



In partnership with gaia-X = Hub Spain





## Welcome Remarks Tech-X

#### 09:20 - 09:30

In partnership with GOIO-X Hub Spain

ICT TECHNOLOGY CENTER







- Gaiamons are disseminated all around the venue and even in the plenary session slides
  - Catch them all to get a chance to...
    - Become the **best Gaiamon trainer**
    - And win a **Temporary Gaia-X Academy access** (sharable if you already have a full access)
- How? Each Gaiamon is linked to a QR Code.
  - Find the QR Codes
  - Scan them to be redirected to the Gaiamon Game
  - and validate to catch the Gaiamons
- You have collected all the Gaiamons already?
  - Wait for **the draw** at the end of the day
  - And discover who the winners will be!



One day I will be the best I will fight without respite...

gaia-x



gaia-x

First, **Get connected** to the Gaia-X Academy (and create an account if you don't already have one)



Stay aware: Wild Gaiamons will appear!



#### EuProGigant: The Path to a Manufacturing Ecosystem Gateway

#### 09:30 - 10:30



Stefan Dumss, Senior Researcher, Posedio GmbH Paul Weißenbach, Head of Research, Posedio GmbH Fabian Gast, Research Associate, PTW | TU Darmstadt Gerald Ristow, Senior Research Manager, Software GmbH Roman Gehrer, Research Associate, TU Wien

## Outline

- Gaia-X Compliance in EuProGigant
  - From start to Loire
- Policy and Compliance Validation
  - Rego and ODRL in Action
- Creating a Gateway for the Manufacturing Industry
  - Connecting with Gaia-X based Ecosystems
- CO<sub>2eq</sub> Footprint in Production Engineering
  - Cross Ecosystem usage
- Digital Product Pass with Asset Administration Shell
  - T-Systems LivingLab and Gaia-X Compliance





## Why Gaia-X in EuProGigant?





## Brief History of EuProGigant with Compliance





## First Gaia-X Compliance Structure

```
"complianceCredential": {
"@context": ["https://www.w3.org/2018/credentials/v1"],
"type": ["VerifiableCredential","ServiceOfferingCredentialExperimental"],
"id": "https://catalogue.gaia-x.eu/credentials/ServiceOfferingCredentialExperimental/1666597637088",
"issuer": "did:web:compliance.gaia-x.eu",
"issuanceDate": "2022-10-24T07:47:17.088Z",
"credentialSubject": {
        "id": "https://ptw.tu-darmstadt.euprogigant.io/sd/serviceOffering/....json",
        "hash": "ef4845e6985cf03484945bbbab051fbbc60b58e7cce01a97951c766f1c3dd4b1"},
"proof": {
        "type": "JsonWebSignature2020",
        "created": "2022-10-24T07:47:17.088Z",
        "proofPurpose": "assertionMethod",
        "jws": "eyJhbGci0iJQUzI1NiIsImI2NCI6ZmFsc2UsImNyaXQi0lsiYjY0Il19..ck...Q",
        "verificationMethod": "did:web:compliance.gaia-x.eu"
```



## Gaia-X Tagus Compliance Credential

"@context": ["https://www.w3.org/2018/credentials/v1", "https://w3id.org/security/suites/jws-2020/v1",
"https://registry.lab.gaia-x.eu/development/api/trusted-shape-registry/v1/shapes/jsonld/trustframework#"],
"id": "https://compliance.lab.gaia-x.eu/v1-staging/credential-offers/d871930a-cb43-4610-b0ba-6e1437be1c5d",
"type": ["VerifiableCredential"],
"issuer": "did:web:compliance.lab.gaia-x.eu:v1-staging",
"credentialSubject": [..]
"issuanceDate": "2025-05-05T09:12:02.285Z",
"expirationDate": "2025-08-03T09:12:02.285Z",
"proof": {
 "type": "JsonWebSignature2020",
 "created": "2025-05-05T09:12:02.299Z",
 "proofPurpose": "assertionMethod",
 "verificationMethod": "did:web:compliance.lab.gaia-x.eu:v1-staging#X509-JWK2020",
 "jws": "eyJhbGci0iJQUzI1NiISImI2NCI6ZmFsc2UsImNyaXQiOlsiYjY0I119...Q"



## Gaia-X Loire Compliance Credential





## Gaia-X Loire Compliance Credential



## A Simple Example – Customer Relations



## ia-x

## A Simple Example – Customer Requirements





## A Simple Example - Compliance





## Auto-Compliance Retrieval on Start





# Auto-Compliance on Start – User Perspective





## **Compliance Credential per Asset**





## Compliance per Asset – User Perspective

```
curl -X 'POST' \
'http://s3.posedio.euprogigant.io/sdbs/v1/getVP
· \
   -d '{
  "fileName": "filename.json",
  "versionID": "12992121201"
                                                             "verifiablePresentation": {
}`
                                                                  "application/vp+jwt":
                                                             "eyJh....h25VyjQ2NQ"
 GXDCH
 Notary
                                                             }
                                   Storage
                Signer
                                   Service
                                                             gx:DataProduct
               Service
                                                             gx:VirtualResource
 GXDCH
                                                             gx:LabelCredential
Compliance
                                                             gx:LegalPerson
                                                             . . .
```



## Is Gaia-X Loire Compliance easy?



## Auto Compliance in Usage policies

- Service Usage Policy for Business company: Employees are only allowed to use services that store companies' customer data within AT or DE. Decision by CEO office to limit legal risks.
- Service Usage Policy for Datareport company: Services (running for Business company) are only allowed to use Storage within AT or DE. Source: Contract with Business company.



## Implement Usage Policy

- ODRL Policy with Gaia-X OVC Profile
- Permission
- Constraint
  - All storage services need to be physically hosted in AT or DE

```
2 > "@context": […
10 ],
11 "@type": "Agreement",
12 "uid": "http://example.com/policy/123",
13 "profile": "https://w3id.org/ovc/1/",
14 "permission": [
```

15

17

18 19

20 21 22

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37





## **ODRL** Policy in Action

- Customer company employee asks:
  - Can I use service X?
- Datareport/Data Storage company technicians:
  - Allow / deny deployment of configuration changes?

## **Access Policy for Data Reports**

- Datareport Company adds a a policy to the files it stores.
- This policy allows the **Business company direct** access.
- Side note: In Aster-X they showed how to convert ODRL to S3/minio policy



## Implement Access Policy

- Policy
- Permission to read a report
- Only for a company with this exact VatID





## Policy as Code Software Architecture

- Policy Enforcement Point

   consequence of
   decision
- Policy Decision Point makes decision by evaluating policy
- Policy Administration Point – allows for managing policies
- Policy Information Point provides data for policy evaluation



# PDP: Support ODRL without losing the features of OPA

- OPA Decision point with extended capabilities
  - Gaia-X (resolve VC-JWT and check compliance)
  - Evaluate ODRL with Gaia-X OVC Profile (we implemented an ODRL engine)
- Benefits from OPA
  - Battle Tested
  - Large Community
  - Decision Logs
  - ...
  - Language (depending on taste)
    - Maintainability
    - Modularity
    - Easier testing
    - ...



## Using ODRL from OPA

- Take VC-JWT as input
- Extract all issuers
- Allow if no errors:

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. . .

- Error when not all issuers are known and trusted
- Error if provided ODRL policy does not evaluate to true.

```
default allow = false
      allow if {
          count(errors) == 0
 8
      re := resolveVPFromJWT(input.jwt)
10
      all_issuers_in_vp := re.vcs[_].issuer
11
12
      # Only allow valid_issuers
      errors contains msg if {
13
          some issuer in all_issuers_in_vp
14
15
              not issuer in data.valid issuer
          msg := `Only EuProGigant, Posedio and Gaia-X compliance
16
                  are allowed as issuer!?`
17
18
19
20
      # Only if odrl_policy evaluates to true
      errors contains msg if {
21
22
          odrl_request := {
23
              "target": input.target,
24
              "action": "use",
              "requestContext": {
25
                  "vcs": participant_vcs
27
28
          not odrl(input.odrl_policy, odrl_request)
29
30
          msg := "ODRL policy Evaluaton failed."
31
```

package storage.access

1



# The Bigger Picture: Policy as Code in Data Ecosystems

- Compliance and Validation together with Gaia-X descriptions
- Federation services (Authorization and as Information provider)
- Within participants internal systems
- At the border of participants
  - Towards other participants
  - Towards federated services







## How to connect to Ecosystems





### How to connect to Ecosystems





## **Unifying Access to Connectors**



Source: Gast, F., et al. 2024. "Automatic Publication of Data to Data- and Service Ecosystems from the Shopfloor" in Procedia CIRP, Volume 130



