

IRRIIS – A new European Project to Increase CII Dependability

IRRIIS enhances the understanding of large complex critical infrastructure (inter)dependencies by creating a synthetic simulation environment and developing novel Middleware Improved Technology.



Dr. Felix Flentge

Dr. Flentge is responsible for all IRRIIS activities inside the Fraunhofer Institute for Autonomous Intelligent Systems and assists the IRRIIS Project Manager Uwe Beyer in co-ordinating the project.



Timo Steffens

Timo Steffens is responsible for the simulation framework at the Fraunhofer Institute for Autonomous Intelligent Systems and for the scientific assessment of the results.

The new EU Integrated Project "Integrated Risk Reduction of Information-based Infrastructure Systems" (IRRIIS) started in February 2006. Within the next three years, IRRIIS will be carried out under the motto: Substantially enhance the dependability of Large Complex Critical Infrastructures (LCCIs) by introducing appropriate Middleware Improved Technology (MIT) components.. IRRIIS aims at increasing the dependability, survivability and resilience of EU Critical Information Infrastructures based on Information and Communication Technology (ICT). IRRIIS has the objectives to:

- determine a sound set of public and private sector requirements based upon scenario and related data analysis;
- design, develop, integrate and test Middleware Improved Technology components suitable for preventing and limiting cascading effects as well as for supporting automated recovery and service continuity in critical situations;
- develop, integrate, and validate novel and advanced modelling and simulation tools integrated into a synthetic environment (SYNTEX) for experiments and exercises;
- validate the functions of the MIT components using the SYNTEX environment and the results of a detailed scenario and data analysis;
- disseminate novel and innovative concepts, results, and products to other ICT-based critical sectors.

IRRIIS will address the challenges of Critical Information Infrastructure Protection (CIIP) by a "diagnosis - therapy strategy" and "therapy implementation and validation approach".. The first CII sectors addressed will be the electrical power and the telecommunication infrastructures. After thoroughly analysing these infrastructures and their dependencies and interdependencies, the synthetic simulation environment (SYNTEX) will be build. MIT components will be developed, tested and validated inside SYNTEX to demonstrate their capabilities before dissemination to potential stakeholders. The IRRIIS approach is open for successively including additional critical infrastructures.

The interdisciplinary research will be performed in the coming three years by a European consortium of fifteen partners. Among these partners are key stakeholders, like Telecom Italia and Red Electrica de España, technology providers, e.g., Alcatel, Siemens and AIS (Malta), and consultants and service providers, like IABG from Germany and AIA from Spain. Additionally, various research organisations and universities from the Netherlands (TNO), Finland (VTT), the UK (City University), Italia (ENEA), France (ENST) and Germany (Fraunhofer SIT, Fraunhofer AIS, TU Dresden) take part in the project.

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"Information Society Technologies" with seven million Euro funding. The integrated project is co-ordinated by the Fraunhofer Institute for Autonomous Intelligent Systems (Fraunhofer AIS).

LCCI Analysis and Requirements

Up till now there is a lack of advanced understanding of the dependability, dependency and interdependency of Large Complex Critical Infrastructures (LCCIs), in particular with regard to the use of Information and Communication Technology (ICT). Although some models and tools dealing with these issues exist, LCCI complexity and criticality can not yet be tackled properly. Basic research is necessary to understand the phenomena of (inter)dependency, dynamic behaviour and cascading effects in order to support the development of solutions for protecting and managing existing LCCIs in case of incidents. IRRIIS will perform in-depth research regarding the topological structure of LCCIs and the dependencies and interdependencies

between different LCCIs. Appropriate analytical approaches

will be applied such as simulation models or analytical models suitable to investigate (inter)dependency, network dynamics and cascading effects.

Starting from a thorough analysis of LCCIs, incorporating the stakeholder's views regarding ICT tools and models, a sound set of public and private sector requirements can be determined. These requirements will build the basis for the development of the SYNTEX simulation environment and the Middleware Improved Technology (MIT) components.

In order to enhance the understanding of LCCIs and to gain a sound foundation for the development of the SYNTEX

simulation environment and the MIT components, IRRIIS will:

- Survey LCCI stakeholder requirements on technology and tools needed for understanding and mitigating cascading effects;
- Survey and analyse existing CIIP tools and models for LCCIs;
- Analyse current research gaps to identify relevant research and development efforts;
- Provide detailed scenario and risk analysis;
- Perform in-depth topological analysis of LCCIs;
- Analyse the dependencies and interdependencies between different LCCIs;
- Analyse the upcoming Next Generation Networks (NGN), i.e. networks based on IP-connectivity or wireless connections with mainly software-based services.

This work will not only help to ensure the adequacy of the SYNTEX environment and the MIT components to the stakeholders' needs but also contributes to the ongoing world-wide research efforts concerning LCCIs.

Middleware Improved Technology

Starting with the knowledge gained from the LCCI analysis and the survey of stakeholder's requirements and existing tools, MIT components will be developed. These MIT components will facilitate the communication between different LCCIs and will allow identifying and evaluating incidents and malicious attacks and responding accordingly.

Currently, a big problem for the dependability, security and resilience of LCCIs is the high level of inter-dependence

of different LCCIs, both within the same sector and between different sectors. The consequence is that problems within one LCCI may lead to severe problems in dependent LCCIs. The resulting cascading effects are not limited to one kind of infrastructure and do not stop at national borders. To make things worse, there is often a lack of appropriate communication structures between the dependent LCCIs. This results in a lack of awareness of problems occurring in other infrastructures and appropriate mitigating actions can not be performed in time.

