The ACEX Initiative

Low-Cost, High-Performance Solutions for the Communications Marketplace

Agenda

- ACEX Overview
- ACEX Applications
- The ACEX 1K Family
- The ACEX 2K Family
- The ACEX Advantage

ACEX Overview

- Communications Marketplace
  - Provide Low-Cost, High-Performance Applications With a Programmable Solution for High-Volume Use
- ACEX Fulfills This Need
  - ACEX is a Broad-Based Initiative That Delivers Necessary Programmable Solutions
    - Architectures
    - Voltages
    - Feature Sets

ACEX Applications

- Communications Marketplace
  - Volume Use in Price Sensitive Applications
    - Cable & xDSL Modems
    - Low-Cost Switches & Routers
    - Remote Access Concentrators
  - High CAGR Applications Opportunities in this Marketplace

ACEX Applications

- Cable Modems
- xDSL Modems
- Remote Access Systems
  - Remote Access Concentrators
- Private & Branch Access Routers
- Low-Cost Switches
- Low-Cost Line Cards
- Laser Printers
- PC Peripherals

ACEX Applications

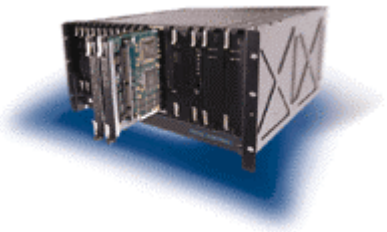
- xDSL Modems

- Cable Modems

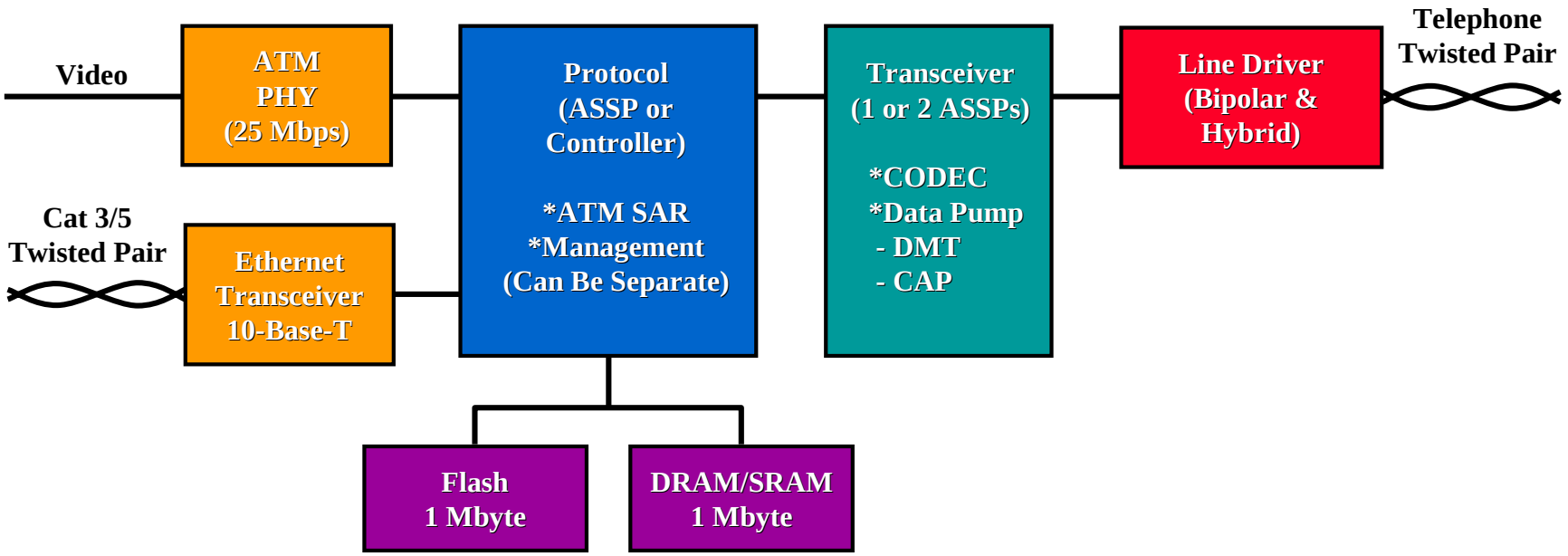
- Access Routers

- Low Cost Ethernet LAN Switches

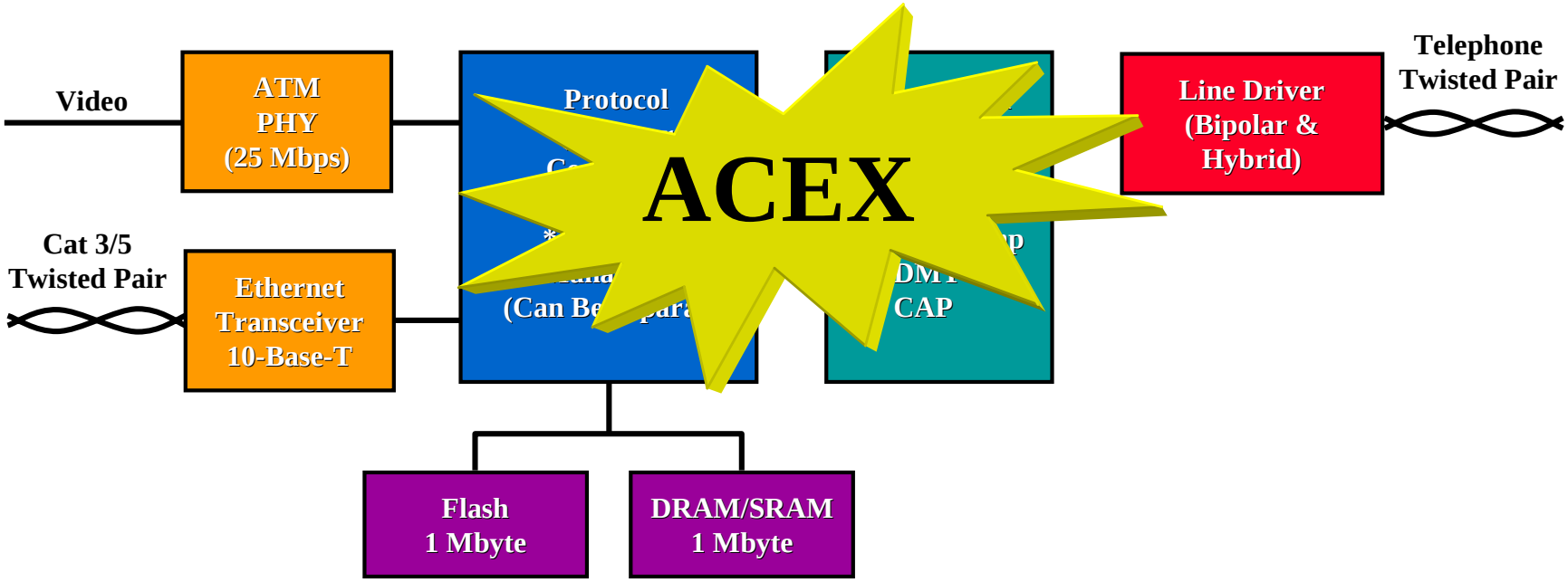
- Remote Access Concentrators



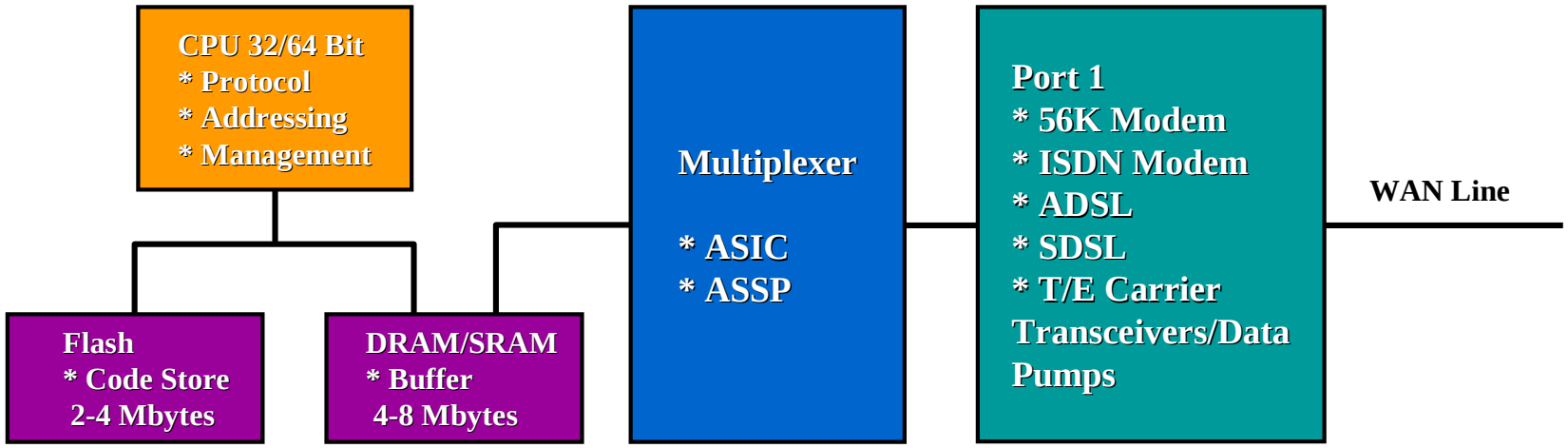
ADSL Modem: Block Diagram



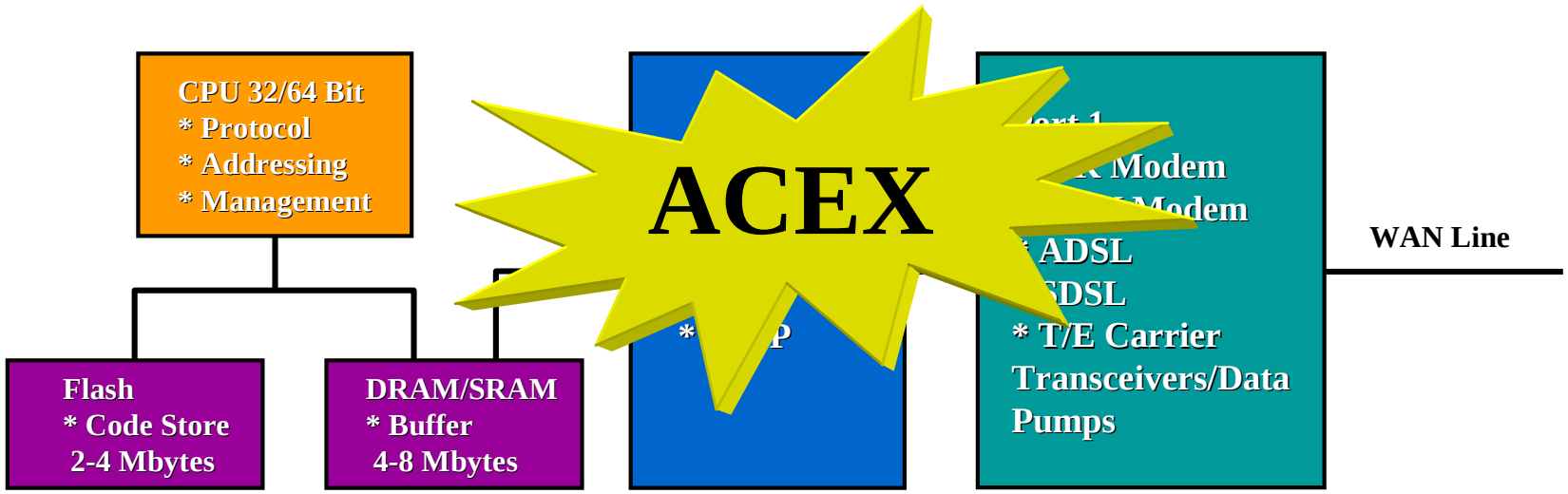
ADSL Modem: Block Diagram



Remote Access Controller: Block Diagram



Remote Access Controller: Block Diagram

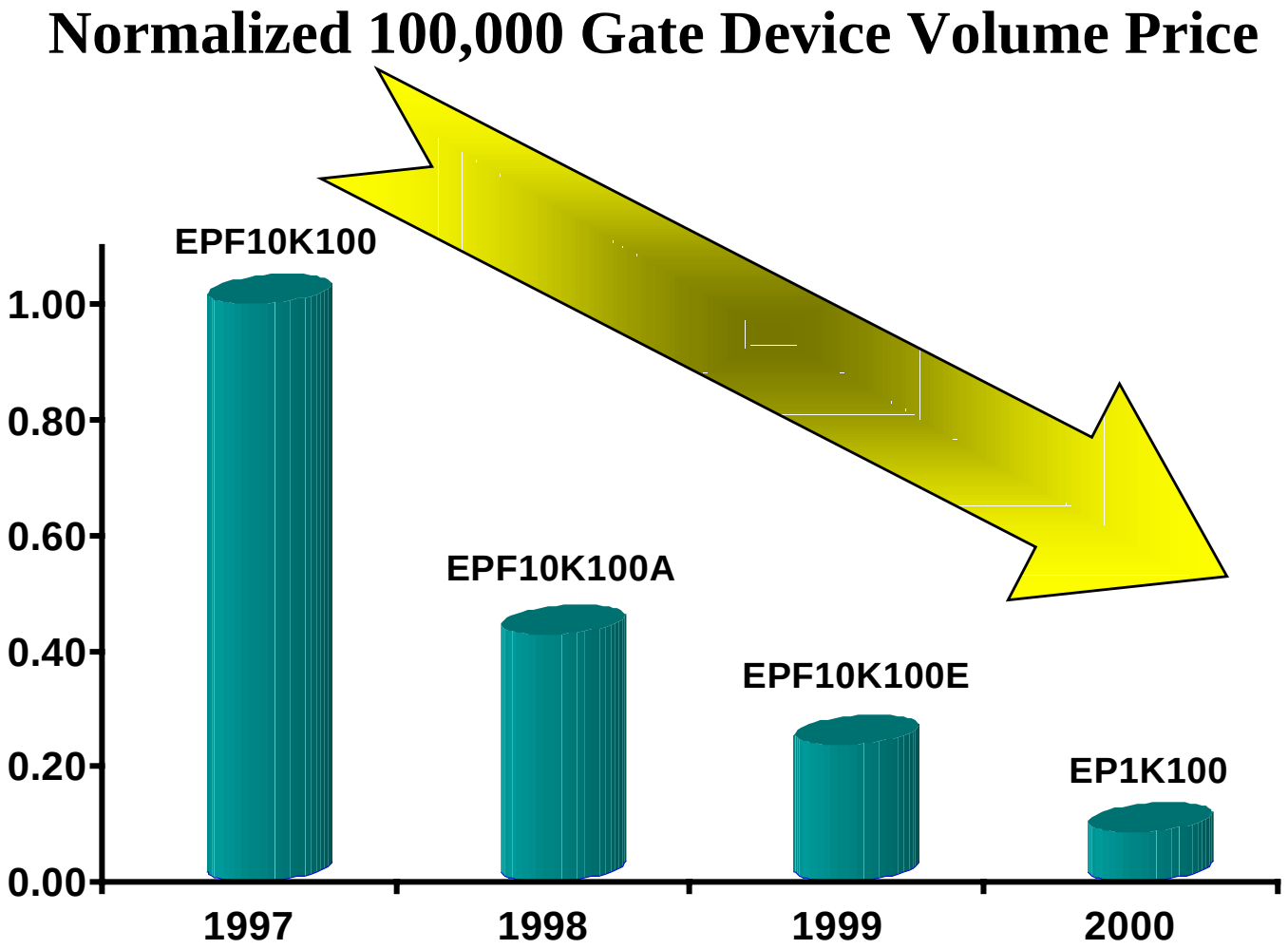


The ACEX Products

- Low-Cost, High-Performance Products
  - High-Volume Applications in the Communications Marketplace
- Multiple Families at Multiple Voltages
- Pricing
  - Establish Price Leadership in Low-Cost Marketplace

