JLPH: Journal of Law, Politic and Humanities
E-ISSN: 2962-2816
P-ISSN: 2747-1985
https://dinastires.org/JLPH dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/jlph.v6i1

On-Chain Off-Chain Regulation On Crypto Asset In Indonesia Market

Aloysius Bernanda Gunawan[1*], M.S. Tumanggor[2], Adi Nur Rohman[3], Amalia Syauket[4]
[1]Business Law, Bina Nusantara University, Jakarta, Indonesia, ab.gunawan@binus.ac.id
[2]Universitas Bhayangkara Jakarta Raya, Jakarta, Indonesia, tumanggor@dsn.ubharajaya.ac.id
[3]Universitas Bhayangkara Jakarta Raya, Jakarta, Indonesia, adi.nur@dsn.ubharajaya.ac.id
[4]Universitas Bhayangkara Jakarta Raya, Jakarta, Indonesia, amalia.syauket@dsn.ubharajaya.ac.id

[*]Corresponding Author: ab.gunawan@binus.ac.id[1]

Abstract: The advancement of blockchain technology has created challenges for traditional regulatory frameworks, regarding consumer protection in crypto asset ecosystems. This paper examines dichotomy between on-chain governance mechanisms embedded within blockchain protocols and off-chain regulatory approaches imposed by state authorities. Through normative legal research and comparative analysis of international regulatory practices, this study identifies critical gaps in Indonesia's current crypto asset regulatory framework. The research reveals that existing regulations, through government's commodity-based approach, inadequately address the technological governance inherent in blockchain systems like smart contracts, decentralized protocols, and automated consensus mechanisms. The study proposes a hybrid regulatory construction that synchronizes technological governance with traditional state regulation to create comprehensive consumer protection. The findings demonstrate that integrating on-chain compliance mechanisms with off-chain oversight can enhance consumer safety while maintaining innovation momentum. This research contributes to digital law study by providing regulatory models suitable for Indonesia's legal system and broader emerging market contexts.

Keyword: Blockchain Regulation, Crypto Asset, Cyber Law

INTRODUCTION

The emergence of blockchain technology and crypto assets represents a paradigmatic shift in financial systems, challenging traditional regulatory frameworks worldwide (Silva & Ferreira, 2020). Indonesia's position as the third-largest crypto adoption market globally according to the 2024 Global Crypto Adoption Index underscores the urgency of developing comprehensive regulatory approaches that balance innovation facilitation with robust consumer protection mechanisms (Chainalysis, 2024). The decentralized nature of blockchain technology creates unique challenges for traditional regulatory approaches that were designed for centralized systems with clear hierarchical control structures (De Filippi & Wright, 2018).

The current regulatory landscape exhibits a significant dichotomy between two distinct governance mechanisms. On-chain regulation operates through automated protocols embedded

within blockchain systems, utilizing smart contracts and consensus mechanisms to enforce predetermined rules without human intervention (Chason, 2023). This technological governance operates according to the principle of "code as law," where algorithmic execution ensures compliance with programmed parameters (Lessig, 2006). Conversely, off-chain regulation encompasses traditional regulatory mechanisms imposed by state authorities, including licensing requirements, compliance monitoring, and dispute resolution through conventional legal channels.

This regulatory duality creates substantial challenges for consumer protection in crypto asset ecosystems. Consumers frequently interact with decentralized protocols that operate beyond traditional regulatory oversight, yet when disputes or losses occur, conventional legal remedies prove inadequate due to jurisdictional complexities and the pseudonymous nature of blockchain transactions (Perdana & Jhee Jiow, 2024). The collapse of major crypto projects such as Terra Luna demonstrates how the misalignment between technological governance and regulatory oversight can result in significant consumer harm without effective recourse mechanisms (Briola et al., 2023).

The research addresses three fundamental questions that are critical for developing effective crypto asset regulation in Indonesia. First, how do existing legal frameworks address crypto asset regulation from a consumer protection perspective, and what gaps exist in current approaches? Second, how can on-chain and off-chain regulatory mechanisms be synchronized to achieve optimal consumer protection while maintaining the innovative potential of blockchain technology? Third, what regulatory construction can Indonesia adopt to ensure comprehensive consumer legal protection while fostering sustainable growth in the digital asset ecosystem?

