The Payments Hub Spectrum: A model for the design of payments hubs

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ABSTRACT

Recent events in the financial sector have given a high profile to financial services governance. In the area of payments, there is a need to provide transparency and traceability of monetary movements. Other changes in the market environment include the strengthening of regulations and the introduction of new euro zone payments frameworks. The credit crunch further highlighted the need to monitor systemic risk exposure associated with settlement — especially for the major clearing banks that process payments for their agency banks. This paper describes a specialised IT component — the payments hub — and the design considerations in meeting the current payments industry business drivers. A conceptual model of a payments hub is introduced and its business benefits described. The functional capabilities of a payments hub are presented, categorised into three areas: process services; business services; and integration services. The technical justification for a hub is presented, highlighting its role in reducing integration complexity and in supporting modernisation initiatives within a bank. The 'Payment Hub Spectrum' is introduced, describing an ordered range of functional services. Depending on the specific business needs of a bank and its underlying IT systems landscape, these are shown to dictate a functionally light or a functionally rich payments hub. The business and technical factors affecting the position on this spectrum are highlighted. In conclusion, the Payments Hub Spectrum is shown to be a useful model for solution analysis, informing the architectural decisions on technology choice and on the apportionment of payments processing capability between the key collaborating components.

Keywords: payment services hub, payment hub design, payments integration, liquidity management, payments capability model

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PAYMENTS HUB OVERVIEW

Figure 1 shows a context diagram of a

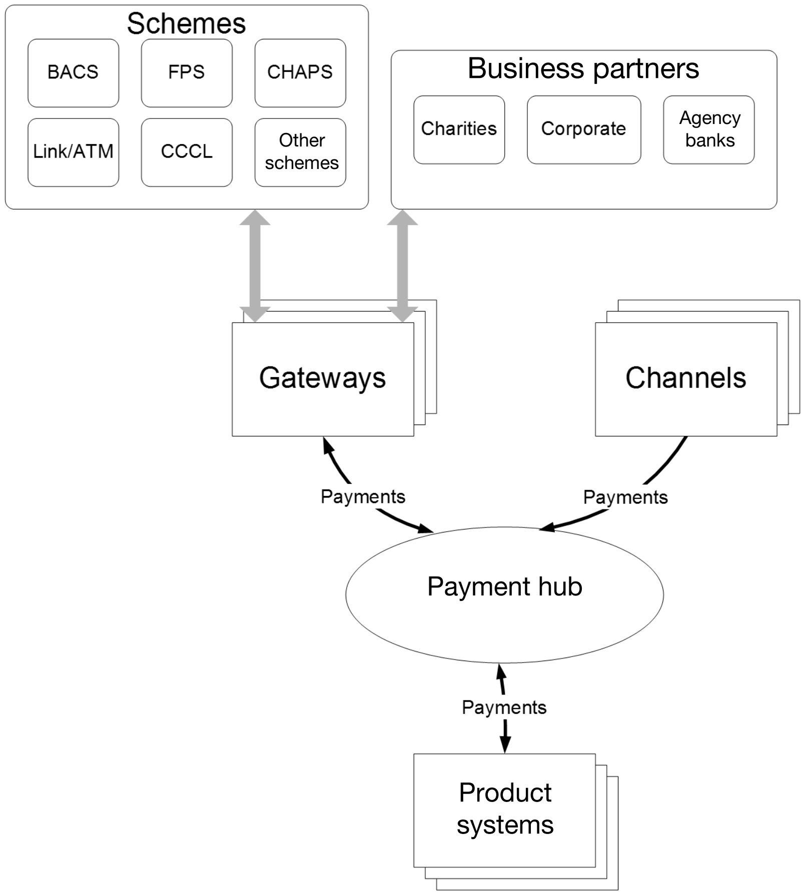


Figure 1
Payments high-level system overview

payments hub at a conceptual level. Subsystems that interact with a payments hub are:

- *Product systems:* these systems domicile the banking ledgers that are the source and destination for payments.
- *Channel systems:* these systems support the customer channels through which payment services are offered. These typically include: branch; Internet; and telephony. In the future, it is expected that new channels such as mobile payments, will be introduced.[1]
- *Payment gateways:* these constitute the gateways to the various payment schemes.

Electronic payment instruments are received from and sent to the schemes and business partners in a variety of industry formats.

Capabilities

Consider a service-oriented architecture (SOA) perspective applied to payments processing. Using a simple layered reference model for SOA,[2] a payments hub can be considered to provide three major categories of service capability:

(i) process services;
(ii) business services;
(iii) integration services.

The combination of these different service types infers that a payments hub is a complex, 'compound' component spanning three architectural layers. Since the hub supports these three different service types, a single, product mapping is difficult to achieve. Rather, a combination of software packages and middleware products is typically required.

A payments hub contains a variety of detailed functional capabilities, each categorised into one of these three types. Furthermore, it is shown that specific capabilities may be apportioned across the other high-level architectural components, ie product systems and gateways. The exact capabilities required and their apportionment are always uniquely dependent on the specific business and IT scenarios within the bank.

Process services

Payment process services relate to the control of processing for the completion of inbound and outbound payments requests. A payments hub fulfils the role of the 'process services' layer in SOA. It will typically offer coarse-grained payments service, these being themselves composed of several, finer-grained services provided by a SOA 'business services' layer. In this way, the systems processing necessary to realise the value chain[3] of a payment can be achieved.

Given its role in coordinating fine-grained business services, the hub is also the sub-system best placed to provide a view of the state of a payment as it progresses through its value chain. The granularity of the services orchestrated in turn determines the number of state transitions defined.

Business services

A payments hub, potentially, gives visibility of all payments into and out of a bank. On this basis, it is considered the system component that is best placed to provide some specialised business services. These include

- liquidity monitoring;
- liquidity information provision;
- scheme cap monitoring.

A payments hub can thus track debit and credit payment value, and accumulate and maintain a net settlement position against each of the schemes. Related to this, the payments hub may also provide information services for enquiring on and reporting the liquidity position.

There are several business benefits associated with undertaking such activities, and these are described below.

Integration services

Payments processing requires significant integration capability to connect the scheme gateways and the product systems. In this respect, a key role of the payments hub is to receive all inbound and outbound payments and perform:

- routing to and from the requisite product systems and gateways;
- transformation of the payments messages into an appropriate format for processing by the schemes, product systems and the bank's business partners.

