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Alien Technology Q&A: Authentication in an RFID Company

Alien Technology is a broad range supplier of RFID products and technologies and holds over 100 US issued patents (roughly 50/50 between manufacturing and ICs & systems), has 19 US patents pending (majority RFID related) and holds 47 International patents (generally in China, Japan, Canada, Korea, Germany, UK). Alien tags enable large objects such as pallets or large boxes to be tracked as well as very small objects. Their 'Squiggle' tag is perhaps the best known and most well respected general purpose tag in the industry while the range expands up to large asset focused tags such as the '2x2' tag, the ultra-compact Small Item Tag (SIT) tag (9mm x 12mm) or the 'G' tag for high-dielectric materials such as glass, plastics and wood. Authentication News® spoke to Neil Mitchell, Director of Product Marketing for Alien Technology. We run this extended interview in recognition of the need to understand the potential role of RFID in authentication.

Authentication News: Does Alien consider brand protection a key market? If so how would you describe your approach to this market?

Neil Mitchell: Alien is a broad range supplier of RFID products and technologies. We are one of the main industry suppliers of RFID IC's or 'chips' to many companies that create the RFID 'tags' or 'labels.' We also produce our own tags & labels using custom designs and unique market knowledge to provide some of the best performing tags in the market place. Finally we provide the 'readers' (both fixed and hand held) that 'power up' and 'read' the tags & labels.

We supply a broad range of different markets (retail, supply chain, mobile asset tracking, pharmaceutical and life sciences, access control, manufacturing, aviation etc), and we supply into different applications including brand protection as well as tracking, identification and others.

Brand protection insures that the product acquired is the genuine product, thus protecting the brand qualities and reputation. Our approach is to provide Alien customers and channel partners the enabling technology and capabilities to support the required security and authentication features that enable brand protection.

I will summarize two groups of features that our chips provide to this end. First,

there are standard features provided by the industry standards that we comply with. We support all the EPC Gen 2 requirements including: Access Passwords, memory 'Locking', Permalocking, a factory programmed 'TID' (Tag Identifier), transmit masking and kill passwords.

Secondly, Alien, not satisfied with this, also provides unique additional authentication features including:

1. A 'UTID', a unique additional factory programmed security code.
2. Dynamic Authentication, a dynamic challenge/response to a non-digital, unique and non-clonable 'finger-print'. This is unique to Alien and quiet novel.
3. ReadLock, the ability to lock normally accessible user memory areas (using a password). Some of Alien's channel partners build on these technologies and provide additional 'step-up' capabilities including physical tamper detection to guarantee the one-to-one relationship between the tag and the asset that the tag has been assigned to.

All this technology allows full 'dual chain custody' of the asset to maintain an electronic record in the IT infrastructure of where the tag is physically located, and to determine physically that the tag is where the system says it should be.

AN: There has been some criticism toward

RFID in terms of how easily it can be hacked and the use of it on blister packs and fluid containers. How have you responded to these criticisms?

NM: Any system, whether RFID, bar code or EAS (electronic article surveillance) can be hacked and circumvented if implemented poorly. The key is to provide the appropriate basic capabilities that allow a

*You can copy the chip in its entirety
and you will not create a duplicate,
identical chip*

robust system to be built. No system is perfect (look at the recent hacking of RSA as an example) but by providing strong additional capabilities at the chip and reader level, some of the strongest RFID systems can and are being built using Alien technology including military systems (that clearly we cannot discuss). The Dynamic Authentication capability is completely unique and uses a non-clonable finger print. You can copy the chip in its entirety and you will not create a duplicate, identical chip.

Fluids & Dielectrics Protection

Fluids and high-dielectric materials are a challenge but with years of experience at

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the chip, tag and the reader side of the business we know how best to obtain the desired behavior for these systems (and it does vary from implementation to implementation). For example we do have specific high-dielectric designed tags that are now well proven in the market place (the 'G' tag).

Blister packs are a different matter and a really good example of where the RFID industry and the target industry must work together. There are rules of physics that despite the strongest desire will not change. We can take a long distance read tag and apply it to metal and the tag will either be non-readable (most of the time) or best case readable from an inch or two. The short read

There are objects and materials that RFID devices work well on and some that work less well

distance may be okay for some uses but certainly not all. This is where the pharma industry has to acknowledge that to use RFID, the packaging may have to change. If there is an area of the blister pack that does not have metallic foil on it, then the tag can be directly applied. For example, the RFID tag could be applied to the plastic bubble side if a part of that could be made flat to receive the tag. Another alternative is to have the 'gap' in the foil area as a receiving area for the tag. The final alternative is a tag that has a spacer (e.g. foam/plastic) between the metal surface and the tag. This adds a small amount of bulk (and cost) to the tag which may or may not be acceptable. Either way you view this, it is highly likely that the use of RFID tags on blister packs will require the packs to be redesigned or the container the packs go into may need to be slightly enlarged (by a couple of mm).

