three Lectures

SDN is a hot topic chosen by many DLT hosts in the past two years. I argued why, where, and when for SDN, and illustrated how SDN works in sections of research, standardization, development, and testing. As a Research Associate of Open Networking Foundation (ONF) and Director of NBL which is the 6th test lab approved by ONF, I reported my first-hand observations on the recent developments. In the lecture on research roadmap driven by NBL, I reviewed the model of development-driven research and its advantages over the traditional literature-driven research. In New Zealand, August is the beginning of the winter semester. The attendees were mostly faculty members and Ph.D. students. The number of attendees per lecture was about 20-40. The number of questions asked was 3-6.

In-Depth Discussions During and After Lectures

The lectures triggered good questions from the audience. I list major questions and my

answers below. For questions similar to the ones listed in my previous DLT reports, they are not repeated here.

1. [SDN] What will be the killer application of SDN?
To enterprise subscribers, Wi-Fi or wireless in general would come to play before the wired switches because enterprises would be more willing to try the less critical or stable infrastructure.
2. [SDN] Will the need of NFV drop if OpenFlow switches are equipped with multi-cores?
Yes, but only at the edge switches with less traffic volume but not at the core switches which still need to redirect traffic to virtualized network functions.
3. [SDN] Will VM (Virtual Machine) become the bottleneck of NFV service chaining?
Yes. As the virtualized data center gets closer to users, network delay drops, which puts a more stringent requirement on server delay. Thus, VM could become the bottleneck easily.
4. [Research Roadmap Driven by NBL] How do we better bridge academia with industry?
Run a model of development-first-research-next. Identify research topics together with the industrial partners.
5. [Research Roadmap Driven by NBL] How do we conduct development with limited resources?
Leverage open source resources and joint funding from both government and industry.



Left: University of Canterbury – Fred Samandari, me, and Harsha Sirisena

Right: University of Canterbury – Dept of Computer Science and Software Engineering



Left: Victor University of Wellington – Terence Betlehem, Stuart Marshall, me, Bryan Ng, Ian Welch

Right: Victor University of Wellington – Ian Welch, me, Terence Betlehem, Bryan Ng



Left: Auckland University of Technology – lecture attendees

Right: Auckland University of Technology - Nurul Sarkar and me

Appendix:

Talk Title: **Software Defined Networking: The 2nd Wave of Cloud Computing**

Abstract:

The first wave of cloud computing was to centralize and virtualize servers into the clouds, with a phenomenal result. The emerging second wave, named Software Defined Networking (SDN), is to centralize and virtualize networking, especially its control, into the clouds. SDN deployment started from data centers and now expands to the model of “networking as a service” (NaaS) offered by the operators to enterprise and residential subscribers. By centralizing the control-plane software of routers and switches to the controller, and its applications, and controlling the data-plane of these devices remotely, SDN reduces the

capital expenditure (CAPEX) and operational expenditure (OPEX) because the devices become simpler and hence cheaper and number of administrators could be reduced. SDN also enables fast service orchestration because the data plane is highly programmable from the remote control plane at controllers and applications. However, as we detach control plane from where data plane resides, new protocols shall be introduced between control plane and data plane, as the southbound API between controllers and devices and the northbound API between controllers and applications. As we further extend the control plane from controllers to applications such as Service Chaining (SC) and data plane from devices to Network Function Virtualization (NFV), newer mechanisms and APIs need to be added to these APIs. We argue why, when, and where SDN would prevail, and then illustrate how to make it happen. We shall introduce the key technology components, including OpenFlow, SC, NFV, and Network Service Header (NSH) and then review the issues on standardization, development, deployment, and research. At the end, the development and deployment experiences of a campus SDN solution for Wi-Fi/switch control and management are shared.

Talk Title: Research Roadmap Driven by Network Benchmarking Lab (NBL): Deep Packet Inspection, Traffic Forensics, WLAN/LTE, Embedded Benchmarking, Software Defined Networking, and Beyond

Abstract:

Most researchers look for topics from the literature. But our research has been driven mostly by development which in turn has been driven by industrial projects or lab works. We first compare three different sources of research topics. We then derive two research tracks driven by product development and product testing, named as the blue track and the green track, respectively. Each track is further divided into development plane and research plane. The blue track on product development has fostered a startup company (L7 Networks Inc.) and a textbook (Computer Networks: An Open Source Approach, McGraw-Hill 2011) at the development plane and also a research roadmap on QoS and deep packet inspection (DPI) at the research plane. On the other hand, the green track on product testing has triggered a 3rd-party test bed, Network Benchmarking Lab (NBL, www.nbl.org.tw), at the development plane and a research roadmap on traffic forensics, WLAN/LTE, embedded benchmarking, and software defined networking at the research plane. Throughout this talk, we illustrate how development and research could be highly interleaved. At the end, we give lessons accumulated over the past decade. The audience could see how research could be conducted in a different way.

Autobiography:

YING-DAR LIN is a Distinguished Professor of Computer Science at National Chiao Tung University (NCTU) in Taiwan. He received his Ph.D. in Computer Science from UCLA in 1993.

He served as the CEO of Telecom Technology Center during 2010-2011 and a visiting scholar at Cisco Systems in San Jose during 2007–2008. Since 2002, he has been the founder and director of Network Benchmarking Lab (NBL, www.nbl.org.tw), which reviews network products with real traffic. NBL recently became an approved test lab of the Open Networking Foundation (ONF). He also cofounded L7 Networks Inc. in 2002, which was later acquired by D-Link Corp. His research interests include design, analysis, implementation, and benchmarking of network protocols and algorithms, quality of services, network security, deep packet inspection, wireless communications, embedded hardware/software co-design, and recently software defined networking. His work on “multi-hop cellular” was the first along this line, and has been cited over 650 times and standardized into IEEE 802.11s, IEEE 802.15.5, WiMAX IEEE 802.16j, and 3GPP LTE-Advanced. He is an IEEE Fellow (class of 2013), an IEEE Distinguished Lecturer (2014&2015), and a Research Associate of ONF. He is currently on the Editorial Boards of *IEEE Transactions on Computers*, *IEEE Computer*, *IEEE Network*, *IEEE Communications Magazine - Network Testing Series*, *IEEE Wireless Communications*, *IEEE Communications Surveys and Tutorials*, *IEEE Communications Letters*, *Computer Communications*, *Computer Networks*, *Journal of Network and Computer Applications*, and *IEICE Transactions on Information and Systems*. He has guest edited several Special Issues in IEEE journals and magazines, and co-chaired symposia at IEEE Globecom’13 and IEEE ICC’15. He published a textbook, *Computer Networks: An Open Source Approach* (www.mhhe.com/lin), with Ren-Hung Hwang and Fred Baker (McGraw-Hill, 2011). It is the first text that interleaves open source implementation examples with protocol design descriptions to bridge the gap between design and implementation.