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| <p>DATE : Sept. 05, 2013</p> <p>Doc : PosiStageNet Protocol description v1.7</p> |  |  | <p>VYV Corporation 5550 Fullum suite 342 Montréal, Québec, Canada H2G 2H4 514.373.2364</p> <p>MA Lighting Technology GmbH Dachdeckerstr. 16 97297 Waldbüttelbrunn Germany Phone: +49 (0) 931 49794 -0</p> |
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PosiStageNet Protocol description v1.7

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VYV Corporation politely requests that any manufacturer who implements this protocol send details to support@vyv.ca so that protocol updates may be communicated. Furthermore, if changes to the protocol are needed, VYV Corporation politely requests that such changes be communicated so that they may be included in the official protocol, rather than create unnecessary redundant standards.

This document defines the PosiStageNet communication specifications. This protocol was developed by VYV Corporation with input from MA Lighting International GmbH, as a means for VYV's Photon server to communicate the position of uniquely identified points in space to MA Lighting systems. Its intent is to provide a means for tracking systems to share tracking data with other show systems through an open, common and royalty-free protocol.

Communication is achieved using **UDP** for efficient and simultaneous access from multiple systems.

The PosiStageNet sends tracking information as calculated by a positioning system; it defines 2 types of packets to transmit tracking information, the **PSN_binary_data** packet and the **PSN_info** packet. **PSN_binary_data** packets are transmitted when the tracking server is active. The default transmission rate is **60Hz**, however this parameter can be modified on the tracking server and transmission could go as fast as the tracking hardware supports it (**250Hz** at the time of this writing). The **PSN_info** packet is transmitted at a slower rate as it is not supposed to change as often as positioning information. The default rate of **1Hz** is used for **PSN_info** packets.

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The PosiStageNet can also receive **PSN_config** packets in order for it to later send **PSN_binary_data** packets that are expressed in a custom coordinate system. It will reply to such packets with a **PSN_config_ACK** packet to confirm their reception.

The PosiStageNet protocol is transmitted as **UDP multicast** at address **236.10.10.10** over the port **56565**. These are the defaults parameters and can be modified on the tracking server.

A **PSN_info** packet contains a list of names and ID of the active trackers configured in the system. The packets are written using a simple XML like syntax. It always starts with **<PSN>** and finishes with **</PSN>**

A **PSN_binary_data** packet contains a world ID followed by a series of positioning and ID data from multiple 3D positions. The packet is written as a binary stream. It always starts with **0x6754** and finishes with **0x4576**.

A **PSN_config** packet contains a world ID, followed by a series of positioning and ID data from multiple 3D positions (at least 3 positions should be supplied). The world ID is chosen by the author of the packet and should be unique; it is then used to identify which world coordinates are transmitted in. ID 0 should not be used as it is reserved to indicate a **PSN_binary_data** packet that is expressed in the PosiStageNet native space. A **PSN_config_ACK** packet is sent by the PosiStageNet to acknowledge the reception of a **PSN_config** packet.

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PSN_info packet contained information

<PSN> ... </PSN>

- Packet Counter

<c> [counter] </c>

A string representation of a 32-bit unsigned int counter that is incremented for each sent packet. This information help ensuring we do not treat old information in the case that UDP packets are swapped.

Note: Make sure to handle the wrap around case.

- PosiStageNet High Version

<vh> [version] </vh>

A string representation of a 8-bit unsigned int defining the high version number of the Protocol.

- PosiStageNet Low Version

<vl> [version] </vl>

A string representation of a 8-bit unsigned int defining the low version number of the Protocol.

- Trackers name information

<tracker_list> [num_trackers] <t> [ID] [name] </t> </tracker_list>

Contains the name information of all expected identified trackers.

[num_trackers]

A string representation of a 32-bit unsigned int representing the number of trackers to be expected in this packet.

<t> [ID] [name] </t>

Contains the information related to a tracker. The space character is used to separate each token.

[ID]

A string representation of a 16-bit unsigned int containing the ID of the tracker.

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[name]

An array of characters containing the name of the tracker. The name can contain spaces but cannot contain the following characters: '<', '>' or '/'.

- PSN_info packet example

```
<PSN> <c> 155 </c> <vh> 1 </vh> <vl> 6 </vl> <tracker_list> 3 <t> 127 my_tracking_marker
</t> <t> 121 Performer on stage </t> <t> 343 moving_props_1 </t> </tracker_list> </PSN>
```

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PSN_binary_data packet contained information

0x6754 [UINT32, packet counter] [UINT8, protocol high version] [UINT8, protocol low version] [UINT16, world ID] [UINT16, num trackers] [UINT8, frame ID] [UINT8, frame packet count] [UINT8, frame packet index] [3 bytes reserved] [tracker stream data]
0x4576

Packet is limited to 1500 bytes

=> Start and end tokens use 2 bytes each

=> Header is 16 bytes long

*=> Each tracker uses 32 bytes **so the maximum number of trackers per packet is limited to 46.***

=> $2 + 16 + 32 \times 46 + 2 = 1492$ bytes

- Packet Counter

[UINT32, packet counter]

A 32-bit unsigned int counter that is incremented for each sent packet. This information help ensuring we do not treat old information in the case that UDP packets are swapped.

Note: Make sure to handle the wrap around case.

- PosiStageNet High Version

[UINT8, high version]

An 8-bit unsigned int defining the high version number of the Protocol. This parameter insures that all systems using the same high version number are compatible with the sent binary packet.

- PosiStageNet Low Version

[UINT8, low version]

An 8-bit unsigned int defining the low version number of the Protocol.

- World ID

[UINT16, world ID]

A 16-bit unsigned int defining the world the coordinates are expressed in.

