CHAMPLAIN COLLEGE

Computer and Digital Forensics

Digital Forensics:

Everything Leaves a Trace in Cyberspace

Parents Day
October 24, 2009
Burlington, VT

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B.S., Computer & Digital Forensics Program

Overview

- What is *cyberforensics*
- Legal issues
- The computer/network forensics process
- Where does the data go -- Some examples
- Locard's Principle

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What is "Cyberforensics"?

- *Forensics*
  - » The use of science to investigate and establish facts in criminal or civil courts
  - » *Computer forensics, digital forensics, network forensics, cyberforensics*
- Branches include
  - » Medical forensics
  - » Physical evidence
  - » Forensic accounting
  - » Computer and network forensics

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Why Cyberforensics?

- Computers/Internet are the fastest growing technology tools for criminals and criminal acts
- Access is nearly ubiquitous
  - » >1B Internet users, ~23% in North America
  - » In U.S., 95% of schools, >50% of classrooms, and >80% of homes have Internet access
  - » >8B Web pages listed by Google before they stopped counting...
    - 85B pages at the Internet Archive waybackmachine
- The technology is smaller, cheaper, faster, more mobile than ever!!

http://www.internetworldstats.com/stats.htm

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Computer Crime is Attractive

- Average armed bank robbery:
  - » Nets $7,500 ($60M annual)
  - » 16% of money recovered
  - » 80% of offenders go to jail
- White collar computer crimes take in about $10B annually
  - » <5% of offenders go to jail
  - » Juries consider this a non-violent crime
  - » Criminal statutes vary internationally

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What Crime Scenes Have Computers?

- Murder
- Kidnap
- Rape
- Extortion
- Stalking
- Drug dealing
- Auto theft
- Espionage
- Identity theft/fraud
- Gun dealing
- Robbery/burglary
- Gambling
- Stock/bond scams
- Confidence games
- Web defacement
- Terrorism
- Theft of computer files
- Child sexual exploitation

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The Fourth Amendment

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

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Searching and Seizing Computers

- 4th Amendment protections still in force
- Exceptions to warrant requirement
  - » Permission
    - Must get permission from competent authority
      - I still expect privacy on a home system even with multiple users
  - » Plain view
    - E.g., child porn screen saver
  - » Exigent circumstances

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Expectation of Privacy

- Company-owned computers and servers do not generally offer a user an expectation of privacy
  - » But it is best if there are explicit policies spelling this out
- No expectation of privacy if third-party is asked to examine a system

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Collecting Evidence

- Search of a computer has few rules if the searcher is not an "agent of the state"
  - » Before involving the police, private entities are not bound by 4th Amendment
  - » This includes system administrators, repair personnel, even "illegal access" by others
- Collecting data **after** calling police requires special care and, possibly, a search warrant

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Federal Laws

- Electronic Communications Protection Act (ECPA) extends federal wiretap protection to computer communications including electronic mail
  - » ECPA protects any in-transit communication
  - » Unopened e-mail is considered to be in transit
  - » Opened e-mail still stored on server is not in transit
  - » ECPA extends the workplace into cyberspace
- Privacy Protection Act (PPA) protects documents that are intended for publication

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Side Note: Define "ISP"

- Commercial service providers are easy...
  - » Sells Internet access, e-mail service, and/or Web hosting for a fee
- What about...
  - » College/university campus?
  - » Organization that provides Internet access to employees?
  - » My neighbor?

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Computer Forensics Process

- Bit-for-bit image of original data
  - » Forensically correct copy of media (mirror image)
  - » Maintain evidentiary chain
- Analyze the copies of the data
  - » Files, deleted files, unallocated space, file slack, logs
- Reconstruct picture of what information is/was on that computer
- Link the computer to a specific human being

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Cyber Investigations

- Computer/network evidence alone will generally not convict a suspect
  - » But if the evidence helps solidify a pattern of behavior, it can be very convincing
- Forensic analysis can also help counter "false defenses"
  - » "Someone else put the pictures on the suspect's computer."
  - » "My client does not know the victim."
  - » "The defendant has never been in contact with {drugs/ guns}."

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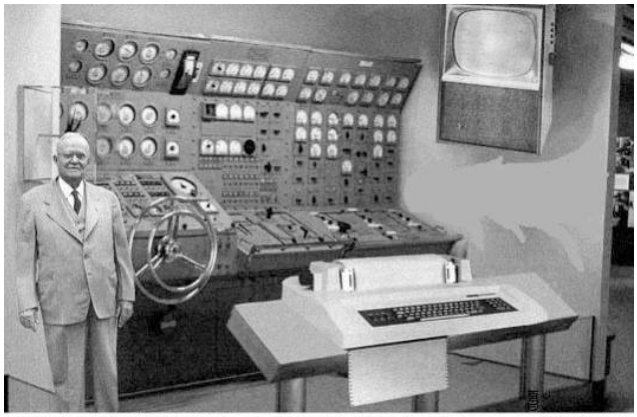
My Idea of a Computer...



Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 30 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use and only

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A Typical Home Computer

Source: National White Collar Crime Center

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Computers

- An increasing number of devices have embedded computers... with logs and memory








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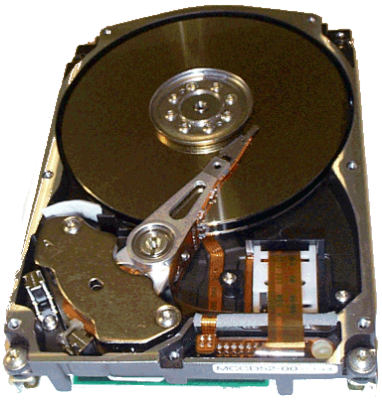
Secondary Storage

- Storage of data, files, programs, images, videos, music, etc.
- Hard drive capacity commonly 40-160 GB; 600 GB and larger available
- Hard drives may be internal or external



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Removable Storage Devices

- Floppy drives, tape, hard drives, CDs, DVDs, ZIP disks, thumb drives, MP3 players, ...

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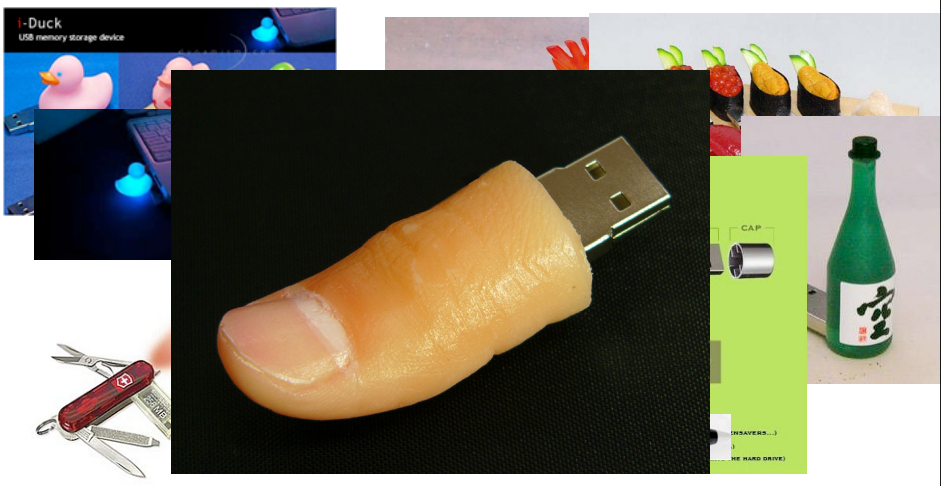
Not Enough Can Be Said About Thumb Drives...



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When Are You Done?

- Just because you don't find something doesn't mean it's not there!!
- Do you stop looking when you feel there's enough evidence to convict? It depends on
  - » Whose computer
  - » Legal basis for the search
  - » Nature of crime
- In some cases, scope of search depends on consent of the suspect or the owner

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So, Where is All This Information?

- Example #1: Deleted Files
- Example #2: Web Browsers
- Example #3: Cell Phones
- Example #4: Metadata
- Real Example: The BTK Killer

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Example #1: Deleted Files

- Files on a floppy
  - » Use hex editor to see what "deleted" files look like
  - » Use EnCase to examine "deleted" information

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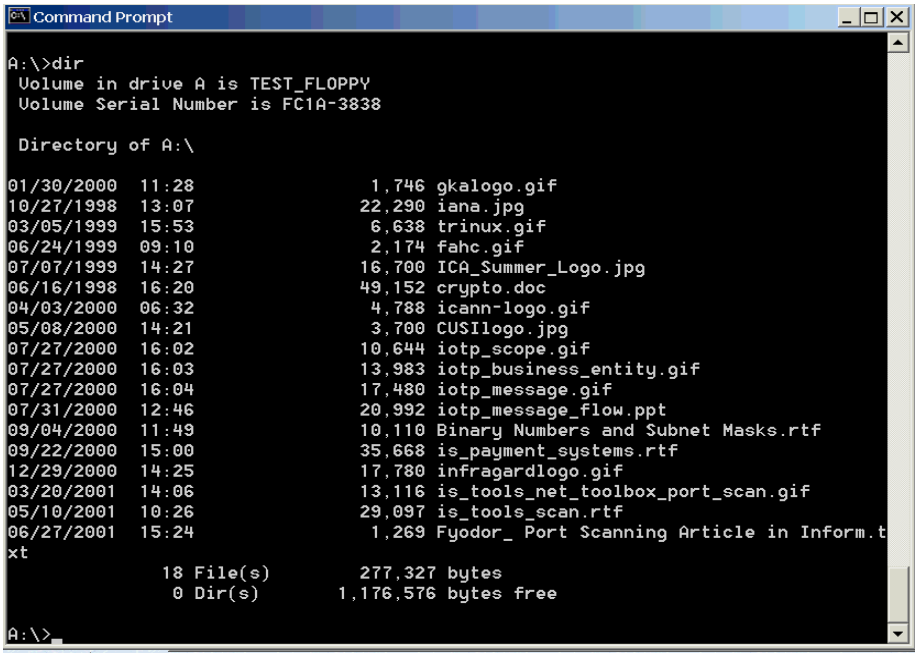

