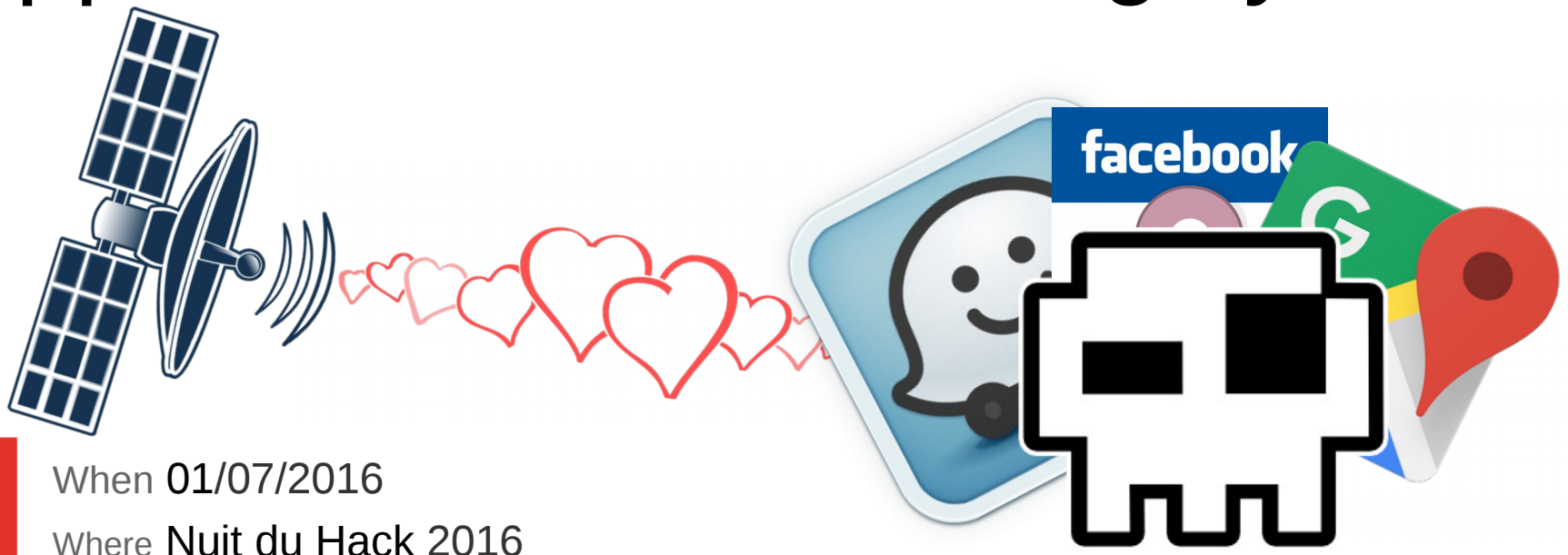
SYNACKTIV
DIGITAL SECURITY

Turning a GPS-based dating application into a tracking system



When 01/07/2016

Where Nuit du Hack 2016

Who Julien Legras (@Julien_Legras) & Julien Szlamowicz (@szLam_)

About us

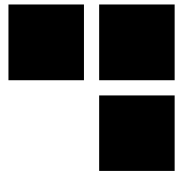
- **Julien Legras & Julien Szlamowicz**
  - Synacktiv **Ninjas**
  - **NDHers**

Big brother

- **Big brother is watching you**

Many ways to perform GPS tracking

Waze



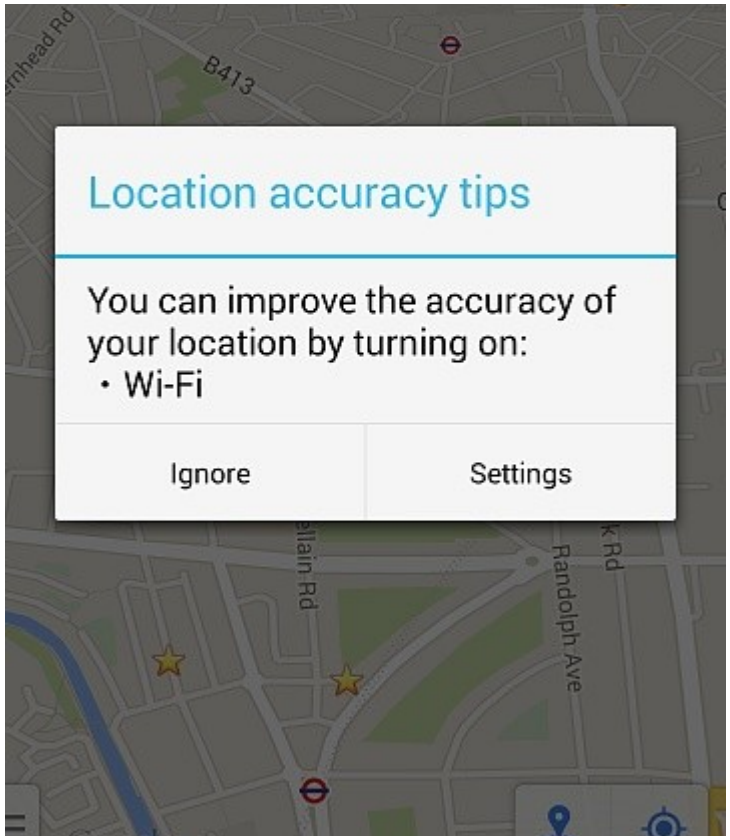
- **2016 – Ben Zhao - University of California Santa Barbara**
- **Scan an arbitrary rectangular zone**
  - Return verbose information about people in the zone
  - Exact location
- **Deploy a 20 probes grid around the target**
- **Center the grid after every target location update**

Uber

- **June 2016 – labs.integrity.pt – Bug bounty write up**
- **Bugs in Uber app:**
  - waybill feature allowing to retrieve previous users trip details when calling a driver
  - Users enumeration with full details (location of course) using phone numbers

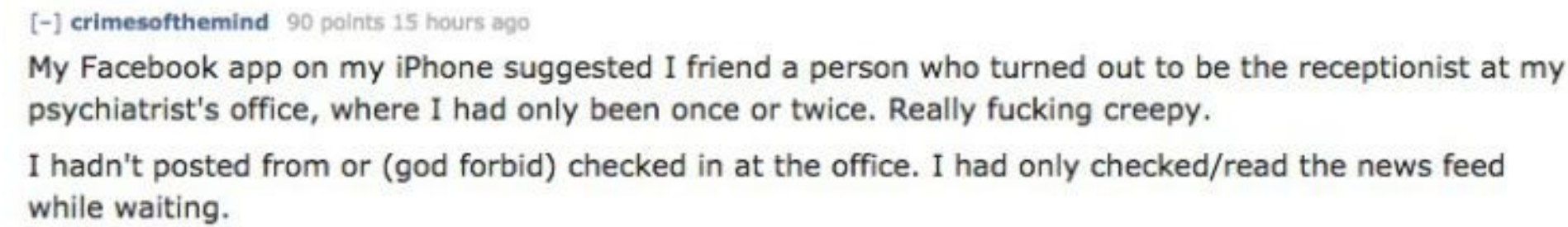
Wi-Fi SSID Google Maps

- **2011 – Google SSID tracking drama**
- **Google Maps used nearby WiFi access points SSID to determine your location**
  - To refine precision
  - If you lose GPS signal for a while
- **You can do a similar app of your own using open databases:**
  - https://www.wigle.net
- **Or check other community projects:**
  - https://github.com/sensepost/Snoopy



Facebook location recommendations

- **June 2016**

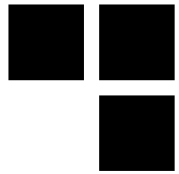


[–] **crimesofthemind** 90 points 15 hours ago

My Facebook app on my iPhone suggested I friend a person who turned out to be the receptionist at my psychiatrist's office, where I had only been once or twice. Really fucking creepy.

I hadn't posted from or (god forbid) checked in at the office. I had only checked/read the news feed while waiting.

- "**we're not using location data**, such as device location and location information you add to your profile, **to suggest people you may know**"
- "We often suggest people you may know based on things you have in common, like mutual friends, **places you've visited [...]**. **That's why location is only one of the factors we use to suggest people you may know.**"



Let's think out of the box… with a dating app

Context

- Once upon a time… we looked for love (separately) … on dating apps of course :-)
- We tested over 9000 apps at least… but not a single real match, bots everywhere :'-(
- We started focusing on GPS-based apps to push our luck a bit!
- How precise is it? Could we follow someone? Let's find out!

