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Towards a Framework of Digital Platform Competition: A Comparative Study of Monopolistic & Federated Mobile Payment Platforms

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Abstract

This paper advances a framework for examining the competitive principles of mobile payment platforms. We postulate that the strategic interplay of platform layers will drive the competitive dynamics of platform-driven ubiquitous systems. This framework has been employed in a comparative case study between monopolistic (i.e., Pingit) and federated (i.e., Paym) mobile payment platforms to illustrate its applicability and yield principles on the nature and impact of competition among platform-driven ubiquitous systems. Preliminary findings indicate that monopolistic mobile digital platforms attempt to create unique configurals to obtain monopolistic power by tightly coupling platform layers, which are difficult to replicate. Conversely, federated digital platforms compete by dispersing the service layer to harness the collective resources from individual firms. Furthermore, the interaction and integration among platform layers give rise to commodity and value platform layers that translate into competitive battlegrounds among mobile payment services. This paper therefore represents a concrete step in unraveling the competitive dynamics of platform-driven ubiquitous systems from an architectural viewpoint.

Keywords: Digital platforms, Layered modular architecture, Mobile payment, Centralized and distributed governance, Ubiquitous systems, UK payment industry

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1 Introduction

Platformization of information technology (IT) has cultivated business ecosystems [2] that challenge the predominant business logics of traditional market structures. At its core, digital platforms mediate the production and consumption of goods and services (e.g., payment) in an efficient manner [45], [47]. As is apparent from the well-publicized cases of Apple's iTunes, iPhone and the App Store (cf. [18]), [28], [30], [50], digital platforms not only possess the capability to deconstruct once vertically integrate value chains, but they also erode the viability of incumbents' business models at an unprecedented speed [20], [23], [39].

Increasingly, digitized goods and services are being distributed through ubiquitous computing systems in the form of mobile devices. As digital platforms and mobile devices become technologically intertwined, the latter typically function as physical proxies of the former. Together, digital platforms and their corresponding proxies resemble *platform-driven ubiquitous systems* that facilitate seamless access to cross-channel goods and services in order to aid users in accomplishing a multitude of tasks. As an illustration, the Android mobile operating system is reflective of a platform-driven ubiquitous system that encourages the creation and delivery of goods and services, which are interoperable across multiple devices. In other words, digital platforms constitute the technical foundation for realizing ubiquitous systems. An in-depth appreciation of digital platforms and their corresponding proxies is thus necessary to comprehend how ubiquitous systems emerge and compete.

As digital platforms constitute the technical foundation for ubiquitous systems, they tend to differentiate and compete on two key fronts: (1) architectural, and; (2) deliverables. Digital platforms differ considerably in their architectural design and configuration in the *delivery* of ubiquitous platform-driven services. Arguably, certain architectural designs and configurations might be more efficient (e.g., high level of vertical integration) due to their competitive and/or generative capabilities. This architectural differentiation, in turn, has an impact on the *attributes* of the delivered platform services (e.g., app user experience). In so doing, digital platforms are confronted with the challenge of striking an equilibrium between internal *stability* to ensure system resilience, and external *usability* to address ever-changing customer needs in the market (cf. [6]). Accordingly, platform providers offering ubiquitous services are compelled to design and configure their digital platforms in a dualistic manner that balances technological flexibility and reliability in order to derive business value.

Platform-driven ubiquitous systems are predominant in the payment industry as well. With the emergence of mobile payment platforms, which are layered modular architectures offering payment services [57], payers and payees can be connected via mobile devices. Mobile devices basically serve as location-independent platform proxies. Although mobile payment is not a recent phenomenon, it is deemed as a novelty that has gained a recent foothold in European markets. For instance, Apple Pay was launched in Summer 2015 in the UK [7]. The delay can be attributed to the existence of well-accepted payment systems in Europe so much so that mobile payment solutions, which were introduced before, did not deliver a convincing value preposition, or that disagreements among stakeholders slowed the rollout of mobile payments services [42].

The number of users and transaction volumes for mobile payment services are growing steadily. For instance, in 2014, 3% of UK adults performed in-store mobile payment, and this figure rose to 13% in 2015 [22]. An outcome of this popular trend is that the mobile payment market becomes increasingly fragmented and competitive. To keep rivals at a distance, mobile payment providers usually strive for innovation to differentiate themselves. Yet, despite the growing prevalence of mobile payment services, there is a paucity of studies that has examined how mobile payment platforms, or more broadly, how *platform-driven ubiquitous systems* compete in the market, especially from an architectural viewpoint.

This paper hence advances a framework for unraveling the competitive logic of platform-driven ubiquitous systems. To do so, we embrace a granular view on mobile payment platforms and their corresponding proxies. Specifically, we expand on the work of Yoo, et al. [57] by delineating mobile payment platforms into five layers: (1) device; (2) (operating) system; (3) network; (4) service, and; (5) content. Furthermore, depending on the governance regime being enacted [4], [38], we argue that each of these aforementioned platform layers signifies a competitive space in its own right to wrestle for market leadership. Taken as a whole, the interaction and the integration among these five platform layers define and drive competition among platform-driven ubiquitous systems, which in turn gives rise to our conceptual distinction between *commodity* and *value platform layers*. Through this study, we endeavor to provide an answer to the following research question:

What are the constituent dimensions of platform-driven ubiquitous systems that drive competition in mobile payment markets?

This paper contributes to extant literature on digital platforms and ubiquitous systems [19], [21], [25], [26], [29], [41], [45], [57] by advancing a preliminary framework that situates competitive drivers of platform-driven ubiquitous systems between and within platform layers. This framework was then employed in a comparative case study between two leading UK mobile payment platforms (i.e., Paym and Pingit) to illustrate its applicability and yield principles on the nature and impact of competition among platform-driven ubiquitous systems.

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It has to be emphasized that this paper focuses on the competition of digital platforms that operate as ubiquitous systems [57]. For this reason, discussions on different platform *categories* (e.g., product or multi-sided platforms) (cf. [13]), [29] are beyond the scope of this research. The remainder of this paper proceeds as follows: In the next section, we provide a working definition for digital platforms and their relationship to ubiquitous systems. Based on this definition, we offer an overview of extant literature on digital platform layers and governance regimes that give rise to distant platform profiles. In Section 3, we present our research method. In Section 4, we present Paym and Pingit as illustrative cases of mobile payment providers that leverage on platform thinking for market competition. In Section 5, we synthesized insights gleaned from analyzing these two cases. In Section 6, we conclude by: (1) summarizing implications for theory and practice; (2) outlining limitations, and; (3) proposing avenues for future research.