METHOD

This research employs normative juridical methodology to analyze existing legal frameworks and develop prescriptive recommendations for improved crypto asset regulation. The normative approach focuses on examining legal principles, statutes, and regulations to identify gaps and inconsistencies in current regulatory approaches while proposing ideal legal constructions based on theoretical foundations and comparative analysis.

The research utilizes three complementary approaches to achieve comprehensive analysis. The statute approach involves detailed examination of Indonesia's current legal framework governing crypto assets, including regulations issued by Indonesia’s Commodity Futures Trading Supervisory Agency or Bappebti, Indonesia’s Financial Service Authority or OJK, and other relevant agencies, as well as broader legal instruments such as the Electronic Information and Transactions Law. The conceptual approach draws from established legal theories including Development Law Theory, regulatory technology frameworks, and consumer protection principles to provide theoretical grounding for analysis and recommendations.

The comparative approach examines international regulatory models from jurisdictions that have developed sophisticated approaches to crypto asset regulation. This includes analysis of the European Union's Markets in Crypto-Assets Regulation, the United States' dual agency approach through the Security and Exchange Commission (SEC) and Commodity Futures Trading Commission (CFTC), and innovative regulatory frameworks from Asia-Pacific jurisdictions such as Singapore and Hong Kong. The comparative analysis focuses on identifying best practices that could be adapted for Indonesia's legal system while considering the unique characteristics of Indonesia's regulatory environment and market conditions.

RESULTS AND DISCUSSION

Current Regulatory Framework Assessment

Indonesia's current approach to crypto asset regulation centers primarily on Bappebti Regulation No. 8 of 2021, which categorizes crypto assets as tradeable commodities rather than legal tender or securities. This commodity-based classification brings crypto assets under the jurisdiction of futures trading regulations, subjecting crypto exchanges and trading platforms to licensing requirements, customer verification procedures, and transaction reporting obligations. However, this regulatory framework exhibits significant limitations in addressing the comprehensive nature of crypto asset ecosystems. This regulation was updated in Law Number 4 of 2023 concerning the Development and Strengthening of the Financial Sector, which transferred oversight of crypto assets from Bappebti to OJK. In earlier 2025, OJK states that all regulation from Bappebti will be implemented during transistion periods.

The existing regulatory structure demonstrates a clear bias toward off-chain governance mechanisms while largely ignoring the on-chain governance structures that are fundamental to how blockchain systems operate (Barbereau & Bodó, 2023). Bappebti's regulations focus primarily on centralized intermediaries such as exchanges and custody service providers, but fail to address decentralized protocols, smart contracts, and peer-to-peer transactions that occur entirely within blockchain networks. This creates substantial regulatory gaps where significant portions of crypto asset activity remain outside the scope of consumer protection mechanisms.

Furthermore, the current framework lacks adequate mechanisms for addressing cross jurisdictional issues that are inherent to blockchain technology. Many crypto assets and protocols operate across multiple jurisdictions simultaneously, making traditional territorial based regulatory approaches inadequate for comprehensive oversight. The pseudonymous nature of many blockchain transactions further complicates enforcement efforts when consumer harm occurs, as traditional identification and accountability mechanisms may not be applicable.

International Comparative Analysis

The European Union's Market in Crypto Asset (MiCA) Act represents the most comprehensive attempt to create integrated regulation covering both technological and traditional aspects of crypto asset governance (Conlon et al., 2024). MiCA establishes unified standards across all EU member states for crypto asset issuers, service providers, and market operators while maintaining specific provisions for different categories of crypto assets including utility tokens, asset referenced tokens, and electronic money tokens.

MiCA's approach to consumer protection includes mandatory reserve requirements for stablecoin issuers, comprehensive disclosure obligations for crypto asset issuers, and specific conduct of business rules for crypto asset service providers (Ferreira & Sandner, 2021). The regulation also establishes clear authorization procedures and ongoing supervision requirements that create accountability frameworks for market participants. Significantly, MiCA attempts to address some on-chain governance issues by requiring crypto asset service providers to have policies and procedures for handling blockchain forks, airdrops, and other protocol level events that can affect consumer holdings.

However, MiCA's approach still exhibits limitations in fully integrating on-chain governance mechanisms. The regulation primarily focuses on traditional regulatory approaches applied to crypto asset service providers rather than directly engaging with the technological governance embedded in blockchain protocols themselves. This suggests that even the most advanced regulatory frameworks continue to struggle with the fundamental challenge of regulating decentralized systems through centralized regulatory mechanisms.

