



# **Exaquantum in the Cloud**

Expand the 'Potential for Collaboration'

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# Executive Summary

After many years of deliberation and contention, rapidly changing market conditions have shifted the digital and technological landscapes to permit Cloud-based software applications to rapidly gain momentum in the production environment. With global organisations facing the emergence of Big Data, Industry 4.0, IIoT and the fusion of IT and OT, Cloud infrastructures can flourish, with comprehensive availability to vast data pools that remove the access barriers to information and enable digital transformation.

From a business perspective, Cloud computing and data storage can optimise efficiencies and improve collaboration, enabling organisations to innovate and stay ahead of the curve. By moving process data to the Cloud, knowledge becomes more accessible through connected locations, bringing together plant data from single and multiple site installations, creating a collective set of actionable information for deeper analysis and to propel improvement initiatives. A Cloud-based solution drives the potential for collaboration, removing any unnecessary geographical, departmental and hierarchical barriers to promote cohesion and cooperation within the organisation. Cloud applications enable companies in process industries to improve business agility, rapidly adjusting to new and innovative ways of doing things, whilst maintaining a unified data platform.

From an operational standpoint, manufacturers are able to operate plants that are safer and more reliable, capitalizing on the increased amount of data to make them more operationally proficient and agile. The Cloud offers the opportunity to fully unlock the value of process data in order to grow the business and at the same time reduce upfront costs. It is a step towards reducing total cost of ownership by driving down costs and saving time. It facilitates a fundamental change in approach, switching towards a subscription model of platforms, infrastructure, software and data. Cloud computing is supporting a shift in business focus, from capital expenses to operational expenses, in a move that matches capacity to need. As an alternative to upfront investments based on peak capacity for physical servers and infrastructure, Cloud enables a pay as you go subscription model with monthly costs based on the services that are used.

Concerns and challenges have been expressed by manufacturers regarding how viable the Cloud is for process monitoring and control applications. Emerging common themes are the ability to establish a clear migration path from the existing install base, uncertainty around maintaining levels of performance, uneasiness surrounding data reliability, cyber security vulnerabilities and data integrity. These factors need to be considered

in any Cloud migration strategy. Cloud adopters are finding ways of making the Cloud work for them and knowing exactly when and where it will be used, whilst alleviating the associated risks.

Connectivity to the Cloud via a range of deployment options is fundamental to enable manufacturers to embrace the next generation of process automation solutions. By establishing and defining the required outcomes and benefits at the start of the journey, it is easier to select the appropriate technology to help meet the desired end goals. Users are pressing for increased versatility with ease of integration and Cloud-based solutions that can offer greater flexibility of migration and adaptable deployment scenarios.

In response, Exaquantum, Yokogawa's plant information management solution provides a platform for gathering and transforming process data which can be deployed in a Cloud environment, on-premise or a combination of both. With its unique and feature-rich set of native applications, built using open connectivity standards, it provides performance and scalable solutions that can be deployed across single or multiple sites and Cloud installations. Offering the flexibility to build complex data and application architectures with a single software platform where components can be deployed in the Cloud or on-premise in the most effective way.

For example, process data can be stored on-premise to be readily available in the control room while alarm management application can be installed in the Cloud to serve multiple sites. With Cloud being able to connect via a range of deployment options, Yokogawa can support a wide variety of Cloud migration strategies and reduce the risks associated with moving data into the Cloud. Once a business has chosen this direction, a phased or gradual path to migration can be a more effective transitional approach that mitigates risks and limits issues during each phase of the process.

Exaquantum deployed in the Cloud is a readily available data historian platform with a feature-rich set of complementary applications, which are available in the Cloud, on-premise or a combination of both and provide a future proof approach to process data management.

With a well-established presence, industry experience and a comprehensive and innovative Cloud-enabled historian platform featuring a suite of value added applications, Yokogawa has the knowledge and capabilities in the process industry to drive operational excellence throughout the business enterprise and co-create value with its customers.

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# 1. Industry Landscape

Cloud-based computing is becoming an increasingly popular delivery platform for web-based applications, especially for those that will vary over time in their capacity needs. With market demands and technological advancements towards a more digitized world, organisations have an opportunity to move their operational and process information to the Cloud to grow their business, reduce upfront costs, and unlock value from their plant data.

