



NOVICORTM

A revolution in real time.

Microgrid Symposium - Newcastle

Panel Session: State-of-the-Art in Microgrid Hardware

Real Time Simulation of Microgrids

WRTDS
Technologies

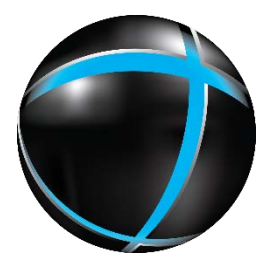




Agenda

Introduction
HIL Requirements
Microgrid Applications
Example Case





The Company Today

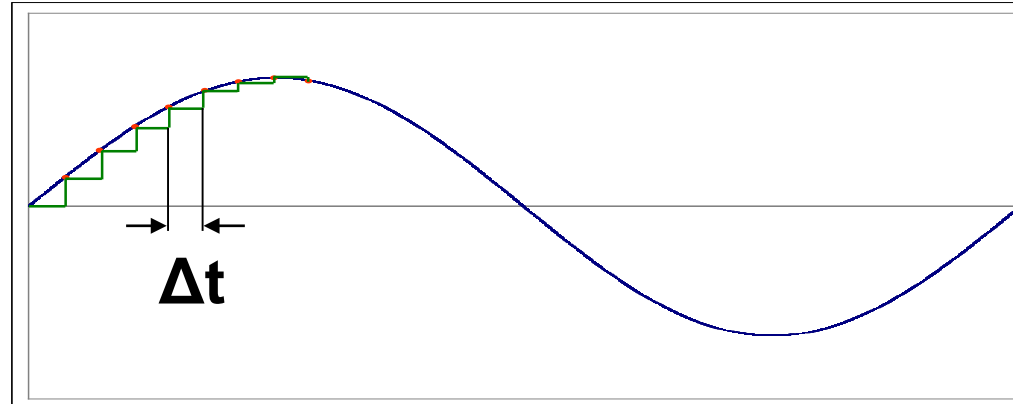
- Current number of employees: 70
- Expanded office space/production line to accommodate company growth
- 380+ customers, 1500+ units, 43 countries





Types of Digital Simulation

Type of Simulation	Load Flow	Transient Stability Analysis (TSA)	Electromagnetic Transient (EMT)
Typical timestep	Single solution	$\sim 8 \text{ ms}$	$\sim 1 - 50 \mu\text{s}$
Output	Magnitude and angle	Magnitude and angle	Instantaneous values
Frequency range	Nominal frequency	Nominal and off-nominal frequency	$0 - 3 \text{ kHz}$ $(>15 \text{ kHz})$





Real time simulation hardware

- Custom parallel processing computer
- Modular design
- Interface through custom user-friendly software
- Calculations completed in real world time less than timestep
- RTDS Simulator hardware completely redesigned for 2017
- Nova = New.....NovaCor™ → new core of the RTDS Simulator
- Custom hardware using IBM's POWER8® RISC-based 10-core processor