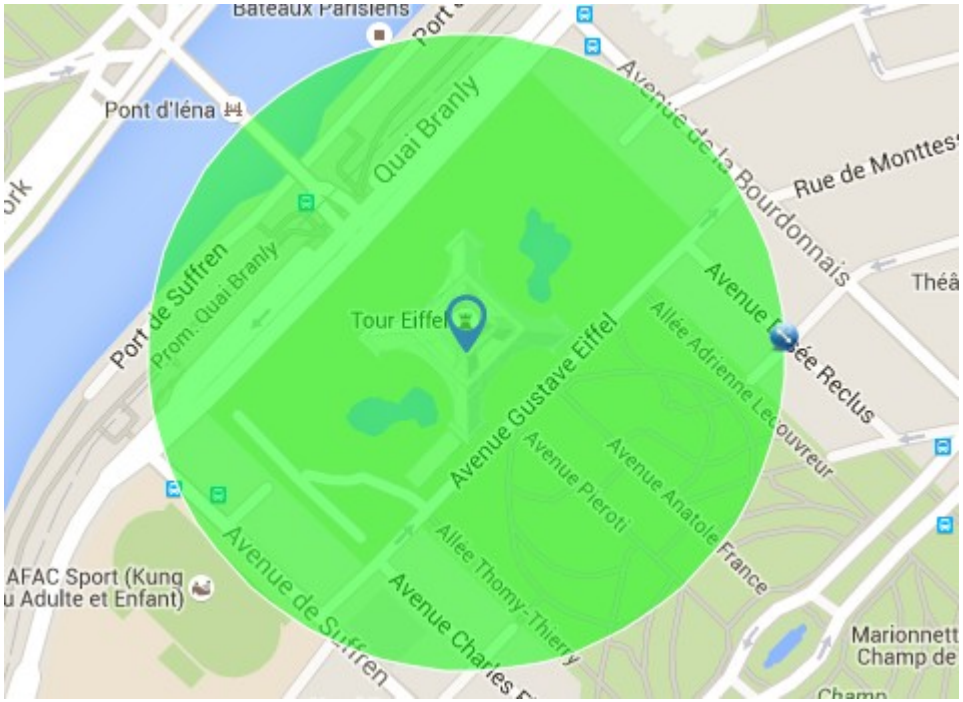
Scenario

- **Let’s say we are women… Everytime we try to find love using mobile apps:**
  - we’re spammed by weirdos (here is Jean-Pierre):

*Ingrid would you f... with me ?

How our targeted app works?

- **The app we chose notifies you when you cross people's way**
- **You are notified only if match preferences are mutual**



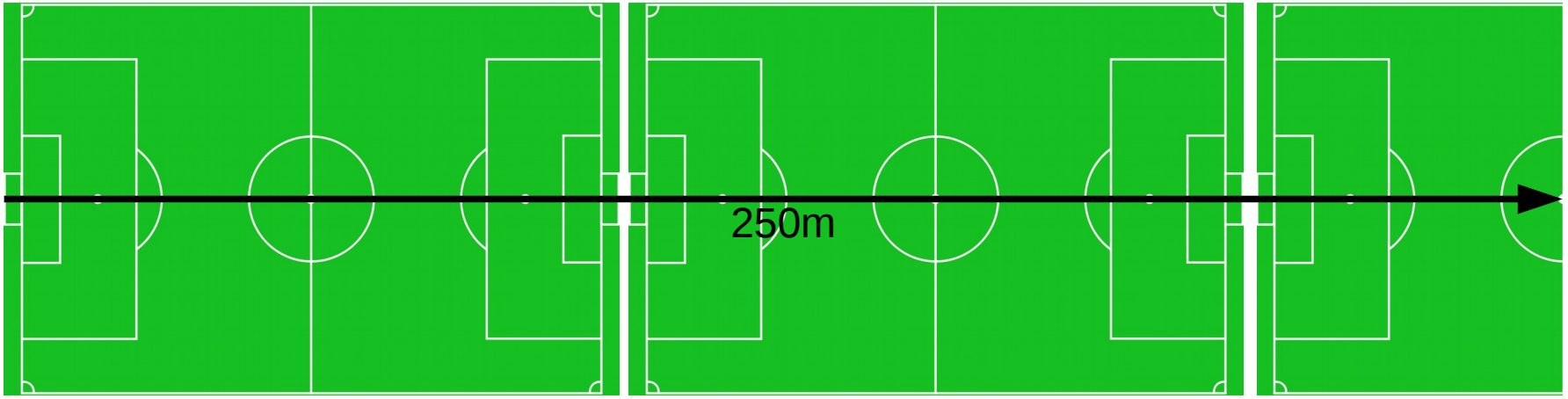
How our targeted app works?

- **The app sends your location to a server all day long**
- **The server computes "matches" regarding location and match preferences**
- **When the server finds a match:**
  - It tells you where and when your were when you crossed someone’s path
  - It tells an approximative distance limited to these values:

    250m, 500m, 750m, 1km

First problems

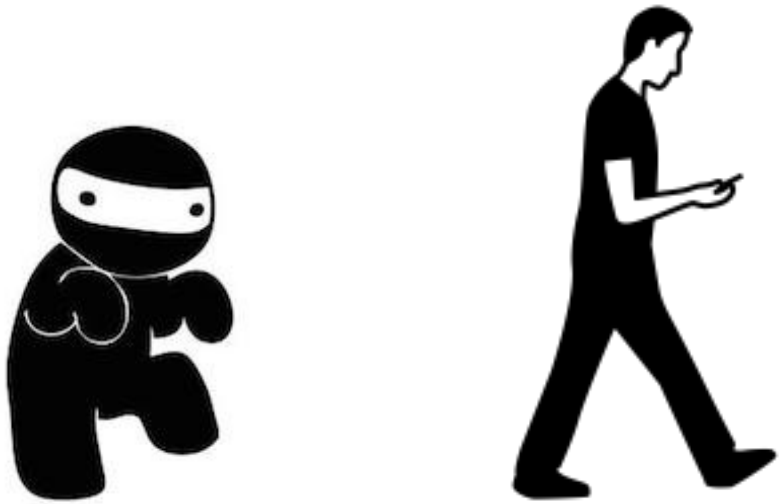
- **Precision ...**



  - Wow! That’s far! (and 360°!)
- **If you move too fast, the server sets a timeout before you can update your location (5 minutes)**

Goals of this talk

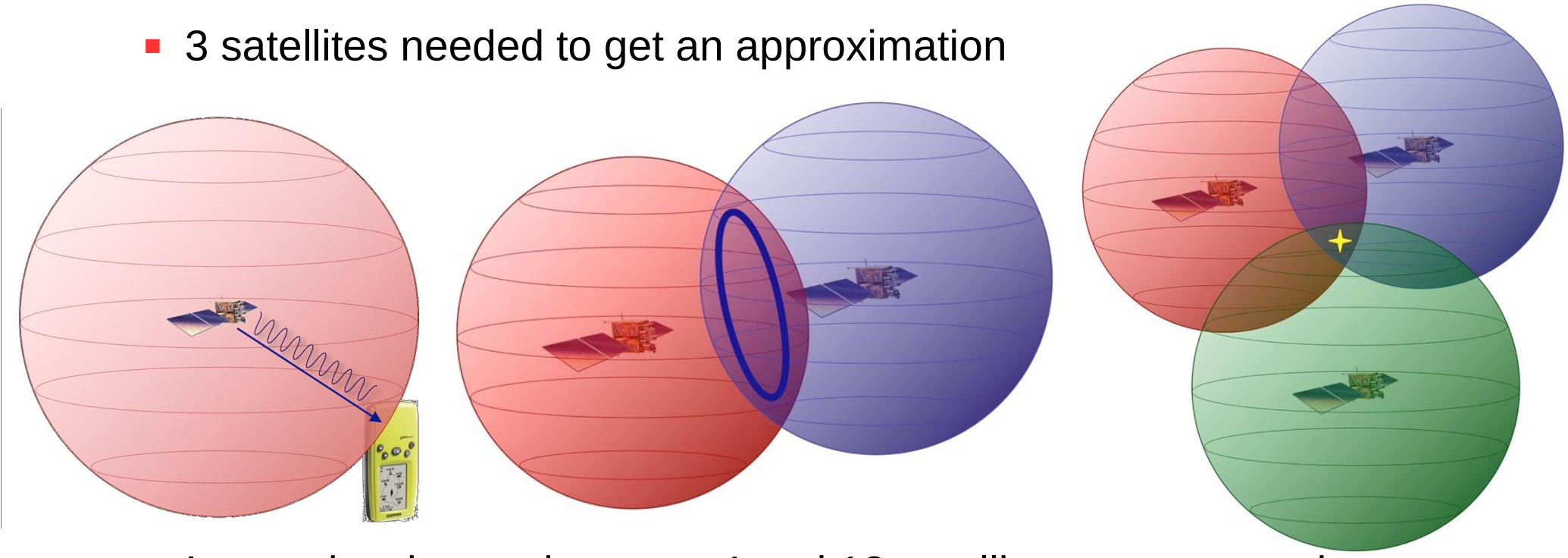
- **Improve the precision so we can catch Jean-Pierre!**
- **Be able to follow him for a while**



