How do you secure a jet engine?
(And what do FPGAs have to do with that?)

FPGA Frontrunner | Thales, Reading | 23/11/23

Simon Bowles

Product Cyber Security Specialist

Rolls-Royce Defence

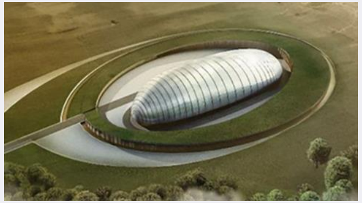
ROLLS

ROYCE

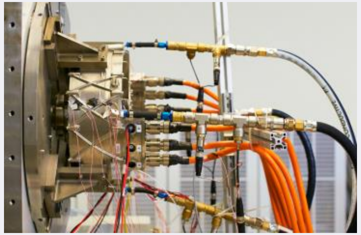
Civil

Defence

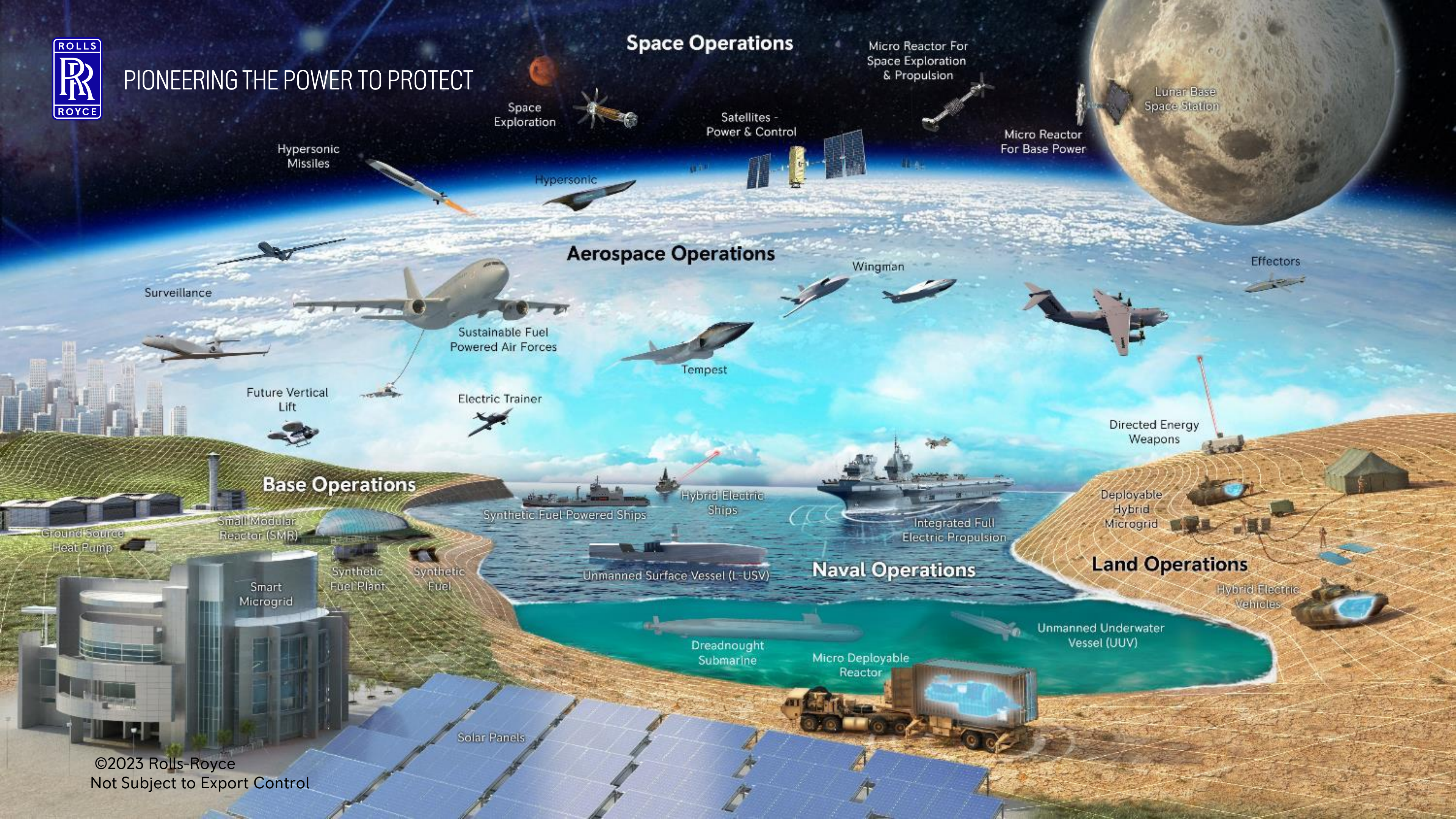
Power Systems

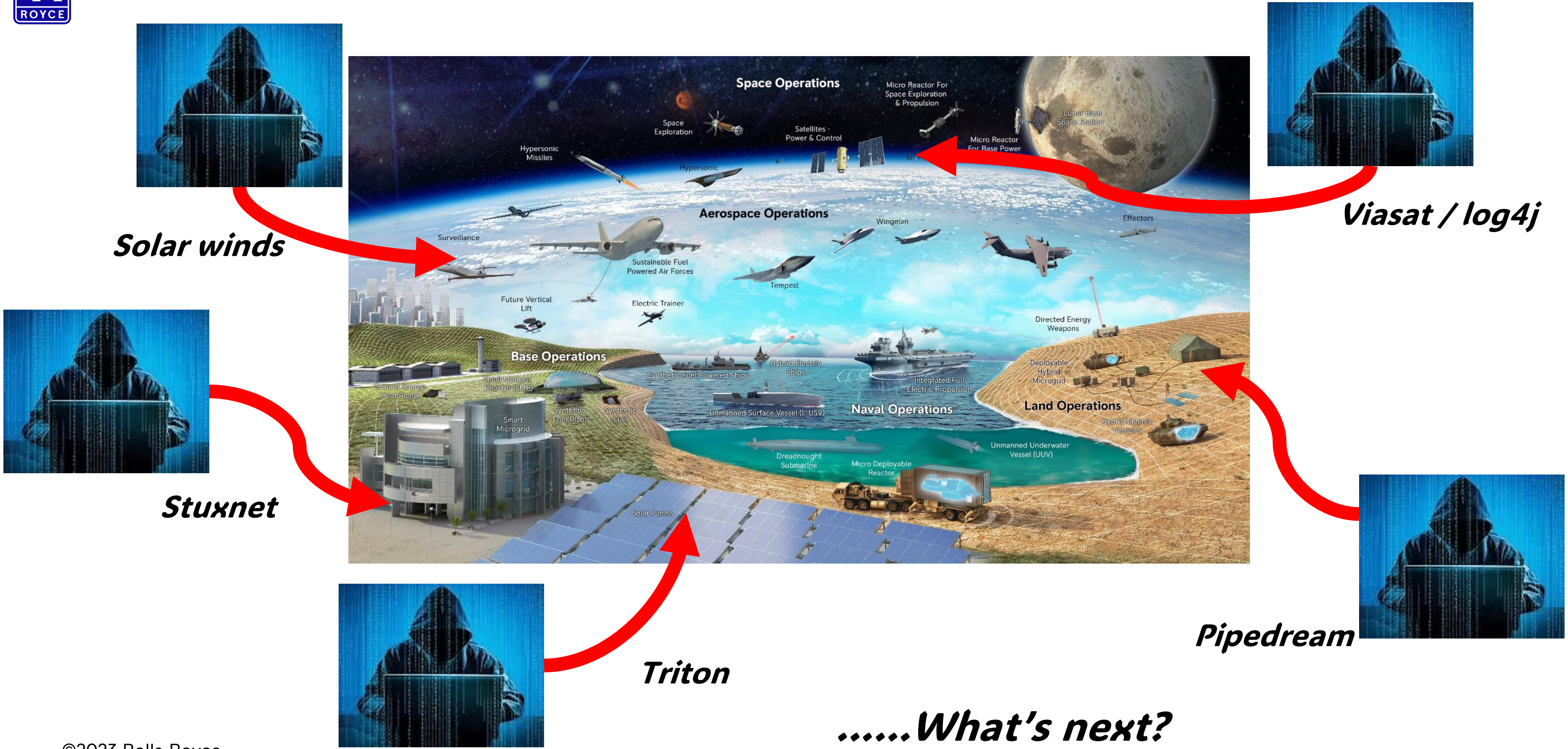


Electrical



