Digital twin of Power GaN board system

Pascal Bolcato

Rafik Bendahmane

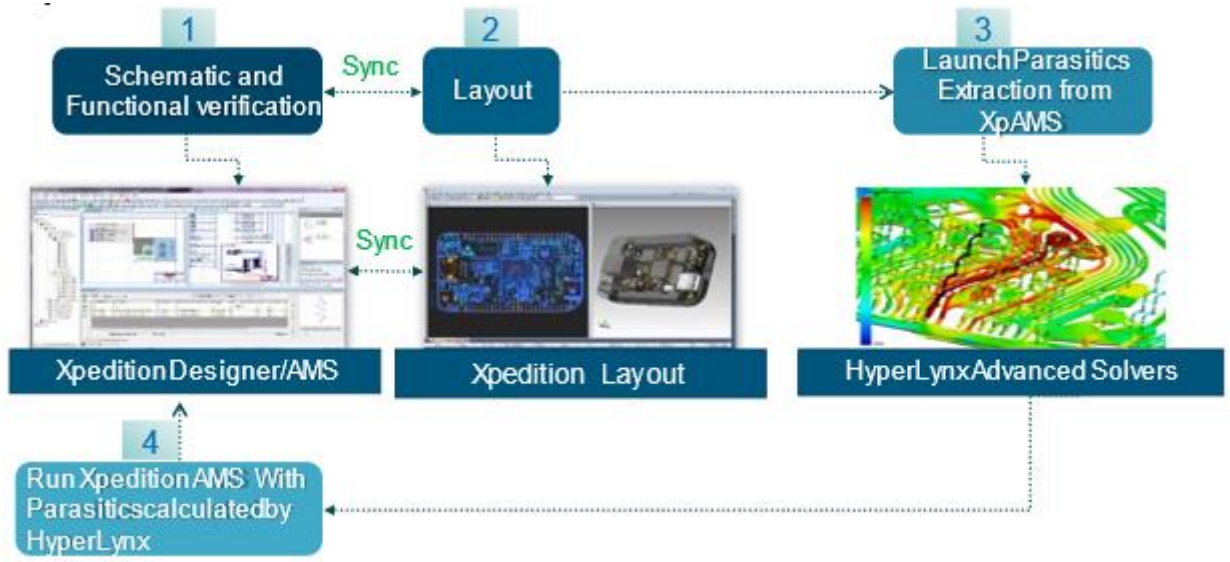
Jean-Marc Talbot

15/03/2022

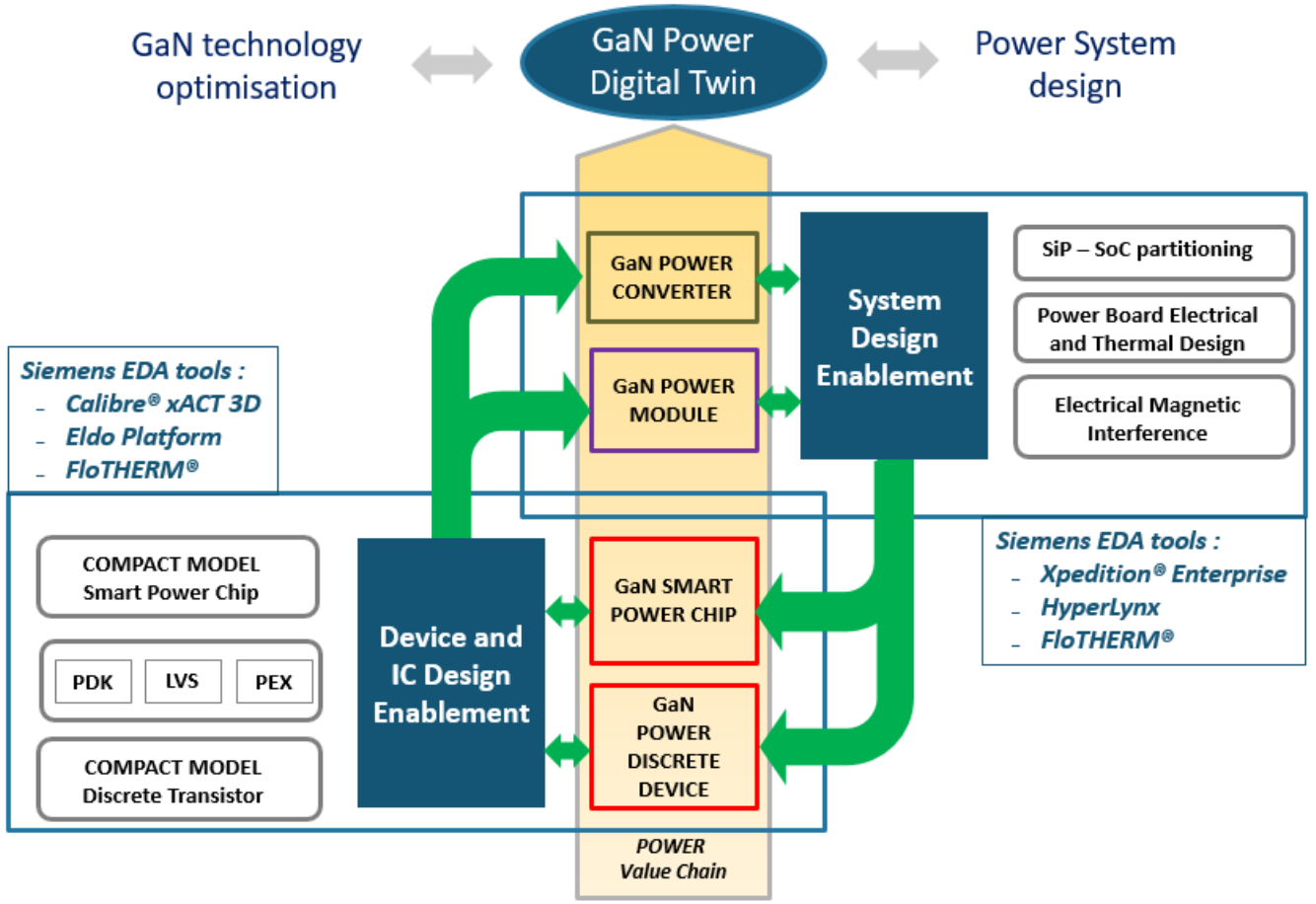
SIEMENS

Digital twin philosophy and objectives

- Digital representation of a Power GaN board system
- Homogeneous environment for design and validation with high-fidelity transistor model and 3D board model
- Seamless integration of advanced solvers allowing the design and optimization of the board within the same environment:
  - ✓ Schematic capture
  - ✓ Layout design
  - ✓ PCB Parasitic extraction, EMC analysis
  - ✓ Thermal and Electrical simulations



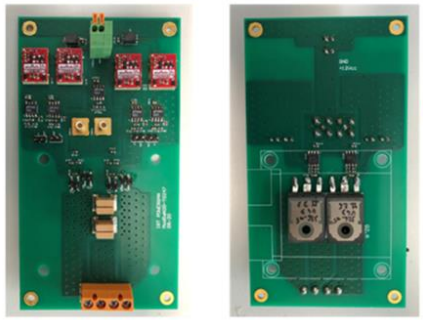
Siemens EDA vision of the Power GaN digital twin



Half-bridge power board with IRT-Power GaN 650V/30A transistors

Study of packaging impact with GaN transistor

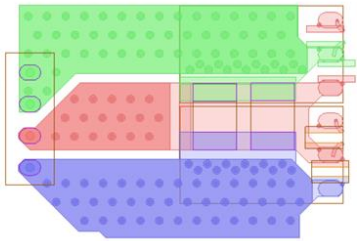
Design under test (DUT)



