INTREPID WirelessHART Field Gateway Product Brief

PRODUCT OVERVIEW – Centero's INTREPID Field Gateway is a WirelessHART (IEC 62591) compliant wireless process automation infrastructure device that manages WirelessHART mesh field instrument networks and also includes industrial Wi-Fi Mesh+ backbone connectivity. It is a rugged Field Gateway, certified for deployment in hazardous areas that meets rigorous wireless process automation requirements for mission critical applications. Deploy highly scalable networks that cover large geographic areas due to the market leading wireless range of the WirelessHART and Wi-Fi MESH+ communications. Support for sub-second process value reporting allows for deployment of field instruments engaged in both monitoring and control. Monitor, configure and manage field instruments via an intuitive web-based application. The integration of both WirelessHART and Wi-Fi MESH+ technologies allow for the deployment of fully redundant mesh field and backbone infrastructure networks.

PRODUCT HIGHLIGHTS

FEATURE	BENEFIT
WirelessHART and Wi-Fi Mesh+ Connectivity	Deploy wireless networks formed of both WirelessHART field and Wi-Fi backhaul self-forming and self-healing mesh networks.
Extended WirelessHART Connectivity Range	Based on Centero's WiHART wireless transceiver with market leading sensitivity of -108 dBm and 118 dB link budget resulting in 1.2 miles (2000 meters) field instrument line-of-sight communication range.
Highly scalable WirelessHART Deployments	Reduce CAPEX expenditures through highly scalable deployments composed of up to 250 field instruments per Gateway and connect Gateways via a Wi-Fi Mesh backbone covering large geographic areas.
Wide Range of Process Value Burst Rates	Process data burst rates ranging from 500 ms to several hours meet the requirements for a wide variety of use cases for field instruments engaged in both control and monitoring.
HART-IP and MODBUS Plant Connectivity	Monitor, configure and control field instruments via the Gateway from a wide gamut of plant network or cloud-hosted applications through a secure HART-IP (HART 7.7 compliant) or MODBUS high-side interface.
Over-the-Air Upgrades	Supports Over-the-Air firmware upgrades for field instruments including both the WiHART communication stack and the application processor firmware.

FEATURE	BENEFIT
Large File Transfers	Secure and reliable transfer of large files collected by field instruments engaged in condition, vibration or corrosion monitoring.
Industrial Wi-Fi MESH+ Connectivity	Native support for high-throughput, low-latency Wi-Fi Mesh connectivity and mobility for simultaneous supports of telemetry field data, video and audio data streams. Configure the two internal Wi-Fi modules to operate independently in Wi-Fi Mesh, Wi-Fi Access Point or Wi-Fi Client modes.
Security	Supports two-layered WirelessHART authentication, AES-128 encryption and SSL/HTTPS certificate-based Gateway access.
Variety of Models Certified for Operation in Hazardous or Non-Hazardous Areas	Variety of models (C1D2 and ATEX) certified for deployment in hazardous environments as well low-cost IP67 rated model for deployment in non-hazardous areas.
Health Diagnostics	Easily assess real-time health of assets deployed by accessing both field instrument and network diagnostics.
Remote Upgrade Capability	All Gateway software and firmware entities can be upgraded remotely via a securely encrypted and authenticated process.
Power Redundancy	Can be DC or Power-over-Ethernet (PoE) powered.

Meet the INTREPID Family of Products

Note: All INTREPID Gateways include antennas for all ports (WirelessHART and Wi-Fi), DC power supply and wall mount kit. For additional or higher performance accessories, please consult the Accessories list included in this product brief.

The INTREPID WirelessHART product family includes Field Gateway models that are certified for operation in C1D2 and ATEX Zone 2 hazardous areas or deployments in non—hazardous areas where ruggedness and IP67 compliance is required. The entire product line complies with level 4 immunity criteria of the IEC 61000 standard for electrostatic discharge, surge and protection against electrical fast transients.

All INTERPID family products can be powered by a wide-range 12-48 VDC supply and/or a secondary PoE power input for power redundancy. Centero offers various models depending on the topology and size of the deployment, wireless connectivity desired and type of area where the equipment will be installed.

