Proofcraft

seL4® verification: status and plans

Michael McInerney @ Proofcraft

seL4

The world’s most highly assured operating system kernel

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Unparalleled mathematical proofs
of correctness and security

⇒ The most trustworthy foundation
for safety- and security-critical systems

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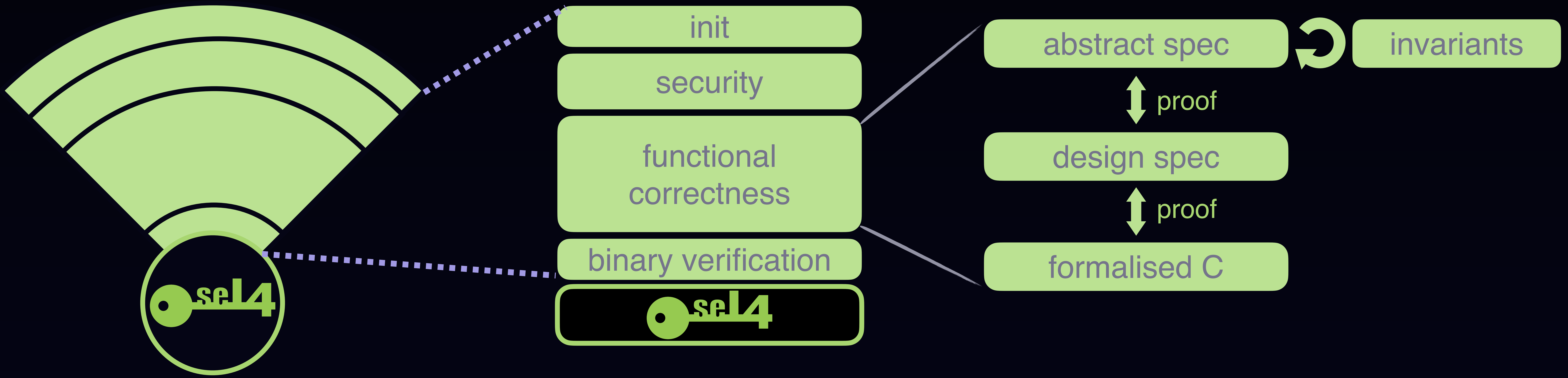
of correctness and security
(FC) (integrity&confidentiality)



Unparalleled mathematical proofs
of correctness and security

NOW & IN THE FUTURE

More architectures verified

More features verified

More platforms verified

More cores

Less need for
expertise & maintenance

Overview: 5 main areas Proofcraft is working on

More architectures verified	Arm 64-bit (AArch64)
More features verified	Mixed-criticality support (MCS)
More platforms verified	Automated platform port verification
Less need for expertise & maintenance	Proof architecture split (arch-split)
More cores	Verified multikernel (MK) on multicore

Overview: status & plans in a nutshell

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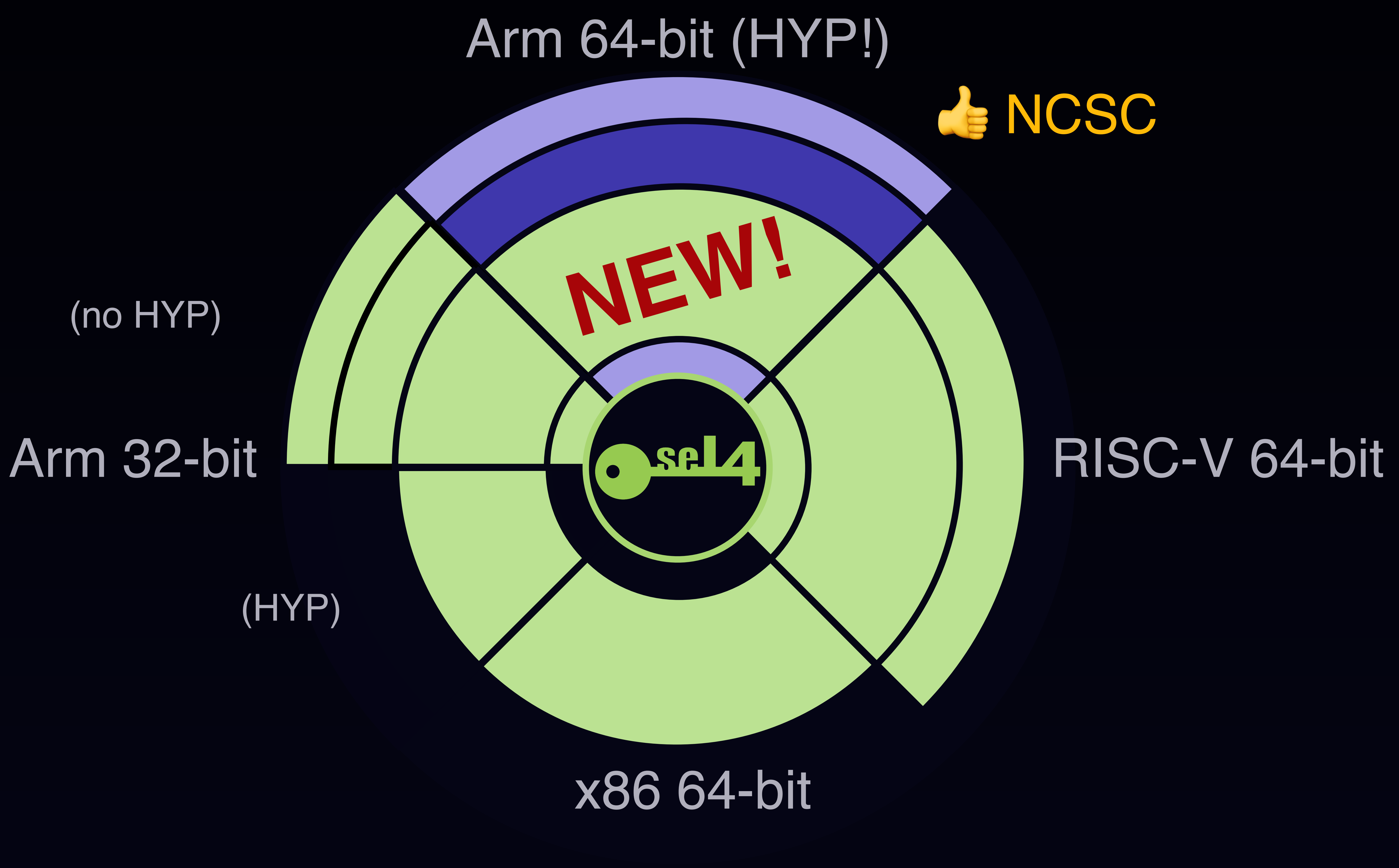
AArch64



