

INTEROPERABILITY OF THE CROSS-BORDER QR PAYMENT INTEGRATION: EVIDENCE FROM ASEAN+3

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ABSTRACT

This study examines the interoperability of cross-border Quick Response (QR) payment systems within Association of Southeast Asian Nations plus China, Japan, and South Korea (ASEAN+3), focusing on how national infrastructures are linked to enable seamless retail transactions. As QR adoption accelerates across Asia, integration between systems such as Malaysia's DuitNow, Indonesia's Quick Response Code Indonesian Standard (QRIS), Singapore's Network for Electronic Transfers (NETS), Thailand's PromptPay, and Cambodia's Bakong has become central to advancing financial inclusion and regional connectivity. Given the nascent stage of regional integration and limited empirical transaction data, this study employs a qualitative, narrative-based approach grounded in secondary data and policy documents to critically review existing national systems and map interoperability gaps. Accordingly, thematic analysis revealed four dimensions shaping readiness and integration: Technological interoperability, regulatory and policy alignment, market adoption, and systemic challenges. Concurrently, findings reveal that while bilateral QR linkages are operational in several jurisdictions, disparities remain in coverage, transaction limits, and regulatory harmonisation, particularly in emerging markets. In particular, Malaysia's DuitNow QR is highlighted as a strategic case, demonstrating how national systems can serve as gateways for regional integration. Additionally, recommendations emphasise the need for ISO 20022 harmonisation, reciprocal regulatory cooperation, and inclusive digital infrastructure to support broader multilateral platforms. Thus, the study underscores the significance of cohesive regional strategies to achieve a financially integrated and digitally inclusive ASEAN+3 ecosystem.

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Introduction

Cross-border QR code payments are rapidly reshaping digital finance in Asia, driven by widespread smartphone usage, fintech innovation, and strong institutional support (Yulius *et al.*, 2023). Within Association of Southeast Asian Nations (ASEAN), member states have developed unified national QR

systems, such as Malaysia's DuitNow in 2019, Indonesia's QRIS in 2019, Thailand's PromptPay in 2017, Singapore's SGQR+/NETS in 2018, and Cambodia's Bakong/KHQR in 2020, that follow EMVCo or ISO 20022 standards and enable diverse payment apps to scan a single code across merchants (Einis, 2023; Yulius *et*

al., 2023; Fintech News, 2025; Gong, 2025). As such, the launch of the ASEAN Integrated QR Code Payment System under the Local Currency Transaction Framework represents a landmark commitment by ASEAN+3 to reduce reliance on major currencies and facilitate seamless regional retail payments (Han & Abdi, 2025).

The growth of e-wallets across ASEAN+3 represents a key enabler of cross-border QR payment interoperability, driven by young, digitally engaged populations, proactive regulatory reforms, and the scalability of QR code technology compared to alternatives such as Near Field Communication (NFC). Correspondingly, policymakers' openness and the adoption of the "same activity, same risk, same regulation" principle have allowed non-financial players to thrive. At the same time, the rise of superapps has created integrated ecosystems that attract strong investor interest. Unlike card-based systems, e-wallets are designed to integrate seamlessly with national QR infrastructures, allowing consumers to transact across borders using familiar applications. According to Boston Consulting Group's (BCG) FinTech Control Tower, payments have been the most well-funded fintech subsector over the past decade, with major players such as Grab, Gojek, MoMo, VNPAY, OVO, and Touch 'n Go collectively raising multi-billion-dollar rounds. This is highlighted by Grab's USD 4.8 billion in 2019 and a record USD 4 billion in 2021, pushing total regional funding that year to USD 10.7 billion (Yulius *et al.*, 2023). Following this, their scalability and widespread adoption provide the technical and market foundation for linking national QR systems, thereby facilitating interoperability across jurisdictions. In this way, e-wallet growth is not a separate phenomenon. Instead, it serves as a necessary mechanism that underpins the success of cross-border QR payment integration in ASEAN+3.

Malaysia is progressing well toward the Financial Sector Blueprint 2022-2026 target of

achieving more than 15% compounded annual growth in average e-payment transactions per capita. In 2024, the volume of e-payment transactions expanded by 19%, reaching 409 transactions per capita compared to 343 in 2023 (Bank Negara Malaysia, 2024c). Concurrently, this growth translates into an average of at least one e-payment per Malaysian per day, a remarkable improvement from just over a decade ago when the national average stood at roughly one transaction per week. Notably, the strong performance in 2024 was largely driven by heightened consumption activity, as reflected in the total value of selected retail e-payment transactions, which grew by 17% to RM698.1 billion (2023: RM592 billion) (Bank Negara Malaysia, 2024c). Generally, this trajectory underscores the deepening adoption of digital payments in Malaysia and highlights its alignment with the national agenda for a more inclusive and digitalised financial ecosystem.

E-payment adoption across ASEAN+3 has also accelerated. In Indonesia, the payments infrastructure market is projected to expand from USD 110.69 billion in 2025 to USD 294.85 billion by 2031. This is driven by Bank Indonesia's BI-FAST system, rapid QRIS merchant onboarding, and widespread mobile wallet use (Mordor Intelligence, 2026b). Meanwhile, Singapore demonstrates maturity, with digital wallets accounting for 39% of e-commerce transaction value in 2024 and penetration reaching 57%. This is supported by PayNow's real-time network used by 80% of consumers and businesses (Antom, 2025a; Asian Banking & Finance, 2025). Moreover, Thailand's PromptPay ecosystem has surged to over 90 million registrations and 74 million daily transactions. At the same time, digital wallet payments reached USD 713.4 billion in 2023, underscoring strong consumer preference for instant payments and Small and Medium Enterprises (SMEs) integration into regional markets (Bank of Thailand, 2021; Ajanapanya,

2025; Antom, 2025b). Nonetheless, China remains dominant, with its payments market valued at USD 43.65 trillion in 2025 and digital wallets capturing over 72% of transactions, reflecting the ubiquity of QR-based superapps (Mordor Intelligence, 2026a; Thunes, 2025). In line with this, Japan's payments market is forecast to grow from USD 280 billion in 2025 to USD 1.36 trillion by 2031. This is anchored by PayPay's QR dominance and modernisation of the Zengin network, alongside government initiatives promoting cashless transactions (Santana, 2025; Mordor Intelligence, 2026c).

