Computer Forensics, Digital Evidence and the Corporate Security Agenda

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ICT Trends

Since 1995:

- **Corporate computing has become more complex and embedded into organisations:**
  - ➔ Provides more information about the business, customers, etc
  - ➔ Uses Web and Internet for a very wide variety of customer/client interactions – many of these are heavily automated
  - ➔ Makes much greater use of Just-In-Time operations
  - ➔ Gives staff much more computing power on the desk and while mobile
- **Range of informal digital records as opposed to formal records has multiplied**

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ICT Trends

- 70% of UK homes have at least one PC; many have several, including older PCs; 93% are connected via broadband
- 38.8 m people (May 2010)
- 97% of all businesses have broadband Internet connections; 70% have a website
- *Cost of data media halves every 18 months*
- 120 cellphones per 100 of population

- Digital evidence is now normal and ubiquitous, not confined to a “hi-tech” ghetto
  - ➔ May be supportive, corroborative, indicative rather than central

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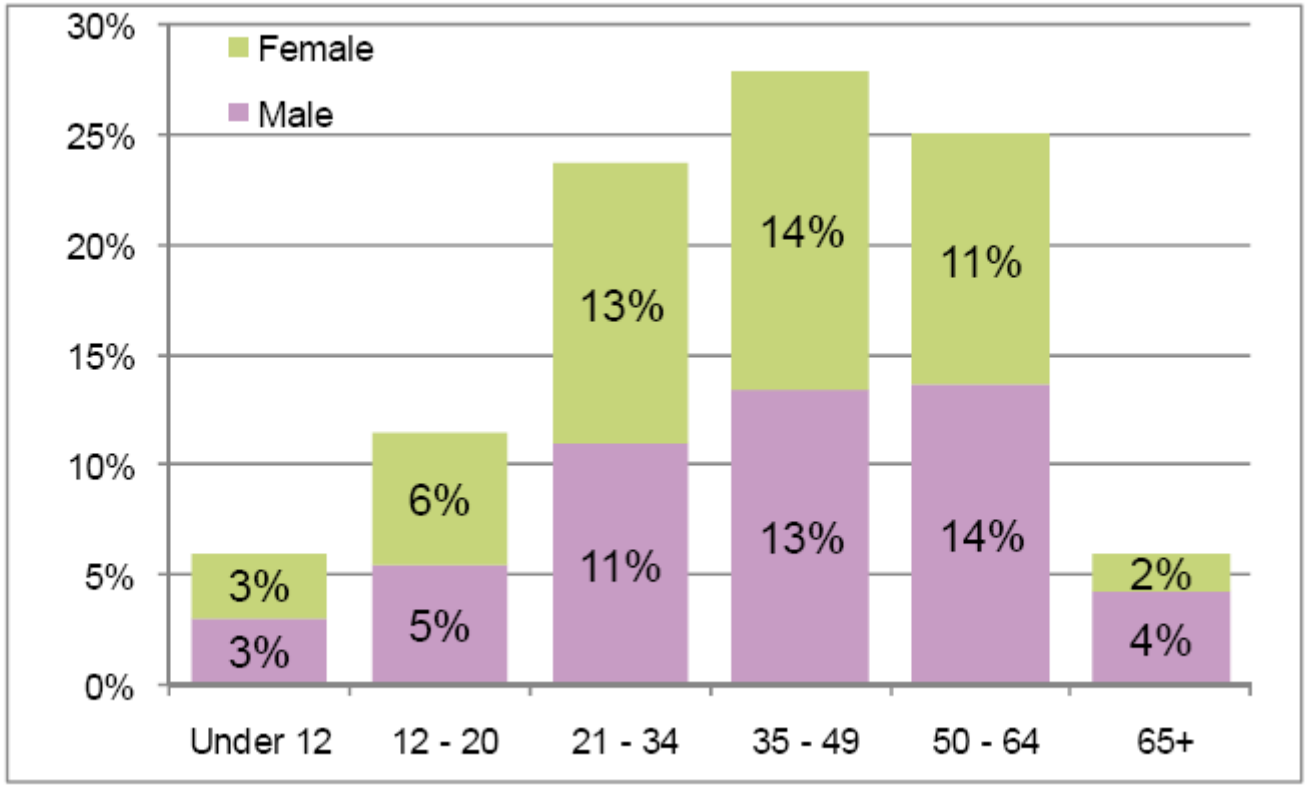
Chart 1: How UK Internet Audience is composed – May 2010



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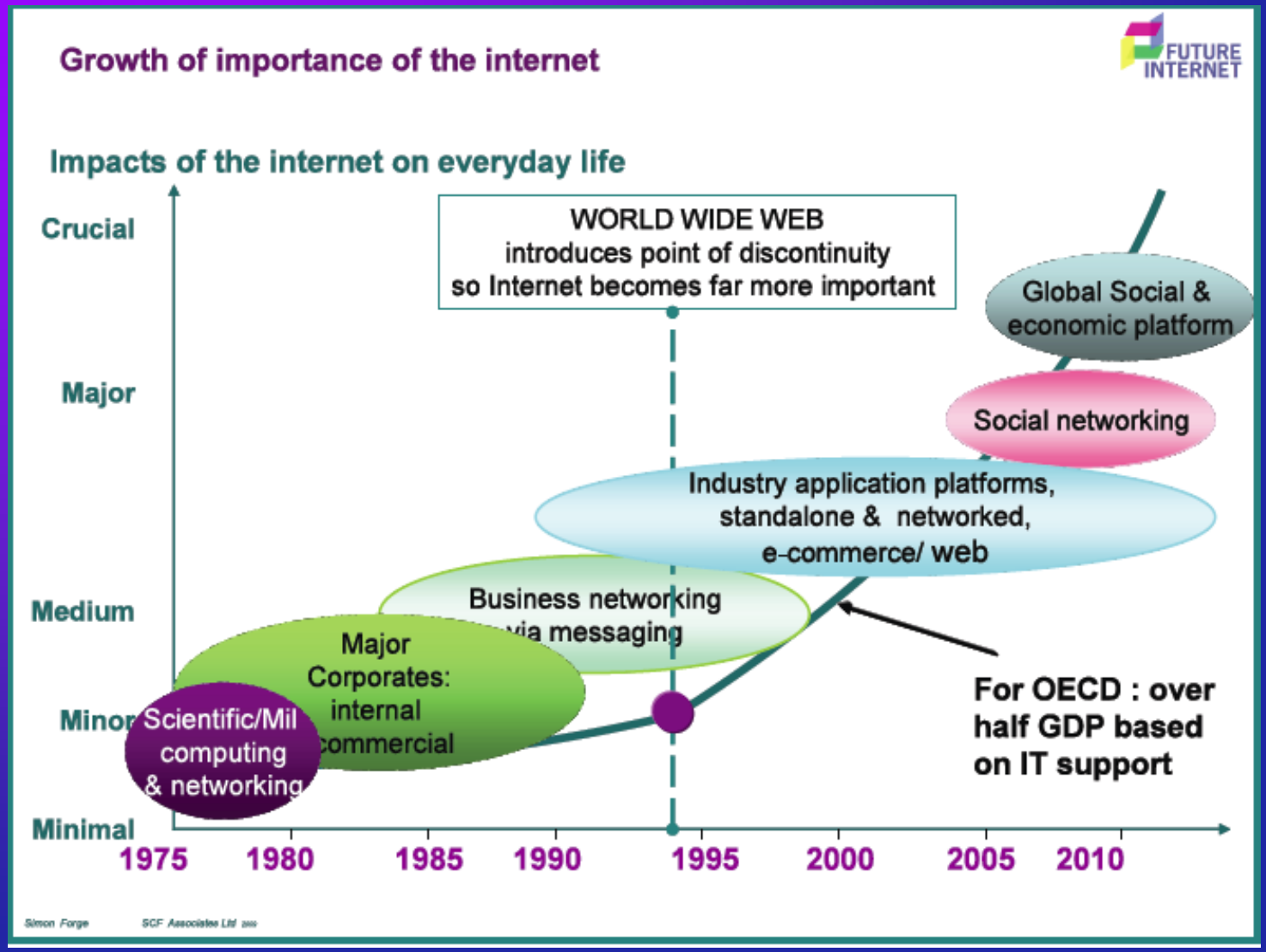

