ELEMENTAL MACHINES GW2 Gateway

ELEMENTAL MACHINES GW2 Gateway User Manual

Contents

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Product Information

Specifications

- **Model:** GW2
- **Data Connections:** Ethernet, Wi-Fi, Cellular
- **Power Source:** AC wall adapter with battery backup
- **Features:** LED Status panel, two antennas, Ethernet port, magnetic feet
- **Maximum Power Output:** 23 dBm (200 mW)

Product Usage Instructions

Safety Information

Batteries: The Gateway contains a rechargeable lithium battery pack. Do not disassemble or expose it to extreme conditions.

Non-ionizing Radiation exposure: Use caution with the device when in close proximity to the body, especially in nations like Canada and Australia.

Environmental Protection: Proper disposal is required when reaching end of life. Contact Elemental Machines for disposal instructions.

Installation

Preparation: Verify your account via email before receiving devices. Devices will appear on the Elemental InsightsTM Dashboard.

Components: Ensure all necessary components are available before installation. Devices may initially show as ‘ connected’ on the dashboard.

FAQ

- **Q: What should I do if the Gateway battery needs replacement?**
  - **A:** Contact Elemental Machines or their agent for proper battery replacement and disposal instructions.
- **Q: Can the Gateway be used without an AC wall adapter?**
  - **A:** The Gateway is primarily powered using an AC wall adapter but has a battery backup for data connection during power outages.

Introduction

This manual provides instructions for installing the Elemental Gateway, GW2, referred to as “The Gateway”, as part of the Elemental
Machines system. It includes additional supplementary information regarding security, specifications, and certifications.

About the Gateway

The Elemental gateway receives data from Elemental Machines “Elements” and communicates to the Elemental Machines Cloud via Ethernet, Wi-Fi, and Cellular data connections. The Gateway is primarily powered using an AC wall adapter but contains a battery backup which can maintain data connections during power outages.

Safety Information

Batteries

WARNING: The Gateway contains a rechargeable lithium battery pack as an alternative power source if primary power is lost. This battery can explode or leak and cause burns if disassembled or exposed to fire, high temperature or rapid warming from extremely cold temperatures.
The environment in which the Gateway is installed must not exceed the environmental operating limits of 0 to 40° Celsius and 0% to 95% Relative Humidity (non-condensing). The Gateway contains an LED Status panel, two antennas, an ethernet port, and magnetic feet for secure placement.

Non-ionizing Radiation exposure

The Gateway regularly communicates over Wi-Fi and Cellular LTE networks and transmits 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 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 the Gateway or connecting the affected equipment into an outlet on a circuit different from that to which the Gateway is connected.

Protecting the Environment

The Gateway is designed with consideration for the environment and complies with the USA's EPA initiative to 'Reduce, Reuse, Recycle'. Elemental Gateways are provided to customers to support the service Elemental Machines provides, but they remain the property of Elemental Machines and should be returned to Elemental Machines 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 Elemental Gateways correctly, to help Elemental Machines in protecting the environment

The Gateway qualifies as Electrical or Electronic Equipment that the EU and UK require 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 to Elemental Machines, or their agent, where:

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

Installation

This is the recommended setup procedure for most customers. Your unique setup may require modifications. If you have any questions, please reach out to your account representative or email **help@elementalmachines.com** for assistance.

Preparation

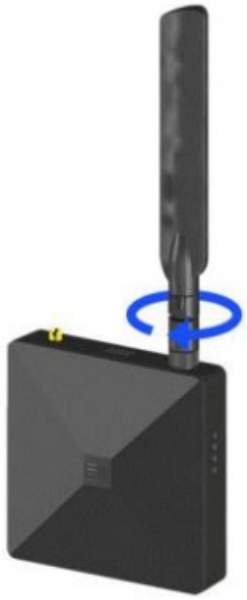
Verification Email

Prior to receiving the devices, you will receive an email for your account verification. Refer to this email to enable the system.
When devices are shipped they will be added to your Elemental Insights™ Dashboard with default names. When you first log in you will see all of your devices with a 'disconnected' status.

Components

Prior to installation, ensure you have all the necessary components. When Elemental Gateways and Elements are shipped, they are automatically added to your Elemental Insights™ Dashboard with default names. Upon first log-in, these devices will be shown with a 'disconnected' status. Additional Elements and equipment may be included in your installation kit. Please refer to the guides for each device for installation instructions.