PIONEERING THE POWER TO PROTECT





Solar winds

Viasat / log4j

Stuxnet

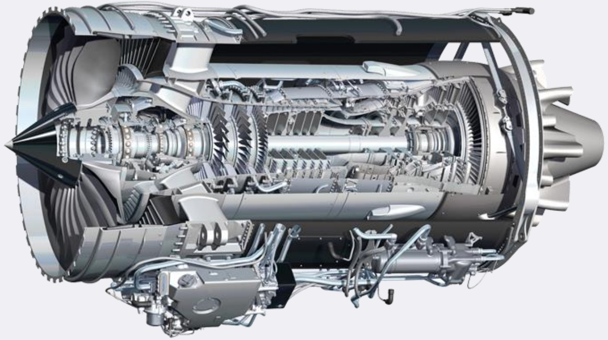
Pipedream

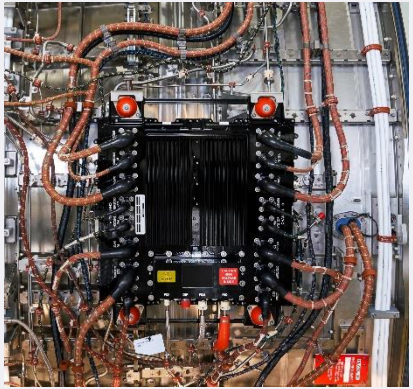
Triton

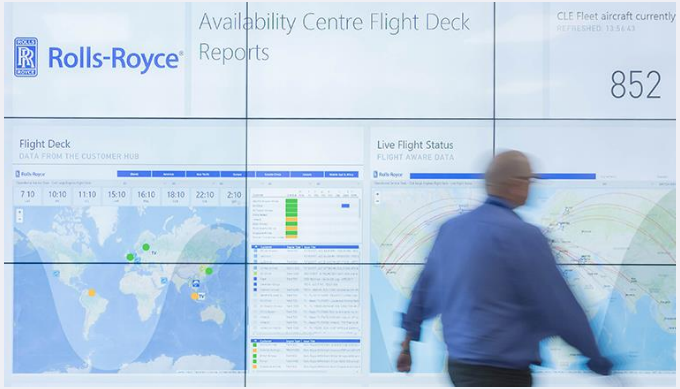
……What’s next?

