Developments in Electronic Monitoring Technology

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Home Office Centre for Applied Science and Technology

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Overview

Latest Developments

– Curfew

– Tracking

– Biometrics

– Alcohol

Assessing EM Technology

– Lab testing

– Operational testing

– Standards

The “Gold Standard”

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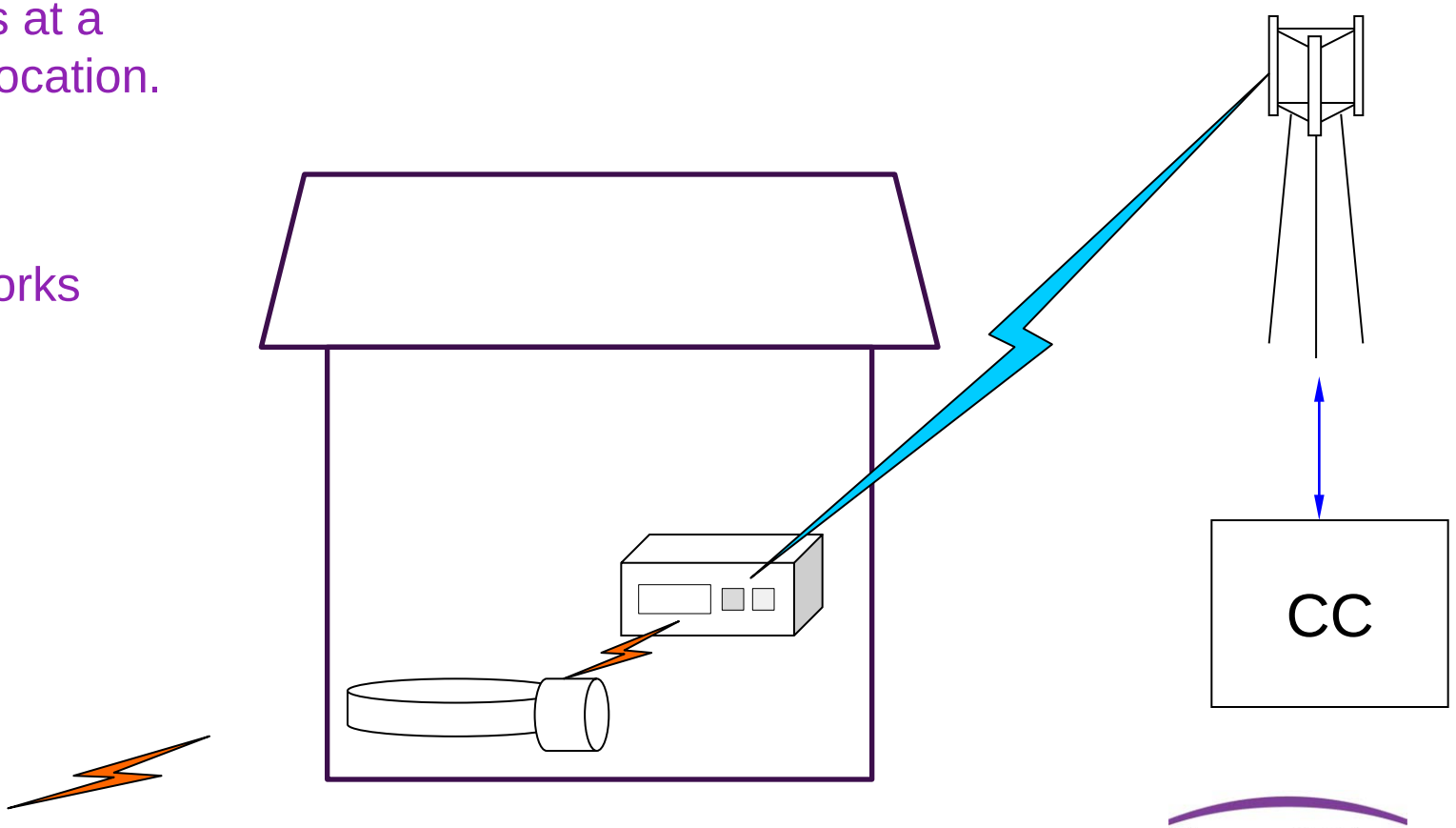
Curfew Monitoring

- Used to monitor if a subject is at a specific location.

