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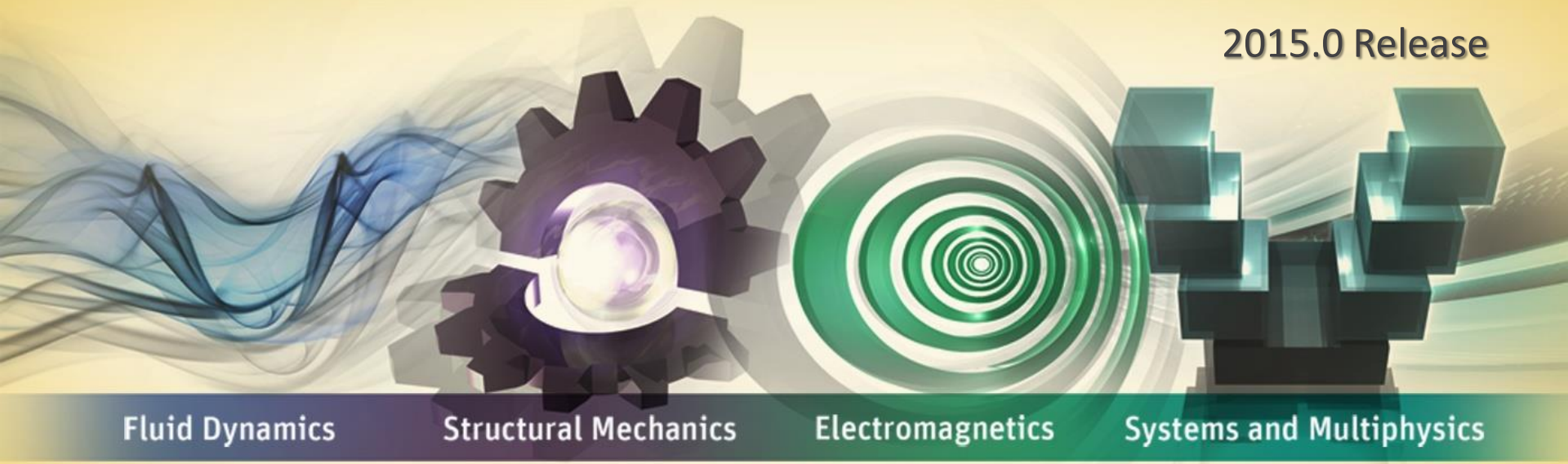
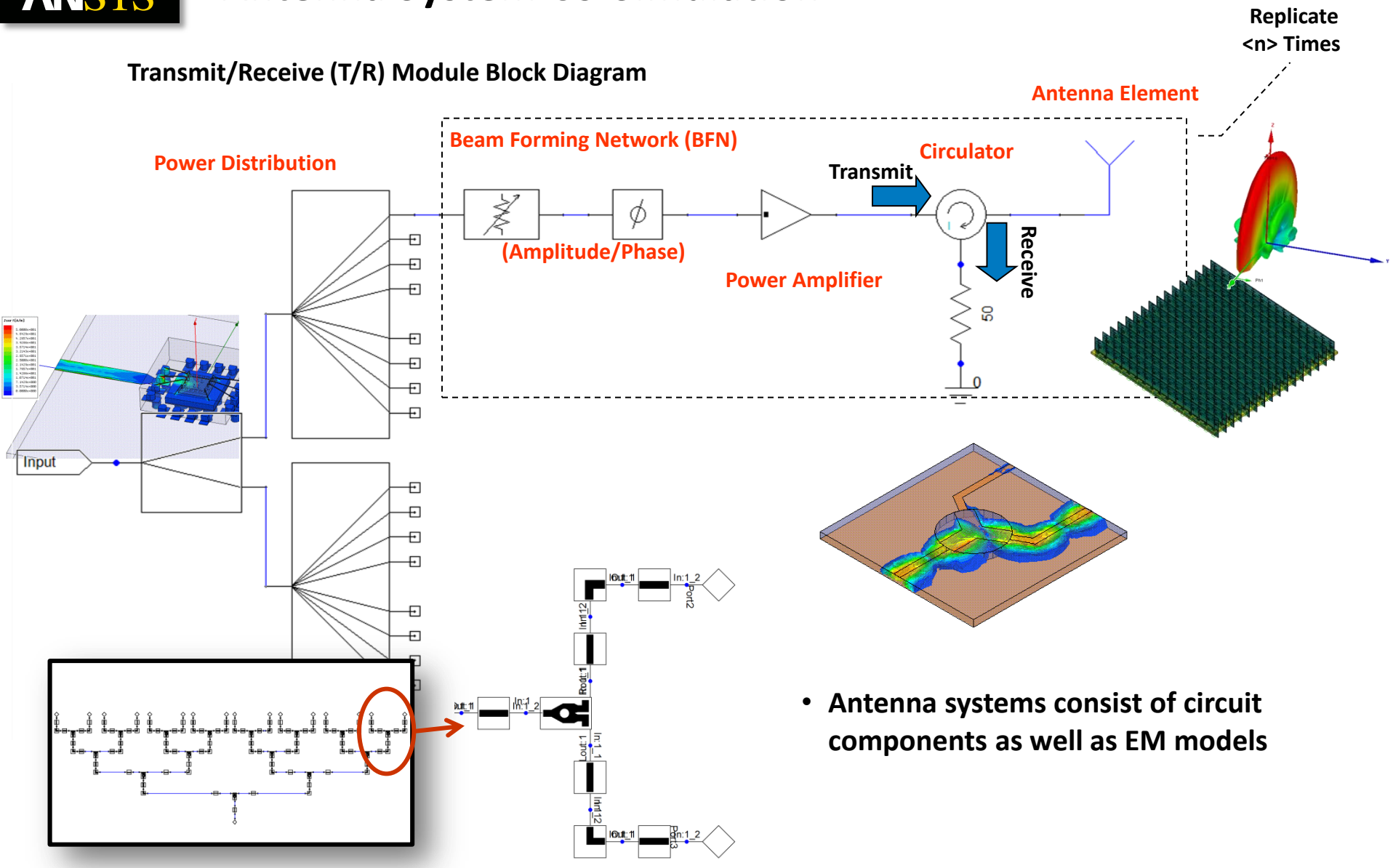
Lecture 5: Dynamic Link



