Typhoon HIL Webinar

The perfect balance of speed, power and flexibility.

Application demos:

e-Mobility

Microgrids

HIL606

4th Generation Flagship

Special guests:

Rolls-Royce

mtu A Rolls-Royce solution

Panelists

Dusan Majstorovic

CTO

Typhoon HIL

David Dunnett

Head of Software Development

Rolls-Royce Solutions Berlin

Dusan Cohadzic

Senior Modelling Engineer

Typhoon HIL

Ioannis Arvanitis

Senior Software Engineer

Rolls-Royce Solutions Berlin

Agenda

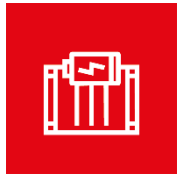
- ☐ Motivation behind the 4th generation flagship | **Dusan Majstorovic**
- ☐ Challenges to Microgrid Controller Design and Testing | **David Dunnett**
- ☐ Application Demo 1 | **Dusan Cohadzic**
  - Microgrid control validation and DER interoperability
- ☐ HIL606 Key features | **Dusan Majstorovic**
- ☐ Application Demo 2 | **Dusan Cohadzic**
  - High-frequency converters in eMobility applications
- ☐ Q&A | **All** (10 mins)

Challenges

HIL applications are getting more complex

- Converter level
  - Complex multi-module converters
  - High switching frequencies

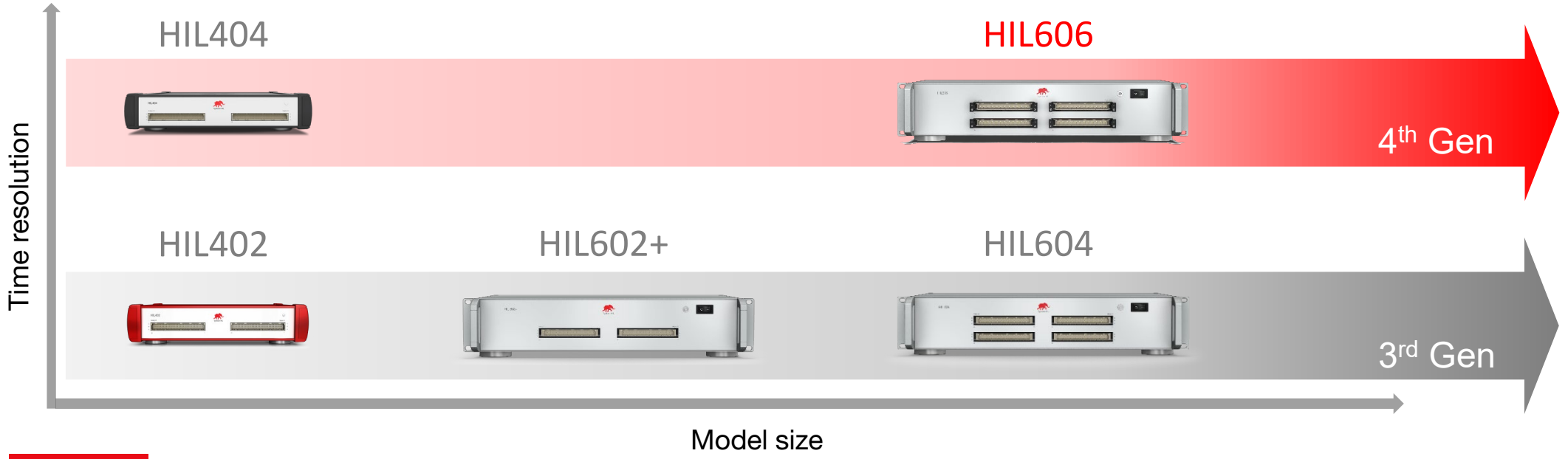
- System level
  - Large models with accurate average component models
  - System models with component controllers in the loop



- Connectivity
  - Many different connectivity interfaces used in different application fields

HIL606 Concept

- HIL606 = HIL604 + HIL404 + more connectivity
  - HIL604 FPGA solver and IO capacity
  - HIL404 FPGA solver time resolution and CPU power
  - New unique connectivity options and improved flexibility



