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The Future of Intellectual Property Protection: Between International Law and Emerging Technologies

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Abstract:

The protection of intellectual property (IP) rights has significantly evolved since the Paris and Berne Conventions. With globalization, digital advancements, and international trade, IP law now tackles complex issues such as piracy, counterfeiting, technology transfer, and access to innovation. This study examines the main international treaties, enforcement procedures, emerging challenges, and proposed solutions, focusing particularly on regional frameworks, WIPO's initiatives, and the TRIPS Agreement. Special emphasis is placed on harmonizing IP protection across jurisdictions, enhancing accessibility, and resolving cross-border legal conflicts.

International legal frameworks aim to align national IP laws with global standards, facilitating rights holders' ability to protect and enforce their rights universally. Through international cooperation, technical assistance, and data exchange, states are better equipped to address IP infringements. The study adopts a descriptive approach to illustrate the protections afforded by international agreements, and an analytical method to assess their practical effectiveness. It incorporates case studies to provide a comprehensive evaluation of how international legal instruments influence IP enforcement and cooperation.

Importantly, this research highlights that although international legal frameworks have substantially advanced IP protection, they are increasingly challenged by the rapid pace of technological change—particularly with the rise of artificial intelligence and blockchain technologies. These innovations not only introduce new forms of creativity and infringement but also offer novel tools for registration, authentication, monitoring, and enforcement.

Therefore, the study concludes that the future of IP protection lies in the adaptive integration of technological solutions within legal systems. Leveraging artificial intelligence to detect violations, and using blockchain to secure and verify ownership, presents a pathway toward more effective, transparent, and inclusive IP governance on a global scale.

Keywords: Intellectual Property,International Law, Artificial Intelligence,TRIPS Agreement, WIPO.

1. General International Intellectual Property Law and Emerging Technological Challenges.

As technological development rapidly redefines the landscape of creativity and innovation, especially through artificial intelligence and machine-generated content, international law faces pressing questions regarding the adequacy and adaptability of its existing IP frameworks. Therefore, a contemporary view of international IP law must consider not only traditional treaty-based mechanisms but also the capacity of these frameworks to respond to the digital and algorithmic production of intellectual property.

Conventions are formal agreements between countries and/or international organizations. International law is the legal basis for the formation, interpretation and enforcement of conventions. Conventions are closely related to international law and play an important role in the development and implementation of national laws and regulations, International law plays a multifaceted role in conventions. Conventions, including international treaties, and protocols .To foster cooperation and coordination on various of problems, including citizenship, aviation rights, arbitration, and energy and environmental concerns, they offer a framework for nations to set common laws and norms[1].

In respect to conventions, international law serves the following important functions:

A. Legal Foundation: The legal foundation provided by international law allows for the drafting, adoption, and ratification of international conventions. It outlines principles and procedures that guide these processes.

B. Establishing Standards: Conventions function as tools for establishing global norms in a range of areas, including commerce, environmental preservation, human rights, and maritime law.

1- Aïchatou Katleho, 'The Evolution of Intellectual Property Rights in the Digital Age' (2024) 4 Journal of Modern Law and Policy 1.

These standards are developed with assistance from international law, which makes sure they adhere to norms and principles that are widely accepted[2].

C. Behavior Regulation: To maintain consistency and order in international relations, international law uses conventions to govern how states and other international players behave.

D. Conflict settlement: Dispute settlement clauses are frequently seen in international treaties. When disputes arise over the interpretation or execution of conventions, international law offers procedures like arbitration and adjudication to settle them.

E. Enforcement Mechanisms: Although there are obstacles to the enforcement of international law, agreements may set up systems to keep an eye on adherence and deal with infractions. These can comprise expert panels, reporting mechanisms, and, in some situations, penalties or other punitive actions.

F. Promotion of collaboration: By offering a framework for the creation and execution of treaties, international law promotes collaboration between nations. This legal framework encourages governments to cooperate in pursuit of shared objectives by fostering consensus on international issues.

2- Elif Naz Němec and Milan Damohorský, 'Climate Litigation in Europe: A Discussion about Emerging Trends in the Context of Principle of Non-Regression' (2024) 70 AUC IURIDICA 111.new practices have emerged in social ,economic ,and legal structures .One of these new practices is doubtlessly climate litigation that aim to pressure states to fulfil their positive obligations concerning the mitigation of the human-induced climate crisis .Global warming ,advancing at an unprecedented rate, is pushing governments to take immediate measures and shape their legislation accordingly .Within this movement ,the principle of non-regression ,rooted in human rights ,has gained a tangible form in environmental law .This study explores the potential role of the climate crisis and ,specifically ,the climate litigation cases in Europe in establishing the principle of non-regression as a settled principle in environmental law .It discusses its value as an argument in climate litigation from a practical point of view",".container-title":"AUC IURIDICA","DOI10.14712/23366478.2024.":" ","8ISSN","0323-0619 ,2336-6478":"issue","1":"language":"en","page-","111-130":" source":"DOI.org) Crossref

G. Adaptation and Evolution: Conventions may be modified and evolved throughout time in response to fresh difficulties and evolving situations thanks to international law. To ensure the continued relevance and efficacy of current conventions, protocols, and amendments might be introduced[3].

