



# **An Integrated Approach to Preventing Counterfeits in Defense Supply Chains**

**Presented at DMSMS 2009**

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**University of Alabama in Huntsville**

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**Some Counterfeits Are Easier To Spot Than Others**

**.....Did they mean Adidas?**





## Other Counterfeits are Almost Impossible to Visually Detect



Counterfeit duplication of the packaging for an injectable drug.



## Lipitor

Pfizer's blockbuster cholesterol drug is the world's bestselling prescription medicine, with \$12.7 billion in sales last year.



COUNTERFEIT. Despite its impressive resemblance to the real pills on the right, the fake Lipitor on the left likely contains little to no active ingredients, putting patients at risk of conditions such as heart disease. In 2003, the U.S. Food and Drug Administration ordered at least 100,000 bottles of Lipitor recalled after consumers complained about bitter-tasting pills, which turned out to be fakes, and large recalls were ordered in Britain in 2005 and 2006.



Approved Fosamax

Counterfeit Fosamax



Source: Merck Chinese Counterfeit Drugs, May / June 2006





## Pfizer Is Using RFID to Fight Counterfeit Viagra



EPCglobal Logo and RFID Tag location (tag is under label)



EPC Data 2D Barcode

Color Shift

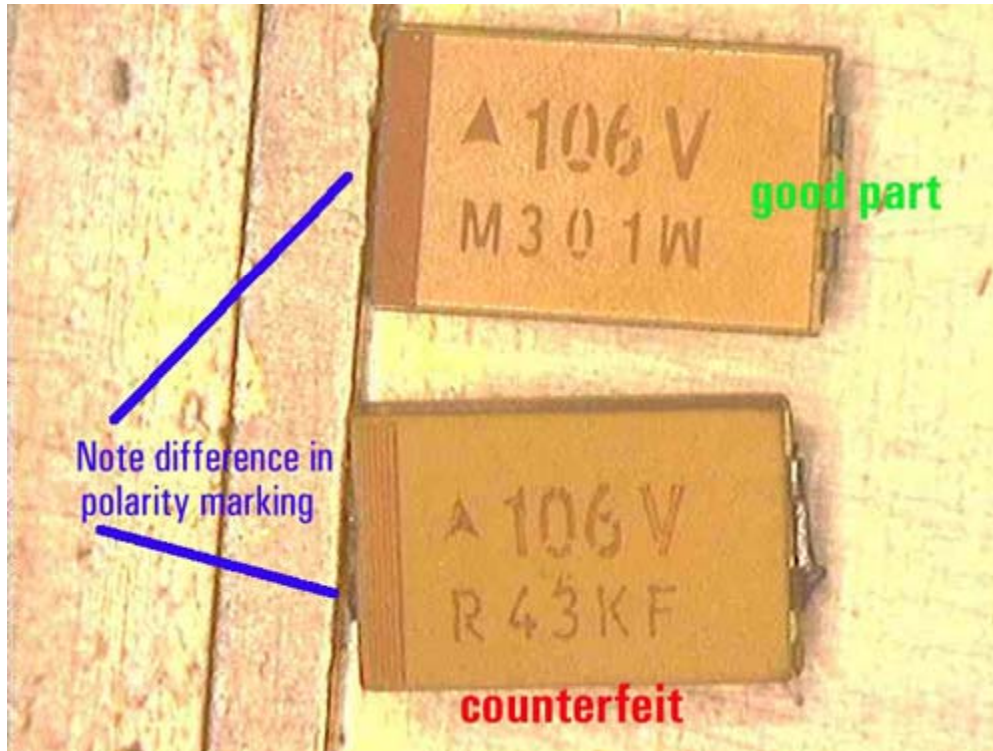


An advertisement for a fake iPhone that is being sold in China.



Technological advances have allowed hundreds of small Chinese companies, some with as few as 10 employees, to churn out what are known here as shanzhai, or black market, cellphones, often for as little as \$35 apiece. This fake Louis Vuitton-branded phone was available at a mobile phone market in Shenzhen, China.





**Genuine and Counterfeit Capacitors**





A'PEXi is concerned about the potential damage that the counterfeit Turbo Timers may cause. Poor circuit design, incomplete programming, use of inferior materials, and inconsistent manufacturing processes could lead to car malfunction, short circuits, electrical fires, electrocution, and possible physical injury and are not recommended for use.

***Key features of the A'PEXi Auto Timer, such as the Parking Brake Safety Protection and Air/Fuel Ratio Monitor functions are non-operational on the counterfeit units.***



