

Research Project



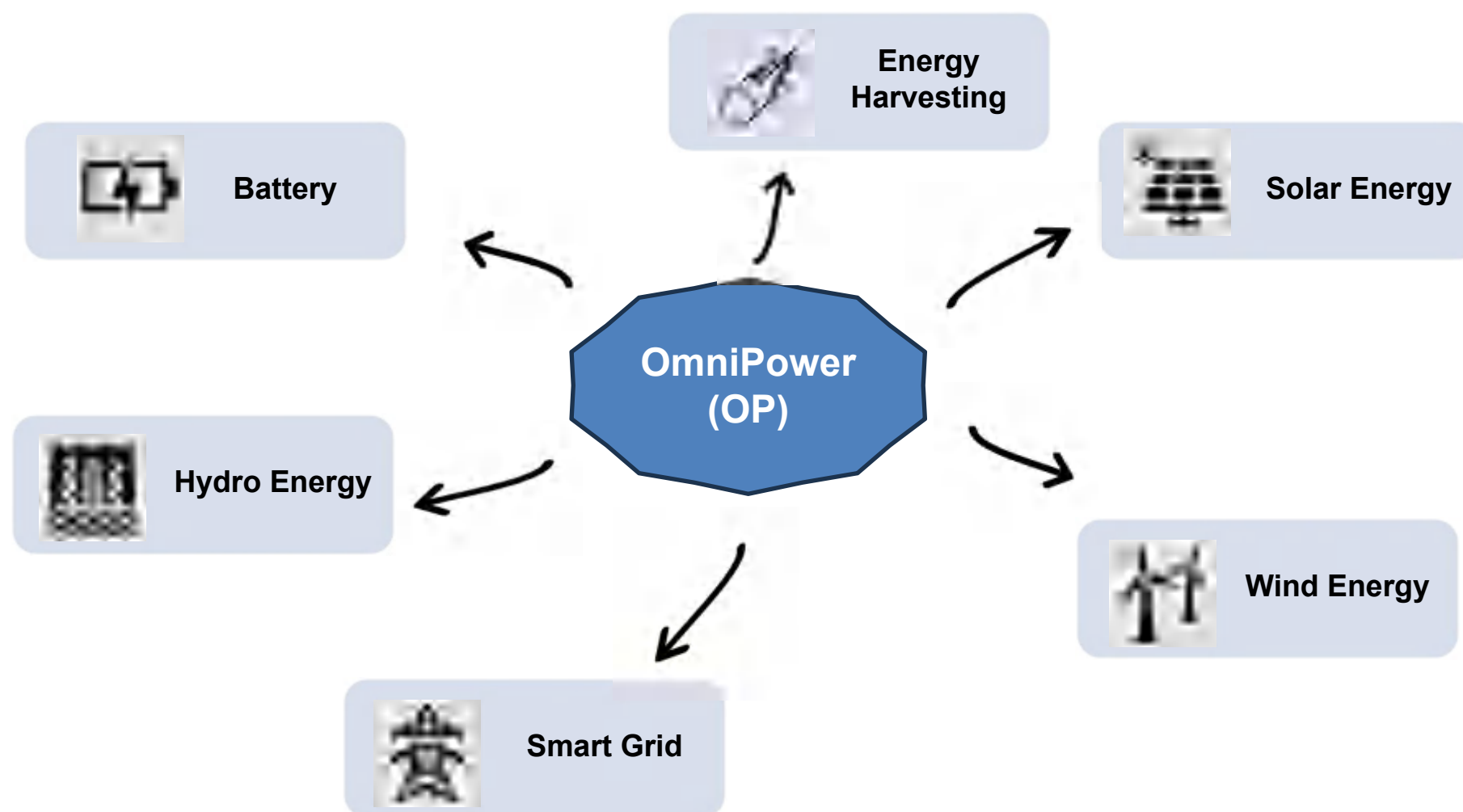
Graz, 30.September2025

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1. OMNIPOWER AI/ML HW & SW PLATFORM



