Ensemble™ Essentials

Ansoft HF Users' Workshop 2002

Los Angeles, CA USA

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Ensemble™ Fundamentals Remain the Same …

Independent of GUI !

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Topics

- 2.5D and 3D Excitations
- Editing layers
- Layer types
- Importing/exporting DXF
- Arranging layers/specifying materials
- Creating vias
- Frequency sweeps
- Meshing
- Port solution
- Normalized & generalized S-parameters
- Accurately modeling thin layers
- Advanced solver options
- Environment variables

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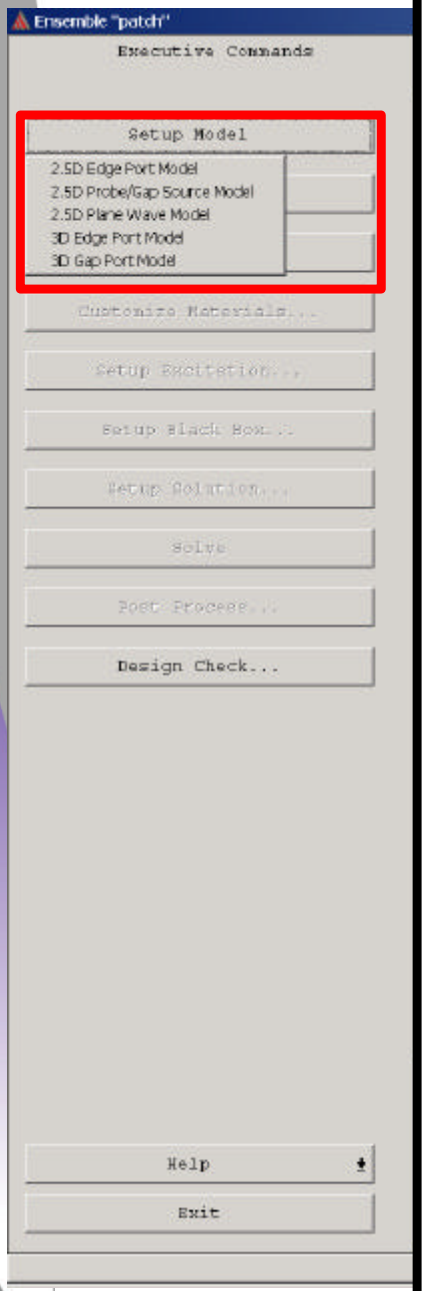

5 Excitation Types:

- 2.5D Edge Port (default choice)
  - Excitation parallel to trace/slot plane(s)
  - High freq.(~>100MHz)/electrically larger geometries
  - .7*lambda de-embedding arms, compute S matrix from currents induced on arm
  - Higher order modes ok
  - 2D mesh, metal thickness accounted for with Zs
  - Orthogonal/cylindrical vias *only*
- 2.5D Probe/Gap Source
  - Coaxial probe perpendicular to signal plane
  - Voltage Gap Sources
    - 1Hz to occurrence of 1st higher order mode
    - 1V at excited port, current computed at all ports (defines Y matrix)
    - No de-embedding arms/overlap issues
- 2.5D Plane Wave
  - RCS only
- 3D Edge/Gap Port
  - 3D ports similar to 2.5D (freqs., de-embed arms)
  - Extra cost/licensed feature
  - Metal thickness modeled using 3D surface mesh
  - Non-cylindrical/orthogonal vias allowed