Rolls-Royce Solutions Berlin

Formerly Qinous

- Energy Storage + Microgrid Control
  - 50+ systems
    - Greenland to Patagonia, Haiti to Indonesia
  - Multiple and varied DERs per MG
  - Standard control solution
  - Real-time, rules-based, goal-oriented

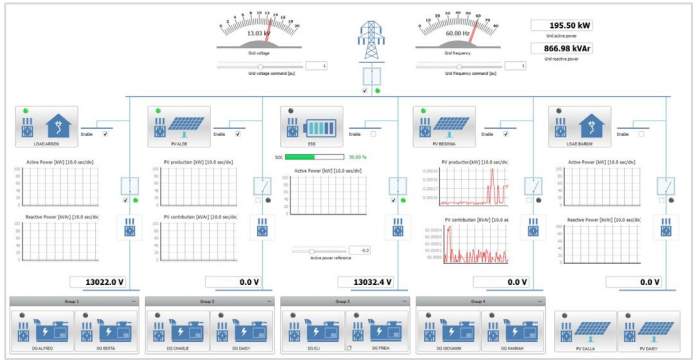
HIL helps with

- Real-time simulation of complex microgrid
- Scenario replay and manual testing
- Automated regression testing

Typhoon HIL

Microgrid Control Testing

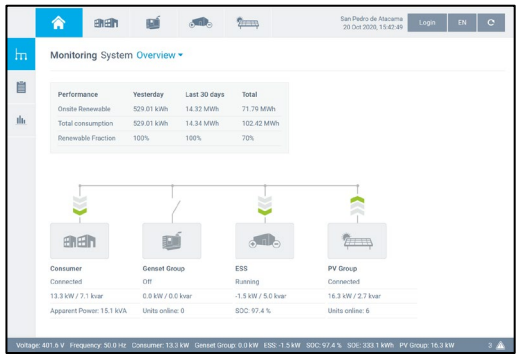
Demo setup #1



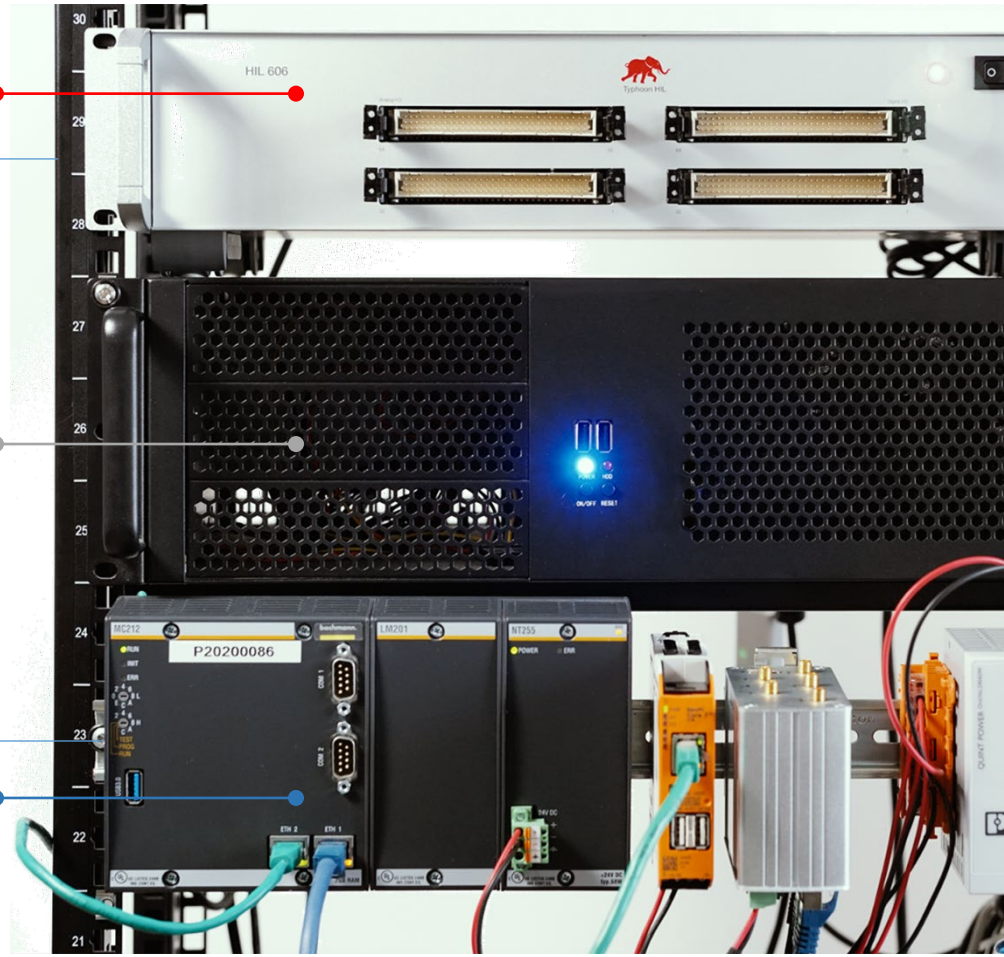
Typhoon **HIL606**

Modbus TCP

HOST PC



mtu Microgrid Controller



HIL606 Highlights

- Fully backward compatible with all devices
  - Plug-and-play upgrade
- FPGA solver
  - HIL604 capacity (up to 8 cores)
  - HIL404 speed
    - **75%** faster than HIL604
    - Sim step down to 200ns
    - 3.5ns DI sampling resolution
- CPU
  - Up to 3 user accessible CPU cores
  - **10x** faster than HIL604
  - 10% faster than HIL404
- IO
  - HIL604 pin count
  - HIL404 speed

HIL Simulators

	HIL402	HIL404	HIL604	HIL606
Model capacity				
Detailed converter models (1ph/3ph)	8/4	8/4	**16/8**	**16/8**
Average converter models (3ph)	**8**	**12**	**10**	**24**
Distribution network simulation	✓	✓	✓	✓
Time resolution				
Minimum simulation step	500 ns	**200 ns**	500 ns	**200 ns**
DI sampling resolution	6.2 ns	**3.5 ns**	6.2 ns	**3.5 ns**
I/O				
Analog I/O per unit	16/16	16/16	**32/64**	**32/64**
Digital I/O per unit	32/32	32/32	**64/64**	**64/64**
Connectivity				
USB	✓	✓	✓	✓
Ethernet	✓	✓	✓	✓
CAN		✓	✓	✓
RS232		✓	✓	✓
EtherCAT				✓
SFP		✓		✓
Time synchronization (PPS and IRIG-B)			✓	✓
