Triton: A Software-Reconfigurable Federated Avionics Testbed

Sam Crow, Brown Farinholt, Stefan Savage, Aaron Schulman, Alex C. Snoeren

UC San Diego

Brian Johannesmeyer

VU UNIVERSITY AMSTERDAM

Karl Koscher

UNIVERSITY of WASHINGTON

Stephen Checkoway

OBERLIN COLLEGE & CONSERVATORY

Kirill Levchenko

ILLINOIS

Analyzing the security of aircraft systems

What happens if an attacker compromises an airplane's electronics?

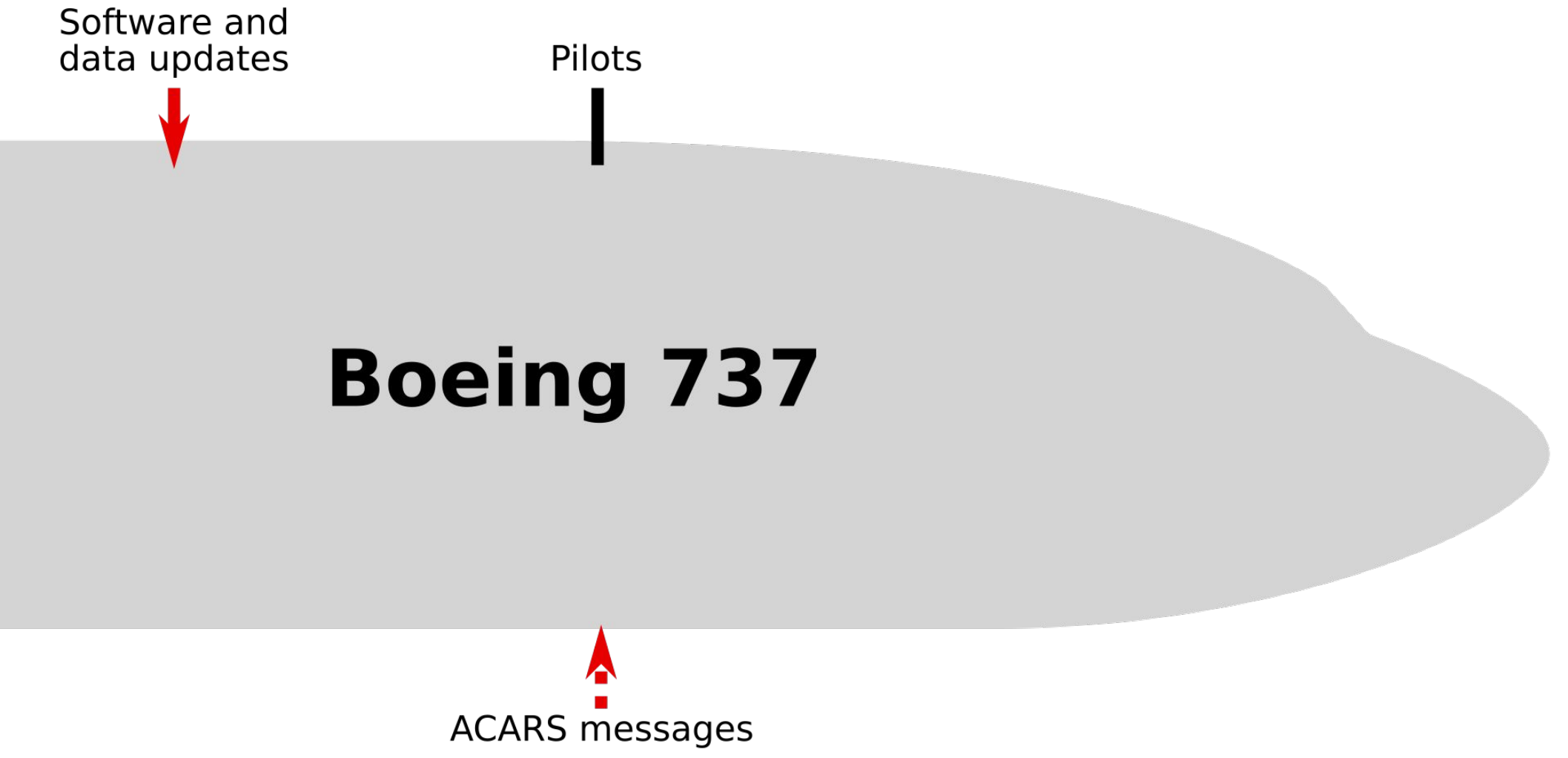
- Can it make the airplane operate in an unsafe manner?
- Can it make the pilots think an unsafe condition is safe?

We need to attack a genuine airplane to answer these questions

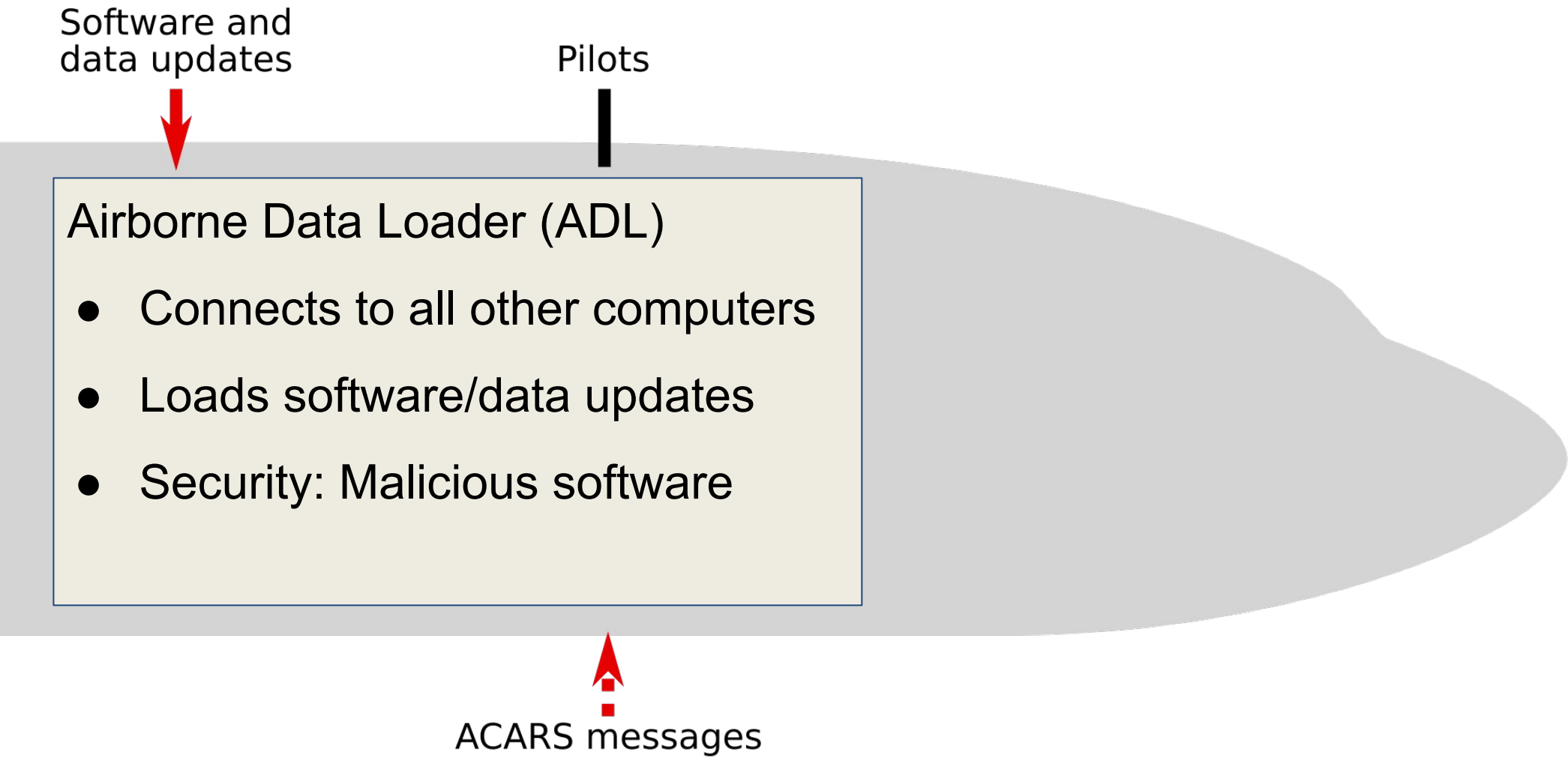
- Attacks in simulation or theory are difficult to believe
- Testing on an airplane is impractical

