



# Virtex-4 Addresses Key DSP System Needs

Virtex-4 XtremeDSP™ Slices provide

- Up to 1.5X Higher DSP Performance
- Up to 3X Lower DSP Power
- Up to 12X More DSP GMACS/Dollar (Value)

.....compared to Stratix-II

# Changes in FPGA-DSP

## Stratix

- Up to 96 DSP Blocks
  - 24 DSP blocks each with four multipliers (300MHz) & three 2-input adders
- Fabric Adder Trees (2 inputs)

## Virtex-II Pro

- Up to 444 embedded multipliers (250MHz)
- Fabric Adder Trees (2 inputs)

## Stratix-II

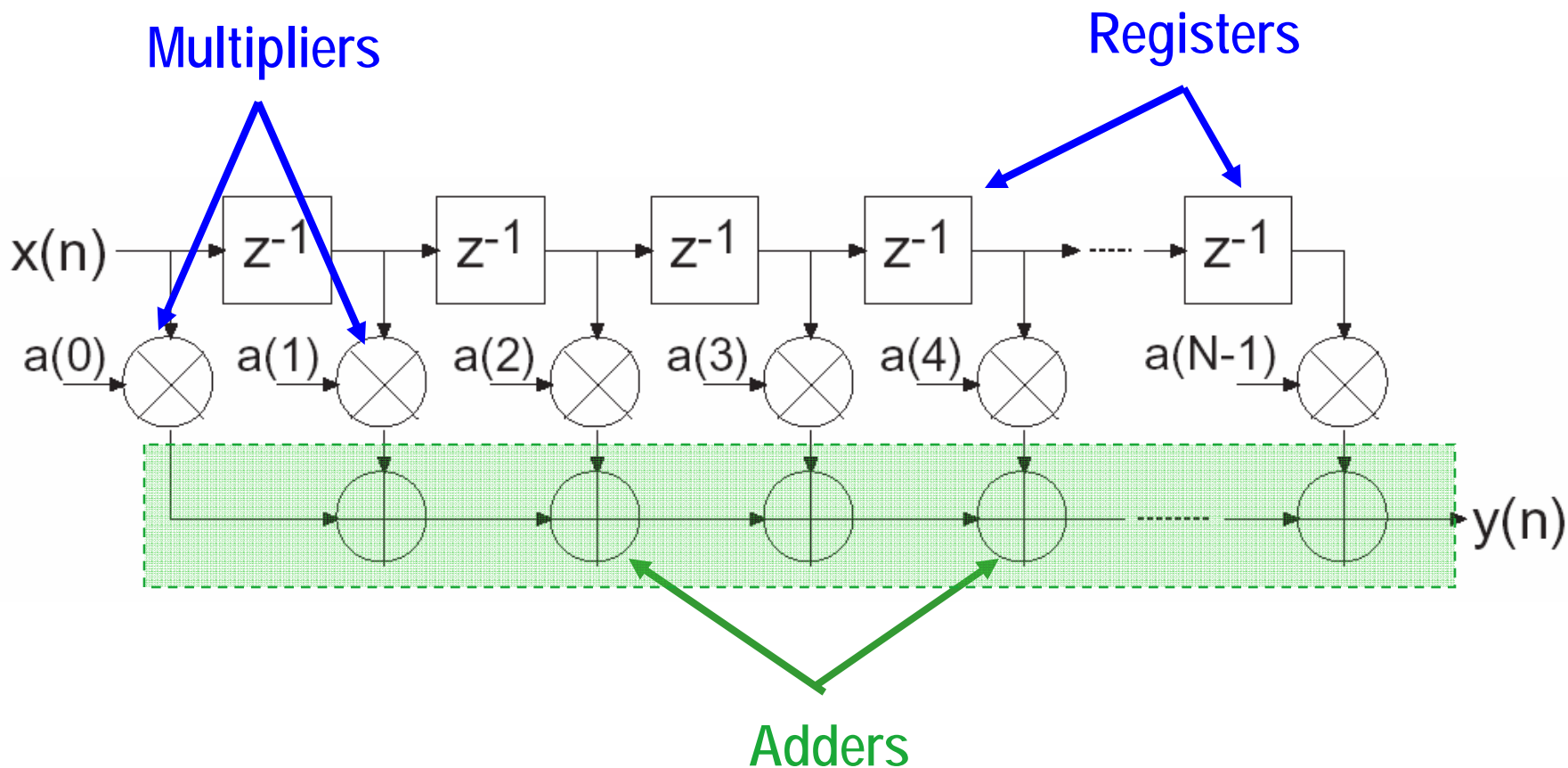
- Up to 384 embedded multipliers
  - 96 DSP Blocks, each with four 18x18 multipliers (450MHz) & three 2-input adders
- Fabric Adder Trees (3 inputs)