ANSYS HFSS for Antenna Design

Antenna System Co-Simulation

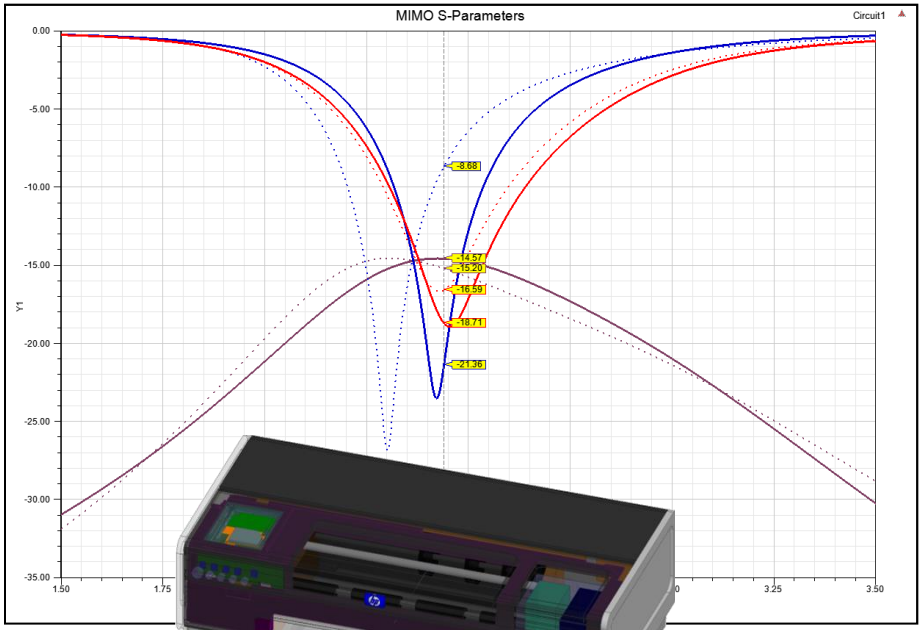
Transmit/Receive (T/R) Module Block Diagram

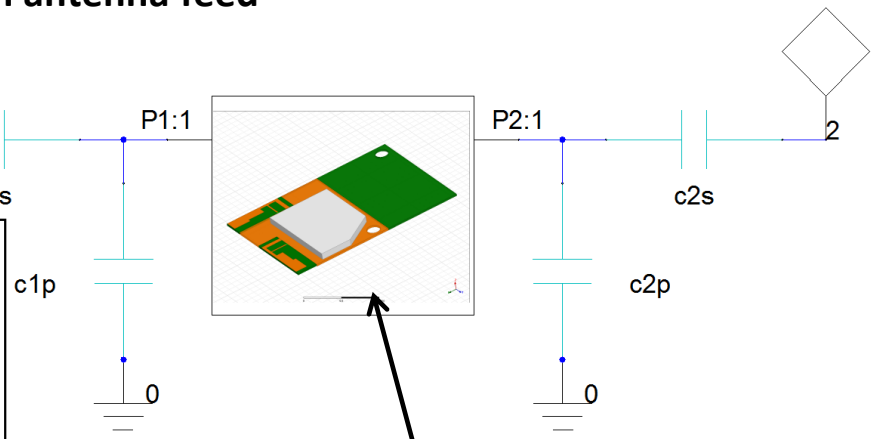


- Antenna systems consist of circuit components as well as EM models

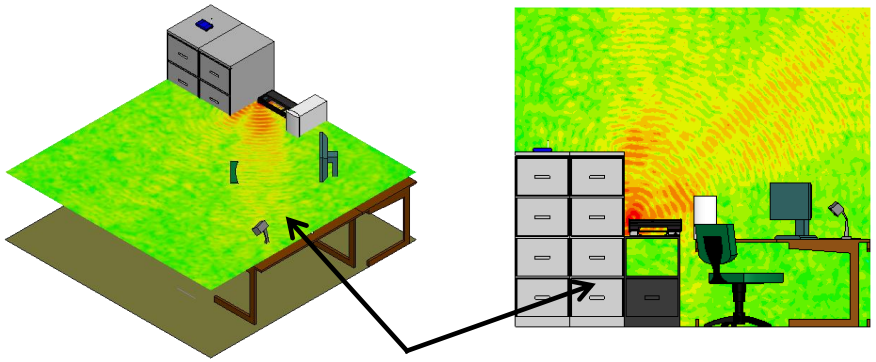
Linear Circuit Simulation

- The HFSS core license enables linear circuit simulation
- Example: Matching network for MIMO Bluetooth antenna feed





