Embedded Computer
I/O Today & Tomorrow
About ACCES

- Founded in 1987 in San Diego, California
- Family owned corporation
- Acquisition, Control, Communications, Engineering Systems.
- Analog, Digital, Serial, Specialty I/O products, Systems
- Long life products, still shipping earliest products
- Custom and Semi-custom engineering
Acquisition and Control

- Large line of 12 and 16 bit analog input boards
- One of the largest lines of analog output boards
- From 24 to 120 line TTL digital input output cards
- Major line of optically isolated digital input products
- Peerless line of digital solid State and mechanical relay Boards and products

104-IIRO-16 shown
Serial Communications

- Large lines of RS-232, RS-422, and RS-485
- From one port to eight port models.
- Many models available with optical isolation
- Low cost serial and USB converters
- LPCI-COM-8SM shown
Specialty Products

- External Mux, signal conditioning and relay boards
- Watchdog boards
- Expansion Bus cards
- Arbitrary Waveform board
- Quadrature Encoder board

- ROB-24H shown
Distributed I/O

- RS-485 remote intelligent analog and digital units
- Wireless remote data acquisition and control
- Ethernet remote intelligent analog and digital units
- NEMA4 enclosures for small remote units

- Wireless RIDAC shown
PC/104 System Enclosures

- Rugged Aluminum stack enclosures
- Rugged NEMA4 dual stack enclosure
- Small dual stack PC/104 backplane enclosure
- All purpose EBX, EPIC, PC/104 box enclosure
- Custom Military PC/104 enclosure solutions

- E4-DAS(104E-BOX) shown
Form Factors
Existing Standards

- ISA- Original PC Bus, one of few large sources
- PCI- All boards are universal 3.3/5V capable
- PC/104- Modern designs with high density and E2 extended temperature models
- PCMCIA-Digital and A/D product
- Low Profile PCI- Only 16-bit 16 ch. A/D LPCI available.
- LPCI-A16-16A shown
Form Factors

New or Potential Standards

- USB/104- ACCES conceived USB I/O built to PC/104 size & mounting holes. Can be used in stacks and existing PC/104 enclosures. See Photo.
- ETX baseboards- Semi-Custom customer solutions can combine any of our I/O designs on to a single ETX baseboard
- PC/104 Express- Awaiting STD approval on connectors
- PCIe-PCI Express on a slot card. New ACCES line being developed
Expertise

- Custom hardware engineering design
- Custom software driver support for hardware
- Special military system testing
- PC/104 & Embedded System Integration
- Long term availability & 3 year hardware warranty
- Designed and Made in the U.S.A.
**New PCI boards: PCI-IDI Series**

**Digital Isolated Inputs**

- Qty 16, 32, 48 digital optically isolated DC/AC inputs
- Change-of-state detection (IRQ) on selected inputs (C models)
- Polarity insensitive AC/DC inputs accept up to 60VDC or AC rms (B models)
- AC or voltage transient filtering
- Optically isolated channel to channel and channel to ground
- Universal PCI, PCi-X, 3.3V and 5V compatible

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**ACCES I/O PRODUCTS, INC.**

**PCI 5 Volt Connector Key**

**PC/104**

**WIRELESS**
New PCI boards: PCI-IDO Series Digital Solid State Isolated Outputs

- Qty 16, 32, 48 digital isolated solid state relay outputs
- Universal PCI, PCI-X, 3.3V and 5V compatible
- Solid-state design permits high-speed switching and long-life expectancy
- Load voltages up to 60 Volts, current up to 2A
- Optically isolated CH. to CH. and CH. to ground.
ACCES PC/104 SOLUTIONS
PC/104 CONCEPT

- Self stacking bus (no backplane)
- Approved standard in 1992
- First built in 1987
- PC/104-Named for original 104 pins used on the ISA connector
- 3.550” X 3.755” (90 by 96mm)
- Bus drive 4mA, I/O modules
- Spacing is .06”(15mm) using four corner standoffs
- I/O modules typically <2W
PCI-104 & PC/104-Plus

- New PCI addition to stacking
  - PC concept (approved in 1997)
- Adds 120 pin PCI connector
- PC/104 size & spacing
- PC/104-Plus adds PCI stack connector to PC/104
- PCI-104 is the same with PCI only (no ISA)
- On Plus cards PC/104 ISA is pass through only
PC/104 BASIC ANALOG IN

