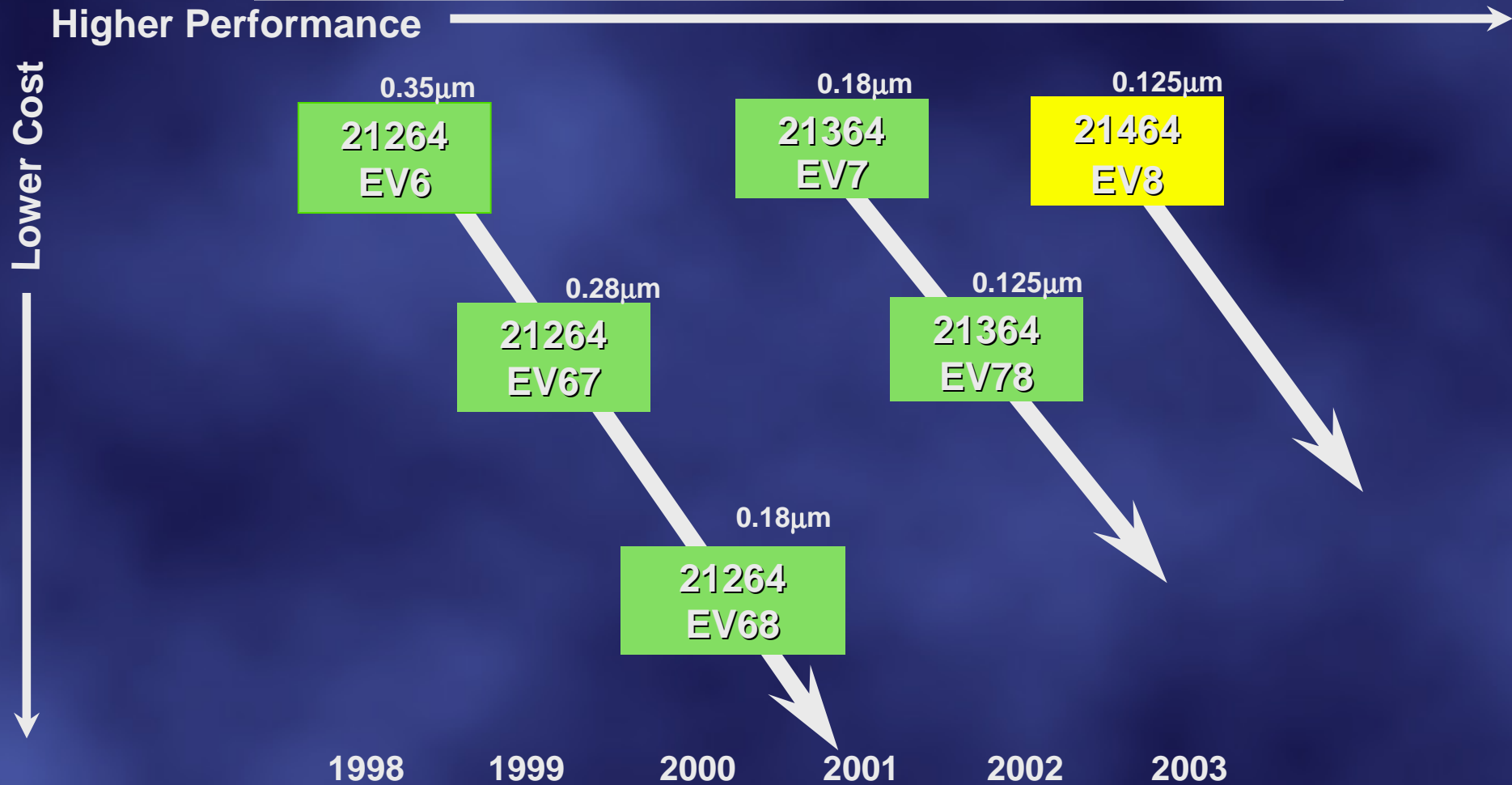




Alpha Microprocessor Overview





Alpha 21464 Architecture Overview

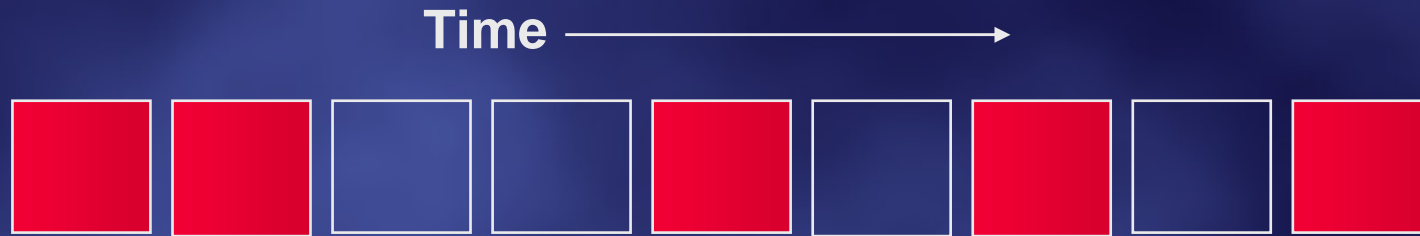
- ◆ Enhanced out-of-order execution
- ◆ 8-wide superscalar
- ◆ Large on-chip L2 cache
- ◆ Direct RAMBUS interface
- ◆ On-chip router for system interconnect
- ◆ Glueless, directory-based, ccNUMA
 - for up to 512-way multiprocessing
- ◆ 4-way simultaneous multithreading (SMT)

