

An application programming interface model for open banking ecosystems

Received (in revised form): 4th February, 2020

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ABSTRACT

This paper proposes a model for an open banking application programming interface (API) ecosystem that supports the expansion of open banking APIs beyond the regulatory minimum. The paper uses specific banking business scenarios as candidates to drive the requirements for a broader set of open banking services. Using the API model framework, specific examples of 'value-add' services are identified to support the scenarios. Future market constructs and associated APIs needed to support a burgeoning ecosystem are proposed and elaborated. Barriers to their development and the realisation of a fully functioning open banking ecosystem are also discussed.

Keywords: open banking, PSD2, CMA Order, API economy, payment initiation

INTRODUCTION

Recent regulatory drivers, such as the Revised Payments Services Directive

(PSD2)¹ in Europe and the Competition and Markets Authority Retail Banking Market Investigation Order 2017² (CMA Order) in the UK have provided the trigger for the opening up of payment-related banking services to third parties. The regulators' objective was to create a marketplace with increased competition from newly-formed entities and to enhance the opportunity for customer innovation. The new entities permitted by the regulation are identified and described in Table 1.

These regulatory drivers, coupled with technology advances that enable collaboration between organisations, notably application programming interfaces (APIs), were conceived to create a new marketplace, positioned as what has been termed the 'API economy'. In this marketplace, opportunities for new business models for intermediaries, interacting with multiple market participants, are now becoming prevalent.

In the UK, the original regulatory driver for open banking was the CMA Order. This was subsequently supplemented by PSD2. Table 2 summarises the scope of each and the difference between them.

The open banking concept and associated regulation were introduced ultimately to provide customer benefits through increased competition and innovation. While the obvious benefits lie with TPPs being able to offer chargeable banking services, open banking should also be viewed as opportunity for ASPSPs. The benefits for ASPSPs include:

- *growth via switching:* increased product awareness through open access to product



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Journal of Payments Strategy & Systems
Vol. 14, No. 1 2020, pp. 75–91
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1750–1806

Table 1: PSD2 entity definitions

Name	Description
Account servicing payments service provider (ASPSP)	Essentially a bank and having a full banking licence. These entities provide the underlying payment account products within the scope of the regulation that are to be made accessible to third-party providers (TPPs).
Payment initiation service provider (PISP)	A TPP that is permitted to provide payment initiation services on behalf of a payment service user.
Account information service provider (AISP)	A TPP that permitted to access account information relating to a payment service user's payment account.
Card-based payment instrument issuer (CBPII)	A TPP that issues a scheme-based account product (<i>viz.</i> debit and credit cards) and can request account information and initiate payments from a related ASPSP account.
Third-party provider (TPP)	A generalisation of all of ASPSPs, PISPs and CBPIIs.
Payment service user (PSU)	A customer that uses payment services via a TPP. A PSU must hold a bank account with an ASPSP, meaning they will be a customer of both the ASPSP and TPP.

Table 2: Comparison between the CMA Order and PSD2

Scope item	CMA Order	PSD2
Account types	Personal current accounts (PCA) Business current accounts (BCA)	'Payment accounts' including: personal and business accounts, credit cards and e-money
Currency	GBP only	Euro, GBP, other foreign currency accounts
Account provider	Limited to nine major UK banks	All banks in the EEA
Reference data	Branch locations ATM locations PCA products BCA products Business credit card products	Not in scope
Read data	Transaction history Account information	Transaction history Account information
Read/write data	Payment initiation	Payment initiation

information provides greater opportunities for account switching;

- *growth via collaboration*: collaborative business models with an ASPSP acting as a 'commodity' account provider and the TPP providing a niche banking service would result in a net increase in bank accounts;
- *monetised APIs*: outside of the regulation, an ASPSP could use the open banking concepts to provide 'value-add' information

services to third-party organisations via bilateral business relationships; and

- *secure access*: unregulated access to a customer's financial data through existing screen scraping approaches is now subject to a regulatory regime and controlled, secure access to the customer data are provided, reducing security risk for the ASPSPs.

As implementations of the CMA Order and PSD2 have progressed, limitations of the

statutory obligations suggest that compliance with the regulation alone will not suffice in meeting needs of third-party providers (TPPs) in their desire to provide a comprehensive customer proposition. Similarly, the opportunities for more sophisticated business models based on ‘co-opetition’ that better supports competition are somewhat limited due to limitations in scope and emerging inherent flaws in the regulation. These factors will stifle innovation and ultimately limit the extent of open banking consumer propositions.

To this end, this paper introduces a layered API model for the open banking ecosystem that addresses the gaps in the capabilities of the market infrastructure and supports additional ‘value-add’ API services that ultimately enable a broader set of cooperative business models, promote innovation and enhance customer confidence in the ecosystem.

THE API ECOSYSTEM MODEL

Technology overview

The ecosystem envisaged in the paper is premised on the use of APIs to support collaborations between the various actors. Traditionally, this term related to a set of software library functions each offering functional services. In the past, a variety of technologies have been used for their implementation. In the open banking ecosystem proposal described here, the term is used exclusively to denote a specific API technology type — the RESTful API.

A RESTful API uses standard HTTP requests to operate on a data. REST technology is now the generally preferred API technology of choice as it is based on open standards, the use of a ‘light-weight’ stateless HTTP protocol for its requests and responses and the use of JavaScript Object Notation (JSON) for representing data. As such, it requires less bandwidth than other API protocols, such

as SOAP/XML, making it more suitable for internet usage.

