

A secure infrastructure for mobile blended learning applications

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Overview

- Motivation & Goals
- Current State
- Case Studies
- Lessons Learned
- Future Work

RWTH Aachen University



~44,000 Students



~5,000 Internationals
from 117 Countries



~10,000 enrollments
in winter term 2015/16



~540 Professors



~8,000 Employees
260 Institutes



9 Faculties
152 Courses of study

Goals

Support the core processes: Teaching, Learning and Research

- Connect legacy systems with a single, consistent API
- Develop an SOA that fits to the processes at the university
 - Start with E-Learning
 - Generalize and try to apply to other fields:
 - Campus Management, Identity Management
 - Research Data Management / E-Science
- Security by design
 - Confidentiality
 - Integrity
 - Availability
- Protect personal and confidential data

Goals

Be able to adopt to the students and institutes processes

- Processes of students and institutes change faster than central IT
- Use custom code to trigger workflows
- Run analytics and reports on their own data
- Offer advanced E-Learning scenarios to their students

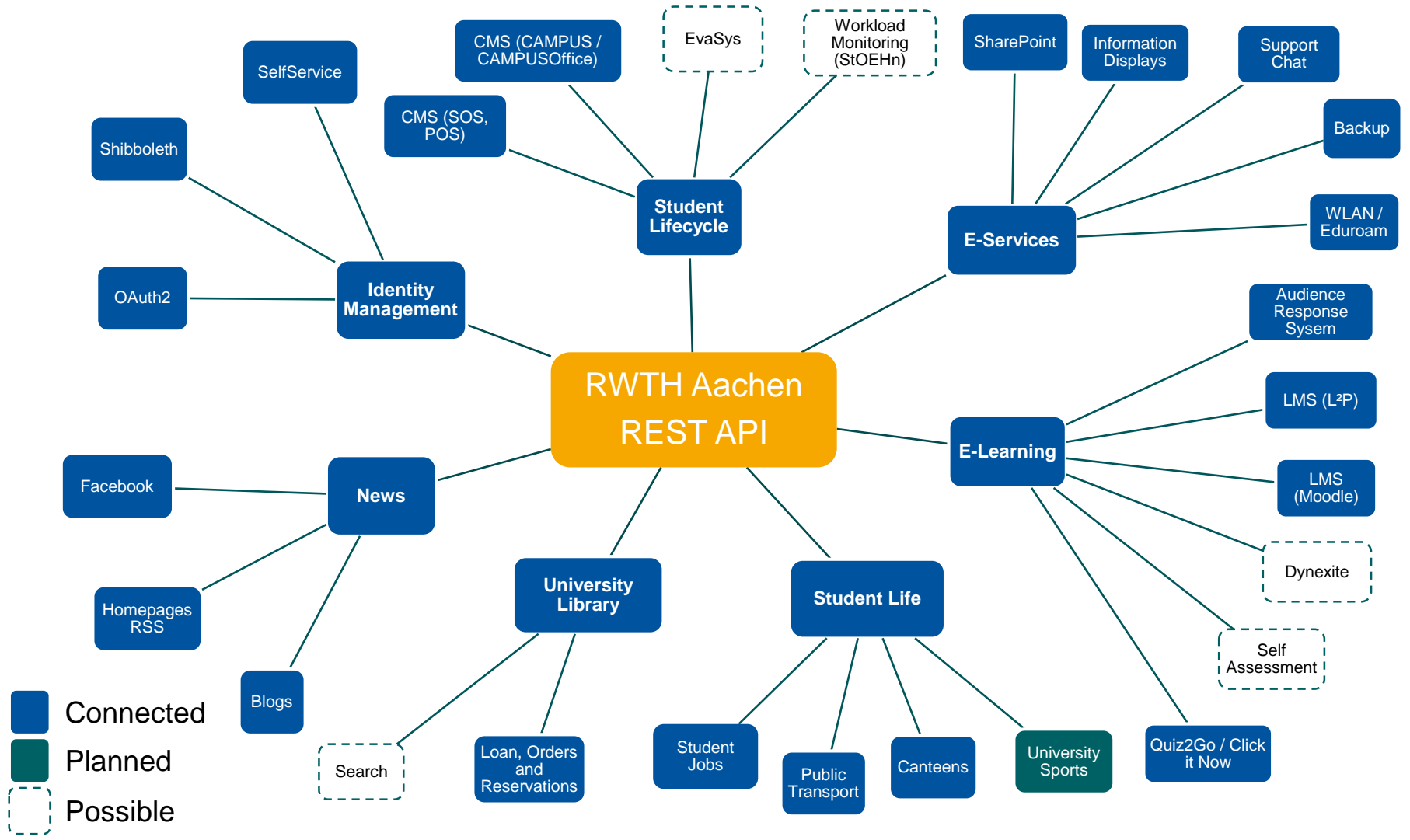
Current State

Where we are coming from

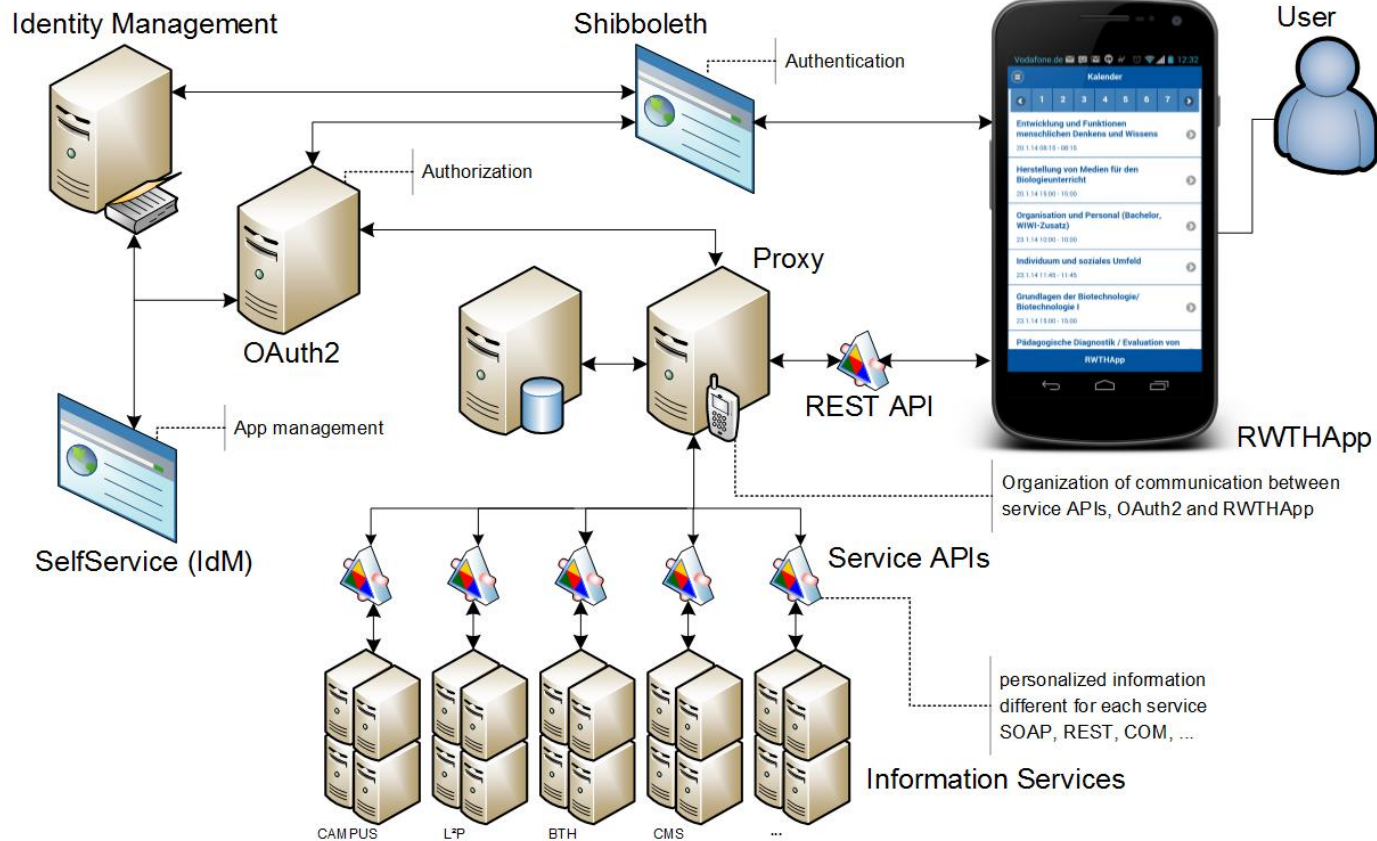
- Project started in September 2013
- Initial goal:
“Develop a mobile app to support students’ daily routines”
- Initially funded by the student council
- Set priorities according to students’ feedback



