



Your world in real time.

IIIRTDSDS
Technologies
AMETEK®

RTDS Technologies Inc.

- 30 years in business
- Headquarters in Winnipeg, Canada
- Customers in 57 countries
- Over 500 installations

CUSTOMER BASE

Our clients are leading...

- Electrical power utilities
- Electrical equipment manufacturers (all major vendors of HVDC/FACTS, protection equipment, renewables, etc.)
- Research and learning institutions
- Consultants

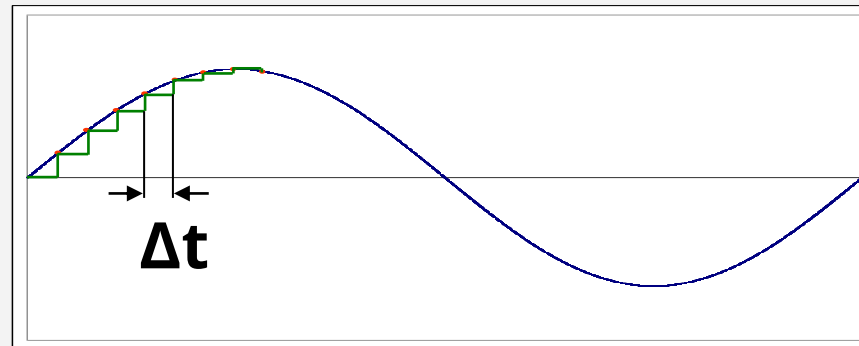


TRUSTED BY UTILITIES WORLDWIDE



TYPES OF DIGITAL SIMULATION

Type of Simulation	Load Flow	Transient Stability Analysis (TSA)	Electromagnetic Transient (EMT)
Typical timestep	Single solution	~ 8 ms	~ 2 - 50 μ s
Output	Magnitude and angle	Magnitude and angle	Instantaneous values
Frequency range	Nominal frequency	Nominal and off-nominal frequency	0 - 3 kHz (<15 kHz)



