
 <p>Connected Photography®</p> <p><i>by</i> FotoNation®</p>	 <p>FotoNation</p>
<p><b>PTP over IP</b> <b>The state of the development</b></p>	
<p><b>PTP WG-18 Ad-Hoc Meeting</b> <b>New York Sept. 2004</b></p>	
<p><b>DISCLAIMER:</b> <i>This presentation represents a Non-Confidential, independent opinion of FotoNation, and does not reflect nor suggests any approval of any Standards Committee</i></p>	
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<p>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</p>	

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# Agenda




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- Introduction ...Q&A
- Technical Description ...Q&A
- Demonstration ....Q&A
- Standardization Process ...Q&A
- Q&A (and Discussion)

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<h2>Introduction</h2> <h3>What is PTP-IP?</h3>	 <b>FotoNation</b>
<ul style="list-style-type: none"> <li>• A new <b>transport specification</b> for PTP (PIMA 15740/2000 standard)</li> <li>• Enables digital cameras for <b>networking</b> usage</li> <li>• Designed for home/business <b>LAN</b></li> </ul> <p>- <i>Specification is available at:</i>  <a href="http://www.fotonation.com/product.php">http://www.fotonation.com/product.php</a></p> <p>- <i>Reference Code is available from</i>  <b>FotoNation Inc.</b></p>	<p style="writing-mode: vertical-rl; text-orientation: mixed; font-size: 2em; opacity: 0.5;">FotoNation</p> <p style="font-size: 0.8em;">PTP-IP Presentation  WG-18 Ad Hoc Meeting  New York Sept-2004</p>

- There is a need to expand on the functionality of PTP over multiple transport layers.
- There is also an interest to design a digital camera as a network device, either for a home use (LAN) or generic network use (WAN).
- Some preliminary products were already offered by few manufacturers. However, the solutions lack the overall uniformity in them.
- Thus the need to expand PTP to support TCP/IP networks.
  
- This specification does not address the WAN use cases and issues such as proxies or firewalls.
- *A draft of the specification is on*  
<http://www.fotonation.com/product.php>
- **Readers are encouraged to sign in with their CORRECT eMail so that FotoNation can send you on going updates.**

## Motivation



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- Widespread industry interest which leads to wide spread adaptation
- Need to secure interoperability
- Backwards compatibility for existing device applications

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# Technical Description




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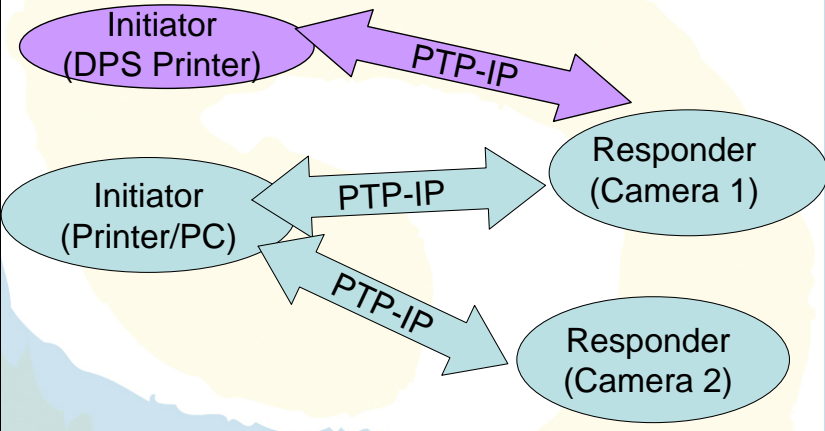


<b>Usage Scenarios (W)LAN Camera</b>	 <b>FotoNation</b>
<ul style="list-style-type: none"><li>• Unloading images to a PC</li><li>• Printing pictures<ul style="list-style-type: none"><li>– A PC or a Printer as a controller</li><li>– DSC as a controller</li></ul></li><li>• Controlling a DSC remotely to:<ul style="list-style-type: none"><li>– Set camera properties</li><li>– Take pictures</li></ul></li></ul>	FotoNation <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

The first level of functionality is to make sure of backwards compatibility of the PTP functionality for the tethered mode.

Thus, PTP-IP should work for a network environment where TCP/IP will replace the existing USB functionality.

In addition, in the networking environment the camera is a logical place for the (UI) controller, since it is where the user physically is.

<h2>PTP-IP vs. USB</h2> <ul style="list-style-type: none"> <li>• Move to Wireless</li> <li>• Device and Service Discovery</li> <li>• Multiple Sessions</li> </ul>	 <b>FotoNation</b>
 <p>The diagram illustrates PTP-IP connections. It features four ovals: a purple oval for 'Initiator (DPS Printer)', a light blue oval for 'Initiator (Printer/PC)', a light blue oval for 'Responder (Camera 1)', and a light blue oval for 'Responder (Camera 2)'. Bidirectional arrows labeled 'PTP-IP' connect the purple initiator to the top responder, and the light blue initiator to both the top and bottom responders.</p>	<p style="writing-mode: vertical-rl; text-orientation: mixed; font-size: 2em; opacity: 0.5;">FotoNation</p> <p style="font-size: 0.8em;">PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</p>

As much as it is that the goal for PTP over IP is to be backward compatible with PTP over USB, inherent differences between the two transport protocols may dictate difference in the implementation and in the functionality.

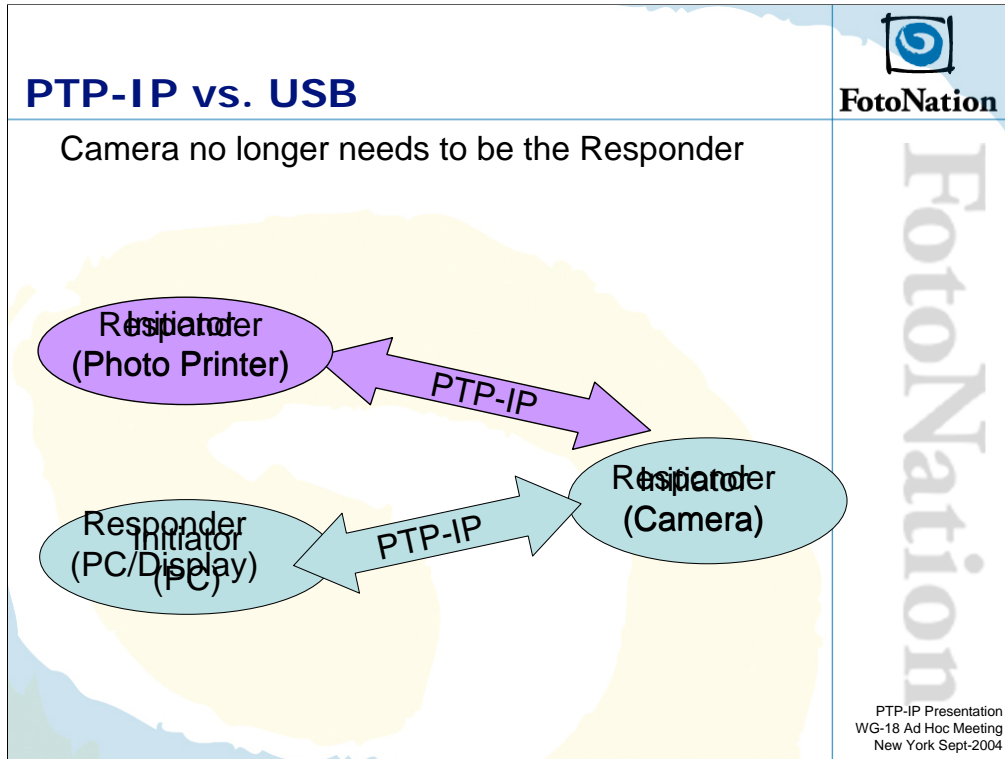
Some examples:

Device & service discovery is more complicated in case of an IP network. USB has no need for authentication, because the camera and the user are “linked” together” by a cable.

