Intelligent **S**elf-describing **T**echnical and **E**nvironmental **N**etworks

http://www.s-ten.eu

Research project for the Web based operation and maintenance of physical networks.

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S-TEN provides support for decision makers in a continuously changing environment.

The S-TEN project applies semantic web technologies to efficiently operate and maintain self-organizing physical networks with measuring points and technical plants.

The technology is evaluated by applications in the field of environmental and technical networks.

S-TEN applies widely used international standards and enhances them.

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Introduction

S-TEN's objective is to exploit the "Semantic Web" for scientific and engineering applications and to provide support for decision makers in a complex and continuously changing environment consisting of lots of measurement points and other components.

The structure of the formal description of information is described by so called *ontologies* (see yellow box). OWL (Ontologie Web Language) is used as ontology language. S-TEN enhances international standards with ontologies for applications within technical and environmental networks.

Within the S-TEN project rules supporting system operations are developed and applied to information available in the Web, e.g. measurements, human observations and design information.

A crucial aspect is that this information is not held within a centralised database but that each node has its own intelligence, is able to register in the network autonomously and publishes information about its position, services and data. The current status of the network is provided by a search operation, which determines which objects are part of it, how they are connected and what they are currently doing.

Events may trigger corresponding alarms and generate Best Practice Advice for the system operator based on the currently valid state of the network. Different organisations (fire brigade, police, control center operators, etc.) may have different views on the same data. River flows, for example, will be handled differently by a fire brigade and a research institute. Therefore each organisation may have their own rule-bases to generate appropriate Best Practice Advice according to the nature of the environmental hazard - i.e. the state of the environmental system.

The S-TEN technologie is evaluated by prototype applications (demonstrators) in the environmental and technical area. For example an application for the management of floods, an application for preventive maintance of production sites and an applications for maintenance and control of decentralised energy resources will be developed.

Use of AIDC devices

The S-TEN ontologies are well suited for data storage on AICD (*Automated Identification and Data Capture*) devices (Barcodes, Smartcards, RFID, etc.).

The Semantic Web

The Semantic Web is an enhancement of the World Wide Web (WWW) and is based on the ideas of WWW-founder Tim Berners-Lee.

The Semantic Web supports cooperation between human beings and machines in the Web.

Information published on the Web is enriched with an additional formal description. Applications are able to process this semantically enriched information and to understand the meaning of it.

Ontologies

For the representation of complex knowledge relation-ships the expression "ontology" became naturalized in computer science in connection with the Semantic Web.

Ontologies exist of components like concepts, instances and relations.

An ontology implies both the definition of properties for classes (semantically related elements) and the description of logic relations.

OWL (Ontologie Web Language) is the standard language for ontologies in the Semantic Web.

Linking OWL and STEP

A crucial part of S-TEN is the linking of the two worlds OWL and STEP (see yellow box). An OWL-STEP converter holds the following advantages:

- publish network design knowledge, created by existing CAD systems and represented using the STEP family of standards, on the Web using OWL
- collect information about self-describing networks published on the Web using OWL, and to represent it using STEP so that it can be visualised by existing CAD systems and STEP tools.

STEP

STEP (STandard for the Exchange of Product data) is a standard for the description of product data (ISO-10303).

The description comprises both physical and functional aspects of a product as well as relations.

Being standardised STEP is well suited for the data exchange between different systems.

With STEP information about the whole product life cycle can be depicted.

Innovations

The innvations S-TEN provides can be summarized as follows:

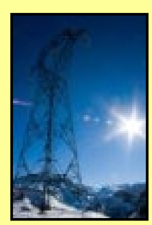
- defining an ontology which enables a device to announce its existence, position in a network, the function it performs and the services it provides;
- capturing human qualitative observations and publicise them on the web with respect to a formal ontology;
- developing rules substantial for automated network management systems, e.g. process monitoring and preventive maintenance applications.
- designing an OWL-STEP converter

Applications for the S-TEN technology

Major industrial enterprises concerned with network management (e.g. control of electricity transmission grids, petrochemical plants, and water supplies) already have systems with the functionality offered by the S-TEN technology. Initially the S-TEN technology will not have any impact upon these traditionally systems.

