

WP 1.2. BOPTEST Update

IBPSA Project 1 Expert Meeting

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WP 1.2. BOPTEST Update

- Motivation and Objective
- Collaboration and Support
- Development Progress
- Next Steps

Purpose

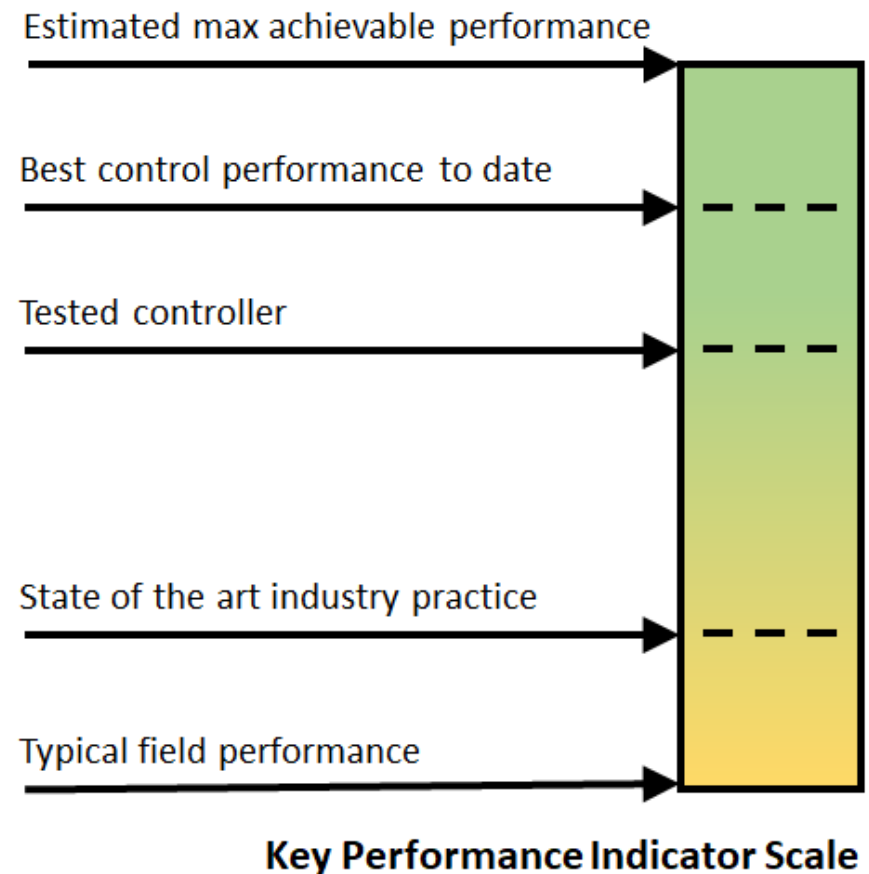
Develop a framework to enable **testing, benchmarking, and comparison** of advanced building control strategies.

