TAPPS

Trusted **Apps** for open CPSs

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Open Networked CPSs

Networked, Cyber-Physical Systems that can be extended during operation by adding Apps on demand, e.g. for vehicles, medical devices, industrial automation

- Functional extension by Apps, as it is already common for mobile and other consumer devices
- Apps which can interact with safety-sensitive component by 3rd parties

Pro

enables products to keep pace with user expectations and latest features (eco-system)

Cons

Apps imply new safety, privacy & security risks

Open Cyber-Physical Systems

Connectivity and new functionality (Apps) will be an integral part of the value proposition

- Consumers expect up-to-date, digital services
- “56% would switch to a different car brand if the one they were considering didn’t offer the technology features they want”,
  Autotrader.com survey, 2014

© Photo: Fotolia

Security Challenges of Connected Cars

- **Hackers Take Control of (moving) vehicles**
  - Hacked Jeep Cherokee while driving
    - www.wsj.com/articles/hackers-show-they-can-take-control-of-moving-jeep-cherokee-1437522078
  - Tesla Model S
    - See www.cnet.com/news/chinese-hackers-take-command-of-tesla-model-s/
  - BMW Connected Drive hack, see heise.de

Security and Safety for new Services

Source: pixbay.com

- Apps in vehicles to **add new functionality**
  - Apps require **open, flexible platforms** with access to car internals
- Need to ensure **safety and security** of the vehicle
  - Security means e.g. unauthorized actions
  - Safety issues may compromise proper operation of the vehicle
- **Security and safety** on existing, open platforms?
  - Abundant security issues for existing mobile platforms and Apps

Vulnerabilities discovered in 2015

				# of issues
2	Iphone Os	Apple	OS	375
3	Flash Player	Adobe	Application	314
⋮				
19	Safari	Apple	Application	135
20	Android	Google	OS	130
21	Acrobat	Adobe	Application	129

Source: http://www.cvedetails.com

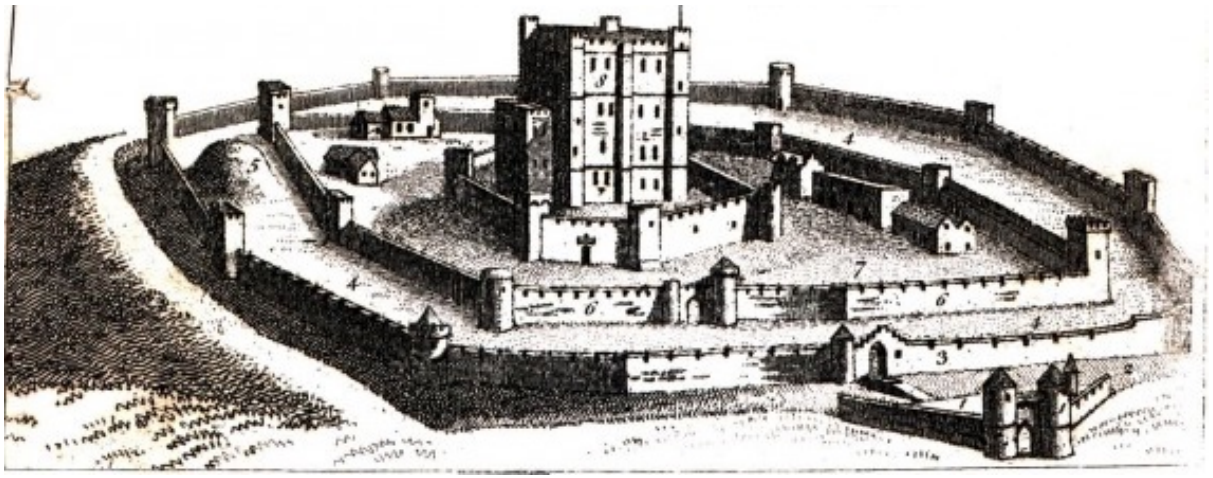
Towards Trusted Automotive Apps

- Main requirements
  - **End-to-end trust chain** for deployment and apps management
    - Including access to **critical APIs**
  - **Highly trusted execution environment**
    - **Multiple, independent layers of security**
- Current solutions **separate** infotainment/apps HW from safety relevant control HW
  - Do not solve the problem of **access** to safety-critical resources (APIs)
  - Requires two physical platforms

Source: pixbay.com

TAPPS Approach: Multiple layers of security

1. **Trusted hardware** with security mechanisms
2. **Computing and network virtualization**
3. **Fine-grained access control** to resources to ensure safety and privacy (API checks, contracts).
4. **Verified, model-based Apps** to ensure correct and secure behavior.



