



# Case study Ludwig-Maximilians- Universität München

- Status Quo of LMUcard
- Services
- The medium & the identity
- Future of LMUcard in the Smartphone Wallet in EUGLOH and ESC context

European Campus Card Association  
Conference May 9th – 11th - Warsaw  
2023-05-11

Alexander Loechel  
Referent IT-Projekte

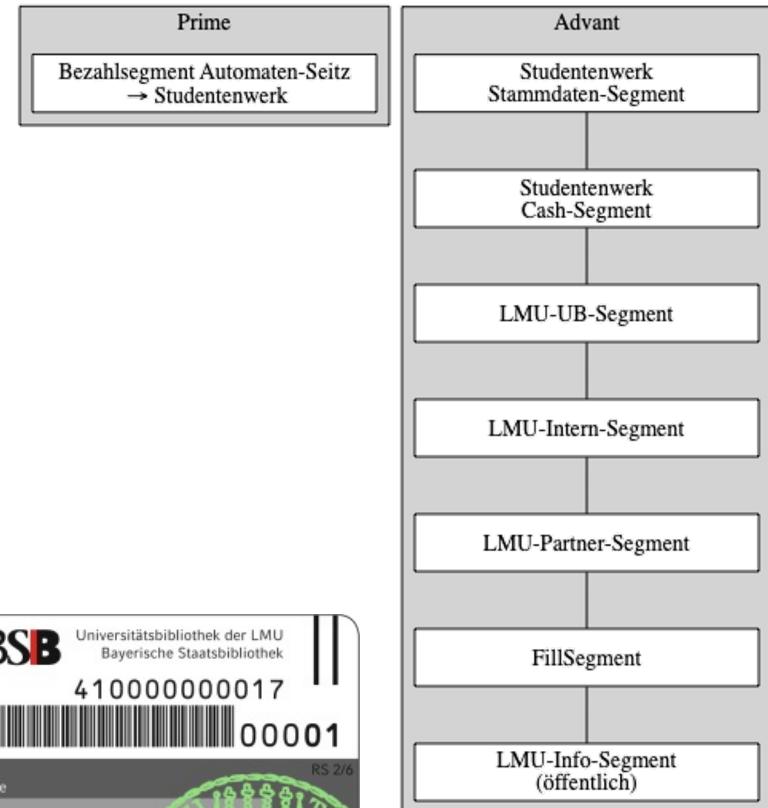


# Status Quo LMUcard

## → The LMUcard Project

### LMUcard project

- started 2015, issues first production cards end of 2018
- focused on student and employees
- payment card of the local Student Union as baseline
  - Technology was set by existing payment card
  - based on a Legic CTC Chip
  - uses Thermo-Rewrite strip for multi semester usage



# Status Quo LMUcard → Audience

LMUcard project has focused on two major audiences:

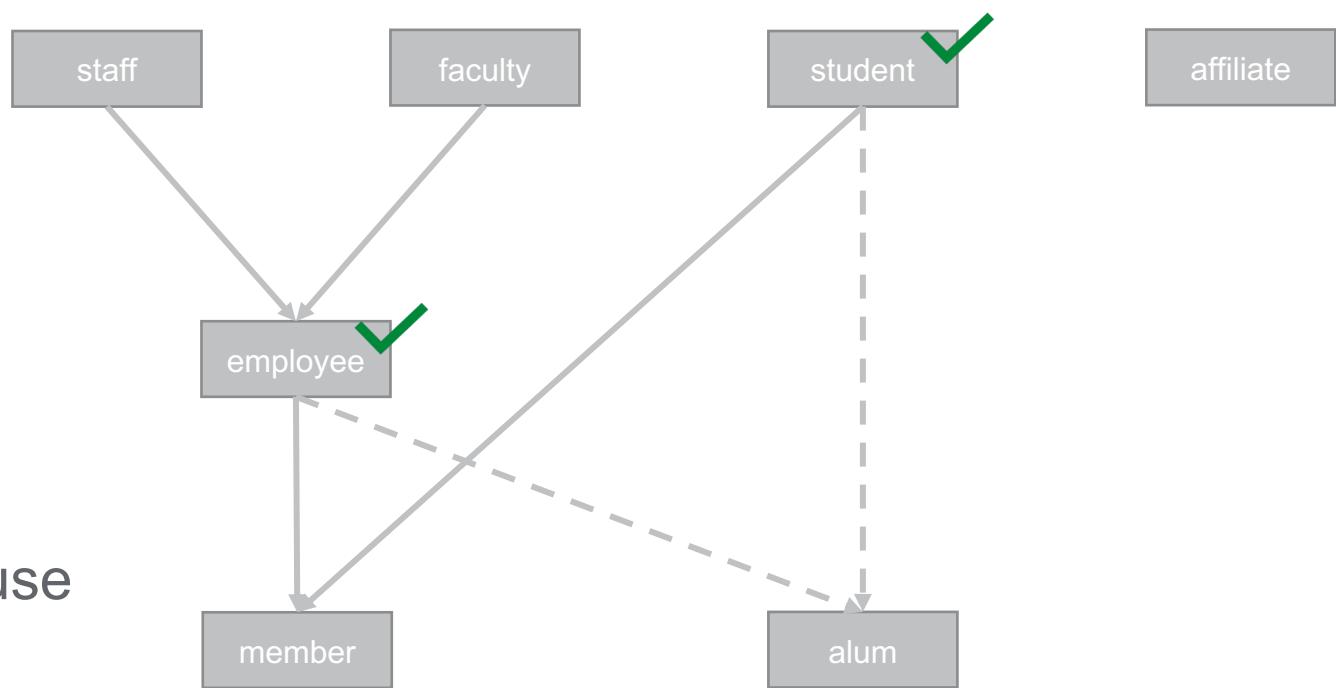
- Students → LMUcard Student ID



- Employees → LMUcard Staff ID



- currently 52.890 active LMUcards in use



# Status Quo LMUcard

## → Services

### Services used via LMUcard

- Visual ID card (Student ID, Staff ID)
- Library ID (University Library and Bavarian State Library)
- **Payment Function of the Student Union**
  - Open core data segment
  - Payment in canteen, cafeteria, vending machines
  - Identify and pay for cloud printing, secure printing
  - Identification for "Physical Access Control" (locking system for students)
  - Identification with the ZEUS/Isgus and BayZeit time recording systems
- Identification at service centers (e.g. student office / examination offices)
- Base semester ticket for the public transport system of Munich for our students



# Status Quo LMUcard Library

- Federation of the University Library and the Bavarian State Library
- More than 20 dedicated libraries across the campus
- 300.000 Users
- providing learning spaces / reading rooms



# Status Quo LMUcard Payment and Canteens

Payment of the Student Union Munich

- canteen, cafeteria, vending machines
- cloud printing, secure follow me printing



# Status Quo LMUcard Physical Access Control



- University buildings are open to public  
6:00 – 22:00
  - specific service locations should be accessible 24/7
    - copy shops
    - computer pools
    - learning spaces
- the need of a scalable solution  
with more than 70.000 users

# Status Quo LMUcard Public Transport System

- Students have a base ticket for the public transport system in Munich allowing free rides in the full system every workday after 18:00 till 6:00 of the next day and whole weekend and holidays



# Status Quo LMUcard

## Identification at Service points and Issuing

The IT-Servicedesk issues  
the LMUcard

- online application
  - takes photos if necessary
  - produced on pickup
  - or send (due to covid) via mail
- 
- quickly identify the users in  
the primary systems
  - give them support





# Path to the future Framework for further development → EUGLOH



LUND UNIVERSITY



UiT The Arctic  
University of Norway



Universität Hamburg  
DER FORSCHUNG | DER LEHRE | DER BILDUNG

## "9 Universities, 1 Goal: Building Europe's Campus for Global Health"

- ✓ A vibrant, multicultural and inclusive **inter-university campus**.
- ✓ Seamless mobility for students, staff and professionals – physical and virtual.

### → Work package Campus Life:

Agreement to make cross-university services as *easily accessible* as possible.

- Library
- Payment function → Access to canteen and vending machines



# Path to the future Framework for further development → EUGLOH

## → Vision:

All university members should be able to easily use the services of the host university during a visit or short-term mobility program.