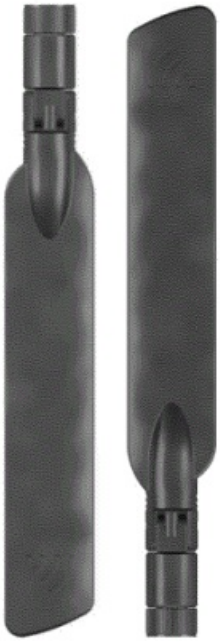
Assembling the Gateway



Before powering on the Gateway, if the device does not have the antennas installed, screw the two provided antennas in the antenna ports by rotating them clockwise.

Important Note: Antennas should be finger tightened. Do not use pliers or other tools to tighten.

The Gateway



Tilt Antennas
(2 per Gateway, may be preinstalled)

Powering on the Gateway

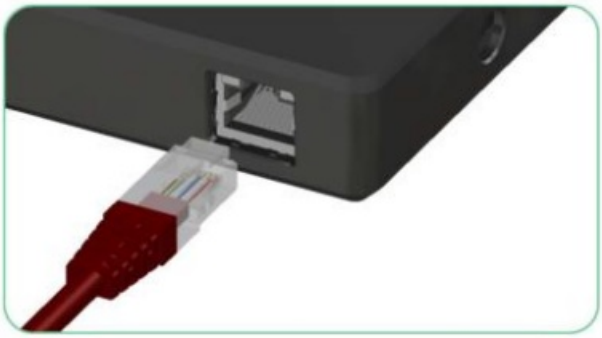
Plug in the provided wall adapter into an AC outlet, plug the round (barrel) connector into the Gateway, and flip the switch. After it is initially powered, you will see the battery indicator LED come on immediately, followed shortly by the Wi-Fi and Cellular connectivity indicator LEDs, and a 4-note 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 boots up.

Connect the Gateway to Your Network

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

Connecting to Ethernet



To connect the Gateway to the internet via an ethernet cord, first check whether the ethernet knock-out on the side of the Gateway 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. 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.

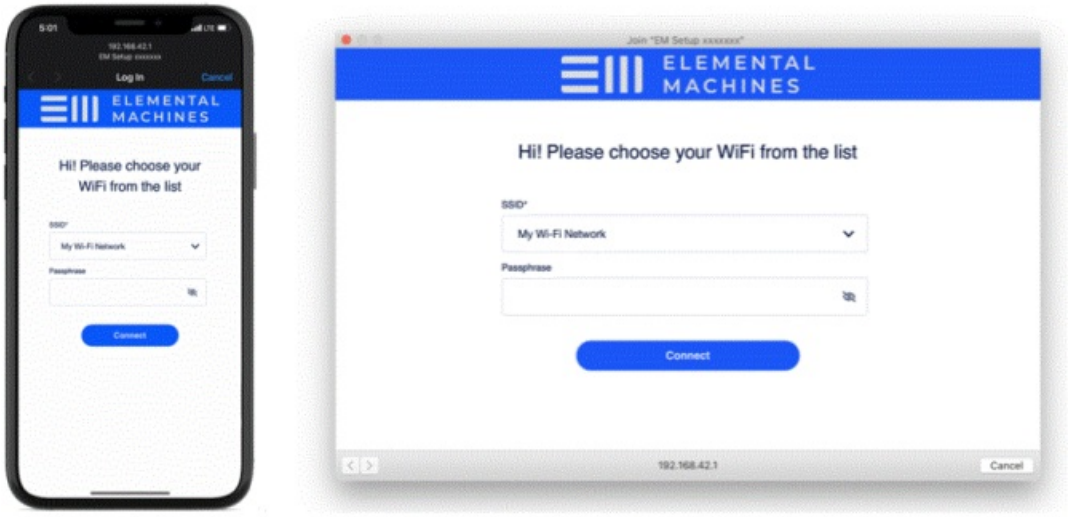
Connecting to Wi-Fi

To connect the Gateway to Wi-Fi, first ensure that no ethernet cable is plugged in. When the Gateway 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 located on the bottom of the Gateway. 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 toselect the SSID of the network to which you would like to connect the Gateway, and to enter the Passphrase

of your selected Wi-Fi network.

After pressing the connect button, the “captive portal” window will be minimized, and the connection process will begin on the Gateway.
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.

Note: If the captive portal window does not appear automatically, you may need to launch a web browser window manually



Positioning the Gateway

The Gateway collects sensor data from Elements, collating and transmitting it across the internet to Elemental Machines’ Cloud.

