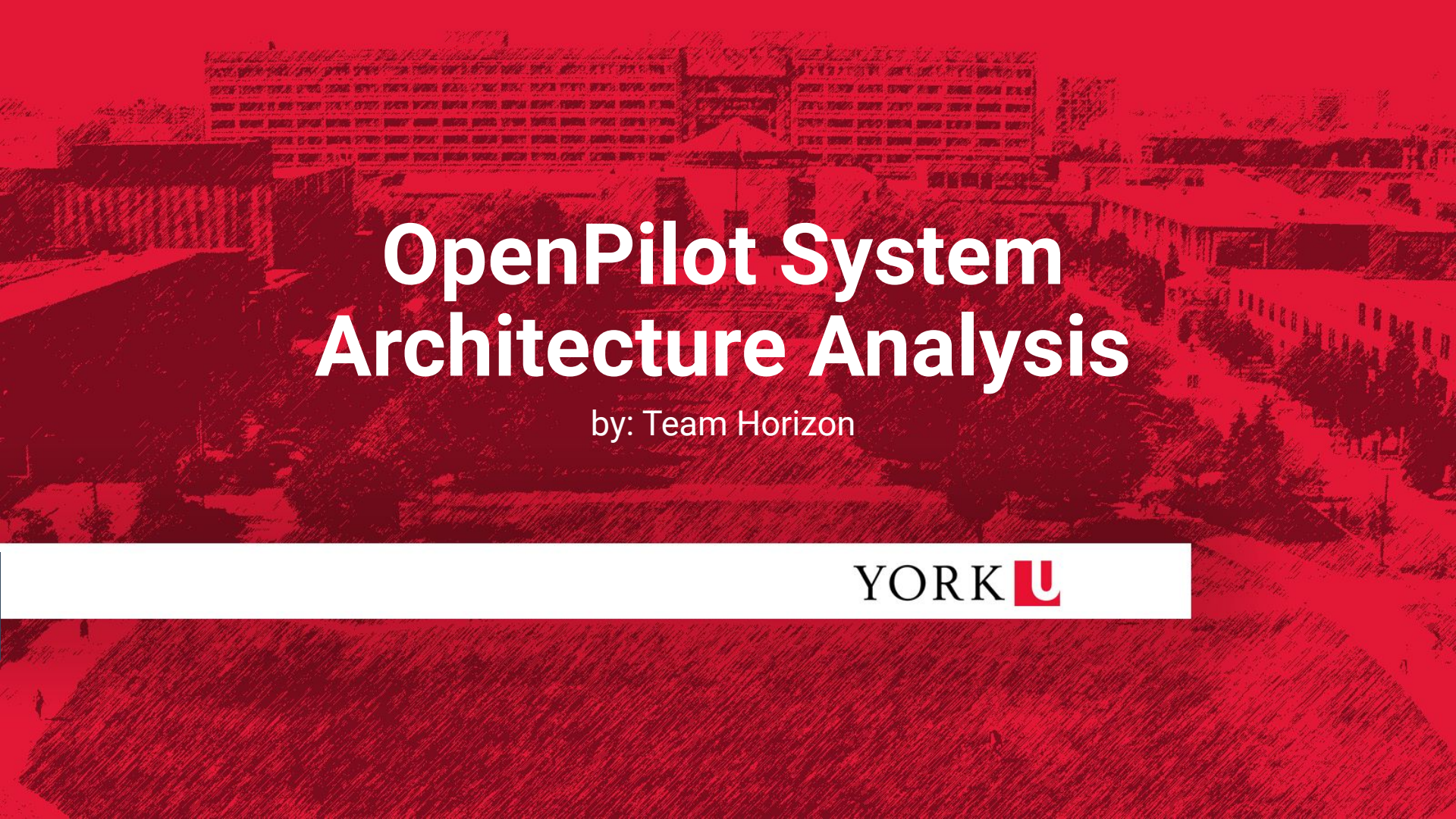

OpenPilot System Architecture Analysis

by: Team Horizon

YORK U

Agenda

1. Analysis Process
2. Top Level of Subsystems and Interactions
3. Comparison of System Architecture
4. Top Level of Panda Subsystem
5. Comparison of Panda Subsystem
6. Concurrency
7. Lessons Learned
8. Conclusion

