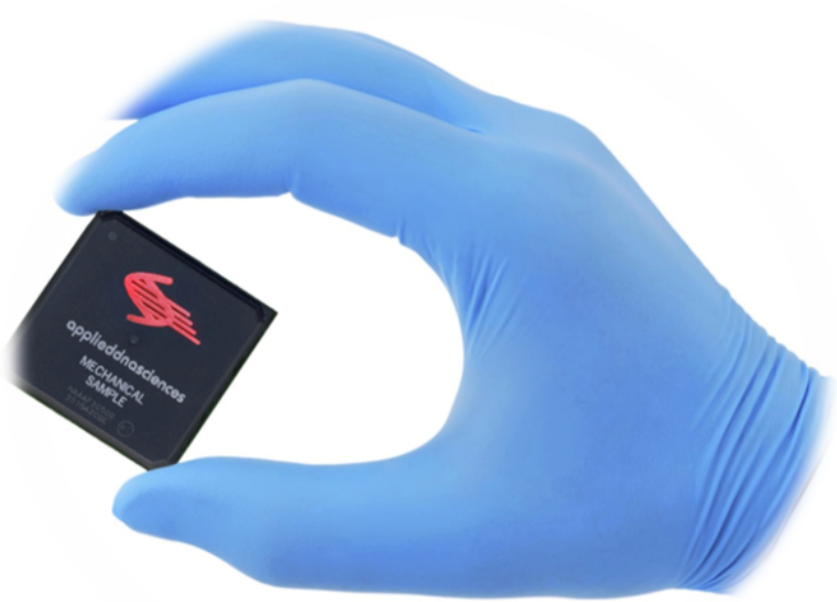
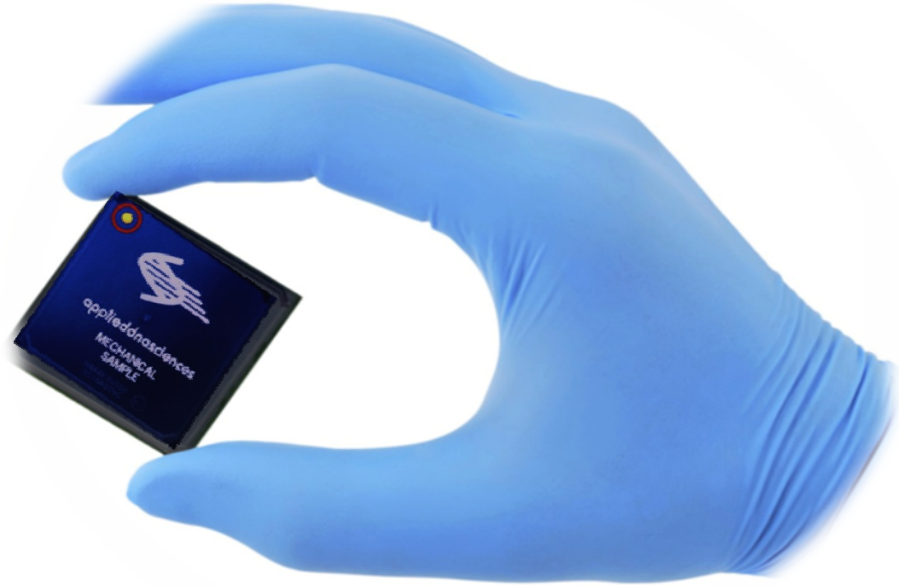
DNA Marking

A Proactive Counterfeit Risk Mitigation Solution



Authenticity



Provenance

Case Study: An Early Adopter Uses SigNature DNA to Secure DOD Supply-Chain and Rack up ROI

By Bob MacDowell
Applied DNA Sciences, Inc.

The electronic component industry remains infested with counterfeit components. Short life cycles for components used in long-term military projects force OEMs to wade out into the murky waters of the 'open market' to procure obsolete parts. Shifting demands cannot always be predicted by the authorized channels, leading to unacceptable lead times, exacerbating the supply challenge.

*** Over 5,000 *5962* microcircuits DNA Marked and shipped to DLA as of April 2013**

SigNature® DNA

Precision-engineered, botanical-DNA-based mark, which can be placed in or on any item to provide absolute authenticity at a forensic level

- *Cannot* be copied.
- Custom DNA markers can be created for specific vendors/suppliers or raw materials.
- Versatile. Can be easily combined with virtually any security feature to create a unique solution with custom functionality.
- Forensic and legally valid.
- Adaptable. Will not require major changes to the manufacturing process or supply chain.

Lessons from Paleontology

- DNA survives in amber for thousands of years (anhydrous, limited diffusion, etc.)
- APDN mimics these conditions in our chemical hosts
- **Markem-Imaje** mil spec inks ~ amber
- Low DNA concentration

Applied DNA Sciences and Markem-Imaje Sign Letter of Intent for Authorized Reseller Agreement Broadens SigNature® DNA Applications in Markem Inks

MEDIA CONTACT: Mitchell Miller, 646-543-3373, fax: 631-444-8848
INVESTOR CONTACT: Debbie Bailey, 631-444-8090, fax: 631-444-8848
FCMN Contact: info@adnas.com
Web site: http://www.adnas.com
Twitter: @APDN, @APDNInvestor

STONY BROOK, NY, April 4, 2013. Applied DNA Sciences, Inc. (OTC Bulletin Board: APDN), (Twitter: @APDN), a provider of DNA-based anti-counterfeiting technology and product authentication solutions, announced today a Letter of Intent (LOI) with Markem-Imaje Corporation (Keene, NH), establishing Applied DNA Sciences as an authorized reseller of Markem-Imaje Fluid inks. The LOI is specifically related to the application of SigNature® DNA botanical markers added into Markem-Imaje inks. This supports suppliers in meeting the Defense Logistics Agency (DLA) requirement for SigNature DNA marking on a class of electronics provided to the Agency.

