Quero

Phishing Defense against IDN Address Spoofing Attacks

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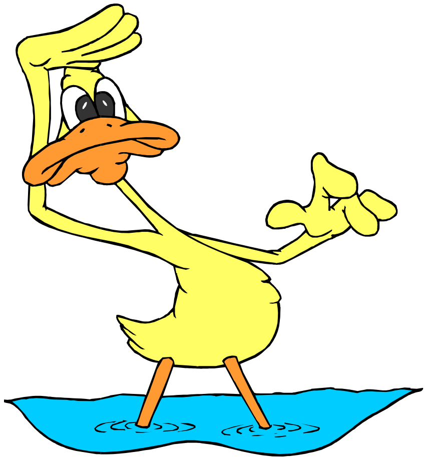
2 Vienna University of Technology

http://www.quero.at/

Qui quaerit, invenit.



Biblia Vulgata, Lc 11, 9

Agenda

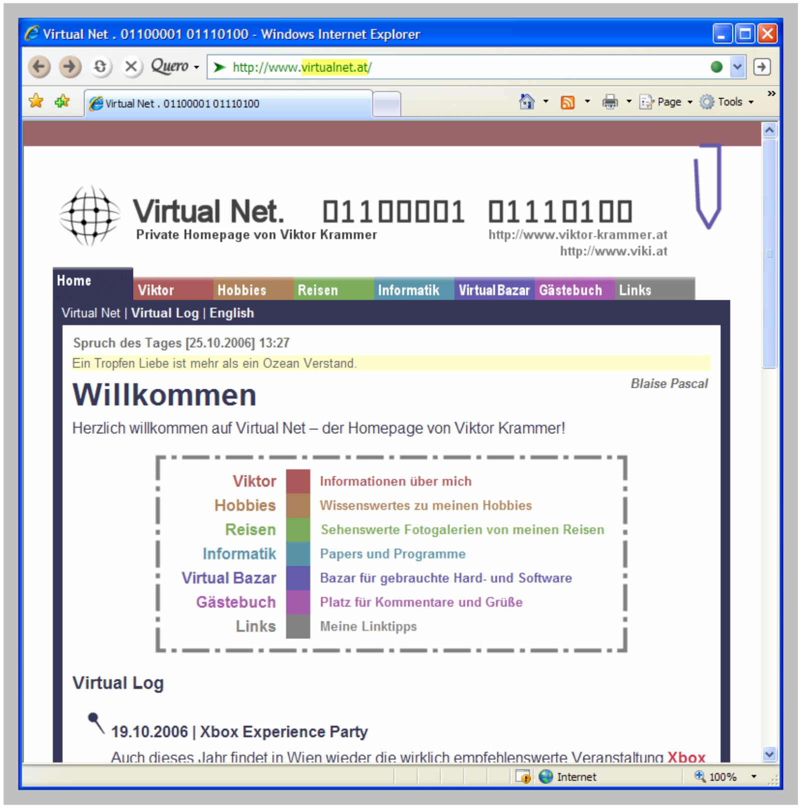
- **About Phishing**
- Internationalized Domain Names (IDN)
- Address Spoofing Attacks
- IDN-based Attacks
- Anti-Spoofing Techniques
- Conclusion

How we authenticate …

People

- Name (first, last, middle, nickname)
- Appearance (face, eyes, body, clothes)
- Voice, Gestures, Behavior
- Documents (driving licence, passport, ID cards)

How we authenticate …


Virtual Net . 01100001 01110100 - Windows Internet Explorer
Quero
http://www.virtualnet.at/
Virtual Net . 01100001 01110100
Page
Tools
Home
Viktor
Hobbies
Reisen
Informatik
VirtualBazar
Gästebuch
Links
Internet
100%

Virtual Net. 01100001 01110100
Private Homepage von Viktor Krammer

http://www.viktor-krammer.at
http://www.viki.at

Virtual Net | Virtual Log | English

Spruch des Tages [25.10.2006] 13:27

Ein Tropfen Liebe ist mehr als ein Ozean Verstand.

Blaise Pascal

Willkommen

Herzlich willkommen auf Virtual Net – der Homepage von Viktor Krammer!