- How it works



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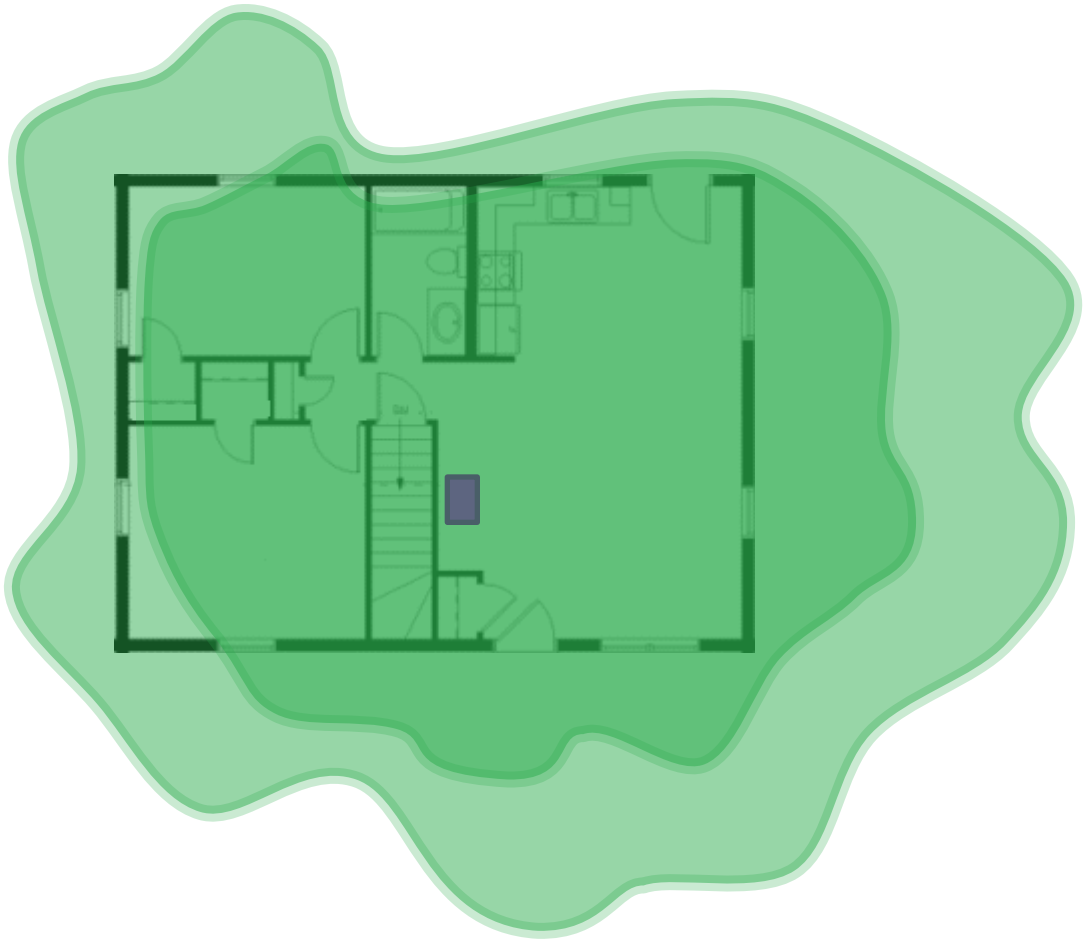
Curfew – Range Variability



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Curfew - Developments

- Two-way communications PID – MU
  - Used to confirm signals received
  - Could be developed for PID to PID communication for association monitoring
- Longer range MUs for large properties
- Other frequency bands for improved consistency
- Integration of biometrics

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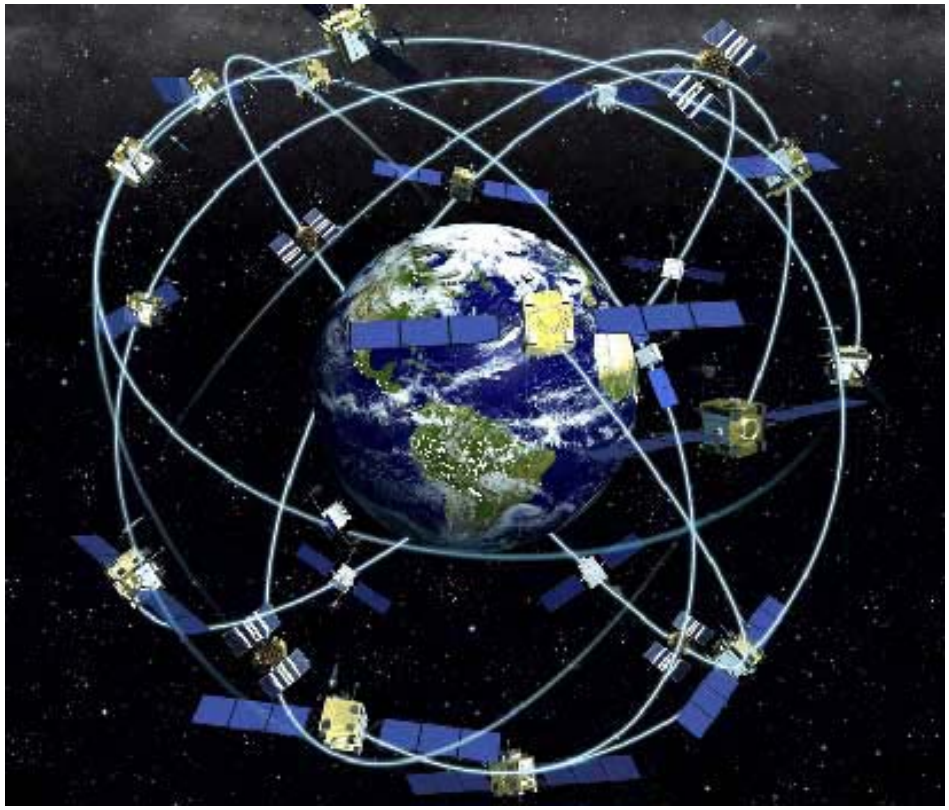
Tracking