This infers a requirement to support all bank payments volumes. Similarly, owing to the critical nature of payments processing, non-functional characteristics of a payments hub are high reliability and robustness to systems failure.

Justification for payments hubs

This section provides the business and technical justification for the payments hub architectural component. The justification is irrespective of any specific vendor technology selection.

Support for core banking modernisation

A common banking scenario is the replacement of heritage product systems

Table 1: Example product migration roadmap for a UK clearing bank

Product system	*As is 2008*	*Release 2 2009*	*Release 3 2010*	*Release5 2011*	*Release 6 2012*
Heritage Retail	■	■			
Heritage Corporate	■	■	■		
Heritage Insurance	■	■	■	■	■
Heritage Mortgages	■	■	■	■	
Treasury	■	■	■	■	■
Heritage Credit Cards	■	■	■	■	
New Retail		■	■	■	■
New Corporate				■	■
Acquired Mortgages					■
New Credit Cards					■

with a new core banking engine. The phasing out of the heritage product systems and the phasing in of the new core banking product system over a defined timeline are illustrated in Table 1, for an example modernisation programme.

A further common scenario is a merger with or acquisition of another financial services organisation. This infers the inheritance of additional product systems (in the example shown, an additional mortgage product system). Realisation of a given bank's business strategy may necessitate future mergers/acquisitions. Hence, providing an architectural capability to support efficiently the integration of more product systems in the future is considered good practice.

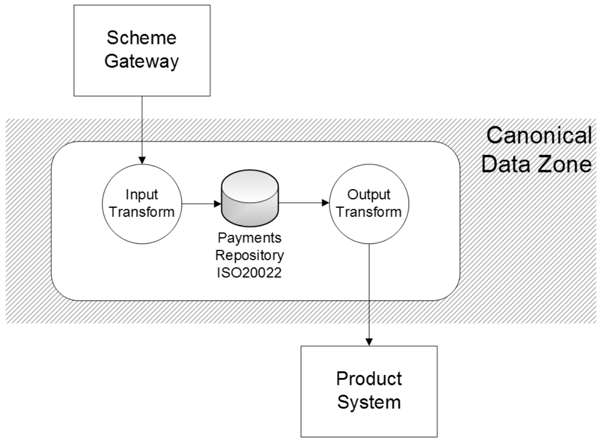
From Table 1, it can be seen, even at the end of the modernisation programme, that there is still a requirement to support multiple product systems. This infers a long-term role for a payments hub, rather than a transient role supporting the duration of the modernisation programme only.

Payments integration complexity

A payments hub solves the classic integration problem of reducing the number of point to point integrations required. The complexity of the integration between the schemes (*S*) and the product systems (*P*) is a well-known $S \times P$ problem. Simplistically, introducing a payments hub, through which all scheme and product system connections are made, reduces this to an $S + P$ problem.

In practice, the scheme integration complexity is lower, as not all schemes connect to all product systems. This reduction, however, is partly offset, as the integration complexity associated with certain schemes is very high (eg UK Faster

Figure 2 Commonality of processing in a SOA process services layer



Payments) and duplication of integration effort is not desirable. Any large bank will typically maintain multiple product systems, and so there is a strong justification for a hub purely on the strength of its integration role alone.

Data management simplicity

Another benefit of the payments hub is that it can reduce the complexities associated with master data management of certain reference data. Examples of reference data include:

- *Industry Sort Code Directory (ISCD).* This consists of a database of meta-data about all the bank/building society branches and bank offices that participate in one or more of the UK clearing systems. These data are necessary to validate destinations for payments and to determine the characteristics of the destination, such as the ability to support a given scheme.
- *Internal routing tables.* These data equate to bank-specific information as to which IT systems accounts are domiciled. This allows inbound payments to be routed to the correct product system and posting applied accordingly.

In the conceptual model presented, the payments hub is the central point for routing of payments. It may also have a similar, centralised role in validating inbound and outbound payment messages. These capabilities require the reference data described above.

In this respect, adopting a payments hub architectural style allows for the reference data required by these capabilities to be deployed once only (or at least a significantly reduced number of times), greatly simplifying the master data management problem.

Architectural simplicity

Architectural simplicity can potentially be achieved through commonality of payments processing across payments schemes (Figure 2). Key to this is the manipulation of the payment in a common data format. In this respect, processing proceeds by first transforming the payment into a common data representation. Once in this 'canonical form', a common service can then be performed on a payment, irrespective of its scheme origin. While, overall processing steps for a payment from a specific scheme may be unique, this approach allows reuse of common processing steps across schemes.

Upon completion of this generic processing, the payment may then be trans-

Table 2: Payments modernisation benefits and enabling capability of the payments hub

Customer benefit	*Description*	*How*
Latest payment processing features	Customers can benefit from improved speed to market of future payments initiatives.	Changes to the heritage product systems are made difficult by the lack of documented code and are constrained by rigid release cycles. These factors lengthen the delivery cycle. By decoupling the product systems from payments functionality, any changes required for new payments initiatives or for regulatory compliance are less extensive. The use of specialised middleware in the implementation of a payments hub allows new message types and schemes to be introduced rapidly.
Consistency of service	Customers (including bank back office) can benefit from a single consistent payments service supporting all schemes. The customer is shielded from complexities of scheme simplifying the customer experience.	The payments hub leverages commonality in payments processing. This enables consistency in the way that payments data is captured in the channel, providing a unified and simpler customer experience. Common payment processes and services will be incorporated into payments processing increasing consistency of service. Eg: • data validation services; • payment submission service; • scheme independent Fraud checking; • anti-money-laundering checks.
Improved transparency	The completion of large financial transactions by customers is very important and can often lead to stressful situations. For example, a customer may be making a major purchase and wish to know that transfer of credit has completed. The provision of information relating to the status of their payment information can reassure customers that a payment has been concluded. This is of great benefit in reducing uncertainty and stress.	The payments hub has visibility of payments and monitors of the state of a given payment. The payments hub can expose services to specific channels (CRM, e-banking) to support enquiries on the state of a specific payment request. The importance of particular sensitivities (such as quarantine of potentially fraudulent transactions) is recognised. Such enquiries will therefore be sensitive to the specific reasons for any delay to payments processing.

