GigE Vision and GenICam Open House

Agenda

Yokohama
May 14th 2010

GiGE VISION
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Agenda

9:30	**Welcome**
9:45	**GigE Vision and GenICam Introduction**
10:45	Break
11:05	**GenICam Technical Walkthrough**
12:45	Lunch
13:45	**GigE Vision Technical Walkthrough**
15:15	Break
15:45	**Interoperability Demonstrations**
16:45	**Conclusion**
17:15	**Networking and Demonstrations**
17:45	Get Together

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GigE Vision and GenICam Open House

GigE Vision and GenICam Introduction

Yokohama
May 14th 2010

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Agenda

- GigE Vision Introduction
  - Goals, Benefits and Overview
  - GigE Vision 1.0, 1.1 and 1.2
  - GigE Vision 2.0 and The Future
  - GigE Vision Compliance
  - Interface Technologies Comparison
- GenICam Introduction
  - Overview
  - System Model
  - Revision History and Roadmap
- Q&A

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GigE Vision

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GigE Vision Goals

- Define an open standard framework for video streaming and device control over Ethernet
  - Not oriented to single company's technology
  - Support different features sets and performance levels
  - Room for innovation and product differentiation

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GigE Vision Technical Benefits

- Long Reach
  - Up to 100 meters without regeneration, further with GigE switches or using fiber
- High Bandwidth
  - 1 Gb/s link between each node
  - 10 GigE already coming on stream
- Low Cost
  - World's most widely deployed transport platform
  - Unmatched economies of scale
- Networking Flexibility
  - Unicast (point-to-point) or multicast (point-to-multipoint)
- Scalability
  - Easy addition of new nodes
- Standard-based

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GigE Vision Business Benefits

- Interoperability between compliant hardware and software products from different vendors
  - Increase spending on development for customer applications
  - No more "siphoning off" of innovation dollars to build multiple interfaces
  - Fewer integration issues and lower support costs
- Foster market growth
  - Leverage standard Ethernet technology to make vision systems more affordable, easier to implement, use, and maintain
- Faster time to market
  - Shorter system implementation times
- In others words:
  - Save money…

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GigE Vision in a Nutshell

Open global standard for transmitting video and control information over Ethernet networks

Four Main Elements

- Device Discovery
  - Defines how compliant devices obtain IP addresses and are identified on the network
- GigE Vision Control Protocol (GVCP)
  - Defines how to specify stream channels, control and configure compliant devices
- GigE Vision Streaming Protocol (GVSP)
  - Defines how images are packetized and provides mechanisms for transmitters to send image data and other information to receivers
- GenICam XML Device Description File
  - Computer-readable datasheet of features in compliant devices
  - Must be based on schema in EMVA's GenICam standard
  - Seven mandatory features

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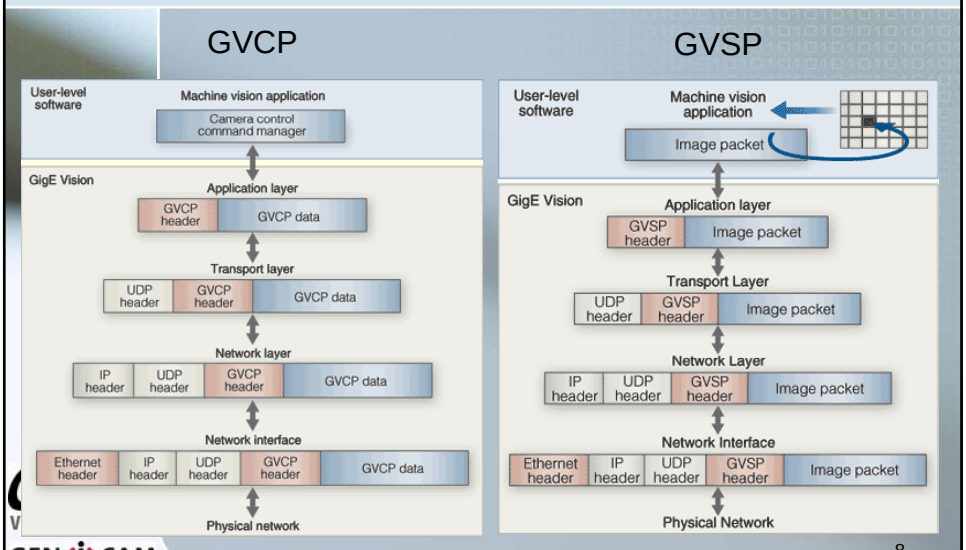
GigE Vison Protocol Stacks



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GigE Vision History

May 2006	Version 1.0 • Defined protocols for video streaming and device control over standard Ethernet networks • Focused on traditional point-to-point connections between cameras and PCs
April 2009	Version 1.1 • Minor upgrades to improve real-world integrations • Provisioned support for GenICam 2.0
January 2010 	Version 1.2 • Enables the registration of new classes of Ethernet network elements as GigE Vision-compliant products • Facilitates the deployment of GigE Vision cameras in mission critical systems

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GigE Vision 1.2 Implications

- GigE Vision is now a proven platform for vision applications
  - Field-hardened in thousands of high-performance installations
- Market requirements are evolving…
- Growing demand for advanced network architectures
  - Customers want more than traditional point-to-point connections between cameras and PC-based receivers

Version 1.2 extends the scope of GigE Vision for next-generation video distribution systems

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What is a GigE Vision Video Distribution System?

Video distribution solution based on client/server Ethernet architectures

- Support mesh network topologies
  - Point to multi-point
    - Simultaneous multicasting from one video source to many destinations
  - Multi-point to multi-point
    - Switched video multicasting from multiple video sources to multiple destinations
- Support various classes of products
  - Hardware or software video sources
  - Hardware or software video receivers
  - Hardware or software processing units
  - Network-controlled devices
  - Management entities

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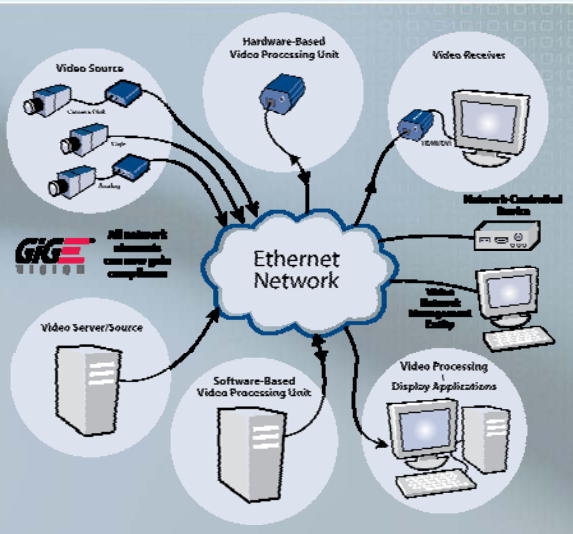
Network Elements of GigE Vision Video Distribution Systems



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The Future: GigE Vision 2.0

High Speed Transfer Working Group

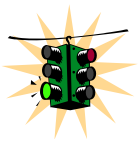
1) The need for speed

10 Gigabit Ethernet and Link Aggregation

3) Minimize packet overhead

Frame Packing

5) Optimize traffic flow



Flow Control Improvements

2) Carry more

Image Compression

4) Improve determinism

Time Synchronization and Real-time Trigger

The Future: GigE Vision 2.0

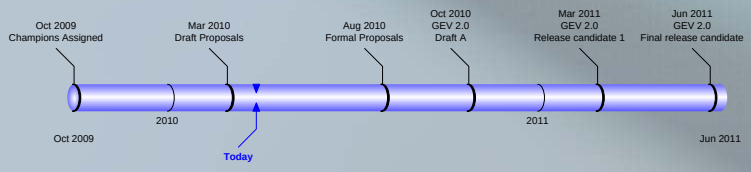
Features for release 2.0:

- High Speed Transfer committee input
- 64-bit block identifier
- Revise mandatory features list
- Pixel format naming convention
- Threaded fastener connector

Items to investigate:

1. IPv6 support
2. Standard device enumeration protocols

GigE Vision 2.0 Timeline



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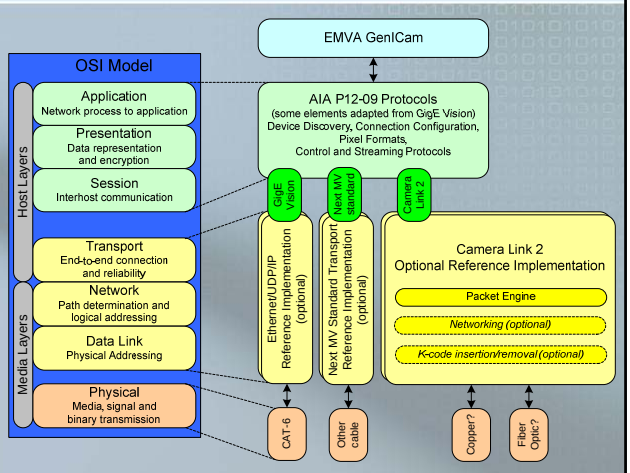
Related Work: AIA P12-09

AIA P12-09 looks at the generalization and reuse of GigE Vision and GenICam concepts to other packet-based Machine Vision standards:

- Device Discovery
- Connection Configuration
- Device Control
- Image Streaming
- Pixel Formats
- etc.