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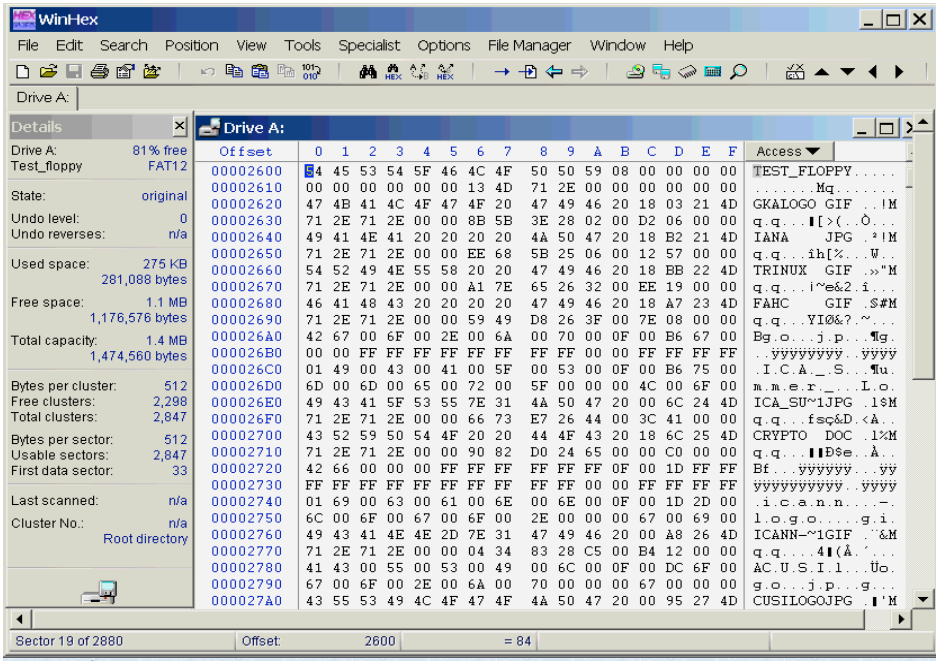

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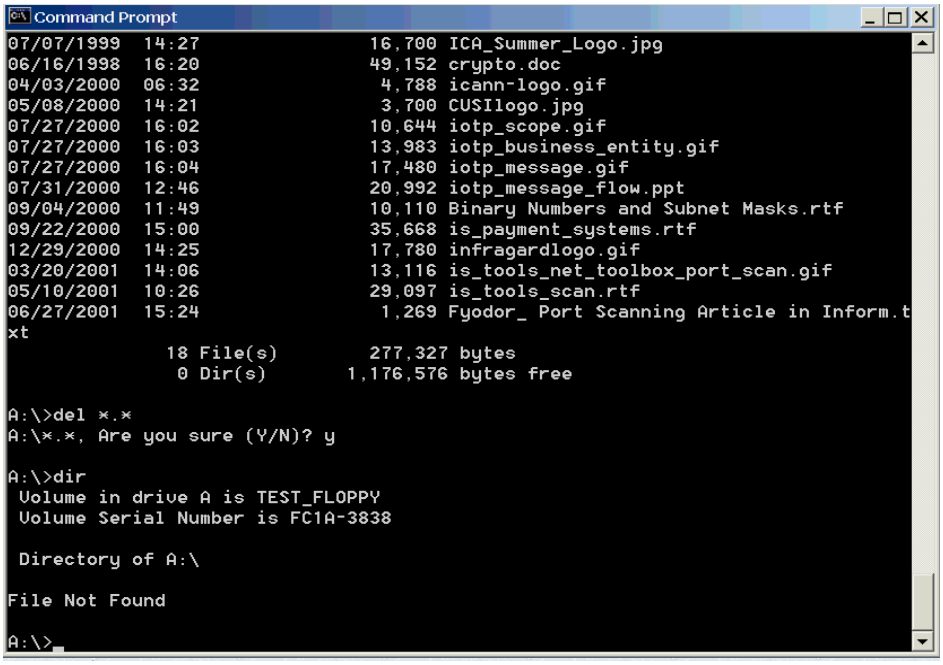

