

Enhancing Scholarly Knowledge Graph Interoperability through SKG-IF Integration in TeslaRIS

Extended Abstract

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1. Introduction and Motivation

Research information systems (CRIS) and scholarly knowledge graphs (SKGs) are core components of modern research infrastructures. Numerous initiatives at institutional, national, and international levels support Open Science by exposing structured scholarly metadata. It includes institutional CRIS platforms, aggregator services such as OpenAIRE Graph, and OpenCitations, etc. Although many of these systems rely on graph-based representations, practical interoperability between them remains limited. Data exchange is often based on heterogeneous APIs, proprietary schemas, or only partially aligned semantic models, which leads to fragmentation and duplicated effort.

This lack of interoperability particularly affects CRIS platforms, which are expected to exchange semantically rich and provenance-aware data with aggregators and European-level infrastructures. The Scientific Knowledge Graph Interoperability Framework (SKG-IF) addresses these challenges by defining a common conceptual model and standardized, API-based access to scholarly knowledge graph data. Its data model reuses established ontologies, notably the Semantic Publishing and Referencing (SPAR) Ontologies (Peroni & Shotton, 2018) and the Provenance Ontology PROV-O (Lebo et al., 2013). Aligning CRIS platforms with SKG-IF enables institutional systems to function as interoperable components of a distributed network of scholarly knowledge graphs, reducing duplication of effort and improving reuse across infrastructures (Aryani et al., 2020). However, production-level implementations of SKG-IF within operational CRIS platforms have so far been limited.

This paper presents the design and deployment of a full SKG-IF integration in TeslaRIS, an open-source CRIS developed and used at the University of Novi Sad, and evaluates its contribution to improving institutional interoperability.

2. Objectives and Scope

The primary objective of this work was to enhance the interoperability of TeslaRIS by implementing full support for the SKG-IF specification. The specific goals were:

1. To align the internal data model of TeslaRIS with the SKG-IF conceptual and semantic model.
2. To design and implement an SKG-IF compliant API for exposing institutional scholarly data.
3. To enable TeslaRIS to act not only as a data provider but also as a consumer of SKG-IF endpoints.
4. To document the implementation in a reusable and transparent manner, supporting adoption by other institutions.
5. To evaluate the solution in a real production environment at the University of Novi Sad.

The scope of the work focuses on core scholarly entities, including persons, organizations, venues, and research products, and their relationships as represented in TeslaRIS.

3. Implementation

3.1 Data Model Alignment

A prerequisite for SKG-IF implementation was the alignment of the TeslaRIS internal data model with the SKG-IF data model. TeslaRIS already maintains a rich object model covering research products, contributors, affiliations, and venues. However, semantic gaps and structural differences required careful analysis.

The alignment process involved:

1. Mapping TeslaRIS entities to corresponding SKG-IF entity types
2. Harmonizing identifiers, controlled vocabularies, and relationship semantics
3. Extending the internal model where necessary to ensure lossless transformation
4. Implementing the required API discovery and healthcheck infrastructure, proposed by API specification

The resulting model alignment was documented using UML diagrams and formalized through a crosswalk expressed in the Simple Standard for Sharing Ontological Mappings (SSSOM). This crosswalk serves as a machine-readable and human-readable specification of semantic equivalence between the two models.

3.2 Crosswalk and Semantic Mapping

The SSSOM-based crosswalk covers key entities, including Agent, Person, Organization Unit, Venue, Journal, Conference Proceedings, and Research Product subtypes (e.g., journal articles and conference papers). A dedicated GitHub Wiki page has been created to publish and document the mappings:

<https://github.com/sci2zero/TeslaRIS-backend/wiki/Crosswalks>. By explicitly documenting these mappings, the implementation ensures transparency, maintainability, and extensibility.

This approach also supports future evolution of either model, as changes can be localized within the mapping layer rather than requiring ad hoc code modifications.

