Using Printing Technologies to Authenticate and Fight against Counterfeits

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Abstract

Today manufacturers and brand owners are engaged in a long-term battle with companies that counterfeit their goods. New printing technologies are making it easier and easier to emulate the packaging of brands, often with readily available office equipment.

This counterfeiting can have severe effects on both the brand owners and the purchasers of the goods. This effect can result in the loss of profit or the end user being misled into buying something that it is not- in effect theft.

For the brand owner the consequence is greater- they lose both the value of the sale and they put their own brand at risk when the products sold turn out to be of poor quality- leading to reduced perception of the brand and potentially lost future sales.

There is now increasing evidence that counterfeiters are moving into product lines where the effect is not only economic, it can put lives at risk. Food, car parts, aircraft parts, medicines, electronics and electrical good are all suffering.

Whilst in first stage counterfeiting the result was only economic, in these categories of goods fake goods put lives directly at risk. Faulty brake pads, drugs with no active ingredient, or sometimes poisons present, unsafe or out of date food, repackaged as wholesome, high quality products. These are life-threatening consequences of the desire to make easy money by copying real products.

Fortunately, the development of new printing and coding technologies also enables new authentication and traceability techniques that are available to manufacturers to trace, authenticate and then defeat the march of counterfeit goods.

In this paper, we will look at techniques that can be cheaply applied to products to ensure that fake goods can be identified, supply chains managed and counterfeiters controlled.

Topics to be addressed are:-

- *Digital printing of products with identifiable features to tie products to batches or markets*
- *The use of active or reactive inks to provide additional features to allow end users to verify the products they buy.*
- *The use of latest generation bar coding to act as a complementary data carrier- allowing verification of products without the need to use expensive or complex IT systems.*
- *The techniques covered use a number of different, low cost and already available printing and coding techniques to show what can be achieved with today's technology.*

We look at coding techniques, authentication and layering options available to manufacturers and show how they can be used as part of an assault against the manufacturers and distributors of fake goods.

The Problem of Counterfeits

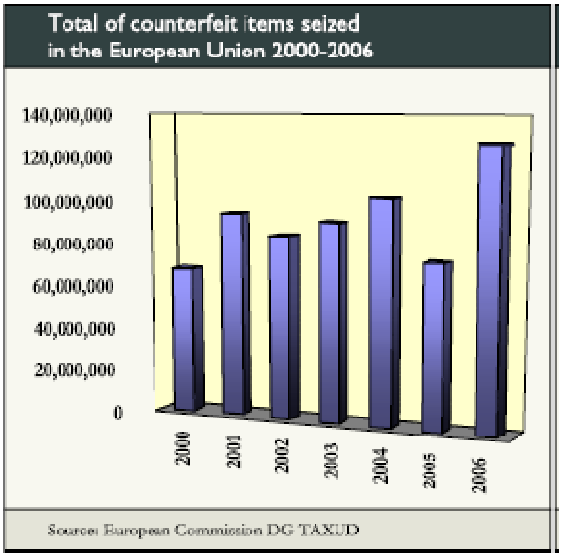
Counterfeiting has changed dramatically and rapidly. A few years ago, this activity was regionally dispersed and engaged in creating poor copies of unattainable products for local consumption.

Now it has changed markedly. No longer are counterfeits easy to spot, the quality can appear as good as or better than the original product, at least when viewed through its packaging. They can infiltrate legitimate supply chains, be intermingled with genuine product and inserted into the genuine supply chain.

Then organizations engaged in counterfeiting are no longer isolated manufacturers hoping to convince the local unwary that a poor copy is the genuine item. In fact the profile of a counterfeiter is more likely to be a group of globally connected, organized criminals who have decided on counterfeiting as a low risk alternative to other criminal activities such as the manufacture and distribution of illegal drugs. In short, they are hard to spot using conventional approaches. A new approach is needed.