Despite these developments, most scholarly work has taken a broad regional lens, with limited focus on how a specific country's national system functions as both domestic infrastructure and regional gateway. In particular, the role of Malaysia's DuitNow QR system, administered by PayNet under Bank Negara Malaysia (BNM), has not been critically assessed in its capacity to connect with other ASEAN+3 systems and support economic benefits such as SME growth, tourism, and financial inclusion. Therefore, addressing this gap is crucial since Malaysia can be viewed as a potential digital payments hub, bridging ASEAN and Northeast Asia through progressively integrated QR mechanisms.

By positioning Malaysia as a gateway for regional digital payment integration, this article contributes to the literature in digital finance and regional economic integration, offering both theoretical insights and practical policy relevance for BNM, PayNet, and ASEAN regulators. It also builds on ASEAN's financial integration agenda, articulated in initiatives such as the Regional Payment Connectivity (RPC) Memorandum of Understanding (MoU), and aligns with ASEAN Economic Community goals and Project Nexus efforts to interlink regional fast payment systems (Bank Negara Malaysia, 2024b; BIS Innovation Hub, 2024).

This article, therefore, aims to fill a critical research void by evaluating the interoperability

of cross-border QR payment systems across ASEAN+3, with Malaysia's DuitNow QR examined as a strategic case to illustrate regional integration pathways. Specifically, the study pursues two objectives: first, to critically analyse the existing national QR systems within ASEAN+3, such as Malaysia's DuitNow, Indonesia's QRIS, Thailand's PromptPay, Singapore's NETS, Cambodia's Bakong, China's Alipay+, South Korea's ZeroPay and Paybooc, and Japan's PayPay, and their readiness for cross-border payment integration. Second, to map the interoperability gaps across technological, regulatory, market adoption, and systemic challenges. Accordingly, by situating Malaysia's domestic progress within the broader ASEAN+3 context, the study contributes to the literature on digital finance and regional economic integration. This includes offering practical insights for regulators, fintech providers, and policymakers.

Literature Review

Cross-Border QR Payment Ecosystems in ASEAN+3: Infrastructures, Standards, and Integration Models

The existing national systems for cross-border payments within the ASEAN+3 region, comprising Malaysia's DuitNow, Indonesia's QRIS, Thailand's PromptPay, Singapore's NETS, Cambodia's Bakong, China's Alipay+, South Korea's ZeroPay and Paybooc, and Japan's PayPay, demonstrate the rapid evolution of QR-based payment infrastructures across economies (Gong, 2025). Notably, these national QR systems are increasingly linked through bilateral and regional arrangements aimed at facilitating seamless, real-time, and low-cost cross-border transactions. As illustrated in Figure 1, Malaysia has successfully established links with several of these systems through its DuitNow QR, serving as a strategic hub for payment connectivity in the region.

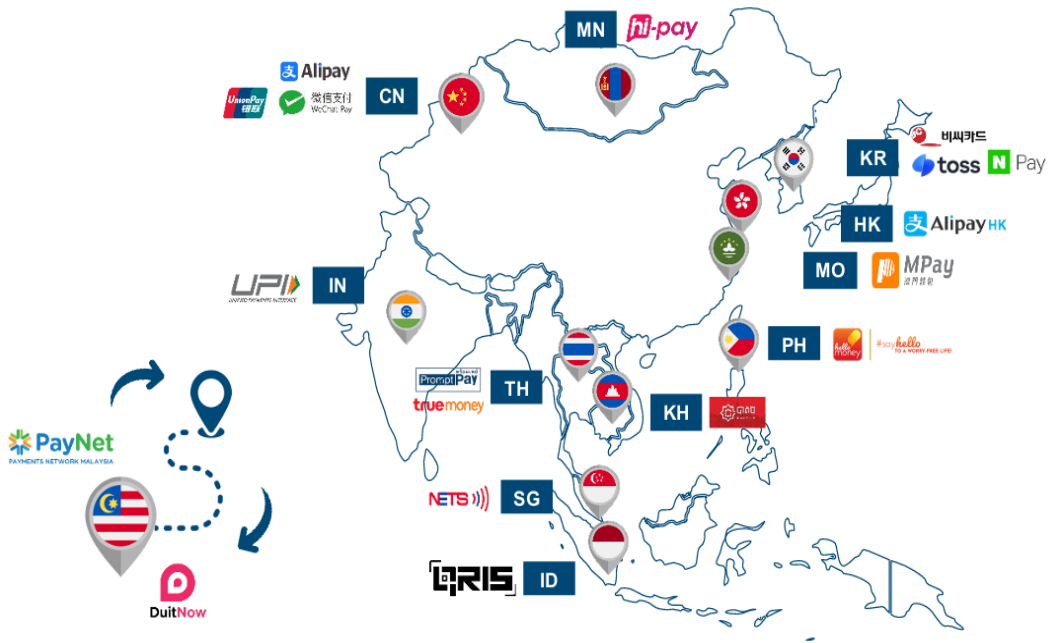


Figure 1: Map of Malaysia’s selected cross-border digital payment partners
 Source: Gong (2025)

In guiding the regional integration, Lammer (2023) proposed a comprehensive framework for cross-border payments, anchored on the adoption and harmonisation of ISO 20022, the international standard for financial messaging. Specifically, ISO 20022 is designed to ensure semantic interoperability, that is, the ability of banks, payment systems, and regulators across jurisdictions to interpret financial data uniformly. This standard plays a critical role in structuring

and exchanging payment instructions, remittance data, and settlement confirmations in a cross-border context (Lammer, 2023). As displayed in Figure 2, ISO 20022 harmonisation must extend beyond message formatting to encompass implementation timelines, usage guidelines, and governance mechanisms. Without such alignment, the risk of fragmented adoption could undermine the efficiency gains promised by the standard.

