OWASP Top 10 Mobile Risks

Sven Vetsch
Leader OWASP Switzerland

Introduction

- Sven Vetsch
- Leader OWASP Switzerland
  - http://www.owasp.ch
- Partner & CTO Redguard AG
  - http://www.redguard.ch
- Focused on Application Security (Web, Mobile, …)

Agenda

- Mobile Security Project
- Mobile Threat Model
- Top 10 Mobile Risks
- Wrap Up
- Q&A

Mobile Security Project

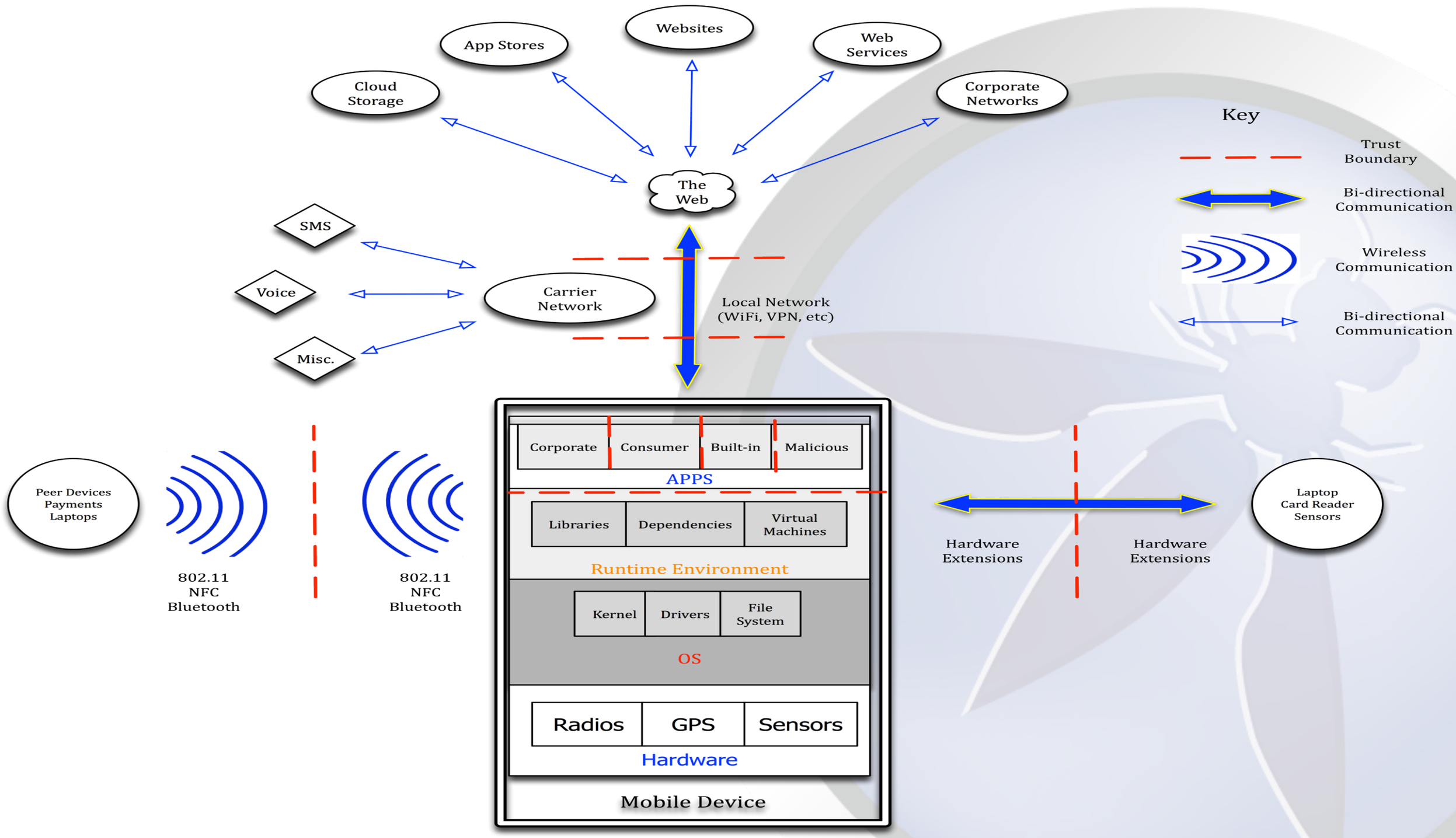
- Started in Q3 2010
- Why?
  - Unique and different security risks
- Goal
  - To build security into mobile dev. life cycle