Markem-Imaje is a top supplier of inks to the electronics industry, both military and commercial, and is said to be the world's largest provider of product identification solutions.

Creating a SigNature DNA Marker

Large Botanical DNA is acquired.

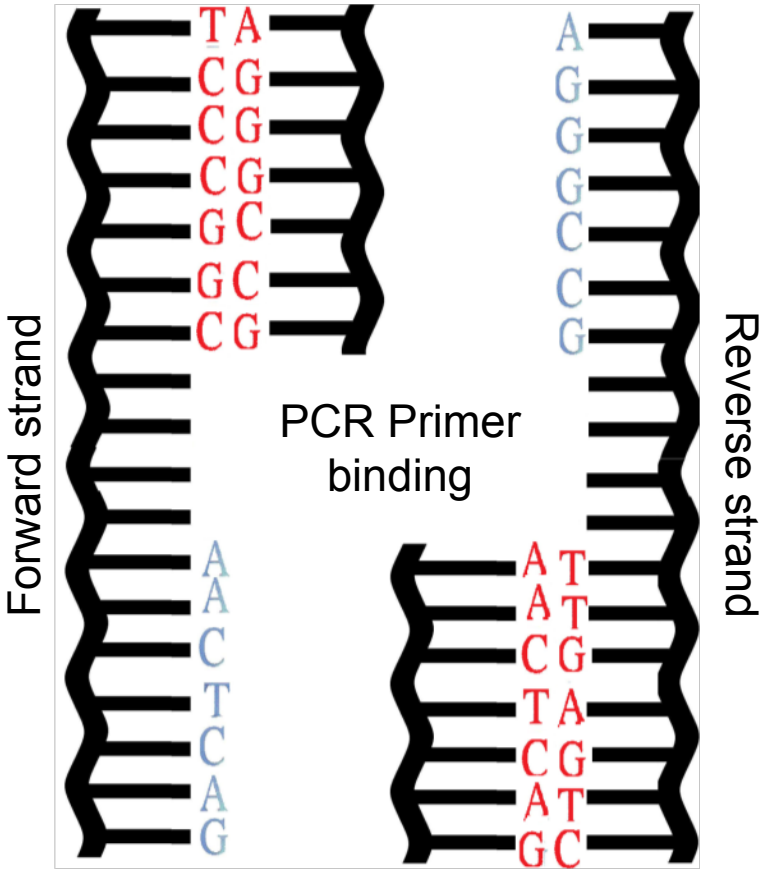
DNA is segmented.

Segments are shuffled and reassembled to form a unique, secure DNA marker.

Uncopyable?

First principles:

- Probability of matching any single nucleotide is 1in 4
- Probability of matching 2 sequential nucleotides is (1/4)(1/4) = 1/16
- Probability of matching two 15-base primers is $((1/4)^{15})^2$ = $(1/4)^{30}$ (**1 in a quintillion**)
- Probabilities radically diminished by multiple marks and decoy DNA



Decoy DNA

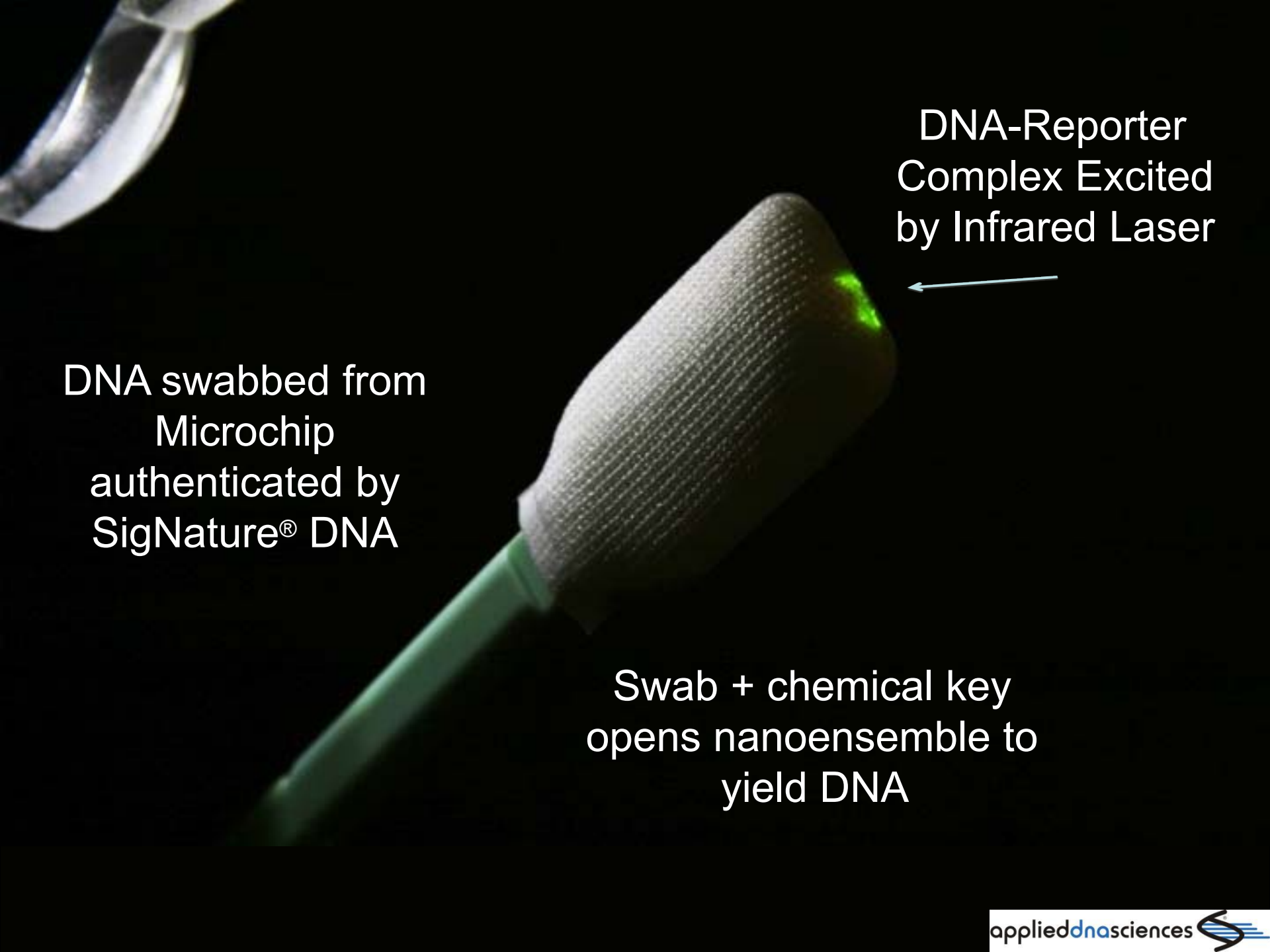
Probability of matching primers to THE amplicon (marker) diminish enormously in the presence of decoy

