Hochschule
Albstadt-Sigmaringen
Albstadt-Sigmaringen University

Defeating the Secrets of OTP Apps

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// Agenda

- Introduction
- Forensic Use
- Background
- Research
- Results
- Conclusion

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- —> Weak PW (user) / **unsalted** Hashes (provider)

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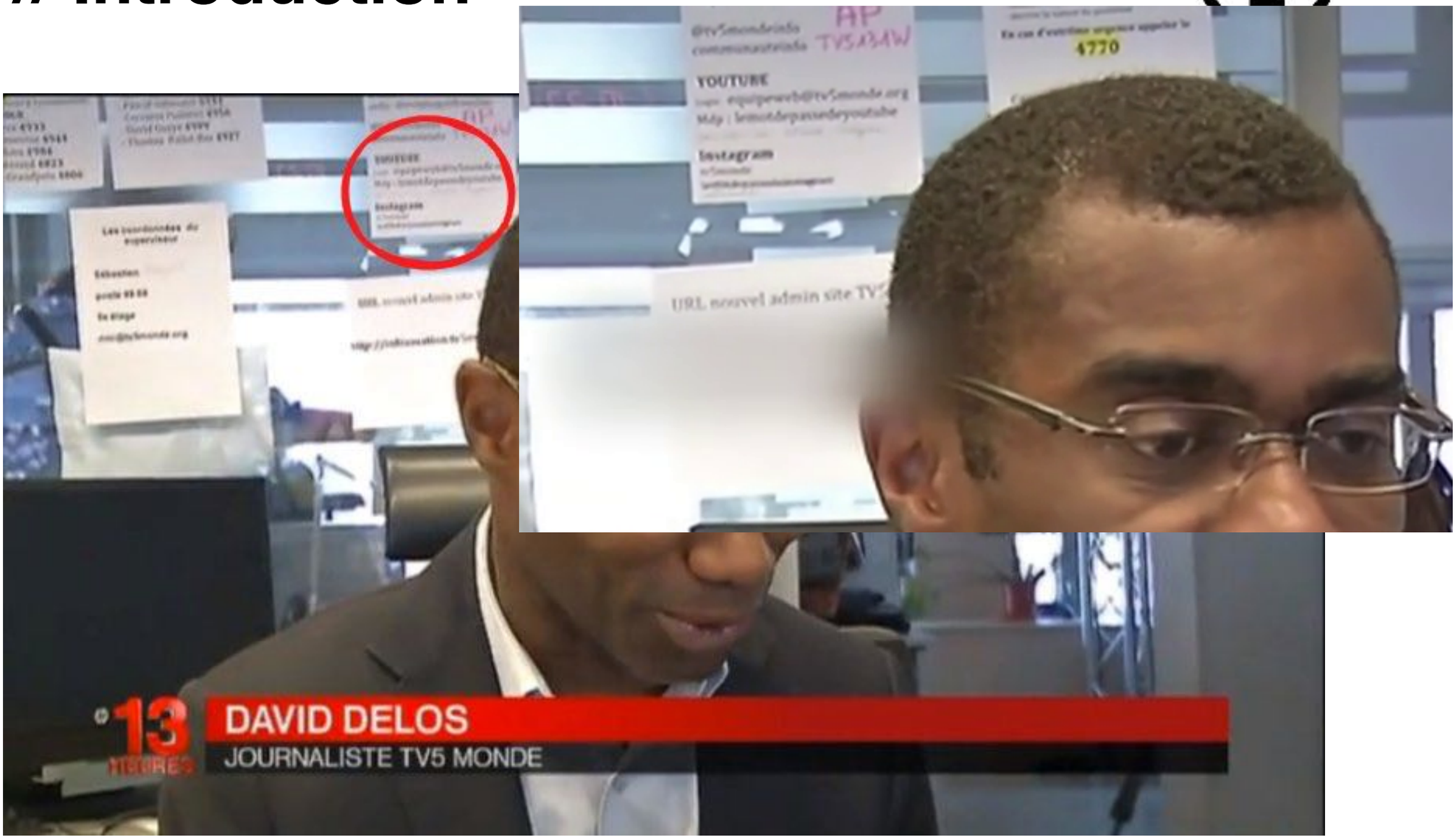

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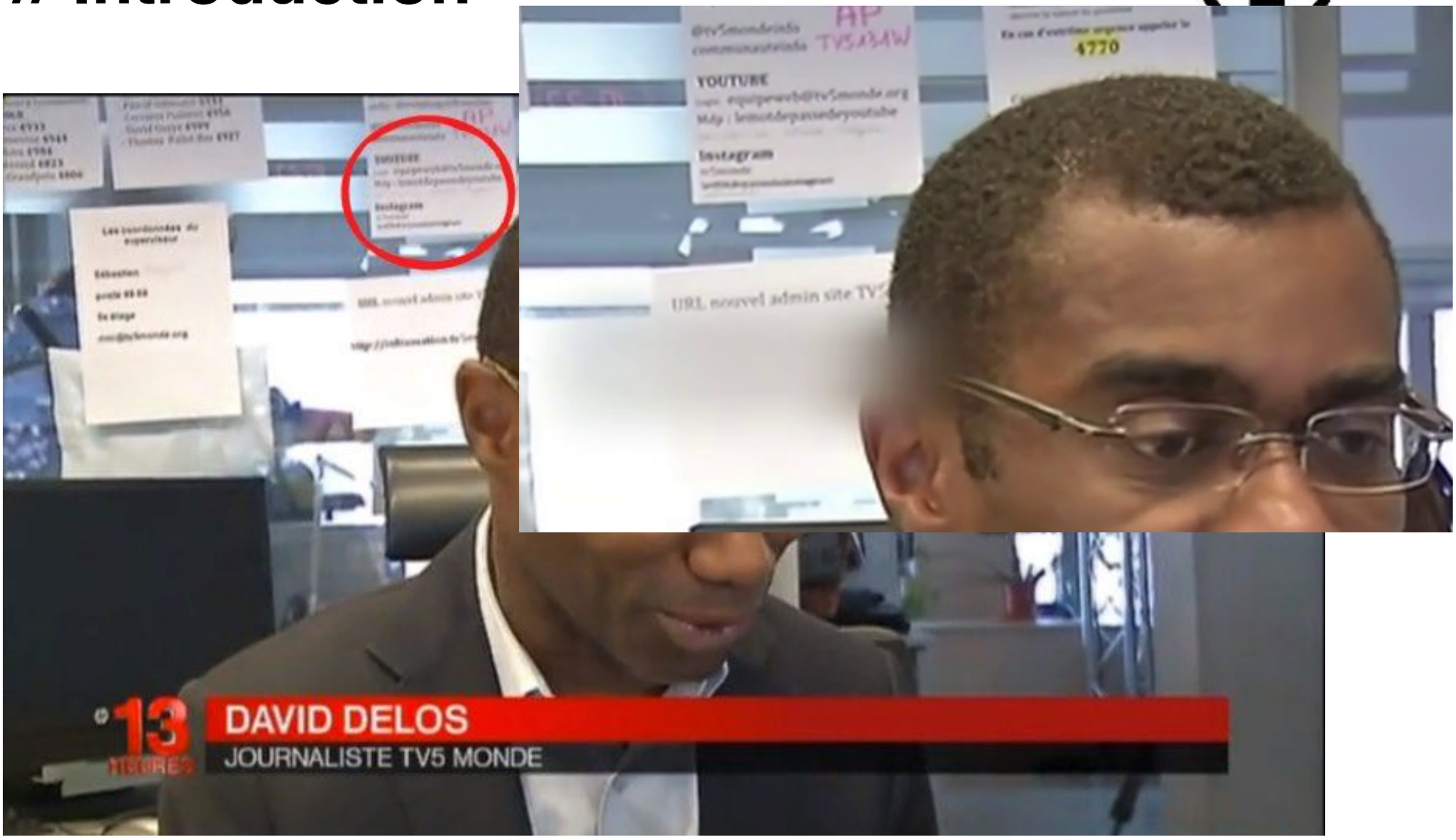

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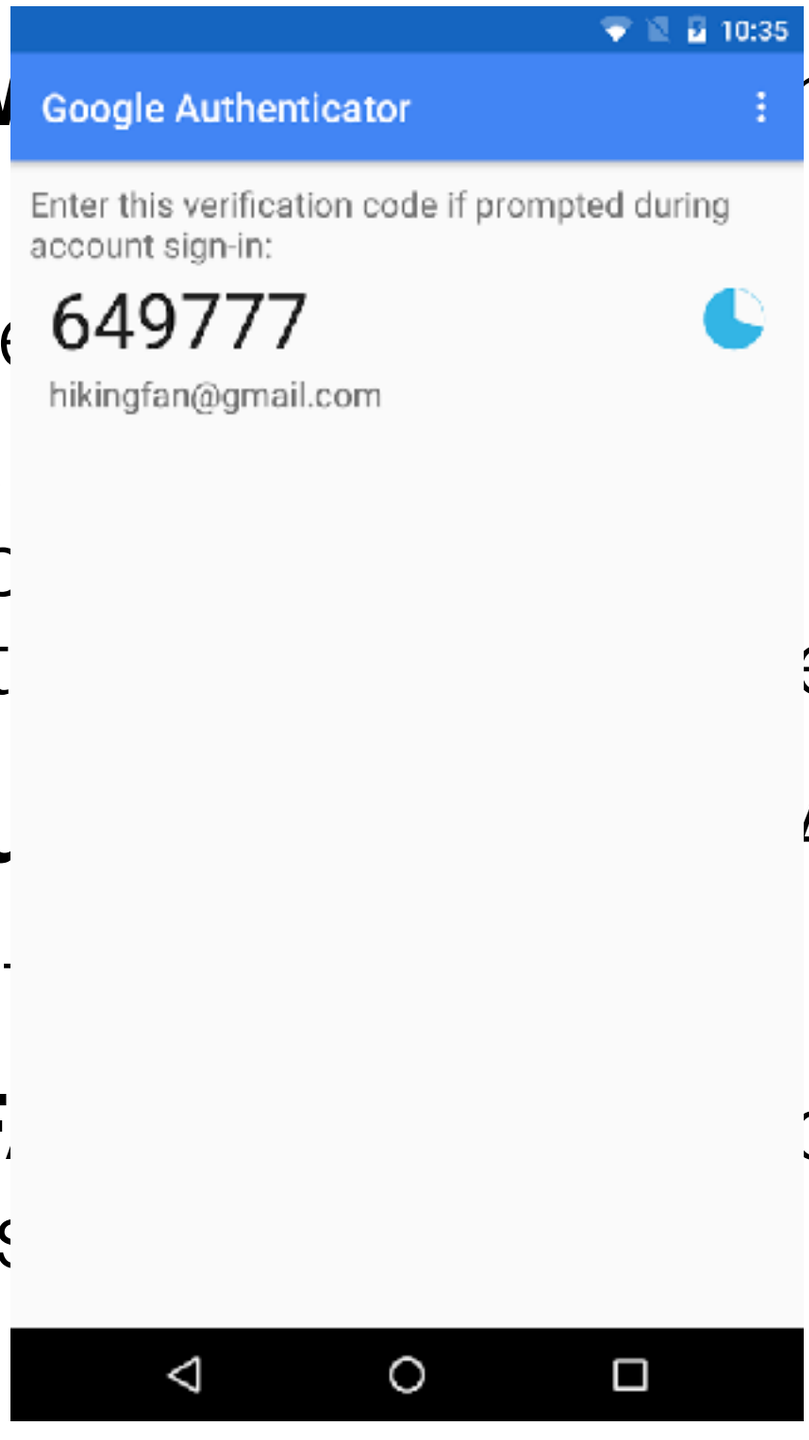

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- **Chain of evidence** could be closed

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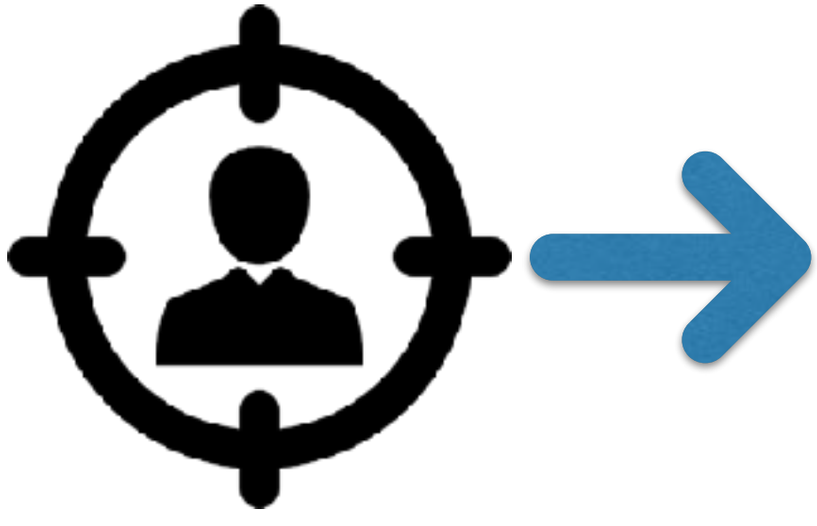