PTP-IP is “Camera Network Protocol” that can be implemented over Ethernet, Modem links, or wireless protocols.

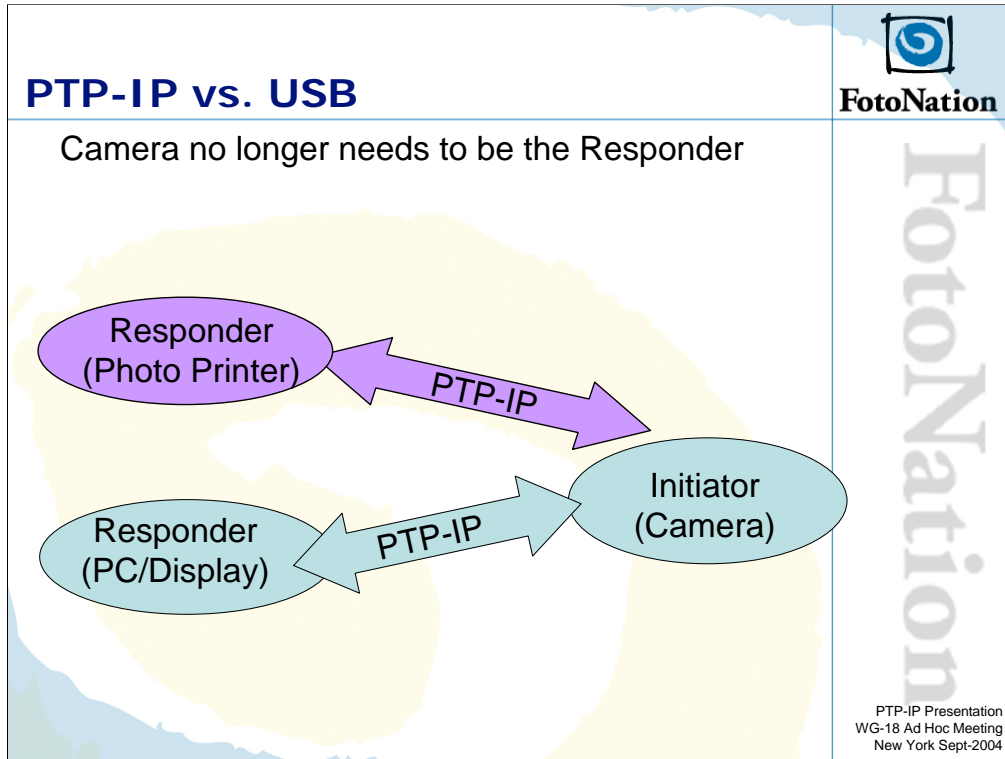
The transfer rate is dependent on the network infrastructure and in some cases, can achieve higher transfer rates than the known USB solutions.

Architecturally, and differently to USB, the IP solution can support multiple sessions (multiple Initiators can connect to same Responder). A practical example may be a camera connected to a PC and to a printer directly



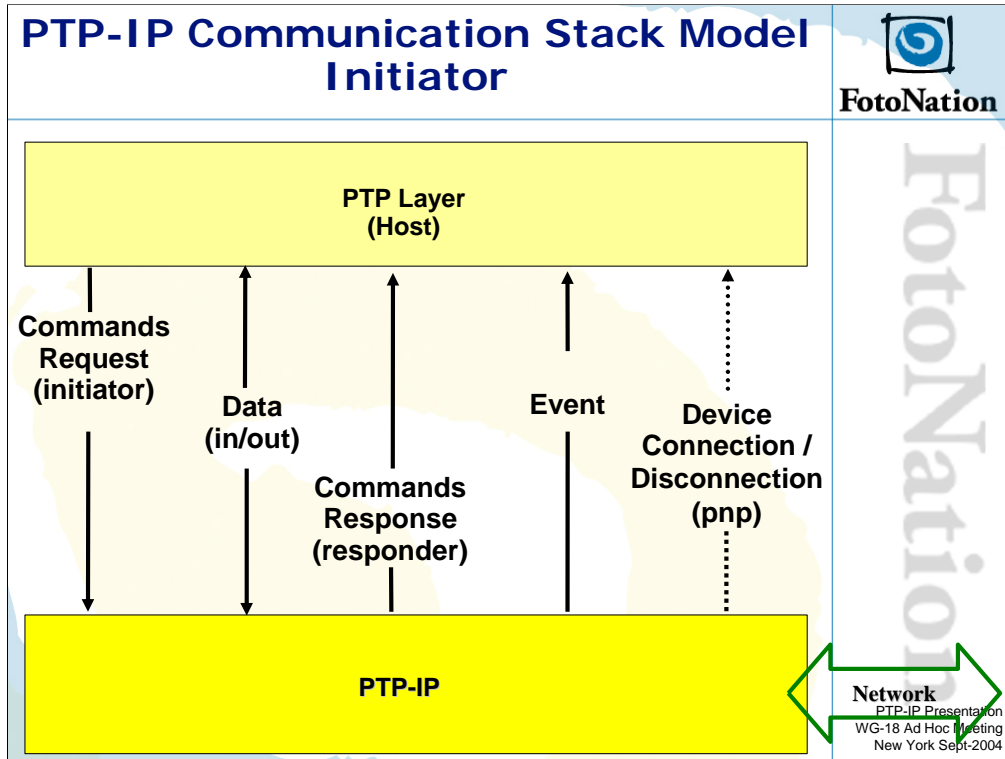
In PTP over USB, due to the definitions of the USB still image device, the camera was a responder. In a Network protocol, it is possible for some applications to reverse the roles and make cameras the initiators.

For the use cases where the user is holding the camera vs. sitting next to the computer, it may be more logical to control the process from the camera. Currently the camera is the responder but is really the Master, which is implemented via a complex/artificial mapping of commands, where the camera sends an unspecified event, and the printer then asks for the event, and the camera packages a new object with the command.



In PTP over USB, due to the definitions of the USB still image device, the camera was a responder. In a Network protocol, it is possible for some applications to reverse the roles and make cameras the initiators.