seL4 proofs

Done
Ongoing
Future

(non-MCS, unicore)

Done: FC
Now: integrity (Q1'25)

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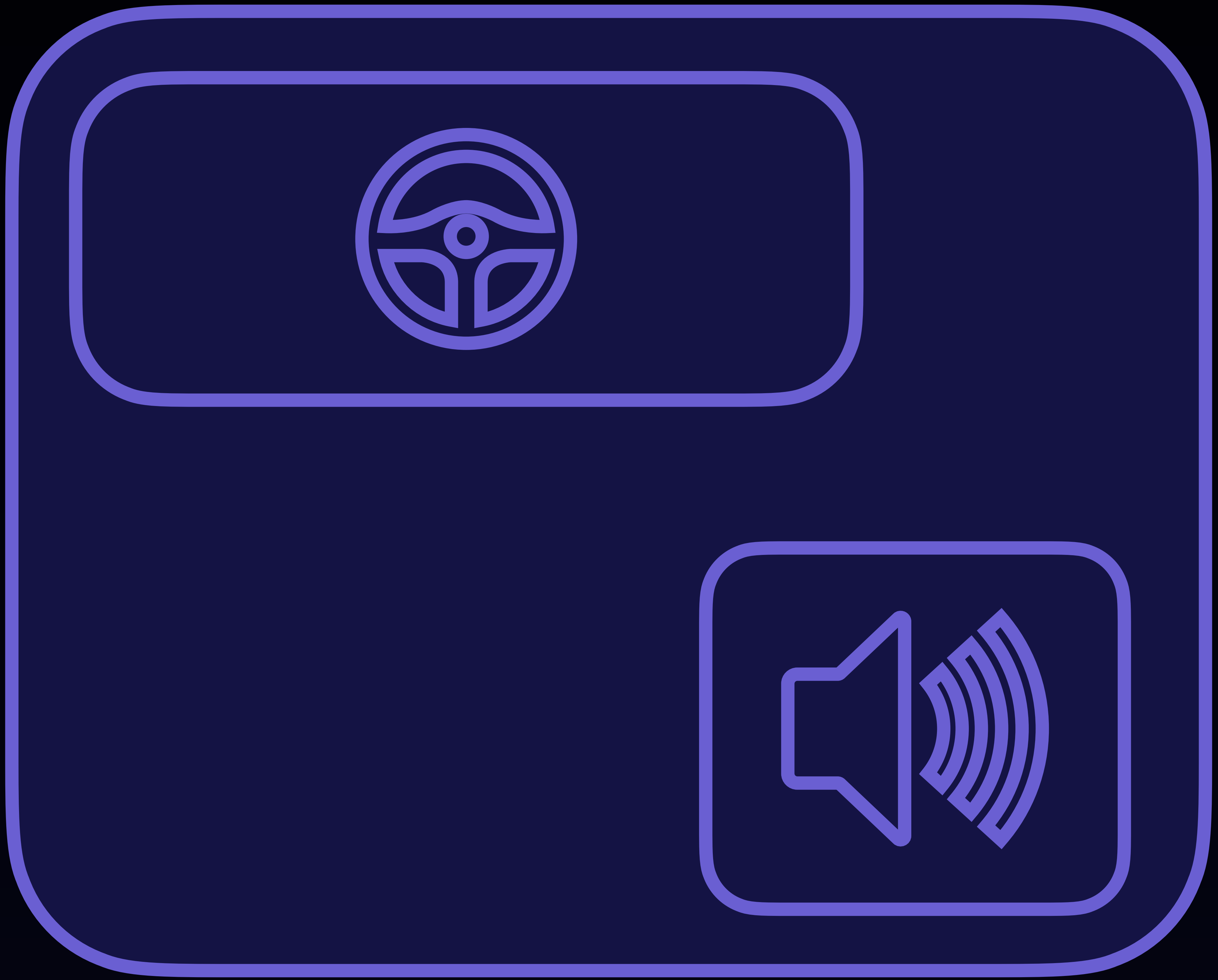

