Research on Electronic Data Forensics Mechanism of Cross-Border Telecommunication Network Fraud

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Abstract: Cross-border telecommunication network fraud crimes are highly dependent on electronic data as the core evidence, but there is a structural contradiction between the easy loss of electronic data and the long period of foreign-related evidence collection procedures, which seriously affects the investigation efficiency and the admissibility of evidence. Based on normative analysis and mechanism analysis, this paper systematically combs the practical difficulties faced by cross-border electronic forensics in legal rules, judicial assistance process and evidence review standards. On this basis, from the three dimensions of rule supply, program operation and technical review, this paper puts forward an integrated governance path with the dual-track program of "emergency preservation-routine assistance" as the core, and combines the hierarchical authorization mechanism, structured process tools and hierarchical review standards to form a grounded, reproducible and auditable evidence collection mechanism. The research shows that the mechanism can effectively alleviate the conflict between the "strong timeliness" of electronic data and the "high procedural cost" of cross-border forensics, and significantly improve the efficiency and admissibility of evidence on the premise of respecting data sovereignty and procedural legitimacy.

Keywords: Cross-Border Telecom Fraud; Electronic Data Forensics; Judicial Assistance; Emergency Security; Admissibility of Evidence; Data Sovereignty

I. Introduction

In recent years, the cross-border, chained and technical features of telecommunication network fraud crime have become increasingly prominent, and the core evidence of its criminal activities is highly dependent on electronic data such as communication records, platform logs and capital flow. However, the electronic data related to cross-border fraud cases are mostly stored in overseas platforms or servers, which is not only short in storage period, but also easy to be deleted or overwritten; At the same time, the process of foreign-related evidence collection and judicial assistance generally has the problems of long cycle and weak certainty in the initiation, approval and execution. The "strong timeliness" of electronic data stems from its technical attributes-the electronic carrier has a short life, and the information can be easily changed without leaving any trace [1], while the "high program cost" of cross-border forensics stems from its institutional attributes. The dislocation of the two constitutes the fundamental structural contradiction of cross-border electronic fraud forensics. How to obtain and fix electronic data timely and effectively on the premise of respecting data sovereignty and procedural legitimacy has become a prominent practical dilemma in combating cross-border electric fraud crimes. Based on this, this paper takes the electronic data forensics of cross-border telecommunication network fraud cases as the research object, comprehensively adopts normative analysis and mechanism analysis methods, systematically sorts out the main obstacles of cross-border forensics in legal rules, procedural processes and evidence review, and then puts forward an integrated governance path with the dual-track program of "emergency preservation-routine assistance" as the core, supported by structured processes and hierarchical review standards, in an effort to provide an institutional solution for cross-border electronic forensics with both efficiency and legitimacy.

2. Literature Review and Research Review

2.1 The Status of Domestic Research

The domestic research on electronic data forensics of cross-border telecommunication network fraud has gradually shifted from a

single dimension to a systematic governance perspective, which has generally formed a research pattern of four levels: conceptual framework, legal rules, procedural mechanism and technical review. In terms of concept definition, some studies first define "cross-border electronic evidence collection" from the conceptual level, emphasizing that it is not an electronic data retrieval in the general sense, but a comprehensive governance problem restricted by factors such as cross-border data flow, foreign storage control and law enforcement authority boundary. In the research framework, more and more literatures no longer only discuss "how to get", but put it in the system structure of "rules-processes-standards". At the level of legal rules, the research points out that the current foreign-related evidence collection provisions are relatively principled, and there is a lack of "strong prescription" rule design for electric fraud cases, which leads to the lack of operational guidance at the grassroots level in the aspects of initiation, approval, delivery and preservation. Focusing on the tension between data sovereignty and procedural efficiency, represented by Du Tao's idea of "equal consultation on data sovereignty" [2], a kind of research advocates reducing uncertainty through clearer negotiation mechanism and authorization chain on the premise of upholding sovereignty. Zhang Xiaojun and others put forward the idea of hierarchical exemption or hierarchical authorization [3], which advocates setting different approval processes according to data sensitivity and case urgency. The mechanism aims to solve the problem that the examination and approval process of high-prescription cases is too long in the field of low-sensitivity data, and emphasizes the allocation of different intensity of examination and approval requirements according to the data sensitivity, case urgency and risk level, in an attempt to form a finer institutional balance between "safety-efficiency". On the level of judicial assistance and program optimization, Hong Hai put forward the mechanism of "one case, one form" [4], emphasizing the unification of information fields and communication contents with structured forms, and reducing the cost of repeated correction and round-trip communication by "doing the materials right once". In terms of technical review and evidence admissibility, the idea of "hierarchical review" put forward by Tang Yunyang is representative [5], that is, electronic evidence review is divided into levels such as procedural legality, source reliability, data integrity and content authenticity, and risk points are eliminated step by step. Wu Hao's research on the boundary and standardization of evidence collection [6] emphasizes that there should be a clear boundary in the scope of technical operation and data retrieval, so as to avoid the exclusion of evidence caused by "technically feasible but procedurally out of order". Generally speaking, domestic research is shifting from "emphasizing technical ability" to "common verifiability of technology and program", for example, it advocates transforming the reliability of electronic data into verifiable and recheckable evidence ability by means of checking values, leaving traces in logs, chain recording and format standardization.