End-to-end cross-border payments chain and ISO 2022 usage guidelines¹

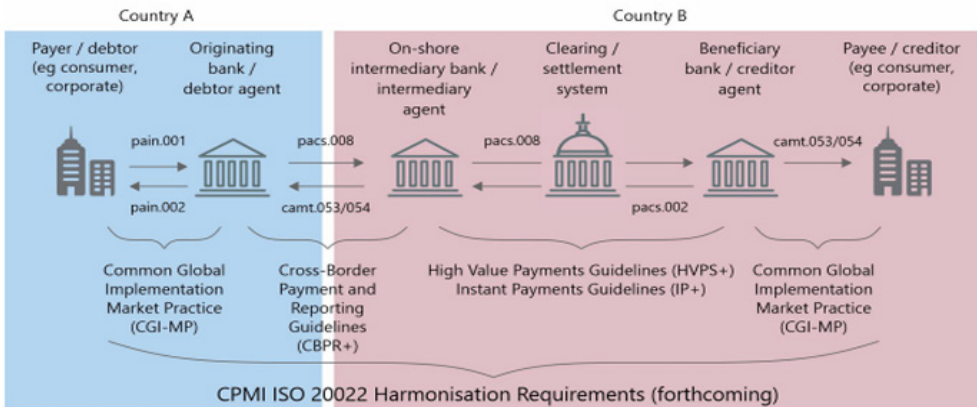


Figure 2: Cross-border payment chain and ISO 2022 usage guidelines

Source: Lammer (2023)

In addition to the international standard for financial messaging, Lammer (2023) stated that the architecture of payment system interconnection also matters. Following this, Figure 3 highlights two models of multilateral cross-border platforms: The hub-and-spoke model and the common platform model. These models, which have been proposed in global initiatives such as the BIS Project Nexus, aim to overcome the complexity and inefficiencies of bilateral arrangements. For

example, the Thailand-Singapore QR payment linkage, connecting PromptPay and PayNow, is coordinated through central banks using a regional hub approach. Subsequently, this model allows countries to connect incrementally while avoiding the burden of full multilateral infrastructure upgrades. Such arrangements are particularly relevant for the ASEAN+3 region, where diversity in technical readiness and regulatory regimes can be significant.

Exploring multilateral platforms for cross-border payments (January 2023)

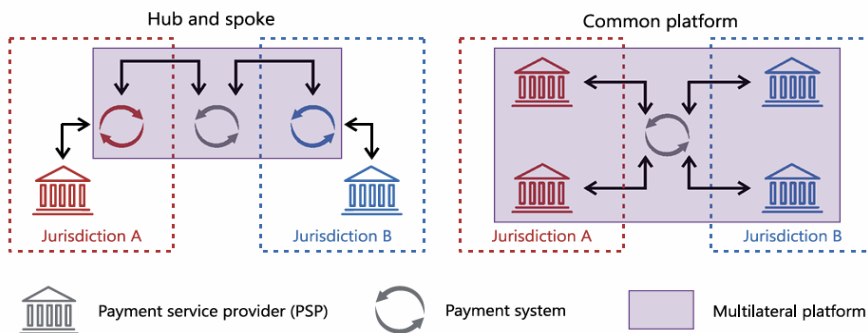


Figure 3: Multilateral platforms for cross-border payment chain

Source: Lammer (2023)

PEST Framework for Assessing Cross-Border Payment Readiness

From a macro perspective of Political, Economic, Social, and Technological (PEST) dimensions, studies confirm that standardised QR infrastructures such as DuitNow, PromptPay, and QRIS are vital to interoperability, reducing fragmentation and ensuring seamless integration across borders (Elms, 2021; Teerapunyachai & Bawornkitchaikul, 2024; Bimantara & Nugraha, 2025). In general, PEST analysis is a strategic framework designed to evaluate the macro-environmental factors that influence industries, organisations, or technological ecosystems. It originated as a derivative of environmental scanning in strategic management studies, with early contributions by Aguilar (1967). The author emphasised the significance of scanning the external environment involving political, economic, social, and technological factors for organisational decision-making. Therefore, to analyse the readiness of ASEAN+3 economies for cross-border QR payment integration, this study adopts the PEST framework, which examines the political, economic, social, and technological factors shaping interoperability and regional adoption.

Political and Legal Dimensions

Political and legal dynamics constitute a foundational layer in shaping the interoperability of QR payment systems across ASEAN+3. Regional initiatives such as the ASEAN RPC reflect significant political commitment to strengthening cross-border financial integration. The QR pay regulation between countries is an agreement outlined in the form of an MoU cooperation document. There are five central banks that have signed, namely Bank Indonesia, Bank Negara Malaysia, Bangko Sentral Pilipinas, Monetary Authority of Singapore (MAS), and Bank of Thailand. Currently, its use is only

based on a cooperation agreement of foreign payments (Tanto *et al.*, 2025). Interestingly, the 2022 MoU between five ASEAN central banks, subsequently expanded to Brunei and Laos in 2024, demonstrates collective momentum toward a unified payment ecosystem (Bank Negara Malaysia, 2022, 2024a; BERNAMA, 2024).

However, political alignment is frequently undermined by regulatory heterogeneity. For instance, Malaysia, Singapore, and Japan permit cross-border data flows under regulated safeguards, whereas Indonesia and Vietnam continue to enforce restrictive data localisation regimes that impede seamless integration (Asian Development Bank, 2023). Although ASEAN introduced Model Contractual Clauses (MCCs) to harmonise regional practices, implementation remains inconsistent, leaving gaps in legal interoperability (Betlehn, 2021; Han & Abdi, 2025). Collectively, these findings indicate that while political coordination establishes frameworks for cooperation, genuine interoperability requires deeper convergence in legal domains. This includes data governance, cybersecurity, and Anti-Money Laundering (AML) standards.

