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Blockchain and Cryptocurrencies in Digital Payment Systems: A Review of Global Practices

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Abstract
Digital technology is rapidly transforming the financial services landscape. Payment networks are moving from cash and centralized control toward digital models that are faster and safer. Among the key innovations are blockchain and cryptocurrencies, two landscape-shaping technologies. They enable payments that are decentralized, transparent, and fast.
This article conducts a literature review of international studies and cases focused on digital payment systems built on blockchain technology. It examines the evolution of these technologies, the settings in which they are deployed, and the challenges they raise. The review draws on academic research, case illustrations, and official reports to demonstrate how blockchain enhances security, speed, and trust in payments. It also evaluates risks, including market volatility, cybercrime, and difficulties with regulation.

The analysis concentrates on the performance of digital currencies, central bank digital currencies (CBDCs), and cross border payments. By comparing country level practices, the paper offers insights, policy implications, and future opportunities. The study contends that when technology, regulation, and governance progress in alignment, blockchain and cryptocurrencies can enable a more inclusive and efficient payment system.

Keywords: - Blockchain Technology, Cryptocurrencies, Digital Payment Systems, Central Bank Digital Currency, FinTech

Introduction
Digital payment systems form a central pillar of the global financial infrastructure, enabling transactions to occur smoothly across temporal, geographic, and physical boundaries. Over the past twenty years, advances in mobile phones and information technologies have accelerated this shift. The service infrastructure of a business credit, card, remittance, or check dependent society has evolved into an information centric wireless and mobile dependent environment. Such improvements arose from parallel objectives: offering consumers easier access while delivering more efficient data management for firms and financial institutions. According to the Bank for International Settlements (2023), the volume of digital payments has surged in both advanced and emerging economies, propelled by mobile banking, contactless payments, and real time gross settlement systems. This transformation has reflected shifts in consumer behavior, notably a stronger preference for cashless transactions because of health and safety concerns brought to the forefront by the COVID 19 pandemic (Auer et al., 2022).

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Amid the ongoing digital transformation, blockchain technology and cryptocurrencies have produced a major shift in paradigm. Where conventional electronic payments typically rely on centralized intermediaries such as banks, card networks, and payment facilitators, blockchain offers a distributed design that recasts the foundations of trust and control for participants. Originally proposed by Nakamoto (2008) through Bitcoin, blockchain records and verifies transactions on shared ledgers while reducing dependence on third party institutions that traditionally guarantee settlement. Cryptocurrencies built upon this system detach digital payments from national boundaries and enable peer to peer transfers that are transparent, secure, and in many instances nearly instantaneous for users and firms. Taken together, these advances have captured the attention of technologists and financial innovators worldwide and have triggered complex policy debates and regulatory deliberations across diverse jurisdictions and markets.

There have been promising and troubling episodes in the expanding blockchain based payments ecosystem and markets. On one side, DeFi and stablecoins have created new pathways to financial inclusion, particularly in regions with limited access to basic banking services (Schar, 2021). Furthermore, the rollout of central bank digital currencies is a clear sign that governments and monetary authorities are embracing blockchain informed models to modernize payment systems, while simultaneously enforcing regulation (International Monetary Fund, 2022). Conversely, the price volatility of cryptocurrencies, ongoing environmental harms from energy intensive mining, and persistent fears of cyber crime among policymakers and economists have raised doubts about the project (Yermack, 2015). Taken together, these developments underscore the need for a balanced assessment of both the disruptive potential and the attendant risks embedded in this technology.

Hence, review aims are threefold. First, this paper attempts to collate and review global academic materials available on the use of blockchain and cryptocurrency in digital payment systems. Secondly, it considers the advantages, limitations and regulatory difficulties that have arisen because of such fusion. Third, it seeks to find trends and best practices which might inform the construction of resilient, inclusive payment ecosystems in the future. Its cross-national focus considers contrasting experiences in developed and developing countries and low-income countries, with a view to identifying patterns of convergence and divergence in policy responses and adoption trajectories.

