

EUROPEAN INTEROPERABILITY REFERENCE ARCHITECTURE TEMPLATE FOR DATA INTEGRATION

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Abstract

EIRA (European Interoperability Reference Architecture) is a reference architecture meant to guide how to build interoperable solutions for European software (digital) services. The main tooling ecosystem is based on the ArchiMate environment. The defining sections of this reference architecture cover Architectural Building Blocks (ABBs), views, viewpoints, and a Data Space perspective.

A Solution Architecture Template (SAT) is a specification of EIRA applied to a particular interoperability problem. A SAT addresses the solution experts and architects of the domain proposal, providing guidance into the organizational, semantic, and technical matters.

The problem of Data Integration comes from the domain of Data Interoperability, which is a main concern of Interoperable Europe initiative of the European Commission. There is an SAT proposal in this area named SAT4OpenData that addresses the Open Data domain, more specifically, "to the practice of publishing (raw) data in a way that is accessible, reusable, machine-readable and licensed permissively".

In this paper, we will discuss the problem of Data Integration in the context of EIRA and how such a SAT proposal could be approached.

Keywords: *EIRA; public services; e-Government; software interoperability; application integration; SOA.*

JEL Classification: L86; C88; M15.

1. EIRA EUROPEAN INTEROPERABILITY REFERENCE ARCHITECTURE

EIRA is an architecture content metamodel “defining the most salient architectural building blocks (ABBs) needed to build interoperable e-Government systems” (European Union, 2020).

EIRA provides a common language to be used in the development lifecycles of the interoperable e-Government systems and extends the ArchiMate language as a modelling notation and uses SOA architectural style.

This architecture is meant to implement the European Interoperability Framework (EIF) and is part of the ISA² programme, Action 2016.32 (European Union, 2023a).

EIRA has four main characteristics (European Union, 2023b):

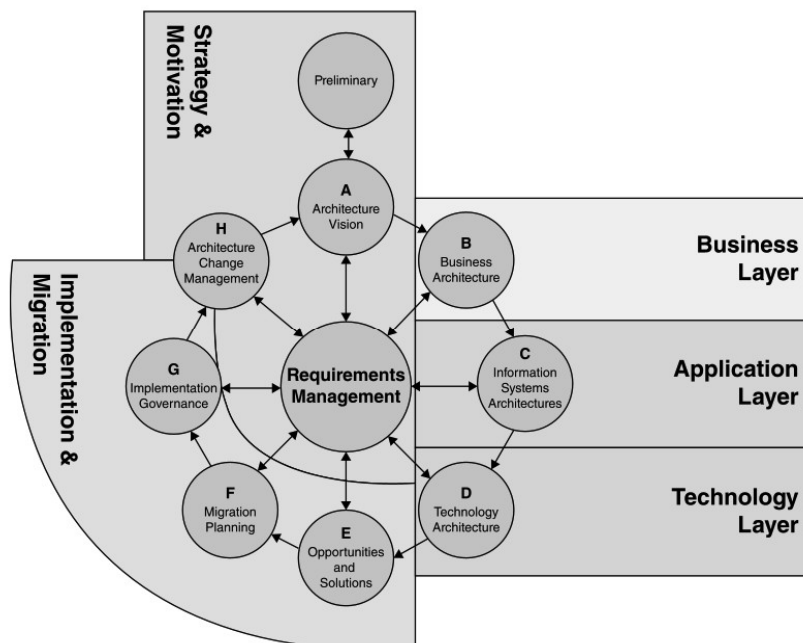
- 1) Common terminology to achieve coordination;
- 2) Reference architecture for delivering digital public services;
- 3) Technology – and product-neutral and a service-oriented architecture (SOA) style;
- 4) Alignment with EIF and TOGAF.

2. ARCHIMATE LANGUAGE

ArchiMate is an open and independent modelling language for Enterprise Architecture that “provides a uniform representation for diagrams that describe Enterprise Architectures and offers an integrated approach to describe and visualize the different architecture domains together with their underlying relations and dependencies” (Josey, 2019).

