

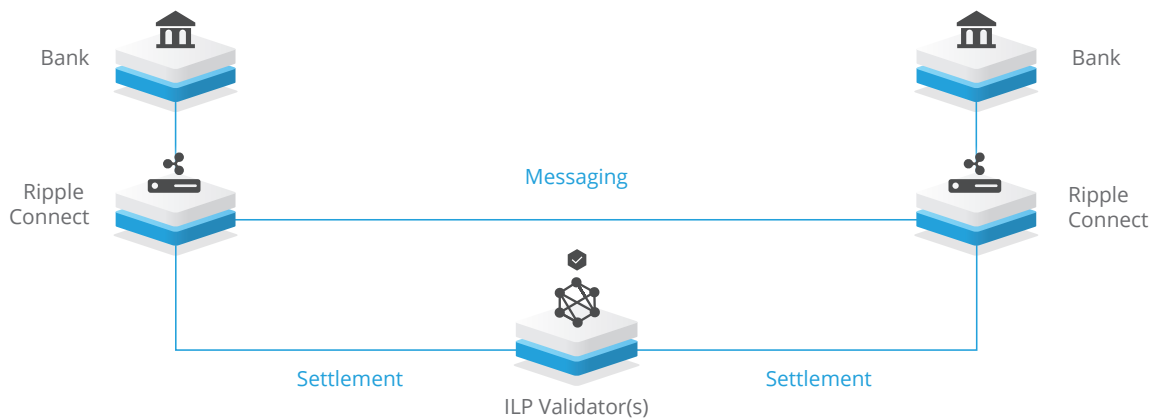


# Product Overview

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# Solution Overview

Ripple's solution is built around an open, neutral protocol (ILP) to interoperate different ledgers and networks. It offers a cryptographically secure end-to-end payment flow with transaction immutability and information redundancy. It is designed to comply with your bank's risk, privacy and compliance requirements. It is architected to fit within your bank's existing infrastructure, resulting in minimal integration overhead and business disruption.



There are two key components to the Ripple solution for banks:

## RIPPLE CONNECT

Ripple Connect is a plug-and-play module that processes international payments for banks. It connects to the beneficiary bank's Ripple Connect to exchange KYC and risk information, fees, FX rates (if applicable), payment details and expected time of funds delivery. It packages this information and presents the entire cost structure to the originating bank, providing unprecedented visibility into the total cost of the transaction. If information is incorrect or missing, transacting parties will find out before initiating the transaction, drastically increasing STP rates. Once the sender approves the transaction, Ripple Connect employs ILP to settle funds and notifies all parties of the transaction confirmation.

## ILP VALIDATOR

The ILP Validator (a component that cryptographically confirms the success or failure of a payment) coordinates the funds movement across the ledgers of transacting parties in a way that removes all settlement risk and minimizes delays in settlement. The ILP Validator provides the single source of truth for the transacting counterparties on the success or the failure of the payment.

# Ripple Connect

Ripple Connect is the messaging component of the Ripple solution that enables banks to exchange sender and recipient information, fees, and the estimated delivery time of the payment before the payment is initiated. The payment data exchanged through Ripple Connect can be used to meet jurisdiction-specific regulatory needs and other enhanced services. Ripple Connect also works in concert with the other components of the Ripple solution to settle funds using the Interledger Protocol (ILP) in a way that removes all settlement risk and preserves transaction privacy.

## How It Works

To send an international payment with Ripple Connect, the originating bank makes a **Get Quote** request to its own Ripple Connect instance, which contacts the Ripple Connect instance at the beneficiary bank to get its fees. The originating bank's Ripple Connect instance queries the FX Connector (component that the liquidity provider uses to post FX rates) to get the FX cost for the payment. The originating bank receives a response to its **Get Quote** request and determines if the terms of the payment (which include the beneficiary bank's fees and the FX rate) are acceptable.

If the terms are acceptable, the originating bank makes an **Accept Quote** request. If the configuration of the beneficiary bank's Ripple Connect has requested additional information about the payment, the originating bank provides that information in the **Accept Quote** request. (Additional payment information is not technically required, but for regulatory reasons, institutions often require information similar to fields in pacs.008 or MT 103 messages to process payments).

The beneficiary bank then reviews the quote and performs compliance checks to ensure that:

- The payment terms are acceptable.
- The additional payment information requested from the originating bank is present and sufficient to process the payment.

If the terms and additional payment information are acceptable, the beneficiary bank locks the quote. A locked quote indicates that both parties intend to process the payment and deliver the funds as described in the contract fields of the payment object.

To execute the payment, the originating bank makes an internal book transfer to debit the funds from the sender's account by making a **Submit Sending Payment** request. This request triggers the settlement payment, which transfers the funds through the Interledger Protocol (ILP) from the originating bank's ILP Ledger (a subledger to track the state of the liquidity provider's funds) to the beneficiary bank's ILP Ledger.

