

# Geolinked Open Data for the Municipality of Catania

Sergio Consoli<sup>a</sup>, Aldo Gangemi<sup>a,c</sup>, Andrea G. Nuzzolese<sup>a,b</sup>, Silvio Peroni<sup>a,b</sup>, Valentina Presutti<sup>a</sup>, Diego Reforgiato Recupero<sup>a</sup>, Daria Spampinato<sup>a</sup>

a. National Research Council (CNR), Institute of Cognitive Sciences and Technologies, STLab, ITALY

b. University of Bologna, Department of Computer Science, ITALY

c. University Paris 13, LIPN, Sorbone Cité, UMR CNRS, FRANCE

[www.sergioconsoli.com](http://www.sergioconsoli.com), [sergio.consoli@istc.cnr.it](mailto:sergio.consoli@istc.cnr.it)

# Introduction

- Smart Cities project *PRISMA* funded by the Italian Ministry of Research and Education
  - within the spirit of the Smart Cities initiatives of the European Commission,
  - aims at bringing together cities, industry and citizens to improve urban life through more sustainable integrated solutions.
- GOAL: experimenting social eGovernment systems aimed at optimizing the performance of the Public Administration (PA) of the Municipality of Catania (MoC) by
  - intelligent ICT services
  - external evaluation of the PA
  - conceiving, designing and prototyping applications for the MoC
- Approach completely generalizable

# A field of implementation: management of mobility

- Road traffic and public transport
- Development of an app to inform on the state of roads in urban areas:
  - to support sustainable mobility,
  - to aid the response to urban emergencies.
- AIM: connecting drivers to create local driving communities that work together to advise on unexpected accidents or other traps.
  - important role on emergency logistics
    - to find rapidly the nearest hospitals,
    - to obtain the best way outs from the emergency zones,
    - to produce the optimal path connecting two suburbs for traffic redirecting.

# HowTo: LOD for PA

- Data source: Geographic Information System of the MoC (SIT)
- Process data in order to make them open, interoperable and compatible with the principles of Linked Open Data.
  - Similarly to initiatives in the United States (data.gov) [10, 11] and the United Kingdom (data.gov.uk) [12]
- LOD have been published in Italy by the city hall of Florence, Agency for Digital Italy, from the Piedmont region, the Chamber of Deputies.
  - Beside these initiatives, another notable for the Italian PA is “data.cnr.it” [13, 14], the open data project of the National Research Council (CNR), designed and maintained by the Semantic Technology Laboratory of ISTC-CNR, and shared with the unit Information Systems Office of CNR.

# Extraction of Linked eGovernment Data for the MoC

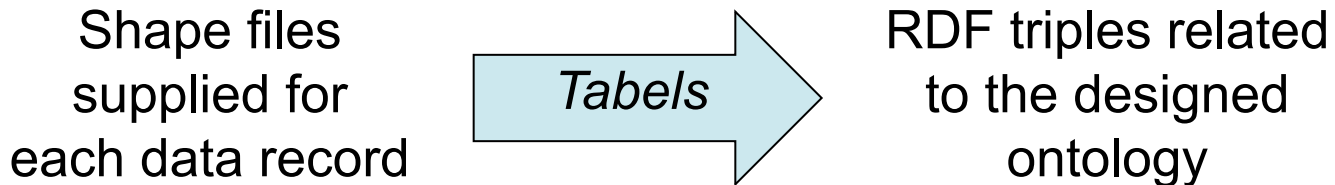
- Methodology based on
  - standards of the W3C,
  - good international practices,
  - guidelines issued by the Agency for Digital Italy [15, 16] and those by the Italian Index of Public Administration,
  - experience of the participants on this field (e.g. “data.cnr.it” [13, 14]).
- Close interaction with the PA experts of the MoC
- The SIT is a data warehouse used for reporting and data analysis
  - databases, hardware, software, and technicians
  - Management of information of the province of Catania based on a geographical space [6].

# Extraction of Linked eGovernment Data for the MoC

- The SIT contains three types of data (in Italian):
  - *register base*,
  - *registry office*,
  - *toponymy*,
- It also includes maps containing geo-referenced information
  - Shape-based files [17] for each data record
  - basic cartography; ortho-photos; road graph; cadastral sections; data from the census of the population; Master Plan; gas network; on-going works; ...
  - accident traffic data; road signs and markings; maintenance state of roads and sidewalks; management of roadway construction; public transport fleet; data of the municipal police; management and working state of the fleet; ....