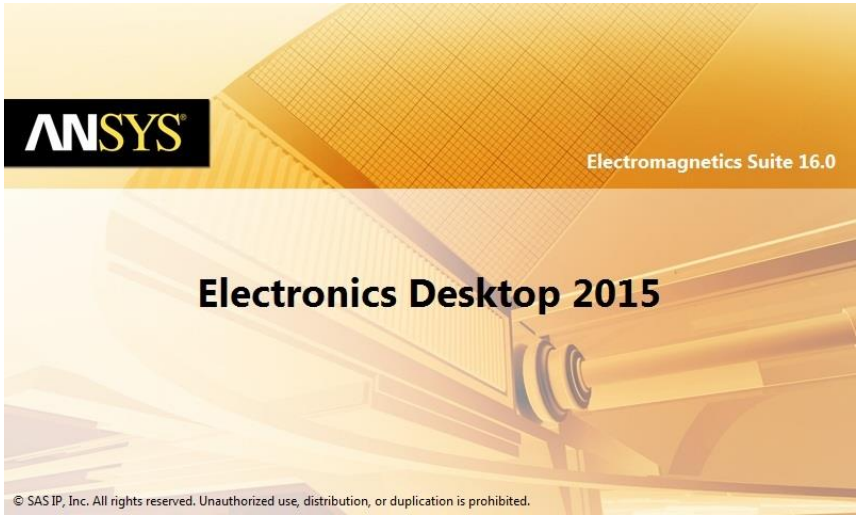
HFSS project embedded in circuit schematic

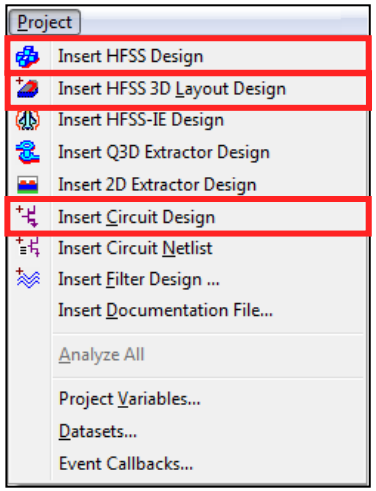


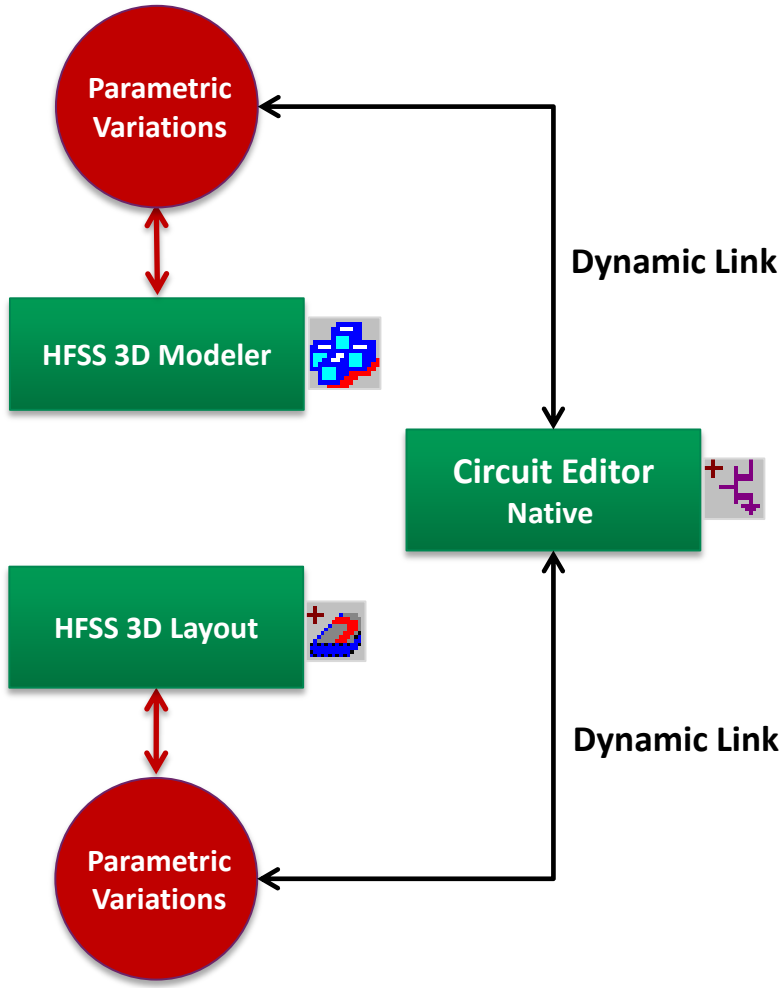
HFSS project excited with voltages solved in circuit simulation

ANSYS Electronics Desktop

- **ANSYS Electronics Desktop 2015.0**
  - Single Desktop Interface for **HFSS 3D Modeler** or **HFSS 3D Layout** or **Circuit Designs**





