A GUIDE TO SELECTING AN OPAL-RT SIMULATON ENVIRONMENT

based on needs & offline (non-real-time) model development apps used

	RT-LAB #rt-lab **Working with Simulink models?** 1. Build device or network models in Simulink plus a range of 3rd party OFFLINE (ie non-real-time) simulation software apps 2. Based on needs, select solver, library or comms OPTIONS below 3. Convert non-real-time PC models using RT-Lab 4. Run these real-time models on the simulator 5. See simulation results in real-time on your PC			HYPERSIM #hypersim **Working with large T&D network models?** 1. Build network models in Hypersim editor 2. Based on needs, select solver, library or comms OPTIONS below 3. Run models in real-time on the simulator; or 4. In the cloud with 'Hypersim On Demand' 5. See simulation results in real-time on your PC
	eMEGASIM #emegasim	eFPGASIM #efpgasim	ePHASORSIM #ephasorsim	
Typical applications >>	• **Mechatronics** • **Power electronics** (behavioural models) • **Power systems** (including power electronics) • **Cybersecurity**	• **Power electronics** (circuit models)	• **Power systems** • **Wide Area Monitoring, Protection & Control (WAMPAC)** • **Cybersecurity**	• **Power systems** • **Power electronics** (system & circuit level) • **Cybersecurity**
Typical model time steps >>	Network solution: **10µs - 100µs** Switches and converters: **200ns – 2µs** (CPU based simulation)	**200ns - 2µs** (FPGA based simulation)	**1ms – 10ms** (CPU based simulation)	Network solution: **5µs - 100µs** Switches and converters: **200ns – 2µs** (CPU based simulation)
Domain & frequency >>	• EMT domain (electromagnetic transients) • 1Hz-20kHz range	• EMT domain (high frequency transients) • 0.5-2MHz range	• Phasor domain(low frequency transients) • 1-100Hz range	• EMT domain (electromagnetic transients) • 1Hz-20kHz range
Uses models created in >>	• Simulink • Simscape Power Systems (SPS) • Other (see Orchestra below) [1]	• Simscape Power Systems (SPS) • PLECS • PSIM • NI Multisim	• ETAP • PSSe • DigSILENT • CYME • PowerFactory • Excel • Dymola • OpenModelica	• Hypersim • Simulink • Simscape Power Systems (SPS)
Real-time capacity per >> activated CPU core	• 90-150 nodes (30-50 3P buses) @ 50µs	• 288 states/ 128 switches • 1x Inverter 2-level 3P @ 200ns • 2x NPC 3-level 3P @ 580ns	• 10,000 nodes @ 10ms	• 200+ nodes (75 3P buses) @ 50µs
Max. model 'bus count' >>	• 1,500 3P buses (5,000 nodes) on simulator	N/A	• 30K 3P buses (108,000 nodes) on simulator • Unlimited on PC (offline/non-real-time mode)	• 9,000x 3P buses (27,000 3P nodes) on simulator • Unlimited on PC (offline/non-real-time mode)
Key features >>	• Multi-physical domain simulation • Solvers for large complex networks & microgrids • Co-simulation of heterogeneous models • APIs for Python, C, Java, LabVIEW	• Automatic scripting - no user programming of the FPGA required • FPGA compilation not required • 200 kHz PWM I/O • Digital I/O sampling @ 5ns • Analogue I/O sampling @ 0.5µs – 2.5µs	• Positive sequence & unbalanced networks • Load flow • FMU (OpenModelica) supported • Real-time & OFFLINE model verification • APIs for Python, C, Java, LabVIEW	• Automatic task mapping • Large, detailed, real-world-verified power systems component library • Data visualisation, post-processing & playback
OPTIONS: Solvers, Model Libraries, Utilities, Courseware & Communications Protocols	• ARTEMIS (5th order solver for SPS) • SSN (State Space Nodal) solver for short transmission lines & microgrids • EXata CPS for co-simulation of ICT control networks • ScopeView • RT-Events • TestDrive • Orchestra [1]	• eHS (Electrical Hardware Solver) • RT-XSG (customer firmware coder) • Electric Machine Library • MMC FPGA Blockset	• IEEE Machine Control Library • Parallel and multi-core execution to speed up calculations and distribute computational loads • APIs for Python, C, Java, LabVIEW • EXata CPS for co-simulation of ICT control networks	• Hypersim-On-Demand (cloud service) • eHS • ScopeView • TestView • Protection Relay Library • IEEE Machine Controls Library • EXata CPS for co-simulation of ICT control networks
Interactive University Lab Courseware	• OP1160: Electric Machines (Sync/Async)	• OP1160: Electric Machines (Sync/Async) • OP1130: Power Electronics	• OP1140: Power Systems	
Ethernet/IP Comms Drivers	Suitable for both RT-Lab & HYPERSIM real-time environments ⇨	• IEC61850 GOOSE & Sampled Value • IEEE C37.118 • IEC 60870-104	• DNP3 • CANbus	• Modbus • Profibus	• FlexRay • ABB PS935	• Siemens S7 • ARINC429

ecadtools