But, how does geolocation work

But… How to geoloc? 101

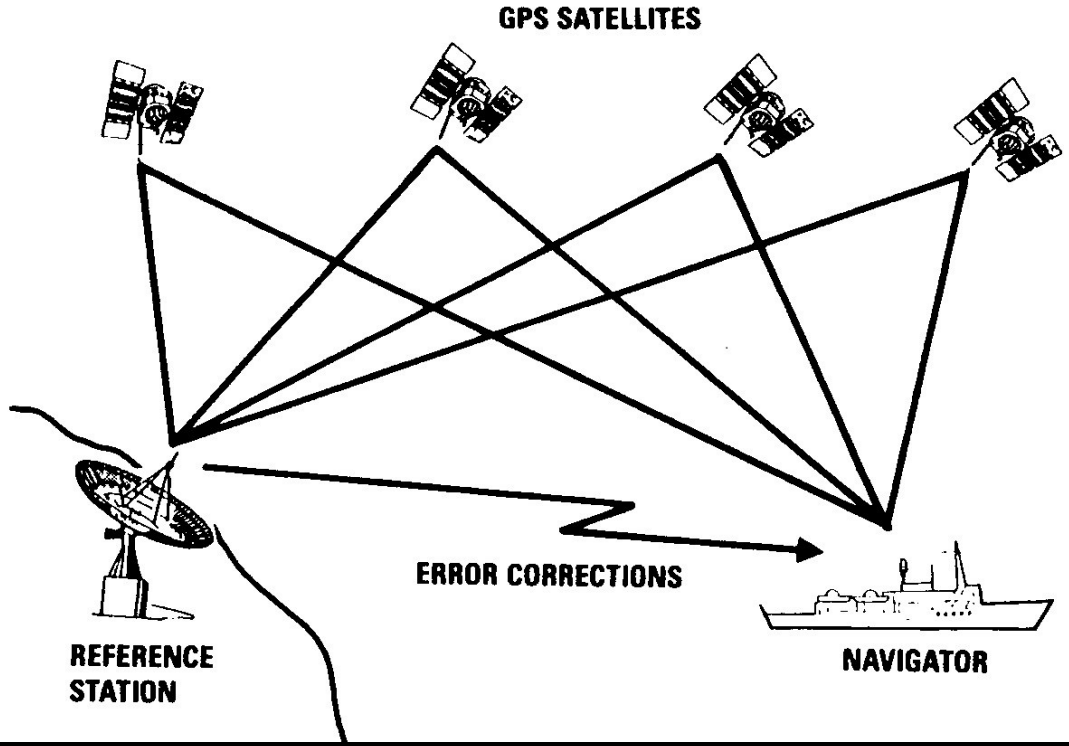
- **Satellites (GPS)**
  - 3 satellites needed to get an approximation



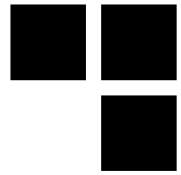
  - In practice, it uses between 4 and 12 satellites to get a precise location
  - 3-8m precision for civilian use, 1-3m for military use

But… How to geoloc? 101

- **Differential GPS (DGPS)**
  - Same approach but adds a terrestrial fixed point
  - Few centimeters precision after post-treatment



But… How to geoloc? 101

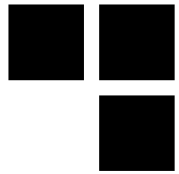


- **GSM geolocation**
  - Most used technique: Cell ID
  - Determine the position based on which antennas are in range
  - Can be used by users themselves to navigate:

    http://opencellid.org/

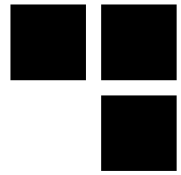
What do we need...

- **To refine Jean-Pierre's location?**
  - Bring friends! They will be our satellites!
- **To track efficiently and avoid being spotted?**
  - Bring even more friends!



OK! Let’s bring up friends!

The devil is in the details



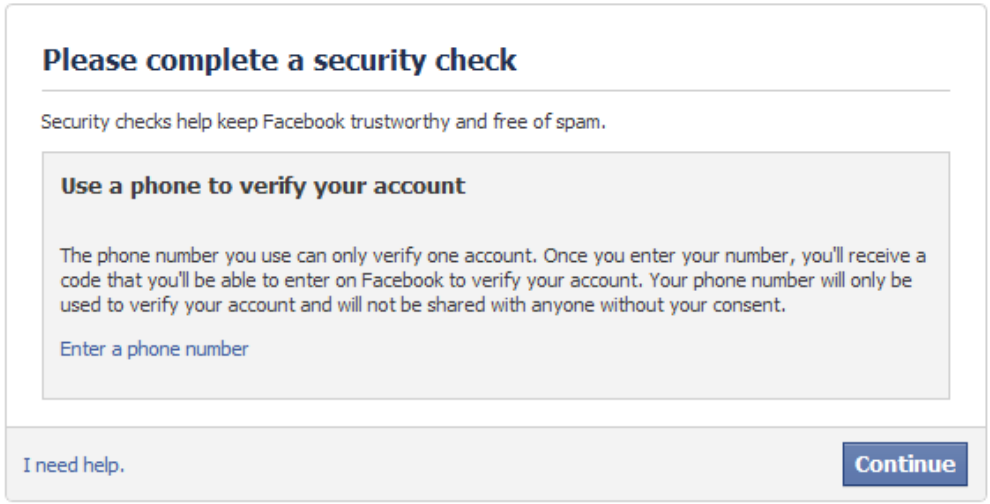
- **Preferences match**
- **→ All our agents must respond to the same characteristics.**
  - 30 y/o women looking for men (and women if you want to extend)

Problems start...

- **The app requires a Facebook account to authenticate**
- **Somehow, Facebook thinks we’re creating bots… nasty little Facebook!**

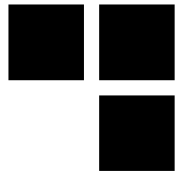
Facebook suspicion

- **Facebook sometimes asks you for an ID card or a phone number**



Solutions

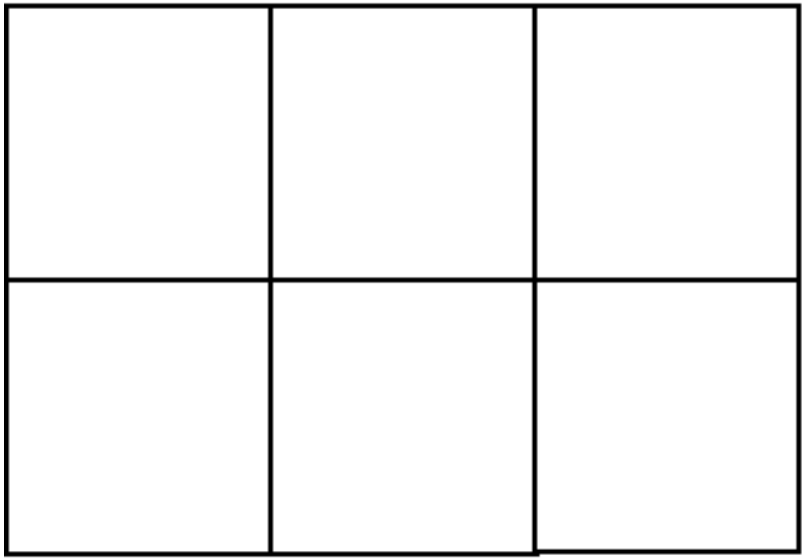
- **FREE!**
  - Ask real friends to receive the confirmation code (annoying)
  - ~~Online SMS services:~~ All phone numbers are blacklisted or already in use
- **$**
  - Get an alternative number from your operator
- **$$$**
  - Buy several Facebook accounts from an East European shop

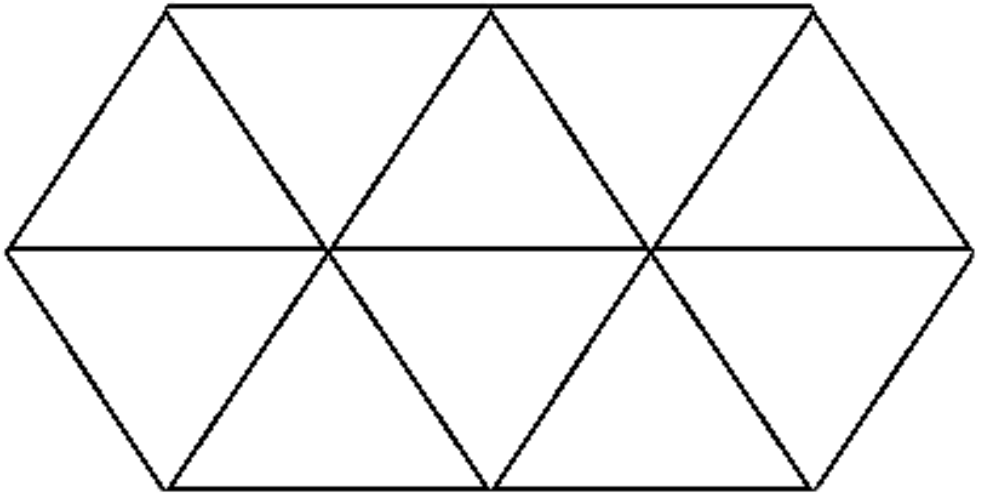


Now we have agents,
how to place them efficiently?