Viktor	Informationen über mich
Hobbies	Wissenswertes zu meinen Hobbies
Reisen	Sehenswerte Fotogalerien von meinen Reisen
Informatik	Papers und Programme
Virtual Bazar	Bazar für gebrauchte Hard- und Software
Gästebuch	Platz für Kommentare und Grüße
Links	Meine Linktipps

Virtual Log

19.10.2006 | Xbox Experience Party

Auch dieses Jahr findet in Wien wieder die wirklich empfehlenswerte Veranstaltung Xbox

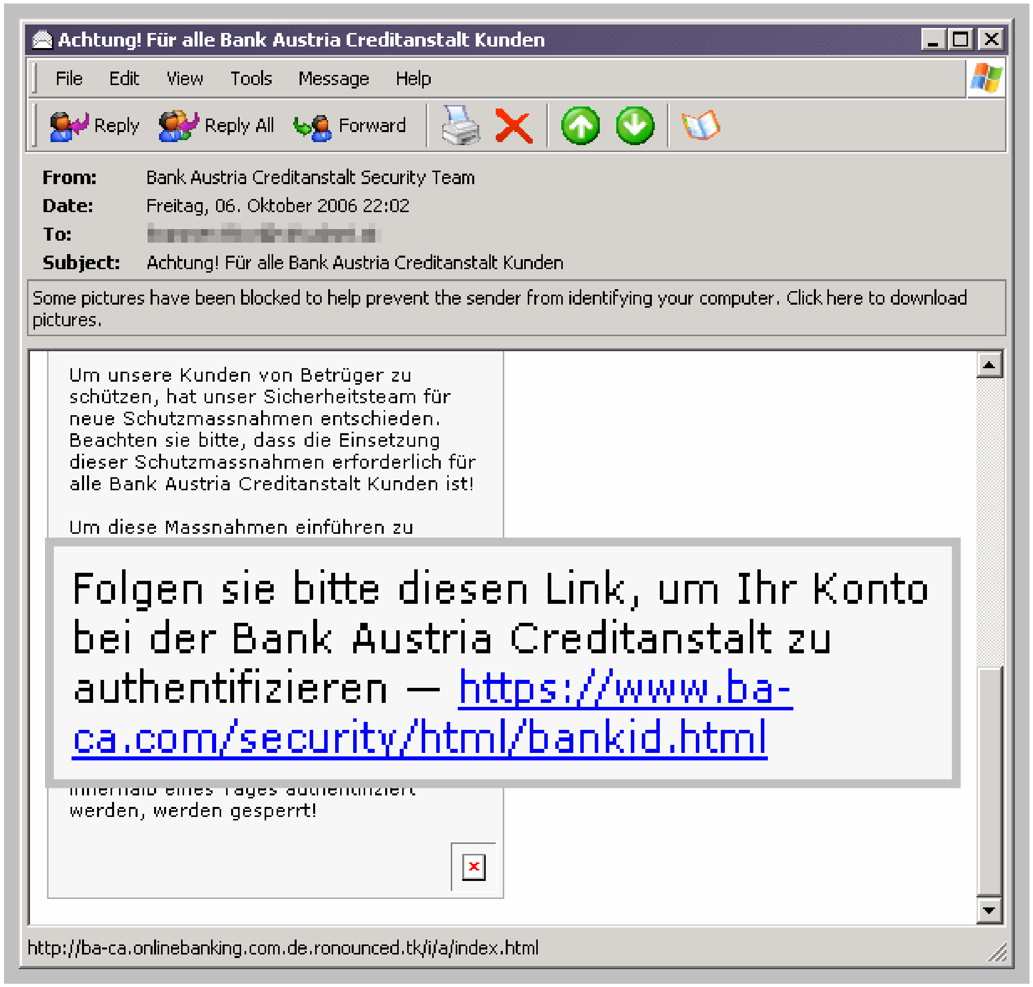
Web sites

- Address (URL, host name, domain name)
- Appearance (page layout, design, logo, colors)
- Content
- Certificate (SSL/TSL)

Addresses per se unique, but not for humans!

- confusingly similar
- likelihood of confusion

Phishing Example (1)



From: Bank Austria Creditanstalt Security Team
Date: Freitag, 06. Oktober 2006 22:02
To: [redacted]
Subject: Achtung! Für alle Bank Austria Creditanstalt Kunden

Some pictures have been blocked to help prevent the sender from identifying your computer. Click here to download pictures.

Um unsere Kunden von Betrüger zu schützen, hat unser Sicherheitsteam für neue Schutzmassnahmen entschieden. Beachten sie bitte, dass die Einsetzung dieser Schutzmassnahmen erforderlich für alle Bank Austria Creditanstalt Kunden ist!

