



# Microgrid Control/Coordination Co-Design (MicroC3)

*Solving microgrid control and implementation challenges using  
a tool suite that designs an optimized microgrid and deploys its  
control implementation*

# Project Objectives

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- ▶ Develop a toolsuite that systematically designs all aspects (plant & control) of a microgrid (MG), given a set of design objectives and performance constraints
- ▶ Tool predicts & achieves the desired MG performance & reliability metrics with significantly smaller and/or less capable & less expensive components.

Metric	State of the Art	Proposed
Stability/Damping	Oversized DER stabilizes system; no guarantee of stability	Right-sized components coordinate to achieve stability; guarantee of stability
Reliability/Contingency planning	Achieved through redundancy/oversizing	Achieved through resource coordination and control
Plug & Play	Small generators/loads	Any generator/load

# Project Team

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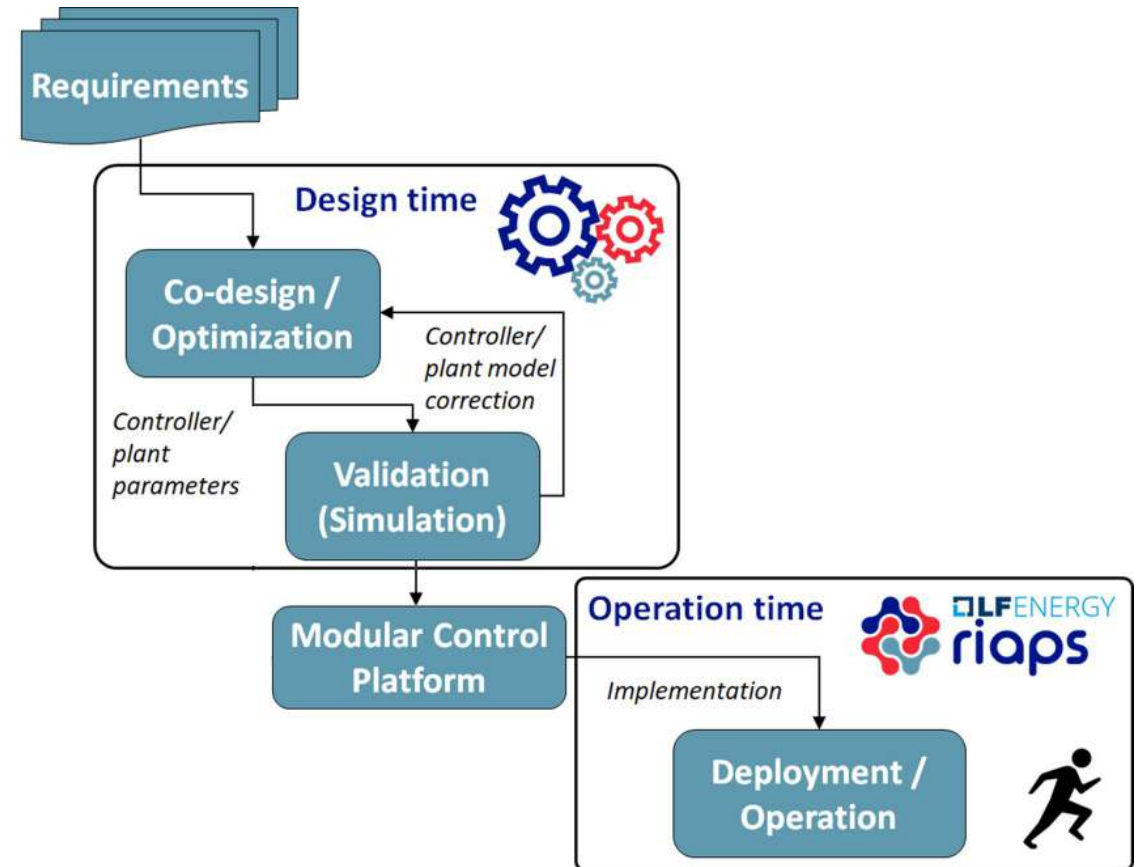
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# Approach