Indicator LED’s

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

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 enclosure.

LED Status Table

STATUS	BATTERY	WI-FI	CELLULAR
*	Battery < 50%, Charging	---	--
*	Battery > 50%, Charging	---	--
	Battery Fully Charger	---	--
	Battery > 50%, Discharging	Good Signal >= -65 RSSI	Good Signal >= -75 RSSI
	---	Fair Signal >= -85 RSSI	Fair Signal >= -87 RSSI
	Battery < 50%, Discharging	Poor Signal < -85 RSSI	Poor Signal <-87 RSSI

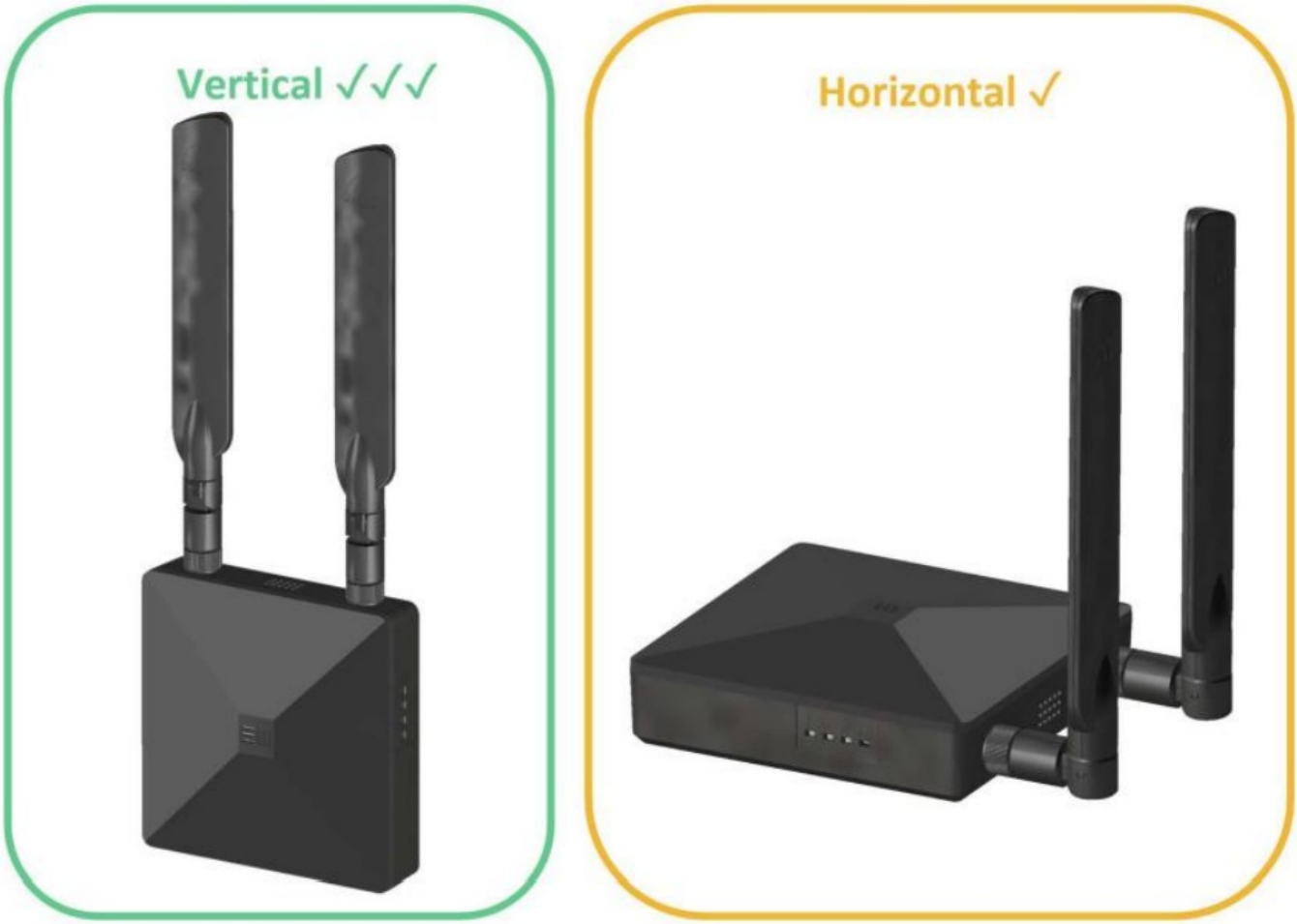
Signal

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

Orientation, Location, and Safety



The Gateway 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 in a Horizontal orientation will make it more difficult to find an out-of-the-way location for the device.