## 1.1 Business Impact of Cloud-based Historians

The process historian remains a key component of every process facility's control system architecture. With Cloud-based installations gaining momentum, process historians are further increasing their ability to generate growth and extract value from historical plant data, which is more relevant to a wider audience of business users.

Cloud-based historians offer additional flexibility and convenience for collecting and distributing data across multiple sites and locations. This could be from the company's headquarters where subject matter experts can perform analysis across more than one site from geographically dispersed organisations. It also offers greater fluency for data access, enabling anyone from within the organisation to view and access critical information. Cloud is an innovative way to extract value from data and encourages the sharing of information for a more collaborative environment as well as having the ability to remove obstacles for a more creative and agile use of data.

Centralized Cloud deployment simplifies the administration as the hardware and infrastructure is supplied via the Cloud provider. Therefore, businesses have the potential to reduce upfront costs from an administration and hardware standpoint.

Cloud facilitates changes and supports the emergence of IT trends such as Big Data and Analytics and the movement towards digital transformation and Industry 4.0 in the digital domain. With the Cloud, there are less access limitations to data that increases the potential for collaboration and versatility across the organisation with a more agile development framework.



### 1.2 Shifting Technology

With shifting technology landscapes, smart sensors and IIoT are taking a prominent role particularly regarding maintenance and asset management. Cloud-based historians are very well suited to address these changing needs and more adept at handling data that is becoming more disparate and distributed, connecting equipment and systems through protocols including OPC Unified Architecture (OPC UA).

In addition, there is a distinctive shift in the way that data applications are being developed. Traditionally, applications were developed in a monolithic way, very structured and rigid, with limited flexibility. In an environment that is now becoming more agile, application development is also adapting to these technological enhancements to make better use of the increase in data availability, extracting relevant data to provide some dedicated and targeted functions. This change in approach is providing the next generation of platform developments with targeted and specific value-added customer applications.

### 1.3 Changing Business Models

Organisations have been traditionally buying and purchasing their own hardware, servers and licenses with large upfront Capex investments and ongoing administration and maintenance costs with on-premise deployments.

With Cloud-based installations, businesses are beginning to move towards a service or subscription model that is more aligned to their data strategies as part of an Opex-based cost model. They select an appropriate infrastructure or Cloud platform that supports a software as a service (SaaS) model, where data is provided on a pay-as-you-go basis where they no longer own the hardware or the licenses that are necessary to run an application. Referred to as 'compute platforms' (ARC) these are Cloud platforms that enable the infrastructure of an organisation to be deployed in a Cloud environment. Two popular examples are Amazon Web Services (AWS) and Microsoft Azure, which are Cloud-hosting platforms that enable you to run your own virtual environment that support your services and applications.



## 1.4 Challenges

The use of historians in a Cloud environment is on the rise as businesses are becoming more aware of the multiple benefits associated with Cloud installations. However, the move to a Cloud-based historian solution can involve a shift in consolidated practices, with significant impacts to the IT infrastructure and system architecture that can make Cloud adoption unclear. All these changes can expose Cloud historian adopters to increased levels of risk and uncertainty that need to be assessed and overcome before a move to the Cloud can be realized.

### 1.4.1 Migration from the existing install base

Cloud migration involves moving a data historian and applications from an on-premise installation to the Cloud, or moving them from an existing Cloud environment to another. Many organisations may already have a large install base, and invested heavily in this infrastructure so are not prepared to change their approach or consider an alternative operational business model immediately.

However, over time conditions and requirements can change quickly, with certain scenarios becoming more favourable with the Cloud. These business drivers can include the need to reduce operational costs, geographic business expansion, wider distribution of expertise and changing cost models from Capex to Opex.

To better address these needs, an installation deployed in the Cloud is preferable, and offers greater flexibility and agility for businesses to remove the barriers of the existing install base.

### 1.4.2 Reliability & Performance

There are various Cloud service models available for the process industries which seem to naturally fit but consideration is still needed to select the most suitable Cloud type. These decisions will be assessed against a number of factors that are closely aligned to the strategic needs and direction of the organisation. For example, Infrastructure as a Service is the preferred choice of companies who desire to outsource their physical infrastructure and have their applications hosted on third party data centres.

This may be installed on a public (AWS, Azure, Google Compute Engine, Alibaba Cloud) or private Cloud provider or spread over both with a hybrid solution. Public Cloud solutions may offer greater flexibility, but invariably increases the risks which is not an option for some organisations.