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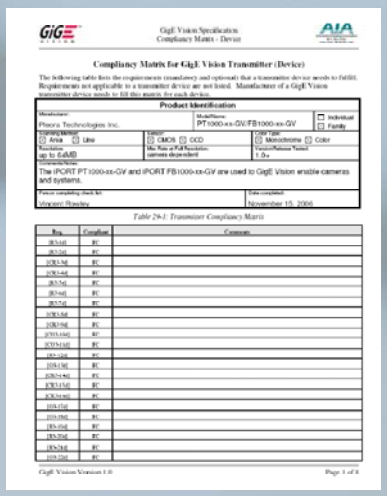
GigE Vision Compliance: Devices

```
<?xml version="1.0" encoding="utf-8"?>
<RegisterDescription ModelName="PT1000CL4" VendorName="Pleora" ToolTip="PT1000-CL4"
        StandardNameSpace="GEV" SchemaMajorVersion="1" SchemaMinorVersion="0" SchemaSubMinorVersion="1"
        MajorVersion="0" MinorVersion="2" SubMinorVersion="0" ProductGuid="167E4A77-DE9A-4406-A1F4-
        F76EC497FD59" VersionGuid="D3A1B3A5-AFB7-4750-963F-84AD391D0DDD"
        xmlns="http://www.genicam.org/GenApi/Version_1_0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.genicam.org/GenApi/Version_1_0 ../GenApiSchema_Version_1_0.xsd">
        <Group Comment="Root">
                <Category Name="Root">
                        <pFeature>DeviceInformation</pFeature>
                        <pFeature>ImageSizeControl</pFeature>
                        <pFeature>AcquisitionAndTriggerControls</pFeature>
                        <pFeature>CountersAndTimersControls</pFeature>
                        <pFeature>EventsGeneration</pFeature>
                        <pFeature>GigEVisionTransportLayer</pFeature>
                        <pFeature>UserSets</pFeature>
                        <pFeature>IPEngine</pFeature>
                        <pFeature>TLParamsLockedCategory</pFeature>
                </Category>
        </Group>
        <Group Comment="DeviceInformation">
                <Category Name="DeviceInformation">
                        <pFeature>DeviceVendorName</pFeature>
                        <pFeature>DeviceModelName</pFeature>
                        <pFeature>DeviceManufacturerInfo</pFeature>
                        <pFeature>DeviceVersion</pFeature>
                        <pFeature>DeviceID</pFeature>
                        <pFeature>DeviceUserID</pFeature>
                        <pFeature>DeviceScanType</pFeature>
                </Category>
                <StringReg Name="DeviceVendorName">
                        <ToolTip>This feature provides the name of the manufacturer of the
        device.</ToolTip>
                        <Description>This feature provides the name of the manufacturer of
        the device.</Description>
                        <Visibility>Beginner</Visibility>
                        <Address>0x0048</Address>
                        <Length>32</Length>
                        <AccessMode>RO</AccessMode>
                        <pPort>Device</pPort>
                        <Cachable>WriteThrough</Cachable>
                </StringReg>
                <StringReg Name="DeviceModelName">
                        <ToolTip>This feature provides the model of the device.</ToolTip>
```

- GigE Vision-compliant devices must provide a GenICam XML file
  - Most implementations provide the XML file in a zip file, stored inside the device
  - The XML file has to describe at least seven mandatory features
    - Width, Height, PixelFormat, AcquisitionMode, AcquisitionStart, AcquisitionStop, PayloadSize
  - All public features of the device should also be in the GenICam XML file
    - Should follow the Standard Features Naming Convention (SFNC) when applicable and possible

GigE Vision Compliance: Devices



Compliancy Matrix for GigE Vision Transmitter (Device)

Product Identification

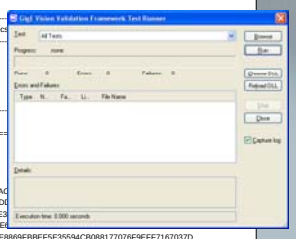
The iPORT PT1000-xx-GV and iPORT FB1000-xx-GV are used to GigE Vision enable cameras and systems.

Table 29-1: Transmiter Compliancy Matrix

- Device vendors must register their products with the AIA in order to be able to use the logo
  - Fill compliancy matrix
  - Provide GEV Validation Framework report to the AIA

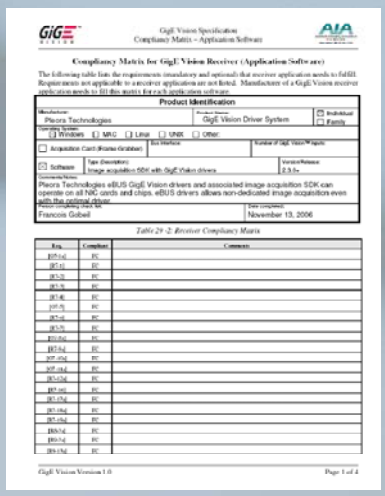
GigE Vision Compliance: Devices

```
==========
GigE Vision Validation Framework Report
----------
Manufacturer Name: Pleora Technologies Inc.
Model Name: NTx-Mini PT01-PBXMX1-32XG25
Device Version: Version 1.0  (02.02.06)
----------
Library: GeValidationFramework_2009_06_08.dll
Checksum: ED96B4300F3A44CCDCDD0A72F7ADE797
----------
Date: 2010/03/02 09:55:13
==========


==========
09:55:16 Starting GenICamTests::Width
Test passed
Elapsed Time: 10359 ms

...

==========
Summary
----------
Total Elapsed Time: 94.625 secs
----------
Number of Test Ran: 91
Number of Successes: 91
Number of Failures: 0
Number of Errors: 0
Success Rate: 100.000%
----------
Verdict: COMPLIANT
==========



<Checksum>
EEF114603F707EC4FC71D6A
076B571516B80280A4301C5D
3ABF77CC71D0A1D7A9C9DE3
8F52A63DFCFC97C41F273CE
40D24398C488834289E271FE8869FBBEF5E35594CB088177076F9EFF7167037D
AAEF647701C05252349CF5C1888BB03CA18F44878F63155A80A7B1DDFFA17E2
6A522584FA0F31D3C096EEAB8D7D276972D64DECE6EF1767A42A85A1F9DE89E5
CB072F41D9B2487F3B34C399EF5DE5933CC8926AD26EA5DF40676B0509946F45
</Checksum>
```



- GigE Vision-compliant devices must pass the GEV Validation Framework
  - One public demonstration required at any AIA-sponsored events
  - Re-submit reports for every new release of validation framework

GigE Vision Compliance: Applications



GigE Vision Specification
Compliancy Matrix – Application Software

Compliancy Matrix for GigE Vision Receiver (Application Software)

The following table lists the requirements (mandatory and optional) that receiver application needs to fulfill. Requirements not applicable to a receiver application are not listed. Manufacturer of a GigE Vision receiver application needs to fill this matrix for each application software.

Product Identification

Manufacturer: Pleora Technologies	Name: GigE Vision Driver System
Operating System: ☐ Windows ☐ MAC ☐ Linux ☐ UNIX ☐ Other:	
☐ Acquisition Card (Frame Grabber)	Bus Interface:
☑ Software	Type (Description): Image acquisition SDK with GigE Vision drivers
Comments/Notes: Pleora Technologies eBUS GigE Vision drivers and associated image acquisition SDK can operate on all NIC cards and chips. eBUS drivers allows non-dedicated image acquisition even with the optional driver.	
Person Completing Check list: Francois Gobeil	Date completed: November 13, 2006

Table 29-2: Receiver Compliancy Matrix

Req.	Compliant	Comments
[DT-1-1]	FC	
[DT-1]	FC	
[DT-2]	FC	
[DT-3]	FC	
[DT-4]	FC	
[DT-5]	FC	
[DT-6]	FC	
[DT-7]	FC	
[DT-8]	FC	
[DT-9-1]	FC	
[DT-9-2]	FC	
[DT-10-1]	FC	
[DT-10-2]	FC	
[DT-11]	FC	
[DT-12]	FC	
[DT-13-1]	FC	
[DT-13-2]	FC	
[DT-14]	FC	
[DT-15]	FC	

GigE Vision Version 1.0 Page 1 of 4

- Device vendors must register their products with the AIA
  - Fill compliancy matrix
  - Perform interoperability testing at any AIA-sponsored events within one year of product registration

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GigE Vision Compliance Summary

- GEV conformance for devices is a combination of
  - Self declaration; and
  - Automated compliancy check by the validation framework
- GEV conformance for applications is a combination of
  - Self declaration; and
  - Perform interoperability testing at any AIA-sponsored events within one year of product registration

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Interfacing Technologies Comparison

Attribute	GigE Vision	Camera Link	USB 3.0	FireWire	CoaXPress	Camera Link HS
Native OS Support	Yes (Ethernet)	No	Yes	Yes	No	No
Cable type	Cat-5/6 or Fiber	Camera Link	USB	Firewire	Coax	CX4
Relative Cable Cost	Low	High	Low	Medium	Low	High
Max Throughput (single cable)	10 Gb/s	6.8 Gb/s	~3.2 Gb/s (Effective)	3.2 Gb/s	6.25 Gb/s	16.8 Gb/s
Max Distance (@max throughput)	100 m	10 m	3 m	4.5 m	120 m (1.25 Gb/s) 40 m (6.25 Gb/s)	15 m
Network Topology (without specialized equipment)	Mesh	Point-to-point	Bus-based tiered star	Tree, star, or ring	Point-to-point	Point-to-point
Power over Cable	Yes	Yes	Yes	Yes	Yes	Future
PC Interface	Built-in or NIC	Frame grabber	Built-in	Built-in	Frame grabber	Frame grabber
Origin of Standard	Industrial	Industrial	Consumer	Consumer	Industrial	Industrial
Vision System Deployments	Wide	Wide	Initial prototypes from one vendor in industrial market	Wide for 1394b; initial prototypes from one vendor for higher speed	Initial field trials (small number of vendors)	Prototype from one vendor in industrial market
Standard Maturity	High	High	Low	High	Under definition	Under definition

GenICam

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emva
european machine vision association

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Questions

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GigE Vision and GenICam Open House