Low Price Leader

The Altera Pricing Advantage



ASIC Replacement

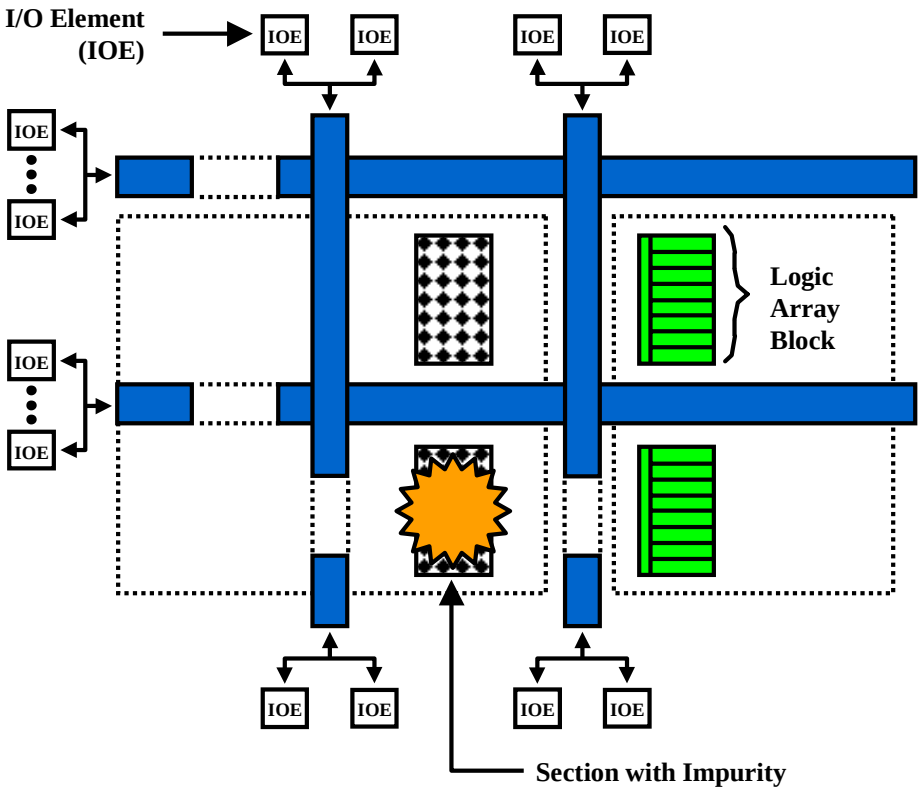
- ACEX Is The ASIC Replacement Solution
  - Cost Competitive with ASICs
  - All the Benefits of a Complete Programmable Solution
    - Fast Time-to-Market
    - Flexibility in Design
    - Reprogrammability
    - Advanced Development Tools
    - Drop-in Intellectual Property
  - No ASIC Risks. No ASIC NREs. No ASIC Restrictions.

ASSP Replacement

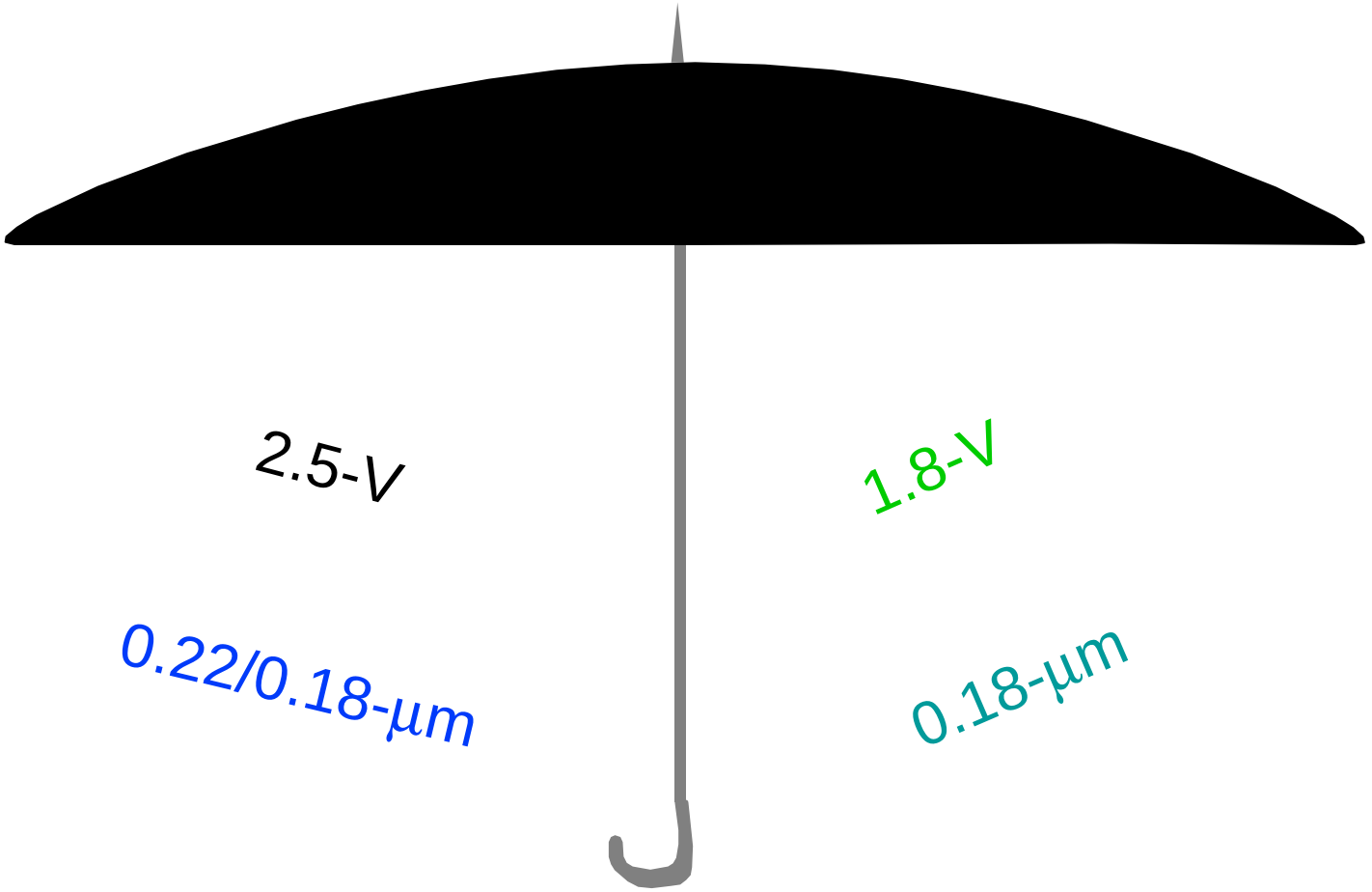
- Advanced Feature Sets Eliminate Specialized ASSPs
  - Advanced Capability PLLs
  - High-Speed FIFOs & Dual-Port RAM
  - Full 64-Bit, 66-MHz PCI Compliance
  - Advanced I/O Standards
  - MultiVolt I/O Capability
- Integrate ASSP Functionality into a Low-Cost PLD
  - Save Device Cost
  - Save Board Cost
  - Save Board Development Cost