COMPAQ

Better answers



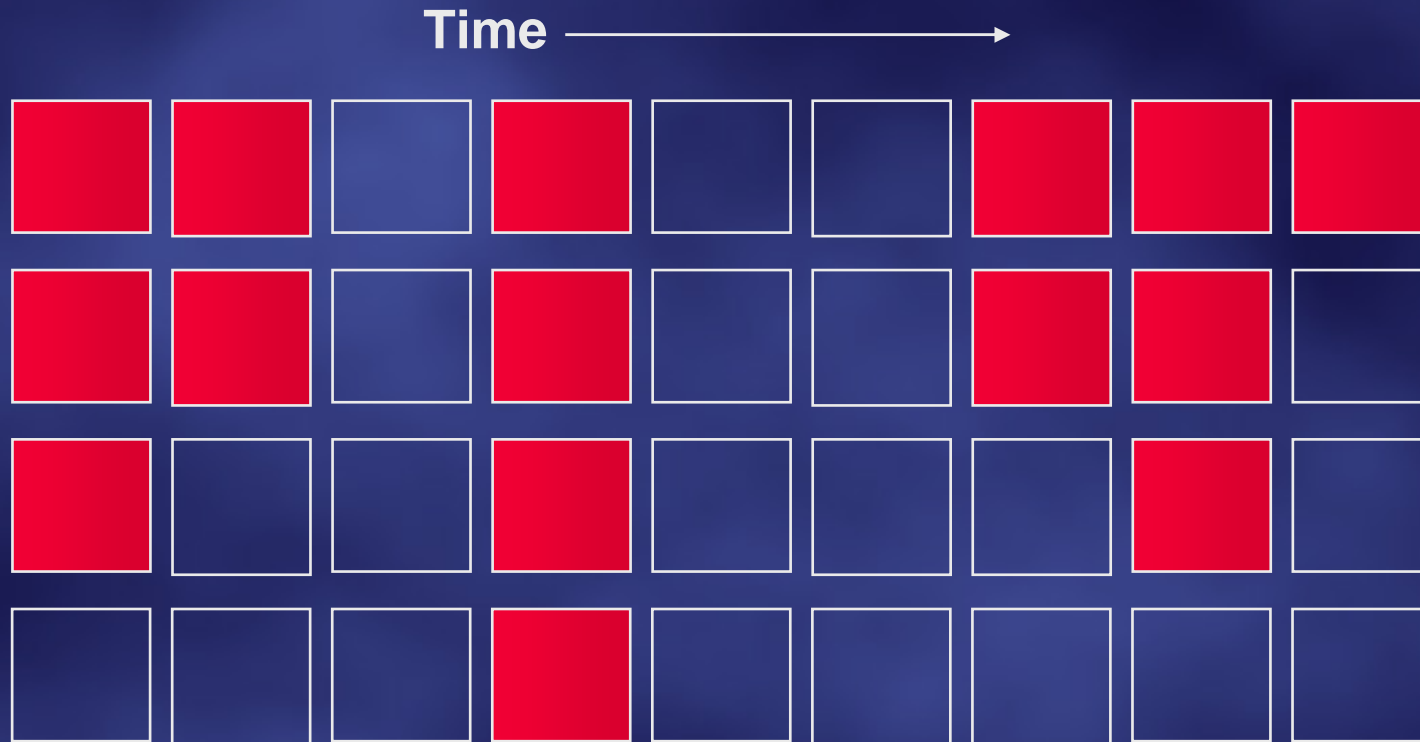
Instruction Issue



Reduced function unit utilization due to dependencies



Superscalar Issue

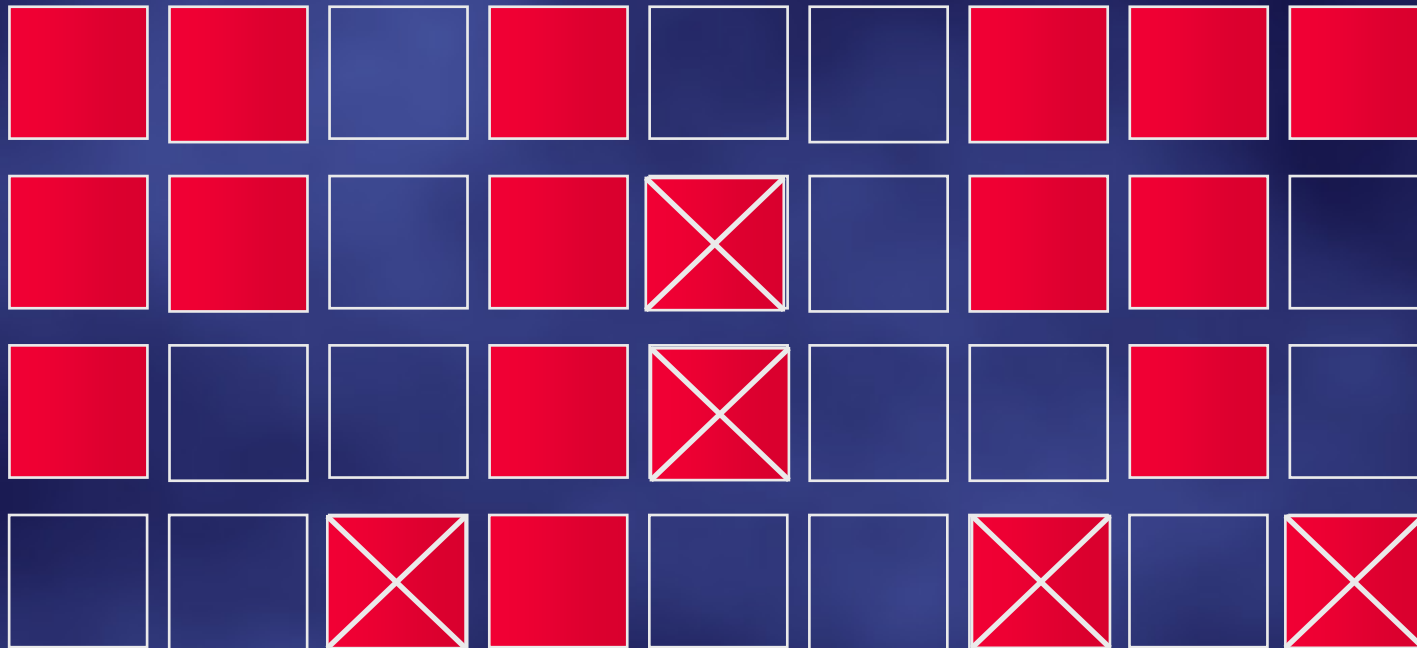


