Cyber Range Organization and Design

NEC Corporation Endowed Chair

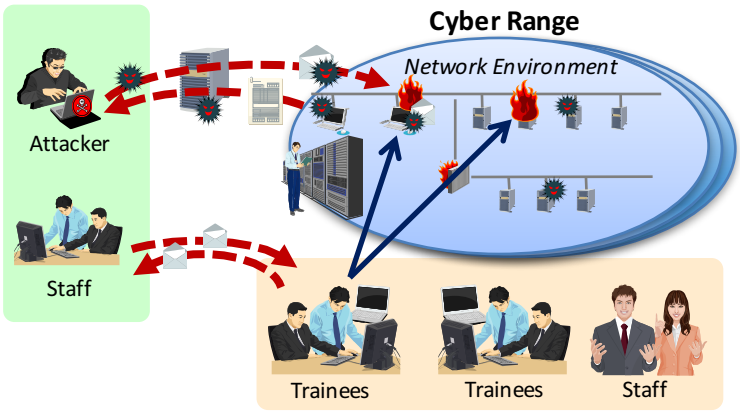
A *cyber range* is a virtual environment created on a computer and network infrastructure for the purpose of conducting practical cyber-security training exercises. The cyber range complexity and content need to be adapted to the actual training purpose, such as cyber attack and/or cyber defense, the number of participants and their skill level, and so on. The *Cyber Range Organization and Design* (CROND) endowed chair in JAIST studies cyber range architectures and instantiation mechanisms, so that realistic cyber ranges can be deployed in a cost-efficient and timely manner.

Background

Recently, the damage caused by cyber attacks such as targeted campaigns is becoming more and more significant, and often results in interruptions of business activities and loss of social trust. This lead to an ever growing need to expand the cyber-security activities and measures.

In these circumstances, the need to create virtual environments for the purpose of cyber-security training, named *cyber ranges*, became a very pressing matter.

Cyber-security training



Chair outline

Chair name
Cyber Range Organization and Design (CROND)

Chair mission
Study and develop mechanisms for the creation of cyber ranges so as to significantly improve the efficiency and effectiveness of cyber-security training for large number of participants. Furthermore, design the related educational programs and teaching materials for the cyber-security training activities that will be conducted using cyber ranges.

National University Corporation
Japan Advanced Institute of Science and Technology
Security and Networks Academic Field

CROND
Cyber Range Organization and Design

CHINEN Laboratory

Research Associate Professor CHINEN, Ken-ichi

E-mail : k-chinen@jaist.ac.jp

Research areas: Network systems

Keywords: Cyber range, network testbeds, server technologies

Control and Security of Network Systems

Required knowledge and skills

We require interests in various systems, communication ability to express your intentions, and ability to record words and diagrams that appeared in discussion. Programming skills are recommended. It would be good if you would also have a rich imagination.

Abilities that will be acquired

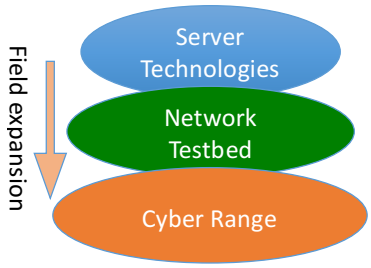
Since we use a lot of computers and networks, you will get the ability to understand systems. Through their operation of them, you will also get the logical analysis and thinking necessary for troubleshooting. The person who can use CLI will probably become as important as endangered species. Through the duties of research and development, you will master programming skills, logical description and illustration drawing abilities. Through repeated experiments you will develop the ability of man-hour and equipment estimation for system building and operation.

[Employment opportunities] Consumer electronics companies, network providers and carriers, related companies

Research outline

Server technologies

This is the era of network services. Server performance improvement makes the society more convenient. We are currently addressing various improvement technologies for server building and operation. We have achieved excellent results in the past in developing server scaling and prefetching for web services.



Network testbed

Various tests are needed for studying servers. A lot of clients are necessary for these tests, and it is complicated to control the client group. We are addressing the technologies for building and controlling such test facilities (testbeds). Because building and control are difficult by conventional tools, we have developed a language for describing test scenarios and procedures, and its processing system.

Cyber range

Since it is a time when human life and assets depend on networks, various security activities are performed. A cyber range is a technological practice site for cyber attack and defense. In a closed environment, players do repeatedly attack and defense exercises. As an extension of testbeds, we are addressing the technologies for building and controlling cyber ranges.

Selected papers

1. Tomoyuki Kobayashi, Satoshi Kikuchi, Ken-ichi Chinen, Toshiyuki Miyachi: Multicast Disk Distribution on Network Testbeds, pp.1136-1144, DICOMO 2015, 2015 [paper award].
2. Eiichi Muramoto, Makoto Kohrin, Hidenori Ishii, Kunio Akashi, Ken-ichi Chinen, Yoichi Shinoda: Transitive Network Emulation Method for the Verification of Adaptive Rate Control of Real-time Audio and Video Streaming via Wireless Network, Internet Conference 2014, 2014 [best paper award].
3. Ken-ichi Chinen, Kazunobu Konishi, Satoshi Kikuchi, Eiichi Muramoto, Yoichi Shinoda: A Potential of Duplicated Content Exclusion Mechanism in Receiving for High-rate Uploading, IN2015-158, Vol.114, No.478, pp.221-226, 2015.

