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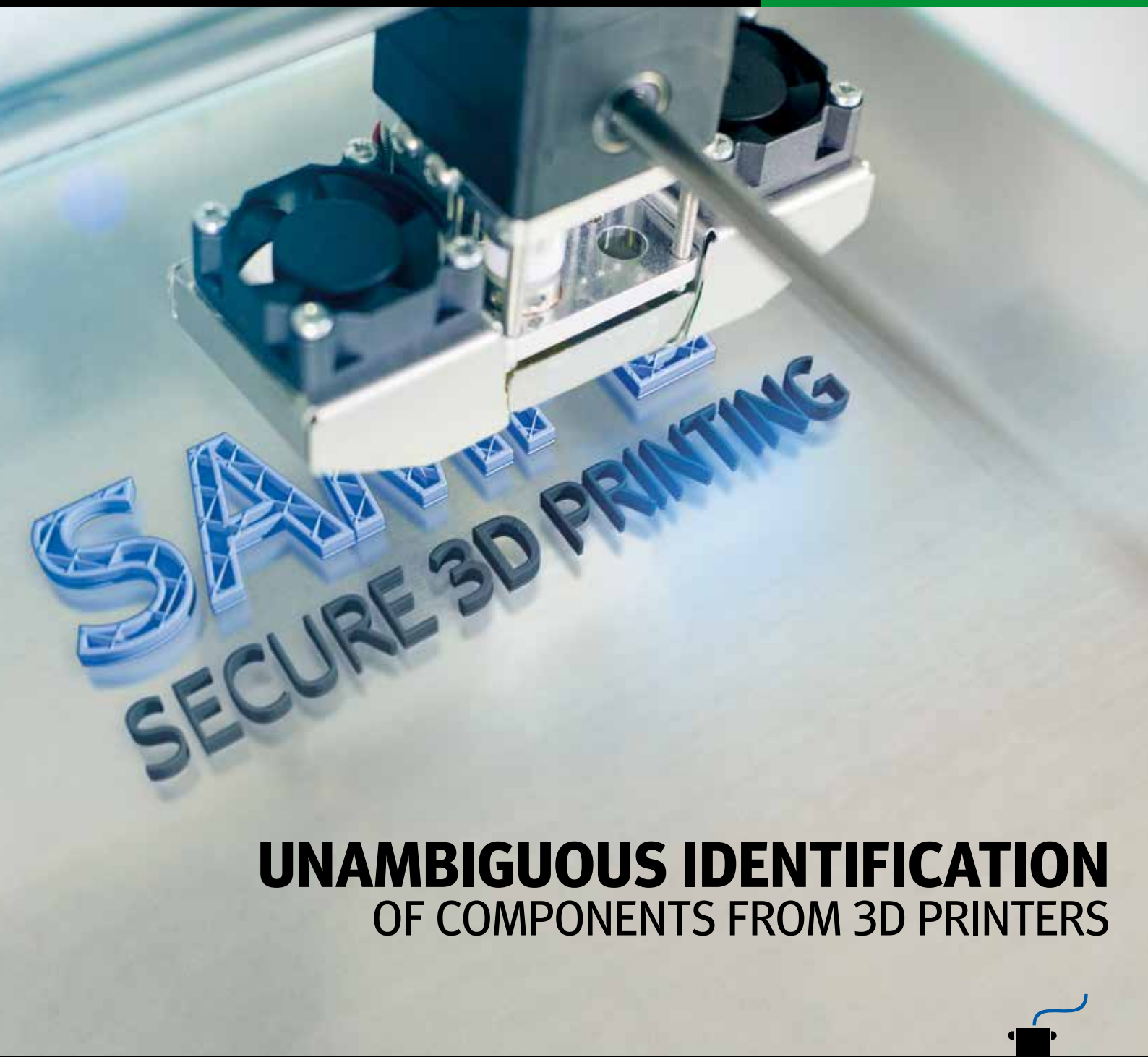


UNAMBIGUOUS IDENTIFICATION
OF COMPONENTS FROM 3D PRINTERS

SPECIAL EDITION

SAMPL
SECURE **3D** PRINTING

SECURE AND TRACEABLE 3D PRINTING

Unambiguous identification of components from 3D printers

At this year's Hanover trade fair, PROSTEP AG presented together with consortium partners a demonstrator for the Secure Additive Manufacturing Platform (SAMPL), which makes it possible to 3D print any type of component in a secure and traceable manner. The platform was developed within the framework of the PAiCE funding program using blockchain technology. The keen interest shown in the security solution has encouraged the partners to develop the demonstrator into a marketable application. BY MICHAEL WENDENBURG

Picture 1: SAMPL stands for Secure Additive Manufacturing Platform. The project is being funded in part by the German Federal Ministry for Economic Affairs and Energy. Picture: PROSTEP AG

