*Economics and Management*
*ISSN: 2367-7600; 1312-594X*
*Volume:XIV, Issue:1, Year:2018, pp.74-87*

# СЪВРЕМЕННИ МЕТОДИ НА ЗАЩИТА СРЕЩУ ФАЛШИФИЦИРАНЕ НА СТОКИ И ДОКУМЕНТИ

**инж. Цветан Китов**

# MODERN METHODS OF PROTECTION AGAINST COUNTERFEITING OF GOODS AND DOCUMENTS

**Eng. Tsvetan Kitov**[32]

Received: 10.03.2018, Accepted: 19.04.2018

***Abstract***

*This article draws attention to the rising of counterfeiting and piracy in the world economic proses. The main methods for combating the counterfeiting of goods and documents are presented. The new method of laser cryptographic tagging allows unified authentication and authentication and cannot be falsified by existing technical means.*

***Keywords:*** *counterfeiting, piracy, technical protection, Laser cryptographic marking, code of material.*

***JEL Codes****: K13*

## 1. Introduction

The use of ingots of precious metals as universal means of exchange (tender) began around the end of the third millennium BC in Mesopotamia. Clay tablets dated to the year 2500 BC mention that silver was also used as tender. The tender was in the form of standardized ingots of gold and silver with a precise value, referred to as 'mini', 'shekels' or 'talents' (Weatherford, J., 2001). Between 640 and 639 BC the Lydi began minting the first coins known to mankind. Soon thereafter in those ancient times the first counterfeit (forged) specimens emerged. These were the same coins, but they were lighter in weight and were made of alloys quite different and cheaper than the genuine ones, or of materials other than precious metals.

A new era in the history of money began with the emergence of paper notes in China. In the year 1273 Kublai Khan issued a new series of notes which were controlled and guaranteed by the State. In order to impose them on his subjects, Kublai Khan undertook measures which any government would use to protect its currency: all

[32] State Agency for Technical Operations, Sofia

payments had to be made only with these notes and everyone in the Empire had to use them as tender or face severest punishment. To ensure that the notes are used by the wider population and not just by civil servants, the government took away from citizens all their silver and gold coins, and replaced them with paper notes. Even merchants who traded with other countries were obligated upon their return to China to surrender to the Treasury all their gold, silver, pearls and gems, which were purchased by the government at rates fixed by the State Commission for Trade and Finance[33].

While the introduction of paper money put an end to the forgery of coins made of precious metals, it opened the gate to another problem – counterfeiting of paper money. Withal, not only notes were forged, but also bills of exchange, bank certificates, shares, bonds, and practically all types of negotiable paper.

Beside the forgery of means of payment, history is fraught with examples of counterfeit goods/commodities. One of the products with the longest history of counterfeiting (more than a thousand years, including in present days) is the spice saffron. This spice has seen a range of counterfeiting techniques – from mixing with other substances (beet, stamens of saffron crocus, red pepper, turmeric, etc.) to replacement of high-quality grades with lower-quality grades (e.g. Cashmere varieties with Iraqi varieties).

## 2. Present state of counterfeits

The extremely rapid development of technique and technology in the early 21st century resulted not only in a new quality of life, new technological facilitations and achievements, but in new problems never seen before. Together with the 'classical' counterfeits, such as banknotes and identity cards/passports, counterfeit documents, products, services, software and databases have massively pervaded our everyday life. These problems are skyrocketing, their threats materialize in an avalanche pattern and may in the near future put at risk the normal functioning of the global economic system. The accessibility of advanced technology, technical solutions and software in various sectors of human activity has made it increasingly easy to obtain financial benefits at the expense of others across a variety of sectors. The most widespread counterfeiting activities affect various kinds of consumer products, such as apparel, shoes, bags, medicines, cosmetics, electronic devices, mobile phones, etc. According to data published in www.frontier-economics.com (the study 'The Economic Costs of Counterfeiting and Piracy'), the value of counterfeit and pirate goods produced and consumed can reach USD 959 billion by 2022.

[33] Ibid.