Mobile Threat Model

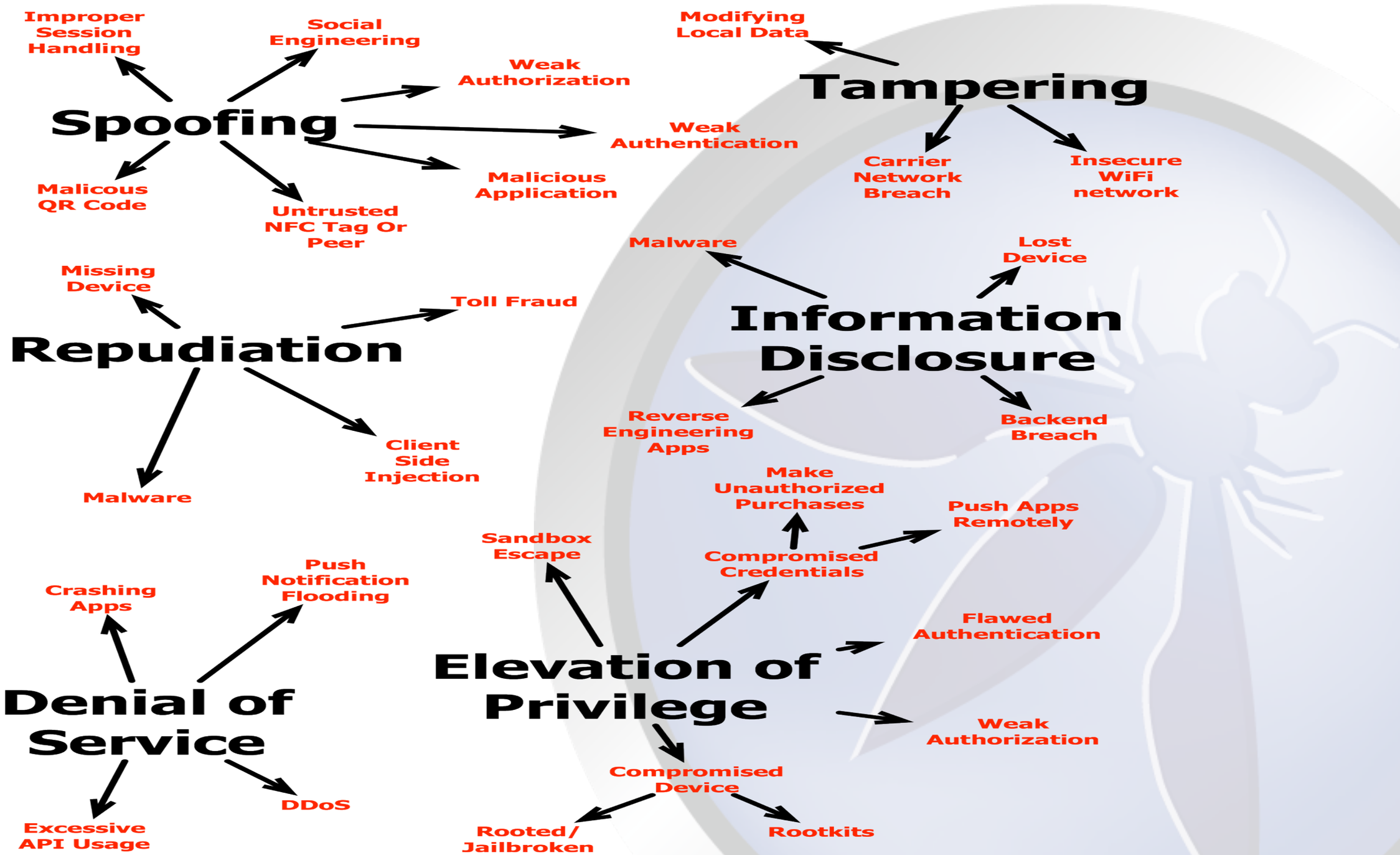
Mobile Threat Model

- Platforms vary heavily
- Very different from traditional web app model due to wildly varying use cases and usage patterns
- Must consider more than the “Apps”
  - Remote web services
  - Platform integration (iCloud, GCM)
  - Device (in)security considerations

Mobile Threat Model



Mobile Threat Model



Top 10 Mobile Risks

Top 10 Mobile Risks

- Intended to be platform-agnostic
- Focused on areas of risk rather than individual vulnerabilities
- Weighted utilizing the OWASP Risk Rating Methodology
  - https://www.owasp.org/index.php/OWASP_Risk_Rating_Methodology

Top 10 Mobile Risks

- Everything in this presentation is in a draft state.
- First final version is planned for around February 2013

Top 10 Mobile Risks

OWASP Top 10 Mobile Risks			
M1	Insecure Data Storage	M6	Improper Session Handling
M2	Weak Server Side Controls	M7	Security Decisions Via Untrusted Inputs
M3	Insufficient Transport Layer Protection	M8	Side Channel Data Leakage
M4	Client Side Injection	M9	Broken Cryptography
M5	Poor Authorization and Authentication	M10	Sensitive Information Disclosure

