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Introduction

We are delighted to help you get up and running as quickly as possible and to support your work. This manual gives you instructions on how to install the Gateway, GW2-NA – which we abbreviate for the remainder of this manual to the “Gateway-2” – as part of your Elemental Machines Sensory Network™ and supplementary information that you or people in your organization may wish to know regarding security, specifications and certifications. But first, let’s start off with some important details about safely using your Gateway-2:

Safety Information

Batteries

WARNING: the Gateway-2 is powered by a rechargeable lithium battery pack when power from the primary power cord is not available. This battery can explode or leak and cause burns if disassembled or exposed to fire, high temperature or rapid warming from extremely cold temperature.

For this reason, it is important that the environment in which the Gateway-2 is installed does not exceed its environmental operating limits in temperature of -10 to 25 °C and in humidity of 0% to 95% RH (non-condensing).

Non-ionizing Radiation exposure

Gateway-2’s regularly communicate over Wi-Fi and Cellular networks. When transmitting, the radio modules inside the Gateway-2 work at a maximum power of 23 dBm (200 mW). This level is not recognized as hazardous, but several nations (e.g. Canada, Australia) advise not to use such a device within 20cm of your body i.e. as a personal electronic device without further precautionary testing.

This equipment has been tested and found to comply with the USA’s (FCC) limits for a Class A digital device, which are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. If not installed and used in accordance with this User Manual, the Gateway-2 may possibly cause harmful interference to other radio communications. Possible remedies for any such interference include reorienting the receiving antennae, increasing the separation between affected equipment and Gateway-2 or connecting the affected equipment into an outlet on a circuit different from that to which the Gateway-2 is connected.
Protecting the Environment

Gateway-2’s are designed with consideration for the environment and comply with relevant regulations such as the EU’s RoHS regulations and Batteries Directive, as well as the USA’s EPA initiative to ‘Reduce, Reuse, Recycle’. Gateway-2’s are provided to customers to support the service Elemental Machines provides, but they remain the property of Elemental Machines and should be returned to EM at the end of their life for reuse, recycling or disposal as appropriate. Elemental Machines relies on customers to play their role in the process of disposing of Element-T’s correctly, to help Elemental Machines in protecting the environment.

The Gateway-2 is marked with this symbol, the EU’s ‘wheeled bin’ symbol, to identify it as Electrical or Electronic Equipment that the EU requires not to be added to unsorted municipal waste when it has reached the end of its life. The correct disposal, which includes when the Battery pack has reached its maximum lifecycle use, is to return the Gateway-2 to Elemental Machines, or their agent, where:

- Lithium battery packs that have reached the end of their life should be removed from the Gateway-2 for disposal according to local regulations (EU Non-hazardous Waste code: 16 06 04).
- Gateway-2’s can have a new battery pack installed or, if have reached the end of their life, will have their batteries removed for disposal as above and then treated as Waste Electronic and Electrical Equipment (WEEE) (EU Non-hazardous Waste code 16 02 14)
Installation Guide

What follows is the process we find most streamlined for setting up the system. Many of the steps below can be done in a different order if that fits your deployment better. But remember, if you have any questions please do contact help@elementalmachines.com or your account representative.

Gateway-2 Installation Components

- Prior to receiving the devices, you will receive an email for your dashboard account verification. Save this email for when the devices arrive.
- When devices are shipped they are added to the Elemental Insights Dashboard™ with default names. When you first log in you will see all of your devices with a 'Disconnected' status.
- When you open the box you will see several pieces of equipment, pictures are included here for reference:

Gateway-2

Tilt Antennas:
Possibly Element T:

And/or possibly Element-A

Assembling the Gateway-2

Before powering on your Gateway-2, install the two cellular antennas provided. Both antennas are identical, and can be screwed clockwise into the two ports, as shown below:

Screw both antennas in until they are finger-tight.