Worse than finding a needle in a haystack, is trying to find a needle in a stack of needles…..

“Copy-Hardened” Optics

Multicomponent Optical-DNA Array

- Interactive optical centers
- Both solid-state and soluble
- Fluorescence pattern is defined by DNA and environment
- “Encrypted” fluorophore revealed by unique APDN test, excludes counterfeit optics
- IR Structured array altered by transfer


DNA-Reporter Complex Excited by Infrared Laser
DNA swabbed from Microchip authenticated by SigNature® DNA
Swab + chemical key opens nanoensemble to yield DNA

Screening & Authentication

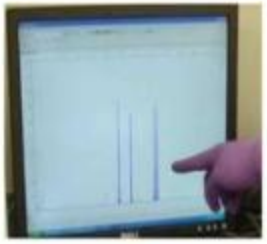
Rapid Screening in the Field

Label sample is received

Sample Preparation

Purified DNA sample into vial

DNA authenticated using PCR machine and/ CE analysis



Results are absolute and definitive

Forensic Authentication in the Lab

Authenticity vs. Provenance

SigNature® authenticity marker

Authenticate Components Marked During Manufacture at OCM

- Covert Marks applied ONLY at OCMs
- Invisible mark embedded within visible marking. Done during packaging.
- DNA sequences contain "**Authenticity Segments**," specific sequences reserved for OCMs only
- DNA sequence is unique to each OCM
- Rapid Read marker complex signifies "AUTHENTIC"

SigNature® provenance marker

Verify Provenance of Components Marked After Manufacture

- Covert Mark applied ONLY at non-OCM (licensed Disty)
- DNA sequences contain "**Provenance Segments**," specific sequences reserved for non-OCM's
- DNA sequence is unique to each distributor or non-OCM source
- Rapid Read marker complex signifies "PROVENANCE"

2 Log R&D Programs

LMI
Complex Problems. Practical Solutions.

