

The digital dawn of German law: from code to courtroom, tokenisation, case-law and the future

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Abstract: Germany's legal system is currently undergoing a profound digital transformation that tests the adaptability of a traditionally codified and conceptually rigorous civil-law order. This article explores how German law responds to technological innovation not by allowing technology to redefine legal concepts, but by integrating new digital realities within established legal frameworks. The central argument is that the digitalisation of law in Germany follows an evolutionary, system-preserving approach, at least in the realm of private law: Rather than constructing a parallel digital code, legislators, courts and legal scholars reinterpret existing doctrines of contract, property and corporate law to accommodate blockchain, tokenisation and artificial intelligence. At the same time, the transformation of regulatory law has been far more dynamic, marked by the creation of new legal regimes governing financial markets, data and digital infrastructures. Together, these developments illustrate an approach of constructing a 'hybrid legal infrastructure' in which digital technologies are embedded under, rather than above, the rule of law, thereby preserving legal certainty while enabling technological progress.

Keywords: *blockchain and tokenisation, digital transformation of law, German civil law, legaltech and AI, regulatory innovation*

1. Introduction

Blockchain, smart contracts and tokenisation are challenging established legal doctrines and necessitating new legislation. Alongside the enduring framework of the German *Civil Code* (*Bürgerliches Gesetzbuch*, hereafter BGB), enacted in 1896 and entering into force on 1 January 1900, recent legislative developments such as the German *Electronic Securities Act 2021* (*Gesetz über elektronische Wertpapiere*, hereafter eWpG) and digital finance reforms signal a deliberate adaptation of German law to technological innovation.

This article examines how courts, legislators and regulators are integrating these advances while maintaining the conceptual coherence of civil law. Through an analysis of case-law, regulatory initiatives and pilot projects in on-chain notarisation and legaltech compliance, it illustrates Germany's evolution towards a hybrid legal infrastructure that incorporates digital technologies into the traditional framework of legal certainty and the rule of law.

At the political level, the current coalition has made adapting the legal framework to the requirements of digital transformation a central pillar of its legislative agenda. Building on the diverse digital policy visions of the governing parties, its work programme seeks to modernise the financial market framework while fostering innovation, market integrity and consumer protection (CDU, CSU and SPD, 2025). The core initiatives include the further implementation of the European Markets in Crypto-assets Regulation (MiCAR) ('Council regulation (EU) 2023/1114', 2023; *CMS Law*, 2023), the creation of a coherent national framework for artificial intelligence (AI) and data governance aligned with the EU's *AI Act* and *Data Act* and preparations for the introduction of a digital euro and open-finance architecture (for a more detailed assessment, see Möslein and Omlor, 2025a, p. 556). Against this backdrop, the present article analyses how German law accommodates blockchain-based mechanisms within existing civil and financial law structures.

The article proceeds in six parts. First, it explores the legal and regulatory status of crypto-assets. Second, it describes legislative reforms with regard to central bank digital currencies (CBDCs) and stablecoins. Third, it addresses the legal recognition and enforceability of smart contracts by examining on-chain notarisation and dispute-resolution models. Fourth, it explores the

tokenisation of real-world assets under private and securities law. Fifth, it assesses the role of legaltech and regtech solutions in compliance and financial supervision. Finally, it explores the legal path ahead for AI-based legaltech.

2. The legal and regulatory status of crypto-assets

The legal treatment of crypto-assets in Germany reflects the tension between technological innovation and regulatory coherence (Möslein, 2025a, p. 765, paras. 16–38). Introduced in 2020, the *Kryptowerte* category of the *Banking Act* (*Kreditwesengesetz*, hereafter KWG) defined digital value representations serving as a means of exchange, payment or investment but neither issued nor guaranteed by central banks (for more detail, see Behrens and Schadtler, 2020; Blassl and Sandner, 2020; Fromberger, Haffke and Zimmermann, 2019; Rennig, 2020; Resas, Ulrich and Geest, 2020, pp. 2099–2107). Germany’s approach exemplifies an expansive implementation strategy: whereas the Fifth EU *Anti-Money Laundering Directive* merely established anti-money laundering (AML) obligations for virtual asset service providers, the German legislator further subjected crypto-assets to comprehensive financial services regulation under the KWG, thereby extending prudential supervision to secondary market activities beyond the EU’s initial AML-focused mandate (Ostrovski, 2024a, p. 299; 2024b; Rennig, 2020, pp. 23–24), a pattern reflecting a commitment to gap-free regulation (*lückenlose Regelung*) that prioritises legal completeness even at the risk of EU harmonisation friction.

However, this early national initiative has since been replaced by MiCAR (‘Council regulation (EU) 2023/1114’, 2023). While the *Act on the Digitalisation of the Financial Market* (*Finanzmarktdigitalisierungsgesetz*, hereafter FinmadiG) and the *Crypto Markets Supervision Act* (*Kryptomärkteaufsichtsgesetz*, hereafter KMAG) integrated therein transpose the European MiCAR structure into national law, they also introduce autonomous concepts, such as *Kryptowerte* with cryptographic instruments (*kryptografische Instrumente*) under the amended § 1 Abs. 1a of the KWG (see, e.g., John and Patz, 2023, pp. 849–888). This new category is intended to capture digital representations of value not covered by MiCAR. However, its function as a residual national definition has provoked critical responses (Möslein and Rennig, 2024, pp. 145–152). Notably, the dual

layering of MiCAR *Kryptowerte* and domestic *kryptografische Instrumente* could lead to interpretative uncertainty and potential conflicts of competence between the Union and national law. In particular, the reliance of the German rule on a national catch-all clause may contravene the two-tier structure of the MiFID II and MiCAR regulatory regime by introducing a three-tier classification under domestic law, thereby undermining the full harmonisation logic of the European rules and threatening the coherence of the internal market in crypto-assets by introducing additional fragmentation.