## Cover Page News: Counterfeits in Defense Supply Chains



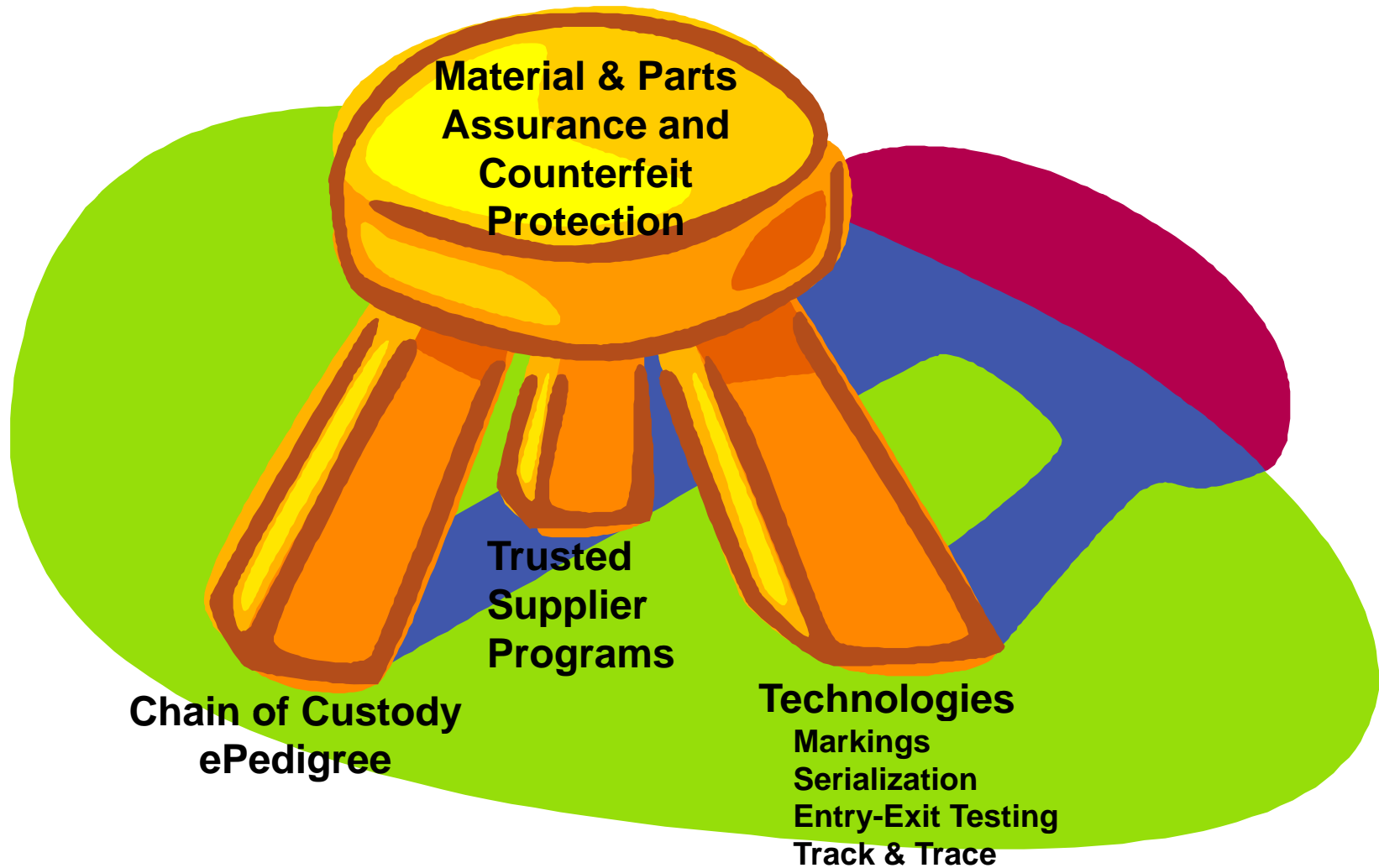


## **Pervasive & Dynamic Problem**

- **Cuts Across Industries**
- **Impacts Low Value and High Value Products**
- **Affects Low-Tech and High-Tech Products**
- **Dynamic and Evolving Battle of Wits**
  - “Trying to Stay One Step Ahead”
- **A Multi-Pronged Approach Seems Strongest**



## Multi-Vectored Approaches





# The First Leg: Trusted Supplier Programs

- **DMEA**
  - Trusted Foundry
  - Trusted IC
- **Purchase from Original Manufacturer or from Distributor, Reseller or Aftermarket Supplier Who is Authorized or Franchised by Original Manufacturer**
- **Independent Brokers Must Sometimes Be Used**
  - Traceability and Custody Documentation
  - Testing, Inspection, Analysis
  - Purchasing Processes



# The Second Leg: Anti-Counterfeiting Technologies





# Path to Success

- **Solution must be appropriately chosen**
  - Robustness, longevity, acceptable cost;
- **Solution must be effectively promoted in marketplace; Customers Must be Aware;**
- **Technology must be implemented at appropriate level**
  - Implemented at the most elemental level, saleable unit.



# Anti-Counterfeiting Technologies

- **Packaging, Marking & Seals**
  - Holograms and security seals;
  - Overt and hidden images;
  - Package modification.
- **Taggants**
  - **Forensic Taggants**
    - Optical taggants
    - Chemical taggants
    - Nanotaggants
- **Mass Encoding**
  - **Digital Mass Serialization: Human Readable/Barcode/RFID**
  - **Digital Mass Encryption: Human Readable/Barcode/RFID**
  - **Serialization With ePedigree: 2D Barcode/RFID**
  - **Serialization With EPCIS: 2D Barcode/RFID**