Defense Logistics Agency

SMT
Corporation

ALTERA

SRI International
SARNOFF

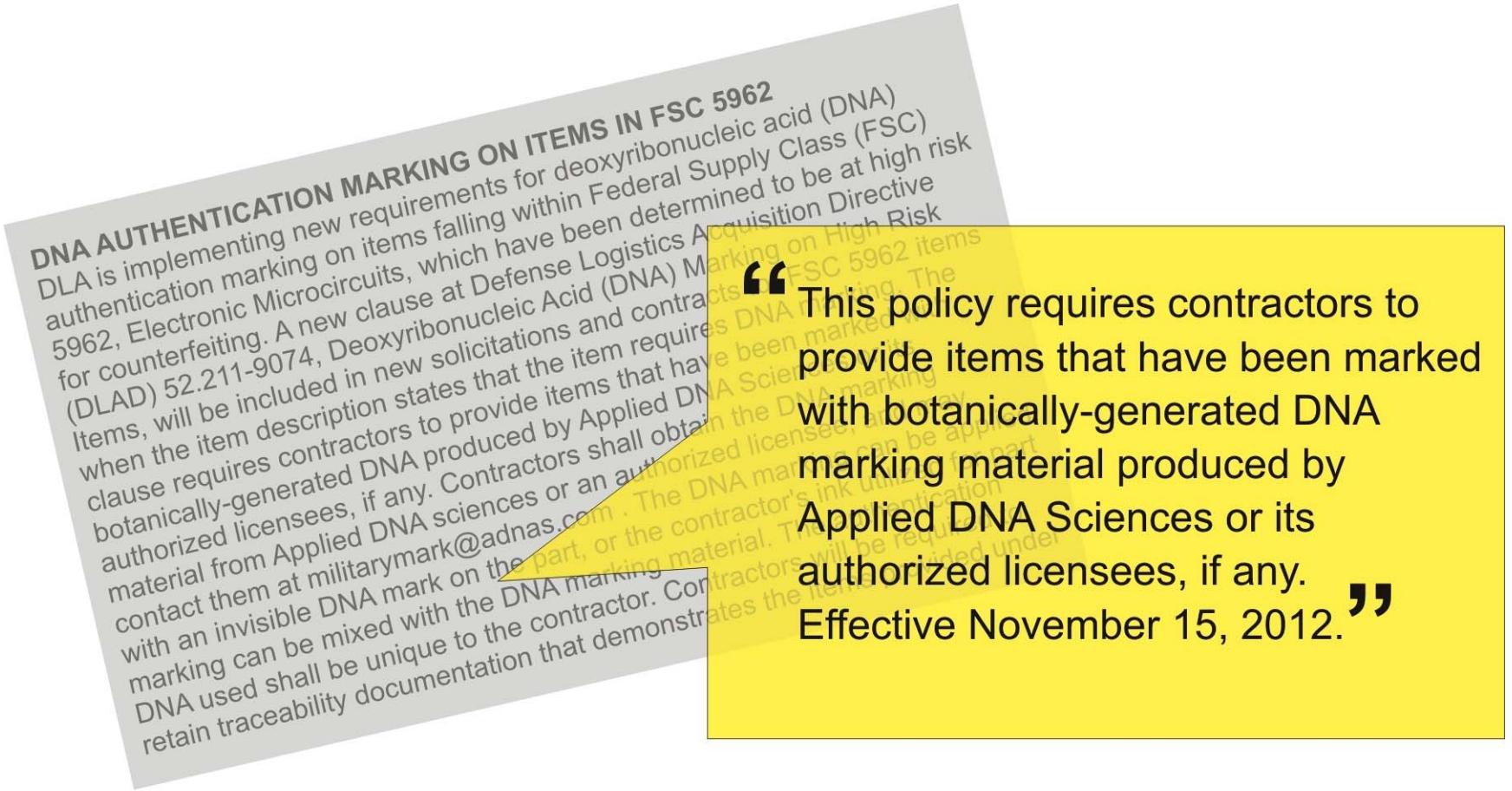
Raytheon

"Red Team" Challenge

Conducted by private, independent lab of national repute

- Full technical brief 1 year in advance by APDN scientists.
- APDN provided 500 marked components
- Red Team had 3 months to defeat SigNature DNA
- 218 submissions were made by Red Team to APDN
- APDN was not allowed access until LMI and DLA were present.
- In one day, all 218 submitted components were demonstrated counterfeit, optically.
- Subsequent DNA authentication proved forensically that all were counterfeit.

DNA Authentication Marking on Items in FSC 5962



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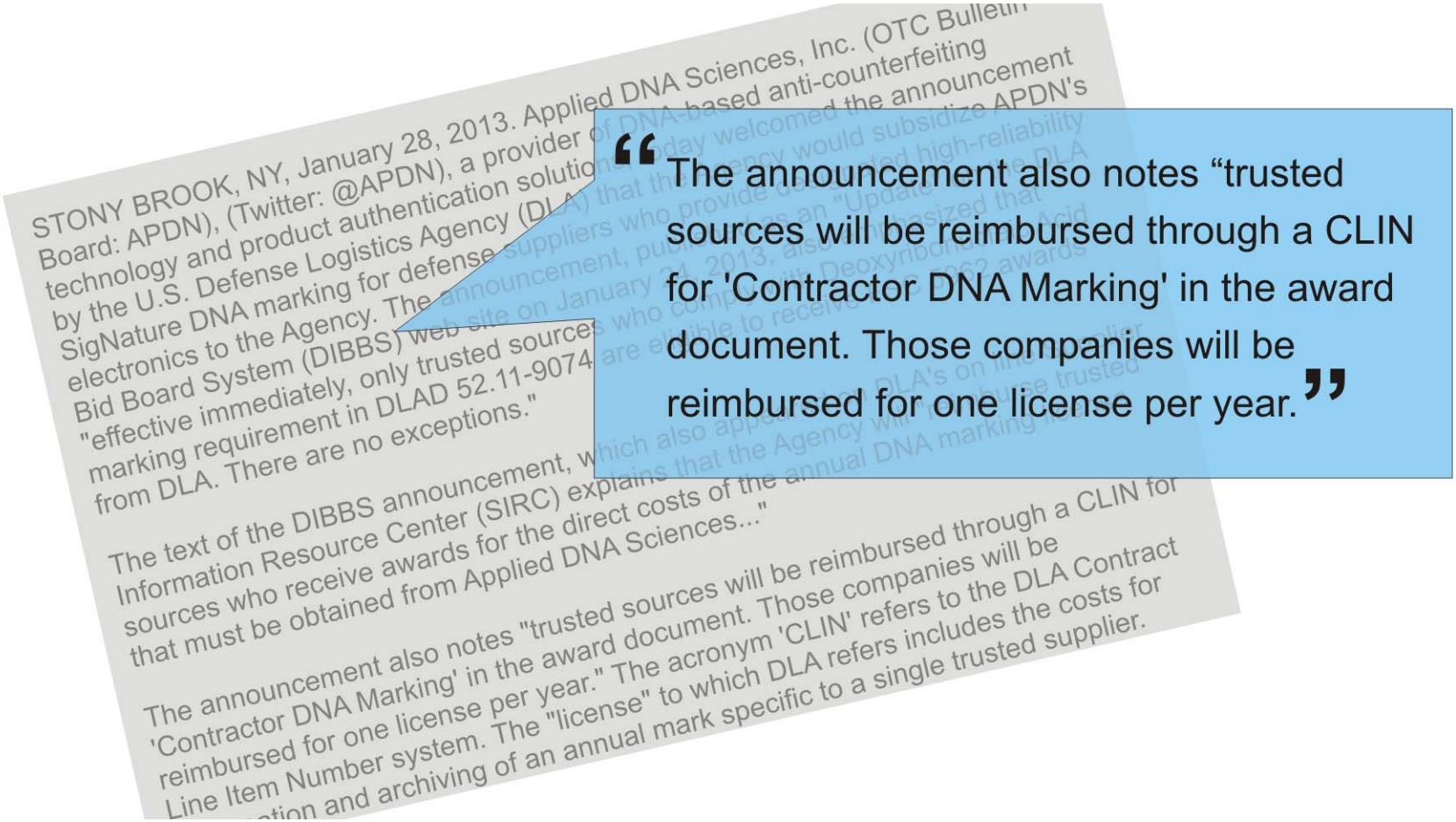
DLA funds SigNature DNA marking for high-rel electronics