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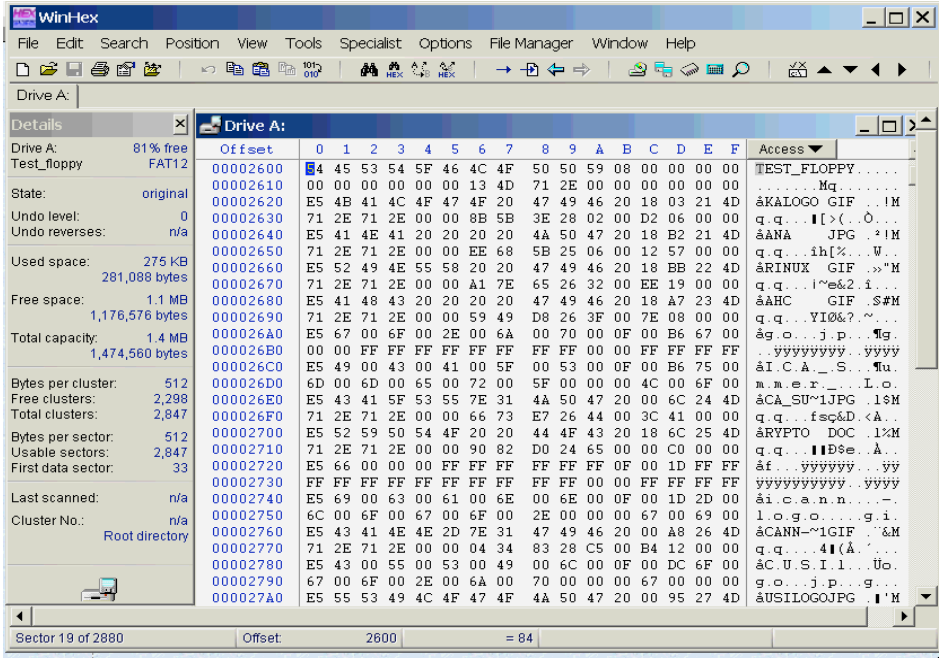
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File Edit Search Position View Tools Specialist Options File Manager Window Help
Drive A:
Details
Drive A: 81% free
Test_floppy FAT12
State: original
Undo level: 0
Undo reverses: n/a
Used space: 275 KB
281,088 bytes
Free space: 1.1 MB
1,176,576 bytes
Total capacity: 1.4 MB
1,474,560 bytes
Bytes per cluster: 512
Free clusters: 2,298
Total clusters: 2,847
Bytes per sector: 512
Usable sectors: 2,847
First data sector: 33
Last scanned: n/a
Cluster No.: n/a
Root directory
