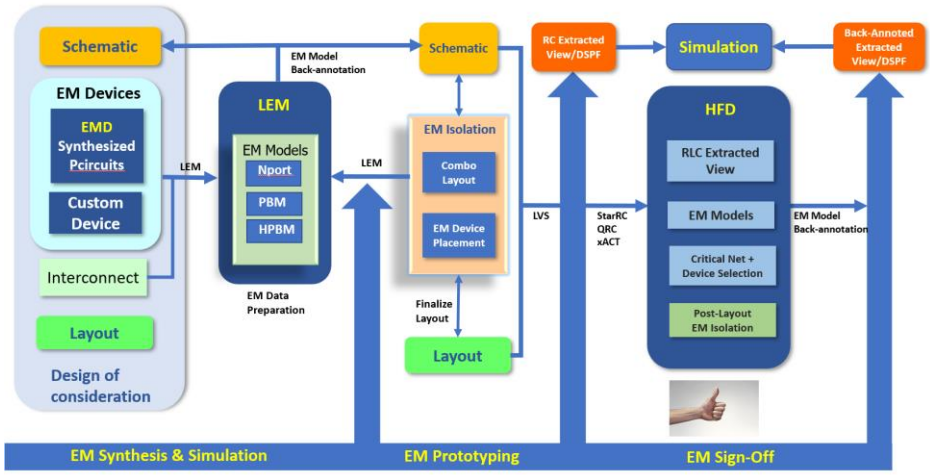
LORENTZ SOLUTION

High Frequency Designer (HFD)

Overview

PeakView™ electromagnetic design platform offers the most comprehensive design solution covering every EM design needs across every design stage for today's most challenging RF/mmWave/TeraHz High Speed IC design applications. With early design capture and modeling of devices and interconnect, hence finding optimal device placement based on EM isolation and coupling analysis along with EM prototyping to reduce the risk of downstream design respin, and finally achieves the high quality EM sign-off with confidence through HFD.



PeakView™ HFD™ is a post-LVS electromagnetic and parasitic inductance extraction tool for signing-off the electromagnetic behavior of critical signal paths and EM isolation in high-speed designs. At microwave and millimeter wave frequencies, full-wave electromagnetic (EM) modeling of interconnect routing becomes indispensable to accurately characterize the fullwave EM effects or parasitic inductive (L) effects of these structures. Today's common LPE flow only focuses on R and C extraction while missing the L parasitic components, unsuitable for high-speed or mmWave extraction needs.

HFD™ will fill the gap for such insufficiencies in LPE solutions, by using PeakView™ EM engine to electromagnetically simulate and model the selected interconnect geometries. Upon completion of Calibre LVS run, users can proceed with their RC extraction flow. After selecting critical nets and coupled devices in Virtuoso schematic or layout views, HFD will automatically separate the selected nets from the design with Calibre's svdb and electromagnetically simulate the corresponding interconnect geometries using PeakView™ EM engine. Finally, the interconnect EM models will be automatically back annotated to the original post-layout parasitic extracted views or DSPF file for netlisting and simulation.

Benefits

EM Sign-Off with DC-mmWave-TeraHz 3D Full-wave Accuracy & Performance

HFD™ offers true EM sign-off for today's most demanding high frequency IC designs. Once the design reaches LVS completion, HFD can perform EM isolation on device and interconnect to ensure EM effects on the overall system performance is within the desired specifications, and the design can be freeze with EM sign off quality, the EM sign-off confidence can be well achieved by HFD's accurate EM models of the parasitic inductive, resistive, capacitive effects and substrate losses using PeakView's 3D full-wave simulation along with the performance from iterative high capacitive solver(HCS) technology.

Automation and Flow Integration

PeakView HFD™ is integrated into Virtuoso® schematic and layout editors and main-stream RC extraction flows. This enables designers to work within a familiar IC design environment. Designers can select nets and devices from the schematic or layout editor. HFD then prepares them for extraction, pin insertion for simulation, model generation and back-annotation. HFD manages all of the details behind the scenes and automatically ensures design data integrity while including the effects of EM coupling in circuit simulations.

Wide Applications

PeakView HFD places special emphasis on electromagnetic coupling effects present in a wide range of RFIC transmission media. In addition, it excels in accounting for skin effect losses not considered by traditional RC extraction tools. HFD is being adopted in analyzing critical interconnect components for voltage controlled oscillators (VCO), low-noise amplifiers (LNA), power amplifiers (PA), differential transmission lines, CPW lines, micro-strip lines, digital clock lines and a host of other high-frequency integrated systems. It is highly suitable for millimeter-wave radar applications at 77 GHz and 94 GHz bands.