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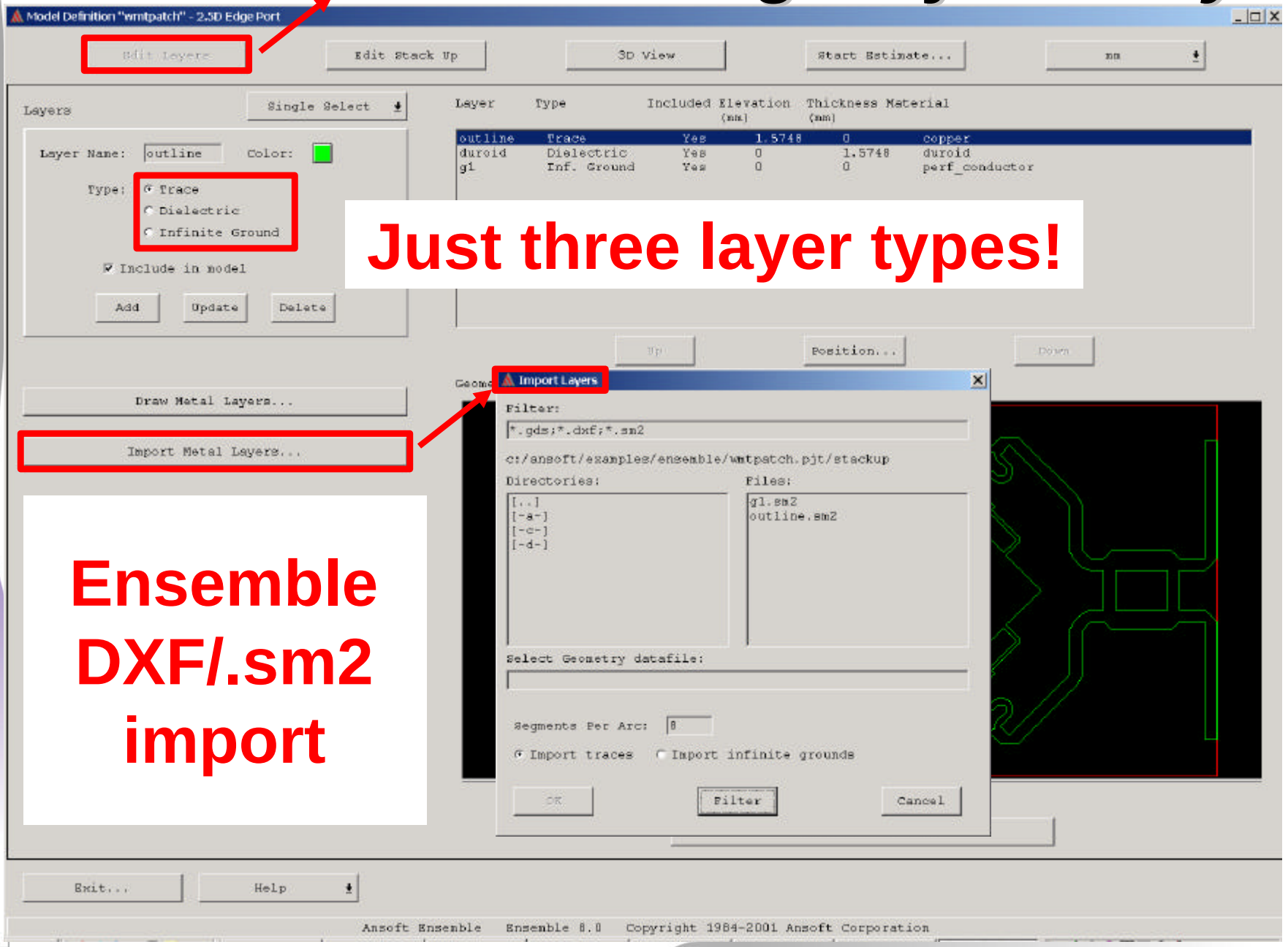
Create/remove/arrange layers *only*



Just three layer types!

