An Easy Path to Exascale

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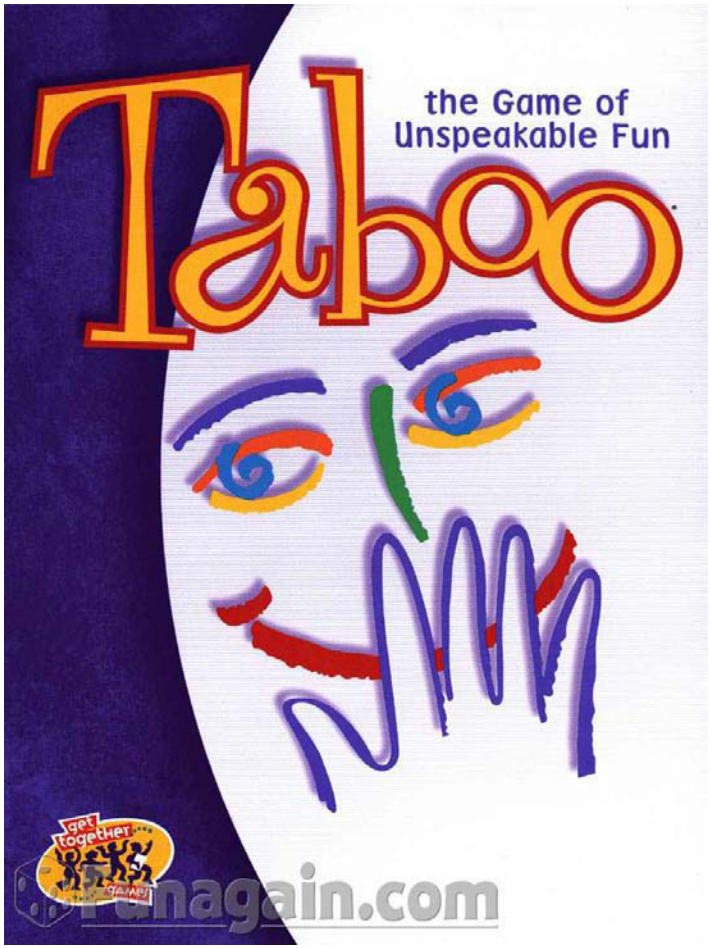
Disclaimer

- **The opinions expressed herein *definitely* do not reflect the positions of Los Alamos National Laboratory, the National Nuclear Security Administration, or the United States Department of Energy**
- **Please don't cut off my funding**

Background

- **Many of us have been to lots of exascale meetings**
- **If these meetings forbade the use of the words**
  - energy
  - resilience
  - programmability
  - co-design