This architectural language is based on these underlying standards:

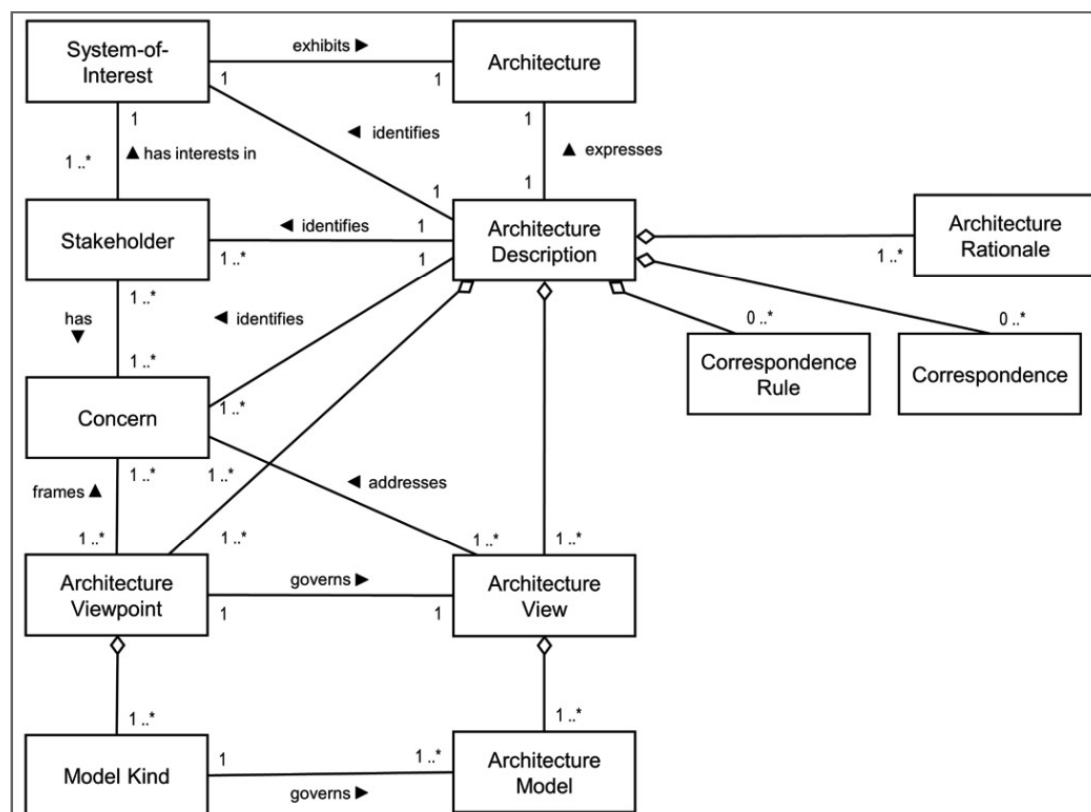
- TOGAF (The Open Group Architectural Framework),
- BPMN (Business Processing Modelling Notation),
- UML (Unified Modelling Language),
- BIZBOK Guide (Business Architecture Body of Knowledge Guide)
- BMM (Business Motivation Model).



Source: Open Group Library (2024)

Figure 1. ArchiMate alignment with TOGAF

The ArchiMate authors propose a conceptual model (see Figure 1) in line with TOGAF enterprise layers (business, application, technology) to build solid and sound enterprise software systems. Also, they propose two orthogonal layers, as Strategy & Motivation, and Implementation & Migration, to align the enterprise systems with the enterprise vision and with the planning and governance objectives of the enterprise (Priyadharshini, 2023).