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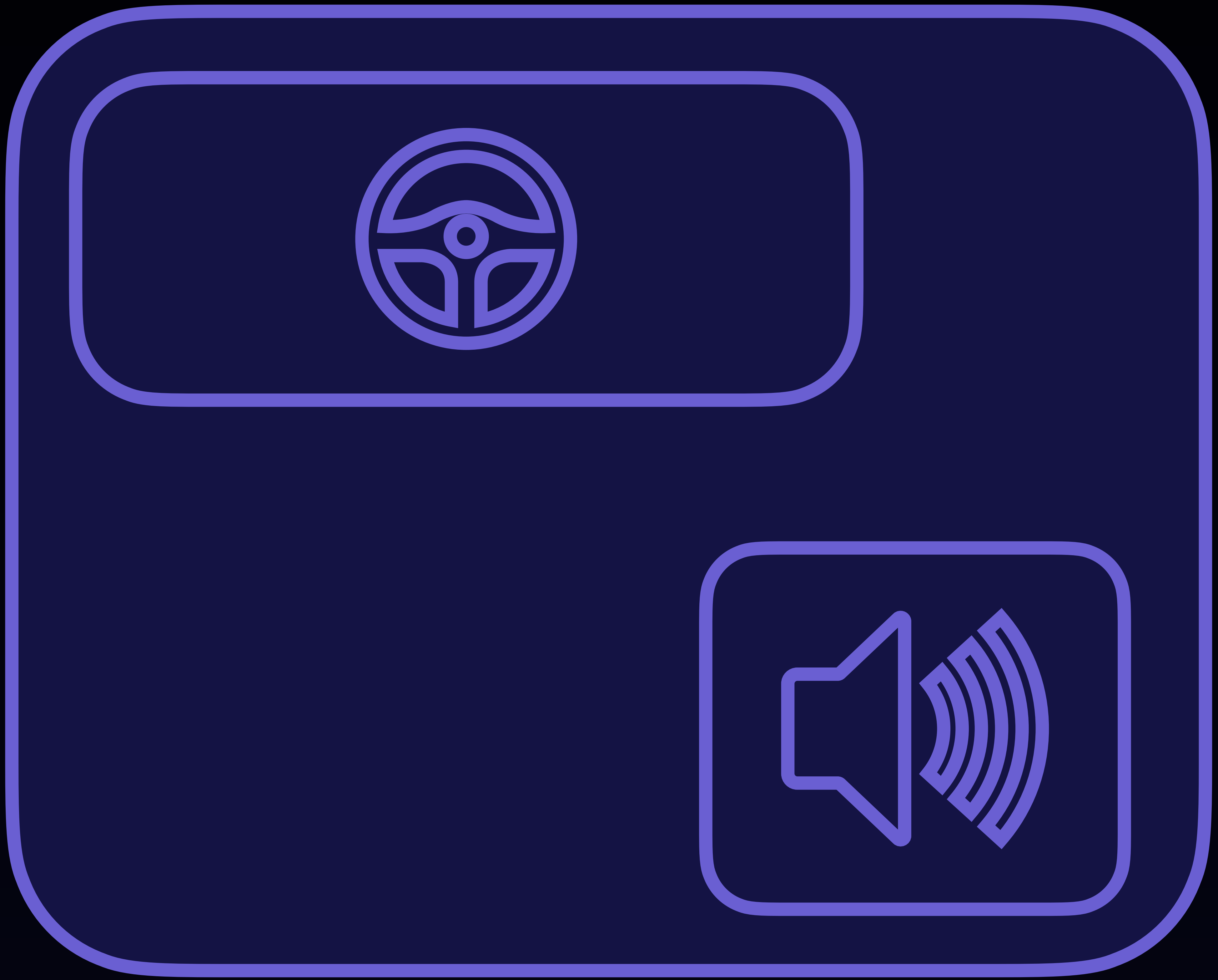
- Support for Mixed-Criticality Systems