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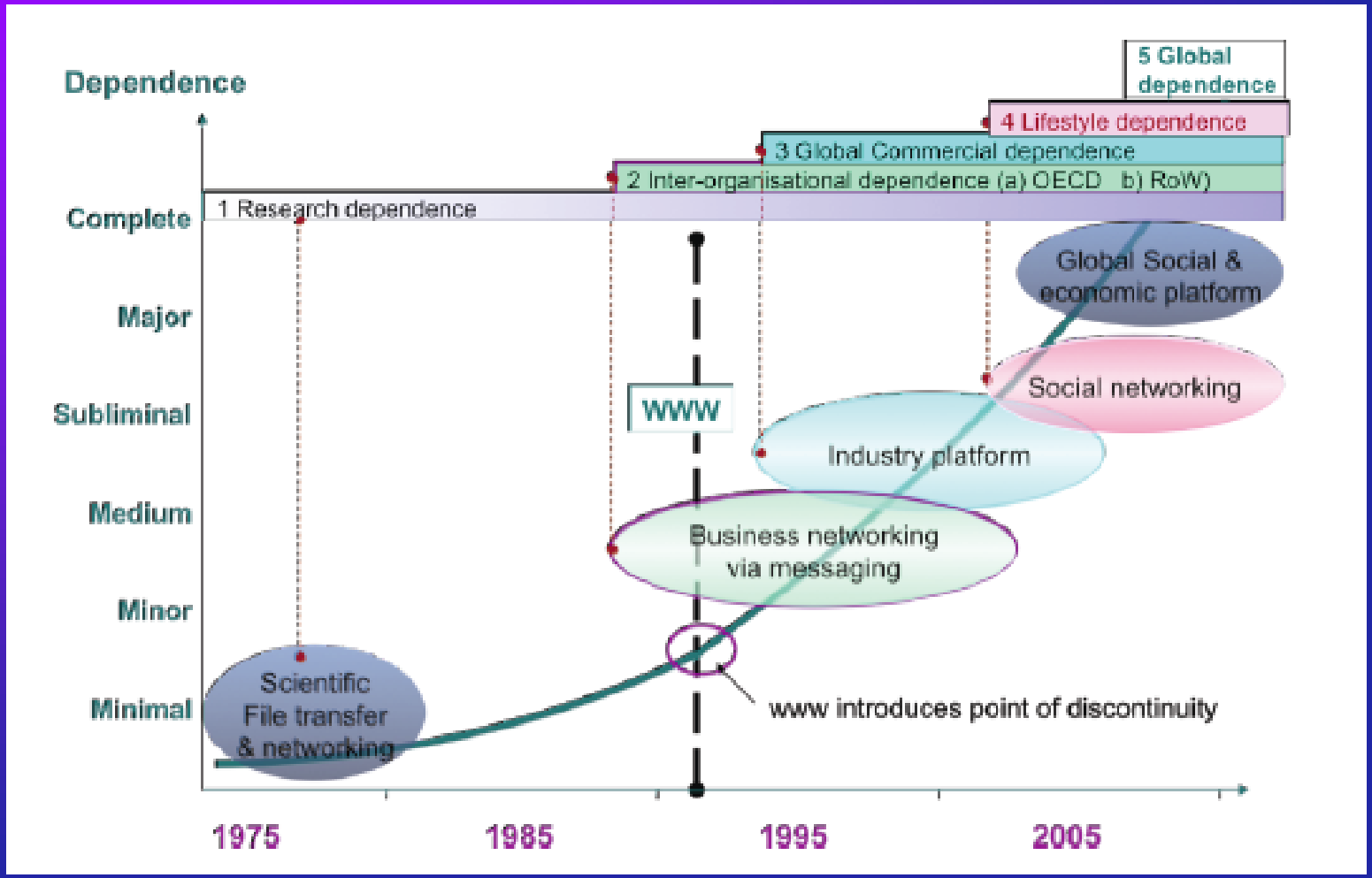

Digital Evidence

- Almost all organisations are heavily dependent on computers and ICT
- Many activities within and around an organisation will create *formal* records in digital form
- Nearly all activities within and around an organisation will create *informal* records in digital form

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Computer Forensics

- **Finding unintended evidence from digital records**

as opposed to

- **Intended formal records:**
  - ➔ **Transaction logs**
  - ➔ **Audit tails**

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Computer Forensics

based on Forensic Science:

- **Every contact leaves a trace**
- **Scientific methodology to "prove" reliability of procedure / artefact**
- **Relies heavily on reverse engineering**

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Digital Forensics Methodology

- Create “clean” or “virgin” test environment
- Make forensic disk image
- Introduce changes to be observed
- Make further forensic disk image
- Look for all the changes
- Repeat until you can formulate a rule to describe what is happening
- Test rule
- Publish
- Develop tool
- Test tool

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Incidents

- Data Loss / DataTheft
- Frauds by employees and 3rd parties
- Contractual disputes
- Allegations of failure of duty of care
- E-mail and Internet abuse
- Breach of confidentiality
- Online defamation
- Employee / HR disputes
- Sexual harassment
- Acquisition and storage of child abuse images
- Datatheft / Industrial Espionage
- Software piracy
- Theft of source code

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Incidents

- Unauthorised access by employees
- Unauthorised access by 3rd parties – “hacking”
- Unauthorised data modification – incl viruses and trojans
- Abuse of corporate IT resources for private gain
- Use of corporate IT resources as one stage in a complex criminal act and where a 3rd party is victimised
- Use of corporate IT resources for illegal file-sharing
- DoS and DDoS attacks
- “Phishing” and “Pharming” attempts
- etc etc

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Incidents

- Rare, Spectacular Events
- Events that occur everywhere to everyone… but still cause panic, distress, loss
- High Impact / Low Frequency
- High Frequency / Individually, Medium-to-Low Impact

Requirements for Evidence

- Employment Issues
- Insurance Claims
- Regulatory Issues / Proof of Compliance
- Civil Litigation
  - ➔ You want to sue some-one
  - ➔ Some-one wants to sue you – and you must defend and disclose
- Criminal Litigation
  - ➔ You are the scene of crime
  - ➔ You may have to defend yourself / your employees
- Freedom of Information Act Requirements

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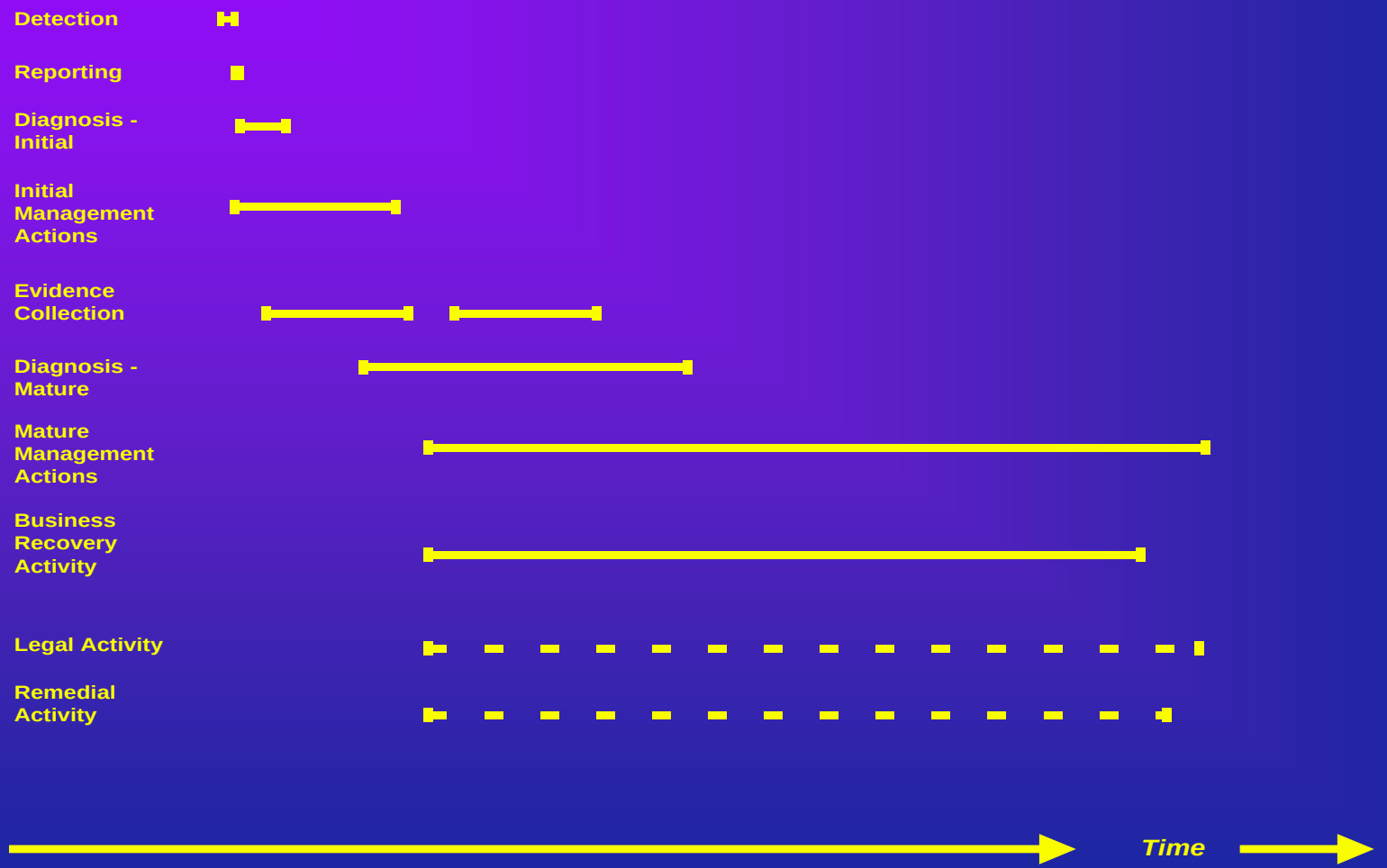
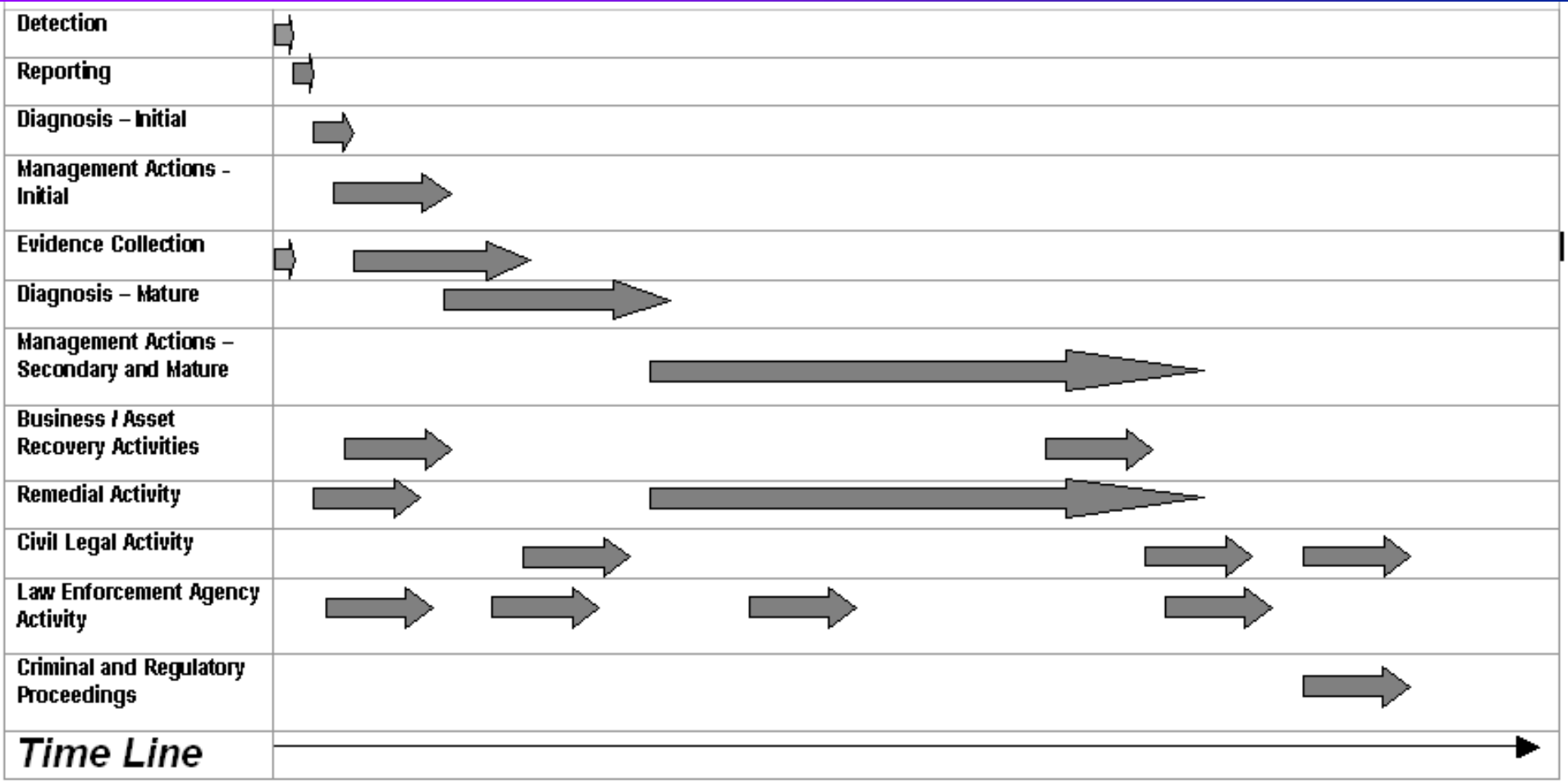
Life-cycle of incidents