The first take up of the S-TEN technology, will be for new applications where a traditional system is not suitable, because of the expense, complexity and inflexibility.

The S-TEN approach is different to traditional systems as it offers high flexibilty and low cost by using standard web technologies:



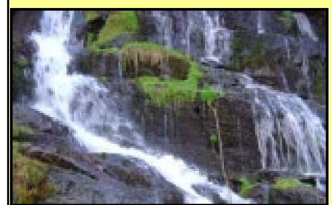
- the Internet provides the communications infrastructure and serves as database

- the publishing of information and measurements on the Web using standard ontologies replaces the functionality of traditional SCADA systems ;
- rule bases also stored on the Web and acting on the Web-published information will provide notification and operator support.

Authentification und encrypted data transfer can be implemented but is not part of the project

As S-TEN is based on the Internet it is not suited for time-critical applications requiring guaranteed response times and high reliability.

Examples for possible applications are described in the following section.

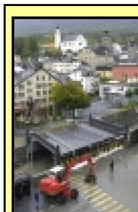


S-TEN demonstrators

The S-TEN demonstrators refer to example applications for which the S-TEN technology is more suitable than traditional systems. The demonstrators will verify the suitability of the S-TEN technology for practical applications and will also be used for presentation purposes:

Environmental Monitoring:

For environmental monitoring applications the flexibility of the S-TEN approach is important, because the nature of the sensors and their positions may be continually changing. Also there may be many different actors wishing to access the data. Each of the actors may have their own rules for notification and may require different types of 'operator support'. In this context, the police and fire services are examples of 'operators'.

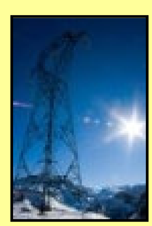


Control of Distributed Resources in Electrical Power Networks:

For an intelligent network management of distributed power generation (wind farms, small hydro power plants, solar power plants, etc.) the expense incurred in the traditional system procurement, and in reconfiguring the system when the network changes, is very significant. The S-TEN technology provides an interesting and cost-effective approach.

Secondary Control of Electrical Power Systems:

Secondary control involves manual intervention to deal with fault situations and other operating problems. Many different types of query and notification are required, for which the configurable rule-based approach of S-TEN is especially suitable.



Initial Operation and Preventive Maintenance in Electrical Systems:

A SME does not have the money or expertise to acquire or develop bespoke systems that add additional functionality to industrial automation systems.

Off-the-shelf automation systems acquire the information that could be used to support production optimisation and to schedule preventive maintenance, but often this information is not used. The S-TEN technology and simple interfaces will provide a simple way of interfacing with the industrial automation system, querying historic data, visualising the current status of a production network and defining the rules for scheduling preventive maintenance activities.

Standardisation

The web publication of network data will rely upon ontologies for engineering data derived from international standards.

A high level of acceptance of the S-TEN ontologies will be reached by enhancing existing international standards and working closely together with the respective working groups.

Ontologies for measuring data have already been developed in the predecessor project ScadaOnWeb (see yellow box) and are being standardised as part of EPISTLE (ISO 15926). A key task is therefore to further enhance this standard which covers lifecycle data for process plants and is widely used in the oil- and gas production.

Besides, STEP (ISO 10303) is of particular importance. This standard is widely used in the automotive industry (ISO 10303-214). ISO 10303-239 covers lifecycle data for mechanical equipment.

Formal ontologies will also be used to record information on AIDC devices (*Automated Identification and Data Capture*), and extensions to ISO 21849[6] to support this are being developed.

ScadaOnWeb

ScadaOnWeb (Web based supervisory control and data acquisition) is a research project co-funded by the European Commission and the Swiss BBW (Schweizer Bundesamt für Bildung und Wissenschaft) running from Sept. 2001 till Oct. 2003.

Within the project ontologies for SCADA (Supervisory Control And Data Acquisition) applications have been developed. These ontologies are based on RDF and OWL definitions for physical quantities and units.

In order to handle huge amount of data typical for SCADA applications, a new Web data type has been set up.

The technology has been verified within five different applicaition in the engineering domain.

www.scadaonweb.com