Economic Dimensions

Economic considerations are equally critical in advancing cross-border QR adoption. Economic Partnership Agreements with various countries played a pivotal role in enhancing Malaysia's trade and investment ties globally, fostering deeper economic integration and collaboration (Karim & Said, 2024). Moreover, the introduction of Local Currency Settlement (LCS) frameworks by countries such as Malaysia, Thailand, Indonesia, Singapore, and the Philippines has reduced dependency on

the US dollar. It also simultaneously lowers transaction costs for consumers and merchants (Han & Abdi, 2025).

On a similar note, bilateral instant payment linkages, such as PayNow-PromptPay, exemplify the economic potential of interoperability by facilitating real-time, low-cost transfers that support intra-regional trade (BIS Innovation Hub, 2024). Furthermore, interoperable QR infrastructures give opportunities to Micro, Small, and Medium Enterprises (MSMEs) by reducing merchant onboarding expenses and circumventing reliance on costly card-based infrastructure (Ananda *et al.*, 2024; Haider & Maulan, 2025). Despite these advantages, disparities persist while mature economies offer free retail fee transactions to incentivise adoption. Emerging markets also struggle with limited merchant penetration and elevated operational costs (Khairul Amree, 2023). Thus, sustaining regional adoption necessitates technological interoperability and equitable economic incentives that balance the interests of advanced and emerging economies.

Social Dimensions

The social dimension of QR payment adoption underscores the significance of consumer trust, awareness, and behavioural acceptance. In mature ecosystems, such as Malaysia, Singapore, Thailand, and Indonesia, strong central bank oversight and extensive merchant participation have cultivated high levels of user confidence (Mahusin & Prilliadi, 2025). Remarkably, some ASEAN countries, such as Singapore and Malaysia, boast advanced financial inclusion due to robust digital infrastructure and literacy. By contrast, others, such as Cambodia and Myanmar, struggle with significant unbanked populations (Endress, 2025). Based on Krishna *et al.* (2025), the performance and responsiveness of national cybersecurity commitments represent the most

influential trust indicators from a citizen-centric perspective.

These factors directly shape users' perceptions of the security and reliability of digital payment systems, thereby influencing their willingness to adopt cross-border QR payment solutions. At the same time, individuals' personal values play a central role in forming trust judgments, as tensions may arise when security mechanisms are perceived as misaligned with societal values such as privacy, transparency, or inclusivity. Within the social dimension of QR payment interoperability, this highlights that building trust requires robust cybersecurity frameworks and value-congruent implementation that resonates with diverse cultural expectations across ASEAN+3 markets (Santi & Chalid, 2024; Shah Alam *et al.*, 2024; Sah, 2025).

Technological Dimensions

Technological readiness remains the most visible enabler of cross-border QR payment interoperability. The adoption of international standards such as EMVCo QR and ISO 20022 has significantly reduced system fragmentation in ASEAN markets, particularly in Malaysia, Singapore, Thailand, Indonesia, and the Philippines (Asian Development Bank, 2015, 2023; Pande *et al.*, 2025). Accordingly, these efforts have been reinforced by initiatives such as Project Nexus, which promotes multilateral linkages through standardised frameworks. Furthermore, innovations in settlement systems, such as Instant Payment Solutions (IPS) and multilateral clearing platforms under the BIS, are being piloted to address inefficiencies in cross-border transfers. Additionally, digitalisation of the RMB is a new Chinese initiative whose pace has increased in recent years.

The main goal of the idea is to replace some of the cash in circulation with Central Bank Digital Currency (CBDC or e-RMB) (He,

2021). At the same time, advancements in fraud detection and data security, including encryption, biometrics, and Artificial Intelligence (AI), are strengthening cybersecurity readiness (TechNode Global, 2025). Yet, uneven adoption across Brunei, Laos, and Myanmar illustrates that technological harmonisation remains incomplete. Consequently, the literature suggests that technological standardisation must be complemented by coordinated policy, legal frameworks, and economic incentives to achieve meaningful regional interoperability (Ong *et al.*, 2023; Gomes & Jacob, 2025).

Methodology

This study adopts a qualitative research design to investigate the integration and interoperability of cross-border QR payment systems within ASEAN+3. As such, two distinct methodological approaches were employed to address the study's research objectives. To achieve the first research objective: To critically analyse the existing national QR systems within ASEAN+3, such as Malaysia's DuitNow, Indonesia's QRIS, Thailand's PromptPay, Singapore's NETS, Cambodia's Bakong, China's Alipay+, South Korea's ZeroPay and Paybooc, and Japan's PayPay, and their readiness for cross-border payment integration, a systematic review of secondary data was conducted.

To ensure rigour and transparency, this study employed a systematic review process covering the period of 2015 to 2025, which captures both the pre-launch policy frameworks and post-launch adoption of QR payment systems in ASEAN+3. Data sources included peer-reviewed journals, central bank publications, BIS Innovation Hub reports, Asian Development Bank (ADB) and International Monetary Fund (IMF) documents, fintech industry analyses, and official policy statements. Concurrently, the search strategy combined keywords such as "cross-border QR payments," "ASEAN+3

interoperability," "instant payment systems," and "digital wallet adoption," using Boolean operators to refine results. Interestingly, this approach aligns with established qualitative synthesis protocols that emphasise contextual relevance and evidence-informed analysis (Gough *et al.*, 2017; Thomas & Harden, 2008).