Computer Incident Management Life Cycle



The Investigator's Perspective

- What are the suspicions?
- How likely is it that the client has mis-interpreted the situation?
- What powers do I have?
  - → I start out with no powers, I need to acquire them from the client
- Now to try and locate evidence …

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The Investigator's Perspective

- Now to try and locate evidence …
- How does the client's organisation work?
  - What functions does it perform?
  - How do I relate business functions to bits of hardware, software, computer records?
- Given the suspicions, what should I go for?
  - Transaction records
  - Emails
  - Web usage
  - Contents of PC, laptop, mobile phone, PDA, memory sticks, etc

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The Investigator's Perspective

- **Are there any restrictions on my access?**
  - → **Client authorisation as employer**
  - → **Limits on employer's powers**
    - **Human Rights Act 1998**
    - **Data Protection Act,**
    - **Protection from Harassment Act, 1997**
    - **Regulation of Investigatory Powers Act 2000**

      Telecommunications (Lawful Business Practice) (Interception of Communications) Regulations 2000
  - → **Computer Misuse Act 1990**
    - **as amended**

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The Investigator's Perspective

- Are there any restrictions on my access?
- Penalties for breach of powers:
  - → Criminal
  - → Abuse of Process
  - → Admissibility
  - → Harassment
  - → Etc etc

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The Investigator's Perspective: Technologies

- PCs
  - ➔ Make reliable complete copy ("forensic image") and analyse
    - Obvious, visible records, emails, Internet activity
    - Recovery of deleted data
    - Chronologies of activities
  - ➔ Now standard procedures, products, training
  - ➔ Imaging can be done covertly over night

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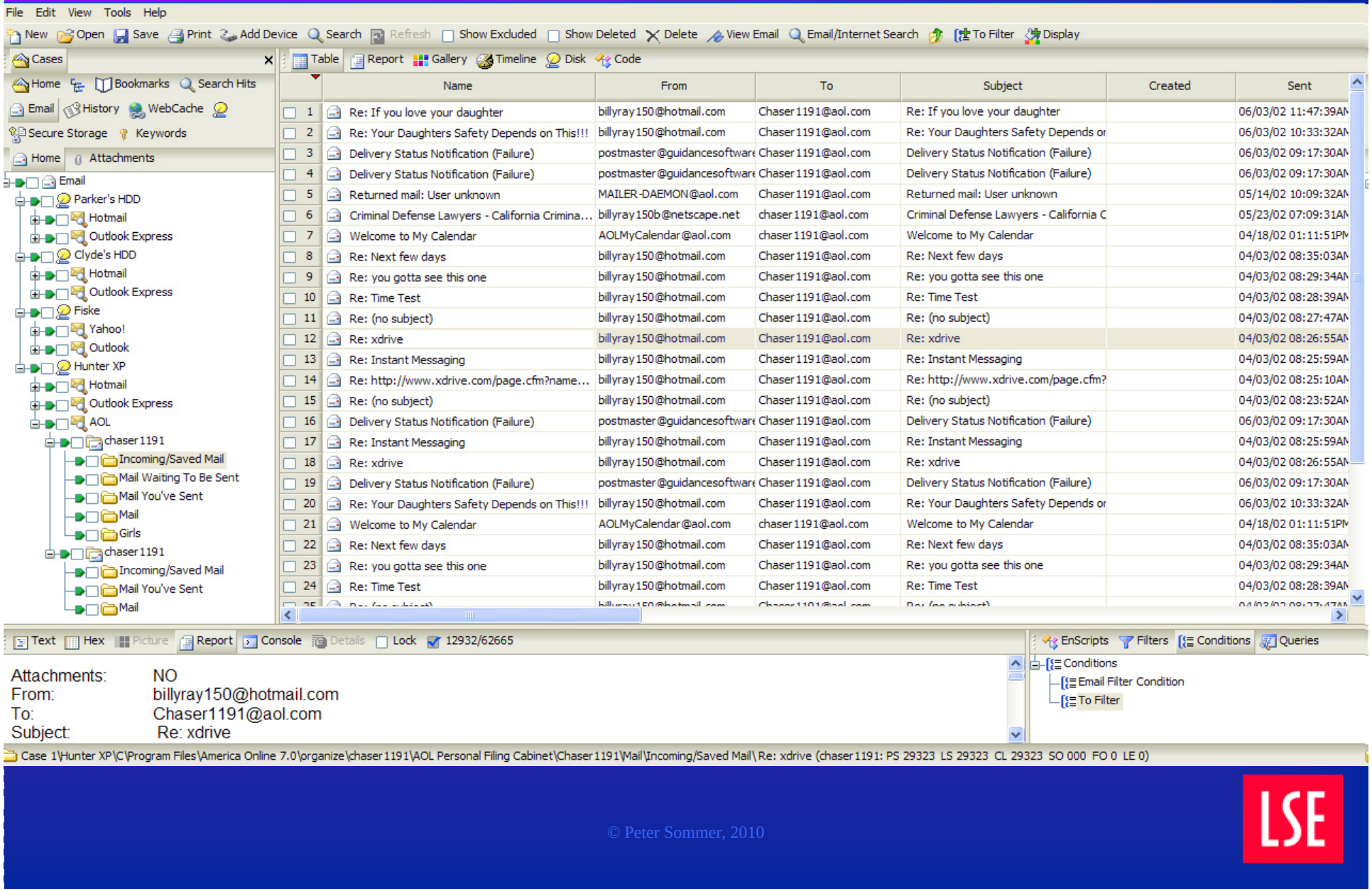