Scale of the problem

Of course, by its very nature the illegal trade in fakes or counterfeits can be hard to measure. The organization for Economic Co-operation and Development (OECD) states that at least 200 billion US dollars of international trade in 2005 could have been in counterfeit or pirated products [ref 1]. In 2008, they updated this figure and now believe that 1.96% of



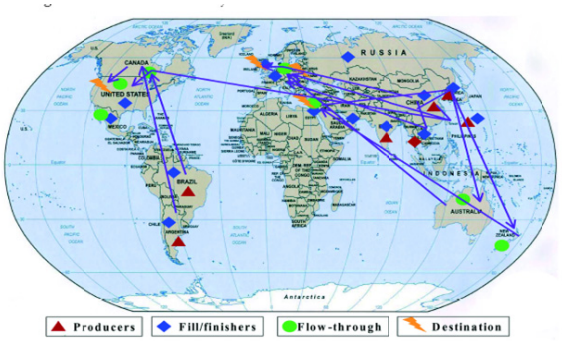
global GDP is in counterfeit goods representing $250BN of trade. [ref 2] This of course represents a compound annual growth rate of 7.7%, much more than most economies and this despite these figures excluding domestically consumed counterfeits, or digital piracy through the internet. The scale is clearly very significant.

Global Nature

With the steady increase in global trade, there has been disproportionate increase in the market access afforded to counterfeit goods manufacturers. The development of free trade zones has reduced the points of inspection making the transfer of goods between related markets simple and virtually risk free.

With the increasing use of the Internet as a sales channel, it has become easier to market counterfeit goods; in fact, consumer inclination is to assume that the internet is a legitimate source of cheap, genuine products, rather than questioning the sources. If you buy a Rolex in a market, you might expect it to be a fake, but bought though the internet you might just expect it to be a bargain. Clearly consumer education is needed.

to illustrate there is a truly global trade in counterfeit medicines as illustrated by figure 1 below provided by UNICRI ref [3]:-



Source: Lilly, (2005), Combating Pharmaceutical Counterfeiting

Types of counterfeiting

There are two main types of counterfeit goods markets.

In the first, consumers purchase counterfeit and pirated products believing they have purchased genuine articles. The products are often sub-standard and carry health and safety risks that range from mild to life threatening. It is this market that can be controlled by technology-enabled market and supply chain discipline.

In this first market, there is a clear financial benefit to brand owners in the deployment of anti counterfeiting technology as it can be used in a legitimate supply chain.

In the second market, consumers looking for what they believe to be bargains, knowingly buy counterfeit and pirated products as a way of gaining prestige or self esteem that they could not legitimately afford. It is here that the use of high end brands is commonplace.

This second market is very difficult to control for commercial organizations as the supply chain is informal and there is no affordable commercial method to control the sales of such fakes. Legal action is expensive and ineffective.

In effect, the purchaser and supply chain collude to offer poor quality copies of otherwise unaffordable goods to the questionable benefit of both. If you do not have visibility of the supply chain, it is impossible to police it.

In this second market, there are only two possible methods of control; consumer education, which is likely to be ineffective, and action by the relevant government bodies, who usually have other priorities with greater perceived public benefit. Fortunately, in this second market, the range of products provided tends to be of a highly branded nature with an emphasis driver on fashion items. The economic loss to the brand owners is debatable as few purchasers of these goods would be able to be legitimate purchasers of the genuine item.

How is digital printing affecting this trade?

Digital printing provides the ability to create short runs of high quality labels or packaging without the need to have access to the traditional printing techniques previously required. This provides manufacturers and converters with a significant advantage, but it also creates an opportunity for the illegitimate use of digital printing technology to create high quality fake packaging.

Whilst making packaging materials at home on home printing equipment is not going to be quick, it is possible. With the large margins possible on some of the categories of goods now being counterfeited, such an activity can be profitable even at this small scale.

However, with the availability of production level digital presses, it is likely that we will see an increase in the scale of such operations as it becomes possible to quickly and cheaply produce large runs of counterfeit packaging. As always, illegitimate businesses are usually early and enthusiastic adopters of new technology.

