



Dynamic Data Driven Application Systems

(Symbiotic Measurement & Simulation Systems)

*“A new paradigm for application simulations
and
a new paradigm for measurement systems”*

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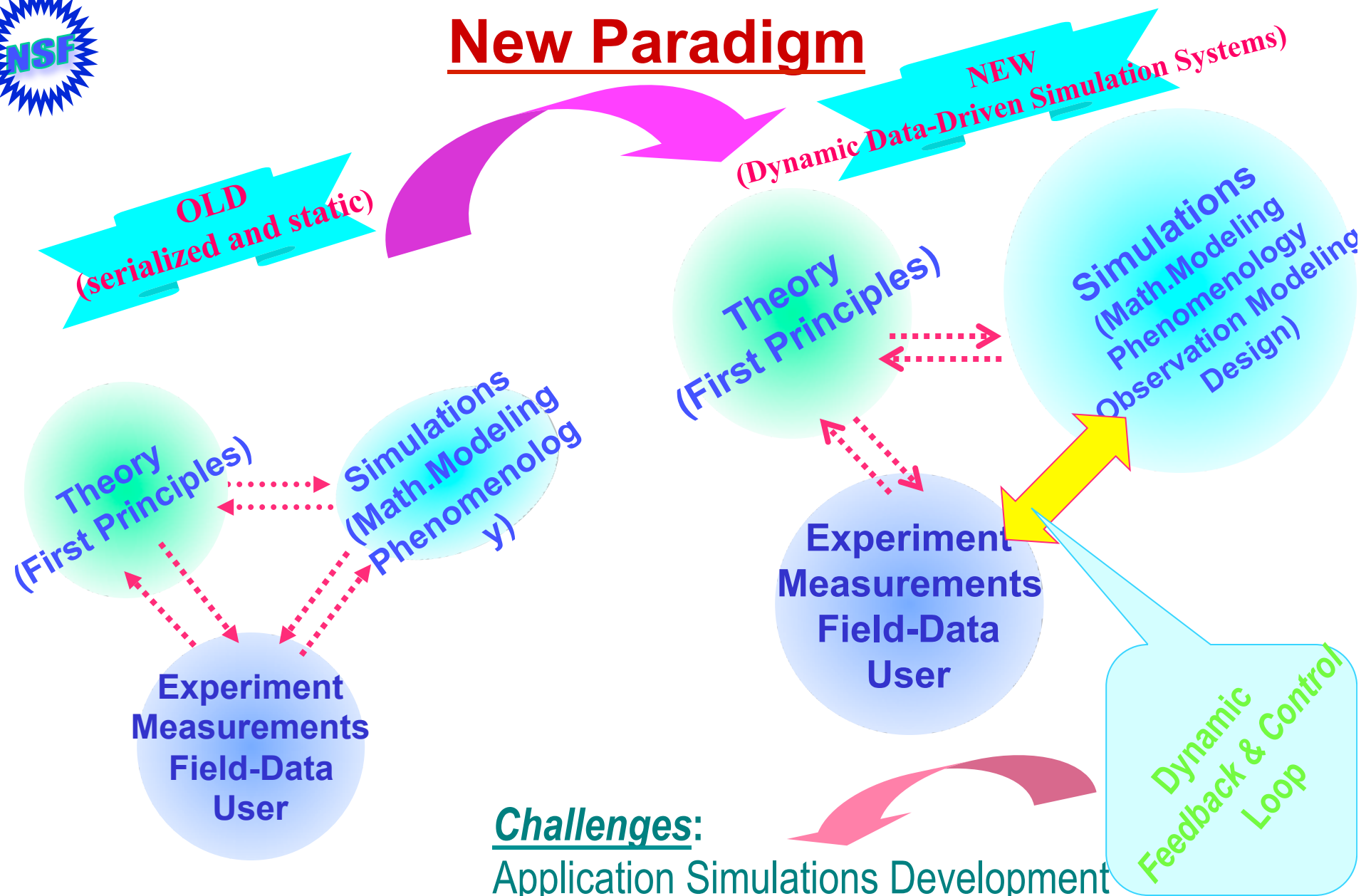


Dynamic Data Driven Application Systems, are:

- New paradigm for application simulations, where
 - the applications can accept and respond dynamically to new data injected at execution time,and reversely
- New measurement methods, where
 - the application systems will have the ability to dynamically control the measurement processes
- The synergistic and symbiotic feedback control-loop between simulations and measurements can open new domains in the capabilities of simulations with high potential pay-off
- Will create applications with new and enhanced analysis and prediction capabilities
- Will create a new methodology for more efficient and effective measurement process.
- Great potential to transform the way science and engineering are done, and induce a major impact on manufacturing, commerce, transportation, hazard prediction/management, and medicine