Source: Open Group Library (2024)

Figure 2. ArchiMate alignment with TOGAF

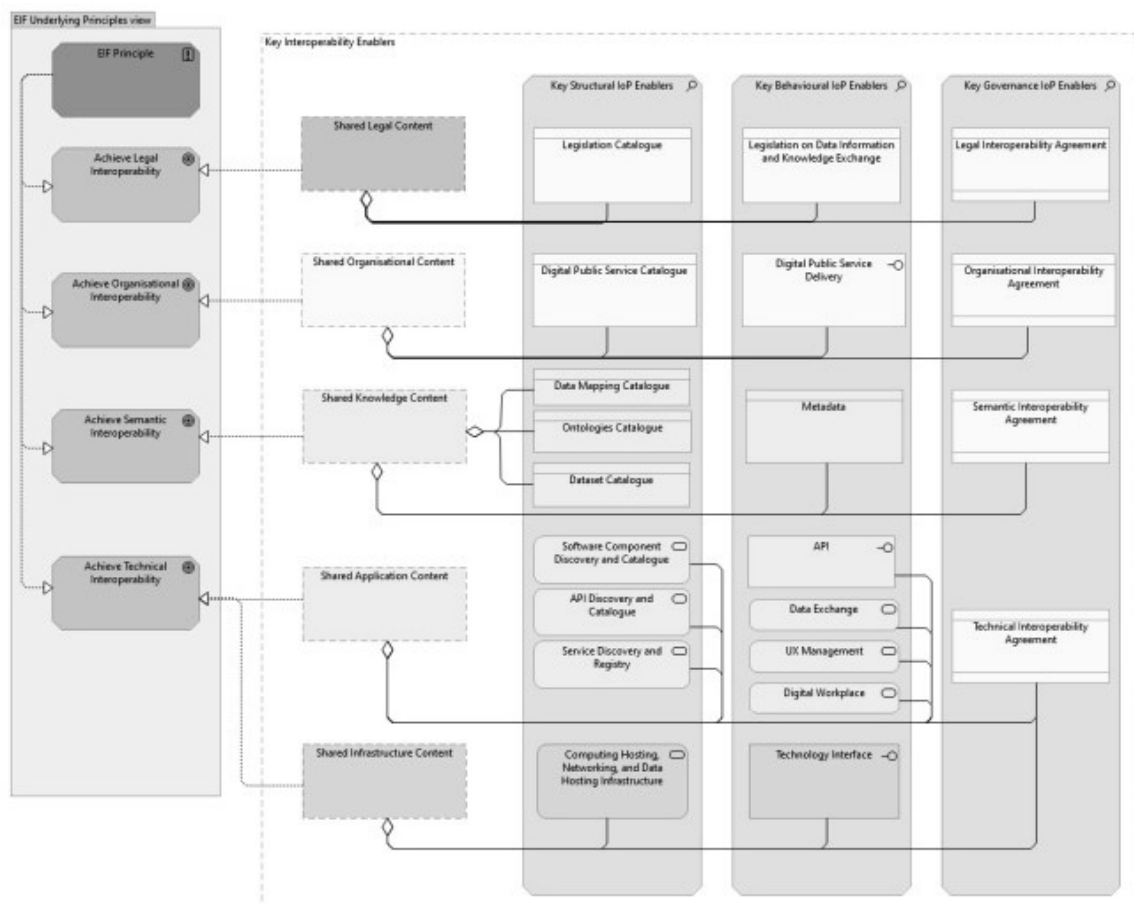
This way the ArchiMate conceptual model is engineered to align with TOGAF tenets so that architectural layers (see Figure 2) to support an architecture described with building blocks from architecture views, architecture viewpoints, and architecture models (application, and technology layers). Also, concepts like stakeholders, concerns, and architecture rationales are critical to align the architecture with the critical enterprise strategies and visions (the business layer).

3. EIRA EXTENSION OF THE ARCHIMATE: KEY CONCEPTS

EIRA (as of European Interoperability Reference Architecture) represents a standardization initiative at the EU level of decision to respond consistently to the public service integration problem. EIRA is founded on ArchiMate conceptual model and extends it in the business context of governmental software services.

