Rod Anthony C. Balaoro

IV - ACSAD

Assignment #04: Narrative Report

The article “Virtualization vs. Containerization: A Comparative Approach for Application Deployment in the Computing Continuum Focused on the Edge” by Sturley and colleagues discusses the growing importance of efficient application deployment methods in modern computing. As technology continues to evolve in areas like smart cities, Industry 4.0, and e-Government, the need for systems that are both powerful and resource-efficient becomes more crucial. The authors focus on comparing two major technologies—virtualization and containerization—and how each performs, especially in edge computing environments where processing power and energy are limited.

The study explains that virtual machines (VMs) offer complete hardware abstraction and isolation, making them secure but also more resource-intensive. On the other hand, containers share the host system’s operating kernel, which allows them to be lighter, faster, and more efficient to deploy. The researchers point out that while virtualization remains ideal for scenarios that prioritize isolation and security, containerization has clear advantages in performance and energy efficiency, making it better suited for edge computing.

To test their findings, the team conducted benchmarking experiments using both ARM and x86 architectures. A Raspberry Pi 4B+ represented the edge computing setup, while an x86-based Proxmox system was used for virtualization. Various tools such as stress-ng (for CPU, memory, and I/O performance), top (for monitoring), and a UM24C power meter (for power measurement) were utilized to collect performance data. They compared container-based platforms like Docker, Podman, and Kubernetes against virtualized environments using QEMU/KVM.

The researchers also demonstrated a real-world application by deploying OpenDroneMap, a program used for processing aerial images. This case study showed that containerization consumed less energy and performed more efficiently on edge devices compared to traditional virtualization.

In summary, the article highlights that both virtualization and containerization are essential technologies in today's computing landscape. However, containerization stands out as the more practical choice for edge computing because of its speed, efficiency, and lower power requirements. The study provides a clear and well-researched perspective on how these two technologies can complement each other in building scalable, efficient, and modern computing systems.