Reducing the Tail Risk of CA Compromise by Enabling Trust in Regional CAs Using Language Community and Locale Annotations

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A heuristic is a simple procedure that helps find adequate, though often imperfect, solutions to difficult problems.

-Daniel Kahneman

Background

- All Trusted Roots are Equal

- Compromise at any CA can impact all names for all users, globally

- Set of CAs is large and growing
  - Operating in 49 countries, many owned or controlled directly by sovereign governments

Who do I need to trust?

- Microsoft, Mozilla, etc. may have significant user bases or potential markets in many jurisdictions

- But any individual user needs to trust many fewer CAs

- Removing a CA from your root store is a manual process accessible only to experts

Result: Lots of tail risk from Certificate Authorities that most users will never legitimately encounter a certificate from.

Tail Risks

- Persian-speaking users in Iran had no need to trust a small CA serving the Dutch language community and Government of the Netherlands

- One country’s “lawful intercept” is another’s industrial espionage or human rights violation

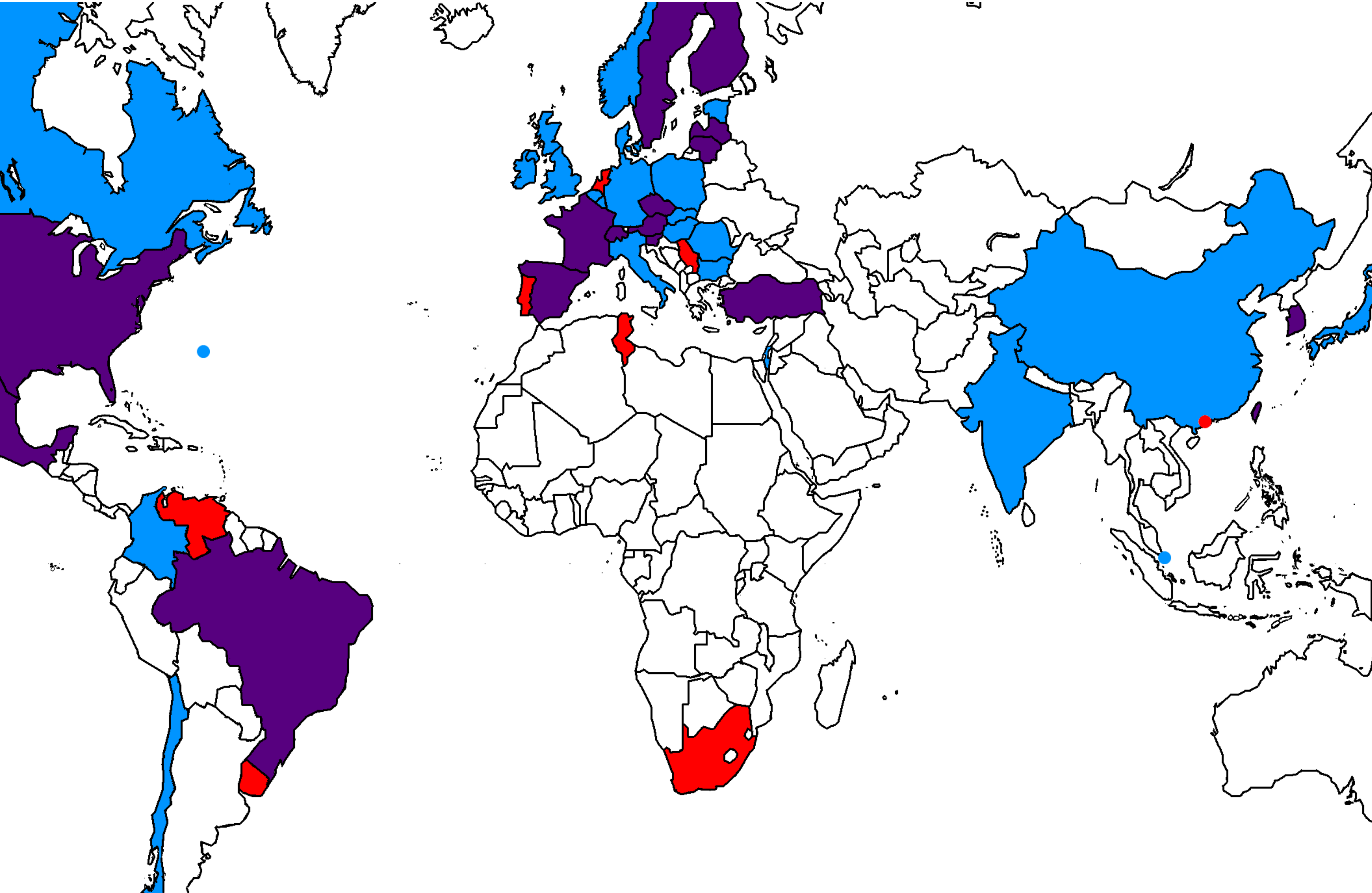
Microsoft Trusted Root Program

http://social.technet.microsoft.com/wiki/contents/articles/14215.windows-and-windows-phone-8-ssl-root-certificate-program-member-cas.aspx

- 352 Root Certificates
- 115 Controlling Organizations
  - 36 Governments
  - 74 Commercial Entities
  - 5 Enterprises

CA Global Distribution

Government
Commercial
Both



Blanks on the Map

- Only 49 of 206 (24%) sovereign nations have a MSFT-trusted CA within their borders
- Only 27 of 206 (13%) sovereign nations have a trusted, government-operated CA.

- Much room for growth here!
  - Good for the Internet as a whole
  - Bad for any individual user

Given the global nature of the Internet, are there manageable ways to address this risk?

Not with name constraints

- Maybe for a few government CAs:
  - .gov, .gouv.fr, …
- But the most used gTLDs (.com, .org, .net, …) are universal
  - Any commercial and perhaps some government CAs will want to support these
  - A “constraint” to .com is effectively meaningless

Related?
Internationalized Domain Names

- IDNs introduced a risk of spoofing using homoglyphs (e.g. example.com with Cyrillic ‘a’)

- IE 7’s algorithm:
  - Display in ASCII encoding by default (punycode)
  - Display in native encoding if the appropriate language pack is installed
    - As consequence of SW version or locale choice
    - As a user-installed add-on

The idea for certificates:

- Annotate CAs with the locales and language communities they serve
- Users have a geographic and language context
- When these contexts clash for names in the global space, alert the user