By placing developments in blockchain and cryptocurrency in the context of the wider development of digital payment systems, this paper sets the conceptual and contextual scene for an overall comparison of practices globally. The following section describes how relevant academic and industry sources on which the following analysis was conducted were identified and appraised, thus ensuring that the results are based on systematic evidence and not anecdotal observation.

Methodology of the Review

The systematic review methodology, with integrative narrative synthesis, is used in this review to provide a broad context on blockchain and cryptocurrency use cases for digital payment systems. The methodology aimed to provide robust and transparent procedures for replication, following well-established guidelines for review studies in social sciences and management (Snyder, 2019).

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The review proceeded through three phases. Systematic search of scholarly and industry literature First, systematic search of relevant academic and industry literature was conducted in the main academic databases, including Scopus, Web of Science, and ScienceDirect, and professional repositories, such as SSRN and BIS, and IMF digital libraries. Terms and search strings, such as "blockchain in payment systems," "cryptocurrency adoption," "digital currency regulation" and "FinTech innovation" were utilized, and references were reviewed from 2010 to 2024. This time span has been chosen to observe the development of blockchain technology, as from its theoretical availability to a more recent establishment in the world of conventional financial transactions.

Second, the researcher used inclusion and exclusion criteria to screen the literature that the researcher had found. All peer-reviewed journal articles, conference proceedings, institutional reports and policy briefs were eligible if authors made direct reference to both blockchain and cryptocurrencies, specifically within the context of payment systems. Letter to the editor, non-reviewed media, and literature that failed to make empirical or conceptual contribution were removed (to maintain intellectual standards). Following the screening stage, the researchers retained a corpus of 162 documents for subsequent detailed analysis.

Third, the analysis also employed integrative synthesis, aligning quantitative and qualitative findings within a single interpretive frame. This approach was chosen to study blockchain and cryptocurrencies as emerging phenomena that require the interplay of multiple perspectives, including technological, economic, regulatory, and behavioral dimensions. The review organizes the literature into four principal themes (i) technological foundations and innovations (ii) adoption patterns and illustrative cases (iii) regulatory architectures and policy debates (iv) opportunities, challenges, and prospective trajectories. Within each theme the researchers then scrutinized the evidence to determine where findings converged or diverged and to identify remaining gaps within the existing scholarship.

To strengthen methodological rigor, conclusions were cross validated by juxtaposing insights derived from academic work with information drawn from empirical datasets and reports issued by reputable organizations, such as the Bank for International Settlements, the International Monetary Fund, and the World Bank. Preference was given, where feasible, to research produced within the past five years in order to preserve currency and relevance in light of the rapid pace of innovation in blockchain technologies.

Although this approach is well grounded, it is not without some shortcomings. The evolutionary pace of blockchain and cryptocurrency research suggests that more recent advances may occur during or after the review of this article. Additionally, some closed source industry data and pilot project assessments could be kept private, limiting the full picture of private sector innovations.

By employing such a structured approach, the review seeks to provide a balanced, evidence-informed summary of leading practices around the world which can inform the subsequent discussion on the potentially disruptive impact and constraints of blockchain-based digital systems.

Blockchain technology in payment system

The birth of decentralized finance Blockchain in payment systems is a watershed in the development of global finance. Unlike traditional electronic payment systems that rely on a few