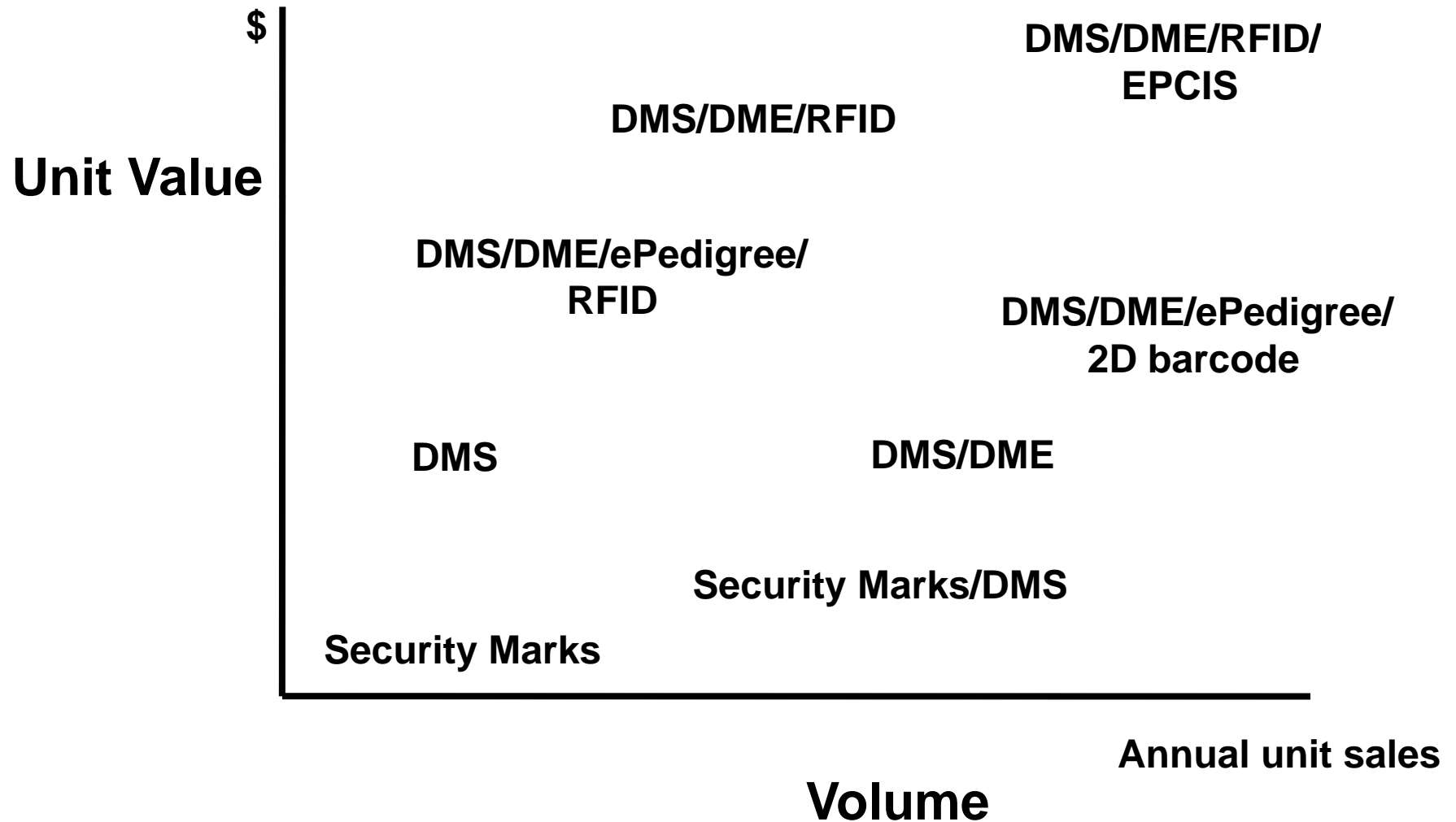


# Five Criteria for Success

- **Customer empowerment;**
- **Cost and value;**
- **Forensics and interdiction;**
- **Simplicity and adaptability; and**
- **Value added features.**

