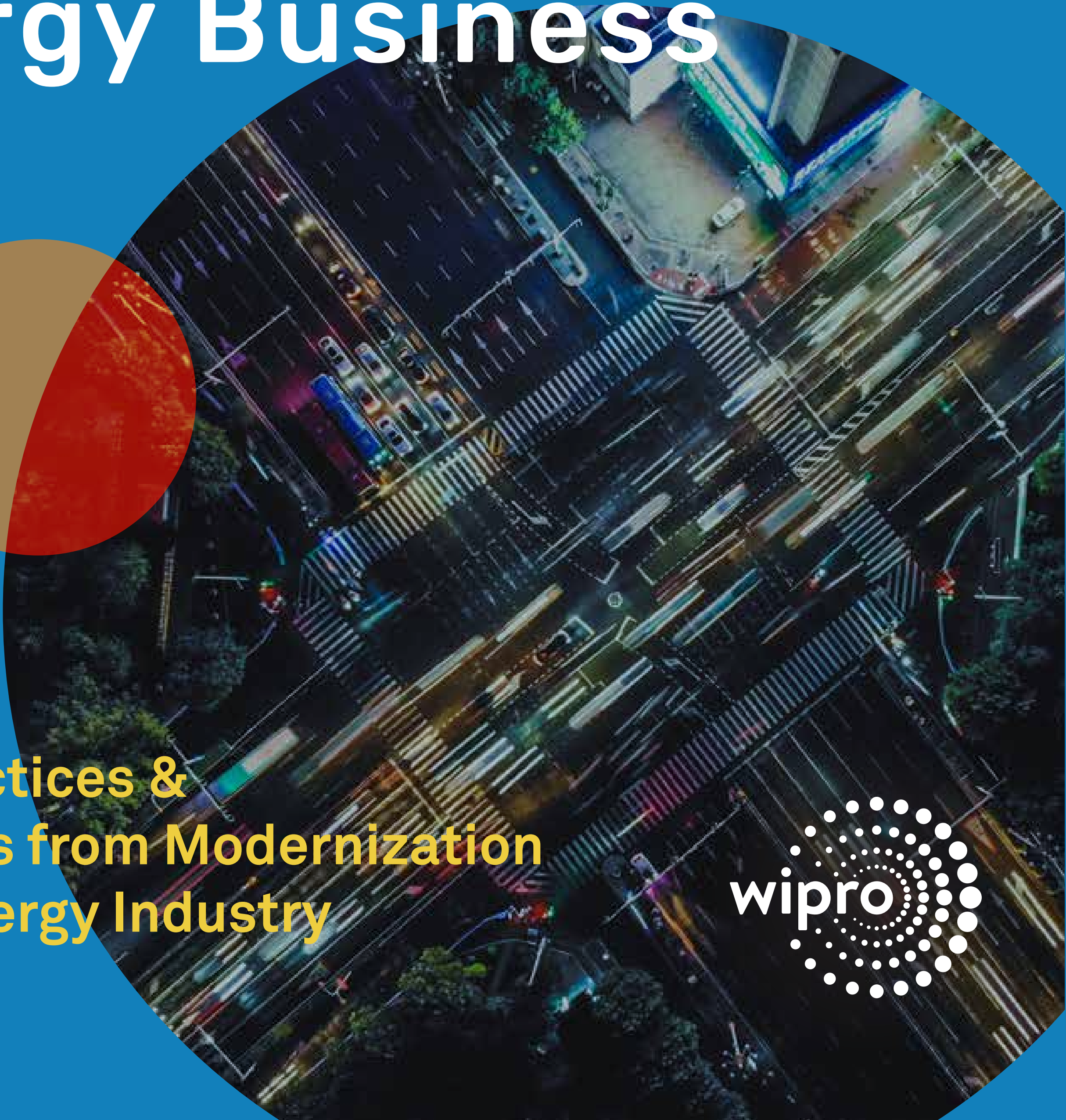
Digital Transformation in Downstream & Alternate Energy Business



Best Practices & Learnings from Modernization in the Energy Industry

wipro

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Abstract

The energy industry is going through a digital transformation like no other. In the context of IR 4.0, this is necessary to address multi-pronged contemporary challenges that we face for our energy needs. Areas include diversification of energy portfolios into renewables, sustainability, gaining end-to-end visibility to energy supply chain management from one end of the hydrocarbon value chain to the other, digital plant automation for productivity and efficiency gains, and many initiatives to modernize various parts of their IT and Industrial Control Systems infrastructure.

This paper describes areas where Wipro and AWS have seen energy customers derive value from several such digital transformation initiatives and adoption of cloud technologies for their operational and tactical needs. Specifically, this paper covers the various Energy Downstream and Alternate Energy Trade platform workloads that benefit from modernization through cloud adoption.

We know that oil and gas lifting, finding, and development costs aren't reducing anytime soon. Energy Companies CIOs opine that adoption of cloud native tech, predictive asset monitoring, Big Data IIOT Analytics are some of the key enablers to bring about digital transformation.

Introduction

The energy industry is undergoing a massive transformation globally. In addition to the uncertainties on the supply side for traditional energy sources and changing trends toward renewables, the COVID-19 lockdown of 2020 created an urgency for energy customers to modernize their IT strategy, adapt to change, and drive new business models for this emerging world economy. These require both short-term and long-term approaches.

"The oil world has seen many shocks over the years, but none has hit the industry with quite the ferocity we are witnessing today.

IEA, International Energy Agency, "The global oil industry is experiencing a shock like no other in its history." April 1, 2020."

Modernizing IT assets and IT consumption models to ease the financial burden on energy companies should be a high priority in the short term. In the long term, energy companies need to look at IT as a business enabler to drive new business models and revenue streams. Industries are already starting to leverage cloud platforms and machine learning technologies toward this approach. This paper describes this strategy and real-world case studies from the energy (oil and gas) industry, specifically along the downstream segment.

Pre-COVID-19 and during the pandemic, the energy industry has been under heavy cost pressures due to falling energy prices from slowing demand, economic uncertainties, and power dynamics between the oil-producing nations. Hence, oil and gas majors have adopted multi-pronged strategies in the immediate and long-term future to ensure business sustainability and resiliency against increased market volatility.