Similarly, certain process data and information is highly confidential and must remain on-premise. A hybrid solution can help, allowing businesses to select which components can live in a public Cloud, and which will remain within their data centre.

### 1.4.3 Security

Data security has become a major concern in recent times with highly publicised cyber threats and cyber security breaches that have increased the levels of scrutiny surrounding all Cloud data storage options. However, the biggest cause of concern for Cloud storage isn't the threat of being hacked, its loss of data and the assurances needed regarding data protection, backups, data security, data transfer and privacy of information. Cloud providers use encryption methods and complex algorithms to conceal and protect information. They also use sophisticated security methods for an added level of protection. Cloud storage avoids risk from localised incidents and events such as fires, floods, hurricanes and computer meltdowns which keeps your data safe and consistently accessible.

### 1.4.4 Data Ownership

Another important aspect of a Cloud hosted Server is determining who the data owner is and where the data is being stored. Data ownership can be a complex issue, and organisations need to be aware of the potential issues, complications and risks to ensure that any Cloud-based strategy takes account of data ownership. Most third-party Cloud vendors are aware of this important issue for many organisations and take the necessary steps to improve the definitions in their standard contracts. Clarifying and defining ownership requirements upfront, including the nature of the data and how it will be used, is an advisable and prudent measure that business owners need to be aware of for any Cloud-based installation.



## 2. Solution

The use of Cloud-based process historians is on the rise, offering companies the opportunity to generate business growth, reduce upfront costs, and unlock value from their data.



With the increased amounts of data now available, Cloud computing and data storage can optimise efficiencies and enable businesses to be more operationally agile. This allows for a shift in data strategy, with organisations considering a move towards a service or subscription model as part of an Opex-based cost model. However, Cloud transformation takes time to implement because businesses will need to adapt their current data strategies, environments and processes in order to make full use of the opportunities that exist in the Cloud. There are a number of challenges to overcome including: uncertainty in terms of migration from the existing install base, data reliability, performance and security.

To explore the benefits of a Cloud-based process historian, and to address the challenges and risks associated with moving to a Cloud infrastructure, Yokogawa is able to leverage the power and flexibility from the solid install base, including value added Exaquantum applications, into a hybrid Cloud-based historian platform.

A Cloud-based Exaquantum deployment overcomes the many challenges associated of migrating a process historian to the Cloud in an optimal way, to reduce risks for all parties and open up new opportunities. By transferring an already familiar and industry recognized solution into a new deployment scenario, it provides the possibility to run the same feature-rich set of tools in the Cloud. It also provides a platform to expand these capabilities with enhanced tools and Cloud specific features for improved collaboration with users.

Migration from the existing install base is a standard task to perform as existing components are reused to significantly reduce the disruption to the existing installation. Exaquantum deployed in the Cloud maintains the same level of reliability and performance when compared to an on-premise deployment.

With data security and concerns surrounding loss of data, Exaquantum in the Cloud contains the same security measures and features with improved data transfer, security and integrity to protect data.

Exaquantum provides a data platform for delivering operational value from the abundance of process automation systems using standard SQL structures and

open interfaces. This provides the foundation to easily create and develop an impressive suite of modularised applications tailored to meet specific customer needs deployed in physical, virtualized or hosted environments (on-premise or in the Cloud). These specialized analysis packages are used for alarm management, safety system monitoring, asset management, mass balancing, off-sites management, and power and energy consumption. These application packages were developed to meet regulatory challenges or solve specific end user problems in a collaborative environment.

By developing applications using a modularized approach, it offers the convenience of viewing and storing data from multiple sites which can be accessed from a single location. It also offers greater fluency for data access, enabling anyone from within the organisation to view and access critical information. As an example, Yokogawa worked on a solution with a leading agribusiness group to analyze alarms and PID (proportional integral derivative) controller performance for ten of their production plants worldwide from a Cloud-hosted centralized control center. They wanted to analyze alarm performance and improve the operation of their PID controllers from their headquarters, and continue to access plant information locally. A centralized pool of subject matter experts would be able to share analysis, advice and best practices across the ten sites. At the same time, plant data would be available locally to aid plant operations and decision-making.

