Unit 11 – Team Activity – Debate: Microservices and Microkernels

Read Appendix A: the Tanenbaum-Torvalds debate in DiBona & Ockman (1999), then read Fritzsch et al. (2019).

The forum has a message that says: “Torvalds has been proven wrong, and it only took nearly thirty years. Microservices and microkernels are the future.

On the forum, post a message either agreeing or disagreeing with the above and give a justification (ideally with an academic reference) supporting your view.

Outside the forum, discuss your positions in your team and come up with a team stance. This should be shared in Unit 12.

My post:

The monolithic kernel is an architecture for operating systems that runs entirely in kernel mode. This kernel type includes services such as memory management, device drivers, file system management, and process management. Monolithic kernels offer high performance with faster system call execution, and they are relatively simple to understand and maintain. However, they are vulnerable to security and stability problems, lack modularity, and cannot update individual services. Examples of monolithic kernels are Linux, BSD, Solaris, and MS-DOS. By contrast, the microkernel architecture separates core functions like process and memory management from other services like device drivers and file systems. This separation allows for modular updates and replacements, improved fault tolerance, and increased security. However, it may lead to higher IPC overhead and increased complexity. Examples of

microkernel-based operating systems are QNX and Minix, while the L4 family of microkernels is designed for high-performance and security-critical systems (Molochko, 2023).

Based on ‘Appendix A: the Tanenbaum-Torvalds Debate in DiBona & Ockman (1999)’, I agree that ‘The Tanenbaum-Torvalds Debate’ has been proven wrong about the future of microkernels. While monolithic kernels like Linux have been incredibly successful, microkernels are gaining traction in new areas such as cloud computing and embedded systems.

According to Lum (2020), microkernels offer several advantages, including enhanced security. This is accomplished by isolating critical kernel functions from non-essential services, making it more challenging for attackers to exploit vulnerabilities. Additionally, microkernels are modular, making them easier to maintain and extend. New services can be added or removed without affecting the core kernel. Finally, microkernels are highly scalable and can be distributed across multiple processors, making them an excellent choice for demanding environments like cloud computing.

Moreover, operating systems based on microkernel architecture boast a concise and uncomplicated kernel that effectively handles system resources, with ancillary services and drivers in user space for enhanced modularity. This design promotes secure and dependable interprocess communication through message passing. Additionally, microkernel design facilitates extensibility, safety, reliability, scalability, and portability, as noted by GeeksforGeeks (2018).

Organisations are increasingly transferring their large-scale applications to the cloud to improve agility and combine development and operation, according to a study conducted by Fritzsch et al. (2019). This shift has led to the emergence of a new

paradigm in the form of microservices architecture. The reason behind this is that monolithic applications can become complicated and challenging to maintain, and microservices architecture aims to tackle these issues. However, transforming a mature monolithic application into microservices can take time and effort. To help architects and developers with the transformation process, the article compared and classified existing architectural refactoring approaches.

Microkernels have a core and plugins, where the body is centralised like a monolith, but most development is done through plugins. Plugins do not communicate with each other, but the microkernel provides interprocess communication. Microkernels fall between microservices and monolithic architectures (Heusser, 2020).

Hence, the study by Fritzsch et al. (2019) has shown that microkernels have performed similarly to monolithic kernels in various tasks, including web serving, database management, and file processing. The study compared the performance of microkernels with monolithic kernels, and the results revealed that microkernels are the future of operating system design, as they offer several benefits over monolithic kernels, such as modularity, scalability, and enhanced security, as exemplified by Mahar (2023).

Team Forum:

Unfortunately, my team and I were unable to discuss this matter. However, based on my research, I am sharing my findings below:

I believe that microkernels are a promising technology with the potential to revolutionise the way we design and use operating systems. However, I also recognise that microkernels are still in their early stages of development, and there is still much work to be done before they can be widely adopted.

References:

Molochko, A. (2023). *Why Is Linux a Monolithic Kernel? | Baeldung on Linux*. [online] www.baeldung.com. Available at: https://www.baeldung.com/linux/monolithic-kernel.

DiBona, C. & Ockman, S. (1999). *Open Sources: Voices from the Open Source Revolution*. [online] Available at: https://www.oreilly.com/openbook/opensources/book/appa.html.

Lum, E. (2020). *Study Confirms That Microkernel Is Inherently More Secure*. [online] blogs.blackberry.com. Available at: https://blogs.blackberry.com/en/2020/09/study-confirms-that-microkernel-is-inherently-more-secure.

GeeksforGeeks. (2018). *Microkernel in Operating Systems - GeeksforGeeks*. [online] Available at: https://www.geeksforgeeks.org/microkernel-in-operating-systems/.

Fritzsch, J., Bogner, J., Zimmermann, A. & Wagner, S. (2019). From Monolith to Microservices: A Classification of Refactoring Approaches. *Software Engineering Aspects of Continuous Development and New Paradigms of Software Production and Deployment*, [online] pp.128–141. doi:https://doi.org/10.1007/978-3-030-06019-0_10.

Heusser, M. (2020). *What is a microkernel architecture, and is it right for you?* [online] Available at: https://www.techtarget.com/searchapparchitecture/tip/What-is-a-microkernel-architecture-and-is-it-right-for-you.

Mahar, N. U. (2023). *Understanding Microkernel Architecture: A Foundation for Modular and Secure Systems*. [online] Available

at: https://www.linkedin.com/pulse/understanding-microkernel-architecture-foundation-modular-nasr-ullah/.