1.1 The role of international law in protecting intellectual property:

International IP agreements aim to coordinate the IP regimes of different countries to minimize conflicts, promote innovation efficiency, and facilitate international trade and investment flows based on intellectual property. However, recent advancements in artificial intelligence pose new challenges to this structure, as AI can now generate creative and technical works without human intervention. This development raises significant legal and philosophical questions regarding authorship, ownership, and enforceability, which current treaties like the Berne Convention or TRIPS do not fully address.

The relationship between intellectual property rights and investment protection is a topic of ongoing debate and has significant implications for integrating of other concerns and values in invest-

٣ -DK Labin and AV Soloveva, 'Between Scylla and Charybdis: Theoretical Reflections on "The Protection of Intellectual Property Rights under International Investment Law" by Klopschinski, Gibson and Ruse-Khan' [2022] Moscow Journal of International Law 54.Christopher Gibson, and Henning Grosse Ruse-Khan ,and entitled The Protection of Intellectual Property Rights under International Investment Law] Klopschinski ,Gibson,Ruse-Khan [2021 provides a welcome contribution to the debate on the issue by addressing the problem from an informed theoretical standpoint. However ,this issue ,as correctly pointed out by the authors ,is not merely a theoretical one ,but rather one with significant consequences in terms of the integration of other concerns and values in investment treaties and arbitral cases ,such as intellectual property rights protection\.n\ n\ n MATERIALS AND METHODS\.n The materials for the article were the book co-authored by Simon Klopschinski ,Christopher Gibson ,and Henning Grosse Ruse-Khan ,The Protection of Intellectual Property Rights under International Investment Law2021)

ment treaties. Here are a few significant global frameworks and institutions that are active in intellectual property protection:

1. Important Conventions and WIPO: The United Nations body known as the World Intellectual Property Organization (WIPO), which is in charge of the Paris Convention, the Berne Convention, and the Patent Cooperation Treaty (PCT), seeks to establish an open and accessible international IP system.

2. Principal IP Conventions:

   - Industrial designs, trademarks, and patents are protected by the Paris Convention (1883), which guarantees signatory governments' national treatment.

   - Literary and creative works are automatically protected by the Berne Convention (1886), which also applies the concept of national treatment.

   - The WTO oversees the TRIPS Agreement (1994), which addresses copyrights, patents, trademarks, industrial designs, geographic indicators, and private data.

3. A single framework for protecting inventions in contracting states is provided by the 1970 Patent Cooperation Treaty (PCT), which streamlines the process of submitting patent applications internationally.

To guarantee that authors and inventors may manage the use of their intellectual works and be paid for their usage globally, these frameworks and others safeguard intellectual property beyond national boundaries. Nevertheless, national laws still govern the actual enforcement of intellectual property rights, and the efficacy of international protection varies throughout nations[4] .

4- Marta Malets, 'International Legal Standards for the Legal Regulation of Intellectual Property: Foreign Experience' (2024) 11 Visnik Nacional'nogo universitetu «Lvivska politehnika». Seria: Uridicni nauki 137.

1.2 Challenges facing international law for the protection of intellectual property:-

Long registration processes for copyrights, copyright violations, plagiarism, unapproved use of copyrighted works, patent infringements, and trademark counterfeiting are some of the obstacles to the protection of intellectual property under international law.However,this has tilted the rights and obligations scales in the exclusive rights holders' favor.In order to counteract this, it is imperative that intellectual property rights protection be included in international law as a whole, enabling a more all-encompassing approach to intellectual property protection.

In addition to conventional issues such as piracy and registration delays, a new set of challenges arises from the increasing role of AI in generating intellectual works. Current international IP law does not clearly define the legal status of AI-generated content, nor does it assign liability or ownership when AI infringes upon protected works. These gaps could undermine legal certainty and require proactive international collaboration to develop adaptive, technology-aware legal instruments[5].

1.3 Artificial Intelligence and the Future of International Intellectual Property Law .

The intersection between artificial intelligence (AI) and international intellectual property (IP) law is shaping up to be one of the most important challenges in today's legal and technological landscape. As AI continues to evolve and influence creative and inventive processes, the traditional legal frameworks that were built around human creativity are struggling to keep up. This situation presents not only legal and ethical dilemmas, but also an opportunity to rethink how we define ownership, creativity, and innovation.

5- ShM Tillaboev, 'International Legal Protection of Intellectual Property in the Period of Digitalization' (2024) 20 Juridical science and practice 57.

1.3.1 Core Challenges in Intellectual Property Law.

One of the biggest questions that keeps coming up is: who owns the work created by AI? Traditional copyright and patent systems are designed with the assumption that the creator is a human being. But now we have AI models that can write stories, compose music, design products, and even come up with technical inventions without direct human involvement. This makes it very hard to decide whether such outputs should be protected by intellectual property laws and, if so, who should be granted those rights[6]. Another issue is that existing legal systems don't offer enough protection for AI-generated content. Most countries have not yet adjusted their IP laws to reflect the reality of autonomous or semi-autonomous content creation. Experts argue that we may need to create new categories within IP law—or even entirely new forms of rights-to ensure fair protection for AI-created works[7] .

6-Katsiaryna Rusinovich, 'The Intersection of AI and Intellectual Property Law: Navigating Legal Frontiers' (2023) 12 International Journal of Science and Research (IJSR) 356.

7- Daniel J. Gervais, *The Human Cause* (Edward Elgar Publishing 2022) <https://www.elgaronline.com/view/book/9781800881907/book-part-9781800881907-7.xml> accessed 9 May 2025.