## Ludwig-Maximilians-Universität München

- Legic CTC Cards (Legic Advant + Prime)
- Payment (Studierendenwerk München Oberbayern)
- Cloud-Printing und Scanning (Secure-Printing and Payment)
- Bibliotheksausweis
- MVV-Semesterticket

## Université Paris-Saclay

- NXP Mifare DESfire Cards
- Payment (izly – les Crous)
- Bibliotheksausweis
- Physical Access Control

## Lunds universitet

- NXP Mifare Classic Cards
- Physical Access Control (online and offline)
- Login at copiers (for copy/print/scan)
- Bibliotheksausweis
- Several other services, but not any payment services

## Universidade do Porto

- NXP Mifare Classic Cards
- Bibliotheksausweis
- Physical Access Control
- Canteen & cafeterias
- Printing Service
- Attendance

# Path to the future Framework for further development

→ Different standards on the transponder side – “Standards” – not compatible to each other

MIFARE Classic  
MIFARE DESFire EV1/EV2  
HID iCLASS  
HID Prox  
Indala  
ioProx  
AWID  
Keri  
CASI-RUSCO

MIFARE Classic  
MIFARE DESFire EV1/EV2  
HID Prox  
EM4102

Communication protocols:

ISO 14443A	ECM-340
ISO 14443B	ECMA-352
ISO 15693	ISO 11784
ISO 18000	ISO 11785
ISO 18092	NFC Tag Types 1-5



MIFARE Classic  
MIFARE DESFire EV1/EV2  
LEGIC  
Calypso  
Moneo  
Oyster  
HID Prox  
EM4102

LEGIC  
MIFARE Classic  
MIFARE DESFire EV1/EV2  
SONY Felica  
TIRIS  
CEPAS  
Octopus  
EM4102

LEGIC  
MIFARE Classic  
MIFARE DESFire EV1/EV2  
EM4102

MIFARE Classic  
MIFARE DESFire EV1/EV2  
HITAG  
HID Prox

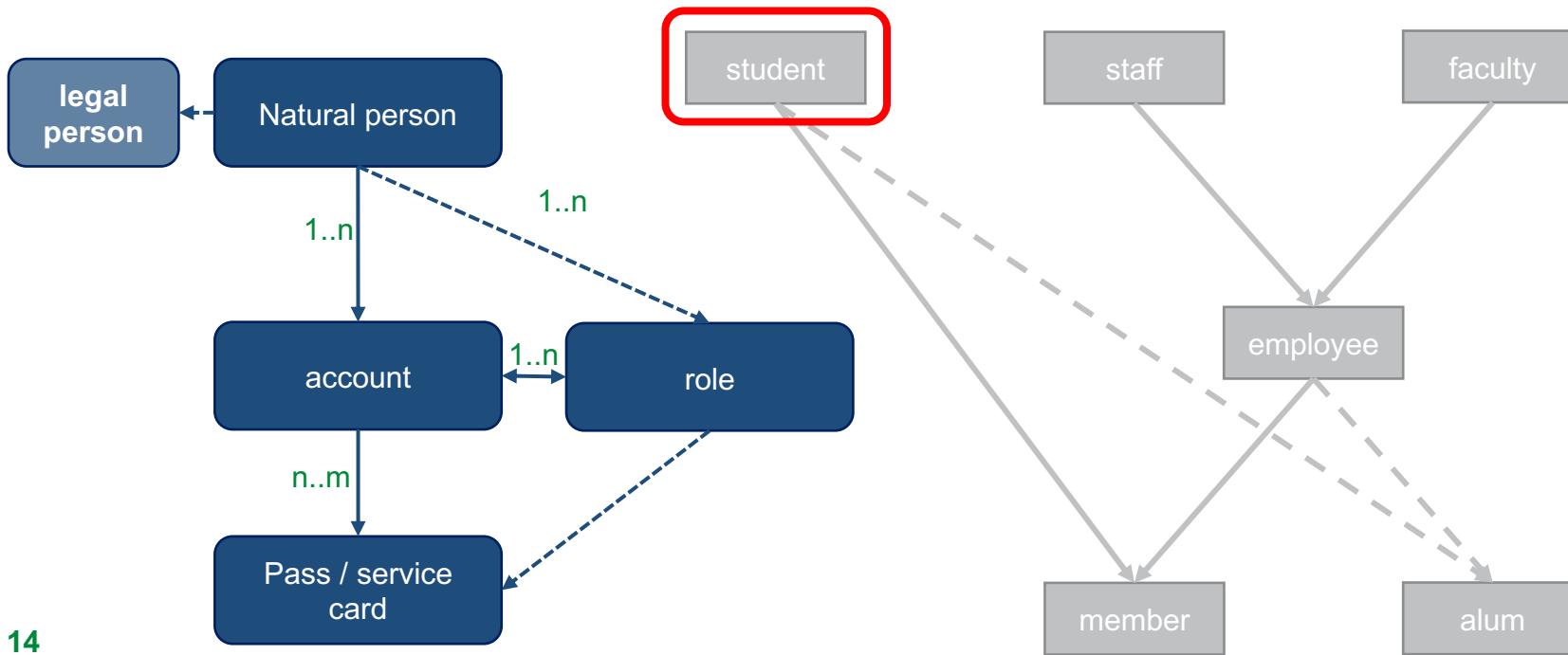
## Card Interoperability happens on the reader side

- Almost all readers in the market could read more than one standard (*maybe a firmware upgrade necessary*)
- QR-Codes are not considered a secure identification element
- A hologram does not provide any interoperability feature



# Path to the future → extend the audience → User scope

- Why focus on students and ISCED:2011 Level 6-8?
- It is about **providing services**
  - For users of the (home or host) institution
  - User incoming for a short-term mobility
- Staff / faculty members are more likely on short-term mobility than students  
→ **leading by example**



Level	Label
0	Early childhood education
1	Primary education
2	Lower secondary education
3	Upper secondary education
4	Post-secondary non-tertiary education
5	Short-cycle tertiary education
6	Bachelor's or equivalent
7	Master's or equivalent
8	Doctorate or equivalent
x	Faculty or Staff member of HEI

ISCED:2011 Level

## Path to the future → User expectations

Definition of Service: (ITSM → FitSM)

Way to **provide value** to customers through bringing about results that they want to achieve

# Path to the future

## → Services

- Identification**
- Identification
  - Status verification
  - Proof of entitlement
  - Single Sign On / 2FA / FIDO2
  - Attendance check
    - Check-in for exams
    - attendance at courses
    - Time recording
  - Electronic Signature (of legal documents)

- Electronic payment / cashless campus**
- Canteen & cafeterias
  - Vending machines
  - Printing / scanning (*secure & follow me printing*)
  - Ticketing (*secure & follow me printing*)

- Physical Access Control**
- Areas (*campus, parking lot*)
  - Buildings
  - Rooms
    - Classrooms
    - Labs
    - Computer rooms
    - Learning spaces
    - Offices
    - Accommodation facilities (i.e., dorms)
  - Sports facilities

- Library services**
- Access to / borrow
    - Physical media (book, audio and video media)
    - E-media (book, audio and video media)
  - Special case of “Proof of entitlement”
  - Learning spaces
    - Special case of “PAC”

- Transport**
- On campus services (*university shuttle service*)
    - Special case of “Proof of entitlement”
  - Public transport tickets & discounts
    - Special case of “Payment” / “discount”

- Discount and promotions**
- Discounts on cultural activities
    - Museums
    - theaters
    - cinemas
  - Shops
  - Restaurants
    - Special case of “Identification” / “Status verification” / “Proof of entitlement”

on- & off-campus → on-site usage  
online services

# Path to the future → Services

- Identification
- Identification
  - Status verification
  - Proof of entitlement
  - Single Sign On / 2FA / FIDO2
  - Attendance check
    - Check-in for exams
    - attendance at courses
    - Time recording
  - Electronic Signature (of legal documents)

## Electronic Payment / cashless campus

Mensa und Kaffees

- Drucken und Scannen (secure & fast printing)
- Ticketing

## Physical Access Control (PAC)

Gelände

- Gebäude

## Library

- Zugang und Ausleihe von
  - Physischen Medien (Bücher, Audio und Video Material)

## Transport / Nahverkehr

- Nahverkehrsticket (z.B. Semesterticket) & Discounted Tickets

## Discount and promotions

- Discounts on cultural activities
    - Museums
    - theaters
    - cinemas
  - Shops
  - Restaurants
- Special case of "Identification" / "Status verification" / "Proof of entitlement"