Integrated magnets make it convenient to attach to the side of many types of lab equipment and metal surfaces. Adhesive metal plates are available, which can be used to mount the Gateway to non-magnetic surfaces while still allowing the Gateway to be moved to a new position.

In many laboratory situations, the side of a lab bench shelf is the optimum location for the Gateway.

To avoid any physical disturbance that might knock the Gateway out of its position or unplug the device, ensure the Gateway is kept away from any equipment that experiences a high volume of door opens/closes, or which might be frequently moved or shifted. Keep cables (ethernet and power) tidy and away from commonly used pathways; cables present trip hazards that can not only disturb the Gateway but also lead to larger accidents.

Additional Information

Network Priority

1. Ethernet
2. Wi-Fi
3. Cellular Connection

Cellular Connection is intended as a temporary data transfer backup only. If a default Wi-Fi network has never been set for the Gateway, and an ethernet connection is not available, data will be collected but not uploaded until a Wi-Fi or ethernet connection is available.

Maintenance and Post-Installation

Alert Tones

The Gateway 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:

ALERT TONE	REPEATS	MEANING	ACTION REQUIRED
4 ASCENDING TONES	Once	Gateway has booted up	None
2 SECOND MONOTONE	Every 3 seconds	Gateway is overheated	Move Gateway to cooler location immediately
3 DESCENDING TONES	Once	Battery has been disconnected	

Powering Off the Gateway

In the case where a Gateway needs to be decommissioned and stored or shipped, it will need to be powered off. To power off the Gateway, first unplug it from the wall adapter. After this is done, quickly press the recessed button shown with a pen tip or paper clip. All LEDs should immediately turn off. The Gateway is now safe to store or transport. Once powered off, the Gateway cannot be turned on again without being powered through the provided wall adapter.

Specifications

GATEWAY SPECIFICATION

- **Model Number**/ GW2-NA
- **Unit Dimensions Without Antenna** /6.0 in x 4.5 in x 1.5 in
- **Operating Temperature Range** /32°F – 105°F (0°C – 40°C)
- **Operating Humidity Range**/ 0 – 95% RH, Non-condensing
- **Operating Pressure Range** /300 – 1100 hPa
- **Battery Life**/ 4 hours

FCC/IC Wireless Regulation Compliant

Compliance

FCC (Part 15.247)

- **ID**/ 2AXYF-GALILEO110
- **Contains ID**/ UDV-SIM7100A
- **IC (RSS 247)**
- **ID**/ 26640-GALILEO110
- **Contains ID** /8460A-SIM7100A
- **Battery** /IEC 62133-2

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 in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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's radiation exposure limits set forth for an uncontrolled environment. This