*Table no. 1 - Summary of counterfeiting and piracy assessments. "The Economic Costs of Counterfeiting and Piracy"*

| Quadrant | Estimate | 2013 | 2022 (forecast) |
|---|---|---|---|
| 1 | Total international trade in counterfeit and pirated goods | $461 Billion | $991 Billion |
| 2 | Total domestic production and consumption of counterfeit pirated goods | $249 - $456Billion | $524 - $959 Billion |
| 3 | Digital piracy in movies, music and software | $213Billion | $384 - $856 Billion |
| | - Digital piracy in film | $160 Billion | $289-644 Billion |
| | - Digital piracy in music | $29 Billion | $53-117 Billion |
| | - Digital piracy in software | $24 Billion | $42-95 Billion |
| | **Total value of counterfeit and pirated goods** | $923 Billion – 1.13 Trillion | $1.90 -$2.81 Trillion |
| 4 | Wider economic and social costs | | |
| - Displacement of legitimate economic activity | | $470-$597 Billion | $980-$1244 Billion |
| - Estimated reduction in FDI | | $111 Billion | $231 Billion |
| - Estimated fiscal losses | | $96-$130 Billion | $199-$270 Billion |
| - Estimated costs of crime | | $60 Billion | $125 Billion |
| 4 | Total Wider economic and social costs | $737-$898 Billion | $1.54 - $1.87 Trillion |
| Estimated employment losses | 2-2.6 million | | 4.2-5.4 million |
| Foregone economic growth in OECD 2017 | | $30 Billion to $54 Billion | |

Source: *http://frontier-economics.com*

Equally alarming are the estimations of the jobs lost (up to 5.4 million) and of the economic slowdown (up to USD 54 billion).

According to the OECD[34] and the EUIPO[35] (the study 'Trade in Counterfeit and Pirated Goods. MAPPING THE ECONOMIC IMPACT'), international trade in these products was up to 2.5 % of the world trade in 2013, or USD 461 billion. Counterfeits are expected to account for more than 5 % of global trade in 2022.

These statistics do not include trading in forged or fraudulent documents of various kind such as diplomas, passports, and securities, which have also reached frightening levels in recent years.

34 OECD - The Organisation for Economic Co-operation and Development.
35 EUIPO - *European Union Intellectual Property Office.*

As the most attractive goods for counterfeiting over the last 10 years, according to OECD/EUIPO[36] data, are:

1. Footwear;
2. Garments- knitted or crocheted;
3. Leather products;
3. Electrical machinery and equipment;
4. Tools - optical, medical, etc.;
5. Wearing apparel – other than knitted or crocheted;
6. Perfumery and cosmetics;
7. Toys;
8. Pharmaceutical products;
9. Jewelry.

These data are derived from the customs seizures of counterfeit goods in the largest economies under the Harmonised System[37].

The leading 15 economies in the field of counterfeiting of goods are[38]:

1. Hong Kong;
2. China;
3. Turkey;
4. Tokelau;
5. Syria;
6. Greece;
7. Nepal;
8. Tunisia;
9. Armenia;
10. Yemen;
11. Morocco;
12. Panama;
13. Cambodia;
14. Afghanistan;
15. Cyprus.

Data on the increase in counterfeiting of labels and packaging are disturbing. The descriptive analysis of confiscation data shows a large number of confiscated packaging and labels, infringing intellectual property rights. This confirms the findings concerning the domestic assembly of counterfeit and pirated articles of imported materials,

[36] OECD/EUIPO (2016), Trade in Counterfeit and Pirated Goods: Mapping the Economic Impact, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264252653-en.

[37] http://dx.doi.org/10.1787/888933345913

[38] http://dx.doi.org/10.1787/888933346073

formulated in a study of the Office for Harmonization in the Internal Market and Europol (2015). This finding deserves additional attention as packaging and labels have a significantly lower value than the final products.

According to the GTRIC[39] methodology, all counterfeit packaging and labels are treated as "packing" and represent the value of the packaging. The results may vary considerably depending on the approach to the product classification of these categories and it is therefore difficult to be fully confirmed.