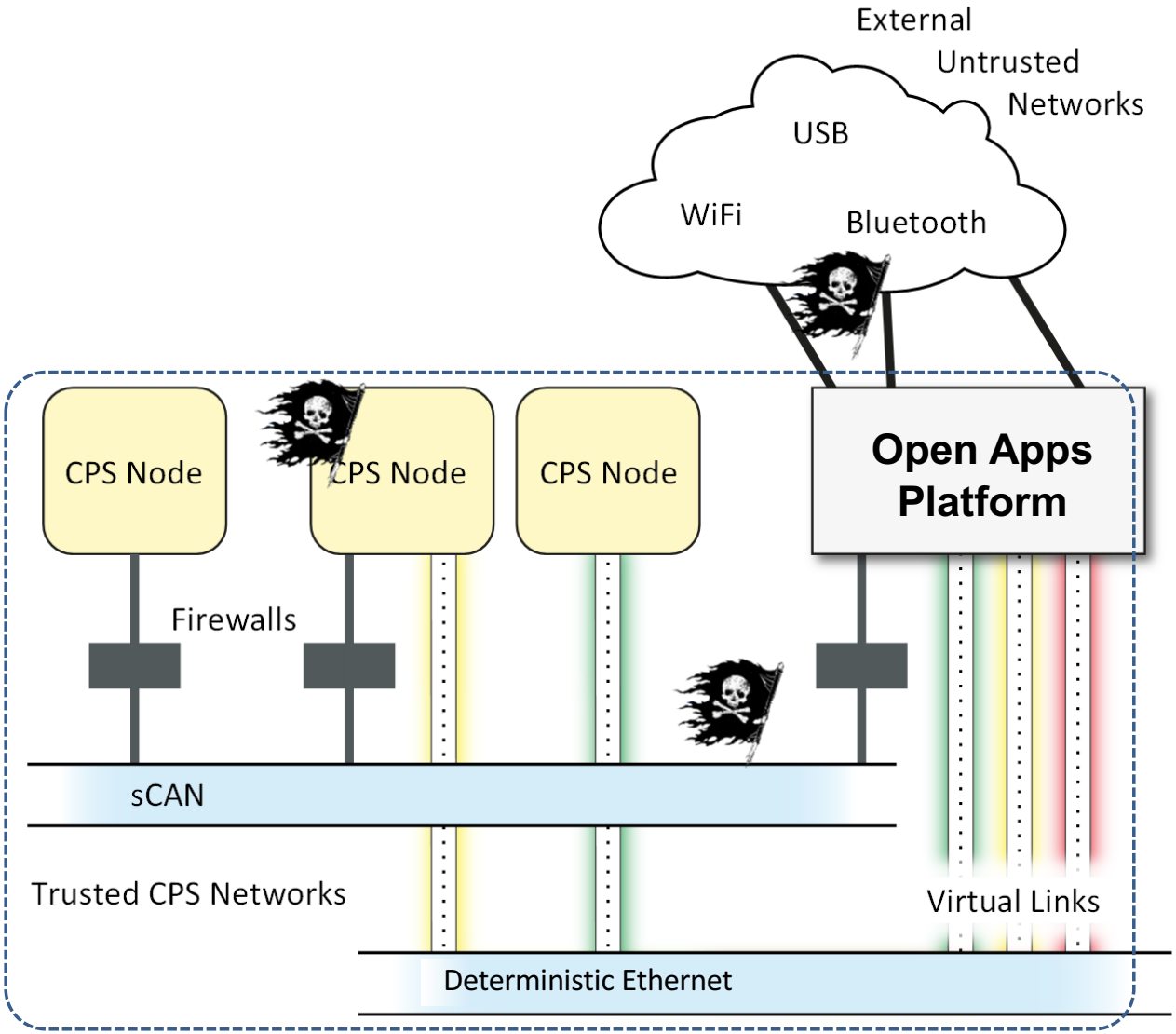
blog.smartbear.com/design/what-medieval-castles-can-teach-you-about-web-security/