Impact

- Establish state-of-the-art
- Development playground
- Demonstrate performance

Example Applications

- Optimal control and MPC
- Advanced control sequences



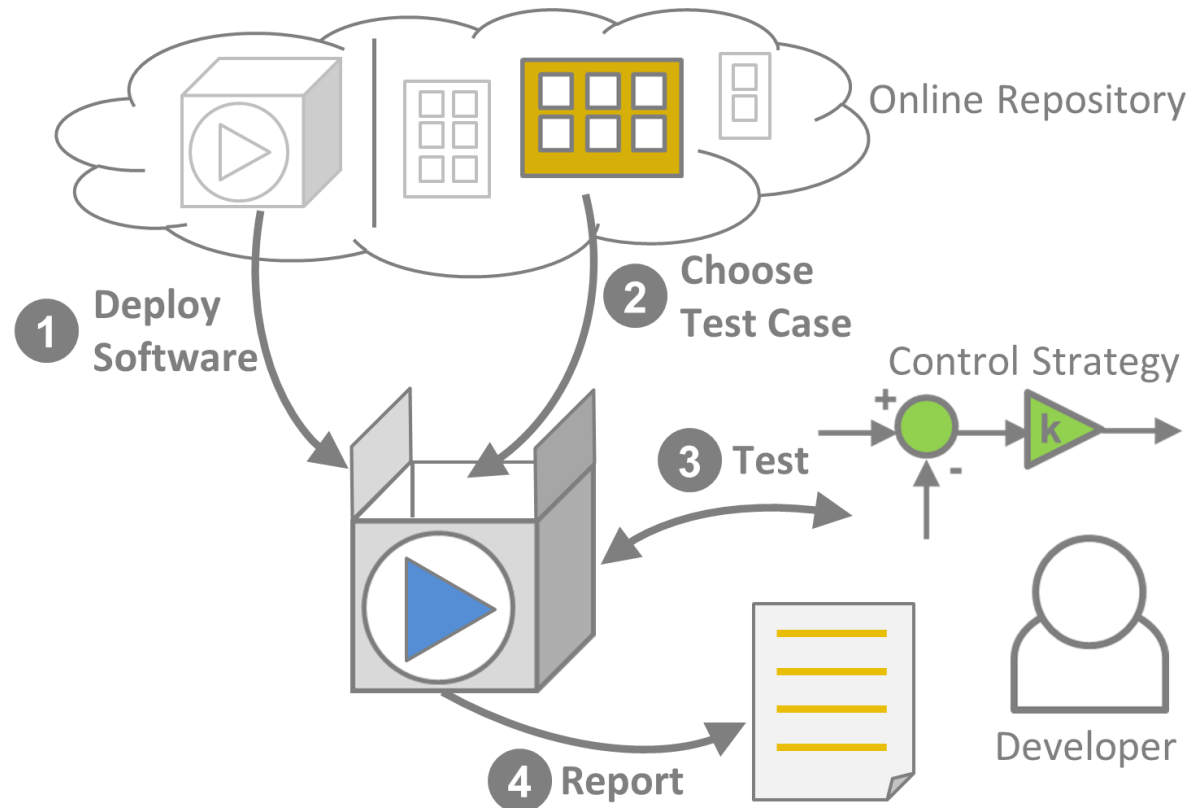
Components

Test Cases

- Building emulator models
- Exogenous data sets
- Control signals & measurements
- Key performance indicators (KPI)

Software Infrastructure

- Test API
- Model simulation control
- Documentation
- Software maintenance



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IBPSA Project 1 Collaboration Activities

- Specific working group meetings on 4/11, 5/9, 6/12
- LBNL, PNNL, NREL, KU Leuven, University of Southern Denmark, 3E, Engie Lab, Engie Axima, Ingersoll Rand
- Functional requirements
- Building emulator model development
- KPI selection and development
- MPC testing



U.S. Funding

- U.S. DOE support for FY19, anticipated through FY22
- Funding for three national labs: LBNL, PNNL, NREL
- LBNL/PNNL primarily on model and KPI development and control testing
- NREL primarily on platform architecture and development
 - Building on <http://alfalstack.net/> for EnergyPlus emulation
- Emphasize collaboration with IBPSA Project 1
- Formation of technical advisory group (TAG)



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Emulator Selection and Development

	Zone	Hydronic	Air
Residential	Single	BESTest Envelope + Hydronic (KU Leuven)	BESTest Envelope + Air (LBNL)
	Multi	8-Zone Radiator + Split for Cooling (EngieLab)	Detached House Central Air (TBD)
Office	Single	Single Zone of OU44 (SDU)	Single Zone VAV for Retail (LBNL)
	Multi-Simple	INFRA X (KU Leuven)	5-Zone VAV Office (LBNL)
	Multi-Complex	SolarWind (KU Leuven)	15-Zone VAV + Plant Office (PNNL)

- Peer review process
- Templates/guidelines for development
- More development on infrastructure required before continuing

