NORTHWEST INSTITUTE *for* ADVANCED COMPUTING

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Modeling
Science & Engineering Applications

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Use of S&E Application Modeling

- **Limited Use in S&E Software Development**
  - Developers understand major computational bottlenecks in their applications
  - Developers often have simple models of application section(s) related to computational bottlenecks

- **Blue Waters Project**
  - Used application modeling in Blue Waters Project and found important improvements in required benchmarks
  - Created modeling service to help developers but only used modestly

- **Convincing Test Cases**
  - S&E application developers needs to be convinced of the utility of going beyond simple models they currently use

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Needs in S&E Application Modeling

- **S&E Application Characteristics**
  - Broad range of applications
  - Large—100,000s to millions of loc
  - Complex—many different algorithms, many different paths through the application
  - Whack-a-mole syndrome—bottlenecks shift as improvements are made

- **Modeling Issues**
  - Computation
  - Data motion
    - Memory hierarchy (on-chip and off-chip)
    - I/O

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Needs in S&E Application Modeling

- **Desired Features**
  - Usability
    - Tools must be targeted at S&E application developers, not computer scientists
  - Supported
    - Too risky to use unsupported software
  - Fast
    - Cannot substantially slow down the development process (best if it actually speeded it up)

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Advantages of S&E Application Modeling

- **Exascale Computer Systems**
  - Architectures dramatically different than current architectures
  - Application modeling required to attain desired performance
    - Current approaches to S&E software development will not be adequate
    - Optimization now multidimensional: performance and power

- **Trickle-down Systems**
  - Most cost effective petascale systems will be based on exascale technologies