LEET '11

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4th USENIX WORKSHOP ON LARGE-SCALE EXPLOITS AND EMERGENT THREATS

Botnets, Spyware, Worms, and More

USENIX

Exposing the Lack of Privacy in File Hosting Services

Nick Nikiforakis

Marco Balduzzi

Steven Van Acker

Wouter Joosen

Davide Balzarotti

KATHOLIEKE UNIVERSITEIT LEUVEN

EURECOM
Sophia Antipolis

Sharing is caring

- Internet expanding
  - More users
  - More Web services
  - More Web technologies
- Users need to share files
  - P2P is not always the answer
  - Emails?

Functional expansion of the Web

- 15 years ago:
  - static content
  - providing information
  - coarse-grained access control
- Today:
  - Web 2.0
  - Service-oriented WWW
  - fine-grained access

Functional expansion of the Web

- Web services
  - Traditional “desktop” software is now available through your browser
    - Office suite
    - Media editing tools
    - Collaborating tools
    - ….
  - At its extreme: ChromeOS

The Good news

- Good news:
  - Broad selection of services with a wide variety of applications
  - Accessible through the Web from anywhere
  - No software-bloating for users
  - More free software due to a different way of making profit

Bad news…

- A user’s data is now located somewhere else:
  - Privacy ⇦
  - Availability
  - Integrity
- Sad story:
  - 2009: “personal information stored on your device--such as contacts, calendar entries, to-do lists or photos--that is no longer on your Sidekick almost certainly has been lost as a result of a server failure at Microsoft/Danger”

File Hosting Services

- Cloud-storage for the masses
- Share files with other users
- Security through obscurity access-control
- Sharing personal documents as well as pirated files [1]

Lifecycle of a file

- Alice decides to shares some digital content (file) through a FHS
- FHS received the file, stores it on its Cloud and generates an identifier which it:
  1. binds with the uploaded file
  2. returns to the user in a URI form
- URI is shared depending on the nature of the uploaded file

File Identifier & Privacy

- The file ID is used to enforce access-control in a security-through-obscurity way
  - ID == access to file
- FHS are typically not-searchable
  - ID acts as a shared secret between a FHS and each user's files
  - Non-owners should not be able to "guess" this secret

Top 100 FHS

- We studied the top 100 FHS to discover, among others, the way they generate unique “secret” identifiers
  - Uploading files, recording the given ID and comparing
- Removed 12 that had search/browse capabilities

Sequential IDs

- 34/88 FHS were generating sequential identifiers
  - numeric, or alphanumerical
- 20/34 did not append any other non-guessable information
  - e.g. filename or secondary ID
- E.g.
  - http://vulnerable.com/9996
  - http://vulnerable.com/9997
  - http://vulnerable.com/9998

Scraping file information

- Given a link a user must follow a set of steps to actually download a file
  - Download “foo.txt” -> “Free user” -> Wait n seconds -> “Download “foo.txt”
- Advantageous for an attacker
  - Visit first page, scrape filename and file-size
  - Download only the files of interest

Crawling 20 FHS

- Designed a crawler for the 20 sequential FHS
- Run for 30 days
  - Random delays to avoid DoS and blacklisting
  - Scraping only the filenames and sizes (privacy)
- Results:
  - > 310,000 file records

Finding private files…

- Depending on the nature of a file, it will be shared in different ways
- Exploit the ubiquity of search-engine crawlers to characterize a file as private or public.
- Given a filename
  - 0 search results -> Private

Private Files Results

- Using Bing:
  - 54.16% of files returned 0 search results
  - Rough approximation of private files due to close pirate communities

Filetype	#Private documents
Images (JPG,GIF,BMP)	27,711
Archives (ZIP)	13,354
Portable Document Format	7,137
MS Office Word	3,686
MS Office Excel Sheets	1,182
MS Office PowerPoint	967

Back to the top 100

- 54 FHSs adopt non-sequential identifiers
- len(ID)