**Dommel algorithm
of nodal analysis
used in RTDS,
PSCAD, EMTP, etc.**

NOVACOR 2.0: CURRENT-GEN HARDWARE

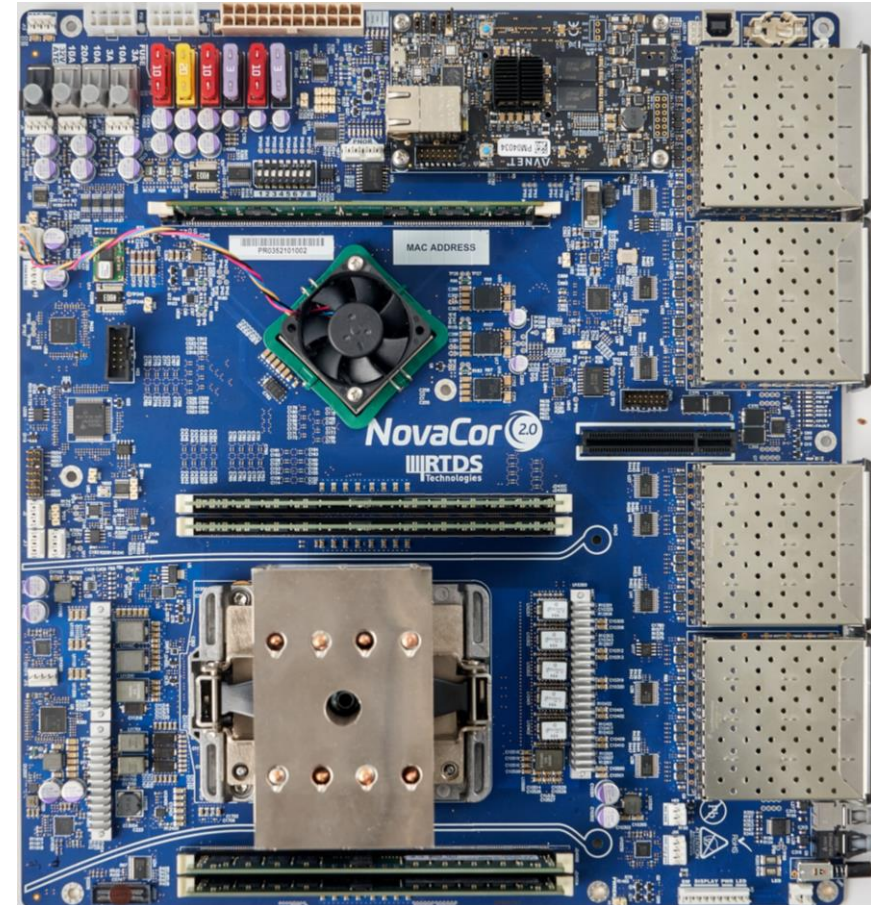


- Custom parallel processing computer
- Modular design
- Main interface is through user-friendly software
- Ample I/O to connect physical devices

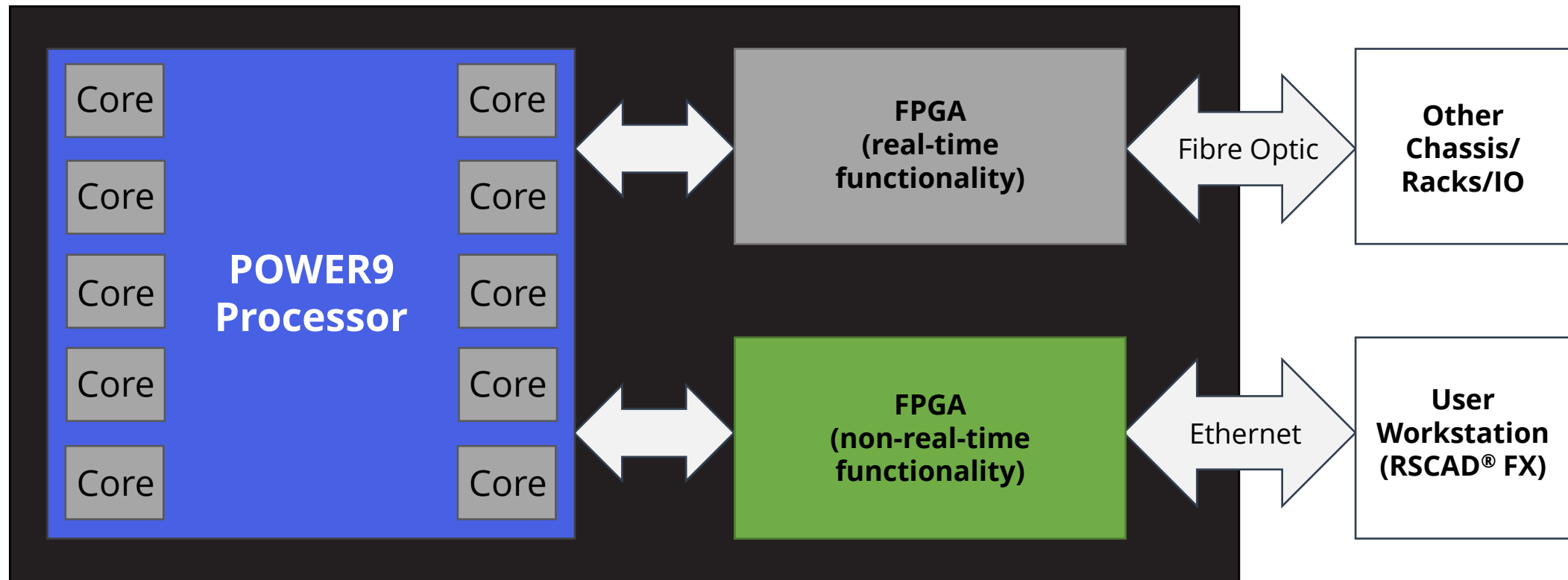
NovaCor 2.0

NOVACOR 2.0: DEDICATED DESIGN

- RTDS Technologies is maintaining the competitive advantage afforded by a dedicated design
- Platform optimized for hard real-time simulation
- IBM POWER9 RISC processor
- No operating system used by the processor while simulation running — bare metal operation
- Operates directly from cache memory for maximum efficiency
- Worked closely with IBM for optimal communication settings
- **Provides ultimate in determinism and performance**



