Information Technology of University of Lund. In Figure 3 we show the comparison of the Doppler spectral density of a road intersection for (a) a real-world measurement, (b) numerical co-simulation and (c) measurement of our real-time channel emulator [3]. We clearly observe that our emulation method captures the non-stationary properties of the communication channel very well. This allows for a repeatable test of communication devices in the laboratory

The developed methods are not limited to vehicular scenarios like road intersections, urban scenarios or highways. They can also be applied to mimic the wireless communication channel in industrial or railroad environments, for example, where robots have to communicate with each other.

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STINGRAY is developing an intelligent train station infrastructure.

Smart Services for Railways

by Felicita Di Giandomenico, Stefania Gnesi, and Giorgio O. Spagnolo (ISTI-CNR) and Alessandro Fantechi (ISTI-CNR and University of Florence)

The project STINGRAY (SmarT station INtelliGent RAilwaY) addresses the role of the railway station, traditionally seen as a meeting point for a city, in order to enhance its importance and integration into the smart city of the future.

Although railway stations are central hub of the city, a primary point of aggregation in the urban environment, they traditionally have a private energy distribution and communication system. The main reasons for this are to ensure uninterrupted power supply and security, but this isolation has two main drawbacks. First, it prohibits integration with "smart cities", in which, ideally, information between different transport systems (i.e. bike sharing, car-sharing, urban transport) is synergically exploited. Second, the station system fails to benefit from modern energy saving techniques.

In the project STINGRAY, researchers from the Formal Methods and Tools and the Software Engineering and Dependable Computing groups of ISTI-CNR are designing and developing a station communication infrastructure, integrating powerline and wireless technologies, which:
- realises a LAN network over the station plants using power line and wireless technologies;
- allows the control and monitoring of station equipment (supervisory control and data acquisition (SCADA));
- creates value-added services for both customers and railway staff, such as connectivity, monitoring, energy man-

agement service (EMS), fault prediction service (FPS), video surveillance, environmental surveying and integration and access to smart city infomobility services.

STINGRAY will utilise powerlines to enable more efficient management of machinery and energetic resources; an innovation that will be far more cost effective and less environmentally damaging than building new infrastructure.

We are currently defining the requirements for the “smart station” and the design of the system architecture. We are also optimising existing strategies for managing energy consumption within the station to avoid wasting energy; for example, we are considering station lighting and the heating of the railroad switches in ice conditions.

STINGRAY is being conducted in the context of the POR FESR 2014-2020 Tuscany Region project will run until July 2020. The project is coordinated by Letizia Bellini from ECM spa (Italy).

Link: https://stingray.isti.cnr.it/

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ProvQL: Understanding the Provenance of your Data

by Giorgos Flouris, Argyro Avgoustaki, Irini Fundulaki and Dimitris Plexousakis (ICS-FORTH)

ProvQL is a high-level structured query language, suitable for seeking information related to data provenance. It is especially suitable for tracking the sources that contributed to data generation, and for helping data experts assess the trustworthiness and reliability of data.

The proliferation of (open) data on the Web, in the form of linked open data, has made it possible to publish structured data so that it can be interlinked and become more useful through semantic queries. This way, web pages are not only useful for human readers, but are also able to include data and information that can be read automatically by computers (metadata).

In this setting, data is being recorded in the form of RDF quadruples, e.g., (Donald_Trump, president_of, USA, DBpedia), where the subject (Donald_Trump) is associated with the object (USA) with a property (president_of), and this information is recorded in a specific dataset (DBpedia). Note that all elements of the quadruple (e.g., Donald_Trump) identify a specific resolvable entity or relation, corresponding to an actual person, role, object, or concept (e.g., the person Donald Trump, the role of being a president etc.). This way, all references to “Donald_Trump”, in any dataset, are automatically associated to each other.

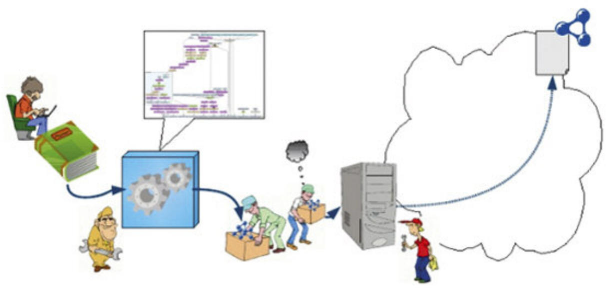

Figure 1: Data Provenance (source: O. Hartig, J. Zhao, “Using Web Data Provenance for Quality Assessment”, SWPM-09).

This constitutes one of the main advantages of linking different datasets, namely the ability to combine data and information from different sources in order to produce new data or knowledge on a domain of interest. However, this advantage comes with a price. For example, if a certain quadruple is later identified to be erroneous or inaccurate, how can one track down its dependencies and identify the (derived) quadruples that should be retracted? And how can one assess the trustworthiness, credibility, authenticity, reliability or accuracy of his/her data, when part of it was the result of some form of reasoning over data coming from other, external, sources? And what about the problem of data accountability?

To address these questions, there is a great need to record the provenance of published data, i.e., their history, their origins and the process through which data records (quadruples) were “copied” from one source to another, modified and transformed in the process and/or reasoned upon to produce new data records (see Figure 1).

In recent years, provenance has been widely studied in several contexts, e.g., databases, workflows, distributed systems, Semantic Web, etc., and with respect to different aspects and applications. These studies have resulted in various theoretical provenance models, each with a different level of complexity and detail, such as the “why, where and how” prove-

Figure 2: Excerpt from the W3C PROV model (Source: Provenance Analysis and RDF Query Processing, Satya Sahoo, Praveen Rao, ISWC2015).