## Policies with the Ecosystem Gateway



## Showcase PEP in Gateway

- Exemplary Publish and Consume in the Pontus-X Ecosystem
- Request to PDP (policyService)
  - Stop execution if policies are not met

```
@GrpcMethod('serviceofferingPublisher')
       async createOffering(
         data: CreateOfferingRequest,
       ): Promise<CreateOfferingResponse> {
         this.logger.debug('grpc method CreateOffering called');
         this.logger.debug(data);
         const results = [];
41
         for (const offering of data.offerings) {
42
           if (offering.pontusxOffering !== undefined) {
             if
               offering.pontusxOffering.additionalInformation.gaiaXInformation
                  .serviceSD.url !== undefined
               const res = await this.policyService.publishPolicy(
47
                 offering.pontusxOffering.additionalInformation.gaiaXInformation
                    .serviceSD.url,
               if (res.result?.allow === false) {
51
                 throw new RpcException({
                   code: GrpcStatusCode.FAILED PRECONDITION,
53
                   message: 'Policies have to be met to publish the asset',
                 });
56
             const result = await this.pontusxService.publishAsset(
               offering.pontusxOffering,
```

## Showcase Publish Policy

- Exemplary Publish and Consume in the Pontus-X Ecosystem
- Integrate Business
   Logic through Policies,
   e.g.:
  - Deny Competitors
  - Region Constraints

```
default allow := false
     result := {
         "allow": allow,
         "errors": deny
     # input:
     # jwt vp mit gx:serviceoffering
     vcs := resolveVPFromJWT(input.jwt)
     service_offerings contains so if {
         some vc in vcs
         some type in vc.type
        type == "gx:ServiceOffering"
         50 := VC
     # Competitor policy must be on the service offering policy
     deny contains msg if {
         not competitor policy on service offering
         msg := "All service offering need prohibition to deny competitors."
     competitor policy on service offering if {
         some so in service_offerings
             so.credentialSubject["gx:servicePolicy"].prohibition[].id == "http://example.com/deny-compe
     competitor policy on service offering if {
34
         some so in service offerings
             some prohi in so.credentialSubject["gx:servicePolicy"].prohibition
                 prohi.action == "use"
                 some constraint in prohi.constraint
                     is_competitor_constraint(constraint)
```


## Where do we need this?

- Multiple Stakeholders
- Smart and sovereign self-orchestration
  - Digital Product Passport
  - CO<sub>2</sub>-Prognosis / Calculation



# a-x

# CO<sub>2eq</sub> Footprint in Production Engineering<sup>gaia-x</sup>

- Look at injection moulding machine
- Processing of the material in the use phase of the injection moulding machine represents the largest share of emitted CO2 equivalents
- Benefit results in the use of the material information

In the product development phase
To optimize process parameters

• Look at the whole value chain



# Original Data Exchange via eMail and Excel!





## Gaia-X compliant Decentralized Data Exchange





## Advantages

- Far fewer manual steps
- Direct Data exchange between partners in the supply chain
  - E.g. SimCon and Arburg; Voestalpine and Haidlmaier
- Retrieve Data directly from REST APIs and local databases
- New REST APIs for process and machine simulations





# **Compare different scenarios**



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## **Create Gaia-X Service Credentials**





## AMIDS



# Data Exchange along the value chain

### AAS and Dataspaces to enable:

- Product Passes
- Process Passes
- Carbon Footprints



## **Product Pass**





# Quality Check for the Product Pass

= Asset Administration Shell Measuremen	t Demonstration			
		User: Roman Gehrer		Asset: Product
Scale Connected Step Link 488.96 g	Weight Measurement Name	Value		Machine Data
	Measurement ID Timestamp Method of Chuality Inspection	ab41049362e 2025-05-08T16:50:53.003Z Weight Measurement		
	Product ID Measured Mass	1 488.96 g		Production Data
	Cancle Measurment Upkoad		Quality Measurement Date Measurement Device Value Unit Status: passed/failed	Material Data Quality Check Data



# **Convenience Connector**





# Compliance for EDC

#### **Asset Creation**

```
"@context": {
   "edc": "https://w3id.org/edc/v0.0.1/ns/",
   "vc": "https://www.w3.org/2018/credentials/v2/"
"@type": "Asset",
"@id": "4ac636d6-f5ce-47ed-bcb1-717aaef01398",
"properties": {
    "name": "Testasset",
   "description": "Demo Asset",
   "edc:originator": "https://amids-connector-01.amids.lila.dih.telekom.com/api/dsp",
   "vc:VerifiablePresentation": "https://vc.tuw.amids.net/4ac636d6-f5ce-47ed-bcb1-717
"dataAddress": §
    "@type": "DataAddress",
    "type": "HttpData",
    "baseUrl": "https://s3.tuw.amids.net/4ac636d6-f5ce-47ed-bcb1-717aaef01398",
    "authKey": "Authentication",
   "authCode": "REDACTED",
    "method": "GET"
```

#### Catalog

```
"dcat:dataset": }
   "@id": "4ac636d6-f5ce-47ed-bcb1-717aaef01398",
   "@type": "dcat:Dataset",
   "odrl:hasPolicy": {
       "@id": "M2JkYjlhYTEtNGY3Yy00Y2YxLThlYjgtMjRmOTY3MWY3MTgx:NGFjNjM2ZDYtZjVjZS00N2VkLWJjYjE
       "@type": "odrl:Set",
       "odrl:permission": {
           "odrl:target": "4ac636d6-f5ce-47ed-bcb1-717aaef01398",
           "odrl:action": {
               "odrl:type": "USE"
       3,
        "odrl:prohibition": [],
       "odrl:obligation": [],
        "odrl:target": "4ac636d6-f5ce-47ed-bcb1-717aaef01398"
   "dcat:distribution": [],
   "edc:originator": "https://amids-connector-01.amids.lila.dih.telekom.com/api/dsp",
   "edc:name": "Testasset",
   "edc:description": "Demo Asset",
   "edc:id": "4ac636d6-f5ce-47ed-bcb1-717aaef01398",
   "https://www.w3.org/2018/credentials/v2/VerifiablePresentation": "https://vc.tuw.amids.net/4
```



# If you have questions...

Meet our experts at our booth or at the hackathon sessions:

- Gaia-X Compliance in EuProGigant
  - Stefan Dumss
- Policy and Compliance Validation
  - Paul Weißenbach
- Gateway for the Manufacturing Industry
  - Fabian Gast
- CO<sub>2eq</sub> Footprint in Production Engineering – Gerald Ristow
- Digital Product Pass with Asset Administration Shell and EDC
  - Roman Gehrer



# Thank you!

#### Stefan Dumss | stefan.dumss@posedio.com

In partnership with GOIO-X THUB Spain



# **Networking Coffee**

#### 10:30 - 11:30



Programme Market-X Workshop Room 11:00 - Top Business Priorities in Ecosystems 12:00 - Gaia-X Member Benefits and What is Gaia-X (in Spanish)

12:30 - Business Data Space Trajectories

# **FIWARE Data Space** Connector

#### 11:30 - 11:45

💶 Hub Spain

Juanjo Hierro, Chairman • **FIWARE Technical Steering** Committee

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## About FIWARE

- FIWARE brings a curated catalogue of open source components which can be picked and easily integrated together to build software platforms easing a fast and cheap implementation of:
  - IoT-enabled smart solutions (smart products)
  - smart organizations
- FIWARE comprises components solving how smart solution providers and smart organizations can be participants in open innovation-driven ecosystems (=> data spaces) where:
  - they can offer services to other parties
  - they can integrate and consume services from other parties
- Based on implementation experience, the FIWARE Community:
  - contributes to creation or evolution of open standards
  - brings a vision on how open standards can be integrated
- Members of the FIWARE Community and the FIWARE Foundation actively participate in relevant bodies and initiatives, trying to drive or influence direction of specs based on implementation experience: W3C, ETSI, TM Forum, IDSA, Gaia-X, …





Integrating systems and sharing data within organizations



Integrating systems and sharing data across organizations (data spaces)





## Some fundamental position statements

- Data Spaces are not just about B2B exchange of datasets !!
- Data Spaces comes with a more powerful vision they are open innovation ecosystems involving:
  - providers offering products that range from simple services to access datasets to complex applications comprising several services, including data processing services
  - organizations extending their systems architecture via integration of services linked to products offered by third providers, without giving up management of their users
  - end users involved as direct consumers of product services
- Data spaces are not just about M2M (B2B) interaction but also H2M (B2C, B2E) interaction, even B2D interaction
- Data services accessible in a data space are not only data access services but data processing (including actuation) and data interpretation/visualization services
- For any data space to become a truly open ecosystem to which organizations can dynamically join and interact, interoperability standards at multiple levels need to be agreed as part of the governance





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#### Each Participant of the Data Space can play the role of a Provider or Customer (or Consumer) of Products

- A Product brings a combination of Services which rely on a number of Resources:
  - Services provide access to, processing (including actuation) or interpretation/visualization of data
  - Resources are required for the execution of the Services
- A Product (and its corresponding services and resources) are provisioned and activated for a particular Customer when it acquires the right to use the Product:
  - Provision and activation may take days in some cases!
  - Not every resource runs on the Cloud: cloud-to-edge products
- Example: Air Quality Monitoring Product
  - Comprises services (e.g., web portal, REST services endpoints, etc) some of which bring access to data (air quality measures) or processing of data (air quality predictions)
  - Activation of services for a given customer, requires that some given resources are provisioned and activated IoT devices in the field and some computing and storage on the backend





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# Some key concepts: Products, Services, Resources