Superscalar leads to more performance, but lower utilization



Predicated Issue

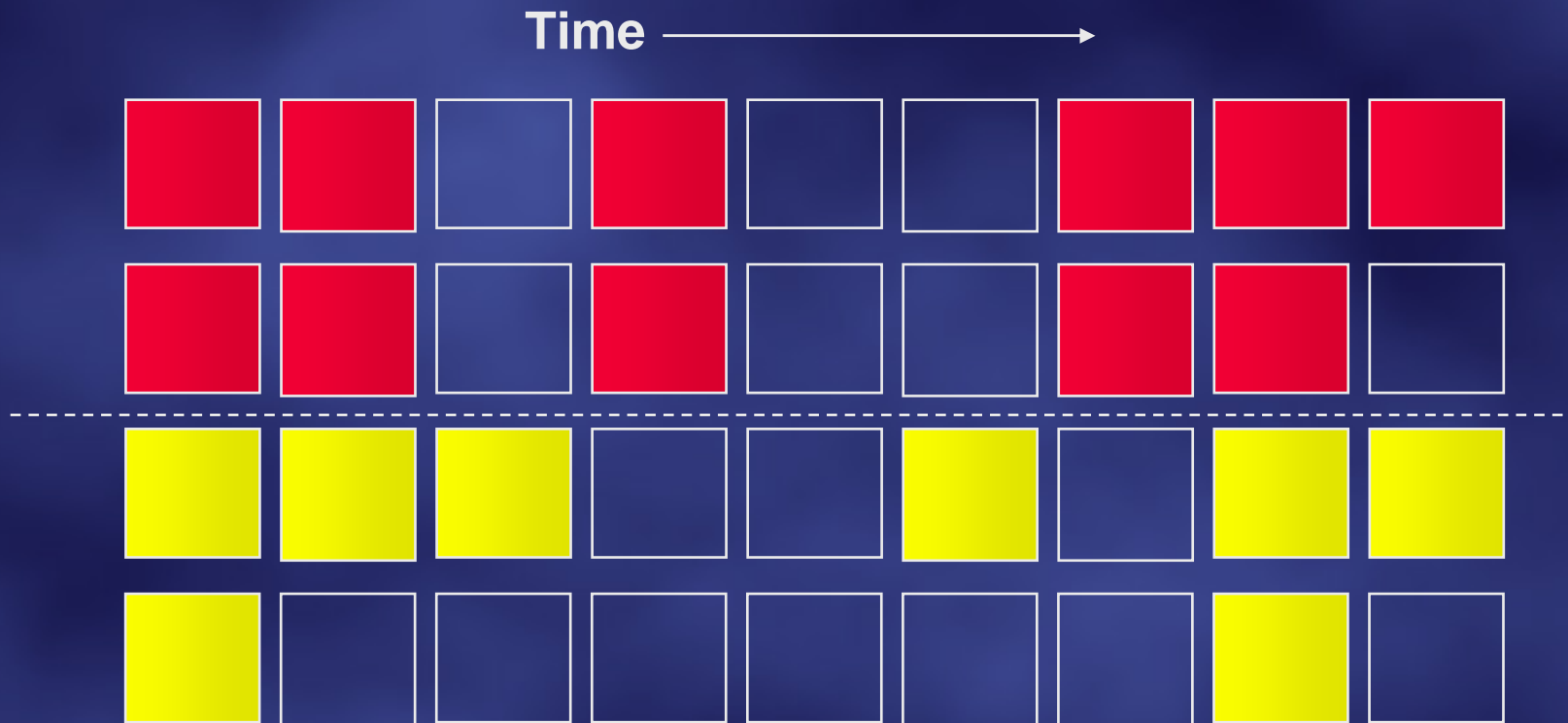
Time →



Adds to function unit utilization, but results are thrown away



