



HYPERLEDGER
FOUNDATION

Case Study

**LACChain uses
Hyperledger Besu
to create the world's
largest permissioned
public blockchain**

LACChain

- Sponsored by Inter-American Development Bank (IDB) Lab and its partners as a regional public good
- Supported by a global alliance for developing blockchain in Latin America and the Caribbean (LAC)
- Launched in March 2019
- The largest permissioned public blockchain infrastructure in the world, based on the number of projects and entities using it directly

Goals

- To break silos in blockchain usage in Latin America and the Caribbean
- To provide a neutral, reliable blockchain infrastructure compliant with regulations
- To reduce barriers to organizations scaling or adopting blockchain by eliminating transaction fees, establishing an assurance framework, and granting compliance with regulation
- To appeal to a variety of users, including start-ups, corporations, banks, academy, governments, and multilateral institutions
- To contribute to social and economic advancement in Latin America and the Caribbean, reducing inequality and empowering people.

Approach

1. Establish a global alliance with key, diverse partners
2. Build an ecosystem with the help of Hyperledger Besu
3. Implement a neutral, accountable, and robust governance
4. Develop tools for economic sustainability
5. Introduce a non-profit orchestration entity

Results

- More than 101 entities on the network since its launch
- As of August, 2022, 191 nodes deployed
- More than 60 projects on LACChain Network
- Over 40 projects with impact on inclusion
- 15 countries co-building ecosystems



Introduction

Permissionless public blockchains are accessible to anyone. But they're often unsuitable for heavily regulated institutions, like banks or public-sector initiatives. They lack the necessary identification, authentication, and authorization requirements. And transaction fees in permissionless blockchains make them too expensive for many projects.

Permissioned private blockchains offer what permissionless public ones lack, but they also cost a lot to develop and support. This makes them hard to scale.

Yet blockchain is still the ideal solution for many use cases.

The Inter-American Development Bank (IDB) struggled to find the right balance by using different networks for different projects. But this variety came with other issues, like compliance, technical support, and accountability. These challenges prevented IDB's pilot projects from expanding into enterprise-level projects.

IDB Lab is the innovation laboratory for IDB. It set about finding solutions to the problems of regulatory compliance, support, and governance. As it investigated the problem, IDB Lab noticed similar struggles throughout Latin America and the Caribbean (LAC). Organizations were looking for an alternative to permissionless public and private blockchain networks to deploy their solutions.

Permissioned public networks—combining the benefits of the other blockchains without their drawbacks—seemed like the answer. Successful networks already existed in the EU, and IDB Lab thought it could develop one for LAC.

In March 2019, it funded a project to create LACChain, a permissioned public blockchain infrastructure. Could IDB Lab develop a scalable and sustainable network for the LAC region...and beyond?



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— Alejandro Pardo Vegezzi, *IDB Lab Principal Specialist and LACChain Leader*

Establishing a global alliance with key, diverse partners

To build a regional blockchain ecosystem, IDB Lab needed help. Establishing the right alliance was the first step of the project.

“IDB Lab intended LACChain as a public good,” says Alejandro Pardo Vegezzi, IDB Lab Principal Specialist and LACChain Leader. “We wanted to be as neutral and inclusive as possible.”

IDB Lab recruited partners from large, established private sector companies, start-ups, multilateral institutions, governments, and universities. “We needed this diversity to ensure the ecosystem and infrastructure would be useful for as many users developing non-cryptocurrency blockchain projects as possible,” Allende says.

The initial project team included people and resources from LACChain partners. IDB Lab coordinated and headed the team. Once it was in place, it was time to design LACChain.

Building an ecosystem with the help of Hyperledger Besu

While LACChain is protocol-agnostic, it needed to begin somewhere. The team wanted a few key features for the LACChain infrastructure: smart contracts, scalability, and widespread use.

In Latin America, most developers knew Ethereum. Its smart contract technology and scalability were proven and established. Also, LACChain partners Everis (now NTT Data), iobuilders, and ConsenSys contributed a test-net built on Ethereum-based protocols. These all made Ethereum-based technology the natural starting point.

LACChain began developing its first test-net in 2019 with Quorum. Then it migrated to Pantheon. ConsenSys was the primary contributor and maintainer Pantheon, which became Hyperledger Besu in 2019. While LACChain already used the framework before it became part of the Hyperledger project landscape, its inclusion was another reason to keep using it.

“We consider Hyperledger Besu as the best Ethereum-based permissioned protocol available for permissioned-public networks” says Vegezzi. “Hyperledger protocols come with a seal of quality. Having LACChain Networks using Hyperledger Besu is attractive to users.”



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Implementing a neutral, accountable, and robust governance

In typical Ethereum-based networks, ostensibly anonymous end users sign transactions. If you look at a transaction, there is always a blockchain address/wallet that signed it, but this is just an anonymous entity or individual. It must be that way for blockchain applications to guarantee privacy. But compliance with regulations requires accountability.

