

Introduction Modern computing, the need for scalable, reliable and effective systems has led to the development and adoption of widely distributed systems. Distributed systems have become the backbone of modern computing, enabling scalable, reliable, and efficient resource sharing across networked computers. We will examine key concepts such as distributed file systems, which allow files to be stored and accessed across multiple nodes; process synchronization, which ensures that concurrent processes execute correctly; and fault tolerance mechanisms, which enable systems to recover from failures without losing data or functionality. Each node in the distributed operating system operates a subset of the global operating system, consisting of the minimum micro-nucleus that controls the node devices and top-level system management components that coordinate activities across the network. Distributed systems are inherently loosely coupled, meaning each node operates independently with its own local memory and resources, yet remains connected to other nodes via communication media such as high-speed buses, ethernet or even wireless networks. In addition, distributed operating systems support the abstraction of virtual machines, which are critical mechanisms for maintaining consistency and performance in distributed environments, enabling users to interact with the system as if it were a single machine, although it may span hundreds or thousands of nodes. These resources can range from hardware components, such as disks, printers and processors, to abstract software entities such as files, databases and even real-time data streams such as video feeding or audio communications. To meet these challenges, distributed operating systems use advanced algorithms and protocols for tasks such as consensus (e.g., paxos, raft), redundancy, and load balancing. From cloud computing platforms such as Amazon Web Services (AWS) and Google Cloud to distributed databases such as Apache Cassandra and Google Spanner, distributed systems are at the heart of modern technology infrastructure. Despite its distributed nature, the system presents itself to users and applications as a single, unified entity that maps the complexities of resource management, communications and coordination. This definition encompasses a wide range of systems, from small networks to global infrastructure such as cloud computing platforms and distributed databases. This abstraction is achieved through sophisticated mechanisms for synchronization of operations, communication and resource allocation. It enables innovations in areas such as artificial intelligence, big data and the Internet of Things (IoT), where the ability to process and analyze vast amounts of data in real time is essential. A distinctive feature of distributed operating systems is their ability to share computational resources, such as CPU strength, memory and storage through multiple nodes. In turn, it allows efficiently balancing loads, improving error tolerance, and enhancing scalability. This loose pairing allows distributed systems to expand horizontally, adding more nodes to the network as demand increases. This report explores the principles, challenges, and solutions associated with distributed systems in the context of operating systems. By understanding the interplay between distributed systems and operating systems, we can appreciate the complexity and elegance of modern computing infrastructures and their role in shaping the future of technology. The distributed system is defined in operating systems as a network of independent software devices or components that connect and coordinate their work only by passing messages between them. By enabling resource sharing across network computers, distributed systems provide a basis for applications that require high availability, error tolerance and scalability. At the heart of

distributed systems lies the concept of distributed operating system (DOS), which expands the functionality of traditional operating systems to manage several independent accounting contracts. This area is becoming increasingly important as organizations rely on distributed systems to deal with large-scale data processing, real-time analysis and critical mission applications. The area of distributed computing focuses on the study and development of systems in which interconnection components are found on different networked computers. Additionally, we will discuss real-world examples and case studies to illustrate how these concepts are applied in practice. Unlike central operating systems, which run on one separate machine, the distributed operating system operates within a network of computers, each with its own local resources and processing capabilities. However, it also presents challenges such as network arrival time, data consistency and error tolerance.