Why Eve and Mallory Love Android
An Analysis of Android SSL (In)Security

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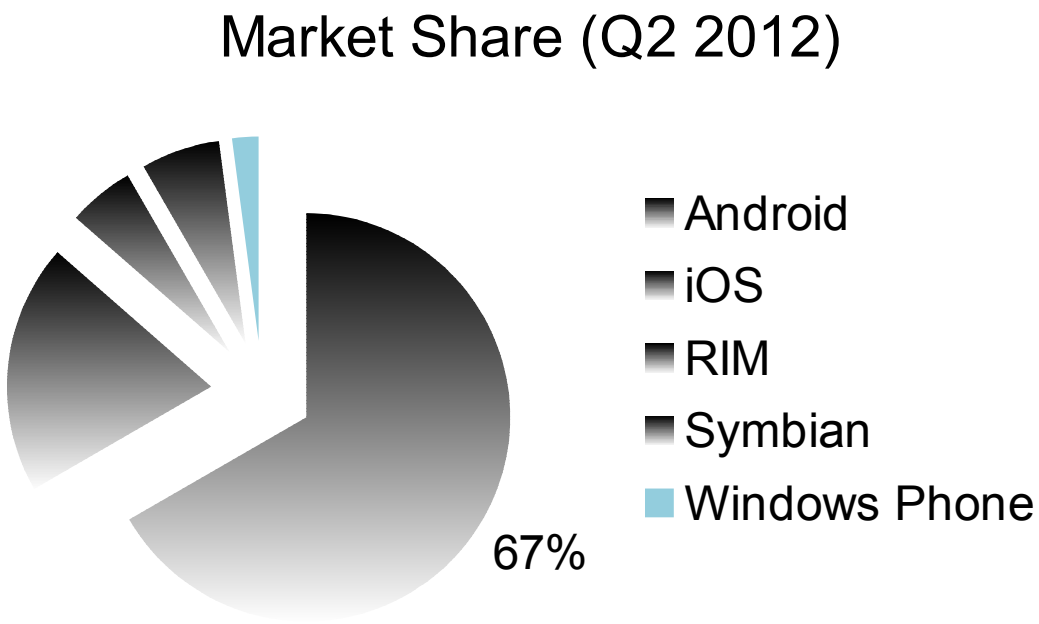
Some Android Facts

- 330 million devices (as of Q1 2012)
- 930,000 activations per day (as of Q1 2012)
- 450,000 apps (as of June 2012)



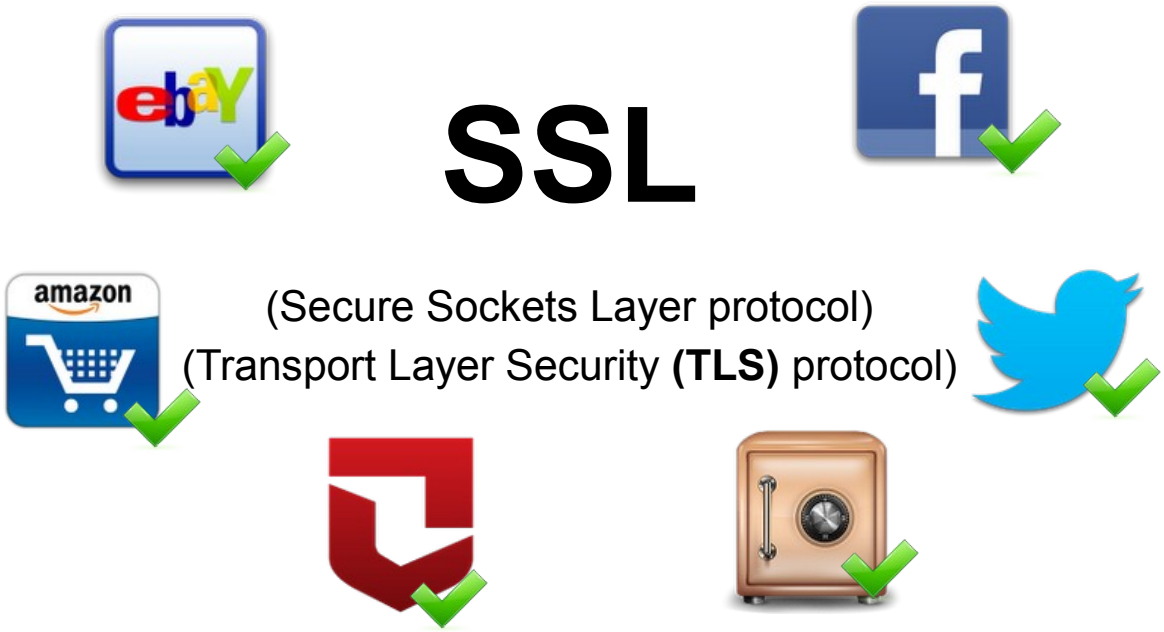
Appification

- There's an App for Everything

What do Most Apps Have in Common?