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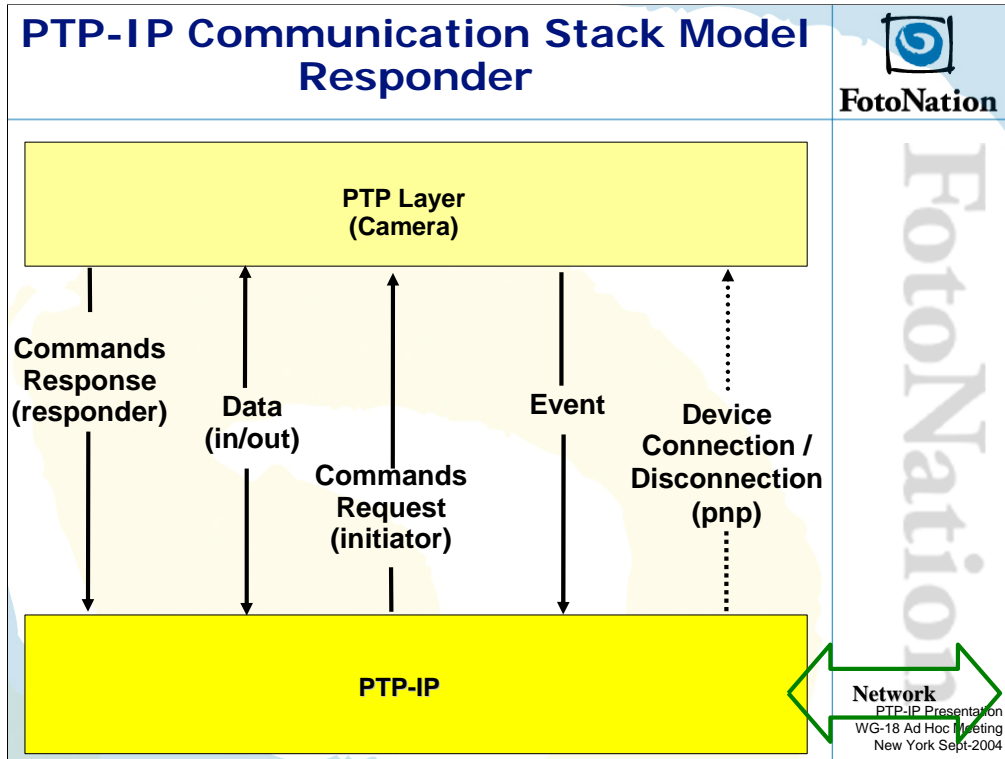


The PTPIP is defined as a new layer in the PTP communication stack.

The interface between the PTP layer and its transport can be done using PTP transactions (Commands=Operation Requests, Responses), events and transport specific notifications ( Device connection/ Disconnection). This layer needs to be implemented on both responder and initiator.

This layer interfaces with the Network Protocol

Events are always form Responder to Initiator, In PTP, (they are defined as bi-directional, but nobody really use them from Initiator to Responder)




In the case of the responder:

The commands flow from the Camera to the Network as responses and from the Initiator as requests

The data is still bi-directional

The Events, flow from the Camera to the Network (although PTP does allow bi-directional communications)

The Device disconnection/connection is an internal communication between the PTP IP and the PTP layer.

<h2>PTP Transport Service Requirements</h2>	 <b>FotoNation</b>
<ul style="list-style-type: none"> <li>• <b>Device discovery and enumeration</b>  Multiple Discovery Mechanisms, external to the scope of the protocol</li> <li>• <b>Reliable, error-free transport</b>  Part of TCP/IP</li> <li>• <b>Connection Lost</b>  Implementation-specific. May be provided by the TCP/IP stack or achieved using communication timeouts</li> <li>• <b>Asynchronous event support</b>  Supported based on the dual channel mechanism</li> </ul>	<p style="writing-mode: vertical-rl; text-orientation: mixed; font-size: 2em; opacity: 0.5;">FotoNation</p> <p style="font-size: 0.8em;">PTP-IP Presentation  WG-18 Ad Hoc Meeting  New York Sept-2004</p>

PTP requires from its TRANSPORT the following requirements:

- Device discovery and enumeration
- Reliable, error-free transport
- Disconnection events
- Asynchronous event support

Some of the requirements were developed as part of the proposed Specification, and others as an implementation guidelines.

The first level of functionality is to make sure of backwards compatibility of the PTP functionality for the tethered mode.

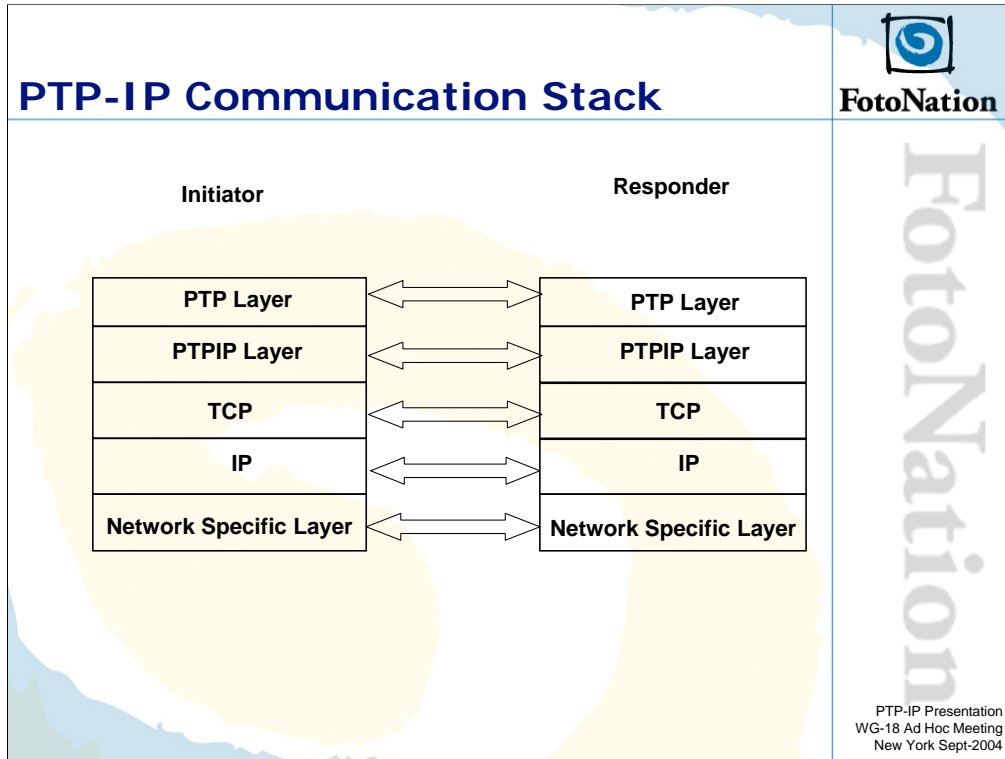
Thus, PTP-IP should work for a network environment where TCP/IP will replace the existing USB functionality.

Enumeration and Discovery is NOT part of PTP-IP but part of an implementation guidelines

The Error free transport is provided as part of TCP

Connections events are implementation specific

Asynchronous events is achieved based on the fact that the implementation of dual channel mechanism.

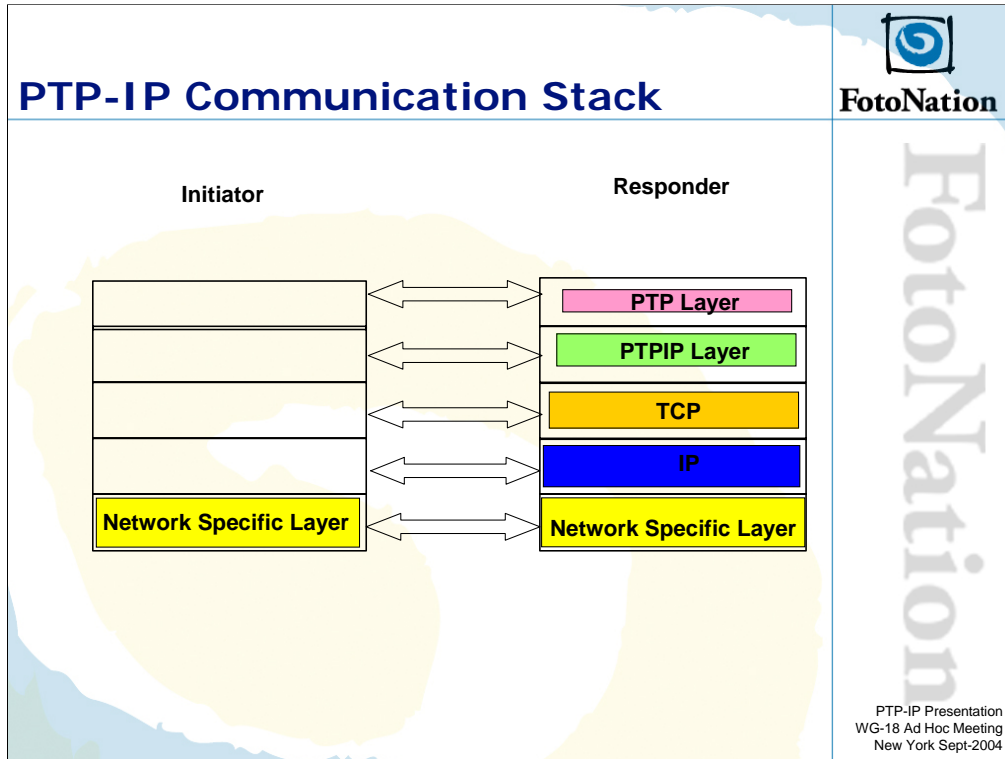


Every layer logically is talking to its corresponding layer, but physically all data is packaged and moved by the layer below its layer (PTP data is packaged by the PTPIP layer etc.)