MODEL	DESCRIPTION
NIO200HAG − C1D2	Field Wireless Gateway − certified for operation in C1D2 rated hazardous locations, includes Wi-Fi MESH+ wireless connectivity.
NIO200HAG −ATEX	Field Wireless Gateway − certified for operation in ATEX Zone 2 rated hazardous locations, includes Wi-Fi MESH+ wireless connectivity.
NIO200HRDK	Field Wireless Gateway − IP67 rated for deployment in harsh locations, does not include Wi-Fi MESH+ wireless connectivity.

WirelessHART INTREPID Network Overview

In addition to supporting WirelessHART mesh connectivity, the Field Gateway also supports Wi-Fi Mesh+ connectivity. The two (2) Wi-Fi Mesh modules are independently configurable to operate in Wi-Fi Mesh, Wi-Fi Access Point of Wi-Fi client modes. Support for Wi-Fi Mesh allows for the deployment of wireless backbone networks that are self-forming and self-healing and offers a reliable and robust wireless mesh backbone for connecting field devices without any wiring constraints.

INTREPID Field Gateways can be wirelessly connected to each other via Wi-Fi Mesh+ where the Wi-Fi connectivity is used to form a wireless backbone infrastructure. The Wi-Fi Mesh+ backbone infrastructure offers increased reliability through redundant communication paths back to the control room.

The INTREPID product family is part of Centero's comprehensive wireless Industrial IoT infrastructure offering that also includes Wi-Fi Mesh routers rated for operation in hazardous areas or in rugged environments as well as Wi-Fi field adapters and Wi-Fi asset management solutions.
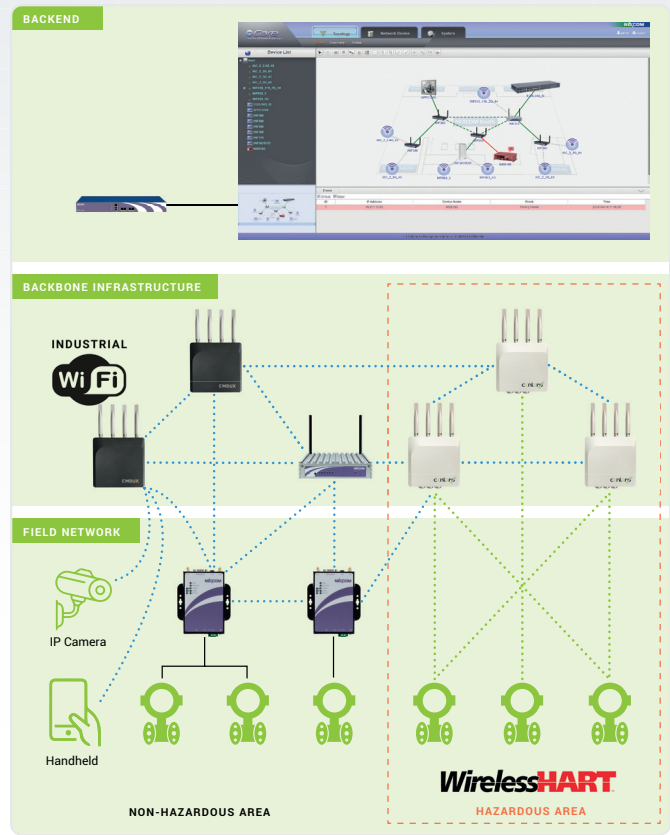

