Vulnerabilites in the SaaS era

SaaS as the new attack vector

About me

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ADALLOM
SECURITY WITHOUT BOUNDARIES

Purpose

- **This talk's purpose:**
  - — Demonstrate how Enterprises use SaaS
  - — Get you thinking about SaaS security
  - — Question the transparency of SaaS security

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- **How many of you use SaaS?**

Vocabulary

- **Cloud – marketing buzz word**
- **On-premise – “datacenters” in enterprises**
- **SaaS – Software as a Service**

  Google Apps (Gmail, Drive), Dropbox, Box, Office 365, Salesforce, SuccessFactors, LivePerson, Jive
- **PaaS – Platform as a Service**

  — Azure, Force.com, Heroku
- **IaaS – Infrastructure as a Service**

  — Azure, Amazon EC2

SaaS crash course

- **Story background – Enterprises**
  - The “old world” – on-premise networks
  - Multiple on-premise services:
    - IM & Mails
    - CRM
    - HR management
    - Collaboration (file sharing)
  - Very well-defined perimeter

Perimeters under company policy

Internal

Workstations

CRM

ERP

Mail

HR

Files

DMZ

Mail services

FWs & Unified Threat Management

WAF

IDS & IPS

DLP systems

DB security systems

Information Rights Management

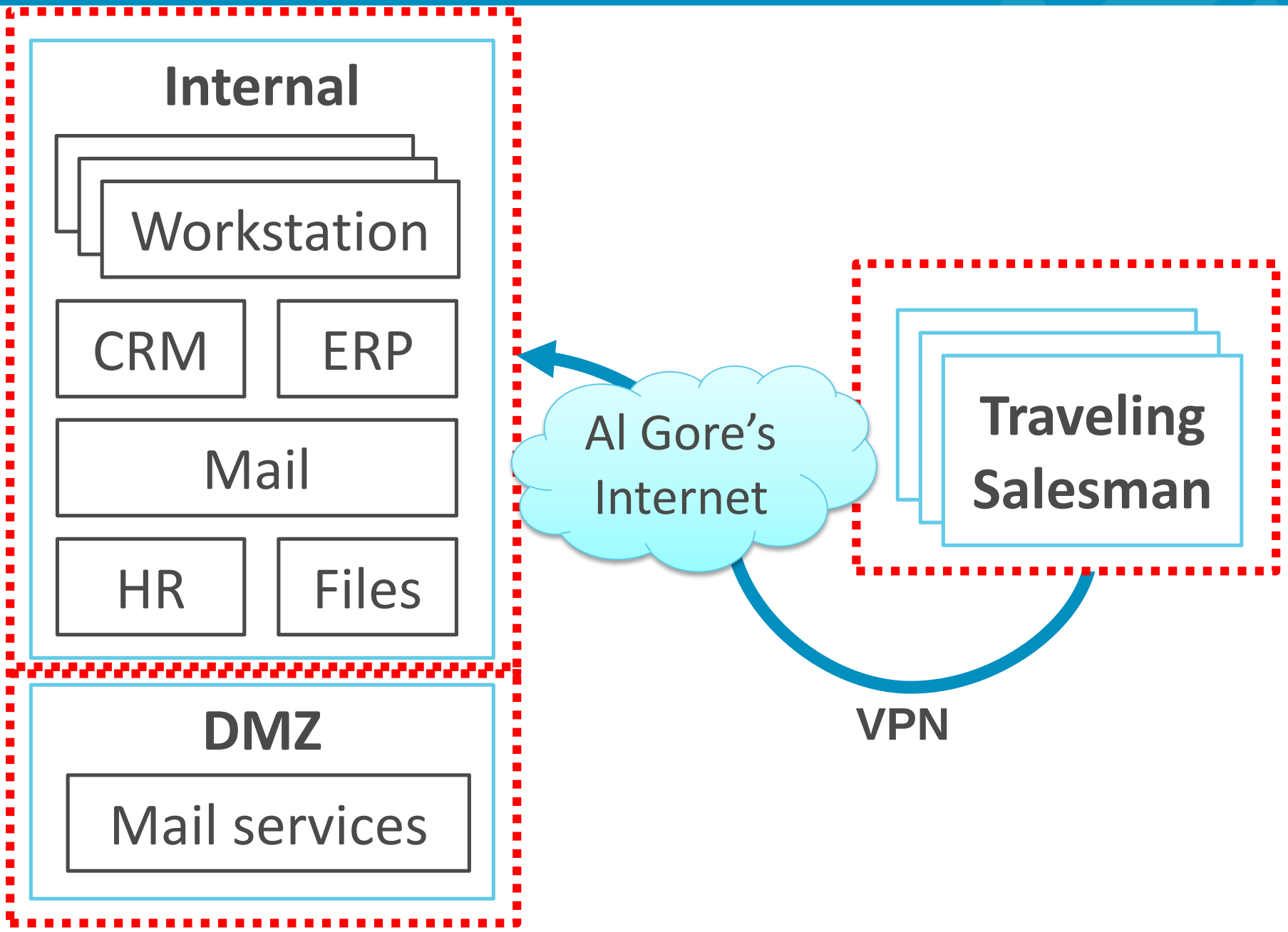
Enterprise users

- **Several types of users:**
  - — Regular users (9-to-5, no home access)
  - — Power users (home access)
  - — Travelers (on-the-road access)
- **Users need remote access to resources**
  - — How to allow access AND keep things secure?

Enterprise users

- **Solution depends on the specific sector**
  - — Financial and medical institutions are the strictest
- **Some allow external access to resources**
  - — Sometimes coupled with 2-factor auth. (OTP)
