KINDRED SPIRITS:
PRIVACY-ENHANCED SOCIAL NETWORKING

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Match to Sentinels Call
This project proposal matches the themes of the Sentinels Call in two ways:
• Health care: Patients with the same disease or treatment are kindred spirits. On-line self-care groups are a particular form of a social network. The project includes one partner (Philips Research) with direct interest in this Sentinels theme.
• Internet and Telecom: Anonymity and identification are at the heart of building a network of kindred spirits. The project includes partners for whose business the balance between privacy and personalized communication (in the sense of being connected to the right social network) is critical (PAIQ, Bureau Promotie Podiumkunsten, Buurtlink, Waag Society).

Other Submission of the Proposal
This proposal has not been submitted to any other funding scheme.

Project Duration
Three years. Anticipated kick-off between July 1, 2009 and December 31, 2009.

Key words

1. Summary

1.1 Research

Computers, handhelds and networks are the fabric that builds the ubiquitously connected world. In such a world, interaction between groups of people is increasingly augmented by being connected through one or more social networks on the internet. The connected user expects the social network to provide the same level of privacy protection as in a real-life interaction. The problem that we address is building social networks of users with similar interests (i.e., kindred spirits) in such a way that (1) users are matched to one another and (2) various levels of personal privacy are respected when the user enters or leaves social networks. We approach this problem
by application-inspired research and solution validation. The project’s research partners and end-user partners provide requirements and constraints from a technological perspective and from an end-user point-of-view, in particular with regard to self-care groups and various forms of dating. Our innovative solutions are based on matching algorithms that exploit users’ privacy-protected (encrypted) data, and on new networking protocols that warrants privacy levels while users meet kindred spirits, establish, enter and leave interest groups. Our research makes an important contribution to more trusted, safer and transparent social networks in which users participate more confidently. In addition, the privacy-preserving protocol provides internet users with an important tool for managing their on-line identities. Our research results will be in the form of algorithms, protocols, and implementations that are validated using scenarios and data provided by the project end-users.

1.2 Utilization

Our project has a strong consortium of partners. Some of the partners are privacy technology consultants or providers, namely, Philips Research, Irdeto, and TNO-ICT. Others are truly end-users who’s current and future (business) success depends on privacy protection technology, such as PAIQ, Bureau PromotiePodiumkunsten (BPP), Waag Society, and Buurtlink. The utilization of our research proposal has three dimensions: case studies, technology research, and validation and dissemination.

Case studies provide an important source of inspiration, context and end-user constraints for the required technical research in the project. Furthermore, the project end-users benefit from case studies by direct interaction with the technical researchers. This will raise their level of awareness of contemporary threats and solutions in identity and data protection on the internet. We have identified two initial case studies with a large degree of commonality but also some essential differences. The first case study focuses on dating. This is the core business of PAIQ, but also the BPP is collaborating with Uitburo on cultural dating (matching people with similar interests in the performing arts who would like to go out but not alone). Waag Society is working on dating highly vulnerable social groups. The second case study, which is driven by Philips Research, focuses on empowering people to be in charge of their own health and well being through social networking (self-care social groups). Buurtlink is similarly interested in empowering people to be in charge of their own neighborhood.

In the second utilization dimension of the project is the joint research of the academic partners and the technology partner (consultants and technology providers). Experts on signal processing and security will cooperate closely on specific research challenges in creating efficient and secure privacy-enhanced matching algorithms and protocols for social networking. The cooperation is stimulated by joint internships of the academic researchers at the venues of the different technology partners.

The third and final utilization dimension of the project is the joint implementation and validation of at least one concrete case study provided by end-users. In this way, the performance and usability of the developed algorithms and protocols will be validated with respect to the constraints and requirements initially put forward by the end-users. This will stimulate and assist the end-users to precisely phrase their current and future expectations and requirements towards the project's (and other) technology providers.

2. Composition of the group

2.1 Current Group

The project team consists of the following nine partners with different roles (academic, technological, end-user), listed in Table 1.
<table>
<thead>
<tr>
<th>Full partner name (short name)</th>
<th>Role in project (partnership role)</th>
<th>Names</th>
<th>Project responsibility</th>
<th>Project involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delft University of Technology (TUD)</td>
<td>Academic</td>
<td>Prof.dr.ir. R.L. Lagendijk</td>
<td>Project leader</td>
<td>Secure matching algorithms</td>
</tr>
<tr>
<td></td>
<td>Ph.D. researcher vacancy</td>
<td></td>
<td>Research and validation</td>
<td>Secure matching algorithms</td>
</tr>
<tr>
<td></td>
<td>Programmer vacancy</td>
<td></td>
<td>Implementation and validation</td>
<td>Specific algorithm and protocol implementation</td>
</tr>
<tr>
<td>University of Twente (UT)</td>
<td>Academic</td>
<td>Prof.dr. P.H. Hartel</td>
<td>Co-project leader</td>
<td>Privacy protecting protocols</td>
</tr>
<tr>
<td></td>
<td>Ph.D. researcher vacancy</td>
<td></td>
<td>Research and validation</td>
<td>Privacy protecting protocols</td>
</tr>
<tr>
<td></td>
<td>Postdoc vacancy (candidate available)</td>
<td>Research, case studies, and supervision</td>
<td>Secure matching algorithms and privacy protecting protocols</td>
<td></td>
</tr>
<tr>
<td>Philips Research Eindhoven (Philips)</td>
<td>Technology</td>
<td>Dr. S.S. Kumar</td>
<td>Technology research and use case</td>
<td>Technical requirements. Policy framework. Validation of self-help use case</td>
</tr>
<tr>
<td>TNO-ICT (TNO)</td>
<td>Technology</td>
<td>Dr.ir. T. Veugen</td>
<td>Technology research and consultancy</td>
<td>Secure matching algorithms and privacy protecting protocols. Extensions to other use cases.</td>
</tr>
<tr>
<td></td>
<td>Drs. L. Kool</td>
<td>Technology research and consultancy</td>
<td>Social aspects and (privacy) perception of users</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G. Bodea MA</td>
<td>Social research and consultancy</td>
<td>Ethical and behavioral considerations of privacy</td>
<td></td>
</tr>
<tr>
<td>Irdeto</td>
<td>Technology</td>
<td>Dr. J. Doumen</td>
<td>Technology developer</td>
<td>Secure identification of users and peers</td>
</tr>
<tr>
<td>Waag Society</td>
<td>End-user</td>
<td>Dr. R. Kranenburg</td>
<td>Use case and data</td>
<td>Requirement and validation of social dating use case. Bridging real and virtual worlds via RFIDs</td>
</tr>
<tr>
<td>PAIQ</td>
<td>End-user</td>
<td>Ir. F.C. van Viegen</td>
<td>Use case and data</td>
<td>Requirement and validation of dating use case</td>
</tr>
<tr>
<td>Buurtlink.nl</td>
<td>End-user</td>
<td>Drs. W. Romijn</td>
<td>Use case and data</td>
<td>Requirements in context of neighborhood use case</td>
</tr>
<tr>
<td>Bureau Promotie Podiumkunsten (BPP)</td>
<td>End-user</td>
<td>Drs. Y. Melsert (director BPP) Ir. P. Luiten (director Amsterdams Uitburo)</td>
<td>Use case and data</td>
<td>Requirement and validation of cultural dating use case</td>
</tr>
</tbody>
</table>

