

# Interoperability for Whom?

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# What Exactly is Interoperability?

- **Interoperability** – not found in typical hard copy or online dictionary
- **Interoperable** – not found
- **Operable**
  - **treatable by surgical operation with a reasonable degree of safety and chance of success**

# Interoperability (IEEE & CAD)

- **IEEE**

- The ability of two or more systems or elements to exchange information and to use the information that has been exchanged

- **Typical Design User**

- Ability to easily access and efficiently use the tools required to complete an integrated circuit design

# Who Needs Interoperability?

- **Designers (actual tool users)**
  - 30,000
- **Flow Developers (CAD)**
  - 3000
- **Programmers (interoperability)**
  - 300

# Three Faces of Interoperability

- **File read/write**
  - Verilog, VHDL, SDC, LEF, DEF, GDSII
  - PDEF, SPDF, DSPF, SPEF
- **Extension language**
  - Tcl, SKILL, Scheme
- **Compiled language API**
  - C, C++

# Who Interoperates With What?

- **Who uses file read/write?**
  - Everyone
  - Primary source of original input / final output
  - Widely used as stop-gap solution
  - Inevitably used to check data/tool integrity
- **Who uses extension language?**
  - Almost everyone
  - Required to successfully drive tools
  - Widely used for simple to complicated processing
- **Who uses compiled language?**
  - CAD interoperability programmers

# How Does Galaxy Platform Interoperate?

- **File readers/writers**
  - Verilog, SDC, LEF, DEF, GDSII, etc.
  - Heavily used today by customers and 3<sup>rd</sup> parties
  - All standard readers/writers included with Milkyway
- **Extension language**
  - Replay, programming, and database access
  - Uses Tcl for some tools and Scheme for others
  - At midyear Tcl becomes primary extension language
- **Compiled language API**
  - Available to customers (1998) and 3<sup>rd</sup> parties (2002, MAPin)
  - Used for proprietary or 3<sup>rd</sup> party tools and data exchange
  - Success for the largest designs in smallest technologies

# Who Needs File Readers/Writers?

- All design flows
- Original input / final output
- Library preparation
- IP import (soft and hard)
- Tool data exchange (as last resort)

# Who Needs Extension Language?

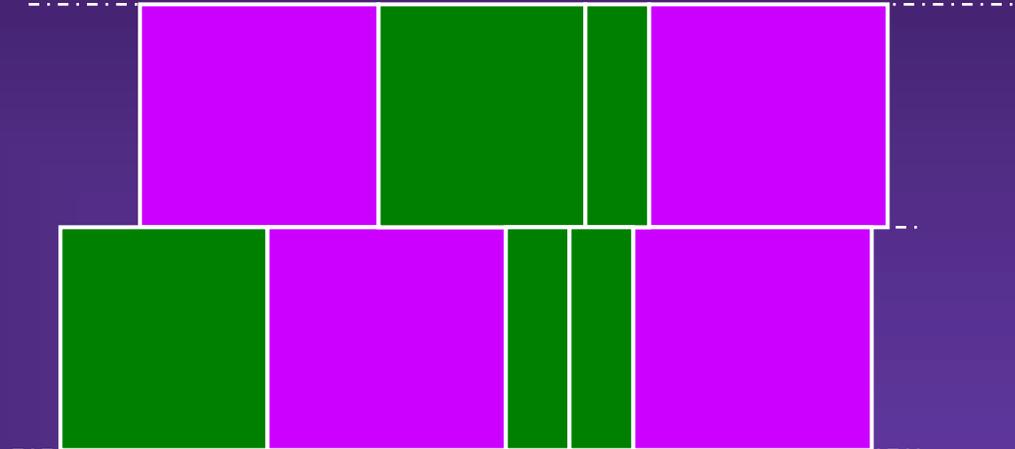
- **Almost everyone**
  - To control tools
  - For simple programming tasks
  - For database access
  - For command replay
  
- **Exceptions**
  - Highly algorithmic operations
  - Special-purpose data structures

# What's Left for Compiled Language APIs?

- Customer proprietary tools
- 3<sup>rd</sup> party tool interfaces
- Database data exchange
- NIH development

# Customer Example: LSI

- Gate Array Backfill
  - Gate-array backfill: Insertion of *backfill* cells into unused standard-cell placement spaces
  - Performed after placement (and usually before routing.)



# Customer Example: NSC

- **Development of custom router for special nets (power)**
- **Development of NSC-specific spare gate flows, antenna correction, etc.**
- **Used for 3<sup>rd</sup> party SI-repair flow by feeding repair ECO's back to Milkyway (Scheme)**

# 3<sup>rd</sup> Party: Silicon Canvas “Laker”

- **Laker Custom Editor**
  - **Basic Polygon Editing Features**
    - **Object Creation**
      - Rectangle, Polygon, Path, Text, Instance
    - **Object Editing**
      - Move, Stretch, Reshape, Split, Merge,...
  - **Point to Point router**
  - **Hierarchical Net Tracer**
  - **Undo/Redo**
  - **DRC Rule Driven**
  - **On-line DRC**
- **Reported less than one staff-year to move to Milkyway**

# 3<sup>rd</sup> Party: Synchronicity's "DesignSync"

The screenshot shows the DesignSync application window. The title bar reads "DesignSync" and the menu bar includes "File", "Edit", "View", "Go", "Bookmarks", "Revision Control", "Tools", and "Help". The address bar shows the location: "file:///d:/Libraries/cmos/CEL".

The left sidebar shows a tree view with "SyncServers", "My Computer", "c:", "d:", "Libraries", "cmos", "CEL", and "FRAM".

The main pane displays a table of files:

Name	Type	Version	Status	Locker	Bl
and1.sync.mw	Milkyway Object	1.1	Needs Update		Tru
and2.sync.mw	Milkyway Object	1.3	Up-to-date		Tru
and3.sync.mw	Milkyway Object	1.1	Up-to-date		Tru
dff1.sync.mw	Milkyway Object	1.1 -> 1.2	Locally Modified	*adrian	Tru
dff2.s		1.2	Up-to-date		Tru
ff.sync		1.1	Up-to-date		Tru
...		1	Up-to-date		Tru

A context menu is open over the "dff1.sync.mw" file, listing the following actions:

- Open (Ctrl-O)
- Hercules
- Check In... (F7)
- Check Out... (F8)
- Cancel Checkout... (Shift-F8)
- Delete... (Delete)
- Go to Vault (Ctrl+Shift-V)
- Data Sheet (F4)
- Refresh (F5)
- Properties... (Ctrl-Enter)

The status bar at the bottom shows "stcl>" and "Check in the selected objects." with a toolbar on the right.

# Summary

- **Today's design flows require interoperability at three distinct levels: readers/writers, extension language, and compiled language**
- **For vast majority of users/developers, a common extension language, specifically Tcl, provides the most productivity**
- **Compiled language APIs are absolutely required, but possibly for a diminishing set of interface applications**