

Oracle Blockchain Platform

Tamper-proof, transparent, and irrefutable business-to-business transactions combined with distributed digital ledgers storing tamper-evident records promise to fundamentally transform how business is done, making these interactions more secure, transparent, and efficient. Blockchain or Distributed Ledger Technology is one of today's most disruptive emerging technologies. Oracle offers the most comprehensive distributed ledger cloud platform on the cloud and on premises to securely extend your business processes and conduct online transactions in trusted networks with your suppliers, banks, and other trade counterparties.

EXTENDING ENTERPRISE BOUNDARIES

A blockchain is a system for conducting transactions and maintaining distributed ledgers that allows organizations, who do not fully trust each other to securely and reliably extend business processes and accelerate B2B interactions. Instead of relying on a central third party or suffering the delays inherent in an offline reconciliation process, blockchain enables organizations to use peer-to-peer protocols and a network of distributed validation nodes to execute common business logic in real-time and record the results in a tamper-evident ledger that's replicated among the participants.

Blockchain has the potential to fundamentally transform how global business transactions are conducted. Currently, some business-to-business transactions are routed through third parties to ensure their integrity. These third parties can introduce delays and add costs. Blockchain technology enables the participants in a trusted business network to transact directly, while still ensuring the validity and non-repudiation of their transactions. Once the proposed transactions are validated and the relevant parties reach an agreement on their results, blockchain participants record them in cryptographically linked blocks that cannot be repudiated. These blocks make up the ledger or transaction history stored on each participating node, and the blockchain protocols enable real-time updates and ensure the ledger's consistency across the network of participating organizations.

"The technology most likely to change the next decade of business is not the social web, big data, the cloud, robotics, or even artificial intelligence. It's the blockchain..."

Harvard business review
"The impact of blockchain goes beyond financial services."

Key Business Benefits

- Increase business velocity with a trusted business network
- Innovate with new business models and revenues from untapped markets
- Avoid reliance on centralized intermediaries, reducing delays, risk, and high fees
- Quickly link provenance, compliance, and sustainability information in the supply chain
- Rapidly integrate data from diverse systems of record into blockchain with REST APIs
- Extend SaaS and on premises applications with blockchain via integration adapters
- Achieve 24/7 operations with high resilience and autonomous monitoring and recoverability

With blockchain your organization and broader partner ecosystem can:

- **Increase business velocity.** Create a trusted network for B2B transactions and extend and automate your operations beyond the enterprise. Achieve real-time settlement and reduce delays by leveraging a peer-to-peer business network. Optimize business decisions with real-time information visibility across your ecosystem.
- **Reduce operations costs.** Accelerate transactions, eliminate the cumbersome offline reconciliations by using a trusted single source of information. Reduce friction in B2B transactions and eliminate intermediaries, manual spreadsheet-based reconciliation and exception handling.
- **Reduce the cost of fraud and regulatory compliance.** Gain the security of digitally signed transactions and tamper-proof business-critical records with a built-in audit trail and transparency. Simplify tracking sustainability information, brand compliance, conflict minerals, food safety, and reduce injection of fraudulent items in supply and distribution chains.

“Our customers and banks wanted a platform that allows startups, financial institutions and any customers to connect directly with their banks without intermediaries and to stop sharing data with them while still reducing the cost for everybody. So, we chose Oracle Blockchain to help us achieve all those benefits.”

**-- Ghassan Sarsak,
CIO, ICS Financial Systems**

ENTERPRISE-GRADE, PRE-ASSEMBLED BLOCKCHAIN PLATFORM

Oracle Blockchain Platform, available as a PaaS offering in Oracle Cloud Infrastructure (OCI) and as Enterprise Edition for on-premises deployment, is built on the Linux Foundation’s [Hyperledger Fabric](#) project with Oracle enhancements to provide an enterprise-grade blockchain platform. It is uniquely able to accelerate innovation for on-premises ERP and cloud-based SaaS and PaaS customers. This comprehensive distributed ledger platform enables you to provision blockchain networks, enroll member organizations, and deploy & run smart contracts to update and query the ledger. As a pre-assembled platform it includes all the required blockchain network components and their dependencies (compute, storage, containers, identity management, events, etc.) with an integrated blockchain operations console and comprehensive REST APIs for DevOps.

