ViWiD : Visible Watermarking based Defense against Phishing

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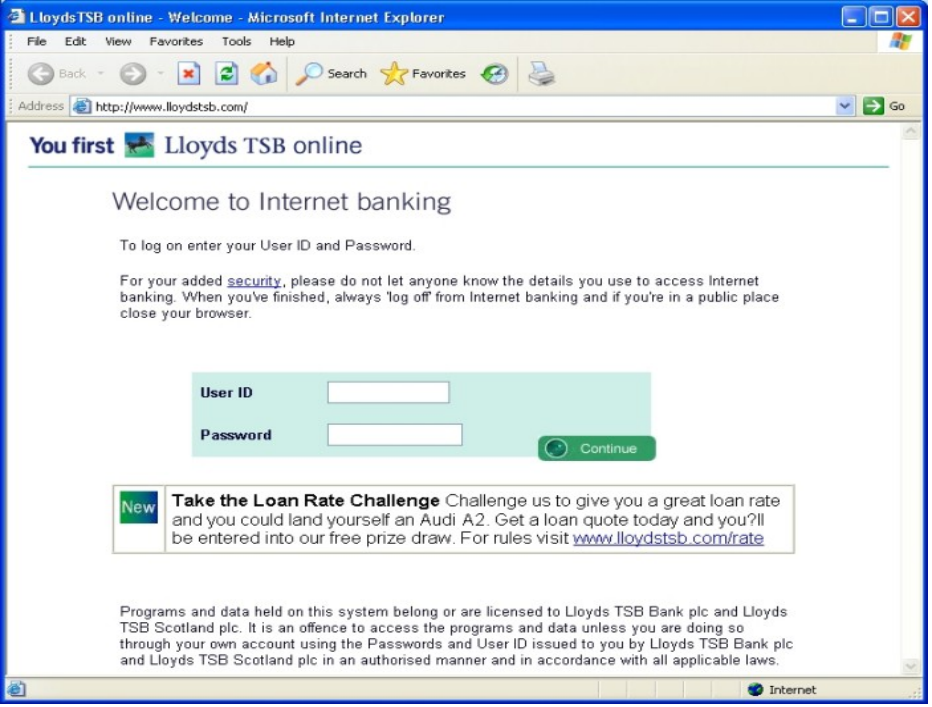
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You first Lloyds TSB online
Welcome to Internet banking
To log on enter your User ID and Password.
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Password
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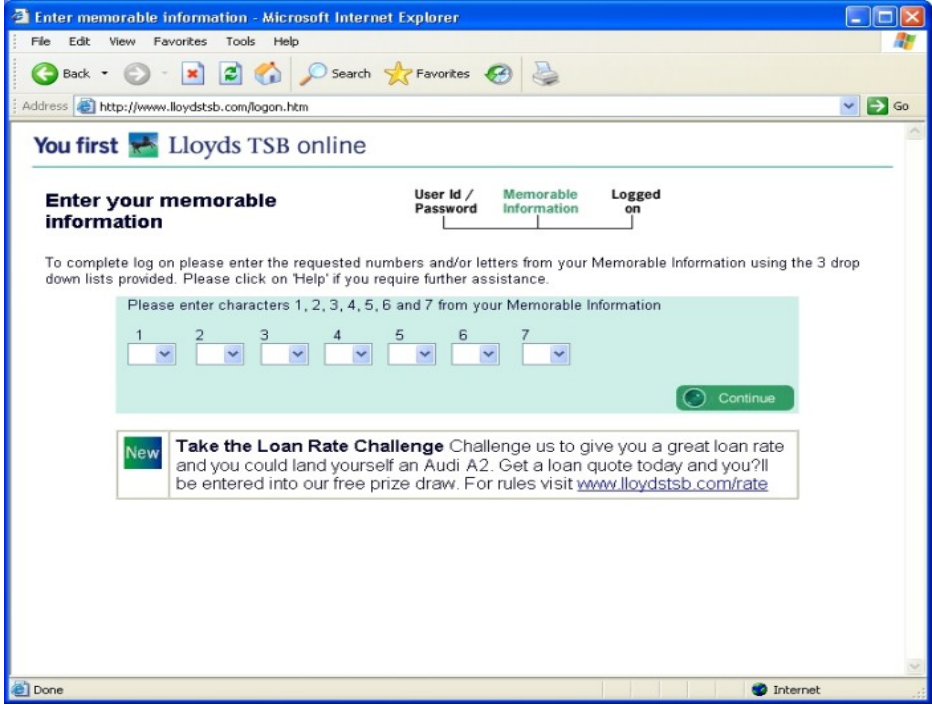
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User Id / Password
Memorable Information
Logged on
To complete log on please enter the requested numbers and/or letters from your Memorable Information using the 3 drop down lists provided. Please click on 'Help' if you require further assistance.