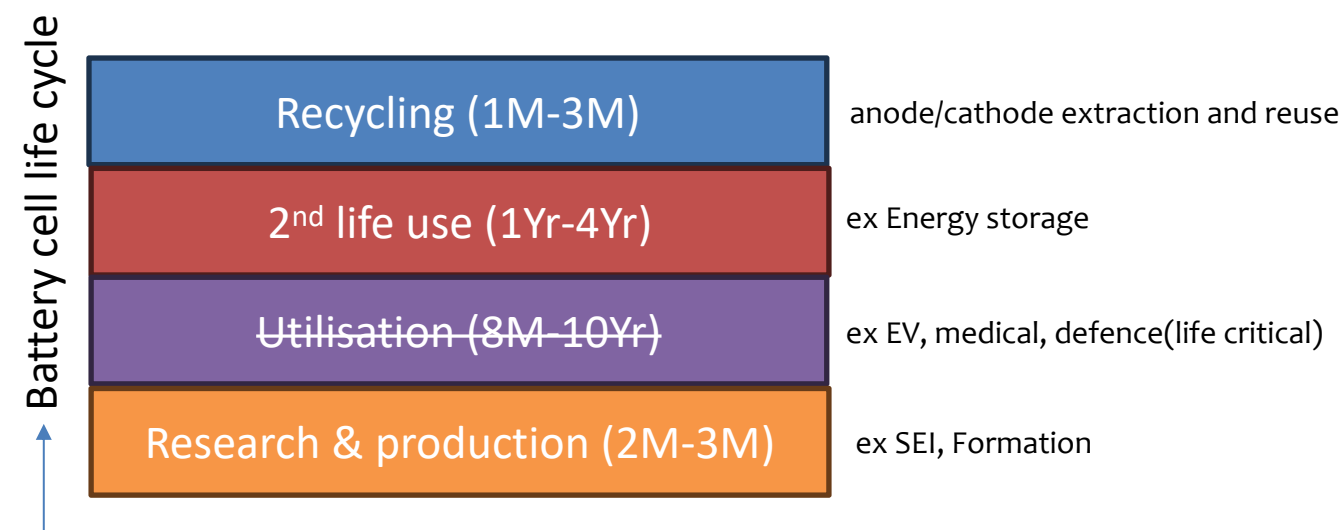
#smartgrid integration, #performance improvement #LP solar plant #Hardware in loop(HiL) #Digital twin
 #low maintance,control and monitoring #AI model #Recycling battery #48v/250w bidirectional

Solving the Challenges

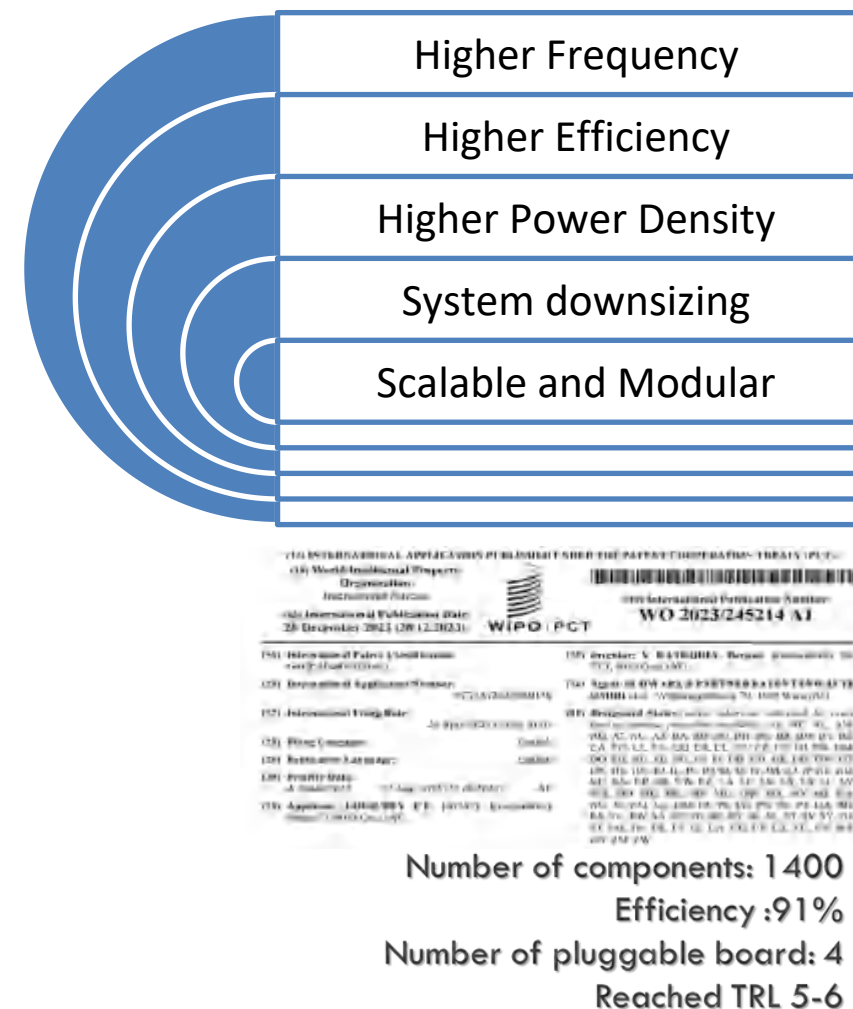
- ✓ Intermittency and variability
- ✓ Efficiency loss (switching, dirt, shading)
- ✓ Maintenance and Fault Detection
- ✓ Condition, Health & Monitoring (CHM)
- ✓ Grid integration
- ✓ Maintenance costs (incl. Offshore/Onshore)
- ✓ Unpredictable solar/wind/water speeds
- ✓ Mechanical wear and tear
- ✓ Sedimentation in reservoirs
- ✓ Seasonal variability in water supply
- ✓ Environmental, ecosystem disruption
- ✓ Ageing infrastructure
- ✓ Data & event logging
- ✓ Performance evaluation & optimisation