To address the second research objective: To map the interoperability gaps across technological, regulatory, market, and systemic dimensions, the study employed thematic analysis and triangulation. In particular, thematic analysis was conducted following the three-phase framework proposed by Braun and Clarke (2006): Initial coding of textual data, development of descriptive themes, and generation of analytical insights. This method allowed for the identification of four main themes and nine subthemes that reflect the structural, regulatory, and experiential dimensions of interoperability. Note that thematic analysis is widely recognised for its flexibility and depth in interpreting qualitative data, particularly in policy and systems research (Saunders *et al.*, 2023).

To enhance the credibility and robustness of findings, triangulation was applied across data sources, researchers, and theoretical lenses. As such, methodological triangulation ensured consistency by comparing insights from diverse document types, while researcher triangulation involved collaborative coding and validation. Building on this, theoretical triangulation integrated perspectives from sustainability, fintech, and institutional governance to enrich interpretation and policy relevance. Furthermore, triangulation is a well-established strategy for enhancing validity and uncovering complexity in qualitative research (Carter *et al.*, 2014; Tsindos, 2023).

Results and Discussions

The Cross-Border Payment Systems Within ASEAN+3

The findings for the first research objective: To critically analyse the existing national systems for cross-border payment within ASEAN+3, highlight the current operational status, institutional participation, and technical configurations of QR payment systems across the region. Accordingly, the analysis is structured around two transactional directions: (1) Malaysian users making payments abroad, and (2) foreign users making payments in Malaysia. Table 1 below summarises the existing systems for cross-border payment within ASEAN+3.

For Malaysian users paying abroad, the data suggests that interoperability is already operational in several ASEAN+3 jurisdictions, notably Indonesia, Singapore, Thailand, China, Korea, Cambodia, and Japan. These countries support Malaysian-issued QR payment instruments, primarily DuitNow QR, through bilateral arrangements or platform-based integrations. For example, in Indonesia, Malaysian users can transact via QRIS using issuers such as Maybank, CIMB, and TNG Digital. Similarly, in Singapore, NETS QR is interoperable with DuitNow QR, supported by major Malaysian banks and e-wallets. Thailand's PromptPay system also facilitates cross-border QR payments from Malaysia, with relatively high transaction limits (RM50,000.00 daily and RM3,000.00 per transaction). Following this, China offers extensive support through Alipay, UnionPay, and Weixin Pay, enabling Malaysian users to transact seamlessly across multiple merchant categories. Simultaneously, Korea and Japan have enabled cross-border payments via Alipay+ and local platforms such as ZeroPay and PayPay, though transaction limits and issuer coverage vary.

In contrast, countries such as Vietnam, Laos, Myanmar, Brunei, and the Philippines present limited or emerging support. Specifically, Vietnam currently does not support outbound QR payments from Malaysia, though future integration is anticipated. In addition, Laos and Myanmar lack operational interoperability, while the Philippines offers partial support through Alipay+ for selected Malaysian issuers, such as TNG Digital and MyPB. Moreover, Brunei is expected to enable cross-border payment through its strategic partnership with Trangolo, a cross-border payment hub.

For foreign users paying in Malaysia, the data indicates that inbound interoperability is strongest for users from Indonesia, Singapore, Thailand, and China. These users can utilise their domestic QR payment apps, QRIS, NETS, PromptPay, Alipay, and Weixin Pay, to transact with Malaysian merchants via DuitNow QR. Cambodia also supports inbound payments through the Bakong application and Maybank KH, although coverage is more limited. Additionally, Korea's BC Card and Paybooc platforms are interoperable with DuitNow QR, enabling Korean users to make payments in Malaysia. Conversely, Japan offers partial inbound support via Alipay+, though direct bank integration remains limited. By contrast, users from Vietnam, Laos, Myanmar, and the Philippines currently face restricted or unavailable inbound QR payment options.

The findings demonstrate that Malaysia has established a strong foundation for cross-border QR payment interoperability within ASEAN+3, particularly with jurisdictions that have mature domestic QR ecosystems and active participation in regional payment initiatives. Nonetheless, disparities in coverage, transaction limits, and institutional integration suggest that further harmonisation and bilateral expansion are needed to achieve seamless regional interoperability.

Table 1: The existing cross-border payment systems within ASEAN+3

Country	Malaysian Users Paying Abroad	Foreign Users Paying in Malaysia	Interoperability Status
Brunei	No interoperability available	No interoperability available	Emerging
Indonesia	Extensive support via DuitNow QR and QRIS; multiple Malaysian and Indonesian issuers	Indonesian users can pay via DuitNow QR at Malaysian merchants	Operational and mature
Singapore	Integration via DuitNow QR and NETS QR; supported by major banks and e-wallets	Singaporean users can transact via DuitNow QR	Operational and mature
Thailand	PromptPay and DuitNow QR enabled; high transaction limits	Thai banks are interoperable with DuitNow QR	Operational and mature
Vietnam	Not yet available for either direction	Expansion planned for DuitNow QR	Emerging
Cambodia	Enabled via KHQR and Alipay+; moderate transaction limits	Bakong app and Maybank KH support inbound payments	Operational but limited
Laos	Limited to Alipay+; no inbound support yet	No interoperability yet	Emerging
Philippines	Enabled via Alipay+ (TNG Digital, MyBP); inbound via GCash	Limited availability; no direct bank participation	Emerging
Myanmar	No interoperability available	No interoperability available	Inactive
China	Strong support via Alipay, UnionPay, Weixin Pay	Chinese users can pay via DuitNow QR	Operational and advanced
Korea	Enabled via Alipay+ and ZeroPay; tiered transaction limits	BC Card and Paybooc are interoperable with DuitNow QR	Operational and expanding
Japan	Enabled via Alipay+ and PayPay	Limited inbound support via Alipay+	Operational but limited

Source: Authors

The Mapping of the Interoperability Gaps of Cross-Border Payment Within ASEAN+3

The second objective of the study is to explore the mapping of interoperability gaps of cross-border payment within ASEAN+3, such as technical interoperability, regulatory and policy alignment, market adoption, and challenges. This objective is achieved through the thematic analysis and triangulation method on the publicly available documents, such as press releases, technical reports, policy statements, and institutional publications

from central banks, financial institutions, and e-wallet providers. Correspondingly, the findings revealed four main themes of the study: technical interoperability, regulatory and policy alignment, market adoption, and challenges.

