APPENDIX II – CHANGES FROM CIGI 2

General Changes

1. Big-endian byte ordering is no longer enforced. The sender now packages data in its native byte format, and the receiver byte-swaps if necessary. This distributes the overhead of byte-swapping between the two devices and eliminates unnecessary processing when both the IG and the Host use little-endian byte ordering.

2. All packets are double word-aligned for reasons relating to performance.

3. The packet opcodes have been reassigned to match their subsection numbers in this document. For example, The **Rate Control** packet's opcode is now 6, which corresponds to Section 4.1.6. The **Line of Sight Response** packet's opcode is 106, which corresponds to Section 4.2.6.

4. All identifying parameters have been contained within the first two words of each packet. These parameters are those that, when combined, uniquely identify an entity, component, articulated part, view, or other object. This allows for fast searches through a CIGI message buffer for a particular packet.

5. All bit fields have been shifted to fill the low-order bits within a byte first.

6. All fixed-point data have been changed to floating-point data.

7. A set of guidelines has been created to facilitate forward- and backward-compatibility between CIGI 3 and future versions of the interface.

8. Support has been added for orthographic views.

9. Increased the number of allowable views and view groups.

10. The number of motion-tracked input devices has been increased from one (1) to 256. All related data have been moved into a new **Motion Tracker Control** packet.

11. The **Environment Control** packet has been removed. The parameters in this packet have been divided among the **Celestial Sphere Control** and **Atmosphere Control** packets.

12. Special Effects have been renamed "Animations" to imply more generality in their use.

13. The **Special Effect Definition** packet has been removed. The *Animation Direction* parameter (formerly *Sequence Direction*) has been moved to the **Entity Control** packet. All other animation-specific properties can be set via the **Component Control** or **Short Component Control** packet.

14. Support has been added for custom Earth Reference Models. These may be defined by the **Earth Reference Model Definition** packet. The *Earth Reference Model* parameter has been added to the **Start of Frame** packet to indicate whether the IG is using WGS 84 or a Host-defined ERM.

15. The **Height Above Terrain Request** and **Height of Terrain Request** packets have been combined into the **HAT/HOT Request** packet. The respective response packets have been combined into the **HAT/HOT Response** packet.

16. Alternate HAT/HOT and LOS response packets have been added, and the existing response packets have been shortened. These changes allow for short responses containing basic information, thereby reducing bandwidth requirements, or for more verbose responses when necessary. The new packets are the **HAT/HOT Extended Response** and **Line of Sight Extended Response**.

17. Support has been added for spherical collision detection volumes.

18. Support has been added for querying the IG of positional and environmental state data. The Host may query the IG for the position of a given entity, articulated part, view, or motion tracker. The Host may also request the weather conditions, aerosol concentration, or ground or sea surface conditions at a given point.

19. Support has been added for environmental regions. These may be defined and manipulated with the **Environmental Region Control** packet. This allows for regional weather layers and surface conditions.

20. Support has been added for global, regional, and entity-assigned surface conditions. The **Maritime Surface Conditions Control** packet is used to specify deep- and shallow-regime sea surface conditions. The **Terrestrial Surface Conditions Control** packet is used to specify ground surface condition attributes.

21. Support for multiple aerosols has been added. Each weather layer ID is associated with an aerosol type.

22. The **Animation Stop Notification** packet has been added to indicate to the Host when an animation has completed its playback sequence.

23. The range of opcodes reserved for user-defined packets has been changed to 201 – 255.

24. Various packet and parameter names have been renamed for consistency and/or clarity.

IG Control

1. The value of *CIGI Version* has been changed to 3.

2. The *IG Mode* parameter has been moved within the packet.

3. A “magic number” called *Byte Swap* has been added. This parameter will allow the receiving device to detect when byte-swapping is necessary.