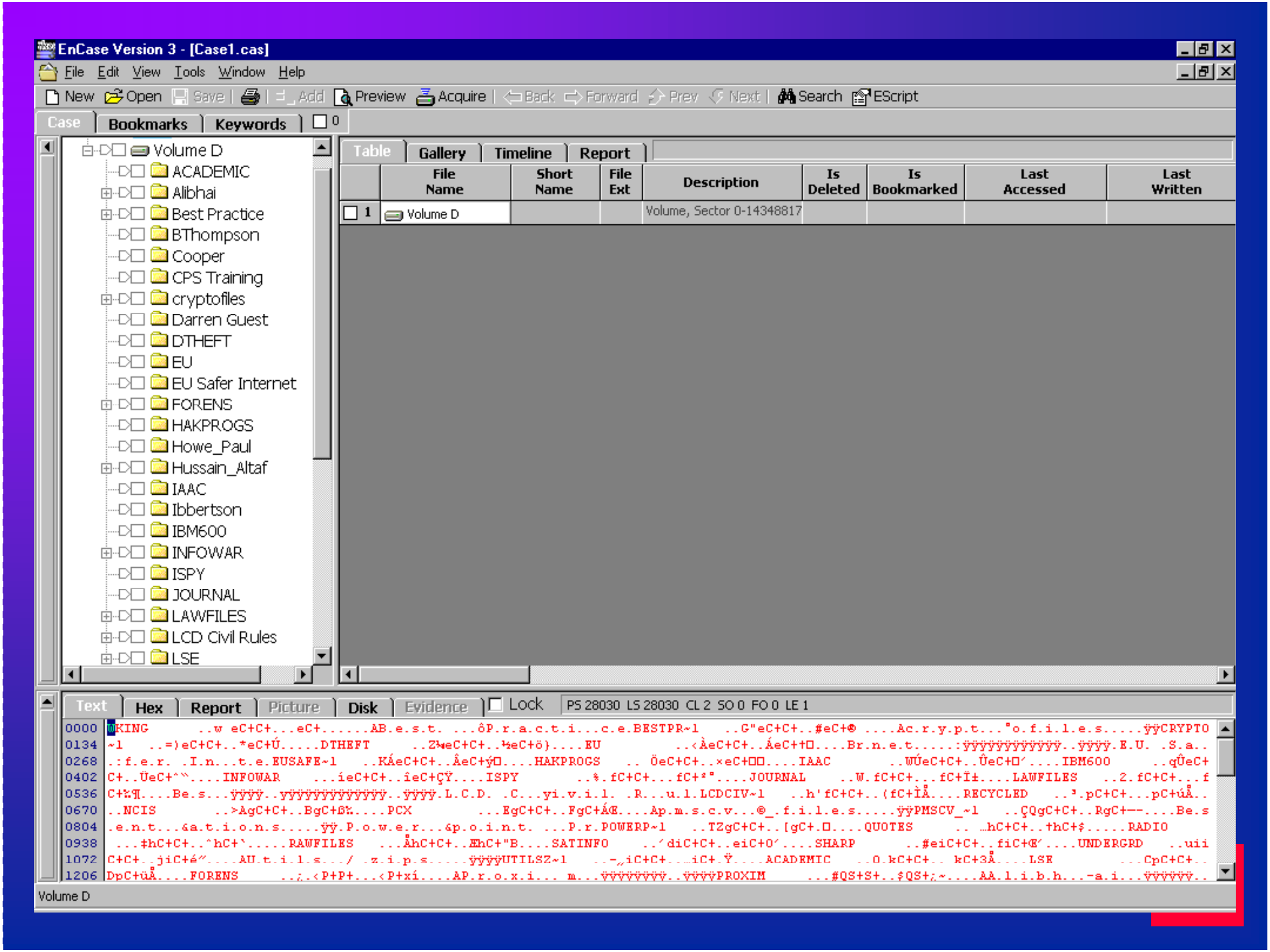
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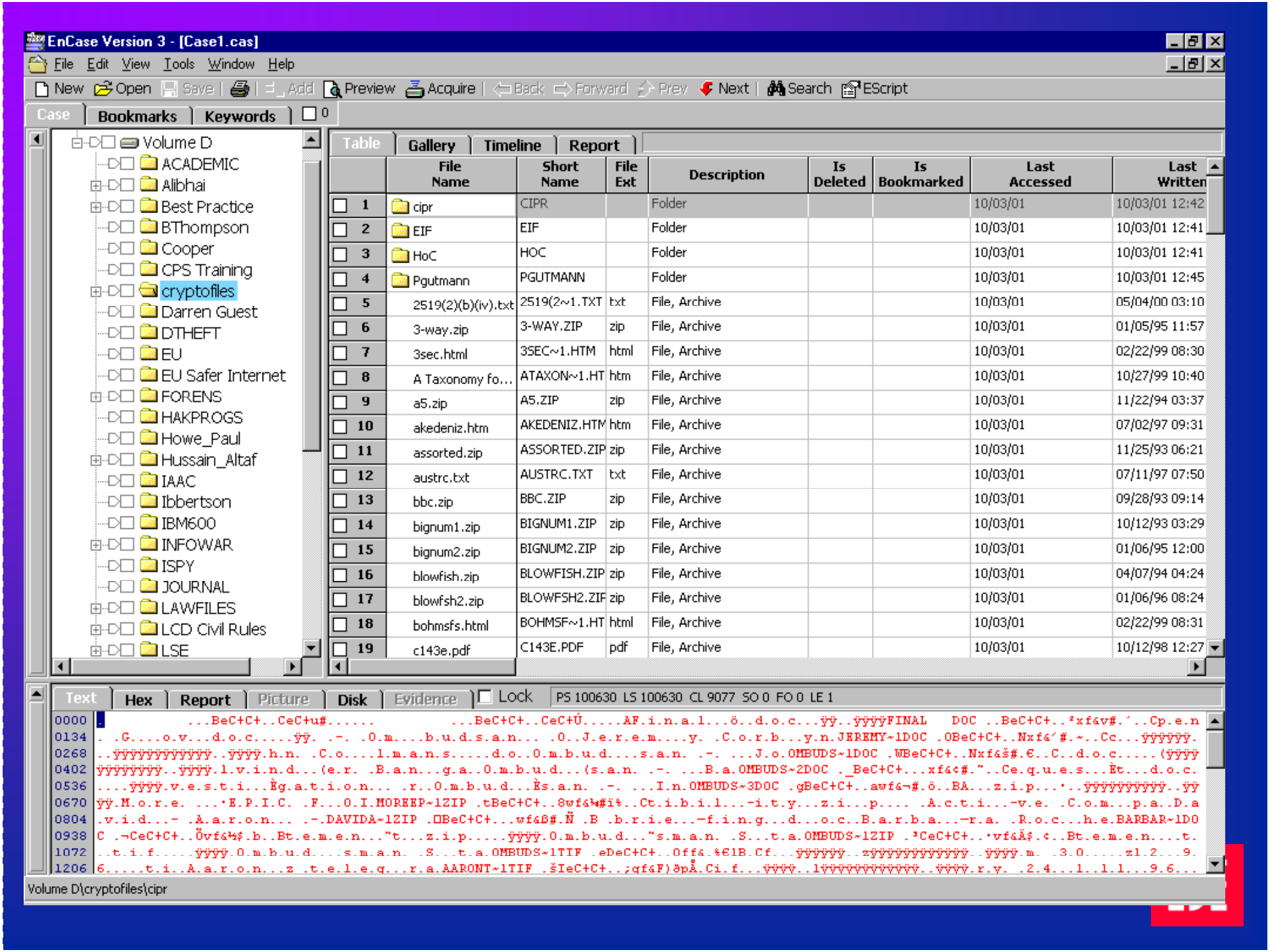
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2 EIF | EIF | | Folder | | | 10/03/01 | 10/03/01 12:41
3 HoC | HOC | | Folder | | | 10/03/01 | 10/03/01 12:41
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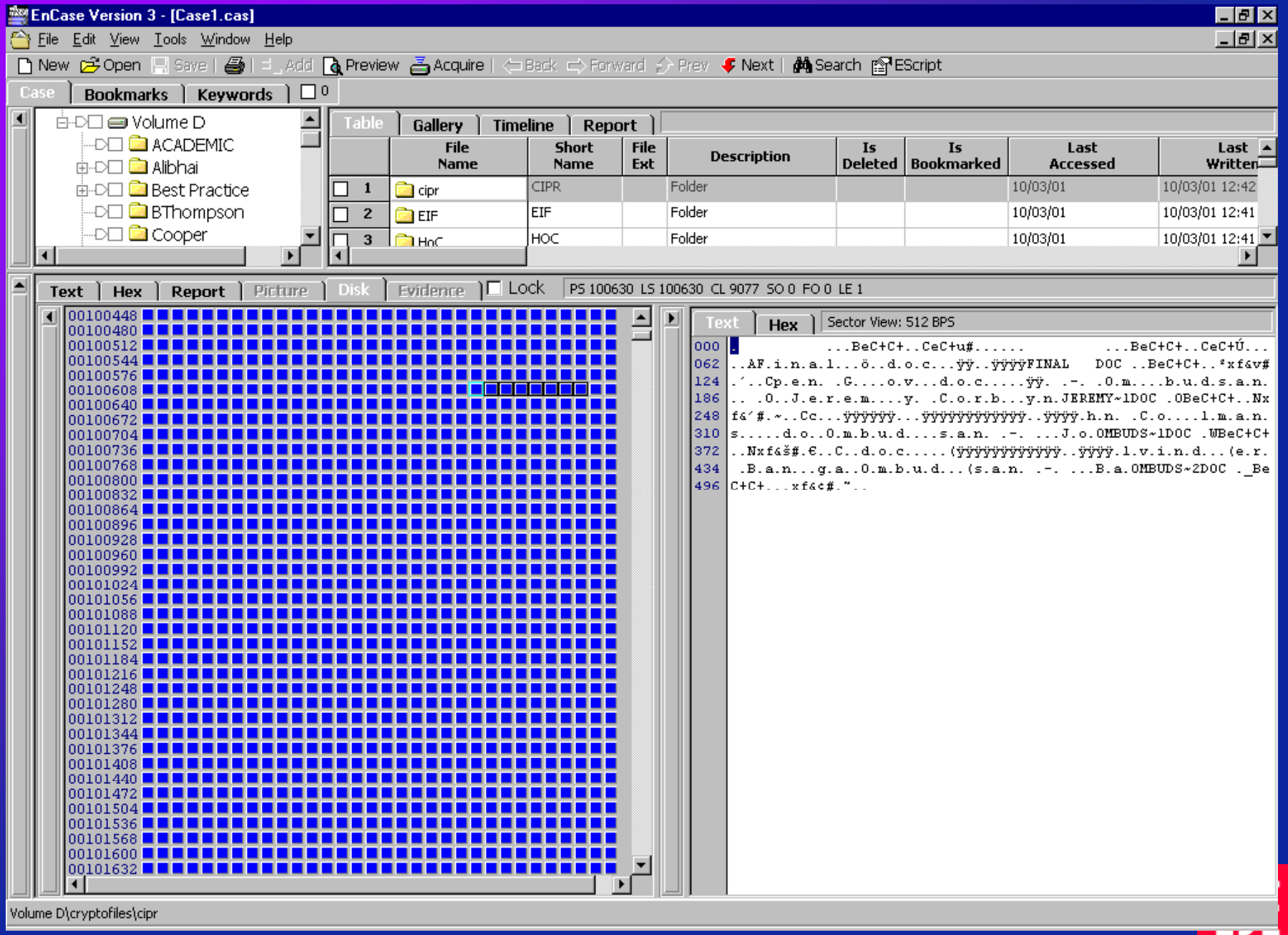
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3 HoC HOC Folder 10/03/01 10/03/01 12:41
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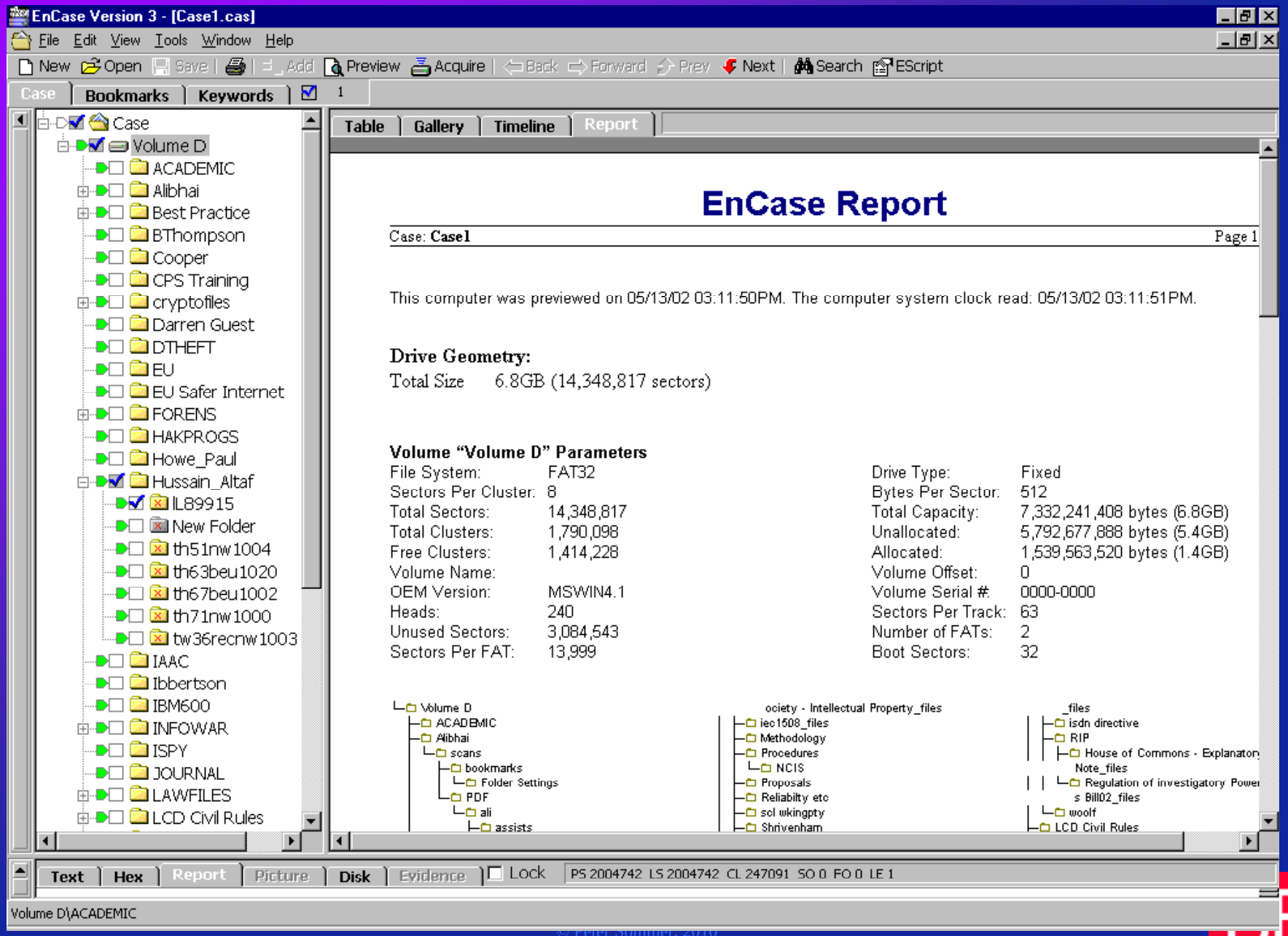