Paralleling		Up to 4 units	**Up to 16 units**	**Up to 16 units**

Explore New Connections

M.2 slot inside

Optional SSD for long-term offline data acquisition.

2 EtherCAT ports

- Hardware-supported slave interfaces
- Low latency daisy chaining with other EtherCAT devices

4 Ethernet ports

The first HIL device to have 4 Ethernet ports for greater flexibility to support multiple networks and different protocols.

- 2 ports for high level protocols
  - Modbus, DNP3, OPC UA
  - Incl THCC communication
- 2 ports for time critical protocols
  - IEC 61850 SV, Ethernet VE

2 CAN + 2 CAN FD ports

- Double the connectivity options with CAN devices
- Full support for flexible data rates in CAN FD ports
- Ideal for e-Mobility

2 SFP ports

- Communication with other devices only
- SFP Simulation Link capable

2 QSFP for paralleling

Connect 16 devices with more connection flexibility

- Bidirectional link
- Not required to close the ring

Features

High Fidelity Modeling

- Switch-level GDS oversampling
- Highly detailed switch models
  - Forward voltage drop
  - Switching delays
  - Semiconductor power losses
- Highly detailed motor models
  - Core saturation and geometric effects
  - Motor losses
  - Fault emulation
- Time-varying passive components

THCC support

- **2021.3 (early July)**
  - Same FW configurations like HIL604
  - 2 user accessible CPUs
  - 2 Ethernet ports supported
  - No CAN FD support
  - Limited SFP support
  - No M.2 support
- **2021.4 (early October)**
  - 3 user accessible CPUs
  - All interfaces supported

Thank you for your attention!

Watch Webinar:

[HIL606: 4th Gen Flagship for Complex Microgrids and E-Mobility Applications]