Dispatch agents

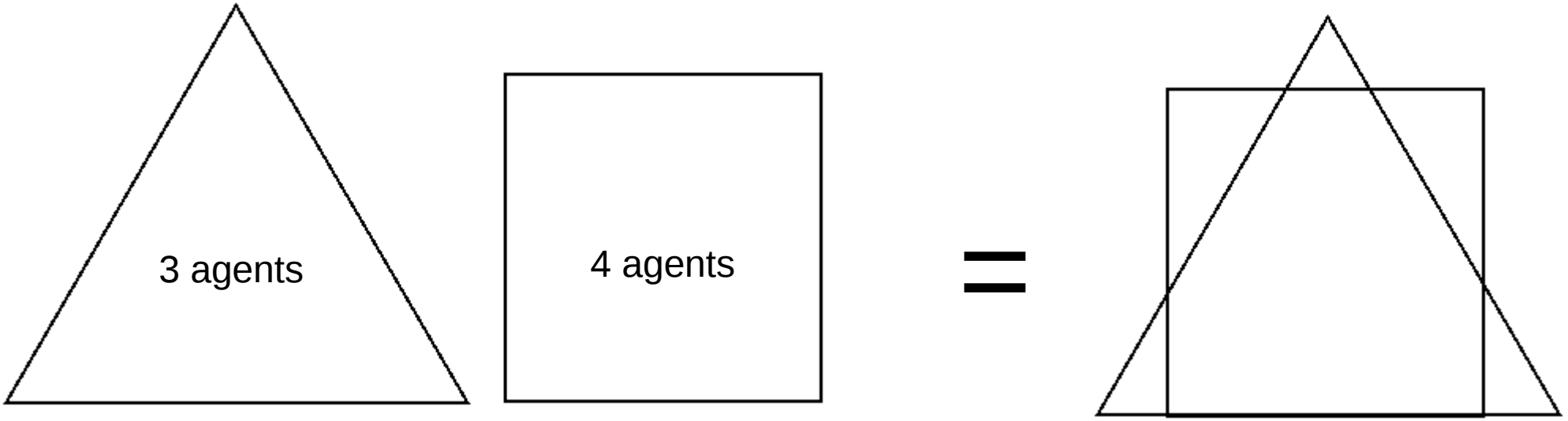
- **Limited number of agents**
- **How to optimize the space covering?**
- **And keep satisfying location results**
- **Tesselation, Tiling**





Dispatch agents

- **Square or triangles?**
  - Same area



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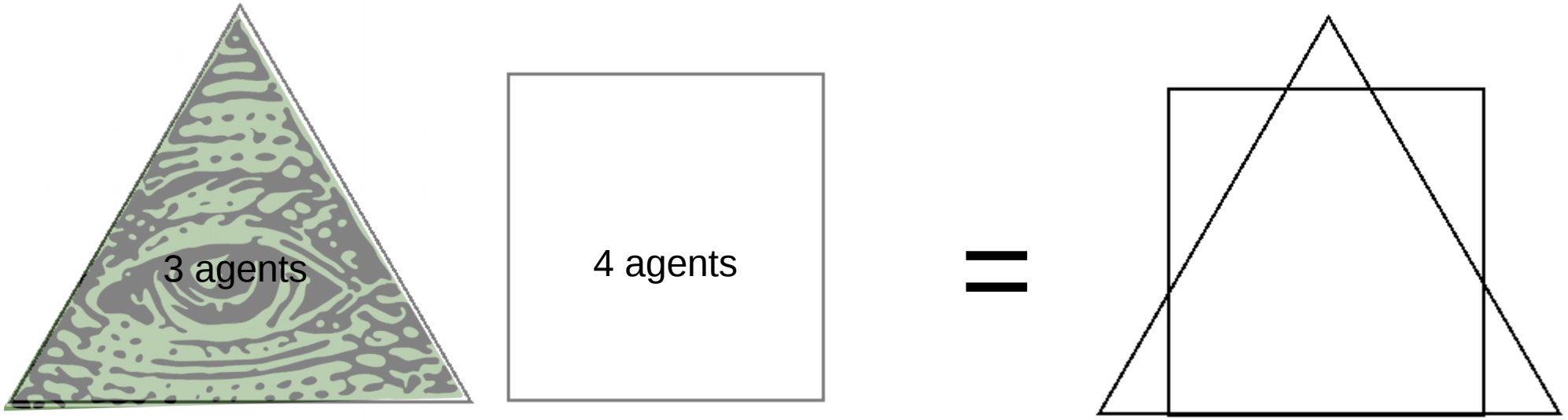
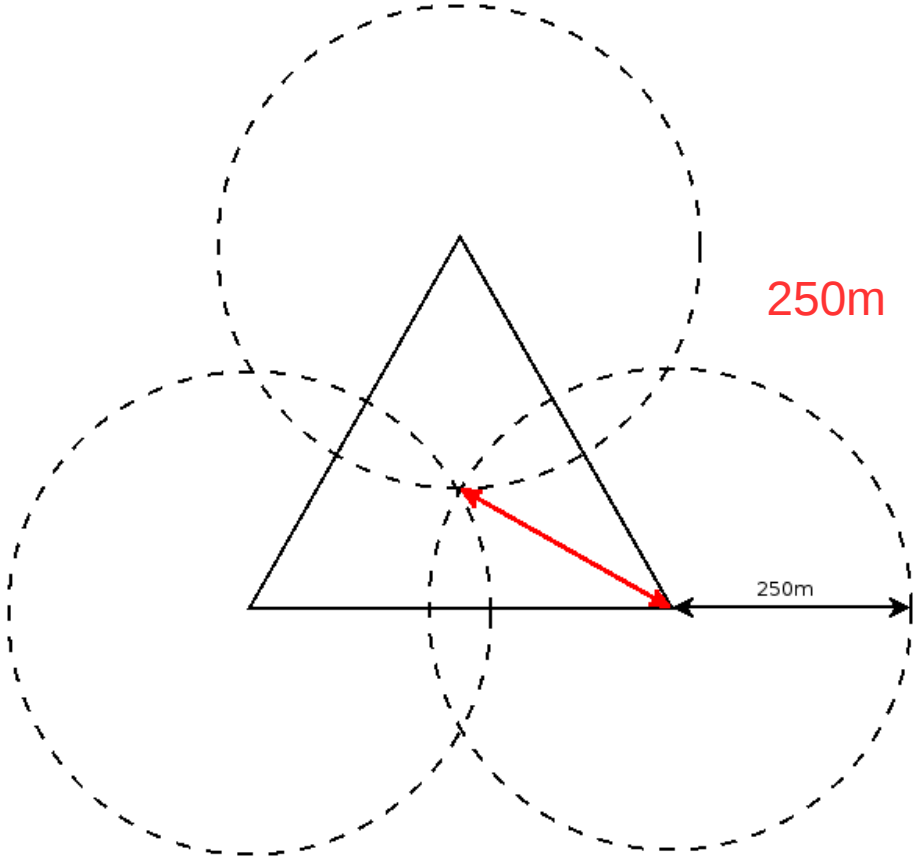
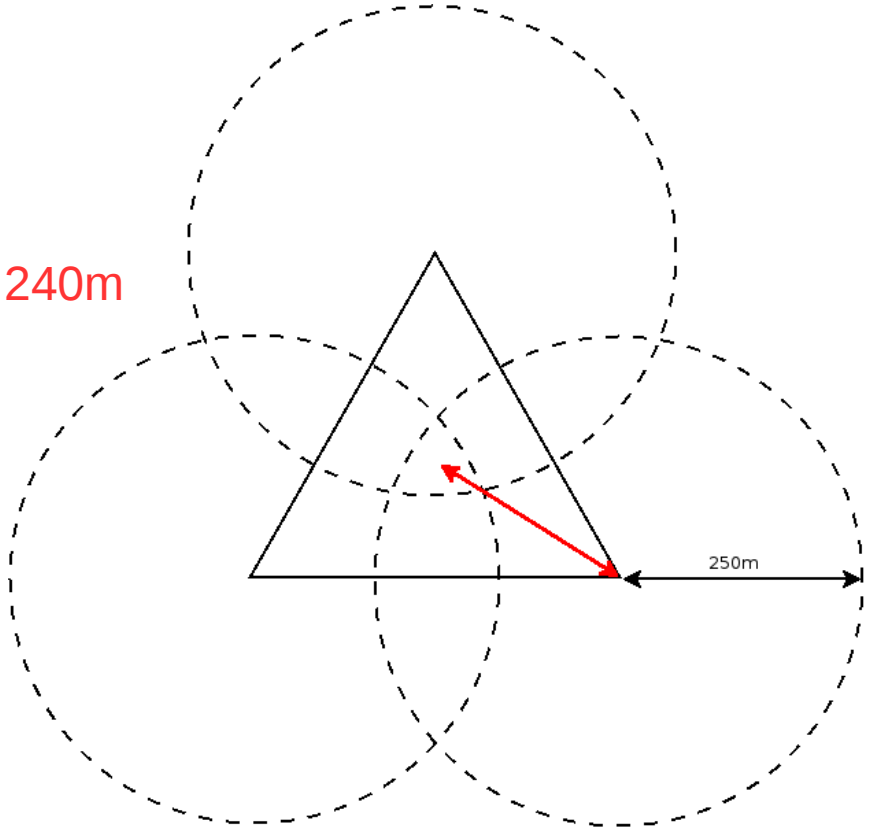