Exaquantum is now ready and tested for Cloud installations, supporting a wide range of deployment and migration scenarios for Cloud, on-premise, or a combination of both. Knowledge is easily accessible and shared, bringing together process data from single and multiple sites to create a collective set of actionable information for deeper analysis and to boost improvement initiatives. With its feature-rich set of applications that can be developed and scaled easily, major investments in application development and training is not necessary, which might be required for generic IT or IIoT Cloud data platforms.



## 3. Value Delivered

### 3.1 No Disruption

Most process industry organizations see a huge upside and real potential of Cloud computing and the benefits associated. In most situations, a step-by-step approach towards Cloud migration is the preferred strategy, which means that businesses must maintain the existing on-premise installations, plus any Cloud-based installations concurrently.

This approach minimizes the impact and helps to simplify the migration process involved in moving a data historian and applications from an on-premise installation to the Cloud. Data disruption and interruption is significantly reduced as Exaquantum, its technology and value-added applications remain the same if deployed in the Cloud or on-premise. Yokogawa uses proven and reliable platforms to ensure data is made available regardless of any deployment scenario implemented to reduce the risk of lost data for the organisation.

### 3.2 No risks (Unknowns)

Cloud migration offers many benefits, but it does not come without its share of challenges and risk, both within the organisation and when deciding who to partner with for an effective Cloud platform. Yokogawa has installed

Exaquantum and the Exaquantum applications on two mainstream public Cloud platforms to understand the technical requirements and installation considerations. This ensures that organisations have more information upfront, aids a clear and compelling business case and are in a position to overcome any challenges.

### 3.3 No Steep Learning Curve

Exaquantum deployed in the Cloud offers greater flexibility and agility to those companies who require data to be more accessible. If Exaquantum is already installed or available as an on-premise solution, it can be used as a base layer or starting point for a Cloud-based installations. There is a level of familiarity and consistency when deploying Exaquantum in a Cloud environment, ensuring there is no barrier or steep learning curve for those who are responsible for the deployment. This can provide an additional layer of confidence and assuredness when organisations are deciding on the right time to make the transition from on-premise to Cloud-based installation.





## 4. Deploying Exaquantum in the Cloud

When data strategies, environments and processes have been considered and scrutinized, organisations will need to carefully consider the most appropriate deployment scenario that will deliver the values and benefits in the most effective way.

Yokogawa considered a number of scenarios and use cases for deploying Exaquantum, Yokogawa's Data Historian solution and applications from your existing install base on two mainstream public Cloud platforms Amazon Web Services (AWS) and Microsoft Azure.

Yokogawa has tested some common deployment scenarios for implementing Exaquantum in the Cloud. The aim was twofold, firstly to ensure that levels of performance can be maintained in a Cloud environment when compared to a typical on-premise solution. Secondly, it was to confirm that data security and reliability measures were not impacted when deploying software solutions to the Cloud.

### 4.1 Deployment Scenarios

#### 4.1.1 Data Replicator

This scenario replicates data from an on-site Exaquantum installation, and mirrors data to a second Exaquantum Server in the Cloud. The Exaquantum to Exaquantum link is established using a remote data synchronization application from Yokogawa (Exaquantum/RDS), to move tag and AE data on a periodic basis. The OPC Server to Exaquantum Link uses the standard OPC DCOM link.

Alternatively, an OPC Server on-site passes data to an Exaquantum Server in the Cloud (via a VPN connection) replacing the need for an Exaquantum Server to be installed on-site. A VPN connection from the OPC Server to the Exaquantum Server is enabled with Exaquantum/VPN (Virtual Private Network). The main function is to open, close and maintain a preconfigured VPN connection between an OPC Server and Exaquantum Server.

