



Mojaloop Executive Briefing

How Mojaloop Can Support Hub Operators to Deliver Instant Interoperable Payments for Schemes

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mojaloop
foundation

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Interoperable Instant Payments and Financial Inclusion

Today the last mile is the longest mile for those millions of people in the world who don't have access to traditional banking services.

Cash is the great leveler, but...

There is a reason cash has been a successful payment instrument for thousands of years and is still often the fallback when other mechanisms fail:

- It's accessible to everyone, no one is excluded.
- The recipient can use the cash received immediately.
- It works without an investment in expensive digital equipment.
- You always know your balance.
- It's widely accepted.

But cash might be a poor fit in some situations:

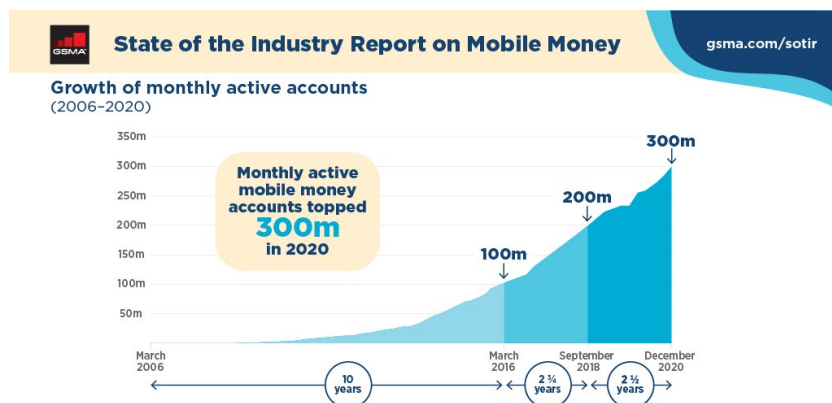
- Sending money to someone remotely is difficult, risky, and expensive.
- As a physical, portable item, it's easily stolen and can often be bulky in large amounts.

And there are also real costs that come with managing cash, despite its appearance of being free. Costs include those arising from seigniorage, security, sorting centers, ATMs, theft, and more.

The emergence of digital solutions for low-income people

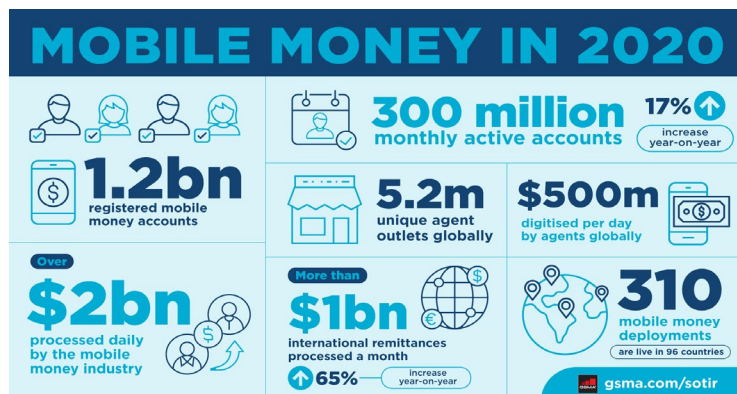
In the last 10 years, the emergence of non-bank digital financial services, including mobile money offerings, has made relevant and valuable services accessible in local communities, using **simple feature phones** and last-mile **agent distribution networks that ensure access to cash**.

According to GSMA's state of the industry report 2021¹, 300 million mobile money accounts are being used globally every month. In December 2020, \$70 billion was transacted via mobile money. This industry is important in the global journey to financial inclusion.



¹ <https://www.gsma.com/sotir/>

Much of the change started with remote payments facilitation via instant push payments. This created trust in digital payments - people were able to retain the security of simply accessing cash when required through a vast agent network - and offered consumers an affordable digital option to pay that gave people back their time and made money storage safer.



Research has shown² that a combination of agent density and safe storage of funds has contributed to lifting households out of poverty.

Defining an Instant Push Payment

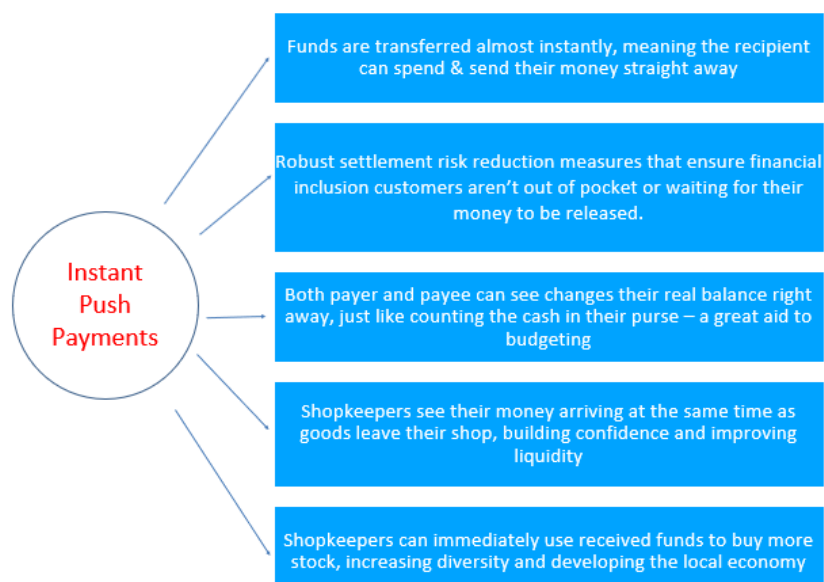
Most successful digital services for financial inclusion customers focus on the delivery of instant push payments as the transaction mechanism because it most closely mirrors the experience of cash.

Once finalized, push payments are irrevocable. In order to refund or reverse a transaction following a dispute, a second push payment transaction must be made in the opposite direction.

Push payments ensure the customer is always in control of when funds leave their account. This helps with budgeting.