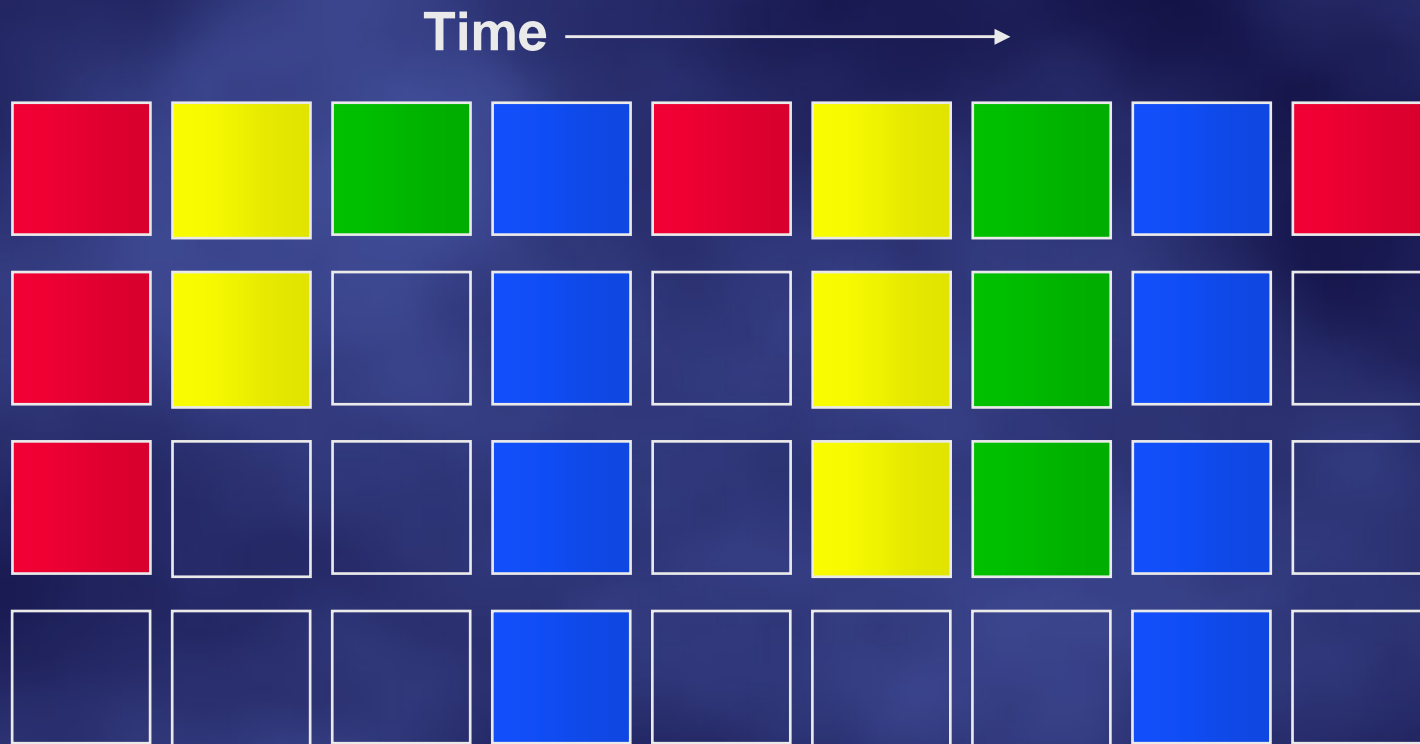
Chip Multiprocessor



Limited utilization when only running one thread



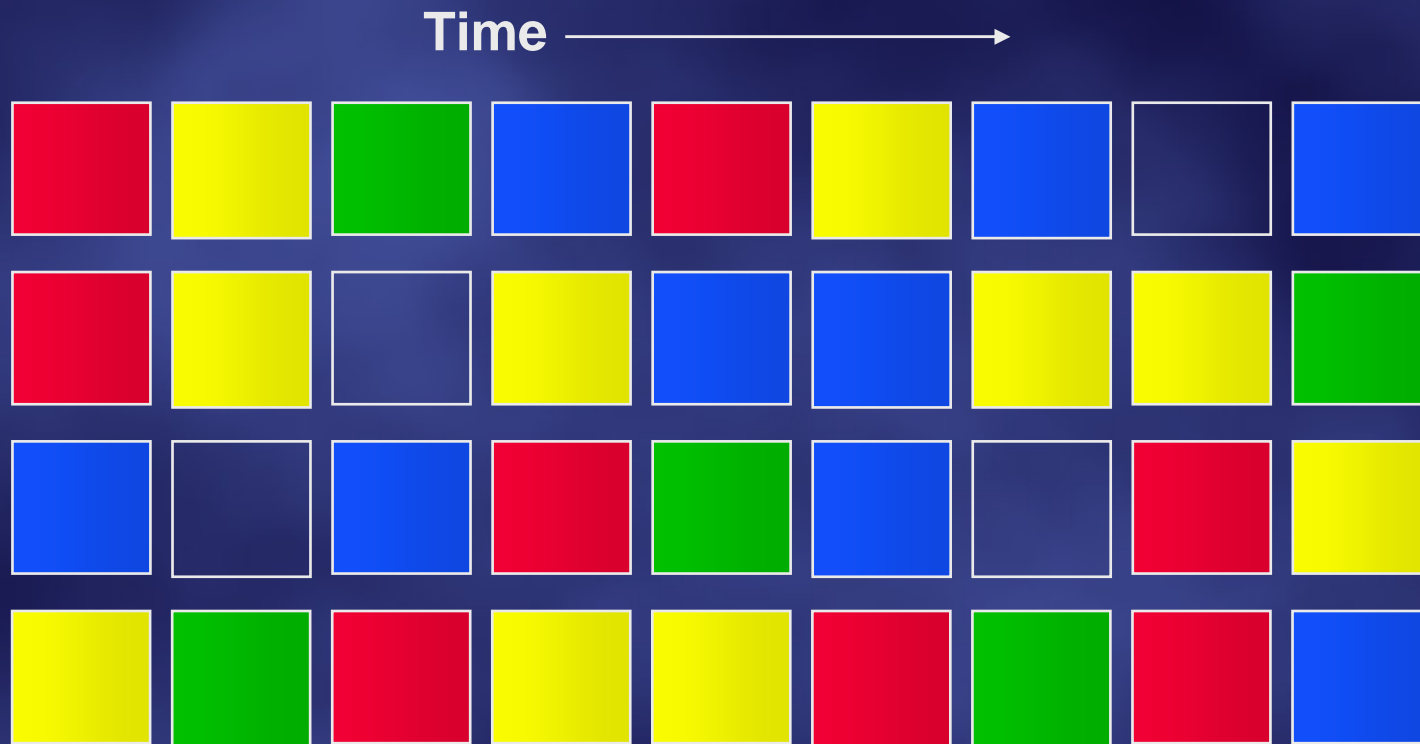
Fine Grained Multithreading



