The fog layer resides between the cloud layer and the IoT layer and is a layer of heterogeneous nodes. For example, fog nodes could range from high-end servers, gateway devices, edge routers, computers, mobile devices, and smart vehicles to sensors with little processing capabilities or supporting different networking technologies, such as high-speed physical links or multiple wireless access technologies such as WiFi, 4G/5G, and LTE. For that matter, fog nodes have an abstraction layer that abstracts out the discrepancy of underlying hardware and technologies and exposes a uniform and seamless interface for management and control. Furthermore, multiple fog nodes interact with each other for data and processing coordination. Figure 3 shows the architecture of the typical fog node.

2.2.1. Fog Agent

The fog agent handles the entire fog node management, which holds core functionality modules such as virtualization, network management, and resource allocation and scheduling. Physical resources are abstracted to the upper layers and provide support for creating virtual hardware components and environments for running processes and services in the node. Due to this mechanism, it is easy to allocate resources according to the processing needs at the run-time by creating virtual machine instances on top of the virtualized infrastructure with the help of HyperVisor. Virtual machines are created to host various services and applications to serve the IoT data processing needs with a dynamic allocation of required virtualized hardware. This functionality helps to efficiently allocate and scale processing needs to certain limits using resources in the node.

Fog has inherent challenges regarding networking, whether inter-VM networking or with an external device. For that matter, the agent has networking modules that elegantly handle complex networking tasks and provides an abstraction layer, simplifying it further. It uses VNFs to provide network services with benefits of hardware independence, a high resilience, quick replacement, and easy configuration and deployment. From recent advancements in networking, it can also be customized to use case-specific networking modes to improve the throughput and reduce the latency in data packet communication.

A fog node can deal with many simultaneous connections demanding various resources and services for different tasks. In that situation, the fog agent acts as a resource allocator and manager for serving virtualized resources and de-allocating when the task is finished. The agent includes service orchestration functionality and policies for life-cycle management with a global messaging bus to send control signals for synchronization. It also deals with secure inter-process communication and consistent data resource sharing between different VMs. Various resource allocation strategies are implemented in the resource management module. These should be selected carefully because allocating resources efficiently is necessary to reduce latency in communication.

In addition, the fog agent also provides APIs to satisfy programmability needs

at a low level in the node architecture. This feature supports the customization of fog nodes to accommodate functionalities such as real-time data synchronization between multiple devices, defining QoS, creating custom computing policies, and centralized control with mobile devices.

Reference

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