4. The range of the *Database Number* parameter has been increased to 0 – 127.

5. The data type of the *Timestamp* parameter (formerly *Timing Value*) has been changed from that of single-precision float to unsigned 32-bit integer. The unit of this parameter has been changed from 1µs to 10µs. A *Timestamp Valid* flag has also been added.

6. The *Tracking Device Enable* and *Tracking Device Boresight* parameters have been moved to the **Motion Tracker Control** packet.

Entity Control

1. The bit fields have been rearranged.

2. The *Entity State* enumerated values have been renamed for clarity. Their functions remain the same.

3. The *Animation State* (formerly *Effect Animation State*) enumerated values have been changed for ease of use. The new values fit the standard “tape player” analogy.

4. The *Animation Direction* and *Animation Loop Mode* parameters have been added.

5. The *Ground/Ocean Clamp* parameter has been added.

6. *Percent Opacity* has been replaced with *Alpha*. The *Inherit Alpha* parameter has been added to provide more control over how child entities behave when their parent’s alpha is changed.

7. The *Internal Temperature* parameter has been removed to reduce the size of the **Entity Control** packet. This parameter was primarily used in sensor applications. The use of this parameter was loosely defined in CIGI 2, since the skin temperature of an entity can vary significantly over the body of an entity. All

temperature components must now be specified with a **Component Control** or **Short Component Control** packet.

8. The *Ground/Ocean Clamp* parameter has been added.
9. The *Heading* parameter has been renamed to *Yaw*.
10. The order of the *Latitude/X Offset*, *Longitude/Y Offset*, and *Altitude/Z Offset* parameters has been changed for consistency.
11. The most- and least-significant words of the *Latitude/X Offset*, *Longitude/Y Offset*, and *Altitude/Z Offset* parameters are no longer specified.

Conformal Clamped Entity Control

This packet has been added to provide a short version of the **Entity Control** packet for conformal ground- or ocean-clamped entities.

Component Control

1. The opcode has been changed to 4.
2. The *Instance ID*, *Component ID*, and *Component Class* parameters have been rearranged to fit into the first 64 bits of the packet. This allows a component to be uniquely identified by the first two words.
3. The *Component Class* parameter has been shortened to accommodate the preceding change. The enumerated values of this parameter have also been changed.
4. The *Component Value* parameter has been shortened to allow it to fit into a portion of the previously unused space of the packet. The range of this value has been shortened; however, one of the user-defined data fields may be used when a larger range is needed.
5. The *Component Data 1* and *Component Data 2* parameters have been changed from single-precision floating-point data to 32-bit, user-defined data.
6. The *Component Data 3* and *Component Data 4* parameters have been added. These parameters are of user-defined format.

Short Component Control

This packet has been added to provide a short version of the **Component Control** packet for components that do not require four user-defined data fields.

Articulated Part Control

1. The opcode has been changed to 6.
2. The bit fields have been moved within the packet to fill low-order bits first.
3. The *Articulated Part ID* parameter has been changed from a signed 8-bit integer to an unsigned 8-bit integer.

Short Articulated Part Control

This packet has been added to provide a short version of the **Articulated Part Control** packet for articulations that require manipulation of no more than two degrees of freedom. This packet can also be used to articulate two different articulate parts, each in one degree of freedom.

Rate Control

1. The opcode has been changed to 8.
2. The *Articulated Part ID* parameter has been changed from a signed 8-bit integer to an unsigned 8-bit integer.
3. The *Apply to Articulated Part* flag has been added.

Environment Control

This packet has been deleted. The data within this packet have been moved to the **Celestial Sphere Control** and **Atmosphere Control** packets.

Celestial Sphere Control

1. This packet has been added to allow the separation of date/time and sky model properties from atmospheric properties. The *Hour*, *Minute*, *Date*, and *Ephemeris Model Enable* parameters have been moved from the CIGI 2 **Environment Control** packet.
2. The *Date/Time Valid* parameter has been added to allow attributes to be set without disrupting the IG's ephemeris model.
3. The *Sun Enable*, *Moon Enable*, *Star Field Enable*, and *Star Field Intensity* parameters have been added.