INTREPID Management and Control Application

The INTREPID Field Gateway hosts a feature rich, user friendly and intuitive application. The INTREPID Management and Control application is web-based and allows users to easily connect, control, manage, and monitor WirelessHART field instruments engaged in various applications such as process automation monitoring and control, condition monitoring, steam trap and relief valve monitoring, gas detection and safety applications, valve control and monitoring, predictive maintenance, corrosion monitoring and many other. The INTREPID application allows users to visualize process data, alerts and alarms as well as manage and configure all aspects of the WirelessHART field instruments and network.
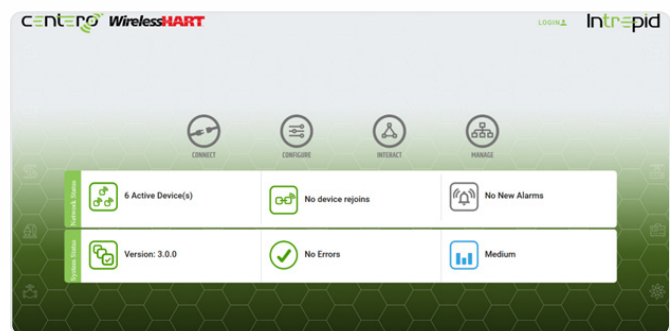
The INTREPID application is structured as a suite of "apps and wizards" modeled based on the field instrument's lifecycle with clear functional segregation requiring minimum training for plant personnel. A Network Status banner that is continuously displayed at the bottom of the application gives the user real-time insights into what is currently happening in the WirelessHART network and provides actionable shortcut icons that direct the user to the appropriate page. It displays actionable data such as number of field instruments active, device rejoins and pending alarms.
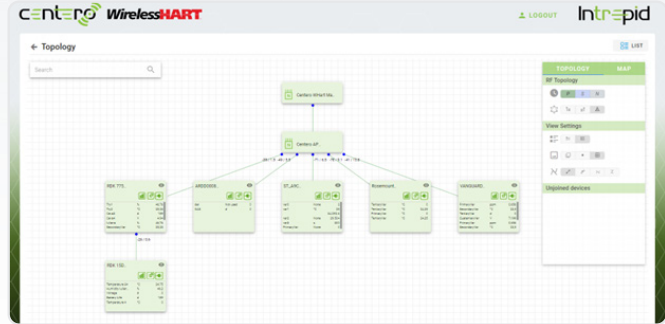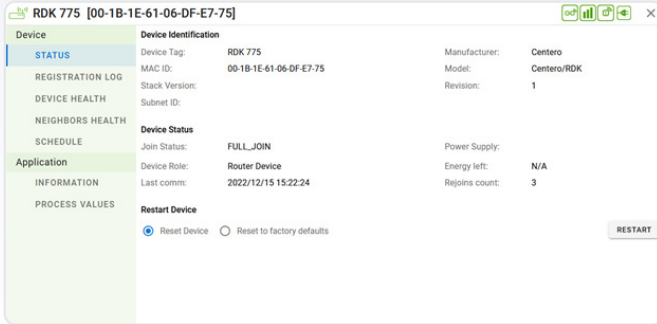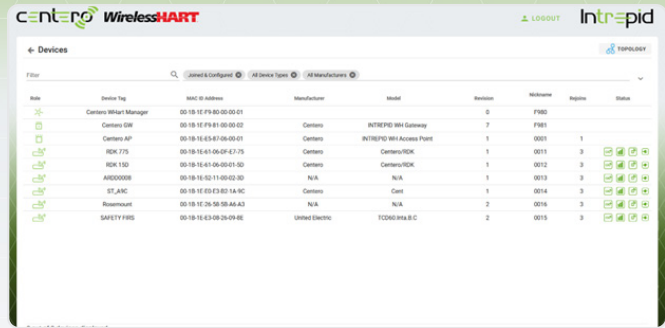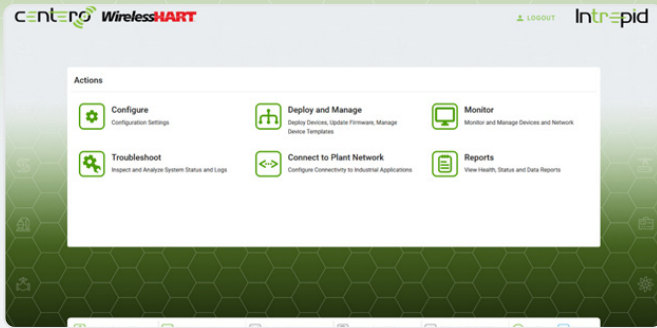
Configure – Centralized configuration settings for the WirelessHART and Wi-Fi networks, the INTREPID Gateway as well as various user preferences. It also includes an interactive Configuration Wizard that provides a guided step-by-step process for configuring the INTREPID Gateway, WirelessHART and Wi-Fi networks.

Deploy and Manage – Used during the deployment phase of the WirelessHART network. Allows users to monitor the join process, configure security credentials and manage the Access Control list for the WirelessHART instruments that need to join the WirelessHART field mesh network.