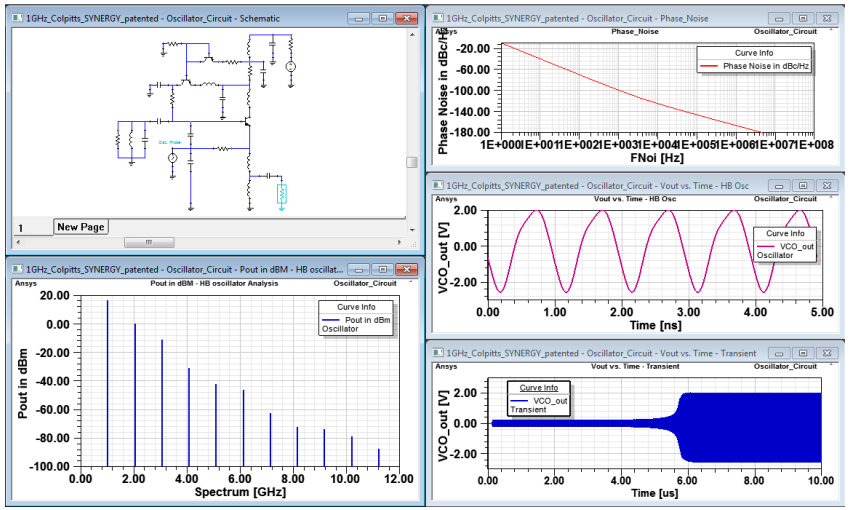


Enhanced Circuit Capabilities

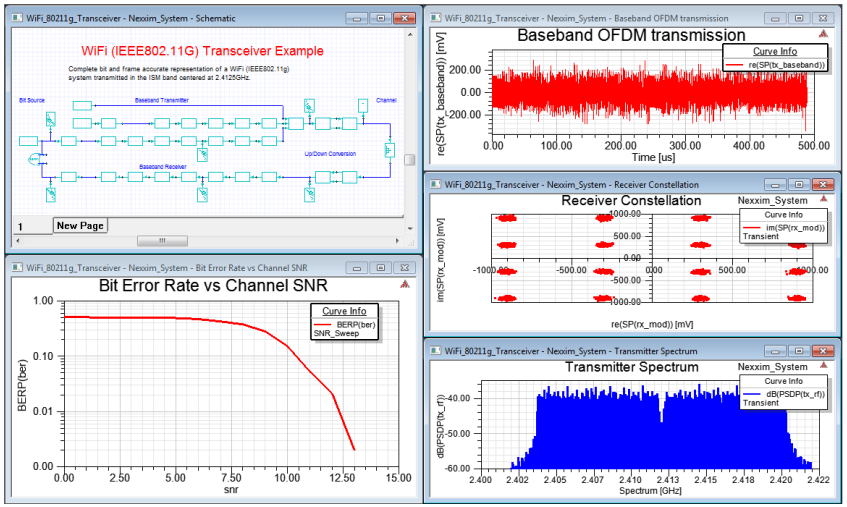
- **Expand the Linear Circuit Capabilities**
  - Add-on the **RF Option** to enable: Harmonic Balance, Oscillator Analysis, Load-Pull, DC, Transient Circuit Simulation
  - Add-on the **SI Option** to enable: DC, Transient Circuit, 3D HFSS-TR, HSPICE Co-Simulation, QuickEye/VerifEye, IBIS-AMI