## What it means acquiring rights to use a product/service?



- Inherent to the business logic of services linked to products is the definition of authorization policies that establish what certain users can do based on their credentials:
  - park visitors vs gardeners in connection to a parks&gardens management product
  - premium vs regular customers in connection to a packet service delivery product
- Participants that acquire rights to use a product:
  - become trusted issuers of VC including claims relevant for data service access
  - acquiring organizations can issue such VCs for users linked to the organization (employees, customers, devices, application agents)
- When participants authenticate against a provider prior to request services of a product, it will be verified whether:
  - it owns VCs meaningful for the product
  - such VCs have been issued by a trusted issuer (participant which acquired the right to use the product) that remains a trusted participant





## FIWARE Data Space Components: enabling data spaces



- FIWARE Data Space Components comprise a number of open source software components already implementing most relevant specs:
  - Trust and Identity Management components based on W3C DID + VC/VP standards and implementing SIOP4VC protocols, interfacing with trust services implementing extended EBSI APIs (Trusted Issuers Registry) compatible with onboarding services based on GXDCHs
  - Authorization Management components enforcing policies specified in ODRL, supporting Gaia-X ODRL VC profile
  - Components implementing TM Forum APIs for contract negotiation and support to monetization
  - Support to IDS Transfer Process Dataspace Protocol (including TM Forum binding for more powerful Catalog Management and Contract Negotiation)
  - DCAT-compliant data resources catalog for discovery of data services, supporting IDS Catalog Dataspace Protocol
- For near-future releases, following modules will be incorporated:
  - Personal Data Consent Management modules (collab with Prometheus-X)
  - Logging and remote attestation modules
- Meaningful standalone, ready to work together (FIWARE Data Space Connector), useful for building connectors (e.g., Prometheus-X colab.)
- Bring best alignment with DSBA recommendations, EU Digital Identity regulation and compatibility with DOME



### **S**FIWARE

## Authentication based on Decentralized IM

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- Based on W3C standards:
  - **Decentralized IDs (DID)**
  - Verifiable Credentials (VCs)
- Implements OID4VC protocols in • alignment with EU Digital Identity framework:
  - **OID4VCI** for issuance of VCs . (supported by Keycloack)
  - SIOPv2 + OID4VP for exchange of • VCs between consumer and provider
- Enables to support both H2M and M2M scenarios
- Compatible with eIDAS end EU DI (Digital Identity) Reference Framework
- Overcomes limitations of Eclipse DCP (Decentralised Claims Protocol)



## Gaia-X Onboarding integration

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- 1. (Creates compliant did:web)
- Actor creates a <u>LegalPersonCredential</u>, signed with the Organization's Key
- 3. Actor creates a VerifiablePresentation, containing the Credential, signed with the Organization's Key
- 4. Actor sends VP to the Compliance Service
- 5. Compliance Service validates contents, verifies the Issuer
- 6. Returns a ComplianceCredential





## Gaia-X Onboarding integration



- Create VerifiablePresentation with LegalPersonCredential and ComplianceCredential
- 7. Present VP to the Verifier
- 8. Check Issuer at GXDCH Registry
  - Verify Credentials
  - Check that both required
     Credentials are present
- 9. Return JWT





## **Authorization Management**



- Standard PXP architecture:
  - Policy Enforcement Point (PEP) APISIX
  - Policy Decision Point (PDP) Open Policy Agent (OPA)
  - Policy Administration Point (PAP) ODRL-PAP
  - Policy Information Point (PIP)
- Policies defined in <u>ODRL</u>, translated and enforced as Rego by the Open Policy Agent (OPA)
  - OPA is used due to its speed, stability and established community
  - already well integrated with APISIX (and various other API Gateways)
- Support to <u>Gaia-X ODRL VC Profile</u> enabling definition of policy rules that make reference to VCs
- Support to policy rules that make reference to attributes of accessed data (compatible with <u>DOME</u> <u>ODRL Profile</u>)





## Contract Negotiation using TM Forum APIs

- The <u>TMF Quote API</u> provides a standardized mechanism for customers to place a **Quote** that providers should respond to
  - A customer Quote comprises a number of **Quoteltems**, each of which bring a description of a requested action (add, modify, remove, ...) on a given **ProductOffering**
  - Based on the response of the provider to a given quote request, the customer may issue further customer quotes until both sides agree on the quote → basis for negotiation
  - The resulting quote after negotiation, is passed as input argument in the **ProductOrder** request that the customer issues which, when completed, means that the customer can start using the data service
- The <u>TMF Product Ordering API</u> provides a standardized mechanism for customers to place a **ProductOrder** request based on:
  - the ProductOffering a provider has published (therefore the customer it is ok with the offering); or
  - a quote already accepted by the two parties, customer and provider, after some negotiation
- A **ProductOrder** request activates the processes related to provisioning and activation of services linked to the given product



## Quote API: easier to express changes

- One great advantage of the Quote API is that quoteltems allow to express what specific parts of a product offering the customer wants to change (see request example)
- With the existing HTTP binding, providers that receive an ODRL which incorporate changes requested by a customer would need to process the new ODRL to "understand" what concrete changes the customer is looking for and act accordingly

```
export QUOTE_ID=$(curl -X 'POST' http://tm-forum-api.127.0.0.1.nip.io:8080/tmf-api/quoteManagement/v4/quote \
     -H 'Content-Type: application/json;charset=utf-8' \
    -d "{
        \"description\": \"Request for Test Offering\",
        \"relatedParty\": [
                \"id\": \"Requesting-Consumer\",
                \"role\": \"Consumer\"
        ],
        \"version\": \"1\",
        \"state\": "inProgress",
        \"quoteItem\": [
                \"id\": \"item-id\",
               \"productOffering\": {
                    \"id\": \"${PRODUCT_OFFERING_ID}\"
               },
                \"action\": \"modify\",
               \"state\": \"inProgress\",
                \"note\": [{
                    \"id\": \"First note\",
                    \"text\": \"We would prefer weekly pricing and a discount\"
               }],
                \"priceAlteration\": [
                        \"name\": \"alternative price\",
                        \"priceType\": \"recurring\",
                        \"recurringChargePeriod\": \"weekly\",
                        \"price\": {
                            "unit": "EUR".
                            "value": 2.0
    }" | jq '.id' -r ); echo ${QUOTE_ID}
```



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## **Contract Management at Connector Level**

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- A LEAR of the consumer organization will start authentication into the contract negotiation portal of the connector of a service provider (steps 1-3 involving scanning of QR code using the wallet)
- The Verifier will request to the user (via his/her wallet) for VCs that accredit a) the user is a LEAR of the organization, b) (s)he owns credentials connected to roles meaningful for contract negotiation and some other VCs (steps 4-5). The wallet will check that the verifier belongs to a participant in the data space (step 6) and return the requested VCs (step 7)
- The Verifier checks whether the LEAR's VC was issued by a trusted participant of the data space (step 8), and rest of VCs required were issued by trusted issuers (step 9). Note that the VC for accessing contract negotiation functions requires that the organization were previously registered in the contract negotiation module, otherwise it will not be found in local trusted issuers registry (step 9.a)
- If verifications were ok, it issues a token (step 10) that is transmitted to the user (step 11)
- Using the returned token, the user invokes TM Forum APIs to order a product (steps 12-18) and the consumer organization is registered as trusted issuer of VCs relevant for the product (i.e., corresponding services) accessible via the connector (step 17) so the VC issuer at the consumer can be configured for issuing product VCs (step 19)
- Product order launches process for provisioning

#GalaX #WarketX25 #TechX25

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#### #GaiaX #MarketX25 #TechX25

description with example code available at this link

## Support to IDSA Contract Negotiation Dataspace Protocol

- In order to start the negotiation process, the **consumer** has to select a ProductOffering from the providers catalog and issue a Quote request, referencing the offer and provide change requests in form of Quoteltems -> State REQUESTED
- REQUESTED Provider can:
  - Approve the Quote -> State OFFERED
  - Reject the Quoteltem, add new Quoteltem in Approved, Approve the Quote -> State OFFERED
- OFFERED Consumer can:
  - Accept the offered Quote & Quoteltem -> State ACCEPTED
  - Reject the Quote, create new one -> State REQUESTED
- ACCEPTED Provider can:
  - accept the State Change of the Quote -> State AGREED
- AGREED Consumer can:
  - create **ProductOrder** referencing the agreed **Quote** -> State ٠ VERIFIED
- VERIFIED Provider:
  - acknowledges the ProductOrder -> State FINALIZED
- **TERMINATED:** The negotiation process can be terminated by both sides at all times by setting the **Quote** to "cancelled" or rejecting the **ProductOrder**





## Support to IDSA Catalog Dataspace Protocol



Setup Products and Offerings:

- Data Provider creates Catalog, Service and Offerings through the TMForum API
- 2. TMForum API sends creation event to the TMForum handler component
- TMForum handler translates the objects and creates relevant DCAT entries in Rainbow(Catalog API)





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## Support to IDSA Transfer Process Dataspace Protocol