We created a testbed to analyze the security of aircraft

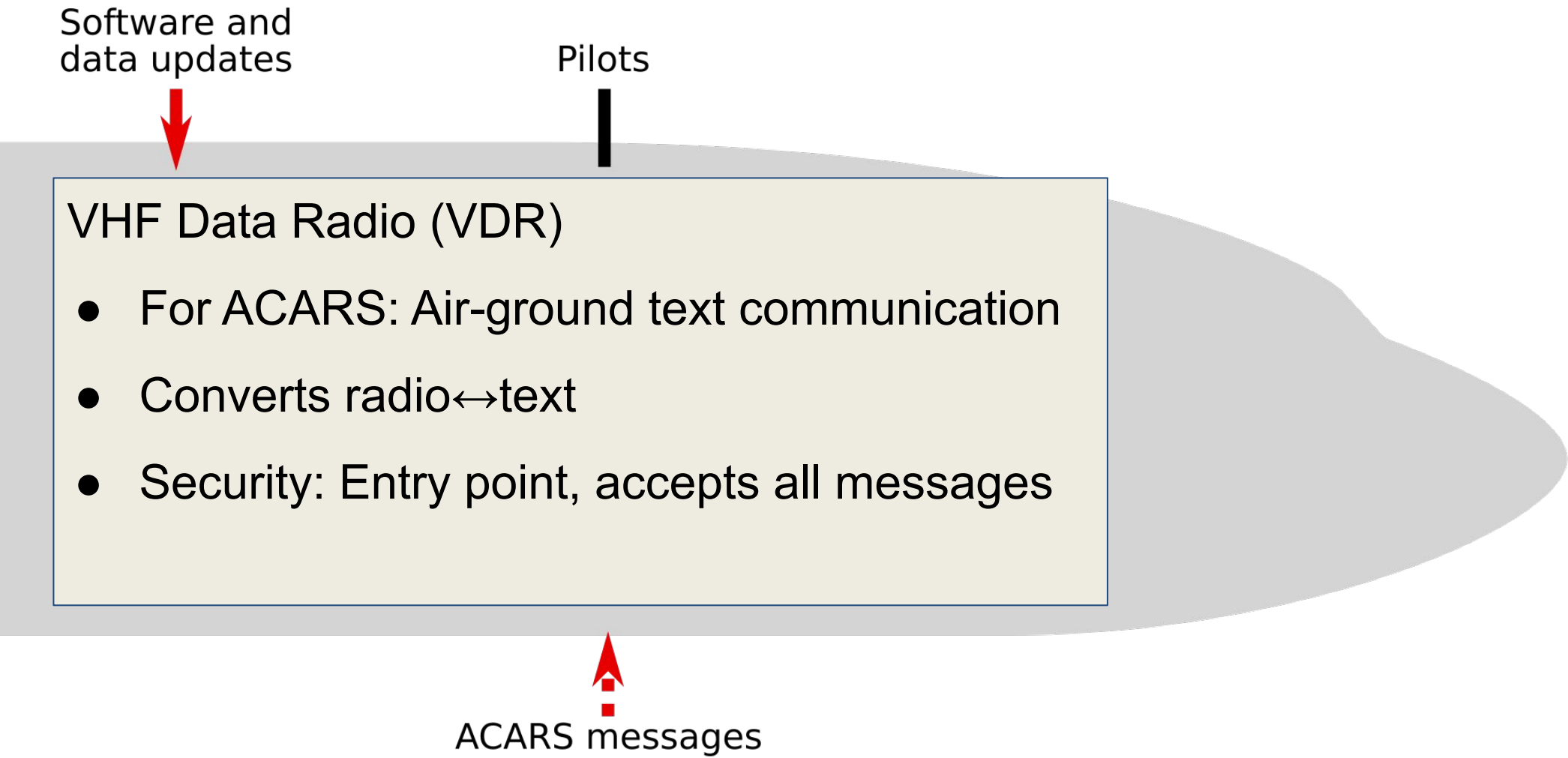
Real aircraft systems



Inputs


Software and
data updates
Pilots
Airborne Data Loader (ADL)
• Connects to all other computers
• Loads software/data updates
• Security: Malicious software
ACARS messages

Inputs


Software and
data updates
Pilots
VHF Data Radio (VDR)
For ACARS: Air-ground text communication
Converts radio↔text
Security: Entry point, accepts all messages
ACARS messages

Inputs

Software and data updates

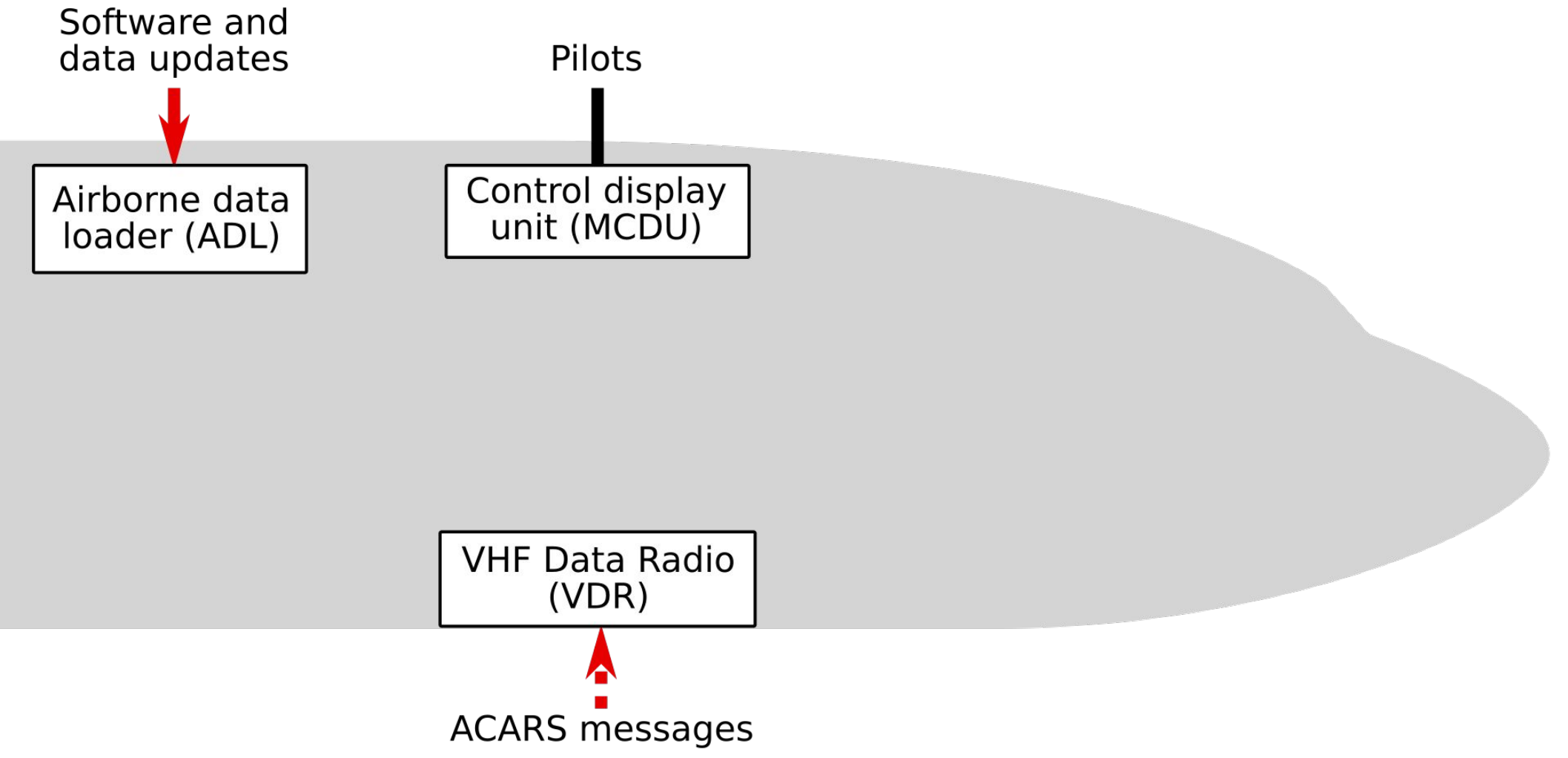
Pilots

Multifunction control and display unit (MCDU)

