RPGC GROUP

Cracking open the

Payments Orchestration Layer

May 2022

spreedly GR4VY APEXX

1. WHAT IS PAYMENTS ORCHESTRATION?

'Payments orchestration' emerged as a fintech buzzword in 2019. The market has run with the term to generate funding and sales. However, there remains a lack of consensus on what payments orchestration is and the role it plays in providing end-to-end processing connectivity.

We at RPGC provided our own definition in 2019; an abstraction layer that met the four following conditions: one API, connectivity to providers that acquire cards and provide local payment methods, end-user routing and management configurable tools, and real-time ledgers. They don't compete with payment service providers (PSPs) like Stripe, Braintree, or Adyen. They are the necessary infrastructure to enable true competition and enable access to additional services whether they be tax calculation or fraud prevention engines.

As of 2022, several companies in the market sell payment orchestration services. Most have similar but distinctly different definitions of what a Payments Orchestration Layer (POL) is and what it should do. The ambiguity of the definition has confused merchants, solution providers, and investors.

2. WHAT DOES THIS PAPER SEEK TO ADDRESS?

Payments orchestration has captured the industry's attention because of the value-added benefits provided to revenue and expense management. Performance is only as good as the support given to it and usually, that support means access to engineering.[1] Optimizing payments requires valuable engineering resources, and because of that, fully developing a POL will always be resource-constrained. Each merchant must draw the line between MVP and a platform that doesn't deliver on the promised benefits.

We asked three companies dedicated to bringing agnostic payments orchestration platforms to market, Spreedly, Apexx.Global, and Gr4vy, what is the absolute Minimum Viable Product required to achieve the benefits of payments orchestration, and how much effort does it take to achieve those benefits. These companies are all agnostic payments orchestration solutions, not reliant on any one PSP.

This paper will clarify the ambiguity around the Payments Orchestration Layer (POL) definition and help readers resolve the buy vs. build conundrum by identifying the requirements to achieve a Minimum Viable Product (MVP) and providing effort estimates to achieve MVP.

3. METHODOLOGY

RPGC drew up product requirements and functional architecture components of a Payments Orchestration Layer (POL). Gr4vy, Spreedly, and Apexx.Global identified the elements from those requirements to define the POL's Minimum Viable Product (MVP) to achieve payments orchestration, and how long it would take to build.

---

[1] "[Surveyed] companies across the board report, availability of software engineers and availability to do things with software to be as big or even bigger a constraint on their progress as access to capital" – "#353 Patrick Collison – CEO of Stripe." *The Tim Ferriss Show*. Podcast audio, December 20, 2018. https://tim.blog/2018/12/20/patrick-collison/.

Because not all merchants are created equal, RPGC created three distinct merchant use cases to capture how different merchants need different features and functions from their POLs. The POL's product features, architecture, and requirements were vetted by Spreedly, Apexx.Global, and Gr4vy in order to identify MVP for each use case through interviews and surveys. Each company then provided developer time estimates required to build the necessary infrastructure from scratch. RPGC took those estimates and compiled this paper to document the effort required to develop a POL MVP. It is our intent/hope/objective that merchants will take these estimations into account when deciding whether or not they are better off building a POL or buying the services from an established POL vendor.

3.1 Requirements Definition

There are multiple ways to build a POL. In order to create a common language for defining the POL's MVP and delivery estimates, RPGC created the following list and provided it to Apexx.Global, Spreedly, and Gr4vy for vetting. These requirements will also be found in the architecture diagrams provided for each use case for the delivery estimates. The requirements are color-coded to their placement within each of the architecture diagrams.

Category	Requirement	Definition
API	Account Verification	Support to explicitly make $0/$1 authorization calls
	Authorization	Authorization API call either for the full, partial, or $0 amount. Transactions can also be automatically captured using this call.
	Capture	The API has a separate call to capture transactions for later submission to PSP/Acquirers
	Lifecycle Notifications	Otherwise thought of as webhooks for logged payment transactions regardless of transaction state
	Partial Refunds	The platform supports multiple refunds of varying amounts on a prior purchase
	Redirects	The platform supports redirect payment methods like PayPal or iDEAL
	Reporting API	An exposable API that enables clients to perform analysis on technical activity using BI tools. The technical and insights dashboards would use this API to create their feeds
Category	Requirement	Definition
Application	BIN File	The consolidated BIN File consumes and normalizes BIN tables from multiple PSPs and/or networks to be referenced for transaction routing
	FX Tracker	The Forex Tracker tracks the currency exchange rates at the time of settlement to ensure that customers are fully refunded regardless of the presentment currency
	Payment Method Presentation	Also referred to as front-end orchestration. The ability to present or not present specific payment methods on the checkout page to the end-customer by product type or geography to maximize checkout conversions. Includes the defined basic parameters to inform front-end orchestration(e.g., IP address, keyboard language, SKU, timing for goods delivery, or stored payment credential in member profile).
	PCI Level 1 Certified Token Vault	The platform has or uses a token vault to generate a common Unique ID regardless of endpoint. PANs are stored in the vault and mapped to the token UIDs, PSP tokens, and if necessary network tokens. The vault also

Category	Requirement	Definition
		provides key management functionality
	Transaction Manager	Orchestrates transactions through the different POL microservices
Category	*Requirement*	*Definition*
Attribute	Idempotency	Attribute that ensures the POL does not permit double spending on the same transaction regardless of outages, for both synchronous and asynchronous payment flows
	Zero decimal and 3 decimal currency support	Amounts are configured to support minor units or are integer based.
Category	*Requirement*	*Definition*
Endpoint	3DS Provider	A direct connection to an EMVCo. certified three-domain secure (3DS) Server and/or SDK. To maintain interoperability between all providers, this endpoint is considered a standalone connection and not through a PSP
	PSP: Global	Global PSP based in the U.S. and EU with REST-JSON API documentation. Typically used for U.S. card processing, access to Southeast Asian wallets, and can process transactions using network tokens.
	PSP: India	Connection to this PSP enables access to process Rupay cards and the Unified Payments Interface in India (UPI). This PSP can also provide access to wallets relevant in Southeast Asia.
	PSP: LatAm	A Latin American based merchant of record provider used to process payment cards approved for domestic transactions in Latin America where the merchants have no local legal entities.
	PSP: Primary EU	The primary PSP for EU card processing. It also provides access to EU-relevant payment methods. The API is REST-JSON based.
	PSP: Primary U.S.	Primary U.S. PSP processes U.S.-based transactions. This endpoint provides better interchange economics in the U.S. than the other processors thanks to L2/L3 processing and PINless debit routing. This PSP is also used to provide US ACH payments. It exposes a SOAP-XML API.
Category	*Requirement*	*Definition*
Endpoint-PayMethod	Bancontact	Local payment card brand in Belgium. Not a direct connection, but a new connection through an endpoint that will process the card directly through the local network, not the global card schemes
	Cartes Bancaires	Local payment card brand in France. Not a direct connection, but a new connection through an endpoint that will process the card directly through the local network, not the global card schemes
	Equal Monthly Instalments (EMI)	The Indian equivalent of Buy Now Pay Later offerings presented at checkout that allow customers to pay for goods and services in smaller tranches of payment. Not a direct connection, but a new connection through a listed endpoint within the product requirements document
	GoPay	Popular e-wallet in Indonesia. Not a direct connection, but a new connection through an endpoint
	GrabPay	Popular e-wallet in Singapore, Malaysia, Philippines, Indonesia, Thailand,