In addition, push payments that are settled to the payee instantly:

- Build trust as the funds can be spent right away
- Let merchants build confidence in digital payments



Creating a reliable instant push payment experience is not simple - but is simpler in a closed ecosystem with a product governed by a single institution than in a fully open and interoperable scaled ecosystem.

² https://www.povertyactionlab.org/sites/default/files/Science%20Daily_Tavneet%20Suri%202016.12.08.pdf

The reality in many markets today is that each service is often bringing siloed offerings to customers. This results in a fragmented experience for customers and greater inefficiency, risk and cost in how money moves across ecosystems.

Reality Check 1: Siloed, fragmented ecosystems make it harder to gain and keep customer trust in digital services

A lack of standardization of approach to interoperability can mean:

1. Customers and businesses need to **open accounts in multiple systems** in order to interact with each other as cost-effectively and simply as possible, rather than because they want multiple accounts. There are also multiple fees to be paid to get the money to its ultimate destination.
2. Customers are expected to learn how to use multiple different systems. When solutions from service providers behave differently and there is a steep learning curve, customers can become disenchanted and return to what they know.
3. Where there are multiple “hops” through a bilaterally or aggregator-connected network, it can often mean there are multiple fees to account holders and a confusing user experience with notification messages to customers that are not clear and simple. **High fees and confusing messaging that hamper widespread adoption.**
4. Customers without access to global card schemes (like Mastercard/Visa) are excluded from paying digitally for many services without employing clunky and sometimes unsafe workarounds that **don't support consumer protection payments principles.**
5. Customer **money can get “caught” for days** and remain unavailable while manual processes between FSPs, aggregators and merchant gateways check multiple systems. This is because there are multiple points of failure and little clarity on where responsibility lies. This delay in availability matters a lot to customers who live on \$2/day or less and small businesses that are dependent on managing their cash flow tightly.
6. When there aren't strong redress mechanisms when sending money across platforms, it can **erode trust when things go wrong.**

These challenges are major barriers to financial inclusion, and a big part of the reason why cash is still king.

Reality Check 2: Siloed, fragmented ecosystems create risk and inefficiency for financial institutions and businesses today

A bilateral approach to creating interoperability similarly creates problems in ongoing operational cost for financial institutions, non-bank financial institutions and last-mile innovators alike:

1. Schemes launching instant payments clearing technology have felt the growing pains of scaling inefficiently through **manual processes for reconciliation and settlement** for billers/merchants/P2P transactions. Perhaps they have even suffered fraud losses and revenue leakage when things go wrong.
2. Businesses, utility companies and SMEs are **managing pre-funds and collections in numerous systems** and running their own treasury (or paying an aggregator service for

this work), rather than minimizing liquidity needs and operational costs. Settlement mechanisms often take days with very manual processes and can be very fragmented - so they are not benefiting from instant push payments as a small business, and from use to use case, need to manage their liquidity across multiple systems. This creates a very inefficient use of pre-funds.

3. Similarly, Digital Financial Services Providers (DFSP) and banks are also managing multiple pre-funds in order to send funds to a mobile money customer account instantly, rather than using end of day settlement or an invoicing approach, because of the nature of e-money system design. A bilateral approach typically requires pre-funds stored in **every bilaterally connected system** to facilitate money movements into that system, **which ties up a lot of capital** and hampers return on investment.
4. Innovation projects to enhance customer propositions through partnerships can often be hampered by the time and cost inefficiency of **repeated integration work with different fragmented behaviors and approaches**. And over time it creates a maintenance burden, as well as operational risk and potential for fraud loopholes. Every use case is separately considered.
5. Where there aren't integration standards in play and clarity from a scheme on how new actors can simply and cost-effectively join as first-class citizens, **it can exclude new valuable financial inclusion-centric service providers and innovators**.
6. As a consequence, innovators are **incurring large costs, knowledge gaps and operational burdens to get started in accepting payments**. Plus, they have to start to learn again every time they take their business to a new country due to lack of standardization and cross border interoperability. Alternatively, they opt to pay extra fees to gateway solutions, and take a less optimal cost approach which is often passed on to the low income customers they serve.

And ultimately, this approach creates regulatory risk:

- **Transparency for anti-money laundering (AML), fraud and regulation reasons is often lost** due to the inability to track money flows through multiple hops and use cases, and the reality of shared accounts blurring the true participants.
- It is often impossible via the data to truly understand what use cases are in play, and **what measures are creating impact**.
- There are **few mechanisms for shared services and collaborative regtech innovation** that help ensure consumer protection is upheld as a pillar; each business is investing separately in reducing fraud, managing disputes and educating customers.

Defining Good Instant Push Payment Interoperability: A vision of the future

The industry working to solve financial inclusion challenges is at a crossroads. A vibrant digital payments market starts by making it easy for **everyone in the ecosystem** – banks, mobile money

operators, Savings and Credit Cooperative Societies (SACCO), Monetary Financial Institutions (MFIs) and more - to simply interact with each other. And that includes the new class of social impact business that is driven by technology built on payment rails, such as solar asset financing, savings, and pension program innovators, ride-hailing, school fee solutions and agricultural value chain innovators.

The future is a value chain where it is fast, easy and safe to send and spend money ubiquitously – including across borders for the purpose of both remittance and trade.

To truly be able to compete with the ubiquity of cash, a scheme needs to create true **open-loop rails** separate from customer propositions, delivering an environment where:

1. A customer of the smallest Microfinance Institution can be connected with a customer of the largest bank
2. Shopkeepers see their money arriving at the same time as goods leave their shop, building digital payments confidence and improving their liquidity
3. Banks, Microfinance Institutions, Mobile Money Operators and Fintechs benefit from lower pre-fund liquidity needs and settlement risk reduction
4. New market actors can cost-effectively join and offer services in a regulated environment
5. Services are interoperable, even cross-border.

Interoperability through instant interoperable push payments in an open-loop system is the cornerstone of true financial inclusion. By making it easy for both customers and service providers to participate, we believe that a vibrant ecosystem of solutions that serve to reduce financial exclusion and support the achievement of sustainable development goal targets will be possible.