The main research effort will be carried out by the two Ph.D. researchers and the postdoc at Delft University of Technology and University of Twente. They are directly supervised by the project leaders, Profs. Lagendijk and Hartel. In the day-to-day supervision during the first half of the project, the postdoc will assist the project leaders in bootstrapping the activities of the two Ph.D. researchers, as well as aligning activities with research at Philips Research, Irdeto, and TNO-ICT. It is planned that the two Ph.D. researchers and postdoc will spend several months away from their own university at the sister university. The postdoc will also coordinate the interaction with the end-users, Waag Society, PAIQ, Buurtlink, and BPP in order to get a clear picture of realistic requirements and constraints for the envisioned privacy-enhanced social networking solutions.

In year two and three, the Ph.D. researchers will carry out several internships at the partners Philips, TNO-ICT, and Irdeto, so as to guarantee sufficient technology transfer between academia and companies. For maximum effectiveness, the two Ph.D. researchers will be stationed at these
partners during the same period. Waag Society will host workshops with Ph.D. researchers as so to maximize interaction with researchers and user groups in various Waag Society projects.

In the second half of the project, a scientific programmer will interact with the academic partners and the technology partners to implement the developed matching algorithms and protocols for privacy-enhanced social networking for one of the end-users. Supervision of the programming effort is by the Ph.D. researchers and by the technology partners. The data, on which the implemented matching algorithms and protocols for privacy-enhanced social networking will be executed, will be provided by one or more end-users.

At Philips Research, Irdeto, and TNO-ICT senior researchers will collaborate in the project team and contribute their specialism (see Table 1) to the development and usage of the privacy-enhanced social networking solution. In addition to regular project team meetings (both face-to-face and in video conference setting), internships will secure the collaboration between academic partners and the companies’ senior researchers.

The three technology partners also have their own specific research and implementation agendas. Philips Research will investigate and develop policies for the self-help use case. Irdeto applies the Kindred Spirits solutions to their recommendation systems, including set top platforms. TNO-ICT not only co-develops Kindred Spirits solutions, but also reaches out beyond the two use cases that are leading in the project. Clearly, in these industrial research agenda’s, the researchers of the two universities will play an important role as carriers of up-to-date and innovative technical solutions.

2.2 Candidates

For the four positions at Delft University of Technology and University of Twente, new personnel need to be employed. For the postdoc position, one candidate has been contacted: his availability matches well the anticipated starting date of the project. Person power at the funded technology or end user partners will be drawn from already employed personnel.

3. Scientific Description of the Project

3.1 Project Content

3.1.1. Introduction

On-line social networks allow users to find kindred spirits by posting personal information. These networks foster social relationships and stimulate better health condition [Ell05, Eys05]. Social networks are, however, under threat. Social networking sites differ considerably in authentication and privacy levels [Eur08]. It is difficult for users of social networking sites to understand if and how their privacy is protected by the service provider. The reputation of some social networking sites has diminished by a number of incidents [Herr02], involving leakage and abuse of personal information, resulting in personal damage. This is a growing problem as millions of profiles containing personal information are added each year, the possibilities to store, retrieve and process personal data are growing, and (professional) search technologies are rapidly progressing [Jun08]. Trust is at stake [Ost01]. It is therefore not surprising that despite the rapid adoption of social networking sites; nearly 50% of European internet users - including those who would benefit from social networks - are still hesitant in using them [Hog07, Jenn08, Oecd07, Ofc08].

3.1.2. Ambition

The ambition of the project is to build a matching and social networking protocol that enables kindred spirits to meet, to establish an interest group, and eventually leave the interest group, while maintaining a hierarchy of privacy levels. The networking takes place in the virtual (internet) and physical world (using RFID devices and mobile phones). The foreseen solution will strengthen the trust in social network sites and will increase online security.
3.1.3. Expected Result
The main *research* result of the project is a privacy-enhanced matching and social networking protocol, called the *KS protocol*, with the following characteristics:

- simple to use;
- satisfy requirements that the end-users have in common;
- supporting gradual and selective lowering of the privacy fence between people;
- supporting momentarily increasing the risks taken;
- gradually increasing the sharing of personal information and experiences with kindred spirits;
- allows for transferring the social network between the virtual and the physical world.

Results for the technology and end-user partners are described in Section 4 of this proposal.

3.1.4. Approach
First, use-cases will be developed and studied in collaboration with the end-users, in which privacy protection in building social networks is required. In this way we derive operational requirements for our solutions. Then, we develop the privacy-enhanced KS protocol and associated theory that allow kindred spirits to match, meet, establish an interest group, and eventually leave the interest group. An implementation of at least one particular end-user case will be made for validation purposes. Results will be validated with the end-users, using data sets provided by end-users.

3.1.5. Technical Realization
The solution matches individuals based on their interest profile using techniques similar to data mining and recommendation systems. However, clustering is based on data that is privacy protected (encrypted) and the results will place individuals in social groups that maintain a prescribed privacy level. Hence the KS protocol is composed of a privacy-preserving K-means clustering algorithm that splits users with similar interests into $K$ clusters with individual non forgeable keys [Buh07, Erk09]. A clever key generation system is used based on fuzzy embedder techniques [Buh08a]. As an example, Figure 1 shows 5 clusters in the “interest space”. Some clusters have more points (users) than others; a key is assigned to each cluster. The exact information represented in the “interest space” is scenario dependent. In general, however, this space can be seen as an $N$-dimensional space in which $M$ users (vectors) are grouped into $K$ clusters.