Range of products affected

The growth in counterfeits has not just changed in scale, the range of products affected has also changed, with some worrying consequences; there is a worrying trend away from low value products into copies of many types of high quality and expensive items including a move from health promoting pharmaceuticals into strong medicines intended to cure serious diseases such as cancer or AIDS.

Consequences for all

The OECD identifies a number of effects in their paper of 2005.[ref 2]

They identified "1)general socioeconomic effects (on innovation and growth, criminal activities, environment, employment, foreign direct investment, and trade); 2) effects on rights holders (on sales volume and prices, brand value and firm reputation, royalties, firm-level investment, costs and the scope of operations); 3) effects on consumers (health and safety risks and consumer utility); and 4) effects on government (tax revenues, expenditures and corruption)."

It is clear that greater action is needed, and many organizations are now seeking effective solutions to this problem.

Market needs

The OECD [ref 1] identifies a number of ways that the market in counterfeits could be controlled, including: "1) establishing a common approach for collecting enforcement data; 2) developing a reporting framework to document the health and safety effects of counterfeit and pirated product; 3) making more extensive use of surveys to provide insights into the markets for counterfeit and pirated products; and 4) increasing co-operation between governments and business."

However, there is a significant problem with all these techniques, you need to be able to prove which items are fake and which ones are genuine, and without a solution to this basic requirement, all of the other levels become compromised.

Traditional Security Solutions

Of course, counterfeit or substandard goods have existed for millennia. Governments have been taking action and setting standards for a similar period. There are many clever solutions to make it hard to copy items such as bank notes, many of them border on the brilliant.

All the techniques have their legitimate place as part of the solution and they all fall into two groups, overt or covert solutions.

However, regardless of the technology the key elements of any solution are that it must be secure, be able to be monitored in all of the channels to the marketplace and justify any costs incurred through genuine benefit to the consumer and brand owner. In practice, many of these solutions fall short.

Overt solutions

Overt solutions, ones that can be seen by the purchaser provide consumer reassurance and have historically proven to be an effective deterrent. They include-

- Optically variable devices (colloquially known as holograms)
- Certificates of authenticity
- Numbering
- Secure features such as metalized strips, micro threads
- Complex or specialized manufacturing processes such as intaglio printing.
- Secure anti tamper tapes or labels

Overt solutions are globally trusted as a sign of quality and legitimacy however often now this reassurance is more illusory than real.

Just like the products themselves, counterfeiters have proven to be very effective at copying these features. As an example holograms, have been copied within weeks and are sometimes found on the counterfeit product and not the original.

The weakness of overt features is that they rely on the purchaser to evaluate legitimacy, and for most applications, this is unlikely to be effective. This leaves overt solutions in the curious position of being a security feature that provides reassurance but in practice can easily be copied.

Covert Solutions

Covert solutions are not intended to be detectable by the customer. Their role is in authenticating the product, or providing information that can be used to manage the distribution chain. They can take many forms such as:-

- Light related markers such as UV or IR absorbers, frequency shift or other optically active techniques
- The use of synthetic DNA
- The use of Isomers or trace contaminants
- Deliberate errors- a form of Steganography

Covert solutions give the impression of greater security than overt solutions but this security itself needs to be protected. For chemical based techniques, this can mean that materials need to be delivered and used securely, giving unanticipated costs and security risks. Once a secure feature becomes known, either it will be replicated or a close substitute applied. Keeping the feature confidential through the product life cycle requires care and a whole life approach.

However, the main draw back comes not in their security, but in the need for a closed system. As the covert feature is by its nature hidden, a network of monitoring points must be established to allow the feature to be detected and the distribution chain behavior monitored- to allow action when a problem is detected and before it becomes significant.

There is little supply chain benefit in a solution that is secure, but is not regularly checked. This is often overlooked when promoting secure features to brand owners.

This network must be able to monitor the distribution chain, if a complex or time consuming detection process is needed, it may be hard or impossible to establish such a monitoring system, and the value of the covert feature may be lost.