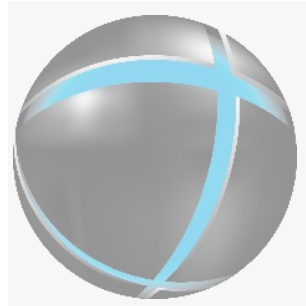
INSIDE THE NOVACOR 2.0 CHASSIS



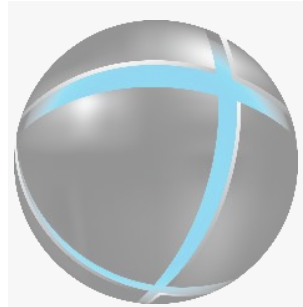
CORE LICENSING



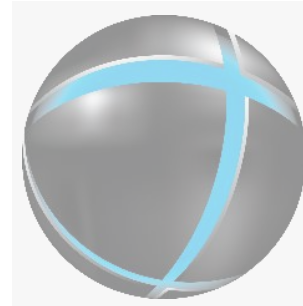
Core 1



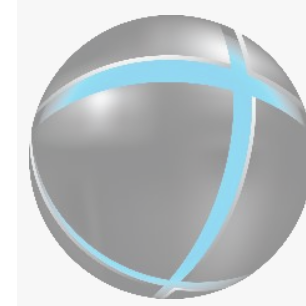
Core 2



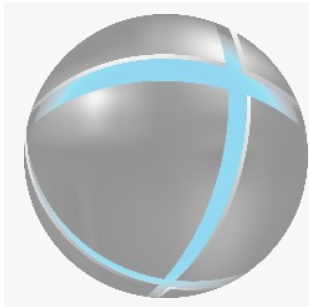
Core 3



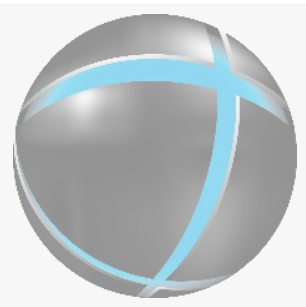
Core 4



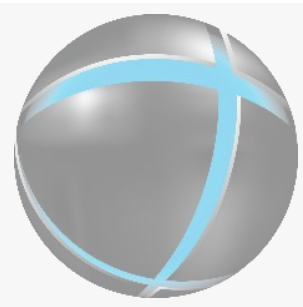
Core 5



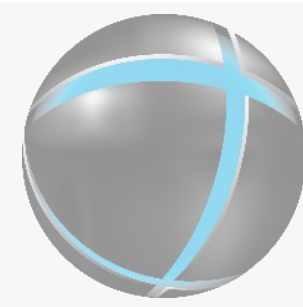
Core 6



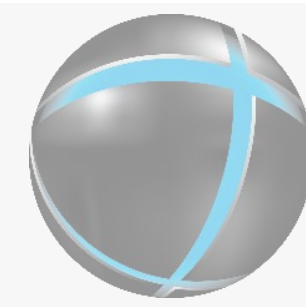
Core 7



Core 8

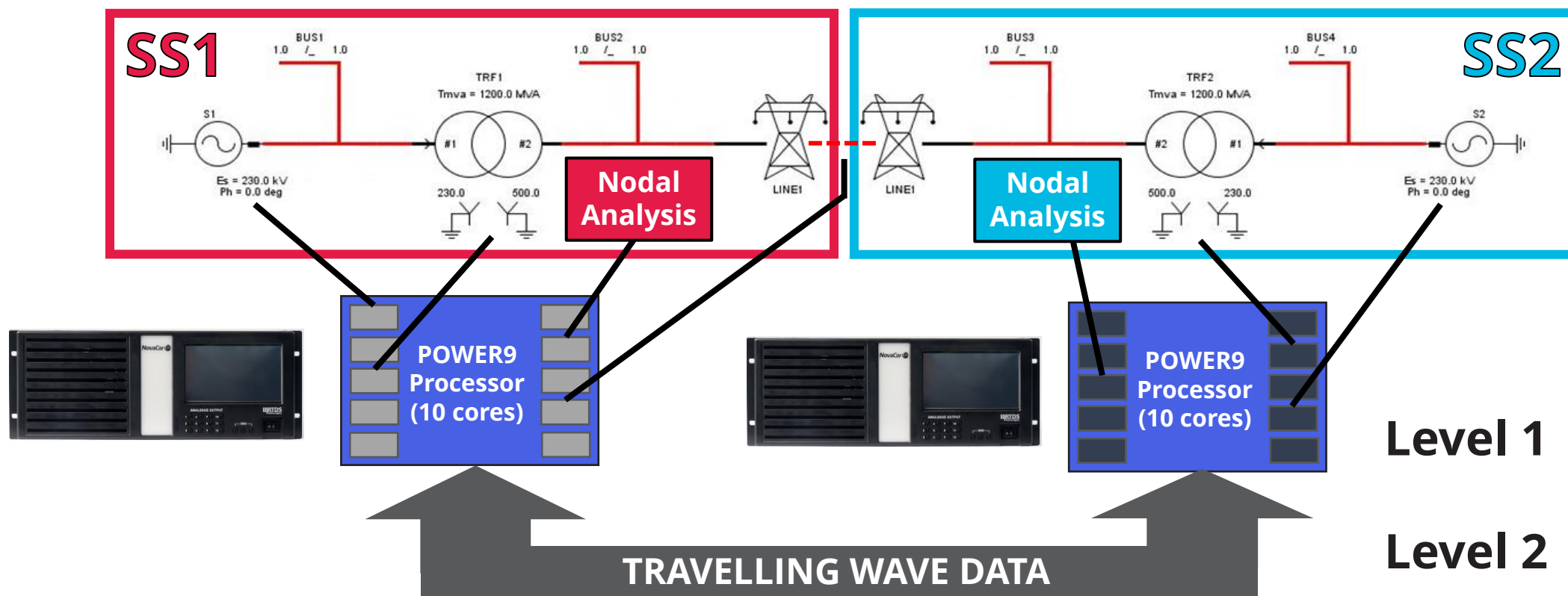