The problem of credit card counterfeiting continues to further deepen. The data set reports a number of seizures of counterfeit cards (e.g. Visa, MasterCard or American Express trademarks), counterfeit holograms of cards, mobile credit card readers, etc. Although the nominal value of a plastic card or label is very low, these cases should be seen in a broader context of credit card fraud. These frauds are increasing all over the world and are becoming a global problem. Credit card frauds have proven to be effective and often easy to commit crimes by introducing new ways to make fraud. Counterfeit credit cards are produced using original credit card details which can be obtained from criminals by: 1) retrieving data from magnetic strips; 2) use of cards stolen from the cardholder; 3) taking over from potential victims along with encouraging the sale of non-existing goods and services. These counterfeit credit cards can be used for many types of transactions, both online and in-store.

The increase of counterfeiting personal and educational documents is disturbing. This scourge not passed even such a colossus in the field of education, as is the United Kingdom. There are a number of sites where you can order without a problem a diploma virtually from every school in UK, the United States, France, Germany, Belgium, Italy and many other countries (www.diplomacompany.co.uk, www.diplomacompany.com, www.fakeid.co.uk/fake-documents/, www.buydiplomaonline.com/fake-uk-degree/ and many others). The price of a HEI diploma in www.diplomacompany.co.uk is 150 GBP.

A forged identity card from each one of the EU member states can be purchased from www.fakeid.co.uk at prices varying from 25 to 60 GBP. They also offer an attractive discount system for certain quantities together with guarantees on quality of paper, printing and protection signs used! The specificities of this market and above all its illegality, make it impossible to assess it, even approximately. During the last 5 years (from 2012 to 2017) technologies allowed the prices of counterfeit diplomas to collapse by about USD 30000 ("Fake degrees: A quick study", Economist, July 7, 2012) to the ones mentioned above.

[39] General trade-related indices of counterfeiting and piracy *https://www.oecd.org/sti/ind/44088872.pdf.*

## 3. Technical protection means against counterfeiting

According to an ASTM[40] definition, there are two main pathways for falsification – counterfeiting and forgery. Counterfeiting is a reproduction of a document, an article or a protective device in order to mislead even the most rigorous inspection of a qualified examiner. Forgery is a copy or change of document data such as amounts, signatures, dates, etc. for fraudulent purposes.

In case of counterfeiting goods, documents, payment instruments, artefacts and intellectual property services, there are several approaches:

- originating – reestablishment, using the same materials and production methods as in the original;
- coping - precise copying, using similar materials or methods, or both;
- imitation – copying, using completely different materials and methods. In this way, only precise copies and imitations of materials shall be made;
- alteration – change of data in the original document.

In order to combat counterfeiting and forgery, there are two basic methods of protection – verification and authentication.

Verification can be defined as a method of establishing and confirming compliance with a specified original and authentication is a method of acknowledgement of authorship. While through verification a true object (product, object or document) is considered to be an object which fully complies with a pre-established model, for authentication a true object is only the one of which it was confirmed not only the model but also the authorship of its legitimate manufacturer (producer).

On these two definitions are based the implemented modern methods of technical protection of products and documents.

The vast majority of technical protection measures are based on verification technologies (verification measures) while the measures validation of authorship (authentication measures) are still few.

Therefore, verification measures for the protection of objects (material assets) can be classified in three groups:

- packaging protection measures;
- product protection measures;
- measures to protect packaging and product (combined measures).

Packaging protection measures aim to make it difficult or impossible to copy or imitate. The main logic here is the use of such materials for the preparation of packaging and protective elements which would make it most difficult for potential evil-doers to

[40] https://www.astm.org - ASTM International is a world-recognised leader in development and delivery of voluntarily recognised standards.

economically and technologically imitate or fully reproduce the packaging. These are the most frequently used verification measures. With regard to the consumer, it aims at creating a sustainable image of certain characteristics of the packaging.

The product protection measures are similar but are targeted at the product and its characteristics.

The combined measures are a combination of the above two, where on both of the objects, packaging and packaging product, certain identical or complementary protective elements are being placed.

Examples may include packaging of alcoholic and tobacco products, as certain protective elements – hologram and kinegram stickers or others, are attached to the general packaging (cardboard) and on the product itself (bottle or package). These protections are usually supplemented by excise stickers that constitute a form of securities and have the respectively approved protection measures.

