Visualizer User Guide for 3D Demo

First, nodes are placed in their various locations. The home node (Node ID 255) is connected to the CPU using the RS232 cable. The home node is then turned on. The reset on the home node is pressed and the test bed executable entitled "Visualizer.exe" is run. When the visualizer screen is displayed, the reset button on the home node is then released after about 10 seconds. The home node appears on the screen. Now, the floating nodes will be turned on. Some nodes may not pop on the visualizer screen. We bring all the nodes on the screen using combination of keyboard keys and the mouse; please go through the visualizer user guide following the link "Visualizer_User_Guide" for detail information before running the demo.

The events and commands themselves are encoded as strings. The strings begin with a character indicating the event type (using uppercase letters) or command type (using lowercase letters). There may be one or more pieces of data following this indicator, giving data specific to that event or command. The example of the format is showed below. The information on different fields will be provided in the following sections.

Example:

P,135,1,1,8672
L,255,135,0.0392157,11141
S,102,2458280000,104,88,245828
B,102,2461570000,88,246157
D,104,176,3.13E+09,246157

Network Generated Events

This section lists the events that can be generated by the network, along with their formats. After each event name, the function used by the hardware code to generate the event is given.

B – Packet Delivery (Begin) `[app_send_B_pkt]`

1 byte	1 byte	4 bytes	1 byte
B	Source	Timestamp	Type

When a packet is delivered to its destination, the visualizer is notified of the sender and the time the packet was sent using this event. Subsequent hops and the destination are given by the **H** and **D** events, respectively.

- `Source` (address) – the address of the source of the packet
- `Timestamp` (int) – the time at which the source sent the packet
- `Type` (int) – an integer representing the type of packet the event pertains to. This corresponds to a bit string 00RRGGBB, where RR, GG, and BB are 2-bit values for red, green, and blue, respectively, specifying the color with which the packet should be displayed by the visualizer.

H – Packet Hop `[app_send_H_pkt]`

1 byte	1 byte	1 byte

```
┌─────────────────────────┐
│  H      Addr  Δt         │
└─────────────────────────┘
```

This event indicates a single hop that a packet took on its way to the destination, along with the time at which it was rebroadcasted.

- `Addr` (address) – the address of the hopping point
- `Δt` (integer byte) – the offset between the time the packet was sent and the time it was rebroadcasted by this hop

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D – Packet Delivery [`app_send_D_pkt`]

1 byte	1 byte	1 byte	4 bytes
D	Dest	Δt	Data

This event indicates delivery of a packet to its ultimate destination, the time at which the packet was delivered, and the data contained in the packet.

- `Dest` (address) – address of the packet's destination
- `Δt` (integer byte) - the offset between the time the packet was sent and the time it was received by this destination
- `Data` (float) – the data contained in the received packet, or NaN if the data is unavailable or irrelevant.

S – Sent Packet [`app_send_S_pkt`]

1 byte	1 byte	4 bytes	1 byte	1 byte
S	Source	Timestamp	Dest	Type

This event indicates that a node sent a packet toward a destination. The event is always sent when a data packet is sent toward a destination.

- `Source` (byte) – the address of the source node
- `Timestamp` (int) – the time at which the packet was sent
- `Dest` (byte) – the address of the packet's destination
- `Type` (int) – an integer representing the type of packet the event pertains to. This corresponds to a bit string 00RRGGBB, where RR, GG, and BB are 2-bit values for red, green, and blue, respectively, specifying the color with which the packet should be displayed by the visualizer.

T – Statistics [`app_send_T_pkt`]

1 byte	1 byte	4 bytes	20 bytes	4 bytes
T	Source	Timestamp	Description	Value

This event sends statistical information about a node to the visualization/control software.

- `Source` (byte) – the address of the source of the data
- `Timestamp` (int) – the time at which the statistic was sent
- `Description` (string) – a description of the statistical data, up to 19 characters, terminated by a NULL character (ASCII value 0).
- `Value` (float) – a numerical value for the given statistic, 4 bytes in size.

Examples of possible statistics include:

```
Packets broadcast
Packets received
Energy usage
Battery level
```

It should be straightforward to add new statistics by simply using a new description for the new statistic.

L – Specify Link and Value [`app_send_L_pkt`]

1 byte	1 byte	1 byte	4 bytes
L	Source	Dest	Value

When a link is established, this event can occur. This event also is used to periodically update the visualizer to reflect changing link values ("scores"), and is used as a confirmation when links are "ignored" or "reestablished" for the demonstration.

- `Source` (byte) – the node that established a link to another node, and also the source of this event packet
- `Dest` (byte) – the node that the source can send to via this link
- `Value` (float) – the value, or "score," currently assigned to the given link, or NaN if the link is disabled.

P – Specify Node Position [`app_send_P_pkt`]

1 byte	1 byte	4 bytes	4 bytes
P	Source	Lat	Long

This event notifies the visualizer of the position of a node and also indirectly indicates that a node joined the network.

- `Source` (byte) - the node that is specifying its position
- `Lat` (float) – the latitude coordinate of the node
- `Long` (float) – the longitude coordinate of the node

Demonstration Commands

This section lists the commands that the visualization/control software may send to the network, for instructing network nodes to perform specific test sequences. After each command name is the function used in the hardware code to perform the action requested by the command.

d – Send "Dummy" Data [`app_send_dummy_data`]

1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	4 bytes
d	Source	Dest	Size	Count	Rate	Time

This command instructs the specified source node to send data packets of the given size (with arbitrary contents) to the specified destination node.

- `Source` (address) – the node to which the command is being sent
- `Dest` (address) – the node to which the data packets are to be sent
- `Size` (integer byte) – the size of the data packets to send, in bytes
- `Count` (integer byte) – the number of packets to send
- `Rate` (integer byte) – the sending rate in packets per second
- `Time` (int) – the time at which the node should begin broadcasting

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e – Send Sensor Data [`app_send_sensor_data`]

1 byte	1 byte	1 byte	1 byte	1 byte	4 bytes
e	Source	Dest	Count	Rate	Time

This command instructs the specified source node to send data from its onboard sensor to the specified destination node.

- `Source` (byte) – the node to which the command is being sent
- `Dest` (byte) – the node to which data is to be sent
- `Count` (integer byte) – the number of times to send the data
- `Rate` (integer byte) – the sending rate in packets per second
- `Time` (int) – the time at which the node should begin broadcasting

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i – Ignore Link [`app_ignore_link`]

1 byte	1 byte	1 byte
i	NodeA	NodeB

This command instructs the given Node A to ignore the link it has with the given Node B.

- `NodeA` (address) – the node that is to ignore a link
- `NodeB` (address) – the node with which Node A has the link that it is to ignore

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r – Reestablish Link [`app_reestablish_link`]

1 byte	1 byte	1 byte
r	NodeA	NodeB

This command instructs the given Node A to stop ignoring the link it has with the given Node B.

- `NodeA` (address) – the node that is to stop ignoring a link

- `NodeB` (address) – the node with which Node A has the link that it is to reestablish