Drive A:
Offset 0 1 2 3 4 5 6 7 8 9 A B C D E F Access
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00002650 71 2E 71 2E 00 00 EE 68 5B 25 06 00 12 57 00 00 q.q...îh[%...W..
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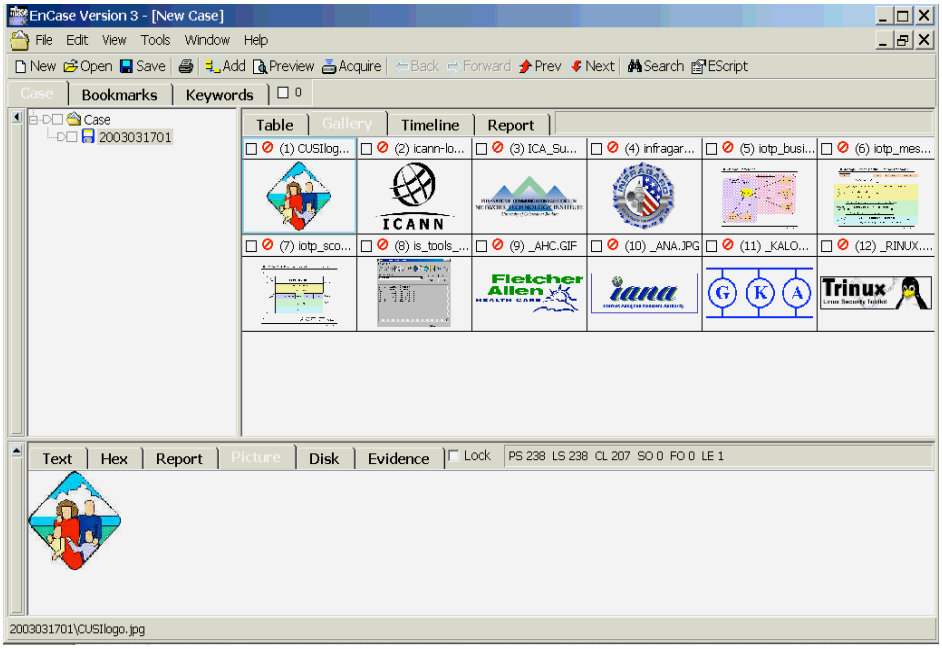
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(2) icann-lo...
(3) ICA_Su...
(4) infragar...
(5) iotp_busi...
(6) iotp_mes...
(7) iotp_sco...
(8) is_tools_...
(9) _AHC.GIF
(10) _ANA.JPG
(11) _KALO...
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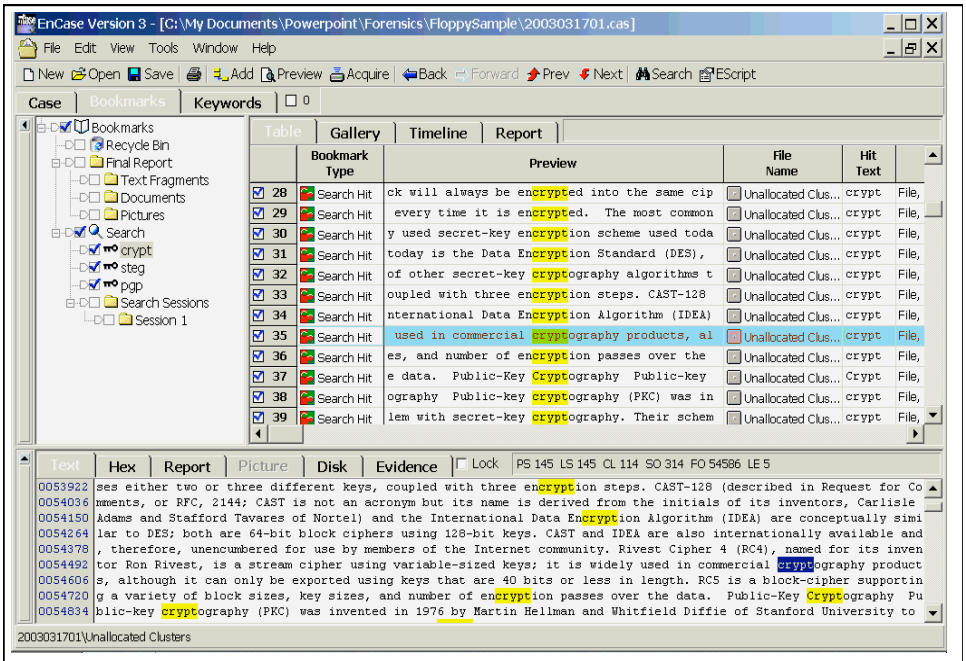
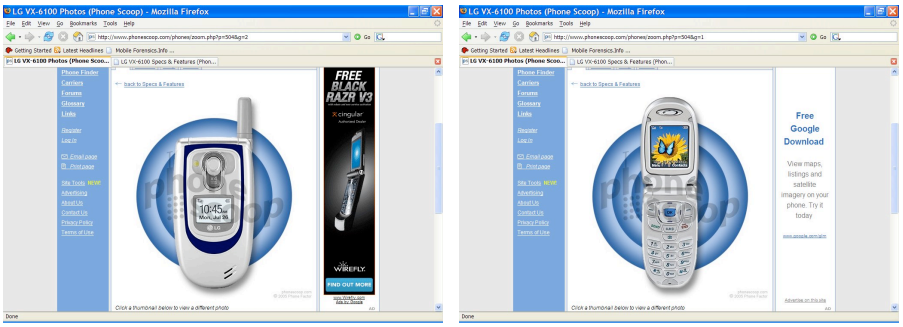