The most characteristic shortcomings of the verification protection measures is that they are based on technologies, the uniqueness of which is measured at no more than 3 to 5 years in the last quarter of a century. This weakness relates to the snowballing development of technologies– both information and production. For example, if the price of certain high-grade printing equipment at the time of its entry on the market has a price of 1 million Euro, after 2-3 years the price of the same new equipment is at least 30 – 40% lower and the price of the same second-use equipment is in times below. This makes it widely available and provides opportunities to be used by a very vast range of customers, including authors of counterfeiting. There are therefore much more accessible materials for the production of complete copies or the imitation of many products and their packaging. This is also confirmed by the data presented above in Table 1.

These measures are detailed and are systematised in the Public Register of Authentic Travel and Identity Documents Online (PRADO), Glossary of Technical Terms Related to Security Features and to Security Documents in General.[41]

The most commonly used protective elements in the manufacturing of packaging, products and documents (without identity documents), are the following[42]:

*3.1. Watermark.*

Traditional watermarks are designs or patterns put into paper during its production: pictures, text or character designs produced by pressure on the substrate during

[41] http://www.consilium.europa.eu/ifado/ifadocontacts.htm
[42]Ibid.

manufacture, leading to a varying thickness of the paper. They are sometimes also called Fourdrinier watermarks.

As its image or pattern is caused by thickness or density variations in the paper substrate, the traditional watermark, as opposed to its printed imitation, will not appear under UV light.

Do not confuse the traditional watermark with a digital watermark, which is printed, often on computer-printed material and used to identify the ownership, or where an identifying cipher is encoded into digitized music, video or picture files.

*Figure no. 1.Watermark*

*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

2. Barcode

A barcode (1D barcode) stores data in the widths of, and spaces between, printed parallel lines (bars) for machine-optical data capture.

A 2D barcode (two-dimensional barcode) stores data along two dimensions and is therefore capable of containing much more information:

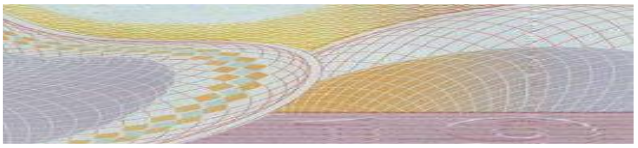
*Figure no. 2. 1D barcode representing serial number.*

*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

3. Guilloches / fine-line patterns

Fine (intricate) designs, consisting of interlaced continuous lines, are arranged in geometric patterns. Security printing uses designs of guilloches or of other fine-line patterns with the aim of raising the barrier for re-origination and reproduction. Guilloches and other fine-line patterns are sometimes combined with rainbow colouring.

*Figure no. 3. Guilloche.*



*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

4. Rainbow colouring.

Rainbow colouring is also called split duct printing. This colouring process used in offset printing is used to protect security documents against colour separation or copying by subtly merging colours into each other, resulting in a gradual colour change.

*Figure no. 4. Rainbow colouring.*

*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

5. Offset printing

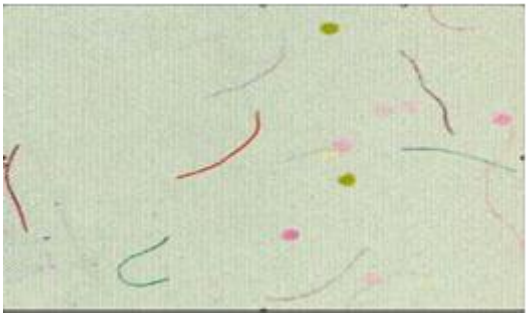
Offset printing (also called lithography, or wet offset) is an indirect printing process in which text and images are transferred from the plate cylinder (with an even surface) to the offset cylinder (rubber blanket) and from there printed on to the substrate. It is characterized by even inking and precise edge limits.

6. Coloured planchettes and fibres

Planchettes are small coloured discs incorporated (scattered) in the paper substrate during manufacture. Planchettes are incorporated in a similar way to coloured security fibres.

Planchettes can also be metallic or transparent; they may also fluoresce under UV light, or be made of an iridescent substance showing colour shifts.

