

The logo for 'sensor to image' features the text in a bold, italicized sans-serif font. A thick green line starts as a smooth curve under the word 'sensor' and then transitions into a stepped, staircase-like line that extends across the top of the word 'image'.

sensor to image

Machine Vision

Camera Interfaces

Korean Vision Show April 2012

Machine Vision

Hardware Interface Standards

- PCI, CPCI V2.2, PCIe V2.x
- USB2, USB3 Vision
- IEEE1394 (no development by Sensor to Image)
- Camera Link[®] V2.0, CameraLink-HS
- GigE Vision[®], V1.2, V2.0 (10Gb)
- CoaxPress[®], V1.1

Comparison of hardware interface standards

	USB2/3	IEEE 1394	Camera Link [®]	GigE Vision [®]	CoaX Press [®]
Connection Type	<ul style="list-style-type: none"> • Master-Slave • Shared Bus • 4 pin STP 	<ul style="list-style-type: none"> • Peer to Peer • Shared Bus • 6 pin STP 	<ul style="list-style-type: none"> • Point to Point • MDR 26 pin 	<ul style="list-style-type: none"> • Point to Point or LAN • RJ-45/Cat-5 	<ul style="list-style-type: none"> • Point to Point or LAN • RJ-45/Cat-5
Data Rate	USB2: 480 Mb/s USB3: 5000 Mb/s	< 512 Mb/s	< 2,380 Mb/s < 4,760 Mb/s < 7,140 Mb/s	< 1,000 Mb/s < 10,000 Mb/s	< 1,250 Mb/s ... < 25,000 Mb/s
Transmission Distance	<5 meters	<4.5 meters	<10 meters	<100 meters	<200 meters
Scalability	127 Devices	63 Devices	1-4 remote devices/PC	Unlimited	1-8 remote devices/PC
PC Interface	Motherboard or PCI card	Motherboard or PCI card	PCI frame-grabber	GigE NIC or LOM	PCI frame-grabber
Evolution	Mature/ Evolving	Mature	Evolving	Evolving	Evolving

Machine Vision Software Interface Standards

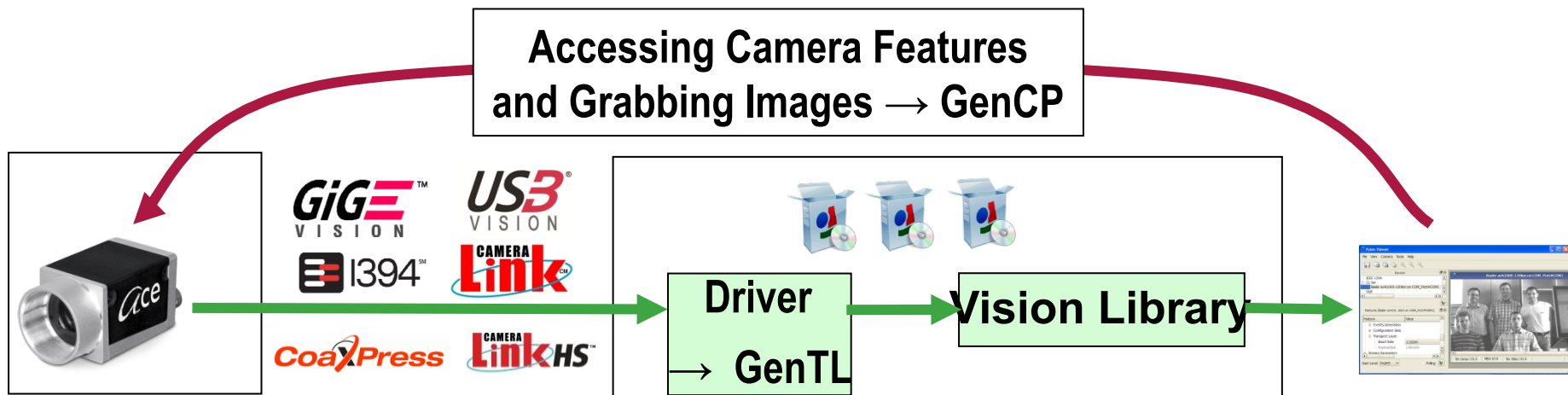
- Vendor specific driver/DLL
- GeniCam[®], EMVA
- GenCP: GeniCam Control Protocol
- GenTL: GeniCam Transport Layer
- Language : application → device → remote device
- Device : camera in GigE/USB3, frame grabber CXP
- Remote device: camera in CXP, CameraLink



Why GenICam?