GigE Vision Technical Walkthrough

Yokohama
May 14th 2010

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- Overview and Definitions
- System Model
- Device Discovery, Attachment and Removal
- GigE Vision Control Protocol (GVCP)
- GigE Vision Streaming Protocol (GVSP)
- GenICam XML File and Minimum Level of Interoperability
- Q&A

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GigE Vision in a Nutshell

Open global standard for transmitting video and control information over Ethernet networks

Four Main Elements

- Device Discovery
  - Defines how compliant devices obtain IP addresses and are identified on the network
- GigE Vision Control Protocol (GVCP)
  - Defines how to specify stream channels, control and configure compliant devices
- GigE Vision Streaming Protocol (GVSP)
  - Defines how images are packetized and provides mechanisms for transmitters to send image data and other information to receivers
- GenICam XML Device Description File
  - Computer-readable datasheet of features in compliant devices
  - Must be based on schema in EMVA's GenICam standard
  - Seven mandatory features

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Key Definitions

- Application
  - GigE Vision control application software running on a host
    - Typically a software application running on a PC but can also be of another nature
      - E.g. micro code running on a FPGA
- Device
  - GigE Vision compliant controllable device
    - Typically a camera but can also be of another nature
      - E.g. a software video server running on a PC

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Key Definitions

- GVSP Transmitter
  - Entity producing a stream of data according to the GigE Vision Streaming Protocol
- GVSP Receiver
  - Entity receiving and capable of de-encapsulating a stream of data according to the GigE Vision Streaming Protocol
- Primary Application
  - Application having exclusive or control access (read/write) to the device
- Secondary Application
  - Application having monitoring access (read-only) to the device

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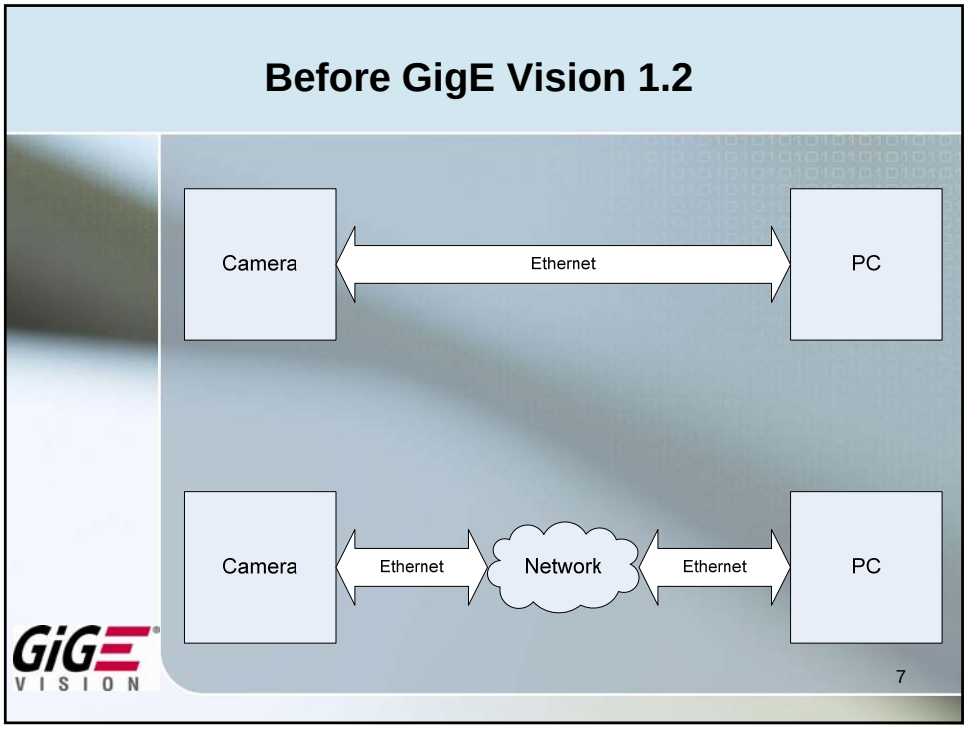
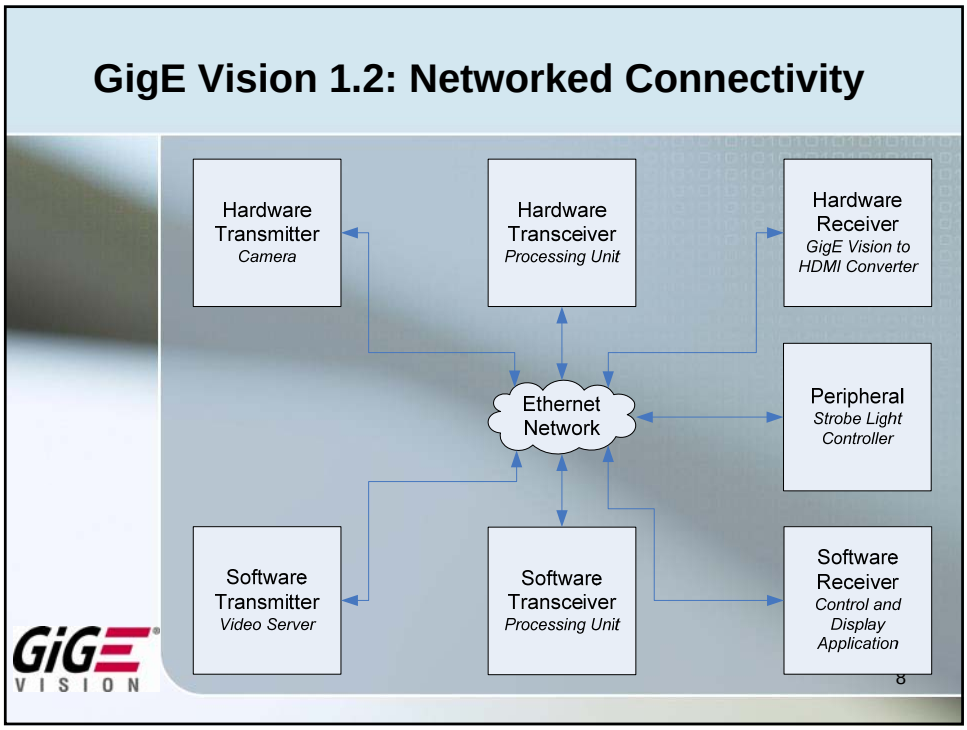

Before GigE Vision 1.2
Camera
Ethernet
PC
Camera
Ethernet
Network
Ethernet
PC
7


GigE Vision 1.2: Networked Connectivity
Hardware Transmitter
Camera
Hardware Transceiver
Processing Unit
Hardware Receiver
GigE Vision to HDMI Converter
Ethernet Network
Peripheral
Strobe Light Controller
Software Transmitter
Video Server
Software Transceiver
Processing Unit
Software Receiver
Control and Display Application
8

Device Classes

- Transmitter
  - Camera
- Receiver
  - GigE Vision to HDMI Convertor
- Transceiver
  - Image Processor
- Peripheral
  - Strobe Light Controller

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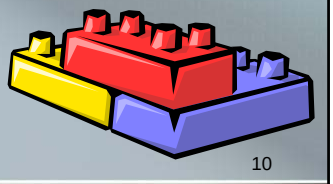
Building Blocks

- Application (A)
  - Master
- Device (D)
  - Slave
- GVSP Transmitter (Tx)
- GVSP Receiver (Rx)



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Product Examples

Product	A	D	Tx	Rx
Camera		✓	✓	
Control + Display Software	✓			✓
Software Video Server		✓	✓	
GigE Vision to HDMI Converter		✓		✓
Strobe Light Controller		✓		
GigE Vision Image Processor		✓	✓	✓

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Device Discovery

- IP Configuration
  - Persistent IP
    - Optional
  - DHCP
    - Mandatory but can be disabled
  - Link-Local Address (LLA)
    - Mandatory
  - Note:
    - ARP is used for IP address conflict detection in persistent and LLA IP address configurations
- Device Enumeration
  - How to discover devices on the network
  - Broadcast Device Discovery
    - Limited broadcast
      - Impossible to enumerate devices on a different subnet
    - Subnet directed broadcast
  - Unicast Device Discovery

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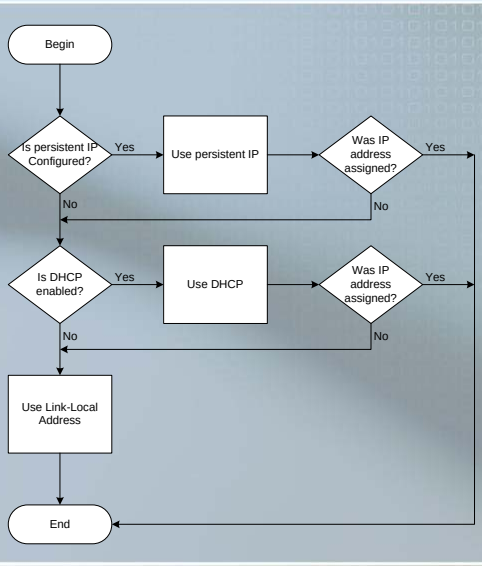
Device Discovery: IP Configuration



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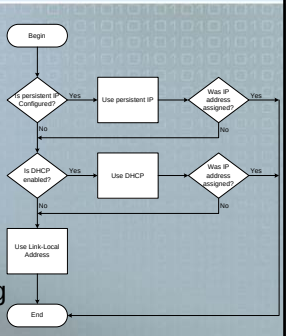
Device Discovery: IP Configuration

- Two Interpretations
  - GigE Vision 1.0 and +
    - The DHCP client in the device stops when moving from DHCP to LLA
  - GigE Vision 1.1 and +
    - The DHCP client keeps running even if a LLA address gets assigned
      - RFC-compliant
      - A LLA assigned IP address gets replaced with the newly obtained DHCP IP address if the DCHP client gets an IP address from the DHCP server after an IP address has been assigned by LLA