Dispatch agents

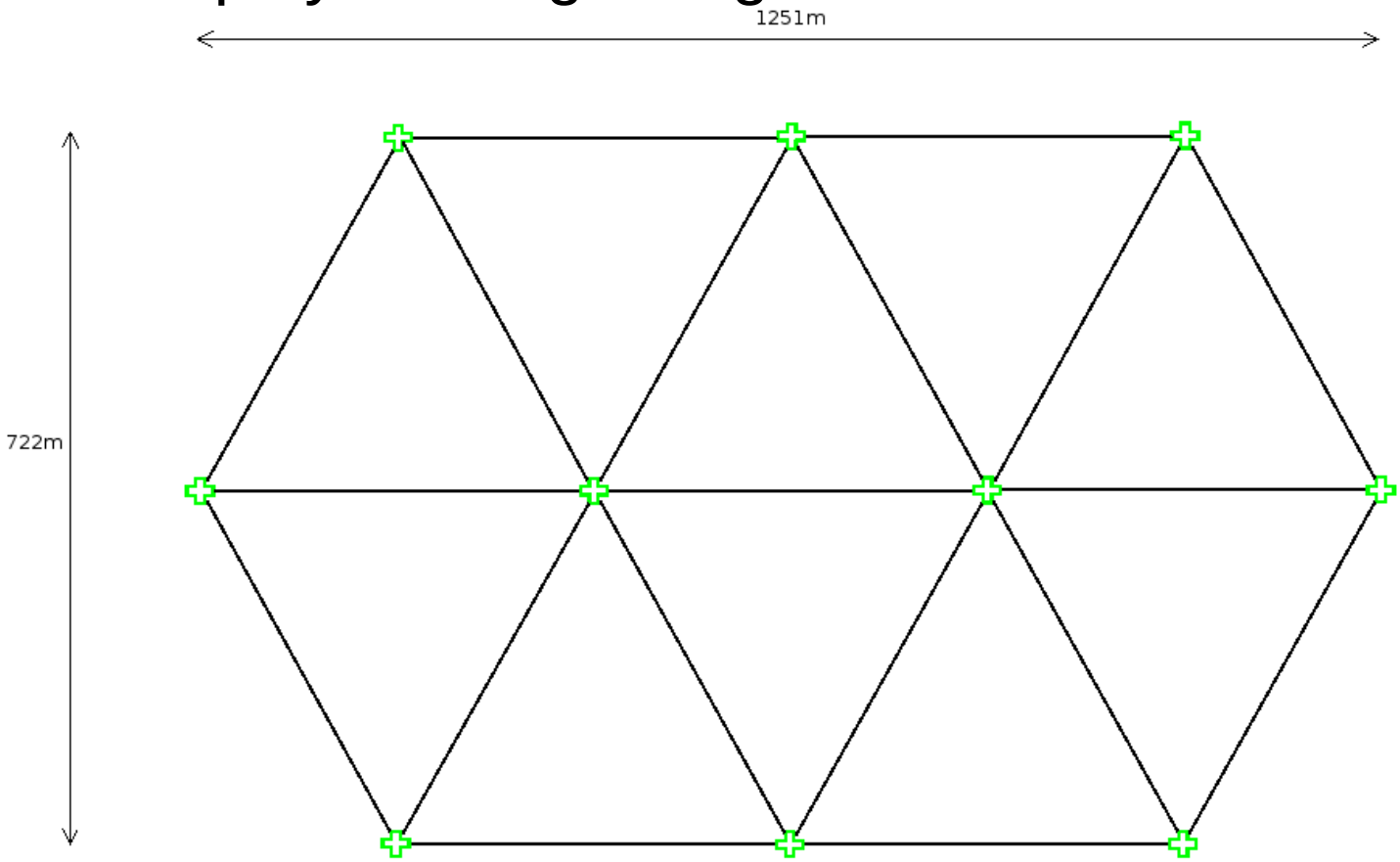
- **Ok we chose triangles**
  - Now: How to space our agents?



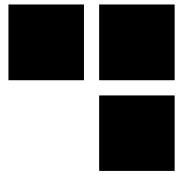


Tiling with triangles

- **240 meters seems good**
  - Let’s deploy a 10 agents grid



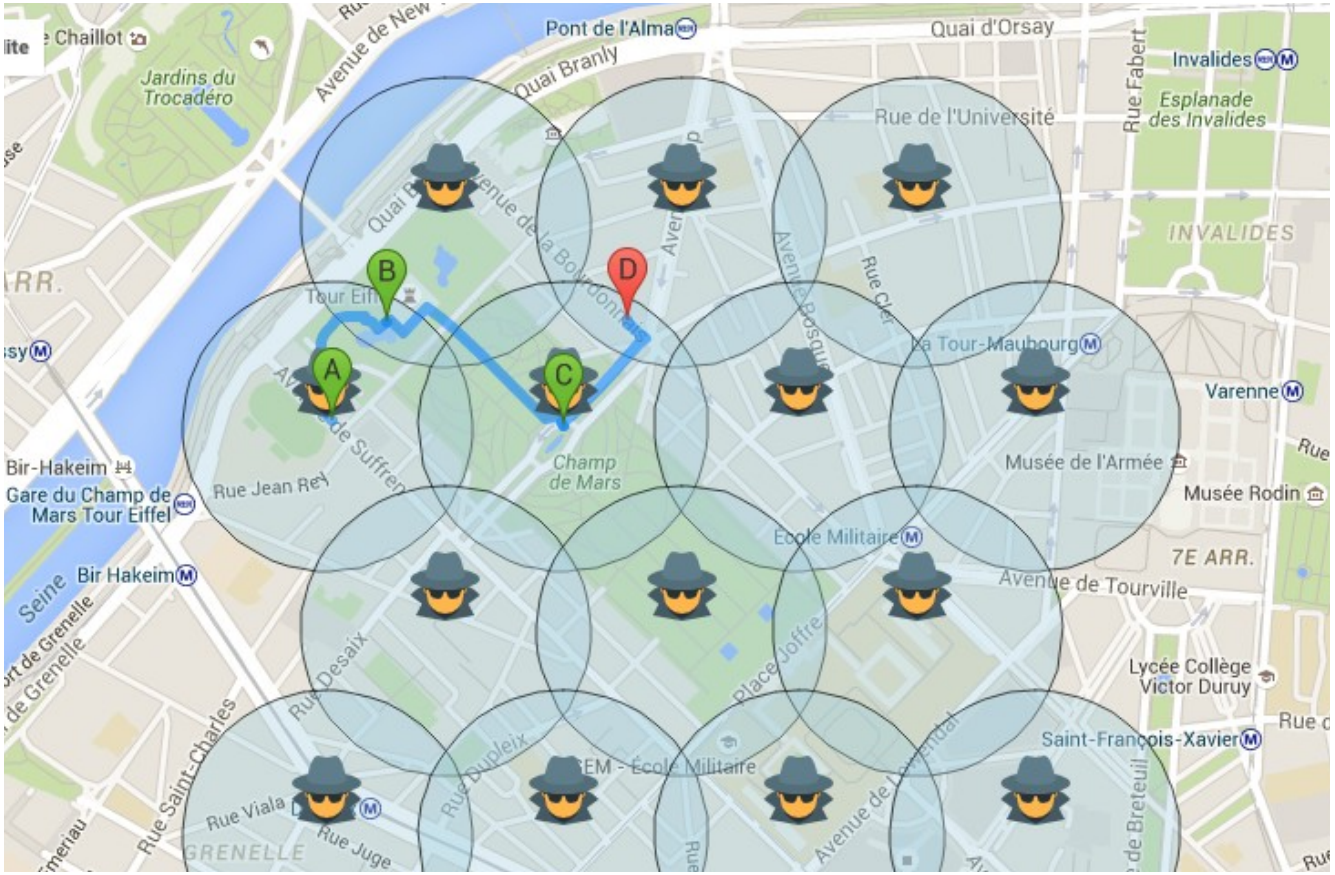
A few stats

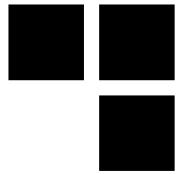


- **Number of agents needed to cover:**
  - DisneyLand Paris: ~75 agents
  - Paris: ~1K agents
  - France: ~ 6M agents

We are legion ...