2 Theoretical Background

In this section we present our theoretical footing to understand digital platforms that enable ubiquities systems.

2.1 Defining Digital Platform

To define digital platforms, it is imperative to first distinguish the concept of platform from that of architecture and infrastructure, terms often employed interchangeably in past studies. *Architecture* is the conceptual and logical structure (i.e., blueprint) of a functional system [51], [52], whereas infrastructure is the actual operationalization of a functioning architecture. Hanseth and Lyytinen [33] defined *infrastructure* as a *shared, open, heterogeneous and evolving socio-technical system* whose structural composition consists of other infrastructures, platforms, applications and technological capabilities, thereby underlining its *recursive* nature.

Conversely, Yoo, et al. [57] conceived layered modular architectures (or digital platforms) as hybrids that blend both modular and layered architectures. Whereas (1) *modular architecture* represent a *nested and fixed* boundary for the assimilation of modular components to build product-specific artifacts, the (2) *layered architecture* supports generativity over and above its modular counterpart by establishing the necessary requirements for creating agnostic platform derivatives (see Figure 1). Taking Apple's iPhone as an illustrative example, its modular architecture comprises modular components (e.g., chips and operating system), which when combined, constitutes a smartphone as a nested, fixed and ubiquitous IT artifact. On the other hand, the layered architecture of the iPhone gives rise to developmental toolkits that can be harnessed by third parties to construct software for the service layer or hardware (e.g., camera lens) on the device layer. Accordingly, digital *platform layers* have the attributes in being symbiotic that connect and expand the functionalities of *platform modules*.

For this study, we hence subscribe to Kazan, et al. [35] definition of digital platform as *a proprietary or open modular layered technological architecture that supports efficient development of innovative derivatives, which are embedded in a business or social context.* We find the preceding definition to be amenable to this study because as emphasized above, digital platforms should not be construed merely as monolithic artifacts, but rather, as the embodiment of both modular and layered architectures.

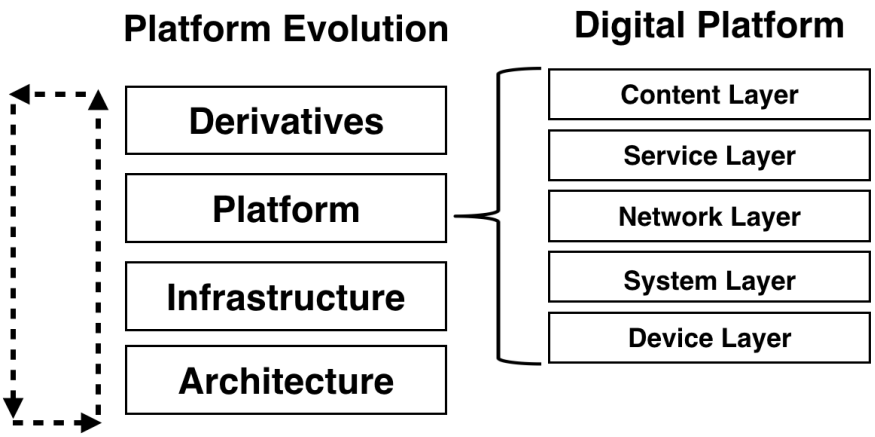

Figure 1: Platform evolution & layered platform

2.2 Digital Platforms and Ubiquitous Systems

Because digital platforms can be construed as a composition of technology layers and modules that facilitate the creation and delivery of goods and services within and across business networks [3], they basically function as building blocks for ubiquitous systems [41]. Ubiquitous systems are omnipresent IT artifacts that are deeply embedded in socio-economic environments through the delivery of location-independent digitized goods and

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services [40]. Most of these ubiquitous systems or devices (e.g., smartphones), however, do not possess the required computational foundation to deliver these services on their own. Digital platforms thus play a vital role by providing the necessary computational foundation and business logic to deliver services that cater to a network of interrelated ubiquitous devices. In so doing, digital platforms and ubiquitous devices complement and support each other by extending and augmenting functionalities in a conjoint manner. To put it differently, digital platforms enable platform-driven ubiquities systems.

Today's organizations face considerable challenges in offering platform-driven ubiquities services. Besides resolving complexities such as interoperability, revenue sharing or data ownership [56], organizational resources and capabilities are unevenly distributed among market participants in the delivery of competitive ubiquitous services.

To understand the logic of ubiquities services within competitive market environments, we subscribe to the layered modular architecture [57] as our theoretical and analytical lens to unpack the constituents and competitive dimensions of platform-driven ubiquitous systems. We posit that the interplay of platform layers is the foundation upon which market competition manifests. For instance, the governance regime of Apple and Google on the *service layer* (Apple Pay vs. Android Pay) differ in their degree of control by blocking or tolerating services on the device layer for conducting moderated or unmoderated contactless mobile payments (cf.[11]), [50]. As alleged by Amadeo [5], Android was deliberately introduced by Google as an open source project to mobilize third-party developers and pre-empt Apple from acquiring dominance within mobile industries.

2.3 Digital Platforms as Layered Modular Architectures

Past studies have laid the foundation for envisioning digital platforms as layered modular architectures [8], [9], [44], [51], [57], especially with respect to how technological capabilities affect interconnected digital platforms [33], as well as how platform owners exercise governance in an attempt to strike an equilibrium between control and openness to foster platform innovation [11], [12], [30], [34], [54].

Consistent with Yoo, et al. [57] conception of layered modular architectures, we theorize digital platforms as encapsulating five distinct and interlinked *platform layers*: (1) device; (2) system; (3) network; (4) service, and; (5) content. Each of these five platform layers can independently support modularity [46], [48] by permitting external parties (e.g., third-party developers) to contribute with their respective software and/or hardware resources in co-creating and capturing value. Modularity [46] in digital platforms thus gives birth to modularized, digital goods and services on each layer (e.g., iOS payment applications).