**Basic Solution Approach**
Our proposed solution therefore requires a system that is able to cluster people based on their interests. We start with the following simplified assumptions:

- Each person has one interest (one vector per user);
- The interest space is endowed with a metric, i.e., one can qualitatively measure how far apart the interests of two users are.

The architecture of the system uses a central, trusted (honest-but-curious) server, which clusters the people, and gives out a cluster key to each person belonging to that cluster. This server is only needed for tracking the clusters, and making sure that each person obtains the correct key. The server will not know the individual interests, and who is member of which cluster as this is the information that needs to be privacy protected.

The system and the users have to take the following steps before a user can enjoy the benefits of cluster membership:
1. The server defines the clusters that are present, e.g., by using a privacy-enhanced version of the K-means clustering techniques [Lind00, Oli04b, Jag05] on the initially available interest profiles.
2. The server assigns a key to each cluster, and hence to each point in the interest space, using the fuzzy embedder technique [Buh08a].
3. A user requests his key from the server in a zero-knowledge fashion [Ver04]. This should happen in such a way that
   - the user does not reveal his interest,
   - the user learns only the key that belongs to his point in the interest space,
• the server does not know which key was assigned.

4. A protocol is carried out that enables two users to determine whether they have the same keys, i.e., whether they are in the same cluster.

![Figure 1: Example of users in five interest clusters with different keys assigned.](image)

These steps are based on the assumption that clusters are static, which is a convenient assumption for the first version of the KS protocol. For the more realistic case, namely that of dynamic clusters, modifications and extensions to the above solution will be necessary. Furthermore, the case that a user has multiple interests also needs be considered separately.

**Secure Clustering**

The idea of privacy-preserving data mining was introduced by Agarwal and Srikant [Agr00] and Lindell and Pinkas [Lind00]. They aim to extract information from users’ private data without having to reveal individual data items [Juel02]. Since then, several privacy-preserving protocols have been developed for data mining problems [Pin02, Cil03, Vai03, Ver04]. These protocols differ in the number of parties involved in the protocol (two versus multi-party), the partition of interest data (vertical, horizontal or arbitrary), and the method to provide privacy (encryption, perturbation). Privacy-preserving clustering protocols based on K-means algorithm [Lind00, Oli04b, Jag05] address the privacy problem using cryptographic techniques for several types of partitioned data.

At the heart of these protocols lies secure multiparty computation [Gol04] which makes any two-party privacy-preserving data mining problem solvable by using Yao’s secure circuit evaluation [Yao89] with a combination of homomorphic cryptosystems [Fon07]. On the other hand, Oliviera and Zaiane [Oli04a, Oli04b] suggest using techniques from signal processing based on randomization and geometric transformation of data to hide individuals’ privacy. Unfortunately, these solutions focus on either applying cryptographic primitives on top of the application or some transformation of data. As in the case of [Lind00, Oli04b, Jag05, Jag06] heavy computation cost of protocols based on secure circuit evaluation causes such solutions impractical for data mining purposes involving more than a few hundreds of items/users. Therefore, rather than relying on the referenced generic cryptographic solutions, the Kindred Spirits project proposal aims to provide a solution that is computationally efficient and scalable. Our hypothesis is that such more efficient privacy-enhanced solutions are feasible if we take into account the nature and structure of the users’ interest data.

**Fuzzy Extractor and Fuzzy Embedder**

In the construction of the keys belonging to the individual clusters, we will reuse some of the ideas from the field of fuzzy extractors [Dod04, Buh07] and fuzzy embedder [Buh08a]. Such extractors have become popular for protecting biometric templates [Jain04]. Constructions proposed for fuzzy extractors and fuzzy embedders depend on the properties of the data, type of distance measure used for measuring closeness and performance properties [Dod04, Buh07,
They all share, however, the property that from some structured data, reproducible uniform binary strings can be derived, which are useful for obtaining secret keys. In the context of the KS protocol, the users’ interest data rather than biometric profiles will be input to the fuzzy extractor as so to obtain cluster-dependent keys. Measures such as that in [Tan08] can be used to protect the privacy of the users’ interest data.

3.2 Required Personnel and Equipment

The project will be carried out by 2 Ph.D. researchers, a postdoc and a scientific programmer at the academic partners. With a total of 9 fte (over 3 years), these researchers form the core of the project. In order to obtain sufficient industrial support and embedding of the research at industrial partners, nearly 2 fte (3150 person-hours over 3 years) research capacity has been allocated to the project by the technology partners Philips Research, TNO-ICT, and Irdeto. The end-user partners have allocated a total of 400 person-hours to the project. No specific equipment is needed by the project.

3.3 Task Plan and Milestones

The task plan below shows the activities of the funded partners in the project. For each task, name and executing partners are listed (left columns). For the tasks that require the involvement (but not execution) of partners that provide requirements, case studies, data, and validation context, the partner names are mentioned in the horizontal taskbar. Task 7 mentions the three technology partners at which the internships will be carried out. The task plan shows the three phases of the project: use cases development and investigation of existing solutions (month 1 – 12), technology research (month 9 – 33), implementation, evaluation and validation (month 21-36)

Table 2: Task plan for Kindred Spirits partners.

<table>
<thead>
<tr>
<th>Milestone number and task</th>
<th>Mo.</th>
<th>Responsibility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS1 (T1)</td>
<td>6</td>
<td>TNO</td>
<td>Specification of requirements and constraints for Kindred Spirits solution</td>
</tr>
<tr>
<td>MS2 (T1)</td>
<td>6</td>
<td>Philips</td>
<td>Specification document of technical requirements self help</td>
</tr>
<tr>
<td>Project Code</td>
<td>Time</td>
<td>Organization/Role</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>--------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>MS3 (T2)</td>
<td>12</td>
<td>TUD/UT</td>
<td>Decision on specific solution to research use case</td>
</tr>
<tr>
<td>MS4 (T7)</td>
<td>15</td>
<td>TUD/UT</td>
<td>Start of series of internships</td>
</tr>
<tr>
<td>MS5 (T9)</td>
<td>24</td>
<td>TUD/UT/TNO</td>
<td>Decision on specific use-case to implement and data to use</td>
</tr>
<tr>
<td>MS6 (T4)</td>
<td>24</td>
<td>Irdeto</td>
<td>Prototype of privacy aware recommender systems using collaborative filtering.</td>
</tr>
<tr>
<td>MS7 (T5)</td>
<td>30</td>
<td>Philips</td>
<td>Policy framework specification self help use case</td>
</tr>
<tr>
<td>MS8 (T6)</td>
<td>33</td>
<td>TNO</td>
<td>Overview document of applications beyond case studies social dating and self help. Includes analysis of typical problems (technical, social or business) that need further attention before a mature solution can be developed.</td>
</tr>
<tr>
<td>MS9 (T3)</td>
<td>33</td>
<td>TUD/UT/TNO</td>
<td>Research journal paper for publication</td>
</tr>
<tr>
<td>MS10 (T10)</td>
<td>33</td>
<td>TUD/UT</td>
<td>First implementation of KS protocol ready</td>
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<tr>
<td>MS11 (T8)</td>
<td>33</td>
<td>Waag</td>
<td>Evaluation and demonstrations of prototypes</td>
</tr>
<tr>
<td>MS12 (T11)</td>
<td>36</td>
<td>Irdeto</td>
<td>Implemented KS protocol on set-top box, plus service demo</td>
</tr>
<tr>
<td>MS13 (T12)</td>
<td>36</td>
<td>Philips</td>
<td>Validation of policy framework self help use case</td>
</tr>
<tr>
<td>MS14 (T12)</td>
<td>36</td>
<td>TUD/UT</td>
<td>Evaluation report of case studies and recommendation to end users</td>
</tr>
</tbody>
</table>