Meanwhile, The United States has developed a complex regulatory framework involving multiple agencies with overlapping and sometimes conflicting jurisdictions over different

aspects of crypto assets (Makarov & Schoar, 2020). The Securities and Exchange Commission (SEC) treats most crypto assets as securities subject to federal securities laws, while the Commodity Futures Trading Commission (CFTC) regulates Bitcoin and Ethereum as commodities. This dual approach creates regulatory uncertainty but also provides flexibility for addressing different types of crypto assets according to their specific characteristics and risks.

Recent enforcement actions by the SEC demonstrate both the potential effectiveness and limitations of applying traditional securities regulation to crypto assets (Saggu et al., 2025). While enforcement actions can address clear cases of fraud and misrepresentation, they often occur after consumer harm has already occurred and may not be well suited for addressing the unique characteristics of decentralized protocols and automated market makers that operate without traditional intermediaries. The United States approach also highlights the challenges of international coordination in crypto asset regulation. Enforcement actions against crypto projects often result in those projects relocating to more permissive jurisdictions rather than ceasing operations entirely, potentially creating regulatory arbitrage opportunities that can undermine consumer protection efforts.

In Asia, Singapore and Hong Kong have developed regulatory frameworks that attempt to balance innovation facilitation with consumer protection through careful market segmentation and graduated regulatory approaches (Burgess & Liu, 2025). Singapore's Payment Services Act creates specific categories for different types of crypto asset services while maintaining lighter regulatory requirements for activities that pose lower risks to consumers. The framework includes provisions for regulatory sandboxes that allow innovative crypto asset services to operate under relaxed regulatory requirements while being closely monitored for consumer protection issues (Hudima et al., 2025).

Meanwhile, Hong Kong's approach emphasizes professional investor protections while maintaining more restrictive approaches for retail consumers (Chan, 2023). The Securities and Futures Commission requires crypto asset trading platforms to limit retail investor access to certain products while providing more comprehensive access to professional investors who are presumed to have greater risk tolerance and technical sophistication. This segmented approach recognizes that different categories of consumers may require different levels of regulatory protection.

On-Chain versus Off-Chain Regulatory Mechanism

The fundamental challenge in crypto asset regulation stems from the coexistence of two distinct governance systems that operate according to different principles and mechanisms (Wendl et al., 2023). On-chain governance operates through automated protocols that execute predetermined rules without human intervention, creating efficient and transparent systems for certain types of transactions and relationships. Smart contracts can automatically execute complex financial arrangements, distribute rewards according to algorithmic formulas, and manage decentralized autonomous organizations without traditional corporate governance structures (Ungureanu et al., 2025).

However, on-chain governance mechanisms also exhibit significant limitations that create consumer protection challenges. Smart contracts cannot be easily modified once deployed, meaning that programming errors or changing circumstances may not be addressable through traditional legal remedies (Weber, 2025). The immutable nature of blockchain transactions means that consumers may have limited recourse when they make errors or become victims of fraud. Furthermore, the pseudonymous nature of many blockchain interactions makes it difficult to identify responsible parties when problems occur.

Off-chain regulatory mechanisms provide important consumer protections through traditional legal frameworks including dispute resolution procedures, compensation schemes,

and enforcement mechanisms that can compel specific actions by identified parties. However, these mechanisms often prove inadequate when applied to decentralized systems where there may not be identifiable parties who can be held legally accountable for system failures or consumer losses. Traditional regulatory approaches also struggle with the global nature of many crypto asset protocols, which may not have a clear legal domicile or regulatory home.

Hybrid Regulatory Construction

The research proposes a hybrid regulatory framework that systematically integrates on-chain and off-chain governance mechanisms to create comprehensive consumer protection while maintaining the innovative potential of blockchain technology. This framework recognizes that neither purely technological nor purely legal approaches are sufficient to address the complex governance challenges presented by crypto asset ecosystems. Instead, effective regulation requires careful coordination between automated technological governance and traditional legal oversight.

The hybrid framework operates through three interconnected layers that address different aspects of Crypto asset governance. The protocol layer focuses on establishing minimum technical standards for blockchain protocols and smart contracts that interact with Indonesian consumers, including requirements for code auditing, emergency response mechanisms, and consumer notification procedures for protocol upgrades or modifications. The intermediary layer addresses traditional financial service providers that facilitate consumer access to crypto assets, maintaining existing licensing and supervision requirements while adapting them to address crypto-specific risks. The market layer establishes overarching market integrity standards that apply regardless of whether activities occur through centralized or decentralized mechanisms.