Please enter characters 1, 2, 3, 4, 5, 6 and 7 from your Memorable Information
1 2 3 4 5 6 7
Continue
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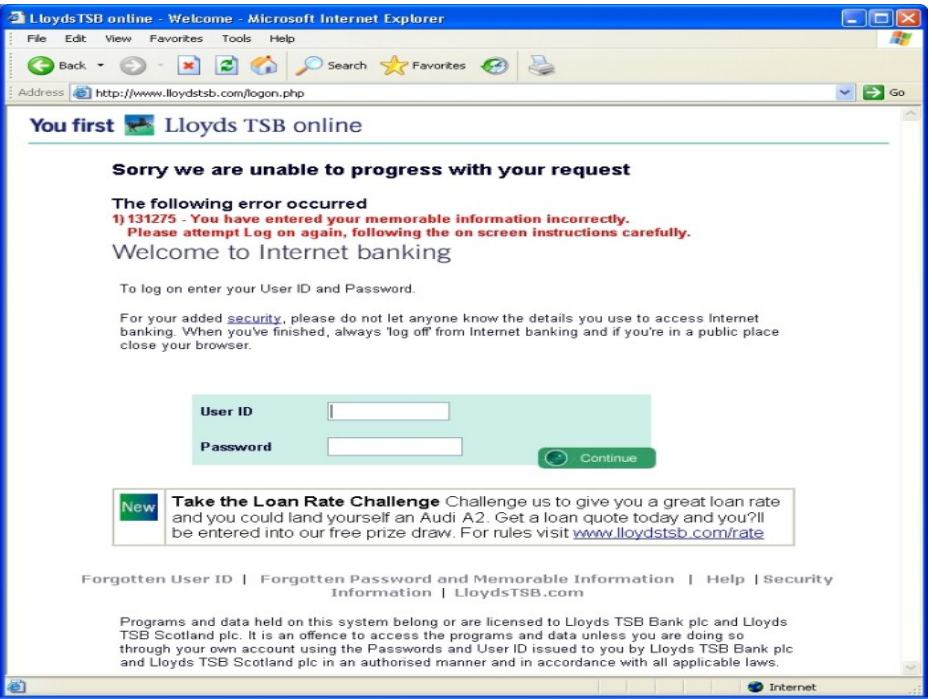
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You first Lloyds TSB online
Sorry we are unable to progress with your request
The following error occurred
1) 131275 - You have entered your memorable information incorrectly.
Please attempt Log on again, following the on screen instructions carefully.
Welcome to Internet banking
To log on enter your User ID and Password.
