Chapter 13
Optimizing Integrated Spatial Data Management Through Fog Computing:
A Comprehensive Overview

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ABSTRACT

Fog computing offers key features such as real-time communication, physical distribution, position awareness, compatibility, scalability, and energy efficiency, which collectively enhance the management of integrated spatial data. It provides benefits such as real-time data processing, seamless data sharing, improved efficiency, enhanced data security and privacy, and effective resource utilization. The distributed architecture and edge processing capabilities of fog computing enable real-time spatial data processing, faster insights, and localized decision-making. It presents opportunities for web-based analytics, real-time analysis, fault tolerance, event-triggered actions, and context-aware applications. However, challenges exist in terms of user needs and requirements, collaboration and partnership, data quality and interoperability, technical infrastructure, and policy and governance. Future work should focus on addressing these challenges and exploring new opportunities.

INTRODUCTION

The management of integrated spatial data has brought about a significant transformation in the utilization of spatial data across government, academia, the private sector, and the general public. This

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practice has profoundly altered how we access and incorporate data by facilitating the easy sharing, discovery, and utilization of spatial data (Hendriks et al., 2012). However, the rapid expansion of spatial data from diverse sources, such as remote sensing, social media, and the Internet of Things (IoT), presents new challenges in terms of data processing and analysis. The sheer volume and diversity of data pose difficulties for conventional methods, particularly when real-time processing is required. Therefore, there is a growing need to explore innovative approaches to enhance the efficiency and effectiveness of integrated spatial data management. To enhance the efficiency and effectiveness of integrated spatial data management, innovative approaches like fog computing are increasingly sought after (Das et al., 2021). These strategies aim to address the evolving needs of integrated spatial data management and optimize the utilization of spatial data in the face of expanding data sources and processing requirements.

A distributed computing paradigm called fog computing has gained attention as a potential solution to overcome these obstacles. Fog computing extends cloud computing to the network edge, enabling efficient processing and storage capabilities with low latency and high bandwidth for real-time and location-based applications. By deploying fog nodes closer to the data sources, data can be filtered and preprocessed before transmission to the cloud for further analysis. This approach minimizes network traffic and processing time, improving overall system performance. Therefore, there is a growing interest in exploring the opportunities and challenges of using fog computing in integrated spatial data management (R. K. Barik et al., 2017, 2019).

To this effect, this chapter investigated the potential of fog computing to support integrated spatial data management and address their challenges. The objectives of this chapter are:

1. To evaluate the potential of fog computing for integrated spatial data management.
2. To examine the benefits and opportunities offered by fog computing in enhancing spatial data management systems.
3. To identify the challenges and obstacles associated with the integration of fog computing and spatial data management.

To achieve these objectives, the structure of this chapter follows a logical progression to explore the potential of fog computing for integrated spatial data management. Firstly, an overview is provided, highlighting the key features and benefits of fog computing in supporting spatial data management systems. This sets the foundation for understanding the significance of fog computing in this context. Subsequently, the chapter delves into the various opportunities and applications where fog computing can be applied, including emergency response systems, navigation applications, precision agriculture systems, real-time monitoring systems, and context-aware applications. The chapter then addresses the challenges and obstacles that arise in the integration of fog computing and spatial data management, such as user needs, collaboration, data quality, technical infrastructure, and policy and governance issues. Finally, the chapter concludes by proposing future directions and research opportunities that can address the challenges and explore new possibilities in fog computing for spatial data management.

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