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Pluggable Components All The Way Down

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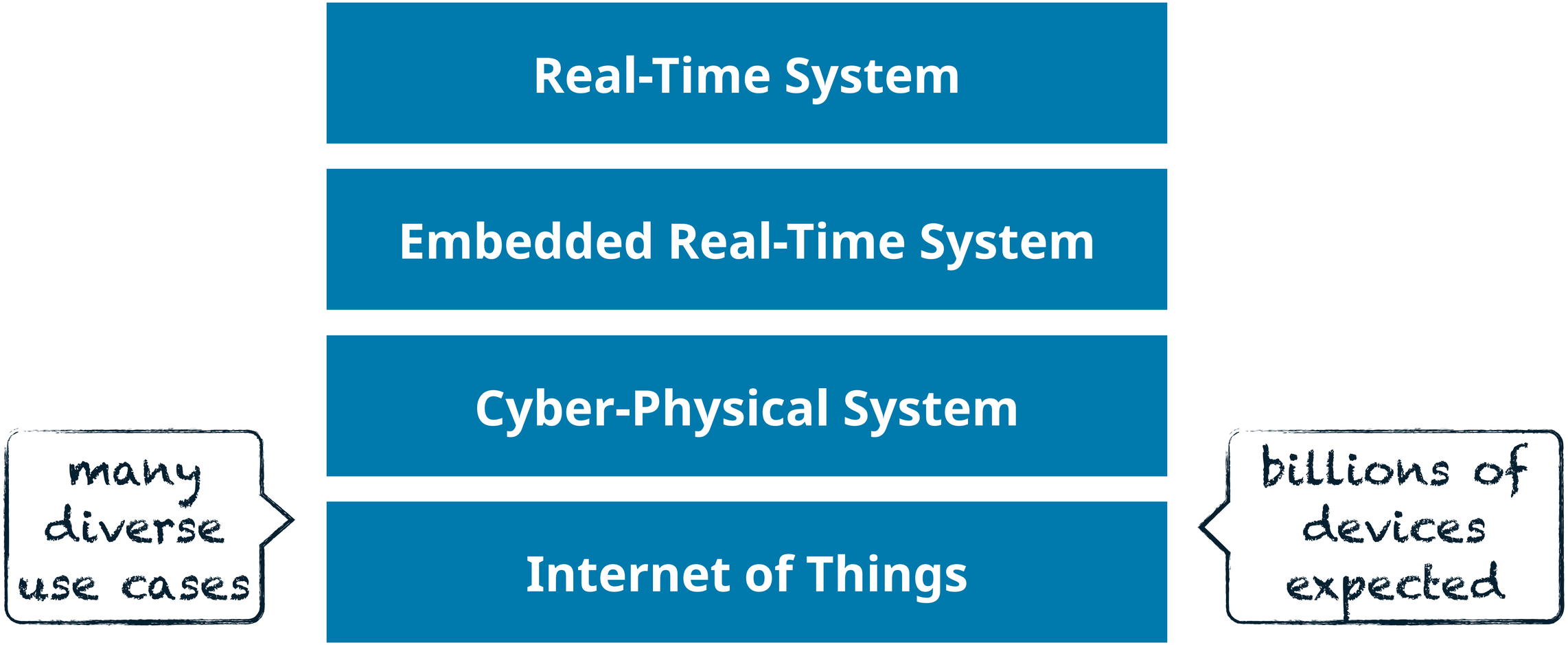
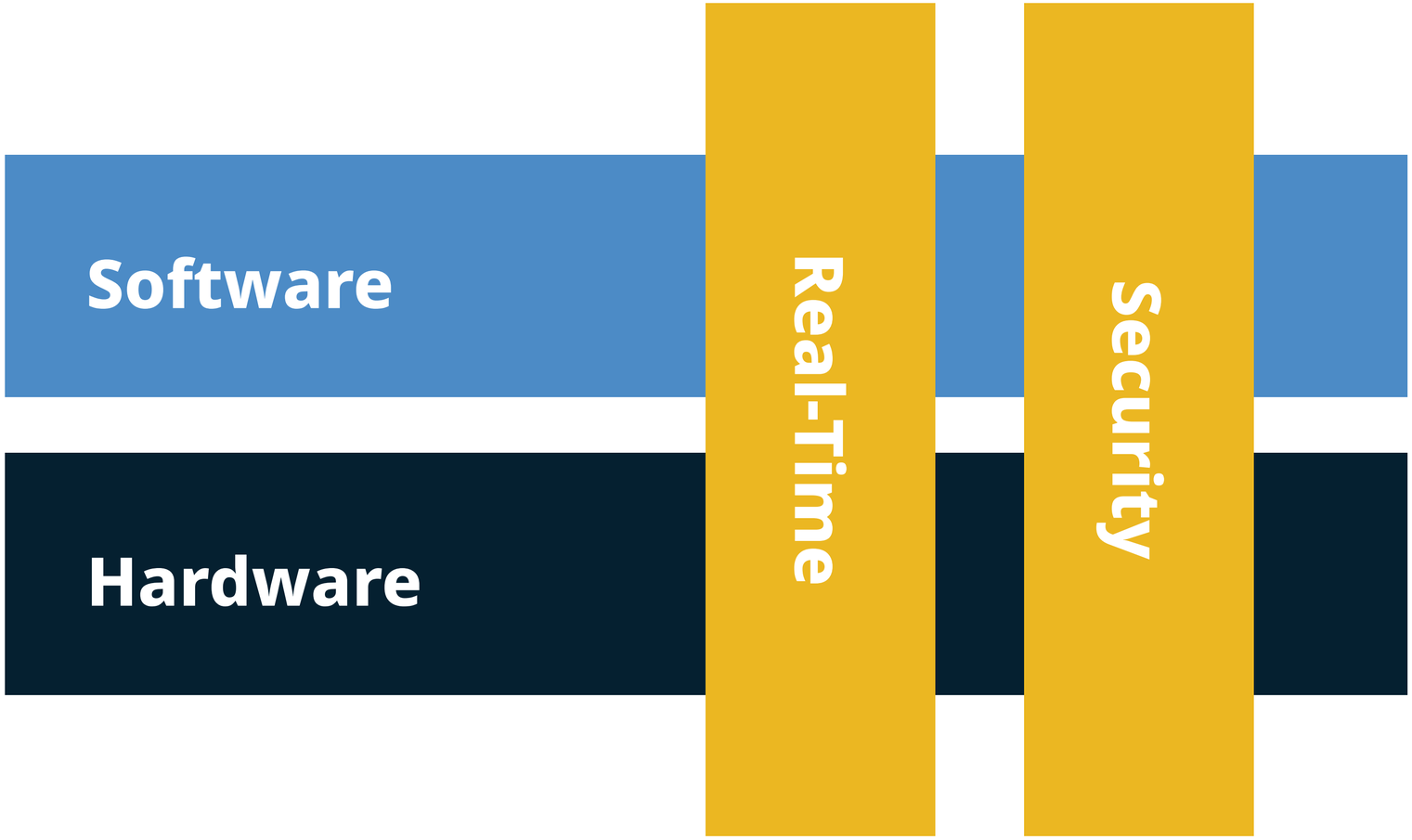
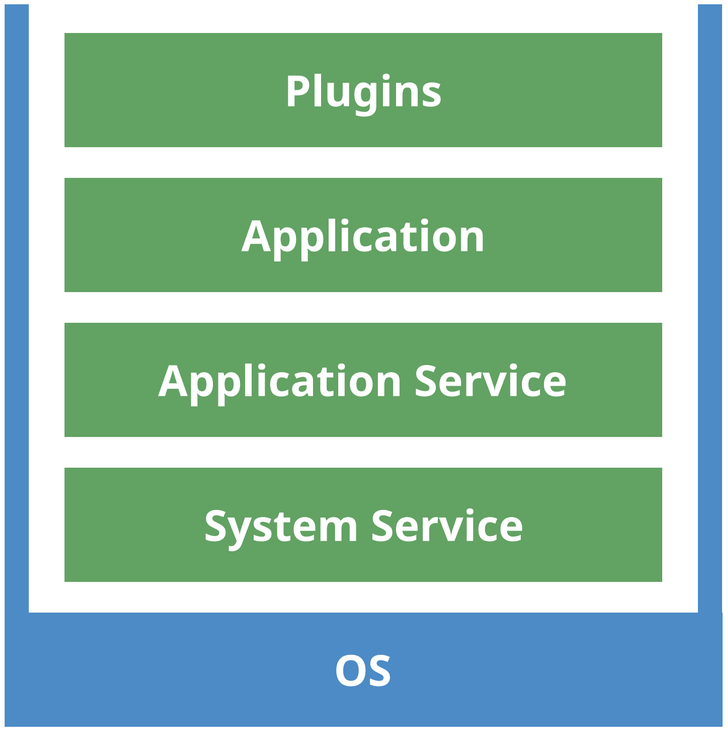
From Real-Time to IoT