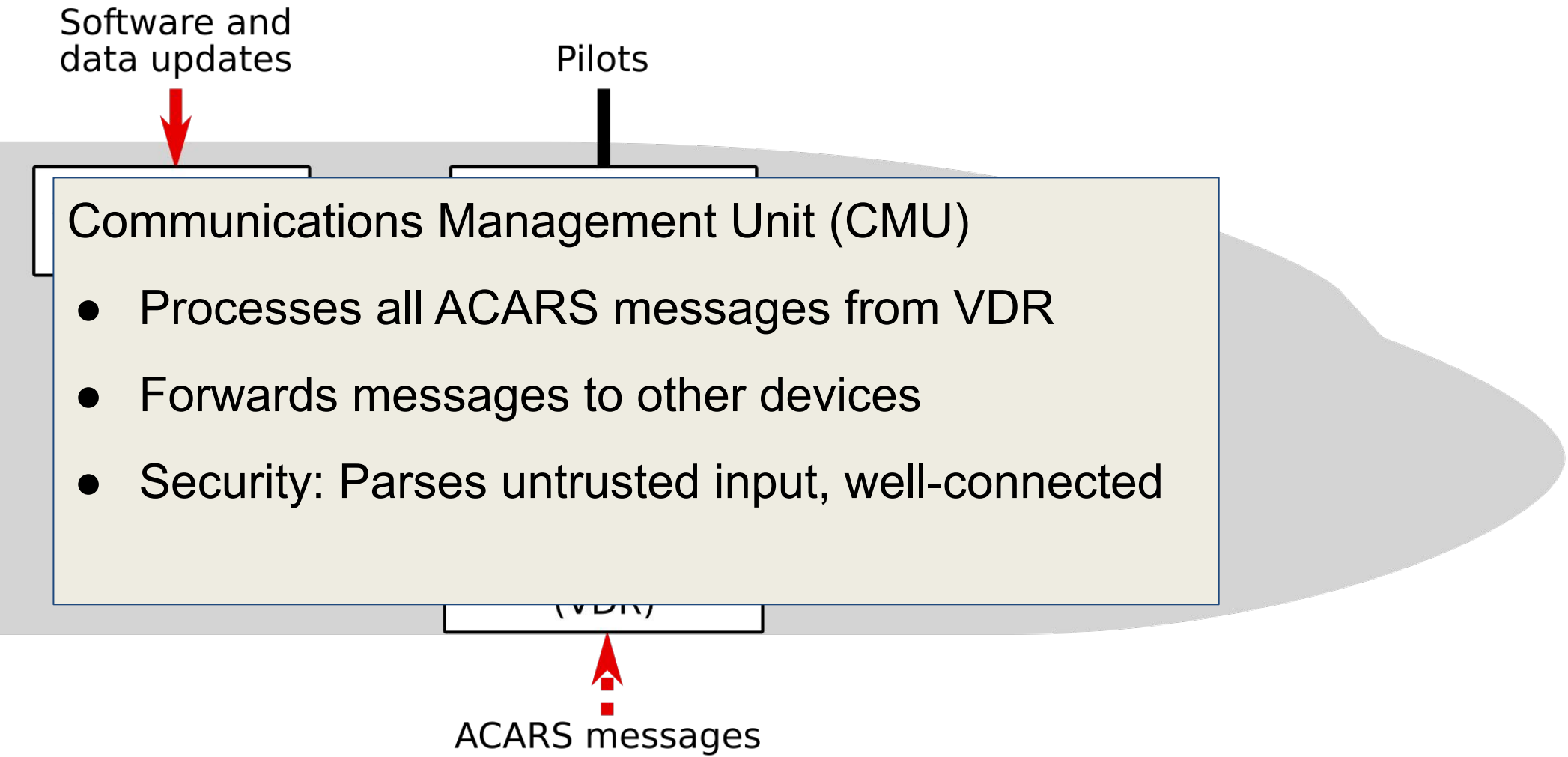
- Interface between pilots and computers

ACARS messages

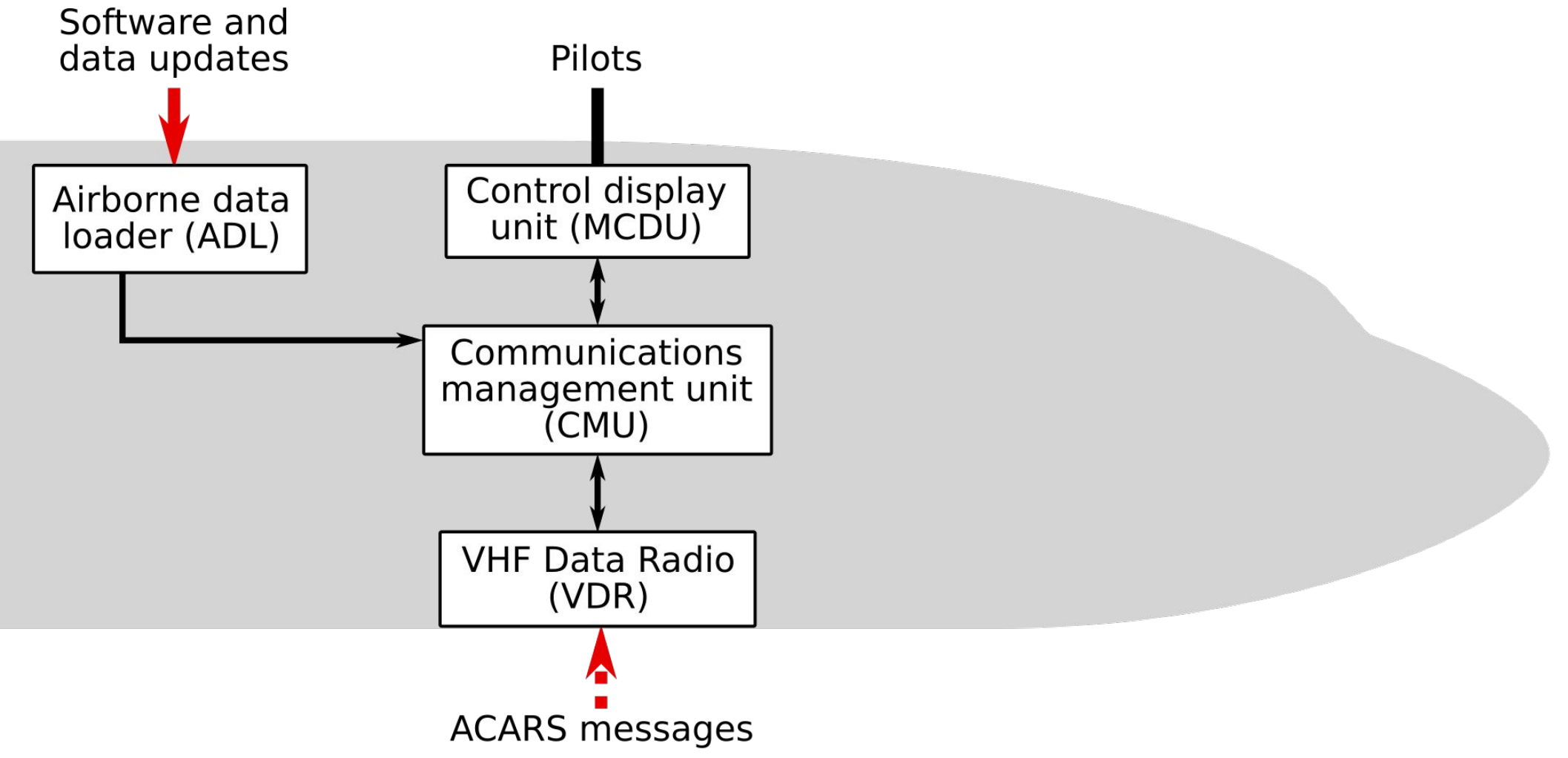
Inputs


Software and data updates
Pilots
Airborne data loader (ADL)
Control display unit (MCDU)
VHF Data Radio (VDR)
ACARS messages