Table 2: Payments modernisation benefits and enabling capability of the payments hub (continued)

Customer benefit	*Description*	*How*
Reliability of service	Customers will benefit from a robust and reliable payments processing service. Given growth in digital channels, payments services must operate on a 24-hour basis, supporting payment requests outside nominal banking hours.	The payments hub IT architecture should: • operate continuously • not permit any loss of payments instructions • not permit duplication of payment messages across all payments schemes • provide validation of payment instructions to reduce the likelihood of payments errors.
Internal customers Monitoring of liquidity position and risk exposure	Treasury can benefit from timely and accurate information on the bank's settlement position against each scheme. This allows the bank to monitor exposure against a particular scheme and pro-actively manage deferred net settlement risk.	The payments hub is the single component that has visibility of all payments into and out of the bank. It is therefore best placed to determine the bank's financial position against a particular payment scheme.
Scheme cap monitoring	Payment operations benefit from being alerted to situations where the settlement position is nearing scheme cap limits. In this way they are able to closedown payments for a particular scheme in a controlled way. Payments are diverted to another scheme, continuing customer service. This also prevents a bank from exceeding the scheme cap limits with associated disbenefits.	The payments hub may perform scheme cap monitoring and is able to provide information services relating to the scheme position relative to the cap.
Reduced operational errors	The bank's internal payments operation will benefit from reduced errors and higher straight-through processing, improving efficiency within the operation.	The payments hub promotes commonality and automation of payments processing. This simplifies payments processing, in turn reducing operational errors, improving efficiency and overall service quality.

formed into a specific format suitable to the target sub-system. A design objective of 'develop once reuse many times' is achieved, which can greatly simplify payments processing.

Customer benefits

The benefits of a payments modernisation approach provided by a hub are captured in Table 2. The role of the payments hub in enabling the benefits is also described.

Figure 3 Payments capability model

Two categories of customer are observed:

(i) *Bank external customers:* These are the retail and wholesale customers of the bank.
(ii) *Internal customers:* These are actors internal to the bank, for example, the payments operations team and treasury.

THE PAYMENTS HUB SPECTRUM

Capability model

The functionality required to undertake payments processing is illustrated in a capability model. The model illustrates the payment domain functions in a technology and vendor-neutral way. Subsequently, it is shown that there are many options for apportioning capabilities between the key payments sub-systems (Figure 3).

The model distinguishes between the realised capabilities and capability facades — calls to external components. The latter are considered equally important, as they relate to a design decision as to the point of control where the underlying capability is called. For example, a complex underlying capability may be realised by an external component, but its services may be called from either the payment hub or the product system. It is the placement of the call to the capability that is significant in the design, and therefore the model reflects such service call placement considerations.

An overview of the capabilities in the model is now provided.

Account Posting (facade)

This capability represents the ability to update a product system account. Ultimately, the service must be provided by the product system itself. A key design issue is whether the posting service is called by the payment hub as an internal service of the product system or indirectly through another component facade.

Account Validation

Account Validation refers to the capability to validate the existence of accounts. Successful validation of the account may provide the type and status of the account. Failure to validate the account will typically lead to the rejection of an inbound credit and a return of the payment to the scheme.

Almanac

The Almanac represents the collection of meta-data relevant to support the interaction of the bank with its payments scheme providers.

The meta-data include, for example:

- scheme daily operating times;
- scheme non-operating days;
- public holidays.

Diary Management

The Diary Management capability is dependent on the Almanac. Given the meta-data defined in the Almanac, the Diary Management capability uses these data to determine specific diarised events on a given day. For example, the schedule of inbound and outbound payment files expected within the operational working day. The schedule can be used in turn to generate alerting mechanisms should, for example, a file not arrive from the scheme or be ready to send to the scheme at the diarised time.

Fraud Service (facade)

The Fraud Service is generally complex, fulfilling regulatory requirements relating to fraud detection. This capability represents the ability to call the Fraud Service. As with the Account Posting capability facade, this represents a service call placement issue.

AML Service (facade)

The Anti-Money Laundering (AML) Service is also complex, fulfilling regulatory requirements relating to anti-money laundering. This capability represents the ability to call the AML Service. This is also a service call placement issue.

Enrichment

This capability refers to the enhancement of the payment instruction with additional data to enable value-added services to be performed by the bank. An example of this relates to collection accounts. The Enrichment provides for the original collection account number to be propagated with the payment instruction to the target product system. If there is subsequently an issue with the posting of the payment, the original collection account number is still available in the payment instruction for use by the payment business operation in problem analysis.

File Validation

This capability refers to format validation, against an industry specification, of inbound and outbound bulk payment files, eg Bankers' Automated Clearing Services (BACS) Standard 18 file validation.

Funds Control (facade)

Funds Control refers to the capability to assess the funds available to fulfil the payment, resulting in a pay/no-pay decision. Funds Control checking must take into account intra-day payment commitments and associated fund reservations on a customer's account. In the case of a retail customer, this is generally a relatively simple assessment. In the case of a corporate customer, this may become more complex, with Funds Control assessment taking into account a net funds position determined from several accounts and perhaps an agreed collateralised credit line.

Intelligent Payments Routing

Intelligent Payments Routing refers to the capability to select the most appropriate method of payment based on general, customer-defined characteristics of a payment. Typical characteristics include cost and speed.

Such selection may also take into consideration other factors such as scheme limits on settlement exposure against the scheme. If the scheme limits are being approached, the Intelligent Routing capability may discount that scheme from the selection process. This approach is preferable to exceeding the scheme limits, which would result in the closure of the scheme to payment submissions.

Liquidity Monitor

The Liquidity Monitor refers to the capability to accumulate the bank's settlement position against the scheme. In the simple case, this may be achieved through a summation of inbound and outbound payment value. More complex liquidity monitoring may involve matching of notices (eg Society for Worldwide Interbank Financial Telecommunications (SWIFT) 210 matching).

Message Validation

This capability refers to the format validation of inbound and outbound payment instructions for message based payment schemes, eg SWIFT messaging for Clearing House Automated Payment Systems (CHAPS) payments.