To facilitate the communication between different infrastructures, IRRIIS will develop appropriate middleware communication components. All communication between different LCCIs should be handled by this middleware layer in a standard way. The advantage is that each LCCI only needs one communication link towards the middleware and does not have to interface several other LCCIs and to implement different protocols.

The middleware will also be used by the optional MIT add-on components which have some kind of build-in "intelligence". These add-on components will monitor data flowing within and between the infrastructures and raise alarm in case of intrusions or emergencies and take measures to avoid negative effects. They will be able to detect anomalies, filter alarms according to their relevance and support recovery actions. In this way, they contribute to the security and dependability of LCCIs. MIT components will interface existing systems and will not require major replacement of existing hardware or software. The flexibility of the middleware shall allow the easy integration of new LCCIs or new kind of information to be exchanged.

Basic research is necessary to understand inter-dependencies, dynamics and cascading effects

SYNTEX Simulation Environment

The purpose of the SYNTEX simulation environment is twofold: First, simulation can be used to improve the understanding of dependent and interdependent LCCIs. Secondly, the MIT components will be tested and validated in experiments using SYNTEX. Their applicability and usefulness will be demonstrated within the SYNTEX environment to critical infrastructure stakeholders before deployment to “real world” systems.

A generic simulation environment is necessary to account for specific stakeholders’ needs

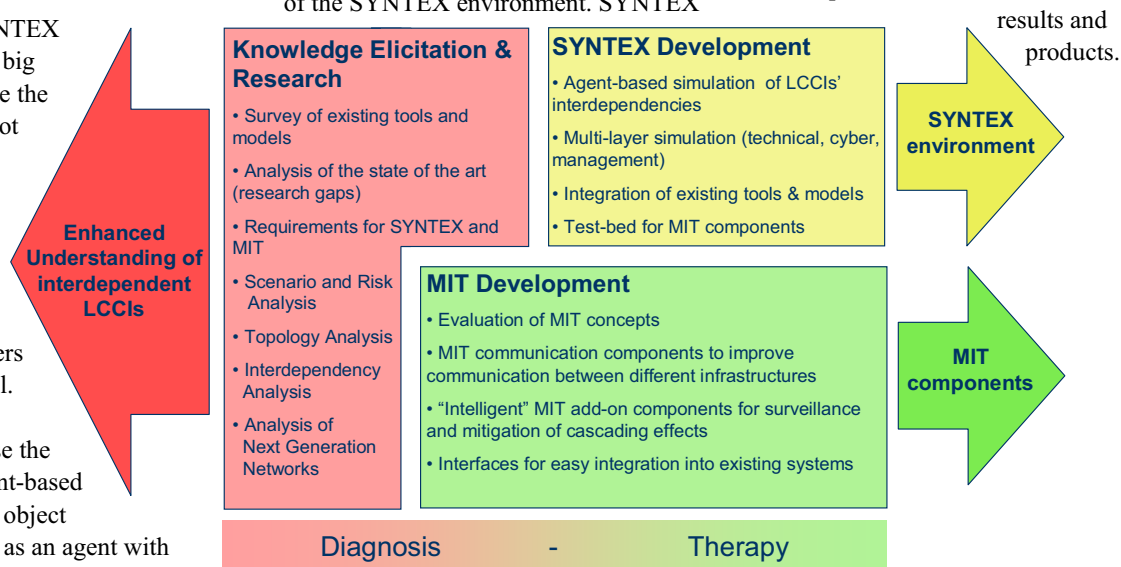
Building the SYNTEX environment is a big challenge because the simulation will not only have to include physical simulations but also has to simulate the cyber and the management layers of a LCCI as well. For this purpose SYNTEX will use the principles of agent-based simulation. Each object will be modelled as an agent with clear interfaces to its environment and other agents. A language for agent-based modelling of scenarios and processes (LAMPS) will be developed in order to precisely define scenarios and the dependencies between objects. LAMPS will be able to cope with the high degree of parallelism in LCCIs and will offer graphical representations for intuitive display of the dependencies.

The SYNTEX environment will include and interface existing tools to keep the simulation meaningful with respect to existing technologies and to allow the use of the results gained in current systems. This also means that the SYNTEX environment does not have to

start from scratch but can rely on already existing and proven technology. To decide which tools and models should be included in SYNTEX, an in-depth survey of existing tools and models will be performed.

However, the main strength of SYNTEX will be the simulation of dependencies and interdependencies between different LCCIs. To that end it will be necessary to have the possibility to model some objects of the individual LCCIs on more abstract levels. This will ensure a high scalability and flexibility of the SYNTEX environment. SYNTEX

of LCCIs, the SYNTEX simulation environment and MIT components able to facilitate communication between different LCCIs and to mitigate negative effects. To disseminate the results broadly to stakeholders, technology and service providers and the research community, these groups will be addressed within the IRRIS project right from the start. IRRIS also relies on international co-operation and is open for joint efforts of all kinds to achieve its goals. To foster co-operation, IRRIS will establish an international conference and form a special IRRIS Interest Group of people, institutions and companies interested in IRRIS



should be as generic as possible to allow its application to various kinds of LCCIs and its adaptation to the specific needs of individual stakeholders.

Summary

The major parts and the main outcomes of the IRRIS project are summarised in the figure on this page. Knowledge Elicitation and Research will lead to a “diagnosis” of the current and the future status of (inter)dependent LCCIs. The “therapy” will be implemented through the MIT components which can be tested and validated in the SYNTEX environment. The main contributions of IRRIS are an enhanced understanding

Contact & Information:

Felix Flentge
 Fraunhofer Institut AIS
felix.flentge@ais.fraunhofer.de
www.irriis.org

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