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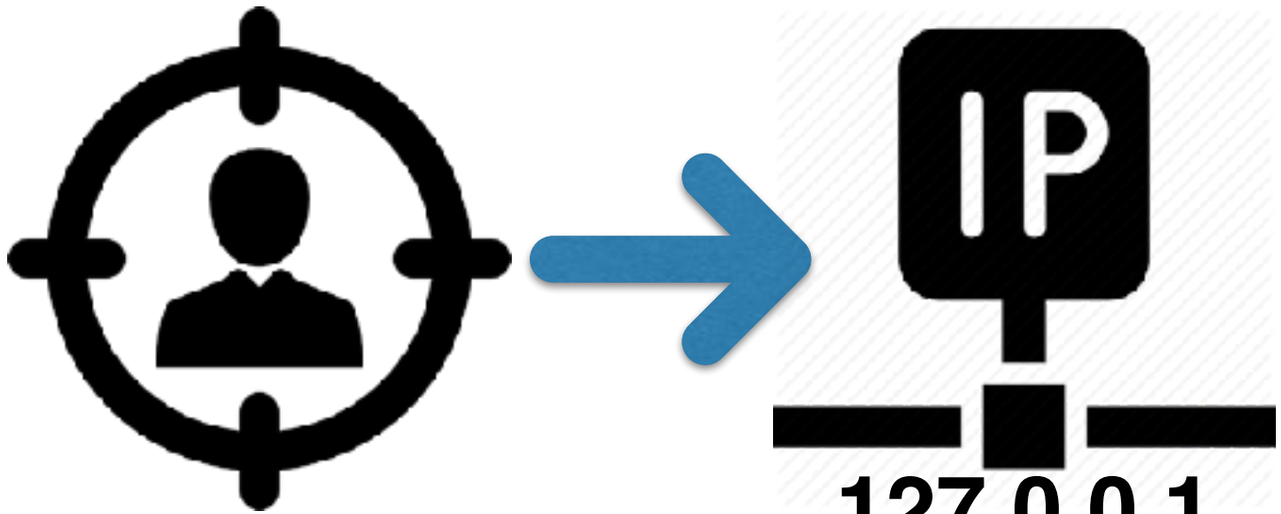

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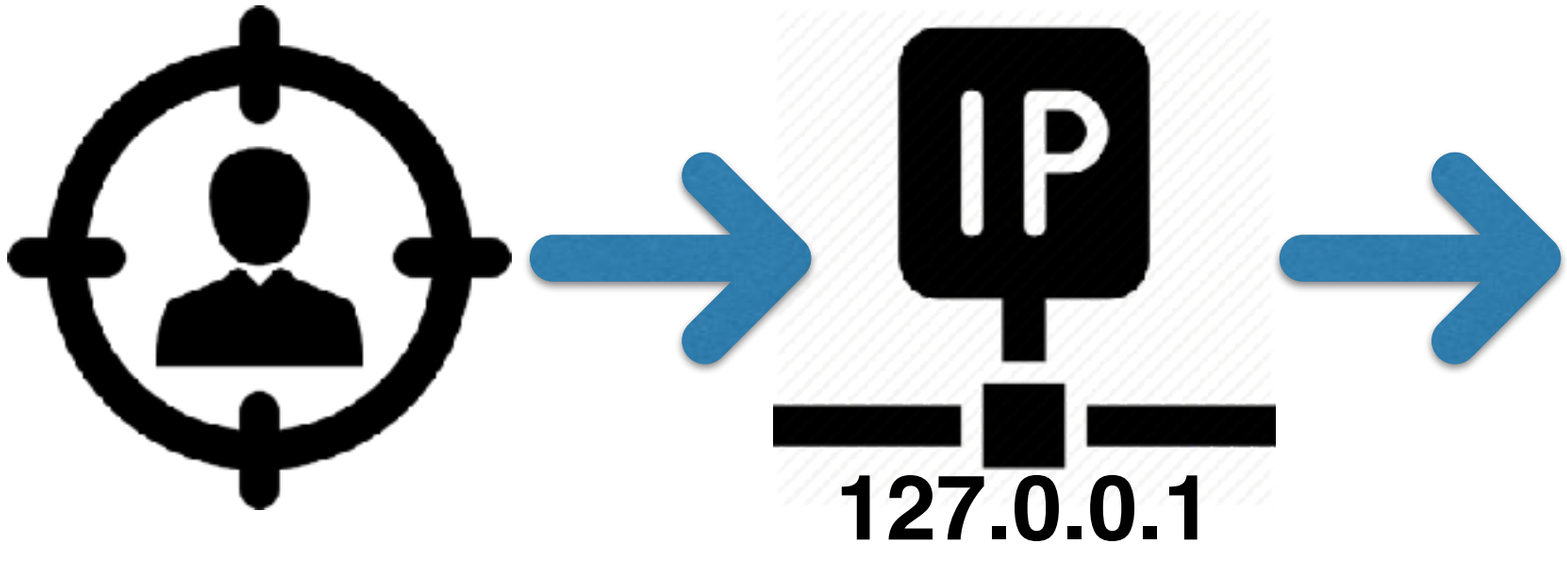

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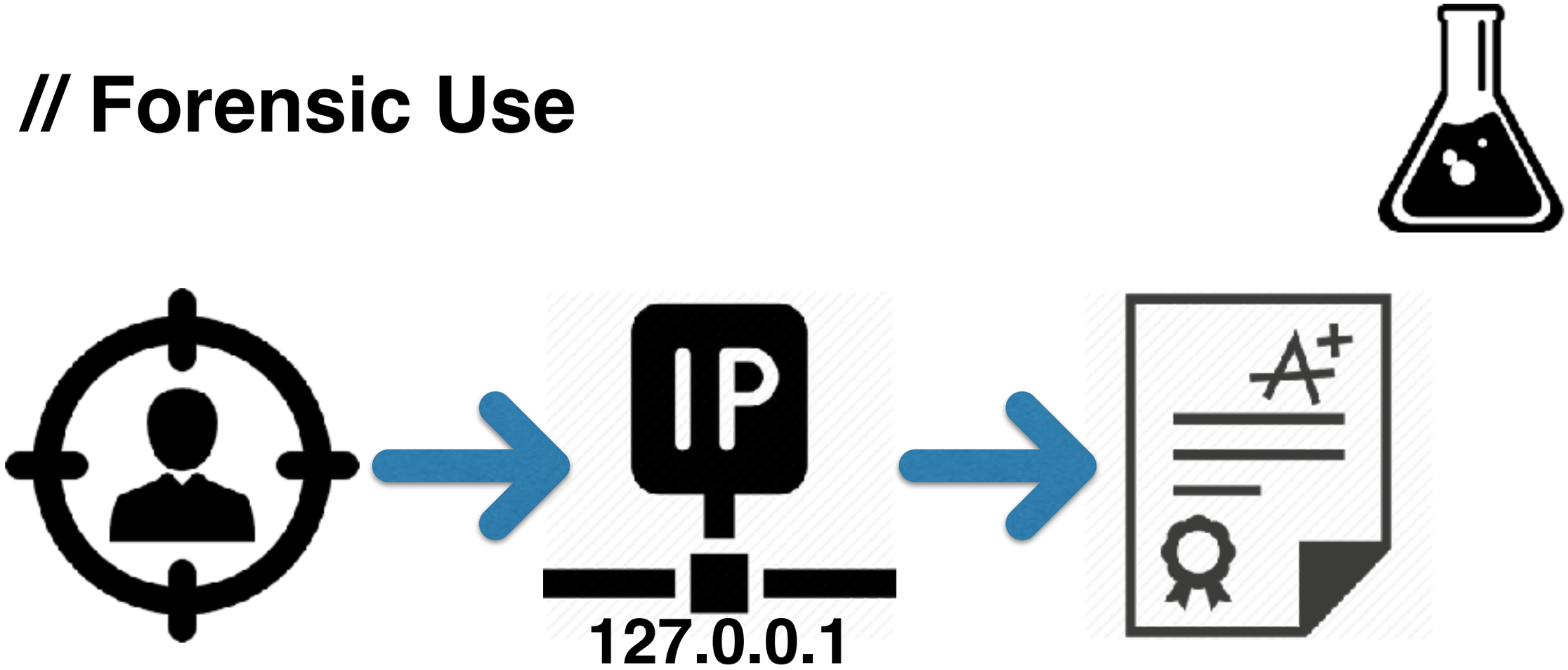

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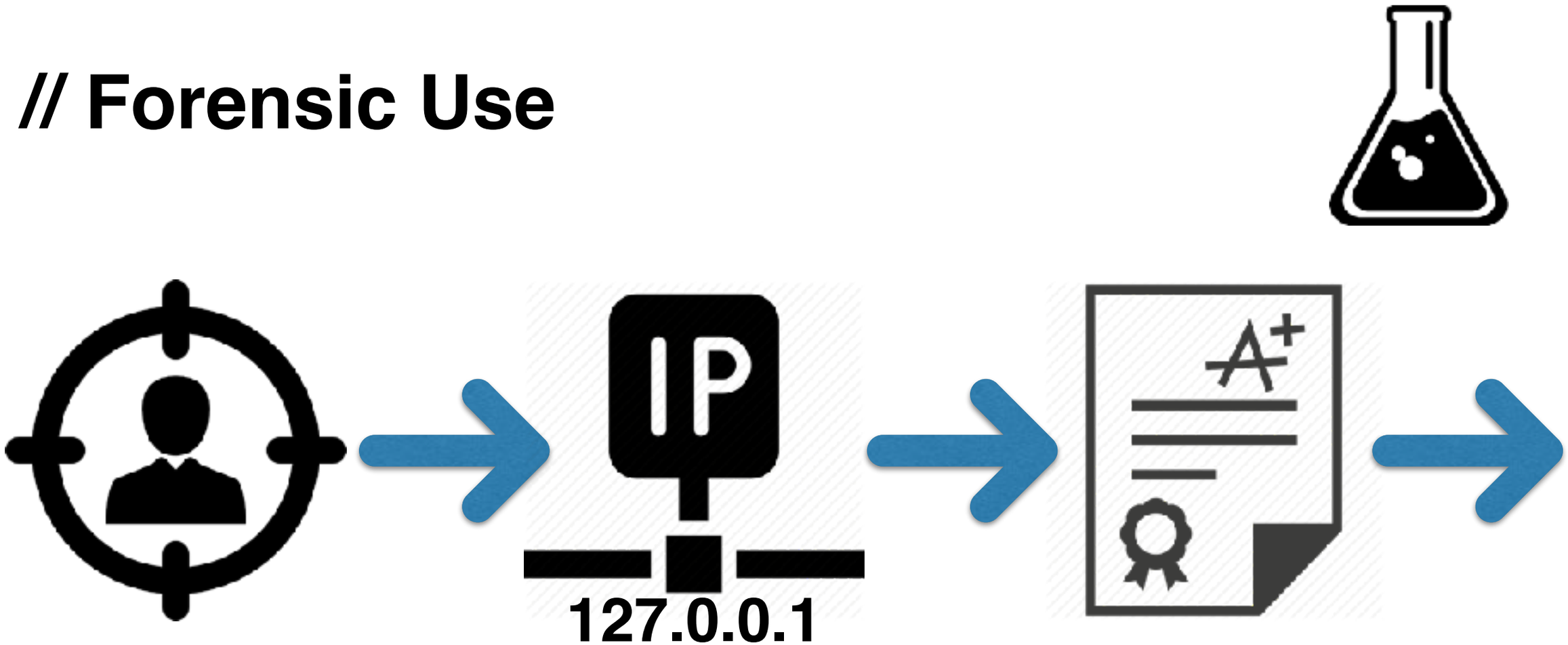