System Landscape in June 2016

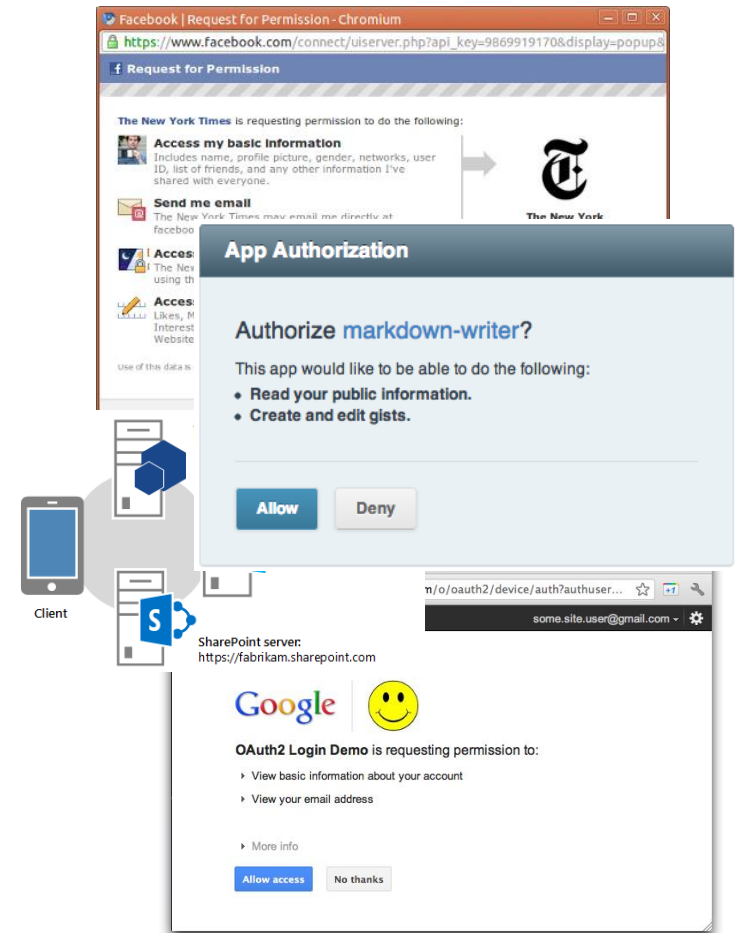


Technical Details



OAuth at RWTH Aachen University

- Secure, device based Authorizations
 - (De)Authorizations via Webinterface
 - No credentials are passed to apps
- OAuth2 as a service
 - Integrates Shibboleth as authentication
 - Possibility to provide a federative service (DFN, ...)
- Established at RWTH
 - RWTHApp has ~20.000 Users
 - Procedure scales across different applications



Expansion to additional scenarios with...