Ensemble DXF/.sm2 import

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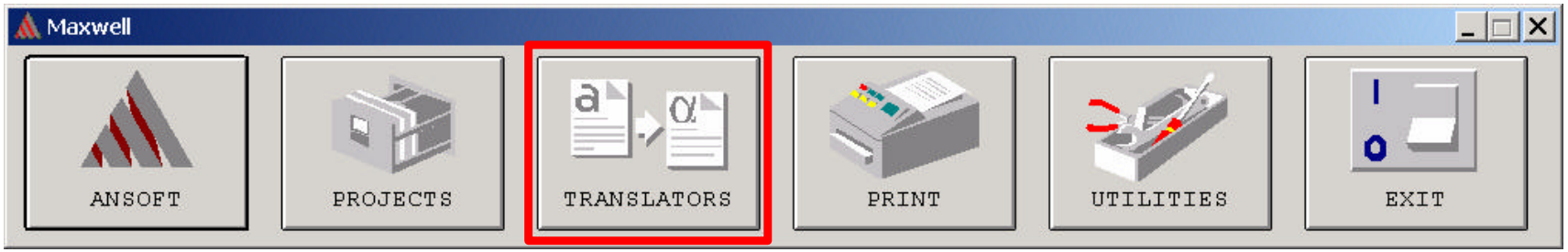
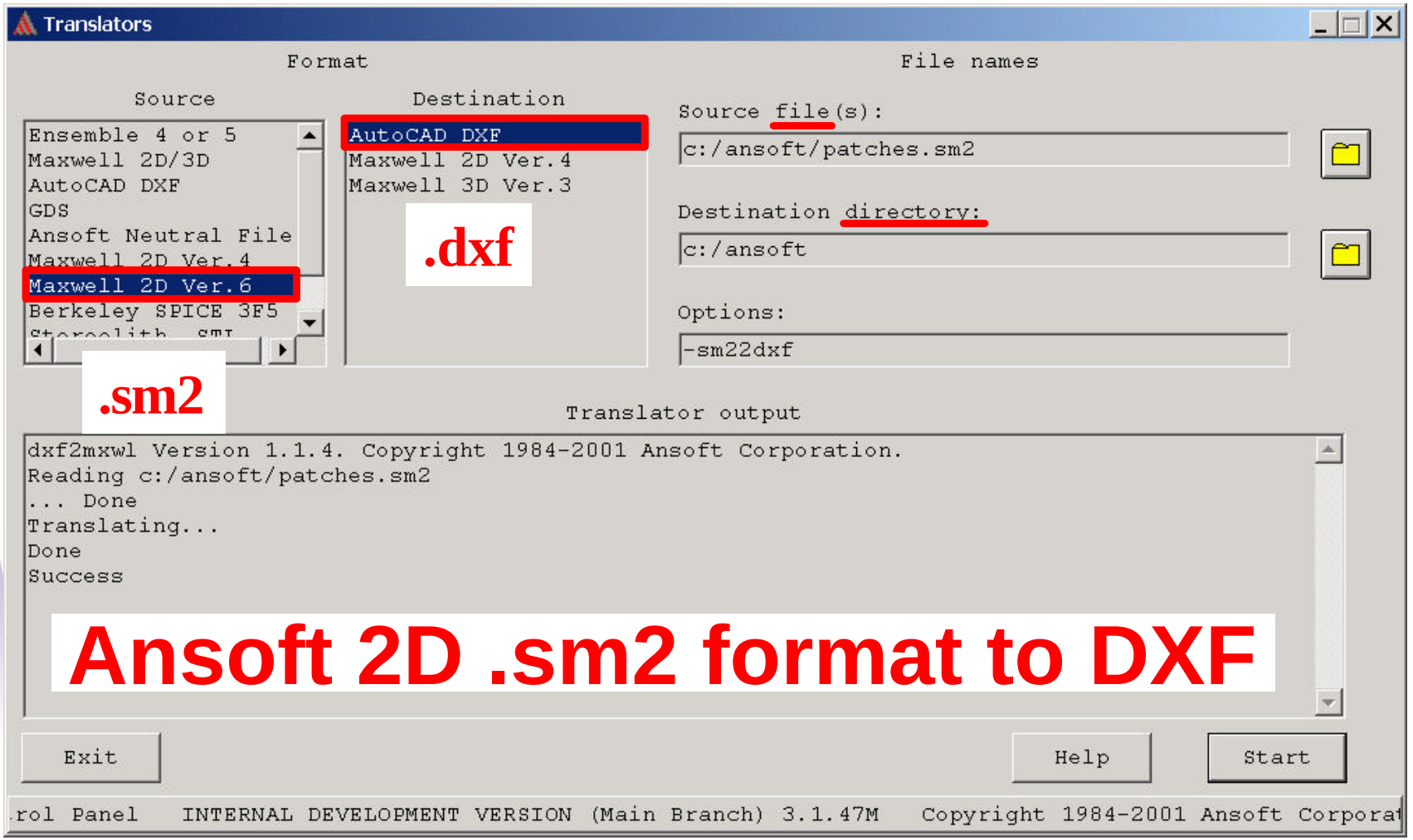
Three Layer Types

- Trace
  - All objects drawn on trace layers are metal
  - To create an aperture drawn within a trace
    - Draw both objects
    - “Customize Materials” inner object to air
- Dielectric
  - Infinite in XY plane, finite in Z direction
  - Infinite dielectric effects
    - Antenna patterns at horizon
    - Other finite dielectric effects not captured
  - Elevation reference for Trace & Inf. Grounds
  - Define first! (dielectrics are elevation reference)
- Infinite Ground
  - Infinite in XY plane
  - All objects drawn on inf. ground layers are slots
  - To create a metal object drawn within a slot
    - Draw both objects
    - “Customize Materials” inner object to metal

Importing/Exporting DXF

- "Zero Width Closed Polylines" Only
  - No thick lines
  - Polyines begin and end at same point
- AutoCAD R14 DXF





