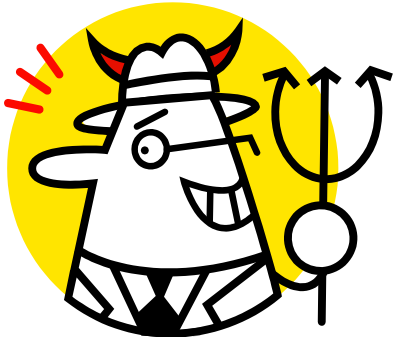
Microsoft

EXTREME COMPUTING GROUP

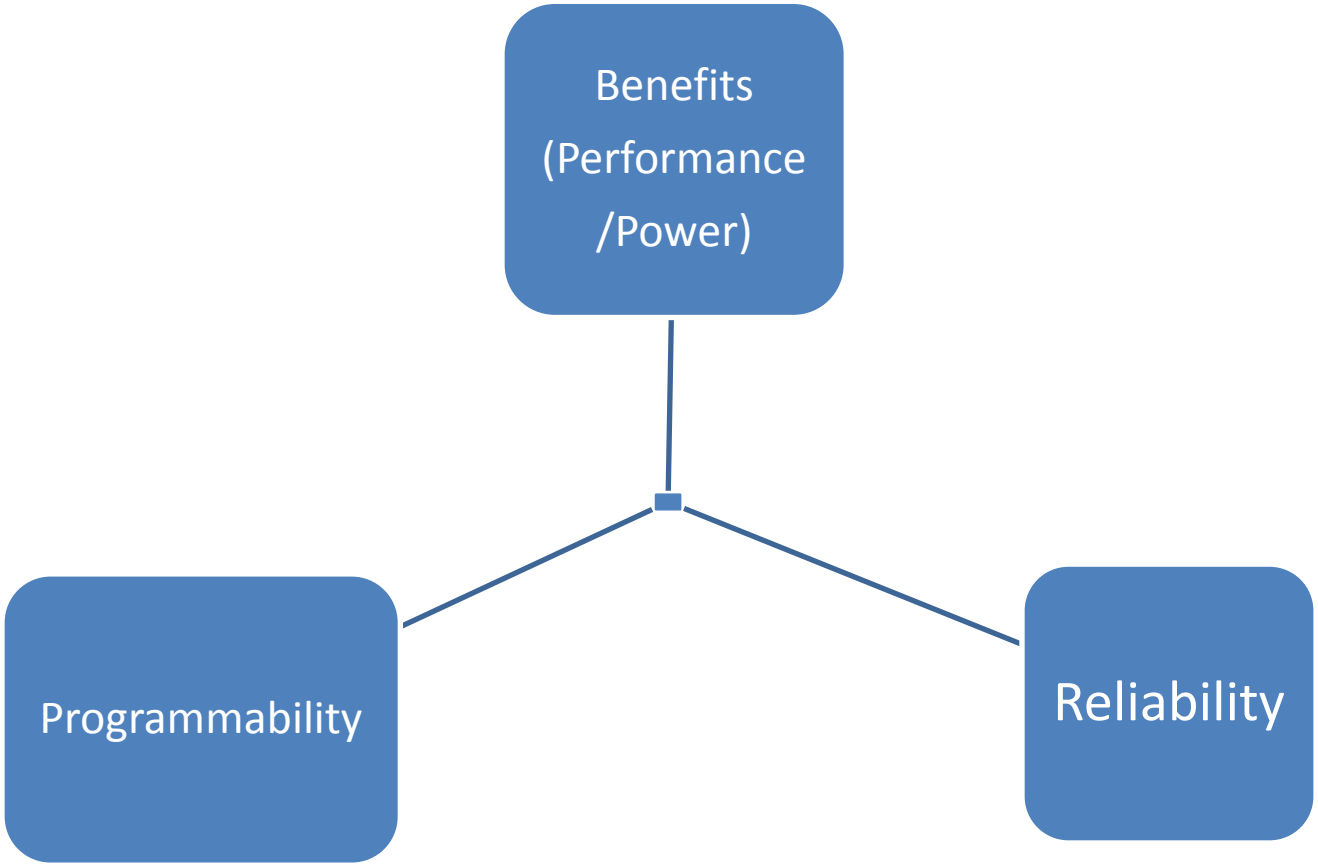
Defining the future.