Schemes and Consortiums: the starting point

Successful open-loop schemes are best adopted when they are born through a collaborative effort between public and private sectors - regulators, banks, and non-banks.

In the private sector, often business departments know they are working in silos and can end up paying more than once for integration or a design because it's not simple to know what's already there or what best practice might be. They know there is risk of revenue leakage and fraud and consumer protection issues if two systems connected to each other behave in different ways.

*“ We could work more effectively together and be more efficient.
No one wants to be the strongest link in a weak chain. ”*

Technology and efficiency of integration alone won't be the sole driver towards financial inclusion however; the business models that have driven the first 10 years of successful service creation will need to continue to evolve. Through collaboration, service providers of different types - mobile money providers, banks, MFIs, SACCOs, and more - can engage and understand the business model drivers that have underpinned the current success story of mobile financial services.

Next, it is paramount for service providers to work together and understand how business models could change in an interoperable ecosystem. It's this understanding of future opportunities that will drive financial inclusion for consumers going forward.

Future-facing consortiums are interested in merchant/fintech ecosystem development through open finance and open payments APIs via shared services rather than individual hero efforts, so that they can focus their available resources on things that will move the needle for their business. They have seen the effect of UPI in India, and want that kind of successful ecosystem creation, too.

They are also interested in harnessing new cross-border settlement mechanisms including the use of digital assets such as central bank digital currencies (CBDC), and being part of a global payment evolution.

Key to scheme success is choosing the right foundational technology and continuing to ensure the right co-opetition boundaries.

Choosing Technology

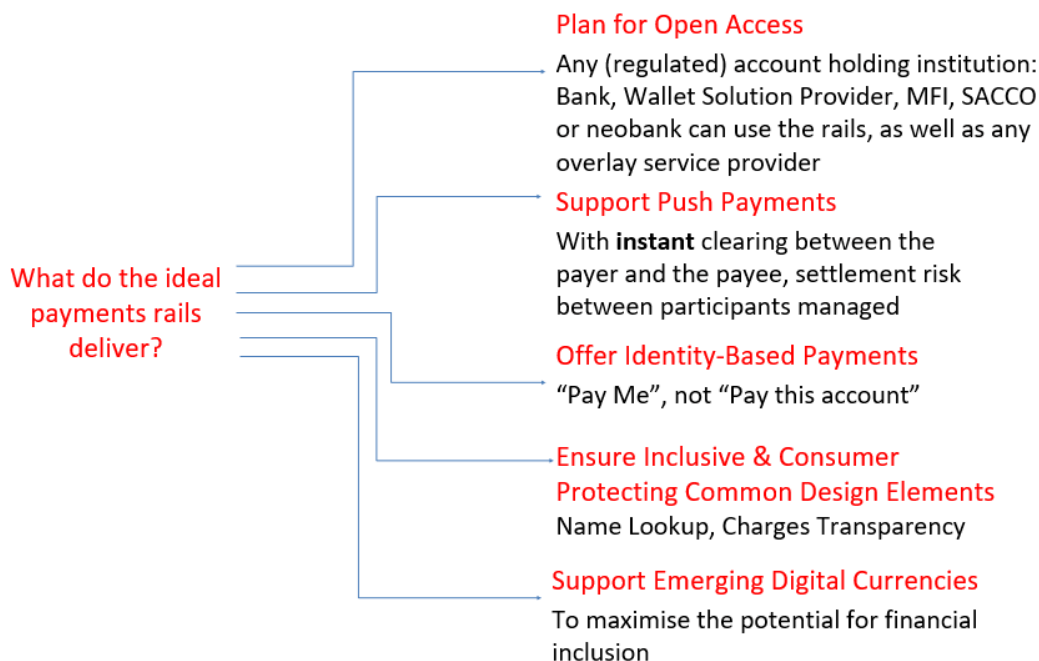
What does good look like?

The choice to procure instant payment clearing system technology is an investment in hygiene factors first and foremost around:

- Efficient and accurate reconciliation and settlement between systems, striving towards straight-through processing
- Reducing customer mistakes and the need for dispute management collaboratively through great service design
- Enabling the widest network of payment acceptance points possible
- Ensuring regulatory compliance
- Continued innovation around the problems involved in the cost of regulatory compliance and the cost of fraud with a community of both business and technology actors.

However, banks, Mobile Money Operators, MFIs, SACCOs, credit unions, and fintechs **all have different business models which affect how they interoperate**. A modern solution should provide the “translation,” particularly in the areas of fees and risk management.

The solution also needs to be future-facing and customer-centric in its design, and responsive to industry innovation and new advances (e.g., readiness for CBDC and Overlay Services enablement).



In looking across the industry trends today, this diagram illustrates common characteristics of good payment rail solutions, on top of which Service Providers can create valuable end user services.

A scheme will typically want to ensure these common building blocks in their selection

| Feature/function | Description/benefit |
|---|---|
| Instant Funds Transfer Customer Experience | The clearing time between transactions needs to be end-to-end deliverable across financial institutions ideally within 15 seconds and with 24/7 availability. Considering that, in many markets, bank electronic funds transfers don't work on weekends because bank account managers aren't at work, this is a massive improvement over traditional payment rails. The scheme should want features that ensure funds are made available immediately to the recipient/payee because the recipient institution understands the risk is well mitigated, and that the solution is robust to network failures and bank system availability, as all participants are collectively responsible for achieving this result. Without designs and digital tools cognizant of network realities, it will be complex to achieve this. |
| Integration tools for participants | In order to achieve 24/7 availability and sub-30 second clearing time, participants' systems need to respond flawlessly to a standardized protocol and workflow in a timely manner. This is not simple to achieve at scale and can often exclude smaller institutions. The right solution will provide technology tools to support DFSPs in: |

