

ATTACHMENT 2: Profile and Detailed Achievements of the Group B Recipients of the 2015 C&C Prize

Dr. Martin Casado

Current Position

Fellow and SVP, VMware Inc

Personal History (born in 1976):

2000: BS, Northern Arizona University

2005: MS, Stanford University

2007: PhD, Stanford University

2000-06: Computer Scientist, Lawrence Livermore National Security, LLC

2007: Co-Founder, CTO, Nicira Networks

2012-14: CTO, VMware

2014-: SVP and GM, VMware

Major awards:

2013: Grace Murray Hopper Award

Prof. Nick McKeown

Current Position

Professor, Stanford University

Personal History (born in 1963):

1986: BS, the University of Leeds

1986-89: Hewlett-Packard Labs

1995: PhD, University of California, Berkeley

1995: Join Stanford University

2002: Associate Professor, Stanford University

2006: Started Program for Clean Slate Design of the Internet

2007: Co-Founder, Nicira Networks

2010-: Professor, Stanford University

Major awards:

2000: IEEE ComSoc Rice Prize

2004: Fellow, Royal Academy of Engineering, UK

2005: Lovelace Medal, the British Computer Society

2005: Fellow, IEEE

2006: Fellow, ACM

2009: IEEE Koji Kobayashi C and C Award

2011: Member, NAE

- 2012: ACM SIGCOMM Award
- 2014: Honorary Doctorate, ETH Zurich
- 2015: Member, AAAS

Prof. Scott Shenker

Current Position

Professor, University of California, Berkeley

Personal History (born in 1956):

- 1978: ScB, Brown University
- 1983: PhD, University of Chicago
- 1984-95: Research Staff Member, XEROX Parc
- 1995-98: Principal Scientist , XEROX Parc
- 1998: AT&T Center for Internet Research
- 1995-01: Adjunct Associate Professor, University of Southern California
- 2002-04: Adjunct Professor, University of California, Berkeley
- 2004-: Professor, University of California, Berkeley
- 2007: Co-Founder Nicira Networks

Major awards:

- 2000: Fellow, IEEE
- 2002: ACM SIGCOMM Award
- 2003: Fellow, ACM
- 2006: IEEE Internet Award
- 2007: Honorary Doctorate, University of Chicago
- 2012: Member, NAE

–Achievements–

Information and communications technologies (ICT) have become a foundation for social activities in recent years. As such, these technologies must provide flexibility and efficiency and therefore be able to respond quickly to changing requirements and usage environments. The introduction of virtualization technologies led to considerable improvements in the flexibility and efficiency of servers. Nevertheless, there were still many physical limitations on the communication devices that play a vital role in networks, and these limitations were too often creating barriers to improved network performance. Software-defined networking (SDN), a term that refers to both the concept of controlling network behavior by using software and the technologies used to do so, eliminated these restrictions by decoupling data-transfer functions into a data plane and control plane in a network. In realizing SDN, OpenFlow was created as an interface used by external software to program the communication devices and has been playing an important role. Today, SDN becomes a core technology being implemented to continue to resolve the issues of infrastructure bottlenecks in data centers and carrier networks. SDN enables large-scale data centers to

operate their massive server infrastructure more efficiently and at a lower cost. This in turn will lead to more innovations in social infrastructure and the launch of a new era of the Internet of Things (IoT) in networking in which diverse and voluminous data can be distributed widely but securely.

Dr. Martin Casado, Prof. Nick McKeown, and Prof. Scott Shenker are the originators of the SDN movements and OpenFlow protocols. They have combined their various talents and taken leadership roles in developing technologies for SDN and OpenFlow. They have also promoted the recognition of its practical applications in society at large.

The Internet is a distributed network in which individual communications devices exchange control information according to certain protocols. If it becomes necessary to change or expand control functions, a new protocol must be designed. Not only that, but all communications nodes must be modified to be compatible with the new protocol. Moreover, in addition to overcoming technological issues, introducing new functionality entails creating standards and implementations and performing verifications. These all take a long time and have the effect of negatively influencing technological innovations. Efforts have been made in the past to solve these issues by making networks programmable. However, these have tended to fail because programmability was not implemented at the right level. That is, the right degree of abstraction was not achieved.

The team of three doctors recognized this issue as a lack of appropriate abstraction in network control and decided to implement abstraction based on flow tables for each communication node. This made the communication nodes externally controllable. Moreover, they explicitly defined the layers at which to abstract external software control and advocated the concept of flexible, software-based control of an entire network, that is, SDN. Based on this concept, the team developed various open-source platforms and tools. In addition, by involving academia, device vendors, telecommunications carriers, and service providers in research at an early stage, they have been able to cultivate and operate ecosystems that have led to widespread practical application of the SDN concepts.

In the course of his research into network security as a graduate student at Stanford University, Dr. Casado advocated a model known as "Ethane," in which flow-based Ethernet switches controlled centrally from the outside. He later generalized this model and used it to develop OpenFlow, which is an interface for programming switch behavior. He also developed platform software to execute a range of control applications. These activities formed the basic concept of SDN. In addition, he has contributed significantly to the standardization and specific technological development of SDN by leading the open-source community in the research and development of SDN and OpenFlow with the goal of creating a new paradigm whereby communications devices whose functions had previously been achieved mainly by hardware could be controlled by software. In 2007, he and the other two doctors founded Nicira Networks as a startup and launched a project to commercialize Ethane-based products. He was appointed CTO of the company and started developing OpenFlow products and spreading SDN technology.

Prof. McKeown was an academic supervisor of Dr. Casado at Stanford University. He showed the world the potential of SDN through the research, development, and demonstration of verification systems. He established the OpenFlow Switch Consortium and organized research communities to standardize and develop SDN and OpenFlow software. He also led the creation of the future network concept and promoted it. In cooperation with cloud and networking companies that supported his activities, Prof. McKeown also established the Open Networking Foundation (ONF) in 2011 and continues to contribute to promoting SDN and adoption as a board member of the organization. In addition, he continues to conduct personal research into devices and hardware based on his longtime studies of high-speed switches and routers. He uses this research to promote the development of OpenFlow switches and control methods as well as SDN system architecture design.

Prof. Shenker has contributed to the team in many phases from the creation of the SDN and OpenFlow concept to its adoption. In particular, he recognized that the essence of SDN was the creation of abstraction layers for control that were not included in conventional networks. Prof. Shenker led the design of SDN architecture and promoted research and development of operating systems and virtualization, and he clarified the necessary control abstraction layers and presented SDN architecture that realizes those abstractions. He also played an important role in organizing the OpenFlow Switch Consortium and ONF and in conducting standardization activities alongside Prof. McKeown and other members. When Nicira Networks was founded, he took on the role of president, and laid the groundwork for the subsequent development of SDN and OpenFlow software such as the OpenFlow virtualization platform (i.e., the Nicira Network Virtualization Platform), which the team achieved in 2012.

These three experts advocated SDN as a core technology for resolving network issues of flexibility, scalability, and efficiency when using advanced and large-scale ICT such as for cloud computing and big data analysis. They also promoted the development and adoption of SDN by leading the standardization movement and encouraging the open-source community to implement SDN and OpenFlow concepts. In conclusion, the NEC C&C Foundation is proud to present the C&C Prize to these individuals in recognition of their achievements as ICT infrastructure innovators who have succeeded in overcoming the limitations of IP networks.