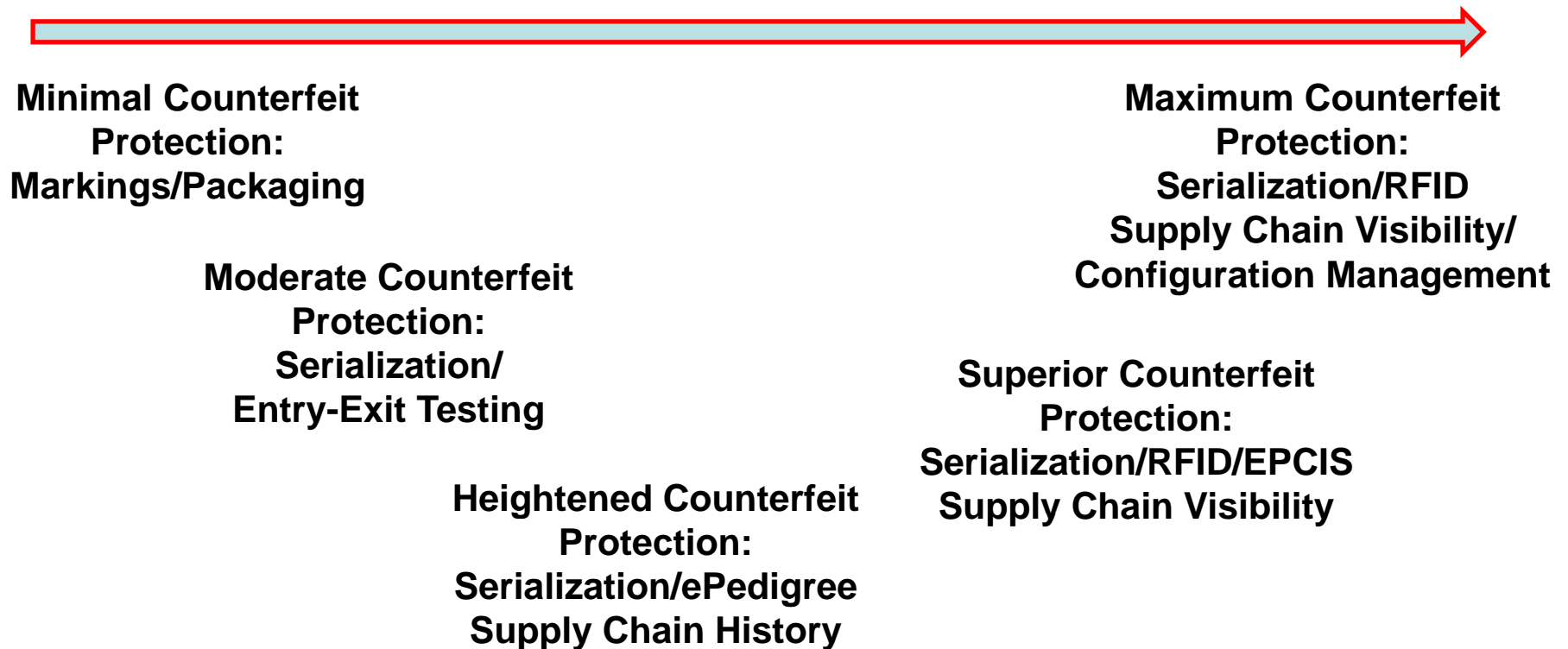


	<b><u>Consumer Empowerment</u></b>	<b><u>Cost and Value</u></b>	<b><u>Forensics and Interdiction</u></b>	<b><u>Simplicity and Adaptability</u></b>	<b><u>Valued Added Features</u></b>
<b>Package, Markings, Seals</b>	<b>Marginal To Fail</b>	<b>Pass</b>	<b>Fail</b>	<b>Pass</b>	<b>Fail</b>
<b>Taggants</b>	<b>Fail</b>	<b>Fail</b>	<b>Pass</b>	<b>Mixed</b>	<b>Mixed</b>
<b>DMS DME ePedigree EPCIS</b>	<b>Pass</b>	<b>Pass</b>	<b>Pass</b>	<b>Pass</b>	<b>Pass</b>





## Value Added Investment Required





# A Basic Approach Using Serialization

- **Unique Serialization**
- **Entry and Exit Point Validation**
- **Provides Increased Protection in Near-Term**
- **Does Not, However, Contribute to Supply Chain Visibility**



## A Basic System

- Based on item level serialization.
- Encrypted serial numbers carried by 2D matrix barcode and/or human readable.
- Serial number is created at “Point of Entry” (manufacturer) and validated at “Point of Exit”.
- Serial number is validated by manufacturer when queried by Exit Point. (Can be done by email, web access, text message, etc.).
- Represents the most basic and straightforward approach to securing the supply chain.
- Other approaches can build on this system by adding track and trace and pedigree features.





## Reference Implementations

- **Philip Morris International**
  - Law enforcement agencies, companies and consumer can authenticate packages of cigarettes.
  - 12 digit unique bar code is printed on the pack.
  - Codes can be transmitted and verified using telephone, text message, email and web-sites.
  - PMI does not store the code, but provides decoding of the code.
- **Roche India has implemented mass serialization anti-counterfeiting technology, using bar codes.**
  - Consumer confirms the authenticity of the product.
  - Every unit of sale has 16 digit alpha-numeric security code.
  - SMS(text message) or email is used for authentication.
  - Roche maintains the database of the unit codes.



## Basic System Summary

- Provides mass serialization approach to prevent counterfeiting.
- Cost-effective solution as compared to other alternatives.
- Reference implementations available from pharmaceutical and non-pharmaceutical industries.
- Barcode based solution is very cost competitive to RFID.



# Track and Trace Technology



## Overview of Approach

- **Two Pronged Attack Builds On IUID;**
- **2D Barcode Data Matrix and/or RFID;**
- **Track and Trace System with Search Capability;**
- **The Third Leg: ePedigree for Backup Assurance of Historical Path.**



*The basic concept is for every object in the program to be uniquely identified and maintained*

**Widget #110056**

**Physical Information**

Bill of Materials  
•Manufacturing work centers  
•Raw material used  
•Sub-components used  
Location  
Condition  
Testing results  
certifications

