CREDENTIAL

Secure Cloud Identity Wallet

You are what you keep!

Secure Identity Services within the Cloud

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infocom world | infocom media

Athens, Greece _ October 25, 2017

OTE GROUP OF COMPANIES

Motivation

- In traditional IDMaaS systems **an IdP has full access to the user's identity data.**
- The shift of such services into the cloud **discloses sensible user data** to the cloud provider.
- **User's privacy is compromised**, and legal issues and challenges for service providers may arise.
- Invention of *proxy-re-encryption* and *redactable signature algorithms* → **outsource an IdP into a cloud environment without disclosing the processed data to the cloud provider.**

➢ ***Novel cryptographic technologies*, but *not yet included in market-ready products.***

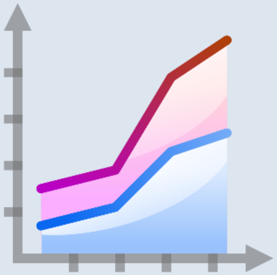
Challenges for Cloud IdM

➢ **IAM towards cloud steadily growing**

- ✓ *MarketsandMarkets:* USD 5.13 billion (*2013*) to USD 10.39 billion (*2015*)
- ✓ *Gartner:* IDMaaS on of the top 3 most sought after services (*2014*)
- ✓ *Forrester:* USD 2.6 billion (*2006*) to USD 12.3 billion (*2014*)

○ **For private sector already a big market**

- *Facebook*, *Google*, Microsoft, …



○ **Identity data is a critical information asset**

- Data accessible by cloud service provider
- Owner not in full control of data

e2e encryption for cloud identity data needed

Goal

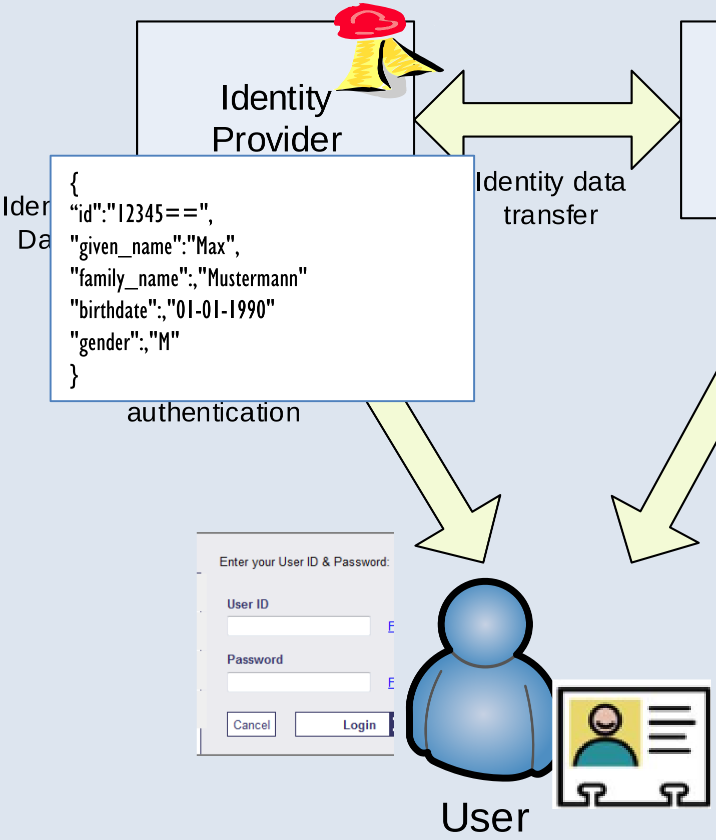
- *Create a data-sharing and IAM platform in the cloud, which increases the security and privacy level compared to already existing solutions by using cryptographic primitives*.

□ Main features & benefits offered

- **Store and view** personal data in the wallet
- **Share** personal data with other participants
- **Using** Wallet as IAM system for accessing other services
- **Hide** information in documents to other participants **while still guaranteeing** the authenticity of the revealed data
- ✓ **Increased flexibility**
- ✓ **High security & strong authenticity guarantees**

The **main idea and ambition** of CREDENTIAL is to enable **end-to-end security** and **improved privacy** in **cloud identity management** services for managing **secure access control.** This is achieved by advancing **novel cryptographic technologies** and improving **strong authentication** mechanisms.

