YOKOGAWA

Co-innovating tomorrow™

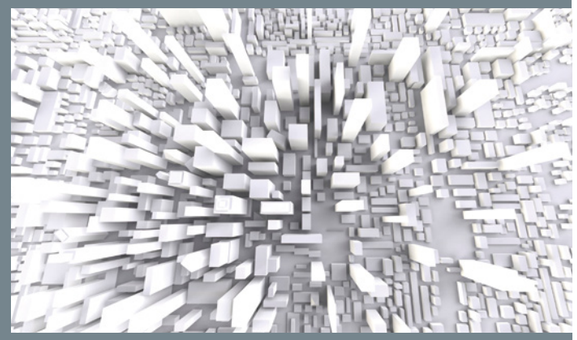
Remote Operation Options

White paper - February 10, 2022

Bulletin 30A05A10-01EN

Remote Operation Options

A plant's control room used to be an isolated island.
Now an entire operation can be monitored and controlled from anywhere
using technology tailored to match exactly what the company needs.
Here are six examples of approaches.



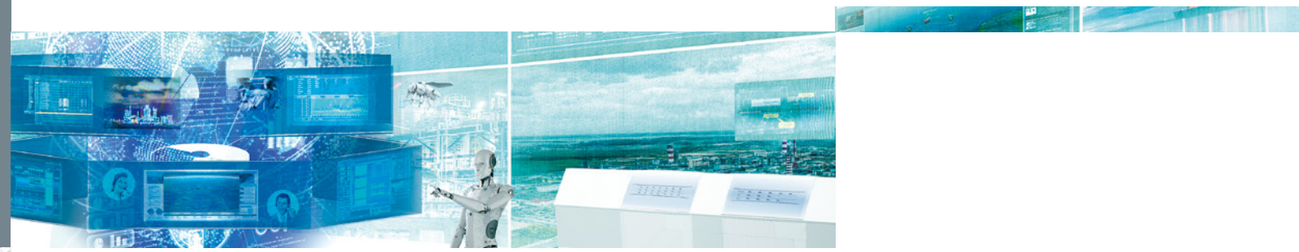
For the last few decades, process manufacturers have been dealing with the effects of workforce changes, and there are few signs of relief in the foreseeable future:

1. Enormous numbers of baby boomers have retired and many more will follow, taking knowledge and experience with them.
2. Fewer young engineers and technicians want to deal with the difficult 24/7/365 work hours of continuous process plants.
3. Plants in remote locations or extreme environments are unattractive to potential employees.

All that to say, companies have no choice but to find ways to operate with fewer people. Automation has been providing the means to do that for decades, and the need for using effective automation today is as great as ever.

The answers for finding ways to work with a smaller workforce begin with a two-fold proposition:

4. A company must bring employees with a virtual workplace to provide a more flexible and adaptable environment.
5. With fewer engineers and technicians available, a company must find ways to extend access to those human resources it has without the need for costly and time-consuming travel.



The solution is applying digital tools to provide a remote office, such that locational remoteness ceases to be an issue because fewer people must be at the actual site. Of course, remoteness doesn't just imply a great geographical distance. Technicians leaving the control room are remote the moment they step out the door if they do not have a means to carry some sort of human interface station (HIS) with them, with the ability to respond to alerts and events.

Effective communication using digital tools allows engineers and technicians to work from a central location so they can watch and control operations—and troubleshoot to solve problems—typically without having to visit any actual production sites. Such technicians can assist anywhere without the delays and costs related to flying and driving. Moreover, since talent is concentrated in one area at a centralized engineering office, colleagues are available for consultation.

At the same time, there are many benefits to implementing such digital tools that go far beyond personnel issues, as the following use cases will elaborate.

So how is it possible to create such an interconnected environment? For the rest of this white paper, we will look at six use cases that illustrate different ways to handle remote access implementations in a variety of contexts. The first use case establishes a benchmark of the most widely encompassing concept, so some of those that follow are variations on its basic capabilities. Many differences are subtle, but over the years and through thousands of projects, Yokogawa has demonstrated the ability to tailor solutions to work optimally in these different situations critical to its clients' success.

Use Case 1

Remote Operation of Yokogawa Process Control System

A hypothetical chemical processor has several production plants in Brazil supported by an engineering and operations office in Japan (Figure 1). It oversees production at the country's sites, rationalizing outputs, and coordinating exchanges of feedstocks and intermediates. Operators in the office can see the same production data as operators at the actual production site, and in an emergency can take over full control of any of the local plants.