Linear Circuit Capabilities

ANSYS RF Option



ANSYS SI Option



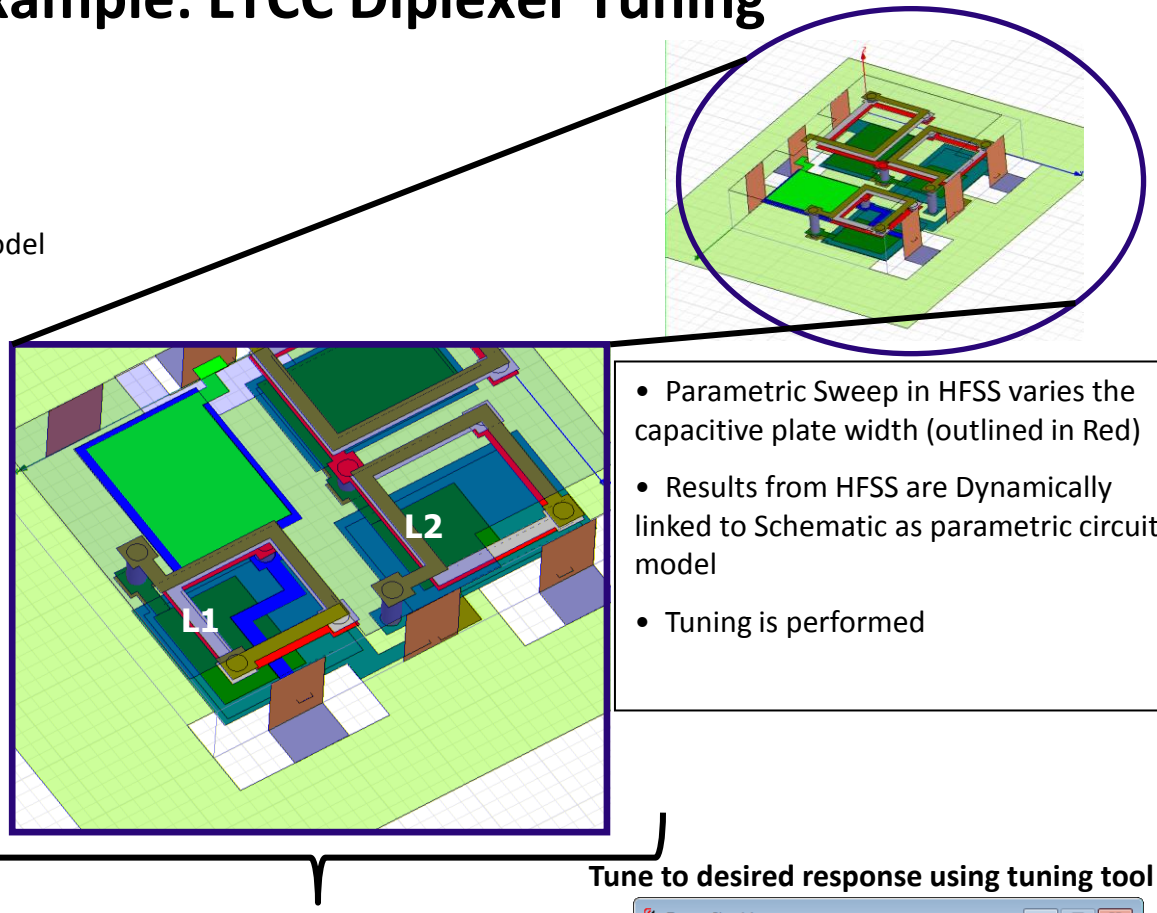
Benefits of Dynamic Link

- **Accelerate Parametric and Design Optimization**
  - Faster design of passive microwave devices,
  - Rapid optimization, sensitivity and statistical analysis of HFSS components
  - Real time tuning of filters, matching networks, etc.,
  - Fast variational studies of high speed channels.

- **Increased design flow power and flexibility**
  - Pushing of phase and magnitude information back into HFSS through Circuit Interface
  - Support design teams by providing parametric HFSS accuracy to circuit designs
  - Generate customer parametric circuit models from HFSS

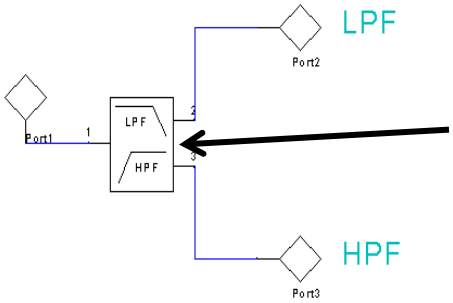
Dynamic Link Example: LTCC Diplexer Tuning

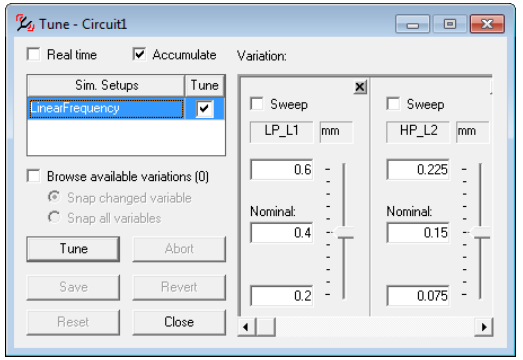
- **Procedure**
  - Model LTCC in HFSS
  - Parametrically sweep capacitive plates in model
  - Dynamically link HFSS Design into Schematic
  - Tune structure
- **Benefit**
  - Diplexer was tuned in real time.
  - Increased tuning resolution
  - Engineer has visual indication of filter performance while optimizing it.



- Parametric Sweep in HFSS varies the capacitive plate width (outlined in Red)
- Results from HFSS are Dynamically linked to Schematic as parametric circuit model
- Tuning is performed

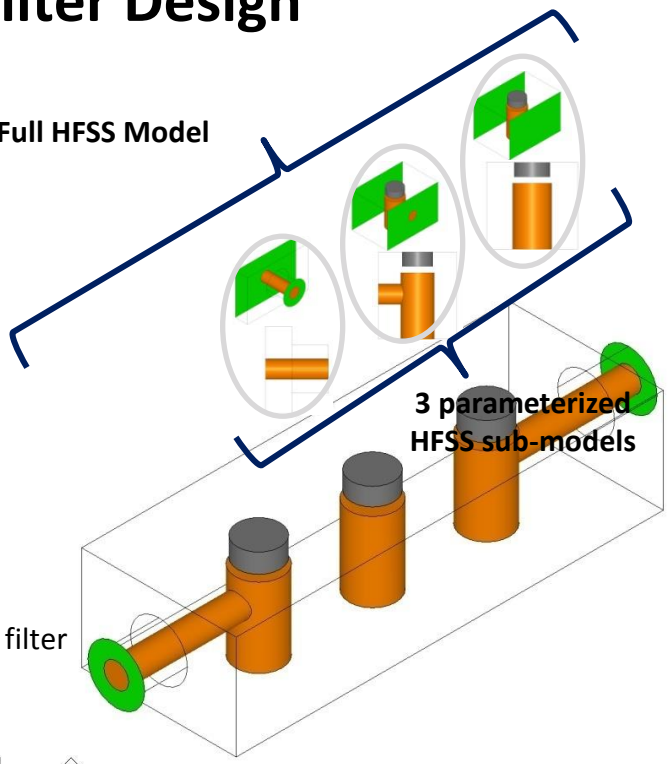
Tune to desired response using tuning tool