Technological Interoperability

Technological interoperability is the cornerstone of cross-border QR payment integration in

ASEAN+3, enabling seamless transactions across diverse financial ecosystems. The adoption of standardised protocols such as EMVCo QR specifications and ISO 20022 messaging formats has significantly reduced fragmentation. Countries such as Malaysia, Singapore, Thailand, Indonesia, and the Philippines have fully implemented EMVCo standards in their national QR systems (e.g., DuitNow, NETS, PromptPay, QRIS, QR PH), while Vietnam and Cambodia are progressing toward compliance (Asian Development Bank, 2015). On a similar note, China, Japan, and South Korea present a mixed landscape, with proprietary systems such as Alipay and WeChat Pay dominating in China, creating barriers to standardisation (Pande *et al.*, 2025).

ISO 20022, endorsed by the ADB, has been adopted or committed to by all ASEAN+3 economies for financial infrastructure modernisation (Asian Development Bank, 2023). This standard supports rich data exchange for backend systems, enhancing settlement efficiency and interoperability (Asian Development Bank, 2015, 2023). Nevertheless, system integration efforts vary: Malaysia, Singapore, and Thailand demonstrate high readiness through bilateral QR linkages and active participation in Project Nexus, a BIS-led initiative to connect instant payment systems multilaterally (Pande *et al.*, 2025). In comparison, Indonesia and Cambodia are building capabilities through regional

partnerships, while countries such as Brunei, Laos, and Myanmar remain in early stages.

Settlement mechanisms are evolving through three models. LCS allows transactions to be settled in domestic currencies, reducing reliance on USD and Foreign Exchange (FX) costs. This model is actively implemented by Malaysia, Thailand, Indonesia, Singapore, and the Philippines under the RPC framework (Han & Abdi, 2025). Notably, IPS integration, exemplified by the PayNow-PromptPay linkage, enables real-time cross-border transfers. In particular, project Nexus aims to scale this model across multiple jurisdictions (BIS Innovation Hub, 2024). Multilateral clearing platforms such as Nexus Global Payments (NGP) are under development to facilitate centralised settlement.

Cybersecurity and fraud prevention are addressed through unified security protocols, regulatory harmonisation, and central bank collaboration. Remarkably, ASEAN is working toward harmonised standards for digital payments, including end-to-end encryption and biometric authentication (Mahusin & Prilliadi, 2025; TechNode Global, 2025). Consistent with this, central banks in Malaysia, Singapore, and Thailand coordinate real-time fraud monitoring and threat intelligence sharing, while AI-driven anomaly detection is increasingly deployed to safeguard transactions (Kokkalakonda, 2022; Fintech News Malaysia, 2025). Table 2 below summarises the emerged subthemes of technological interoperability.

Table 2: Summary of the technological interoperability

Subtheme	Key Inputs/Insights
Standards compliance [use of recognised QR standards (EMVCo, ISO 20022)]	<ul style="list-style-type: none"> <li data-bbox="417 1489 1189 1580">• EMVCo QR was adopted by Malaysia, Singapore, Thailand, Indonesia, and the Philippines, with partial adoption in Vietnam, Cambodia, and mixed use in China, Japan, and Korea. <li data-bbox="417 1586 1189 1644">• ISO 20022 was adopted for RTGS/CSD in most ASEAN+3 countries, though the Philippines and Vietnam are in transition. <li data-bbox="417 1649 1189 1678">• ADB confirms regional commitment to ISO 20022.

System integration (the capability to connect domestic switches with foreign networks)	<ul style="list-style-type: none"> • High readiness: Malaysia, Singapore, Thailand (Project Nexus). • Emerging efforts: Indonesia, the Philippines, Cambodia. • Limited progress: Vietnam, Brunei, Laos, Myanmar. • Proprietary systems challenge: China (Alipay/WeChat), Japan, Korea.
Settlement mechanism (how transactions are settled across borders)	<ul style="list-style-type: none"> • LCS: Active in Malaysia, Thailand, Indonesia, Singapore, the Philippines. • IPS Integration: PayNow-PromptPay, Project Nexus. • Multilateral Clearing Platforms: NGP under BIS.
Cybersecurity and fraud prevention (measures to secure cross-border QR transactions)	<ul style="list-style-type: none"> • Unified security protocols under RPC. • Regulatory harmonisation: KYC/AML, data protection. • Central bank collaboration: Fraud monitoring, threat intelligence. • Technological safeguards: Dynamic QR, biometrics, AI fraud detection.

Source: Authors

Regulatory and Policy Alignment

Regulatory and policy alignment is essential to operationalising cross-border QR payments. The RPC initiative, signed by eight ASEAN members, promotes interoperability through standardised QR formats, regulatory harmonisation, and LCS (Bimantara & Nugraha, 2025; Han & Abdi, 2025). Malaysia has signed MoUs with key ASEAN+3 partners, including China [through China Construction Bank (Malaysia)], Japan, and South Korea, facilitating bilateral QR linkages and advancing regional integration goals (Bank Negara Malaysia, 2013, 2022a, 2023a, 2023b, 2024a; Fintech News Malaysia, 2021; BERNAMA, 2024). Meanwhile, Project Nexus, operationalised through NGP, provides a multilateral governance structure supported by central banks and the BIS Innovation Hub.

Still, data protection laws remain a critical challenge. Countries such as Malaysia, Singapore, and Japan permit cross-border data transfers under adequacy or contractual safeguards, while Vietnam and Indonesia enforce stricter localisation requirements. In

particular, the ASEAN MCCs aim to harmonise standards and facilitate secure data flows, but implementation is uneven (Asian Development Bank, 2023). Thus, these legal divergences complicate interoperability and necessitate coordinated policy efforts to ensure compliance and trust across jurisdictions.

