BDEC Software Session Report

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Extreme Computing versus Big Data

- Big Data
  - It’s not merely about the size!
  - New interaction patterns with focus on diverse types of data, sophisticated data models, communication and interactivity, 3V, etc.
  - Relevant to science not just commercial applications

*We started out from different assumptions – then new requirements came in – but those assumptions are now hardwired into the design of EC systems*
## EC vs BD: Applications

<table>
<thead>
<tr>
<th>Extreme Computing</th>
<th>Big Data</th>
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<tbody>
<tr>
<td>Static/predictable requirements for resources</td>
<td>Volatile/unpredictable requirements for resources</td>
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<tr>
<td>Non-interactive</td>
<td>On-demand/predictable response time, often interactive</td>
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<tr>
<td>Focus on performance</td>
<td>Focus on “productivity”</td>
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<tr>
<td>Data is private</td>
<td>Data is shared and managed for sharing (e.g., provenance)</td>
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<tr>
<td>Focus on domain-dependent methods</td>
<td>Include a wider range of methods including domain-independent methods (e.g., statistical methods)</td>
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## EC vs BD: Models and Technology

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<th>Extreme Computing</th>
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<tbody>
<tr>
<td>Scheduling optimizes provider concerns, e.g., utilization</td>
<td>Scheduling optimizes user concerns, e.g., response time and a range of other QoS</td>
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<tr>
<td>Resource management focuses on compute</td>
<td>Resource management focuses on multiple resources including compute, memory, storage and network</td>
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<td>Application is the focus of adaptation and optimization</td>
<td>Platform fit is automatic and the focus of optimization</td>
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<td>Assume a static resource model optimizing to fixed assumptions</td>
<td>Assume a dynamic resource model: programming models that adapt to platform change</td>
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<td>Fault tolerance is expensive</td>
<td>Redundancy-based fault tolerance</td>
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Stepping Stones: Towards EC/BD convergence

- Sharing the same resources
  - Resource management methods need to evolve so that BD and EC can share resources
    - Dynamic, QoS-aware, multi-aspect, leverage trends towards resource programmability, incentives
    - Knowing and communicating more about the application is key

- Programming models
  - Exploration of more flexible/malleable programming models
  - Resilience: models intolerant of failure versus models based on redundancy

- Security: from coarse-grained security (firewalls) for EC to fine-grained for BD
Domain Testbeds

- Experimental CS Testbeds
  - Chameleon, CloudLab, Grid’5000, FED4FiRE

- Resources exploring the BD management models
  - Comet, JetStream

- Industry
  - Amazon, Google

- How about supercomputers?
  - Which ones are amenable for running convergent workload?
Game Changers

- Convergence towards “stepping stones”
- Challenges and demonstrations: software representing an entire system that can be used for BDEC
- Convergence
  - HPC features available in the cloud (HPC)
  - “Cloud” features available on HPC platforms (availability, predictable response time, etc.)
- End of Moore’s Law is a catalyst ;-)
Towards Convergence: Proposed Actions

- Grand Challenges (disqualify Google ;-) and Success Stories
- “Throw money on the problem”
  - Research calls focusing on “stepping stones”
  - Mandate as part of procurement
- Workshops, forums, “melting pots” between communities
- Make available representative traces and workloads (chicken and egg problem?)
- Documents: create common vocabulary, architecture
- Solve incentive problems
Success of BDEC

- Documents and methodology plus key problems to drive community research
- Formation of a community
- Formulation of research programs
- Long-term: adoption of convergence technologies