  the meetings would be a *lot* shorter
- **(but perhaps more fun)**

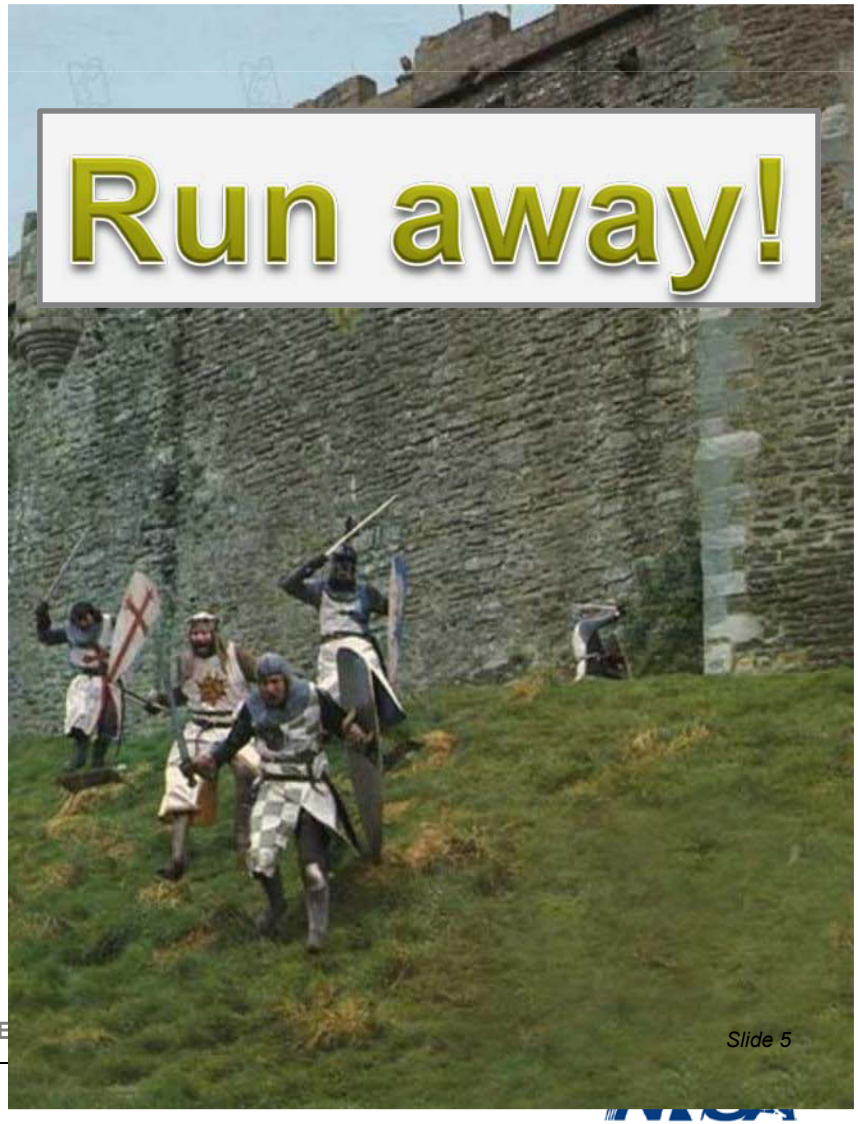


Exascale Refrains

- **We don't know how to reduce system power**
- **We don't have a good way to tolerate frequent faults**
- **As component heterogeneity increases, programmability decreases**

Solution

- **How can we deal with all of the problems of exascale?**



My Proposal

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- **Different locations → distribute load across the power grid**
- **Fewer components → faults occur less frequently**
- **Less complex hardware → can stick with MPI+*X* (where *X*=∅)**
- **Dedicated systems → no long queues waiting for job to start**
- **More aligned with vendor roadmaps → no cajoling needed**