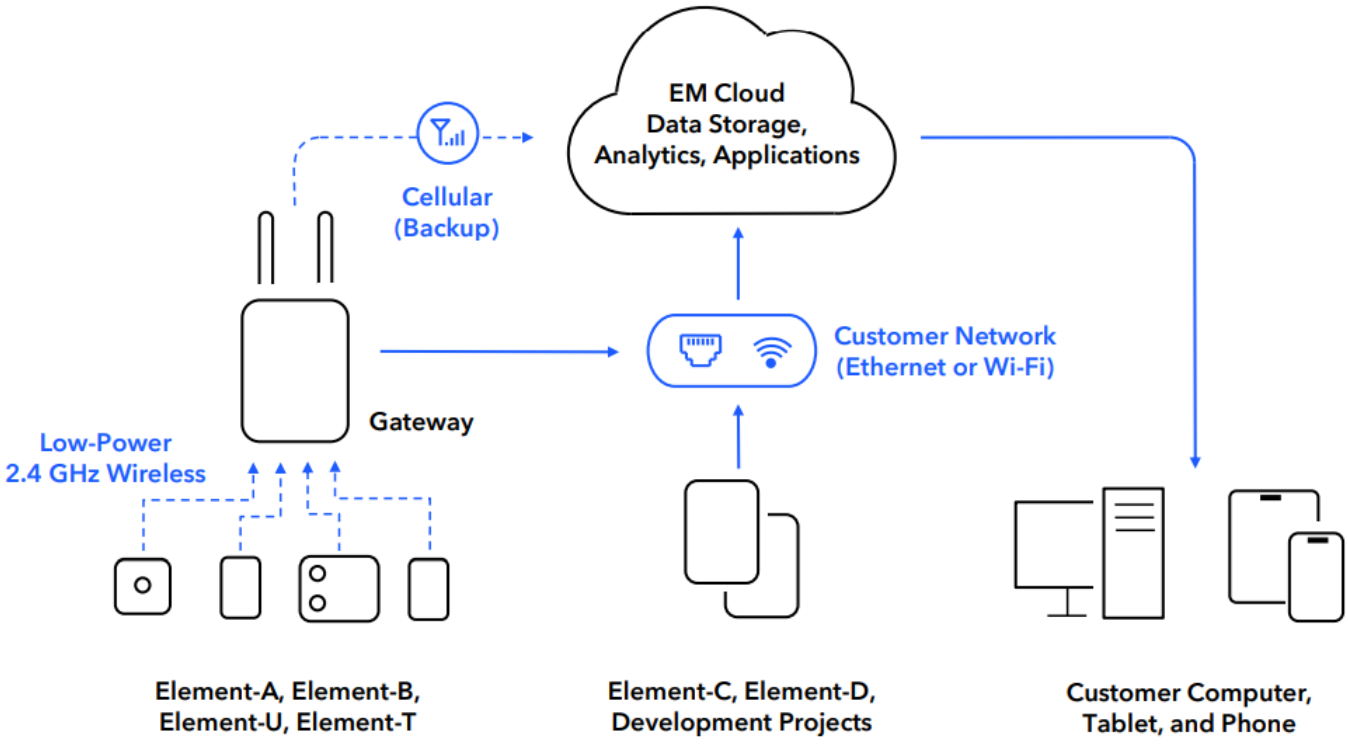
equipment should be installed and operated with a minimum distance 20cm between the radiator & your body. This device complies with Industry Canada licence-exempt RSS standard (s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Appendix 1: **Platform Network Summary**

Elemental Machines' platform delivers actionable intel to operators that will help improve operations and speed discovery.
Elemental Machines devices are designed to operate securely on our customers' networks. The entire platform includes:

- Devices called Elements that monitor critical equipment and/or the ambient environment
- Elemental Gateway that gathers data from the non-cloud connected Elements
- Elemental Insights™ dashboard

The full scope of Elemental Machines' Data Services is shown below:



Local Communication

Wireless sensors (Element-T, Element-A, Element-U Model EU2, and Element-B) communicate individually to a local Elemental Gateway (either an Elemental Tablet Gateway, Elemental Gateway models GW2 or GW3) via a low-powered 2.4 GHz wireless communication protocol. These devices do not connect to the corporate network. Each Elemental Gateway will only process data from Elements that are on a pre-defined list that is unique to each installation. This list is created prior to shipping the Gateway and is updated whenever new Elements are added to the network.

Element-C, Element-D, and Element-U model EU1 devices do not require an Elemental Gateway and transmit data directly from a piece of equipment to the Elemental Insights™ dashboard via customer Wi-Fi or ethernet.

Communication through Customer Ethernet or Wi-Fi

Elemental Gateway Models GW2/GW3 and Element-C, Element-D, and Element-U Model EU1 will always connect to Ethernet first, if available. If there is no Ethernet then the device will connect to Wi-Fi. The system uses HTTPS to protect data transmitted between Elemental Gateways, Element-C, Element-D, and Element-U

Model EU1 devices and necessary API and data ingest endpoints, such as Elemental Insights™. HTTPS is the established communication and security standard for protecting sensitive data transmitted across the web, with applications that include usernames, passwords, credit card, and banking information. Elemental Machines devices use socket connections through port 80, 123, and 443 of a customer's firewall, opening only outbound connections.