Suitability for RFID

AN: What stability and compatibility issues should potential users consider?

NM: RFID tags do replace barcodes and have huge advantages over them including things such as reading many tags simultaneously and reading 'through' objects (i.e. you do not need a 'line-of-sight' to read an RFID tag). However, you do need to consider what you are tagging. In early days when people tried to put a barcode on darker containers there were insufficient contrast for the early readers. You cannot invert the colors of a bar code and put a white barcode on a black box. Bar codes do not work that way. This is why we see white bar code stickers on dark pack-

aging today. You will have a challenge placing a barcode on an object that is too curved, an extreme case is a sphere. This will optically distort the tag so that it cannot be read by a bar code reader that expects the tag to be on a flat surface. In fact, printing the bar code in the first place may be a challenge. Bar coding an oil drum makes little sense as the dirt and grime will soon make the bar code unreadable. We all take these issues for granted today.

This is somewhat analogous to what we have in RFID. There are objects and materials that RFID work well on and some that work less well. There are environmental conditions that you need to be aware of. For example, can RFID tags be used in hot, direct sun or cold environments? Yes they can. You need to make sure the tag supplier will provide the appropriate tag for these conditions (and they may cost a little more than a tag not built for these conditions). You don't want the RFID tag peeling off in hot weather or the tag becoming brittle and dropping off in cold weather. There are tags for all these types of conditions.

Understand the Materials and Content

The contents of the container being tagged must be understood. Some materials, for example objects with high water content such as water, liquid soaps and drinks are more RF opaque and absorbent. So it takes more RF (radio frequency) power from a reader/antenna combination to read a tag on a container that holds one of these fluids. Can they still be read? Yes, but the reader set up and the location where the read happens and other environmental conditions must be appropriate. The read distances will usually be much smaller, particularly if the RFID tag is on the opposite side of the container in relationship to the antenna. It will always be better to have the tag oriented without the fluid between it and the antenna if possible. Sometimes you can control the environment, and sometimes you can't. If the fluid is oil based (e.g. baby oil, cooking oil etc) then as these do not contain water, these do not pose any problems for RF tags. They are fluids but ones that are RF transparent.

The container material is important. For example, most cardboards and plastics are fine. Metal is a problem. Metal 'shorts out' the potential difference needed to power up the tag. This can be circumvented by using tags that provide an additional insulating layer between the tag and the metal object. This allows a gap between the metal and the tag so the tag can pick up the RF power

without 'shorting out' through the metal.

So in other words, just like barcodes have restrictions on how they are used and you can design a barcode to work on most objects (perhaps not a sphere). RFID is the same. There are some containers and objects that are easier to tag than others. For the difficult ones, it is more important to control the read environment and the read distance. An interesting container type is metalized coatings used to make cardboard containers look shinny (e.g. often used in

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cosmetics packages). Many of these do contain metallic compounds that shield RF signals. Scoring the surface at one of the folded edges may be enough to provide a path for the RF signal inside the package. The best alternative is to provide one side or a small area of one side that does not have the coating for the RFID tag. So packaging design has to be involved in the use of RFID technologies.

Helping the Customer

AN: What consultative services does Alien Technology offer customers?

NM: Alien is well known throughout the industry as having one of the best training, consulting and support services. We have expertise in site analysis, tag selection and placement, project management, system design, simulation & testing, RFID installation services, feasibility analysis, reader configuration and commissioning and the solution partner ecosystem and help our customers. This is done at the RFID Solutions Center in Dayton, OH in the USA (see contacts below) which is run by Alien.

AN: What research does Alien Technology conduct in developing new technologies?

NM: Alien is continuing its research in all key areas including IC's, RF tags, RFID readers, the behavior of RF systems in challenging environments and manufacturing of RFID tags and chip. Alien has considerable intellectual property as a result of these efforts, especially in the area of Fluidic Self Assembly (FSA®) manufacturing of RFID inlays.

AN: What is the greatest challenge to Alien Technology as a supplier of RFID?

NM: I believe any RFID provider would provide the same response. The market has been slower to adopt RFID technologies than many at first predicted. This was at a time when there were a lack of standard and

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interoperability within the industry. These issues have since been resolved with industry standards such as EPC Gen 2 (Electronic Product Code global UHF Class 1 Generation 2) and ISO/IEC 18000-6C compliance. For example ISO/IEC 18000 is a series of standards created by ISO/IEC/JTC 1/SC31/WG4 and SG3. They have created the RFID air interface standards for the item identification world. Another element of the slow adoption that Alien has already addressed is the diversification of the customer base. To address the complete customer base it is key to have a strong channel-partner base. We are particular proud of both the depth and breadth of our channel-partners that allow Alien technology to be applied to a wide variety of customers and market verticals.