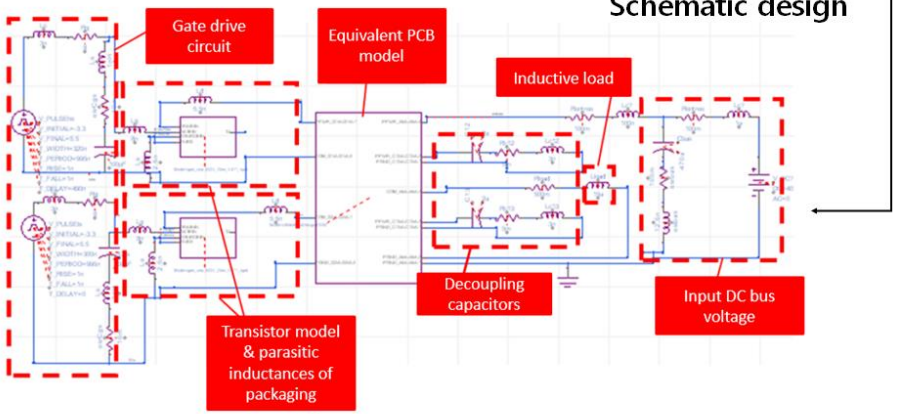
TOP

BOTTOM

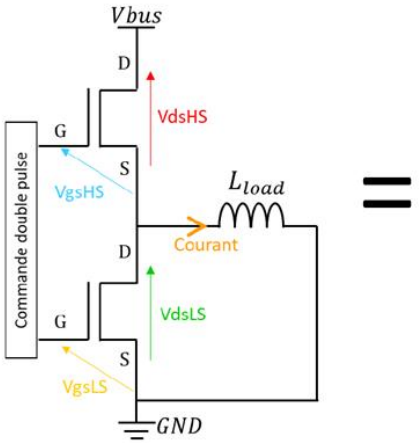
Import in Siemens EDA



Parasitic extraction sent automatically to Schematic design

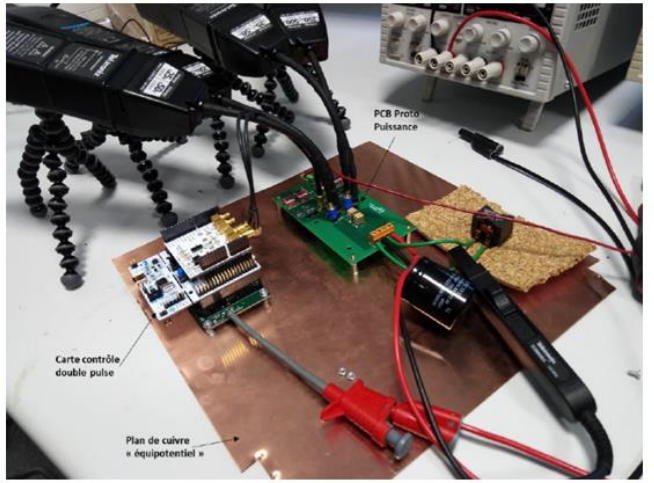


Digital twin model of DUT



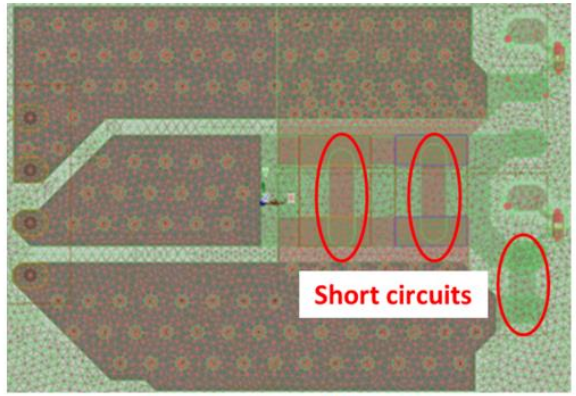
Half-bridge topology

=

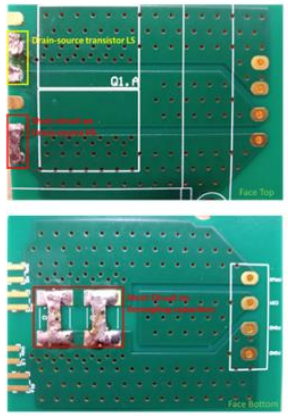


Experimental test setup

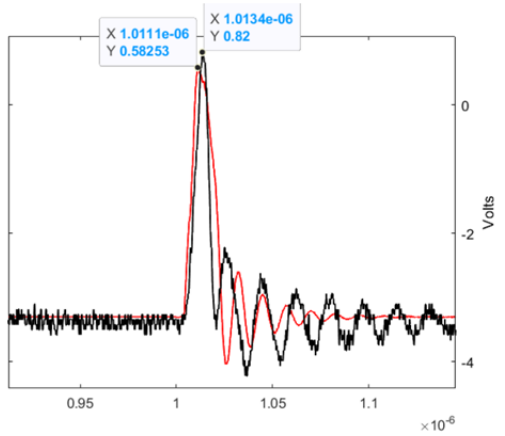
Results : Simulation Vs Measurement

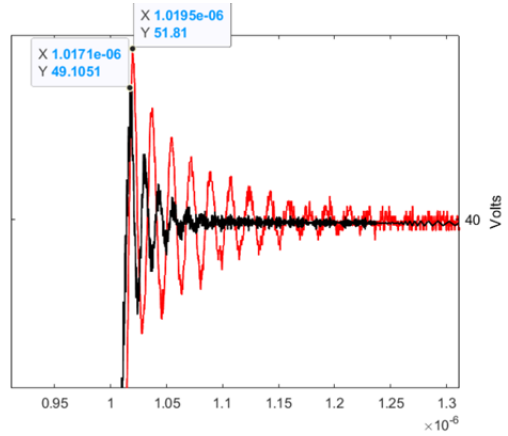


Hyperlynx results: 7,4nH

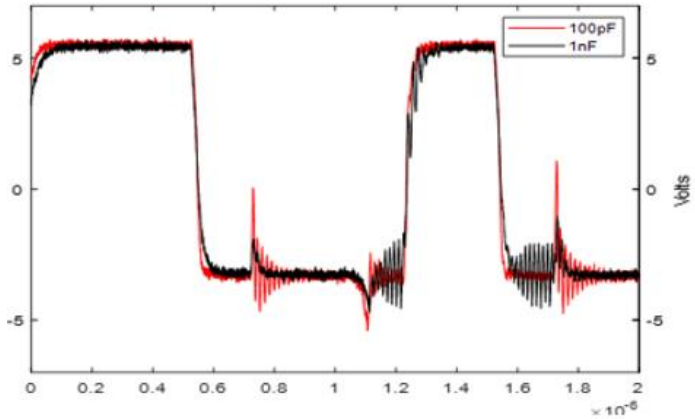


