ICNS3 2025 Keynote Talk

"Fluid-Based Modeling for Large-Scale Network Simulation"

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Abstract: As network infrastructures scale in size and complexity, packet-level simulation approaches become increasingly infeasible due to excessive computational cost. Fluid-based modeling has emerged as a promising alternative for simulating large-scale networks with high efficiency and reasonable accuracy. In this keynote, we introduce our research group's decade-long contributions to this field, focusing on scalable and accurate fluid-based modeling techniques for TCP/IP and ICN networks.

We begin by presenting our analytic framework that models core network components (such as TCP congestion control, link delays, and router buffers) as interconnected continuous-time systems using fluid-flow approximation. We demonstrate how this framework improves both scalability and accuracy by rigorously incorporating mechanisms like TCP timeouts and RED-based packet dropping.

We then describe our development of several flow-level simulators (FSIM, FICNSIM, and FLNET), each tailored to different network paradigms. These simulators achieve significant performance gains while maintaining compatibility with existing tools and supporting adaptive numerical techniques for solving differential equations.

Through this talk, we aim to provide both an overview of the current state of fluid-based network simulation and insight into its future potential as a foundation for analyzing and designing next-generation, large-scale communication networks.

Speaker Biography: Hiroyuki Ohsaki received the M.E. degree in Information and Computer Sciences from Osaka University, Osaka, Japan, in 1995. He also received the Ph. D. degree from Osaka University, Osaka, Japan, in 1997. He is currently a professor at the Department of Computer Science, School of Engineering, Kwansei Gakuin University, Japan. His research work is in the area of design, modeling, and control of large-scale communication networks. He is a member of IEEE and IEICE. His e-mail address is ohsaki@lsnl.jp.