Design Specification: Manufacturability

In previous lectures we learned how to turn transistor level circuits into silicon level layouts. A big question remains: How do we know that our circuit can actually be fabricated?
Design Rules
Each layer is manufactured with specifications on the minimum width, spacing to adjacent layers, overlap over connecting layers, and other geometrical constraints derived from the limits of a specific fabrication process. Some examples:
Design Rule Checker - DRC

The CAD toolset you use to do layout of a VLSI circuit (Cadence, for example) has a DRC program that checks every polygon against the set of design rules, to ensure manufacturability.
Silicon Foundries:
Manufacture designs submitted by users. Allows access to state-of-the-art processes (it is very expensive to build a fabrication facility). Foundries give a set of Design Rules for each of their available processes.

**MOSIS: MOS Implementation Service**
(www.mosis.com)
- US government-sponsored
- Provides foundry access to universities and small companies

**TSMC: Taiwan Semiconductor Manufacturing Company**
(www.tsmc.com)
- Global foundry
- Provides foundry access to large companies and well-funded individuals
Feature sizes are changing so rapidly:

Are these design rules always changing?
Lambda Design Rules

In order to avoid constantly revising design rules, chip-manufacturers like MOSIS and TSMC let users submit designs with simplified design rules that are given in terms of “Lambda” which scale by process. For example, a “6λ” distance for a process with λ = 0.15 μm, the actual design constraint is a distance of 0.90 μm.

Advantages

• Relative dimensions of a design stay the same, but can be submitted to other processes
• The process doesn’t need to be specified at the beginning of the design phase

Disadvantages

• The maximum packing density cannot be achieved
A look inside an INTEL Fab

- [http://www.youtube.com/watch?v=oMNaBkElyj0](http://www.youtube.com/watch?v=oMNaBkElyj0)

There are a few other links to good videos about semiconductor processing that you should watch outside of class:

- Discovery Channel program on how silicon wafers and computer chips are made. Great footage of silicon wafer growth [http://www.youtube.com/watch?v=aWVywHzuHnQ](http://www.youtube.com/watch?v=aWVywHzuHnQ)
- Current TSMC Fab Technology [http://www.youtube.com/watch?v=4Q_n4vdyzzc](http://www.youtube.com/watch?v=4Q_n4vdyzzc)
- Packaging a fabricated INTEL Microprocessor: (Watch from 1:00 – 5:30) [http://www.youtube.com/watch?v=Cg-mvrG-K-E&feature=related](http://www.youtube.com/watch?v=Cg-mvrG-K-E&feature=related)
- Future: 22 nm 3d FETS [http://www.youtube.com/watch?v=_zldnUY0t1M&feature=related](http://www.youtube.com/watch?v=_zldnUY0t1M&feature=related)