### 3.4 Existing Infrastructure

Research will be carried out at Delft University of Technology (TUD) and Twente University (UT) (academic researchers), Philips research, TNO-ICT, and Irdeto (senior technology researchers), and Waag Society (end-user with prototyping activities). The infrastructure needed for the project is an excellent knowledge infrastructure, leadership, and project management experience.

Prof. Lagendijk (TUD) is expert in signal processing and data/media protection methods. He has led multiple larger national and international research projects in the field of multimedia signal processing, compression, and security [Erk07, Erk09]. Prof. Lagendijk is fellow of the IEEE, and member of the advisory committee of ICTRegie. Prof. Hartel (UT) is expert in computer and information security. His research concentrates on constructions and security performance of fuzzy extractors and fuzzy embedders [Buh07, Buh08a, Buh08b, Tan08]. He has been actively involved in stimulating security research in the Netherlands through his role in the national “Veilig Verbonden” research agenda and his membership of the Sentinels program committee.

The Information and System Security of Philips Research, Eindhoven, headed by Dr. van Rijnsoever, has a world-class reputation in security research for multimedia. The department has spun out several security technology companies (audio fingerprinting, broadcast monitoring, biometric).

TNO-ICT has over 350 people working in the area of applied research and consultancy on various ICT topics. The knowledge infrastructure provided to the project is (a) security and privacy, including technical aspects of privacy preserving protocols in sensitive domains, and practical consequences and requirements for secure technical solutions; (b) policy, society and users, including social, ethical and policy aspects of technological innovation, and international trends on privacy (perception).

Dr. Doumen is member of Irdeto’s recently formed research team, that provides technology and functionality knowledge for future business, including recommendation systems and targeted advertising.
3.5 Relationship with Other Research

We refer to Section 3.1.5 for a discussion of related fundamental international research and papers. Delft University of Technology and Philips have established a partnership in a European FET project called Signal Processing in the Encrypted Domain (SPEED). The project has four other partners, namely Universita degli Studi di Siena, Universita degli Studi di Firenze, Ruhr-Universitaet Bochum, and Katholieke Universiteit Leuven. The goal of SPEED project is to foster the advancement of the marriage between signal processing and cryptographic techniques, both at theoretical and practical level. In this respect, the SPEED project forms a valuable basis for the proposed project with the experience gained [Erk07].

Philips has an active research program on medical security and privacy [Pet07, Kat08, Kev05]. Results of this activity are being standardized in the Continua Alliance, which is an industry initiative to provide interoperable personal tele-health solutions. Philips Research is also active in the Sentinel project Sedan on searchable encryption of databases: approaches being developed in SEDAN may be (partially) usable for the data clustering approach.

Waag Society is part of a subgroup of the DIFR network (Dutch interdisciplinary forum on RFID). One of the activities of DIFR is the study and implementation of privacy policies for RFID [Kran07]. These results relate to the Kindred Spirits project proposal because Waag Society will study the extension of the KS protocol to the physical world via RFID. The Sentinel project PEARL, which includes the partners Philips Research, TNO-ICT, UTWente and TU Delft, may contribute to linking RFID privacy and security to the current project’s privacy-enhancing social networking protocol.

4. Utilization Plan

4.1 Practical Challenges and Anticipated Solutions

The project addresses two practical challenges. The first challenge is privacy concerns in various forms of (internet) dating. People who take part in online dating may request that their profiles are protected at various levels, and that their profiles can be removed securely from the dating site. Dating – in one or another form – and matching between people and groups of people is a fast growing business on the internet. Dating to get involved into a relationship is the core business of the project’s end-user PaiQ. Also BPP, together with Uitburo and CJP, is closely following what is known as “cultural dating”. Basically this involves matching people with similar interests in the performing arts, who would like to go out but not alone [Haa08]. Waag Society is involved in various societal projects to break down cultural barriers of minorities in the Netherlands using ICT. Especially when dealing with highly vulnerable social groups, privacy protection is of utmost importance.

The second challenge concerns similar privacy concerns in online self-care groups or communities. The end-user and technology provider Philips Research has an interest in building social groups that can help patients with chronic conditions to inform and motivate others with similar conditions. However, members to such self-care social groups can reveal a lot of privacy sensitive health data both explicitly and implicitly. From this background, Philips Research can provide technical requirements that need to be fulfilled for the realization of such self-care social groups. Matching and social networking that enables chronic patients to meet and to establish an interest group while maintaining a hierarchy of privacy levels is relevant for the trust and success of such social groups. Buurtlink has a similar interest, but with the focus of making people responsible for their environment. Again, adjustable privacy levels of participant in the local on-line communities are essential, yet no solutions exist.
The above two end-user case studies drive the requirements of the security solutions to be researched. Both case studies deal with social capital that has a high emotional value, which if not protected adequately can lead to major disappointments on the part of the participants and major revenue losses to the business involved. Therefore, theory, algorithms, and technology will be developed for privacy-enhanced social networking by the academic and technology partners in the project. The societal consequences of providing a privacy-enhancement layer to social networks are relevant for all of the project’s end-user businesses, and will be the subject of study of TNO-ICT.

