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May 2026 Patent Analysis

Digital Product Passport & Traceability Technologies

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Responsible Partner : INTRACT

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LIST OF ACRONYMS

AI	Artificial Intelligence
CPC	Cooperative Patent Classification
DPP	Digital Product Passport
EPO	European Patent Office
ESPR	Ecodesign for Sustainable Products Regulation
IPC	International Patent Classification
IoT	Internet of Things
PCT	Patent Cooperation Treaty
RFID	Radio Frequency Identification

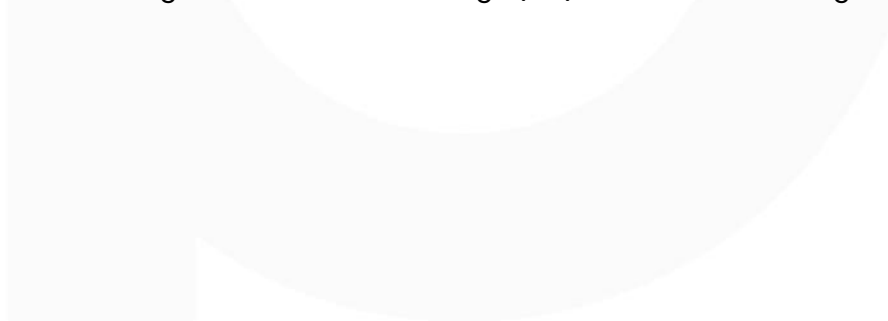
EXECUTIVE SUMMARY

This report presents a comprehensive patent landscape analysis of Digital Product Passport (DPP) and traceability technologies, based on 14,729 patent families retrieved from the European Patent Office's (EPO) Espacenet database. The search combined relevant Cooperative Patent Classification (CPC) classifications (including G06Q30/0185, G06Q50/28, G06Q50/06, blockchain, Radio Frequency Identification (RFID), and sustainable production codes) with full-text terms for traceability, tracing, and traceable products.

The analysis reveals an extraordinary acceleration in patent activity from 2016 onward, with annual filings growing from approximately 110 families in 2015 to over 2,500 in 2025—representing a more than 20-fold increase within a decade. This surge reflects global momentum driven by regulatory frameworks, particularly the European Union's DPP initiative under the Ecodesign for Sustainable Products Regulation (ESPR), as well as the accelerated digital transformation catalysed by the COVID-19 pandemic.

China dominates the landscape in terms of filing volume with 13,458 family designations, reflecting massive state-backed investment in supply chain digitalization and blockchain-based traceability systems. However, Europe holds a strategically influential position: the EPO ranks as the second-largest CPC assigning office with 6,823 documents, and European applicants from France, Germany, Switzerland, Italy, the United Kingdom, and other EU member states demonstrate strong quality-focused innovation. Multiple European national jurisdictions collectively represent a significant and diverse innovation ecosystem.

Key technology pillars identified across the dataset include data security and digital signatures (G06F21), sustainable production traceability (Y02P90/30), commerce and product passport systems (G06Q30/0185), blockchain and distributed ledger technologies (G06F16/27), and energy sector applications (G06Q50/06). The convergence of these technologies underlines the multidisciplinary nature of DPP innovation spanning IT security, supply chain management, Internet of Things (IoT), and artificial intelligence (AI).



1. INTRODUCTION

1.1. Background

The DPP is an emerging concept at the intersection of sustainability, supply chain transparency, and digital technology. It represents a structured digital record that accompanies a product throughout its lifecycle, capturing information about origin, composition, manufacturing processes, and environmental impact. The concept has gained significant regulatory traction, particularly within the European Union, where the ESPR mandates DPPs for various product categories starting from 2027.

Traceability—the ability to track and trace products, components, and materials across complex global supply chains—forms the technological backbone of the DPP concept. Technologies enabling traceability include blockchain and distributed ledger technologies, RFID and automatic identification systems, cryptographic security mechanisms, and AI-powered data management platforms.

1.2. Scope and Methodology

This analysis is based on patent data exported from the EPO’s Espacenet database. The search strategy combined CPC classification codes (G06Q30/0185, G06Q50/28, G06Q50/06, G06K19/07, G06K7/10, G06F16/27, G06F21/60, H04L9/3236, Y02P90/30) with the full-text keyword “product passport” and traceability-related terms (“traceability,” “tracing,” “traceable”). The query returned 14,729 patent families, which were analysed across multiple dimensions including geographic distribution, temporal trends, technology classifications, competitive landscape, and inventor analysis.

2. PATENT PUBLICATION AND FILING TRENDS

2.1. Publication Timeline

The earliest patents in the dataset trace back to the late 1960s, reflecting early foundational work in product identification and tracking. However, activity remained minimal through the 1990s, with fewer than 10 families published annually. A gradual upward trend began in the early 2000s, with publication counts reaching 34–55 families per year between 2004 and 2015 (Figure 1).