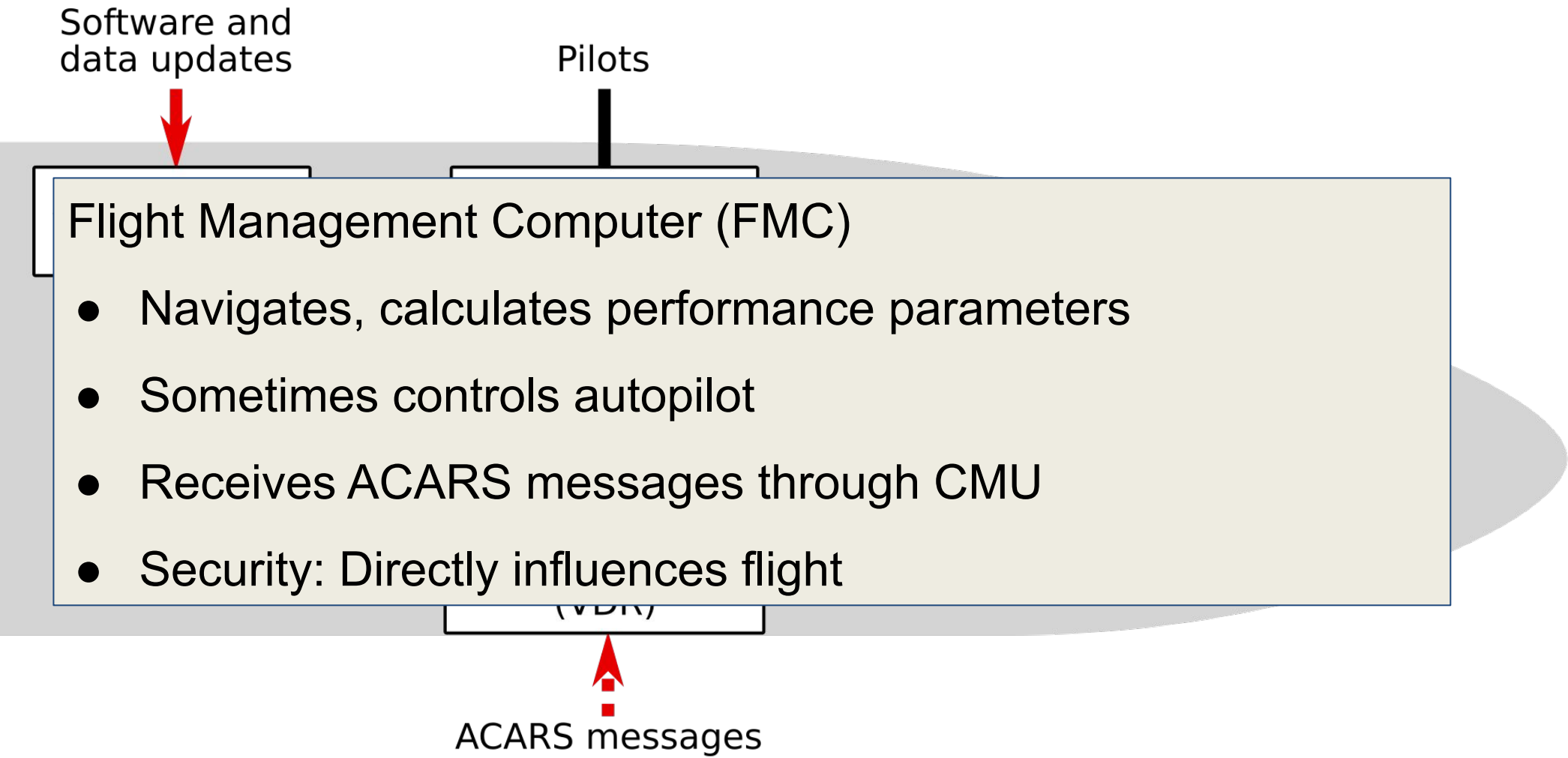
The CMU is the heart



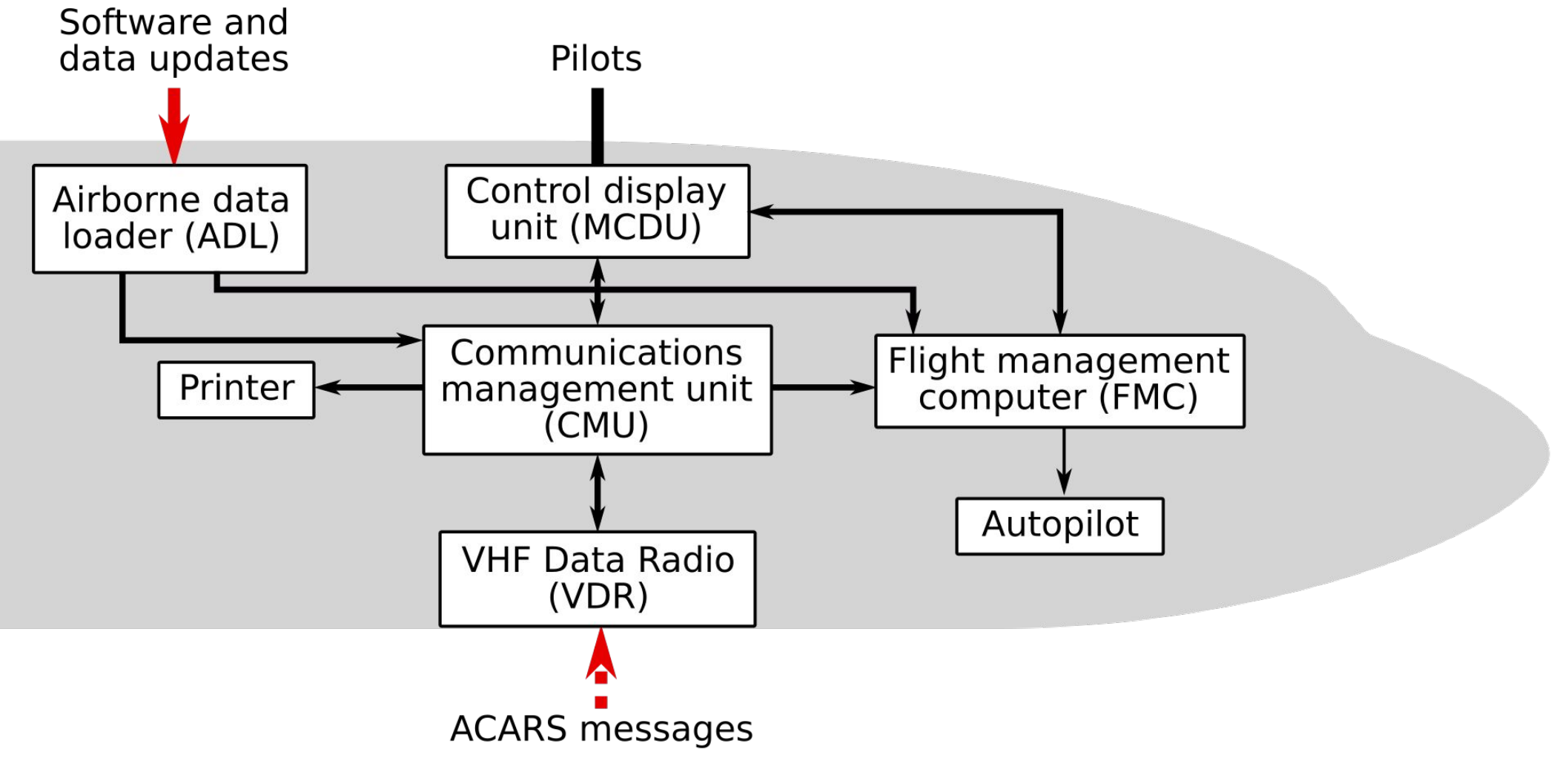
The CMU is the heart



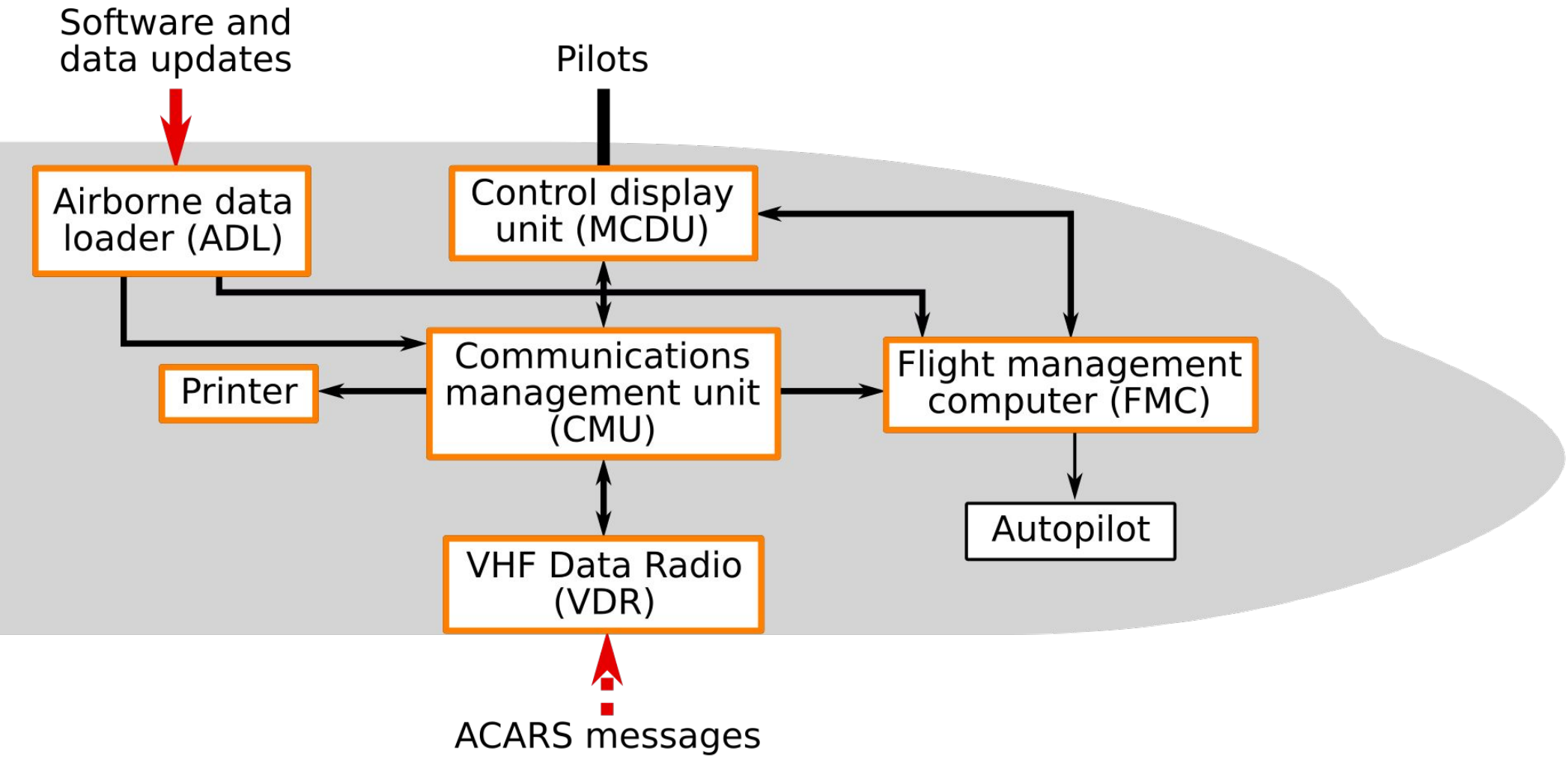
More computers



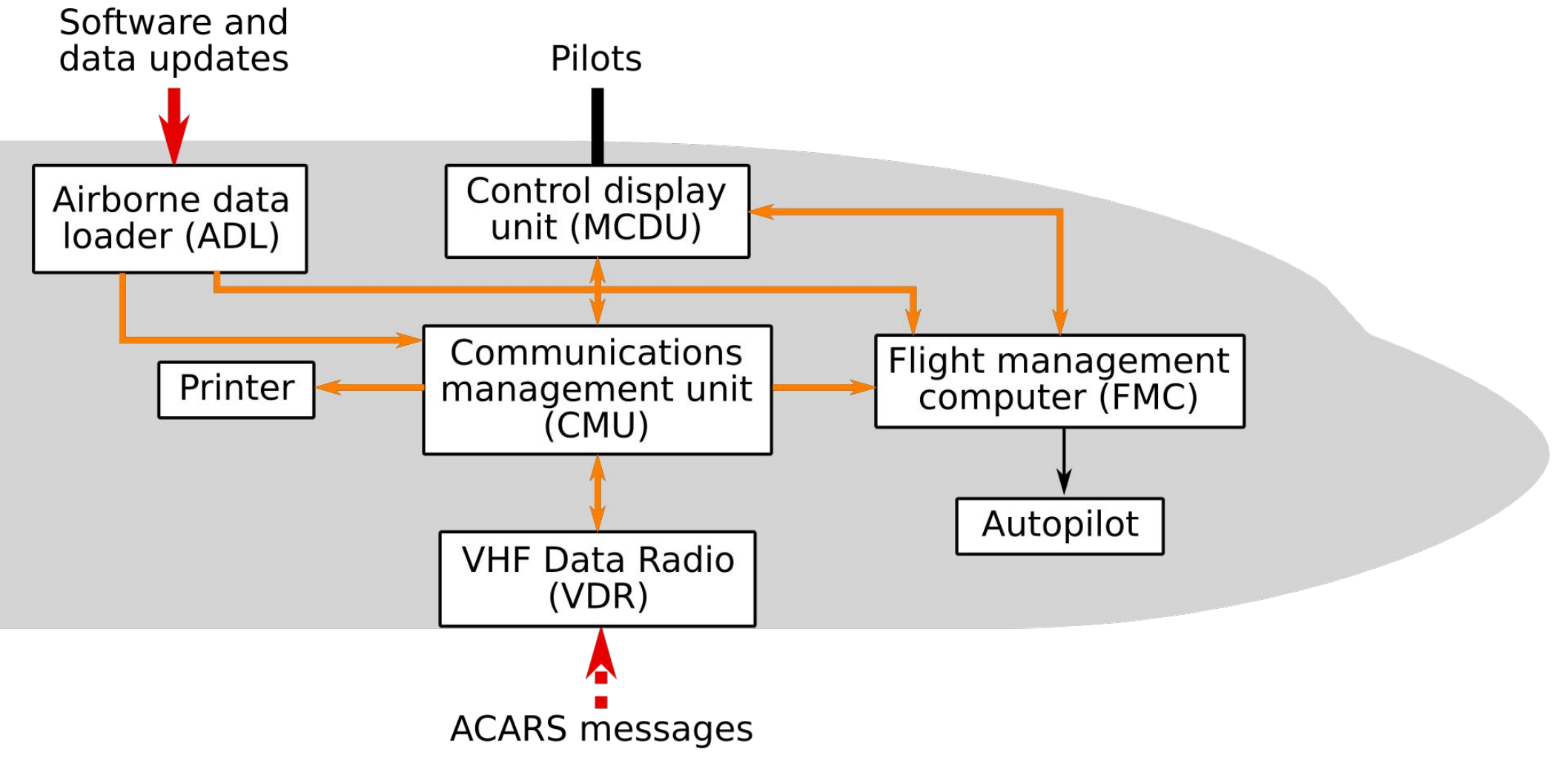