- **VPN clients and company policy enforcement**
  - — Managed laptops
  - — VPN with enforcement of strict OS, AV, FW policies

Perimeters under company policy



Troubles in paradise

- **Security often stands in the way of work**
  - — People work better with mobile access
  - — Multi-site deployment hell
  - — Slow response to new needs
- **Ever increasing costs**
  - — Skilled IT staff is expensive
  - — Hardware, licensing
  - — Disaster recovery
- **You are as secure as your IT security skills.**

Introducing SaaS..

- **All you need is a browser! IT staff's dream..**
- **Predictable costs**
  - — $ / user / month
- **No scaling issues**
  - — No need to buy more servers to support more users
- **"Access anywhere" (+ predictable performance ww)**
- **Secure**
  - — SaaS vendors invest a lot in infrastructure security
  - — End user security is a different story..

Nothing is without problems

- **Data is out of your sight**
  - — It’s somewhere in the “cloud”. Where?
  - — What are the backup policies?
  - — How do I know if my data was accessed?
- **Availability**
  - — Helplessness during technical issues
- **Privacy issues**
  - — Some countries (mostly European) have tough restrictions on data residency

New security challenges

- **Access data anywhere**
  - Any location
  - Any computer
  - Any operating system
  - Any browser
  - Any AV (if any)
- **Auditing logs – at the discretion of the SaaS vendor**
- **Effectively a new (and broad) attack vector. `**
- **Alerts? SIEM?**

Type I Attack – Infrastructure layer

- APT against the SaaS provider
- Physical security
- Data center security
- Side-Channel Attack
- DDoS

Type II Attack – Application layer

- Web vulnerabilities (e.g. XSS)
- SQL injection
- Authentication bypass
- Configuration error vulnerabilities