Fragmentation in regulatory frameworks also affects the pace of RPC adoption. ASEAN+3 Macroeconomic Research Office (AMRO) highlights that while bilateral arrangements are expanding, the complexity of integration increases with each new linkage. Accordingly, regulatory alignment, technological capacity, and central bank engagement are key determinants of success (TechNode Global, 2025). Similarly, the ASEAN Leaders’ Declaration on Advancing RPC (2023) underscored the need for innovation-driven approaches and the promotion of local currency transactions to strengthen economic sovereignty (ASEAN, 2023; Ammar, 2025). Table 3 below outlines the emerged subthemes of the regulatory and policy alignment.

Table 3: Summary of the regulatory and policy alignment

Subtheme	Key Inputs/Insights
Bilateral and multilateral agreements (formal agreements enabling cross-border QR linkages)	<ul style="list-style-type: none"> • MoU between the Central Banks of Indonesia, Malaysia, the Philippines, Singapore, and Thailand in 2022. • Brunei Darussalam Central Bank and Bank of the Lao P.D.R. formally joined the Regional Payment Connectivity Initiative in 2024. • MoU between Brunei Darussalam Central Bank and Bank of the Lao P.D.R. on Cooperation in Regional Payment Connectivity (MOU RPC) in 2024. • MoU between BNM and the National Bank of Cambodia in 2024. • MoU between China Construction Bank (Malaysia) (CCBM) and Payments Network Malaysia (PayNet) in 2021.
Data protection laws (rules for handling cross-border payment data)	<ul style="list-style-type: none"> • Varying national laws: Malaysia, Singapore, and Japan allow transfers with safeguards, while Vietnam and Indonesia impose localisation. • ASEAN MCCs aim to harmonise standards, though implementation is uneven.

Source: Authors

Market Adoption and User Experience

Market adoption and user experience reflect the practical realities of QR payment usage across borders. Merchant acceptance is uneven: Although Malaysia's DuitNow QR supports foreign users from most ASEAN+3 countries, including China, Japan, and South Korea, it lacks integration with Brunei, Laos, Vietnam, Cambodia, and Myanmar (Bank Negara Malaysia, 2023b; Khairul Amree, 2023; Gomes & Jacob, 2025). Consequently, this limits the reach of cross-border payments and underscores the need for broader merchant onboarding.

Consumer awareness is growing in countries with operational bilateral linkages. In Singapore, Malaysia, and Thailand, public confidence is bolstered by central bank oversight and the perceived security of national systems. The RPC initiative has helped demystify cross-border payments by promoting local currency usage and reducing reliance on traditional banking intermediaries (Ong *et al.*, 2023; Mahusin &

Prilliadi, 2025). However, in emerging markets such as Vietnam and Cambodia, awareness remains limited outside urban centres. In addition, trust issues persist due to fragmented infrastructure and concerns over fraud and data privacy.

Transaction costs and incentives play a pivotal role in driving adoption. The RPC framework enables direct payments in local currencies, bypassing USD-based conversions and reducing FX costs. Interestingly, many bilateral QR linkages offer fee-free transactions for small payments, promoting financial inclusion and encouraging habitual QR usage for travel, remittance, and commerce (Han & Abdi, 2025). Strategic pricing models also reduce intermediary costs, making QR payments more accessible to MSMEs (Mahusin & Prilliadi, 2025). Table 4 below tabulates the emerged subthemes of the market adoption and user experience.

Table 4: Summary of the market adoption and user experience

Subtheme	Key Inputs/Insights
Merchant acceptance network (merchant coverage and readiness for foreign customers)	<ul style="list-style-type: none"> • DuitNow QR supports inbound payments from nine countries. • Brunei, Laos, Vietnam, and Myanmar are not yet interoperable.
Consumer awareness and trust (public understanding and confidence in cross-border QR payments)	<ul style="list-style-type: none"> • High awareness: Singapore, Malaysia, Thailand, Indonesia. • Trust anchored in central bank oversight. • Challenges in emerging markets: Limited education, infrastructure gaps.
Transaction costs and incentives (pricing and promotional strategies)	<ul style="list-style-type: none"> • LCS reduces FX costs. • Fee-free transactions for retail users. • Incentives promote financial inclusion and QR usage.

Source: Authors

Challenges and Way Forward

The implementation of cross-border QR payments across ASEAN+3 faces several structural and operational challenges that must be addressed to ensure seamless interoperability and inclusive adoption. One of the foremost challenges is the fragmentation of regulatory frameworks across jurisdictions. Despite regional efforts such as the RPC initiative, countries continue to operate under divergent licensing regimes, Know Your Customer (KYC)/Anti-Money Laundering (AML) protocols, and consumer protection standards (Mendelson, 2025; Twimbit, 2025). As a result, this lack of harmonisation complicates bilateral and multilateral integration, especially when onboarding new participants or scaling existing linkages. Additionally, data governance and privacy laws vary significantly, with some economies enforcing strict data localisation requirements that hinder real-time transaction processing and cross-border data exchange (Baker, 2024).

Another critical issue lies in technological disparities among member states. While countries such as Malaysia, Singapore, and Thailand have advanced digital payment

infrastructures and support EMVCo QR standards, others, such as Laos, Myanmar, and Brunei, face limitations in system readiness, merchant onboarding, and digital literacy. Correspondingly, these gaps create uneven access and restrict the full potential of regional interoperability (Hamada, 2025). Moreover, cybersecurity vulnerabilities and the absence of unified fraud prevention protocols pose risks to consumer trust and system resilience (Gomes & Noor Baharin, 2023; HiTRUST, 2025).