Core 9



Core 10

PARALLEL PROCESSING ON TWO LEVELS



LARGE-SCALE SIMULATION

- Maximum of 144 NovaCor chassis in one simulation
- Precise timing shared between all chassis, one master
- Star point interconnection between all chassis for ease of communication
- Tens of thousands of buses running hard real time EMT simulations



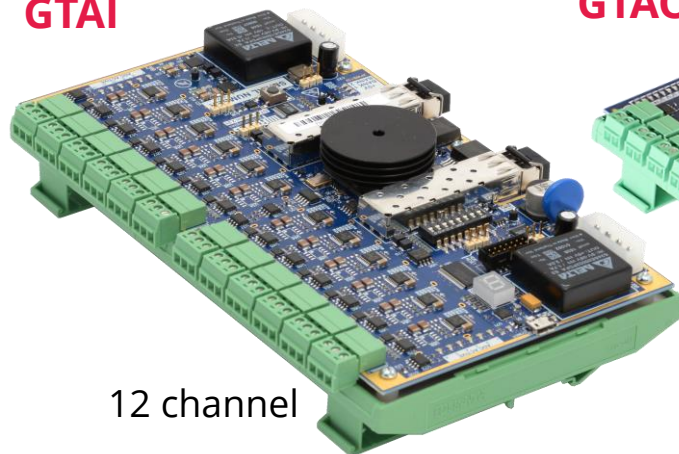
CUSTOM HARDWARE COMPONENTS

Flexible and Expandable I/O

- Isolated 16-bit analogue input/output cards
- Easily daisy-chain connected to a single NovaCor fibre port