SOTA: Identity Management



```
{
“id":"12345==",
"given_name":"Max",
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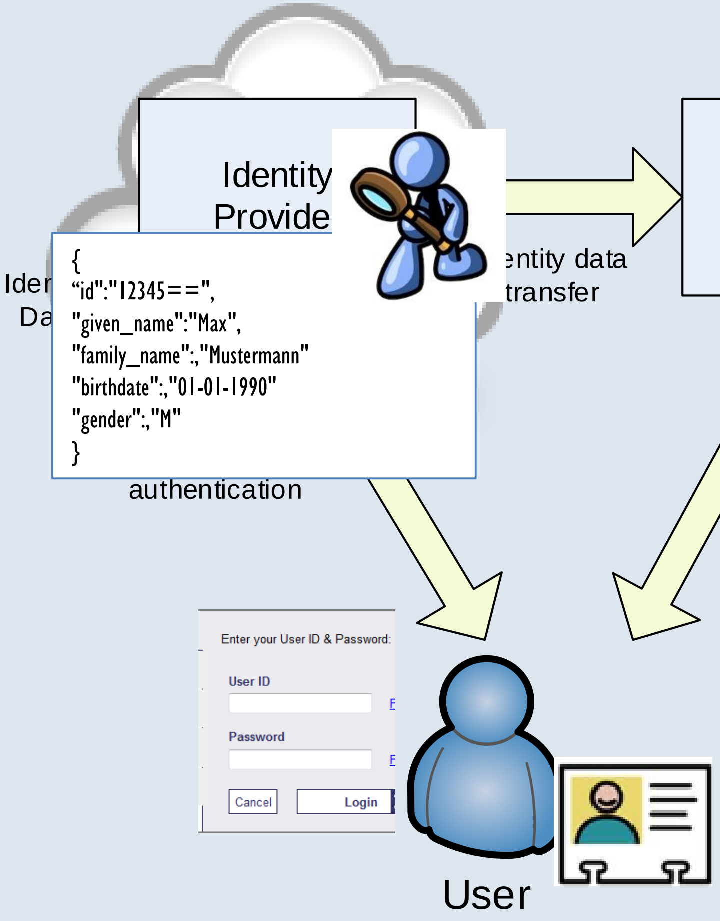
"gender":,"M"
}
```

- **Service Provider (SP)**
  - provides different online services to users
- **Identity Provider (IdP)**
  - handles identification and authentication of users for the SP
- **User**
  - wants to access protected service at SP that requires authentication

SOTA: Cloud Identity Management



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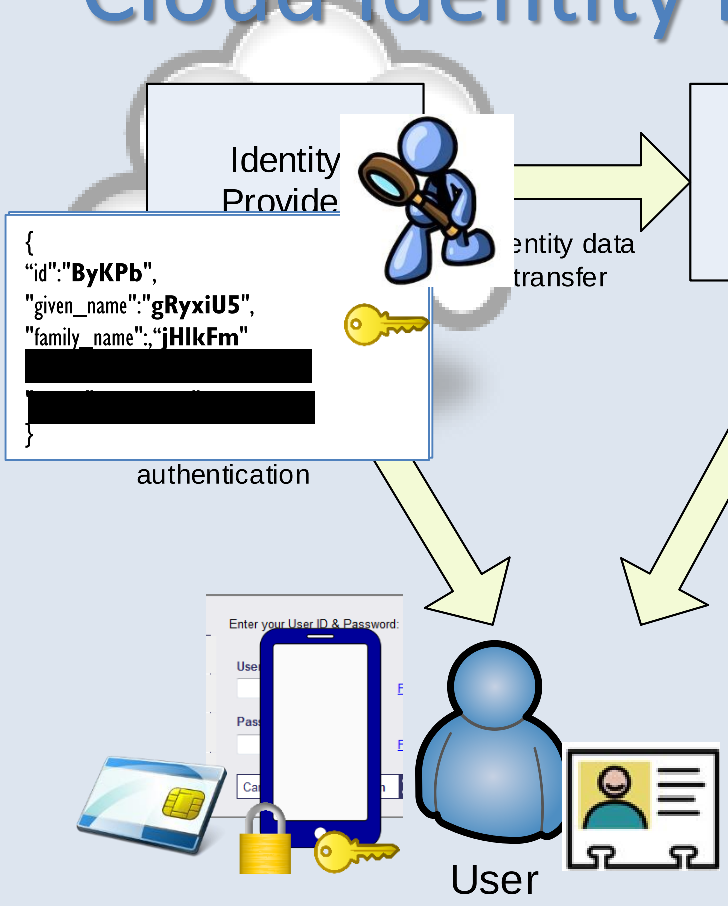
  - Scalability, Elasticity, Cost Effectiveness…
- **Disadvantages:**
  - Privacy