From a strategic viewpoint, layered modular architectures have the competitive advantage, as well as the challenge, in being *doubly distributed* [57]. They are *distributed* in that external actors collaborate and contribute with their respective resources towards different platform layers. At the same time, they are *doubly* in their nature as internal and external actors conjointly or independently (1) control and (2) generate component knowledge in select areas of a layered modular architecture. Consequently, organizations that mutually contribute to a single layer can be viewed as collaborators in pursuit of common business goals, but at the same time, they could be fierce competitors on other layers. Take Apple's iPad as an example. Amazon contributes with its Kindle eBook service towards iPad's content and service layer. But concurrently, Amazon competes with Apple on the device layer with its own Kindle eBook readers and tablets [57]. By drawing on the conceptual granularity of platform layers, we can better comprehend how the design and configuration of digital platforms (i.e., arrangement of platform layers) impact their competiveness within ubiquitous ecosystems.

In the following, we illustrate the five platform layers through the example of Apple Pay, Apple's mobile payment service (see Figure 2).

- Device Layer: A physical, programmable IT artifact for storing and processing digitally encoded data and instructions. Apple's iPhone and smartwatch embody these traits by being physical IT artifacts that store and run the Apple Pay software (integrated in passbook app), and initiate Near-Field-Communication (NFC) payments.

- System Layer: A logical software system for controlling and executing software and hardware components. Apple's mobile payment solution Apple Pay requires iOS and Watch OS as operating systems to regulate the functional operations of the payment app (software), NFC chips and its secure element (physical).

- Network Layer: Communication channel for transporting data packages among different nodes. Apple's mobile payment service relies on the services of mobile operators (e.g., AT&T) and payment networks (e.g., Visa and MasterCard) to process and settle payments.

- Service Layer: Software applications for storing, generating and distributing proprietary and/or third-party data. Apple Pay is a payment service that not only mediates commercial transactions, but also offers Application Programming Interfaces (API) and Software Development Kits (SDK) to facilitate the integration of Apple Pay into third-party applications.

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- Content Layer: Representation of digital data in terms of audio, video, text and images. Apple Pay generates payment data in the form of purchase amount, merchant, time and/or location, to name a few.

Arguably, each of the aforementioned five platform layers possesses the capability to support modularity and that the depth of access to these platform layers leads to (un)moderated generativity and competition opportunities [58], which in turn attests to the criticality of governance regime in digital platforms.

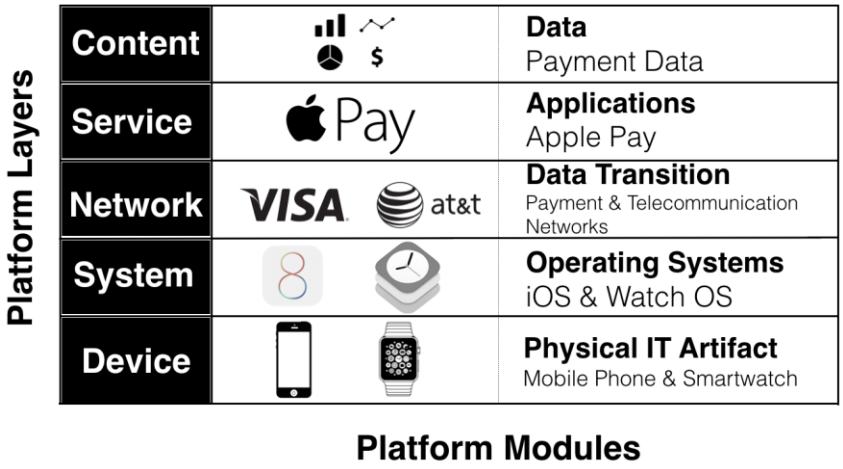

Figure 2: Digital platform layers & modules of Apple Pay

2.4 Digital Platform Governance

Extant literature on IT governance espouses the notion of alignment between IT functions and organizational structures to ensure the efficiency and effectiveness of firms' response to internal and external environments. Anecdotal evidence from these studies suggests that organizations typically adhere to one of three IT governance regimes: centralized, decentralized and hybrid governance, the latter being the simultaneous application of both centralized and decentralized governance in certain business units within the same organization [4], [16], [17], [27], [38].

Ahituv, et al. [4] defined centralized systems as those with the entire computing power concentrated in one site, and that all strategic decisions are made in one location. Conversely, decentralized systems deploy processors (computing power) in various locations, which are not linked through a network, and that strategic decisions are located in a core location, but other decisions can be made in an unrestricted number of locations. Likewise, Leifer [38] and Ahituv, et al. [4] employ the same terminologies, but define them differently. For instance, Leifer [38] emphasized the connectedness of decentralized systems, describing such systems as peer networks where no central processor exists through which communications must pass, offering a high degree of communication freedom. For instance, consider Apple Pay and Bitcoin. Both represent novel forms of payment systems, but their governance structures differ substantially. Whereas Apple moderates access to its payment service through boundary resources (i.e., centralized and closed) [30], Bitcoin is ungoverned (i.e., decentralized and open). Conceivably, distributed digital platforms resemble a hybrid of centralized and decentralized platforms, where governance and control is dispersed among various permissioned stakeholders.

In light of the above discussion, we differentiate and focus in this study on *centralized* and *distributed* governance for digital platforms. For *centralized digital platforms*, decision rights are concentrated with tightly coupled platform layers, what we labeled as *nested* and *fix* platform. This gives rise to monopolistic power over a digital platform and its layers exhibit the attributes of being vertically integrated. For *distributed digital platforms*, decision rights are dispersed among various permissioned third parties with loosely coupled platform layers, what we termed as *federated* platforms and its layers exhibit the attributes of being horizontal in nature.

3 Research Method

Research Method: Interpretive Case Study. The method of enquiry for this study is a comparative and interpretative case study aimed at uncovering how platform-driven ubiquitous ecosystems compete [53], [55]. Accordingly, we adopt a descriptive and exploratory approach [31] by synthesizing focal concepts from digital platform literature to craft an analytical lens for deriving competitive attributes pertinent to platform-driven markets and disentangling how competition plays out among platform layers. We deem the case study approach to be an appropriate mode of enquiry as it can answer *how* and *why* questions in complex and nebulous research environments [24], [55]. The

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case study approach is therefore suitable for untangling the intricate relationship between market forces and platform layers, both of which are responsible for shaping competition in the mobile payment market.

Research Setting: UK Mobile Payment Market. For this study, we turn to the UK mobile payment market as our empirical context. The UK payment industry is in the midst of a massive transformation. New actors with little or no prior industry backgrounds (e.g., mobile network operators and payment start-ups) have entered the payment industry and are beginning to encroach on the traditionally protected payment market. Institutionalized incumbents (e.g., banks) are thus under threat from these new actors, transforming payment to a commoditized service and a by-product for other lucrative services.