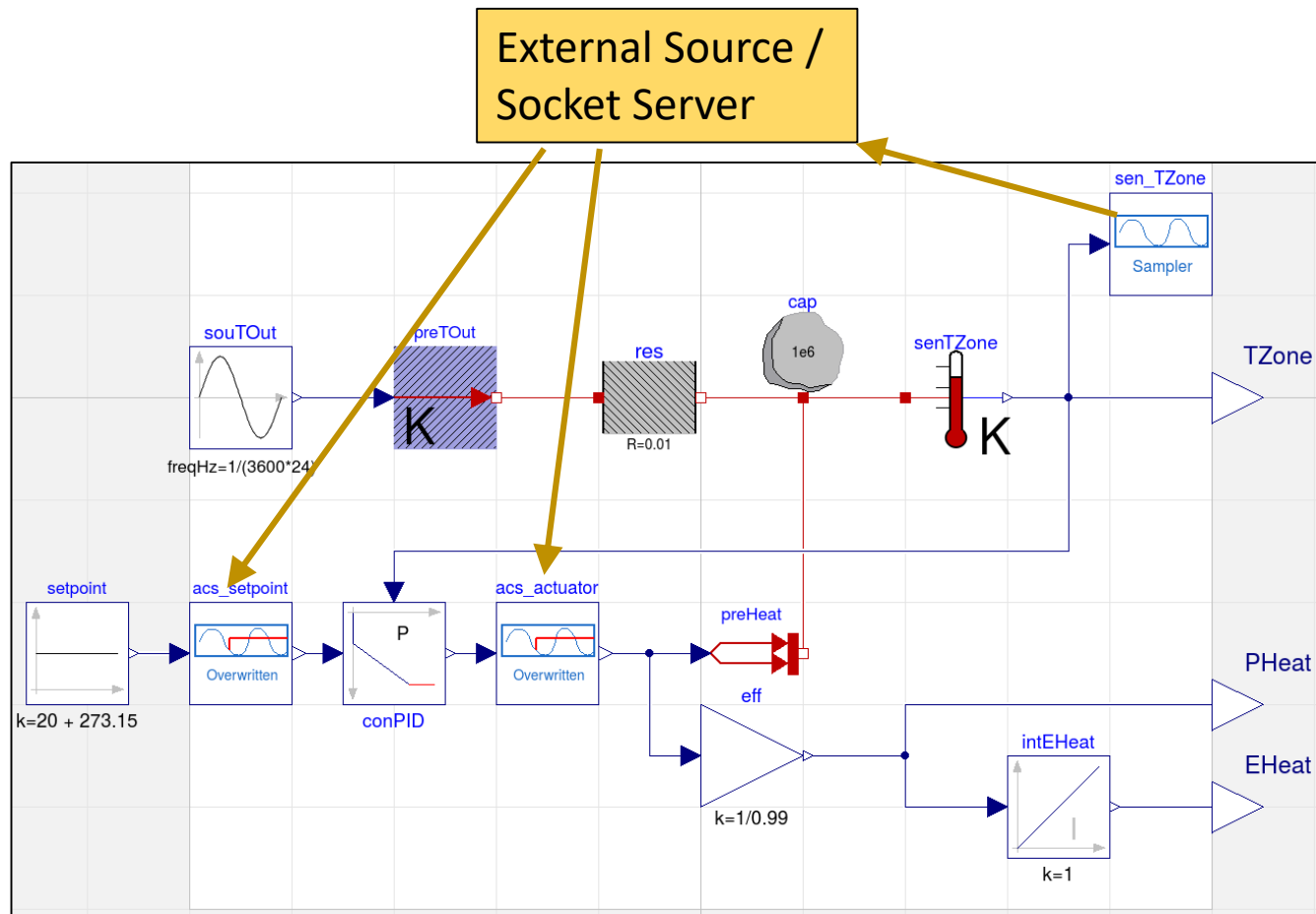
KPI Specification and Development

	Var 1	Var 2	Var 3	Var 4
KPI 1	X	X		
KPI 2	X		X	
KPI 3		X	X	X

- Matrix informs emulation model development template
- Python module for KPI calculation to be developed

