D6.2 Report on awareness and wider societal implications

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Authors:	Vincent van der Leest (IID)
Abstract:	The UNIQUE project has developed technologies that can help solve massive economic and security problems. Counterfeiting of goods and intellectual property has reached a level that threatens industrial production, organisational functions, health systems and even national security when malicious elements are deployed for critical infrastructures.
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1 Introduction

The UNIQUE project has developed technologies that can help solve massive economic and security problems. Counterfeiting of goods and intellectual property has reached a level that threatens industrial production, organisational functions, health systems and even national security when malicious elements are deployed for critical infrastructures. Today, this threat applies to a wide range of items, such as avionic and automotive spare parts, silicon chips, design material, (embedded) software, pharmaceuticals as well as multimedia content. Counterfeit electronics are estimated to account for 1-10% of global sales. Examples include mainstream computing and network products as illustrated by the January 2008 seizure of a set of counterfeit Cisco routers with a value of $78 Million. Counterfeiting erodes the revenues of legitimate producers and causes substantial brand damage. In addition to revenue erosion, non-genuine components and products could house undetected malicious elements capable of bringing significant damage to the foundation of today's digital economy and society.

Apart from the economic impact, there can be more tragic consequences of counterfeiting. Due to the use of fake anti-malaria drugs, many people die every year in South-East Asia. It is estimated that 40% of the drugs in China are fake. Also in the Western world various examples of fake drugs are known, particularly when distributed over the Internet. One approach to solve the problem of counterfeit drugs is to incorporate into the packaging material a unique IC chip, e.g., an RFID (Radio Frequency Identification) tag that is hard to forge and to clone. Solutions developed in the UNIQUE project can be the foundations for testing the integrity of chips (either at point of sale or directly in the patients' homes), in order to be able to establish the origin of the pharmaceutical.

From the examples above, it becomes clear that the problem of counterfeiting and tampering with integrated circuits (ICs) is at the core of modern electronics products and IT systems. Our interest concerns generic hardware systems and components. In particular we have focussed on those ICs and hardware components that provide cryptographic and security functionality (e.g., cryptographic co-processors, smart cards, etc.) and are used as security anchors in the devices they are embedded in. We refer to these types of ICs as "security hardware". In order to address the IC counterfeiting and tampering problem in a comprehensive fashion, we have investigated and developed complete solutions: from hardware-based crypto, security building blocks, security architectures, protocols and algorithms to design and evaluation principles necessary to detect or prevent counterfeiting of hardware.

The UNIQUE project has developed an integrated approach to protect hardware systems against counterfeiting, cloning, reverse engineering, tampering, and insertion of malicious components; our approach consisted of an innovative combination of hardware-based cryptography and security building blocks, security architectures, protocols and algorithms as well as design and evaluation principles.

The UNIQUE project has focussed on the problem of detecting counterfeit and maliciously altered ICs and exploring security architectures that inhibit counterfeiting of hardware. We emphasise that the techniques developed in this project will not only contribute to solving a serious economic problem, but also to the security of critical infrastructures (in the military, health and energy sectors) and the identification of counterfeited goods by providing robust, uncloneable labels. In particular, we have devoted a significant part of our research and investigation to the hardware components that provide cryptographic and security functionalities and are used as a security anchor.

The strong combinations of expertises (both from industry and academia) in the UNIQUE project have been leveraged to develop PUF based systems withstanding a wide variety of physical attacks. A deep understanding of the physical properties of PUFs as well as of the properties of the algorithms that process the PUF responses to guarantee a fully secure solution has been built up during the project. The combination of this deep understanding of the physical building blocks with a good cryptanalytic insight in the used cryptographic components has been the foundation for success within the UNIQUE project.

The success of the UNIQUE project in terms of awareness and societal implications are indicated by the following results:

- A large number of papers from the project have been accepted at the important security conferences, such as CHES, HOST, and TRUST.
- UNIQUE partners have had both contributed and invited presentations at important security workshops and conferences.
- An ASIC has been developed in the UNIQUE project, which is a one-of-kind test platform containing six different PUF instantiations (one of which, Buskeeper, is a completely new PUF type).
- Besides the Buskeeper PUF, the UNIQUE consortium has also introduced the Logically Reconfigurable PUF to the scientific (and industrial) community.
- The UNIQUE project has successfully created two working prototypes to demonstrate PUF-based solutions for different use case.
- All project partners, academic and industrial alike, have actively contributed to the success of UNIQUE. This shows that hardware security based on PUFs continues to be a hot topic in both communities

2 Questionnaire on societal implications

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	238811
Title of Project:	Foundations for Forgery-Resistant Security
Name and Title of Coordinator:	Technikon Dr.-Ing. Klaus-Michael Koch

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***0Yes X No***
2. Please indicate whether your project involved any of the following issues (tick box):	***YES***
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	No

RESEARCH ON ANIMALS	
• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	No
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	3
Work package leaders	1	4
Experienced researchers (i.e. PhD holders)	1	7
PhD Students	2	13
Other	7	9

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**4**
Of which, indicate the number of men:	3

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	○ X	Yes No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				Very effective
❑ Design and implement an equal opportunity policy	○	○	X	○	○
❑ Set targets to achieve a gender balance in the workforce	○	X	○	○	○
❑ Organise conferences and workshops on gender	X	○	○	○	○
❑ Actions to improve work-life balance	○	○	○	X	○

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

X Yes- please specify: Austrian research nights, awareness days

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

X No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

X Main discipline[1]: 2.2

X Associated discipline[1]: 1.1 | X | Associated discipline[1]: 1.2

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	X ○	Yes No

[1] Insert number from list below (Frascati Manual).

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

- X No
- ○ Yes- in determining what research should be performed
- ○ Yes - in implementing the research
- ○ Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ Yes X No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ○ No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- X Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- X Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights
Audiovisual and Media		Enlargement		**Information Society** ✓
Budget		Enterprise		Institutional affairs
Competition		Environment		Internal Market
Consumers		External Relations		Justice, freedom and security
Culture		External Trade		Public Health
Customs		Fisheries and Maritime Affairs		Regional Policy
Development Economic and Monetary Affairs		Food Safety		**Research and Innovation** ✓
Education, Training, Youth		**Foreign and Security Policy**	✓	Space
Employment and Social Affairs		Fraud		Taxation
		Humanitarian aid		Transport

13c If Yes, at which level?

- ○ Local / regional levels
- ○ National level
- ○ European level
- X International level

H Use and dissemination

14. How many Articles were published/ accepted for publication in peer-reviewed journals?	**±45**
To how many of these is open access[2] provided?	**0**
How many of these are published in open access journals?	**0**
How many of these are published in open repositories?	**0**
To how many of these is open access not provided?	**All**
Please check all applicable reasons for not providing open access:	
X publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[3]: ……	

15. How many new patent applications (‘priority filings’) have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**0**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		

[2] Open Access is defined as free of charge access for anyone via Internet.
[3] For instance: classification for security project.

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
X	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:

Indicate figure:

30

Difficult to estimate / not possible to quantify ❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes X No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	X	English
X	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]