Preventive Protection Mechanism

Effective consumer protection in crypto asset markets requires robust preventive mechanisms that address risks before they materialize into consumer harm. The proposed framework establishes mandatory technical standards for smart contracts and protocols that serve Indonesian consumers, including requirements for formal verification procedures, comprehensive testing protocols, and ongoing security monitoring. These standards would be enforced through a combination of certification requirements for protocols that wish to market to Indonesian consumers and liability frameworks for intermediaries that facilitate access to non compliant protocols.

The framework also establishes enhanced disclosure requirements that go beyond traditional financial service disclosures to address the unique risks presented by crypto assets. These requirements include plain language explanations of technical risks such as smart contract bugs, protocol governance risks, and key management responsibilities. Consumer education initiatives would be integrated into the regulatory framework through requirements for intermediaries to provide standardized educational materials and risk assessments before consumers can access higher risk crypto asset products.

International coordination mechanisms represent another crucial component of preventive protection.The framework establishes procedures for cooperation with foreign regulators and information sharing agreements that enable coordinated responses to cross border crypto asset risks. This includes participation in international standard setting bodies and the development of mutual recognition agreements with jurisdictions that maintain comparable consumer protection standards.

Responsive Enforcement Mechanism

When preventive measures prove insufficient and consumer harm occurs, the regulatory framework must provide effective mechanisms for investigation, enforcement, and consumer remediation. The proposed framework establishes specialized investigation capabilities that can trace blockchain transactions, analyze smart contract code, and coordinate with international partners when crypto asset investigations cross jurisdictional boundaries. This includes technical expertise within regulatory agencies and partnerships with specialized service providers who can assist with blockchain analytics and forensic investigations.

The framework creates graduated enforcement mechanisms that can be tailored to different types of violations and market participants. Minor violations by licensed intermediaries may be addressed through supervisory measures and corrective action plans, while more serious violations or unlicensed activities may warrant civil enforcement actions or criminal referrals. The framework also establishes specialized dispute resolution mechanisms for crypto asset disputes, including expedited procedures for cases involving technical issues and alternative dispute resolution options that can provide faster and less expensive resolution than traditional litigation.

Consumer remediation mechanisms represent a particularly challenging aspect of crypto asset enforcement given the immutable nature of blockchain transactions and the difficulty of identifying and recovering assets in decentralized systems. The framework establishes compensation schemes funded by industry contributions that can provide remediation for consumers who suffer losses due to fraud system failures, or other qualifying events. These schemes would operate similarly to deposit insurance programs but would be adapted to address the unique characteristics of crypto asset risks.

CONCLUSION

The reconstruction of crypto asset regulation through integrated on-chain and off-chain mechanisms represents a fundamental paradigm shift in how regulatory frameworks can address technologically mediated financial systems. The proposed hybrid regulatory framework offers a viable pathway for Indonesia to balance the promotion of blockchain innovation with robust consumer protection mechanisms that address the unique risks and opportunities presented by crypto asset ecosystems.

The research demonstrates that traditional regulatory approaches, while necessary, are insufficient to address the comprehensive governance challenges presented by blockchain technology and decentralized financial systems. Effective regulation requires sophisticated integration of technological governance mechanisms with traditional legal frameworks, creating coordinated systems that can address risks and protect consumers regardless of whether activities occur through centralized or decentralized mechanisms.

The success of this approach depends critically on sustained commitment to implementation across multiple regulatory agencies, significant investment in institutional capacity building, and ongoing international cooperation to address the global nature of crypto asset markets. The framework's emphasis on preventive measures rather than purely reactive enforcement represents an important shift toward proactive consumer protection that can reduce the likelihood of significant consumer harm while maintaining space for beneficial innovation.

Future research should focus on empirical validation of the proposed framework's effectiveness once implemented, comparative analysis of how similar approaches perform in other jurisdictions, and ongoing refinement of the framework to address emerging technologies and market developments. The integration of technological and legal governance mechanisms represents an important step toward creating resilient and inclusive financial systems that can

harness the benefits of blockchain innovation while maintaining appropriate protections for consumers who participate in these systems.

The proposed framework should offers significant potential benefits not only for Indonesia but also for other emerging market jurisdictions that face similar challenges in regulating crypto assets while promoting financial innovation. By developing comprehensive and adaptive regulatory approaches, Indonesia can position itself as a leader in digital asset regulation while creating an environment that supports sustainable growth in blockchain based financial services and maintains strong consumer protection standards.