## Virtex-4

- Up to 512 XtremeDSP slices
  - One 18x18 multiplier (500MHz)
  - Integrated Adders that can be chained together (500MHz)

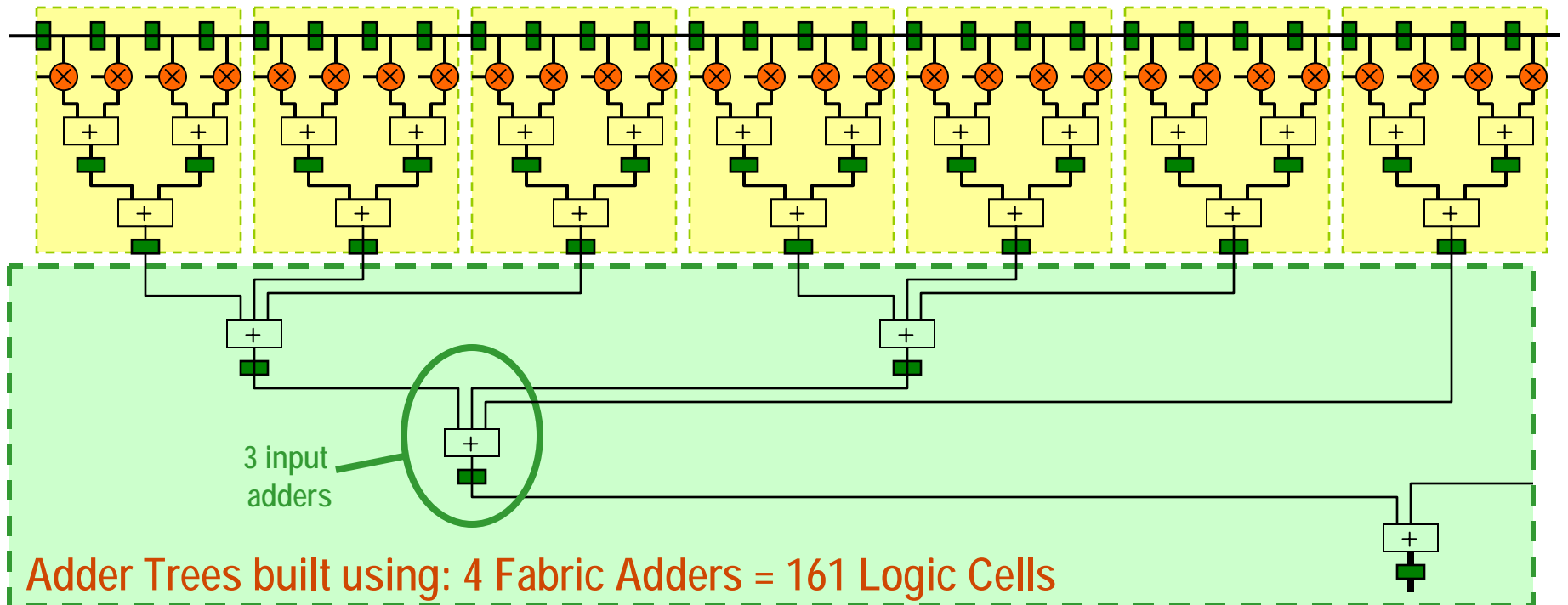
# Design Example: Parallel FIR Filter

