ARIZONA CENTER FOR INTEGRATIVE MODELING AND SIMULATION

Interaction Modeling for Independent Water and Energy Models with Distributed Simulation

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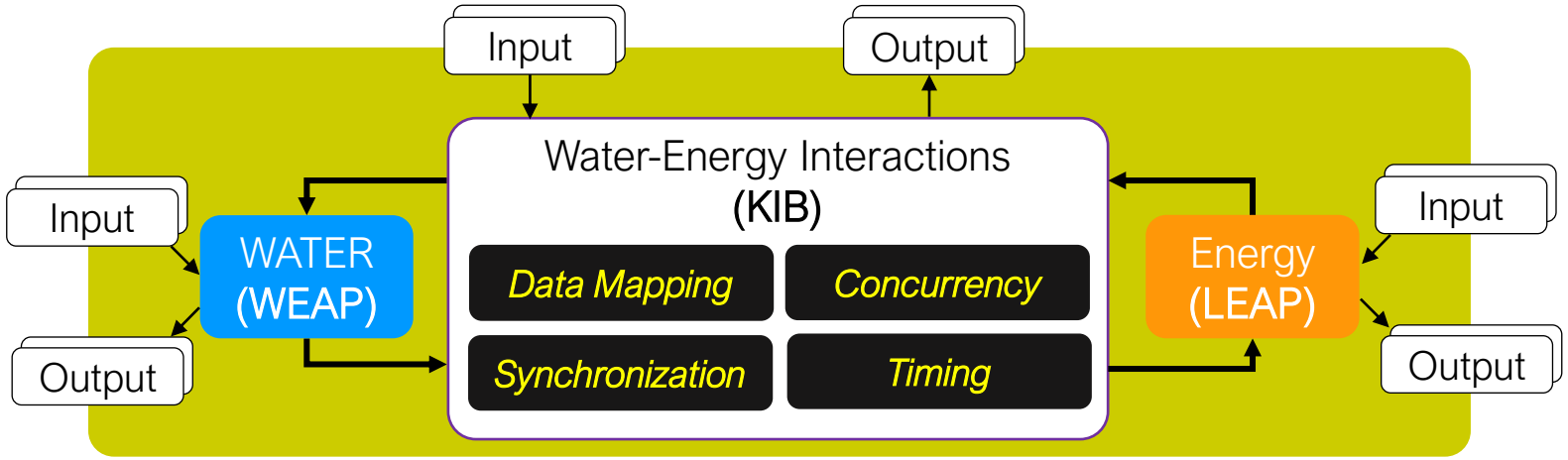
Pervasive System/Model Heterogeneity



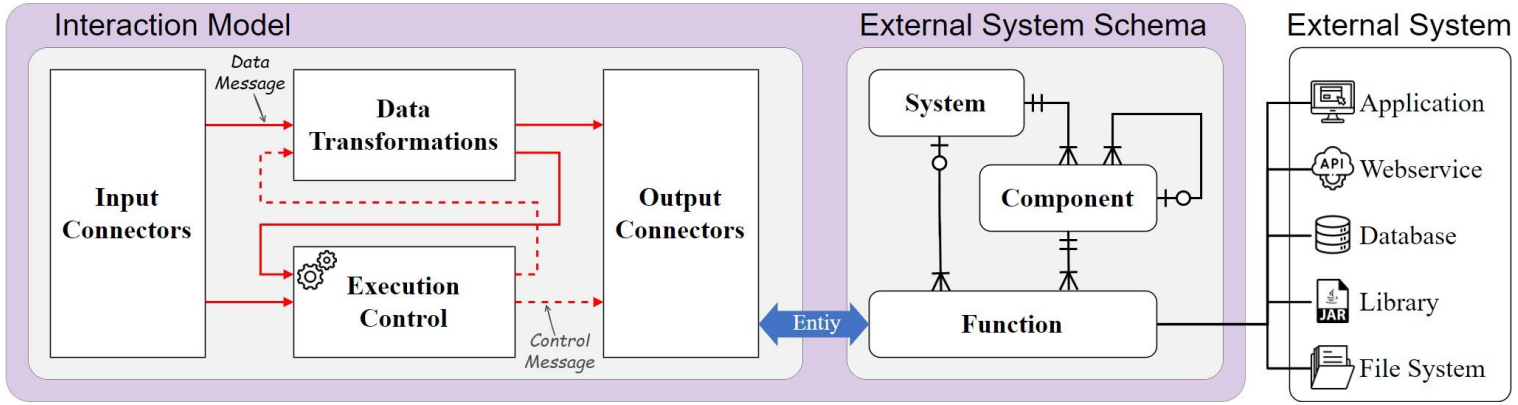
Heterogeneous Models
- Structures
- Behaviors
- Time bases