REFERENCE

Barbereau, T., & Bodó, B. (2023). Beyond financial regulation of crypto-asset wallet software: In search of secondary liability. *Computer Law & Security Review*, *49*, 105829. https://doi.org/10.1016/J.CLSR.2023.105829

Briola, A., Vidal-Tomás, D., Wang, Y., & Aste, T. (2023). Anatomy of a Stablecoin's failure: The Terra-Luna case. *Finance Research Letters*, *51*, 103358. https://doi.org/10.1016/J.FRL.2022.103358

Burgess, T., & Liu, J. (2025). A tale of two jurisdictions: Contrasting cryptocurrency regulations in Hong Kong and the United Kingdom. *Journal of Economic Criminology*, *8*, 100150. https://doi.org/10.1016/J.JECONC.2025.100150

Chainalysis. (2024). *2024 Global Crypto Adoption Index*. https://www.chainalysis.com/blog/2024-global-crypto-adoption-index/

Chan, G. (2023). Anti Money Laundering Laws - a Thorn in the Side of the Four Asian Tigers. *Journal of Law, Market and Innovation*, *2*(1). https://doi.org/10.13135/2785-7867/7443

Chason, E. D. (2023). *Regulating Crypto, On and Off the Chain* (Vol. 64). https://scholarship.law.wm.edu/wmlr

Conlon, T., Corbet, S., & Oxley, L. (2024). The influence of European MiCa regulation on cryptocurrencies. *Global Finance Journal*, *63*, 101040. https://doi.org/10.1016/J.GFJ.2024.101040

De Filippi, P., & Wright, A. (2018). *Blockchain and the Law*. Harvard University Press. https://doi.org/10.2307/j.ctv2867sp

Ferreira, A., & Sandner, P. (2021). Eu search for regulatory answers to crypto assets and their place in the financial markets infrastructure. *Computer Law & Security Review*, *43*, 105632. https://doi.org/10.1016/j.clsr.2021.105632

Hudima, T., Kamyshanskyi, V., Kulyk, O., & Dovhan, V. (2025). Stability without Consensus : Legal Approaches to Stablecoins in the EU, UK, Singapore and Japan. *Financial and Credit Activity: Problems of Theory and Practice*, *3*(62), 577–588. https://doi.org/10.55643/fcaptp.3.62.2025.4745

Lessig, L. (2006). *Code 2.0*. https://archive.org/details/Code2.0

Makarov, I., & Schoar, A. (2020). Trading and arbitrage in cryptocurrency markets. *Journal of Financial Economics*, *135*(2), 293–319. https://doi.org/10.1016/J.JFINECO.2019.07.001

Perdana, A., & Jhee Jiow, H. (2024). Crypto-Cognitive Exploitation: Integrating Cognitive, Social, and Technological perspectives on cryptocurrency fraud. *Telematics and Informatics*, *95*, 102191. https://doi.org/10.1016/J.TELE.2024.102191

Saggu, A., Ante, L., & Kopiec, K. (2025). Uncertain Regulations, Definite Impacts: The Impact of the U.S. Securities and Exchange Commission's Regulatory Interventions on Crypto Assets. *Finance Research Letters*, *72*, 106413. https://doi.org/10.1016/J.FRL.2024.106413

Silva, J. F., & Ferreira, F. de S. (2020). Navigating the Transformative Potential and Legal Challenges of Cryptocurrencies and Blockchain Technology. *Revista Ft*, 50–51. https://doi.org/10.69849/revistaft/ar10202012011050

Ungureanu, P., Bellesia, F., & Cochis, C. (2025). Dealing with blame in digital ecosystems: The DAO failure in the Ethereum blockchain. *Technological Forecasting and Social Change*, *215*, 124096. https://doi.org/10.1016/J.TECHFORE.2025.124096

Weber, R. H. (2025). *From traditional to decentralized governance in the crypto environment: legal framework for decentralized autonomous organizations and decentralized finance* (J. Lee & A. Darbellay, Eds.; p. 267). Edward Elgar Publishing. https://doi.org/10.4337/9781803929996

Wendl, M., Doan, M. H., & Sassen, R. (2023). The environmental impact of cryptocurrencies using proof of work and proof of stake consensus algorithms: A systematic review. *Journal of Environmental Management*, *326*, 116530. https://doi.org/10.1016/J.JENVMAN.2022.116530