Layered Solutions

To make a product more secure there can be advantages in layering up different techniques so that a range of needs can be addressed. Examples of this could be using an optical technique to carry out a basic level of authentication, whilst using a chemical marker to provide a greater degree of authentication, if greater certainty were needed.

It is usual to find many different layers specified in a brand protection program, but these will add cost and must be applied with care.

How can printing technology help

Modern production lines for goods will almost inevitably have a coding system at the end of the line that is used to apply batch numbers of sell by dates to products. This can be one of a number of techniques, but they are usually capable of printing unique information on each product that passes under them. This has come about because of the need for "to the second" recording of manufacturing date, to allow modern process control and traceability.

Although not thought of as such, these systems are small digital printers and can apply unique features to products to be used as a barrier to counterfeiting.

Most significantly, unique product marking enables the use of encryption as a form of authentication or the use of centralized databases to track unique products.

This uniqueness is a significant advantage when compared to batches of products- you can know absolutely which product you have, and thus batches cannot be enlarged to allow the mixing of genuine and fake products.

Levels of implementation

Although each system will be different here are some illustrations of the system architectures building up in stages.

End and end system

A unique and non-predictive series of characters is printed on the product at the point of manufacture and scanned at point of sale or by the consumer. A secure link would confirm the correlation of the two numbers and potential of authenticity. This is an end and end solution only. This is illustrated in figure 3

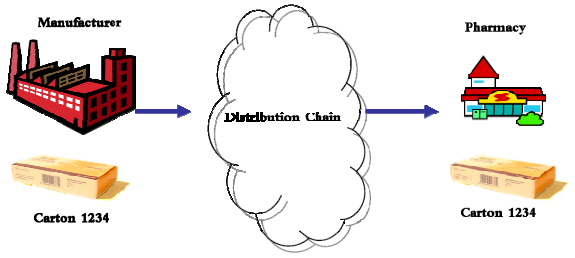


Figure 3

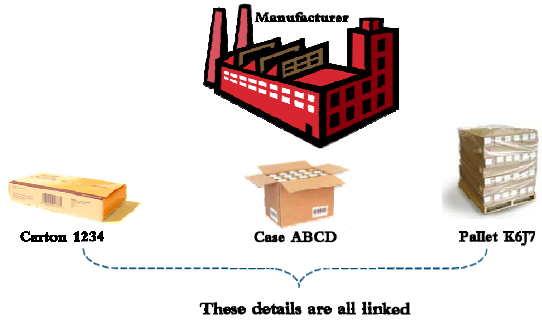
A layered solution with unique numbers

With a layered solution, a second layer, possibly covert, or additional measures would be added. These would not be scanned at point of sale; instead the manufacturer or compliance provider would use them as additional confirmation of authenticity.

When supply chain monitoring is required, then aggregation of each level of packaging can be utilized. Such a scheme is necessary if routine authentication checks are required thought-out the distribution chain.

Unique character sets are printed at each packaging step; these numbers are then related by generation or associated by the manufacturing process. To provide greater levels of traceability some industries are considering the use of aggregation data to relate each individual product to its location in the supply chain. To date these types of solution have only been attempted in state driven schemes, but it is possible that we will see these techniques applied more widely with the globalization of e- commerce.

This type of scheme is illustrated in figure 4



Using the consumer as a monitoring system

Once you have a unique number on a product, then it becomes possible to apply a number of techniques to make the supply chain more secure.

Key to this is the use of modern communication paths as a method of allowing self-authentication by a customer, or other point in the distribution chain.

The customer can be encouraged to look up the number of their unique products using the telephone to a call centre, SMS to an automated service or through a web page.

Care has to be taken to prevent the "spoofing" of the authentication process, but when implemented correctly this process allows the location and status of products to be identified and tracked, giving the consumer confidence, and the brand owner useful information on the flow of their products through to the market.

