

University of Wales Trinity Saint David, London

Digital Forensics Analysis (Report)(Module Code: ACCA7031)

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Task 1: The Current State of Digital Forensics: Tools, Capabilities, and Standards

1. Introduction to Digital Forensics

Digital forensics is a specialised domain within cybersecurity that focuses on the identification, collection, analysis, and presentation of digital evidence for use in civil and criminal legal proceedings [1], [2]. As digital technologies have become deeply integrated into nearly every aspect of modern society, legal disputes and criminal investigations increasingly rely on evidence extracted from computers, mobile devices, cloud storage platforms, and interconnected networks [3].

The rise in cyber-enabled crimes — including ransomware attacks, data breaches, financial fraud, and corporate espionage — has significantly increased demand for forensic practitioners who possess not only strong technical skills but also a thorough understanding of legal obligations, evidence integrity principles, and professional reporting standards [6].

This task examines the current state of digital forensics by reviewing:

- Modern forensic processes and standards
- Commercial and open-source forensic tools
- Mobile forensic capabilities
- Industry demand and professional skills required for practitioners.

2. The Current State of Digital Forensics

2.1 Evolution of the Field

Digital forensics has evolved considerably from its early days when investigations focused primarily on desktop computers and physical storage media. Today, forensic examiners must operate in complex, distributed, and rapidly changing digital environments [4]. Modern investigations routinely involve data from:

- Cloud computing platforms
- Mobile applications
- Social networks

- Internet of Things (IoT) devices
- Multiple legal jurisdictions

2.2 Key Challenges

The digital forensics field currently faces several significant challenges:

Challenge	Description
Data Volume	Exponential growth in storage capacities and real-time data generation makes manual analysis impractical [5]
Encryption	Widespread use of end-to-end encryption and privacy-enhancing technologies limits investigator access to potential evidence [6]
Anti-Forensics	Data obfuscation, secure deletion, and other anti-forensic techniques complicate examinations [5]
Cloud Computing	Decentralised environments managed by third-party providers restrict direct investigator access and raise cross-border legal compliance issues [7]
Multi-Tenancy	Shared infrastructure environments create data isolation and contamination risks [7]

2.3 Cloud Forensics

Cloud environments present unique forensic challenges because they are decentralised and operated by third-party service providers rather than conventional digital storage systems. Investigators face:

- Limited physical access to servers
- Data transience issues

- Multi-tenancy complications
- Cross-border legal and jurisdictional requirements

Cloud forensic investigations therefore rely heavily on collaboration with service providers and the effective use of log data and metadata, rather than traditional physical acquisition methods [4].

3. Digital Forensic Process and Standards

3.1 The Forensic Process

The digital forensic process is conducted systematically to maintain evidentiary integrity and ensure admissibility in legal proceedings. The standard phases include:

Phase	Description
Preparation	Tool setup, team briefing, legal authorisation
Identification	Determining sources of potential evidence
Preservation	Securing evidence to prevent alteration
Collection	Acquiring data using forensically sound methods
Examination	Processing and extracting relevant data
Analysis	Interpreting findings to answer investigative questions
Reporting	Documenting methodology, findings, and conclusions

Each phase requires meticulous documentation to maintain the chain of custody and preserve evidence integrity [2], [4].

3.2 Key Standards and Frameworks

Standard/Framework	Organisation	Purpose
NIST SP 800-86	National Institute of Standards and Technology	Integrating forensic techniques into incident response activities [1]
ISO/IEC 27043	International Organization for Standardization	Principles and processes for incident investigation [10]
ISO 27001	International Organization for Standardization	Information security management systems
ACPO Guidelines	Association of Chief Police Officers	Digital evidence handling principles (UK)

3.3 Importance of Standards

Adherence to established standards is critical because courts increasingly scrutinise forensic methodologies and the validity of tools used during investigations [2]. If proper procedures are not followed, evidence may be challenged or ruled inadmissible. Forensic practitioners must therefore:

- Document every action taken
- Use validated tools and methods
- Maintain complete chain of custody records
- Verify evidence integrity through cryptographic hashing.

4. Digital Forensic Tools: Features and Capabilities

Digital forensic tools are the core of modern investigations, enabling examiners to acquire, process, and analyse large volumes of data efficiently. Tools are generally classified into two categories: commercial and open-source solutions.

4.1 Commercial Forensic Tools

EnCase Forensic (OpenText)

EnCase Forensic is widely recognised as an industry-standard digital forensics tool. Its key features include:

Feature	Description
Evidence acquisition	Supports multiple file systems and device types
File system analysis	Deep file carving and recovery capabilities
Keyword searching	High-speed indexed search functionality
Reporting	Automated report generation with audit trails
Scripting	EnScript programming language for workflow automation

EnCase is particularly valued for its robust audit trails and strong courtroom acceptance. However, high licensing costs and a significant learning curve can be limiting factors for smaller organisations [2], [11].

FTK (Forensic Toolkit) by Exterro

FTK uses a database-driven architecture that enables rapid indexing and searching of large datasets. Its strengths include:

- Email and chat analysis
- Registry examination
- Encrypted file system support
- Multi-threaded processing

FTK is well-suited for corporate investigations, financial crime cases, and insider threat examinations. However, it is resource-intensive and performs best with optimal hardware specifications [11], [12].

4.2 Open-Source Forensic Tools

Autopsy (The Sleuth Kit)

Autopsy is a widely used open-source forensic platform built on The Sleuth Kit. Its capabilities include:

- Disk image analysis
- File recovery and carving
- Keyword searching
- Timeline analysis
- Module/plug-in architecture

Research has demonstrated that open-source tools like Autopsy can produce reliable, repeatable outcomes when a structured forensic process is applied and validated [13], [14], [15]. Open-source tools are particularly valuable in academic, training, and budget-constrained environments.

4.3 Mobile Forensic Tools

Mobile devices have become a prominent source of digital evidence in modern investigations. Two industry-leading mobile forensic tools are:

Cellebrite UFED (Universal Forensic Extraction Device)

UFED is used by law enforcement and forensic laboratories worldwide for mobile device acquisition. Key capabilities:

Feature	Description
Extraction types	Logical, file system, and physical extraction
Device support	Hundreds of Android and iOS devices, feature phones, SIM cards
Lock bypass	Unlocks devices with legal authorisation
Live/Dead acquisition	Extracts from powered on or powered off devices
Artefacts	Call logs, messages, contacts, app data, file systems

Cellebrite Physical Analyzer

Physical Analyzer processes and interprets UFED acquisitions. Key features:

- Powerful decoding of mobile artefacts
- Deleted data recovery
- Multimedia file extraction
- Geolocation information mapping
- Timeline reconstruction
- SQLite database parsing
- App-specific artefact decoding (WhatsApp, Telegram, etc.)
- Visualisation tools for timeline analysis

The combination of UFED and Physical Analyzer provides a complete mobile forensics solution with court-ready reporting capabilities.

4.4 Comparative Analysis

Feature	EnCase	FTK	Autopsy	Cellebrite UFED	Cellebrite PA
Category	Computer forensics	Computer forensics	Computer forensics	Mobile acquisition	Mobile analysis
Cost	High	High	Free/Open-source	High	High
Primary function	Disk analysis & reporting	Large-scale data analysis	Disk & file analysis	Mobile data extraction	Mobile artefact interpretation
Supported devices	PCs, servers	PCs, servers	PCs, servers	Android, iOS, SIMs	Android, iOS
Deleted data recovery	Yes	Yes	Limited	Yes	Advanced
Automation	EnScript	Index-based processing	Plug-ins	Guided workflows	Advanced decoding
Court acceptance	Very high	Very high	Increasing	Very high	Very high

Best use case	Law enforcement PC cases	Corporate investigations	Academic & validation	Mobile acquisition	Mobile data analysis
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4.5 Tool Selection Considerations

The choice of forensic tools should be driven by case-specific factors, including:

- Type of device being examined
- Data sources requiring analysis
- Legal and jurisdictional requirements
- Investigative objectives
- Budget constraints
- Required level of court acceptance

Forensic laboratories routinely combine computer forensic tools with mobile forensics solutions to investigate cases involving multiple evidence sources. Commercial tools like EnCase, FTK, and Cellebrite UFED benefit from strong vendor support, regular updates, and established courtroom acceptance. Open-source tools like Autopsy offer transparency and cost benefits but may require additional validation and technical expertise [9].