- Used to monitor a subject's location.
- Can be used for exclusion monitoring or general whereabouts.
- Mostly uses GNSS Tracking.
- Global Navigation Satellite Systems (GPS, etc)



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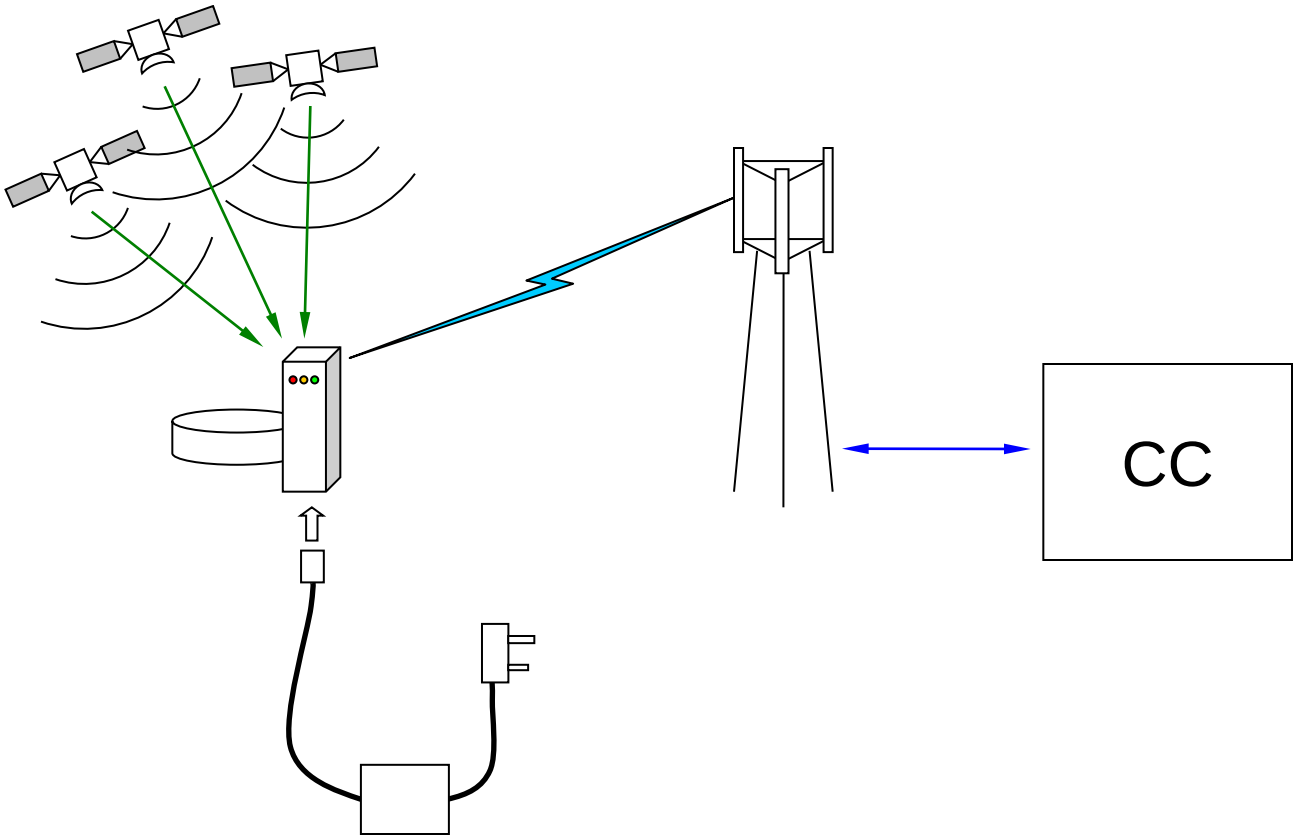
One Piece Tracking