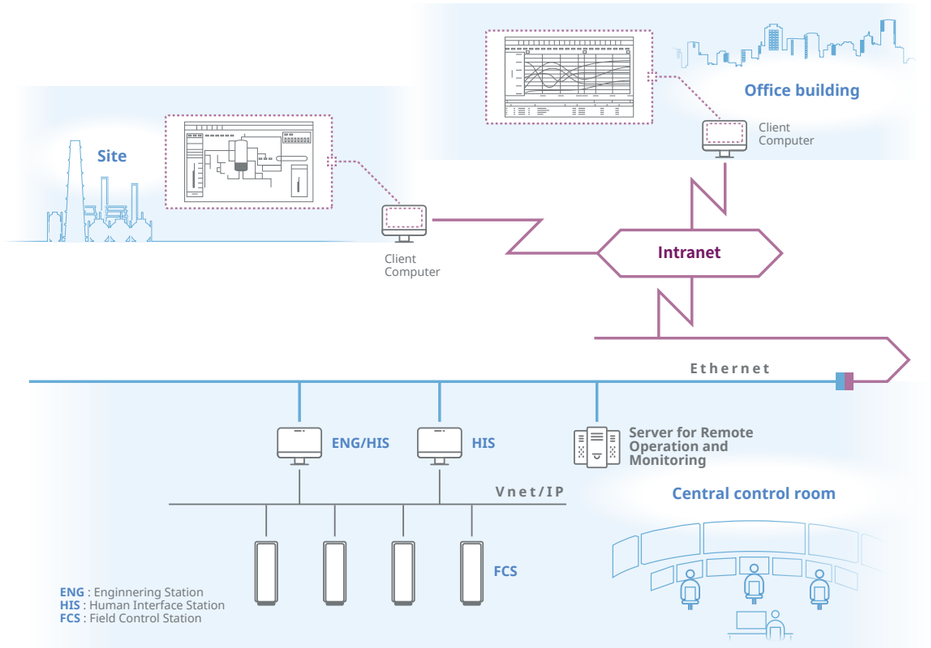


Figure 1: Local communications are handled by an intranet, but when reaching other offices around the world, the web ties everything together. For many companies, this represents the fullest realization of remote access and control.

The Brazil office also connects to the parent company's corporate headquarters in Japan, where there is a central control room watching over all the company's plants around the world, including those in China, Singapore, U.S., Brazil, and Germany. If necessary, operators at the central control room can take over operation at any site or unit anywhere.

Process engineers can also evaluate all production units to ensure production rates, feedstock usage, energy consumption, and product quality are all up to standards. When necessary, they can recommend solutions for any number of possible problems, spreading their expertise while remaining in a single location, which maximize personnel efficiency and productivity. Authorized company managers can also log into the central control room from any location across the globe.

Let's look at the kind of network architecture necessary to support this kind of operation.

Starting at the edge, a CENTUM VP distributed control system (DCS) at each site connects to a local intranet. Local in this case means it reaches all the individual sites and offices in Brazil, and similar intranets exist in corresponding areas around the world. This interconnects all the local plants, plus the intranet connects to Japan via the web.

Yokogawa's approach is to build interconnection and remote access capabilities based on a variety of industry-standard hardware and software technologies to ensure the best security, performance, and consistency. Some examples are:

- Microsoft Windows remote desktop service (RDS).
- Wired Ethernet and wireless Wi-Fi networking.
- Virtual private networks (VPNs).
- Thin client devices, web browsers, and mobile devices.

Deploying these technologies in the right combination enables one or more users located onsite or offsite to access the right information securely via an appropriate device and take action.

Use Case 2

Remote Operation of Yokogawa Process Control System and Other Software

Many companies do not see the need, or may be opposed, to extending real-time plant control accessibility to a remote location. For these companies, it is sufficient for management to monitor plant activity, perhaps in granular detail, from a central office or other remote location. However, the ability to control remotely is still useful, but on a more limited scale, such as by an operator within the facility using a mobile HIS (Figure 2).