⚠️ Do not use pliers or other tools to tighten the Cellular antennas!
Powering on the Gateway-2

To power on your **Gateway-2**, simply plug in the provided 12V wall adapter, after installing it into a mains outlet.

After it is initially powered, you will see the battery indicator LED come on immediately, followed shortly by the Wi-Fi and Cellular connectivity indicator LEDs, and a 4-note ascending tone from the built-in buzzer.

The battery indicator LED should be solid red when it is first powered up, indicating that the battery has been detected and will charge as soon as the **Gateway-2** boots up. For more on the meaning of the LED color display, see the ‘Indicator LEDs’ subsection on page 10 below.
Connecting the Gateway-2 to a Network

The Gateway-2 requires either an Ethernet or Wi-Fi connection to begin collecting data.

Connecting to Ethernet

To connect the Gateway-2 to the internet via an ethernet cord, first check whether the ethernet knock-out on the side of the Gateway-2 enclosure has been removed. If it has not, you can remove it by inserting the tip of a flat-head screwdriver behind the knock-out and levering the plastic out from there.

Once the knock-out has been removed, you can then insert an ethernet cord directly into the exposed RJ-45 jack on the Gateway-2. Make sure that the cord’s locking mechanism has engaged fully after installation by gently tugging on the cord, which should remain firmly in the RJ-45 jack.
Connecting to WiFi

To connect the Gateway-2 to Wi-Fi, first ensure that no ethernet cable is plugged in. When the device is plugged into power and fully booted without an ethernet connection, it will begin to broadcast an access-point Wi-Fi network with the name “EM Setup xxxxxxx”, where xxxxxxx is the 7-character serial number which is available on the bottom of the Gateway-2. Connect to this Wi-Fi network on any iPhone or Android device, or on a Macintosh or Windows PC.

After a connection is established, your device will bring up a “captive portal”-style window which will prompt you to select the SSID of the network to which you would like to connect the Gateway-2, and to enter the Passphrase of your selected WiFi network:

After pressing the connect button, the “captive portal” window will minimize, and the connection process will begin on the Gateway-2. If the Passphrase you entered was incorrect, then the network “EM Setup xxxxxxx” will be available again in ~30 seconds, and you can re-enter the Passphrase.
Positioning the Gateway-2

Gateway-2’s collect sensor data from Elements, collating and transmitting it across the internet to Elemental Machines’ Cloud. The Gateway-2’s transmit data in order of precedence:

1. by Ethernet,
2. by Wi-Fi,
3. and lastly 4G Cellular connection (if Ethernet or Wi-Fi connections are temporarily unavailable).

If all network connections are lost there is a danger of data delay or even loss, so Gateway-2’s should be located and orientated where they can get good Wi-Fi and Cellular connection; this is discussed in more detail on page 11 below. But first, the next subsection describes how to read the indicator LEDs to determine signal strength.

Indicator LED’s

The strengths of the Wi-Fi and Cellular connections are displayed by the Wi-Fi indicator LED and the Cellular indicator LED, found on the side of the Gateway-2 enclosure. The table below gives a complete list of indicator LED statuses.

![Gateway-2 Indicator LEDs](image)

From left to right: Battery indicator LED, Wi-Fi indicator LED, Cellular indicator LED, recessed Powering Off button

For a complete list of LED statuses and how to interpret them, please reference the table below:

<table>
<thead>
<tr>
<th>STATUS</th>
<th>BATTERY</th>
<th>WI-FI</th>
<th>CELLULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Battery &lt; 50%, Charging" /></td>
<td>Battery &lt; 50%, Charging</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><img src="image" alt="Battery &gt; 50%, Charging" /></td>
<td>Battery &gt; 50%, Charging</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><img src="image" alt="Battery Fully Charged" /></td>
<td>Battery Fully Charged</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><img src="image" alt="Battery &gt; 50%, Discharging" /></td>
<td>Battery &gt; 50%, Discharging</td>
<td>Good Signal &gt;= -65 RSSI</td>
<td>Good Signal &gt;= -75 RSSI</td>
</tr>
<tr>
<td><img src="image" alt="Battery &lt; 50%, Discharging" /></td>
<td>Battery &lt; 50%, Discharging</td>
<td>Poor Signal &lt; -85 RSSI</td>
<td>Poor Signal &lt; -87 RSSI</td>
</tr>
</tbody>
</table>