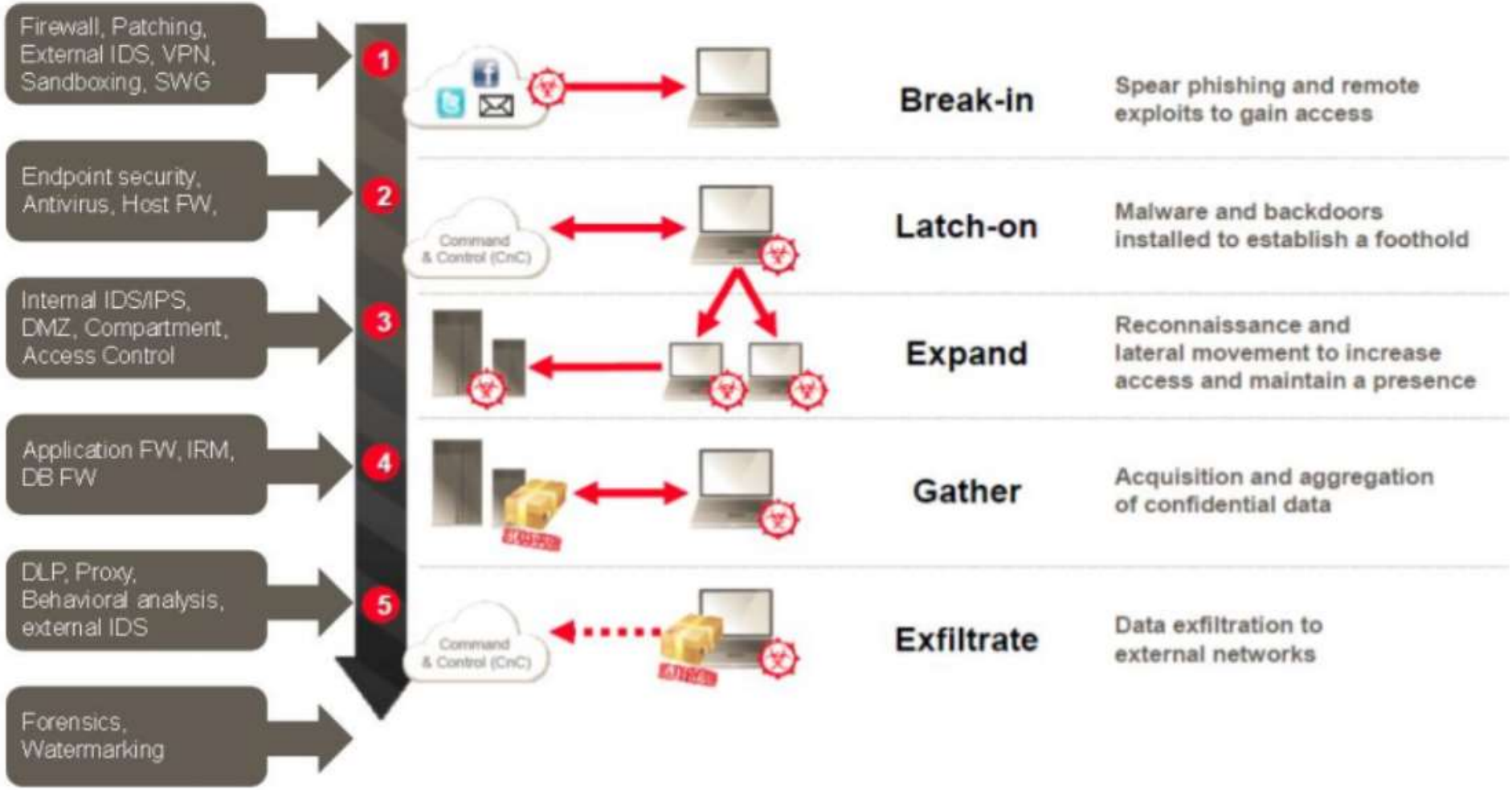
Type III Attack – End user

- Credential theft
- Data harvesting
- Exfiltration
- Data alteration
- Defamation