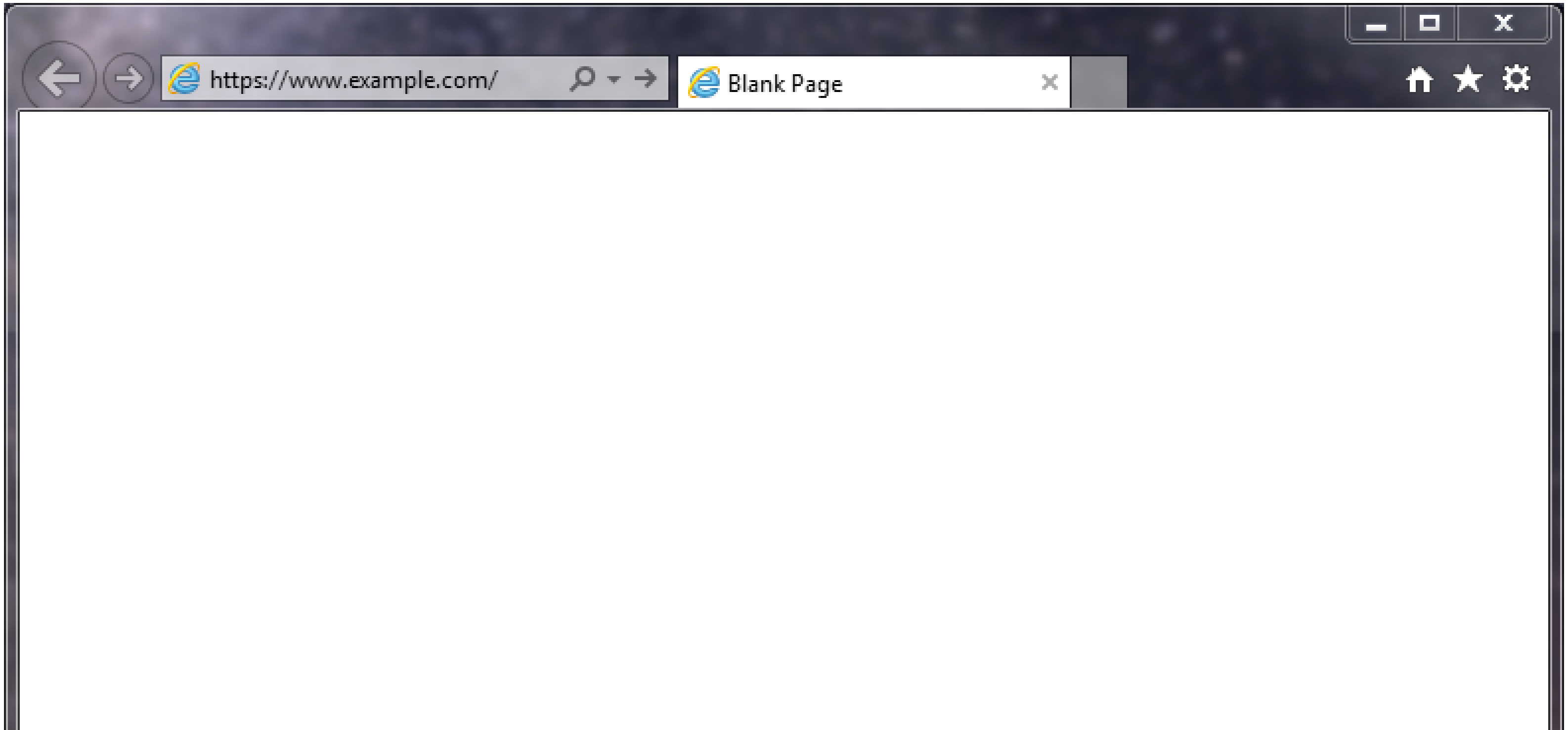
Example User: Aaron in Seattle

- A USA-based user with US English as the default locale and language
- Also an Israeli immigrant with the Hebrew language pack installed