By offering accessible, interchangeable and novel payment instruments (e.g., smartphones), these new players are pursuing a strategy of cultivating new consumption habits. These new consumption habits may aid in establishing fresh customer relationships and yielding opportunities for potential disintermediation. In this sense, incumbents (i.e., banks) were forced to launch their own mobile payment solutions as a preemptive move to discourage potential entrants or safeguard existing market structures. Specifically, current market incumbents introduced following mobile payment solutions to preserve current market: (1) Pingit offered by Barclays with 2.7 million active users (September 2015) [10], and (2) Paym with 3.2 million strong user base (February 2016) [43].

Mobile Payment Platforms: Orchestrating IT Artifacts. Mobile payment platforms are complex financial technology (i.e., FinTech) IT artifacts that are embedded within innovative and competitive business networks to mediate payment transactions. Fundamentally, payment is the process of transferring money from a sender to a receiver that involves payment instruments, payment processing and payment settlement [37]. Most moderns payment systems or platforms are four-party schemes (e.g., Visa, Pingit), where platform owner primarily orchestrate and set the rules [32], [45] for how payment transactions are transferred among (1) payers; (2) payees; (3) acquirer (i.e., payee's bank), and; (4) issuer (i.e., payer's bank).

Figure 3 illustrates the logic of a mobile payment transaction within a four-part scheme. The payer authorizes the payee (e.g., merchant) with its mobile phone (e.g., through a QR-code scan) to debit a payment amount from the payer's bank account. The payee in turn, sends a debit payment request to its acquirer, and the acquirer forwards the debit payment request through the mobile payment platform provider (e.g., Pingit) to the relevant issuer. If the payer's bank account has sufficient liquidity, the issuer authorizes and settles the payment between the payment service provider and acquirer. The payee, at the end, gets notified about the successful transaction and hands over the (digital) goods to the payer.

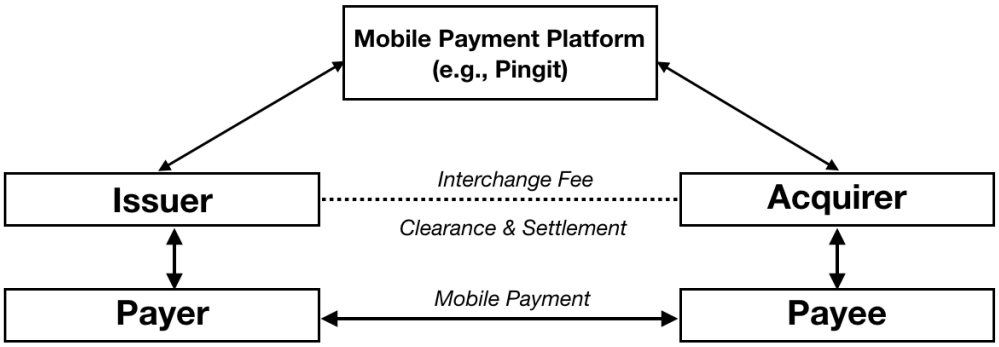

Figure 3: Mobile payment platform within a four-party scheme

Case Selections: Two UK Mobile Payment Platforms. To identify platform-driven competition in the UK mobile payment market, we began with four semi-structured interviews with experts, who are knowledgeable about the UK payment industry. These four experts were selected based on their familiarity with the UK payment industry and job capacity in prominent finance-related organizations. Interviews with these experts guided us in constructing an overview of the UK payment landscape and gleaning insights into the roles of various payment actors (e.g., banks, acquirers, technology providers, payment networks and infrastructure providers). From these interviews, we identified the two largest mobile payment platforms operating in the UK mobile payment: (1) Paym (a collaborative solution offered by UK banks), and; (2) Pingit (a proprietary solution promoted by Barclays).

Furthermore, industry experts aided us in identifying invisible payment actors (e.g., technology providers) that enable mobile payments behind the scenes. For instance, one expert states: *Paym itself is owned by the Payments Council […] they are the group responsible for setting the rules, running the overall project and getting it live. What Vocalink provides is the technical infrastructure behind that but maps the mobile phone numbers to your bank account [….] the connectivity between something like Visa, MasterCard would be at a Faster Payments Link BACS type level […] there's then connectivity at a level above that, those overlay type services of Pingit and Paym*.

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Both mobile payment platforms offer payment solutions targeted towards businesses and individuals. We opted for these mobile payment solutions as our case organizations because Pingit and Paym are the dominant solutions in the UK mobile payment market. Large financial institutions do not only operate them, they also boast of large and growing user bases with rising transaction volumes. In addition, we deliberately selected these two mobile payment platforms for comparison because they are representative of two distinctively different governance regimes: centralized managed by one organization (i.e., Pingit) versus distributive managed by a group organizations (i.e., Paym).

Data Collection. The empirical basis for this study is based on two semi-structured interviews and secondary data. Specifically, we conducted in-depth and face-to-face interviews with: (1) the Head of Development at Paym, and; (2) the Senior Vice President (SVP) of mobile solutions at Barclays. Interview questions were adapted from extant literature on digital platform, paying particularly close attention to how platform layers are designed and configured. Our interview strategy is devised to unravel the mechanisms behind how each of the two mobile payment platforms functions in practice (i.e., narrative and visual reconstruction of mobile payment transactions) and ascertain external partners, who are vital in supplying complementary capabilities and resources to enable the corresponding payment service. Additionally, we triangulated the interview data with payment reports, white papers, press releases and archival records from industry associations (e.g., the European and UK Payments Council), payment industry online news outlets (e.g., Finextra) and payment news aggregators (i.e., The Paypers) in order to reconstruct the UK payment landscape with its respective stakeholders and pinpoint commercially active mobile payment platform providers and infrastructure providers.

Data Analysis. After a careful review of the secondary data, relevant data points were interpreted [53] to reconstruct the UK payment industry. We conceptualized what a typical mobile payment transaction looks like for Paym and Pingit respectively (see Figure 3). We then identified external partners on the network and service layer, who are vital in supplying complementary capabilities and resources to achieve and sustain an operational mobile payment service. Ultimately, our research goal was to discover similar and different platform layer configurations in order to derive competitive platform principles.