Specific solutions for the use-case solution-provider are capable to provide

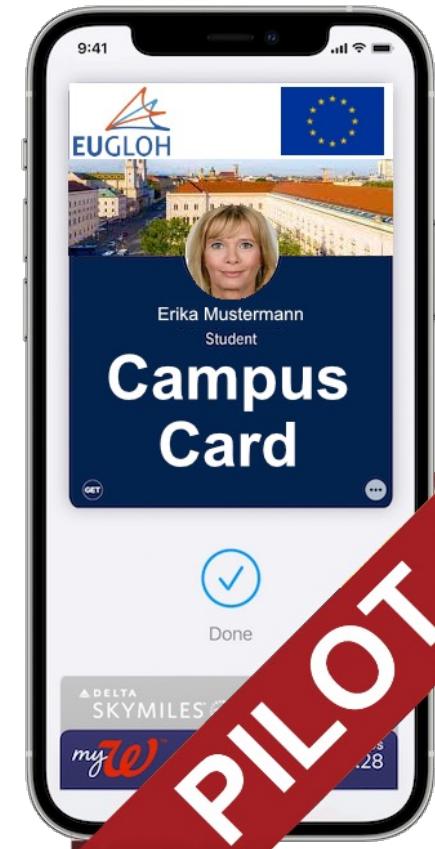
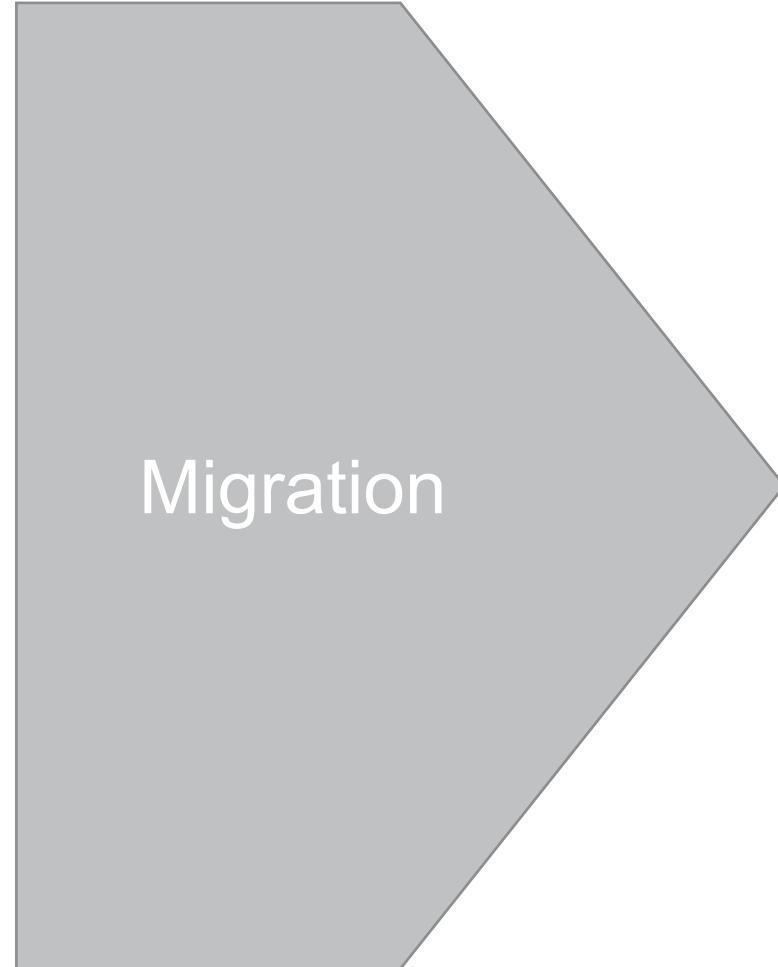
→ separate service passes

(Service Provider can choose the reasonable technology)

on- & off-campus → Nutzung vor Ort

ONE common pass for HEIs  
→ ISO/IEC 18013-5

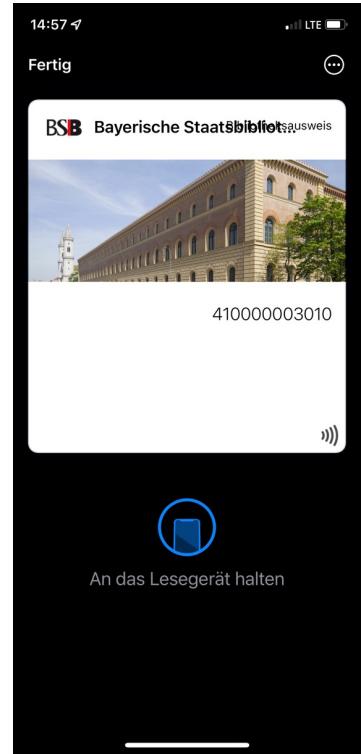
# Path to the future → Campus Cards in the Smartphone Wallet



# Path to the future → Campus Cards in the Smartphone Wallet – Library IDs

## Library ID

- First service pass in the Wallet to issue within our Alliance
- Rollout of first larger test group within the next weeks
- Issuing via a card portal
- Based on Google Smart Tap



# The future of passes in HEI context

Each HEI will have a „*European Campus Card Portal*“

## For the user:

- Request / download European Campus Card
- Users can search for and book / download additional services
- Service listing with further information (including search) (also via Erasmus+ App)
  - Which university / which university location (e.g., Munich), category
  - What personal data is required → [Privacy information](#)
  - The user himself decides which services he would like to use and for this purpose, passes on his data → [Self Sovereignty Identity \(SSI\)](#)
- Listing of all linked services with the possibility of blocking / deleting them, and calling the account / information pages of the service provider.



[Back](#)

## European Student Card

Here you can manage your european student card and card services provided by the LMU and our partner universities.



European Student Card

John Doe  
Name 01.01.2000  
Birthday  
Ludwig-Maximilians-Universität  
Institution  
1234567890 Identifier 05.06.2024  
Expiration date

[G Pay](#) [Save to phone](#) [Add to Apple Wallet](#)

---

### Services

Munich

[Search](#) [Activated Cards](#)

<b>Mensa Card</b> Munich <a href="#">+</a>	<b>UB Card</b> Munich <a href="#">+</a>	<b>StaBi Card</b> Munich <a href="#">-</a>
Card for paying in all cafeterias operated by the Studentenwerk München. <a href="#">Food</a> <a href="#">mena</a> <a href="#">pay</a>	Grants access to the checkout system of the university library. <a href="#">books</a> <a href="#">library</a>	Required for accessing the reading halls of the Staatsbibliothek Bayern. <a href="#">books</a> <a href="#">library</a>
<b>MVG Card</b> Munich <a href="#">+</a>	<b>Cafeteria</b> Berlin <a href="#">-</a>	
Transport ticket for students in Munich and surrounding counties. <a href="#">transport</a> <a href="#">subway</a> <a href="#">bus</a>	Card for paying in all cafeterias operated by the Studentenwerk Berlin. <a href="#">food</a> <a href="#">mena</a> <a href="#">pay</a>	

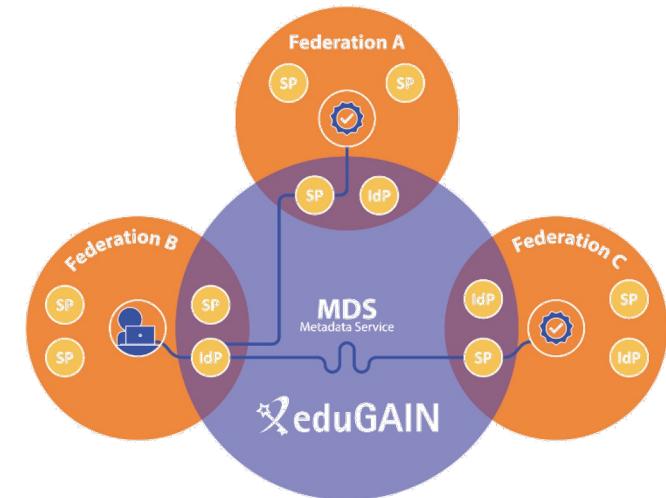
## For the Service-Provider:

- Centralized service provider directory
- Data is transferred via identity linking through eduGAIN infrastructure
- Own passes or apps are made available via own website

## Path to the future → technology and information for identification

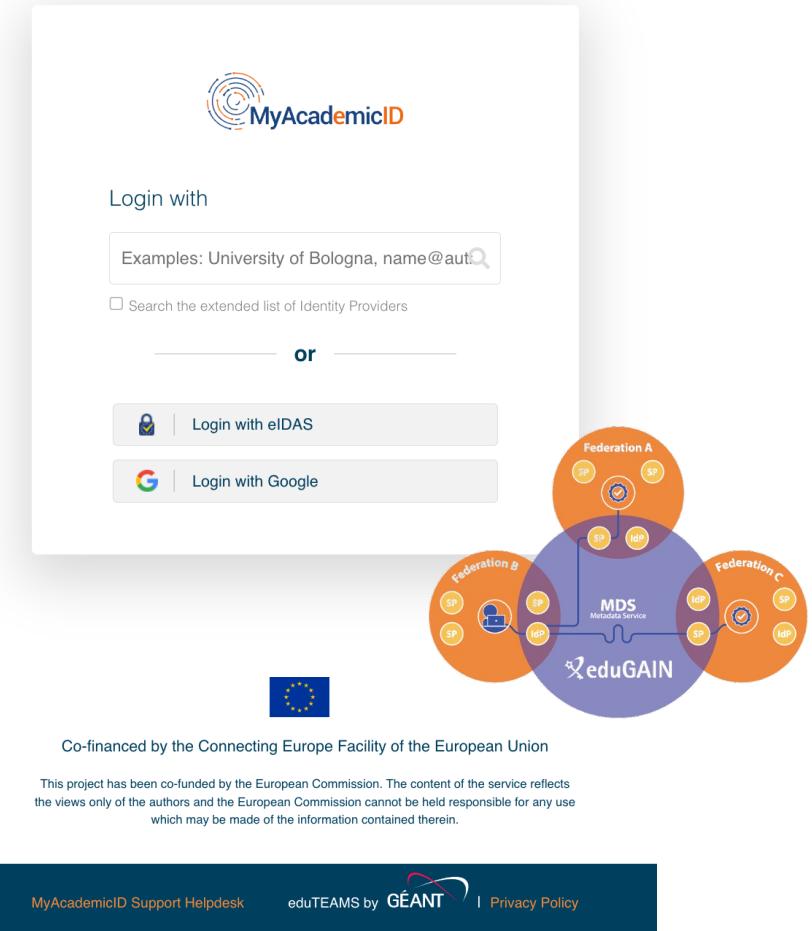
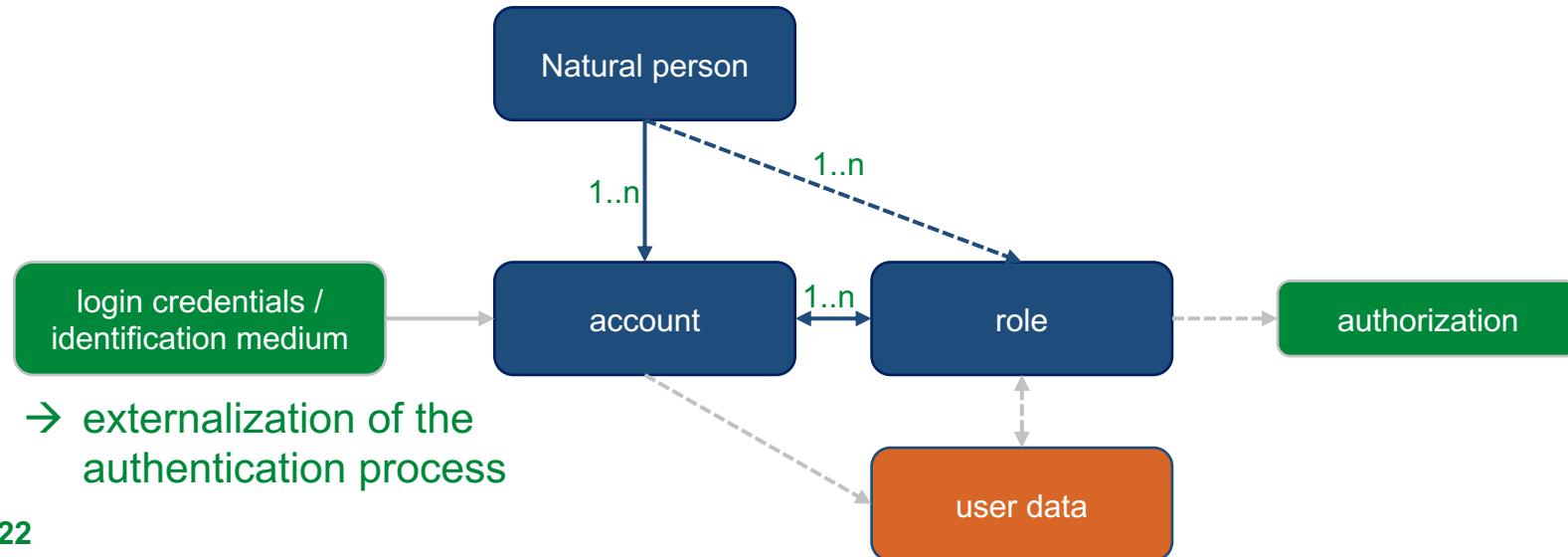
# User and Role bind services → Identity Management