Meanwhile, the European MiCAR regime represents a decisive step towards legal certainty in the classification and oversight of crypto-assets (for further detail, see Möslein, 2024a, pp. 1729–1739). It introduces a comprehensive licensing system for issuers and service providers, standardises disclosure obligations and increases the protection of investors and customers in crypto markets. In Germany, the Federal Financial Supervisory Authority (*Bundesanstalt für Finanzdienstleistungsaufsicht*, hereafter BaFin) retains a central role as the national competent authority under the KMaG, ensuring continuity with the established framework for financial market supervision (Oppenheim and Andrélan, 2025, pp. 83–90). While MiCAR primarily covers crypto-assets intended for public offering or trading, certain residual categories, particularly those that fall outside the MiCAR definitions, remain subject to domestic oversight as cryptographic instruments. Despite persistent criticism, the German legislator considered this structure to be a pragmatic compromise that integrates crypto-assets into the European framework where possible and maintains national competences when certain technologies or business models cannot be clearly classified.

Beyond the regulatory sphere, the civil-law status of crypto-assets remains uncertain. The prevailing opinion is that such assets do not have the status of *Sachen* under § 90 of the BGB,¹ as they lack physical embodiment (see Möslein, 2026, p. 765, paras. 22–25). This means that classical ownership and good-faith acquisition rules do not apply to them. In the absence of a statutory fiction comparable to § 2 Abs. 3 of the eWpG, crypto tokens confer only factual control via private keys rather than normative dominion. By contrast, § 2 Abs. 3 of the eWpG establishes a *Sachfiktion* that treats electronic securities as *Sachen* within § 90 of the BGB, thereby enabling the application of traditional property-law principles, including transfer, bona fide acquisition and possessory protections, to purely digital registry entries (Conreder and Meier, 2023). The doctrinal obstacle lies in the

¹ In German civil law, *Sachen* refers to tangible things or objects that are capable of being possessed and owned (BGB § 90).

classical definition of *Sachen* under § 90 of the BGB, which excludes purely digital assets from the protective regime of traditional property law. Recent scholarship has undertaken to overcome this limitation through a normative reinterpretation of the concept of things (*Sachbegriff*), arguing that digitally understood corporality (*digital verstandene Körperlichkeit*) could enable the recognition of possession and ownership rights in blockchain-based tokens (von Hülst, 2024, pp. 1–50).² This reconceptualisation would afford crypto-token holders absolute protection (*absoluter Schutz*), historically reserved for tangible property, thereby closing the gap between economic reality and legal doctrine. Such a reform would complement the existing regulatory framework established by MiCAR and FinmadiG by providing a cohesive private-law foundation for digital assets, one that acknowledges tokens as independent legal objects rather than mere contractual claims.

Consequently, tort law protection under §§ 823 et seq. of the BGB applies only in exceptional cases, such as intentional interference or computer-related offences (Spindler and Meyer, 2023, pp. 907–913; Omlor, 2024, pp. 335, 338). Contractually, crypto-assets can be the subject of obligations under § 453 of the BGB, but they are transferred according to the law of assignment rather than conveyance (Denga, 2022, pp. 288–296). The discrepancy between economic reality and legal doctrine highlights the necessity of a comprehensive private law of crypto-assets (*Privatrecht der Kryptowerte*), a dedicated set of private-law rules that would acknowledge digital assets as independent objects of legal relations (see, in particular, Omlor, 2024, pp. 335, 338). Such a reform would complement, rather than duplicate, the regulatory framework established by MiCAR and the FinmadiG. This would ensure that Germany's legal system can accommodate the dematerialised value structures of the digital economy.

A central element of Germany's supervisory framework for crypto-assets is the regulation of qualified crypto-custody business (*qualifiziertes Kryptoverwahrgeschäft*) under § 1 Abs. 1a S. 2 No. 6 of the KWG (cf. Möslein, 2026, p. 765, paras. 26–31). Introduced in 2020, and narrowed following MiCAR, this provision now requires authorisation specifically for custody of cryptographic instruments and DLT-based securities, reflecting the shift from regulating all crypto custodians (under the KWG licensing) to addressing residual categories not covered by the MiCAR framework. It covers technical custody, such as the secure storage of private keys in digital wallets, as well as fiduciary management functions comparable to those of traditional depositories (again, see Möslein, 2026, p. 765, para. 27, with

² Advancing a normative interpretation of the concept of *Sachen* through comparative analysis with Italian civil law to establish possession and ownership in blockchain tokens.

further references). The KWG thus extends the logic of prudential regulation to new technology-driven asset classes, maintaining functional equivalence with existing financial services. Under the new European regime, these custodial activities will generally qualify as a ‘crypto-asset service provision’ in the meaning of Articles 3 and 59 MiCAR, requiring a licence under the harmonised European authorisation procedure (for an account of that regime cf. Mösllein, forthcoming). During the transitional period, national licences issued under § 32 of the KWG will be recognised as MiCAR authorisations, but they will ultimately be superseded by EU-based permissions granted under the KMAG (cf. Asatiani and Siadat, 2023; Siadat and Asatiani, 2023, p. 221). The German approach anticipated and now integrates the MiCAR structure, ensuring that crypto-custody service providers remain subject to consistent prudential, organisational and conduct requirements throughout the Union.