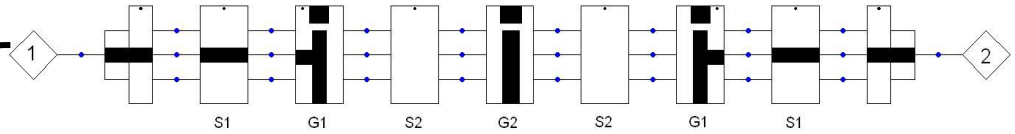


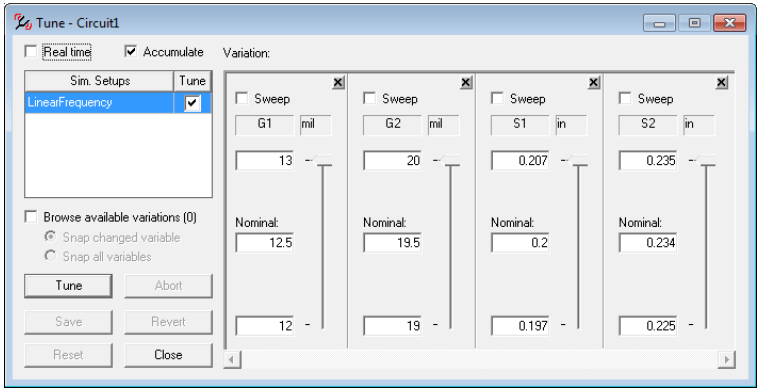
Dynamic Link Example: Resonator Filter Design

- **Nominal Requirements**
  - -20dB bandwidth of 10%
  - center frequency of 10.0 GHz
- **Procedure**
  - Break filter into pieces or sub-models
  - Parametrically solve each sub-model
  - Dynamically link HFSS sub-model results into Schematic
  - Tune device performance
- **Benefit**
  - Model is scalable, circuit design simply adds more sub-models to create higher order filter
  - Engineer has visual indication of filter performance while optimizing it.

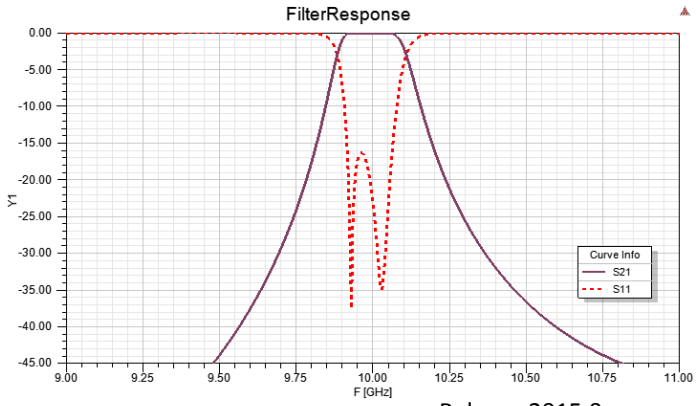


Fully tuneable Circuit assembly representing above filter

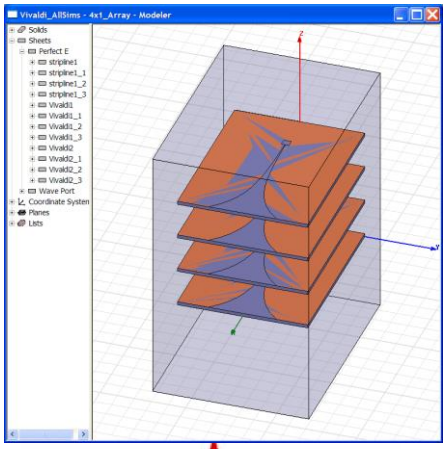




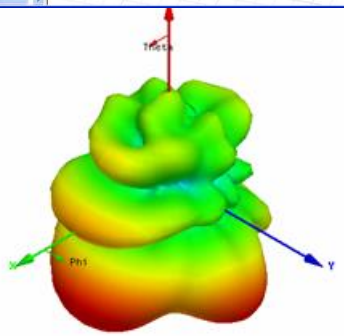
Tuned Filter Response



Example: Pushed Excitations

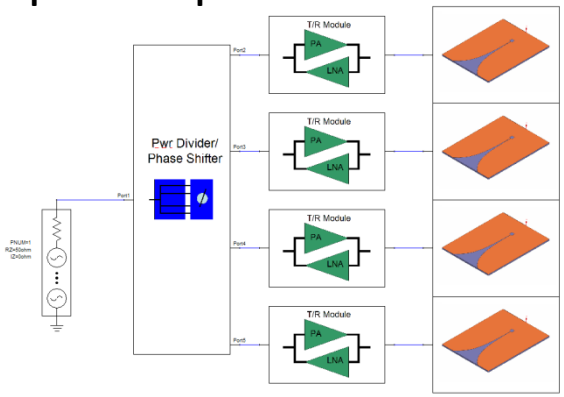


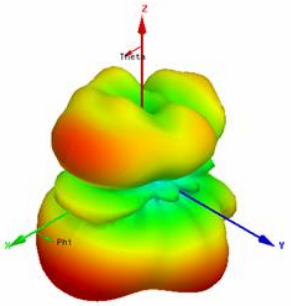
- **Procedure**
  - Simulate 3D HFSS design
  - Create system schematic, including active circuitry in Schematic
  - Dynamically link HFSS
  - Using Nexxim Circuit, solve linear system
  - Pushes true magnitudes and phases back into HFSS for far field calculation.
- **Benefit**
  - Obtain a realistic far field pattern based on the actual magnitudes and phases presented to antenna
  - Better understanding of what happens in non-ideal excitation scenarios
  - Ability to incorporate compensation schemes into design



Baseline (HFSS Only)

Example: Phase imbalance associated with power amplifier compression in a transmit channel

