Cybersecurity of UAS: Medium Risk Operations in Brazil

Second Unmanned Aircraft Systems – Remote Piloted Aircraft Systems Implementation/Regulation Workshop (UAS/RPAS/W) for the NAM/CAR/SAM Regions

28 September 2021

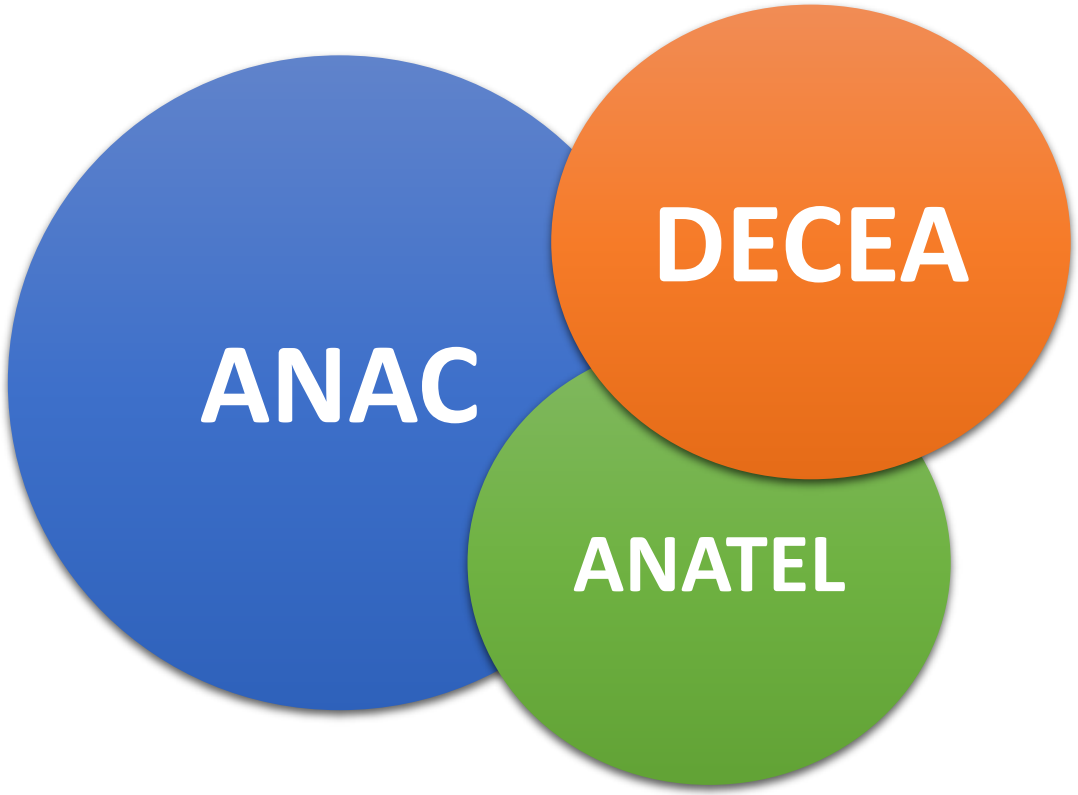
Agenda

- Brazilian UAS Regulation
- Cybersecurity and Safety Concerns
- Open Problems
- Conclusions

Brazilian UAS Regulation

- In 2017 ANAC published the RBAC-E nº 94
- This regulation has established operational rules, airworthiness requirements, pilot licensing, UAS registration criteria, etc.
- 86,000 drones are registered at the ANAC database, of which 36,000 were reported as commercial (professional uses)

