HELLENIC REPUBLIC National and Kapodistrian University of Athens



Towards a Decentralized, Trusted, Intelligent and Linked Public Sector: A Report from the Greek Trenches*

Themis Beris, **Iosif Angelidis**, Ilias Chalkidis, Charalampos Nikolaou, Christos Papaloukas, Panagiotis Soursos and Manolis Koubarakis

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Pipeline - Nomothesi@



Ontology - Nomothesi@ (ELI)



Persistent URI: http://legislation.di.uoa.gr/eli/{typeoflegislation}/{year}/{id}

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Ontology - Nomothesi@ (Entities)



Persistent URI: http://legislation.di.uoa.gr/entity/{typeofentity}/{id}

Diavgeia: The Greek Transparency portal (current state)



Four problems of the current implementation

- 1. The decisions are PDF files which follow no structuring of their textual content \rightarrow Keyword search
- 2. The decisions also make references to the Greek legislation → How can we be sure that the decisions are taken according to the law (i.e. that legislative references exist)?
- 3. Possible Metadata Text Document inconsistency
- 4. No integrity mechanism which ensures the immutability of all decisions over time

Our motivation is simple:

Diavgeia Redefined

A reengineering of Diavgeia to solve these problems, using Semantic Web Technologies and Permissionless Blockchains



Contributions

Semantic Web Tools

- Diavgeia Ontology (models the decisions of Diavgeia)
- Web Editor and Visualizer (author and visualize the RDF decisions)
- SPARQL endpoint (interested parties pose interesting queries)

Blockchain tools

- Stamper (stores decisions expressed in RDF on Bitcoin blockchain)
- Consistency Verifier (verifies the immutability of the decisions)

The decisions follow a common pattern:

Appointment of R.F. as Full Professor

In accordance with:

- 1. The provisions of Law 3549/2007, article 25, paragraph 1.
 - 2. The provisions of Presidential Decree 2011/54.
- 3. The provisions of Law 4386/2016, article 70, paragraph 4.

We decide:

1. The appointment of R.F. as Full Professor at the X department, at the Y university, on the subject of "Semantic Web".

The decision is also assigned a unique **Internet Uploading Number (IUN)** and **Version token** that are its identifiers. **Appointment** is 1 out of **34** different decision types that a public authority may upload on the transparency portal.

DiavgeiaRedefined Ontology



Persistent URI: *http://www.diavgeia.gov.gr/eli/{iun}/{version}* **121 different properties** to cover all the particularities of different decision types.

Web Editor: A tool to author the decisions

- This tool is used exclusively by the public sector authorities.
- The Web Editor is a well-structured HTML form that authorities use to write online their decisions → The entities of the HTML form are mappings to the properties of the Diavgeia ontology.
- Upon the form submission, the decision is stored both as a compressed Notation3 file in the filesystem of Diavgeia and in Jena Apache's triple store.
- Interlinking with other public sector datasets (Nomothesia and administrative geography dataset of Greece).

Decisions are now 5-star open linked data



Visualizer

- This tool is used both by the public sector authorities and citizens.
- Provides a visualization of the RDF decisions inside a Web browser → The entities of the RDF decisions are mappings to HTML entities.



Stamper: The tool towards decentralization



Stamping data published on Diavgeia

After the end **of each stamping transaction**:

• The **order of the decisions**, as used on the Merkle Tree construction.

It is also published **once**:

• The **Master Public Key** of the Bitcoin Wallet of Diavgeia.

Experimental results: Consistency Verifier

Setup

<u>Data</u>

 Synthetic compressed Notation3 decisions

<u>Simulation</u>

- Verify the consistency in a month's common workload (22 days)
- 3 datasets (8, 16 and 24 thousand decisions per day)

<u>Test Environment</u>

 Macbook Pro with 2.9GHz i5, 8GB RAM



Evaluation of Consistency Verifier

Experimental results: Disk Space reduction

Diavgeia currently hosts over 26 million PDF-decisions.

• Disk space limitations.

Sample consisting of equivalent PDF and compressed Notation3 files.

• Compressed Notation3 files \rightarrow x86 disk space reduction.

Diavgeia Redefined in a nutshell



Lessons Learned (socially)

- Bringing new technologies to the public sector in Greece is very difficult.
- Keep working on systems which positively disrupt the public sector.
- Knowledge about Semantic Web technologies makes the public more supportive.
- Teaching postgrads Semantic Web and Linked data technologies could be beneficial.
- Collaborate with researchers from other disciplines to improve the lives of citizens.

Future Work

Nomothesia

- Implementation of QA systems, chatbots.
- Make Nomothesia more robust (NLP technologies) and augment the corpus of docs.
- Interlink with more third-party datasets, extend ontology.

DiavgeiaRedefined

- Use other underlying blockchain technologies (e.g., Ethereum).
 - Transaction cost
- Full verification procedure to ensure the data integrity of the SPARQL endpoint.

Thanks!

Any questions?



http://legislation.di.uoa.gr



http://pyravlos-vm5.di.uoa.gr/diavgeia