#### Consumer acquires access to the data service:

- 4. Consumer creates Product Order at TMForum API
- TMForum API sends Product Order Event to the TMForum handler
- 6. TMForum handler translates the objects
  - a. creates and Agreement at Rainbow
  - b. (optional) creates Policies at the Policy Administration
     Point
- 7. Client Application sends Transfer RequestMessage
- 8. Rainbow checks:
  - a. connected Agreement
  - b. connected Participants
  - and sends back a TransferStartMessage
- Consumer requests the Data(with the Transfer Process ID in the header)
- 9. PEP/PDP checks the PID at Rainbow
- 10. Request is forwarded to the Data Service







## FIWARE Data Space Components: enabling data spaces



- FIWARE Data Space Components comprise a number of open source software components already implementing most relevant specs:
  - Trust and Identity Management components based on W3C DID + VC/VP standards and implementing SIOP4VC protocols, interfacing with trust services implementing extended EBSI APIs (Trusted Issuers Registry) compatible with onboarding services based on GXDCHs
  - Authorization Management components enforcing policies specified in ODRL, supporting Gaia-X ODRL VC profile
  - Components implementing TM Forum APIs for contract negotiation and support to monetization
  - Support to IDS Transfer Process Dataspace Protocol (including TM Forum binding for more powerful Catalog Management and Contract Negotiation)
  - DCAT-compliant data resources catalog for discovery of data services, supporting IDS Catalog Dataspace Protocol
- For near-future releases, following modules will be incorporated:
  - Personal Data Consent Management modules (collab with Prometheus-X)
  - Logging and remote attestation modules
- Meaningful standalone, ready to work together (FIWARE Data Space Connector), useful for building connectors (e.g., Prometheus-X colab.)
- Bring best alignment with DSBA recommendations, EU Digital Identity regulation and compatibility with DOME







## Summary

- FIWARE has a good track record in moving from vision to execution, making things happen!
- If you look for a data space where ...
  - not only legal persons but natural persons are involved as consumers and you wish they can access services using digital wallets (compatible with DI Wallet Arch & Reference Framework in the EU → support to OID4VC)
  - transactions are not limited to the exchange of datasets but also the invocation of APIs for data access (both for large or discrete data), data processing and data visualization/interpretation services
  - authorization policies can be defined over credentials of users (employees, customers, even devices!) issued by trusted organizations

then FIWARE Data Space Components will be for you!

- We shall not re-invent the wheel: leverage mature open global standards and open source frameworks compatible with applicable regulations
- FIWARE Data Space Components and the FIWARE Data Space Connector help to accelerate the creation of data spaces compatible with Gaia-X specifications, supporting IDSA Dataspace Protocol (with TM Forum binding for Contract Negotiation), compatible with DOME, and compliant with EU policies on Digital ID





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# Thank you!

Juanjo Hierro | juanjose.hierro@gmail.com

In partnership with GOIO-X Hub Spain

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# **Data Transfer Agent**

#### 11:45 - 12:15

In partnership with **gaia-X** Hub Spain



 Benoit Tabutiaux, CTO, TeraLab • Frederic Bellaiche, PhD, Vice **President of Technology and** Research, Dawex – Data **Exchange Technology** • Christoph F. Strnadl, CTO Gaia-X AISBL

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The **architecture document** (AD) provides rules-agnostic technical and syntactic interoperability guidelines.

The **compliance document** (CD) provides a set of rules to ensure the organisational and semantic interoperability. This specification is technology agnostic.

The **Identity, Credentials and Access Management Document** (ICAM) provides specifications on how-to implement credentials, as well as it describes mechanism for rights delegation, authentication, authorization and access management.

The **Data Exchange Document** specifies the processes, rules and requirements to allow the exchange of Data in the Gaia-X Community.









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We have a **Data Exchange** conceptual model

- Data Products
- Data Producers
- Data Consumers
- Data Usage Agreements





#### We are aligned with CEN/ CENELEC Trusted Data Transaction







### How to manage Gaia-X-based Data Exchange in the real world?



### **Introducing the Data Transfer Agent**

A collective effort to bring an **efficient**, **secure**, **resilient**, **scalable** agents for **decentralized data transfers** compliant with **Gaia-X** principles



Lightweight, uncluttered and scalable architecture



Containerized, One-click deployment



Can be deployed **as a service,** next to any component or software



### What is the Data Transfer Agent ?

A software component that comes into play after two parties have agreed on a **data transaction** 

Carries out the verifications (gx:Credential is valid, reception server is located in Europe and GX-Label3, Contract date, Usage Restriction, Consumer Identity) required before performing the transaction

- Grant access to the data
- Transfer the data
- Stream data

The component implements the Gaia-X Trust Framework and OIDC4VC / OIDC4VP.

The aim is to be modular and as **light** as possible.

## Is it similar to a « Data Space Connector »?<sup>gaia-x</sup>

DTA are **lightweight** by design, so they **focuse** on a subset of functions that you may find in the definition of the DSP Data Plane (performing the transaction) and Control Plane (usage and access policies verification)

#### but

- They implement OpenID4VC and OpenID4VP protocols.
- They interact directly with the **clearing house** and **wallets**
- Component can run as « **standalone** »
- Interactions not only reserved to similar components, and it can handle gx:participants and delegations
- It would implement « Data Usage Agreement » as decribed in Gaia-X Specs
- Native support of the GX:ontology to verify contrains (Data Product / Service Offering / Infrastructure / Label)



### What is the Data Transfer Agent?



### Where are we now ?



 Code source is available on Gaia-x Gitlab × × × *× / / /* 

gaia->

• Apache 2.0 licence



### What are the next steps ?

#### **Data Transfer Agent**

- A seamless agent for decentralized data transfer
- Compliant with Gaia-X de facto standard.
- Released as open source
- Easy to deploy Easy to setup



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# Join the collective effort to bring Data Spaces into a new era !



C

## Thank you!

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#### InferIA: Improving Discovery in Data Spaces through Artificial Intelligence

#### 12:15 - 12:30

In partnership with gaia-X = Hub Spain



 Jose Norberto Mazón, CDO, InferIA

> InferIA

gaia-x



# **Inferia** <u>https://inferia.io/</u>



#### **Data Science Lifecycle**



Team Data Science Process de Microsoft

https://learn.microsoft.com/en-us/azure/architecture/data-science-process/lifecycle-data



### One challenge: discovering useful data

- "An important challenge for data lakes is <u>finding relevant</u> data for a given task efficiently."
  - Abadi, D., et al (2022). The Seattle report on database research. Communications of the ACM, 65(8), 72-79
- "Data sharing and collaboration have become increasingly important [...] This also demands novel methods to enable data discovery at the dataset level that support high-level analytics tasks including deriving data explanations and improving machine learning models."
  - Ailamaki, A., et al (2025): The Cambridge report on database research. arXiv preprint arXiv:2504.11259



### Metadata extension for data spaces

Data Catalog Vocabulary (DCAT)



Kitchin, R.: The data revolution: Big data, open data, data infrastructures and their consequences. Sage (2014)

data value is transferred to the recipient

S. A. Azcoitia, N. Laoutaris, A survey of data marketplaces and their business models, ACM SIGMOD Record 51 (2022) 18–29.



### Al-based data discovery

- Search capabilities based on data samples for integrable datasets
- Data discovery driven by specific requirements or user intents
- Both structured and "structurable" data according to data models



> InferIA	Servicios P	roductos Personas Blog Contacto	l> InferiA				
			Q ¿Cuales son las zona	s con mayor posibilidad de	e inundación?		
Productor y services innovadores basedos en d Somos InferIA	tatos e IA		Resultados: 16		Únete a la lista de espera para disfrutar del producto complet	۵	
Desarrollamos soluciones no convencionales a p	problemas que requieren pensar		Aqui tienes unas prop	uestas que podrían sert	te útiles:		
fuera de lo comun			Identifica áreas hist	ricamente afectadas.			
Servicios + Productos +			Zonas inundables o frecuente	e inundación	Zonas afectadas por inundación en la zona de la Ribera	Zonas inundables. Zonas de Riesgos POT	
			Muestra niveles de p	recipitación anuales.			
			Precipitación : 200	9 - 2016 Precipitacio	ón. 2016		
			Determina la densid	ad de población afectad	ia.		
			Mapa de densidad	de población Estadi	ística de densidad de población en pedanias y casco urbano	Densidad de población	
Innovación al servicio de nuestros clientes	Desarrollar solucio	ones a medida requiere una combinación única de	Muestra la frecuenc	a de eventos extremos.			
Servicios tecnología y metodología			Estanques de torm	Estanques de tormentas			
			Evalúa el cambio en	patrones climáticos.			
			Climatología				
Motor de	Espacios de datos Datasets Esta Historia de Alexandre de Carlo de	Identifica infraestru	Identifica infraestructura vulnerable a daños.				
bûsqueda avanzado IA, LLM & ML		Obres d'infraestruc	tura / Obras de infraestruc	ctura Infraestructuras Infraestructuras viarias			
		Recolección y puesta a disposición de datos fiables y de	Revela esfuerzos pr	Revela esfuerzos previos de mitigación.			
Motores de búsqueda basados en	datos	calidad	Riesgo de inundaci	Riesgo de inur	ndabilidad Area Prevención Riesgos Inundaciones		
A Generativa y adaptados a nuestros clientes	Descubre más +	Descubre más +					
Descubre más +							

#GaiaX #MarketX25 #Tech

### Al-based data Discovery

Berenguer, A., Alcaraz, O., Tomás, D., & Mazón, J. N. (2024). From research on data-intensive software to innovation in data spaces: a search service for tabular data. IEEE Software, 41(3), 59-66.