New Paradigm



Challenges:

Application Simulations Development
Algorithms
Computing Systems Support



Examples of Applications benefiting from the new paradigm

- **Engineering (Design and Control)**
 - aircraft design
 - oil exploration
 - semiconductor mfg
 - computing systems hardware and software design
(performance engineering)
- **Crisis Management**
 - transportation systems (planning, accident response)
 - weather, hurricanes/tornadoes, floods
 - fire propagation
- **Medical**
 - customized radiation treatment, x-rays, NMR, surgery, etc
 - epidemics
- **Manufacturing/Business/Finance**
 - Supply Chain (Production Planning and Control)
 - Financial Trading (Stock Mkt, Portfolio Analysis)

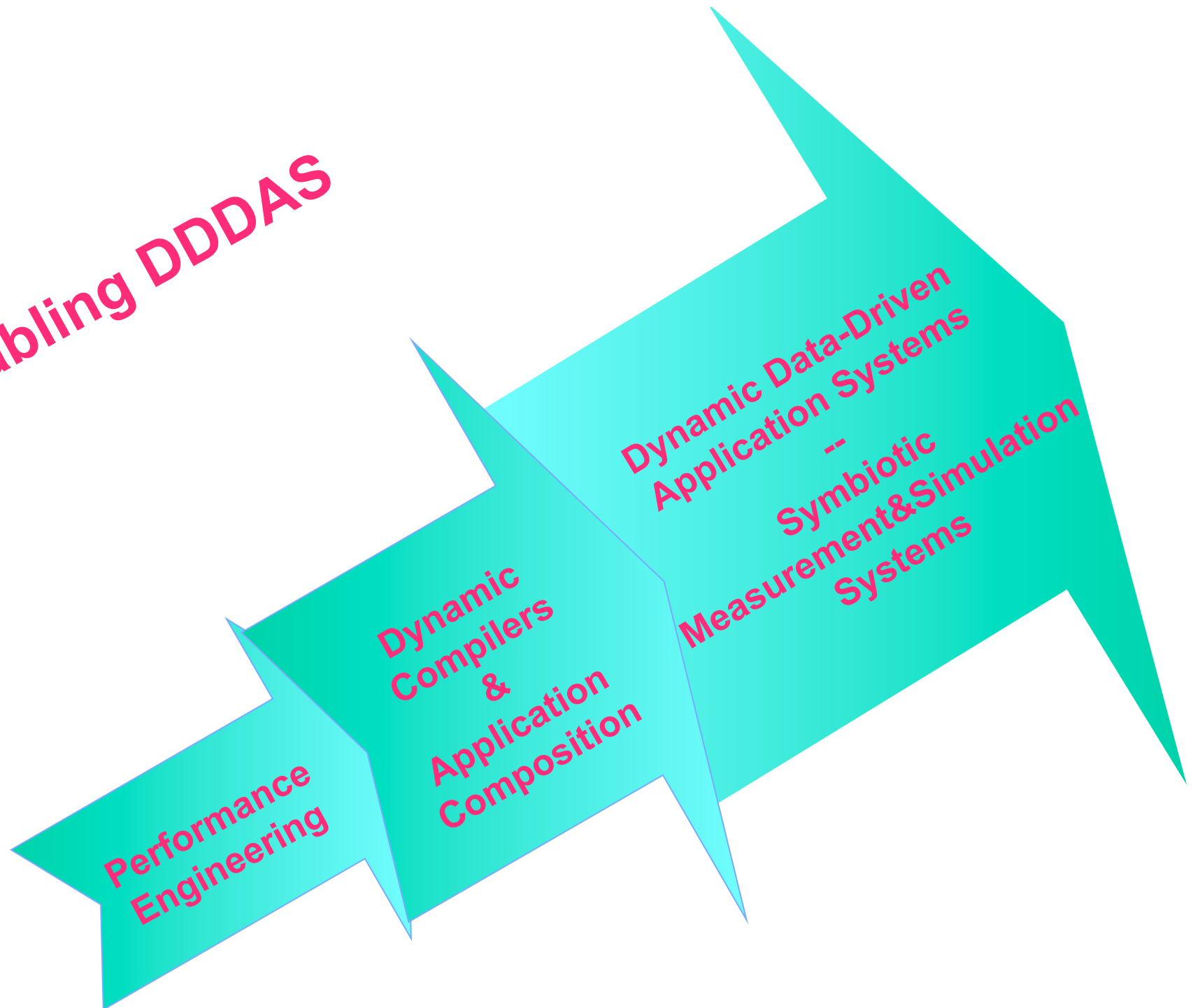


Examples of Technology Challenges

- Application development
 - interfaces of applications with measurement systems
 - dynamically select appropriate application components
 - ability to switch to different algorithms/components depending on streamed data
- Algorithms
 - tolerant to perturbations of dynamic input data
 - handling data uncertainties
- Systems supporting such dynamic environments
 - performance engineering technology
 - application development and run-time support