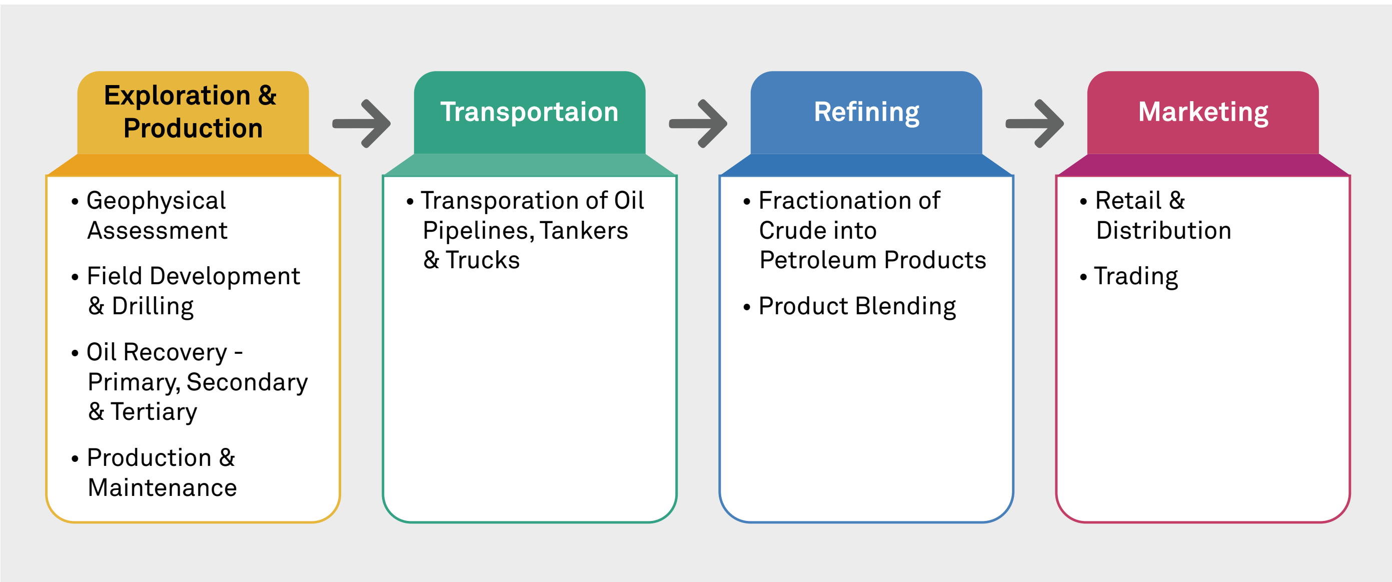
The case studies presented in this paper cover:

- Fast adoption of cloud for hosting real-time, plant-process historian data analytics and visualization platform
- Refinery Laboratory Information Manage ment System hosting infrastructure migration to the cloud
- Migration of global IT applications for higher scalability, resiliency, and TCO (Total Cost of Ownership) benefits

The energy technology landscape

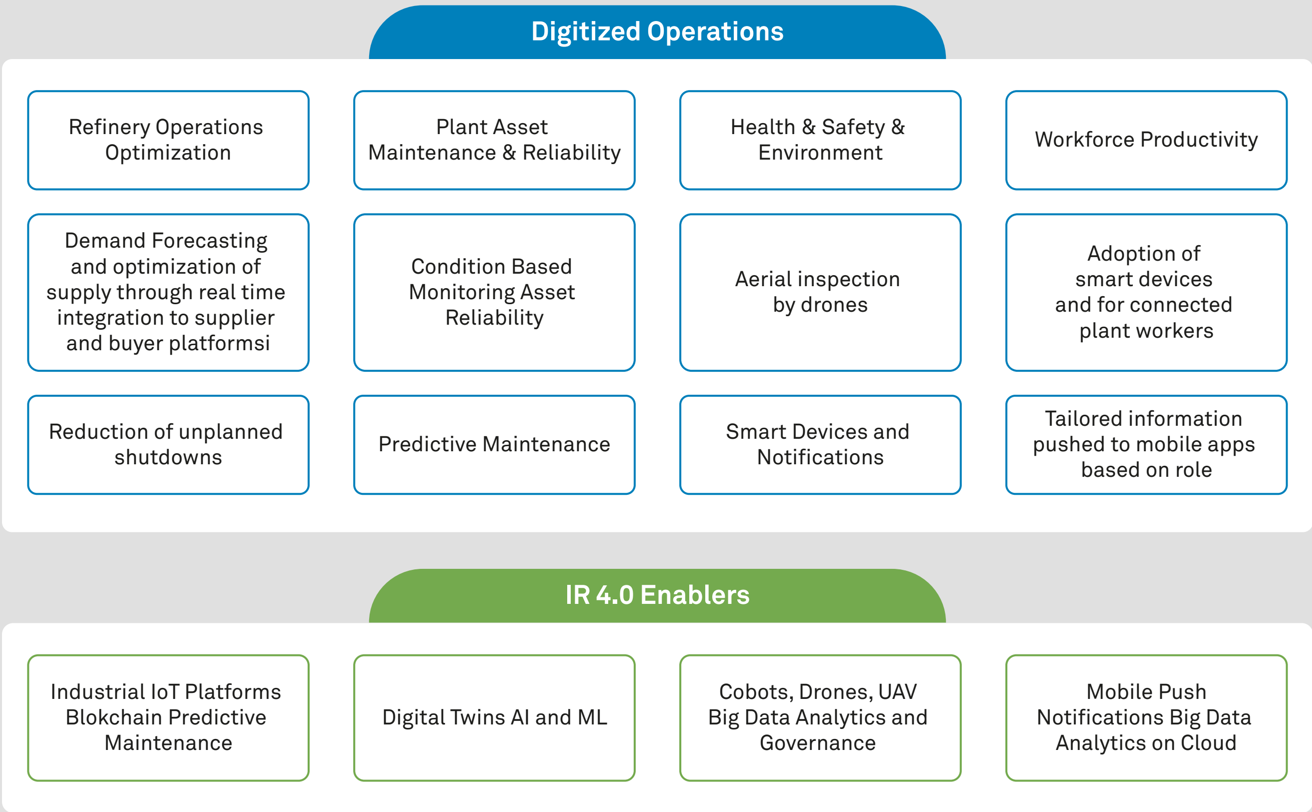
The oil and gas sector comprises upstream, midstream, and downstream segments. The downstream segment includes the refining and marketing of finished petroleum products, such as gasoline, aviation fuel, diesel oil, lubricants, LPG, and hundreds of other specialty petrochemical products for the global consumer market through primary and secondary sales channels.