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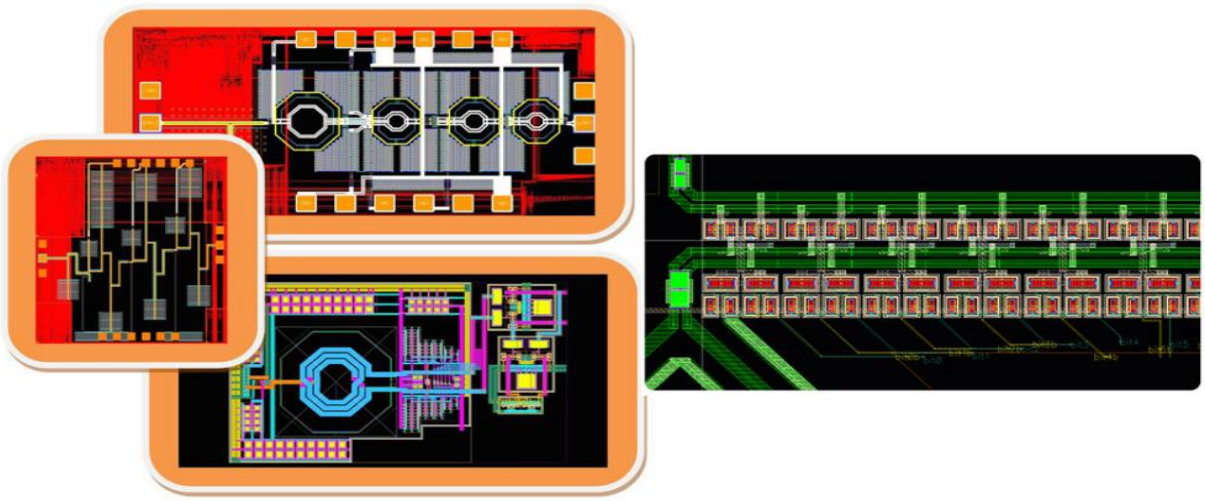
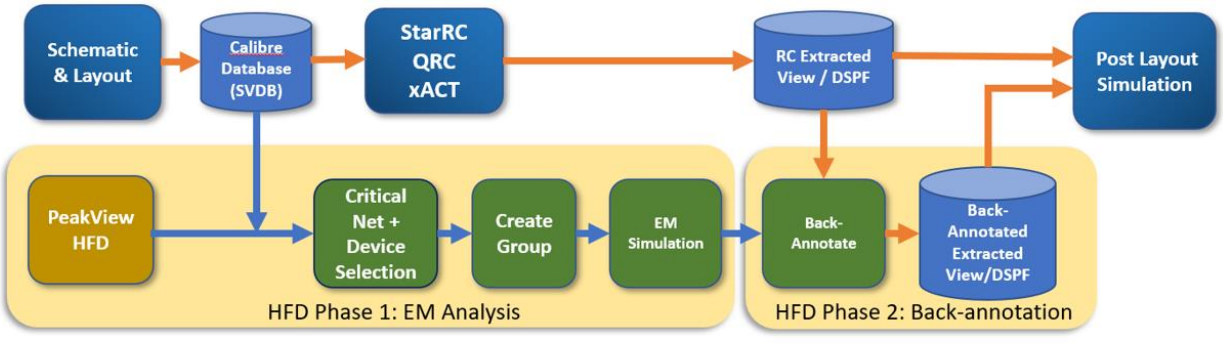