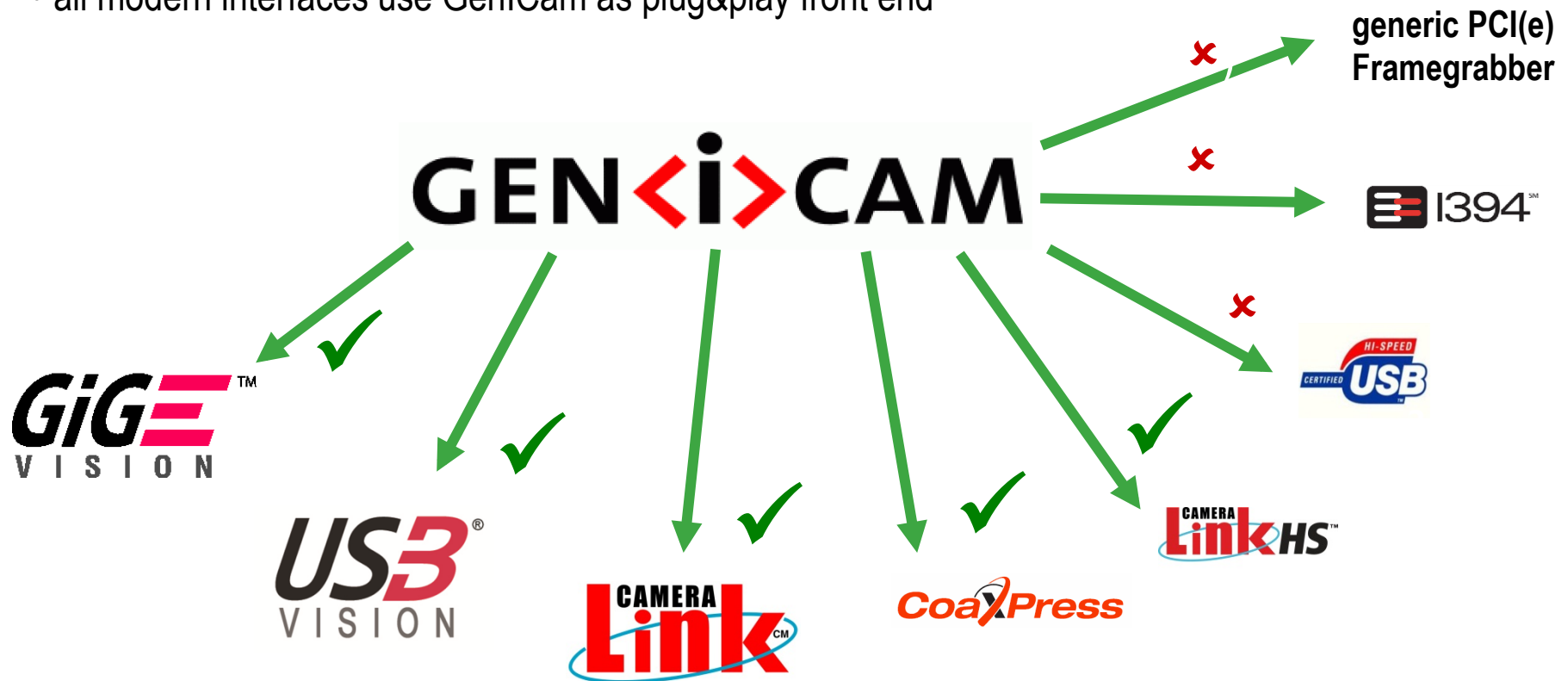
GEN*<i>*CAM

provides **plug&play** to machine vision cameras



Why GenICam?