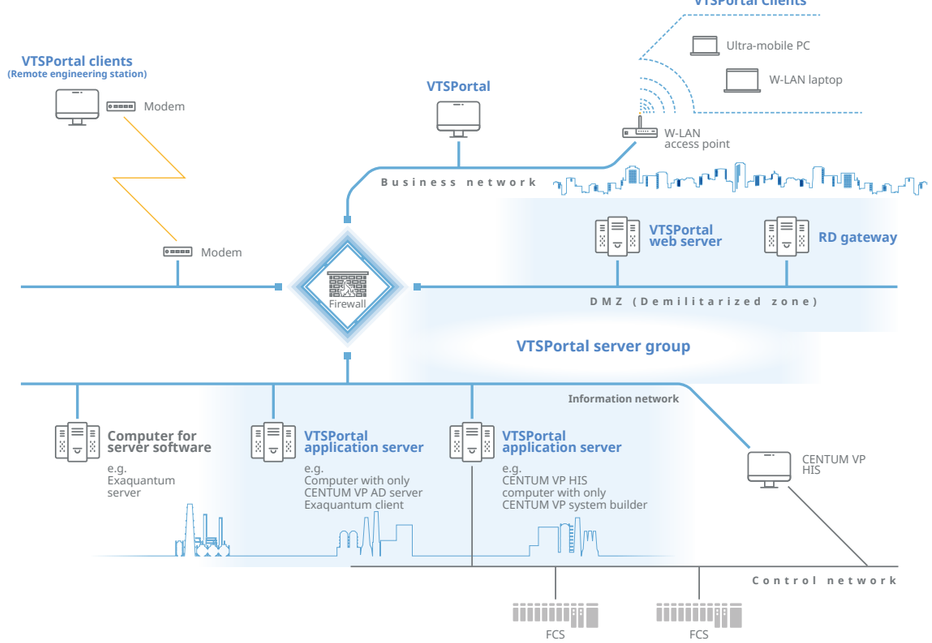


Figure 2: Yokogawa's VTSPortal allows a location to deploy an application on a dedicated thin-client basis, with functionality limited to meet each user's requirements.

If the user is within the plant or at another company facility, the connection may be via a plant Wi-Fi network using a VPN. If located more remotely, data transfer to a PC or tablet is via the internet, perhaps using a dedicated thin client, with the degree of functionality determined by the company based on each user's needs.

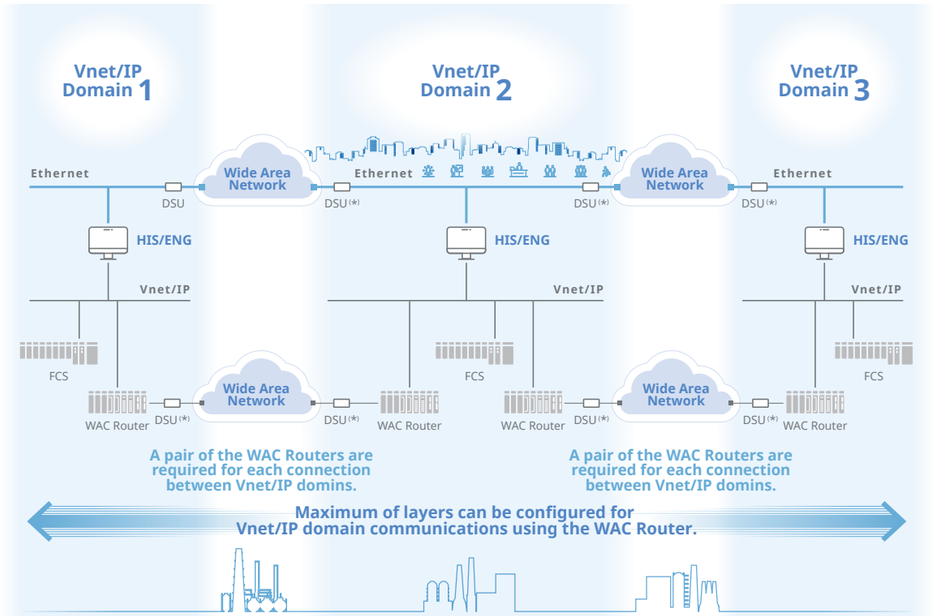
This approach can aggregate data from all Yokogawa-based platforms deployed in the facility, whether related to instrumentation control and safety systems, or support functions such as manufacturing execution systems and plant asset management applications. For example, Diagnostic data from condition monitoring sensors appears at the plant and office, so reliability and maintenance efforts can be coordinated to support production. Such platforms are accessible using web browsers and can support remote terminals, such as a mobile human machine interface (HMI) on offshore platforms, remote tank farms, and other unmanned facilities.

As a more-secure alternative, Yokogawa offers the VTSPortal application server, which enables users to host manufacturing software applications on a website via standard Microsoft technologies mentioned previously. Clients can display and operate authorized functions by accessing the portal site. This improves security by avoiding a direct connection between clients and core operations systems, with data only available for viewing via the VTSPortal. In addition, the VTSPortal extends beyond each CENTUM VP HIS, allowing a user to monitor and operate plant resource manager and other applications.

Use Case 3

Remote Operation through a Limited-Bandwidth Network

In some situations, a remote facility may be constrained by available communication bandwidth, making it difficult to engage with other networks or the web. Offshore floating production units (FPUs) for oil and gas are a prime example of this situation since they often depend on satellite data transfer. This limits the ability for operation and monitoring from a central control room onshore. Yokogawa has deployed technology solutions (Figure 3) for FPUs and similar remote facilities to reduce project cost and improve operational productivity.



DSU : Digital Service Unit

Figure 3: The right technology solutions can mitigate bandwidth bottlenecks.

A wide area controller router extends the process control network from the FPU to a shore-based operations and support center, providing monitoring and remote control even with low-bandwidth and high-latency communications, such as satellite connections.

Use Case 4

Integrated Operation of Geographically Distributed Systems from Multiple Vendors

When companies operate multiple plants, perhaps in several countries, it is rare to find that they all use the same type of automation platforms, or even the same vendor. This is often a result of plants being built with different automation needs, at different times, or even by different companies originally, and then joined together via mergers and acquisitions. Making these multi-vendor platforms from different eras work together on a scale described in Use Case 1 requires a specific strategy to bridge communication gaps and inconsistencies characteristic of such a product mix.