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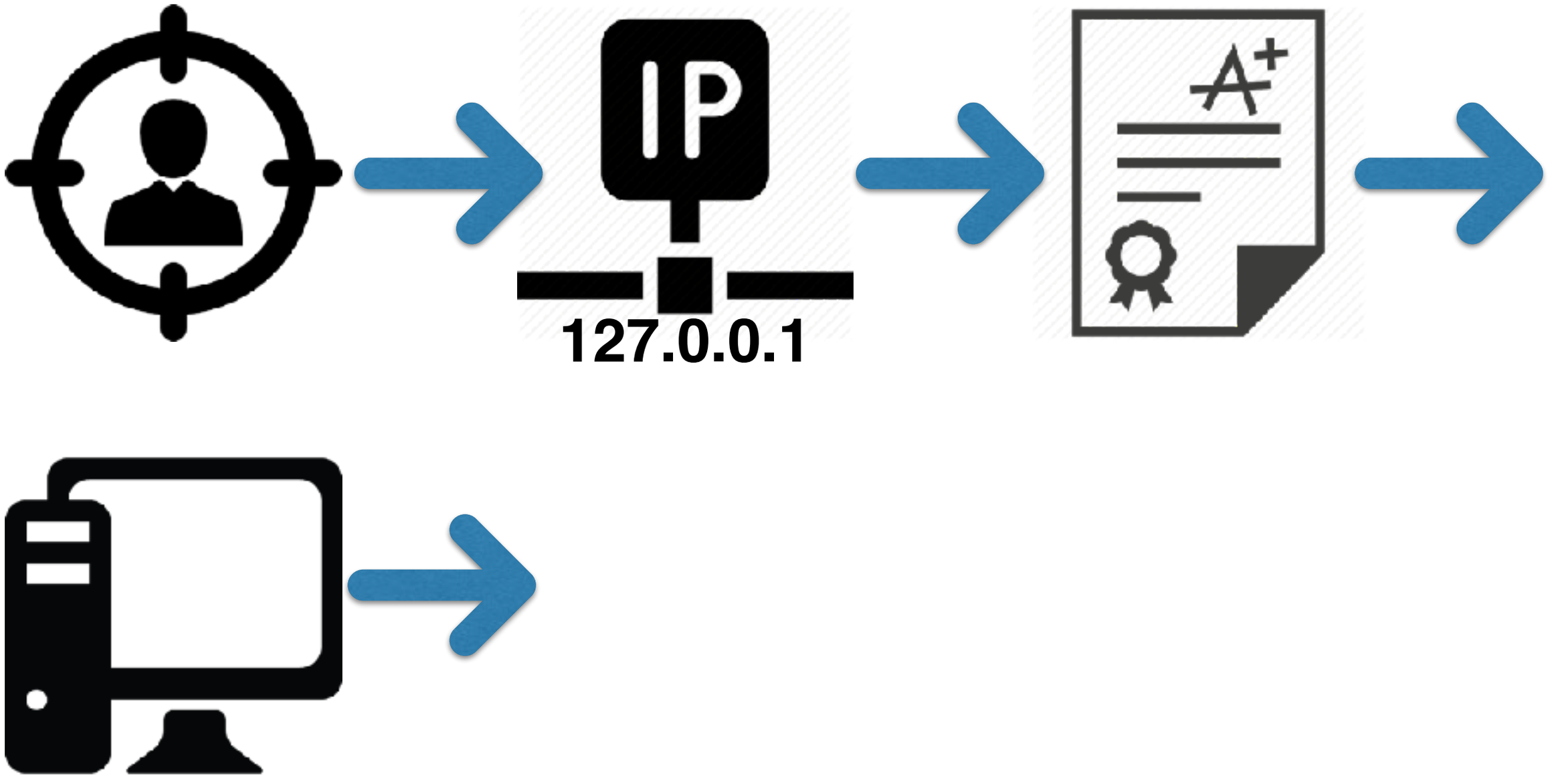

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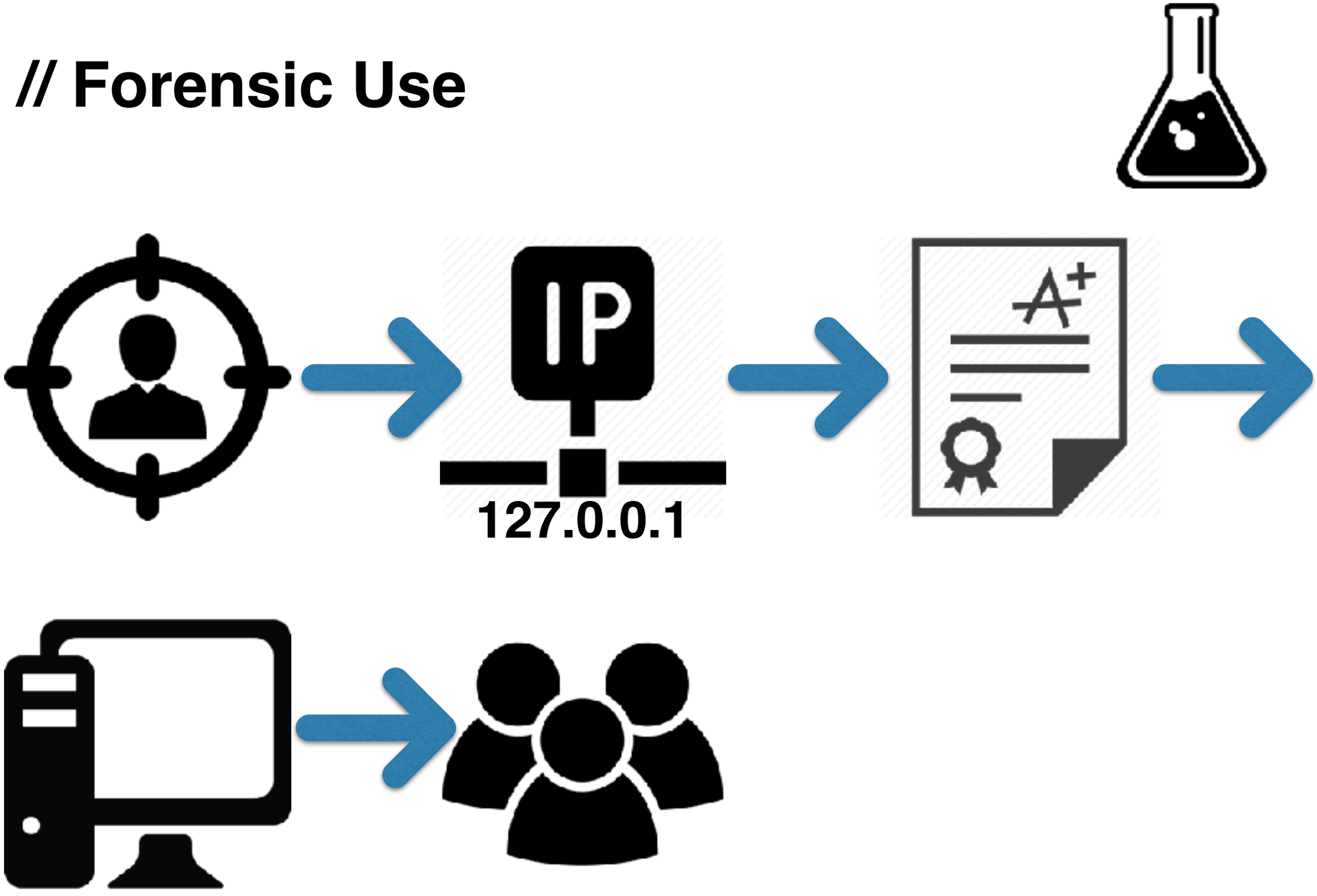

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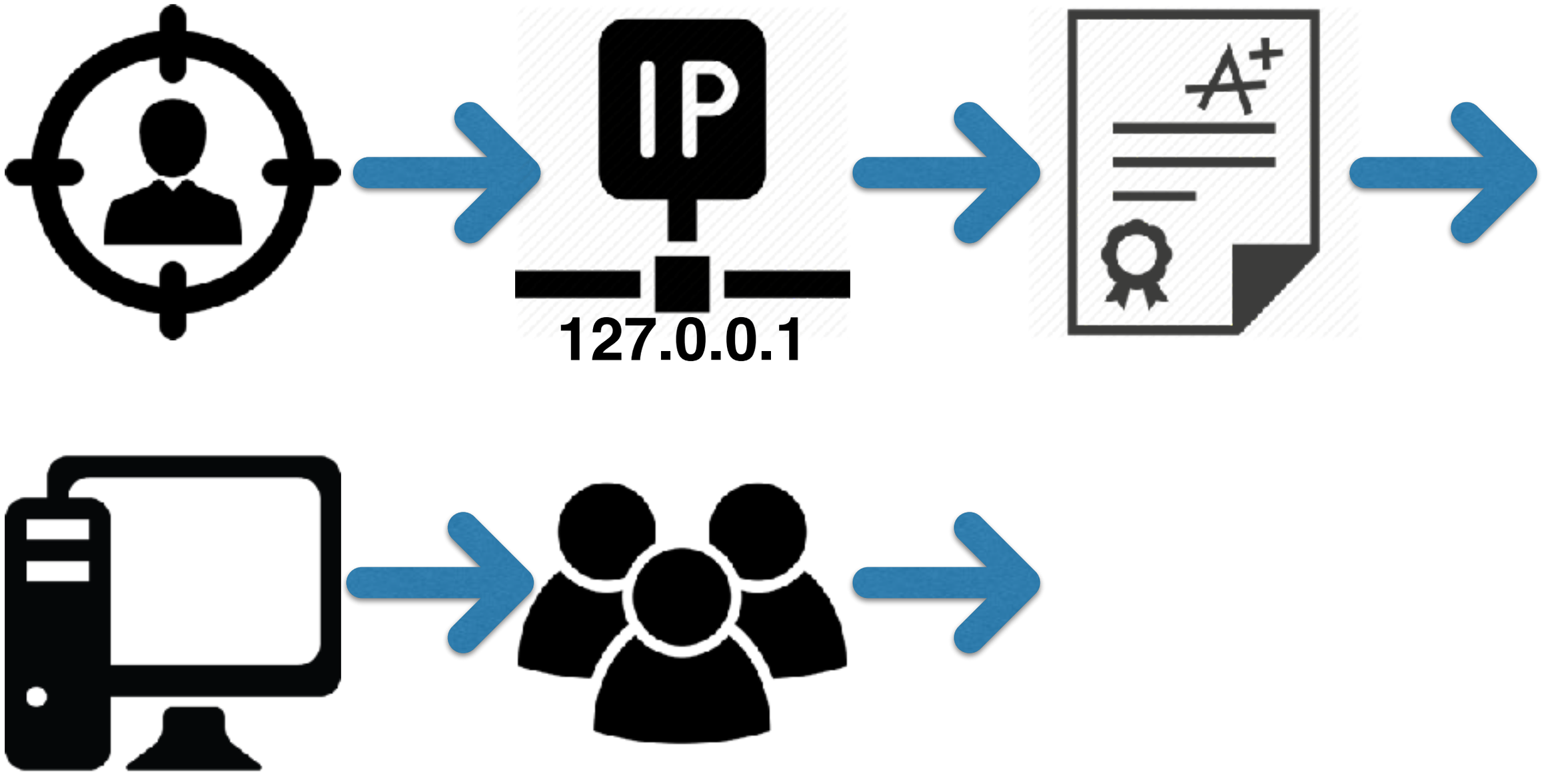

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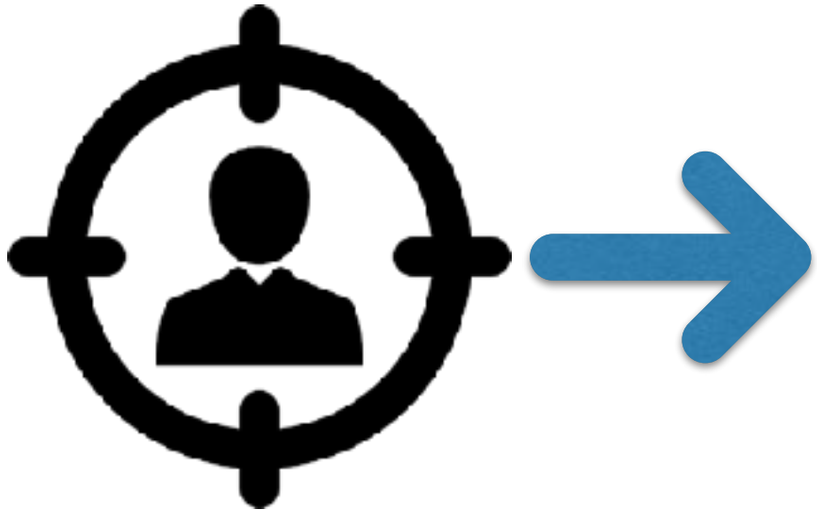

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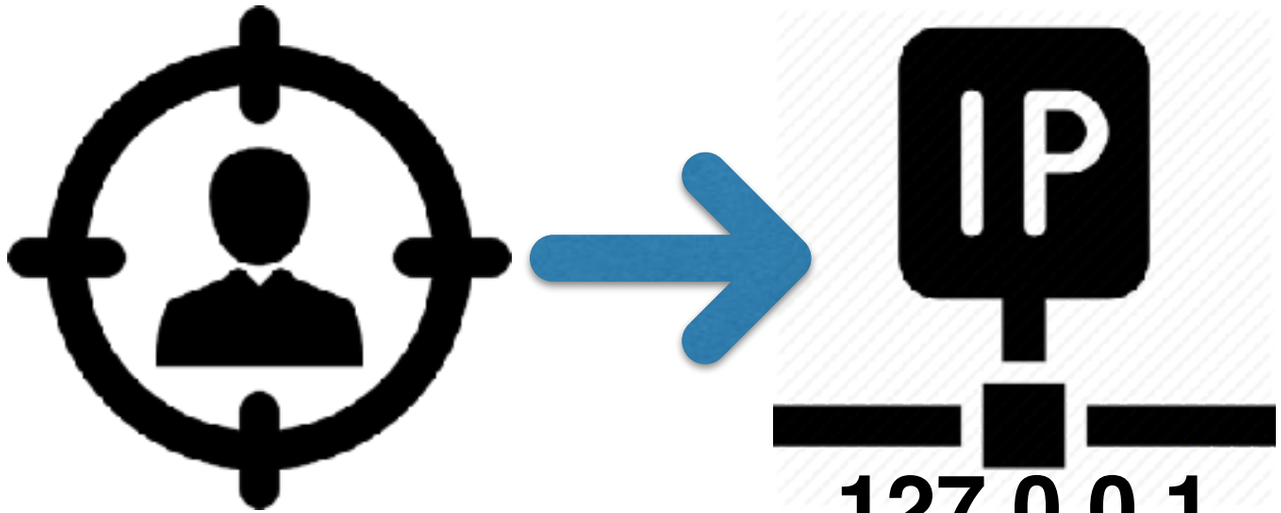