- **Same view on a real map**

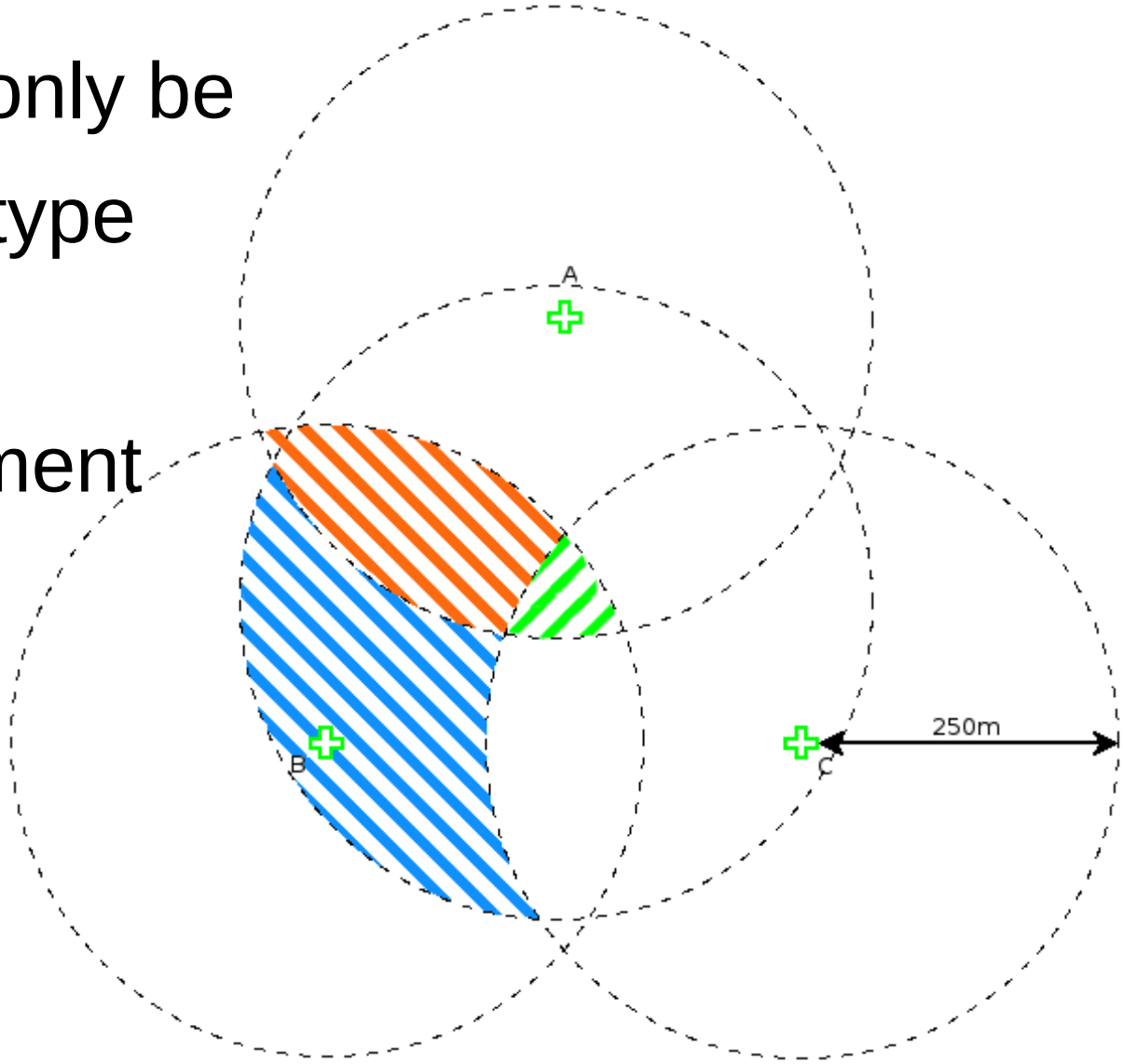




Jean-Pierre enters our grid!

Precision improvement

- Jean-Pierre could only be located in 3 different type of areas
- Precision improvement
  - Blue : x 4
  - Orange : x 18
  - Green : x 357

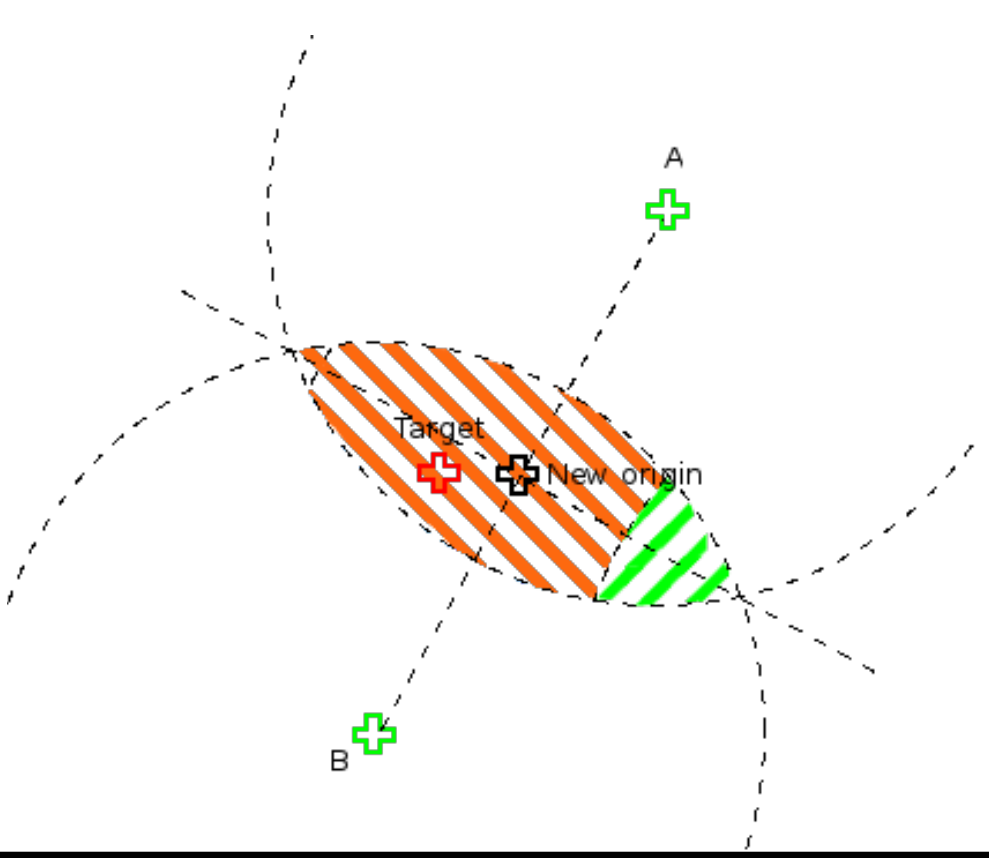


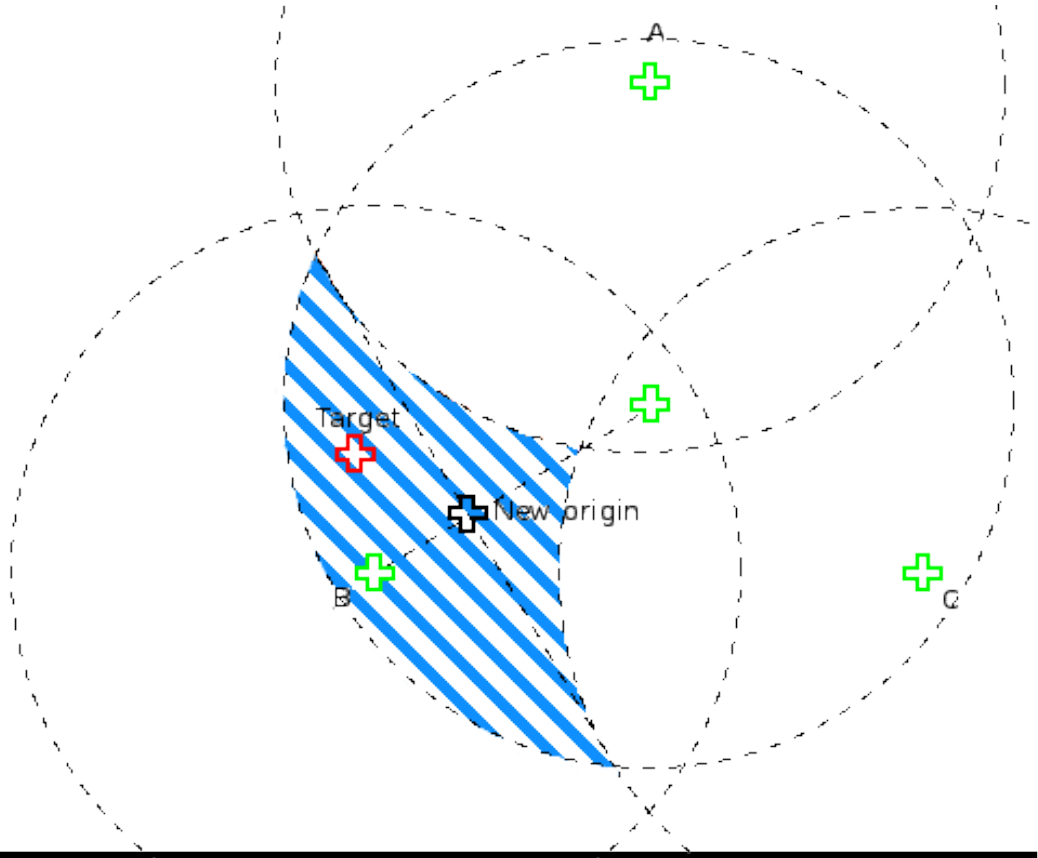
Can’t we do better?