Um diese Massnahmen einführen zu

Folgen sie bitte diesen Link, um Ihr Konto bei der Bank Austria Creditanstalt zu authentifizieren – https://www.ba-ca.com/security/html/bankid.html

innerhalb eines Tages authentifiziert werden, werden gesperrt!

http://ba-ca.onlinebanking.com.de.ronounced.tk/i/a/index.html

Target:
Bank Austria

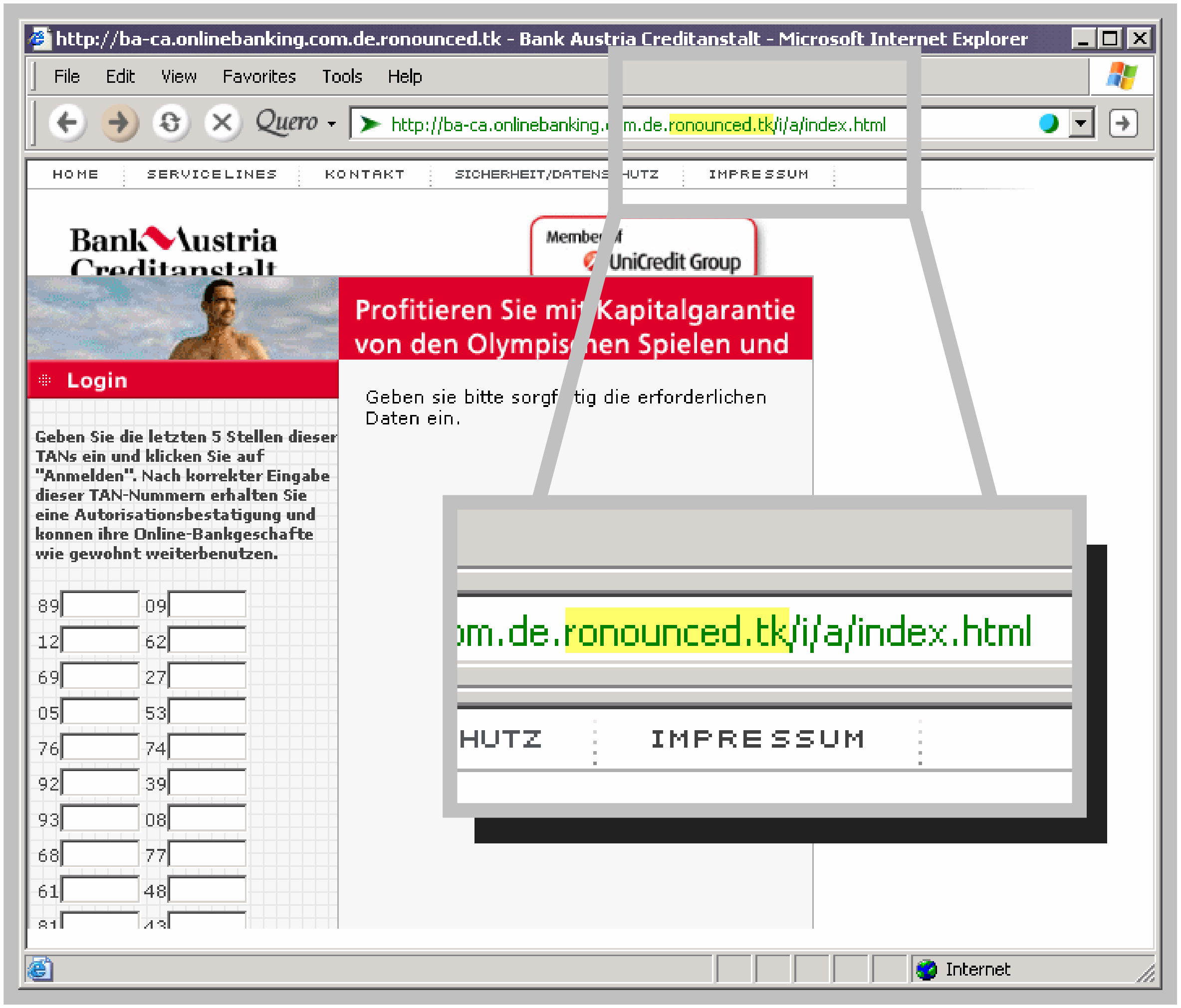
Sender:

From: Bank Austria Creditanstalt Security Team

Real Address:
online.ba-ca.com

Fake Address:
ba-ca.onlinebanking.com.de.ronounced.tk

Phishing Example (2)



http://ba-ca.onlinebanking.com.de.ronounced.tk - Bank Austria Creditanstalt - Microsoft Internet Explorer

http://ba-ca.onlinebanking.com.de.ronounced.tk/i/a/index.html

Profitieren Sie mit Kapitalgarantie von den Olympischen Spielen und

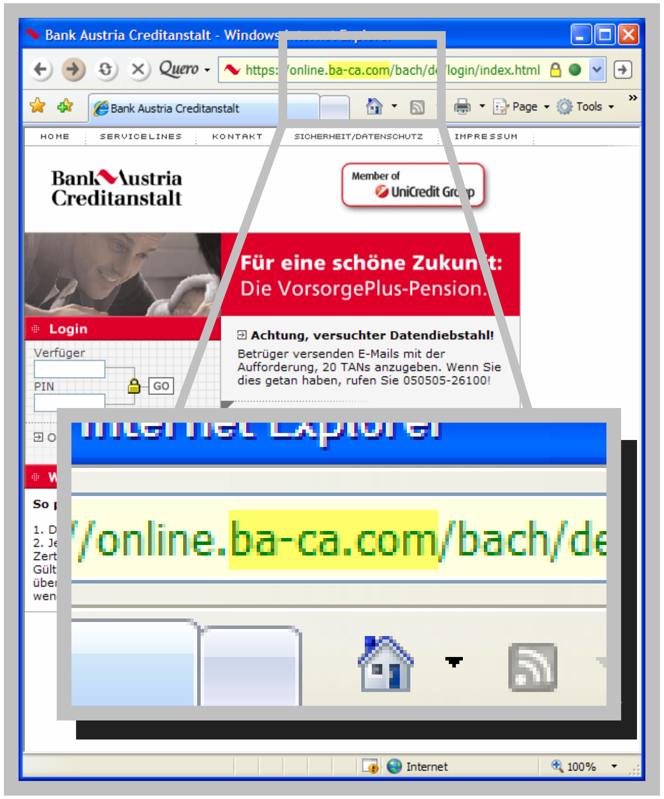
Geben sie bitte sorgfältig die erforderlichen Daten ein.

Geben Sie die letzten 5 Stellen dieser TANs ein und klicken Sie auf "Anmelden". Nach korrekter Eingabe dieser TAN-Nummern erhalten Sie eine Autorisationsbestatigung und konnen ihre Online-Bankgeschafte wie gewohnt weiterbenutzen.

89	09
12	62
69	27
05	53
76	74
92	39
93	08
68	77
61	48
81	43

om.de.ronounced.tk/i/a/index.html

Real



Bank Austria Creditanstalt - Windows Internet Explorer

https://online.ba-ca.com/bach/de/login/index.html

Für eine schöne Zukunft: Die VorsorgePlus-Pension.

Achtung, versuchter Datendiebstahl!

Betrüger versenden E-Mails mit der Aufforderung, 20 TANs anzugeben. Wenn Sie dies getan haben, rufen Sie 050505-26100!

/online.ba-ca.com/bach/de

Why Phishing Works

- User study conducted by Rachna Dhamija et al. (presented at CHI 2006)
- 22 participants classifying 20 Web sites
- Key Findings
  - 23% of participants looked only at the content to authenticate the Web site

    → 77% looked at the address bar or at other security indicators
  - 90% were fooled by well-crafted Phishing sites

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- IDN-based Attacks
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Internationalized Domain Names

- Defined in RFC 3490, 3491, 3492, 3454, 3743, 3987
- Client-side extension of DNS allowing non-ASCII characters in domain names
- Based on a subset of Unicode 3.2
- Backward compatible with existing DNS (IDN labels are stored in ASCII beginning with “xn--”)
- Uses Punycode for encoding Unicode domain labels efficiently (run-length compression)
- Example 東京理科大学.jp
  Punycode xn--1lq68wkwbj6ugkpigi.jp
  UTF-8 %E6%9D%B1%E4%BA%AC%E7%90%86%E7%A7%91%E5%A4%A7%E5%AD%A6.jp

Brief history of IDN (1)