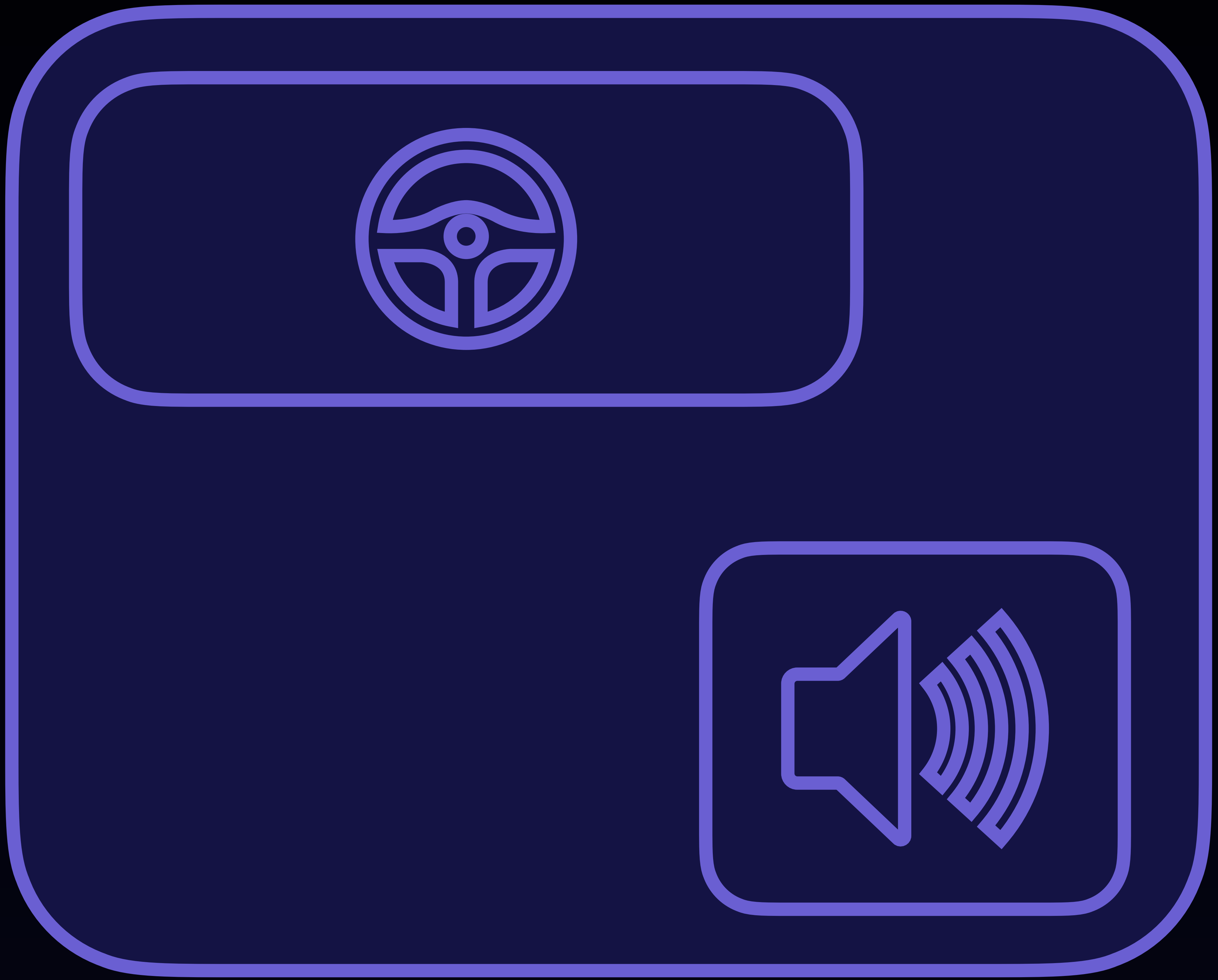
- Time as a resource



What is MCS?

- Support for Mixed-Criticality Systems

- Time as a resource
    - scheduling context objects



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Two examples:

- bound notification endpoints
- bitfield scheduler optimisation

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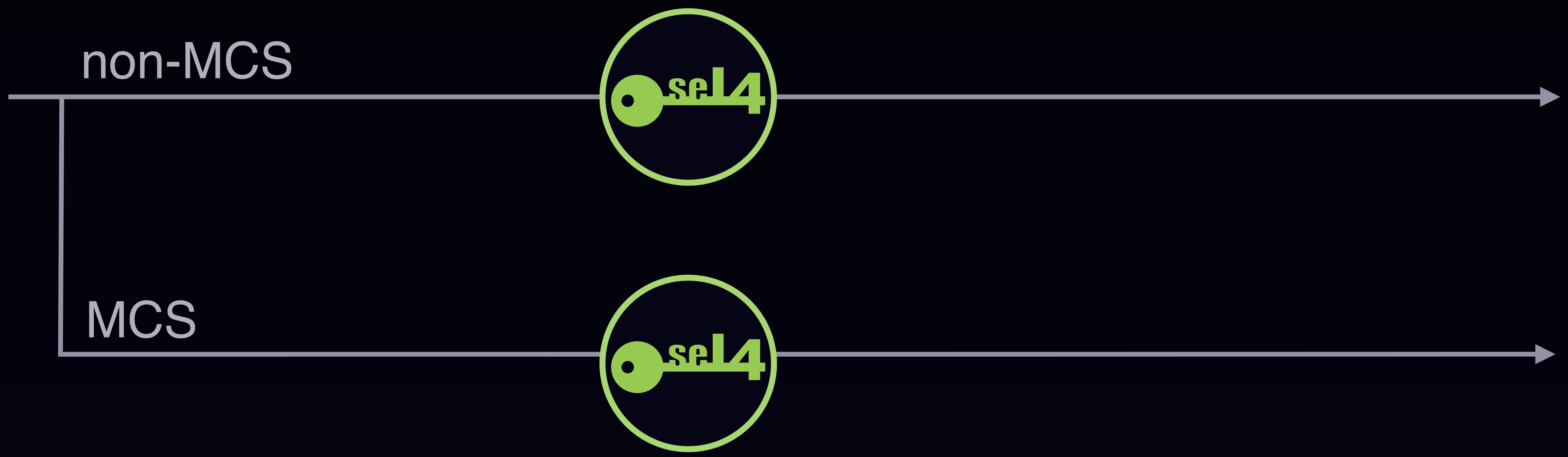
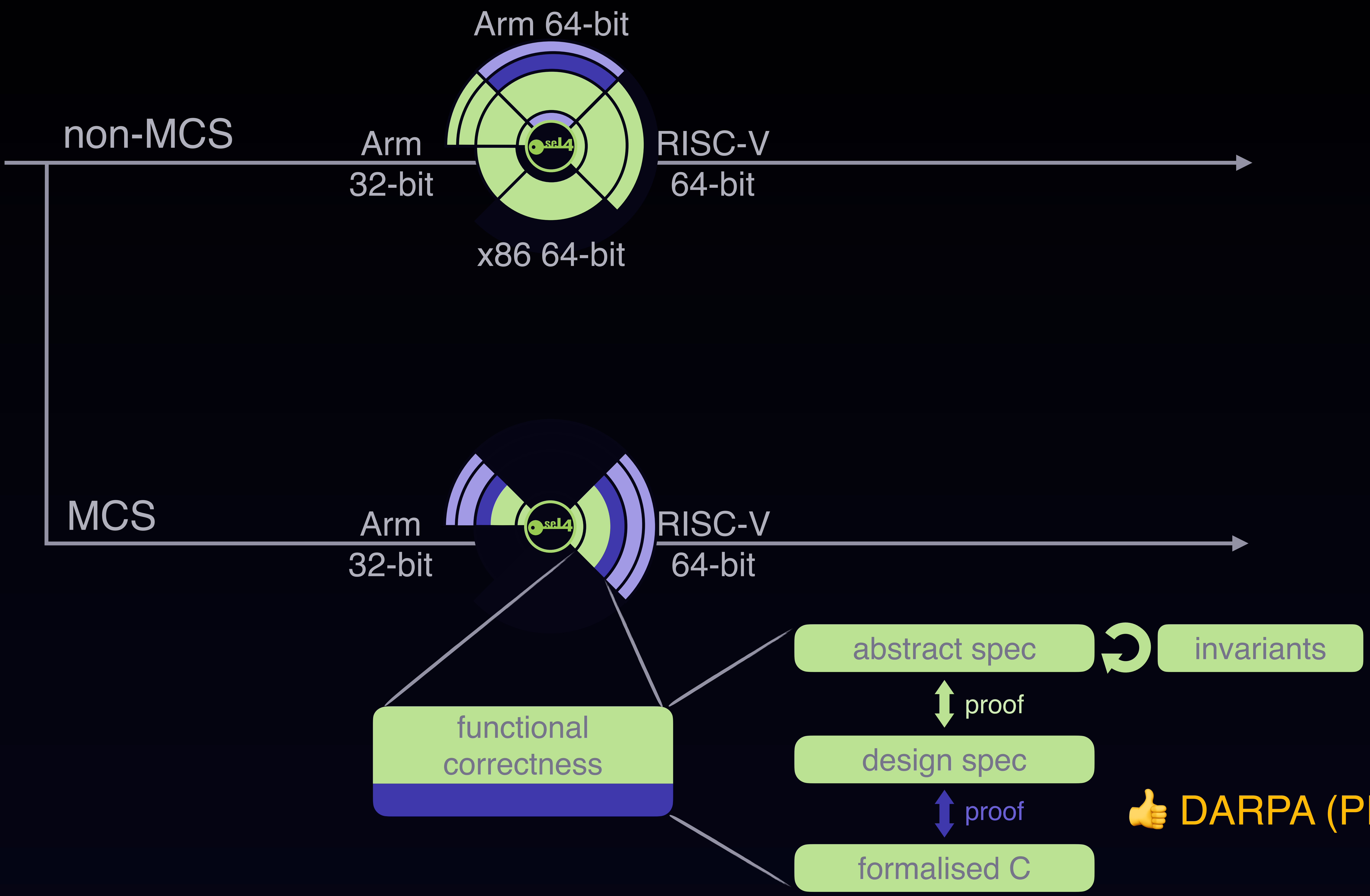
MCS is different:

- large, invasive change

Big Feature: Mixed-Criticality Systems



Verification of multiple configs in parallel



👍 DARPA (PROVERS)

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- Many pre-existing functions are now much longer

Loops in MCS

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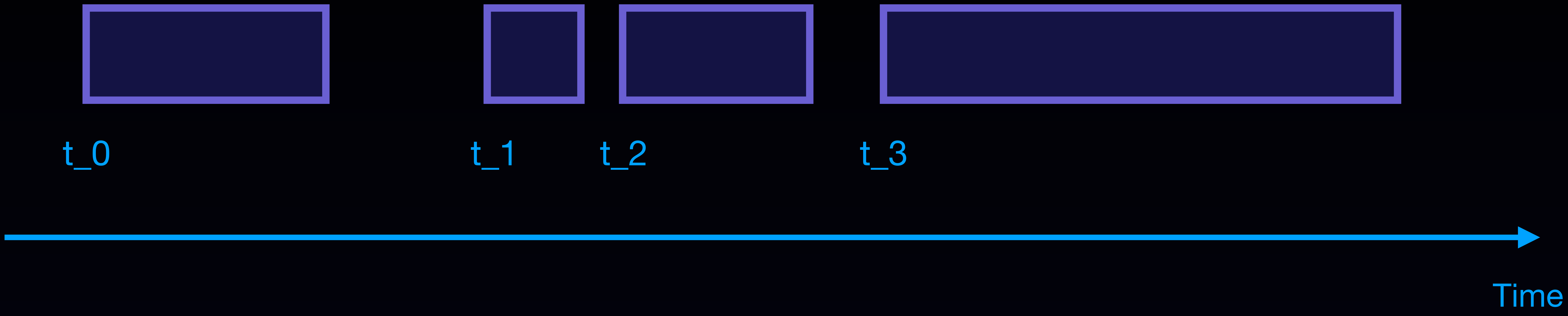