✓ **Power problem solved**

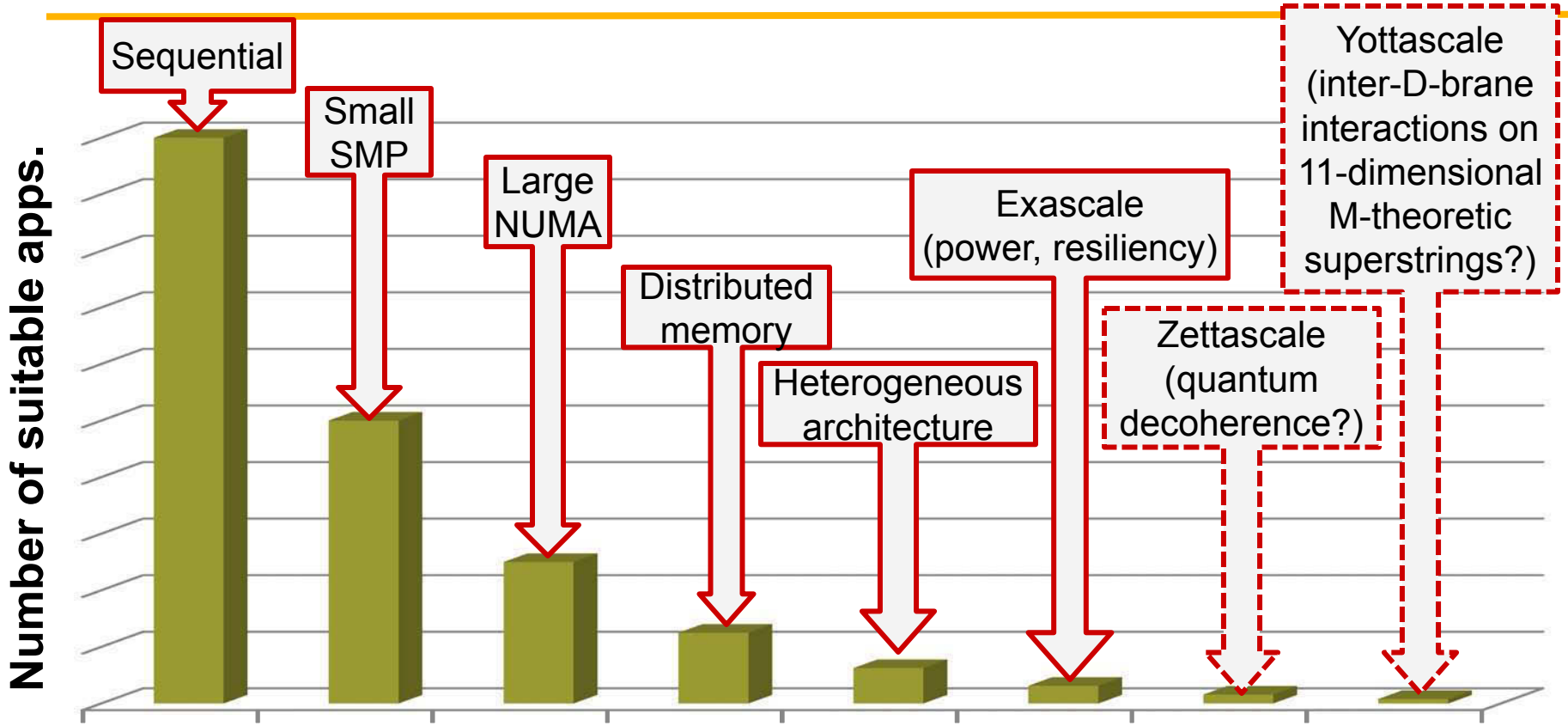
✓ **Resiliency problem solved**

✓ **Programmability problem solved**

✓ **Increased productivity**

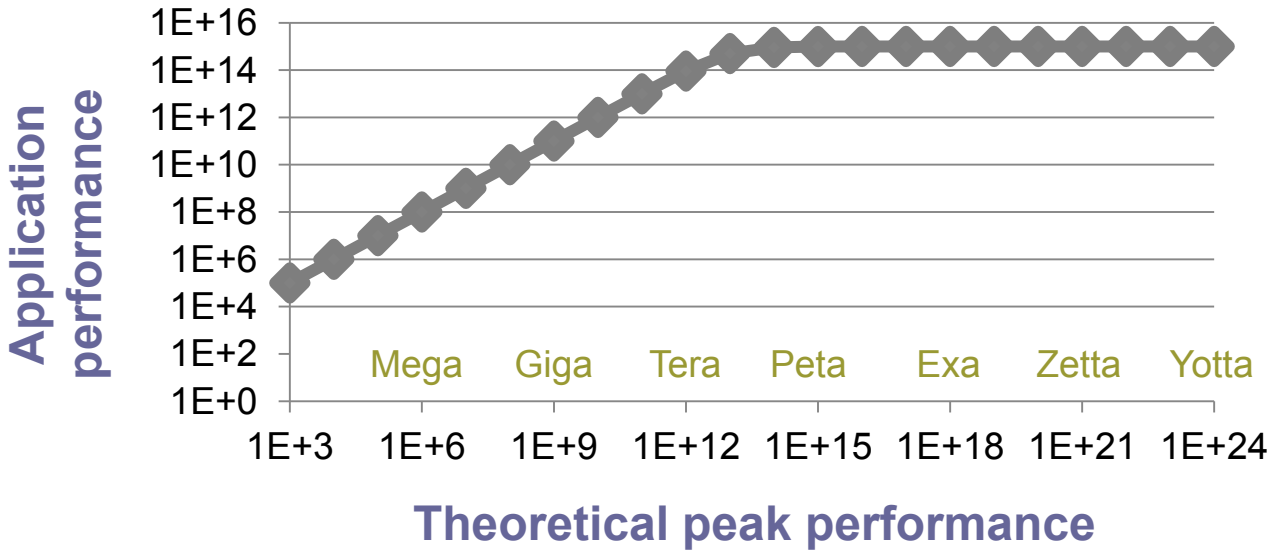
✓ **Lower cost**

What About Applications that *Require* Exascale?



- **Approaching a singularity where we don't *have* any applications**
- **(except perhaps LINPACK)**

We May be Facing a Petascale Performance Asymptote



- **Parallelism**
  - By Amdahl's Law, if your application is less than 99.9% parallelized, you'll see at best only petascale performance on an exascale system
- **Resilience**
  - Performing the same work three times gives you 1/3 of the remaining performance
- **Power**
  - To stay within the power budget, some components may have to be turned off or downclocked, lowering performance even further

Summary

- **Exascale computing poses numerous challenges**
  - Energy, resilience, programmability
- **Relatively few applications both require exascale *and* can be programmed to exploit complex exascale hardware**
- **Many applications can take advantage of petascale**
  - Limited by access to machines
  - (Long queue if you want the machine for yourself)
- ***Proposition*: Buy 1000 research teams their own petascale computer**
  - Increases scientists' productivity
  - Why put ourselves through the pain of an exascale before its time?
  - I'll wait until I can borrow an exascale cell phone from my grandkids
- **It's not like there isn't still exciting research to be done at petascale**