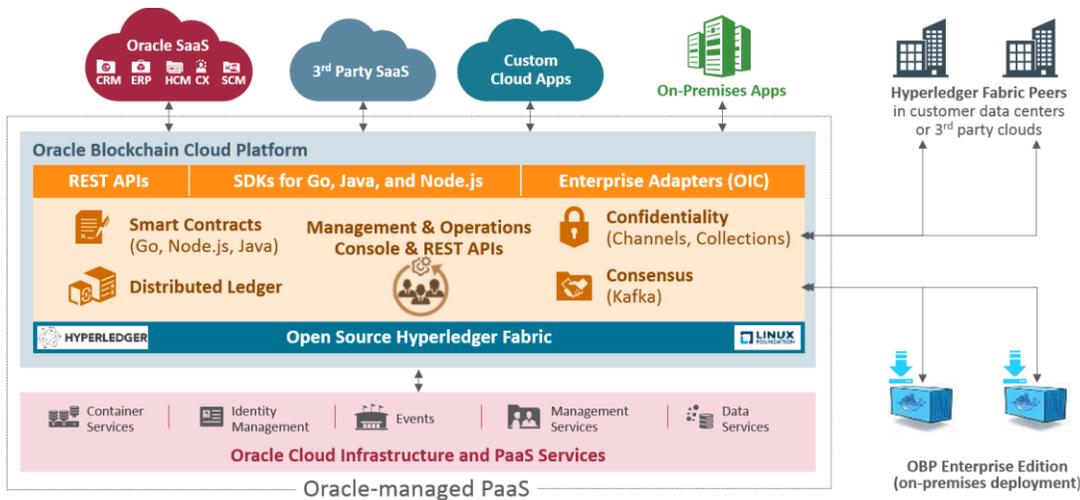


Figure 1. Oracle Blockchain Platform - Managed PaaS Offering

The Oracle Blockchain Platform is designed for continuous operation as a highly secure, resilient, scalable platform with continuous monitoring and automated recovery of all network components with continuous backup of the configuration changes. Managed VMs and container framework ensures high availability of peer nodes and chaincode execution containers across replicated VMs. Autonomous agents for monitoring of all components and real-time backup of all configuration updates enables quick autonomous recovery from any failure.

“The inclusion of Oracle Blockchain Platform in our offering enables us to deploy more innovative products and solutions for our customers globally, in particular with improved time to market for business intelligence reporting solutions. Oracle’s comprehensive enterprise-grade offering will open our customers to realizing more from our blockchain-based platform and crystalize value from the data in their own systems.”

**-- Leanne Kemp,
CEO & Founder, Everledger**

“We are leveraging blockchain to simplify complex shipping documentation processes and improve customers' operational efficiency by building a collaborative network. Oracle Blockchain Platform enables a shorter application delivery lead time with 30% productivity gains compared to other solutions.”

**-- Steve Siu,
CEO, CargoSmart Ltd.**

To ensure security and data integrity within a permissioned blockchain network with enrolled members, all organizations use X.509 certificates for their identity and exchange digitally signed messages over TLS-encrypted links. In case a certificate has been compromised OBP provides certificate revocation management and distributes CRLs across the network. All nodes run in managed containers, which in the managed PaaS cloud service only permit access through the gRPC messages or REST APIs. Built-in encryption for data-in-transit (messages) and data-at-rest (world state and ledger blocks) protect against any access at the network or storage level outside the blockchain containers. For normal operations the access to the blockchain nodes through gRPC messages and REST APIs is handled by the Load Balancing service, which supports TLS 1.2 and prioritizes the forward-secrecy TLS ciphers. User authentication in the cloud for the console and REST APIs is performed by Oracle Identity Cloud Service (IDCS) using OAuth2 protocol with federation capabilities to remote identity providers. In the Enterprise Edition deployed on-premise, the authentication is performed via the embedded OpenLDAP or customer-provided Directory Services.

