TRUSTED DATA REUSE IN RESIDENCE CERTIFICATE REQUESTS BETWEEN PUBLIC OFFICERS AND MUNICIPALITY EMPLOYEES

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Distributed data interoperability and their efficient reuse is a key asset in enabling better back-office service integration in e-Government scenarios so as to allow a more efficient services provision at a front-office level. In this paper we address the problem of improving the effectiveness and efficiency of a telematic solution allowing an authorized public officer to obtain updated citizens' residence certificates from the Municipality office. The presented application is built on top of the InterDataNet architecture allowing users to collaborate aggregating distributed data from the Web. In InterDataNet each data unit has an owner responsible entitled of its management. Each authorized user will (re)use data directly from its origin without duplicating the data locally.
This work demonstrated the technical viability of this service solution through the realization of a Proof of Concept and raised the interests of the involved parties allowing the setting up of its operational prototyping.
The solution described in this work may generalize to other Public Administration scenarios where distributed actors need to collaborate on distributed data organized into structured documents. The InterDataNet infrastructural solution which handles collaboration and trust issues related to data and documents reuse, can therefore serve other application scenarios.

1. – Introduction

In this paper we provide the design details of an application related to the Italian e-Government scenario related to a specific step of the process of taxes collection managed by Equitalia S.p.A, in which an authorized public officer needs to obtain updated citizens' residence certificates from the Municipality office. The analysis of the case study will highlight the roles of the actors involved in the scenario and the models of the exchanged documents. The collaborative workflow will also be described. The presented solution is a Proof of Concept aimed at demonstrating the benefit of developing e-Government applications on top of a middleware named InterDataNet. InterDataNet (IDN) [1,2], is an infrastructural solution supporting a decentralized and scalable publication space for the Web of Data. IDN sustains global addressability of concepts and resources as well as basic collaborative-oriented services (responsibility control, versioning and replica management) for distributed and heterogeneous data management thus allowing their consistent reuse. Notwithstanding the specificities of the described scenario, the constraints and requirements easily generalize to the case in which a Public Authority, entitled to manage citizen's personal data, has to exchange those data with third parties under specific conditions while fulfilling the related regulation.

2. – The application scenario at a glance

The scenario is framed within the process of tax collection in Italy. The actors involved in the process are: Equitalia S.p.A. (the public body entitled with the tributes collection in almost all the Italian regions), Creditor Institutions (institution to which the citizen is debtor, e.g. the Municipality Police), Agent (employee of the Delivery Service), Municipalities and citizens (i.e. the taxpayers). The Creditor Institutions provide to Equitalia the list of taxpayers containing all the information needed to be authorized for tax collection. The list of taxpayers details the amount of the due charge, the reason for payment and the identification data of the taxpayer. The taxpayers list needs to be "validated" by Equitalia, through the functions performed by Equitalia Servizi, an associate company of Equitalia. The process of list validation implies: 1) verifying of the correctness of data coming from multiple taxpayers lists 2) grouping list items by taxpayer's tax code occurrence in order to create a single folder for each taxpayer; 3) finding a unique postal address for each taxpayer from a centralized tax record, namely the Anagrafe Tributaria (this means also arbitrarily affecting one address when one taxpayer is associated to multiple postal addresses); 4) assigning a tax folder number to each taxpayer's sheet; 5) creating a single data stream to be transmitted to printing services in order to obtain the paper sheets folders to be physically delivered to the taxpayers.

The printing service dispatches the printed folders to the services distributed over the national territory, entitled of delivering the "envelopes" containing the paper sheets to the citizens. The delivery service receives also the electronic version of the taxpayers list in which each debtor citizen is associated to his/her postal addresses. At this point of the workflow the Delivery Service activates an Agent entitled to physically deliver the envelopes to the citizens. The whole process is governed by national Laws; specifically, in the final phase of physical delivery of the envelopes, the official process of "address certification", i.e. the official validation of the residence address, is often required to fulfil the formal legal procedure.

This situation is therefore complex and requires that multiple actors interact and collaborate around physical as well as electronic documents containing sensible personal data. Several errors can occur throughout the process due either to incomplete or incorrect data provision by Equitalia, and due to an incorrect interpretation of the data by the other actors of the chain. Such mistakes can invalidate the process and cause economic damage either to Equitalia or to the creditor institution and therefore to the whole Nation.

