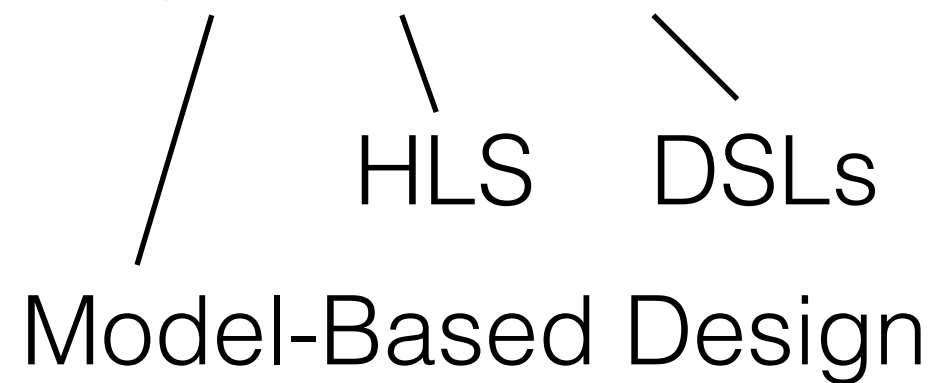


Fast FPGA Tool Flows with Overlays

Suhaib A Fahmy
University of Warwick

The productivity gap is twofold:

Design Abstraction



Design Flow Complexity

“How many trillion CPU cycles have been spent arranging the parts of a 32-bit counter?”