Intra-thread dependencies still limit performance



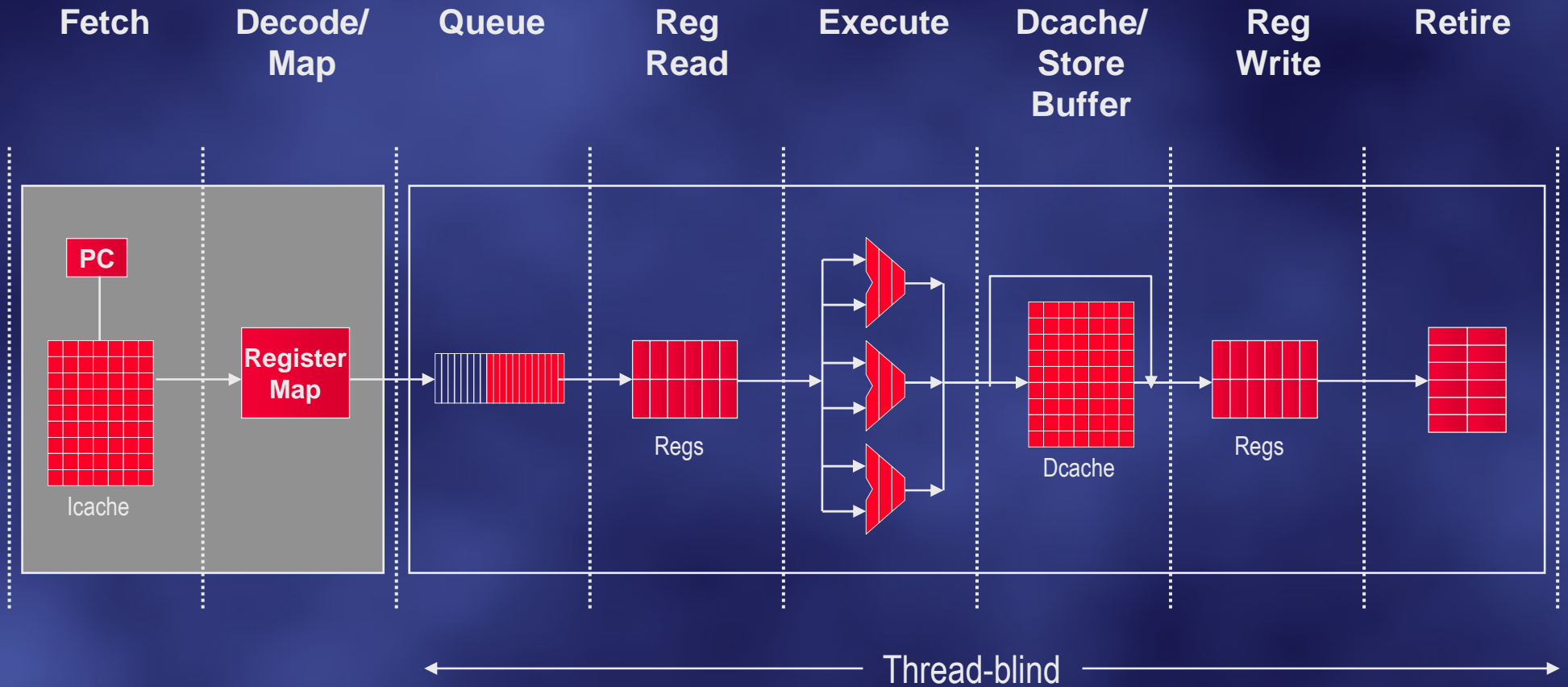
Simultaneous Multithreading



Maximum utilization of function units by independent operations

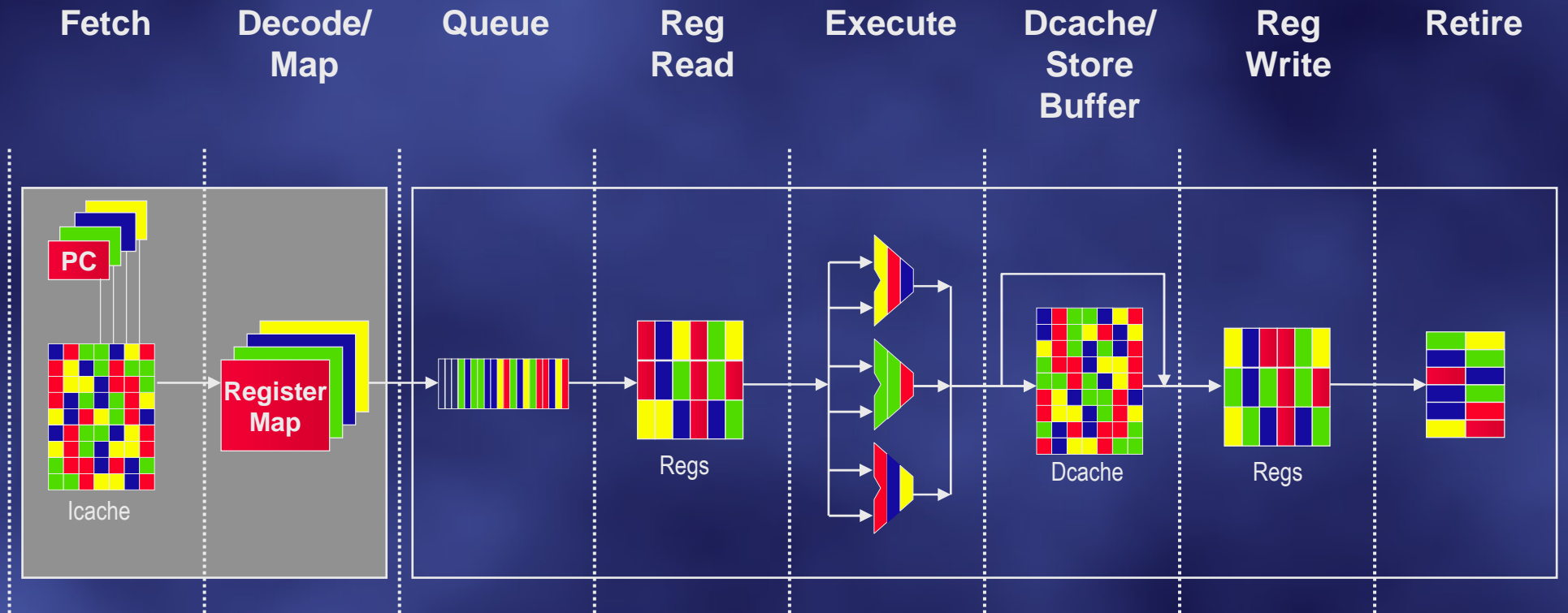