Engagement Under DLA

DLA posts solicitations on DIBBS

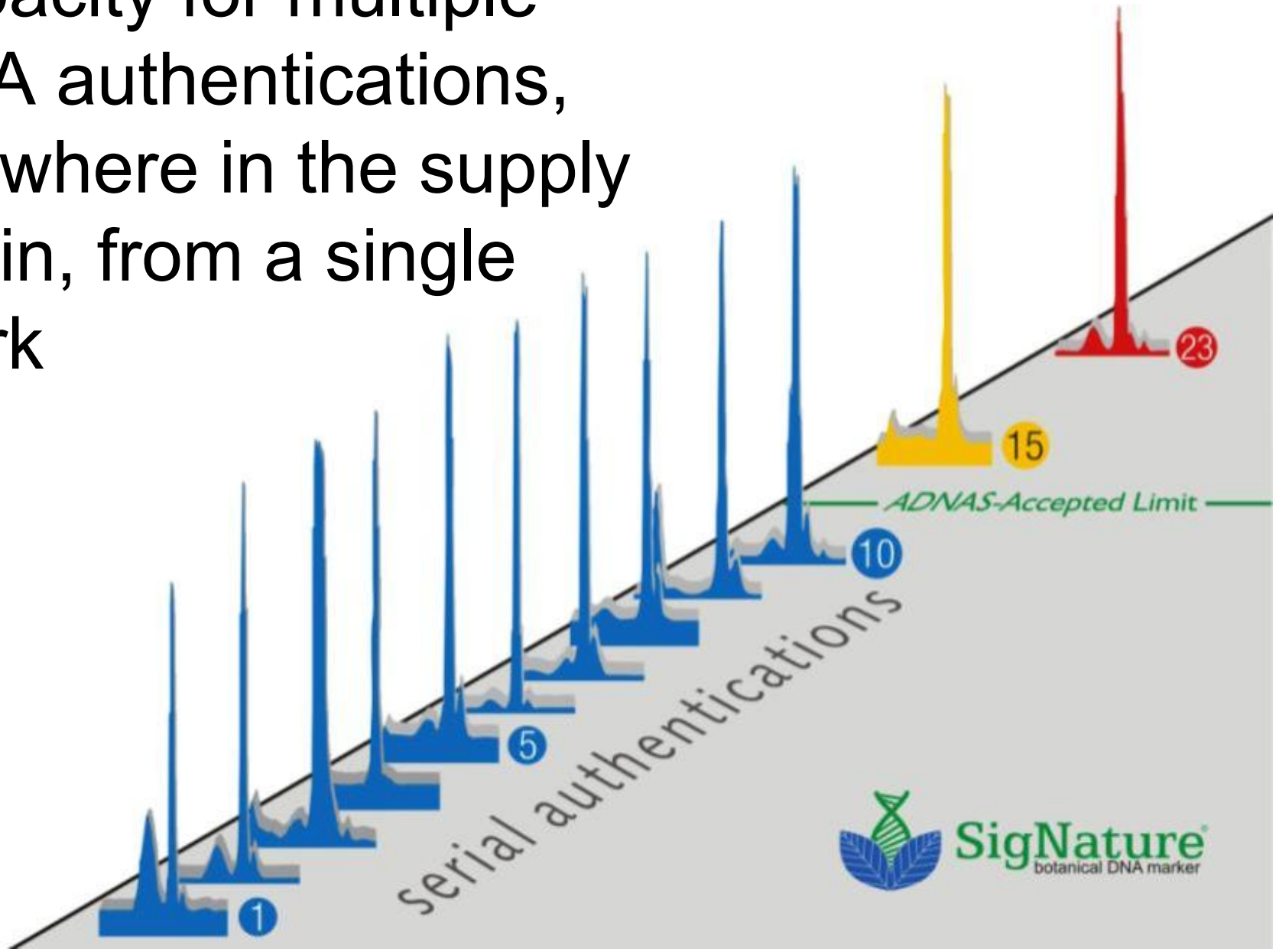
DLA suppliers submit bids to DIBBS

DLA awards orders to suppliers

Suppliers engage APDN for DNA marking capability:
In house (audit, training, certification, ink) or 3rd party

