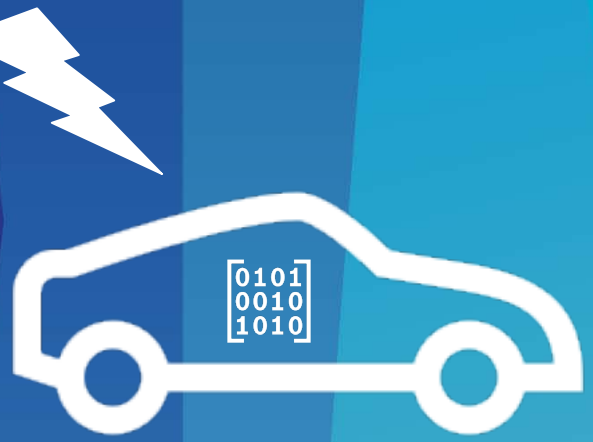
WHAT'S DIFFERENT ABOUT FUZZING AUTOMOTIVE SOFTWARE?



FuzzCon Europe 2020

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What's different about fuzzing automotive software?
What is this talk about?

- Why fuzz automotive software?
- What's the difference?
- How to cope with the differences?
- Conclusions and Takeaways

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What's different about fuzzing automotive software?

Why fuzz automotive software?

- Take proactive measures
  - Continuous fuzzing of automotive software (especially for SAE automation level 3 and above)
- Technically effective
  - Fuzzing also makes technical sense: to combat large number of false positives of static analysis, finding subtle bugs that go beyond simple coding guideline checks etc.

Fuzzing makes sense and just doing it!

- Compliance to internal/future norms
  - Internal guidelines and norms at companies
  - Future Norms e.g. ISO/SAE 21434
- Requirements from customers
  - Automotive manufacturers emphasize that fuzz testing be done

Fuzzing gets imposed and having to do it!

Intrinsic and extrinsic motivations for fuzzing automotive software

What's different about fuzzing automotive software?

- Why fuzz automotive software?
- **What’s the difference?**
- How to cope with the differences?
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What's different about fuzzing automotive software?
Difference #1: Platform dependence

Peculiarities

- Stronger platform dependence due to resource constraints and optimizations
- Well established Hardware-in-the-Loop (HiL) testing
- Customary use of certified compilers

Impediments

- Stubbing necessary to eliminate platform dependencies
- Execution on Linux is not always possible out of the box
- Complex build chains (e.g. code generation) require special treatment
- Non trivial interfaces make creation of fuzz targets challenging

Challenge: High entry barrier for fuzzing automotive applications

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What's different about fuzzing automotive software?
Difference #2: Statefulness

Peculiarity

- Automotive software is predominantly stateful -> a set of state transitions have to occur before something interesting happens

Impediments

- Traditional fuzzers target software with single input whereas stateful programs require sequence of inputs
- Adequate consideration of evolving program state during input generation is missing
- Resetting (cleaning up resources for) the software that runs on its own (in infinite loop) is challenging

Challenge: Novel fuzzing techniques are required to fuzz stateful embedded software

What's different about fuzzing automotive software?

Difference #3: Integration of 3rd Party Binaries

Peculiarity

- Automotive software often involves multiparty software (binaries) from different vendors

Impediments

- Unavailability of source code makes it hard to achieve the performance equivalent of state of the art modern fuzzers
- Executing native automotive binaries virtually is not always possible using prominent instruction set emulators like QEMU, UniCorn, Gem5