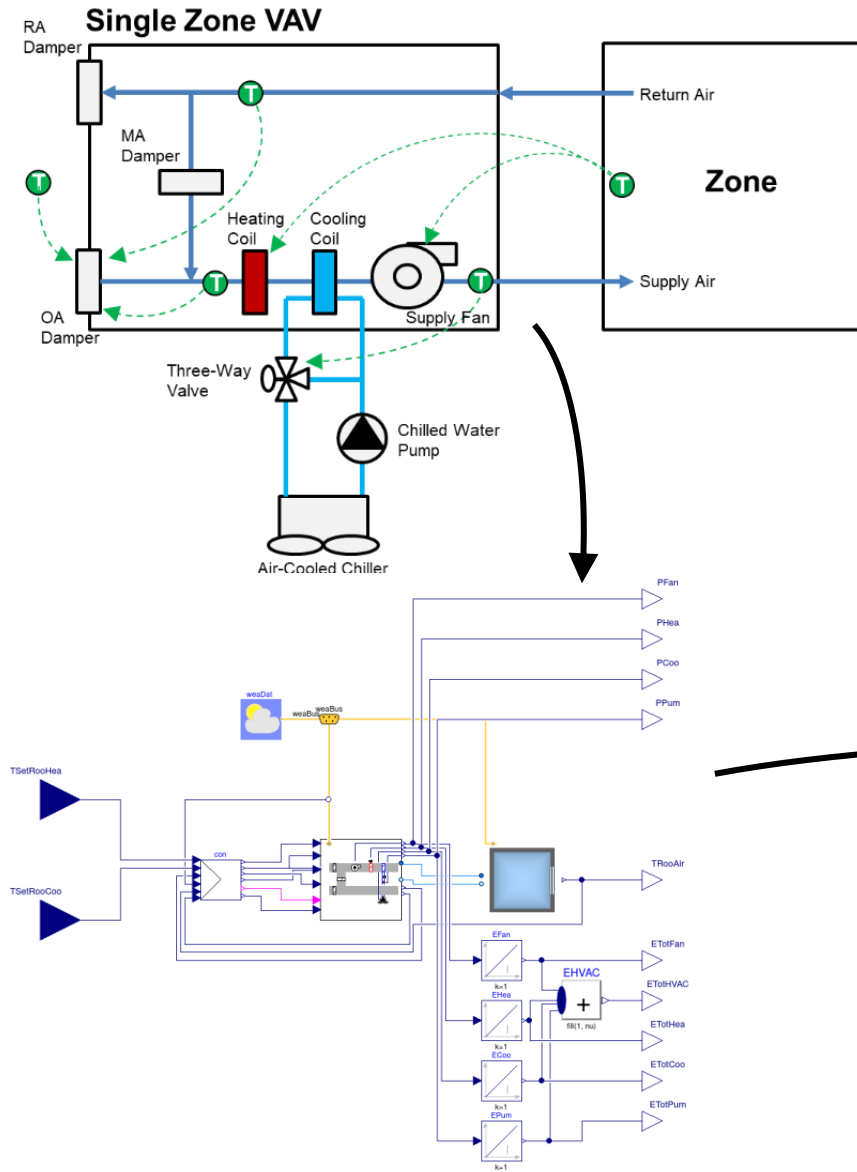
Signal Exchange Modelica Block

- Overwrite actuator signals or setpoints and measure model variables
- Flexibility in enabling/disabling control signals and sensors in model
- Convenience in model development for signal routing
- Collaboration with WP1.1. to add block to IBPSA Library



Prototype Architecture

<https://github.com/ibpsa/project1-boptest>



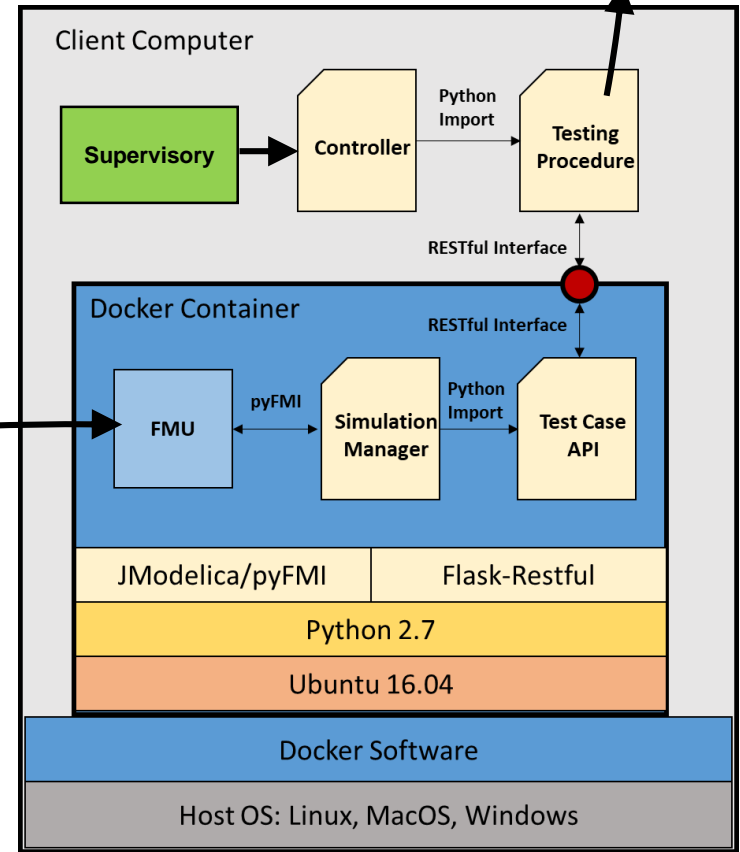
```
dhb-lx@dhb-lx:~/git/ibpsa/boptest/project1-boptest/examples$ python szvav-sup.py

TEST CASE INFORMATION
-----
Name: SingleZoneVAV_TestCaseSupervisory
Control Inputs: [u'TSetRooHea', u'TSetRooCoo']
Measurements: [u'PHea', u'ETotFan', u'PCoo', u'TRooAir', u'ETotCoo', u'PPum', u'PFan', u'ETotHea', u'time', u'ETotHVAC', u'ETotPum']
Default Simulation Step: 3600.0

Running test case...

Test case complete.
Elapsed time of test was 2712.17990518 seconds.

KPI RESULTS
-----
Heating Energy: 31915756983.5
Cooling Energy: 8285626945.89
Fan Energy: 596832229.18
HVAC Energy: 40843397465.3
Pump Energy: 45181306.7174
dhb-lx@dhb-lx:~/git/ibpsa/boptest/project1-boptest/examples$
```



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Next Steps

- Finalize signal exchange block implementation
- **Feedback on functional requirements**
- **Handle exogenous data (e.g. weather, internal loads) and forecasts**
- **Templates/guidelines for emulator development**
- **Add KPI calculation module**
- **Documentation (User Guide)**
- Upgrade platform architecture leveraging Alfalstack project
- Development of emulator models
- MPC Testing