They share data over the Internet

Some of them secure transfer using:



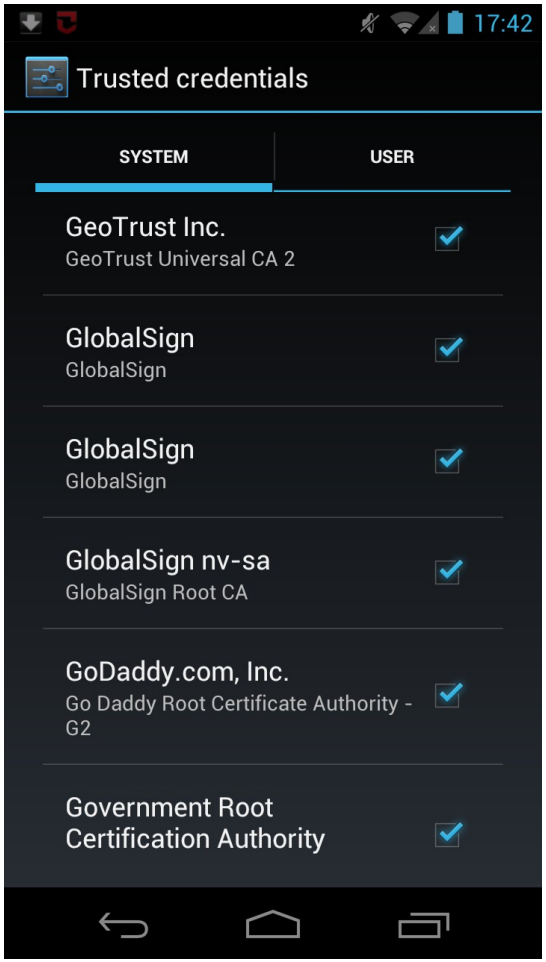
SSL Usage on Android

The default Android API implements correct certificate validation.

What could possibly go wrong?