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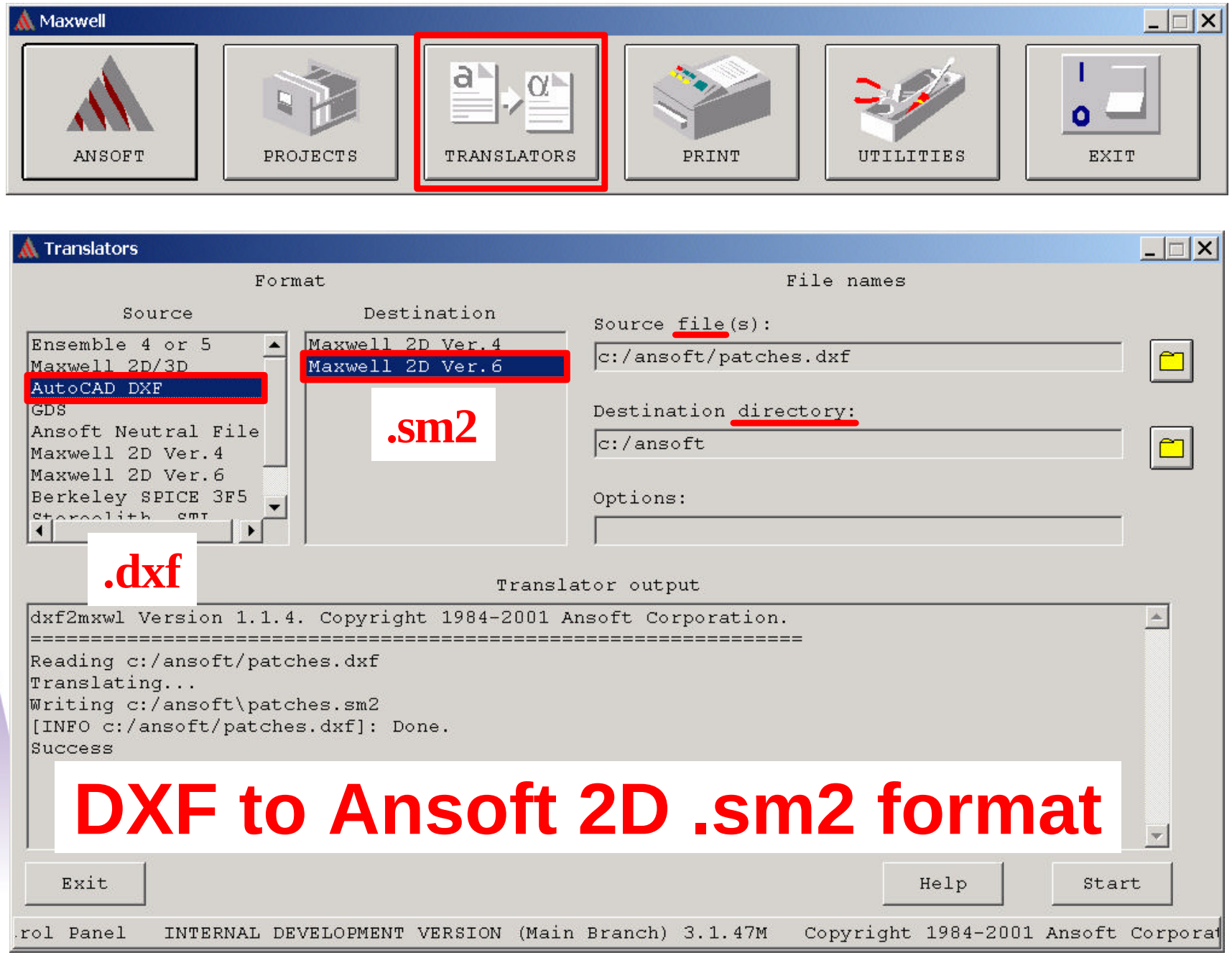