2.1 The Address Certification

The Address Certification is the official act by which the Agent for the Delivery Service obtains a Residence Certificate of the debtor citizen from the entitled employee at the Municipality office. At present Agents can operate in different procedural framework to obtain citizens' addresses certification: 1) they can use fax messaging, 2) they can use the ordinary postal service 3) they can personally go to the Municipality related office, 4) they can avail of telematic solutions. The effectiveness of the above mentioned approaches is measured and compared empirically by Delivery Services in terms of "number of days between the residence certificate request and response" as illustrated in figure 1.

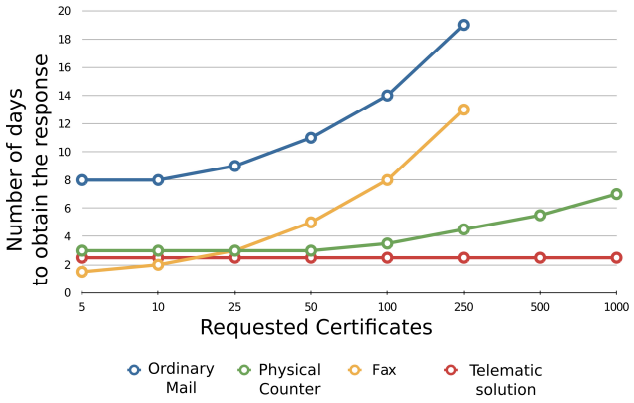

Figure 1: Effectiveness of the current approaches used for address certification (source: Il Punto Delivery Service internal report)

As a matter of fact even the telematic solution, otherwise the "expected most efficient" collaboration framework between Municipalities and Delivery Services, shows latencies in the response time due to the fact that cooperation agreements between the parties suffer from the following constraints: they are always ad-hoc, they imply different conditions of access to citizens data which span from the interrogation of an ad-hoc Web Portal provided by the Municipality (in the best case) or from the periodical duplication of citizens' addresses data base retained by the Municipality (in the worst case).

2.2 The Address Certification, design of the telematic interaction

The actors involved in the process of address certification (see figure 2) are: 1) the Agent: employee of the Delivery Service. He/she is responsible for the delivery of the envelopes to the citizens. Acting as a public official, he has the right to request and receive residence data of the population resident within his competence zone; 2) the Municipality Officer: a municipality employee responsible for the management of data related to the demographic situation of the Municipality. In the first phase of the interaction between the two actors, the Municipality Officer verifies that the agent has the authorization credentials to access the requested information, i.e. he is a public officer and holds an envelope to be delivered to a taxpayer. In the second phase of the interaction the Agent submits the request for the address certification about a specific citizen and the Municipality officer provides the requested residence certificate.

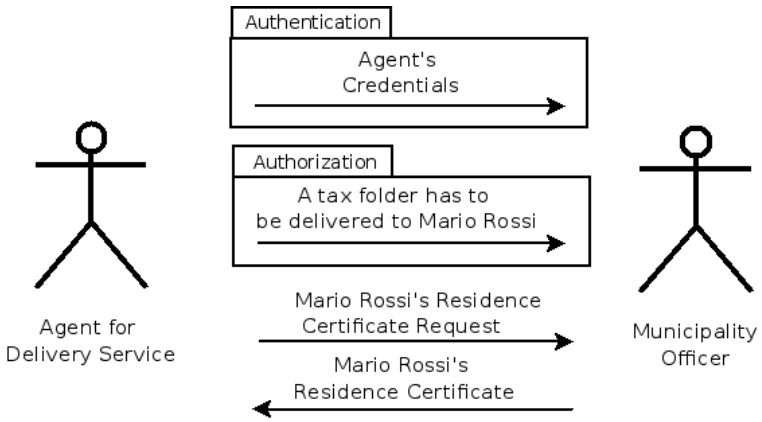

Figure 2 : The Address Certification workflow

The two actors interact and collaborate around the following information elements: 1) the envelope to be delivered to the taxpayer: this is the official act that allows the Agent to be authorised to request the address certificate of the taxpayer; 2) the address certificate of the taxpayer: the document allowing the agent to conclude the envelope delivery according to the formal procedures ruled by national Laws.

The web application described in this paper refers to the scenario detailed in figure 3 where:
- the Agent needs a residence certificate of a given taxpayer to be issued by the Municipality;
- the Agent asks the online registry office of the Municipality and requires a residence certificate to the entitled Municipality officer;
- the Municipality employee queries the resident population archive and manually fills the residence certificate with the related data.