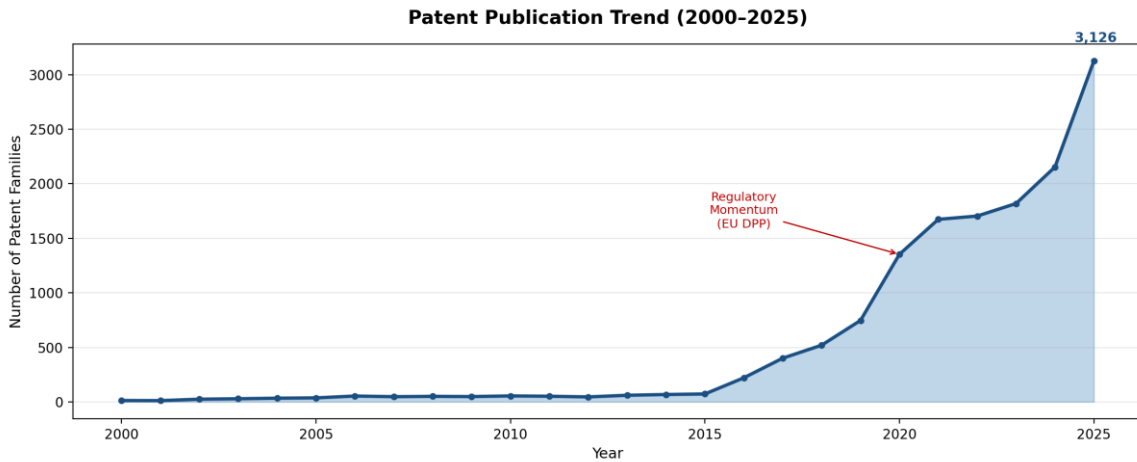


Figure 1 Patent Publication Trend (2000–2025)

The transformative inflection point occurred around 2016–2017, when annual publications jumped from 73 (2015) to 221 (2016) and then to 401 (2017). This dramatic shift correlates with several concurrent developments: the maturation of blockchain technology and its application to supply chain use cases, growing global regulatory attention to product traceability, and China’s strategic national investments in supply chain digitalization.

The growth trajectory continued to accelerate through 2018–2019, with 520 and 747 publications respectively. The year 2020 marked another significant leap to 1,353 families, nearly doubling the previous year’s output. This surge can be partially attributed to the COVID-19 pandemic, which exposed vulnerabilities in global supply chains and dramatically accelerated demand for digital traceability solutions across food safety, pharmaceutical distribution, and manufacturing sectors.

From 2021 through 2025, the landscape maintained its rapid growth trajectory: 1,674 (2021), 1,704 (2022), 1,819 (2023), 2,154 (2024), and 3,126 (2025). The 2025 figure is particularly notable, representing the highest annual output in the dataset and confirming that innovation momentum in this field continues to intensify. The 2026 figure (245 families as of early 2026) suggests this trend will persist

2.2. Priority Date Trends

The priority date analysis provides a more accurate picture of actual inventive activity, as it reflects when patent applications were first filed rather than when they were published.

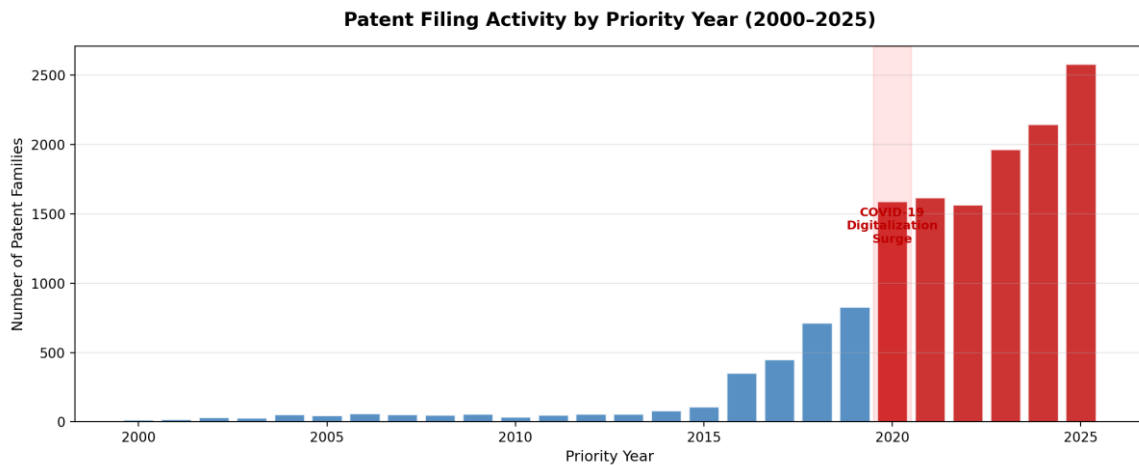


Figure 2 Patent Filing Activity by Priority Year (2000–2025)

The priority date data confirms the publication trends with a similar exponential growth pattern from 2016 onward (Figure 2). Notably, the priority date data shows 2020 as a particularly significant year with 1,590 families, representing a near-doubling from 2019’s 829 families. This sharp increase during the first year of the COVID-19 pandemic underscores how the global health crisis served as a powerful catalyst for traceability innovation, as organizations worldwide urgently sought digital solutions for supply chain visibility.