- Blue and Orange cases are more precise but still not satisfying
- What if we move our agents and try to get Jean-Pierre in the Green zone?
  - Reminder: Our agents just moved and there might be a 5 minutes timeout before they can move again
  - Solution: Recruit 3 flying agents!

How to build a 6 pack?

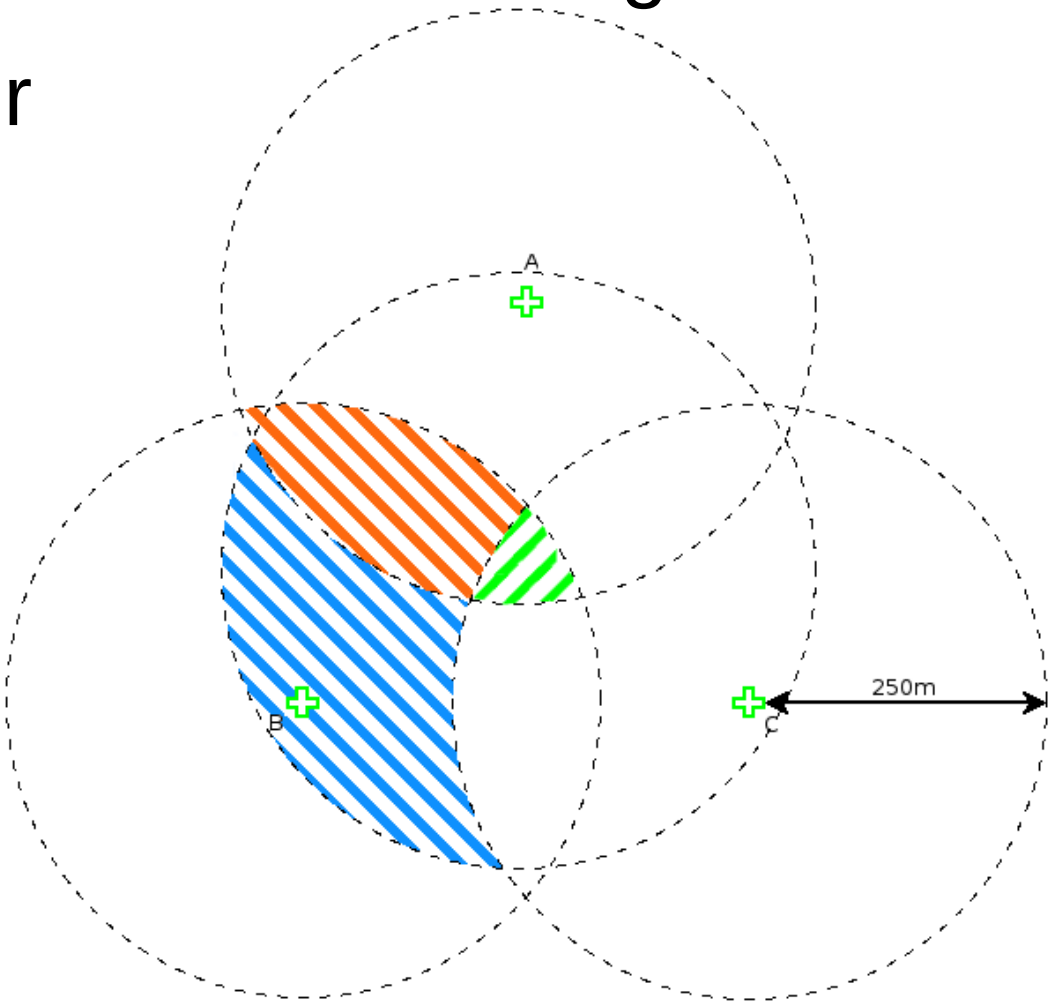
- Define a new origin
- Refine Orange and Blue cases!

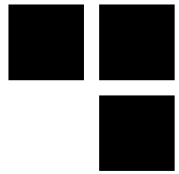




Precision improvement 2

- Repeat the process from the new origin
- 6 agents required for the operation

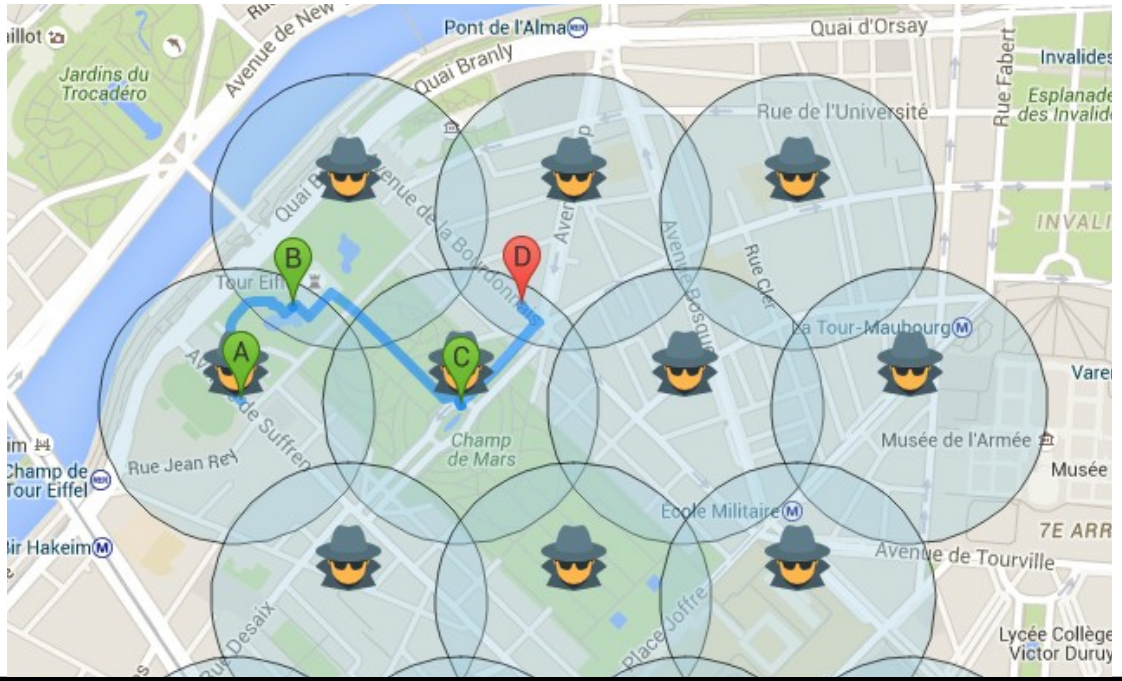




Let’s put all that geometry stuff inside a web app

Idle mode

- **Deploy the grid**
- **List potential Jean-Pierres detected by friends**
- **Monitor people's moves**