**This scenario would be applicable for single sites.**

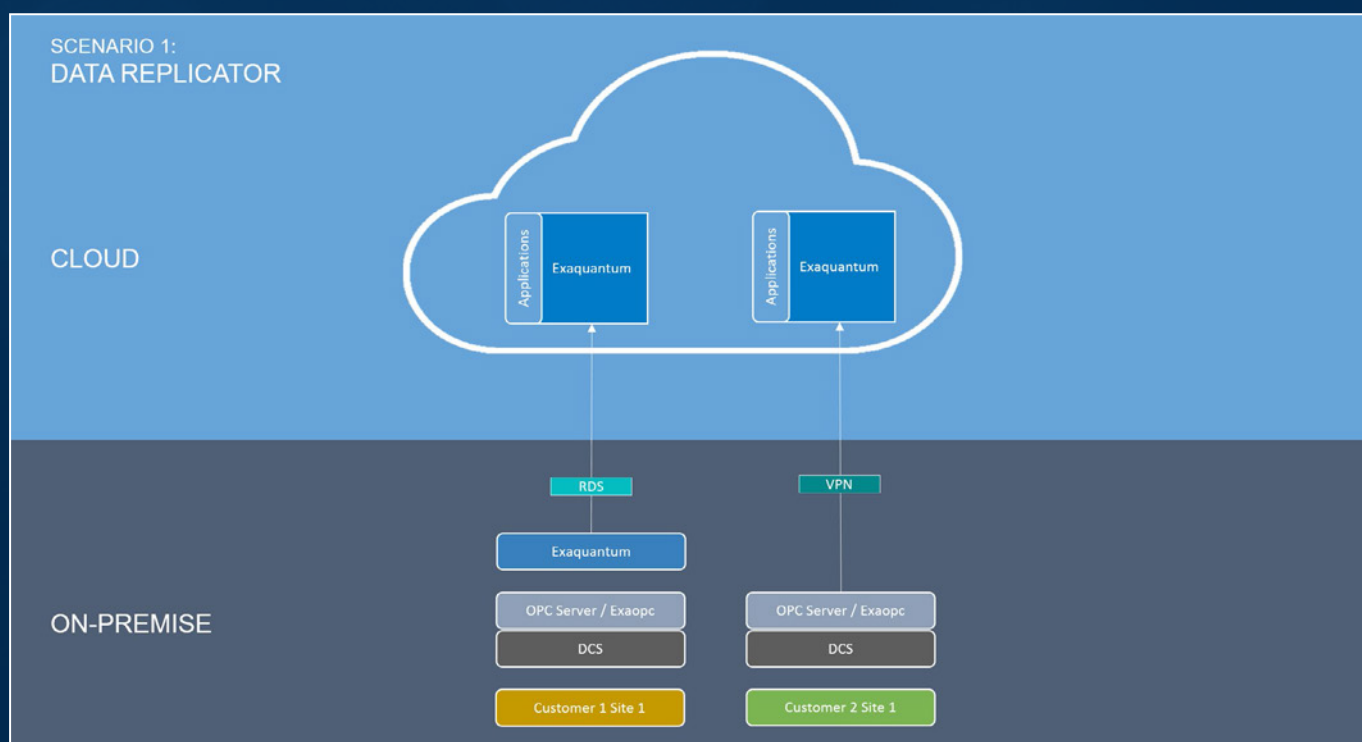


Figure 1: Data Replicator

#### 4.1.2 Data Replicator / Aggregator

This follows the same configuration, but this scenario is replicating data from multiple on-site Exaquantum installations, and aggregates data to one or more Exaquantum Servers installed in the Cloud.

As with Figure 1: Data Replicator, the Exaquantum to Exaquantum link is established using a remote data synchronization application from Yokogawa (Exaquantum/RDS), to move tag and AE data on a periodic basis. The OPC Server to Exaquantum Link uses the standard OPC DCOM link.

Alternatively, single or multiple OPC Server(s) on-site, pass aggregated or replicated data to one or more Exaquantum Server(s) in the Cloud (via a VPN connection) replacing the need for an on-premise Exaquantum Server(s) to be deployed.

A VPN connection from the OPC Server to the Exaquantum Server is enabled with Exaquantum/VPN (Virtual Private Network). The main function is to open, close and maintain a preconfigured VPN connection between an OPC Server and Exaquantum Server.