Category	Requirement	Definition
		and Vietnam. Not a direct connection, but a new connection through an endpoint
	iDEAL	Preferred mobile wallet for online bank transfers in the Netherlands. Not a direct connection, but a new connection through an endpoint
	Klarna PayNow	Previously known as Sofort. Available in many EU countries using a redirect service. Not a direct connection, but a new connection through an endpoint
	PayPal	Direct connection to PayPal through a PayPal-owned property to process PayPal wallet transactions globally
	RuPay	Indian payment card scheme. Not a direct connection, but a new connection through a listed endpoint within the product requirements document
	SEPA Direct Debit	Cross-continental EU bank transfer payment scheme. Not a direct connection, but a new connection through an endpoint
	U.S. ACH	U.S. bank transfer payment method. Not a direct connection, but a new connection through an Originator Depository Financial Institution or ODFI.
	UPI wallet	Access to any one of the wallets that provide access to the UPI payment network. Not a direct connection, but a new connection through an endpoint
Category	*Requirement*	*Definition*
Feature	Algorithmic Routing for Least Cost	The ability to supply their own proprietary algorithms to route transactions to maximize cost savings on a Client's behalf without the need for further code development.
	Integration to Account Updater programs	The platform is able to perform Visa Account Updater and Mastercard Billing Updater regardless of the client's acquirer agreements.
	Dynamic Routing	Also known as Cascading or fallback routing. The ability to reroute a transaction from one acquirer to another without notifying the customer of an issuer decline
	Endpoint Timeouts	The platform can tell the user when an endpoint has timed out but not the specific latency of endpoints
	Installment payments	The platform supports installment payment solutions like BNPL, EMI, or card installments found commonly in LatAm
	Merchant Initiated Transactions	The platform is able to support recurring transactions by applying the necessary indicators (e.g., stored credential and Merchant initiated transactions) and IDs
	Partial Captures	The ability to submit the same transaction for clearing multiple times for customizable amounts.
	PSP decline codes	The platform's API returns the issuer's decline codes without normalizing the response codes or obfuscating them under technical error codes.
Category	*Requirement*	*Definition*
Instance	2nd Cloud Instance Europe	Public cloud infrastructure necessary for meeting redundancy requirements in Europe
	2nd Cloud Instance USA	Public cloud infrastructure necessary for meeting redundancy requirements in the U.S.

	Local Cloud Instance Europe	Public cloud infrastructure necessary for meeting checkout latency and/or regulatory requirements in Europe
	Local Cloud Instance India	Public cloud infrastructure necessary for meeting checkout latency and/or regulatory requirements in India
	Local Cloud Instance rest of APAC	Public cloud infrastructure necessary for meeting checkout latency and/or regulatory requirements in Southeast Asia. Not located in India or China.
	Local Cloud Instance USA	Public cloud infrastructure necessary for meeting checkout latency and/or regulatory requirements in the U.S.

Category	*Requirement*	*Definition*
Reporting	A/B Testing Suite	The platform has means of tracking A/B tests in a configurable manner and generating a report against historical technical authorization data
	Access Reporting	Reporting to track user activity within the platform for when systems were accessed and when changes were made to the system.
	Insights Dashboard	A dashboard that aggregates transaction activity into specific insights such as approval/decline rates by provider, issuer, country, and card product
	Routing Reporting	The ability to report performance by endpoint on approval/decline rates, average response times, and retries (attempts and success rates)
	Technical Reporting Dashboard	A dashboard to conduct analysis on transaction activity performed within the platform and technical responses from 3rd parties such as approvals, declines, and endpoint latency reports. At a minimum, it must display transaction volumes, and monetary values of transactions.

Category	*Requirement*	*Definition*
Service	Android SDK	Means for safely collecting PCI data within Android applications natively
	Blocklist	Table of payment credentials, IP addresses, or other predetermined data used to prevent further transaction activity
	Canonical Message Converter	Receives incoming messages from 3rd party clients and canonically converts disparate 3rd party message formats into a single message format for processing within the POL. The Message Handler also converts internal POL messages into external endpoint formats (e.g., PayPal, Stripe, SEPA)
	Customizable hosted form field to capture sensitive data	PCI or account data is captured via a hosted iFrame form field or via SDK in browser
	iOS SDK	Means for safely collecting PCI data within iOS applications natively
	Logger	Records each transaction state and each transaction state activity for messages passed internally within and externally out of the POL
	Message Decision Handler	The function of this component is to receive PSP and payment method response messages and provide a decision on the appropriate actions to take on the transaction, whether that be a successful checkout message, a failure message, or a cascade attempt.
	MID Manager	Library of merchant accounts (MIDs) that each transaction can be mapped to. Each listed MID identifies the appropriate endpoint message format (e.g., PSP), expectations for responses, and which products or lines of business can process on the MID.

	Network Token Requestor	Certified as a Visa Token Services and/or Mastercard Digital Enablement Services token partner.
	Payment Method Catalog	A library of payment methods including their technical requirements, branding, and regulatory restrictions to be presented to the customer
	Payments Data Warehouse	Captures the information for each transaction in a resting state for future analysis or processing (e.g., submit for clearing)
	Retry Manager	The function of this component is to determine whether a transaction is immediately retryable and if so, what action to take. This function includes 3DS soft declines.
	Transaction Router	Refers to the BIN file and routing rules for the available endpoints to determine the transaction's predetermined path. On retries, it can intake information from the Retry Manager to cascade retries accordingly.

3.2 About the Use Cases

RPGC created three broad perspectives that make ideal product-market fits for payments orchestration. Each use case has checkout, geographic, and infrastructure requirements. The use cases detail the needs of a merchant that sells physical goods within the United States, a European-based marketplace with a large average order value, and a digital goods subscription merchant that garners a great deal of interest from consumers in India and Southeast Asia.

For the sake of simplicity, all 3rd party processors/acquirers/payments service providers (PSPs) will all be referred to as PSPs.

Ultimately all the use cases require the same microservice abstractions, yet each use case demands specific requirements to achieve MVP. The POL needs to present the right payment methods and collect vault-sensitive data. Transactions need to be logged, converted into a consistent message format, routed, retried, and potentially blocked. Libraries of MIDs, BINs, and payment methods need to be maintained. And all activity needs to be logged. While not all of the features and functions of a POL[2] have a clearly demonstrable ROI, they all contribute to creating a product that is greater than the sum of its parts.

3.3 Consensus and Assumptions

3.3.1 Consensus

Given how many different configurations could be used to build a POL, RPGC found consensus from this paper's sponsors on the following points:

- The POL's API supports authorization requests, capture, account verification, redirects, refunds, and partial refunds.
- The POL also exposes formatted metadata via webhooks that allow other services to log each payment transaction data. Each transaction, whether completed or failed will have its metadata formatted so that it can be used for analytics, reconciliation, or some future purpose.
- Each transaction is idempotent for synchronous and asynchronous transactions.
- The POL's transaction router will understand when to route a transaction to the provider that will generate the least amount of fees by checking against a set of parameters and tables to determine the MID best predetermined to route any given transaction including the fallback routing option.

---

[2] And those of integrated third parties.

- The MVP POL provides two dashboard modules, one for reporting and the other for insights. For each transaction, the reporting dashboard provides the transaction's monetary amount, how it was routed, and whether the transaction was approved or declined. The insights dashboard provides information on approval/decline rates,[3] transaction volumes, and transaction counts by card brand, card product type, PSP, currency, and country. The insights dashboard is where users can see performance findings such as the technical impact of introducing a new payment method or splitting volume from a legacy PSP to a new PSP.