- Anonymous access
 - Identification of the application and not the users themselves

- Authorization of Apps and Web Applications
 - Different levels of trust for applications with different scopes
 - Transparency for the user and the owner of the service

- Claim-Based Authorization
 - For „Full Trust“ B2B Applications
 - Self-Authorization for Webservices
 - Multiple Authentication Mechanisms

Cache Implementation

Cache Invalidation

- Reduction of expiration time not possible
- Automatic invalidation on change

Reference Data

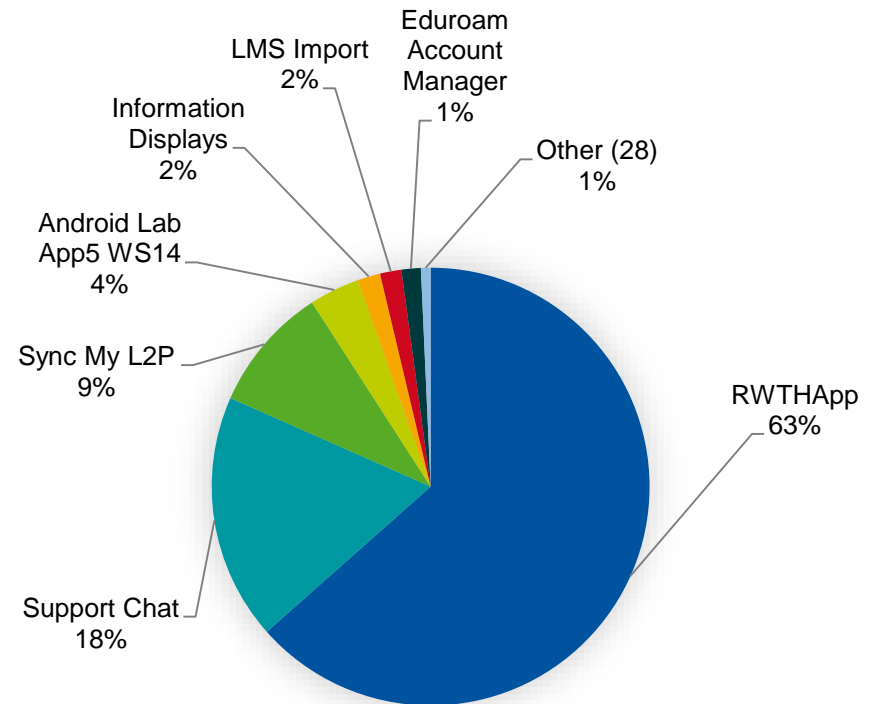
- Keep data in cache and refresh in regular intervals
- Update more often in background

Proactive Caching

- Caching of possible future requests based on current actions
- Data set: Sequence of actions for a user session (30 minutes)
- Sequential rule mining:
„If action x is performed, in ..% of all cases, action y will be performed at a later point in time“

App Landscape

- Since 2014 as a service
- 35 active apps
 - 10 by Institutes
 - 25 by Students
- 50.000 authorized app instances
- 20.000 active users