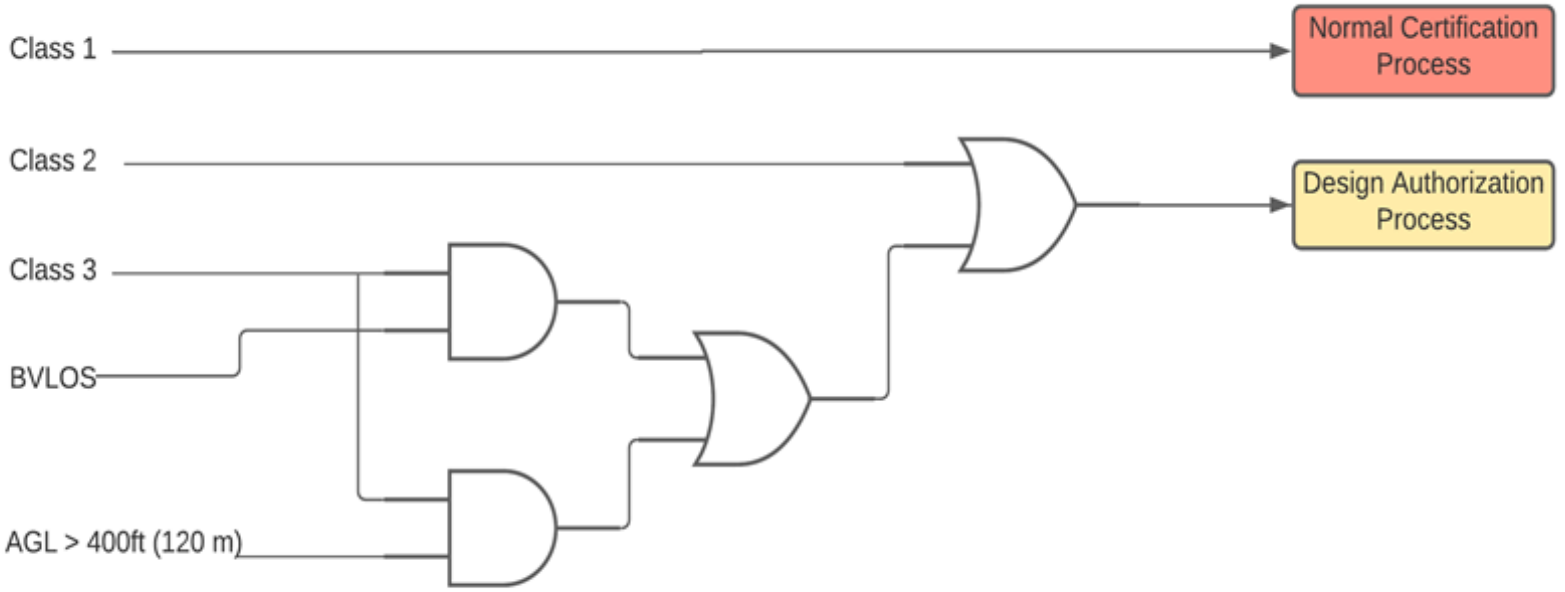
Brazilian UAS Regulation



UAS Airworthiness in Brazil

- ANAC has divided UAS into 3 groups: Class 1, Class 2, and Class 3
- Class 1 >= 150 kg;
- Class 2 above 25 kg and below 150 kg
- Class 3 above 250 g and below 25 kg
- There are also distinctions between VLOS and BVLOS, and above or not 400 ft AGL

UAS Airworthiness in Brazil



- There is no UAS Class 1 certified until now
- There are nine (9) models approved through the Design Authorization Process

Authorized UAS

Arator 5B / 5C
Manufacturer: XMobots (Brazil)
Operations: E/VLOS (2 km) up to 2.000 ft AGL or BVLOS (5 km) below 400 ft AGL
A5B: Authorized 08JUN2018
A5C: Authorized 07APR2021

eBee Classic/Plus/X
Holder: Santiago&Cintra (BR)
Manufacturer: Senselfy (Switzerland)
Authorized operations: BVLOS (5 km) below 400 ft AGL
EBEEC/EBEEP: 15APR2019
EBEEX: 19JUL2021

Echar 20D
Manufacturer: XMobots (Brazil)
Authorized operations : BVLOS (30 km) up to 6,000 ft AMSL
Authorized 10MAR2021

RPAS-112
Manufacturer: Energias (Brazil)
Authorized operations: BVLOS (7,2 km) below 400 feet AGL
Authorized 10JUN2021

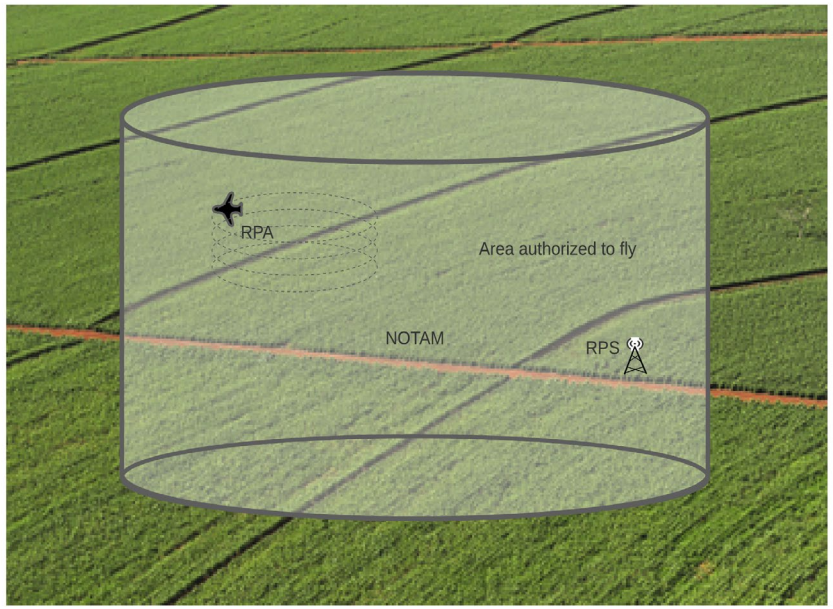
Cybersecurity and Safety Concerns

- For Class 1, certified UAS, we expect to use standards as RTCA DO-326A, DO-355 or DO-356