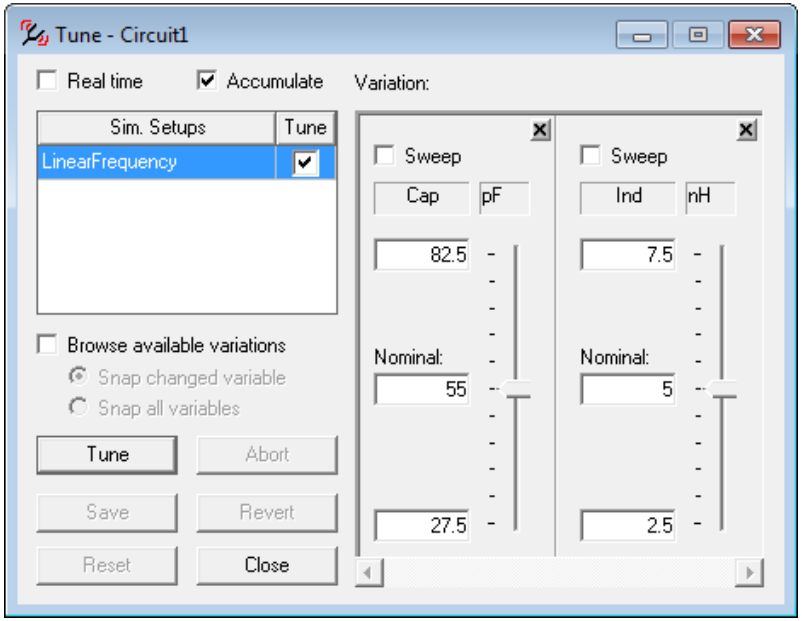


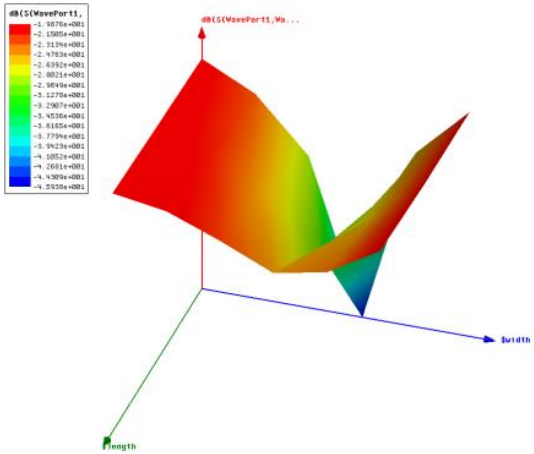


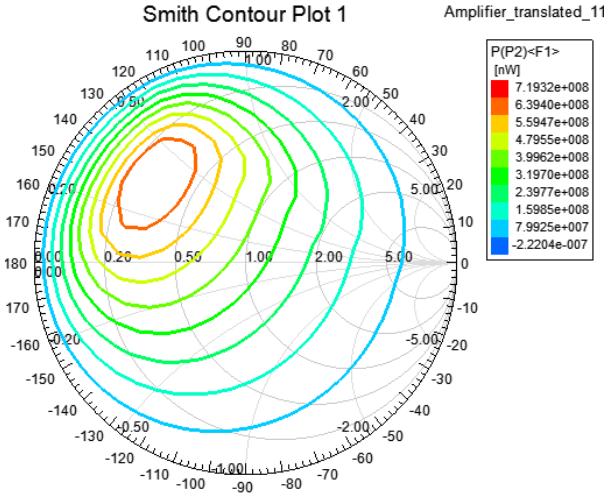
Compression modeled with HFSS + Circuit

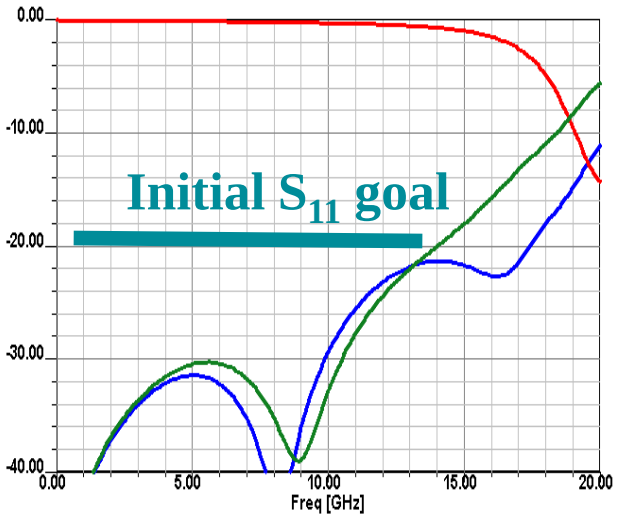
Linear Circuit with Optimetrics

- **Featured Optimetrics Capabilities:**
  - Parametric Analysis
  - Optimization
  - Tuning
  - Sensitivity Analysis