New Users

Great Designs

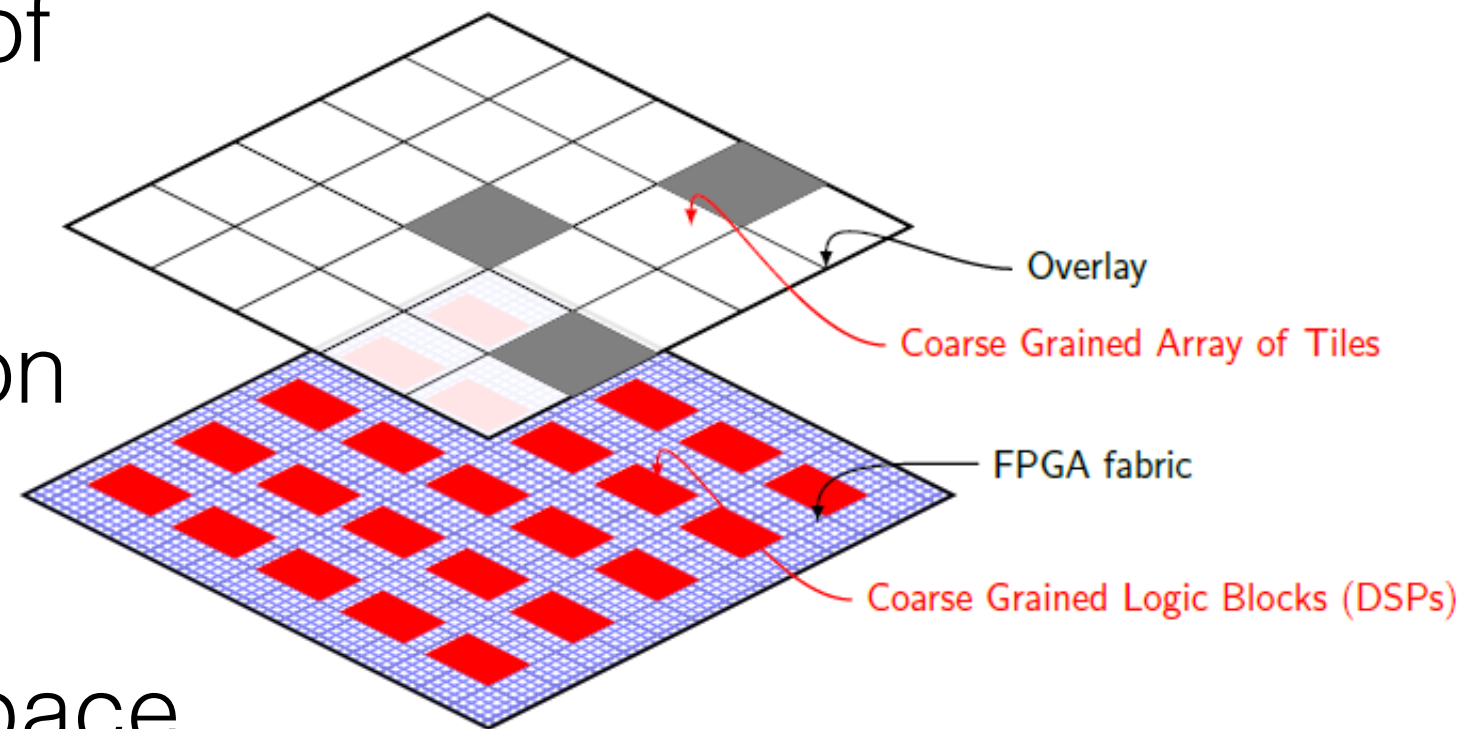


Solving the
abstraction
problem is
only half the
challenge!

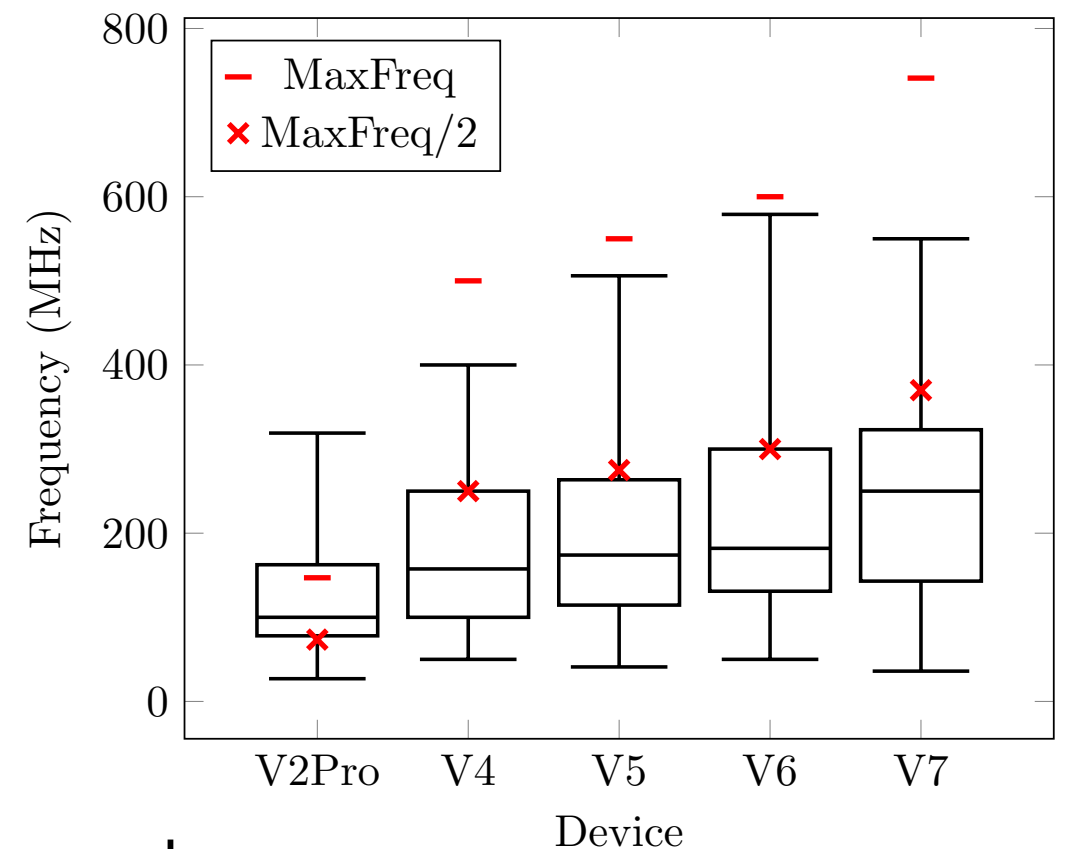


Overlays help us
avoid the trip down
and back up

- Building coarser grained architectures on top of FPGAs:
- Closer to application description
- Reduces design space (tool complexity)
- Reduces configuration space (“bitstream” size)