| Feature/function | Description/benefit |
|---|---|
| | <ul style="list-style-type: none"> ● Getting connected, tested and transacting with real money ● Understanding the state of the network and transactions simply ● Fulfilling their scheme responsibilities |
| Use of account aliases (“pay me”) | <p>In order to create a service that promotes both privacy and convenience to drive adoption and impact, there is no need for a payee or merchant to remember and hand over their full bank details to receive payment. The design will allow scheme participants to design solutions with multiple aliases for a single account (e.g., for merchant payments with multiple outlets, or for a customer to have a government beneficiary alias separate from the MSISDN used for P2P payments). Over time, this becomes incredibly valuable as the system grows in participants as a way to simply access a large ecosystem of merchants and businesses without each innovator having to acquire and design for their own ecosystem independently.</p> |
| Alias portability delivering customer choice | <p>Each scheme needs a set of business processes and underlying software designs that allows a customer to retain their personal identifiers and change service providers simply based on agreed scheme rules. By ensuring the chosen design has a dynamic account look-up mechanism as part of the protocol (and doesn't instead rely on mobile phone number format or merchant ID format for routing), it allows an end user to retain choice.</p> |
| Confirmation of payee | <p>By ensuring it is possible for a customer to see the name of the person or merchant they are paying before finalizing funds movement, the number of errors and disputes can be greatly reduced, creating more efficient rails. The chosen system should be able to ensure cybersecurity-by-design and data minimization as part of the overall design. The source of the data should be authoritative, not a duplicate centralized name database.</p> |
| Channel-agnostic user experience | <p>The same rails should be capable of providing a safe and robust experience for customers to move money, regardless of the options DFSPs provide to their customers: smartphone customers and feature phone users alike. This means choosing a protocol that ensures it is inclusive.</p> |

| Feature/function | Description/benefit |
|--|--|
| Features to support merchant schemes done well | <p>The architecture will support schemes to collaborate to create a vast ecosystem of merchant interoperable acceptance points at scheme level, optional interoperable QR scheme merchant identifiers for those with smartphones, and collaboration tools to spot and mitigate fraudulent merchant activity swiftly. For example, this could include formally registered scheme-level merchant names available via confirmation of payee features, verifiable QR codes to reduce fraud, the ability to recognize a merchant with multiple outlets, and support for deduplication where possible. A merchant similarly should benefit from choice: they can retain their merchant identifier and change who they transact with.</p> |
| Request to pay | <p>For financial inclusion reasons, schemes are moving towards request to pay (an e-invoice) as the mechanism for securely allowing a payee (typically merchant or biller) to initiate a payment request, rather than pull payments with direct debits where money will leave the account without explicit consent from the customer. This allows low income customers to remain in charge of their balances at all times while offering a new choice for payment initiation. With the financial inclusion customer base in mind, this ensures that customers are in control of their funds and know when debits from their account have been requested.</p> |
| Scheduled payment requests | <p>To build on the request to pay feature, direct debit requirements are transformed on push payment rails into scheduled payment requests that allow customers to remain in control but understand their future obligations. This can be complementary and a new extra service alongside existing direct debit rails, and has proven to be the future model of choice for financial inclusion customers in other markets such as the UK, driven by PayUK.</p> |
| Scheme rule checks inflight ahead of money movement | <p>Regulated financial service providers are responsible for monitoring and protecting their system against fraud, suspicious activity and money laundering. The design should ensure inflight tiered know-your-customer (KYC) and AML checks can be done by DFSPs before accepting a transfer request as part of the protocol, to ensure no breaches of rules, such as exceeding maximum balance limits or monthly trading limits without manual intervention, no funds to blocked or inactive accounts, as well as any agreed scheme rule checks. This feature is fundamental to creating a straight through push payment environment in the future that is inclusive of organizations that must enforce policy.</p> |

| Feature/function | Description/benefit |
|--|--|
| Accurate liquidity monitoring and settlement risk minimization as part of clearing | <p>The clearing solution should connect banks, mobile money, microfinance, SACCOs and neobanks, and ensure rules set by the scheme such as net debit caps are enforced and pre-funding needs are optimized. The solutions should have strong mechanisms to ensure straight through processing and non-repudiation by design. This reduces manual reconciliations and minimizes risk and disputes.</p> |
| Features supporting tiered participation for settlement | <p>An inclusive solution will include a settlement position calculation mechanism that recognizes non-bank liquidity monitoring features via net debit cap checks for all, even though they are not entitled to central bank direct settlement today.</p> |
| Scheme compliance reporting and dispute management: | <p>A well-designed system will be able to provide information as an authoritative source on participant usage of the system, and how the overall network is performing - including where there are errors and failed transactions. Dispute management will have clear data accessible that showcases the full lifecycle of a transaction.</p> |
| Safe support for new generation of fintech-led businesses as overlay service participants in the scheme, using 3PPI initiation and smartphone biometric authorization | <p>This is similar to the very successful UPI model created in India. Ultimately in a world of embedded finance solutions and conversational commerce, customers will have a choice of user experience that should make it as easy to use push payments to pay for services in-app.</p> |
| Participant lifecycle management and alias lifecycle management | <p>Particularly in an open loop system, it is essential that the supporting business processes enabling a DFSP, overlay service provider or merchant to join and be a good scheme member deliver a safe, efficient experience for all, including processes for scheme reporting and acting swiftly when things go wrong. Good service design can help payment system operators deliver best-in-class onboarding and lifecycle management experience, and can support development of a vast network of quality merchant outlets if done thoughtfully.</p> |
| Multi-currency support | <p>Many markets operate more than a single currency - this should be supported.</p> |
| Readiness for “network of networks,” including cross-border support | <p>By connecting to robust cross-border settlement solutions, such as the blueprint envisioned by BIS at https://nexus.bisih.org/, this could help to facilitate use cases such as cross-border remittances, regional</p> |

| Feature/function | Description/benefit |
|---|--|
| | merchant payments settlement, and B2B cross-border trade more simply than is possible today. |
| A future-facing design that allows for scheme rule logic and shared service extensibility in the roadmap | As a scheme develops its shared roadmap, it is likely to consider shared services to support more efficient fraud and risk management and more. It must be simple to imagine how additional extensions can be added without vendor choice lock-in. |

However, the Business Case showcases a need for careful selection

When looking at creating a vibrant pro-poor ecosystem of high-volume/low-value digital payments, the operating model is intensively cost sensitive.