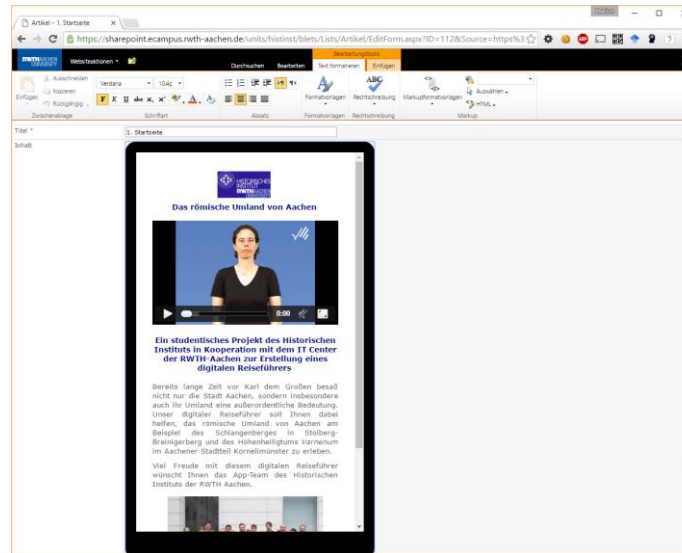
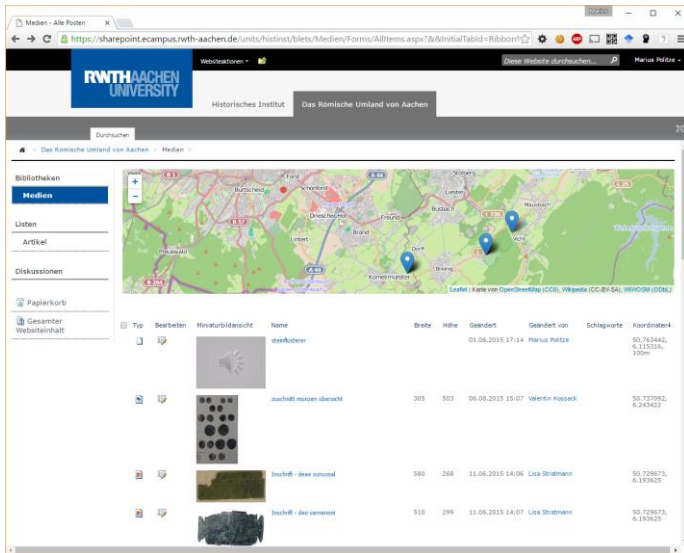
Number of authorizations of different apps using the university APIs

Content Driven Apps: Interactive Tour Guide

collect multi
media
ressources

compose
articles

view in
(mobile) app



Directfeedback: An audience response system using Smartphones

- Get Feedback from students in large-scale lectures (1000+ students)
- Acoustics in big lecture halls is usually too bad to understand questions
- Students do not dare to ask
- Lecture is streamed to multiple room so students have no physical contact with the teacher
- Low threshold: easy to use for students and teachers

RWTHApp ermöglicht direktes Feedback

18.06.2014



WhatsApp im Hörsaal: RWTH-Professor auf neuen Wegen

Von: Thorsten Korbach
Letzte Aktualisierung: 27. Mai 2014, 19:08 Uhr

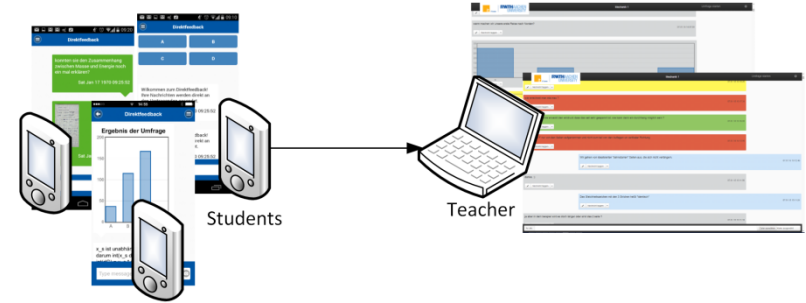
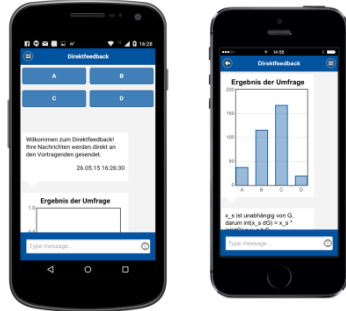


Steht während der Vorlesung permanent Rede und Antwort: RWTH-Professor Bernd Markert lässt sich die Fragen der Studenten per WhatsApp aufs Laptop schicken. Die Antworten baut er in den Vortrag ein. Eric Steindl

Dirctfeedback Core Features

Interactive Polls

Classic „Audience Response System“ to evaluate and discuss multiple choice questions during the lecture