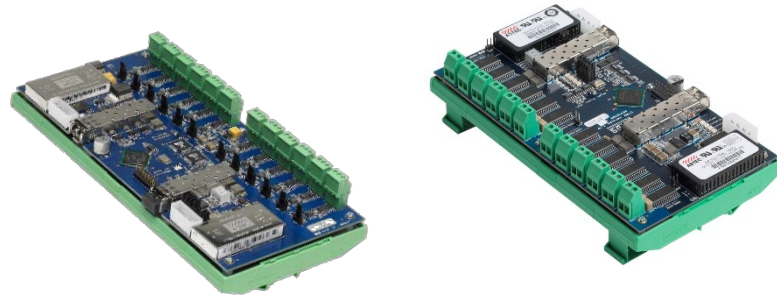


HIL

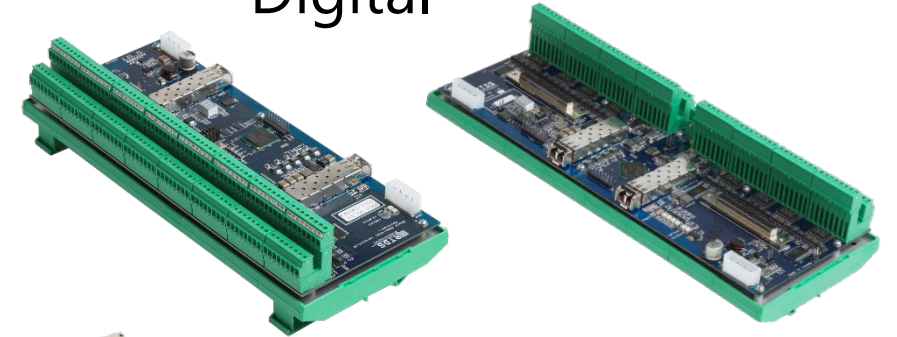
- Protocols

- Aurora
- IEC 61850
 - GSE
 - SV
- SCADA
 - DNP3
 - IEC 60870-5-104
- PMU (IEEE C37.118)
- MODBUS
- TCP/UDP

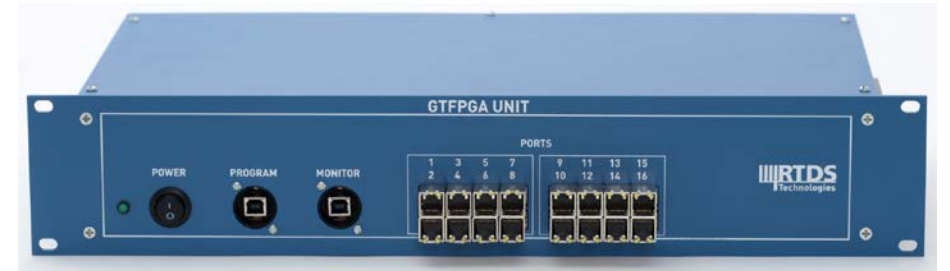
Analogue