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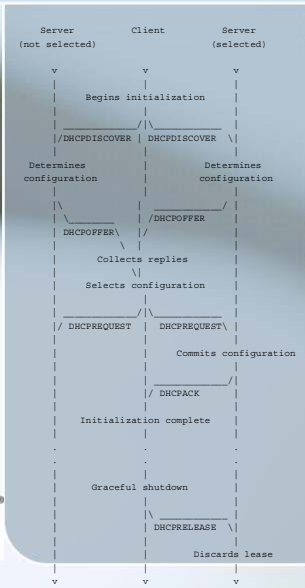
Device Discovery: IP Configuration



- DHCP
  - DHCP Retransmission
    - When timing out while trying to get an IP address from the DHCP server
    - 1st transmission timeout
      - 2 seconds +/- 1
    - 1st retransmission timeout
      - 4 seconds +/- 1
    - 2nd retransmission timeout
      - 6 seconds +/- 1
    - DHCP process elapsed time when no DHCP server available
      - 9 to 15 sec
  - DHCP Lease Expiration
    - When DHCP assigned IP address lease expires, the IP configuration process must be restarted

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Device Discovery: IP Configuration

- LLA
  - LLA cannot fail by definition
  - Assigned IP address looks like:
    - 169.254.x.x with a subnet mask of 255.255.0.0

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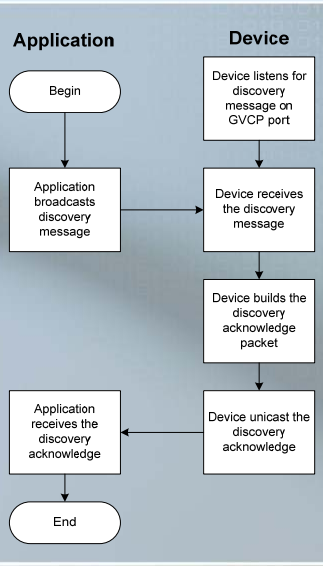
Device Discovery: Device Enumeration



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Device Attachment and Removal

- Attachment
  - DHCP
    - Close interaction between the server and the application required
    - Not common
  - Discovery
    - Consumes network bandwidth
- Removal
  - Handled by control protocol
    - Devices disconnect if no heartbeat packet is received
    - Primary applications disconnect if heartbeat packets are not acknowledged by devices

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Agenda

- Overview and Definitions
- System Model
- Device Discovery, Attachment and Removal
- GigE Vision Control Protocol (GVCP)
- GigE Vision Streaming Protocol (GVSP)
- GenICam XML File and Minimum Level of Interoperability
- Q&A

20

GVCP Transport Protocol Considerations

- Enables GEV device parameters control over Ethernet
- Enables the delivery of asynchronous events from a device to an application
- Provides a uniqueness access scheme so only one application can control a device

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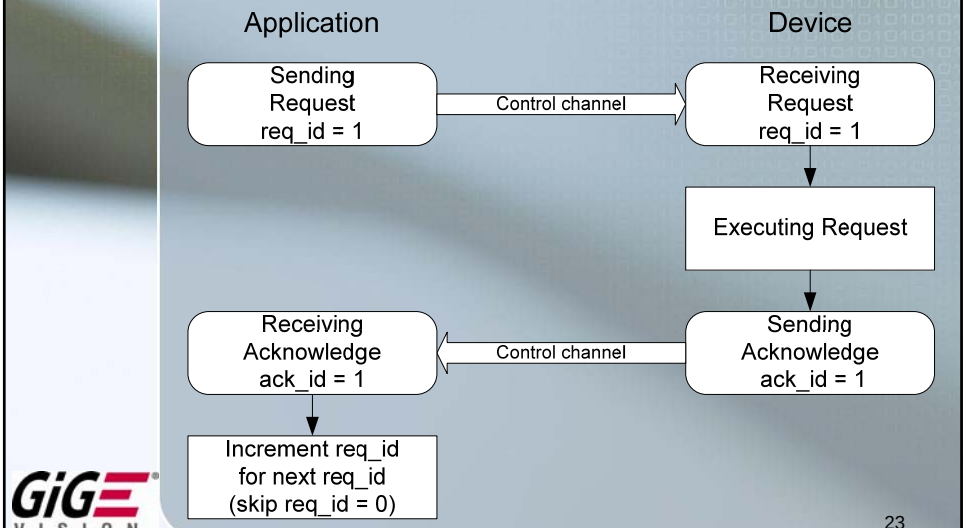
GVCP Transport Protocol Considerations

- Built on top of UDP with IPv4
  - Flow Control
    - Simple command/acknowledge protocol
  - Fragmentation
    - Avoided by protocol definition
      - Command and acknowledge messages contained in a single packet
      - GVCP maximum payload size is 540
        - » Meets maximum IP packet size to avoid IP fragmentation
  - Packet Size
    - Multiple of 32 bits
  - Built-in reliability and error recovery mechanism
    - Necessary since UDP doesn't guarantee data ordering and delivery

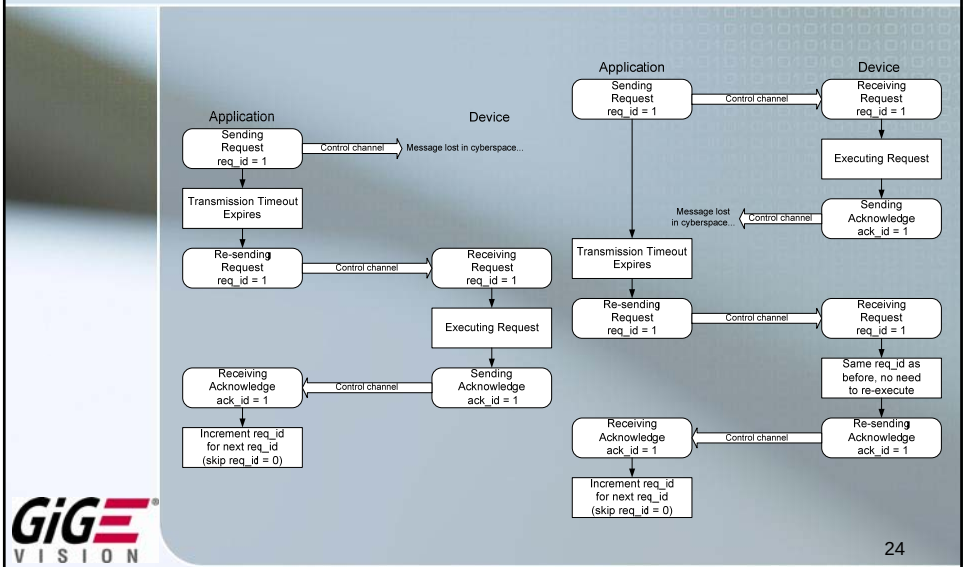
22

GVCP: Reliability and Error Recovery



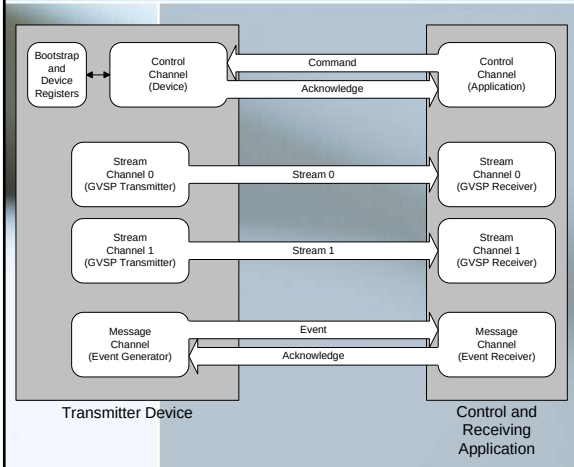
23

GVCP: Reliability and Error Recovery



24

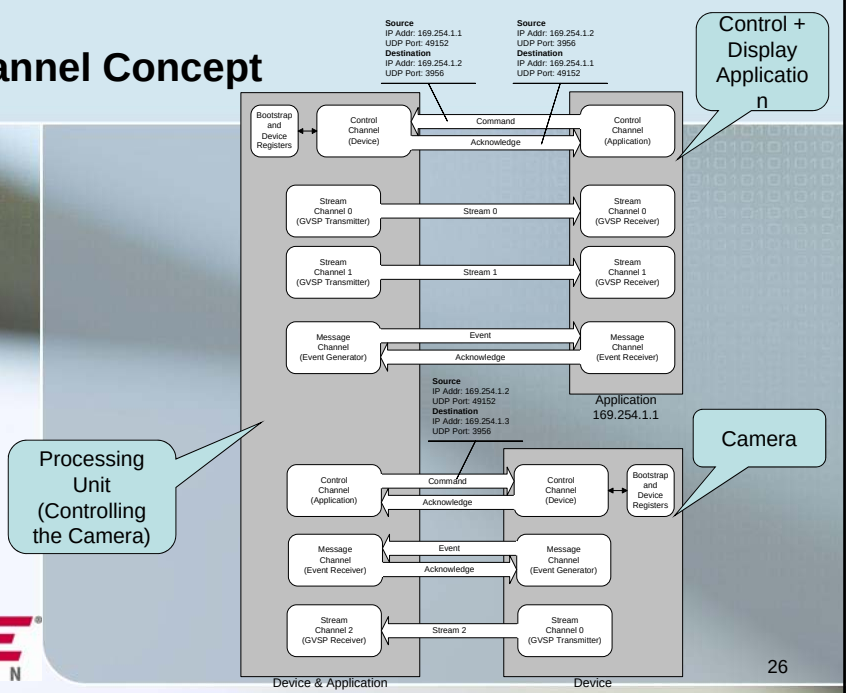
Channel Concept



- Control Channel
  - 1
  - GVCP
- Streaming Channels
  - 0 to 512
  - GVSP
- Message Channel
  - 0 or 1