3. Central bank digital currencies, stablecoins, etc.

The legal framework for a digital euro, as in the European implementation of a retail central bank digital currency (CBDC), rests on a multilayered structure combining the Union competences and national execution. At the European level, the proposed regulation on the establishment of the digital euro (‘Council proposal COM(2023) 369 final’, 2023) would provide the legal basis for the issuance of a digital euro by the European Central Bank (ECB), serving as a legal tender alongside cash and deposits, accessible through licensed payment service providers and the national central banks of the euro area pursuant to Article 133 of the TFEU (Sillaber and Eggen, 2023, pp. 501–502). The ECB’s competence to issue a digital euro derives from Article 128 of the TFEU (Birne, 2024a, pp. 407, 417 et seq.). Beyond this European layer, the German legal debate has focused on the private-law and procedural aspects of CBDC transfers. Building on the principles of § 929 of the BGB, recent scholarship proposes *de lege ferenda* a digital possession (*digitale Inhaberschaft*) model, under which the transfer of CBDC units occurs through the factual control of a cryptographic token or access credentials recorded within the infrastructure of the Eurosystem (Eggen, Birne and Sillaber, 2022; Beilner, 2024, pp. 469, 471; Birne, 2024a, pp. 407, 431 et seq.). This doctrinal proposal, not yet adopted by the legislator, mirrors the logic of *Sachfiktion* under § 2 Abs. 3 of the eWpG, demonstrating scholarly interest in extending property-law concepts to digital monetary instruments. This approach mirrors the logic of value-based (token) systems, granting the holder direct

entitlement to central bank money without the intermediation of deposit claims. The transfer is thus in effect by a change of control authenticated within the ECB's ledger, producing effects analogous to the delivery of banknotes, but governed by the public-law rules of central bank issuance rather than private conveyance. Germany's doctrinal elaboration of these rules—particularly the recognition of CBDC units as *sui generis* monetary objects rather than claims—demonstrates a characteristically German attempt to preserve legal certainty while accommodating programmable, cryptographically secured state money within the civil-law framework.

In contrast to CBDCs, stablecoins represent privately issued digital units of value that seek to replicate monetary stability through linkage to a reference asset or currency. Under MiCAR, stablecoins are divided into asset-referenced tokens and e-money tokens, the latter being legally equated to electronic money by virtue of Article 48 (2) of MiCAR (Terlau, 2023, p. 809). German law thereby faces the complex task of reconciling MiCAR's functional concept of e-money tokens with the existing framework of the ZAG and the civil-law understanding of e-money as a contractual claim against the issuer (Birne, 2024b, pp. 521–529). While e-money tokens formally qualify as *E-Geld* under § 1 Abs. 2 S. 3 of the ZAG (John and Lösing, 2023, p. 373), they lack the tangible claim structure and deposit relationship characteristic of traditional money, giving rise to uncertainties regarding the precise moment of transfer and the legal protection of good-faith acquisition (Strobel, 2023, pp. 90, 94). Since MiCAR does not create an independent *Privatrecht der Token*, transfers remain real acts (*Realakte*) rather than conveyances of property (cf. Omlor, 2024, pp. 335, 340, with further references), and token holders have only a restitution claim (MiCAR, Article 49). This absence of a national private-law framework—combined with MiCAR's full-harmonisation intent—poses a specifically German dilemma: while prudential regulation of stablecoin issuers is now firmly harmonised across Europe, the civil-law underpinnings of payment and transfer continue to rely on domestic doctrinal constructs that were never designed for dematerialised, ledger-based money. Similar jurisdictional tensions arise more broadly in the relationship between MiCAR and the Payment Services Directive or PSD2 ('Council directive (EU) 2015/2366', 2015),³ particularly regarding overlapping supervisory competences and licensing requirements (Ostrovski, 2024a, pp. 389 et seq.).

³ Implemented by the *Payment Services Oversight Act (Germany) 2009* (*Zahlungsdiensteaufsichtsgesetz* or ZAG).

4. On-chain legal infrastructure

4.1 Smart contract recognition

German law does not provide explicit statutory recognition of smart contracts as a distinct legal category. Whether a given smart contract qualifies as a contract (*Vertrag*) under German law depends on whether it satisfies the substantive requirements of §§ 145 et seq. of the BGB. The widely cited aphorism “smart contracts are neither smart, nor contracts” captures the core principle: the mere use of code does not create legal contractual status; rather, general contract law principles under the BGB determine enforceability on a case-by-case basis. Where the requirements of offer and acceptance are met, smart contracts are treated like any other agreement: no special statutes are required and the usual rules on offers, acceptance, interpretation (Jünemann and Milkau, 2021, paras. 6.2 and 7.1), transparency and form apply. A smart contract is considered binding if it satisfies the requirements of the offer and acceptance under §§ 145 et seq. of the BGB⁴ (Bons *et al.*, 2022, p. 12, figure 1). The use of code to automate performance does not, in itself, negate legal enforceability. As Maume, Maute and Fromberger (2022, chapter 17 (Germany), §§ 1.62 and 1.94) argue in *The law of crypto-assets*,⁵ many of the novel phenomena of on-chain contracting must be interpreted through the lens of existing doctrines, rather than through new standalone regimes.

The determination requires analysing whether the parties have exchanged corresponding declarations of intent (*Willenserklärungen*) to satisfy the mutual assent requirement under §§ 145, 147 and 150 of the BGB. Code-based interactions may constitute such declarations if they objectively manifest contractual intent in a manner recognisable to a reasonable recipient (BGB § 133).