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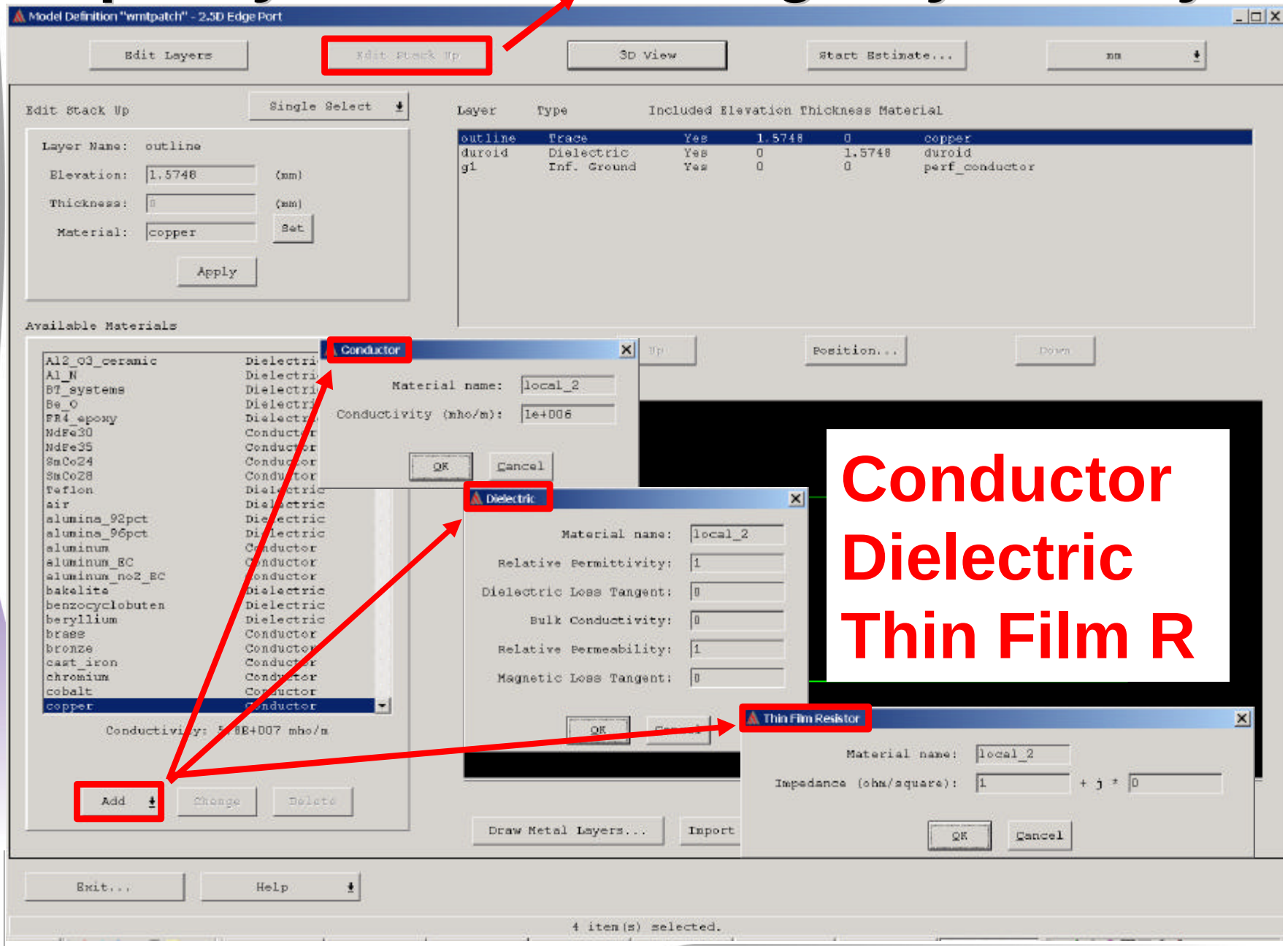
Specify materials/arrange layers only



Conductor
Dielectric
Thin Film R

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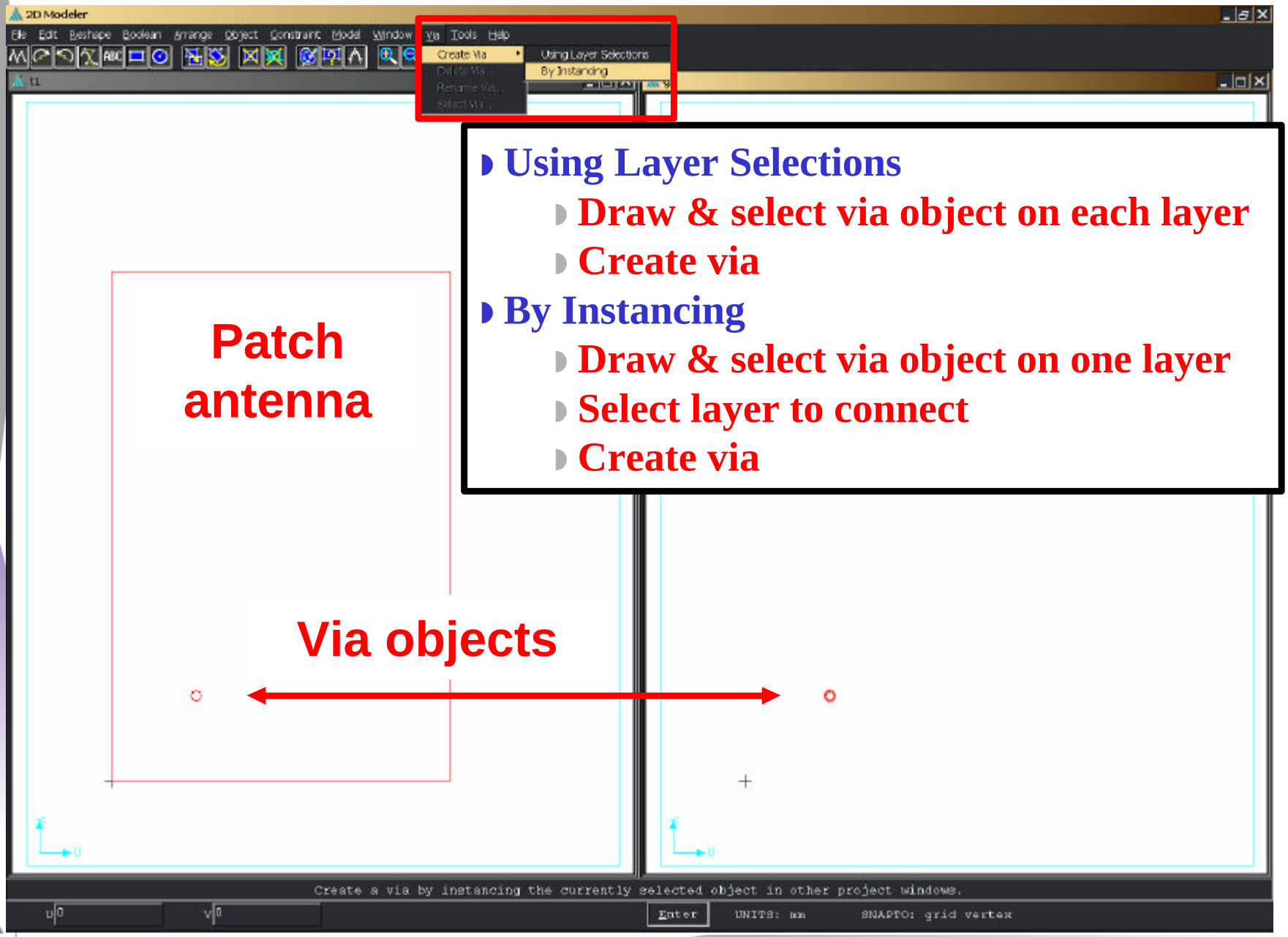
Creation of Vias