In the steps above the role of a specific entity mediating the interaction is highlighted: the *Office Counter*. This is a virtual entity acting as the service access point, governing the information exchange between the two main actors of the scenario in order to reflect the correct workflow carried out in the physical world. The narrated scenario resorts in the functions/steps described in figure 3. In the presented Proof of Concept it's worth noticing that the authorization/authentication assumption is not carried out by the office counter, instead it is delegated to other levels of development.

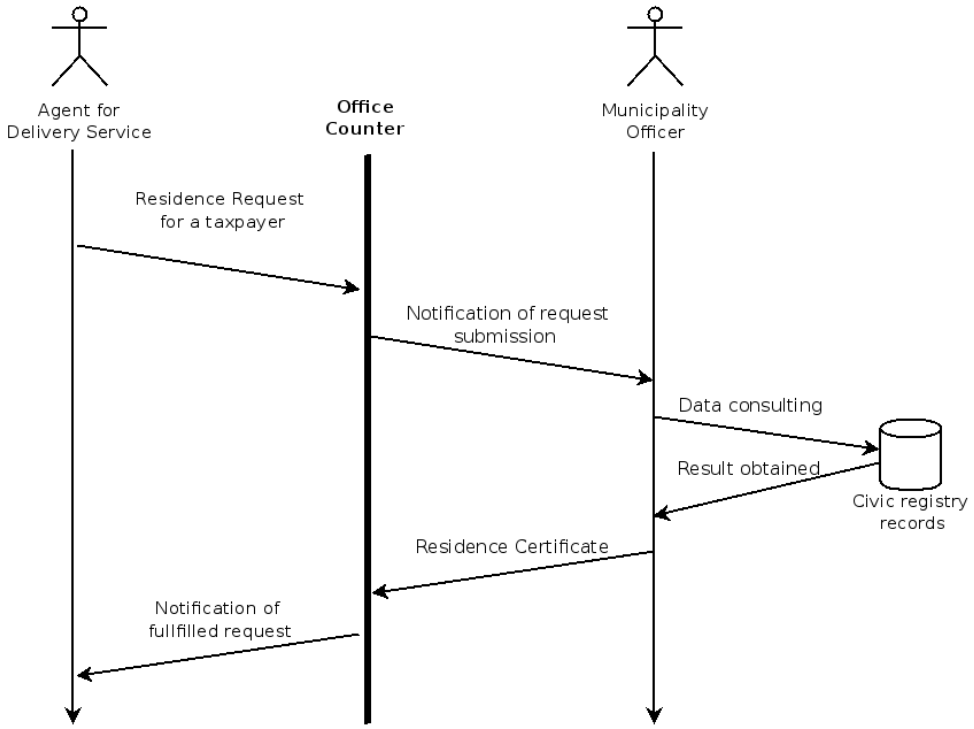

Figure 3 : Address Certification simplified workflow

3. InterDataNet in brief

InterDataNet (IDN) framework [1] [2] is described through the ensemble of concepts, models and technologies pertaining to the following three views: 1) IDN-IM (InterDataNet Information Model). It is the shared information model representing a generic document model which is independent from specific contexts and technologies. It defines the requirements, desirable properties, principles and structure of the document to be managed by

IDN. 2) IDN-SA (InterDataNet Service Architecture). It is the architectural layered model handling IDN-IM documents (it manages the IDN-IM concrete instances and allows the users to "act" on pieces of information and documents). The IDN-SA implements the reference functionalities defining subsystems, protocols and interfaces for IDN document collaborative management. The IDN-SA exposes an IDN-API (Application Programming Interface) on top of which IDN-compliant Applications can be developed. 3) IDN App (IDN- Compliant Application). It is an application which uses the documents' abstraction to perform the collaboration process for the specific context of use. Interfacing to the VR layer, the application is entitled to specify the temporal instance of the document requested.

InterDataNet middleware allows the effective and efficient information organization. InterDataNet specificity is that each data unit has an owner entitled of its management. Each user, who demonstrates the privileges needed to (re)use such data unit, will use them directly from its origin (i.e. the archive under the owner's responsibility) without duplicating the data locally. Possible data replicas as well as data versioning are managed at an infrastructural level thanks to the layered IDN Service Architecture and are protected against unauthorized use and diffusion.

