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." Discuss.

By Neelam Pirbhai-Jetha and Thien Liu

In the 1990s, microkernel operating systems were just being launched. From the exchanges on the forum (DiBona & Ockman, 1999), even if both Tanenbaum and Torvalds explained their choice of OS with some concrete examples many of their comments were veering towards the personal, and becoming insulting. This tends to lessen the seriousness of the discussion. But a few interesting points were noted. The table below summarises some of their reasons for their OS choice:

Tanenbaum's arguments		**Torvalds' arguments**	
Monolithic system	**Microkernel System**	**Monolithic system**	**Microkernel System**
older OS such as UNIX, MS-DOS…	Windows/NT (not yet released in 1992)	It was available	Not vastly available in 1992, even if nicer
Runs in 'kernel mode'	Runs as separate processes, mostly outside the kernel		Issues with multitasking in the kernel
	Communicate by message passing	More portable (in the API) – much simpler design	
Performance was the main argument for using Monolithic system	Performance as good as Monolithic system (Mach 3.0 was compared in research papers)		
Costly (especially to	Modern, free	free	

make it run – for students)			

About thirty years later, both, monolithic and microkernels OS, are, however, still being used. The question of who was right or wrong is not the main point, since all technologies have both advantages and disadvantages. It is, therefore, up to the software architects to decide upon and select the best OS (Fritzsch, 2019), after having done some thorough research.

Ongoing research on the different OSs focus on the security issues of both operating systems (Shropshire, 2014; Biggs et al, 2018), and some show how “monolith is hard to maintain and cumbersome with regards to adapting newer and better technologies” (Fritzsch, 2019). Monolithic OS, with its complex, long and “difficult to configure and understand” codes, is also not a good choice to design “IoT devices” (Jaskani et al, 2019). The authors (Jaskani et al, 2019) even did a comparative study of the different OS being used in an IoT system:

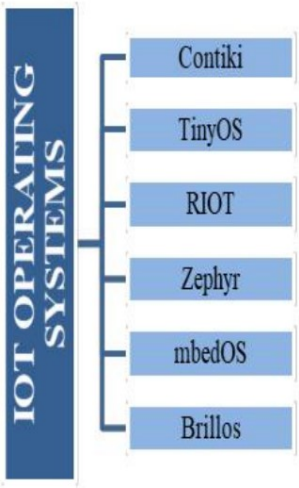

Figure 1. Layout of Different Operating Systems

Table 1. Comparison of different IoT Operating Systems as referred in [10]

OS	Min RAM	Min ROM	C Support	C++ Support	Multi-threading	Architecture	Scheduler
Contiki	< 2 KB	<4 KB	~	×	~	Monolithic	Cooperative, Preemptive
Tiny OS	<1 KB	<30 KB	×	×	~	Monolithic	Cooperative
RIOT	~ 1.5 KB	~ 5KB	✓	✓	✓	Microkernel	Preemptive, Priority based
Zephyr	~ 2 KB to ~8 KB	~ 50 KB	✓	✓	✓	Microkernel	Preemptive, Priority based
Mbed	~ 5KB	~15 KB	✓	✓	✓	Monolithic	Preemptive
Brillos	~ 32KB	~128 MB	✓	✓	✓	Monolithic	Completely fair

The figure and table above were taken from Jaskani et al (2019).

In conclusion, the authors posit that “there is no generic operating system that exists for IoT devices” and only “the best operating system according to the requirement of IoT devices” has to be chosen.

References:

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