

資訊學院陳志成教授團隊 大幅提升核心網路效能

文／秘書處公共關係組



榮登國際頂尖會議 ACM SIGCOMM 2022

本校資訊學院陳志成教授與美國加州大學河濱分校之 K. K. Ramakrishnan 教授共同指導四位陽明交大學生與二名加大河濱分校學生，整合陽明交大開發之 free5GC 與加大河濱分校開發之 openNetVM，2022 年 8 月於國際頂尖會議 ACM SIGCOMM Conference 發表論文：L25GC: a low latency 5G core network based on high-performance NFV platforms，該論文探討如何有效將 5G 核心網路元件虛擬化 (Network Function Virtualization, NFV)，並大幅提升網路效能，且將所有程式碼公開。SIGCOMM 全名為 Special Interest Group on Data Communication，是全球通信網路領域的頂尖會議，SIGCOMM 對論文的品質要求極高，經五位委員雙盲審查 (double-blind peer review)，接受率約 10% - 20%。自 1987 年 SIGCOMM 開辦 36 年以來，陳教授團隊論文為第四篇台灣團隊人員發表至該頂尖國際會議之長篇論文 (full paper)。SIGCOMM 之長篇論文被接受後，大會另組織一委員會檢驗程式碼，經三位匿名審查委員嚴格檢驗後，free5GC 與 L25GC 獲得大會最高三項徽章：可獲得 (Available)、正常運作 (Functional)、結果再現 (Results Reproduced)。在 SIGCOMM 今年 55 篇被接受論文中，僅有 23 篇論文同時獲得三項徽章。由於 SIGCOMM 審查非常嚴謹，錄取的論文大多數都會被廣泛引用，具有非常大的影響力。

陳教授從就讀博士班開始，一直投入電信網路系統之研究，尤其著重通信協定與系統軟體，以「十年磨一劍」之精神，長期深耕於此一領域。陳教授將其過去二十幾年從 3G 至 5G 之研究經驗，

具體打造出全世界第一個符合 5G 國際標準之免費開源軟體 - free5GC。過去由於電信網路之核心網路相當昂貴，動輒十幾億甚至上百億台幣，一般從事此領域之研究者，僅能用數學分析或電腦模擬來驗證提出之想法，無法於真實的電信系統驗證。因為 free5GC 的開源性、完整性、且可與商用基地台與手機互聯，越來越多的研究者使用 free5GC 當作驗證平台發表論文，如美國的普林斯頓大學、約翰霍普金斯大學、Cisco、Nokia 等世界各國的研究者，皆已採用 free5GC 發表論文。free5GC 的出現，改變了此領域的研究方式。此外，free5GC 打破傳統產業的枷鎖，將核心網路的軟體，釋放到任何硬體平台上。因軟、硬體分家，可普及核心網路於行動通訊網路的市場，眾多小型網通廠可以生產白牌機，並使用 free5GC 為軟體，打入高門檻之電信產業，打破核心網路被少數國際大廠獨占的情形，進而產生新的產業鏈。陳教授帶領的團隊，已做出對產業界與學術界真正有實質影響力之研究，於國際舞臺佔有一席之地。

此次發表於 SIGCOMM 論文之陽明交大作者除陳教授外，另有張宏鈺博士後研究員、謝承穎博士生、李家安與朱浩澤碩士生。此外，蔡瀚興與劉又聖碩士生亦參與此研究。陳教授團隊表示，希望這次的研究成果能讓大家將來可享受效能更佳的電信網路系統。陳教授團隊並免費開放所有程式碼於：

L25GC: <https://github.com/nycu-ucr/l25gc>

free5GC: <https://www.free5gc.org/>

The Team of Dr. Jyh-Cheng Chen of the College of Computer Science Greatly Improve the Efficiency and Performance of the Core Network Presented at a Top International Conference – ACM SIGCOMM 2022



Four students, advised by Professor Jyh-Cheng Chen of the College of Computer Science, and two students advised by Professor K. K. Ramakrishnan of the University of California, Riverside, integrated free5GC developed by NYCU and openNetVM developed by UC Riverside, and published the paper, "L25GC: a low latency 5G core network based on high-performance NFV platforms", at the top international conference ACM SIGCOMM in August 2022. This paper explores how to effectively virtualize 5G core network components (Network Function Virtualization, NFV) and greatly improve network performance. Meanwhile, the team also makes the source code publicly available. SIGCOMM, Special Interest Group on Data Communication, is a top conference in the field of communication networks globally. SIGCOMM has extremely high requirements on the quality of accepted papers. After double-blind peer review by five committee members, the acceptance rate is around 10% - 20%. This is the fourth full-length paper with Taiwanese teams that was published at the SIGCOMM conference since its inauguration in 1987. After a full paper was accepted, SIGCOMM organized another committee to examine the source code. Passing rigorous testing by three anonymous reviewers, free5GC and L25GC won the top three badges of the conference: Artifacts Available, Artifacts Evaluated – Functional, and Artifacts Evaluated – Results Reproduced. Only 23 papers were awarded with these three badges among the 55 accepted papers at SIGCOMM this year. Most SIGCOMM papers are widely cited with great influence due to the rigorous review of SIGCOMM.

Since studying for PhD, Dr. Chen has devoted himself to the research on telecommunication network systems, especially focusing on communication

protocols and system software. With the spirit of "Ten years to sharpen a good sword," he has long been deeply involved in the field. Drawing his research experience with 3G, 4G, and 5G networks, Dr. Chen and his team create the world's first free and open-source software complied with the international 5G standards - free5GC. In the past, because the core network of the telecommunications network was quite expensive, which was worth billions or even tens of billions Taiwanese dollars, ideas proposed by researchers in the field can only be verified using mathematical analysis or computer simulations, not real telecommunication systems. Because of free5GC's completeness, openness, and excellent interoperability with many base stations and cellular phones complying with the international standards, more and more researchers from all over the world, such as Princeton University, Johns Hopkins University, Cisco, and Nokia, etc., utilize free5GC as a platform to verify their research ideas. The emergence of free5GC has changed the way of research in the field of the telecommunications network. In addition, free5GC breaks the shackles of traditional industries so as to deploy the core network software to any hardware platform. Released from software's dependence on hardware, the core network can be popularized in the mobile communication network market. Many small manufacturers can build white-box machines with free5GC built-in to penetrate the high-barrier telecommunications industry so as to break the situation that core networks have been dominated by few international manufacturers for years, thereby creating a new industrial chain. The team led by Dr. Chen has made the research with real impact on the industry and academia, and succeeds in the international arena.

The authors of the SIGCOMM paper from NYCU includes Dr. Jyh-Cheng Chen, postdoctoral researcher Hung-Cheng Chang, as well as Hao-Tse Chu, Chia-An Lee, and Cheng-Ying Hsieh. In addition, Han-Sing Tsai and Yu-Sheng Liu also joined the research. The team hopes that the results of this research may enable everyone to enjoy a more efficient telecommunication network system in the future. The source code is open for free at:

L25GC: <https://github.com/nycu-ucr/l25gc>

free5GC: <https://www.free5gc.org/>