- all modern interfaces use GenICam as plug&play front end



GenICam Members

(2006) : 9 → 20 → 47 → 60 → 77 → >104 : (April 2012)

The image displays a collection of logos for GenICam members, organized into a grid. A central red-bordered box highlights the 'Core Team' members. The logos are arranged as follows:

- Top Row:** ABS, ab software, AccuSoft, Adaptive Vision, Adimec, ALLIED Vision Technologies, ANDOR TECHNOLOGY, Automation Technology Vision Systems for Automation.
- Second Row:** Baumer, 极明源科技, BitFlow, Burget Metrics, COGNEX, COHU, inc., COLOUR CONTROL, CREVIS, DIAPLOUS COMPONENTS FOR VISUAL PERCEPTION.
- Third Row:** 4DSP, DVC, ELTEC, EPIX, EVK DI Kerschhagl GmbH Elektronisch Visuelle/Klassifizieren, Fairchild imaging, FAST, FASTVISION TruePic 1, FLIR, GE FANUC.
- Fourth Row:** Hitachi, **Core Team** (BASLER VISION TECHNOLOGIES, DALSA, EURESYS, e2v, Leutron Vision, MATROX IMAGING, NATIONAL INSTRUMENTS, Pleora Technologies, STEMMER IMAGING), Gigalink.
- Fifth Row:** i2s, IDS: Imaging Development Systems, imagsa 1, impuls, imac, intek (Integrierte Kamera- und Softwaretechnik), imi tech.
- Sixth Row:** solutions collaboration solutions, kappa K, MATRIX VISION, MaxxVision, mp, MIKROTRON, MontiVision Imaging Technologies, Monitoring Technology, pco. imaging, photon focus, INFODIE, IOI IO INDUSTRIES, Lumenera Corporation.
- Seventh Row:** sensor to image, SICK IVP, SILICON SOFTWARE, SOFTHARD custom imaging solutions, SVS-VISTEK, PIXELINK.
- Bottom Row:** The MathWorks, TOSHIBA TELI, unibrain THE D34 INNOVATORS, University of BRISTOL, vieworks, vision(ite), VRmagic, X-SCAN IMAGING CORPORATION.

What is USB3 Vision[®]?

- **Camera Interface Standard developed by the Automated Imaging Association (AIA)**
- **High bandwidth performance**
 - High bandwidth (5,000 Mbps) allows large uncompressed images to be transferred quickly in real time
 - data transfer up to 5 meters in length
 - Based on USB BULK data protocol for secure data transfer
 - Net speed of up to 250MByte/sec can be reached, which is comparable to PCIe
- **Standard hardware, cables allow easy, low cost integration**
 - Low cost standard USB3 cables and standard connectors on most PC main board
 - No additional PC integration cost
- **Allows single/multiple camera connection on a single PC**
- **Software support**
 - Full GeniCam integration with GenCP and GenTL
 - Compliant to all major software packages from very start
 - First products to be expected late 2012