Like PTP, also PTPIP expects from its transport layer reliable, error free communication channels. TCP (in the TCP/IP protocol stack) is the natural transport layer to provide those requirements.

TCP is a stream based transport layer, that provides multiple communication channels (TCP connections) and error free data delivery.

The PTP-IP implementation is based on the use of TCP layer as its own transport layer

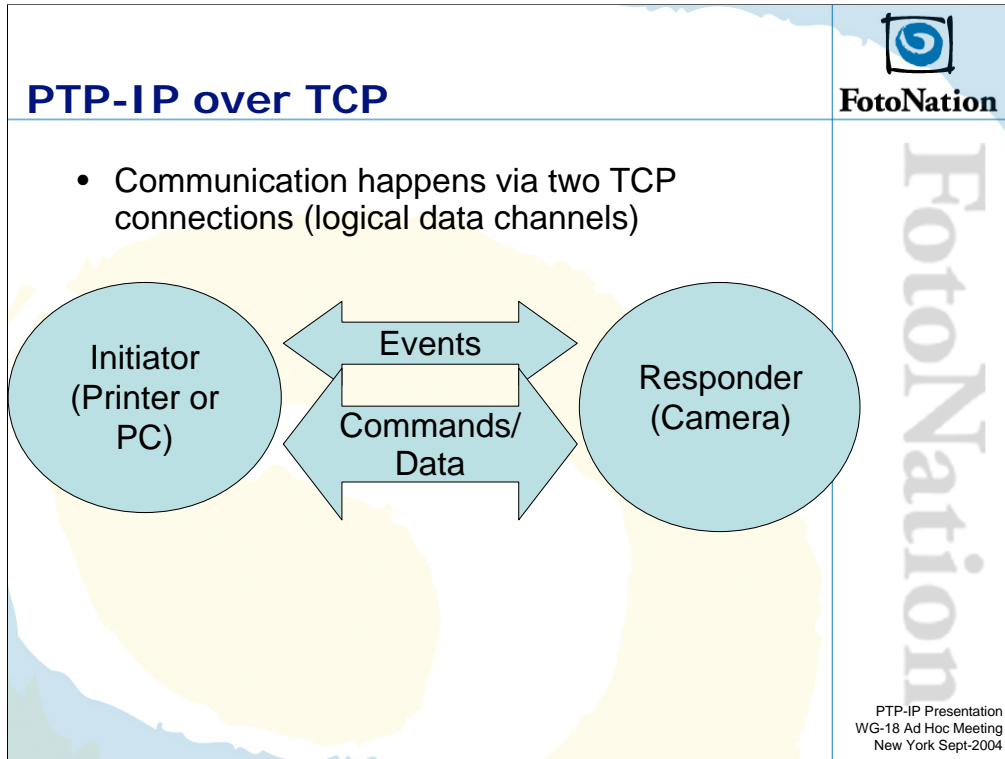


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The first TCP connection is dedicated to Operation Request, Response and Data transaction packets, i.e. Command/Data Connection. The second TCP connection is used exclusively for the Event transaction packets, i.e. Event Connection.

Both connections are established by the image Initiator device. The Responder's IP address and port number are provided through the device discovery mechanism or manually configured on the Initiator.

The Event packets are transported separately from the Operation and Data transaction packets because of their asynchronous nature.

<h2>Transport channels establishment</h2>	 <b>FotoNation</b>
<ul style="list-style-type: none"> <li>• Initiator is a TCP client and Responder/listener (camera) is a TCP server</li> <li>• Initiator opens two TCP connections to the Responder             <ul style="list-style-type: none"> <li>1) Commands/Data      2) Events</li> </ul> </li> <li>• Responder waits on a specific port number             <ul style="list-style-type: none"> <li>– Port Number default (spec) or discovered</li> </ul> </li> </ul>	<p style="writing-mode: vertical-rl; text-orientation: mixed; font-size: 2em; opacity: 0.5;">FotoNation</p> <p style="font-size: 0.8em;">PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</p>

In the communication between Initiator and Responder, it's the responsibility of the Initiator device to initiate the establishment of PTP-IP TCP connections to the Responder device whenever these transport channels are needed.


The two TCP connections should be established before any event and data communication can take place.

Request for 15740 as the port number was sent to IANA Jan-2004

1. Initiator device opens the TCP connections to the responder
2. Two TCP connections should be established:
  1. One for Commands/Data
  2. One for Events

(If one of the TCP connections fails to establish, the other one should be closed)
3. Initiator is a TCP client and Responder is a TCP server
4. Responder waits on a specific port number (either default or automatically discoverable) for incoming connection requests
5. After both connections are established, the Initiator sends the 16-bit local port number of the Event connection, over the Command/Data connection (to associate the two connections)

TCP connections should be configured with “keep alive” option

<b>Connection/Session Implementation</b>	 <b>FotoNation</b>
<ul style="list-style-type: none"><li>• PTP-IP connection request - initiator will generate two new TCP connections at the PTP-IP layer</li><li>• TCP connections uniquely identify a session</li><li>• No need to transport the SessionID from the Initiator to Responder</li></ul>	FotoNation <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

A new session request will generate the creation of two new TCP connections at the PTP-IP layer



TCP connections identify uniquely a session

SessionID is NOT from the Initiator to Responder (SessionID is a legacy form USB which was a single session between responder and host)

(Responder would have had to allocate the session which does not make sense).

Note: you can have multiple PTP sessions on the same pair of TCP connections if you do Open Session-Close Session; The PTPIP connection is established all the time, to allow GetDeviceInfo to be issued any time.


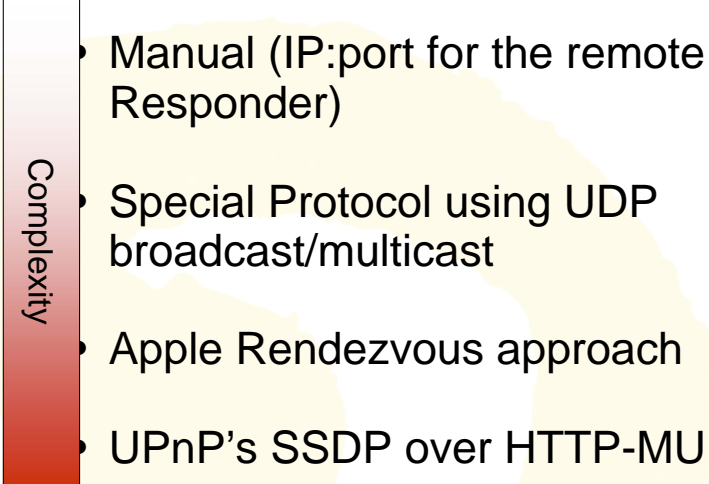

Note: closing the PTP session doesn't drop the connection.