Such a strategy requires a flexible HMI (Figure 4) able to separate systems responsible for data collection and application execution, such that data can be made more translatable, overcoming the incompatibilities. Communication standards such as OPC UA, MQTT, and ODBC provide the translatable format. This flexible HMI is built into Yokogawa's Collaborative Information Server (CI Server, see Sidebar), and it provides the translating mechanism. The large network tying together all the locations consists of a CI Server in each location, with these servers communicating with each other.

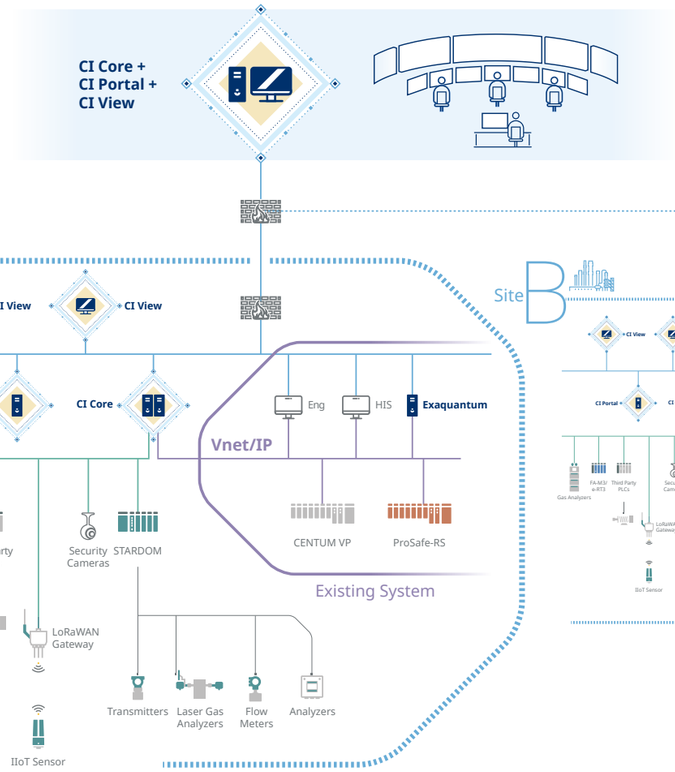


Figure 4: A flexible HMI is necessary to create mechanisms capable of tying together different types of devices and networks into a cohesive whole.

Using HTML5, a CI Server can interact with any PC or mobile device capable of hosting a web browser to duplicate each HMI of connected systems, allowing any authorized individual to monitor and control a system. This is a critical step for companies advancing toward deeper digital transformation, resulting in a reduction of operational maintenance costs, while building a network to integrate the plant floor horizontally by bringing in process information from equipment and sensors.

Use Case 5

Remote Operation with Cloud Technology

The use cases discussed so far share a common assumption that everything is running on in-house hardware, so all software resides on company servers with internal support. This mindset might be driven by tradition, or by the assumption that this is necessary for control or security. The downside is the cost to purchase and maintain all that equipment, including both physical maintenance and software updating.

This is no longer necessary, and in many cases not even advisable, thanks to cloud technology (Figure 5) via public providers such as Microsoft Azure and Amazon Web Services. Yokogawa's CI Server is designed to work seamlessly with the cloud or in-house networks, so it can support either approach.