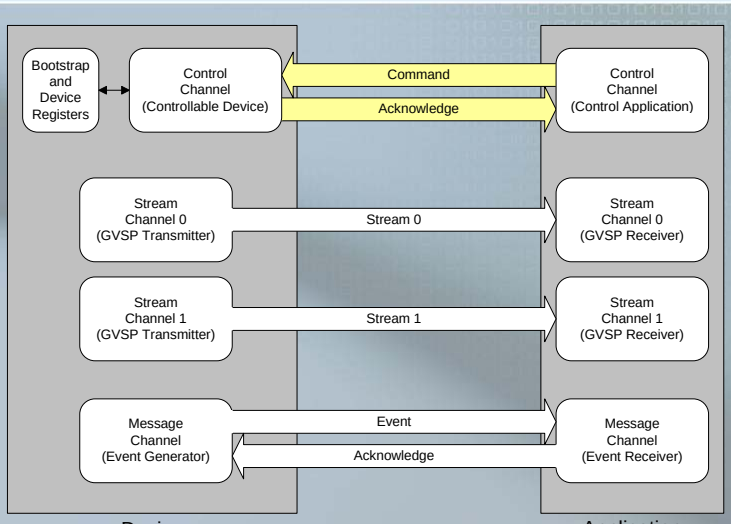
25

Channel Concept



26

Control Channel



27

Control Channel Key Concepts

- Opening and Closing
  - Done by writing to the Control Channel Privilege bootstrap register (CCP)
- Privileges
  - Exclusive access
  - Control access
  - Control access with switch over enabled
  - Monitor access
- Heartbeat
- Pending Acknowledge
- Action Command

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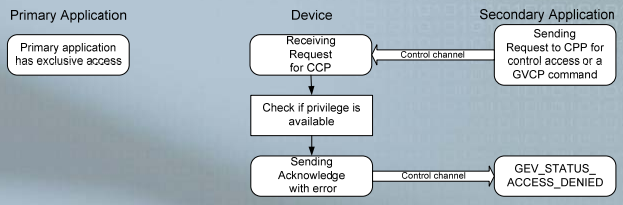
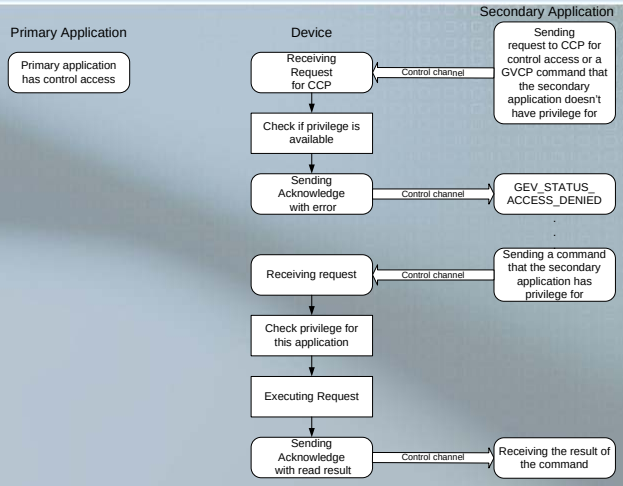
Exclusive Access Privilege



- Secondary application cannot access the device

29

Control Access Privilege



- Secondary application can read device registers

30

Other Access Privileges

- Control access with switch over enabled
  - Same as control access privilege but an other application can take control over a device
  - Useful in mission critical systems where redundancy and fault recovery is needed
- Monitor access
  - The application has no particular exclusive or control access over a device

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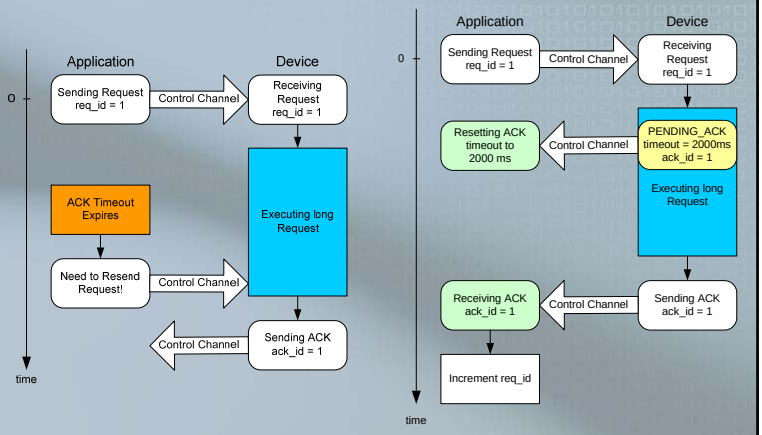
Heartbeat

- Application periodically sends heartbeat packets
- Application disconnects if not receiving acknowledges to heartbeat packets
- Device releases its CCP register if not receiving heartbeat packets
  - In order to make itself available to an other application in case a primary application crashes
  - Disconnect when not receiving heartbeat packets can be disabled on the device

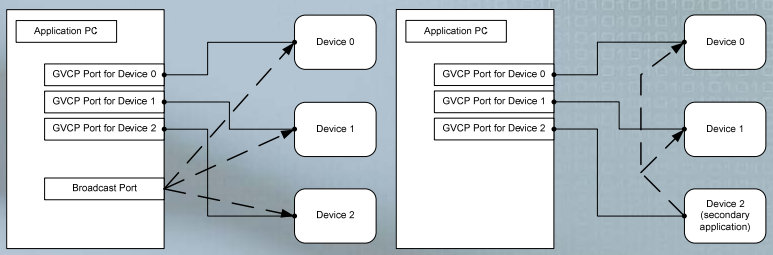
32

Pending Acknowledge



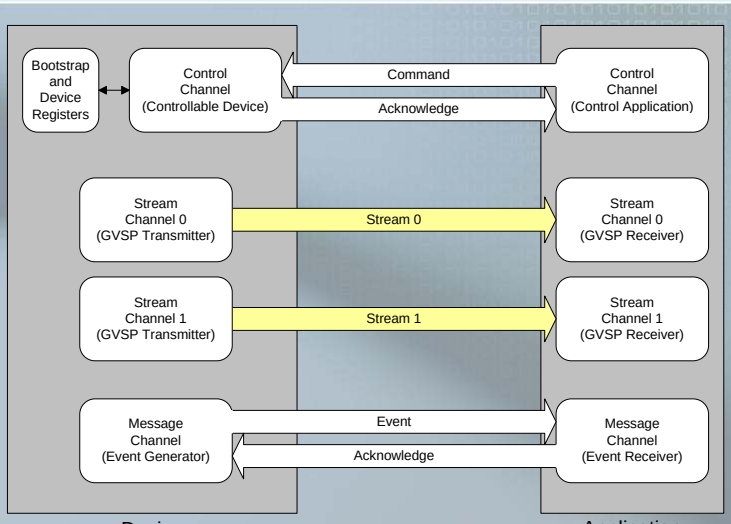
- To handle commands that take a long time

Action Command



- Use Case: “Simultaneously” trigger a number of cameras over the Ethernet link
- Can be done from a primary or secondary application

Stream Channel



35

Stream Channel Key Concepts

- Opening and Closing
  - Done via bootstrap registers
- Packet Size
  - Can be set by the primary application
  - Optimal packet size to use for the system can be auto negotiated at connection time
- Multicasting
  - Simultaneously streaming to multiple locations
- Multiple Network Interface
  - Support the design of multiport products

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Stream Channel Key Concepts

- Firewall Friendly Procedures
  - Different than heartbeat!
- Unconditional streaming
  - Enable a transmitter to continue streaming even if its primary application goes away
    - Useful mission critical systems

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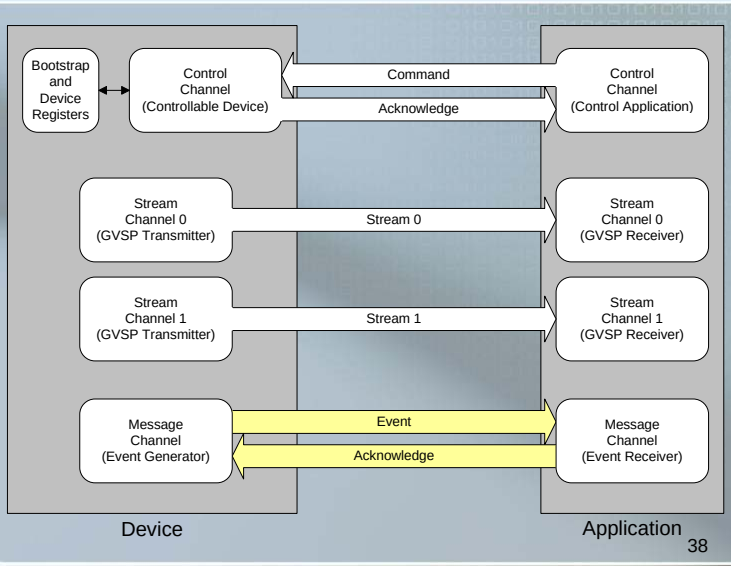
Message Channel



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Message Channel Key Concepts

- Opening and Closing
  - Done via bootstrap registers
- Asynchronous Events
  - From device to application
    - Example: Hardware trigger received
  - GigE Vision Standard Events
  - Device-specific Events
- Multicasting
  - Sending the event to multiple destinations
  - No acknowledges are requested
- Firewall Friendly Procedures
  - Like for stream channel

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Multiple Network Interfaces Support