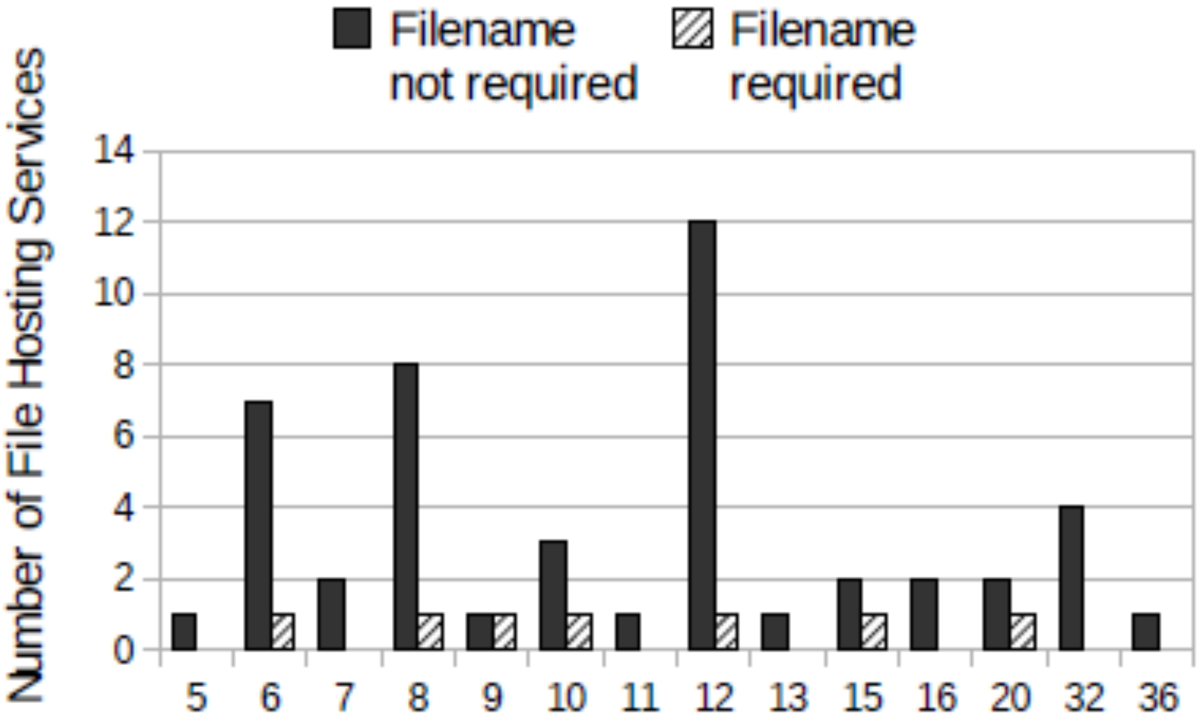


Figure 1: Length of the Identifier

Back to the top 100

- 54 FHSs adopt non-sequential identifiers
- len(C_SET)