Elemental Tablet Gateway requires the following outbound TCP/UDP connections to be open in a customer's firewall for the system to work

ENDPOINT	PORT	PROTOCOL	DESCRIPTION
***.elementalmachines.io http://api.elementalmachines.io ingest.elementalmachines.io**	443	TCP	sending data to the dashboard
s3.amazonaws.com	80, 443	TCP	configuration files
***.awmdm.com appwrapandroid.awmdm.com discovery.awmdm.com signing.awmdm.com gem.awmdm.com**	443	TCP	mobile device management
http://play.google.com android.clients.google.com android.googleapis.com	443	TCP	provisioning
time.elementalmachines.io	123	UDP	time synchronization
***.pubnub.com *.pubnub.net *.pndsn.com**	443	TCP	secure IoT device messaging
***.papertrailapp.com**	443	TCP	log management

Elemental Gateway Models GW2 and GW3 require the following outbound TCP/UDP connections to be open:

ENDPOINT	PORT	PROTOCOL	DESCRIPTION
***.elementalmachines.io http://api.elementalmachines.io ingest.elementalmachines.io**	443	TCP	sending data to the dashboard
s3.amazonaws.com	80, 443	TCP	configuration files
time.elementalmachines.io	123	UDP	time synchronization
***.balena-cloud.com vpn.balena-cloud.com cloudlink.balena-cloud.com api.balena-cloud.com registry2.balena-cloud.com registry-data.balena-cloud.com**	443	TCP	device management
***.docker.com *.docker.io**	443	TCP	For verified operating system images
***.pubnub.com *.pubnub.net *.pndsn.com**	443	TCP	secure IoT device messaging
8.8.8.8			Google's Public DNS server (Balena default, can be reconfigured)

For All Devices, no inbound ports need to be opened. Security vulnerability using the above configuration is prevented as follows:

- Internet communication over Port 80, 123, and 443
- Device must be able to transmit outward to the Internet on 443
- Clients do not open inbound ports
- There is no need to open the firewall to receive on port 80, 123, or 443
- There is no way for outside users to get into the user's network
- No ports are listened to by Elemental Machines, that is the case even if the user opened ports 80 or 443 for receipt

Elemental Insights™ Dashboard

Communication between the Dashboard and web browsers always uses HTTPS. User access to the Dashboard is restricted to invite-only, requires hardened passwords, and can be revoked by admins at any time. Users are further restricted in what they can access or edit by role-based account policy.

Supplemental Security Information

Elemental Tablet Gateway is based on Android technology and therefore enjoys the security benefits of the Android Development

Network and Google. Security benefits, as listed in a security whitepaper from Google about Android, are as follows:

- Strives to prevent security issues from occurring through design reviews, penetration testing, and code audits

- Performs security reviews prior to releasing new versions of Android and Google Play
- Publishes the source code for Android, thus allowing the broader community to uncover flaws and contribute to making Android the most secure mobile platform
- Works hard to minimize the impact of security issues with features like the application sandbox Detects vulnerabilities and security issues by regularly scanning Google Play applications for malware, and removing them from devices if there's a potential for serious harm to the user devices or data
- Has a rapid response program in place to handle vulnerabilities found in Android by working with hardware and carrier partners to quickly resolve security issues and push security patches

Elemental Gateway Models GW2, GW3 as well as Element-C, Element-D, and Element-U Model EU1 devices are based on the balenaOS, a thin Linux environment that supports the balenaCloud services and user application containers. Balena offers security by design

- API access control
- Multiple authentication methods
- Minimized available attack surfaces
- Balena operates its own Virtual Private Cloud (VPC) on Amazon Web Services (AWS) This isolation gives Balena an added layer of security

Elemental Machines Cloud Services

Elemental Machines' data ingestion and server infrastructure are hosted on Google Cloud Platform, which provides a managed security layer for Google services (PubSub, BigQuery, etc.) and are automatically updated by Google. Other components such as Ruby-on-Rails, Influx, and Postgres databases are maintained to at least the minimum supported version and are updated for any high/critical security vulnerabilities per vendor guidance.

Elemental Machines Network Information

- **Wireless Requirements:**
- **SSID**: Not hidden is preferred
- **Security**: WEP, WPA, or WPA2
- **IP Assignment**: Dynamic is preferred
- **Number of Unique Devices:** Sum of the Gateways and ElementC, Element-D, and Element-U1 devices
- **Captive Portal:** Not Supported

Local Wireless Network Information:

- SSID:
- Password

Documents / Resources

	ELEMENTAL MACHINES GW2 Gateway [pdf] User Manual GW2 Gateway, GW2, Gateway

References

- Elemental Machines - API
- Elemental Machines - API
- balena dashboard
- Docker: Accelerated Container Application Development
- Docker: Accelerated Container Application Development
- Elemental Machines - Home
- Elemental Machines - Home
- Papertrail - cloud-hosted log management, live in seconds
- pndsn.com
- Build, manage, & optimize real-time apps at scale | PubNub
- registry2.balena-cloud.com
- Cloud Object Storage - Amazon S3 - AWS
- User Manual