How to make a testbench



How to make a testbench

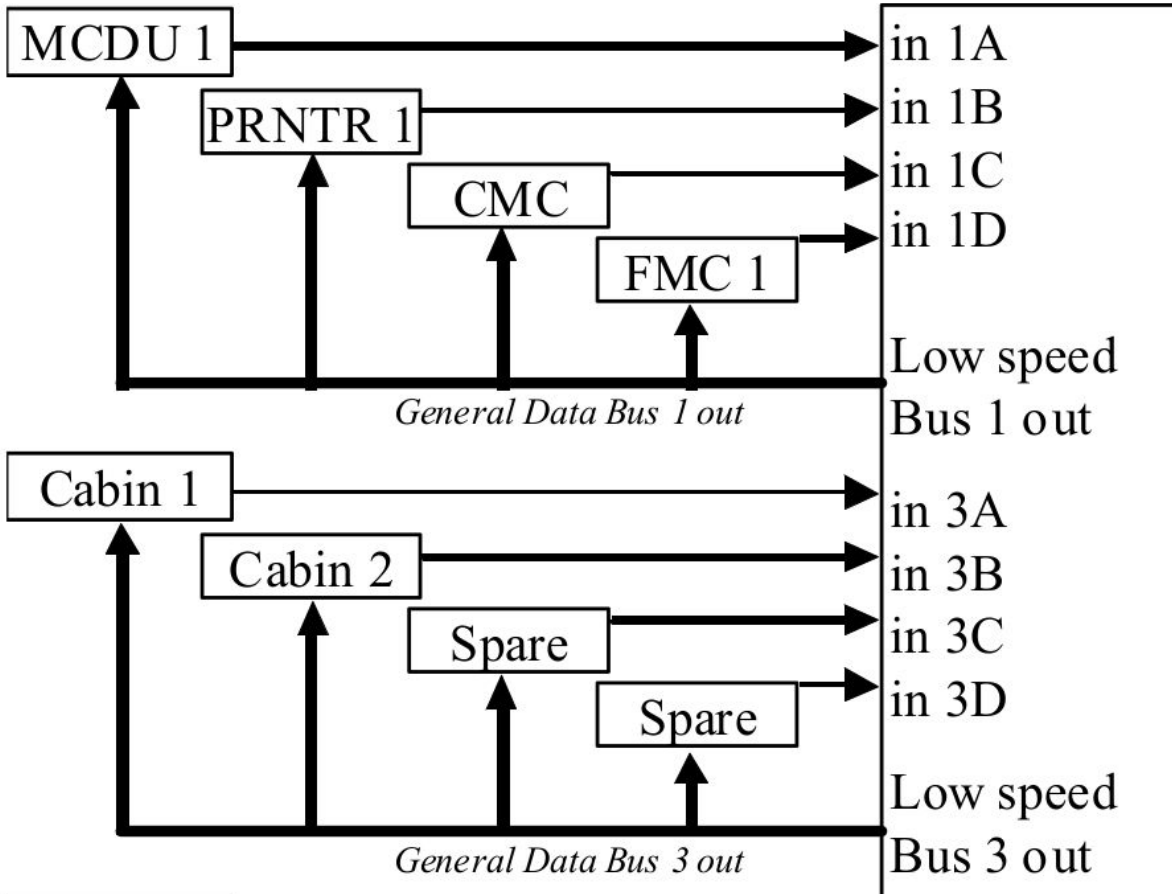


How to make a testbench

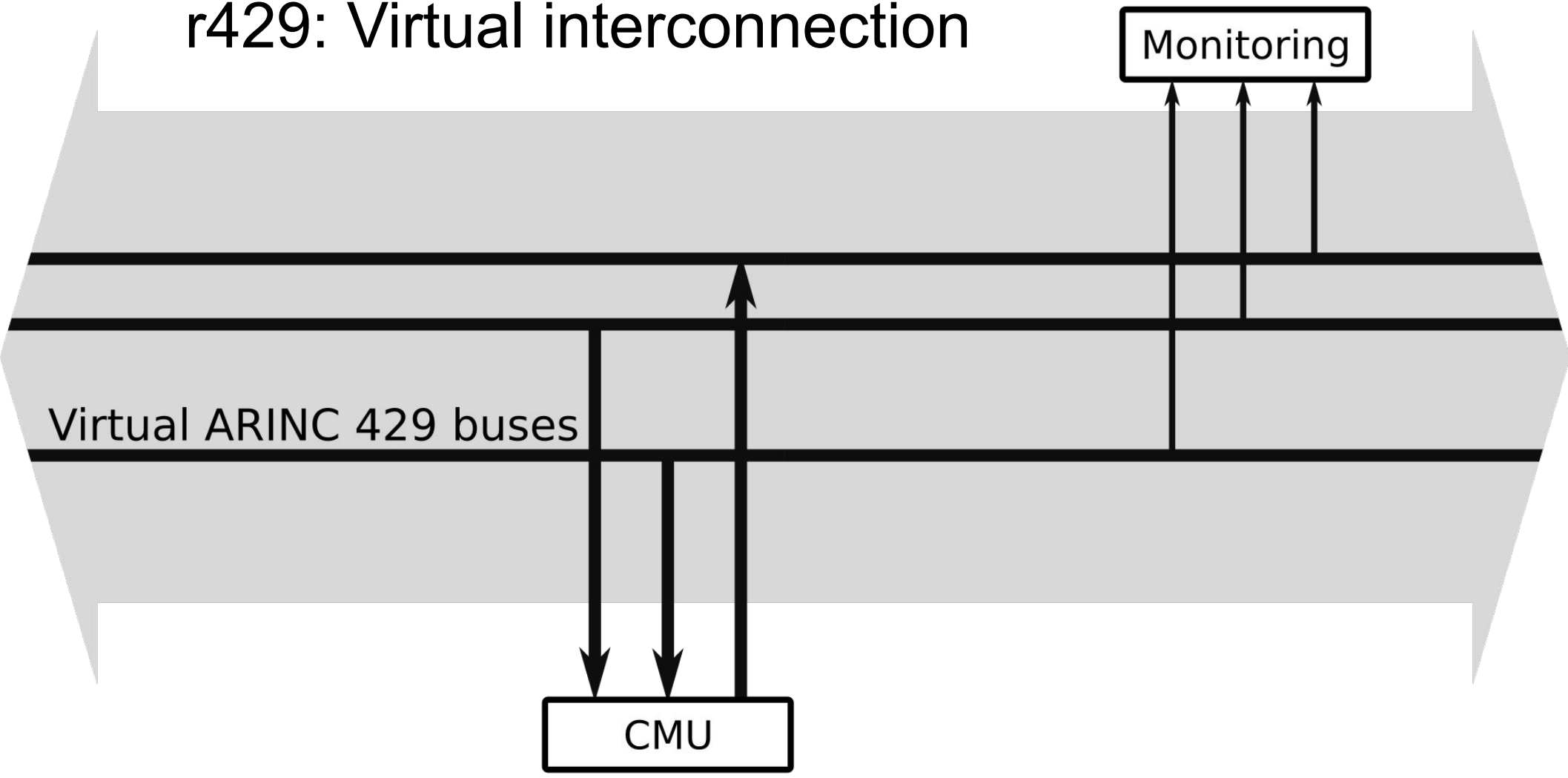


Connections: ARINC 429