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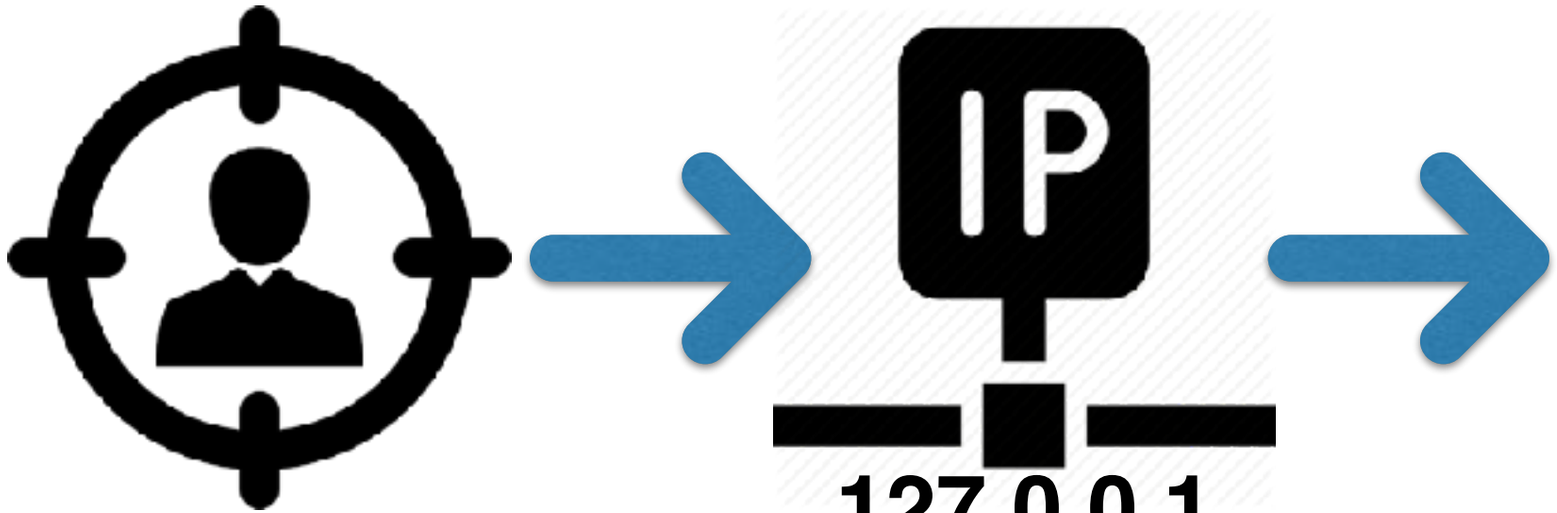

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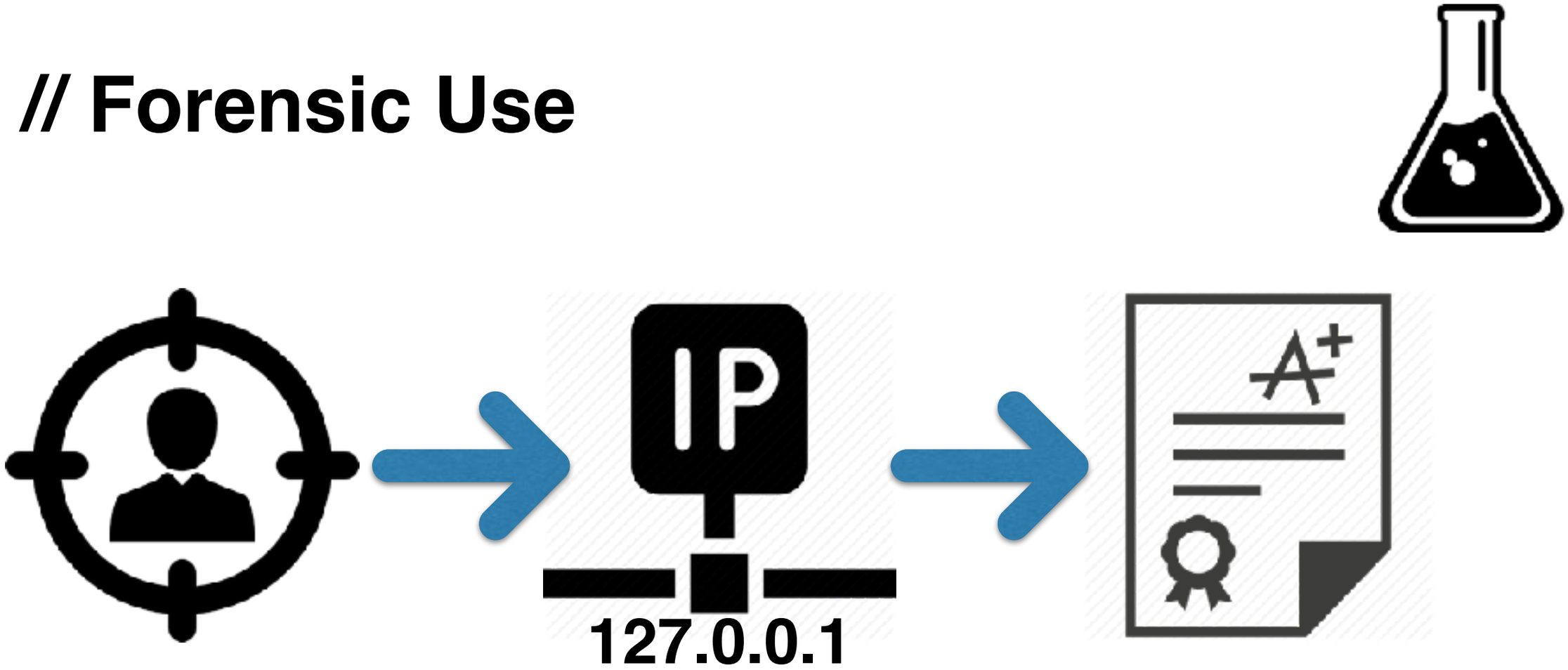

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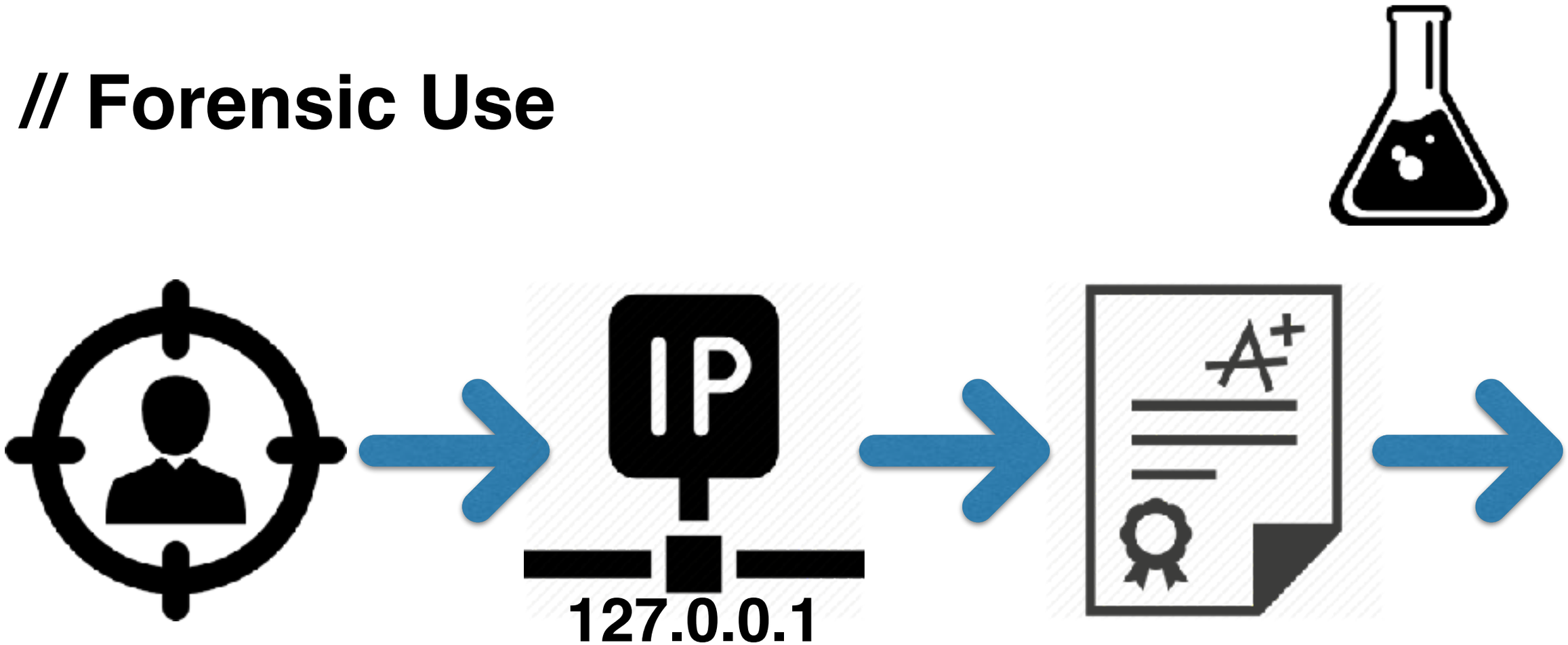

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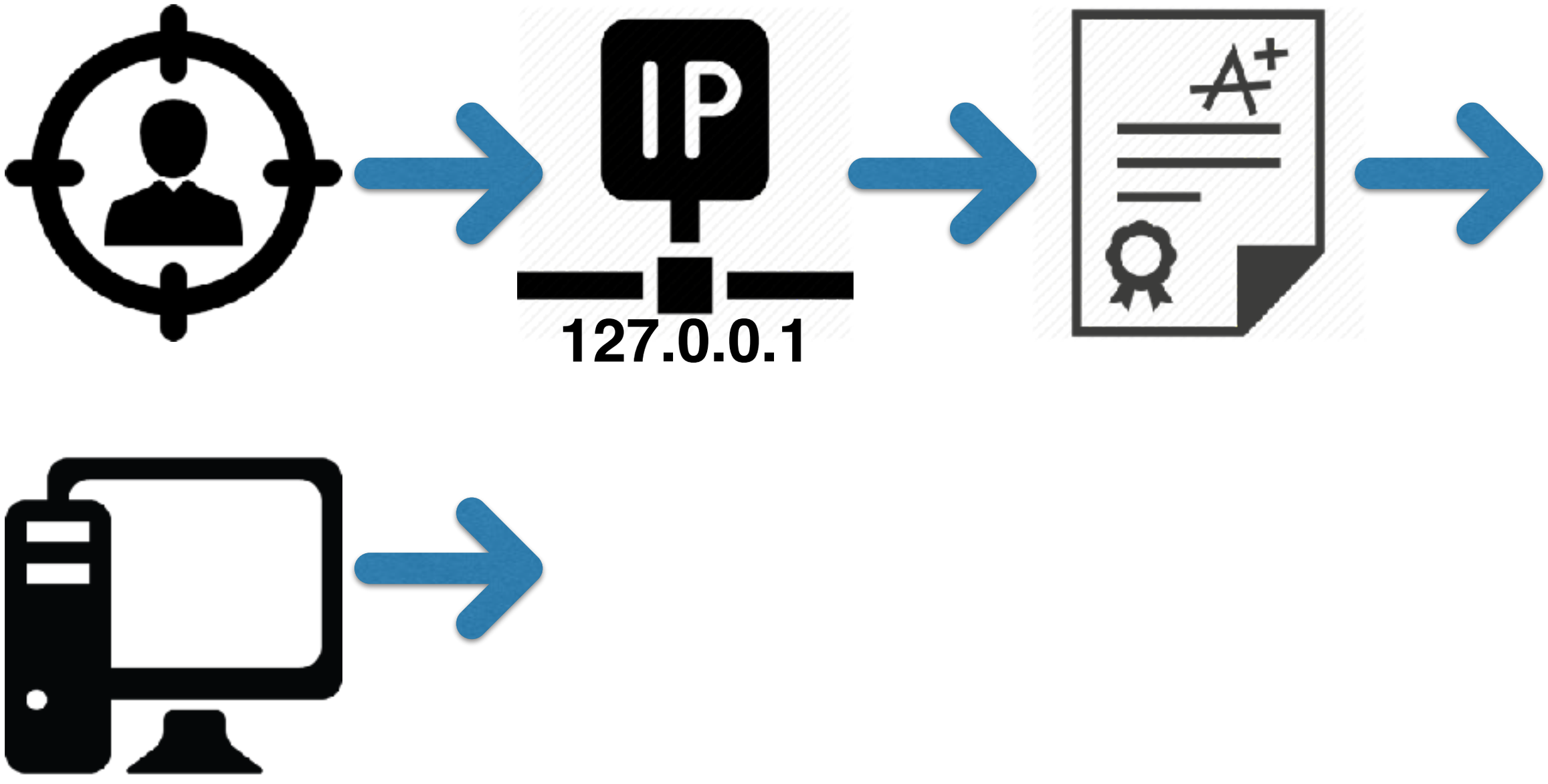