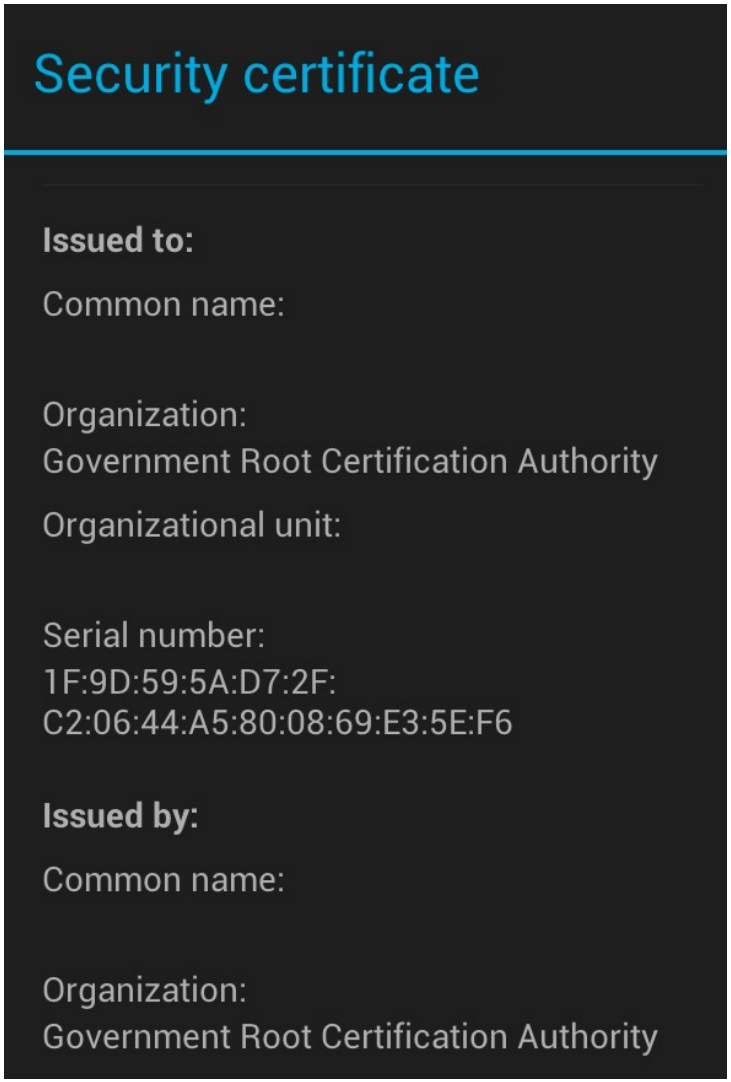
SSL Usage on Android

- A server needs a certificate that was signed by a trusted Certificate Authority (~130 pre-installed CAs)



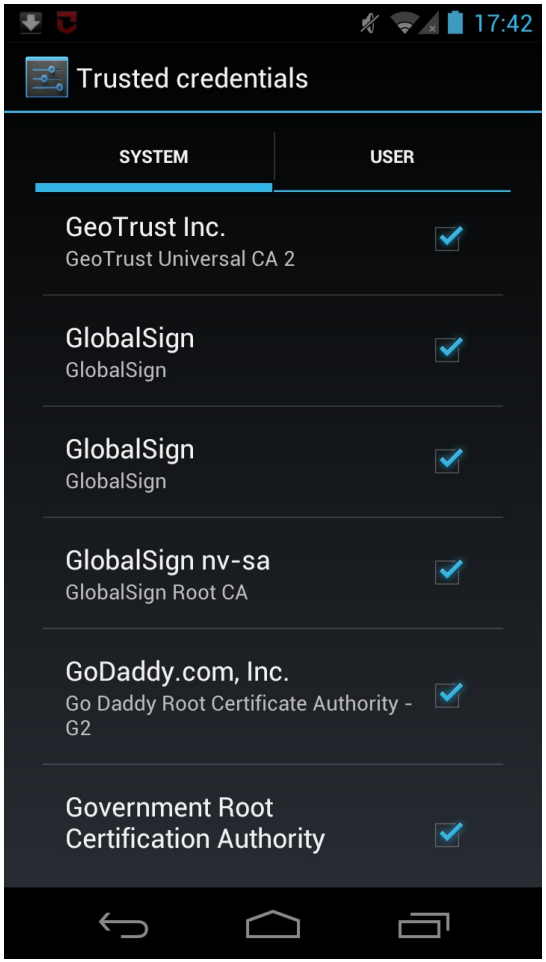
SSL Usage on Android

- A server needs a certificate that was signed by a trusted Certificate Authority (~130 pre-installed CAs)
- Some are quite strange...



SSL Usage on Android

- A server needs a certificate that was signed by a trusted Certificate Authority (~130 pre-installed CAs)
- For non-trusted certificates a custom workaround is needed



What about using a non-trusted certificate?

Q: Does anyone know how to accept a self signed cert in Java on the Android? A code sample would be perfect.
A: Use the EasyX509TrustManager library hosted on code.google.com.

Q: I am getting an error of „javax.net.ssl.SSLException: Not trusted server certificate“. I want to simply allow any certificate to work, regardless whether it is or is not in the Android key chain. I have spent 40 hours researching and trying to figure out a workaround for this issue.
A: Look at this tutorialhttp ://blog.antoine.li/index.php/2010/10/android-trusting-ssl-certificate

stackoverflow.com

Our Analysis

- downloaded 13,500 popular and free Apps from Google's Play Market
- built MalloDroid which is an androguard extension to analyze possible SSL problems in Android Apps
  - broken TrustManager implementations
  - accept all Hostnames

Eve/Mallory

Webserver

Static Code Analysis Results

- 92,8 % Apps use INTERNET permission
- 91,7 % of networking API calls HTTP(S) related
- 0,8 % exclusively HTTPS URL
- 46,2 % mix HTTP and HTTPS

- 17,28 % of all Apps that use HTTPS include code that fails in SSL certificate validation
  - 1070 include critical code
  - 790 accept all certificates
  - 284 accept all hostnames