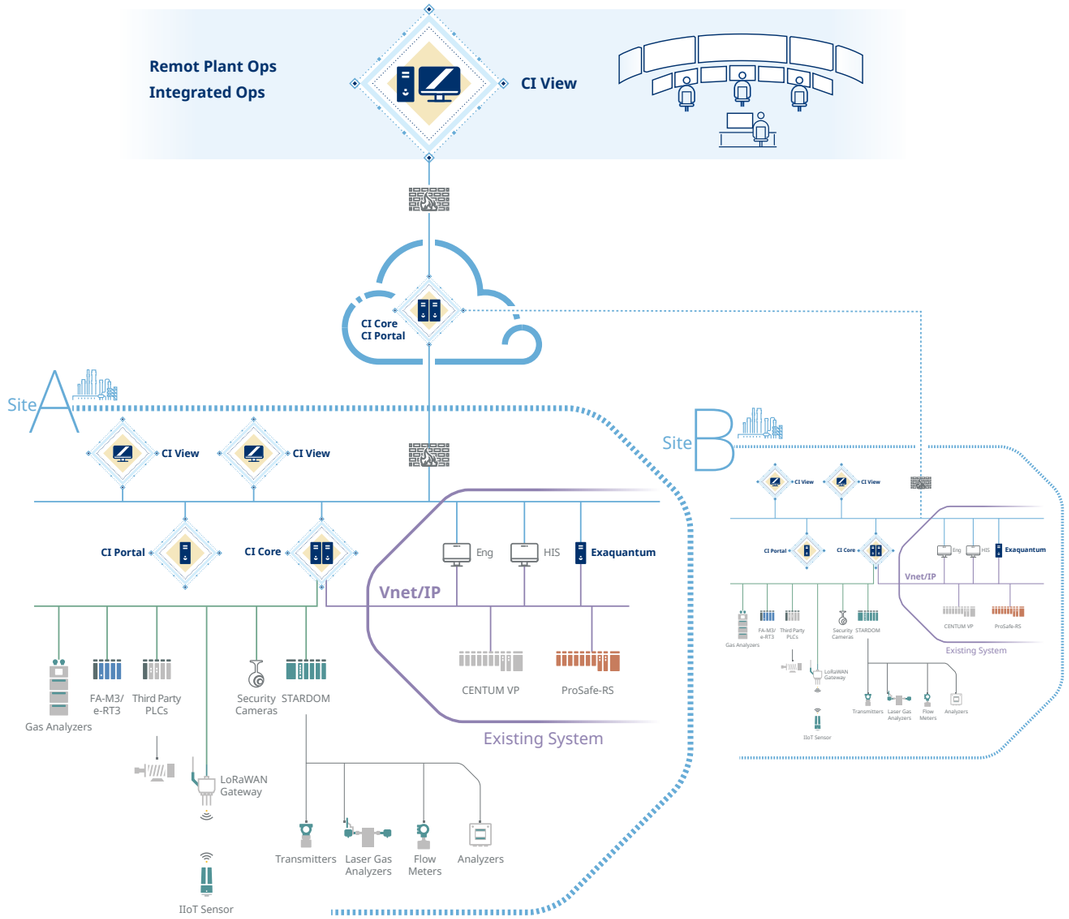


Figure 5: Using cloud hosting for software minimizes on-site hardware and can improve security.

Security using Yokogawa's cloud service is often stronger than many companies' own efforts. Yokogawa's Security Operation Center service ensures the security of the interface between on-premises networks and the, with automatic updates as new threats are discovered.

The combination of sophisticated security—combined with the cloud's low initial cost, fast development, easy scalability, and reduced volume of on-site hardware when compared with in-house solutions—makes this approach far more attractive as companies move into more extensive remote networking solutions.

Use Case 6

Remote Maintenance of Assets at Level 0 to 3

So far, the use cases have mainly been related to the monitoring and control of actual manufacturing processes. However, the same motivation also applies to asset management and maintenance.

Many process plants and facilities are located in harsh environments, and they are sometimes in places where it could be difficult, or even impossible, to reside. Company headquarters may be in a big city, but the plants themselves could be in a desert, a frigid area, or even offshore. It is not easy to constantly deploy maintenance personnel to these locations and check that the plant assets are in good working condition.

Until recently, reactive maintenance has been the norm, with plant personnel identifying failed equipment and replacing it, but this has many disadvantages, such as making it difficult to control budgets and increasing downtime. However, by using a platform like Yokogawa's Managed Service Suites (MSS) to remotely connect OT/IT plant assets, the health, reliability, and security status of these assets, and the entire plant, can be visualized with a glance on a single dashboard.

Moreover, with the OpreX™ Managed Service provided by Yokogawa and based on the MSS platform, end users can be released from cumbersome day-to-day manual rounds, allowing them to perform maintenance work more efficiently. Collected data can be used to manage the lifecycle, condition, and availability of spare parts, etc., enabling planned maintenance and facilitating budget management (Figure 6).