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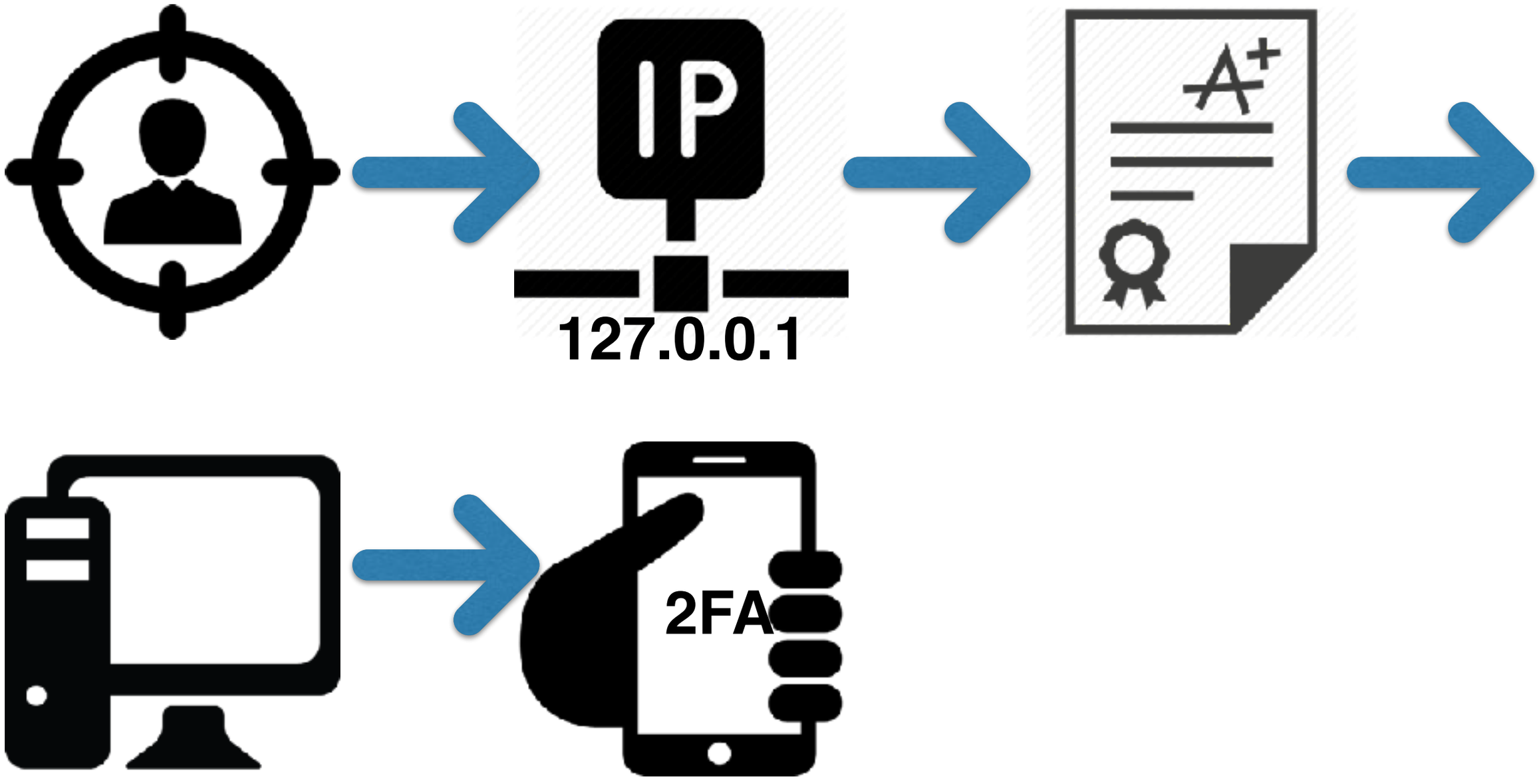

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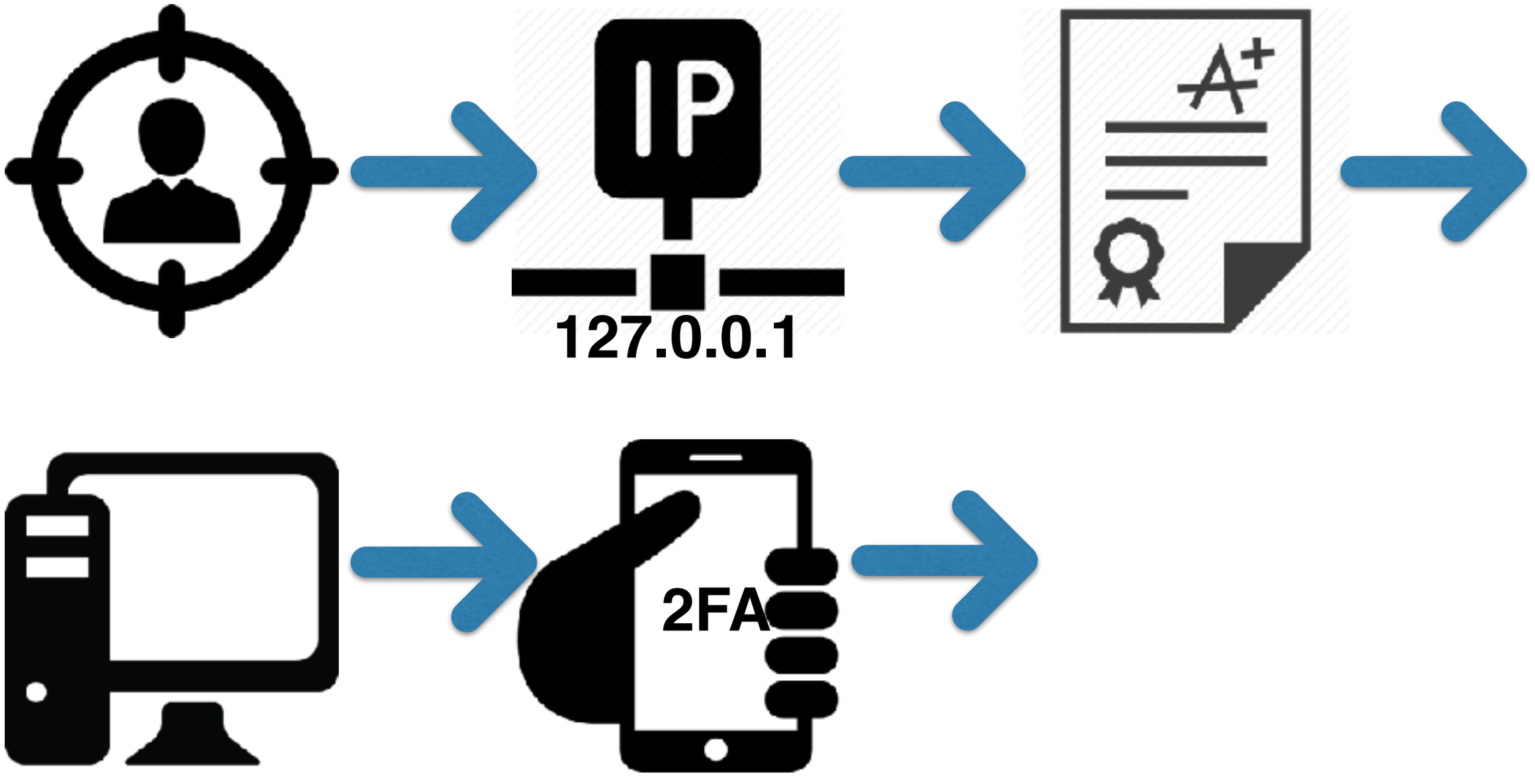

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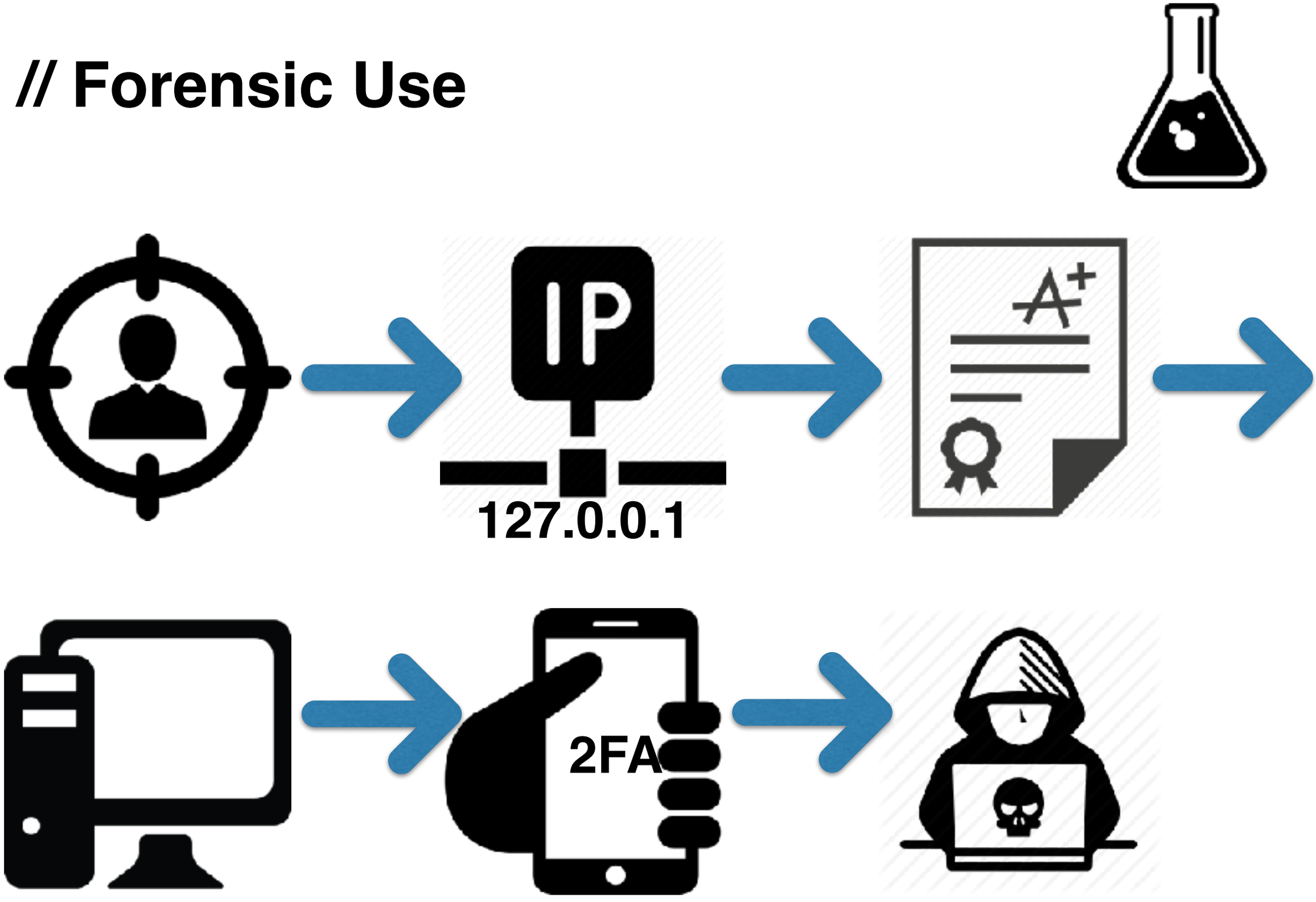