The continued strong filing activity in 2023 (1,964 families), 2024 (2,147 families), and 2025 (2,581 families) indicates that the innovation pipeline remains robust and that significant new patented technologies will continue entering the landscape in the coming years

3. GEOGRAPHIC DISTRIBUTION

3.1. Country Overview

The geographic analysis reveals a highly concentrated patent landscape with distinct regional patterns and strategic positioning.

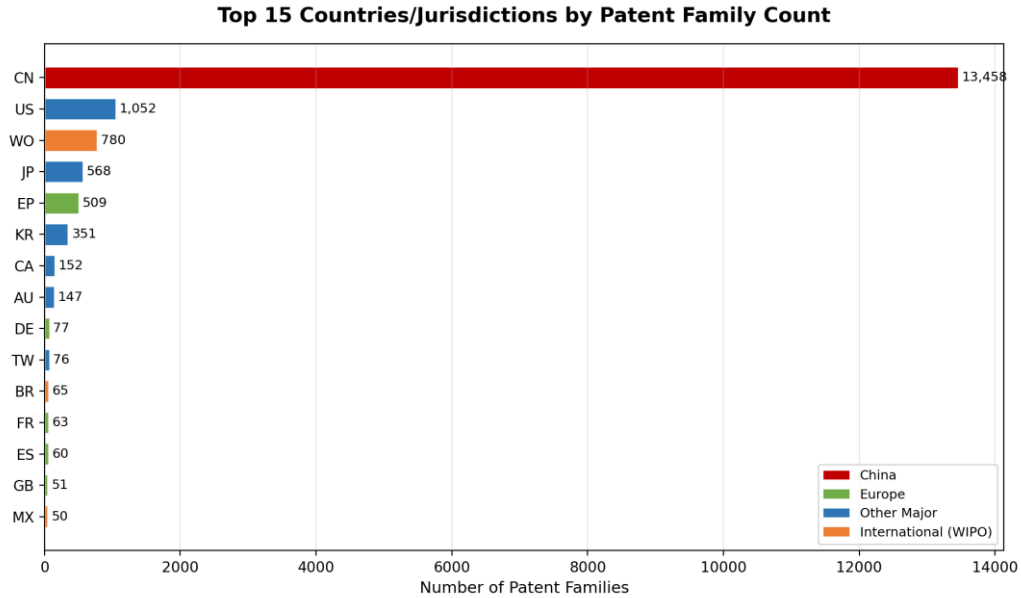


Figure 3 Top 15 Countries/Jurisdictions by Patent Family Count

China leads the dataset with 13,458 family designations, accounting for the vast majority of filings (Figure 3). This dominance reflects China’s massive state-driven investment in blockchain technology, supply chain digitalization, and smart manufacturing systems. State Grid Corporation of China alone holds 177 patent families, and numerous Chinese universities and technology companies feature prominently among the top applicants.

The United States ranks second with 1,052 family designations, followed by WIPO (780 international PCT filings), Japan (568), the EPO (509), and South Korea (351). These figures represent the filing jurisdictions where patent protection has been sought.

3.2. Europe’s Strategic Position

Europe’s position in this patent landscape deserves particular attention and a nuanced interpretation that goes beyond raw filing numbers. While China leads in volume, Europe demonstrates a strategically sophisticated innovation profile built on regulatory leadership, quality-focused R&D, and a diverse multi-country ecosystem.

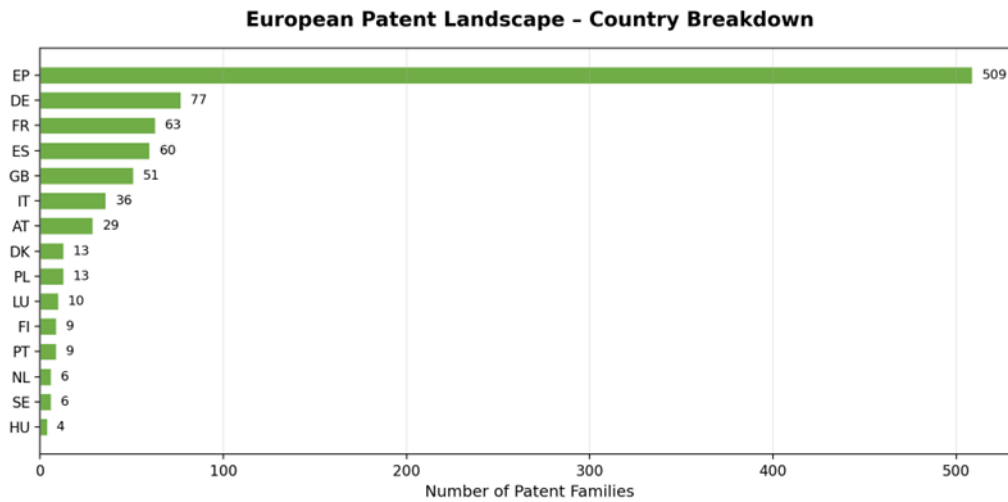


Figure 4 European Patent Landscape – Country Breakdown

The EPO designation with 509 patent families represents pan-European patent protection of high strategic value, as EP filings undergo rigorous examination and typically reflect high-quality inventions with commercial significance (Figure 4). Additionally, individual European countries collectively contribute substantially: Germany (77), France (63), Spain (60), the United Kingdom (51), Italy (36), Austria (29), Denmark (13), Poland (13), Luxembourg (10), Finland (9), and others. When these national filings are combined with EP designations, Europe’s collective footprint is significantly larger than any single country figure suggests.