Digital

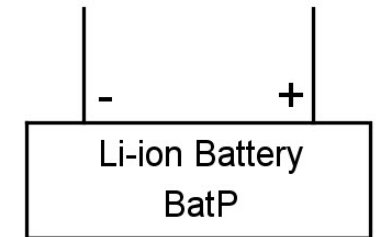
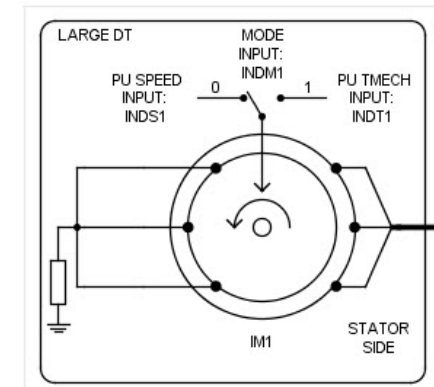
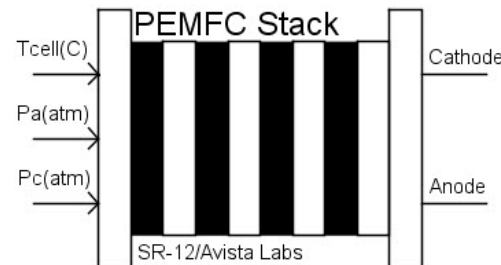
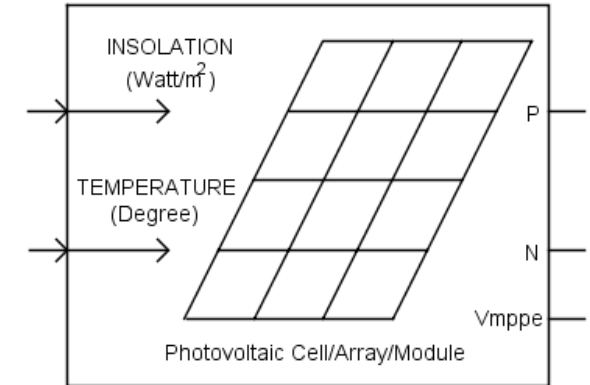
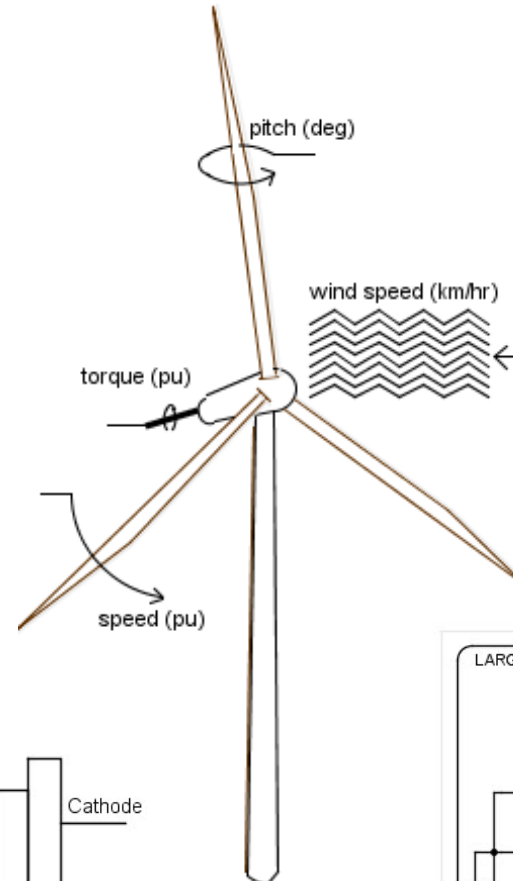
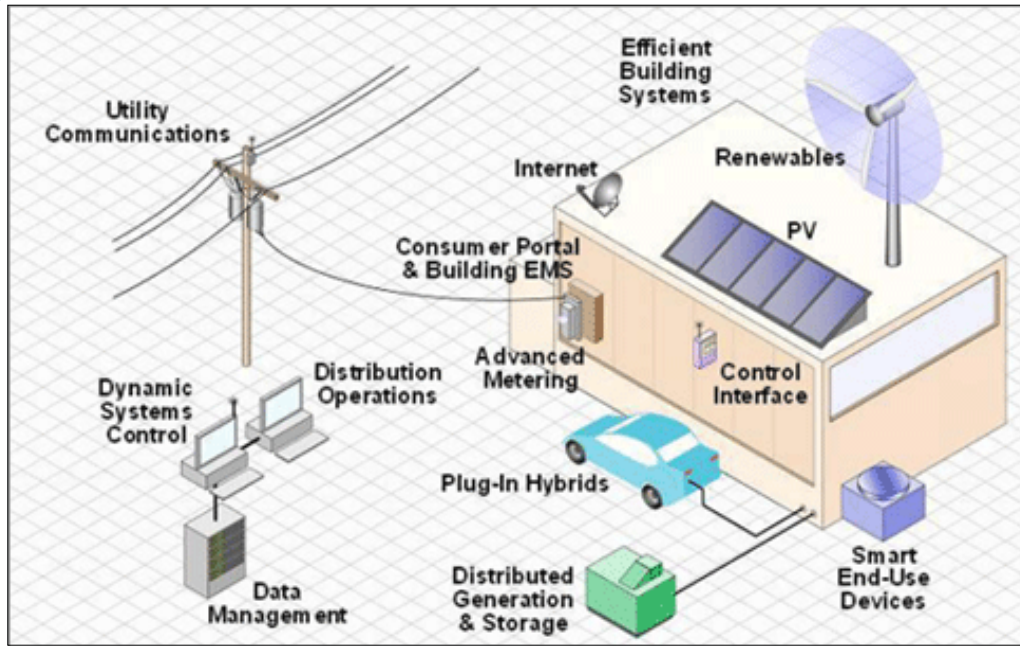