Eco-system participants

Figure 1 illustrates the categories of participants in the open banking ecosystem envisaged in the long term. In the short term, the ecosystem must accommodate those participants dictated by the regulation, notably the ASPSPs, PISPs and AISP. To enable the implementation of the regulation, market infrastructure providers are identified and included in the ecosystem. These are positioned to provide services to support the proposed operation of the ecosystem as per the regulation and also the additional, ‘value-add’ services that serve to make the operation of the ecosystem more effective.

As open banking matures, additional participants in the form of ASPSP partner organisations will utilise open banking concepts to provide their services within the market. A final stage in the maturity of the ecosystem will see the inclusion of recognised industry bodies into the ecosystem. This allows for the creation of fully digital processes relating to monitoring the compliance of the ecosystem participants and the support of ombudsman services such as customer complaints.

An open banking API model to support such an ecosystem is proposed in Figure 2.

The model comprises three layers:

- regulatory compliance;
- walled garden; and
- industry ecosystem.

In technology terms, each of the services in these layers is provided by a set of RESTful APIs accessible to the participants within the ecosystem, constrained by appropriate access control mechanisms.

A description of the model layers, the market participants within each layer and

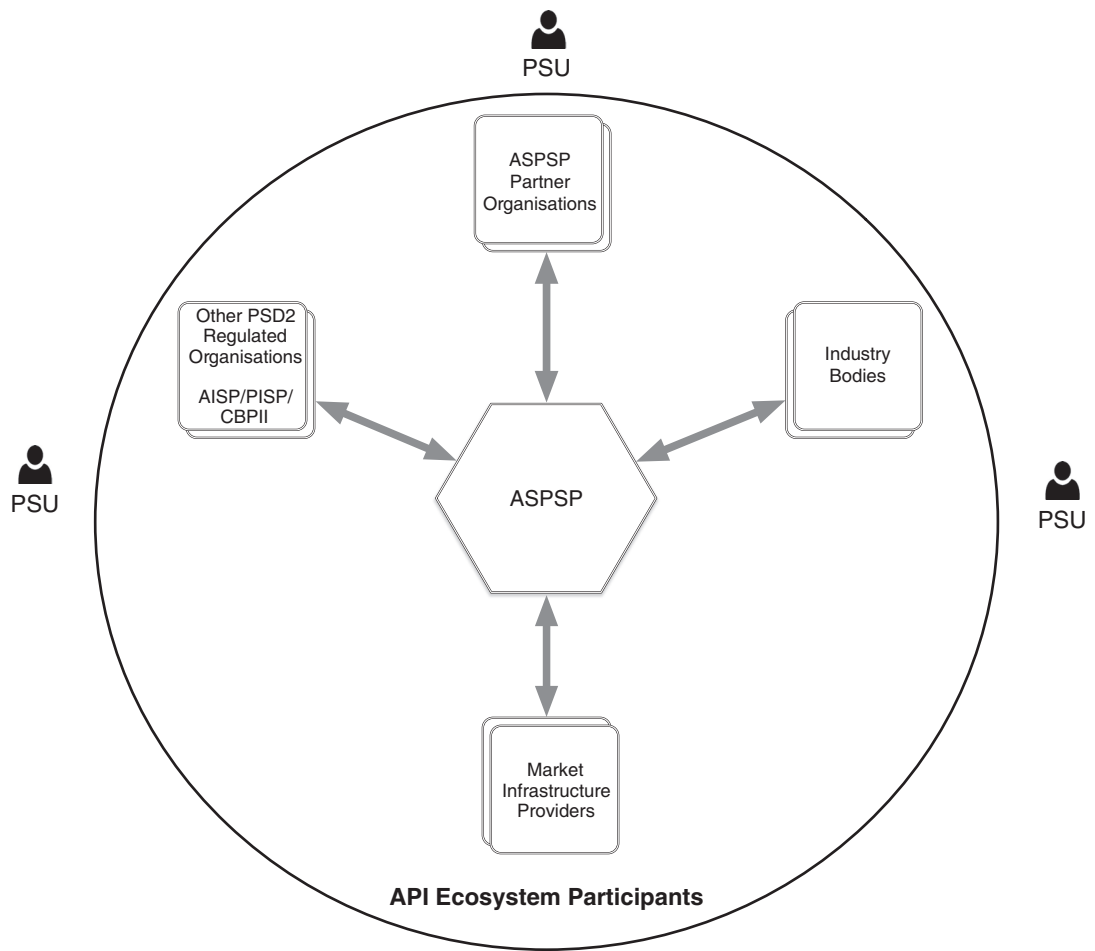


Figure 1: API ecosystem participants

the scope and purpose of their collaboration is provided in Table 3.

It is interesting to discuss in further detail the classification of the standards within each layer. In this respect two dimensions are considered:

- *accessibility*: the degree of openness of the standard in terms of who is allowed to use it — this ranges from public to private; and
- *maintenance*: the ownership of the standard in terms of who defines its specification — this ranges from being proprietary to maintenance by a standards body.

API standards grouping

For the analysis of the market adoption of APIs, logical groupings of APIs have been identified and used to illustrate the implications for their maintenance and accessibility.

The groupings and their placement in the API model are illustrated in Figure 3.

The groupings depicted in Figure 3 are described in more detail in Table 4.