For your added security, please do not let anyone know the details you use to access Internet banking. When you've finished, always 'log off' from Internet banking and if you're in a public place close your browser.
User ID
Password
Continue
New
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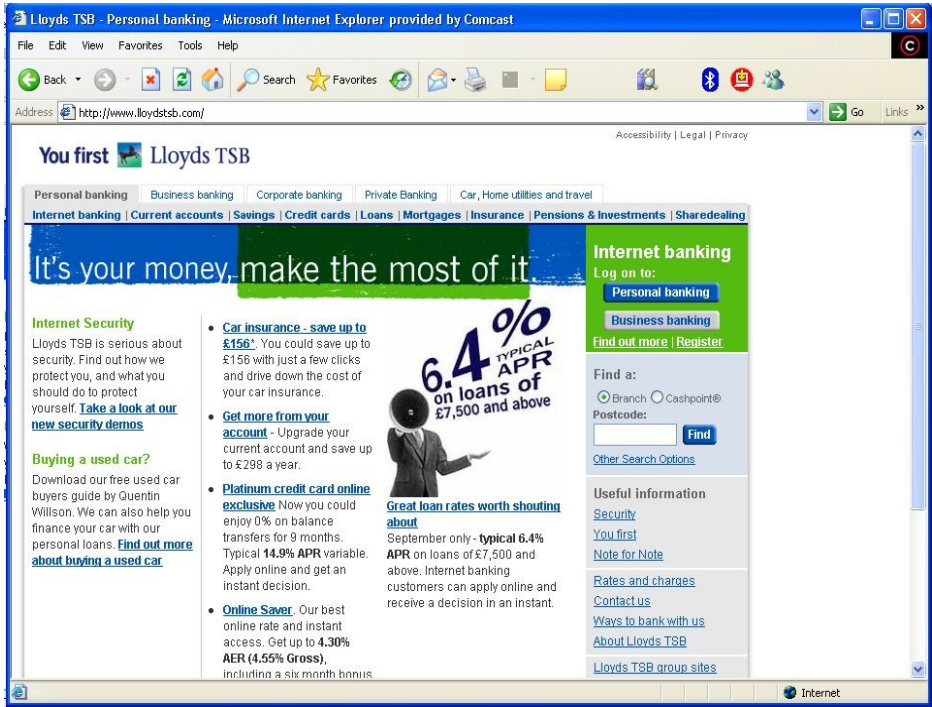
Internet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Online Saver. Our best online rate and instant access. Get up to 4.30% AER (4.55% Gross), including a six month bonus
6.4% TYPICAL APR on loans of £7,500 and above
Great loan rates worth shouting about
September only - typical 6.4% APR on loans of £7,500 and above. Internet banking customers can apply online and receive a decision in an instant.
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Outline