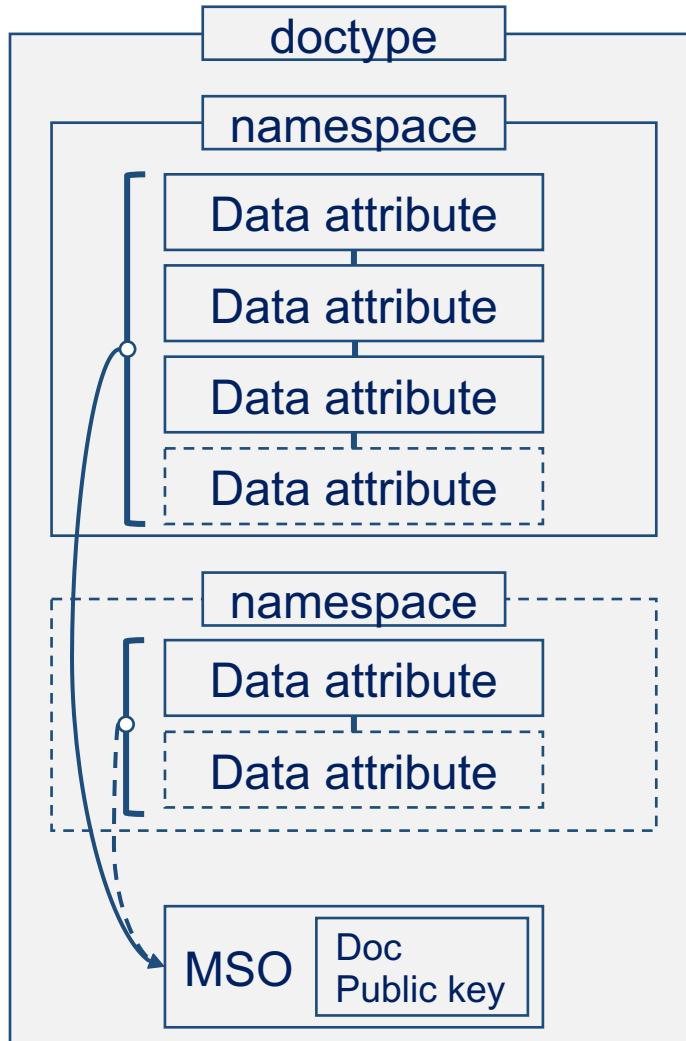
- Existing technologies:
  - Directory Services → LDAP (Protocol and Schema definitions)
- LDAP-Schema for Higher Education
  - eduPerson (V4.3 from 30. November 2021; V1.0 from December 2007)
  - SCHAC – SCHEMA for ACademia (V1.6.0-proposed from 24. March 2022 / V1.5.0 from 15. April 2015; V1.0 from May 2006)
  - SAML – Security Assertion Markup Language
- Essential **LDAP-Schema Attributes**:
  - eduPersonAffiliation / eduPersonScopedAffiliation → Roles
  - eduPersonEntitlement → Mapped Entitlements ← **Services provided**
  - eduPersonAssurance → Assurance Class / Level of Data
  - schacHomeOrganization
  - schacPersonalUniqueCode → European Student Identifier  
→ additional Identifiers necessary
  - Pairwise Id → Pseudonym
  - Subject Id → Unique Person Identifier



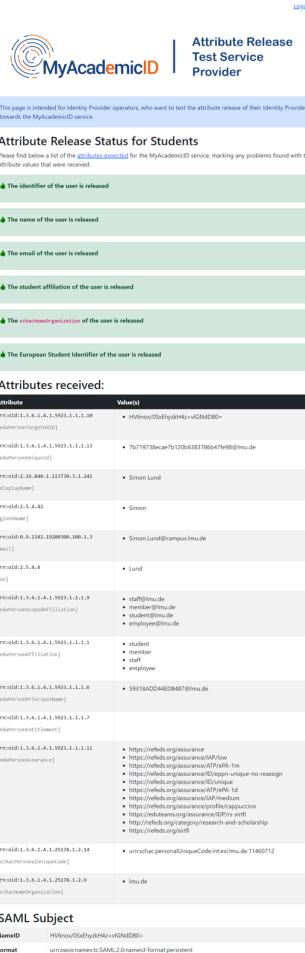
# Identity Linking → reduced amount of logins

- Utilization of decentralized / federated Authentication and Authorization Infrastructure
  - Less login credentials – **higher assurance levels**
  - Data flow**
- Example application fields (at LMU):
  - Initial account creation for application / enrollment process (SDG / OZG / BayEGovG)
  - Issuing of Library IDs (OZG)
  - Mobility and cooperation processes → Zweithörer Status (BayHIG)