Altera Redundancy Feature

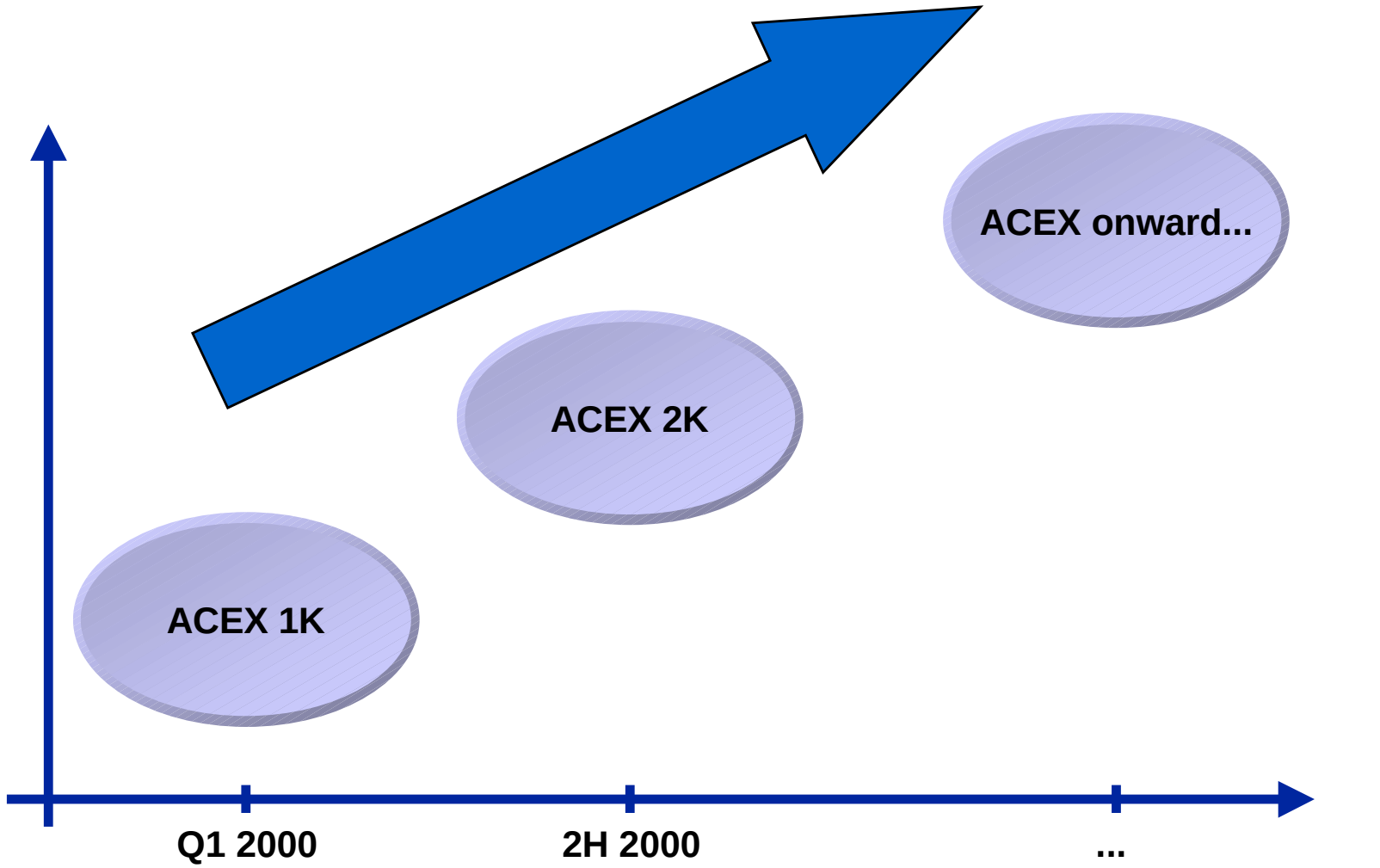
- Altera-Patented Technology on Application to PLDs
- Significant Yield Improvement



The ACEX Product Umbrella



The ACEX Roadmap



The ACEX 1K Family

The ACEX 1K Family

- 0.22/0.18-µm, 5LM Hybrid Process
  - 2.5-V Core Operating Voltage
- Availability
  - Sample Availability in March, 2000
  - Software Support in MAX+PLUS II v9.6

The ACEX 1K Family

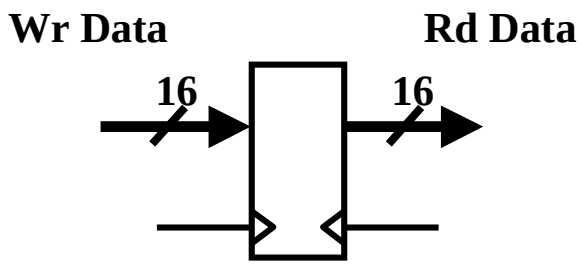
- The Altera Process Advantage
  - Hybrid Process
    - 0.22-µm Transistors
    - 0.18-µm Metal Interconnect
    - Maintains 2.5-V Core Operating Voltage
    - Provides Key Cost Improvements
  - Yield Improvements
    - Smaller Die Size Improves Yield
  - Patented Redundancy Feature

The ACEX 1K Family

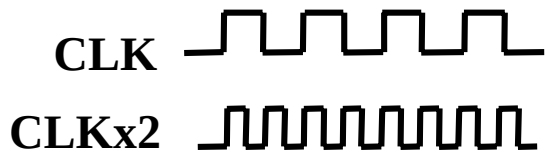
- ACEX 1K Features
  - 64-Bit, 66-MHz PCI Compliant
  - PLL Support
    - ClockLock Synchronization Circuitry
    - ClockBoost Multiplication Circuitry
      - Simultaneous Clock Lock and Clock x2 Outputs
  - Embedded Dual-Port Memory Blocks
    - 4 Kbit RAM Blocks
  - MultiVolt™ I/O Interface
    - 5-Volt Tolerant I/O

The ACEX 1K Feature Set

Dual Port RAMs & FIFOs



PLL Capability

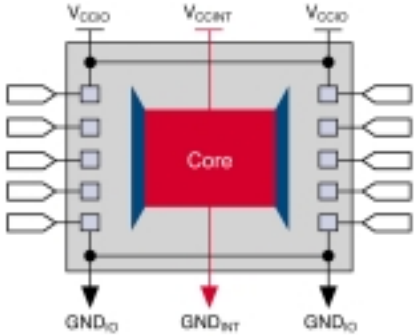


ClockLock

ClockBoost

ACEX 1K

MultiVolt I/O Interface



5-V Tolerant I/Os

64-Bit, 66-MHz PCI

AMPP SM
ALTERA MEGAFUNCTION PARTNERS PROGRAM

MegaCore™

ACEX 1K Family Members

Feature	EP1K10	EP1K30	EP1K50	EP1K100
Typical Gates	10,000	30,000	50,000	100,000
Logic Elements	576	1,728	2,880	4,992
RAM Bits	12,288	24,576	40,960	49,152
User I/O Pins (Max.)	130	171	249	333
Package Options	100-Pin TQFP, 144-Pin TQFP, 208-Pin PQFP, 256-Pin BGA[1]	144-Pin TQFP, 208-Pin PQFP, 256-Pin BGA[1]	144-Pin TQFP, 208-Pin PQFP, 256-Pin BGA[1], 484-Pin BGA[1]	208-Pin PQFP, 256-Pin BGA[1], 484-Pin BGA[1]
Available	Q3 '00	March	March	March