## *The Most Common DSP Function*



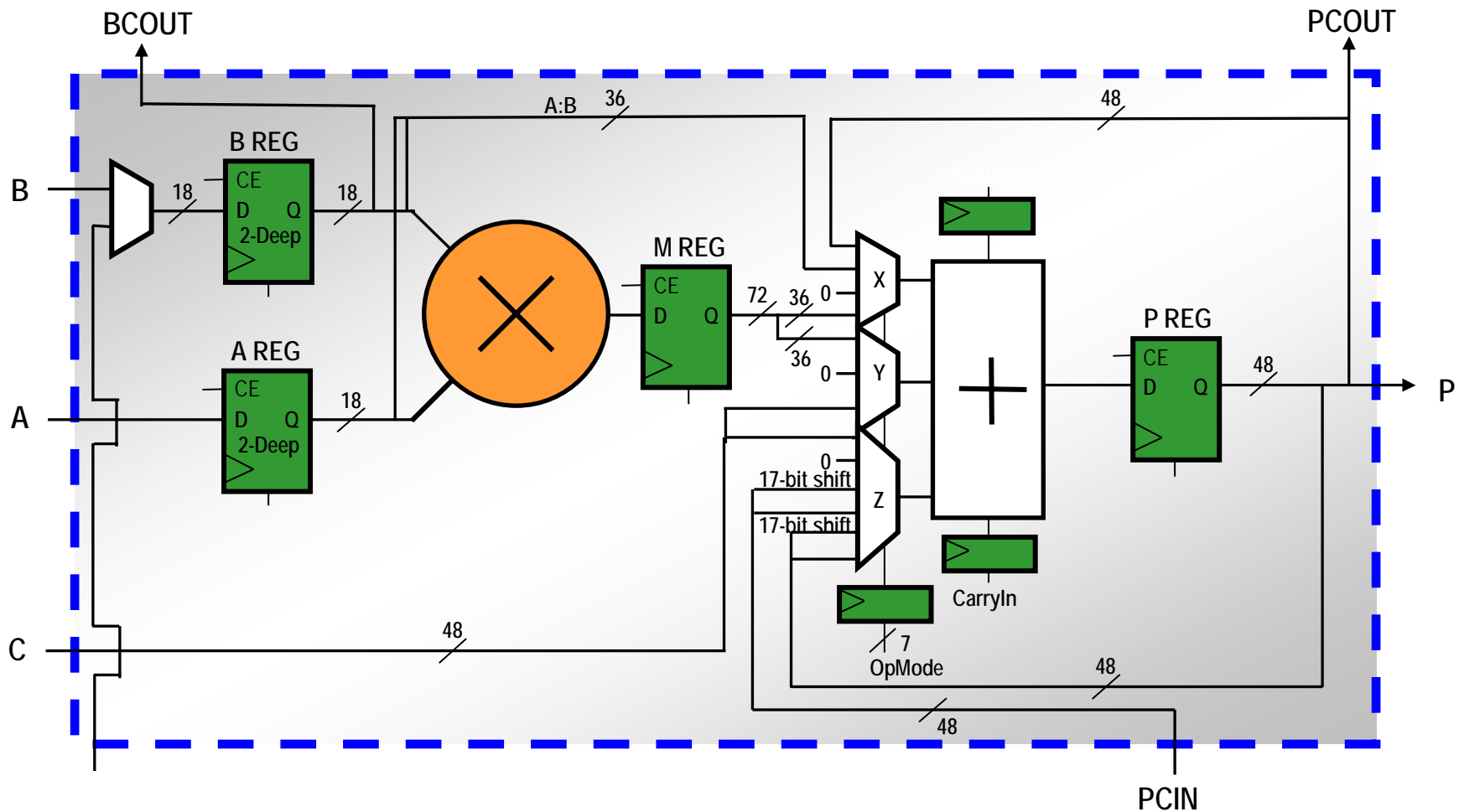
# Parallel FIR Filter in Stratix-II Using Fabric Adder Trees

Multiplication: 32 embedded multipliers using 8 DSP Blocks (18x18)



