**Definitions**

**Entity**: One or more bytes of data that can be accessed. The meaning of the data is application dependent. An entity will typically include items that are grouped together when they must be accessed simultaneously in order to ensure that the integrity and coherence of the items are maintained during read and write operations. How items are grouped into entities is application dependent. Note that since entities will be passed over the GEA2 bus, the total length of an entity must fit within a GEA2 packet.

The purpose of an entity is to allow arbitrary data to be transmitted or transferred between two endpoints without any intermediate transferring agents having to know the structure of the contained data. Only the endpoints need to know how to interpret the data contained within an entity.

In the abstract, an entity is essentially an intermediate storage agent. It does not have to know about the structure of the data stored within the entity. It only needs to know how to reference the entity and its length.

**Entity Reference Designator (ERD)**: The entity reference designator (ERD) is a 16-bit number used to reference an element. This number is used when reading and writing entities. ERD’s will be unique across appliance product lines. If ERD’s are reused across product lines, they will have the identical function.

**Actor:** An actor is a board, device, or program that is communicating with another board, device, or program.

**End Point**: An end point is an actor that is either serving as the source of an ERD or interested in accessing an ERD

**Subscription**: A subscription is a request to be notified when an ERD value changes. Not all available ERD’s support subscription. Whether an ERD supports subscriptions is appliance-dependent. Subscriptions are meant to support binary values or values that have a limited number of logical states. Subscriptions are not meant to support values which are of an analog nature, such as temperature.

**Timed Subscription**: A time subscription is an ERD value that is sent periodically whether the value has changed or not. Timed subscriptions can be used to send ERD’s of any type, even those that are of an analog nature. The time interval is specified in minutes.

**Subscription List Aging**: If no response is received from the subscribing end point when an ERD is published after 10 attempts, the subscriptions for the non-replying end point are removed.

**Rules:**

1. Entities must be small enough to fit within a GEA packet.
2. Entities can be padded as needed by the application in order to accommodate byte alignment constraints. Padding is implementation specific and needs to be agreed upon by the endpoints.
3. Endpoints must know how to interpret the data contained within the entity.
4. The endpoints must store data in the entity in big-endian byte order. This makes reading and writing entities independent of the endian-ness of the endpoints. It is up to the endpoints to disassemble and reassemble the data appropriately.

**Example**

As an example, consider the following. Assume that there are two parameters determining the operation of a motor, speed and direction. Assume that speed is a 16-bit number and that direction is a byte. Assume these two items must always be accessed together. A pseudocode struct could be created to hold the parameters:

struct {U16 u16Speed; U8 u8Direction};

The endpoints must know this underlying structure. Since these two items must be read and written simultaneously, as required by the application, they constitute a single entity. The entity would have an ERD assigned to it and would be at least 3 bytes long plus any padding bytes.

**Reserved ERD’s**

The following ERD’s are reserved for the purposes indicated. All ERD’s are listed in hex.

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| ERD | Use/Meaning |
| FFFF | All ERD’s. Used to unsubscribe to all ERD’s |

### Entity Read Query/Response (TBD)

This command takes the form of a query and a response.

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| **Entity Read Query Query** | | |
| Message ID | 0xF0 | |
| Description | This message will request one or more entities from the recipient. The data field contains a list of ERD’s to be returned by the recipient. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Response | Yes | |
| Packet Data Size | 3 + 2n, where n is the number of entities to be read and must be > 0. | |
| Data Field | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to be read |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 1 |
| Byte x | MSB of ERD n |
| Byte y | LSB of ERD n |

The rows shaded in gray are repeated for the remaining requested ERDs.

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| **Entity Read Query Response** | | |
| Message ID | 0xF0 | |
| Description | This message is the response to an Entity Read query | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + the entity data | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities returned |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 2 |
| Byte 6 | Size of entity in bytes |
| Byte 7 | MSB of entity 1 |
| Byte k | LSB of entity 1 |
| Byte z | MSB of ERD z |
| Byte z+1 | LSB of ERD z |
| Byte z+3 | Size of entity in bytes |
| Byte z+3 | MSB of entity z |
| Byte z+n | LSB of entity z |

The rows shaded in gray are repeated for the remaining requested ERDs.

### Entity Write Command/Response (TBD)

This command takes the form of a command and a response.

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| **Entity Write Command** | | |
| Message ID | 0xF1 | |
| Description | This message cause the entities included in the data payload to be written to the receiving actor. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + the entity data | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to write |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 2 |
| Byte 6 | Size of entity in bytes |
| Byte 7 | MSB of entity 1 |
| Byte k | LSB of entity 1 |
| Byte z | MSB of ERD z |
| Byte z+1 | LSB of ERD z |
| Byte z+3 | Size of entity in bytes |
| Byte z+3 | MSB of entity z |
| Byte z+n | LSB of entity z |

The rows shaded in gray are repeated for the remaining requested ERDs.

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| **Entity Write Response** | | |
| Message ID | 0xF1 | |
| Description | This message returns the number of entities written and each ERD that was written. If the number of entities written does not match the number of entities included in the write command, some error occurred that caused one or more entities to not be written. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities actually written |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 1 |
| Byte x | MSB of ERD n |
| Byte y | LSB of ERD n |

### Entity Subscribe Request/Response (TBD)

This command takes the form of a request and a response.