Within the blockchain network transaction confidentiality can be achieved by using private channels with segregated ledgers or private data collections within a shared channel. A channel and its ledger represent a sub-net within a blockchain with an authorized subset of member organizations and governance policies for adding new members. When an organization joins a channel, its members can be granted ReaderWriter access allowing them to perform all operations on the channel including invoking smart contracts. Organizations that are granted ReaderOnly permission can only query for blocks or transactions, but cannot invoke smart contracts to update the ledger. Private data collections are key/value stores that are only maintained by a subset of the peers on a channel for a given smart contract. When these values are updated by the smart contract, only a hash of the key/value pairs ends up on the ledger as a proof, while the peers in the collection share the updates among themselves. This essentially provides platform-managed off-chain data, which can be configured to automatically be purged after some number of blocks.

SPEED TO MARKET WITH INTEGRATION ACCELERATORS

In order to simplify and accelerate application development and integration, Oracle's platform includes a REST Proxy for invoking smart contract transactions, querying the ledger, and subscribing to blockchain events from cloud-based or on-premises applications. You can also invoke blockchain operations from Java, Golang, or JavaScript client SDKs from new or existing on-premise or cloud applications, including container-based environments and digital assistants (chatbots) for web or mobile front-ends. ERP and other on-premises or SaaS systems of record can integrate with blockchain platform via a rich set of enterprise application adapters in Oracle Integration Cloud. As a further benefit of built-in IDCS authentication, single sign-on (SSO) enables same account access from PaaS and SaaS environments to Oracle Blockchain Platform within the same identity domain.

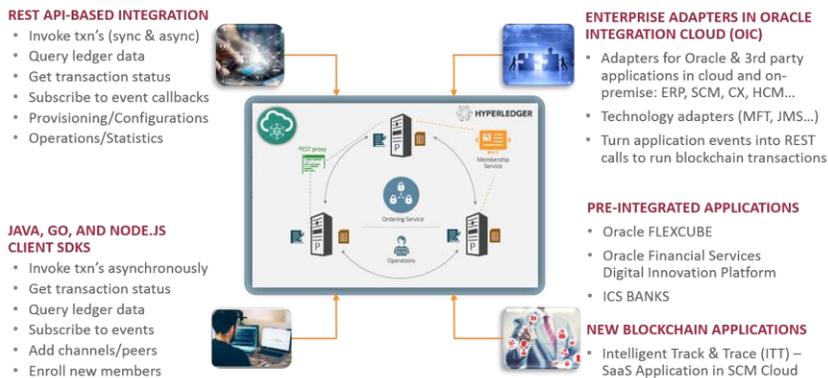


Figure 2. Ease of Integration and Systems of Record Connectivity.

Key Features

Build Trusted Business Networks

- Quickly provision complete enterprise-grade blockchain
- Include members inside or outside the Oracle Cloud using identity federation and existing 3rd party certificates
- Built-in resilience, HA with autonomous recovery, zero-downtimes managed patching

Automate with Smart Contracts

- Deploy Smart Contracts for real-time B2B transactions
- Manage smart contract lifecycle – deploy, expose via REST APIs, and update versions
- Automate partner ecosystem tasks via event subscriptions
- Improve developer productivity with SQL-based rich queries
- Define endorsement policies for required number of signatures

Ensure Confidentiality

- Define confidential channels and ledgers for private transactions
- Easily control member access privileges using ACLs & policies
- Dynamically configure channels and authorize members to join
- Use private data collections for sensitive data in a channel

Link Blockchain to Applications

- REST API-driven development – invoke transactions, queries, and subscribe to event callbacks
- Client SDK-based development (Java, GO, and Node.js)
- Plug-n-play integration for Oracle and 3rd party SaaS and on-premise applications
- Pre-integrated blockchain APIs in FLEXCUBE, NetSuite ERP, Open Banking API platform

Powerful Operations Tools

- Dynamically change the configuration with intuitive operations console
- Easily monitor and troubleshoot with built-in dashboards, ledger browser, and log viewers

These integration options allow your enterprise applications to easily conduct cross-system transactions and leverage partner data posted in the distributed ledger. The event-based bi-directional integration allows your enterprise systems to subscribe to blockchain events and receive callbacks with relevant data simply using REST APIs.