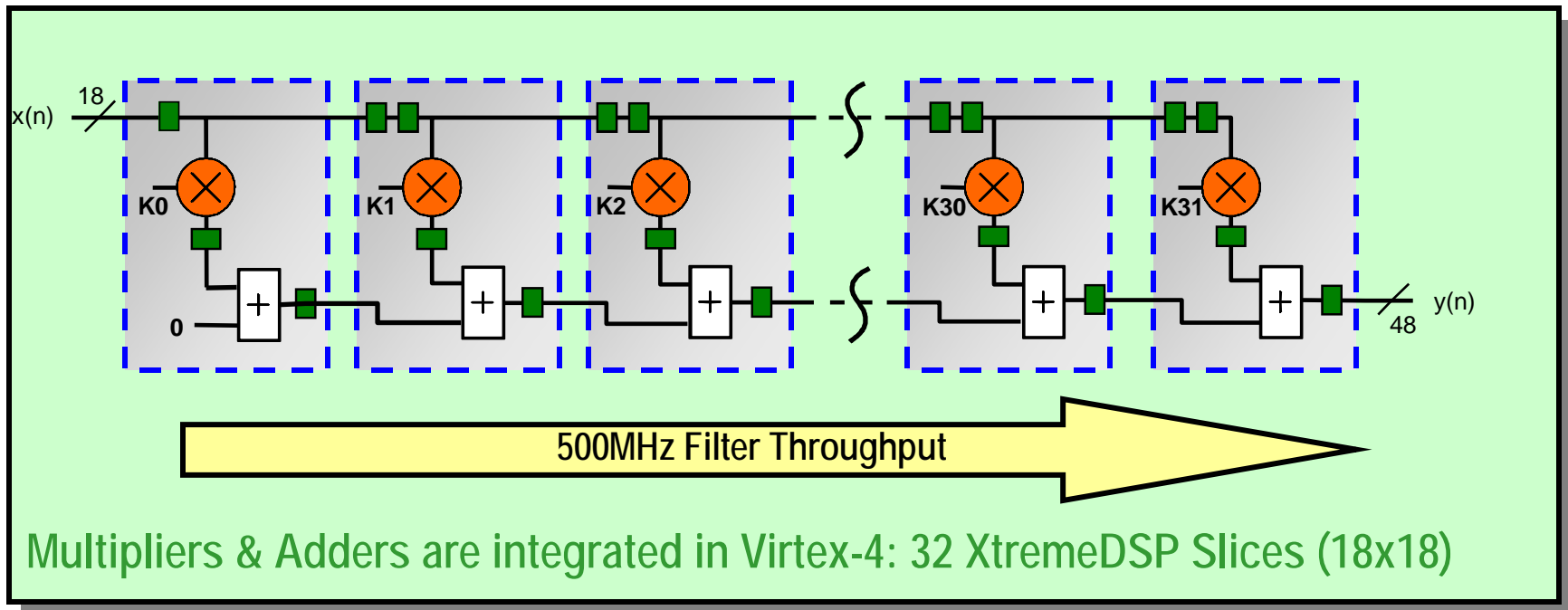
Stratix-II Adder Trees mean  
High Cost, High Power and Lower Speed

# Virtex-4™ XtremeDSP Slice



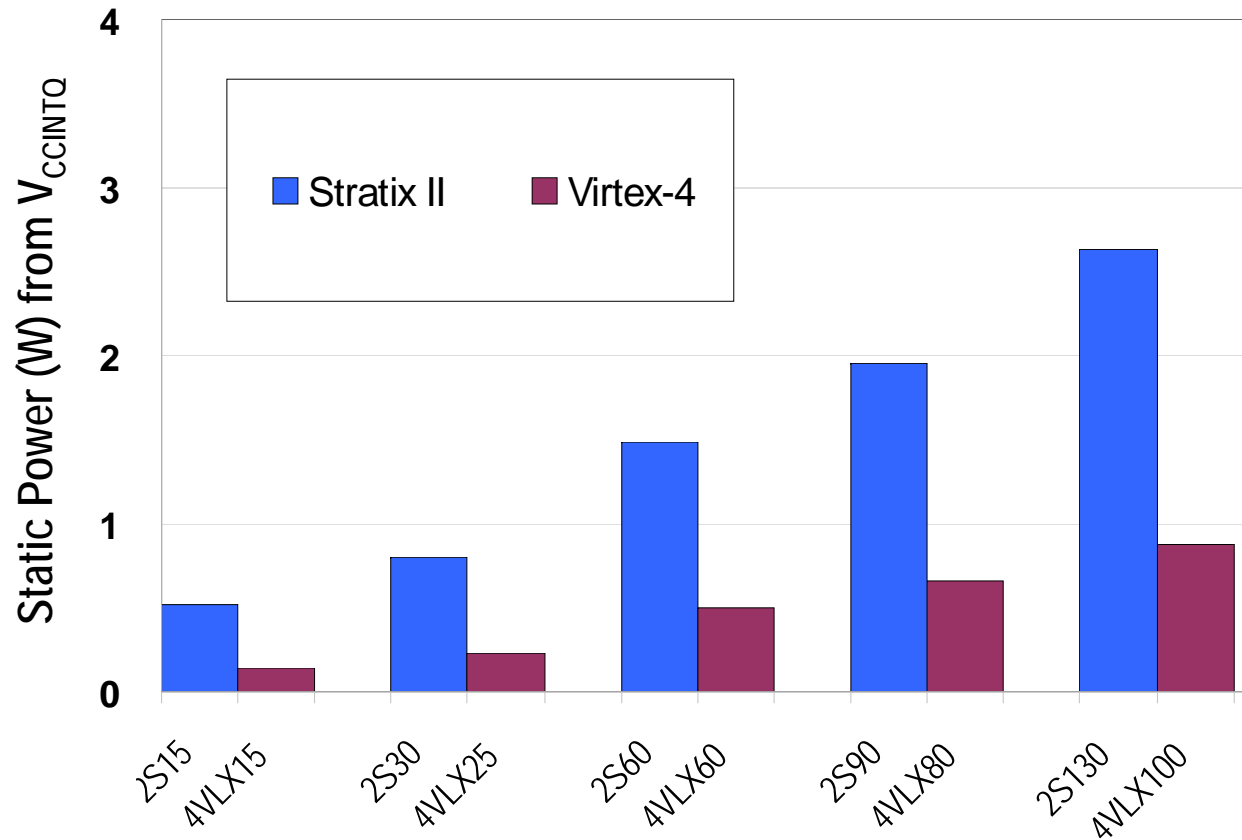
500 MHz maximum frequency in the fastest speed grade