2. OMNIPOWER EDGE AI FOR DIGITISATION

A dedicated motherboard explicitly designed for energy applications across generation, transmission, and consumption. It supports digitization, AI/ML integration, digital twin, testing, grading, and predictive maintenance.



Where is Omni needed?



A hardware-based **Digital Twin** is a virtual representation of a physical object or system. HIL testing is a type of simulation-based testing that combines physical hardware with virtual components in a controlled environment.



3. Twin bridge for Robotic

- Hardware bridge platform Co-Robotic operation
- ROS2-based solution
- 5G SA connected (**Latency, Reliability**)
- AI/ML-based algorithm for vision control x3 Camera
- AI Accelerator (12 ToPS)



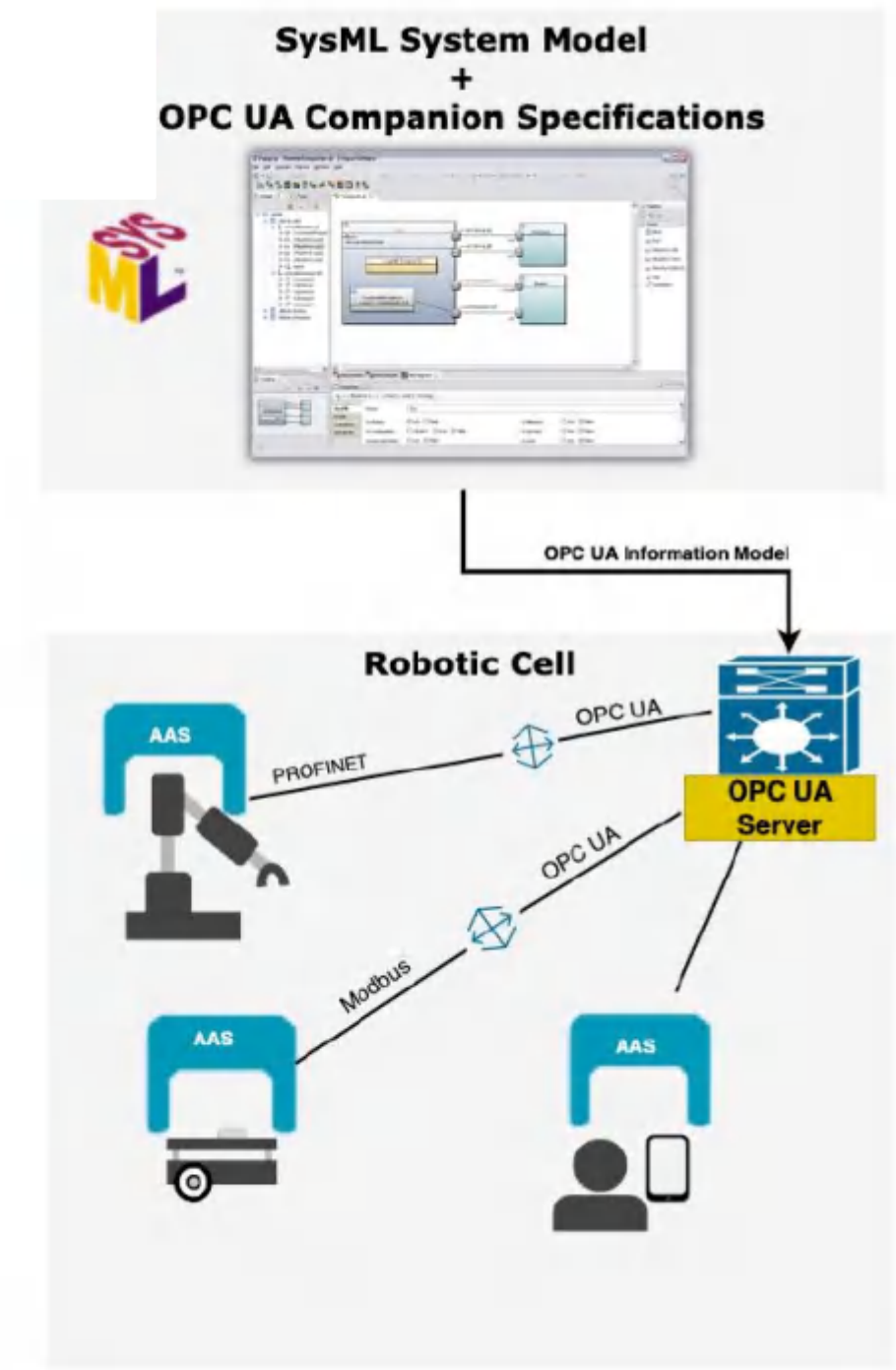
Programmable Hardware solution



Robotic & Co-bot application (WZL der RWTH Aachen, DE)