`example.com`

Certified by *MegaWholeWorld CA*

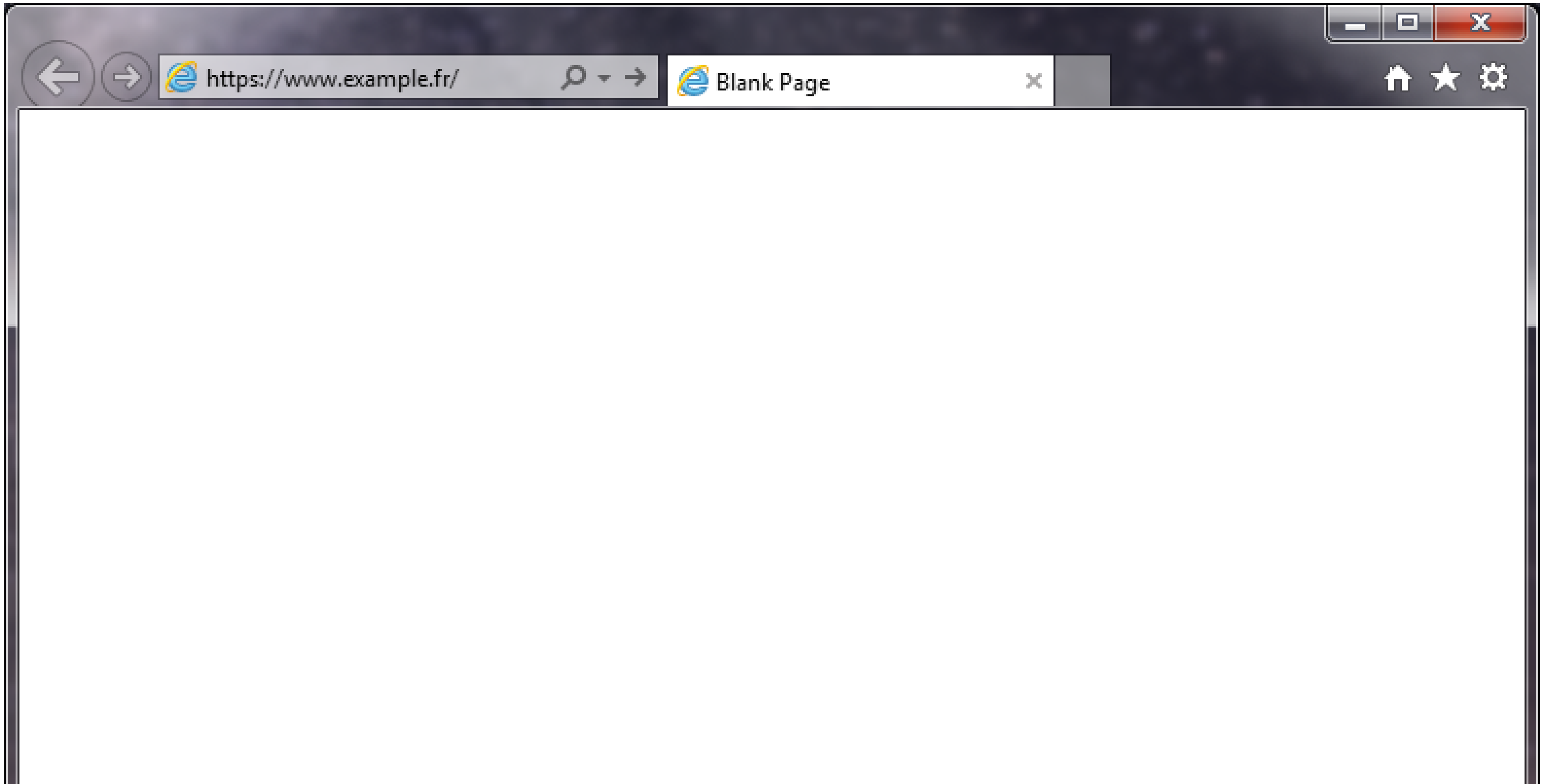
Globally trusted CA: **OK!**



`example.fr`