When the beneficiary bank sees that the ILP transfers have been validated by the ILP Validator, the beneficiary bank makes an internal book transfer to deliver the funds to beneficiary's account. After executing the internal book transfer, the beneficiary bank makes a **Submit Receiving Payment** request to its Ripple Connect instance. This request notifies the originating bank's Ripple Connect instance that the funds have been delivered to the beneficiary. After receiving the notification, the originating bank's Ripple Connect instance changes the state of the payment to **succeeded**. At this point, the payment is considered complete by both parties.

Throughout the entire process, either bank can query the state of the payment at any time because each payment is assigned a unique payment ID and is fully automated.

## Key Features

The key features of Ripple Connect include:

### **Pre-Transaction Communication:**

Ripple enables information exchange between transacting banks that include transaction fees, delivery time, FX rate and additional payment information before executing the payment. This information can be used to pre-validate the transaction to increase STP rates.

### **Fee Transparency:**

Ripple allows financial institutions to disclose the total cost of payment (including the processing fee charged by the originating and beneficiary banks and the FX rate for the payment) to the originator before executing the payment.

### **Funds Settlement with Unique Identifier:**

Each end-to-end payment has a payment ID that can be used to query the status of the payment at any point during payment execution, including funds settlement, and thereafter.

### **Configurable Fees and FX Rates:**

Financial institutions can set fees and the FX rate for payments made with Ripple Connect. FX rates are set in the FX Connector and queried by Ripple Connect during the quoting process.

### **Payment Delivery Confirmation:**

Financial institutions receive notifications about each phase of the payment, including when the funds are delivered to the beneficiary's account.

### **Secure Communication:**

Ripple Connect uses Transport Layer Security (TLS) v1.2 for secure communication with existing financial institution systems, partner Ripple Connect instances, and the ILP components of the Ripple solution.

### **End-to-End Transaction Visibility:**

Both the originating and beneficiary banks have full visibility into the state of the payment, allowing them to troubleshoot failed or delayed payments.

# ILP Validator

The ILP Validator performs the function of coordinating ledger updates across multiple financial institutions involved in a transaction. Financial institutions have the option of running their own ILP validator and using that validator for all their transactions, or (in future product releases) relying on the network of ILP validators reaching consensus through a byzantine-fault-tolerant (BFT) consensus algorithm.

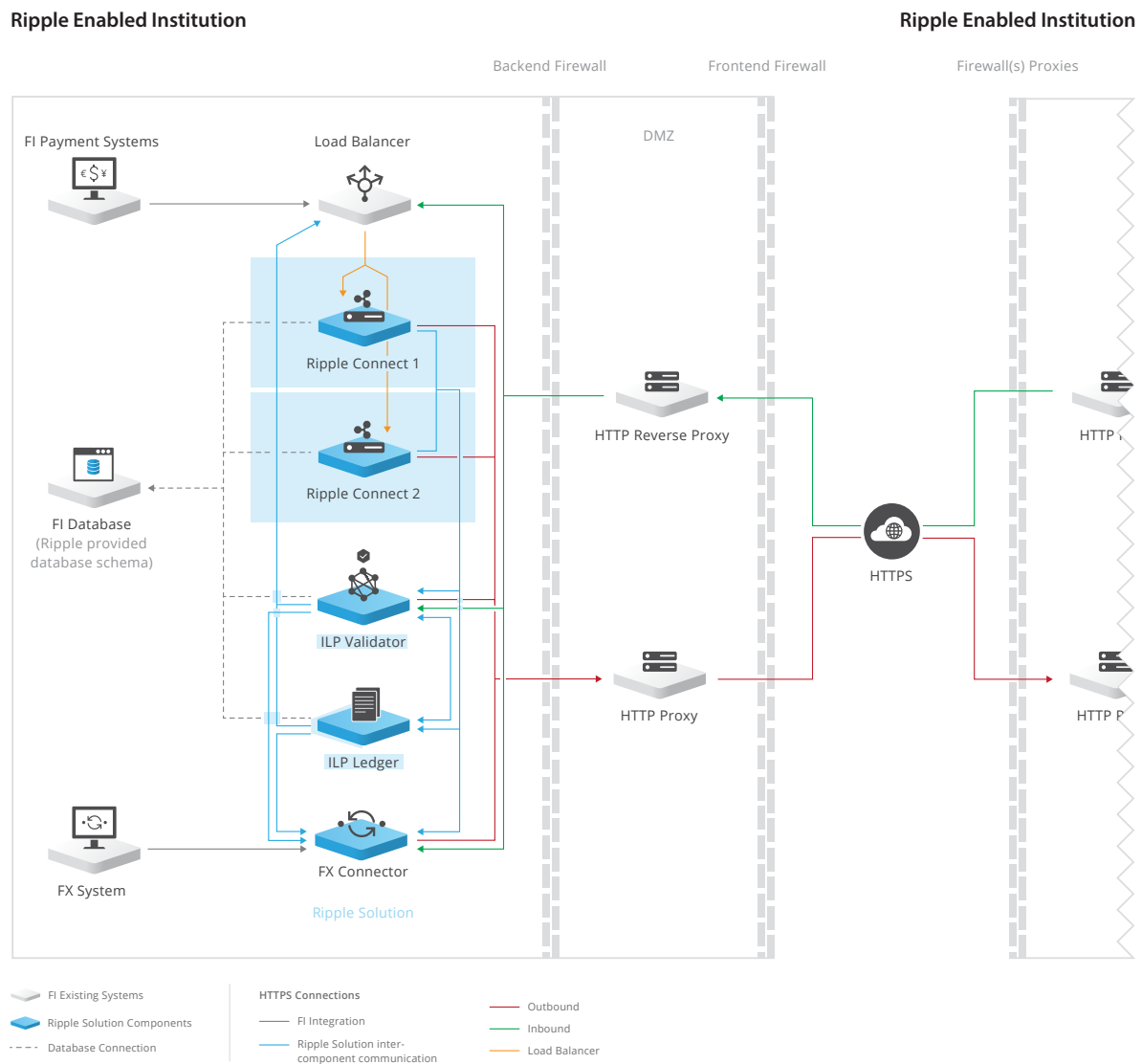
ILP Validators provide a central source of truth for validating transactions while preserving transaction privacy. The transaction details remain private to only the transacting banks, while the ILP Validator is used to verify whether certain “crypto-conditions” have been fulfilled (i.e. whether the funds are available for delivery).