LAYER 1 APIS
Market infrastructure APIs

The PSD2 is complemented by various Regulatory Technical Standards (RTS)³ of which the RTS on strong customer

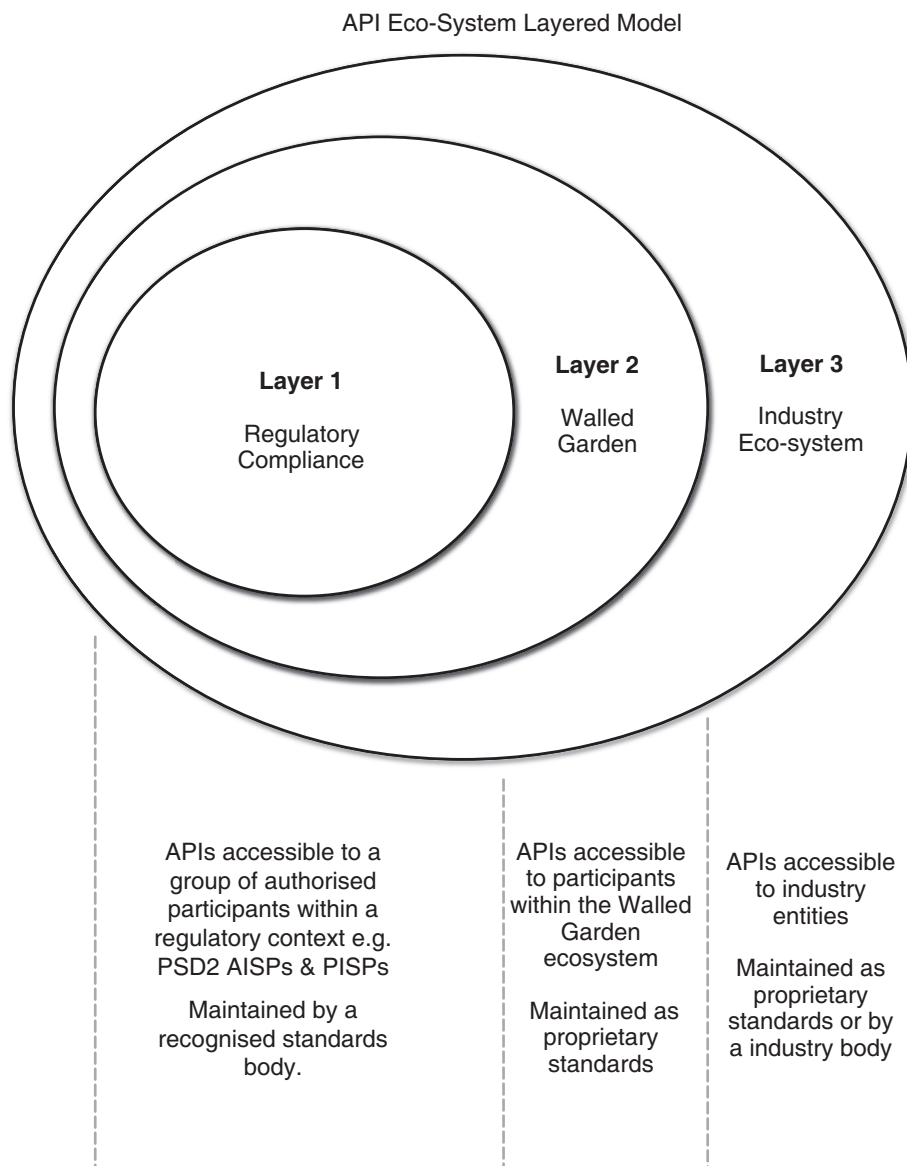


Figure 2: Layered API ecosystem model

authentication and secure standards of communication, specify the requirements for security elements of the ecosystem in terms of a digital certificate construct, the eIDAS certificate. This certificate is issued by a market actor called the Qualified Trust Service Provider (QTSP).

A deconstruction of the eIDAS proposals from the European Telecommunications

Standards Institute (ETSI)⁴ highlights flaws in the eIDAS concepts, namely that they attempt to combine two different functional purposes, namely, to prove:

- the identity of an organisation; and
- that organisation's PSD2 role and consequently their right to transact in the ecosystem.

Table 3: API collaborations and characteristics

Layer	Name	Participants	Description
1	Regulatory compliance	PSD2 Regulated entities — ASPSP/ PISP/AISP/CBPII	This layer provides APIs that fulfil the mandated regulatory services. Participants use the available services dictated by the PSD2 regulation. To support interactions between ASPSP, PISP, AISP and CBPII as defined by the regulatory requirements.
2	Walled garden	ASPSP partner organisations	This layer constitutes a private ecosystem available for business partners that contains ‘value-add’ services over and above the basic regulatory compliant services. To support interactions with all partner organisations within the walled garden.
3	Industry	Industry bodies	To support interactions between participants within an entire industry ‘vertical’ segment, eg retail banking, savings and lending, insurance or energy.