Join

Operation

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.... gaia-x





### InferIA data discovery in different sectors European Common Data Spaces





### InferIA in data discovery different sectors Data Explorer – multisectorial (open data)

ECRETARÍA DE ESTADO JE DIGITALIZACIÓN INTELIGENCIA ARTIFICIAL	datos.gob.es	I> InferIA	
	reutiliza la información pública	Q puntos de carga de coches eléctricos	
E DATOS $\lor$	IMPACTO $\lor$ SECTORES $\lor$ ACTUALIDAD $\lor$ INNOVACIÓN $\lor$ INTERAC	Resultados: 24	
OS DE DATO	S ACCESO NSIP API PUNTO SPAROI	Únete a la lista de espera para disfrutar del producto completo	
		Puntos de Recarga de Vehículos Eléctricos           Ubicación de los puntos de la Red de Recarga para los vehículos eléctricos.	•
puntos d	e carga de coches eléctricos BUSCAR	Punts de recàrrega elèctrics / Puntos de recarga eléctricos           Punts de recàrrega elèctrics a Torrent / Puntos de recarga eléctricos en Torrent	<b>&gt;</b>
Lo sentimos, no se encontraron conjuntos de datos para <b>Ordenar por resultados:</b> "puntos de carga de coches eléctricos"		Puntos Carga Vehículos Eléctricos Islas Baleares           Se publican los puntos de carga de vehículos eléctricos instalados en las Illes Balears.	•
Por favo	or intente otra búsqueda.	Puntos de recarga de coche eléctrico           Puntos de recarga de coche eléctrico	•

### https://demo.inferia.io/

#### |> InferIA

Q Quiero hacer un análisis de las mejores ciudades para instalar placas solares





Resultados: 23



#### Different data and proposals to support user intention

#### https://demo.inferia.io/

酀

	gaia-x ´´```
Q perros peligrosos	Q dangerous dogs
Resultados: 3	Resultados: 2
Únete a la lista de espera para disfrutar del producto completo	Únete a la lista de espera para disfrutar del producto completo
Censo de perros potencialmente peligrosos Censo de perros potencialmente peligrosos. A los perros potencialmente peligrosos (pitbull, rottweiler, dogo argentino, fila, tosa, akita, s staffordshire y staffordshire bull) y cruces interraciales, así como aquellos con antecedentes de agresión, los adiestrados para la defens con morfología vigorosa han de cumplir la normativa específica en cuanto a tipo de licencia, seguro, bozal y correa, conducidos por adu	Censo de perros potencialmente peligrosos Censo de perros potencialmente peligrosos. A los perros potencialmente peligrosos (pitbull, rottweiler, dogo argentino, fila, tosa, akita, am staffordshire y staffordshire bull) y cruces interraciales, así como aquellos con antecedentes de agresión, los adiestrados para la defensa, con morfología vigorosa han de cumplir la normativa específica en cuanto a tipo de licencia, seguro, bozal y correa, conducidos por adulto
Tríptico Perros peligrosos Tríptico informativo sobre perros peligrosos	Tríptico Perros peligrosos Tríptico informativo sobre perros peligrosos
Q gossos perillosos	Q gefährliche Hunde
Resultados: 2	Resultados: 6
Únete a la lista de espera para disfrutar del producto completo	Únete a la lista de espera para disfrutar del producto completo
Censo de perros potencialmente peligrosos Censo de perros potencialmente peligrosos. A los perros potencialmente peligrosos (pitbull, rottweiler, dogo argentino, fila, tosa, akita, i staffordshire y staffordshire bull) y cruces interraciales, así como aquellos con antecedentes de agresión, los adiestrados para la defens con morfología vigorosa han de cumplir la normativa específica en cuanto a tipo de licencia, seguro, bozal y correa, conducidos por adu	Censo de perros potencialmente peligrosos Censo de perros potencialmente peligrosos. A los perros potencialmente peligrosos (pitbull, rottweiler, dogo argentino, fila, tosa, akita, americ staffordshire y staffordshire bull) y cruces interraciales, así como aquellos con antecedentes de agresión, los adiestrados para la defensa, ata con morfología vigorosa han de cumplir la normativa específica en cuanto a tipo de licencia, seguro, bozal y correa, conducidos por adulto;
Tríptico Perros peligrosos           Tríptico informativo sobre perros peligrosos	Tríptico Perros peligrosos Tríptico informativo sobre perros peligrosos

× × × / / /

22622



### InferIA data discovery in different sectors UA Explorer - Education



### https://uaexplorer.inferia.io/

Matriculados
 Grado con más alumnos
 matriculados

**B** Igualdad Distribución por sexo de los doctorandos **Tiempo**Duración media del grado de matemáticas

Movilidad
Procedencia del estudiantado de máster

Envía un mensaje a Infer

El asistente puede cometer errores. Considera verificar la información importante.

### InferIA data discovery in different sectors **UA Explorer - Education**



qué grados tienen una nota de corte alrededor de 11? me podrías dar una gráfica?

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Este gráfico muestra los grados que tienen una nota de corte cercana a 11 para el curso 2023-2024.

Grados con nota de corte alrededor de 11 para el curso 2023-2024



El asistente puede cometer errores. Considera verificar la información importante.



### InferIA data discovery in different sectors LicitIN - procurement

Licit

• Al-based procurement data search



#### https://licitin.es/

Tema de interés 🔘			
Inteligencia artificial			
Tipo de contrato 🔘			
Cualquiera			
Lugares de ejecución 🕕			
Ambito nacional Cantabria Couta Couta Itals Baleares Mellia Presupuesto Base(e) Dende 0 € Crganizaciones Ej. Agencia Estatal de Invo	Andalucia Castilla y León Comunidad Valenciana Hasa Canarias Murcia	Aragón □ astilla-La Mancha □ Extremadura □ La Rioja Navarra Hasta 100.000 €	Asturias Cataluha Galicia Madrid Pals Vasco
		Añadir alerta	

Recibir alertas los fines de semana

Aún no tienes alertas ¡Crea tu primera alerta y recibe notificaciones de licitaciones relevantes



https://licitin.es/

🔘 Licitln



### InferIA data discovery in different sectors







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https://www.segittur.es/plataforma-inteligente/proyectos-plataforma-inteligente/caso-de-uso-de-turismo-cultural-material/ https://www.segittur.es/plataforma-inteligente/proyectos-plataforma-inteligente/caso-de-uso-de-turismo-termal-y-aguas-terapeuticas/





> InferIA

## Thank you!

Jose-Norberto Mazón jnmazon@inferia.io

In partnership with GOIO-X E Hub Spain





### Decoding Gaia-X: the Path to Compliance Labelling

#### 12:30 - 13:00

Enrique Areizaga, Tecnalia & Gaia-X Evangelist

tecnala

MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE



ICT TECHNOLOGY CENTER

### Warming up: Why Trust is important?

- Innovation = Invention \* Commercialization (1)
  - Innovation is something that generates value for the world
  - Commercialization is the difficult part.
  - Example: mp3 from Fraunhofer (invention), iPod from Apple (Innovation)
- Data Spaces = Data flows \* Trust (Data Flows at the speed of Trust)
  - A Data Space is the place where value is generated around data
  - Trust is the difficult part.
  - Remember: "Trust takes years to build, seconds to break and forever to repair".

(1) Bill Aulet- Disciplined entrepreneurship





### How can I show my Trust compliance?

🛞 DOME MARKETPLACE	Publish your offering	Browse About	🕜 🔅 Register Login			
	Featured	offerings	٩	CISPE.cloud https://cispe.cloud	Learn more on how the CISPE Federation Catalogue meets the Gala-X Labelling framework Learn more	C Log in 88 Register a Service 6
		eize.	Smart City Monitor	Y Gala X Labels by CISHE     Gentific     Level 1: services offerings where     signed self-assessment from     providers     Level 2: services offerings where     expected criteria are met through     Level 2: services offerings where     expected criteria are met through     O Provide given third are weat the Gala-X labelling     rules	a all       1-10 of 1484 services < 1 2 3 4 5 ··· 149 > 10 / page          results by name, keyword, location, etc.         a all         ud VPS       Gala-X label Level 3 * * *         ud VPS is a service offered by ARUBA         ) ARUBA S.P.A.       Im table Arezzo         Image: VPS       VPLat Mechanic         Image: VPS       VPLat Mechanic         Image: VPS       VPLat Mechanic	aroba.it
Level     Agriculture.Forestry,Fishing     Internet of Things ligh     Internet of Things ligh     Dr Monitor     A web-sequice a offension dista from Lot.	Agriculture, Forestry, Fishing      Meat Price Tracker      A web service providing up-to-date prices of meat products from Spanish	Creef      Creef	Level     A Service Management     Internet of Things (IoT)     Software as a Service (SaaS)     Operations	Level 3: same criteria than Level + additional criteria for "European Control" defined within the Gaia- Iabelling rules	Cloud VPS Gale-X label Level 3 * * *	
A web service offening data from for devices installed on cows, including	(b) View details	Elliot>>Data>>Knowledge>>Best	Smart City Monitor for a Mid-sized Urban area (MUA) Cloud service for medium-size urban areas.		Cloud VPS is a service offered by ARUBA	aroba.tt
					See more	