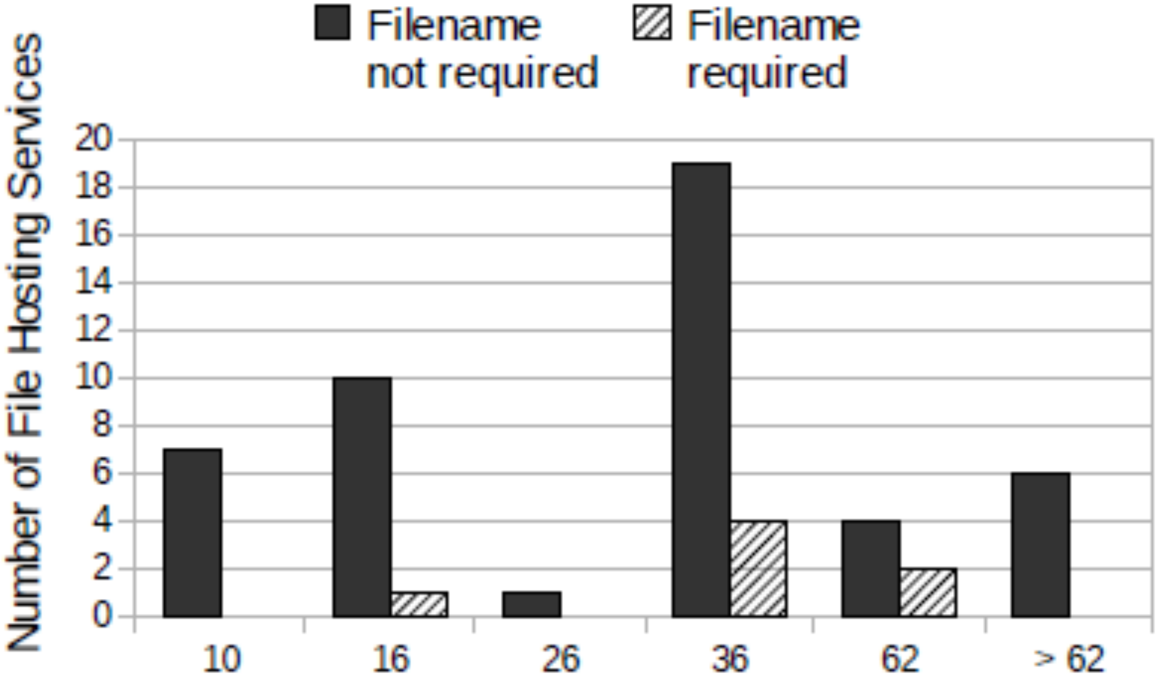


Figure 2: Size of the Identifier's Character Set

Random but short

- Brute-force short random identifiers

Length	Charset	#Tries	#Files Found
6	Numeric	617,169	728
6	Alphanumeric	526,650	586
8	Numeric	920,631	332

Design & Implementation errors

- Security audit of a popular FHS software product
  - Used in 13% of FHSs
  - Directory traversal vulnerability
  - De-randomization attack for deletion code
    - Report-link contained the first 10 characters of the 14-charater delete code
      - 16^14 -> 16^4 combinations

Status…

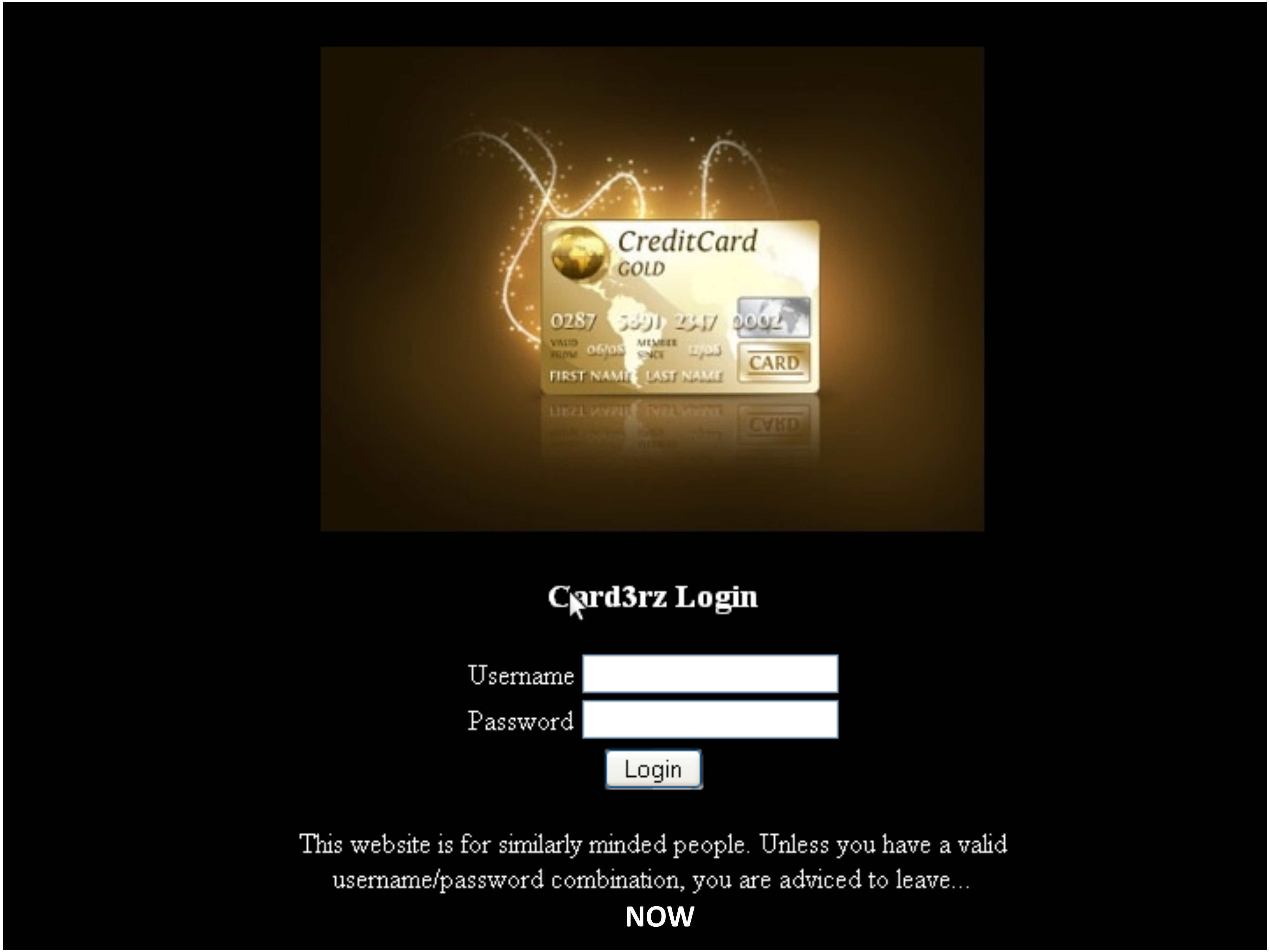
- File hosting services are vulnerable
  - Sequential identifiers
  - Weak non-sequential identifiers
  - Bugs in their source code
- Do attackers know about this?
  - How do we found out?