Mandate Management

Mandates refer to both standing order mandates for outbound credits and direct debits mandates for outbound direct debit instructions or inbound direct debit validation. The Mandate Management capability refers to the creation, maintenance and execution of such mandates.

Payments Repository

The Payments Repository is provided to enable a store and forward paradigm. An example is the ability to store future-dated payments until the scheduled payment date. An outbound payment is held until the future date is reached, when it subsequently is released to a scheme. Payments should be held in the preferred canonical data form until their validity date and then converted into the selected scheme-specific format on creation of the payments instrument.

Repair

The Repair capability refers to an ability to repair payment instructions and hence improve 'straight-through processing' rates. A repair may relate to simple formatting repairs, eg the removal of white space in the account number. It may also refer to more advanced repairs, eg the lookup of a disused sort code/account number and its mapping to a successor.

Routing

This capability refers to simple payments routing, which consists of two main activities:

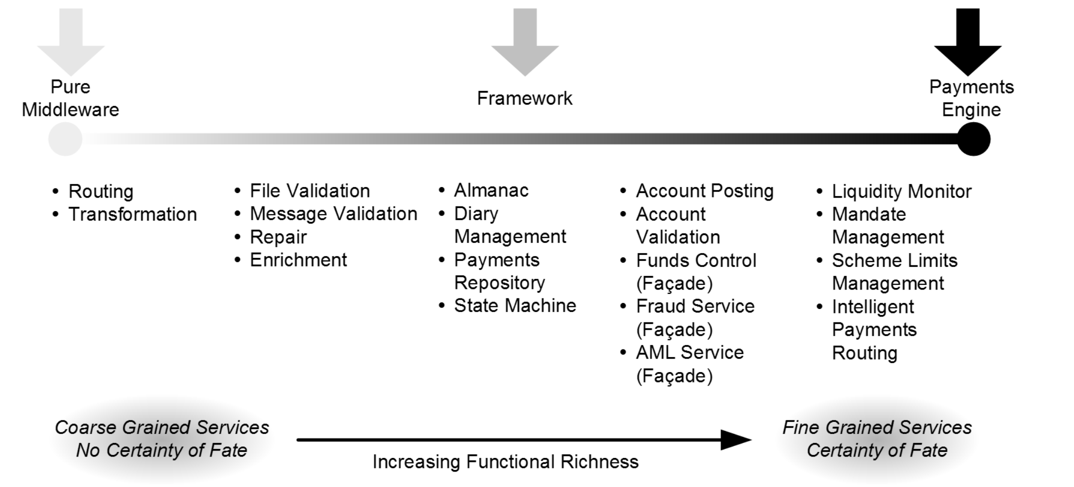
(i) destination determination;
(ii) logical routing of the payment based on the derived destination.

The Routing capability requires ISCD data and also IBAN reference data (depending on schemes supported).

Scheme Limits Management

Limits refer to the maximum allowable size of the bank's exposure to the scheme. Above the scheme limit, payments submitted to the scheme will be rejected. Exceeding the scheme limit may result in a loss of service for a customer — they will no longer be able to use that scheme to fulfil their payments. It is desirable to

Figure 4
Payments Hub Spectrum



achieve a more graceful degradation of service as the scheme limit is approached. In this respect, the Limits Monitoring capability enables this by totalling the bank's exposure to the scheme. When the limit is approached, within a certain tolerance, this can trigger an alert to the bank's payment operation.

State Machine

The State Machine is a technical capability which enables the status of a payment to be specified as it progresses through its value chain[3] until *certainty of fate* is accomplished. A State Machine is a well understood capability, but in this case it must specifically reflect the specialised events and states that occur in payments processing within the organisation.

Transformation

Transformation refers to the capability to transform payment instructions from one data representation to another. This capability is essential for transforming scheme-specific formats into the organisations' preferred canonical data form.

The Payments Hub Spectrum defined

The Payments Hub Spectrum constitutes the range of potential capabilities with the capabilities ordered, loosely, by increasing functional richness. This is illustrated in Figure 4, showing the placement of the capabilities from the model within the spectrum.

A hub design at each of the extremes of the spectrum will have significantly different characteristics. The factors affecting the positioning of the hub design on this spectrum are now discussed.

DESIGN ISSUES

This section discusses some key issues for consideration in the design of a payments hub. The issues identified are discussed in terms of how they influence the positioning of the hub on the defined spectrum.

Service granularity

Service granularity relates to the coarseness of the services orchestrated by the payments hub in processing a payment. The following design characteristics are observed:

- Service granularity becomes finer grained at the right-hand side of the hub spectrum shown in Figure 4. This

side is termed the 'high-frequency' end of the spectrum, as a relatively high number of fine-grained service calls are expected.
- Conversely, service granularity becomes coarser at the left-hand end of the spectrum. This side is termed the 'low-frequency' end of the spectrum on the basis of a lower number of coarse-grained service calls.

Consider a simple illustration. If the target product system is rich in capability, there are few services for the hub to coordinate. The interactions of the hub are few and are typified by a single coarse-grained service call to the product system — effectively a handoff of the payment for processing by the product system. The hub positioning is therefore at the left-hand side of the spectrum.

If the hub contains the capability to fulfil or orchestrate certain steps in the value chain, the product system is effectively tasked to perform much finer-grained services. For example, an inbound debit requires that a Funds Control check is performed. If the result of the check indicates funds are available, the debit may then be posted to the account. This supports the premise of finer-grained services towards the right of the spectrum.

Certainty of fate

Certainty of fate refers to knowledge of the outcome of a payment, ultimately identifying the account to which the payment was posted (or other outcome). The extent to which certainty of fate is known by the hub is determined by the service granularity.

Consider the principle that the payments hub is the single system with full visibility of the payment processing states. This is perhaps a desirable goal, but may not be achievable, and a factor affecting this is the service granularity. If a hub model towards the left of the spectrum is adopted, a coarse-grained service model is inferred. Visibility to the hub of the internal payments processing steps by the product system is not likely, and knowledge of certainty of fate therefore lies with the product system.

In a model towards the right-hand end of the spectrum, finer-grained services are prevalent, and full visibility of the processing steps is more likely. Knowledge of certainty of fate within the payments hub is therefore more achievable in this hub model.