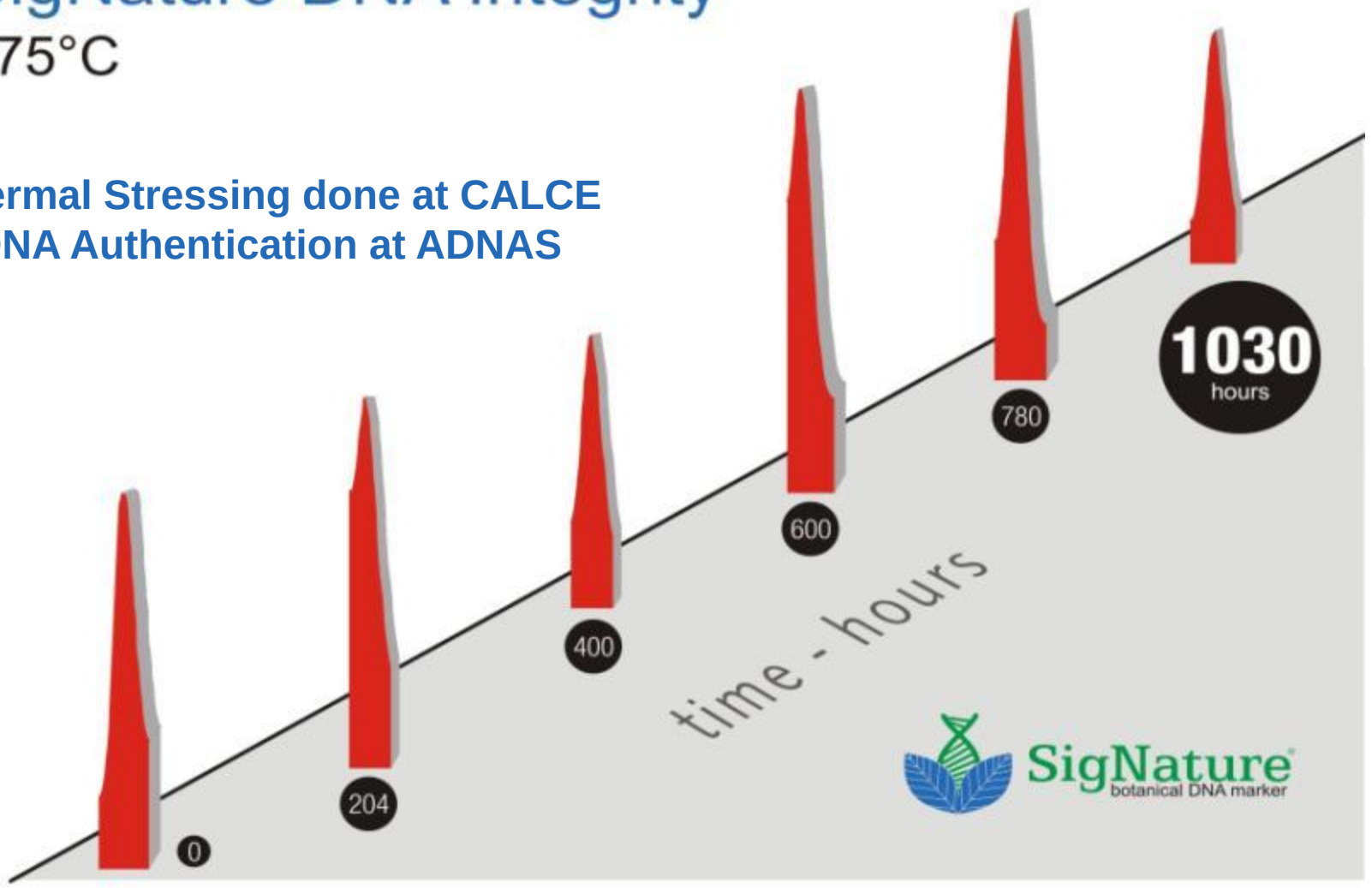
Ink deliveries to coincide with DLA orders; ability for supplier to order additional ink for non-DLA orders

Capacity for multiple DNA authentications, anywhere in the supply chain, from a single mark



Calce Life Cycle Testing:
SigNature DNA Integrity
175°C

Thermal Stressing done at CALCE
DNA Authentication at ADNAS



MIL-STD-883 TM 1019.7

- Ionizing radiation (total dose) test procedure

RHA level designator	Radiation and total dose (Rads(Si))	DNA SURVIVES
	No RHA	
M	3000	
D	10^4	
P	$3x10^4$	
L	$5x10^4$	
R	10^5	YES
F	$3x10^5$	YES
G	$5x10^5$	YES
H	10^6	YES

- *conducted at Aeroflex-rad

SigNature DNA

Tested on metal, ceramic and epoxy surfaces

- Thermal Cycle*
  - MIL-STD-883 TM 1010**: 100** cycles, -65°C to +150°C
- Thermal Shock*
  - MIL-STD-883 TM 1011: -65°C to +125°C; 15 cycles
- Unbiased HAST*
  - JESD22-A118, 130°C/85% RH; 100 hours
- Cyclic Moisture Resistance*
  - MIL-STD-883 TM 1004 (+25°C - 65°C, -10°C); **100** cycles
- Resistance to Solvents
  - MIL-STD-883 TM 2015

*Conducted by Silicon Cert Laboratories without applied voltage.