1.3.2 Future Policy Directions.

Some researchers suggest introducing a new category of rights known as sui generis rights, specifically designed for AI-generated works. These rights would recognize the uniqueness of AI outputs without undermining human creativity or innovation[8] .

There's also a push for more international alignment in how countries handle AI and IP. Agreements like TRIPS have been crucial in standardizing IP protections globally, but they don't yet address AI in any specific way. Many believe that updating such treaties or adding new protocols could help ensure consistency across borders[9].Moreover, AI itself could be a useful tool within IP offices around the world. It can help with patent searches, prior art analysis, and even assessing the originality of creative works. In this sense, AI could be both a challenge and a powerful ally in managing intellectual property .

1.3.3 Legal Ambiguity Around AI-Generated Works

At the heart of this debate is a legal grey area: Can works created entirely by machines be owned? Most current laws say no, because they only recognize human authorship. That leaves AI-created art, code, or inventions in a kind of legal limbo .

8- Peter Georg Picht and Florent Thouvenin, 'AI and IP: Theory to Policy and Back Again – Policy and Research Recommendations at the Intersection of Artificial Intelligence and Intellectual Property' (2023) 54 IIC - International Review of Intellectual Property and Competition Law 916.

9-Leonid Tominec, 'POLICY IN THE FIELD OF INTELLECTUAL PROPERTY IN THE CONDITIONS OF DEVELOPMENT OF ARTIFICIAL INTELLIGENCE: APPROACHES AND DIRECTION OF DEVELOPMENT' (2022) 10 Advances in Law Studies 41.every year the interest of society in the development of artificial intelligence is noticeably growing. Intelligent systems can multiply the productivity and efficiency of work and, at the same time, provoke discussions around the future of intellectual property. The study of the issue of the protection ability of objects created by artificial intelligence showed that they are subject to legal protection within the framework of two institutions of law, depending on the degree of human intervention, determined by its functions (technical, organizational, controlling

There's also a lot of variation between countries. Treaties like the Berne Convention and TRIPS don't cover AI-generated content directly, so each country can interpret and regulate it however they see fit[10] .

So far, courts haven't provided clear answers either. There are only a handful of cases dealing with AI authorship or ownership, and the results are mixed. Until we have a solid body of case law, this area will likely remain uncertain .

1.3.4 **Suggested Reforms and the Path Forward**

To fix this legal gap, many experts are calling for legislative reforms that clearly address AI's role in content creation. Some even suggest that we might need to legally recognize AI as a "creator" in certain contexts or create new legal categories that apply only to machine-generated content .

But it's not just about granting rights. There needs to be a balance between encouraging innovation and protecting creators-both human and non-human. If we focus too much on one side, we risk either stifling creativity or undermining the value of human authorship[11] .

1.3.5 **Ethical Considerations in Machine-Created Content**

Beyond law and policy, there are serious ethical concerns to think about. For example, how do we ensure transparency in how AI creates content? What if an AI model is trained on biased data

-10Tanveer Ahmed, 'A Comparative Legal Analysis of Copyright and Patent of Outputs Generated by Artificial Intelligence: In Search of Possible Approaches for Bangladesh' (2025) 2 Chinese Journal of Transnational Law 39.

11- 'IP Rights to AI-Generated Works: Barriers Presented by Existing Law and Reformations Needed' [2022] Canadian Journal of Business and Information Studies 37.commerce ,industries ,arts ,literature ,music composition ,scientific operations, etc .Consequent to this technological development ,the claims for Intellectual Property rights)) IP

and ends up reproducing harmful stereotypes? Who's responsible if it plagiarizes? And what about the economic impact on human artists and creators, who might lose jobs or visibility as machines take over more creative work?

Because of these concerns, many scholars argue that future international treaties should include ethical guidelines, not just legal standards. These could help protect cultural diversity, human dignity, and fair compensation in a world where machines increasingly contribute to creative fields.[12]

2. Intellectual property research is based on a multidimensional concept of international law.

This section tries to demonstrate how viewpoints, methodology, and approaches of this subject may interact with and enlighten research involving intellectual property law, building on the broad knowledge of international law presented above. I will start by describing how public international law approaches shape research on IP law, even if there is special value in taking into account the interaction or combined functioning of the many conceptions of the international when applied to the regulation of IP.

2.1 The benefits of an integrated, multidimensional approach.

This section examines the interactions between intellectual property (IP) law study and various perspectives, methods, and techniques in international law. It emphasizes the importance of combining different international law principles and how public international law influences IP law research.

A. Comprehensive International Legal Structure: The Paris

12-Anatolii Biehun and Eleonora Starina, 'Features of information law in the context of artificial intelligence' [2023] Modeling and Information Systems in Economics 37.

and Berne Conventions are still important even though they were signed so long ago. Nonetheless, both conceptually and practically, the more comprehensive facets of public international law in IP regulation remain underdeveloped.

B. IP and Customary International Law: In addition to treaty law's protection standards, customary international law promotes cross-border IP protection by offering guidelines for interpreting, putting into practice, and upholding IP laws[13].

C. Various International Legal Systems: This framework places international intellectual property law in the context of other worldwide legal orders, contrasting it with general international law and other domains such as commerce, cultural heritage, investment, and human rights, addressing gaps and unresolved issues in specialized systems like IP[14] .