3.3 SKG-IF API Implementation

The SKG-IF API was implemented as a native component of the TeslaRIS backend. The implementation fully complies with SKG-IF specification version 1.1.0 and includes:

- Standard SKG-IF endpoints for entity retrieval
- Support for pagination and filtering mechanisms defined by the framework
- Content negotiation with support for JSON-LD (default) and RDF/Turtle serializations
- Proper handling of identifiers and links between entities
- Follows SKG-IF context and vocabulary standards
- Additional TeslaRIS extensions, including date range filtering and output format selection (for single entity export) are fully backward compatible

The API exposes more than 125,000 scholarly entities stored in the TeslaRIS instance at the University of Novi Sad, making them accessible to external systems in a standardized, machine-actionable manner. The endpoint is available at <https://cris.uns.ac.rs/api/skg-if/>. At the February 8th 2026 there are:

- [38.811 research products](#)
- [77.653 venues](#)
- [12.817 persons](#)
- [269 organisations](#)

One example of filtering research product is by contributor, for instance to fetch all products published by the researcher Lidija Ivanovic (<https://cris.uns.ac.rs/sr/persons/3066>), the following filter can be used https://cris.uns.ac.rs/api/skg-if/product?page=0&page_size=50&filter=contributions.by:3066, or if we want to use a global identifier such as ORCID ([0000-0003-4168-8633](#)), Scopus Author ID ([55196082500](#)), OpenAlex ID ([A5054736502](#)), we can use the following request filters:

https://cris.uns.ac.rs/api/skg-if/product?page=0&page_size=50&filter=contributions.by:identifiers.value:0000-0003-4168-8633

https://cris.uns.ac.rs/api/skg-if/product?page=0&page_size=50&filter=contributions.by:identifiers.value:55196082500

https://cris.uns.ac.rs/api/skg-if/product?page=0&page_size=50&filter=contributions.by.identifiers.value:A5054736502

For a certain research output we can request response in JSON or Turtle format, for instance:

<https://cris.uns.ac.rs/api/skg-if/product/32467?format=json>

<https://cris.uns.ac.rs/api/skg-if/product/32467?format=ttl>

3.4 Importing Data from External SKG-IF Sources

```
{
  "sources": [
    {
      "sourceName": "CRIS UNS",
      "baseUrl": "https://cris.uns.ac.rs/api/skg-if",
      "metadataFormatParameter": "format",
      "dateFromFilterParam": "dateFrom",
      "dateToFilterParam": "dateTo",
      "additionalFilters": "product_type:literature",
      "converterClass": "SKGIFConverter",
      "sourceIdentifierPrefix": "TESLARIS"
    }
  ]
}
```

In addition to exposing data, TeslaRIS was extended to consume data from external SKG-IF endpoints. A configurable harvesting mechanism allows administrators to define external sources, specify filtering parameters, and control identifier management to avoid conflicts, all using simple JSON-based configuration files. After defining sources in respective configuration files, they will seamlessly appear in the harvester UI, ready for use.

Harvest data

External sourcesOAI-PMH sourcesSKG-IF sourcesScheduled harvests

SKG-IF source*
CRIS UNS

Contributor identifierInstitution identifier

Start dateEnd date

DayMonthYearDayMonthYear

Schedule scan

Once set-up, the scheduled task will appear in the “Scheduled Harvests” tab.

This dual role (provider and consumer) positions TeslaRIS as an active participant in a distributed SKG ecosystem rather than a passive data source.

4. Conclusions

The SKG-IF integration was deployed in the production TeslaRIS instance and achieved full compliance with SKG-IF version 1.1.0, including discovery and health-check endpoints. Interoperability was validated through successful bidirectional data exchange between two TeslaRIS instances configured in a provider-consumer setup.

From a CRIS perspective, SKG-IF offers a promising complement to established standards such as CERIF. Rather than replacing existing reporting-oriented formats, SKG-IF enables dynamic, API-based interoperability suitable for modern, graph-driven research infrastructures.

This work directly addresses key themes of the euroCRIS community, including interoperability, Open Science, and integration with the European Open Science Cloud (EOSC). By operationalizing SKG-IF within an institutional CRIS, the project demonstrates how local research information systems can align with the EOSC Interoperability Framework and participate in a federated European knowledge space.

The open-source nature of TeslaRIS and the documented SKG-IF integration provide a reusable blueprint for other institutions, particularly those seeking vendor-neutral solutions. The approach supports FAIR principles at the metadata level, with particular emphasis on interoperability and reusability.

References

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