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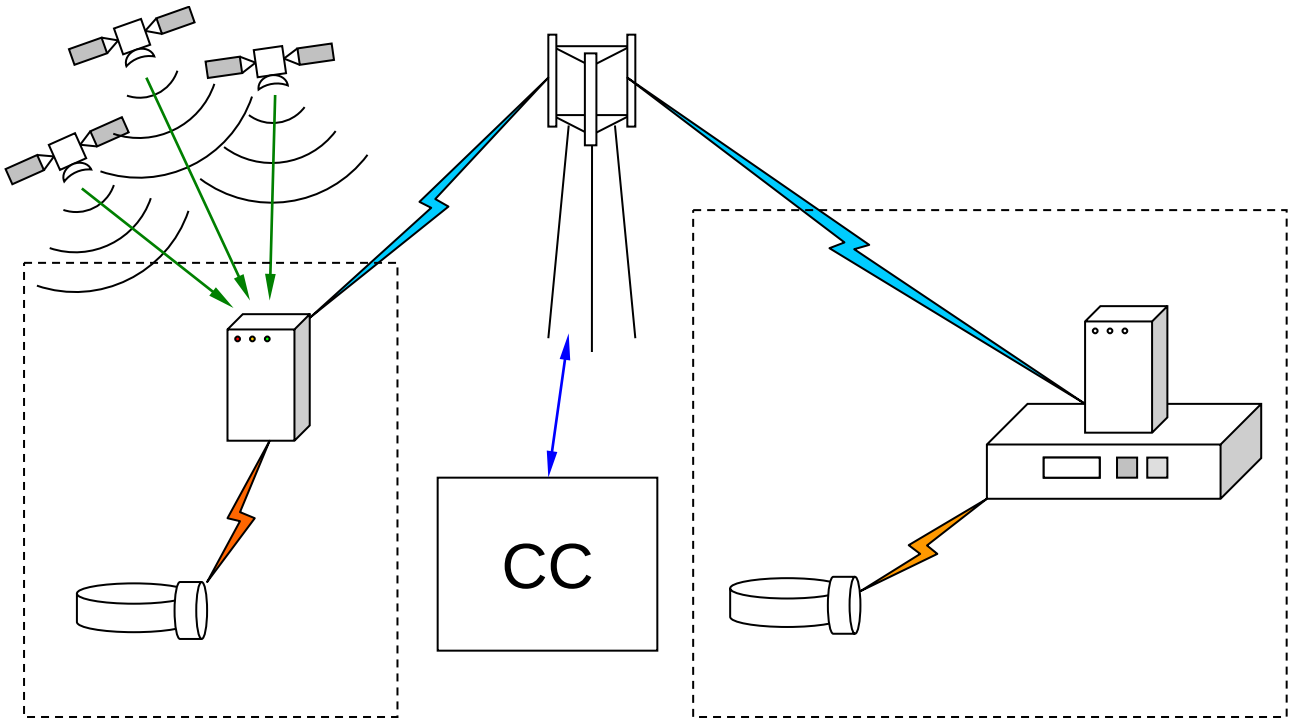
Two Piece Tracking



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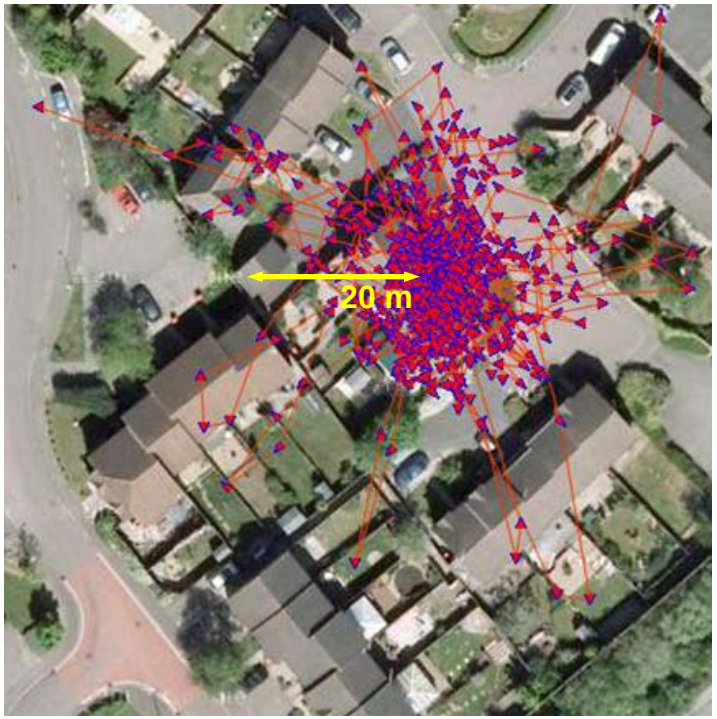
Issues with GNSS Tracking

- No signal underground and sometimes indoors
- How do you respond to a lack of signal?
- Poor accuracy in built up areas
- Easy to circumvent
  - Shield with kitchen foil
  - Use GPS jammer
- GPS spoofing provides the perfect alibi
- Battery life - compliance issue
- Not currently sufficiently accurate for curfew monitoring
- Will courts accept evidence as reliable?