AUTOMATE WITH SMART CONTRACTS

Blockchain network is more than just a shared information store, it's also an automation platform that can execute business logic based on the data in the ledger and external inputs. Encapsulated in smart contracts (a.k.a. chaincode) the business logic can validate the ledger updates or evaluate multiple inputs to determine if an agreed condition has been met, triggering an event notification for downstream processing. For example, if an invoice and purchase order for some equipment match, and a delivery confirmation has been received, chaincode can update the records to transfer ownership of the equipment and trigger an event to issue payment.

Chaincode can be installed on multiple peers and instantiated separately on each channel. When application uses the REST API to invoke the chaincode, it also specifies the channel, thus ensuring that the transaction is operating on the data in the right ledger. For each chaincode there's an endorsement policy, which you can use to specify how many organizations must endorse the transaction (that is send back digitally signed execution results) and, optionally, explicitly select any mandatory endorsers. Chaincode can determine the identity of the transaction originator and related attributes from their signing certificate to apply within the business logic, for example, to manage access permissions to certain data. To increase developer productivity when writing chaincode, Oracle blockchain platform uniquely enables use of SQL-based rich queries to more efficiently select the data in the world state database.

SIMPLIFIED OPERATIONS AND ADMINISTRATION

After initial provisioning of an OBP instance, you can easily extend the blockchain network by adding other members running their own OBP instances or a compatible Hyperledger Fabric release outside of Oracle Cloud. The OBP console provides an intuitive Web UI and fully-featured REST API for dynamic configuration, monitoring and troubleshooting.

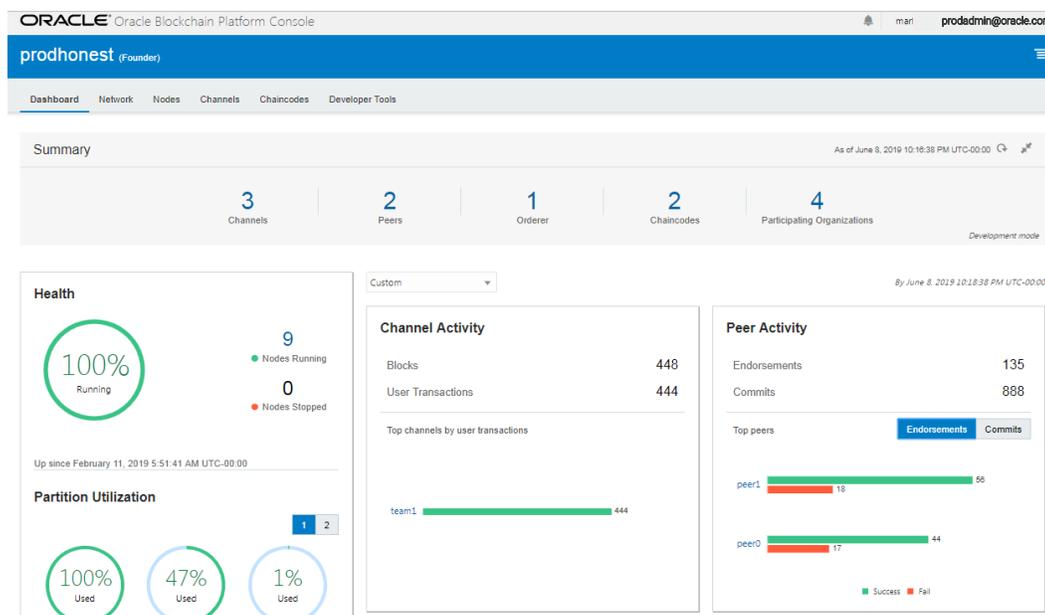


Figure 3. Blockchain Network Dashboard View

Smart Contract Examples

- Verify account balances & AML rules before transferring funds.
- Check & update records for goods in supply chain.
- Transfer ownership of assets once conditions are met.
- 3-way match POs, invoices, and receipts for settlement.
- Update a provenance record to protect IP rights.