The exploration of crude to its final product distribution in retail markets is capital intensive, and the costs of production and refining have little margins. Therefore, improving process efficiencies across the hydrocarbon value chain is critical.



In addition to IT infrastructure modernization, data and insights are also driving modernization of downstream. This is achieved through digital twins for modeling and decision making, predictive asset maintenance and IIOT big data analytics using cutting edge data streaming technologies.

Key digital enablers for the future of downstream oil and gas exist in the following areas:



Downstream Digitization Solution Areas and Tech Enablers

Key digital priorities and drivers for energy companies

Smart plants and petrochemical manufacturers of the Industry 4.0 era need to rely more than ever on process data and key performance indicators and not merely on weekly production reports to stay ahead of the curve.

Secondly, existing on-premise OT systems within a process control network are often close to end-of-service-life, thus expose customers to risk and security vulnerabilities.

Working with AWS, Wipro is helping energy customers build the foundation to accelerate their energy future in three different ways:

- Optimizing efficiency
- Driving business agility
- Increasing business intelligence

Priorities

Any digital solution must address the needs of all its stakeholders: operators, process engineers, maintenance engineers, refinery site management, and the enterprise as a whole.

Real-time data management of plant assets data and different production processes data is vital and requires modernization by transforming to real-time streaming data analytics on the cloud. While adopting new and low operating cost models, there is a need for modern, scalable, highly available digital platforms to monitor refinery production operations and performance indicators.

Key downstream challenges

Our energy customers often talk about the following downstream challenges:

- Lack of end-to-end visibility on plant asset lifecycle management from procure ment to decommissioning
- Unplanned plant shutdowns
- Sub-optimal production
- Premature failures
- Missing overall production targets
- Lack of coordination for field execution and safety

Also, we have seen the following best practices that some of our energy customers have adopted:

- Connected refinery providing support for wireless voice, video, security, and other multi-service access resulting in increased physical safety, worker collabo ration, and real-time access to a data historian
- Industrial wireless sensing systems deployed at process control network for monitoring asset health and safety applications, such as gas sensing and corrosion
- Operator rounds automation and integra tion to a real-time data platform
- Predictive analytics optimize equipment maintenance overheads
- Failures predicted 1-2 weeks prior
- Full system optimization
- Automated tie back into field execution and enterprise reporting

Key benefits of digital transformation for energy companies

Although downstream digitalization is in the early stages, it is a central focus area and strategic driver for most Fortune 100 energy companies. Digitalization initiatives enable downstream manufacturing process automation, transparency, and visibility to end-to-end operations and its efficiencies as well as some of the other key improvements, such as:

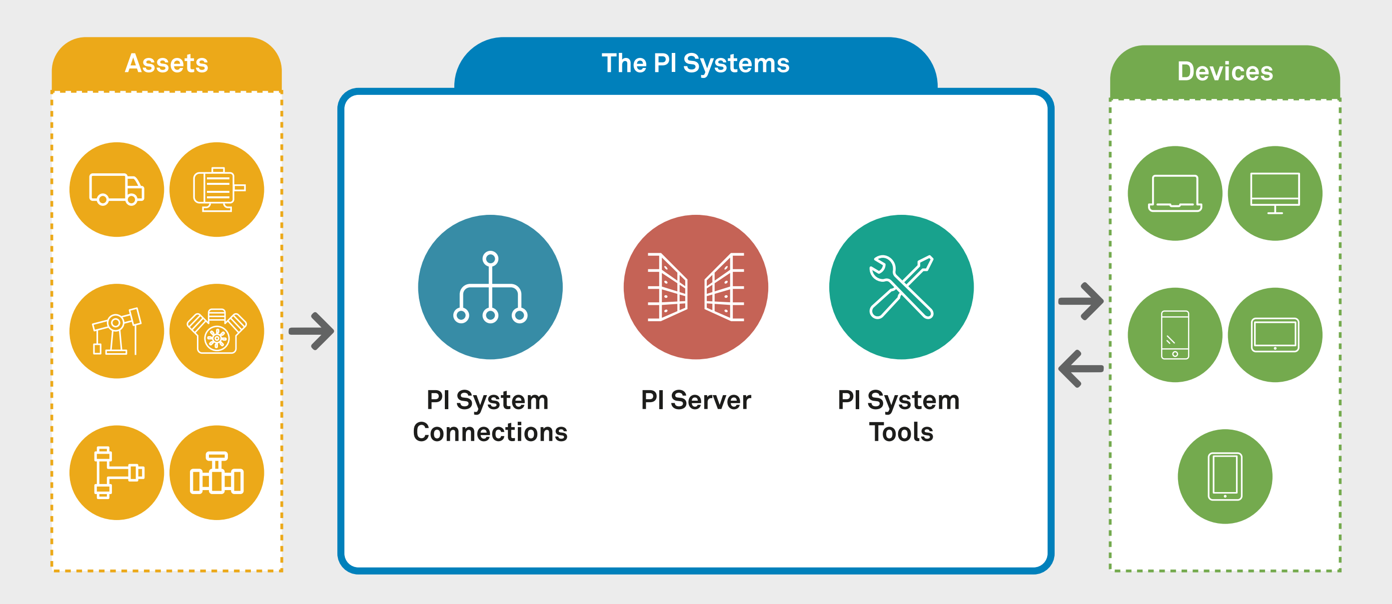
- Improved supply chain management through the availability of real-time, demand-and-supply data and accurate forecasting techniques
- High degree of plant asset proactive main tenance capability through AI and ML-based predictive models
- Enhanced plant operations simulated modeling using a digital twins platform and thereby increasing plant production, improving the supply chain, and predicting maintenance issues before a breakdown
- Reduction in unplanned plant shutdowns
- Higher worker productivity through quick and easy access to relevant and fine-tuned production data and KPIs
- Prevention of digital security breaches through automated OS upgrades manage ment and platform refresh

Case studies

Case study 1

OSI PI Infrastructure Modernization and Deployment on AWS

OSIsoft's PI system is an industry critical downstream operational intelligence system designed to collect, analyze, visualize, and expose a large amount of high fidelity, time-series data across multiple enterprise systems in plants. It is of immense value in accurately identifying where and how to improve refinery plant operational efficiency. The typical PI system logical architecture is shown below:



Source: www.osisoft.com

Customer challenges were as follows:

- Eliminate end-of-service-life risk on PI system infrastructure
- Deploy a scalable infrastructure on the cloud for real-time data management that can support an initial small-asset deploy ment and can easily be expanded for future enterprise deployments
- Stream process data to a data discovery platform for deriving insights
- Set the foundation for leveraging advanced analytical tools

Wipro's Digital Engineering Team conducted separate kick-off meetings with the site's single point of access (SPA) for thorough as-is system analysis and made the customer aware of upcoming deployment architecture for PI on AWS.