4.2 Partners and Implementation

This section lists the projects partners and their direct interest in the project. The implementation of the project results are directly related to the partners’ interests: for that reason we have combined the subsections “Users” and “Implementation” into this single section on “Partners and (their) Implementation”.

<table>
<thead>
<tr>
<th>Philips Research Eindhoven</th>
<th>Technology research and end-user</th>
<th>Dr. B. van Rijnsoever</th>
<th>Senior director Department head information &amp; system security</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><a href="mailto:Bart.van.Rijnsoever@philips.com">Bart.van.Rijnsoever@philips.com</a></td>
<td></td>
</tr>
</tbody>
</table>

Philips has a strong presence in the home healthcare product-service offerings with its solutions like Motiva which provides an interactive healthcare platform that connects patients with chronic conditions to their healthcare providers - via the home television and a broadband internet connection. Philips is also involved in encouraging interoperability in this domain by its active participation in standardization in the Continua Alliance which is an industry initiative to provide interoperable personal tele-health solutions.

Philips is initially involved in providing the technical requirements that needs to be fulfilled for the realization of its end-user case of the self-care social groups. Philips would be additionally involved in providing technical input to the policy framework that enables the use of the cryptographic algorithms and protocols in a final implementation for the end-user case. The policy framework would enable users to control in which social groups they intend to participate, how to gradually increase the personal data that they would like to expose and when to momentarily increase the risk. Philips would be finally involved in the validation of the technologies to its end-user case of self-care social groups and within the context of its home healthcare business.

<table>
<thead>
<tr>
<th>TNO-ICT Delft</th>
<th>Technology research and consultancy</th>
<th>Dr.ir. T. Veugen</th>
<th>Senior scientist security</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><a href="mailto:Thijs.veugen@tno.nl">Thijs.veugen@tno.nl</a></td>
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</tbody>
</table>

TNO has a leading role in the Netherlands for bringing new technologies and innovative ideas to the market. Based on earlier work [Bod08, Koo08], within the project TNO-ICT will:

- develop secure matching algorithms with TU Delft with particular attention to the practical usability of these algorithms,
- develop privacy protecting protocols together with TU Delft and U Twente with particular attention to the practical usability of these protocols,
- look for cases where the algorithms and protocols that are developed could be applied, beyond the two already identified cases of dating and self-care social groups, possibly extending the algorithms and protocols in these directions,
- study user requirements and broader social aspects of the cases that are foreseen within the project.

The knowledge that will be developed in this project will help TNO to bring solutions to companies suitable for social networks of users with similar interests. Due to the increase of such networks (on the internet or mobile) and the need for privacy-preserving solutions, such knowledge will be critical for TNO in the coming years.
Irdeto empowers companies to protect and monetize their digital assets with innovative and reliable software technologies, end-to-end solutions and services. The company’s products include conditional access, digital rights management, and set-top box software solutions. Customers worldwide trust Irdeto to secure and enable the delivery of their content across digital broadcast, IP, and mobile networks. Irdeto solutions currently provide a walled garden, into which the content can be released safely.

One of the current trends is for users to generate and distribute their own content. The concept of content should be viewed in broad sense – content can take on the traditional meaning of pictures or home videos, but can also be extended to metadata such as movie ratings used for collaborative filtering. However, distribution of this content should be selective – users rarely want to share their content with everyone worldwide, but usually want to restrict it to a group of peers – their kindred spirits.

The first problem here is for users to locate their kindred spirits: for instance, an airplane spotter might search a group of fellow spotters to share and discuss his pictures with. In the case of collaborative filtering, one is interested in taste buddies who can give good recommendations on movies. Here, privacy is an important consideration, when searching for kindred spirits, but also afterwards – a collaborative filter might be entirely automated and thus the shared content needs to be anonymized. The proposed research project therefore has a direct business impact, in enabling Irdeto to support and secure user-generated content.

Waag Society develops creative technology for social innovation. The foundation researches, develops concepts, pilots and prototypes and acts as an intermediate between the arts, science and the media. Waag Society cooperates with cultural, public and private parties. Waag Society has a strong focus to let user groups participate in internet, new media and technology that otherwise have limited access. Examples are The Storytable, a multimedia table for elderly people to share stories and BoardMessenger, a tool for mentally impaired people to communicate.

In the Kindred Spirits project, Waag Society has an interest in technology [Kran07] and prototyping for connecting social groups not only in the virtual worlds, but also on the physical world. Waag Society will contribute to the project in the following way:
- rapid prototyping of tangible objects in the fablab: these objects will represent the physical implementation of the privacy-enhanced social network created in the virtual world,
- study and knowledge of privacy profiles,
- building scenarios and adding narrative structure in collaboration with BPP, PAIQ, and BuurtLink, and others.

The KS protocol developed in the project is intended for the (virtual) internet worlds. Waag Society will study ways to extend this protocol to the physical world. For instance, people who were connected and met in a social network, may still wish to maintain some level of privacy in the physical world before a meeting actually takes place. Vise versa, a meeting in the real world may be mirrored in a internet social network. Waag Society is studying the use of RFID tags for linking physical and virtual worlds in this manner.

Paiq is becoming one of the major local players in the field of online dating. Paiq uses an innovative approach to match individuals, based on artificial intelligence. Like any dating site, Paiq needs
enormous amounts of personal information from its users. Paiq does not share this information with other users, but uses it as raw data in the process of matching users. The personal information of hundreds of thousands or millions of individuals, that is or will be collected, has to be processed in the matching process. At this moment, these data is unencrypted and can be accessed by employees, or anyone who would be able to break in into the system. For now it is almost impossible to protect and secure these data against people, or perhaps even organizations, who intend to abuse it or have the wrong intentions. In respect to the fast growing role of internet criminality this seems to become a serious complexity.

Since personal information is spreading all over the world wide web, more and more over the last years, a public debate on the role of privacy in this matter seems feasible. Therefore it seems wise to prepare on a debate on this issue and try to find possible solutions in advance. Even more important is the trust our users have in the security of our system. In the long run, handling and storing data in an encrypted way may well prove to be the road forward. Trying to tackle this issue as an individual organization is impossible and consumes too much of company resources. Therefore joining this project as a SME end-user is a great opportunity to contribute to a solution for this social problem.