<h2 style="text-align: center;">IP Address Configuration Alternatives (FotoNation Implementation Guideline)</h2>		 <b>FotoNation</b>
<div style="background-color: #f0f0f0; padding: 5px; border: 1px solid #ccc;">             Complexity         </div>	<ul style="list-style-type: none"> <li>• Static configuration</li> <li>• DHCP client</li> <li>• Dynamic Configuration</li> </ul>	  <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

### FotoNation Implementation Guidelines:

The foundation for PTP-IP is the TCP/IP protocol suite and the key to this suite is the addressing. The Responder and/or Initiator must obtain valid IP addresses using one of the following methods:

- Manual configuration – the IP address and other associated information is configured manually by the user, to reflect the topology and address schema of the local area network in which the imaging devices will function
- DHCP server running in local network. In this case, the imaging devices should implement a DHCP client that will automatically obtain an IP address from the DHCP server running in the system. There may be a case where DHCP is not available (such a camera connecting to a single PC at home via ad hoc wireless connection, or a LAN that does not implement DHCP)
- Dynamic Configuration for example IPv4 Link-Local Addresses (v4LL) - standard that describes how an IP address is automatically configured in order for a new device to work in a local area network, without having to setup a DHCP server

<b>Device/Service Discovery Alternatives (Implementation Guideline)</b>	 <b>FotoNation</b>
 <ul style="list-style-type: none"> <li>• Manual (IP:port for the remote Responder)</li> <li>• Special Protocol using UDP broadcast/multicast</li> <li>• Apple Rendezvous approach</li> <li>• UPnP's SSDP over HTTP-MU</li> </ul>	  <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

The PTP standard requires device discovery and enumeration. In PTPIP this requirement can be fulfilled by using a few approaches, all proposed as implementations guidelines:


∅ Instruct the Initiator manually where to connect (IP:port for the remote Responder)

∅ A device and service discovery mechanism, that can be special case for PTP-IP based on UDP protocol. Each Responder (Camera) arriving in a new network and periodically thereafter will use UDP protocol to broadcast a defined packet (TO BE DEFINED) that will contain information about itself (Such as supported protocol – i.e. PTP, port numbers where it waits for incoming connections, its IP address, and other useful information). All the devices that may need to act as Initiators will run background processes that would intercept this message and configure the PTPIP layer.

∅ UPNP –The family of protocols defined by UPnP™ Forum to facilitate automatic device configuration, service discovery and invocation. Only the device and service discovery features of UPNP are to be used.


∅ Rendezvous – A device discovery and service discovery mechanism defined by Apple Computer, Inc.

The implementation complexity is estimated in the order the items appear.

<b>Device Disconnection (FIG)</b>	 <b>FotoNation</b>
<ul style="list-style-type: none"><li>• Notification of Network Disconnect Event - Broken Sockets</li><li>• Transmission Timeout</li></ul>	FotoNation  <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

In PTPIP, the device disconnection or network loss detection is based on a number of criteria. The network may or may not detect the disconnection.

- The capabilities of the network layer to notify the applications about a network disconnect events (i.e. media disconnected). Losing the connection on one of the PTP-IP channels (Data/Commands or Event sockets) (i.e. broken socket).
- Transmission timeout on one or both of the PTP-IP channels. Most likely the Network layer will detect the disconnect and notify PTP-IP layer, so this event will not be triggered.

<b>Related Issues</b>	 <b>FotoNation</b>
<ul style="list-style-type: none"><li>• Device Bonding (Pairing)<ul style="list-style-type: none"><li>– PTP-IP supports device ID (GUID)</li><li>– Bonding can be implemented <b>on the application level</b></li></ul></li><li>• Authentication and Encryption<ul style="list-style-type: none"><li>– Provided by the underlying link layer</li></ul></li></ul>	FotoNation  <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

The Discovery step, although not part of PTP, should be implemented and not relied on the transport layer (no such thing for TCP)



It is not clear though if Authentication and Encryption should be part of the PTP-IP protocol.

Is the device bonding and authentication part of this specification?

Can it be delegated to the underlying network?

Is the data encryption part of this specification?

It is usually part of the underlying network technology that is used (e.g. WEP is part of the 802.11b protocol standard)

<h2>Implementation Size (rough idea)</h2>	 <b>FotoNation</b>
<ul style="list-style-type: none"><li>• Win32<ul style="list-style-type: none"><li>– Without discovery: 10-15KB</li><li>– With UDP-based custom discovery: 17-18KB</li><li>– With Rendezvous-based discovery: 60-65KB</li></ul></li><li>• Embedded solutions<ul style="list-style-type: none"><li>– As low as 5-10KB</li></ul></li></ul>	 <small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small>

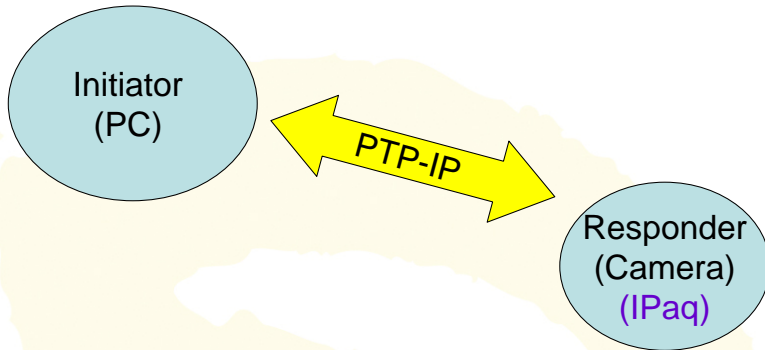
**Implementation Size (rough idea):**

This slide provides guidelines of implementation based on FotoNation's practical experience. Code base is available based on those figures.