4. Modelling the IDN-document for the Equitalia scenario

Two different applications have been created in order to serve the two actors, namely: 1) the Agent IDN-application; 2) the Municipality Registry IDN-application.

In section 2.2 we illustrated the high-level interaction between the agent and the municipality officer. The analysis performed has been centred around the introduction of the office counter entity, which acts as an access point to the service bridging the interactions between the actors. The adoption of the office counter allows to separate tasks and responsibilities between the actors involved in the process. Moreover it allows an asynchronous communication between the parties which is closer to reality scenarios where a latent period can exist between request and response due to different workflows on the two sides.

Hereafter we will detail the model of the (IDN-) documents handled by the two applications[3].

The IDN-document handled by the office counter entity is named "Registry Office Counter". This document has several children nodes related to the different Municipalities that can decide to offer such a service. The model proposed for "Registry Office Counter" is represented in figure 4 part (a). Moreover the two main IDN-IM documents involved in the process are:

1) IDN-Residence Request: it consists of a "root node" containing the request ID, as well as a set of "children nodes" related to the request: tax code, surname, first name, birthplace and birth date of the taxpayer as shown in figure 4 part (b).

2) IDN-Residence Certificate: it consists of a root node containing two children, which in turn contain the "Residence Situation" and "citizen's personal data" certified by the Municipality since it may happen that the residence data provided by the Registry office are not the same as those indicated in the request, both due to possible errors in transcription or following subsequent residence changes, or other events such as taxpayer death etc. This document structure is illustrated in figure 4 part (c).

The whole modelling process using IDN-IM documents leads to the following information network which synthesises the main elements of the presented case study (see figure 4).