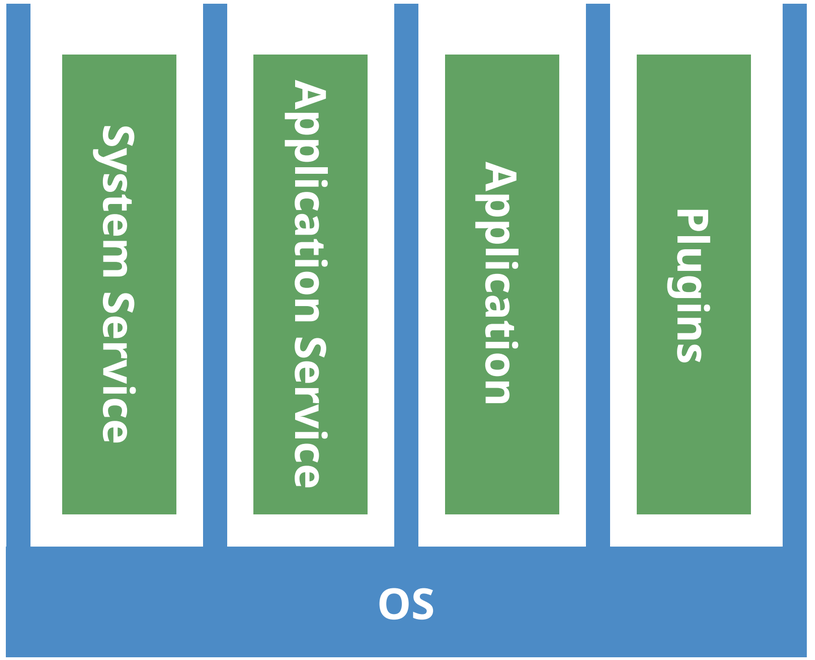
Challenges



Software Components

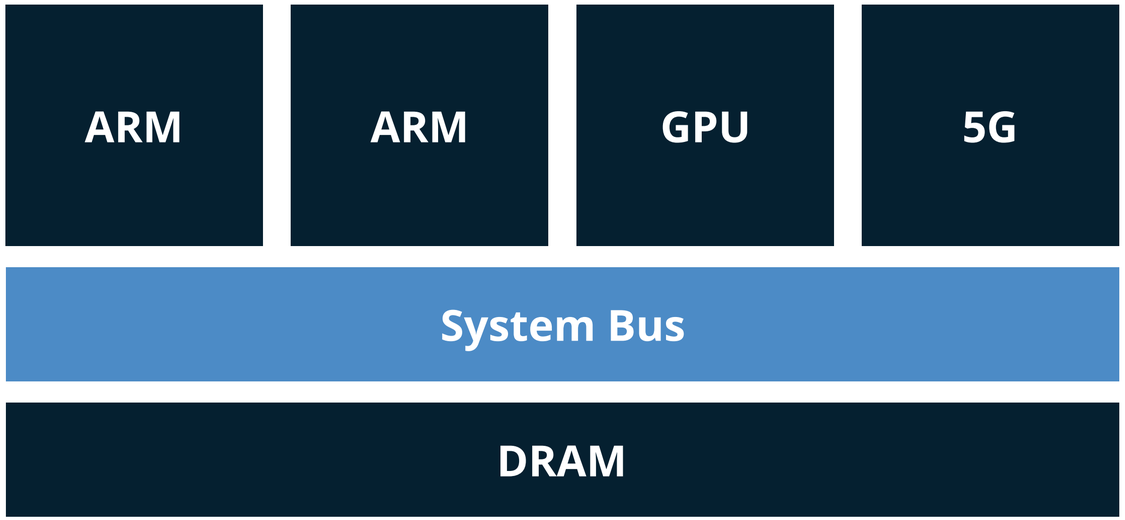


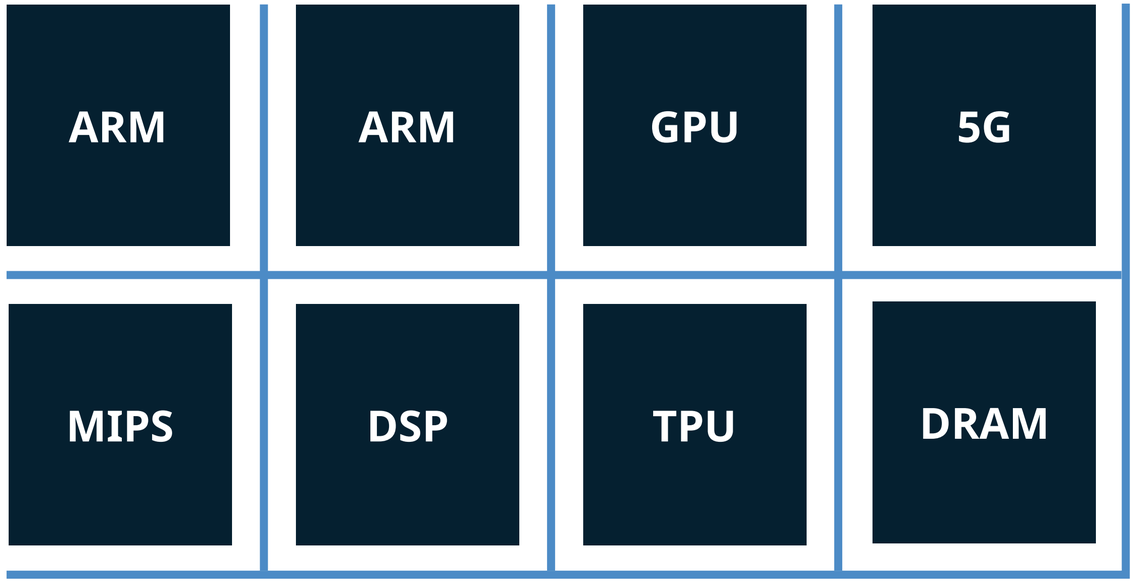
Traditional Software Stack



Microkernel Platform

Hardware Components

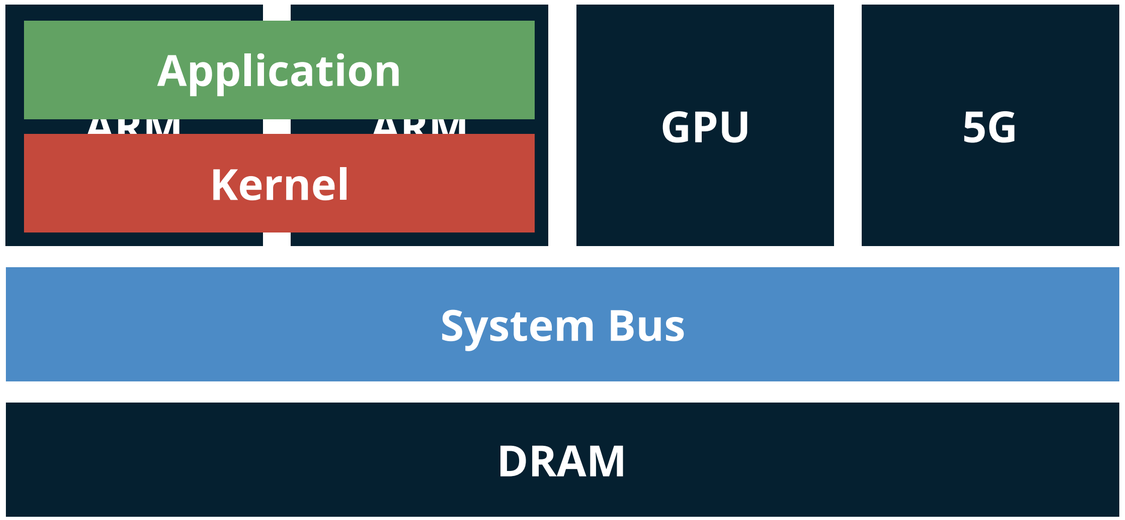


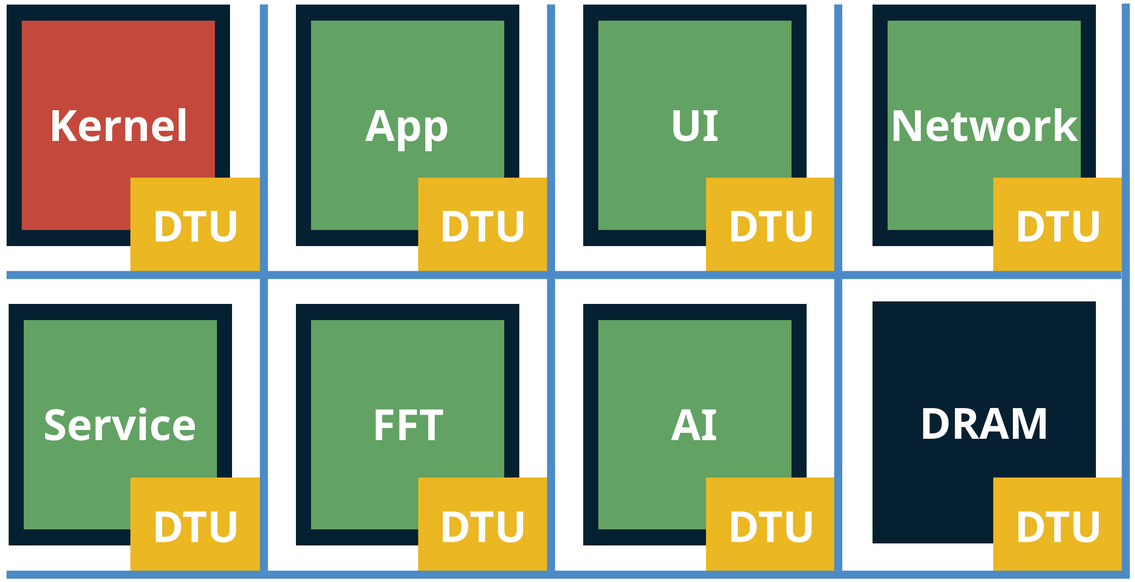


Traditional Hardware Architecture

Tiled Hardware Architecture