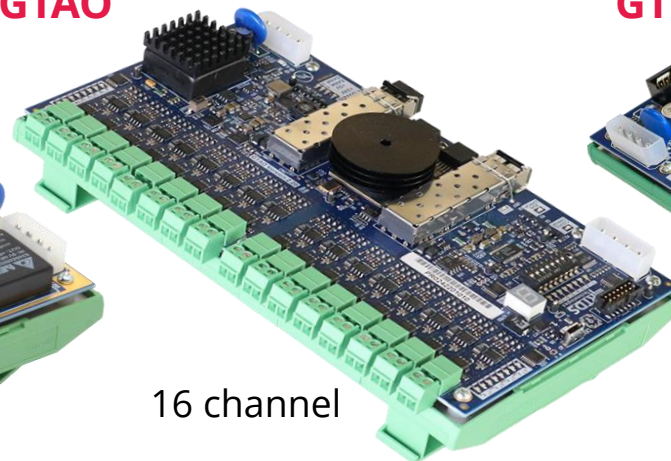
Analogue

GTAI



12 channel

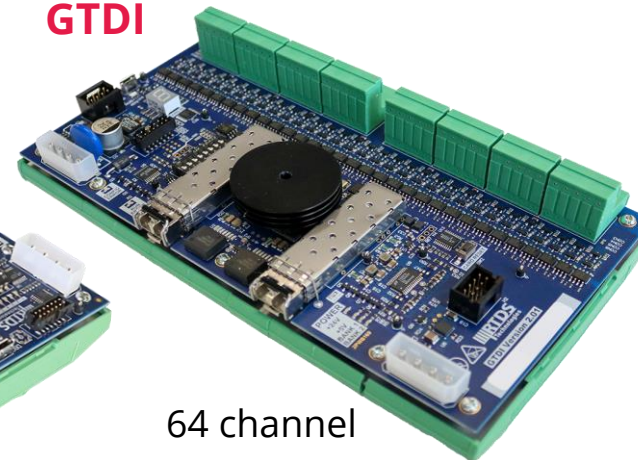
GTAO



16 channel

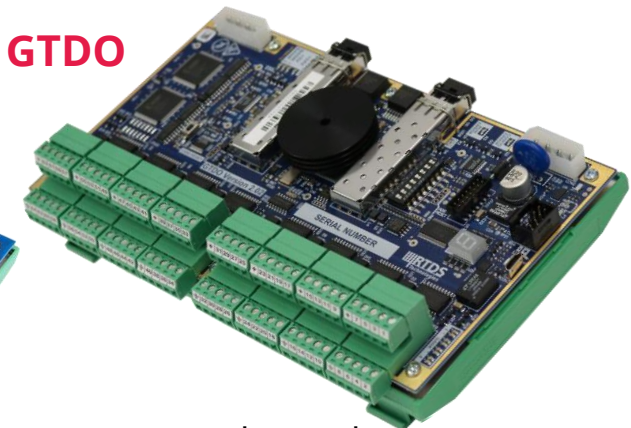
Digital

GTDI



64 channel

GTDO



64 channel

CUSTOM HARDWARE COMPONENTS

GTNETx2: Network Communication

- Communication with external devices over Ethernet
- Card has two “modules” and can have two network protocols operating simultaneously