2.2 The Theoretical Gap of Existing Research and the Research Direction of This Paper

Although some achievements have been made in domestic research, there are still obvious gaps and deficiencies. First, the exclusive rules of electric fraud cases are insufficient. Foreign-related evidence collection clauses and judicial interpretations are mostly general provisions, and there is still a lack of more targeted institutional arrangements in the face of the characteristics of "high frequency, strong timeliness and chain" in electric fraud cases. Second, the connection between rules and processes is not enough. Some studies focus on legal principles or suggestions on clauses, but there is insufficient discussion on "how to embed clauses into assistance processes, how to transform them into material templates and operational steps", which leads to a gap between system design and grass-roots enforceability. Third, the standard system is fragmented. Tools such as technical specifications, review standards, assistance forms and platform collaboration are often promoted independently, lacking a unified "rule-process-standard" integration scheme, and it is difficult to form a replicable, trainable and evaluable governance model.

Based on the above research gaps, this paper aims to solve the structural conflict between the high dependence and easy loss of electronic data and the long period of foreign-related evidence collection procedures in cross-border telecommunication network fraud cases. Aiming

at the problems of insufficient supply of rules, poor convergence of processes and fragmentation of standard system in existing research, this paper puts forward a research theme centered on "rule-process-standard" integrated governance. Specifically, at the rule level, the dual-track procedure of "emergency preservation-routine assistance" and the hierarchical authorization mechanism are designed to respond to the "strong prescription" demand of electric fraud cases; At the process level, the system optimization of judicial assistance procedures is realized through structured tools such as "one case, one form"; At the standard level, a hierarchical electronic evidence review model is constructed to ensure the admissibility of evidence. This paper tries to build a set of cross-border electronic evidence collection mechanism that can be implemented, copied and reviewed through the cooperation of three dimensions, and provides an institutional solution to solve the contradiction between the "strong timeliness" of electronic evidence and the "high program cost" of cross-border evidence collection.

3. The Practical Difficulties and Causes of Cross-Border Fraud Electronic Evidence Collection

At present, cross-border telecommunication network fraud electronic data forensics faces multiple practical dilemmas, which are rooted in the deep dislocation between the virtual technical characteristics of electronic data, the barrier attribute of international jurisdiction and the lag of traditional forensics procedures. It is embodied in the following three levels:

3.1 The Structural Contradiction between the Strong Timeliness of Electronic Data and the Inefficiency of Cross-Border Evidence Collection Procedures

Telecommunication network fraud crimes are highly dependent on electronic data such as instant messaging records, platform logs and capital flows, which have the technical characteristics of short storage period and easy to be tampered with or deleted. For example, cross-border e-fraud platforms often set a 24-hour automatic cleaning rule. Once an account is blocked or an abnormal login is detected, the server may immediately clear the relevant logs, resulting in a shortened forensic window to several hours and a very short forensic window. However, the traditional cross-border judicial assistance procedure involves lengthy links such as domestic examination and approval, diplomatic transmission, review and implementation by the requested country, and the cycle is usually measured in months. This model is called "inverted U-shaped" evidence collection in academic circles, which is complicated and inefficient, and seriously out of line with the timeliness requirements of electronic data [7]. Therefore, the time difference between "the data is fleeting" and "the procedure is lengthy" constitutes the most basic structural contradiction in cross-border evidence collection, which often leads to the passive situation of "the procedure is incomplete and the evidence has been destroyed".

3.2 The Institutional Tension between the Principle of Data Sovereignty and the Efficiency of Investigation and Evidence Collection

Cross-border evidence collection is essentially an extraterritorial extension of judicial sovereignty, which is strictly restricted by the data sovereignty and judicial jurisdiction of the requested country. There are significant differences in data protection laws and regulations among countries, and the requested country often sets up barriers on the grounds that data security, privacy protection or the principle of "double criminality" are inconsistent. This institutional rigidity based on sovereign security forms a tension with the efficiency demand of "quick access and quick protection" that is urgently needed to combat crime. In the face of urgent cases, investigation agencies often lack clear legal authorization and quick response channels for "emergency situations", and the rapid iteration of fraud means, such as the abuse of AI face-changing, GOIP equipment and other technologies [8], further exacerbating the gap between legal authorization and actual combat needs. As a result, the behavior of obtaining evidence is ambiguous on the legal boundary, and it is caught in the dilemma of "seeking fast is illegal, and seeking law is delayed".