- IP Configuration
  - Done on a per interface basis
- Control Channel
  - Associated to interface #0
- Stream Channels
  - Packet resend sent to interface #0
- Message Channel
  - Associated to interface #0

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Channel Dictionaries

- Control Chanel
  - DISCOVERY
  - FORCEIP
  - READREG
  - WRITEREG
  - READMEM
  - WRITEMEM
  - PACKETRESEND
  - PENDING
  - ACTION
- Message Channel
  - EVENT
  - EVENTDATA

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Network Management and Administration

- ICMP
  - Mandatory messages supported by devices
    - Echo
      - Device Reception
    - Echo Reply
      - Device transmission
    - Destination Unreachable
      - Device Reception

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GVSP

- Enables the transport of streams of data over Ethernet
  - Images
  - Raw data
    - Example: Acquisition statistics delivery
  - File
    - Example: Encrypted video delivery
  - Chunk and extended chunk data
    - Example: Attach metadata to images
  - Device-specific

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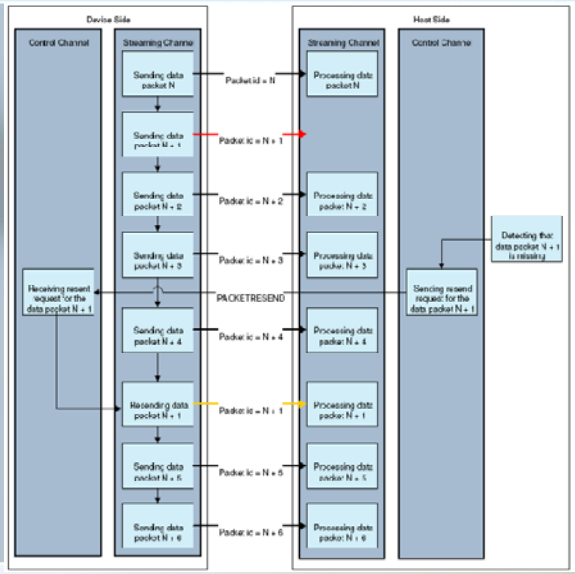
GVSP

- Built on top of UDP with IPv4
  - Fragmentation can be enabled by applications
  - Packet Size
    - Byte resolution is allowed
    - No restriction on maximum size
    - Packet size auto negotiation
  - Built-in reliability and error recovery mechanism
    - Necessary since UDP doesn't guarantee data ordering and delivery
      - Packet Resend
  - Flow Control
    - Inter packet delay (IPD)

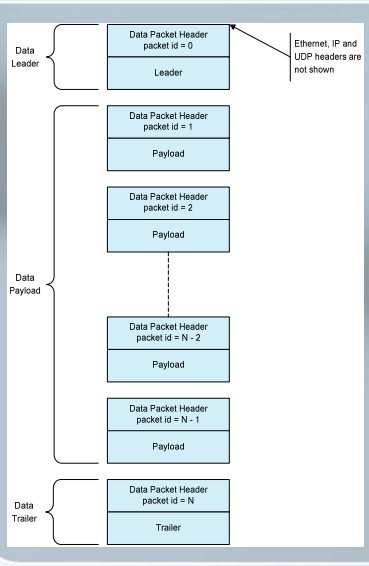
45

GVSP: Reliability and Error Recovery



46

GVSP: Data Block



- Three Elements
  - Data Leader
  - Data Payload
  - Data Trailer
- Payload Types
  - Image
  - Raw Data
  - File
  - Chunk Data
  - Extended Chunk Data
  - Device Specific
- Test Packet

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GVSP: Test Packet

- Fill test packet payload with pseudo random data
  - Optional
  - In order to make the packet size auto negotiation more reliable
    - Checking the size of the returned packet is not good enough in some cases!

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GVSP: Pixel Formats

- Monochrome
  - 8-bit
    - Unsigned and signed
  - 10 and 12-bit
    - Unpacked and packed
  - 14-bit
  - 16-bit
- Bayer
  - 8, 10, 12 and 16-bit
  - GR, RG, GB and BG
  - Unpacked and packed
    - For 10 and 12 bits per pixel
- YUV
  - 4:1:1
  - 4:2:2
    - UYVY
    - YUYV
  - 4:4:4

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GVSP: RGB Pixel Formats

- 8-bit per component
  - RGB and BGR
  - RGBA and BGRA
- 10 and 12-bit per component
  - RGB and BGR
    - Each component occupies 2 bytes
- 10-bit per component
  - BGR V1 and V2
    - 3 x 10-bit packed into 32 bits
- 12-bit per component RGB V1
  - Each component occupies 1.5 byte

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GVSP: RGB Pixel Formats

- 16-bit per component RGB
- RGB and BGR 5:6:5
  - 5-bits red, 6-bits green, 5-bits blue
- 8, 10, 12 and 16-bit per component planar
  - One streaming channel per component

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GenICam XML File

- Must be supplied with device
  - Must follow the schema defined by the GenICam standard
  - A device may support multiple versions of the GenICam XML schema
    - Manifest Table
    - Enables the migration to version 1.1 of the GenICam schema file
- Can be stored:
  - Device non-volatile memory
  - Vendor web site
  - A local directory on the application side

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GenICam XML File

- Typically retrieved with READMEM
- Must include 7 mandatory features
  - Width and Height
  - PixelFomat
  - AcquisitionMode
  - AcquisitionStart and AcquisitionStop
  - PayloadSize
- The inclusion of other features is desired but not mandatory
  - Should follow the GenICam Standard Features Naming Convention (SFNC) when applicable

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Minimum Level of Interoperability for GigE Vision Cameras

- Continuous Acquisition and Display
  - Camera's acquisition parameters set in such a way that it is ready to start streaming video out of the box!
  - Required Actions:
    - Control the camera using GVCP
    - Create a stream channel using GVSP bootstrap registers
    - Retrieve image characteristics through the GenICam XML camera description file
    - Allocate image buffers on the PC
    - Start the continuous acquisition through the stream channel

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Q&A

56

References

- GigE Protocol Stacks
- Mapping to OSI Model
- Ethernet Frame Format
- IPv4
- UDP
- GVSP

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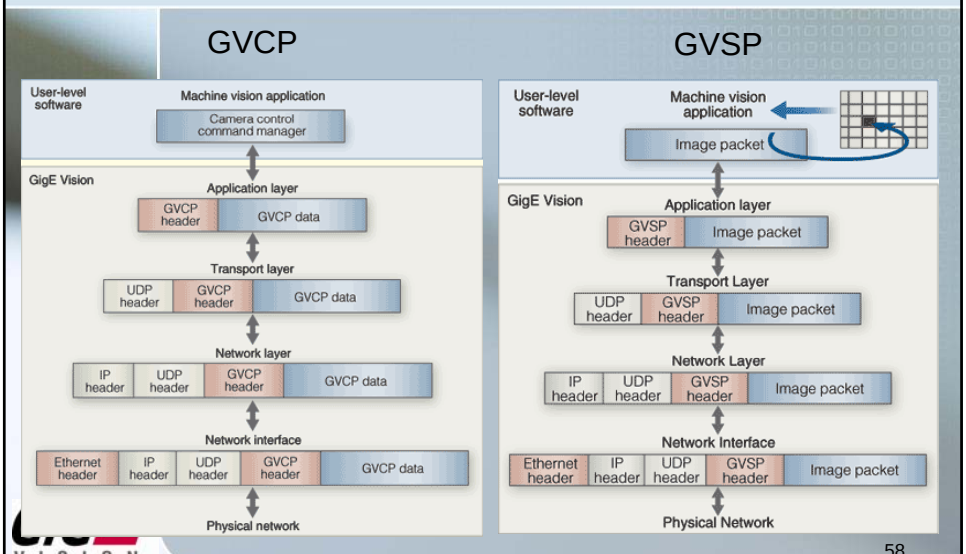
Protocol Stacks



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Mapping to the OSI Model

7	Application	DHCP
6	Presentation	
5	Session	GVCP, GVSP
4	Transport	UDP
3	Network	IP, ICMP, IGMP
2	Data Link	Ethernet (MAC)
1	Physical	Physical Medium (Copper, Fiber)

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Ethernet Frame Format

Preamble	Start-of-Frame-Delimiter	MAC destination	MAC source	Ethertype/Length	Payload	CRC32
7 octets of 10101010	1 octet of 10101011	6 octets	6 octets	2 octets	46-1500/9000 octets	4 octets
		64-1518/9018 octets				
72-1526/9026 octets						

- Standard Ethernet Frame
  - Minimum Size = 72 bytes
  - Maximum Size = 1526 bytes
  - Payload Data = 46 to 1500 bytes
- Jumbo Packet
  - Size not really standardized
  - Typically 9000 bytes payload
- Overhead
  - 1.7% for standard frames (1500 bytes of raw data)
  - 0.3% for jumbo frames (9000 bytes of raw data)

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IPv4

	0 3	4 7	8 15	16 18	19 31
0	Version	Header Length	Type of Service	Total Length	
32	Identification			Flags	Fragment Offset
64	Time to Live		Protocol	Header Checksum	
96	Source Address				
128	Destination Address				
160	Options				
160 or 192+	Data				

- 20-byte Header
  - When options are not used
- Overhead
  - 3.0% for standard frames (1480 raw data)
  - 0.5% for jumbo frames (8980 raw data)

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UDP

	0 15	16 31
0	Source Port	Destination Port
32	Length	Checksum
64	Data	

- 8-byte Header
- Overhead
  - 3.5% for standard frames (1472 raw data)
  - 0.6% for jumbo frames (8972 raw data)

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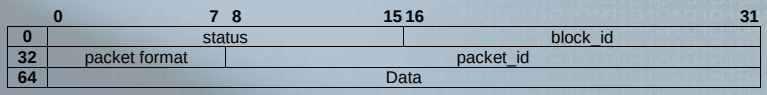
GVSP