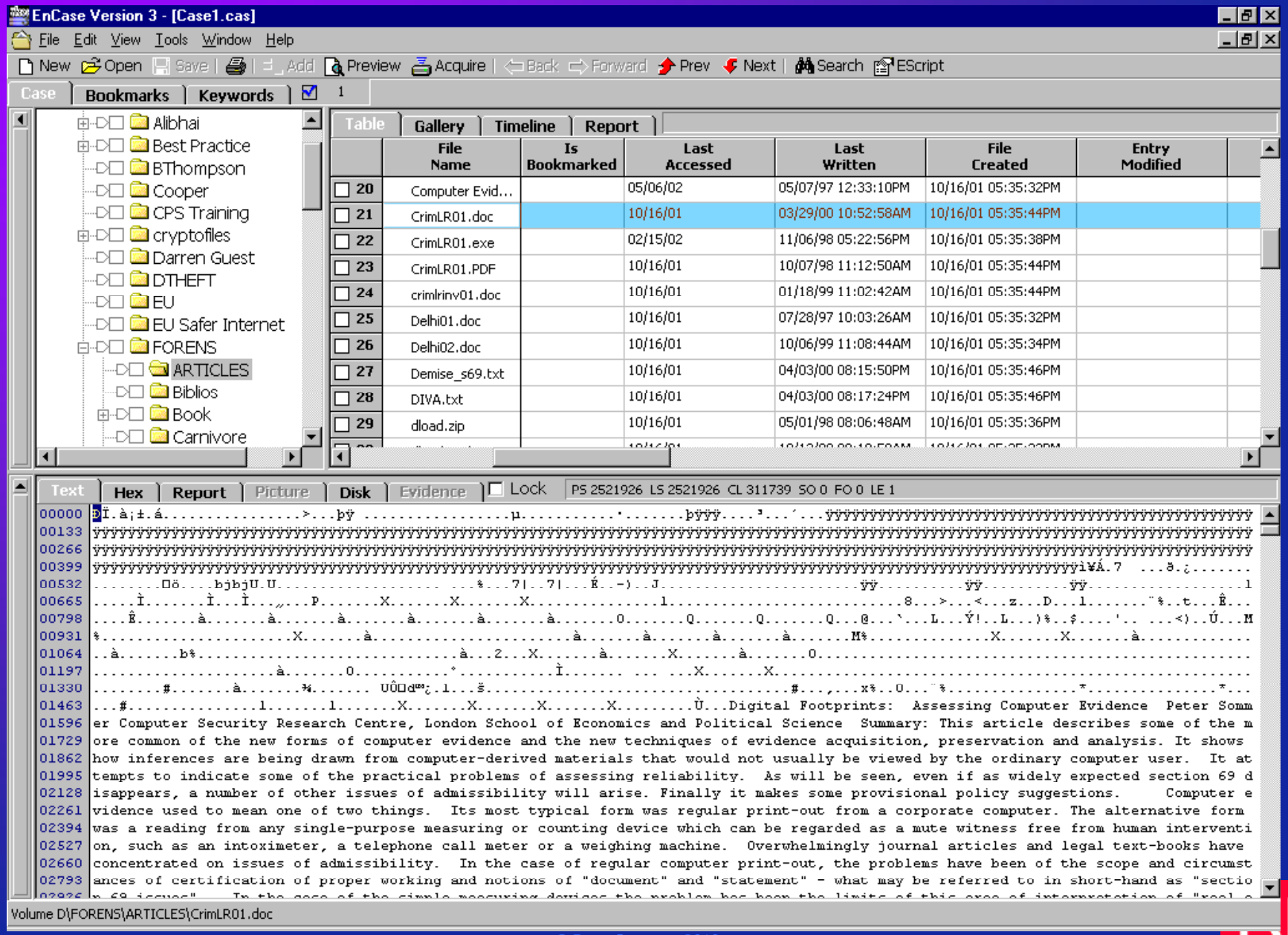

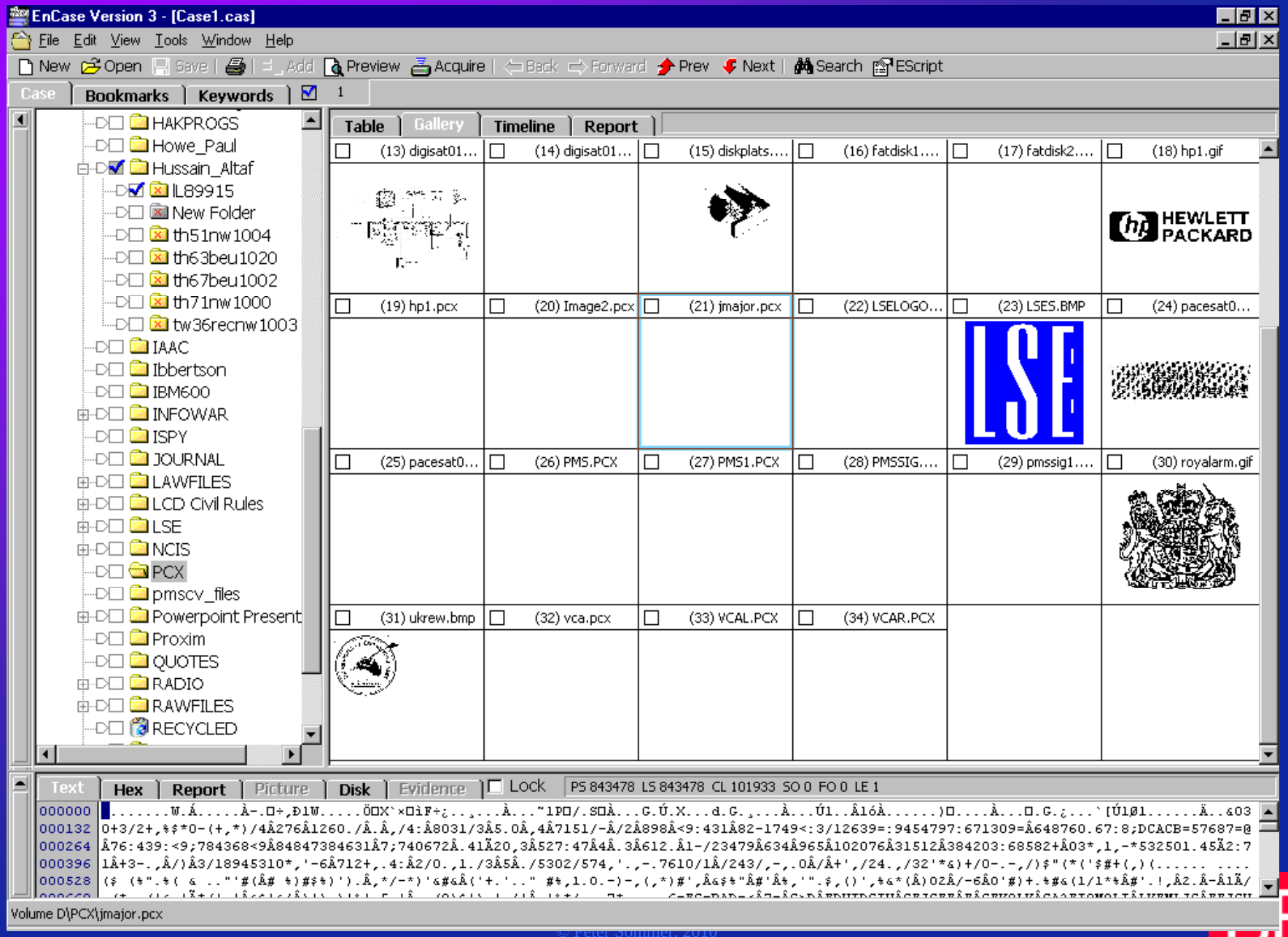

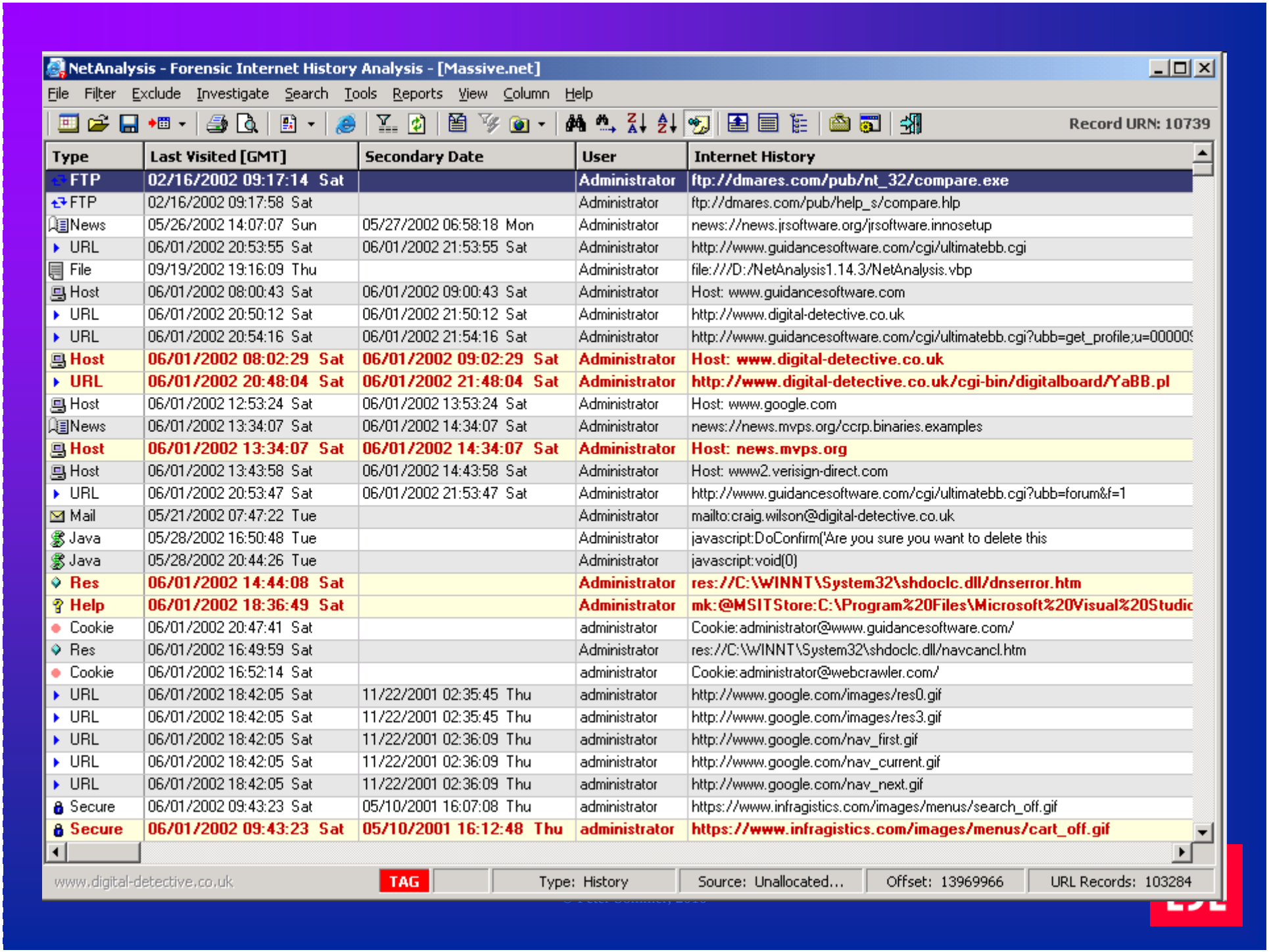
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The Investigator's Perspective

- **Main systems**
  - ➔ Full imaging likely to be technically difficult
  - ➔ Imaging is easier on a system taken off-line
    - But then the business is no longer functioning
  - ➔ Partial copying runs risk that it shows an incomplete picture of events
  - ➔ How far do existing back-up/archiving systems assist?
  - ➔ How do I limit my examination so as not compromise the rights of third parties?
    - Employees, customers, clients

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The Investigator's Perspective

- **Subsidiary systems**
  - Eg small specialist sub-systems
  - PDAs, laptops, cellphones, memory sticks, media players etc
  - Can we identify?
  - May be disputes over ownership, expectations of privacy
  - Some devices may be technically difficult to examine

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The Investigator's Perspective

- **On-going suspicions: "live" investigations:**
  - → **Keyloggers**
  - → **Servlets**
  - → **Network monitoring**
  - → **CCTV**
  - → **Human surveillance**
  - → **Background investigations**
  - → **Physical searches**

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Technical Support

- **Keyloggers**
  - → **hardware**

completely invisible for computer operation (pure electronic device)
No software or drivers required
Huge 2MB flash memory disk, organized as a FAT file system
Installs as a flash drive for data retrieve (visible to system as additional disk)