Bureau Promotie Podiumkunsten (BPP, Foundation Collective Performing Arts Promotion) is a not-for-profit foundation funded through the “Theatre & Concert Token” and public/private project grants. Its objective is to generate more attention for the performing arts (e.g., in the media) and to draw more people to theatre shows and concerts. Its guiding principle is the conviction that the performing arts – in the widest sense, including all kinds of music, dance, theatre, cabaret, mime and musical theatre – enrich life and can be a force that cements society together. BPP is the only national organization in this field that is dedicated exclusively to marketing and bringing in audiences; that prefers a collective approach, working with both stages and producers; and that does this for all genres. BPP initiates, organizes and coordinates collective promotional activities, such as the annual youth theatre days, classical music week, and public theatre awards.

In organizing activities for collective promotion, BPP often does its own research and, wherever possible, builds upon prior experience, be it at BPP or elsewhere. Knowledge and expertise is shared with the cultural sector: this makes BPP a national expertise centre on marketing and audience development for the performing arts.

From recent research [Foe08, Mei08], BPP has learnt that people like to go out but don’t always know where to go to, and don’t want to go on their own. ‘Buzzing’ and ‘showing the way’ is our most urgent challenge. Together with the arts organizations Nederlands Uitburo (NUB) and CJP we strive for social networks in which users can participate confidently and which lead to a healthy cultural sector that serves the attendees. BPP and related organizations face a growing use of internet and social networking by visitors (and visitors-to-be) of performing arts and music. In this respect, for the research BPP/NUB/CJP can offer all the entrances needed to customer cultural databases, like www.uitburo.nl, www.cjp.nl and www.cultuurkaart.nl.

Buurtlink.nl is a small non-profit foundation that aims at improving the social coherence, and in particular the coherence of city’s neighborhoods. The means to this end is the social website www.buurtlink.nl. This website is continuously improved and expanded based on the foundation’s
ideas and the feedback of the users. The ambition is that through the website neighborhood’s citizens will be stimulated to meet and that mutual understanding of citizens in neighborhoods will improve. The process of bringing together of citizens raises many privacy issues. It is this particular aspect of Buurlink’s activities that will help to direct the research in the Kindred Spirits proposal.

4.3 Past Performance

The project proponents have collaborated before in the BSIK Freeband project I-Share on sharing technology such as P2P systems. An important application of the I-Share project is the Tribler software: a social P2P multimedia sharing system [Trib08]. TU Delft and U Twente have collaborated in several other projects, o.a. the Sentinels project PEARL.

U Twente has contributed significantly to the theory and practice of the fuzzy embedders that will be used extensively in the Kindred Spirits project. Dr. Ilena Buhan [Buh07, Buh08a, Buh08b], formerly with U TWente and now with Philips Research, won the EBF European Biometric Industry Award 2008 with her paper on "Spontaneous Secure Pairing using Biometrics". The work was funded by STW’s Secure Grip project.

Philips and TU Delft have collaborated closely in the EU project SPEED, in which as innovative privacy-preserving face recognition system was developed [Erk09]. Philips and U Twente have collaborated in several projects under the Sentinels program.

The partner TNO-ICT has extensive experience in running projects in the field of privacy technology, such as: “Burger in Control” which addresses the question if Dutch citizens are sufficiently in control of their personal information, and “User Generated Privacy”, a project on the implications of web 2.0 applications, and social networks in particular, for privacy risks and privacy perceptions of users. TNO-ICT has collaborated with Philips, TU Delft and U Twente in several Sentinel projects as well as other projects under the BSIK Freeband program.

Waag Society has extensive experience in projects in the field of social communication. Non-verbal, implicit forms of communication are essential in keeping intimate relationships. The project named Scottie researched the possibilities of using information and communication technology to create virtual immediacy between long-stay absentees and their primary social contact group.

5. Knowledge Management

5.1 Contracts

Not applicable

5.2 Patents

To our best knowledge, no patents exist that are directly relevant for the (new) field of privacy-enhanced social networking.

6. Budget

6.1 Personnel

The project proposal requests funding for:

- 2 Ph.D. researchers for 3 years each (100% funding)

---

1 Financial details can be found in the budget sheets attached as Appendix to this proposal.
• 1 postdoc for 1.5 years (100% funding)
• 1 scientific programmer for 1.5 years (100% funding)
• 3450 person hours at three technology and one end-user partner (32% funding)

6.2 Material Costs
We estimate the material costs at € 5,000 per year, for a total of € 15,000.

6.3 International Travels
We estimate the travel expenses at € 12,000 per year, for a total of € 36,000.

6.4 Investments
No investments are planned.

6.5 Contribution of Partners
The technology and end-user partners contribute € 337,793.

6.6 Overall project costs

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7. Literature

7.1 Publications by project members


7.2. Other literature


8. Appendix

The letters of intent of the technology and end-user project partners are attached as Appendix to this project proposal. The project budget sheets as prescribed by the Sentinels call is also attached as Appendix.
Onderwerp
Kindred Spirits Project

Geachte Prof. Dr. Ir. Inald Lagendijk,

TNO maakt wetenschappelijke kennis toepasbaar om het innovatief vermogen van bedrijfseven en overheid te versterken. TNO Informatie- en Communicatietechnologie is een uniek innovatiecentrum in Nederland, waarbinnen de ICT en Telecom disciplines van TNO zijn gebundeld. Wij helpen bedrijven, overheden en (semi-)publieke organisaties succesvol te innoveren met ICT. Hierbij staat de waardecreatie voor de klant centraal en ligt onze toegevoegde waarde in een combinatie van innovatieve kracht en diepgaande kennis. Wij benaderen innovatie integraal en praktisch. Naast technologie wordt waar nodig uitdrukkelijk de gebruikersvriendelijkheid, de financiële onderbouwing en de bedrijfprocessen meegenomen. Via technische en markt pilots werken wij ook mee aan de implementatie. Wij zijn sterk in innovatiestrategie en innovatiebeleid en bieden een omvangrijke bron van ICT kennis voor maatschappelijke vraagstukken.

Het onderzoek dat binnen het Kindred Spirits (Privacy Enhanced Social Networking) project zal worden uitgevoerd past goed binnen ons portfolio, en we zijn daarom ook graag partner in dit project. Privacy en identity management is een van de speerpunten van onderzoek binnen TNO ICT, en het spanningsveld tussen security en privacy wordt hierin duidelijk gevoeld. Verdere kennisontwikkeling op dit gebied zal TNO helpen in het adviseren van de overheid bij het privacy vriendelijk, maar ook toerekenbaar implementeren van e-overheids diensten.

