Secure Data Sharing and Processing in Heterogeneous Clouds

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Presentation Outline

- SUNFISH Project
- Cloud Service for Public Administration
- Practical Approach
- Data Sharing and Processing
- Enforcement and Monitoring Architectures
- Summary

SUNFISH Project

- **S**ec**U**re i**NF**ormat**I**on **SH**aring in federated heterogeneous private clouds
- H2020 Project, ICT: *Advanced Cloud Infrastructure and Services*
- Started in January 2015, aimed for three years
- Budget ~4,5 Mil. €
- Involves eleven partners from diverse environments, including: public bodies, universities, IT developers, R&D institutions
- Partners from six countries: Italy, UK, Israel, Estonia, Malta, Austria

Cloud Services for Public Administration

- Public Cloud Services?
  - Administrative obstacles (e.g. *procurement*)
  - Legal issues (e.g. *data localization*, *cross-border transactions*)
  - Security and privacy (e.g. *confidentiality*, *integrity*, *accountability*)

- Federation of private clouds for public administration?
  - Lack of infrastructure and technology
  - Considering public sector needs and requirements
  - Additional dimensions of efficiency, utilization, elasticity

- Challenges:
  - Heterogeneity and interoperability
  - Data security, process transparency, legal compliance

Cloud Services for Public Administration

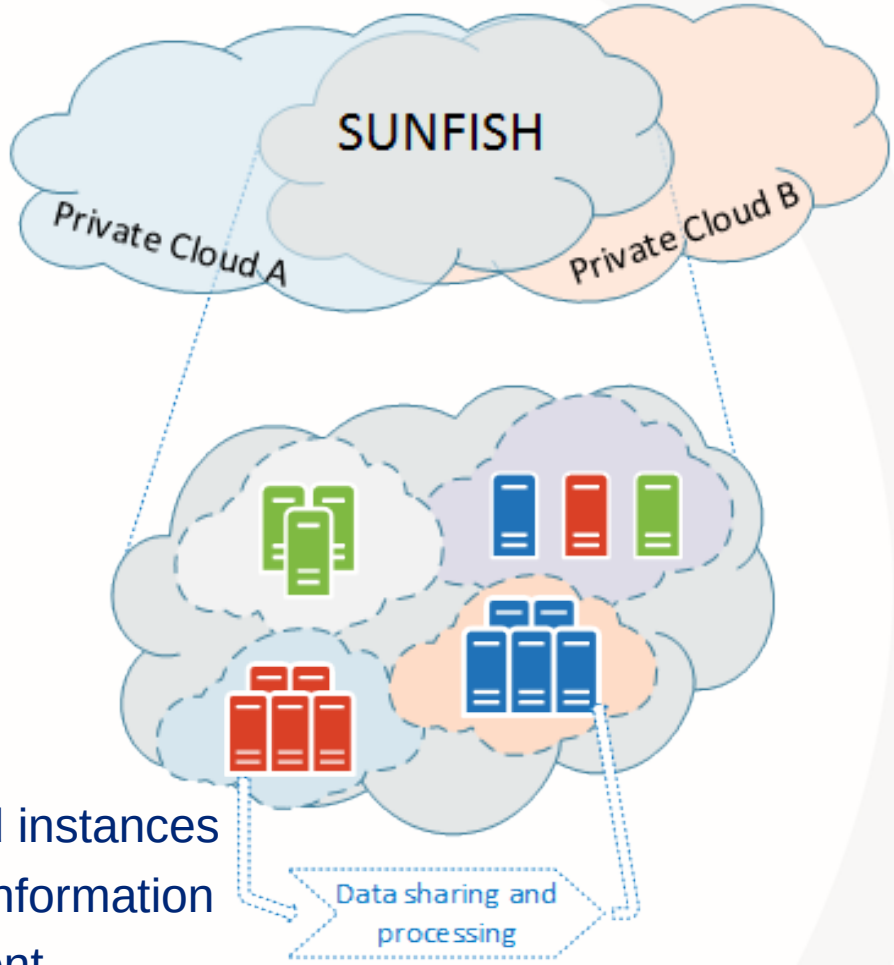
- SUNFISH aims to address the lack of infrastructure and technology for federation of private clouds considering the needs of public sector