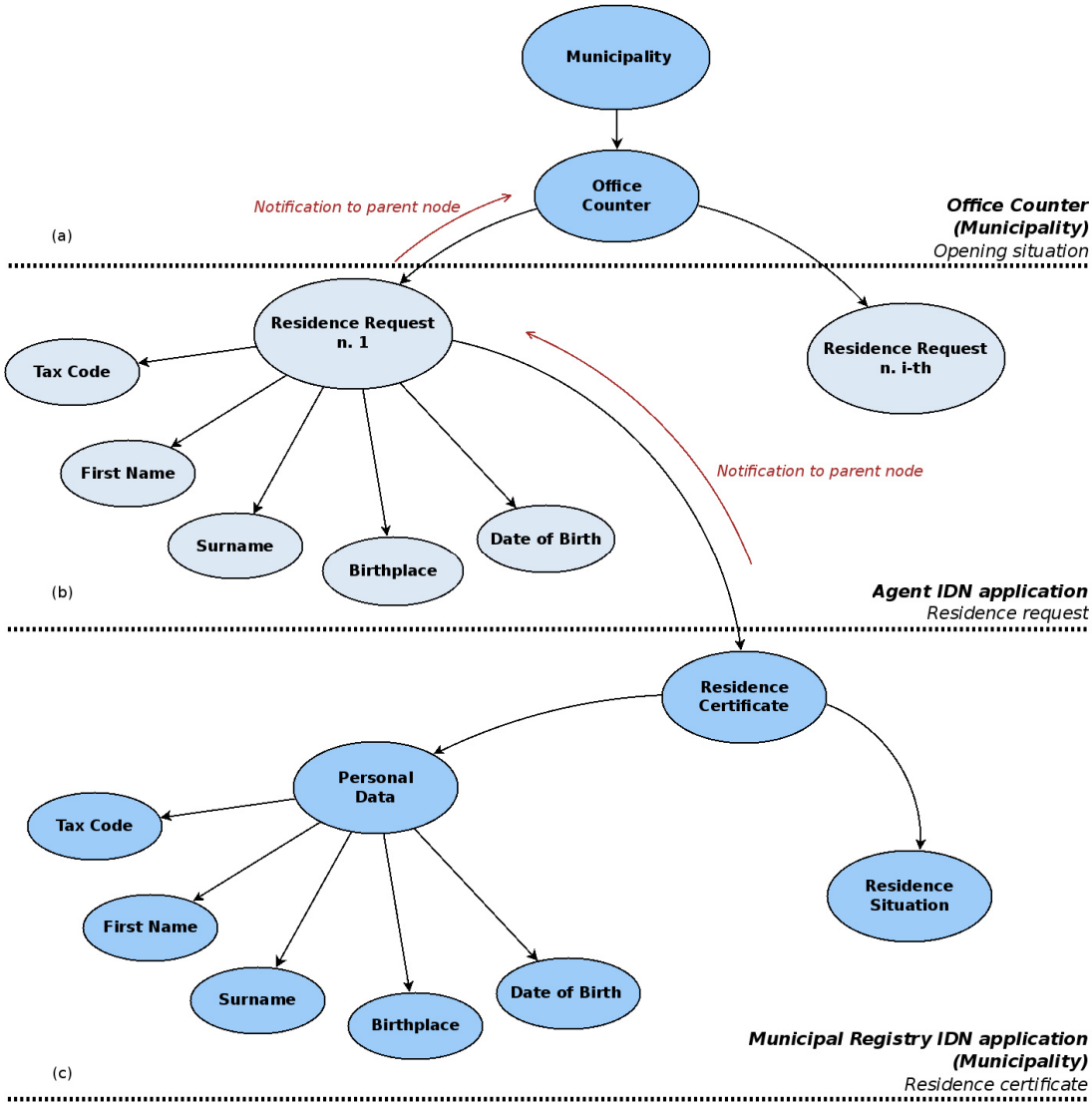

Figure 4: Modeling the case study documents with IDN

This modelling allows the creation of the following workflow:

- the Agent generates a document “residence request” filling the form with the required information from his/her side (see figure 5);
- the Office Counter “notifies” the Registry Municipality Officer application of a new incoming request. This notification is a direct consequence of having modelled the documents through IDN-IM which envisage an automatic back link every time that a child node is modified or appended to a parent node (see figure 6);
- the Municipality Officer is activated by the Office Counter notification and handles the residence. He/she consults the archives of the resident population of the City with ordinary application at his/her disposal; he/she compiles the response consistent of residence certificate with pertinent data and submits the document;
- the submission of the residence response produces a notification (back link) to their parent nodes;

- the Agent is therefore notified of the incoming response and can access the requested certificate and proceed with his delivery tasks (see figure 7).

Figure 5 : Agent IDN-App Residence Request

Figure 6: Municipality Registry IDN-App Pending Request

The complete modelling of the scenario via IDN-IM documents envisages also the possibilities handling seven response certificate types which correspond to the various possible situation of a citizen. The Residence Situation node is itself the root of an IDN Residence Situation Document that can have seven different structures as described in the following list:

- *residence in the Municipality*, it has the subnode: village of residence;
- *death status*, which contains the subnodes: date and place of death and, if known, last known residence address;
- *missing status*, which contains the subnodes: starting unavailability date, cause of unavailability, if known, the known residence address;
- *status of emigrated abroad and subscribed to the AIRE* (Association of Italians Resident Abroad), which contains the subnodes: address in the foreign country, the former known address in Italy, further notes;
- *status of emigrated abroad*, which contains the following subnodes: date and place of emigration abroad;
- *immigrant status*, which contains the following subnodes: Italian Municipality and date of immigration;

- *status of non-resident in this Municipality*. This document does not require any additional information (i.e. nodes).

Figure 7: Agent IDN-App Residence Request submitted

4.1 Designing with REST in mind

The design underlying the implementation [3] follows the methodology presented in [4] for the design of REST Web Service. It is based on the following seven steps detailed in the following subparagraphs:

- Identify resources to be exposed as services (e.g., yearly risk report, book catalogue, purchase order, open bugs, polls and votes);
- Model relationships (e.g., containment, reference, state transitions) between resources with hyperlinks that can be followed to get more details (or perform state transitions);
- Define “nice” URIs to address the resources;
- Understand what it means to do a GET, POST, PUT, DELETE for each resource (and whether it is allowed or not);
- Design and document resource representations;
- Implement and deploy on Web server;
- Test with a Web browser.

Identification of the resources

Three types of resources are identified:
- *office counter*: it is the resource which allows to model the communication between the Agent and the Municipality Officer. It is a one-off resource type as it is created outside the usual flow of operations and is not affected by it;
- *residence request*: it is the request that the Agent submits to the office counter
- *residence certificate*: it is the response that is provided by the Municipality Officer in connection with the aforementioned request.