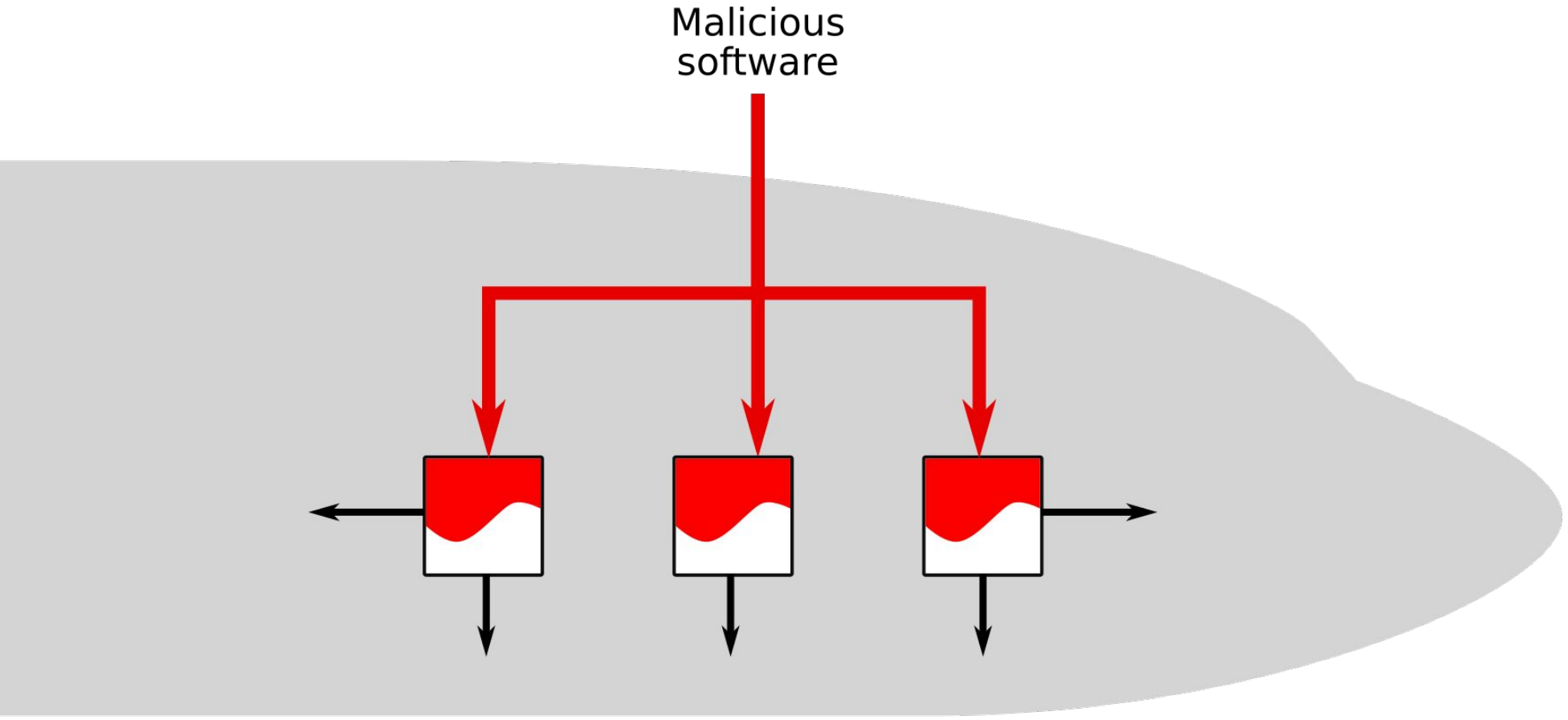
One transmitter per bus
-> Many buses



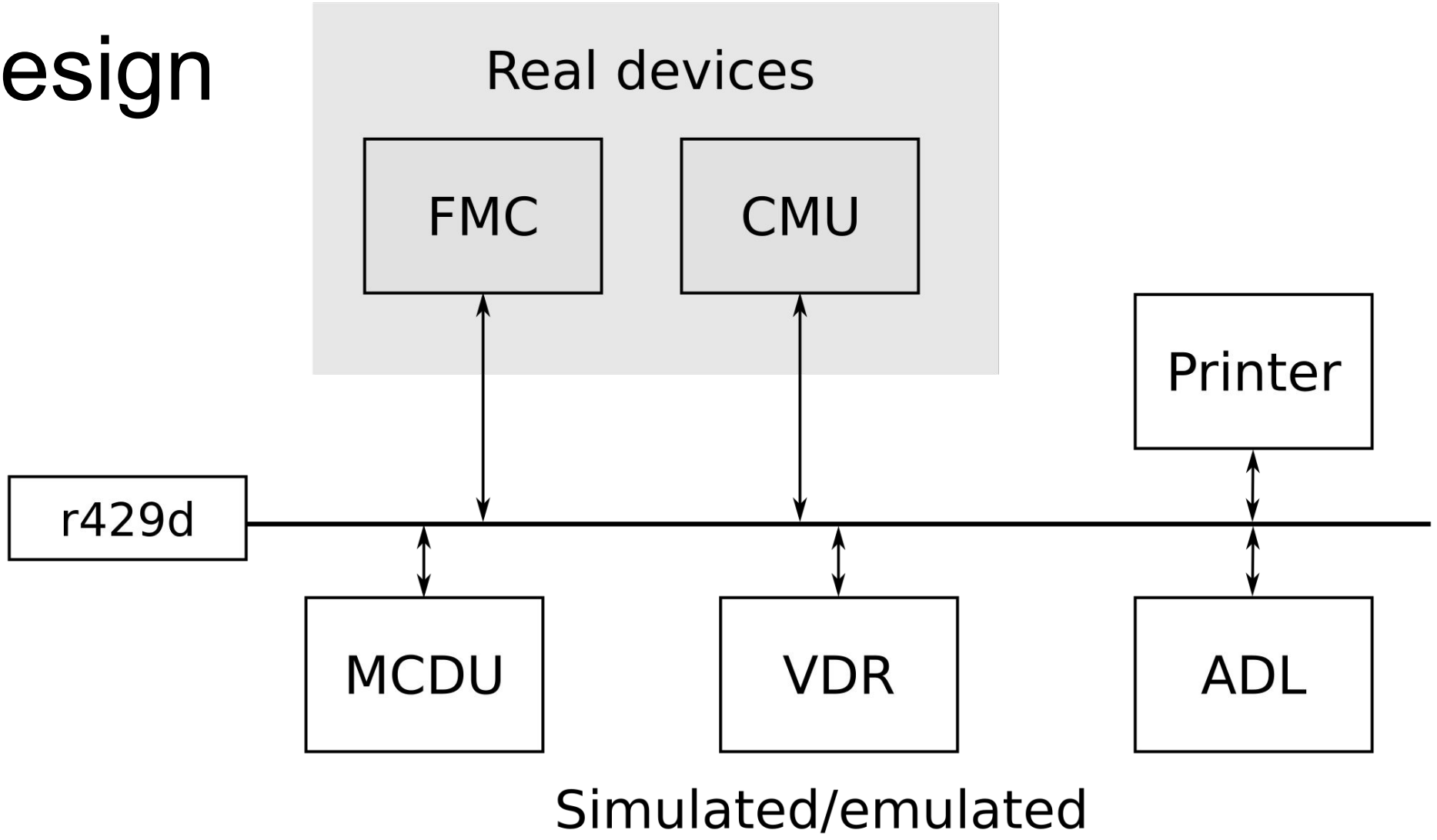
r429: Virtual interconnection



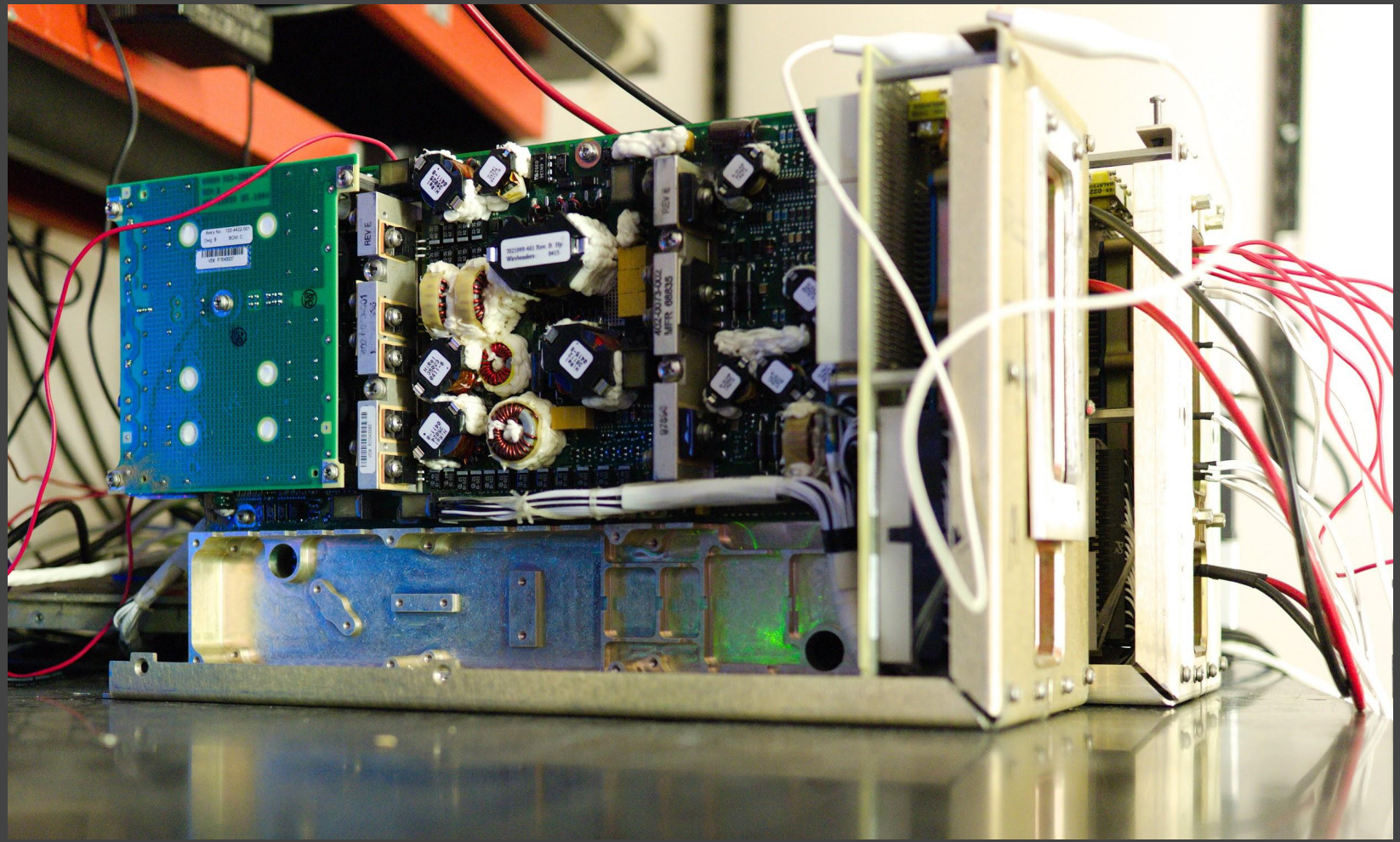
Attack vector: Software updates



