Unmanned air vehicles

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RISKS

• Mid-air collisions with manned aircraft

• Harm to people

• Damage to property, in particular, sensitive infrastructure
Drone regulations

- remote pilot
- commercial
- registration
- flying
- hobby
- part 107
- knowledge test
- preflight inspection
- safety
- aviation
- technology
- USA
- rules
- airworthiness
- air space
- visual contact
- visual observer
- exemptions
- law
- unmanned aircraft
- limitations
- weather
- aviation
- industry
- model aircraft
• **European Commission**
  - 150K jobs in 10 years
  - Strict rules on safety
  - Protect the citizens rights, surveillance, monitoring
  - Tough controls to ensure security
  - Guaranteed third party liability and insurance

• **EASA Safety approach**
  - Open category
  - Specific Operation
  - Certified

• **CAA**
  - Certification authority <150Kg
  - Dronecode
USA

Milestone announcement
22 June 2016

“$82B, 100,000 jobs in a decade”

- Small drones <55lb
- Visual Line of Sight in day and twilight
- Speed and over flight restrictions – waivers from online portal
- Pilot certificate > 16 years old, tested every two years
- Operators responsible for safety – visual checks, comms
- All pilots given ‘privacy’ training
Don’t fly near airports or airfields

Remember to stay below 400ft (120m) and 150ft (50m) away from buildings and people

Observe your drone at all times

Never fly near aircraft

Enjoy responsibly
Infrastructure: 45.2
Agriculture: 32.4
Transport: 13
Security: 10
Media & Entertainment: 8.8
Insurance: 6.8
Telecommunication: 6.3
Mining: 4.4

Total: $127.3 Billion
The detection challenge

Drone targets - Small, low and slow

Typical size of target

- LARGE AIRLINER
- MEDIUM AIRLINER
- LIGHT AIRCRAFT
- PERSON
- LARGE BIRD
- LARGE INSECT
Holographic Radar

Software based, scalable radar – wide application

3D Airport Primary Radar

3D Infill Radar

3D Drone Detection (strategic asset protection)
Holographic radar for drone detection and tracking

- “Floodlight” transmit, planar array of receivers
- Digital beamforming on receive
- Detection of 0.01m² target to 5km
- 3D location and tracking
- 90° sector coverage
- No moving parts
- 0.25s update rate (variable, can be increased)
- Continuous staring at all targets, all the time – very fine Doppler resolution
- Micro-Doppler resolves rotor motion, distinguish from birds
Drone tracked incoming from 5km
### Autonomy

<table>
<thead>
<tr>
<th>Degree of automation</th>
<th>Pilot authority</th>
<th>Computer autonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commanded</td>
<td>Full</td>
<td>None</td>
</tr>
<tr>
<td>At call</td>
<td>Full</td>
<td>Advise, only if requested</td>
</tr>
<tr>
<td>Advisory</td>
<td>Acceptance of advice</td>
<td>Advice</td>
</tr>
<tr>
<td>In support</td>
<td>Acceptance of advice &amp; authorizing action</td>
<td>Advise, and if authorized, action</td>
</tr>
<tr>
<td>Direct support</td>
<td>Revoking action</td>
<td>Advised action unless revoked</td>
</tr>
<tr>
<td>Automatic</td>
<td>Interrupt</td>
<td>Full</td>
</tr>
</tbody>
</table>
How can we sense an impending collision?

We need to exchange information, either visually, electronic telemetry, noise, etc.

When we have information about each other, we can negotiate our paths.
Drones are an increasing part of everyday life, but they are not taking over the world.

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