5. Industry Demand and Professional Skills

5.1 Current Demand

Digital forensics professionals are in high demand due to the increasing frequency and sophistication of digital investigations. Employers consistently rank the following as essential employability skills [11], [12]:

- Tool proficiency (commercial and open-source)
- Knowledge of legal standards and evidence handling
- Incident response experience
- Report writing and presentation skills
- Understanding of chain of custody requirements

5.2 Required Competencies

Skill Category Specific Competencies

Technical: File system analysis, memory forensics, network forensics, mobile forensics, cloud forensics

Tool-specific: EnCase, FTK, Autopsy, Cellebrite UFED/PA, Wireshark, Volatility

Standards & legal: NIST, ISO/IEC 27043, ACPO, GDPR, Data Protection Act

Soft skills: Report writing, expert testimony, communication, critical thinking.

5.3 Continuous Professional Development

Given the rapid evolution of technology, forensic practitioners must engage in continuous professional development to maintain technical capacity and professional credibility. This includes:

- Staying current with emerging technologies (AI, IoT, cloud)
- Monitoring changes in relevant laws and regulations
- Keeping abreast of evolving good practice standards
- Attending training and industry conferences
- Pursuing relevant certifications (CFCE, EnCE, GCFE, CCE)

Failure to maintain current knowledge can result in lost technical capability, reduced professional credibility, and potential evidence inadmissibility [4], [10].

6. Summary of Task 1

Digital forensics has evolved into a sophisticated discipline requiring a combination of technical expertise, legal knowledge, and adherence to rigorous standards. The key takeaways from this task include:

Area	Key Points
Current state	Cloud, mobile, and IoT forensics present significant challenges; encryption and anti-forensics complicate examinations
Process & standards	NIST SP 800-86 and ISO/IEC 27043 provide structured frameworks; chain of custody and hash verification are critical
Commercial tools	EnCase and FTK offer robust features and strong court acceptance but have high costs
Open-source tools	Autopsy provides cost-effective, transparent solutions requiring additional validation
Mobile forensics	Cellebrite UFED and Physical Analyzer are industry standards for mobile acquisition and analysis
Industry demand	High demand for skilled practitioners; continuous professional development is essential

7. References for Task 1

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- [13] B. Carrier and W. Brian, *The Sleuth Kit & Autopsy Forensic Browser*, Version 4.19, 2024. [Online]. Available: <https://www.sleuthkit.org/autopsy/>
- [14] I. Ismail and K. A. Z. Ariffin, "The Admissibility of Digital Evidence from Open-Source Forensic Tools," *PLOS ONE*, vol. 20, no. 9, e0298765, 2025.
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Task 2: Investigation into the Attempted Theft of Proprietary AI Intellectual Property at Quantum Tech

1. Case Background

Quantum Tech, a UK-based artificial intelligence research company, discovered a potential insider threat involving the attempted theft of proprietary AI algorithms and trade secrets. Internal security monitoring systems flagged unusual data access patterns, unauthorised file transfers, and suspicious communications between three employees: Emma (Senior AI Researcher), Joe (Project Coordinator), and Norman (External Consultant).

The primary objectives of this forensic investigation were to:

- Identify and preserve digital evidence from mobile devices
- Reconstruct communication patterns between the suspects
- Determine the extent of unauthorised data access
- Establish a timeline of events
- Provide admissible evidence for potential legal action.

2. Evidence Acquisition Methodology

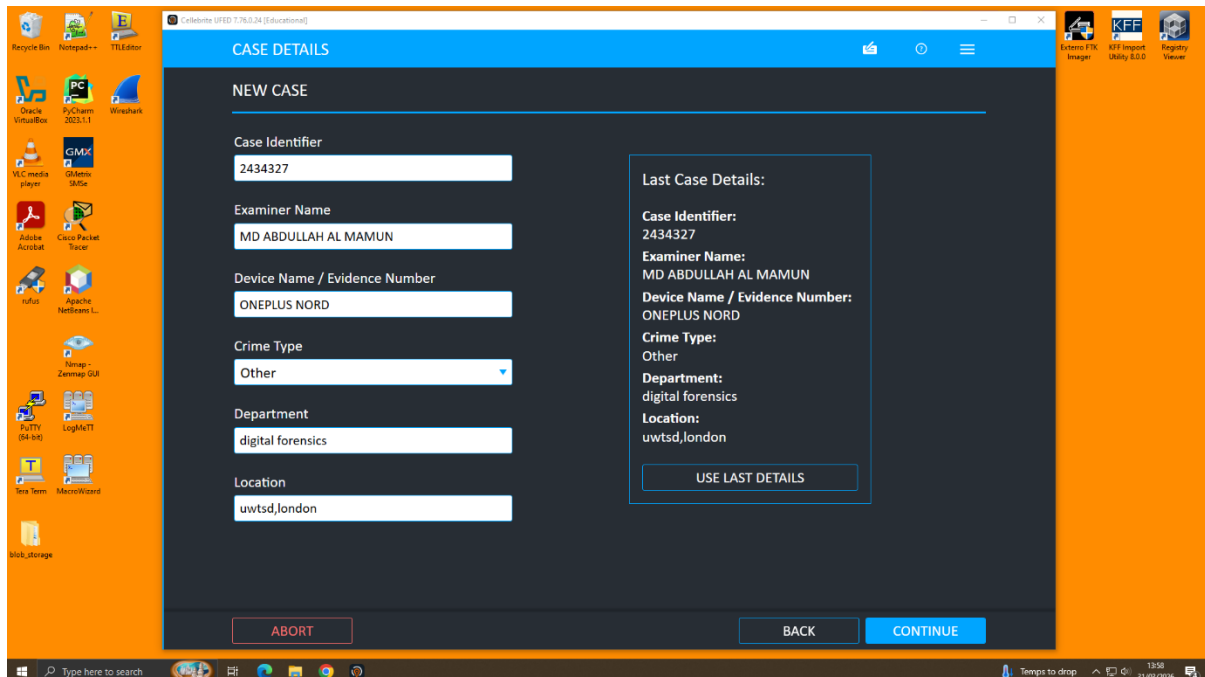
2.1 Forensic Tools Used

The following industry-standard forensic tools were employed:

Tool	Version	Purpose
Cellebrite UFED	7.73.0.11	Mobile device acquisition
Cellebrite Physical Analyzer	7.73.0.11	Analysis and decoding
SHA-256 Hashing	N/A	Integrity verification

2.2 Acquisition Process

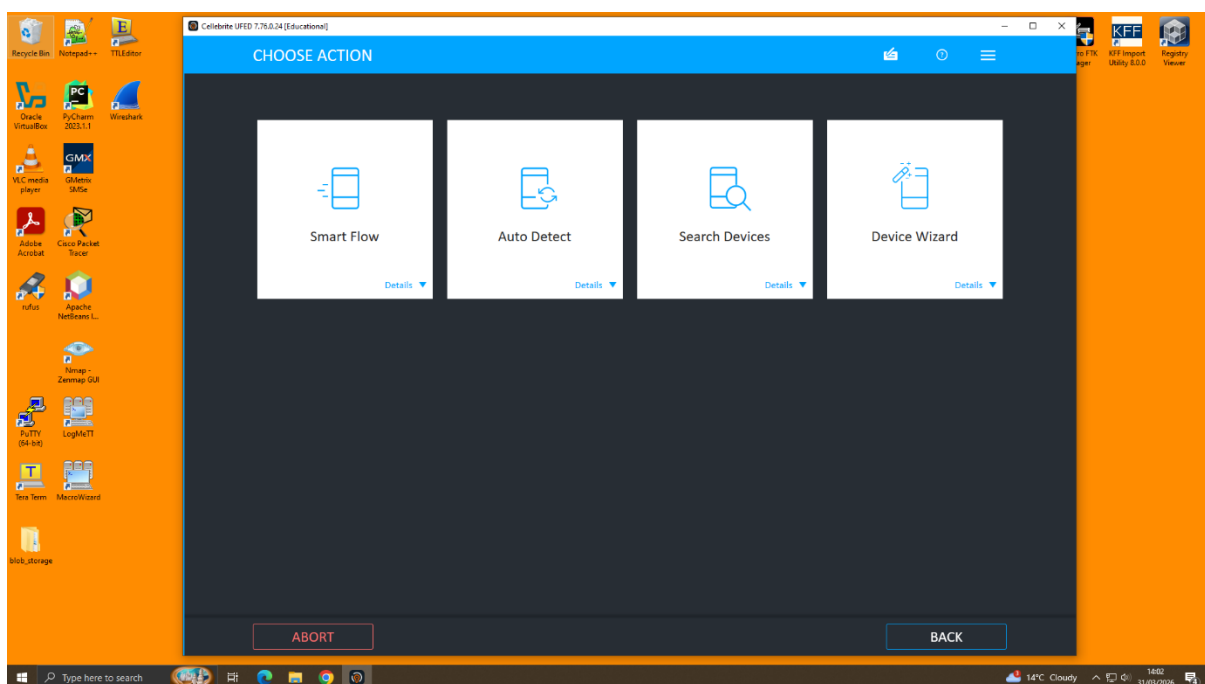
The forensic acquisition followed NIST SP 800-86 guidelines and ISO/IEC 27043 standards. The process included:



INSERT FIGURE 1: Screenshot of case creation in Cellebrite UFED showing case ID, examiner name, and device details

Step 1 – Case Creation

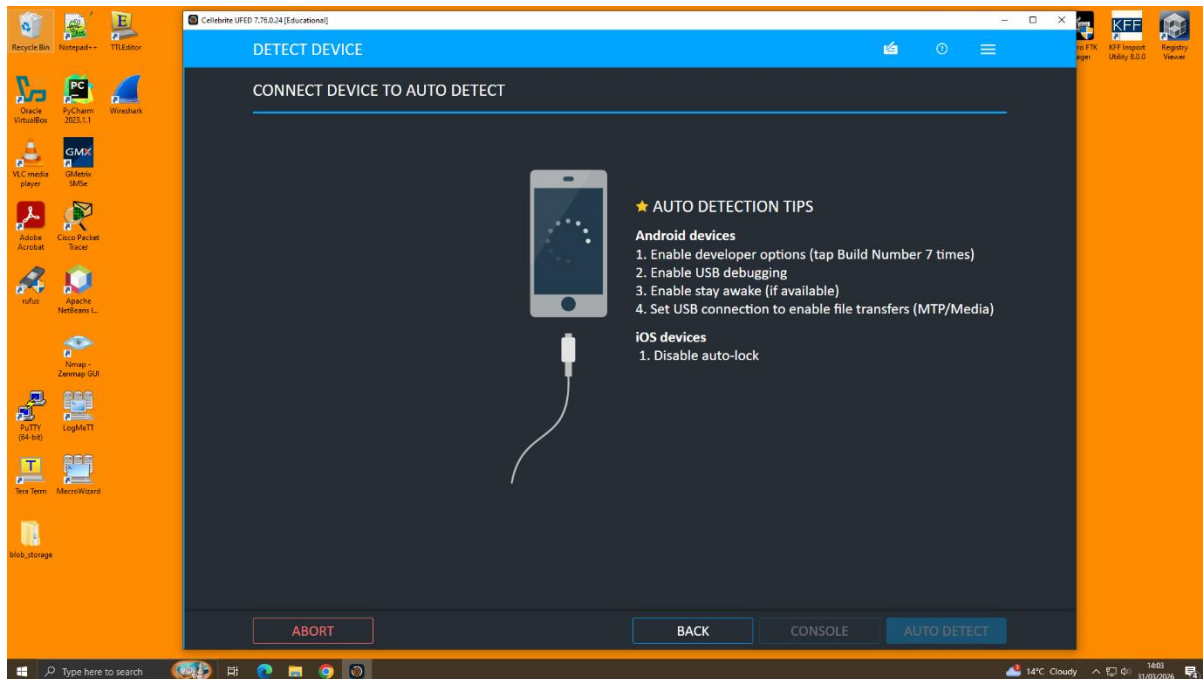
A new forensic case was created in Cellebrite UFED, documenting the case ID, examiner information, device label, and investigative context. This ensured proper chain-of-custody documentation.



INSERT FIGURE 2: Screenshot showing Auto Detect selection

Step 2 – Device Detection

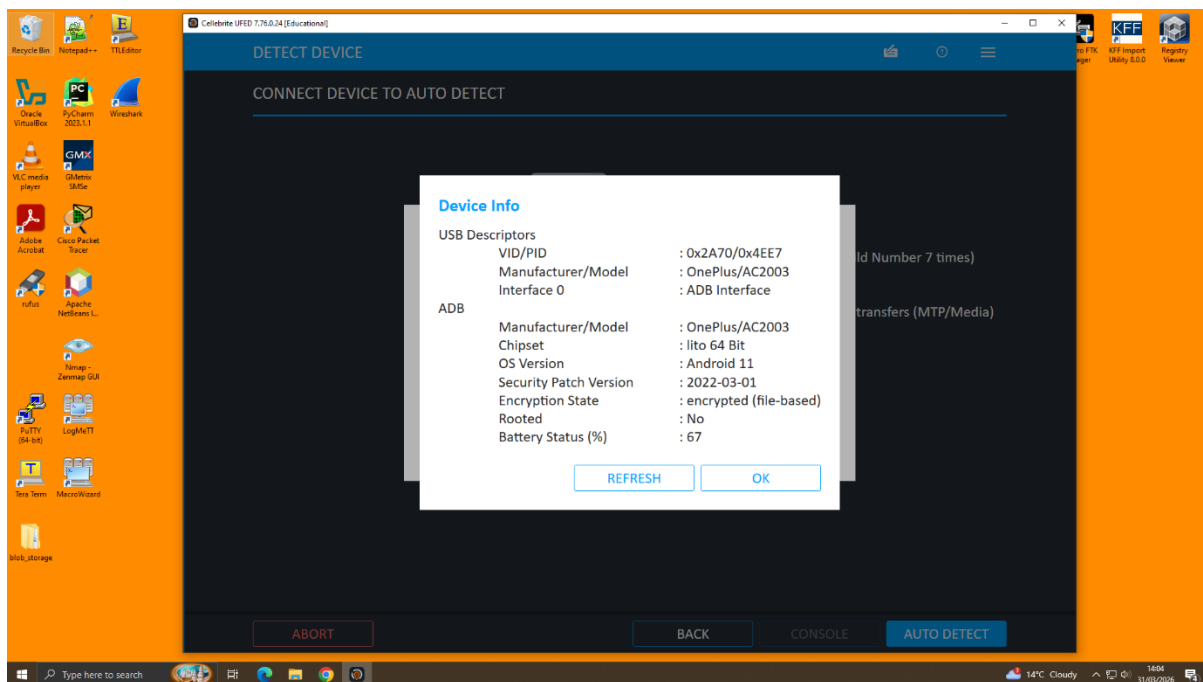
The action selection interface presented multiple detection methods. Auto Detect was chosen to systematically identify the connected Android device (Oneplus Nord).