In practice, a smart contract behaves as a coded offer that a counterparty “accepts” via a user interface. Courts will interpret the parties’ intent (BGB § 133)⁶ and standard term requirements (BGB §§ 305 et seq.; Canaris and Grigoleit, 2011, pp. 587–618; BGB §§ 305 et seq.) just as they would for a paper contract (Bons *et al.*, 2022, pp. 17, 26, 28). In fact, the parties may agree

⁴ Regulating offer and acceptance, *Antrag und Annahme*.

⁵ The authors note that established concepts such as fairness, good faith and consumer protection should guide interpretation, supplemented where necessary by technological or regulatory updates (such as the EU’s GTC-Directive and MiCAR).

⁶ Interpretation seeking true intention rather than literal meaning, considering good faith and customary practice.

that a programming language serves as the contract language (compliance with *Allgemeine Geschäftsbedingungen* notwithstanding), provided the code remains transparent to all parties under §§ 305–305c of the BGB (Bons *et al.*, 2022, pp. 17–18, 26, 28, 35–36).⁷ Mandatory legal norms—for example, the bans on usury (BGB § 138) and the anti-circumvention provisions of §§ 306a and 487 of the BGB—remain in force, meaning that a smart contract that violates consumer or standard-term protections is void (Bons *et al.*, 2022, p. 23, para. 2). Notably, German law mandates that contract terms be understandable to the counterparty (BGB §§ 305–305c) and relying solely on unreadable code in a B2C contract is impermissible because a consumer cannot be expected to know programming. In short, a German smart contract is simply a digital offer-and-acceptance machine whose “terms” must comply with all existing BGB requirements.

However, the enforceability of code-based obligations remains bounded by the traditional limits. For example, in a recent case of the Federal Court of Justice (*Bundersgerichtshof*, hereafter BGH) from 26 October 2022, a contractual clause allowing a car leaser to remotely disable a battery was struck down (German Federal Court of Justice, 2022). The court found that unilateral blocking of the battery constituted unlawful interference with possession under German law (BGB § 858), since property rights (*Eigentum v. Besitz*) prevail over any “smart” enforcement mechanism (German Federal Court of Justice, 2022; Pestalozzi Attorneys at Law, 2022, p. 2, para. 6). This limitation reveals a deeper structural issue: the focus of property law on tangible things and analogous natural forces. While doctrines such as unlawful interference with possession protect physical possession and control, these protections do not extend to purely digital states (Pestalozzi Attorneys at Law, 2022, p. 4, para. 3). As a result, while automated code can disable or restrict use of a physical asset (e.g., a battery) and thereby implicate possession-based protection, the same concept does not directly

⁷ “Aus technisch-rechtlicher Sicht dürfte die Vereinbarung der Programmiersprache des Smart Contracts als Vertragssprache ... grundsätzlich AGB-rechtlich zulässig sein, so dass im Ausnahmefall die Vertragsparteien auch den Programmcode des Smart Contracts nutzen können, um ihre Willenserklärungen inhaltlich auszudrücken” [15, S.622]. (Bons *et al.*, 2022, p. 18)

“Eine zulässige gewählte Vertragssprache kann schließlich auch die Sprache von wirksam einbezogenen allgemeinen Geschäftsbedingungen sein. Das gilt auch für eine Programmiersprache, wenn in den beteiligten Verkehrskreisen diese Sprache geläufig ist und deshalb durch einen offengelegten Quellcode und die Dokumentation der verwendeten Compiler und Ablaufumgebung in zumutbarer Weise von dem Vertragsinhalt Kenntnis genommen werden kann. Von der Frage zu trennen, ob ein Smart Contract als Vertrag qualifiziert und sein Vertragsinhalt allein in einer Programmiersprache formuliert werden kann, ist dessen Zustandekommen, seine Auslegung und sein Verhältnis zur Privatrechtsordnung. [46, S.55]” (Bons *et al.*, 2022, pp. 35–36)

extend to digital assets that lack the civil-law attributes of *Sachen*, as discussed previously.⁸ Extending property-law remedies to native digital assets would require legislative action or carefully crafted analogies; until then, smart-contract design must bridge code with off-chain legal enforcement rather than assume that code-based self-help will be legally cognisable. The criminal law framework still struggles in this space, with crypto tokens falling outside of traditional theft offences (Braunschweig Higher Regional Court, 2024; Krempl, 2025). The absence of clear criminal protections further underscores the necessity of contractual and technical safeguards.

This underscores that the code cannot override fundamental civil-law rules. Similarly, for contracts with statutory form requirements, declarations made by smart contracts only meet “text form” (BGB §126b) and not the required written or notarised form (BGB §§ 126, 128; Bons *et al.*, 2022, p. 29, para. 2). Thus, a land sale concluded solely via smart contract would be void (under BGB § 311b and 125). Consequently, any contract that the law ties to written form or notarial certification cannot be validly concluded by smart contract code alone. Instead, the required declarations must still be made in the “real” form prescribed by the statute (*Grundstückskaufvertrag*), after which blockchain may be used merely for payment processing or registry entries. This layered procedure is deliberate: the legislature intended that transactions with weighty legal consequences retain the protective functions of the written form and notarial oversight and that the protective safeguards of formal requirements must be maintained even in automated transactions (Bons *et al.*, 2022, p. 29, para. 2; German Federal Court of Justice, 2022). Furthermore, in corporate form requirements, for example, a notarisation ruling highlights that tokenisation must respect written and notarial formalities (Zweibrücken Higher Regional Court, 2022; see also Orttmann, 2023; Rödl & Partner, 2025). Blockchain can be helpful in moving notary on-chain (Fiedler, 2022). In practice, this means that form-bound transactions (real estate conveyances, certain consumer loans, etc.) still require physical notary signatures or paper; blockchain, as suggested, may execute payments or record acts, but the legally decisive *Willenserklärungen* must be made in the prescribed form. German legislators have deliberately preserved these formal safeguards, recognising that, at least for the time being, transactions with far-reaching consequences must undergo a human-performed notarial or written process.

