Contribution for Question – What are the latest initiatives for reducing the computational time of offline wide-area EMT simulation for power systems with high share of inverter-based resources, and how are these off-line models compared in general against wide-area real-time EMT models?

Many countries across the world are seeing exponential increase in the inverter-based resources connected to the transmission and distribution system. To develop an accurate operating envelope and derive power system stability limits in the presence of high inverter-based resources (IBR), wide-area Electromagnetic Transient (EMT) models have been used by some countries including Australia.

Although, the power system limits derived based on wide-area EMT models are much more reflective of the state of the power system with high penetration of inverter-based resources, the offline studies to develop these limits are often computationally intensive and can take number of hours. The computational time would depend on the size of the wide-area EMT model, the way they are configured and developed, computational capability of the hardware etc.

The Australian power system is experiencing large share of inverter-based resources connected to the grid. The Australian Energy Market Operator (AEMO) is using wide-area EMT models to develop power system stability limits and assessing low system strength phenomenon in areas with high concentration of IBRs. The four-state wide-area EMT model that is being used by AEMO has been develop on PSCAD version 4. The wide-area EMT model has approximately 150 IBR and several hundreds of high voltage transmission lines and buses. Majority of the IBR models are site specific and runs on a very small time-step. The wide-area EMT model takes approximately 5 hours to complete a 30 second simulation when three dedicated servers with 14 cores each is used. Recently, AEMO migrated four-state wide-area EMT model to the PSCAD version 5. In parallel, AEMO made several improvements to the models such as better initialisation of the model, splitting of the network case etc. Also, the tool has been configured to use shared memory for multi-rate data transfer when communicating between projects with different time-steps. These improvements resulted in a substantial decrease in the computational time of off-line studies. The updated model reflecting the improvement outlined earlier takes an hour and 45 minute to complete a 30 second simulation on one dedicated 64 core server.