**Component Information**

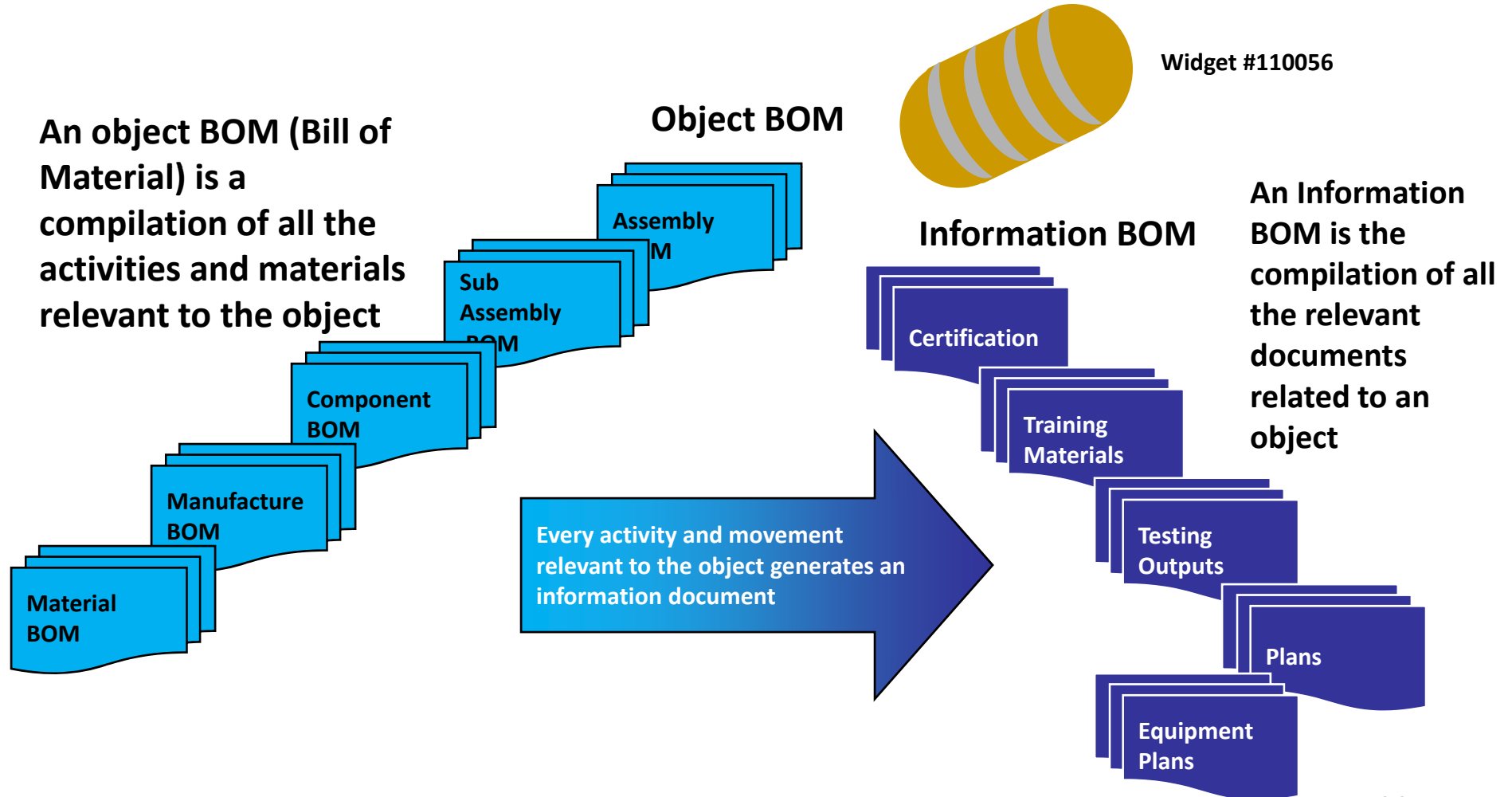
Production routing  
Component heritage  
Raw materials heritage  
Certification BOMs  
Manufacturing SPC / SQC data  
Manufacturing video  
Design documents  
Version controls

**Programmatic Information**

Timeline / schedule  
Budget  
Dependencies  
Sourcing  
Certifications  
Contractual deliverables



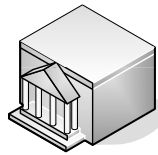
# Enterprise Operating Model Master Scenarios







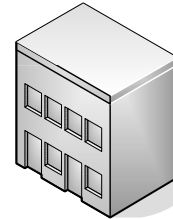
# Enterprise Participant Concept



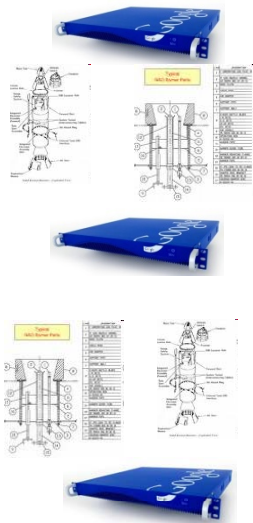
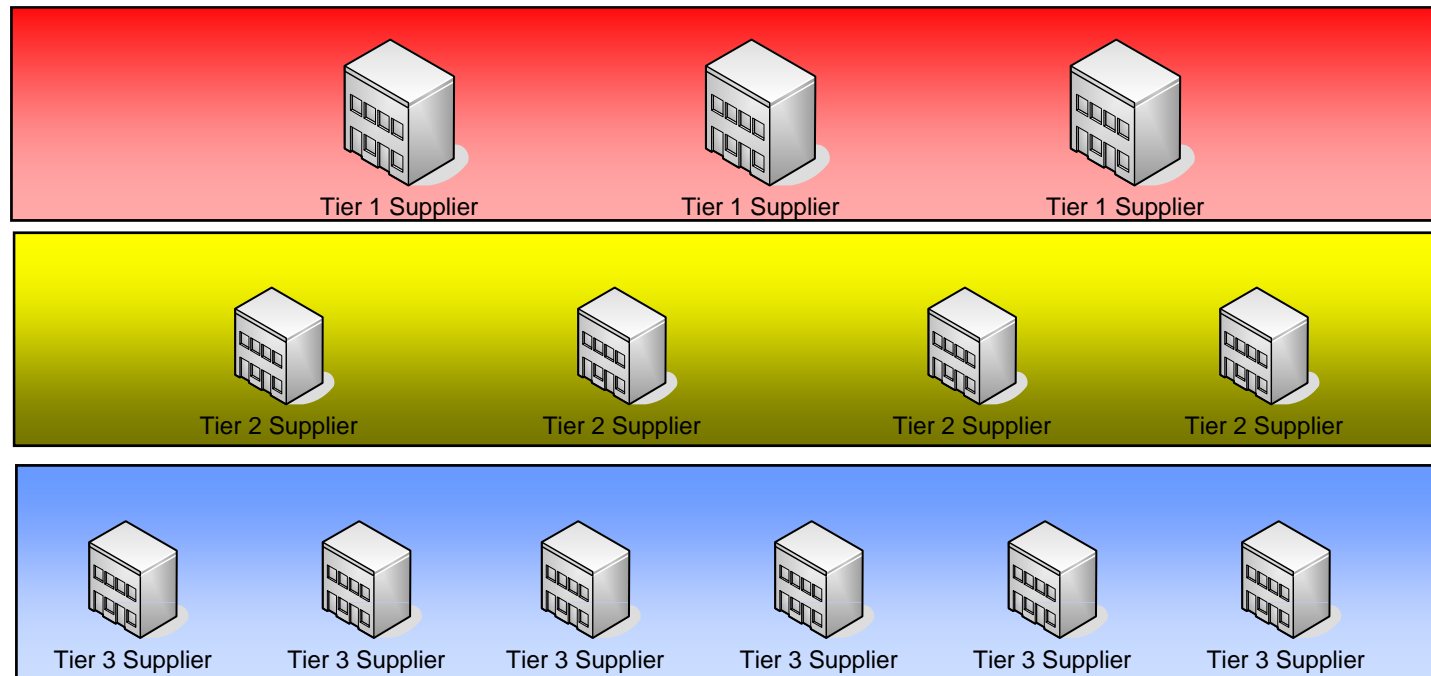
MDA