Applications with Pre-built Integrations to Oracle Blockchain Platform

- [Oracle FLEXCUBE Universal Banking Adapter for Blockchain Interface](#)
- [Oracle FLEXCUBE Investor Servicing Adapter for Blockchain Mutual Fund Transactions](#)
- [Oracle.com/industries/financial-services/digital-innovation-platform.html](#)
- [Netsuite.com/portal/platform.shtml](#)

Custom Integration Options for New and Existing Applications

- Oracle Integration Cloud enterprise [adapter library](#) for Oracle & 3rd party apps (see [certifications](#) for details.)
- REST APIs for transaction invocation, queries, and event subscriptions w/REST callbacks
- Client SDKs for Java, GO, and Node.js for complex integrations

The Web UI provides an overall dashboard view, showing network summary as well as channel and peer activity, and includes health views for each node within the OBP instance. Network, Nodes, Channels, and Chaincodes tabs provide further detailed access to network components. Using the console UI you can perform common administration and operations tasks, such as:

- Control the blockchain network and manage its components – peers, orderers, etc.
- Add member organizations that want to join the blockchain network
- Configure network channels, authorize organizations and set policies, ACLs, etc.
- Deploy chaincodes to peers and channels, update new versions, export their REST end-points
- Browse each channel's ledger and transactions in the appended blocks
- Monitor the network using dashboard and logs to troubleshoot any issues
- Download smart contract development aids and application integration SDKs
- Deploy and use sample smart contracts provided in the platform
- Enable automated off-chain synchronization of blockchain transactions to rich history DB

In addition to the Web UI, a comprehensive set of REST APIs for DevOps is provided by the platform, including administrative operations for Organizations, Nodes, Channels, and Chaincodes as well as a rich set of Statistics APIs. For example, you can add a new Organization, add it to a channel, and deploy chaincodes on its peer nodes.

Once the network is running and you've deployed smart contracts, you can leave infrastructure updates, backups, and other operational worries behind with Oracle-managed services. This includes built-in continuous ledger backup, infrastructure monitoring and troubleshooting, as well as zero-downtime managed patching and release updates.

OFF-CHAIN SYNCHRONIZATION OF THE BLOCKCHAIN TRANSACTION DATA

As blockchain gains adoption in the enterprise it becomes a significant source of value for business intelligence and analytics. However, the way transaction history is stored in a blockchain ledger makes it hard and costly to perform deep and broad searches necessary for interactive visualizations and reporting. Instead of leaving this as a challenge for application builders, OBP provides a built-in mechanism to stream blockchain transactions and world state updates to a relational store in Oracle's Autonomous Data Warehouse (ADW) or other databases. Once you've configured the database connection for your OBP instance, you can enable any channel to synchronize its ledger to the database. As each transaction is committed in the ledger, the asynchronous streaming process unpacks transaction information into the pre-defined schema. The database maintains the history information, world state, and block height indication to ensure consistency for any queries and reports.

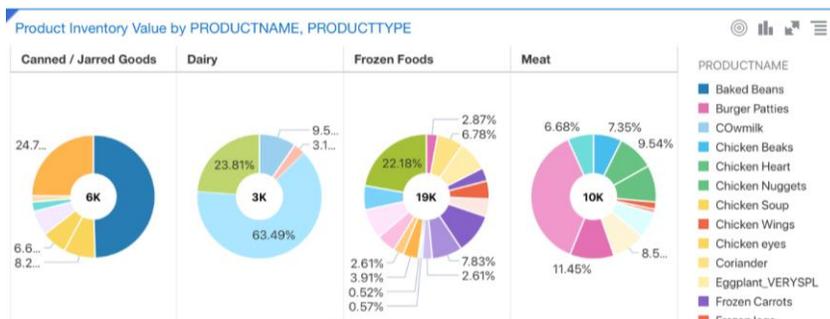


Figure 4. Visualization Dashboard Created in Oracle Analytics Cloud From the OBP rich history DB

ENTERPRISE EDITION FOR ON-PREMISE DEPLOYMENT

Some customers operate in industries and countries where in order to meet the data sovereignty or data residency requirements they can't deploy their blockchain instances on Oracle Cloud. The Enterprise Edition provides an independently-installable version of Oracle Blockchain Platform built on Docker containers and delivered as a pre-built VM image for multiple virtualization options. The VM is delivered in an Open Virtualization Appliance (ova) format and can be imported and started using VMWare ESXi, Oracle VirtualBox, and Oracle Linux Virtualization Manager. Once the VM is running, the Blockchain Platform Manager is used for configuration, provisioning, and patching multiple Blockchain Platform instances using Developer and Enterprise configurations, which can be deployed over multiple VMs to distribute the Docker containers running OBP nodes. Similarly to the cloud PaaS, this edition is fully pre-assembled and can create new complete blockchain instances in minutes.