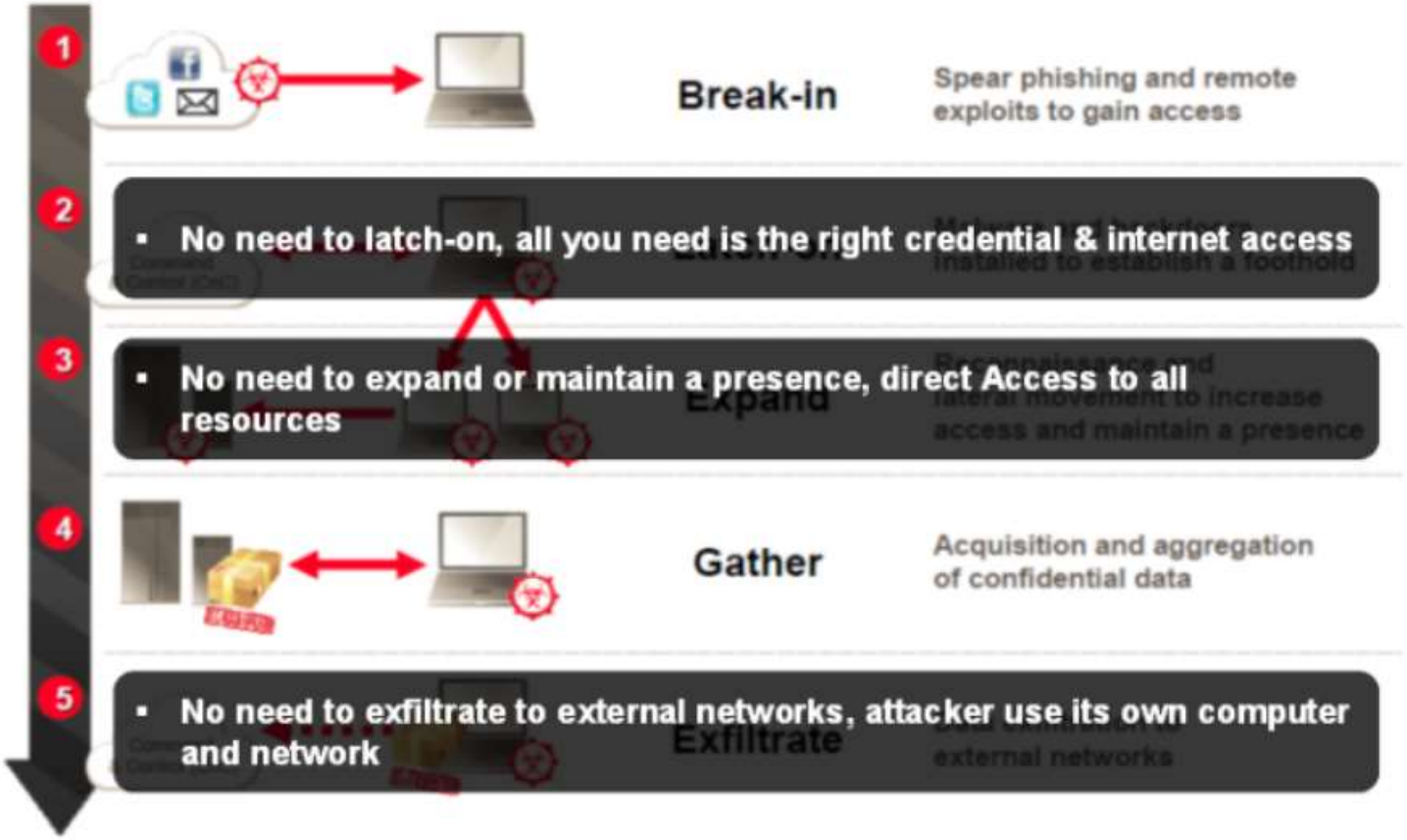
SaaS provider responsibility

Enterprise responsibility

Targeted attack – on-premise



Targeted attack - SaaS



Authentication in the Cloud

- **Starting point: simple username & password**
- **What if I use 20 applications at Work?**
  - — Single sign on
  - — User (de-)provisioning
- **SSO (IdP) providers**
  - — Cloud: OneLogin, Okta
  - — On-premise: Microsoft ADFS, IBM Tivoli, HP IceWall
- **Protocol war for SSO**
  - — SAML 2.0 emerged victorious (unless you ask MS)

SAML 101

- **Security Assertion Markup Language 2.0**
  - — Celebrated its 9th birthday last week!
- **Used to exchange claims (assertions) about a user's identity in signed XMLs.**
- **Instead of presenting a password:**
  - — You presents a claim signed by a trusted IdP.
- **SAML or similar protocols are used:**
  - — Between SaaS applications
  - — Within(!) SaaS applications

