Edgecell

Modern edge computing for manufacturing

Edge computing is not a return to closet servers like we had in the 1990s. Edge computing is the computing that is not in the cloud, but is managed and monitored with tools and processes like those used in the cloud.

What are those processes used in the cloud? You have heard the terms: continuous integration (CI), continuous deployment (CD), DevOps, infrastructure as code (IAC), GitOps. Edge computing brings those processes to the factory floor.

Old versus new

To appreciate the difference, let's compare the old way of on premise computing to the new way of edge computing.

The old way of on premise computing

1. Buy hardware
2. Buy OS license
3. Install OS on hardware
4. Send technician to install hardware on factory floor
5. Shell into server either remotely or with keyboard and monitor attached
6. Configure network settings
7. Run commands to install and configure software
8. For upgrades, repeat with technician

Problems with the old way

- Upfront capital cost of hardware
- Cost of OS license
- Cost and time constraint of technician to install and configure
- No record of exactly what the technician did
- Not repeatable or replicable or scalable
- Potential build up of tribal knowledge
- Very strong incentives to delay or avoid upgrades

The new way of edge computing

1. Define infrastructure as code, text files checked into Git repository that specify the hardware and its network configuration
2. An edge provider ships the hardware to the location specified
3. Anyone on the factory floor (non-technician) plugs in and turns on the hardware
4. The hardware automatically configures its network settings and updates its software
5. To upgrade the hardware or software, someone changes the text in the Git repository and issue a pull request
6. The pull request is reviewed, approved and merged
7. If it is a hardware change, the provider ships out a replacement
8. If it is a software change, the hardware on the factory floor automatically applies the changes

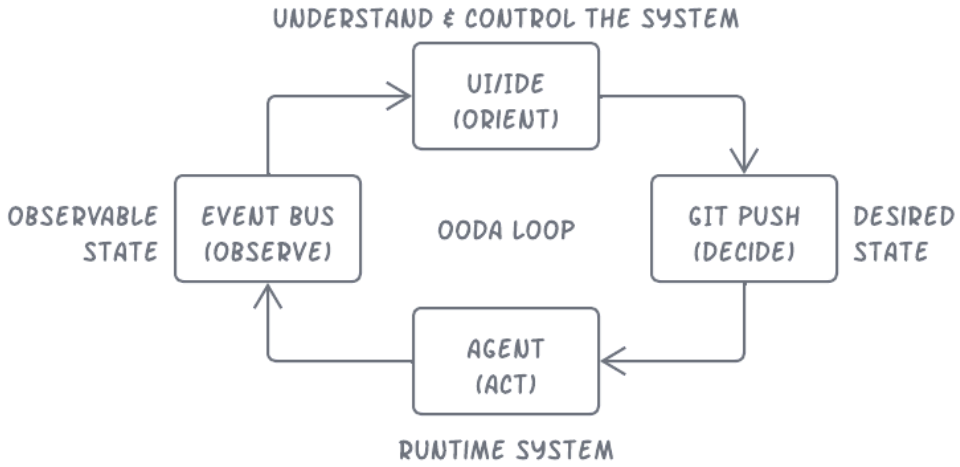
Advantages of the new way

- No upfront capital costs
- A repeatable, replicable and scalable process
- No time and cost constraint of technicians on site to install, configure or upgrade
- Complete record of what is installed and how it is configured
- Complete record of every change, when it occurred and who approved it
- Built to enable continuous improvement