Ter ondersteuning van het Kindred Spirits project voorstel, en als ondersteuning van het belang dat TNO hecht aan het binnen Kindred Spirits voorgestelde onderzoek, zouden we graag actief willen participeren in het Kindred Spirits project. Om precies te zijn, en zoals nader in detail uitgewerkt in het project voorstel, is TNO bereid om over een periode van 3 jaar 1500 uur mensinzet aan het project bij te dragen, wat volgens de SENTINELS budgetteringsregels overeenkomt met een bijdrage van € 214,500. Hiervoor vraagt TNO, eveneens in overeenstemming met de SENTINELS budgetteringsregels, een vergoeding van SENTINELS ter hoogte van € 73.071. De netto bijdrage van TNO aan het Kindred Spirits project is dus € 141,429.

Met vriendelijke groet,

Prof. Dr. Ir. Erik Huizer
Directeur Kennis, TNO Informatie- en Communicatietechnologie
Dear professor Lagendijk,

On behalf of Philips Research I would like to confirm our intention of participating as funded technology partner and end user in the Sentinels project Kindred Spirits: Privacy Enhanced Social Networking.

We are very pleased to be involved in Kindred Spirits. In collaboration with the partners, the project enables us to develop technology for secure sharing of information in social networks. The main application of this technology for Philips is sharing of health and wellness data between consumers.

Our contribution in the project amounts to 750 hours and is valued at € 107,250, for which we request a subsidy of € 36,535.

Participation of Philips in this project is subject to agreement on a policy for intellectual property rights.

Kind Regards,

Fred Boekhorst
Senior Vice President Philips Research
Program Manager Lifestyle

High Tech Campus 34 (M/S 52)
5656 AE Eindhoven, The Netherlands
Tel. +31 40 2749774, Fax. +31 40 2744911
E-mail: Fred.Boekhorst@philips.com
Prof.dr.ir. R. L. Lagendijk  
Information and Communication Theory Group  
Department of Mediamatics, Faculty of EEMCS  
Delft University of Technology  
Mekelweg 4, 2628 CD DELFT  
The Netherlands  

Project Participation Kindred Spirits  
November 28, 2008  

Dear prof. dr. ir. Inald Lagendijk,  

On behalf of Irdeto I would like to confirm our intention of participating as funded technology partner in the project Kindred Spirits. Privacy Enhanced Social Networking.  

Our involvement will consist of 900 hours against an hour tariff of € 143.50, in sum therefore € 128,700. As we apply for a project subsidy of € 43,843, our corporate contribution amounts to € 84,857.  

We are very pleased to be involved in the Kindred Spirits project.  

For us, the Kindred Spirits project is the first step in our efforts to develop technology which enables users to securely distribute their own content among their peers. One of the problems encountered here is that these peers need to be identified and located – which is the problem that the Kindred Spirits proposal focuses on.  

Best Regards,  

Mathieu Goudsmits  
Director Technology Business Development Irdeto
Delft University of Technology
Prof. dr. ir. R.L. Lagendijk
Mekelweg 4
2628 CD DELFT

Subject: Project Participation Kindred Spirits

Amsterdam, 26 November 2008

Dear prof. dr. ir. Lagendijk,

On behalf of Waag Society I would like to confirm our intention of participating as funded end user partner in the project Kindred Spirits: Privacy Enhanced Social Networking.

Our involvement will consist of 300 hours against an hour tariff of € 143,--, in sum therefore € 42,900. As we apply for a project subsidy of € 14,004, our corporate contribution amounts to € 28,896.

We are very pleased to be involved in the Kindred Spirits project.

We will bring to the project our expertise from the Scotty project (HealthCare), the Self City project (Health) and Smart Environments program, DIFR network and RFID expertise.

DIFR http://www.difr.nl/
Smart Environments en Internet of Things publikatie http://www.waag.org/project/smartenvironments
Scottie http://www.waag.org/project/scottie
Self City http://waag.org/project/selfcity

For us, the Kindred Spirits project is an important research and prototyping trajectory to which we can bring our expertise on tangible interfaces in the Waag Fablab (www.fablab.nl) and conceptual approach to transparent privacy policies in smart environments.

As our role in the Kindred Spirits project, we see Requirement and validation of social dating use case. Bridging real and virtual worlds via RFIDs

Best Regards,

Drs. Rob van Kranenburg
Programme Leader Public Domain
Waag Society
Subject: Project Participation Kindred Spirits

Enschede, 01 december 2008

Dear prof. dr. ir. Inald Lagendijk,

On behalf of Implicit Link I would like to confirm our intention of participating as non-funded end-user in the project Kindred Spirits: Privacy Enhanced Social Networking.

We are very pleased to be involved in the Kindred Spirits project. For us, the Kindred Spirits project is a unique opportunity to anticipate on privacy-issues in the future. As dating sites use enormous amounts of personal information as input to the matching-process, privacy will be a growing concern. It seems feasible a large public debate might originate on the issue of using large amounts of relatively exposed data. Society might demand extensive measures on the protection personal data. We believe encryption may provide a solution, but methods need to be invented to process this encrypted data in a useful manner.

Joining the Kindred Spirits Project as a use case and end user is a great opportunity for us to be at the cutting edge in the field of privacy, and to contribute to a solution for this social and technological problem. Our involvement will consist of 48 hours against an hour tariff of € 143,--, representing € 6,864 in kind. We do not apply for a project subsidy.

Sincerely yours,

Ir. F.C. van Viegen
Dear prof.dr.ir. Inald Lagendijk,

On behalf of Stichting Bureau Promotie Podiumkunsten I would like to confirm our intention of participating as non-funded end-user in the project “Kindred Spirits. Privacy Enhanced Social Networking”. Our involvement will consist of 48 hours against an hour tariff of € 143,-, representing € 6.864,- in kind. We do not apply for a project subsidy.

Bureau Promotie Podiumkunsten is a not-for-profit foundation and performing arts network organization. Our objective is to generate more attention for the performing arts & music (e.g., in the media) and to draw more people to theatre shows and concerts, starting from the idealistic point of view that performing arts and music are a necessary condition for a resilient society. Bureau Promotie Podiumkunsten is also one of the founders of Nederlands Uitburo, the national cultural agenda and information database (3,014,330 visitors of www.uitburo.nl in 2007). In attracting young people to visit performing arts, we work together very closely with Cultureel Jongeren Paspoort/ Cultuurkaart (CJP).

From recent research we know that people like to go out, but don’t always know where to go to and don’t want to go on their own. ‘Buzzing’ and ‘showing the way’ is our most urgent challenge. Together with the arts organizations Nederlands Uitburo and CJP we strive for social networks in which users can participate confidently and which lead to a healthy cultural sector that serves the attenders.