IRIG-B, 1PPS, IEEE 1588



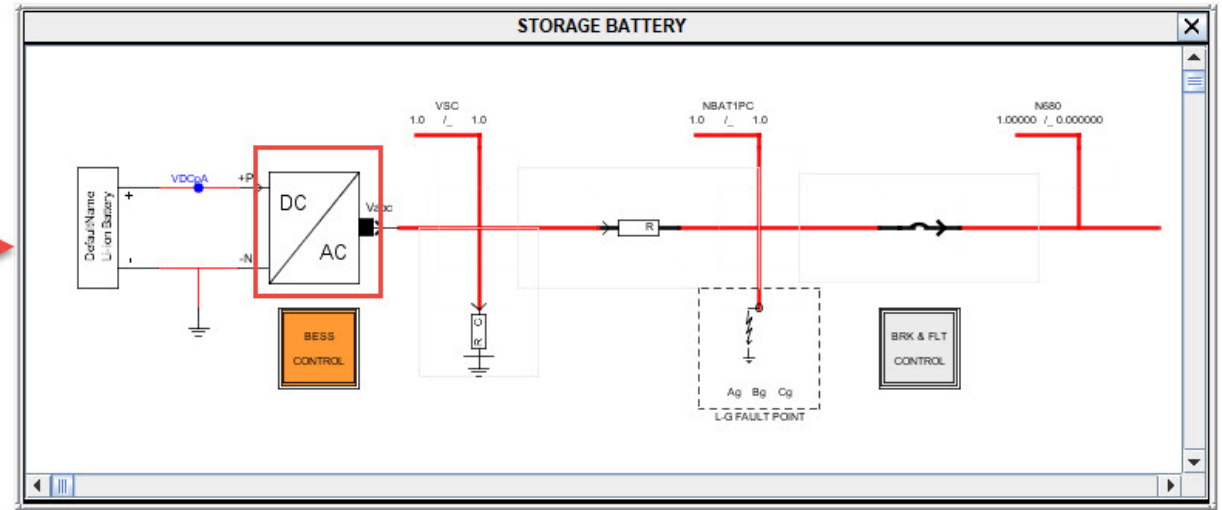
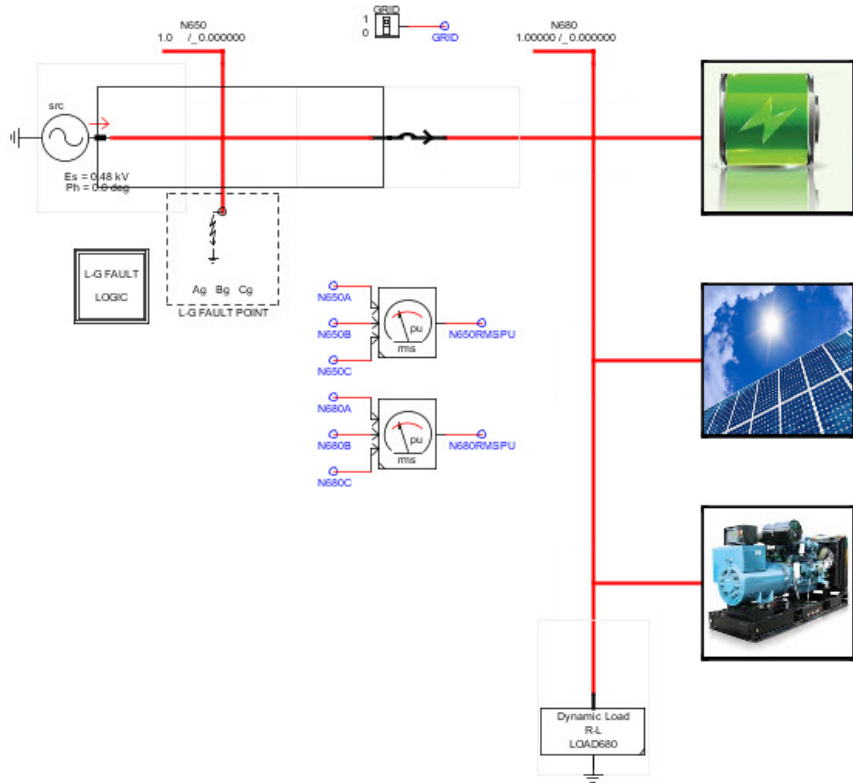