- The Phishing Problem
- Previous Approaches
- ViWiD System Overview
- Experimental Results
- Security Analysis and Discussion
- Conclusion

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September 2005

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Phishing

- **Online deception for malicious purpose**
  - Attackers send fake e-mails and use web sites that spoof a legitimate business
  - Lure unsuspecting customers into revealing personal information like password, credit card number, SSN etc
- **Huge financial losses and damage to reputations**
  - **Lost Dollars …**
    - 70,000 calls/hour for 12 hours
    - Banks and card issuers lost $1.2 billion in 2003
  - *"It's a question of trust, a question of brand", says Tom Salmond, manager of the E-Banking Fraud Liaison Group at the APACS*
- **Exploits**
  - Unauthenticated E-mail
  - User Actions
  - Deceptive View

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Players: the Phisher

- **Impersonates a trusted source**
- **Misuses legitimate content for convincing the user into revealing personal information**
- **Can carry out 'man-in-the-middle' attack in some cases**

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Players: the Victims

- **Legitimate Company:**
  - provides trusted online services
  - has a database of customer information
  - needs to maintain its brand image
  - has high computational power
- **Average User:**
  - busy or lazy
    - disables security options
    - uses same login/password for different sites
    - trusts e-mails
  - not tech savvy
  - uses multiple computers

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Defense Against Phishing

- **Secure E-mail**
  - Privacy Enhanced Mail (PEM), Secure Multipurpose Internet Mail Extension (S/MIME) and Pretty Good Privacy (PGP)
- **Client Side Defense**
  - SpoofGuard, NetCraft, Trusted Credentials Area, Firefox Pet Name Extension
- **Cryptography-based Defense**
  - TriCipher Armored Credential System
- **Shared Secret Schemes**
  - 2-Way Authentication Tool, Dynamic Security Skins