- 8-byte Header
- Overhead
  - 4.1% for standard frames (1464 raw data)
  - 0.7% for jumbo frames (8964 raw data)
  - Need to factor in GVSP leaders and trailers
    - 1 leader and 1 trailer per block (image)

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Additional Slides for Product Examples

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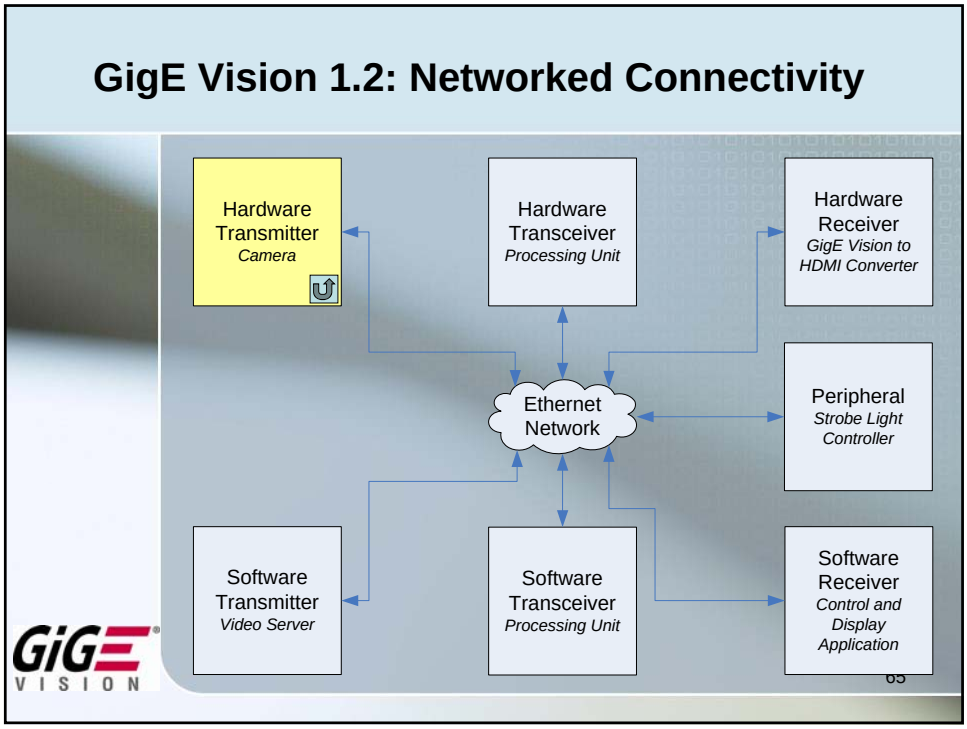
GigE Vision 1.2: Networked Connectivity



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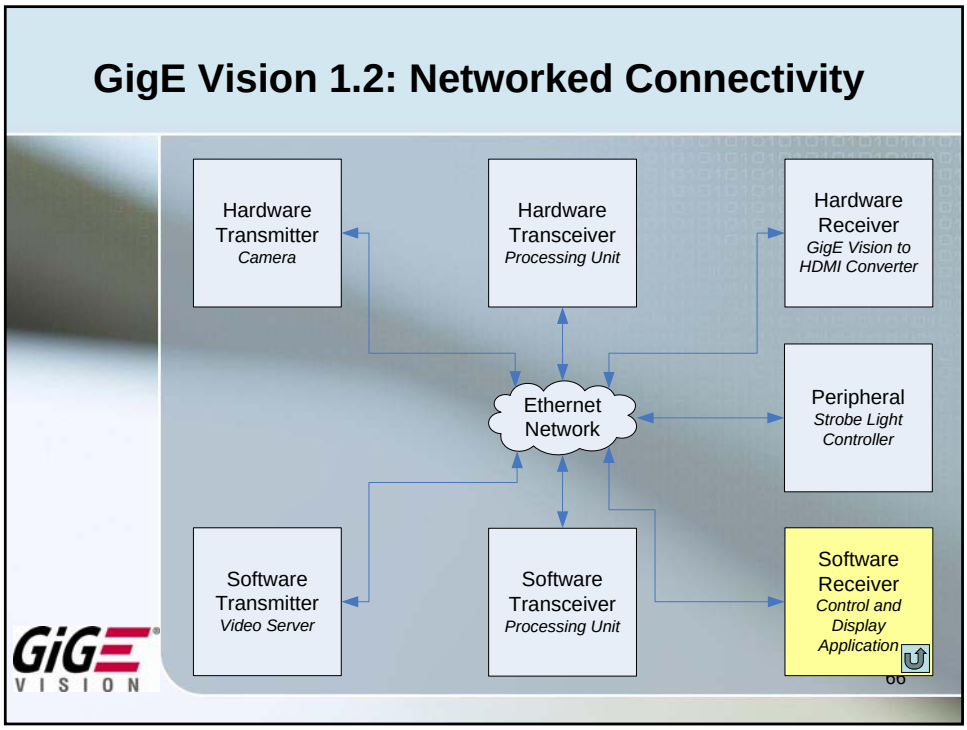