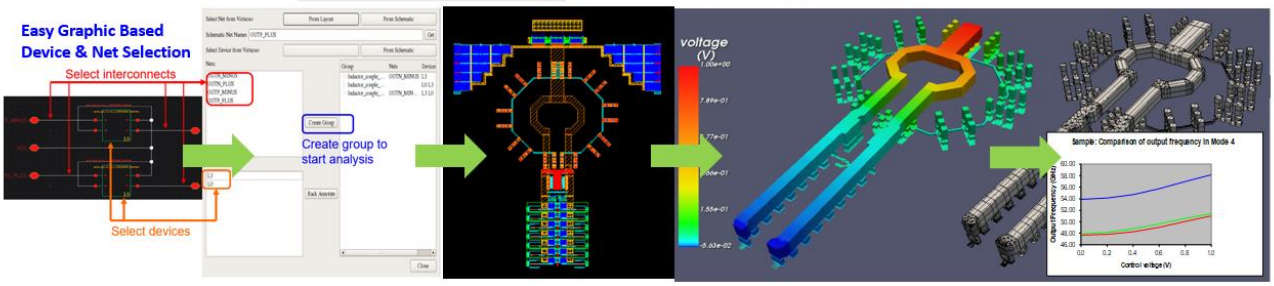
Left: High-frequency signal nets in power amplifiers (PAs), low noise amplifiers (LNAs) and voltage-controlled oscillators (VCOs) (courtesy of TSMC RDK) Right: Millimeter Wave interconnect design, (courtesy of Stanford University)

HFD™ Flow

PeakView HFD™ is compatible with Calibre LVS™ and standard LPE flows for ease of use in the Cadence® design environment. Users have the choice to select critical nets and devices of interest from either their schematic or layout. Interconnect EM models will be generated by HFD and then back annotated to the LPE generated extracted view or DSPF file and ready for SPICE simulation.



Net and Device selection in schematic or layout, and corresponding geometry in PeakView HFD



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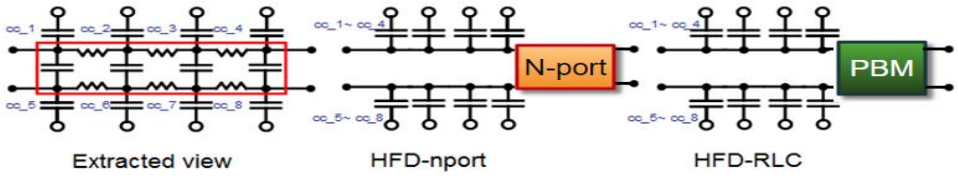
Powerful Back-Annotation Options

PeakView will automatically incorporate EM simulated (nport /lumped model) results back into specific locations of the parasitic extracted view or DSPF file. User decides how this new information is stitched back to existing data:

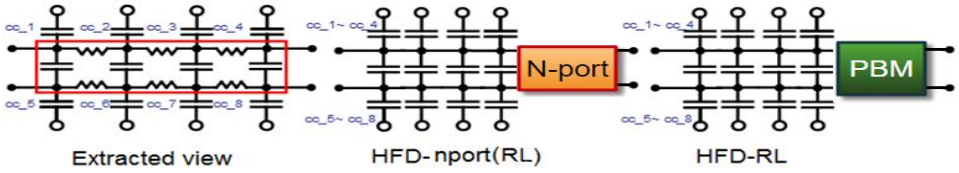
Option 1

Back-annotation with RLC consideration in N-port and PBM model



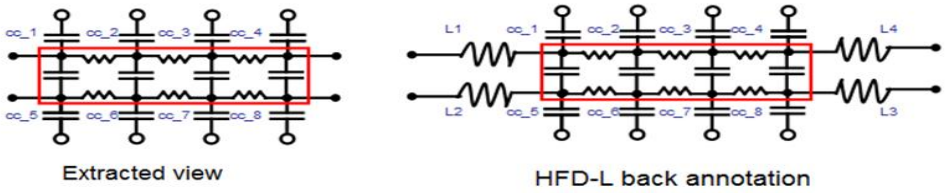
Option 2

Back-annotation with RL consideration in N-port and PBM model



Option 3

Back-annotation with L-only consideration in N-port and PBM model



High Performance & Capacity Advantages

1. 3D Full-Wave EM Engine with DC to Terahertz Accuracy, Performance and Capacity

PeakView's revolutionary iterative High Capacity EM solver technology (HCS) provides the accuracy, performance and capacity needed to prepare devices and circuit interconnect for the latest industry standards. The new PeakView™ HCS simulation engine typically runs upto 10s x faster than traditional structure bsed simulators while maintaining high correlated accuracy. It is designed to handle the complex structures found in today's on-chip devices. Its special meshing algorithm considers advanced process nodes with tall sidewalls, high frequency skin effects and thick metal layers for superior quality EM results. HFD has the capacity to efficiently handle a large assortment of interconnects with hundreds of ports to generate accurate electromagnetic models.