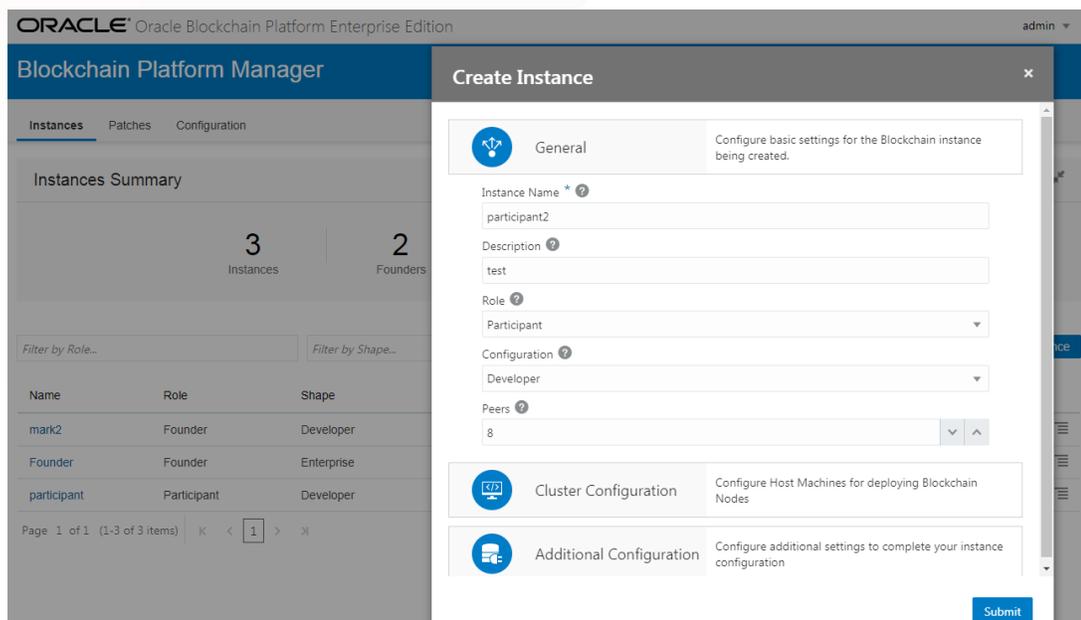


Figure 5. Platform Manager and Create Instance Wizard in the OBP Enterprise Edition

In addition to flexible virtualization options, the enterprise edition enables dynamic scalability to handle the evolving workloads by increasing the resources in the current VMs, adding OBP nodes (e.g., peers, orderers,) or scaling out by adding more VMs to run the additional nodes. Additional VMs can be deployed in other datacenters across a WAN for disaster recovery (DR.) Unlike typical applications, OBP's distributed ledger and the distributed metadata database handle data replication out-of-the-box.

Feature parity with the cloud version of OBP ensures that customers can deploy chaincode and use the same chaincode APIs across both versions. Oracle innovations in using Berkeley DB for world state with SQL-based queries, built-in transaction synchronization to off-chain rich history database, intuitive and comprehensive console with powerful operations and monitoring tools, and all the other unique enterprise-grade features are shared across the cloud and on-premise versions.

In fact, customers can link both types of instances in hybrid networks, which may be the optimal topology for some global deployments. Either the cloud or on-premise version can run the Founder instance and add participants from either environment. Both of them can also interoperate with non-Oracle instances of Hyperledger Fabric deployed in customer's environment or 3rd party clouds. Such flexible, hybrid blockchains are ideal for supporting evolving blockchain-based consortiums in many industries and across many countries.

For More Information

- [OBP EE Documentation](#)
- [Oracle.com/Blockchain](#)
- [Blockchain Platform Cloud Service](#)
- [Getting Started Video](#)
- [Customer Examples](#)
- [Partner Marketplace](#)
- [Blockchain Developer Materials](#)
- [Oracle Blockchain Blog](#)
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Integrated Cloud Applications & Platform Services

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