(1) 256- and 484-Pin Packages Are 1.0-mm FineLine BGA™

Available in MAX+PLUS II v9.6

The ACEX Price Advantage

ACEX Is The Low Price Programmable Leader

ACEX	High-Volume Price
EP1K10	$3.50
EP1K30	$7.00
EP1K50	$9.00
EP1K100	$11.95

Note: End-2000 Pricing in High Volume Quantities

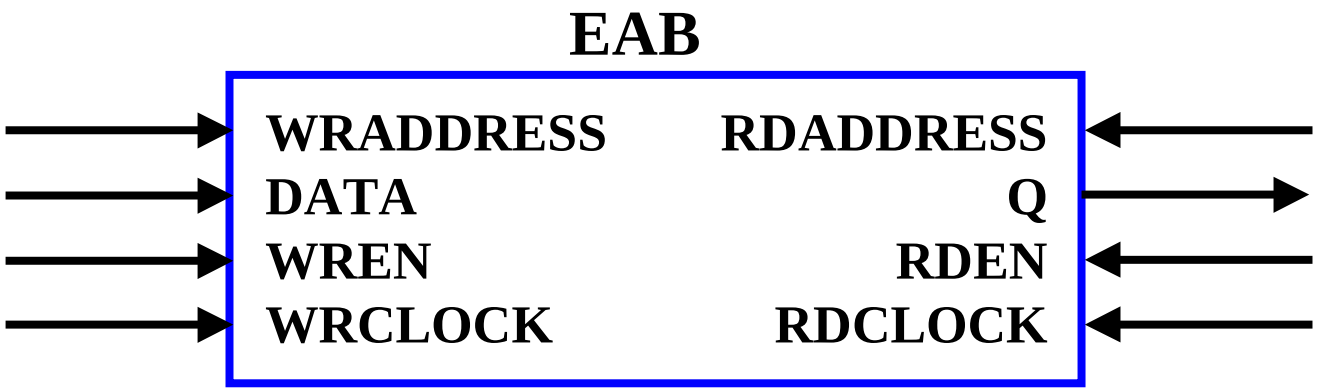
The ACEX I/O Advantage

- Communications Applications Require High I/O Counts
  - Allows High Performance Communication
  - Wide Bandwidth Capabilities

Device	EP1K10	EP1K30	EP1K50	EP1K100
Max. I/O	130	171	249	333

High-Performance Dual-Port RAM

- Independent Read/Write Ports
  - Synchronous/Asynchronous Access
  - 6.5-ns Access Time
- Wide Range of Configuration Options
  - 4 KBits/EAB for Flexibility
  - Width up to x16 for Maximum System Bandwidth
- Fast and Effective FIFO Implementation



ClockLock - Improve I/O Performance

- ClockLock Increases I/O Performance

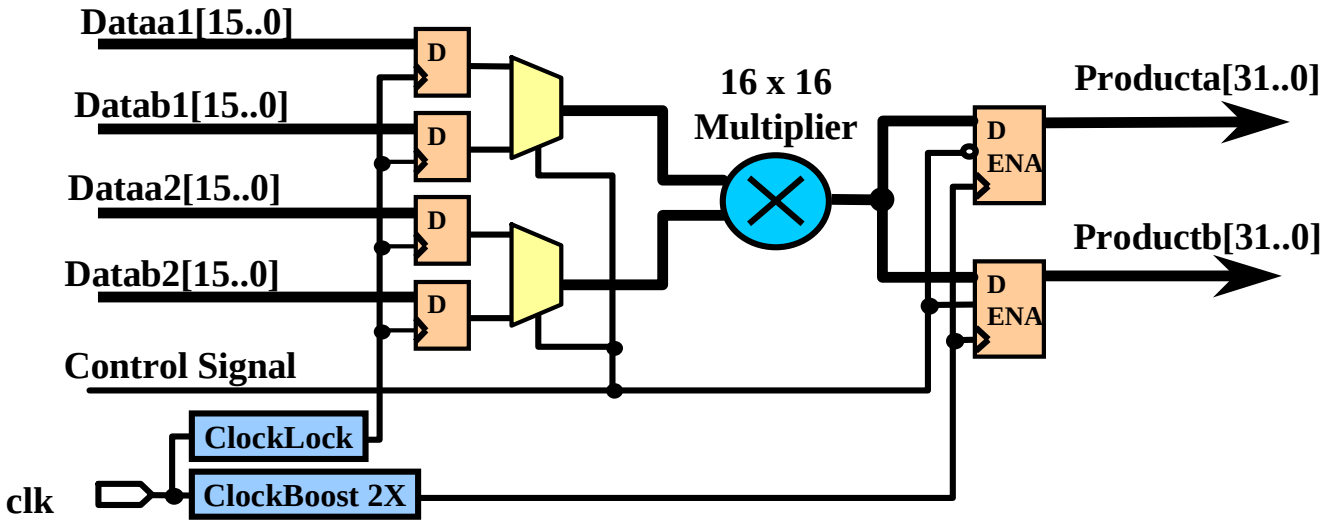
	Tco	Tsu
Without PLL	**5.2**	**2.0**
With PLL	**4.2**	**1.5**

Improved Timing!

Note: ACEX 1K data from MAX+PLUS II v9.6

ClockBoost - Time-Domain Multiplexing

- Multiplied Clock Used to Share Resources



	Required LEs	
Design	**Without** ClockBoost	Without ClockBoost
Two 16 x 16 Multipliers	**1,160**	680
Four 16 x 16 Multipliers	**2,320**	873

The ACEX 2K Family

The ACEX 2K Family

- Advanced 0.18-µm, 6LM Process
  - 1.8-V Core Operating Voltage
  - Altera Process Leadership
    - Volume Yields at Introduction via Excellent Defect Densities
- 20,000 to ~150,000 Gates
- Dual Port RAM Blocks
- Availability
  - Sample Availability in 2H ‘00
  - Software Support in Quartus only

The ACEX 2K Family

- ACEX 2K Features
  - PCI-X Compliant
  - 64-Bit, 66-MHz PCI Compliant
  - Advanced Capability PLL
    - ClockLock Synchronization Circuitry
    - ClockBoost Multiplication Circuitry
      - Multiplication and Division by Factors as High as 133
    - ClockShift Phase & Delay Adjustment Circuitry
  - Advanced I/O Standard Support
    - SSTL-2, SSTL-3, GTL+
    - HSTL, AGP, CTT
  - Embedded Dual Port Memory Blocks

The ACEX Advantage

PCI Market Status

- PCI is the De Facto Bus Standard for Open Systems
  - Emerging I/O Standard for Embedded Applications
- 64-Bit, 66-MHz Required for High-Performance Systems
  - High-Performance Communications Applications
  - Gigabit Ethernet, Fiber Channel
  - High-end Systems Require 64-Bit Addressing
- PCI-X is the Next Generation Solution
  - Frequencies of up to 133 MHz

Altera PCI Solutions

Megafunctions
32- & 64-Bit
33- & 66- MHz
PCI-X

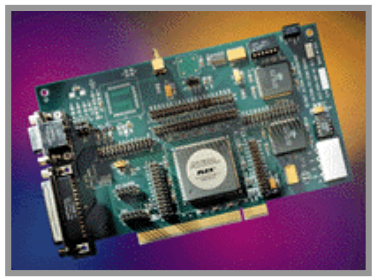
ALTERA MEGAFUNCTION PARTNERS PROGRAM

MegaCore™

ACEX

The Altera PCI Solution

Devices
ACEX 1K
ACEX 2K



Verification
Test Vectors
Hardware Testing

Tools
MAX+PLUS II
Quartus
OpenCore Evaluation
MegaWizard™ Plug-Ins
Test Benches

IP Solution Alternatives

- In-House ASIC Development
- Off-the-Shelf ASSP
- Programmable Logic Devices (PLDs)