There are many cost elements that should be taken into consideration by a scheme when choosing technology to create interoperable rails in creating a pro-poor financial inclusion solution, and some of them relate to the cost of procuring technology.

The following five elements of technology cost aren't always fully modelled at the outset and can become a pitfall for the scheme to deal with later when full business model implications are understood:

| Feature/function | Description/benefit |
|--|---|
| Licensing | Most proprietary platforms come with annual licensing fees that must be factored into the business model and cost covered by the participants, regardless of transaction volumes achieved. |
| Tools to support DFSP integration, testing/certification and network robustness | Another element of the cost model is DFSP integration work. When the integration cost is high, it can exclude smaller players, such as MFIs and SACCOs, that provide valuable financial services in last mile rural economies. |
| Maintenance costs and change requests | As they evolve scheme rules, schemes will make local decisions that will require reconfiguration of the solution. Additionally, effort will be required to ensure that the technology remains secure and is patched regularly, adding to maintenance and regression testing costs. And as digital payments continue to evolve to support features such as biometrics, identity, CBDC and open banking enablement, there will continue to be a need to plan for the cost of ongoing innovation into the program. |

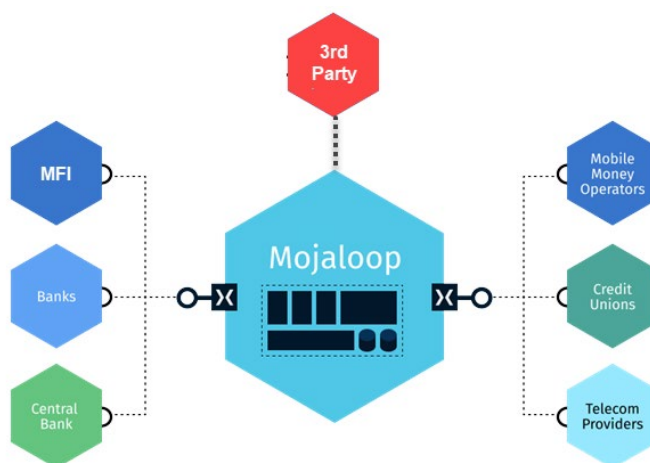
| Feature/function | Description/benefit |
|---|--|
| | Traditionally, procurement requires all requirements to be known upfront for a five-year budget, rather than having the ability to make decisions more frequently and exercise deeper control over the outcomes iteratively alongside scheme evolution. |
| Lack of local market ability to change the product | Often there is insufficient local market knowledge and handover because the solution is a proprietary “black box” and cannot be changed by others. As such, it may not be designed to be modular and extensible. This can mean that any change projects must be vendor-led with lengthy delays as a consequence. |
| Vendor lock-in | Often the sales process and the reality of implementation don’t align and often the RFP process itself doesn’t uncover enough of the gap in alignment. This can lead to lack of shared understanding, expectations not met on both sides of the relationship, and a reality of vendor lock-in. Contracts are often for lengthy time periods and changing direction in the future will not be simple once a product is in production. The solution can often be monolithic and as a consequence, the choice creates a longstanding dependency. In addition, a full solution often must be procured from a single vendor, rather than having the ability to procure different services from different technology vendors and know they are compatible with each other |

Introducing the Mojaloop Foundation

The Mojaloop Foundation is a new body that maintains open source instant payment clearing system software as an alternate approach to creating instant push payment rails.

The Mojaloop software is a modular and extensible open source instant push payment clearing solution, maintained by the Mojaloop Foundation (a charitable non-profit organization) as a digital public good.

We believe that if banks, MMOs, payment service providers and microfinance Institutions can connect to the same rails and the same API design, it can create a vastly improved end-user experience. This will improve customer adoption



and reduce trust problems significantly, enhancing digital inclusion at scale where today cash is king.

Mojaloop software focuses on low value instant push payments enablement between account holding licensed institutions. It does not replace existing card and pull payment infrastructure (ACH, Card, POS, ATM).

Combined with an open source operating model, it acts as an accelerator for real time payments interoperability infrastructure, enabling schemes to collaborate with a common standard that drives removal of payments fragmentation at scale.

What does the software do?

The software delivers:

1. **Enterprise grade API-first payments clearing software** that can connect all market actors – banks, MFIs, SACCOs, MMOs, gig economy platforms, wallet-based innovators - to the same system, for instant interoperable payments as a core capability. It supports multiple use cases **using a push payment three-step protocol between participants (“Discovery - Agreement - Funds Transfer”)** that is designed from the ground up for emerging markets last-mile realities. It facilitates multiple modalities for settlement typically via existing RTGS settlement rails.
2. **Open source tools to support the scaled rollout and swift onboarding and integration** of DFSPs and banks to the rails, as well as a reference UX and demos to showcase features, because a switch with no participants connected does not create impact.
3. **Future extensibility** – for example, to add in fraud and risk management shared services, dispute management ticketing solutions, merchant scheme features, regtech and supotech solutions and more.

In the majority of markets, fraud detection/management and KYC/sanction screening/AML checks are legally a DFSP responsibility today, however, this situation could change to put responsibilities at the center also. Mojaloop’s design supports schemes to share required information with each other as part of a transaction, and to make that information available to regulatory bodies on request.

The data stored in Mojaloop is minimized by design, but could be used by schemes for shared centralized services, such as fraud and risk management. Schemes could choose to enrich the data they wish to share centrally to such third-party solutions in service of a stronger Fraud Risk Management Solution (FRMS). The overall Mojaloop API protocol allows markets to take different approaches to transaction monitoring for suspicious activity, varying from centralized FRMS solutions owned and operated by the hub, to distributed fraud and risk management, owned and operated by individual DFSPs.

Three-Step Clearing Workflow foundational to the design: Discovery – Agreement – Transfer

For the clearing solution to be effective, participants need to agree at scheme level to play their role in the system; simply having a technology switch is not enough. The workflow of Mojaloop

provides standardized behaviors as a blueprint for scheme discussions to get started and tools that help scheme participants more simply integrate with each other.