HoneyFiles

- HoneyPot for FHS attackers
  - Decoy files promising valuable content
  - Each file “called-home” when opened
    - <img/> in HTML files
    - embedded HTML in doc files
    - TCP socket in executables
    - Attempt to open page in pdf files

Carding forum

- card3rz.co.cc
  - fake underground carding community
  - One of the decoy files contained valid credentials for the forum
- Reasons:
  i. Hide our monitors
  ii. Do attackers use data that they find in illegally obtained files?



Card3rz Login

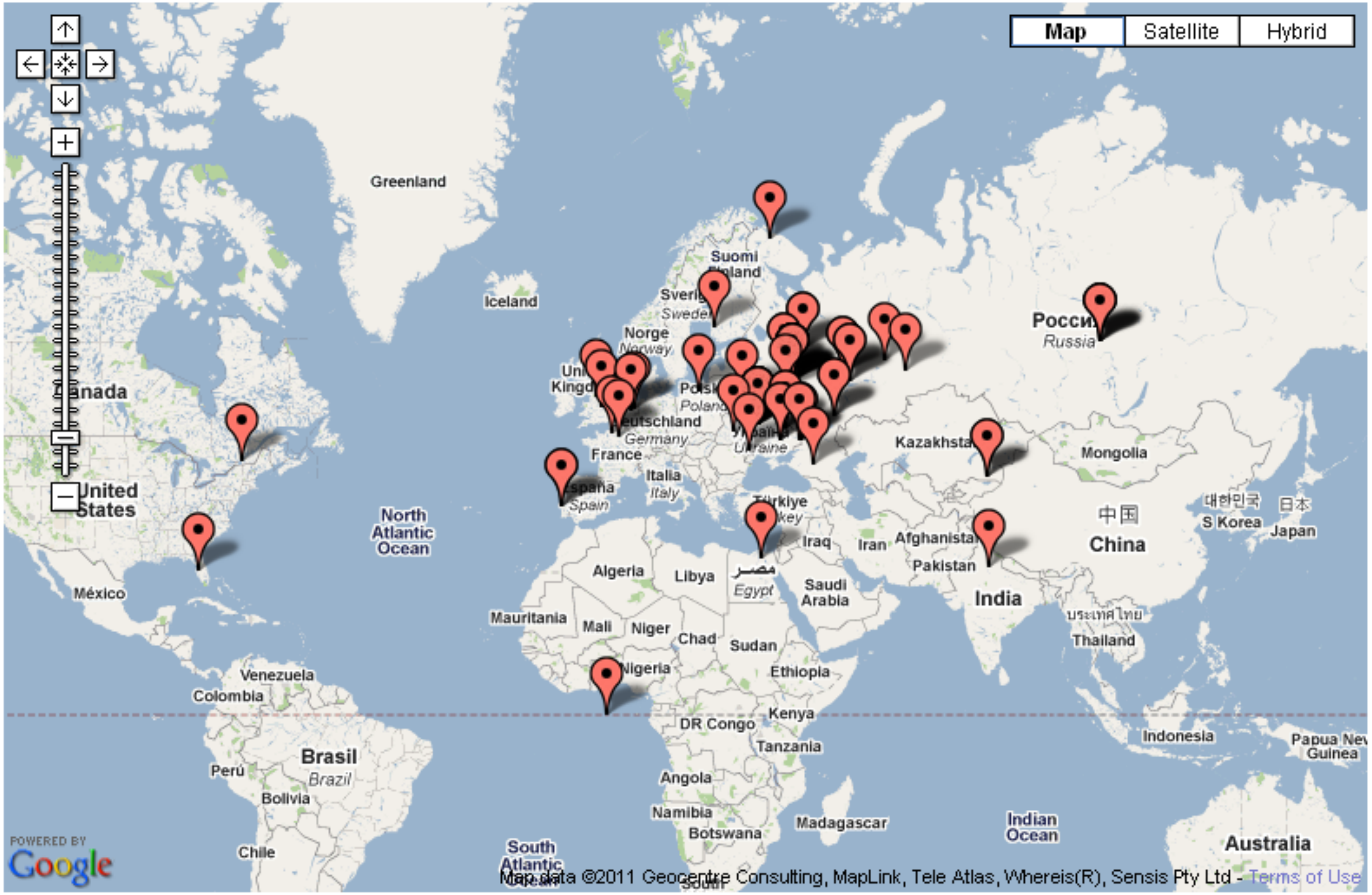
This website is for similarly minded people. Unless you have a valid username/password combination, you are adviced to leave...