MainStreet Applications  
System Ops / Admin



Prime







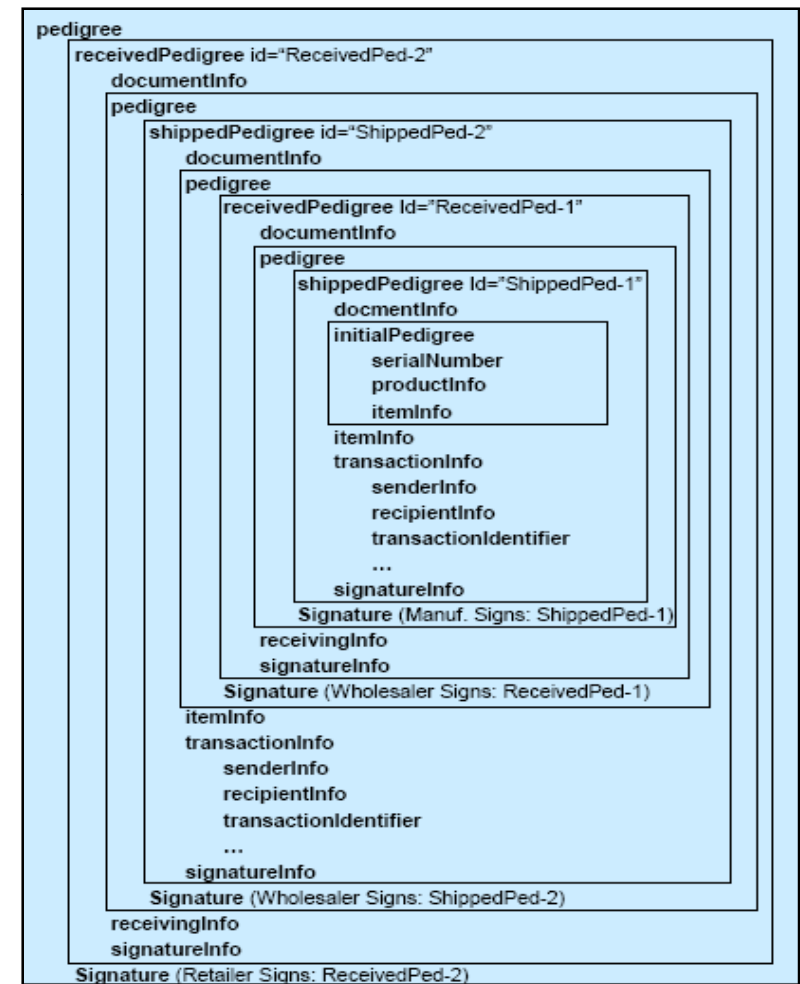
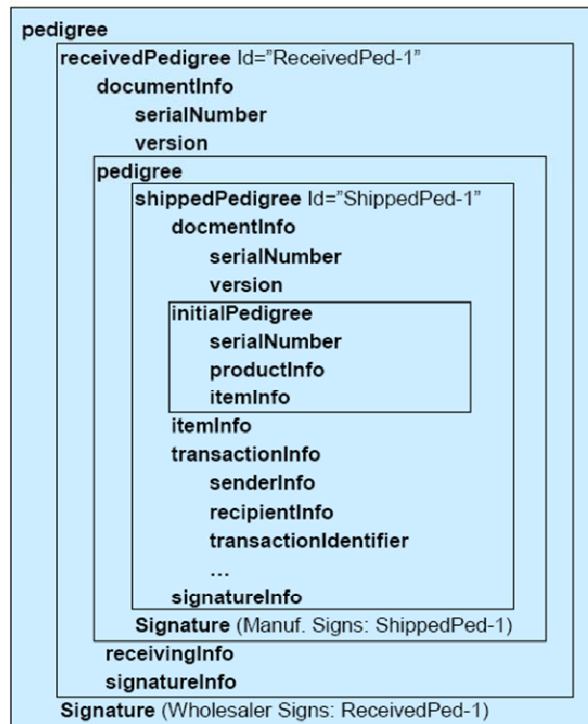
# The Third Leg: Electronic Digital Pedigrees