3.4 Assumptions

To develop effort estimates and reduce inconsistencies, RPGC made the following assumptions to inform this exercise:

- All services are built on public cloud infrastructure. Cloud instances were not subject to the differences between Amazon Web Services, Google Cloud Platform, Microsoft Azure, etc.
- All of the PSPs did not create a lock-in effect with three-domain secure (3DS) to authorize transactions enabling the POL to perform either an authorization-first or an authentication-first strategy.[4]
- Fraud service providers, whether they be rule-based engines, device fingerprinting solutions, or chargeback management solutions were not considered during this assessment.
- While large merchants want a configurable routing tool whether that takes the form of routing tables or a workflow editor, there was disagreement between the providers on whether this feature is considered as an MVP feature. Why? Because transaction flows can theoretically be hard-coded or edited within a script, making such a tool an extremely "nice to have" feature but not an indispensable one. Others found this definition a violation of the principle of payments orchestration since the goal is to reduce merchant engineering resources devoted to payments and thus should seek this functionality from a third party. Given that the following case studies take the perspective of a merchant building the solution in-house, it was omitted from MVP considerations.
- Effort was only evaluated on payment acceptance, payouts were not considered as part of this scope.
- Due to the interchange complexity between geographic markets and PSP proprietary reports, financial reporting and reconciliation were not considered for the scope of this exercise. Given that the POP has little influence on interchange and card scheme fees, those fees can be considered to be the same for any given transaction, regardless of routing.
- Tax calculation, while provided at the customer's point of purchase, was considered as a separate module outside of the scope of this exercise.
- For the transaction router, variables in the shell script will check against a merchant-maintained BIN file for the payment card's country of issuance to determine not only which processors to

---

[3] The ratio of successful authorizations (approval rates) or unsuccessful authorization attempts (decline rates) to checkout attempts.

[4] "The optimal strategy for merchants to achieve the best possible conversation rates appears to be authorization-first with exemption flagging, with fallback to authentication on soft decline. Many large merchants and payment service providers have minimized the impact of PDS2 enforcement with this strategy." - Dean Jordaan, SCA Performance - May 2021

prioritize, but also what type of account verification[5] check or multi-factor authentication[6] protocol to trigger. The shell script will also refer to a library of IP address ranges to present the relevant payment methods and brands at checkout. The router will also be able to use prior timeouts from PSPs as a routing decision input, but nothing more sophisticated than using logged HTTP 500 errors.

- All of the use cases were designed for enterprise merchants with a minimum pre-existing revenue of USD $100 million in GMV.

4. USE CASE 1 - PHYSICAL GOODS RETAILER

4.1 Background

The consumer electronics retailer, E-Tronics. is based in the United States and processes USD $100 million in Gross Merchandise Value. Their average ticket size is USD $100.

After a handful of short but impactful outages, E-Tronics has decided they need provider redundancy in the U.S. They've decided to add a provider that can provide PINless debit routing[7] and level 2/level 3 card processing[8] but uses legacy API technology. To minimize continued core business maintenance, all payment tokens need to be in the same format.

Because most of their business comes from the U.S. (around 90%), PayPal is considered a necessary payment method. Yet, to ensure full market entry, card payments in LatAm and the EU are in scope and require providers that can process these transactions locally. For checkout optimization, it is preferable that the solution be hosted on instances within North America only.

Due to the risk level on the core products the E-Tronics sells, they aren't interested in adding bank transfer payments (e.g., SEPA), but are interested in adding the relevant wallets in Europe that will provide a conversion rate uplift focusing on Klarna PayNow and iDEAL.

It is imperative that the merchant can route card transactions by country or card product type. E-Tronics usually ships orders within 48 hours of a successful authorization.

---

[5] Before initiating an authorization, merchants will initiate an account verification to ensure that the customer's account, whether it be a credit line or a DDA, exists, is active and in good standing.

[6] By providing no less than two of the following proofs: (1) proof of knowledge (e.g., password), (2) proof of possession (e.g., SMS one time password), (3) proof of inherence (e.g., Face ID).

[7] A single message transaction sent to a traditional U.S. PIN debit card network (e.g., PULSE, NYCE, STAR, Shazam) that does not include a PIN - PINless Transaction Clarifications by Fiserv

[8] Enhanced transaction information called Level 2 and Level 3 data sent with an authorization request. Merchants are incentivized to send enhanced transaction information on corporate cards to qualify for less expensive interchange fees. Level 2 data typically requires merchants to submit transactions' sales tax amount, the merchants' tax ID, and customer reference numbers in addition to all of the Level 1 data requirements. Level 3 data requires merchants to submit additional data elements if the merchant is an airline, rail, hotel, car rental company, or travel agency - for example - such as full travel itineraries as well as length of stay or length of rental. - 202: Exploring Card Types and Products, Merchant Advisory Group

4.2 Assumptions About the Solution

E-Tronics' payments orchestration solution needs to migrate all PANs from their original PSP into a new level-one certified vault. New PCI[9] data will have to be collected securely and fed into the vault. Customers will be offered the ability to store their payment information during checkout for future use.

PCI metadata and BIN data will be used to route transactions to the best provider for approval rates or pricing, whether that be a new PSP based in Europe that enables the acceptance of local payment methods, the U.S. PSP, or the Latin American Merchant of Record provider.[10] iDEAL and Klarna PayNow are accessed through the global PSP. Soft declines are to be immediately retried through the fallback providers.

In this case, the merchant's core business engine, not the payments orchestration layer, will handle capture file management and submit fulfilled orders to each PSP using out-of-band processes.

All activities within the POL will be logged, be they incoming messages, outgoing messages, or any other sub-service activity including user activity. Reports can be generated to see when changes were made to the system and by whom.

4.3 Use Case Findings

To support four PSP connections,[11] a PayPal connection, and a 3DS provider connection, E-Tronics requires a unified checkout experience that presents the most relevant payment methods. If a merchant were building this POL in-house, it is likely that the merchant would inform the customer of their payment result through a non-payment service that handles order management.

Payment Orchestration providers argue that least cost routing using an algorithm is an important MVP feature. The rules built within the algorithm need not be complex, however. But, the algorithm must use the BIN to route qualifiable debit card transactions to whichever PSP offers the PINless debit routing within the U.S. Any further routing specifics could be handled further by the PSP.

Physical goods retailers oftentimes will split their orders for shipping efficiency or tax management purposes. While the capture file management may be better performed by each PSP or initiated from within an order management system, a physical retailer's POL needs to be able to initiate partial capture calls to PSPs to be viable.

There is a large payoff for offering customers the ability to store their payment credentials at checkout as it facilitates repeat shopping visits. That dictates the need to capture the necessary parameters to create consent of payment credential capture. For a physical goods retailer, we find account updater and network token acceptance to be projects that will improve performance, but not an urgent priority to achieve MVP. In the U.S., penetration for both of these card brand products is high. Yet, we presume that the value add of reducing customer input error and checkout speed outweighs payment-specific optimizations on one-time purchases that come from card account updater or network token acceptance.

---

[9] The Payment Card Industry (PCI) Security Standards Council develops the standards and supporting services that seek to protect payment card information. As a part of accepting card payments, merchants must undergo annual PCI audits to demonstrate compliance with protecting customer data.