- **2002** The Homograph Attack (Gabrilovich, Gontmakher)
- **2002** Unicode 3.2
- **2003** VeriSign releases i-Nav plug-in for IE5/6
- **2003** ICANN publishes IDNA RFCs
- **2003** Opera 7.11 adds IDN support
- **2004** Mozilla adds IDN support to Firefox 0.8
- **2005 February** IDN security receives big media coverage resulting from an article by Shmoo Group exploit: “own any domain, no defense exists”
- **2005 July** Unicode Security Considerations rev.3

Brief history of IDN (2)

- **2005 July**
  Quero Toolbar 2.1 released with IDN script highlighting and mixed-script security warnings
- **2005 November**
  Quero Toolbar 2.2 reached RFC-compliance
- **2006 October**
  Microsoft released IE7 with native IDN support, mixed-script detection and an integrated Phishing filter

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- ▪ IDN-based Attacks
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Address Spoofing Attacks (1)

User Confusion-based Attacks

- Confusion by Name Similarity
  Example:
  southtrustonlines.com vs. southtrust.com

- Confusion by Address Complexity
  Example:
  http://61.129.33.105/secured_site/www.skyfi.com/index.html?MfcISAPICommand=SignInFPP&UsingSSL=1

Address Spoofing Attacks (2)

User Confusion-based Attacks (cont‘d)

- Confusion by Random Addresses
  Example:
  http://secure-user-survey.com/exec/obidos
  /subst/home/sv/

Vulnerability-based Attacks

- Client-side Vulnerabilities
- Server-side Vulnerabilities

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IDN-based Attacks (1)

- **Mixed-script Spoofing**

▨ mapped by Nameprep

substituting characters with visually similar ones

Latin				Cyrillic		Greek	
▨ P 0050	p 0070	▨ Ｐ FF30	▨ ｐ FF50	▨ Р 0420	р 0440	▨ Ρ 03A1	ρ 03C1
▨ S 0053	s 0073	▨ Ｓ FF33	▨ ｓ FF53	▨ Ѕ 0405	ѕ 0455	▨ Σ 03A3	ς 03C2
▨ T 0054	t 0074	▨ Ｔ FF34	▨ ｔ FF54	▨ Т 0422	т 0442	▨ Τ 03A4	τ 03C4

IDN-based Attacks (2)

- **Whole-script spoofing**
  using characters from only one script that are reinterpreted in another script

  Example: Latin caxap.ru
  Cyrillic сахар.ru (xn--80aa2cbv.ru)

- **Single-script spoofing**
  exploiting similiarities between characters within one script
  0 vs. o; l vs. t; 1 vs. l; m vs. rn; etc.

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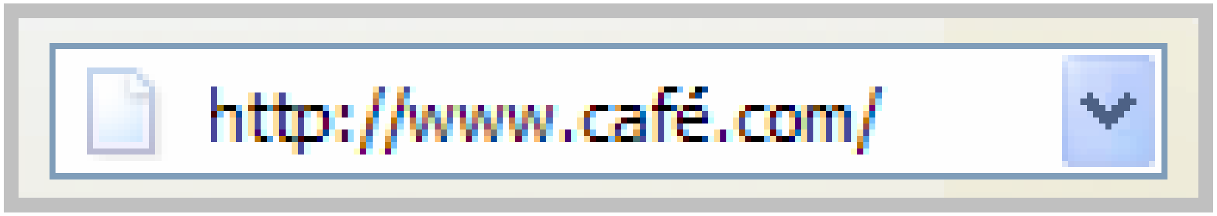
IDN-based Attacks (3)

- **Syntax Spoofing**
  / (U+002F) vs. ⁄(U+2044), ∕ (U+2215)
- **Numeric Spoofing**
  8 (U+0038) vs. U+09E6, U+09EA
- **Invisible Character Injection**
  control, formatting, tagging and spacing characters are prohibited by IDN Nameprep
- **Bidirectional Text Spoofing**
  eliminated by IDN Nameprep

IDN-based Attacks (4)

- **Combining Mark Order Spoofing**
  encoding specific threat: order of combining marks can be ambiguous

