



In-Design Physical Verification (PV) For Improved Designer Productivity

Thomas Luczejko
Principal Engineer
LSI Corp.

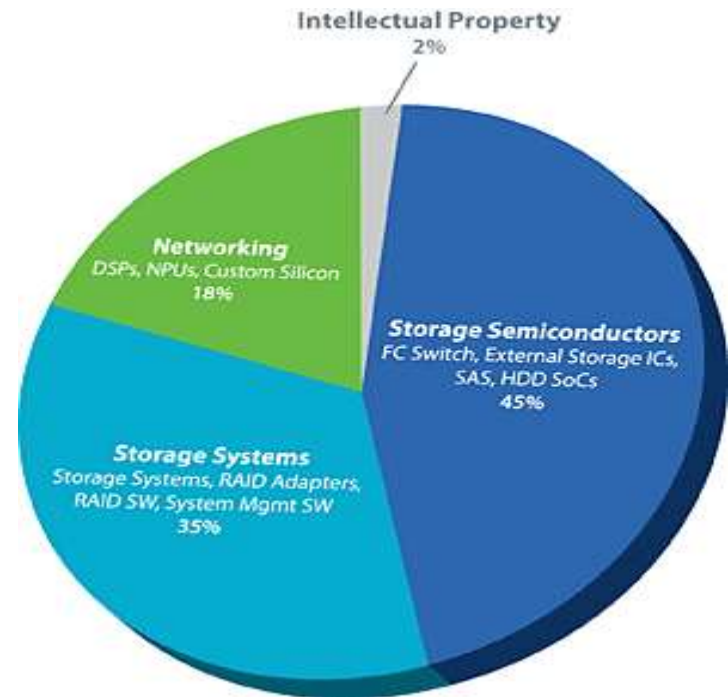
14th June 2010
Design Automation Conference



LSI Corporation

- Leading provider of **silicon**, **systems** and **software** solutions for the **storage** and **networking** markets
- Based in Milpitas, California and founded in 1981
- Design centers around the world
 - US, India, Europe, China
- Storage ICs
 - Pre-amplifier, read channel, motor controller, SAS, SAN
- Networking ICs
 - Media, Network, Content Processors
 - Custom Silicon (Serdes)

REVENUE BY MARKET
First Quarter 2010



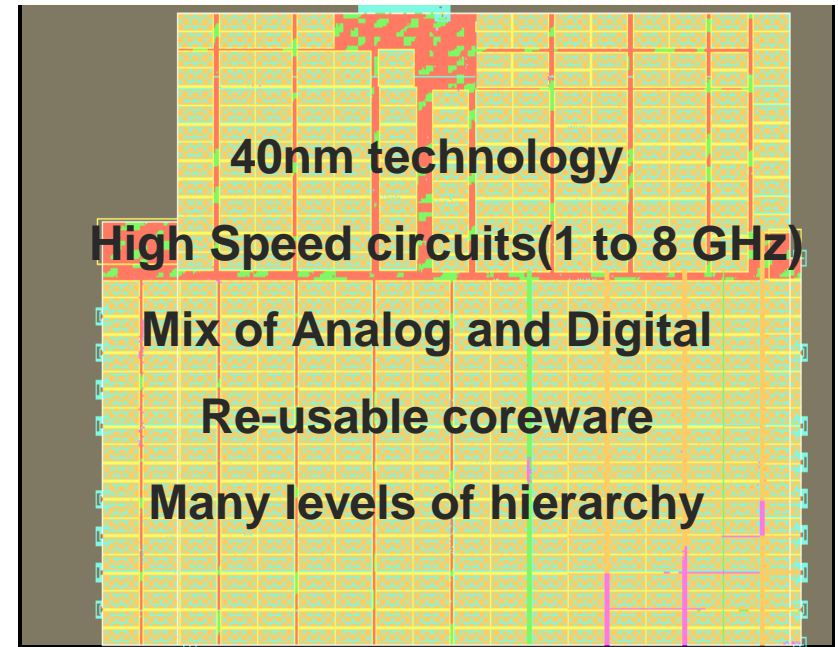
(1) LSI Corporate Fact Sheet: http://www.lsi.com/about_lsi/corporate_information/corporate_fact_sheet/index.html