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Limitations of Previous Approaches

- **Hard to widely deploy due to**
  - Difficulty to use
  - Must download on all client computers
  - Update on the browser view
- **Vulnerable**
  - Mosaic attack
- **False Alarms**
- **No tie of what is displayed on a web page to its origin**

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Introducing ViWiD …

- **Visible Watermarking based Defense against Phishing**
- **Mitigating phishing attacks through integrity checking of web site logos using visible watermarking techniques**
- **All of the integrity related computation on the company's web server**
- **Unique watermark message for each user**
- **Thwart the "one size fits all" attacks**

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Challenges

- **Communicating to naive users the true identity of the web site**
- **Maintain the aesthetics of the watermarked logo**
  - Preserve its marketing value
- **Robust visible watermarking of logo images that have large uniform areas and very few objects in them**

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Features of ViWiD Approach

- **Integrity check "travels with the content"**
- **Visible watermark avoids key distribution issue**
- **Thwarting the "one size fits all" attacks**
  - A user-specific time-stamped message
  - Carelessly using non-secure connection is less deadly
- **Can use multiple browsers / computers**
  - Compromise of one is less disastrous (mnemonic is not stored)

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Watermark Messages

- **The time alone:**

- **The time and the mnemonic:**

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ViWiD Framework

- **Recall that in visible watermarking**

$$I' = K_1 \times I + K_2 \times W$$

$$D(E_I(I'), E_I(I)) < Threshold_I$$

$$D(E_W(I'), E_w(I)) < Threshold_W$$

- **Two Types of Displays**

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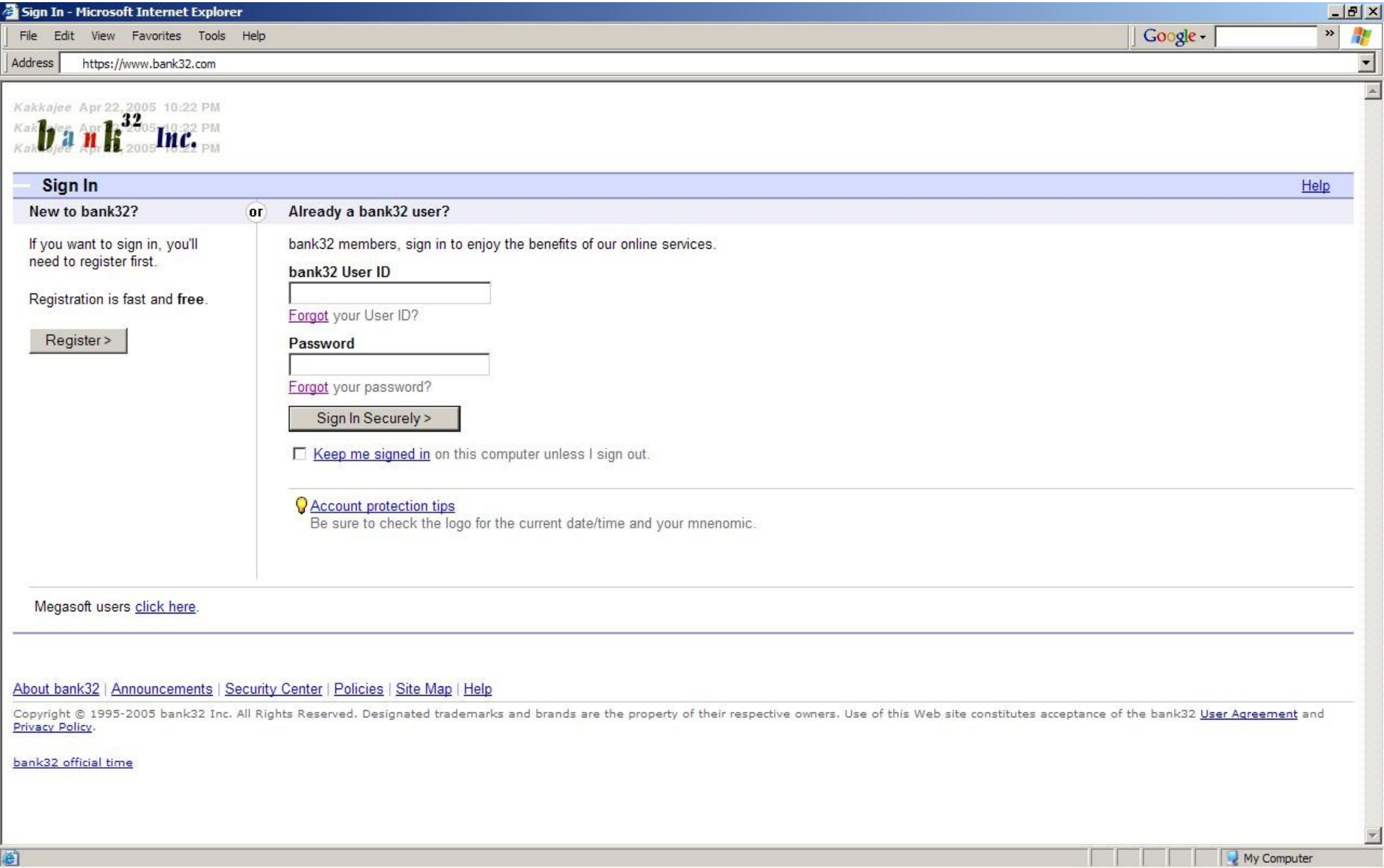
Screen Shot