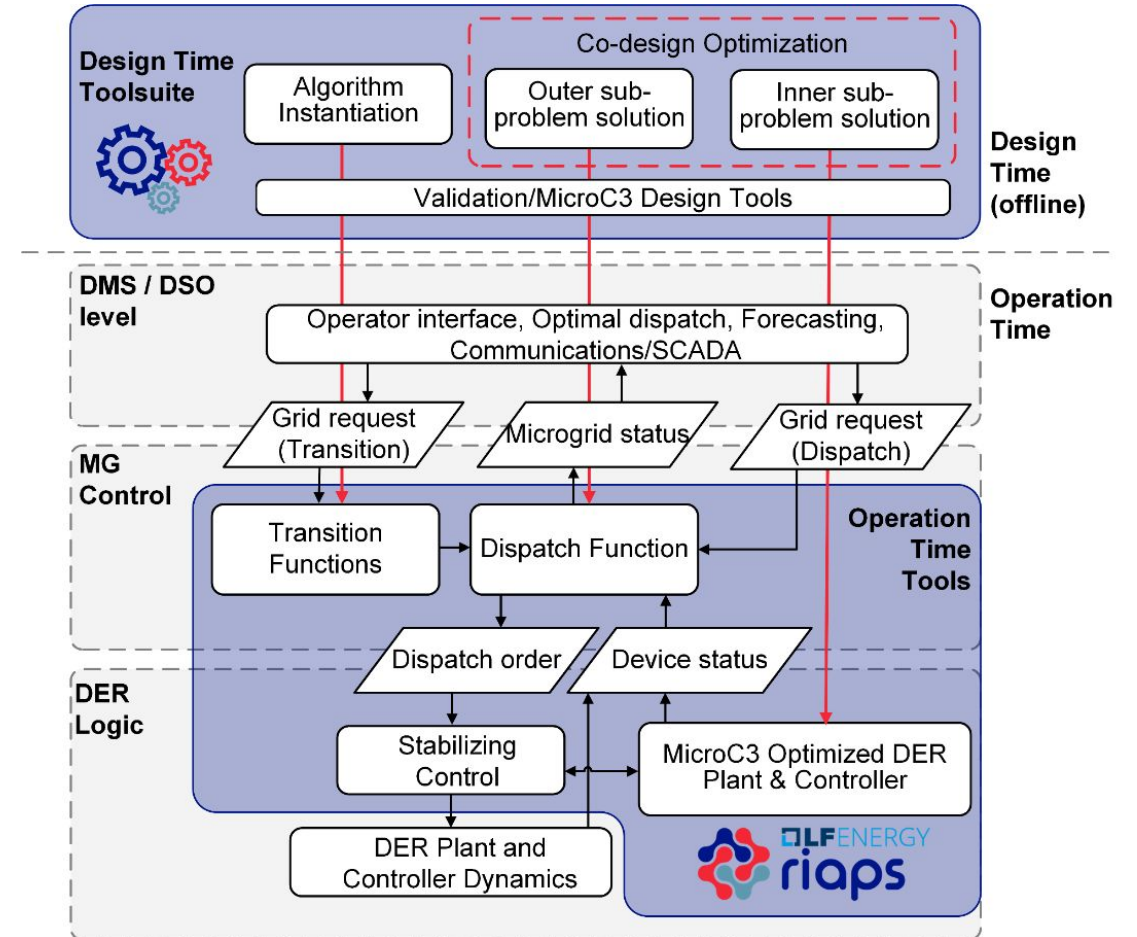
- ▶ Design tool identifies low-cost, non-trivial MG design (plant & control)
- ▶ Validation tool verifies predicted performance and generates implementation, including code and configurations for control, communications and coordination
- ▶ Implementation is executed on MCP: ARPA-E funded open-source platform (RIAPS) extended with time sensitive networking capabilities



MCP: Modular Control Platform; RIAPS: Resilient Information Architecture Platform for the Smart Grid

# Key Outcomes

- ▶ **Co-design formulation and solution** that defines the MG design and implementation.
- ▶ **Run-time Platform** that implements TSN and provides visibility and control at primary, secondary and tertiary level
- ▶ **Seamless integration into a single tool** that starts with system sizing and delivers executable code on distributed controllers located at each asset.



TSN – Time sensitive networking



# Project Milestones and Timeline

## Go/No-Go Milestone (Q6)

- ▶ Co-Design Formulation correctly predicts performance of Banshee and Bronzeville Community MG in HIL. Metric: match V,f during contingencies
- ▶ Co-Design formulation outperforms state-of-the-art plant optimization techniques for 3 optimization goals (lowest cost, 100% renewable and zero inertia). Metric: 10% lower LCOE.

## Final Deliverable

- ▶ Field deployment of run time tool in Maywood and MicroC3 (NCSU) MG MG-microgrid; HIL-hardware in the loop; LCOE-levelized cost of energy.

Quarter	1	2	3	4	5	6	7	8	9	10	11	12
<b>Co-Design Optimization and Validation</b>												
M0.1 Management Plan Delivererd	X											
M1.1 Benchmark State-of-the-art MG Design tools		X										
M1.2 Formulation of the co-design problem				X								
M1.3 Implementation of a novel iterative algorithm						X						
<b>Design Time Toolsuite Development</b>												
M2.1 MG Design-tool architecture defined		X										
M2.2 Integration of validation tool with co-design algorithm								X				
M2.3 Final release of the MG design toolsuite											X	
<b>Operation Time Toolsuite Development</b>												
M3.1 Implementation of TSN and fault tolerance in RIAPS			X									
M3.2 Design for MicroC3 computational & hardware platform							X					
M3.3 Integration of microgrid control algorithms to validation									X			
M3.4 Implementation of design-time/run-time interface										X		
<b>Demonstration</b>												
M4.1 Fully validate DER models using field data					X							
M4.2 Co-Design Formulation Validation on HIL models						X						
M4.3 Design-time & run-time tools validation on HIL models										X		
M4.4 Complete construction of Maywood and MicroC3 MG											X	
M4.5 Field deployment of run time tool in HW MG												X
<b>Technology to Market</b>												
M5.1 T2M Point of Contact	X											
M5.2 Industry Advisory Board (IAB) Established			X									
M5.3 Initial T2M plan submitted for ARPA-E acceptance				X								
M5.4 Updated T2M plan submitted for ARPA-E acceptance								X				
M5.5 End-of-project T2M report and updated impact sheet												X