Monitor – Monitoring of the field instruments during their normal operation. Includes an actionable device list of all WirelessHART network devices, process and health diagnostics data as well as various topology views of all assets deployed. It also displays PVs, diagnostics and management parameters for each WirelessHART field instrument.

Troubleshoot – Displays all alerts, alarms and events generated by the WirelessHART field instruments. Also includes detailed logging capabilities for various device and network level events, alarms, and alerts, and allows users to send HART/WirelessHART commands to the field instruments.

Connect to Plant Network – Configure and manage Gateway high-side interfaces for connectivity to the plant network. This includes the MODBUS server interface that allows quick drag-and-drop mapping of parameters reported by the field instruments into INPUT and HOLDING registers. It also allows end users to configure the HART IP interface.

Reports – View, analyze and export various field instrument and network level reports.

WirelessHART Network Management

The INTREPID Field Wireless Gateway hosts the WirelessHART network manager entity. The WirelessHART network manager is responsible for managing and ensuring the proper functioning of all WirelessHART field instruments. It manages all aspects of these devices throughout their entire lifecycle including the provisioning, configuration and joining phases as well as the operational and decommissioning phases.

Provisioning
All WirelessHART field devices including field instruments and Wireless Access Points need to be provided the appropriate security credentials that allows them to securely join the WirelessHART network. These security credentials are provided during the provisioning phase. The INTREPID Gateway supports individual or batch provisioning of the field instruments.

Join and Network Formation

The network manager is also responsible for discovery of the field instruments that want to join the WirelessHART network, and jointly with the security manager also responsible for the join process. Once devices have joined, the network manager will configure the field instruments to form mesh subnets that are optimized to ensure the highest level of reliability for the wireless communications as well as prolonging the battery life of these instruments. Reliability of the wireless communications is ensured through path diversity (mesh topologies), frequency diversity (frequency hopping) and time diversity (TDMA) as well as optimal wireless media contention/access. All these mechanisms are managed by the network manager that collects health diagnostics and continuously improves the reliability of communications of field instruments as well as the entire mesh network.

Operational Management

Once the field instruments have joined the WirelessHART network, the network manager is responsible for managing the operation of these instruments according to their intended needs. This includes allocating network resources to meet the instrument's requirements. The INTREPID WirelessHART network manager accommodates field instruments that are engaged in both monitoring as well as control applications and use cases.

It will allocate network resources to allow the instruments to periodically publish the process values and health diagnostics based on their requirements. It will also allocate network resources to allow these instruments to have bi-directional communications with the Gateway as well as send alerts/alarms as needed.

Security Features

The INTREPID WirelessHART Field Gateway includes advanced security features and mechanisms that ensure data confidentiality, authenticity, integrity, and availability for the WirelessHART as well as Wi-Fi Mesh+ connectivity.

WirelessHART Security

The INTREPID Gateway hosts the WirelessHART security manager entity that is responsible for managing all security facets of the WirelessHART field devices and network. This includes the join and provisioning processes for all WirelessHART field devices and Access Points. Once the WirelessHART field devices have joined the network the security manager oversees all security aspects during the operational life of the field device.

Network Provisioning Phase

A wired HART network provisioning tool is needed to inject the security credentials generated by the security manager into the field instrument. The INTREPID Gateway includes various access control mechanisms that only allow accredited field instruments to join the WirelessHART network.

Network Join Phase

The security manager is also responsible for managing the network join phase. The INTREPID Gateway also includes additional access control security features which ensure that only authorized field instruments are allowed to join the network. Following the successful completion of the join phase, the security manager hands out the appropriate cryptographic materials needed for the operational phase of the field instrument.

Operational Phase

WirelessHART networks use a two layered security construct that consists of link-layer (hop-to-hop) and network layer (end-to-end) security relationships. All data transactions are authenticated and optionally encrypted using AES-128 at the link-layer. Link-layer security (hop-to-hop) secures data transactions within the scope of the WirelessHART mesh network and terminates at the Wireless Access Point. All data transactions are authenticated and encrypted using AES-128 at the network layer. Network layer security secures transactions within the scope of the entire WirelessHART network and terminates in the Gateway. The security manager is responsible for security key management, including periodic key renewal and key revocation.