- Using Layer Selections
  - Draw & select via object on each layer
  - Create via
- By Instancing
  - Draw & select via object on one layer
  - Select layer to connect
  - Create via

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2.5D & 3D Vias

- 2.5D Vias
  - Cylindrical
  - Induced currents are vertical
  - Induced currents are circularly symmetric
- 3D Vias
  - Arbitrary cross section
  - Induced currents in any direction
  - Meshed similar to other metal surfaces

Frequency Sweeps

- Fast Sweep
  - S-parameters only
  - MoM matrix solved only at freqs. needed for interpolation
  - Faster in general than Discrete for large number of freq. points
  - No way to know in advance how long sweep will take
  - Currents not saved
- Discrete Sweep
  - MoM matrix solved at every freq.
  - Currents may be saved/plotted
  - Near/Far fields may be generated
  - Solve time may be estimated

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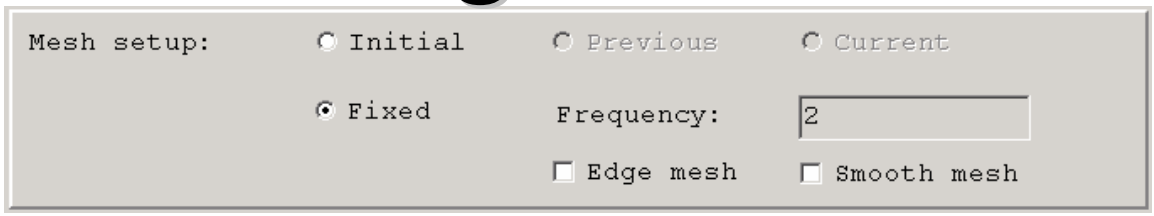
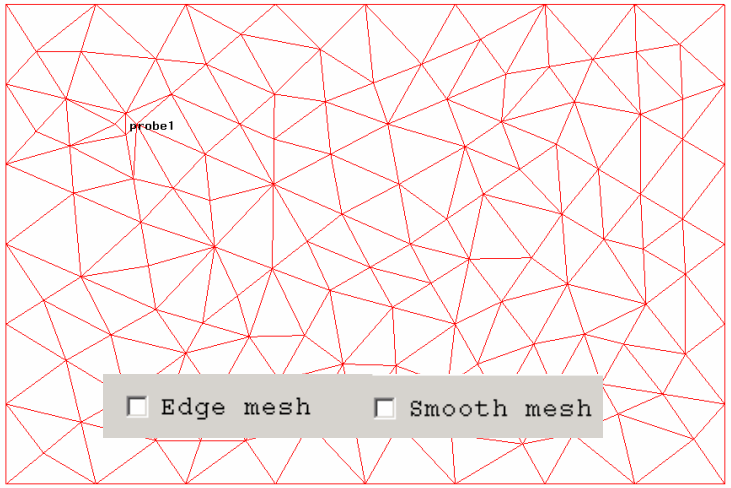
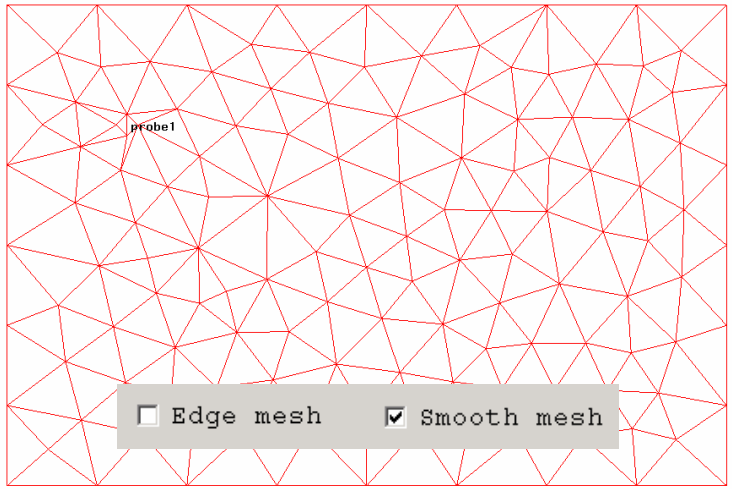
Meshing Guidelines