**This scenario would be applicable where data is being collected from multiple and/or geographically dispersed sites.**

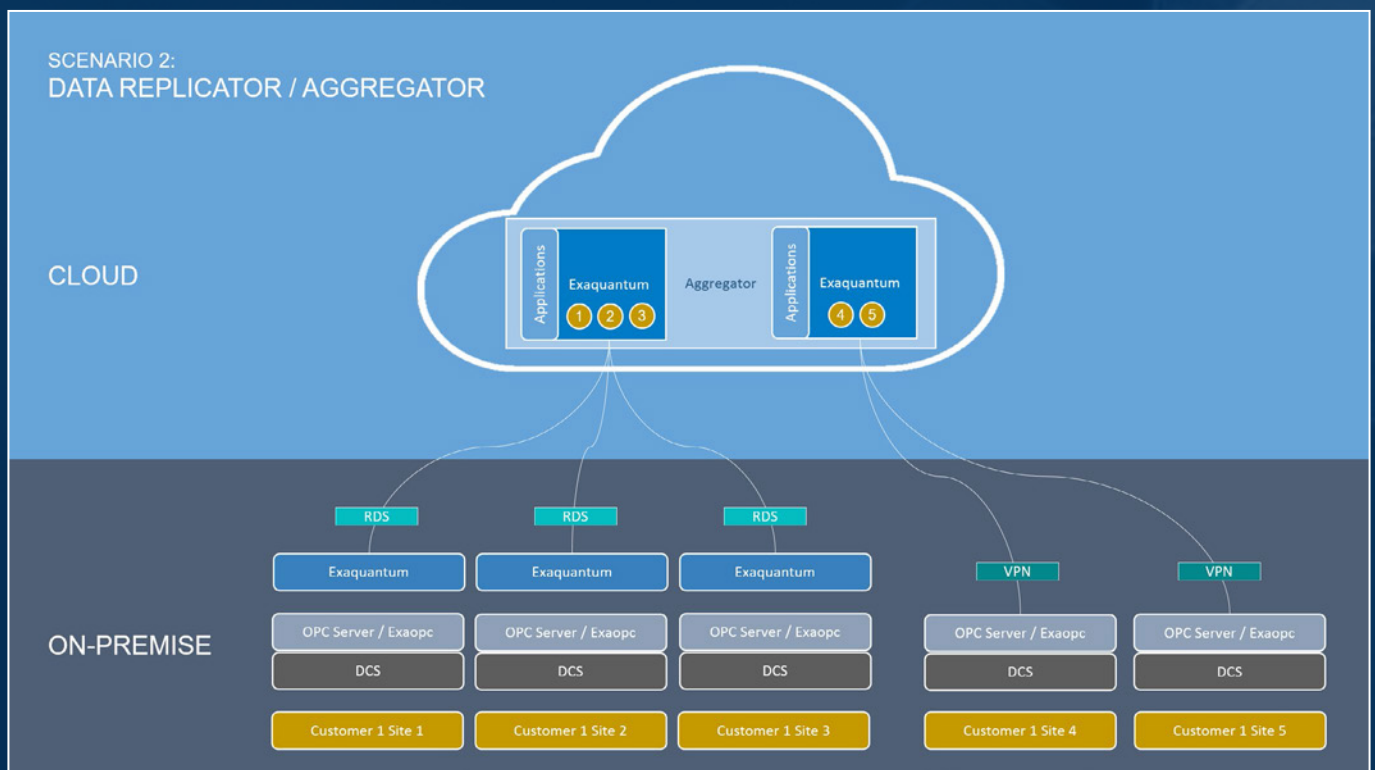


Figure 2: Data Replicator / Aggregator

#### 4.1.3 KPI Aggregator

In this scenario, a Cloud Exaquantum is aggregating a sub-set of data from multiple on-premise systems and stores them in a single consolidated Exaquantum Server in the Cloud. For example this could be specific alarm information, or PID controller performance data that has been identified as a priority and needs to be easily accessible across the business enterprise.

As with Figure 1: Data Replicator, the Exaquantum to Exaquantum link is established using a remote data synchronization application from Yokogawa (Exaquantum/RDS), to move tag and AE data on a periodic basis. The OPC Server to Exaquantum Link uses the standard OPC DCOM link.

Alternatively, this aggregated sub-set of data from OPC Server(s) on-site, passes data to a single consolidated Exaquantum Server in the Cloud (via a VPN connection) replacing the need for an on-premise Exaquantum Server(s) to be deployed.

A VPN connection from the OPC Server to the Exaquantum Server is enabled with Exaquantum/VPN (Virtual Private Network). The main function is to open, close and maintain a preconfigured VPN connection between an OPC Server and Exaquantum Server.