Gateway Access

Gateway access from the plant network is secured using SSL/HTTPS certificates. An airgap between the WirelessHART network and data accesses from the plant network ensures that the two networks are segregated from a security standpoint. All WirelessHART data transactions terminate in the Gateway, are buffered or stored and are accessible via various standards based high-side protocol such as MODBUS or HART-IP. This adds to the robustness of the security construct by protecting the WirelessHART network from cybersecurity attacks that could potentially be initiated via the plant network.

Wi-Fi Mesh+ Security
All Wi-Fi Mesh+ data transactions are secured using standard based IEEE 802.11 security mechanisms that include both authentication and encryption. The Wi-Fi security scheme is configurable via the INTREPID Gateway.

WirelessHART Gateway Features

The WirelessHART Gateway software entity is responsible for the application layer connectivity between the WirelessHART field instruments and the plant network. It is responsible for receiving and sending as well as buffering, caching and storing application payloads. The Gateway also provides plant network connectivity via various standard based high-side interfaces.

The Gateway supports various data flows including burst data that is periodically sent by the field instruments. It also supports bi-directional client/server data exchanges between the field instruments and the Gateway as well as alarms and alerts.

Over-the-Air Firmware Upgrades (OTA)
The INTREPID Gateway boasts upgrade capabilities of all firmware/software entities that are operational in the WirelessHART network. This includes support for secure Over-the-air firmware upgrades for all field instruments, including their wireless communication stacks running on the WiHART wireless modules and vendor specific firmware running on the application processor that are based on Centero's WirelessHART reference implementation. Over-the-air upgrades are performed via Centero's Utility Tool that resides on the plant network. All firmware upgrades are authenticated and secured and require explicit user activation.

Gateway Software Upgrades
All software and firmware entities running on the INTREPID Gateway are upgradeable via an AES-256 encrypted and authenticated, secure process.

Support for Large File Transfers (LFT)
The WirelessHART protocol supports the transmission of short data packets in order to conserve battery power and extend the battery life of the wireless field instruments. Various types of field instruments engaged in vibration, condition or corrosion monitoring collect larger files that need to be transmitted to the plant network for data reporting or further analysis.

The INTREPID Gateway supports the transmission of large files through a LFT (Large File Transfer) mechanism. Collection of large files via the LFT mechanism can be periodically scheduled or on demand as needed. The LFT mechanisms ensures that these large files are transmitted in a reliable and secure manner. It includes flow control as well as fragment recovery in case fragments of the large file are lost during the wireless transfer. Secure transfers are ensured through large file integrity and authenticity checks that are additional to the security mechanisms inherently present in the WirelessHART protocol. Large file transfers are performed via Centero's Utility Tool that resides on the plant network.

Plant Network Connectivity Interfaces
The INTREPID Gateway provides connectivity to the plant network through various standards-based interfaces.

MODBUS TCP
The INTREPID Gateway hosts a MODBUS TCP server that allows software entities running on the plant network

TARGET VERTICAL MARKETS AND APPLICATIONS
The INTREPID WirelessHART Field Gateway can be deployed in any Industrial IoT project, large or small.

Verticals
- Oil and Gas
- Petrochemical
- Paper and Pulp
- Mining
- Factory Automation
- Power Generation
- Power Distribution

Applications and Use Cases
- Process Automation
- Temperature and Pressure Monitoring
- Condition Monitoring
- Valve Positioning and Control
- Steam Trap and Relief Valve Monitoring
- Predictive Maintenance
- Gas Monitoring
- Safety applications
- Corrosion Monitoring
- Tank Level Monitoring

WirelessHART Gateway Features

to extract or send data from/to the WirelessHART field instruments. Any of the data parameters reported by the field devices can be mapped into MODBUS input registers including process data as well as health and diagnostics data. Client applications can also map data into holding registers that will be sent to the field instruments.

HART-IP
The HART-IP protocol is a standards-based, open technology that extends the original HART protocol to include communications across IP networks. With HART revision 7.7 released in 2021 requirements for specific minimum security suites are also specified with HART packets encapsulation in secure IP packets.

The INTREPID WirelessHART Field Gateway includes a HART-IP server that is compliant to the HART 7.7 protocol specification. It concurrently supports up to eight (8) TCP/UDP HART-IP client sessions with each client session requiring its own security credentials. HART-IP clients running on the plant network can subscribe to burst/publish process data streams sent by the WirelessHART field instruments. They can also send HART commands in a secure manner to the WirelessHART field instruments.