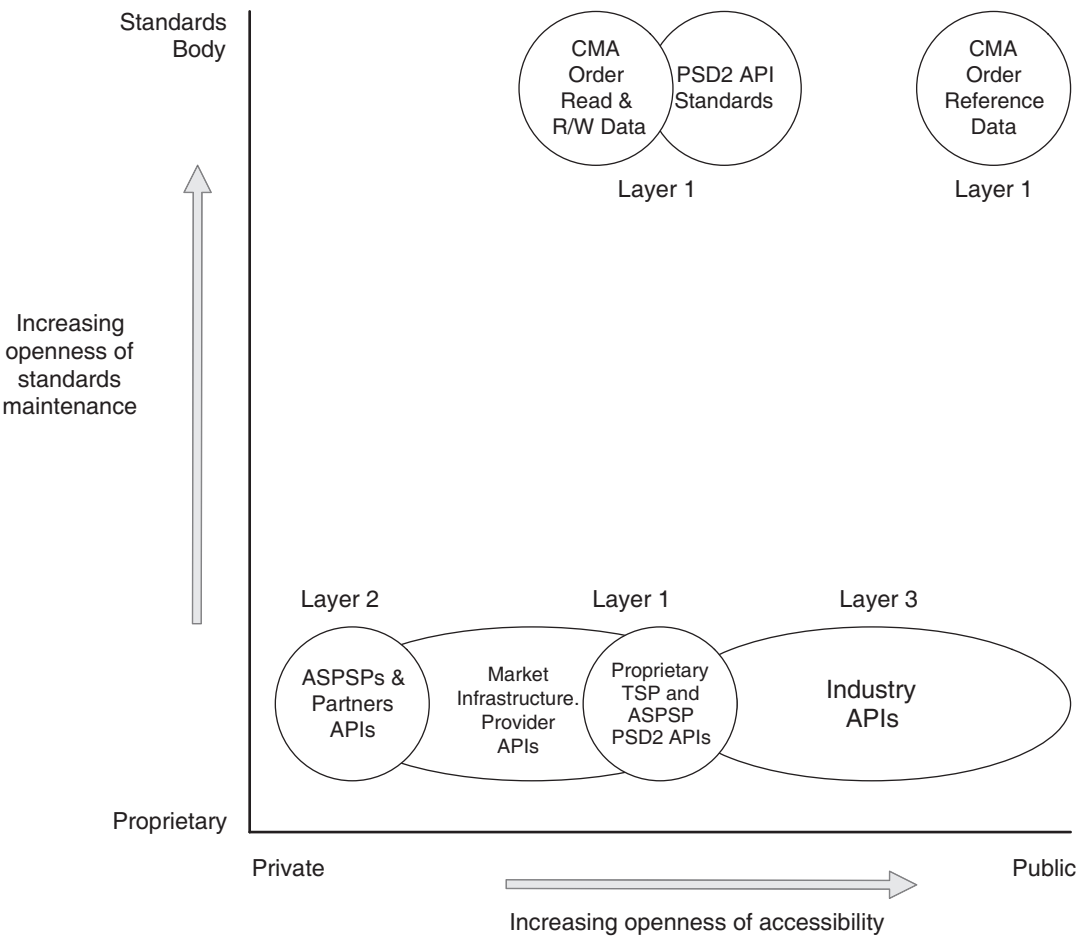


Figure 3: API groupings within the ecosystem model

Table 4: API model standards grouping descriptions

<i>Layer</i>	<i>Grouping</i>	<i>Description</i>
1	CMA Order reference data	These APIs support services mandated by the CMA Order to provide information on bank reference data. The standards for these are maintained by the open banking implementation entity (OBIE). These APIs are fully accessible to the public.
1	CMA Order read and read/write data	The API specifications for read and read/write data mandated by the CMA Order are maintained by the OBIE. These APIs are provided by a closed group designated 'CMA 9' banks and to other UK banks that voluntarily adopt the use of these standards. They are accessible by regulated entities only.
1	PSD2 API standards bodies	API standards bodies, namely the OBIE, STET and the Berlin Group, provide a complete set of API standards ASPSPs to implement to achieve PSD2 compliance. PSD2 APIs support open access to payment accounts, however the accessibility is restricted to a large, but closed, group of participants, namely the regulated entities. Public access is not permitted.
1	Proprietary PSD2 APIs	This grouping represents APIs that comply with PSD2 but are developed by ASPSPs that do not adopt the standards of one of the standards bodies. They may also be developed by a third-party open banking technical service providers as part of a commercial offering. These APIs may relate to either: a monetised 'value-add' service only accessible to those entities paying for service; or a non-monetised service provided by a regulatory body for the regulated entities, such as the OBIE Directory.
1	Market infrastructure provider APIs	This grouping represents APIs that provide the additional market infrastructure services to make the operation of the ecosystem more effective. These APIs are accessible only to participants in the regulatory ecosystem.
2	ASPSPs and partner APIs	Represents functional APIs provided by ASPSPs and their partners to support private API ecosystems. These APIs are accessible to participants in a private, closed, ecosystem.
3	Industry APIs	Represents APIs that provide a broad set of industry services. These services may be a mixture of APIs that are accessible publicly and those that are restricted to regulated participants.

Conceptually, identity is considered an immutable construct as an organisation identity does not change during its lifetime (by analogy, consider a passport as a form of identity issued to an individual). Within the eIDAS certificate, the PSD2 role of the participant in the ecosystem is encoded. The problem with this approach is that:

- the organisation's role may change; and
- the organisation's authorisation status may change over time, for example, if the company ceases to operate or becomes suspended due to inappropriate activity

In these circumstances a reissuing of the certificate must take place. Regarding this point, in the business process specified by ETSI, the National Competent Authority (NCA) must inform the QTSP of any change in status, for example, a suspension or withdrawal of their licence as a PISP or AISP. This is problematic as there is no guarantee that this communication will be performed in a timely manner, even ignoring the fundamental issue as to whether the NCAs are willing and able to support such a business process. Therefore, given the likely lag between status change and the request

by the NCA for the minting of a new certificate, the existing certificate will be out of step with the participant's authorisation status. In these circumstances, simply checking the validity of the certificate and the role field within it will incur a risk that the organisation is a bad actor but still allow a transaction to proceed.