CREDENTIAL: Cloud Identity Management



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"family_name":"jHIkFm"
[redacted]
}
```

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- **Advantages:**
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  - **Privacy**
  - **Strong Authentication**

Technological Context

- **Encrypted identity data**
  - Encrypt data in a way that we can selectively reveal parts of it to different service providers
  - Identity provider should learn none of the attributes (identity data)
  - Apply proxy re-encryption

- **Malleable signatures**
  - Identity provider should be able to verify that attributes are authentic
  - When using conventional signature schemes removing attributes invalidates the signature
  - Apply malleable signatures (e.g., redactable signatures)

- **Strong HW-*based* authentication mechanisms**
  - Two-Factor authentication instead of username/password
  - Inclusion of strong hardware-based approaches incorporated in client devices

CREDENTIAL Ecosystem

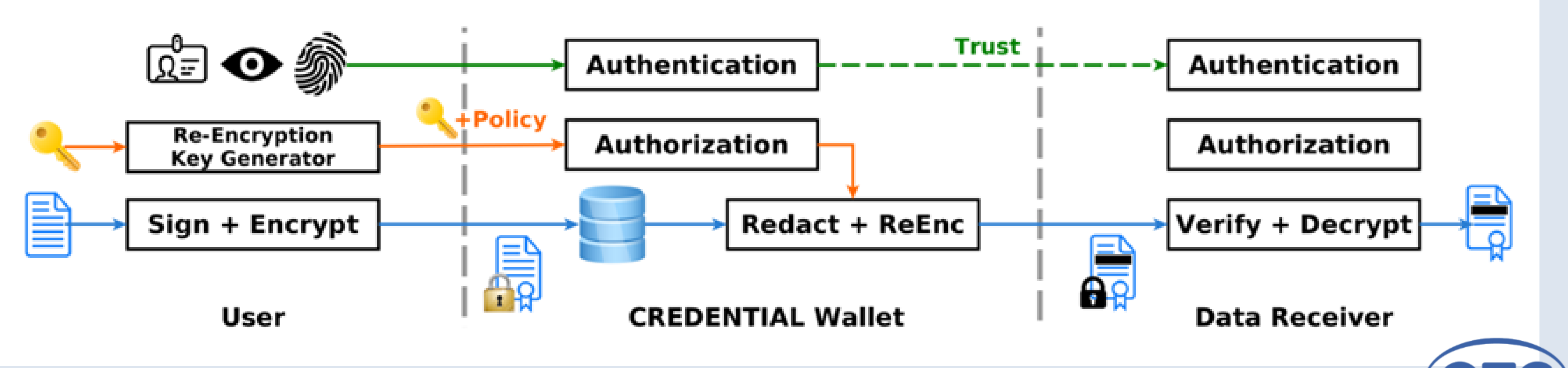
- **CREDENTIAL Wallet:**
  - **Stores** user data and identity data in a secure cloud.
  - A cloud platform **enabling** others sharing user data with other participants or service provider, in a secure way and preserving user privacy.
  - **Comprises** an IAM system, **performing** authentication and **providing** authorization to access those data.

***Main advantages*:**

- ✓ Proxy re-encryption system does not expose plain data.
  - → ***data confidentiality***
- ✓ Once a re-encryption key is available for some specific set of data as specified by the user, *these data can be shared with specified receivers even if the user or his/her client application are not available.*

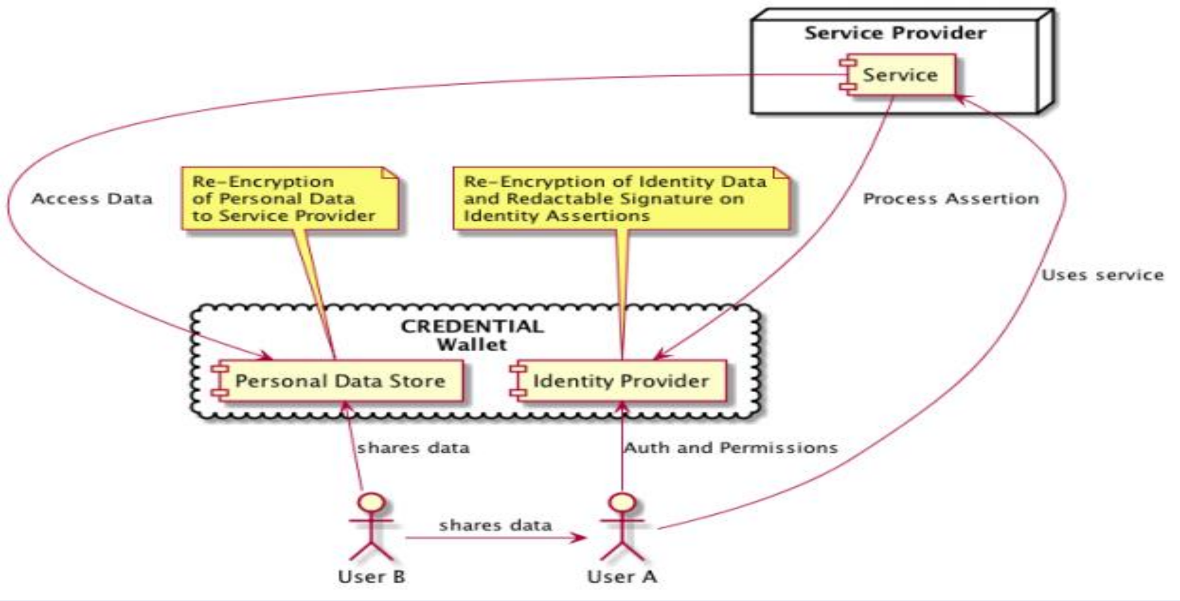
CREDENTIAL Ecosystem *(cont.)*

- An **external Identity Provider** can be embedded to offer authentication functionality for end-users.
- The **end-user**
  - **owns** data securely stored or shared with other account-holders