Certified by *Fromage CA*

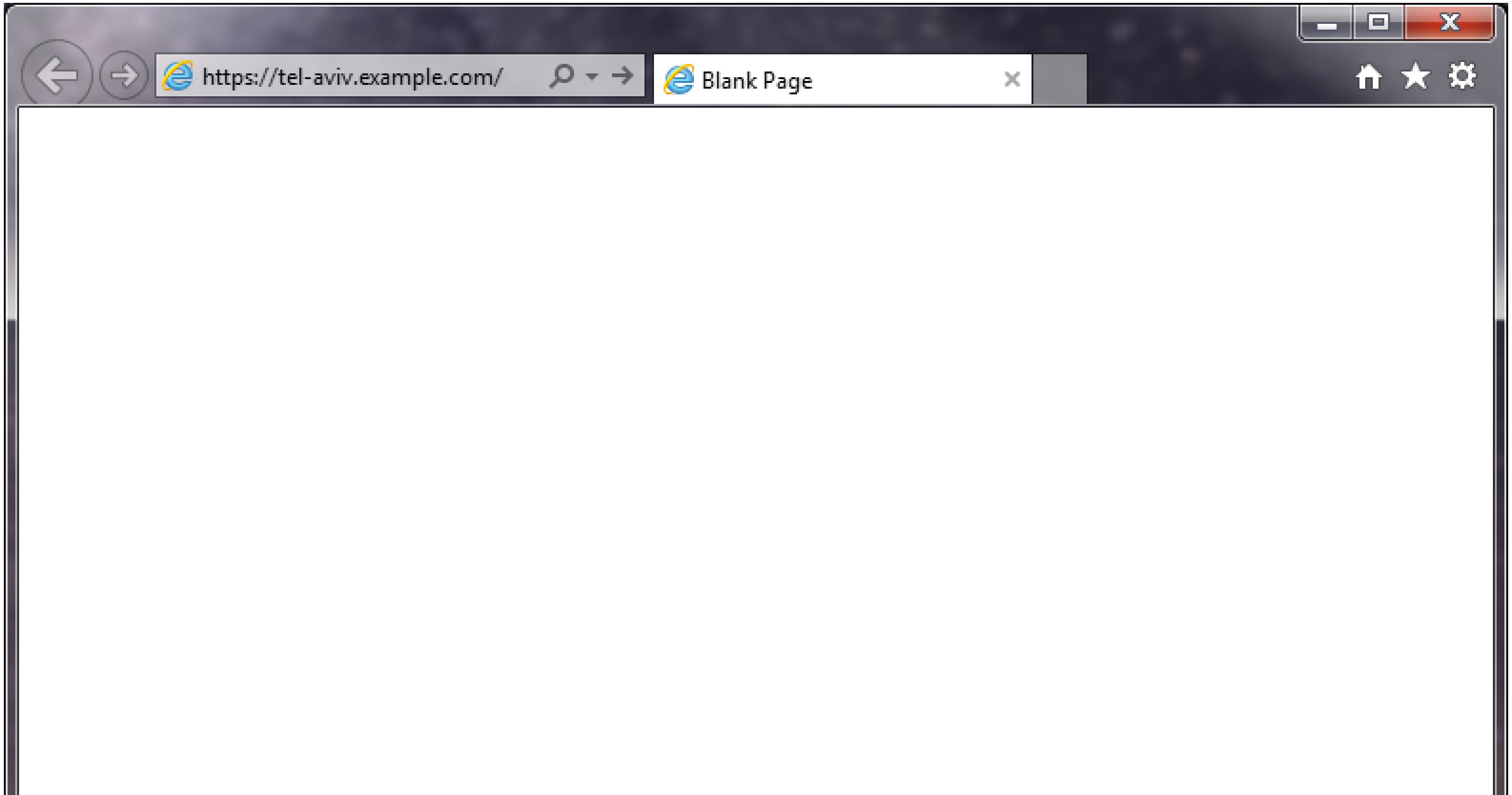
French-region CA, .fr ccTLD: **OK!**



tel-aviv.example.com

