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# A Blueprint for Implementing IIoT in a Brownfield Facility

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## Brownfield Solution Overview

Corlina's brownfield monitoring solution blueprint is intended to enable monitoring and decision-making based on information captured from already-in-place equipment. These existing systems are often implemented on closed architectures and/or closed data buses for reliability reasons, or they may not include any embedded sensors whatsoever. Corlina provides a cost-effective means to instrument these systems – systems like conveyor belts, cooling systems, and presses or pumps, to name a few – with sensors and analytical capability without interfering with existing equipment.

And with the *Corlina System of Trust™* central to the blueprint, you ensure the security and integrity of the solution simultaneously so that you have confidence that your devices are protected from tampering and your system is producing reliable, trustworthy data.

This Blueprint is designed to help you replicate this set-up in your own environment by providing you a model for everything you'll need including:

- ✓ Shopping list for all solution components
- ✓ Links to required software
- ✓ Skills list
- ✓ Physical setup checklist
- ✓ Application setup checklist

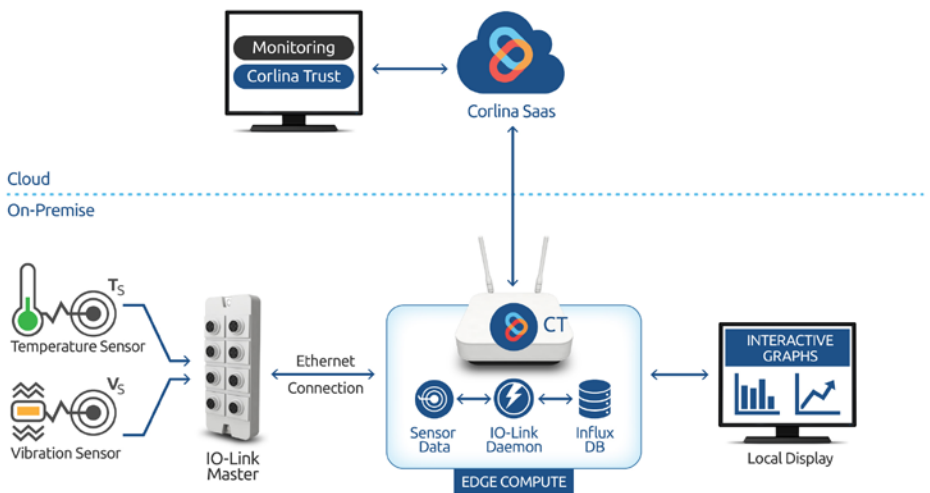
## Solution Configuration

The basic solution architecture is shown below. You can install the number of sensors you'll need to measure vibration, temperature, pressure, or other physical characteristics that are indicative of the health of your process. If you use more than 8 sensors, you'll need to deploy multiple IO-Link masters to account for all the required connections.

IO-Link sensors are available from numerous vendors offering a range of measurement capabilities. You can find out more about the members of the IO-Link Consortium and the types of products/sensors they offer [here](#).

To view your data and graphical output, you can simply connect a laptop or standard PC to your Edge Compute device. The Chronograf system makes viewing and manipulation of the data simple, and no special equipment is required.

### Brownfield solution schematic



In the demonstration case that we installed at our customer, we instrumented an injection press hydraulic pump system. The setup included one vibration sensor mounted on the motor, a pair of temperature sensors on the hydraulic oil pump, one at the inlet and one at the outlet, to measure temperature increases beyond threshold levels, and a pair of temperature sensors on the cooling water system. All 5 sensors were integrated using one IO-Link master (IOLM).

While many IIoT solutions will connect sensors via WiFi, Zigbee, Bluetooth, or other wireless protocols, we've opted to hard-wire the sensor connections in our solution. We made this decision to increase the reliability and consistency of the connection because it was physically possible to do so.

# Shopping List

## Hardware



### Vibration sensor

[\*ifm JN2200 Inclination sensor\*](#)

Sensor used in VibrationSensor mode rather than inclination mode

U.S. List price: **\$303**

We have used only 1 vibration sensor in our solution, but you can source up to about 100 units depending on equipment to be monitored. At this point, you may experience some reliability issues so we don't recommend using more than 100 sensors.