Specifications

WIRELESSHART SPECIFICATIONS		
Wireless Communication	Standard: IEEE 802.15.4 Data Rate: 250 kbps Modulation: Q-PSK Spread Spectrum: DSSS RF Output Power: Max +10 dBm Sensitivity: -108 dBm Link budget: 118 dB Communication Range: 1.2 miles (2000 meters LoS) Connector: N type	
Scalability	250 WirelessHART field instruments	
Burst/Publish Report Rates	Configurable: 0.5s, 1s, 2s, 4s, 8s, 16s, 32s and 60s, multiples of 60 seconds	
Scalability for Periodic Burst/Publish Rates Supported	Burst/Publish Rate	Number of Field Instruments
	0.5 seconds	10 field instruments[1,2]
	1 second	24 field instruments[1,2]
	2 seconds	32 field instruments
	4 seconds	64 field instruments
	8 seconds	128 field instruments
	8s, 16s, 32s, 1m, multiples of 1m	250 field instruments
	[1] Client/server (bidirectional) communication rate at max 7 seconds for each field instrument	
	[2] Number of concurrent wireless firmware upgrades - 3 field instruments	
Mesh Network Depth	Configurable, up to 5 hops	
HART-IP Interface	HART-IP server Sessions: up to 8 concurrent TCP/UDP sessions with session specific security credentials	
MODBUS-TCP Interface	MODBUS TCP server – INPUT and HOLDING registers	

Specifications

WI-FI WIRELESS SPECIFICATIONS	
Wi-Fi Mesh+ Radios	Two (2) modules – independently configurable
Modes of Operation	Mesh, Access Point, Client
Wireless Radio	IEEE802.11a/n x 2, MIMO 2 x 2
Frequency Bands	USA: 5.15~5.25 GHz, 5.725~5.825 GHz Europe: 5.47~5.725 GHz
RF Output Power: IEEE 802.11a	802.11a - 28 dBm with 2 antennas 802.11n (HT20) - 27 dBm with 2 antennas 802.11n (HT40) - 27 dBm with 2 antennas
Security (AP Mode)	WEP (64/128/152) WAP/WPA2 mixed WPA2-personal (PSK+CCMP/AES) Hidden ESSID support MAC address filtering (MAC ACL) Station isolation

CERTIFICATIONS AND COMPLIANCE	
Hazardous Certifications	UL: Class I, Division 2, Groups A, B, C, D, T4 ATEX: Zone 2; II 3G Ex nA IIC T4 Gc
Safety Compliance	UL 60950-1; 60950-22 IEC 60950, 2nd edition EN 60950, 2nd edition IEC 61000-4-2 level 4 ESD immunity IEC 61000-4-5 level 4 AC surge immunity IEC 61000-4-4 level 4 electrical fast transient burst immunity
Wireless Certifications	FCC Part 15.247, 15.407 EN 300 328 EN 301 893
EMI and Immunity	EN 301 489-1, -17 FCC Part 15.107, 15.109

| HARDWARE SPECIFICATIONS	
Weight	2.50 kg (5.5 lbs)
Dimensions	260 x 250 x 93 mm (10.23 x 9.84 X 3.66 in)
Power	12~48 VDC Power-over-Ethernet (standard PoE 802.3at)
Ethernet	WAN: 10/100/1000 Base-TX MDI/MDIX LAN: 10/100/1000 Base-TX MDI/MDIX Ethernet compliant with: IEEE802.3/802.3u Hardware based 10/100/1000, full/half, flow control auto negotiation
Mounting Methods	Wall and pole
Environment Protection	Operating temperature: -40~75°C (altitude: up to 3,000m) Storage temperature: -40~80°C Humidity: 0% to 95% maximum (non-condensing)

Specifications

HARDWARE SPECIFICATIONS (Continued)	
Buttons and Indicators	Push buttons: 1 x reset/restore to default LEDs: 2 x Ethernet 2 x Wi Fi radio 1 x WirelessHART radio 1 x Power/Status