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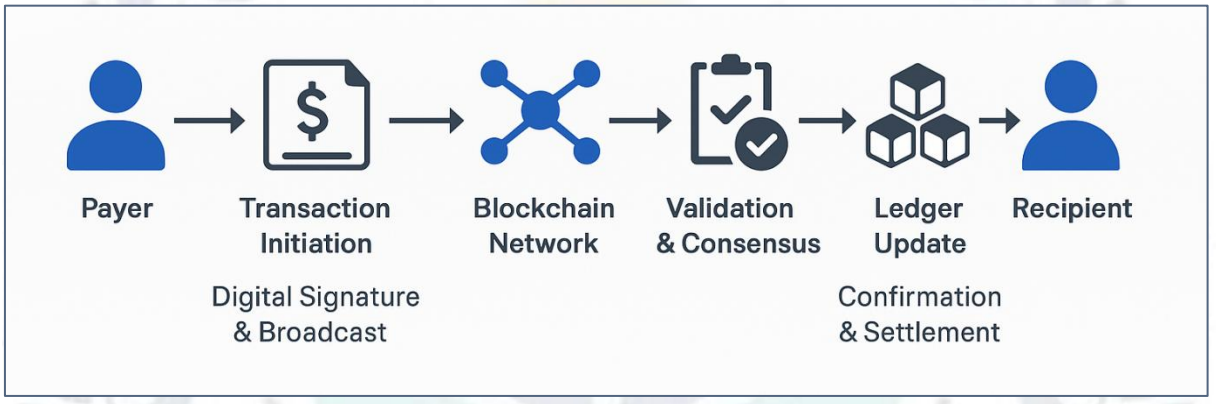
intermediaries (e.g., banks or card networks), the blockchain operates under a distributed ledger mechanism, in which every qualified transaction is verified and recorded by a plethora of participants via consensus protocols. This element of decentralization of trust is expected to be transformative into trust-based corporate commercial structures and creates scope for the redesign of payment clearing systems (Catalini & Gans, 2016).

At the heart of the blockchain's promise of payments is the opportunity for peer-to-peer transactions, with no need for a trusted intermediary. Through their immutable record of transactions recorded in time sequence, blockchain systems facilitate auditability and guard against the threat of double-spending. Blockchain's properties have not only attracted the growth of cryptocurrencies but have also enabled cross-border remittances, especially in traditional banking systems that tend to be slow and expensive (Narula, 2021). Ripple's blockchain-based settlement network has been implemented by financial institutions to send international payments faster and with lower costs than the SWIFT network for cross-border payments like Santander and MoneyGram (Scott et al., 2021).

Figure 1: - Workflow of blockchain-enabled payment system



Source: - Author's own illustration (2025)

Blockchain also makes possible programmable payments via smart contracts, self-executing codes that automatically conduct the terms of an agreement. This goes beyond mere value transfers, enabling possibilities for conditional payments, escrow services, and even the administration of a supply chain or fast trading (Schar, 2021). These developments are in line with the wider open banking and embedded finance trends empowering businesses to embed payment services seamlessly within their business operations.

The two most promising use cases have been for the creation of stablecoins and central bank digital currencies (CBDCs). Stablecoins — like USD Coin or Tether — are intended to reduce fluctuations by pegging their value to a "real" currency, thereby making them more useful for peer-to-peer transactions. CBDCs, meanwhile, are the central banks' own attempts to mimic blockchain designs, albeit with regulatory supervision and oversight over monetary policy. Countries like China, Nigeria, and Brazil have already rolled out or tested CBDCs to modernize their payment systems and increase financial inclusion (International Monetary Fund, 2022).

Nevertheless, blockchain has its impediments that prevent it from being applied in payment systems. Scalability and energy efficiency are still key challenges, particularly in consensus mechanisms based on proof-of-work that require substantial amounts of computational power. Alternative consensus protocols such as proof of stake aim to mitigate these issues but introduce

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their own governance complexities (Narayanan et al., 2016). Moreover, the immutability of blockchain records, while beneficial in many contexts, creates challenges for data protection, regulatory compliance, and the correction of errors.

At the regulatory tier, blockchain based payments intersect with AML and CTF obligations, prompting proposals for uniform global regulatory frameworks (Zohar, 2015). The potential for misuse within underground and black market related transactional settings has unsettled policymakers, even though the transparency of blockchain can furnish powerful forensic auditing instruments when applied responsibly in practical contexts.

In sum, blockchain technology holds substantial promise for reconfiguring the architecture of payment systems by enabling transactions that are faster, more secure, and more transparent. Yet realizing these benefits requires overcoming technical constraints, instituting robust governance mechanisms, and aligning regulatory approaches. Hybrid arrangements appear likely as payment ecosystems continue to evolve, with models that combine centralized oversight and distributed innovation expected to become a defining trajectory.