When banks are ready to settle funds, the originating bank sets the terms of the payment with the ILP Validator, requiring the beneficiary bank to provide proof of funds on hold ready to be posted to the beneficiary. The originating bank also puts the funds on hold from the sender and sends the ILP Validator a cryptographic receipt of the hold. When the beneficiary bank puts the funds on hold, it provides a cryptographic receipt to the ILP Validator proving the condition has been met. The ILP Validator verifies the time-stamp and the receipts, and instructs both banks to release the hold and transfer funds (for the originating bank, to the liquidity provider and for the beneficiary bank, to the beneficiary). For more information how ILP Validators work, see the ILP Whitepaper ([interledger.org/interledger.pdf](https://interledger.org/interledger.pdf)).

As this model gets expanded to multiple intermediaries in the future, this model ensures that all legs of the payment process simultaneously or none of them do, removing settlement risk from the transaction. It also ensures that the transaction details are not shared with anyone other than the transacting banks. The ILP Validator does not see any payment details - rather it cryptographically verifies whether certain conditions are fulfilled.

# Reference Architecture

The Ripple solution is typically installed on-premises behind the corporate firewall of a financial institution, with a load balancer handling inbound connections to Ripple Connect and a proxy server handling inbound and outbound connections to all Ripple solution components. As a financial institution, you can deploy multiple instances of the Ripple Connect behind the load balancer to scale to your volume of payments. A typical production deployment of the Ripple solution at a financial institution looks like the following example:



Note: If you are not providing liquidity, you only need to configure Ripple Connect and ILP Ledger.

This has the following features:

- Both Ripple-enabled institutions can send and receive payments through the Ripple solution.
- The originating or beneficiary institution can provide liquidity.
- The Ripple solution is deployed in a secure, trusted network zone, behind corporate firewalls and the DMZ. (The Ripple solution should not be deployed inside the DMZ.)
- All components of the Ripple solution are co-located on a single application server and communicate with each other over HTTPS and use TLS certificates for authentication.
- The Ripple solution deployment communicates with partner Ripple solution deployments over HTTPS and use TLS certificates for authentication.
- The databases for Ripple Connect, the ILP Validator, and the ILP Ledger are created with the provided database schemas and deployed on the same database server. (The FX Connector does not currently require a database.)

## Technical Requirements

Operating System	Red Hat Enterprise Linux (RHEL) 6.7 and 7.2
Architecture	x86 (64-bit)
RAM	8 GB
CPU	4 Cores
Disk Storage	100 GB
Supported Database Connections	<ul style="list-style-type: none"><li>• PostgreSQL 9.4</li><li>• Microsoft® SQL Server® 2012</li></ul>
Deployment Options	RPM
RPM Dependencies	Node.js v6.9.0 or later

## About Ripple

Ripple provides global financial settlement solutions to ultimately enable the world to exchange value like it already exchanges information – giving rise to an Internet of Value (IoV). Ripple solutions lower the total cost of settlement by enabling banks to transact directly, without correspondent banks, and with real-time certainty of settlement. Banks around the world are partnering with Ripple to improve their cross-border payment offerings, and to join the growing, global network of financial institutions and liquidity providers laying the foundation for the Internet of Value.

Ripple is a venture-backed startup with offices in San Francisco, New York, London, Luxembourg and Sydney. As an industry advocate for the Internet of Value, Ripple sits on the Federal Reserve's Faster Payments Task Force Steering Committee and co-chairs the W3C's Web Payments Working Group.

## Contact Us

To learn more about how your financial institution can adopt Ripple, please contact us at [ripple.com/contact](https://ripple.com/contact)

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