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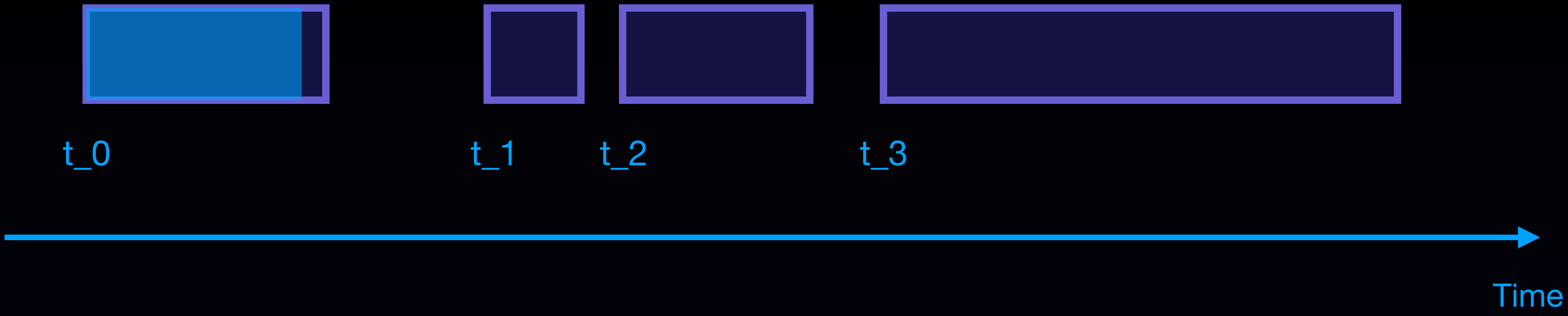

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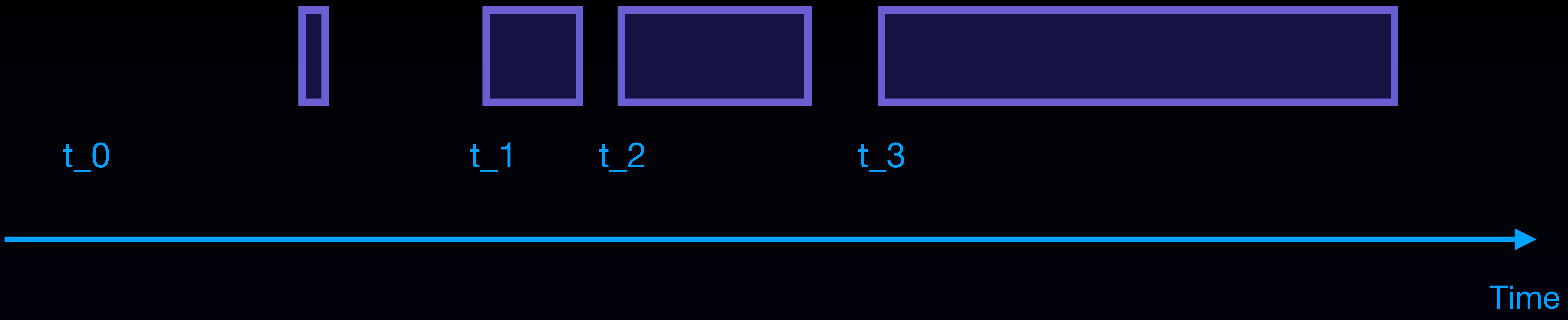