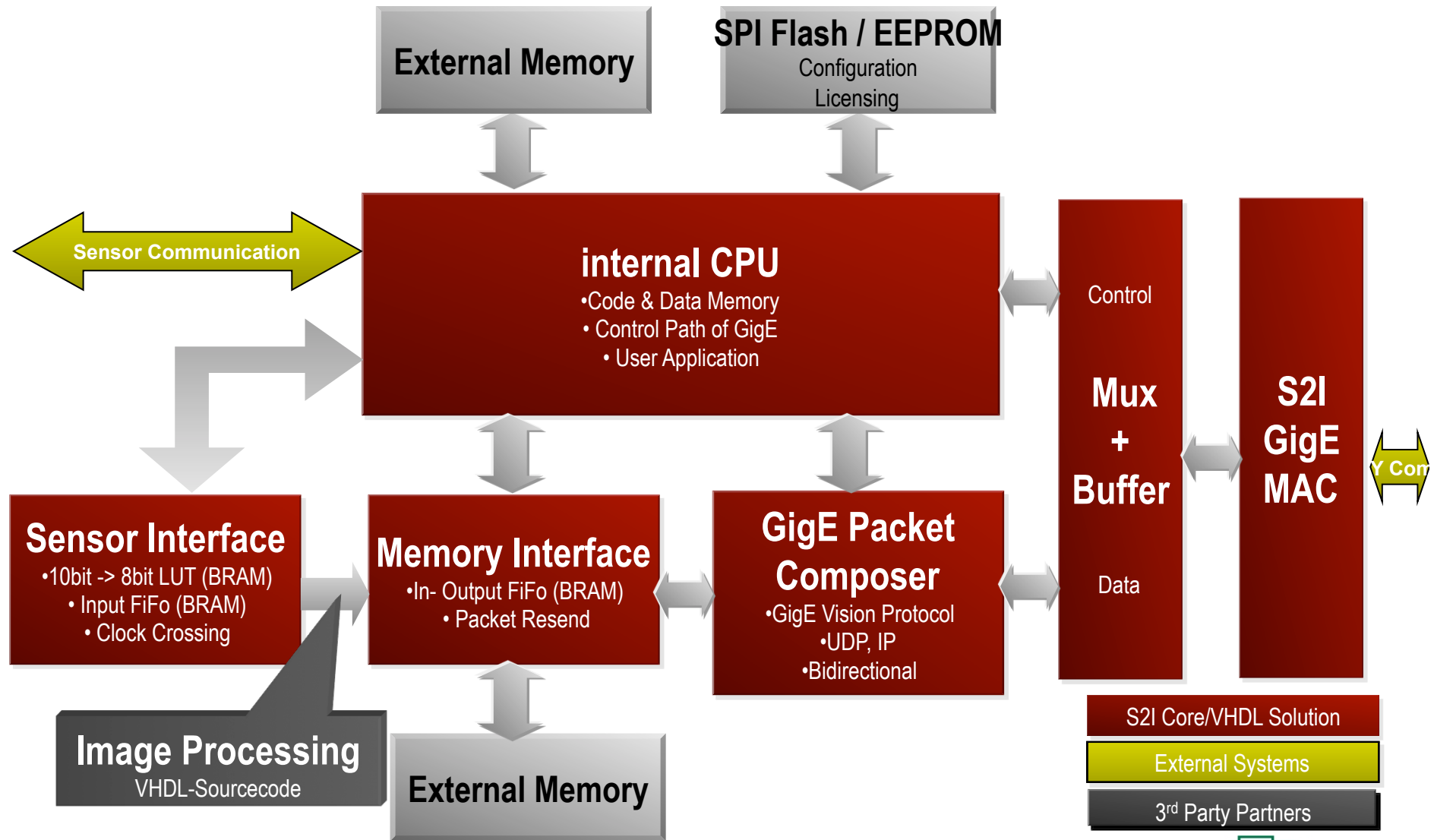


What is GigE Vision[®]?

- **Camera Interface Standard developed by the Automated Imaging Association (AIA)**
- **High bandwidth performance**
 - High bandwidth (1,000 Mbps) allows large uncompressed images to be transferred quickly in real time
 - Uncompromised data transfer up to 100 meters in length
 - Based on UDP protocol with some security add-ons
 - Net speed of up to 100MByte/sec can be reached, which is comparable to PCI 2.x
- **Standard hardware, cables allow easy, low cost integration**
 - Low cost cables (CAT5e or CAT6) and standard connectors
- **Allows single/multiple camera connection**
 - Point to point
 - Point to multipoint
 - Distributed
- **Highly scalable to follow the growth of Ethernet bandwidth.**
 - 10/40Gbit GigE2.x becomes mainstream, GigE Vision[®] can compete with other standards
 - No frame grabber required as with USB3, but long and stable cabling