# Same FIR Filter in Virtex-4 Using Integrated Adder Chains



No Fabric Adder Trees needed for Virtex-4 Filters  
This means Higher Speed, Lower Cost, Lower Power

# Stratix-II Consumes 0.4-2W More Static Power Than Virtex-4

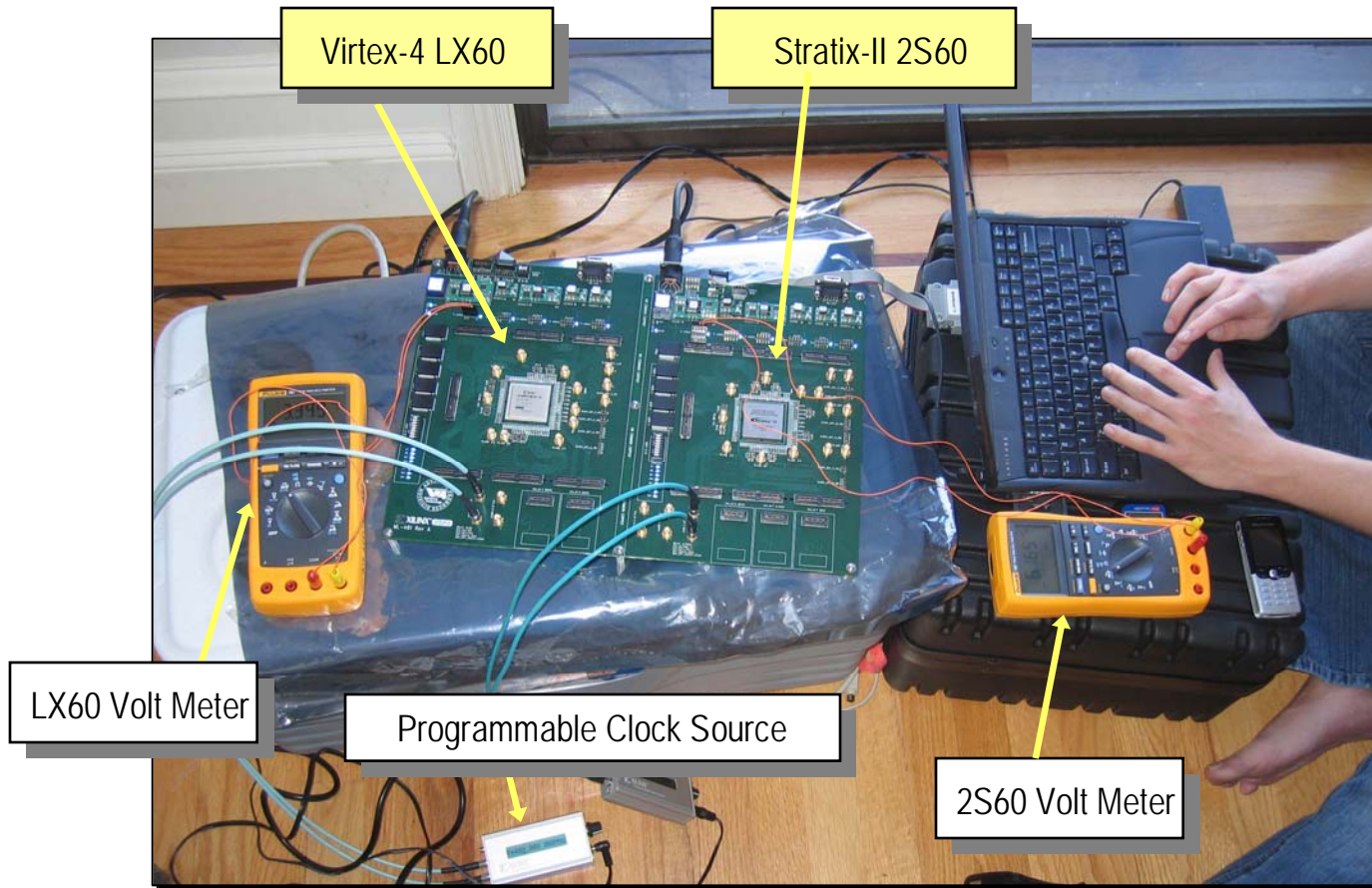


Source: Altera PowerPlay Predictor v2.1 and Xilinx Web Power 4.0 and datasheets





# Battle Board Measurements for Actual DSP Designs

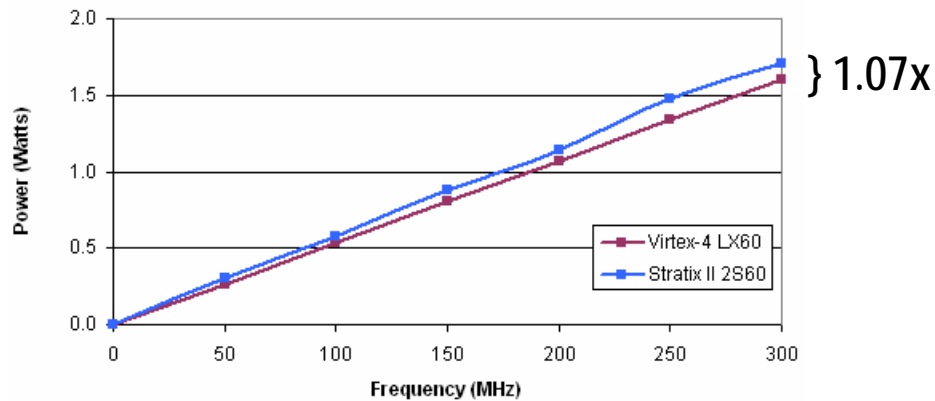