The team also conducted a quick PoC by hosting a central PI system in AWS chosen by region closest to the end customers and connecting it with various site systems. Shared PoC results satisfied key stakeholders and site SPAs.

Later, certain business users were having reservations regarding response time when they tried using desktop-based clients. The team addressed the concerns by using AWS-based Citrix clients and AWS workspace nodes to address the performance issues. The long-term strategy was to enable PI data visualization on PI Vision, an AWS web-based visualization tool.

Other business challenges included:

- Limited availability of site SPAs for provid ing details on the site-based PI systems
- Non-standard PI architecture across client's downstream estate
- No documentation available for custom legacy applications dependent on the PI platform to be migrated to AWS
- Network-induced latency for end users accessing migrated PI sites

A short-term strategy was to migrate a few PI systems to AWS and a few systems to a process information network. The long-term plan was to have a scalable architecture to deploy centralized PI systems on the AWS cloud for all the downstream sites to set the foundation for leveraging advanced analytical tools. A scalable enterprise PI system architecture and migration approach was finalized to achieve minimum CAPEX and OPEX.

The client's adopted centralized PI server architecture with connectors to PI visualization on AWS brought about considerable scalability and near real-time analytics for vital process data.

The PI deployment on AWS was successfully deployed, and the Wipro domain consulting staff set up 12 PI systems across 14 PI sites. Central PI systems are also streaming data to multiple third-party platforms used for big data analytics to achieve operational excellence under the Intelligent Operations program.

Factors and Deployment Options for OSI PI Solution Deployment on AWS

The AWS solution architect adopted the hybrid option, namely Solution Option 2, based on the reasons below:

- Ease of site migration to AWS
- Low impact of the system to end users working at local sites
- Technical effort needed to migrate to AWS is less compared to a more centralized approach

Design Criteria	Solution Option 1	Solution Option 2 (Recommended)
Deployment Architecture Style (Centralized vs. Hybrid)	**Centralized** Global PI Data Archive Global PI AF Global PI Analytics Global PI Vision	**Hybrid** Site-wise PI Data Archive Global PI AF Global PI Analytics Global PI Vision
AWS Hosting Region for Availability of Services	AWS region closest to customer	AWS region closest to customer
Infra OPEX cost YoY (with HA) in USD	Approx. 1,99,020	Approx. 1,90,716
Additional Infra Cost YoY (per Site with HA)	5,125	23,220
Application Yearly Cost for 4 Sites (USD) Dollars	61,523	65,151
Total Migration Cost for 4 sites (USD)	4,90,374	2,24,677
Architectural Complexity	Low	Low
Change Management	High	Medium
Release Management	High	Medium
Possible Impact on End-User Performance	High	Medium
Enterprise Analytics Capability	High	Medium
Replacement for Redundant Apps	Yes	Yes
Impact on 2003 security Vulnerability Risk Remediation	High	Low
Migration Effort	14 months	6.5 months

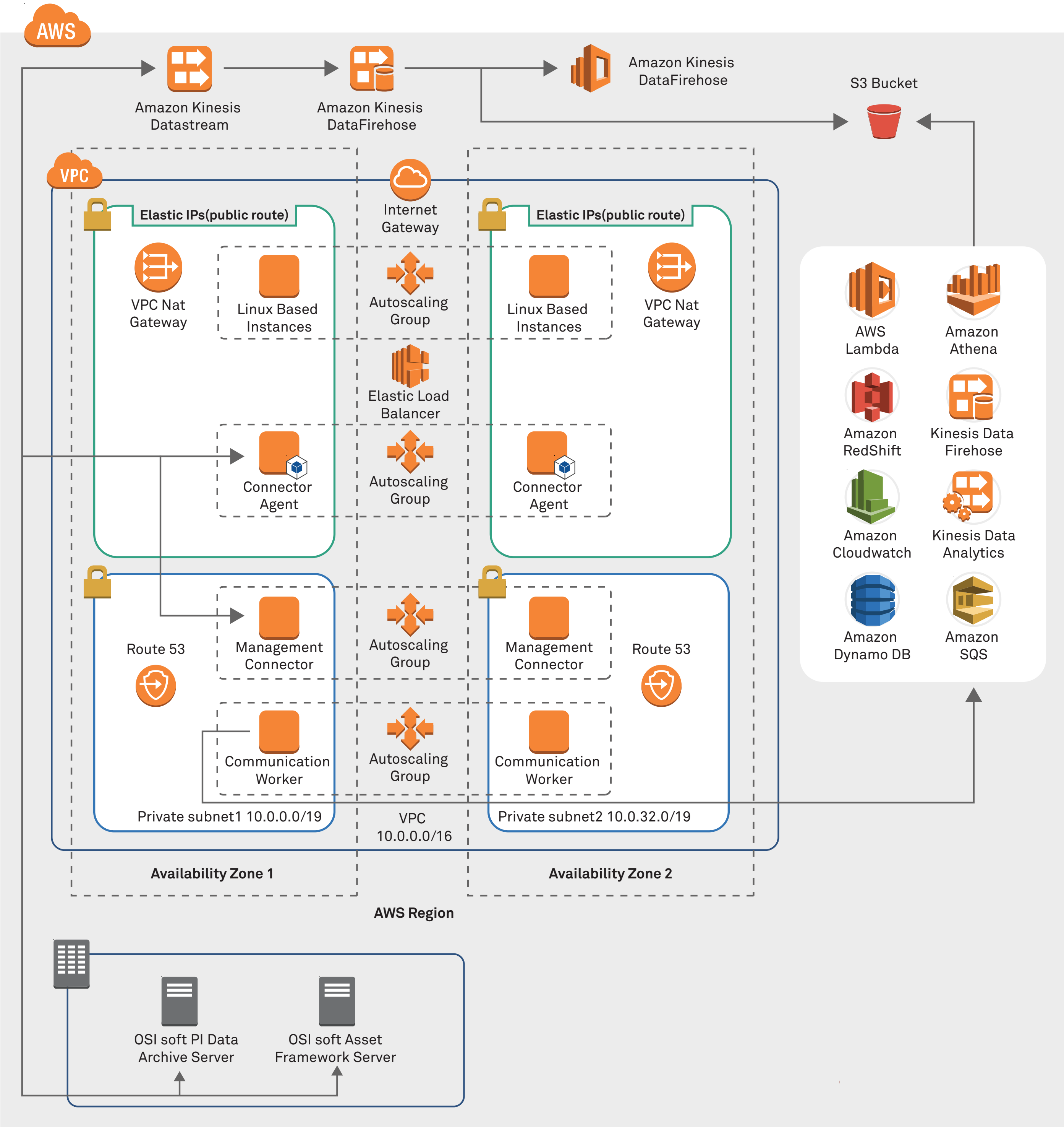
Benefits

- Global Standard PI cloud architecture across downstream resulting in no CAPEX and reduced OPEX due to elasticity and on-demand scaling
- Migration of OSI PI infrastructure to AWS significantly improved the availability of data insights on plant operations through better data analytics and visualization
- Informed decision-making by the plant supervisory level due to globally distributed PI servers on AWS at multiple sites and easy access to consolidated data visualization on asset performance