Super fast data download (up to 100kB/s)
Quick and easy national layout support
Compatible with all Low-Speed USB keyboards (including Linux & Mac)

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With the Spector Pro Keylogger, you will be able to:

- Capture ev (including us
- Get the exa
- Capture &
- Read every
- Review ev
- See everyt
- See every
- See every
- Quickly fin

Completely Invisible

Stealth Technology

The most advanced stealth technology available ensures that the Spector Pro keylogger is completely protected from everyone except those with authorized access.

Spector Pro does not appear in the Start Menu, Add/Remove Programs, Task Manager, Running Processes, System Tray, Registry, or on the Desktop – there aren't even any visible files.

"Spector Pro does the BEST job of hiding"
– PC Magazine

"EVERY word they type, EVERY link they click, SpectorSoft will be watching"
– InfoWorld Magazine

Instant Alerts

See What They Type and What They View

The Spector Pro keylogger will instantly inform you whenever they type – or even simply VIEW – any "alert words" or phrases that you specify.

Spector Pro continuously looks for alert words in EVERYTHING they type, EVERY web site they visit, ALL chats/Instant Messages and in EACH email sent or received.

EVERY time a keyword is detected, Spector Pro will immediately email you a detailed report of WHEN, WHERE and HOW the keyword was used.

Alerts are sent to your office, home, cell phone or wherever you want!

"This is one slick piece of technology"
– US News & World Report

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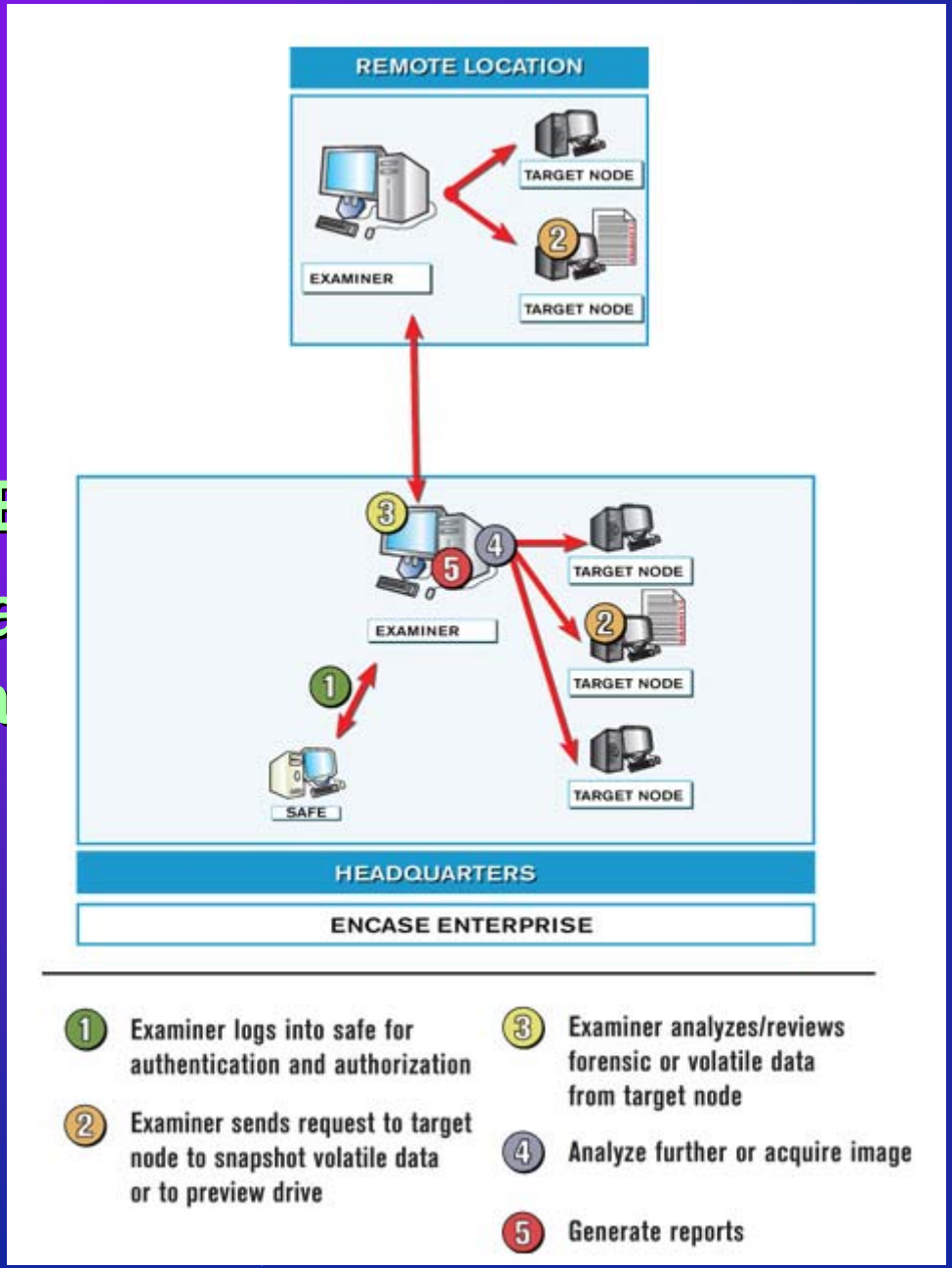
Tech