Analysis Process

- Architecture from Previous Reports
  - Conceptual
  - Concrete
- Reflexion Model Venn Diagram
- Possible Changes to Conceptual

Top Level of Subsystems and Interactions

- Report 1 - Conceptual
  - **Architectural Styles:** Layered, Implicit Invocation, Process Control, Client-Server, Pipe and Filter, Repository
  - **Subsystems:** Sensors, actuators, neural networks, localization, controls, logging, hardware
  - **Key Components:** panda, openDBC, board, cereal
  - **Functionality:** Data and communication flow, concurrency
- Report 2 - Concrete
  - **Focus on panda:** using Understand and its role in Openpilot
  - **Dependencies** on panda
  - **Data and communication** flows
  - Found **implicit invocation**
  - **No** design patterns

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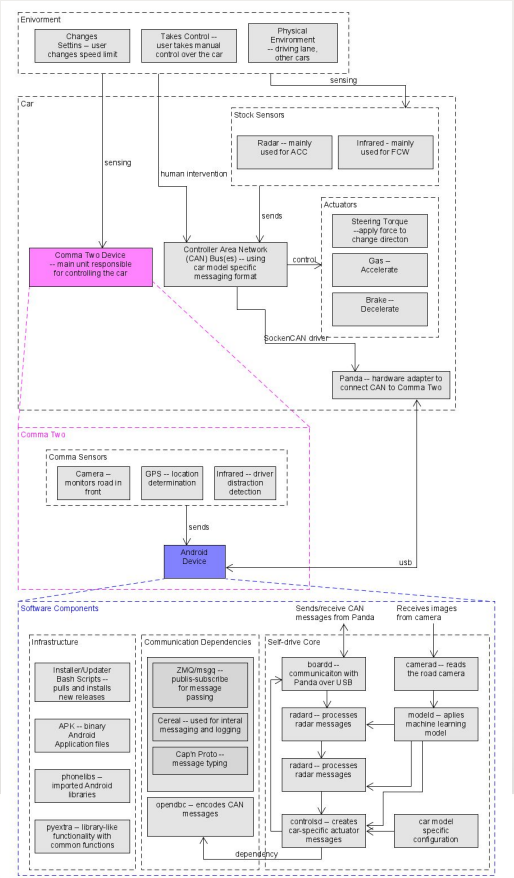
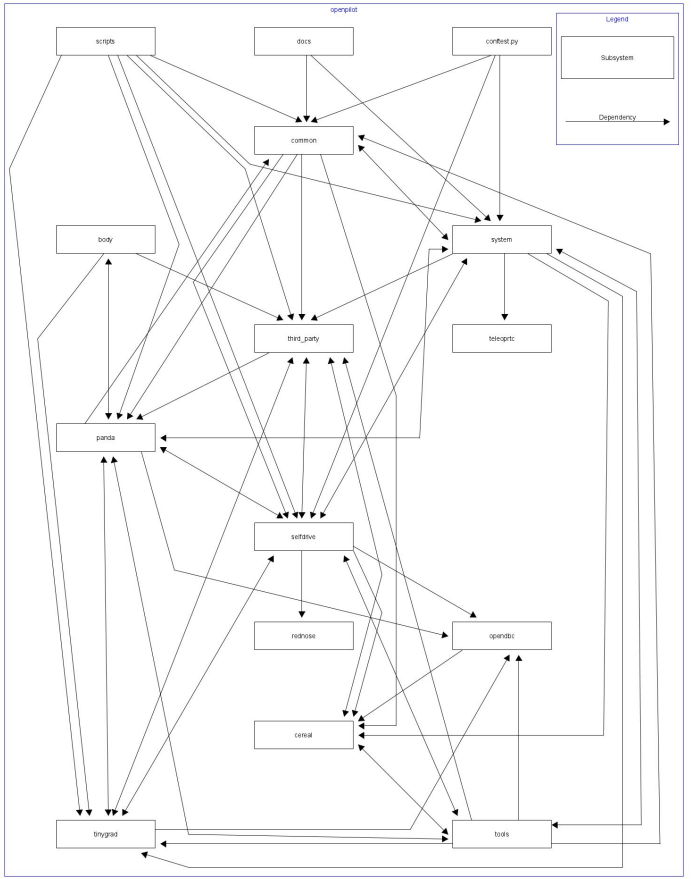
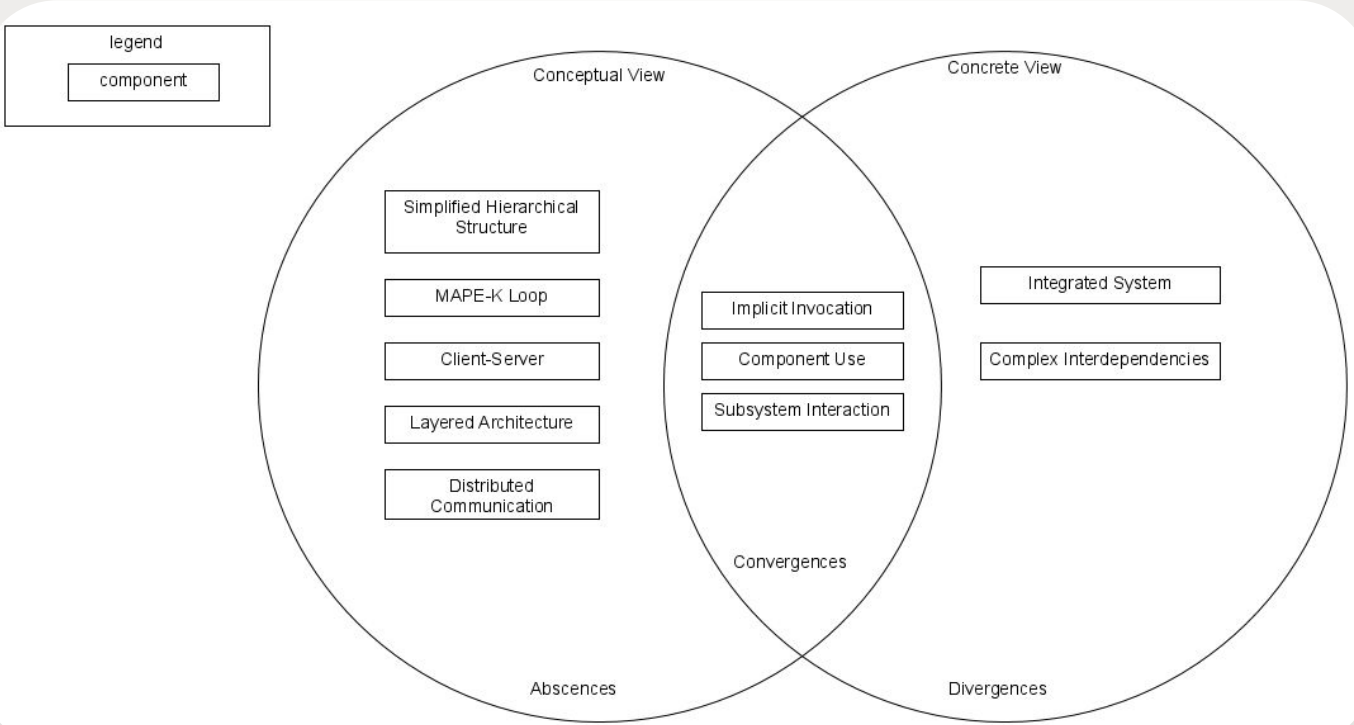
Top Level of Subsystems and Interactions