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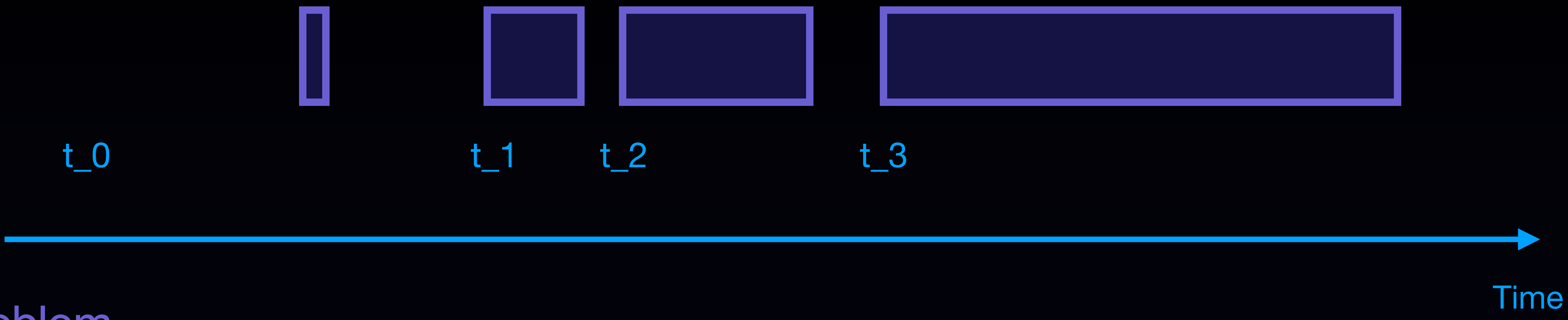
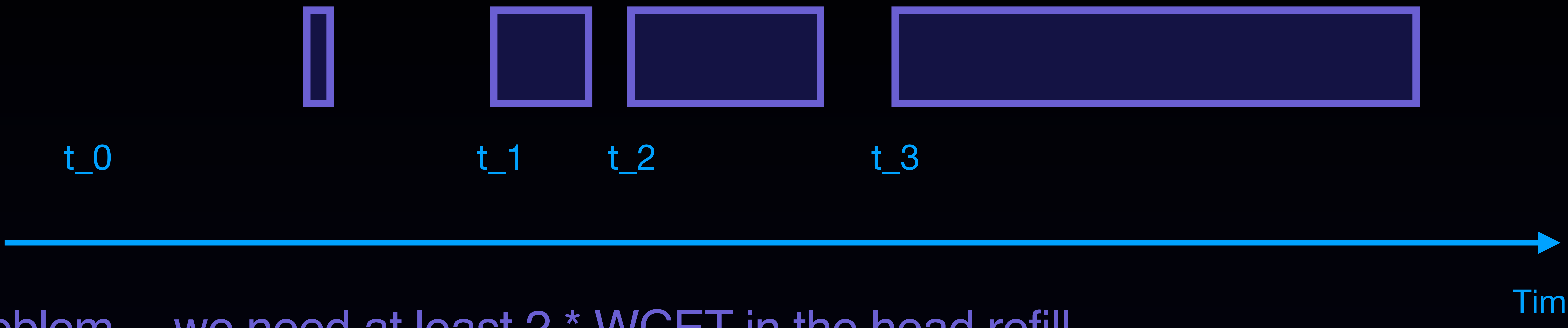


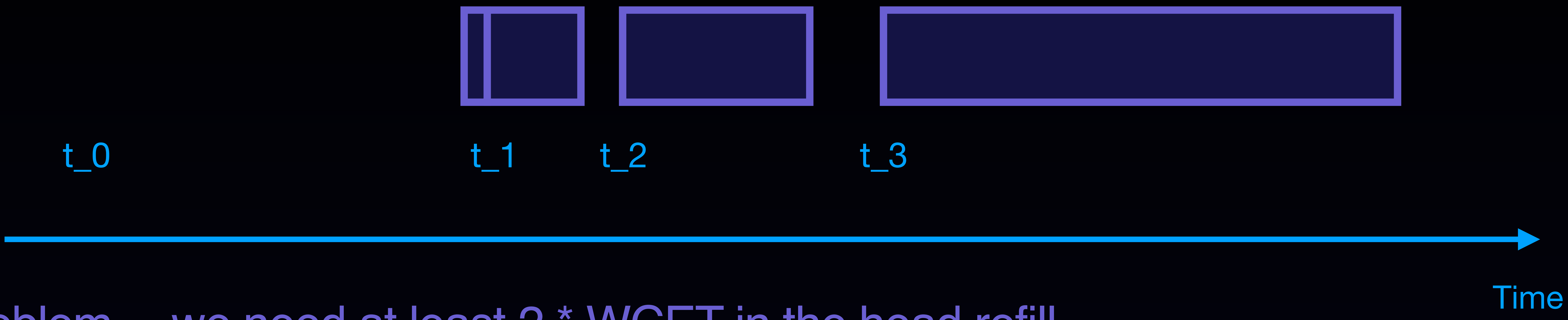
Problem…

Loops in MCS



Problem… we need at least 2 * WCET in the head refill

Loops in MCS



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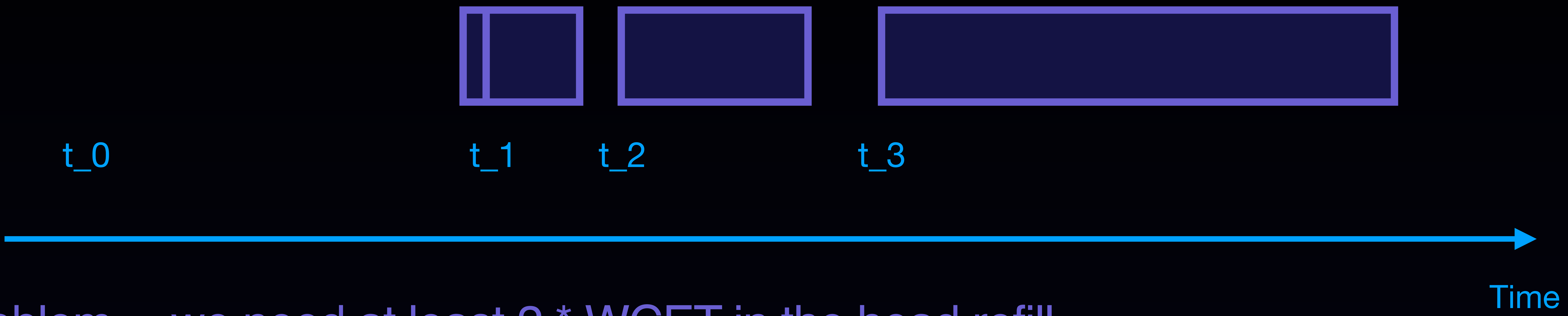
Loops in MCS