Reluctance to Use RFID

AN: What are some of the reasons customers might resist using RFID?

NM: Mostly this is application dependent, but if we are to note the most frequent I would suggest: when being used in a low-cost item asset tagging to replace a bar code, the price of an RFID tag is inherently more than the bar code it replaces. However, the cost advantages are also significant but are usually more challenging for management to understand or picture. As more RFID systems roll-out, the overall cost benefits will become more evident and easier for management to comprehend. Some examples of 'hidden savings' include increased accuracy of received goods (quantity, type and value), the quality of inventory management, the reduction in the misplacement of items (i.e. loss or loss of time in locating), internal shrinkage, customer theft, POS (point-of-sale) errors, inaccurate management of returns and by no means least, asset authentication. There are many applications where environmental conditions have relatively little concern but some that do. In rare cases (such as blister packs), there may be a need to modify the packing to accommodate an RFID tag due to the materials being used in the packaging and the physics of radio signals. This is far from insurmountable but just takes some thought and planning to find a solution that either does not impact the packaging or minimizes the impact.

Getting the Costs Down

AN: How much does the price of silver ink for antennas and polysilicon for wafers impact the cost of RFID tags?

NM: The antenna costs have been massively cost engineered over the past few

years and we do not use silver these days. Instead there are less expensive materials that can be used that have 'similar' RF properties and are not so much printed but are 'etched and printed'. This makes them very low cost, very RF efficient, very reliable and very repeatable (in the manufacturing process). The IC costs a little more than the antenna, especially by the time you factor in the mounting of the chip. The converting of the tag to a label and other costs (such as shipping) all add up and represent a significant portion of the tag's overall cost. In other words, there is no single component of the tag that represents a significant % of the overall tag cost on its own and there are already many years of cost reduction represented in today's designs. There will be further cost reductions, particularly as RFID volume continues to increase.

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AN: Compared to luxury products companies, pharmaceutical companies as a group appear to spend a very tiny portion of their budgets on brand and product protection; why do think this is the case?

NM: It is amazing that they do not spend more. The pharmaceutical industry is losing \$60 billion a year due to fraud and counterfeit drugs. The industry has been fighting against this for a long time and have only had limited effect. The money to be made from counterfeit drugs or ingredients is so large that the criminals are investing huge sums and have very sophisticated operations and technologies enabling them to duplicate certain authentication technologies such as holographic labels.

The Challenge for the Pharma Companies

The challenge is for the whole pharma supply chain to come on board and agree to a new standard and adopt a new technology. This is not a simple task given that despite there being relatively few large 'drug companies', their supply chain is extremely complex and therefore open to a variety of attacks and compromises. Consider that the basic ingredients themselves may be fraudulent so that the drug manufacturer may be unaware themselves of an issue. The company that packages the drug (into caplets, pills or some other form) is often not the same company as that manufacturing the drug. Then finally at the end of the chain is the pharmacy with other wholesalers and

suppliers in between. So, there are a lot of companies in adjacent roles that would need to agree to a new standard that involves RFID. So there has been little motivation by the pharmaceutical companies to move to a true 'ePedigree' until very recently.

In the US, the federal and state governments play a role and motivating factor here. As a purchaser of drugs themselves and as the operator of many agencies who have interest in controlling the misuse of drugs, they are the one to push a mandate. They have attempted a number of times to do this and the drug companies have been able to delay the introduction of such requirements. This is no longer the case as the largest player, the US FDA (Food & Drug Administration), and the second largest player, the California State Board of Pharmacy, have wised up and are now forcing through ePedigree requirements. The bottom line is that there is a firm deadline in California of 2015-17 for manufacturers, wholesalers and pharmacies to implement the ePedigree requirements at defined milestones through this implementation period and RFID should be part of this.

AN: What is the number one reason for using RFID?

NM: If we are talking of the pharma industry, it's pretty much like the real-estate mantra of location, location and location. It's ePedigree, ePedigree, ePedigree – which incorporate elements of anti-counterfeiting and anti-fraud. Tracking and inventory control are issues that RFID technology can also help the industry improve but have not been strong enough to encourage the Pharma industry to take the plunge and perceived risk of implementing new technology into their systems. With the ePedigree mandate coming, with minimal additional cost, RFID can addressing the tracking and inventory management aspects of the industries challenges while solving (or contributing to solving) the ePedigree aspects.

Generic Medicines RFID Role?

AN: Do you envision the use of RFID on generics?

NM: Yes. A couple of reasons. Even the generic providers have a reputation that they want to maintain and don't want a dangerous replacement drug being used in place of their product.