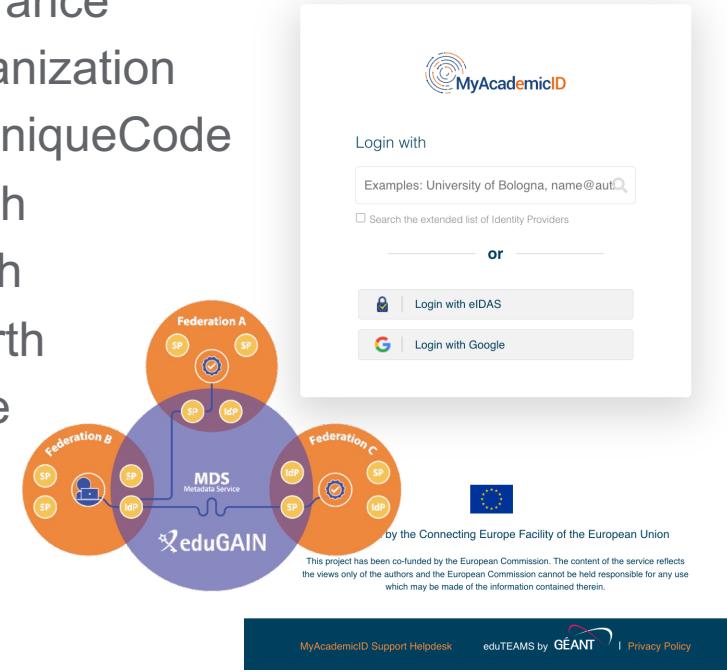




## Identity Management Schemas of eduGAIN (eduPerson + SCHAC)



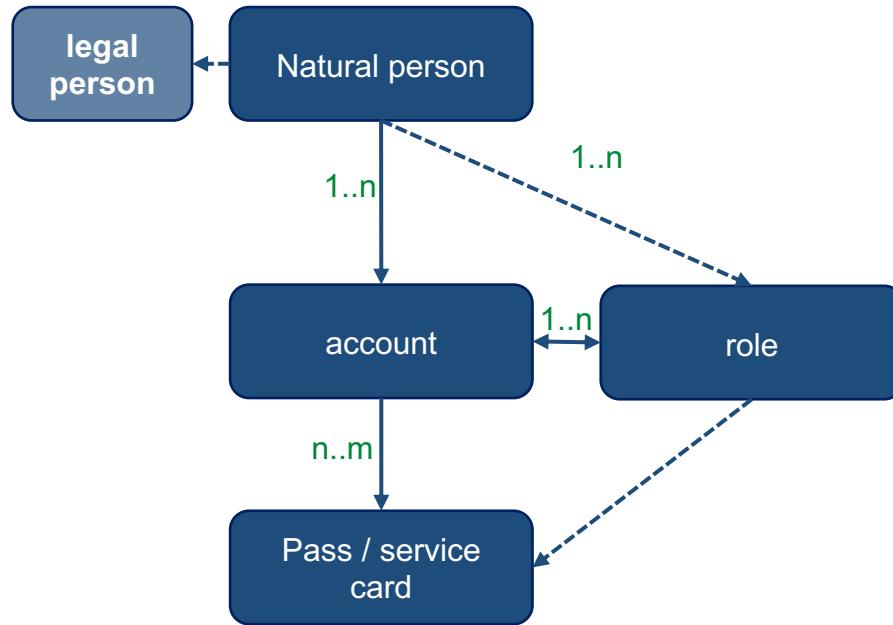
- givenNames
  - sn
  - eduPersonAffiliation / eduPersonScopedAffiliation
  - eduPersonEntitlement
  - eduPersonAssurance
  - schacHomeOrganization
  - schacPersonalUniqueCode
  - schacDateOfBirth
  - schacYearOfBirth
  - schacPlaceOfBirth
  - schacExpiryDate



# Path to the future → technology and information for identification

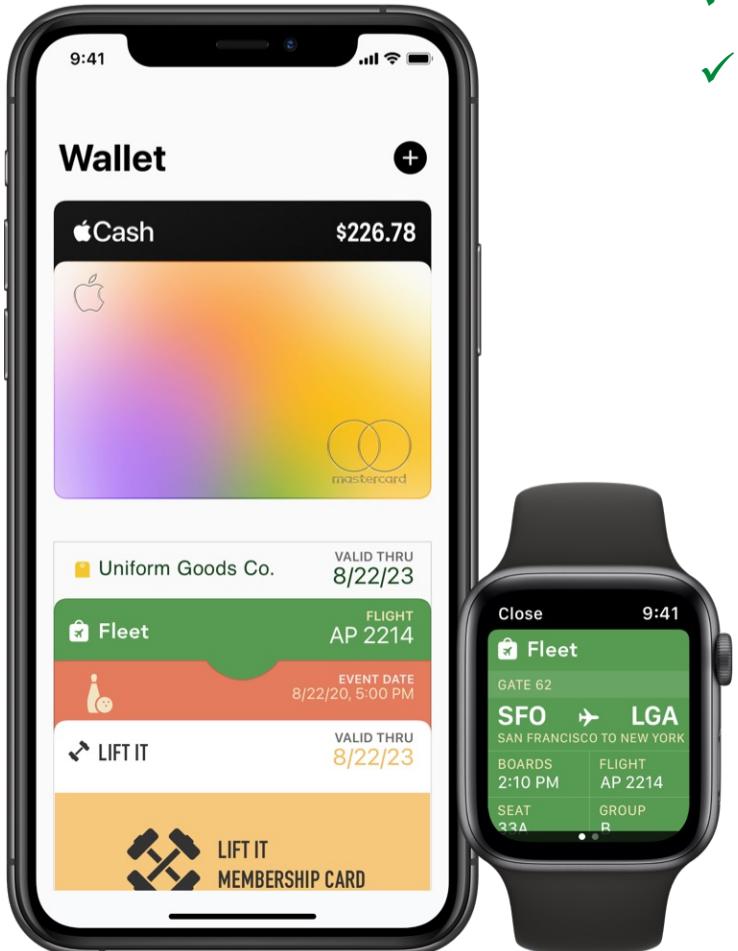
We do always talk about cards / passes

But those are just a medium representation of certain roles of your virtual identity



In the end, it is about connected services that meet the convenience of use and expectations of users

# Path to the future Smartphone Wallets

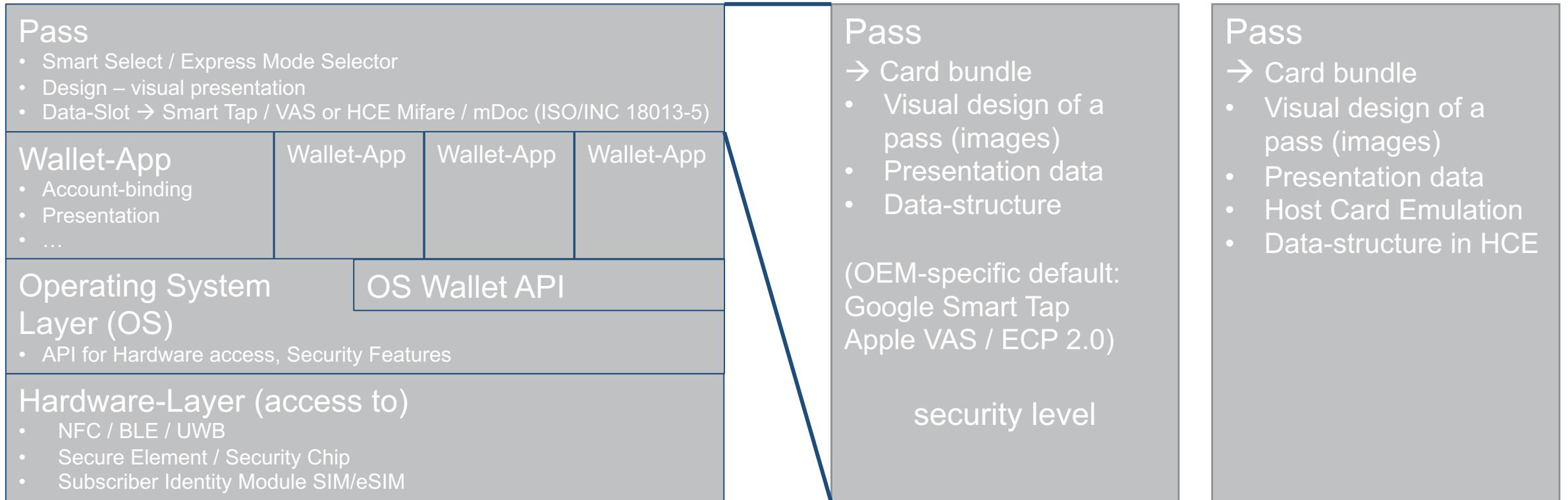


- ✓ The smartphone is the essential tool
- ✓ High integration capability and possibilities for interoperability

Features of the wallets:

- Smart / Quick Select Option (Express-Mode)
- Host Card Emulation possible
- Usable offline
- Security features
- Battery reserve
- Validity dates and limits
- Remote updateable and revokable

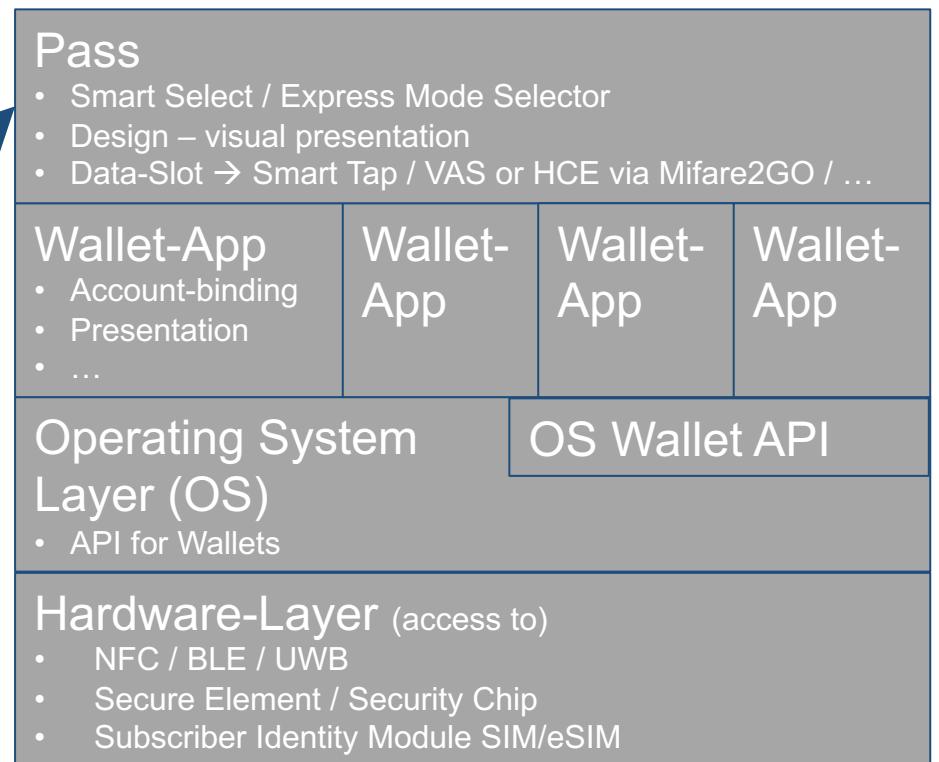
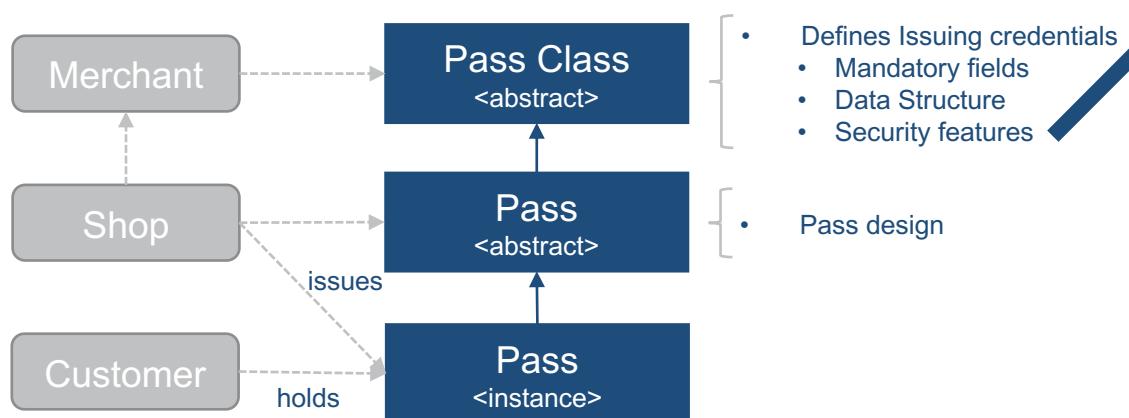
# Path to the future Smartphone Wallets – Technical details