Certified by *BenGurion CA*

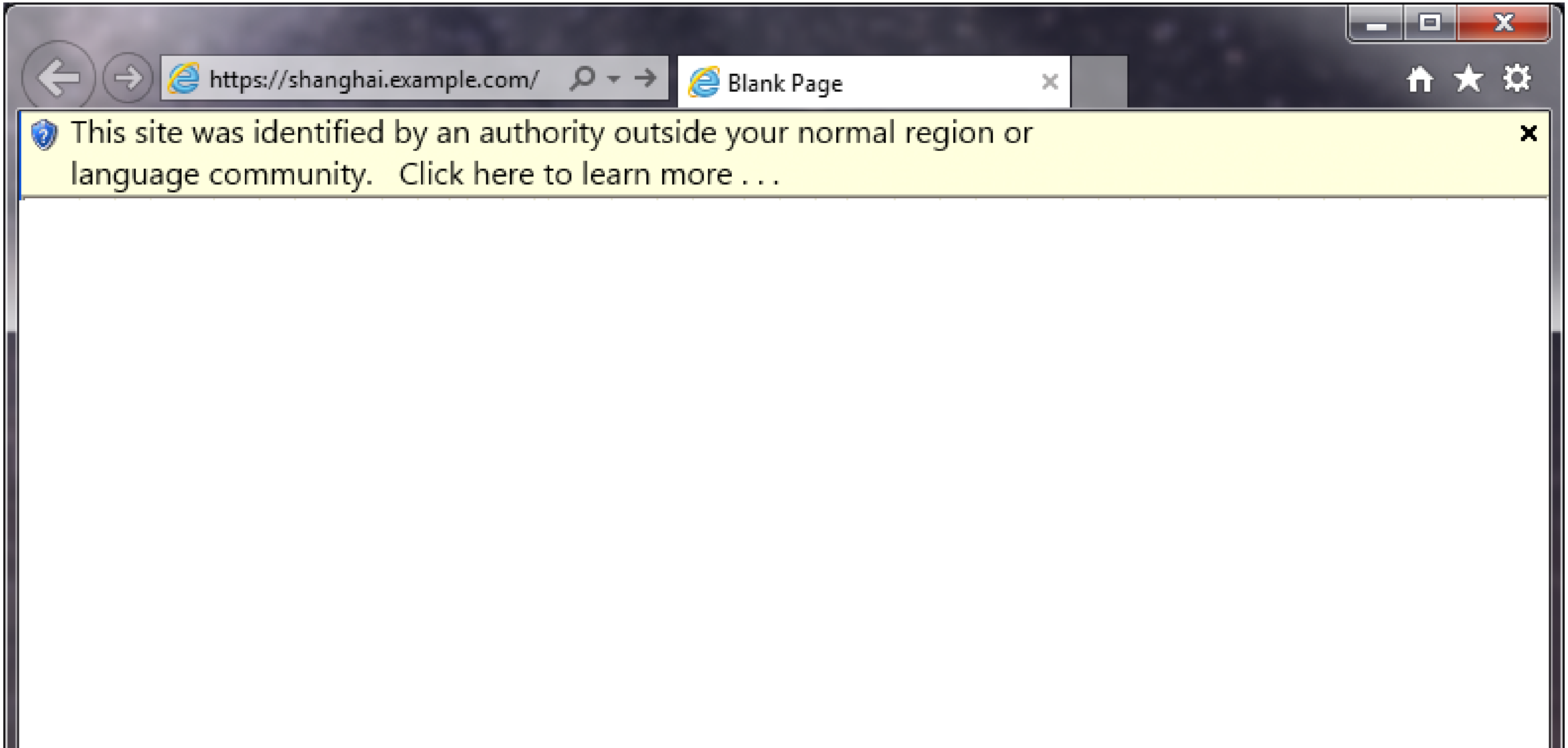
User has Hebrew language pack installed: **OK!**