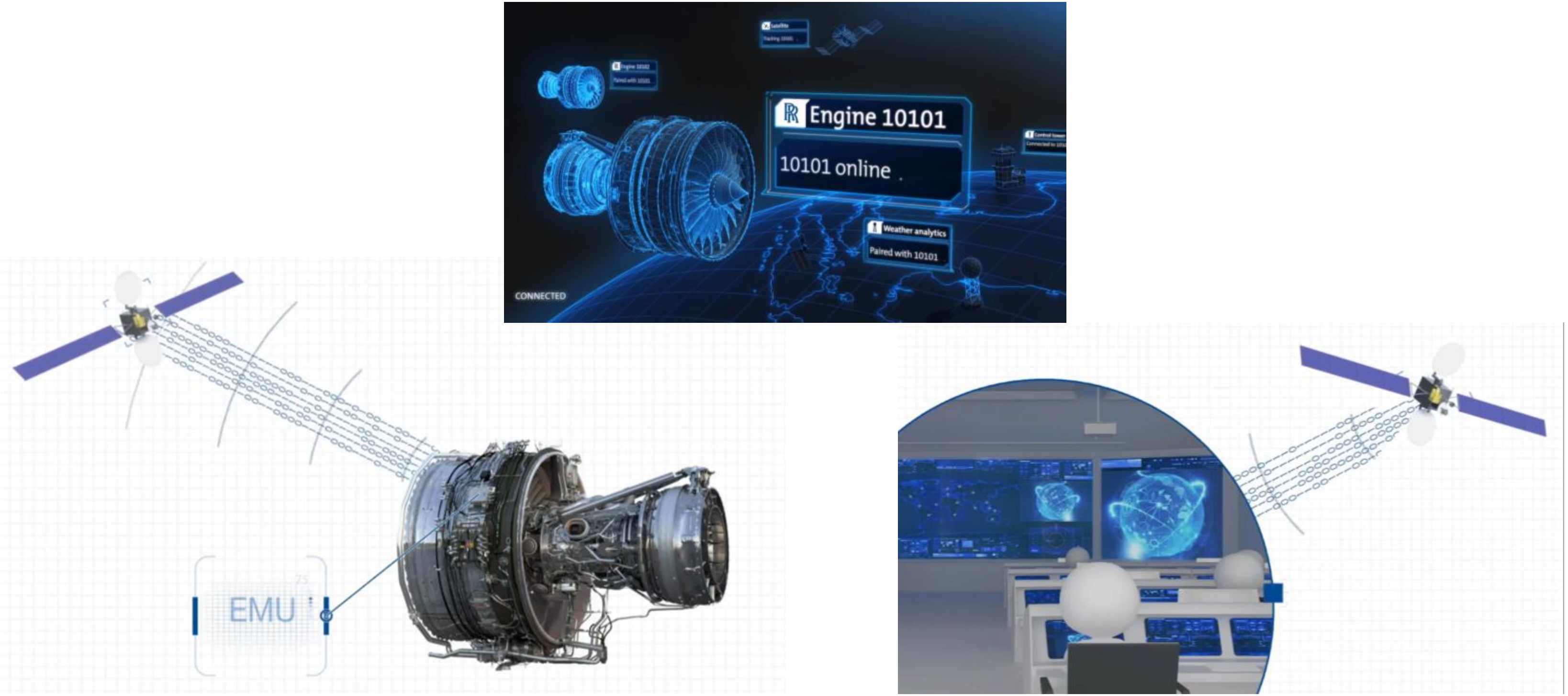
Not Subject to Export Control

Securing Cyber - Physical Systems





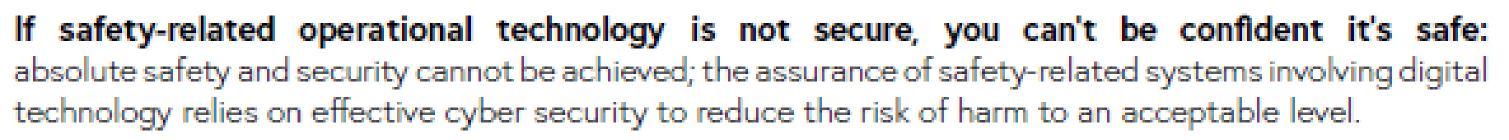

Rolls-Royce®
Availability Centre Flight Deck Reports
CLE Fleet aircraft currently
852
Flight Deck
DATA FROM THE CUSTOMER HUB
Live Flight Status
FLIGHT AWARE DATA



Pearl 16 - The “Intelligent Engine”

Connected, Comprehending, Contextually aware

“If it’s not secure, you can’t be confident it’s safe”



If safety-related operational technology is not secure, you can't be confident it's safe: absolute safety and security cannot be achieved; the assurance of safety-related systems involving digital technology relies on effective cyber security to reduce the risk of harm to an acceptable level.

https://electrical.theiet.org/guidance-and-codes-of-practice/publications-by-category/cyber-security/code-of-practice-cyber-security-and-safety/

FPGAs

Current uses in Rolls-Royce

Health Monitoring

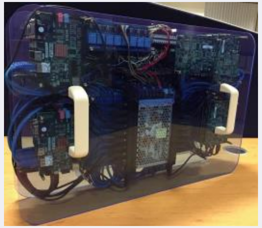
Analogue data acquisition, format conversion, ARINC429 interface and signal validation

Power Converters & motor drives

High speed signal processing and control, e.g. current and voltage measurements, field oriented control algorithms, safety time-critical electrical protection

Processor technology development

Implementing solutions rapidly on FPGA e.g. PQC and PUF



Austere Environments

- -55^0 C to 125^0 C
- Single Event Effects
- Sand, water, moisture, lightning, EMC, vibration…

Certification and Compliance

- FAA / EASA Safety and Cybersecurity Certifications
- US DoD / UK MOD cybersecurity compliance
- DO356 / DO178 up to **DAL A**
- Platform/customer-specific requirements