# Path to the future

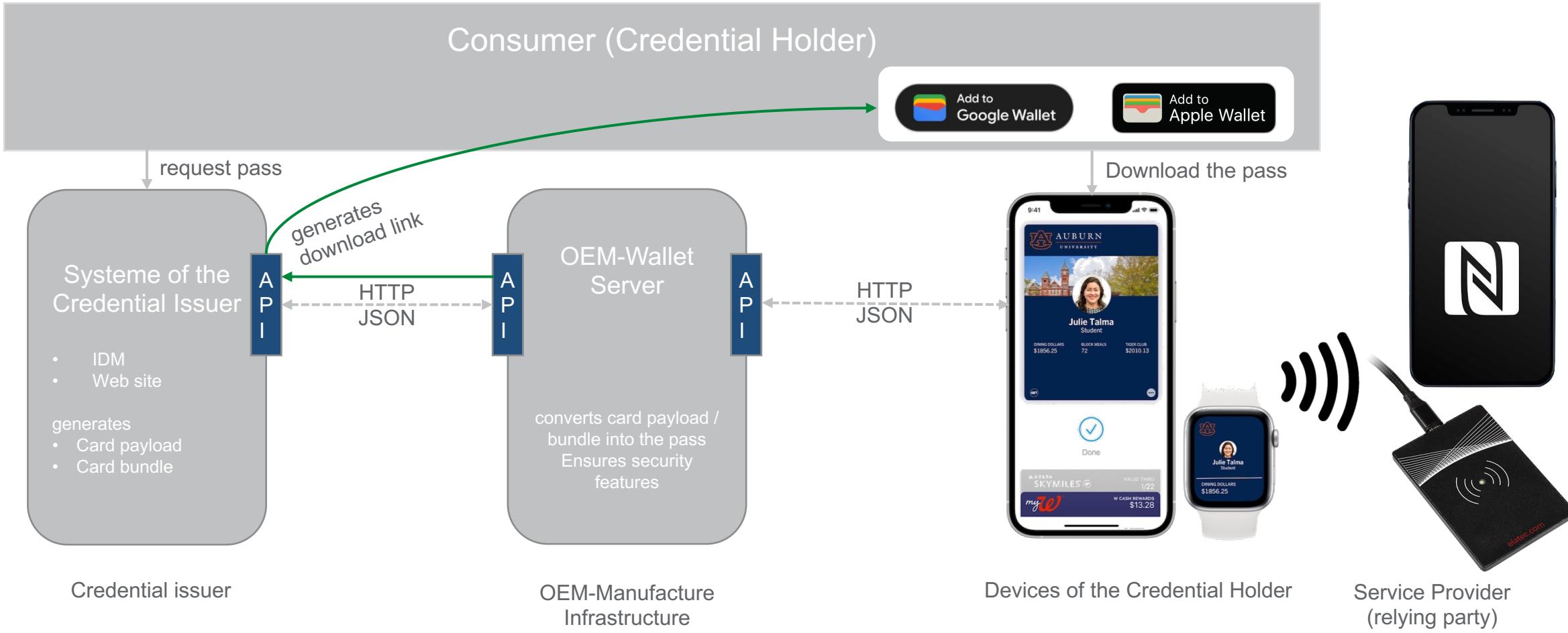
## Smartphone Wallets – Technical details

- Wallet Provider interacts with a hierarchy of contact roles
    - Merchant / Credential Issuer
      - Defines data structure of the pass class
      - Defines security features
    - Shop / credential Issuer → issuing the pass
      - Defines specific design