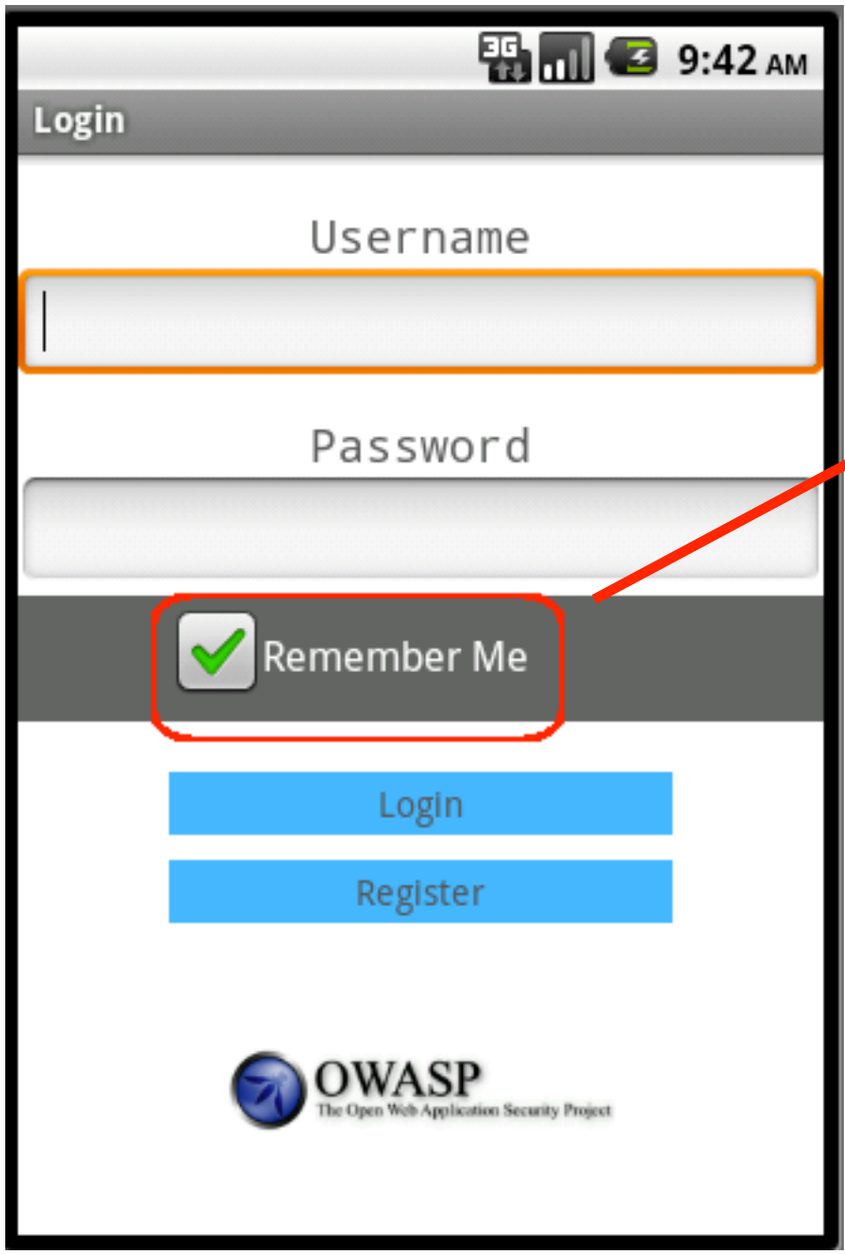
M1- Insecure Data Storage

- Sensitive data left unprotected
- Applies to locally stored data + cloud synced
- Generally a result of:
  - Not encrypting data
  - Caching data not intended for long-term storage
  - Weak or global permissions
  - Not leveraging platform best-practices

Impact

- Confidentiality of data lost
- Credentials disclosed
- Privacy violations
- Non-compliance

M1- Insecure Data Storage




```
public void saveCredentials(String userName, String password) {

    SharedPreferences credentials = this.getSharedPreferences(
            "credentials", MODE_WORLD_READABLE);
    SharedPreferences.Editor editor = credentials.edit();
    editor.putString("username", userName);
    editor.putString("password", password);
    editor.putBoolean("remember", true);
    editor.commit();
}
```

— Very Bad

— Convenient!

M1- Insecure Data Storage
Prevention Tips

- Store ONLY what is absolutely required
- Never use public storage areas (ie- SD card)
- Use secure containers and platform provided file encryption APIs
- Do not grant files world readable or world writeable permissions

Control	Description
1.1-1.14	Identify and protect sensitive data on the mobile device
2.1, 2.2, 2.5	Handle password credentials securely on the device

M1- Insecure Data Storage
Prevention Tips

European Network and Information Security Agency (ENISA) "Smartphones secure development guidelines for app developers"

Control	Description
1.1-1.14	Identify and protect sensitive data on the mobile device
2.1, 2.2, 2.5	Handle password credentials securely on the device

- Store ONLY what is absolutely required
- Never use public storage areas (ie- SD card)
- Leverage secure containers and platform provided file encryption APIs
- Do not grant files world readable or world writeable permissions