Get information on other sensor options [here](#)



### Temperature sensor

[\*ifm TA2002 Temperature transmitter\*](#)

U.S. List price: **\$197**

As with the vibration sensor, you can source up to 100 units depending on equipment to be monitored.

We've used 4 temperature sensors in our initial solution.



### IO-Link master (IOLM) with Ethernet/IP interface

[\*ifm AL1323 IO-Link Master\*](#)

- Up to 8 connected devices
- high protection rating; suitable for food and beverage production

U.S. List price: **\$424**

- Source 1 IO-Link master per 8 sensors
- If fewer ports are required (4 or less) or you require a different OT fieldbus, please see [this list](#) of additional options
- If have fewer than 8 sensors, but some are located more than 20 meters apart, you will need to source a second IOLM unit.



### Edge Compute

[\*Advantech UNO-2272G-3S51\*](#)

Intel® Atom N2800 processor with 2 Mini-PCIe slots

Be sure to order configuration with Advantech Linux OS; unit ships with Windows 7 unless otherwise specified

U.S. List price: **\$495**

We've certified [several gateways and Edge compute devices](#) for effective operation with our solution, that are tested to run the Corlina Technology (CT)

## Software



### Sensor Data Capture Daemon

[Corlina GitHub](#)

Application used to capture raw data collected by temperature and vibration sensors

U.S. List price: **free**

OpenSource software created for community usage; shared on our public GitHub repository



### Corlina System of Trust™

[Corlina SaaS sign-up](#)

The *Corlina System of Trust* has a 30-day free trial available for all users. At the conclusion of the trial, you can choose to activate the plan of your choice.

U.S. List price:

**\$0** for first 30 days;  
**\$300** / month for Pilot Plan



### InfluxDB

[InfluxDB](#) is InfluxData's open source time series database.

U.S. List price: **free**




### Chronograf

[Chronograf](#) is InfluxData's open source web application which is used to visualize your monitoring data.

U.S. List price: **free**

## Additional Equipment

	<b>IO-Link interface</b> <a href="#">ifm E30390 USB IO-Link Master</a> for connecting IO-Link enabled sensors to a PC for configuration	<b>U.S. List price: \$385</b> Source 1 IO-Link interface; this is a one-time configuration tool only used for sensor validation and configuration.
	<b>Ethernet connection cable</b> <a href="#">ifm E12492</a> 10 m PVC cable to connect IO-Link master with your Edge Compute device	<b>U.S. List price: \$111</b> Purchase 1 per IO-Link master unit used; for cables in other lengths, see our <a href="#">list of options</a> .
	<b>Switched-mode power supply</b> <a href="#">ifm DN4012</a>	<b>U.S. List price: \$216</b> Purchase 1 per IO-Link master unit used. For other current requirements, we have compiled a <a href="#">range of options</a> .
	<b>Connecting cable with socket</b> <a href="#">ifm EVC349</a> 3 m PUR / M12 connector for connecting your IO-Link master (IOLM) to its power supply	<b>U.S. List price: \$14</b> Purchase 1 per IO-Link master/switched-mode power supply unit used. Available connectors range in length from 1 to 80 m; if a length other than 3 m is required in your environment, see <a href="#">more options here</a> .
	<b>Sensor connection cable</b> <a href="#">ifm EVC049</a> <ul style="list-style-type: none"><li>• 5 m PUR cable</li><li>• M12 connector (at both ends)</li></ul>	<b>U.S. List price: \$24</b> Purchase 1 per sensor used. Lengths range from 0.3 to 15 m for connection; some cables include the 90-degree connector head option (as shown). Please refer to this <a href="#">complete table</a> for additional available cabling options.

All items listed above (*Hardware and Additional Equipment*) are the exact products we have used in the solution we deployed. You may have the need to include more or different types of sensors, IO-Link master units with different connectors, longer cabling, or a larger Industrial PC/Gateway.

Please refer to the lists of additional options we've compiled at the links above to modify your purchases according to the specific requirements of your solution and the physical parameters of your manufacturing environment.

All items include a list price, recorded at the time of the production of this guide. Pricing may change at any time, so please refer to the reseller site(s) to see appropriate pricing.

