Power Management Design and Verification

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Power Trends

- **Power:** Dynamic, Leakage
- **Dynamic:** Activity, Frequency, Capacitance, Supply Voltage (V)
- **Dynamic Power** $\alpha V^2$
- **Leakage:** Sub-threshold, Gate-Tunneling
- **Leakage Power** $\alpha V, e^{-Vt}$
- **Manage:** Dynamic, Active Leakage, Standby Leakage
Power Consumption in a Mobile Phone

Voltage is the key variable to manage power in all modes.
Power Management Techniques

- Multiple Supply Voltage (MSV)
- MTMCOS & Power Gating (PG)
- Power Gating & State Retention
- Dynamic or Adaptive Voltage Frequency Scaling (DVS, DVFS, AVS, AVFS)
- Low-VDD Standby
## Power Types Targeted

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<td>Adaptive Body-Biasing</td>
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- **Primary** indicated by green squares.
- **Secondary** indicated by yellow squares.
- **Verification Impact** indicated by magenta squares.
Typical Power Managed SoCs

Core1  Core2  Accltr1  Accltr2

Interconnect

Power & System Control

On-Chip Memory Subsystem
In Domain Power Sequencing

- CLK
- CLK-EN: Disable Clock
- SAVE
- ISO: Enable Isolation
- PWR EN: Disable Power
- VDD
- PWR RDY: Disable Ready

Enable
- Clock
- Power
- Ready
- Isolation
Power Management Tutorial

- Power management techniques
- Implementing power management techniques
- Verification issues arising due to power management techniques
- Working with verification issues examples in real design situations

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