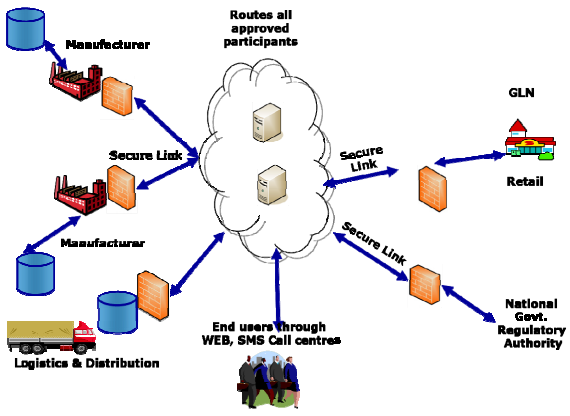
The actual numbering scheme used can take many forms but it needs to be large enough to be secure and small enough to be printed and read online. For example:-

- Unique number
- Random Number
- Pseudo Random Number (algorithm based)
- Unique AND Random / Pseudo Random Number
- A number that is related to the packs characteristics- permitting authentication and traceability in one-step.

This type of solution is illustrated in figure 5

This last combination of layers of security with serialization and authentication offers the significant advantages of a high level of authentication for key points in the supply chain and serialization to enable consumer checks through the web, all through the use of low cost, widely available coding equipment.

If the number is printed in a machine-readable format, it is possible to get widely available devices, such as smart phones, to read the information and then to verify the authenticity of the product in one automated step- increasing customer convenience.



Example the Secure Trace program

A combination of layers of security based around printing equipment was recently trialed in a government-funded project led by Pera, a UK independent research body and involving many partners, including Domino. Although the trial was focused on the needs of the pharmaceutical supply chain, a simplified form could be applied to many supply chains with little additional product cost.

The secure trace concept had at its core Laser Surface Authentication (LSA) This technique converts the microscopic imperfections in surfaces such as paper & plastic into an equivalent number that is more unique than human biometrics and which can be quickly authenticated (circa 1 second per 100 million readings) using low cost handheld scanners. Depending on the implementation method, authentication can be local, made by comparing scanned readings from the product with information printed upon it, or a database look up technique can be used.

A number of different layers of security solution were evaluated and the trial demonstrated that these techniques could all be applied at full production line speed and that authentication could be consistently achieved.

Conclusions

Counterfeiting of products is growing fast and expanding in scope.

Traditional methods of guaranteeing authenticity are becoming less effective as counterfeiters become better organized and better equipped.

The introduction of digital printing technology has the potential to make this situation worse as it will enable high quality reproductions to be created simply and with little investment.

Existing anti-counterfeit techniques whilst secure, do not allow end consumers to self authenticate and gain confidence in their products.

If unique pack serialization is introduced, it becomes possible for end consumers to carry out a significant level of self-authentication, providing a low cost surveillance and monitoring system to brand owners and increased levels of reassurance to their customers.

If latest generation bar coding is used as a data carrier then verification of products can be carried out by end users without the need for without the need to use expensive or complex IT systems.

If layers of security are applied to the product, then it is possible to build a system that meets all the required goals.

The use of a system like Laser Surface Authentication (LAS) as one of these layers allows a high level of authentication to be carried out on packaging materials, without the need for expensive or complex product features and avoid the security risks of other covert techniques.

References

[1] The Economic Impact of Counterfeiting and Piracy, OECD 2005, ISBN: 978-92-64-04551-4Published: June 2008

[2] MAGNITUDE OF COUNTERFEITING AND PIRACY OF TANGIBLE PRODUCTS: AN UPDATE- OECD 2008

[3] Counterfeiting, a global threat, a global spread UNICRI

Author Biography

Lee Metters received a BSc in Mechanical Engineering from Southampton University in 1984 and a Diploma in Marketing from the CIM in 1993.

His career started electronic instrument manufacturing but since 1990, he has specialized in B2B marketing and business development in the rapidly changing marketplace of Energy, Utilities and Industrial Printing. He has worked with products, systems and services both within the UK and for international markets...