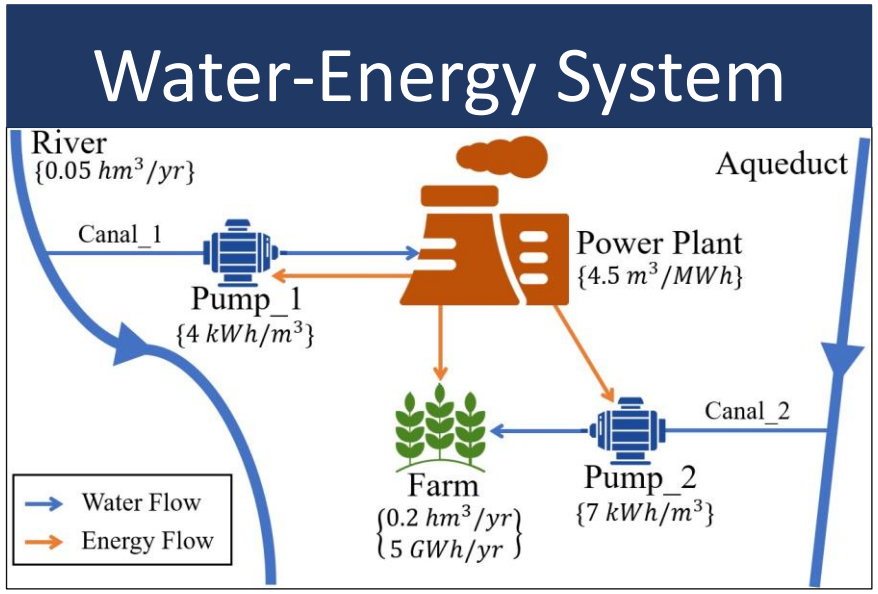
Real-world systems
- ***hybrid***
- ***multifaceted relationships***

Hybrid systems have multifaceted relationships

- Relationship between independent mass-balance discrete-time **Water** and **Energy** models are formalized using **Knowledge Interchange Broker** (**KIB**) and **DEVS**

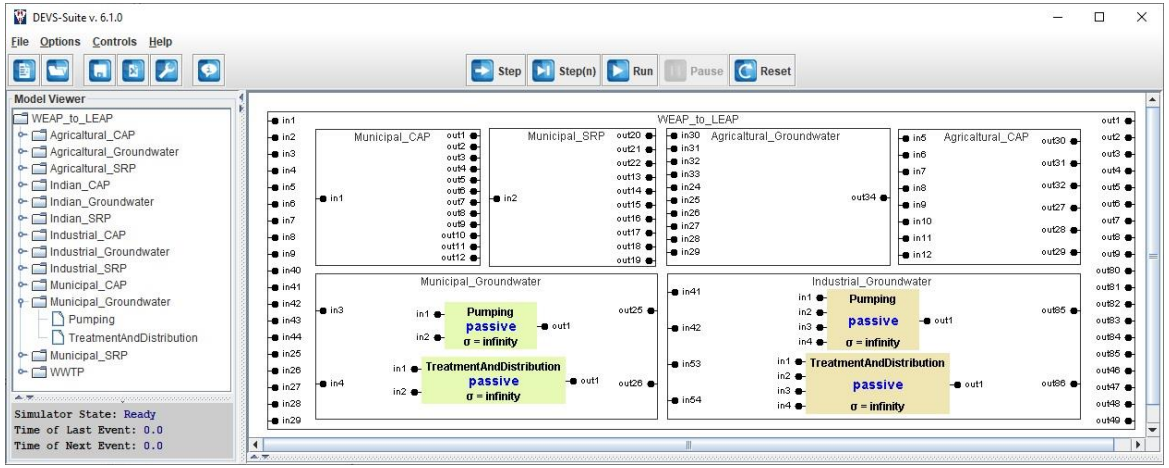
Water-Energy Nexus Model





DEVS Interaction Model (DEVS-IM)

- **structure**, **behavior**, **time**
- Time-based and event-driven interactions
- Lightweight I/O connectors to external simulators/systems



Conclusions

Developing heterogenous composable models pose challenges that are beyond the reach of data schemes and

- Concise syntax and operational semantics (KIB and DEVS)
- Developed using RESTful framework technology for WEAP-KIB-LEAP distributed simulation

- DEVS-IM provides model templates for WEAP and LEAP tools
- Supports partial DEVS-IM code generation for the DEVS-Suite simulator
- Supports persistent interaction models using MongoDB

Performance (water-energy simulations for Phoenix, Arizona, USA)

Simulation Performance Measurements (seconds)		
Direct Data Exchange	**Algorithmic**	**KIB (DEVS-IM)**
394.5	**975.2**	**960.8**

SW/HW platform

- Windows 10 64-bit OS
- 3.2 GHz (Intel CPU)
- 20 GB RAM

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