Basic Out-of-order Pipeline





SMT Pipeline





Changes for SMT

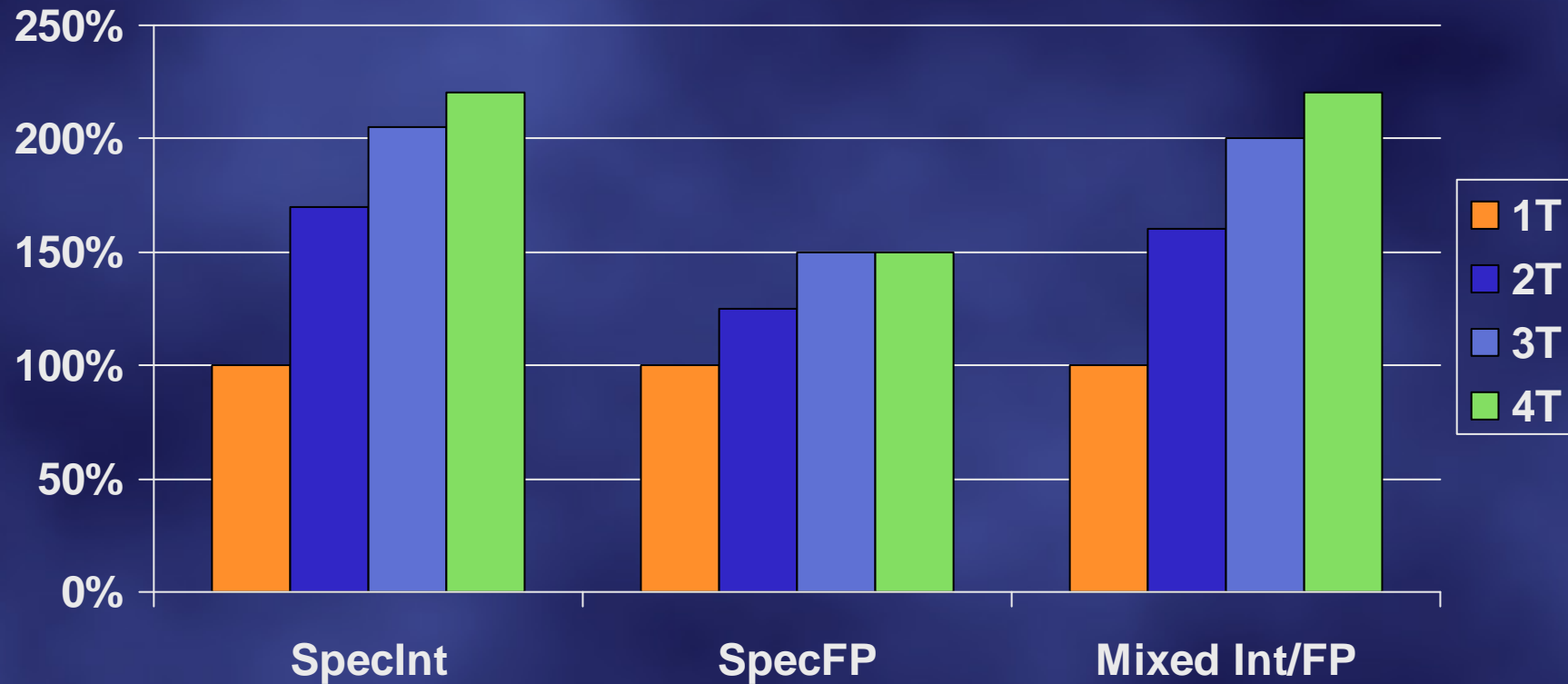
- ◆ Basic pipeline – unchanged

- ◆ Replicated resources
 - Program counters
 - Register maps