Reference architecture

The typical reference architecture is modeled on the following principles:

- AWS Connector or PI data archive and PI asset framework server is secured using VPN and leveraging MS Active Directory as the Identity Provider
- Synchronization of OSI PI asset framework and PI data points with Amazon S3 storage using a connector
- Real-time plant process control data in PI points exploration through AWS Athena
- Visualization of data using highly scalable analytics services, such as Elasticsearch to store up to petabytes of data
- Near real-time subscription to PI snapshot updates via AWS Kinesis data streaming services



Reference Architecture on OSI soft PI Migration to AWS

Best practices

AWS PI systems quick start templates are the fastest way to deploy PI infrastructure and connectors to AWS. It uses automated infrastructure as code deployment using AWS cloud formation templates, which are more scalable and reliable. The quick start template uses a cloud formation template to create VPC, internet gateway, NAT gateways, and an OSI PI data connector application agent, which integrates with the OSI PI asset framework server and data archive. The quick start connector provides integration to different AWS analytics services, such as Athena, Elasticsearch with Kibana, and Kinesis for predictive operational data analysis and visualization.

Case study 2

Downstream retail and lubes application portfolio migration to AWS

An oil and gas major had an end of service life risk because of aging hardware infrastructure and a non-supported Windows 2008 operating system. This major security vulnerability had to be remediated through a lift and shift migration to the cloud.

The remediation was global, so setting up a program to bring together various stakeholders for remediation work was a challenge. The client's downstream IT estate varied across commercial off the shelf (COTS) applications and bespoke applications. Hence, a one-solution-fits-all approach was not applicable, making the migration very complex. Application migration work cut across various vendors and suppliers.

The client preferred to migrate their applications to the AWS cloud to take advantage of AWS's cloud-native architectures. Wipro introduced a program governance framework to track progress globally across all client sites and develop and review/agree to treatment paths with the central architecture team.Wipro consultants introduced a phased approach toward migration to AWS cloud-native architecture from on-premise. Wipro institutionalized a technical design assurance (TDA) process for architecture design review and digital security review. The program used a scrum-based, agile delivery and an Azure DevOps (earlier VSTS) board to track remediation work across various sites to provide progress to stakeholders. We put controls in place to track the quality of delivery.

Downstream applications spanned refinery sites, petrochemical sites, supply applications, retail applications, lubricant applications, and enterprise services applications.

As a result of this engagement, Wipro remediated Windows 2008 security vulnerabilities and end of service life of Win2K3 downstream IT estate successfully. More than 90% of the applications successfully migrated to AWS. Wipro migrated 101 applications hosted on Win2K8 across the downstream estate. 124 Win2K8 servers were decommissioned. More than 97% of the applications migrated to AWS. As a part of this engagement, more than 512 Win2K3-based servers were decommissioned.

Solution design factors for downstream retail and lubes applications for migration to AWS

Options	Description	Pros	Cons
AWS Migration Using Open Source App Server – JBoss	• Migrate AppServer from WebLogic to JBoss	• Lower cost for application server	• Will require 12 weeks of PoC 1 & PoC 2 for evaluating the feasibility of moving to JBoss
	• Move to RDS Oracle 19c	• Managed RDS	• JBoss enterprise support needs to be evaluated
	• Move to RHEL 7 from RHEL 6.7		• Digital security evaluation of JBoss
	• Move to RHEL 7 from Solaris 10		• Customizations from the last 15 years must be understood, documented, and aligned to the new framework being migrated to JBoss. Requires an additional Wipro resource.
			• End-of-year deadline might be missed
AWS Migration Continuing with Oracle WebLogic Server	• Migrate application to upgraded WebLogic Server on AWS	• Proven architecture in the on-prem server	• Faster migration path
	• Move to RDS Oracle 19c		• Substantial WebLogic license cost in the AWS cloud environment
	• Move to RHEL 7 from RHEL 6.7		
	• Move to RHEL 7 from Solaris 10		
Co-Lo Facility	• Migrate application to upgraded WebLogic Server in another Co-Lo facility	• Proven architecture in the on-prem server	• Availability of co-located application that also uses WebLogic Server
		• Lower cost of app server due to on-prem servers	• Substantial WebLogic license cost in the AWS cloud environment
On-Premise Upgrade	• Upgrade WebLogic Server on-prem	• Proven architecture in the on-prem server	• Datacenter availability is a challenge as the client wants to move out of on-premise datacenters
		• Lower cost of app server due to on-prem servers	• Substantial WebLogic license cost in the AWS cloud environment
Do Nothing	• No migration to the cloud	• No additional impact	• Application is at risk due to EOSL components and a critical security issue in WebLogic

