A Secure and Reliable OS for Automotive Applications
Cars on Code

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TU Berlin
Spring 2010 SIDAR - Graduierten Workshop ber Reaktive Sicherheit

July 7th, 2010

Outline

Introduction

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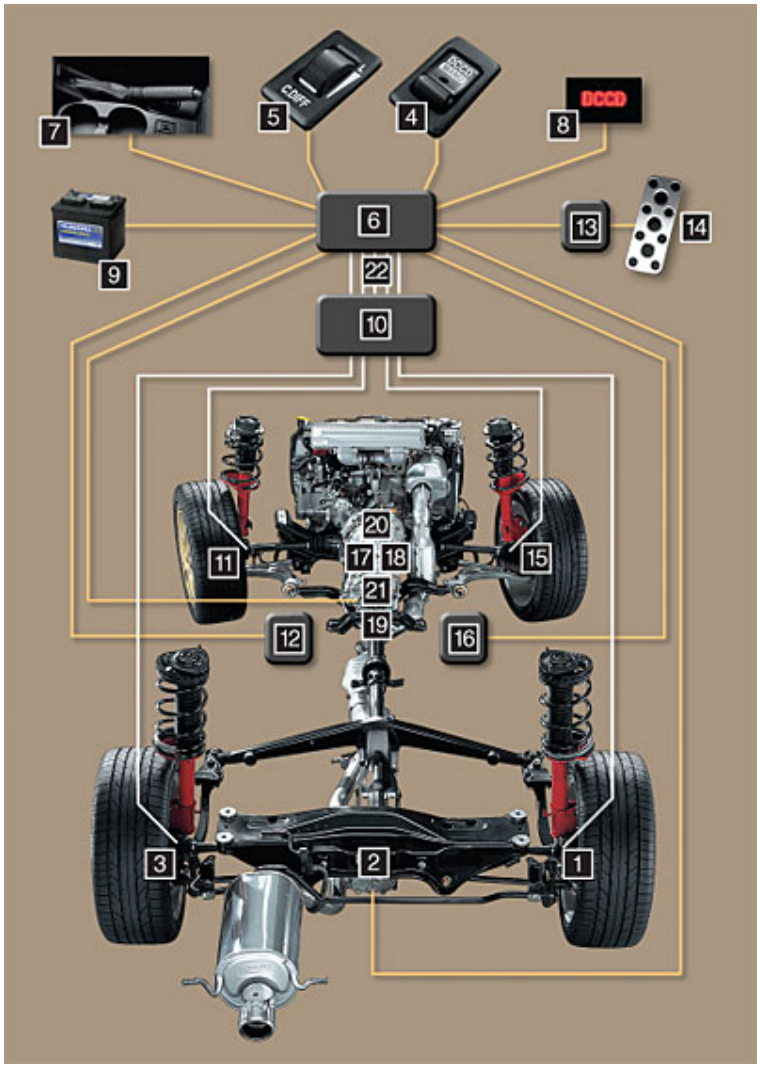
- Cars remained static for 80 years
  - Gasoline engine
  - Four wheels
  - Familiar user interface
- Change since late 70's
  - Computers coordinate and monitor sensors
  - Ca. 100MB of binary code spread over 50 - 70 ECUs

Objective of Computerization



- *Safety*
  - Anti-lock Brake System
  - Airbag
  - Assistance
- Value added features
  - Automatic crash response
  - Remote diagnostics
  - Stolen vehicle recovery
- Economically advantageous
  - Cost
  - Weight

Future Trends

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User Customization

App Store, let the user buy “upgrades”

Challenges

Isolation

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New Attack Vectors

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New Threats

Computerized environments bring new array of potential new threats.