The role of the switch in the protocol is to:

- Enable effective routing between participants
- Enforce net debit cap logic on all incoming transfers from all classes of participant - as decided by the scheme
- Act as the authoritative voice on scheme protocol and non-repudiation, particularly on timeouts
- Provide the scheme with event data to support dispute management, interchange calculations and strong controls enforcement
- Enforce any additional centralized scheme logic and rules

The API protocol ensures that routing lookup, name lookup and fees transparency are part of the design and allows initiation by either payee or payer. Payments are instant and irrevocable once the value transfer workflow has completed.

Confirmation of payee is part of the API protocol. The overall protocol includes obtaining a customer name look-up in flight before the funds are moved, with an assumption that the lookup source of truth is a verified and regulated identity provider and/or distributed system, with its own processes to manage changes to the data (typically DFSPs themselves in many markets) rather than part of the hub itself. This ensures that the core value transfer component abides by a data-minimization-by-design principle – it is not aware of an individual customer’s Personally Identifiable Information (PII).

Features of the Discovery Phase

Use of an alias to simplify the customer experience

The customer doesn’t need to know where their recipient has an account or complicated account details - any scheme-unique identifier, such as a Mobile Phone Number, will work.

Customer choice - “Pay Me”

The customer does not need to change their alias to change their account provider. The customer can have multiple identifiers linked to different accounts, too.

Confirmation of payee

The flow is designed to allow the payer to see the name of the other party before funds are moved.

Decentralized personal information

The payee’s DFSP is the “source of truth” in name look-up in the default system set-up.



Features of the Agreement Phase

Scheme checks inflight

The protocol ensures that the recipient DFSP has a choice whether or not to accept the funds on behalf of their customer. **Fees transparency and sender authorization before money movement**

The protocol ensures it is possible to ask the sender to confirm they want to continue after some programmatic fact-finding between DFSP participants.



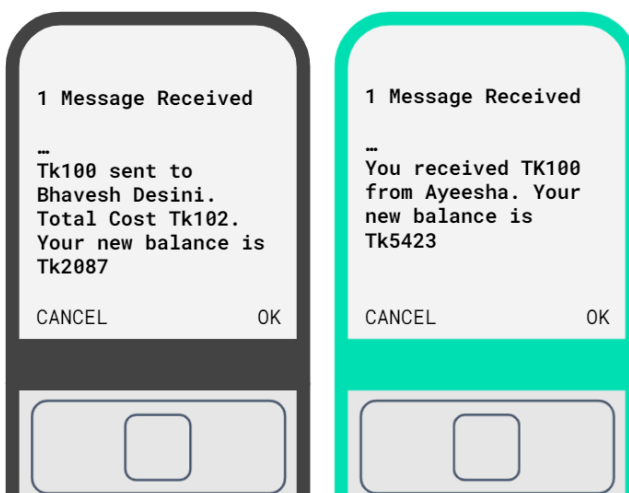
Features of the Transfer Phase

Minimize settlement risk for the payee DFSP and maximize liquidity cover for the payer DFSP

The hub design performs net debit cap checks on every transaction for every participant if the scheme chooses to set this up. Liquidity that has been finalized as cleared can be instantly reused in the NDC check. And cryptography checks enforce non-repudiation between parties, which ensures that the protocol has been followed correctly. This minimizes human interaction and the need for manual reconciliation steps before settlement.

Instant funds to the end recipient

Because the settlement risk has been reduced, the scheme can expect funds to be made available immediately to the recipient/payee, even where there is deferred settlement in place.



What is significant about the Mojaloop approach?

For a scheme to deliver instant interoperable payments well, it requires five elements:

1. Clearing: API standards and standardized behaviors
2. Liquidity management and settlement risk management
3. Modularity
4. Business and use case focus
5. Privacy and security standards



This section showcases how a combination of inclusive design and an open source governance model enables Mojaloop to deliver all five required elements.

1. Clearing: API standards and standardized behaviors building a roadmap by and for the community

API standards and expected behaviors from each institution need to be established at an industry level to ensure customers have clarity on what to expect.

Mojaloop's interoperability API (and expected workflow logic and behaviors) was developed in collaboration with the world's leading mobile money vendors who service one billion mobile money accounts and reach 96% of the countries where a majority of the population can't access traditional banking services. It delivers on some key customer-centric behavioral principles that allow schemes to design for system responses that customers can rely on and expect – no matter who they have accounts with.

A Mojaloop Change Control Board is tasked with maintenance of the API design in the open source community and all decisions and changes are fully documented via the Mojaloop Foundation. **Any scheme can adopt the design, independently of payment switch vendor selection, and any adopter of the API can propose and champion changes via the Mojaloop Community model.**

The Clearing Workflow outlined is based on an asynchronous event-driven design that deals effectively with network timeouts, to ensure funds do not get held for days for manual reconciliations when things go wrong. **This is a fundamentally different and more robust approach to dealing with transaction failures, timeouts and consequent consumer complaints.**

Mojaloop's design is inherently built around the open Interledger Protocol (www.interledger.org). This enables schemes in different currencies/countries to simply interconnect via Forex service providers and settlement solutions.

In addition, the Mojaloop Foundation continues to work with API standards bodies, for example, www.iso20022.org - the global standard for banks on payment messaging formats. Our members were recognized for a solution that connects formal financial services that use ISO20022 to non-bank networks powered by Mojaloop in the last-mile. <https://mojaloop.io/mojaloop-named-iso-20022-hackathon-winner/>

2. Liquidity management and settlement risk management

The settlement calculation functionality in the hub is the foundational pillar of reducing settlement risk and improving liquidity usage efficiency. The service determines the principal value movements and fee / interchange components to be distributed between participants. It also maintains a real-time “position” for every participant that is used for net debit cap rule checks inflight, calculates net settlement positions for all participants, and communicates net positions to a chosen settlement system as the authoritative entity.