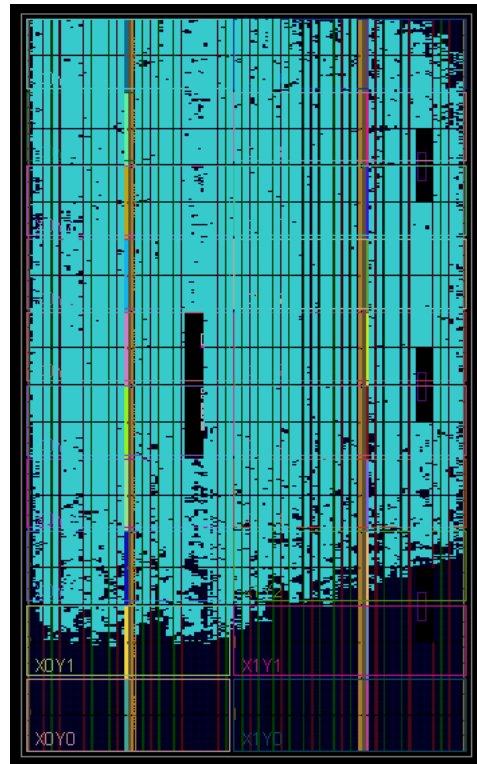
- Improving FPGA architectures not matched by improvements in mapping tools
- Many overlay designs are architecture agnostic:
 - Poor performance
 - High programmability overheads
- Build around the architecture!



iDEA Soft Processor

Demonstrate that DSP Block can be used at near limits for a general purpose processor

Cheah, Maskell, Fahmy, Kapre
FPT 2012, TRETs 2014, FPGA 2015



Large DSP Block Overlay

Showed that architecture aware design of an overlay can enable implementation of a large overlay on Zynq/V7

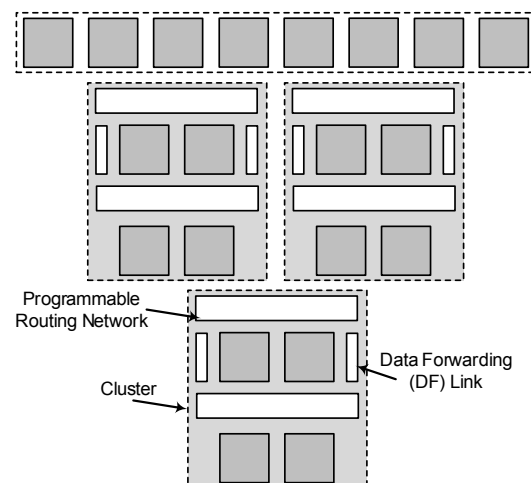
800 DSP block overlay at 380 MHz

Jain, Fahmy Maskell, DATE 2016

DeCO Datapath Overlay

For many applications, completely general routing is not needed so built a feed-forward overlay with reduced area and more balanced LUT/DSP Block usage
Configuration in 2 us.

Jain, Maskell, Fahmy, FCCM 2016 – **TOMORROW!**



DSP Block DySER

Showed that properly exploiting DSP Block programmability and pipelining improves overlay area by 25% and frequency by 2.5x

Jain, Maskell, Fahmy, HEART 2015

Mapping to DSP Blocks

Showed that even vendor HLS tools fail to exploit DSP block capabilities fully, but that this is possible from high-level descriptions

Ronak, Fahmy, TCAD 2016

Research Directions

- Compiling high level descriptions directly to overlays
- Exploiting faster run-time programmability for improved virtualisation in SW/HW systems
- Standard interface blocks
- Domain-specific overlay architectures?