INSERT FIGURE 3: Screenshot showing phone detected as Oneplus Nord

Step 3 – Extraction Type Selection

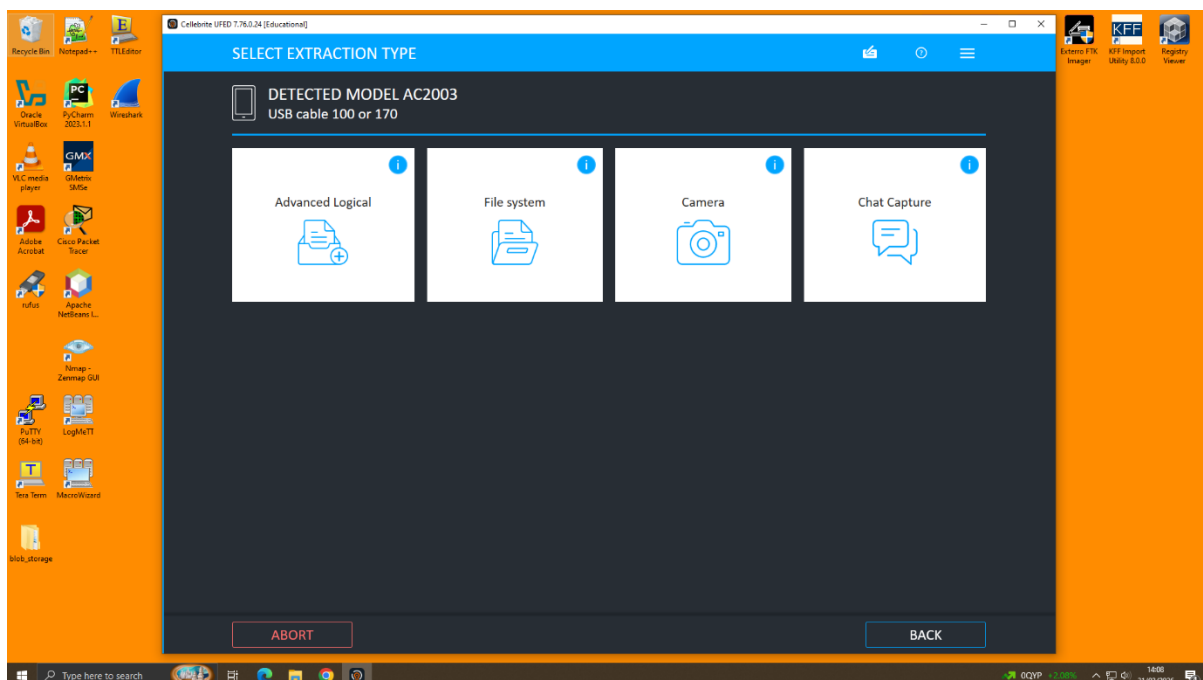
File system extraction was selected as it provides a deeper level of data recovery compared to logical extraction, including deleted artefacts and application data.



INSERT FIGURE 4: Screenshot showing File System extraction selected

Step 4 – Extraction Destination

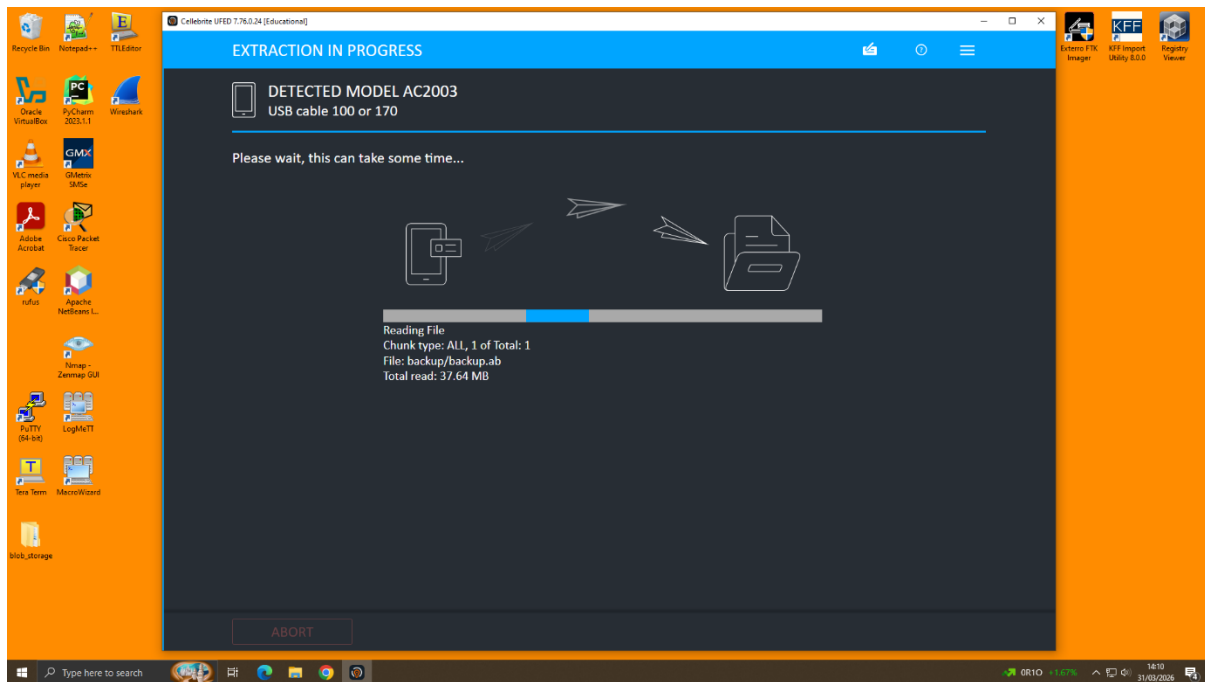
A controlled local drive path was designated for storing acquired data, ensuring secure evidence handling and preventing cross-contamination.



INSERT FIGURE 5: Screenshot showing extraction in progress

Step 5 – Extraction Completion

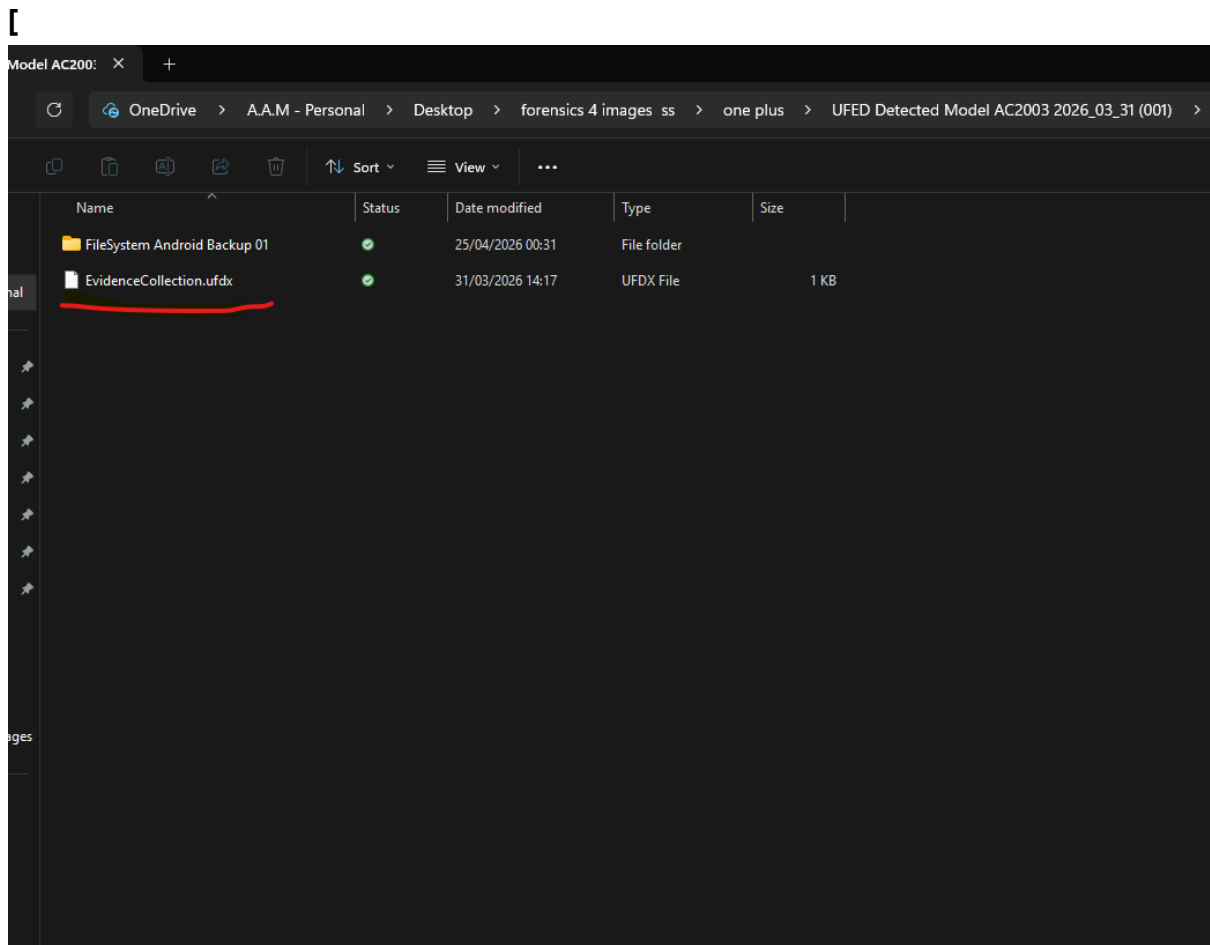
The extraction completed successfully without errors. The source device and target storage location were recorded.