Other application

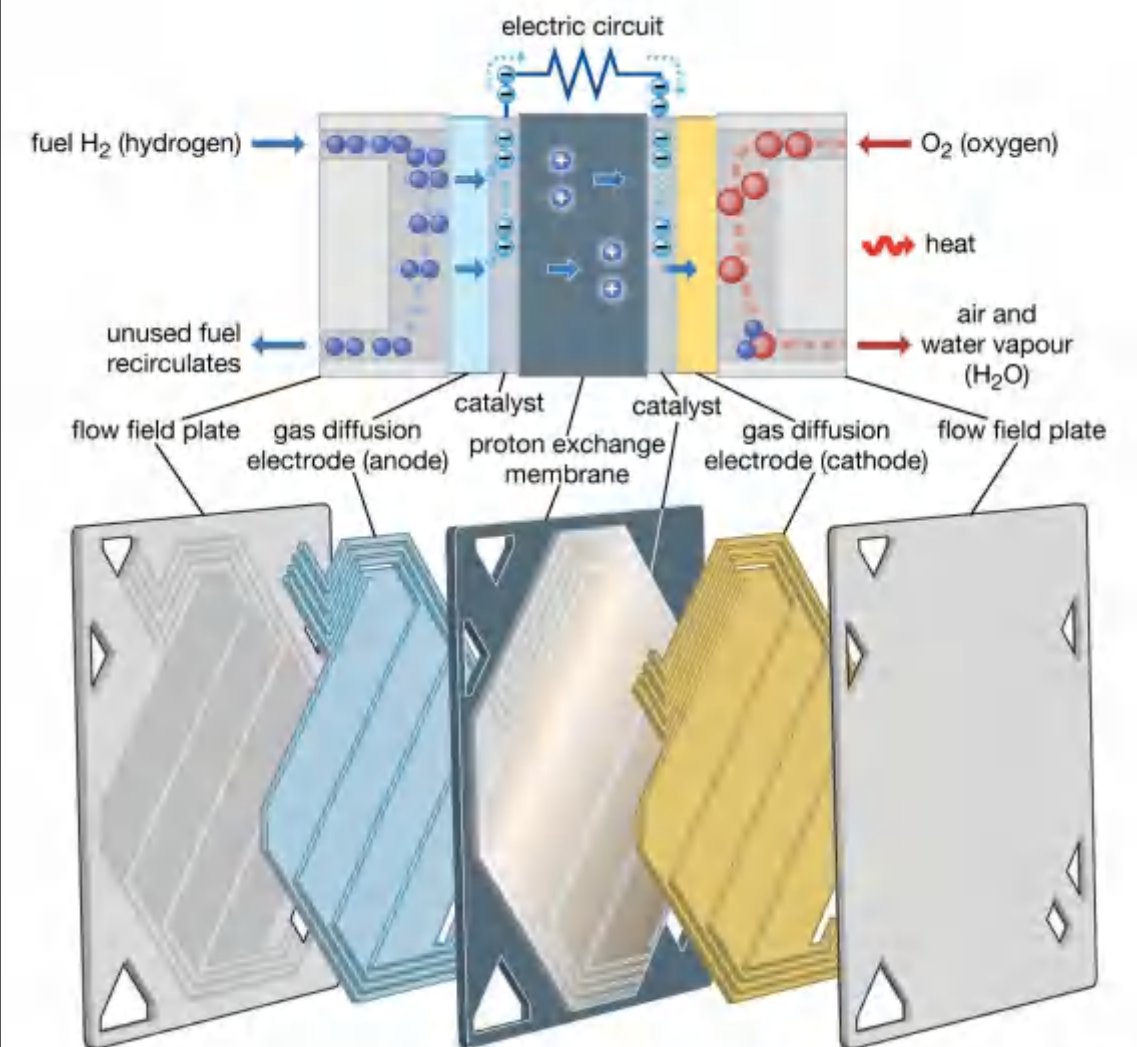


MODEL DRIVEN TOOLSET FOR INDUSTRY 4

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4. Omni Electrode -Monitoring, Optimisation, Prediction

In process



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As shown in Fig. 4, there is a significant difference in the reaction resistance between a pristine and a degraded