Additive manufacturing was one of the top topics at this year's Hanover trade fair. In the halls of the Digital Factory, many hardware and software vendors demonstrated what is feasible and technically possible in the field of 3D printing. However, hardly any of the exhibitors addressed the security-related questions that this disruptive technology raises. Interest in SAMPL was correspondingly great: "We made many valuable contacts both with potential users and with software companies and manufacturers of 3D printers, who are becoming increasingly aware of the fact that 3D printing cannot be used efficiently for spare parts provisioning, prototype construction and other business processes unless the misuse of the 3D data can be excluded during every phase of the process," said Dr. Martin Holland, Head of Strategy and Business Development at PROSTEP in his summary of the event. Although 3D printing technology has the potential to revolutionize value chains such as spare parts handling, it also raises a series of security-related and legal questions. When it comes to the globally distributed manufacturing of security-critical components, how can it be guaranteed that only authorized persons have access to the data, that only the original data is printed and that this data will not be misused to manufacture pirate copies? In order to distinguish between authorized copies and pirate copies, it will be necessary to license the 3D models in a similar way as software programs and digital media are Licensed. Digital rights management will thus become a key technology for the commercial exploitation of 3D printing.

Blockchain-based security solution

Within the framework of the project coordinated by PROSTEP, the consortium partners from industry and the research community developed an end-to-end security solution – also referred to as a chain of trust – for additive manufacturing. The solution covers the entire process from creating the digital 3D print data to exchanging the data with 3D print service providers and their trusted 3D printers, which are safeguarded using special secure elements, right through to tagging the printed components with RFID chips. In addition to existing mechanisms for encrypting 3D data, PROSTEP has also integrated a digital license management based on blockchain technology in the data exchange solution OpenDXM GlobalX. OpenDXM GlobalX is now "blockchain ready". Up till now, blockchain was best known from the world of finance. It is a cryptographic method used to verify the authenticity of digital payment transactions. A concrete blockchain application is the cryptocurrency bitcoin. When a transaction is performed, bitcoins are sent from a digital wallet to the wider bitcoin network together with the recipient's encrypted address. There, so-called "bitcoin miners" verify the transaction and place it in a block, which is subsequently added to the blockchain as a new block. To put it simply: verification is complete when more than 50 percent of the miners have confirmed the transaction. Blockchain technology can be used not only for financial transactions but also for mapping transactions such as issuing licenses. In this case, instead of bitcoins, a person receives a license to print a component a specified number of times. "Our aim is to go beyond the assignment of licenses

and validate component identification by means of blockchain technology so that it is possible at all times to determine who printed a spare part with a given ID when and what product it is installed in," explains Holland

Picture 2: Platform for security in additive manufacturing. Picture: PROSTEP AG

Unambiguous identification

Products are basically identified by applying a marking containing information about the origin, manufacturer, etc. and/or by means of methods ensuring the unambiguous identification and, therefore, also the traceability of each individual product. An informative overview of the various methods can be found in the VDMA Product and Know-How Protection guideline (http://pks.vdma.org/). When choosing the method to be used, it is important to take account of its admissibility as evidence, that is to say the recognition of the method by the courts, for example in the case of product liability claims. As originally planned, the aim of the project was to examine the 3D printing process chain (see Figure 3) for technical loopholes and risk factors and to identify possible solutions. Working together with the prestigious law firm DWF, the next step currently involves an examination of the legal aspects of 3D printing that arise throughout this process chain. Indeed, additive manufacturing is accompanied by changed production processes, the use of new materials, new delivery and service conditions, and innovative business models that raise a great many legal questions. "For the companies involved, it is extremely important to take account of the complexity of the legal questions and circumstances in the field of 3D printing at an early stage if they are to be able to take full advantage of the economic potential it offers. Only by considering the legal aspects up-front and ensuring that their business models comply with legislation can they avoid the legal pitfalls," explains Klaus M. Brisch, LL.M., Global Head of IT and legal expert for IT law at DWF.