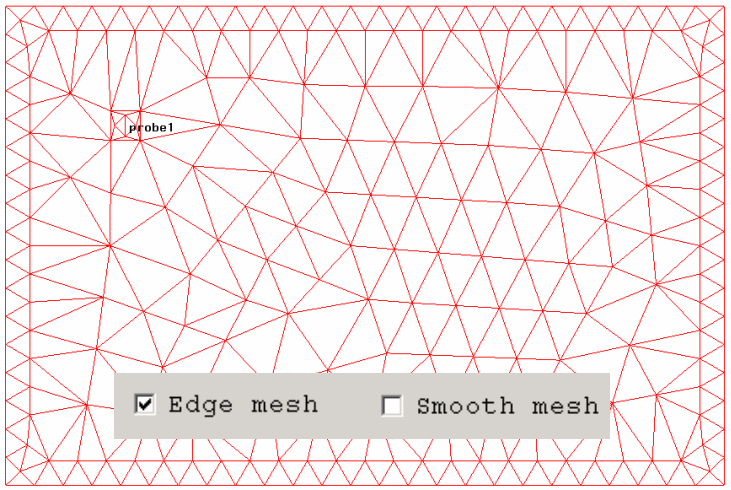


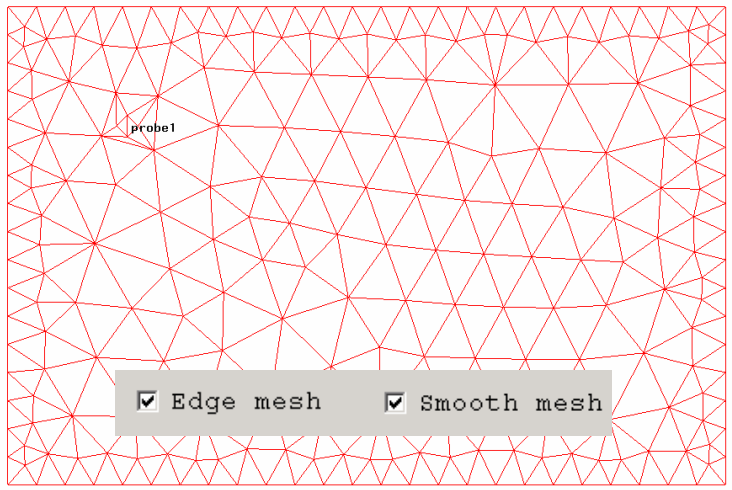
- Use Fixed mesh
- Use highest freq. of interest as starting point for mesh frequency
- Investigate effect, in band of interest (i.e. shift in resonance), of increasing mesh density
- Edge meshing/virtual objects* may assist in capturing behavior, as currents flow along the edge of conductors
- Poor mesh = poor result ("Garbage in, garbage out")

Mesh Illustrations









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Port Solution

- Microstrip, Stripline: $Zo=Z_{PI}$
- Slotline, CPW: $Zo=Z_{PV}$
- Full-wave eigenvalue problem (includes dispersion)

Normalized and Generalized S-Parameters

- Normalized
  - Zo typically the same for all ports
  - Zo typically 50 ohms
  - Zo constant over frequency
- Generalized
  - Computed by default
  - Each port may have different Zo
  - Zo varies with frequency