Design Profile and Challenges

Storage And Network ICs

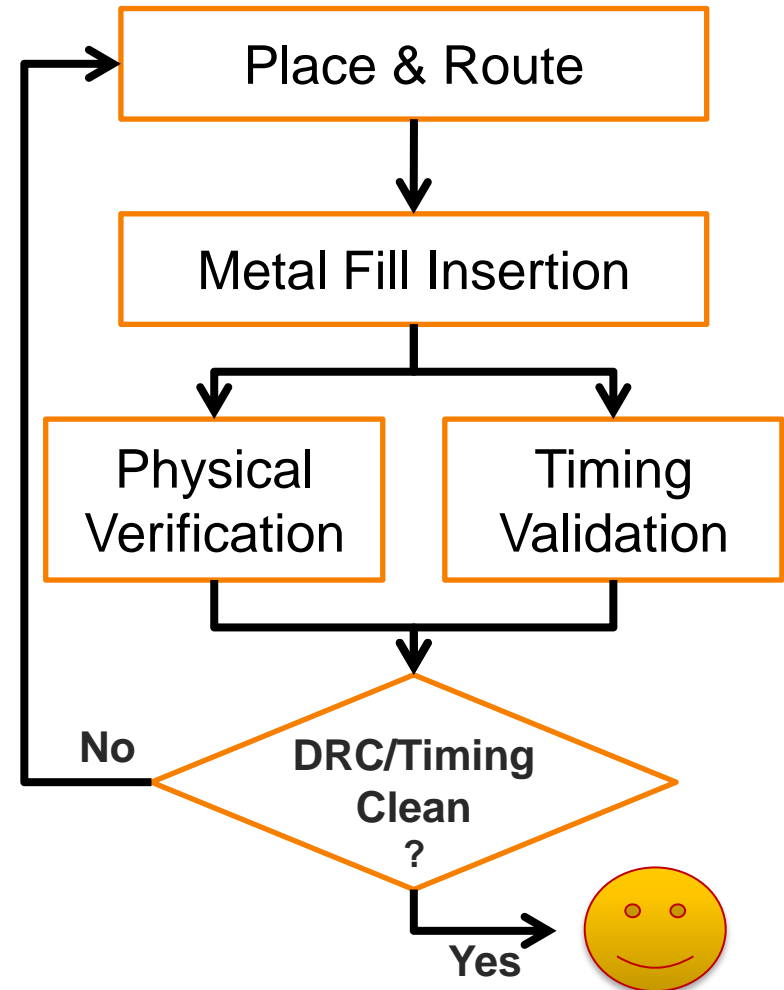
- Challenges

- Meeting aggressive design schedules
- Reducing power
- Achieving and maintaining timing closure
- Complex DFM requirements for 40nm designs to achieve optimum yield
- Reducing metal fill impact during design (today's topic)