Technology selection

Figure 5 shows the mapping of portions of the hub spectrum to the suggested optimal technology selections. For each spectrum portion, the characteristic features of the technology are highlighted and the advantages and disadvantages of its selection. Some example technologies are given within each defined portion, but this is illustrative and not exhaustive.

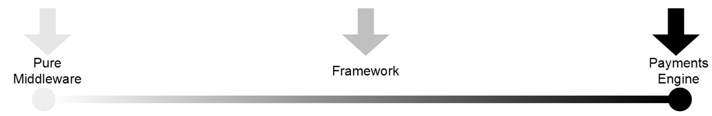
Low-end segment

The low end of the spectrum is considered well suited to pure middleware technology implementations. Functional processing by the hub is simple or lightweight, as business services are provided by the product systems (or other components). In these circumstances, there is little or no business functionality to build, or it is considered practical to build the functionality of the simpler business services in the base middleware technology, perhaps supplemented by a procedural programming language.

Mid segment

In the middle segment, functionality is richer. A pure middleware solution in this portion of the spectrum may require significant enhancements to base functional capability. Given the richer functionality

Figure 5 Technology mapping of the hub through the spectrum



	Middleware	Framework	Engine
Features	Pure middleware product supporting messaging/ transformation Stateless	Pre-build sub-flows, Payments Repository, Scheme transformations, Stateless/full Grey box component	Pre-built scheme level processing Black box component, Stateless/full
Advantages	Low technology cost Relative low cost	Standard based, Modular	Low implementation cost if implementation 'out of the box'
Disadvantages	Building enhanced functions is costly	Customisation can still be extensive	Customisation cycle slow Black box component High product cost
Examples	IBM MQ/Message Broker, Oracle (BEA Weblogic)	IBM Enterprise Payments Platform, Clear2Pay, Dovetail	Fundtech GPP

specified in this portion of the spectrum, it is considered less cost effective to provide this via custom build. It is more effective to start from a position of some base functionality. A payments framework technology solution therefore becomes more cost efficient in this portion of the spectrum. For example, the framework technology may already be provided with an 'out of the box' State Machine capability and with pre-built transformations for some scheme-specific formats.

High-end segment

In the high end of the spectrum, functional capability is richer still and broader in scope, containing all process, business and integration capabilities. The scale of the customisation, even for a framework solution, may make this particular technology selection less cost effective than for the mid portion of the spectrum. A full payments engine package solution may offer:

- a richer set of pre-configured transformations;
- 'out of the box' advanced components, such as a Liquidity Monitor;
- pre-build processing flows for specific payment instruments.

For these reasons, a full package solution may become more cost effective at this end of the spectrum.

Canonical data zone

Industry-standard formats are important, as they are required by a scheme to support routing of payments between banks. A selection of relevant industry standards used within payments processing is shown in Table 3.

A significant issue in the design of payments processing systems is considered to be the selection of the data standards for the representation of the payments instruments, as they progress through processing stages in the various system components.

Table 3: Sample data standards in payments processing

Data standard	*Description*	*Type*	*Classification*
SWIFT	Standard for SWIFT Fin payments processing	Closed	*De facto*
UNIFI (ISO20022)	Standard for non-realtime payments	Open	*De Jure*
ISO8583	Standard for near-realtime payment instructions	Open	*De Jure*
APACS Standard 18	Standard for BACS processing	Closed	*De facto*

An obvious design approach would be to select one or more of the industry standards as the internal canonical data standard. Bank-specific business processes and the practicalities of the actual systems realisation, however, typically dictate that additional meta-data are required. For example:

- Head Office Collection Accounts (HOCA) processing — mapping of collection accounts to actual current accounts. It is necessary to retain the original HOCA sort code such that exceptions relating to subsequent processing can be handled manually. Payment operations personnel may need the original account data as a context to process the exception manually.
- Addition of technical meta-data is often required: for example, pertaining to the destination system, sequence numbering or prioritisation of the payments instruction to inform the middleware of how technically to route the payment.

The use of a canonical data form is critical to achieving commonality of the processing of payments and realise the advantages of architectural simplicity outlined earlier.

Other considerations of note are:

- BACS Standard18 to move to SEPA compliance and, by implication, ISO20022 data standards by 2014.
- Additional meta-data are generally required to enhance the original message received from a gateway.

In summary, there are technical and business reasons why a *de jure* payments standard is not appropriate as the choice of canonical data for use within a bank's payments systems. In practice, an extended version of a *de jure* standard is considered appropriate, this being unique to each bank.

Service placement issues

Account servicing

The centralisation of payments capabilities within the hub and the associated use of a canonical data model create opportunities to improve broader customer account servicing and internal operational activities.

One potential area of benefit is Enquiries and Investigations. This operational area within the bank is typically characterised by multiple enquiry systems, specific to a given scheme. This makes operational management overly complex, inefficient and unreliable.

Storing payments events in a hub 'operational data store' enables a single, centralised view of the state of all payments within the operation. Employing a canonical data model in the operational data store means these services can be used trans-scheme. These factors in turn allow unified, streamlined, services to be built to support customer enquiries and operational investigations, improving the quality and timeliness of the investigations.

Account portability

Account portability is the requirement for customers to be able to retain their account numbers when switching banks. Account portability requires that a standard format is used for the account number, this being eight digits in the UK. Currently, not all UK banks conform to this standard.

In heritage systems, the account number itself is quite often used as the database key in the product systems. A better design approach in general is to not use the business data as the database key. Thus, to aid portability, one must treat the account number as a data attribute and use a separate artificial key to identify the account uniquely.

For those UK banks that use a non-standard account number in the product systems, to conform to future account portability requirements, a mapping from standard account number to the heritage format must be provided. This mapping can be provided by the payments hub.

Similarly, even for standard account number formats, there may be benefit in identifying the customer key in advance of the payment hitting the products system or other components. Again, the hub is capable of providing this capability. Alternatively, this capability may be provided by an external component with the hub the central point of control of the lookup (as per the facade pattern previously discussed).

Payments origination

Payments origination refers to the capability to initiate payment instructions from the payment hub. Two scenarios are anticipated:

(i) The hub receives an instruction to create a payment from a channel system. For example, a customer via a self-service channel makes a request to initiate a payment. The hub then starts the processing to fulfil that request, controlling the services necessary to authorise the payment (eg Funds Control check), create the payment instrument and send to the appropriate gateway.