Worldwide adoption of cryptocurrencies

Global uptake of cryptocurrencies as instruments for payment and the transfer of value has accelerated over the past decade, propelled by technological innovation and evolving socio-economic demands. Initially conceived as a new form of money beyond the authority of governments and banking institutions, digital assets such as Bitcoin and Ethereum have moved from fringe circles into the mainstream awareness of global finance. By 2024, cryptocurrency market capitalization had surpassed 2 trillion USD, alongside participation from retail and institutional investors, while several governments experimented with blockchain based solutions for payments and settlements (Chainalysis, 2023).

Adoption dynamics, however, differ significantly by area. Many advanced economies, including U.S. and EU member states, have seen cryptocurrencies used as a speculative investment asset class or as a trial settlement mechanism for cross-border transactions. Crucially, several fintech companies and leading payment processors such as PayPal and Visa have enabled customers to transact with cryptocurrencies as part of crypto backed services (Scott & Zachariadis, 2021). Simultaneously, developing economies have seen a more pragmatic adoption, driven frequently by financial inclusion imperatives and a push for remittances. For example, the 2021 move of El Salvador to adopt Bitcoin as legal tender was introduced to circumvent excessive costs of international transfer systems, yet it has produced mixed economic and social reactions (World Bank, 2022).

Table 1: - Recent global blockchain and cryptocurrency payment initiatives (2021-2024)

Year	Country/Region	Initiative	Description / Focus Area	Source
2021	Nigeria	eNaira (CBDC)	Africa's first central bank digital currency launched for retail payments	IMF, 2022
2021	El Salvador	Bitcoin as Legal Tender	Government initiative integrating Bitcoin into domestic payment systems	BIS, 2022

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2022	European Union	European Blockchain Services Infrastructure	Pilot cross-border blockchain network for payments and public services	EU, 2022
2022	India	Digital Rupee (Pilot)	Reserve Bank of India testing blockchain-enabled wholesale/retail CBDC	RBI, 2023
2023	United States	FedNow (Instant Payment System)	Real-time payment infrastructure with parallel blockchain pilots in banks	Federal Reserve, 2023
2023	China	e-CNY (Digital Yuan) Expansion	Expansion of pilot cities for the central bank digital currency	PBOC, 2023
2024	Brazil	Drex (CBDC Project)	Nationwide pilot for blockchain-based CBDC aimed at instant payments	BIS, 2024
2024	United Arab Emirates	Project Aber II	Cross-border blockchain-based payment corridor with Saudi Arabia	BIS, 2024

Note: - Table compiled by the author based on information from official publications by the Bank for International Settlements (BIS), the International Monetary Fund (IMF), the Reserve Bank of India (RBI), the People's Bank of China (PBOC), the Federal Reserve, and European Union (2021-2024).

Decentralized finance (DeFi) and the issuance of stablecoins have been two of the strongest catalysts for cryptocurrency adoption. This means that you can use such an instrument to transact with less of the volatility risk, much in the same way that you can use a derivative to buy it in the marketplace. According to Schar (2021), the existence of dollar-pegged stablecoins has offered a pseudo-stable medium of payment in jurisdictions with volatile domestic currencies, forming a parallel digital cash system available through mobile wallets.

For the use of cryptocurrency, responses by governments show a double-edged treatment. On the one hand, regulators are raising the bar on compliance, introducing a set of new regulations around anti-money laundering (AML) and counter-terrorism financing (CTF) that acknowledge the risk of using cryptocurrency for unlawful activities. Elsewhere, governments and central banks are also experimenting with central bank digital currencies for similar reasons, such as in China, Nigeria, India, Brazil, to incorporate innovations inspired by blockchain within regulated financial systems (International Monetary Fund, 2022).

Nevertheless, challenges persist. The high price volatility of cryptocurrencies also hinders their adoption as a reliable medium of exchange at scale. The technical constraints around the inability to scale and power-hungry consensus mechanisms serve to prevent wide adoption (Narayanan et al., 2016). In addition, digital literacy and infrastructure dividing between areas are an obstacle to the standardization of adoption.

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To conclude, worldwide uptake of cryptocurrencies has been driven by innovation and by necessity, following distinct paths in advanced and in emerging economies. Although cryptocurrencies promise to democratize finance and lower transaction costs, their eventual place within mainstream digital payments will hinge on resolving regulatory, technological, and socio-economic constraints. The evolving landscape therefore calls for a comprehensive assessment of global practice to delineate routes toward the responsible incorporation of cryptocurrencies into payment systems.