# Geo-data modelling and reengineering

- We used *Tabels* by CTIC



- Spatial KML geometry representation
  - geodetic system Gauss-Boaga (or Rome 40)
- Mapping to existing vocabularies (NeoGeo, suitable for geo-data)
- Transformation program → Customizable SPARQL script
  - Each column value is converted into a new RDF triple where the subject is the instance mentioned, the predicate is a property based on the name of the column header, and the object is the value of the column as a `rdfs:Literal`.

# Ontology

- 1) Conversion into draft OWL ontology
  - each table represented by a class and each field by a data property.
  - fully automatic XSLT transformation from supplied XML
  
- 2) From interim draft ontology and available data, a first version of the ontology in OWL was produced.
  - Followed W3C Organization Ontology (name of classes at singular; names of data properties showing the same semantics were aligned; data properties that seemed to refer to individuals of other classes, probably having foreign key functions on the data base, were transformed into object properties;.....)
  
- Resulting ontology (854,221 triples):

<http://www.ontologydesignpatterns.org/ont/prisma/ontology.owl>



# Ontology: example

- Resource “*Ente*”:

<http://www.ontologydesignpatterns.org/ont/prisma/Ente>

## Ente

### Predicate

<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>

<http://www.w3.org/2000/01/rdf-schema#label>

### Object

<http://www.w3.org/2002/07/owl#Class>

ente



### Credits

# Data consumption

- Ontology and data can be publicly queried by selecting the RDF graph called *<prisma>* on the dedicated SPARQL endpoint accessible at <http://wit.istc.cnr.it:8894/sparql>
- The endpoint is also accessible as a REST web service, with synopsis:
  - URL ⇒ <http://wit.istc.cnr.it:8894/sparql>
  - Method ⇒ GET
  - Parameters ⇒ query (mandatory)
  - MIME type supported output ⇒ text/html; text/rdf+n3; application/xml; application/json; application/rdf+xml.
- Data are also accessible through content negotiation (also as REST ws)
  - Namespace for the ontology (prefix *prisma-ont*):  
<http://www.ontologydesignpatterns.org/ont/prisma/>
  - Namespace for data (prefix *prisma*):  
<http://www.ontologydesignpatterns.org/data/prisma/>

# Content negotiation: example

- Resource “*Arco Stradale*”:

<http://www.ontologydesignpatterns.org/data/prisma/arcostradale/1001>

## arcostradale/1001

### Predicate

<http://www.ontologydesignpatterns.org/ont/prisma/codice>

<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>

<http://www.ontologydesignpatterns.org/ont/prisma/forma>

<http://www.ontologydesignpatterns.org/ont/prisma/ente>

### Object

1001^^<http://www.w3.org/2001/XMLSchema#integer>

<http://www.ontologydesignpatterns.org/ont/prisma/ArcoStradale>

<http://geovocab.org/geometry#LineString>

<http://www.ontologydesignpatterns.org/data/prisma/ente/01>

### Credits



# Conclusions and outlook

- Application of Linked Open Data for PA of the MoC (Geographic Information System, SIT)
- Followed standards of the W3C, good international practices, guidelines issued by the Agency for Digital Italy and the Italian Index of Public Administration, as well as the experience of the participants
- Data are publicly accessible to users through a dedicated SPARQL endpoint, or alternatively through calls to dedicate REST web services
- In currently on-going work a mobile application based on this LOD and related to sustainable mobility and emergency vehicle routing is under development.
- Boosting the metropolis towards the route of a modern Smart City.