Measure from Low Side Vds voltage~ 7nH



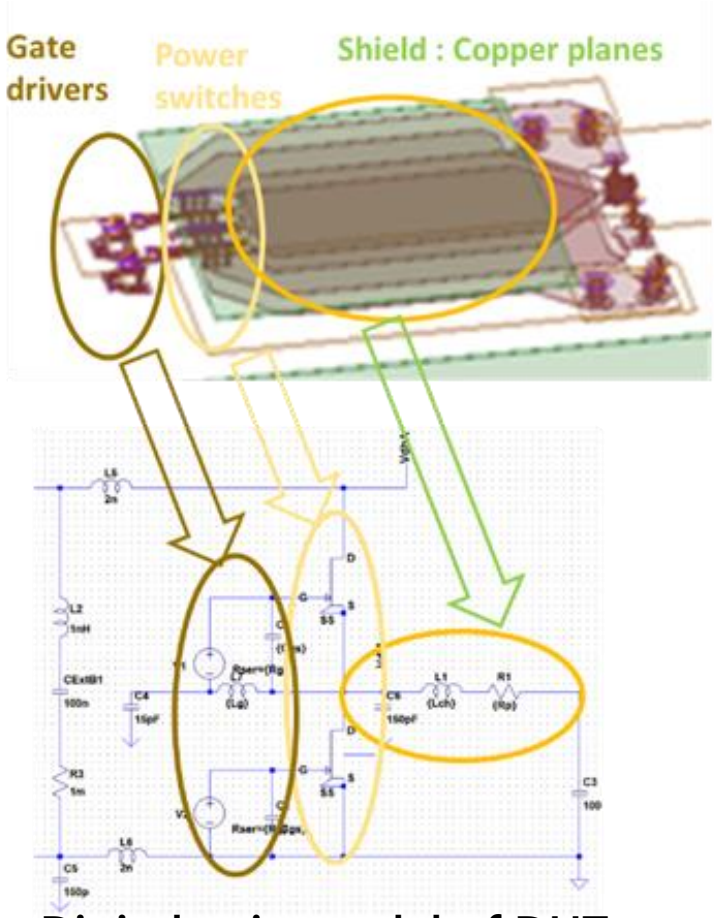


Simulation (Red) vs. Experimental (Black) results



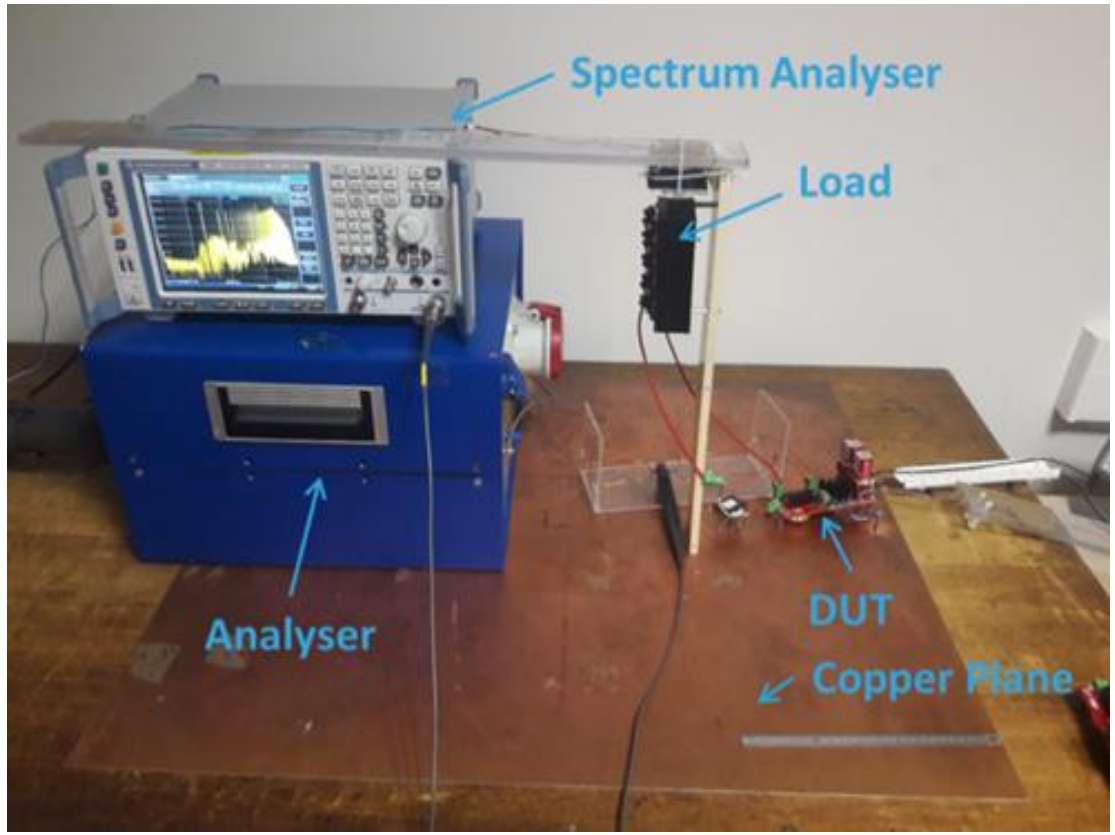
Half-bridge power board with GaNSystem 650V/30A GaN transistors

Study of conducted common mode emission with GaN transistor

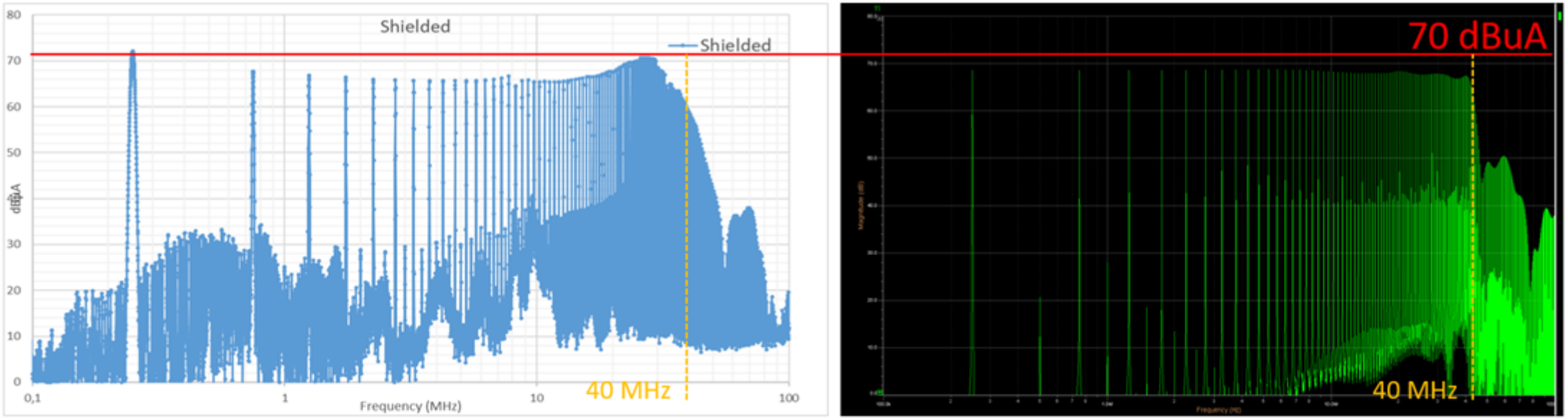


Digital twin model of DUT

Experimental EMC test bench



Results : Simulation Vs Measurement



Simulation (right) vs. Experimental (left) results

Conclusion

Highlights:

- Good consistency between experimental versus simulation results for both functional analysis and EMC emission
- This holistic approach using automated simulation campaign within a unified design environment is mandatory to increase design quality

Challenges:

- The correlation between experimental and simulation results may not be always satisfactory; there is a need to understand all potential causes of differences
- The selection of the right electromagnetic field solver for a given simulation purpose needs a certain expertise level from the user
- Compact models of GaN transistors are young and they should mature over time