(ii) The hub enquires on the mandate database or receives notifications from the mandate database that a payment is to be made. Again, the hub starts the process controlling the services that ultimately result in a payment instruction (eg for an outbound credit) being created and sent to the payments gateway.

The key design consideration in both these scenarios is that the hub is the component that first receives the trigger to initiate the creation of the payment instrument. The hub then orchestrates the activities necessary to fulfil the creation of the instrument, notifying the initiating channel if a failure in a processing step occurs.

The design alternative for scenario (i) above is that the channel component interfaces directly with the product system, which performs the Funds Control check as an internal function and creates a formatted payment instrument.

The design alternatives for (ii) are that:

- A separate Mandate Management component interprets the daily payment schedule and creates all the payments instructions; this scenario is typical to many heritage systems.
- Mandate Management is a sub-component of the product system and the daily payments schedule is created by the product system; this scenario applicable to modern package solutions.

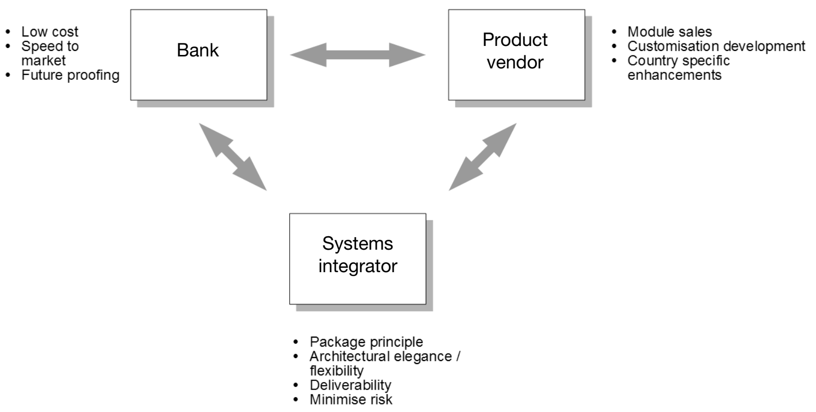


Figure 6 Architectural tension between payment hub stakeholders

These design alternatives infer a hub design that is towards the low-frequency end of the spectrum; while the former infers a hub that fits the mid-/high-options-frequency end of the spectrum.

AML/Fraud Check

Given its visibility of inbound and outbound payments, the hub is potentially a point of control of a number of regulatory and compliance driven services. Fraud, anti-money laundering and Financial Action Task Force (FATF) checks on the payments are such services, and these can all be initiated from the hub.

Furthermore, given its State Machine capability, the hub already has the ability to provide the state management of a payment arising as a consequence of the fraud, AML or FATF checks. A payment can be held in the hub Payments Repository pending resolution of investigation of a condition flagged by the fraud, AML or FATF services. Once investigation is complete, a release of the payment can be triggered by the Fraud/AML Service.

Traversing the spectrum

Figure 6 illustrates the tension arising within a payments hub delivery due to differing perspectives of the delivery partners. Three delivery partners are assumed — the bank, the product vendor and a systems integrator responsible for the delivery of the overall solution. The bank's perspective is a desire to reduce cost and achieve the business objectives: for example, reduced time to market. The product vendor perspective is a desire to achieve sales of modules, services development and local region enhancements to the base product. The system integrator perspective is a desire to achieve deliverability of the solution at low risk.

These perspectives each drive the placement of the hub on the spectrum in different directions, creating an architectural tension in the solution. Agreeing the precise capabilities and placement of the hub is a non-trivial task.

A decision to move to a different operating point on the spectrum can result in product/supplier reselection. Furthermore, the governance of the solution may have to be revisited if major architectural decisions are changed. Finally, compliance and risk checks may also need to be revalidated.

All these factors make a decision on positioning within the spectrum a difficult and time-consuming exercise.