- Specific objectives:
  - *Integrate different clouds* assuring information security
  - *Greater infrastructure usage efficiency* thanks to a *more effective workload management* in shared private clouds
  - *The development of services for EU citizens* which use sensitive data shared securely between different private clouds

Practical Approach

- **Use case 1**

Data and resource sharing in federated private clouds



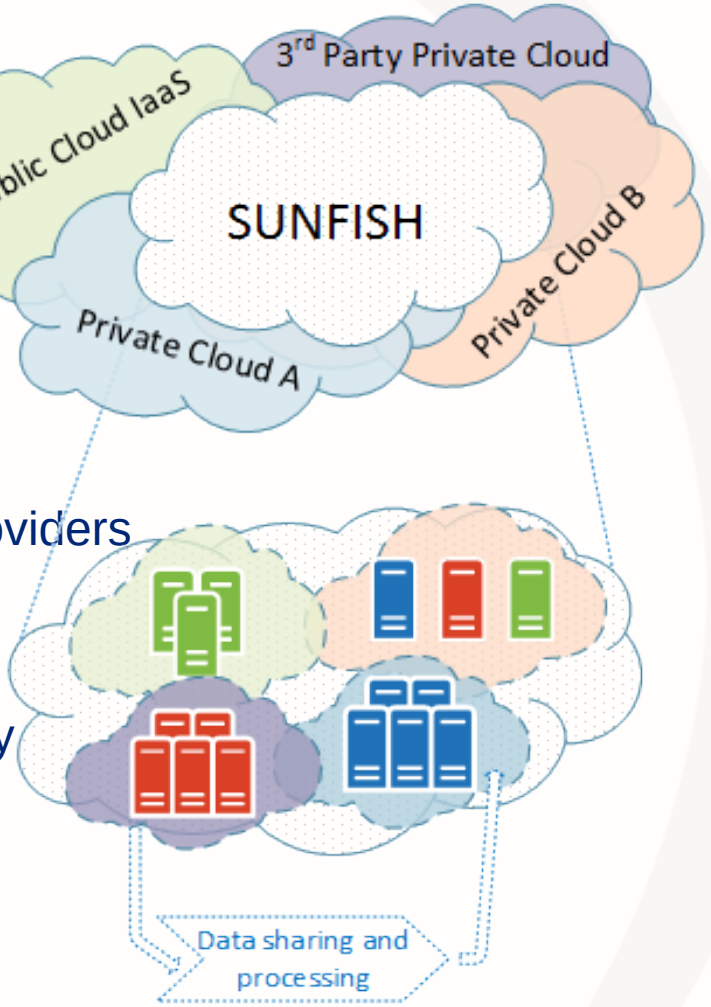
- Collaboration of two organizations
- Requirements: scalability and security

- Private, shared and secure zones
- Data is shared and processed in isolated instances
- Data transformation: masking sensitive information
- Monitoring the data flows and enforcement

Practical Approach

- **Use case 2**

Data and resource sharing in federated private – public clouds



- Secure collaboration of public entity with data providers
- Sharing the data between entities, traversing from private sector, to public, and back
- Requirements: scalability, security, interoperability

- Transforming the data, masking sensitive parts
- Performing processing in secured environment
- Monitoring the data flows and activities