Models





Average Models



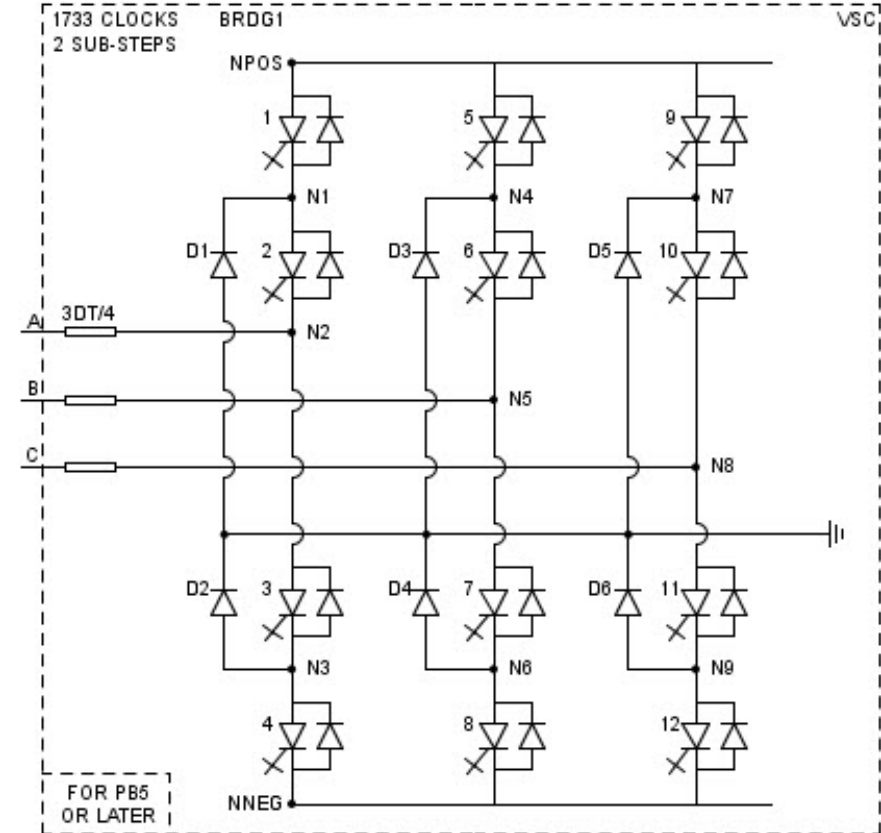
- Timesteps of 30-50 μ s
- No high frequency switching
- Test system protection and control features



Small Timestep Subnetworks

Features

- Processor-based
- Timesteps between 1-4 μs
- Sub-step 2/3 level models ($< 1 \mu\text{s } \Delta t$)
 - 2 level resistive switching
- 2 subnetworks per core with NovaCor
- Connection to larger power system
- Used to model switching power electronics in detail
- Detailed machine models