Design

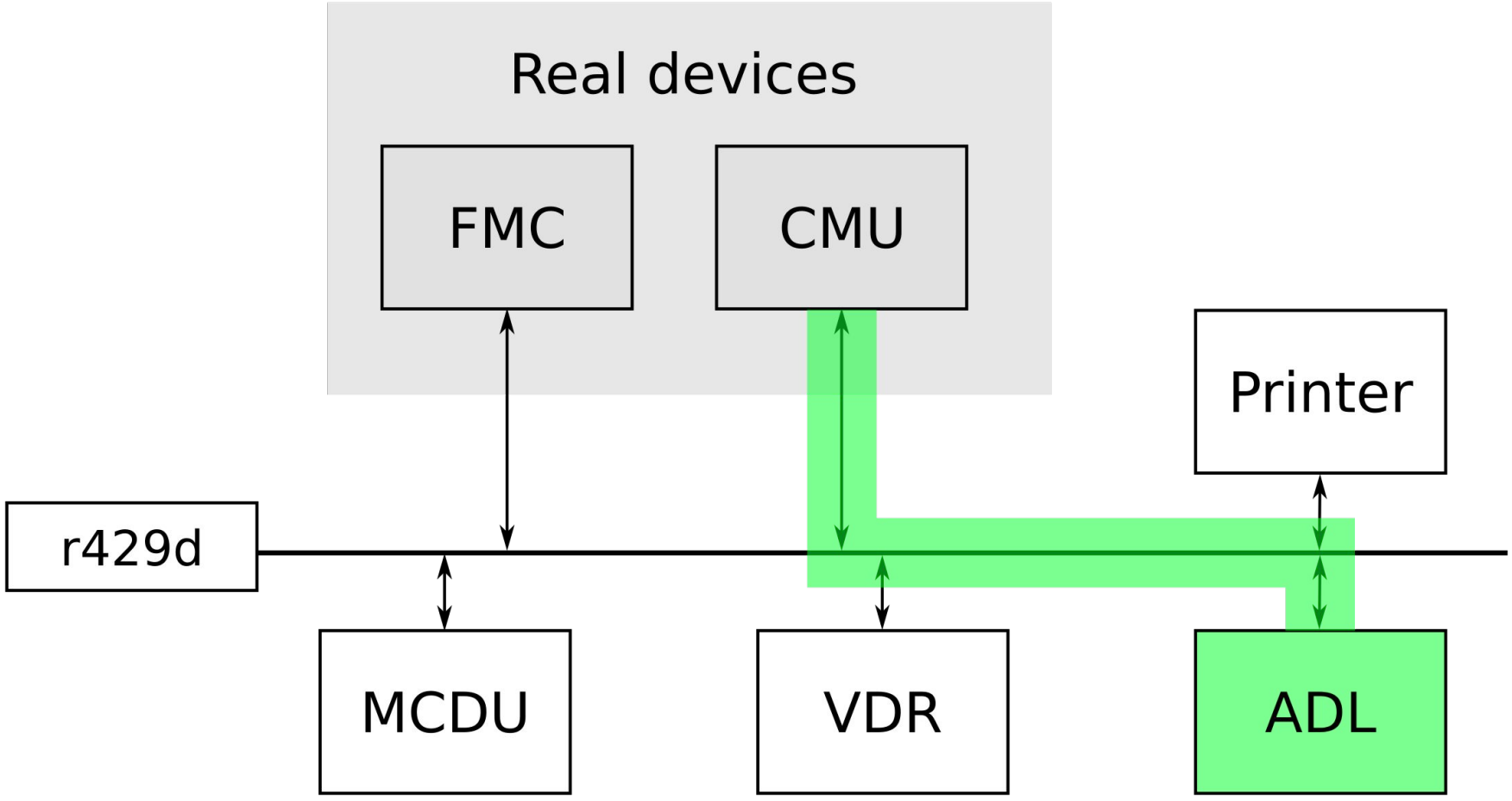

Real devices
FMC
CMU
Printer
r429d
MCDU
VDR
ADL
Simulated/emulated

How it looks

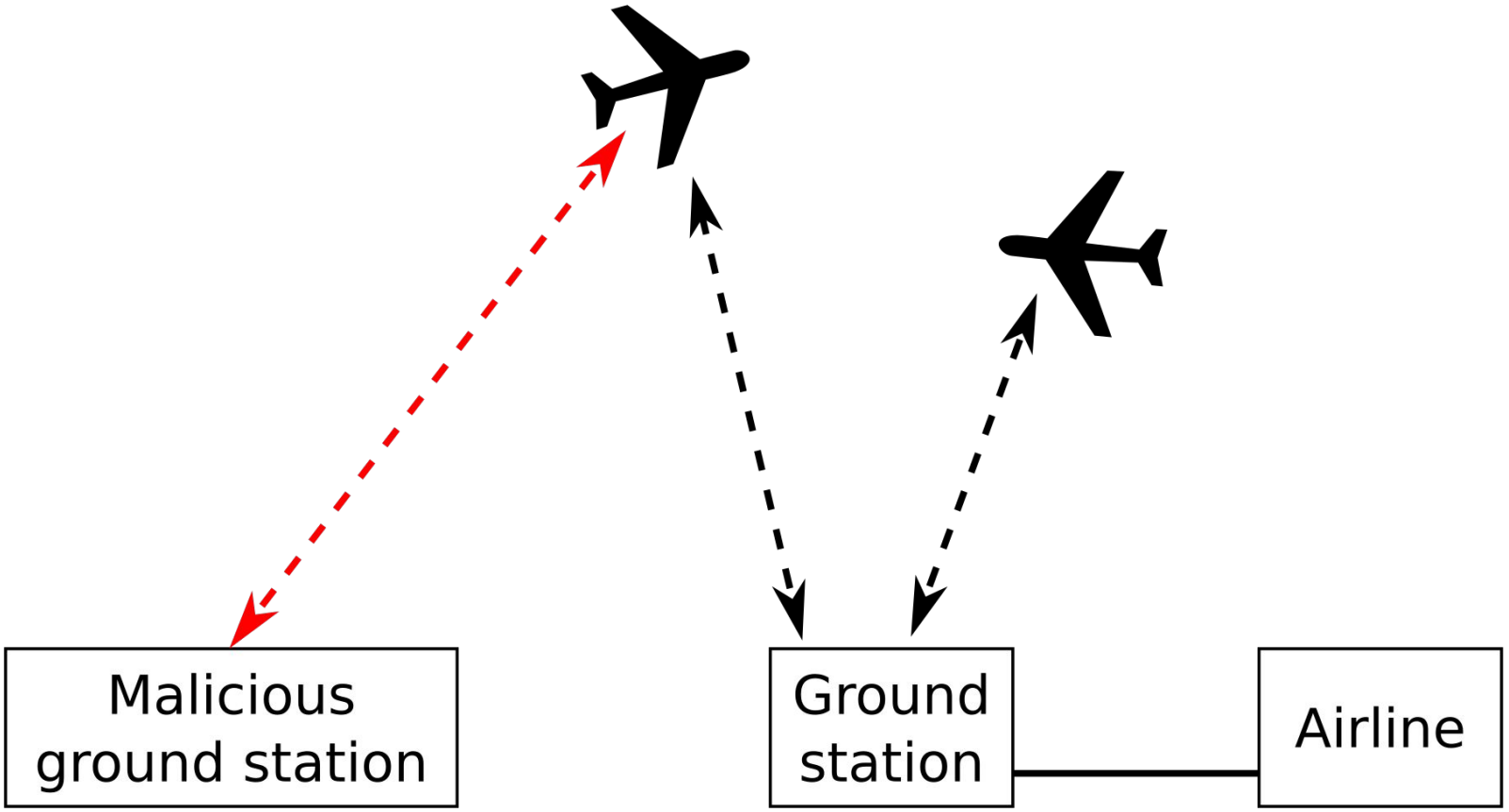


~16 cm

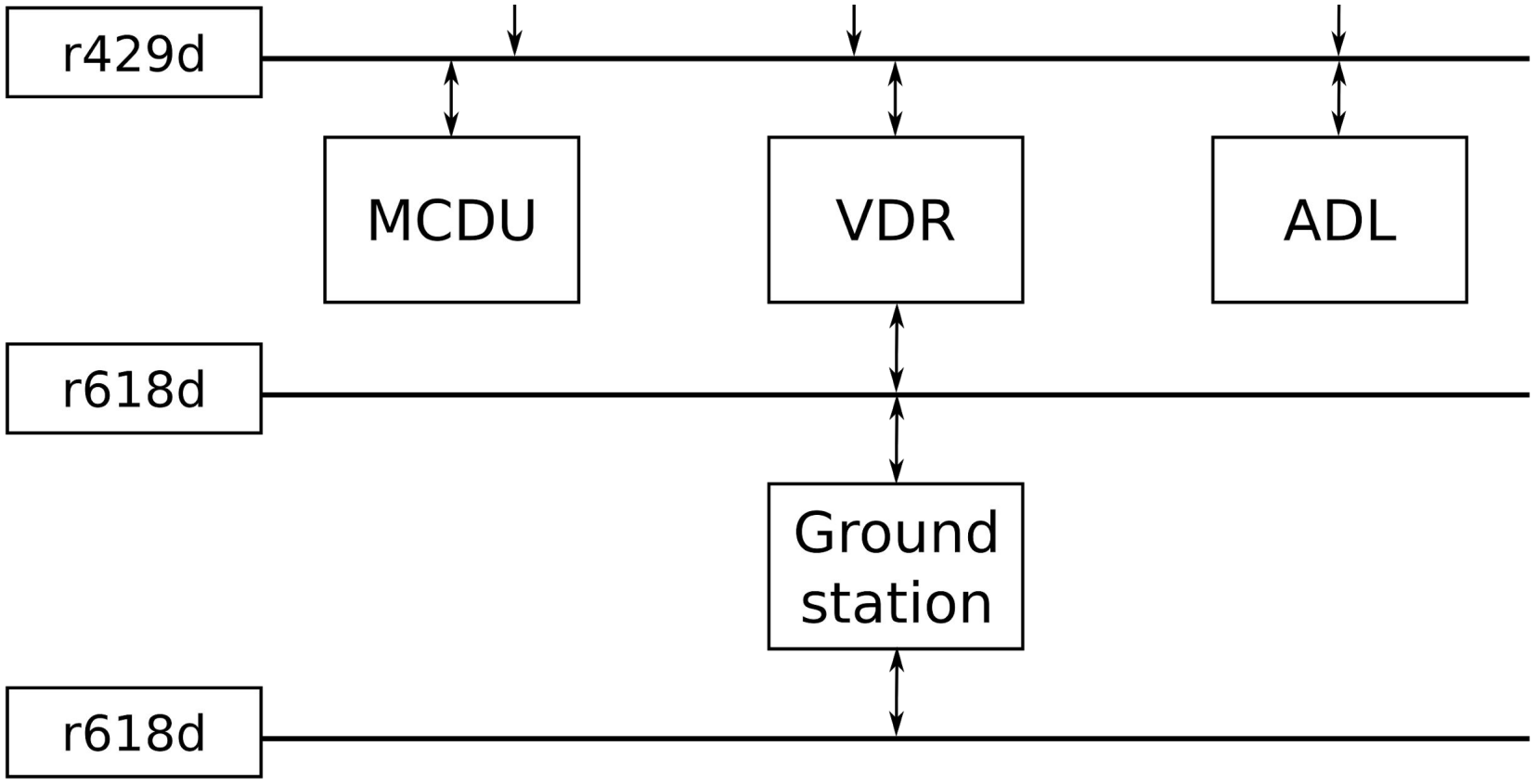