Lithium-ion battery. In applications that involve charging and discharging at low temperatures or deep charging and discharging (SOC between 0% and 100%), degradation is likely to occur. The degradation of charge transfer resistance is particularly noticeable in the Nyquist plot as reaction resistance.

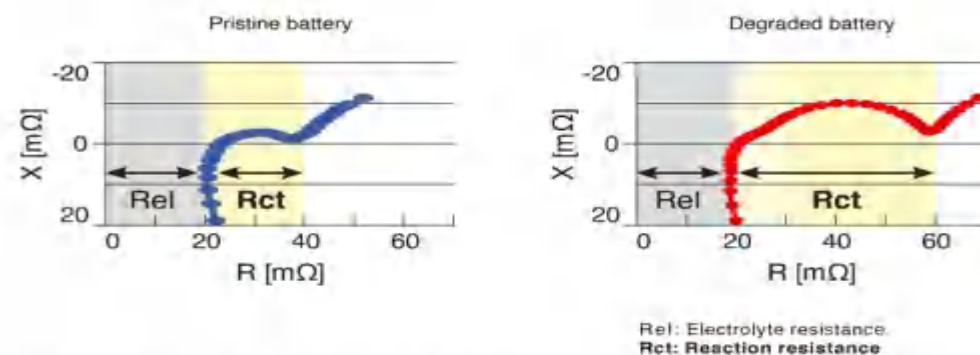
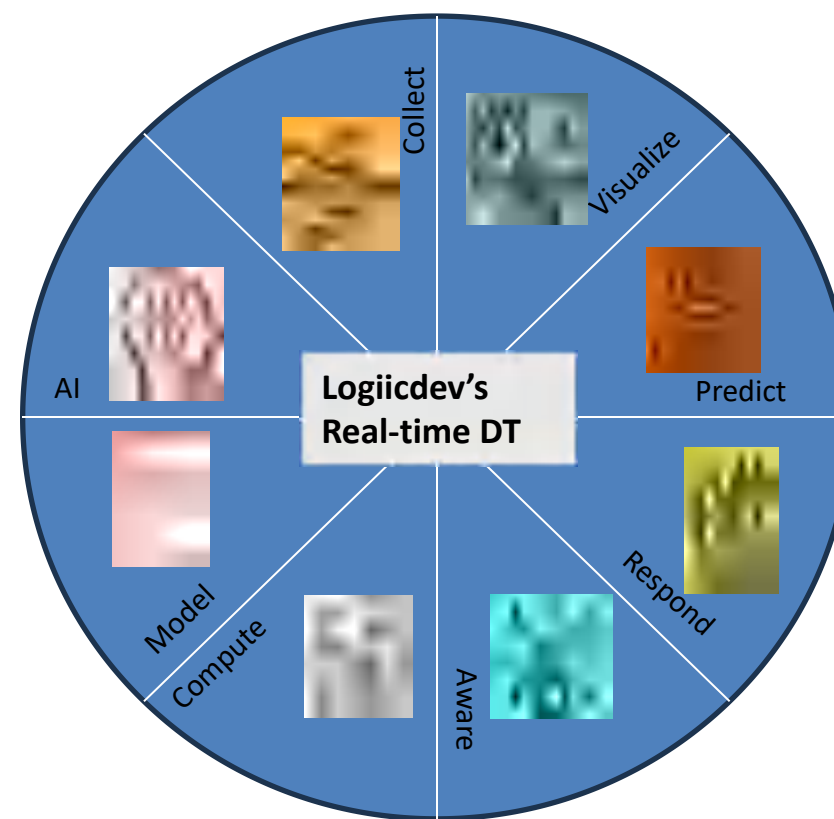