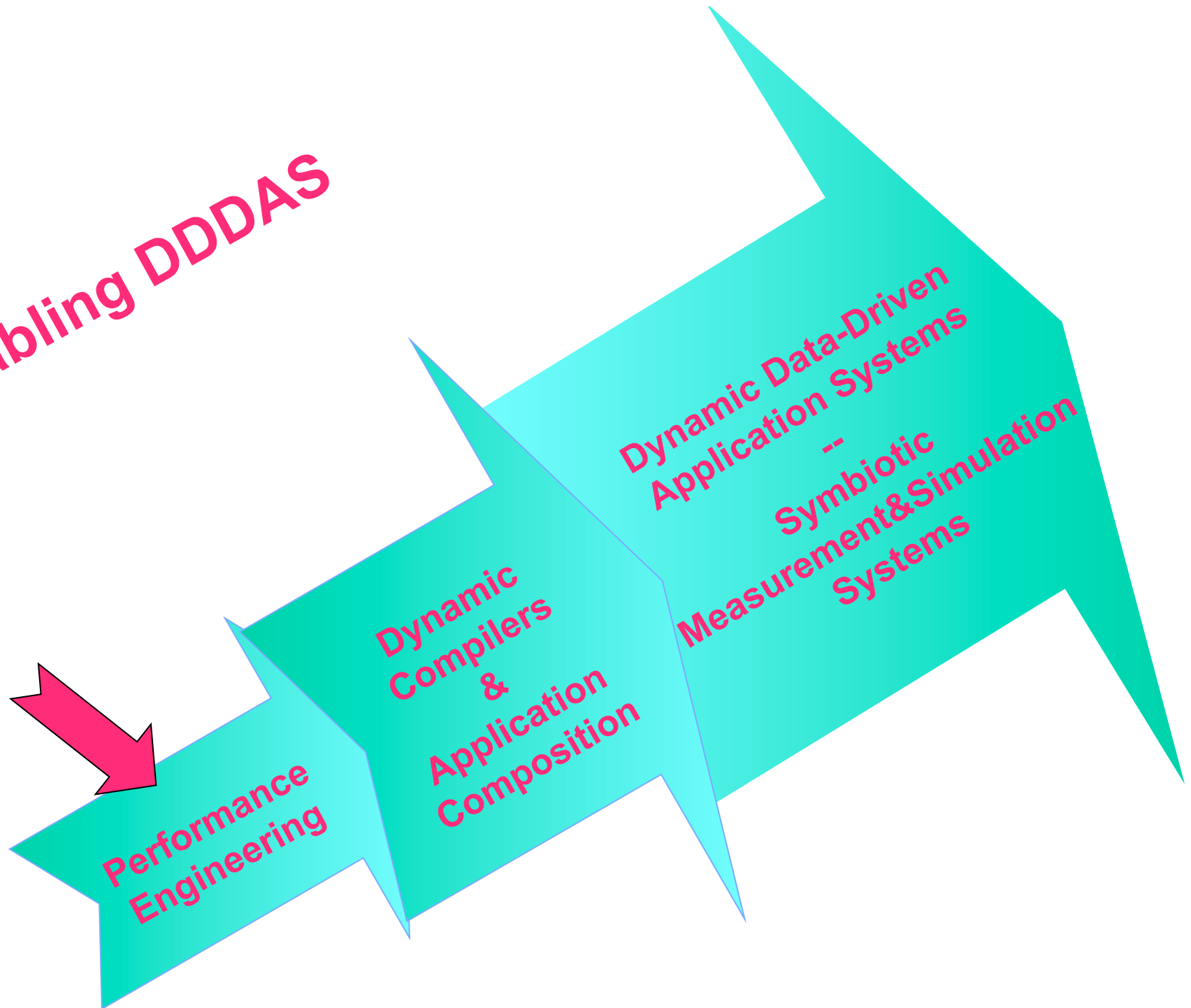


Enabling DDDAS