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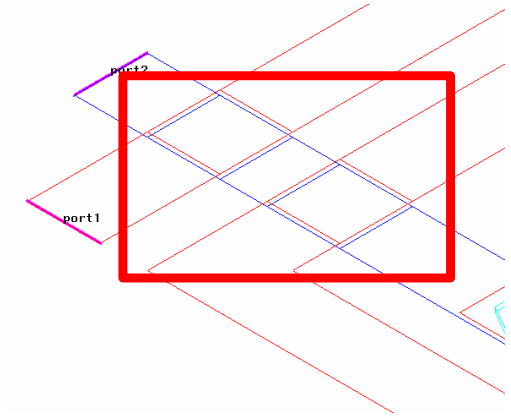
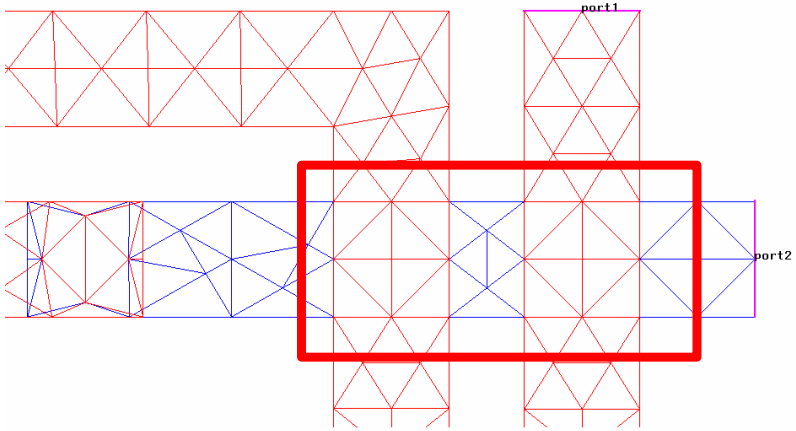
Accurate Modeling of Thin Layers: Meshing and Trace Thickness

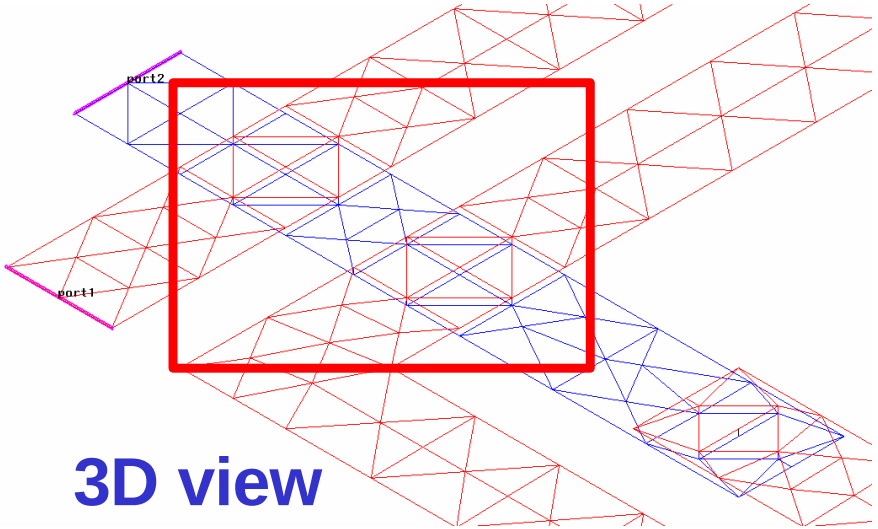
Example:
Spiral inductor



Virtual objects force same mesh on both layers, improves calculation of current interactions

mesh top view





3D view

Appropriately set ENSEMBLE_TRACE_THICKNESS*

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Advanced Solver Options I

- Loop Tree
  - Utilized by default
  - MoM matrix re-ordering
  - Stabilizes calculations at very low frequencies
- Gap Port Calibration
  - Eliminates mismatch between port and feedline
  - Uses Through Reflect Line (TRL) method
  - Provides most improvement at high frequency
- Accuracy Level
  - Adjusts accuracy of MoM integrals, port solver, and matrix resolution
  - Default is lowest setting of 1

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Advanced Solver Options II

- Direct
  - Used for small problems requiring highest accuracy
  - Used by default up to 1000 unknowns
- Iterative
  - Resolves MoM matrix equation faster than Direct for problems larger than approximately 1000 unknowns
  - MoM matrix accumulation, memory use, and accuracy levels the same as Direct
  - Used by default for problems with 1000-5000 unknowns
- Fast (SVD FastSolve™)
  - Uses loop tree, iterative solver, Ansoft matrix compression
  - Far less memory required
  - Memory compression ratio problem & frequency dependent
  - Used by default for problems >5000 unknowns
  - Not efficient for problems <~5000 unknowns

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Environment Variables

- ENSEMBLE_TRACE_THICKNESS
  - Utilized by 2.5D engine only, Zs(t)
  - Default 17.5um (1/2 oz Cu)
  - 0<thickness<1mm
  - Global setting – all trace layers
  - Setting other than default appears in profile
- ENSEMBLE_CPW_BOTH_MODES
  - Set to compute even and odd mode CPW
  - Both CPW slots must be the same width

Ensemble™ Fundamentals Remain the Same …

Stay tuned for NextGen !

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