*Figure no. 5. Coloured planchettes and fibres.*



*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

7. Endless text and microtext

Endless text denotes repeated, sometimes unspaced, lines of text in the background/security printing or in a security thread. Microtext may be put together or incorporated into the endless text.

*Figure no. 6. Endless text..*

*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

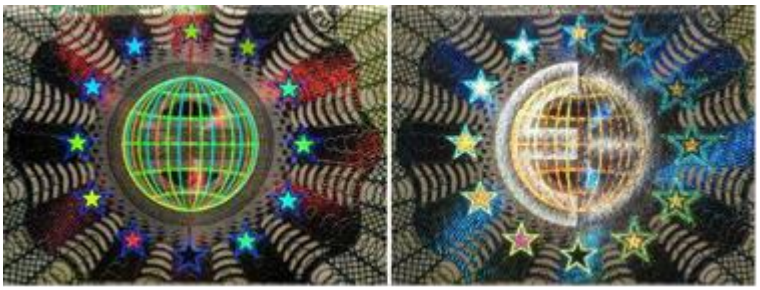
8. Holograms and Kinegrams.

The hologram is the most popular traditional type of DOVID (Diffractive Optically Variable Image Device) that is used as a security element. A number of effects are possible, e.g. 2D holograms (2-dimensional holograms) with structural and color changes, 3D holograms with images, holograms with kinematic effects, etc.

The Kinegram is a computer-generated hologram (DOVID) capable of producing multiple high-resolution images. It contains special types of computer-generated diffractive optical elements. These can be designed in different ways to exhibit kinematic, color changing, contrast reversal and other special effects.

Holograms and Kinegrams are destructive and nondestructive.

*Figure no. 7. Kinegram.*



*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

9. Laser perforation

Using laser technology, perforations of different types or can be produced:

- laser-perforated serial number
- laser-perforated image or other element

Characteristic distinctive features are obtained:

- traces of burning round the edges of the holes
- no raised edges round the holes in the substrate (paper) on the back of the perforations
- conical decrease in size of the perforated holes in the booklet document when viewed from front to back
- can have different shapes

*Figure no. 8. Laser perforation.*

*Source*: Glossary of Technical Terms Related to Security Features and to Security Documents in General.

All technical verification measures listed above, regardless of the protection level provided, have one major shortcoming – due to the development of technologies and the increased availability of the materials required for their production, they can be counterfeited to one or another extent.

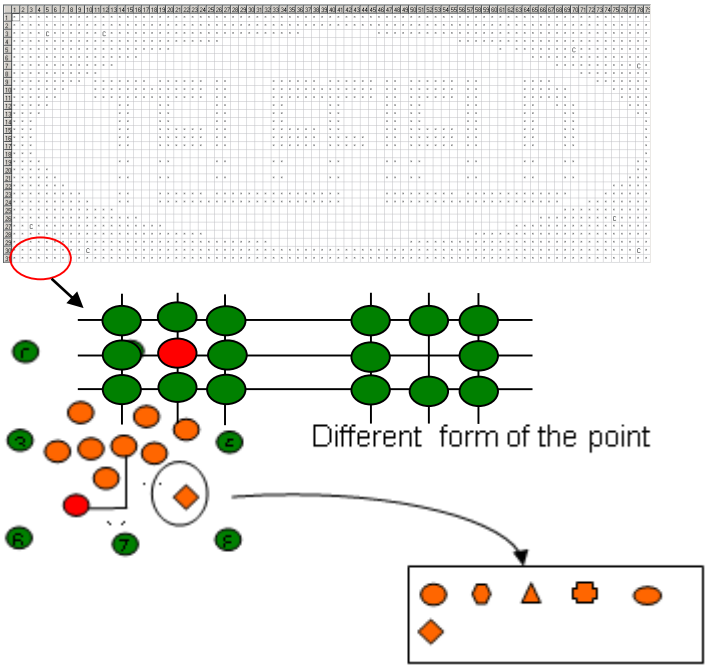
These deficiencies can be avoided by applying a combined verification and authentication technology based on laser cryptographic marking, combined with capturing of the so-called "material code" – a microscopic photograph image of a particular section from the material (substrate) where the laser encryption protective marking is applied (Bulgarian patent No. BG 63518).