  - **has** the absolute control over the data flow of his/her personal and sensitive data
  - a *client application* **handles** cryptographic operations involving the user's private key
- The **data receiver** reaches data stored in or authentication assertions and can perform arbitrary data processing
  - *another CREDENTIAL user*
  - or a *service provider*



CREDENTIAL Ecosystem *(cont.)*

- A *user* can **store any personal information** safely in the cloud and **decide to share** such information with other users by providing a *forward rule* in the Wallet.
- The *other user* is able to **read the data without** any more user **interaction from data owner**, because the *wallet can process the forward rule*. Since the data is encrypted, the wallet has to **re-encrypt** the data for the other user. Thus, the **data** is **never disclosed** for the wallet provider by design.
- Users can also **share** their **data with service providers**.



Data Sharing Process

1. The user **authenticates** at the Wallet **to get read and write permission** to her Wallet account, which are used to upload signed and encrypted data.

2. To later **share** this **data**, the user **generates a re-encryption key** towards a selected data receiver in her trusted domain. Along with this key, the user **defines a policy** *defining which data may be disclosed to which entity* and **installs it at the Wallet**.

3. When an authorized receiver tries to access the user's data, **not required parts are redacted** and the **remaining parts are transformed** into cipher-text for the data receiver **by using the re-encryption key**.

4. Finally, the data receiver is able to **decrypt the data and verify the signature** on the disclosed parts.

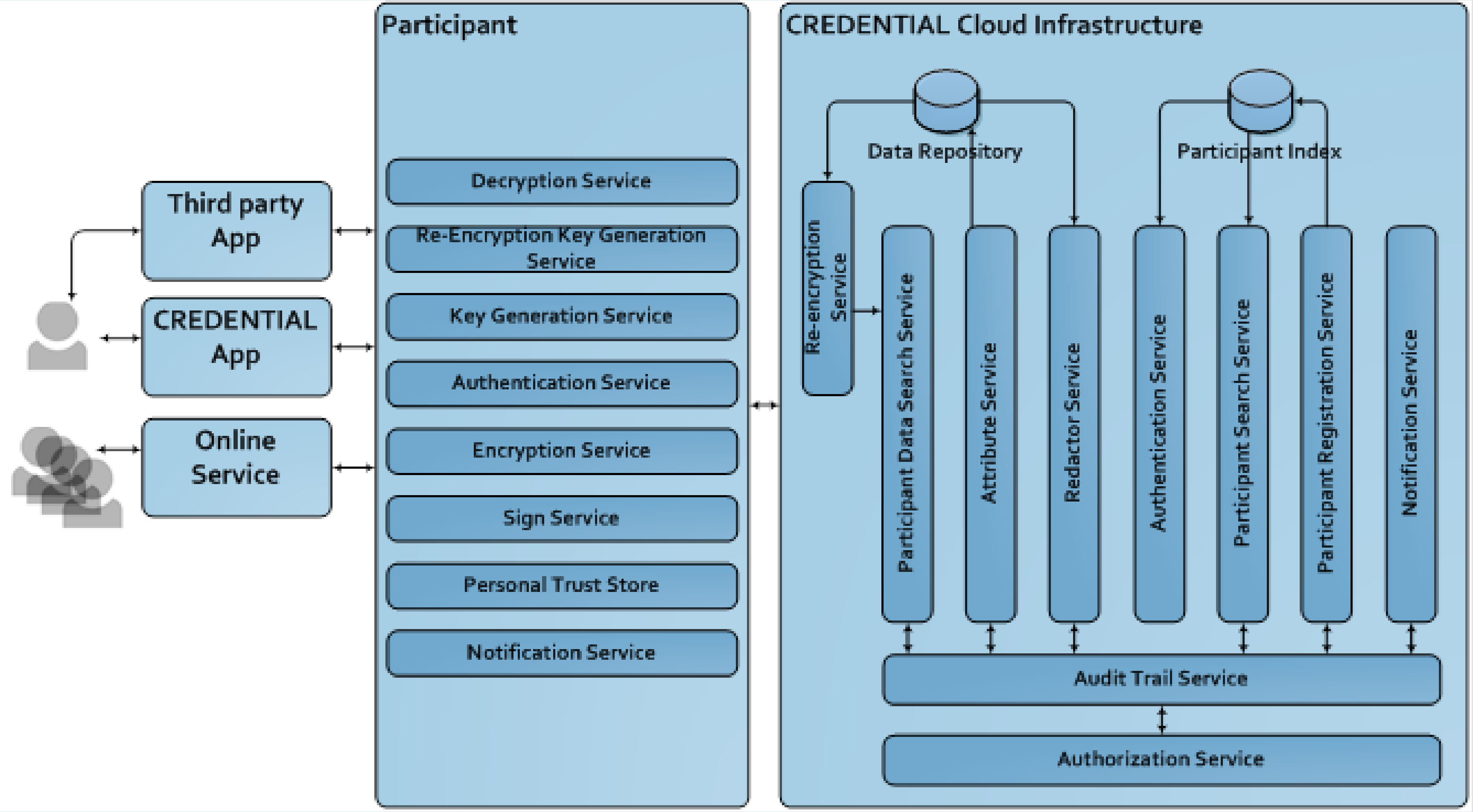
Functionalities

- **Account Management**
  - **Enabling users to create a new account** that involves the creation of its proxy-re-encryption enabled key material and an account association on the CREDENTIAL Wallet.