With regards to the fully transcribed semi-structured interviews, the first author performed thematic analysis [14], [15]. Thematic analysis is an analytical method to identify, analyze and report patterns (i.e., themes) within rich datasets. Specifically, we utilized theoretical thematic analysis, where codes or themes are guided by existing research to expand theory. The first author began by identifying emerging and recurring patterns from the dataset that exhibit architectural attributes (e.g., platform layers, modules) of platform-driven ubiquitous systems. These patterns were in turn filtered through the layered modular architecture framework (see Table 1) to derive competitive dynamics and principles on each platform layer. To do so, we adhered to an iterative approach similar to the one advocated by Klein and Myers [36] in that we go back and forth between our findings and the analytical framework.

To overcome potential biases on the part of the first author, we further pursued a differentiated role strategy during data analysis [1]. As the first author conducted the initial data analysis, the other co-authors play the role of the devil's advocate by coming up with alternative interpretations, and counter-arguments. The entire data analysis process followed an iterative cycle as well and it was only concluded when all authors agree on the findings in accordance with the analytical framework.

Table 1: Sample coding from Pingit

Platform Layers	Exemplary Quote	Synthesis
Content Layer	[…] it will be a lot of rigor around analyzing what those API's and what information they have access to […] it's very much about providing information into, or to, the Pingit app as opposed to integrating Pingit into another app, for example.	Pingit is guarding its data (i.e., payment data) and that the data flow is orientated inwards to enrich the payment service further.
Service Layer	It has to be, of course, then commercially relevant to be disclosing any API's to that party. So [Pingit] available to anybody in the UK with a UK mobile number and a UK current account so you don't have to be with Barclays to use Pingit.	Pingit is providing through application program interface (APIs) moderated access to its payment service. Furthermore, the payment service is accessible to all UK banks customers (i.e., including customers from rival banks).
Network Layer	So yeah, when we use the Faster Payment infrastructure we as, of course, is one of the founders of the Faster Payments infrastructure we'll have connectivity into the Payments Councils faster payments product […]	All major UK banks, including Barclays, have access to the Faster Payment infrastructure to send and clear payments across the UK.
System Layer	In terms of the support that we provide for Pingit for consumers, we're running on certainly iOS, on Android, on Blackberry or - and Microsoft now as well.	Pingit is compatible with major mobile operating systems.
Device Layer	So the consumer side, we provide the app that runs on the different smartphone platforms or tablets.	Pingit is designed to work on various ubiquitous devices.

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4 Comparative Case Study of Two Mobile Payment Platforms

In this section, we present two distinctive mobile payment platforms: Paym and Pingit. Consistent with Hagiu and Wright [32], digital payment providers are multisided payment platforms that connect payers and payees. To illustrate the explanatory power of our proposed framework for deciphering competition of platform-driven ubiquitous systems, we perform a comparative cross-case analysis to pinpoint competition on different platform layers that give rise to competitive profiles.

Pingit by Barclays. In 2012, Barclays was the first UK high street bank to launch its own internally developed mobile payment service called Pingit. Pingit was initially designed to be a pure person-to-person (P2P) mobile payment service, enabling individuals to perform direct payments among one another. After successfully establishing a solid installed user base, Barclays grew its Pingit customer base further by targeting small business owners and online retailers, enabling businesses to conduct end-to-end mobile commerce for the first time.

Barclays was highly strategic in rolling out Pingit, having the ambition to attain market dominance in a rapid fashion. A key measure was garnering the support of all major mobile platforms right from the start (i.e., iOS, Android and Blackberry), which enabled Barclays to leverage on customers' smartphones (and smart watches lately) to issue digital payment instruments. Compared to conventional means (e.g., plastic payment card), the issuance of digital payment instruments (e.g., iOS app) has the advantage of issuing affordable payment instruments in a rapid manner with the latest features, directly into the hand of the customers. Moreover, the Pingit service is made available to users from rival UK banks as well. This sets the foundation for establishing new customer relationships in a subtle manner while harvesting valuable customer data over time.

To grow its Pingit ecosystem even further, Barclays operates an accelerator program in parallel, granting select startups with privileged access to Pingit APIs. After an internal review process, Barclays chose startups that can harness Pingit APIs to innovate new services with the ultimate objective of bolstering the value proposition of the mobile payment service. In general, these measures help to boost transaction volume on the Pingit platform, which in turn benefits from economies of scale effects while increasing prospects for data collection. With a 2.7 million strong user base, Barclays recently decided to expand Pingit's usefulness and market reach by improving its compatibility with Paym, an alternate consortium-driven mobile payment system.

To initiate Pingit payments, users enter the mobile phone numbers of the recipient where phone numbers serve as proxies for bank account details stored on the Pingit system. After receiving the payment instruction, Barclays applies a dual approach in processing and settling Pingit payment transactions. For Pingit users who are Barclays customers, the settlement occurs internally within the Pingit platform in real-time (see Figure 4). In elaborating it further, the SVP states that: *a consumer [pushes] the money which is what a Pingit transaction [is…] we can just move the money from one Pingit account to another Pingit account*. For Pingit users who are non-Barclays customers, Pingit routes the (push) payment through the Faster Payments network. As a founding member of the Faster Payments scheme, Barclays has express access to the Faster Payments network, enabling interbank transfers in near real-time. As the SVP states: *we use the Faster Payments infrastructure, of course, as one of the founders of the Faster Payments infrastructure we have connectivity*.

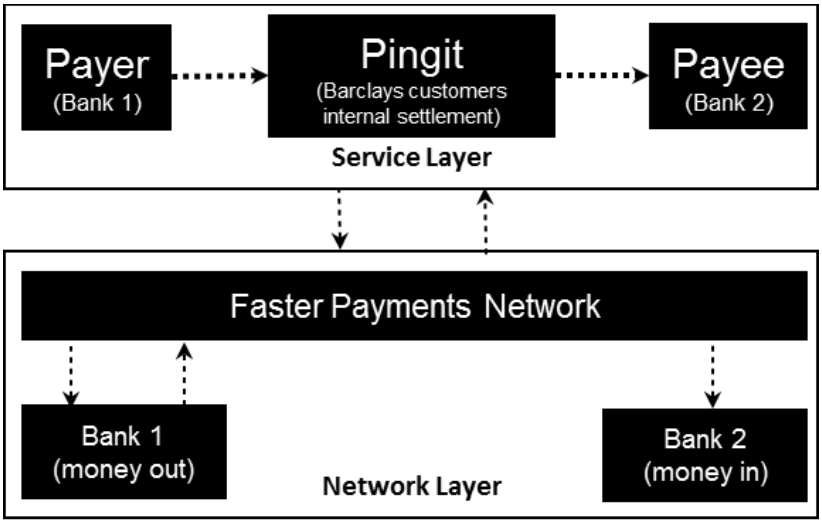

Figure 4: Pingit mobile payment platform

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Paym - Industry Consortium Solution. Launched in April 2014, Paym is a mobile payment service developed by the UK Payment Council and is now jointly owned by its participating members of financial institutions. The UK Payment Council, an industry-wide consortium representing financial institutions, has the mission of fostering innovation and collaboration in the British payment landscape. As Barclays has proven market readiness and success with its own mobile payment service in the form of Pingit, the UK Payment Council was commissioned to develop a competitive, though, collaborative solution. Specifically, the Paym initiative has the intention of equipping bank institutions with basic mobile payment functionalities that serve as the foundation for an industry-wide standard. Arguably, the industry collaboration represents a preemptive move against Barclays to impede its market dominance and preserve pre-existing customer relationships.