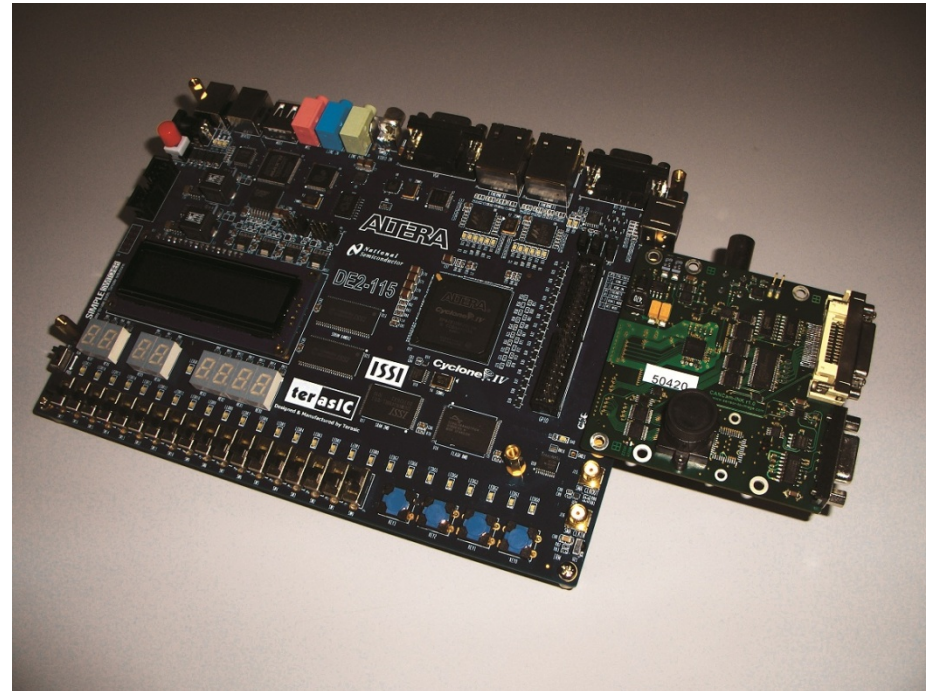


GigE Structure inside single FPGA



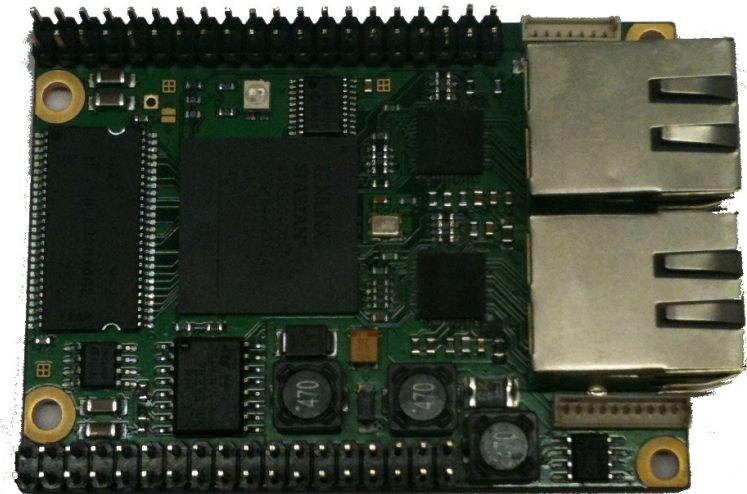
ALTERA-Cyclone4 GigE design for ALTERA INK

- **ALTERA Device:** Cyclone® IV EP4CE115 with 17% resources used
- **3in1 HSMC Module:**
 - MT9V022IA7ATM or MT9V022IA7ATC CMOS sensor with a lens adaptor for 12mm lens system
 - lens f=8mm with 12mm mounting system
 - 8kByte I2C EEPROM
 - CoaxPress digital out running at 2.5GBit
 - CameraLink Base out running at 2GBit and PoCL
- **Connectors and Interfaces:**
 - BNC connector for CoaxPress
 - Mini SUBD for CameraLink
 - One RS232 Interface
- **PCB size:**
 - 80 x 100mm



Spartan-3ADSP Gige Vision Interface Module

- **Xilinx Devices:** Spartan-3A (XC3S1800/3400DSP-FG484) with 40/20% resources used
- **Memory:**
 - 8MByte SPI Flash for FPGA configuration and application storage
 - 32MByte SDRAM on a 32bit data bus with clock speed of 125MHz (MicroBlaze code&data, video buffer)
 - 8kByte I2C EEPROM
 - max. image size 8MByte, bandwidth >100MByte/sec on 1Gbit, bandwidth >150MByte/sec on LAG
- **Connectors and Interfaces:**
 - Broadcom low power Ethernet 10/100/1000 PHY with RJ45
 - 55 unbuffered LVTTTL lines directly connected to FPGA on 2 100mil spacing double row male connectors
 - JTAG connector for FPGA load and debug
 - SPI based CAN-Interface
 - One RS232 Interface, two buffered LVTTTL-In and two buffered LVTTTL-Out
 - Power supply pins on a 10pin 1mm spacing single row male connector
- **PCB size:**
 - 70 x 50mm
 - one of the following modules can be connected to this interface module
 - mechanical and electrical full compatible to the S3E module