⁸ See Part 2 of Pestalozzi Attorneys at Law (2023), ‘Legal and regulatory status of crypto-assets’.

4.2 On-chain dispute resolution and notarisation

Having established that smart contracts cannot substitute statutory form requirements, the following section examines how notarial functions are being explored on-chain. Blockchain notarisation pilots (e.g., *Gültigkeitsregister*) currently lack binding legal force. They serve as evidentiary aids only, and the underlying documents must still be executed in statutory form by a human notary (Bundesnotarkammer, 2021, para. 2), for instance, in real estate conveyances under § 311b of the BGB.⁹

German legislators have deliberately preserved traditional form requirements; this is evident in the preparatory materials to the eWpG, where the Bundestag explicitly noted that “for transactions with far-reaching legal consequences, such as real-estate conveyances, the protective functions of §§ 126, 311b of the BGB must remain inviolate and cannot be displaced by code” (eWpG, 2020, para. 7).

Some German states have explored blockchain-based land registers, and private initiatives use blockchain for timestamping contracts. While not legally determinative, such tools may serve evidentiary purposes under § 371 of the ZPO (*Zivilprozessordnung*),¹⁰ depending on how a court evaluates them. In short, on-chain registries can assist or enhance transparency but cannot yet substitute the notary’s constitutionally and statutorily established role.

In lieu of formal on-chain justice, some providers embed dispute-resolution clauses into smart contracts. For example, the CodeLegit platform (Datarella, Munich) allows parties to pause a smart contract and trigger arbitration through smart contract function calls (Jünemann and Milkau, 2021, paras. 6.2 and 7.2).¹¹ Such mechanisms remain private agreements (like ordinary arbitration clauses) since German law has not created any special legal status for “on-chain arbitration”. They illustrate that the industry can selfregulate via code, but enforcement of any decision would still rely on the traditional legal system.

To reiterate, Germany applies the existing contract law to on-chain contracting. In particular, automated code cannot unilaterally defeat prohibitions of German law, as the BGH battery case shows (Pestalozzi

⁹ Requires notarisation of real estate purchase agreements as a mandatory form requirement (otherwise void).

¹⁰ § 371 on evidence by view, inspection or presentation of documents.

¹¹ Especially subsections 7.2 ‘Smart dispute resolutions and risk management’ and 6.2 ‘German approach’.

Attorneys at Law, 2022; German Federal Court of Justice, 2022, p. 4, para. ‘Next steps’). Any use of blockchain for notarisation or dispute resolution is currently confined to pilot schemes or contractual arrangements, pending regulatory changes.

5. Tokenisation of real-world assets under German private law

German private law response to blockchain and tokenisation has emerged through recent judicial decisions that clarify how code-based mechanisms interact with fundamental property, contract and corporate law principles (German Federal Court of Justice, 2022; German Federal Fiscal Court, 2023).¹²

5.1 Real estate

Real estate tokens cannot substitute for the land registry (*Grundbuch*). German property law ties legal ownership to notarial deeds and land registry entries. Thus, a token by itself carries no title or enforceable lien on land. In practice, tokens represent rights in property funds (SPV shares), not direct land titles. *Genussrecht*, *Aktie*, *Anleihe*, etc. are tokenised, while *Grundstück* is directly not (ITRechtler, no date; Hamburg Commercial Bank and Frankfurt School Blockchain Center, 2021; de la Rubia, 2021).¹³ In other words, the token represents a contractual or corporate claim (e.g., an SPV share in a property fund) rather than the deed. Without rewriting land-registry law (and creating a blockchain-based *Grundbuch*), a token cannot create a new property right. Legal experts emphasise that true tokenisation of ownership would require radical reforms (e.g., storing the *Grundbuch* on a blockchain), which Germany has not pursued. Current practice is

¹² The 2022 Federal Court of Justice (*Bundesgerichtshof* or BGH) decision on remote battery disabling unlawful interference with possession and the 2023 Federal Fiscal Court (*Bundesfinanzhof* or BFH) decision (IX R 3/22) on cryptocurrency gains taxable as “other assets” under § 23 I 1 No. 2 of the *Einkommensteuergesetz* (EStG).

¹³ ITRechtler demonstrates that a token cannot substitute statutorily required registries; legal title and validity in property law demand more than cryptographic proofs. Hamburg Commercial Bank and Frankfurt School Blockchain Center (2021) show that, in practice, real estate tokenisation in Germany is limited to intermediary rights (such as SPV shares), with legal and industry exercising caution against direct tokenisation of land titles. Cyrus de la Rubia (2021) notes that while fractionalised, automated real estate tokenisation is being promoted as revolutionary, such innovation faces key preconditions: liquid secondary markets, legal recognition and digital land registries are not yet established.

therefore ‘asset mapping’—tokenising economic interests or cash flows from real property, while the underlying title remains governed by traditional conveyancing rules.