* indicates flashing between two colors
Gateway-2 Location and Orientation

The Gateway-2 should be installed in the “Vertical” orientation. While the “Horizontal” orientation will work, it is often harder to take advantage of the magnetic mounting feet in this orientation. This in turn means that installing the Gateway-2 in a Horizontal orientation will make it more difficult to find an out-of-the-way location for the device.

Signal

To prevent data loss or delay, make sure that the Wi-Fi and Cellular indicator LEDs are both green at the location you have chosen, before you finalize your installation.

Heat

Because the Gateway-2 is installed in environments containing equipment which might rise significantly above the ambient temperature of the room, it is important to position the Gateway-2 far away from any equipment which might vent significant amounts of heat. For more information on
handling the effects of heat, see the Post-Installation Guide on page 13 below on responding to heat-related alert tones.

**Element Sensor Network**

All Element-T and Element-A sensors will need to be within *Bluetooth® Low Energy range* of the Gateway-2. This range is usually up to 30 feet from a Gateway-2 but can depend on the layout and concentration of equipment in your lab. *Bluetooth® Low Energy* signal strength for an individual Element can be checked on the **Elemental Insights Dashboard™**. Navigate to the Machine Overview of the device in question and the signal icon will have 1 to 4 bars of strength (with 4 bars indicating the best signal strength). For *Bluetooth® Low Energy* signal, if there are 2 or more bars, the connection’s strength should be sufficient to prevent data delay or loss.

**Disturbance**

To avoid any physical disturbance which might knock the Gateway-2 out of its original mount position, thus damaging or unplugging the device, make sure never to install the Gateway-2 on any equipment which experiences a high volume of door opens/closes, or on any equipment which might be frequently moved away from the wall. Also, keep cables (ethernet and power) tidy and away from commonly used pathways; trailing cables present trip hazards that can not only disturb the Gateway-2 but also lead to larger accidents.
Post-Installation Guide

Responding to Gateway-2 Alert Tones

The Gateway-2 contains a buzzer capable of producing several situationally dependent alert tones, some of which require user response or interaction. These alert tones are described in the table below:

<table>
<thead>
<tr>
<th>ALERT TONE</th>
<th>REPEATS</th>
<th>MEANING</th>
<th>ACTION REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 ascending tones</td>
<td>Once</td>
<td>Gateway-2 has booted up</td>
<td>None</td>
</tr>
<tr>
<td>2-second monotone</td>
<td>Every 3 seconds</td>
<td>Gateway-2 is overheated</td>
<td>Move Gateway-2 to cooler location immediately</td>
</tr>
<tr>
<td>3 descending tones</td>
<td>Once</td>
<td>Battery has been disconnected</td>
<td></td>
</tr>
</tbody>
</table>

Powering Off the Gateway-2

In the case where a Gateway-2 needs to be decommissioned and stored, or shipped, it will first need to be powered off. To power off the Gateway-2, first unplug it from the 12V wall adapter. After this is done, quickly press the recessed button shown below with a pen tip or paperclip. All LEDs should immediately turn off. The Gateway-2 is now safe to store or transport.

Once powered off, the Gateway-2 cannot be turned on again without being powered through the provided 12V wall adapter.
Sensory Network Security Overview

The Elemental Machines Sensory Network™ is designed to operate securely on our customers’ networks. The system includes Elements, wireless devices that monitor critical equipment and/or the ambient environment, Gateways, which gather data from Elements, and the Elemental Insights Dashboard™.