Asymmetric Multicore



Himanshu Raj, Ripal Nathuji

Dimensions


Benefits (Performance /Power)
Programmability
Reliability

Benefits

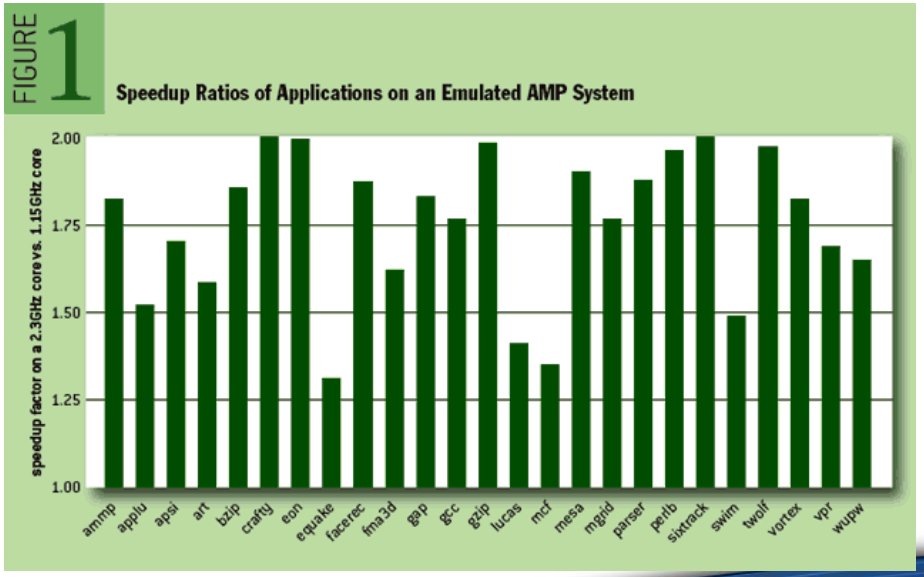
Diverse level of parallelism at application-level

- Some sequential component, some parallel

Mixing various workloads that require different CPU capabilities

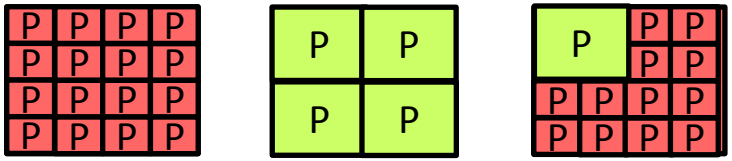
- CPU bound vs. memory bound vs. I/O bound