- Eight Channels, 12-bit resolution
- Low cost multifunction board
- Bipolar/unipolar programmable ranges
  - 0-5V, 0-10V, +/-5V, +/-10V
  - (4-20mA factory option)
- Single Ended or True Differential
- 100K samples per second
- Direct Sensor Interface,
  optional gain of 1-200
- 24 Digital TTL I/O 50pin w/COS
PC/104 ANALOG IN/OUT

- Eight Channels, 12-bit resolution
- Low cost multifunction board with four 12-bit D/A
- Bipolar/unipolar programmable ranges 0-5V, 0-10V, +/-5V, +/-10V (4-20mA factory option)
- Single Ended or True Differential
- 100K samples per second
- Direct Sensor Interface, optional gain of 1-200
- 24 Digital TTL I/O 50pin w/COS

104-AIO12-8
PC/104 16-BIT ANALOG IN

- 16-bit Channels, 16-bit resolution w/ 2K FIFO
- Economic multifunction board with two 12-bit D/A
- 11 software/hardware selectable ranges
- Channel programmable gain of 1, 2, 5 and 10.
- 16 Single Ended or 8 Differential
- 250K samples per second
- Auto calibration
- 16 Digital TTL I/O
- Optional 5V only, E2 temp.
PC/104 HIGH SPEED 16-BIT ANALOG INPUT

- Multifunction 16 A/D Channels, 16-bit resolution
- 11 software/hardware selectable ranges
- Channel programmable gain of 1, 2, 5 and 10.
- 16 Single Ended or 8 Differential
- 500K samples per second with full 16-bit wide data path & FIFO
- Auto calibration
- 16 Digital TTL I/O & Two High Speed 12-bit D/A channels

104-AIO16-16W
PC/104 ANALOG INPUT MULTIPLEXER

- Expand one PC/104 A/D input to 32 Ch A/D inputs
- Programmable ranges +/-25mV, +/-50mv, +/- .1V, +/-2.5V, +/-5V, +/-10V
- 32 Single Ended or 16 Differential Inputs
- Up to 8 boards per stack (256) IN
- Direct Sensor Interface options, 4-20mA, RTD, Thermocouples,
- 5V only operation, E2 option

104-AIM-32
PC/104 ANALOG OUTPUT

- Standard Eight D/A Channels, 12-bit resolution
- Extra Arbitrary Waveform Generator 8A model
- Output programmable ranges
  0-5V, 0-10V, +/-5V, +/-10V, 4-20mA
- 128K SRAM for ARB data storage
- 32-bit counter for timed outputs
- 16-bit counter for interrupt generation
- 5V only operation, Extended temperature option -40 to 85°C

104-DA12-8A
PC/104 DIGITAL TTL I/O

- Standard 24 & 48 Digital TTL Inputs or Outputs
- Type 83C55 PPI mode 0 & 50-pin connector compatible with Opto-22 or Greyhill module racks
- Each 24-bit group (two 8 bit ports, two 4 bit ports) per connector
- Buffered, 64mA sink, 32mA source
- I/O pulled up to 5V, option for pull-down resistors.
- Fused 5V only operation, Extended temperature option -40 to 85°C
PC/104 DIGITAL TTL I/O
w/ Change-of-State interrupt

- 24 & 48 Digital TTL In/Out w/ Change-of-State Interrupts allows reduced CPU load
- Type 83C55 PPI mode 0 & 50-pin connector compatible with Opto-22 or Greyhill module racks using relay modules
- Each 24-bit group (two 8 bit ports, two 4 bit ports) per connector
- Buffered, 64mA sink, 32mA source
- Fused 5V only operation, Extended temperature option -40 to 85C
PC/104 PLUS DIGITAL
HIGH SPEED 96 TTL I/O

- 96 Digital TTL-DTL Input/Output channels
- Four 50-pin connectors compatible with Opto-22 or Greyhill module racks using relay modules
- Emulates Type 8255 PPI mode 0
- 7.37M bytes per second data rate from I/O connector to/from PCI bus:
- Full 32-bit PCI interface design
- Buffered, 64mA sink, 32mA source
- Fused 5V only operation, Extended temperature option -40 to 85C