Atmosphere Control

1. This packet has been added to allow the separation of date/time and sky model properties from atmospheric properties. All parameters relating to atmospherics and weather have been moved from the CIGI 2 **Environment Control** packet.
2. The *MODTRAN Enable* parameter has been renamed to *Atmospheric Model Enable* to make its use more general.
3. The *Wind Speed* parameter in the CIGI 2 **Environmental Control** packet has been replaced with the *Global Horizontal Wind Speed* and *Global Vertical Wind Speed* parameters to allow for three-dimensional wind vectors.
4. The *Aerosol* parameter has been removed. CIGI 2 defined this parameter as the concentration of water suspended in the atmosphere. This is redundant, given the *Global Humidity* parameter. It also limits the types of aerosol that can be created.

Environmental Region Control

This packet has been added to allow the definition and/or control of regional weather and surface conditions.

Weather Control

1. The opcode has been changed to 12.
2. The bit fields have been moved within the packet to fill low-order bits first.
3. The *Entity ID* parameter has been changed to *Entity/Region ID* to allow weather layers to be assigned to environmental regions.
4. The *Phenomenon Type* parameter has been renamed to *Layer ID* to better describe its intended use. The enumerated values for this parameter have been slightly changed, and additional values have been added. This parameter has also been shortened to accommodate additional bit fields.
5. The *Cloud Type* parameter has been added.

6. The *Scope* parameter has been added to distinguish between global, regional, and entity-assigned weather.
7. The *Random Lightning Enable* parameter has been added.
8. The *Opacity/Runway Visibility Range* parameter has been replaced with *Visibility Range*. Visibility is now specified as a range through all weather, not just ground fog layers.
9. The *Elevation* parameter has been renamed to *Base Elevation*.
10. The *Winds Aloft Speed* parameter has been replaced with the *Horizontal Wind Direction* and *Vertical Wind Speed* parameters to allow for three-dimensional wind vectors.
11. The *Humidity*, *Barometric Pressure*, and *Aerosol Concentration* parameters have been added to allow these properties to vary from layer to layer or entity to entity.

Maritime Surface Conditions Control

This packet has been added to support sea surface conditions.

Wave Control

This packet has been added to support the definition and control of multiple waveforms.

Terrestrial Surface Conditions Control

This packet has been added to support ground surface conditions.

View Control

1. The opcode has been changed to 16.
2. The *View ID*, *Group ID*, and *Entity ID* parameters have been rearranged.
3. The range of the *View ID* parameter has been increased to 0 – 65,535.
4. The range of the *View Group* parameter has been increased to 1 – 255.
5. The bit field parameters have been rearranged to accommodate the enlarged *View ID* and *View Group* parameters.

Sensor Control

1. The opcode has been changed to 17.
2. The range of the *View ID* parameter has been increased to 0 – 65,535.
3. The range of the *View Group* parameter has been increased to 1 – 255.
4. The bit field parameters have been rearranged to accommodate the enlarged *View ID* and *View Group* parameters.
5. The *Response Type* parameter has been added to allow the Host to indicate whether it needs a **Sensor Response** or **Sensor Extended Response** packet from the IG.
6. The *AC Coupling* parameter's unit has been changed to μs, and its range has been extended.

Motion Tracker Control

This packet has been added to enable control of multiple tracked input devices.

Earth Reference Model Definition

This packet has been added to enable the Host to specify an ERM other than WGS 84.

Trajectory Definition

1. The opcode has been changed to 20.
2. The *Acceleration Factor* parameter has been replaced with *Acceleration Azimuth*, *Acceleration Elevation*, and *Acceleration Magnitude*. This will allow the Host to define acceleration as a 3D vector.

Special Effect Definition

This packet has been removed. Animation-specific properties may be set via **Component Control** or **Short Component Control** packets.