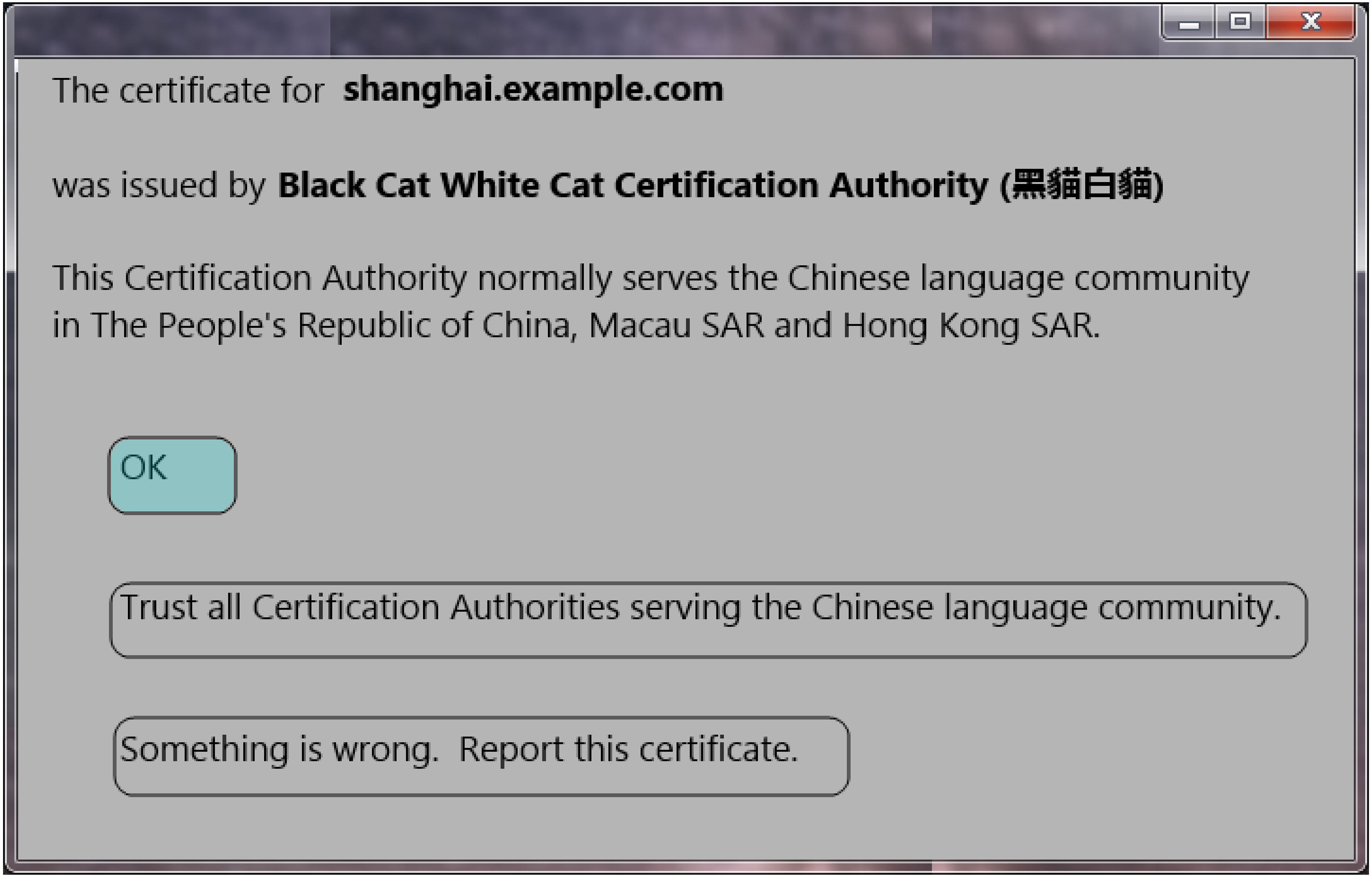
shanghai.example.com

Certified by *BlackCatWhiteCat CA*

Notification



This site was identified by an authority outside your normal region or language community. Click here to learn more . . .



The certificate for **shanghai.example.com**

was issued by **Black Cat White Cat Certification Authority (黑貓白貓)**

This Certification Authority normally serves the Chinese language community in The People's Republic of China, Macau SAR and Hong Kong SAR.

OK
Trust all Certification Authorities serving the Chinese language community.
Something is wrong. Report this certificate.

“Soft Warning” Enables Situational Trust

- All CAs still installed and enabled by default
  - All CAs can issue in .com without warnings *to their own regional + language customer base*

- Detective, not Preventative Control

- Warning would be in-context and expected in most situations they occur
  - Booking a foreign hotel, applying for a visa, etc.

NOT ANOTHER DIALOG!!!

- Yes… but….this is not meaningless crypto mumbo-jumbo

(no data yet, but my hunch is that…)

- Users already have good working concepts of governments, countries and languages and are able to apply those concepts to most sites they visit

Who will build the lists?

- Governments mandatorily opted-in
  - Perhaps too much legal or geopolitical risk for browser vendors to go farther than this

- Smaller or regional CAs may volunteer in order to reduce their attractiveness as a target

- Community-curated lists an easy possibility

- Or commercially-curated
  - As part of anti-virus/malware or trust broker software

Browsers may eventually set differential requirements directly

- Audit by globally-certified 3rd party vs. possibly unreliable local audit regimes or self-asserted government audits

- As a non-death-penalty punishment
  - E.g. as with revocation of EV bit for TurkTrust incident