Your Gateway to Europe's Premier Digital Ecosystem

Platform benefits



### Where Trust Framework is in the DS stack?





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### **Overall decision Flowchart**





### How to implement a Compliance Engine

- The Gaia-X Code, released by the Gaia-X Lab with the support and contribution of the Gaia-X open-source community, is the implementation of the <u>Gaia-X Compliance Document</u> and the <u>Gaia-X Architecture document</u>.
- From the latter, the **Gaia-X Lab is using the selected standards to build a Compliance Engine** able to compute the policy rules expressed in the Gaia-X Compliance Document.
- In other words, **the open-source Gaia-X code can easily be used by any organisation or individual** as an example on how to implement, in a technical Gaia-X compatible way, the rules to fulfil in order to bring forward trust and interoperability between data spaces.
- Practically, the Compliance Engine is processing the given credentials from a participant and its services in order to validate or verify if the requested policies and rules are fulfilled.
- As a result, the Compliance Engine is issuing, if the criteria are validated, a Gaia-X credential attesting the Gaia-X Standard Compliance or the Gaia-X Labels level 1, 2 or 3


# **Compliance Criteria for Cloud Services**

- Contractual Governance: 5 Criterion
- General material requirements and transparency: 9 Criterion
- Technical Compliance requirements: 2 Criterion
- Data Protection: 3 Criterion
- GDPR Art. 28: 7 Criterion
- Cybersecurity: 20 Criterion
- Portability: 2 Criterion
- European Control: 7 Criterion
- Access to Customer Data: 1 Criterion
- Sustainability: 4 Criterion





# Compliance Criteria for Data Exchange Services

- In Gaia-X, Data is at the core of Data Exchange Services. Data are furnished by Data Producers (for instance data owners or data controllers in the GDPR sense, data holder in EU data acts sense, etc.) to Data Product Providers who compose these data into a Data Product to be used by Data Consumers.
- 8 Criterion: D1.1.1, D1.1.2a, D1.1.2b, D1.1.3, D1.1.4, D1.1.5, D1.1.6a, D1.16b



# CSP- Contractual Governance Criteria (I)

- **P1.1.1**: The Provider shall offer the ability to establish a **legally binding act**. This legally binding act shall be documented.
- **P1.1.2**: The Provider shall have an option for each legally binding act to be **governed by EU/EEA/Member State law**
- **P1.1.3**: The Provider shall clearly identify **for which parties** the legal act is binding
- **P1.1.4**: The Provider shall ensure that the legally binding act **covers the entire provision** of the Service Offering.
- **P1.1.5:** The Provider shall clearly identify in each legally binding act **the applicable** governing law.
  - Self-Declaration for Gaia-X Standard Compliance, Labels level 1, 2 or 3.



# CSP- Contractual Governance Criteria (II)

- **P1.1.1**: Checks that the ServiceOffering has at least one LegallyBindingAct in its legalDocuments.
- **P1.1.2:** Checks that the ServiceOffering has at least one LegallyBindingAct in its legalDocuments that is governed by an EAA country referenced in its governingLawCountries.
- P1.1.3: Collects all the LegallyBindingAct s in each ServiceOffering 's legalDocuments attribute.

Then checks that every LegallyBindingAct involved party involvedParties attribute) is declared in a LegalPerson entity.

- **P1.1.4**: Verifies that each ServiceOffering provides either:
  - a serviceScope attribute
  - an aggregationOfResources or a dependsOn attribute
- P1.1.5 Verifies that every LegallyBindingAct of ServiceOffering s have at least one country code in governingLawCountries.

https://gitlab.com/gaia-x/lab/compliance/gx-compliance/-/blob/development/docs/labelling-criteria.md#criterion-p111



# CSP- Contractual Governance Criteria VC





# Gaia-X Credentials Helper

- <u>https://credential-helper.lab.gaia-x.eu/main/</u>
- Generate W3C Verifiable Credentials and Presentations for Gaia-X participants based on SHACL shapes and OWL ontologies.





# CSP- Contractual Governance Criteria VC



https://docs.gaia-x.eu/ontology/development/classes/LegallyBindingAct/

"type":[ "VerifiableCredential". "https://w3id.org/gaia-x/development#LegallyBindingAct" "issuer": "did:web:gaiax.oasees.digital.tecnalia.dev", "validFrom": "2025-04-23T08:35:15.646185Z", "credentialSubject": { "@id": "did:web:gaiax.oasees.digital.tecnalia.dev#myResource#cs", "gx:governingLawCountries": { "@value": "ES", "@type": "xsd:string" "gx:mimeTypes": { "@value": "text/html", "@type": "xsd:string" "gx:url": { "@value": "https://www.example.com/legal", "@type": "http://www.w3.org/2001/XMLSchema#anyURI"



# **GaiaX Entity**

URI: gx:GaiaXEntity



],

https://docs.gaia-x.eu/ontology/development/classes/ GaiaXEntity/



# Service Offering

URI: gx:ServiceOffering



#### •GaiaXEntity

- ServiceOffering
  - InfrastructureServiceOffering
  - <u>DataProduct</u>

https://docs.gaia-x.eu/ontology/development/classes/ serviceoffering/



# InfrastructureService Offering

URI: gx:InfrastructureServiceOffering



- Inheritance •GaiaXEntity
  - <u>ServiceOffering</u>
    - InfrastructureServiceOffering
      - <u>ComputeServiceOffering</u>
      - <u>ConnectivityServiceOffering</u>
      - StorageServiceOffering

#### https://docs.gaia-x.eu/ontology/development/classes/ infrastructureserviceoffering/



# **ComputeService Offering**

URI: gx:ComputeServiceOffering



GaiaXEntity

- <u>ServiceOffering</u>
  - InfrastructureServiceOffering
    - ComputeServiceOffering
      - <u>VirtualMachineServiceOffering</u>
      - <u>ContainerServiceOffering</u>
      - <u>BareMetalServiceOffering</u>
      - <u>ComputeFunctionServiceOfferi</u>

https://docs.gaia-x.eu/ontology/development/classes/ computeserviceoffering/



# **BareMetal Service Offering**



https://docs.gaia-x.eu/ontology/development/classes/ Baremetalserviceoffering/

# BareMetal Service VC

"@id": "did:web:gaiax.oasees.digital.tecnalia.dev#myResource", "type": [ "VerifiableCredential", "https://w3id.org/gaia-x/development#BareMetalServiceOffering" "issuer": "did:web:gaiax.oasees.digital.tecnalia.dev", "validFrom": "2025-05-06T09:49:16.875050Z", "credentialSubject": { "@id": "did:web:gaiax.oasees.digital.tecnalia.dev#myResource#cs", "gx:dataProtectionRegime": { "@value": "GDPR2016", "@type": "xsd:string" }, "gx:codeArtifact": { "@id": "did:web:gaiax.oasees.digital.tecnalia.dev/#PXEImage 2"

#### Note: only shown a small portion of the Bare Metal VC

### #GaiaX #MarketX25 #TechX25

"@id": "did:web:gaiax.oasees.digital.tecnalia.dev/#Memory 13", "type": [ "VerifiableCredential", "gx:Memory" "issuer": "did:web:gaiax.oasees.digital.tecnalia.dev", "validFrom": "2025-05-06T09:49:16.875167Z", "credentialSubject": { "@id": "did:web:gaiax.oasees.digital.tecnalia.dev/#Memory 13#cs", "gx:memorySize": { "@id": "did:web:gaiax.oasees.digital.tecnalia.dev/#MemorySize 15" "gx:memoryRank": { "@value": "1R RDIMM", "@type": "xsd:string" "gx:memoryClass": { "@value": "SDRAM", "@type": "xsd:string"





# Signing the Credential Helper VCs

- Sign all the credential gathered from the credential helper
- Receive a list of Enveloped Verifiable Credentials, in the VC-JWT format.
- As result you will have a signed Verifiable Presentation with all the required Credentials, keep this Verifiable Presentation on hand as it will be needed in the Certificate afterward.