The EIRA key (extended) concepts refer to (European Union, 2023b):

- *EIF interoperability level* and *EIF principles* cover the recommendations and principles to define the public services.
- EIRA views and EIRA viewpoints formalize EIF principles (as of ArchiMate graphical notations) and apply to specific stockholders' interests.
- *Architecture Building Block (ABB)* represents abstract and reusable components to be used in SBB concrete specifications.
- *Solution Building Block (SBB)* consists in the actual architectural solutions to business requirements.
- *Reference Architecture* make up an architectural solution using ABBs.
- *Solution Architecture* embodies an actual solution using the reference architecture.
- *Solution* implements the Solution Architecture with SBBs.



Source: The Open Group Library (2024)

Figure 3. EIRA architectural viewpoints

The EIRA specific architectural solution is based on several viewpoints (see Figure 3 that emphasize the viewpoints' relationships):

- Conceptual Model for Integrated Public Service Provisioning viewpoint,
- EIRA Ontology viewpoint,
- High-level viewpoint,
- Interoperability Governance viewpoint,
- Interoperability Privacy viewpoint,
- Interoperability Security viewpoint,
- Key Interoperability Enablers viewpoint,
- API viewpoint,
- Interoperable European Solution viewpoint.

Based on the viewpoints (pictured in Figure 3) EIRA define 5 architectural views extended from TOGAF principles of ArchiMate model:

- The Legal view,
- The Organizational view,
- The Semantic view,
- The Technical view (composed of an application and infrastructure part),
- The European Interoperability Framework underlying principles view.

4. OPEN DATA INITIATIVE

The EU defines “Open data” as ”data that anyone can access, use and share.” (European Union, 2024a).

Open data coming from public services (public data, public sector information- PSI or government data) should support the decision process of governments and businesses and are regulated by:

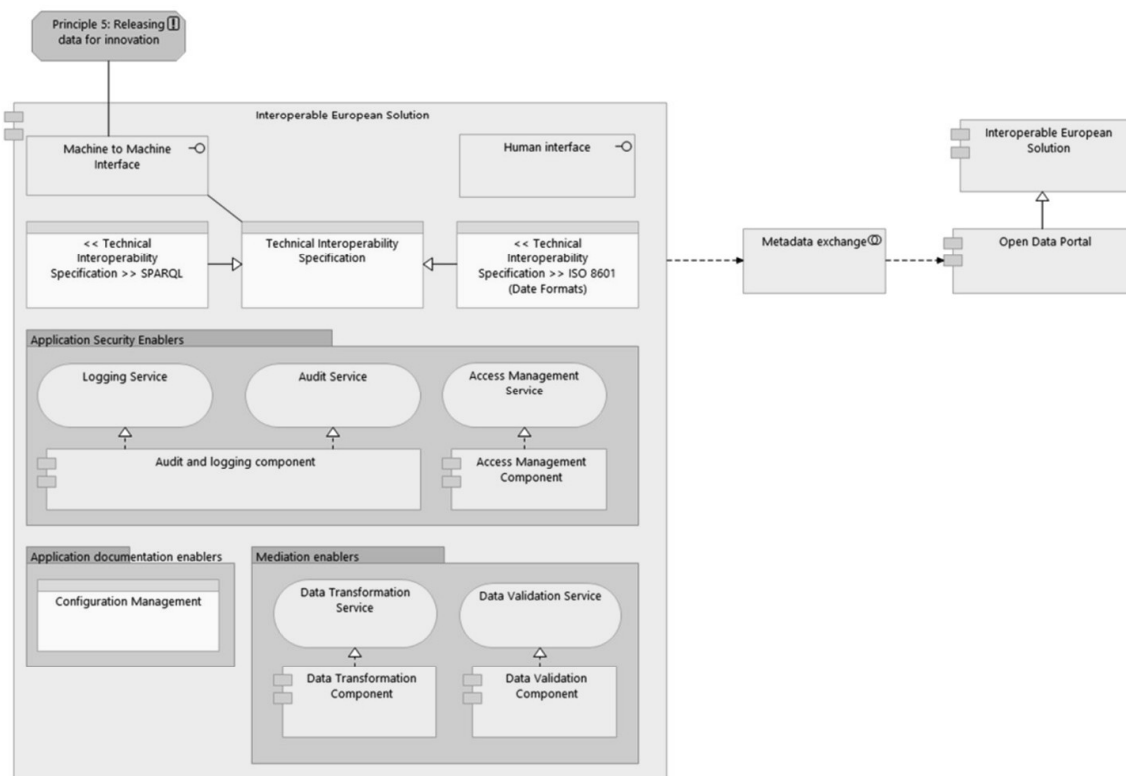
- Open Data EU directive: Directive (EU) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information.
- Open Transposition to Romanian Legislation: “Legea nr.179/2022 privind datele deschise și reutilizarea informațiilor din sectorul public”.