LACChain solved the problem by creating two signature levels, buffered by a permission layer on Hyperledger Besu. It works like this:

- Any entity can join the LACChain networks by deploying a node.
- Nodes can be validators, boots, writers, and observers. Entities choose their deployment environment, which can be cloud or on-premises. There are only a few minimum hardware requirements for nodes to perform properly.
- Entities must comply with the terms and conditions for LACChain testnets and the Adscription Agreement for LACChain Mainnet. Per the T&C, every node operator is responsible for the transactions they send to the network and their content. This is enforced by requiring each writer node that broadcasts transactions to sign them, in addition to the anonymous end-user signature.

Along with the work on the infrastructure and governance, the project team considered two other issues: self-sovereign identity and quantum resistance.

LACChain implemented protocols for self-sovereign identity that are inclusive and respectful of personal data. “In the era of digital wallets and verifiable credentials, we’ve been concerned people might be left behind,” says Allende. “Already, there is an inclusion problem in many areas.”

Allende, a quantum physicist, also looked ahead to future attacks by quantum computers. “Quantum computers will be available over the next few years,” he says. “And people aren’t going to raise their hands to say they have a quantum computer that forges signatures and steals assets.”

LACChain uses a solution developed by IDB Lab, in collaboration with Cambridge Quantum Computing and Instituto Tecnológico de Monterrey. The solution uses CRYSTALS-Dilithium Signature Algorithm and FALCON post-quantum algorithms to implement an attack-resistant layer on top of blockchain networks.¹

“It’s unique,” Allende says. “The solution is open source because we believe it’s a necessary resource for the community. It’s better to act now, before quantum computers are robust enough to hack blockchain.”

Yet even with strong governance and advanced security, LACChain faced two significant challenges related to sustainability.

Developing tools for economic sustainability

The first sustainability issue was economic. It wasn't simply a question of how to remain economically sustainable without transaction fees or cryptocurrency. It was also a question of whether the network could sustain fair access and avoid DoS attacks with "free" transactions.

All transactions on an Ethereum-backed network require GAS, which covers the computational power needed to process a transaction. Typical GAS Distribution Protocols allow account owners to request GAS. However, this opens the possibility a permissioned entity could transfer GAS to a non-permissioned entity. It also risks these permissioned or non-permissioned entities accumulating GAS and provoking a DoS attack to collapse the network.

LACChain developed a new GAS Distribution Protocol to solve these problems using smart contracts. This protocol assigns GAS per block to permissioned writer node accounts, not end-users.

Distribution is also dynamic and dependent on how stressed the network is. If fewer entities use the network at a specific time, more GAS is available for them. If more entities use the network, less GAS is available. The network makes sure there is no saturation.

It's a smart contract-based solution. Smart contracts evaluate transactions sent to the network and keep an on-chain accounting of how much GAS each node is using per block. They check that a permissioned writer node signed the transaction, and that the writer node has enough GAS remaining for the present block to register that transaction.

Depending on how much GAS and technical support it requires, an entity chooses from three membership levels for the Mainnet—Basic, Standard, and Premium—while the Testnet is free to use.

The project team developed the GAS distribution protocol using Hyperledger Besu and its open-source resources. The team also created a second protocol with Hyperledger Besu. This one rotates validator nodes using an algorithm to maximize performance and decentralization.

The membership levels and protocols help support the economics of the project and the fair distribution of resources to participants. But they didn't solve the other sustainability issue, which was operational: IDB Lab projects have end dates.

Introducing a non-profit orchestration entity

LACChain was never intended to stay governed by the initial project team. But without the team of IDB Lab and LACChain Partners, how would LACChain support the entities using the network?

Technical support and security assurances attract users to LACChain Networks. Someone needed to coordinate with the different working groups across the network. Someone

needed to permission new nodes. Someone needed to sign the Adscription Agreements with node operators.

The team solved this problem by creating LACNet, an international non-profit association based in Uruguay. It's funded by Red Clara—a non-profit that connects the academic community in Latin America—and LACNIC—the Internet Addresses Registry for Latin America and the Caribbean—in collaboration with IDB Lab.

LACNet orchestrates the LACChain Networks developed by the LACChain Alliance. “LACNet provides centralized orchestration that gives regulatory accountability, technical support, and resiliency to the infrastructure,” says Allende. “After that, everything is as decentralized as possible.”

In February 2022, the neutral LACNet began orchestrating LACChain. More than 60 projects are using the LACChain networks today. And while LACChain and LACNet have campaigns and attends events, most times, entities come to them seeking solutions.



“We are lucky to have developed an infrastructure many entities want to join. There are no incentives besides the network’s direct benefits for entities using blockchain technology.”