# Measured Power for 1024 Point FFT (Stratix II EP2S60 and Xilinx Virtex-4 XC4VLX60 at 85 °C)

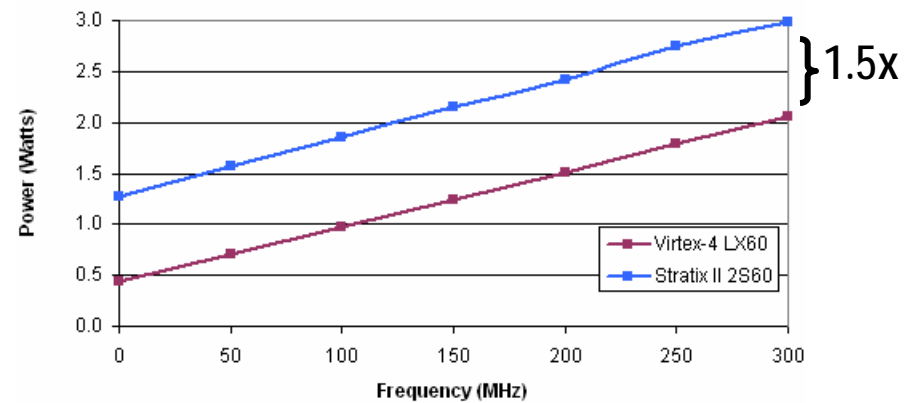
## Dynamic Power Consumption

## Dynamic + Static Power Consumption

Stratix II EP2S60 vs Virtex-4 XC4VLX60 Dynamic Power from  $V_{CCINT}$  Power vs. Frequency at (1024 Point FFT)



Stratix II EP2S60 vs Virtex-4 XC4VLX60 Total Power from  $V_{CCINT}$  Power vs. Frequency at 85 C (1024 Point FFT)