Example #2: Web Browsers

- Browser store just about everything
  - » Registry keys and directories
  - » Bookmarks, cookies, browser history, Internet cache, typed URLs, stored forms, stored passwords, download tracking
- IE and Firefox are predominate browsers but there are many others in wide use
  - » AOL
  - » Epiphany
  - » Netscape
  - » Opera
  - » Safari

Example #3: Mobile Phones



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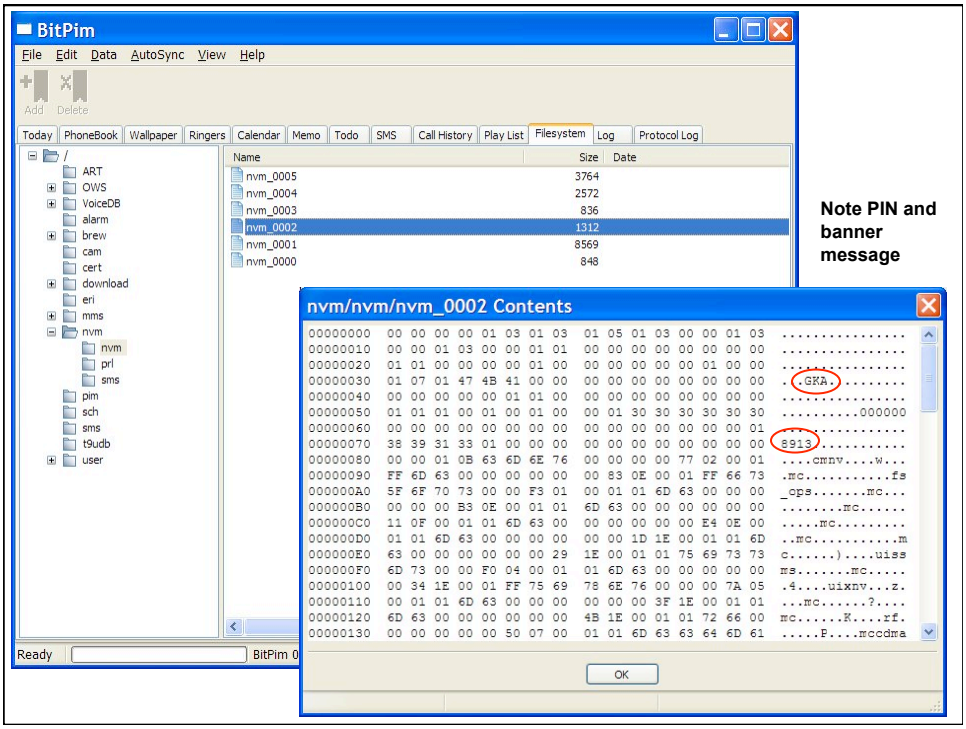

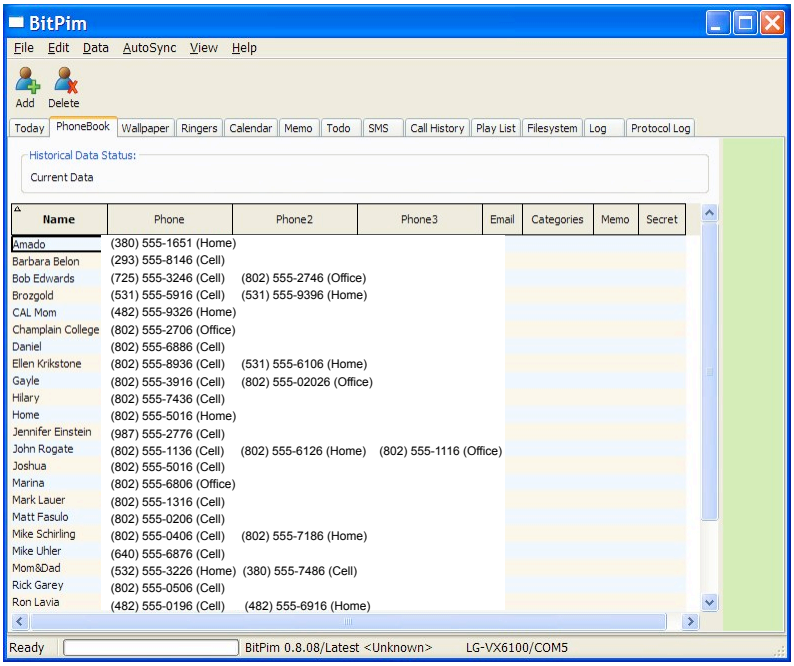

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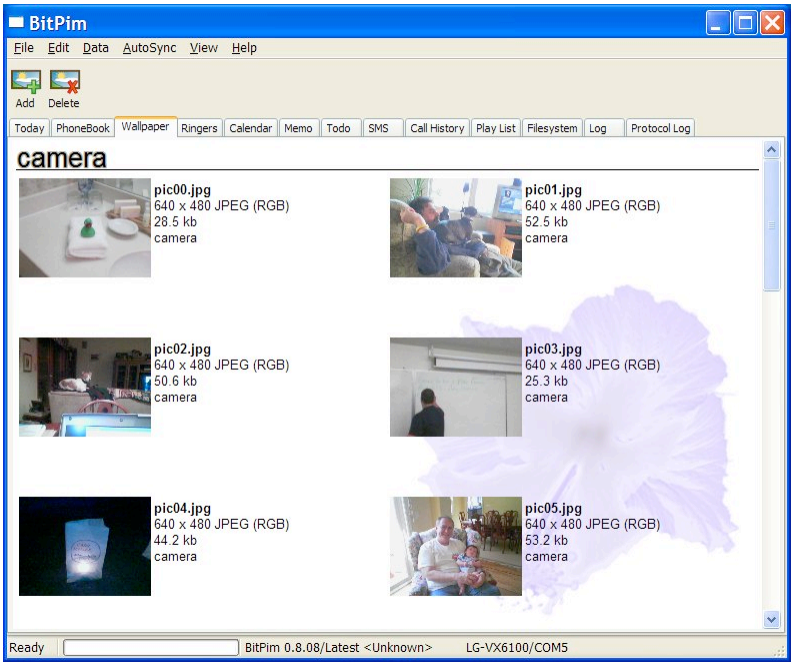