- As part of their own community standards
  - E.g. Mozilla might restrict CAs operating in countries where they consider there to exist human rights issues around surveillance, state coercion, etc.

A Band-Aid, not a Panacea

- Top 8-10 global CAs that issue >95% of certificates cannot have meaningful constraints of this type
  - Perhaps few or no commercial CAs will opt-in

- Requires a user at the keyboard to make a decision based on a warning

- Does significantly reduce the attack surface for an opportunistic adversary who wishes to remain undetected
  - “herd immunity” for most users who don’t care from a tiny number who will

- Does “automatically” scale with lots of new gTLDs
  - Though new regional TLDs will need some annotation

A heuristic produces wrong answers sometimes

- Mappings are imperfect, languages and borders are messy
  - North / South Korea
  - Taiwan / China
  - Punjabi in India and Pakistan

- ccTLDs used as *de facto* gTLDs: .tv .ly

- From perspective of US consumer:
  - Is Samsung a Korean or Japanese company?
  - Is Motorola a US or Japanese company?

So, why do it?

- Quick and easy to implement relative to many other solutions on the table

- Can re-use or slightly modify existing technologies like Trust Anchor Management Protocol (TAMP) [RFC 5934]

- Significant, long-term attack surface reduction

- Targets threat scenarios most likely to cause large-scale loss of trust by the public

Work to be done:

- Can be done entirely by any individual user agent
- If interoperability in community-curated annotations is desired:
  - Add to TAMP/CMS to allow conveyance of additional unsigned attributes for Apex Trust Anchors
  - Need additional data mapping regional TLDs to language communities
  - Standardize a subscription mechanism?
  - PKIX WG at IETF retiring – could be done as an AD sponsored experimental draft

QUESTIONS?

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