  - **Users can perform various management functionalities** *(e.g., showing an activity protocol on its data or delegate access rights to its data).*
- **Identity Management**
  - **Integrating identity data stored within the CREDENTIAL Wallet in the authentication mechanisms towards other service providers.**
  - **Securely sharing the identity data** in the CREDENTIAL Wallet.
- **Data Sharing**
  - **Storing, reading, sharing of user data** that is assigned to the CREDENTIAL Wallet.

Services

- ✓ **Cryptographic Services:** Related to the management of cryptographic material and its usage to protect data.
- ✓ **Data Management:** Management of the data and the policies to access it.
- ✓ **Account and Identity Management Services:** Credentials, accounts and identity and attributes management.
  - o *Account management:* Handling the life-cycle of CREDENTIAL accounts.
  - o *Access management:* Controlling the access to the users' data by managing and evaluating requests against user-defined policies.
- ✓ **Auditing & Notification:**
  - o *Auditing:* Stores information regarding attempted access and authorizations to access stakeholders' data, in compliance with current legislation framework and privacy requirements.
  - o *Notification:* Recognizing events happening on the CREDENTIAL Wallet and notifying users according to their preferences (*customize notification settings*)s

Services *(cont.)*



Conclusions & Future Work

- ✓ **Main functionalities of the CREDENTIAL system, as well as the overall logical and physical architecture, to provide a *privacy-preserving data sharing platform*.**

Future work:

- ➢ **Functionality and added-value services** will be showcased by concrete pilots from the domains *of eGovernment*, *eHealth*, and *eBusiness (currently under deployment).*
- ➢ **Further elaboration on mapping CREDENTIAL features into acceptance factors** to explain *how the technology is perceived*.

Thank you very much for your attention!

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