# Demonstration

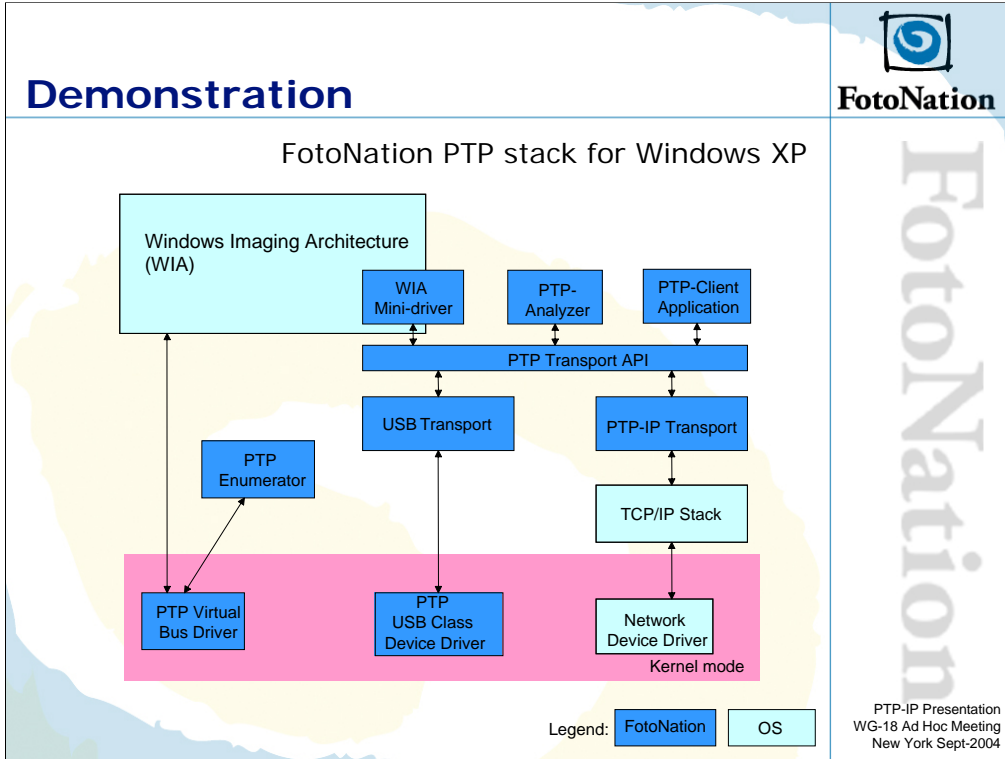


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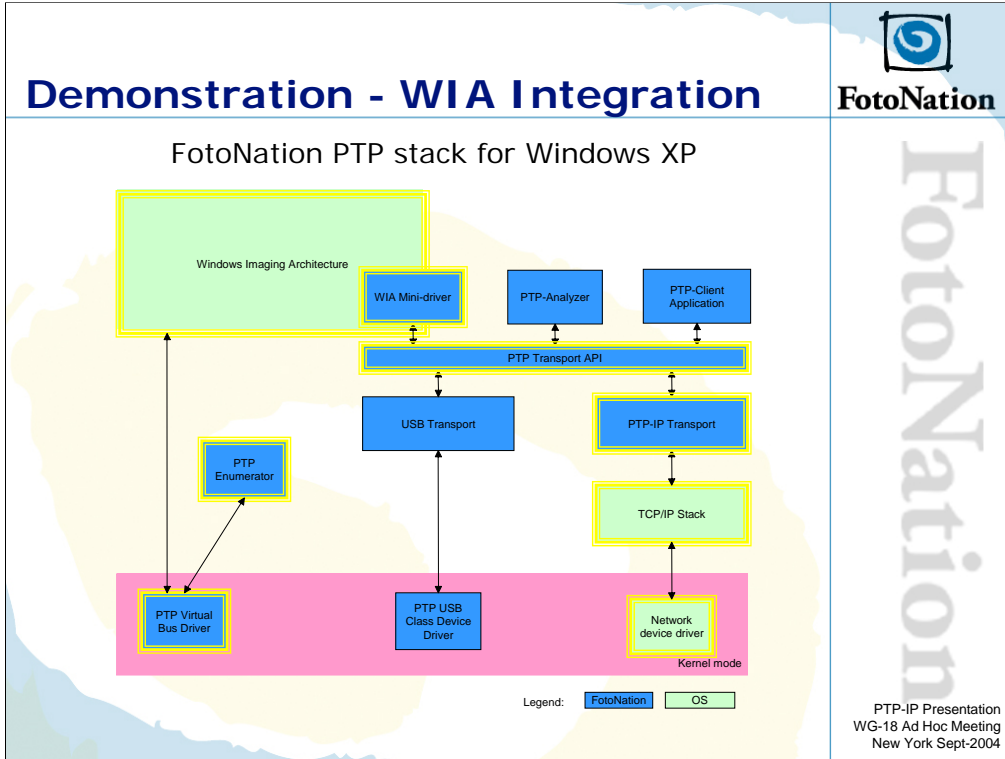


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This diagram represents the components on Windows XP for demonstration purposes only. Similar structure is available for Other operation systems.



The highlighted (yellow) regions define potential components necessary for implementations of PTP-I  
 (Note: This diagram represents FotoNation’s opinion only and may or may not be implemented as suc

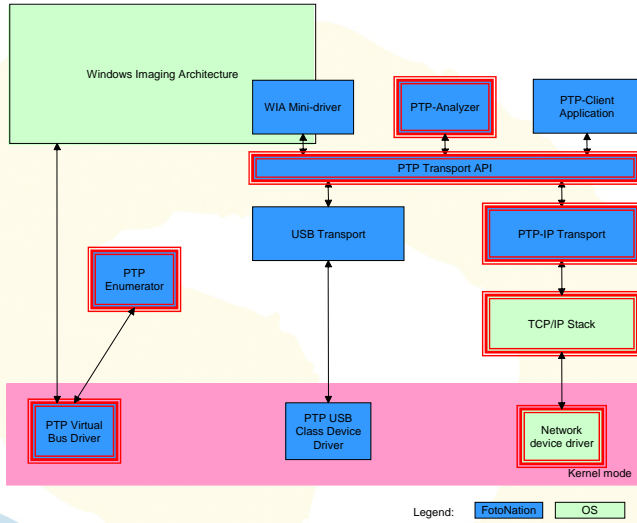
<b>Demonstration</b>	 <b>FotoNation</b>
<p><b>PTP/PictBridge Analyzer:</b></p> <ul style="list-style-type: none"><li>– an example of an application built on top of PTP-IP</li><li>– a tool for camera developers to help with PTP and Pictbridge (USB or PTP-IP)</li><li>– Demonstrates possibilities of PTP-IP stack to support various applications (for example, PictBridge)</li></ul>	<p><b>FotoNation</b></p> <p><small>PTP-IP Presentation WG-18 Ad Hoc Meeting New York Sept-2004</small></p>

PTP/PictBridge Analyzer is an example of an application that is built on top of PTP-IP, but  
The Analyzer is a tool for camera/printers developers to help with PTP and PictBridge  
This tool supports PTP on multiple transport layers (USB or PTP-IP for this specific purpose)  
And it demonstrates possibilities of PTP-IP stack to support various top level applications

# Demonstration – PTP Application



FotoNation PTP stack for Windows XP



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This highlighted regions (red) diagram represents an implementation of an application directly from t

## Standardization Process

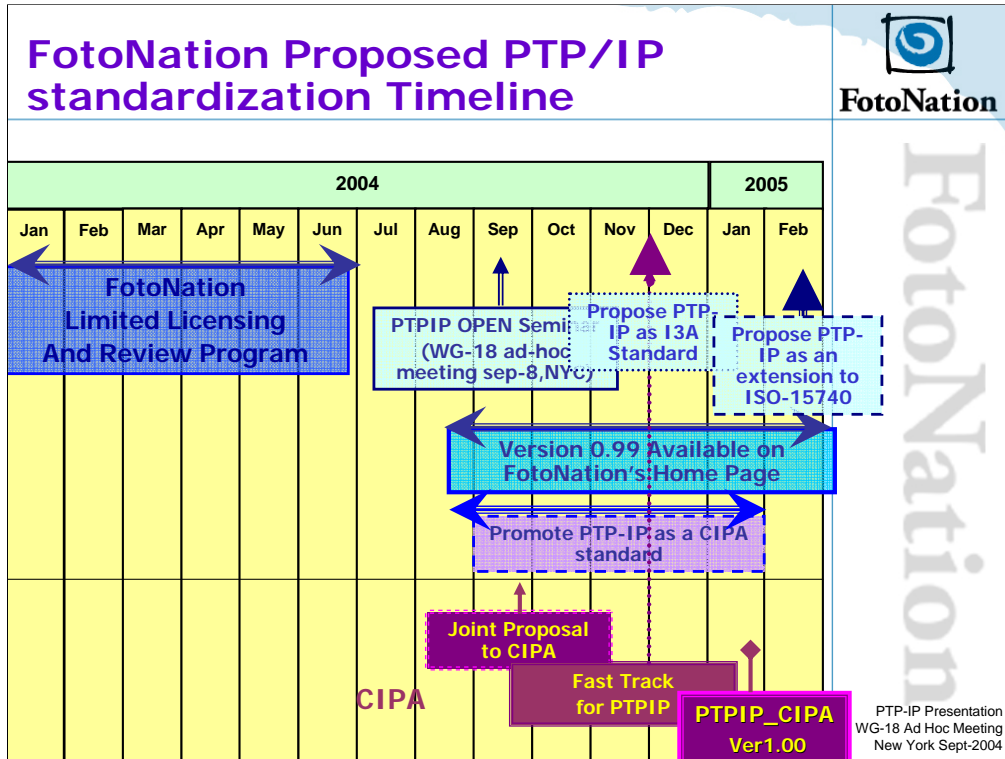


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- Reach Industry consensus on the need and method of solving the problem
  - Internal, private discussions
  - Open discussions
- Freeze an acceptable reference as soon as possible
  - CIPA standard
  - I3A standard
  - Company technical publication
- Create an internationally accepted standard
  - ISO 15740/2

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This slide represents one approach towards cementing a publicly available fixed standard.