Criteria	ASIC	ASSP	PLD
No NRE Cost	–	✓	✓
Fast Development Time	–	✓	✓
Fast Time-to-Market	–	✓	✓
Easy Customization	✓	–	✓
High Flexibility	✓	–	✓
Product Upgrade	–	–	✓

Altera Megafunction Programs

- Sourced by IP Partners
- Wide Range of Functions
- Optimized for Altera

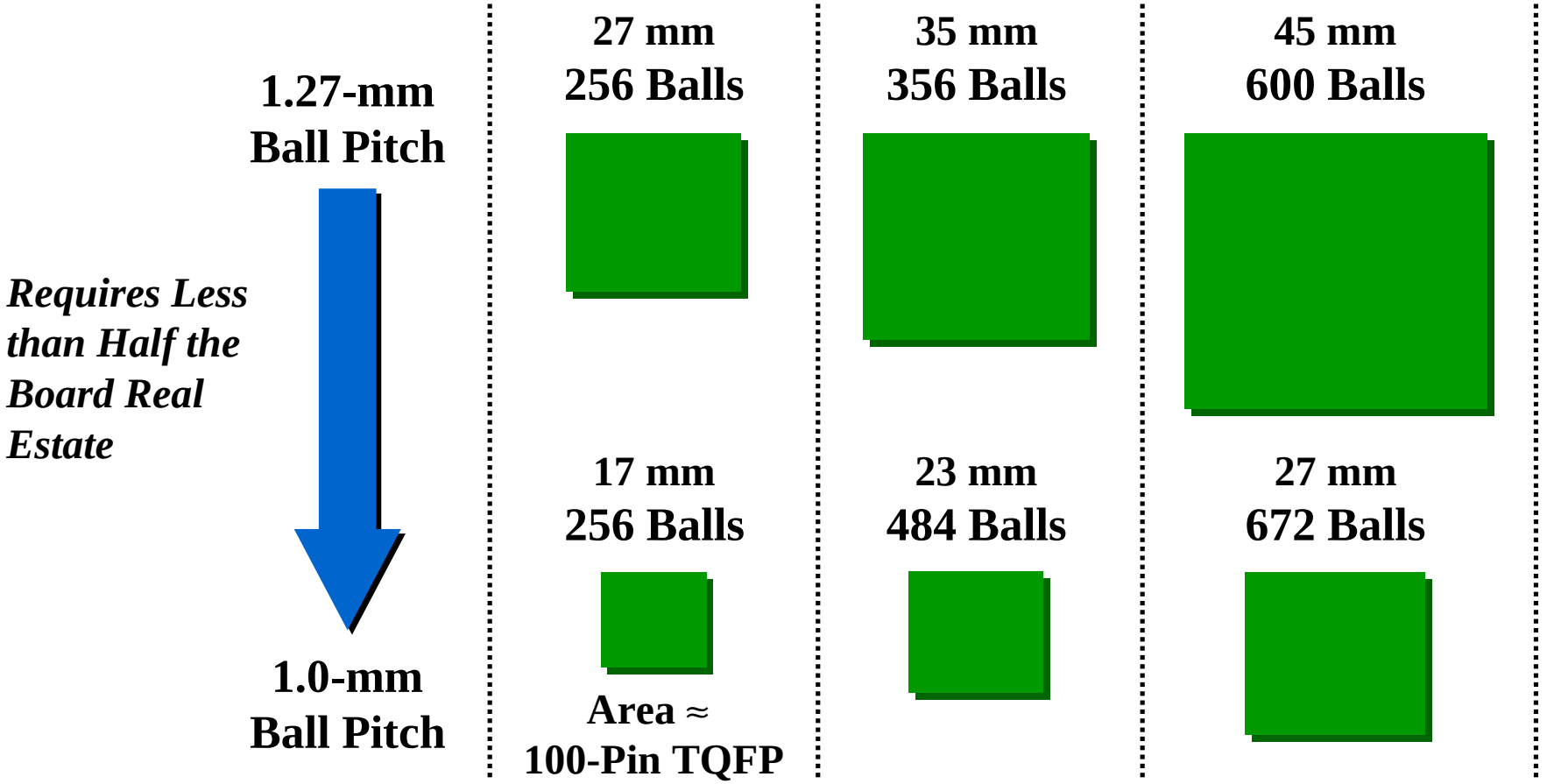
- Sourced by Altera
- Focused Set of Standard Functions
- Optimized for Altera

Optimized IP for Altera Devices

100+ Available IP Cores...

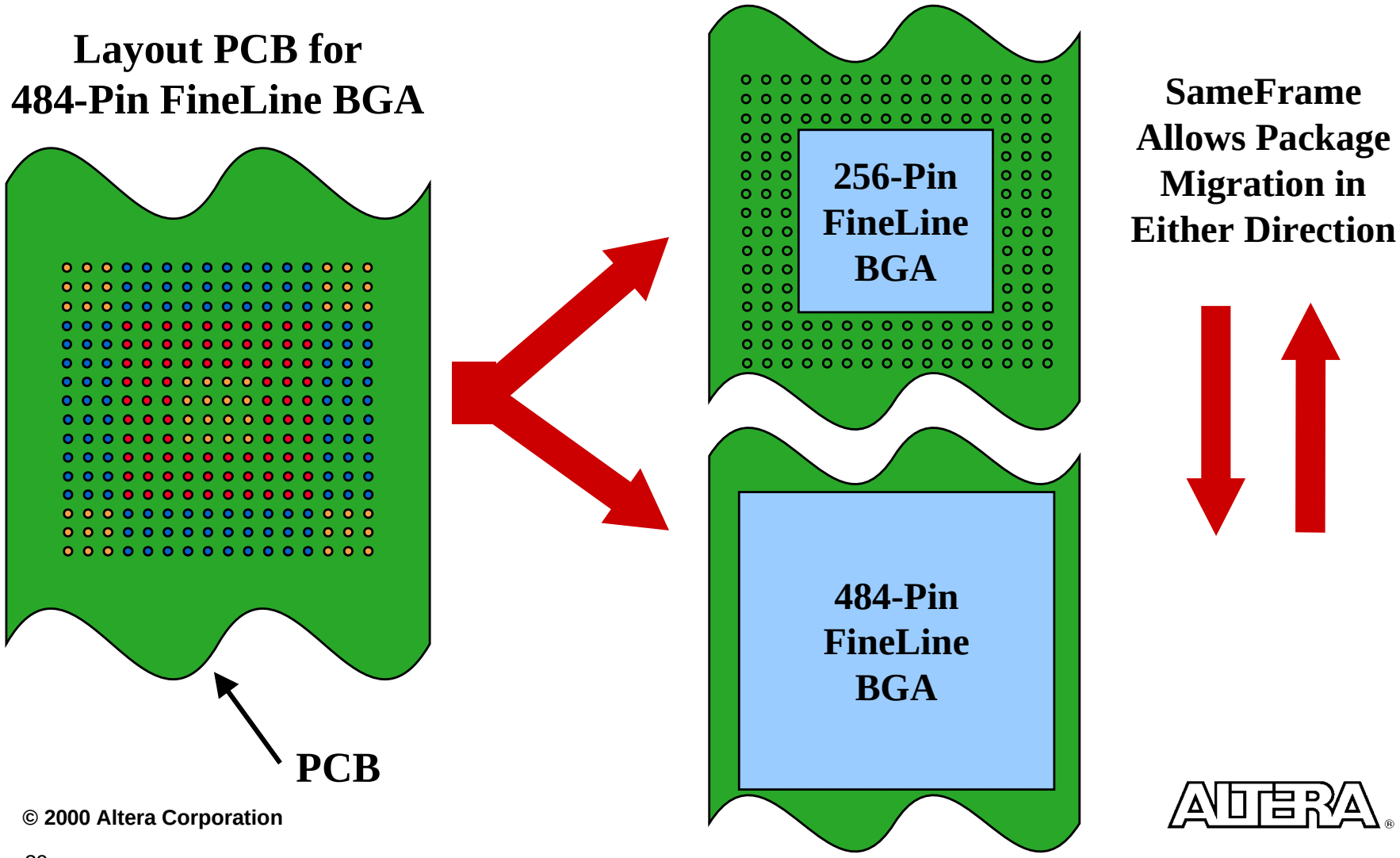
10/100 Fast Ethernet MAC
2910, 2910A Controllers
29116A 16-Bit Processor
49410 Controller
68450 DMA Controller
6850 ACIA
8255A Interface
16450/16550 UART
6502 Processor
Z80 Processor
8031/8051 Processors
8032/8052 Processors
Adaptive Filters
Convolutional Interleaver
Cordic
Decimating Filter
Digital Modulator
Digital Data Acquisition Function
DVB FEC Subsystem
FFT/IFFT
FIR Compiler
FIR Filter
HDLC
IIC Master and Slave
IIR Filter Library
Image Processing Library
Linear Feedback Shift Register
Numerically Controlled Oscillator
Packet over SONET Controller
PCI Master/Target
PCI-PowerPC Bridge
PowerPC Bus Arbiter
PowerPC Bus Master
PowerPC Bus Slave
Reed-Solomon Decoder
Reed-Solomon Encoder
SDRAM Controllers
SONET Byte Bus I/F
Speedbridge FIFO
Symbol Interleaver
Telephony Tone Generation
USB Function Controller
USB Host Controller
UTOPIA 2 Master/Slaves
Viterbi Decoder