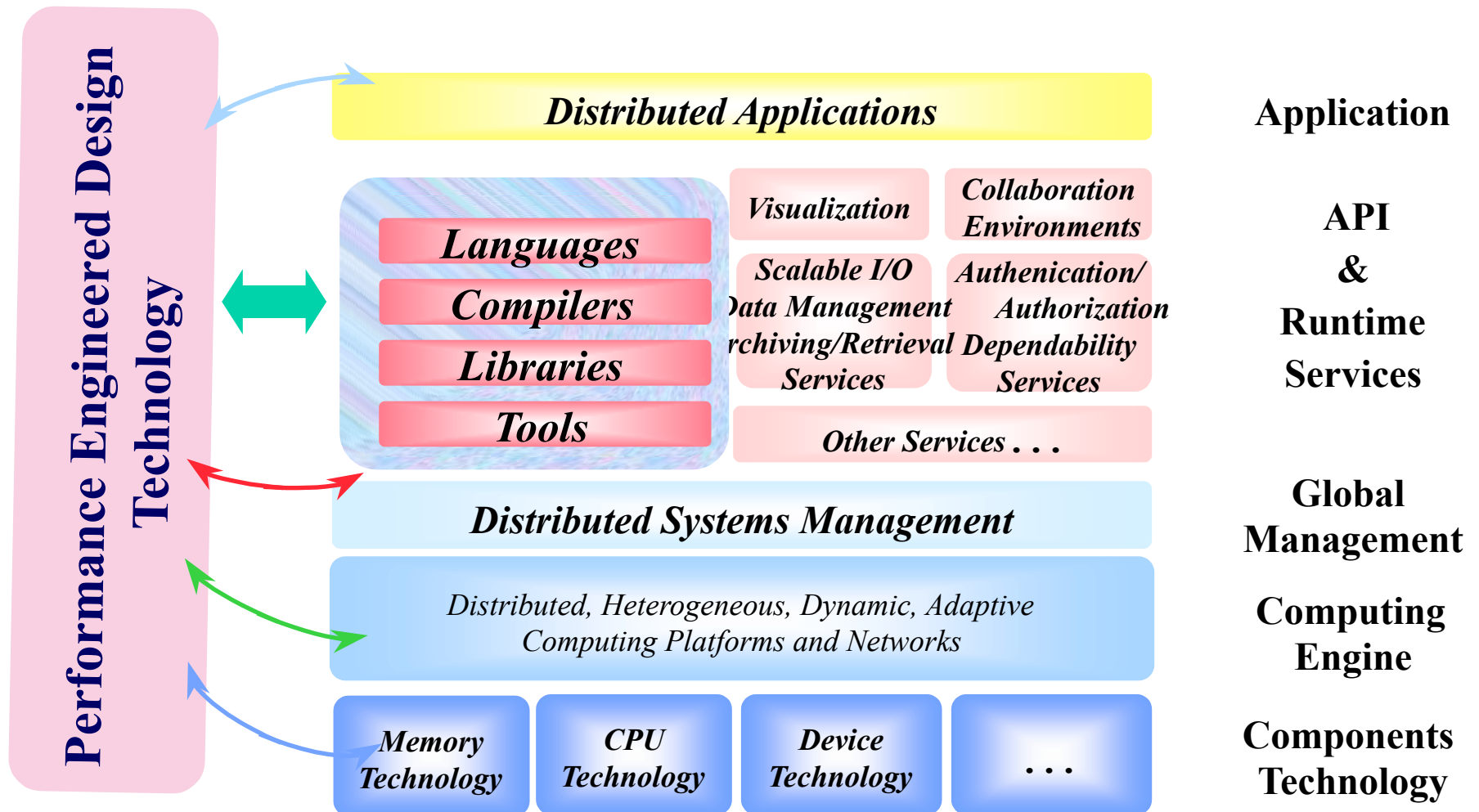


Enabling DDDAS





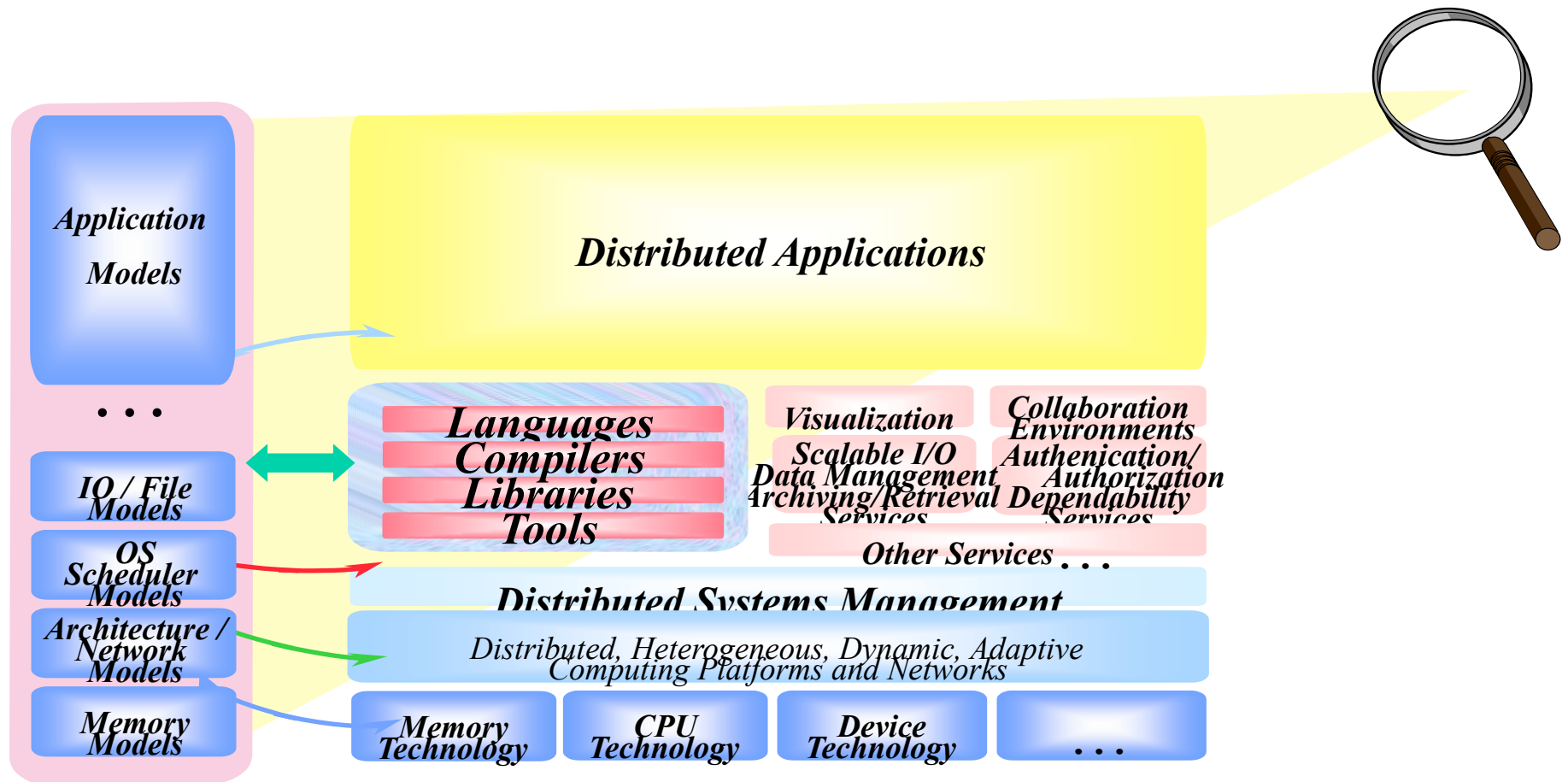
Distributed Systems Software/Hardware Architectural Framework





