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

*These slides are available under a non-commercial license. To view a copy of this license, visit http://creativecommons.org/licenses/by-nc-sa/4.0/.
Motivation - Nomothesi@
Ontology - Nomotethi@ (ELI)

Persistent URI: http://legislation.di.uoa.gr/eli/{typeoflegislation}/{year}/{id}
Ontology - Nomothesi@ (Entities)

Persistent URI: http://legislation.di.uoa.gr/entity/{typeofentity}/{id}
Diavgeia: The Greek Transparency portal (current state)

Public Authorities (Ministries, Court System, Independent Authorities, etc.)

Greek Government

Public Authorities

Ordinary Citizens

Journalists
Four problems of the current implementation

1. The decisions are PDF files which follow no structuring of their textual content → 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:
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.
Diavgeia Redefined 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

1. Public authorities upload their decisions

2. Start of Stamping

3. Merkle Tree Construction

4. Bitcoin transaction (OP_RETURN)

Centralized Network of DiavgeiaRedefined

1. Public authorities upload their decisions

2. Start of Stamping

3. Merkle Tree Construction

4. Bitcoin transaction (OP_RETURN)
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

Data
- Synthetic compressed Notation3 decisions

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

Test Environment
- Macbook Pro with 2.9GHz i5, 8GB RAM
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

Web Editor → Diavgeia Ontology

Diavgeia Redefined

Stamper

Visualizer
Consistency Verifier
Semantic Queries
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