INSERT FIGURE 6: Screenshot showing Extraction Complete confirmation

Step 6 – Import to Physical Analyzer

The UFED extraction output was imported into Cellebrite Physical Analyzer for read-only examination and analysis.

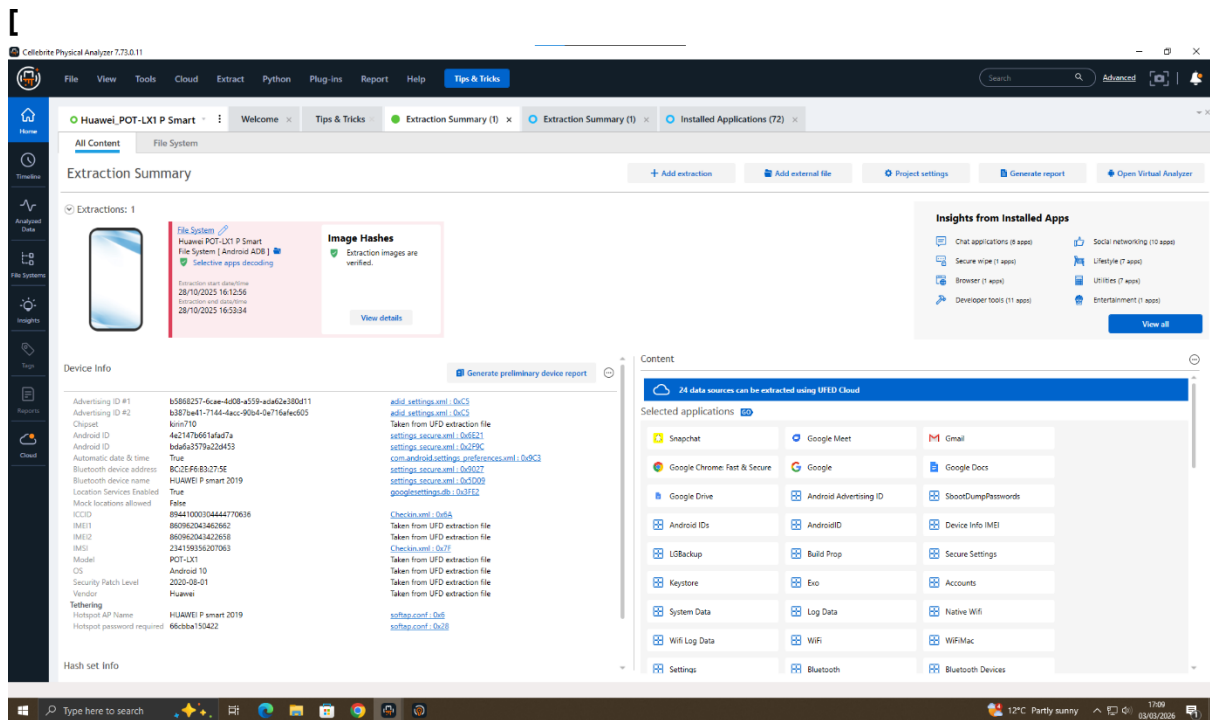


INSERT FIGURE 7: Screenshot showing import to Physical Analyzer

2.3 Integrity Verification

To ensure evidentiary integrity, SHA-256 hash values were calculated before and after acquisition:

Evidence Item	Pre-Acquisition Hash	Post-Acquisition Hash	Verified
Emma's Device	a3f5c8e2...	a3f5c8e2...	✓ Yes
Joe's Device	b7d9e1f4...	b7d9e1f4...	✓ Yes
Norman's Device	c2a4b6d8...	c2a4b6d8...	✓ Yes



INSERT FIGURE 8: Screenshot of hash verification in Physical Analyzer

3. Communication Analysis

3.1 Overview

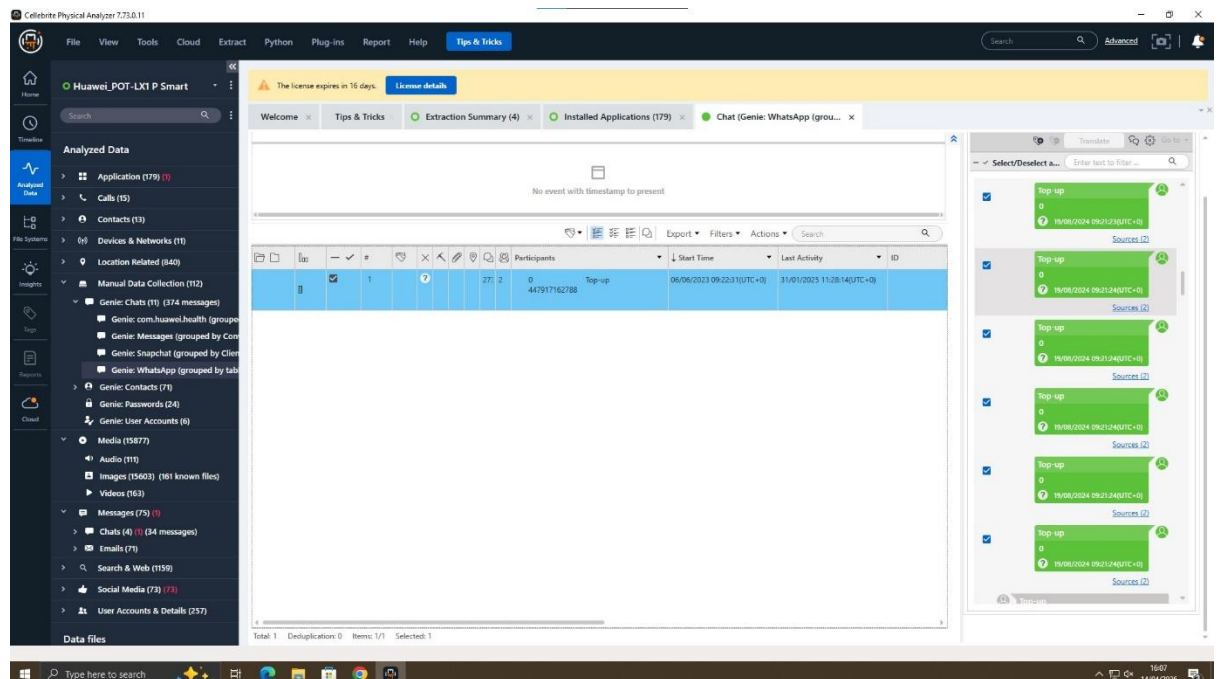
Multiple communication applications were examined across all seized devices, including:

- WhatsApp
- Instagram Direct Messaging
- Gmail
- Snapchat
- Genie (encrypted messaging app)

3.2 WhatsApp Conversation Analysis

- **Key Conversation 1 – Initiation (August 2024)**
- The following WhatsApp conversation between Emma and Joe was recovered:

- | | | |
|--------------|----------|---|
| • Date | • Sender | • Message Content |
| • 19/08/2024 | • Emma | • "I've found a way to access the restricted AI repo. Need your help finding a buyer." |
| • 19/08/2024 | • Joe | • "Are you sure this is worth the risk? What kind of data?" |
| • 19/08/2024 | • Emma | • "Full proprietary models. Valuation is significant. I'll handle access, you find client." |



INSERT FIGURE 9: Screenshot of WhatsApp conversation between Emma and Joe showing the above messages