Visible and invisible product identification

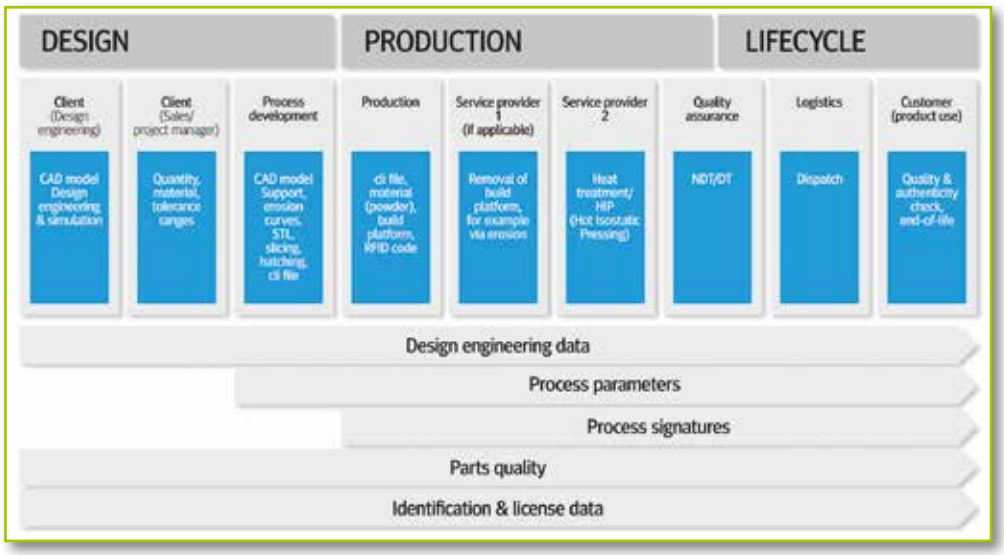
Products manufactured using 3D printing can be identified either visibly or invisibly. For example, visible identification can be applied in the form of security labels or holograms that are destroyed if removed. By using RFID (Radio Frequency Identification) technology, it is possible to provide further information about origin, supply chain or production parameters in a radio tag that draws the energy required for reading, writing and computation processes and even the processing of cryptographic algorithms from the electromagnetic waves emitted by the reading device. To prevent the cloning of these tags, they can be combined with a high-resolution, cloud-type printed image which loses its precision if cloned. These images can also be added as direct markings on the product during the additive manufacturing process. However, this type of inseparable combination can also be achieved by directly applying a serial number to the surface of the component by means of stamping, laser marking or a similar technique. Alongside these "visible" marking systems, there are also virtually invisible or only machine-readable markings, for example using special security pigments that are displayed as individual spectral characteristics at the reader. These permit the unique identification of each individual product and consequently guarantee traceability. Another method is to scan certain surface areas, for example in combination with a bar code or RFID, or to incorporate specific "marker" particles in the product during the manufacturing process. Because these particles are located inside the part, their layout can only be detected with special technologies and cannot be manipulated.

All the identification methods are being examined by the SAMPL project. Taking the example of RFID technology, the project team wants to demonstrate how this information can be stored and used on the basis of blockchain technology. The aim is to make this information transparently available throughout the entire product lifecycle.

OpenDXM GlobalX is being made blockchain ready

"By combining product identification with blockchain technology, we are able to ensure the traceability of 3D-printed products for the very first time. This will help additive manufacturing processes take hold in precisely those areas where enterprises have to meet particularly stringent security requirements," stresses Dr. Holland. PROSTEP expects the implementation of this technology in OpenDXM GlobalX to open up new markets in the field of additive manufacturing and other areas of application in which the authenticity of product data and licenses has to be ensured.

SAMPL is leading the way in this respect as the use of blockchain technology to exchange 3D print data is one of the first engineering-specific use cases. The consortium project received 2.6 million euros in funding from the German Federal Ministry for Economic Affairs and Energy (BMWi) within the framework of the PAiCE program with the consortium's industry partners contributing another 1.5 million euros. The consortium comprises PROSTEP, the Hamburg-based companies NXP Semiconductors and consider it, 3D MicroPrint in Chemnitz, the University of Hamburg, the University of Ulm, Harburg Technical University and the Fraunhofer Institute ENAS in Chemnitz. The industry partners are implementing the requirements as practice-oriented solutions, while the uni-



Picture 3: The process chain for 3D printing.
Picture: Falko Böttcher, 3D MicroPrint GmbH and André Gratias, Fraunhofer Institute for Electronic Nano Systems (ENAS)

versity partners are developing the foundation for implementation and taking care of disseminating the project results. As an associated partner, the aircraft manufacturer Airbus specified the requirements and contributed the use cases for additive manufacturing. Following the successful presentation of the demonstrator at the Hanover trade fair, EvoBus GmbH, a Daimler group company, also decided to become an associated partner in order to help speed up the transfer of the project results into industrial application. The globally active bus manufacturer expects the use of 3D printing to accelerate the provision of spare parts to its customers worldwide. "Thanks to the blockchain cryptographic technology, SAMPL provides an important tool for data encryption, data security and license management that is allowing our company to implement additive manufacturing for an inspiring, decentralized business model. It is a vital milestone in the advance of Industry 4.0," says Ralf Anderhofstadt, Head of Project CSP 3DD Additive Manufacturing at Daimler Buses.

After their fruitful discussions at the HMI, the partners in the consortium are considering the functionality and business model with which the SAMPL solution is to be offered as a cloud-based service. To do this, it will be necessary to map not only the information about the printing process but also the information about the employed printing material and the use of the component in the blockchain. **RT** |

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