P104-DIO-96
PC/104 8 DIGITAL ISOLATED & RELAY BOARDS

- 8 Optically Isolated Inputs for up to 31V DC or AC
- Change-of-State Interrupt model reduces CPU load from constant polling
- 8 Form C Electro-mechanical relays for digital outputs
- 8 non-isolated TTL digital inputs
- Slow/fast filter to accommodate AC voltages and noisy DC inputs
- Relay contact rating of 1A@24VDC & .5A@125VAC
PC/104 16 DIGITAL ISOLATED & RELAY BOARDS

- 16 Optically Isolated Inputs for up to 31V DC or AC
- Change-of-State Interrupt model reduces CPU load from constant polling
- 16 Form C Electro-mechanical relays for digital outputs
- Relay only, Input only versions
- Slow/fast filter to accommodate AC voltages and noisy DC inputs
- Relay contact rating of 1A@24VDC & .5A@125VAC
PC/104 32 DIGITAL ISOLATED & 4 RELAY BOARD

- 32 Optically Isolated Inputs for up to 31V DC or AC
- Change-of-State Interrupt model reduces CPU load from constant polling
- 4 Form C Electro-mechanical relays for digital outputs
- Economy (No COS) & E2 options
- Slow/fast filter to accommodate AC voltages and noisy DC inputs
- Relay contact rating of 1A@24VDC & .5A@125VAC

104-II32-4RO
PC/104 DIGITAL ISOLATED & SOLID STATE BOARDS

- 8/16 Optically Isolated Inputs up to 31V DC or AC
- Change-of-State Interrupt model reduces CPU load from constant polling
- 8/16 FET solid state isolated relays for digital outputs
- Economy (No COS) models
- Solid State output only models
- Slow/fast filter to accommodate AC voltages and noisy DC inputs
PC/104 RS-232 SERIAL BOARDS

- PC/104 8/4/2 RS-232 asynchronous serial COM
- Operates as a standard COM port in all OS
- Speeds up to 230.4K with 64-byte FIFO
- Programmable IRQ sharing simplifies system design and installation
- Low power required: 5VDC @80mA typical
- E2 Extended temp option

104-COM232-8
PC/104 PLUS 8 PORT
RS-232 SERIAL BOARD

- PC/104 Plus 8 RS-232 asynchronous serial COM
- Operates as a standard COM port in all OS
- Speeds up to 460K with 64-byte FIFO on PCI bus
- Global interrupt source register
- Data Transfer in Byte, Word or Double-Word
- Transmit & Receive FIFO counters
- Extended Temperature Standard

P104-COM232-8
PC/104 2 PORT ISOLATED RS-422/485 SERIAL

- PC/104 two optically isolated asynch serial COMs
- Field selectable RS-422/485 on either port
- Auto-RTS for half-duplex RS-485
- Speeds up to 115.2K STD, 460.8K w/128-byte FIFO option
- Fixed bias and jumper selectable termination provided
- Operates as a standard COM port in all OS
- E2 Extended temp option

104-ICOM-2S
PC/104 RS-422/485 SERIAL BOARDS

- PC/104 8/4/2 port RS-422/485 async serial COM
- Field selectable RS-422/485 on each port
- Speeds up to 115.2K STD, up to 921.6K w/jumper selection & 128-byte FIFO option
- Auto-RTS for half-duplex RS-485
- Fixed bias and jumper selectable termination provided
- E2 Extended temp option
- Standard COM port under all OS

104-COM-8S
PC/104 RS-232/422/485 SERIAL BOARDS

- PC/104 8/4/2 port RS-232/422/485 asynch serial
- Field selectable RS-232/422/485 on each port
- Speeds up to 115.2K STD, up to 921.6K w/jumper selection & 128-byte FIFO option
- Auto-RTS for half-duplex RS-485
- Fixed bias and jumper selectable termination provided
- E2 Extended temperature option
- Operates as a Standard COM port in all Operating Systems
PC/104 DIGITAL QUADRATURE ENCODER INPUT BOARD

- 4 or 8 channels of quadrature encoder inputs and channel index inputs
- Input ranges: ±25V and ±7V common mode
- 4.3MHz maximum clock rate
- Programmable for counting, speed, and direction
- Limit setting with interrupts; factory flexible interrupt options

104-QUAD-8
PC/104 DC-DC POWER SUPPLY BOARDS

- PC/104 Bus 30/40Watt DC/DC Power Supplies
- Three Wide Input Voltage Ranges of 12, 24, 48V
- Multiple outputs of 5, 12 and -12VDC, with 5VDC only economy model
- Up to 84% efficiency
- Voltage status LEDs
- Reverse power protection on inputs
- Top or Bottom fanless heat sinking
- Resettable fused input line
- Fully protected outputs