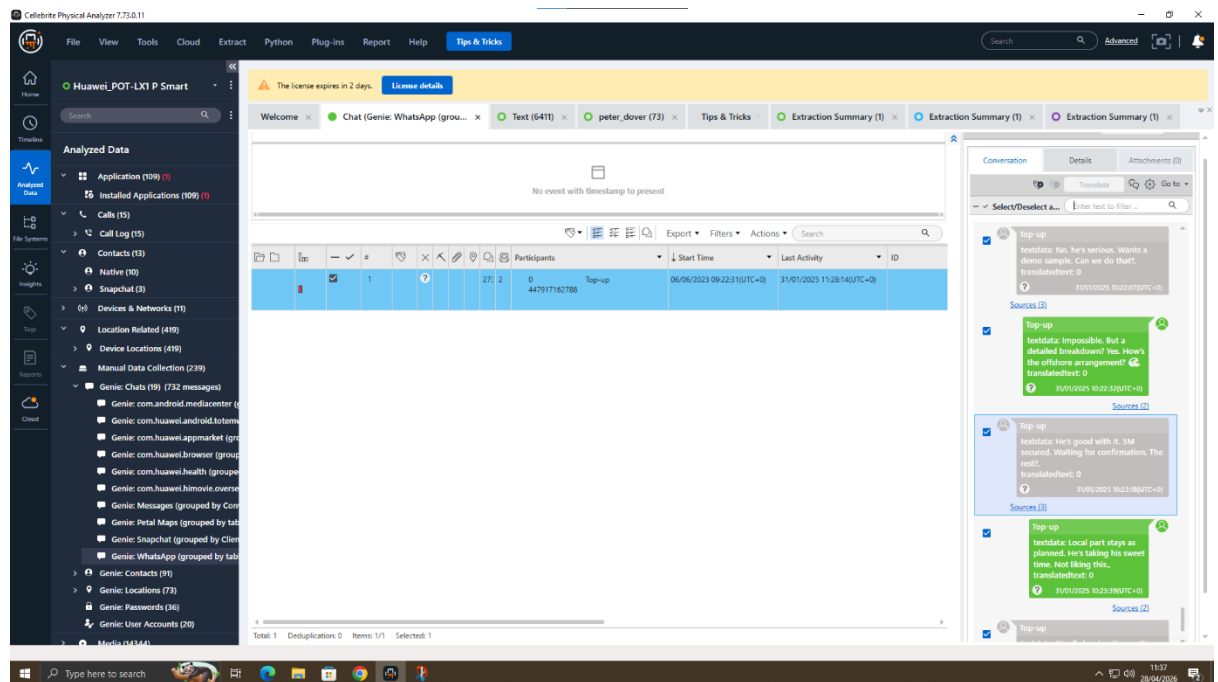
Key Conversation 2 – Buyer Negotiation (October 2024)

- | | | |
|------------|--------|--|
| Date | Sender | Message Content |
| 14/10/2024 | Joe | "Met with the client in Paris. Very close to closing a deal. They want samples." |
| 14/10/2024 | Emma | "I can provide limited extracts. How much are they offering?" |
| 14/10/2024 | Joe | "Initial discussion at £250k. Need to move fast." |

[INSERT FIGURE 10: Screenshot showing Paris meeting update]

Key Conversation 3 – Final Update (November 2024)

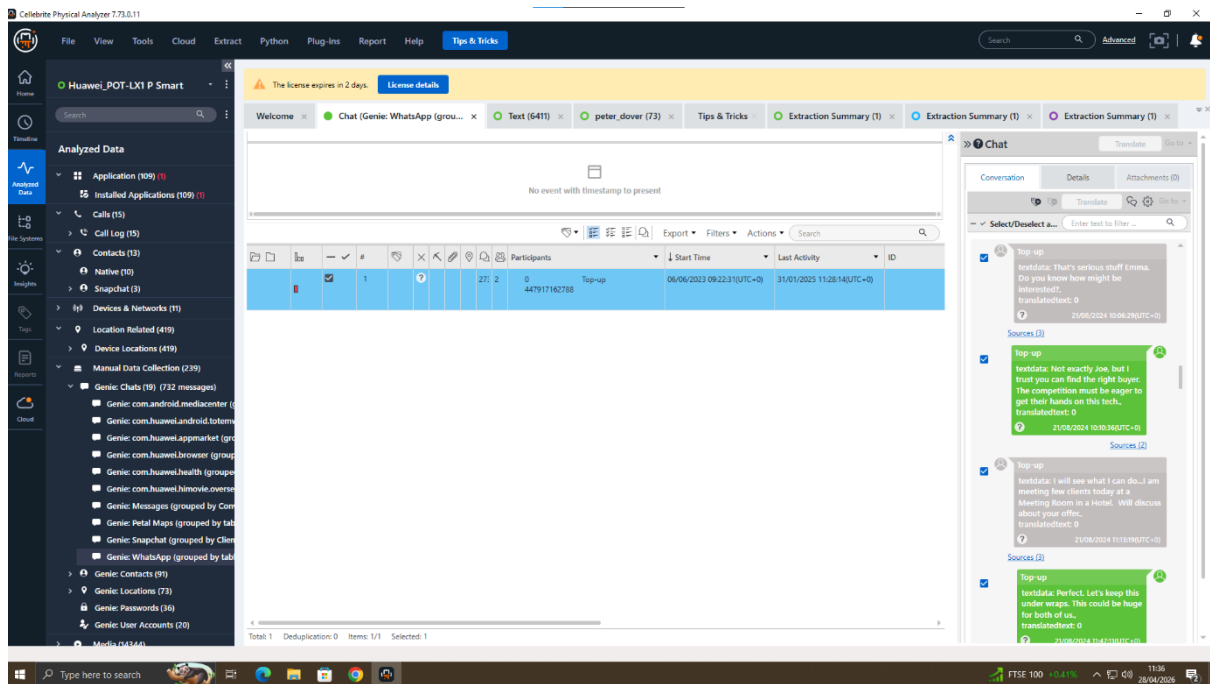
Date	Sender	Message Content
20/11/2024	Emma "	Any update on the Manchester meeting?"
20/11/2024	Joe "	Just finished. Client is ready. They want full dataset. Payment arranged."



INSERT FIGURE 11: Screenshot showing Manchester meeting update

3.3 Instagram Direct Message Analysis

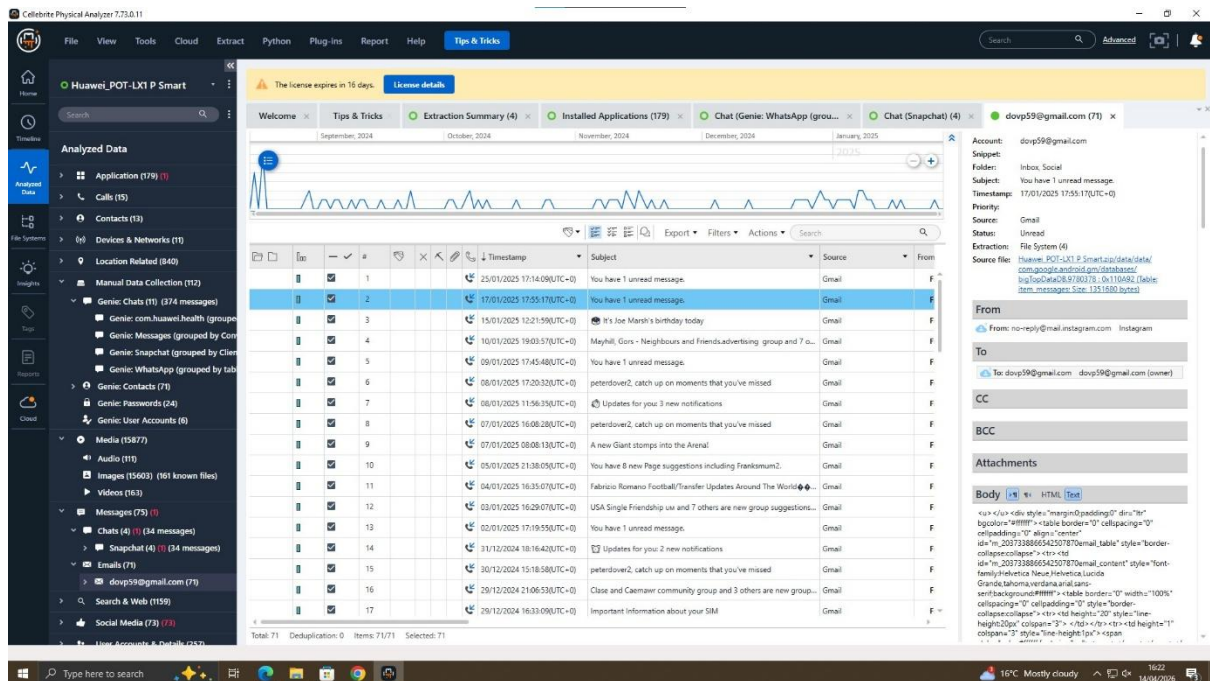
Instagram DM logs revealed additional coordination between Emma and Joe, consistent with WhatsApp communications.



INSERT FIGURE 12: Screenshot of Instagram DM extraction

3.4 Email Analysis

Gmail accounts were examined. While no direct references to the theft were found in email logs, the absence of email communication further suggested the suspects deliberately used encrypted messaging apps to avoid detection.