[10] A Merchant of Record provider is a merchant service provider that aggregates and presents transactions to acquirers on behalf of its merchant clients. Merchants use these providers in Latin America to improve authorization rates and to settle transactions in their preferred currency such as USD or EUR without setting up legal entities in each country.

[11] In 2022, North American merchants support 4.1 gateway or processor connections on average - MRC Global Fraud and Payments Survey Report 2022 by the Merchant Risk Council, Verifi, Cybersource, and B2B International

While no BNPLs were included in the review of this effort sizing, all the payments orchestration platforms interviewed conveyed how important it is that the POL be able to perform installment payments either through a PSP or using a redirection connection to a BNPL.

Given the immediate checkout needs, mostly from the U.S., it was imperative that E-Tronics' POL have HOT-HOT instances[12] within the United States.

---

[12] "A hot failover is designed to detect a failure and immediately switch over to a secondary running system: the end-user of the application will see little or no interruption of performance when the switch occurs." - Resilience: Hot or Cold failover…which one is right for my operation? By Surefire Systems

4.4 Proposed Architecture for MVP

The below diagram identifies the functional architecture the POL requires to meet MVP. Each component or feature is defined in the Requirements Definition section.
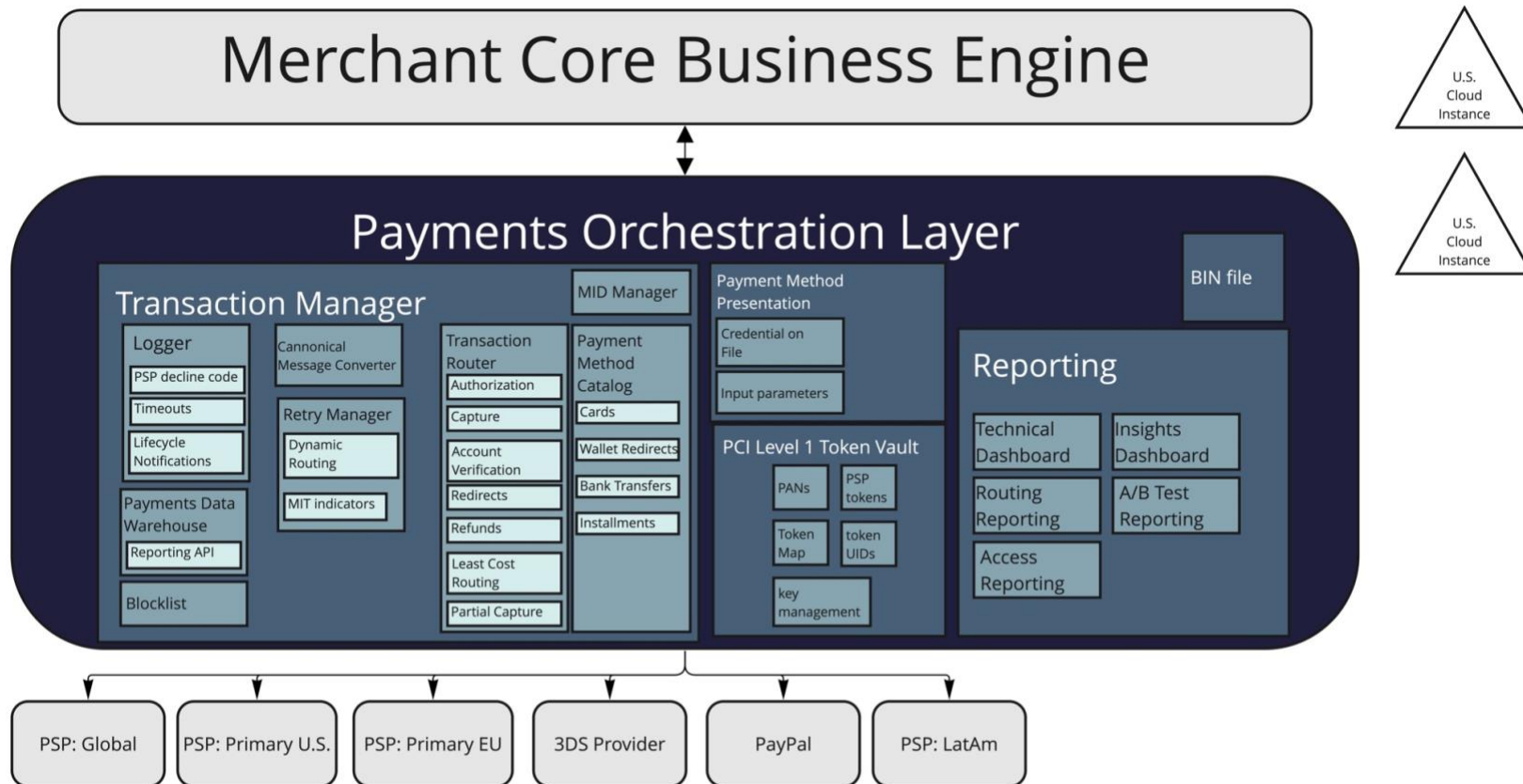

Figure 1: Proposed Architecture to achieve Minimum Viable Product for the Physical Goods Retailer Payments Orchestration Layer

5. USE CASE - MARKETPLACE MERCHANT

5.1 Background

Market4U is a European-based marketplace with offices in the United Kingdom. The average ticket size is USD $1,000. Despite the large transaction size, fraud has not been a historical problem in the U.S. and the EU.

Market4U operates using a merchant of record model. About 30% of its visitors come from Europe (primarily in France, Belgium, and the Netherlands), 10% from the United Kingdom, 40% from Brazil and Mexico, and 20% of visitors from the U.S. Forty percent of sales come from customers using their mobile app.

Because Market4U has a presence on three continents, they already need to support card acceptance through multiple PSPs. Now they want to consolidate their processing into one single layer. Over the years, they have developed relationships and work with:

- A legacy PSP that operates in the U.S. and offers them ACH payments.
- A European PSP that does not have an acquiring license in the U.K.
- A Latin American PSP that provides Merchant of Record services, and can enable local bank transfers in Brazil and Mexico.
- PayPal for acceptance as a local payment method in all countries where PayPal and Market4U are present

In the past, segmenting volume by country was acceptable. Post-Brexit, Market4U now seeks a PSP that could provide UK acquiring and redundancy in other countries. Thus, terms were agreed to with a global PSP that can acquire in the U.K. to offer new payment methods[13] including:

- SEPA Direct Debits
- iDEAL
- Cartes Bancaires
- Bancontact
- Klarna PayNow

While much of Market4U's business comes from Latin America (around 40%) there is little desire to add local legal entities in those countries. There is a desire to accept local bank transfers and improve card payment performance across the region by expanding the use of their current merchant of record providers.

5.2 Assumptions About the Solution

With the introduction of a new provider, transactions must be able to be routed between providers without adding an unreasonable burden to the teams managing the checkout and reconciliation. It is imperative that the marketplace be able to route card transactions by country or card product type but, for launch, no user interface is required for routing rule configurations.

---

[13] In 2022, Enterprise merchants on average accept 3.9 payment methods after having added an additional 2.4 payment methods during 2021. The top three reasons cited for adding new payment methods were 1) improving the customer experience (57% of surveyed merchants), 2) reaching new customer segments (42% of surveyed merchants), and 3) providing access to new markets (40% of merchants). - 2022 Global Fraud and Payments Survey Report by the Merchant Risk Council, Verifi, Cybersource, and B2B International

For each transaction, regardless of provider, the PSP will automatically capture transactions approved for the full authorization amount. The POL will not be responsible for capturing and submitting transactions for clearing.