Safety Critical

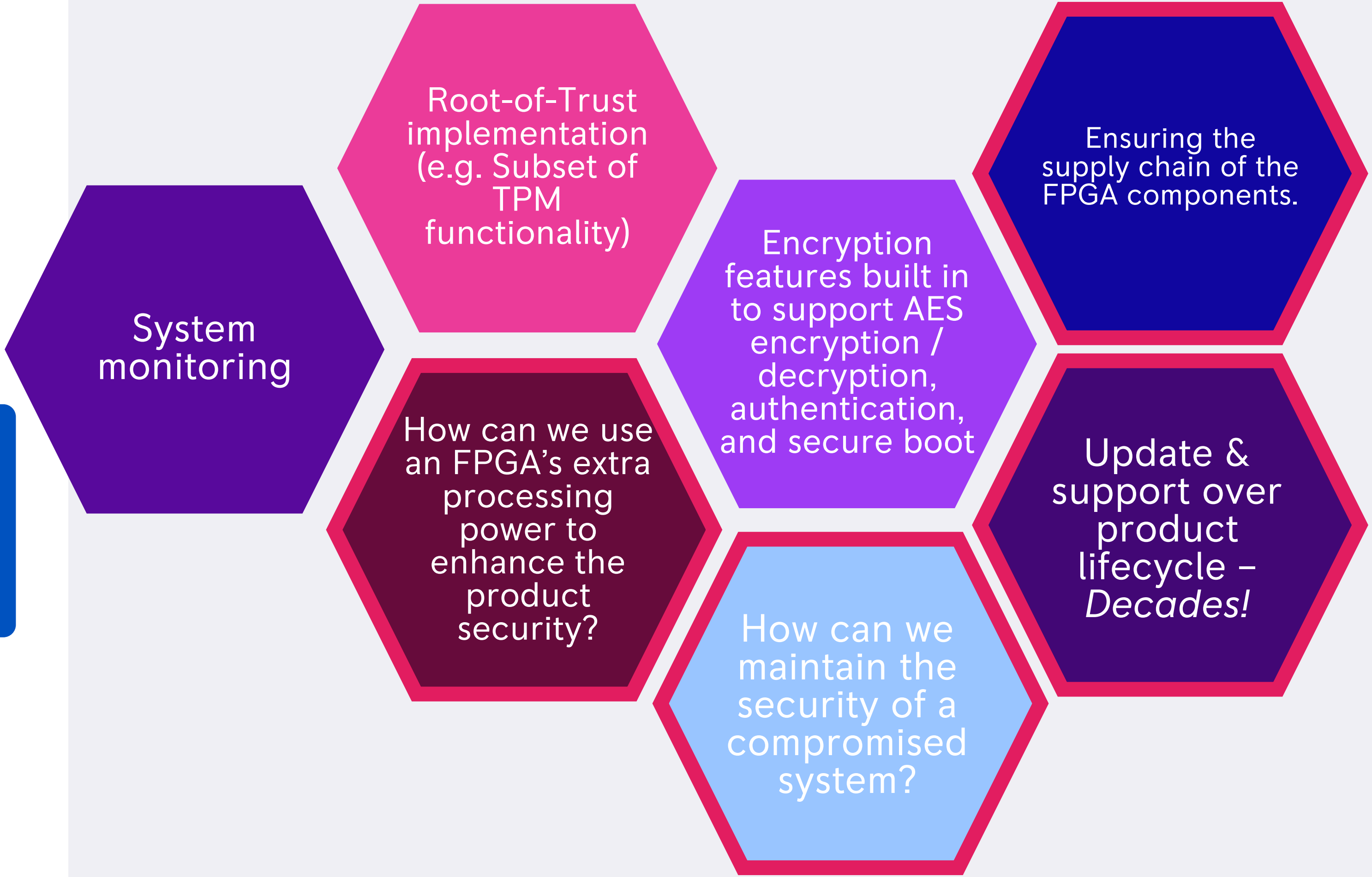
- Must be secure while also failing safe.
  - Fail secure – but not safe – is not an option.
- Extremely fast power-up and boot times: ~100-200ms.

Long Development and Support Lifecycles

- Years-long development lifecycles
- 20-50 yr operational lives
- Infrequent updates

Areas of interest

Can you think of other hard problems we should be investigating?



System monitoring

Root-of-Trust implementation (e.g. Subset of TPM functionality)

How can we use an FPGA’s extra processing power to enhance the product security?

Encryption features built in to support AES encryption / decryption, authentication, and secure boot

How can we maintain the security of a compromised system?

Ensuring the supply chain of the FPGA components.

Update & support over product lifecycle – *Decades!*

Safety is our top priority

To be safe, we need to be resilient

To be resilient, we need to be system thinkers