Assumptions:

1. The entities to which you can subscribe are implementation defined and may be a subset of the entities available to be read and written.
2. No analog entity can be subscribed to. (All analog entities must be periodically read by the endpoint.)
3. Notifications occur when a change in the entity value occurs.
4. Timed notifications are not supported. Time-based notification (polling) must be handled by the requesting endpoint.
5. Subscription lists are not maintained through resets (power outages). It is the responsibility of the subscriber to resubscribe following a reset.
6. A successful subscription request will force a publication of the subscribed entities.

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| **Entity Subscribe Request** | | |
| Message ID | 0xF2 | |
| Description | This message will request that notifications be sent when the requested entity changes value. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + 3n where n is the number of entities to be subscribed to. | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to subscribe to |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 1 |
| Byte 6 | Subscription time in minutes if > 0, 0 if not a timed subscription |
| Byte x | MSB of ERD n |
| Byte y | LSB of ERD n |
| Byte z | Subscription time in minutes if > 0, 0 if not a timed subscription |

The rows shaded in gray are repeated for the remaining requested ERDs.

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| **Entity Subscribe Response** | | |
| Message ID | 0xF2 | |
| Description | This message will responds with the number of notifications successfully subscribed to. If this number does not match the number requested, some error occurred that caused one or more entity subscription requests to fail. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities successfully subscribe to |

### Entity Subscription List Request/Response (TBD)

This command takes the form of a request and a response. The response returns the current subscription list.

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| **Entity Subscription List Request** | | |
| Message ID | 0xF3 | |
| Description | This message will be used to request a list of the ERD’s which have been subscribed to. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 2 | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command – See Message ID |

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| **Entity Subscription List Response** | | |
| Message ID | 0xF3 | |
| Description | This message will be the response containing the list of ERD’s which have been subscribed to. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + 3n where n is the number of entities to be subscribed to. | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to subscribe to |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 1 |
| Byte 6 | Subscription time in minutes if > 0, 0 if not a timed subscription |
| Byte x | MSB of ERD n |
| Byte y | LSB of ERD n |
| Byte z | Subscription time in minutes if > 0, 0 if not a timed subscription |

The rows shaded in gray are repeated for the remaining subscribed ERDs.

### Entity Unsubscribe Request/Response (TBD)

This command takes the form of a request and a response.

Notes:

1. If the reserved ERD of 0xFFFF is used, the requestor will be removed from all subscription lists. If this is used, the number of entities to unsubscribe from would be 1 and only 0xFFFF would be in the unsubscribe list.
2. If the subscriber is not currently subscribed to an ERD appearing in the ERD list, a failure shall not occur. That ERD will simply be ignored.
3. Comment: If period subscriptions are added later, this request can serve to unsubscribe from both periodic and event subscriptions.

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| **Entity Unsubscribe Request** | | |
| Message ID | 0xF4 | |
| Description | This message will cancel notifications subscribed to by the requestor for the ERD’s listed in the message. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + 2n where n is the number of entities to be unsubscribed from. | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to unsubscribe from |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 1 |
| Byte x | MSB of ERD n |
| Byte y | LSB of ERD n |

The rows shaded in gray are repeated for the remaining requested ERDs.

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| **Entity Unsubscribe Response** | | |
| Message ID | 0xF4 | |
| Description | This message as used as an application-level acknowledgement that the subscriber was removed from the subscription list of each ERD in the request. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 2 | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |

### Entity Publication Notification/Response (TBD)

This command takes the form of a request and a response.

Notes:

1. Although the notification method allows for multiple entities to be transmitted in a single notification message, the actual behavior is implementation defined. A device could send one or multiple entities per notification.
2. If no response is receive after 10 attempts to send a notification to an endpoint, the subscriptions associated with the non-responding endpoint are removed.

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| **Entity Publication Notification Command** | | |
| Message ID | 0xF5 | |
| Description | This message is sent when one or more entities appearing in the list have changed state or the subscription is a timed subscription and the timeout has expired. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 3 + the entity data | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |
| Byte 3 | Number of entities to write |
| Byte 4 | MSB of ERD 1 |
| Byte 5 | LSB of ERD 2 |
| Byte 6 | Size of entity in bytes |
| Byte 7 | MSB of entity 1 |
| Byte k | LSB of entity 1 |
| Byte z | MSB of ERD z |
| Byte z+1 | LSB of ERD z |
| Byte z+3 | Size of entity in bytes |
| Byte z+3 | MSB of entity z |
| Byte z+n | LSB of entity z |

The rows shaded in gray are repeated for the remaining requested ERDs.

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| **Entity Publication Response** | | |
| Message ID | 0xF5 | |
| Description | This message serves as an application-level acknowledgement that the publication was received. | |
| Publisher | Any device | |
| Data Received | Any device | |
| Frequency | As needed | |
| Packet Data Size | 2 | |
| Data | Byte 1 | Source (sender) address |
| Byte 2 | Command - see Message ID |