According to this proposal, PTP-IP will be proposed to CIPA by a few companies towards a Fast-Track approval.

An ISO proposal will be submitted following the CIPA approval process. The official discussion on the ISO level is withheld until the completion of the ISO-15740 accreditation.

Note: This is a FotoNation proposal with some industry support. However, it does not represent CIPA, WG-18 or any other Standards body.



## Intellectual Property

- FotoNation does not intend to assert nor enforce any patents relating to the PTP-IP specification as disclosed.
- FotoNation highly recommends that companies/standard organizations performs the necessary prior art examination
- FotoNation is willing to assist companies interested in such collaboration

**DISCLAIMER:**

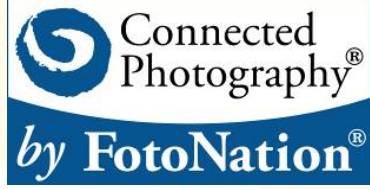
***This slide does not represent a legal statement***

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# Q&A (and Discussion)



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Thank you




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Supplemental Slides

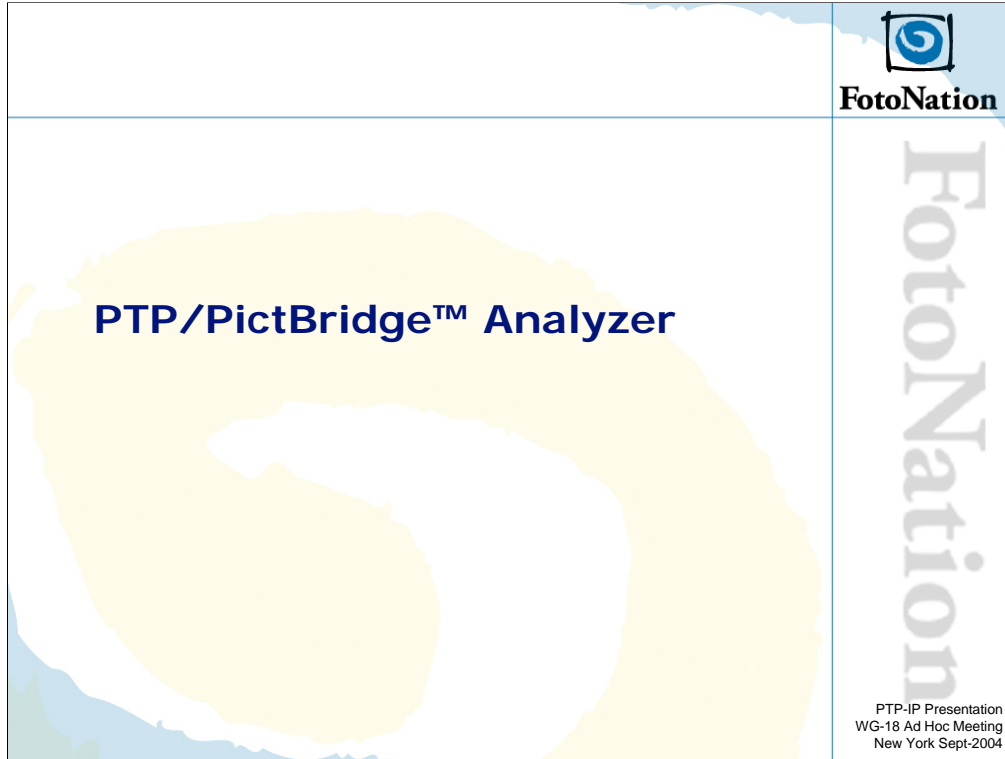
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<h1>FotoNation's Offering</h1>	 <b>FotoNation</b>
<ul style="list-style-type: none"> <li>• <b>Promotional Activities:</b> <ul style="list-style-type: none"> <li>– <i>A working demonstration (PC/HHC simulation)</i></li> <li>– <i>PTP-IP protocol specification Ver 0.99c</i></li> </ul> </li> <li>• <b>Licensing (Available immediately):</b> <ul style="list-style-type: none"> <li>– <i>Reference implementation (both Initiator and the Responder sides). PTP stack featuring transport-independent API</i></li> <li>– <i>Integration into WIA</i></li> <li>– <i>Mac library</i></li> </ul> </li> <li>• <b>Expert Consulting &amp; Services:</b> <ul style="list-style-type: none"> <li>– <i>Porting and implementations</i></li> <li>– <i>Intellectual Property Analysis</i></li> <li>– <i>PTP-IP Certification Tools</i></li> </ul> </li> <li>• <b>Tools:</b> <ul style="list-style-type: none"> <li>– <i>PTP/PictBridge Analyzer</i></li> </ul> </li> </ul> <p style="text-align: right;"><b>Support in Implementation &amp; Standardization</b></p>	<p style="writing-mode: vertical-rl; text-orientation: mixed; font-size: 2em; opacity: 0.5;">FotoNation</p> <p style="font-size: 0.8em;">PTP-IP Presentation Ad Hoc Meeting New York Sept-2004</p>

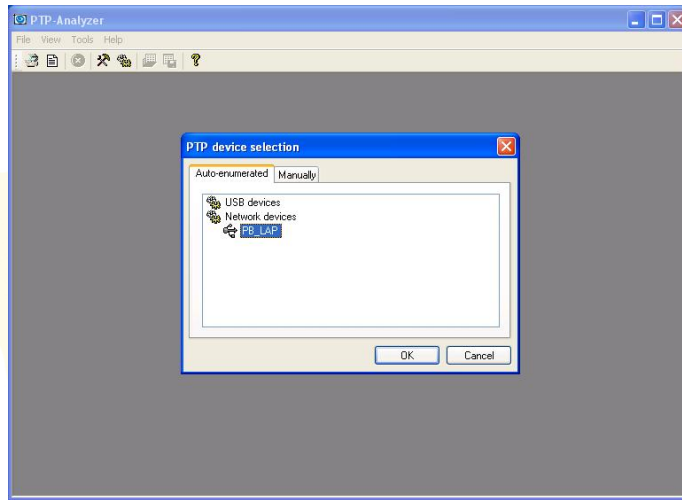
FotoNation is offering on its Web site ([www.fotonation.com](http://www.fotonation.com)) a draft specification as well working demonstration.

FotoNation does have an implementation based on several platforms. Some products based on FotoNation's implementation/specification/reference code will be demonstrated during PhotoKina-2004. Interested companies should approach FotoNation directly for such discussions.



PTP/PictBridge Analyzer: Designed for testing digital cameras compliance with PTP (Picture Transfer Protocol) and PictBridge™ protocol by simulating a PTP host or a PictBridge™ printer connected to the camera. This tool is available for development and verification of PTP based products.