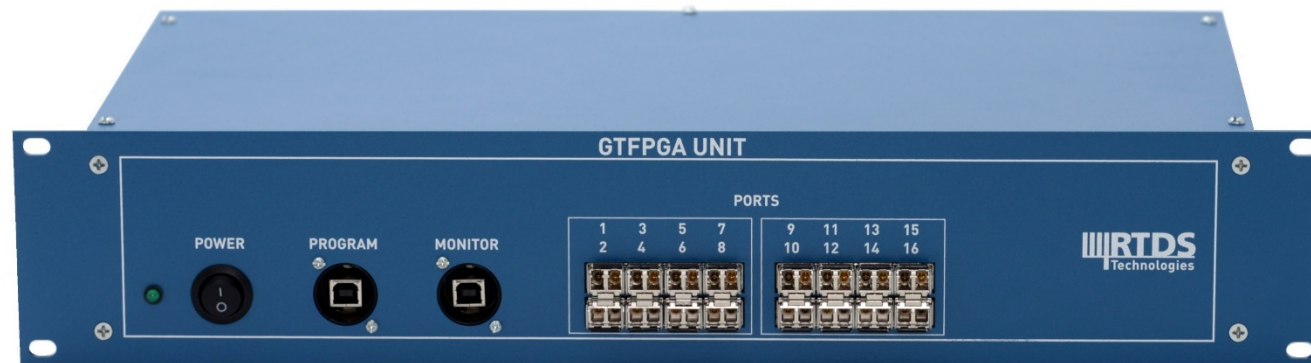


1 to 3 LEGS OF A THREE LEVEL VSC
LOW LOSS SUB STEP MODEL



GPES

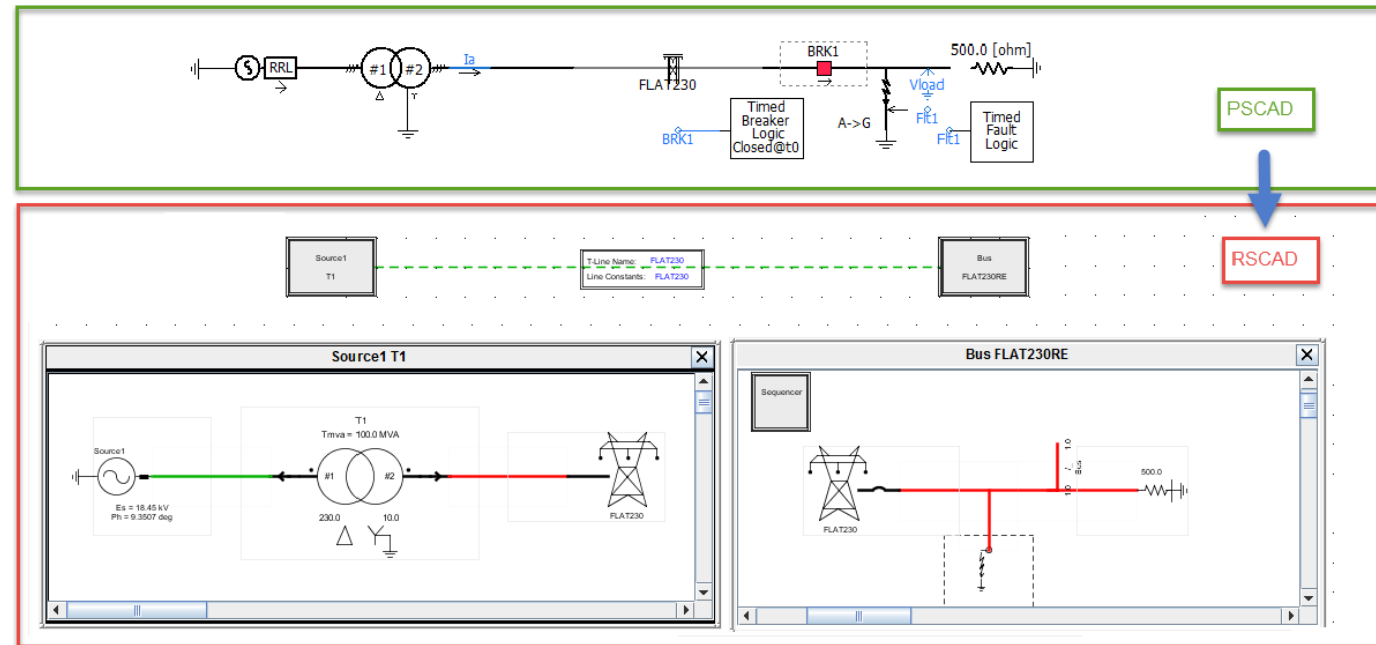
- Power electronic converter modelling on the GTFPGA Unit
- Freely configurable – custom topologies
- Timesteps in the nanosecond range
- Connect to small timestep subnetwork running on the rack/chassis
- Aurora interfacing block – receive firing pulses directly from external controls
- 128 nodes, 256 branches