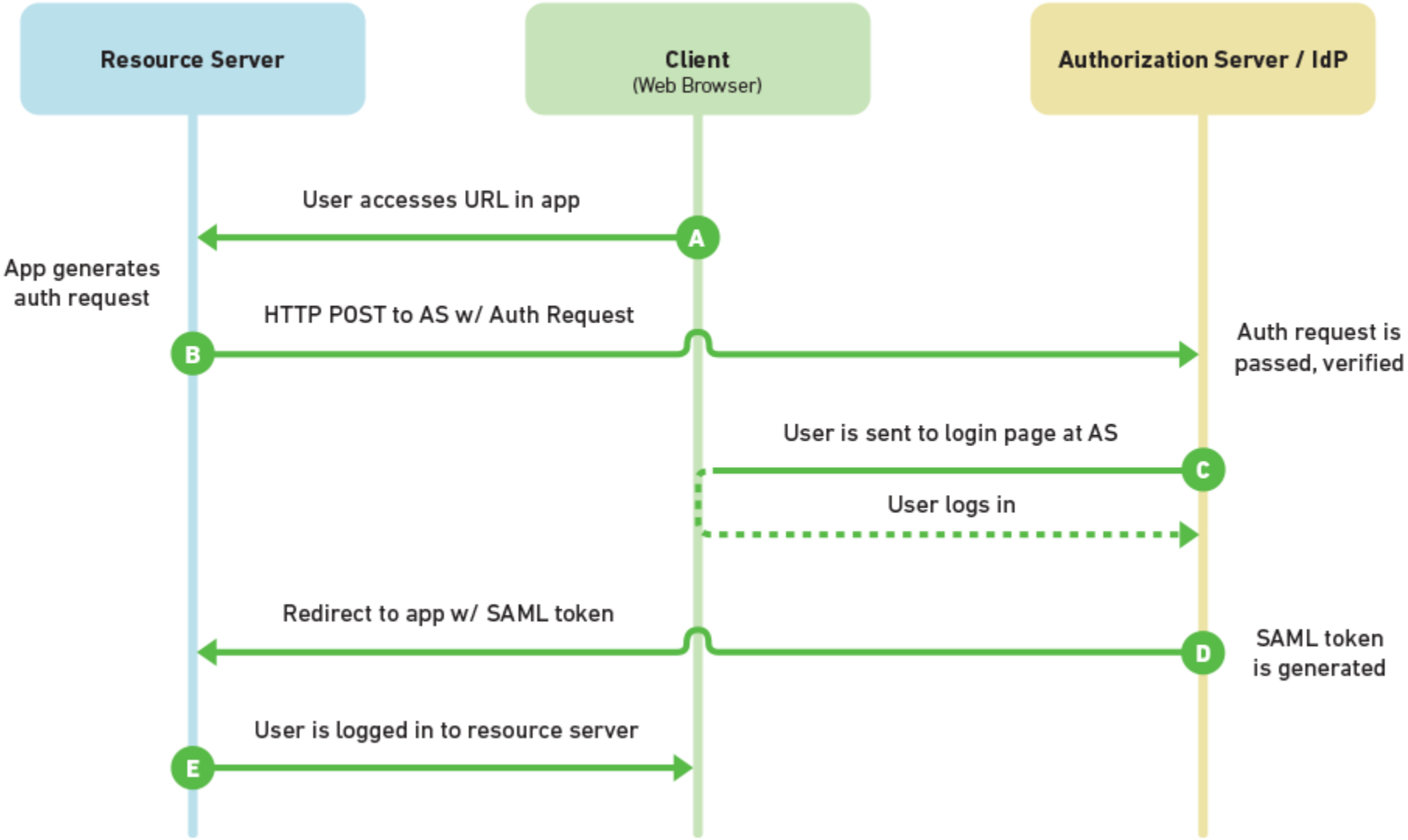
SAML flow

- **Three parties to every authentication:**
  - — Service Provider – the consumer of claims.
  - — Browser
  - — Identity Provider (IdP) – the producer of claims.