5.2 Securities and the eWpG

Historically, German securities law used to be grounded in the principle of the concept of *Wertpapierbegriff*, which understood securities as rights embodied in physical certificates pursuant to § 793 of the BGB. Prior to the eWpG, German law did not recognise dematerialised securities: legal validity and transferability were inextricably linked to the existence of a tangible document.

The eWpG represents a departure from this doctrine. In contrast, securities tokenisation has advanced under the eWpG, which explicitly allows certain securities to exist in purely electronic form based on distributed ledger technology (DLT). This means that the eWpG is indeed a watershed: it allows certain (not all) securities to be issued in purely electronic form either via a central registry or a crypto registry on DLT, thus modernising German securities law. eWpG provides for both types: central registry securities (*Zentralregisterwertpapiere*) and crypto securities (*Kryptowertpapiere*). In addition, the law is designed to be technology neutral, so that blockchain or DLT is only one eligible technical implementation, not the exclusive one. The idea, however, was to use a DLT-based system (eWpG, 2021, §§ 1–3). Initially, shares (*Aktien*) were largely excluded, but recent legislative changes are opening the door for registered or bearer shares (if conditions are met) to qualify. Notably, since December 2023, the *Future Financing Act* expressly amended the eWpG to permit both bearer and registered shares in electronic form (ZuFinG, 2023; BGBI, I No. 354, Article 16, p. 18).¹⁴ Registered shares (*Namensaktien*) and bearer shares (*Inhaberaktien*), under certain conditions (e.g., entry in a central registry), may be eligible for the electronic form. But wherever possible, there are prerequisites: the corporate statute or articles must allow it, the registry must be established, physical securitisation or embodiment in certificates (*Verbriefung*) might need to be excluded, etc. Bonds and fund shares may be issued without paper certificates and recorded, instead, in an official crypto-assets registry. In these cases, blockchain tokens are essentially digital bearer instruments with full legal standing. Electronic shares (eWpG, 2021)¹⁵ now “dematerialise” the share certificate

¹⁴ Noting that the ZuFinG amended the eWpG to cover bearer and registered stocks.

¹⁵ § 2(3) as amended by ZuFinG, Article 16, 2023. Although the law’s “fiction” that an electronic

and confer ownership via a registry entry, complete with transfer and bona fide acquisition protections (eWpG, 2021; Hogan Lovells, 2021, p. 16).¹⁶ The eWpG feigns (*fingiert*) electronic securities to be *Sachen* within property law, as discussed above, thereby rendering property-law rules applicable by default unless specific *lex specialis* provisions apply. This statutory fiction preserves securities law (*Wertpapierrecht*), while accommodating digital dematerialisation, treating the registry entry as the legally equivalent possessory nexus. eWpG's narrow scope leaves many asset classes uncovered and calls for amendments to harmonise it with DepotG, KWG, KAGB and PfandBG.

German law thus fully accommodates blockchain-based securities: tokens created under the eWpG are equivalent to traditional securities (*Wertpapiere*) and can circulate in secondary markets. Tokenised securities under the eWpG are taxed under § 20 Abs. 2 No. 1 of the EStG (gains from share disposition), which applies capital gains treatment to their disposal like traditional securities, reflecting technological neutrality. In contrast, the Federal Fiscal Court case-law addresses only payment-type crypto tokens, not securities tokens, classifying them as *andere Wirtschaftsgüter* (other economic goods) under § 23 Abs. 1 S. 1 No. 2 of the EStG, subject to ordinary income tax rates if disposed within one year.

It is evident that the German approach to digital securities reflects a methodical evolution rather than a revolution in private law. The eWpG represents a paradigm shift in form, not in substance: it “dematerialises” the traditional share certificate while preserving the core legal architecture of securities law (*Wertpapierrecht*) (Möslein, 2024b, pp. 93–123). The Act does not replace securities law with technology; instead, it embeds digital issuance within the established doctrine of possession and transfer, substituting the physical certificate with a registry entry as the functional equivalent of ownership evidence. This continuity ensures that investor protection, bona fide acquisition and corporate governance principles remain intact, even as shares migrate onto distributed ledgers. In effect, the German legislator has engineered a ‘hybrid legal infrastructure’, where blockchain serves as the technical substrate for legal concepts that retain their classical contours. This cautious, system-preserving digitisation mirrors the treatment of smart contracts under the BGB: technology may alter the medium of expression but not the legal DNA of obligation and ownership.

security is equivalent to a physical one (treating the registry entry as if it were the certificate) is powerful, in practice it is contested in corner cases (e.g., insolvency or boundary disputes).

¹⁶ See §§ 24–27. See also Hogan Lovells (2021) on transfer, good faith and presumption provisions in the eWpG, and the challenges in registry operation.

However, it should be noted that the eWpG covers securities and certain investment assets; real estate or intellectual property rights are not issued as *Wertpapiere* according to that law (eWpG, 2021; BaFin Fachartikel, 2021).¹⁷ As observed by Omlor and Dilek (2022, pp. 67–72),¹⁸ the statute's scope is explicitly limited to securities (*Wertpapiere*) via § 1 of the eWpG. Moreover, Omlor (2023) argues in 'Tokenisierung von Vermögenswerten und das deutsche Sachenrecht' that tokens in current German practice tend to represent claims *in personam* (i.e., corporate or contractual rights) rather than claims *in rem* (proprietary rights) because the traditional civil-law constraints of *numerus clausus* and the publicity doctrine inhibit the establishment of new proprietary forms outside the statute. Furthermore, practical and legal challenges or limitations remain. Even if the law allows issuance, actually building and operating compliant registries (under BaFin's supervision, technical requirements, integrity and transitions) is nontrivial. Some securities types are explicitly *not* eligible (e.g., certain order-type debt instruments) under the current rules.