104-PWR-512A
PC/104 TWO BOARD CHASSIS

- PC/104 dual board backplane in low profile chassis
- Two PC/104 boards can be mounted side by side
- Opening on both ends for ribbon cables, wiring and cooling
- Rugged low cost enclosure
- Easy panel mounting provisions
- Protect system components during proto development

104T-BOX
PC/104 FOUR BOARD
NEMA4 CHASSIS

- PC/104 dual board backplane in NEMA4 chassis
- Four PC/104 boards can be mounted side by side
- Provision for heat sinking CPU & Power Supply to Aluminum chassis.
- Measures just 8.7” x 5.6” x 3.25”
- Cover incorporates a recessed gasket to maintain seal
- Two or four watertight glands provide cable strain relief
PC/104 RUGGED STACK ENCLOSURE

- PC/104 conductive cooled aluminum chassis
- Four, Five & Six PC/104 board models
- Removable railed card cage subassembly
- Measures just 6.75” x 5” x 5” on four board model
- Lightweight, attractive, Chem-Film finished aluminum enclosure
- Perfect for rugged E2 environments
USB I/O Concept

- Standard created in 1996
- USB-Stands for Universal Serial Bus
- Serial bit stream up 480Mbits/s
- External Hot-plugging I/O Interface
- Up to 127 devices from single USB Host port
- Motherboard host uses Type “A” connector & USB I/O uses Type B connector
USB Speed

- USB 1.1 supports Low-Speed and Full-Speed
- USB-2.0 supports these plus High-Speed
- Low-Speed, data rate up to 1.5Mbps
- Full-Speed, data rate up to 12Mbps
- Hi-Speed, data rate up to 480Mbps or theoretical maximum of less than 60MBs (55MBs) for a single device.
- Control transfers, 4k transactions per second due to overhead and latency on digital units. 32bits per transaction
USB I/O Power

- Maximum available power at host port is 500mA
- Bus powered hubs supply only 400mA for all four ports
- Some motherboards supply less than 500mA
- ACCES USB I/O has external power option on most designs
- Only a few models require external power, ie 16 relays

Type A & B pins

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vcc</td>
</tr>
<tr>
<td>2</td>
<td>Data -</td>
</tr>
<tr>
<td>3</td>
<td>Data +</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>Shield</td>
</tr>
</tbody>
</table>

4.75-5.25VDC
USB/104

- Creating a full USB/104 product line
- OEM “board only” USB products
- Bus agnostic PC/104 size I/O board with the same hole mounting
- Fits in most PC/104 Chassis
- Mounts on PC/104 stack
- Can be used inside rack mount and bench mount computers as extra I/O when all slots are full
- Can be used inside OEM products
USB Serial Single Port

- Add a RS-232, RS-422 or RS-485 serial port to any USB equipped computer
- Data transfer rates up to 920K baud
- Built in six foot cable
- Ideal for laptops & portables
- No available board slots needed
- RoHS versions available
- Plug-n-Play Hot Swap device for quick connect/disconnect

USB-232,-422,485
USB Serial Dual Port

- Add two RS-232/422/485 serial ports to any USB equipped computer
- Data transfer rates up to 921.6K baud on RS-422/485
- Small (4” x 3.75” x 1.8”) rugged metal enclosure, USB/104 board
- Ideal for laptops & portables
- No available board slots needed
- USB bus power only required
- Plug-n-Play Hot Swap device
USB Serial Four Port

- Add four RS-232/422/485 serial ports to any USB equipped computer
- Data transfer rates up to 921.6K baud on RS-422/485
- Compact low-profile rugged metal enclosure with power/activity LEDs
- Ideal for laptops & portables
- No available board slots needed
- USB bus power only required
- Plug-n-Play Hot Swap device

USB-COM-4SM

ACCES I/O PRODUCTS, INC.
USB 32 Digital I/O

- Add Qty 32 digital TTL input/outputs to any USB equipped computer
- High-speed USB 2.0
- Small (4” x 4” x 1.25”) rugged metal enclosure, USB/104 board
- Four 8-bit ports, individually selectable as inputs or outputs
- Buffered lines with Sink 64mA & Source 32mA current capabilities
- USB bus power only required