2. Customized Accuracy Tuning with Simple Click of a Button

In addition to pre-configured EM simulation types, PeakView™ has implemented Customized Accuracy Type to enhance the flexibility of accuracy settings and to configure layout processing and EM simulation options. By composing a configuration file, users are able to easily tune the tool such that the entire EM simulation process is optimized for special test cases. This is particularly useful for scenarios where concurrent simulation for structures of varying scales is required.

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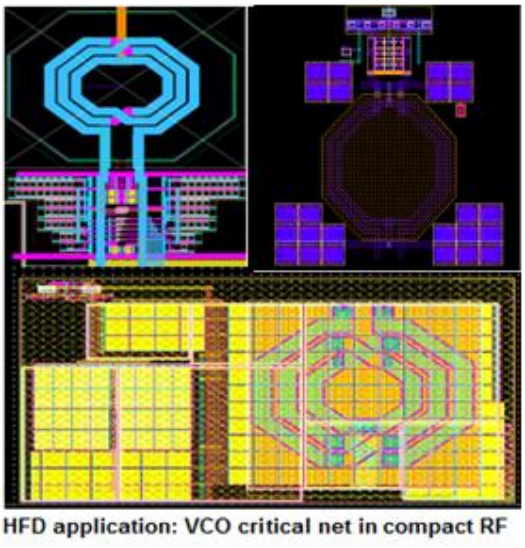
3. Multi-core Processing and Distributed Computing

In order to maximize utilization of computing resources, LEM™ takes advantage of PeakView's multi-core processing, GPU capability. Design jobs can be run on computer farms consisting of multi-core machines, as well as on standalone platforms with multi-core processors to achieve maximum parallel efficiency via multi-threading. PeakView provides different distributed computing modes to concurrently accelerate the EM modeling. Users are able to specify different frequency points to be simulated on different machines in a computer farm.

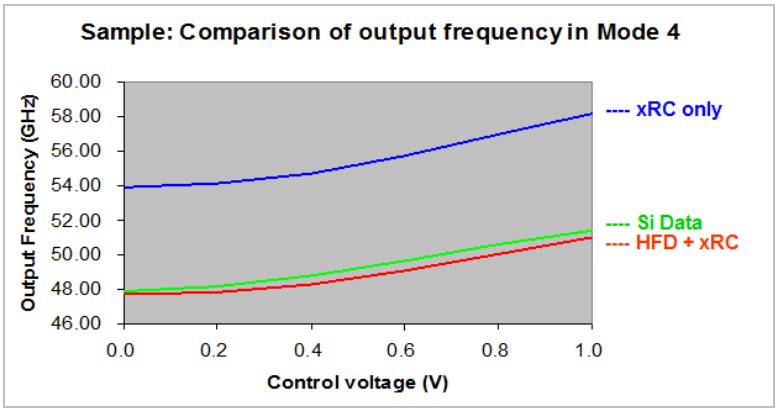
Silicon Data Correlation

HFD simulations capturing parasitic influences from DC to 60 GHz and beyond continue to demonstrate excellent correlation to silicon data in advanced process nodes deployed in major wireless companies and foundries.

The HFD flow has been demonstrated on RF Reference Design Kits from TSMC, where the results have been validated to match silicon from 40 GHz to 60 GHz. Lorentz Solution, Inc. has also collaborated with Stanford University on research projects where HFD results correlated very well with silicon measurements in the range of 50-70 GHz.



HFD application: VCO critical net in compact RF



50 GHz VCO output frequency comparison
(Silicon data courtesy of TSMC)

HFD has been benchmarked by our high-frequency, RF and mixed-signal IC design customers to be the most reliable and efficient electromagnetic extraction tool to date. It is also emerging as a revolutionary millimeter wave technology aiding in the design and verification of broadband gigabits per second (Gbps) on-chip wireless systems. Full-scale implementation of this technology will greatly facilitate research and development in the 5G (5th Generation wireless network) standards and associated hardware, where millimeter wave frequency bands are of primary interest.

Standard Format Support

HFD Setup

iRCX format technology file from TSMC
ITF format technology file from foundries

HFD Input

Calibre LVS® clean design
PEX: Calibre xRC®/Synopsis StarRC™/Cadence® QRC results in extracted view or DSPF file

HFD Output

Cadence® format (OA/CDBA) PeakView extracted view, ready for circuit simulation

Platform

Linux 64-bit, i.e. Red Hat and SUSE
LSF/NC-based computing farm