NOW

HoneyFiles results

- Monitoring sequential FHSs for 30 days:
  - 275 honeyfile accesses
  - more than 80 unique IP addresses
  - 7 different sequential FHSs
    - 1 had a catalogue functionality
    - 2 had a search functionality
    - 4 had neither
  - Accesses from all around the world

Geo-location



HoneyFiles results

- Download ratio of each file:

Claimed content	Download ratio
Credentials to PayPal accounts	40.36%
Credentials for card3rz.co.cc	21.81%
PayPal account Generator	17.45%
Leaked customer list	9.09%
Sniffed email	6.81%
List of emails for spamming purposes	5.09%

card3rz.co.cc results

- 93 successful logins
  - 43 different IP addresses
  - 32% came back at a later time
- Attacks against the monitor and the login-form
  - SQL-injection & file-inclusion attacks
- Attackers do in-fact use data from illegally obtained files

Honeyfiles cntd.

- Monitor 20 non-seq. FHSs for 10 days:
  - 24 honeyfile accesses
  - 13 unique IP addresses
  - 3 different FHSs
    - Two of them offered a search functionality
    - The third didn't
      - but actually did…

Status…

- File hosting services are vulnerable
  - Sequential identifiers
  - Weak non-sequential identifiers
  - Bugs in their source code
- Attackers are abusing them
  - They are using the data found in other user’s files

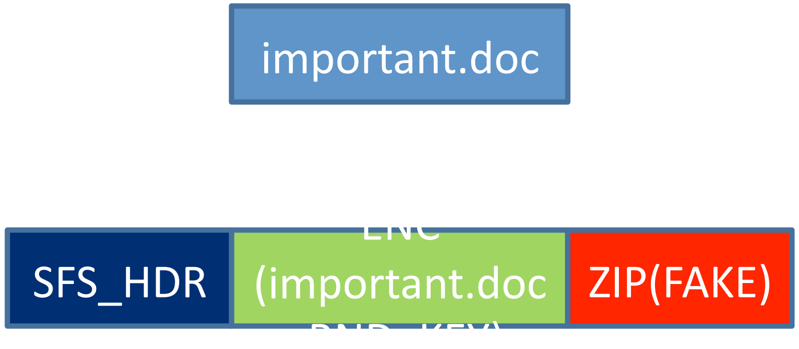
SecureFS

- A client must protect himself
- Encryption is a good way
  - Do people know how to?
  - If they do know, does their OS assist them?

- SecureFS
  - Encryption to protect a user’s data
  - Steganography to mislead potential attackers

SecureFS

- Browser-plugin monitoring uploads and downloads
- Protects uploads on-the-fly:



important.doc

SFS_HDR

ENC (important.doc RND_KEY)

ZIP(FAKE)

SecureFS

- Browser-plugin monitoring uploads and downloads
- Rewrites download links to include the random key
  - http://unsafefhs.com/12345
  - http://unsafefhs.com/12345/sfs_key/[RND_KEY]

Future Work

- Security/Privacy monitor for well-known FHS
- Every illegal download/open would be registered to a Web service
  - Insecure FHS
    - Help users to choose a safe one
    - Put pressure on FHS developers to redesign their systems

Ethics

- We didn’t download user files
- HoneyFiles were not harmful to a user’s computer in any way
- HoneyFiles were uploaded as private files in various FHSs
- All vulnerable FHSs were notified

Conclusion

- Large percentage of FHSs fail to provide the user with adequate privacy
  - Hundreds of thousands of files ready to be misused
- Attacker know & exploit this fact
- A user must protect himself:
  - SecureFS