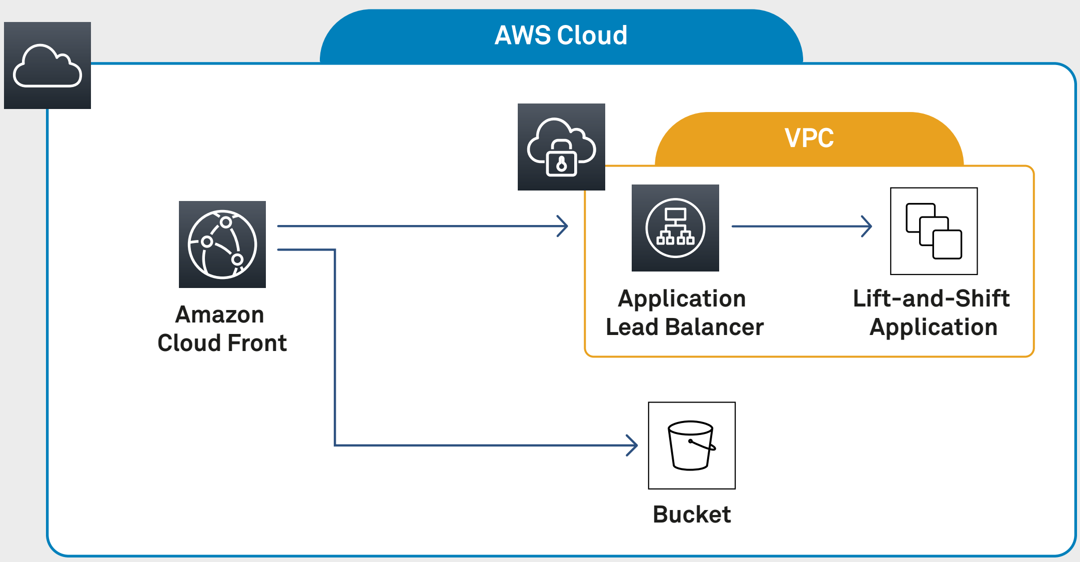
Key benefits

- End of service life B2B and B2C applications running on aged plat forms needing an upgrade
- Remediation of EOSL servers through AMI upgrades on AWS and decom missioning where rationalized
- Security vulnerabilities associated with Win2k8 server remediation done through upgrades of OS to Win2016 AMI on AWS
- Standardize on a single platform using AWS native architecture
- Reduce TCO
- Increase efficiency

Reference architecture

The migration of B2B and B2C application workloads was carried out in a lift and shift mode. This essentially is a transitional step toward re-platforming the workloads using AWS native architectures. The design princi-ples employed include:

- AWS-managed services instead of self-managed Amazon EC2 instances
- Leveraging AWS autoscaling groups for improved capacity management
- Cost-effectiveness through reduction of TCO
- Leveraging Amazon S3 static content for web hosting to reduce cost and improve end-user accessibility



Optimizing a lift-and-shift for cost-effectiveness and ease of management

Best practices

It's essential to choose the right pricing model for the deployed Amazon EC2 instances. Typically, the lift and shift applications deployed on reserved Amazon EC2 instances with a commitment of 1-3 years provide up to 75% cost reduction.

Amazon EFS (Elastic File Storage) provides high availability and reduces the need for configuring storage replication across availability zones.

Use Amazon Application Load Balancers for Http and Https traffic for internal and external workloads

AWS CloudFront is a recommended distribution network service for hosting static web content. It retrieves the content from Amazon S3 and makes it readily available by distributing content to the customer's nearest edge locations.

Case study 3

Lab Information Management System for Lubes Deployment on AWS

The management team of a major oil and gas client's lubricant company was considering adopting a cloud-managed global laboratory information management system (LIMS). The business was specifically looking at a solution that would enable the following:

- Better transparency and visibility to the end-to-end sample management workflow and productivity
- Ability to scale as and when required
- Easily managed services with high availability

The preferred technology solution vendor was Thermo Fisher Sample Manager (SM) and Integration Manager (IM) and its migration to AWS. The reasons behind choosing a LIMS system were easy alignment to organizational business processes, IT strategy, and adherence to corporate information security standards.

The pilot site implementation comprised of the following tasks:

- IaaS design for Amazon VPC and subnet (private/internet facing) setup
- Dedicated hardware setup on AWS cloud
- DB migration of legacy databases to AWS

- Integration of third-party lab interface, MI reports
- OEM product constraints needed to be re-addressed with custom code or reworking with business to update third-party lab interface program

The Wipro team adopted the following solution strategy:

- Understood the LIMS product technical compatibility and support on AWS as managed services, which helped in designing the AWS deployment architecture better, including the Amazon VPC, DB migration, and third-party system integration
- Proactive remediation of data quality issues on the fly resulting in fewer data issues in DB migration to the AWS-managed RDS instance
- Leveraging the principle of elasticity and pay-per-use resource utilization, the team decided to shutdown dev and test environments during non-business hours
- Configured AWS multi-AZ deployment for LIMS critical components SM and IM for ensuring higher availability for end users

Key benefits

Executing the lubricant company's global LIMS solution on the AWS cloud with high availability via load balancers and consistent project management functions/practices across the customer's enterprise resulted in more than 30% savings in hardware, software, and support costs that are still growing.

Efficient lab operations

Wipro designed the strategic implementation of a single instance global LIMS using the Thermo Fisher Sample Manager on AWS cloud across various business units. The solution provided standard templates, automation of workflows, sample tracking and labeling, report templates, MI dashboards, and role-based access, which have dramatically saved time, reduced human error, and enabled the automatic collection of data samples and the sharing of data across multiple locations for easy viewing and managing.

Data security / value delivery

The new LIMS system load balancing failover scenarios minimized time spent in administrative tasks troubleshooting IT issues. The AWS deployment helped to deliver lab management services on a global scale.

Data aggregation

Centralized deployment of the LIMS solution on AWS helped create fragmented historical data sets onto a resilient platform.

Standardization using templates

Using the AWS cloud formation templates for infrastructure deployment helped ease deployment with low risk, achieving high availability and fault tolerance. It also resulted in the lowering of TCO.