Without coordinated threat monitoring and shared intelligence frameworks, cross-border QR systems remain exposed to exploitation and reputational damage. From a market perspective, consumer awareness and merchant acceptance remain uneven. Conversely, in more developed economies, users are familiar with QR payment systems and trust their reliability. However, in emerging markets, low digital literacy and limited outreach efforts have slowed adoption (Gomes & Noor Baharin, 2023). Merchants, particularly MSMEs, may lack the incentives or infrastructure to support foreign QR transactions, further limiting the network effect needed for scale.

To address these challenges, a multi-pronged strategy is essential (Gomes & Noor Baharin, 2023). First, ASEAN+3 should accelerate regulatory harmonisation by adopting shared standards for licensing, compliance, and consumer protection. Notably, the ASEAN MCCs and the Data Management Framework offer viable tools for aligning cross-border data governance. Second, technical capacity-building must be prioritised in less-developed markets through sandbox testing, infrastructure grants, and public-private partnerships.

Third, cybersecurity coordination should be institutionalised via central bank collaboration, regional CERTs (Computer Emergency Response Teams), and AI-driven fraud detection systems (Gomes & Noor Baharin, 2023). Fourth, market development efforts, including merchant onboarding campaigns, fee waivers, and consumer education, should be scaled to ensure inclusive adoption. Finally, the region must embrace a phased multilateral integration model, building on successful bilateral linkages while preparing for broader participation in platforms such as Project Nexus (Bank Negara Malaysia, 2022b).

Conclusions

This study provides a comprehensive, narrative-based examination of the cross-border QR payment ecosystem within the ASEAN+3 region from Malaysia's strategic vantage point. Thus, by evaluating the existing infrastructure, interoperability mechanisms, policy frameworks, and macroeconomic readiness across member countries, the paper underscores both the progress made and the gaps that persist in achieving seamless regional integration. Following this, the analysis reveals that while Malaysia, Singapore, Thailand, and Indonesia have made significant strides in real-time payment linkages and adherence to common standards such as ISO 20022, broader

integration across the ASEAN+3 region remains uneven.

The thematic findings suggest that a successful cross-border QR payment ecosystem hinges on three critical enablers: (i) Interoperability infrastructure (both bilateral and multilateral), (ii) regulatory alignment and data governance, and (iii) inclusive market participation across consumer, merchant, and institutional levels. In particular, DuitNow QR's linkage to regional systems such as QRIS and PromptPay demonstrates Malaysia's pivotal role in advancing interoperability. It also highlights the need for multilateral platform approaches to reduce dependency on bilateral corridors. Furthermore, macroeconomic and sociopolitical variances, especially in legal harmonisation, trust, and digital inclusion, pose challenges that go beyond technical integration.

The potential benefits of full interoperability are clear: Enhanced financial inclusion, accelerated digitalisation of micro and small businesses, and improved tourism and trade facilitation. Nevertheless, realising these benefits requires a stronger commitment to common regional frameworks, deeper stakeholder engagement, and more proactive policy experimentation. Generally, the findings of this study offer significant implications for multiple stakeholder groups engaged in shaping, regulating, and implementing cross-border QR payment integration in the ASEAN+3 region. Following the conclusion that regional interoperability is progressing yet fragmented, it becomes crucial to translate these insights into actionable steps.

First, for policymakers and central banks, the study highlights the importance of regulatory alignment and cross-border cooperation. The urgency of adopting common messaging standards, such as ISO 20022, and developing data-sharing frameworks that respect national sovereignty while enabling efficient transactions

cannot be overstated. Institutions such as BNM, the MAS, and the Bank of Thailand are in positions to lead these regional dialogues. Second, financial institutions and fintech providers must consider how to reconfigure backend infrastructures to accommodate multilateral interoperability. The study underscores the need for robust cybersecurity measures, customer authentication technologies, and seamless user experiences across borders. Overall, these enhancements will be essential to building trust and encouraging merchant and consumer participation at scale.

Third, from an academic standpoint, this non-empirical contribution provides a conceptual foundation for future empirical research. By framing the narrative through the PEST analysis, the study opens pathways for economic impact assessments or policy benchmarking among ASEAN+3 nations. Finally, for the broader regional development agenda, cross-border QR payment systems offer more than just financial convenience. They also serve as a conduit for economic inclusion, especially for MSMEs, rural consumers, and informal sector participants. Additionally, the integration of these systems aligns well with ASEAN's digital economy aspirations, though to ensure equitable benefits, inclusive policy mechanisms and capacity-building initiatives must be intensified across less digitally mature economies in the region.

This study is subject to several limitations that should be acknowledged. First, the analysis relies primarily on secondary data sources, including policy documents, institutional reports, and industry publications. Consequently, this restricts the ability to capture real-time consumer behaviour and transaction-level outcomes. Second, while Malaysia's DuitNow QR is examined as a strategic case within ASEAN+3, the findings may not be fully generalisable to economies with less mature payment infrastructures. Third, the rapidly evolving

nature of fintech and payment systems means that some insights may become outdated as new bilateral and multilateral initiatives emerge. Finally, regulatory and policy variability across ASEAN+3 creates challenges for comparability and may limit the scope of generalisation. In response, future research should therefore incorporate empirical transaction datasets, comparative case studies across multiple ASEAN+3 economies, and deeper investigation into regulatory harmonisation and multilateral platform development to validate and extend the findings.

Declaration on the Use of Large Language Models (LLMs)

The authors declare that no generative AI tools were used in the preparation of the research content, analysis, or findings of this manuscript. The entire conceptualisation, methodology, data collection, and interpretation were conducted solely by the authors. For the purpose of improving clarity, grammar, and language style, the authors utilised ChatGPT as a language editing tool. The use of this tool was limited to linguistic refinement only and did not contribute to the generation of substantive content, ideas, or arguments presented in the manuscript. The authors take full responsibility for the originality, accuracy, and integrity of the manuscript.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest, either for self-benefits, commercial purposes, or any financial conflicts, regarding the publication of this manuscript.

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