



## Webinar: De-risking Microgrids with Real-time Simulation and HIL Testing

Wednesday, April 29, 2020

### Questions and Answers

**Q1: Can we discuss the main difference of real-time simulators over other power system simulators (like etap and others), other than the fact of being real-time?**

The RTDS Simulator runs an electromagnetic transient (EMT) simulation. EMT simulation is fundamentally different than phasor-based simulation types (e.g. load flow) which are more restricted in the bandwidth of solution they can provide. Other EMT tools such as ETAP or PSCAD do not run in real time, so the main difference between these tools and the RTDS Simulator is real-time operation. This requires dedicated hardware to run the simulation (rather than running on the user's PC). Real-time operation allows for the connection of external equipment (hardware in the loop testing) which requires input/output devices. It is also much more efficient than non-real-time operation.

The RTDS Simulator's software, RSCAD, will also be different than ETAP in terms of graphic user interface and the models themselves, though the types of models available will for the most part be similar.

**Q2: Will the webinar recording and/or the slide deck be offered for download?**

Yes, a recording of the webinar and the slides are both available at this link:  
[youtu.be/ByUyal hoTU](https://youtu.be/ByUyal hoTU)

**Q3: How detailed are the generator, load, BESS and PV models (including converters)? What would be the necessary computational power for this?**

The models can be very detailed – you have control of the level of detail when you create and parametrize the model. The example shown in the demonstration today, the Banshee Microgrid model, uses average models of the converters, but they could also be included as switching models (full detail with switching in the tens of kHz





range). The load model is a variable load and can be programmed to react based on a number of different inputs (e.g. V, f, etc.). The generator, battery, PV panel are all detailed electrical behavior models.

**Q4: How is the external controller connected to the GTNET card?**

In the demonstration today, the external controller is connected to the network interface (GTNET) card via Ethernet. The RTDS Simulator passes data to the GTNET card via optical cables, and the GTNET card then creates standard-compliant data packets which are sent out onto the LAN via Ethernet cable. The NovaCor, GTNET card, and external controller are all connected to the same Ethernet switch.

**Q5: What are the main differences between PSCAD and RSCAD?**

PSCAD and RSCAD are based on the same simulation type (electromagnetic transient) and solution method (the Dommel algorithm), but PSCAD does not run in real time. PSCAD runs on the user's PC which means it usually needs more time to calculate the network response. RSCAD is paired with the RTDS Simulator's dedicated simulation hardware, so the simulation does not run on the user's PC –it runs in real time on dedicated hardware. This means the simulation time to run an event is the same as the actual time the event would take on the power system. This real-time operation is the main difference between PSCAD and RSCAD, but as they are totally different softwares, they also feature different graphical user interfaces and different modelling libraries – there are many differences. That being said, there is a PSCAD to RSCAD conversion tool available for converting PSCAD cases for use on the RTDS Simulator.

**Q6: Are all the samples of each timestep available to the external controller or are the data samples reduced?**

The answer depends on exactly how the controller is connected to the simulator. For conventional analogue and digital input and output, the answer is definitely yes – we can make each individual timestep sample available to the external device. If the controller is connected via Ethernet communication protocol like it is today, the signal availability will depend on the capability and design of the protocol itself.





**Q7: You mention that there is an example hydro pump storage case in RTDS. I couldn't see that in the sample cases folder. Can you share the exact path?**

The flywheel and pumped hydro storage sample cases are not available in the most recent release of the RSCAD software but will be included in the next release. We may be able to provide these cases to current customers if they contact us at [marketing@rtds.com](mailto:marketing@rtds.com).

**Q8: What's the maximum time domain resolution of signals which we can view in Runtime in Substep mode?**

Runtime offers access to the full Substep resolution, meaning regardless of the Substep timestep you are using, you are able to view each individual output in Runtime. The Substep environment is typically used for timesteps in the 1 to 3 microsecond range, but you can achieve sub-microsecond timesteps or simulate networks at up to 10 microseconds.

**Q9: I was wondering if RTDS can simulate a only DC microgrid/nanogrid and also with script for controllers?**

Yes, this has been done. The typical timestep would be in the range of a 1-2 microseconds.

**Q10: Was the microgrid shown in the demonstration simulated on a single core?**

No, the simulated network shown was simulated on one NovaCor unit using multiple cores. An advantage of the RTDS Simulator is that it does not force a subsystem split when multiple cores are used – data can be shared between cores without requiring mathematical coupling.

**Q11: Can you explain how to calculate the processor estimation for a network?**

Generally, each network component (machines, transformers, loads, etc.) has a different quantity of “load units” associated with it, and each core on a NovaCor unit can handle a certain quantity of load units. In parallel, dedicated cores are also required for solving the network solution, and those cores have a node maximum





associated with them. You can have up to two network solution cores running on a single NovaCor chassis without decoupling the network into subsystems. It is important to keep in mind that we use “embedded breakers”, meaning that the breakers on transmission lines, transformers, and generators are solved as part of the component and not as explicit nodes that contribute to the network solution limit. This means that often, networks that have more nodes than the stated limit can fit on a unit. For these reasons, it is important to contact us with your circuit information to determine the quantity of hardware required to simulate the network. Given a detailed network diagram, we can definitely quantify this.

If you are curious about how a specific network would be allocated to the RTDS Simulator hardware, please email [marketing@rtds.com](mailto:marketing@rtds.com).

**Q12: What is the fault clearing time generally?**

The fault clearing is normally determined by the external equipment performance. The operating time of the breakers can be programmed in our model to account for that factor. If modelling protection/control within RSCAD, controls components can be used to set and vary the fault clearing time.

**Q13: When modelling PMU- not all PMU algorithms are the same- tend to vary by manufacturer. Do you apply sensitivities to the settings in your library model- are these informed by comparisons to physical devices? Have you seen this impact the performance of the controllers you've studied?**

Yes, you are absolutely correct that not all PMUs have the same algorithm. In RSCAD our model is generic - we are not trying to model any particular vendor-specific PMU. We do however make our PMU algorithm available to users and provide the ability to implement new/different algorithms via our Component Builder module.

If you have the idea to explore PMUs in greater depth, please let us know. We have a few experts in our Protection and Automation group that can provide more in-depth comments.

**Q14: If time permits, please show how to configure the GTNET card for different protocols (to connect PMU & IEDs etc).**





Configuring the GTNET card for different protocols is normally a part of our RTDS Simulator training courses as it can take some time and is case-specific. Perhaps we will make it available as an online tutorial video. If you have specific questions, please contact [support@rtds.com](mailto:support@rtds.com).

**Q15: Is there any session planned for Substep Mode simulation / Documentation available?**

There is extensive documentation available regarding the Substep environment in general and also on specific models available within it. RTDS Simulator users can access this directly in RSCAD. Otherwise please contact [marketing@rtds.com](mailto:marketing@rtds.com).

We will be hosting a webinar regarding Substep simulation later in the year. Please join our mailing list at [www.rtds.com](http://www.rtds.com) to stay informed of our upcoming events.

**Q16: During the simulation, were the different areas 1-3 interconnected?**

The three feeders in our microgrid simulation have intertie breakers which allow them to function in an interconnected manner, but in this particular simulation those breakers were open so each feeder was operating separately.

**Q17: Can cases from Digsilent PowerFactory be imported into RSCAD?**

We are currently developing a conversion facility for PowerFactory models. We hope to release it in 2021 if not sooner.