Trusting all Certificates

- Correct SSL certificate validation is so easy
  - Only a (costly) trusted CA signed certificate required
- What some Apps do:

```
// Create a trust manager that does not validate certificate chains
TrustManager[] trustAllCerts = new TrustManager[] { new X509TrustManager() {

        public java.security.cert.X509Certificate[] getAcceptedIssuers() {
                return null;
        }

        public void checkClientTrusted(X509Certificate[] chain, String authType) throws CertificateException {
                // do nothing
        }

        public void checkServerTrusted(X509Certificate[] chain, String authType) throws CertificateException {
                // do nothing
        }

} };
```

Allowing all Hostnames

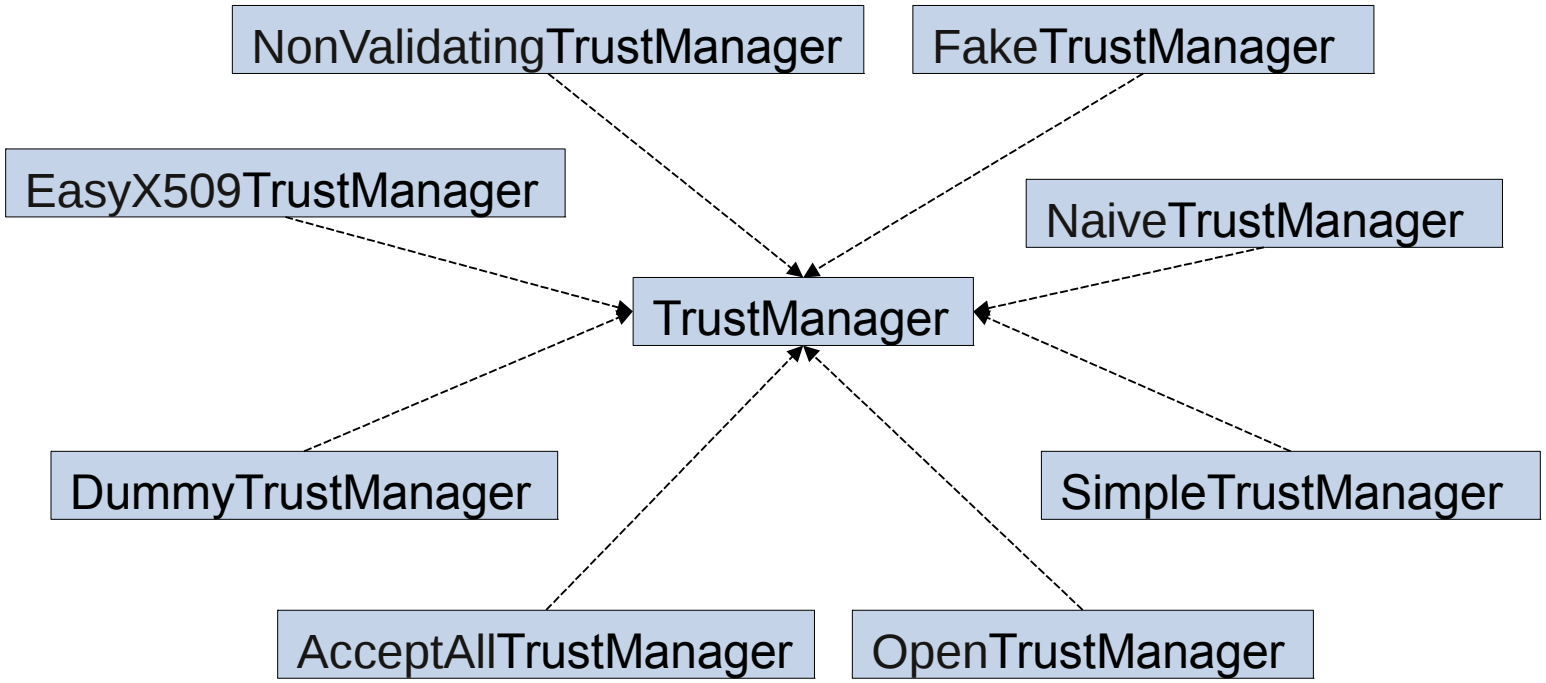
- What other Apps do:
  - Check CA signature, but allow mallory.com for google.com

```
KeyStore trustStore = KeyStore.getInstance(KeyStore.getDefaultType());
trustStore.load(null, null);

SSLSocketFactory sf = new MySSLSocketFactory(trustStore);
sf.setHostnameVerifier(SSLSocketFactory.ALLOW_ALL_HOSTNAME_VERIFIER);
```

TrustManager Implementations

- 22 different TrustManager implementations



- and all turn effective certificate validation off

Manual App Testing Results

- cherry-picked 100 Apps
- 21 Apps trust all certificates
- 20 Apps accept all hostnames

What we found:

Manual App Testing Results

39 – 185 million affected installs!