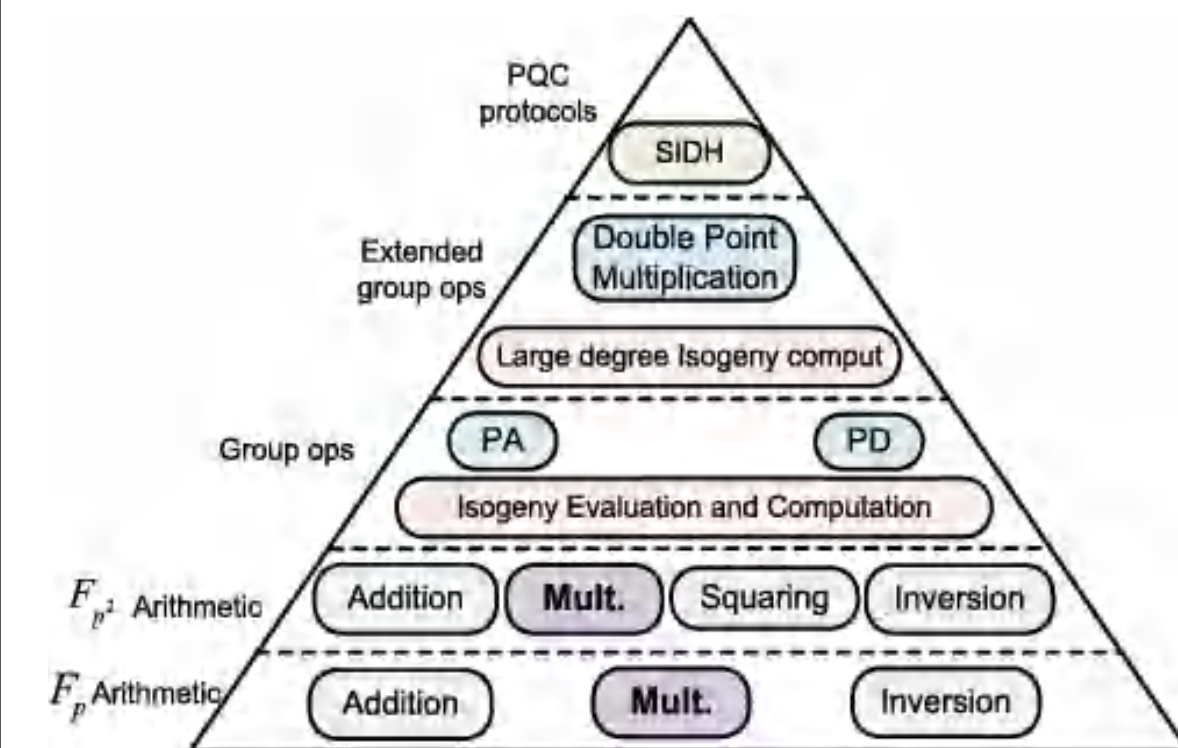
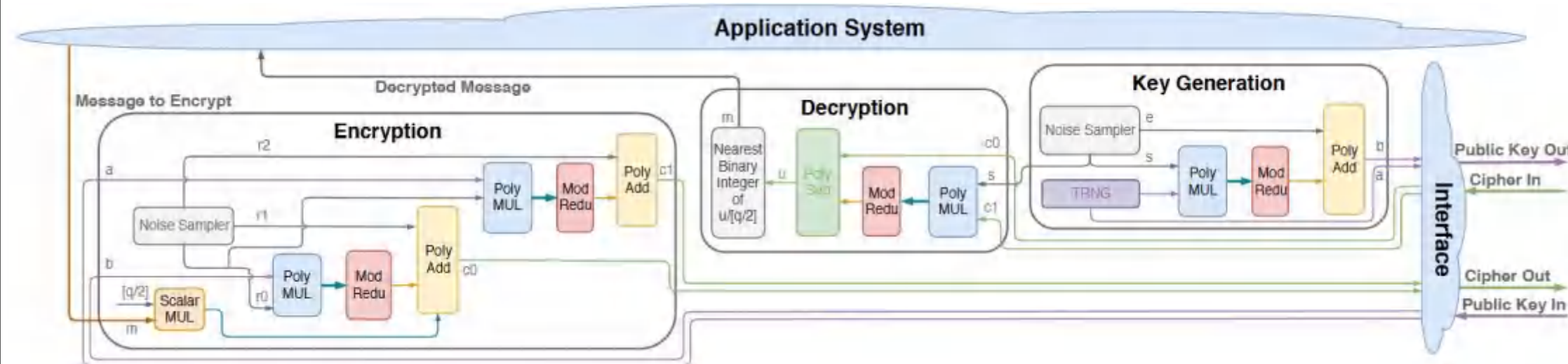
Fig. 4: Comparing the measured data for pristine and deteriorated lithium-ion batteries with the Nyquist plot.