High-Level System Architecture

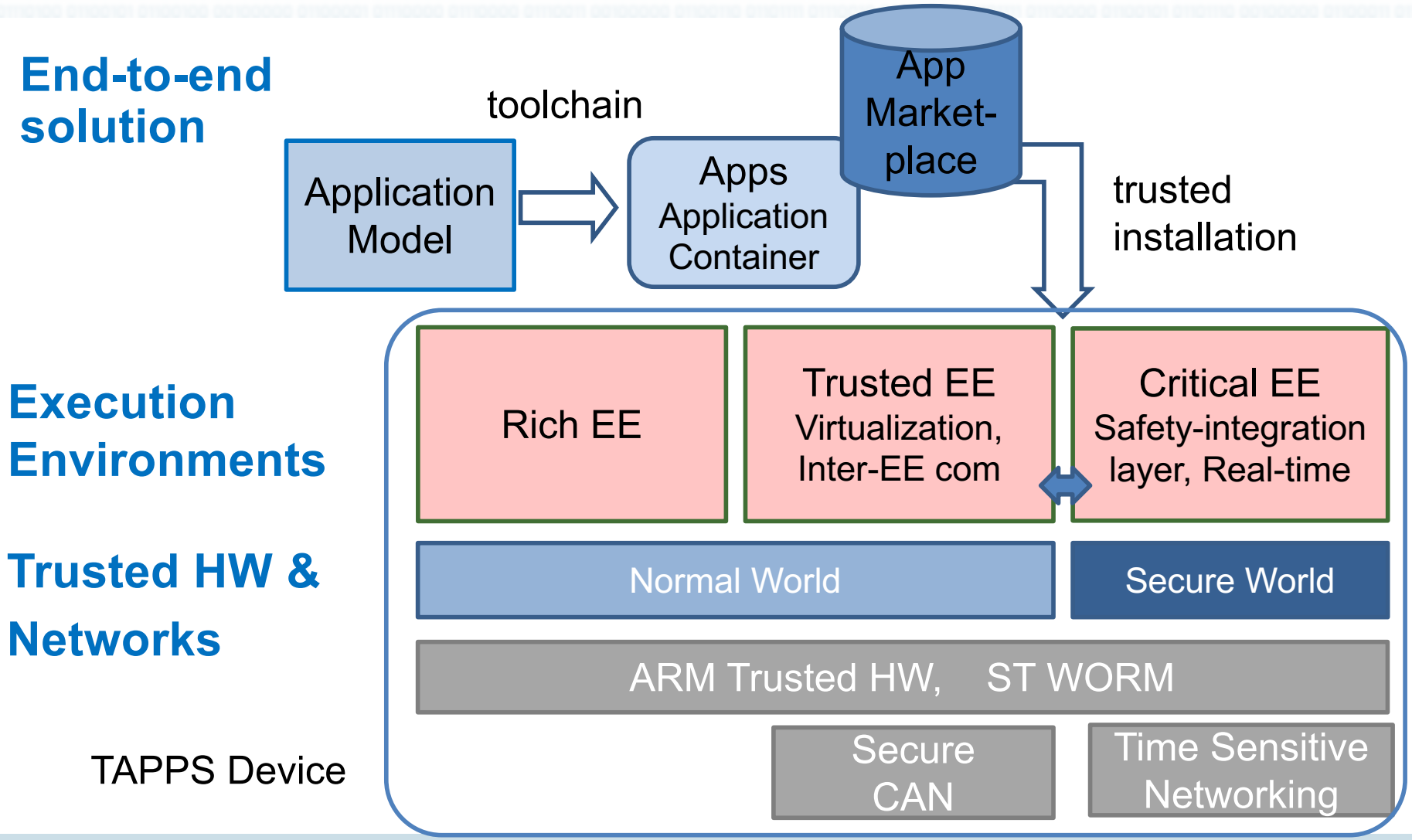
TAPPS Application Domains

Automotive

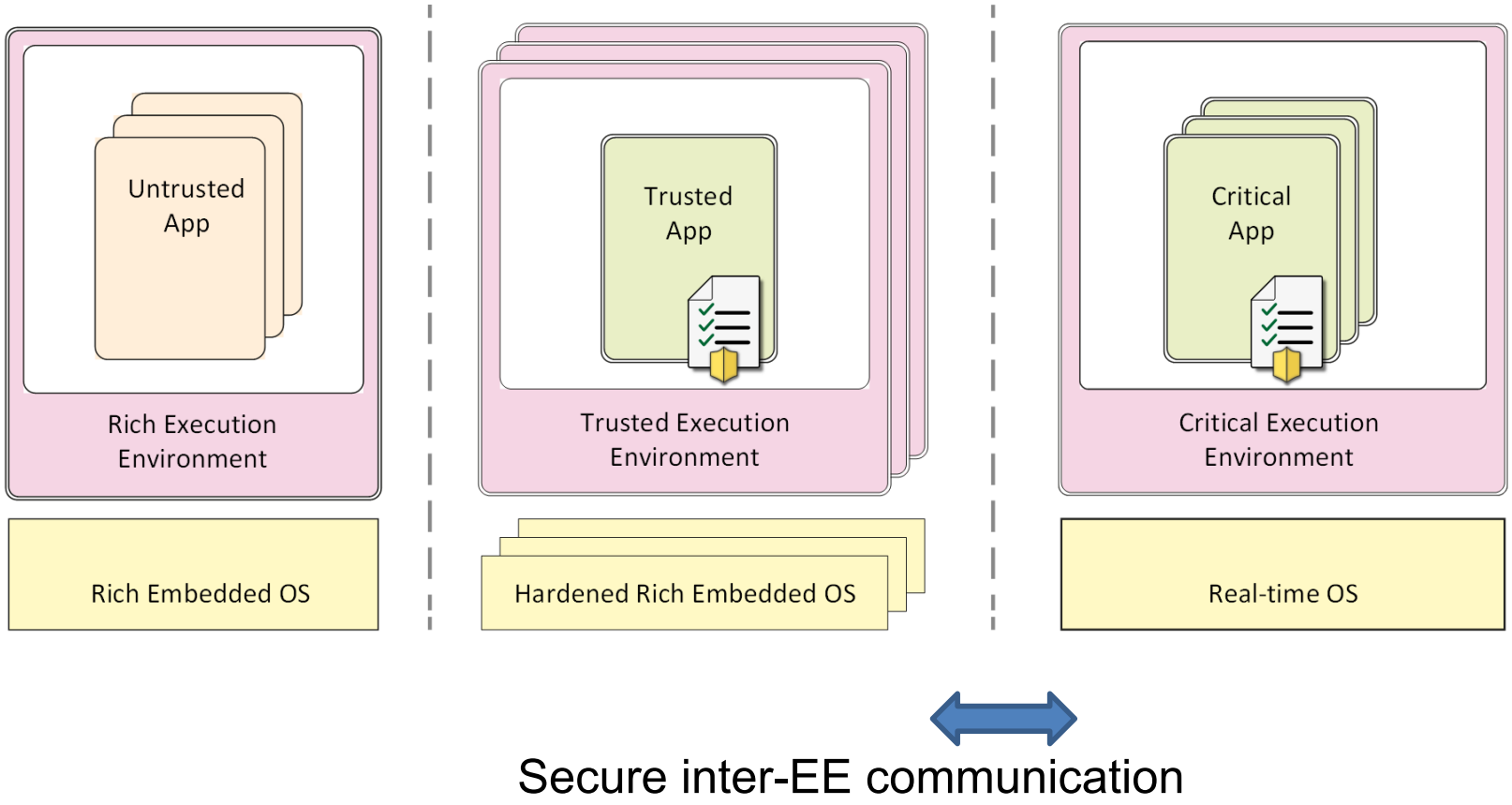
Healthcare



TAPPS Architecture for Open CPS Devices



Individual Protection Profiles via three Execution Environments



Validation
Trusted Apps Platform

Automotive domain

- check trip capability based on traffic conditions and battery status
- sport package changing driving behavior
- braking adjustment depending on environment conditions

Motorbike

Smart Trolley

Healthcare domain

- automatic drawers for safe drug management
- patient identification
- access to electronic health records
- monitoring of vital signs

Summary

- TAPPS Project provides open platform with
  - Multiple layers of security
  - Execution environments with different protection level

- Challenges
  - Integrated security, safety, RT over all layers
    - From HW, NW, virtualization to SW
  - End-to-end security, boot, installation, operation,
  - Adaptation under real-time
  - …