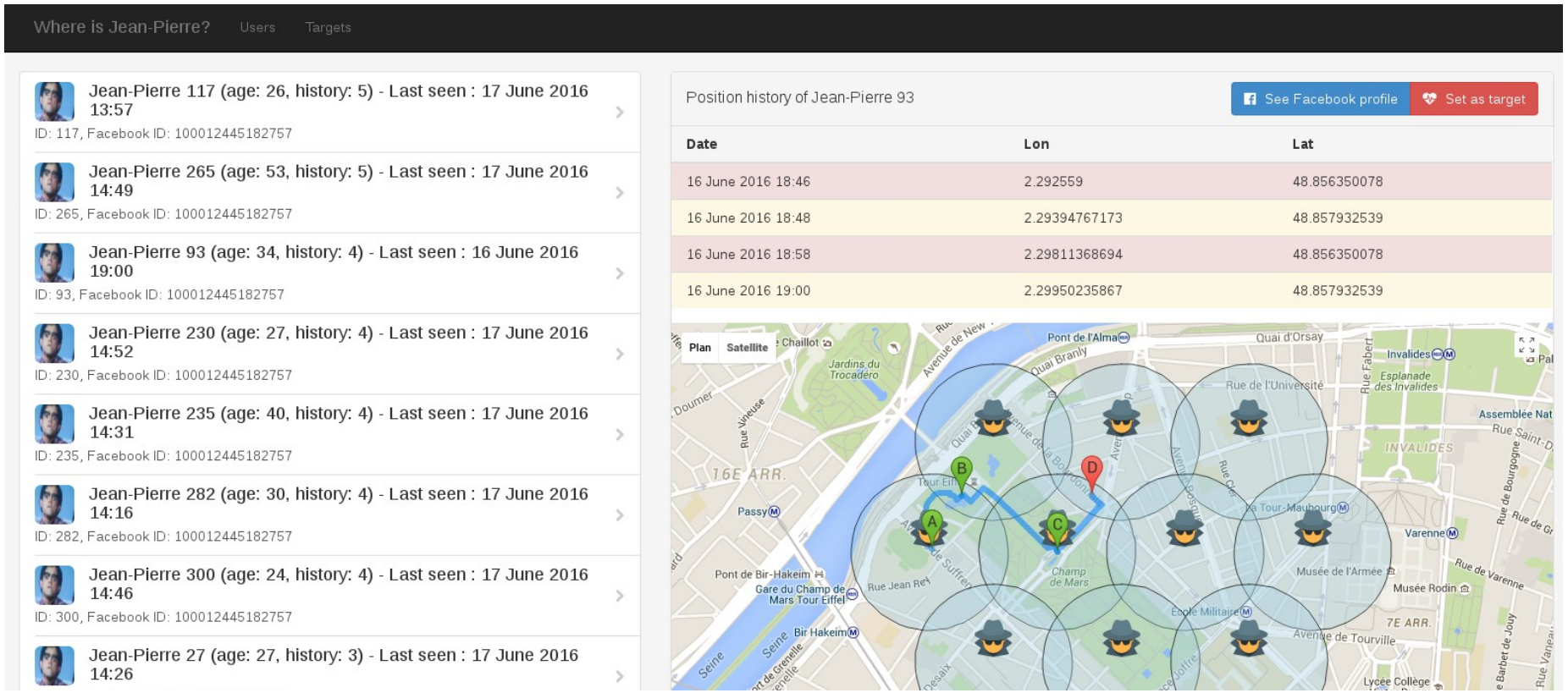


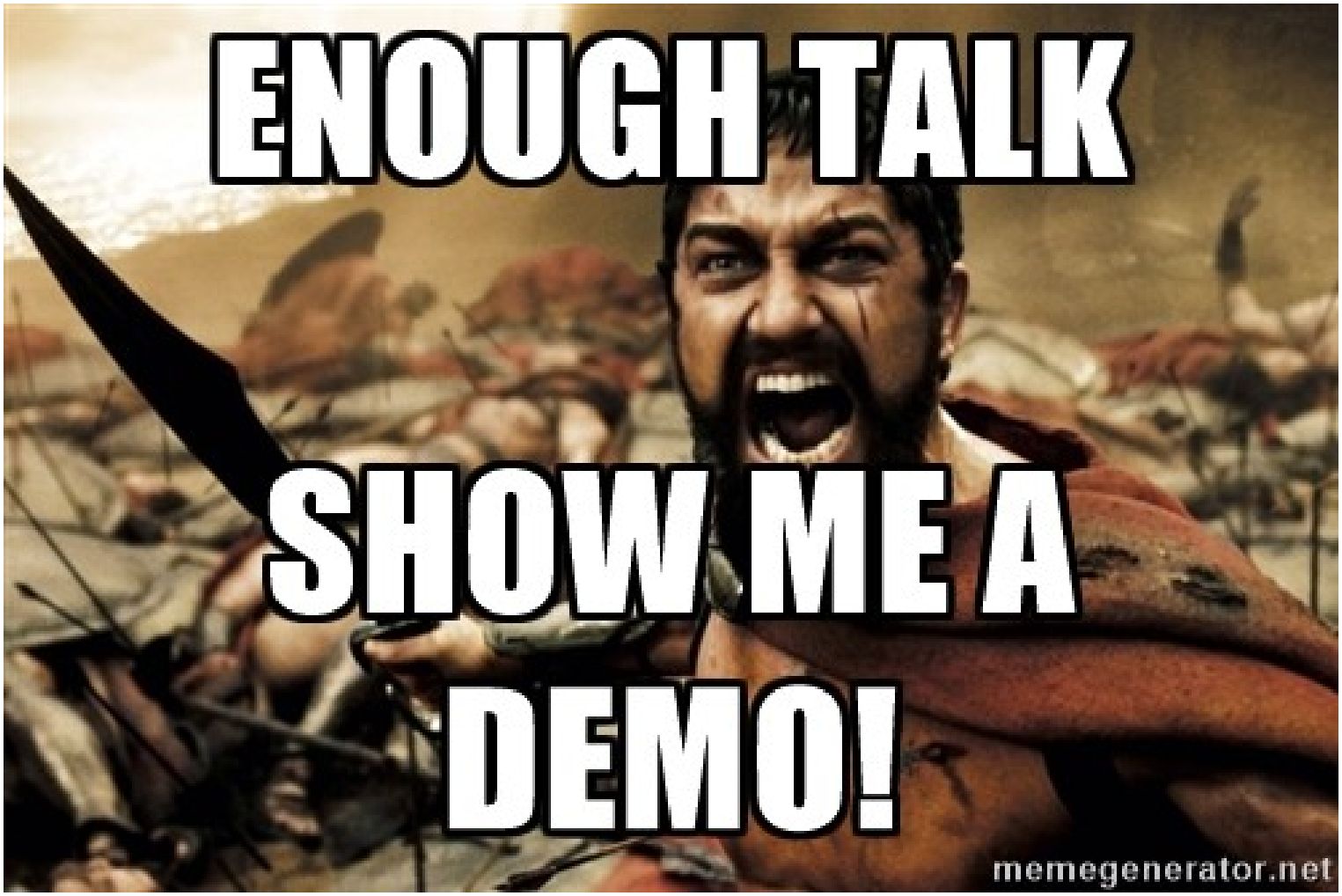
Track mode

- **Jean-Pierre is in the grid!**
- **Improve precision**
- **Shift the grid to keep him in the center**
- **Repeat**

It works!

- **2016 trends: Python, Flask, Bootstrap, Docker, Google Maps API ...**

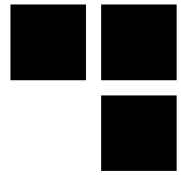



ENOUGH TALK
SHOW ME A
DEMO!
memegenerator.net

Mitigations

- **Possibility to turn on invisible mode**
  - Similar as a plane mode
  - Used by other similar apps to protect users
- **Possibility to blacklist some users**
  - If you don’t like them
  - If you feel they might be following you
  - Whatever reason

Extending the tool



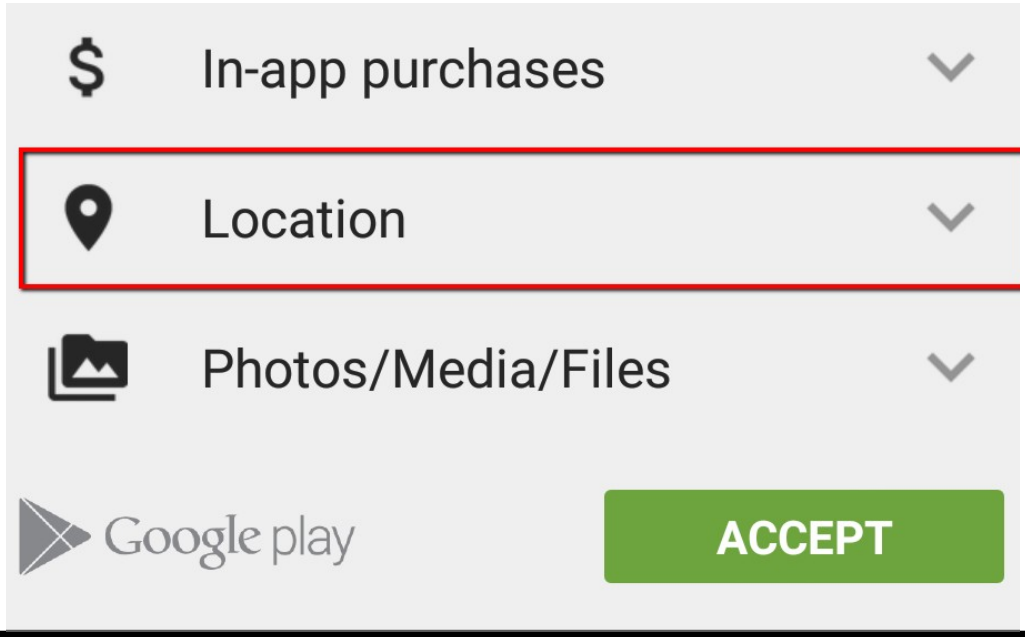
- **Detect if an agent have been blacklisted by Jean-Pierre**
- **Use other geoloc methods as "plugins"**
- **Intersect data sources to improve precision**
- **Crawl related social networks to find more location data**
  - Google+ images EXIF data
  - Facebook Nearby friends or location pinning

Conclusion

- **Now we are able to**
  - locate Jean-Pierre quite precisely
  - track him for a while
- **Almost any app using GPS can be turned into a tracking system, we just need:**
  - A user identifier
  - Partial location
  - Timestamp
- **You don’t need to be a government agency or an Internet Giant to do it!**

Conclusion

- **When installing an App**
  - Try to think how it could be used against yourself
  - Not limited to location (WiFi, Bluetooth, NFC…)
- **Don’t be a Jean-Pierre**



ANY QUESTIONS?

Thank you for your attention!

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