In the proposed model, the residence request and the residence certificate are resources belonging to object type, not to algorithmic type. However, it is possible to assume, following an extension of the model, the introduction of algorithmic resources, gaining resources that model, for example, the result of the search for residence data which have not yet been completed by the Municipality Officer.

Relationship between resources

The second phase in the design methodology covers the definition of the relationship among resources defined in the previous step (see figure 8).

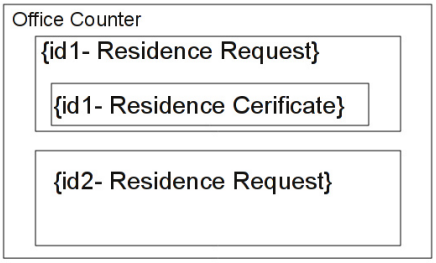

Figure 8: The relationship among the resources in the address certification scenario

For each Municipality is defined a office counter resource which can be referenced for the creation of new residence request resources. Consistent with the REST modelling approach new residence requests are created as subordinate resources of the office counter otherwise they share a containment relationship. Similarly, the residence certificate is a subordinate resource of the residence request resource and they share a containment relationship too.

URIs Definition

The third step involves the assignment of nice URIs to identify resources. As a residence request resource is subordinate to office counter resource and residence certificate resource is subordinate to residence request resource, it follows that, as prescribed in REST, this hierarchy should be made explicit in the identifier of resources. Then the following pattern can be ensued for the names of resources:

- Office Counter URI pattern : .../ Office_counter
- Residence Request URI pattern: .../ Office_counter / request
- Residence Certificate URI pattern: .../ Office_counter / request / response

Three classes of URI template have been introduced: the first for the office counter, the second for the request and finally the third for the response. Clearly, these patterns have to be adapted for the context previously described where a 1 to 1 relationship exists between the Municipality and the office counter, a 1 to n relationship between the office counter and the residence request and 1 to 1 relationship between residence request and residence certificate. As for the office counter the URI template is defined by a steady path related to the responsible municipality with an arbitrary relationship:

...(MunicipalityXYZ).../ office_counter

Each municipality is free to organize their resources independently, the only important thing is to communicate to those concerned which is the URI reserved for the office counter of interest, as in the example:

https: / / fi.comuni.example.com / services / Equitalia / office_counter

Once defined the template for the office counter resource it is possible to determine how to identify a residence request.

In the administration context all acts usually are associated to a protocol number (which represents an unique identifier) then each request could be identified through this number.

The template for the URI of a residence request resource could be:

.../ office_counter / request _ID _request

An example of a (partial) URI for a request is:

.../ office_counter / request _000742

Finally, as regards the residence certificate a steady path and the template can be defined consistently with the 1 to 1 relationship existing with the residence request to which it refers:

.../ office_counter / request _ID _request / certificate_ID

The URI of the response concerning the request could be:

.../ office_counter / request _000742/certificate_08

The meaning of GET, PUT, POST and DELETE methods

At this point, the REST design method requires defining the meaning of each of the four HTTP methods and whether such operations are allowed or not. The following list will show the three types of resources and, for each of them, the explicit meaning of the four methods.

The methods allowed for the *office counter* resource are: - GET: admissible and it returns a resource that contains a list of all residence request submitted; - PUT: ineligible because by definition the office counter can not be changed; - POST: admissible and it allows to submit a new residence request at the office counter; - DELETE: ineligible because by definition the office counter can not be changed;	The methods allowed for *the residence request* resource: - GET: admissible and it returns a representation of the residence request and, if any, of the residence certificate; - PUT: admissible and it allows to change a residence request previously submitted; - POST: admissible and it allows the insertion of a residence certificate; - DELETE: ineligible because once submitted to the office counter a request can not be eliminated (possibly it can be invalidated and/or replaced by another one);

IDN envisages the existence of an owner of the information which sets out the licensing and privacy criteria of documents by the creation of access lists which record users allowed to perform a set of operations. So additional restrictions can be set on above mentioned operations described based on the type of user.