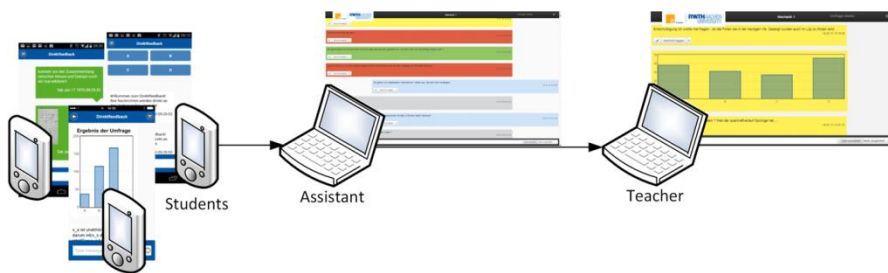
Filter and categorize

For better evaluation and handling so the focus can stay on the topic of the lecture.



Exchange Textmessages between teachers and students

Send messages from smartphone to the teachers notebook and respond to students questions.



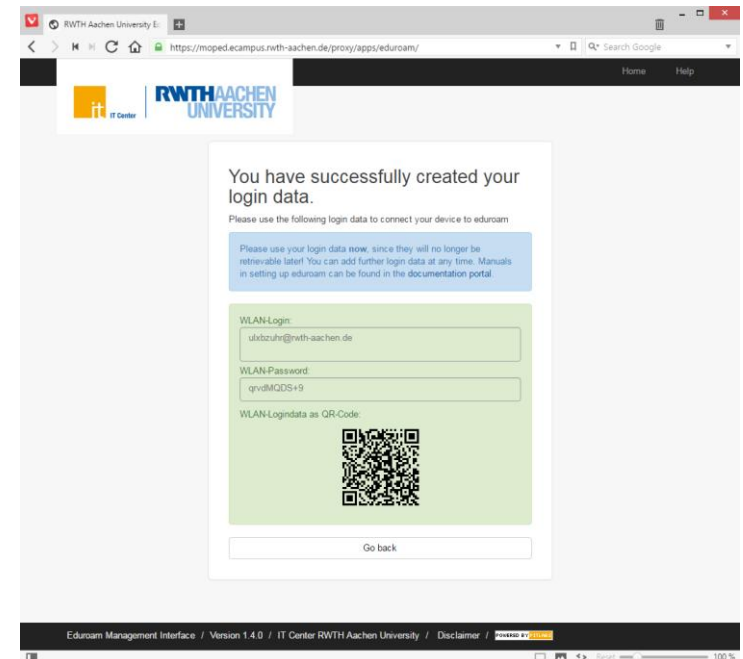
Handwritten Formulas and Drawings

A picture is worth a thousand words: Exchange images with the teacher

Device Based Authorization for Eduroam

Reduce the effects of Evil Twin Attacks [1]

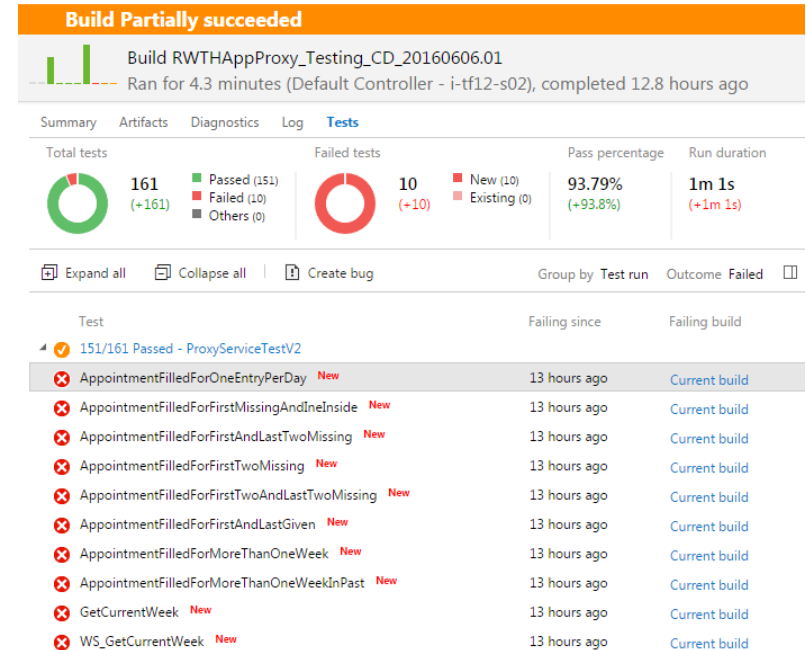
- Allow single devices to be granted or denied access to Eduroam
 - e.g. when after selling or losing a device
 - regularly in fixed intervals
- Automatic creation of credentials for Eduroam
 - To create credentials a internet connection is needed
 - An app can configure the WLAN connection
- Passwords are randomly generated
 - Cracking the Eduroam password does not harm other services
 - New passwords can be generated using the app