Market4U's POL needs to migrate all PANs from all of their PSPs into a level-one certified vault. New PCI data will have to be collected securely and fed into the vault. Customers will be offered the ability to store their payment information during checkout for future use. Since so much of sales come from smartphones, native SDKs in iOS and Android are also required. Those SDKs will also need to support 3DS, regardless of PSP.

For checkout optimization, the solution needs to be hosted on instances within Europe and North America. Due to timing lags from Latin American acquirers that the PSP in that region is connected to, Market4U's engineering team decided that local instances are not required in Brazil.

Market4U has additional currency complexities to consider. To be truly global, Market4U must also support exotic 0-decimal and 3-decimal currencies.[14] Even more difficult, the platform must be able to track the forex rates applied to each transaction to ensure customers can get refunded exactly the same amount they paid in their local currency.

All activities within the POL will be logged, be they incoming messages, outgoing messages, or any other sub-service activity including user activity. Reports can be generated to see when changes were made to the system and by whom.

5.3   Use Case Findings

The Message Decision Handler is considered an important component of the marketplace POL due to the larger ticket order value and additional routing complexity that wasn't present in the prior use case. Fallback routing not only applies to Visa and Mastercard transactions but also to Cartes Bancaires and Bancontact cards. If either PSP has local acquiring in France, Denmark, Norway, Portugal, Germany, or Belgium, that would also affect routing paths and impact success rates.

Unlike in the physical goods retailer use case, partial captures were not considered as an integral part of the marketplace's requirements. This is likely due to the way this use case was framed since each transaction is captured for the full amount.

The greater amount of payment methods Market4U wishes to accept makes Payment Method Presentation, also known as front-end orchestration, even more pivotal. Without checkout options based on the customer's geography, user preferences, or risk profile, a merchant can risk providing the user with the opportunity for choice paralysis and risk losing the sale.

Despite the high ticket value, account updater and network tokens were not seen as priorities for MVP in this use case. We can attribute this outcome to issuer participation for both products outside of the U.S.

Least cost routing was not prioritized for this particular use case given the fixed interchange pricing regardless of card product. With new interchange rates and cross-border assessments set to debut in the United Kingdom, this requirement may be revisited in the near future.

---

[14] For instance, KRW and JPY are 0. KWD and OMR are 3.

5.4 *Proposed Architecture for MVP*

The below diagram identifies the functional architecture the POL requires to meet MVP. Each component or feature is defined in the Requirements Definition section.
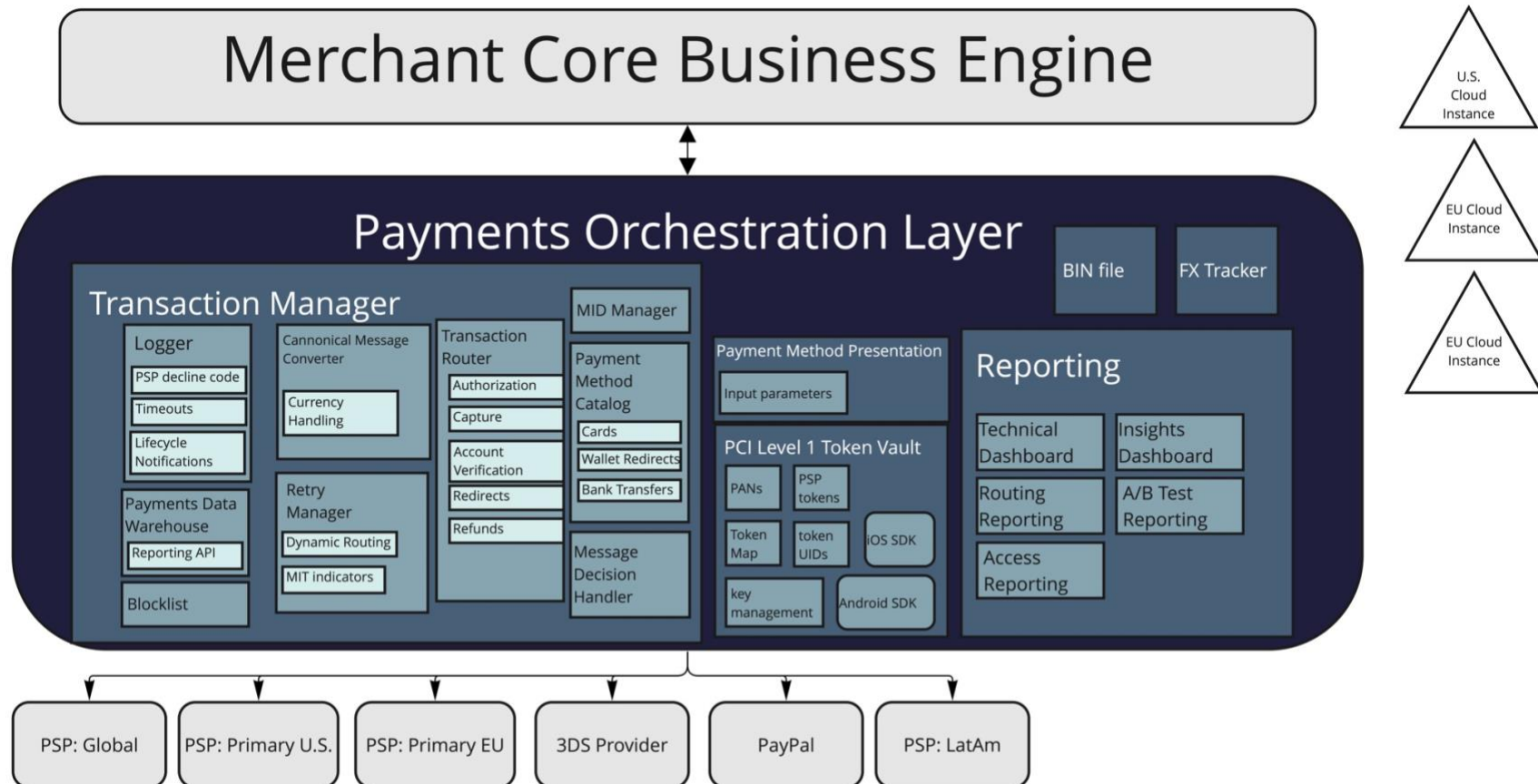

Figure 2: Proposed Architecture to achieve Minimum Viable Product for the Marketplace Payments Orchestration Layer

6. USE CASE - DIGITAL GOODS SUBSCRIPTION MERCHANT

6.1 Background

Share.io is a U.S.-based digital goods merchant that sells one product. The Share.io team knows that there is a great amount of interest in their product in India, but sees poor authorization success rates in that market. Additionally, they think that they have room to improve throughout Southeast Asia, where a healthy percentage of their site and app visitors also come from. They also have a sizable customer base within the U.S.

Due to India's data residency requirements, Share.io will need a local instance within India and will also benefit from keeping another instance in the APAC region for checkout and customer service requirements. An instance will also need to be replicated in the U.S. to serve the originally intended customer base.

India also presents recurring payments challenges. The Reserve Bank of India (RBI), India's Central Bank and financial regulator requires an e-mandate that the issuing bank get explicit consent from the consumer for every auto-debit within 24 hours of the purchase, leading many customers to opt out of subscription services. Equal monthly installments, similar to Buy Now Pay Later solutions in other parts of the world don't qualify for the e-mandate and can be a path to mitigate this explicit opt-in if a 1-year plan is sold instead of monthly packages.