View Definition

1. The opcode has been changed to 21.
2. The range of the *View ID* parameter has been increased to 0 – 65,535.
3. The range of the *View Group* parameter has been increased to 1 – 255.
4. The bit field parameters have been rearranged to accommodate the enlarged *View ID* and *View Group* parameters.
5. The *Projection Type* parameter has been added to allow for support of orthographic views.
6. The *Tracker Assign* parameter has been removed. Assignment of motion trackers to views is now done via the **Motion Tracker Control** packet.

Collision Detection Segment Definition

1. The opcode has been changed to 22.
2. The *Segment ID* parameter has been changed to an unsigned 8-bit integer.
3. The *Segment Enable* parameter has been moved within the packet.
4. All fixed-point data have been changed to single-precision floating-point data.
5. The *Collision Mask* parameter has been renamed to *Material Mask* for clarity.
6. Padding has been added to the packet to enforce 8-byte alignment.

Collision Detection Volume Definition

1. The opcode has been changed to 23.
2. The *Volume ID* parameter has been changed to an unsigned 8-bit integer.
3. The *Volume Enable* parameter has been moved within the packet.
4. All fixed-point data have been changed to single-precision floating-point data.
5. The *Volume Type* parameter has been added to allow for both cuboid and spherical volumes.
6. The *Height* parameter has been renamed to *Height/Radius* to indicate its use for cuboid volumes.
7. Padding has been added to the packet to enforce 8-byte alignment.

Height Above Terrain Request

This packet has been combined with the **Height of Terrain Request** packet to form the **HAT/HOT Request** packet.

Height of Terrain Request

This packet has been combined with the **Height Above Terrain Request** packet to form the **HAT/HOT Request** packet.

HAT/HOT Request

1. A *Request Type* parameter has been added to allow the Host to request either a HAT, HOT, or combined extended response from the IG.
2. The most- and least-significant words of the *Latitude*, *Longitude*, and *Altitude* parameters are no longer specified.
3. The *Latitude*, *Longitude*, and *Altitude* parameters have been rearranged for consistency.

Line of Sight Segment Request

1. This packet has been renamed from “Line of Sight Occult Request.”
2. The opcode has been changed to 25.
3. A *Request Type* parameter has been added to allow the Host to request either a basic or extended response from the IG.
4. The *Material Mask* parameter has been added.
5. The *Alpha Threshold* parameter has been added.
6. Padding has been added to the packet to enforce 8-byte alignment.
7. The most- and least-significant words of the *Source Latitude*, *Source Longitude*, *Source Altitude*, *Destination Latitude*, *Destination Longitude*, and *Destination Altitude* parameters are no longer specified.
8. The *Source Latitude*, *Source Longitude*, *Source Altitude*, *Destination Latitude*, *Destination Longitude*, and *Destination Altitude* parameters have been rearranged for consistency.

Line of Sight Vector Request

1. This packet has been renamed from “Line of Sight Range Request.”
2. The opcode has been changed to 26.
3. A *Request Type* parameter has been added to allow the Host to request either a basic or extended response from the IG.
4. The *Material Mask* parameter has been added.
5. The *Alpha Threshold* parameter has been added.
6. Padding has been added to the packet to enforce 8-byte alignment.
7. The most- and least-significant words of the *Source Latitude*, *Source Longitude*, and *Source Altitude* parameters are no longer specified.

Position Request

This packet has been added to enable the Host to query the IG for the position of a given entity, articulated part, view, or motion tracker.

Environmental Conditions Request

This packet has been added to enable the Host to query the IG for weather conditions, aerosol concentrations, or ground or sea surface conditions at a given point.