## Secure Digital ePedigree

### Signed manufacturer pedigree

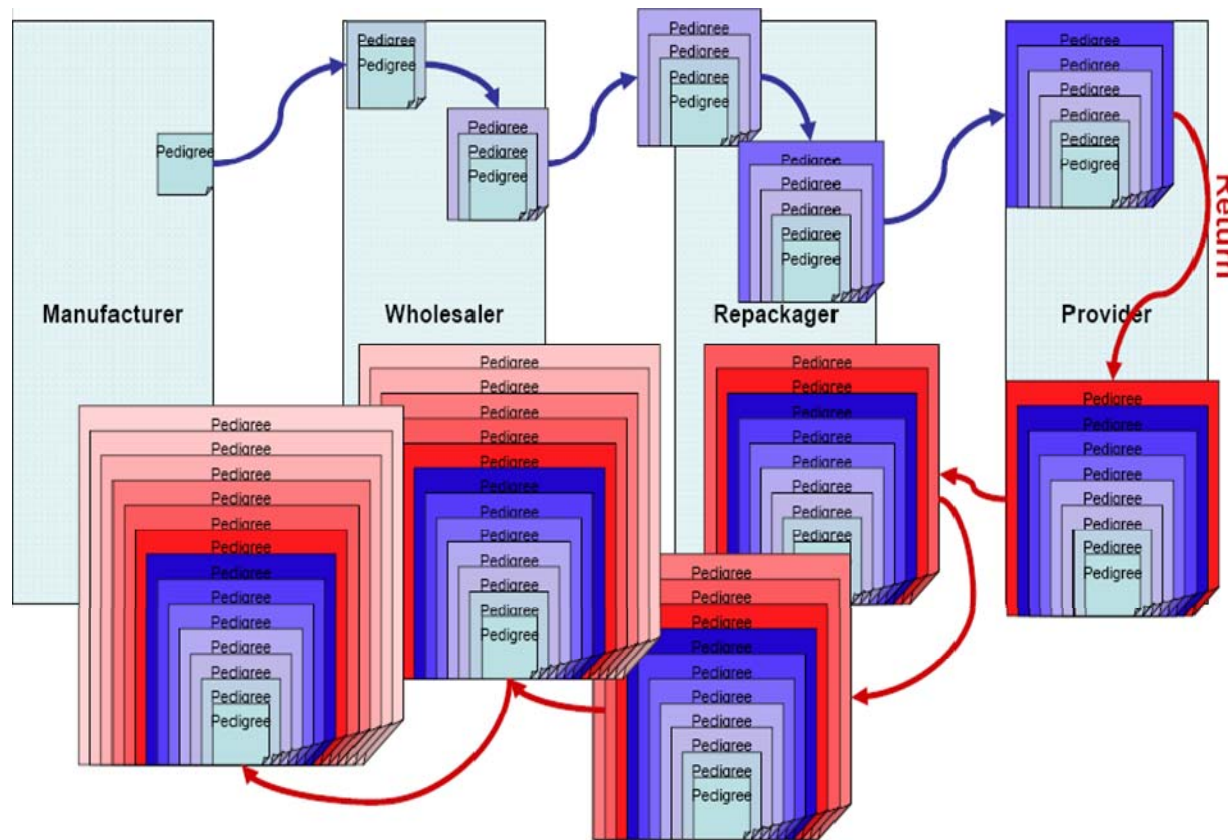
(Initiated by manufacturer, after the wholesale distribution, signed by both manufacturer and wholesaler)



**Secure Nested XML Pedigree Standard  
 Established by GS1/EPC Global**



# ePedigree Is Built Up As Part Moves Through Supply Chain





# Sample Pedigree

Product Information		Pedigree Serial Number	
<b>Transistor</b> Terrific Transistors 3 Prong, 100, Test NDC542 3334447771		um:uuid:47ba1902-c716-4659-b3e0-8fdb1aedc7b6	
History			
SELLER	TRANSACTION	BUYER	TRANSACTION IDENTIFIER / TRANSACTION DATE
<b>1</b>	<b>Terrific Transistors, Ltd. Sale</b>	<b>Quality Missile Parts</b>	<b>247906670004 02 Oct 2007</b>
Seller: <b>Terrific Transistors, Ltd.</b> 1 Elm Street, Sun Lakes, AZ 85248 USA License Number: 00:00001 NC Transaction Identifier: 247906670004 InvoiceNumber 02 Oct 2007 Authentication Contact: Jinseok Behr Boss 800-555-1365 JinseokBehr@terrific.com <a href="http://www.terrific.com">http://www.terrific.com</a> Certified By: dennis fryer Certifier User 800-555-1234 dfryer@suppliescape.com Thu Oct 23 17:21:49 EDT 2008		Buyer: <b>Quality Missile Parts</b> 1 Spring Street, Portland, ME 04096 USA License Number: 00:00002 FL Date Received: 23 Oct 2008 Certified By: dennis fryer Certifier User 800-555-1234 dfryer@suppliescape.com Thu Oct 23 17:22:50 EDT 2008	
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# Pedigree Standard

*Product/Transaction Data in One Secure Source*

## Pedigree Data

## Pedigree Security

### *Product and Transaction Specifics*

1. Product ID #
2. Serialized Product Title
3. Lot #
4. Expiration Date
5. Exact Quantity
6. Product Serial #s
7. Financial Link (Invoice, PO)
8. Transaction Date
9. Trading Partner Identification
10. Transaction Validation

1. **Standard, universal format** that supports interoperability, serialization, and future extensions
2. **Digital signatures** to protect each transaction's integrity and stop people from refuting the pedigree content
3. **Digital certificates** to verify distribution authorization by each party on the pedigree
4. **Self-authentication** for fast, secure chain of custody tests



1. Pedigree is initiated by Terrific Transistors and signed with a digital certificate issued by an DOD authorized Certificate Authority.
2. Pedigree is received by Quality Missile Parts (QMP) and authenticated. Pedigree system verifies no tampering or adulteration. QMP receiving supervisor certifies the pedigree with his digital signature.
3. QMP sells the part to Missiles R Us (MRU). Prior to shipping the pedigree is digitally signed by QMP's shipping supervisor.
4. MRU receives pedigree, verifies no tampering/ adulteration and signs the pedigree.
5. MRU transfers product to warehouse-pedigree certification performed as above.