While much of the business comes from India, there is little desire to add local legal entities in India or throughout Southeast Asia at this time. There is a desire to accept UPI-based payment methods and improve card payment performance in India and throughout Southeast Asia.

6.2 Assumptions About the Solution

Share.io seeks to have a configuration where:

- The primary U.S. PSP processes U.S. issued debit cards through the domestic EFT debit networks when they are qualified, credit cards, and to use account updater.
- The PSP for India processes Indian issued cards, including RuPay, Equal Monthly Installments (EMI) for purchases on annual plans in India, and UPI-based payment methods such as Paytm.
- The Global PSP processes non-U.S. issued cards, offers gopay, and grabpay in Southeast Asia and it also processes qualifiable credit cards as network tokens.
- It is directly connected to PayPal for local PayPal payment acceptance.

Since many of the purchases are generated from within the Share.io app, iOS and Android SDKs are a top-of-mind requirement.

3D-Secure is mandated within India and needs to be provided by either a 3rd party 3DS provider or the PSP that serves India. All recurring transactions need to apply the merchant-initiated transaction indicator flag. The POL's reporting API must also provide a webhook that can notify the email marketing service to potentially triage missed payments due to the RBI e-mandate pre-debit notification.

For non-Indian transactions, it is imperative that Share.io can route card transactions by country or card product type between the primary U.S. PSP and the global PSP. But to launch, no merchant user interface is required for routing rule configurations. The POL's router uses the customer's issuer country to determine which type of account verification check to perform ($0 or $1 authorization).

Partial authorizations and captures are not part of the scope of this use case. Share.io's PSPs automatically capture transactions approved for the full authorization amount, meaning the POL is not responsible for

capturing and submitting transactions for clearing. While dynamic statement descriptors might be useful for optimizing dispute performance, there is only one product type.

Due to the multiple currencies this Share.io accepts, the POL needs to be able to accept exotic currencies and track forex applied to each currency, and refund customers the full amount paid using the presentment currency.

6.3 Use Case Findings

Given the U.S. presence and subscription business model, network token acceptance and account updater are the primary features that need to be included in this use case. Most U.S. subscription merchants already retry failed payments, use account updater, and email customers to update their credentials.[15] However many subscription merchants initiate these retries from their billing engines days later as opposed to tactics better done by the POL such as instantly retrying the transaction and on first-time transactions cascading transactions to fallback providers.

Working with or as a network token requestor is incredibly useful for merchants because transactions can be routed between different providers as opposed to when the PSP is the network token requestor. The programs (account updater and network tokens) also provide a great return on investment[16] and higher approval rates[17][18] at participating issuers. In the U.S., issuer participation is high, making this functionality part of any POL MVP for this use case.

In India, working with a network token requestor may prove to be even more critical. The Reserve Bank of India, advises that neither the authorized Payment Aggregators (PAs) nor the merchants on-boarded by them shall store customer card credentials, also known as Card-on-File (CoF).[19] As of May 2022, the most straightforward way to continue handling card payments in India requires connections to Visa's Card-On-File tokenization service and the NPCI's Tokenization service for Rupay cards.[20] Though given the lack of readiness across the payments ecosystem in India, one *could* envision acquirers or regulated gateways getting future permissions to store customer PANs for refunding or lifecycle management purposes.[21] After June 30, 2022, a PCI Level 1 vault may not be necessary for India-based transactions but, it remains necessary for the rest of the countries Share.io operates within.

To reach their non-U.S. customers, Share.io requires physical instances in India and in another Southeastern Asia location (Singapore or Hong Kong would suffice). All Indian data would need to be processed and stored in the India instance. While redundancy in any one of these markets would be preferred, it may not be necessary to start processing operations for the POL.

---

[15] Recycling Benchmarking Survey by Derek Blatter and Josh Karoly, presented at PaymentsEd Forum 2018

[16] Every dollar spent on Account Updater leads to a return of $150 - Spreedly

[17] Network tokens lead to a 4.74% approval rate uplift in the U.S. - Adyen

[18] Over 79% of North American issuers participate in network tokenization - Spreedly

[19] "Guidelines on Regulation of Payment Aggregators and Payment Gateways" Reserve Bank of India

[20] NPCI launches tokenisation platform for RuPay cards: How it will work

[21] MRC Closed-door Stakeholder Discussion on India Payments Regulation - 19 May 2022; 4-5pm IST

6.4 Proposed Architecture for MVP

The below diagram identifies the functional architecture the POL requires to meet MVP. Each component or feature is defined in the Requirements Definition section.
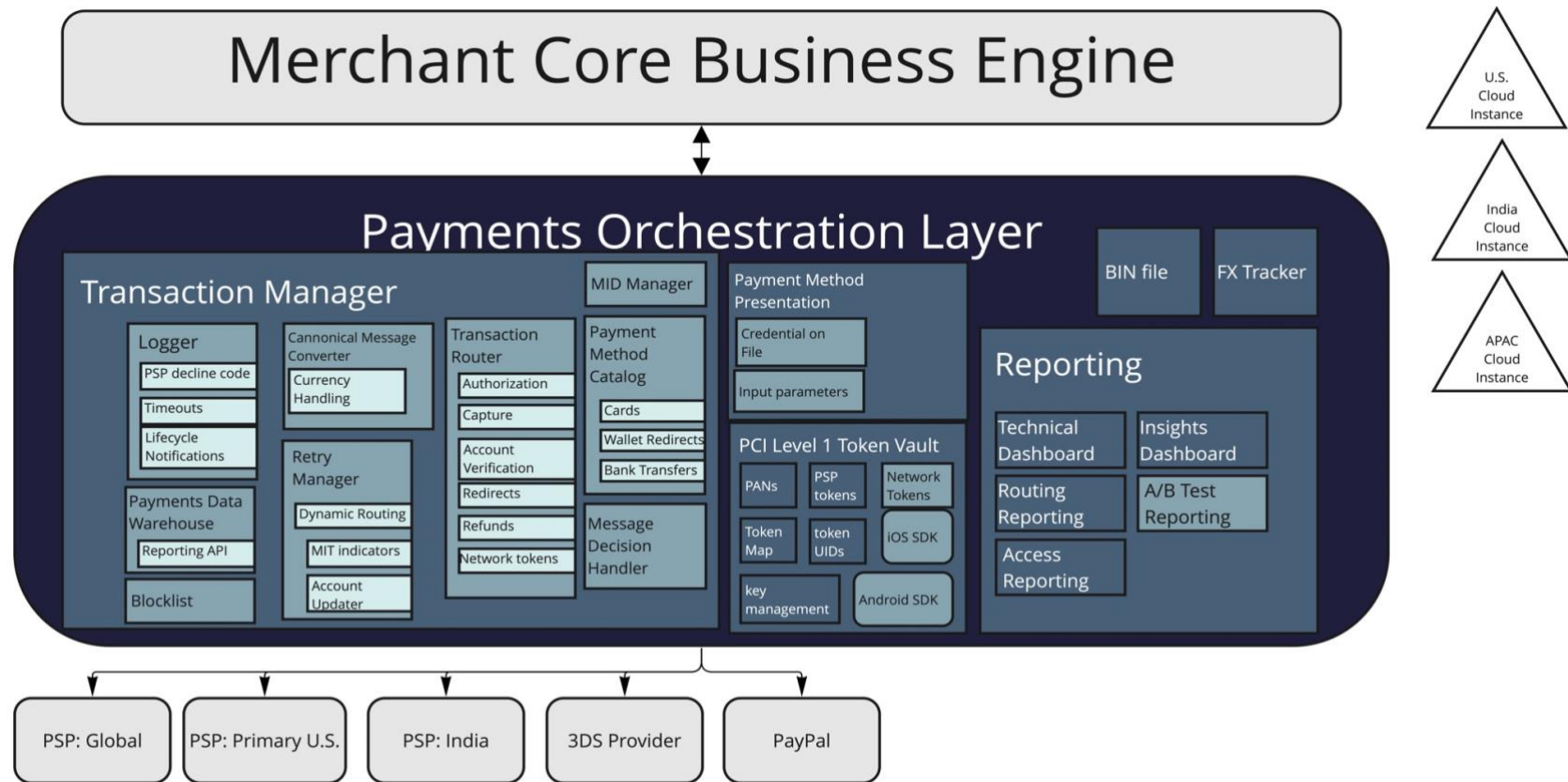