Available equipment

NICT Hokuriku StarBED Technology Center; 1000+ PCs
JAIST: Murubushi network testbed; 20+ PCs
Laboratory PCs, switches, routers, etc.

Laboratory guidelines

URL: http://www.jaist.ac.jp/~k-chinen/

The master thesis theme will be based on the student's topic of interest in the field of computers and networks. Laboratory members are in small number, therefore seminars and joint activities will be held together with other laboratories. In the past years these joint activities involved the Shinoda, Tan and Shikida laboratories. In addition, meetings with NICT and other universities and organizations with activities in the field were organized twice a year.

BEURAN Laboratory

Research Associate Professor BEURAN, Razvan Florin
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Research areas: Network systems, cyber security, performance evaluation

Keywords: Cyber range, network emulation, Quality of Experience (QoE)

Secure the Network, Secure the People

Required knowledge and skills

We welcome students with abilities related to networks and network security who also have good computer programming and/or mathematical skills. Independent thinking and a strong motivation to learn and develop oneself are a must.

Abilities that will be acquired

Students who graduate will have a deep knowledge of networks and network security. They will be able to develop network-related software and perform network experiments and assessments using various methods: analytical modeling, simulation, emulation and actual trials. Students will also have hands-on network security experience; thus they will be able to deal with cyber-security issues in the real world. Their English paper reading/writing and presentation skills will also improve significantly.

[Employment opportunities] ICT and cyber-security companies, related organizations

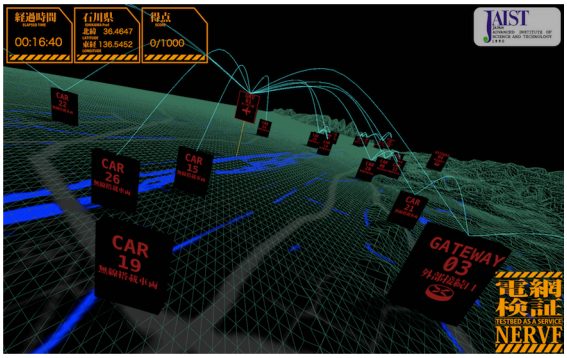
Research outline

People have become more and more reliant on the Internet for daily communication. In addition, networks are and will be more and more used to improve people's quality of life in the context of smart homes, but also in the area of industrial automation. This will lead to a world in which devices and people are all connected to the same network, the *Internet of Everything* (IoE).

Network emulation

Such a pervasive network infrastructure requires to be able to provide guarantees regarding the network performance, so that *Quality of Experience* (QoE) requirements are met.

Network emulation is an experiment technique that makes possible carrying out the performance evaluations needed in this context by recreating a wide range of network conditions. We developed the framework called NERVF to make possible various complex experiments, including with emulated wireless networks and mobility.



Network emulation and real-time visualization framework

Cyber-security

Although network communication makes life more convenient, it also exposes users to risks they must be aware of, such as malware, phishing, etc. As a consequence, the network applications that people use, especially in mission-critical and safety-critical environments, need to be designed and analyzed from the perspective of such security risks. Furthermore, IT and security specialists must have the practical skills needed to be able to properly handle computer security incidents.

This knowledge can be acquired only partially through theoretical lectures, and it is of utmost importance to have practical experience with actual threats in order to be able to deal with them in an efficient and timely manner. This kind of experience can only be obtained in *cyber ranges*, realistic environments for cyber-security training.

Selected papers

1. K. Akashi, T. Inoue, R. Beuran, Y. Shinoda, "Meteor: Design and Implementation of a Wireless Network Emulator for Large Scale Experimental Networks", IEICE Transactions on Communications, vol. J98-B, no. 4, April 2015, pp. 357-372.
2. R. Beuran, S. Yasuda, T. Inoue, S. Miwa, Y. Shinoda, "Using Emulation to Validate Post-disaster Network Recovery Solutions", SIMUTools 2014, Lisbon, Portugal, March 17-19, 2014, pp. 92-97.
3. R. Beuran, "Introduction to Network Emulation", Pan Stanford Publishing, ISBN: 9789814310918, August 2012.

Available equipment

StarBED[3] Large-scale Network Experiment Testbed
URL: `http://starbed.nict.go.jp/`

Laboratory guidelines

URL: `http://www.jaist.ac.jp/~razvan/`

We aim at providing a dynamic environment in which students can increase their knowledge, learn new skills and develop new abilities. We lay a strong emphasis on applying theoretical knowledge in practice, and on hands-on experience with various aspects of networks and network security. Publishing and presenting one's work are highly encouraged and supported.

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1990

Security and Networks

The *Dependable Network Innovation Center* (founded in 2011; formerly *Internet Research Center*, founded in 2001), and the *Center for Highly Dependable Embedded Systems Technology* (founded in 2007) at JAIST have conducted a significant number of large-scale network and security experiments. In addition, these centers have participated in the technical content and curriculum development of the environment used in the training program *Cyber Defense Exercise with Recurrence* (CYDER) sponsored by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. The *Cyber Range Organization and Design* chair was created on these foundations in 2015 to further advance the field of cyber-security training.

CROND
Cyber Range Organization and Design

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