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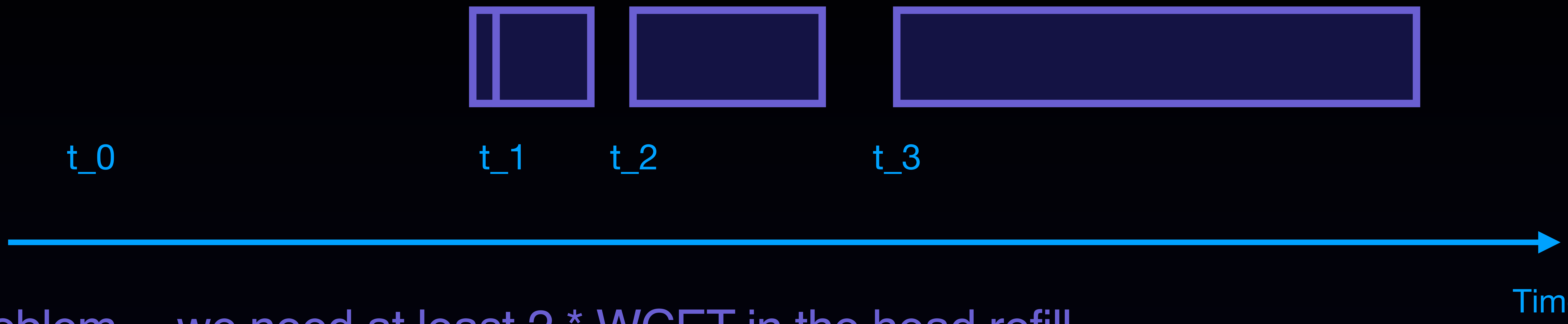

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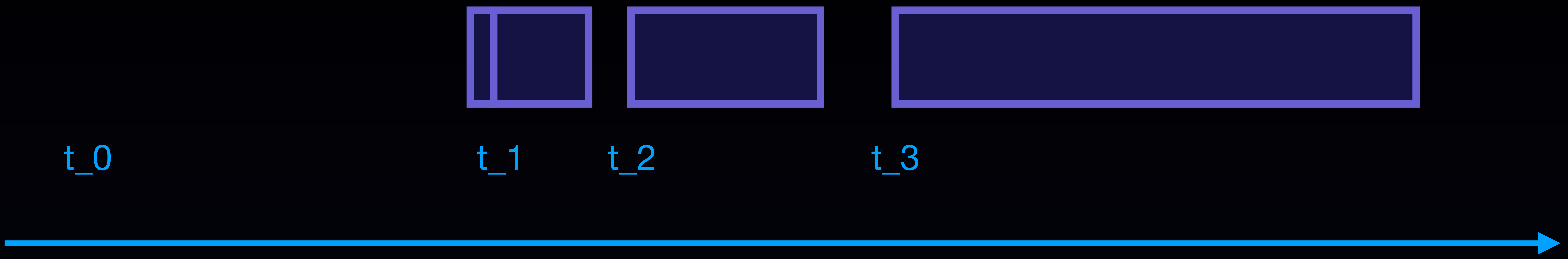
Loops in MCS



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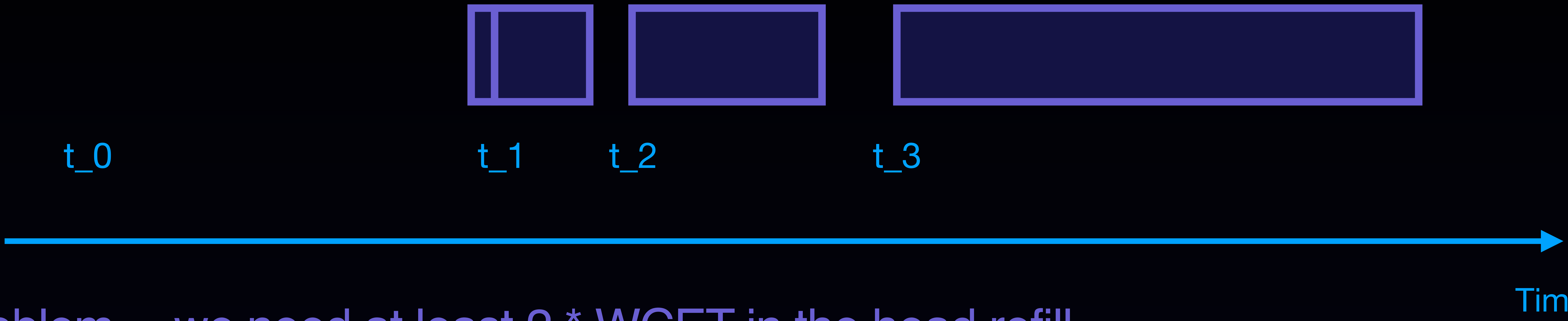

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Data refinement? Ring buffer of refills versus list of refills

Conclusion

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https://proofcraft.systems