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Nested digital signatures



## Securing the Pedigree

- Receipt of electronic pedigree by ePedigree system verifies:
  - Current transaction digitally signed
  - Each prior transaction unaltered and digitally signed
  - Signed content includes the original hash and reference to the public key for verification
- Each transaction is electronically authenticated by recipient's ePedigree system
  - Verify each signature
  - Verify each layer of signed content to ensure it was not altered since digitally signed
  - Each 'nested' transaction is signed (certified)
- Each digital certificate is issued to a specific individual representing the organization



# ePedigree Transmission & Security

- **Secure transmission must provide for document immutability, non-repudiation, and must be secure and authenticated;**
- **Secure transmission methods such as secure FTP or AS2 are used to send and receive pedigrees between supply chain partners;**
- **Stored pedigrees contain hashes and digital signatures for compliance, but also guard against unauthorized modification and contain an implicit audit trail; and**
- **AS2 transport is recommended for transmitting and receiving pedigrees with supply chain partners, providing non-repudiation and message integrity in addition to a secure data stream.**



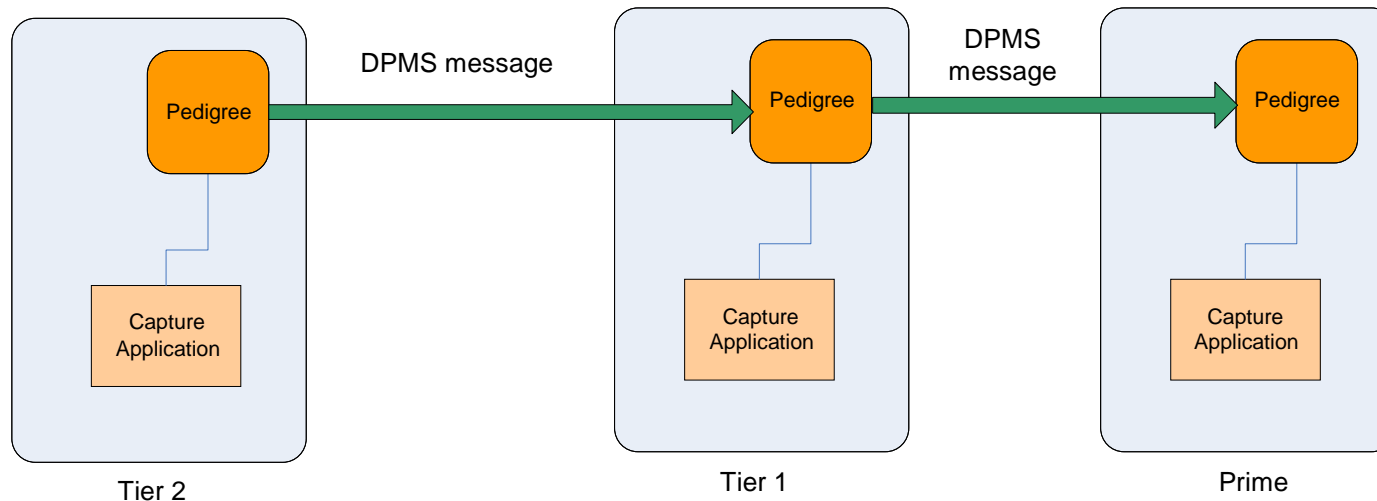


# Digital Certificates in ePedigrees

- The digital signatures used in the pedigree schema comply with several of the FIPS (Federal Information Processing Standards) standards;
- An E-Pedigree system should provide the necessary Public Key Infrastructure (PKI) for managing digital certificates used to sign electronic pedigrees for electronic certification of pedigrees. This includes use of X.509 certificates, FIPS 186-2 digital signature system, FIPS 180-2 hash function, and FIPS 140-2 cryptographic module.
- The use of FIPS for the digital signatures qualifies them as legally binding signatures just as if an individual had signed a paper legal document with pen in hand.
- There is an important distinction between digital signatures used to encrypt a document simply to keep it private, and the signatures in an electronic pedigree document, where the signature is used to legally bind an individual or company to the contents of the document.



## ePedigree Is Pushed Forward Through Supply Chain



**ePedigree Does Not Provide Track and Trace Capability But It Provides Important, Secure Documentation of Movement in Supply Chain and Establishes Historical Path and Precludes Entry of Counterfeits.**



# Summary

- **Greater oversight and visibility into the entire supply chain network (SCN) enables true Supply Chain Management;**
- **Linking of physical assets and supporting documentation enables Product Lifecycle Management;**
- **Information tracking and secure data storage for all parts and materials supports Product Lifecycle Management;**
- **Material and part tracking through final assembly supports complete reconciliation of EBOM and MBOM;**
- **Obsolescence Plan and Technology Refresh Contributes to on-going Readiness;**
- **Central, secure data repository/vault enables management and oversight; and**
- **Track and Trace Plus ePedigree Creates High Protection Against Counterfeits**