











The Scale of Computing Latencies






To computers, we humans work on a completely different time scale, practically geologic time. Which is completely mind-bending. The faster computers get, the bigger this time disparity grows.






- *Jeff Atwood*

For all scale analogies, consider 1 CPU cycle = 1 second
(In reality, 1 CPU cycle = 0.3 nanoseconds)

<p>ONE CPU CYCLE = .3NS, WHICH = 1 SEC, OR IS EQUAL TO</p>  <p>Clapping your hands</p>	<p>L1 CACHE ACCESS = .9NS, WHICH = 3 SEC, OR IS EQUAL TO</p>  <p>Blowing your nose</p>	<p>L2 CACHE ACCESS = 2.8NS, WHICH = 9 SEC, OR IS EQUAL TO</p>  <p>Bill Gates earning \$2,250</p>	<p>L3 CACHE ACCESS = 12.9NS, WHICH = 43 SEC, OR IS EQUAL TO</p>  <p>COMPLETING AN AVERAGE MARIO BROS. Level 1-1 speed run (THE WORLD RECORD IS ABOUT 28 SECONDS)</p>	<p>MUTEX LOCK/UNLOCK = 17 NS, WHICH = 56 SEC, OR IS EQUAL TO</p>  <p>Washing your dishes</p>
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<p>MAIN MEMORY ACCESS = 100 NS, WHICH = 6 MIN, OR IS EQUAL TO</p>  <p>LISTENING TO QUEEN'S "Bohemian Rhapsody"</p>	<p>COMPRESS 1KB WITH ZIPPY = 2µs, WHICH = 2 HOURS, OR IS EQUAL TO</p>  <p>Watching a movie</p>	<p>READ 1M BYTES SEQUENTIALLY FROM MEMORY = 9µs, WHICH = 9 HOURS, OR IS EQUAL TO</p>  <p>COMPLETING A STANDARD US workday</p>	<p>SSD RANDOM READ = 16 µs, WHICH = 14 HOURS, OR IS EQUAL TO</p>  <p>TAKING A FLIGHT FROM New York to Beijing</p>	<p>SOLID-STATE DISK I/O = 50-150 µs, WHICH = 2-6 DAYS, OR IS EQUAL TO</p>  <p>WAITING FOR A STANDARD GROUND-SHIPED US domestic package</p>
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<p>READ 1M BYTES SEQUENTIALLY FROM SSD = 200 µs, WHICH = 8 DAYS, OR IS EQUAL TO</p>  <p>IF THERE WERE 8 DAYS IN A WEEK, IT WOULD NOT BE ENOUGH TIME FOR The Beatles TO SHOW THEY CARE</p>	<p>ROUND TRIP IN THE SAME DATACENTER = 500 µs, WHICH = 19 DAYS, OR IS EQUAL TO</p>  <p>Free climbing EL CAPITAN'S DAWN WALL IN YOSEMITE NATIONAL PARK</p>	<p>READ 1M BYTES SEQUENTIALLY FROM A SPINNING DISK = 2MS, WHICH = 70 DAYS, OR IS EQUAL TO</p>  <p>PLANTING + HARVESTING A zucchini</p>	<p>DISK SEEK = 4MS, WHICH = 5 MONTHS, OR IS EQUAL TO</p>  <p>TRAINING FOR YOUR first marathon IF YOU'VE NEVER DONE ONE + YOU'RE AT AN AVERAGE FITNESS LEVEL</p>	<p>ROTATIONAL DISK I/O = 10-12MS, WHICH = 1-12 MONTHS, OR IS EQUAL TO</p>  <p>WAITING UNTIL THE NEXT SEASON OF Game of Thrones</p>
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<p>INTERNET: SF TO NYC = 71MS, WHICH = 7 YEARS, OR IS EQUAL TO</p>  <p>ATTENDING + GRADUATING Hogwarts IF YOU'RE A WITCH OR WIZARD</p>	<p>OS VIRTUALIZATION REBOOT = 4 S, WHICH = 423 YEARS, OR IS EQUAL TO</p>  <p>423 YEARS AGO, Shakespeare WROTE RICHARD III</p>	<p>SCSI COMMAND TIME-OUT = 30 S, WHICH = 3,000 YEARS, OR IS EQUAL TO</p>  <p>3,000 YEARS AGO, PEOPLE STARTED wearing pants</p>	<p>HARDWARE VIRTUALIZATION REBOOT = 40 S, WHICH = 4,000 YEARS, OR IS EQUAL TO</p>  <p>4,000 YEARS AGO, THE PHARAOS STILL ruled Egypt</p>	<p>PHYSICAL SYSTEM REBOOT = 5 MINUTES, WHICH = 32,000 YEARS, OR IS EQUAL TO</p>  <p>32,000 YEARS AGO, THE AREA THAT IS THE Sahara desert was well-watered</p>
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ORIGINAL CONCEPT, PETER NORVIG: NORVIG.COM/21-DAYS.HTML#ANSWERS
 COLIN SCOTT: EEDS.BERKELEY.EDU/RCS/RESEARCH/INTERACTIVE_LATENCY.HTML

SOURCES

SYSTEMS PERFORMANCE: ENTERPRISE + CLOUD BY BRENDAN GREGG: AMAZON.COM/DP/0133390098/
 AT&T US NETWORK LATENCIES: IPNETWORK.BGTM0.IP.ATT.NET/PWS/NETWORK_DELAY.HTML