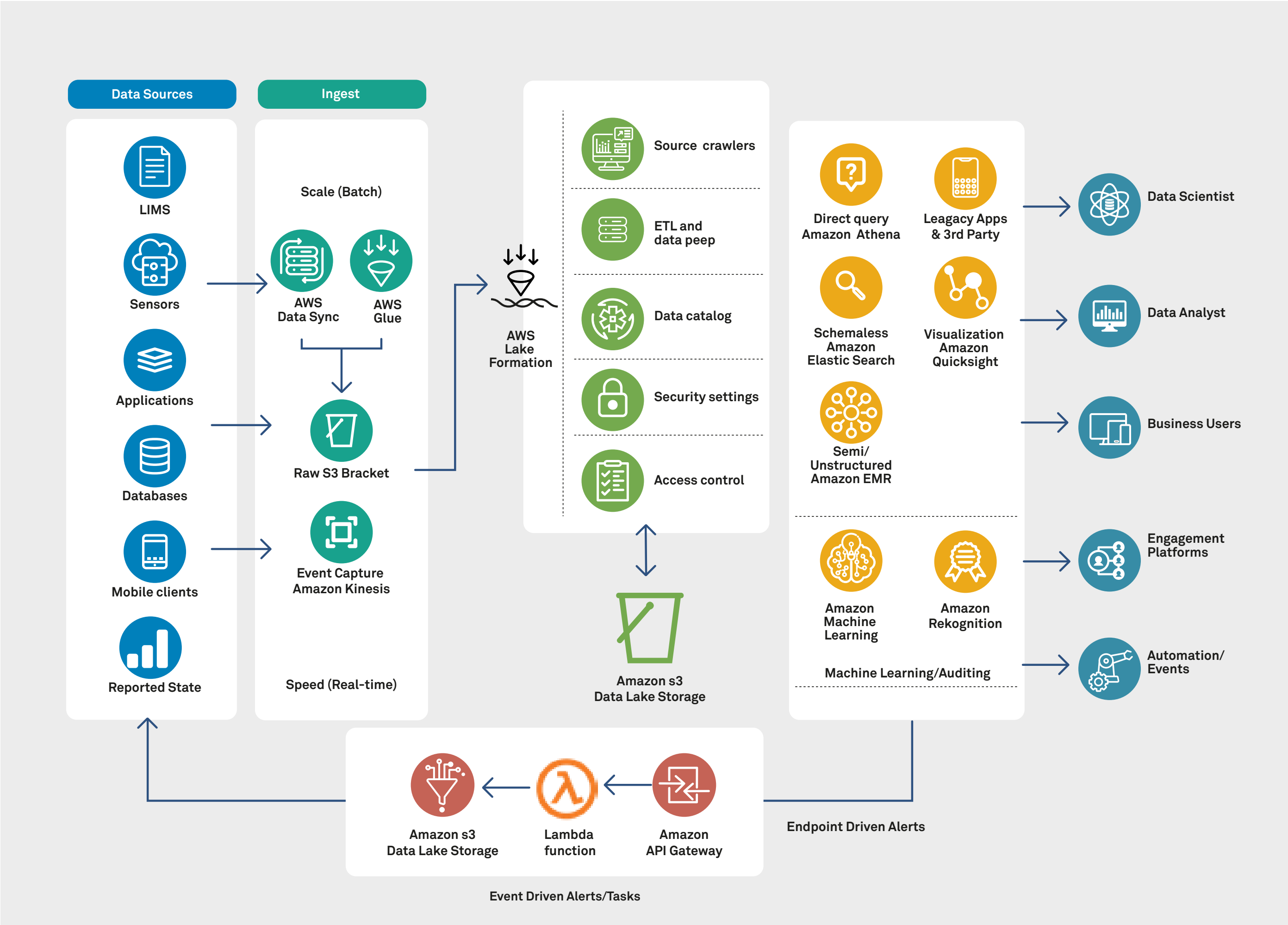
Reference architecture

The AWS recommended target architecture design is based on principles associated with the digital laboratory management system:

Data Collection: Collecting real-time streaming data from devices and static sources, such as electronic lab notebooks and databases. The data is ingested into the AWS-native platforms, such as AWS Kinesis, AWS data sync, and AWS Glue using standard API and ETL tools.

Data Processing: AWS Lake Formation enables extraction, transformation, and loading of data to durable storage, such as S3. The real-time data is then cataloged using AWS Glue and capturing of metadata. AWS Elasticsearch is used for exploring the data, and EMR (Elastic Map Reduce) is used to process huge data streams through shards. Effective KPI visualization and calculation is realized using AWS Quick Sight. AI and ML tools are leveraged extensively at this stage to derive accurate, insightful analytics.

Results Alerts & Notifications: Real-time lab analysis alerts and notifications are exchanged via messaging services, such as Amazon SNS or via email gateways.



Foundation for Lab of the Future using AWS

Best practices

Data Security

LIMS deployment on AWS ensures access to data is strictly audited, monitored, and revoked on a need basis.

Collaboration

A large lab samples data from multiple lab sites, including photos that can be ingested from lab microscopes through AWS storage gateways and uploaded to S3 data lake for processing.

Workflow Management

Tagging lab sample photos with barcodes for indexing. The indexed sample can undergo machine learning algorithms to detect anomalies and share the observations for approval on the observations using AWS workflows.

The objective behind the digitalization of lab sample analysis is to increase efficiency and accuracy.

Case study 4

Renewables energy trade management platform

An oil and gas major's diversification into the foray of carbon renewables and sustainability triggered an imminent need to create a proof of concept energy management digital platform. The team reegineering the architecture to take the platform to internet scale was required.

Traditional applications (N-tier architecture) cannot react to changes, auto-scale, and support message passing; hence, we wanted to have reactive micro-services architectures for solar energy management on a decentralized platform. We were looking for a solution that provided the following:

- A responsive and robust distributed system based on asynchronous message passing
- Deploy a scalable infrastructure on the cloud for on-demand load
- Pay as we go. Client was paying for unused compute resources; there fore, wanted to cut down unneces sary cost
- Reduce/eliminate operational tasks, such as patching, maintenance, etc. and focus more on business value

Using a microservices-based reactive architecture meant using Elastic Kubernetes Services. The Wipro team conducted a PoC by configuring Amazon EKS Fargate in a specific AWS region and integrated with Amazon RDS, Amazon SQS, Amazon API Gateways, etc. Shared PoC results satisfied key stakeholders and site SPoCs.

The long-term strategy was to have a serverless microservices-based reactive architecture deploy services on the AWS cloud. The outcome was a seamless capability to scale with increasing workloads but with no added overhead on resource utilization.

This microservices architecture on AWS is now adopted for several other B2C services, such as meter reads collection, billing management, and customer management on AWS. This has brought about considerable scalability and data load that reduces cost and manual efforts.

The reactive microservices-based architecture reduced cost by around $900 per month per environment. This also eliminated the maintenance activities, such as servers/Amazon EC2 instances upgrade, patching, etc., which resulted in reduced manpower.