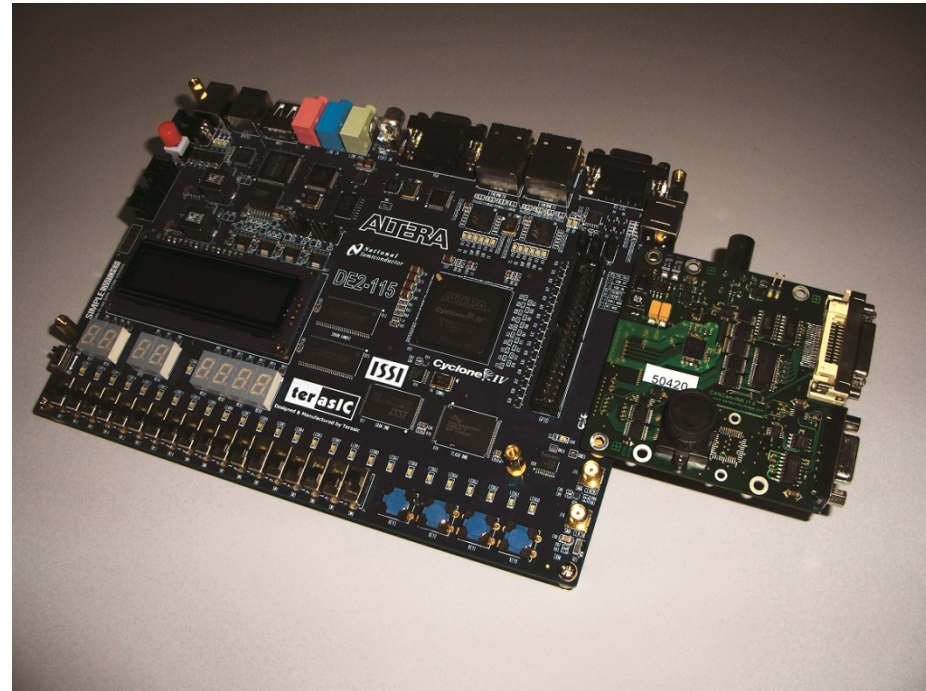
What is CoaXPress®?

- **Camera Interface Standard developed by the Japan Industrial Imaging Association (JIIA)**
- **High bandwidth performance**
 - High bandwidth (1,250 – 25,000 Mbps) allows large uncompressed images to be transferred quickly in real time
 - Uncompromised data transfer up to 200 meters in length
 - Net speed of up to 2500MByte/sec can be reached, comparable to PCIe 2.x
- **Standard hardware, cables allow easy, low cost integration**
 - Low cost cables 75Ohm BNC cables and standard BNC connectors
- **Allows single/multiple camera connection**
 - Point to point
 - Up to 4 cameras on one frame grabber, 4 FG/PC
- **Highly scalable to follow the growth of bandwidth**
 - New FPGA SERDES will allow 40GBit by end of 2012