- **The browser is pimped around by the SP and IdP.**

SAML flow

Security Assertion Markup Language 2.0



A potential Achilles heel

- **Really difficult to implement right**
  - — You can take advantage of _some_ libraries
- **No mainstream/standard implementation**
  - — Shibboleth is closest to that, but it's far from popular
  - — Everybody's winging it
- **Many different implementations**
  - — Compatibility issues
  - — Very few "eyes" (like us) tried to find bugs
- **Lots of bugs that are waiting to be discovered**

High-profile vulnerabilities

- **Facebook remote code execution (due to SSO bug!)**
  - — And why defaults are important
- **The Enemy Within (currently in responsible disclosure)**
  - — And the border between customization and security
- **Ice Dagger – MS13-104**
  - — Embarrassing Office 365 token theft bug

Facebook OpenID RCE vuln.

- **Found by Reginaldo Silva in November 2013.**
  - — Facebook's highest bounty: $33.5k
- **Optional "forgot password" flow:**
  - — Use Google account to prove ownership
  - — Works using OpenID
- **Facebook is using libxml to process these XMLs**
  - — Default settings permit XML External Entity

Facebook – cont'd

- **Basically, you get to open local files and conns.**
- **The fix? Simply add:**
  - `libxml_disable_entity_loader(true);`
- **The truth?**
  - These things are quite common.
  - Default values aren't always secure.
- **Our example: libxmlsec**
  - Requires user to explicitly disable the option to specify custom certificate during XML sig. check

The Enemy Within

- **A vulnerability in one of the Top 10 SaaS apps.**
- **Currently in responsible disclosure.**
- **Takes advantage of the paradigm that SaaS apps consider their own domains to be trusted.**

- **But what happens when users are able to upload custom files or even customize JS?**

- **Easy (and silent) drive-by theft of token & cookies.**

Office 365 token disclosure vuln.

- **Nicknamed “Ice Dagger” – leaves no trace..**
- **Crafted HTTP response retrieves one’s O365 token**
  - — “The keys” to Office 365 – Microsoft’s cloud platform
- **Timeline:**
  - — Found **in the wild** at one of our clients in April 2013
  - — Temporary fix for the client in place 2 days later
  - — Reported on May 2013
  - — Patched on December 2013

Some background

- **Our proxy processed an unusual HTTP request.**
- **Flagged by our heuristics engine due to two strikes:**
  - — Destination host was a known TOR gateway
  - — The request was performed by Microsoft Word
- **Scheduled for in-depth review by Adallom Labs.**