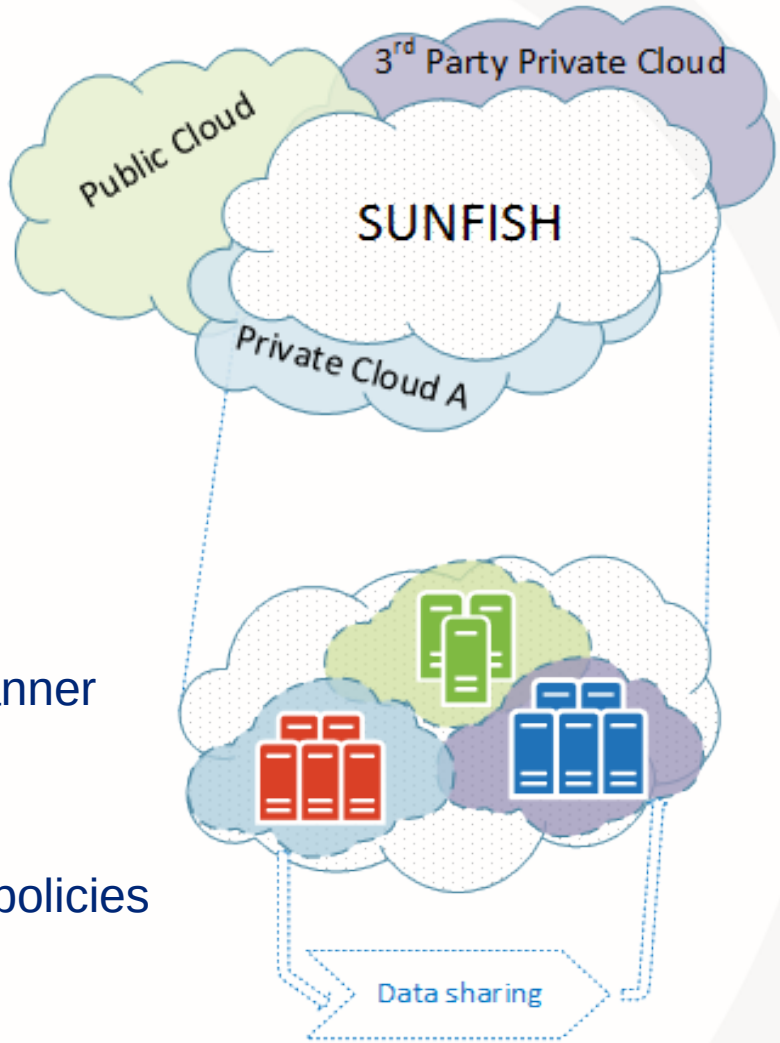
Practical Approach

- **Use case 3**

Data sharing based on fine grained, dynamic policies

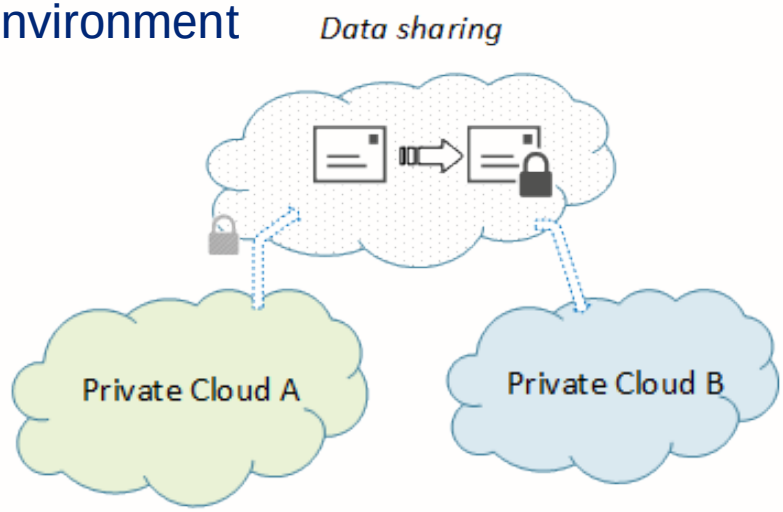
- Private-cloud centered
- Data shared to external entities, in controlled, transparent and traceable manner
- Requirements: security, interoperability

- Fine grained, adaptable, dynamic security policies
- Monitoring the data flows and enforcement



Data Sharing

- Data sharing
  - Conforms to common and organization-specific *security policies*
  - Using *legislation aware* approach
  - Performed using isolated and secure environment
- Data transformation based on:
  - Format-preserving encryption
  - Masking/tokenization
  - Attribute-based encryption
- Key and tokenization management using SUNFISH framework services [1)]