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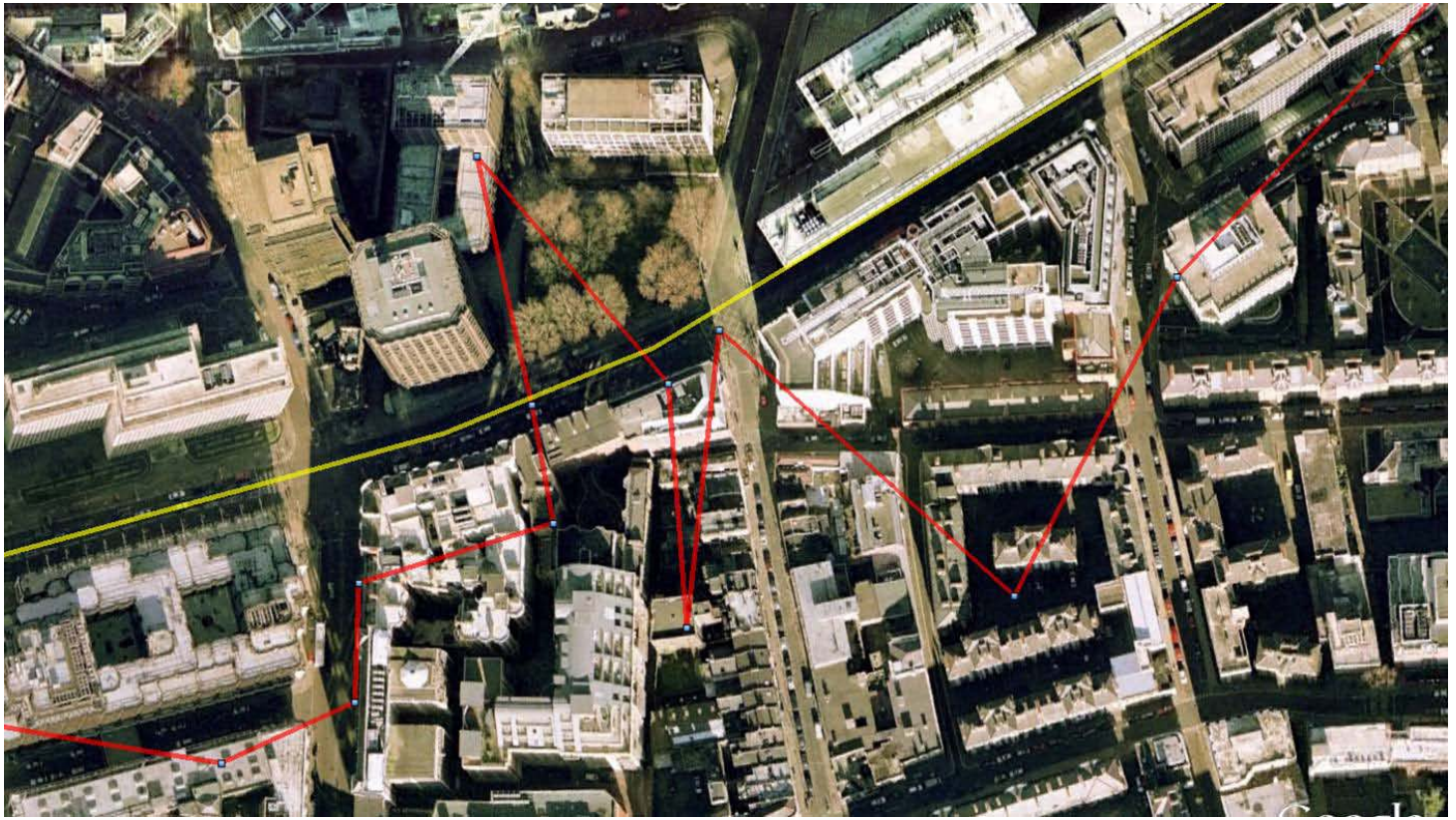
GNSS in Built Up Areas



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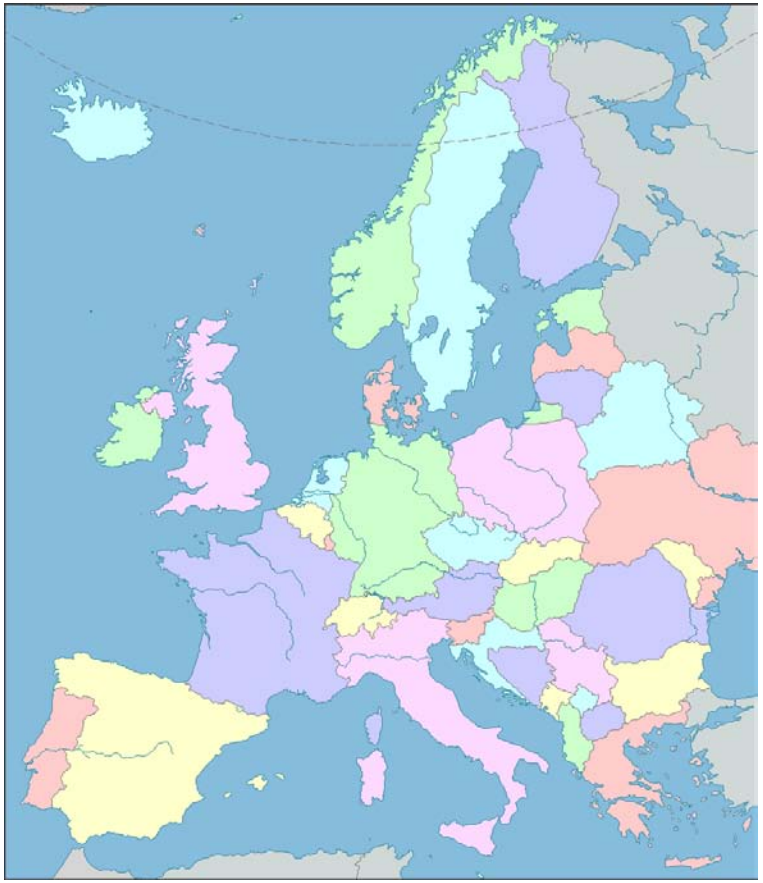
Backup Tracking