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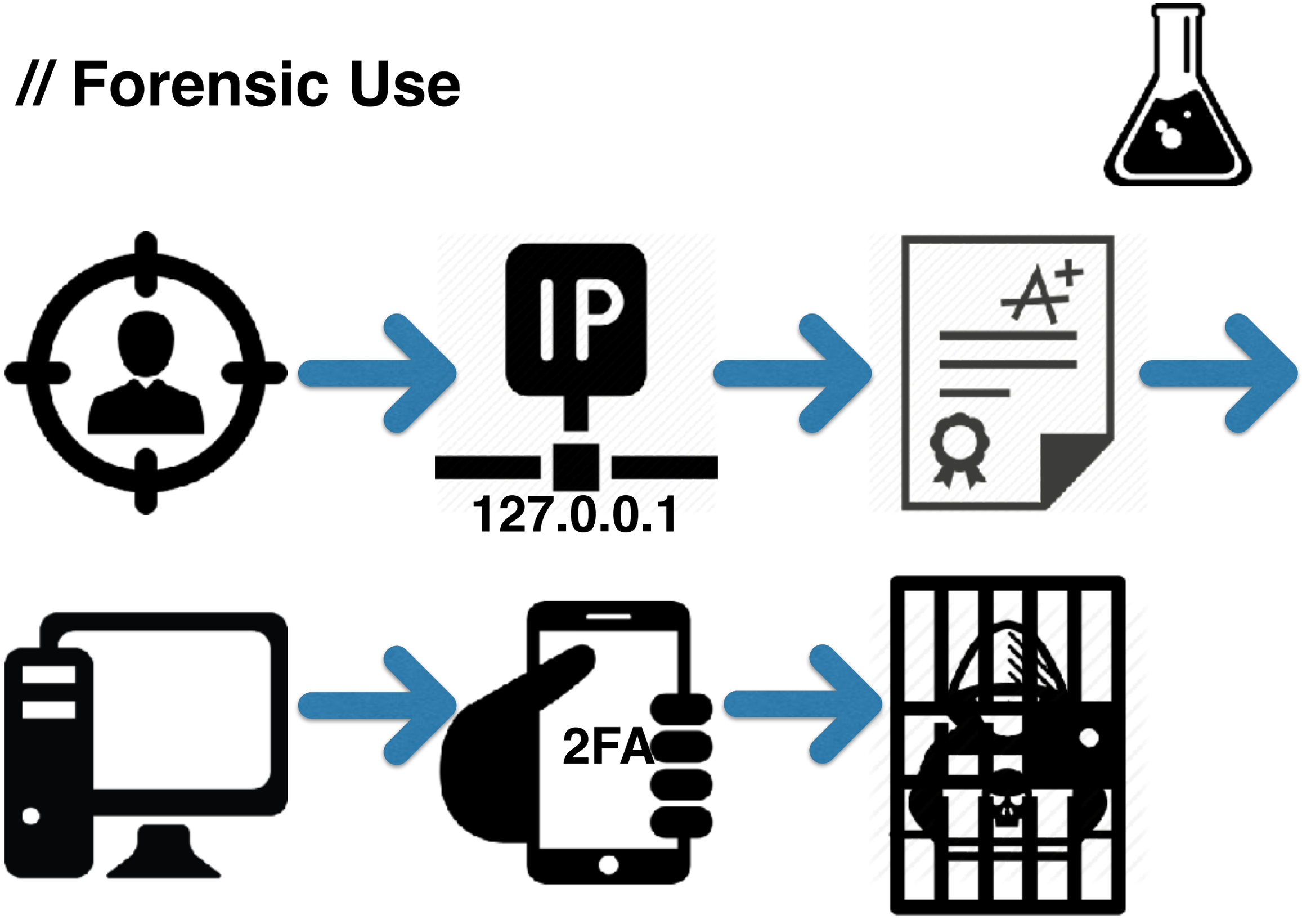

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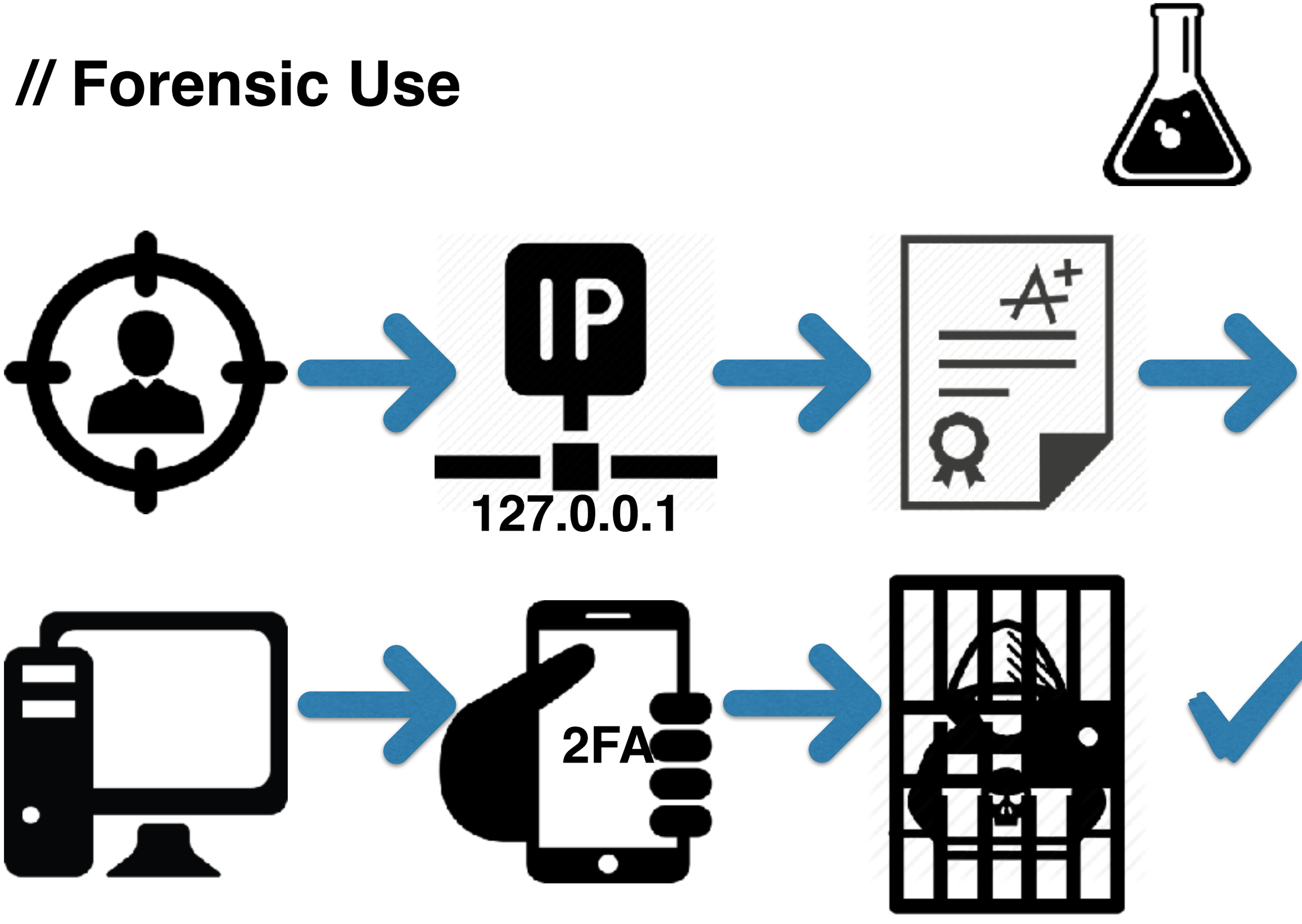

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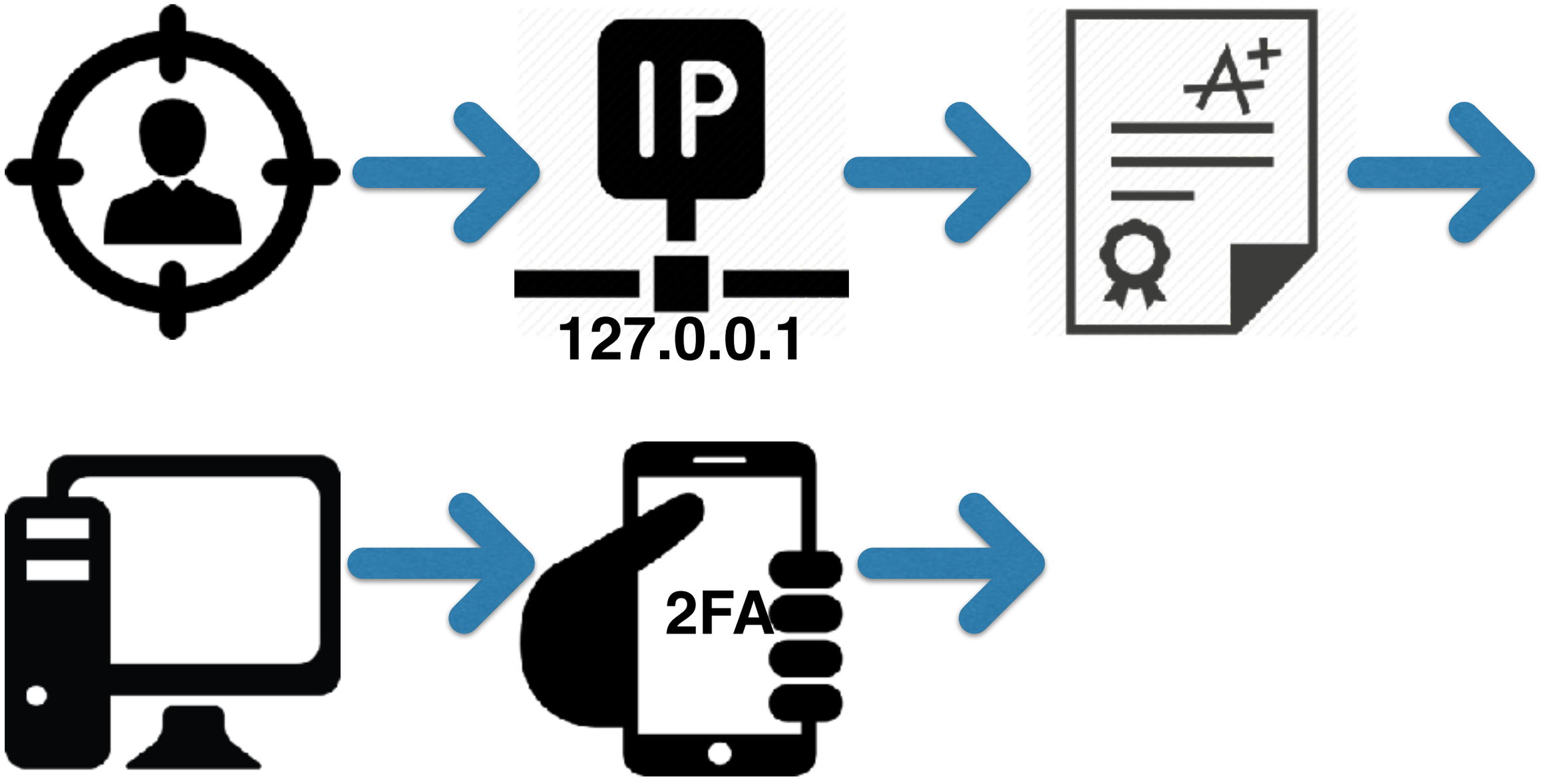

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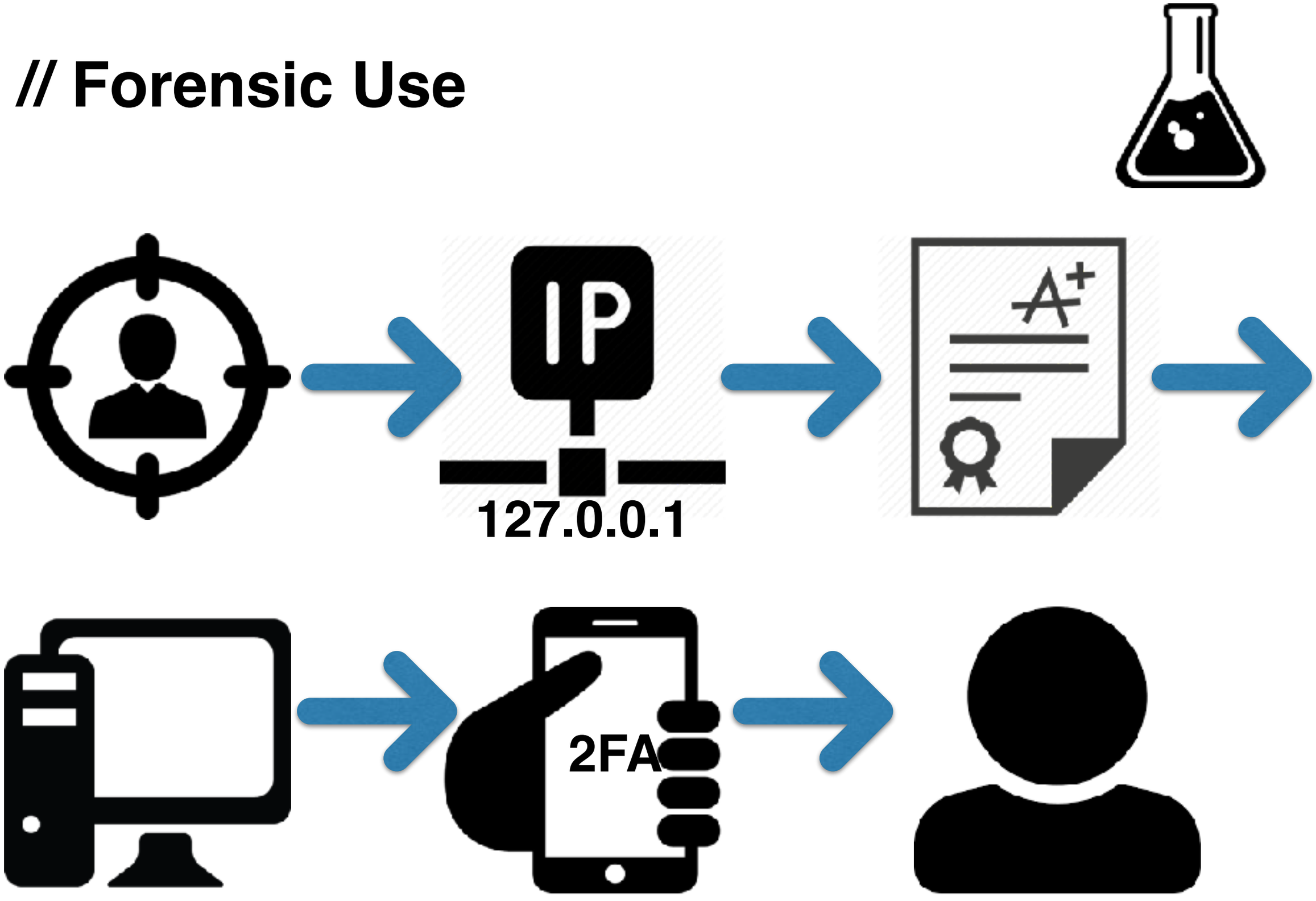