Critically, Europe is the global regulatory pioneer in Digital Product Passports. The EU’s ESPR and the Battery Regulation are the world’s first comprehensive legislative frameworks mandating product passports. This regulatory leadership creates a powerful “first-mover advantage” that positions European innovators to set global standards and shape how DPP technologies are developed and deployed worldwide. Companies and research institutions in Europe are not merely filing patents; they are building the foundational infrastructure for a regulatory framework that the rest of the world is increasingly expected to follow.

Furthermore, the CPC assigning office data reveals that the EPO is the second-largest CPC classification authority with 6,823 classified documents—far exceeding the US figure of 1,070. This indicates that a very large share of global patent families, including many Chinese-origin filings, seek or receive European classification, reflecting the strategic importance of the European market for DPP technologies.

3.3. Applicant Headquarters Analysis

The applicant country analysis (based on corporate headquarters location) provides a complementary perspective that reveals different patterns from the filing jurisdiction data.

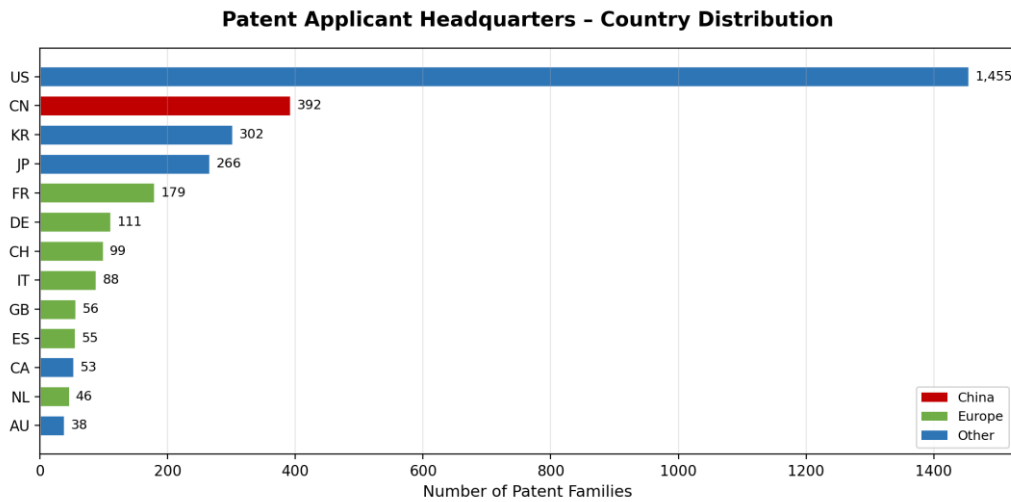


Figure 5 Patent Applicant Headquarters – Country Distribution

The United States leads with 1,455 applicant-linked families, reflecting the strength of major US technology corporations (IBM, Microsoft) and specialized technology companies in areas such as barcode/RFID systems (Figure 5). China follows with 392, South Korea with 302, and Japan with 266. European countries are well represented: France (179), Germany (111), Switzerland (99), Italy (88), the United Kingdom (56), Spain (55), the Netherlands (46), and others. Collectively, European-headquartered applicants represent a substantial share of the innovation base, demonstrating broad participation across both large multinational corporations and specialized SMEs

4. TECHNOLOGY CLASSIFICATION ANALYSIS

4.1. IPC Main Groups

The IPC (International Patent Classification) analysis reveals the core technology pillars underlying DPP and traceability innovation.