Multiple settlement models are offered, with multilateral net settlement with multiple settlements per day being the choice of many schemes. A settlement position calculation engine uses configurable window lengths and cryptographic transaction signing checks on every transaction (using the open Interledger Protocol www.interledger.org), making manual reconciliations between systems a thing of the past.

Settlement window-calculated information is preserved automatically to transaction level, as part of the settlement window process, to inform reconciliation processes across DFSPs. Settlement positions for each participant are independently calculated and managed with a net debit cap for every participant, even those settling via a sponsor bank – enabling a tiered settlement model while retaining direct participation.

3. Modularity, because forever is a very long time

The reality is that business needs and technology needs change with time. **Everything has to be modular.** Mojaloop was built with this reality in mind, and itself has taken dependencies on best - in-class open source tools to retain its “license-free” pillar. The Mojaloop Community will continue to monitor those dependencies and ensure compatibility into the future.

An Open-source Payment Gateway



12 Factor Principles

A methodology for building **modern, scalable, portable and maintainable** software-as-a-service applications. Mojaloop's **microservice designs** are guided by these principles. Ref: <https://12factor.net/>



Microservices

Mojaloop is build using **loosely coupled services** with **lightweight protocols** used for inter-service communication.



Containers

Microservices are containerised using **Docker**, a **OS-level virtualization run-time package** (application, configuration, etc), which **isolates** the underlying **application** processes from one another and the underlying host OS, and ensures **runtime consistency**.



Event Driven

Mojaloop uses **Apache Kafka**, a **highly performant and distributed message streaming** platform that ensures all internal events are **durable**. It **reduces tight coupling** between microservices and guarantees **ordered processing**.



Runtime

Mojaloop is build using **Node.js**, a **unified lightweight, asynchronous event-driven JavaScript lightweight runtime** which is highly **portable / scalable** for both front-end and backend applications.



Infrastructure Agnostic

Runs on **Kubernetes**, an open-source system for **automating deployment, scaling, and management of containerized applications** with self-healing capabilities based on policies. It provides a standard platform which **supports on-prem, on-cloud or hybrid** deployment models.



Persistence & Caching

Utilising **MySQL** as an open source, and robust **persistence store**. **Redis** used as a performance **caching solutions**. With **MongoDB** being used as an **object-store** for bulk-processing.



Tracing & Log analysis

Utilises **ElasticSearch, FluentD and APM** to **collect/filter logs and tracing** information for all microservices, with **Kibana** being used for presentation of **operational dashboards**. These technologies are fundamental to **tracing and troubleshooting issues**.



Real-time Monitoring

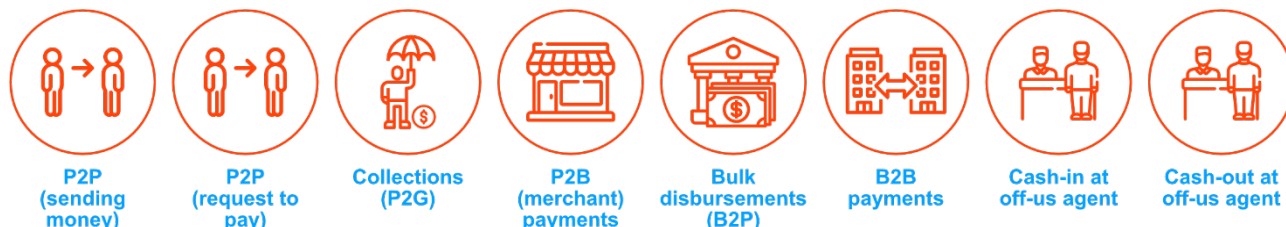
Grafana and **Prometheus** are used for **collection and display of real-time operational metrics**:

- Performance
- Health
- Alerts

4. Business and use case focus to deliver lasting impact

Switch technology alone won't create impact, and schemes will want to be use case-driven as they launch services, and be able to measure the use case adoption/impact to understand on-the-ground behavior at scheme level.

Mojaloop's core design supports multiple use cases to be launched by a scheme based on the same foundational core features and discovery-agreement-transfer blueprint.



Within each of these categorizations, the API protocol allows schemes to request supplemental data to further categorize transactions more deeply as desired for the local scheme, for example: taxes and customs, utility bills, fees for government services, supplier payments, incentive payments, lending and interest payments, SME supplier payments, salaries, ecommerce, retail merchants, domestic remittance, salary payments for help, and ROSCA/SACCO/Chama money movements.

5. Privacy and security standards by design

Payments solutions must be designed with an interconnected world in mind, and technology and cybersecurity standards are at the center of this. And with a global adoption of cloud based services even in financial services and governments, emergence of open banking, PSD2, UPI and embedded finance, the growth of the fintech and regtech industry and the emergence of inclusive digital identity and biometric authorization tools - what good looks like is evolving continually.

The Mojaloop software is architected on privacy-by-design and cybersecurity-by-design principles and the solution architecture's future technical direction is **overseen formally by the Mojaloop Foundation Technical Governing Board**. It uses best-in-class open security protocols to agree money movements cryptographically, to ensure non-repudiation principles.

The full security model of the solution must use an industry-best-practice API management platform, and Mojaloop has pre-integrated an optional reference solution using an open source solution (WSO-2), but with full support for deployment using cloud-native solutions (such as AWS and Azure).

A myth is often "How can it be secure if everyone can see it?" It certainly does not imply an open-to-all production system. And in the solution itself, every technical design decision is documented and defensible in public records. Doing foundational cybersecurity work via an open source community-driven operating model has been **proven as a robust and swift mechanism to ensure that issues are swiftly resolved³ - there is often instant action to remediate issues**

³ <https://www.finos.org/blog/danese-cooper-debunking-common-fears-about-open-source>

<https://www.finos.org/blog/finos-open-source-in-fintech-podcast-debunking-common-fears-about-open-source-danese-cooper>

(unlike the slow response from some proprietary vendors) and every decision is documented and peer-reviewed.

What does Mojaloop Foundation offer?

The Mojaloop Foundation does not run the software. It is not a network. The **software is freely available online** to schemes who will select their own payments system operator to run their payment rails.