Figure 3: Proposed Architecture to achieve Minimum Viable Product for the Digital Subscription Payments Orchestration Layer

7. FINDINGS - DEVELOPMENT EFFORT

The following table details the hours required to develop an MVP POL as defined in the prior sections use cases and architectures.

The provided estimates are in developer hours since every company will have its own organization and cost structure for payments projects. Some teams may have full 8- or 9-person product teams while others may only be able to ask an engineer and a product manager to spend part of their time on payments. It's safe to assume that achieving MVP would take a fully staffed product team at least two years to achieve.

The estimates assume no contract delays, or any other legal or regulatory investigation. The timing estimates only include scoping, building, and QA testing through to production.

Category	Requirement	Physical Goods Retailer	Marketplace Merchant	Digital Goods Subscription Merchant
API	Account Verification	336	336	336
	Authorization	252	252	252
	Capture	252	252	252
	Lifecycle Notifications	782	782	782
	Partial Refunds	376	376	376
	Redirects	358	358	358
	Reporting API	755	755	755
API Total		3110	3,110	3,110
App	BIN File*	593	593	593
	FX Tracker*	0	1,185	1,185
	Payment Method Presentation	536	536	536
	PCI Level 1 Certified Token Vault	1534	1,534	1,534
	Transaction Manager	1336	1,336	1,336
App Total		4000	5,185	5,185

Attribute	Idempotency	456	456	456
	Zero decimal and 3 decimal currency support	0	336	336
Attribute Total		456	793	793
Endpoint	3DS Provider	855	855	855
	PSP: Global	1372	1,372	1,372
	PSP: India	0	0	1,452
	PSP: LatAm	1599	1,599	0
	PSP: Primary EU	635	635	635
	PSP: Primary U.S.	662	662	662
Endpoint Total		5123	5,123	4,976
Endpoint-PayMethod	Bancontact	0	238	0
	Cartes Bancaires	0	238	0
	Equal Monthly Instalments (EMI)	0	0	264
	GoPay	0	0	264
	GrabPay	0	0	264
	iDEAL	238	238	0
	Klarna PayNow	238	238	0
	PayPal	582	582	582
	RuPay	0	0	264
	SEPA Direct Debit	0	435	0

	U.S. ACH	0	435	0
	UPI wallet	0	0	435
Endpoint-PayMethod Total		1057	2,402	2,074
Feature	Algorithmic Routing for Least Cost	2298	0	0
	Integration to Account Updater programs	0	0	816
	Dynamic Routing	595	595	595
	Endpoint Timeouts	308	308	308
	Installment payments	376	0	0
	Merchant Initiated Transactions	515	0	515
	Partial Captures	376	0	0
	PSP decline codes	376	376	376
Feature Total		4846	1,280	2,611
Instance	2nd Cloud Instance Europe	0	316	0
	2nd Cloud Instance USA	316	0	0
	Local Cloud Instance Europe	0	316	0
	Local Cloud Instance India	0	0	316
	Local Cloud Instance rest of APAC	0	0	316
	Local Cloud Instance USA	816	816	816
Instance Total		1133	1,449	1,449
Reporting	A/B Testing Suite	513	513	513

	Access Reporting	371	371	371
	Insights Dashboard	1385	1,385	1,385
	Routing Reporting	371	371	371
	Technical Reporting Dashboard	902	902	902
Reporting Total		3542	3,542	3,542
Service	Android SDK	0	704	704
	Blocklist	360	360	360
	Canonical Message Converter	816	816	816
	Customizable hosted form field to capture sensitive data	748	748	748
	iOS SDK	0	704	704
	Logger	536	536	536
	Message Decision Handler	0	256	256
	MID Manager	536	536	536
	Network Token Requestor	0	0	1,035
	Payment Method Catalog	268	268	268
	Payments Data Warehouse	1892	1,892	1,892
	Retry Manager	624	624	624
	Transaction Router	1055	1,055	1,055
Service Total		6837	8,502	9,537
Grand Total		**30,104**	**31,385**	**33,277**

* Estimates were only provided by one of the three companies

Regardless of use case, each POL needs a canonical message converter, a token vault, a transaction router, a data warehouse, reporting, and a transaction manager to tie all these different services together. Every POL must have a transaction API that supports redirects (e.g., PayPal or iDEAL) in addition to authorizations and captures. A POL must also provision a reporting API or webhook for each transaction with raw response data from each PSP or payment method a merchant may use.

We presume the estimates for endpoints, payment methods, and cloud instances are faster than a merchant's internal estimates due to Spreedly, Gr4vy, and Apexx.Global implementing replicable processes that speed up new integrations after the first processing model has been completed. This enables them to provide accelerated deliveries on new payment methods or card brands through new PSPs. Thus, although this would give the third-party providers an advantage when building end-point connections, this advantage has not been included in this analysis.

With 2 fully staffed engineering teams, it is possible to build a POL MVP within a year, but we've typically only seen such levels of staffing from the largest technology companies such as the FAANGs.[22] The following table assumes each engineer works 40 hours per week, remains on the project until completion, and does not account for holidays, emergencies, leaves of absence, or reallocation.

Count of Engineers working concurrently	Weeks to MVP		
	Physical Goods Retailer	Marketplace Merchant	Digital Goods Subscription Merchant
2 Engineers	376	392	416
4 Engineers	188	196	208
8 Engineers	94	98	104
12 Engineers	63	65	69
16 Engineers	47	49	52

Additional time, (10- 30% of the estimated amount) may need to be added to each estimate to properly forecast contingency for execution risk. Payment processing is often pressured by time-to-market concerns, but how many merchants would devote so many in-house engineers for a year, or a more manageable amount over the course of years in order to build their own POL MVP?

We can compare the developer hour estimates with local average software engineering wages to generate financial impact estimates. Average base salaries were sourced from PayScale[23] for software engineers from the U.S., Germany, India, and Brazil — all countries that provide a large portion of their region's

---

[22] Facebook (Meta), Apple, Amazon, Netflix, Google (Alphabet)

[23] We find PayScale's numbers to be low compared to what we have seen across the payments industry, but they provide a useful benchmark that can be replicated for providing cost estimates.

developers. When salaries from each of these regions are normalized into USD[24] we find the hourly rates based on the provided working assumptions about hours spent working per year:

Country	USD Hourly Rate	USD Base Salary	Hours Worked Per Week	Weeks Worked Per Year	Local Currency Base Salary
USA	$41.07	$78,853.00	40	48	USD 78,853
Germany	$31.72	$58,371.02	40	46	EUR 55.067
India	$7.12	$10,595.00	48	31	INR 815,000
Brazil	$9.92	$19,041.60	40	48	BRL 95,208

And then can extrapolate those hourly rates into the following MVP cost estimates.