— Marcos Allende López, *Technical Leader of LACChain and IT Specialist in Blockchain, Digital Assets, Quantum Technologies, and SSI, Inter-American Development Bank*

“We just try to spread the word about blockchain technology and the LACChain network and let people decide if it’s suitable for them,” says Allende. Many organizations start a test project on Ethereum. But when they look to deploy in a scaled environment, they discover that the network may not be the best fit. That’s when they find LACChain and its orchestrator, LACNet.

“We are lucky to have developed an infrastructure many entities want to join,” Allende says. “There are no incentives besides the network’s direct benefits for entities using blockchain technology.”



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Future steps

The project is now building interoperable sidechains and layer-2 networks to be able to scale as demanded. After December 2023, when the IDB Lab project phase winds down, the LACChain networks will remain sustainable, strong and orchestrated by LACNet.

“We see them becoming a regional public good used by a variety of entities for tokenization, for interoperability, and for supply chains,” Allende explains. “Basically, for everything that’s coming with Web3.”

IDB will stay involved as a contributor to LACNet and a network user. Today it has more than 20 projects on LACChain Networks orchestrated by LACNet, which is just the beginning. “We see how the infrastructure keeps growing and developing more tools and interfaces,” Allende says. “That makes it even easier to develop projects focused on financial inclusion and social impact, which are IDB’s goals.”



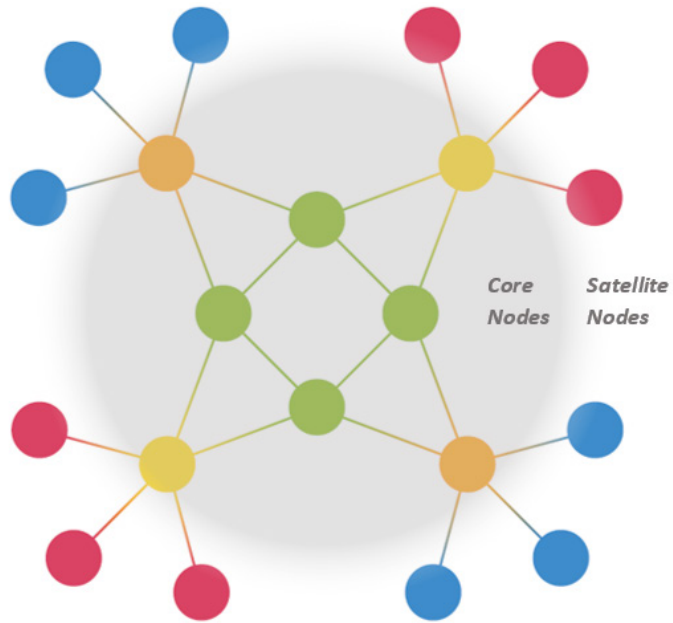
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LACChain won’t be limited to the LAC region, either. Already operating nodes exist in the United States and Europe.

For now, IDB Lab’s project focuses on perfecting and enabling the regional infrastructure. This included adapting the Hyperledger FireFly tool to run in compatibility with LACChain networks. The tool is a complete stack for enterprises to build secure, production-ready apps on popular chains and protocols.

“Our priority is to enable this infrastructure for financial, social, and gender inclusion,” says Allende. “And then to continue assisting and funding projects that use this infrastructure to support these goals.”



- **(Observer) Boot Nodes**
Routing nodes that connect validators and observer nodes
- **(Writer) Boot Nodes**
Routing nodes that connect validator and writer nodes.
- **Validator Nodes** participate in the consensus protocol and generate new blocks.
- **Observer Nodes** can only read the blockchain, not broadcast
- **Writer/Regular Nodes** broadcast transactions to the network

For more information on the threat and solution, see “Quantum-resistance in blockchain networks” at <https://arxiv.org/abs/2106.06640>



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About LACChain

LACChain is a global alliance of participants in the blockchain environment. It's led by the Innovation Laboratory of the Inter-American Development Bank Group (IDB Lab). LACChain develops and maintains a cohesive blockchain ecosystem in Latin America and the Caribbean.

To learn more about LACChain, visit <https://www.lacchain.net/home>



About LACNet

LACNet is an international non-profit association that results from the alliance between Red Clara—a non-profit that connects the academic community in Latin America—and LACNIC—the Internet Addresses Registry for Latin America and the Caribbean—in collaboration with IDB Lab.

LACNet has been created by the LACChain Global Alliance to orchestrate the LACChain Blockchain Networks guaranteeing neutrality and sustainability. To learn more about LACNET, visit <https://lacnet.lacchain.net/lacnet-eng/>



About Hyperledger

Hyperledger is an open source collaborative effort created to advance cross-industry blockchain technologies. It is a global collaboration including leaders in banking, finance, Internet of Things, manufacturing, supply chain, and technology. The Linux Foundation hosts Hyperledger under the foundation. To learn more, visit <https://www.hyperledger.org/>