Sign In - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Google
Address https://www.bank32.com
Kakkajee Apr 22, 2005 10:22 PM
bank32 Inc.
Sign In
Help
New to bank32?
or
Already a bank32 user?
If you want to sign in, you'll need to register first.
Registration is fast and free.
Register >
bank32 members, sign in to enjoy the benefits of our online services.
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Forgot your User ID?
Password
Forgot your password?
Sign In Securely >
Keep me signed in on this computer unless I sign out.
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Experimental Setup : ImageMagick™

$$\text{midpoint} = \frac{\text{maxRGB}}{2}$$

$$offset_{i,j}^{w} = I_{i,j}^{w} - \text{midpoint}$$

$$B'_{i,j} = B_{i,j} + \frac{(p \times offset_{i,j}^{w})}{\text{midpoint}}$$

p=10

p=15

p=20

p=30

p=40

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Experimental Setup : Mohanty et. al's Technique

- **Modifies the gray values of the host image based on both its local and global statistics.**

$$I_n^{'} = \alpha_n \times I_n + \beta_n \times I_n^w$$

- **Y component vs K component**

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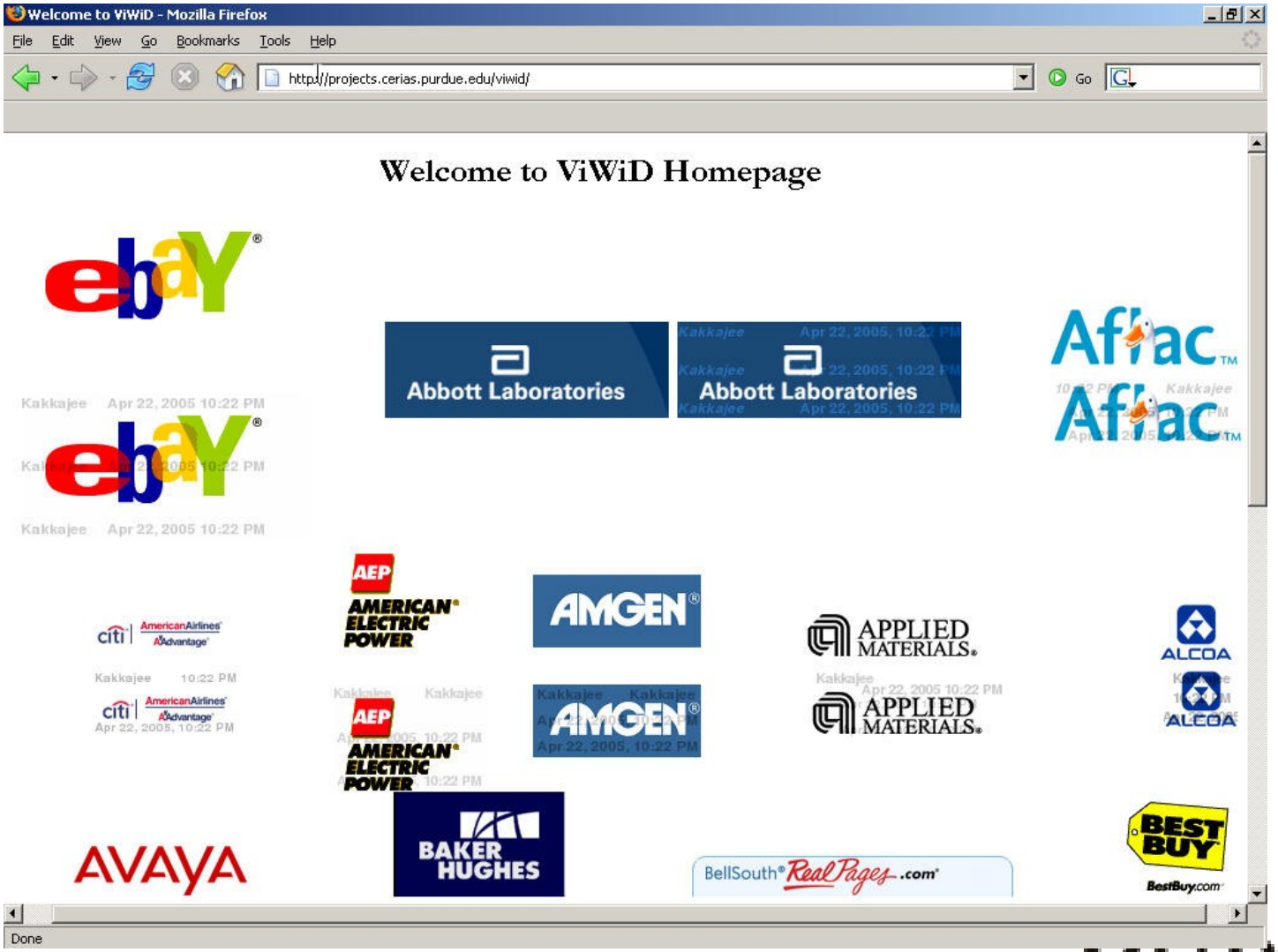
Results

- http://projects.cerias.purdue.edu/viwid/



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Attacker Behaviors Outside Our Model

- **Replace a watermark by another**
  - Removing can be done through the use of (e.g.) the Huang and Wu scheme, which requires human intervention for every image
  - Requires man-in-the-middle
- **Recreate the logo image and insert a valid watermark**
  - Recreating a logo image is hard
  - Requires man-in-the-middle
- **Man-in-the-middle without image processing**
  - ViWiD mitigates this attack

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Security Analysis and Discussion

- **If the shared secret between server and client would simply be presented as is (e.g. in text or image format) without ViWiD, why wouldn't that work?**
  - Puts the message in a place conspicuous to the user
  - Binds it to the legitimate site's logo
  - Forces the attacker to do image processing on the logo

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Conclusion

- **ViWiD mitigates phishing attacks through integrity checking of web site logos using visible watermarking techniques.**
- **ViWiD performs all of the computation on the company's web server and does not require installation of any tool or storage of any data on the user's machine.**
- **ViWiD also involves the user's mind in the integrity checking process, making it harder for the phisher to engineer an attack.**

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