One possible answer to this is a third-party information service that provides up-to-date status on an organisation's authorisation by its NCA. In this respect, a centralised directory construct and its associated information services is being championed by a commercial entity, namely Open Banking Europe in the form of the PRETA Directory.⁵ This addresses the requirement for a standardised enquiry interface but does not necessarily result in guaranteeing that information is updated with minimal latency. A window where a bad actor can continue to operate remains an identified risk in the ecosystem that is difficult to eliminate entirely.

A further refinement to this concept is that the organisation's identity could be decoupled from the eIDAS certificate. For example, the use of the Legal Entity Identifier, available from the UK LEI Register, offers a potential solution for definitively identifying an organisation's identity in this respect. This could be used as the reference to fulfil a claim on an organisation's identity, other identity data being provided by other industry bodies, such as Companies House in the UK.

In a similar vein to this, another deficiency of the RTS is that organisational information ascribed in the eIDAS certificate is limited in granularity to that of the legal entity. In practice, the legal entity may not be a recognised brand known to the customer, which could lead to confusion if presented to them as part of an authorisation step. Finer-grained identification of the TPP actor would be beneficial in terms of providing clarification to customers as to which

entity is transacting on their behalf. Such enhanced information could again be provided as part of a directory service. Indeed, the UK Open Banking Directory currently supports the provision of such branding information from ecosystem participants.

By implementing such capabilities, the eIDAS certificate becomes a transient technical construct to support the use of public key infrastructure (PKI) operations such as digital signing and encryption. A TPP presenting an eIDAS certificate to an ASPSP, as required by the RTS, would trigger a process to validate the authorisation status via a centralised participant directory and, if necessary, obtain identity and branding information from other directory services rather than relying the data in the eIDAS certificate itself.

To summarise, in terms of market infrastructure services, a directory of participants and their associated authorisation status is beneficial. The relevant enquiry service would be implemented as an API. Given that the source of the authorisation is a country-specific NCA, one may conclude that an information service provided by the NCA could satisfy this requirement. However, for this to work effectively, a standard enquiry interface would be beneficial. Furthermore, at the time of publication, each register of authorised participants maintained by an NCA is not guaranteed to be available in an electronic form. Consequently, human processes are still required to support enquiry services. In IT terms, this clearly does not make for a low latency information service regarding the authorisation status.

The issues highlighted above are relevant to Layer 1 of the model to realise a trust model for known, regulated participants. In the walled garden layer of the API model, a sub-ecosystem of participants, representing the ASPSPs business partners is envisaged. While participants in this sub-ecosystem do not have to be regulated participants, by analogy, it is necessary to implement a

similar trust model to identify business partners and their respective role within the private sub-ecosystem. A similar, but private, directory service specific to the ASPSP's private sub-ecosystem is the logical inference of this. Services implemented as APIs for this purpose would provide the necessary market functionality for this layer:

- an API for the registration of partner organisations; and
- an API to test the authorisation of a partner attempting to consume a Layer 2 API.

Pan-European open banking payments

As identified in the API groupings, a number of standards bodies exist for the specification of regulatory APIs and, with the exception of the UK, the use of a specific standard is not mandated. Without the adoption of a common standard across the EEA, it is difficult to implement the vision of a pan-European payment services envisaged by PSD2 or even in achieving a global open banking payments service analogous to of standards limiting pan-European and global open banking payments initiation. Rather, the market is likely to support clusters of participants that adopt a specific set of standards. This clustering may be on a country-specific cluster, as envisaged in the UK using the UK open banking standards. It could also be on a regional level, such as the Nordic region where, for example, Nordea Bank is driving PSD2 API standards across the countries in which it operates.

In these scenarios, third parties can provide services within their cluster only, the integration complexity of having to integrate multiple API standards into their applications being a barrier to achieving broader pan-European access.

A proposal from Common Access to Payments (CAPS) attempts to address this situation with the concept of a Pan-European

Account Roaming Service⁶ (PEARS) through the introduction of a new actor in the ecosystem that performs the role of an integration broker. This actor is denoted as the account roaming service provider and is illustrated in Figure 4.

The account roaming service provider's role is to transform the API standards employed by the third-party provider in one cluster to those of an ASPSP used in another cluster, enabling the TPP to operate with a broader reach. In this scenario, APIs that facilitate the brokering services between the different standards clusters would be provided by the account roaming service provider. While technical implementation details and commercial models around such a service remain challenging, this approach is highlighted as a potential solution that addresses a practical problem in the implementation of PSD2.

LAYER 2 APIS

Account type extensions to PSD2

The PSD2 scope covers 'payment accounts' only, that is, those accounts with a payments capability that are routinely used for such a purpose. As a consequence of this, other types of account are beyond the scope of the PSD2, such as:

- mortgage accounts;
- loan accounts; and
- savings accounts.

In the aggregator business model identified, to get a full financial picture of a customer's financial position, it would be beneficial to have visibility of account information for all such accounts. Indeed, such a scope has been built into the vision for Australian open banking via the Consumer Data Rights Designation from the outset. It is therefore easy to envisage Layer 2 extensions to the PSD2 regulatory APIs to support access these account types.

