Delay Models

Delay Calculation

- The delay calculation is needed because of complex Input Capacitance, Voltage Drop, Voltage Islands, High Impedance nets etc.
- Delay calculation parameter data are stored as Lookup-Table format

Delay Models

Interconnect Delay Models

- Lumped RCL Delay Models
- Wire Load Delay (WLD) Model
- Elmore Delay Model
- Arnoldi Delay Model

Cell Delay Models

- Non-Linear Delay Model (NLDM)
- Scalable Polynomial Delay Model (SPDM)
- Effective Current Source Model (ECSM)
- Composite Current Source (CCS) Delay Model

Interconnect Delay Models

Wireload	Elmore	Arnoldi
• Delays are estimated based on the number of fanout of the cell driving the net • Values of unit resistance R and unit capacitance C are given in technology file • Fanout vs net length is tabulated in WLMs • Once the net length is known delay can be calculated	• Delays are estimated based on first moment of impulse response • used where speed of calculation is important but the delay through the wire itself cannot be ignored • Less accurate, but if the nets are very small, Elmore can provide sufficient accuracy with less run time • Inherently cannot handle inductance effect but can be extended to include inductance • Need higher order moments • Useful for interconnect optimization	• More accurate • Need more run time • Used in cases where the driver resistance is much less than the impedance of the network to ground, especially when a very strong driver is connected to a very resistive network

Cell Delay Models

Non-Linear Delay Model	Effective Current Source Model	Scalable Polynomial Delay Model	Composite Current Source Delay Model
• Modeled as a linear voltage ramp in series with a resistor	• Models a unique dataset for each Voltage-Temperature	• Models the delay and slew values as a function of voltage and temperature	• Modeled as current waveform from a time varying current source

resistor • Less accurate • Less run time • Intermediate values are interpolated • Assumes load is purely capacitive • Variation may range anywhere from 5-10% • Linear k-factors required for handling of IR-drop, Delay • Transition time are functions of Input slew and Output load	temperature combination • Improved accuracy • Easy to characterize • Increased characterization • Smooth non-linear interpolation/extrapolation • Can't use for memory or complex cell characterization • Models IR Drop non-linearly • Data characterized for three voltage corners	and temperature • SPDM is a polynomial abstract • Less accurate • More runtime • Extra characterization setup required • Increased characterization time • Extrapolation is unreliable • SPDM requires elaborate curve fitting techniques for an accurate curve fit	source • More accurate • More run time • Extra setup required for characterization • CCS libraries are huge in size • Addresses the effects of deep submicron processes

VLSI BACK-END ADVENTURE