How it works

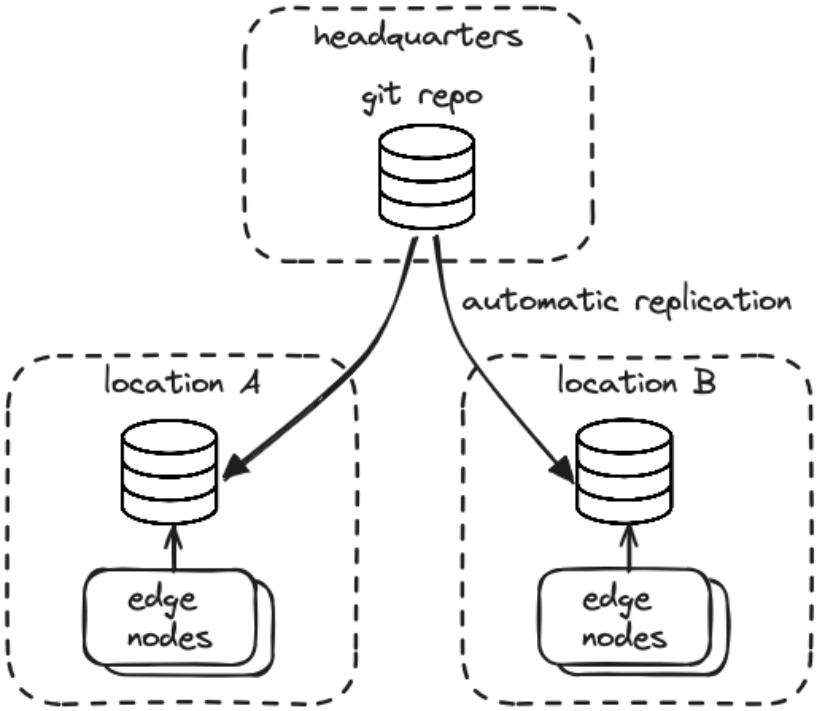
GitOps

Edgecell GitOps applies the OODA loop to software development and deployment at the edge.



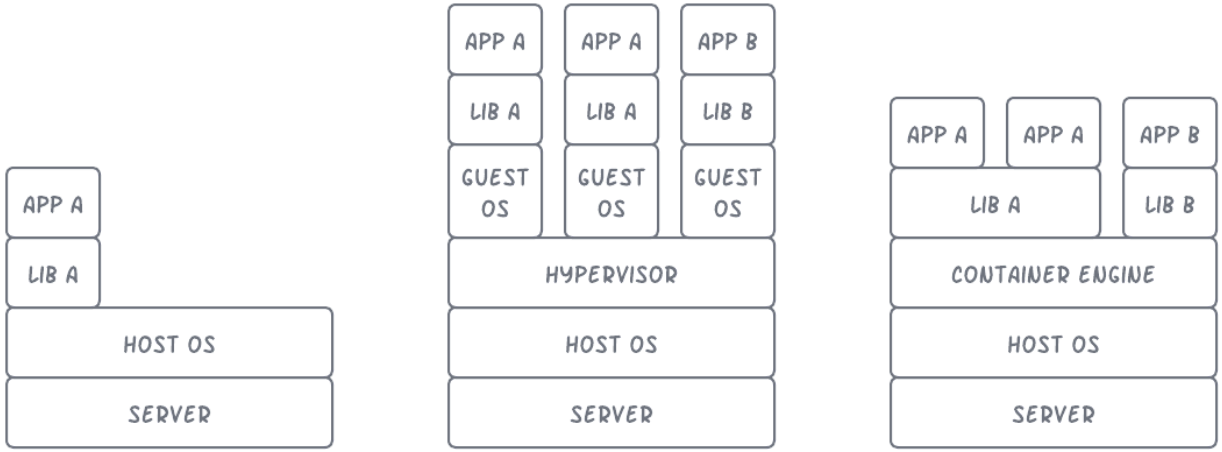
1. **Observe**. Engineers observe the behavior of the system through events, primarily log events.
2. **Orient**. Engineers understand the events through graphical user interface (UI) that aggregate events. They control the system by making changes to the code and configuration using an integrated development environment (IDE).
3. **Decide**. Engineers commit to a decision by pushing code to the version control system repository (Git).
4. **Act**. Agents act upon the decision by implementing the changes pushed to the repository.

You are not using someone else's website to manage your infrastructure. Edgecell operates on your terms, behind your firewalls.



Virtual machines versus containers

For industrial personal computers (IPC), we install applications directly to the operating system (OS). We used to do the same for applications running on servers in the data center. However, to increase security and avoid resource contention, it was best to install one server application per server. The consequence of this approach was that huge amounts of compute resources went unused.



Virtual machines (VM) solved this problem of underutilized resources. A VM isolates an application in its own guest operating system, which removes the resource contention and security risks of having multiple applications running in the same OS. However, it created a lot of overhead in order to run multiple instances of an OS on the same server.

Containers are the latest evolution in how to package and deploy applications. Containers are self-contained and isolated, so they address the issues of security and resource contention. However, they do not need a dedicated OS. Furthermore, containers can share common libraries. The result is dramatically increased efficiency in the use of compute resources. A server that might only be able to run ten VMs can run hundreds of containers.