- Can deal with signal loss and accuracy issues through combining GNSS with other technologies.
- GSM Location
- eLORAN
- WiFi
- Inertial Sensing



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GSM Backup

- Use the known location of the nearest GSM (mobile phone) base-stations to work out approximate location of the tag.
- Good in built-up areas where there are lots of small cells.
- Not good in rural areas where cells can cover several kilometres.
- Difficult when dealing with exclusion
- Definitely better than nothing.

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eLORAN

- Maritime system using ground based transmitters which works over land
- A robust positioning and timing technology that penetrates buildings, is hard to jam or block with shielding
- Governments are required to maintain the system
- Antenna currently quite large and power consumption quite high but both under development

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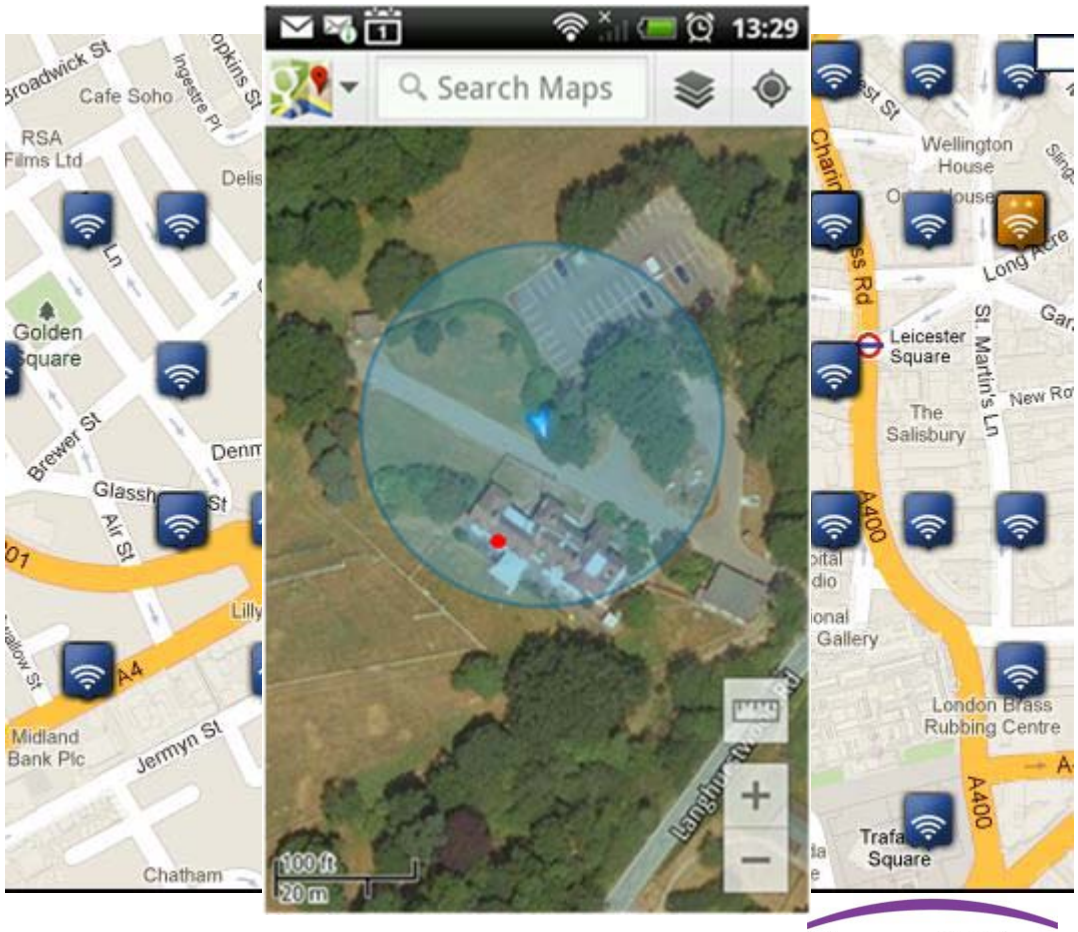
WiFi

- Wifi points detectable even if not usable
- Can construct a map of which wifi points are where
- Can use this to identify location
- Need to keep maps up to date
- No guarantee of WiFi presence



