Strategic Implementation Plan (SIP) for a Community-based Unified Modeling System

System Architecture Working Group

Presented by
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# System Architecture WG

## Membership

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SAWG initiated in October 2016  
SAWG website: [https://esgf.esrl.noaa.gov/projects/sawg/](https://esgf.esrl.noaa.gov/projects/sawg/)  
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Definition and Relevance

- **Definition**: Fundamental organization of a system
  - Components
  - Relationships among components and the environment
  - Principles that govern its design and evolution

- **Relevance for operational prediction**
  - Backbone of a unified modeling system
  - High-performance, reliable, technical and scientific functions for a range of different forecast products

- **Relevance for research community partners**
  - Facilitates experimentation
  - Facilitates participation as full partners in model development
System Architecture

Layers and Elements

General Recommendations

• Meet the needs of stakeholders
• Be cost effective and timely
• Enable acknowledging, managing, and mitigating risks
• Be implemented using modern software engineering practices
• Be interoperable with coupling architectures at U.S. partner institutions

Technical Recommendations

• Document requirements for coupling, outputs, ensembles and data assimilation, workflows, and the interface between atmospheric dynamics and physics
• Support diagnostic interrogation of model output for testing, model evaluation, and operational prediction quality assessment
• Enable high scalability on current and emerging large, high-performance computer systems
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Initial Findings

Structural Recommendations

• Implement a layered design with clear interfaces that supports deployment of modeling and data assimilation applications at multiple organizations

• Link to governance processes that support the unified modeling system
  – Limit divergence of independent development paths
  – Authorize requirements and milestones
  – Review requirements, code, and processes for obsolescence

• Balance independence with coordination
  – Application development groups have their own requirements and timelines but need to share components and infrastructure as part of a unified modeling system

Modeling Application Recommendations

• Evidence included in initial report
  – Gap analysis (management, unified modeling, ESMF/NUOPC)
  – Sources of requirements
  – Interoperability case studies
Modeling Application Recommendations (cont.)

• Explore feasibility of replicating an existing science approach (e.g. GFDL) using NEMS, with test problems and metrics
  – leverage community interoperability infrastructure and expertise in coupled modeling
  – identify significant differences in framework capabilities
  – assess interchangeability of NEMS and non-NEMS components

• Establish new leads and processes (links to Governance WG)
  – Standing science lead or steering committee responsible for direction of overall NOAA unified modeling system
  – Formal processes that allow for external participation in technical and scientific decision-making
  – Modeling system lead at EMC to serve as the primary POC and coordinator for coupling science and technology

• Partner with CESM and others in the community
  – Engage coupled system science contributors from the broader community
  – Develop community-friendly infrastructure
  – Leverage established outreach and training programs in coupled modeling

• Understand best practices and restructure legacy scripts
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Key Issues to Resolve

• Relationships among other aspects of system architecture and applications
  – Data assimilation and ensemble applications
  – Physics interface, including aerosols/chemistry
  – Workflow layer
  – Libraries and utilities layer

• Resolution of modeling application strategy following activities and tests

• Critically important governance issues to be resolved with the SIP Governance WG
  – Need for steering body responsible for overall unified modeling system
  – Need for a way to process and implement recommendations
  – Need for integrated and authorized requirements and milestones

• Software process issues to be resolved with the SIP Infrastructure WG
  – Need for modeling lead and software management
  – Need for development coordination across application teams
  – Strategies needed for community engagement in software processes

• Balancing demands on computing and human resources