The second factor, which is true for the brand name suppliers as well, is that it is critical for company profits for the desired drug to reach the desired location and not be diverted to a different country. For

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example, most drugs sell for more on the US market than just over the border in Canada or Mexico. So it is critical to the Pharma industry that drugs for the US don't end up being sold in Mexico for less or drugs sold in Canada don't end up being sold at Canadian prices in the US.

AN: What other trends has Alien Technology seen with brand protection and product protection?

NM: A couple of trends we have seen include: combining RFID with taggant materials to provide visual tamper indications and combining RFID into a tamper construction so that a tag's RFID properties are irrevocably changed (or even destroyed) when an attempt is made to move a tag to a different product (such as one of higher or lower value or a dangerous substitute).

AN: What other considerations and ideas does Alien Technology think are important for product and brand protection?

NM: Every company exists in a different ecosystem with different suppliers and customers. For any technology, including RFID, it is important for someone to 'walk through' the supply chain and understand how the product flows through it, points of weakness and what the goal of the RFID system is (e.g. ePedigree vs track/trace). Only then can the correct readers, tags and system be installed to have the desired outcome. This sounds logical but it is amazing how many times companies try to take a short cut through this process.

AN: Success case you can share?

NM: It is very difficult to pick one as we are so broad based. We have successes with the DoD (Department of Defense) and NASA on one extreme and retail in the other. For obvious reasons we cannot talk about the DoD/NASA applications. Much of the retail is still in the process of rolling out so we cannot mention specific names but suffice to say we are working with most of the big name players. Additionally, there are also a lot of niche applications that we sell into such as systems used in race timing. Some data made public by the US Marines. I jump on this as the DoD has done in depth study and published data that commercial organizations are keen to keep to themselves:

1. Up to 75% reduction in time required to conduct inventory.
2. Real-time precision and accounting: 100% accuracy -> Compared to 68% using other AIT methods.
3. Maintain more accurate physical inventories with less manual labor (labor savings can be reduced by 75 -90%).
4. Positive ROI by year 3.
5. Average delivery time fell from 28 to 16 days with RFID, and the backlog of supply shipments dropped from 92,000 to 11,000.
6. Other (non-Marine) metrics include: The Pentagon estimates it will spend nearly \$500 million on RFID technology, but it expects net savings of over \$1.7 billion by reducing accidental re-orders and misdirected shipments over the first seven years of its implementation.

AN: Most unusual request from customers?

NM: How do I get 100% read rate? As with any system with humans involved that is never going to happen 100% of the time. However, we can guarantee ~100% data integrity across the system. By this we mean that a SYSTEM can be designed so that there is robustness built into the system to get close to that 100% goal. Don't forget, bar codes are not 100% either. We can read tags as they go onto a pallet, read '100% of them' through this process (as we are more likely to be able to have ideal RF conditions as the items are still separate from each other) or on a shrink wrap station, and then we add a pallet tag on the outside so you no longer need to read all the tags. You now have a hierarchical system to make sure your system is more robust. As with any system, you can design it poorly and you will not be close to 100%. Design it well, with the correct technology and systems and your data integrity across the system will be very close to that 100% goal.

AN: Most unusual request from customers?

NM: We have all kinds, but one example from the life sciences is to understand how robust we are to gamma radiation exposure. As with all IC's we are robust to a certain point (which we do not disclose). We do work with the US military and NASA so they are obviously happy with this. In fact, there are Alien tags and chips aboard the ISS (International Space Station).

Protecting Alien's Products

AN: How do you prevent fraudsters from obtaining Alien Technology products?

NM: We have a layered approach that allows users to protect their supply chain to the level they desire. For example:

1. To protect from 'casual theft': Alien employs passwords to access the EPC. This is pretty much standard.
2. However, in addition to this we use two additional fields that can be used to uniquely identify the tag beyond the EPC. These are the TID & UTID fields. These can be used to validate the EPC is valid (i.e. it is not counterfeit). (UTIDs are programmed at manufacturing time).
3. To extend this last technique further (and to support other protection schemes), Alien's Higgs-3 supports both read and write lockable user memory blocks. This is not part of the standard and this level of granularity is unique to Alien. Memory is lockable by individual banks (i.e. not readable without the password). So unless you have the password, you can't even read these memory areas.
4. Finally there is the full Dynamic Tag Authentication which protects from cloning of IC's with fraudulent chips. You can directly create a reverse engineered version of the Higgs-3 and program it with the same EPC and even if you could read all the data and duplicate this, the dynamic authentication between the duplicate chip and the original will be different. Hence the chip is not digitally clonable.

We can't discuss what physical and electronic security we have as a company, but clearly we take all of this very seriously. We work with the Department of Defense and NASA on a number of projects, so you can imagine the lengths we have to go to as a result of this. I work here and there are parts of this building I have never seen.

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