At the same time, the Paym initiative was deliberately designed to leave room for differentiation in order to create competitive space among its members. Specifically, Paym differs from Barclays' Pingit standalone application in that it functions as a feature within existing mobile banking applications. Accordingly, Paym is identical in its functionality for each financial institution. However, the competitive turf among participating financial institutions occurs in their own mobile banking applications, competing through service differentiation and interface usability.

Paym's availability towards end-users (private or businesses) is determined by whether: (1) a financial institution has entered into a Paym service agreement, and; (2) a mobile banking app is supportive of certain mobile platforms (e.g., Android, Windows). Accordingly, the physical payment instrument, usually provided by financial institutions in the form of plastic payment cards, comes now in a digital form while leveraging on end-user smartphones. Consequently, the Paym platform acts as an overlay service on top of existing banks accountants that links bank account numbers with mobile phone numbers. As soon a Paym transaction is tied to a mobile phone number, the service initiates a traditional bank transfer to the associated bank account (see Figure 5).

Paym is hence a highly complementary service that supports existing bank-customer relationships, preserves existing customer data ownerships, and utilizes existing payment rails (i.e., Faster Payments and LINK). As the Head of Development states: *the idea is that you already trust your bank, you get this functionality and then everybody can send money to each other using their existing relationship […] I'm then providing my bank with the instruction to make a payment and that payment will either go through Faster Payments or it will go through LINK and those are the two approved, two supported, payment schemes in this service.*

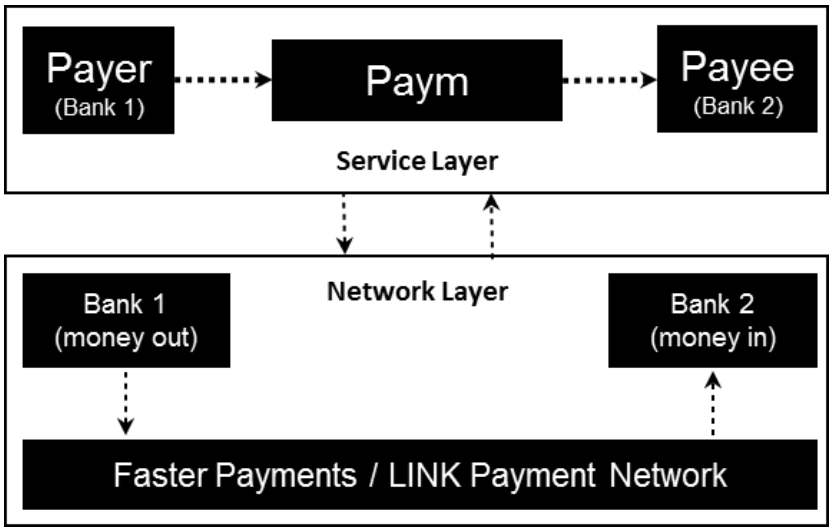

Figure 5: Paym mobile payment platform

5 Case Analysis and Findings

In this section, we present insights gleaned about the competitiveness of mobile payment platforms for each of the five platform layers through a comparative analysis of Paym and Pingit. For each layer, we will describe the layer dynamics and their underlying competitive principles. Whereas the platform layer dynamics depict how each platform layer is designed and configured from an internal viewpoint, the platform layer competitive principles reveal the underlying competitive principles that transpire in the marketplace.

5.1 Device Layer

Platform Layer Dynamics: Paym and Pingit leverage on customers' mobile devices to offer and distribute their mobile payment services to the market. Requirements for mobile devices to participate in these mobile payment services are relatively low, as they require simply an Internet connection and phones number to settle payments between

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payers and payees. By offering mobile payments to end users, both mobile payment platforms have the ability to issue *affordable* digital payment instruments in a rapid fashion. In so doing, Paym and Pingit demonstrate that these mobile payment platforms are neither interested nor capable of controlling the device layer (i.e., smartphones). In this sense, both mobile payment platforms have to adapt their payment applications accordingly in order to piggyback on customers' mobile devices to utilize them as ubiquitous distribution channels.

Competitive Principles: Both mobile payment platforms adhere to a cost-driven approach on their device layer by leveraging on readily available and affordable payment devices to realize service *ubiquity. We therefore propose that the adoption and leveraging of affordable mobile devices on the device layer creates a commodity layer and does not present a competitive ground between mobile payment platforms, due to easy replication by rival firms.*

5.2 System Layer

Platform Layer Dynamics: Both mobile payment services leverage on widely *available* mobile operating systems (i.e., iOS, Android, Blackberry) in offering their payment services to the market. Mobile payment platforms are highly dependent on mobile operating systems to offer reliable and secure payment services. Similar to the aforementioned device layer, Paym and Pingit have no control over the system layer of mobile devices. Therefore, both payment services have to accept and comply with systems specifications stipulated by the software vendors. Competitiveness may only occur between both mobile payment platforms by striving for high compatibility with the operating system to provide the best mobile payment application experience.

Competitive Principles: Both mobile payment platforms leverage on dominant and standardized mobile operating systems to avoid fragmentation and ensure *interoperability* in their service delivery. As these mobile operating systems are likewise highly accessible for rivals, it does not justify a competitive advantage. *We therefore propose that mobile payment platforms leverage on widely available mobile operating systems to achieve service interoperability. In so doing, both mobile payment platforms treat the system layer as a commodity platform layer due to the lack of control and ownership.*

5.3 Network Layer

Platform Layer Dynamics: Paym and Pingit depend on Faster Payments and LINK payment networks to send, process and settle payments. The aforementioned payment networks are vital, as they present the binding glue between financial institutions to transmit payments throughout the UK payment industry. The owners of Pingit (Barclays) and Paym (industry consortium) co-own these *inclusive* payment networks. Thus, competition is negligible due to mutual governance and ownership. Other mobile payment platforms (e.g., PayPal) that have no direct access to these payment networks are indeed disadvantaged, as they have to enter into contractual agreements to have access to the industry-specific resource. Nevertheless, the financial institutions behind Paym and Pingit have the economic interest to avoid transactions through these payment networks, as the costs for maintaining these networks are based on transactions volumes. As such, each financial institution has the business goal to maintain and increase transaction volumes within their own mobile payment services and by extension, to stay isolated as much as possible.