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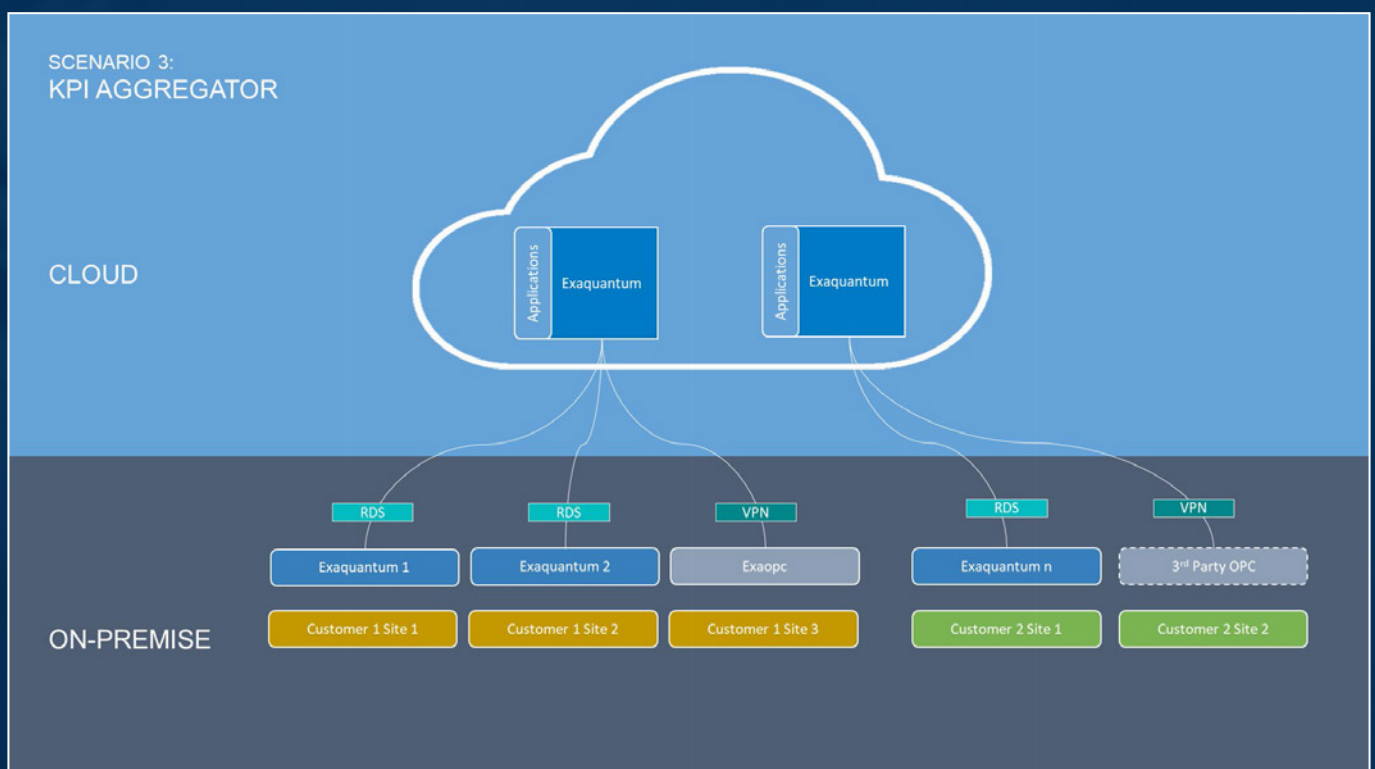


Figure 3: KPI Aggregator



#### More Information

##### [Exaquantum Cloud Implementation - Technical Note](#)

Read our technical note that explains more about best practices and recommendations for implementing Yokogawa's Exaquantum and Exaquantum Application solutions in the Cloud.





## 4.2 Cloud Connectivity

Exaquantum deployed in the Cloud requires a connection between the on-premise network and the Cloud network. There are two logical approaches to network configuration, the first is a permanent VPN connection managed by AWS/Azure, and the second is with a public IP address for Cloud Servers.

### 4.2.1 Permanent VPN connection managed by AWS/Azure

The Cloud network becomes part of the internal network without any direct exposure to the Internet. The only limitation is in the number of separate on-premise systems that can be connected to the Cloud network (typically 10).

This approach establishes a private pipe between the on-premise network(s) and the Cloud virtual network. There is no need for a public IP address for the Exaquantum Server, as all traffic is over 'internal' networks. The VPN can become a single point of failure, but it can be configured with failover sets from AWS or Azure.