Power/Performance benefits



*Fedorova09

Benefits



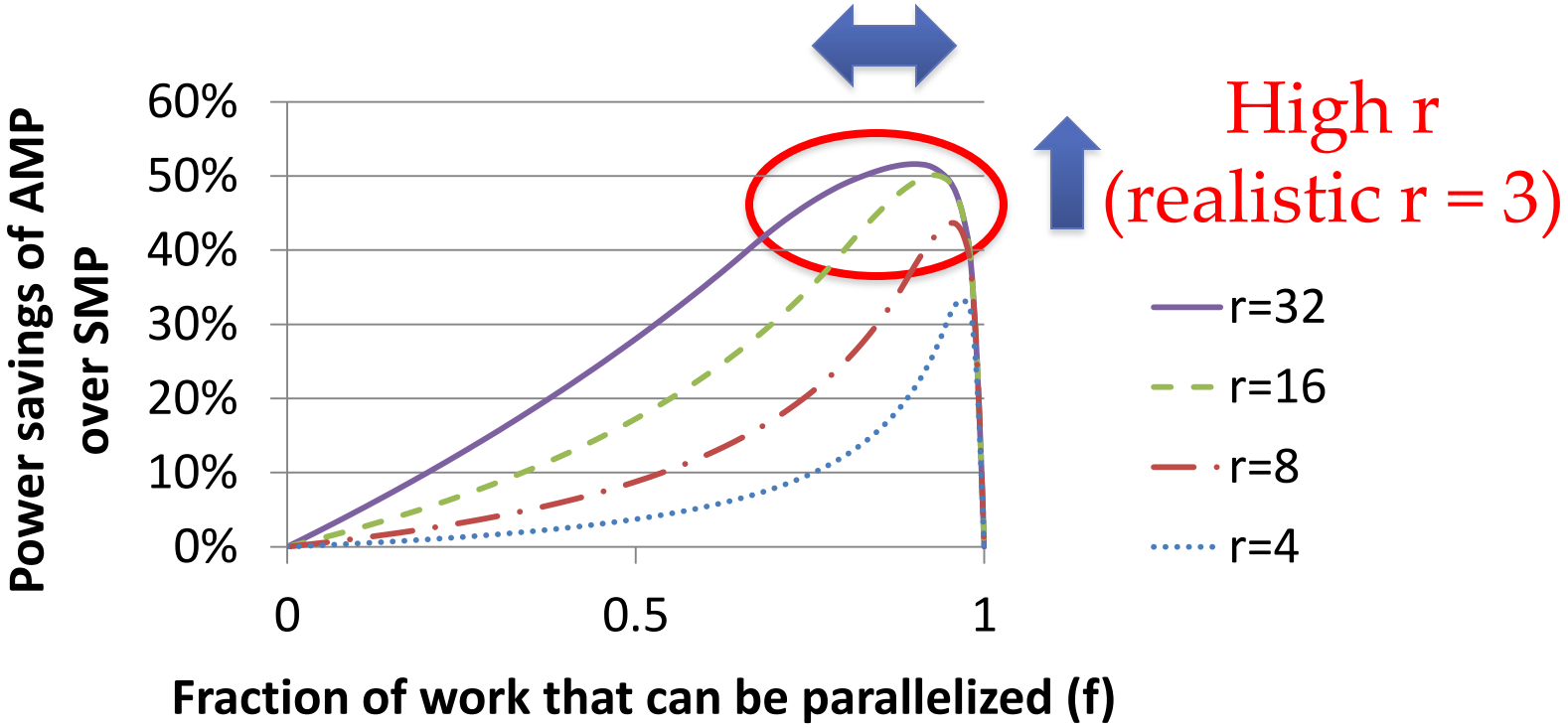
SMP
n=16, r=1

SMP
n=16, r=4

AMP
n=16, r=4

High (but not too high!) f

High r
(realistic r = 3)



*Gupta10

Practical Considerations

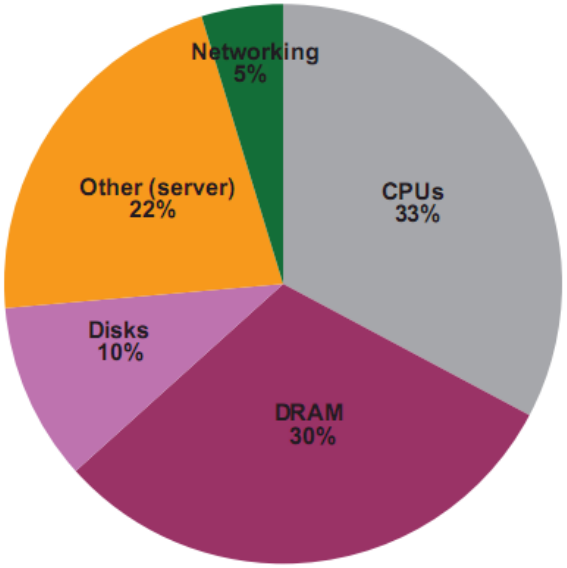
Scalability: Amdahl's law assumes unbounded scalability

Migration overhead: zero migration overhead

Perfect scheduling: oracle scheduler

Actual savings are going to be lower

CPU power vs. System power



Running on slower core decreases CPU power consumption, but **increases system power** consumption.

Source: The Datacenter as a Computer (Hoelzle & Barroso, 2009)

Programmability

What is the right level of abstraction to hide asymmetry?

- ISA
- ABI/API
  - Re-design of OS/VMM, major cost
- Libraries

Don't! Let apps deal with it

- Parallel programming is hard enough!
  - Help from specialized runtime (Harmony)

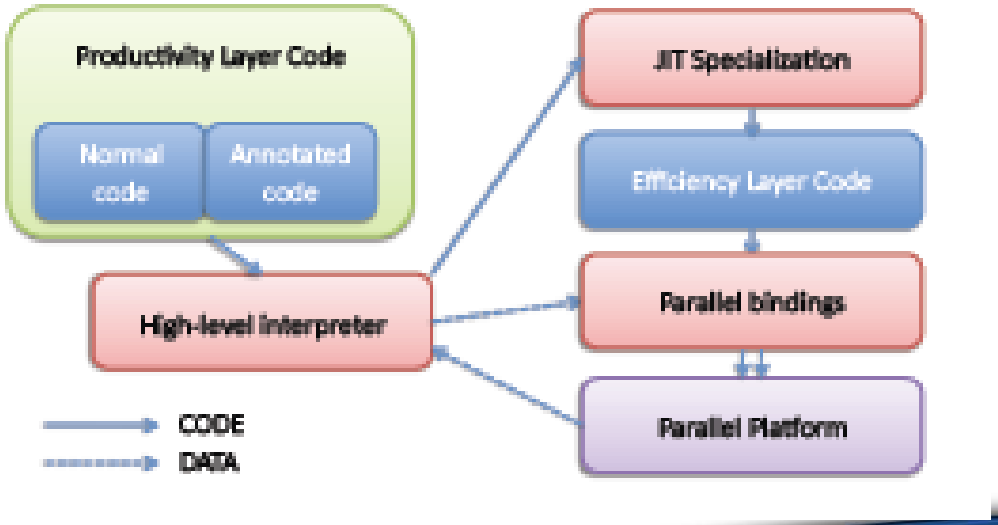
Programmability

Different compiler tool chain with language extensions

- DirectX, CUDA, Cell

S(elective)E(mbedded)JITS(pecialization) approach

- Productivity programming vs. Performance programming



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Programmability

Would this generalize in future?

- Application uses annotations
- Tools auto-magically map annotations to resources

Reliability

Implement S/W components for asymmetric components

More code -> more bugs -> more failures

Asymmetric Multicore Benefits?

- How much of benefits translate to actual savings?
- Vertical cost - rethink application, compilers, tools, libraries, OS, VMM
  - Impact on programmability and Reliability
  - What if we are willing to be < optimal possible by AM system?
- Many interesting research problems and applications in specific areas, but is it viable for industry to invest in this for general purpose computing?