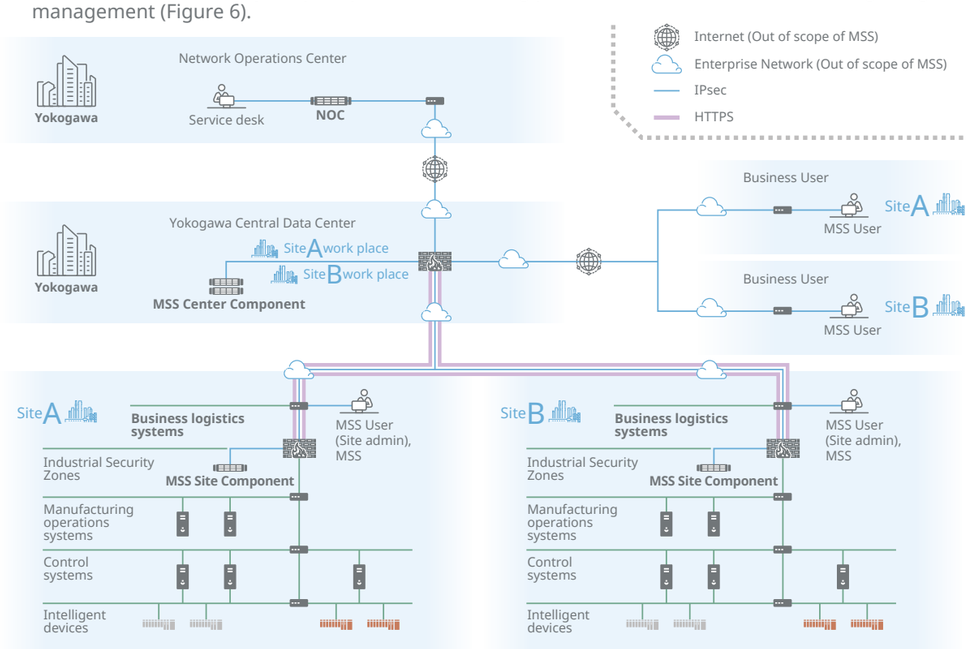


Figure 6: Remote monitoring requires a specialized tool able to analyze traffic, and read diagnostic data from components Level 0 to 3.

If an incident such as a failure or deterioration occurs, an alert will be issued, and the ticket will be registered in an IT Service Management . This process allows Yokogawa engineers to identify the problem, often before the end user is aware of it, and perform the necessary troubleshooting. In the past, plant personnel had to go to the location of the problematic equipment, check its condition, and replace it, but this laborious process can now be significantly improved.

With remote monitoring and maintenance, end users can enjoy the benefits of less equipment downtime, fewer interruptions to critical operations, longer asset life, and improved efficiency.

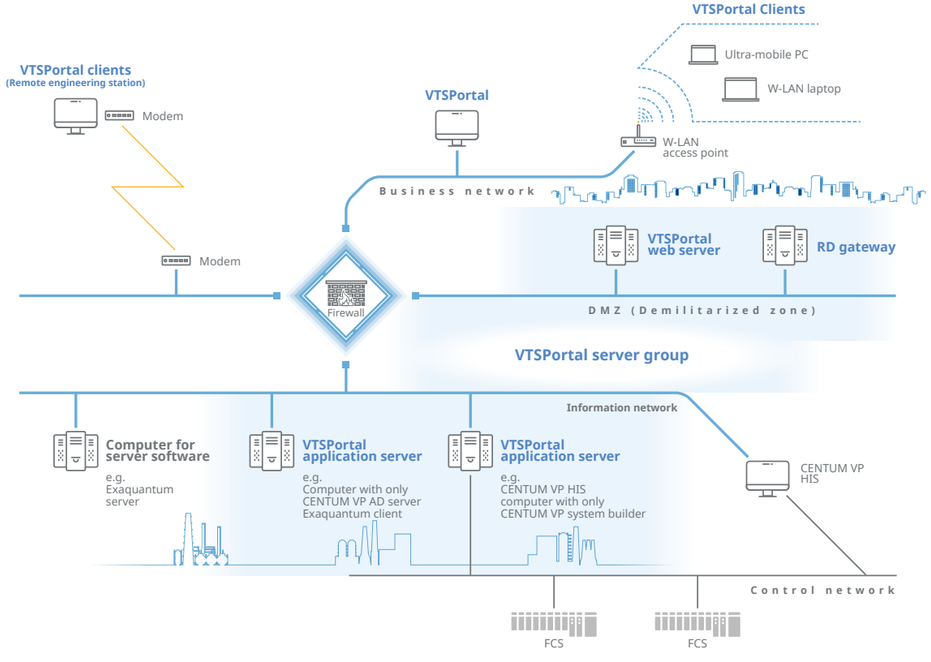
Addressing Your Company's Needs

The benefits of remote access and the technologies necessary to achieve it in the most effective way change from company to company. For some, the ability to control anything from anywhere is of primary importance. Others may want a more modest approach, or they may struggle with constraints such as bandwidth availability.

The critical element for success is working with an implementation partner that has the experience and variety of product offerings to create a solution for today, as well as what may be needed down the road. Yokogawa can provide that combination, plus the experience of working with process manufacturers of all types, to ensure the right remote access solutions is selected, installed, commissioned, and maintained.

Sidebar

Versatile Terminal Service Application Portal



Yokogawa's Versatile Terminal Service Application Portal (VTSPortal) allows users of Yokogawa's application platforms to perform monitoring and control functions via a website using the Microsoft Windows remote desktop service. This means users of CENTUM VP, Exaplog, Exapilot, and other related platforms can use various means of communication, including the internet, for remote access to critical manufacturing data and control. The VTSPortal provides an integrated HMI framework for Yokogawa's applications, such as CENTUM VP HIS, so they can be used from remote locations.

This provides a variety of capabilities:

- Technicians can perform remote maintenance and engineering work for CENTUM VP systems via a WAN connection.
- Access points for all Yokogawa applications deployed in a facility are aggregated.
- Connections to applications for each user are via a thin client, so users require only access software.
- Because access to CENTUM VP HIS is supported via any device capable of hosting a web browser, operators and technicians can use portable HMI terminals when visiting offshore platforms, remote tank farms, and other unmanned control centers.