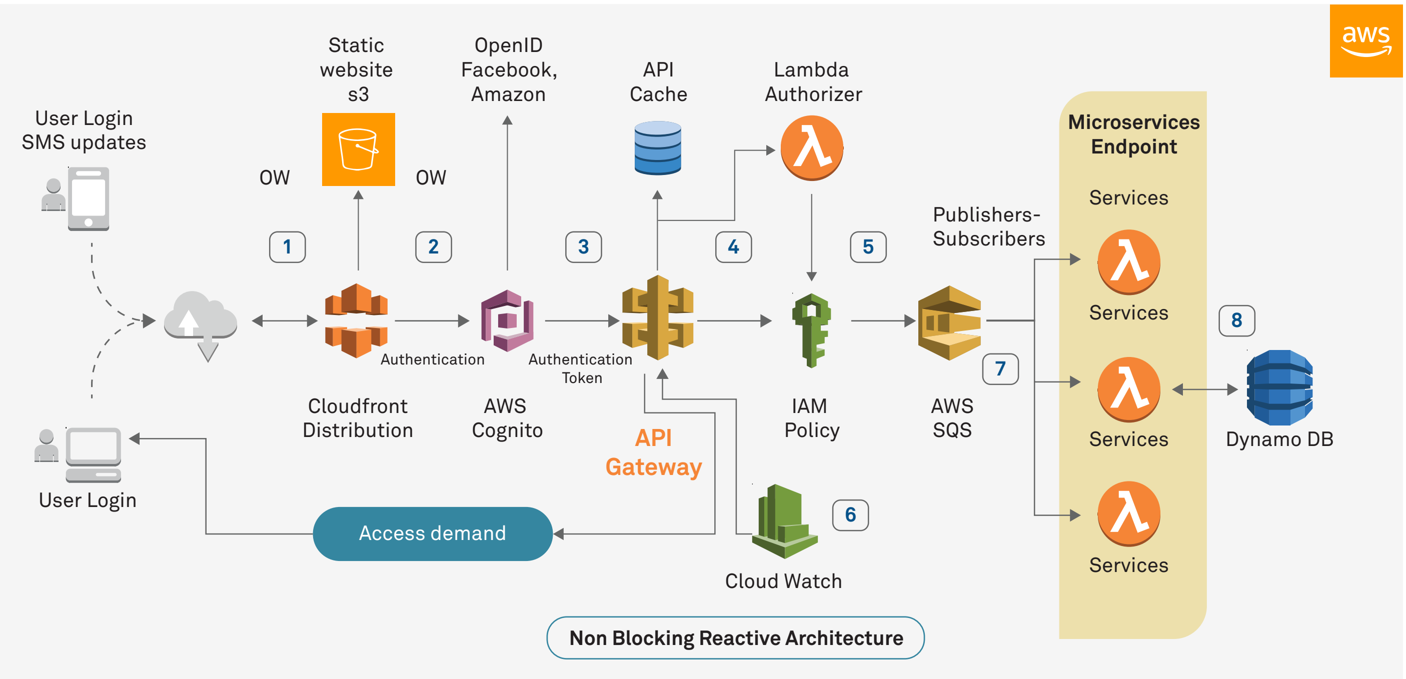
Key benefits

- Define serverless microser vices-based reactive architecture for managing solar power management system on the AWS cloud for down stream sites
- Event/message-driven approach
- Use of serverless technologies, e.g., Amazon EKS with Fargate, AWS Lambda functions, Amazon SQS, and Amazon CloudWatch
- Reduced significant infrastructure cost and headcount

Reference Architecture

As the digital platform needs to have internet scale, the web and mobile applications' performance can be made more responsive through reactive non-blocking architectures.

An outcome of non-blocking architecture adoption is faster response times for web and mobile clients. The backend's main computing resources are decoupled from the high workloads hitting the API gateway using the API endpoints. The API gateway acts like a proxy server to publish the events and payloads from the requests to an asynchronous Amazon SQS topic. The events published to the Amazon SQS topics are subscribed to by the reactive Lambda functions on a real-time basis. This means much faster event processing and response publishing to web and mobile clients. The application logic can be executed on serverless technology for which significant cost can be saved.



User flow

- User logs in to the web and mobile application by entering the credentials
- Credentials are authenticated by Cognito using Open ID authentication with Facebook, Google, or Amazon. Cognito generates a JWT token that is sent with the API request header to the API gateway
- AWS API gateway checks whether the endpoint method is configured with the AWS Lambda authorizer. If yes, the API gateway forwards the API with the token to the Lambda authorizer.
- Lambda authorizer checks the validity of the token and generates an IAM policy associated with the role of the identity and grants access to the required AWS resources, such as SQS and Lambda microservices endpoints. The IAM policy is validated by the API gateway. If validation fails, access to the AWS resources is denied, and the user gets a 403 Access Denied message. If the IAM policy is valid, the API gateway executes the SQS push event, which triggers the Lambda function. The IAM policy is pushed to the API gateway cache for subsequent retrievals.

- CloudWatch monitors the API integration latency and overall responsiveness of backend Lambdas, CacheHitCount, and CacheMissCount to optimize cache capacities.
- Lambda are the microservices that respond to events from the SQS. Since the SQS invokes the Lambda functions asynchronously, this results in non-blocking calls to Lambda. The Lambda functions subscribe to a specific SQS topic. In some cases, Lambdas may be executing a function to query the DB table and publish the query result message to the SQS topic. The calling mobile or web-client application pointing to the API endpoint receives this promptly.

  Message driven SQS architecture is therefore non-blocking as each message can be processed by the polling Lambda APIs asynchronously. Each is subscribing to a single topic for an event. Every Lambda function is isolated and autonomous and is triggered in response to an event generated by API endpoints.
- In some cases, Lambda functions may be updating DB tables, which would instantly update the mobile and web application client through an API endpoint,

Best practices

Decoupling: Decoupling of asynchronous messages using an Amazon SQS topic from subscribers leads to picking events without blocking any other subscriber from processing the published message.

Serverless: Using Lambda architecture reduces overhead on AWS compute, memory, and storage resources using the functions on runtime-based on specific event triggers.

Responsive: Request processing response times are extremely fast due to response messages being published to API endpoints.

Secured: Highly secured transactions through API gateway that acts like a proxy server abstracting the actual messaging services from direct interface to public IP.

Conclusion

Wipro has gained valuable experience from leading the digital transformations of major energy companies' IT and OT landscapes.

- Key design decisions are an outcome of several important factors that focus on OPEX and CAPEX, deployment architecture standards, ease of integration to third-party systems, and reduced network latency by hosting in the AWS regions closest to the customer sites.
- Working with domain architects and digi tal leads for addressing stakeholder apprehensions and speculation
- Scalability and ability to provide real-time data access and visualization from the centralized PI server on AWS
- Ability to ideate and deliver the best pos sible deployment strategies for LIMS applications that are non-standardized to ensure high availability, resiliency, aggre gation of lab historical datasets, and automation of lab sample collection
- Adoption of new-age reactive microser vices architecture design helping speed to market of several key services used in alternate energy digital platforms

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