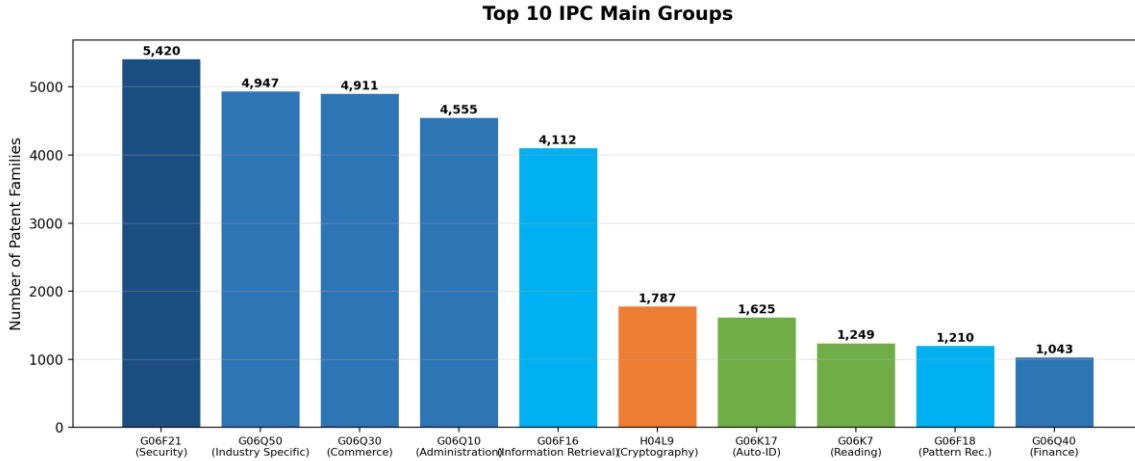


Figure 6 Top 10 IPC Main Groups

The dominant classification is G06F21 (Security Arrangements) with 5,420 patent families, underscoring the critical importance of data security, authentication, and digital integrity in traceability systems (Figure 6). Product passports must ensure tamper-proof data recording, secure access control, and verifiable digital signatures—all core functions addressed by this classification.

G06Q50 (Industry-Specific ICT Applications, 4,947 families) and G06Q30 (Commerce, 4,911 families) together reflect the commercial and sector-specific application of traceability technologies across manufacturing, energy, agriculture, healthcare, and retail. G06Q10 (Administration/Management, 4,555 families) captures supply chain management, quality control, and logistics optimization systems.

G06F16 (Information Retrieval, 4,112 families) is highly significant, as it includes blockchain and distributed ledger technologies (subgroup G06F16/27 with 2,287 families) that provide the immutable data infrastructure for many product passport implementations.

Additional important classifications include H04L9 (Cryptographic Mechanisms, 1,787 families), G06K17 and G06K7 (Automatic Identification and Reading Systems, 1,625 and 1,249 families respectively), reflecting RFID, barcode, and IoT-based identification technologies essential for physical product tracking. G06N3 (Neural Networks/AI, 1,034 families) and G06F18 (Pattern Recognition, 1,210 families) highlight the growing role of AI in automated quality inspection, predictive analytics, and intelligent supply chain management.

4.2. Key CPC Subgroups

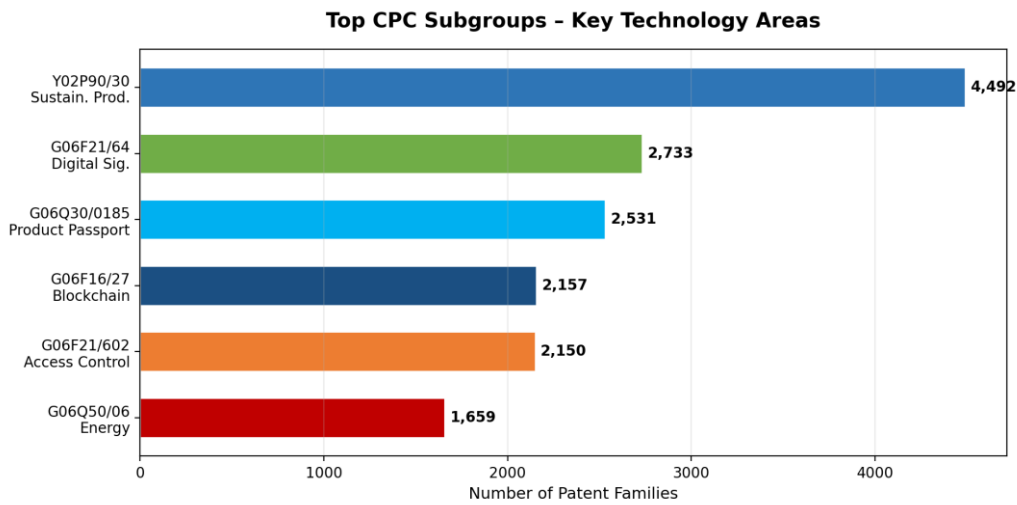


Figure 7 Top CPC Subgroups – Key Technology Areas

The CPC subgroup analysis provides granular insight into specific technology focus areas. Y02P90/30 (Sustainable Production, 4,492 families) is the leading CPC subgroup, directly connecting this patent landscape to sustainability and environmental goals—confirming that traceability innovation is fundamentally driven by sustainability imperatives (Figure 7). G06F21/64 (Digital Signatures, 2,733 families) and G06Q30/0185 (Product Passport, 2,531 families) represent core DPP functionalities. G06F16/27 (Blockchain/DLT, 2,157 families) confirms the central role of distributed ledger technologies in providing the trusted data layer for product passports. G06F21/602 (Access Control, 2,150 families) addresses the critical requirement for managing who can read, write, and verify product passport data across complex multi-stakeholder supply chains.