MVP Cost Estimates by Country			
Country	Physical Goods Retailer	Marketplace Merchant	Digital Goods Subscription Merchant
USA	$1,236,349	$1,288,959	$1,366,662
Germany	$955,001	$995,638	$1,055,659
India	$214,349	$223,470	$236,942
Brazil	$298,556	$311,261	$330,025

Offshoring this work makes the proposition of building a POL financially palatable. But these costs do not account for maintenance, cloud infrastructure fees, or staffing on Partnerships, Product Management, Design, or Operations.

8. CONCLUSION - BUILD VS. BUY

To get routing and connectivity, merchants need a PCI Level 1 vault agnostic from each PSP it processes with. When merchants support direct connections to multiple PSPs, each PSP token is not interoperable with other PSPs. The merchant's token vault must then support one to many token relationships to use a customer's PAN across multiple PSPs, increasing complexity and cost. While outsourcing payments orchestration to a third-party provider could increase per-transaction costs, it will also eliminate the cost and burden of full PCI compliance. The most prominent reasons merchants use a third-party POL instead of building them in-house are:

1. Access to engineering is a constraint,

---

[24] Exchange rates applied on May 21, 2022

2. PCI concerns, costs,[25] and constraints,
3. Execution risk.

Payment Orchestration Layers are designed to store and maintain all of the payment credentials. Providing PCI-Level 1 vault is the foundational starting point for a POL. In addition, POLs are already Visa and Mastercard network token requestors, a trait that will grow in value as global issuer participation increases and more countries pass network-focused card tokenization regulations.[26] When it comes to account updater, payment orchestration platforms have a distinct advantage over 1st party build solutions as they can join the Visa and Mastercard account updater and real-time account updater programs whereas merchants must join through Visa and Mastercard partners such as PSPs.

Furthermore, the cost of setting up, automating, and scaling cloud infrastructure can be substantial and time-consuming. Given the sensitive nature of payments data, transaction latency concerns, and how regulators in India or companies in Europe and the U.S. are now thinking about where the data is processed and stored, we expect to see a greater need for local cloud processing and storage.

The 2020s remain the age of the "10x engineer."[27] Yet, payments, while one of the top costs for large established merchants after staffing and infrastructure fees, is not often a space that generates 10x returns for merchants compared to building new product lines or competitive moats. Payments, while core to a merchant's health, isn't core to a merchant's identity which is why we rarely see POLs built by merchant engineering teams. We also have yet to observe a merchants payments organization have separate teams, one for implementations and one for the core POL product, which is now becoming an emerging trend at payment orchestration providers.

Merchants are unlikely to gather benchmarking data in real-time to drive and realize optimizations without a POL. After all, POLs are strategically positioned to leverage multi-merchant performance data to inform routing decisions, payment method presentation, and decline code analysis.

A common criticism of payments orchestration solutions is that they lack the fidelity of a direct connection to a PSP. Since most merchants will only build exactly what they need, their connections also lack this same completeness of integration. What 3rd party payment orchestration providers can provide is mitigated execution risk since their platforms are already live and have replicable processes to add new endpoints whether they be new card processors, payment methods, or other value-added services.

An underrated but critical element that is better served by third-party POLs than 1st party builds is how documentation and the bus factor[28] are addressed. Solutions serving many customers must have documentation that is clear and quick to understand. Payment orchestration providers also have policies to mitigate unexpected departures of key personnel so the loss of tribal knowledge isn't nearly so detrimental.

As for specific features within the platform, third parties also have a few differences worth considering:

---

[25] Security Metrix reports that, for large merchants, the assessment alone can cost as much as USD $70,000+ per year. TrustNet reported that compliance costs range from less than USD $10,000 per year to several Millions of dollars annually. - "How Much Does PCI Compliance Cost? 9 Factors to Consider," by Jacqueline von Ogden

[26] Heading into July 2022, due to the Reserve Bank of India's card tokenization mandate, Apple exited the Indian market and Paytm announced it was tokenizing all existing card data on its platform and deleting the PANs. In an effort to reduce payment transaction fraud, only Indian card issuers and the card networks may retain sensitive PCI data.

[27] https://knowyourmeme.com/memes/10x-engineer

[28] "A project's bus factor (or truck factor) is a number equal to the number of team members who, if run over by a bus, would put the project in jeopardy. The smallest bus factor is 1. Larger numbers are preferable." - Bus Factor

Lifecycle notifications may not be considered MVP for a merchant build but, for any 3rd party provider, they are absolutely essential since merchants may have to build custom services or subscriptions to the POL to initiate orders. This interpretation of the need for lifecycle notifications will affect development estimates.

A hosted payments page or hosted form fields were also a point of ambiguity for the build and the buy parts of the conversation. These features and other means for capturing PCI information such as SDKs for iOS, Android, and browser are seen as essential for 3rd party providers to offer a true MVP solution, but may not be necessary as part of a merchant build given direct connections into a merchant maintained PCI vault.

The merchant reader may decide that all the features listed in the POL MVP aren't relevant for their own POL design. However, the reader is encouraged to re-use these estimates that best fit their specific use case for building their business case, regardless of a buy or build decision.

9. ABOUT THE AUTHORS

Founded in 2016, APEXX Global is a multi-award-winning global payments platform that combines acquirers, gateways, shopping carts and Alternative Payments Methods into a single marketplace and one-stop solution for Enterprise/Tier 1 merchants. APEXX builds an integrated and transparent service that manages the authorisation, processing, and optimisation of transactions.

APEXX takes an agnostic approach to partnerships, working with many different solutions providers across the payments industry. Our approach creates a more efficient and cost effective solution that cuts through the complexity of e-payments and leaves behind legacy technology systems. Our mission is to help businesses grow by reducing unnecessary costs, increasing conversion rates and simplifying the global payment ecosystem.

Gr4vy is a cloud-native payments company that takes the complexity out of merchants running payments infrastructure, freeing them to focus on what matters most. We redefine payments by providing an intuitive, cutting-edge payment orchestration platform (POP) that leverages the power of the Cloud to modernize payments infrastructure. Our orchestration layer upgrades merchants' payments stack to make them more nimble. Our no-code dashboard centralizes the integration and management of a merchant's payment methods, providers, conditions and transactions and empowers them to do more in less time. We enable merchants to streamline and manage payment methods, services and transactions all in one place. At Gr4vy, we're passionate about payments, efficiency and extraordinary customer experience.

Spreedly's Payments Orchestration platform enables and optimizes digital transactions with the world's most complete payment services marketplace. Global enterprises and hyper-growth companies grow their digital business faster by relying on our payments platform. Hundreds of customers worldwide secure card data in our PCI-compliant vault and use tokenized card data to enable and optimize over $40 billion of annual transaction volumes with any payment service.

[Retail Payments Global Consulting Group](#) (RPGC) was founded to help and educate merchants grow globally. As an advocate of payments as a strategic asset, RPGC provides advisory services in payments strategy, education, RFP management, and functional architecture design.

RPGC was sponsored by the other authors to research, write, and distribute this work.