Partners of TAPPS

fortiss

life.augmented

TTTech

Virtual Open Systems

actility
Making Things Smart

Fondazione
CENTRO SAN RAFFAELE

T.E.I. of Crete

eNERGICA

OSPEDALE
SAN RAFFAELE

Third party

Contact

www.tapps-project.eu

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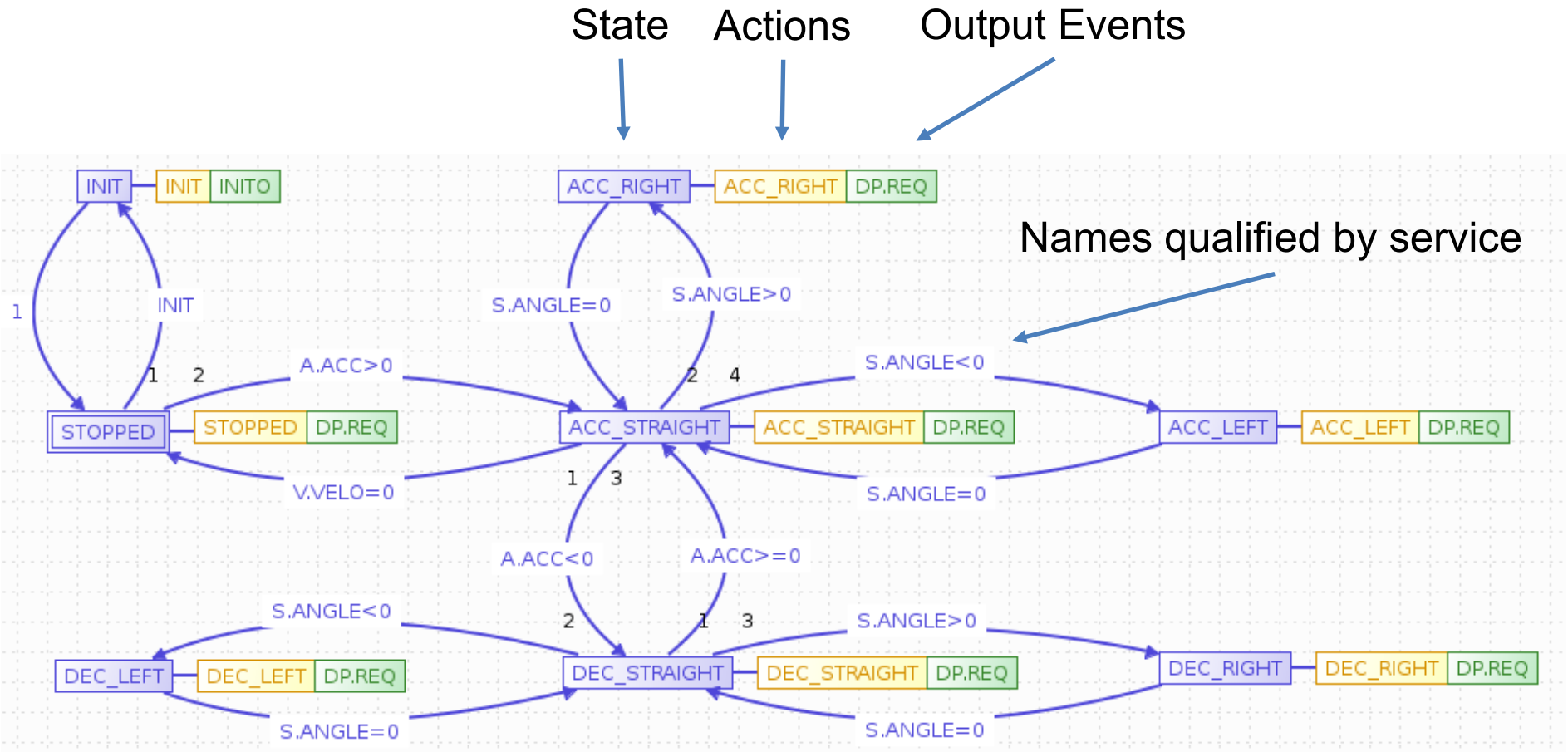
Security for Connected Devices – State of the Art

- Symantec report on **security for Internet of things**
  - „Around 19 percent of all tested mobile apps that are used to control IoT devices did **not use Secure Socket Layer** (SSL) connections to the cloud“
  - „The use of **weak passwords** is a security issue that has repeatedly been seen in IoT devices“
  - „Most of the IoT services did not provide signed or **encrypted firmware updates**“
  - „Conclusion: Any code that is run on a smart device, be it the firmware or application, should be verified through a **chain of trust**.“