Challenge: Scalable approaches needed for fuzzing native automotive binaries

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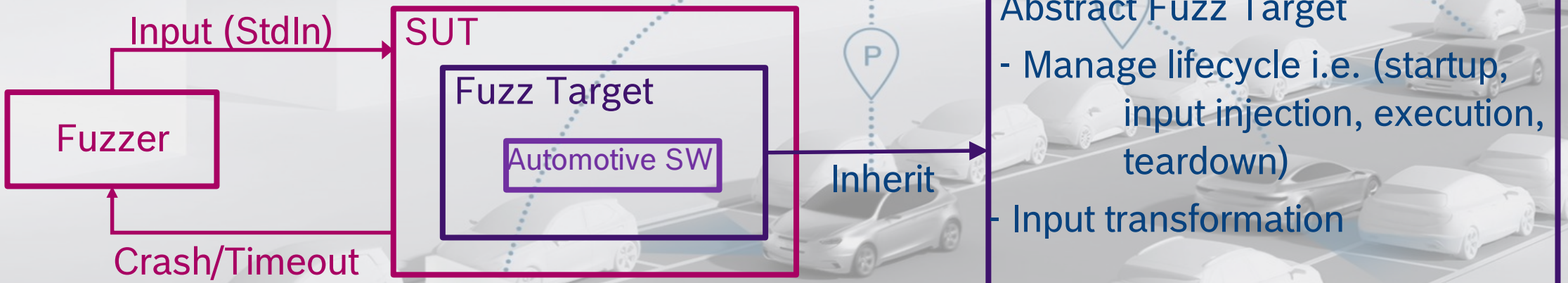
Solution: Lower the barrier



Automotive Software:
- Non-trivial input format required
- Special setup phase required

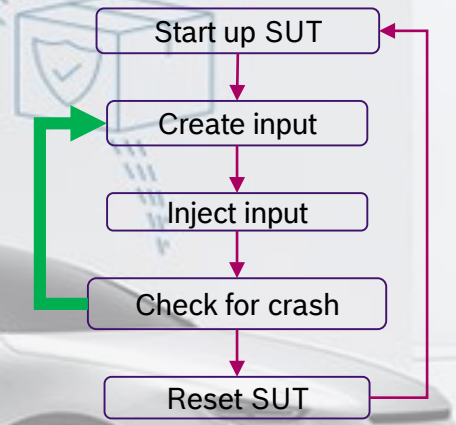
Fuzz Target:
- Directly affects quality of fuzzing
- Most effort in connection to fuzzer + writing fuzz target

Separate security specific activities from projects to lower the overhead for security testing

What's different about fuzzing automotive software?

Solution: Provide support for stateful fuzzing (ongoing research)

- **Motivation:**
  - The more (automation in finding internal states), the better
- **What will stateful fuzzing help with?**
  - Allows systematic testing for sequences of inputs leading to security vulnerability
  - (Ideally) no knowledge or specification of “critical” internal states necessary
- **Open research avenues?**
  - State identification
  - Building sequences
  - Picking a state to fuzz



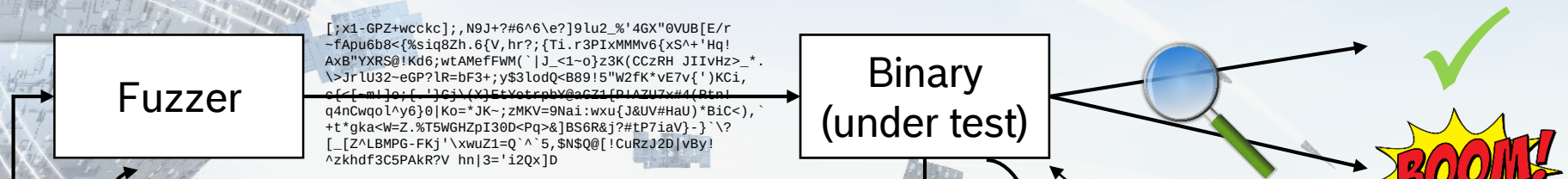
Recent research that addresses stateful aspects for network protocols in Servers:

AFLNET: A Greybox Fuzzer for Network Protocols

Fuzzing stateful programs has potential for further research in the context of embedded software

What's different about fuzzing automotive software?

Solution: Fuzz native binaries (future work)



Recent research addressing smart fuzzing on RISC-V based virtual prototypes:

Fuzzing Embedded Binaries leveraging SystemC-based Virtual Prototypes

Going ahead, systematic and scalable approaches for fuzzing automotive binaries are needed