- Num trackers

[UINT16, num_trackers]

A 16-bit unsigned int representing the number of trackers to be expected in this packet.

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- Frame ID

[UINT8, frame ID]

An 8-bit unsigned int defining the current frame ID. A frame is a short period of time in which we analyze active trackers and give them a position and a velocity. As the maximum number of trackers per packet is 46, it may happen that we need to split the information of one frame into multiple packets. The frame ID is then used to merge back the information on the client side.

- Frame packet count

[UINT8, frame packet count]

An 8-bit unsigned int defining how many packets are to be expected for the current frame ID.

- Frame packet index

[UINT8, frame packet index]

An 8-bit unsigned int representing the current packet index for the current frame ID. For example, if the frame ID is 13, the frame packet count is 3 and the frame packet index is 2, it means that the current frame was split into three packets and that we are currently receiving the second packet.

Note: On the client side, a temporary list should be used to buffer all the trackers corresponding to a unique frame ID until it received all the packets for this frame.

- Reserved bytes

[3 bytes reserved]

Reserved for future use.

- Tracker Stream Data

[UINT16, ID][UINT16, state][UINT32, reserved][FLOAT32, pos_x][FLOAT32, pos_y][FLOAT32, pos_z][FLOAT32, vel_x][FLOAT32, vel_y][FLOAT32, vel_z]

Contains information for uniquely identified trackers along with their ID, state, 3D position, and 3D velocity.

[UINT16, ID]

A 16-bit unsigned int containing the ID of the tracker. ID is a unique number identifying the tracker.

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[UINT16, state]

A 16-bit unsigned int containing state information for future use.

[UINT32, reserved]

A 32-bit unsigned int reserved for future use.

[FLOAT32, pos_x][FLOAT32, pos_y][FLOAT32, pos_z]

3x 32-bit float representing the Euclidean Coordinates of the tracker current position. Positive x is right, positive y is up and Positive z is depth. Position is expressed in meters (m).

[FLOAT32, vel_x][FLOAT32, vel_y][FLOAT32, vel_z]

3x 32-bit float representing the tracker current velocity. Velocity is expressed in meters per second (m/s).

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PSN_config packet contained information

`<PSN_config> ... </PSN_config>`

- Packet Counter

`<c> [counter] </c>`

A string representation of 32-bit unsigned int counter that is incremented for each sent packet. This information help ensuring we do not treat old information in the case that UDP packets are swapped.

Note: Make sure to handle the wrap around case.

- PosiStageNet High Version

`<vh> [high version] </vh>`

A string representation of an 8-bit unsigned int defining the high version number of the Protocol.

- PosiStageNet Low Version

`<vl> [low version] </vl>`

A string representation of an 8-bit unsigned int defining the low version number of the Protocol.

- World ID

`<i> [world ID] </i>`

A string representation of a 16-bit unsigned int defining the world ID that coordinates are expressed in. This ID is chosen by the listener of PosiStageNet data and should be unique to this listener. ID 0 should not be used as it is reserved to indicate a **PSN_binary_data** packet that is expressed in the PosiStageNet native space.

- Trackers position information

`<tracker_plist> [num_trackers] <tp> [ID] [pos_x] [pos_y] [pos_z]</tp> </tracker_plist>`

Contains the ID and position of **at least three** identified trackers. The position is expressed in the world coordinates of the PosiStageNet client and is then used by the PosiStageNet server to translate coordinates from its coordinate system to the client's coordinate system.

`[num_trackers]`

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|---|---|--|---|

A string representation of a 32-bit unsigned int representing the number of trackers to be expected in this packet.

`<tp> [ID] [pos_x] [pos_y] [pos_z]</tp>`

Contains the information related to a tracker. The space character is used to separate each token.

`[ID]`

A string representation of a 16-bit unsigned int containing the ID of the tracker.

`[pos_x] [pos_y] [pos_z]`

3x string representations of a 32-bit float representing the position of the tracker expressed in the world coordinates of the PosiStageNet client. Position must be expressed in meters (m).

- PSN_config packet example

```
<PSN_config> <c> 155 </c> <vh>1</vh> <vl>6</vl> <i> 3 </i> <tracker_plist> 3 <tp> 127 2.467
1.324 0.456 </tp> <tp> 121 1.23 2.3732 3.2323 </tp> <tp> 343 2.543 4.323 0.342 </tp>
</tracker_plist> </PSN_config>
```

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PSN_config_ACK packet contained information

<PSN_config_ACK>...<PSN_config_ACK>

- Packet Counter

<c> [counter] </c>

The same string representation of a 32-bit unsigned int counter that was included in the PSN_config packet that this packet is meant to acknowledge.

- Return Code

<rc> [return code] </rc>

A string representation of a 16-bit unsigned int return code indicating any issue that may have been detected with the PSN_config packet that this PSN_config_ACK packet is acknowledging. Any non-zero return code indicates an error and indicates that the PosiStageNet has discarded and ignored the PSN_config packet.

| Return code | Meaning |
|-------------|---|
| 0 | OK |
| 1 | Invalid world ID (will be returned if author is requesting world ID 0, which is reserved). |
| 2 | Insufficient number of trackers. At least 3 tracker positions must be supplied. |
| 3 | Invalid point set. This may occur if no transformation matrix can be found. Reasons why a transformation could not be found include: <ul style="list-style-type: none"> - The required scale would be non-uniform; - The points supplied are co-linear. |
| 4 | The packet format is not valid. |
| 5 | The packet counter is not valid. |
| 6 | Protocol version mismatch. |
| 7 | An unknown error occurred. |

- PSN_config_ACK packet example

<PSN_config_ACK> <c> 155 </c> <rc> 0 </rc> </PSN_config_ACK>