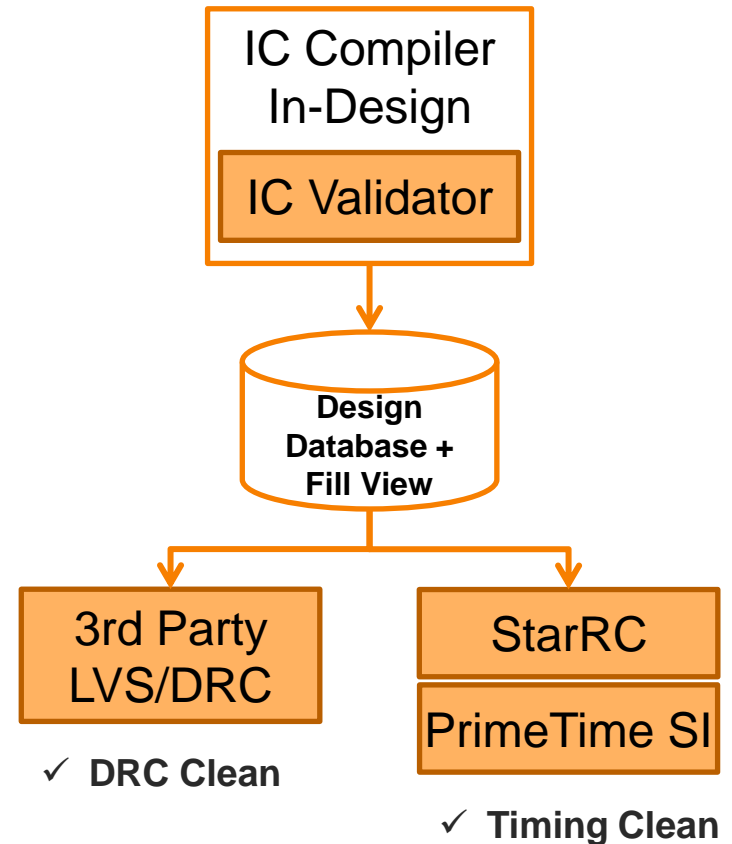
Existing Metal Fill Flow

- Steps In Flow
 - Adjust routing parasitic extraction to improve pre/post metal fill timing correlation
 - Implement design in P&R
 - Use 3rd party software and runsets to complete chip level metal fill
 - Physical signoff (LVS/DRC) done by another physical verification tool
 - Timing signoff with StarRC/PTSI
- Requires multiple iterations to close timing
 - Re-route requires metal fill insertion
 - Fill timing impact not completely correlated
- Post metal fill ECOs are challenging
 - Changing customer requirements lead to more iterations



New, In-Design PV Metal Fill Flow

- IC Compiler tightly coupled with metal fill insertion
 - P&R TCL Language
 - P&R timing engine
 - P&R database to create/store fill
- Benefits of In-Design metal fill
 - Metal fill is timing-aware, reducing impact on critical nets
 - Automatic, timing-aware fill in ECO loop limits scope of changes
 - Uses complete physical view eliminating errors and data transfers



Value Add Throughout the Flow: From Setup to ECOs

Value #1: Ease of Automation

Setup – Simple Flow Scripting

- Flow steps captured with minimal effort using P&R TCL
- Support organization can easily maintain/qualify/deploy
- Eliminates user induced mistakes

Create Fill Up to M8

```
signoff_metal_fill \  
  -select_layers {m1 m2 m3 m4 m5 m6 m7 m8}
```

Repair metal fill features after M4 to M6 routing changes

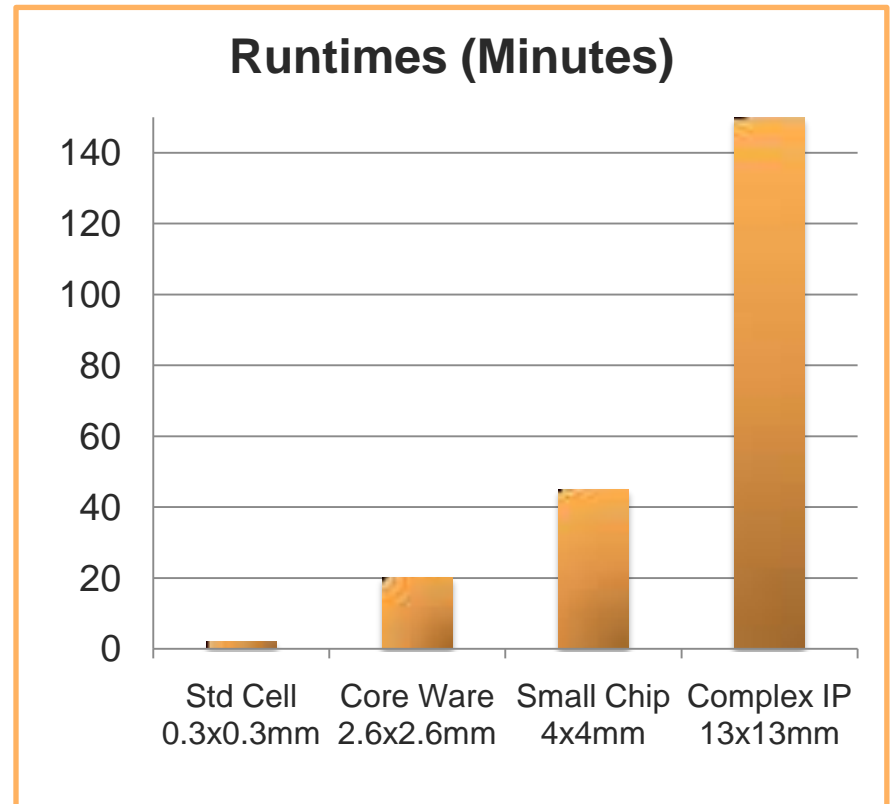
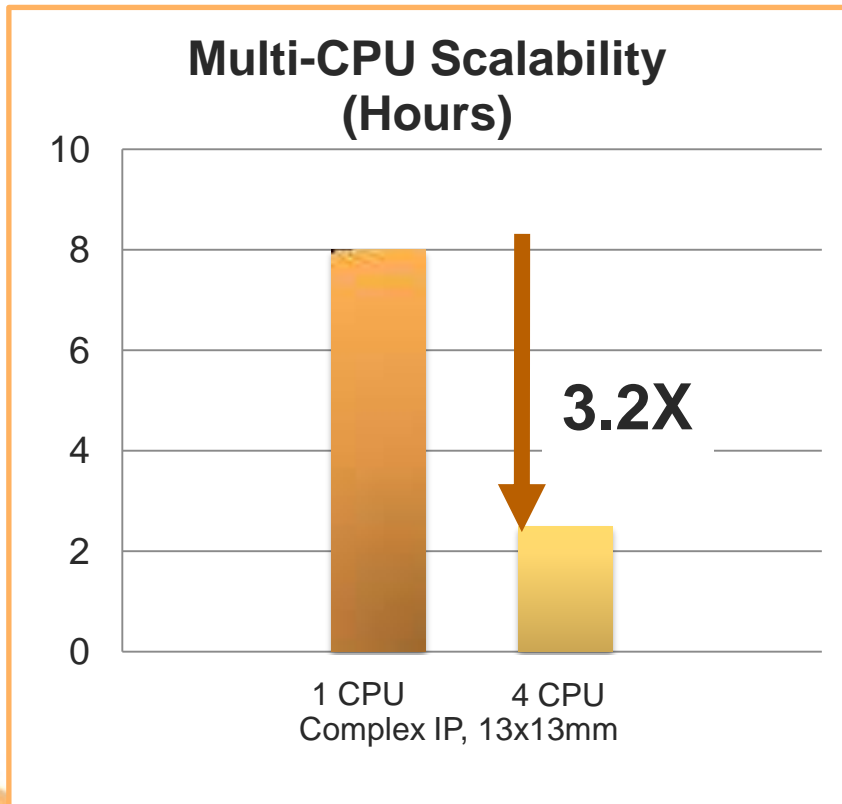
e.g. metal only ECOs

```
signoff_metal_fill \  
  -select_layers {m4 m5 m6} \  
  -remove_overlap_with_nets {*} \  
  -space_to_critical_nets {m4 1.5 m5 1.5 m6 1.5}
```