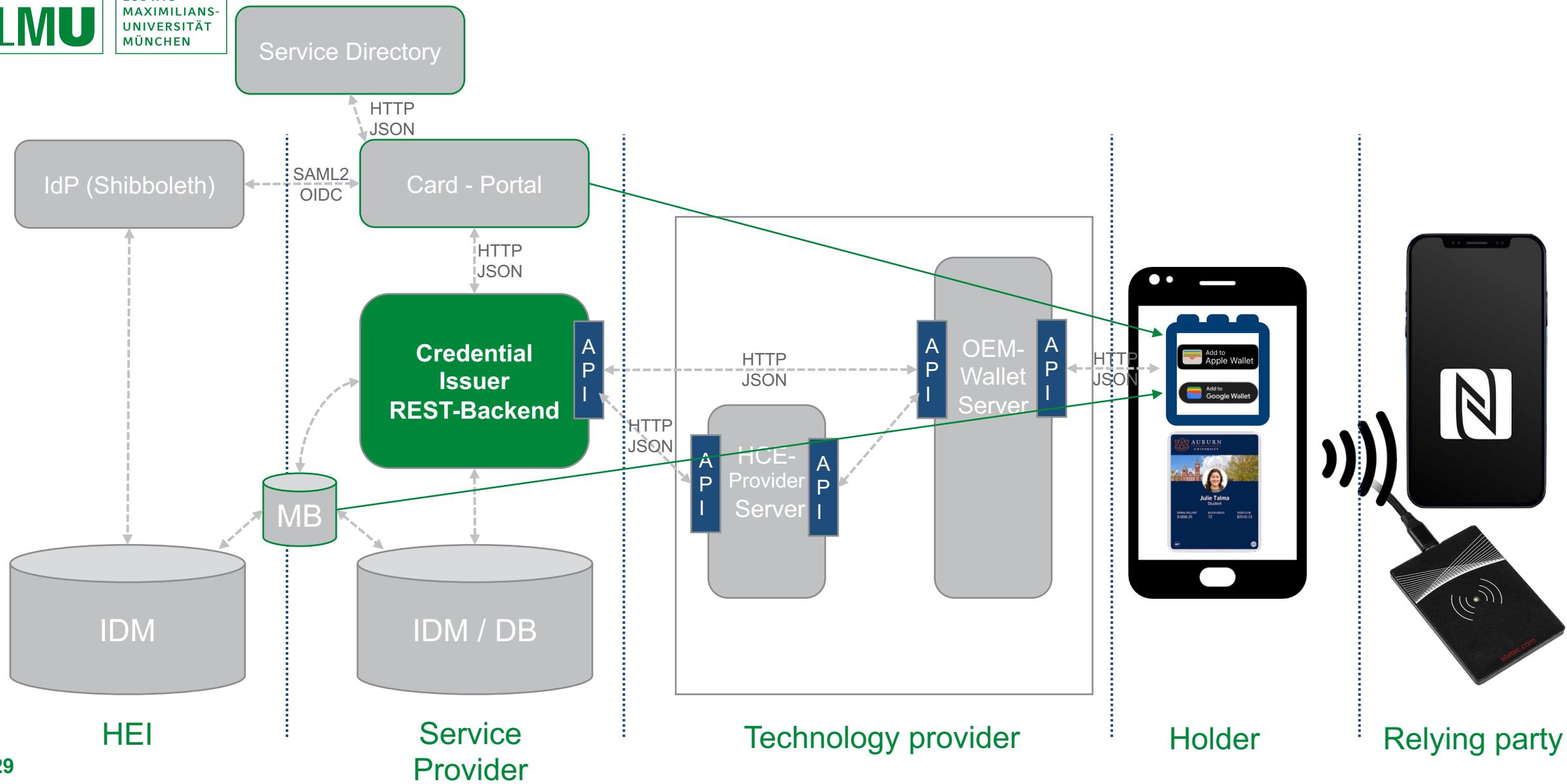


# Path to the future Smartphone Wallets – Technical details

## Issuing process for passes in Smartphone Wallet

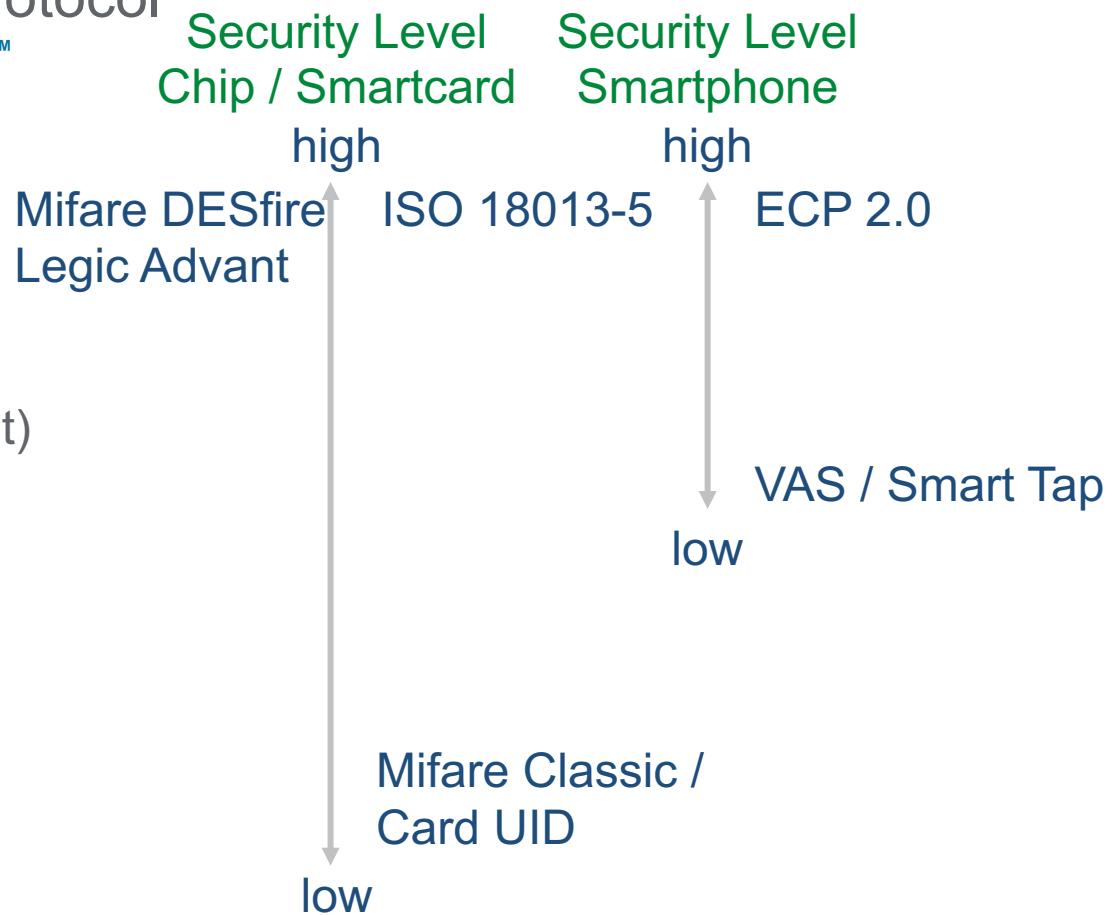


# Path to the future – Smartphone Wallets – Technical details



## Path to the future Smartphone Wallets – Technical details

- For contact less communication: NFC is the protocol
- Communication via ISO 14443
- Data Formats (File System access)
  - Google Smart Tap
  - Apple VAS (Value Added Services)
  - NFC ECP 2.0 (Enhanced Contactless Polling)
  - Mifare DESfire (via Mifare2GO / NXP secure element)
  - ...
- ISO 18013-5 Personal Identification  
*Core functionality in Android and iOS OS API*
- Security consideration required by use case

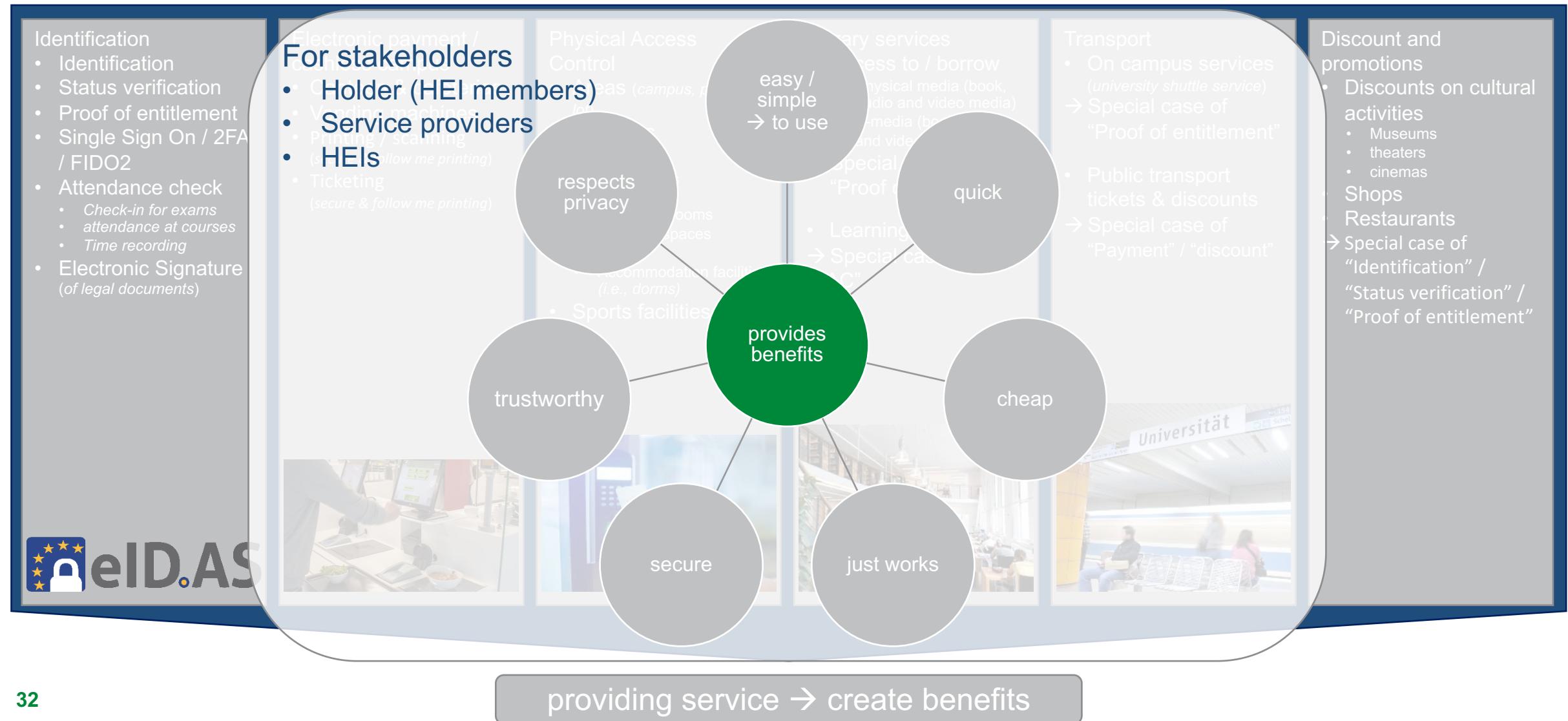


## Path to the future → User expectations

Definition of Service: (ITSM → FitSM)

Way to **provide value** to customers through  
bringing about **results** that they want to achieve

# Medium → Services → on-site usage



# Stages of Digitalization

Digitalization 1.0

- Digitization – create digital versions of analog documents

Digitalization 2.0

- Digitalization with internal focus
- Optimize internal administrative processes – organization centric optimizations -
- Processing of data

→ Digital transformation

Digitalization 3.0

- Digitalization with focus on the user – user centric optimizations -
- Optimization on how services are discovered and seamlessly used
- Flow of data