USB-DIO-32
USB FAST 32 Digital I/O

- 32 high-speed digital I/O lines feature continuous throughput of 24MB/s
- Digital outputs capable of 132MB/s bursts with synchronous clocking
- Small (4” x 4” x 1.25”) rugged metal enclosure, USB/104 board
- Two 16-bit ports, one for inputs & one for outputs on 68 pin SCSI HD
- Buffered lines with Sink 64mA & Source 32mA current capabilities
USB Digital Isolated Inputs & Relay Outputs

- Add Qty 16 isolated input/16 relays to any USB equipped computer
- High-speed USB 2.0
- Small (4” x 4” x 1.5”) rugged metal enclosure, USB/104 board
- Removable internal screw terminals
- Form C electro-mech. 1A relays
- 16 Relay versions require external power supply, 8 & 4 relay pwr. option

USB-IIRO-16
USB Digital Isolated Inputs, Relays & Serial Combo

- Qty 4 digital isolated inputs
- Four Form C electro-mech. relay outputs, 1A
- Two serial RS-232/422/485 ports
- USB 2.0 & 1.1 compatible
- Small (4” x 3.75” x 1.8”) rugged metal enclosure, USB/104 board
- USB bus power only required
- Expansion USB hub connector

USB-IIRO4-2SM
USB Counters

- Add 15 independent 16-bit counter/timers to any USB equipped computer
- Clock, gate and out signals from all 15 counters buffered & accessed via 1 connector
- Small (4” x 4” x 1.25”) rugged metal enclosure, USB/104 board
- Removable screw-termination board
- User wiring card adaptor supplied
- USB bus power only required
USB Analog Input

- Add 16 single-ended or 8 differential channels of 16-bit A/D at 500kHz to any USB equipped PC
- Two 16 digital I/O lines & 16-bit programmable counter
- High-speed USB 2.0 device
- Small (4” x 4” x 1.25”) rugged metal enclosure, USB/104 board
- Auto calibration & Programmable Gain (choose from 8 ranges)
- Self standing mode optional w/1M

USB-AI16-16
USB Analog Output

- Add 8 independent 12-bit DACs to any USB equipped computer
- Two models either Standard D/A or Arbitrary Waveform generator
- USB 2.0 bulk buffered or streaming waveform output
- Small (4” x 4” x 1.5”) rugged metal enclosure, USB/104 board
- 128K sample buffer buffer outputs one million DACs/second

USB-DA12-8E
USB-DA12-8A
ETX Concept

- Standard created by Kontron in 2000
- ETX-Stands for Embedded Technology eXtended
- Computer module size 95mm X 114mm
- Uses four surface mount Hirose FX8 connectors
- Routes PCI/ISA Bus & all motherboard I/O lines through connectors
ACCES & ETX

- First exclusive I/O manufacturer doing ETX baseboards
- Semi-Custom ETX Baseboard concept introduced
- Select ACCES COTS I/O for foundation
- Kontron Certified ETX baseboard partner & distributor
Embedded World Positioning

- **EPIC PC/104**
  - Off-the-shelf
  - Complexity low
  - High margin
  - Distribution
  - Standardized
  - ASP high

- **EBX or 3.5" with PC/104, PCI**
  - Semi-custom add-on

- **Embedded Modules ETX & COM EXPRESS**
  - Custom carrier

- **Full custom board design**

<table>
<thead>
<tr>
<th>Sales Volume</th>
<th>10k units</th>
<th>Around 1k units</th>
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<tr>
<td>Project business</td>
<td>Complexity high</td>
<td>Low margin</td>
</tr>
<tr>
<td>Direct sales</td>
<td>Semi/full custom</td>
<td>ASP low</td>
</tr>
</tbody>
</table>
Puzzle vs ETX Building Block

- CPU
- North-bridge
- South-bridge
- Full custom board
- Headers/Connectors
- Video
- Audio
- LAN
- USB
- Analog
- Digital
- Power

- CPU
- North-bridge
- South-bridge
- ETX embedded module
- Analog
- Digital
- USB
- LAN
- Connectors
- Power

Custom carrier card
ETX CUSTOM vs ACCES ETX

Custom carrier card

CPU  Video
North-bridge  Audio
South-bridge  USB
ETX embedded module
ANALOG  DIGITAL
Connectors  Power

Semi-Custom carrier card

CPU  Video
North-bridge  Audio
South-bridge  USB
LAN
ETX embedded module
ACCES Analog
ACCES Digital
Connectors  Power