FineLine BGA Package Efficiency



Total BGA Solution

SameFrame™ Pin-Out Advantage



ACEX Summary

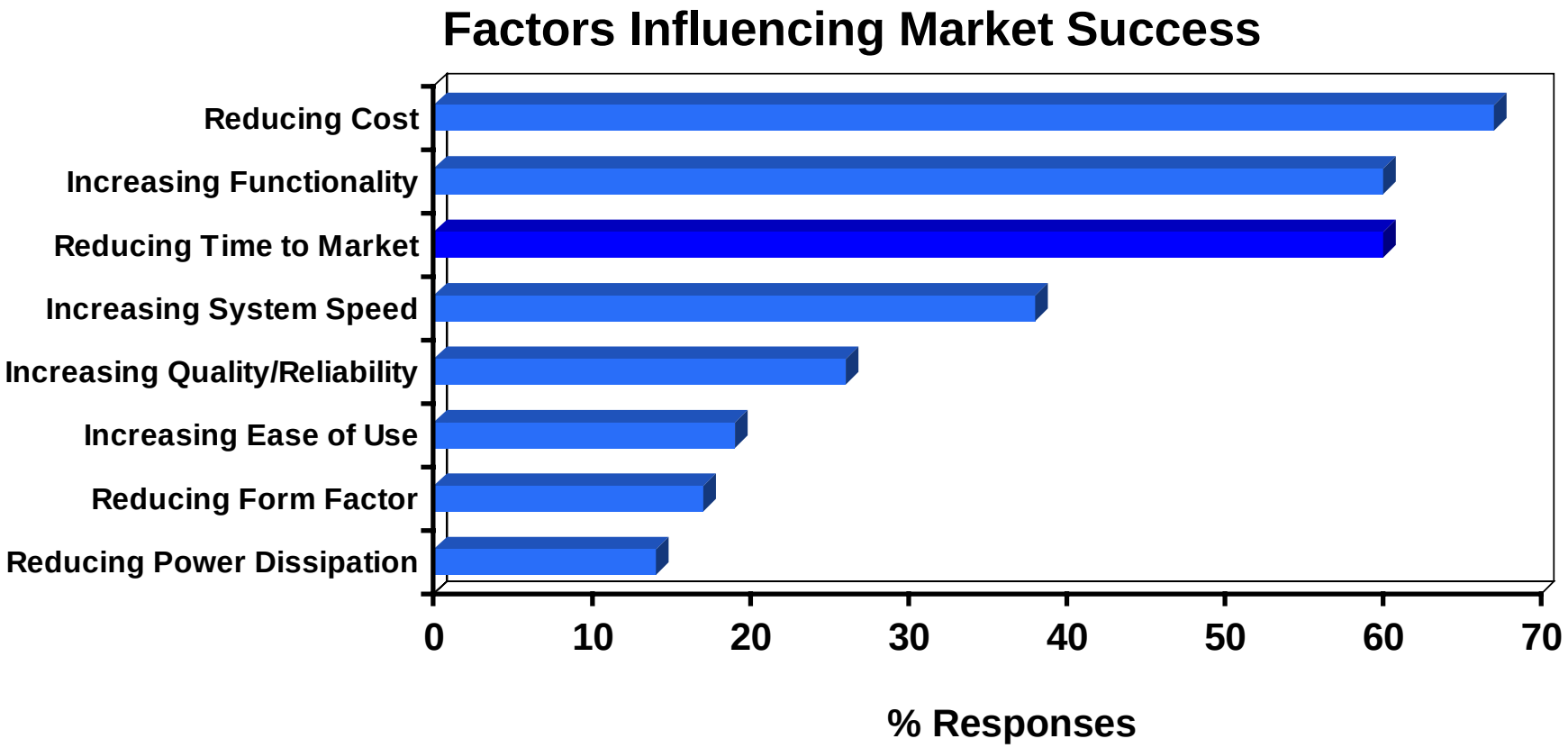
- The Premier Programmable Low-Cost Communications Solution
  - Low-Cost for High-Volume Use
  - High-Performance Capabilities for Communications Applications
  - Feature Rich Architectures
  - Software and Intellectual Property Leadership

ACEX: The Low-Cost, High-Performance Communications Solution

Backup Slides

Market Success Factors

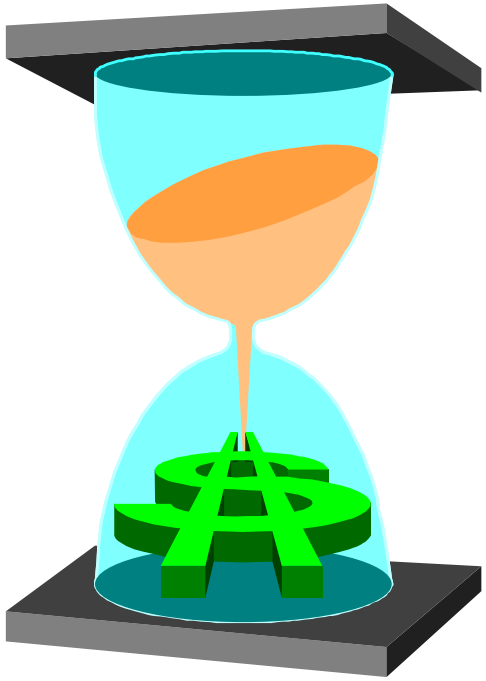
- ***Low Cost*** *&* ***Time-to-Market*** Critical for Success