→ Service oriented  
→ **Digital identity**  
→ Interoperability

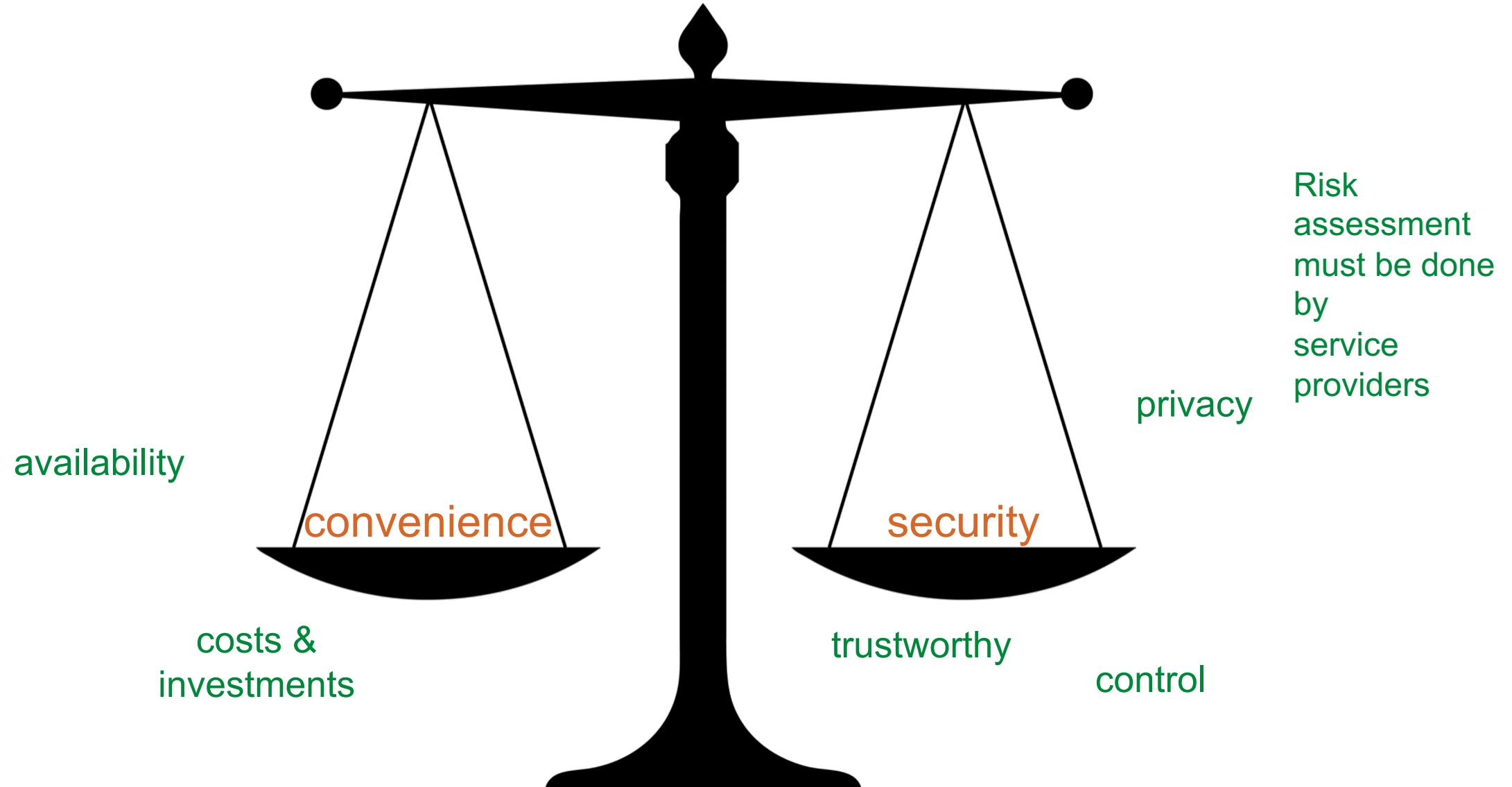
## Path to the future → Digitalization 3.0 – User centric optimizations

# Digitalization can and should be disruptive

We should not put old business processes into concrete.  
The best for organizations are not always the best for consumers

→ creating value for consumers

## balance of objectives



## **Path to the future → Digitalization 3.0 – User centric optimizations**

Convenience always takes precedence for the users over most safety concerns.

The best technology is worthless if it is not adopted.

```
>>> import this
```

The Zen of Python, by Tim Peters

Beautiful is better than ugly.

**Explicit is better than implicit.**

**Simple is better than complex.**

Complex is better than complicated.

Flat is better than nested.

Sparse is better than dense.

Readability counts.

Special cases aren't special enough to break the rules.

Although practicality beats purity.

Errors should never pass silently.

Unless explicitly silenced.

In the face of ambiguity, refuse the temptation to guess.

There should be one-- and preferably only one --obvious way to do it.

Although that way may not be obvious at first unless you're Dutch.

**Now is better than never.**

Although never is often better than \*right\* now.

If the implementation is hard to explain, it's a bad idea.

If the implementation is easy to explain, it may be a good idea.

Namespaces are one honking great idea -- let's do more of those!

## Conclusion

- Technology is not the problem
- Cards or passes are just a medium, but it is about identity and trust
- The hard part are the processes and legal issues
- Not the best technical / secure solutions wins

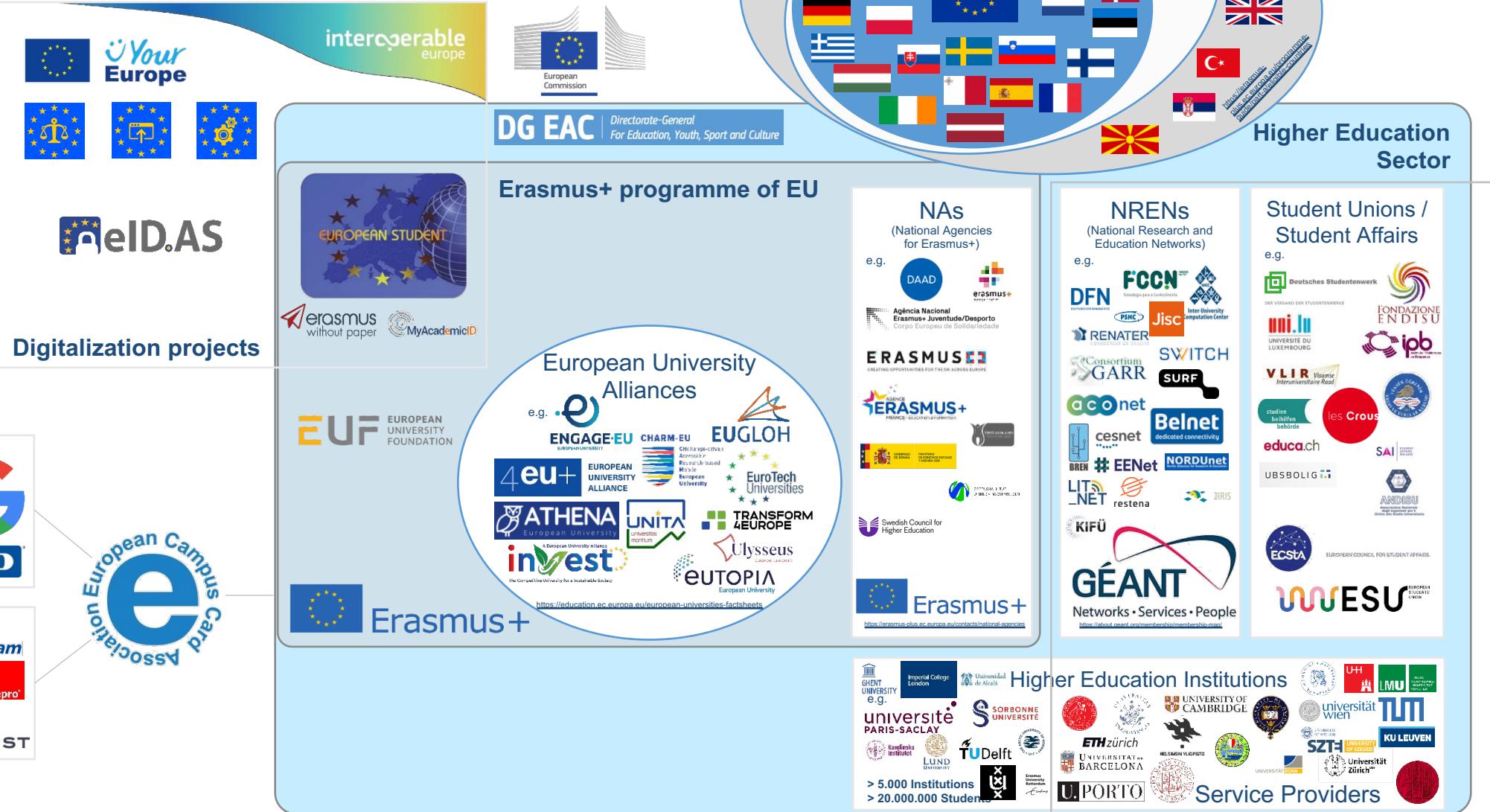
Convenience is the key



# The Stakeholder-Landscape



Higher Education Sector



When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.

Source: Clarke's First Law – Arthur C. Clarke

- ✓ Vision of the European Commission: Towards a European Education Area
- ✓ The European Student Card Initiative (ESCI)
- ✓ European Charter for Higher Education (ECHE) of the Erasmus+ Program



# A great vision!

*Let's make it come true*

## Path to the future → Digitalization 3.0 – User centric optimizations

The best way to predict the future is to create it.

Peter Drucker

## Every revolutionary idea

— in science, politics, art, or whatever — seems to evoke three stages of reaction.

They may be summed up by the phrases:

1. "It's completely impossible — don't waste my time"
2. "It's possible, but it's not worth doing"
3. "I said it was a good idea all along"

Source: Clarke's Law of Revolutionary Ideas – Arthur C. Clarke

Progress is only possible with the will and the right partners



Thank you

**LEGIC®**

**NXP**



**ELATEC**  
RFID Systems

Alexander Loechel  
Referent IT-Projekte  
Dezernat VI · Zentrale Universitätsverwaltung · Ludwig-Maximilians-Universität München  
Martiusstraße 4 · 80802 München · Tel. +49 89 2180 9831  
[Alexander.Loechel@lmu.de](mailto:Alexander.Loechel@lmu.de) · [www.lmu.de](http://www.lmu.de)