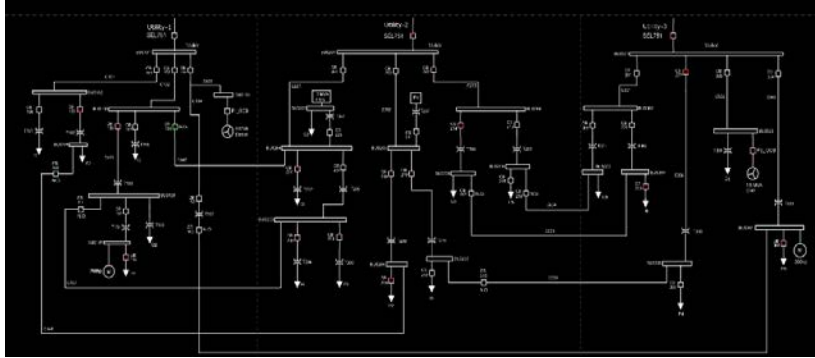
Conversion Programs

- **PSCAD -> RSCAD**
- CYME -> RSCAD
- PSS/e -> RSCAD
- Simulink Controllers -> RSCAD



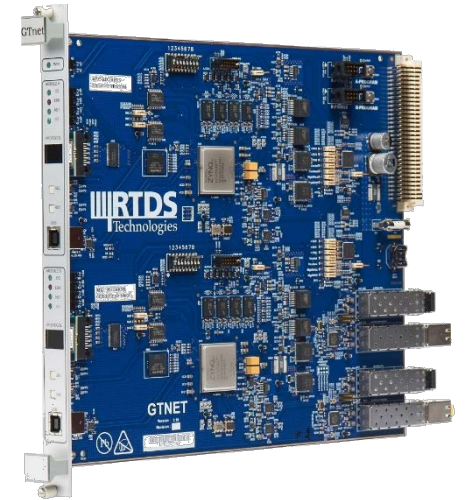
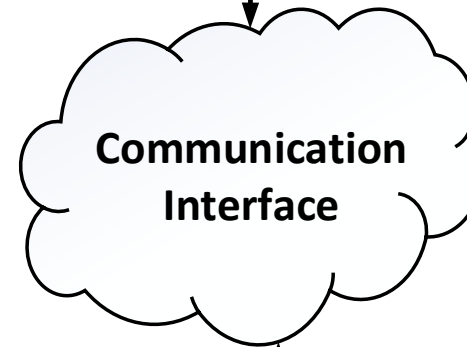


Banshee Microgrid



Banshee Microgrid Model
MIT Lincoln Labs

SEL RTAC
Load shedding Functionality



DNP3 & IEC 61850 GOOSE



Some RTDS Users

SIEMENS



UNSW
THE UNIVERSITY OF NEW SOUTH WALES



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



DTU
Technical
University of
Denmark



THE UNIVERSITY OF
MELBOURNE



Queensland University
of Technology

ABB



MITSUBISHI

RWTHAACHEN
UNIVERSITY



Operador Nacional
do Sistema Elétrico



THE UNIVERSITY OF
SYDNEY

TOSHIBA



MANCHESTER
1824

The University of Manchester

Manitoba
Hydro



TRANSPower



पावरग्रिड

RTDS
Technologies

Introducing NovaCor™ – the new world standard for real time digital power system simulation