Evolution

Containers and container orchestration such as Kubernetes may seem overwhelming. It should not. Creating and using containers is very simple, much easier than creating and using VMs. A developer can be up and running in minutes using his own desktop.

Any application can be converted into a container, even legacy Windows 95 applications. (Yes, we see some of those on the factory floor.) Most vendors are eager to migrate their applications to containers. Just ask. If they are hesitant, Edgecell engineers are more than happy to help.

Edgecell supports VMs, Docker and Kubernetes. As such, there is a simple process of evolution:

1. If the application is currently running on bare metal, we create a container or a VM for it.
2. If the application is currently running as a VM, we deploy it as a VM to the new edge node using GitOps.
3. Eventually we want to convert the VM to a container.
4. We deploy a single container to a single node (Docker)
5. We deploy multiple containers to a single node (Docker Compose)
6. We deploy multiple containers to multiple nodes with high availability (Kubernetes)

In reality, under the hood, it's Kubernetes the entire time. The conversion is handled as part of the deployment process.

Unified namespace and zero trust networking

Edgecell applies a unified namespace (UNS) to the deployment of all hardware nodes and applications. Edgecell also comes with an edge private network (EPN), which is an overlay networking tool designed to be fast, secure, and scalable. It connects any number of devices with on-demand, encrypted tunnels that work across any IP networks and without opening firewall ports. You can easily leverage the UNS to apply firewall rules to all nodes and applications.

UNS and EPN are what enable Edgecell's zero touch installation with confidence and security. UNS enables other business objectives which we will discuss next.

Business objectives

The task of IIOT is to empower all devices and processes in the factory to self-report in real time. In other words, you want access to the data that is in the machines on the factory floor.

Noticed I said task, not objective. You are not collecting and processing data for the sake of processing data. Your objective is to use data to do what you do better. In fact, you want to become better at using data to do what you do better.

You are hoping to achieve a strategic breakthrough, somehow transform your business so that you use data in ways that are not immediately apparent now. At the very least, you do not want to be left behind by other companies that are transforming themselves into data-driven enterprises. Companies that are now at the forefront of their industries have come to understand that their data is a valuable asset which they can leverage to drastically improve the way they do business.

You want your firm to evolve to a higher level of analytics. There are four levels of business analytics:

1. Descriptive
2. Diagnostic
3. Predictive
4. Prescriptive

One begins with descriptive analytics, which is basic reporting of what has happened, such as sales reports or sentiment surveys. Descriptive analytics provide only hindsight, but they are a necessary building block to moving forward to higher analytics.

Diagnostic analytics is the application of statistical tools to discover trends and correlations. It seeks to answer why events happen, but it is still retrospective.

The next stage in evolution is predictive analytics, to seek what will happen. A common example is sales forecasting.

The final objective, however, is prescriptive analytics, which is the ability to answer how to make something happen. An example of prescriptive analytics is price optimization.

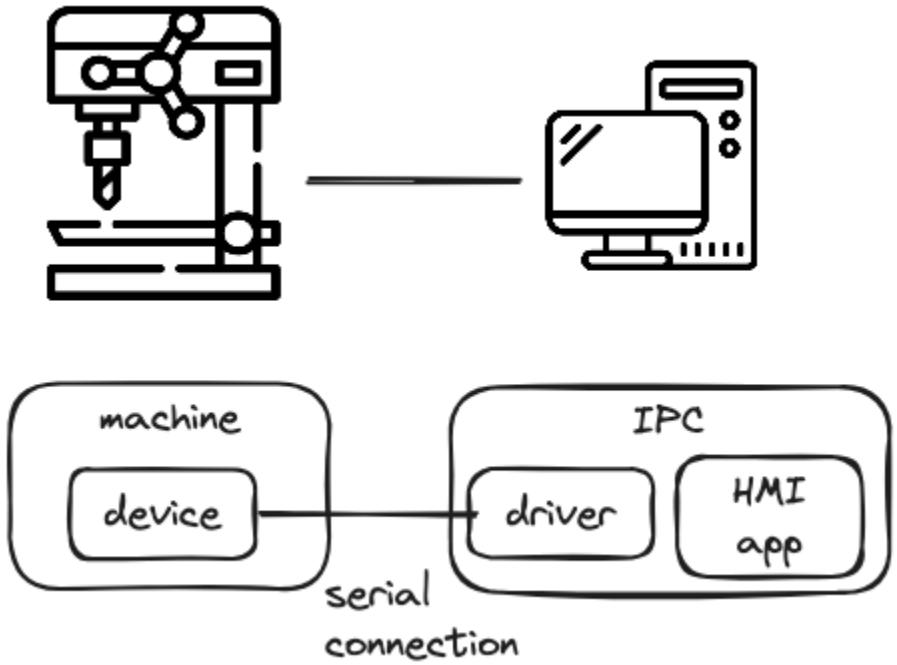
Sounds perfect: use data to know what actions to take in order to achieve our business goals. How do we get started?

