Triton: A Software-Reconfigurable Federated Avionics Testbed

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I ILLINOIS
Analyzing the security of aircraft systems

What happens if an attacker **compromises an airplane’s electronics**?
- Can it make the airplane operate in an unsafe manner?
- Can it make the pilots think an unsafe condition is safe?

We need to attack a **genuine airplane** to answer these questions
- Attacks in simulation or theory are difficult to believe
- Testing on an airplane is impractical

We created a testbed to analyze the security of aircraft
Real aircraft systems

Software and data updates

Pilots

Boeing 737

ACARS messages
Inputs

Airborne Data Loader (ADL)
- Connects to all other computers
- Loads software/data updates
- Security: Malicious software
VHF Data Radio (VDR)

- For ACARS: Air-ground text communication
- Converts radio↔text
- Security: Entry point, accepts all messages
Multifunction control and display unit (MCDU)

- Interface between pilots and computers
The CMU is the heart

Communications Management Unit (CMU)
- Processes all ACARS messages from VDR
- Forwards messages to other devices
- Security: Parses untrusted input, well-connected

Software and data updates

Pilots

ACARS messages

(VDR)
The CMU is the heart

Software and data updates

Airborne data loader (ADL)

Control display unit (MCDU)

Communications management unit (CMU)

VHF Data Radio (VDR)

ACARS messages

Pilots
Flight Management Computer (FMC)

- Navigates, calculates performance parameters
- Sometimes controls autopilot
- Receives ACARS messages through CMU
- Security: Directly influences flight
How to make a testbench
How to make a testbench

Software and data updates

Airborne data loader (ADL)

Control display unit (MCDU)

Pilots

Communications management unit (CMU)

Flight management computer (FMC)

Printer

VHF Data Radio (VDR)

Autopilot

ACARS messages
How to make a testbench
Connections: ARINC 429

One transmitter per bus
-> Many buses
r429: Virtual interconnection

Monitoring

Virtual ARINC 429 buses

CMU
Attack vector: Software updates
How it looks

~16 cm
Experiments: Software update
Attack vector: ACARS
Design: ACARS
Experiments: ACARS
Conclusion

● Triton: Runs real computers, simulates an airplane on a workbench
● Use to test security
● Next steps: Flight Control Computer