WARRANTY AND LICENSING	
Warranty	2 years
Licensing	No recurring license fees

Dimensional Drawings
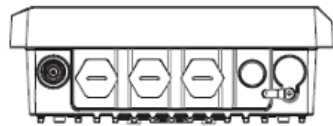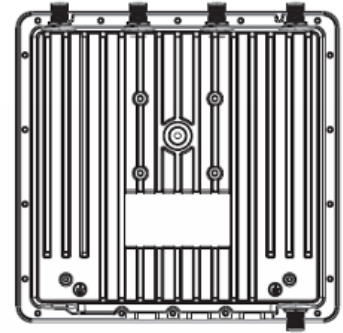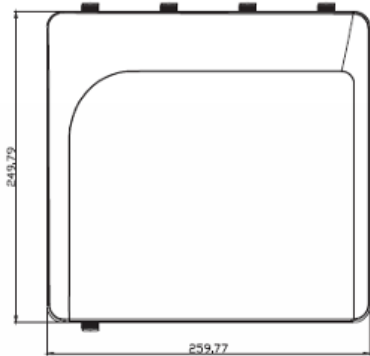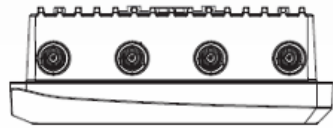
Ordering Information

| Model	Part Number	Description
INTREPID NIO200HAG	NIO200HAG-C1D2	INTREPID WirelessHART Field Gateway, Wi-Fi Mesh+ connectivity, UL C1D2 certified
INTREPID NIO200HAG	NIO200HAG-ATEX	INTREPID WirelessHART Field Gateway, Wi-Fi Mesh+ connectivity, ATEX certified
INTREPID NIO200HRDK	NIO200HRDK	INTREPID WirelessHART Field Gateway, No Wi-Fi

Related Products

Model	Part Number	Description
WiHaRT Rapid Development Kit	WIHARTRDKES	WirelessHART Rapid Development Kit – Enterprise Source Code Package
WiHaRT Wireless Module	CW-24-012-WHx	WirelessHART Wireless Module
NIO200WMR	NIO200WMR	Industrial Wi-Fi Mesh Router C1D2/ATEX certified
IW610	IWF610	Rugged IP67 Wi-Fi Mesh Router
IWF310	IWF310	Rugged IP40 Wi-Fi Mesh Router
NIO51	NIO51	MODBUS/Serial/Ethernet to Wi-Fi Mesh Field Adapter and Router
nCare IWF800	IWF800	Industrial Wi-Fi Asset Manager

Accessories

Part Number	Description
603ANT0008X01	Omnidirectional 2.4 GHz, 9 dBi gain antenna
603ANT0014X00	High-gain, omnidirectional dual band 2.4/5 GHz with 4.5/7.0 dBi gain *(antennas included with the INTREPID Gateway)*
603ANT0011X01	High-gain, omnidirectional 5.0 GHz, 10 dBi gain antenna (Wi-Fi antenna)
603ANT0013X01	Extreme-gain, directional, single band 5GHz MIMO panel, 23 dBi gain antenna (Wi-Fi antenna)
603ANT0009X00	High-gain, Directional MIMO Panel 2300~2700 MHz, 17 dBi gain antenna
IWF310	Rugged IP40 Wi-Fi Mesh Router
PI100GA	Power-over-Ethernet Injector, IEEE 802.3at/af,
5040210012X00	Wall mount kit – *included with the INTREPID Gateway*
5040410110X00	Pole mount kit
7A00000066X00	RF lighting arrester N-MALE to N-FEMALE

Centero is a provider of wireless technologies, products and services for the Internet of Things.
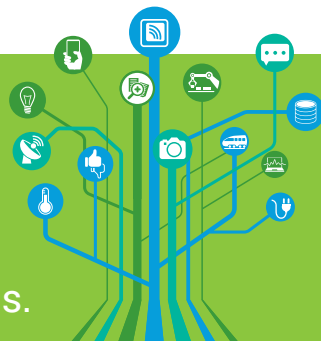
Centero is a privately owned technology company headquartered in Atlanta, Georgia. We are the forefront of the Industrial Internet of Things revolution which is transforming a wide array of vertical markets. Centero offers standards-based products and solutions for wireless Industrial IoT connectivity.

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