5. COMPETITIVE LANDSCAPE

5.1. Top Applicants

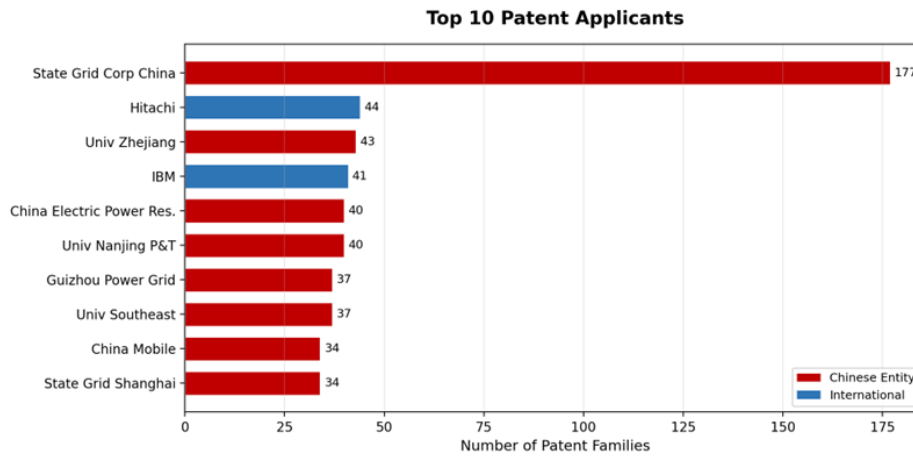


Figure 8 Top 10 Patent Applicants

The top applicant landscape is heavily influenced by Chinese entities, particularly state-owned enterprises and major universities (Figure 8). State Grid Corporation of China leads with 177 patent families, reflecting China’s strategic integration of blockchain and traceability technologies into its national power grid and energy management infrastructure.

Hitachi (44 families) and IBM (41 families) represent established multinational technology corporations with long-standing expertise in supply chain solutions, IoT platforms, and enterprise blockchain. Their presence confirms the strategic importance of this technology domain for global IT leaders.

Chinese universities feature prominently (Zhejiang University 43, Nanjing University of Posts & Telecommunications 40, Southeast University 37), indicating significant government-funded academic research programs in traceability technologies. Chinese state-owned banks (Bank of China 30, ICBC 26, China Construction Bank 22) also appear, reflecting the integration of blockchain-based traceability into financial services and trade finance.

Notable international applicants further down the list include Microsoft (18 families), Toyota (18), and Fujitsu (17), demonstrating participation from leading technology and automotive companies in DPP-related innovation.

5.2. Inventor Analysis

The inventor analysis shows a landscape heavily dominated by Chinese researchers, consistent with the overall filing patterns. The most prolific inventor is Shang Guangyong with 89 patent families. Many Chinese inventor names appear frequently (Wang Wei 73, Zhang Wei 72, Wang Jian 67, Li Wei 63), though it should be noted that common Chinese names may represent multiple distinct individuals across different organizations.

The inventor country analysis reveals that the United States leads with 1,269 inventor-linked families, followed by China (439), Japan (265), South Korea (258), and France (178). European countries collectively show strong inventor representation: the UK (116), Germany (103), Italy (81), Switzerland (71), Spain (62), Israel (50), and the Netherlands (32) among others.