5.3 Intellectual property

Intellectual property (IP) remains governed by copyright and patent law. Tokenisation of IP generally means using NFTs or tokens to represent IP contracts or licences. German law does not recognise an NFT as itself an "absolute" right or title to the underlying IP (Noerr, 2021).¹⁹ NFTs are merely digital identifiers; any rights in the work (copyright, licensing rights) continue to exist in the creator under the *Copyright Law* (*Urheberrechtsgesetz* or *UrhG*), transferred only by a separate legal act. Practically, an NFT sale in Germany can transfer whatever usage rights the parties agree to in contract (e.g., an exclusive licence), but it does *not* automatically transfer copyright or patent ownership. In short, tokens can certify or evidence IP ownership or licences, but German law requires any assignment or licensing of exploitation rights (*Nutzungsrechte*) to comply with the applicable form requirements. While § 31a of the *Copyright Law* imposes a written form

¹⁷ § 1 (scope), the Act limits itself to securities—"bearer bonds, registered shares and shares made out to bearer when registered in a central register and does not extend to real estate or intellectual property rights. BaFin explains that the eWpG enables the issuance of bearer bonds, mortgage bonds and certain fund units in purely electronic format, implicitly showing that its scope is on financial instruments rather than property or IP.

¹⁸ Which analyses the scope limitations of the eWpG and how § 1 of the eWpG delineates that the law is confined to securities, thereby implying that it does not cover non-securities such as real estate rights or IP rights.

¹⁹ See, especially, subsection 'Urheberrechtliche Relevanz der Prägung' (Copyright relevance of the coinage), under section 'Urheberrechtliche Fragen' (Copyright issues).

specifically for the transfer of future exploitation rights, the applicability of general form requirements to NFT-based IP transfers remains doctrinally unsettled and requires case-specific analysis. Thus, NFT tokenisation of art or IP relies on conventional contract law and cannot by itself conjure legal IP title where none exists or where formal prerequisites are unmet.

6. Legaltech tools in crypto compliance (KYC/AML requirements, transaction monitoring and blockchain analytics)

Germany's crypto custodians, exchanges and other virtual-asset service providers are fully subject to financial regulation, notably the German *Anti-Money Laundering Act 2017* (*Geldwäschegesetz*, hereafter GwG) and the oversight of BaFin as the public financial supervisory authority in Germany.

Know your customer (KYC) and anti-money laundering (AML) tools are widely used in the crypto sector. In practice, virtual-asset firms implement digital identity verification (video-ID, biometric checks), sanction-list screening and ongoing transaction monitoring. Many firms rely on established regtech solutions: for example, automated KYC platforms and global blockchain analytics engines (e.g., Chainalysis, Elliptic or ScoreChain) help flag risky addresses (Olasehinde and Henry, 2025, pp. 2–3). BaFin's 2025 AML guidance interprets obligations under § 15a of the GwG (implementing the EU Funds Transfer Regulation, see 'Council regulation 2023/1113', 2023). The tightened due diligence requirements for self-hosted wallet transfers derive from the EU and national legislation, not from BaFin's norm-creating authority. Accordingly, crypto service providers must employ appropriate technological means to fulfil their statutory risk management duties (Forstmann, Sentürk and Sarican, 2025, para. 3).

Beyond transaction monitoring and KYC compliance, a second layer of legaltech innovation addresses preventive consumer protection at the disclosure stage. The ZEVEDI (2025) project has developed an AI-driven system combining rule-based checks for MiCAR compliance with large language model analysis to detect scam characteristics and regulatory gaps in crypto white papers. By mapping findings to MiCAR obligations (Article 6 et seq.) and generating risk scores, this approach demonstrates how legaltech can extend protective scrutiny beyond transaction monitoring to document governance, strengthening integrity in crypto capital formation (ZEVEDI, 2025).

BaFin's stance appears cautiously supportive of innovation. It has closely monitored crypto activities but is also engaged with the industry; for instance, the AML officer requirement and risk assessment rules in 2025 cover crypto-asset providers. BaFin operates a FinTech Dialogue and Innovation Hub, where startups can discuss new models under supervision. Moreover, Germany participates in various EU sandbox initiatives. Under the EU's DLT Pilot Regime (effective March 2023), qualified projects can run regulated trading/settlement with temporary waivers. A landmark example is Frankfurt's fintech 21X: after 18 months of scrutiny by BaFin, Bundesbank and European Securities and Markets Authority (ESMA), it obtained in December 2024 the first German licence to operate a DLT-based multilateral trading and settlement system for tokenised securities. This milestone, using Polygon blockchain, demonstrates that German regulators will authorise legaltech-driven crypto infrastructure when it complies with existing law. BaFin has neither banned crypto-compliance tech nor ignored it; instead, it enforces AML and KYC rules (as updated in 2024–2025) and concurrently fosters fintech testing (via supervisory dialogues and the DLT Pilot sandbox). German regulators treat blockchain analytics and KYC software as positive compliance tools, requiring firms to integrate them as part of standard regulatory obligations.