Regulatory and Policy Perspectives

The rapid spread of blockchain and cryptocurrency payment mechanisms has sparked extensive regulatory and policy debate worldwide. Unlike legacy payment instruments that function within regulated banking systems with clear avenues for redress, cryptocurrencies mark a break from established norms by enabling borderless and pseudonymous transfers. Such decentralization creates room for innovation but also produces complex governance challenges. Unsurprisingly, regulators are portrayed as mediating the balance between financial innovation and the imperatives of consumer protection, financial stability, and national security (Zohar, 2015). Their design shifts trust from central authorities to protocol governed networks.

One persistent regulatory concern regarding cryptocurrencies is their use in illicit activity, including money laundering, tax evasion, and terror financing. Bodies such as the FATF have issued recommendations for the regulation of virtual assets to ensure they face compliance obligations comparable to those imposed on traditional financial firms (FATF, 2021). Nevertheless, rules remain uneven across jurisdictions. While the European Union has adopted a fully fledged framework through the Markets in Crypto Assets regulation, many developing economies are still at an early stage of designing effective oversight (European Commission, 2023).

Another central policy issue is the volatility of cryptocurrencies, which can undermine their function as a medium of exchange. Central bankers also warn that widespread use of volatile privately issued tokens could disrupt the transmission of monetary policy. In response, many authorities are piloting central bank digital currencies, which aim to combine the technical advantages of blockchains with the stability of sovereign money. For instance, the People's Bank of China's e CNY project and the European Central Bank's inquiry into a digital euro signal growing interest in central bank digital currencies (Auer et al., 2022).

There are also cross border challenges for regulators, since blockchain transactions routinely traverse national boundaries. Financial regulation largely remains domestic, yet the borderless character of virtual currencies means unilateral action has limited effect. This has prompted calls for international coordination, with institutions such as the Bank for International Settlements advocating harmonized policy responses that curb regulatory arbitrage arising from these platforms while still fostering innovation (BIS, 2022). Cooperation tools include information sharing, supervisory colleges, and common standards for identity and risk.

Concerns about consumer protection and operational resilience have likewise moved to the forefront of the policy agenda. The collapse of prominent cryptocurrency exchanges and decentralized finance protocols, exemplified by the FTX failure in November 2022, underscores the dangers posed by unregulated venues and the absence of investor safeguards. Consequently, regulators in many jurisdictions are considering rules that impose stronger governance, capital, and operational risk management standards on digital payments service providers.

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These regulatory currents are producing a more formal environment for the use of blockchain and cryptocurrency, yet innovation and regulation do not always coexist comfortably. Excessively strict rules may stifle innovation, whereas insufficient oversight can heighten risks within financial systems and for consumers. Accordingly, forthcoming policy proposals should articulate principles for proportional regulation, transparency obligations and accountability, and cross border collaboration in order to harness the transformative promise of blockchain based payments in a responsible way.

Challenges

The adoption of blockchain and cryptocurrency for payments has raised serious issues. One fundamental concern is the scalability of the system, namely how fast it can operate while remaining efficient. Public blockchain systems such as Bitcoin and Ethereum are often throughput limited because consensus protocols impose significant computational demands, and therefore they cannot efficiently process a high volume of transactions due to protocol performance. These bottlenecks make them less suitable for large scale retail payments and cross border settlements where speed and throughput (transactions processed per second) matter (Narayanan et al. 2016). While neither layer two solution nor other consensus mechanisms like PoS are silver bullets, the latter are under development and come with trade offs for security and decentralization.

Energy and the environment present a further challenge. Mining in proof of work blockchains is computationally demanding and energy intensive, prompting questions about carbon footprints. Although more energy efficient consensus mechanisms (e.g., proof of stake) have emerged (de Vries, 2021), the shift toward greener alternatives is at varied stages across blockchain networks.