2.2.Appropriation of international law by European law:

The principles and regulations established by EU and international law serve as mandatory standards for European nations, and case law resolves inconsistencies with foreign laws. The GDPR will have an impact on international organizations by emphasizing the EU's adherence to global standards.[15]

13-Henning Grosse Ruse-Khan, 'The Role of Customary International Law for Intellectual Property Protection beyond Borders' in Henning Grosse Ruse-Khan and Axel Metzger (eds), *Intellectual Property Ordering beyond Borders* (1st edn, Cambridge University Press 2022) <https://www.cambridge.org/core/product/identifier/9781009071338%23CN-bp-5/type/book_part> accessed 9 May 2025.

14-Nico Krisch, 'Global Legal Pluralism' in Jeffrey L Dunoff and Mark A Pollack (eds), *International Legal Theory* (1st edn, Cambridge University Press 2022) <https://www.cambridge.org/core/product/identifier/9781108551878%23CN-bp-11/type/book_part> accessed 9 May 2025.

15- Carmen Martínez-Capdevila, 'Customary International Law as a Source of European Union Law: The European Parliament, the Council and the Commission' in Fernando Lusa Bordin, Andreas Th Müller and Francisco Pascual-Vives (eds), *The European Union and Customary International Law* (1st edn, Cambridge University Press 2022) <https://www.cambridge.org/core/product/identifi-

A case that exemplifies the European Court of Justice's (ECJ) role in interpreting international texts is Sankyo (C-414/11, July 18, 2013). In certain cases, the ECJ uses its own interpretation of international law instead of secondary European legislation. The ECJ can handle legal issues with this strategy without running afoul of the secondary laws of the internal market[16]. This is the common commercial policy which falls under the exclusive remit of the EU:

1. Article 27 of the TRIPS Agreement, part of Annex 1C to the WTO Agreement from the Uruguay Round negotiations, falls under the common commercial policy.
2. The European Court of Justice (ECJ) interprets the TRIPS Agreement uniformly, binding on EU member states, ensuring that pharmaceutical inventions can be patented unless exceptions apply.
3. A patent granted only for the manufacturing process of a pharmaceutical product does not extend to the product itself, according to TRIPS Articles 27 and 70.

3. International protection of industrial and commercial property rights.

The international protection of industrial and commercial property rights (ICPR) is a complex framework shaped by various treaties and legal principles. This protection is essential for fostering innovation and economic growth globally. Key aspects include the role of international treaties, the mechanisms for enforcement, and the implications of varying national laws on ICPR.

3.1 Protection within the framework of the Paris Agreement and special agreements.

The Paris Convention about the Protection of Industrial Property of 1883 serves as the foundation for the protection of intellec-

er/9781108966535%23CN-bp-10/type/book_part> accessed 9 May 2025.
16- ibid.

tual property rights[17]. This convention served as the cornerstone of the global system of public administration practices in the area of intellectual property[18], and it was crucial in the establishment of shared norms and standards for IP protection as well as the formation of legal institutions. The goal of conferences conducted in Vienna and Paris in the 1870s and 1880s was to establish worldwide industrial property protection, which led to the creation of the Paris Convention[19].

The convention covers the fundamentals of international treaties and trade systems, as well as the minimal degree of protection, enforcement strategies, dispute settlement, and transitional measures. Ukraine, a signatory to more than 50 international treaties on intellectual property, has included it as a fundamental aspect of its national legal framework.

Under the Paris Agreement, intellectual property faces both substantial potential and problems[20]. There is no language expressly addressing intellectual property in the Paris Agreement. It does, however, stress the significance of technology transfer and relies on partnerships and technology networks to encourage the spread of green technologies[21].The efficacy, accountability, and efficiency of these technology networks have drawn criticism. Additionally, a major barrier to the rapid and effective transfer of technology is intellectual property rights. Modifications to intellectual property

17-Jiayin Huang, 'Analysis of Green Intellectual Property Issues and Countermeasures from the Perspective of International Law' (2024) 6 Scientific Journal Of Humanities and Social Sciences 49.

18- P Sean Morris, *Intellectual Property and the Law of Nations, 1860-1920* (Brill | Nijhoff 2022) <https://brill.com/view/title/58943> accessed 9 May 2025.

19-'Protection of Intellectual Property Rights per Protocol No. 1 of the Convention for the Protection of Human Rights and Fundamental Freedoms' (2023) 72 GRUR International 317.

20-Kujo Elias McDave, 'Intellectual Property Rights as Ethical Response to Global Climate Change Crisis' (2022) 10 Global Journal of Politics and Law Research 50.

21-Chen Zhou, 'Can Intellectual Property Rights within Climate Technology Transfer Work for the UNFCCC and the Paris Agreement?' (2019) 19 International Environmental Agreements: Politics, Law and Economics 107.

laws are required to support technology transfers that are both accessible and flexible. Despite these obstacles, there are still chances to reconsider conventional intellectual property strategies and advance technology access by using a human rights perspective.

3.2 Madrid Agreement:-

A treaty about worldwide registration of trademarks was established in Madrid in 1891. It makes registered marks legally protected and makes it easier for domestic businesses to become international names. The Nice Pact, the Madrid Protocol, and the Paris Convention for the Protection of Industrial Property provide the framework that the pact is a part of that. For example, the Madrid Protocol streamlines the trademark registration procedure by enabling the use of a single application,a single language, and one currency. In the age of globalization, ratifying the Madrid Protocol is viewed as a step in the right direction toward bolstering the defense of homegrown businesses and encouraging fair trade competition. However, sufficient infrastructure, technology, and human resources are needed for the Madrid Protocol to be implemented effectively[22] .