7. AI-based legaltech

Within the crypto space, AI appears not merely as another legaltech “tool”, but as a cross-cutting infrastructure linking doctrinal questions of contract, property and procedure to technical design choices on model alignment, resiliency, auditability (Software Bill of Materials / AI Bill of Materials) and human–machine control. Embedding such systems under, rather than above, the rule of law requires a much denser interface between legal doctrine and AI engineering, ranging from prompt and agent design and trustworthy AI metrics to behavioural insights on how human decision-makers actually interact with automated systems in courts, markets and public administration.

AI security, postquantum cryptography, blockchain resilience and agentic AI architectures show that the “black box” problem is no longer limited to explainability but extends to the opacity of entire AI-enhanced infrastructures, from enterprise pipelines to digital identity and court technologies. These broader systems perspectives underscore that any future private law

regarding digital technologies (*Privatrecht der digitalen Technologien*) must be capable of addressing not only discrete AI applications but also the interaction between automated decisionmaking, cybersecurity standards²⁰ and regulatory duties under the *AI Act*, MiCAR and data governance law. While infrastructure-level risks focus on technical resilience, the application of generative AI at the user level introduces unique doctrinal challenges, particularly regarding the integrity of legal documentation.

The use of generative AI for drafting crypto white papers and more generally in legal practice entails significant risks; foremost among them is the phenomenon of so-called ‘AI hallucinations’—the tendency of large language models to produce information, citations or authorities that appear plausible but are, in fact, entirely fabricated (cf. Möslin and Hartmann, 2025). As a recent decision of a German district court illustrates, such AI-generated inaccuracies can not only impede judicial decision-making but also erode public trust in professional diligence and the integrity of the rule of law (Köln District Court, 2025). From a legal standpoint, uncritical reliance on hallucinated content may amount to a breach of a lawyer’s contractual and professional duties to exercise independent and competent judgment. Under German law, this includes the duty of careful case handling pursuant to §§ 611, 675 of the BGB and the obligation of truthfulness under § 43a (3) of the *Federal Lawyers’ Act* (*Bundesrechtsanwaltsordnung* or BRAO) (for more detail, see Möslin and Hartmann, 2025). Negligent or knowing use of fabricated sources can therefore trigger liability for damages or disciplinary sanctions. More broadly, the risk of hallucination underscores a fundamental limitation of current AI systems: while they may enhance efficiency and analytical capacity, they cannot substitute human responsibility, critical evaluation and professional accountability in the administration of justice. Importantly, such systems remain subject to audit and contestation: if an issuer disputes an AI risk score, the underlying evidence basis is transparent and can be rebutted by human experts. This hybrid model reflects responsible AI integration, as demanded by the *EU AI Act* (‘Council regulation (EU) 2024/1689’, 2024).

Beyond the issue of AI hallucinations, the substantive content and risk disclosure in crypto white papers themselves warrant scrutiny through systematic assessment frameworks. The International Monetary Fund’s (IMF) Crypto-Risk Assessment Matrix (C-RAM) provides a comprehensive

²⁰ E.g., the National Institute of Standards and Technology Artificial Intelligence Risk Management Framework and the International Organisation for Standardisation or International Electrotechnical Commission 42001, referred to as the AI Management System Standard.

methodology for evaluating vulnerabilities inherent in crypto-token ecosystems, vulnerabilities that ought to be transparently disclosed in white papers but are frequently obscured or understated (Hacibedel and Perez-Saiz, 2023). The C-RAM framework categorises risks into seven distinct vulnerability groups: systemic importance, credit risk, concentration risk, liquidity risk, market risk, regulatory risk and operational risk. For each category, the framework identifies specific indicators, potential triggers, risk implications and policy responses, providing a structured lens through which the adequacy of white paper disclosures can be assessed. This systematic approach is particularly relevant in light of the MiCAR, which mandates that crypto-asset white papers contain clear, fair and non-misleading information on associated risks, including market, technological and legal vulnerabilities ('Council regulation (EU) 2023/1114', 2023, Articles 6, 18–19). The integration of C-RAM principles into white paper review processes, whether conducted by regulators, auditors or prospective token holders, can serve as a counterweight to the opacity and promotional bias that characterise many crypto offerings, ensuring that risk disclosure matches the sophistication of the underlying technology and market dynamics.

8. Conclusion

The Modernisierungsagenda für Staat und Verwaltung, recently published by the German Federal Ministry for Digital and Public Administration (*Bundesministerium für Digitales und Staatsmodernisierung*, BMDS), envisions a “fast, digital and capable Germany” built on transparent digital processes, efficient administration and technology-driven legal innovation. This political agenda provides an appropriate framework for understanding the trajectory of the digital transformation of German law. In private law, change remains evolutionary and system-preserving: blockchain, tokenisation and AI are integrated into existing doctrines rather than redefine them. This reflects the resilience of the civil-law method, which adapts by interpretation rather than reinvention. Regulatory law, in contrast, has evolved more dynamically. New legislative regimes in finance, data and digital infrastructures embody a proactive effort to make the legal system operationally digital, turning law into a tool of governance rather than a mere framework for it.

Yet this transformation also exposes structural and conceptual limits. The

absence of a coherent private law for digital assets, the unresolved legal nature of smart contracts and tokenised rights, and the risks of overreliance on algorithmic or AI-based tools reveal the boundaries of technological substitution in law. As the *Modernisierungsagenda* rightly stresses, digital acceleration must not come at the expense of legal certainty, transparency or accountability. The future of German law will therefore depend on maintaining a careful equilibrium: combining regulatory innovation with doctrinal continuity, enabling digital progress without eroding the normative depth that defines the civil law tradition. In that balance lies the promise of a legal order that is not only digital in form but also lawful in substance.

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