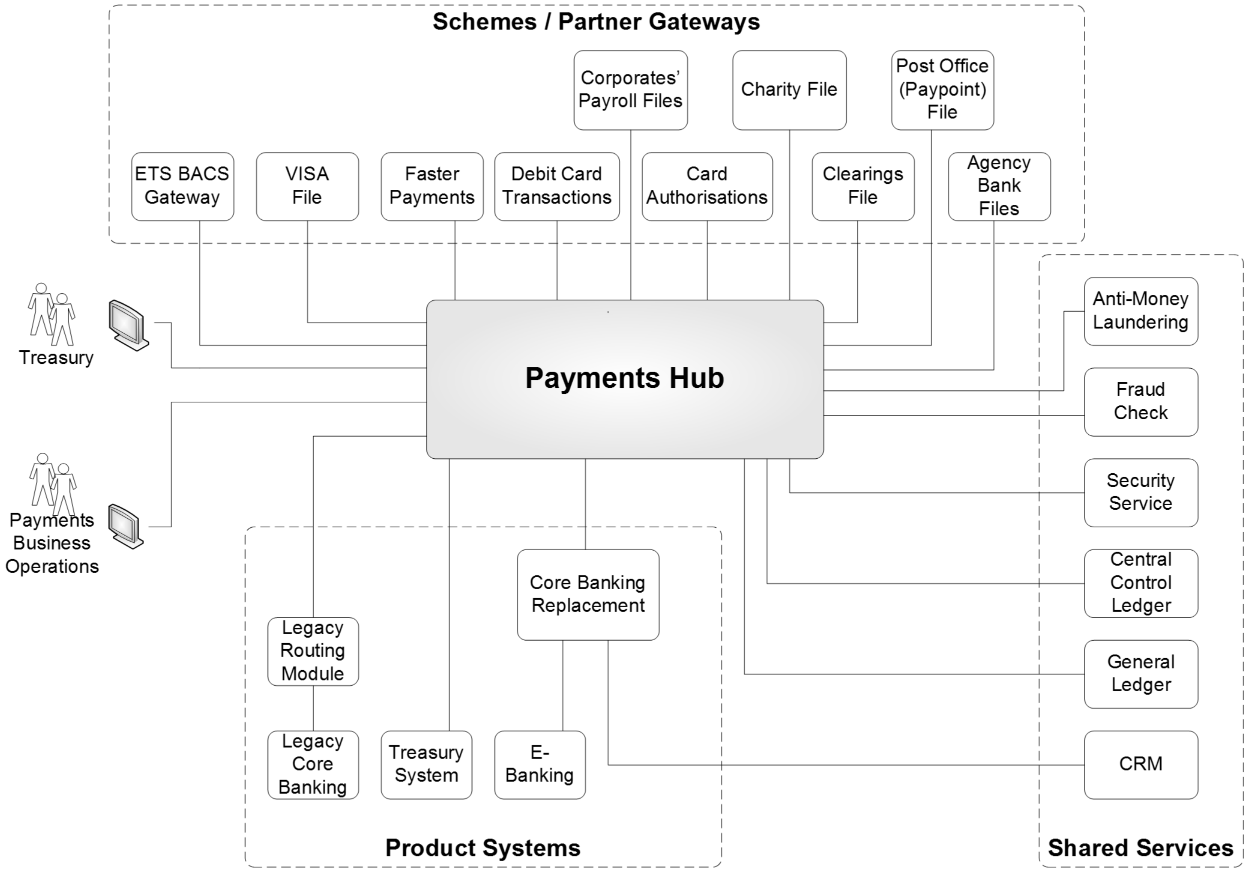


Figure 7 UK clearing bank payments hub architecture overview

CASE STUDIES

UK clearing bank

Context

This case study relates to a UK clearing bank undertaking a core product system replacement programme. The bulk of the bank's products were supported through a heritage system with the typical associated constraints, simplistically:

- unresponsiveness to market changes in the marketing environment due to constrained life cycle and deployment windows;
- 'knowledge monopoly' by an outsourced supplier managing the heritage application, further limiting ability to deliver timely changes.

The timing of the programme was soon after the financial liquidity crisis (the 'credit crunch'). Consequently, there was a heightened sense of concern relating to the risk exposure of the bank. This was further amplified because a large portion of its payments business was with agency banks. In this respect, the bank was making payments on behalf of many other banks, but only settling with them some time after the daily settlement cycle with the Bank of England.

Within the lifetime of the core product replacement programme, the bank also underwent a merger with another finan-

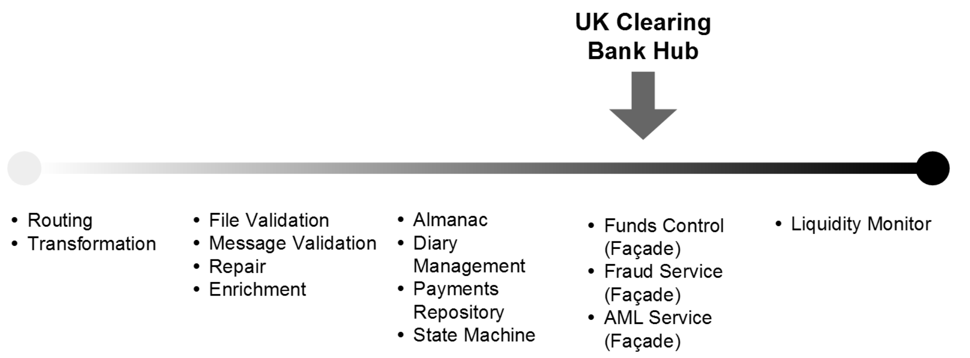


Figure 8 UK clearing bank hub spectrum placement

cial institution. This further emphasised the need to facilitate payments to multiple product systems in the short to medium term, irrespective of the target product system landscape.

Design drivers

A payments hub was conceived as a solution to the payments processing requirements. An overview of the system architecture, highlighting the scale of the integration required and the key role of the hub, is shown in Figure 7.

Key design drivers were to support the phased rollout of the new package-based product engine as described above, specifically:

- to support the limited payment schemes needed by the savings products initially, namely credit transfers, and then transitioning to a richer set of schemes to support current accounts, including cheque clearing and debit card schemes;
- to support the actual migration, switching user payments from the heritage product system to the new one triggered by a scheduled migration date;
- that the 'package principle' was applied to ensure that the features of the new core banking platform were leveraged.

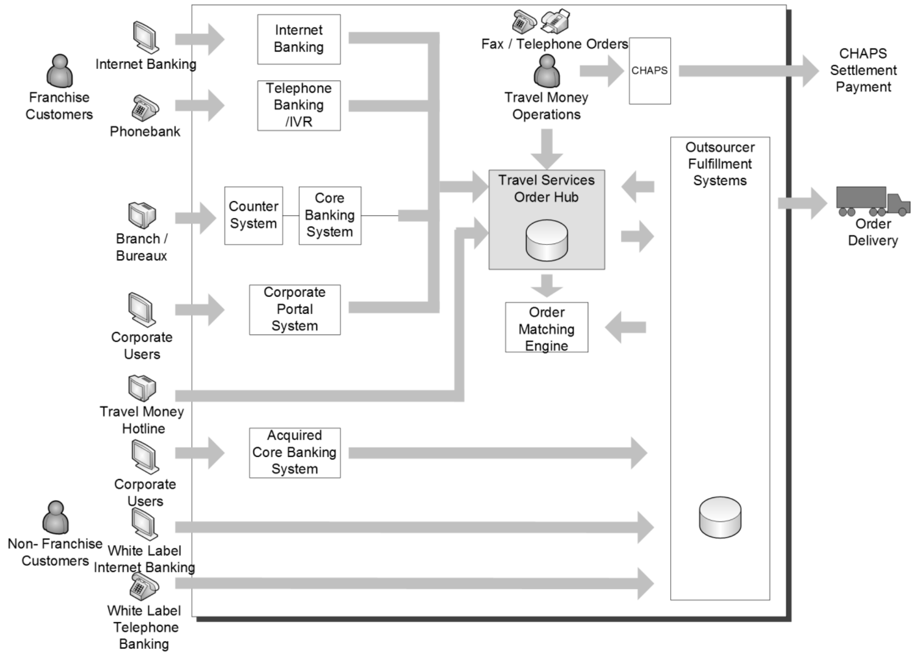
The package provided capability at generic automated clearing house (ACH), country-specific and bank-specific levels. The core capability and the country-specific capability were inclusive in the licensed cost. This implied a commercial driver to use the 'out of the box' package features available so as to minimise development costs associated with customisation. For the core product servicing capabilities provided by the package, there was no contention with the capability model defined. Some of the capabilities in the model, however, were available in the package, and the placement of that capability in the payments hub or in the product engine was a major source of architectural tension in the solution.