Source: http://www.symantec.com/IoT/

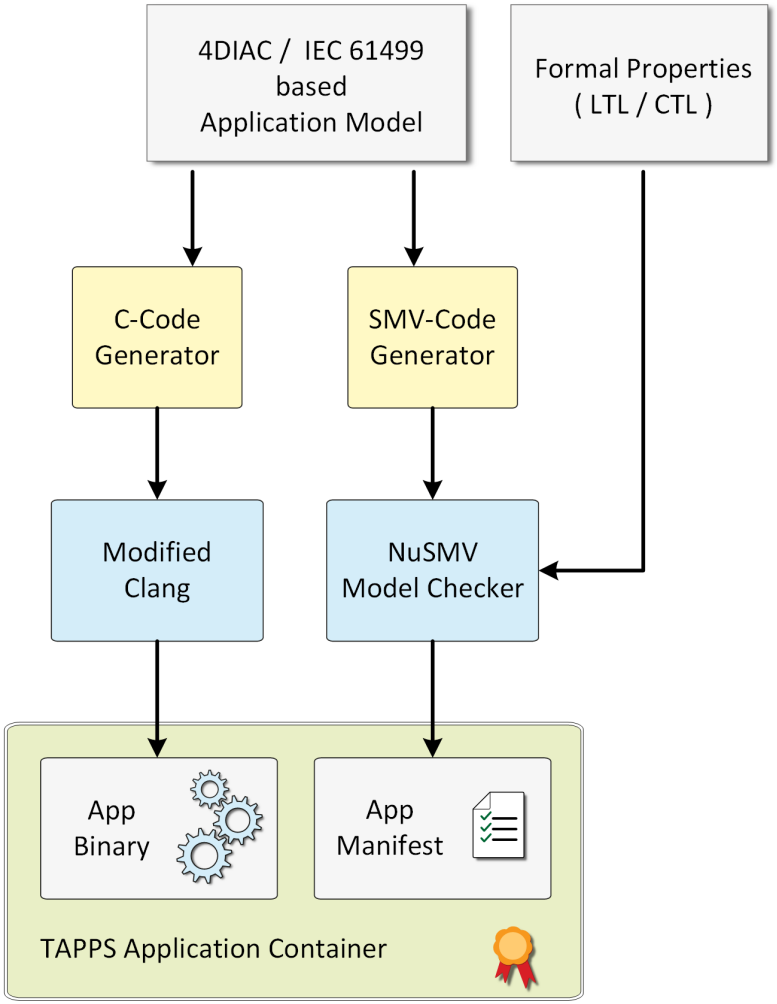
Example State Machine
Active Suspension (simplified)



Secure Apps by Design

Using a Model-based Toolchain

- 4DIAC: Established and standardized model-based toolchain from the industrial automation domain (IEC 61499)
- Code generation for TAPPS architecture
- Formal proof of Apps by model checking (NuSMV)
  - Test all possible executions



App Categories for Connected Cars

1. Pure **infotainment**, external services
   - Safety relevance is low
2. Apps which **access internal information**
   - E.g. address book, sensors, location, ...
   - Privacy issues, little safety issues
3. Integrated Apps which **modify internals**
   - E.g. customize vehicle dynamics (traction, ESP, ...) based on weather conditions
   - E.g. customize assistance systems
   - High demands on safety and security
   - May be **real-time critical**

Source: http://kaddigart.deviantart.com/art/Apps-Box-1-Icon-334214248

4DIAC Tool for Model-based Development

IEC 61499 Standard

- Origin
  - 1990s: holonic and agile manufacturing systems
  - Requirements: flexibility, adaptivity, and distribution
- Goals
  - Standardized architecture for function blocks in distributed industrial-process measurement and control systems
  - Basic support for dynamic reconfiguration
- Developed by IEC TC65/WG6, Started 1993

Engineering Tool

- Open Source, Eclipse Public License
- Components of solution
  - Engineering tool
  - Reusable component library
- Application domains:
  - Building automation, process industries, laboratory automation, smart grids, machine control, ...
- Core developers
  - fortiss GmbH
  - Profactor GmbH (AT)
  - Automation and Control Institute (ACIN)
  - Austrian Institute of Technology (AIT)
- Many users in industry and research/education