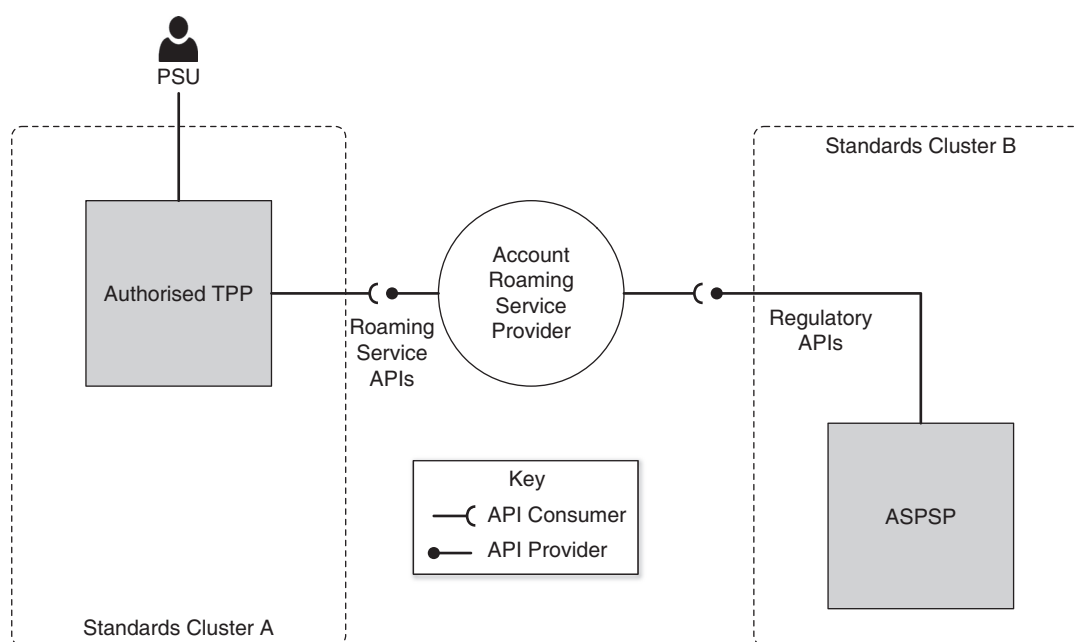


Figure 4: Account roaming service concept

Other financial services domains

There are other financial services domains that, by analogy, would also benefit from the same open access to accounts approach as open banking. The most relevant of these is perhaps the pensions domain. To obtain account information pertaining to a pension holding would again be most useful from the perspective of a third-party financial adviser attempting to get a holistic picture of a customer's finances.

Once again, it is easy to envisage a complementary API ecosystem, supported by pension platform providers, that provides information services on investment value, the assets within the fund and a statement of transactions.

Functional APIs

This section explores the drivers for additional functional APIs within Layer 2 of the ecosystem. In principle, any external interface between a bank and its many partner organisations is a candidate for implementation via an API. Two specific examples of partner organisations are discussed and potential

additions to the regulatory ASPSP APIs to support account life-cycle management are discussed. The API collaborations between the participants are shown in Figure 5.

Account life-cycle management

The open banking model is premised on underlying account product being provided by the ASPSPs. Third parties are expected to layer their own innovative products on top of these accounts and provide value-add services to the customer (PSU). A number of third-party provider business models have been identified and outlined in Table 5.

As the trend towards digital transformation and fully digital banks continues, it is reasonable to expect that full account life-cycle management banking services could also be provided by APIs. Additional services required to support a fully digital account life-cycle management include:

- account opening;
- account closure; and
- account switching initiation.