How to get there

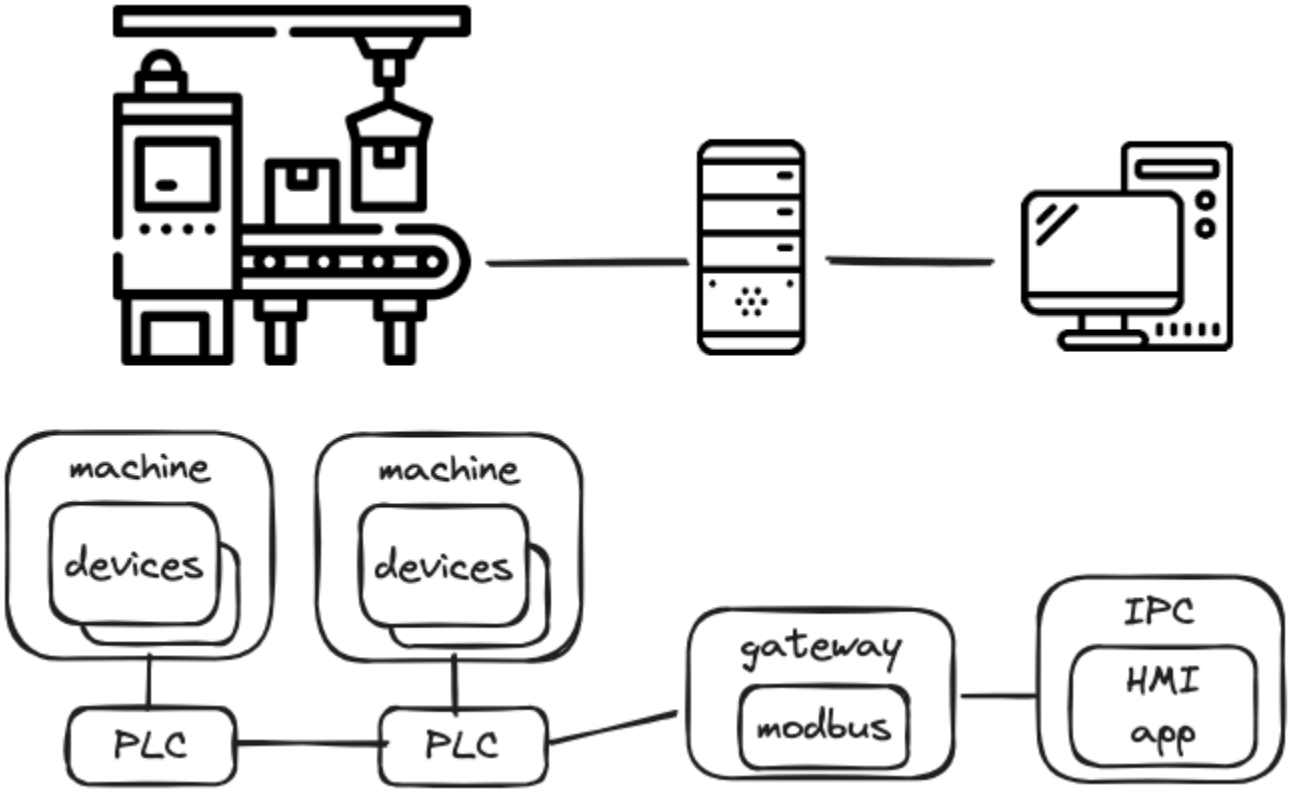
The first step toward business analytics is to democratize the data. To unleash innovation with data, you must unleash the data. No more silos. No more gatekeepers. No more tribal knowledge.

Legacy deployments

The following images demonstrate common deployments in manufacturing. The first is an IPC running a human machine interface (HMI) application has a direct serial connection to a machine.