Regulatory challenges are likewise formidable. As an international form of money, cryptocurrencies cross borders and slip outside jurisdiction, leaving gaps within existing Anti Money Laundering (AML) and Counter Terrorism Financing (CTF) frameworks. Moreover, the diverse approaches countries have taken to regulate cryptocurrencies have created compliance burdens for market participants and constrained innovation in global payment products (FATF, 2021).

Consumer trust and digital literacy also pose practical difficulties. Insufficient awareness of wallet and key management, combined with the irreversibility of transactions on the blockchain, exposes users in low literacy and low technology literacy regions to heightened risk.

Limitations

Beyond these immediate concerns, several foundational constraints still prevent blockchain and crypto from functioning as mainstream payment systems. Not least is price volatility, which renders many cryptocurrencies a poor medium of exchange. Frequent extreme price swings expose consumers and firms to risk and make such assets unsuitable for routine transactions. Although stablecoins can mitigate this problem, their value depends on credible collateral arrangements that remain vulnerable to market stress (Arner et al. 2020).

Another barrier to progress is the absence of formal consumer protection for many retail users. The very immutability of blockchain has produced irreversible losses through fraud, hacking, or operational failure, and this stands in contrast to the fiat banking system, including deposit insurance provided by governments such as in the United States.

Finally, blockchain platforms face interoperability frictions with conventional and legacy financial infrastructure. A lack of common technical standards obstructs straightforward

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connections between blockchain payment platforms and banking networks, thereby significantly constraining large scale deployment in practice.

Best Practices and Future Trends

As the integration of blockchain and cryptocurrencies with digital payment solutions has moved into the mainstream, several best practices have taken shape. The first is that cooperative regulatory architectures have proved essential. Jurisdictions that pursue technology neutral, forward looking rules, such as the European Union's Markets in Crypto Assets proposal, are building ecosystems that are innovation friendly while accounting for systemic risk. Adherence to benchmarks issued by bodies such as the Financial Action Task Force for AML and CTF has strengthened consumer trust and market quality.

Public and private collaboration is another element, illustrated by central bank digital currency pilots. Experiences in China, Brazil, and India demonstrate how regulators can partner with technology firms to steer innovation toward public goals, including financial inclusion and safe cross border payments. Alongside these efforts, there is a shift toward scalable technical designs such as proof of stake consensus, interoperable blockchain networks, and layer two protocols, which raise transaction throughput while reducing environmental harm.

Looking ahead, trends point to hybrid payment settings that blend the decentralization of blockchain with the oversight of trusted institutions. The meeting point of blockchain with artificial intelligence and the Internet of Things will enable smart payments that are integrated into the routines of businesses and households. Notable too is the rise of tokenized assets that use blockchain to represent claims on physical property such as real estate and securities, as well as intellectual property, which may broaden blockchain uptake in financial services.

Global payment systems will likely become more open and more transparent, yet outcomes will depend on the capacity to innovate, to internationalize regulation, and to construct resilient and well integrated infrastructure that is efficient and secure. If history offers a guide, by applying lessons from earlier waves of adoption, the broader blockchain community can build a more sustainable and inclusive future for blockchain based payments.

Conclusion

This review examined the evolution and integration of blockchain and cryptocurrency technologies within the global digital payments landscape around the world today. The analysis indicates that blockchain provides advantages in decentralization, transparency, and security, while cryptocurrencies function as innovative financial instruments and as enablers of alternative payment arrangements. Adoption patterns worldwide have differed, with advanced market economies emphasizing financial innovation and efficiency, whereas developing economies deploy these tools to enhance financial inclusion and access for low value, cross border remittances. At the same time, regulatory initiatives by policymakers, including central bank digital currencies, demonstrate continuing efforts to embed these developments within stable and well supervised frameworks that enhance financial stability and integrity.

The review also identifies enduring barriers to overcome, such as scalability, high energy consumption, regulatory ambiguity, and the potential for consumer harm. These obstacles highlight the fact that, although blockchain and cryptocurrencies are redrawing the future of payments, they have yet to be fully realized, as they depend on robust governance models, technological readiness, and international collaboration. The extent to which such innovation is allowed to flourish as digital financial ecosystems are formed will be a key factor in the viability of the blockchain-based payment solutions.

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