- For UAS Class 2, and Class 3 (BVLOS or above 400 ft), Medium Risk, the cybersecurity is addressed through safety assessment analysis which should cover intentional and non-intentional interferences and their effects

- For UAS Class 3 (VLOS and below 400 ft), Low Risk, there are no airworthiness evaluation. The Cybersecurity is not considered today for those aircraft

ConOps


RPA
Area authorized to fly
NOTAM
RPS


Delivery point
DP
Sunset Park
Bosque Imperial
Jardim Apolo II
Jardim Esplanada II
Google Earth

Cybersecurity and Safety Concerns

- Cybersecurity is a concept not fully understood by the applicants
- Extensive use of COTS (Commercial Of-The-Shelf) components
- UASs are migrating from point-to-point connections to over the Internet
- Lack of guidance or guidelines focused on UAS cyber

Cybersecurity and Safety Concerns

- JARUS (Joint Authorities for Rulemaking on Unmanned Systems) https://jarus-rpas.org/

- SORA (Specific Operations Risk Assessment)

- SORA objectives:
  * Avoid fatal injuries to third parties on the ground
  * Avoid fatal injuries to third parties in the air
  * Avoid damage to critical infrastructure

Cybersecurity and Safety Concerns

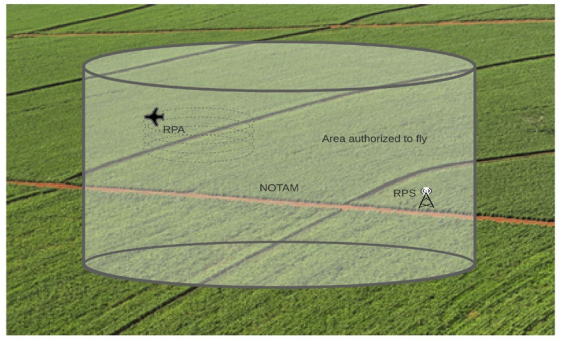
- Cybersecurity analysis needs to achieve the SORA objectives?

- SORA objectives:
  * Avoid fatal injuries to third parties on the ground
  * Avoid fatal injuries to third parties in the air
  * Avoid damage to critical infrastructure

C-I-A triad

Common Cyber-Threats

- GPS spoofing
- DDoS
- Communication Spoofing
- GPS Jamming
- Malware Infection
- Communication Jamming



Methodology

- System Architecture Overview
- ConOps Description
- Identify the Assets
- Identify and Rate the Threats
- Risk Acceptance or Application of Mitigations
- Life Cycle procedures

Open Problems

- The airworthiness requirements and operational rules are not harmonized yet
- There are no guideline or guidance to perform UAS cybersecurity risk assessment
- We have different ConOps, operational scenarios, manufactures etc. A unique solution to address all cyber cybersecurity concerns seems far from current stage
- Artificial Intelligence (AI) will probably increase the cyber-attacks

Open Problems

- Should we consider cybersecurity of UAS Open Category?
- Which standards from industry can we use in UAS?
- Does the operator need some training?
- UAS ATM will move from voice to data coordination. What is the impact of such change? What are the cyber concerns related with?
- What will be the impact of UTM, 5G or full automation?

Works

- ANSI, in its Standardization Roadmap for Unmanned Aircraft Systems, states that “Cybersecurity is a critical safety concern that must be addressed in the design, construction, and operation of UAS.”

- ENISA, its document Artificial Intelligence Cybersecurity Challenges - Threat Landscape for Artificial Intelligence, calls attention to problems as lack of robustness and vulnerabilities of AI models and algorithms, attacks against Cyber-Physical Systems (as drones and self-drive cars), data manipulation, Distributed DoS attacks, adversarial model interference and manipulation, etc.

Works

- JARUS WG6 is developing a document do address cyber concerns related to SORA methodology

- The SORA Annex E (Cyber) was available to external consultation in June/21. Currently, the team is on adjudication process of the comments, and It is expected that in the next JARUS plenary the document will be released.

Conclusions

- Cybersecurity is a hot and challenging topic for UAS
- CAAs and Standard Organizations have identified the problem but, up to now, we do have a solution that fits to our needs
- ANAC has not certified UAS under certified category yet. Therefore, today we are not sure if standards like RTCA DO-326A, DO-355 or DO-356 will be enough to address all the concerns of such operation

Conclusions

- From the Design Authorization Process, medium risk, we realize that for complex ConOps, is missing a guideline/framework to perform the security risk assessment
- Cyber-threats are not so unlikely, specially in urban environments
- JARUS SORA, and specially Cyber Annex E, are useful to tailor the assessment and requirements
- We need to develop some studies to pavement the way for more challenging uses of UAS


Obrigado!
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