6. LANGUAGE AND CPC OFFICE ANALYSIS

6.1. Language Distribution

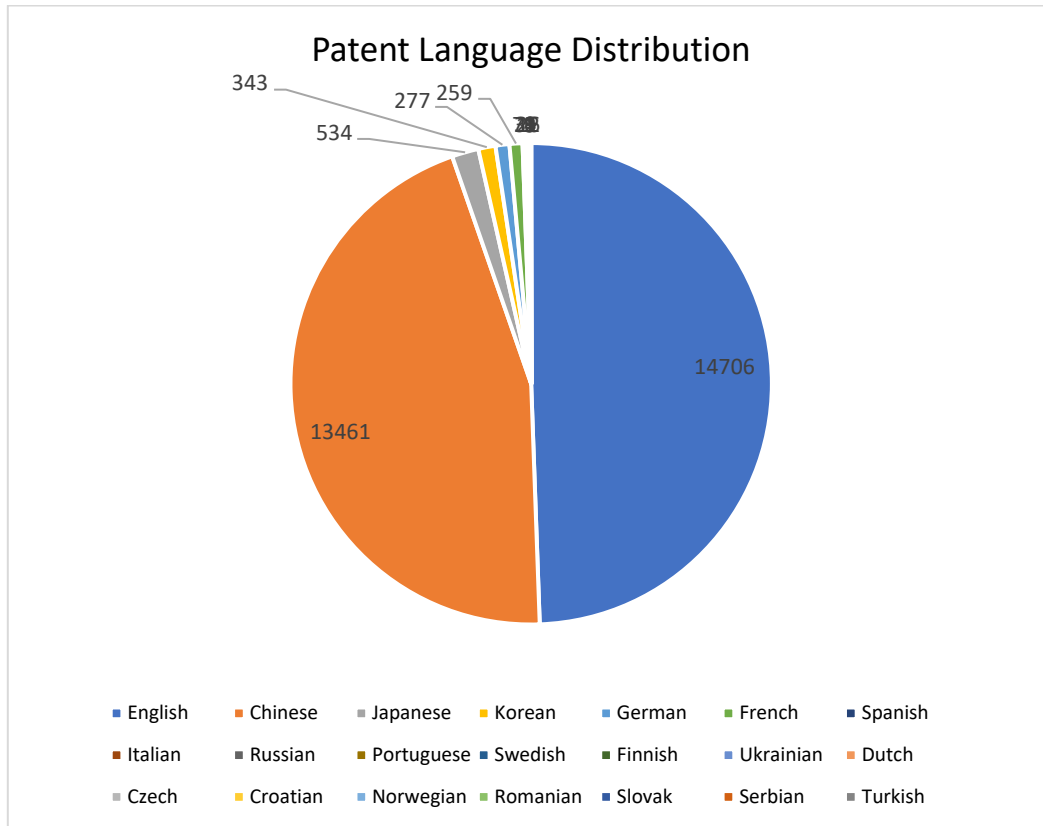


Figure 9 Patent Language Distribution

English (14,706 families) and Chinese (13,461 families) together dominate the language landscape, consistent with the geographic filing patterns (Figure 9). The high English count reflects both US-origin filings and the common practice of providing English translations or abstracts for international filings. Japanese (534), Korean (343), German (277), and French (259) follow as significant patent languages. The presence of German and French as major patent languages underscores Europe’s active role in the innovation landscape.

6.2. CPC Assigning Offices

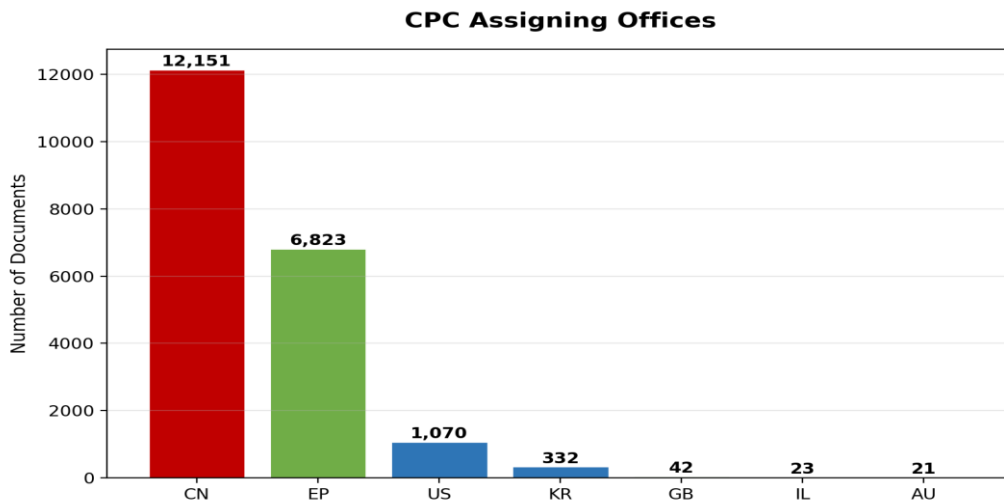


Figure 10 CPC Assigning Offices

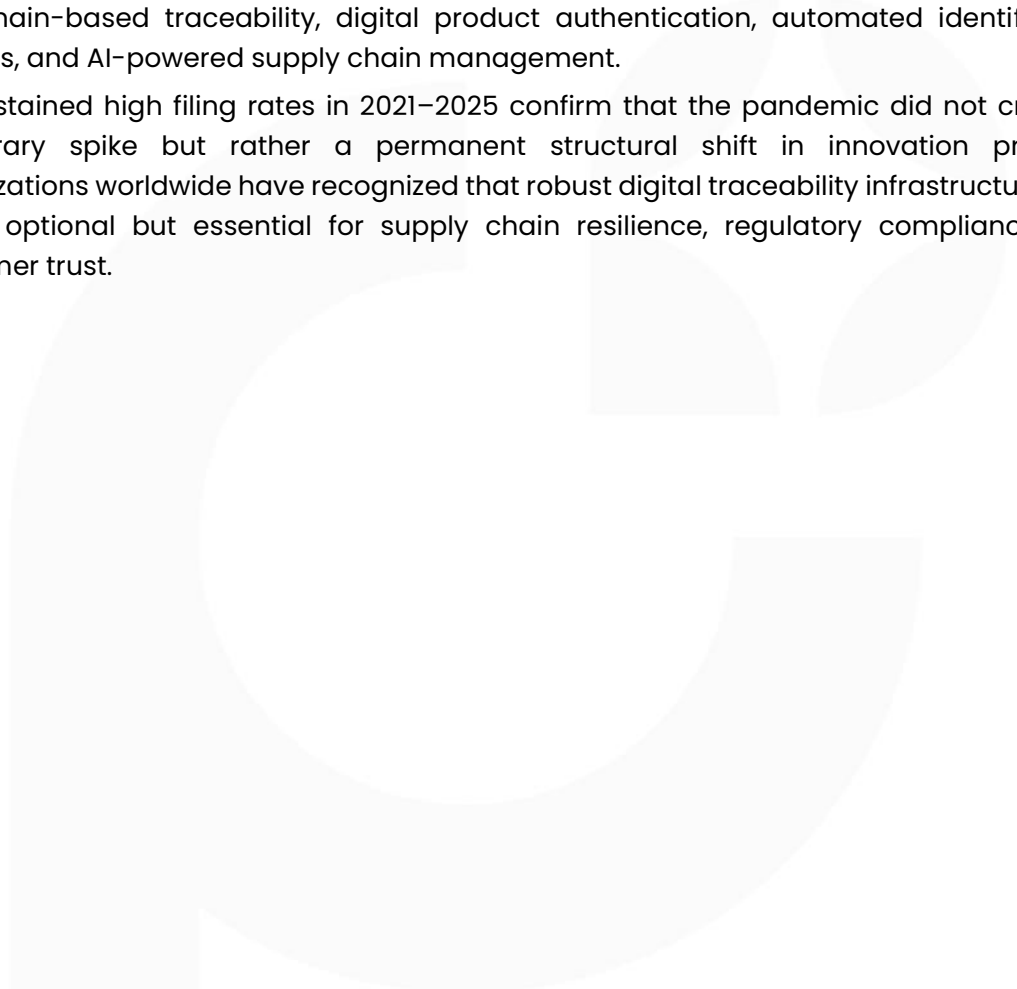
The CPC assigning office data provides a unique perspective on the examination landscape (Figure 10). China’s patent office (CNIPA) leads with 12,151 classified documents, while the EPO ranks second with 6,823 documents. The US Patent and Trademark Office follow with 1,070. The EPO’s substantial classification volume—far exceeding the US figure despite fewer EP-designated filings—reflects the EPO’s comprehensive examination of international filings and confirms Europe’s role as a critical gatekeeper in global patent quality assessment for DPP technologies.