Why monitoring is essential:

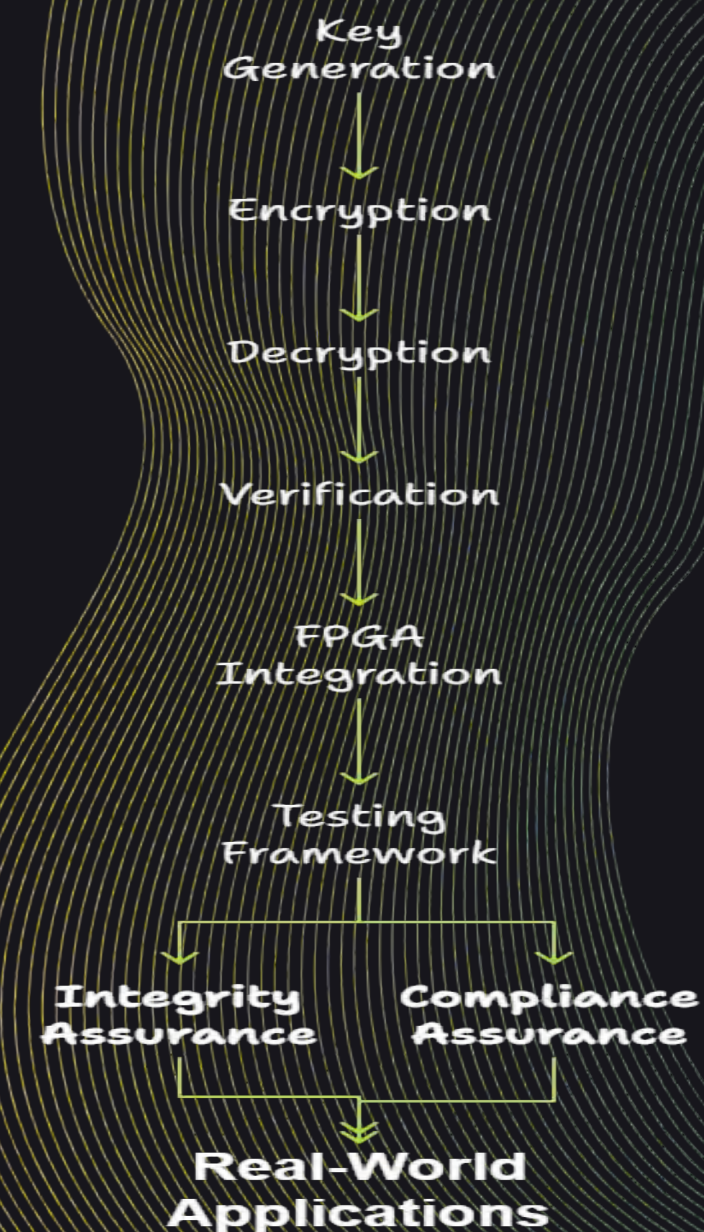
- Performance Optimization
- Preventing Failures
- Data Collection and AI Analysis
- Safety
- Compliance and Regulatory Requirements

5. NueralOmni- PQC



NueralOmni is **Quantum safe** system using FPGA based low SWaP-C (Size, Weight, Power and Costs).

Post Quantum Cryptography Block Diagram



Made with Neptin



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