[1] S.Brenza et.al. (2015): A Practical Investigation of Identity Theft Vulnerabilities in Eduroam
http://syssec.rub.de/media/infsec/veroeffentlichungen/2015/05/07/eduroam_WiSec2015.pdf

Lessons Learned

- OAuth2 subsystem offers flexibility to securely expand system landscape
- Redundancy is key to achieve high availability
- Failures in attached systems produce failures in our infrastructure
 - Unit tests often do not only test our code but also if the legacy systems still work as expected



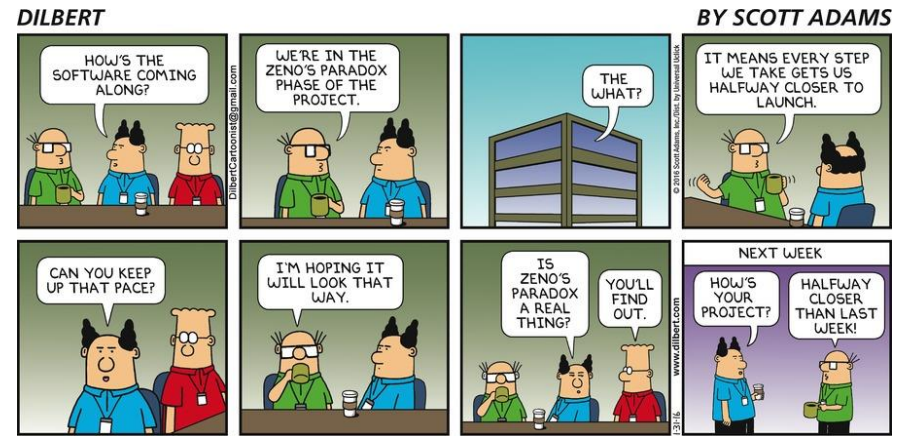
Lessons Learned

- Cache Evaluation
 - Different configuration for every server
 - Comparison of individual server performance
- For some applications more general services are needed
 - Caching / In-Memory-DB
 - Queriable Storage
 - Mass / Object Storage
- Speedup in developing new applications on top of the services
 - Better understandable
 - Better maintainable

	LRU	Proactive
Hit Rate	48.32%	70.89%
Avg. Duration	1557.47 ms	1004.24 ms
Requests <700 ms	81.03%	87.63%
Dirty Reads	2.27%	2.29%

Future Work

- Apply infrastructure to other applications
 - E-Science and Research Data Management
 - Campus Management
- Case studies need further improvements
 - Eduroam configurator app
 - Publish a reference design for content driven apps
- Create formal definition and apply maturity rating
 - Measure if the infrastructure fulfils current requirements
 - Support continual improvement process
- Supply more detailed reporting...
 - for services
 - for apps
 - for users
- Further extend scope of the API



Thank you for your attention

Vielen Dank für Ihre Aufmerksamkeit