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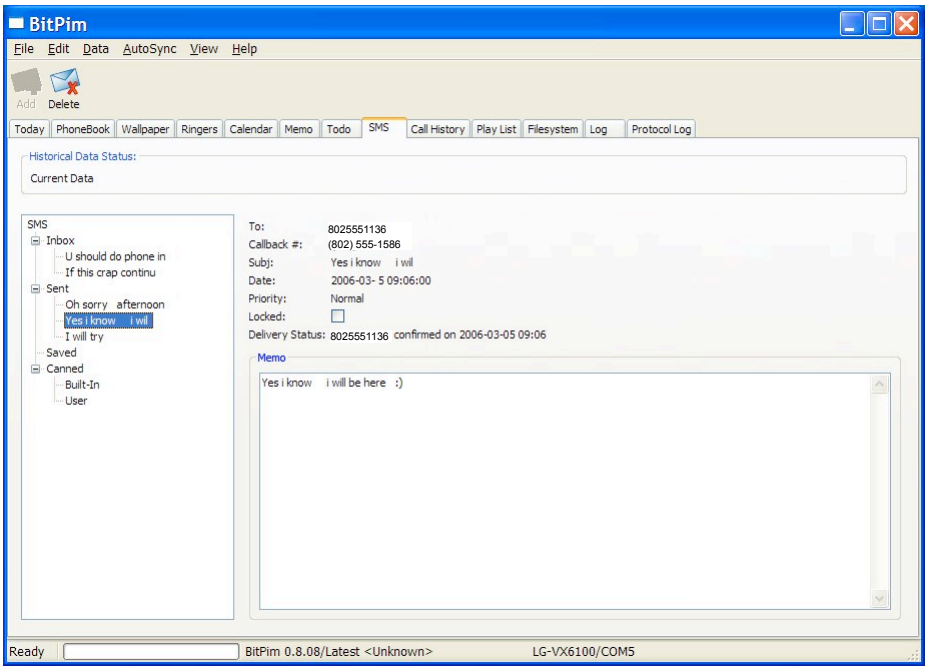

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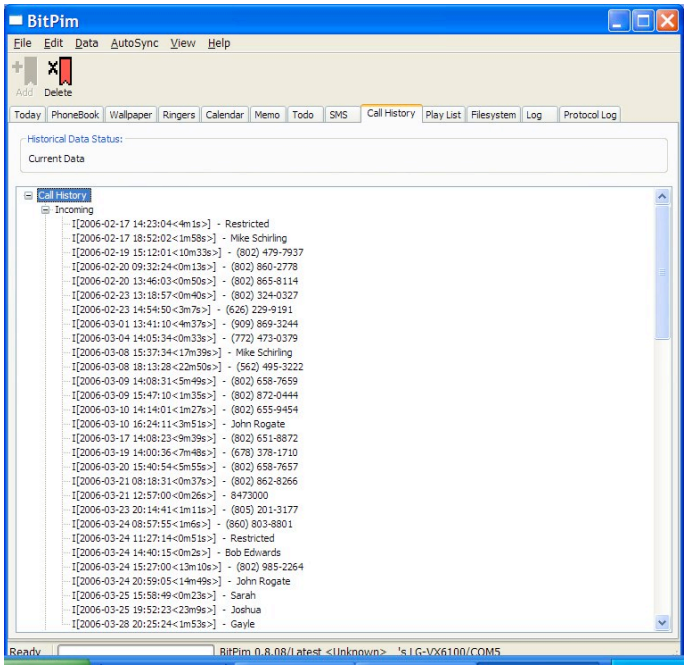

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Example #4: Metadata

- *Metadata* is data about data
  - » Information that describes the *contents* of a container or describes the *container* itself
- Type of metadata
  - » File system: Location and size, pertinent dates
  - » Document: Author, organization
  - » Image: Source software/hardware