Comparison of System Architecture



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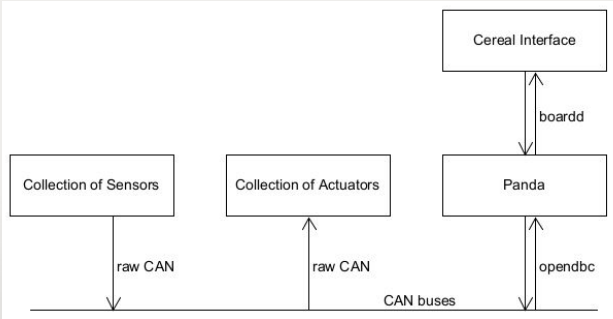
Top Level of Panda Subsystem

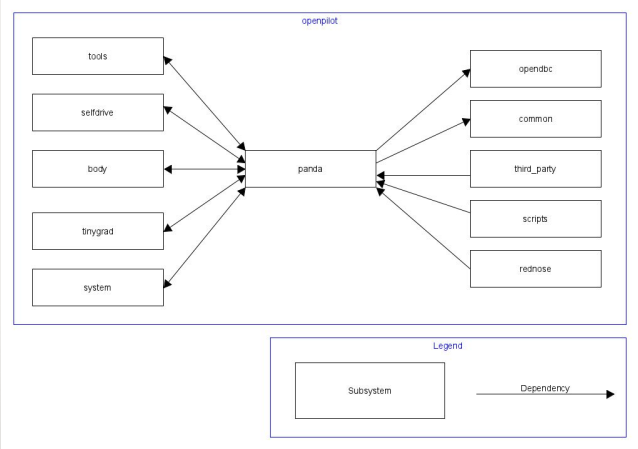
Conceptual

- Dependencies
  - boardd, opendbc, cereal
- Communication
  - CAN buses, collection of sensors, collection of actuators