3.3 Fragmentation of Evidence Admissibility Review Criteria and Risk of Cross-Border Circulation

Cross-border electronic evidence goes through many links, such as cross-border transmission,

format conversion and media storage, from extraction to court presentation, and the chain is lengthy. The current dilemma lies in: first, the review standard is fragmented, and there is no unified and operable checklist standard for the integrity verification and source legality review of electronic data in practice, which leads to the arbitrariness of the identification of evidence capacity; Second, the risk of circulation is uncontrollable, and there is a lack of technical trace and hash verification mechanism in the whole process. Data pollution or media damage in any link may be fatal to court cross-examination, which seriously affects the admissibility and final validity of evidence.

4. The Integrated Governance Path of Cross-Border Electronic Fraud Evidence Collection

In view of the practical difficulties faced by cross-border telecommunication network fraud electronic data forensics, a single program repair or technical improvement has been difficult to work, and a trinity governance model of "rule-process-standard" must be constructed. The so-called "integration" refers to the closed-loop relationship of mutual support and logical nesting: rules are the premise and provide legal authorization for process operation; Process is the carrier, which transforms abstract rules into concrete evidence collection efficiency; The standard is to ensure that the evidence finally obtained is admissible in court. This systematic framework aims to break the fragmentation mode of "emphasizing on cracking down on norms, emphasizing on entities and neglecting procedures" in traditional governance, and realize all-round regulation of cross-border electronic fraud evidence collection.

4.1 To Build a Dual-Track Program to Solve the Contradiction of Prescription

In view of the time mismatch between the technical characteristics of electronic data "easy to lose" and the "long period" of foreign-related judicial assistance, it is necessary to improve the efficiency of evidence collection through process reengineering, and the core is to build a dual-track parallel procedural mechanism of "emergency preservation-routine assistance" As a "fast track", the emergency security track aims to cope with the urgent risk of evidence loss. By using police cooperation channels or bilateral agreements, before the data is deleted or the server is migrated, the other party is given priority to request data mirror backup or "snapshot" fixation, which is only for procedural security and does not involve entity handover, thus greatly reducing the response time; As a "slow track", the conventional assistance track is essentially transferred in strict accordance with the criminal judicial assistance treaty. The key is to set up a process transformation node, which requires the investigation organ to complete the routine assistance procedures within the legal time limit after taking emergency security measures, and realize the closed-loop procedure of "fixing first and then handing over". This design aims to reduce the communication cost through process reengineering, effectively seize the window of evidence collection, and accurately solve the practical dilemma of' incomplete procedures and destroyed evidence'.

4.2 The Establishment of Hierarchical Authorization to Ease the Tension of the System

The essence of cross-border evidence collection is the extraterritorial extension of judicial sovereignty. In order to ease the institutional tension between the security of national data sovereignty and the efficiency of investigation and evidence collection, it is necessary to define the power boundary through the supply of rules, and the core measure is to establish a hierarchical authorization mechanism. In view of the dilemma of "to be quick is to violate the rules", the traditional "one size fits all" examination and approval mode should be broken, and a three-level authorization model with data sensitivity and case urgency as variables should be established with reference to the idea of hierarchical exemption put forward by scholars such as Zhang Xiaojun. For low-sensitivity data involved in the case, the grass-roots investigation organs should be authorized to start simplified examination and approval procedures and reduce the system cost on the premise of meeting the emergency identification standards; For highly sensitive data involving state secrets and large-scale personal privacy, strict procedures for approval at or above the provincial level must be maintained. This refined rule design delineates the boundary of the exercise of investigation power at the legal level, which not only adheres to the bottom line of data sovereignty, but also

provides a legal basis for rapid response in emergency situations, and fundamentally solves the legal problem of obtaining evidence caused by the lag of system supply.

4.3 The Implementation of Hierarchical Review to Ensure the Admissibility of Evidence

There are many links and high risks in the cross-border circulation of electronic evidence. In order to solve the problem of evidence admissibility caused by different review standards, a unified and technical standard system must be built, and the core lies in establishing a hierarchical review model and a whole process marking mechanism. Combined with the idea of hierarchical review put forward by Tang Yunyang [5], a four-dimensional review standard of "authenticity-relevance-legality-technicality" should be constructed: in the authenticity review, a Hash verification mechanism should be forcibly introduced, requiring digital fingerprint comparison from data extraction to presentation. As the core component of cryptography, hash function has the properties of antigenicity, anti-collision and avalanche effect, which can ensure the integrity of data to be reliably verified [9]. In the relevance review, the method of time axis comparison and cross-validation of capital flow is used to build a logical chain. This hierarchical review system is in line with the development trend of foreign electronic data admissibility rules. For example, Singapore's Evidence Law lightens the burden of proving the authenticity of electronic data through the presumption rule, and solves the application problem of the best evidence rule with the theory of "fiction original" [10].