The VTSPortal operates on multiple network systems depending on the application requirements. For example, when an operator needs a walk-around HMI to monitor changes to equipment in the plant, such local communication can be via a LAN environment, such as an office network. On the other hand, if the operator visits a remote pumping site, the same data can be sent via a WAN environment with remote access capabilities through the internet. Both methods can operate simultaneously as needed.

From an architectural standpoint, a VTSPortal client is a station providing access to the VTSPortal web application server. The connection can be made via an Ethernet-based LAN, wireless LAN, or network WAN. The VTSPortal web server hosts the portal site, and VTSPortal clients access this portal to display and operate applications.

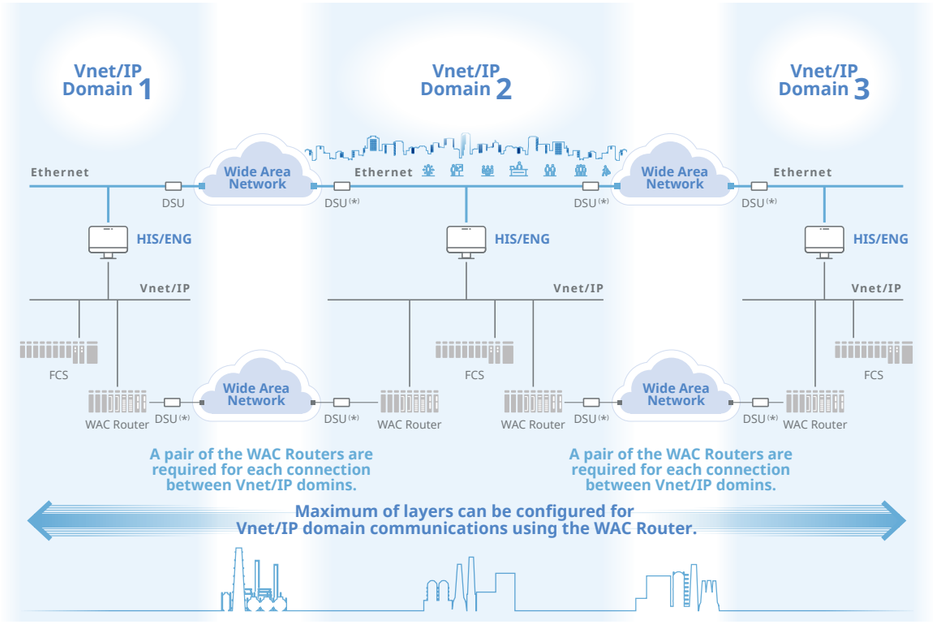
To support client access, the computer serving as the VTSPortal application server provides HMI functions to clients for applications hosted on the VTSPortal by using Microsoft Windows remote desktop service. The Windows remote desktop service, various software packages, and the VTSPortal application server functions are installed on this computer, which becomes the application server.

As the diagram illustrates, the application servers for CENTUM VP and Exaquantum can be separate and independent to support traffic demands. (Some of the functions must be separate, for example the VTSPortal web server and application server can't be on the same computer.) Where network demand is heavy, the VTSPortal multiple client builder license is installed on the application server, and builder functions can run on several client computers simultaneously.

Yokogawa's VTSPortal offers a high degree of functionality, flexibility, and scalability, making it easy to adapt to different facilities, or multiple facilities in a larger corporate environment.

Sidebar

Wide Area Communication Router



DSU : Digital Service Unit

When companies design large-scale networks covering multiple locations and even multiple continents, they may encounter situations where they are forced to use communication methods that are less than optimal. These may include public communication lines or satellite links, each with bandwidth as low as 1 Mbps, which are problematic because they limit transmission data capacity, increase latency, and/or provide no mechanism for redundancy.

Yokogawa's WAC Router is designed for these types of communications networks, allowing users to monitor and control their CENTUM VP systems remotely via a WAN supported only by these constrained methods. Even in these situations, the WAC Router provides the same high reliability and security as the Vnet/IP control network, with data transfer speeds reflecting bandwidth limitations. It compensates for limitations and delays by prioritizing traffic based on criticality, data type, and recipient.

When connecting multiple Vnet/IP Domains, it is often necessary to compensate for reduced transmission reliability. The WAC Router has dual redundant communication modules that can be linked with the WAN by two communications lines. The two lines may be the same type, or different, such as a satellite link for one and fiber optic cable for the other.