Source: Dataquest

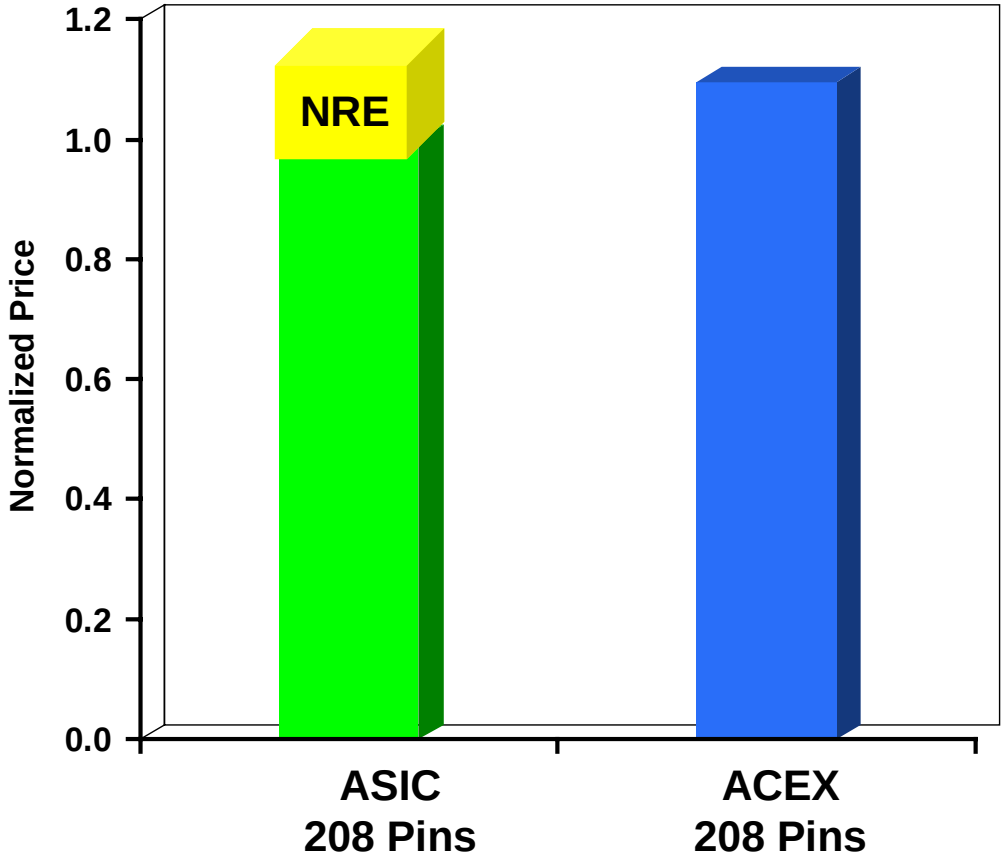
ACEX Time-to-Market Advantage

- Quick to Prototyping
  - In-System Design Verification
  - Dramatically Reduced Simulation & Verification Time
  - No Test Vectors Required
  - No Prototype Lead-Times
- Quick to Production
  - No Lengthy Sign-off Cycle
  - No Production Lead Times



Pricing vs. ASICs

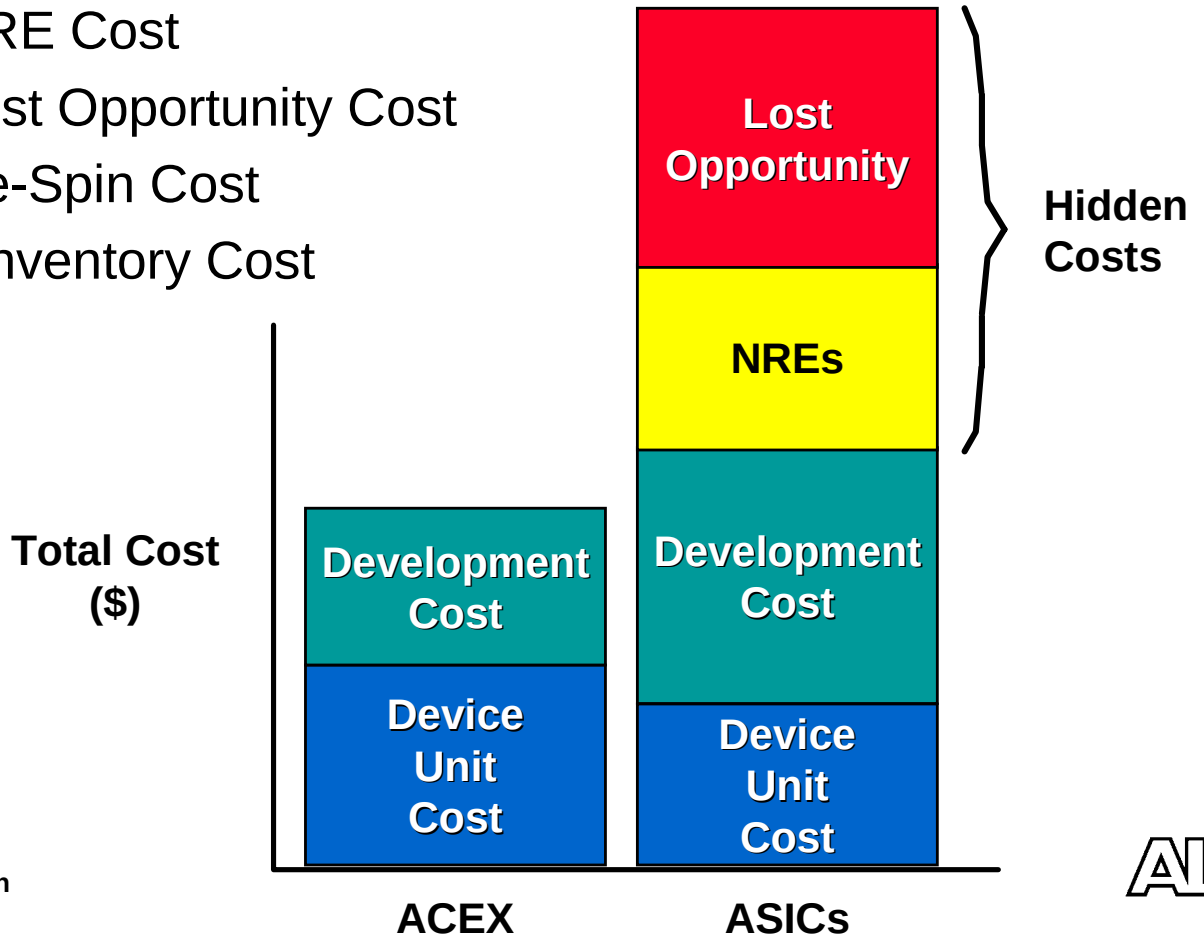
- Competitive with ASIC Unit Cost
- Benefits of Programmable Logic
  - **Faster to Market**
  - **Low Risk**
  - **No NRE**
  - **No Re-Spin Cost**
  - **Short Lead Times**
  - **Low Inventory Cost**



ACEX Provides Low-Cost Flexibility

Total Cost vs. ASICs

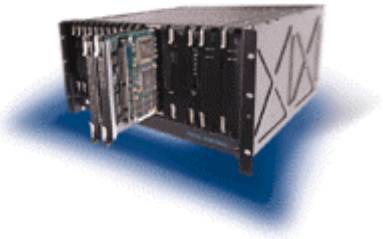
- Total Cost = Device Unit Cost + Hidden Costs
- ACEX Minimizes Hidden Costs
  - No NRE Cost
  - No Lost Opportunity Cost
  - No Re-Spin Cost
  - Low Inventory Cost



ACEX & APEX Applications

Ethernet LAN Switch

Central Office Switch



Remote Access Concentrators

XDSL Modem

Layer 3 Switch

WAN Router

ACEX

APEX

The ACEX Price Advantage

ACEX Is The Industry's Lowest Price per Function

ACEX	Cents/Logic Element
EP1K10	0.61
EP1K30	0.41
EP1K50	0.31
EP1K100	0.24

Note: End-2000 Pricing in High Volume Quantities

ACEX Summary

- ACEX Low-Cost Flexibility

Item	ASIC	ACEX
Device Cost	Low	Low
Total Cost	High	Low
Design Flow	✓	✓
No NRE	-	✓
Time-to-Market	-	✓
In-System Design Verification	-	✓
No Test Vectors	-	✓
No Re-Spin Cost	-	✓
Low Inventory Risk	-	✓