3.3 Washington Agreement:

The Washington Convention on Patents, often known as T.C.P., was signed on February 3, 1984; it was dated February 3, 1979; on June 19, 1970, it was updated by executive regulations dated January 1, 1994.The primary functions of the Washington Convention for International Patent Cooperation (PCT) are to standardize disparate methods and make it easier for patents to be filed in several nations[23]. The international phase and the country phase

22- Arthur Elvis Chukwu Esq, 'Evaluation of the Madrid Treaty for the Protection of Trademarks' [2022] International Journal of Research Publication and Reviews 1889.
23- Selena A Dickey, 'The Case of the Option Agreement: Erle Stanley Gardner, Intellectual Property Management, and Radio's Perry Mason' (2022) 61 JCMS: Journal of Cinema and Media Studies 9.

make up the PCT system. An application is filed in a PCT Receiving Office and is the subject of an international prior art search during the international phase. The national patent offices of the nations where the applicants seek protection are where they can pursue their PCT patent during the national phase. It is crucial to remember, though, that national patent offices frequently carry out their searches for previous art, which results in duplication and extra expenses.

3.4 Protection under the Strasbourg Convention on International Standard Classification:

Signed on March 23, 1971, this agreement came into effect in 1975. Regarding the sorts of refined materials, technology is broken down into eight parts, with a total of sixty-seven thousand sub-sections. The sections are organized alphabetically within each division.

There are several obstacles in the way of putting the Strasbourg Convention on International Standard Classification into practice. The availability of suitable matrix-based certified reference materials (CRMs) and the requirement for international cooperation in their supply and manufacture provide one obstacle [24].A further difficulty is the necessity for regulatory approval[25] , which varies by nation and necessitates submitting recalibration revisions to several regions where a measurement system is sold. Furthermore, the way standards are now categorized is flat and heavily ramified, which makes it challenging to link standards to quick responses to shifting

24- W Greg Miller and others, 'Overcoming Challenges Regarding Reference Materials and Regulations That Influence Global Standardization of Medical Laboratory Testing Results' (2023) 61 Clinical Chemistry and Laboratory Medicine (CCLM) 48.trueness control materials and human samples\n . Among the challenges to implementing metrological traceability are the availability of fit-for-purpose matrix-based certified reference materials) CRMs

- 25Silvia Favalli, 'MISURE DI AUSTERITÀ E DISCRIMINAZIONE SULLA BASE DELLA DISABILITÀ: UNA RECENTE DECISIONE DELLA CORTE DI STRASBURGO' (2021) 252 Il Politico 168.

requirements[26].to obtain internationally consistent outcomes, these issues emphasize the necessity of stakeholder participation, the priority of metrics for standardization, and more uniform regulatory submission criteria.

3.5 Protection under the Washington Convention on Integrated Circuits:-

Topographic design, which is a three-dimensional arrangement of elements, at least one of which is an active element, and some or all of the connections of an integrated circuit, were defined by the agreement as formal designs related to the electronic field and are based on the integration of a large number of electrical functions into a small component and in a specific manner. Regarding the integrated circuit, it is a product made up of conductors and elements, at least one of which must be active in order for the integrated circuit to work electrically. Conductors may be integral to the material or just partially so [27].

26- Ryan Solinsky and Steven C Kirshblum, 'Challenging Questions Regarding the International Standards' (2018) 41 The Journal of Spinal Cord Medicine 684.

27-LA Zolotorevich and VA Ilyinkov, 'Monitoring the Reliability of Integrated Circuits Protection against Trojans: Encoding and Decoding of Combinational Structures' (2021) 18 Informatics 7.systems on a chip are the key links in various industrial systems and state defense systems .The emergence of counterfeit integrated circuits ,problems of piracy ,overproduction ,unauthorized interference in the design of microcircuit ,hardware Trojans require the development of methods and means of their timely detection .Trojans can be introduced into the integrated circuits structure both on the development stage and during the production process ,including the stages of specification ,design ,verification and manufacturing. The inclusion of additional elements in the integrated circuits structure jeopardizes the functional suitability and reliability of the system as a whole .For the purpose of hardware protection of projects ,the methods of hardware coding are currently used\.n The paper discusses the features and reliability of logical coding of combinational circuits .An algorithm for cracking the code of combinational circuits is proposed ,based on the description of encoded structure by the resolution function and reducing the problem to SAT CNF .The initial data for decoding the structure of a digital device is the structural implementation of encoded circuit ,obtained, for example ,by reverse engineering) prototype design

The Washington Convention's Article Two, Paragraph Three stated that the object to be protected must fulfill two requirements: the design must be unique, and the integrated circuit industry and the designers of the designs must not be familiar with it.

Its Article 7 permitted the member state to require registration as a prerequisite to protection, with the filing having to happen no later than two years from the beginning of exploitation. Regarding the length of protection, Article 8 of it said that domestic law may extend protection to at least that long.

3.6 TRIPS Agreement .

The TRIPS Agreement, which stands for Trade-Related Aspects of Intellectual Property Rights, has a history that dates back to the establishment of the World Trade Organization (WTO) on January 1, 1995. The agreement was included as part of the WTO Agreement, which aimed to promote trade liberalization and establish general provisions related to trade[28]. The TRIPS Agreement introduced minimum international standards for the protection of intellectual property rights, but it has been a subject of criticism and debate. Some argue that it restricts the ability of developing countries and least developed countries to adapt their national laws to their own socioeconomic environment and development level[29]. The pact has drawn criticism for failing to meet developing nations' demands for access to research and development and for being a textbook example of corporate takeover of the process of drafting international law.