Start of Frame

1. The value of *CIGI Version* has been changed to 3.
2. The *IG Mode* parameter has been moved to the low-order bit of the byte.
3. The value zero (0) is no longer valid for the *Database Number* parameter. This fixes an inconsistency in prior versions of CIGI.
4. A “magic number” called *Byte Swap* has been added. This parameter will allow the receiving device to detect when byte-swapping is necessary.
5. An *Earth Reference Model* parameter has been added to indicate whether the IG is using WGS 84 or a Host-defined ERM.
6. The data type of the *Timestamp* parameter (formerly *Timing Value*) has been changed from that of single-precision float to unsigned 32-bit integer. The unit of this parameter has been changed from 1µs to 10µs. A *Timestamp Valid* flag has also been added.

Height Above Terrain Response

This packet has been combined with the **Height of Terrain Response** packet to form the **HAT/HOT Response** packet.

Height of Terrain Response

This packet has been combined with the **Height Above Terrain Response** packet to form the **HAT/HOT Response** packet.

HAT/HOT Response

1. The *Material Code* parameter has been moved to the **HAT/HOT Extended Response** packet.
2. The *Valid* field has been moved to the low-order bit of the byte.
3. The most- and least-significant words of the *Height* parameter (formerly *Altitude*) are no longer specified.

HAT/HOT Extended Response

This packet has been added to provide extended HAT and HOT data.

Line of Sight Response

1. The opcode has been changed to 104.
2. The *Latitude*, *Longitude*, *Altitude*, and *Material Code* parameters have been moved to the **Line of Sight Extended Response** packet.
3. The *Occult Response* parameter has been changed to *Visible*.

4. The *Entity ID* and *Entity ID* Valid parameters have been added.
5. The bit fields have been moved within the packet to fill low-order bits first.

Line of Sight Extended Response

This packet has been added to provide extended LOS data.

Sensor Response

1. The opcode has been changed to 106.
2. The *View ID* parameter has been changed to an unsigned 16-bit integer.
3. The *Sensor ID* parameter has been changed to an unsigned 8-bit integer.
4. The *Sensor Status* parameters have been moved within the packet.
5. The *Target X Offset* and *Target Y Offset* parameters have been renamed to *Gate X Position* and *Gate Y Position*, respectively. Both parameters have been changed from fixed-point data to single-precision floating-point data.
6. The *Frame Counter* parameter has been added to allow the Host to calculate sensor sampling rate and latency.

Collision Detection Segment Notification

1. This packet has been renamed from “Collision Detection Segment Response.”
2. The opcode has been changed to 113.
3. The *Segment ID* parameter has been changed to an unsigned 8-bit integer.
4. The *Collision Type* parameter (formerly *Entity/Non-Entity Contact*) has been moved to accommodate the enlarged *Segment ID* parameter.
5. The *Collision Point X*, *Collision Point Y*, and *Collision Point Z* parameters have been replaced with the *Intersection Distance* parameter, which defines the intersection point by specifying a distance along the collision segment.

Collision Detection Volume Notification

1. This packet has been renamed from “Collision Detection Volume Response.”
2. The opcode has been changed to 114.
3. The *Volume ID* parameter has been changed to an unsigned 8-bit integer.
4. The *Collision Type* parameter (formerly *Entity/Non-Entity Contact*) has been moved to accommodate the enlarged *Volume ID* parameter.
5. The *Contacted Volume ID* parameter has been added.

Sensor Extended Response

This packet has been added to provide extended sensor response data.

Weather Conditions Response

This packet has been added to provide the weather conditions at a given point.

Aerosol Concentration Response

This packet has been added to provide the concentration of a single aerosol at a given point.

Maritime Surface Conditions Response

This packet has been added to provide the sea surface conditions at a given location.

Terrestrial Surface Conditions Response

This packet has been added to indicate the presence of a single terrestrial surface condition attribute at a given point.

Animation Stop Notification

This packet has been added to allow the IG to notify the Host when an animation has completed its animation sequence.

Event Notification

This packet has been added to allow the IG to notify the Host when an event occurs.

Image Generator Message

The maximum packet length for this packet has been established as 104 bytes to minimize bandwidth and to ease implementation.