What we found:

BankDroid

- Swedish banking app
- Support for ~60 banks/payment services
  - PayPal
  - Steam Wallet
  - Eurocard
  - Swedbank
  - …

BankDroid - Aftermath

- 26 out of 41 broken
- Deliberately broken
- NO user warning

Anti-Virus

Zoner AV

AV-TEST
The Independent IT-Security Institute
Magdeburg Germany

- Anti-Virus App for Android
  - Awarded best free Anti-Virus App for Android by av-test.org

Zoner AV

- Virus signature updates via HTTPS GET
- The good thing: It uses SSL
  - Unfortunately: The wrong way
- Does not check the update's authenticity!

```
static final HostnameVerifier DO_NOT_VERIFY = new HostnameVerifier()
{
        public boolean verify(String paramString, SSLSession paramSSLSession)
        {
                return true;
        }
};
```

Zoner AV

- We did the following

More Examples

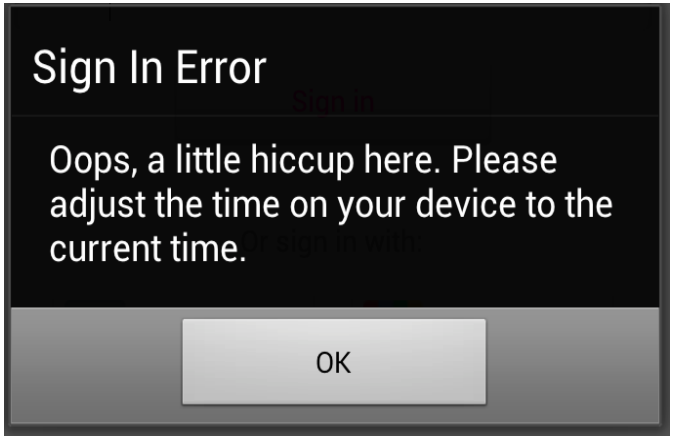
- Remote Control App

- Remote Code Injection

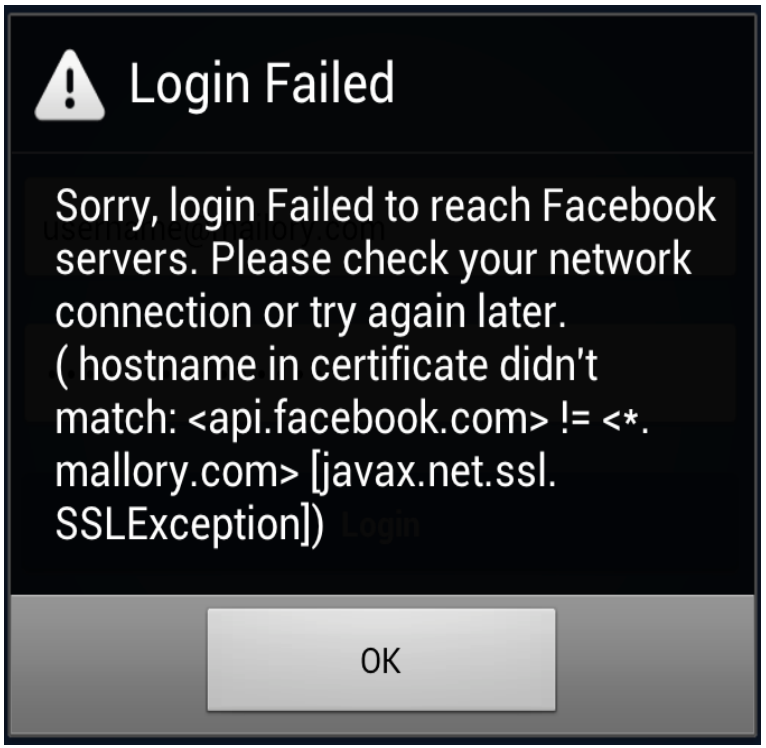
- Unlocking Rental Cars

How Do (Good) Apps React to MITMAs?