M2- Weak Server Side Controls

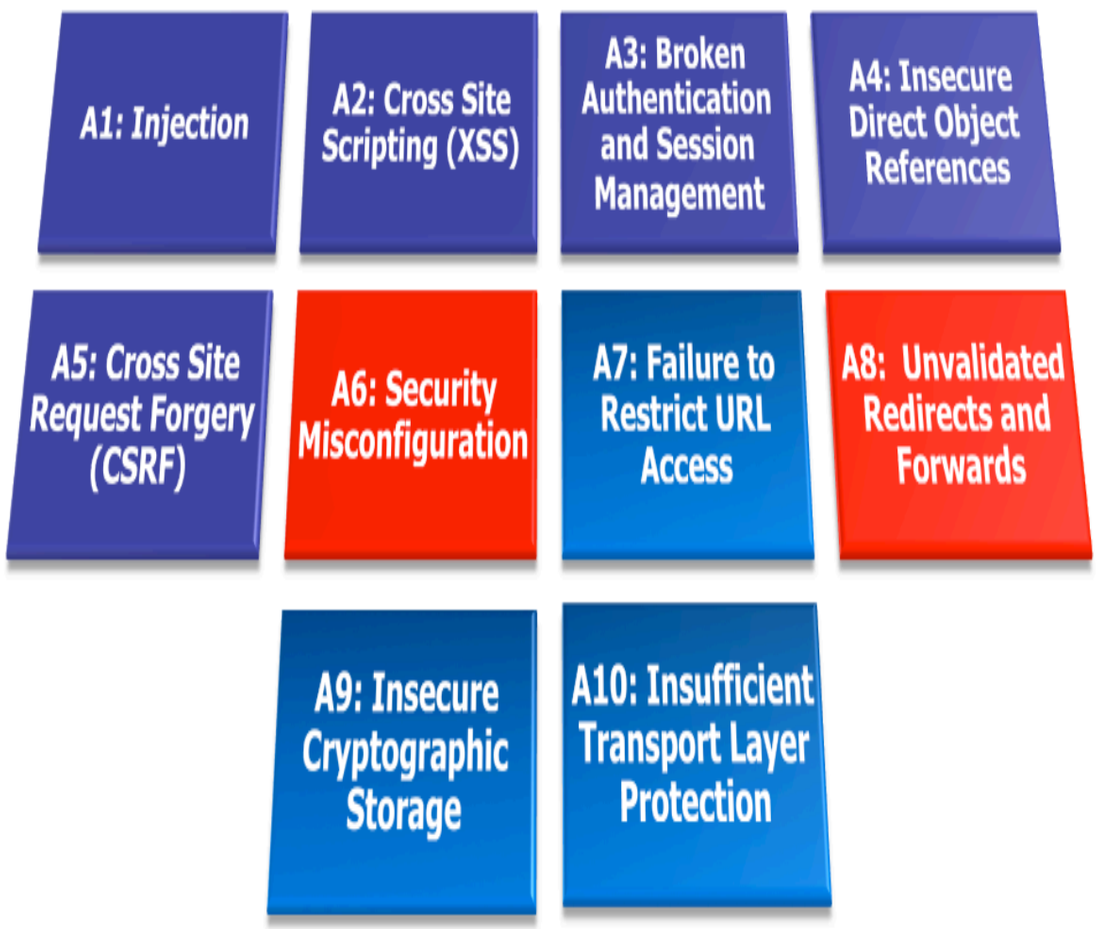
- Applies to the backend services
- Not mobile specific per se, but essential to get it right
- We still can't trust the client
- Luckily, we understand these issues (quite) well
- Existing controls may need to be re-evaluated

Impact

- Confidentially of data lost
- Integrity of data not trusted

M2- Weak Server Side Controls

OWASP Top 10



- https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

OWASP Cloud Top 10

- https://www.owasp.org/images/4/47/Cloud-Top10-Security-Risks.pdf

M2- Weak Server Side Controls
Prevention Tips

- Understand the additional risks mobile apps introduce into existing architectures
- Leverage the wealth of knowledge that is already out there
- OWASP Web Top 10, Cloud Top 10, Web Services Top 10
- Cheat sheets, development guides, ESAPI

Control	Description
5.1-5.8	Keep the backend APIs (services) and the platform (server) secure

M3- Insufficient Transport Layer Protection

- Complete lack of encryption for transmitted data
  - Yes, this unfortunately happens often
- Weakly encrypted data in transit
- Strong encryption, but ignoring security warnings
  - Ignoring certificate validation errors
  - Falling back to plain text after failures

Impact

- Man-in-the-middle attacks
- Tampering w/ data in transit
- Confidentiality of data lost

M3- Insufficient Transport Layer Protection

Real World Example: Google ClientLogin Authentication Protocol (fixed)

- Authorization header sent over HTTP
- When users connected via wifi, apps automatically sent the token in an attempt to automatically synchronize data from server
- Sniff this value, impersonate the user
  - http://www.uni-ulm.de/in/mi/mitarbeiter/koenings/catching-authtokens.html

M3- Insufficient Transport Layer Protection Prevention Tips

- Ensure that all sensitive data leaving the device is encrypted
- This includes data over carrier networks, WiFi, and even NFC
- When security exceptions are thrown, it's generally for a reason…DO NOT ignore them!

