

Advanced Operating Systems (CS 202)

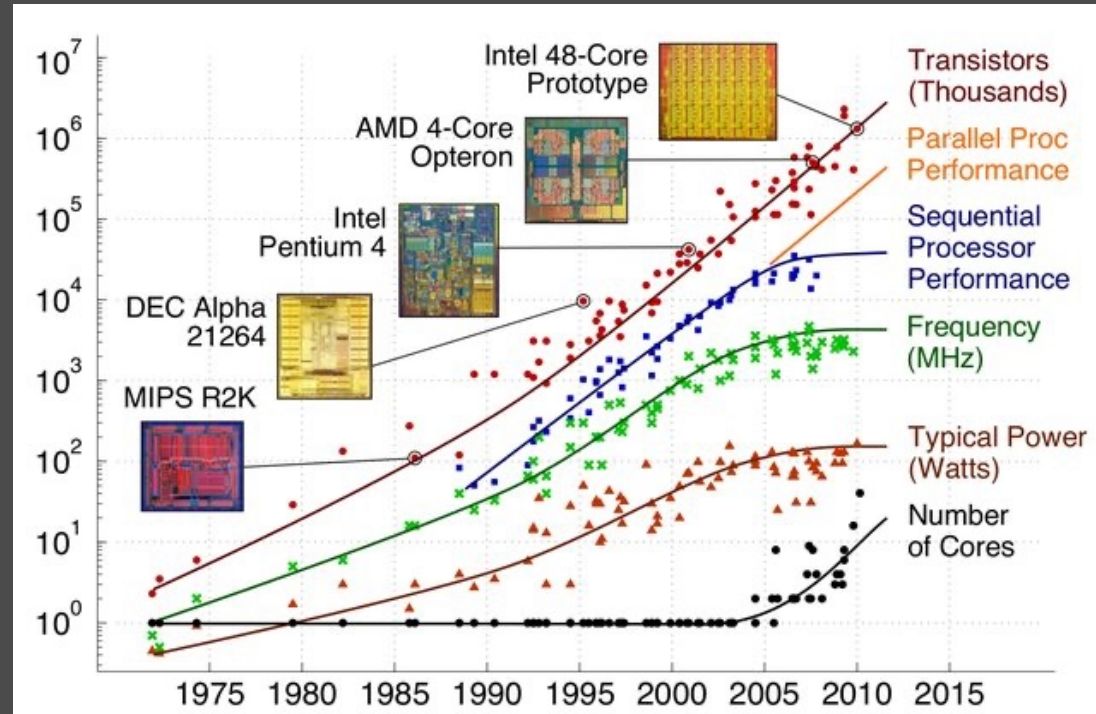
Distributed OS– intro and discussion

Overview

- Hardware is changing, so software must too
 - Multicores are here to stay
 - Architectures are heterogeneous
 - Applications are unpredictable unlike specialized systems
- How do operating systems scale?
- Do we need new OS architectures?

Landscape at that time

- Moore's law still here
 - barely (10nm->7nm->?)
- Dennard's scaling ended
 - Power wall
- We have transistors, but can't power them
 - Dark silicon
 - Can be used for important applications such as security
- Doubling moves to number of cores?
 - Common wisdom at the time



Landscape/motivation

- Systems are diverse
 - different implementations require different tradeoffs
 - Can we continue to optimize the OS to the hardware?
- Cores are increasingly diverse
 - Different general purpose cores
 - Accelerators and specialized processors
 - Typically cannot share an OS with such differences
- More cores—scalability?
 - Interconnects matter: within cores and across cores

What has gone on before?

- Early on, locks were not so expensive
 - Just use them
- Hardware evolved, memory expensive
 - Large caches
 - Cache coherence
 - NUMA machines
 - Increasing gap between memory and processor
 - Shared memory expensive!

Older SMP OS projects

- E.g., Tornado
- Locality matters
- Customize OS to underlying hardware
 - But now we have high diversity
 - Cannot have one size fit all
- Use replication as an optimization
- Still good principles

What we will cover

1. Many argue that we need new models
 - Sharing is bad, try to have per core data structures
 - Multikernel/Barrelfish paper as a representative
2. Linux scalability paper shows that maybe conventional OS model still works
3. We will look at OS for extreme heterogeneity and resource disaggregation (LegoOS)
 - Multi-kernel influenced ideas

What actually happened

- Did not have exponential growth of cores
 - So, traditional OS's continue to limp with some updates (see linux scalability paper)
 - Accelerators/GPUs second class citizens
- Barrelfish open source/downloadable
 - Backed by industry, actively developed
- Big impact on OS research
 - Basis for LegoOS
- Inspired/was used in commercial products
 - Arrakis, FlexiNet, LXD, ...