TRIPS must be independent and integrated within the WTO

28- Anastasia Zefanya, 'The Role of the WTO in Making a Trips Agreement as Part of International Economic Law Sources' (2022) 1 Law and Humanities Quarterly Reviews <https://www.asianinstituteofresearch.org/lhqrarchives/the-role-of-the-wto-in-making-a-trips-agreement-as-part-of-international-economic-law-sources> accessed 9 May 2025.

29-Luqman Hakim, 'Implementasi Lisensi Wajib TRIPs Agreement Dalam Produk Farmasi Di Negara Swedia' (2023) 4 Jurnal Hukum Lex Generalis 28.

in order for disputes under the agreement to be resolved. A useful tool for resolving disputes and authorizing trade penalties is provided by the WTO. Government-to-government intellectual property disputes were handled differently prior to the WTO's founding. Standards pertaining to the extent of protection include the TRIPS clauses on restrictions and exceptions to exclusive rights. When it comes to WTO dispute settlement procedures, it is the complaint member's responsibility to provide evidence supporting any claim that another member has neglected to apply a TRIPS norm.

4.protecting artistic and literary rights.

The protection of artistic and literary rights is a fundamental aspect of intellectual property law, particularly under the frameworks established by national and international legislation, The scope of protection encompasses a wide range of works, including literary, musical, and artistic creations, yet challenges persist in enforcement .and the potential chilling effects of content-based laws

4.1Berne Convention for the Protection of Artistic and Moral Rights-:

The Berne Convention, adopted in 1886, deals with the protection of works and the rights of their authors. The Convention is based on three basic principles and includes a set of provisions relating to the minimum protection to be granted and some special provisions designed for the benefit of developing countries that wish to use it.

The Berne Convention provides several benefits for authors and publishers. Firstly, it introduced the concept of moral rights, protecting the personal component of copyright and allowing authors to maintain control over their work.

Furthermore, the growth of the internet and network technol-

ogies has presented hitherto unheard-of difficulties for copyright protection, like information sharing and digitalization circumvention, which threaten copyright holders' rights. These difficulties draw attention to the necessity for a more precise agreement on simultaneous publishing, more harmonization of local and international legal frameworks, and the establishment of a common standard for copyright protection[30].

4.2 Geneva Convention and Copyright .

It was developed by UNESCO as part of a project that was approved on September 6, 1952, at the Intergovernmental Conference on Copyright held in Geneva. On July 24, 1971, it was modified.

This agreement's preamble states that its goals are to implement copyright protection on a global scale, provide access to an international framework that is appropriate for all countries, uphold individual rights, and promote the advancement of the arts, sciences, and literature[31].

30- am Ricketson and Jane C Ginsburg, 'Restrictions on the Exercise of Rights: Limitations and Exceptions (Articles 2bis (2), 9(2), 10, 10bis, 11bis (2), 13, 17; Later Agreements)' in Sam Ricketson and Jane C Ginsburg, *International Copyright and Neighbouring Rights* (Oxford University Press 2022) <https://academic.oup.com/book/43114/chapter/361642738> accessed 9 May 2025.

31- nesco, 'Protocol 1 Annexed to the Universal Copyright Convention, Concerning the Application of That Convention to the Works of Stateless Persons and Refugees Geneva, 6 September 1952' in Unesco (ed), *Standard-Setting at UNESCO* (Brill | Nijhoff 2007) <https://brill.com/view/book/edcoll/9789047422174/Bej.9789004164543.1-760_005.xml> accessed 9 May 2025.

The Convention's extra protection is likewise enjoyed by them. It may be observed by extending the terms of the Geneva Convention, which was revised in Paris in 1971, that there is no conflict between the Berne Convention and this supplemental accord. Article 17 of the Convention acknowledged this, stating that "this declaration is an integral part of the Berne Convention, and this Convention does not affect in any way its provisions." from this contract.

4.3 **Rome Convention:**

Three primary adjacent rights are recognized by the 1961 Rome Convention for the Protection of Performers, Producers of Phonograms, and Broadcasting Organizations: protection of performers, protection of producers of phonograms, and protection of broadcasting organizations. Nonetheless, the Rome Convention started with fewer members than other comparable treaties like the Berne Convention and the Universal Copyright Convention. However, it is seen as a significant addition to the global copyright protection framework set up by the Berne Convention. Over time, the Rome Convention has been expanded to include provisions that provide broadcasting organizations authority over the use of broadcast signals for at least 20 years, as well as protection for performers and creators of sound recordings for at least 50 years.

To address this, the special conflict-of-law rule of the Rome II Regulation applies to non-contractual obligations arising from copyright infringement[32].

32-Sapientia Hungarian University of Transylvania, Department of Legal Science, Cluj-Napoca and others, 'The Law Applicable to Non-Contractual Obligations Arising from Copyright Infringements in the Light of the Rome II Regulation' (2022) 2 Erdélyi Jogélet 87."plainCitation":"Sapientia Hungarian University of Transylvania ,Department of Legal Science ,Cluj-Napoca and others' ,The Law Applicable to Non-Contractual Obligations Arising from Copyright Infringements in the Light of the Rome II Regulation2022) '

4.4 WIPO Agreement.

Through the establishment of uniform IP protection rules and norms, the WIPO Convention aids in the protection of intellectual property. All member nations benefit from this network of international treaties, which guarantees that they are bound by established rules and cannot act unilaterally. States commit to partially renounce their domestic intellectual property rules and harmonize with international law by signing these accords. International classifications about innovations, trademarks, and industrial designs are managed by WIPO, which also regularly reviews and enhances them. International intellectual property agreements from WIPO, including the Madrid, Hague, and Patent Cooperation Treaties, have improved international collaboration and connected the demands of inventors and brand owners in a global economy with the territorial character of intellectual property,due to these accords, WIPO's international filing procedures are now genuinely global and appealing to IP users everywhere[33].