Hardware Components

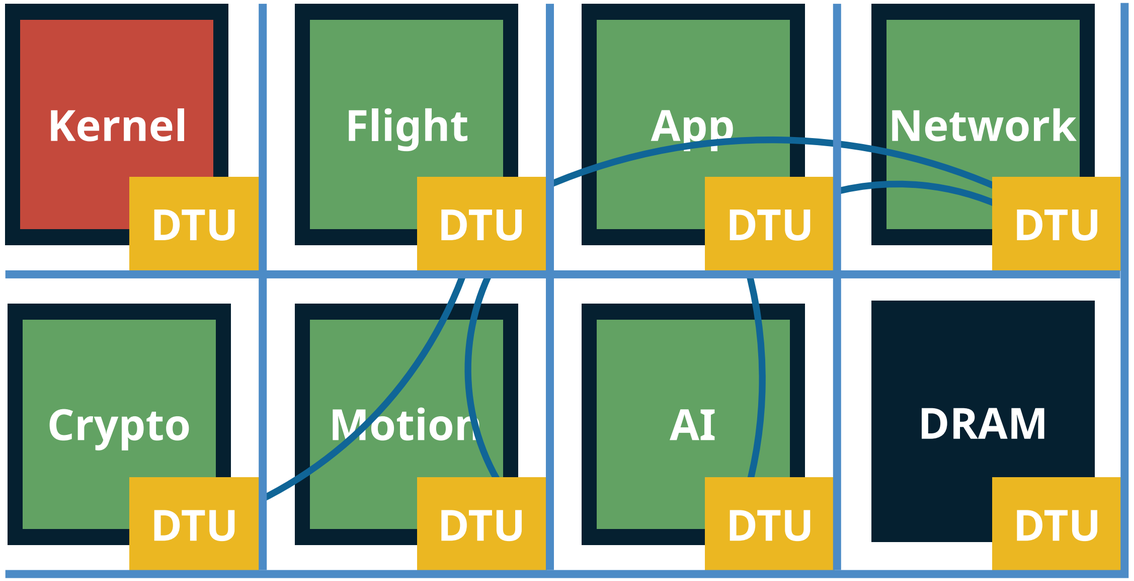




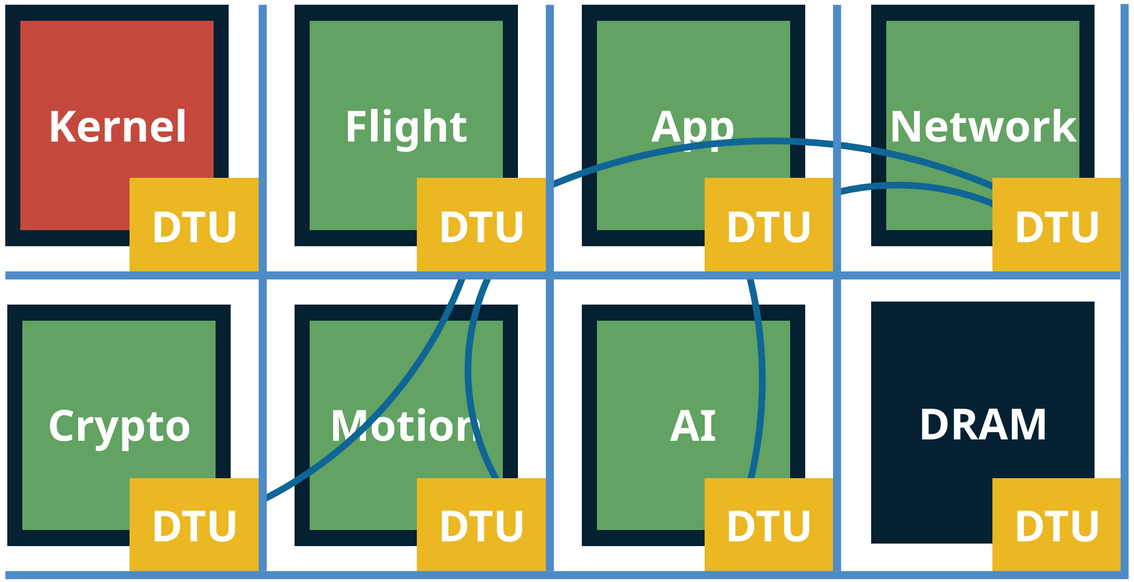
Traditional Hardware Architecture

M³ Architecture

Example Scenario

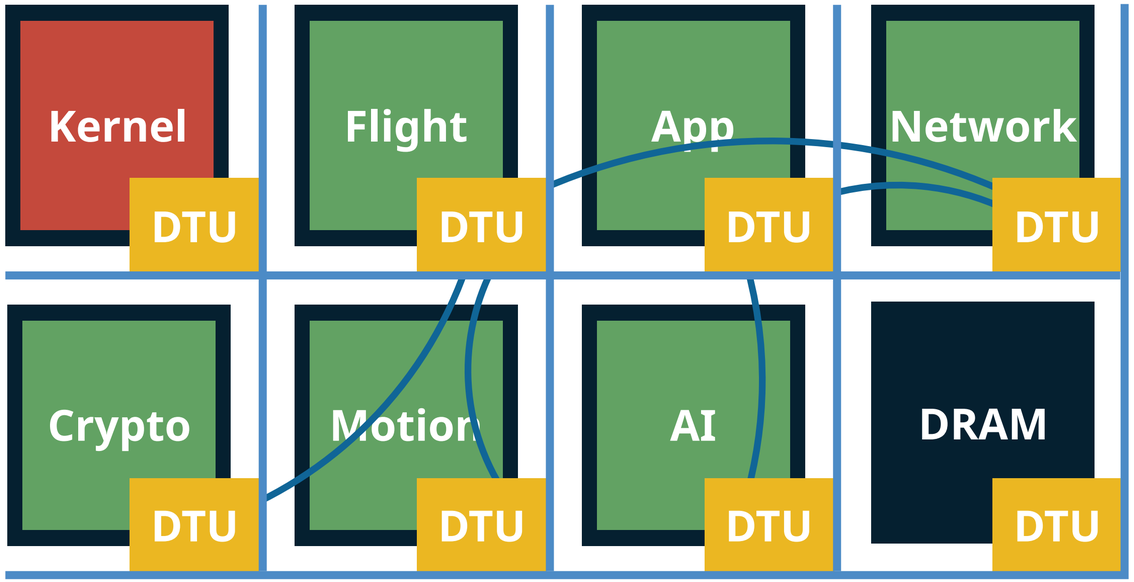


Challenges: Security



- **placement** decisions to trade core count against security
- combine M³ with microkernel
- **remote attestation**
- secure partial **updates**
- representation of isolation in **programming languages**

Challenges: Real-Time



- guaranteed **low-latency** communication across tiles
- **scheduling** of the NoC and communicating tiles
- islands of **hardware-assisted** scheduling without kernel
- **approachable** scheduling framework for developers

Conclusion

- construction of systems from **strongly isolated components**
- applied to both **hardware and software**
  - software isolation: L4-style microkernel
  - hardware isolation: M³-style architecture
- isolation helps both **security** and **real-time,** but challenges remain
- simplify life for system integrators: “app store” for components
- **Barkhausen Institut** in Dresden plans to address these challenges
- not entirely vaporware …