Control	Description
3.1.3.6	Ensure sensitive data is protected in transit

M4- Client Side Injection

- Apps using browser libraries
  - Pure web apps
  - Hybrid web/native apps
- Some familiar faces
  - XSS and HTML Injection
  - SQL Injection
- New and exciting twists
  - Abusing phone dialer + SMS
  - Abusing in-app payments

Impact

- Device compromise
- Toll fraud
- Privilege escalation

M4- Client Side Injection

Garden Variety XSS….

```
@Override
public void onCreate(Bundle savedInstanceState) {

    super.onCreate(savedInstanceState);
    setContentView(R.layout.demo);
    context = this.getApplicationContext();
    webView = (WebView) findViewById(R.id.demoWebView);
    webView.getSettings().setJavaScriptEnabled(true);
    webView.addJavascriptInterface(new SmsJSInterface(this),
            "smsJSInterface");
    GetSomeInfo getInfo = new GetSomeInfo();
    getInfo.execute(null, null);
}

public String generateHTML(String untrustedData) {

    return "<b>Check this out!</b><br>" + untrustedData;
}
```

With access to:

```
public class SmsJSInterface implements Cloneable {

    Context mContext;

    public SmsJSInterface(Context context) {

        mContext = context;
    }

    public void sendSMS(String phoneNumber, String message) {

        SmsManager sms = SmsManager.getDefault();
        sms.sendTextMessage(phoneNumber, null, message, null, null);
    }
```

M4- Client Side Injection
Prevention Tips

- Sanitize or escape untrusted data before rendering or executing it
- Use prepared statements for database calls…concatenation is still bad, and always will be bad
- Minimize the sensitive native capabilities tied to hybrid web functionality

Control	Description
6.3	Pay particular attention to validating all data received from and sent to non-trusted third party apps before processing
10.1-10.5	Carefully check any runtime interpretation of code for errors

M5- Poor Authorization and Authentication

- Part mobile, part architecture
- Some apps rely solely on immutable, potentially compromised values (IMEI, IMSI, UUID)
- Hardware identifiers persist across data wipes and factory resets
- Adding contextual information is useful, but not foolproof

Impact

- Privilege escalation
- Unauthorized access

M5- Poor Authorization and Authentication

```
if (dao.isDevicePermanentlyAuthorized(deviceID)) {
    int newSessionToken = LoginUtils.generateSessionToken();
    dao.openConnection();
    dao.updateAuthorizedDeviceSession(deviceID,
            sessionToken, LoginUtils.getTimeMilliseconds());
    bean.setSessionToken(newSessionToken);
    bean.setUserName(dao.getUserName(sessionToken));
    bean.setAccountNumber(dao.getAccountNumber(sessionToken));
    bean.setSuccess(true);
    return bean;
}
```

M5- Poor Authorization and Authentication Prevention Tips

- Contextual info can enhance things, but only as part of a multi-factor implementation
- Out-of-band doesn't work when it's all the same device (i.e. MTAN)
- Never use device ID or subscriber ID as sole authenticator

Control	Description
4.1-4.6	Implement user authentication/authorization and session management correctly
8.4	Authenticate all API calls to paid resources

M6- Improper Session Handling

- Mobile app sessions are generally MUCH longer
- Why? -> Convenience and usability
- Apps maintain sessions via
  - HTTP cookies
  - OAuth tokens
  - SSO authentication services
- Using a device identifier as a session token is a bad idea

Impact

- Privilege escalation
- Unauthorized access
- Circumvent licensing and payments

M6- Improper Session Handling
Prevention Tips

- Don’t be afraid to make users re-authenticate from time to time
- Ensure that tokens can be revoked quickly in the event of a lost/stolen device
- Utilize high entropy, tested token generation resources