There are limitations in the number of separate VPN connections that can be made from the site to the VPN gateway managed by AWS or Azure based on the total bandwidth available.

### 4.2.2 Public IP Addresses for Cloud Servers

The on-premise system has access to the internet and therefore is exposed to the Internet. This allows for a greater number of on-premise systems to connect (compared to VPN) but exposes the in-Cloud Servers to the Internet. In order to ensure data protection, this option will require additional security set-up.

## 4.3 Data Security

As previously stated, cyber security is perhaps one of the most common concerns for businesses, and is much more than just an IT issue. The biggest concern for the process industry of having Cloud stored data is how to protect it and ensure its availability across the enterprise. With Exaquantum, the same data security measures are available as with an on-premise installation. The main difference is context and how to provide and administer this same functionality within a public Cloud environment and the various considerations that are associated. This includes the provision of access to data for users, windows domain infrastructure, active directory domains and user authentication and authorization provisioning.

Implementing Exaquantum in the Cloud requires consideration of how to provide and administer this functionality, with a number options available depending on the Cloud platform to be used and the specific models that meet user's requirements.

## 5. Conclusions

With rapidly shifting market conditions, increased competitiveness, new digital technologies and emerging data trends, the demand for Cloud-based installations in the process industry is growing. Exaquantum deployed in a Cloud environment can allow organisations to benefit from the opportunities that exist, providing a framework for collaboration, improve business agility, capitalize on increased amounts of data, reduce upfront costs, and drive down total cost of ownership.

For organizations that are considering moving their operational and process data to the Cloud, the time is right to begin the Cloud transformation strategy with Yokogawa's Exaquantum data historian and take advantage of the many benefits associated.

Exaquantum is now ready and tested for Cloud deployment. Knowledge is easily accessible, bringing together process data from single and multiple sites to create a collective set of actionable information for deeper analysis and to boost improvement initiatives. With Yokogawa's knowledge and expertise over many years in the manufacturing space, we are perfectly positioned to enable our customers to unlock their true potential and value in the Cloud.

With a feature-rich set of applications that can be developed and scaled easily, combined with Yokogawa's vast domain knowledge, major investments in application development and training is not necessary, which might be required for generic IT or IIoT Cloud data platforms.

Yokogawa's Exaquantum data historian offers the best combination of tested features and flexibility for many Cloud, on-premise, or hybrid deployment scenarios and migration options.

To succeed in the Cloud is not straightforward. Uncertainties and challenges when moving legacy applications to the Cloud exposes organisations to heightened levels of risk and increase their concerns. There are a number of factors and conditions that need to be assessed and comprehensively evaluated before Cloud migration becomes a reality.

This is where Yokogawa can partner with our customers, combining our unique knowledge and experience over many years, to provide an unequalled solution. Enabling customers to drive their business forward to ensure the successful implementation of any Cloud or hybrid migration strategy to realize and achieve their ambitions in the future.

### **Yokogawa Electric Corporation World Headquarters**

9-32, Nakacho 2-chome, Musashino-shi, Tokyo 180-8750, Japan  
<https://www.yokogawa.com/>

### **Yokogawa Corporation of America**

12530 West Airport Blvd, Sugar Land, Texas 77478, USA  
<https://www.yokogawa.com/us/>

### **Yokogawa Europe B. V.**

Euroweg 2, 3825 HD Amersfoort, The Netherlands  
<https://www.yokogawa.com/eu/>

### **Yokogawa Engineering Asia Pte. Ltd.**

5 Bedok South Road, Singapore 469270, Singapore  
<https://www.yokogawa.com/sg/>

### **Yokogawa China Co., Ltd.**

Room 1801, Tower B, THE PLACE, No.100 Zunyi Road,  
Changning District, Shanghai, China  
<https://www.yokogawa.com/cn/>

### **Yokogawa Middle East & Africa B. S. C. (c)**

P.O. Box 10070, Unit A7, Building 1320, Road 1516, Block 115, BIIP,  
Al-Hidd, Kingdom of Bahrain  
<https://www.yokogawa.com/bh/>

Visit our website at:

[https://www.yokogawa.com/solutions/products-platforms/  
solution-based-software/data-historian/](https://www.yokogawa.com/solutions/products-platforms/solution-based-software/data-historian/)



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