Impact of ECI on DOE Co-design Strategies

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ECI Provides DOE a Key Opportunity

- Time frame and funding to:
  - Design hardware and system architectures
  - Modernize DOE’s legacy applications portfolio

- ECI can support two complementary Co-design strategies
  - *Clean sheet* development of applications/algorithms with largely predetermined Hardware and System Architectures
  - *Clean sheet* development of hardware/system architectures with largely predetermined Applications and Algorithms
Clean Sheet development of Application/Algorithms with *a priori* defined HW/System Architectures

- This maps to an *Application-centric Proactive Co-design* path
- This approach has synergy with DOE/SC applications that are un-encumbered by a large legacy code base
- Note: Even if there were enough ECI budget to scale this strategy to the entire portfolio of DOE Legacy Applications, *we do not have enough application and algorithm developers to rely solely on this strategy*

  e.g. AMD Two Level Memory Concept
Clean Sheet development of HW/System Architectures with a priori defined Applications/Algorithms

- ECI provides an opportunity to pursue a complementary strategy. This is an Architecture-centric Proactive Co-design path with a required “bridge” to DOE’s portfolio of legacy applications.

- This strategy complements Application-centric by focusing Computer Industry R&D efforts on designs that reduce DOE application and algorithm developer efforts.

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**Diagram:**

- Chain 0
- Chain 1
- Module Manager
- …
- CPU

*e.g. Advanced Concept: Modules of Chains of HMCs*
Fully Funded ECI is Required to Pursue these Strategies

- These two strategies, while distinct are not necessarily independent
- Progress in the strategies can inform each other, i.e., Holistic Co-design
- Both strategies require System Software R&D, but needed System Software capabilities may differ due to Application and Architecture differences
Final Thoughts about ECI Impact

- Despite misperceptions, ECI is not about reaching $10^{18}$ floating point operations per second.
- We should not squander our ECI opportunity.
- Prioritization criteria for DOE Exascale Co-design:
  - All Architecture R&D is not equal. Should prioritize efforts that ease the Application/algorithm developer burden.
  - All Application Development is not equal. Should prioritize approaches that can “bridge” to our legacy code base.
  - System Software Investments that support these priorities are critical to DOE Exascale Co-design.