- **Inadequate Rendering Support**
  Example: repeating combining marks
  <c, a, f, e, U+0301, U+0301> looks like
  <café>
  ́ U+301 Combining Acute Accent



http://www.café.com/

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- ✓ IDN-based Attacks
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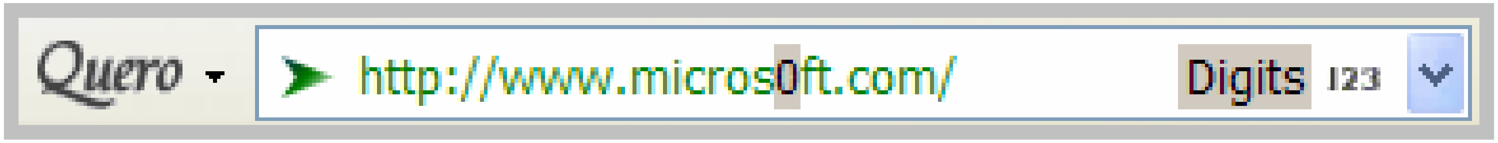
Anti-Spoofing Requirements

- RFC Compliance
- Avoiding Discriminiation
- Preferring Self-contained Solutions
- Alerts
- Appropriate Rendering Support
- User Preferences (allow opt-out, Whitelist)

Visualisation Techniques (1)

- **Digit Indication**



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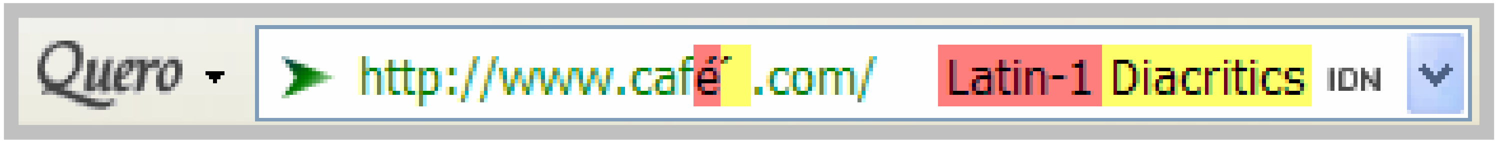
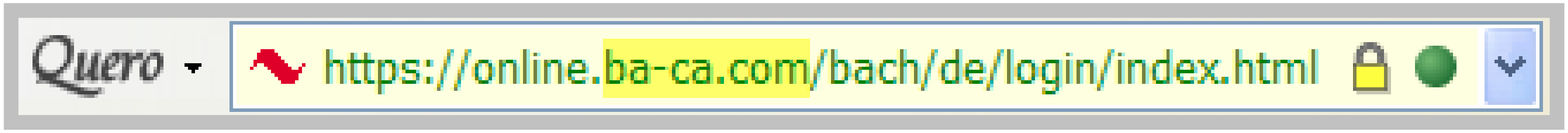
- **IDN Indication & Highlighting**
  - Characters from different script groups receive different background colors
  - Displaying the names of the script groups to mitigate whole-script attacks



Quero ▾ ➤ http://www.café´ .com/ Latin-1 Diacritics IDN

Visualisation Techniques (2)

- Secure Connection Indication
- Core Domain Highlighting



https://online.ba-ca.com/bach/de/login/index.html

„Core Domain“: most relevant part of the address
usually: 2nd and 1st level domain label

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UI Improvements

- **Address Bar Integration**
  Security Related Information:
  - Current Location (URL)
  - Core Domain
  - Secure Connection Icon (Certificate Details)
  - Blocked Content
  - Securtiy Warnings
- **Support for Larger Font Sizes** (default: 8 pt!)
- **Switching to ACE Form**

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Security Warnings

- **Invalid Addresses**
  not well-formed according to RFC definition
- **Suspicious Character Detection**
  alerts the user in cases of mixed-script
  Assumptions:
  - harder to exploit similarities within one script
  - rather undesireable to mix scripts (harder to input, read, recognize and memorize)
- **Missing Glyph Detection**

Quero Toolbar

- Add-on for Internet Explorer
- RFC-compliant implementation of IDN standards
- Adds IDN support to older versions of IE
- Demonstrating anti-spoofing techniques
- New user interface (combines search and navigation into one toolbar)
- Integrated content filter
- Over 10.000 times downloaded (2005/01–2006/01)
- Freeware licence

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- ▪ **Conclusion**

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Conclusion

- Besides the padlock icon the address is still the most important indicator for authenticating a Web site.
- Spoofed addresses are no longer visually distinguishable from their legitimate counterpart.
- Quero helps the expert and non-expert user to make better trust decisions based on the current URL.
- Major Web browser vendors have adopted mixed-script detection and included a blacklist-based phishing filter.

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