- ◆ Shared resources
 - Register file (size increased)
 - Instruction queue
 - First and second level caches
 - Translation buffers
 - Branch predictor



Multiprogrammed workload



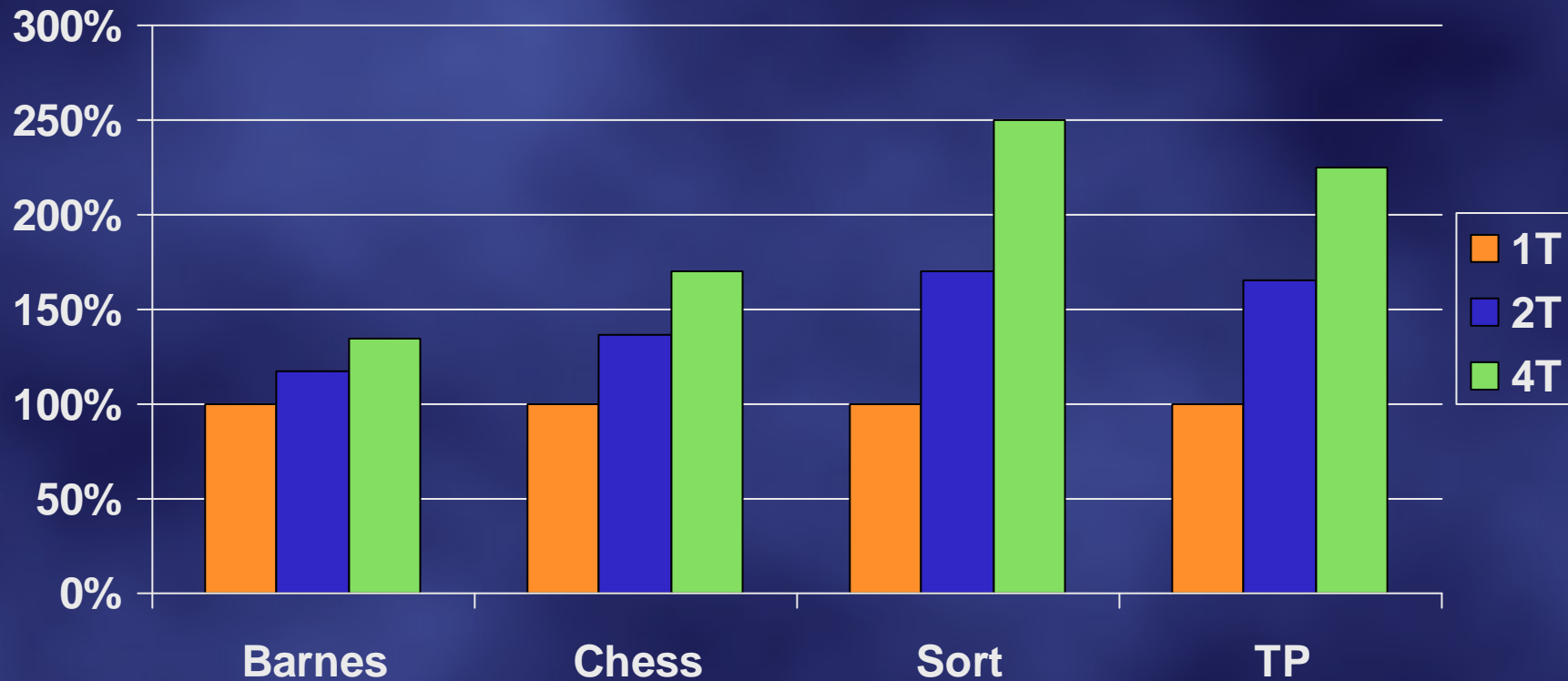


Decomposed SPEC95 Applications





Multithreaded Applications





Architectural Abstraction

- ◆ 1 Processor with 4 Thread Processing Units (TPUs)
- ◆ Shared hardware resources