~0.2W Lower Dynamic Power Using Virtex-4

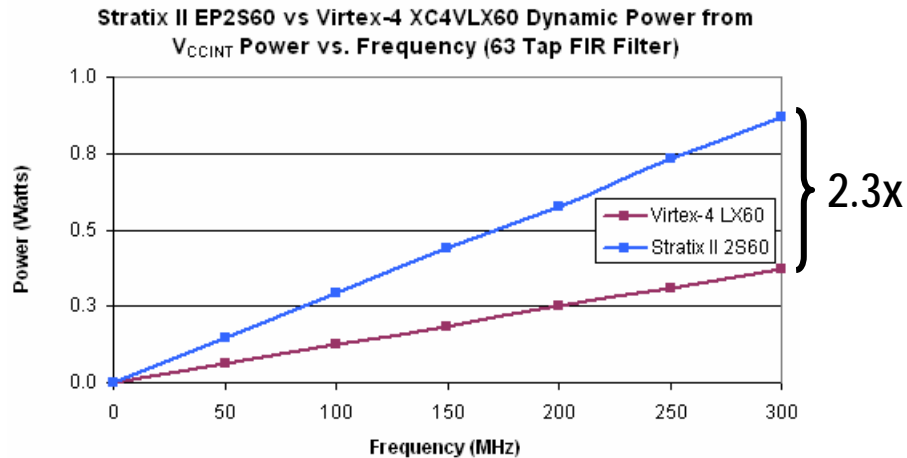
~1W Lower Total Power Using Virtex-4

Source: Niall Battson - Battle Board Power Measurements, FAE Conference April 2005



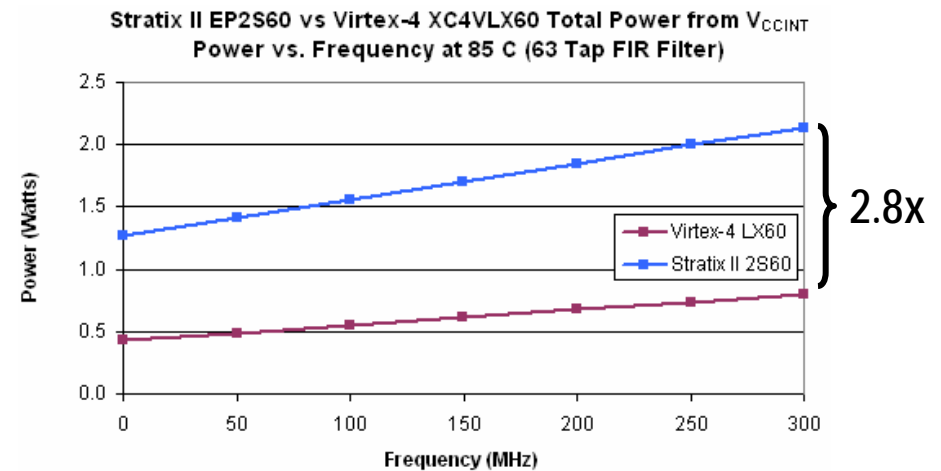
# Measured Power for 63 Tap FIR Filter (Stratix II EP2S60 and Xilinx Virtex-4 XC4VLX60)