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	ZYMUZCI na ZPhho 50 ZWMU WWYNYSSKZZY I CIrawloioi Ikawlodd 20 i Omdhawlf 41 mgho 201 cy Skawldodde ei nal 205
	bclbimpldiNKV0evM0TwiVTTOS10
	out http://www.commercedure.com/
	b23bl2ddbaWEtaC0kZVZ3bC0wbW/udCMiLUciZVg30j3bdWBw0j9vZXbbbVRcZCEvcmcif/ActkRoZCT4TmVA0kd
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	MDg6NTc6MDEuNzQxKzAw0jAwIIw1Y3JIZGVudG1hbFN1Ymp1Y3Q10ns1QG1kIjo1ZXg6R1BTVW5pdF830CNjcyI
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ety ac	<pre>qKKYjHF71EELNZXqwWpiyQnsRh_MbQ6ItuVF3M7t8GzWm0WD29YL2No6VfVWcCejdXgbJp4U4u9H0jJ3yHxd_a1 3NG7L0yGTCPc4KXV0XlQsoyS7qk3yjdgpZNpspNczmp2zpeaH2yAtJwH-rmwLveOF1HMlhCLKKWfCw", pe": "EnvelopedVerifiableCredential" ontext": "https://www.w3.org/ns/credentials/v2", ": "data:application/vc+jwt, eyJhbGci0iJQUzI1NiISInR5cCI6InZjK2p3dCISImN0eSI6InZjIiwiaXNzIjoiZGlkOndlYjpnYWlheC5vYXN ZXMuZGlnaXRhbC50ZWNuYWxpYS5kZXYiLCJraWQi0iJkaWQ6d2Vi0mdhaWF4Lm9hc2Vlcy5kaWdpdGFsLnRlY25 bGhLmRldiNKV0syMDIwLVJTQSJ9. eyJAY29udGV4dCI6WyJodHRwczovL3d3dy53My5vcmcvbnMvY3J1ZGVudGlhbHMvdjIiLCJodHRwczovL3czaWQ</pre>

https://technical-compliance-workshop-fe23a7.gitlab.io/loire-compliance/



# Calling the Gaia-X Compliance Level

https://compliance.lab.gaia-x.eu/main/docs https://compliance.lab.gaia-x.eu/v1-stagging/docs#menu

#### gx-compliance <sup>271</sup> <sup>0AS 3.0</sup>

Prototype for a compliance service as defined in https://gaia-x.gitlab.io/policy-rules-committee/trust-framework/

#### conformity

POST /development/api/credential-offers/standard-compliance Checks Gaia-X standard compliance rules and outputs a VerifiableCredentials from your VerifiablePresentation	$\sim$
POST /development/api/credential-offers/label-level-1 Checks Gaia-X label level 1 rules and outputs a VerifiableCredentials from your VerifiablePresentation	$\sim$
POST /development/api/credential-offers/label-level-2 Checks Gaia-X label level 2 rules and outputs a VerifiableCredentials from your VerifiablePresentation	$\sim$
POST /development/api/credential-offers/label-level-3 Checks Gaia-X label level 3 rules and outputs a VerifiableCredentials from your VerifiablePresentation	$\sim$



# Applying filters to the Compliance Engine



P1.1.1 : Valid P1.2.3 : Please check that ... P2.1.2 : Valid P2.1.2 : The Service Offering does not ...

https://gitlab.com/gaia-x/lab/compliance/gx-compliance/-/blob/development/docs/labelling-criteria.md#contractual-governance

P1.1.1 Filter: ServiceOfferingHasLegallyBindingActFilter

P1.2.3: Filter:ServiceOfferingHasDocumentedChangeProceduresFilter

P2.1.2: Filter:ServiceOfferingHasRoleAndResponsibilitiesFilter



# Getting a Gaia-X Label



- Tax Nexus = Connection between an Entity and the relevant jurisdiction
- Gaia-X Labels = Connection between Gaia-X Entities and the relevant Compliance rules



# Gaia-X Labels format

A Gaia-X Label is a machine readable, structured and signed document that comprises at a minimum the following information attributes:

- Label ID, as unique identifier for the label being issued for a specific Service Offering.
- Participant ID, as unique identifier for the Participant that is awarded the Label.
- **Participant Business ID**, presenting the firm business ID of the Participant.
- Service Offering for which the Label is applicable.
- Conformity assessment scheme, as Gaia-X Standard Compliance, Gaia-X Label Level 1, Gaia-X Label Level 2 or Gaia-X Label Level 3.
- Reference to the assessment scheme version that comprised the **Gaia-X criteria** for which the claims and evidences were prepared.
- **Compliance Service ID**, as unique identifier for the Compliance Service that issued the Label.
- Compliance Service version, as the software version that issued the Label.
- **Issuance date** on which the Label was issued.
- Validity start and end date on which the Label will expire.



# Gaia-X Labels format (II)

- gx:labelLevel corresponds to the conformity level (Standard Compliance, Label Level 1, Label Level 2, Label Level 3)
- gx:engineVersion the Compliance Engine version in order to trace the filter chain code base used in the credential issuance process
- gx:rulesVersion the Compliance Document version implemented and used by the Compliance Engine to validate the input VC-JWT
- gx:compliantCredentials a snapshot with a unique hash of each input credential subject that has been validated
- gx:validatedCriteria the criteria that have been validated by the Compliance Engine to generate this compliance credential

For more details about the gx: LabelCredential format please checkout the Label Credential class in the Gaia-X ontology documentation.

# gaia-x

### Gaia-X VC Label Credential

```
"type":[
   "VerifiableCredential",
   "gx:LabelCredential"
1.
"id":"https://storage.gaia-x.eu/credential-offers/b3e0a068-4bf8-4796-932e-2fa83043e203",
"issuer":"did:web:compliance.lab.gaia-x.eu:development",
"validFrom":"2025-01-16T08:48:27.622Z",
"validUntil":"2025-04-16T08:48:27.611Z",
"credentialSubject":{
   "id":"https://storage.gaia-x.eu/credential-offers/b3e0a068-4bf8-4796-932e-2fa83043e203#cs",
   "gx:labelLevel":"SC".
   "gx:engineVersion":"2.7.1"
   "gx:rulesVersion":"CD24.06",
   "gx:compliantCredentials":
         "id":"ex:RegistrationNumber_733",
         "type":"gx:RegistrationNumber",
         "gx:digestSRI":"sha256-a8e24c9da0ca22fbe4ddcee60ec146cb8306a16b1bb5984fde0d115908d8457e"
      },
         "id":"ex:LegalPerson_712",
         "type":"gx:LegalPerson",
         "gx:digestSRI":"sha256-842b91ce23585312b53b7e64e3b4ac509378fbd0f33524b2b0495fe8e3a8dd37"
      },
      (...)
```



### Gaia-X VC Label Credential

#### "gx:<u>validatedCriteria":[</u>

"https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.5", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.1.1", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.3", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.1.3", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P2.1.3", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.8", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P2.1.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.8", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P2.2.1", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P2.2.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.7", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.3.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P2.2.7", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.5", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.1", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.4", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.3", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.6", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.9", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P4.1.1", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P4.1.2", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.11", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.13", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.14", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.15", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.16", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.17", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.18", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.19", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.20", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.12", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P5.2.1", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.6", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P1.2.7", "https://w3id.org/gaia-x/specs/cd24.06/criterion/P3.1.10"





# Thank you!

#### Enrique Areizaga | enrique.areizaga@tecnalia.com

In partnership with GOIO-X Hub Spain ICT TECHNOLOGY CENTER



# **Networking Lunch**

#### 13:00 - 14:00



#### Programme Market-X Workshop Room

14:00 - Exploring Spanish Projects

Converting Existing Data Ecosystems into Gaia-X-Compatible Data Spaces – Things to Consider Based on the X-Road Journey

#### 14:00 - 14:15



 Ville Sirviö, CEO, the Nordic Institute for Interoperability Solutions (NIIS)

gaia-x

# **CONVERTING EXISTING DATA** ECOSYSTEMS INTO GAIA-X-**COMPATIBLE DATA SPACES** - THINGS TO CONSIDER BASED **ON THE X-ROAD JOURNEY** Ville Sirviö, CEO Nordic Institute for Interoperability Solutions (NIIS)

Tech-X 2025, Valencia

# **DIGITAL SOCIETY SOLUTIONS AND CROSS-BORDER COOPERATION**





Non-profit association to ensure the development and strategic management of digital government solutions that allow NIIS members to provide excellent digital public services.

**Open-source software and** ecosystem solution that provides unified and secure data exchange between organisations.

x-road.global

A free and actively maintained open-source component for joining one or more eDelivery policy domains. edelivery.digital

niis.org

### NIIS DATA SPACE JOURNEY

#### 2023 NIIS CEO elected to the Gaia-X Board of 2020 Directors 2025 NIIS becomes DSSC NIIS joins the International NIIS starts actively Expert Group following ongoing data **Data Spaces Association** participant and space initiatives (IDSA) Blueprint contributor $\mathbf{O}$ 2024 2021 NIIS joins the Eclipse NIIS joins the Gaia-X Foundation and its Data European Association Space Working Group for Data and Cloud (EDWG) as a Supporter AISBL Member

# **UNDERSTANDING X-ROAD**



### A free and open-source data exchange solution

Open source software x-road.global

#### Digital Public Infrastructure (DPI)

One of the most deployed DPIs worldwide undp.org/digital/digital-public-infrastructure

#### Digital Public Good

Recognised by the Digital Public Goods Alliance digitalpublicgoods.net







### **X-ROAD VS POINT-TO-POINT**



### DATA EXCHANGE IN X-ROAD





### **TRUST FEDERATION OF X-ROAD ECOSYSTEMS**

#### Available since 2014 (X-Road 6.0-)

- Federation is a one-to-one relationship between two ecosystems.
- Members of the federated ecosystems can publish and consume services with each other as if they were members of the same ecosystem.
- Federation is not only about technology administrative and/or legal agreements are also needed between:
  - X-Road operators of the federated ecosystems.
  - Member organisations that exchange data (data exchange parties).