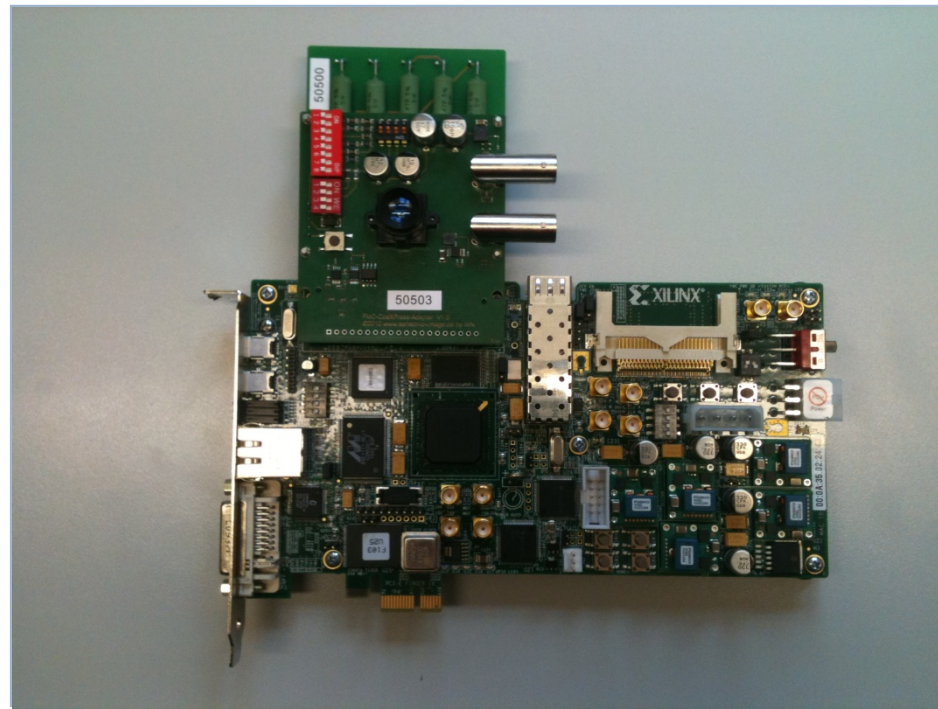
ALTERA-Cyclone4 CXP design for ALTERA INK

- **ALTERA Device:** Cyclone® IV EP4CE115 with 17% resources used
- **3in1 HSMC Module:**
 - MT9V022IA7ATM or MT9V022IA7ATC CMOS sensor with a lens adaptor for 12mm lens system
 - lens f=8mm with 12mm mounting system
 - 8kByte I2C EEPROM
 - **CoaxPress digital out running at 2.5GBit**
 - CameraLink Base out running at 2GBit and PoCL
- **Connectors and Interfaces:**
 - **BNC connector for CoaxPress**
 - Mini SUBD for CameraLink
 - One RS232 Interface
- **PCB size:**
 - 80 x 100mm



XILINX FMC CXP design and protocol analyzer

- CXP camera reference design
- CXP receiver reference design
- Single lane, up to 3.125Gbit on Spartan6 (SP605), up to 6.25Gbit on Virtex6 (ML605)



CXP protocol display: Wireshark

The screenshot shows the Wireshark interface with a list of CXP protocol packets. Packet 1228 is selected, showing its details and raw bytes.

No.	Time	Source	Destination	Protocol	Length	Info
1217	13.020319	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 235
1218	13.029999	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 236
1219	13.047840	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 237, Line Marker
1220	13.057360	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 238
1221	13.067039	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 239
1222	13.076639	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 240
1223	13.086160	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 241
1224	13.095839	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 242
1225	13.105359	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 243
1226	13.115040	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 244
1227	13.132879	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 245, Line Marker
1228	13.142399	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 246
1229	13.144879	Host	Device	CXP	26	Control Command Packet: Memory Read -> Address 0x04000000
1230	13.151999	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 247
1231	13.161600	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 248
1232	13.171199	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 249
1233	13.180880	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 250
1234	13.190400	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 251
1235	13.208239	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 252, Line Marker
1236	13.217759	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 253
1237	13.227440	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 254
1238	13.237040	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 255
1239	13.246639	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 0
1240	13.256240	Device	Host	CXP	162	Stream Data Packet: Stream ID -> 1, Packet Tag: -> 1

Offset	Hex	ASCII
0000	00 00 fb fb fb fb 01 01 01 01 01 01 01 01 f6 f6
0010	f6 f6 00 00 00 00 20 20 20 20 ff ff ff ff ff ff
0020	ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
0030	ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

File: "C:\Temp\cxp-test1.pcap" 698 KB 00:00:46 | Packets: 4017 Displayed: 4017 Marked: 0 Load time: 0:00.203 | Profile: Default



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