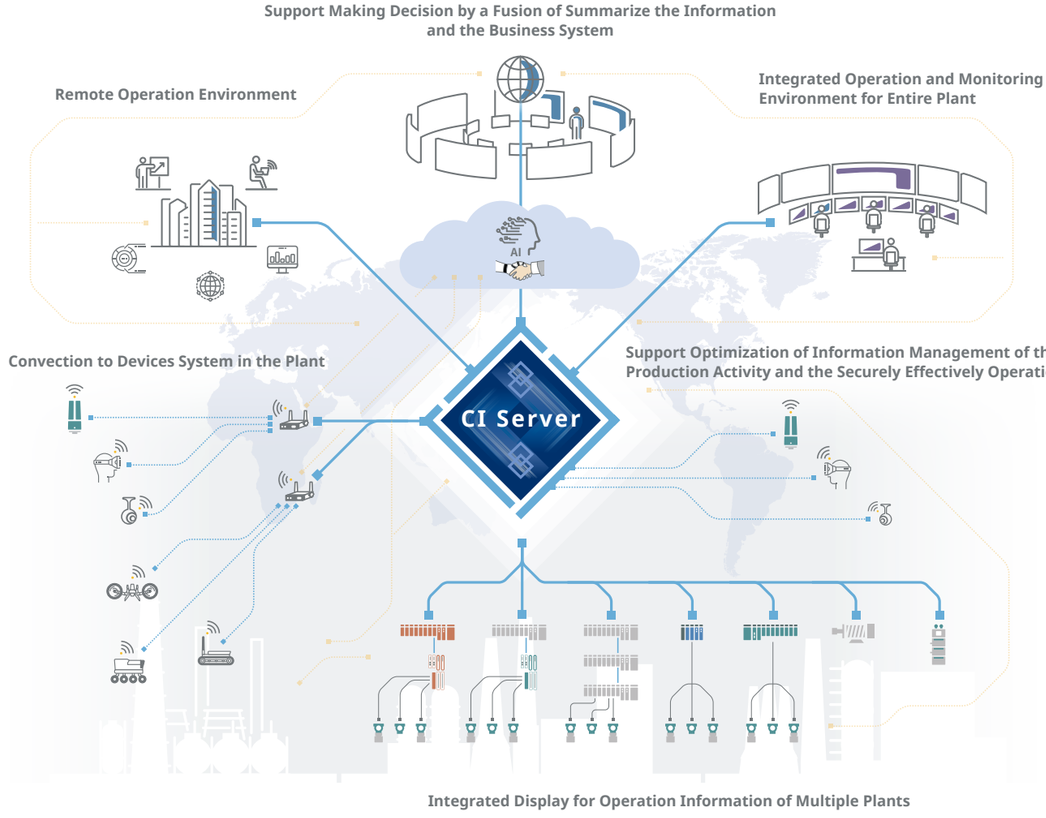
System architecture includes configurable functions, including:

- Transmission data capacity down to 1 Mbps.
- Frame filter function to reduce the number of control communication frames for using limited bandwidth more efficiency.
- Time synchronization function to account for time differences among Vnet/IP domains within 5 seconds.
- Bandwidth limit function and preferential forwarding controls communication frames to protect critical data.
- Security functions using the same protections as conventional Vnet/IP networks, including the ability to destroy packets not used in the WAC Router.

These capabilities provide the means to bridge problematic gaps found as networks grow and accommodate network limitations.

Sidebar

Collaborative Information Server



Yokogawa's CI Server is a cross-platform control and information system that integrates all aspects of operations, process control, data collection, data analysis, and artificial intelligence in a central location. Providing these capabilities calls for the latest technologies, combined with deep experience in process control and plant technology. A company wanting to improve its ability to respond to everything from large-scale industry changes to individual process changes must keep the big picture in mind, and CI Server provides the means to do this.

For example, when implementing remote access to improve operational efficiency and productivity across all sites and units, it is essential to provide a consistent experience for operators stationed at each site, as well as with headquarters personnel and specialists in the field.

A CI Server supports these and other efforts by providing a variety of external communication drivers, along with an industry-standard open interface, enabling the collection of all process and operational data, plus interaction with digital twins as needed. This contributes to overall production optimization efforts by utilizing data collected over long time periods, and then linking it with applications for process analysis and diagnosis, as well as with information and quality improvement systems.

To spread out resources more uniformly, a CI Server facilitates plant operations by providing these and other capabilities:

- Local and geographically distributed plant control from a central location.
- Safe and secure data consolidation and distribution.
- Centralized artificial intelligence capabilities with access to the large pools of data needed to provide sophisticated analysis.

This results in improved decision making at all levels, from an individual process unit control room operator, to production and executive management.

As a case in point, when remote operation is a routine availability, specialists such as mechanical and electrical engineers, technical staff for information systems, and experts in plant processes who are at headquarters or other sites can serve the entire company, rather than being tied to a specific site. From a central location, they gain a panoramic view of the entire company's operations and can see where their skills should be applied most effectively.

It is also often necessary to remotely monitor the operations at each site to solve problems made worse by the increasing scarcity of experienced operators, and the corresponding problem of retaining skills and organizational knowledge. A CI Server can connect people wherever they may be, enabling the provision of remote assistance. This improves personnel productivity for the entire company by making best use of limited human resources, ensuring stable and efficient operations, even at remote sites.

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, Japan
https://www.yokogawa.com/

[Ed : 01/d] 202

YOKOGAWA Co-innovating tomorrow™