- **Servlets**
  - → Eg EnCase E
  - → Applied on a
    forensic exa



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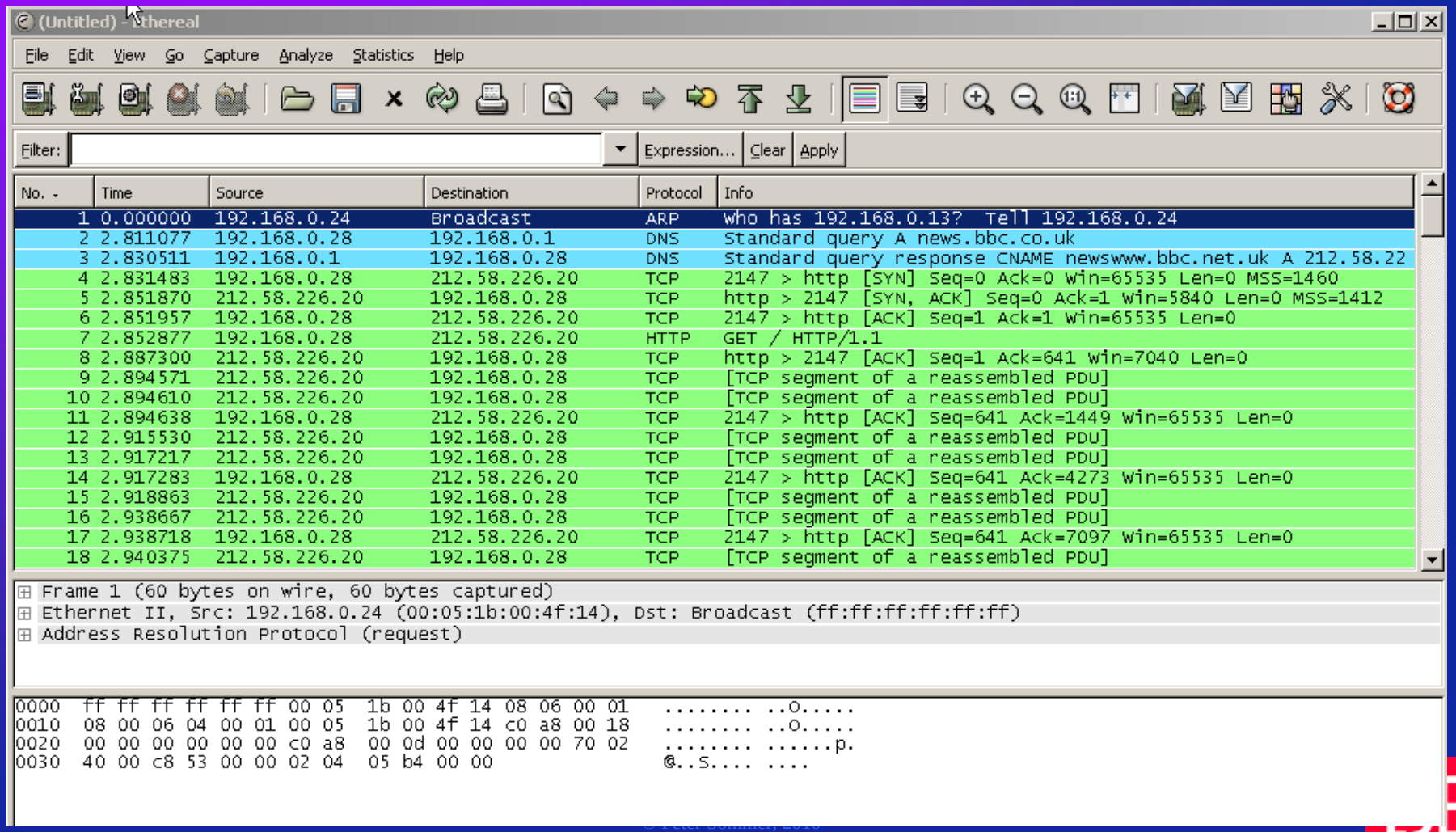
Network Surveillance



External Logs

- System Logs
- Web Logs
- Intrusion Detection System Logs
- Anti-Virus Logs
- ISP Logs
  - → RADIUS
  - → Web-Logs

Subject to DPA/ RIPA authorisation and/or consent!

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Squid Logs

```
1007949021.553     86 192.168.0.103 TCP_MEM_HIT/200 6947 GET http://us.a1.yimg.com/us.yimg.com/i/ww/m5v6.gif graeme NONE/- image/gif
1007949022.484   4374 192.168.0.103 TCP_MISS/200 22349 GET http://www.yahoo.com/ graeme DIRECT/64.58.76.223 text/html
1007949022.884     74 192.168.0.103 TCP_HIT/200 4043 GET http://us.a1.yimg.com/us.yimg.com/a/ya/yahoo_promotions/fp2.gif graeme NONE/- image/gif
1007949027.488   4418 192.168.0.103 TCP_MISS/000 0 GET http://us.a1.yimg.com/us.yimg.com/i/us/auc/b/auc16_1.gif graeme NONE/- -
1007949028.056   4569 192.168.0.103 TCP_MISS/000 0 GET http://us.i1.yimg.com/us.yimg.com/i/us/sh/pr/hol01/rib.gif graeme NONE/- -
1007949028.059   4604 192.168.0.103 TCP_MISS/000 0 GET http://us.i1.yimg.com/us.yimg.com/i/us/sh/pr/hol01/bow.gif graeme NONE/- -
1007949028.061   4544 192.168.0.103 TCP_MISS/000 0 GET http://us.i1.yimg.com/us.yimg.com/i/space.gif graeme NONE/- -
1007949028.063   4346 192.168.0.103 TCP_MISS/000 0 GET http://us.a1.yimg.com/us.yimg.com/i/sh/h99/holly.gif graeme NONE/- -
1007949028.065   4258 192.168.0.103 TCP_MISS/000 0 GET http://us.a1.yimg.com/us.yimg.com/a/an/anchor/shopping/ads/new37/dell.gif graeme NONE/- -
1007949029.233   1163 192.168.0.103 TCP_MISS/302 148 GET http://www.yahoo.com/r/m1 graeme DIRECT/64.58.76.227 -
1007949032.096     73 192.168.0.103 TCP_HIT/200 1365 GET http://us.i1.yimg.com/us.yimg.com/i/us/pim/maillogin.gif graeme NONE/- image/gif
1007949032.324   3089 192.168.0.103 TCP_MISS/200 12044 GET http://mail.yahoo.com
:
```

```
    lwn.net/images/sp.gif
H   lwn.net/images/linuxpower2.png
    lwn.net/images/rarrow.png
    lwn.net/images/eklektixsm.png
    stats.lwn.net/1pixtrans.gif
    lwn.net/2002/0214/security.php3
    lwn.net/images/security.png
(96.03% to 100.00%) 60.00% Fri Feb 15 08:48 2002                    | h = help
```

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Forensic Readiness Plan

Why have plan?

- To reduce costs and panic
- External consultants will have to “learn” the business
- Lawyers will have to identify admissibility and privilege issues on the spot
- Can also be used for other legal situations, eg internal disciplinary disputes, routine transaction disputes, to aid law enforcement

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Pro-active strategies

Two apparent alternative routes:

- **Certification of compliance with appropriate standards**
- **Forensic Readiness Program**

(in fact they can complement each other)

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Standards Compliance

MANDATORY REQUIREMENT 37

Departments and Agencies must have the ability to regularly audit information assets and ICT systems. This must include:

a) Regular compliance checks carried out by the Accreditor, ITSO etc. (documented in the RMADS audit of the ICT system against configuration records).

b) A forensic readiness policy that will maximise the ability to preserve and analyse data generated by an ICT system, that may be required for legal and management purposes.

b) A forensic readiness policy

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Standards Compliance

Standards Compliance

- **IS027001:**
  - **Ch 4: processing information & documents (retention)**
  - **Ch 7: Combatting Cyber Crime (evidence)**
  - **Ch 13: Compliance – legal and policy**
  - **Ch 14: Detecting and Responding to Incidents**
- **IS027037: Guidelines for identification, collection and/or acquisition and preservation of digital evidence (DRAFT)**

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Standards Compliance

- **BIP 0008-1: Code of practice for legal admissibility and evidential weight of information stored electronically**
- **BIP 0008-2: Code of Practice for Legal Admissibility and Evidential Weight of Information Communicated Electronically**
  - ➔ **Emails, SMS, IMs, web-services, EDI**
- **BIP 0008-3: Code of Practice for Legal Admissibility and Evidential Weight of Linking Electronic Identity to Documents**
- **BIP 0067:2006: A guide to developing a retention and disposal schedule for business information**
- ***and associated work-books***
- **ISO 15489: Records Management**

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Reliable record keeping regulatory compliance

- Sarbanes-Oxley
- Basel II
- UK Combined Code of Corporate Governance
- Freedom of Information legislation
  - ➔ Particularly important for the public sector!

