Sentinels is a national Dutch research program on security in ICT, networks and information systems. The program was designed to boost ICT security research and expertise in the Netherlands, and foster collaborations between universities, knowledge centres, and companies to build a national ICT-security research community. Sentinels was launched in 2004, financed by the Ministry of Economic Affairs, the Netherlands Organisation for Scientific Research (NWO), and the Technology Foundation STW. In three rounds, in 2005, 2007 and 2009, the program funded a total of 16 collaborative research projects between academia and industry.

The Sentinels research program

The Sentinels research program aims to improve ICT, networks and information security, including PCs, corporate and home networks, handheld devices, smart cards, and wireless networks. It targets the technical aspects of security through scientific research in close collaboration by academia and industry.

Sentinels uses the standard procedure of the Technology Foundation STW, which funds collaborative utilisation-oriented research projects that are pre-competitive and tackle long-term problems. Here collaborative means that research projects are carried out by a consortium consisting of at least one university and one industry partners. Industry partners participate in the research and contribute to the project costs, with additional funding for personnel from Sentinels for PhD students or post-doctoral researchers at universities. This means that projects typically run for 4 years, the duration of a PhD. Each project has a panel of End Users that follows the progress to ensure broader dissemination and provide additional steering of the research.

Project grants are awarded through an open competition within the scope of the program, where project proposals are judged both on scientific merit and on utilisation, i.e. the application of the results of the research.

In addition to the research projects, Sentinels funded a part-time position of a Sentinels ambassador (drs. A. Eisner) to promote the programme and its results to wider Dutch audience, especially in industry and government. Sentinels also supports networking and knowledge exchange by organising its own events (the Sentinels Security Day and the conference STW/ICT), by taking part in events such as the ICT-Kenniscongres and ICT-Delta, and by sponsoring the SAFE-NL workshops on ICT security research.

Total public financing for Sentinels was 8.345 M€ (2.5 M€ each from Economic Affairs, STW, and NWO, and another 845 k€ from ICTRegie). Companies participating in projects contributed another 2.4 M€. The first call for proposals for Sentinels was launched in 2004, with subsequent calls in 2006 and 2008. The first generation of projects, which started in 2005, have all ended now. Projects awarded in the last round started in 2009 and will end around 2013.

Many more companies are active as End Users in Sentinels project fora. Around 35 PhD students/post-docs are employed and trained in these projects.

The 16 Sentinels projects span a range of topics such as biometrics, risk assessment, searchable data encryption, intrusion detection, worm detection, virtual security perimeters, identity management, smartcards, RFID, mobile devices, mobile phones, privacy-enhancing technologies, social networks, and smart metering. These projects involved six universities: (TUE, UT, TUD, VU, RU, CWI); the knowledge centres TNO and Novay (formerly Telematics Institute); 18 companies (Brightsight, Chess IT, Philips, NXP, STMicroElectronics, Rabobank, Corus, Akzo, DSM, Hoffman, AtosOrigin, BiZZdesign, Ericsson, GetronicsPink-Roccade, Fox-IT, Alliander, Ideto, Civolution), and several government agencies (B/CICT, ICTU, RDW).

Results of the first Sentinels round

The six projects in the first round (DeWorm IPID, JASON, PINPAS, Practical Approaches to Secure Computation, and ProBite) have now all ended, allowing there results to be assessed. These projects resulted in two patents and in two spin-off companies, namely SecurityMatters and Priv-ID.

ProBite had a follow-up with UT participating in the EU FP7 project Turbine. ProBite also received the European Biometrics Forum Industrial Award 2009.
DeWorm had a follow-up with VU participating in the EU FP7 project Wombat and provided the basis for ERC (European Research Council) Starting Grant of 1.3 M€ for dr. H. Bos the Rosetta project on binary reverse-engineering. Practical Approaches to Secure Cooperation saw a follow-up in the NWO Vici awarded to prof. R. Cramer to work on secure computation.

IPID had three follow-up projects (HERMES, CASTOR, MIDAS) looking at security of industrial SCADA projects in collaboration with Fox-IT, ABB, Brabant Water, Waternet, Alliander and the GasUnie.