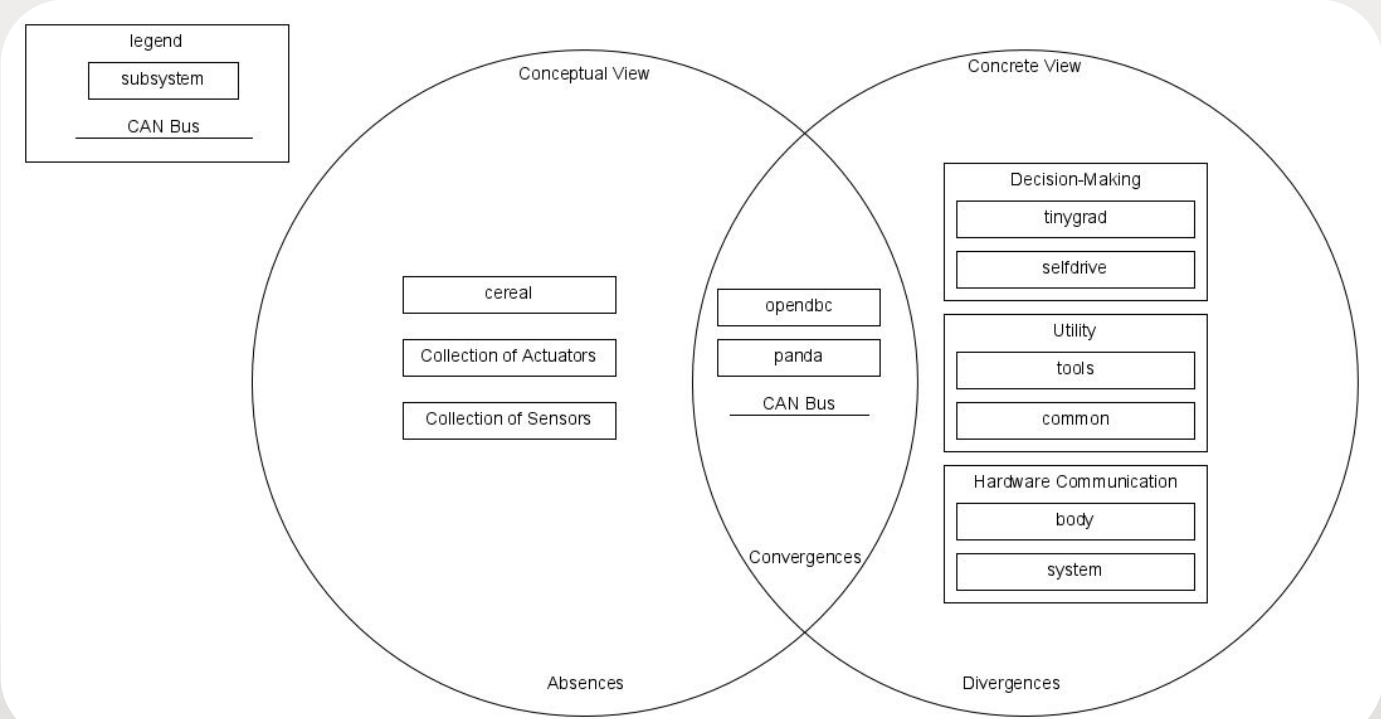


Concrete

- Dependencies
  - tools, selfdrive, body, tinygrad, system, opendbc, common



Panda Comparison



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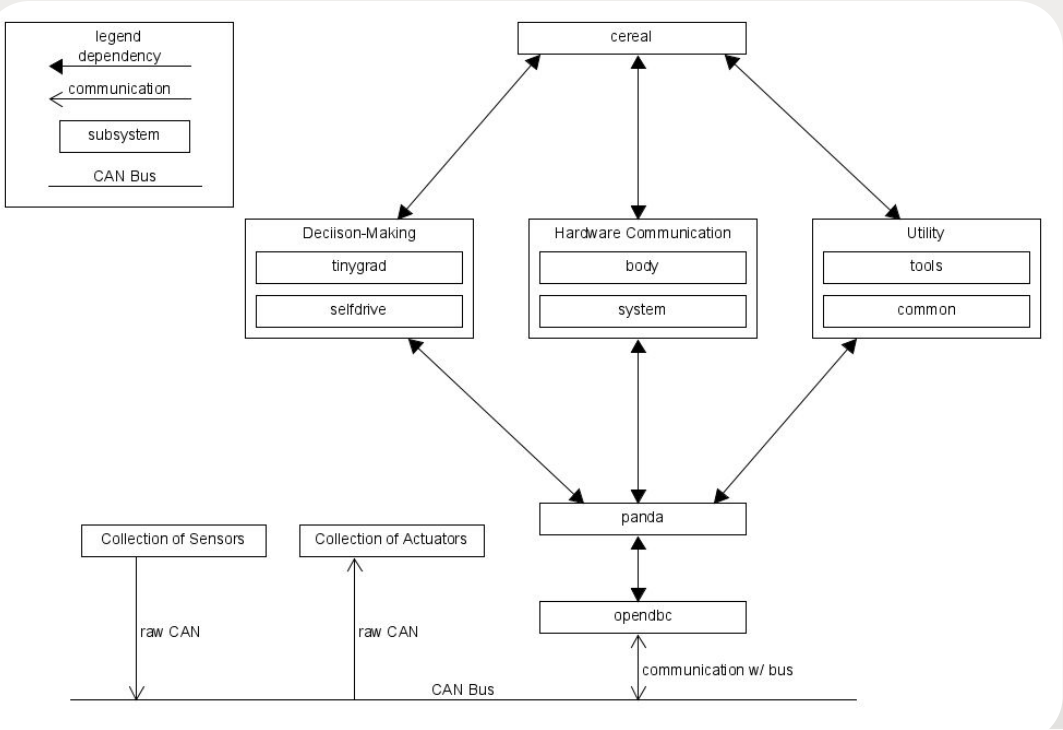
Panda Remade



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Concurrency

- Report 1 highlighted concurrency in the conceptual architecture
  - Concurrency Identified based on multiple inputs (e.g., cameras, sensors)
- Report 2 emphasized concurrency in concrete architecture
  - Implicit invocation mechanisms (e.g., pub/sub, event driven bus architectures) enabling concurrency
- Comparison
  - Report 1 correctly identified concurrency but lacked comprehensive understanding of its extent
  - Report 2 provided a detailed picture of concurrency, through the use of implicit invocation mechanisms
- Solutions
  - Perform a more comprehensive exploration of the conceptual system architecture
  - Focus on identifying and analyzing mechanisms such as implicit invocation to better predict concurrency

Team Issues

- Team Issues
  - Issues within Openpilots Github repo showed disagreements or differentiating viewpoints among the team.
  - Disagreements often due to differences in technical approaches, time constraints, and project priorities

Lessons Learned

- Beneficial Use of Reflexion Models
  - Reflexion models provide a clear method of comparison when comparing conceptual and concrete software architectures.
  - Clear & organized result in terms of absences, convergences, and divergences.
  - Divergences shows which components we failed to consider in the conceptual view.
- Gained experience and understanding of how documentation and source code can mismatch.
  - From a user/feature perspective, we expected the system to be structured a certain way. This was different from implementation.
- Something we'd do differently - Reference other system architecture to create the conceptual model in Assignment 1.

Conclusion

- Discrepancies in Architecture: Gaps in dependencies and concurrency from documentation reliance.
- Complexity Underestimated: Missed prediction of concurrency and invocation mechanisms.
- Expectations vs. Reality: Initial models (MAPE-K, Client-Server) misaligned with implementation.
- Reflexion and Code Review: Essential for bridging theory and actual system design.


Thanks for your attention!
Any questions/
suggestions/
concerns?
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