Control	Description
1.13	Use non-persistent identifiers
4.1-4.6	Implement user authentication/authorization and session management correctly

M7- Security Decisions Via Untrusted Inputs

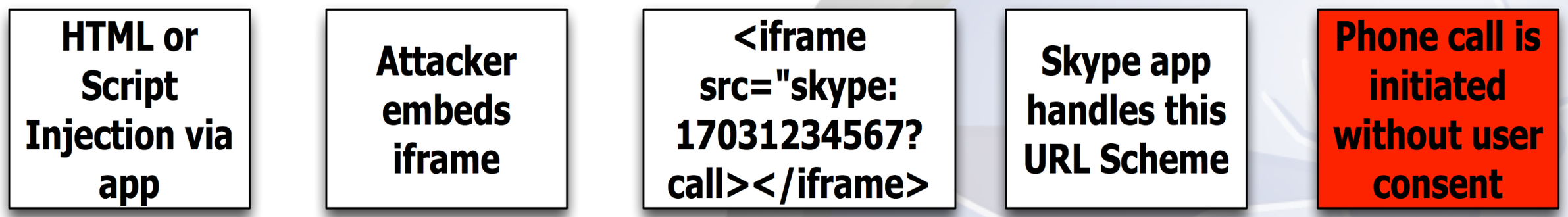
- Can be leveraged to bypass permissions and security models
- Similar but different depending on platform
  - iOS: Abusing URL Schemes
  - Android: Abusing Intents
- Several attack vectors
  - Malicious apps
  - Client side injection

Impact

- Consuming paid resources
- Data exfiltration
- Privilege escalation

M7- Security Decisions Via Untrusted Inputs

Skype iOS URL Scheme Handling Issue



- http://software-security.sans.org/blog/2010/11/08/insecure-handling-url-schemes-apples-ios/

M7- Security Decisions Via Untrusted Inputs

Prevention Tips

- Check caller's permissions at input boundaries
- Prompt the user for additional authorization before allowing
- Where permission checks cannot be performed, ensure additional steps required to launch sensitive actions

Control	Description
10.2	Run interpreters at minimal privilege levels

M8- Side Channel Data Leakage

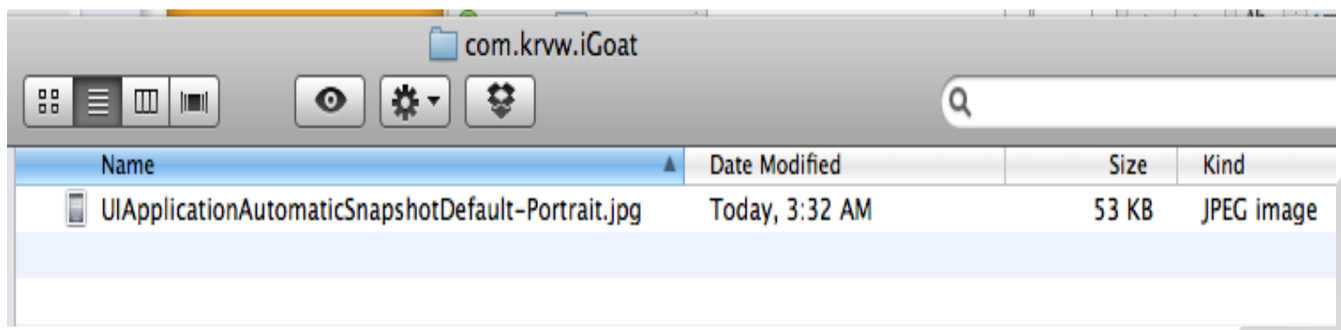
- Mix of not disabling platform features and programmatic flaws
- Sensitive data ends up in unintended places
  - Web caches
  - Keystroke logging
  - Screenshots (i.e. iOS backgrounding)
  - Logs (system, crash)
  - Temp directories
- Understand what 3rd party libraries in your apps are doing with user data (i.e. ad networks, analytics)