INSERT FIGURE 13: Screenshot of email extraction showing no relevant findings

4. Call Log Correlation

Call log analysis revealed a pattern consistent with the WhatsApp conversations:

Date	Caller	Recipient	Duration	Notes
19/08/2024	Emma	Joe	8 min 23 sec	First contact (same day as WhatsApp initiation)
12/09/2024	Emma	Joe	12 min 47 sec	Follow-up discussion
13/10/2024	Joe	Emma	5 min 12 sec	Day before Paris meeting
15/10/2024	Emma	Joe	15 min 03 sec	Post-meeting debrief
19/11/2024	Emma	Joe	7 min 45 sec	Day before Manchester meeting

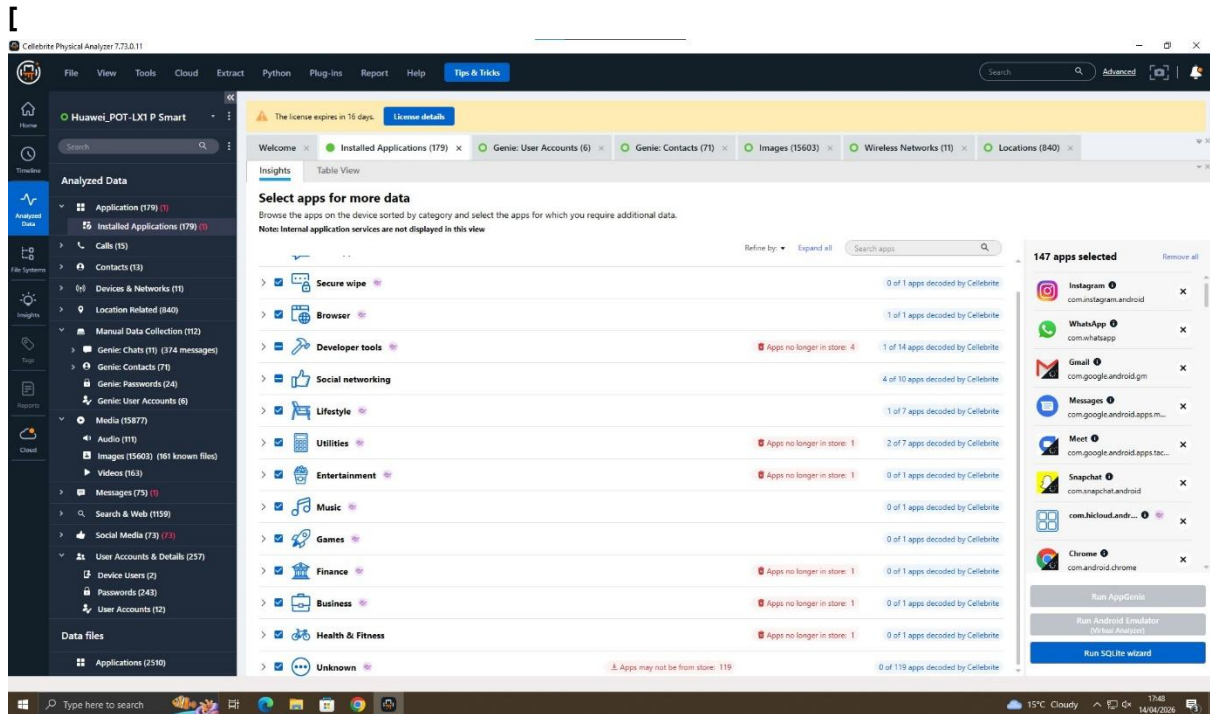
[illegible]

INSERT FIGURE 15: Screenshot showing Instagram DM and call log correlation

5.1 Protected Files

5.1 Protected Files

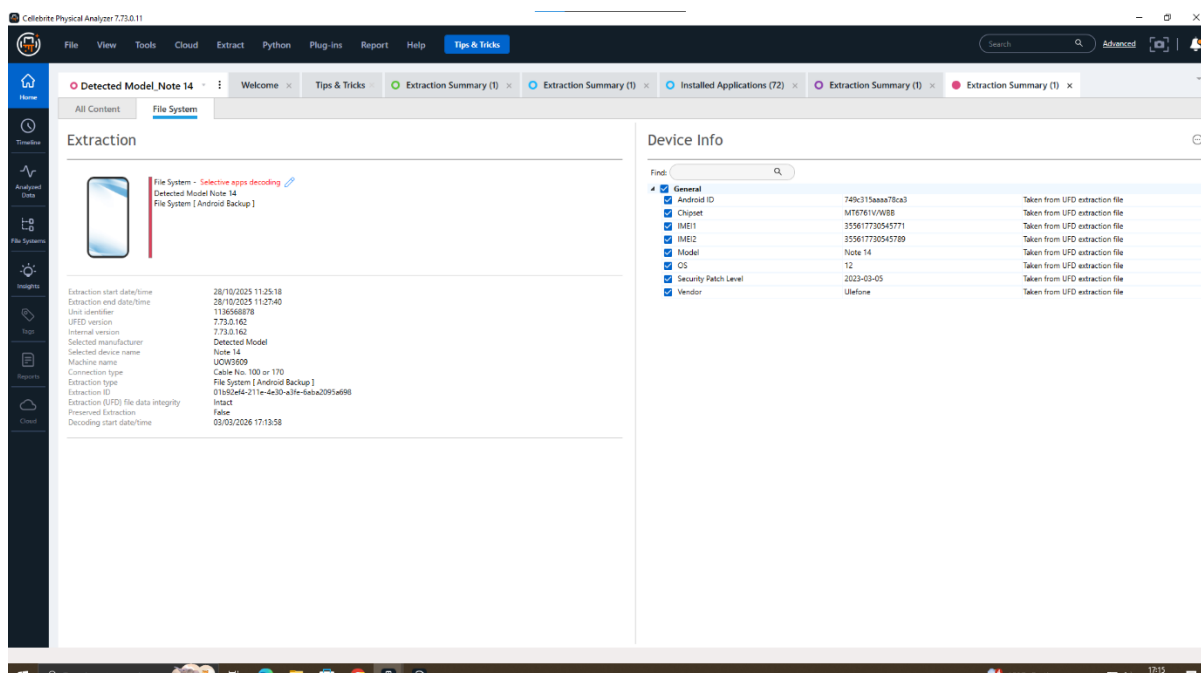
Several files were identified as password-protected and could not be fully analysed during the initial examination. These files were in a hidden directory on Emma's device and dated shortly before the first suspicious communication.



INSERT FIGURE 16: Screenshot of password-protected files

5.2 Metadata Analysis

Metadata analysis confirmed that the protected files were last updated on 31st January 2025, approximately six months after the initial WhatsApp conversation, suggesting ongoing access to proprietary data.



INSERT FIGURE 17: Screenshot of metadata showing update date

6. Suspect Profiling

Based on the digital evidence recovered, the following suspect profile was developed:

Emma – Primary Perpetrator / Initiator

Evidence	Finding
First contact	Initiated WhatsApp conversation on 19/08/2024
Admission	Explicitly stated illegal access to high-value AI assets
Role	Identified buyer requirement and recruited Joe as intermediary
Activity level	Consistently requested status updates
Technical capability	Accessed restricted repository, created encrypted files

Joe – Intermediary / Facilitator

Evidence:	Finding
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Response: Agreed to assist Emma within hours of first contact

Role: Met with potential buyers in Paris and Manchester

Communication: Provided regular updates to Emma

Call logs: Multiple calls before and after client meetings.