PINPAS had a follow-up at the TU/e with a project where end user Riscure sponsored a research position. At the RU it had follow-ups in collaborations with Collis and PwC (e.g. for the EU agency FRONTEX) and a project where TransLinkSystems funds a PhD student on smartcard-based e-ticketing solutions.

### Impact of Sentinels

- The Sentinels program has provided and continues to provide an important catalyst for security research and expertise in the Netherlands. There is now a well-connected ICT security research community, that spans and links industry, academia, and the public sector. One concrete manifestation of this community is through the IIP Veilig Verbonden www.iip-vv.nl. Universities have also recognized the growing importance of computer security and invested in the area.

- Apart from the direct impact of the research carried out in Sentinels, the highly skilled researchers trained in the projects are maybe the more valuable contribution. Here the PhD and post-docs trained in Sentinels projects represent only the tip of the iceberg of much larger numbers of Bachelor and Master students finding their way to the ICT security field.

Researchers active in Sentinels can also lay claim to real societal impact. They have been involved in debates on topics such as the ov-chipkaart electronic voting, electronic patient records (EPD), the biometric passport, smartcards, electronic voting, electronic patient records, electronic roadpricing.

### List of projects

Below a list of all Sentinels projects, with project leaders and partners, in chronological order: projects 1-6 are from the first call, 7-11 from the second, and 12-16 from the last.

1. JASON, Generic and Secure Remote Management Infrastructure
   Project leader: dr.ir. E. Poll (RU).
   In collaboration with Philips Research.

2. IPID (Integrated Policy-based Intrusion Detection
   Project leader: prof.dr. R.J. Wieringa (UT).
   In collaboration with Rabobank Nederland and TNO ICT.

3. Practical Approaches to Secure Cooperation
   Project leader: prof.dr. R.J.F. Cramer (CWI).
   In collaboration with Philips Research.

4. ProBiTe, Protection of Biometric Templates
   Project leader: dr.ir. R. Veldhuis (UT).
   In collaboration with Philips Research.

5. DeWorm, Worm monitoring on Internet backbones
   Project leader: dr.ir. H. J. Bos (VU).
   In collaboration with TNO ICT.

6. PINPAS JC, Program INferred Power-Analysis in Software for Java Card
   Project leader: dr. E.P. de Vink (TUE).
   In collaboration with UT, RU, Brightsight and STMicroelectronics.

7. S-Mobile: Security of software and services for mobile systems
   Project leader: dr. B. Crispo (VU).
   In collaboration with Philips Research, TUE, TNO ICT.

8. VISPER: The virtual security perimeter for digital, physical, and organisational security
   Project leader: Prof.dr.ir. P.H. Hartel (UT).
   In collaboration with Atos Origin, B/CICT (Belastingdienst/Centrum voor ICT), Bizzdesign, Fox-IT, and Getronics-PinkRoccade.

9. SEDAN: Searchable data encryption
   Project leader: prof.dr. H. van Tilborg (TUE).
   In collaboration with Philips Research.

10. VRIEND: Value-based security risk mitigation in enterprise networks that are decentralized
    Project leader: prof.dr. R. J. Wieringa (UT).
    In collaboration with Akzo Nobel, Corus, DSM, Homann Bedrijfsrecherche, and Philips International.

11. PEARL: Privacy enhanced security architecture for RFID labels
    Project leader: dr. S. Mauw (TUE).
    In collaboration with Philips Research and TNO ICT.

12. Secure metering
    Project leader: Prof.dr. M.C.J.D. van Eekelen (RU).
    In collaboration with RDW and Alliander (formerly Nuon).

13. CREST: Collusion resistant tracking
    Project leader: Dr. B. Skoric (TUE).
    In collaboration with Philips Research and TNO ICT.

14. Mobile IDM: Identity management on mobile devices
    Project leader: Prof.dr. S. Etaile (TUE).
    In collaboration with RU, TNO ICT, Ericson, and Novay.

15. Kindred Spirits: Privacy enhanced social networking
    Project leader: R.L. Lagendijk (TUD).
    In collaboration with UT, TNO-CIT, Philips, Irdeto, De Waag, PAIQ, BPP, BL.

16. Revocable privacy
    Project leader: Dr. J.H. Hoepman (RU).
    In collaboration with CWI, TNO, and ICTU.

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Colophon

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