If the two laser marking methods are compared – the regular laser perforation and the laser cryptographic marking, the following significant differences may be noted:

With regard to the regular laser perforation, holes or perforations are located in the centre of the coordinate system. Additional information may be recorded only if in the given coordinates the presence or absence of perforation is being fixed. Thus, the absence or presence of perforation can only be perceived as the two states of 1 bit (1 –present, 0 – absent).

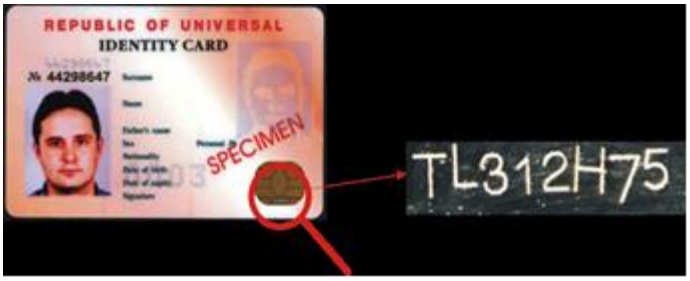
When the new method is applied, perforations can be located both in the grid centres and in certain positions around this centre, defined by a certain mathematical algorithm. This significantly increases the information intensity of the perforation, and the possible meanings are determined by the number of the possible positions. This is just the first set of possible meanings. The second set is determined by the form of the perforated point. This point, unlike the normal perforation, may have different form rather than a round one, defined again by a mathematical algorithm.

*Figure no. 9. Laser cryptographic marking.*



An example of practical realization of such protection is shown in figure no. 10:

*Figure no. 10.* Practical realization of the laser cryptographic marking. An electronic chip marking in the ID card.




*Source*: KEIT Ltd., Sofia, Bulgaria.

As shown in the example, the perforated text has three new sets of incorporated meanings – size, offset from the center, and rotation of the alphabetic and numeric characters with which the given text or number is written. They further increase the complexity of the algorithm in which the shape, positions and rotation of perforations and symbols are calculated.

In the capacity of additional protection for each individually perforated text, an additional algorithm shall calculate the marking surface area of which a microscopic photograph is made (United States patent No. US 7,925,885 B2), individually for each single text. This microscopic photograph is unique for each separate marking and is considered to be a kind of "fingerprint". It binds unambiguously to the data of the marking in the database and in combination with them represents the most powerful best-known method for unambiguous authentication and verification.

This method, based on its material neutrality, can be used for marking, respectively for verification and authentication of a variety of products, materials and documents – from foods (including meat and fruit) to vignette stickers, holograms and ID documents.

**REFERENCES**

Bulgarian patent No. BG 63518 - Device for recording of one and several, one- and multi-level, two- and three-dimensional multimedia encoded markings on documents, securities and the like. Providing a database of hidden code and clear markup

OECD/EUIPO (2016), Trade in Counterfeit and Pirated Goods: Mapping the Economic Impact, OECD: Paris.
http://dx.doi.org/10.1787/9789264252653-en.

United States patent No. US 7,925,885 B2 - Method for recording and reading a code of material products for protection and control of their authenticity, and a system therefor.

Weatherford, J. (2001). History of Money: Obsidian, Sofia.

http://dx.doi.org/10.1787/888933345913 - Mapping Counterfeit and Pirated Products Patterns: Preliminary Analysis of Seizure Data

http://dx.doi.org/10.1787/888933346073 - Counterfeit and Pirated Trade: Provenance Economies and Impacted Industries

http://www.consilium.europa.eu/ifado/ifadocontacts.htm - European Union, 2007-2017, Council of the European Union, General Secretariat, Directorate-General for Justice and Home Affairs, Directorate Home Affairs, Schengen, Visas and Borders Department (DGD 1A). Rue de la Loi 175, 1048 Brussels, Belgium, Europe.

https://www.astm.org – ASTM International is a world-recognised leader in development and delivery of voluntarily recognised standards.

https://www.oecd.org/sti/ind/44088872.pdf. – 09.03.2018 – General trade-related indices of counterfeiting and piracy