Competitive Principles: Payment networks are vital, as they connect financial institutions with each other with their corresponding mobile payment platforms. However, as the financial institutions behind Paym and Pingit have non-discriminatory *access* to the same payment networks, access to these payment networks does not constitute a competitive advantage. In this sense, the network layer of both mobile payment platforms (i.e., Paym and Pingit) exhibits attributes of a commodity layer. *We therefore propose that the adoption of inclusive network layer strategy by mobile platform providers does not contribute to competitive advantage over rivals, because it does not impose accessibility constraints.*

5.4 Service Layer

Platform Layer Dynamics: Barclays' Pingit payment platform obtains its competiveness by offering a tightly integrated *monopolistic* mobile payment service to provide the best payment and mobile commerce experience in the market place. To achieve this degree of control, Pingit goes beyond Paym by developing and offering a dedicated mobile payment application (i.e., Pingit app), which co-exists with Barclays' mobile banking application. From a customer viewpoint, Pingit also reduced multi-homing apps, as it allows customers to send payments from the Pingit application to Paym users, incentivizing users not to use Paym.

Paym, on the other hand, has the traits of a *federated* mobile payment platform that exist as a feature within heterogeneous and isolative mobile banking applications. It can be argued that Paym may not achieve user experience consistency as Pingit does, because each financial institution decides how Paym is implemented within their own mobile banking applications. With respect to user acquisition, Pingit has the competitive advantage in being an inclusive app by having the capability to serve non-Barclays customers. Therefore, Barclays has, through Pingit, the potential to build meaningful customer relationships. On the contrary, Paym, the industry consortium

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solution, does not have the same facility. Paym is not designed to collect customer data from rival institutions because it merely preserves existing customer relationships within each mobile banking application.

With regards to platform access, Barclays exercises monopolistic power over its own service by protecting its platform from external systems and granting exclusive API access to select partners. Pingit platform access is granted under the condition that these complementary third party services (e.g., startups) advance the Pingit ecosystem further by increasing usefulness and transaction volume with the ultimate objective of amplifying Pingit's value proposition. At this stage, Paym does not provide access options towards third parties.

Competitive Principles: Both mobile payment platforms are attempting to create a dominant design in the mobile payment space by creating their own value ecosystem. Barclays possesses the internal resources and the first mover advantage to protect and grow its Pingit ecosystem through its *germination* strategy to extract value. Paym, on the other hand, has entered the market as a second mover. It can be argued that the rollout of Paym is a preemptive move to erode Barclays' potential market dominance. Individually, these financial institutions would not have the leverage to create a competitive solution that could challenge Pingit. Nevertheless, to remain competitive with Pingit, Paym applies an *orchestration* strategy by augmenting the resources of individual financial institutions into a federated mobile payment platform. *We therefore propose that the service layer of mobile payment platforms presents a competitive ground to extract business value while applying a germination or orchestration strategy. Accordingly, the service layer represents a value layer for mobile payment platforms.*

5.5 Content Layer

Platform Layer Dynamics: Each financial institution is *protective* of its payment data because it serves as a valuable resource for generating competitive business insights and by extension, embodying the potential for value extraction. Accordingly, financial institutions are selective in sharing payment data with third parties and prefer to silo their content layer from external ones. Barclays, though, has the advantage to overcome this hurdle due to its own developed mobile payment application. As non-Barclays customers have the ability to install and link their personal data to the Pingit app and generate rich data through their payment habits, Barclays *absorbs* and collects valuable payment data to build future customer relationships (e.g., purchase behavior to for marketing purposes). On the contrary, Paym does not possess the same prospects for data collection. Paym does not exist as a standalone application, but rather as a feature within heterogeneous and isolated mobile banking applications that reinforce existing customer relationships.

Competitive Principles: The content layer is manifested in the form of payment data, which is a valuable and competitive industry specific resource for financial institutions to capture value. Both mobile payment platforms are guarding their content layer by isolating it from third parties. Barclays, however, *infiltrates* the content layer of rivals by applying a Trojan horse strategy through its standalone payment application Pingit, which is installed on non-Barclays customer smartphones. *We therefore propose that the content layer of mobile payment platforms constitutes a value layer to capture business value and that the issuance of dedicated and inclusive mobile payment applications enables data collection opportunities of customers belonging to competitors.*

5.6 Competitive Principles across Platform Layers

To generalize our observations, mobile payment platforms embody two types of platform layers: value and commodity layers. In this study, commodity layers (i.e., device, system, and network) merely serve as a means to reach out and distribute services towards end customers. In other words, commodity layers are means to achieve platform-driven service ubiquity. Conversely, value layers (i.e., service and content layers) present value creation and capturing opportunities, translating into competitive battlegrounds among mobile payment services. Prior to mobile payments, traditional payment instruments (e.g., payment cards) were proprietary and vertically integrated into the organizational boundaries of a financial institution that enabled control and enforcing switching costs. With the prevalence of mobile payment services, previous vertically integrated payment platforms show early signs of deconstruction, which is driven by ubiquitous and affordable smartphones as a new form of payment instrument. In this sense, financial institutions lost the control and the right to issue propriety payment instruments and by that lock-in mechanisms. The result is that financial institutions concentrate their organizational efforts to protect the remaining value layers of digital payment platform. Table 2 summarizes the insights from our comparative case study.

6 Conclusion

This paper was motivated by a growing urgency to improve our comprehension of digital platforms and how the constituent dimensions of such platforms shape market competition for platform-driven ubiquitous systems. Prior platform research has typically treated digital platforms as a generic phenomenon. Whereas one research stream explores the pricing mechanisms among platform users, others either examine how certain platform management strategies induces growth and innovation or investigate the idiosyncrasies of different platform categories (e.g. product or multi-sided platforms) in order to better explain distinctions among these categories [49].