# Skills List

In order to implement the solution on your site, you'll want to have access to the following skills for implementation:

- **A licensed electrician**  
for setting up the power supply to your IO-Link master
- **A mechanic**  
to mount your sensors securely on the equipment you will be monitoring
- **A network cabling specialist**  
to ensure appropriate physical connectivity of devices
- **A network admin**  
to establish an IP address for your Edge Compute device
- **A Linux-Unix specialist**  
for setting up your Edge Compute device

## Preparing Your Environment

Your next step once all your equipment has arrived is to prepare your production environment for installation and set-up. These preparation steps include setting up your power supplies, preparing mounting for sensors, and ensuring your network connectivity is ready to support your roll out.

### ○ Determine location for Edge Compute device and each IOLM

*You will need to determine where the Integration Server and each IOLM will be located for ongoing operations. This will determine where power and network connectivity must be provided. If you have a server room or central office, that may be the ideal location for your Edge Compute PC provided that you have good network connectivity available. Your IOLM(s) will need to be located near your sensors and an Ethernet connection.*

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### ○ Wire and mount power supply for IOLM

*This step includes mounting the power supply, wiring the transformer directly into an electrical line, and connecting to the IOLM. It requires support from a licensed electrician. You can access [detailed instructions here](#).*

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### ○ Network connectivity and prep; operating location assessment

*The solution requires an Ethernet connection for each IOLM and the Integration Server. We recommend 100 Base-T or better for each. And because the Integration Server will need to share trust data with the Corlina SaaS, traffic will need to be segmented to ensure that operational data is isolated from the Internet. [Read more here](#).*

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### ○ Determine mounting points and mount sensors and IO-Link master devices

*This step includes determination of the appropriate mounting hardware to ensure secure placement during ongoing operations.*

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## ○ Set up the [IO-Link interface](#)

*Configuration of the IO-Link master and any sensors to be attached to it should be accomplished using the USB point to point interface provided by the [ifm E30390 USB IO-Link Master](#) connected to a Windows (or Windows VM) via USB.*

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## ○ Configure sensors and set logical names

*For sensor configuration, we recommend referring to the manufacturer documentation for installation of each sensor: for the [JN2200](#) and for the [TA2002](#). Once they are configured, [set the logical names](#) and collect serial numbers.*

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## ○ Determine temperature and vibrational threshold values

*A. The temperature is a Celsius value for where we would want to send out warnings for temperatures that exceed acceptable levels. (Each of the 4 sensors can have its own threshold.)*

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*B. The vibrational thresholds are two numbers: the acceleration of the sensor in milli-gravities (accurate to 2 decimals) and the velocity of the sensor in millimeters per second.*

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*Because you may not have a good reference point for setting these thresholds, we recommend that you set up your solution and track values for the first 2 weeks to establish a normal operating range.*

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This checklist [<link to pdf download>](#) can be downloaded for your use in tracking your activities.



# Solution Installation

- ☐ Install [Ubuntu](#) Linux (or confirm factory install)
- ☐ Set up [ssh](#) or [VNC](#)
- ☐ Confirm [Java Runtime Environment](#) is present and active on Linux Java
- ☐ Install [PyCharm Community Edition](#) for debugging
- ☐ Install [Archive Manager](#) (File Roller) on Ubuntu
- ☐ Confirm Python 3.5 or higher is present, create Python virtual environment, and install [required Python modules](#)
- ☐ Back-up the installation to USB using sbackup
- ☐ Install [Influx](#)
- ☐ Set up [Chronograf](#) rendering server for graphical display of monitoring time-series data
- ☐ Set up Corlina
  1. Establish network access to the Corlina SaaS dashboard
  2. Create account
  3. Download and install agent
  4. Set up factory
  5. See [Getting Started](#) for more details
- ☐ Set [logical names for sensors](#) and collect serial numbers
- ☐ Install monitoring [daemon](#)
  1. Copy over zip file and unpack
  2. Set daemon owner to root and root group
- ☐ Set temperature and vibrational threshold values

## Running Your Solution

From here, you'll be up and running, monitoring your system and guaranteeing that it's performing as you expect. You'll want to review your threshold values periodically, and potentially adjust them based on the results you're capturing.

If at any time you have questions or need assistance, please contact Corlina at [support@corlina.com](mailto:support@corlina.com).