Value #2 Runtime

Speed of Execution

- Ability to use multi-CPU reduces execution time
- Large jobs can be launched on large machine farms using “LSF”
- Runtimes scale based on design size, better predictability

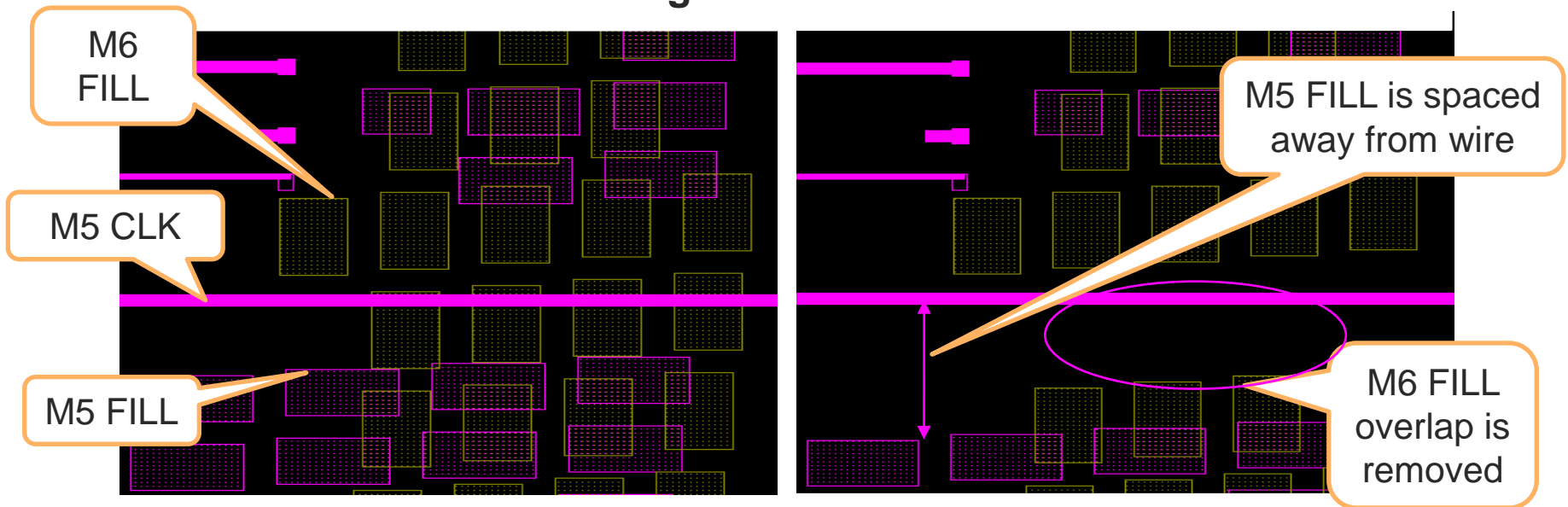


Value #3 Reduced Design Iterations

Control of Metal Fill Around Critical Nets

- Reduces design interval by
 - Maintaining delay on timing critical net
 - Maintaining skew for clock and balanced delay on bussed nets
- User controlled spacing and overlap to balance timing and density requirements