The methods allowed for the residence certificate resource are: - GET: admissible and it returns a representation of the residence certificate resource; - PUT: admissible and it corresponds to a	The agent is allowed to apply the following methods to the office counter resource: - GET ineligible as the agent is not allowed to see the overall list of requests submitted to the office counter; - PUT: ineligible;

change in a residence certificate previously submitted; - POST: ineligible because subordinate resources to residence certificate are not foreseen; - DELETE: ineligible so far as for the residence request;	- POST: admissible as the agent is allowed to submit request to the office counter; - DELETE: ineligible;
The messenger is allowed to apply the following methods to the residence request: - GET: admissible; - PUT: admissible; - POST ineligible as the agent is not authorized to create residence certificate resources; - DELETE: ineligible;	The agent is allowed to apply the following methods to the residence certificate: - GET: admissible; - PUT: ineligible as the agent is not allowed to create or edit residence certificate resources; - POST: ineligible; - DELETE: ineligible;
The municipality officer is allowed to apply the following methods to the office counter resource: - GET: admissible; - PUT: ineligible; - POST: ineligible as the Municipality officer is not authorized to create residence request resources; - DELETE: ineligible;	The municipality officer is allowed to apply the following methods to the residence request resource: - GET: admissible; - PUT: ineligible as the Municipality officer is not authorized to edit residence requests; - POST: admissible; - DELETE: ineligible;
The municipality officer is allowed to apply the following methods to the residence certificate resource: - GET: admissible; - PUT: admissible; - POST: ineligible; - DELETE: ineligible.	

Design and documentation of the performances of resources

The fifth step of the design method requires the design and documentation of the representations of the resources that are manipulated by methods discussed in the previous steps.

1. Discussion & Conclusion

The innovation introduced with the work presented in this paper is related to the set up of a Proof of Concept related to the request/response of citizens' residence certificates scenario in an innovative telematic architecture - InterDataNet - allowing the collaborative exchange of documents containing citizens personal data among distributed entitled actors. InterDataNet architecture is designed to:
1) keep the sensible data (in this case the residence certificate of a citizen) under the control and authority of the responsible entity (in this case the Municipality) without data duplication;
2) grant access to data only to authenticated and authorized parties (in this application scenario the Agent who is entitled to deliver the envelope to the citizen);

3) provided data are therefore automatically certified by system since data are issued only by responsible entities;
5) real-time data update is guaranteed by construction since the documents (e.g. the residence certificate) aggregate single data units (e.g. the residence address) from their origin (the Municipality) and a change in the aggregated data unit is notified back to the aggregating documents.
As a consequence of the above characteristics the proposed Proof of Concept highlighted that InterDataNet Equitalia implements a more effective and efficient telematic solution for requesting and receiving citizens' address certificates since the time, and consequently the costs, needed to obtain the response to the residence certificate request are reduced.
InterDataNet provides the possibility to avail - at the infrastructural level - of a document and data versioning which can enable the traceability of a citizen's address certificate history; moreover, thanks to the design approach of architecturally enabling collaboration via data organized in documents, the interacting actors have the possibility to separate their respective workflow procedures without affecting the interaction paradigm.
This Proof of Concept was aimed at demonstrating the technical viability of the proposed solution. Further steps in the direction of prototyping this concept are already underway and are related mainly to the adoption of the updated version of the IDN-SA in which versioning as well as replica capabilities are enabled; the enforcement of access security at a single data level through attributes-enhanced RBAC (Role Based Access Control) to provide - on an application basis - the fulfilment of regulation of privacy and data management; the development of a plug-and-play adaptors solution to interface the IDN-SA with the Municipalities databases.

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References

[1] Franco Pirri, Michela Paolucci, Davide Chini, Maria Chiara Pettenati and Samuele Innocenti(2008) InterDataNet: Interoperability Middleware Infrastructure to Support Collaborative Creation and Management of Official Documents in e- Government Processes 41st Hawaii International Conference on System Sciences (HICSS 41) January 6 to 10, 2008. The paper has been nominated for a HICSS-41 Best Paper Award.

[2] Paolucci M., Chini D., Pettenati M.C., Pirri F.(2007) Interoperability Middleware Infrastructure to Support Collaborative Creation and Management of Official Documents in e-Governement Processes 1st International Conference on Methodologies, Technologies and Tools enabling e-Government (MeTTeG07), Camerino (Italy), 27-28 September 2007.

[3] Ciofi, L.: Future Internet: Evoluzione in chiave REST per InterDataNet. Unpublished Doctoral dissertation, University of Florence Italy (2010)

[4] Pautasso, Cesare (2009) RESTful Service Design . In: 18th International World Wide Web Conference, April 20th-24th, 2009, Madrid, Spain.