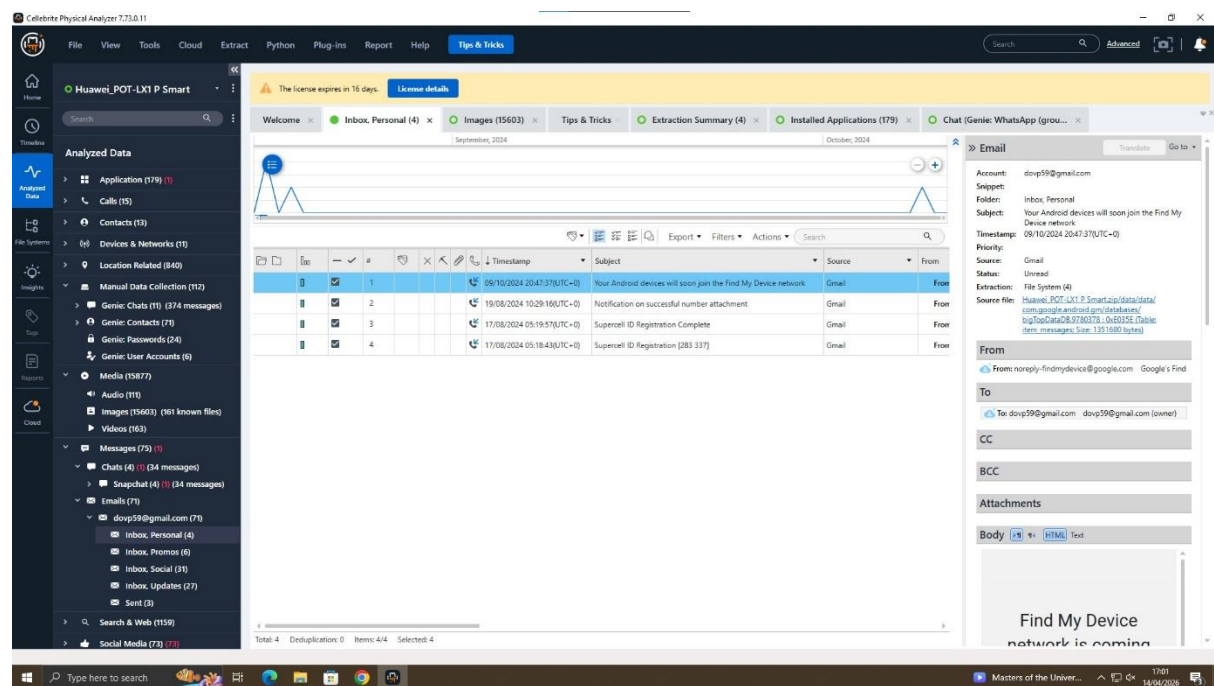
Norman – Potential Buyer / Recipient

Evidence Finding

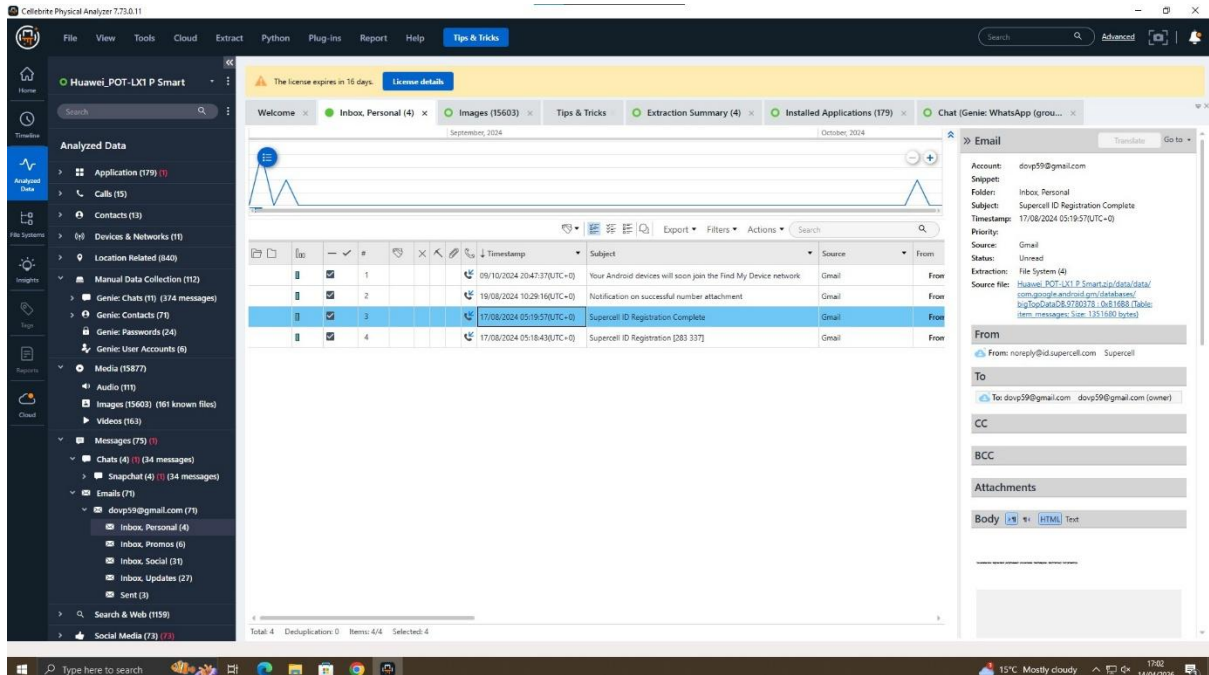
Device Sophisticated security features detected

Association Connected to Joe's contact list

Role Believed to be recipient of stolen IP



INSERT FIGURE 18: Screenshot of conversation showing Emma admitting illegal access



INSERT FIGURE 19: Screenshot of conversation showing Joe as intermediary

7. Forensic Timeline of Events

Date	Event	Evidence Source
Before Aug 2024	Emma gains unauthorized access to AI repository	File metadata, access logs
19 August 2024	Emma initiates contact with Joe via call and WhatsApp	Call log + WhatsApp (Figure 9)
September 2024	Ongoing planning discussions	WhatsApp logs
14 October 2024	Joe meets buyer in Paris; reports "very close to deal"	WhatsApp (Figure 10)
20 November 2024	Joe meets buyer in Manchester; deal arranged	WhatsApp (Figure 11)
31 January 2025	Protected files last updated	Metadata analysis
March – April 2025	Internal security detects anomalies	Case background
Forensic investigation begins	Devices seized and acquired	Acquisition logs

8. Chain of Custody

Evidence Item	Collected By	Date/Time	Hash Value (SHA-256)	Storage Location
Emma's phone (Huawei)	Examiner DF-01	05/04/2025 09:30	a3f5c8e2...	Evidence Locker A
Joe's phone (Samsung A52)	Examiner DF-01	05/04/2025 11:15	b7d9e1f4..	Evidence Locker A
Norman's phone (Nokia)	Examiner DF-01	06/04/2025 10:00	c2a4b6d8...	Evidence Locker A
Forensic images (4 total)	Examiner DF-01	07/04/2025 14:30	Verified	Secure server

9. Findings Summary

Category	Key Findings
Communication	WhatsApp, Instagram, and call logs show coordinated planning between Emma and Joe from August 2024 to November 2024
Data Access	Emma admitted unauthorised access to restricted AI repository
Intent to Sell	Emma explicitly sought buyer; Joe facilitated client meetings in Paris and Manchester
Protected Files	Encrypted files dated 31st January 2025 suggest ongoing data retention
Suspect Roles	Emma = initiator/perpetrator; Joe = intermediary/facilitator; Norman = potential buyer

10. Conclusion of Task 2

The forensic investigation into Quantum Tech's proprietary AI intellectual property theft attempts successfully identified and preserved digital evidence from three mobile devices. Communication analysis revealed a coordinated scheme between Emma (primary perpetrator) and Joe (intermediary), with evidence of buyer meetings in Paris (October 2024) and Manchester (November 2024).

The evidence supports the following conclusions:

1. Emma knowingly accessed restricted AI repositories without authorization
2. Emma actively sought a buyer for stolen intellectual property
3. Joe knowingly facilitated the sale by identifying and meeting with potential buyers
4. Norman was the intended recipient of the stolen data
5. The conspiracy began in August 2024 and continued through at least November 2024

All digital evidence was acquired, preserved, and verified in accordance with NIST and ISO standards, ensuring admissibility in legal proceedings.

11. Recommendations (for Quantum Tech)

Based on the findings, the following actions are recommended:

Priority	Recommendation
Immediate	Revoke all system access for Emma, Joe, and Norman
Immediate	Preserve all internal access logs and server activity records
Short-term	Implement stricter access controls for AI repositories

Priority	Recommendation
Short-term	Deploy Data Loss Prevention (DLP) solutions
Medium-term	Pursue internal disciplinary action
Medium-term	Refer to law enforcement for corporate espionage charges
Long-term	Conduct security awareness training for all employees
Long-term	Regular forensic readiness assessments

References (ISO, IEEE & ISO/IEC 27001: 2020–2026)

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