5.Leveraging Technology for IP Protection.

Many facets of intellectual property (IP) protection have undergone radical change since the invention of technology. Blockchain technology and artificial intelligence (AI) are two noteworthy technological developments that hold great promise. Blockchain offers a strong framework for IP registration and management, while AI delivers advanced capabilities for tracking and identifying IP infringement. This section examines how these technologies can be used to improve intellectual property protection, going into their workings, advantages, and practical uses.

33- Lisa Jorgenson and Carsten Fink, 'WIPO's Contributions to International Cooperation on Intellectual Property' (2023) 26 Journal of International Economic Law 30.WIPO's international intellectual property (IP

5.1AI in Monitoring IP Violations

Automating and improving the identification of intellectual property breaches has been made possible by artificial intelligence, especially machine learning and deep learning. Large volumes of data can be analyzed by AI systems to find trends and abnormalities that might point to possible violations [34].

A. **Automated Content Monitoring:**AI-powered technologies can identify illegal use of copyrighted items by scanning and analyzing digital content on the internet. These tools compare uploaded content to a database of protected works using algorithms. An AI system called Content ID, for example, is used by websites such as YouTube to automatically recognize and handle copyright-protected content and notify owners of illicit uses.

B. **Trademark Infringement Detection:**Additionally, AI can help detect trademark infringements. Conventional approaches to trademark infringement detection are frequently slow and labor-intensive. However, AI algorithms can swiftly search social media and the internet for trademark infringement. These algorithms identify brand names, logos, and words that sound similar by using natural language processing (NLP) and picture recognition.

C. **Patent Analysis and Prior Art Search:**AI has the potential to greatly speed up the prior art search and patent analysis processes. To identify prior art that could render a new patent application invalid, AI systems can search through millions of patent filings, scholarly publications, and other pertinent material. This improves the accuracy of the patent inspection process while simultaneously accelerating it[35].

34-Can Sinan Canpolat, 'Using Artificial Intelligence to Detect Violations and Disinformation on Social Media Networks, Including Intellectual Property Rights Infringements' (2024) 8 Next Frontier For Life Sciences and AI 73.

35- АВ Горбунов, БЛ Генин and ДС Золкин, 'Prior art search as a problem of determining the elements of the semantic cluster of patent documents' [2023] Научно-техническая информация. Серия 1: Организация и методика информационной

D. **Identifying Counterfeit Goods:** By examining product photos, descriptions, and reviews on e-commerce sites, artificial intelligence (AI) systems can detect fake goods. Images of authentic and fake goods can be used to train machine learning models to identify minute variations that human inspectors might miss. For firms hoping to safeguard their goods and keep customers' trust, this skill is essential [٣٦].

5.2 Blockchain Technology in IP Registration and Management

An innovative method for managing and registering intellectual property is provided by blockchain technology, which is renowned for its decentralized and unchangeable ledger system. Blockchain guarantees efficiency, security, and transparency in the administration of intellectual property rights.

A. **Secure and Transparent IP Registries:** An IP right cannot be changed or removed after it has been registered because of the blockchain's ability to generate safe, unchangeable records of IP registrations. This openness guards against false claims and aids in settling disagreements over intellectual property ownership. For instance, blockchain is being investigated by the European Union Intellectual Property Office (EUIPO) to provide a safe and transparent IP registry[37].

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36- Kanishka Vaish and others, 'Artificial Intelligence Reducing the Intricacies of Patent Prior Art Search', *2023 International Conference on Computational Intelligence and Sustainable Engineering Solutions (CISES)* (IEEE 2023) <https://ieeexplore.ieee.org/document/10183481/> accessed 9 May 2025.

37-Haritha Madhava Reddy, 'Role of AI in Security Compliance' (2024) 08 INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT 1.\ndetect intricate patterns ,and automate complex\nprocesses significantly improves risk management and\nregulatory adherence .AI enables real-time data\nanalysis ,promptly identifying potential violations and\nflagging security threats ,thereby strengthening an\norganization's overall security framework.

B. **Smart Contracts for Licensing Agreements:**IP licensing agreements can be streamlined with smart contracts, which are self-executing contracts with the terms of the agreement encoded directly into the code. These agreements automatically enforce their terms, guaranteeing that licensees obtain the IP as specified and licensors are paid. Because of this automation, there is less need for middlemen and a decreased chance of conflict [38].

C. **Proof of Authenticity:**Blockchain technology can be used to confirm the legitimacy of digital assets and goods. Customers and companies can verify the authenticity of a product by tracking its origin and journey by documenting every stage of the supply chain on a blockchain. This is especially helpful in the fight against fake goods and protecting the integrity of digital media, luxury goods, and medications[39] .