Architecture

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  - Tasks, Threads and IPC
  - Object capabilities

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  - Drivers
- Reuse existing, collaboratively developed software
  - OS rehosting
  - Virtualization

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- Full binary compatibility at API level
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- Intrusive modifications to Linux kernel required

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- Almost no modifications to virtualized OS kernel required
- With nested paging negligible performance impact
  - up to 30 percent otherwise
- Relies on hardware support
- VT, SVM (and Trustzone)

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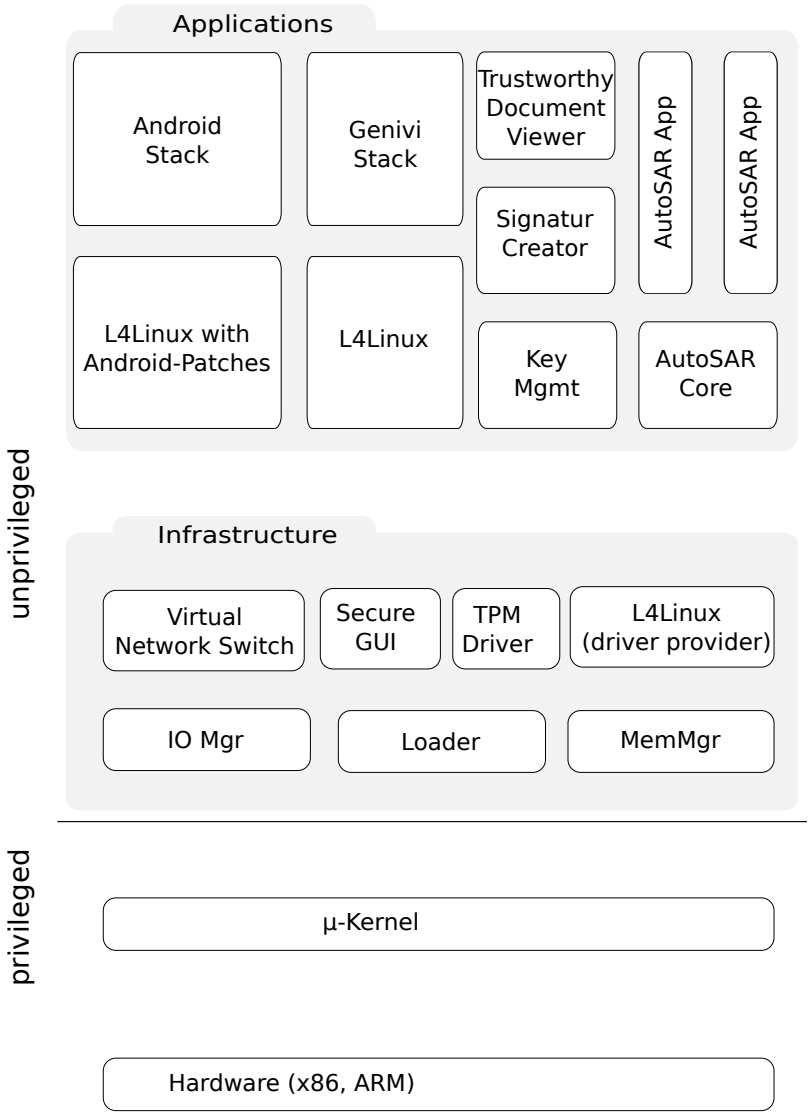
- Staged virtualization for faithfull virtualization

Achitecture



Proof-of-Concept Implementation

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- Intel Atom Z510 platform @1.1GHz, 512MB RAM
- Two instances of Android, realtime AutoSAR task
- One Android, one L4Linux with Busybox, realtime AutoSAR task

Further Research

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Scheduling

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Virtualization

Inter VM communication, performance improvements, hybrid tasks

Important Related Work

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- Experimental Security Analysis of a Modern Automobile
  Koscher, Karl Czeskis, Alexei Roesner, Franziska Patel et al.
- L4Cars
  Kevin Elphinstone Gernot Heise Ralf Huuck Stefan M. Petters Sergio Ruocco

Thank you!