SigNature DNA

Tested on metal, ceramic and epoxy surfaces

- Simulated wave solder immerse in solder*; JESD22-B102E, Sn96.5Ag3.0Cu0.5, at 245° C for 5 seconds
- Simulated solder reflow solder*; JESD22-B102E reflow at 260°C
- Ten X-ray exposures*; MIL-STD-883 TM 2012 Radiography
- Salt Atmosphere*; MIL-STD-883 TM 1009 Condition D, 35° C, 240 hours
- Resistance of Insulating Surfaces**ASTM D-257 07 Sample exceeded the measuring capability of the Megaohmeter. Surface Resistivity (Ω/square) is greater than 5.24E+15; SigNature DNA is non-conductive

*Conducted by Silicon Cert Laboratories without applied voltage.
**Conducted by Intertek

SigNature DNA

Tested on metal, ceramic and epoxy surfaces

- Outgas Testing***; ASTM E 595, Vacuum < $5x10^{-5}$ torr – 24hrs @125^{o}C, DNA falls 30-80% below the rejection criteria
- Non nutrient for fungus****; MIL-STD-810G METHOD 508.6: Resistance to Fungus Test; all SigNature® DNA-embedded inks are NEGATIVE in 28 day test

***Conducted by Pacific Testing Laboratories
****Conducted by APDN Laboratories

MSDS

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the ultimate reality check

Clear Thermal DNA Embedded Ink w/ Rapid Reporters

Material Safety Data Sheet

Document Number: 105-046.01
Effective: 19-Nov-2012

Section I: Chemical Product and Company Identification

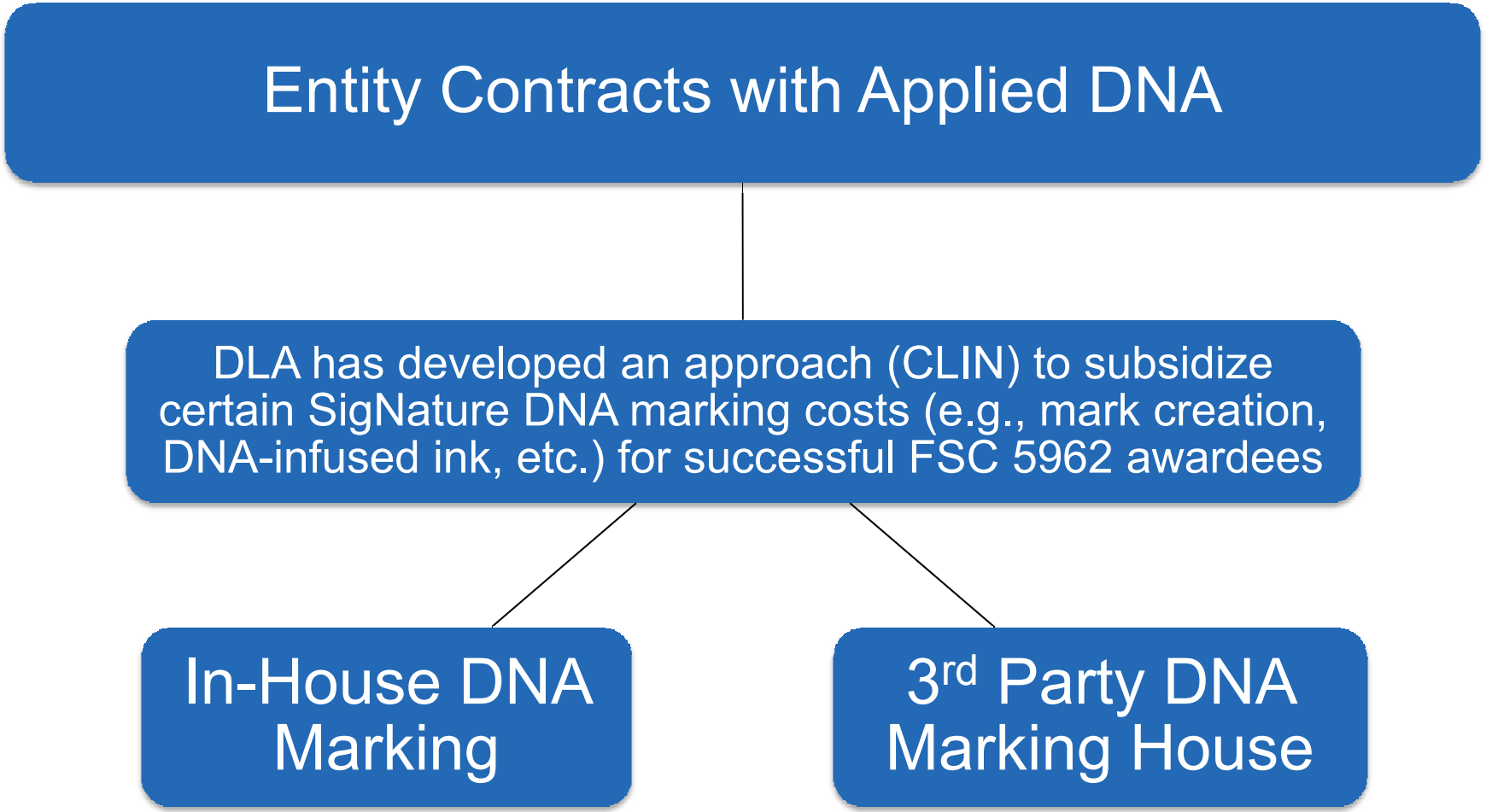
Manufacturer's Name :	Applied DNA Sciences, Inc.	**Chemical Name & Synonyms:**	Pad Printing Ink
Business Address :	25 Health Sciences Drive Stony Brook, New York 11790-3350 United States of America	**Trade Names & Synonyms:**	Component marking ink with Rapid Reporters
Business Phone:	1-631-444-6370	**Chemical Family:**	UN1210 Printing Ink Related Material
Emergency Phone:	1-631-444-6370	**Email:**	safety@adnas.com
Business Fax:	1-631-444-8848		