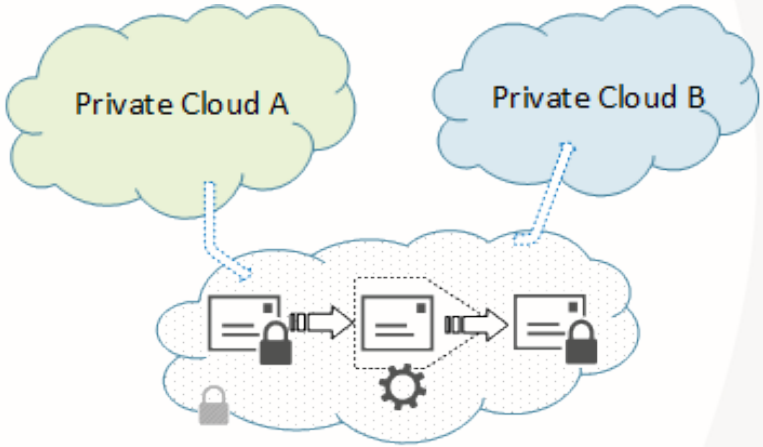


[1)] Reimair et al. *WebCrySIL - Web Cryptographic Service Interoperability Layer*. (2015)

Data Processing

- Data processing
  - Common and organization-specific *security policies*, considering security-level objectives and legislative requirements
  - Performed in isolated and secure environment

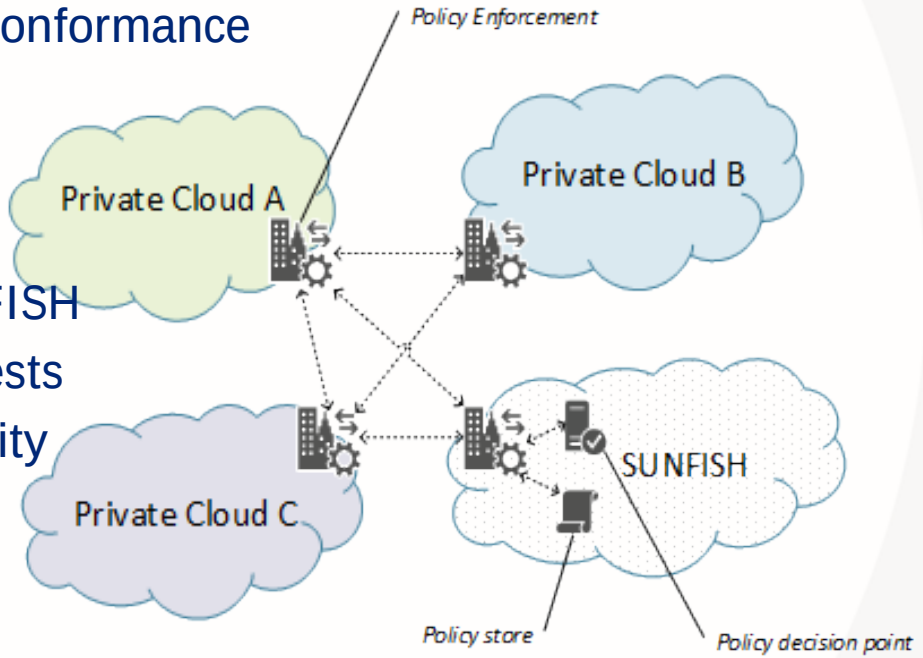
- Data processing based on:
  - Original data, decrypted or unmasked and processed in a secure environment
  - Using *secure multi-party computation* [2)]



[2)] Bogdanov et al. *A universal toolkit for cryptographically secure privacy-preserving data mining*. (2012)

Enforcement Architecture

- Based on enhanced XACML architecture and policy language
- *Policy-enforcement point* ensures the conformance to security policies on the level of each zone and instance
- *Policy-decision* point is located in SUNFISH common environment, evaluates requests and checks their conformance to security policies and legal requirements



Monitoring Architecture

- Assuring security and accountability
- Exists independently of the enforcement infrastructure
- Deployed at various service and infrastructure levels, in cross-cloud setting
- Intercepts and monitors each action and interaction, on a *cloud-wide* basis
- Validates policy enforcement and executes the actions upon its violation
- Integrated with visual console

Summary

- Establishment of secure system for federated private clouds
- Conforming to the needs of public administrations
- Focused on security
- Neutral in the terms of vendors, platforms, systems
- Validated using real-world use cases

Any questions?

Thank you very much