# THE X-ROAD JOURNEY SINCE 1998



25 COUNTRIES WITH X-ROAD ECOSYSTEMS

DEPLOYED BY GOVERNMENTS OR OTHER ORGANISATIONS 162 COUNTRIES WITH X-ROAD COMMUNITY MEMBERS

REPRESENTED IN THE X-ROAD COMMUNITY

4600 X-ROAD COMMUNITY MEMBERS

> PARTICIPATING IN THE X-ROAD COMMUNITY

**542M** END USERS OF DIGITAL SERVICES OFFERED VIA X-ROAD
### EXAMPLES OF X-ROAD ECOSYSTEMS TODAY

	X-tee (Estonia 2001-)	Suomi.fi Data Exchange Layer (Finland 2015-)	Straumurinn (Iceland 2019-)
Services	2.680 services	660 services	70 services
Organisations	1.372 institutions and enterprises, 272 public sector institutions, 82 NGOs 52k organisations as indirect users	211 municipalities, 122 companies, 45 government agencies, 32 educational organisation, 21 other organisations	42 government agencies, 32 companies, 8 educational organisations, 6 municipalities
Information systems	1.974 connected information systems	1.180 connected information systems	219 connected information systems

# HOW EXISTING SYSTEMS CAN EVOLVE TO BE GAIA-X COMPATIBLE DATA SPACES?



# X-ROAD 8 "SPACESHIP"

### X-ROAD 8 "SPACESHIP" VISION

X-Road 8 "Spaceship" nurtures the proven ecosystem model and security while it takes X-Road to the next level by providing a solid data space infrastructure.

Additional features such as enhanced monitoring and metrics and advanced cloud compatibility make X-Road 8 an outstanding solution for any public or private organisation.

https://x-road.global/spaceship



### **TRANSITION TO A DATA SPACE TECHNOLOGY**





#### **Current state**

X-Road has its own custom protocol stack and being interoperable with other data exchange ecosystems requires building and maintaining custom ecosystem-specific gateway solutions. NIIS is alone responsible for maintaining and developing X-Road.

#### Target state

X-Road uses the standard data space protocol stack and is interoperable with other data exchange ecosystems following the same standards and specifications. X-Road is based on existing open-source components that are maintained by their international developer communities. NIIS contributes to the maintenance, but the main focus is in developing new business features for the NIIS members.





X-Road 8 is implemented iteratively using agile software development methods.

All the changes are not included in the first production version, but they will be introduced one by one over time in various X-Road 8 minor versions.



# THINGS TO CONSIDER BASED ON THE X-ROAD JOURNEY

### GENERALISABLE TECHNICAL PATTERNS

- Scope the transformation carefully: Decide whether the transformation will only focus on data space compatibility or also include other technical upgrades.
- Iterative vs. all-at-once implementation: Weigh the pros and cons of implementing all changes in a single release versus rolling them out in multiple, manageable iterations.
- Build vs. re-use: Consider leveraging existing open-source components and communitysupported tools rather than building everything from scratch.
- Backward compatibility: Clearly define how much legacy support is needed to ensure existing services and integrations remain functional.

### **GOVERNANCE IMPLICATIONS**

- Compliance across stakeholders: Assess whether all member organizations within the ecosystem need to become Gaia-X compliant.
- Process impact: Analyze how technical changes will affect current management and operational processes.
- Policy updates: Review and revise ecosystem-specific policies and rules to align with data space standards.

- Role alignment: Ensure all roles required by Gaia-X (e.g., trust anchor, operator) are represented in your ecosystem.
- Federation strategy: Develop a governance model for federating with other Gaia-X-compatible ecosystems, including legal and administrative aspects.

### **ARCHITECTURAL DECISIONS**

- Trust framework approach: Decide whether to adopt the Gaia-X Trust Framework directly, extend it, or maintain a separate trust framework while supporting Gaia-X compatibility.
- Deployment model support: Ensure new architectural and software components can support current deployment scenarios, even if not originally designed for them.
- Performance assurance: Address potential performance issues caused by more complex protocol stacks through architectural planning and benchmarking.

- Protocol standardisation: Choose among alternative protocols (e.g., DCP vs. OI4VC) considering community adoption, interoperability, and long-term viability.
- GXDCH decision: Determine whether to operate your own Gaia-X Digital Clearing House (GXDCH) instance or rely on publicly available instances.
- ODRL extension strategy: Plan how to implement ODRL (Open Digital Rights Language) extension profile(s) without compromising interoperability with other ecosystems.



### THANK YOU!

x-road.global niis.org

ville.sirvio@niis.org linkedin.com/in/villesirvio

### Sovereign AI: Fine-Tuning LLMs Through Trusted Data Exchange

#### 14:15 - 14:45

In partnership with GOIO-X Hub Spain



Ramy H'cini, CTO, Think-it

gaia-x





### Who We Are



- Official Connector Maintainer
- Official Connector as a Service provider



• Architecture committee member



- Top core EDC committers
- DCP co-authors



- Data Spaces Partner
- MVDS guide authors



### What We Do

#### Interoperability, Identity and Trust

- Eclipse Dataspace Components (EDC)
- Trust Frameworks: GAIA-X and others
- DID and Decentralized Claims Protocol

#### Make Data Space Technology Easy

- Data Spaces as a Service (DaaS)
- Connector as a Service (CaaS)
- Suite of OSS SDKs
- Onboarding Partner









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# **Common Vision for Sovereign Al**

- A future present where data collaboration and AI performance are not mutually exclusive.
- An infrastructure for high-value data AI-ready—while keeping it compliant and sovereign







### Why This Matters







# Challenges turned into opportunities

• **Challenge:** LLMs need high-quality data to be fine-tuned effectively, but access is limited by trust, compliance, and sovereignty concerns.

• **Opportunity:** Data spaces and trusted, sovereign exchange frameworks enables secure collaboration without giving away control.





### The Big Picture for **Data Spaces**



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### Gaia-X Trust Framework as an enabler







### What We Set Out to Prove

• **Goal:** enable trusted, secure and sovereign LLM fine-tuning using shared datasets from a data space

 PoC Iteration 0: evaluate integration potential of EDC-based connectors, Langfuse for Datasets Management, and Unsloth for LLMs Fine-Tuning.



# PoC Layered Approach

#### **Dataset Management**

Role: LLM fine-tuning datasets management. [Provider]

#### Inputs:

- Existing datasets (e.g., downloaded from Hugging Face)
- User annotations and metadata

#### **Outputs:**

- Managed fine-tuning datasets with rich metadata
- Dataset export capabilities via API
- Dataset quality metrics

#### Data Sovereignty

**Role:** Contract-based data exchange and policy enforcement.

#### Inputs:

- Dataset metadata
- Usage policies defined by providers

#### **Outputs:**

- Contract agreement to access datasets
- Secure peer-to-peer data transfer
- Policy enforcement and verifiability

#### **Fine-Tuning Pipeline**

**Role:** Fine-tuning pipelines using data from a data space. [**Consumer**]

#### Inputs:

- Transferred datasets (transformed to Unsloth-compatible format)
- Model configuration parameters

#### Outputs:

- Fine-tuned LLM models
- Training metrics and validation results
- Optimized model formats (GGUF, HF)



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# **PoC Key Components**

**EDC-based connectors** enables contract negotiation, usage control enforcement, logging, and secure transfer.

Langfuse: adds real-time observability and structured feedback loops.

**Unsloth**: optimized for efficiency; works with quantized models and LoRA for resource-sensitive environments.













### **PoC Architecture Overview**







# Iteration 0: Outcomes and Learnings

Requirement		Notes	
Metadata enrichment		Data Space Protocol (DSP) with DCAT allows for rich metadata for quality metrics and provenance analysis.	
Contract-based data exchange		Formalized agreements between data providers and consumers with explicit usage terms. Coupled with GAIA-X Trust Framework to ensure sovereignty and verifiability.	
Distributed Identity and Verifiable Credentials		DID-based identity management ensuring participants are trusted entities.	
Format compatibility and efficient fine-tuning	$\checkmark$	Support for various dataset formats and model architectures.	
		LoRA and QLoRA techniques enabling fine-tuning on consumer hardware.	





### What's Next

**Large Dataset Handling:** Enabling efficient transfer of potentially large fine-tuning datasets (often multiple GB) using EDC's data plane streaming capabilities, combined with chunked transfers.

**Data quality assessment:** Enabling automated data quality assessment is crucial to ensure reliable fine-tuning (e.g., model cards that reference dataset provenance and traceability)

**Policy Enforcement for Fine-Tuning:** Ensuring consumers adhere to usage policies by enforcing digital contracts using Verifiable Credentials and GXDCH, through the EDC Policy Engine.



# Bringing it all together with Data Space and Connectors







# Thank you!

#### Ramy Hcini | ramyhcini@think-it.io

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#### Second day best Gaiamon trainers:

- o Julien Vanwambeke



The winners will be contacted by the Gaia-X Academy team

# Hackathon Winner Announcement

#### 14:45

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