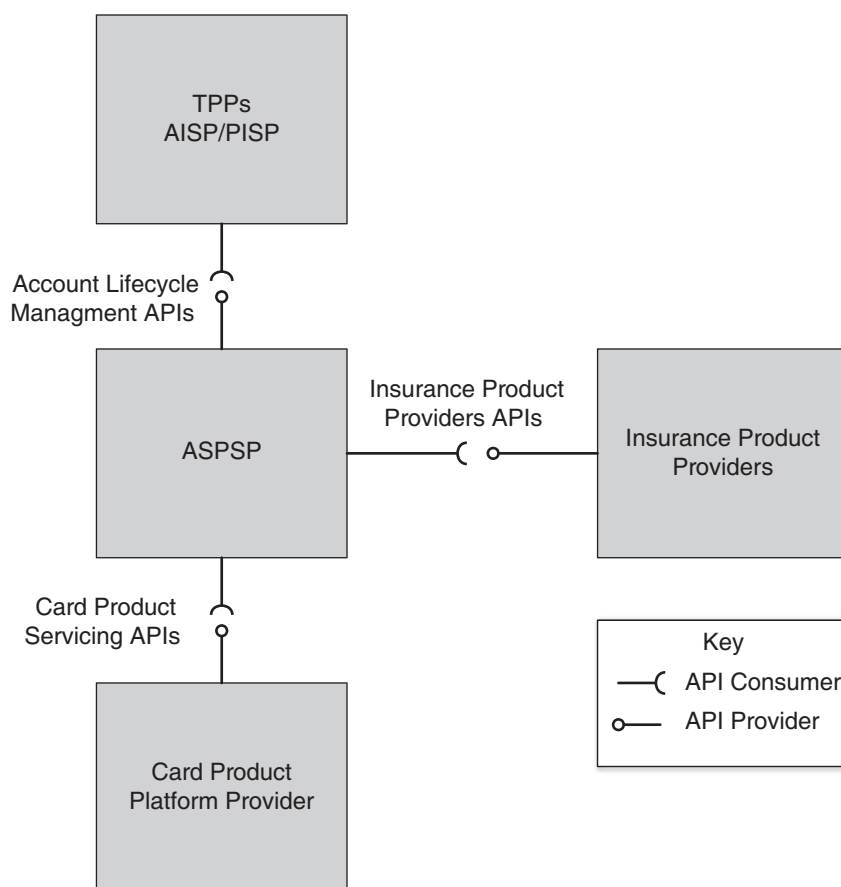


Figure 5: Layer 2 example partners and API interfaces

Table 5: Open banking business models

Business model	Overview	Examples
Aggregator	Provides a convenient interface to view and service multiple accounts possessed by a PSU	Runpath, Yodlee, Yolt
Money Manager	Analyses account balance and transaction information to provide value-add forecasting and account sweeping services	Emma, Moneyhub, Money Dashboard, Tandem, N26
Neobank	A direct bank that is 100 per cent digital and reaches its customers via mobile apps and personal computer platforms rather than physical branches	Monzo, Atom and Starling

The open banking model allows for a different implementation of a neobank in that they no longer need to be an ASPSP. Rather, they can act as an AISP/PISP and consequently utilise an underlying account provided by an ASPSP. In this context, the customer's interaction with banking services is via the TPP's application and not the ASPSP's.

In this context, digital account opening is considered vital for the neobank business model, whereby a customer may be attracted to a TPP offering but not yet have an existing ASPSP account. In these circumstances, the TPP could leverage a partner relationship with a preferred ASPSP to initiate the account opening via an API. This approach could also be considered to lower the barriers to entry for the adoption of third-party services, as an alternative manual process for account opening could take many days or weeks to plan and organise, particularly if a branch visit were required. Digital services for performing immediate identity checks, such as those provided through GOV.UK Verify (eg Experian and the Barclays Identity Service), are already available and these could be incorporated as part of the account opening know-your-customer (KYC) checks.

Low barriers to entry for TPPs are a key mantra for the implementation of PSD2, so the significance of the account opening API is highlighted as being particularly relevant for a fully functioning and effective open banking API ecosystem.

Aggregators use account information to suggest alternative or complementary financial products for a customer. For the case of complementary products, again, digital account opening API services without compromising legal KYC requirements would be vastly beneficial to TPPs, for example to open a savings account recommended to a customer by an aggregator service. This capability would enable the TPP to add value through immediacy of action and the automation of the switching process, relieving

the customer of potentially time-consuming manual activity.

Similarly, for alternative personal current account products, the ability to digitally perform an account switch to a recommended product would be greatly beneficial. It is easy to envisage an API to initiate a switch request. The ASPSP would then manage the request using the established ASPSP to ASPSP process for switching. In the UK, the Current Account Switching Service (CASS) provides this capability; in the EEA, however, such capability is immature.

APIs that enable wholly digitised services would strengthen the product offering of the third parties by enabling immediacy of action and automation of the necessary steps in a 'one-stop shop' style service. This in turn will help to gain wider adoption of the open banking model.

Retail banking — Bundled insurance products

An established retail account product trend has been to bundle a number of complementary products with the underlying personal account product. In this context, typical complementary products are insurance product oriented and include:

- travel insurance;
- mobile phone insurance; and
- breakdown cover.

From an ASPSP perspective, APIs offered by third parties providing such insurance products would facilitate the creation and management of these complementary products via wholly digital processes, on the basis that the providers were business partners of a given ASPSP. These APIs would fit into Layer 2 of the ecosystem model.

Similarly, it is conceivable that TPPs in the form of neobanks could provide a new generation of bundled personal account products. In this respect, collaboration between the neobanks and the third-party

insurance product providers would also take place and operate within an ASPSP's own private Layer 2 API sub-ecosystem.

Wholesale banking — Cash management

Banks typically partner with third-party organisations for the delivery and collection of cash from ATMs, and branches. In this respect there are existing interfaces between the bank and their providers for cash services for:

- submitting cash orders to a partner organisation for fulfilment; and
- submitting fulfilment information from the third party to the bank for use in reconciliation.

It is conceivable that in the future these interfaces will be implemented using APIs. There are multiple drivers for this, including:

- to conform to the bank's technology policy for integration;
- to achieve economies across the bank of scope by standardising the technology for all external interfaces; and
- to avoid of costs associated with specific proprietary middleware.

For these APIs, consider the approach to standardisation. From the bank's perspective, a standard API specification would be beneficial as this would provide:

- consistency and simplicity of order processing and reconciliation services; and
- ease of substitution of providers as providers could be swapped without incurring the switching costs associated with implementing different provider interfaces.

From the cash service provider's perspective, the exact opposite may be true, and they would be more inclined to support a proprietary standard to enable an interface to be precisely tailored to their service

offering and also to keep switching costs high.

Retail banking — Card platform provision

Another example in the retail banking space is credit card platform provision. This service is often outsourced to a third-party provider as a business service. Another scenario is that there is no business outsourcing, but the card platform is hosted by a third party. The latter is of increasing relevance as the provision of product platform and core banking engines are moved to cloud infrastructure and provided as software as a service (SaaS). There are similar interfacing considerations in both scenarios.

From a traditional banking model perspective, a number of interfaces are typically necessary to support this approach. Furthermore, as credit cards are deemed to fall in scope of PSD2, interfaces to support the additional open banking use cases could also be provided. The essential interfaces are highlighted in Table 6, but this is by no means definitive.