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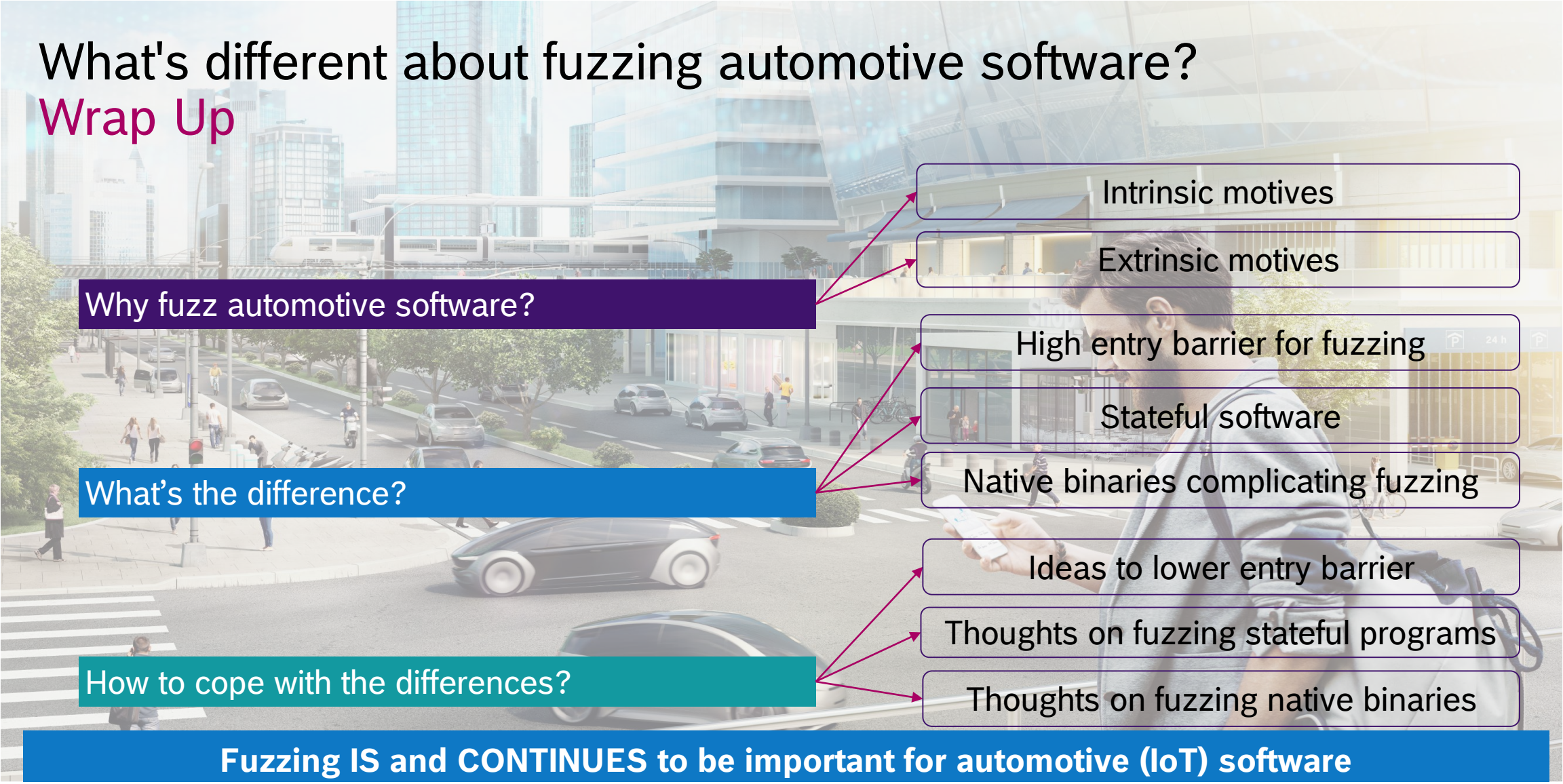
Wrap Up