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Motion Sensing

- Accelerometers and MEMS gyros now used in many consumer electronics
- Much more advanced motion sensing ought to be possible, measuring approximate distance moved, not just vibration or tilt
- Accuracy insufficient for tracking on its own
- Useful in combination with other tracking technologies

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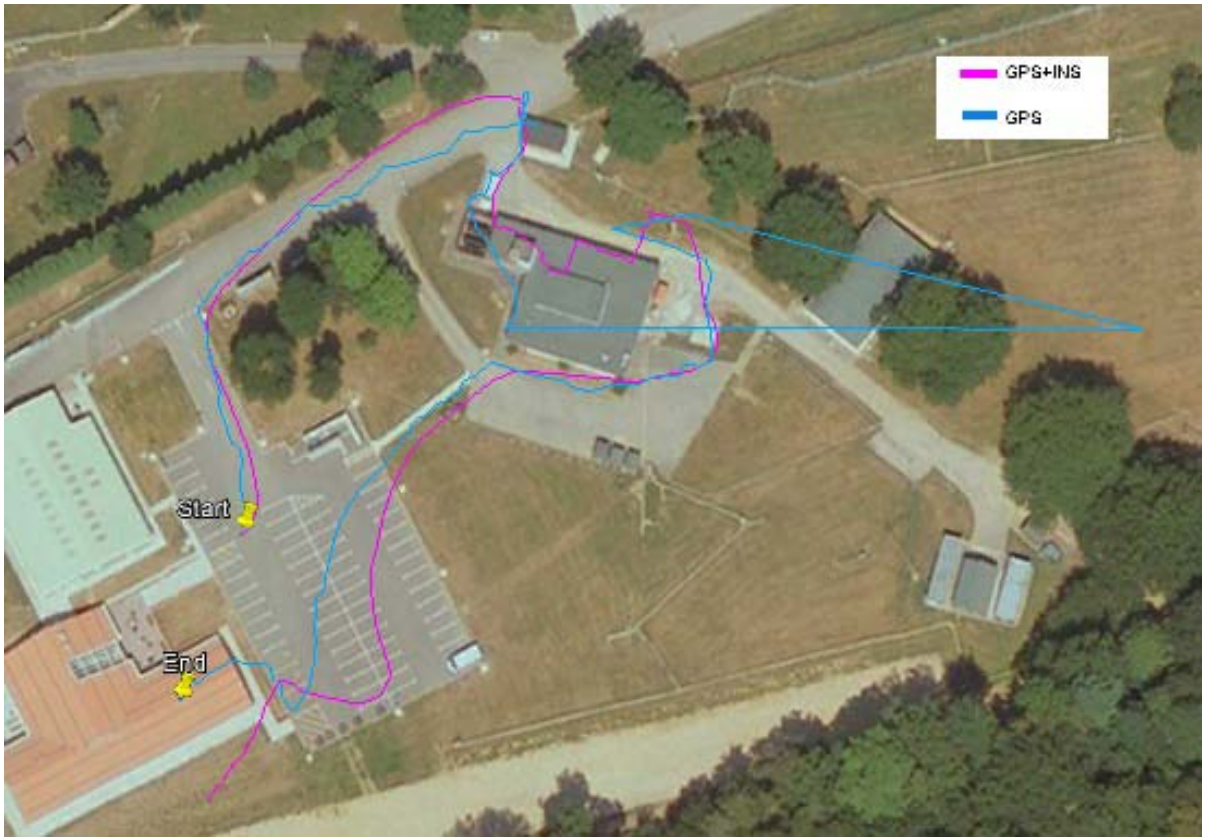
Motion Sensing



– Example of combined GPS and Motion Sensing

– Thanks to Cambridge Consultants, UK

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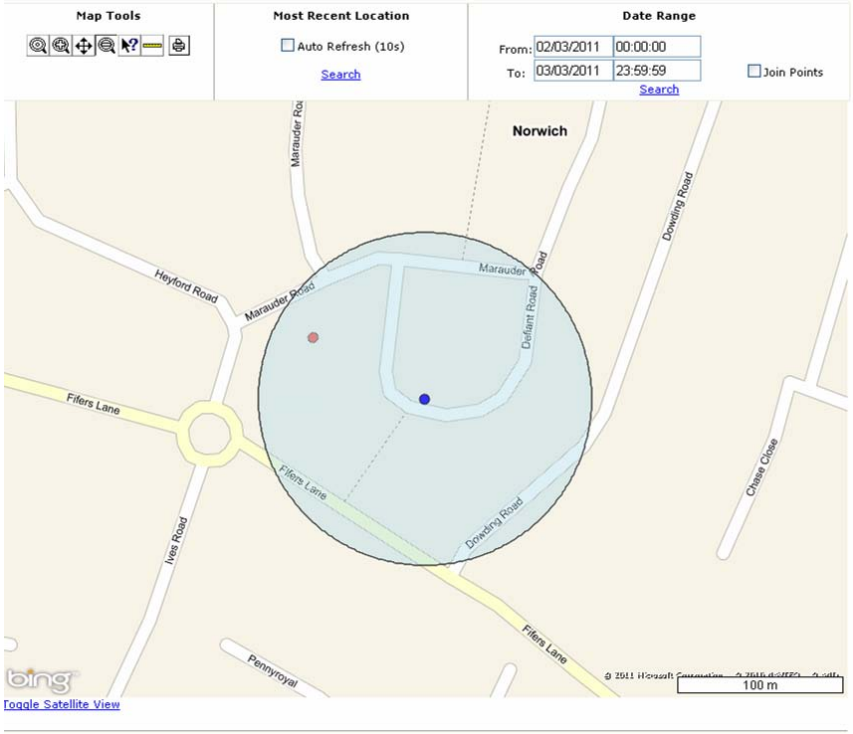
Tracking for Curfew Self Install