- Technically ✔
- Usability ?



Flickr



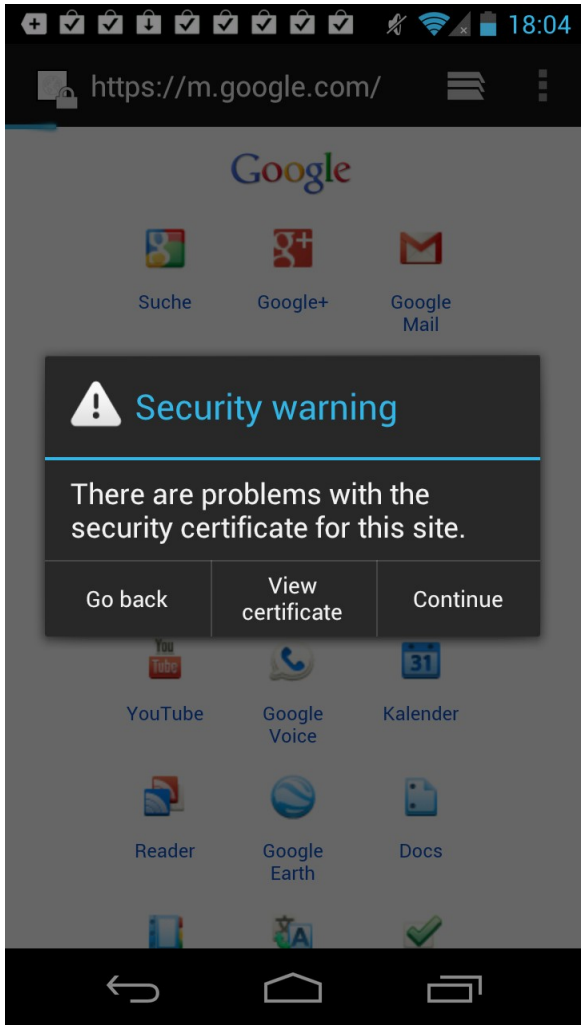
Facebook

Browser Warning Messages

All do SSL certificate validation correctly…

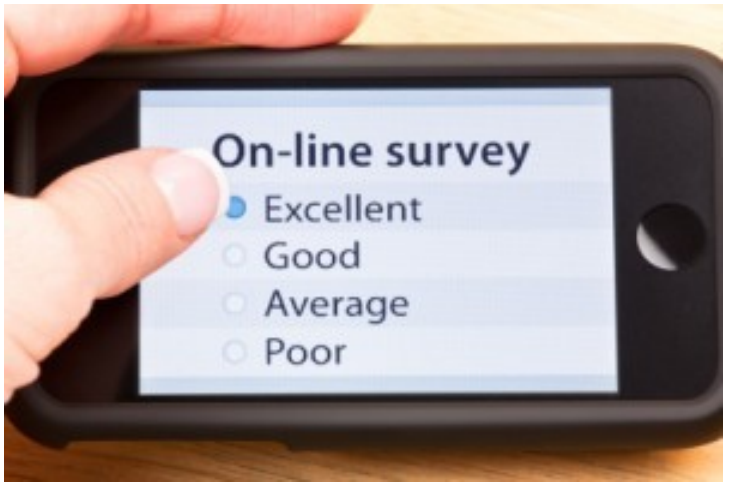
… and warn the user if something goes wrong….

SSL Warning Messages – Android Stock Browser



Online Survey

- To find out if the Browser's warning messages help the users
- presented an SSL warning message
- To see if users know when they are surfing on an SSL protected website
- half of the participants HTTP
- half of the participants HTTPS



Online Survey - Results

- 745 participants
  - 47.5% of non-IT experts believed they were using a secure Internet connection...although it was plain HTTP.
  - ~50% had not seen an SSL warning message on their phone before.
  - The risk users were warned against was rated with 2.86 (sd=.94) on a scale between 1 and 5
  - Many participants stated they did not care about warning messages at all.

Our Recommendations

- Integrate SSL certificate validation testing into the development process

- Inform the user
  - INTERNET_SSL and INTERNET_PLAIN permission
  - global SSL warning message

- Move SSL handling to the OS
  - Developers should not have to write code to use SSL
  - SSL via config instead of code (still enough room for error)