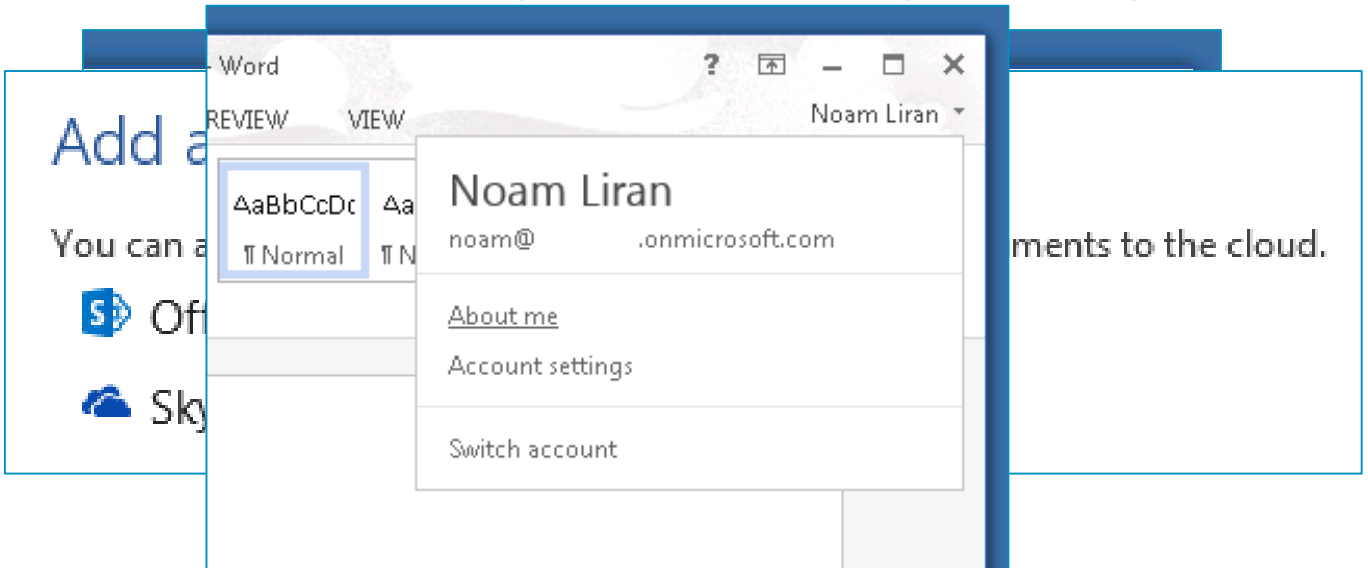
- **Our story begins.**

Office 365 crash course

- **Microsoft's cloud offering for organizations**
  - — Main competitor is Google Apps for Business
- **Comprised of:**
  - — Exchange Online (hosted email service)
  - — SharePoint Online (collaboration services)
  - — OneDrive Pro (file storage, formerly SkyDrive)
  - — Office 2013 desktop applications (Word and friends)
- **These are very different products fused together**

Office 2013 changes for the cloud

- **We're going to talk mainly about Word**
  - — But it's the same for PowerPoint, Excel, OneNote
- **Instead of serial numbers – you sign in to activate.**
- **Must be signed for SharePoint and OneDrive.**
- **There's a psychological campaign to sign you in:**



Once you’re signed in

- **Word exchanges your credentials for a token**
  - — It is then internally stored.
- **When you try to access SharePoint or OneDrive**
  - — Word trades its token for an authentication cookie
  - — The cookie has a short life span, the token has a really long one

Back to our case

- **We started tracing the request**
  - — We got to the specific device
  - — Questioned the employee
  - — Reconstructed his actions with him
- **The trigger: a spear fishing email**
  - — Contained information relevant to his job.
- **The link destination was a TOR gateway**
  - — Using a TOR hidden service

Back to our case – cont'd

- **The hidden service was no longer accessible**

  — Duh!

- **The IP in the email was an anonymous proxy.**
- **No document to investigate**
- **No file hash to track**

Demo time

- **We’re going to use Fiddler**
  - — Web Debugging Proxy
  - — Available for free from http://www.telerik.com/fiddler
- **We’re going to do it step-by-step**
  - — Please – slow me down if something is unclear.

Aftermath

- **We managed to fully reproduce and develop a POC**
- **We contacted MSRC on the 29th of May with:**
  - — Detailed research
  - — Working POC
- **We begun our quest for a patch**

Aftermath

- **It took over 6 months (!) for the patch to come out**
  - — Bypassing MSFT's bullshit filters took a few weeks
  - — Reproduction took them a few weeks too.
    - — Even though we supplied a working PoC.
- **Responsible disclosure – or irresponsible one?**
  - — Users were vulnerable for a long period of time
  - — No pressure on the vendor to fix the issue
  - — Some companies could have protected themselves

Aftermath – cont'd

- **Why was vulnerability classified as "Important"?**
  - — According to MSFT it's because *"It does not result in remote code execution"*
- **How are they be assessing SaaS vulnerabilities?**
  - — Could it be using metrics from the Windows world?

What if I told you..

- **That most of these vulnerabilities are fixed silently?**
- **That there's no CVE/NVD for SaaS applications?**
- **That SaaS vendors are reluctant to have one?**
  - — And to fix the reported ones

- **It's our shared responsibility**
  - — Insist on having a CVE for every disclosure
  - — Push for a unified disclosure mechanism for SaaS
  - — Insist and apply pressure for early patching

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THANK YOU

Questions?