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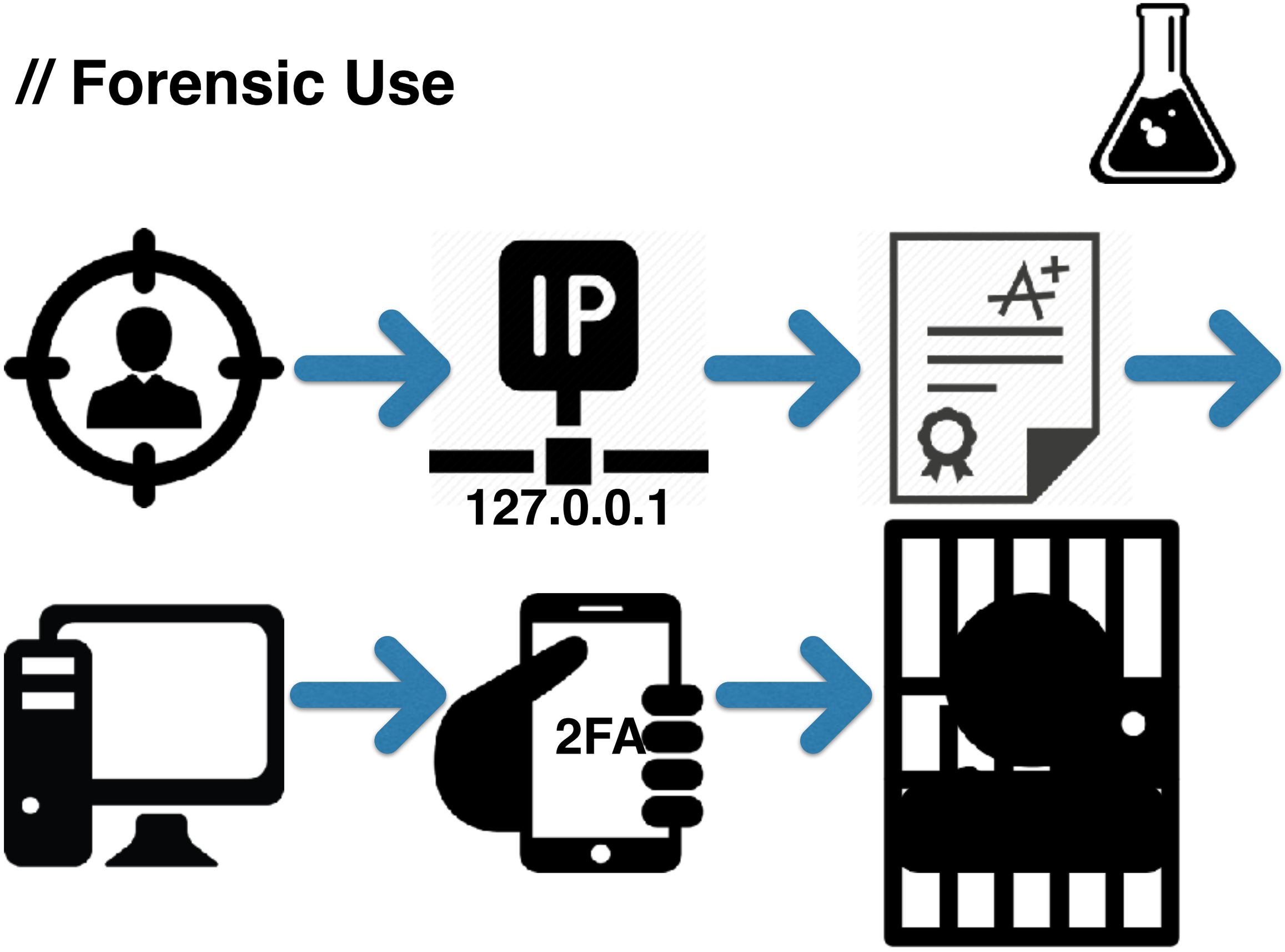

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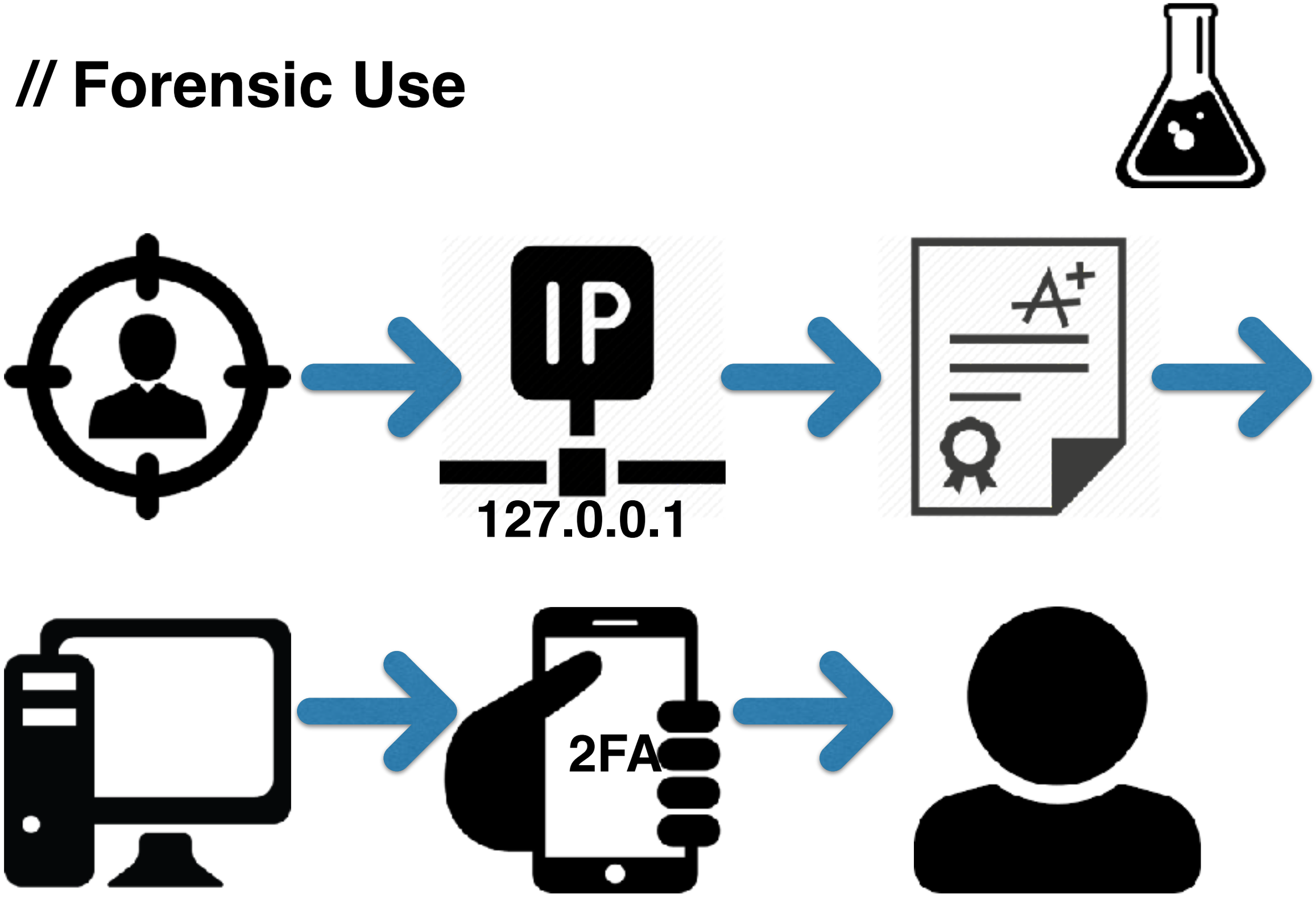

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- Three different types can be distinguished:
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- Security of the **2FA app** strongly depends on **integrity** of the **operating system**

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  - enable **stealing** of „shared secret“

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  - Record **network-traffic** during execution

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  - **Analysis** of the collected data
  - **Verification** of the results using tests in AVD

// Results

Sample: „Google Authenticator“

Icon	Anwendung	Version	Hash (MD5)	Größe
	Google Authenticator	4.74	2658652deea2a274c90e111135634e1f	6,9 MB
Programmpfad:	/data/data/com.google.android.apps.authenticator2			
UID:	u0_a128			
Ablage Shared Secret:	{app_verz}/databases/databases (SQLite)			
Format des TOTP:	Dezimal (6-stellig)			
Shared Secret:	rffl4xngz3bzhe5g7fhji4rzra			

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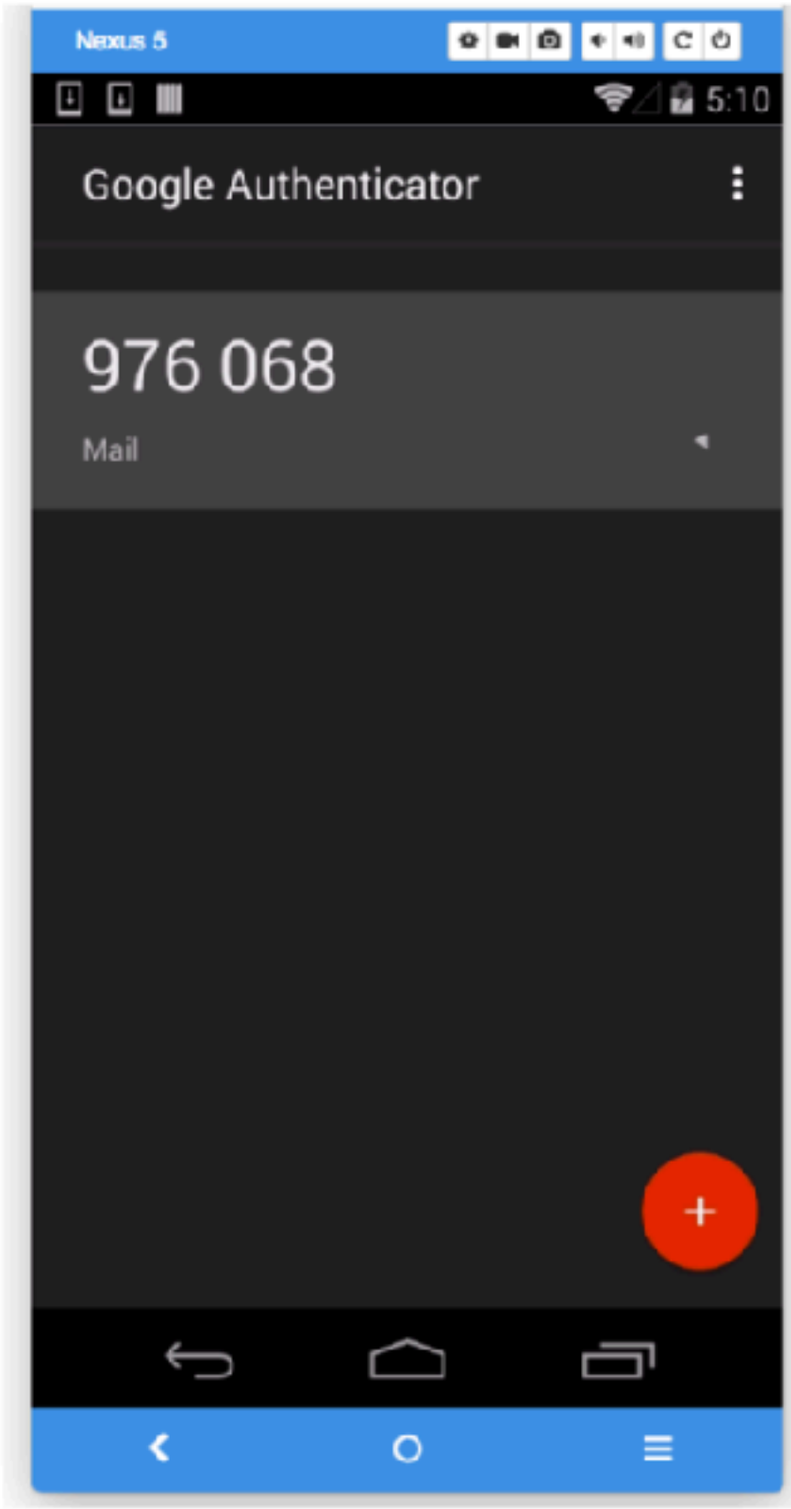
UID:	u0_a128			
Ablage Shared Secret:	{app_verz}/databases/databases (SQLite)			
Format des TOTP:	Dezimal (6-stellig)			
Shared Secret:	rffl4xngz3bzhe5g7fhji4rzra			