Standards Compliance

Reasons for aiming for Standards Compliance:

- **Process is likely to identify a wide range of deficiencies which can then be corrected**
- **May be useful (or essential) contractually as defining expected service standards**

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Standards Compliance

Typical discovered deficiencies:

- No information policy document
- No retention schedule
- Inappropriate / inadequate security controls
- Lack of procedural documentation
- Insufficient control of document input procedures
- Insufficient information about the technology from the system supplier

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Standards Compliance

Typical discovered deficiencies:

- lack of documentation on audit trail content and access procedures
- use of inappropriate facilities, such as image clean-up or “deletion” facilities
- no thought of future migration requirements

Standards Compliance

Limitations of Standards Compliance

- Standards do not absolutely guarantee admissibility or acceptability for weight
- Standards are inevitably generic – may not cover everything you really need and may also ask you to spend much time explaining and justifying why some aspects are irrelevant
- Can be disproportionately costly and disruptive
- Introduces a box-ticking approach over more fundamental analysis (if done badly)

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Standards Compliance

Limitations of Standards Compliance

- Rather useless if nearly all detailed activity is left to outside consultants
- Can produce a false sense of security
- May omit important informal records
  - ➔ PCs, laptops, cellphones, PDA etc
- May not be especially persuasive in certain overseas jurisdictions
- May not deal effectively with the practical mechanics of disclosure, explanations to court, issues of inextricably linked material

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Forensic Readiness Programs

Essentially:

- **Based on threat analysis / scenario development**
- **Requires identification of potential evidence / disclosure requirements – and plan for their formal production**
- **Results in a proper Contingency Plan – which is tested and kept up-to-date**

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7-step Forensic Readiness Plan

Identify:

- the main likely threats/ legal challenges faced by your organisation
- what sorts of evidence / disclosure you are likely to need if you have to proceed to civil or criminal litigation
- what you will need to do to meet various regulatory and compliance requirements (incl FoIA)
- how far you may have that material already
- what you will need to do to secure additional essential material

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7-step Forensic Readiness Plan

- the management, skills and resources implications for your organisation
- turn the results into an action plan – which will need regular revision as the organisation and its ICT infrastructure develops.

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7-step Forensic Readiness Plan

The Good News:

quite a bit of the work may already have been carried out elsewhere in the organisation….

…….Disaster Recovery / Business Contingency Plans

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Business Contingency Plans

- **Preparation against disaster:**
  - → Fire
  - → Flood
  - → Terrorism
  - → Denial of access
  - → Computer failure
  - → Etc etc

Business Contingency Plans

- **Tells organisation what to do:**
  - ➔ Emergency Priorities
  - ➔ Team that will act / Reporting Responsibilities
  - ➔ Migrated offices, locations
  - ➔ Migrated people
  - ➔ Migrated ICT
  - ➔ PR for customers, clients, investors, bankers, public-at-large etc

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Business Contingency Plans

Research, Design

- Business Analysis
  - ➔ to determine priorities (it's too expensive to restore everything instantly)
- Relation of business processes to specific ICT resources, hardware, software, communications links; availability of back-up
- Detailed plan for who does what when
- Emergency Response Team
- Internally published Plan
- Frequent Testing and Revision

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Forensic Readiness Plan: Additional Requirements

- Legal / Regulatory requirements
- Analysis of back-up plans
  - → Incremental / complete
- Specific Data Retention / Destruction requirements
- Decisions about mode of disclosure
  - → Electronic, print-out, extents, etc
- Witness to explain systems, material produced, testify to reliability and completeness

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In-House Capabilities?

- How far should you try to do some of this internally?
- The First Aid analogy:
  - ➔ Everyone has a first aid box, most have a trained first-aider, some have in-house nurses, a few have in-house doctors, no-one has a full complement of specialised surgeons
- Forensic Computing
  - ➔ First Responder
  - ➔ Incident Analyst
  - ➔ Evidence Preservation skills
  - ➔ Management Advisor

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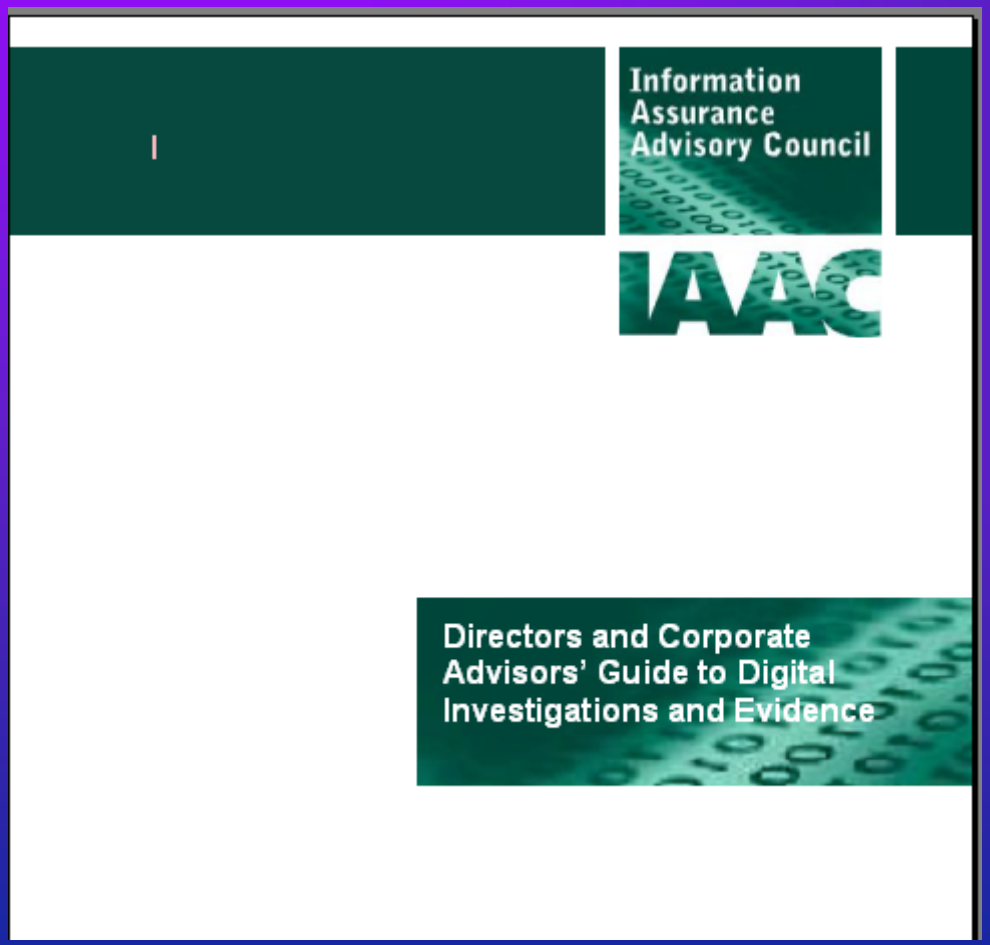
Guide to Digital Investigations and Evidence



First published 2005; now updated

www.iaac.org

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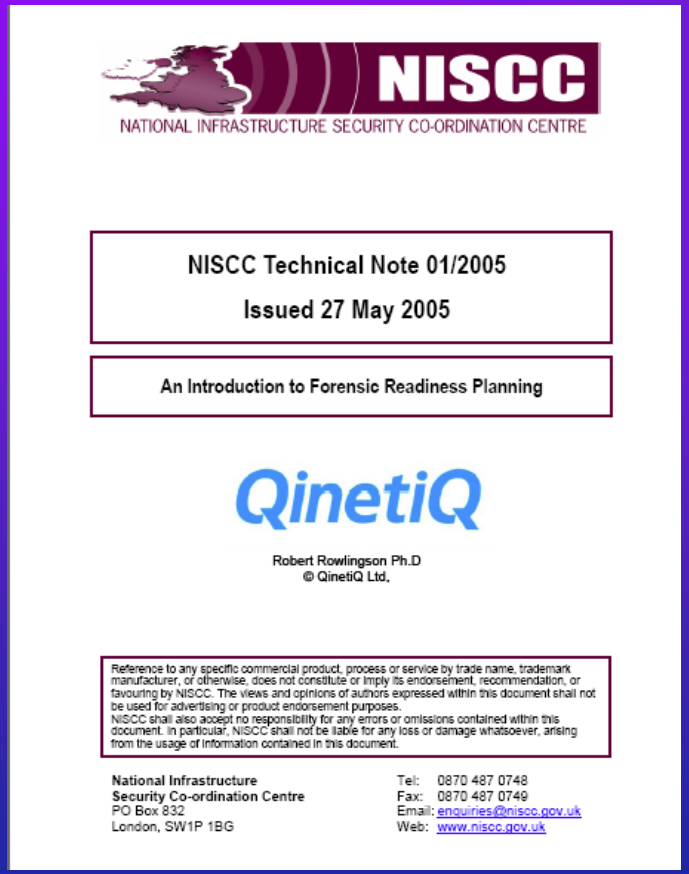
CPNI Guidance



NISCC

NATIONAL INFRASTRUCTURE SECURITY CO-ORDINATION CENTRE

NISCC Technical Note 01/2005

Issued 27 May 2005

An Introduction to Forensic Readiness Planning

QinetiQ

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10-step

Guidance

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OU M889

- Open University Module in Digital Investigations
- Distance-Learning – 26 week course
- Designed to bring “computer security” people and others up to speed with forensic readiness
- Within an academic framework

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Remedial Activity

- **The final "prize" from having a FRP:**
- **Closing the Loop / Learning the Lessons**

- ***Although the FRP is aimed at legal outcomes, after any event you will have a detailed explanation of what went wrong***
- ***Should lead to precise remedial actions***

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Computer Forensics, Digital Evidence and the Corporate Security Agenda

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