In choosing Mojaloop for your scheme, your payment system operator and their vendors get:

1. Clearing system software, blueprint designs, training programs and use case playbooks, openly available as a digital public good;
2. A Partner Program and Technology Community who will support schemes commercially and a technology community that designed, created and continue to enhance the assets in open collaboration with those running on-the-ground deployments;
3. A non-profit member organization that maintains the software and its formal governance.

Payment schemes adopting Mojaloop technology are in charge of their own destiny.

Deployments will benefit from Mojaloop Foundation support to source talent and best practice knowledge. The Mojaloop Foundation is actively growing a partner network made of organizations and individuals with Mojaloop expertise – both payments scheme consultants and technologists – that will support schemes and Payment System Operators.

Payment System Operator developers and vendors also benefit from a collaborative technology community effort to deliver standards, extensions, cybersecurity-by-design principles and best practice scheme-thinking for global innovation trends in the open. Our fintech and technology sponsors have seen firsthand the impact of creating solutions such as UPI in India, and bring their expertise and knowledge of emerging markets payments ecosystems globally to the work. Their commercial expertise is balanced by our philanthropic sponsors.

Next Steps

1. How does a Payment System Operator get started?

Deployment programs are designed in multiple ways and are run by schemes and their payment system operators directly. Early strategic deployments will benefit from Mojaloop Foundation support to source talent and best practice knowledge in more depth as part of our strategy.

Deployment, Customization and Maintenance, as well as ongoing improvements, can be planned for in multiple ways and can evolve over time as expertise in-market grows.

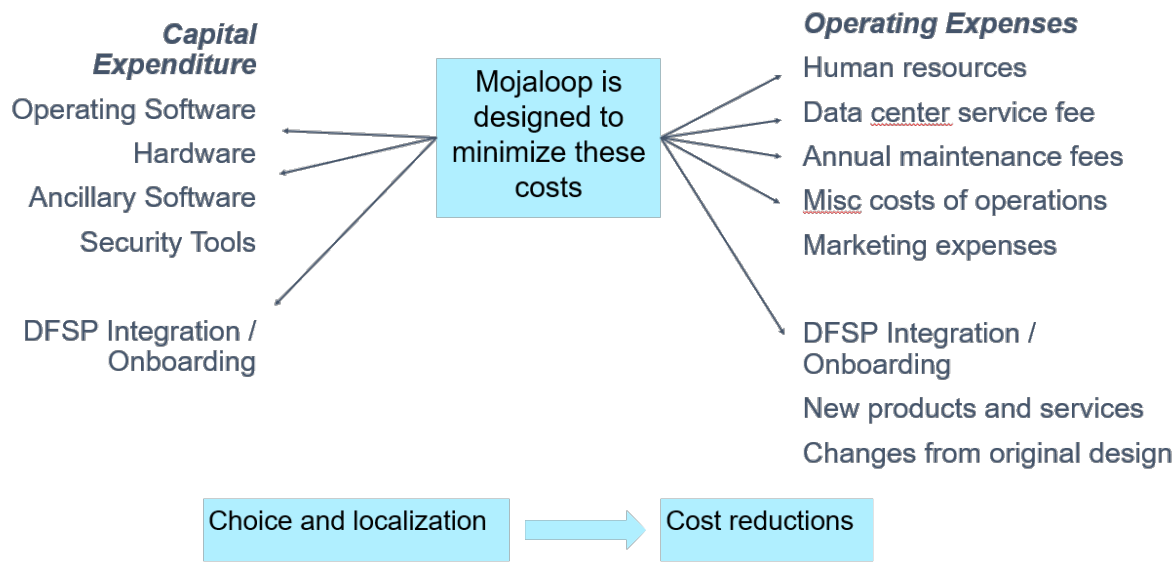
The software is freely available and the Mojaloop Foundation hosts the software in a sandbox at <http://sandbox.mojaloop.io>. Once the basic features and the protocol have been explored, the first

step for potential adopters is to study the business case for open source and to consider various implementation models available.

2. Modelling for cost benefits of open source

The nature of an open source project is that the program design can be accelerated through the use of multiple vendors simultaneously for different elements, but it can also be completely taken in-house with payment system operators hiring and training their own talent; and the model can change over time.

Many existing deployments have chosen to do work to accelerate going live with experienced Mojaloop enterprise vendors, **with a plan to build local talent to enhance and extend.**



In making the business case for open source, the scheme should consider as part of their cost model:

- **Licensing costs:** A core hub that is a digital public good removes this cost, while allowing for local customization of software connected to the core in a microservices modular architecture.
- **Advocacy costs:** An open source core can allow for easy creation of demonstration capabilities to help showcase the envisioned outcome, and work with FSPs to understand and mitigate concerns in a different manner to that possible with licensed software.
- **Support costs:** OSS means options and competition for implementation and support - with vendor selection in your control in an ongoing manner. Costs decrease as local technology firms improve capacity to support and configure the platform. Rather than a change request model tied to a single vendor, in an open source model, it is possible for multiple vendors to collaborate to test and deliver change in parallel.
- **Hardware costs:** The hardware costs for Mojaloop will scale as capacity needs scale, with sublinear cost scaling as part of the design parameters.

- **New feature costs:** Where new features are contributed by another program that are of benefit to you, they can be tested and rolled out to your platform at lower cost than proprietary change request programs building from scratch.
- **Operational costs:** Operational costs are minimized by design.
- **Onboarding costs:** Onboarding costs for DFSPs are minimized by tools and training. Open source community contributions have actively created tools to make this process as pain-free as possible. It is possible for an FSP to be connected to the switch with a two-week program if they have a robust core solution.
- **Revenue sharing:** Revenue sharing options are likely available as open source gives a choice of vendor.
- **Donor funding support:** Donor funding support from the development sector funding ecosystem may be available if financial inclusion goals are firmly committed to in the design (NB: revenue share models can de-incentivize this). The Mojaloop Foundation does not provide funding for deployment efforts; all schemes must directly source funding.

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