National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Strategies for Optimizing Fog Computing Performance for Internet of Things Applications
Speaker	: Prasenjit Maiti (Rollno : 515cs1006)
Supervisor	: Prof. Bibhudatta Sahoo
Venue	: CS323, Department CSE
Date and Time	: 24 May 2024 (10.00AM)
Abstract	: Internet of Things devices generate large amounts of data crucial for various applications, demanding real-time processing due to latency constraints. Fog computing extends cloud capabilities to the network edge, enabling efficient data processing. Resource management is vital for fog computing, which faces complexity due to finite node resources compared to the cloud's virtually limitless ones. Moreover, different types of resources are necessary depending on the applications, and the nodes providing these resources exhibit significant diversity. The performance of the fog computing environment needs to be assessed, and the performance of the fog computing environment needs to be enhanced to meet the needs of various Internet of Things applications. This thesis focuses on the performance assessment of fog computing environments for Internet of Things applications, with a specific emphasis on fog node placement and task offloading strategies. Through a comprehensive review of existing literature, various metrics and methodologies for evaluating fog computing performance are examined. Key parameters such as latency, cost, and makespan are identified as critical factors influencing the effectiveness of fog environments. Additionally, the thesis proposes novel approaches for fog node placement optimization and task offloading decision-making, aiming to enhance the efficiency of the fog computing environment. In this study, the offloading strategy in a hierarchical fog-cloud network, comprising multiple heterogeneous fog devices, alongside an assisting fog and a centralized cloud server. The thesis commences with a review of state-of-the-art research focusing on resource management in the context of edge computing. A taxonomy is proposed to provide an overview of current research and identify areas requiring further exploration. One of the identified challenges is investigating computation offloading and application placement for Internet of Things applications within a fog computing framework. Techniques for minimizing response time and ensuring deadline-compliant service delivery for different types of Internet of Things applications in a fog computing environment are explored. A system model is proposed to distribute real-time Internet of Things applications across the infrastructure level of a fog computing environment. Additionally, a multi-tier fog-cloud model is proposed for offloading tasks to suitable computing devices based on their resource requirements. For Internet of Things application placement, a multi-objective function is designed based on multiple Quality of Service objectives of real-time Internet of Things applications, namely latency and cost. An efficient Directed Acyclic Graph application placement strategy is then proposed on the multi-tier fog-cloud model to improve makespan and reduce response time. Furthermore, novel algorithms and approaches are proposed and evaluated to address the challenges associated with dynamic Internet of Things environments, heterogeneous device capabilities, and varying application requirements. Through extensive simulations and experiments, the effectiveness and performance of the proposed strategies are validated, demonstrating significant improvements in terms of makespan, response time, and cost. In conclusion, this thesis contributes to the advancement of fog computing research by providing a comprehensive analysis of performance evaluation methodologies and proposing novel optimization strategies for fog node placement and task offloading.