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This study contributes to extant literature on digital platforms and ubiquitous systems by delineating platform-driven ubiquitous systems into five constituent dimensions that drive their potential for market competition. Our study serves as a fitting response to Yoo, et al. [57] call for a deeper understanding of the competitive strategies of layered modular architectures. Specifically, a key theoretical thrust of this paper is our postulation that platform-driven ubiquitous system competition manifests within and across five *platform layers* (i.e., device, system, network, service and content). Furthermore, we discovered that the industry context determines which of the platform layers are designated as: (1) commodity layers enabling service ubiquity, as well as; (2) value layers offering strategic business opportunities to create and capture value.

Table 2: Comparative cross-platform analysis

Platform Layers	Paym	Pingit	Competitive Principles within Platform Layers
Content Layer (Value Layer)	**Protected** Paym adopts a guarded content layer approach by preserving existing data collection rights for each financial institution within heterogeneous mobile banking applications	**Protected & Absorptive** Pingit adopts like Paym a guarded content strategy that does not share the payment data of Pingit users with third parties. The Pingit app, though, is inclusive by serving non-Barclays customers as well that creates data collection opportunities.	**Guarded vs. Infiltrative** Both mobile payment platforms showcase protective behavior on their content layer as payment data serves as valuable industry resource to create value. By releasing a dedicated mobile payment application, Pingit performs a Trojan horse strategy that collects customer and payment data from rival institutions.
Service Layer (Value Layer)	**Federated and Isolative** Paym is a federated mobile payment platform that attempts to augment the individual resources of various financial institutions. In so doing, it preserves existing market structures by being a mobile payment feature within existing mobile banking applications.	**Monopolistic and Breaching** Like Paym, Pingit protects its service layer, moderating and shielding it platform from third parties. Access is granted if these services enhance the value proposition of Pingit. Lastly, Barclays uses the Pingit app as a mean enter in to the territory of rivals to build customer relationships with non-Barclays customers.	**Orchestration vs. Germination** Paym has on its service layer the strategy to offer a competitive industry consortium mobile payment application that solidifies existing market structures and data sovereignties. Barclays has the strategy nurture its own Pingit ecosystem, but leverages on Pingit as a Trojan horse to challenge rivals on their content layer.
Network Layer (Commodity Layer)	**Inclusive** Both mobile payment platforms have non-discriminatory access to the Faster Payment or Link payment network to clear mobile payments. Thus, not presenting a competitive advantage between these two mobile services.		**Accessibility** Network layer for both payment services shares the traits of a commodity layer due to the inability to create access constrains.
System Layer (Commodity Layer)	**Availability** Both mobile payment platforms leverage on widely available and standardized mobile operating systems. Competiveness may occur by developing the mobile payment application that makes the best use of the system resources to ensure best application experience.		**Interoperability** System layer shares the attributes of a commodity layer, as the control and governance is not the realm of financial institutions, but rather controlled by the smartphone vendor.
Device Layer (Commodity Layer)	**Affordability** Both mobile payment platforms leverage on standardized smartphones in delivering their mobile payment services to end customers.		**Ubiquity** Device layer has the attributes of a commodity layer, as the mobile phone as a new payment instrument is now owned by end users and designed by the smartphone vendor.
Competitive Principle across Platform Layers	**Value Layers: Content and Service** Both mobile payment platforms treat the content and service layer as value layers, as they serve as industry specific resource to create and capture business value. **Commodity Layers: Network, System and Device.** Contrary to the content and service layers, the remaining layers serve merely as a mean to deliver the mobile payment as a ubiquitous service to the market.		

As observed in the mobile payment context, the content and the service layers represent value layers that give rise to value creation and capturing opportunities while harnessing payment data as an industry specific resource. The remaining platform layers, on the other hand, share the attributes of commodity layers that foster service ubiquity. Specifically, device, system and network layers of a mobile payment platforms are co-owned or governed by third parties (e.g., smartphones vendors) and that these commodity layers serve merely as *distribution layers*, which are

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accessible to rival firms and obstruct mobile payment providers from enforcing monopolistic power to acquire competitive advantage. We argue, though, that other industries may consider other platform layers as more valuable than the payment industry does. For instance, in the context of smartphone manufacturers, value layers are arguably concentrated on the device and system layers, as they present the most fitting competitive grounds for creating and capturing value.

From our comparative case study, we offer preliminary evidence of the applicability of our framework in unraveling how competition could manifest between monopolistic and federated platform providers offering ubiquitous services. Evidently, Paym, which exhibits attributes of a federated mobile payment platform, obtains its competiveness by augmenting the resources of individual financial institutions (mobile banking applications) on the service layer. This in turn allows the development of a competitive industry consortium solution that solidifies existing market structures and preserves payment data sovereignties on the content layer. Pingit, on the other hand, showcases the traits of a monopolistic platform that obtains its competiveness by tightly coupling the service and content layer. Moreover, Pingit, with its stand-alone mobile payment application attempts to increase its dominance in the market place by internalizing and monetizing valuable payment data of non-Barclays customers as well. In other words, Pingit functions as a Trojan horse on the service layer that attempts to establish new customer relationships that grants Barclays access to the content layer of rival banks.

Pragmatically, we provide decision support by increasing awareness of different platform governance regimes and layer configurations choices available to payment platform providers. Specifically, current and future mobile payment providers can utilize our proposed framework to: (1) identify commodity and value layers of a mobile payment service; (2) unearth their underlying competitive principles, as well as; (3) channel internal resources accordingly to reach their organizational goals. More broadly, our proposed framework supplies managers in other industries with a conceptual tool to analyze and comprehend the dynamics of other digital platform-driven markets in order to arrive at their own competitive strategies. Lastly, the study may assists policymakers and regulators in disentangling industry-specific competitive dynamics in order to design legal frameworks to foster effective market competition and innovation among various stakeholders.

This study is constrained in its generalizability as it utilizes only two cases of mobile payment providers. Furthermore, because we embrace a platform centric approach, this study is constrained in its analysis about privacy or security requirements that may have an impact on the competitive dynamics of platform-driven ubiquitous systems. Having said this, these limitations serve as impetus for future research in this direction, an undertaking we have planned for the near future. Future studies can explore the option of administering a quantitative survey on stakeholders of digital platforms to validate our proposed framework in Table 2. Other avenues for future research could include the exploration of necessary and sufficient conditions for market competition within and across layers as well as the prescription of effective mechanisms to defend against competition from an incumbent and challenger viewpoint.

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