## Dynamic Power Consumption



0.5W Lower Dynamic Power Using Virtex-4

## Dynamic + Static Power Consumption



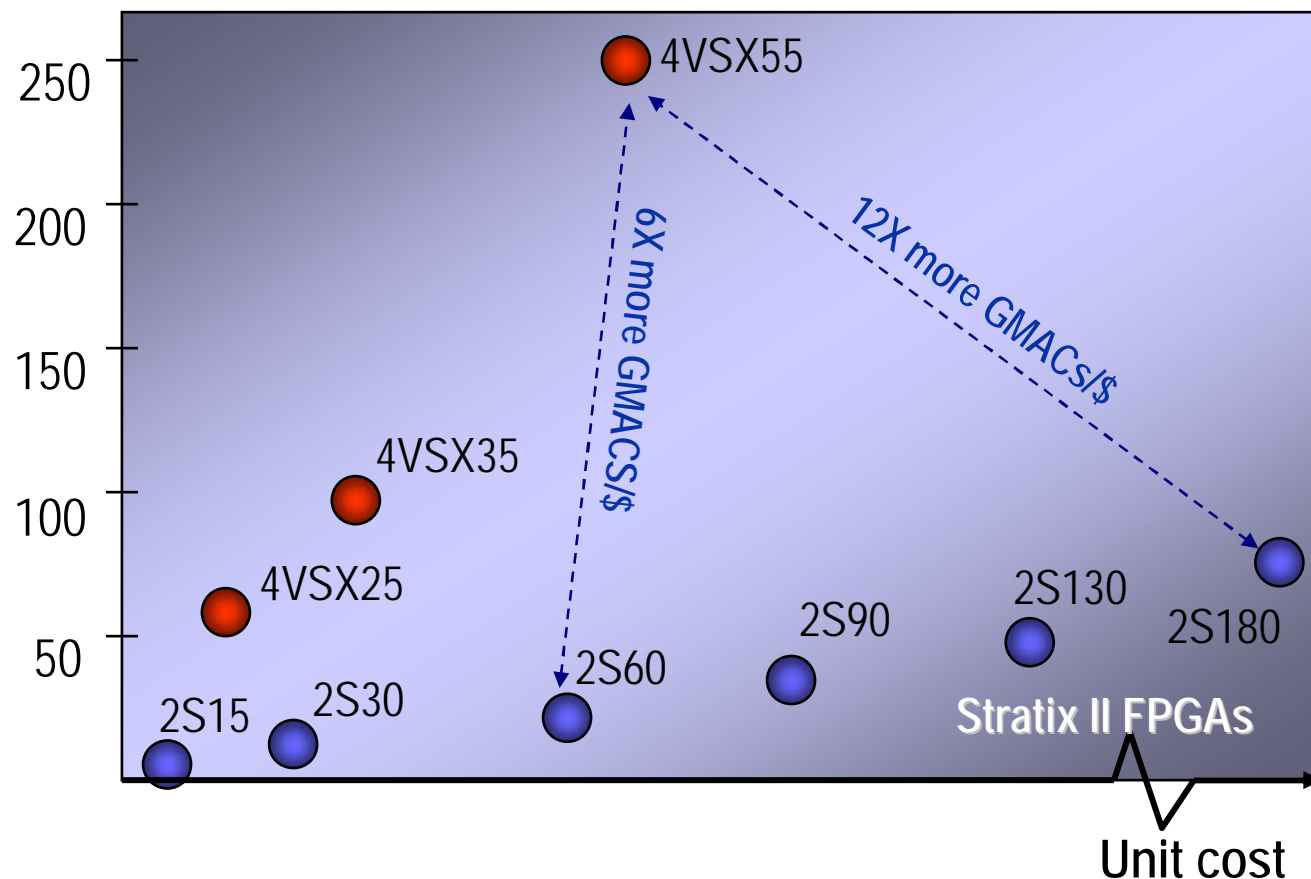
1.4W Lower Total Power Using Virtex-4

Source: Niall Battson - Battle Board Power Measurements, FAE Conference April 2005



# 12X Higher DSP Performance/\$ than Altera Stratix-II

GMACS



Example 1:  
4VSX55 vs. 2S60  
8.5x more 18x18 MACs  
1.2x higher performance  
1.7X the price  
1.7X the price  
6X GMACS/\$ ratio

Example 2:  
4VSX55 vs. 2S180  
2.6x more 18x18 MACs  
1.2x higher performance  
1/4 the price  
12X GMACS/\$ ratio

Based on 18x18 multiplication + 48-bit accumulation using Stratix-II DSP Blocks and Virtex-4 SX XtremeDSP slices only



# Benefits of XtremeDSP Slices

	Virtex-4	Stratix-II
<b>Up to 12X more GMACS/\$</b>		
Integrated Multipliers	Yes	Yes
Integrated Adders	Integrated Adder Chains ✓✓	Still Need Fabric Adder Trees X
Flexibility	47 Dynamic Op Modes ✓✓	1 Dynamic Op Mode X
<b>Up to 3X Lower DSP Power</b>		
90nm	Yes	Yes
Integration	Mults & Adder Chains ✓✓	Need Fabric Adder Trees X
<b>Up to 1.5X Higher DSP Performance</b>		
Faster Multipliers	500MHz ✓✓	450 MHz ✓
More Multipliers	512 ✓✓	384 ✓
Faster Adders	500MHz ✓✓	Speed limited by Fabric X



# Summary

- Virtex 4 XtremeDSP Slices enable
  - Up to 1.5x Higher Performance (500MHz)
  - Up to 12x more GMACs/\$
  - Up to 3x Lower Power
- Adder trees are THE speed bottleneck in FPGA-DSP
  - Virtex-4 XtremeDSP slice removes this bottleneck