Experiments: Software update



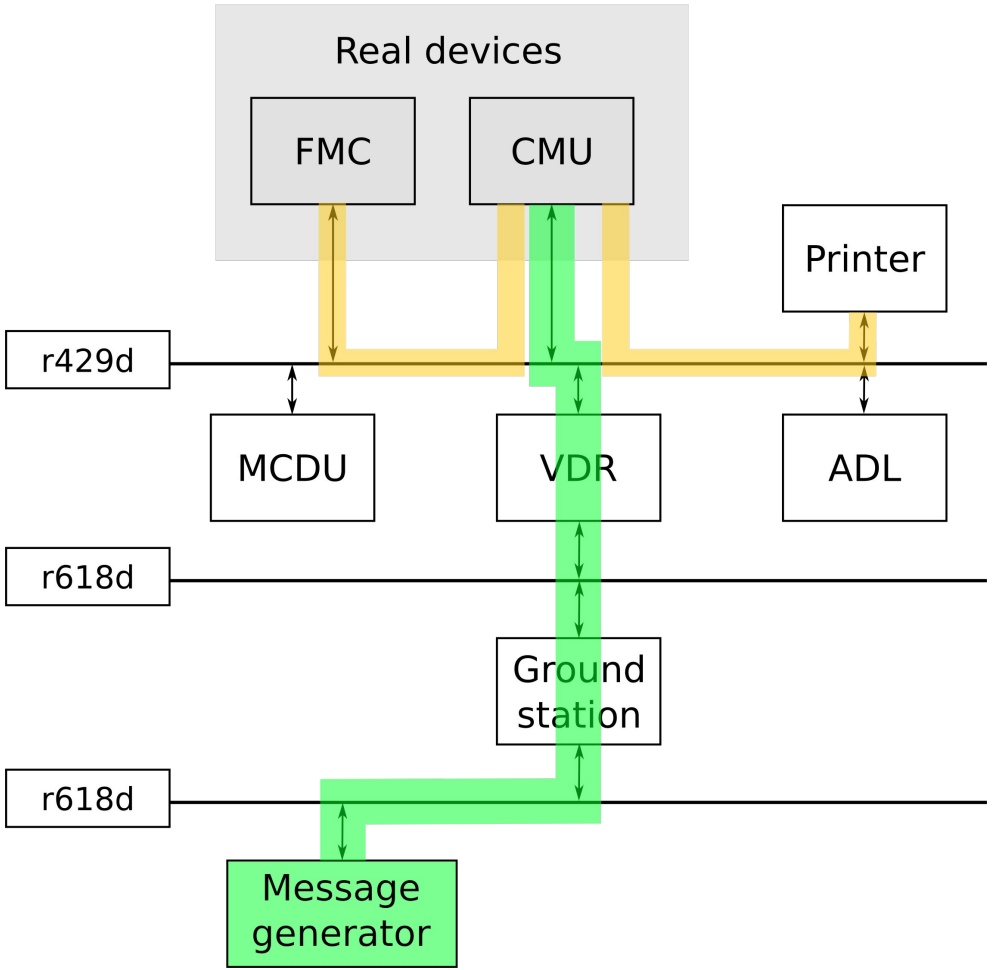
Attack vector: ACARS



Design: ACARS



Experiments: ACARS



Conclusion

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