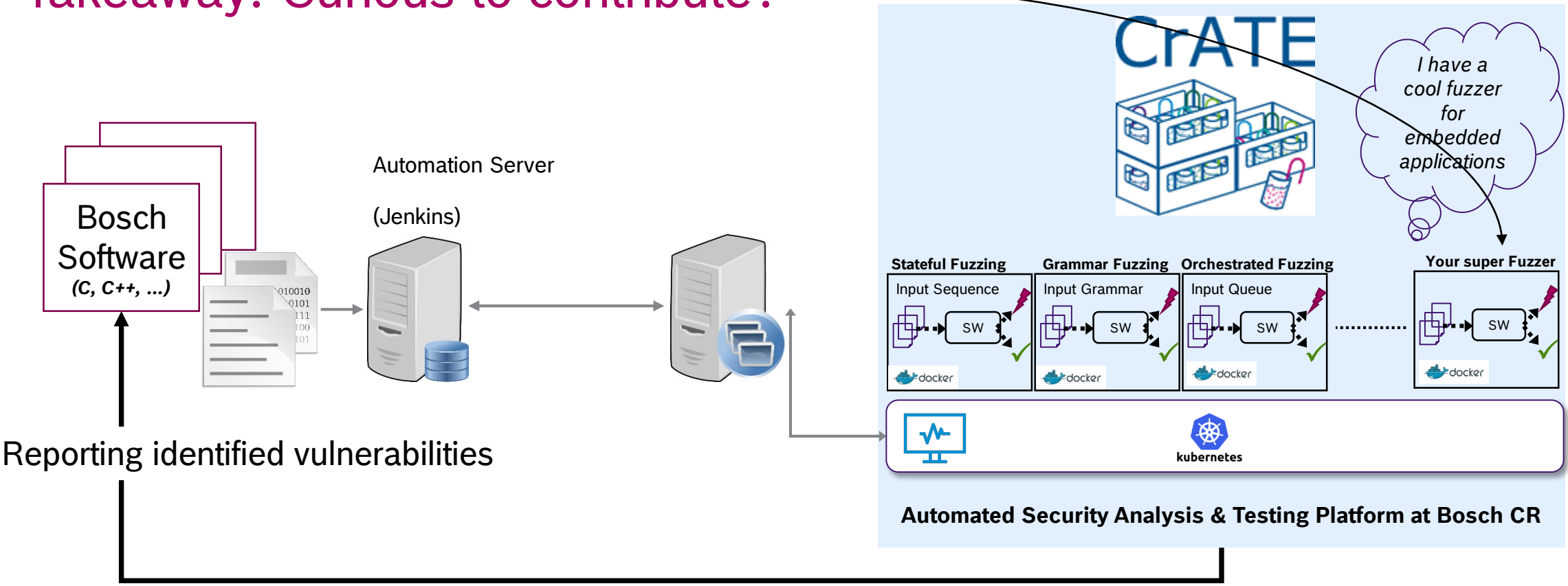


- Why fuzz automotive software?
  - Intrinsic motives
  - Extrinsic motives
- What's the difference?
  - High entry barrier for fuzzing
  - Stateful software
  - Native binaries complicating fuzzing
- How to cope with the differences?
  - Ideas to lower entry barrier
  - Thoughts on fuzzing stateful programs
  - Thoughts on fuzzing native binaries

Fuzzing IS and CONTINUES to be important for automotive (IoT) software

What's different about fuzzing automotive software?

Takeaway: Curious to contribute?



Extensible platform enables contributions from the fuzzing community

What's different about fuzzing automotive software?
Acknowledgements and Contact

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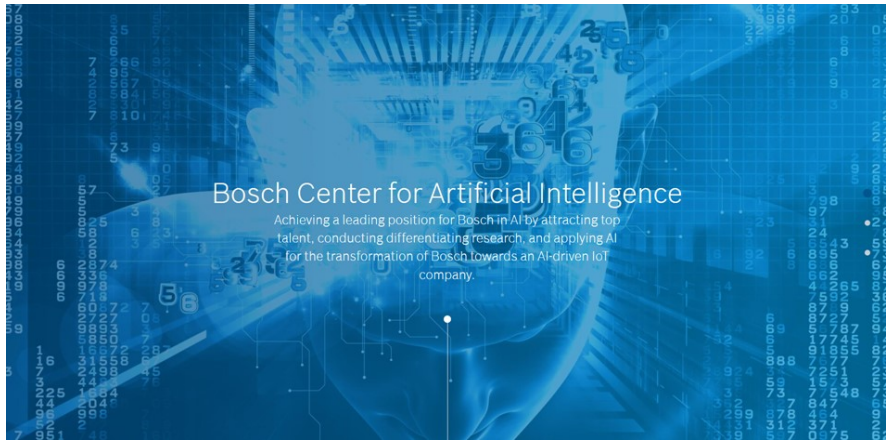
  - Dr. Andreas Nauerz

Feel free to reach out to me on LinkedIn or ✉ firstname[dot]lastname[at]bosch[dot]com

What's different about fuzzing automotive software?
Time for Questions



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