- Aim: provide confidence of installation at correct address
- GNSS used to track path home
- Will not provide signal in some residences
- Accuracy issues
- Could reduce installation costs



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Biometrics

- Voice verification
  - Low cost
  - Limited accuracy
  - Evidential quality?
- Automated facial recognition
  - Better than voice
  - Need for anti-spoofing when unattended
- Fingerprint
  - May be useful during enrolment
  - May be spoofed when unattended

- **Sample compliance only**

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Alcohol Monitoring

- Home Breath testing
  - With curfew monitoring
  - Need to verify identity
- Trans-dermal sensor
  - Worn like curfew tag
  - Detects ethanol in sweat
  - Not an absolute reading
- Through skin technology
  - Detects alcohol in blood using light
  - Need to verify identity

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Assessing EM Technology

- Why test at all?
- Complex technology is unpredictable
- Particularly in hostile environments
- Manufacturers can only test within their parameters
- Need to go beyond those to test your particular needs

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Know what you want

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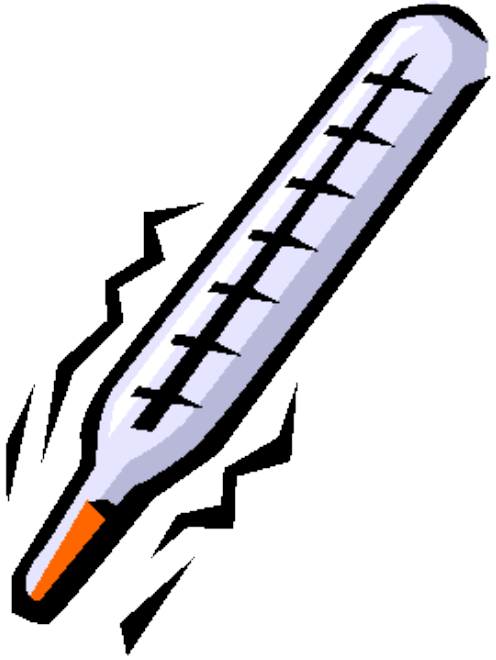
Lab Testing - External

- Repeatable lab testing is good for things that are easily measured.
- Example: Does the tag work between 0ºC and 50ºC? – Easy to test
- Can apply this to many things – humidity, shake, shock, immersion etc.
- Know what you want in advance and why
- The UK specifies what they want then has an external lab test against it



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Lab Testing - CAST

- We want to test things that are hard to measure too.
- Example: Security
- Every tag has different security features – not possible to specify performance in a meaningful way
- Have to test each case as it comes

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Security Testing

- Assume that the designs are known
- security should not rely on the subject not knowing how the device works
- Attack using tools available to a technically capable subject (and household items)
- Judge likely risk on complexity of attack
- In the UK, CAST do this themselves.

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Think perpetrator

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Operational Testing

- Trying it for real tells you about things you wouldn't have asked
  - Comfort
  - GPS acquisition time
  - Real-world battery life
  - Ease of use
- Good to use technical and non-technical testers

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There’s no substitute for trying it

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Standards

- Standards set out explicit requirements for specific products, systems or services
- They allow a user to judge performance without having to do the tests themselves
- They also allow integration across national boundaries
- Often cover things like safety or interoperability

bsi.

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Standards

- 4 types
  - Private (e.g. CAST)
  - National (e.g. BSI)
  - Regional (e.g. ETSI)
  - International (e.g. ISO)

- Example: ETSI EN 301 489 3

- We define which standards we expect EM products to meet then allow manufacturers to demonstrate the fact

- Tests should be independent and accredited (e.g. by UKAS in UK)

- Some standards are legally binding

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Current Challenges in EM

- Curfew blind spots
- Automatic interpretation of tracking data
- Detecting drug use
- Preventing incorrect fitting
- Reliable self-installation

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Innovation

- There is no final “Gold Standard” – technology can always be improved
- Innovation is vital
- Innovation is driven by the market
- This doesn’t always work
- Price vs. Quality

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You get what you pay for

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Thanks

- David Ebling
- CAST
- MoJ
- CEP

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The End

– Any questions?

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