# References

- [1] Berners-Lee, T., Chen, Y., Chilton, L., Connolly, D., Dhanaraj, R., Hollenbach, J., Lerer, A., Sheets, D.: Tabulator: Exploring and analyzing linked data on the semantic web. In: Proceedings of the 3rd International Semantic Web User Interaction Workshop, SWUI 2006, Athens, USA (2006)
- [2] Bizer, C., Heath, T., Berners-Lee, T.: Linked Data - The Story So Far. *International Journal on Semantic Web and Information Systems* 5(3) (2009) 1–22
- [3] Tan, P.N., Steinbach, M., Kumar, V.: *Introduction to Data Mining*. Addison, Boston (2006)
- [4] Diaz, R., Behr, J., Toba, A., Giles, B., Manwoo, N., Longo, F., Nicoletti, L.: Humanitarian/emergency logistics models: A state of the art overview. Volume 45. (2013) 261–268
- [5] Liu, B.: Route finding by using knowledge about the road network. *IEEE Transactions on Systems, Man, and Cybernetics Part A: Systems and Humans*. 27(4) (1997) 436–448
- [6] Municipality of Catania: Il Sistema Informativo Territoriale. [Online] <http://www.sitr.provincia.catania.it:81/il-sit> (last accessed: May 2014)
- [7] Geiger, C.P., von Lucke, J.: Open Government and (Linked)(Open)(Government) (Data). *JeDEM - eJournal of eDemocracy and Open Government* 4(2) (2012)
- [8] Geiger, C.P., von Lucke, J.: Open Government Data. In Parycek, P., Kripp, J.M., Edelmann, N., eds.: *CeDEM11. Conference for E-Democracy and Open Government*. Volume 6317 of *Lecture Notes in Computer Science*. Springer Berlin Heidelberg (2011) 183–194
- [9] Alani, H., Dupplaw, D., Sheridan, J., O’Hara, K., Darlington, J., Shadbolt, N., Tullo, C.: Unlocking the potential of public sector information with Semantic Web technology. In: Proceedings of the 6th International Semantic Web Conference (ISWC 07). Volume 4825 of *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Springer Berlin Heidelberg (2007) 708–721

- [10] Ding, L., DiFranzo, D., Graves, A., Michaelis, J., Li, X., McGuinness, D., Hendler, J.: Data.gov Wiki: Towards Linking Government Data. In: Proc of the AAAI 2010 Spring Symposium on Linked Data Meets Artificial Intelligence, CA. Volume SS-10-07. AAAI Press (2010) 38–43
- [11] Ding, L., Lebo, T., Erickson, J.S., DiFranzo, D., Williams, G.T., Li, X., Michaelis, J., Graves, A., Zheng, J.G., Shangquan, Z., Flores, J., McGuinness, D.L., Hendler, J.A.: TWC LOGD: A portal for linked open government data ecosystems. *Web Semantics: Science, Services and Agents on the World Wide Web* 9(3) (2011) 325 – 333
- [12] Shadbolt, N., O’Hara, K., Berners-Lee, T., Gibbins, N., Glaser, H., Hall, W., Schraefel, M.: Linked Open Government Data: Lessons from data.gov.uk. *IEEE Intell Syst* 27(3) (2012) 16–24
- [13] Baldassarre, C., Daga, E., Gangemi, A., Gliozzo, A., Salvati, A., Troiani, G.: Semantic scout: Making sense of organizational knowledge. In Cimiano, P., Pinto, H., eds.: *Knowledge Engineering and Management by the Masses*. 6317 LNCS Springer Berlin (2010) 272–286
- [14] Gangemi, A., Daga, E., Salvati, A., Troiani, G., Baldassarre, C.: Linked Open Data for the Italian PA: the CNR Experience. *Informatica e Diritto* 1(2) (2011)
- [15] Agency for a Digital Italy: Linee guida per i siti web delle PA. Art. 4 della Direttiva n. 8/2009 del Ministro per la pubblica amministrazione e l’innovazione [Online] [http://www.digitpa.gov.it/sites/default/files/linee\\_guida\\_siti\\_web\\_delle\\_pa\\_2011.pdf](http://www.digitpa.gov.it/sites/default/files/linee_guida_siti_web_delle_pa_2011.pdf) (2011)
- [16] Agency for a Digital Italy: Linee guida per l’interoperabilit`a semantica attraverso Linked Open Data. Commissione di coordinamento SPC [Online] [http://www.digitpa.gov.it/sites/default/files/allegati\\_tec/CdC-SPC-GdL6-InteroperabilitaSemOpenData\\_v2.0\\_0.pdf](http://www.digitpa.gov.it/sites/default/files/allegati_tec/CdC-SPC-GdL6-InteroperabilitaSemOpenData_v2.0_0.pdf) (2012)
- [17] Lamb, A., Johnson, L.: Virtual expeditions: Google Earth, GIS, and geovisualization technologies in teaching and learning. *Teacher Librarian* 37(3) (2010) 81–85
- [18] Dodsworth, E., Nicholson, A.: Academic uses of Google Earth and Google Maps in a library setting. *Information Technology and Libraries* 31(2) (2012) 81–85

# Thank you very much for your attention

- Questions?