Local Communication

Individual Elements communicate to a local Gateway-2 via Bluetooth® Low Energy 4.2 (a low power 2.4GHz wireless communication, typically 5.3 dBm or lower power). Only whitelisted devices can connect with the Gateway-2’s.

Communication through Customer Wi-Fi:

Transport Security

The system uses established communication and security standards to protect data transmitted between Gateway-2’s and the Elemental Insights Dashboard™.

- **TLS**, the web standard for protecting sensitive data including usernames, passwords, credit card, and banking information.
- **Asymmetric Cryptography** is used to encrypt the data transmitted. The keys for this symmetric encryption are generated uniquely for each connection and are based on a shared secret negotiated at the start of the session.

The Elemental Machines Sensory Network’s™ external communication is designed to work even in the strictest environments. The communication uses an adaptive transport mechanism that is designed to work well when confronted with proxy authorities, firewalls, and antivirus software.

No inbound ports need to be opened. Security vulnerability using the above configuration is prevented as follows:

1. Internet Communication over Port 80, 123, and 443
2. Device must be able to transmit outward to the Internet on 443
3. Clients do not open inbound ports
4. There is no need to open the firewall to receive on port 80, 123, or 443
5. There is no way for outside users to get into the user's network
6. We do not listen to any ports; this is the case even if the user opens ports 80, 123, or 443 for receipt
Network Whitelist

Gateway-2’s open connections through port 80, 123, and 443 of a customer's firewall, opening only outbound connections. **Gateway-2’s** require the following outbound TCP and/or UDP connections to be open on your firewall for the system to work:

- ***.elementalmachines.io**:443, TCP – for sending data to the dashboard
- **s3.amazonaws.com**:80/443, TCP – various files
- ***.balena-cloud.com**:443, TCP – for device management
- ***.docker.com**:443, TCP – for verified operating system images
- ***.docker.io**:443, TCP – for verified operating system images
- **time.elementalmachines.io**:123, UDP – for time synchronization
- **8.8.8.8:443**, TCP – for DNS resolution

Network Requirements

Wireless Requirements:

- **SSID** – Not hidden
- **Security** – WEP, WPA, or WPA2
- **IP Assignment** – Dynamic Preferred
- **Number of Unique Devices** – Sum of all Gateways and other Element-D/C/U devices
- **Captive Portal** – Not Supported
## Specifications

<table>
<thead>
<tr>
<th>Element-T Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Number</strong></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
</tr>
<tr>
<td><strong>Operating Temperature Range</strong></td>
</tr>
<tr>
<td><strong>Operating Humidity Range</strong></td>
</tr>
<tr>
<td><strong>Operating Pressure Range</strong></td>
</tr>
<tr>
<td><strong>Battery Life</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wi-Fi 2.4GHz Max. TX Power</strong></td>
</tr>
<tr>
<td><strong>Wi-Fi 5GHz Max. TX Power</strong></td>
</tr>
<tr>
<td><strong>Cellular Band 2 (1900MHz) Max. TX Power</strong></td>
</tr>
<tr>
<td><strong>Cellular Band 4 (1700MHz) Max. TX Power</strong></td>
</tr>
<tr>
<td><strong>Bluetooth® Reception Range</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FCC ID</strong></td>
</tr>
<tr>
<td><strong>ID</strong></td>
</tr>
<tr>
<td><strong>Contains ID</strong></td>
</tr>
<tr>
<td><strong>IC ID</strong></td>
</tr>
<tr>
<td><strong>ID</strong></td>
</tr>
<tr>
<td><strong>Contains ID</strong></td>
</tr>
<tr>
<td><strong>Battery</strong></td>
</tr>
</tbody>
</table>

www.elementalmachines.com
sales@elementalmachines.com

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Certifications

United States FCC:
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

WARNING: Changes or modifications not expressly approved by Elemental Machines, Inc. could void the user’s authority to operate the equipment.

Canada IC:
This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device complies with Industry Canada licence exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.