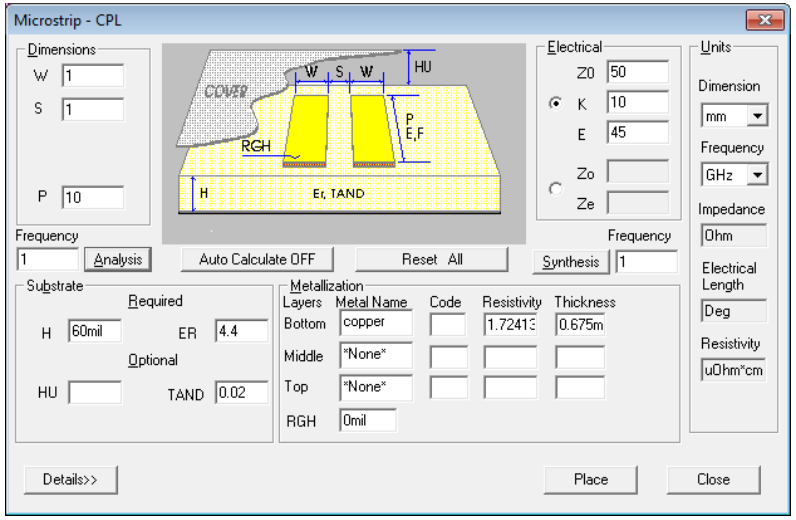




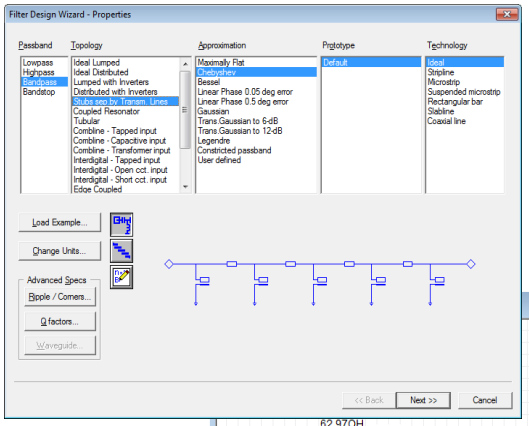


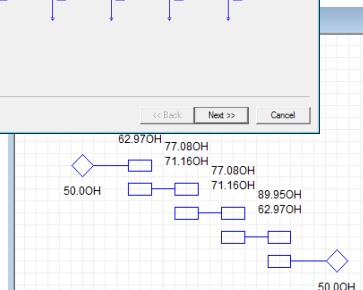
Circuit Design Utilities

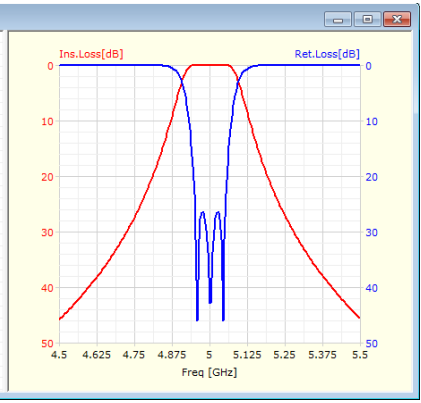
Transmission Line Calculator



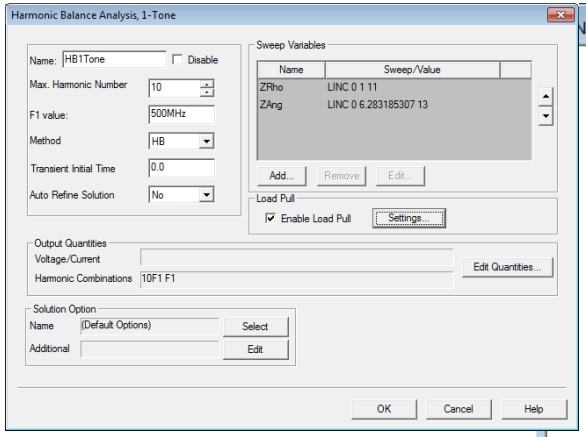
Filter Synthesis

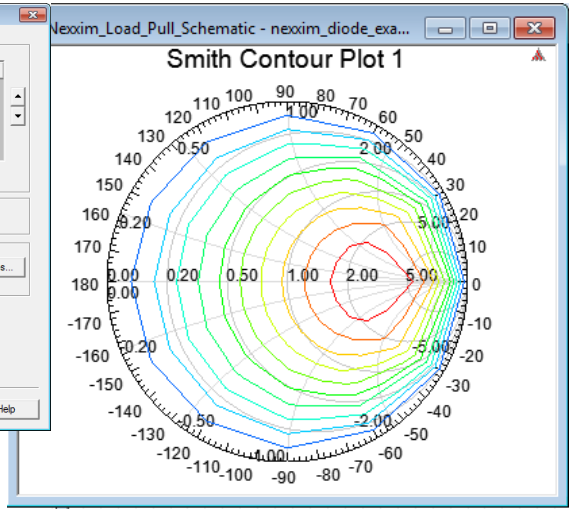




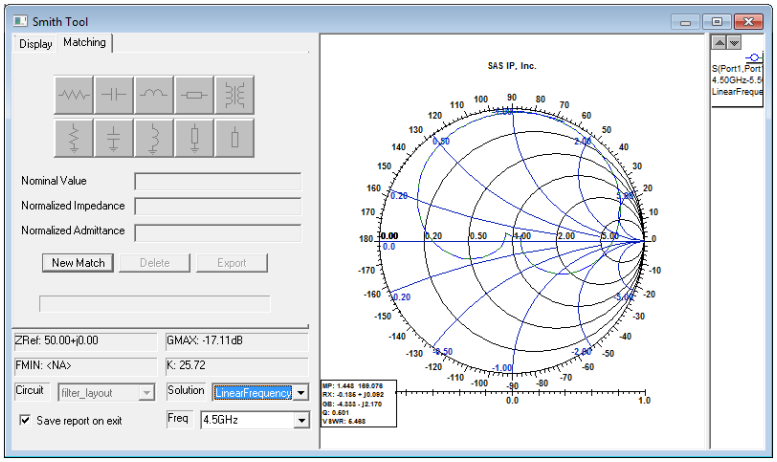


Load-Pull Utility





Smith Tool: Matching Network Synthesis



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