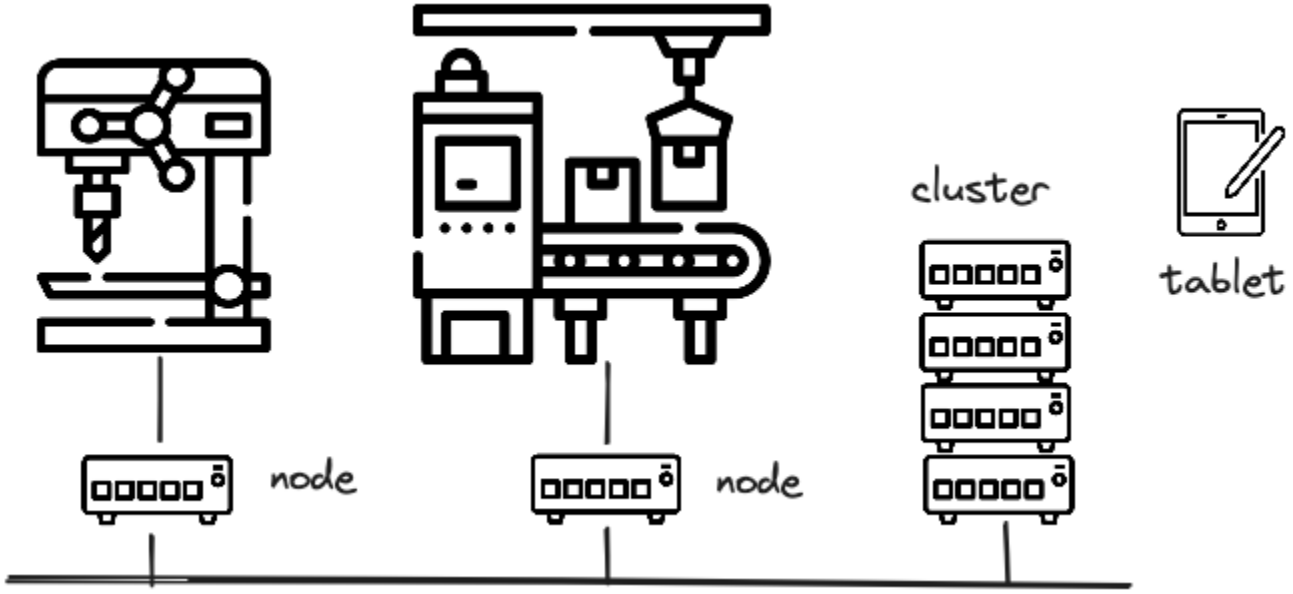


The second is a set of machines on a line with programmable logic controllers (PLC). The PLCs connect to a Modbus gateway. An HMI running on an IPC connects to the machines through Modbus.



Modern deployment

Modern edge computing would look something like the next image.



Some key features of this deployment:

- The edge nodes convert the legacy protocols (serial, Modbus, etc.) to Sparkplug B protocol.
- The nodes themselves are managed with UNS, so conversion of the data to UNS is seamless.
- The cluster runs the message bus (MQTT), the HMI apps and any business analyst applications.
- All applications are in high availability mode. That means if one of the nodes in the cluster should fail, the application and its data are still available.
- Users can access the HMI apps through tablets or thin clients.
- All the data is democratized, discoverable and explained through the UNS.
- Nevertheless, the organization has the ability to control access to data as necessary by applying rules with the UNS to the EPN zero trust networking.

How Edgecell can help

The Edgecell team is ready to help you evolve to a modern edge computing infrastructure. In addition to our technology platform, we also can provide your organization with the following consulting services.

1. **Baseline assessment.** We conduct a thorough documentation and assessment of your existing edge infrastructure and processes.
2. **Strategic consulting.** We work with your leadership to craft a specific edge modernization strategy for your organization, which includes a migration plan.
3. **Proof of value.** We can deploy Edgecell in one of your factories to demonstrate its simplicity, power and value.
4. **Architecture consulting.** We work with your team to define a blueprint for your edge deployments, which includes evaluating third party solutions.
5. **Application migration.** Our engineers work with your team and your vendors to migrate applications to containers.
6. **Systems integration and deployment.** Our engineers can assist in deploying your edge architecture globally.

Please do not hesitate to contact us. We are here to help. Thank you!

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