5. SAT4OpenData

SAT means *Solution Architecture Template* and represents Solution Architecture tailored for a specific domain (within EU interest). This way, *SAT4OpenData* represents a SAT proposal for Open Data domain and its audience consists in architects, policy makers and public administrations. (European Union, 2024b). SAT4OpenData proposes several Interoperability Views:

- Legal View
 - Public Data Policies, Constraints
 - Legal Interoperability Specification.

- Organization View
 - Public Services, Providers and Consumers
- Semantic View
 - Representation, Data Model, Data Set, Descriptive Metadata
- Technical View - Application
 - Technical Interoperability Specs like SparQL
 - Data Transformation Services and Components
- Technical View – Infrastructure (pictured in Figure 4)
 - Data Publication Services
 - Metadata Management Services.



Source: EIRA 6.0.0 Specifications (European Union, 2024b)

Figure 4. Technical View – Application

6. DATA INTEGRATION

We consider SAT4OpenData a very welcome SAT initiative, but at the same time, we think that there are several data integration challenges that must be taken into consideration by this architecture, and this way it could be enhanced as the next level of Open Data Architecture.

There are several consistent Data Integration definitions in the literature:

“... a set of techniques that enable building systems geared for flexible sharing and integration of data across multiple autonomous data providers” (Doan *et al.*, 2012)

“... a set of procedures, techniques, and technologies used to design and build processes that extract, restructure, move, and load data in either operational or analytic data stores either in real time or in batch mode.” (Giordano, 2010)

“The practice associated with managing data that travels between applications, data stores, systems, and organizations is traditionally called data integration. (Reeve, 2013)

Taking into consideration the above definitions, one could summarize several data integration problems and challenges that must be addressed also in the context of EU Open Data initiatives:

- Format: heterogeneous data format/data models,
- Accessibility and autonomy: networking, access drivers, web-enabling
- Synchronous/Asynchronous Systems,
- Scope: Operational/Transactional (OLTP) vs. Analytical (OLAP.BI),
- Complexity: number of sources, data format (in)compatibilities,
- Source Data Query Language/Procedures (to extract data).

7. CONCLUSION: SAT4OPENDATA EXTENSION FOR DATA INTEGRATION

In this paper, we try to make an argument for an initiative that *SAT4OpenData* to further develop or extend the following interoperability extension views:

- Legal View: to describe the licenses required to combine data,
- Semantic View
 - Semantic Interoperability Spec to cover also the specific aspects of Data Integration,
 - Data Standard to describe the Data formats implied by the Data Integration operations,
- Technical View - Application
 - Technical Interoperability to produce the REST and/or GraphQL API Specifications for Interoperability,
 - Data Transformation Services and Components as Data Integration Services and Components,
- Technical View - Infrastructure
 - Digital Service Infrastructure to take into consideration the Infrastructure Data Integration and Consolidation Service Specs.

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