These interfaces are candidates for APIs that would fit within Layer 2 of the ecosystem model. As per the discussion on Wholesale banking — Cash management, similar arguments for and against the standardisation of such interfaces are relevant. It is difficult to envisage that traditional banking services vendors will develop and adopt open standards for the specification of such APIs. On the other hand, with the open banking model, there is stronger case to adopt a standard interface specification as defined by one or more of the standards initiatives — UK Open Banking, the Berlin Group or STET. Provision of 'out of the box' regulatory-compliant services by the card platform SaaS vendor could be a positive differentiator.

LAYER 3 APIS

Layer 3 APIs are positioned to support a broader set of business services within an

Table 6: High-level candidate API services

<i>Traditional banking model</i>	<i>Description</i>
Pay/no-pay decision	Real time decision to support a POS payment
End of day scheme payments file processing	Processing ofVISA and Mastercard end-of-day files to apply payments to accounts
Statement provision	Monthly statement generation
Balance payment	Receipt of a payment to pay some or all of the account balance
Chargeback	A return of money to a payer. A chargeback reverses a money transfer from the consumer's credit card account. Typically, a chargeback occurs when a credit card holder disputes a charge and the transaction is reversed as a remedy for billing errors or fraudulent purchases.
<i>Open banking model</i>	
Balance enquiry	The current balance on the account
Transaction history	Enquiry on the set of account transactions
Account information	Metadata about the account

entire industry domain. Business services that are relevant relate to those provided by additional actors, such as the ombudsman and the regulator. For example, in the case of financial services in the UK, this would imply the Financial Ombudsman Service (FOS) and the Financial Conduct Authority (FCA), the latter being the regulator. Additional actors in this domain may include the Competition and Markets Authority as the arbiter of fair competition and the sponsor of the CMA Order, a key driver of the open banking philosophy.

In terms of these actors, potential API services provided are highlighted and discussed in Table 7.

SUMMARY

A layered model for the open banking API ecosystem has been introduced. This provides a convenient categorisation of the types of API services that may become prevalent in an open banking ecosystem. This model has been used to explore the likely growth of the open banking API ecosystem and its extension into other industry vertical domains.

In Layer 1 of the model, a variety of API candidates were identified that provided enhanced market infrastructure services while addressing a number of gaps in the regulatory initiatives, notably PSD2. Without these additional, ‘value-add’ services, it difficult to see the wide market adoption of open banking services as envisaged by PSD2. In this respect, APIs to support directory services have been highlighted that provide centralised services for ascertaining participant authorisation status and other information, such as details of the legal entity and its branding. In particular, there remain barriers to a pan-European open banking model due to the lack of a single unified API standard. This is likely to result in local market clusters within which common standards are applied. To address

such misalignment of standards across such clusters, additional market infrastructure enhancements such as integration brokering services may become relevant. It is too early to say if there are commercially viable models to support these services and achieve a truly pan-European or even a global open banking service.

Layer 2 of the model supports private API ecosystems between ASPSPs and their business partners. The uptake of Layer 2 APIs is not strictly dependent on the success of Layer 1 API services as it is decoupled from regulatory standards and market infrastructure. In this layer, proprietary standards and closed accessibility, rather fully open standards, will be prevalent. A number of examples of functional value-add services have been provided but it should be recognised there are no constraints on the type and volume of such APIs. Indeed, wherever an ASPSP has an existing interface with a business partner, these can be considered as candidates for APIs.

Layer 2 is expected to be a huge area of growth within the open banking ecosystem as ASPSP partners, in the form of vendors and outsourced service providers, increasingly employ the advantages of cloud infrastructure and switch to SaaS style offerings for their product platforms or service offerings. Consequently, the need for ASPSPs to provide a directory service to manage the identities and access rights of the Layer 2 ecosystem participants has been identified and is a key enabler for a wider ecosystem, beyond the regulatory minimum.

Layer 3 of the model has highlighted API candidates required to support a mature vertical industry domain. The ecosystem has been extended to include new participants, notably a markets competition regulator and an ombudsman, and the types of API interfaces between these market actors explored. Other industry vertical domains, such as insurance and ‘life and pensions’, are expected to adopt analogous models to open

Table 7: Industry participants and API interface candidates

<i>API provider</i>	<i>API consumer</i>	<i>API service description</i>	<i>Purpose</i>
FCA	ASPSPs Value-add information reseller, eg Open Banking Europe	An enquiry on the register of authorised participants.	To inform the ecosystem participants of the status of authorised participants in a timely manner.
ASPSPs	FCA, CMA	Raw data to support the production of management information.	Management information is important to monitor the performance of the ecosystem and for continued assessment of compliance of the actors against the regulation.
FOS	ASPSPs PISPs AISP _s	Support for submission of information relating to complaints from customers such that they can be fairly arbitrated in the event of other participants failing to agree a satisfactory outcome.	Digitising the processes for complaint resolution will improve service levels relating to the timeliness of their resolution and in turn provide consumer confidence in the open banking ecosystem.
FOS	ASPSPs PISPs AISP _s	Raw data to support the production of management information detailing statistics for complaint submission and resolution.	Monitoring the effectiveness of the complaints process is vital to ensure the processes are optimal and to ensure consumer confidence in the ecosystem.

banking in the very near future. The same API ecosystem development issues identified here for open banking are considered just as relevant for these other domains.

AUTHOR'S NOTE

Thanks are due to Peter Davey for discussions relating to the ideas in this paper and to Will Hall for draft manuscript reviews.

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