Impact

- Data retained indefinitely
- Privacy violations

M8- Side Channel Data Leakage

Screenshots



Logging

```
try {
    userInfo = client.validateCredentials(userName, password);
    if (userInfo.get("success").equals("true"))
        launchHome(v);
    else {
        Log.w("Failed login", userName + " " + password);
    }

} catch (Exception e) {
    Log.w("Failed login", userName + " " + password);
}
```

M8- Side Channel Data Leakage
Prevention Tips

- Never log credentials, or any other sensitive data to (system) logs
- Remove sensitive data before screenshots are taken, disable keystroke logging per field, and utilize anti-caching directives for web content
- Debug your apps before releasing them to observe files created, written to, or modified in any way
- Carefully review any third party libraries you introduce and the data they consume
- Test your applications across as many platform versions as possible

Control	Description
7.3	Check whether you are collecting PII, it may not always be obvious
7.4	Audit communication mechanisms to check for unintended leaks (e.g. image metadata)

M9- Broken Cryptography

- Two primary categories
  - Broken implementations using strong crypto libraries
  - Custom, easily defeated crypto implementations
- Encoding != encryption
- Obfuscation != encryption
- Serialization != encryption

Impact

- Confidentiality of data lost
- Privilege escalation
- Circumvent business logic

M9- Broken Cryptography

```
byte[] arrayOfByte1 = { 110, 72, 113, 80, 114, 89, 52, 52, 68, 115, 55, 71, 104, 98, 72, 71 };
sKey = new SecretKeySpec(arrayOfByte1, "AES");
sKeySize = 16;
sIvBytes = new byte[16];
byte[] arrayOfByte2 = sIvBytes;
sIvSpec = new IvParameterSpec(arrayOfByte2);
sPaddingChar = 32;
```

M9- Broken Cryptography
Prevention Tips

- Storing the key with the encrypted data negates everything
- Leverage battle-tested crypto libraries vice writing your own
- Take advantage of what your platform already provides!

Control	Description
1.3	Utilize file encryption API's
2.3	Leverage secure containers

M10- Sensitive Information Disclosure

- We differentiate by stored (M1) vs. embedded/hardcoded (M10)
- Apps can be reverse engineered with relative ease
- Code obfuscation raises the bar, but doesn't eliminate the risk
- Commonly found "treasures":
  - API keys
  - Passwords
  - Sensitive business logic

Impact

- Credentials disclosed
- Intellectual property exposed

M10- Sensitive Information Disclosure

```
if (rememberMe)
    saveCredentials(userName, password);
//our secret backdoor account
if (userName.equals("all_powerful")
        && password.equals("iamsosmart"))
    launchAdminHome(v);
```

```
public static final double SECRET_SAUCE_FORMULA = (1.2344 * 4.35 - 4 + 1.442) * 2.221;
```

M10- Sensitive Information Disclosure
Prevention Tips

- Private API keys are called that for a reason…keep them off of the client
- Keep proprietary and sensitive business logic on the server
- Almost never a legitimate reason to hardcode a password (if there is, you have other problems)

Control	Description
2.10	Do not store any passwords or secrets in the application binary

Wrap Up

Going Forward

- 12 month revision cycle
  - Rapidly evolving platforms
  - Stale data == not as useful
- If you have suggestions or ideas, we want to hear them!

Conclusion

- This is a good start, but we have a long way to go
- We’ve identified the issues…now we have to fix them
- Platforms must mature, frameworks must mature, apps must mature
- The OWASP Mobile body of knowledge must grow

Q&A

Thanks for listening!

- Thanks to Jack Mannino, Zach Lanier and Mike Zusman for their original OWASP Top 10 Mobile Risks presentations.

- Contact me:
  - sven.vetsch@owasp.org
  - Twitter: @disenchant_ch / @owasp_ch