RESEARCH BY EXPERIMENTATION FOR DEPENDABILITY ON THE INTERNET OF THINGS

RELYonIT

Key Innovation

The Internet of Things (IoT) provides a substrate to realize applications in several domains of utmost importance for our society, including surveillance of critical infrastructures, smart cities, smart grids, and smart healthcare. However, many of these applications are only possible if the IoT provides dependable performance. Application-specific guarantees on network performance parameters such as data delivery reliability and latency must be given for all system operation conditions. Failure to meet these requirements at all times may lead to reduced user satisfaction, increased costs, or to critical system failures. Unfortunately, existing IoT and underlying Wireless Sensor and Actor Network (WSAN) technologies mostly follow a best effort approach and do not offer guaranteed performance.

Hence, major investment is necessary for each WSAN deployment requiring performance assurances to be constructed, tested, and tuned as custom solutions to ensure that the specific application requirements can be met. Consequently, lack of dependability has been identified as a roadblock to adoption of IoT technologies. The major hurdle to providing a dependable IoT is that the operation of WSANs linking the real world to the Internet is deeply affected by their surrounding environment. Environmental properties such as electromagnetic (EM) radiation, ambient temperature, and humidity have significant impact on achievable network performance. Not only are these environmental conditions hard to predict for a given deployment site, they also may largely vary from one deployment site to another, thus hindering scalable deployment of IoT applications as every new deployment site requires costly customization.

Hence, the aim of RELYonIT is to provide a set of generic methods and tools for deploying dependable IoT infrastructures by addressing the challenging interaction of WSANs with their environment.

Technical approach

RELYonIT will enable the cost-effective construction of IoT applications that provide performance guarantees in hostile environments. To this end, RELYonIT devises environmental models that capture how environmental properties vary over time and platform models that capture how these environmental properties affect the operation of a hardware platform. These models typically have parameters and we will develop techniques and tools to learn these parameters for a given platform and for a given deployment environment.

Existing protocols will be optimized and where necessary new protocols are designed that provide performance guarantees for a given deployment environment and hardware platform by exploiting knowledge

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Project coordinator

TU Graz (TUG)

Contact person

Kay Römer

Institute for Technical Informatics

TU Graz

Inffeldgasse 16

8010 Graz, Austria

Tel: +43 316 873 6400

Fax: +43 316 873 6903

roemer@tugraz.at

Project website

www.relyonit.eu

Community contribution to the project

1,450,000 Euro

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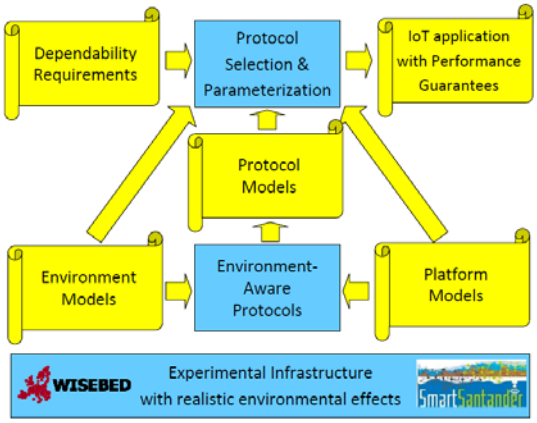
28 months

from the respective environmental and platform models.



A specification language will be defined to allow a user to specify dependability requirements for a given application. Given such a specification of dependability requirements, techniques and tools will be provided to automatically select protocols and their parameters such that the performance requirements are met for a given deployment environment and hardware platform or the infeasibility of these requirements will be detected. If runtime assurance detects that environmental properties have significantly changed, the parameters of the protocols will be automatically adapted to reflect the new environmental model.

A fundamental requirement of RELYonIT is the availability of an experimental infrastructure with a large number of different hardware platforms that can be exposed to a wide variety of environmental conditions. While FIRE experimental facilities such as WISEBED or SmartSantander meet these requirements, it must be possible to repeat an experiment under identical environmental conditions. Existing FIRE testbeds will therefore be extended with the ability to record and playback the effects of environmental conditions.

Demonstration and Use

The work in RELYonIT is driven by real-world scenarios that are of interest to our end-users ACCIONA and WorldSensing. One of the candidates for a final demonstrator is a smart parking solution that allows users to find the nearest free parking spot using a smart phone application. Sensors embedded into the pavement detect the occupancy of parking spots. These sensors are exposed to extremely variable environmental conditions, yet the system must meet latency and lifetime requirements.

Scientific, Economic and Societal Impact

RELYonIT has a dual contribution and impact. Firstly, existing FIRE experimental facilities are enhanced with the ability to record and playback realistic environmental effects. Compared to previous solutions that used custom hardware, our software-based approach is more cost-efficient and easily scales to a large number of FIRE experimental facilities with many nodes each. The environment-dependent performance and thereby the feasibility of IoT applications can be predicted prior to deployment by running it on an enhanced FIRE experimental facility.

RELYonIT, secondly, uses this enhanced infrastructure to provide a dependability framework for the IoT. With that, a large class of dependable IoT applications that could not be realized before becomes technically feasible. The time and cost needed for developing dependable IoT applications will be substantially reduced, thereby making certain dependable IoT applications economically feasible. Safety and comfort of a future IoT-enabled world will be substantially improved.

Project partners	Country
TU Graz	Austria
SICS, Swedish ICT	Sweden
Technische Universiteit Delft	The Netherlands
University of Lancaster	United Kingdom
Worldsensing	Spain
Acciona Infrastructuras S.A.	Spain