7. IMPACT OF COVID-19 ON INNOVATION TRENDS

The data reveals clear evidence of the COVID-19 pandemic’s transformative impact on DPP and traceability innovation. The period from 2019 to 2020 shows a dramatic doubling of patent filings (from 829 to 1,590 by priority date), representing the most significant year-over-year increase in the entire dataset.

The pandemic exposed critical vulnerabilities in global supply chains: disrupted logistics networks, lack of real-time visibility into inventory and shipment status, difficulties in tracking pharmaceutical and medical supply provenance, and the urgent need for contactless identification and verification systems. These challenges created intense market demand for exactly the types of technologies captured in this patent landscape—blockchain-based traceability, digital product authentication, automated identification systems, and AI-powered supply chain management.

The sustained high filing rates in 2021–2025 confirm that the pandemic did not create a temporary spike but rather a permanent structural shift in innovation priorities. Organizations worldwide have recognized that robust digital traceability infrastructure is no longer optional but essential for supply chain resilience, regulatory compliance, and consumer trust.



8. CONCLUSIONS AND STRATEGIC OUTLOOK

This patent landscape analysis of 14,729 families reveals a rapidly maturing technology domain with exponential growth, driven by the convergence of regulatory mandates, technological advancement, and market demand for supply chain transparency.

Explosive Growth Trajectory: Patent filings have grown more than 20-fold since 2015, with no signs of deceleration. The 2025 filing volume (2,581 by priority date) represents the highest annual output on record, indicating continued strong innovation investment.

China's Volume Leadership: China dominates raw filing numbers through coordinated state investment in blockchain, smart grid, and supply chain digitalization. State Grid Corporation, major universities, telecom operators, and financial institutions all contribute to a broad-based national innovation effort.

Europe's Strategic Leadership: Europe holds a uniquely influential position as the global regulatory pioneer through the ESPR and Battery Regulation. The EPO's role as the second-largest CPC assigning office (6,823 documents) and the diverse multi-country European innovation ecosystem (with strong contributions from France, Germany, Switzerland, Italy, and others) position Europe to shape global standards and derive significant competitive advantage as DPP mandates become international norms.

Technology Convergence: The landscape demonstrates deep integration of security technologies, blockchain, AI, IoT/RFID, and sustainability metrics, confirming that effective product passport systems require a multidisciplinary technology approach.

COVID-19 as Permanent Accelerator: The pandemic triggered a structural shift in innovation priorities, with traceability and digital supply chain transparency becoming recognized as essential infrastructure rather than optional enhancements.

Outlook: As DPP mandates expand globally—beginning with EU requirements from 2027—patent activity in this domain is expected to continue its strong growth trajectory. Organizations that have invested in building patent portfolios in DPP and traceability technologies are well positioned to benefit from the approaching regulatory-driven market expansion. Europe's role as both regulatory standard-setter and active innovation hub creates a powerful platform for shaping the future of global product transparency.

9. APPENDIX: KEY DATA TABLES

9.1. A.1 Top 15 Filing Jurisdictions

Rank	Country	Patent Families
1	CN	13,458
2	US	1,052
3	WO	780
4	JP	568
5	EP	509
6	KR	351
7	CA	152
8	AU	147
9	DE	77
10	TW	76
11	BR	65
12	FR	63
13	ES	60
14	GB	51
15	MX	50

9.2. A.2 Top 10 IPC Main Groups

IPC Group	Description	Families
G06F21	Security Arrangements	5,420
G06Q50	Industry-Specific Applications	4,947
G06Q30	Commerce	4,911
G06Q10	Administration/Management	4,555
G06F16	Information Retrieval/Blockchain	4,112
H04L9	Cryptographic Mechanisms	1,787
G06K17	Auto-ID Systems	1,625
G06K7	Reading/Detection	1,249
G06F18	Pattern Recognition	1,210
G06Q40	Finance	1,043

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