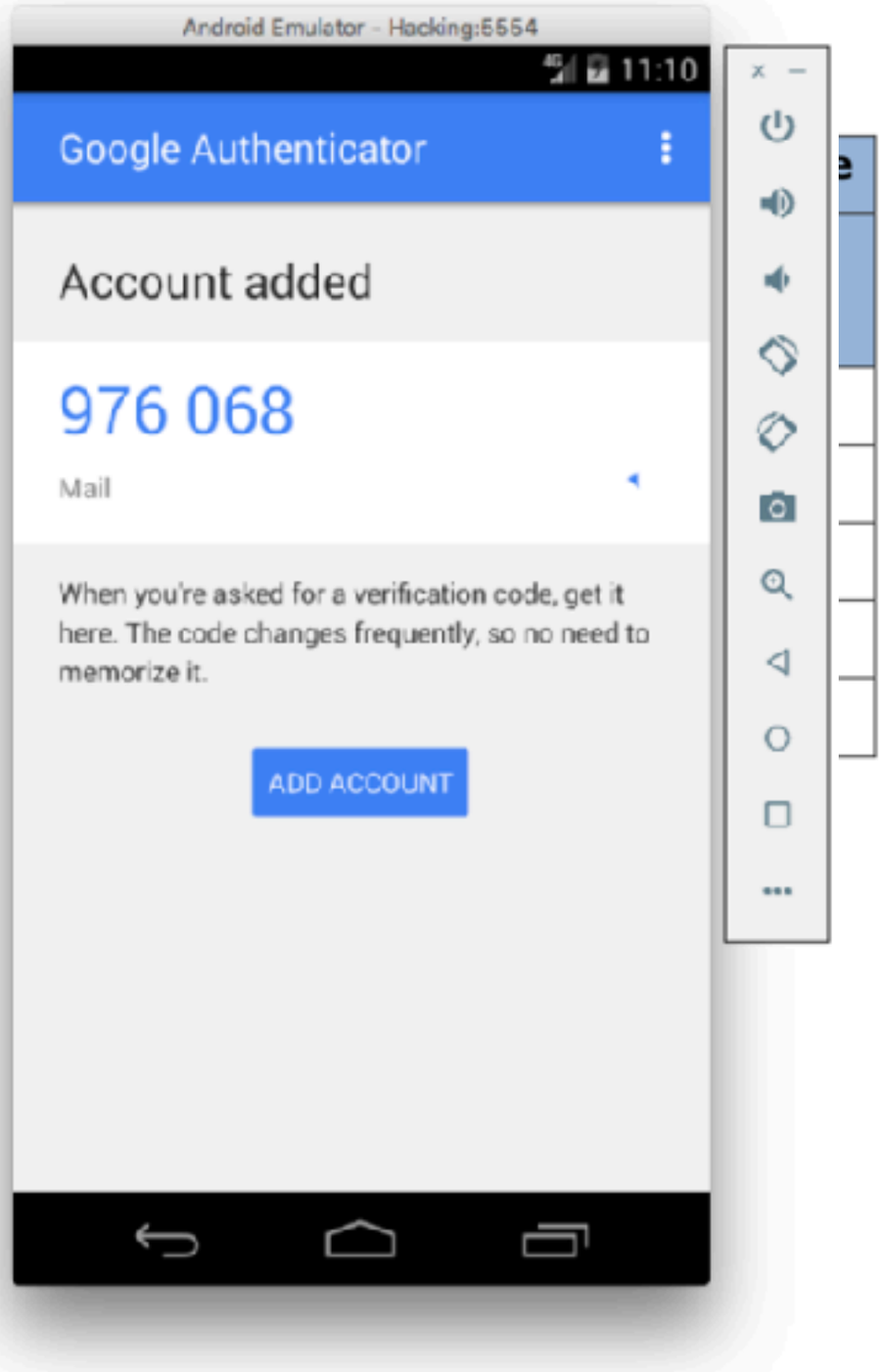
```
42:GA philip$ adb pull /data/data/
com.google.android.apps.authenticator2/databases/databases/

42:GA philip$ sqlite3 ./databases "select * from accounts" >
google_authenticator_secret.txt


42:GA philip$ cat google_authenticator_secret.txt 1|Dropbox|
rffl4xngz3bzhe5g7fhji4rzra|0|0|0||Dropbox


42:GA philip$
```

// Results

```
>> POST https://91.215.103.66/appcfg.php
        ← 304 [no content] 601ms
   POST https://172.217.23.174/fdfe/apps/contentSync
        ← 200 application/protobuf 61b 816ms
   POST https://172.217.23.174/auth
        ← 200 text/plain 266b 327ms
   POST https://172.217.17.42/plusi/v3/ozInternal/gmsgnotsfetchbyidentifier?alt=proto
        ← 200 application/x-protobuf 610b 426ms
   GET
https://172.217.23.161/proxy/RmHevzGfWbmd87_FmcOWySSx1f5WGNu7rNiv7_Zq5OYs8UvbUmv9aQfdAqp
vdBUiOiGxWTs1OMcquRF9RLhRAOzJbJUdOKyV_uEg=w360
       ← 200 image/png 18.5k 186ms
   POST https://172.217.17.42/plusi/v3/ozInternal/gmsgnotssetreadstates?alt=proto
        ← 200 application/x-protobuf 48b 151ms
   POST https://216.58.214.74/play/log?format=raw&proto_v2=true
        ← 200 text/plain 38b 268ms
   POST https://172.217.23.174/auth
        ← 200 text/plain 265b 238ms
   GET https://66.102.1.102/history/api/lookup?client=web_app
       ← 200 application/javascript 55b 235ms
   GET https://66.102.1.102/history/api/lookup?client=device
       ← 200 application/javascript 55b 220ms


⇩  [1/10]
                                                              ?:help
[*:8080]
```

// Results





42:G
com.

42:G
goog

42:G
rffl4x

42:G

// Results

Sample: „Duo Mobile“

Icon	Anwendung	Version	Hash (MD5)	Größe
	Duo Mobile	3.16.1	afe74d12a8f4f9cb8e107727d0010727	12,3 MB
Programmpfad:	/data/data/com.duosecurity.duomobile			
UID:	u0_a156			
Ablage Shared Secret:	{app_verz}/files/duokit/accounts.json			
Format des TOTP:	Dezimal (6-stellig)			
Shared Secret:	hvwb64jexhst5xg2rg5j5nfwci			

// Results

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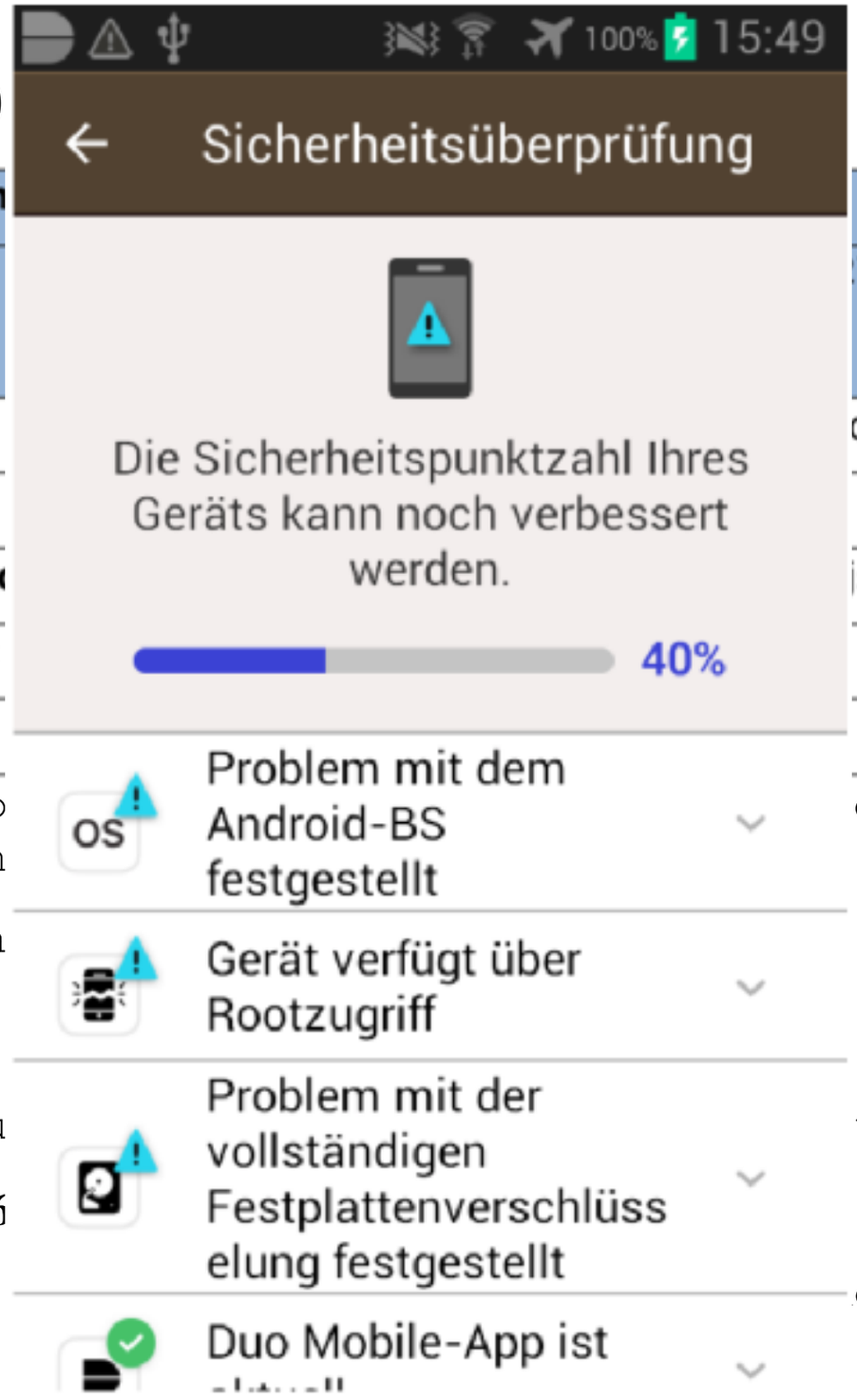
```
42:Duo philip$ adb pull /data/data/com.duosecurity.duomobile/files/
duokit/accounts.json

42:Duo philip$ cat accounts.json
[

{
"name": "philipevalu@wegwerfemail.info", "otpGenerator": {

"otpSecret": "HVWB64JEXHST5XG2RG5J5NFWCI" },

"logoUri": "android.resource://com.duosecurity.duomobile/drawable/
ic_dropbox"

} ]
```

// Results

Sample: „D

Icon	Anwendun		Größe
DUO	Duo Mobile	7d0010727	12,3 MB
Programmpfad:		obile	
UID:			
Ablage Shared Se		ison	
Format des TOTP:			
Shared Secret:			




```
42:Duo philip$ adb p                                    duomobile/files/
duokit/accounts.json

42:Duo philip$ cat a
[

{
"name": "philipevalu                                    tor": {

"otpSecret": "HVWB6

"logoUri": "android.                                    obile/drawable/
ic_dropbox"

} ]
```

// Results

X = Yes; O = No; - = unwanted behavior; + = wanted behavior

2FA App Name	Cloning Possible	Encrypted Secret	Device Integrity Check	PIN Protection	Secure SSL-Connection	Secure OTP-Push
Google Authenticator	X-	O-	O-	O-	N/A	N/A
Microsoft Authenticator	X-	O-	O-	O-	X+	O-
Authy 2-Factor Authentification	O+	O-	O-	X+	X+	N/A
DUO Mobile	X-	O-	X+	O-	X+	X+
FreeOTP	X-	O-	O-	O-	N/A	N/A
Sophos Authenticator	X-	O-	O-	O-	N/A	N/A
Push Authenticator	X-	O-	O-	O-	N/A	N/A
OTP Authenticator	O+	O-	O-	O-	N/A	N/A
Yandex.Key	O+	X+	O-	X+	N/A	N/A
Symantec VIP Access	O+	X+	O-	O-	X+	X+
2FA Token	X-	O-	O-	O-	N/A	N/A
Launchkey	X-	N/A	O-	X+	X+	N/A
CyAuth Cylocklite	X-	X+	O-	O-	X+	N/A
Topicus KeyHub	X-	O-	O-	O-	X+	N/A
Latch	O+	X+	O-	O-	O-	N/A
Okta Verify	O+	X+	O-	O-	X+	N/A

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- 12.5 % of the apps only use other **notation**
- Security strongly dependent on OS
- 56 % of the apps allow **copying the DB**
- Only about 1/5 of the apps offer PIN protection
- Only 44 % do not generate **network traffic**

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- Pro HW-Token

  - HW token self-sufficient -> no area of attack via remote
  - "Stealing" the "shared secret" undermines factor **property**
  - 2FA apps persuade to use a single device only
  - Spread of specific malware threatens 2FA apps
  - FIDO-Alliance combines secure hardware and PKI

Thank you for your attention
Questions? 42!