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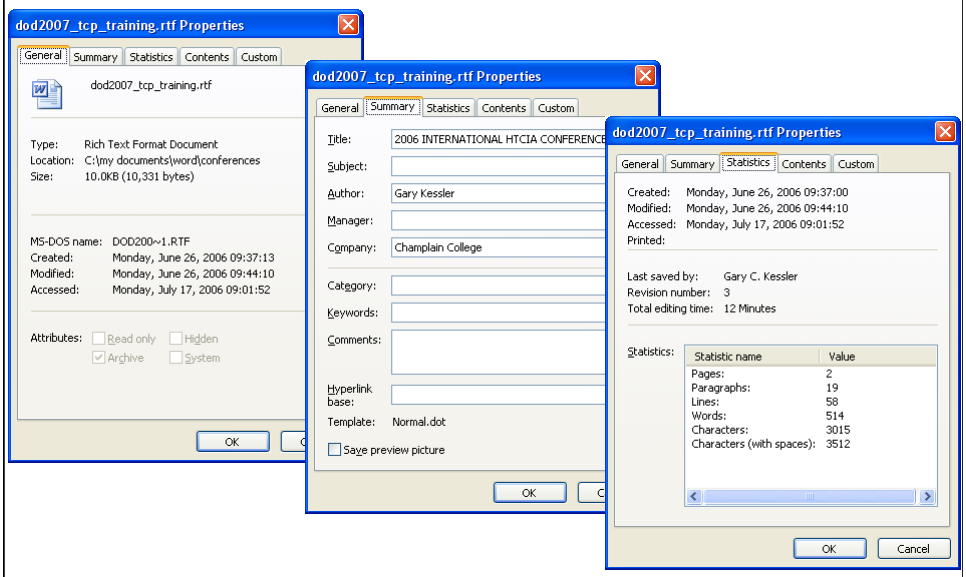
Metadata in MS Office



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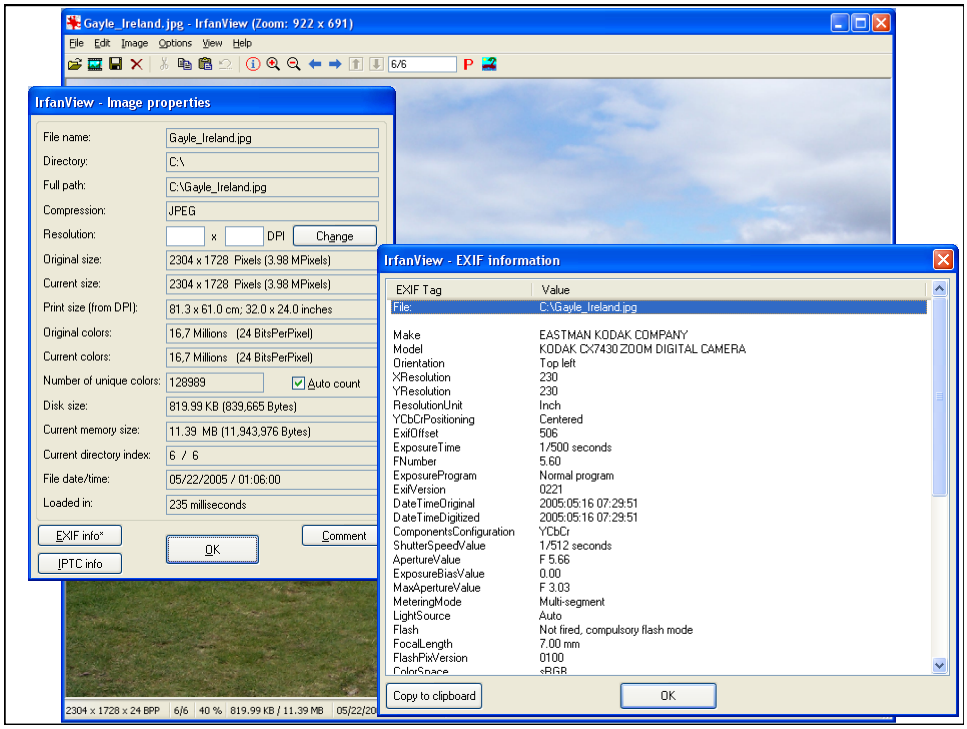

Case Study: BTK Killer

- BTK Killer was a serial killer in Wichita, KS, who killed at least 10 people between January 1974 and his arrest in 2005
  - » BTK = "Bind, torture, kill"
- BTK sent a message to local media after each killing
  - » Communiqués in 2004 were e-mailed to local TV stations

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Case Study: BTK Killer (2)

- Examination of metadata in a Word file pointed to a person named Dennis, associated with the Christ Lutheran Church in Wichita
- Web site (*http://christ-lutheran.org/*) listed "Dennis Rader" as church president
- Police went to church to search computers and found disk given by Rader to pastor with upcoming meeting agenda
  - » Also found "deleted" copy of a letter to the TV station
- Dennis L. Rader, 59, arrested Feb. 26, 2005

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Parting Thoughts

- Locard's Principle -- "Every contact leaves a trace" -- applies to cyberspace as well as realspace...

"Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value."

Prof. Edmond Locard, c. 1910

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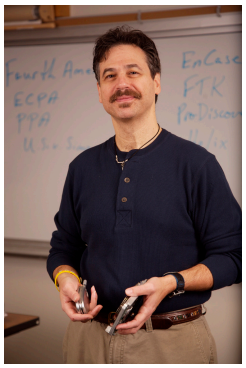

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