# PTP/PictBridge™ Analyzer USB/IP Support



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Support for PTP-USB and PTP-IP devices

# PTP/PictBridge™ Analyzer Support PTP Command Set



The screenshot shows the PTP-Analyzer application window titled "PTP-Analyzer - [Network devices: PB\_LAP]". The interface includes a menu bar (File, View, Tools, Window, Help) and a toolbar. On the left, there is a list of PTP commands under the "PTP Standard" tab, including "Get device info", "Open session", "Close session", "Get storage IDs", "Get storage info", "Get number objects", "Get object handles", "Get object info", "Get thumbnail", "Delete object", "Send object info", "Send object", "Initiate capture", "Format store", "Reset device", "Self test", "Set object protection", "Power down", "Get device property description", "Get device property value", "Set device property value", "Reset device property value", "Terminate open capture", "Move object", "Copy object", and "Get partial object". A "Run" button is located at the bottom of this list. The main area on the right displays a table with columns for "Time", "TzID", and "Message". Below the table, there is a "Data" section with tabs for "Data" and "Hex". The "Data" tab is active, showing the following information:

**Device info**  
Standard version: 1.0  
Vendor extension ID: 12  
Vendor extension version: 99.99  
Vendor extension description: FotoNation  
Functional mode: 0

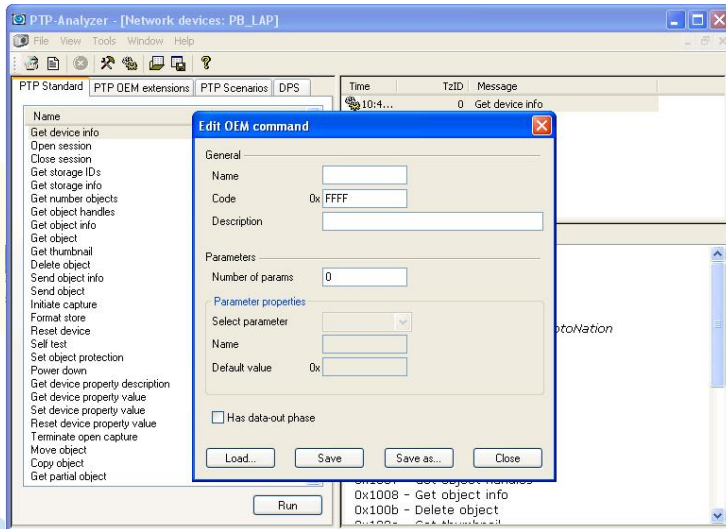
**Operations**  
0x1001 - Get device info  
0x1002 - Open session  
0x1003 - Close session  
0x1004 - Get storage IDs  
0x1005 - Get storage info  
0x1006 - Get number objects  
0x1007 - Get object handles  
0x1008 - Get object info  
0x100b - Delete object  
0x100c - Get thumbnail

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PTP-Analyzer provides support for full set of PTP commands and events

# PTP/PictBridge™ Analyzer Vendor Extensions

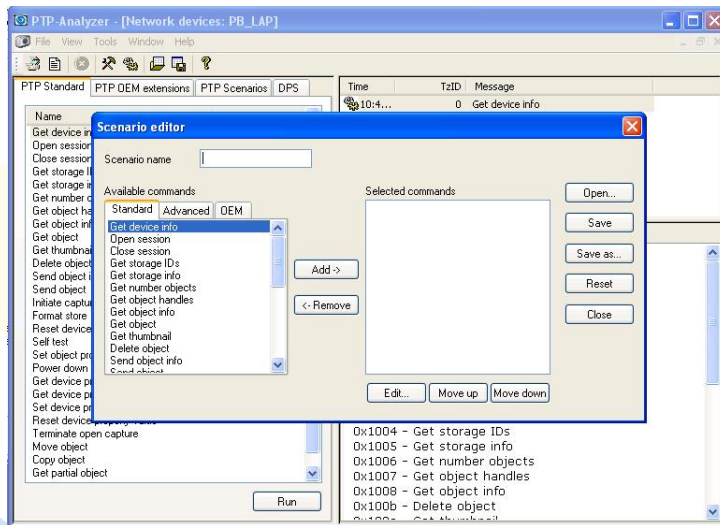


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Support for manufacturer specific extensions

# PTP/PictBridge™ Analyzer Custom Tests

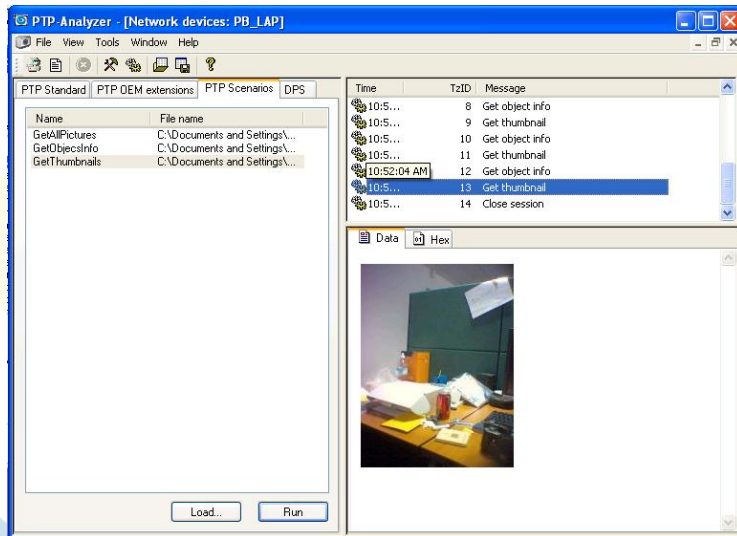


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Scenarios editor support to allow creation of custom test scenarios

# PTP/PictBridge™ Analyzer Predefined Scripts

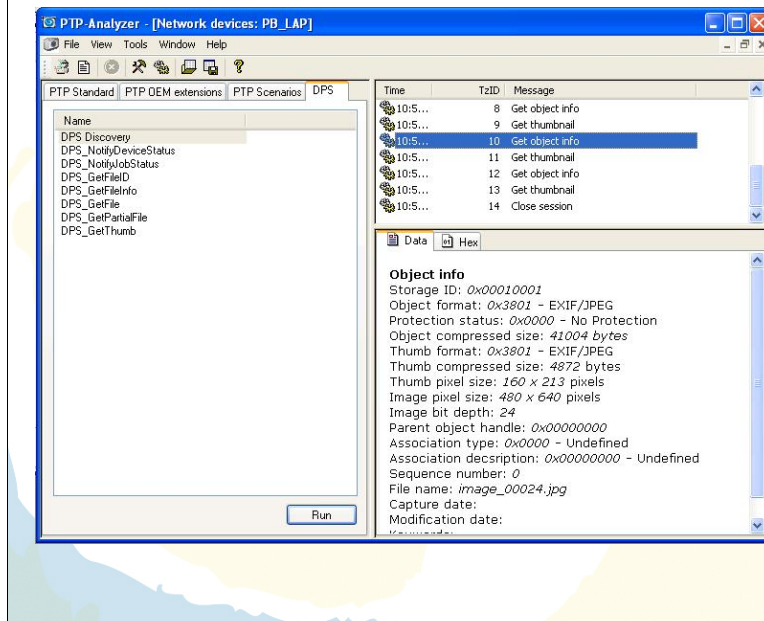


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Standard predefined test scenarios

## PTP/PictBridge™ Analyzer PictBridge Support



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PictBridge™ fully scriptable support

Able to emulate a well behaved printer as well as various incorrect behaviors