ACCES I/O PRODUCTS, INC.
Semi-Custom ETX Baseboard

- First define all your I/O needs both motherboard and application add on I/O
- Get development baseboard
- Select ACCES I/O cards
- Select computer module
- Use this to write software and prove application
- ACCES provides proto baseboard with I/O & connectors included
ETX vs. CUSTOM COMPARISON

Full Custom Design == 24 Weeks

- Schematics: 6 weeks
- Placement & Routing: 6 weeks
- Build Prototypes: 2 weeks
- Test & Validation: 6 weeks
- Design Touch Up, Build Revised Units, Test & Release: 4 weeks

ETX Semi-Custom Design == 12 Weeks

- Schematics: 3 weeks
- Placement Routing: 3 weeks
- Build Prototypes: 2 weeks
- Test & Release: 4 weeks

Enter market 3 months ahead
ETX-EVAL Development Baseboard

- ATX motherboard ETX baseboard
- Power connectors for ATX & Baby AT P/S
- FFC connector for LVDS flat panels
- Four PCI & Three ISA slot
- All STD motherboard I/O
- Standard four ETX connectors for using all ETX compatible modules
- Use for application proto custom development
ETX-NANO-104

- Wide range of ETX CPU modules supported
- Small size only 120mm X 125mm (4.72” X 4.92”)
- Full PC/104 Plus I/O Expansion
- Four rear mounted USB 2.0
- VGA, PS/2 Mouse/Keyboard
- Two Serial, 1 RS232/422/485
- 10/100 Ethernet LAN port
- Flat Panel, IDE, Flash support
- AC97 audio; Line In/Out/MIC
NANO I/O SERVER

- Up to Core Duo 1.66Mhz Fanless computer
- Small size only 127mm X 159mm (5.00” W X 6.25”)
- 2.5” laptop drive mount if only one PC/104 board
- 2 two PC/104 Plus I/O cards
- Flush side opening for Compact Flash card
- Black anodized aluminum
- Rear I/O Panel
- 12VDC to ATX P/S
PCI Express (PCIe)
PCI Express I/O Concept

- Intel standard created in 2004
- 1X lane serial bit stream up to 250MB/s
- Slots in 1X, 4X, 8X & 16X and eventually 32X lanes
- 1X double PCI slot bandwidth
- Full duplex and point to point
- No shared bandwidth between I/O boards
- One device per slot
- I/O path of 1 bit serial

PCIe I/O slot connectors
PCI Express Non-Bus “bus”

- Riding on a public bus vs private freeway lane
- Even 16X device has parallel private data lanes that do not act as shared data bus
PCI vs PCIe Motherboards

- Common motherboards mostly have 16X to replace AGP and 1X for I/O boards
- Motherboards will often not be able to used for embedded

Current PCI & PCIe Motherboards
PCI Express Device Lane

I/O Use

- 16X mostly used by graphic boards. 80 Gbps (encoded), 64 Gbps (8 GBs)
- 8X for dual 10Gig Ethernet board or advanced graphic capture boards
- 4X for SAS drive controllers and multiple Gigabit Lan server boards
- 1X single Gigabit workstation board, SATA drive controller, other I/O boards. 5 Gbps (encoded) 4 Gbps, 500 MBs (unencoded)
PCle Embedded Density

- PCle provides higher performance with less pins
- This saves space on small embedded boards
- Allowing more capability on smaller I/O board
PCI Express Form Factors

- Slot based PCI Express low profile, 1X, 4X, 8X, 16X for motherboards and PICMG 1.3 passive backplanes
- Mini Card replaces Mini PCI (1X, USB, SMBus)
- Express Card: successor to PC Card or PCMCIA (1X PCIe and USB 2.0 hot-pluggable)
PCI Express
Form Factors

- XMC: replaces CMC/PMC (4X PCIe or Rapid I/O)
- MXM & AXIOM graphics modules for laptops
- PC/104 Express coming (1 year)
- COM Express: (shown) successor to ETX CPU modules
PCI Express Slots

- 1X slot cards can fit in 1X, 4X, 8X slots
- Meets the needs of most data acquisition, control and communication boards
- 1X connector shown to the right
- PCIe 1X will have reduced costs
- PCI compared to 1X PCIe seen below
- Less of PCB allocated to bus routing
We have come a long way
Computer I/O Yesterday, Today & Tomorrow
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