D. **Decentralized Marketplaces:** Blockchain makes it possible to establish decentralized markets where intellectual property rights can be purchased, sold, and licensed without the involvement of conventional middlemen. These markets provide a more effective and transparent platform for intellectual property transactions, which lowers ex-

However\,nwhile AI offers transformative advantages ,its\nintegration into existing security systems introduces\nnew challenges ,such as data privacy concerns\,nalgorithmic bias ,and the need for transparent\ndecision-making .This paper explores the dual role of\nAI in both enhancing compliance efforts and\npresenting risks that require careful management .By\nadopting a balanced approach—leveraging AI's\ncapabilities while ensuring robust oversight\—norganizations can optimize compliance processes\,naddress regulatory challenges ,and mitigate associated\nrisks. Achieving this balance is critical to securing\nlong-term success in an increasingly regulated and\ndigitized landscape\.n\nKeywords—Artificial Intelligence) AI

38- Bhanupratap Sahoo and Prof. Revati Sakalkar, 'Smart Contracts, Smarter Royalties: Tech for India's Music Industry' (2024) 2 International Journal for Multidimensional Research Perspectives 22.

39-Hassen Louati and others, 'Adopting Artificial Intelligence to Strengthen Legal Safeguards in Blockchain Smart Contracts: A Strategy to Mitigate Fraud and Enhance Digital Transaction Security' (2024) 19 Journal of Theoretical and Applied Electronic Commerce Research 2139.

penses and boosts participant trust[40].

5.3 Case Studies and Real-World Applications.

An important development in the battle against IP infringement is the use of blockchain and artificial intelligence in IP protection systems. Blockchain offers a safe, open, and effective mechanism for IP registration and management, while AI improves the capacity to identify and address violations. These technologies will become more and more crucial in protecting intellectual property in the digital era as they develop.

A. **YouTube's Content ID System:** One of the most well-known instances of AI being used for IP protection is YouTube's Content ID system. By automatically identifying copyrighted content in billions of videos, the method enables rights holders to efficiently manage their intellectual property, Content ID has settled millions of disputes and paid out billions of dollars in licensing payments and ad revenue to rights holders[41].
B. **IBM's Watson for IP:** AI is used by IBM's Watson to help with prior art searches and patent examination. Watson can uncover pertinent previous art and help patent examiners and IP attorneys make well-informed conclusions by analyzing thousands of papers in a fraction of the time it would take a human[42].
C. **VeChain's Blockchain for Supply Chain Integrity:** VeChain uses blockchain technology to improve product authenticity and supply chain transparency. Business-

40-Veno Ivankovic, Zeshun Shi and Zhiming Zhao, 'A Customizable dApp Framework for User Interactions in Decentralized Service Marketplaces', *2022 IEEE International Conference on Smart Internet of Things (SmartIoT)* (IEEE 2022) <https://ieeexplore.ieee.org/document/9874498/> accessed 9 May 2025.

41-Waleed Afandi and others, 'Fingerprinting Technique for YouTube Videos Identification in Network Traffic' (2022) 10 IEEE Access 76731.

42- Deepti Hegde and Suneeta Hegde, 'Artificial Intelligence for Mitigating Patent Process Hurdles' (2022) 9 International Journal of Engineering Research in Computer Science and Engineering 50.

es can use the blockchain to document each step of the supply chain, giving customers the ability to confirm the legitimacy and place of origin of goods. This use has proven especially successful in sectors like luxury goods and pharmaceuticals that are afflicted by counterfeiting[٤٣].

6. Conclusions And Recommendations.

This research has demonstrated that while international legal frameworks such as the TRIPS Agreement and WIPO conventions have established a strong foundation for global intellectual property (IP) protection, they remain insufficient in the face of modern technological disruption. Emerging innovations, particularly artificial intelligence and blockchain, are challenging the conventional notions of authorship, ownership, and enforcement. Legal ambiguity surrounding AI-generated works, inconsistencies in national enforcement, and significant barriers to technology transfer—especially for developing countries—highlight the urgent need for reform. Moving forward, the international community must adopt adaptable, inclusive, and forward-thinking strategies to ensure that IP protection evolves alongside technological innovation, while maintaining fairness and accessibility for all stakeholders. We therefore recommend the following:

1. Modernize and Expand International Treaties:Introduce supplementary protocols to existing treaties such as TRIPS and the Berne Convention to explicitly address AI-generated content, blockchain-based IP registration, and emerging technological challenges.

2. Support Developing Countries:Provide targeted technical assistance and capacity-building programs through WIPO to enable effective domestic implementation of international IP obligations, ensuring that low- and middle-income countries are not left

43- Ainur Jumagaliyeva and others, 'Identifying Patterns and Mechanisms of AI Integration in Blockchain for E-Voting Network Security' (2024) 4 Eastern-European Journal of Enterprise Technologies 6.

behind in the digital economy.

3. Establish International IP Courts or Panels:Create specialized international tribunals or adjudicatory bodies with jurisdiction over cross-border IP disputes, particularly those involving digital technologies, to ensure consistent and efficient resolution.

4. Set Global Ethical and Technical Standards:Promote the development of universal ethical guidelines and technical standards for the use of AI and blockchain in IP systems, ensuring transparency, accountability, and cultural sensitivity.

5. Harmonize Laws: Through the TRIPS Agreement, WIPO and the WTO should modernize national laws and harmonize member nations' legal systems in order to promote creative energy-based global economic development.

6. Monitor and Evaluate Implementation:Establish an independent global observatory to oversee the implementation of IP laws and agreements, track compliance, assess effectiveness, and issue regular reports to inform policy decisions.

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