Section II: Composition / Information on Ingredients

Chemical Name	CAS #	Weight %
Cyclohexanone	108-94-1	1 – 5
Trimethyl benzene	25551-13-7	1 – 5
Xylenes (o-, m-, p-isomers)	1330-20-7	1 – 5
Ethyl benzene	100-41-4	0.1 – 1
Pseudocumene	95-63-6	0.1 – 1
1, 3, 5-trimethylbenzene	108-67-8	0.1 – 1
Hexamethylene diisocyanate	822-06-0	0.1 – 1

Percentages may not equal 100% since only hazardous components are listed

SigNature® DNA



In-House DNA Marking

Assessment
- Vendor Assessment for QMS
- Risk Assessment Necessary for DNA Marking (Marking, Curing, Storing and Control)

Equipment
- Oven with Fume Hood
- Secure Storage Area

On-Site Training
- DNA Marking Training Manual (SOPs)
- DNA Marking Demo
- Personnel Qualification Process

DNA compliant

OCM
Full Trace
Testing Protocol

Third Party DNA Marking House

Assessment

- RICQ, Quote, Agreement

Partner

- Align with SMT Corp
- SMT/APDN Quote 3rd Party Price

DNA compliant

Full Trace
Testing Protocol

DNA Marking Lab

DNA Marking Lab

Secure DNA-Specific Work Area

DNA Marking Third Party Quote

a) Minimum set up fee per marking shipment of $495.00 (includes First Line Item Documentation Fee - LIDF)

b) Each additional line item (part number) will incur a $125.00 LIDF

c) Below pricing is applied to each individual line item quantity; pricing is not cumulative for multiple line items.

Price Breaks per line item/part number:

1 - 250 components = $0.60/component

251 - 500 @ .50

501 – 1,000 @ .40

1,001 – 5,000 @ .25

5,001 and over @ .20

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Certificate of DNA Analysis

Product Name (Description): M4465 Clear UV Ink with DNA and Rapid Reporters (on printed cured microchips samples and uncured ink)
Client:
Part Number:
Lot number(s) of vial codes produced:

Manufactured on: 23 Aug 2012

Material Tested	Sample ID	SigNature® DNA Tests	Lab NB Ref	Result
Microchip sample #1	*C120829-001*	*UV/IR Rapid Reporter*	*Authentication Binder #1 – JR591*	*Pass*
		Authentication DNA	*Authentication Binder #1 – JR591*	*Pass*
Microchip sample #2	*C120829-002*	*UV/IR Rapid Reporter*	*Authentication Binder #1 – JR591*	*Pass*
		Authentication DNA	*Authentication Binder #1 – JR591*	*Pass*
Microchip sample #3	*C120829-003a*	*UV/IR Rapid Reporter*	*Authentication Binder #1 – JR591*	*Pass*
		Authentication DNA	*Authentication Binder #1 – JR591*	*Pass*
Microchip sample #4	*C120829-003b*	*UV/IR Rapid Reporter*	*Authentication Binder #1 – JR591*	*Pass*
		Authentication DNA	*Authentication Binder #1 – JR591*	*Pass*
Microchip sample #5	*C120829-004*	*UV/IR Rapid Reporter*	*Authentication Binder #1 – JR591*	*Pass*
		Authentication DNA	*Authentication Binder #1 – JR591*	*Pass*

FY' 13 NDAA Section 833

Contractor responsibilities in regulations relating to detection and avoidance of counterfeit electronic parts

(B) The cost of counterfeit electronic parts and suspect counterfeit electronic parts and the cost of rework or corrective action that may be required to remedy the use or inclusion of such parts are not allowable costs under Department contract, unless -

(i) the covered contractor has an operational system to detect and avoid counterfeit parts and suspect counterfeit electronic parts that has been reviewed and approved by the Department of Defense pursuant to subsection (e)(2)(B)

Trace *or* Test
QC Requirement **SD-5962**

- Unless otherwise specified on Award, all 5962 components for **DLA** must have full OCM trace or undergo QTSL protocol (based on AS6081).

- As a default, all non 5962 components must undergo **AS6081**.

- Customer-driven. Participate in the establishment of non-DLA QC Standards.

D11C22 52.211-9074 DEOXYRIBONUCLEIC ACID (DNA) MARKING - FEDERAL SUPPLY CLASS (FSC) 5962 (11/2012) DLAD

(b) **The DNA marking material used shall be unique to the Contractor.** The Contractor shall apply the DNA marking material directly to the part with an invisible DNA mark or mix the DNA marking material with the Contractor's ink utilized for part marking.

(c) The Contractor shall-

1) Provide **DNA marking traceability documentation** demonstrating compliance with this clause upon request by the Government. Failure to provide the requested documentation within the specified timeframe may result in cancellation/termination of the purchase order/award.

(2) Retain for 5 years after final payment under this contract the traceability documentation that demonstrates the items provided under this contract have been marked with DNA material produced by Applied DNA Sciences, or an authorized licensee, and that **the DNA marking is unique to the Contractor.**

Applied DNA Sciences

Janice Meraglia
Janice.meraglia@adnas.com
631-444-6293

Bob MacDowell
Bob.macdowell@adnas.com
631-444-1090

www.adnas.com

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