Timing Aware Metal Fill

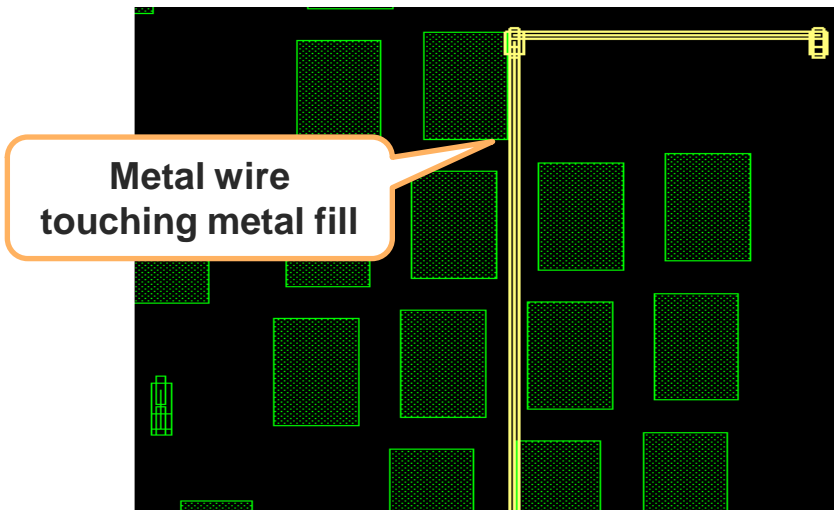


Value #4 Faster ECOs

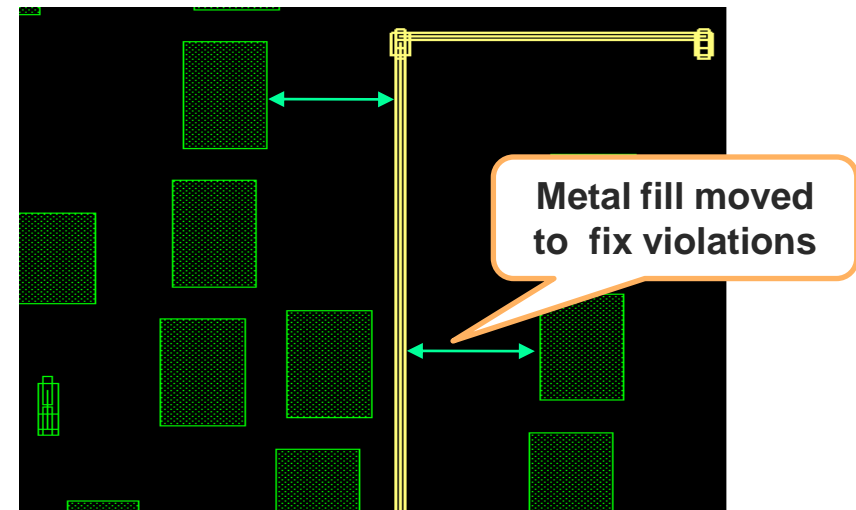
Automatic Fixing After Metal only ECO

- Reduces design interval by
 - Eliminating the need to do a complete re-fill for minor changes
 - Removing time consuming and error prone manual editing step
 - Controlling timing impact using timing aware options

**Post ECO
Before Metal Fill**



**Post ECO
After Incremental Metal Fill**



Summary and Next Steps

- In-design physical verification metal fill used on targeted designs
 - Simple flow scripting enables a high level of consistency
 - Speed of execution reduces fill insertion time from days to hours
 - Metal fill adjustments on critical nets reduces timing impact
 - Automatic metal fill correction makes ECO changes easy to handle
- Next Steps
 - Investigate use of IC Validator for OD/PO fill
 - Work with Synopsys on enhancements to provide more user controls over fill creation and viewing

**Ease of Use, Execution Speed and Controllable Metal Fill
Improving Design Productivity at LSI**