Multiple views of the system

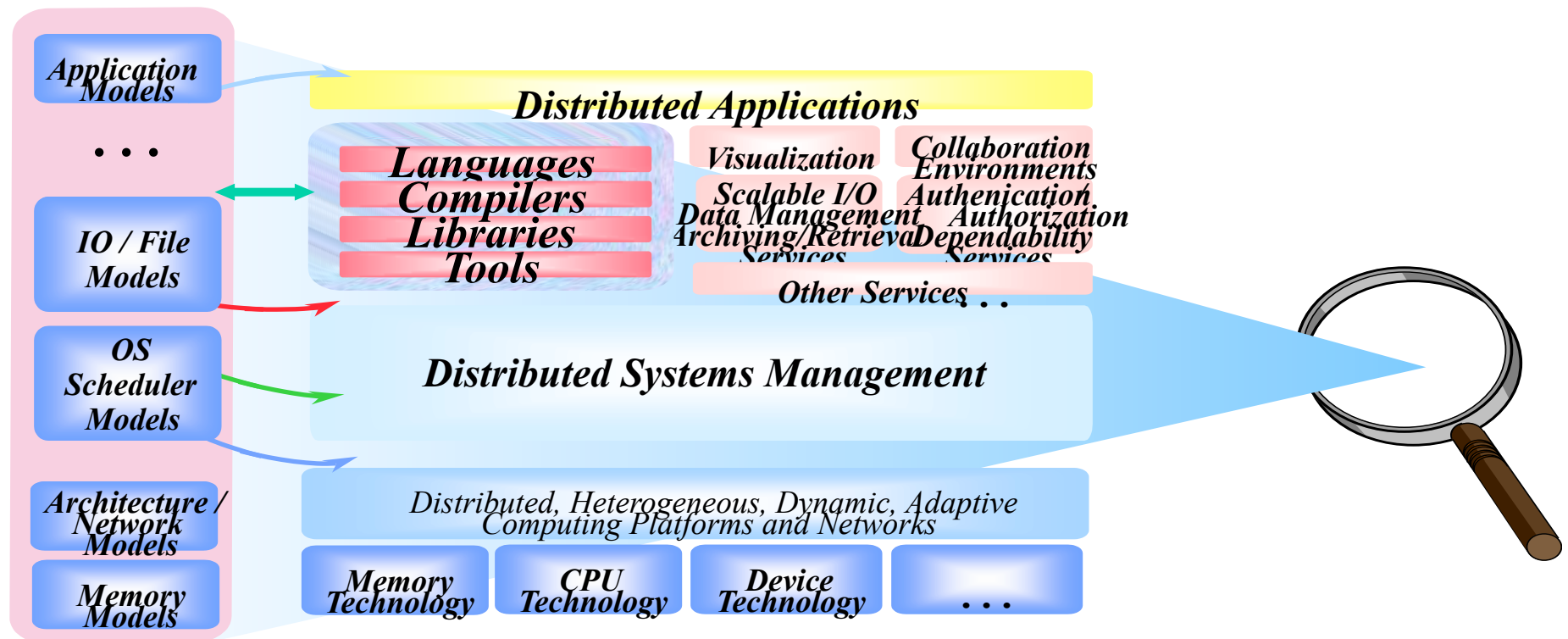
The applications' view





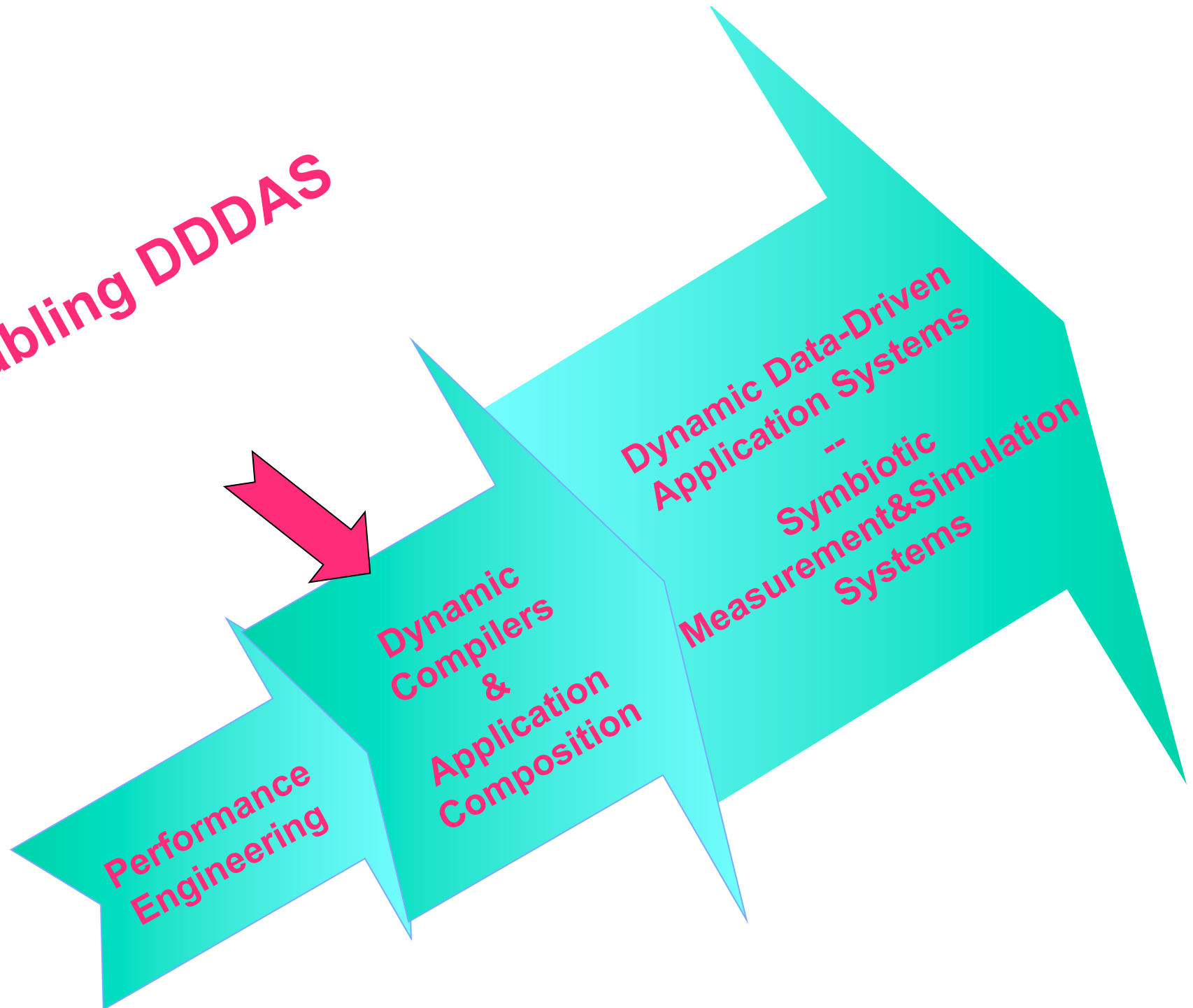
Multiple views of the system

The Operating Systems' view



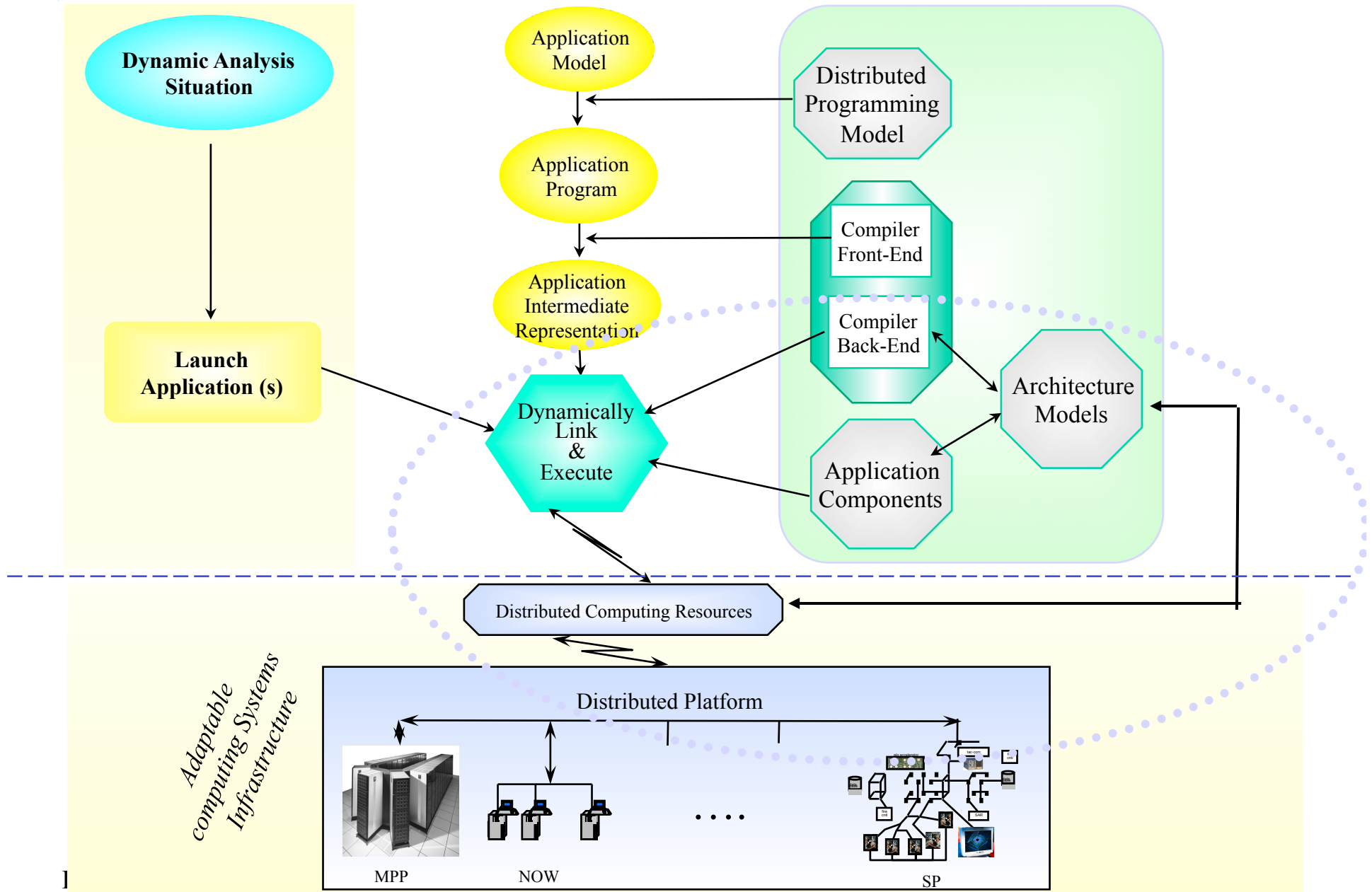


Enabling DDDAS



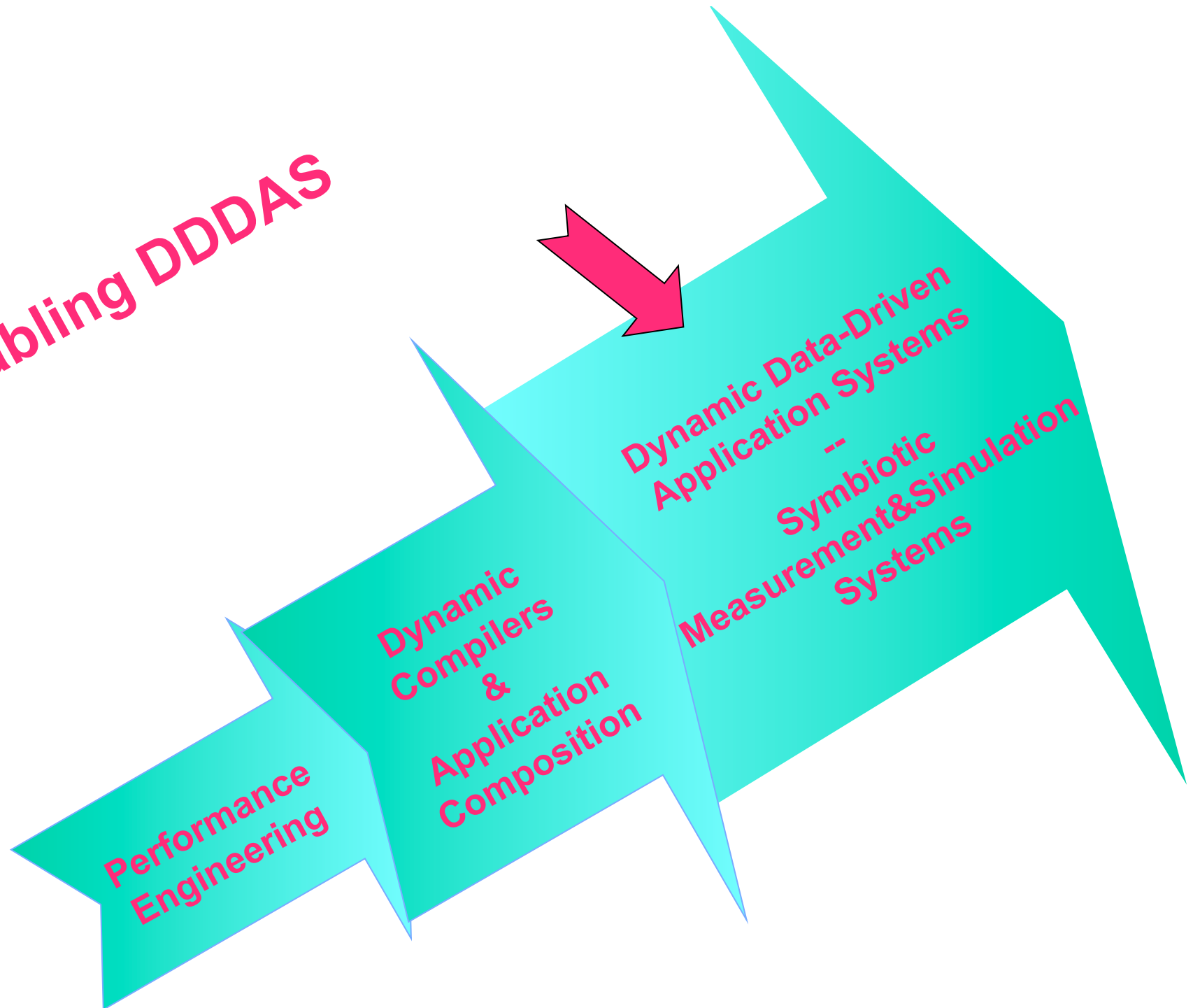


New Technology for an integrated feedback and control compiling system





Enabling DDDAS





Relevant Agency Efforts

- NSF
 - NGS: The Next Generation Software Program
 - **Funds Research on Performance Engineering, and Dynamic Compilation and Application Composition Technologies for Adaptive Runtime Support**
 - SES: Scalable Enterprise Systems
 - ITR: Information Technology Research
 - In addition aiming to develop a DDDAS Program:
 - “***Symbiotic, integrated simulations and measurements***”
 - leap-ahead initiative
 - will provide a focus for new exciting work in applications areas, algorithms and in systems’ areas
- Also DARPA, NASA, DoE interested in these programs



What about Industry

- **Industry has history of both**
 - forging new research and technology directions and
 - adapting and productizing technology which has demonstrated promise
- **Need to strengthen the joint academe/industry research collaborations**
 - joint projects / early stages
- **Technology transfer**
 - establish path for tech transfer from academic research to industry
 - joint projects, students, sabbaticals (academe <----> industry)
- **Initiatives from the Federal Agencies / PITAC Report**
- **Cross-agency co-ordination**
- **Effort analogous to one that pushed the frontiers for VLSI, Networking, and Parallel and Scalable computing**
- **DDDAS impact akin to the impact of computers in the 50 's**



<http://www.cise.nsf.gov/eia/dddas>

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