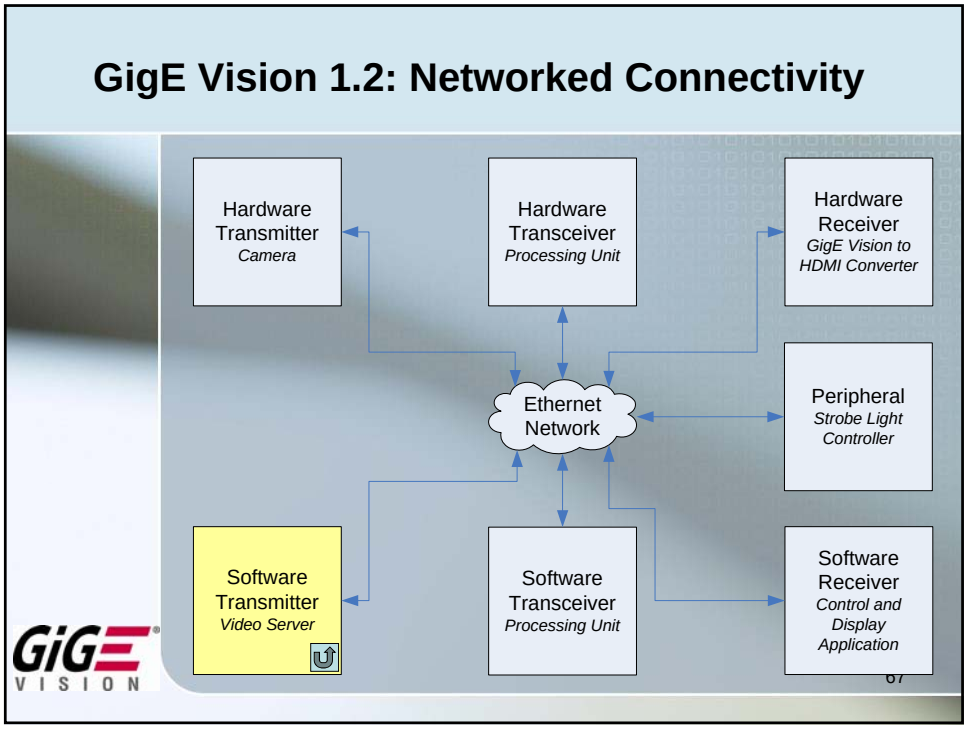
GigE Vision 1.2: Networked Connectivity
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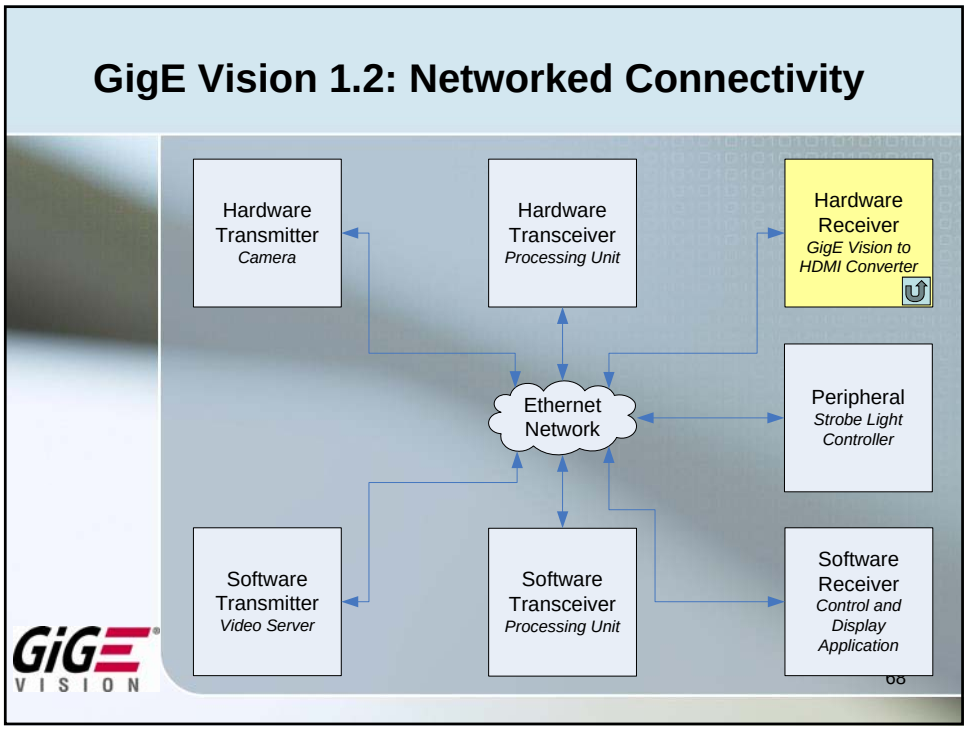
Camera
Hardware Transceiver
Processing Unit
Hardware Receiver
GigE Vision to HDMI Converter
Ethernet Network
Peripheral
Strobe Light Controller
Software Transmitter
Video Server
Software Transceiver
Processing Unit
Software Receiver
Control and Display Application
67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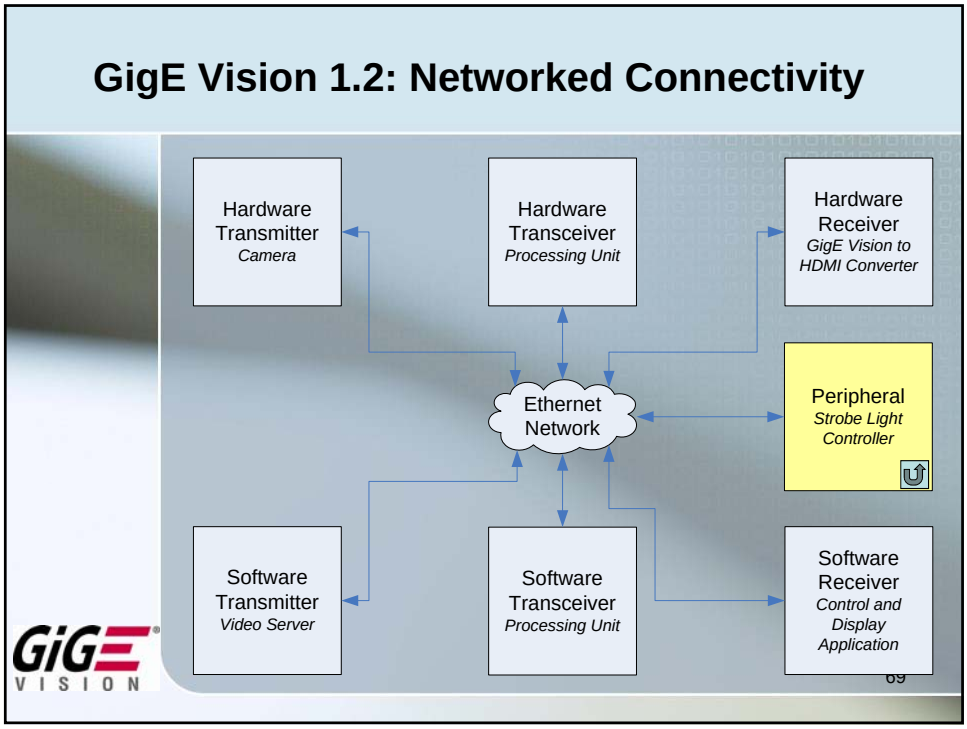
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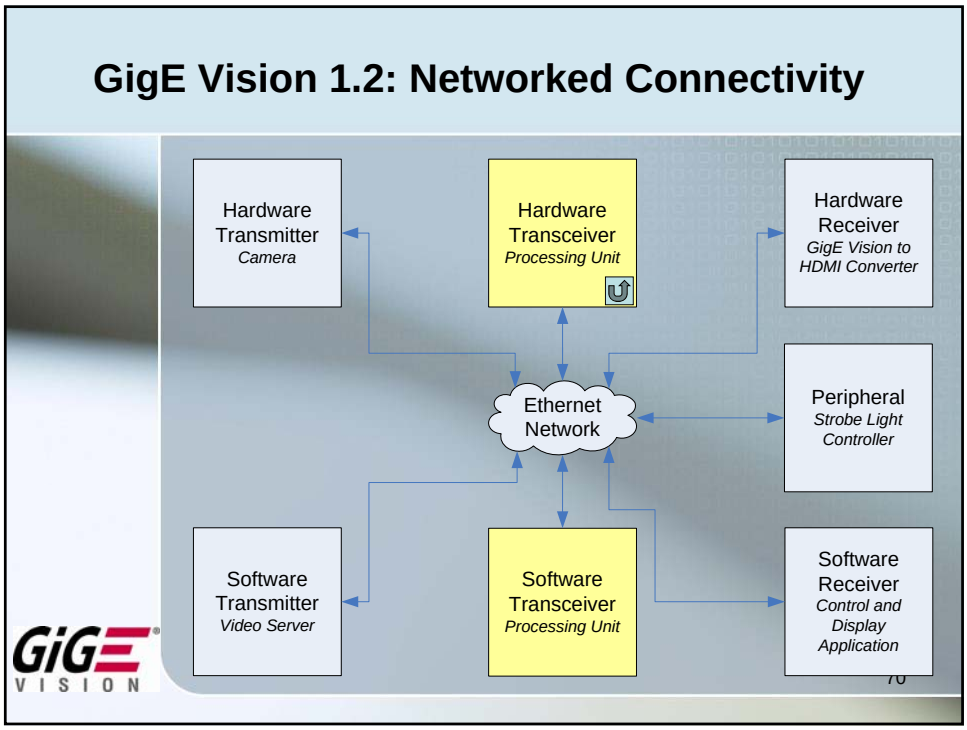
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Software Transceiver
Processing Unit
Software Receiver
Control and Display Application
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GigE Vision and GenICam Open House

Conclusion

Yokohama
May 14th 2010

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Automated Imaging Association
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GigE Vision

GigE Vision Committee Structure

- Sponsored by the AIA
- Organization Structure
  - Coordinating Committee
  - Technical Committee
  - Secretariat
- Officers
  - Chair: Eric Carey (DALSA Corp.)
  - Vice Chair: Vincent Rowley (Pleora Technologies Inc.)
  - Secretary: Jeff Fryman (AIA)
- Standard Access
  - Members of the AIA (from $900 annually)
    - AIA supplier level membership starts at $800 annually
    - GigE Vision standard committee annual committee fees ($100)
  - Non members can buy a hardcopy of the standard at a nominal cost ($750)
  - Available in English and Japanese languages

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GigE Vision Coordinating Committee

- Membership
  - Representatives of AIA member companies who do or intend to produce or market registered product compliant with the GigE Vision standard
    - Over 100 member companies
- Main Responsibilities
  - Proposing work within the scope of the group
  - Adopting committee procedures and revisions thereof
  - Other matters requiring action
- Meetings
  - Generally meets twice a year
    - During machine vision commercial exhibitions (one in North America and one in Europe)
  - ~2 hours per meeting

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GigE Vision Technical Committee

- Membership
  - Representatives from Coordinating Committee member companies who agree to a specific level of active participation in the detailed development and maintenance of the standard including attendance at called meetings
- Main Responsibilities
  - Approval and maintaining the GigE Vision standard and other approved work
  - Establishing appropriate subject matter subcommittees for the purpose of developing and writing supporting documentation or related technical papers
  - Establishing appropriate technical certification and validation requirements
  - Other matters requiring action as required

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GENICAM

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GigE Vision Technical Committee

- Meetings
  - Generally meets twice a year
    - In conjunction with GenICam face-to-face meetings
    - ~2 days per meeting
  - Meeting locations vary
    - Usually hosted by member companies

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GENICAM

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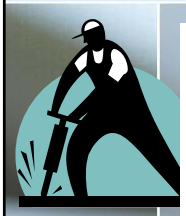
GigE Vision Technical Committee Members



BASLER VISION TECHNOLOGIES
Baumer
DALSA
iAi See the possibilities
kappa
Leutron Vision
MATROX IMAGING
MVTec Software GmbH
NATIONAL INSTRUMENTS
Pleora Technologies
sensor to image
STEMMER IMAGING
teli

GiGE VISION
GEN<i>CAM

GigE Vision Secretariat

- Membership
  - Led by a designated member of the AIA staff and consisting of the GigE Vision chair, vice-chair, and sub-committee chairs (as applicable)
- Main Responsibilities
  - Overseeing the GigE Vision Committee's compliance with the committee procedures
  - Representing the GigE Vision Committee in all activities related to development not requiring action by the committee as a whole
  - Reporting to the AIA Board of Directors on all matters related to GigE Vision development
  - Publication of the standard and other works developed by the GigE Vision Committee
  - Providing secretary and administrative functions

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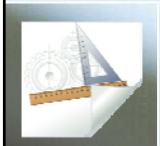
Typical GigE Vision Product Development Cycle



- Obtain the standard
  - Several methods available from the AIA
- Develop your product
- Register (and certify) your product
  - See GigE Vision compliant product development rules on-line at
    - http://www.machinevisiononline.org
    - Click on “Vision Standards” and then “GigE Vision”
- Demonstrate conformance at AIA sponsored events (plug fests)

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Other GigE Vision Deployment Use Cases

Looking to use GigE Vision for:

- Internal Company Use
- Integration Services
- Embedded System

visit:

- http://www.machinevisiononline.org/vision-standards-details.cfm?id=142&type=5

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Ongoing Series of International Plug fests

- Hardware/software interoperability testing events
- 2-3 events per year
  - Asia
  - Europe
  - North America
- Opportunity for public demonstration of compliance with GigE Vision standard
  - Required for product certification
- Opportunity for interoperability testing and interactions with technical experts from various GigE Vision products vendors

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GigE Vision Resources

- AIA's GigE Vision website
  - http://www.machinevisiononline.org/vision-standards-details.cfm?type=5
- GigE Vision technical committee website
  - http://www.gigevisioncommittee.org
- Mailing lists
  - Maintained by GigE Vision committee chair (Eric Carey)
    - eric.carey@dalsa.com
  - Coordinating Committee
    - all@gigevisioncommittee.org
  - Technical Committee
    - tc@gigevisioncommittee.org

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GenICam

GEN<i>CAM

emva
european machine vision association

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Questions

GiGE VISION
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