5. Conclusion and Prospect

5.1 Research Conclusions

The structural contradiction between the strong timeliness of electronic data and the high procedural cost of foreign-related evidence collection in cross-border fraud cases has been effectively solved by constructing an integrated governance mechanism of "rules-processes-standards". This mechanism is not only a technical repair of the evidence collection link, but also a systematic reconstruction of the traditional passive and fragmented evidence collection model: at the rule level, the hierarchical authorization mechanism establishes the power operation boundary that pays equal attention to safety and efficiency, dissolves the institutional tension between data sovereignty and investigation efficiency, and fills the gap in the exclusive rules of electric fraud cases; At the process level, the dual-track procedure of "emergency preservation-routine assistance" and the structural tool of "one case, one form" have solved the contradiction of timeliness and realized the efficiency jump of judicial assistance; At the standard level, a hierarchical review system has laid a solid foundation for the admissibility of evidence and eliminated the evidence risks brought by cross-border circulation. Together, the three forms a complete governance closed loop from legal authorization, efficient process to effective evidence, which provides a replicable system sample for solving the dilemma of cross-border evidence collection and also provides empirical support for enriching the procedural justice theory of electronic evidence law.

5.2 Policy and System Recommendations

The first is to popularize standardized governance tools and reshape the operation mode of evidence collection. In the public security, judicial and other substantive departments, the "one case, one form" and the hierarchical review list of electronic evidence will be comprehensively promoted, and the best practices will be solidified into standard operating procedures. By unifying the information fields and evidence standards, compressing the discretionary space, we can solve the problems of nonstandard evidence collection documents and broken evidence chain from the source, reduce the communication cost at the grass-roots level and the frequency of correction, and improve the standardization level of evidence collection.

The second is to improve the dual-track operation mechanism and build a defect cure system. Clarify the transformation node between emergency preservation and routine assistance, establish a supporting mechanism for curing procedural defects, and stipulate that the procedural defects caused by emergencies will be recognized as evidence after being corrected afterwards. At the same time, promote the flexible connection between domestic evidence collection standards and international judicial

assistance treaties, reduce the cooperation resistance caused by legal and cultural differences, and improve the tacit understanding and success rate of cross-border cooperation.

The third is to strengthen the construction of actual combat capability and promote the transformation of experience and knowledge. Relying on typical cases, practical training will be carried out, and hidden experiences such as hash value verification and cross-validation of capital flow will be made explicit and transformed into replicable and inheritable organizational capabilities. Comprehensively improve the foreign-related forensics literacy of investigators under the background of data sovereignty, and promote the transformation of forensics from "experience-driven" to "rule-driven".

5.3 Research Deficiencies and Future Direction

This study is limited by the confidentiality of cross-border data and the difficulty of case acquisition, and the empirical analysis is relatively limited, mainly relying on normative analysis and logical deduction. At the same time, the iteration of cross-border criminal means and the change of data sovereignty policies in various countries put forward higher requirements for the dynamic adaptability of system design. In addition, with the development of quantum computing and the popularization of Internet of Things devices, the research and development of anti-quantum hash function and lightweight hash algorithm will become an important direction supported by cross-border electronic data forensics technology. Future research should be deepened and expanded in the following three dimensions:

First, deepen the research on the effectiveness and mutual recognition mechanism of transnational execution. This paper focuses on the system construction from the domestic perspective, which not only provides an operation manual for judicial practice, but also fills the theoretical gap in the cross-border digital sovereignty and criminal justice cooperation at the academic level. By constructing the "rule-process-standard" integrated governance model, it provides a new paradigm for criminal judicial cooperation in the digital age. In the future, we should focus on how to connect domestic standardized tools with international mutual legal assistance treaties, explore ways to break legal obstacles at the level of transnational implementation, and promote the formation of a system of evidence collection rules recognized bilaterally or multilaterally.

Second, strengthen the rule game research under the background of data sovereignty. In-depth study of data protection laws and regulations in different jurisdictions, on the premise of adhering to the bottom line of data sovereignty, explore and adjust the mechanism of reciprocal cooperation, enhance China's voice and rule-making ability in international judicial assistance, and change from a passive receiver of rules to an active constructor.

Third, strengthen empirical research and dynamic evaluation. Through practical investigation at the grass-roots level, the key indicators such as examination and approval time and correction rate are quantitatively analyzed, and the system design is continuously optimized to make it more suitable for actual needs. To sum up, through the systematic reconstruction of rules, processes and standards, it is expected to find the best balance between safeguarding national data sovereignty and protecting human rights, and promote the modern transformation of cross-border electronic forensics governance system.

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