Hub solution

The resulting overall payments hub design was weighted towards the right of the spectrum with the selected capabilities shown in Figure 8.

From a functional perspective, the commercial considerations dictated that the payments hub should not duplicate the capabilities already provided by the package. This consideration tended to limit the functional richness of the payments hub, positioning the overall hub design to the lower end of the spectrum. From a 'design purity' perspective, however, certain capabilities were considered to be better placed in the payments hub, tending to increase the functional richness and positioning the

Figure 9 Foreign currency order hub architecture overview



overall hub design towards the high end of the spectrum.

The ‘package principle’ also inferred that the payments hub should support the interfaces offered by the package, presenting the payments in a format expected by the package, the objective again being to minimise costs associated with any interface customisation. In this respect, the number of data transformations that arise as a consequence of the interface selection should be noted (Scheme to Canonical to Package).

Given the concern over settlement risk, a component to monitor exposure to each of the payments schemes was a key functional requirement. The Liquidity Monitor capability was therefore included as an advanced feature of the hub.

Foreign currency order hub

Context

The acquisition of a major bank created the need to integrate two businesses and their respective IT systems. To fulfil this activity, an Integration Programme was conceived. The Foreign Currency Programme was part of this overall Integration Programme.

Post integration, the merged banking group required a single service offering in the area of foreign currency ordering and fulfilment, specifically:

- the sale of foreign currency and travellers’ cheques;
- the purchase of foreign currency.

Foreign currency services were to be offered through the multiple channels, harmonised as part of the Integration Programme. Fulfilment of foreign currency orders was provided by a third-party business partner of the acquired bank.

An order hub, depicted in Figure 9, was introduced to provide the integrated solution.

Design drivers

Key design drivers were:

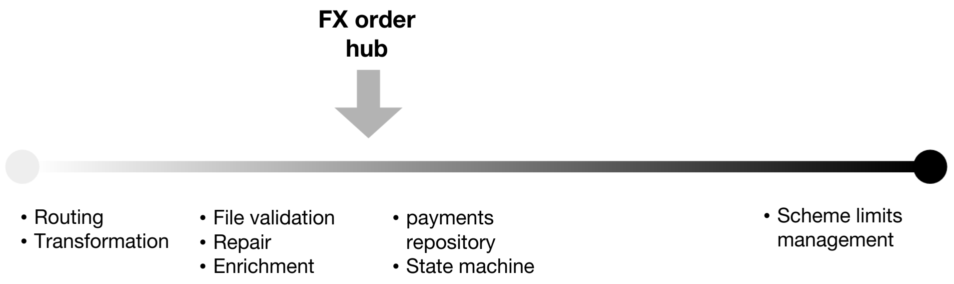


Figure 10 Foreign currency order hub spectrum placement

- Impacts on channels systems were time consuming, and it was desirable to keep these to a minimum. The interface formats to and from the channels were therefore to be preserved.
- Foreign currency fulfilment was to be outsourced to a third party. This inferred a 'pseudo scheme' with specific operating characteristics and a defined interface for the orders.
- The order capture and fulfilment systems were all file based.

The foreign currency orders are analogous to payments instruments. Consequently, the design considerations are identical to those described for a payments hub.

Hub solution

The resulting hub design was weighted towards the left of the spectrum with the selected capabilities shown in Figure 10.

Transformation of order formats was essential to covert multiple order formats into a single format required by the fulfilment partner. Routing was not strictly a required capability, although there was a fan-out capability for the FX rate distribution following a simple publish/subscriber model. File Validation of the order files was undertaken, and there was a store and forward capability and a very simple State Machine implementation. More advanced features included limits management on the order values to ensure that delivery value restrictions were adhered to.

CONCLUSION

There are a number of business scenarios in which a payments hub is shown to have relevance. Specifically, a payments hub has been shown to be useful in supporting:

- core banking modernisation initiatives, the key driver here being to support the migration of existing customer accounts to a new core banking engine;
- business acquisitions or mergers, the key driver here being to support the multiple products systems arising in the merged it operation.

Given an organisational IT strategy of a small, unchanging number of consolidated product systems, it could be argued that a payments hub has a temporary role, used only while account migrations are in flight. In practice, in any large banking organisation, the dynamics of the business environment mean that the IT landscape is continually changing through acquisitions, mergers and de-mergers, necessitating a long-term role for the payments hub.

There are other business drivers that support the long-term need for a payments hub, these being regulatory, compliance and the competitive nature of the business environment. Given these business drivers, a number of functional issues in the design of payment hubs have been identified.

In this respect, a capability model for payments processing has been developed and described. The apportionment of these capabilities between gateways, payments hubs and product systems can take many different forms, dependent on the underlying business drivers and the specifics of the IT landscape within the bank. In the case studies discussed, it became apparent that this apportionment was a fundamental design consideration. This led to the concept of the 'Payments Hub Spectrum' as a vehicle for the analysis of a solution.

At the low-frequency end of the Payments Hub Spectrum, the hub has the characteristics of a pure middleware solution. As the spectrum is traversed, more functionality is added to the payments hub until, at the high end of the spectrum, the hub constitutes a fully functional payments engine.

To conform fully to the concept of a spectrum, one may expect a quantifiable, linear attribute of the payments hub to be increasing/decreasing as the spectrum is traversed. The attribute presented here is the functional richness of the hub.

In practice, the functionality of the hub is not a strictly linear attribute or even necessarily cumulative. Capabilities towards the high end of the spectrum may be included, but this does not necessarily infer the inclusion of some mid-spectrum capabilities. Despite this, the model is considered valid in broad terms and a useful vehicle for considering the general style of hub that an organisation requires.

Major changes to the underlying architecture for payments processing are difficult, infer prescribed, minimum timescales and present high business risk for the bank. In this respect, the technology selection for a payments hub is an early decision which underpins the IT architecture and is important to get right at the outset. In conclusion, understanding the required operating position on the Payments Hub Spectrum allows an organisation to make an explicit, informed choice about the foundation technology for the hub, avoiding costly re-architecting and minimising delivery risk for a bank.

Acknowledgements

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