IEC 61850

- GOOSE Messaging
- IEC 61850-9-2LE, IEC 61869-9 Sampled Values

SCADA

DNP3 and IEC 60870-5-104

Large data playback

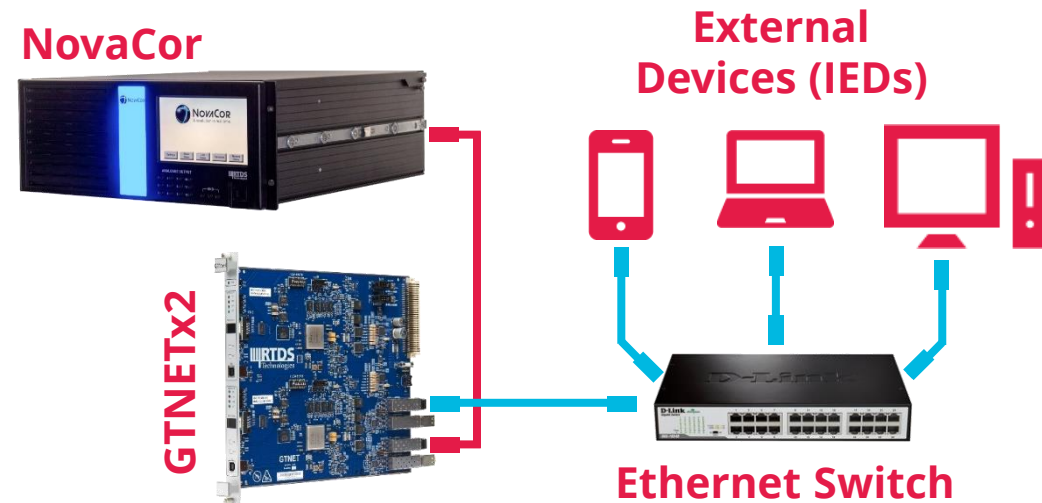
PMU

IEC/IEEE 60255-118-1

MODBUS

TCP, RTU over TCP,
ASCII over TCP

Generic TCP/UDP
Sockets



GTSOC V2

Optional auxiliary hardware based on FPGA and system-on-a-chip (SOC)

- Amalgamates the functionality of the GTFPGA Unit (previous hardware), plus black box control
- Function defined by active firmware
- MMC Valve and Control
- Sampled Values (-9-2LE + IEC 61869-9)
- Small timestep frequency dependent tline
- Generic Power Electronics Solver (GPES)
- Black box control



The new GTSOC V2

Supporting Vendor Black-Box Controls

- ARM cores on the GTSOC V2 support execution of static library file (.a) compiled from original source code using .exe provided by RTDS Technologies
- Control code is not accessible by user, but vendor can choose to make some parameters changeable
- Compatible with NovaCor systems (connected via fiber cable)



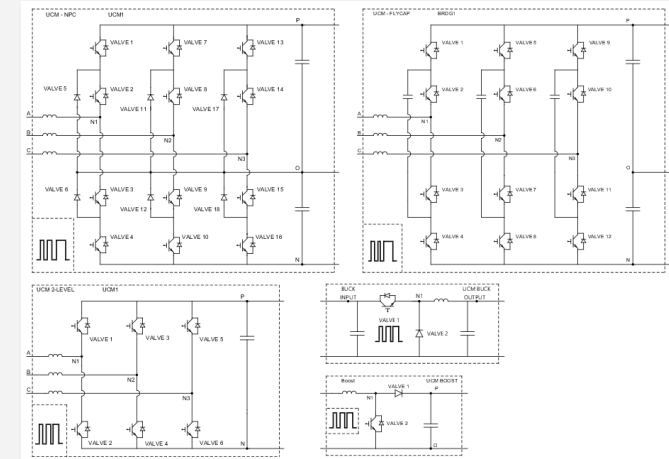
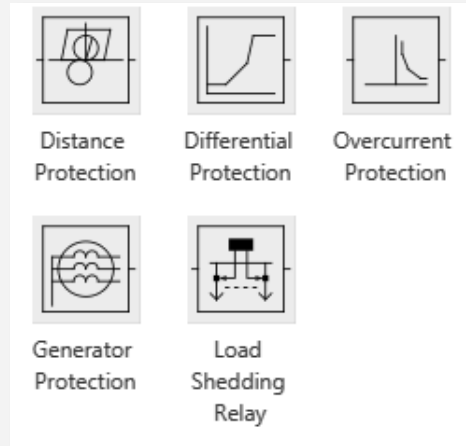
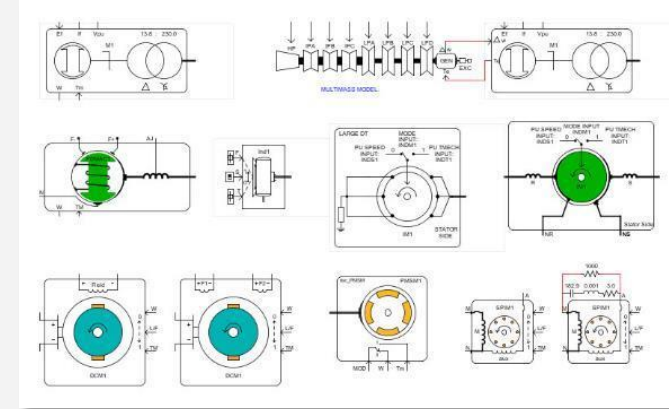
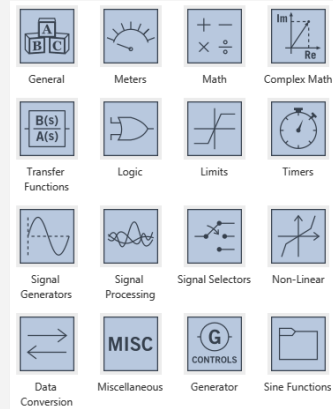
SIMULATION SOFTWARE:

RSCAD® FX

- Includes everything required for simulation studies
- Comprehensive and proven component libraries
- No additional add-on modules required for any aspects of simulation
- No third-party modules
- Site license and one maintenance agreement

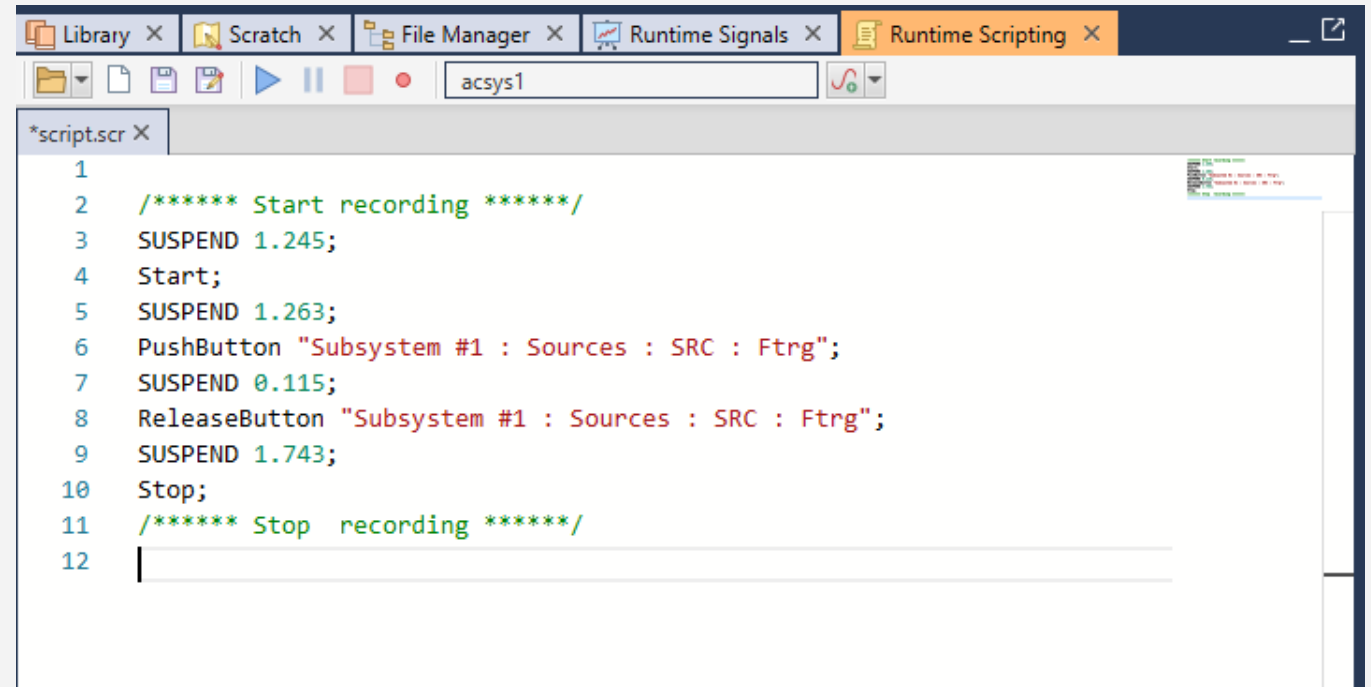
RICH COMPONENT LIBRARIES

- Power systems
- Controls
- Power electronics
- HVDC & FACTS
- Protection
- Renewables
- Etc.