We are pleased to be involved in the Kindred Spirits project, as we face a growing use of internet and social networking by visitors (and visitors-to-be) of performing arts and music. In this perspective, for the research we can offer all the entrances needed to customer cultural databases, like www.uitburo.nl, www.cjp.nl and www.cultuurkaart.nl.

Best regards,

Drs. Yolande Melsert
Director Bureau Promotie Podiumkunsten

Funenpark 1, 1018 AK Amsterdam
Tel +31 20 5789200
directie@promotiepodiumkunsten.nl
www.promotiepodiumkunsten.nl
www.theaterenconcertbon.nl
BUURTLINK Commitment Letter

Stichting Buurtlink
Anthony Fokkerweg 1
1059 CM Amsterdam

Subject : Project Participation Kindred Spirits

12 th December 2008

Dear prof. dr. ir. Inald Lagendijk,

On behalf of Stichting Buurtlink I would like to confirm our intention of participating as non-funded end-user in the user committee of the project Kindred Spirits. Privacy Enhanced Social Networking.

Our involvement will consist of 2 working days per year, amounting to 48 hours for the complete project duration. Capitalized at an hourly rate of € 143, yields our “in kind” contribution to the project of € 6,864.

We are very pleased to be involved in the Kindred Spirits project. For BuurtLink, the study of privacy and identity management in communities is an important development. Abuse of (sensitive) personal information threatens the further growth and development of on-line social communities, and hence the interest of the Stichting Buurtlink. We look forward to discuss practical constraints and requirements for the project with you and the other project team members.

With best regards,

Wilfred Romijn
Marketing Manager Stichting Buurtlink
Sheet om te controleren of de totale bedrijfsbijdrage voldoende is om aan de Sentinels normen te voldoen Versie 3.3, Technologiestichting STW, Rik D.T. Janssen. Email aanvullingen en opmerkingen naar r.janssen@stw.nl.

Aan het gebruik kunnen geen rechten ontleend worden. Controleer zelf of de berekeningen kloppen.

De meest recente versie van deze sheet te vinden op: www.sentinels.nl/contribution.xls. Controleer regelmatig (en zeker vlak voor de deadline) of je de meest recente versie hebt.

Vul alleen de gele velden in

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**Stap 2. Vul materieel krediet, buitenlandse reizen en investeringen in:**

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**Stap 3a. Vul de bedrijfsbijdrage in (voorbereiding van en deelname aan vergaderingen van de GC wordt niet gezien als bijdrage):**

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<th>Irdeto</th>
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**Stap 3b. Vul het bedrag in dat een bedrijf door Sentinels vergoed wil hebben:**

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| maximum bedrijfsvergoeding | 73,943 |
| bedrag te vergoeden | 73,943 |
| totaal netto bedrijfsvergoeding | 140,557 |
| totaal netto bedrijfsvergoeding | 140,557 |
| totaal universitaire projectkosten | 0 |

**De totale projectkosten:**

<table>
<thead>
<tr>
<th>bedrag</th>
<th>0000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>vergoeding Sentinels aan bedrijven</td>
<td>170,069</td>
</tr>
<tr>
<td>totaal universitaire projectkosten</td>
<td>467,493</td>
</tr>
<tr>
<td>totaal projectkosten</td>
<td>637,562</td>
</tr>
</tbody>
</table>

**Controles:**

| Totaal univ. projectkosten max. 53% | klopt |
| Bedrijfsvergoeding max. 17.7% | klopt |

**Controles per bedrijf:**

<table>
<thead>
<tr>
<th>naam bedrijf</th>
<th>TNO-ICT</th>
<th>Philips</th>
<th>Irdeto</th>
<th>De Waag</th>
<th>PAIQ</th>
<th>BPP</th>
<th>BL</th>
</tr>
</thead>
<tbody>
<tr>
<td>netto bedrijfsvergoeding &lt;= 25% bedr. bijdrage</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
<tr>
<td>netto bedrijfsvergoeding &gt; 25% bedr. bijdrage</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
<tr>
<td>bedrijfsvergoeding in orde</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
<tr>
<td>bedrijfsvergoeding &lt;= 14%</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
<tr>
<td>bedrijfsvergoeding &gt; 14%</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
<tr>
<td>bedrijfsvergoeding &gt; 37%</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
<td>klopt</td>
</tr>
</tbody>
</table>

**Overige controles op aangesteld bedrijfs personeel (niet automatisch te testen):**

<table>
<thead>
<tr>
<th>projectduur</th>
<th>36 maanden</th>
<th>3 jaar</th>
</tr>
</thead>
<tbody>
<tr>
<td>p pos. &lt;= 72 E/u, &lt;= 1500 u/j</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>dr pos. &lt;= 100 E/u, &lt;= 1300 u/j</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>nr pos. &lt;= 143 E/u, &lt;=1100 u/j</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

LET OP: Het is in principe mogelijk om aio- posities aan te vragen, maar met het volgende voorbehoud. De einddatum van het Sentinels-programma is vastgesteld op 31 dec. 2012. Dit betekent dat alle toevoegingen in de derde call slechts tot die datum zullen gelden en dat de projecten met de derde ronde per die datum een soort afronding in het kader van Sentinels bereikt moeten hebben. Sentinels zal de mogelijkheden verkennen om de einddatum van het programma naar achteren te verplaatsen, maar over de uitkomen daarvan is nog niets te zeggen. Zodra het nu is, past er dus geen aio-periode in de projecten van de derde ronde. Zij kunnen wel aangemeld worden, maar de aanvragers dienen rekening te houden met het bovenstaande voorbehoud.

NB: Er is een klein verschil (enkele honderden euro's) tussen de bedragen hier opgevoerd bij TNO, Philips, Irdeto en Waag als vergoeding/bijdrage, en de bedragen genoemd in de commitment brieven. Het leek niet nodig de brieven te laten wijzigen.

Sentinels zal de gesubsidieerde partners claimen subsidies volgens de Sentinels regeling.

<table>
<thead>
<tr>
<th>bedrijf</th>
<th>TNO-ICT</th>
<th>Philips</th>
<th>Irdeto</th>
<th>De Waag</th>
<th>PAIQ</th>
<th>BPP</th>
<th>BL</th>
</tr>
</thead>
<tbody>
<tr>
<td>totaal financiering door Sentinels</td>
<td>637,562</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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