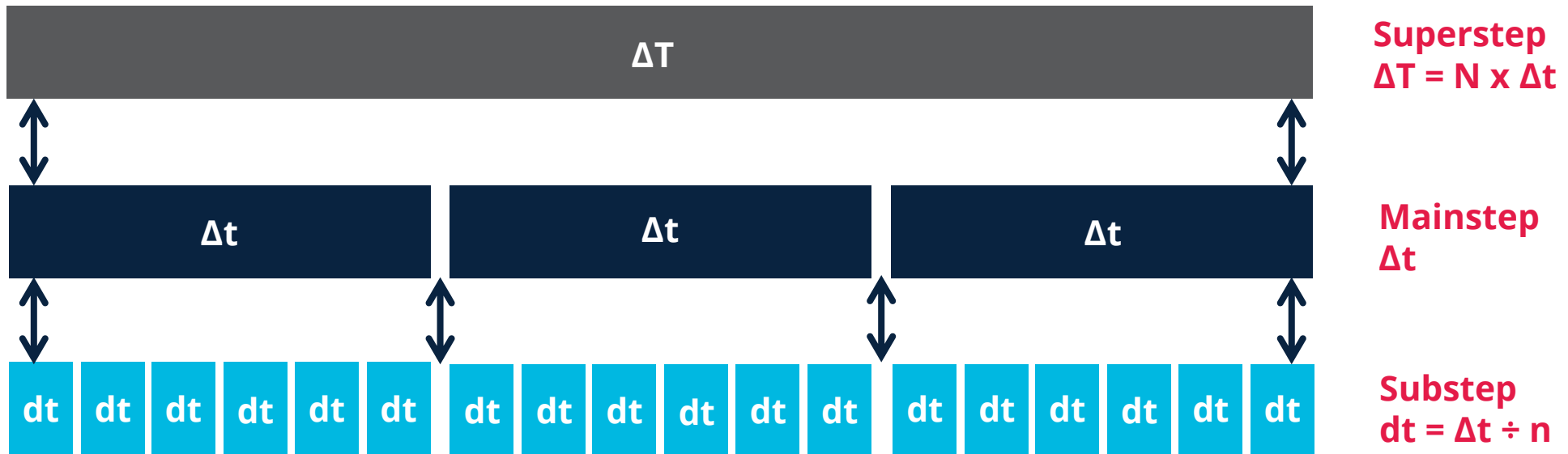
SCRIPTING

- Efficient means of running many cases
- Scripting Utility Tab
- Scripts can be written or recorded from user actions
 - C-like programming language
 - Adaptive via **if, for, while** statements
 - User-defined subroutines
 - Customized results reporting
 - Automated plot printing
- **Python scripting support**



```
1
2 /***** Start recording *****/
3 SUSPEND 1.245;
4 Start;
5 SUSPEND 1.263;
6 PushButton "Subsystem #1 : Sources : SRC : Ftrg";
7 SUSPEND 0.115;
8 ReleaseButton "Subsystem #1 : Sources : SRC : Ftrg";
9 SUSPEND 1.743;
10 Stop;
11 /***** Stop recording *****/
12
```

MULTI-RATE SIMULATION



HARDWARE IN THE LOOP FOR GRID MODERNIZATION

Distribution

- Microgrid testing
- Renewables/DERs
- Distribution automation
- Inverter testing

Smart Grid

- WAMPAC testing
- PMU studies
- Cyber security

Power Electronics

- HVDC and FACTS
- Energy conversion
- Drives
- PHIL

Protection

- Digital substations (IEC 61950)
- Travelling wave based relay testing



THE ADVANTAGES OF THE WORLD LEADER

**RTDS Technologies is the world leader
in real-time power system simulation.**

- Customers in 50+ countries — **trusted** by leading manufacturers, utilities, research institutions across the globe
- Proven reputation for a **quality** product and excellent customer **support**
- Continued product **development** in response to customer needs
- Flexible, modular solution composed of **custom** hardware and software designed in-house
- Global market leadership means **experience** with a range of applications



**THANK YOU!
QUESTIONS?**

